

DISSERTATION

YESTERDAY'S VALUES IN TOMORROW'S INDUSTRY: THE FUTURE OF WORK IN GLOBAL
PRODUCTION NETWORKS OF RENEWABLE ENERGY

Submitted by

Brendan B. Davidson

Department of Political Science

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Doctoral Committee:

Advisor: Dimitris Stevis

Marcela Velasco

Ryan Scott

Suzanne Tegan

Lynn Badia

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ABSTRACT

YESTERDAY'S VALUES IN TOMORROW'S INDUSTRY: THE FUTURE OF WORK IN GLOBAL PRODUCTION NETWORKS OF RENEWABLE ENERGY

This dissertation examines “green” and “climate” jobs in a period of so-called “energy transition”. Renewables play a crucial role in making the switch from fossil fuels to other forms of energy and associated forms of work, green and climate jobs, play a prominent in legitimizing the transition. Despite their promise, we know comparatively less than we should about these growing sectors and associated social relations at work. In this, my dissertation develops a systematic critique of existing social relations of “green” work under capitalistic social relations. I do so to show that many jobs with these labels are not as desirable, both ecologically and socially, as they could otherwise be.

I map, both theoretically and empirically, what green jobs and climate jobs look like in the renewable energy sector. I do so principally from the US, but move across global, national, and local scales to make my argument. I focus on wind energy and Vestas’ global production network, in particular. I also develop an eco-social typology to help me examine different “green” and “climate” jobs according to their associated processes, outputs, and uses, with additional consideration to spatial and temporal dimensions. I then fuse that typology with an interpretive framework called labor regime analysis, an instrument that derives from scholarship associated with labor process theory, which helps me to explain how political structures, institutions, and actors coalesce into particular labor regimes that condition the jobs we see. Using these tools, I show that many of the jobs we see

are marked by social processes that are harmful and precarious. Using labor regime analysis and the eco-social typology, I show how jobs affiliated with renewable energy production networks, including those associated with wind energy and Danish company like Vestas, are not necessarily desirable socially. More specifically, I use labor regime analysis to show how many of the same political economic social relations have rooted themselves in the renewable energy sector—social relations of spatial competition, provincialism, and pursuit of surplus value over human needs. In line with what we have seen historically, green capitals continue to leverage structural power and difference across race and class in pursuit of their further valorization. Among other things, these practices are driven by conditions of competition in the energy sector.

After developing this critique, I conclude with some reflections on necessity and realization of “eco-social” jobs anchored in politics of renewal, regeneration, and connection. Ultimately, however, I conclude that we cannot realize more ecologically and socially sensitive futures for workers or the planet without reckoning with the aforementioned relations of competition and interests that simply seek to “green” capitalism.

I contribute to literatures that intersect with the political ecology of labor, labor process theory, and global and comparative political economy that exist across disciplines. These include methodological advancements that pair scholarship in global production networks and labor regime analysis through a comparative logic of “siting” (see Riofrancos 2021). It also emphasizes the manner in which ideas, mutually constituted among actors, material relations, and associated structures, act in a contradictory manner to maintain the labor process. However, ideas about work, including “green”, point the way to avenues of contestation.

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We too infrequently have occasion to thank, in a publicly facing forum, the network of people who not only make life possible, but worth living. No one is an island unto themselves. Although this dissertation bears my name, I could not have produced this without the insight, support, and guidance of many people. I have a penchant for sententious musing, so bear with me while I record those who helped enable this project.

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Concerning some of the ideation and theorization of this dissertation, the lively conversations this past year with William Westgard-Cruice, Vincent Collins, and Luke Neal in the development of a collaborative paper have left an imprint on this dissertation. Our meetings have been generative and the multiple references to their work throughout mine demonstrate their influence and recognition that social science is just that, a *social* endeavor.

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Next, I would like to record appreciation for the staff of the Center for New Energy Economy. Several insights in this work are the byproduct of my time working for the Center. In particular, discussions on utilities and energy markets would not nearly be so robust were it not for my time at the center. I especially want to thank Trina Hoffer for her patience working with me and my schedule.

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Finally, I would like to thank my parents, Kathleen and Thomas Davidson. You both mean the world to me. You gave me literal and metaphoric fire for life. In both of you I came to understand that life’s purpose can be found in caring for others, both human and non-human, to make the world just a bit easier to live in.

POSITIONALITY STATEMENT

Like all works, this dissertation is the byproduct of the time, experience, and knowledge of not only the author, but their social network. In my case, those relations facilitated an interest in understanding the connection between humans and more-than-human nature (i.e., the environment, in common parlance). These interests have grown sharper and more specific over time through accumulated experience; namely, work with the state of Colorado on issues of human trafficking, the National Park Service, Fish and Wildlife Service, and later with the National Renewable Energy Laboratory. To most people these worlds appear distinct from one another and, in some respects, I experienced them in that way.

Nevertheless, the journey to this dissertation began with an appreciation that the same systems that contribute to the exploitation of labor are similarly responsible for harms inflicted on the natural environment. I did not know it at the time, but that gut feeling I had about the relation between human and environmental exploitation had already been named by other thinkers. My intuition began with volunteer experiences at the Global Refugee Center in Greeley where I encountered migrant workers, many of whom worked at the JBS meat packing plant, and who experienced much harsher work conditions than I had as a landscaper and dining hall attendant at the time. Meanwhile, in my geography classes I learned about associated emissions from eating meat and harm to animals in production. That workers who were involved in the process of slaughter received nary a mention—the space of production and exploitation was rendered in abstract, rather than embodied terms.

My “awakening” to the close-knit relationship between environmental and worker exploitation came later after reading Kevin Bales (2016) book *Blood and Earth*, where he drew an explicit connection between human trafficking and ecological degradation. When I began ideating on how I might address what I saw as a looming issue on the horizon—changes to energy systems and, by proxy, the related world of work, I grew interested in this relationship and how I might also bring these seemingly divergent worlds together. In this respect, this dissertation offers a snapshot in time as to where my thinking currently lies on how to bridge these ostensibly separate worlds together, which includes revelation of the systems and structures that generate genocidal and ecocidal outcomes.

At the time ideas for this project began gestating, two major events—one global and one personal—clarified what was at stake. On the macro-scale, I began researching and applying to PhD programs during the COVID-19 pandemic. As dismal, bleak, and chaotic as those years were, they showed that alternative political arrangements *were possible*. Indeed, nature appeared to recover in those early days of the pandemic when the world grew still; enough to hear birds sing above the constant din of a world in motion. It also showed that many of us had an appetite for some alternative mode of living. Perhaps more importantly, such alternatives were possible if states chose to use their resources in ways that met human needs. And yet, many politicians seem to have collectively stuck their heads in the sand in some vain hope that things can “return to normal” or, perhaps more pointedly, that we can “Make America Great Again”.

As it relates to the central subject of this dissertation, work and workers, the return to normal entailed most of us going back to our jobs. It was as if nothing happened. In the case of “essential workers” like those in hospitals, grocery stores, agriculture, or the veritable army of people who build and maintain energy systems, they have again faded into the background of everyday life even

though the well-being of entire communities depends on the work they perform. So as not to mince words, that erasure is absurd and we need to bring work and workers back to the forefront of our political dialogue.

On a more personal note, I suffered a severe injury—one I have physically recovered from but nevertheless left a not so inconsequential depression on my psyche. Just a few months prior to the start of the pandemic, I injured my arm weightlifting. It would take nearly two years for a proper diagnosis, which left me in the position of having to navigate the American healthcare system—with the pandemic lurking in the background—before finally getting a firm diagnosis. I experienced “radial nerve compression”, a clinical name that belies the acuteness of the experience. More bluntly, I crushed my radial nerve. That translated into a 24/7 experience that felt as if someone stabbed a heated screwdriver into the notch of my outer elbow and twisted. Spikey pain radiated from the midpoint of my arm into my fingertips. I felt like asking doctors to simply amputate my arm in hopes of escape.

As I would later find out, my injury is somewhat rare. Surgeons and physical therapists have taken to calling the radial nerve “unforgiving” given its reluctance to absolve those who injure it. I will not recount the full experience here, but this ordeal parlayed into a cascade of mind-body health issues. Chief among these being persistent chronic pain and an autoinflammatory condition known as *hidradenitis suppurativa*, both of which I have treated with years of psychosomatic therapeutic intervention to, quite literally, rewire my brain. Alongside the pursuit of a Political Science PhD, that rewiring has been my main “life” project. It has been an endeavor to lay down alternative neural pathways to respond to the world with a sense of curiosity and safety rather than fear. It (almost) goes without saying, but such experiences are not soon forgotten. Given the insanity of the world we live in

today, my experience no doubt informs the character and position of this dissertation. As I have endeavored to rewire my brain, so too do we need to think about the role work plays in society.

One of the great privileges of having the time and space to write a work like this is the opportunity it gives the writer to reflect—in our fast-paced world, that time is a luxury. I hardly think it is incidental that it was not until I *left my job* in preparation for graduate school that I had the time to get an accurate diagnosis.

Such an experience gives one the impression that if the priorities of our social systems were different, I would have gotten the proper diagnosis sooner. Instead, my main concern was to ensure for my survival first, which included *going to work* so that I could pay rent, get food, and yes, receive health insurance. The doctors and nurses who helped, meanwhile, were overworked and overwhelmed by the system in which they operated, all of which was compounded by COVID. All of this is deepened by what I, and apparently many others, perceive as greedy insurance executives who would sooner shuffle me around than help me. The same market logic that drives many “negative patient outcomes” governs much of the world today, and that logic not only produces terminal outcomes for people, but for the planet.

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CHAPTER 1: INTRODUCTION

This dissertation cuts at a central narrative told about the “energy transition”, an expression used as shorthand to denote a shift from an economy powered by fossil fuels to one powered by alternative energy systems like renewables. According to this narrative, economies (i.e., capitalism) can be “greened” or made ecologically friendly by decoupling economic growth from ecological impact.¹ As part of this, we are told that these changes will result in the expansion of new forms of work, “green” or “climate” jobs, that simultaneously improve ecologies while providing “good” employment to resolve the immiseration of a great many people.

Although intuitive in its appeal, focus on employment alone obscures more fundamental questions. What do these jobs look like? Who occupies them? And, ultimately, who benefits? Questions of this sort suffuse the dissertation, which sets out to answer what “green” and “climate” jobs in the renewable energy sector look like and why they look as they do.

I suggest that political institutions, actors, global economic structures, and associated ideas constitute labor regimes and these condition the standards, practices, and outcomes in the renewable energy workplaces. More specifically, these constitute labor regimes that are shaped by local histories

¹ For our purposes, capitalism refers to a historically contingent mode of economic production that organizes the world in particular ways. It does not refer to a system of private property rights and marketplaces as is sometimes invoked. Although these may feature, they have existed at other points in history. Instead, capitalism should be understood as a dynamic system of production and consumption whereby capital constitutes a social relation premised on the need for continuous growth in that system. These social relations may be understood as a circuit whereby the money form of capital is (re)invested into a commodity and associated labor for the purpose of the creation of surplus value (i.e., $m - c - m'$) (Marx 1976: 256). As the above implies, that system depends on the exploitation of labor and the expropriation of nature to generate surplus value to enable the continuance of the system.

and spatial competition that not only shape what “green” and “climate” jobs look like in the renewable energy sector, but also influence ideas about what these jobs look like. As I will argue, these jobs are not as ecologically or socially sensitive as they could be.

Instead, the outcomes we see, rather than unlocking better futures for workers, reproduce conditions of precarity (i.e., jobs marked by instability and loose social protections). Many of the values that have produced today’s crises—competition, provincialism, complexity, and abstraction under capitalism—that make many jobs intolerable have rooted themselves in expanding industrial sectors like wind and solar. Hence the title I chose for this dissertation.² How is it that we can demand a transition to an economy free of fossil fuels if we do not ensure that the world we are moving towards works for people too?

To make my case, I develop a systematic critique of relations of “green” production under capitalism. I do so principally from the vantage point of Colorado, but also consider how global, national, and local processes, as well as ideas about work itself constructed through these relations produce certain outcomes. Although others have similarly criticized narratives of the energy transition, my contribution focuses on work as the central sphere through which transformation occurs.

I began this broader project hoping to understand both the challenges and opportunities for improving lives and livelihoods in this period of energy transition. It sets out to make an intervention into discourses related to the energy transition and associated threads concerning “green” and “climate” jobs and associated livelihoods—an intervention that harkens back to Richard White’s (1995)

² The inspiration for the title comes from the refrain of a Dropkick Murphy’s song aptly titled, *Tomorrow’s Industry*.

criticism of some environmentalists and their disconnect from the realities of working people. Given my goal in writing this, my dissertation speaks to other members of the labor-climate movement, environmentalists who support renewable energy systems, critical and heterodox thinkers of varying stripes, and policymakers invested in making the lives of working people (i.e., most of us) and surrounding ecologies secure and safe—a political economy premised on work that valorizes connection, care, regeneration and democracy.

The Centrality of Work

Why focus on work? Well, look around you. I'm serious. Pause for a moment, avert your eyes from this page, and consider the myriad ways energy manifests in your surroundings. Perhaps it powers the device on which you read this. Or, perhaps, you printed out this manuscript, choosing to read it under the fluorescent glow of your office lamp, the one with a penchant to flicker on especially frigid or sweltering evenings. Now, consider how you move and interact with the world. In every instance, energy is omnipresent; after all, anything you do involves some measure of *work*, broadly conceived, as the expenditure of energy. Despite its central role in our lives, energy often appears as a matter of fact rather than an essential part of life. Because of its centrality to how we survive, energy is nothing if not political and, as alluded to, tied directly to the idea of "work".

What is more, all of what I described above was ultimately enabled by the *work* of human hands. Hardly anything in your immediate surroundings, apart from more-than-human nature, could exist without energy or workers of one sort or another. Even you! We are all byproducts of various forms of reproductive labor, that is, the work it takes to make someone into a person. Karl Marx had it quite right when he wrote, "Labour is the living, form-giving fire" (Marx 1857).

And yet, when it comes to contemporary politics of ecology and climate change, work barely registers as a blip on the radar (Iskander and Lowe 2020; Coe 2021). Not only is this a disservice to workers who occupy critical positions in energy production networks, but it limits the horizons of what our politics might look like otherwise.

I hardly need to convince those of you reading this dissertation that the continued increase in emissions, especially among countries in the Global North, necessitates a rapid shift away from fossil fuels. I wager, as many do, renewable energies are perhaps best situated to *assist* with this. I emphasize *assist* because these technologies, at least on their own, do not have the capacity to change the politics of work or people's relationship with the environment. If we desire such changes, that necessitates adjustments to social relations of production and consumption. Again, this is an arena where work and workers play a central role. Workers enable the economy to function as it does. We enable "the circuits of capital" to flow. It is hardly a coincidence that in places like the US, railway and airline workers have their ability to strike strictly curtailed because they are deemed *essential* to making the economy move. More than that, work is central as it is through work that people come to define themselves and their relationship to the environment (White 1995: 178). One of the implicit promises of environmentally sensitive forms of work, sometimes labeled "green", is how they exist for the purpose of the environment and perhaps instill a sense of responsibility to more-than-human nature.

Green Dreams: The Promise of "Green" and "Climate" Jobs

Much has been said about the transformative potential of "green jobs" and "climate jobs", especially as it relates to activities intended to wean societies from fossil fuels (see Brecher 2024; Klein

2014; 2019; Ordower and Zafir 2024). Stretching back to at least the 1970s, beliefs that jobs could make progress on both economic and ecological issues existed (see Chapter 3 for an extended discussion). However, simple labels guarantee little.

Unfortunately, the renewable energy sector largely matured during a period of heightened neoliberalism. Consequently, much of what we come to see in the sector, the heavy use of subcontracting, temporary hiring, and flexibilization, are consistent with trends towards precarity more broadly (Luce 2022). This same period has also been responsible for the general decline of unions globally, including in the US, a function of capital's relative mobility and an institutional environment engineered to generate spatial competition between workers both within and across countries. Policymakers therefore make trade-offs between competing priorities of economic integration and related access to global markets, state sovereignty, and democracy (Rodrik 2000).³

"Green jobs" and their more recent variant, "climate jobs" are billed as a potential antidote to these conditions. They can provide high quality jobs for working people, while responding to ecological issues like climate change (Beuret 2025). A frequent refrain of the Biden Administration was that "green" jobs would be "good union jobs". They would help reshore industrial activity and provide long-term work to thousands of people.⁴ Although intuitive in its appeal—net job gains and filling

³ Despite several waves of democratization across the world, the past several decades has witnessed democratic retrenchment. Business concerted efforts to maximize shareholder profits for future investments were enabled by neoliberal policies in countries like the US and UK and adopted by international organs of global governance like the World Monetary Fund and World Bank, which to use Rodrik's analogy, sacrificed national sovereignty or local democracy to secure future investments. As part of this, businesses working with state leaders the authority of workers and unions as a check on corporate power and capital flight (I detail this in Chapter 3). These conditions have produced several effects, including the establishment of conditions that allow populist leaders, including their authoritarian variants, to take power through politics of resentment (Brown 2019).

⁴ Similarly, European Commission leader Ursula von der Leyen advanced a European Green New Deal in 2019, in addition to subnational efforts like UK's Labour Party and Spain's Partido Socialista Obrero Español perhaps going furthest to advance

industry workforce needs seem to be one of the few things politicians of all stripes can agree upon—there is a very real danger that newly established jobs in the renewable energy sector may further erode trade union power and further entrench conditions of precarity. That not only includes displacement of trade unionists in heavy industrial and fossil fuel sectors, but as I argue throughout this work, the expansion of more precarious work in the renewable energy sector.⁵ Declines in the material conditions of working people's lives help fuel politics of resentment and recrudescent nationalism that propel actual and would be authoritarian politicians to power (Zuk and Zuk 2024).

Perhaps it is too obvious a point, but a wide sweep of evidence suggests workers, organized or otherwise, act as critical change agents in world history (see Skocpol 1979; Silver 2003; Bresnihan and Milner 2023). Labor unions often serve as proxies for understanding the relative power of the working class. Some may try to waive away this claim as being “too ideological”. Consider, however, how odd it is that the space in which most of us spend our lives, the workplace, is blatantly *undemocratic*. That this is accepted as “common sensical” is itself pure ideology.

A wide variety of authors within Political Science and Industrial Relations literatures demonstrate that where trade unions are weak, workers not only have less autonomy, but democracy often suffers (O'Donnel 1973; Ost 1990, 2022; Roberts 1998; Drake 1996; Silver 2003; Riedel 2011; Bishara 2018; Cornell 2022; Roberts 2022). The mechanism for why this is true, again, makes sense. Where workers

the idea of a “just transition” with backing of the Comisiones Obreras (Rathzell and Uzzell 2019). And, in some countries like Denmark, Danish Prime Minister Mette Fredericksen has hardly needed to invoke the language of “green” jobs, with the country's expansion of wind power embedded within its institutions of social dialogue and sectoral level bargaining.

⁵ When I invoke the word “precarious” throughout this dissertation, I am generally referring to non-stable employment arrangements that offer little in the way of benefits or security—things like a decent wage, healthcare, legal protections, and other important attributes.

are better organized, they can effectuate change through a strategic withdrawal of their labor power. However, the strength of worker agency in certain sectors, like energy, may be especially important as it is the sweat from these workers' brow that ultimately greases the skids of global capital (see Mitchell 2011; Moore 2015; Malm 2016). Or, to use a more contemporary metaphor, workers in the energy sector enable the flow of electrons in contemporary political economy.

Rather than recognize their importance, a parallel "future of work" discourse exists alongside and informs discussions of "green" and "climate" jobs. Within it, it advances a tired market-oriented logic that valorizes technical fixes as the antidote to both ecological and social maladies (see Gupta, Lerner, and McCartin 2018; Schulze-Cleven and Vachon 2021; Jackson and Meer 2023). We can see this discourse in action where economic and employment trends associated with climate are simply dealt with as necessary inputs for the realization of renewable energy capital (see J.P. Morgan's Annual Energy Report – Cembalest 2025). Or, more recently, the introduction of generative artificial intelligence (or genAI) is again supposed to determine the future of work. Why is it that these models, trained on the collective works of humanity, should dispossess people of their jobs and channel the benefits of the technology into the hands of just a few individuals? That, of course, brings us to the political dimension of this discourse, one in which various incarnations of political power shape the trajectory of these technologies and the fortunes of people and the planet.

If it is true workers in "strategic" locations (see Silver 2003; Mitchell 2011) play a critical role in social change, we should not only consider the work involved in "green" jobs for its own sake (although this is itself important), but that changes and improvements to work in these sectors may ripple beyond them to rebuild worker power and, perhaps, invite other ways of working and living. Indeed, green jobs and union mobilization may be an indirect, but promising route to climate policy (2013).

Beyond material attributes of work, there are also distinct ideas that attach to beliefs about “green” work to consider. These may or may not offer fertile soil for the revitalization of democracy at work, in addition to helping restore the environment. We therefore need to not only consider what the realm of possibility might be for work and workers in the transition, but consider alternative social arrangements to move us in more socially and ecologically sensitive directions.

Energy Transition, Expansion, Transformation?

“Energy transition” exists as shorthand to denote broadscale changes in the world economy’s prevailing energy regime.⁶ Although “energy transition” is often used this way, I largely use it as a term of art. Evidence suggests that “transition” periods are, in fact, periods of energy “expansion” where the metabolic rate of production and consequent stress on the surrounding environment increases (see Sweeney et al. 2021; York and Bell 2019). Irrespective of debates on whether ours is a period of energy transition or expansion, most agree major changes are underway and the expansion of renewables, energy efficiency technologies, autonomous energy systems, and now artificial intelligence and even nuclear energy constitute important changes to the world economy and associated politics. When I invoke “energy transition” I use it to refer to ongoing changes in the present moment, doing so to elide quarrels about whether this is a moment of “transition” or “expansion”. Although important, this debate is beyond my remit.

⁶ In broad historical terms, we have undergone three prior transitions: the “domestication” of fire, the agricultural revolution and use of animate labor (animals), and the industrial revolution’s use of steam power and later fossil fuels (Smil 2004, Crosby 2006, Huber 2009). The globalization of economic activity resulted from many factors, but this includes the expansion of metabolic activity (i.e., how much energy and materials are used by society) enabled by steam power and fossil fuels. It is the abstraction of energy, understood as “the capacity to do work”, that has enabled the current edifice of civilization to come about (McNeill 2000: 13).

As the discussion on labor's role in creating political shifts implied, transition periods are essentially political processes whereby social actors struggle over the direction of such changes (see Shove and Walker 2007; Meadowcroft 2009; Smith and Stirling, 2010; Köhler et al. 2019). In their run down of the "state of the art" in the politics of the transition, Köhler et al. (2019) highlight several possible research avenues for energy transition, including focus on collective action politics, civil society, spatial differences, and ethical dimensions of the energy transition. Labor and work receive nary a mention, though study authors flag how focus on ethical dimensions of the transition have been more limited. Others similarly castigate transitions research that focuses on raw inputs and outputs as having a "moral vacuum"—a major omission that may curtail the possibility for more just and livable futures for people, their communities, and the countless non-human species we share the planet with (Newell and Mulvaney 2013).

Furthermore, a historic understanding of changes in energy production and consumption shows how these transitions alter global political economy, in important ways, including those aspects of capitalistic reproduction considered routine in daily life (Huber 2009; Malm 2016). Most people experience periods of transition in the realm of "work", broadly conceived as the day-to-day, routine, and at times mundane activities that people do to survive. However, the nature of these changes is not solely determined by the material aspects of the energy systems themselves (though they have an influence), but in the associated social relations in which they are embedded—and it is in the assessment of these social relations where questions of power and the distribution of costs and benefits come to the fore.

Energy, once a blind spot for historical materialist scholarship (Huber 2009), now occupies an increasingly central role (Bridge et al. 2013; Burke and Stephens 2018, Iskander and Lowe 2020). An

understanding of the political potentials implicit in energy systems also increasingly features in popular works like Naomi Klein's (2016) *On Fire*, Jonathan Neale's *Fight the Fire* (2021) or more recently Kōhei Saitō's, *Slow Down* (2024), as each comes to terms with the centrality of "work" as a metabolic relation at the center of contemporary political economy.⁷ In each case, the author's endeavor to advance alternative social imaginaries for the future. In fact, much of the animus surrounding the energy transition from segments of the labor-climate movement (LCM), those organizations and individuals dedicated to advancing the cause of both trade unions and progress on climate issues, stems from the potential opportunity for more widespread political change and a historical understanding of the importance of the labor movement to emancipatory politics (Silver 2003), and, again, those employed in the energy sector especially (Mitchell 2011; Malm 2016).

Once again, however, mainstream political discourses with liberal institutions espouse a view of work consistent with ecological modernisation or green growth—through efficiencies, technological change, and tweaks around the edges it is possible to make political economy more ecologically sustainable. Work is considered as a form of employment, and the pleasant byproduct of these innovations and entrepreneurial spirit. Of course, this view glosses over the messy and often contradictory details of the lived realities of workers and communities in industries or sectors most closely associated with "future" energy systems like wind, solar, geothermal, energy storage, or electric vehicles. More importantly, such a view does not recognize how technologies are "socionatural"

⁷ The metabolic relation refers to exchange of energy between humans and nature, mediated by labor, and upon which human societies depend for their survival (Foster 1999). Critically, however, a "rift" develops in this metabolism, as the increasing rate of production disrupts human societies from natural cycles. That produces alienation which grows more acute the greater the extent of separation becomes (Foster 1999: 380).

strategies for the redistribution of human labor power (Hornburg 2021: 679). *Work, both waged and unwaged, is and always has been a sociopolitical construct.* How the future is built, who builds it, and by what means will determine the extent to which changes to energy systems and associated labor processes do or do not contribute to eco-social change.⁸

Primary Research Questions and Methodology

To study changes in work associated with renewables, I focus on the experience of work at the point of production, that is, the labor process for waged workers in the renewable energy sector.⁹ In essence, I ask what do “green” and “climate” jobs look like in the renewable energy sector, and what conditions explain the forms of work we see?

To answer this, I use several tools and data generation methods to argue that there are distinct and overlapping “labor regimes” that are mutually constituted by a diverse array of actors, institutions (rules, laws, regulations), practices, and systematic structures at varied spatial scales that mediate and produce the outcomes we see—that constitutes its principal empirical contribution.

To do so, I use an interpretive framework called labor regime analysis (LRA). I combine LRA with a heuristic typology I lay out in Chapter 4 to consider the extent to which different green jobs and climate jobs do, or do not, contribute to eco-social change. The value of combining the typology with LRA is to think through an array of aspects of different jobs, which includes ecological, social, spatial,

⁸ Here is the first of many references to the “labor process”. What this entails has a long history, but for my purposes, it refers to a dialectical *process* (i.e., ongoing relation) between humans and more-than-human nature through which people mediate their social metabolism, that is, how they reproduce themselves (Marx 1867 [1976]: 283). In contemporary political economy, the labor process is often embedded in the capital-labor relationship.

⁹ The labour process as I use it refers to purposeful activity of work and the associated means of transforming an input, often nature, into surplus value for capitalist enterprise.

and temporal dimensions. LRA organizes observations and thinking across four spheres—production, circulation, social reproduction, and ecology—that mutually constitute what the capital-labor relationship looks like in the renewable energy sector. In effect, I describe renewable energy work, explain why these look as they do using LRA, and then juxtapose descriptions with my heuristic typology to show how existing social and political institutions constrain the possibility for more emancipatory forms of “green” work in the energy sector.

My analysis takes place across spatial scales. However, I focus on wind energy production processes and those affiliated with the original equipment manufacturer Vestas, in particular. I focus on Vestas as a Danish company with an international footprint that allows me to move between sites in the production network to observe how the capital labor relationship does or does not look similar according to the respective settings in which it operates. Furthermore, as one of the largest and oldest wind companies, it has influenced what work looks like and how it operates in important ways.

Methodology

I put the labor process at the center of my analysis, doing so “from the ground up” (Räthzel *et al.* 2014). To answer my questions, I needed an approach that can explain how actors within and outside the workplace shape the experience of renewable energy work, including multiscalar configurations of politics and power that touch down into workers’ lives. LRA offered the best tool for the job as it provided an organizing schematic to help me determine what information I needed to construct the myriad of influences that construct labor regimes that govern the renewable energy workplace.

LRA does not focus on a single category of actors or institutions (Rubbers and Lochery 2022: 43). Instead, it focuses on the *regime* that conditions relations among varied groups, structures, and

institutions in explaining why the capital-labor relationship looks as it does in specified settings. Doing so, it better captures the social relationships in a particular moment and place, situating them temporally and spatially with other regimes as points of contrast.

We cannot directly *observe* labor regimes. Instead, they offer us a useful analytical tool for how to think through a complex constellation of internally related interactions that mediate observed outcomes in the workplace. I build on the approach by fusing it with an eco-social typology to enable an additional form of comparison—not only across sites, but through a juxtaposition of how “green jobs” compare with a wider range of possibility. Doing so helps me to explain how “green” jobs do, or do not, represent qualitative changes to the world of work.¹⁰

Because of the imbricated and multi-scalar nature of labor regime analysis, the dissertation similarly assumes a structure that considers production and work processes at global, national, regional, and local levels. On its face, such an approach might appear at its onset to be little more than a cacophony of “noise”. However, as the Geographer Doreen Massey argued, the point of research is to “theorize generatively within and across difference, to illuminate varied configuration pathways, and to point to conjecturally specific stress points and sites of intervention” (Peck et al. 2018). In this respect, while the principle sites of analysis include wind developments, especially in Colorado, these are part of processes that connect to sites across the US and globally that defy political borders understood in the conventional sense of lines on a map. That is to say, I do not focus on “cases” in the traditional sense (apart from, say, making wind energy and Vestas my primary cases

¹⁰ Consider the analysis I present as a form of “unbound comparison” (see Cheesman 2022). That is to say, my goal is not to offer a controlled comparison that entails holding various factors constant and then executing the analysis.

of investigation), but instead consider various sites of inquiry understood as *points of conjuncture* within interrelated political economic processes. As I discuss in Chapter 4, attentiveness to these spatiotemporal relations is necessary as a range of social and environmental injustices may be produced when we do not consider social relations generated through interactions across time and space (Adam 2008). Within International Relations, such a conceptualization has a greater affinity to an ontology of multiplicity and hierarchy than anarchy as constitutive of how the world is ordered (Rosenberg 2016; Rosenberg et al. 2022).

Data Generation

The observations, descriptions, analysis, and explanations found throughout this dissertation are the result of continuous engagement with the subject of work and production in the renewable energy sector over the span of at least eight years as both a place of work and subject of study. In this respect, the dissertation is informed with an “ethnographic sensibility” (see Simmons and Smith 2021). That includes time having worked inside the “new energy economy” in public affairs and research capacities for a several organizations that include the National Renewable Energy Laboratory (now called the National Laboratory of the Rockies) and Center for New Energy Economy. It is also the result of well over five years of engagement with interlocutors relevant to this study, including direct time within the renewable energy industry as a writer and project manager. Finally, it also involved systematic generation of data through analysis of policy and business documents, semi-structured interviews with relevant groups and individuals, participant observation, and archival research.

In line with labor regime analysis, I adopt a historical and relational orientation to better situate and understand concepts like “green” and “climate” jobs, and work with renewable energy systems. To

do so, I use Chapters 3 and 4 to both historicize and then subsequently problematize “green jobs” and “climate jobs”. In this regard, discussion about these forms of work provide the contrapuntal theme that weaves throughout this dissertation as it concerns to “green” workers, their relationship to work, and these jobs contribution to alternative political economic arrangements. Related to this, the aforementioned typology helps elaborate what is necessary to realize “regenerative” eco-social politics that contribute to politics anchored in social and ecological restoration, connection, and dealienation. Although abstract, the consequences for how we think about green and climate jobs are anything but. What we expect from work, how we think about “green” and “climate” jobs, establishes the boundaries for what is politically permissible to discuss. The typology shows that a far greater range of possibility is possible than is often considered and that many jobs fail to move us in the direction of greater social emancipation and ecological restoration.

The Central Argument

As discussed, much is said about the potential of green and climate jobs, and how these can respond to ecological issues more broadly. However, less has been done to *systematically assess what mediates the conditions of work among green jobs and climate jobs associated with renewable energy technologies*.

That the energy transition may further lock in existing relations of injustice impugns the character of the transition. Social relations of this sort may generate distrust of future decarbonization efforts if communities feel that these changes will negatively impact their living conditions. Although several authors have made similar arguments focusing on the financial and market dimensions of electricity (see Christophers 2024) my intervention focuses on what this looks like for workers.

I make my case by showing that many of the institutions, practices, and ideas that generate politics of precarity and ecological degradation continue to haunt the renewable energy sector. Renewables did not cause these issues, but are nevertheless shaped by them. More specifically, coercive laws of capitalist competition drive the outcomes we see. These conditions suppress work quality for individuals employed in these expanding sectors. These conditions of competition are further enshrined in existing policies and practices that govern the energy sector, which are reinforced by institutions, laws, and ideologies hostile to labor that valorize profits over other forms of value. Furthermore, and related to the prior point, I discuss how global companies shaping the transition continue to enact relations of exploitation, built on global and local relations of dependence for work. These are connected to the economic power of capital—what Søren Mau (2023) refers to as “mute compulsion”—that governs the ideational space of work. So long as social reproduction (i.e., the ability of people to reproduce themselves) depends on the dictates of capital, that will influence “green” and “climate” jobs in a way that prevents more socially and ecologically desirable futures.

In Chapters 8, 9, and 10, I examine how the local labor regime for wind energy both nationally and globally ties together with processes of globalization and divestment, which establishes the terrain upon which workers think about their prospects in the sector. These help to form a pervasive hegemonic “common sense” of expectations for work, in a Gramscian sense, that continues to govern how people think about the various roles they occupy.

Now, much of the criticism I bring to bear on the state of work in renewable energy, it should be noted, has little to do with technology. I believe there are unique material and ideational attributes associated with renewable energy that can lend themselves to better futures. To this end, I elaborate an alternative, albeit partial vision of what work and renewable energy *could* look like with changes to

ownership structures in the power sector. In particular, my work engages with the recent work of Mijin Cha (2024) and Kohei Saito's (2023) discussion of André Gorz's (1967) notion of "open" and "locking" technologies. I pair these with my own research, theorization, and interpretation of renewable energy systems, using ideas advanced by Gorz, Marx, and Murray Bookchin as guides. Although I do not fully unpack those ideas in this dissertation, I offer some general reflections in the conclusion to emphasize how renewable energy technologies could lend themselves to public forms of energy ownership. I am not the first to make this point, and it is a central platform advanced by the group Trade Unions for Energy Democracy and Franziska Paul (2025). These could help establish future politics based on solidarity, reciprocity, and eco-social regeneration. However, that cannot happen within existing energy policy frameworks and it is especially important to question the hegemony of private capital in decisions concerning the production and distribution of electric power.

Dissertation Contributions

My dissertation makes several contributions. First, I contribute to a decades (arguably centuries) long conversation of politically engaged scholarship that has sought to elaborate the labor process and associated social relations by extending theorization on how ecological and ideational dimensions constitute labor regimes, and how these may shape the labor process. Methodologically, I suffuse labor regime scholarships with methodological insights from comparative political economy to improve the forms of comparison employed by labor regime scholars. More specifically, I make a methodological move to assess a series of "sites" rather than cases. I elaborate the distinction to a greater degree in my methodology, but siting refers to an understanding of our research settings as being comprised by a diverse array of internally related phenomena that mutually constitute multiscalar outcomes locally, nationally, and globally. Sites are thus points of conjuncture where we

can observe how multiscalar political and economic practices shape political outcomes. In the parlance of Global Production Network (GPN) scholarship, these sites exist as critically embedded nodes in the circuits of global capital comprised through a diverse set of relations across spatial scales.

Theoretically, I incorporate insights from Comparative Politics and contemporary Marxist political thought to better elaborate how ideas, in this case concerning the nature of work in “green industries”, influence labor regimes. I extend labor regime theorization for how ecological dimensions and “remoteness” influence the labor regime and related labor process outcomes. Critically, I discuss the ways in which material elements of the production process are internally related to ideas about work in the renewable energy sector. In Chapter 8, I elaborate this relationship in greater detail explain that future labor regime scholarship, not only in renewables, but across sectors, should more thoroughly probe how ideas about the labor process are shaped, as well as the potential avenues for worker agency that may result.

Next, I synthesize labor regime scholarship with parallel developments in economic geography and ongoing theorization from Jamie Gough (2014) concerning “local capitalisms” to show the importance of localities and “workforce development” as critical nodes in the configuration of global production networks. I show how local capitalisms not only exist as institutionally manufactured environments for firms but exist as territorially embedded labor regimes that put collectivities of workers in spatial competition with one another. Critically, these locally embedded labor regimes depend on multiple intersecting ideas: ideas about what role work serves, the fetishization of jobs in the abstract, and perceived racialized attributes that are coopted for capitalistic enterprise, which demonstrate the amoral calculus of capital and how it leverages these attributes for the purposes of its accumulation strategy (see Quijano 2000). Theoretically, I pair this conception of local capitalisms

with labor regime analysis to articulate how the manufacture of work—green jobs or otherwise—does not exist as a bounded container but as a relational site where historical, material, and ideational components mutually constitute the accumulation strategies of global capital and interrelated strategies of the state and collectivities of workers to survive.

Informed by attentiveness to both spatial and temporal dimensions of work, I showcase how a relational understanding of local labor regimes, one anchored in the historical memory of place and the broader dynamics of GPNs, informs the evolution of labor regimes. More specifically, Chapter 10 situates labor regime analysis historically to help us better appreciate how labor agency depends on past periods of industrialization and deindustrialization, in line with the theorization of Doreen Massey (1984 [1995]) and Dimitris Stevis (2022).

Additionally, Chapter 10 explores how labor regimes evolve and influence how companies operate in particular areas, I also elaborate another form of ‘spatial fix’ in the parlance of David Harvey (2001) that occurs when companies locate their corporate headquarters away from the principle sites of manufacture and accumulation in the production process, which helps managers at these companies treat the production process as a site of abstraction, that is, helping enterprise maintain profitability through social and ecological disconnect from the production process.

Throughout, I demonstrate the importance of the typology I advance in Chapter 4. In particular, I show why it is indeed important to consider ecological, social, spatial, and temporal relationships together when assessing different forms of work and, critically, the associated political economic formations they portend. The main contribution comes through attentiveness to the associated uses of different economic production processes, which allow us to better differentiate between jobs not

only in terms of their products and processes, but how associated uses also color the character of different jobs. Doing so, we can better understand questions about the distribution of benefits and costs of different jobs through society and, relatedly, who these systems serve and what mechanisms of power might shape them otherwise.

Structure of the Dissertation

The first four chapters orient the reader to the landscape of “green jobs” and related themes (labor environmentalism), both historically and across global production networks. These chapters consist of the historical and conceptual foundations of the dissertation, from which I later juxtapose my empirical field work and analysis in the dissertation’s latter half. **Chapter 2** reviews the state-of-the-art when it comes to understanding labor rights and standards in affiliated networks of renewable energy production. In so doing, it offers a global perspective on the energy transition across countries, and also establishes reference points of comparison for this dissertation’s empirical research. **Chapter 3** provides a history of one of the dissertation’s central concepts, “green jobs” or “climate jobs”. These terms are often used to denote how work in the expanding renewable energy sector differs from their counterparts in the rest of the economy, notably for the ostensible environmental benefits they offer. In constructing a genealogy of these terms, the chapter situates them within the multiple and contested history of labor environmentalism in the US to trace the emergence of “green jobs” and “climate jobs” linked to an older history of labor environmentalism. In articulating this history, I establish a foundation for later chapters that probe ideational elements about what constitutes “green” or “climate” jobs among various actors and groups encountered during field work, many of whom use these terms to advance different conceptions of work and political economy. **Chapter 4** builds on the genealogy constructed in Chapter 3 and introduces a typology of green and climate

jobs. Given the multiple and competing definitions of what “good”, “decent”, or “sustainable” jobs entail, the typology comprises an analytical prism through which we—both the reader and the author—can think about various political and economic practices and associated labor regime outcomes. It offers a necessary conceptual grounding through which to view different jobs and the degree to which existing social relations in wind energy, and the energy sector more broadly, do or do not contribute to more emancipatory futures (i.e., eco-social futures).

Chapters 5, 6, and 7 set forth the methodology and data collection approaches for empirical contributions that look at the world of wind work. It offers an integrated roadmap for how various tools, theories, and concepts I use—most notably labor regimes and GPNs—fit together for the empirical study of labor processes of wind energy development, the principal “case” in this dissertation. **Chapter 5** provides a summary of labor regime analysis (LRA)—the specific tool I use to think through how a wide constellation of actors, institutions, norms, ideas, and structures come together to shape what the workplace looks like. In it, I describe the history of LRA, how it is performed, and offer a justification for why this approach suits my project. Where the typology offers me lenses to consider different GJ/CJ and what they look like, LRA helps me to see how certain political configurations (regimes) mediate workplace outcomes. **Chapter 6** constitutes a methodological contribution to labor regime scholarship, taking insights from contemporary Comparative Politics literature and fusing it with labor regime analysis to help scholars more thoroughly consider how we select what and where to study and why. Here I elaborate why I chose to focus on wind energy and, more specifically, sites associated with Vestas’ production network. **Chapter 7** expounds the various data generation techniques I relied on to produce my findings. It also includes

a discussion of some of the research challenges this dissertation faced with a presidential administration in office that is actively hostile to renewable energy.

The last half of the dissertation focuses on wind energy production and associated labor processes. **Chapter 8** provides an overview of phases of work in a general “national” labor regime of onshore wind in the US. It moves into the empirical portion of the dissertation to understand how processes across scales (global, national, local, and at the level of workplace) create conditions of competition that, according to my theorization, suppress unionization in the renewable energy sector. I also use this chapter to elaborate how ideas about work emerge from the labor process itself. More specifically, I discuss how ecology interacts with other elements of the labor regime in some important ways that shapes the labor process for green jobs in the spheres of operations and maintenance and project development and installation. I show how ideas condition and maintain expectations of the workplace, which helps to stabilize the larger labor regime. However, these ideas contain contradictory elements, which could conceivably lend themselves to greater worker agency in the future. **Chapter 9** focuses on a more specific site of analysis, that of Vestas’s manufacturing cluster in Colorado. In it, I extend my analysis in the proceeding chapter, but do considerably more to articulate how conditions of competition within and across political boundaries shape local labor regimes in important ways. These regimes are themselves manufactured by local and state policies that respond to these conditions of competition. Consequently, transnational companies like Vestas not only choose manufacturing operations through things like transnational coupling in strategic locations as discussed in GPN literatures, but also select zones of operation according to differentiated labor regimes, some of which are more conducive to the accumulation of profit than others. These regimes also take on class and racialized aspects linked to the local memories of different localities, preserved in associated

laws and institutions that inform the local labor regime that conditions workplace outcomes. Crucially, transnational capitals consciously leverage difference in selecting where to operate. Where Chapter 9 focuses primarily on the spatial dimensions of Vestas' locational decision, **Chapter 10** compliments the analysis in the prior chapter and adds onto it a temporal dimension to examine how labor regimes in wind energy evolve over time. Here I show how what initially began as a "European style" labor regime gradually became more American the longer it remained in Colorado. I use this chapter to show how local labor regimes that shape green jobs in places like Colorado depend on the strata of historical relations that have come prior, in line with the theorization of Doreen Massey (1984). Here I also demonstrate how Vestas, like other corporations, relies on ideas attached to paternalism to limit autonomy in the workplace. The analysis in Chapters 9 and 10 combined show the importance of attending to both the spatial and temporal dimensions in considering jobs, especially in how history shapes the jobs that result and how jobs and workers across space influence both the ecological and social potential of jobs.

Finally, **Chapter 11** concludes the dissertation. In it, I argue based on the evidence I have arrayed that existing practices of renewable energy production will continue to reproduce crises related to work and the environment without larger scale changes to political economic systems. I conclude with some recommendations and reflections—both policy oriented and political in their orientation—for what might shift work in the renewable energy sector in more ecologically and socially just directions. As part of this, I point to some hopeful developments by various social movements and workers with an energy nexus as indications that viable political alternatives are not only necessary, but possible. I also outline some preliminary thoughts on what eco-social communities might look like that lean into

the eco-social potential of renewable energy technologies when freed from the constrictions of capital and common-sensical notions that ownership should lie in the hands of a relative few individuals.

I hope that this dissertation offers some utility to social actors, especially trade unionists and working people involved in renewable energy, to improve social relations at work. Consistent with labor environmentalism (see Rathzel *et al.* 2021: 19),¹¹ I would like to see this work help bridge the conversations between labor and environmentalists. More specifically, I believe that we must rethink work, just as we rethink power generation. Perhaps most critically, I hope that this research can elevate the voices of the people responsible for the construction of tomorrow's industries.

¹¹ Also consistent with labour environmentalism, you will discover that this is a research project that draws on a variety of disciplines. These include, among others, political economic studies in Political Science, Geography, Sociology, and more. Although the core of the research is situated in the US, it takes on a global character as global production networks shape ecological and social relations encountered throughout the pages of this dissertation.

CHAPTER 2: A GLOBAL PICTURE OF WORK IN RENEWABLE ENERGY¹²

Global electrification is moving apace. China leads the way, producing significantly more solar, wind, and electric vehicles (EVs) than any other country by several orders of magnitude (IEA 2025). Despite awesome growth in the sector, that has depended on the exploitation of Uyghur Muslim's in the Western part of China. Revelations of forced labor in the supply of solar panels shook the industry as Chinese corporations account for 71 % of the world's solar modules and 97% of the wafers used to produce these devices (Murphy and Elimä 2021). Moving South of China, many young migrant workers seek 'green jobs' on solar development projects like those in Khavada, Gujarat India. However, they soon find themselves working 12-hour days in sweltering heat, with wage theft rife throughout (Nagaraj 2025). Both instances represent extreme examples of labor exploitation and abuse, but raise important questions about the nature and conditions of work in "green" industries.

Growth in renewables is the byproduct of several factors. A significant influx of investments has spurred industry growth (again, especially in China), that amounted to \$3.3 trillion in 2025 (IEA 2025). Policy analysts attribute this to a rapid decline in the levelized cost of energy for renewables in combination with China's emergence as the principal manufacturer of these technologies. China now accounts for 74% of new solar and wind project developments by some accounts (Millard 2025). In both instances, the policy consensus is that China's manufacturing capacity in combination with these cost reductions will continually make these technologies available for electricity development.

¹² This chapter is a modified version of an article I wrote for *Energy Research and Social Science*, published in 2023.

Such data points evince the process of an ongoing ‘energy transition’, whereby the global economy shifts from one powered predominately by fossil fuels to one where electrification via low-carbon technologies dominates. Within this discourse, certainly at the global level, but also in much of Europe and the Democratic party of the US, the expansion of renewables focuses on the role of private enterprise and the promise of ‘green capitalism’, in principle if not in name, that enables continued economic growth alongside reduced emissions. Workers frequently take a back seat in such conversations.

To understand the state of the research on “green jobs” and “climate jobs” associated with networks of renewable energy production, I ask two interrelated questions. First, what do we know about labor rights and standards across renewable energy production networks? And, related to the first question, what production phases, geographies, and groups need greater attention?

Authors like Benjamin Sovacool (2021), Teresa Kamarz and their co-authors (2021), Dustin Mulvaney (2013), Ryan Stock (2021), Nikki Luke (2022), and Alexander Dunlap (2018; 2021) have demonstrated the need to probe the energy transition and what it might portend for local communities and ecologies. Although they (and many others) shed light on the necessity to interrogate practices of the energy transition, no *systematic review* has attempted to cover the state of the literature as it relates to labor rights and standards for workers involved in the production of renewables. This chapter, based on an article written by me and published in *Energy Research and Social Science*, provides that review to ground the rest of the dissertation, which largely focuses on developments in the US, within a global perspective. It shows a pattern of exploitation in which the expansion of newer energy technologies can, without intervention, replicate rather than change exploitative social and ecological relations—both within and between communities and workers.

What is the Energy Transition?

The International Energy Agency (IEA) estimates that almost 90% of global electricity generation in 2050 will need to come from renewable energy sources, with solar PV and wind energy accounting for 70% of that mix (2021). Despite growth in renewables like wind and solar (and geothermal, concentrating solar power, and hydroelectric to lesser extents), electricity demand has outstripped capacity additions. More recently, these additions have been further accelerated with the increased computing demands of large language models that have quickly become fixtures in our lives (IEA 2024). Even before AI, several authors characterized our present moment as one of energy expansion, rather than transition (Sweeney 2021; Yergin 2025; York and Bell 2019). Indeed, as Brett Christophers (2022) notes, a transition is not so much a decline in fossil fuel use, but more so *an expansion* in energy uptake, including renewables. Others like Jean-Baptiste Fressoz (2025) take the argument further, noting the interdependence of energy systems that, under the all-consuming system of capitalism, does not displace resource use, but arguably increases the use of resources from the prior energy regime.

Following COP 26, 151 nations had submitted new climate plans, with many nations setting net-zero goals between the years 2050 and 2070¹³ (Mountford et al. 2021). While the US has once again backed out of the 2015 Paris Accords, China, as previously discussed, has put significant investments into wind and solar power. These investments are meant to meet the country's energy demands, but also make inroads into making China more central to the core of the global political economy of

¹³ It can be debated whether "net-zero" targets are sufficient to achieve reduce carbon emissions as net-zero language supposes that fossil-fuel production can continue so long as certain "offsets" like the replanting of forests take place.

energy. As a result of shifts in policy in some parts of the world, and China's prodigious production capacity, renewable energy boasts the overwhelming share of new power generation capacity and figure prominently into country plans to meet both emissions targets and bulk energy needs (Fouquet and Pearson 2012; IEA 2025; Graham et al. 2025). Russia's actions in Ukraine and the resulting shock to gas and oil markets in Europe and parts of Southeast Asia have similarly contributed to a pivot away from fossil fuels in some regions like Pakistan (Gardiner 2025), although it has arguably also further solidified the US' role as a purveyor of natural gas exports, reinforced by the Trump Administration's preference for fossil fuels. More recently, oil shocks from the war between the US-Israel and Iran similarly disrupted global energy markets in a way somewhat reminiscent of the 1973 oil crisis—a crisis that was, in many respects, the initial impetus for government investments into renewable energy systems.¹⁴

In addition to countries responding to changes in the international landscape, the aforementioned precipitous drop in the levelized cost of energy for renewables is often cited as the rationale for widespread adoption (Lai and McCulloch 2017). Further accelerating deployment, improvements in autonomous and interconnected energy systems and improved battery storage technologies diminish the drawback of intermittency.¹⁵ Nevertheless, it is important to recognize that in many places where energy functions through state sanctioned markets like in the US and much of Europe, the decisive factor for adoption has less to do with cost, and more to do with *profit*. The level of investment in

¹⁴ I take up this point in greater detail in Chapter 8, where I discuss the history of the wind energy industry.

¹⁵ Intermittency refers to how sun is not always shining and the wind does not always blow. The natural forces of power are not always there. Crucially, that does not make these energy sources *variable*—when the energy is present, it generates power consistently in a way that is predictable.

renewables offers a better barometer of how capital views these technologies and their uptake (Christophers 2021; Christophers 2024). That investments into renewables outstrip fossil fuels in some countries indicates a preference for these technologies, but fossil fuel companies and associated investment portfolios still comprise a large share of tradeable financial activities (IEA 2024; IEA 2025). As Brett Christophers (2024) argues, this is due to a variety of factors. Entrenched fossil fuel interests play some role, but arguably more important are that new energy projects, especially large-scale renewable projects, require significant capital expenditures. That does not disincentivize renewable energy production necessarily, but it implicates financial capital in investment. The Blackrock and Vanguard of the world continue to see fossil fuel investments as a surer return on investment in comparison to renewables, especially given the centrality that these fuels play in making the broader circuits of global capital function (Christophers 2024).

Nevertheless, for my purposes, what matters is that there *is* a major shift in patterns of global production and consumption underway. Renewables play a vital role in that shift and, as such, create a space for us to rethink questions related to electricity production, associated uses, and what work looks like in these and other parts of the economy.

Growing Industry, Growing Employment?

Investments and consequent expansion in energy infrastructure drives expanding energy employment. Since 2019, 5.4 million energy workers have taken up roles in global political economy, or about 2.4% of all new jobs globally (IEA 2025). China contributes one in five of these new jobs, with the electric sector, in particular, now outstripping employment in fuel supply (IEA 2025).

The power sector, which includes electricity generation and grid management, employed 22.6 million workers in 2024 (IEA 2025: 97). 14.2 million of these were related to power generation, while 8.5 million workers were employed in activities related to the power grid (IEA 2025: 97). Solar PV accounts for the largest share in job growth at 40%, with three-quarters coming from China. Some prognosticators have taken to calling it the world's first "Electrostate" as a result (White 2025).

Several studies about employment growth demonstrate that employment gains for low-carbon technologies appear to outstrip conventional generation sources, further establishing renewable energy as a primary driver for job creation in the future (Renner et al. 2022; Llera et al. 2013). EU researchers find that climate mitigation policies could modestly boost both GDP and total employment (Alexandri et al. 2022). Yet, as study authors note, distributions differ by country and are not generalizable beyond the EU. Nor do they cover how climate mitigation activities in parts of the Global North impact the Global South and vice-versa.

Questions remain regarding the distribution and longevity of employment opportunities too. Specific information about employment across sectors is difficult to capture too, due to an increasingly fragmented employment both spatially and across sectors. Information collected by government agencies similarly depends on information reported to them by private companies, which also raises its own set of issues with respect to the reliability of data reported, including who "counts" as a worker of the company. Nevertheless, policymakers (understandably) continue to rely on information of this sort to justify different policies. However, net employments can mask disparities in opportunities across geographies, countries, sectors, and social categories (García-García et al. 2020). For instance, the renewable energy sector employs more women than conventional energy industries globally, representing about one-third of employment (Renner et al. 2022). However, women's

participation in the sector may remain marginal without broader attitudinal shifts towards gender roles in both industrialized and less-industrialized nations, meaning women may not optimally benefit from a shift in production (García-García et al. 2020; Baruah 2017; Pearl-Martinez et al. 2016). Nor do these estimates say a great deal about the sorts of roles women occupy. Central to this work, whether the jobs people occupy are worth having. As a consequence, discourses related to expansions in employment and attendant opportunities for women tend to treat the issue of energy change in a way that is “neutral”, putting aside questions related to community norms around electricity production and consumption, related work, and what electricity ownership looks like in terms of control and representation across multiple identities (Kelkar 2017; Standal et al. 2021). In any case, the crucial lesson is how employment estimates often serve as tools to legitimize certain politics and practices and not others.

In addition to the methodological and practical challenges of tracking “green jobs”, there are conceptual issues. As I will discuss in the next two chapters, there is no singular definition that applies to categories like “green” or “climate” job, which makes them contested categories. Putting aside the matter of how some jobs—like those in manufacturing or production—result in indirect and induced jobs and other forms of economic activity (a subject unto itself), the range of conceivable employees within renewable energy production networks covers a wide range that may include anyone from artisanal miners to white-collar workers who provide legal consulting. Given the wide variation in work affiliated with renewable energy, deciding who to count as a “green” worker matters a great deal for how we understand the expansion of employment opportunities associated with renewables. Perhaps more importantly, the associated processes and uses of different forms of work create differentiation between jobs, even when they carry the same label.

The International Labour Organisation and the International Trade Union Confederation (ITUC) emphasize that green jobs should have the qualities of being 'decent' in addition to helping with conservation efforts (International Labour Organization 2016; ITUC n.d.). A key pillar for an international sustainable development agenda, decent work entails work that provides "a fair income, security in the workplace and social protection for all, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men" (International Labour Organization n.d.(a)). The decent work agenda intersects many dimensions of the 2030 Agenda for Sustainable Development, including its environmental goals. "Green jobs", therefore, not only preserve or restore the environment, but should uphold fundamental principles and rights for work.

Growth in "green" jobs, however, focuses on the quantity of jobs, not the quality of work they offer to workers (Kouri and Clarke 2014; García-García 2020). Nor does it consider their durability and longevity (Zwickl et al. 2016). This is perhaps unsurprising as the dominant discourses in the energy transition advance green growth and green economy strategies, which cite employment opportunities as a benefit (García-García 2020). I will expand on this history in greater detail next chapter, but for now ecological modernization in the energy transition frames the shift from non-renewable to renewable sources of energy as occurring through ostensibly sound policies and technological innovations that creates a double dividend for both environment and employment (Jones and Zabin 2015; Crowley 1999; Jaenicke and Lindemann 2010). The benefit of this framing lies in its ability to break through what is often discussed as the "jobs versus environment" debate (again, discussed in Chapter 3). However, ecological modernization in its 'weak' form does not capture social or normative

dimensions of environmental issues (Dryzek 2013; Carter 2018). Even here, however, there is debate among trade unionists, with varied responses of support, opposition, and ambivalence on the prospects of green employment in renewable energy jobs (Mattera 2009; Räthzel and Uzzel 2011; Mulvaney 2013; Stevis 2013; Lundström 2017; Sicotte 2024; Vachon 2023; Cha 2024).

A Synthetic Review of Literature on Labor Rights and Standards with Renewables

No systematic review at the intersection of renewable energy and labor rights and standards had taken place until this review. The closest approximations were undertaken by Benjamin Sovacool and his colleagues (2021) that covered social and ecological impacts attendant to energy transition and Teresa Kramarz et al. (2021) who created a typology of global displacement to demonstrate how mineral extraction associated with the expansion of low-carbon technologies may dispossess communities. Given the outsized importance of three forms of renewable energy to future decarbonization efforts—wind, solar PV, and lithium-ion batteries—authors focus on displacements resulting from these technologies. My review similarly focuses on key, rapidly expanding renewable energy technologies and associated processes for solar photovoltaics (PV) and concentrating solar power, onshore wind power, and lithium production for electric vehicles (EVs) and energy storage. It, however, also considers biofuels/biomass and offshore wind.

Labor rights and standards refer to the International Labour Organization definition whereby workers are afforded: freedom of association and the effective recognition of the right to collective bargaining, the elimination of forced or compulsory labor, the abolition of child labor, the elimination of discrimination in respect of employment and occupation, and right to a safe and healthy working

environment (International Labour Organization).¹⁶ Despite its recognized importance, less research applies this lens towards expanding renewable energy sectors than we might hope for. Instead, most work treats work in the transition in a technocratic way, quantifying labor as one among a variety of necessary inputs for energy production (Burke and Stephens 2018; Mulvaney 2014; Agusdinata et al. 2018; Bazilian et al. 2021; Luke 2022). I have elected to focus on labor rights as a baseline to which green and climate jobs should strive (e.g., fair treatment, safe conditions, freedom to collectively bargain, etc.). I have chosen, therefore, to generate a review of the literature at the intersection of renewable energy and the workplace using this language, in part because what constitutes a “quality” job varies greatly according to context, setting, and the predilections of different researchers. Rather than expand on my interpretation here (I save that for Chapter 4).

To organize my review, I count findings across production stages for renewable energy technologies. For now, I use a loose definition of production network that refers to the full range of activities that firms and workers perform to bring a product or service to market, including related repowering and deposition activities (see Dicken 2015). Given this definition, renewable energy production comprises a wide array of activities distributed among many phases and businesses across the globe. So many, in fact, I cannot do justice to the full suite of possible positions within a GPN. So, to organize study counts, I use a qualitative and descriptive framework that relies on existing work by IRENA, Llera et al. 2013, and Briggs et al. 2020). In that regard, I organize study counts and associated findings according to qualitative categories that include:

¹⁶ Labor rights refer to things like fair treatment, safe conditions, equitable pay, dignity on the job, and freedom to collectively bargain. These are ratified rights recognized by members of the international community (but not all states) Standards refer to the governance mechanisms that help ensure labor rights.

- Inputs (extractive activities and biofuel crop production activities)
- Equipment manufacture and component assembly
- Construction, commissioning, and project installation
- Operations and maintenance
- End of life processes (which includes activities like decommissioning, repowering, recycling, and disposal)
- Transportation, distribution, and logistics activities across stages.

Changes in one phase create impacts in others, which makes understanding the linkages between them important as the spatial extent and fragmentation of global production can obscure environmental and social impacts through things like offshoring, to use just one example (Chan et al. 2013). As a practical matter, framing literature by production stages helps reveal what segments have received comparatively more or less attention, which can help establish areas for future inquiry. Such research can also help us understand how work in one place might mirror or differ from similar work in a different context, including the global patterning of different outcomes. Doing so contributes to our descriptive knowledge about recent developments in the transition and also establishes theoretical knowledge about what things elevate or suppress the labor rights and standards in different contexts. As geographers are quick to point out, the transformation of space features prominently in shifting energy geographies that manifest in changing economic, social, and political activities (Bridge et al. 2013; Pearse and Bryant 2021). I therefore combine production network study counts with a summary of which countries have received more or less attention to guide future research.

To reduce the scope of this review, I did not include research that covers utility or distribution workers as part of my analysis, unless they were explicitly tied to renewable energy. Although essential to electricity production and distribution, it can be difficult to identify or connect these workers to the renewable energy sector, despite how essential they are too it. That said, this is a critical area of additional research future scholars can explore as they occupy a central role in enabling capital circulation through the arteries of transmission grids.

Similarly, this review does not cover white collar workers (legal, engineering, etc.). From the standpoint of capital, these are critical jobs that provide “value add” activities to production networks. In our era of AI and, in places like the US, these workers confront a far more precarious work environment than perhaps did in decades past.¹⁷ Similarly, I do not include articles that do not explicitly tie certain activities (smelting, certain transportation jobs) to renewable energy. These exclusions are meant to reduce the scope of the present review, not to diminish their importance.

My review collects and classifies academic (peer-reviewed articles, conference papers, book chapters) and grey literature (international government organization reports, national government reports, reports from national industry associations, and both white and working papers from think tanks or university affiliated organizations) that intersect with specified technologies (wind, solar, battery storage, biofuels) and labor rights and standards for workers. I included grey literature for analysis as this is an underexplored arena for research, and organizations like IRENA and the ILO have

¹⁷ I do not have the space to explore this idea in greater detail, but as it relates to the importance of building worker power and solidarity, now is perhaps a moment where “blue” and “white” collar workers might seek to break down the artificial boundary erected between them to realize the same processes of capitalist accumulation makes their respective conditions of existence more tenuous than it should be.

been active in their attempts to understand the state of labor rights and standards for workers during the energy transition. To ensure a broader sweep of the literature, I include research covering common occupational hazards resulting from work in these industries, as these impact working conditions and worker safety, and therefore may impede a worker's right to safe and healthy work environment. For the purposes of this review, I consider green jobs for analysis as those involved or related to the production, distribution, and disposal of specified technologies.

The initial search using related terms yielded 482 results in Web of Science.¹⁸ However, I cut several articles after reviewing the abstracts of individual articles and determining that they did not cover labor rights and standards. For example, several articles discussed forms of energy justice in electricity markets associated with renewables but did not cover labor rights or standards as part of their analysis. While a wealth of literature has been produced on labor rights (or lack thereof) and working conditions in the extractives sector for minerals relevant to renewable energy, I only included those studies that *explicitly* consider extractives associated with the production of specified technologies. Shaving away unrelated studies resulted in a list of 47 articles.

Knowing this initial search does not represent the entire literature on the subject, I supplemented the Web of Science search using a snowball sampling method. I combed through the citation lists of these articles for additional ones to include in my review. Additionally, I include books that intersect the topic of renewable energy and labor rights not captured by the Web of Science search using search engines offered through Colorado State University's library system, JSTOR, Proquest, Google

¹⁸ Full list of search terms and syntax available in 7. Appendix.

Scholar, and the university's synthetic search engine. To further supplement this review, I used many of the same search terms from the Web of Science search in browser-based search engines Google and DuckDuckGo. Please note I constructed much of this synthetic review *before* the introduction of ChatGPT and genAI tools in twilight days of 2023. Browser based searches occurred through more straightforward and simple phrases, rather than the complex, expansive syntax used in the initial Web of Science search. Since I initially conducted this review, the literature has continued to advance, and I have endeavored to stay apprised of developments by visiting interdisciplinary journals on this topic, reviewing articles that cited my review, and the receipt of Web of Science search alerts that I continue to field since I originally conducted my review.

Methodological Limitations

While I believe the systematic method employed for this review provides a strong encapsulation of the state of the discourse, it has some blemishes. First, given the subject matter and framing of this research through labor rights and standards, much of what is included tends to emphasize the negative aspects of work associated with an emerging low-carbon economy. To be clear, the shift to renewable energy has potential positives—especially with respect to reduced emissions and decent employment opportunities for some. Also, because I analyzed the full corpus of articles without the aid of automated character recognition or machine learning software, I elected to focus on major peer-reviewed publications and pieces of grey literature, in addition to major organizations like the IEA, ILO, and IRENA that work on these issues. However, this omits a considerable body of journalism that has been probing the same questions posed by this article. Furthermore, smaller, localized organizations with insights into this topic similarly do not register in my review.

Though the meta-analysis provided here synthesizes a wide body of literature of interest to scholars across disciplines, its focus on labor rights and standards may omit other important contextual pieces of research. Finally, the size, scope, and complexity of the global political economy of energy makes it impossible to do justice to all possible angles from which we might consider labor rights and standards. Related to this point, while this chapter summarizes the state of the discourse, it should not be read as a fully exhaustive account of all existing research. Instead, it should be read as a snapshot in time and, as is my intent, a baseline for future work.

Results

Bibliometric Analysis

All told, 140 documents for review resulted from the search process as shown in Figure 1. The sample includes 93

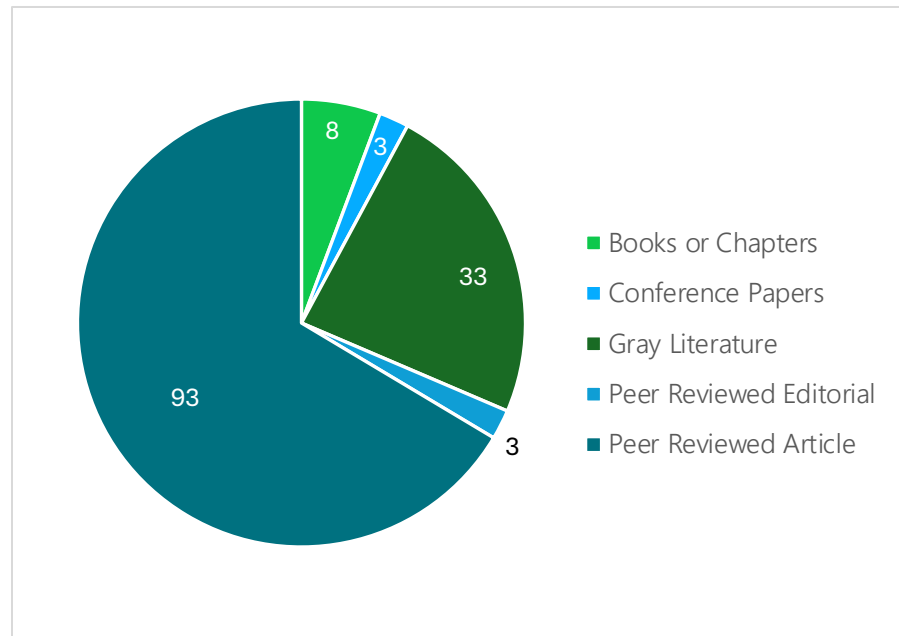


Figure 1. Publications by type.

peer reviewed journal articles, 3 editorial (opinion) pieces included in peer-reviewed journals, 3 conference papers, 8 books or book chapters, and 32 pieces of grey literature.

As Figure 2 shows, the number of publications has grown since the first study that covered solar energy impacts on health was published at Sandia Laboratories in 1977 (Young 1977). The

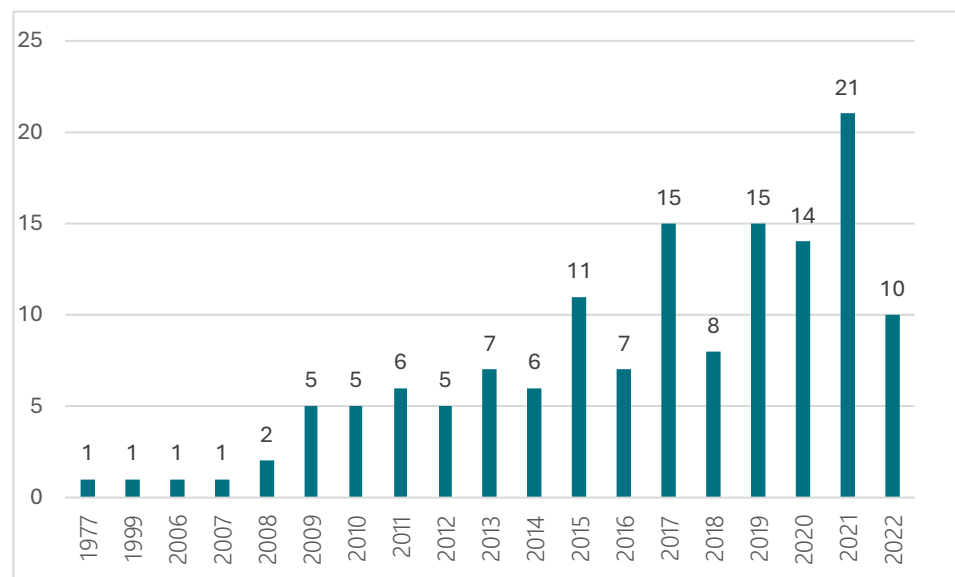


Figure 2. Study counts by year.

increase in studies shows an upward trend of interest following the 2008 financial crisis, helped in part

by the just transition discourse becoming more mainstream with groups like the ITUC advancing the idea (Rosemberg 2013), and its adoption into the preamble of Paris Climate Agreement (United Nations 2015) and ILO's Just Transition Guidelines (International Labour Organization 2015).

As depicted in Table 1, 32% of studies cover freedom of association and collective bargaining as part of their analysis. Another 29% of studies cover occupational risks and hazards associated with low carbon renewables, many of which exist in journals and publications related to healthcare outcomes, with minimal attention on labor rights and standards. Notably, about 16% of studies call attention to gender as a critical dimension of labor rights and standards in the transition, though less literature (1.4%) has considered migration as a relevant lens through which to approach the topic.

Studies that cover collective bargaining	Studies that cover occupational health and safety risks	Studies that provide end to end value chain analysis across stages	Studies that provide macrolevel, general assessments of worker issues in value chains for renewables	Studies focused on the Global South	Studies focused on Global North	Studies that cover gender	Studies that cover migration
46	41	10	76	61	74	23	2
32.4%	28.9%	7.0%	53.5%	43%	52.1%	16.2%	1.4%

Table 1. Please note that a single article included for analysis may be counted across categories.

Geographic Distribution

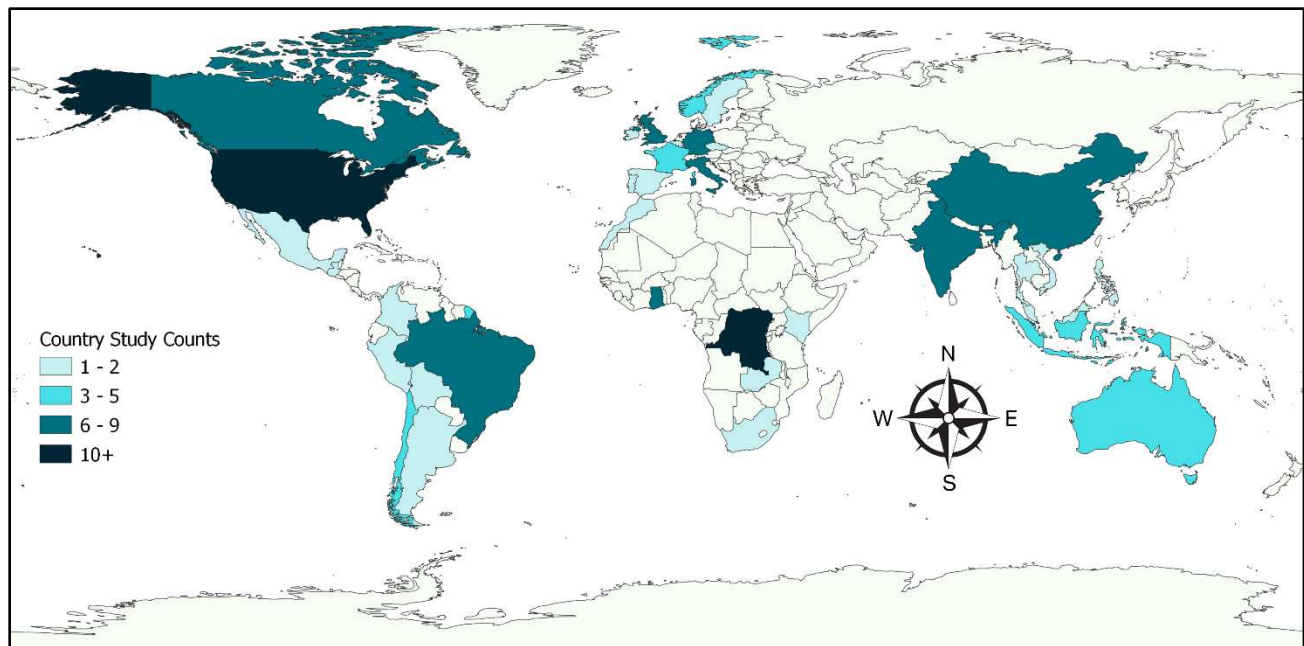


Figure 3. Counts of articles that focus on particular countries as part of their analysis. Map produced by author using QGIS.

Figure 3 displays country counts to capture their *specific* geographic country of focus. Though several areas of the map remain unshaded, studies sometimes consider broader geographic regions in their analysis or speak generally about labor rights and standards across the globe. All to say, even though some areas of the map remain unshaded, that does not mean no work has occurred there. Instead, the map reflects where studies have carried out place-based research as part of their analysis. Though countries in the Global North have received more attention, studies that include analysis in the Global South tend to focus on processes at the ends of value chains (i.e., extractives and disposal processes) and commodities in specific locations like Brazilian biofuels or cobalt extraction for electric vehicles and batteries in the Democratic Republic of the Congo (DRC).

In this review, 61 studies focused on countries or regions in the Global South compared to 74 in the Global North, which demonstrates that the predominate geographic focus of research has focused on so-called 'core' countries to the world economy. When I remove studies from the sample

that focus on both the Global North and Global South, then 34 studies focus on the Global South compared to 44 in the Global North.

Study Counts Across the Value Chain

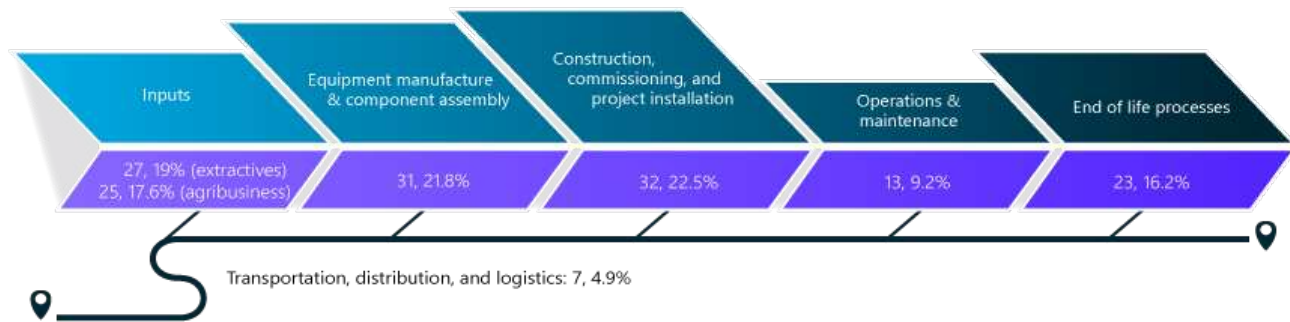


Figure 4. Study counts across the value chain for renewable energy.

Figure 4 tallies studies that incorporate different stages of the value chain as part of their analysis. If we consider the full scope of technologies and geographies needed to produce renewable energy, each stage appears understudied. However, the transportation and distribution and operations and maintenance stages have garnered the least amount of attention. For transportation and distribution, this might reflect the challenge of delineating between transport workers associated with renewables and those unaffiliated. Yet, transportation, distribution, and logistics remain a critical aspect of industry activities that tie production phases together. Operations and maintenance workers help extend the life of renewable power developments and may provide long-lasting work individuals at this stage. Recognizing this, it is surprising it has not registered more attention in the literature. Of the 52 studies that cover inputs and downstream processes of the value chain, 42 (80.1%) of these focus on impacts in countries or regions associated with the Global South.



Figure 5. Study counts by renewable energy sector.

Figure 5 displays study counts by renewable energy sector type. Of technologies reviewed, Solar energy registered the highest tally of studies, with 70 or 49.6% of the sample. Wind energy (both onshore and offshore) tailed solar with 41 or 29.1% of the sample, closely trailed by bioenergy (34, 24.1%) and energy storage/electric vehicles (23, 14.9%).

Inputs: Mineral Extraction & Biofuels

Given the preponderance of information in the social sciences concerning the extractive industries, it is unsurprising that upstream assessments of labor rights in both the extractives and agribusiness industries received the greatest share of attention. 47 (33.1%) studies cover this stage, including 25 on biofuels and 27 focused on extraction (of minerals) of studies reviewed. However, researchers in this category point out that the larger body of literature related to extractives and the energy transition emphasize its technical dimensions, mapping out mineral reserves, flows, and identifying bottleneck issues (Ali et al. 2017).

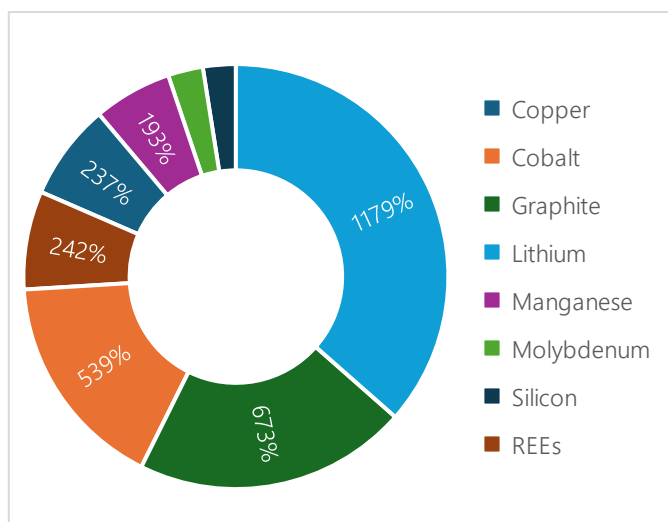


Figure 7. Percent increase in mineral requirements between 2020 and 2040 according to existing state policy scenarios. Data courtesy of the International Energy Agency, May 2021 Report on Mineral Requirements for Clean Energy Transitions.

These studies have prompted other researchers to investigate localized and global

socioenvironmental impacts that low carbon energy may create as a result of a global rush on critical minerals like copper, lithium, rare earths, cobalt, and molybdenum shown in Figure 6 (see Sovacool et al. 2021; Sovacool et al. 2020; Agustdinata et al. 2018; Church and Crawford 2018 for more assessments).

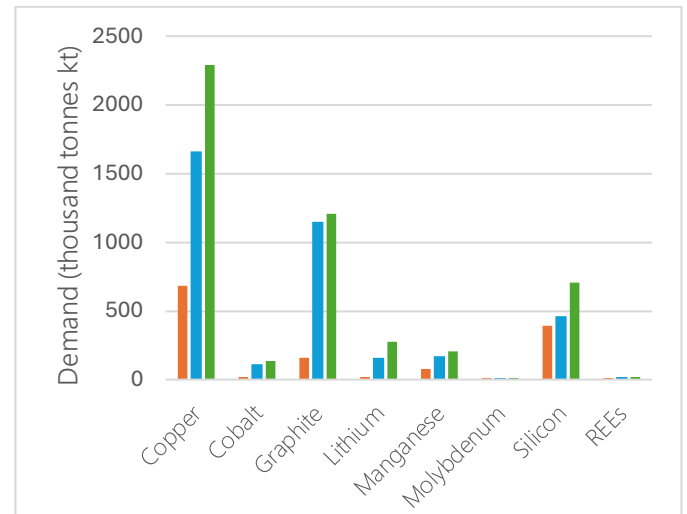


Figure 6. Critical minerals needed according to existing state policy scenarios. Data courtesy of the International Energy Agency, May 2021 Report on Mineral Requirements for Clean Energy Transitions.

The race towards renewable energy and the attendant mining rush may exacerbate various forms of dispossession and perpetuate the metabolic rift between countries in the Global North and South as the benefits of clean technology rely on environmentally hazardous extraction and production practices elsewhere (Church and Crawford 2018; Organisation of Economic Co-operation and Development 2020; Sonter et al. 2020). More pointedly, it appears that the global land rush on critical minerals for renewable energy may emulate other extractive intensive industries like fossil fuels, whereby extractive activities degrade local environments and the quality of life for those communities in the vicinity of these activities (Bazillian et al. 2021; Sovacool et al. 2020).

Some studies show that the extraction of cobalt can occur through child labor or debt bondage (e.g. Sovacool 2019). Many of these take place in the Democratic Republic of the Congo (DRC) where 69% of worldwide raw material for lithium-ion batteries and electric vehicles (EVs) derives (Moore 2021). Though mining activities can provide wages and reduce poverty, these activities degrade local environments, and many industrial and artisanal miners experience human rights abuses through violent conflict and occupational health hazards.

Findings concerning dispossession for biofuel production echo those in the extractives industry for minerals, with literature covering an array of socio-economic and ecological impacts (e.g. Rutz 2014). Biofuel production predominates in the United States and Brazil with these two countries producing 52.3 and 33.1 billion liters per year respectively (IEA 2021). The industry employs over 3 million people worldwide and, like other low-carbon energy, can potentially boost. However, many characterize biofuels as an unsustainable resource as they require large bands of land for production—sometimes acquired through land grabbing behavior—which creates enclosure over what were once lands held in common, sometimes by Indigenous peoples (Baka 2017; German et al. 2011; Montefrio et al. 2013). As a result of these dispossessions, workers and their communities find themselves living in far more precarious situations where instances of labor exploitation and coerced labor take root (Solomon and Bailis 2014; Dos Santos 2007; Olsen 2010; Mendonça et al. 2013; Selfa et al. 2015; Welch 2006). Particularly pronounced in the Global South, workers in this sector struggle to maintain livable arrangements with biofuel crops, as they do not pay living wages and global fluctuations in demand for biofuels makes work sporadic and unstable (Alonso-Fradejas 2021; Massieu 2015; Johnson et al. 2020).

Manufacture, Assembly, and Refining

In 2011, the ILO described employment in the renewable energy space as “front-loaded”, with the majority of associated work occurring through equipment manufacture, project development, and construction and installation (International Labour Organization 2011). Of the literature reviewed 31 studies (21.81% of the sample) consider labor rights in the manufacturing, assembly, refining, and warehousing phase of low-carbon technologies. The manufacture and assembly of energy storage

technologies for grid and electric vehicles, along with working conditions, are a particular blind spot, with most studies that touch on these technologies focused on the extractives sector.

Like other industries, renewables like solar energy rely on contract manufacturing and offshoring practices to reduce costs (Mulvaney 2013). These outsourced contracting schemes require less capital investment for companies as they can avoid sunken costs on manufacturing equipment. However, as the Foxconn case attests to, contract schemes sometimes mingle with poor labor standards, as contracted facilities further reduce costs by waving workplace safety measures and suppressing wages, often relying on a migratory workforce with few alternative options (Chan et al. 2013). Mulvaney's (2013; 2014) work on the production of solar energy detail some of the workplace hazards solar installers and manufacturers face, like exposure to dangerous levels of cadmium. His warnings about the use of contracted work in solar manufacturing proved prescient with the subsequent revelations of forced labor working conditions of Uighur minorities in Xingjian province. Not unique to China, similar contracting practices can take place inside the United States. A *Reuters* news story chronicled how a large solar manufacturing company relied upon prison labor programs with a disproportionate number of minority workers to produce their panels below minimum wage (Solomon 2022). Considering both the Chinese and American examples, industry firms and states can sometimes target racial and ethnic groups to manufacture renewables as cheaply as possible.

Outside of suppression of wages and labor abuse, contracting schemes that shift production elsewhere can create job losses where solar manufacturing once existed (Kramarz et al. 2021; Cha et al. 2022). For instance, some 5,000 solar manufacturing jobs were lost in Bitterfield, East Germany as local manufacturing could not compete with subsidized Chinese production that oversupplied the market and drove down market prices by 75% (Sovacool et al. 2021; Brock et al. 2021).

Regarding biofuels, scholars lament the difficulty and seeming impracticality of tackling labor issues in the value chain for the production and processing of biofuels (Pashaei et al. 2018). Despite these challenges, well known hazards associated with the production of biofuels include flammability, dust explosions, and toxic or corrosive material handling, and at least in Brazil, this has led to worker deaths (Perry 2009).

Construction, Commissioning, and Installation

32 studies (22.5%) examined labor rights and standards in the commissioning phase of renewable energy projects. Like other stages of the value chain, we have spotty knowledge about work associated with low-carbon renewables, but what we do know about labor rights and standards comes primarily from solar energy.

As previously mentioned, construction and installation account for a large portion of labor activities. However, the installation of utility scale solar and wind plants is largely a temporary and rural phenomenon and there is some question about the extent to which local communities derive employment benefits (Pearse and Bryant 2021). Like other workers in the construction industry, those hired on wind or solar construction projects may work under temporary and less secure employment contracts (Pearse and Bryant 2021; Gadzanku et al. 2023). However, wind energy projects can provide significant potential benefits to local communities in the form of increased tax revenues and a broader base of workers when a project exists near a town (Lambert and Silva 2012; Stefek et al. 2019).

One California study showed that large utility-scale (>20 Megawatt) solar plants that sell wholesale electricity to energy providers have produced lower energy costs and better career outcomes than small-scale (<1 MW) customer-sited rooftop solar. Larger scale work products have a

higher likelihood to employ unionized workers, and the average solar worker on these utility-scale projects received \$78,000 per year replete with associated health and pension benefits (Phillips 2014).

In contrast to these unionized workers, rooftop solar installers receive comparatively little pay, around \$23.27/hr according to the Bureau of Labor Statistics. The California Occupational Guides report even lower hourly wages for solar installers, with rates ranging between \$11.50 and \$21.00 per hour (Employment Development Department N.D.). These numbers likely do not capture the full spectrum of pay, particularly at the low-end, for rooftop solar installers who may be misclassified as independent contractors and, as a consequence, may not appear in data collected by state and federal agencies (Jones and Zabin 2015). Confounding data collection efforts, solar photovoltaic installer only became a federal occupational category in the United States in 2010, so many instances of solar installation may not be capture. As a result of these factors, capturing the rate of pay solar rooftop installers receive as a collective group faces several data collection challenges that may obscure both wages paid to workers, and the number of people affiliated with the sector.

Evidence from other parts of the world hints at better outcomes for construction and installation workers, however. In Germany, solar and wind construction and installation activities come with a 10% wage premium for workers compared to other similar sectors (Antoni et al. 2015), they attribute this premium as a “positive indirect effect” of renewable energy promotion within the sector.

Both wind and solar industries have socioecological impacts on the places they are built that can raise tensions within communities. Such dynamics are perhaps especially pronounced in the Global South. Alexander Dunlap calls attention to ‘green grabbing’ behaviors in the Isthmus region of Oaxaca, in which large scale wind energy developments displace local Indigenous communities

through racialized processes of 'green-colonialism'. Locals in the Northern part of the isthmus oppose these projects, rightly pointing out the exploitative nature of the land deals and labor contracts (Siamanta and Dunlap 2019). Careful planning and effective siting can mitigate some impacts from wind energy development, but they do alter the character of the landscape. For instance, they can cause wildlife mortality through collisions, degrade or fragment habitats, deforest areas, and induce soil erosion (Dai et al. 2015).

Like wind, the construction of solar parks creates similar ecological and social impacts on rural or cultural communities (Mulvaney 2013; Mulvaney 2019; Stock and Birkenholtz 2021). Though employment can ostensibly be made available to local residents, they are often overlooked, either lacking the necessary qualifications for these projects or companies choosing to hire workers through short-term labor recruiting agencies (Pearse and Bryant 2022). In either case, construction activities for both wind and solar may bring with them promise of development but sometimes do not manifest in social or ecologically sustainable arrangements with people in the vicinity of new project developments.

Operation and Maintenance

13 studies (9.4%) examined labor rights or standards for workers engaged in the operation and maintenance phase of a renewable energy installation, which is somewhat surprising since job opportunities at this stage may produce more long-term employment benefits. Of course, it is also true that this stage of the value chain produces comparatively less opportunities for employment than manufacturing, assembly, construction and installation stages, which might help account for why it has received less attention.

Authors Ryan Stock and Trevor Birkenholtz (2021) have been pioneers in probing this production phase, conducting interviews with workers and community members at Gujarat Solar Park, India. Several respondents were disappointed that the solar park did not offer many ongoing employment opportunities, as positions dried up once the solar park entered its operations phase. Only 39.3% of people whose lands were used for solar park development received work offers at the new facility and those able to secure employment report instances of wage theft and artificially depressed wages (Stock 2021a; Stock and Birkenholtz 2021). Instead of providing sustainable work to the community, those reaping benefits tended to occupy higher positions in the community or represent elite groups in control of contract opportunities, something that mirrors historic instances of dispossession in other industries (Ghosh et al. 2022).

Dispossessions often articulate themselves along gender and intersectional identities. In another study from Stock, solar park developers promised 'gender positive' outcomes that would empower women through employment opportunities, but these pledges did not materialize once the project was complete (Stock 2021). The enclosure of the solar park also blocked access to areas locals previously relied on for firewood and grazing lands (Stock and Birkenholtz 2020).

End-of-Life: Repowering, Decommissioning, Disposal, and Recycling

Like other stages of the value chain for these technologies, the quality of work affiliated with end-of-life processes remains understudied. 23 studies (16.2%) considered labor rights and standards in the end-of-life processes for low-carbon technologies.

Several studies find that smart meters and EV batteries get dumped into a huge e-waste scrapyard in Agbogbloshie, Ghana (Amankwaa et al. 2017; Amuzu 2018). Study authors remark on

both social and ecological impacts from the disposal of batteries and other discarded items that contaminate the water and air of nearby communities where e-waste workers live. Furthermore, scrapyards workers dig out copper, aluminum, and wiring for resale without personal protective equipment, breathing in the toxic chemicals of burn pits produced at the scrapyard. Children frequently work at the scrapyard and migrant workers often receive the worst jobs at the facility—such material burning for copper (Sovacool et al. 2020b).

Like other technologies, solar panels reliant on microelectronics can be difficult to recycle and break down creating hazardous waste exacerbating an already significant e-waste burden in parts of the Global South (Cross and Murray 2018). In this, a new economy surrounding renewable energy repairs is sprouting up in places like Kenya as individually purchased, distributed energy systems reach their end-of-life.

Transportation, Distribution and Logistics Across Production Network Stages

Transport and distribution work stretches across all stages of the production network, making it a critical element of any study aimed at understanding the nature of work during the energy transition. Despite this, few studies (7) aimed to examine labor rights and standards for transportation in sectors affiliated with renewable energy. The lack of literature could reflect challenges to delineate between transport workers affiliated with renewables, and those outside the industry. After all, truck drivers, railcar operators, and ship captains may haul other cargo other than those associated with renewables.

Putting definitional issues aside, transportation jobs could very well be vanguards for a low-carbon future. Policies in places like California press the industry to adopt low- and zero-emissions

vehicles in the commercial trucking sector (Appel 2019). Aside from hastening the shift to low-carbon EVs, such actions may impact the way transport workers secure access to vehicles to conduct their work.

However, there are some structural problems in the industry that suppress work quality. Studies from University of California, Berkley's Labor Center indicate power differentials between trucking companies and truckers has led many drivers to be misclassified as independent contractors rather than employees as these companies shift the costs of truck ownership onto individual drivers, making them purchase their vehicle from the company to haul freight (Appel 2019). The worry here is that the costs of transforming the fleet of electric vehicles will be borne by truck drivers rather than capital owners in the trucking industry.

The International Transport Federation also conducts some interesting work in this arena. They raise awareness of how intensified weather events will increasingly impact workers in the sector with extreme heat, air pollution, and flooding, and these impacts will disproportionately be borne by young people and women who hold precarious "gig" jobs with little protection (International Transport Federation 2022). Recognizing this and the changes happening in the transport sector, they have called for a gender equal transition, job guarantees, and advocate for health and safety as a fundamental right for all transport workers.

Macro Level Assessments of Labor Rights and Standards for Low-Carbon Renewables

Rather than focus on specific value chain stages, a little over half (76) of the studies reviewed performed macrolevel assessments, speaking more broadly about the issue of labor rights and standards across production network phases and technologies. Within those studies that provide

macrolevel assessments, 31 discussed unionization rates, likely a recognition that unionization tends to improve the quality of work afforded to people. Or it could simply be that unionization rates are more easily studied in the aggregate, rather than attempts to access workplaces and workers directly.

In contrast, several studies focus on those workers being left behind by the transition. These call attention to how those industries subject to ‘creative destruction’ (Schumpeter 2014) result in job losses for fossil fuel workers. In addition to calling attention to the needs of unemployed workers, they discuss how the comparative quality of jobs in the renewable energy space does not match that in the fossil fuel sector, which animates skepticism for workers who fear being left behind or abandoned as patterns of power generation, financing, and distribution of available work plays out unevenly (Newell and Mulvaney 2013; Räthzel and Uzzell 2011).

In more concrete terms, workers in the fossil fuel industry enjoy comparatively stronger unionization rates, at least in the United States, compared to renewables (Stavis 2014). Low unionization rates may help to suppress wages afforded to workers and result in more dangerous working conditions, something that has plagued the coal industry as its unionization rates have dropped (Cha 2017). To this point, no cross-country analysis of unionization rates associated with renewable energy or ‘green jobs’ professions has taken place.

10 studies reviewed provided end-to-end analysis on labor rights and standards by attempting to link production of materials in one stage and location of value chains with their counterparts in other parts of the globe. Unfortunately, the labyrinthian complexity of world supply chains and subcontracting networks makes it difficult to work out who is producing what and for whom (Blanpain

2015). As a result, most studies confine their analysis to a particular phase of production, often in a fixed locality.

Though the topic of gender was somewhat marginal in literature reviewed (23), some notable findings emerge. First, women in some parts of the value chain for these technologies, but more broadly in STEM fields, may be perceived as less competent than their male peers, regardless of qualifications (Baruah 2017). Much of this relates to cultural and social norms, perceptions of gender roles, but also reflects existing hiring practices inside industries (IRENA 2019). For some women in so-called “peripheral countries”, prejudices combined with already precarious livelihoods limits their options for entering direct or indirect careers in the renewable energy space (Baruah 2017; Mortensen and Boyland 2019). Women in both industrialized and less-industrialized countries might learn skills to install and repair solar technology but could find it difficult to generate a regular income as opportunities emerge on an intermittent basis through short-term contracts (Baruah 2017). Johnson et al.’s (2020) thorough review of the gendered aspects of labor provides an interesting look at the contradictory role renewable energy can play as both a tool or profession in potential empowerment, but also shifting existing inequities and creating ruptures in local norms and practices.

Synthesis: Reflecting on the State of the Research

An impressive multi-disciplinary scholarship has already emerged on labor rights and standards in the renewable energy space. Many of these provide a macro level picture of the challenge at hand, but more studies are beginning to delve into the experiences of specific workers and communities in production networks. These on the ground research efforts are admirable given the challenges of access. The following section provides a reflection on the state of the discourse, weaving together the

disparate threads of knowledge into several patterns that help capture a general picture of existing labor rights and standards associated with renewables, and possible directions future research might explore.

An Emerging Global "Ephemerate"?

Low-carbon technologies can create short-term job opportunities. However, they may not be sustainable for the environment, the people who occupy these positions, or surrounding communities. Each production network phase for various low-carbon technologies exhibits attributes of precarity, including work in biofuel production, solar energy, wind energy, associated extractives activities for all-low carbon technologies, and the disposal and recycle of outputs (see Econie and Dougherty 2019 for disposal and recycling issues in the US).

We might describe many jobs created by renewables as *ephemeral*. Power disparities between countries and corporations, regulatory differences across boundaries, and the availability of specific equipment or materials in one place may result in job losses as company's shift production activities across an assemblage of global commodity flows. Consequently, workers in renewables may face similar conditions of transition as those in other sectors have historically experienced due to spatial competition that results in downgrading of both ecological and social conditions (see Mulvaney 2013; Kramarz et al. 2020; Sovacool et al. 2021; Brock et al. 2021). It is crucial to recognize this dynamic, as it shows that renewable energy systems may similarly create ruptures to communities that echo past periods of divestment.

The ephemeral nature of work also stems from a combination of seasonality in industries like biofuels. Especially in places like Brazil with extensive biofuel production, jobs fail to preserve secure

livelihoods, while also degrading the surrounding environment. Crucially, these jobs come and go depending on seasonality, as well as the whims of companies. Taking up wind, but especially utility scale solar production and installation, an itinerant workforce of roving bands of installers move between communities working on projects through subcontracted networks; a practice that occurs in both the US (Gadzanku et al. 2023; Morely and Spaans 2025) and in Australia (Pearse and Bryant 2022).

Recognizing the ephemeral nature of work should prompt us to question whether net-job gains or employment estimates from different projects adequately capture the longer-term economic welfare for workers and communities (see also Johnson et al. 2021; Pearse and Bryant 2022).

In that sense, *ephemeral* work exists as a subset of the more general concept of precarious work. Where precarious work refers to things like insecure employment, limited legal protection and insufficient wages and other social benefits, the *ephemeral* nature of renewable energy employment, like others, varies according to the vagaries of global capitalism, spatial patterns of production, and ecological and seasonal forces that influence what forms of work occur and when. Of course, this then suggests a dire need for states and policymakers to develop safeguards and safety nets to help ensure workers can navigate the cyclical nature of job creation and destruction endemic to a capitalist mode of production. My argument bears similarity to the need for stronger social safety supports and transition policies, both for communities and individuals, to help secure those whose jobs are subject to replacement.

What this chapter reveals is that because some of the work in these industries is ephemeral, that the work comes and goes, there may similarly need to be transition programs for these workers to have access to stronger social safety nets and supports. Taken together, a recent publication advanced by the United Nations Research Institute Development for Social Development has it right in

emphasizing the need to put social welfare and human security front and center in policy discourses related to changes to global political economy—be those changes to energy systems or otherwise (see Barca et al. 2025).

Along these lines, it is important to acknowledge that work quality does not exist inside a vacuum. The livelihoods and welfare of workers depend on things like social welfare and various offices of the state. Not only does this invoke us to pay closer attention to these political structures, but the way jobs in these industries present themselves depends to a significant degree on the social settings of work. That is to say, the capital-labor relationship is shaped to a significant degree by what happens *outside of production*. I will expand on this later, but I am referring to the “social reproductive” elements of society that exist outside the workplace. The sphere of social reproduction enables capitalism to function by performing unpaid or domestic forms of care and maintenance that enable so-called “productive” enterprise, that is, the accumulation of surplus value for capitalists for the purpose of further expansion of capital. Social reproduction thus constitutes invisible architecture that enables capitalism (like other forms of living) to function as it does—buttressed by feminized forms of work. Once again, that means that jobs do not exist in a vacuum. They are irreducibly political and are embedded in the day-to-day rhythms of living—an imperial mode of living that benefits some parts of humanity at the expense of others (Brand and Wissen 2018; 2021).

Who Benefits from Green Jobs?

Though ecological modernisation may have initially served to break through the work versus nature dichotomy (Dryzek 2013), it tends to reify existing patterns of development that perpetuate the same economic systems that contributed to today’s ecological crises. In that regard, low-carbon

renewable energies uphold a status quo founded on existing forms of dispossession anchored in colonial practices (Lennon 2017; Dunlap 2018). Though several studies have called into question impacts to workers in solar energy in varied contexts, they may be especially pronounced on rural populations and marginalized groups (Stock 2021b). It is important to note, however, that while exploitation such as this may concentrate in parts of global political economy associated with the Global South, workers in the North also confront conditions of exploitation. To me, that suggests a need for us to at once acknowledge differences between settings, but also recognize how we all experience exploitation to greater or lesser degrees within the current system. It is through the embrace of both difference and similarity across difference that we can begin to think generatively for how to more effectively respond to challenges collectively.

Just as there are divisions between the North and the South, this synthesis shows how formal sectors and informal elements of the renewable energy economy depend on one another. For instance, the use of precarious labor drives the biofuel industry in rural communities of Brazil, many of whom are put into these situations through the dispossession of land. Wind production in Oaxaca relies on the enclosure of Indigenous peoples' lands, which separates people from their means of subsistence (Dunlap 2021). Solar energy reflects the mutually constitutive relationship between the formal parts of the industry that relies on informal and marginalized workers to perform precarious work through extractive activities, solar installation, e-waste recycling and disposal (Stock 2021b). Across renewables, ecological impacts and displacement resultant from biofuels, extractive activities, solar and wind plant construction in the Global South can push people into positions of precarity. These actions create a cheap, disposable workforce for these companies who hire the very people removed by their projects, as they have little recourse but to accept what little opportunity is made

available to them. Myles Lennon (2017) cuts to the heart of the matter, noting that regardless of the form industrialized energy takes, the commercialization and commodification of matter into energy renders certain populations expendable and historic patterns of coloniality help explain why black, indigenous, people of color (BIOPOC) experience the greater share of these burdens.

What this suggests is a need for research that not only focuses on primary firms and their attendant employees, but also employment in the peripheries of wage labor markets where precarity concentrates as a function of control strategies of employers and state regulation of labor markets. As this review demonstrates, fewer studies have analyzed labor rights and standards through the prism of migration than we might hope, despite the significant role migrants play across the global economy. For example, investigative reports like that of Louis Hansen have investigated Tesla's abuse and misuse of H1B visas in the United States to recruit Serbian electricians for low wages using subcontracts to help build their EV facilities (Hansen 2021).¹⁹ Such arrangements bear hallmarks of a fissured workplace, relying on low wage workers recruited through contract and subcontracted networks that, "operate competitive markets that create conditions for non-compliance" (Weil 2014). Future studies might consider the role migrants play in the production of low-carbon technologies, such as the transfer of skills and labor inputs across borders, and how their identity as migrants impacts the roles made available to them (Sovacool et al. 2020; Pearse and Bryant 2022), and how these differ from similar roles occupied by non-migrants.

¹⁹ Tesla, for example, does not include the right to free association in their corporate social responsibility policy and their CEO, Elon Musk, famously questioned why his workers would want a union on Twitter back in 2019.

A handful of studies (23), consider the role of gender in the production of these technologies. Most of these estimate the percentage of women who work in affiliated industries and the need for greater representation (Pearl-Martinez and Stephens 2019). Though white-collar work was not a primary focus of this study, white males continue to dominate the sphere of “energy experts”, and thus shape energy systems as a reflection of existing power structures in energy distribution (Lennon 2017; Burke and Stephens 2018). While women occupy 32% of positions according to IRENA’s 2021 job report, many of these exist outside STEM fields, which gives rise to questions about the diversity of thought in those sectors of the industry helping to shape its future. Arguably more important, many studies related to gender and energy policy treat the topic as if it were gender neutral, despite how energy flows and associated norms of work in communities take on gendered aspects (Standal et al. 2021). Along these lines, women in certain parts of the globe may experience greater burdens when renewables move into an area. Returning to the work of Stock and Birkenholtz (2021a), they call attention to such asymmetries by reviewing local community responses to the Gujarat Solar Park in India. As part of this, there were health impacts on the community. These included embodied affective impacts that women experienced through the dispossession of lands due to the solar development and, relatedly, disruptions to long established social norms and relations around things like gathering fuel (fire wood) for cooking.

In North America and Europe, we might also consider the political implications of shift in energy systems. Job losses for some and downgrades in work quality across sectors can breed additional “politics of resentment” that embed themselves into broader antidemocratic and populist movements (Brock et al. 2021; Zuk and Zuk 2024). Ignoring these dispersed impacts from the transition will likely only create further polarization across countries, which should prompt us to respond to market’s

processes of creative destruction. Once again, this returns us to ideas about the need for more robust transition policies.

Authors Robert Pollin and Brian Callaci (2019) argue retraining programs should be included alongside a larger package of benefits to ease burdens during the transition. These provisions could go further and need to be considered as part of a larger, ongoing package of social safety nets that include things like universal health care, unemployment benefits, wage replacement, paid-sick leave, access to higher education and vocational school programs, and a real living wage (Just Transition Listening Project 2021). These protections and social safety nets compensate those who lose their jobs, but also help expand 'decent' work arrangements by remedying some of the factors that drive people into precarious conditions (Pollin and Callaci 2019). Considered collectively, these prescriptions suggest that a core solution to handling displacements and impacts to workers in this energy transition relates to creation of new social contracts that provide greater security for workers in an unstable global economy (Neale 2021).

The North South Divide

Evidence suggests production activities associated with renewables in the Global North continue to rely on the expropriation and exploitation of people and resources in the Global South. More specifically, social and ecological dumping from one region to another that tends to accumulate in the peripheries of production networks creates new sacrifice zones or exacerbating existing injustices (Sovacool 2021; Brock et al. 2021). These are consistent with an "imperial mode of living" whereby transition efforts in the North to enable the continuance of unsustainable lifestyles depends on exploitation elsewhere (Wissen and Brand 2018). These dynamics not only occur between countries,

but within them too. For example, renewable energy companies rely on subcontracted workers to perform rooftop installation to obtain greater profits at the cost of worker wages (Mulvaney 2013).

In terms of where and how research has been conducted, macro-level assessments appear to be the most common way of approaching this issue. It tends to focus on industrialized societies in the Global North, with the exception of research on the extractives industries and biofuels sectors. Some of this may reflect a general bias in the direction of research in the Global North, as well as the collection method employed by this review.²⁰

However, there appears to be multiple conversations occurring in parallel vis-à-vis our understanding of how the labor movement might respond to the energy transition, and where impacts to workers accumulate.

On the one hand, labor advocates in places like the United States and Europe have been making the case for a union led labor movement in the energy transition. These efforts understandably center on winning project labor agreements with energy companies on large, utility-scale energy projects with the potential to employ significant numbers of affiliated workers. In fact, offshore wind has generated much excitement from groups like the Climate Jobs National Resource Center and its affiliates for its potential to bring considerable renewable energy capacity onto the grid through capital intensive energy projects using union labor. That a skills shortage exists in industries like

²⁰ By focusing on literature more readily accessed through university systems and search engines here, it likely misses a large body of scholarship produced by scholars across an array of languages in different parts of the world.

Offshore Wind and structural and material attributes of offshore wind power might also lend itself to future organizing and more opportunities for unions in the Northeast (Westgard-Cruise 2026).

On the flip side, however, this omits the vast array of contracted and subcontracted workers responsible for a wide suite of activities ranging from installation of distributed rooftop solar, to recycling workers, transportation workers, and so on. Instead, the dominant discourse in the Global North treads the path of “weak” ecological modernisation, which encourages a business centric perspective on new energy projects and investments through policy mechanisms that, while beneficial for accelerating transition activities in some places, do not account for the quality of new positions or attendant impacts from production in other parts of the world. It is here the other stream of conversation intersects.

Despite their green veneer, renewables rely on “ecologically unequal exchange” between different parts of global political economy. The exchange takes place through the extraction of natural resources that results in ecological damage, displacement of local communities, and worker impacts in the so-called “peripheral” and “semi-peripheral” nations usually associated with parts of the Global South (Bonds and Downey 2012).

As many of the scholars reviewed suggest, we have an immediate and apparent need to better understand the distribution of impacts attendant to the energy transition. Part of this inquiry requires exploration regarding the geographic distribution of mineral resources to build these technologies, considering how their territorial and political embeddedness might impact the rights of workers and local ecologies. The energy transition, as it is currently playing out, appears to perpetuate historic patterns of dispossession in countries and communities of the Global South rather than altering their

position in global political economy. Collectively, the insights from the stages furthest upstream and downstream in the value chain suggest that much of what makes renewables “clean” relies upon deleterious processes harmful to environmental and human health that concentrates in the peripheries of the economy. In that regard, while low-carbon renewables may help industrialized countries achieve carbon reductions and fewer environmental impact to their communities, the associated impacts ultimately bear down on local peoples and ecologies in the Global South (or parts of the South in the North). It will therefore be critical to consider both spatial and historical relations between collective communities of workers when assessing different forms of green jobs.

Debates and Future Research Directions

Filling in the Gaps

Mulvaney's (2013) work in the solar energy industry has undertaken the difficult task of mapping out linkages between production network stages for various technologies to understand the drivers influencing the expansion of contracted work in the industry, why firms choose to produce in one place rather than another, and how these movements impact labor rights and standards for workers. The combination of production network pressures and loose labor regulations in different nations suppresses work quality in industries like solar. As Stock (2021b) describes it in the context of solar energy, these pressures create a new “solar *praeclariat* class” who labor in harsh conditions for little benefit in the informal economy to generate value for larger solar energy companies. While by no means a unique phenomenon to the solar energy sector, it calls into question blanket statements that claim renewable energies singularly upgrade the lives and livelihoods of people across global value chains without other social supports.

In addition to mapping out these linkages, there is a need for more comparative research that examines conditions for workers on the ground to better facilitate our understanding of the broader regulatory, political, cultural, and spatial dynamics impacting work quality in the energy transition. The significant increase in mineral needs will create a rush on mineral reserves that exist in fixed, territorially embedded locations that influence development pathways associated with these resources. These attributes make communities near these resources sensitive to economic, political, environmental, and cultural turmoil as companies and nations jockey to position themselves to control critical reserves. Though several studies have already begun the process of tracing the contours of the global land rush on critical minerals (e.g. Sovacool et al. 2020, Riofrancos 2023, Bazillian et al. 2021; Martin and Iles 2021), these can be paired with more comparative research that adds to our theoretic understanding of this issue, while maintaining dialogue with real world problems. Along these lines, William Westgard-Cruice and co-authors (*forthcoming*) are developing an analysis of wind energy production networks across parts of the US and Europe to better map the opportunities, challenges, and ambivalences of workers towards wind energy production for improvements to work and labor organizing, in particular. Other useful activities would include returning to ideas of dependency in the context of energy transitions, or to further probe the self-reinforcing nature of ecological and labor exploitation through land grabbing or ecological destruction discussed earlier.

Some of the most significant gaps in our understanding of labor rights and standards for renewable energies are geographic. As Figure 4 shows, there are countries in the world where renewable energy work activities take place that have gone understudied. Future comparative research aimed at a specific technology and stage of the value chain could help us broaden both the scope and depth of our knowledge concerning labor rights and standards for renewables. These

findings should help us to map out linkages in the value chains for these technologies and understand why companies choose some communities and sites of production rather than others. Though research points to costs, offshoring, and expediency as probable explanations (Pearse and Bryant 2021), more research that answers this question could provide valuable information to identify gaps in regulations that allow companies to exploit local communities and ecologies, as well as supplement our theoretical knowledge about how firms choose to operate in the economy under the context of energy transition.

Accounting for Low Unionization Rates

Despite conflicting data on the rate of unionization in the wind and solar industries, unionization rates in solar and wind lie below their peers in other private industries. While some workers recognize the need to address environmental priorities, the lack of comparatively decent employment for workers coming from the fossil fuel industry and dearth of social safety supports creates hesitancy to fully embrace environmental priorities (Cha and Vachon 2021; Cha 2024).

Given these circumstances, understanding what currently suppresses unionization rates in the renewable energy space and what could be done to boost them could alleviate some of these concerns and hasten a more complete embrace of climate adaptation. It could very well be the case that higher levels of unionization in the fossil fuel industry reflect its development during a more robust period of unionization, whereas the renewable energy sector matured during a period of declining unionization rates worldwide. However, no such study has sought to understand this phenomenon.

A comparison of biorefineries in the United States and Norway found that those working in the United States were at more significant risk of labor abuse than those similarly employed in Norway. Indicators for this risk relate to the vastly different views on collective bargaining and the unwillingness of the United States to ratify parts of the ILO convention on labor rights (Valente et al. 2017). That labor rights and standards within the same industry differ is no surprise. However, such analyses should prompt us to consider why companies and industries choose to produce in some countries and not others, and to what extent existing labor laws and regulations influence the placement of production and assembly facilities. I will return to this point later on when I examine Vestas' decision to develop its North American manufacturing operations.

Challenges and Opportunities for Upgrading Labor Rights and Standards

Siemens-Gamesa, one of the wind industry's leading firms with over 743 GW of wind energy capacity installed worldwide, signed an international framework agreement (IFA) with IndustriALL Global Union to employ its workers and uphold social, labor, and environmental standards (see, also, Stevis 2010 on IFAs). In addition to including references to the ILO's fundamental conventions on labor rights, the agreement also extends these protections and rights to company operations across the company's supply chain, regardless of whether the country in which a facility or contract group exists has ratified the ILO's convention. Though voluntary, IFAs may have a higher level of commitment to established standards, representing bilateral negotiation between a firm and trade union representatives, although power differentials remain.

The highlighted examples, however, focus primarily on the Global North, and within collective groups of individuals better positioned (through their unions) to advocate for themselves and quality

jobs that uphold fundamental labor rights and standards. Though broader expressions of solidarity like IndustriaALL's IFA speak to the need for improved labor rights and standards across supply chains; they may not fundamentally alter historically entrenched patterns of energy production and labor affecting workers in the peripheries of both the Global North and Global South. In her analysis of just transitions organizing opportunities in the U.S. South, Nikki Luke (2022) demonstrates that just transition policies aimed solely at securing benefits for union-based workers may exacerbate inequalities rather than remediate them. Though much of Luke's analysis focuses on individuals in the fossil fuel industry, she is right in demonstrating how exclusive focus on one segment of the workforce (unions) does not address the broader array of work settings that have also experienced widespread declines in work quality. Similarly, a look to the history of the US shows how some trade unions were exclusionary, which left legacies that continue to be felt today. Though this example only covers the United States, unions across different national contexts function differently (often as an arm of the government), and not all these groups contribute to democratic and just outcomes for their workers (Solomon 2022). As a result, centering a just transitions discourse for workers within the sole domain of union access to jobs may perpetuate inequalities, skewing the benefits towards a smaller segment of the workforce.

There are also questions regarding the types of new energy systems being built, and who benefits from them. Lennon (2017) draws a distinction between "Big-E energy" and "small-e energy" as a template for decolonizing energy systems. Big E energy relies on centralized production processes that echo historic forms of dispossession, whereas "small-e" energies reflect decentralized, community owned projects anchored in a relational ontology that keeps energy production in the community (i.e., is not export centric) and in closer harmony with local environments.

It is possible unions tend to support large scale energy projects that require a great deal of capital investment, like previously highlighted offshore wind projects. These projects provide a greater opportunity for unions to secure employment for their workers replete with collectively bargained benefits. Smaller distributed and locally owned community projects do less to endear themselves to unions as they cannot provide comparable material benefits, despite the emancipatory potential they might provide by decentralizing energy ownership. Bargaining dynamics are exacerbated in places like the U.S. because no national agreements exist between labor, business, and the state, which forces bargaining to occur in the workplace rather than the broader industry. In that regard, the requirements of global capitalism and relationship states maintain with business and workers (both organized and unorganized), limits possibilities of conceiving of new energy arrangements without larger scale societal transformations. Despite the apparent challenges, these tensions and debates demonstrate how workers, rather than being victims of climate policies, can also act as agents of change who might advocate for more ecologically and socially robust forms of work.

Rather than small-e energy projects, authors like Jonathan Neale (2021) make the case for governments to develop “Climate Corps” job programs that build out continental scale super grids that connect energy systems over vast distances that accommodate renewable energy intermittency. The program would guarantee social benefits and a job for anyone involved in building out new energy infrastructure, which would require many new solar and wind developments, alongside improvements to energy transmission infrastructure to make super grids possible. All to say, such an effort would require a more significant centralization of authority into the hands of federal governments to mobilize such a vision.

Even if a Climate Corps does emerge in various parts of the world, it will still reflect the idiosyncrasies and needs of people in each region, depending on levels of existing development and resource availability—something constrained both geographically and politically. As such, a more universal shift towards decent work that uphold fundamental labor rights and standards will likely not emerge from a homogenized set of prescriptions to similar problems that works for all people in all spaces. Instead, future efforts to uphold labor rights and standards will appreciate the peculiarities of workers in varying places of global production networks alongside an acknowledgement of the broader social forces increasing instability in the lives of individuals, such as growing within-country inequality, and deeply entrenched patterns of inequality, environmental degradation, and dispossession (Stiglitz 2013).

Despite the varied ideas of what can help improve labor rights and standards in a new energy economy, each vision suggests the usual modes of doing business do not serve us (and perhaps, never did). Instead, the move towards a just transition needs to expand its focus beyond technical and material requirements and consider in tandem other broad domains of human security like access to a living wage, access to food, freedom from environmental degradation and pollution, access to healthcare, and other dimensions that constitute social welfare. In any case, as Laurie Parsons and Nithya Natarajan suggest, the only certainty is that work will continue to be, “a site of struggle, agency, and compromise” in these political arenas as we move forward (Parsons and Natarajan 2021).

Conclusion

Changes to energy systems provide a window of opportunity to transform the face of work alongside energy infrastructure. The answer, however, does not lie in simply producing new energies,

but in transforming the politics and associated social relations around them. The task before us, therefore, is far steeper than technical analyses suggest. While more researchers have shifted their gaze towards the subject of work, it has registered less attention than warranted given its central role in meeting the challenges of a changing climate (Coe 2021). Recognition of this has given cause to some to make the case for an “environmental labor geography” that foregrounds unions and class struggle to make more rapid progress on climate issues (Kleinheisterkamp-González 2023).

In this Chapter, I summarized the state of the literature concerning labor rights and standards associated with renewables. Though it is difficult to draw definitive conclusions from a synthetic review of this kind, it provides a baseline from which we can begin to draw some broader observations and overarching lessons concerning the nature of green and climate jobs associated with renewable energy systems, including the broader structural dynamics of political economy that condition them. In no particular order:

- 1) While renewables can help respond to the need to reduce emissions, without foresight the expansion of these technologies can impact labor rights of workers and their respective communities in negative ways. These technologies have ecological and social impacts that tend to accumulate in upstream and downstream phases of production, and in economic peripheries. Rather than steering renewables towards a future that upgrades labor rights and standards and transforms the face of work, existing industry practices and policies across nations may instead exacerbate existing inequities for some groups of people. For this reason, it will be critical for future analyses to appreciate spatial relations between places and groups of workers.

- 2) All production network stages for these technologies have received some attention, but less than we might hope for. Transportation, distribution, and logistics have been the most understudied, despite serving as the connective tissue in production networks. Some of this may reflect definitional issues regarding who counts as a worker in the energy transition. Nevertheless, that these enable circuits of capitalist accumulation suggest that we more thoroughly attend to these spaces.
- 3) Related to the second point, defining who occupies 'green jobs' or 'climate jobs' confounds data collection about employment in the sector. This has real consequences for how we understand the quality of work afforded to individuals, including which workplace settings better uphold labor rights and which do not. Some production network stages also have more informal work which tend to be occupied by women and migrants who experience impacts differently across contexts.
- 4) Two separate, but salient tracks of research characterize the literature on labor rights and standards associated with renewables. On the one hand, some discuss opportunities for a revitalized labor movement led by unions in the core of the economy. Some take this further an advance analysis that suggests trade unions may serve as the vanguard for a transition (Huber 2022; Kleinheisterkamp-González 2023). On the other, there is evidence in the Global South, as well as in informal parts of the economy, that suggest the new energy economy may exacerbate precarity, rather than safeguard the rights of workers. Both these stories may well be true at the same time. Nevertheless, we have an imperative to bring these conversations into alignment and to better articulate dependencies and social relations between *both formal and informal aspects of the economy surrounding renewables*. That entails analyses that

appreciate how the totality of society constitutes outcomes and that workplaces do not exist in isolation from one another or across history. Better appreciation of this can help generate knowledge useful for political praxis, in addition to advancing theorization about the nature of the “green” and “climate” jobs in expanding networks of renewable energy. I suggest this process might be aided with research that merges both the local and the global, filling in knowledge gaps with both theoretic and descriptive research across a wider array of geographies and contexts.

- 5) Building on the previous point, we have a need for future research that bridges production network phases. We need to understand how labor rights and standards at one stage do or do not mirror the experiences of workers in another place within that same stage. Likewise, we need to better understand the internal relations between stages and how what happens in one part of a production network shapes what occurs elsewhere. While a significant body of research has developed surrounding the upgrading of labor rights across value chains, less research of this kind has occurred in the renewable energy industry. A broader research agenda of both international and comparative research committed to marrying global trends and activities with local impacts could do much to open the “black box” (Mulvaney 2013) that currently characterizes work associated with renewables.

CHAPTER 3: A HISTORY OF GREEN AND CLIMATE JOBS IN THE US²¹

The passage and implementation of the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Acts (IIJA) were perhaps the most significant pieces of industrial policy oriented around green employment that has come about outside of China. Both policies were heralded for a variety of reasons, but potential employment benefits to states occupied the centerpiece of messaging. Climate jobs featured in the discussion, with the establishment of the Civilian Climate Corps as a more specific type of green job—those tied to climate. In both cases, the promise of these policies is succinctly captured by the BlueGreen Alliance (2024) which writes, “Americans don’t have to choose between creating good jobs and protecting the environment. We can and must do both.”

The apparent simplicity of the phrase “green job” obscures contestation about them, both among dissidents and adherents (Bowen, Kuralbayeva, and Tipoe 2018; Stanef-Puică et al. 2022). Like other concepts, ideological preferences produce diverse views on sustainability and the proper role that work (and workers) should play in society. In this respect, different conceptions of “green jobs” or “climate jobs” serve as proxies for the broader political economy and associated pathways through which the ‘energy transition’ might develop. While many academic studies and gray literature calculate green job requirements for the energy transition, fewer cover both their ecological *and* social aspects or what kind of political economy they advance.

²¹ This chapter is a modified version of a book chapter authored by me and Dimitris Stevis titled, “Green Jobs, Climate Jobs, and Competing Visions for a New Energy Economy.” In *Climate Jobs*, edited by Richard Benton and Laura Skinner. Labor and Employment Relations Association Series. University of Illinois at Urbana-Champaign.

To help break the concept from its more stale use as a label that simply denotes different categories of jobs in certain sectors, I examine green jobs and climate jobs from two angles. In the next chapter, and in line with the stated goal, I will construct a typology next chapter to show the range of possibility that exists for different forms of “green” or “climate” work. Before doing so, however, I use this chapter to situate “green” and “climate” jobs concepts within a longer history of labor environmentalism. As most of the broader work of this dissertation is anchored in the US context, I construct my history accordingly, while also making references to global developments as applicable. In so doing, I aim to historicize the relationship between labor and environmental issues—and perhaps the labor and environmental movements more generally—to situate the expansion of employment in the renewable energy sector within a larger struggle over what the proper relationship between labor and the environment should look like. In this respect, this chapter takes begins the conceptual enterprise of defining what “green jobs” and “climate jobs” are, doing so by considering various instantiations of these social relations within a longer history of labor environmentalism in the US, with references to international developments and other social settings as appropriate.

My account of the origins and usage of these terms makes clear that there is significant variability, both diachronically and synchronically, in how different groups come to understand “green jobs” or varied notions of sustainability in employment. Beyond the analytical utility of this endeavor for the dissertation, this chapter serves a political function in demonstrating the ways in which some segments of labor—especially organized labor—has contributed to environmental issues and, in some instances, sought to construct an alternative political economic arrangement that cuts against the grain prevailing political-economic logics in liberalized market society like the US.

Early Examples

Environmental employment programs have existed for decades, stretching at least as far back as President Franklin Roosevelt's Civilian Conservation Corps (CCC) program (Maher 2009). A project informed by Roosevelt's own time conserving forest land on his property, the program sent millions of young American men from mostly urban areas to rural places to work on resource conservation projects (Dewey 2019; Maher 2009). The CCC also included opportunities for immigrant youth to become part of the American workforce, politically framed to help young men build both muscles and American values—including a conservation ethos (Dewey 2019). Like many American programs, however, fewer opportunities were made for African Americans, and those who participated sometimes worked in segregated camps (Dewey 2019). The New Deal also provided employment through the Works Progress Administration and Public Works Administration, which created a great deal of public infrastructure that was considered environmental by the standards of the time.

While the CCC is celebrated as one of the most significant conservation and work programs in the country's history, labor environmentalism in the United States goes back much further (Montrie 2018). Enslaved African Americans in the antebellum South developed an environmental ethos by cultivating land, hunting, and fishing to supplement their meager rations. In so doing, they became more attuned to the landscape (Dewey 2019). In the early 1800s "mill girls" in New England's textile factories turned to the nearby woodlands to escape the increasingly harsh conditions of industrial capitalism, and their writings helped inspire early labor agitation (Dewey 2019). The famed Wobblies of the Industrial Workers of the World argued for clean and healthy forests and bodies, finding resonance between workers and environmental issues, despite lacking contemporary language consistent with environmental justice (Loomis 2021: 131).

Despite these early years, modern conceptions of environmentalism or even conservation were somewhat scarce among the broader population (Dewey 2019). Instead, many conservation measures adopted in the 19th century served the interests of the wealthy. Such moves included the criminalization of traditional pursuits like fishing and hunting (Montrie 2018: 55), and the expropriation of indigenous lands through enclosures of a variety of means, including the National Parks (Montrie 2018; Treur 2021).

In the 20th century and related to these pursuits, the UAW would institute a Recreation Department in 1939 to provide opportunities for members and their families to bask in the regenerative glow of ‘wilderness’ (Dewey 2019; Montrie 2008). Hunting and fishing surged in the American workforce following World War II, which helped spur efforts to protect game species habitat (Dewey 2019). Groups like the AFL-CIO supported outdoor recreation and the protection of open spaces, in part, for anticipated increases in free time from the country’s prosperity, increased productivity, and increasing automation in the post-war era (Dewey 1998: 50). Such reasoning led AFL-CIO President George Meany, a supporter of “business-unionism”²², to support the 1958 National Wilderness Preservation Bill declaring wilderness as a benefit for all American people, not just commercial enterprises or the wealthy elite (Dewey 1998). President Al Hartung of the International Woodworkers of America (IWA) would also testify in favor of the Wilderness Act when Congress debated it in 1960, knowing what would happen to forests if timber companies were granted full control (i.e., they would disappear, along with associated jobs) (Crowley 2024: 73; Loomis 2022).

²² Business unionism prioritizes the immediate interests for trade union members through things like improvements to wages and working conditions, often doing so within existing political economy structures and cooperation with management.

The 1960s often mark the beginning of “environmentalism” in popular consciousness with the publication of *Silent Spring* by Rachel Carson in 1962 (2002), although Murray Bookchin (1962) also published their book, *Our Synthetic Environment*, a few months before, which did more to problematize the notion of the “environment”, its relation to modern industrial society, and anticipated later theorization on social ecology. Prior to these, the 1948 Donora Smog that killed 20 people in Donora and Webster Pennsylvania led local leaders and the United Steelworkers Union to pressure the Public Health Service to investigate the smog (Jacobs et al. 2018).

The 1960s also saw the establishment of another Youth Conservation Corps by President Johnson, although the program struggled to succeed in the rural West when young men, often minorities, were dropped into unfamiliar and unfriendly environments (Sanders 2021). However, as the preceding history demonstrates, many working people from a diverse array of backgrounds and experiences moved environmentalism forward, both at and outside of the workplace.

In and around the 1970s, the ascension of environmental politics in the US and in other parts of the world like Germany made these issues a possible new terrain for ‘contentious politics’ (Radkau 2014: 259) in which different actors, including trade unions, made claims on the state to influence associated policies on environmental issues. As the preceding history indicates, states and workers have always been environmental actors to some extent, but modern environmental politics and associated policies like many of the air and water regulations passed at that time did not begin until this period of more widespread “environmental consciousness” (Steinberg and VanDeever 2016). As Stefanie Barca (2024: 106) argues, these earlier instances of labor environmentalism in industrialized countries largely centered on the workplace as a site of occupational health and safety, alongside

concerns related to public and environmental health connected to the larger built environment where workers lived.

Seeking a Response to Jobs vs. the Environment

Labor environmentalism picked up steam after WWII and accelerated during the 1960s and 1970s (Kazis and Grossman 1991 [1982]; Leopold 2007; Miller 1980; Montrie 2018; Stevis 2013). The passage of the Clean Air Act (1963), National Environmental Protection Act (1970), and Clean Water Act (1972) marked the new political salience of environmental issues in the United States (Vig and Kraft 2013: 2). Even before the passage of these laws, however, worker activists brought environmentalism into the fold of their unions (Gordon 2004). UAW President Walter Reuther espoused environmental virtues and hosted a 1965 event titled the “United Action for Clean Water Conference” (Dewey 1998: 51). The UAW also brought together unionists, conservationists, and community organizers before the first Earth Day took place in 1970 (Dewey 1998: 52). Indeed, several unions including the UAW were early supporters of Earth Day and lent it substantial financial, logistical, and advertising support (Uehlein 2010; Velut 2011). In 1976, the UAW sponsored the first ever conference on environmental justice that brought together unionists and other social and environmental activists (Rector 2018).

Labor environmentalists such as Tony Mazzocchi of the Oil, Chemical and Atomic Workers (OCAW) also worked with Ralph Nader’s network to pass the Occupational Safety and Health Act (OSHA) of 1970 (Page and O’Brien 1973). The OCAW executed a 1973 strike and boycott against Shell Oil with support from environmental groups regarding workplace and general environmental conditions (Dewey 2019; Velut 2011). The United Farm Workers would also use the country’s newfound environmentalism strategically, playing on consumer concerns about pesticide use to run a successful

boycott campaign of the grape industry, helping them win their first contract (Bresnihan and Millner 2023; Dewey 2019; Nicholson 2014). Similarly, the IWA would also leverage environmentalism to promote timber worker protections (Loomis 2021: 137).

Despite this early promise of alignment between labor and the environment, the early 1970s marked a turning point. First, there was a systematic reaction to the mobilizations of the 1960s and early 1970s, reflected in Nixon's Southern Strategy and the infamous Lewis F. Powell memo, the latter of which can be said to mark the neoliberal turn in US politics (Harvey 2007: 43). Second, and related, there was an unraveling of the post-WWII settlement at the Treaty of Detroit (1950), in which union leadership at the time traded better wages for deradicalization of its membership (i.e., the removal of socialists, "communist sympathizers", and other dissidents from its ranks), including abandonment of strategic decisions to the corporation (Loomis 2018). Unions thus found themselves unable to contain corporate decisions over location, including the U.S. South that had been systematically inviting capital to take advantage of its weak labor policies, in addition to other technological pressures.

Capital flight and deindustrialization enabled corporations to employ "job blackmail" against unions and communities. "Job blackmail" is not limited to the environment but is a general strategy against any countervailing corporate regulation and mobilization. However, it was used to divide unions and environmentalists—with the active participation of conservative business unions and the AFL-CIO—during a time that environmental regulations were questioning a range of corporate (and state) practices (Loomis 2021: 128). This concern is evident in a 1972 presentation by then-UAW President Leonard Woodcock at the Institute of Industrial Relations at the University of California, Berkeley.

In his speech, Woodcock (1972) argued that companies would use “environmental blackmail” to drive a wedge between workers and their communities and the environment, a partial consequence of a 1971 NLRB decision ruling in favor of GM against Local 864 and the UAW stating that unions had no say in “fundamentally managerial issues,” such as where company facilities should operate (National Labor Relations Board 1971). Woodcock’s speech proved prescient.

The confluence of policies hostile to labor, new environmental regulations, and structural features of the world economy (i.e., increased globalization and the potential for capital flight, deindustrialization, and automation) created opportunities for private employers to divide trade unionists and environmentalists through “job blackmail” (Kazis and Grossman 1982; Loomis 2021: 129; Stevis 2019; Vachon 2023: 35). That is not to say that environmentalism is the sole object of job blackmail strategies. Even a cursory look at today’s headlines shows how politicians use gender, race, citizenship and other attributes to disrupt emancipatory politics. Consider also the ways in which competition between countries (like, say, Chinese and US competition in artificial intelligence) is used to justify the pursuit of policies at the expense of both workers and the environment. Instead, in recounting this particular moment in the history of labor environmentalism, I wish to underscore how transitional periods unfold through a series of political choices, and that political elites may use them to drive wedges between would be allies and their issues. In any case, the hegemonic “jobs versus environment” frame has haunted labor environmentalism ever since.²³

²³ The field of environmental labor studies, which this dissertation derives many of its insights, was founded, in part, to help overcome the “othering” whereby labor was cast as nature’s “Other” (Räthzel and Uzzell 2013). These authors and others like them reasoned the othering present in political discourses was reified in social science’s treatment of labour and environmental studies as separate spheres (Räthzel, Stevis, and Uzzell 2021)

During the late 1970s and early 1980s, groups such as Environmentalists for Full Employment sought to address this narrative by advocating that the country could achieve full employment by moving away from fossil fuels and nuclear energy—a major disagreement among unions—to alternative energy sources such as solar and wind, voicing many of the same arguments for these technologies still used today (Gordon 2004, Chapter 7; Grossman and Daneker 1979; Hultgren 2025).²⁴

Despite some of these early instances of labor environmentalism and alliances between labor and the environment, labor environmentalism was more tempered in the 1980s as neoliberal policies took hold and the Reagan administration put workers and organized labor on its heels. These same processes of neoliberalization that limited the autonomy of workers in places like the US and UK also shifted environmental issues from one dominated by state regulation to a sphere in which market mechanisms were increasingly used to respond to environmental issues (Meadowcroft 2012).²⁵

Despite these trends, things like the Black Lake conference hosted by the UAW and corresponding social democratic policies like the *Freedom Budget*, showed the promise of a joint labor-environmental-civil rights coalition (Gordon 2004; Rector 2018). Workshop participants at the conference also discussed the potential of job creation in what many today would consider

²⁴ An oft-referenced reason for shifting to alternative energy technologies is their potential to increase employment. For instance, Richard Grossman and Gail Daneker (1979: 79) argue that solar development requires two and a half jobs more than the same amount of power produced from nuclear fission.

²⁵ Such a shift has important ramifications for not only how we come to understand and treat environmental issues, but also how this shaped related policies governing renewable energy systems and their inclusion on the power grid. More specifically, this shift to econometric treatments of environmental issues influenced related discourses concerning electricity generation globally, but perhaps especially in countries like the US and the UK. In both of these countries, what were once vertically integrated systems of power provision became unbundled and marketized (Christophers 2024: 54-58), an important point that has influenced the maturation of renewables and corresponding forms of work.

quintessential examples of “green jobs” in professions like conservation, pollution control, and wind and solar power (Rector 2018). However, despite the promise of such efforts, unemployment, capital flight, austerity and other structural forces made establishing a long-lasting coalition across social movements extremely difficult.

The complexity of labor and environment relations was evident in the spotted owl controversy that took center stage during the 1980s as union leadership of the IWA—once supporters of environmental protections—allied themselves with the timber industry, coming into conflict with environmentalists over the protection of old growth forests where the spotted owl resides (Cooper 1992; Loomis 2015; Loomis 2021; Radkau 2014: 275–279). In popular consciousness, the spotted owl represents the quintessential example of the jobs versus environment frame in action. It also serves as the backdrop to a 1991 Worldwatch Institute report by Michael Renner titled *Jobs in a Sustainable Economy*. The report begins with an oft-used bumper sticker that reads, “Save a logger. Kill an owl” (Renner 1991: 5), which Renner suggests is indicative of how many people, including politicians, often consider the relationship between economic and environmental issues (Renner 1991: 8). Like Grossman and Daneker and the emerging ecological modernization and sustainable development approaches, Renner suggested that the environment and *sustainability* can act as potential drivers for economic growth and innovation. In framing environmental issues this way, we see how civil society would often seek to overcome the jobs versus environment frame, doing so by advancing an (arguably Western) belief that societies can adapt to environmental issues and accommodate imperatives for economic growth with technological innovation. Of course, an implicit assumption is

baked within this view that sees dematerialization and decoupling between resource use and economic growth as possible (Carter 2018; Mol et al. 2009).²⁶

Efforts to combine environmental policy and economic growth/performance globally have their roots as early as the 1972 United Nations Conference on the Human Environment in Stockholm. Around that time, there was intense debate between the Global North and Global South over environment and development; a debate that remains to this day. An early response was that of ecodevelopment, an approach that was refined by Ignacy Sachs (Monneret 2020). In the United States, Amory Lovins extolled the promise of green innovation and growth. Continental Europeans, some influenced by Lovins and Sachs, developed the concept of ecological modernization while the 1987 Brundtland Report²⁷ popularized the idea of sustainable development (i.e., paid work in formal arrangements that meet the needs of the present generation without compromising the capacities of future or foreign people to meet their needs). At the Rio Earth Summit in 1992, unions were involved in sustainable development discussions and policy development through Agenda 21 proposals (Räthzel and Uzzell 2011; Silverman 2006; Snell and Fairbrother 2010). As a result, trade unions could raise concerns about the implications of sustainable development for workers (Snell 2021). Renner's framing, as well as those of other unions during the 1990s, need to be understood in a longer context

²⁶ Beverley Silver (2003) might refer to this as a "technological fix" employed by capital—here understood as an assemblage of the state and corporate power—to resolve environmental crises that arise from the capitalist mode of production. Silver reasons this is one of two different fixes employed by capital, the other being capital's "spatial fix" (see Harvey 2001), which as this history has sought to show, was manufactured not only by technology, but by political elites as a disciplining tool for labour.

²⁷ The World Commission on Environment and Development produced a report in 1987 titled "Our Common Future" (also known as the Brundtland report for its principal architect) that popularized the concept of sustainable development (Carter 2018: 213). Sustainable development was crafted as a "bridging concept" to temper the tensions between environmental and development (similar to jobs versus environment) that had become an important South–North issue since the very early 1970s (Meadowcroft 2009).

of attempts to fuse environment and development or growth. However, approaches varied a great deal, even within U.S. labor.

During the late 1980s, the OCAW developed the ‘superfund for workers’ approach that soon morphed into the just transition strategy (Leopold 2007; Stevis 2019; Vachon 2023: 117). Jobs and green industrial policy were central to a just transition but the opposition to this idea was strong in the United States. Some were in favor of a green transition (e.g., USW and even elements of the AFL-CIO; see United Steelworkers 1990 and Stevis 2021b).²⁸ Other unions, particularly the UMW and the IBEW, were resolutely against any transition, particularly in the production of energy, which could jeopardize access to these jobs. One reason offered was that “transition” was too reactive and cast workers as supplicants—hardly in keeping with an ideological ethos of rugged individualism.

That a strategy of just transition attended a broader democratic socialist platform of a labor party that the OCAW sought to create did little to endear it to a public that had experienced decades of “education” that rendered socialist ideas verboten, even if demands were for relatively modest things like single payer healthcare and free college (Stevis 2021b: 597). Stated differently, “just transition” placed a broader political economy on the agenda of labor unions. A third reason had to do with the fact that the OCAW was a small union with internal problems that led to its absorption by an anti-environmentalist union, first, and the USW later. These tensions played out during the 1990s.

²⁸ In 1990, the United Steelworkers published “Our Children’s Future,” calling attention to several environmental issues and the imperative for the union to preserve and protect their children’s future. The report cuts through the mirage of jobs versus the environment and makes a case for how production processes can be “greened,” offering an intermediate or long-term view of what the future might look like—flagging that the issues are “not technical, but political” in nature.

Green Jobs With and Without Just Transition

The 1990s, in general, was a period of engagement between unions and environmentalists. One motivating issue was that of trade, exemplified by NAFTA and the 1999 WTO protests in Seattle (Dewey 2019). These were responses to the hollowing out of the working class due to globalization. The USW and Sierra Club joined forces to argue for enforceable labor and environmental standards as part of these protests (Labor Network for Sustainability 2009) and established a relationship that continues today through the BlueGreen Alliance (BGA).

“Green jobs” as explicit phrases first began to appear in the 1990s as well. These included references from a Worldwatch Institute report (Renner 1991), the Washington Post (Rifkin 1990), Orlando Sentinel (Harris 1994), and in a book from the California Department of Conservation titled “Good, Green Jobs,” (1995). It would take until the 2008 housing and financial crisis for the term to gain more widespread popularity, however (Peters, Ethington, and Swenson n.d)

A key attempt to bring environmentalists together was the AFL-CIO’s BlueGreen Working Group, which came about during a period of increased climate awareness (reflected in the 1997 Kyoto Protocol) and the aforementioned labor and environmental opposition to neoliberal trade policies like NAFTA and the WTO (Stavis 2021b: 599). A central effort of the working group was to formulate a comprehensive labor–environmentalist agenda in which climate policy and just transition became central tenants. Early hopeful signs (e.g., Fellner 1998) were defeated by strong opposition to transition by energy unions and the slow uptake of just transition by most mainstream environmentalists. The final effort to salvage this initiative coincided with September 11, 2001. Needless to say, the meeting did not occur. Some working group efforts found their way into print, but the

language of just transition was largely absent (Barret et al. 2002; see Renner 2000 for a full background). Nonetheless, discussions between some unions and some environmentalists—particularly those that resulted in the Apollo Alliance and the BGA—continued.²⁹

September 11 was important for many reasons, including strengthening the already existing nationalistic tendencies within U.S. labor and expanding it into environmental employment. For instance, the Apollo Alliance (which would merge with the BGA in 2011) suggested that a shift in energy resources away from fossil fuels could simultaneously produce jobs, tackle climate issues, and enhance the country's energy security—a banner on their website from 2003 reads, “Three Million New Jobs. Freedom from Foreign Oil” (see Figure 7). Supported by key elements within the Democratic Party but also by environmental organizations and labor unions, Apollo offered a view of

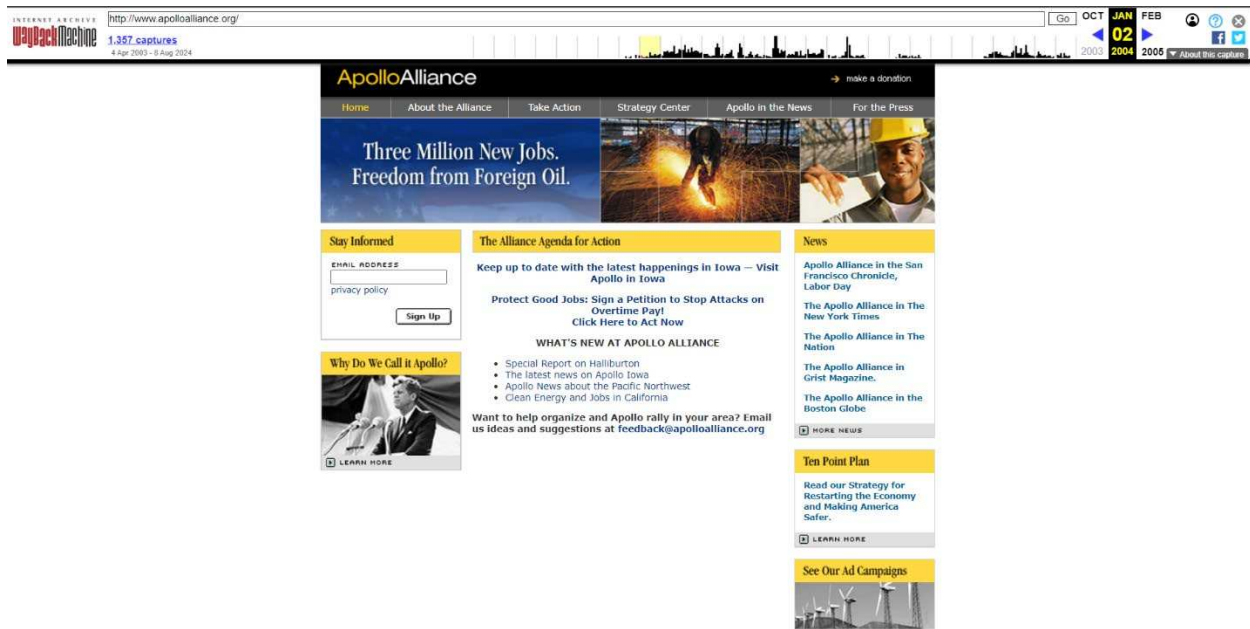


Figure 7. A screen capture of the Apollo Alliance home page captured through the Wayback Machine.

²⁹ The debate on jobs and environment was not limited to the negotiations between unions and environmentalists. For example, see Goodstein (1999). In general, a wide range of think tanks had been converging around some form of ecological modernization—without using the term—for many decades. These include Resources for the Future (1952–), World Resources Institute (1982–), Rocky Mountain Institute (1982–), and others.

“sustainable employment” that combined environmental goals with economic and technological innovation (Little 2005; Stevis 2013). In keeping with ecological modernization, they cited the potential for economic investments and technological innovation to spur job growth.

Another outcome of this period is the establishment of the BGA in 2006 (Mattera 2009: 10; Stevis 2021b: 607). BGA was jointly established by labor and environmental groups—led by the USW and the Sierra Club—which gave it legitimacy from both camps. BGA also blazed its own trail through the adoption of an “all-of-the above” approach to energy, but especially natural gas. Its position was that fracking could be achieved with minimal damage to the environment, so long as the necessary precautions are taken—and this natural gas would lessen U.S. dependence on foreign energy resources (Stevis 2019). The BGA, which absorbed the Apollo Alliance in 2011, increasingly coalesced around the idea of green industrial policy but one which did not include just transition. Others—like the Labor Network 4 Sustainability formed in 2007 with the leadership of Joe Uehlein, the ex-director of the AFL-CIO’s Industrial Department—would chart an alternate direction, floating the notion of a just transition once again (Stevis 2021b: 613).

Green Jobs Before and Into the Financial Crisis

The strategy of green jobs as a form of sustainable employment and economic expansion had already become prominent outside of the United States, including Australia and the United Kingdom. In the mid-2000s, the Comisiones Obreras and their labor environmentalist NGO, Sustainalabour, as well as Cornell’s Labor Institute, spearheaded a collaboration between the International Trade Union Confederation, the International Labour Organisation (ILO), and the United Nations Environment Programme (UNEP) centered around green jobs. The lead author was Michael Renner, mentioned

earlier. This resulted in a report titled, *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World*, which is described as “the first comprehensive report on the emergence of a ‘green economy’ and its impact on the world of work in the 21st century” (Renner, Sweeney and Kubit 2008; United Nations Environment Programme 2008).³⁰ Perhaps because the report is written from a global perspective, it considers the importance of tracing social and environmental impacts across borders and that strategies incorporating social and environmental full-cost pricing are necessary to discourage unsustainable patterns of production and consumption (Renner, Sweeney, and Kubit 2008: 4). The authors argue for the ILO’s decent work agenda³¹ and notably that social and environmental upgrading as a green economy strategy is *incompatible with economic policies* in which companies compete according to prices, as it invariably leads to the externalization of social and environmental impacts elsewhere as companies seek the cheapest inputs of materials and labor to remain competitive. In this respect, we see the emergence of a mild critique of global political economy and an incipient radicalism within the ILO agenda through the basic, but fundamental observation that coercive laws of competition in an interconnected global economy can create a race to the bottom if left to their own devices. That is to say, these markets should be reembedded into a sphere of social control in both domestic and international institutions.

³⁰ Similarly, while employment was part of discussions during the United Nations Framework Convention on Climate Change (UNFCCC), it was not until COP15 in Copenhagen that worker issues formally appeared in negotiation texts (see Rosemberg 2017).

³¹ Both the ITUC and ILO make the case that green jobs are “decent jobs,” meaning that they provide “opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for all, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men” (International Labour Organization 2013).

As the report was being finalized, the financial crisis began. As it wore on, labor–environment organizations increasingly made green jobs and green industrial policy central to the recovery ((AFL-CIO 2009; Apollo Alliance 2008; BlueGreenAlliance 2011a; Good Jobs First 2009 (see Mattera 2009)).³² While Apollo was probably the most nationalistic, elements were present in all cases. BGA, for instance, responded to the 2008 financial crisis with a nationwide jobs plan to drive job creation through policies and investments into a sustainable and *growing* economy, stressing economic dimensions to keep workers employed (BlueGreenAlliance 2011a). The AFL-CIO even re-engaged with just transition, albeit on the green jobs side. It also allowed the International Trade Union Confederation to place just transition on the agenda of global climate negotiations.³³ Good Jobs First stressed that newly created jobs should be “good” to put the country on a *high road* to recovery (Mattera 2009). To do so, they suggested strong labor rights and standards and increased union participation in middle-class sectors such as construction and manufacturing were necessary to improve work conditions for Americans across the board. Later when the Biden Administration advanced the IRA and IIJA, it was this very rhetoric that took center stage, (i.e., “good green jobs”). It is worth noting, however, that they all stop short of calling for international agreements to establish global standards, despite a keen awareness of the issue of capital flight (see Mattera 2009: 19).

The Obama administration brought further attention to green jobs (Pollin et al. 2008). The American Reconstruction and Redevelopment Act of 2009 was designed to help reboot the economy

³² Parallel to these organizations, there was increasing academic research, both theoretical and applied (e.g., Block 2011; Pollin 2009: 13; Stevis 2013, 2014).

³³ It is worth noting, however, that almost none of the Green New Deal proposals that were created during the crisis includes just transition as a detailed and central component, even though crises and periods of economic change are essential components of the global economic order.

in the throes of recession and included earmarks for renewables, electric vehicles, smart grid, and transit alongside other investment tax credits (Osaka 2020). On the heels of this, the U.S. Bureau of Labor Statistics (BLS) established the Green Jobs Initiative in 2010 to track green jobs throughout the economy. As part of this, the bureau defined green jobs as employment in “businesses that produce goods or provide services that benefit the environment or conserve natural resources, [or] jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources” (U.S. Bureau of Labor Statistics 2011).

Established to assess policy initiatives and labor market impacts of economic activity for the purpose of environmental protection and conservation, the BLS noted that such information will be useful for the state, business, and job seekers.³⁴ By framing green jobs as those that “make processes more environmentally friendly”, the BLS upholds existing views of workplace practices. That is, these are jobs like any other, only that they have processes and, perhaps, outputs that are better for the environment—although little is said about what that entails. In this, the BLS view of green jobs is consistent with ecological modernization, as it advances a view of environmental work that conforms with existing economic practices—hardly a socially or transformative restructuring of the U.S. economy.

Along these lines, few governments or organizations seriously grappled with the idea that the cause of the 2008 housing and financial crisis had a great deal to do with the crisis prone nature of capitalist accumulation. No regulatory apparatus existed to curtail or oversee things like mortgage-

³⁴ The BLS stopped tracking green jobs in 2013 due to budget cuts. Groups such as Data for Progress argue that a proper accounting of work in the green economy requires the BLS to reinstate its green jobs tracking initiative (Carlock, Mangan, and McElwee 2019: 17).

backed securities and credit default swaps. In the words of George Orwell, “it wouldn’t do to mention” such things, as these would fundamentally reshape how the economy functions and what it values; that is, a shift away from financialization of the economy and related markets, to one instead oriented towards socially and ecologically beneficial “use” values (to be discussed in greater detail next chapter). Instead ‘green jobs’ came to be seen by liberal policy makers as a common sensical way to stimulate economic growth to address the crisis, but without addressing the more fundamental underlying issue of an unthinking, amoral drive for capital accumulation that creates crises like the 2008 recession.

At the global level, the 2012 Rio Earth Summit and associated development of the Sustainability Development Goals (SDGs) in 2015 was also drafted amidst the backdrop of the financial crisis and continued tensions between more and less-industrialized countries. While flawed, the resulting list of 17 goals sought to incorporate many issues relevant to labor unions and less industrialized countries—namely issues related to inequality and decent work. However, the language of such changes was fairly weak, replacing words and concepts like “just” and “sustainable” with “responsible” or “strong” (Adams 2015). The decent work agenda also continues to accommodate economic growth, with the subgoals continuing to emphasize GDP and increased economic productivity through measures useful to capital, like technological upgrading, innovation, and other “value adding” activities (SDG 8). A brief mention of labor rights is made, but it occupies a low rung on the list of priorities (SDG 8.8).

Energy Back in the Mix

It is well known that U.S. labor unions lack the bargaining position of their peers in different parts of Europe. As a consequence, many support business unionism, meaning they focus primarily on projects that can deliver benefits to their members.³⁵ Even during the Obama administration, BGA and other groups tempered their expectations and messaging on “green jobs” at the national level as Republicans controlled Congress and the labor movement remained divided over the Keystone XL and Dakota Access pipelines (Stavis 2019: 6; Sweeney 2012). BGA and associated members such as the pipefitters and steelworker manufacturing unions advocated for an “all of the above” approach to employment in energy and environmental sectors in the mid-2010s, arguing that methane emissions and natural gas leakages could be prevented through responsible practices (Stavis 2019: 11). Similarly, the AFL-CIO supported (and continues to support) nuclear energy, an industry that increasingly markets itself as a clean, emissions-free energy source to provide bulk and baseload power needs for utilities (Savage and Soron 2011). Of course, while nuclear energy may limit emissions in the short run, it may not consider the social and environmental consequences of nuclear waste in the long run or the potential impacts of mining to local communities (Höffken and Ramana 2024; Kyne and Bolin 2016).

The debates over the pipelines made clear that there are significant tensions over the green transition as well as the nature of green jobs. In the mid-2010s, natural gas had become a dominant

³⁵ Many unions in the United States espouse an ethos consistent with business unionism, which sees a union’s role as primarily in direct service to its members to help negotiate contracts and resolve business disputes with management. Contrast this with social unionism, which views unions as potential vessels for more widespread societal transformation, including improving working conditions (Burawoy 2008).

energy source in the country, brought about by technological innovation in hydraulic fracturing also known as “fracking” that led to a 5.1%-per-year average growth rate between 2015 and 2020 (U.S. Energy Information Administration 2020: 46). In many respects, it is natural gas, not renewables, that in combination with increasing automation, have contributed to the rapid shuttering of coal power plants across the country, as they simply cannot compete with natural gas production based on cost and associated profit. However, unlike wind and solar, natural gas does not lead to net reductions in climate emissions. The resulting consequence of this are divisions within the labor movement, with some labor unions in support of the potential job opportunities within the industry, whereas others—especially those not in the energy sector like the American Federation of Teachers or Communication Workers of America—believe natural gas does not go far enough in achieving progress on state- and national-level renewable energy portfolio standards or climate reductions more generally (AFT 2020; CWA ND).

Increasingly, those more concerned about climate change sought another narrative. Writing from outside the United States, Jonathan Neale (2008), to our knowledge, offers the first concrete differentiation between green jobs and climate jobs. In the report, “One Million Jobs,” Neale argues that climate jobs are those that focus on emissions reductions while making communities more resilient to climate change (Neale 2014: 4). Written at a time of ascendent discussions for climate justice, climate jobs represent a smaller slice of “green jobs,” with a narrower focus on addressing climate issues and arguably greater attention to social justice issues.

Domestically, the idea of climate jobs appears to have gained traction with Climate Jobs New York, which began in 2017 as a “labor-led coalition that works to combat climate change, create good union jobs, and reverse racial and economic inequality by building a worker-centered clean energy

economy” (Climate Jobs National Resource Center 2024). Superstorm Sandy inspired the establishment of Climate Jobs New York, as the hurricane cost upwards of \$88.5 billion according to NOAA estimates (National Centers for Environmental Information 2024). Climate Jobs New York began as a coalition of groups including District 37 of the American Federation of State County and Municipal Employees and the Building & Construction Trades Council of Greater New York (BCTC), that were more invested in climate change mitigation efforts, and had early successes in securing climate investments in offshore wind and working to pass state-based legislation to advance investments into lower-carbon infrastructure. Later in 2020, Climate Jobs New York joined with the Climate Jobs Institute to form the Climate Jobs National Resource Center (CJNRC) and CJNRC Action Fund to help advance a climate work agenda across the country.

CJNRC differentiates itself from BGA with membership solely comprised of labor unions and councils, largely from the building and construction trades, groups that have been historically skeptical about the green transition and, even more so, a just transition. The organization is making important progress in redirecting these unions, although just transition appears even less prominent than it does with the BGA. CJNRC and its local affiliates have helped pass legislation such as a 2021 New York budget bill that included prevailing wage and project labor agreement requirements for construction on renewable-energy projects of five megawatts or greater, in addition to sourcing American steel and iron where feasible (ILR Climate Jobs Institute 2021).

Interestingly, the CJNRC expanded what climate jobs might look like. In a series of vignettes, they explore different climate jobs, and these include stories from educators and IT technicians. On the surface, these professions have seemingly little to do with climate issues. However, dig a little bit deeper and we can understand their climate nexus. For example, the IT technician provides a critical

service to the community by ensuring residents, including schoolchildren, can access the Internet and all the opportunities that entails. In addition to reducing pollution associated with transportation, it simultaneously ensures more equitable access to information, making this form of work more just and human centered. Another vignette explores the role teachers play in educating the next generation about environmental issues and can take an active role in helping the school district and community pursue locally owned renewable energy systems for the school (Vachon 2023). This move by CJNRC suggests that we broaden our lens to consider how all forms of work—waged and non-waged—might help us to move in more socially and ecologically sensitive directions.

A Green New Deal

The tensions within the world of labor were clearly reflected in their response to the Green New Deal (GND). In 2018, Representative Alexandria Ocasio-Cortez and Senator Ed Markey introduced a GND resolution to Congress to advance principles of jobs, justice, and climate action (Ocasio-Cortez 2019).³⁶ The GND put a climate spin on an industrial policy agenda that harkens back to President Franklin Roosevelt's federal government works and conservation programs during the dregs of the Great Depression.³⁷ The GND resolution sent ripples throughout the country by calling for nationwide mobilization to achieve decarbonization through 100% renewable energy power generation and modernization of grid infrastructure. Like FDR's New Deal programs, the GND recognizes that larger-scale efforts are necessary to transform the economy so that it provides material security to all, but

³⁶ It should be noted that a Green New Deal task force entertained the idea in 2006 (Stewart 2018).

³⁷ Mark Twain was actually the first to introduce the idea of a "new deal" as a call to reduce inequality and economic volatility in the gilded age (Calhoun and Fong 2022: 11). As the old adage goes, history does not repeat itself, but it often rhymes—a quote usually attributed to Twain.

especially through the creation of millions of high-wage jobs. Unsurprisingly, the resolution's emphasis on economic change and reductions to inequality led many conservative pundits and politicians to label it as socialist propaganda masquerading as climate activism.

The AFL-CIO formally came out against the measure, citing potential job losses to some of its union members, as well as resentment for not having been included in drafting the resolution (Roberts and Stephenson 2019). Other unions who signed in opposition included the UMWA, IBEW, LIUNA, UA, USW, IBB, IW, UWUA, IUOE, and NABTU. Both the United Mine Workers of America and International Brotherhood of Boilermakers criticized the GND resolution for not approaching the transition with "rational policy." Both organizations recognize the presence of an unfolding transition but remain skeptical it can occur in a "just" manner. In both cases, the organizations advocate for carbon capture use and storage technologies (CCUS), which attempt to remedy ecological harms in a post-hoc fashion (Jones 2019; Young 2021).

Despite the opposition to the GND resolution, it helped expand what elements of labor and environmentalists believed to be possible (Brecher 2024). Even still, many local unions and affiliates with the AFL-CIO, like the AFT and CWA, supported the GND resolution. Moreover, several organizations published their own vision of a GND. BGA members who initially opposed the GND resolution—such as the UWUA, UA, and USW—would later support a BGA report titled *Solidarity for Climate Action*, written in reference to the initial GND resolution. The BGA report also argues that 'ironclad' protections are necessary to protect workers across the supply chains of an industry, an important extension of ethical considerations across space. BGA's report also calls for guaranteed pensions and social security nets for workers impacted by the transition. Even still, the BGA report champions technological fixes and associated employment as the primary way to achieve emissions

reductions and continues to advocate for an “all-of-the-above” approach that includes things like carbon capture, removal, storage, and nuclear (BlueGreen Alliance 2019: 4). Such a maneuver likely reflects dynamics and realities unions in the US (but arguably globally) face, in which the strategies adopted seek to align themselves with business interests in order to secure prospective employment for membership—a dynamic explored in Todd Vachon’s (2023) book *Clean Air and Good Jobs*.

Others, such as the Labor Network 4 Sustainability, published the aptly titled *18 Strategies for a Green New Deal* (Brecher 2019), which presents one of the clearest depictions of a transformative vision of a new energy economy painted with darker green hues. The report has several key provisions, like a jobs guarantee, the protection of worker rights, and the elevation of unions as vanguards for infrastructure build out. It recognizes that jobs are embedded within a broader political economy, which leads the report authors to call for binding international agreements to ensure the transition occurs equitably across borders, and this includes knowledge sharing to make the transition achievable in both the Global North and South. At the heart of the report lies recognition that the hegemonic neoliberal policies that helped accelerate globalization and environmental damage do not serve us, and fundamental changes cannot be achieved through technological innovation alone. As part of this, there is greater emphasis on questions of power and control in a “new energy economy,” including the manner in which energy is produced, consumed and distributed—each of which are fundamentally political—even though technologies might change the scope of what is possible.

COVID Aftermath, the IRA, and Green Jobs and Climate Jobs Go Mainstream

In the midst of the COVID-19 pandemic, earlier efforts of the labor-climate movement (LCM) organizations like the CJNRC, who worked to promote the idea of green industrial policy, bore fruit. In

August 2022, Congress passed the Inflation Reduction Act (IRA). The law includes many policies designed to help accelerate investment into low-carbon technologies and manufacturing, supplementing other acts such as the Infrastructure Investment and Jobs Act (2021) and CHIPS and Science Act (2022). Early reports indicate that the IRA alone may add nearly 1.5 million jobs to the U.S. economy by 2030 (Foster, Maranville, and Savitz 2023).

IRA impact estimates vary widely because of the broad-based set of incentives and heavy use of tax credits throughout the law, credits that include multipliers for projects in qualifying “energy” or “low-income” communities. Regardless, actual climate spending could be much higher than the Congressional Budget Office (CBO) pegged the number at, which totaled about \$391 billion, with others such as Goldman Sachs putting the number closer to \$1.2 trillion (Saul 2023). IRA incentives included provisions that stipulate new energy projects must fulfill Fair Labor Standards Act (FLSA) requirements, uphold the Davis–Bacon Act and pay prevailing wages, and that they use a certain percentage of registered apprentices to receive tax credits. The associated tax credits cover 30 percent of total project costs if the employer pays the prevailing wage on a project and meets an apprenticeship ratio of 10% in 2023 and 15% by 2024 (Manzo, Wilson, and Kashian 2022: 14). Finally, the IRA included incentives to improve racial equity and better help underserved communities as part of President Biden’s Justice40 initiative that sought to deliver 40% of these investments into disadvantaged communities (U.S. Department of Energy 2021).

While the tax credits and other incentives in the IRA are a positive signal of intent, their impact on quality of work remains to be seen and now, following the 2024 election, we may never know. Prevailing wages can be useful, but they do not ensure workers receive crucial benefits such as retirement, healthcare coverage, or family and sick leave. What is more, prevailing wages may still be

inadequate to provide sufficient economic security to workers—if the prevailing wage is still inadequate for families to support themselves, that does little to improve their lives in a material way. The IRA specifies that failure to comply with prevailing wage and apprenticeship standards in claiming tax credits makes the company liable for back wages and IRS penalties. However, these amount to little more than a mild reprimand when it comes to enforcement. Many companies may choose to leverage subcontractors in their production networks to keep costs down on projects (Gadzanku, Kramer, and Smith 2023; Mayers 2024).^{38, 39}

Few measures in these bills seek direct emissions reductions, instead favoring tax credits and other incentives to supercharge investments into the expanding new energy economy. Rather than reconstitute environmental and economic relations, these continue to reinforce the underlying logic of capital expansion. When workers are directly invoked by legislation, it often emphasizes the importance of social reproduction—training individuals to create a pipeline of workers. Many of the reports from the U.S. government, including the Department of Energy and affiliated laboratories, describe employment in the energy transition this way.

³⁸ On this front, the IRA also includes new measures that encourage the use of project labor agreements (PLAs) and community workforce agreements (CWAs). Unique to the construction industry, PLAs establish terms and conditions of employment between one or more unions and one or more employers on a specific project (29 U.S.C. § 158 (f)). PLAs in the IRA are used to help employers secure tax benefits by ensuring compliance with the IRA's prevailing wage and apprenticeship requirements. The IRS would waive potential penalties for employers who have a qualifying PLA in place, so long as back wages and interest owed to laborers and mechanics are paid by the day they file for the increased credit (U.S. Department of Labor 2023). In any case, these provisions signaled the Biden administration's interest in providing a supply of a low-carbon workers to achieve decarbonization efforts.

³⁹ As I learned during my time working on issues related to human trafficking in Colorado, companies are *generally* willing to live with civil liabilities and the associated costs for things like wage theft. Change in behavior comes about when criminal liability comes into the picture.

Also of note, President Biden launched the American Climate Corps through executive action in September 2023 to get young people trained into climate and environmentally focused careers (White House 2023). As part of Biden's Justice40 efforts, the initiative includes projects beyond energy that look to conserve and restore lands and waters, including in environmental justice communities. Like the IRA, this effort is significant but hardly transformational. In a cursory scan of the potential employment opportunities on the Climate Corps website during the Biden Administration, many positions were nonunion, and many paid wages that fall far short of the living wage requirements where these jobs exist (how feasible is a part-time job that pays \$20/hour in San Francisco?). Moreover, there is little oversight to enforce or oversee that the Justice40 initiative actually directs a flow of funding and hiring to disadvantaged communities within the American Climate Corps. By contrast, the Civilian Conservation Corps, to which the Climate Corps owes inspiration, put millions of Americans to work and was instrumental in helping shift American attitudes toward the environment, tilting it to a more conservation-minded ethic (Maher 2009).⁴⁰ In any case, the American Climate Corps program was not a relief program; instead, it focused on providing green businesses and industries the workers they needed to make progress on Biden's industrial agenda.

A Green Crisis?

The IRA, Climate Corps, and other policies had more limited provisions to support communities in transition. Some funding has been carved out for communities in transition, and the Interagency

⁴⁰ Labor unions did not support the CCC initially, believing that CCC jobs would undercut them. However, the AFL later came to support the CCC, recognizing it as an important relief program for the country. By contrast, environmentalists such as Aldo Leopold were initially supportive of the CCC (and he even helped lead one of its regional offices) but increasingly took issue with the program's emphasis on land use for economic productivity rather than for its intrinsic properties (Maher 2009).

Working Group on Coal and Plant Communities was set up to assist communities with economic revitalization efforts. Despite this, these policies had few explicit just transition components to expand the social safety net for workers and communities. Even within the labor climate movement, however, advocacy for a just transition has been, unsurprisingly, somewhat tepid (Stavis 2021(b)). With Trump back in office, many initiatives like the Interagency Working Group have stopped meeting—after all, acknowledging the replacement of coal by natural gas and renewables does not fit the administration’s narrative. The President has promised to “unleash American energy” (White House 2025) and has made permitting for new solar and wind projects far more onerous (see Department of the Interior 2025a; Department of the Interior 2025b, Department of the Interior 2025c, Department of the Interior 2025d, Friedman et al. 2025). More recently, unleashing American energy also refers to plunder in places like Venezuela and Iran as the Trump Regime attempts to “liberate” oil for their own financial gain.

President Trump loathes renewables, and wind in particular, ever since the construction of several offshore wind turbines near his Aberdeenshire golf course in Scotland after losing a court case in the United Kingdom to prevent their construction (Keane and Stanton 2025). The President’s attacks on the industry are not without precedent, however. President Reagan famously uninstalled the solar panels on top of the White House when coming into office in a symbolic gesture further reinforced by cutting US Department of Energy’s (DOE) research and development programs for energy conservation and renewable energy (Narum 1992). The Reagan Administration argued, much as Trump’s Administration does today, that government intervention led to destabilized energy markets and that government should not interfere with energy markets and related production. Free market rhetoric aside, the government *is* in the business of picking winners and losers and has been for quite

some time. The oil depletion allowance has been in place since 1926 that allows oil producers to make tax deductions on a portion of their gross revenues (Gilson *et al.* 2014), intangible drilling costs that make certain activities to get the wells up and running tax deductible have been in place since 1913 (Kenton and Smith 2024), and Master Limited Partnerships provide special tax status to avoid some corporate income taxes for oil and gas companies (Royal 2024). So, the logic of the “free market” is somewhat dubious given the extensive history of government support for the exploitation of various mineral resources.

As it relates to the broader argument of this dissertation, the treatment of changes to energy systems and related flows of capital through these processes of neoliberalization simultaneously worked, in different fashions, to increasingly marketize energy while suppressing labor power. It is therefore critical to ask whether energy markets can deliver a transition away from fossil fuels and whether or not that can be done in a way that does not come at the expense of workers or ecology.

Reflections on Green Jobs and Climate Jobs

What can we learn based on the preceding history? Starting with the most basic observation, groups use salient political events to frame their viewpoints on green jobs/climate jobs. Organizations infrequently discuss jobs or work without acknowledgement of the broader political economy in which it is embedded. With the recent actions in Venezuela and incoming oil shocks brought about the war in Iran, we will very likely see a return of nationalistic “green” and “climate” jobs rhetoric by some parts of the political left (and even political right), who argue for the pursuit of renewables, nuclear, and carbon capture to insulate the country from the “volatility” of global energy markets.

In this, to discuss a green job necessarily brings with it a normative vision of what the economy ought to look like, as green jobs exist as counterpoints and frames of juxtaposition to the other forms of work considered the standard or norm in society.

Perhaps unsurprisingly, most groups referenced in this history frame sustainable employment for its potential to benefit the economy while addressing environmental issues (and climate emissions, in particular)—a posture adopted in opposition to the hegemonic jobs versus environment frame. Organizations often reason a ‘double dividend’ can benefit both the economy and environment. Many of these stress how markets, technology, and efficiency gains can produce employment. The promotion of green jobs/climate jobs in these views is explicitly linked to the development of new green industries that are being driven by capital investments by U.S. state and financial sectors under the auspices of environmental sustainability; in other words, a prototypically ecologically modernist approach to employment and the environment—one that emphasizes continual capital growth and the expansion of the economy. Such efforts may help to overcome the apparent jobs versus environment divide, but they do not necessarily reconstitute or shift social and environmental relations in a direction that simultaneously protects the environment and empowers workers and communities.

However, we have seen some labor unions and LCM-aligned groups advocate for more socially transformative work arrangements. For instance, Good Jobs First (Mattera 2009) emphasizes that employment should make the lives of working people more secure. Earlier, Mazzochi advocated for a “worker superfund” to help individuals and communities cope with transitions to the economy—indeed, he reasoned the government should pay workers *to not work* to avoid environmental destruction. While this may seem like a marginal difference from mid green/blue visions, it has consequential policy implications for labor during an energy transition. One vision caters to

businesses by asking it to “green” its production processes, which has the knock-on consequence of creating new employment opportunities. Many of these are engendered by public policies like the IRA, which was designed to create a pipeline of workers *for* industries. By contrast, social imaginaries put forth by people like Mazzochi center justice, job quality, and better appreciate broader economic change into their political platforms of work. In so doing, *they propose a fundamental shift in societal values and associated relations*. They consider how waged labor, and in some instances non-waged labor, might act as the vanguard for more just communities.

Historically, federal and state governments have an important role to play in the social upgrading of work, as businesses will not create “good green jobs” of their own volition. However, with the absence of support from the federal government and many state governments, it has (once again) fallen to workers themselves to make new jobs in green industries good jobs. Groups such as Green Workers Alliance have worked diligently to make inroads among solar and wind energy workers to improve work conditions. As they stand now, green industries are no different than other sectors with respect to their goals and purposes. However, these industries and changes to the energy sector more broadly differ in the potential they bring to create political change—energy is nothing if not political, and history demonstrates how workers in energy sectors or other “strategic locations” at the heart of the world economy are positioned to create change that reverberate far outside the confines of their individual workplaces (Braverman 1998, Mitchell 2011, Malm 2016, Silver 2003).

Of course, this raises the question as to whether certain visions of “green” that harmonize ecological and social processes with one another are possible within the current architecture of U.S. society and global capitalism by attaching the ability to survive to access to waged employment controlled by others. LCM-aligned organizations and trade unions are well aware of such dynamic,

and this influences how they think about employment in a green economy (Stavis 2019; Vachon 2023). As we saw in the case of union divisions over the Keystone XL pipeline, unions may support a business position if it helps secure employment for their members.

In the United States and throughout much of the world, the tables are tilted in favor of business when it comes to social dialogue around labor and environmental issues, which reinforces what groups believe to be politically feasible. Even with the Biden administration, arguably the most pro-union administration since FDR (a far from diminutive statute, to be clear), the litany of tax credits and investments available to corporations in the IRA, IIJA, and CHIPS and Science Act lets the hand slip—businesses and private utilities are the primary beneficiaries of these policies. Combined with a regulatory environment hostile to organized labor and a social welfare regime that attaches healthcare to employment, the willingness and possibility for unions and other LCM groups to demand more transformative changes is significantly curtailed. As a result, many organizations encountered in constructing this history pursue strategies that amount to tweaks around the edges to withdraw concessions from the political process rather than a reconstitution of social and environmental relations.

While this is understandable given the society in which they are embedded, if we read labor history as an ever-expanding tent of concern, then future visions for deep ‘eco-social jobs’ that constitute genuine transformation will require us to rethink what social solidarity looks like. More specifically, it requires a recollection of the most nonprovincial and encompassing ideas during the

heroic age of labor⁴¹ that lies dormant in the collective memory of the labor movement, as well as an extension of the notion of justice to other communities, including future generations and the planet (Pederson et al. 2024). To do so, however, also requires us to not only delegitimize the present form of social organization of society, but also advance a range of possible visions of what “green” and “climate” jobs might look like.

⁴¹ The “heroic age of labor” in the US lies roughly falls between 1865 and 1893, with groups like the Knights of Labor who sought to build solidarity across working people, including in their ranks workers across industries regardless of race, gender, or religion—although the group supported the Chinese Exclusion Act of 1882, which is a mark against their solidaristic pedigree (Nicholson 2014). Regardless, the group was instrumental in the promotion of the eight-hour workday until the Haymarket Riot of 1886 curtailed its influence.

CHAPTER 4. AN ECO-SOCIAL TYPOLOGY OF GREEN JOBS⁴²

"We must reexamine the cleavages that separated humanity from nature, and the splits within the human community that originally produced this cleavage, if the concept of wholeness is to become intelligible and the reopened eye to glimpse a fresh image of freedom." – Murray Bookchin 1991: 42

A copy of the Poetic Edda occupies a comfortable nook in my bedside stand. When I have difficulty sleeping, I wrest myself from my attempted state of torpor and instead drift into stories where tales of gods, heroes, and monsters reign before the coming of Ragnarök. In Norse mythology, Ragnarök heralds the ending of the nine-realms as Yggdrasil and associated worlds are engulfed in fire, chaos and war before beginning anew. Given such a description, I now ponder why I use it as a sleep aid. In any case, the social ecologist Murray Bookchin instead uses it as a metaphor for seeing the world, which I incidentally find quite useful and relevant to this Chapter.

Bookchin likens humanity's relation to nature as something akin to that of the Allfather, Odin, who bequeaths one of his eyes to the World Tree to gain knowledge, insight and mastery over the natural world. However, that wisdom comes at a cost. Bookchin, borrowing the teachings of Josef Weber, relates this as representative of humanity's separation from its "primordial bond with nature" in the pursuit of "exactness, predictability, and above all, manipulability"; which is to say Western scientific

⁴² This chapter is a modified version of a peer reviewed article co-authored with Dr. Dimitris Stevis submitted to the journal *Ecological Economics*. At the time of writing that article has been accepted with minor revisions.

understandings of the world (Bookchin 1991: 41).⁴³ Like Odin, science has a condition of one-sidedness whereby technology contains significant creative potential, but also seeds of destruction. It is a proverbial double-edged sword and we must keep both eyes open to appreciate its potential for destruction as well as liberation. For our purposes in this chapter, what matters is that technocratic approaches to ecological change, including those that focus on the expansion of green jobs, provide a one-sided vision of reality.

In so doing, we fetter our ability to not only understand the nature of jobs being produced at this time and in crucial industries, but we constrain our ability to consider the larger range of possibilities that exist between workers and ecology. Existing and historic social relations of work have been shaped by legacies of domination in our thinking, values, emotions, and musculature, to adapt Bookchin's naming of the problem (Bookchin 1991: 41). In this, it is our ideas about work—anchored in material conditions and history—that influence what we believe to be possible when it comes to prospects on green or climate jobs. To realize a better future, and improvements to the workplace, we thus need to (re)surface those ideas that, perhaps, lurk in the liminal spaces of our subconscious, so that we might make possible what is now unthinkable.

To help with this project, I construct an eco-social typology. If we accept the premise that labor, along with nature, are the ultimate sources of wealth, then qualitative changes to what work looks like must occupy a central role in any discussion concerning environmental and societal change

⁴³ I specify Western scientific understanding here as political ecologists and political theorists of varying stripes increasingly recognize the importance of other cosmological visions of reality and corresponding ontologies and epistemologies (Inoue 2018). Consider, also, efforts at occupying borderlands and spaces to decolonize epistemologies and scientific practice (Mignolo 2012).

(Plumwood, 1993; Moore, 2015; Räthzel, *et al.* 2021). The typology offers a valuable contribution to literatures attempting to conceptualize different types of jobs (especially “green” and “climate” jobs) by advancing a heuristic tool that can help us think through the qualitative differences that exist between work forms. It encourages us to put on bi-focal lenses, to consider jobs holistically along both ecological and social dimensions, when considering different types of jobs and the political-economic platforms they portend.

Moreover, the typology assists with labor regime analysis, discussed in greater detail next chapter. Where labor regime research explains the constellation of systems and structures that govern the labor process, the eco-social typology offers a lens through which to evaluate the qualities and outcomes of work within these regimes. A value-theoretic perspective that differentiates between labor and the associated value it produces also helps us better grasp the nature of exploitation. In this, the eco-social typology offers a vital theoretic and methodological tool to help researchers, especially heterodox political economists and labor regime researchers, more effectively grapple with the evolving nature of capitalist production. The typology I advance here also encourages us to consider the outcomes and the qualities of different jobs that exist within analytically distinct, but spatially interdependent political economic settings. All to say, considering each dimension—social, ecological, spatial, and temporal—helps me better discern the labor process and tensions between these elements.

I begin with a brief discussion of existing accounts of green and climate jobs. I use these in combination with Marxist theorization to help me identify my typology criteria. As Chapter 2 indicated, “green jobs” can have negative environmental or social consequences. I therefore need a typology that fuses both ecological and social dimensions, but considers them analytically separate to

ensure we attend to both spheres. I similarly discuss the importance of attending to spatial and temporal dimensions of work. Once again, this is a lesson imparted in Chapter 2, but that will become increasingly important as we move forward to consider work in global production networks of wind energy.

Existing Accounts of Green Jobs and Climate Jobs

In the last Chapter we saw how ideas about “green” and “climate” jobs changed over time. In each case, the notion of “green jobs” was a response to broader debates concerning sustainable development, with ecological modernization and green growth coming to dominate the discourse.

With the expansion in the use of these terms, academics and policy makers have endeavored to develop assessments to measure employment associated with “green” sectors.⁴⁴ These have branched into a series of other debates, some conceptual (i.e., what *is* a GJ/CJ?) and others methodological (i.e., how do we measure or count GJ/CJ?). Here I focus on the former, leaving to others critiques and formulations of occupational measurement across the economy (see Villani et al., 2026).⁴⁵

On the theoretical side of things, two broad perspectives to classify GJ/CJ exist. One centers on output and the other process (Urban *et al.* 2023). The output-based approach defines ‘green’ sectors and associated jobs according to their outputs or products (Vona *et al.* 2018; Vona 2021). Although

⁴⁴ Consider, for instance, O*Net green occupations once used by the US or the European Union’s ESCO classification system, both of which created categories to track jobs in sectors associated with green, environmentally oriented activities.

⁴⁵ Existing definitions of sustainable work focus on formal employment. In so doing, they omit social reproductive aspects of work (Alyssa Battistoni 2024: 109; Barca 2019), post work perspectives (Graeber 2018; Hoffmann and Paulsen 2020), and multi-species forms of work (Coulter 2015). Our approach applies to all work.

intuitive in its appeal, the output-based approach may obscure how green products can be produced through work processes that vary in their sensitivity to social and ecological harms.

In response, others instead emphasize process over output. Authors in the process-oriented camp often focus on specific tasks and skills to underscore transitions at the worker level (Vona et al., 2018; Bowen et al., 2018; Urban *et al.* 2023: 9). These approaches allow for assessments that consider “greenness” and sustainability on a spectrum, rather than a simple binary (Urban *et al.* 2023). In this respect, outputs can be labeled “green” but come about through production processes that are ecologically unsustainable or otherwise harmful to those in the production process.

The focus on both output and process is necessary. However, there is something to be said to consider the *uses* of different outputs and products. It is quite easy to conceive of any number of instances in which the output of an economic process can have better or worse outcomes depending on its associated use. A cartographer may produce a map to help protect a nature reserve, or instead make maps as tools of imperial oppression. A shovel may be made to garden or instead dig foxholes and kill humans in war. Relevant to us, an electric car produced through the best ecological and social processes may prevent the adoption of public transportation and a more thorough reckoning with the need to reorganize space (Climate and Community Project 2025). In each case, the associated use is a crucial factor that determines the desirability of these jobs.

In that vein the United Nations Environmental Programme (UNEP), for instance, defines green jobs as “those that contribute appreciably to maintaining or restoring environmental quality and avoiding future damage to the Earth’s ecosystems” (Renner *et al.* 2008: 35). According to this view, products and processes have to be evaluated in terms of their uses too, i.e., the degree to which they

contribute to environmental quality in an appreciable fashion. In this sense, green jobs represent different conceivable political economic platforms, some transformative and others, not so much.

Patrick Bottazzi (2019) offers a critical review of varied approaches to climate jobs, delineating between conventional perspectives that promote 'green job' growth and critical approaches that aim to decommodify work. In this, there are some forms of work, green or otherwise, that contribute to systemic lock-in whereas other forms emphasize the expansion of free time and contributive economics to help build a more emancipatory and sustainable relationship with ecosystems. Adding to the focus on product and process there has been a more recent push to consider how different forms of work contribute to "sustainable" lifestyles, as employment serves both a productive and consumptive role in society (Hoffmann and Paulsen 2020). Other authors move in the direction Bottazzi suggests, focusing less on jobs, but instead different political economic configurations that societies, organizations, and unions can adopt towards socio-ecological change that influence work and the environment (see Hampton 2015; Schulze Waltrup 2023; Dupuy and Pasquier 2024) including for variations on "just transition" (Krein 2020).

The typology I propose considers output, process and use while placing them within their spatial and temporal contexts. As I demonstrated in Chapter 2, even seemingly benign work processes and related outputs associated with renewables can depend on ecological degradation or social exploitation elsewhere, both across time and space (see also Stevis 2013; Loomis 2015). As I move forward through the empirical portion of this dissertation, the heuristic typology outlined in this chapter offers a lens through which to view varied forms of work in the renewable energy sector.

Typological Accounts of Green Jobs and Climate Jobs

Several authors have sought to explore and conceptualize Green Jobs in a systematic way. The first to do so is Kate Crowley (1999).⁴⁶ Created in the context of the proliferation of Australian ecological modernization policies, Crowley sought to understand if employment opportunities associated with this trend could overcome the “labor versus environment” binary. Building on earlier work (Crowley 1996a, Crowley 1996b), she employs a number of criteria to assess different views of sustainable employment and classified green jobs into light-, mid-, or deep-green.⁴⁷ Crowley shows how competing views can include both sustainable and unsustainable qualities depending on an array of political-economic considerations, anticipating the output versus task-based perspectives on green jobs that came later.

A gap appears between the development of Crowley’s scheme and the introduction of others. However, interest in green jobs continued (Renner et al. 2008; Pollin et al. 2008) and gained traction in political discourse following the 2008 financial crisis when interest in “green jobs” for sustainable employment expanded in response to the economic downturn. For instance, we see the emergence of the O*NET classification system that organizes occupational codes to job-related requirements such as tasks, skills and objectives, some of which are associated with “green” activities (Dierdorff et al. 2009). The ILO (2013) similarly developed its own definition of green jobs and related schema,

⁴⁶ Please note that many eco-social classification schemes have been advanced over the years, especially those in relation to broader eco-social policy analysis (see Hopwood et al. 2005, Schulze-Waltrop 2023; Dupuy and Pasquier 2024). However, the analysis in this chapter confines itself to existing typologies of work to reduce the scope of review, even if inspiration comes from some of these broader eco-social accounts.

⁴⁷ Light-, mid-, and deep-green jobs are additionally referred to as jobs that create superficial, pragmatic, and fundamental ecological improvements (Crowley 1999, 1017).

combining both a process and task-based approach to both measure and quantify green jobs. However, because these analyses occur at the sectoral level and focus only on green processes and outputs they do not capture “green” occupations that could exist outside these sectors (Urban *et al.* 2023: 26).

Building on Bottazzi’s (2019) work, Katherina Bohnenberger (2022a) advances a schema that classifies different views on sustainable employment along four dimensions: the output type approach, the occupation approach, the work-lifestyles approach, and the outcome efficiency approach. Bohnenberger and others criticize existing classification schemes for their omission of “brown” jobs—those actively detrimental to the environment—when considering green jobs (Hancke, Overbeke, and Neos 2020; Bohnenberger 2022b). On this point, Katherina Bohnenberger’s (2022b) advances a taxonomy that classifies jobs into ‘green’, ‘mixed’, and ‘brown’. Bohnenberger’s intervention extends sustainability analysis to all jobs, not just “green jobs” conventionally conceived, reasoning that ecological well-being depends not only on the expansion of green jobs, but the replacement of brown jobs that perpetuate unsustainable occupations and work lifestyles. They also differentiate between macro and micro levels of analysis and direct and indirect workplace and socio-economic effects. The macro level comprises activities across industries, whereas the micro level focuses on worker experiences within these industries. Direct effects focus on the workplace itself and indirect effects emerge from the interaction between the workplace and broader society in which these processes are embedded. I extend this reasoning through an articulation of spatiotemporal dimensions of work, but I do so through a relational logic (more on this below) that better appreciates the mutual constitution of both social and ecological dimensions of work.

Constructing An Eco-Social Typology

On the concept of alienation

In constructing the typology, I begin from the understanding that a metabolic rift exists between ecological and social spheres. The rift depends on an assumed position of external relations between humans and nature (see Foster 1999; Moore 2015; Malm 2016; Barca 2024).⁴⁸ It also stems from a process of alienation that occurs in a dual sense. First, it entails a disconnection from the environment, but also a separation of the individual from themselves as an embodied aspect of nature. In this, the individual comes to understand themselves and their work through the language of market-exchange (or, 'commodity fetishism') that obscures social and environmental relations between people and nature. As Marx puts it, "whilst capitalism organizes production in definite social relationships between men, these relationships are expressed and appear as relationships between things" (1976, p. 25). In this, work becomes alienating through the enactment of "relations of relationlessness" (Jaeggi 2014), meaning humans come to view themselves and nature according to their worth in the marketplace rather than their essential or organic attributes (Jordhus-Lier *et al.* 2021: 5). Such a relation depends on capital's "mute compulsion" in which a worker's ability to reproduce themselves depends on "*those who control the conditions of social reproduction*", i.e. capital, which inserts an impersonal form of economic power into the sphere of social reproduction, conditioning the labor process in important ways (Mau 2023: 129). These conditions establish both the material and psychological conditions of

⁴⁸ External (or atomistic) relations treat entities as logically independent from one another, in contrast to an ontology of internal relations, which understands phenomena as constituted through relations that are *internal* and intrinsic to the relation (Ollman 2015; Bieler 2025). For example, we cannot conceive of North and South apart for the relation that constitutes them.

estrangement referred to as *alienation*. In this fashion, as I will argue in this chapter, genuine transformation in political economy to something more ecologically and socially desirable means overcoming conditions of alienation or, at the very least, moving in that direction.

Existing accounts of ‘green jobs’ and sustainable employment, especially at the level of policy, have little to say about this dynamic. After all, it “wouldn’t do to mention” that most forms of work are, by nature, alienating. And existing attempts to assess GJ/CJ tend to collapse the social dimensions of work into the ecological domain, assuming that if a GJ/CJ is ecologically good, it must be socially good too.

However, as Chapter 2 demonstrated it is quite possible for a “green” job to be socially harmful, whether for the worker or the broader society. The ILO (2013) implicitly recognizes this noting that green jobs must also offer “decent” work to those that occupy these positions. I do not wish to reify the distinction between human and more-than-human nature but wager there is *analytical utility* in thinking through ecological and social dimensions of work on separate axes, so to speak. On a conceptual level, a distinction between more-than-human nature and humanity (i.e., the “social”) helps to conceptualize the real difference between the value of something in terms of its chemical composition versus the value added to it through its transformation in the production process (Mau 2023: 105). Mau makes this point in reference to Kate Soper (1995: 132) who they cite writing that nature is:

“those material structures and processes that are independent of human activity (in the sense that they are not human created product), and whose forces and causal powers are the necessary condition of every human practice and determine the possible forms it can take”.

What differentiates humans from other species is the near limitless number of ways in which they may transform these conditions (Mau 2023). That is to say, they are biologically underdetermined (Soper 1995). By holding the social and ecological spheres analytically separate, we can better see work as a social relation where the realization of any number of outputs and associated uses is possible—some more ecologically and socially desirable than others and some in tension with one another.

On a more practical level there are additional reasons to treat social and ecological categories separately. For instance, varied interpretations of GJ/CJ and sustainability exist among local unions and labor climate movement (LCM) organizations. This is particularly relevant because labor environmentalism can result in seemingly contradictory positions. For example, Sean Sweeney (2012: 33) observes how labor groups who support environmental priorities can also support projects like the Keystone XL Pipeline, such as the Laborers' International Union of North America (LIUNA 2014) and United Association of Apprentices of the Plumbing and Pipefitting Industry (UA 2021). In other words, different conceptualizations of GJ/CJ can have more progressive commitments along one axis and rather limited commitments along another.

Where Todd Vachon's (2023) work offers a spectrum of varying levels of support for environmental goals, I instead construct my typology to examine GJ/CJ and the associated social relations they embody along social and ecological dimensions in terms of output, process and uses. Process refers to what goes into a product or service's creation. It considers what the labor process looks like, what material inputs are necessary and what potential effluents are produced. Outputs refer to the particular product or service that results. Finally, use(s) refers to the purpose of a particular output and how it functionally operates in the world, including the consequent activities related to that output.

For example, a manufacturing facility and its related job may produce a particular output like a wind turbine. The process of that output refers to the activities to make the turbine (the techniques, technologies, chemicals and inputs to make the product) and the extent to which that process is democratized. The use(s) of the turbine would include various forms of electricity output. Perhaps it produces electricity for a utility. Or, the turbine may produce electricity for a local cooperative or for a private entity via a power purchase agreement that goes to powering a data center. The use value associated with the turbine differs according to context.

Considering the Spatio-Temporal

Jobs in any place or time—green or otherwise—take place within a global division of labor that has both spatial and temporal elements (Massey 1995; Adam 2008; Stevis 2013). Without explicitly naming this, I illustrated the replication of that global division of labor in the development of renewable energies and how “green” products depend on exploitation or externalized harms elsewhere. That process is hardly new, but instead exists as a continuous example of the commodification of land and labor through “new international divisions of labor with the concomitant globalization of ecological degradation” (Escobar 1996: 329). These divisions characterize the respective positions of the peoples, states, and societies that exist in relation to one another. It is, however, to note that this can occur *within* countries, as well as between them.

Considering the broader political-economic formations attached to different green jobs, it is important to observe that historical patterns of production and consumption “presuppose the disproportionate access to nature and labor power on a global scale”, which also means a shifting of social and ecological impacts (Brand and Markus Wisen (2021: 701). The shift might occur more locally,

like between a worker and their partner who enables their productivity through unwaged labor at home (Barca 2024). Or the shift might occur across production networks via processes of extraction or disposal of waste products to global peripheries (Christoff 1996; York et al. 2003). Or, shifts may instead occur when companies adjust their operations and associated jobs in search for the realization of greater surplus value, what David Harvey (1981; 2001) would call a “spatial fix”. In each case, there are two critical takeaways. First, that production and consumption are internally related to one another. Second, workers across territories exist in relation to one another, a point well-established by labor geography (Gough 2010), which has important theoretic and political implications for how we think about green jobs.

Existing typological accounts may acknowledge differential impacts and levels of greenness, but do not exhibit sufficient or explicit appreciation for the relational dimensions of work across space and time. In other words, accounts of GJ/CJ can be improved through a better appreciation of “breadth” (i.e., the scale and scope of a practice or policy) and “depth” (the extent to which a practice or policy is ecologically and socially (in)egalitarian) in their corresponding social relations (Stewis 2023).

Different GJ/CJ platforms may consider how workers connect with one another through processes of production and their workplace. Working from an ontologically relational position, various GJ/CJ connect workers with one another and environments through social processes that generate the respective positions of these workers, and hence, their shared fate. Based on the theorizing of Iris Young (2004), social connection, and by extension ethical consideration, derive from obligations of justice that connect people and their environments through the processes that bind them together. Such a position differs from how justice is typically conceived, in which liability or fault for a particular action establishes the need for justice (Young 2004).

In addition to the spatial processes that connect people, we must also consider temporal and historical processes that constitute relations. Those relations can extend to the past, present and future. As Barbara Adams (2008) notes, whatever perspective we adopt in time shifts our ontological perspective and, by extension, our ethical considerations.

Consider employment associated with nuclear energy. Lawmakers, investors, and some trade unions increasingly turn to nuclear energy as a “clean”, zero-carbon form of energy. However, if we consider nuclear energy production as a social relation across spatial and temporal dimensions, it takes on a different character. Looking to the past, we would see the high rates of lung cancer among Navajo Nation people that resulted from uranium mining (Brugge and Gobble 2002). From today’s standpoint, we would consider vast monetary costs required to build nuclear, diverting critical resources away from other uses (Eash-Gates et al. 2020; Sovacool and Ryu 2025; Hradický 2025). Looking to the future, we must also consider that although nuclear power produces relatively small volumes of spent fuel, the longevity of its radioactive waste extends far beyond human lifespans—by several orders of magnitude. This creates a form of temporal injustice: the decision to generate nuclear waste is made in the present, while the responsibility for managing its risks is deferred to future generations, let alone other species, who have no voice in that decision.

The Ecological Dimension: From Corrective to Regenerative Work

Green and Climate jobs vary with respect to their ecological ambition and impacts. In what follows, I describe three points along the ecological continuum to illustrate various forms of green jobs that might exist: ecologically corrective, enhancing, and regenerating, each of which grows progressively more transformative and dealienating in its orientation.

	Ecologically Regenerating	Ecologically Enhancing	Ecologically Corrective	Ecologically Damaging
Outputs	Products that enable ecological restoration, across time and space	Products that minimize ecological harms, but do not necessarily restore ecologies	Products that react or attempt to "correct" ecological harms	Ecologically harmful products and outputs
Process	Processes are ecologically sensitive and restore as much as they deplete	Ecologically efficient processes that minimize impact on society and nature	Efficient at the level of product or process, but do not dematerialize impact	Toxic, actively harmful to people and ecology
Use(s)	Uses that restore, revive or otherwise reconstitute social relations with the environment that enable continual renewal to ecologies	"Greens economic processes" to balance ecological and economic goals, but does not change social relations of value in the economy towards ecological wellbeing	Reacts to ecological harm, does not address causes of harm	Reinforces social inequality, harms society and nature (even if the product is considered "green")

Table 1. Ecological dimensions to consider when assessing GJ/CJ and associated social relations.

Ecologically Corrective

Ecologically corrective jobs are those that treat the environment in an instrumental way, consistent with weak forms of ecological modernization (Christoff 1996; Howes *et al.* 2010) or sustainability (Dobson 1996) forms, and leaning in the direction of or industrial ecology approaches (Dietz 2009). While they recognize, voluntarily or due to policy, that "brown" or ecologically damaging jobs cause serious environmental harm, the goal is to rectify or contain their worst impacts largely through technical means. Thus, they do not challenge the logic of existing unecological practices but aim to temper their impacts. The possibility of a rebound effect (Ruzzemmenti and Basosi, 2008) therefore, is significant. We can observe this with the proliferation of electric vehicles at the expense of public

transportation and more urban density. In some instances, these forms of work might be consistent with green growth strategies that are based on decoupling (Pollin 2015 and 2018; for a critique see Hickel and Kallis 2020).

We might say these jobs “react” or “correct” environmental harm. For example, work associated with creation or maintenance of carbon capture sequestration (CCS) might fit the “ecologically damaging” category. The direct air capture facility constitutes the output of economic activity, which is a reaction to negative environmental impacts that constitutes its primary use, which allows for the continued combustion of fossil fuels. These are jobs that exist to enhance or exacerbate the metabolic rift in pursuit of further capitalist accumulation (i.e., “ecologically damaging”). Or, to use another example, biomass and gas from animals are classified as renewable energies by the 2005 Energy Policy Act. As Stephanie Eccles (2025) points out, however, this form of energy is little more than an exercise in “greenwashing” largely manufactured by the interests of large-scale agribusiness at the expense of nearby community health, to say nothing of other species implicated by such processes. By contrast, some jobs that react to environmental issues are essential—those involved in collecting trash, treating sewer, and any number of other environmentally necessary jobs might be said to occupy positions that primarily “correct” potential ecological issues. What differentiates forms in this category, therefore, is whether the activity is necessary (e.g. water treatment for drinking or returning it to waterways), meaning its value helps maintain people and their environments. Here it is useful to also distinguish between types of use value. Let us consider an EV.

A luxury style EV vehicle represents a product whose uses emphasize the output’s exchange value, rather than the use value it provides. It thus constitutes an output that does little to shift social

relations, and may even create harm through the continued valorization of a luxury good that depends on critical minerals and resources that might be put to better use elsewhere.

Ecologically Enhancing

In contrast to ecologically reactive green work, ecologically enhancing jobs strive to bring economic and ecological priorities into alignment. Where the prior category tries to contain or manage the impacts of inherently hazardous practices, this category attempts to modify these practices, e.g., renewable energy, and ease the pressure on the environment. These forms of work embody “stronger” ecological modernization or sustainability principles, whereby environmental concerns integrate into institutions and wider society, recognizing the international and interconnected dimensions of environmental issues (Hajer 1995; Dobson 1996; Christoff 1996; Carter 2018). This may occur through an attempt at *dematerialization* (i.e., producing the same unit of economic output with fewer environmental inputs) and *decoupling* (i.e., loosening the connection between economic prosperity and environmental damage) (Carter 2018). While ecologically enhancing jobs prioritize nature, they do so within the parameters of a regulated or reformed growth political economy. Their primary goal is the pursuit of exchange value and, in this way, represent a form of ‘technological fix’ to resolve contradictions in capitalist accumulation (Fox 2023). In this sense, this category occupies a middle range between corrective and regenerative forms of work in which the exchange value of associated economic outputs remains, even if it is no longer the only or even primary consideration.⁴⁹

⁴⁹ Evidence suggests absolute decoupling between economic expansion and ecology cannot occur within the time horizons necessary to mitigate the worst impacts of global warming and other planet system boundaries (Hubacek et al. 2021; Vogel

To return to the EV example, an EV produced for public transportation that replaces a diesel bus is qualitatively different from an EV used as a status symbol for high-speed commuting by an individual. However, even a huge number of EVs can be produced through relatively benign and ecologically efficient processes, which does not temper ecological problems produced by sprawling cities if access to public transportation is limited, privatized, or cost prohibitive. In this fashion, we return to the importance of how the production process and consumptive patterns are internally related with one another—attending to both is necessary.

Ecologically Regenerative

Ecologically regenerative work is consistent with strong ecological modernization or sustainable development (Christoff 1996; Dobson 1996). (Re)generative work, in that sense, does not simply aim to correct unecological practices or enhance/mitigate it within the parameters of practices that stretch ecological limits and health, but seeks to change the rules of the political economy. Several political theories and philosophies have been advanced that approximate what we have in mind for strong-ecological jobs. These include degrowth (Hickel and Kallis 2020; Saito 2024), (re)generative economics (Morseletto 2020), and eco-social economics (Laurent 2024). Despite their differences, they all recognize that a transformative ecosocial political economy requires changes in how and why we work.

What would a job in this category look like? Perhaps the production and maintenance of a publicly owned agriphotovoltaic solar project controlled by a political community, rather than an

and Hickel 2023; Freire-González et al. 2024; Kallis et al. 2025). So, there are very real reasons to suspect that these mid-ecological jobs, reformist in their orientation, cannot adequately respond to ecological change on their own.

investor-owned entity, can serve as an illustration. Communities would similarly share information and technical standards with one another to ensure for the large-scale maintenance of such a system. Jobs on these projects would similarly provide socially and ecologically beneficial use values like electric power to local schools and hospitals, while also providing low-cost access to fresh fruit and vegetables to the local community grown on the premises of the solar facility. The local community would retain these seeds and use them for next year's harvest, the goal being to break the commodification of food and return it to those who grow it (see Klein 2025 for discussion on seeds and sovereignty). Along these lines, jobs might also include larger scale efforts for soil and wildlife monitoring, watershed remediation, and other ecological restoration activities. Human needs for healthy natural environments and meaningful opportunities for connection and reconnection to nature (see Barragan-Jason et al. 2023) could also inform the creation of other jobs. That means getting people to work in and with nature, rather than separating workers from nature as its other (Räthzel and Uzzell 2013, p. 2; Stevis et al. 2026). It would also include a retrofitting program to advance urban renewal while making communities and buildings more ecologically sensitive and livable through retrofit programs, not to increase housing prices and force people out, but to ensure for better and more ecological living. Projects like these could be attached to a national jobs guarantee program, one that would uphold the social dimensions of work, which we will discuss in the next section. Manufacturing processes for things like solar panels, would ensure that the production processes across the supply chain use the highest possible standards and that these do not simply improve efficiency but reduce material throughput. Crucially, ecological and social externalities should not be shuffled around to enable such forms of living. Instead, (re)generative jobs will also produce more durable and repairable products.

Ecologically regenerative jobs, therefore, are those that transform the purposes of economic activity through their emphasis on outputs that are ecologically restorative and humane, both in themselves and in their uses. They help revitalize local and global ecosystems, including particular sensitivity to human needs for healthy natural environments and meaningful opportunities for connection and reconnection to nature as essential elements of human welfare (see Barragan-Jason et al. 2023).⁵⁰ The associated processes are ecologically sensitive and do not create local or trans local sacrifice zones. Like Jostein Hauge and Jason Hickel (2025) suggest, economic outputs can contribute to ecological restoration and long-term socio-ecological well-being by scaling down ecologically harmful industries and reducing energy and resource use.

The Social Dimension

The social dimension includes more than the workers engaged in green and climate jobs. However, focusing on the role of workers in the production, use, and process related to the environment and energy, often labelled green, can tell us a great deal about their social content and impacts.

What is produced and why poses important questions. Should people work to produce luxuries or necessities? Do workers participate in deciding what they work on? Questions like these stretch back to at least as far as Marx concerning the distinction and identification of socially necessary labor time (and, we might now add, ecologically necessary). However, the hegemony of capital obscures that

⁵⁰ Here I acknowledge what regenerative work might look like at the local level, and that further considerations are necessary to detail what this would look like more broadly radiating out from a community center. This constitutes future work, but I do not wish to suggest that the establishment of regenerative forms of work or living should be delimited to what might otherwise be described as free standing islands (or, in popular consciousness, “communes”) that exist to isolate themselves from the rest of humanity.

there are many examples of workers and communities contesting what should be produced and why (Wainwright and Elliott 1982). If we expand our ideas of what is produced to include public goods that we take for granted, workers and progressive forces have, in fact, played a role in determining what is to be produced and how it is to be used (Wright 2013). However, in the private economy the decision role of workers and society is quite limited and privatization of what could be public goods continues to accelerate, including in the energy sector.

Occupational and health and safety (OHS) standards and associated politics is one example of struggles in industrial relations (Sellers and Melling 2011). With respect to OHS, should technical standards be determined by professionals and companies, or should they be determined by workers in these processes? Should they only deal with what happens to worker bodies in the workspace, or should they also include how the workspace affects the society around them, that is, the effluents of enterprise? With respect to industrial relations they range from human resource approaches that are based on benign concern by management to society wide democratic planning about what is to be produced, why and how, however aspirational that may be (Kaufman 2004). As we shall see in Chapter 10, this is not an inconsequential question and management may adopt a paternalistic position in an attempt to obviate the need for workplace democracy. Table 2 provides the range of possibility that exists, one that ranges from socially corrective to socially regenerative.

	Socially regenerative	Socially enhancing	Socially corrective	Socially damaging
Output	Socially just, humane, and restorative	Socially useful and/or beneficial, but "hedging"	Growth oriented	Socially harmful and/or oppressive
Process	Socially determined and worker led	Reformist, shared decision making	ILO labor rights recognized,	Exploitative, exclusionary,

			including unionized labor processes	little or no autonomy
Use(s)	Solidaristic, empowering, oriented to socially humane uses that restore communities	Inclusive, adaptive, and some social determination	Single uses, or socially necessary and embedded (e.g., car or cell-phone access)	Exclusive, reinforces social injustice; exchange value focused

Table 2. Social dimension of eco-social jobs typology.

Social processes at work and associated voice in the production process is likely to be the most contested concept, largely dependent on standpoint, a point made by Marx (see Przeworski 2021) and considered by contemporary labor relations scholars (Wilkenson *et al.* 2020). Far too often, it is assumed that what is good for business is good for communities—this is the logic of trickle-down economics and the implicit assumption that “good” jobs follow from investments. It is an ideological trick that is frequently played on workers that they should be grateful for the jobs they have, as it was capital that “took a risk” in hiring them or investing into a particular community. Of course, such a view does not appreciate the power imbalance between employers and workers and how this division creates diverging interests and associated structures that limit the potential for worker voice in production processes (Barry and Wilkinson 2016). Nor does it consider the means through which wealth was generated in the first place, and continues to be produced. For my purposes now, what matters is that *voice* represents workers’ desire to determine the affairs that affect their working lives, including the challenges posed by spatial divisions of labor that, as I and many others have argued, are *actively* manufactured by capital and sanctioned by the state.

Socially Corrective Jobs

A great deal of the world economy does not attend to the views of workers or communities on what ought to be produced and why. Pockets of more robust participation in decision making exist

in things like public services or cooperatives, but even here managers play a dominant role (see the work of Trade Unions for Energy Democracy and Public Services International). Socially corrective jobs do address some social concerns; avoiding the production of dangerous products and replacing them with safer ones and improving the work process through workplace standards that enhance safety but do not give workers decision-making rights.

Corrective jobs do not imply the absence of worker or union voice. There is a long tradition of unionism that fully subscribes to capitalist social relations, provided that workers get their 'fair share'.⁵¹ While this liberal or business unionist tradition is more apparent in liberal capitalist countries, unions in coordinated and, even more so, developmental capitalist countries subscribe to this view. After all, it may be possible to have forms of work that enable and respect collective bargaining rights, but these are nevertheless co-opted into purposes that are socially or ecologically harmful. Consider work on a coal plant, for instance. Even still, the human right to collectively bargain *is* important and, in considering social processes, therefore constitutes a baseline level of worker voice that any job performed for someone else's profit should recognize.

Considering uses, a particular output may be conditionally socially useful but nevertheless constrained by broader political economic barriers that stratify access to potential benefits. For example, rooftop solar is provisionally a transformative energy solution, but access to rooftop solar depends greatly on existing wealth like owning a home and having the means to purchase solar panels (Konzen *et al.* 2024). Instead, a more socially just form of the same job would be the

⁵¹ Consider, for instance, the prior Chapter's discussion of how the UAW at the Treaty of Detroit traded its socialist elements in exchange for the promise of a shared bounty with capital after World War II had decimated much of the world, leaving US manufacturing capacity untouched.

installation of distributed panels, but these would exist outside of the logic of private ownership that perpetuates existing inequities and, in some cases, allows individuals with greater wealth to isolate themselves from the rest of the community. In other words, questions concerning social ownership and worker voice and the purposes to which power is produced would come to the fore.

Socially Enhancing

Socially enhancing forms of GJ/CJ represent reforms to work and its social purposes, but these do not go so far as to transform the ultimate purpose of jobs. In some sense, these might be thought of as regulating but not reorganizing corporate power (Stavis 2002; Dupuy and Pasquier 2024). They seek to “humanize” economic activity, but the social relation has not undergone a more fundamental political economic transformation that prioritizes different use values over exchange values—it remains wedded to economic growth.

Socially enhancing jobs do reform the labor process in some important ways, especially when it comes to worker voice and autonomy. For example, unionized work combined with work councils that offer a formal mechanism for worker consultation in productive capacities may represent employment forms in this category. Nevertheless, despite reforms to the labor process, these forms still exist in a hierarchy of corporate power (Braverman 1974[1998]).

Perhaps the most widely known example of a mid-social arrangement might be something akin to the Mondragon Corporation in Spain. As a cooperatively owned entity, workers are empowered to take ownership of the company, and different parts of the enterprise determine the manner in which work is completed. Nonetheless, the Fagor Ederlan within Mondragon, one of its most successful entities, acts like other corporations via hierarchies in decision making and through a reliance on

subsidiaries as a regular part of the enterprise (Bretos and Erasti 2017). The use of subcontracting, in this regard, enables some of what Mondragon can accomplish by shifting exploitation elsewhere, reminding us of the need to attend to social relations across spatial and temporal dimensions.

Nevertheless, I suggest socially enhancing jobs imply some social input, other than that of corporations and socially unregulated state agencies (e.g., the military). In contrast to corrective forms of work, the outputs of these jobs offer services or goods that are humane and useful within existing social structures—a reformist orientation that can improve things but does not redistribute power. Outputs might include things like public transit infrastructure, increased availability of various medical and counselling services, various forms of education, and jobs that somehow contribute to more widely accessible pharmaceutical treatments. These outputs contribute to uses that emulate something like what we see in Nordic countries—the uses are broadly accessible and serve human needs, but remain mediated by market mechanisms, even if limits are placed on these mechanisms by the state.

Socially Regenerative

Socially regenerative jobs reflect a transformation of social relations through work processes and outputs that are humane in themselves and in their uses. Democratic decision making plays a crucial role in the process of production, including the right of workers to voice and choice in the workplace and in deciding what will be produced and why. This does not imply that workers are the only ones deciding. But workers are empowered to make decisions in the workplace as community residents, and determine what ends their work should serve; that is, how their work contributes to the community and ecosystem. This reconstitutes work as a social good, which helps to advance human autonomy through recognition of interdependent social relations and the understanding that people

are not robotic utility maximisers, but embodied entities with needs to feel connected with their work, nature, and the broader community. In this manner, socially solidaristic jobs imagine workers as “makers of their own futures” and those futures emphasize the use value of different economic outputs, rather than their potential for increased profits (Rathzel and Uzzell 2012).

It may be difficult to imagine or conceive of a wholly socially solidaristic platform today. Doing so, however, is necessary to confront today’s polycrisis. Possible examples for such a platform include something like the 1976 Lucas Plan that sought to repurpose harmful military and industrial activities towards ecologically and socially useful ends through labor control (Smith, 2014). It may also be seen as an instance of “cross-collar” solidarity and organizing where engineers and manufacturing laborers worked together to advance their social alternative. Or another example might include efforts like that of the Detroit Printing Cooperative that sought to liberate the process of print from corporate oversight, helping to spur and inspire arts and information to realize not only free expression, but a more socially just community (Aubert 2019). In any case, the realization of deep social forms of work will require some form of democratic control over productive activities that serve human and ecological needs, rather than profit.

To this end, even people who are not directly involved in the production process—other members of the community—would have a stake in the outputs and uses of production. This can help orient economic activity to community needs rather than profit enterprise for a small subset of people. Such a move would entail a shift in power sharing between capital and labor towards labor. Capital is defined on its relation to money and the way it valorizes profit over the needs of people, community, and nature. A shift away from this paradigm would run through the prioritization of use values oriented towards meeting social needs and regenerating ecosystems. Of course, this necessarily runs

counter to capital's growth paradigm that continually manufactures new crises and "needs" in the pursuit of continued growth. In this fashion, regenerative forms of work would represent a shift in values and, in so doing, focus on what actually needs to be produced and why. Doing so would help unlock a politics not oriented around production, but also leisure time. In Marx's parlance,

"Society regulates the general production and thus makes it possible for me to do one thing today and another tomorrow, to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner, just as I have a mind, without ever becoming hunter, fisherman, herdsman or critic" (Marx 1845).

Of course, capital will resist the move to this form of production. Indeed, if a capitalist chooses not to pursue the valorization of surplus value, it ceases to be capital—its survival depends on the valorization of commodities and expropriation of labor and thus cannot be the source of economic and ecological change. In this fashion, where a capitalistic economy manufactures new contradictions and consequent areas of expansion and innovation, regenerative social relations of work *stabilize and regenerate* human communities and nature to enable politics anchored in security, connection, and expression. When we consider dealienating forms of work and what authentically regenerative and transformative forms of green and climate jobs might look like, this is what I have in mind.

Eco-Social Synthesis: Regenerative Jobs for (De)alienation

Figure 8, or the "eco-social schematic" offers a visual representation of the envisioned typology. It includes an x and y axis that correspond with ecological and social dimensions respectively. As discussed, axes also consider spatiotemporal relations. A green or climate job would not be ecologically or socially regenerative if it externalizes harm across space and time, no matter how brilliant it seems within its specific time and space. The typology's utility lies in its ability as a heuristic device to describe and analyze social relations, not in its ability to offer precise measurements of work

forms. In an immediate methodological sense, it helps us think through different jobs and identify tensions in varied political platforms, namely those linked to green and climate jobs. Theoretically it orients us to the necessity of fusing ecological and social dimensions in pursuit of dealienating green and climate jobs.

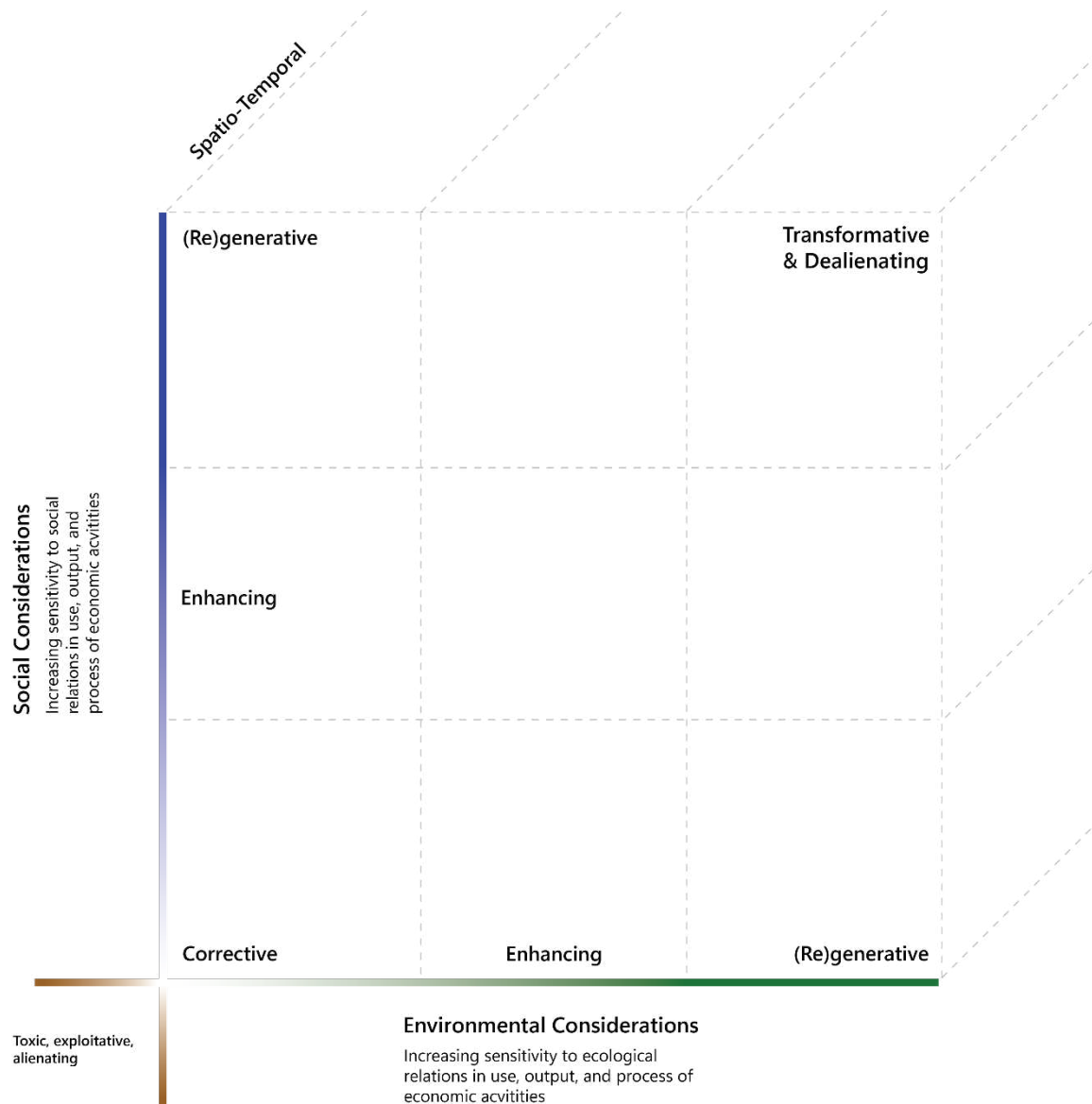


Figure 8. The Eco-Social typology takes inspiration from Hopwood et al. 2005 in its design. It was designed by the author using Adobe Illustrator.

Despite the treatment of social and ecological dimensions along different axes, the relationship is one of interdependence. Society and ecology constitute an interdependent system humanity depends

on for survival. Once again, the fetishism of market exchange obscures the ecological and social relationship that exists between workers and nature, which contributes to the exploitation of the worker and expropriation of nature. A fragmented understanding of socioecological relations emerges if we explore capital-nature relations as an abstraction separate from value relations (Moore, 2021).. That is because global production processes depend on a complex entanglement of social relations, and this complexity serves to obscure these social relations, rendering them as an abstraction. Economic transformation therefore requires demystifying the relationship between work and the associated values it produces. Doing so occurs through revelation that the exchange values and accompanying money forms used to quantify labor are contingent social relations, not concrete facts of reality. Such a revelation cannot occur while work remains alienated, however.

The world of the “green” and “blue” economy is replete with examples of companies and advocacy organizations that highlight the utility and attractiveness of green technologies. For example, there is a strong movement around the world for distributed solar installations, especially in countries of South Asia like Pakistan, helping provide many Pakistanis critical power (Shah 2025). At the same time, residential construction and installation may not be unionized and depends on precarious migrant and immigrant workers (Gadzanku et al. 2023; Morley and Spaans 2025). Moreover, Tesla cars are produced by a company that is militantly anti-union and whose overall portfolio includes patently anti-ecological practices and a fetishistic fascination with the colonization of other planets. On second thought, perhaps it is a fascistic fascination?

In any case, the history of labor politics includes many instances in which historic successes resulted in the associated marginalization of other groups of people. To achieve the passage of the US National Labor Relations Act of 1935, the Roosevelt Administration worked with southern Democrats

to carve out exemptions for some workers like farmworkers—many of whom were Black and immigrant—as well as domestic workers (Nicholson 2004; Hogler 2015). It is possible, accordingly, to imagine social policies that lean regenerative or solidaristic for some groups, but that exclude particular categories of workers and, certainly, more-than-human nature.

Consistent with the analytical scheme employed by Hopwood et al (2005) the bi-focal social and ecological lenses offer a more comprehensive view. It is quite possible that one could add more dimensions or break up these two dimensions. The inclusion of temporal and spatial considerations provides the lenses a sort of prescriptive power to better discern job practices, something developed in more detail elsewhere (Stavis 2013; Stavis and Felli 2016; Stavis 2023).

Closing Comments

Regenerative GJ/CJ exist as dealienating forms of work. Dealienation is a point of synthesis and convergence between the social and ecological. Without greater say in the work process, it is not possible to realize more humane and ecologically sensitive outputs and associated uses. Without socially solidaristic or ecologically restorative outputs, it is not possible for these processes to be characterized as socially determined or worker led, as the voices of both workers and the surrounding community would, assuming awareness of spatiotemporal relations and democratic input, prevent externalizing social and environmental costs onto others. In this, the politics of work is a politics of reconnection—to the labor process, to one another, and to ecology.⁵²

⁵² In my interaction with students in the classroom, I introduce students to ideas such as these. Often, I receive rejoinders that people are greedy and selfish by nature. I find these interactions useful, as they stage the ground for students to explore that perhaps things are not so fixed as we think them to be. After all, consider the many ways, both spatially and temporarily,

As we enter the next section of the dissertation, I will refer back to this typology from time to time. The typology can be thought of as the heuristic prism through which we look at different green jobs and climate jobs. Once again, where labor regime analysis discussed in the next chapter helps us to understand what political structures, institutions, and processes interact to govern the workplace, this typology helps us to better consider the outcomes and qualities of “green” jobs in these regimes.

Furthermore, by articulating a range of possibility that exists for work, we can better appreciate the implicit, but unrealized potential of “green” and “climate” jobs that, heretofore, offer little more than simulacra of what they might otherwise be. Crucially, where most accounts of eco-socialism deal with the necessary changes to the purposes and uses of various forms of economic activity, this typology appreciates how it is through work, the labor process itself, that change may come about. In this respect, the typology better recognizes the source from where eco-social change will come; workers like you and I, and reveries for better worlds we might live in.

people organize themselves to survive. I tell them that it is this flexibility that has allowed humans to expand as we have. If there is a “human nature” it is one that is, at once, both adaptive and maladaptive, depending on our choices.

CHAPTER 5. METHODOLOGY: LABOR REGIME ANALYSIS, A SYSTEMATIC APPROACH TO MAP GREEN AND CLIMATE JOBS

In this chapter, I discuss labor regime analysis (LRA), its application to my work in renewable energy GPNs, and how it complements the eco-social typology developed in the chapter prior. Where the eco-social typology helps us discern the attributes of different green and climate jobs and the political economies they portend, LRA offer an interpretive framework to help us understand why these jobs look as they do. More specifically, LRA is a tool that helps the analyst describe and analyze the associated structures and institutions of labor control that constitute distinct “labor regimes”, which condition the labor process and produce the outcomes we see (i.e., what jobs look like). Labor regimes are historically formed, multiscalar, temporarily stable arrangements between capital and labor that make labor processes capable of study (Rioux 2022; Bartley 2018; Smith et al. 2018; Baglioni et al. 2022a). Where the eco-social typology tells us about the desirability or quality of different jobs and offering a point of perspectival juxtaposition (see Schaffer 2022), labor regimes help us understand why these jobs look as they do. The combination of these tools helps me answer my central question: what do “green” and “climate” jobs look like in the renewable energy sector, and what conditions explains the conditions of work we see?

LRA, summarized by Elena Baglioni and co-authors (2022a), takes up Paul Thompson and Chris Smith’s (2009) contention that labor process theorists who study different types of jobs and their evolution need to move beyond single workplaces in their analysis. More specifically, they need to better appreciate the larger political economic social formations and processual structural changes that condition the labor process. I believe LRA, the framework advocated for by Balgioni et al (2002a)

is well adapted to this project and suitable for my purposes. It can, however, be extended in some important ways.

First, I combine LRA with the relational logic of “siting” (see Riofrancos 2022) that can help analysts better select and theorize what they study across global production networks (GPNs). Although scholars recognize the need to move beyond single case studies in specific workplaces to discern how structural changes influence the labor process, little methodological guidance is offered in how to do this, or how to select what we study. Such an omission has important analytical and political implications for understanding different jobs and corresponding forms of worker agency across GPNs. This is known as the “connectivity gap” (Taylor et al. 2013: 5; Baglioni 2022: 14). I dedicate Chapter 6 to unpacking how “siting” logic can help respond to this.

Second, in summarizing LRA in this chapter, I discuss inadequacies to labor regime analysis my work helps address. Despite the impressive array of scholarship that has been produced over the decades about how different formations produce distinct workplace outcomes, these have thus failed to seriously consider the important role ecology may play in shaping the labor process, something especially relevant to renewable energies. More fundamental, I discuss the relative lack of analytical focus on how ideas emerge from the labor process itself, including surrounding ecologies, that govern and maintain labor regimes as a productive form of diffuse power (see Barnett and Duvall 2005).⁵³ Ideas do not emerge from nowhere, but interact with local ecologies, social structures, and institutions

⁵³ Productive power refers to socially diffuse *production* of subjectivity and meaning across social system (ideology). As it concerns the day-to-day rhythms of people’s working lives, productive power maintains people’s expectations of what to expect from their jobs, and what the bounds of political possibility are. I refer to this as a Gramscian “common-sense” expectations of work.

in a contradictory fashion that at once maintains existing practices but also contain in them seeds for alternative social imaginaries of what work *could* or *should* look like. Here the eco-social typology outlined in the prior chapter is especially useful as it can help us see what different jobs look like, and of greater interest to labor regimes scholars, how “common sense” expectations about work processes, outputs, and associated uses of work govern the workplace.

Discerning the Nature of Production

Renewables have expanded in a somewhat chaotic fashion, especially in the early years, scraping by with tight profit margins and government support (Knuth 2023). However, because of the era in which they matured—in response to the oil-related shocks of the 1970s, precipitated by the end of the Bretton Woods system—their development has been one that coincides with a period of heightened globalization in the world economy. A vast array of minerals, production processes and workers enable the production of these technologies, but their sources and installation locations are geographically dispersed as part of complex webs of economic activity.

In effect, I am describing renewable energies as a global production network (GPN). GPNs comprise interconnected economic activity across the world, typified by a dense mesh of activities organized across and within complex and interdependent networks (Dicken 2015: 6). GPN scholars study these activities to capture qualitative changes to political and economic relationships across geographic space. Labor regime scholars operate within this and other related literatures and associated traditions in comparative and international political economy.

The word *network* refers to the structural and relational nature for how economic activities are organized (Coe *et al.* 2008: 272). GPNs exist in constant flux, their existence and evolution dependent

on their ability to convert inputs into outputs for the purpose of greater surplus value accumulation. As they shift, GPNs leave an indelible footprint on local and global economies, which requires attention to multiscalar, multitemporal, and multiform processes (Jessop 2002: 113-14). Critically, GPN scholars envision the process of accumulation as a circuit, rather than a chain, in which component aspects of production can be disaggregated organizationally and geographically by a variety of inputs (e.g., technology, energy, logistics, finance) coordinated across space (Dicken 2015: 54). These circuits create linkages that extend across national boundaries and touch down at points of conjuncture (nodes), which binds the fates of different communities together.

Given the joint connections across space and time, what happens both inside *and* outside a firm matters a great deal—at least within GPN 2.0 (see Yeung 2020). Because of its more relational orientation, GPNs have more to say about the state and related institutions, particularly as it relates to conceiving the state as a space of hegemonic contestation (in the Gramscian sense) with governing bodies acting more receptive to some economic strategies than others (Jessop 1990; Kelly 1999). We may thus adopt a strategic-relational view of the state (Kelly 1999), which avoids essentializing definitions and instead approaches it as a historically contingent form of governance that vacillates, evolves, and changes in contradictory ways. Approaching the state in this manner offers a perspicacious, if somewhat unconventional way to understand how the state may simultaneously both aid and hinder workers' ability to survive or socially reproduce themselves. Such a view is critical because within capitalist society the conditions of production are also the conditions of social reproduction (Marx 1976: 711)—that is capital's economic power (Mau 2023).

The world, however, is not borderless. The unevenness of political institutions and histories between and within states produces conditions that inform the development of some production

nodes within a network and not others. Within conventional economic theory, the development of certain industries (like renewables), stems from conditions of comparative advantage (Peck et al. 2025). In other words, states and firms will develop industries according to how efficiently they can produce a particular commodity or service and the associated value that entails.

However, a purely economic accounting of GPN activities does not capture the social, political, and ecological dimensions that influence firm decisions on how to coordinate activities across a production network. Furthermore, it does not seriously consider how governments create different institutional environments to attract investments (Vogel 2018), often to resolve the contradictions of capital. Theoretically, this means countries and localities do not operate according to a logic of production efficiency. Instead, they function according to their ability to enhance firm value capture in different nodes of a production network. It is again the potential for surplus value and profit that matters when firms consider decisions related to their economic enterprise (Christophers 2022). Accordingly, value may also derive from surpluses in skills, technologies, and historical geographies of production that can create certain path dependencies in the spatial division of labor (Massey 1985). Localities may also seek to court company investments through regulatory regimes useful to business operations that have looser restrictions on social and ecological matters (Dicken 2015: 186), reinforcing again the need to attend to both the social and ecological aspects of production when considering the labor process.⁵⁴

⁵⁴ Looser restrictions do not imply deregulation, but instead suggest the manufacture or creation of regulatory regimes that provide a more conducive environment to capitalist accumulation, and this may include regulations that restrict what governments can and cannot do to influence company operations.

Why GPNs and Not GVCs or GCCs?

The assumed ontological relationality of the GPN approach stems from its disciplinary roots in geography. By contrast, more linear economic and business analyses often typify commodity and value chain approaches (Bair 2005).

For the purposes of my research, I rely on a GPN framework to theorize the nature of production processes. GPN scholarship better accommodates relationality and has done more to incorporate the state's role in setting production outcomes. By contrast, GVC approaches, while sharing some overlap with GPN scholarship, tend to be more linear and less flexible in adapting to fluid and fragmented changes to production processes. That does, however, perhaps lend them a greater degree of parsimony (at least at first glance).

In the context of this research, the energy transition and the “greening” of capitalism represents an ongoing historical process in which an assemblage of actors—business, government institutions, workers—constitute one another's respective positions in global political economy. A relational logic invokes the researcher to approach, as much as is possible, a totalizing view of these relations to understand how these and associated differences in power constitute outcomes. As discussed in the prior chapter, production and consumption are one such internal relation and we cannot properly understand what green or climate jobs look like without adopting a relational perspective on work.

When I refer to internal relations, I use Erik Olin Wright's (2016) definition. Wright distinguishes between gradational and relational views of class. The gradational view treats entities as ontologically separate, or as “atoms” that make up the whole. By contrast, a relational view understands *relations* as internal and constitutive of entities. In other words, the relations constitute the *relata* (Mau 2023: 74).

Consequently, the unequal distribution of power in social relations (i.e., capital-labor, north-south) produces the social structure that reproduces the ordering of positions.⁵⁵

Labor Regimes in GPNs

Despite their centrality and recognition by GPN scholars, critics point out failures within the approach to deliver analyses beneficial to an understanding of the state, labor, and finance in global political economy (see Yeung's 2020 summary and riposte to such critiques). More recently, it has received criticism in its inattentiveness to the digitization of various aspects of the global economy (Butollo 2021) and its potential to deliver on promises of social liberation (Selwyn 2025). I would also add that it has little to say or offer in how energy flows, and especially access to cheap electricity for production, influences the evolution of GPNs. Instead, GPN research, like its contemporaries, have continued to emphasize firm centric analysis that reifies business' position as the principal actor that shapes local and global political economy (Selwyn 2025).

In response, some scholars within critical political economy adopted labor regimes and corresponding forms of analysis, especially among economic geographies, to redress these issues (Baglioni et al. 2022a). The infusion of labor regimes into GPN research can help better theorize how private governance, commercial pressures, and the state⁵⁶ shape working conditions and

⁵⁵ However, when considering larger shifts in global political economy, we can similarly apply a relational logic to changes in the energy landscape, albeit with some modifications. Jason Jackson and Patrick Nexon (1999) move beyond class-based analysis and consider how entities (such as states) do not precede one another but instead represent an intercedence of the 'ties' between these entities that exist within processual interactions that constitute the interplay of entities through the process itself.

⁵⁶ For my purposes, the state refers both to the associated offices and institutions of legitimate authority to govern, which have calculated preferences of their own and exist as a central site of contestation in the capital-labor relation.

corresponding forms of worker struggle (Selwyn 2012; Anner 2015; Pattenden 2016; Coe and Yeung 2019).

But what on earth is a “labor regime”? To start, they should be understood as a useful tool of abstraction. They exist as a mediating category, meaning that we cannot directly “observe” a labor regime. Instead, the labor regime analyst seeks to observe its effects on the labor process. As Jonathan Pattenden (2016) argues, labor regimes connect the day-to-day experience of the workplace with the varied manifestations of exploitation, including more abstract “general forms of domination” under capitalism. In the parlance of International Relations scholars, these regimes are governance frameworks mutually constituted through both implied and explicit institutions, rules, norms, and procedures. The word *regime* connotes how they are relatively stable, but evolve overtime according to differential configurations of power. By understanding how labor regimes are formed, we can then better discern why jobs look as they do.

Given the definition above, labor regimes take on place-based characteristics. These, however, vary according to the scale of analysis employed by the researcher as labor regimes are multi-scalar (i.e., they exist at multiple analytical scales). In my case, I use labor regime analysis to assess more general forms of exploitation that exist within wind energy production at a national level, as well as more specific forms that exist within local labor control regimes in Colorado. Correspondingly, certain labor regimes may be modestly benign when it comes to the capital-labor relationship and others a great deal more vicious.

Like GPNs, labor regimes are understood relationally, mediated and organized across different spatial scales (local, national, regional, global) that, while treated as analytically distinct, simultaneously

condition one another (Bartley and Coe 2022: 214). As a result, labor regimes are irreducibly sociopolitical in character, informed by institutions, structures, and cultures of production in different places. These factors help to explain the manner of exploitation, and seek to elaborate the relative durability of specific labor regime arrangements and how these condition the labor process—often “jobs”, but also non-waged forms of work like domestic labor. Labor regime analysis, therefore, compliments GPN scholarship through its *explicit foregrounding of the labor process* embedded in production networks. In this regard, we might say that labor regimes analysis makes the labor process its principle “unit of analysis” (see Barrientos 2011).

Like other Marxist informed approaches, LRA does not seek to quantify things (although quantification may occur), but endeavors to construct qualitative assessments of different social forms to better reveal and critique the underlying mode of production (i.e., capitalism). LRA comprises the method that attends the labor regime concept. It seeks to reveal how social relations of the labor regime impose themselves into the social life of workers. In line with the theorization of the philosopher Søren Mau (2023), these may take the form of concrete, direct forms of control and exploitation, or more likely occur through diffuse and impersonal forms of power (2023: 66). That is not to suggest, however, that both more overt and violent forms of power do not share a relation with more diffuse forms.

LRA suits my purposes as it focuses on social relations of work and how these produce different outcomes. Critically, describing and analyzing how the labor regime shapes the labor process is a necessary step to better consider varied “green” and “climate” jobs, including what settings and conditions are enabling for eco-social forms. I suggest that we can use the typology in the prior chapter to consider different jobs and their corresponding social and ecological relations, across time

and space, and compare these with the implicit, unrealized political potentialities of particular configurations and social relations of work.

I also believe labor scholarship can better achieve its political aspirations through a more ready embrace of perspectival logics of comparison—one that I am attempting to do using the eco-social typology. Labor regime scholars must be willing to not only offer descriptions and analysis of what is, but elaborate points of comparison that both do and do not exist. We must be willing to entertain differences to better imagine how politics (Ragin 2004: 128), including the politics of work, might be conceived of otherwise. Doing so better reveals the possibilities for worker agency, axes of political struggle, and creates a space from which to view “common sense” expectations in the day-to-day rhythms of life from a new vantage point.

A Brief History of Labor Regime Research

Now, if that's what labor regimes are, then how did labor regime research come about? Like many prominent social theories, labor regimes first emerged as a concept in Sociology. More specifically, the work of Sociologist Michael Burawoy (1983; 1985) who investigated “factory regimes” in the seminal work, *The Politics of Production*. An offshoot of labor process theory, labor regime scholarship owes much to Harry Braverman's (1976) work that expounds the importance of the labor process for the valorization of capital. Among the many things Braverman discusses is the development of capitalism and, in contrast to technological optimists, how these technologies may systematically de-skill the labor force as an inherent attribute in capitalism (Braverman 1974). Burawoy's contribution of “factory regimes” offered a corrective to many analyses that under politicized the production processes, rendering it static and incapable of considering how the state, in particular, conditioned workplace

practices (1983: 587). In so doing, Burawoy connected “the micro-politics of the workplace and the macro-politics of the state” to explain workers’ acquiescence to existing labor relations and the ways in which this was “manufactured” (Knutsen and Hansson 2010: 159). Upon later reflection, Burawoy instead characterized his own work as simply trying to explain why workers on the factory floor worked as hard as they did (Burawoy 2013).

Operating in parallel with Burawoy, others explored broader questions of global political economy and the restructuring of international divisions of labor in parts of the Global South as part of longer histories of colonial exploitation (Banaji 1977; Bernstein 2007). These efforts differentiated between modes of production and the various forms of capitalist exploitation that could exist in both rural and agrarian settings as opposed to industrial ones. In so doing, they sought to underscore how economic foundations were inextricably linked with the political apparatuses and associated institutions of different countries. Other key contributions to labor regime inquiry came from feminist agrarian and global political economy that not only explored the historic and racialized aspects of labor regimes, but their gendered dynamics too (Bair, 2022). In both developments, they emerged alongside and with the influence of Marxist influenced Dependency and World-Systems Theory from the likes of Immanuel Wallerstein, Samir Amin and Ernest Mandel (Baglioni et al. 2022a). These literatures endeavored to explore Peruvian Sociologist Aníbal Quijano’s (2000) “coloniality of power” and how colonial enterprise is not wholly but essentially oriented to capitalist purposes in the “center” or “core” of the world system. These practices and theories continue to this day, and I explore them in the wind energy industry in Chapter 9.

Following these early works, labor regimes underwent a second conceptual development phase brought on by economic geographers who sought to understand the social formation of local labor

markets (Peck 1989). Authors considered how labor market regulation and segmentation were spatially differentiated and formulated at local scales—even if broader forces set the context for their emergence (Peck 1996). The principal conceptual development was an understanding that “local labor control regimes” (a term coined by Jonas 1996) are stable, but not:

“static and fixed object(s) but rather a fluid and dynamic set of social relations and power structures which are continuously reproduced and/ or transformed by the forces of domination, control, repression and resistance operating at a variety of scales” (Jonas 1996).

Labor regimes have always had a distinct relational ontology, but it is in this second phase we see a more explicit emphasis on how spatial dynamics between actors mediate the workplace.

The hastening of neoliberal globalization in the 1980s and 1990s set off another wave of intellectual activity to better conceive of how spatially fragmented elements of global production were structured in relation to labor (Baglioni et al. 2022a). In this third wave, scholars began to more seriously consider the cross-border and international nature of labor regime development. Early conceptual developments owe a great deal to economic and industrial geographers like David Harvey (1982) and Doreen Massey (1995), both of whom inquired how capital structures space and put communities in relation with one another. Some, like Harvey, gave capital a more determinant role. Massey and others instead held open the possibility for contingency and change to a greater degree. Between the two, my analysis tends towards Harvey, but the political elements of this dissertation and my consequent framing lean towards Massey’s emancipatory spirit. As part of this “global turn” in labor regime literatures, researchers sought to historicize their understanding of specific forms of

control that emerge locally but depend on national and international developments, once again considering how racial and gender dynamics play into these processes (Baglioni et al. 2022a).

Bringing these phases together, we can say labor regime scholarship has entered a fourth phase of conceptual development. Where the previous phases developed the *modus operandi* and underling ontology for labor regime analysis, today's labor regime scholars seek to further elaborate these points but also develop a more *systematic analytical tool* to help researchers better discern changes to global political economy and labor's role in these shifts. The development and implementation of this kind of tool is a project my dissertation contributes to.

Executing Labor Regime Analysis

No single data generation technique or tool characterizes LRA. Instead, LRA depends on an intensity of observations and related processing of these to generate inferential leverage on the evolving nature of the labor process in a diversity of settings.

Given this goal, labor regime studies investigate 1) the particularities of an industry, 2) the mutual constitution of labor regimes through ongoing historical relations of the state, institutions, and cultures, and 3) comparative designs to assess how local labor regimes differ across spatial and temporal contexts. In each case, the approach aims for both descriptive and analytical inference, the latter of which is reinforced through comparative explorations that can help shine light on how the particularities of different places shape the labor regime (Oya 2022: 104).

LRA does not aim at constructing particular stories to identify specific mechanisms that act as exogenous determiners of the labor process. Instead, the intensity of the method aims to draw out broader lessons from specific labor regimes, which are then considered alongside a larger body of

scholarship to better theorize the evolving nature of the capital-labor relationship, including what antecedent conditions shape social relations in the workplace. Such analysis allows for some measure of generalizability—indicating to other scholars what conditions are worth attending to in their own settings—while also holding open the possibility for social change and labor agency changing the nature of production dynamics and associated labor regimes. In this sense, the research method is “intensive” (see Sayer 1992) as it tends to focus on a small number of cases to identify and elaborate mechanisms that can give rise to certain outcomes. Critically, however, these comparisons embrace a logic of complexity, rather than that of linear causality. To adopt the language of Joachim Blatter and Till Blume (2008), LRA aims at bringing into congruence observed reality and theorization, even with the understanding that completely realizing this is not possible. Nevertheless, it is the dialogue between theory and observed reality that propels the conversations and debates within the literature forward.

While specific approaches to LRA vary, theory helps assess the validity and thoroughness of the analysis. In some cases, researchers proceed deductively and assess theorized labor regime types according to a series of case studies (see, for example, Anner 2015). In other instances, the researcher will proceed abductively, tacking back and forth between theory and their observations during the study (see Smith et al. 2018). In both instances, however, the scholar proceeds according to a combination of “small-t” or soft theory (see Flyvbjerg 2004) and empirical observation. Accordingly, labor regime research begins from some idea about the labor process or different settings of work that the scholar believes to be important—informed not so much on what is universally generalizable,

but instead on what is politically important or useful to a particular group of people to which a study is relevant.⁵⁷

As I laid out in the introduction, I believe there is something politically relevant and salient about studying work associated in the renewable energy sector. Distinct material and symbolic attributes attach themselves to renewables like wind energy owing to the form of power they produce—ubiquitous, cheap, renewable electricity. Yet, despite these distinct material elements, these technologies are being ported into electrical systems that were not designed with them in mind. That includes the technology itself, but also what the work in sectors like wind and solar look like—work that has an ephemeral character—work that can come and go, well, like the wind. Moreover, if these sources of power are renewable aspects of nature, why is it that the benefits of them goes into the hands of a small number of individuals? Could this power also not be communally owned? Questions of these sorts make work in the renewable energy sector especially important to consider.

How to Generate Data

To generate data, labor regime scholars rely on various tools and techniques, most of which are qualitative. These often include ethnographic research, participant observation, interviews, and document analysis, although quantitative data and techniques may also feature in the analysis (Oya 2022). Because reliable, granular data is often lacking in settings or contexts that interest labor regime researchers, we tend to rely on qualitative data generation techniques. This is especially true when

⁵⁷ That is to say, it is often *phronetic* in its orientation as described by Bent Flyvbjerg (2001) and Fred Dallmayr (2005). Such studies are then situated alongside the broader corpus of existing literature to better theorize how the labor process continues to change across varied settings.

researchers investigate newer or more difficult to access settings characterized by isolation or high levels of precarity.⁵⁸ I found this to be the case in my research.

LRA analysts then use the data they generate, both about the labor regime itself and its effects, to make inferences about the labor process. They may do so in a variety of ways, although case studies—both individual and comparative—tend to predominate. That is not to say other forms of analysis do not exist (thematic analyses or narrative analyses), but the literature’s focus on mapping and describing phenomena before analysis means most are inductive or abductive in their orientation.

To summarize, LRA analysis combines intensive data generation methods to create multiple and diverse observations, which the analyst uses to interpret how particular labor regimes condition the labor process. In so doing, LRA seeks to contribute more general theorization about the changing nature of the capital-labor relationship as it continues to evolve with changes in global political economy. I elaborate my data generation techniques in Chapter 7.

Methodological Justification: Why Pair Labor Regimes and GPNs?

For my purpose, the LRA’s utility lies in its *raison d’être*—to uncover how labor regimes are constituted and condition the labor process. As discussed, it was adopted by GPN and GVC scholars to better center labor in explanations of changes to GPNs. Conversely, purely ethnographic approaches, perhaps best typified by Burawoy’s (1984) factory regimes, do not always consider the broader political economic dynamics outside the workplace. Today, however, LRA strives for systems

⁵⁸ My claim here is based on my knowledge of this scholarship. That said, in conducting several searches concerning labour regime approaches and related methods, not bibliometric assessment of extant literature or attempts to systematically map out “how” to do labour regime research exist. The closest approximation I was able to find is a review of methodologies concerning labour relations scholars who study agricultural production in parts of the Global South (Kissi and Herzig, 2020).

level analysis that does not restrict itself to a single category of actors or point of analysis. Instead, it brings companies, workers, trade unions, and various offices of the state across scales into dialogue with one another to effectively triangulate different explanations (Barrientos et al., 2011; Rubbers and Lochery, 2021: 28). That is to say, it aims at a systemic and totalizing explanation of how labor regimes are constructed and how this mediates the labor process and corresponding forms of worker agency. In this respect, LRA analysis focuses primarily on the *relationships* among actors both diachronically and synchronically.

Development of a Systematic Approach to Labor Regime Analysis

Recent scholarship offers some guidance on how to proceed systematically. Sebastian Rioux (2022) identifies four interrelated spheres that help us think through what constitutes labor regimes: production, circulation, reproduction, and ecology. The resulting set of relations across these spheres overlap and intersect to mutually constitute labor regimes at multiple scales that influence how industries motivate workers, use their bodies and minds, and ultimately reproduces itself to perpetuate capital production (Rioux 2022: 122). Rioux suggests using spheres not only as a heuristic to think through the constitution of labor regimes, but as an organizing schema for data generation too. To summarize each sphere:

1. *Production* refers to processes and social divisions of labor and capital. It captures how workers are employed, who employs them, where they are employed, for what tasks, and how they are managed and controlled. Though it may be simple enough to identify what workers do, it is far more complicated to answer why and who appears in certain contexts and not others. Indeed, the expropriation of labor value from workers occurs differently across

variegated contexts that foreclose fixed notions of a singular working class (Bernstein 2007).

How labor regimes coalesce depends on institutional configurations at different sites of study, the actions of both workers and companies in these settings, and macrostructural processes of change that put places of production in relation to one another (Gough 2010). In this regard, the analyst must consider the ways in which both individual and collectivities of workers, different companies, and various institutions of the state—offices, officials, and laws—inform how the labor regime coalesces to influence the labor process.

2. *Circulation* emphasizes those who control production (i.e., capital) and the processes of creating new markets for the purposes of commodity creation and exchange. It details how capitals control these relations to extract rents and generate surplus value, as well as how credit and debt relations between workers and their managers influence worker lives. Circulation expands the analyst's awareness outside the immediate workplace to consider how it relates to other spheres—especially as it relates to how capital moves and is reinvested into the production process. It also highlights the importance that interfirm competition plays in shaping the labor regime in different spaces (Baglioni et al. 2022b: 84).
3. *Social reproduction* assesses the sphere outside the immediate workplace, but that nonetheless helps to make and shape the workplace. It veers into other, related dimensions of work and aspects of human security more generally, things like the living space of workers, the treatment of families, how unpaid or domestic work enables other forms of work, and broader social policies that enable the reproduction of the workforce. This dimension underscores the essential social embeddedness of the labor regime and the importance of understanding the broader social, cultural, and political context in which reproductive work occurs (Rioux 2022:

130). Associated social welfare provisions and labor laws play a crucial role in this sphere, and often play a critical, even decisive role in conditioning the capital-labor relationship in different contexts (Baglioni et al. 2022a).

4. *Ecology* considers the various environmental obstacles and opportunities capital encounters as it seeks to valorize itself. These obstacles and opportunities may relate to both the biophysical (i.e., the “environment” conventionally understood as a sphere separate from humanity) and the affective, embodied experience of workers, their families, and communities as biological beings. This dimension also captures the materiality of an industry as ecology plays a significant role in determining global environmental processes (like climate) and meso-scale atmospheric processes that influence where so-called “green” or “climate” jobs manifest themselves in relation to these ecological dimensions. Given the nature of work in the energy sector, the materiality of the industry is especially important as it influences where commodity production takes place, and these may shape relations and processes of production and exploitation of human and more-than-human worlds. In any case, this ecological dimension owes a debt to its usage in political ecology where the focus is on the intersection between biophysical systems of the environment, at local and global scales, with humanity under capitalism (Moore 2015: 119).

LRA uses these four spheres as an analytical heuristic to construct a totalizing picture for how each of these functions in relation to the other under the logic of capitalism and, ultimately, how this shapes the labor process.

Not all relations are created equal, however. As previously stated, the capital-labor relation occupies the central space of understanding how labor regimes form and condition the labor process.

We must, therefore, allow for degrees of difference in the capital-labor relationship (Mau 2023: 75).

So, while we can accept internal relations as constitutive of the labor process embedded in the labor regime, there are some relations that are more important and have a greater degree of significance in their influence on the labor process. In this fashion, existing labor regime scholarship offers theorization and a heuristic for which relations play a more significant role in constituting the workplace. These vary by context, but LRA's utility lies in its ability to help the analyst think more systematically about which of these relations matter most in conditioning the labor process.

Criticisms and Necessary Extensions

Criticisms

A common criticism of the labor regime approach, one that could be levelled at case studies and qualitative research of varying sorts, is its penchant to make sweeping generalizations based on the analysis of particular settings or cases (Rubbers and Lochery, 2021). However, like case studies, the characteristic quality of labor regime research owes to its "thickness" (see Blatter and Blume 2008), with respect to the *depth* of data generated and corresponding intensity of reflection. Indeed, criticisms of both the case study and labor regime scholarship are only unavoidable if our aim is to generalize findings towards a wider population of similar cases, as is the goal in a positivistic, co-variational research agenda. However, if we strive for deeper insights that bring theory and observed practice into congruence through intensive research methods, then some of these criticisms are moot.

To elaborate this point, LRA operates according to a logic of congruence (see Blatter and Blume 2008), in which "site" or "case" specific analyses have value as inferences drawn by the researcher that can apply towards a broad set of specific debates or ideas. Again, these are selected according to

what the analyst believes to be important, which their peers judge accordingly. In my project, my inferences exist alongside several literatures across comparative and international political economy, political ecology, economic geography, and labor geography that take up similar questions. In this respect, this dissertation exists as part of an older, constantly woven tapestry that is repeatedly stitched and reworked as political and technological changes provide new thread to the loom of labor regime inquiry.

Challenges and Necessary Extensions

Historically, how ecologies shape labor regimes have been somewhat underdeveloped and theorized (Campling and Havice, 2019; Baglioni, et al. 2022b; Campling and Kim, 2025). This is problematic as the ‘free gifts’ of the environment and embodied labor power are the ultimate source from which value derives (Battistoni 2024). Energy (and nature) are often treated as strictly physical and apolitical phenomena, which reinforces a particular understanding of production and its interaction with ecology. However, when we consider energy systems, ecology is an essential, inescapable influence on work in the energy sector. Related to this, ecology brings attention to the relative fixity of resources and other materialities of production that pose distinct challenges and opportunities for companies and worker agency, shaping labor regimes in important ways (Baglioni and Campling 2017; Irarrazaval and Atienza, 2025). Indeed, among critical geographers, certain material attributes set renewables apart from the ‘subterranean energy regime’ (see Huber and McCarthy, 2017) of fossil fuels that could perhaps lend itself to alternative eco-social relationships.

However, scholarship while acknowledging the importance of ecological issues, sometimes treats natural environments in an instrumental way. To be fair, some of this has to do with the nature of

the analysis—LRA scholars put themselves into the shoes of the capitalist to better understand the enterprise of production and circulation for the purpose of surplus value accumulation. However, it nevertheless results in outcomes where the environment is either treated as a source of value or an obstacle capital must overcome in the valorization process.

The typology introduced in the prior chapter may help guard against this tendency in some respect. I leave to my reviewers to judge me on this account. However, the typology very much helps me to consider how work that takes place in one place may result in social and ecological impacts across space and time—that is to say, a better appreciation for ongoing social relations generated through shared fates in the production process itself, which is crucial in today's highly interconnected world.

Despite advances in LRA in recent years, I believe additional elements also need more attention. In particular, how ideational aspects of work connect to ecology and condition labor regimes appears somewhat unattended to. Hardly unique to labor regime scholarship, this is true of geographic political economy more generally, an umbrella that covers labor regime research (Peck *et al.*, 2025). Here the inclusion of cues from comparative politics is useful. Comparative Politics underwent an “ideational turn” that highlighted how ideas can foster changes to political institutions and political economic structures more generally (see Blyth, 1997; Hay, 2004; Rueschemeyer, 2006; Béland 2009). However, it is important to note that “ideas” should not be understood as exogenous influences on the labor process. Instead, they exist as emergent, mutually constituted immaterial social relations formed through ongoing interactions between actors in society.

Baglioni, *et al.* (2022b) reference how culture plays a role in maintaining labor regime outcomes. However, it often assumes a perfunctory role when considering the relative intensity or manner of labor exploitation. Moreover, while it may be true that cultural dynamics are not strictly derivative of capital's logic, there is value in elaborating how different spheres of the labor regime, including ecology, inform expectations of work that explain the relative durability of the labor process; something that may be especially important if the experience of work is precarious and contestation is relatively quiescent.⁵⁹

The invocation that culture explains the durability of particular labor regimes, however, falls into the analytical trap other cultural theories do. Few deny that culture does not play a critical role in influencing politics—it does represent the broader holistic and shared aspects of collectivities. But culture may also exist as a residual category that simply reflects other dynamics, perhaps most notably associated historical, political, economic and material conditions that shape and inform cultural attitudes. To my mind, a more apt approach is to instead consider *ideas* and *historical social relations* in labor regime analysis, including the manner in which particular ideas about ecology and work are manufactured—a topic explored in greater detail in Chapter 3, and will continue to surface throughout the remainder of this work.

By emphasizing ideas in labor regime analysis, we can supplement studies that focus on the material dimensions of work with attentiveness to how subtle and diffuse mechanisms of power shape expectations of work and related outcomes. We can also consider how ideas about the labor process

⁵⁹ Social theorists in the 1970s like Michel Foucault, Pierre Bourdieu, Anthony Giddens, Bruno Latour and others criticized Marxist 'economism', but went too far by not attending to the way in which economic power governs the materiality of social reproduction (Mau, 2023: 10-11)

emerge from the material conditions of the labor process itself, which better help explain the relative durability of particular regimes in a way that is more specific and concrete than genuflecting in the direction of “culture” as a container and explainer of outcomes.

Instead, in considering changes to energy systems and forms of work, I believe ideas connected to the labor process constitute a ‘hegemonic common sense’, in a Gramscian sense, that governs social relations through ideas anchored in the day-to-day rhythms of life and work (Gill, 2008; Brand, 2022). In this, the focus on ideas in this dissertation, particularly Chapters 8 and 10 does not owe to their “persuasive power” or the extent they become institutionalized in formal institutions, but instead to “hegemonic power” in which received ideas become normalized in a person’s thought (Cartensen and Schmidt 2016). Crucially, these ideas depend on local and global histories that govern people’s perceptions (see Gaventa 1982). As several writers have noted, these ideas may take the form of “social imaginaries” and different visions of what could be deployed for different hegemonic projects (Sum and Jessop, 2013; Peck *et al.* 2025: 248)—green growth or ecological modernization being some of those projects which reinforce the more general hegemony of GDP growth in the ostensible pursuit of political and economic well-being.

As political theorist Alyssa Battisoni (2024) argues, the value in probing these ideational elements (in her case considering the expectations of social reproduction) lies in its ability to help us reveal the contradictory and uneven ways in which capitalist accumulation shapes and remakes social life, including how people think about their lives. If we accept the proposition that labor regimes and corresponding forms of exploitation are manufactured (Baglioni, *et al.* 2022b) and that they are mediated by workers’ struggles against exploitation, it suggests a need to not only attend to the material aspects of labor control and resistance, but to consider both the origins and maintenance

function of ideas and how these both enable and restrict changes to the labor process. Or, to repackage this *idea*, I consider how different thoughts about work, green or otherwise, exist as an immaterial social relation both inside and outside the mind of individuals and groups, which condition the workplace and perhaps stage future opportunities for change. It is for this reason why I have spent the early half of this dissertation probing various ideas of what “green” and “climate” jobs entail, including the construction of the eco-social typology to plot existing instantiations of GJ/CJ and ideas of what these jobs *might* look like—a necessary step to enrich the politics of a green transition.

Along these lines, it is therefore important to have a clear-eyed sense of not only what constitutes jobs (i.e., the labor regime), but the jobs themselves. That is the function the eco-social typology is meant to play. For labor regime analysts, it plays several roles. For one, it contributes to the enterprise of attending to the spatial and temporal relations that workers have with one another across space and time. Second, and more crucially, it offers a way to more explicitly consider both ecological and social aspects of jobs and how labor regimes mediate different job processes, outputs, and uses. In other words, the eco-social typology helps me to describe and interpret the jobs I observe and LRA allows me to explain why these jobs look as they do.

A Final Note on Conditionality and Causality

In general, I prefer the language of “conditioning” and “mediation” to that of causality. I do so for many of the same reasons area studies and economic geographers do, as a way to indicate that there are particular social relations that are “enabling rather than determinant in their effects” (Massey 1995: 4), meaning that they hold true at a particular moment in time and space, but that may nevertheless

shift or change when other sets of social relations enters into the equation, or the existing set of social relations evolves.

When I hit on particular ‘causal relations’, I do so to indicate how they enable or inhibit particular outcomes—they are not, however, set in stone. Instead, these *contingent* practices should be considered alongside the longer history of production practices that have enabled capital accumulation on a day-to-day basis within a long arc of scholarship that traces capitalism’s historical development (Sewell 2008; Rubbers 2021). Doing so holds open the possibility for contingency and labor agency that other epistemological frameworks do not—it also holds open space for how *ideas*, connected with material realities, may similarly shape and move social relations in new directions.

I do not wish to suggest, again, that ideas appear as a sort of *deus ex machina* that act, in some sense, as exogenous influences on the conditions of labor (see Blythe 2007 for critique). Rather, ideas should be understood as internally related to the labor process itself, which is conditioned by a sundry of political economic, institutional, and historical exigencies that establish the milieu and related labor regime that influences what various actors might think about political economy. As we shall see in Chapters 9 and 10, this is especially important for understanding how both global and local histories condition the ways in which people in the renewable energy sector think about green jobs and climate jobs.

CHAPTER 6: THE COMPARATIVE LOGIC OF SITING, AND WHY I CHOSE TO STUDY WIND ENERGY AND VESTAS

To this point, labor regime analysts have had limited success in their ability to offer comparative analysis across different but interconnected political economic formations (Baglioni et al. 2022). Theoretically, this is known as the “connectivity gap”, which refers to challenges in how we understand the way the labor process at the point of production connects with broader political economy (Taylor et al. 2013: 5; Baglioni 2022: 14). Although labor regime researchers use GPN or GVC approaches to help think through how global processes connect to the local level, they have struggled to make labor central to understanding how developments across phases of production create shifts in the GPN. Conversely, GPN and GVC scholars within more conventional economic geography tend to discuss the evolution of GPNs in a way that largely ignores labor’s role at local and regional scales in shaping their evolution, outside of loose acknowledgements that “labor controllability” and, perhaps, union avoidance plays a role (Gough 2003; Dicken 2015). In this, connecting local and global processes with one another in a way that helps to better explain GPN development and associated labor regimes has vexed researchers.

The aforementioned gap may be especially problematic for labor regime researchers. The research enterprise implores us to situate local labor regimes inside uneven processes of capitalist restructuring and regulation that take place across spatial scales (Peck 2022: 64). Similarly, our political commitments urge us to develop analysis that help identify points of leverage that can help improve lives and livelihoods in particular industries. Even still, most analyses content themselves with a focus on a particular “case”, understood as a bounded entity. To be sure, this is partially a function of

pragmatic issues and resource constraints—something that influenced the character and direction of this dissertation.⁶⁰ Nevertheless, even with these challenges, a focus on a particular industry, time period, and geographic case ignores the “constitutive multiplicity” of the phenomena we study (see Riofrancos 2021: 108). Constitutive multiplicity poses analytic challenges for how we understand the constellation of distinct, but interrelated local labor regimes across GPNs. As jobs in different workplaces exist in relation to one another across spatialities, that suggests a need to attend to the broader constellation of spatial and temporal relations. Inattentiveness to these dynamics can make analyses partial at best, and in some instances, plain wrong.

Methodologically, labor regime researchers must confront how they choose to select and operationalize their study. While the labor process constitutes the unit of analysis, the scale at which this is conceived and how the labor regime influences it varies. In some instances, authors will speak of “local labor control regimes” that condition the labor process (Jonas, 1996; Riisgaard and Hammer 2011). Other times they will reference regional and national labor regimes (Selwyn 2009; Oseland *et al.* 2012; Peck 2016) or refer to different types of idealized labor control regimes (Anner 2015), which are further mediated by international governance mechanisms for supply chains both nationally and internationally. The various levels of analysis do not reflect contrary understandings of what labor regimes are. Moreover, they are not distinct levels (in terms of a nested hierarchy, let us say), but rather analytical entries for understanding how social relations govern labor control and social

⁶⁰ My initial plan was to carry out comparative work in Denmark too, but changes at the federal level and a consequent lack of funding made comparative field work in the country difficult. Indeed, one of the goals of the dissertation, which remains longer term, is to consider comparisons in which workers across renewable energy GPNs in different industries and countries confront similar challenges across divergent contexts (see Boswell, Corbett and Rhodes 2019 for an elaboration of this mode of comparison that is consciously creative and interpretive).

reproduction. What this means, in practice, is that labor regimes are constituted by interactions among local labor markets, historical settings, institutions (both formal and informal), and international governance. The challenge, therefore, is about how to explain the way labor regimes operating at different spatial scales mutually constitute one another.

To help make sense of multiscalarity, we can conceive of labor regimes as nodes in the circuits of global capital (see Coe and Jordhus-Lier 2011; Baglioni 2018). This logic connects to earlier theorization by Marxist economic geography that understands the capital-labor relationship as one that embodies 'structured coherence' (Harvey 1985) within a local economy, that not only includes inter-firm relations among companies, but also the larger array of class and social relations in a place (Gough 2003: 43). These social relations create 'local dependence' among actors (Cox and Mair 1991; Cox, 1998) in a fashion similar to dependency among states in the global economy (Dos Santos 1970; Cardoso and Falleto 1979), which results in material conditions that reinforce the ideas and strategies workers choose for their social reproduction.

However, while GPN inclined labor regime scholars have theorized on the nature of labor regimes embedded in the nodes of global production networks, little methodological guidance is offered with respect to how to select different nodes, or even how to carry out research across an interconnected GPN. For this, I turn to a logic of "siting" to guide methodological decisions concerning what nodes and which GPNs offer us significant inferential leverage in understanding changes to global capital, including those associated with the "energy transition".

“Siting” Logics for GPNs

Not to be confused with “siting” used as a term to describe the process of selecting where to install a new energy project, “siting” here refers to an alternative of how to both think about and choose what we study empirically. In brief, sites exist as places, times, or “scenes” of comparative inquiry where mutually constitutive political processes can be observed. To paraphrase Thea Riofrancos (2021), “sites” exist as points where the analyst can observe historical changes to constitutive social relations in the specific local contexts they emerge, become institutionalized, and are ultimately contested (2021: 108). Siting meshes with labor regime research because it sees how local labor regimes embedded in nodes of global production exist as mutually constituted points of intersecting multiscalar and temporal political relations constituted through an ongoing interplay of internal relations.

Where the language of a “case” implies the instance of a particular class, event, or a geographically housed entity, such bounding ignores the constitutive multiplicity of observations at different points (Riofrancos 2021: 107). In this regard, we might use the language of Marcus Kreuzer (2023) to say that siting encourages the researcher to “unfreeze” both geography and history. Siting captures both diachronic (discrete, but related moments of a process unfolding over time) and synchronic (a cross-sectional snapshot of a social configuration) dimensions of global processes (Riofrancos 2021: 117). Doing so helps us think through the way how global processes interact with particular “scenes” and contexts. Analytically, this offers important lessons for how we consider the evolution of changes to global capitalism. In particular, how GPN processes at the global level interact with localities and associated political institutions, cultures, and political economic structures. Crucially, these specific sites where the researcher conducts their observations similarly influence and constitute

changes in GPNs and the broader circuits of global capital. In this respect, siting logic helps us move outside the logic of “cases” that often imply atomistic relations between phenomena, and instead more fully grapple with how labor regimes exist as sites of conjuncture between macro-, meso-, and micro-scalar processes.

“Siting” Wind Energy

In the next several chapters, I focus on work in the wind energy industry. As described in Chapter 2, wind energy has generally received less attention in comparison to other industries, despite its crucial role in decarbonization and energy production. Because of certain distinct material dimensions—owing to the size and location of these turbines—I believe work associated with these technologies may be more conducive to labor organizing than other sectors. Wind energy work likely looks better than work in other sectors, which suggests that if green or climate jobs are not ecologically or socially desirable here, the same likely holds true in other settings.

In brief, I believe that the size and scale of these machines create “chokepoints” (see Neal *forthcoming* or Mitchell 2011), that give workers greater structural leverage in demanding improved conditions. The relatively constrained job market for some workers, a so-called “workforce gap” (see McDowell et al. 2024) also grants wind technicians a greater deal of structural leverage in the capital-labor relationship (Westgard-Cruice 2026). I also theorize that because of the size, scale, and political salience of these machines—that is to say their political salience to both supporters and detractors—may lend themselves to future organizing, at least when it comes to project construction. Many of these same attributes do not exist in wind’s sister industry, solar. I reason that if there are certain practices that limit the quality of jobs and eco-social potential of renewable energy work in wind, they

are likely to be more intense in solar. It therefore made sense to focus on wind before also assessing solar. Recent findings from Cornell's ILR Climate Jobs Institute affirm my intuition (see Morely and Hoek Spanns 2025), as do preliminary conversations I have had with several solar workers and affiliate organizations.

Both within the pages of this dissertation and future research, "siting" enables what Charles Tilly calls "encompassing comparisons" whereby the researcher chooses locations within a structure or process and attempts to explain what is similar and/or different among the varied locations based on their relationship to the larger process (Tilly 1984: 125). Charles Tilly in some sense anticipated siting logics that came later by advancing an encompassing approach to comparison. Such comparisons, however, contain within it a danger of proffering "functionalist" explanations. Simply put, explanations become byproducts of a phenomena's location in the broader whole (Tilly 1984: 125-126; Riofrancos 2021: 116). To guard against this, the analyst may adopt an understanding of the whole process as essentially constituted as an "emergent totality" (McMichael 1990: 391), one that is continually made and remade. I do this in Chapters 8, 9, and 10 where I explore onshore wind energy labor regimes in the US at both national and local levels and how these produce particular kinds of green and climate jobs.

Studying Vestas

In this study, and in line with existing work on GPNs, I chose a corporation to help orient my research. In this instance, I chose the Danish firm Vestas and associated sites across the production network.

There are several reasons I chose Vestas, some practical and others theoretic. Vestas has a local footprint in Colorado, which meant there was a greater possibility to facilitate access to these locations and/or speak with people familiar with its operations. More important, however, are the theoretical reasons. Vestas serves as a reasonable proxy for global transition processes in wind energy. It is one of the largest wind OEMs in the world. Moreover, Danish companies in general, and Vestas in particular, have had an outsized influence on the wind energy industry owing to the length of time they have spent developing it. They were early pioneers of the upright three axis turbines we have grown accustomed to, a response to the global oil shocks in 1973 (Meyer 1995). From that time, Danish companies have dominated the industry and remain stalwarts through companies like Vestas and Ørsted. Based on interviews in this dissertation and verified through internet sources, other companies like the Spanish firm Gamesa and related activities of Bonus Energy, which would later merge with the German firm Siemens to form Siemens-Gamesa, were reliant on Danish technology, including Vestas designs (Siemens-Gamesa N.D.). Vestas similarly had inroads into US markets early on, as Zond Energy Systems (now bankrupt), purchased and relied on Vestas turbines in the early years of the US wind industry during the 1980s and early 1990s (Vestas N.D.). Vestas continues to be one of the largest original equipment manufacturers (OEM) in the world with turbines installed in at least 36 countries (GWEC 2024), including existing and former facilities here in Colorado—although Chinese firms like Goldwind have since surpassed it in market share (Wood Mackenzie 2024).

Essentially, Vestas acts as a stand in for helping me to understand wind energy GPNs. Its historical influence in the renewable energy sector and continued importance thus make it an important site for our understanding of GJ/CJ in the energy transition. In this, we may describe Vestas as, “a

personification of economic categories, the bearers of particular class-relations and interests” (Marx 1867 [1976]: 92). In this case, Vestas exemplifies the interests of renewable energy capitals.

The other theoretic reason Vestas matters is how it, a Danish corporation, influences the constitution of local labor regimes in the places it touches down. As a Danish firm from a coordinated market economy—one with a reputation for more amenable social relations between capital and labor—there is an expectation among some workers and trade unionists in the US, that they would operate differently than American companies. Such a belief is reinforced by some of the literature on Varieties of Capitalism that maintains that firms often carry with them some of the management practices—identities and cultures of the company—to the places they operate (see Hall and Soskice 2001; Thelen 2014). However, and in keeping with a relational logic of siting, the reality is more complex. I dedicate Chapter 10 to exploring this dynamic, elaborating how TNCs like Vestas both influence but are also influenced by the local settings in which they operate, which shapes the labor regime and corresponding green jobs in important ways. It may also be the case that companies like Vestas, consistent with theorization in economic and labor geography, *actively* seek out opportunities for greater capitalist accumulation according to geographies of difference when it comes to both ecological and labor governance, a point I explore in Chapter 9.

Consistent with the logic of siting, I visit (literally and metaphorically) different sites where Vestas touches down, which includes several manufacturing facilities in Colorado as part of Vestas’ North American manufacturing hub. It also includes, however, sites and points of comparison in the wind energy industry connected to Vestas. In some instances, this includes other companies and their workers with whom Vestas competes or offers a referent point of comparison as a leading wind energy OEM. In any case, the “siting” logic I deploy here is intended to help me break outside the

confines of territorial boundaries that often delimit the scope of what a “case” implies.⁶¹ Analytically, the trick is to appreciate local setting and specificity without, “falling back into narratives of self-contained spaces and places” (Räthzel et al. 2014). Here we turn to economic and labor geography.

Local Labor Regimes and “Sites” of Capitalist Accumulation

Vestas may help guide the selection of sites I analyze, but it is by no means the only logic at play. Vestas sites are embedded within “local labor control regimes” that are mutually constituted through web of legal and extra-legal institutions regulated by states concerning labor, employment rights, work conditions, and environmental oversight that inform conditions of work (Pattenden 2016: 1814; Smith *et al.* 2018). These attributes influence employment structures but are also shaped by the labor process itself at the site of production and corresponding forms of worker agency (Peck 1996). Once again, these also occur at multiple governance scales—international governance, national/state governance, and local governance. As I explained in the last chapter, the workplace is conditioned by sphere of reproduction, which is then expressed in both worker and management expectations of the labor process in a particular setting, thus influencing corresponding trade union strategy (Herod 1991; Castree *et al.* 2004; Gough 2014). The sphere of social reproduction, in particular is conditioned by national and local institutions and corresponding governance.

⁶¹ While Riofrancos (2021) introduces siting as a new logic to guide decisions on what to study and where, geographers and anthropologists reached a similar conclusion earlier—their disciplines being specifically focused on the uniqueness of space and place and how that influences corresponding human experience. For example, feminist industrial geographer Dorreen Massey ((1993) [2018]), argued that spatio-temporal processes condition social forces—in this case workers—and their corresponding ability to both reproduce themselves and form different strategies to contest social inequities. Massey reasons that every locality has a “global sense of place” and in world marked by histories of coloniality and capitalist expansion, it is improper to conceive of different locations as existing ontologically separate or removed as territorial boundaries on the map would seem to imply.

However, a contradiction emerges from the construction of distinct local labor control regimes and various workplaces within it, as capital has incentives to move elsewhere (see Harvey's 1981, 2001 'spatial fix'), or remain in a place it has invested in (Swyngedouw et al. 1992; Cox 1998).⁶² Indeed, capital's mobility allows it to move from and between territories when social relations become problematic, profitability declines, or to access untapped resources in other places (Gough 2014). The labor process at the point of production therefore plays an important role in influencing investment decisions (Massey and Meegan 1979) and corporations may consider "labor controllability" to avoid areas of labor militancy (Gough 2003: 65). Localities and associated workers develop strategies to account for the laws of competition that put them in diffuse social relations across space, as they may be "out-competed" by more malleable labor (i.e., reduced) labor costs or higher quality accumulation opportunities elsewhere (Storper and Walker 1989). As a result, local state institutions respond to this spatial competition as attempts to resolve the "contradictions of the whole" (Gough, 2003).

State institutions thus play a critical, sometimes decisive role in firm decision making, which makes it a central site of political contestation between capital and labor (Coe and Jordhus-Lier 2011). The state is not a neutral arbiter in this affair, with people in offices of the state seeking their own political economic goals to maintain a relationship both with capital and their local constituents as they deal with contradictions in capitalist processes (Gough 2014). As we shall see in Chapters 9 and 10, these

⁶² Building Marx's insights, David Harvey (1981; 2001) explains that capital employs a 'spatial fix' when confronted with obstacles to continued accumulation, which may entail a locational shift in activities, or the geographical scale of capitalist organization (like the growth of supra-national organizations like the European Union or global governance organizations like the World Trade Organization and International Monetary Fund). Structurally, this asymmetry emerges from the internal relations of capital and labour. Labour exists by virtue of its relationship to capital (and vice-versa), but unlike capital, it is relatively anchored to a given locality. By contrast, capital can travel with relative ease to other places for the purposes of expanded accumulation opportunities (Rodrik 1998).

have been important things in shaping the kinds of green jobs we see in Vestas operations, with a particular focus on manufacturing in Colorado.

To summarize, I do not wish to suggest that siting collapses the local into the global and vice versa. Instead, siting helps us better appreciate how processes and interactions across scales constitute labor regimes and corresponding workplace outcomes. After I discuss the various data generation techniques for this dissertation in the next chapter, I spend the remainder of the time building on the initial review set forth in Chapter 2 to show how at national, local, and even individual scales (within the minds of particular individuals) that workers respond to and actively shape the changing contours of the energy transition, but that these are constrained in many respects with the broader political economic formations in which green jobs of the transition are embedded.

CHAPTER 7: DATA GENERATION

As discussed in Chapter 2, little reliable quantitative data about work in the renewable energy sector exists outside of national level job estimates. Moreover, because I emphasize the experience of “green” and “climate” jobs within industries like wind, I have opted to rely on generating my own data according to my research questions. In this, the data I generate helps to produce “thick descriptions” (see Blatter and Blume 2008) of the phenomenon of interest. The production of such information is especially important in onshore wind energy as associated conditions of work have been relatively unattended to.

Figure 9 (below) provides a visual snapshot of the dissertation’s data generation plan. It is not meant to offer a comprehensive view, but instead describe the cyclical and abductive nature of my thinking during the course of research. In brief, it summarizes relevant questions, information I needed to answer these questions, and who or where I might get that information from. The exploratory nature of the research design reflects the relative paucity of information about the wind workplace, including the various factors that construct the labor regime and influence the labor process.

Moreover, because elements of my research design are interpretive—i.e., understanding concepts like “green jobs” or “climate jobs” and how these ideas help maintain the labor regime or otherwise shape the labor process—it made little sense to construct my data generation plan as a linear process, as certain ideas and concepts emerged during my time “in the field”. I could not have anticipated the importance of certain symbolic and ideational concepts attached to “green” before interactions with my interlocutors. To reiterate, labor regime analysis provides a systematic way to

identify what information is needed for different categories, how to organize observations, and then theoretically make sense of how data generated fits together to explain observed patterns or outcomes.

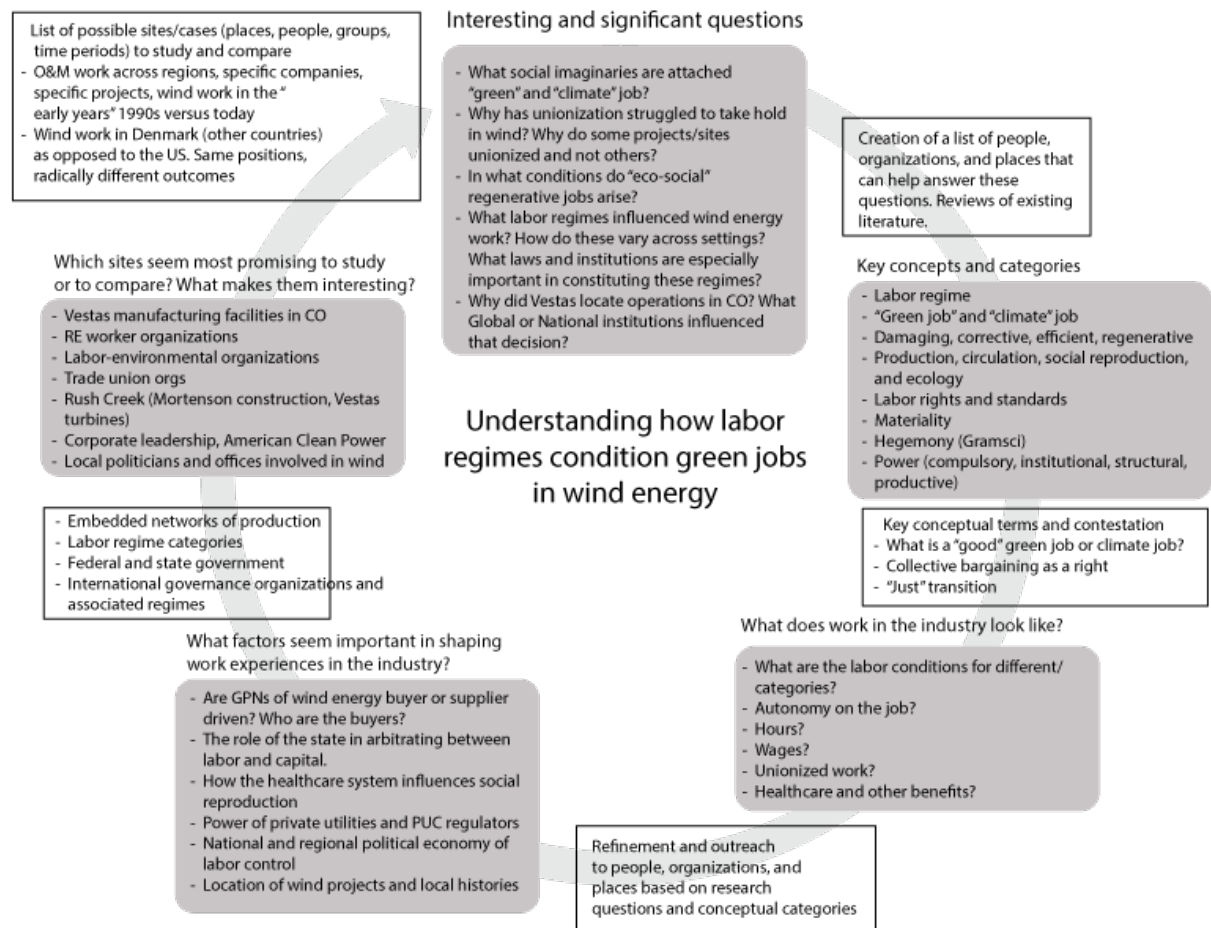


Figure 9. The figure above provides a data generation plan for an exploratory research design aimed at better understanding the green and climate jobs associated with wind energy (i.e., the wind energy labor process). It is not comprehensive, but offers a glimpse into the data generation process for understanding green jobs and how labor regimes shape them. The figure takes inspiration from Kapiszewski, Maclean and Read (2015), created in Adobe Illustrator.

Desk Based Sources

Both before and during the empirical research stages, I reviewed a wide swath of literature. I read through government agency websites and reports, online job postings, industry association reports, company corporate social responsibility statements, and any number of various local, state, and

national policies relevant to this study's questions, but especially those connected to wind energy or that had anything to do with Vestas.

To maintain an understanding of the global picture of wind energy production, I similarly reviewed reports from international governance organizations like the International Labor Organization, United Nations Environmental Program, International Renewable Energy Agency, International Energy Agency, and Global Wind Organization. Each of these groups had information related to the expansion of renewable energy systems, associated employment estimates, and dynamics in the global energy markets. I also reviewed market data such as Fortune 500 company listings, and tried to stay apprised of industry trends and happenings through news outlets like the Financial Times or, more specific to my dissertation, reNEWS, CanaryMedia, E&E News (energy and environment news) and data reports from Bloomberg New Energy Finance. Although I used the Danish company Vestas to inform many of my decisions on which sites to study and who to speak with, this information help me stay apprised of broader industry trends and government policy that influenced how Vestas and other renewable energy companies operate, as well as how localities accordingly adjust their policies.

Related to this, I also kept tabs on developments at the federal level with the flurry of changes brought about first by the Biden Administration (like the Inflation Reduction Act), and then by the Trump Administration. These shifts have created headwinds for renewable energy developers, state level policy makers, clean energy advocates, and workers of varying stripes who all must navigate an increasingly turbulent policy landscape. Indeed, both white and blue collar workers have been impacted by changes at the federal level, which has resulted in several rounds of layoffs among research and development and other "value adding" activities so as to "no longer subsidize" wind and

solar (DOE 2025; Dabbs 2025), these in addition to jobs that have been lost or gone unfilled due to siting and permitting changes impacting production pipelines (DOI 2025).

Archival Information

Chapters 9 and 10 of this dissertation also relies on information from the Colorado State Archives. I called the state archives to request information regarding interactions between state government offices and the Danish corporation Vestas, specifying Governor Bill Owens and Governor Bill Ritter as the time frames to search for files. My goal in contacting the archives was to help me better understand the sequence of events that led to Vestas' decision to locate here, including discussions that transpired between the company and the state on financial incentives and other matters. Access to these materials helped me construct a timeline of Vestas' decision to come to Colorado, and also provided me critical information about how Vestas' decision was influenced by state and local governments.

Archival materials consist primarily of emails from various individuals across Colorado agencies, as well as several presentation materials from Vestas that described market conditions in the US in the early to mid-2000s. To protect confidentiality, I do not refer to the names of those in the emails and files obtained from the Colorado State Archives, unless it is public knowledge that they were involved in interactions of these decisions (evidenced by newspaper and online articles covering the subject). I instead refer to the original date of the file (often an email). For example, I may cite correspondence accordingly: (Vestas Wind Records, July 1, 2009).

I do not wish to suggest that these are the only materials that exist concerning Vestas' decision to locate its operations to Colorado. It is very likely there are other materials that exist that were not

retrieved from the archives and/or have been lost for any number of reasons. That is to say, the information from the archives likely represents a fraction of what was produced in relation to Vestas' decision to locate operations here. Where possible, I attempt to triangulate information from the archives with media reports and interviews with those knowledgeable about the decision. I also used information in the files to corroborate interlocutors statements concerning Vestas' operations and decision to locate in Colorado.

Question Development and Outreach Preparation

In addition to reviews of desk-based sources, I generated data through a combination of participant observation, semi-structured interviews, and an "ethnographic sensibility" (see Simmons and Smith, 2021) as a former member of the wind energy industry and policy intern with the Center for the New Energy Economy. These experiences, combined with my eco-social typology and labor regime theorization informed the questions I developed and the information I believed necessary to help me answer these questions.

Participant observation included attendance at various webinars. These included wind workforce webinars or trade union discussions about "green jobs". Others were more tangential, covering broader themes related to renewable energy development, the energy sector, and workforce issues in the sector. A list of webinars I attended and relied on for information included in this dissertation can be found in the Appendix. In each instance, the webinars were publicly facing, often held on zoom. I would attend these webinars and take notes on anything relevant to the dissertation.

I used semi-structured interviews as my primary form of data generation. Before conducting the interviews, I constructed a list of contacts with their affiliations, respective perspectives for my

purpose, and notes on what questions I believed they could help me answer. The list was constructed through a combination of reviews from desk-based resources (see above) and my knowledge of the industry as a former member of it. In constructing the list of potential interviewees, I wanted a diversity of perspectives on work in the wind energy industry, and in line with the “siting” logic of this dissertation, interviews with those linked to Vestas or who could speak to its operations and development. I spoke with people from the following categories, each of whom could help me better understand the dynamics of production, circulation, reproduction, and ecology associated with wind energy industry. In some cases, individuals I spoke with offered more general insight into global and national scale dynamics that influenced the development of local wind energy labor regimes. In other instances, I identified and spoke with individuals who could offer insights into these broader dynamics, but could speak to Vestas operations, in particular. Individuals I identified include:

- Workers across manufacture, installation and turbine maintenance,
- managers and executives in the wind energy industry,
- industry consultants,
- trade union representatives,
- politicians and bureaucrats across levels of government,
- economic development corporations or agencies,
- workforce development programs and human resource professionals,
- legal professionals,
- journalists,
- subject matter experts on workforce development challenges,
- individuals associated with labor-climate organization groups, and

- legal professionals and subject matter experts in renewable energy development and/or public utility commissions.

The diversity of perspectives outlined above is necessary as labor regimes are constituted by a diverse array of actors and factors that no single individual can fully appreciate. Furthermore, because the subject of work in the energy transition is *essentially political*, it is important to collect a variety of viewpoints to triangulate the most accurate and precise picture of what shapes particular labor regimes and how these influence the workplace.

With respect to workers in the industry, a wide array of processes and actors comprise activities and potential “workers”. I differentiate between workers in value add and research and design activities from those who do “wind work” in popular consciousness, that is, manufacture, operations and maintenance, and project construction where the bulk of wind employment resides (Hamilton n.d.). That is not to say public affairs, research and design, engineering, legal, or any other forms of employment do not similarly matter; they absolutely do—especially when considering potential “value add” for a company. However, I elected to focus on local and national labor regimes that condition the experience of wind workers as these phases are likely to experience the greatest extent of labor exploitation and are “essential” from the standpoint of capital as the subjects who ensure capital valorization through the creation or maintenance of the “commodity” (i.e., wind turbine). All to say, when I invoke “wind worker” I am usually referring to those associated with “blue collar” forms of work. In the future, I will have more to say on “white collar” work in the sector, including my own experience, and how these do or do not resonate with other categories of worker.

All told, I conducted 42 semi-structured interviews with 43 unique participants. I interviewed 7 individuals classified as representing the perspective of “the state” in terms of economic development agencies, government officials, and other similar positions. I spoke with several industry insiders, managers, executives, and consultants, 10 of which I classified as representing the interests of capital. I interviewed workers, trade unionists, or groups that represent the interests of wind energy workers, 22 of whom I identify as occupying the standpoint of labor. I also interviewed 2 individuals representing the perspective of environmental groups, who had knowledge of labor issues and 7 individuals identified as subject matter experts of wind energy and its intersection with the workforce and/or the political economy of energy systems. I spoke with 23 interlocutors who had knowledge about Vestas’ operations and/or specific projects associated with the company—these insights are both internal and external to the company. In some instances, interviewees occupy multiple identities according to the above categorization. For example, someone interviewed may have once been a worker but now represents the role of an industry manager. The Annex should be consulted for more details about interviews referenced throughout. Personally identifiable information is not included to better protect participant confidentiality. As we move forward, I cite interviews with an identifying number that corresponds to a table in the annex (e.g. I13, I35 etc.).

Interview Procedure

While I was in the process of drafting my initial list of prospective interviewees, I simultaneously developed a list of questions, each tailored to different groups and perspectives (see Annex). I also developed different forms of outreach material (both verbal and written) that I could use via telephone, email, or LinkedIn to solicit involvement in my research (see Annex). Once I had developed

these materials, I submitted them to Colorado State University's Institutional Review Board (IRB). Once I had received IRB approval, I began to reach out to the list of individuals I identified.

In interviews I relied on a semi-structured questionnaire. Questions were organized according to several principles. These included a) ensuring that I could get the information I needed out of each interview, b) to build rapport with my interlocuter before proceeding into potentially more contentious topics, and c) providing space for insights and perspectives I had not considered to organically emerge.

Interviews lasted between 60 to 90 minutes, although sometimes longer or shorter depending on the person and their knowledge and/or willingness to speak on the topic. My questions followed a general pattern, outlined below, but I would pivot between questions according to the natural ebb-and-flow of conversation as topics or transitions rose organically.

Interviews would begin with "grand tour" style questions (Leech 2002) that allowed the respondents to take the conversation in any direction they deemed most relevant or productive, which itself could often be telling about why they elected to speak with me (Aberbach and Rockman 2002). I would often tailor this opening question to the specific attributes of my interlocuter to encourage them to talk about themselves and their relationship with wind energy. This strategy would often prompt additional questions to ask later in the interview, in addition to helping build rapport by demonstrating that I had "done my research" and believed that they held a genuinely important piece of the proverbial puzzle.

After this initial question (or questions, in some cases) I would ask more "matter of fact" questions about how the wind energy industry works, or their respective position within the energy sector and

how it might intersect with industry operations. Once we had covered basic questions related to industry operations and procedures and their involvement in these, we would proceed to more politically charged questions likely to change the tenor and direction of the conversation, including interviewee withdrawal—although that never happened. Questions of this sort were directly related to labor rights and standards, including questions related to workplace safety, wages, hours worked, and collective bargaining rights.

Finally, the last set of questions moved from those that probed the labor regime and its influence on the labor process to questions concerning social and ecological imaginaries associated with “green jobs” and “climate jobs”. I reserved these questions for the latter part of the interview, invoking my interlocuter to “think philosophically” and consider their particular definition of “green” and “climate” job, and then “green” and “climate” work. My reason for putting these questions at the end of the interview was to ensure that these normative questions did not lead my interlocuter into thinking about work in production networks any differently than how they would normally think about such things. Of course, we must acknowledge that the setting of the interview already adjusts their thought process to some extent. By putting the questions at the end of the interview, my aim was to use the proceeding conversation as a shared basis of understanding between myself and my interlocuter, which could be juxtaposed against different interpretations and imaginaries of what jobs or work in the sector could look like both socially and ecologically. Sometimes my interviewees could launch directly into such thoughts, but I often needed to prompt them further (or, cajole, if you like) by giving them power or a “magic wand” so they could better inhabit an Imaginative state of mind.

I would then complete each interview with a series of procedural questions. I would ask demographic questions and gauge their political leanings, in addition to creating space for them to ask questions or offer final remarks on things we had not talked about.

After each interview, I sent a follow-up note to thank them for their time. For non-salaried workers who participated in the study, I also sent a \$50 gift card to thank them. I did not advertise that I would provide gift cards to the study participants during outreach as a) not all would receive them (I could not afford to), b) in the event workers circulated knowledge about the study, I did not want this to create animosity between them, and c) I did not want that to influence who chose to participate and who did not. Finally, I circled back with each participant in this study and shared with them the findings of this dissertation, giving them an opportunity to speak with me again.

Interview Locations

Interviews took place in varied settings. Sometimes these were remote, other times they were in-person. When making contact, I would ask my interviewers to attend the interview alone or in a location where they could speak freely. With worker interviews, I encouraged them, when possible, to speak outside of their work hours and normal working environment to better preserve confidentiality and also limit ethical issues that might arise from conducting interviews during the workday (i.e., identifying them as research participants, impacting their hours and wages, creating suspicion between employees). I also encouraged people to speak with me individually. In two separate interviews, I made exceptions to this to accommodate a discussion with two people at once according to the preference of my interlocuter. I judged that this would not change the interview in a way that meaningfully would impact the information I gathered. Of course, despite my attempts at control,

people have families, busy lives and other matters to attend to, so sometimes interviews, especially those performed remotely, were less distraction free than I should have liked. Nevertheless, with a few notable exceptions (more on this later), my interlocuters were generally forthcoming and appeared unconcerned about the place of the interview.

For in-person interviews, I would meet them in a previously agreed upon location, one I would strive to make as neutral as possible (my preference being for meeting rooms at local public libraries). Again, these varied according to the needs of my interlocuter. I also tried to choose locations that were not too close to their place of work, but not so far as to burden the interviewee.

Interview Procedure

In each instance, I would ask permission to record the interviews to ensure for the creation of an accurate transcript for analysis. I would then record these interviews on a password-protected device (i.e., my cell phone) or a separate audio recording device if the interview was conducted via telephone. In each instance, I would then take the audio MP3 recording and move it into a password protected file on my computer and scrub the recording from the recording device.

In addition to these recordings, I also created a set of field notes that included details on where and when the interview was conducted. It also allowed me to jot down my thoughts before, during, and after the interview. Doing so helped ensure I would reflect on the interaction, including any things that I felt were especially relevant about the setting of the interview, or how I perceived the person with whom I was interacting. In this respect, the field notes provide me with a level of participant observation to enrich the study, but not so intensive as an ethnographer would produce.

Interviewee Access and Outreach

Access

Following the logic of siting and my data gathering protocol, I reached out to corporate offices, business associations, and other industry insiders with access and perspective both inside and outside the US who I thought could help me better understand what factors constituted wind energy labor control regimes, including labor regimes associated with Vestas, in particular.

As researchers in industrial and employment relations describe it, gaining access to workplaces, “involves some combination of strategic planning, hard work, and dumb luck” (Kolb and Van Maanen 1985: 11). I found this to very much be the case. Based on the initial list of contacts I had created, I reached out to individuals and organizations using recruitment materials (see Appendix). After the interviews and throughout the process, I would look for additional individuals to interview who I thought would have useful information for my research. In essence, I began with a targeted outreach campaign, from which a chain-sampling method took hold.

My main research challenges concerned access. Recognizing the challenges of obtaining access to field sites and recruiting interview subjects through “cold calls”, I followed existing guidance and sought entry according to people that I know or who could serve as orienting figures for field work (Patton 2015; Monahan and Fisher 2015; Weiss 1994). My preference was to work initially through my network of contacts to identify interviewees with whom I could speak (Burgess 1984; Patton 2015). This yielded many of the interviewees included in this dissertation, including key informants at multiple Vestas locations and at varying levels. Following this step, I also contacted local community colleges

throughout Colorado who had programs and students who received training to work at companies like Vestas.

Once I exhausted the above steps, I then began the process of cold calling individuals for access. Initially, I began by reaching out to the public relations and/or media contacts on the company website. After both calling and emailing and being ignored, I turned to other strategies. Here I relied on my prior google searches, supplemented by company LinkedIn profiles to identify and contact “gatekeepers” like HR professionals, executive assistants, public affairs professionals, and in some cases, managers of specific departments. In the instances where I had an individual’s phone number, I would send both electronic and telephone messages. My initial preference to begin with interviewees identified through affiliate networks had to do with the associated risks of working with gatekeepers in the research process. They could determine the terms of the research, influencing the candor with which people spoke, in addition to further restricting access (Buchanan et al. 1988: 56; Monahan and Fisher 2015). As discussed above most, but not all the gatekeepers ignored my emails and telephone calls.

As part of the contact process, I also subscribed to LinkedIn Premium for a month (i.e., the free trial period) so that I could reach out to people directly affiliated with Vestas or CS Wind (formerly Vestas). As stated, I performed several searches through Google’s search engine. After this struggled to yield meaningful traction, I used the generative AI tool ChatGPT to crawl through LinkedIn to help me identify potential research participants at specific companies and locations. As these chats include personal information, I will not provide a link to the original chat log to protect confidentiality of the study participants. However, my process and interaction with ChatGPT included the following prompts:

- 1) Please review LinkedIn and other publicly available information on ___ website to help me identify workers, executives, and managers at ___ in ___. Can you help me with this?
- 2) Please export these into a CSV file with links to the corresponding locations where you obtained the information. Please sort the sheet by name, role, and provide a link to your information source. Please include email addresses and/or phone numbers too. Please only draw from publicly available sources.

At this point, ChatGPT would produce the CSV file. Most of the time, it only produced LinkedIn profile references. I would click on the links it provided to ensure that who it identified did in fact work for a specified entity. In many instances, it was wrong and/or the person no longer worked for who I specified. It did produce some people worth contacting, and I subsequently reached out to these individuals with my recruitment materials.

Outreach

In brief, my outreach procedure involved a multi-step process to identify interviewees and informants. Persistence was crucial as workplaces are notoriously difficult to access outside of national surveys (Whitfield and Strauss 1998: 19; Monahan and Fisher 2015). I often contacted people multiple times (two or three, depending on their importance to the study). I made clear in my outreach that involvement in my study would be confidential. Doing so encouraged them to speak more openly. I noted that their involvement would be voluntary and anonymous to the extent I could provide. I also explained the purpose and nature of the study and that findings would be published in a dissertation that I would later share with them once the study was completed.

It was through networking and digging online that I was able to identify interviewees and informants for study. Here “informants” refer to those who could provide information on my topic. Some conversations were with “candid analyzers” (see Laurila 1997) that provided detailed information about the wind energy industry, and with whom I spent many of my early interviews. It then included insiders—both with Vestas and within the industry—who spoke more or less cautiously and openly depending on their position within the industry, both as current and former employees and managers “guarded informants”. It also included conversations with “advocates” who were generally knowledgeable of industry practices and had a particular interest in trying to move it in one direction or another. Finally, I also spoke with political operatives both inside and outside the industry who held varied political stances on renewables and labor issues.

Transcript Creation, Coding and Analysis

As previously stated, I recorded my interviews when possible. I did this to ensure I had an accurate transcript for analysis. Memory is a fickle thing.

Similarly, and as it relates to the next section, the creation of interview transcripts allowed me to code the interviews I generated to see what themes emerged from my interactions, but especially with respect to understanding the labor process in the wind energy industry and varied perceptions about the nature of green and climate jobs.

I would import the audio recording into Adobe Premiere Pro, which I would use to produce a transcription of the recording. I would then listen to the recording alongside the associated transcription and clean up inaccuracies produced in the prior step. I would also scrub personally identifiable information. While doing this, I would highlight parts of the script that were particularly

interesting or relevant to the questions posed by this dissertation. All the while, I kept a separate Excel spreadsheet where I stored various ideas about themes that emerged during my interviews. This helped me to develop additional themes and potential codes, in addition to the codes and themes I had planned from the outset. Following this procedure, I ported the transcripts into Nvivo and subsequently reviewed each script again, coding various themes according to labor regime analysis (i.e., production, circulation, reproduction, ecology) and the GJ/CJ typology (output, process, use, spatiotemporal, correct, regenerative, etc.). In addition, as I reviewed the transcripts multiple times and my familiarity with the topic grew, new themes began to emerge that I would code. All told, each transcript received two reviews, with particularly rich interviews receiving multiple reviews.

The coding process helped me to organize the data I generated, which facilitated easier access to information throughout the writing process. Core themes and codes related to labor regime analysis across its spheres, codes related to specific actors (i.e., utilities, companies, regulatory entities), and codes related to the GJ/CJ typology to help discern how people think about these jobs, and the quality of these jobs.

As for the labor regime analysis itself, it proceeded abductively as I tacked back and forth between my interactions with my interviewees, reviewed the associated transcripts, and considered how this compared with existing labor regime theorization and my working knowledge of work in the renewable energy sector. In this fashion, I sought to theorize systematically in accordance with a reflexive mode of social science, meaning the analysis I generated reflects what I saw and heard from my interlocutors according to how it did or did not align with my preexisting cognitive map of wind energy labor regimes I had constructed based on reviews of existing literature. In the words of Michael Burowoy (1998: 5):

“Reflexive science starts out from dialogue, virtual or real, between observer and participants, embeds such dialogue within a second dialogue between local processes and extra local forces that in turn can only be comprehended through a third, expanding dialogue of theory with itself”.

In this fashion, the data I generated through interviews, participant observation, and secondary data were juxtaposed with existing labor regime theorization, my eco-social typology, and interactions with my interlocutors about both the opportunities, challenges, and ambivalences around green and climate jobs in renewable energy sectors like wind.

Research Challenges

I confronted several research challenges in the course of constructing this dissertation. First, and counter to my initial vision, I did not carry out in-person research in Denmark. My plan was to create a more robust comparison between experiences of work across the US and Denmark. However, the likely revocation of a Fulbright Grant impacted this.

Furthermore, access to certain interviewees proved to be far more challenging with the shifting political terrain that put certain individuals and groups in a more precarious position, especially given the Trump Administration’s unique hostility to renewables in general, and wind in particular. Given the periodic cycles of boom and bust in the wind energy sector, I anticipated challenges in firm willingness to work with me, but these were exacerbated by added wariness of additional scrutiny heightened by the Trump Administration’s hostility towards wind.

Nevertheless, it is useful to note that this research affirms how the same processes and obstacles found in other work settings are alive and well within the renewable energy sector. These are further compounded by the nature of the work itself, work that often takes place in isolated buildings

(manufacture), or in remote project locations on private land—to be discussed in greater detail in the next chapter. In both cases, trespassing is not permitted.

Despite these challenges, I believe this dissertation provides a strong foundation for future comparative research, but especially those that engage in combined multi-sited fieldwork, cross-national comparison, and engagement with workers across settings—all necessary steps to further advance our understanding of work in expanding “green” sectors and the development of corresponding worker strategies for a more just future.

"A green job? I think of it as a job that doesn't pay as well as a job in a traditional energy sector. I would think of it as a job that pays lower than if you work for the utility and it pays lower and has less of a like a career possibility than, let's say, even if you were to like a coal fired power plant. A high paying, long term career job. And it doesn't seem like that is what the renewable industry is at this point" – (I39)

As I wrote in Chapter 3, ideas about green jobs as political economic platforms vacillate over time in accordance with political shifts. In Chapter 4, I constructed a spectrum for how we can view different green and climate jobs. Here and in the next several chapters, I will not only describe what green jobs in the US wind energy sector look like, but begin to explain why they look as they do.

To do so, I construct a description of onshore wind energy labor regimes in the US. I describe, in general terms, how the processes of production, circulation, social reproduction, and ecology mediate the labor process across phases of wind production. More specifically, I explain how conditions of competition in the energy sector constitute the labor regime in important ways. These conditions not only shape the labor regime that mediates the conditions of work for different green job occupations in wind. In particular, I show that social processes of work are severely constrained in the US, placing them somewhere in the socially harmful or corrective categories of the typology.⁶⁴ The focus on wind

⁶³ Please note that this dissertation chapter is a modified version of an article I published in the *Economic Labour Relations Review* (2026).

⁶⁴ Unionisation rates within wind hover somewhere around 9-10%, with some reporting lower numbers (NASEO, 2021) and others reporting higher numbers (American Clean Power, 2021). The most recent estimate puts the number at around 12% for wind, according to the U.S. Department of Energy's 2023 Employment and Jobs Report (2024). Regardless, this number

energy is important because if my theoretical priors are true, then we should expect that wind work would generally see improvements—in terms of organizing, wages, and so on—than a comparable industry like solar. I reason this to be the case as certain material elements of wind energy, like the size and scale of turbines, may constrain capital flight. Furthermore, wind technicians are highly skilled individuals and exist in a constrained job market, which should give them further structural leverage in the capital-labor relationship. As such, while I discuss other forms of wind work in this chapter to better appreciate relations across wind energy GPNs, I spend significant time on the experiences of wind technicians.

I also contribute to theoretical debates on how the socioecological indeterminacy of production (see Baglioni and Campling 2017; Campling and Kim 2025) that influence the constitution of local workplace labor regimes. Related to the above points on the capital-labor relationship, I emphasize how the relative mobility and remoteness of work activities conditions the intensity of exploitation experienced by workers, in line with recent analyses by Felipe Irarrazaval and Miguel Atienza (2025). I extend my analysis, however, arguing how different facets of the labor regime, including ecological aspects, mediate how workers perceive their jobs according to the particularities and settings of work, which comingles with the wind industry's historical formation and the broader political economic conditions of the US' 'social workfare' regime (see Peck 2016). Expounding this ideational element can better explain the relative durability of labor regimes. As I discussed in Chapter 5, this is an area that requires greater attention in labor regime scholarship.

lies below the national private sector average for coal, which sits around 17% (U.S. Department of Energy, 2024). Hardly unique to renewables, the decline of trade unions reflects a broader trend towards precarity due to neoliberal policies and the subversion of trade union power across the world (Brown, 2018; Cornell, *et al.* 2022; Wallace *et al.* 2025).

Third, and in relation to other recent renewable energy labor regime studies (see Neal forthcoming; Krommyda et al 2025), I argue that the labor processes associated with wind energy in the ‘main’ spheres of production (manufacture, project development, and operations and maintenance) are conditioned by capitals-in-competition. This competition is driven by overarching profit incentives of project developers, owners, and investor-owned utilities, which suggests an axis along which labor unions and environmentalists can contend with capital; that is, democratic control and ownership of the power grid. Critically, the production of electricity for a small share of beneficiaries brings questions concerning the social and ecological *uses* of energy production to the fore. If renewable energy power remains captured by the interests of small groups of shareholders, not only may this slow energy transition processes (see Christophers 2024), but this has consequences for types of green jobs we see in the renewable energy sector.

The chapter is organized according to three empirical subsections that examine the labor regimes of onshore wind energy in three phases of production: manufacturing, project development, and operations and maintenance (O&M) and the broader national labor regime that influences each. Throughout, I provide commentary on how different facets of wind production and the societal milieu in which it operates contribute to, or hinder future organizing efforts. Based on my analysis, I argue that ecological dimensions play an important role in constituting the labor regime, including how wind techs, in particular, think about their jobs. This serves a contradictory function that both maintains the labor process, but also contains within it seeds for organizing potential.

Waking the Wind: An Abbreviated History

To properly understand the formation of wind energy labor regimes in the US, let us first consider the industry's historical development in the US. In particular, we will explore the state's role in helping establish the industry and its maturation alongside broader trends of neoliberalization in the power sector. As I will discuss later, the conditions of competition and "unbundling" (see Christophers 2024) of electricity markets helped enable more widespread project development of renewables. However, these also heighten circumstances of capitals in competition across the spheres of production and circulation, which influences the labor regime in important ways.

Renewable energies as we understand them today began in the 1970s following the 1973 Oil Embargo (IRENA 2013). In the US, the embargo led to the creation of the US Department of Energy (DOE) in 1977 and subsequent passage of the Energy Security Act in 1980. In both instances, Congress sought better coordination between federal energy programs, and this included investments into alternative energy systems such as wind to secure the country from the volatility of global energy markets.

Around the same time, Congress passed the Public Utility Regulatory Policies Act (PURPA) in 1978, which required utilities to buy power from qualified third parties at a utility's avoided cost, the cost the utility would have incurred for a power project. Before PURPA, utilities had no obligation to consider independent power producers (IPPs) for electricity procurement, and IPPs were not guaranteed access to corresponding transmission. The implementation of PURPA in 1981 increased the salience of IPPs as utilities increasingly sold off their generating assets, while maintaining control of distribution infrastructure like transmission lines and substations (Cleary and Palmer 2022; Federal Energy

Regulatory Commission 2024). These changes ultimately led to the passage of the Energy Policy Act of 1992, which established the foundation for wholesale electricity market competition by removing barriers to things like transmission access. Today, about one third of utilities are vertically integrated and regulated (that is, the utility owns the generators and transmission lines) and most others are serviced by wholesale electricity markets in the form of independent system operators or regional transmission organizations (Cleary and Palmer 2022). As a result of these changes, IPPs could compete with regulated utilities at favorable rates, which trailblazed later electricity deregulation and created a more favorable environment for renewables to take hold (Knuth 2023).⁶⁵

Wind energy experienced its first boom in the 1980s because of these changes. During this period, more durable Danish wind turbines dotted the California landscape alongside lighter American made turbines, which reflected federal policy on top of which California stacked tax credits (17). However, the industry floundered in the late 1980s and early 1990s beset by several challenges. Early projects often functioned as tax shelters for investors, which contributed to ‘fly-by-night’ developments plagued by poor design and construction (Richter 1996; Garud and Karnøe 2003; Van Est 1999; Knuth 2023). Consequently, American OEMs largely shuttered their doors.⁶⁶

When Congress passed the Energy Policy Act of 1992, it introduced a *production* tax credit of 1.5 cents kw/hr. Congress sought to avoid the repeat of earlier projects that reaped capital gains simply

⁶⁵ It should be noted that the trend of neoliberalization in the energy sector is mirrored, or even preceded by similar efforts in labour governance, including through the Reagan Administration’s efforts to dismantle the power of organized labour through various legal mechanisms and actions that, in combination with increasing globalization, contributed to a precipitous decline in unionisation (see Nicholson, 2014 Ch. 8, 9, 10; Loomis 2018; Loomis 2021; Wallace, et al. 2025; Davidson and Stevis, 2025 forthcoming).

⁶⁶ Zond Energy Systems, acquired by Enron in 1996 and then later by GE in 2002 survived (Bradley, 2016), even though one of the largest manufacturers in the world, Kenetech, went bankrupt in 1996 (WINDPower Monthly, 1996; 17).

through the instillation of wind power equipment—such projects offered nothing in the way of use value outside of the exchange value it provided to those who built the projects. Not surprisingly, the industry went through a dry spell through the mid to late 1990s, with those companies that survived being those able to maintain sufficient revenue to keep operations and maintenance on existing plants underway, as early years were heavily dependent on tax incentives (17).

Utilities at the time were also skeptical of bringing wind power onto their systems, believing intermittency of power output would destabilize the grid. However, a joint project between DOE and the Electric Power Research Institute called the Turbine Verification Program sought to address this in 1992. The program helped break through utility reticence by having them build and install small wind projects through incentives that gave them experience working with wind in their power mix, which gave them confidence for how to integrate wind without jeopardizing grid stability (17; Rhodes-Weaver and Conover, 2000).

Eventually, the wind industry recovered and took off in the mid-2000s through a combination of technological improvements, industry standardization, maturing supply chains, and state support through tax incentives and research activities in centers in the US and Europe that helped improve technological standards (Knuth 2023; 17). The wind industry experienced another major bump in 2015 when the Obama Administration signed a five-year production tax credit (125), which encouraged further investments and rapid expansion (see White House 2015).

More recently, the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA) boosted the pipeline of new wind projects. The Congressional Budget Office pegged federal spending associated with the IRA around \$391 billion, with several programs earmarked for low-carbon energy

and climate projects. Goldman Sachs put the number closer to \$1.2 trillion (Saul 2024). Perhaps unsurprisingly, these investments have been rolled back by the Trump Administration with the cessation of tax credits for projects placed in service after December 31, 2027 (David 2025). The Trump Administration has similarly made permitting of new projects more difficult, further limiting the expansion of wind projects, especially on federal land (DOI 2025a; DOI 2025b). Because capital requirements of wind power are relatively fixed, these policies that slow renewable energy development will likely result in the continued use of business practices to reduce labor costs as a malleable sphere for companies to secure themselves in the face of volatility.

The Onshore Wind Energy Labor Regime in the US

With the industry's history established, let us now turn to how imbricated spheres of the labor regime mediate the resultant jobs. Here I focus primarily on the spheres of production, circulation, and ecology in this analysis, with references to social reproduction dynamics, especially pertinent to national level dynamics, as appropriate. I bracket this to limit the scope of the analysis. There is simply far too much to cover the innumerable ways social reproduction conditions the labor process to do it justice while also considering the other dimensions. I pivot between phases of production—manufacturing, project development, operations and maintenance (O&M) work—organically as the different production phases, especially for project and development and O&M work, often overlap. Moreover, because production phases depend on one another, I discuss them as internally related elements of the production process. As onshore wind energy aims at the valorization and transformation of a natural phenomenon, let us begin there.

The Ecology and Materialities of Wind Production

Wind results from the uneven heating of Earth's surface by solar radiation and consequent movement of air from areas of high to low pressure. The process of valorization occurs when kinetic wind energy transforms into electricity through the spinning of a turbine rotor, which converts that kinetic energy into electricity for distribution on the electric grid. Or, more simply put by one DOE program, wind energy converts "atmosphere to electrons". Despite the ubiquity of wind resources as one of nature's 'free gifts', the means of conversion into electricity are controlled by a project owner. In this fashion, we can say wind project owners, in some sense, quite literally extract rents from thin air (Wade and Ellis 2022). In basic terms, this works when a project owner creates an enclosure through the purchase or lease of land with high wind potential. They then enter into a long-term contract or agreement with a distributor, often a utility, to provide power over a certain amount of time. More often than not, the power producer or entity building the wind project relies on an investment mechanism of some sort to generate the financial capital necessary for construction. Plant owners receive two income streams, one for its availability to generate power and the other delivering the power it generates (Christophers 2024: 67). I will explain in the production of green workers why this interaction between production, circulation, and ecology matters in shaping green job conditions, but especially for wind technicians. It does, however, also matter for the purposes of the speed of transition too.

The uncertainty in power generation potential and the ability to generate revenue creates uncertainty among the investment class. That doubt constrains investments into the renewable energy sector, especially if the state does not offer a backstop to ensure for some guaranteed return on profits. Christophers points out how this dynamic makes it difficult for renewable energies to compete.

They may deliver an internal rate of return in the order of 5-8% in comparison to somewhere in the order of 15-20% for similar investments into oil commodity futures (2024: 215). Countries like Denmark pursued renewable energy development more quickly, in part, because they subsidize (or *socialize*) the costs of production and deployment, rather than project developers having to raise the necessary capital on their own (Christophers 2024: 89). In any case, the lesson is that production and circulation interact in important ways. As it relates to the typology, we also see that in the US at least, emphasis is on the continued valorization of exchange value over the potential use value that renewable energies could provide (i.e., carbon free power). That is to say, ecology and production interact in a way where the uses are put towards continued economic growth, rather than towards socially or ecologically beneficial uses.

The sale of electricity through wind on the power grid thus represents the commodification of nature via legal mechanisms that sanction accumulation through the conversion of an 'unproductive space'—even if other activities like farming occur—into a productive one. Ecology is therefore embedded within the broader political economy and associated expectations of value. In the US, this process often occurs on privately owned land, where a landowner earns a share of the value produced by a wind project (ACP 2025). The preference for private land stems from reductions in permitting timelines (Tegen 2015; Tegen, *et al.* 2016), which reduces associated costs of regulatory hurdles.

One of the distinctive material attributes of wind energy is the commodity itself: electricity. Wind is not the commodity for sale. It is a "free gift" to the capitalist. Instead, wind OEMs sell turbines and their potential to convert wind into electricity as commodities. For the project developer or utility (sometimes the same entity), the electricity produced by the power plant constitutes the commodity

for sale. Or, for a subcontracted or temporary hiring agency, they commodify human labor power. They do so according to their ability to recruit and/or control human labor and sell that to the project developer. An entity like Mortenson who builds projects and any number of temporary hiring groups represents outfits in this category.

In each case, capitals involved in wind energy production depend on the relative ubiquity of wind resources and human labor for all aspects of the enterprise. Common sense beliefs attached to the legality of enclosures of lands with high wind potential and that these *unproductive* spaces should be converted into productive ones for profit on behalf of the project owner.⁶⁷ Like other sectors, this outcome is legitimated through rhetoric that capitals “risked” or put “skin in the game” to make the project happen, ignoring the risks similarly taken on by workers (more on this later). It also ignores how other species and people live in these areas who may oppose, or similarly wish to benefit from the project.

As discussed by Pearse and Bryant (2021), those employed in campaigns to advance renewable energy development or who occupy ‘white collar’ positions of research and engineering infrequently consider how changes to ownership would change the nature of energy production and, consequently, the labor process. Based on my interviews with several technical experts, I think I would offer a slightly different perspective. Several with whom I spoke indicated awareness for some of the challenges posed by the above description, and how changes to ownership and greater state involvement would shift this. However, they showed reticence in speaking to these ideas as they exist

⁶⁷ These same material attributes unique to renewables—their relative ubiquity and simplicity—could theoretically lend themselves to alternative social arrangements (see Burke and Stephens, 2018).

outside the boundaries of what is considered *acceptable* when discussing these issues (I2, I3, I6; see also a discussion of LCOE and the hegemony of economic reasoning in Christophers 2024: 99-111).⁶⁸

Wind Workforce Production

Wind companies require workers across several phases of production as outlined in Figure 10 (BLS 2024). The bulk of employment activities occur within manufacturing, project development, and O&M phases (NASEO 2021). Each phase contributes to project completion. In both project development and manufacturing work, the commodities differ, but the source of value comes from the associated labor. Considering the ‘general intellect’ of the workforce, wind capitals leverage R&D activities and ‘white-collar’ workers to demonstrate the viability of turbine technology, and through the development of innovations to enhance relative surplus value. Consider, for instance, the wind turbine verification program sponsored by DOE. Today, companies also increasingly use direct drive turbines engineered by white collar workers that are more reliable and suffer less down time than their gearbox counterparts. These reduce the need for gearbox repairs for wind project asset owners. As

⁶⁸ I must put a pin in this idea for now, but in the future, I should like to explore how experts in the energy space generally think about issues related to ownership, including the emergence of a hegemonic common sense for how electricity ought to be governed. As others like Peter Newell (2019) have explored this conceptually, and how these ideas shape renewable energy policy and related discourses in important ways.

Erick Lachapelle (2017) and co-authors argue, technological developments like this have been central to wind capital's accumulation strategy in the US.

Turning once more to how ecology shapes labor regimes, labor regimes vary based on the spaces where work occurs, as well as the corresponding mode of production. For instance, manufacturing work takes place in urban settings with access to workers and necessary infrastructure for rail transport (16; 132; 137). As I will discuss, in greater detail next chapter, local labor regimes for wind manufacturing depend significantly on historical relations and the existence of pre-existing manufacturing capacities in urban centers. However, project development and O&M often take place in remote landscapes, which creates several effects.

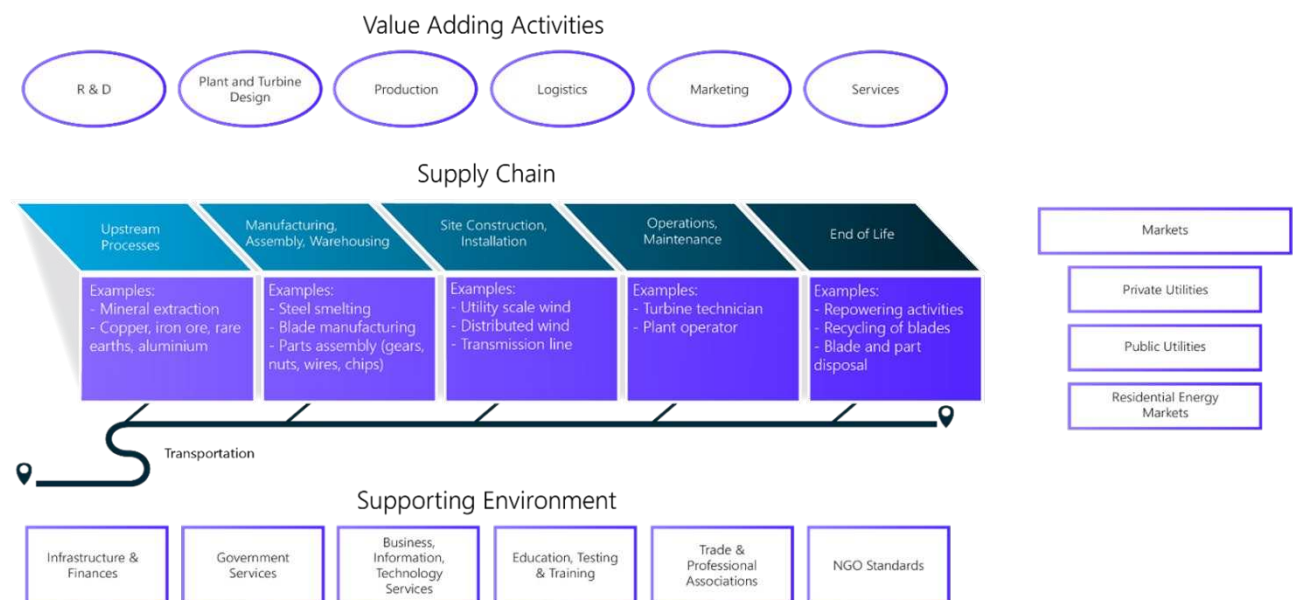


Figure 10. Wind energy production involves a diverse set of activities, including an enabling support environment from both state and private interests. The figure was created in Adobe Illustrator using information from Liu et al 2018.

First, this creates variance on the extent of local labor used (Stefek et al. 2019, Manzo et al 2022). Construction activities often require a sizeable base of workers, often too many for rural communities to supply. As a result, temporary hiring firms and short-term contracts for construction are common,

especially as it allows the project developer or asset owner to save costs by limiting the number of direct hires across the country (I6).

In the case of O&M work, groups of usually three wind technicians (wind techs) visit remote sites to maintain various turbine parts (I28).⁶⁹ Wind techs often travel extensively throughout the year. In some instances, they maintain turbines under the warranty contract of an OEM, in which case they are usually direct employees (I28; I38). In other instances, they take employment as part of a subcontract network in which project owners hire technicians to maintain or repair turbines (I4; I12; I28; I39). Some companies will rely on their subcontractors, entities like Sky Climbers, to help identify which people they ultimately want to bring on as full-time employees (I39). With relatively high attrition rates for wind turbine technicians (I39), this allows the lead firm to outsource some of the expense of training by putting a technician through their paces before bringing them on as a full-time employee. Not to put too fine a point on it, but a senior wind tech is often someone who has worked five or more years (I25). In any case, it is a combination of the remote nature of the work itself and the affiliated social relations that shape the form of exploitation and disciplining, but especially with respect to the intensity of hours worked as capital seeks to enhance surplus value extraction.

In concrete terms, wind project owners cannot generate revenue when the blades of the turbines do not spin. Therefore, downtime for a wind turbine or repair constitutes potential revenue loss for the project owner or a breach in their contract with another entity. Because of the level of competition in the energy sector for access to electricity market—a point I expand on below—this results in the

⁶⁹ I should note here that I am not equating O&M work to only wind turbine technicians. There are other forms of O&M work that occur, but for my purposes, I focus on O&M work that occurs in field settings.

asset owner either pressuring their employees, the OEM with a warranty, or a subcontractor to complete repairs or construction as soon as possible. Intense work schedules are the result that are socially exploitative according to the typology.

Schedules vary, but six weeks on, one week off schedule is common among traveling wind technicians (NREL 2024; I20; I28). For comparison, oil and gas workers often work a schedule of three or four weeks on the job, and one week off (NREL 2024). Although a six-day work week schedule is common, technicians and installers may be called on to work seven days a week and holidays because downtime corresponds to a loss in profits. The remote nature of work further intensifies this pressure as some workers reason that if they are in a rural setting with little else to do, they might as well work to make more money (I28).⁷⁰ Although overtime pay represents a potential benefit to work, it also creates dangerous work conditions as the rigors of an extended work schedule in a physically demanding job can create lapses in judgement. Put more simply, when people get tired, they make mistakes that can put them and others at risk (I4; I28). According to one interviewee (I28), the recent deaths of two experienced turbine technicians was the result of these pressures (see Saegert 2025 for an associated periodical). In this regard, the intensity of work can be attributed to capital's pursuit of absolute surplus value, which they achieve by lengthening the duration of both the working week and number of hours worked.

These pressures are further heightened by the remote nature of wind projects, which increases the risk of serious injury or death given the vast distances first responders need to travel. Despite this, no

⁷⁰ The same interlocutor noted that 'wind groupies' exist in some of the rural places where wind techs operate, as technicians make more money on average than those in rural communities (I28).

OSHA guidelines specific to wind energy exist (Mayers 2024). Instead, the closest thing to an industry wide safety standard is promulgated by the Global Wind Organisation (GWO) led by turbine manufacturers and owners (I7; I12). Because of the remote nature of work, everyone on a wind project is ostensibly granted authority to stop work, aptly named “stop work authority”, if they feel something is potentially dangerous (I25; I28; I38). However, workers have differential levels of comfort in their willingness to invoke such authority. Their comfort often varies in accordance with their respective position in a project’s pecking order with those who occupy lower rungs on the ladder less likely to speak up for fear of reprisal (I4; I28; I38). Even with companies like Vestas with comparatively strong safety standards put alongside their peers, trade unionists who have organized wind technicians note how workers feel the need to ignore safety protocols on occasion due to pressures on the job, especially with respect to meeting deadlines (I39). That is to say the work processes themselves, even in “socially corrective” settings with unionized workers, can still be dangerous as the demands for wind projects to run as frequently as possible constrain worker autonomy. As I will discuss, these conditions have much to do with the nature of the production process in wind and other energy sectors more generally, which are driven by capitalist competition, which produces both material and ideological pressure on workers to keep working, even when that work is dangerous.

The remote location of wind projects creates both opportunities and challenges for organized labor, or conversely, challenges to capital for how to maintain labor control. Remote project locations means that wind techs or those involved in construction are often away from management supervision. Indeed, an appealing attribute of wind work is the opportunity to occupy what can often be beautiful landscapes away from the prying eyes of upper-level management. As one interviewee put it, it was an ideal situation for someone “who has problems with authority” (I28) or generally

prefers their independence (I39). However, these same qualities also isolate workers from their peers, which can make raising class-consciousness and broader solidarity more difficult.

The ability for unions to make inroads into the sector also faces challenges linked to the locations of wind projects. Several interlocutors noted a mismatch between shop-model unionism whereby project developers recruit workers from union shops, which does not correspond with what is often itinerant and remote work (I6; I12; I25). Others instead reference how the remote location of projects (and that they exist on private land) similarly makes it difficult to have organizing conversations with wind technicians (I39). Outside organizers simply cannot access wind turbine projects or manufacturing locations easily. Even still, that has not prevented the Utility Workers of America (UWUA) from making inroads with Vestas wind technicians in Michigan (UWUA 2025). All of that said, the remote setting of wind turbine developments does not explain why manufacturing facilities, which are anchored to a particular location, have similarly struggled with unionisation. Indeed, several interlocutors noted renewable energy companies are vehemently opposed to unions (I4; I15; I17; I22; I27; I28) and actively work to keep them out of their business (I15). In this respect, across phases of production there exists a concerted effort to cultivate a particular type of wind worker in the industry to aid its accumulation strategy.

It is important to acknowledge at this stage that while these ecological dimensions influence the labor regime, they do not dictate the capital-labor relationship on their own. Indeed, while it is true that renewables like wind give distinct political and geographic attributes that reconfigure spatial patterns of energy production (Pearse and Bryant 2021), these are ultimately mediated by the state and associated institutions (Coe and Jordhus-Lier 2011). Considering wind energy production alongside ecology, we can see that many of the best wind resources for wind project developers and

utilities exist in the middle of the country in states such as Texas, Iowa, Oklahoma, Kansas, and Illinois (EIA 2023). As Figure 10 shows, these wind resources coincide with states with labor governing institutions that actively suppress unions through the existence of so-called 'right to work' laws that constrain union security agreements.⁷¹ In this respect, the geographic dispersion of wind energy and its intersection with the surrounding institutional environment plays an important role in establishing the ground rules for worker contestation in many settings of wind energy, including the unevenness of the labor process in differentiated settings. Two interviewees noted the interaction between energy

⁷¹ The Labor Management Relations Act of 1947, or Taft-Hartley, restricted the power of labour unions by adding new language that stipulated employees had the right to refrain from participating in union (NLRB, 2022). In effect, these laws make it difficult for unions to maintain both their membership and fiscal solvency.

geographies in concert with the surrounding legal environment was the main reason for the lack of unionisation in the industry (12; 16).

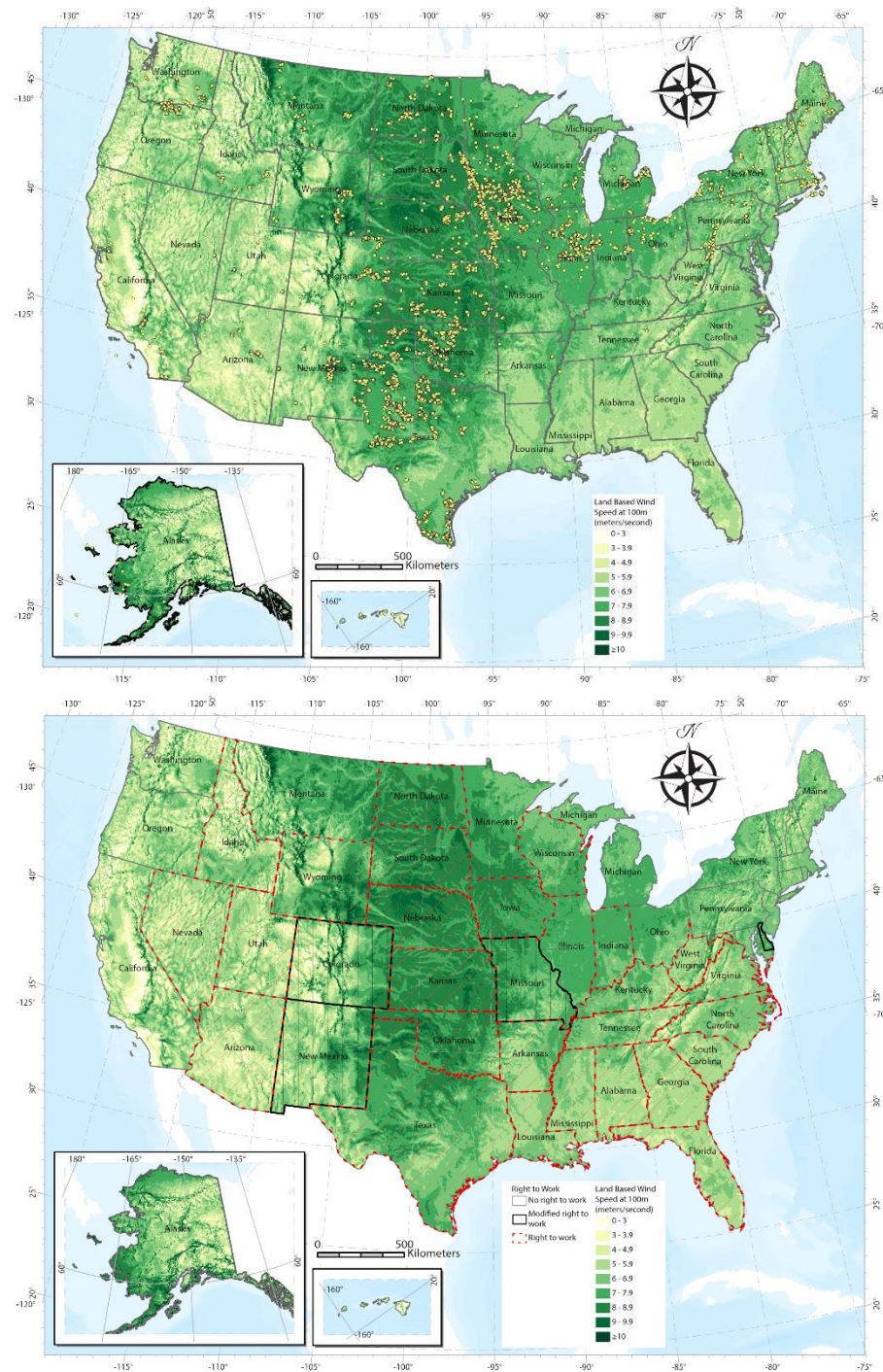


Figure 10. Many states with the best wind resources exist in the middle of the country, within the boundaries of right to work states. The top map displays wind turbine project locations overlaid over a wind speed layer at 100m above surface level. The second map shows how wind resources collocate with many right to work states. Data for the map relies on WindToolkit Data from the National Laboratory of the Rockies (see Draxl and Mathias-Hodge 2016). Right to work state data layer developed by the author according to their review of right to work legislation across the country. The map was developed by the author using ESRI ArcGIS with enhancements in Adobe Photoshop.

The Production of 'Green' Wind Workers

Who is, or is not, a direct employee of a wind company depends on their relative credentialling, and a wind project may bring together a variety of workers with varying levels of precarity. It is well known that across industries, precarious workforce practices are more common where the use of labor brokers and other intermediaries is commonplace (Barrientos 2013). Within wind, this is most common within project development and entry level positions for wind turbine maintenance (I4; I20; I28; I38). The fragmentation of the labor process makes building worker solidarity more challenging, and like other settings where labor contracting is common, markers of precarity like safety short cuts, wage theft, and few benefits are present (I4; I12; I28). Several interlocutors noted that many workers enter the industry, across production phases, because they 'have a pulse' and therefore provide the necessary bodies for a subcontractor or temporary hiring agency to fulfill their contract (I4; I28). Many of these individuals thus do not have the training or experience needed to keep themselves or others safe, conditions exacerbated with a general lack of training or apprenticeship opportunities (I2; I5; I6; I12). Considering again the stratification of the wind workforce, those who work directly for an OEM receive a great deal more training and often have prior experience before joining the OEM (I25). Meanwhile, the social stratification of work enables OEMs to maintain power and control in hiring and firing decisions, having wind techs join their ranks only after having accrued sufficient experience or having demonstrated appropriate attitude and aptitude according to the company.

As a function of this division between workers, a distinctive hierarchy exists within the industry and on construction projects, in particular. For example, wind techs or equipment and crane operators with prior on-the-job-training, certification, and supervisory experience specific to wind energy are more likely to be employees or have positions that oversee operations on wind projects (Hamilton

and Liming 2024). Meanwhile, the bulk of workers needed for project construction are often hired through labor brokers and temporary hire firms (I4), although this fluctuates in degree depending on industry stability (I15). Individuals recruited by temporary hiring firms who receive less investment compared to those directly employed by the OEM perform 'lower-skilled' or menial functions on wind projects. Things like creating post holes for a fence, to use one example. Such stratification reproduces a permanent underclass to perform some of these 'lower-skilled tasks'. It is difficult to break out of these roles unless the individual who occupies them knows someone in management or some other connections to break out of this cycle (I4).⁷² According to the typology, these are jobs that are socially exclusionary. These hierarchies are crucial to capital's accumulation strategy, which leverages these structural inequalities to ensure the availability of workers on remote projects through subcontracted networks. It also helps to ensure that these workers embodied labor value remains accessible for recruitment in the future. As others have theorized, the stratification of the workforce may occur along gendered and racial lines (Pearse and Bryant 2021), which this study affirms in the context of project development.

Critically, while ecological dimensions may condition the use of these business practices, it is abetted by the state and associated institutions, which allows for temporary hiring and subcontracting in the name of individual freedom. The result is that commodified energy forms like wind power rely on the continued use of certain populations deemed "disposable" and that more often

⁷² It should be noted that while this phenomena is present in wind, it is perhaps more acute in the solar industry based on preliminary conversations with those experienced in solar project development.

appears to occur to groups with identities that have been historically marginalized, in line with theorization by Myles Lennon (2017).

The use of subcontracting and temporary hiring also bears the hallmarks of a ‘fissured workplace’, in which companies use these practices to reduce costs and offload responsibilities from the lead firm (Weil 2014). Such a strategy is also used by firms or major brands to distance themselves from negative aspects of production (environmental degradation, violations of labor rights and standards) through the structuring of their activities (LeBaron et al 2017). Biden era incentives in the IRA and IIJA sought to allay these issues with concessions in the form of prevailing wage standard and PLA incentives for companies, but these do not resolve the overarching coercive laws of competition that emanate from the structure of the energy sector, which drives these outcomes (more on this soon).

There is also a distinct gendered element to wind work, which partially reflects the ecological sphere of the labor regime and its intersections with social reproductive elements. As alluded to earlier, the life of a wind tech can be quite nomadic because of the locations of wind projects. As a result, many traveling wind techs are often younger individuals, with those who are older and with more experience moving into positions that require less travel (e.g. servicing a single location) or moving into managerial positions. One interlocuter noted that young males were a ‘better match’ for the industry’s needs (I25). The itinerant nature of the work makes dating and maintaining a relationship challenging (I4), but companies benefit from this in not having to provide family healthcare coverage, which can help them maintain more profit. In this respect, the so-called “workforce gap” (Stefek et al 2022; McDowell et al 2024) to fill wind tech and development positions is not only attributable to a lack of education or awareness of the industry, but also a byproduct of the labor process itself. The work requires individuals who are willing to work in remote areas in a

physically demanding job, at heights, with weather conditions that range from enervating heat to bone-chilling cold. The demands of these jobs require that they perform that work under tight deadlines and pressures pushed by the asset owners who want turbine blades to spin as much as possible to produce power for sale in electricity markets. Needless to say, the combination of these factors means there simply is not a large pool of individuals who have both the willingness and physical aptitude for the job (I25).

In this respect, the specialized skills and attributes of wind turbine technicians grants them a measure of structural leverage in the capital-labor relationship not afforded to workers in other phases of production. That the labor market is constrained conceivably aids their ability to advocate for different work conditions and collective bargaining rights. Although none of my interlocuters made this connection explicitly, one interviewee had some notion of this, remarking in reference to the historical experience of coal workers that,

...I see our work as being also incredibly dangerous and that we just really need our own union. And then I am always telling coworkers, especially when I was a contractor, like, hey, all of these people that work in the office, we're the ones paying their bills and we're paying their salaries. We're doing this dangerous work that's paying all of us. Yeah, they work for us like, you know, these project managers, these human resources people, we are doing the thing and risking our lives to do the actual thing that gets them paid as well as us (I28).

In the same interview, they would go on to discuss some of the challenges they have faced creating solidarity among their peers. Several interlocuters chalked this up to a pervasive ideology of individualism in the political economy of the US (I17; I28; I38) or even the significant presence of MAGA inclined individuals in their work settings (I20; I22; I28)—a contradiction given the Trump Administration's hostility to renewables.

These ideational elements bring us to a discussion about how socioecological aspects of the labor process itself, conditioned by historical contingencies of the larger wind energy labor regime in the US, have emerged and help to maintain the capital-labor relationship between wind technicians and wind capitals (OEMs, project developers, utilities). Beginning with the historical formation of wind workers in the growth period of the 2000s and 2010s, many were former veterans (I7; I15; I25; I27). Combined with the material realities of wind work—often isolated and remote—the idea of a wind “brotherhood” emerged as a salient concept regularly invoked by my interlocuters (I12; I15; I25; I27; I28; I38). The pervasive sense of “brotherhood” as opposed to “family” reflects the male-dominated nature of the industry, despite efforts to change this (I25). The notion of brotherhood also reflects several values that govern expectations of work in the sector. First, the incumbency of workers to act as one another’s primary line of security, linked to the remote and dangerous nature of the work (I15; I25; I27; I28).

Belief in a wind brotherhood also represents a diffuse form of productive power (see Barnett and Duvall 2005) that governs the labor regime. It reflects a ‘common sense’ belief, in a Gramscian sense, that worker safety is incumbent on individual workers to secure themselves and one another. In this fashion, it deflects attention away from some of the systems and structures that can sometimes make work dangerous; things like extended work hours and tight deadlines stemming from the needs of project owners. It does so by shifting the burden for safety away from the company and onto the shoulders of workers and their peers.⁷³

⁷³ Along these lines, another interlocuter noted how they were expected to provide their own equipment—safety boots and apparel—when working on project construction, things the company or contractor ought to provide (I4). However, this appears less likely to be true when it comes to the work of wind technicians (I28; I39)

The notion of a brotherhood also plays a contradictory role in which an appeal to familial values could conceivably lend itself to future organizing efforts. However, it may also be wielded as a shield to keep unions out of the workplace, as they are 'outside' the family of wind work, so to speak. Indeed, one interlocuter noted that potential access to a more loyal workforce influenced their locational decision when siting new manufacturing facilities (I32). Two former workers also felt unions would jeopardize wind company success, which they referenced as having enough challenges in maintaining profitability as is (I15; I27).

At this point, I would be remiss not to remark on how the state mediates the capital-labor relationship in the sphere of social reproduction. It does so by ensuring that the successful social reproduction of the worker depends on their use and availability to capital. The US is a 'social workfare' state, meaning the receipt of essential benefits like healthcare and wages depend on employment (MacLeavy and Peoples 2009; Peck 2016). As a tool of control, binding healthcare coverage to employment stacks the capital-labor relationship in favor of capital, as job loss and consequent losses in not only wages, but healthcare coverage act as a more overt form of control. Several interviewees remarked that when unionisation at a wind manufacturing facility was entertained, the individuals involved backed off for fear of reprisal and attendant losses in wages and healthcare (I16; I17; I21).

The US context provides a concrete articulation of Søren Mau's (2023) description of capitalist society in which workers are dispossessed of their ability to meet their basic needs, which necessitates the sale of their labor power for their social reproduction (Mau 2023, 134). The combination of this dynamic reinforced by the ideology of individualism pervasive throughout the US, present in wind, creates conditions that make one-to-one organizing conversations difficult. The resulting

consequence of a social setting with healthcare attached to employment and regular work in isolated settings is that many workers, understandably, choose strategies for their social reproduction and that may include union avoidance. In labor environmentalism scholarship, the same is true for coal workers who question the benefits and rationale of a 'just transition,' if there is no social safety net to speak of (Cha et al 2021; Sicotte 2024). In other words, within the social workfare regime of the US more generally, and within the particularities of wind energy labor regimes, the day-to-day experience of both survival and work reinforces the belief that it is better to remain in a job, however marginal, than risk unemployment and consequent loss in healthcare coverage and, ultimately, death. Such conditions also help to explain why some workers, especially those from marginalized backgrounds, will not invoke their stop work authority even when something may be unsafe.

Similarly, and considering ecological processes of wind energy production, although the manufacture and production of wind turbines for electric power produce outputs that minimize carbon emission and for uses that can balance ecological and economic goals (i.e., ecologically corrective), ecological processes of work can still be damaging. Throughout the phases of production, there is a risk of exposure to hazardous agents through skin, ingestion, inhalation or adsorption (Karanikas et al. 2021). Wind techs also regularly handle toxic substances and associated fumes from volatile compounds use to maintain turbine blades (Karanikas et al. 2021). Both manufacturers and wind techs are also exposed to gases and dust that, if touched or inhaled, can prove damaging to human health during buffing and resurfacing of blades (Karanikas et al. 2021). Again, it is important to stress that no OSHA standards currently exist for the wind energy industry, which feels like a significant oversight given the array of potential hazards it can present to those who occupy these positions.

Capitals in Competition in Energy

As I have alluded to several times, it is impossible to fully comprehend how the onshore wind energy labor regime shapes work without considering the pressures of competition in the energy sector. In this section, I argue that the dynamics of production and circulation within a triad of cooperation and competition between OEMs, project owners, and utility corporations play an important role in conditioning the labor process. It helps explain the intensity of working hours, reliance on business practices associated with workplace fissuring, and union avoidance as companies seek to secure themselves in a highly competitive electricity markets to ensure access to the power grid.

Within wind energy production networks, the project owner will purchase the turbines for a power plant from an OEM and usually subcontract with a construction firm like Mortensen to complete the project. In this fashion, the project owner acts in a manner like that of a lead firm in more traditional commodity GPNs, as they coordinate activities among actors and establish the parameters and goals of a particular project. In the US, companies like NextEra Energy, Invenergy, and Enel Green Power represent some of the major production firms that coordinate industry activities, and they have an outsized influence on the goals, information, and messaging of industry association groups like American Clean Power (ACP) (I18).

Meanwhile, OEMs and project developers tend to avoid cooperation outside of ACP convenings or during political lobbying (I18). In the US, three OEMs dominate the market: Vestas, Siemens-Gamesa, and GE Vernova. They rarely share technology or expertise to enhance their competitive viability (I7). As a result, more specialized OEM work will sometimes use imported workers with whom

a developer is familiar (Sweeney 2021). However, OEMs do subcontract to suppliers for specialized parts and smaller components like wind blade epoxies, inverters, and controllers that major firms later assemble into major turbine components. Subcontracting by OEMs and project development is common and includes some measure of spatial differentiation on where manufacturing activities take place or from where (and from who) workers are recruited. Wind OEMs choose their locations according to where existing and future markets reside (explored in greater detail next chapter), in addition to other cost-factors that include local governmental tax breaks and subsidies, the availability and relative cost of labor, and suitability of transportation infrastructure (Westgard-Cruice 2024).

Towers manufactured in the US receive pressure from low-cost steel imports from Asian markets such as Indonesia, South Korea, Vietnam, and India (Baranowski et al 2022). Beyond the spatial movement of manufacturing locations, companies may also choose to offload associated costs of production by subcontracting production of parts to other companies, which results in rounds of layoffs, as recently occurred at tower manufacturing facility in Pueblo, Colorado (Vestas Wind Systems 2021). Alternatively, OEMs attempt to exert their power in their relationship with project owners by extending control of turbine assets through extended warranties, which allows them to extract more value by limiting the amount of aftermarket investments facility owners can make on a project (I24).

Finally, in order to enhance surplus value on both the manufacture and operation of wind turbines, asset owners and manufacturers pursue technological innovation that enable their plants to generate more power and operate with less downtime. Indeed, during my time with the National Renewable Energy Laboratory (now the National Laboratory of the Rockies or NRL), much of my work involved working with research scientists on the “leading edge” of innovation and how to tailor associated messaging in a way that would attract further investments by improving wind turbine

power output and reliability. In this respect, value adding activities in places like NLR plays a critical role in enabling and enhancing industry profits. These white-collar workers were also involved (unwittingly), in activities that would reduce the need for more turbine maintenance and, by proxy, the necessity of a larger wind technician workforce. This includes research oriented towards resolving issues like “white etch cracking” in gearbox turbines, and generally the pivot towards, especially in offshore wind, the use of large scale permanent magnet generators that can produce power more efficiently and are not susceptible to some of the common faults in gearbox based turbines (i.e., faults that arise due to the continuous wear on gears). However, these direct drive turbines, as opposed to their gearbox counterparts, require more critical minerals, copper, and rare earths for their production, which implicates wind energy in global spatial dynamics for access to the minerals needed to produce these machines.

The Importance and Power of Utilities

The intervening role of electric utilities differentiates energy industries from other GPNs. As discussed earlier, wind projects are often built through financing mechanisms like PPAs in which the power off-taker (i.e., entity purchasing electricity, often a utility) negotiates certain terms and conditions for the project rates paid for electricity, installed capacity of the project, and predicted electric production over the project’s lifetime (Energy I-Spark; Jacobs, *et al.* 2022). In the US, private investor-owned utilities (IOUs) exist as natural monopolies, servicing 72% of US electricity customers (EIA 2019). Because of their frequent role as both project owner and purchaser, they hold a great deal of relative structural power that influences which energy projects are built, how they are built, and the way they are built. Let us pause and again turn to history to understand why this is the case.

The Federal Power Act of 1935 divides authority of electric power distribution between state and federal governments. Federal regulators oversee ‘wholesale’ electricity (sale for large-scale purchases between power generators and utilities) and interstate transmission lines (16 U.S.C. § 824a.). Both federal and state governments granted a virtual monopoly over power generation to utilities so long as their decisions are ‘just and reasonable’ (Welton 2018, 594). What constitutes the public interest is not always specified beyond cost and stability, however (I3). When the Federal Energy Regulatory Commission allowed markets to determine wholesale electricity rates across much of the country in the 1990s, this shifted the dynamic between utilities and their respective public utility commissions (PUCs) (Welton 2018, 595). Up to that point, most utilities in the US were vertically integrated—they controlled generation, transmission, and distribution of power (Christophers 2024: 45)

Today, PUCs at the subnational level across much of the country ostensibly determine what is just and reasonable by overseeing the rates charged to customers and reviewing proposed projects. The increasingly diverse array of power producing assets makes resource planning, forecasting, and power distribution much more complex. Many PUCs do not have sufficient in-house expertise or staffing capacity, so they end up relying on the information given to them (I3). For example, while a PUC oversees the ratemaking decisions of utilities or the different projects they develop, they depend on the utility’s models for which project bids are most competitive. As they are often under-resourced and understaffed, they generally defer to the utility (I11). The asymmetry of information and expertise means utilities have cover to make decisions that result in greater shareholder profit than what is in the public interest (I3; I11). Labyrinthian grid operations and dense legalese mean that very few people truly understand the landscape of energy production and consumption (Burke and Stephens 2018; Welton 2018). As a result, those with a vested interest in maintaining existing structures of power

(literally and metaphorically) are also more likely to serve as commissioners on boards that oversee utilities (I3). Even still, consumer advocates and other intervenors will sometimes attempt to disrupt this process.

When selecting projects, those deemed most viable are those most likely to reap the greatest profit. It can, however, be difficult to discern what the relative ROI on an investment might be over the duration of what can often be lengthy contracts (Christophers 2024). Capital expenditures on a powerplant project are usually highest upfront, that is, the capital necessary to build the projects in the first place (Mone et al 2015). These costs, however, are relatively fixed and thus require investment mechanisms of some kind to raise the money necessary to get a project off the ground. These circumstances are responsible for the halting, on-again, off-again, nature of renewable energy growth. However, it also has consequences for what sorts of green jobs result. Because capital costs for the projects are largely fixed and consequent investments sometimes uncertain, it is the workforce where it is often the easiest place for a project developer or owner to shave costs (I26). This helps explain the prevalence of subcontract and temporary work. Or, it may also be the case that a company will choose to increase the rate of exploitation of its workforce by not hiring new turbine technicians as they may not have adequately considered increases in production costs associated with inflation rates over the period of a 20+ year contract (I39).

Conceivably, however, utilities could elect to choose projects or sign PPAs that include preferences for things like unionisation. Indeed, some states like Colorado have sought to bring greater clarity to the bidding process and associated labor costs through Best Value Employment Metrics that considers local labor and apprenticeship training requirements (CRS § 40-2-129). However, the information asymmetry remains, and such measures do not guarantee the use of union

labor even though they may have more robust apprenticeship training. This is especially true as project developers have grown reliant on the services of specific groups like Mortensen that have a preference to use non-unionized labor for their wind projects (I6). In this respect, investor-owned utilities, especially those within wholesale energy markets, produce value-squeeze on project developers as they are required to purchase power at low costs while maintaining grid reliability. As one interviewee put it,

“The fact of the matter is that you have to have a utility, private or public, in play to get your power purchase agreement in place. And until you have that in play, development can't continue. Like, right. It's like you're working on your environmental assessment and you're checking out your land locations and you're doing your MET tower data research. But until all of that comes together and a PPA is in place, nothing is going to happen. And so public or private utilities have everything to do with this. And they hold a piece of the purse. They're also being, I don't want to say forced, but they're getting their hands held to the fire if the state is making huge proclamations for goals like, you know, 100% clean energy by 2050, so then the utility is a huge player in that and helps an organization or helps a state move that needle.” (I25)

What I am describing is how the dynamics of capitals-in-competition across the spheres of production and circulation produce the conditions that help explain the consequent hiring practices of companies, as well as conditioning the intensity of work in remote settings. In essence, competition in the energy sector for access to the power grid conditions how companies pursue their accumulation strategies, which parlays into practices consistent with workplace fissuring and an increasing rate of labor exploitation, especially in terms of hours worked and, often, hostility to unions and other forms of labor autonomy that would push back against some of the conditions of work in this sector.

Wind Jobs: Eco-Social or Elsewise?

In essence, this chapter shows, empirically, how some of the same structures and social relations that made work precarious in other settings also exist in wind energy. These risk further ‘lock-in’ and

perpetuation of relations of exploitation. As other authors have argued, a shift to low-carbon electric power prioritizes the reproduction of capital over the security of communities in the face of climate crisis (Adreucci et al 2023; Krommyda et al 2025). Like Pearse and Bryant (2021) I argue this is partially a function of neoliberalized electricity markets and corporate capture of PUCs that ostensibly oversee what projects are built and grid operations (see the above history). However, I take this further by emphasizing the role played by IOUs, project owners, and the mediating role of the state, including the sociohistorical contingency of these relations. In revealing this, I suggest utilities and the PUCs that govern them are critical points of conjuncture and a potential site of contestation that can bring labor and environmental coalitions together, a point similarly made by the group Trade Unions for Energy Democracy, more thoroughly explored by Christina Paul (2024).

With respect to the uses of different outputs of these jobs, in this case, those attached to electricity, these are constrained by the associated uses of electricity production. Based on both the primary and secondary data used in this section, wind power and associated jobs continue to emphasize the exchange value of electricity production, with little consideration of what the consequent uses of the electricity will be. Instead, companies erect wind turbines for the potential returns on profits these may deliver. As a result, associated jobs are, at best, socially corrective. *What is more, these same dynamics might actually work against a more rapid expansion of renewable energy projects, as the need to deliver higher rates of exchange on projects constrains how much renewable energy power can be produced* (see Christophers 2024).

Shifting our attention to the ecological dimension, the potential for reductions in greenhouse gas emissions helps make wind work more desirable. However, this assumes ecological externalities, things like mining, do not result in sacrifice zones elsewhere. Moreover, wind turbine technicians and

manufacturing workers, when not properly suited with PPE, can experience respiratory and skin issues due to exposure toxic chemicals, paints, and epoxies on the job (Karanikas et al. 2021). Also, the way electricity is distributed in no way guarantees that electricity produced by wind goes towards socially or ecologically beneficial uses. Instead, one interlocuter remarked that the industry has maintained a robust rate of wind turbine production due, in no small part, the expansion of data centers and consequent PPAs signed by companies who run them (I42).

Considering the social dimensions of the typology, associated work processes exhibit contradictory tendencies. On the one hand, O&M workers like wind technicians have a high degree of autonomy in the workplace on account of the nature of the work itself. Yet, this independence, while attractive to particular individuals, may also make it easier for wind companies to keep unions out of their ranks. As I argued, state institutions and the associated social reproductive elements of the labor regime throughout much of the US contributes to this (i.e., social “workfare”). Instead, unions do not have a significant presence in the wind energy industry. Company management also largely places the ownness for safety on individual workers. Some of this has to do with the material realities of the work (i.e., where it takes place), but in considering the circulatory and social reproductive elements of the labor regime, we can see how conditions of exhaustion can create hazards or lapses in judgement at the workplace stem from pressures put on workers by asset owners, driven by dictates of competition. Taken together, social processes of work are not necessarily socially desirable. Within my typology, wind work therefore vacillates between socially “corrective” or “harmful”, which suggests needed changes to improve the workplace.

And yet, significant social and ecological potential exists in wind energy, and for wind turbine technicians to take a vanguard position in improving workplace outcomes. Wind technicians have

skills, competencies, and attributes that make them difficult to replace. In this, they have potential to exert a greater degree of influence in the capital-labor relationship than peers in other parts of the production network. Constraints in technician availability further buttresses their position, which is not true of other segments of the industry. Furthermore, they may have an enhanced position given their importance to the maintenance of wind power projects that exist on long term contracts. For these reasons, wind technicians make comparatively high wages, compared to their peers elsewhere in the production network and, by some accounts, approaching standards in sectors with more robust histories of unionization (and labor contestation) like coal. Given the lengthy contracts and spatial fixity of project developments, capital cannot simply move locations in response to a unionization campaign, which further aids the potential for building worker power here. It is for this reason productive power in setting conditions and expectations of work in the sector is so critical, but especially in spaces where more overt forms of labor control and disciplining are not available.

Despite these advantages, organizing challenges exist. Again, these owe to the unique nature of the work itself. Considering both wind technicians and project development, work takes place in a spatially fragmented manner. The combination of these locational attributes and the reliance on subcontracted networks for workers on things like project development can make it difficult to create solidarity between workers—at least outside of the familial sort of relations that develop within small wind technician teams (i.e., the idea of a “wind brotherhood”). Future organizing efforts across the industry may, therefore, come from within the ranks of wind turbine technicians, who may choose to leverage their collective structural power to create improvements to labor rights and standards in other parts of the production network.

Where I focused primarily on project development and O&M work in this chapter, with a few references to manufacturing, I now turn my attention to manufacturing activities that, unlike project development and O&M work, exhibit a greater degree of spatial fixity emblematic of industrial sectors in other eras. As we shall see, many of the same political and economic dynamics that characterized past industries appear to reproduce themselves in the wind energy industry. To show why this is the case, let us now turn to various sites of analysis associated with the global wind OEM Vestas.

CHAPTER 9: THE DEVELOPMENT OF A LOCAL WIND MANUFACTURING CLUSTER IN COLORADO

In March 2008 the Danish corporation Vestas opened its wind blade manufacturing facility in Windsor (Fried 2008), the first of a manufacturing cluster located along Colorado's front range at the base of the Rocky Mountains. Vestas later opened a nacelle facility in Brighton in July 2010, a tower facility in Pueblo later that year, alongside an engineering and research center in Louisville. But why would a Danish firm choose Colorado for its North American manufacturing cluster? Moreover, what does this tell us about how labor regimes both shape, and are shaped by, the locational decisions of a company like Vestas? And, in line with the goals of the rest of the dissertation, what does this tell us about the "green" and "climate" jobs that result?

Although Vestas' locational decision may seem like an open and shut case of market expansion, the story is a great deal more complex. Vestas could have located its cluster elsewhere in the US, Canada, or Mexico as peer competitors had done. Indeed, archival research shows Colorado was not a forgone conclusion; Ohio also sought to bring Vestas to its state. And, more recently, Vestas leveraged a clause in its contract with TPI Composites in the Northeastern part of Mexico to produce blades for Vestas' turbines (Weston 2018), a partnership later extended and expanded in 2022 (Vestas 2022).

In this chapter, I explain why and how Vestas chose to locate the core of its North American operations in Colorado. In so doing, I show how "green" capitals continue to rely on an amoral calculus that limits the potential quality of work affiliated with green sectors, including more emancipatory forms of eco-social work. As part of this, I argue that state institutions across

governance levels—subnational and localities—play an essential role in cultivating distinct labor control regimes to attract capital investments from transnational companies to develop nodes in certain places. Related to this, I also show how capital continues to rely on the construction or use of difference, across class and race, in its accumulation strategy.

Race and Place in the Construction of Local Labor Regimes

Economic development processes are essentially historical and political in character. Although dependent on national context, the consequent development of local economic activities depends a great deal on local histories. A series of distinct local capitalisms understood as, “a nexus of production, reproduction of people, and the state within a locality” results (Gough 2014).

Each of these localities are themselves constructed through internally related attributes of gender, ethnicity, and class that differentiate communities from one another, which establish conditions of uneven and combined development. ‘Uneven’ refers to the particular social relations and resources that develop from the expansion of capital to different parts of the world, and ‘combined’ describes how the development of different territories depends on the flow of commodities, money, and productive capital to them (Trotsky 2004; Smith 1984 [2008]). Theoretically, this means local communities and corresponding governing institutions are connected to past periods of development in capital’s search for greater surplus value, and these developments condition the associated politics of place. When assessing transnational investment decisions of an entity like Vestas, the pivot to localities helps us see how social life and lived experiences of people in different places acts as the impetus for institutional development. In the words of Ian Bruff (2011) it is not just varieties of

capitalism, but varieties *in* capitalism that matter (Bruff 2011). We might point to Nixon's Southern Strategy as an example of what this looks like in the US.

None of this is new, of course. The construction of difference by capital is well acknowledged in a range of literature. Nevertheless, labor regime scholars seek to better integrate how local and global processes connected with colonial legacies mutually constitute such outcomes (Baglioni *et al.* 2022). Turning again to the US, labor relations are shaped to a significant degree by its history of slavery and associated ongoing relations, and the appropriation and abuse of indigenous peoples and migrant workers (Hogler 2015).

Where the prior chapter discussed how infrastructure, labor costs, ecological challenges, and markets at a national and regional level influence labor regimes in general terms, here I focus on the manufacture of *local* renewable energy labor regimes. In particular, those associated with Vestas sites in Colorado. As part of this, I show how they are constitutive of classed, gendered, and racialized relations that are essentially oriented towards capitalist needs (see Mignolo and Walsh, 2018; Svampa, 2019; Brand, 2022). That the constitution of wind GPNs depends upon, at least partially, the reproduction of social divisions along racial and class lines impugns the green bona fides of renewable energy. It suggests that renewable energy capitals operate like any other enterprise, they function in the pursuit of surplus value at the expense of social and ecological considerations in the output, processes, and uses of their product. Critical to the larger argument of this dissertation, renewable energy capitals appear to reify existing social relations of difference.

Vestas Blows into Colorado: A History

"Project Chinook" – Vestas Comes to Windsor

Vestas began looking for opportunities to expand into the North American market sometime in the late 1990s and early 2000s. Despite the company's interest, this did not translate into formal conversations until the mid-2000s. Nevertheless, Colorado was not the obvious choice as few wind plants existed in the state at the time (I32).

Formal conversations between Colorado and Vestas began during Governor Owens administration when the Royal Danish Consulate initiated communications with the Office of Economic Development and International Trade (OEDIT) in Fall 2006, notifying it of a Danish company's intent to locate a manufacturing facility in North America (Vestas Wind Records, January 15, 2007, email p. 5).⁷⁴ Vestas Blades A/S, a subdivision of the larger Vestas Wind Systems corporation, was the company in question. In October 2006, company representatives visited two sites that matched their criteria, one in Jefferson County and another in Weld County. In November 2006, the Vestas Board of Directors approved its North American expansion, selecting Windsor, Colorado in Weld County as the site of development. Colorado's Economic Development Commission (EDC) made an initial offer to Vestas on November 9th, which would later be amended for an offer of \$1,016,500 in direct cash incentives, not including local incentives offered by Windsor (Vestas Wind Records,

⁷⁴ OEDIT is an office associated with the state of Colorado for the purpose of helping to attract outside businesses to the state, as well as supporting local ones. As we shall see, it plays a critical role in advertising Colorado attributes that are attractive to business, which include making the state capital and resources (not just money, but also training) available.

December 11, 2006, memo p. 9). The offer was contingent on building the site in Windsor and hiring 464 new full-time employees, both of which the company fulfilled.

Considering the wind market at the time, Vestas sought a central location in the West or Mid-West from which turbine parts could be transported via railway across the US, and into Canada and Central America. In this case, the initial decision was to determine appropriate locations for a possible facility with reasonable proximity to existing or expanding markets. Colorado, but many other states in the Western and mid-Western US matched their criteria. Several other blade companies like Siemens, TPI for General Electric, and others already had operations based in Iowa, as well as locations along the eastern seaboard, including in Montreal, Canada. At the time, however, the Western US east of the Rockies remained open territory with respect to proximal access to future wind deployment activities—something that would make some of these states more attractive to develop, particularly considering the associated logistical challenges and associated costs of moving large turbine parts. Of course, while this proximity to available resources matters, it only provides us with a necessary condition for why Vestas chose to locate a manufacturing cluster in Colorado.

Around this same time period, Colorado's governor race was underway. Democratic nominee Bill Ritter ran a campaign that included the idea of a "new energy economy" for the state of Colorado. He ended up winning the nomination during ongoing negotiations between Vestas and Governor Bill Owens administration, which may have given the company more confidence to locate *additional* manufacturing operations in Colorado—they could not only take advantage of the federal Investment Tax Credit (ITC), but also local policies in the state. In this regard, Ritter's ascension to governorship was a pleasant happenstance for the company, but hardly definitive. That said, even if this does not provide a definitive explanation, it may have helped to facilitate additional investments into the state

as capital is generally attracted to environments with minimal risk (i.e., stability in the surrounding political environment). That Colorado had demonstrated commitment to renewable energy in both its politics, but also through research enterprises like the National Renewable Energy Laboratory in Golden, Colorado offered a measure of assurance to Vestas leadership that Colorado could be a surer long-term bet for investment than other states at the time. However, that Vestas considered Colorado in the early 2000s shows that even before the policy shift and adoption of RPS standards in 2005, it was already thinking about CO. All to say, the RPS policy environment was important but it not definitive for Vestas locating to Colorado.

Windsor and Workforce Development

During negotiations, company representatives suggested that employee training for the manufacture of wind blades is unique and represents some of the most significant start-up costs for the company (Vestas Wind Records, December 11, 2006, memo p. 7). Where other capital expenditures are relatively fixed, labor represents a malleable sphere where capital extracts surplus value. In negotiations, Vestas amended its request for monetary assistance to train new employees at the Windsor Facility. The total included financial support of \$928,000 (464 employees x \$2,000) to the company (Vestas Wind Records, p. 7). The state reasoned that this investment would help Colorado compete with other locations in the US. As stated in archival research, the OEDIT solicited the EDC to pay this amount to secure Vestas for Colorado.

In an email sent to Kjaer Jakobsen, Vice President of Business Development for Vestas Blades A/S, then OEDIT director Brian Vogt made a formal offer of the \$928,000 for training, alongside touting Colorado's "low taxes, low regulation, and solid workforce" as rationale for why the company might locate its operations in the state. As previously stated, the offer totaled \$1,016,500, which included

\$928,000 for training and an additional \$88,500 for job creation-based performance incentives (Vestas Wind Records, Dec. 11, email memo, p. 10). That is to say, it would offer incentives to cover some of the social reproductive costs associated with Vestas operations (i.e., training and education for workers). Although Colorado's government could not match direct cash incentives offered by other governments—Colorado being somewhat strapped by TABOR (19; 137)—it *could*, and did, tout a business-friendly environment marked by low regulation. Indeed, VP of business development Kjær Lund Jakobsen referenced Colorado's professional response and business-minded "bureaucracy" as helpful in further securing Vestas' decision (Bruns 2009). Colorado even hired a single point of contact to work with Vestas as "their man on the ground" who could take care of anything the company needed to accomplish and smooth over rough edges or challenges associated with working internationally (137). That same individual would later go on to work for the company. Even still, while the "business friendly" bureaucracy may have helped secure Vestas for Colorado, it does not explain the initial rationale to locate in the state, or what was appealing about certain localities, in particular.

Historical Influence

In the case of Windsor, the initial population primarily worked on harvesting sugar beets to process at the Great Western Sugar Company, which had a factory in Windsor. As a result, Windsor is crisscrossed with railroad tracks where a predominantly immigrant workforce would gather sugar beets, place them in large "beet dumps", and then send them to the factory for processing. These same rail lines were appealing to Vestas, which requires access to rail to transport large parts (137).

More importantly, Windsor had a reserve of semi-skilled manufacturing workers the company could tap into. Kodak—the camera company—established manufacturing operations in the town during the 1970s shortly after the Sugar Beet Factory closed down (Ferrier 2021). By the time Vestas

was looking to locate its facilities in Colorado, traditional film technologies used by Kodak cameras were in dramatic decline as digital photography and video took off in the late 1990s and early 2000s.⁷⁵ Kodak's decline made attracting future investments a top priority for Windsor. Politicians in Windsor, and Colorado more generally, sought to resolve capital's contradiction (i.e., the simultaneous expansion and contraction of enterprise) brought about by the transition from film to digital photography. They did so by providing over \$11 million in business incentives, including \$617,964 to Vestas Blades America in 2007 (Ferrier 2021) in addition to the money put up by the state. As part of this, the town also offered a 50% rebate on personal property taxes paid on new equipment used by the Vestas facility, which led to an additional \$27 million in plant investments from the company. Furthermore, BROE Real Estate cut a deal with Vestas and sold some of the additional land it required for its facility at a discount (I37), constituting an additional incentive for Vestas (Ibid).⁷⁶ Here we can see how the development of new industries rests on the "archaeology" of past cycles to use Massey's (1984) turn of phrase, similarly remarked upon by William West-Guard Cruice in his studies of wind energy manufacturing in Europe (2024).

The case of Windsor reaffirms Dorreen Massey's (1984) observation that localities attract investments through an abundant supply of labor power or cheap property, both of which were present in Windsor. Critically, the locality itself plays an important role in attempting to rectify the contradictions of past periods of divestment through policies designed to help secure future

⁷⁵ Ironically, Kodak pioneered digital photography technology, but failed to see how it would change the marketplace (World Economic Forum 2016).

⁷⁶ Notably, BROE would not extend the same discount to Vestas when it wanted to expand its blade facility and, as a result, Vestas instead extended blade production activities to its Nacelle facility in Brighton where they were able to acquire real estate at a discounted price (I37).

employment opportunities. In the next section, I further elaborate this point by pivoting to another part of Vestas' Colorado manufacturing cluster, Pueblo, to reaffirm the role "local capitalisms" play in resolving the contradictions of global capital. More specifically, I discuss how localities seek to manufacture local labor regimes to help attract capital as part of this effort. Critically, the site of Pueblo exists in relation to other manufacturing sites in Colorado, and as I will explain in greater detail next chapter, they exist in relation to other localities across Vestas' GPN.

Strong as Steel: Vestas Comes to Pueblo

Vestas would open several other manufacturing centers in Colorado in the following years, including a hybrid wind blade and nacelle facility in Brighton, and an R&D facility in Louisville along the metropolitan corridor colloquially known as the "Front Range". The largest expansion, however, was the October 2010 opening of the nearly 13 million square foot wind tower manufacturing facility on the south end of Pueblo.

Vestas Towers began looking into "brown field" (i.e., previously developed) sites around the middle of 2007 (137). Because of the size of the plant, Vestas did not want to build the plant up North where land was much more expensive. So, one of the places it could purchase cheaper land was in Pueblo. The initial proposal included a retrofit of two buildings previously occupied by Boeing, and the construction of a third building for heavy manufacturing. The selection of the two buildings made sense given the cylindrical shape of airplane cabins, something that could theoretically be adapted to wind turbine towers. However, after a series of failed design attempts, Vestas decided it needed to create a new facility, which was similarly reinforced by shifts towards larger, higher capacity turbines that required more steel and larger scale infrastructure.

The development of a greenfield site led to ongoing negotiations between June and December 2007 among Pueblo, Vestas Towers, and the Pueblo Economic Development Corporation (PEDCO), a local economic development non-profit (Vestas Wind Records, October 9, 2007, p. 1-2). In these negotiations, PEDCO would agree to cover infrastructure and costs like extending water, sewer, and electricity access to the newly developed greenspace (I36), amounting to millions of dollars in indirect support to enable the company's operations.

Around the same time, Vestas confirmed for Colorado their support for "one state manufacturing" in January 2008. Vestas leadership believed one-state manufacturing could ease challenges associated with outbound logistics (I37). "Unit-trains" would combine 60-72 railcars or about eight complete wind turbine generators on one train (I32). Reduced distances between manufacturing units within the same state could make this possible and save the company money on logistics. As before, the state of Colorado offered Vestas some marginal direct financial incentives. This included \$2-3 million in cash, including additional money for associated job creation through the PIF Program, Enterprise Zone Program, and Colorado FIRST. That included \$2.25 million with \$2 million in the form of community block grants, \$125,000 from Colorado's Clean Energy Fund and \$125,000 from the EDC (p.1-2). PEDCO also put up \$10 million in cash incentives, in addition to the infrastructural investments to connect the tower facility to the community's utility systems (I36). In the end, the estimated level of financial support from PEDCO amounted to \$32,710,000 based on the assumption of 550 employees at the tower plant (p.1). As part of its offer, Pueblo, like Windsor, offered training support to Vestas through Pueblo Community College, which maintains its relationship with the plant to this day (I36). When the tower facility was ready to open, over 10,000 applications were filed for roughly 500

positions (I32), revealing a structural asymmetry in the job market at the time, one tilted in Vestas' favor.

"Pittsburgh of the West"

Vestas's decision to locate its tower facility in Pueblo echoes Windsor's in many respects, but with some added wrinkles.

Like Windsor, Pueblo's industrial history helped establish a foundation on which new capital investments developed. In the case of Pueblo, the central activity was the creation of the steel mill, which began operations in 1872. It quickly became the preeminent steel city in the American West—one that, quite literally, forged the rail lines that helped enable large scale mining and agriculture industries (Steelworks Center of the West n.d.). Like Windsor, many immigrants around the world worked for CF&I and the mill (Schreck 2022).

Fast forward several decades, the steel mill was acquired by the Crane Company of New York in 1969 when it purchased 82% of CF&I Steel Corporation's stock. US steel manufacturing was making significant profits in the 1960s and 1970s and consequently would run its plants overtime, even when it cost extra, because it reaped significant profits (I21). However, US companies failed to reinvest in their steel mills, and higher tech steel making options in countries like Germany resulted in a decline in US steel. Where the steel mill had once employed somewhere between 9,000 and 10,000 people in 1970, its workforce shrank to around a thousand people in the 1980s (I21). In response, Pueblo established PEDCO in 1981 for the primary purpose of job creation and to bring private investments back to the city (PEDCO n.d.). In 1984, Pueblo voters approved of a half-cent sales tax for the purpose of economic development and to fund capital projects and equipment purchases for companies like

Vestas. It is an example of how localities not only seek to resolve contradictions of the locality put into global competition, but also an example of collective worker agency as these voters sought to make their locality attractive to future investments and, by extension, employment opportunities.

Considering ecological and production spheres of the labor regime, wind towers are steel intensive, and their production requires welders, machinists, painters, electricians, and assembly line workers among others. Because of Pueblo's history, it had such skills in abundance. Indeed, one interviewee noted that they believed Vestas' put its location where it did, in part, because it could attract workers from the steel plant to come work for it (I21). However, few people employed at the mill chose to voluntarily move to Vestas unless circumstances forced them to do so (I21).⁷⁷ In this fashion, we can see the ways in which workers exist in relation to one another not only within a specific workplace, but also across industries in localities, which conditions the formation of the labor regime and brings with it important analytical implications for how we choose to understand the evolution of global production networks.

NREL's Pull: Considering the "Collective Worker"

Alongside the availability of a semi-skilled labor force for manufacturing, several interviewees noted Vestas was intrigued by the possibility of locating its blade facility near the National Wind Technology Center along the southern edge of Boulder (I9; I32; I37).⁷⁸ Under control of NREL, now named the National Laboratory of the Rockies (NLR), the wind facility houses some of the world's

⁷⁷ Along these lines, when unionized workers at the steel mill receive wage increases, the same occurs at Vestas (I17).

⁷⁸ The facility has since been renamed the Flatirons Campus as part of a rebrand to demonstrate how the site increasingly pursues other forms of research outside of wind energy research.

foremost experts on the advancement of the engineering and science of wind energy. Indeed, researchers at NLR have close relationships with researchers at the Technical University of Denmark (DTU) and play an important role in the governance and research of wind energy through both the Global Wind Organisation and International Energy Agency Wind Task Groups (I6).

These relationships and expertise would have appealed to Vestas to perhaps increase the relative surplus value of their operations. Indeed, Vestas located its now since closed R&D facility in Louisville, just a few miles east of the wind research facility. In this respect, we can see how it is not only the direct workforce that a manufacturer may consider, but also the broader working class of individuals who could theoretically aid a company's accumulation strategy. Analytically, this suggests that workers not only exist as individuals, or as groupings in specific places, but may also be considered as part of a larger collective assemblage with differential aptitudes capital can take advantage of for the purposes of surplus value accumulation (see Gough 2014). This is why it is important to not only consider how local labor regimes not only depend on the immediate site of work, but also capital-labor relations in a place more broadly—both spatially and across time.

Local Labor Regimes Embedded Within National and Global Political Economy

As highlighted in the prior chapter, the US represents a prototypical example of a labor-market control regime, in which managers control workers through market forces and repressive actions against workers (Anner 2015). The US experience demonstrates how the 'mute compulsion' (see Mau 2023) of capitalist accumulation generates a self-help environment that conditions corresponding worker strategies for survival. These dynamics are buttressed by a more specific labor control regime known as a social workfare regime (Peck and Theodore 2000; MacLeavy and Peoples 2009) whereby

social benefits like access to health care depend on employment. The compulsory and structural power this provides capital should not be discounted. There have been at least two attempts to unionize Vestas facilities in Colorado, but the most recent attempt stopped when the person who reached out to the United Steel Workers ceased activities for fear of reprisal and consequent losses to both wages and associated healthcare benefits (117). That Vestas manufacturing operations in Colorado are not unionized makes the associated green jobs socially harmful according to the typology. It is, however, state institutions at both the local and national level that may be to blame for such an outcome.

It (almost) goes without saying, but institutions at both the local and national level play an important role in manufacturing distinct local labor regimes that govern the capital-labor relationship. In many respects, Colorado is ground zero when it comes to not only local labor relations, but also industrial relations in the US more generally.

The national passage of Taft-Hartley in 1947 that affirmed states could impose right to work laws that prohibit union security agreements was modelled on the 1943 passage of the Colorado Labor Peace Act (Hogler 2009; Hogler 2015: 126; Sherer and Gould 2025). In both cases, the laws resulted from white and elite backlash against multi-racial organizing and claim making among black, brown, and immigrant workers (Hogler 2015).

Unlike typical right-to-work legislation, Colorado's law does not preclude union security agreements (i.e., the thing that requires workers to pay membership dues for joining a unionized workplace), but it nevertheless makes union survival a difficult prospect through the implementation of a two-vote procedure. The first vote constitutes a standard union election in which only a majority

is necessary to establish the union. However, the second state administered vote is much more challenging and entails a separate supermajority (75%) before a union can negotiate a security agreement that requires membership dues or fees from all employees represented by the union (8-3-106).⁷⁹ Given the high threshold, this second vote usually fails, which strips a newly formed union of necessary resources in terms of prospective members and financial support.

More recently, Colorado legislators have attempted to change the Colorado Labor Peace Act twice, once in 2007 under Governor Ritter and twice under Governor Polis in 2025 and 2026 (Paul 2026). Both times, the Legislature has passed the measure only for a Democratic Governor to veto the bill. Governor Polis—a former businessman—argued that individual workers should have more say in negotiating what he framed as a “mandatory wage deduction” (Wilson 2025), describing the issue of one of individual rights and liberty. Governor Ritter similarly rejected the bill but was more forthright in his rationale citing Colorado’s ability to attract new businesses (like Vestas) and the state’s economic viability (The Denver Post 2007).⁸⁰ Given this understanding, jobs become a form of concession offered by capital to locals and localities in exchange for acquiescence to their preferred accumulation strategies. Colorado’s government, in concert with national policy, has manufactured an institutional environment to constrain labor organizing to attract capital investments. That includes the

⁷⁹ In 1976 a lawsuit supported by the National Right to Work Legal Defence Foundation led to an NLRB ruling that the second election requirement in states like Colorado could be enforced (Sherer and Gould 2025). Where federal law was presumed to supersede Colorado law, this ruling called into question the legality of thousands of collective bargaining agreements in the state, which ultimately led unions to strike a deal with lawmakers to retroactively validate existing collective bargaining agreements, but at the cost of continued imposition of secondary election requirements in all future organizing efforts (Hogler 2007).

⁸⁰ During the Obama Administration, lawmakers in 13 states introduced right-to-work bills in 2011 for the same reasons, to help “attract businesses and create jobs” according to one survey (Hogler 2015: 2)

aforementioned social workfare regime, and the surrounding institutional environment that is largely hostile to labor unions. Such is the crucible from which Colorado's new energy economy is born.

Worker "Loyalty" and the Preservation of Value

GPN scholars are well attuned to the ways in which subnational regions are included in the global circuits of capitalist accumulation (Coe *et al.* 2004). Generally, these analyses discuss developments as a matter of "strategic coupling" in which global firms interact with localities and regions with unique institutional configurations to bring about economic development. As the preceding analysis shows, Colorado and its many localities are no different in this regard. The principle sites, Windsor and Pueblo, both worked with Vestas and the state government to court Vestas. While they directly collaborate through various forms of economic development, they further influence TNC decisions by attempting to cultivate local labor regimes with certain characteristics to conceivably attract future investments from the circuits of capital.

These local labor regimes take on distinct characteristics that influence capital decisions not only through the construction of an institutional landscape, but according to sociohistorical processes of place. In the case of Colorado, this relates to earlier periods of industrialization, and considering things like Colorado's Labor Peace Act, these also trace to legacies in the construction of class and race. Indeed, as previously stated, much of the impetus for the Colorado Labor Peace act was to restrain cross-racial organizing as immigrants and other subaltern workers made claims on their rights at work (Hogler 2015).

Capital is aware of such dynamics and continues to leverage them in their accumulation strategy. Even in ostensibly more socially progressive industries like renewables, or from socially democratic

countries like Denmark, preference for different labor control regimes is conditioned by perceived attributes connected to class and race. One interviewee put it like this,

"Vestas went down South to get outside the big cities. A large share of people in Pueblo are Hispanic. Hispanics are generally more loyal than other groups, especially to their family. That means the investments you put into an area will remain there, even if they become unemployed. That's just not how it is up North. In the Northern part of the Front Range, the people get more training, power and then leave. So, I can tell you that because of the amount of training needed, worker loyalty was a factor. There were also a lot of people in Colorado Springs who were former military that could also be loyal workers too." (I32).

From the standpoint of capital, there is a great deal of value in a workforce that remains in a fixed location, which preserves capital's "investments". In this case, the local labor regime takes on racialized and class-based attributes according to spatial and temporal relations, and in regard to the sociohistorical legacies and institutional apparatus that results. If capital believes a certain workforce will be loyal and less disruptive, they will be more likely to invest into a place they believe will preserve value associated with labor power in the event of disruptions to capital circuits from changes in market conditions. This is especially important for wind companies as it has been prone to periods of disruption characteristic of a relatively new capitalistic industry (see Chapter 8 and Westgard-Cruice *et al. forthcoming*). Critically, local labor regimes and corresponding forms of control are not only constructed through legal institutions and past cycles of investment and divestment, but also through capital's conscious belief about different "capabilities" inherent in a population—in this case, assumptions tied to perceptions of ethnicity and military training.

Colorado Linkages to other Manufacturing Sites

To further understand Vestas' decision, the comparative logic of siting comes into play—the comparative logic that helps us attend to global and local scales simultaneously. While Vestas was

opening its manufacturing cluster in Colorado, it was engaged in the closure of one of its blade plants in the United Kingdom. In July of 2009, workers staged a sit-in protest at a Vestas wind turbine blade factory on the Isle of Wight in response to the facility's announced closure. Approximately 25 workers took part, believing their factory was still economically viable (Trevor 2009; Gibbs and Kerr 2022). Reports from workers themselves indicate that they believed a factory conversion to produce larger wind blades was moving ahead (Trevor 2009). The British government had just published a paper on the expansion of "green jobs" to make progress on emissions goals and to boost the economy just before the company announced the plant closure (Vidal 2009).⁸¹ The sit-in ended when 18 days into the dispute when a British court approved an eviction order filed by Vestas (Gibbs and Kerr 2022). Vestas plant managers delivered termination notices to 11 of the 25 protestors positively identified during the sit-in by sliding notices under evening pizza delivered to the protestors (Walker 2009).

Vestas informed the workers that its decision to close the plant was done for "commercial reasons". As discussed in the previous chapter, wind energy is capital intensive and the costs of raw materials and other capital expenditures remain largely fixed, with prices fluctuating according to inflationary pressures (see also Westgard-Cruice 2024). In this instance, the conservative Isle of Wight MP Andrew Turner informed the House of Commons that Vestas chose to cut jobs and close the

⁸¹ In response, Joan Ruddock, a Labour Party MP and head of the State for Energy at the Department of Energy and Climate Change met with the workers to discuss their needs. In a somewhat humorous (and telling exchange), an interviewer asked why the British government could not intercede on the workers' behalf and take ownership of the production facility to save these jobs and aid the local community. In responding to a question concerning the creation of a feasibility study to explore such a strategy, Ruddock remarked that "There has not been a feasibility study because we are not going to nationalize, because we are sticking to our principles" (Trevor 2009). Principles that entail the continuation of the neoliberal project and prioritization of a commodity's exchange value, rather than its use value.

factory not because of the recession, but that it believed it could produce wind turbines more profitably in the United States and China (Turner 2009; Hampton 2015: 208).

For our purposes, the decision to close the Isle of Wight facility helps to further contextualize Vestas' decision to locate operations in Colorado. The pivot to Colorado and the US market was deemed more profitable not only because the company wanted to move into an expanding market, but they also leveraged mobility as a disciplining mechanism, shifting operations to a locality they believed had a labor regime that made for a more controllable workforce, something that would aid their accumulation strategy. The perception of labor controllability is therefore not only dependent on the availability of a reserve group of workers and the governing institutions that mediate the capital-labor relationship, but also beliefs about the characteristics of different groups of workers that take on perceived racialized and class-based attributes from the standpoint of capital.

The Purpose of Green Jobs from the Standpoint of Capital

As the preceding analysis demonstrates, workers and local capitalisms not only exist in relation to one another across space, but across time. To understand Vestas' locational decision, we can see how prior periods of industrialization and deindustrialization provide the foundation for new forms of capital. In this instance, the two primary sites of analysis, Pueblo and Windsor, had experienced prior periods of industrialization and deindustrialization that provided a base for future wind energy developments. If we understand capital in the Marxian sense of "value in motion", then the accumulation strategy for new industries like wind entails the use of "dead capital" (i.e., where the motion has ceased or slowed). Dead capital does not often remain idle, and these past areas of divestment and deindustrialization may be resuscitated in future accumulation strategies. This includes

both the material infrastructure of an area, as well as the collective workforce available in a locality. Of the two influences, the latter is the more critical as labor power reanimates the value latent in a place. However, while this is a necessary condition, it does not fully explain Vestas' choice to come to Colorado. Here we need to shift our attention to labor.

Colorado's industrial legacy ensured Vestas had the necessary base of semi-skilled workers to carry out its core accumulation strategy, while also having access to Colorado's highly educated workforce and the presence of NREL for the purposes of greater surplus value accumulation through a partnership with a research entity primarily funded by American taxpayers. Localities like Pueblo and Windsor further cater to capital through training programs with local education institutions which serves to offload costs associated with social reproduction (upskilling, in this case), which helps companies further maximize relative surplus value.

Analytically, labor regimes and the eco-social typology's attentiveness to spatial and temporal relations demonstrate the important role that state institutions play in arbitrating the capital-labor bond. Critically, and in line with the theorization of Jamie Gough (2014), localities or "local capitalisms" act so as to resolve past contradictions of capital to aid in the social reproduction of the workforce. In this chapter, I have shown how states may seek to entice companies like Vestas by manufacturing distinct local labor regimes. They may do so through policies like the Colorado Labor Peace Act that constrain more contentious forms of labor resistance—a point I will expand on in greater detail next chapter. States may also craft regimes in which states and localities largely take on the responsibility of some of the social reproductive aspects of a company, namely, the costs associated with training workers.

Analytically, this suggests local capitalisms and the associated workforce express agency in a contradictory manner. Localities placate capital by helping train workers for production, which also upskills individual workers and affords them a greater deal of individual agency. At the same time, however, forms of collective agency and autonomy are limited by structural dynamics internal to capital, spatial disciplining, and most importantly the manufacture of local, regional, and national labor regimes that govern the capital-labor relationship and that are contingent on ongoing sociohistorical relations. For GPN scholars, labor regime analysis and its foregrounding of labor at the center of analysis reveals how both lead firms and state institutions play a crucial role in constituting workplace outcomes. However, these are themselves responses to historical relationships between capital and labor, in addition to contemporary shifts in markets.

It is therefore crucial to understand how these historical relations shape arrangements between capital and labor, as this has important implications for how workers perceive newer industries like wind. For Jamie Gough (2010), the logic of competition reinforced by periods of past divestment extends into the minds of workers themselves, who pursue various strategies to ensure their social reproduction, like individual career advancement, social discrimination, and collaboration with capital to enhance production and efficiency. The logic of neoliberalism legitimizes this competitive logic as an ideological mechanism that puts the onus on individuals to secure themselves in the face of the 'natural' consequences of the marketplace (Gough 2010; Brown 2019). In any case, the lesson from this is that structural economic power governs the actions of local governments and associated offices, as well as the strategies of both organized and unorganized workers, actions that shape GPNs through strategies that vary according to cooperation, organization, and resistance (Herod 1997). However, these histories and material conditions also shape the ideational terrain workers occupy (see Gaventa

1982). Again, none of what I am describing here is new, but that these social relations embed themselves in elements of expanding industries like wind may give us pause. They appear to reproduce injustice of the sort that fuels politics of resentment and engenders distrust.

Considering the larger argument of the dissertation, this chapter shows how the locational decisions of companies like Vestas may reproduce historical inequities and forms of exploitation of the past rather than establishing new pathways. As I showed, this also continues to happen along divisions of race and class. Although I recounted exploitation associated with production activities in Chapter 2, this chapter shows in more precise terms how the amoral logic of capital continues to leverage difference in its accumulation strategy. In this case, the preference for “loyal” workers attached to perceived attributes of residents in Pueblo and Colorado Springs, and a belief that certain localities would be better than others to better preserve investments in the likely event of industry upheaval.

The exploitation of labor power within localities thus continues to be oriented towards capital centers along racialized and class-based divisions in keeping with theorization of Aníbal Quijano’s (2000) “coloniality of power”. That is to say, when we consider green and climate jobs, a division of labor not only exists between parts of the Global North and South in rough geographic terms, described in Chapter 2, but elements of “the South” find themselves in parts of the North that companies may leverage for their own gain. In essence, the logic of renewable energy logics within GPNs do not transform eco-social relations but instead reproduce historical relations of development through the production of difference, arguably a natural tendency of capital (Mau 2023: 171).

Taking Stock

How are we then to put the above discussion into succinct terms and juxtapose it to the range of possibility for green or climate jobs that might otherwise exist? The analysis in this chapter shows that a dialectical relation exists between workers, past periods of labor militancy and associated institutional responses of the state at varying levels of governance. The resulting uneven landscape of development puts workers in relation to one another across space (Gough 2010), which conditions the labor process at the point of production embedded in a local labor regime. Crucially, these regimes are not natural. Instead, they are manufactured or “crafted” to use the language of Steven Vogel (2018). TNCs *consciously leverage* perceived attributes of the workforce in production strategies connected to class, race, and place. A combination of control through economic power connected to the nature of capital reinforced by state institutional governance in the sphere of reproduction conditions the outcomes we see in the energy transition that limits its transformational potential. These impugn the realization of more robust eco-social forms of work that give greater voice in the social processes of work, as well as what the uses of wind power could be put toward.

Indeed, pause for a moment and consider how odd it is that labor is responsible for the manufacture and development of wind energy projects, and that workers like those at NREL are responsible for many of the technical advances in the wind energy industry. These advancements are advanced by US taxpayers, which should prompt us to ask why wind projects remain in the hands of a small minority of people, and that the associated uses of electric power is not democratically determined.

With respect to political interventions, therefore, it is local capitalisms where manufacturing workers, trade unions, and their allies may choose to focus their political energies. To move the industry in a direction that is more socially just for workers, we cannot depend on the goodness of renewable energy capitals, but require policies that create a more even playing field across sites both within and outside of local communities. In the case of Colorado, an essential first step involves repealing the Colorado Labor Peace Act.

Let us now turn our attention to what the conditions of manufacturing work look like, and how green and climate jobs within local wind energy labor regimes may evolve over time.

CHAPTER 10: LABOR REGIME EVOLUTION, CONSIDERING VESTAS AND TRADE UNION POWER

Historian William Convery describes the Colorado Coalfield war between the years of 1913 to 1914 as the, "bloodiest civil insurrection in American history since the Civil War" (2019). The conflict involved striking miners, mostly immigrants, against deplorable work conditions of the Colorado Fuel & Iron Company (CF&I), the main proprietor of the coal mines and the Pueblo Steelworks among other things. The conflict came to a head when the Colorado National Guard attacked a tent colony of striking miners, killing twenty-four people, more than half women and children, in an event known as the Ludlow Massacre (Library of Congress n.d.).

To use John Gaventa's (1980) parlance, Ludlow signaled an important moment of 'rebellion' in social relations between capital and labor, both in Colorado and the US more broadly. It led to the further elevation of some of labor's most deified (and vilified) figures, like "Big Bill" Haywood of the Industrial Workers of the World and Mary "Mother" Jones. Ludlow also presaged the establishment of company unions as a form of ostensible worker representation in the production process, although these were outlawed in 1935 by the National Labor Relations Act (Hogler 2015: 69). In effect, Colorado workers not only built the rail lines that connected communities across the Western US, but laid foundations for US labor relations more broadly—forged in furnaces of iron and blood.⁸²

⁸² Ludlow and labor relations in Colorado were just one in a series of events that led to the later passage of the NLRA that, as a reminder, carved out protection exemptions for certain groups of workers along racist and class lines. And, again, Colorado acted as a staging ground for the hegemonic backlash against worker rights with the passage of the Colorado Peace Act, which served as the framework for Taft-Hartley in 1947 (Hogler 2015).

I begin with this history because, as we shall see, it has shaped the formation of Colorado's politics and associated labor regimes, including the regime that governs wind manufacturing work associated with Vestas. I use this history to draw parallels between historical labor relations in the US and those leveraged by Vestas, namely, the legitimization of anti-union practices through paternalistic language. Moreover, this history helps explain the circumspect attitude that some elements of Colorado's trade union movement (and arguably some trade unions across the US more generally) have towards the prospects of employment in renewable energy (see also Stevis 2013; Betsill and Stevis 2016; Vachon 2023; Cha et al. 2021; Cha 2024).

In essence, I situate the wind energy labor regime in Colorado historically, using a relational history (see Stevis 2022) to show how labor regimes in Colorado, including those that govern wind energy work, have been shaped by this history. I will show how this history not only influenced the locational decision of Vestas discussed in the prior chapter, but how these local histories reproduce particular labor regimes that then mediate and condition the types of jobs that result in industries like wind.

To make that argument, I also examine how management processes may evolve, including how this influences the conditions and settings of work elsewhere in the production network. I add what I believe is another subcategory of 'spatial fix'—elaborated extensively by David Harvey (1981) and Beverly Silver (2003)—that not only includes things like capital flight to other locations or the import of workers, but how transnational capital adopts management characteristics emblematic of the host country in which they are embedded. Related to this, I explain how companies may locate their regional management offices in places away from where the bulk of employment activities occur. I wager this acts as a form of psychological insulation from the socioeconomic impacts of management

decisions (a 'psychological fix'). A contradictory relationship therefore exists between the avowed paternalistic tendencies of a company in plant management and the physical, and by extension psychological, distance that exists between regional corporate headquarters and the bulk of its workforce that better enables restructuring decisions by rendering the workplace and associated jobs as an abstraction. That is to say, management decisions occur through metrics rather than through established relationships. The extent to which this holds true within the host country, or with other companies is an area for further exploration. Regardless, the underlying logic for strategies of this sort remain the same. It derives from capital's incessant need for profitability in response to crisis.

Unfreezing Colorado Labor Relations

As the prior chapter implied, steel production played an important role in Pueblo's history. So much so, the city dedicates a local museum, The Steelworks Center of the West, to that role. Pueblo also represents a historic bastion of militant organizing and organized labor power in Colorado. For these reasons and its relation to Vestas, I use Pueblo to help anchor Colorado labor relations.

From Ludlow to USW

Steel operations in Pueblo began in 1872. Later, operations consolidated into the Colorado Coal and Iron Company in 1880. Coal and Iron later merged with its chief rival, the Colorado Fuel Company, in 1892 to form Colorado Fuel and Iron, an industrial titan that would run the plant for most of its history (CF&I) (Schreck 2022). In the late 19th and early 20th century, CF&I was the state's largest employer as a vertically integrated company in control of mining, smelting, and refinement operations for production. In 1903, John D. Rockefeller added CF&I to his empire of assets, taking advantage of an earlier, but expensive modernization campaign that put the company in financial jeopardy (Schreck

2022). As was true in many Colorado's industries, immigrants from around the world comprised the bulk of CF&I's labor force at the steel mill (Schreck 2022).

CF&I took measures to "Americanize" the lives of those who worked at the factory. It established a Sociological Department in 1901 to provide classes in English and other skills the company deemed "necessary" to become American (Schreck 2022). In effect, the company adopted a paternalistic position to legitimize its enterprise, including the provision of company housing and shopping at a company supply store owned by CF&I. Many workers, of course, saw these relations of dependence in quite a different light.

Issues related to wages and working conditions led to the 1913-1914 coal strike, which culminated in the Ludlow Massacre. Although tensions had been rising for some time, the incident and subsequent conflict was precipitated when Colorado's State Militia attacked a tent colony of striking workers and their families who had been evicted from CF&I-owned housing for protesting their working conditions (Schreck 2022). It also led John D. Rockefeller to hire Canadian labor relations expert MacKenzie King, who suggested CF&I develop a company-led trade union, one of the first of its kind in the US. Company unions were a common union avoidance strategy adopted by managers that gave the illusion of input into company operations, but these were prohibited by the National Labor Relations Act of 1935 (Hogler 2015). In asserting labor's right to unionize, employees at the steel mill voted to leave the employer run organization and joined with the Committee for Industrial Organization (CIO) in 1942, with some members joining the United Mine Workers of America and those at the steel mill joining the United Steel Workers (Howell n.d.; Steelworks of the West Archives).

Spatial Competition, Deindustrialization, and Steelworker Resistance

Fast forward several decades, the steel mill was acquired by the Crane Company of New York in 1969 when it purchased 82% of CF&I Steel Corporation's stock. At the time, US steel manufacturing made significant profits in the 1960s and 1970s, being somewhat insulated from foreign exports. Steel plant owners at the time consequently ran the plants overtime, even when it cost extra, because it reaped significant profits (I21).

However, steel mill operations would fall prey to the conditions of spatial competition enabled by trade liberalization in the 1970s and 1980s (Harvey 2007: 87).⁸³ US companies failed to recirculate the profits they had made in the decades prior and struggled to compete when put into competition with foreign manufacturers. Consequently, where the steel mill once employed somewhere in the neighborhood of 9,000 to 10,000 people in 1970, its workforce shrank to around a thousand in the 1980s (I21).

In response, Pueblo established the Pueblo Economic Development Corporation (PEDCO) in 1981 for the purpose of job creation and to bring private investments back to the city (PEDCO n.d.). In 1984, Pueblo voters approved of a half-cent sales tax for the purpose of economic development and to fund capital projects and equipment purchases for companies like Vestas—a quintessential example of how local communities and the associated workforce attempt to make their locality more

⁸³ As discussed in Chapter 3, this began with President Nixon's Southern Strategy, the general pursuit of neoliberal policies with the backing of corporate financing, and reinforced through legal decisions like the 1971 NLRB ruling in favor of GM against Local 864 and the UAW that stipulated unions do not have a say in "fundamentally managerial issues" like when to move work locations. These are, of course, the byproduct of conditions of neoliberalism discussed extensively across social science literatures.

attractive to future investment opportunities to enable the social reproduction of the “collective worker”.

The steel mill was eventually acquired by the Oregon Steel Company in 1993, which subsequently renamed the plant Rocky Mountain Steel Mills in 1998. The mill's acquisition was an ill-omen for the Colorado AFL-CIO and USW workers at the mill. They knew Oregon Steel had broken the union at its Portland facility in 1983 with the backing of President Reagan.

Sure enough, Oregon Steel attempted to do the same in Pueblo. Adjustments to profit sharing strategies, increasingly harsh work conditions that entailed 70-to-80-hour shifts, and seven-day work weeks eventually led to the decision to strike (I21). Plant steel workers voted to do so on October 3, 1997, which would not end until a settlement in 2004 (Martinez n.d.). The strike was supported by the national AFL-CIO, which launched a boycott campaign against Wells Fargo bank who held most of Oregon Steel Company's money (I21). Pueblo plant workers traveled to other locals across the country, imploring fellow trade unionists to withdraw money from Wells Fargo. In the end, about \$7 billion was withdrawn, including pension funds of Las Vegas culinary workers, which put the necessary pressure on Oregon Steel to capitulate (I21). The strike resulted in a new agreement that included a five-year contract, including the return of jobs to those strikers who wanted their jobs back. It also included a new early retirement incentive package and back pay for time missed during the strike.

Oregon Steel subsequently sold the steel mill to the oligarchic Russian conglomerate Evraz who purchased it in 2007 and who maintains ownership today (McMillin 2022). As part of that transfer, the

company took over USW's union contract in a process known as successorship.⁸⁴ Around the same time Evraz took control of the plant, Vestas operations began in Colorado, including expansion of the tower plant down in Pueblo. In both instances, two major transnational corporations moved into the heart of the "American West" and these operations existed in relation to one another. So much so, in fact, that when wages increase at the steel factory, they reportedly go up at the Vestas facility (I21).

Now, why discuss this history? Apart from recounting a successful strike in relatively contemporary times, it shows a few things. For one, when labor organizes across space and difference, it still has power. Second, situating this history helps us to not only understand the development of local labor control regimes in places like Pueblo, but how the states and localities respond to the capital-labor relationship and, ultimately, how ideas emerge in relation to these histories that continue to structure how workers, politicians, and managers think about workplace practices. Crucially, these local labor regimes not only attract investments, but can gradually change management relations between capital and labor.

It is also useful to recount this history because Colorado trade unions were initially enthusiastic about the prospects of a new global industry coming to the state (I10; I11). They believed wind manufacturing could offer its members significant employment opportunities, in addition to the general economic investments that would flow into places like Pueblo, Windsor, and Brighton. What's more, that a Danish company was coming to Colorado gave some trade unionists hope that they

⁸⁴ Siemens, another TNC that produces wind energy among other things, was cited in a Human Rights Watch report for not taking on a union contract when it took over powerhouse stations operations in New York in 2002, despite its espoused commitments to workers' freedom of association when it joined a Global Compact for standards of businesses and suppliers in 2002.

could more easily make inroads into an expanding industry by working with company leadership anchored in a country with more amicable trade relations. That hope proved fleeting.

European Mindset, American Muscle?

Early Days & Paternalism

When Vestas opened its facilities in Colorado, first in Windsor and then in Brighton and Pueblo, it tapped into a reserve of workers from these and surrounding communities. As discussed in the prior chapter, the Windsor facility tapped into former workers from Kodak. The Brighton facility similarly sought to tap the reserve of workers from the surrounding area (I15; I16; I31; I32). At the Brighton facility, it also included aircraft mechanics that had been laid off from airline operations at Denver International Airport (DIA) (I31). Many of the initial skilled workers employed by Vestas across operations were former military veterans (I31).

Although the prospects of entering a new industry attracted workers, the provision of strong benefits helped solidify a reputation of relative beneficence that attracted initial applicants. When Vestas began operations, it benchmarked its employee benefits to other companies in the areas it had operations (I31).⁸⁵ As a result, many people applied. Despite this, in places like Pueblo, few people who were employed at the steel mill chose to voluntarily move to Vestas unless circumstances forced them to do so (I21). Why give up a pension plan if the wages and benefits are comparable?

⁸⁵ In another interview, others reported that Vestas wind turbine technicians (i.e., those not necessarily based in Colorado), including those subcontracted by the company, had wages and benefits similarly benchmarked to the surrounding community (I39). They also noted that the company would exceed such benchmarks, which could make workplace organizing difficult (I39). Speaking rhetorically, if workers believe they are doing better than others in the area, why would they want to mess with a good thing?

Vestas offered high wages and strong healthcare coverage. Company leadership, filled with Danes at the time, prided itself on offering these things as something that distinguished them from other OEMs generally and companies in the areas where they operated (I15; I31; I32). One interlocutor noted that benefits were so good, workers paid no health insurance premiums and received four weeks' vacation up front, in addition to tuition assistance (I15). Like others I spoke with, they attributed this to company leadership and Danish values.

In the early days of Vestas operations in North America, Danes occupied leadership positions across the production network. Many of these individuals were those who had previous experience helping the company expand into other markets (I25). Corporate leadership thus had a distinctly "European" management, training, and benefit practice (I15). In particular, the training stood out as a notable difference, with several interviewees noting Vestas had more rigorous and tight procedures for safety than American competitors (I28; I38; I39; I40).

Here the social reproductive aspect of the labor regime again becomes an important element of the story. Transnational companies leverage the healthcare situation in the US when considering how to conduct their operations. According to one interpretation, the provision of robust healthcare benefits and vacation time can be read as a gesture of good faith, or an act of corporate social responsibility. Although not wholly disconnected, we can also read these actions as a form of paternalism to both entice and bind workers to the company. Indeed, one interviewee hit on this, remarking that these benefits were designed to ensure employees the company hired (or as they put it, "invested in") would stick around (I31). That is to say, Vestas wanted 'loyal' employees, in line with the prior chapter's analysis. This is especially true in manufacturing where attrition rates are relatively high and new hires costly to train (I40; I42). Adopting a paternalistic stance, one that marks the

company as doing operations differently from others in a community, can be read as a way to facilitate smoother and more efficient operations. As implied, however, it plays a dual function.

Anti-Union Position

Danish leadership may have had an aspiration to operate in a more egalitarian fashion, but the lines between capital and labor remained quite clear. For example, one interviewee recalled an all-hands meeting where the facility manager fielded a question intended to make him look bad. The worker who asked the question was subsequently fired (I15). Although hardly unique to Vestas, such instances represent moments of disciplining. They serve to weaken associational power between workers, which can occur in mutually reinforcing implicit and overt forms.⁸⁶ In this case, the firing of an “out of line” worker signals to others where control and autonomy in the workplace rests. When a union is in place, the chances of something like this happening, while not zero, are reduced. Of course, if companies arbitrarily fire someone, workers may seek to secure themselves in the face of such actions; by improving their associational power on the shop floor (Silver 2003; Marslev and Whitfield 2025), or if they are able, seeking employment elsewhere.

In one interview, I asked an individual who had been present at the beginning of Vestas operations in Colorado and throughout much of its tenure about collective association at Vestas facilities in Colorado. They remarked, “Oh, you mean like unions? Yeah, severely and strongly

⁸⁶ For Beverly Silver (2003: 13) and Erik Olin Wright (2000: 962) associational power is premised on power connected to the collective organization of workers, e.g. labor unions and political parties. The firing of a worker for making a statement in a larger general meeting can be read as a more overt way of ensuring management control over. Making an “example” out of the disrespectful employee.

discouraged. Like, actively campaigned against” (I15). When I asked them why and to expand on this further, they continued:

“I mean, the why is pretty obvious, right? Like, dealing with unions is very hard in there. They’re extremely inefficient. They destroy efficiency and typically destroy businesses. Yeah, I know they exist for a really good reason. You know, and if the company can’t take care of their people, then they can step in and do it. But then everybody might not have a place to work. So, my approach has always been just do the right thing and don’t worry about it. But, yeah, Vestas would prefer for no one to be unionized” (I15).

In this case the interviewee was sympathetic to the company. They would go on to remark that the reason Vestas had no factories in Denmark was because of labor union power in the country (I15).

While not factually accurate (there are Vestas factories in Denmark), the underlying logic has a discernable origin. It relates to histories of deindustrialization and belief that labor unions are “bad for business”. However, it also has something to say about how Vestas’ GPN has evolved over time, including the evolution of local labor control regimes in the places it operates—which I will elaborate further in the next section.

Nevertheless, what this and other interactions (i.e., I10; I11; I15; I27; I28; I39) reveal is that regardless of the company’s more egalitarian treatment of workers, its management model was still distinctly “American” in its posture towards organized labor. There have been at least two attempts to unionize Vestas facilities (I10; I16; I17; I21) in Colorado, but none of them made significant headway beyond initial conversations between organizers and employees. In at least one instance, discussions of unionization occurred within the last ten years (I17). Again, considering the sorts of green and climate jobs that exist in manufacturing, we see that social processes of work do not meet the threshold of “socially corrective” according to the typology.

To return to the quote above, paternalism plays a legitimizing function for enterprises that do not offer the autonomy of a unionized workplace. The local labor control regime reinforces this through policy, things like at-will employment and right to work statutes. Workers may resent these conditions, but come to internalize them as the way things are.

As discussed in the prior chapter, the state of Colorado has helped manufacture these conditions to attract future investments. A contradiction exist where localities simultaneously empower their communities by attracting investments for job creation, but they similarly may constrain worker power and autonomy through the adoption of practices hostile to organized labor. Considering the city of Pueblo, John Norton, a former business reporter for the Pueblo Chieftain, remarked that PEDCO would not speak with companies that had union contracts in place. In one instance, a unionized call center wanted to move to Pueblo, but was sent away. In another instance, a warehouse operation with a Teamsters contract was rejected because PEDCO would not support them based on reports (Woodruff, 2023). Although it goes unstated, the likely reason for this stems from the same idea remarked by the quote above—that unions would make it difficult to operate.

More importantly, the movement of these contracts into Pueblo could disrupt the balance of the local labor control regime. For PEDCO, the presence of another unionized entity in the area could make it more difficult to attract future investments. Unions raise wages not only for their members, but also for those in related industries in the surrounding areas in which they operate (Cornell 2022). As flagged previously, when wages go up at the steel mill, they similarly go up at the tower facility (I21). Such findings confirm what authors writing about European company operations in the US have seen with other businesses (Compa 2010; Stevis and Fitcher 2012).

We can also glean something from where Vestas chose to locate its corporate headquarters in North America. Located in Portland, Oregon, managers at these offices occupy an intermediate role in the company hierarchy to coordinate activities and investments in the North American market. While corporate leaders may prefer locations with “rich social and cultural amenities” and access to high-quality external services (Dicken 2015: 144), the spatial separation of headquarters from production sites can be interpreted as insulating corporate decision makers from where value production occurs—in this case, the manufacture of wind turbines. By creating a buffer between company leadership and the workers most affected by structural adjustment decisions in a GPN—things like company workforce reductions or the sale of assets to other companies—leadership removes itself from the immediate social and political repercussions of its decisions. Managers are humans too. It is more difficult to make corporate decisions if they live in proximity and know, intimately, the people it will affect (Landier et al. 2007). Put differently, the separation of corporate leadership and the manufacturing base helps ensure that market decisions in the abstract, not relationships, governs critical business decisions. I wager this similarly functions as a “spatial-fix” of a kind, one that shows the ways in which life under capitalism, for both workers and managers, is governed by these abstractions.

Becoming American: Local Labor Regime Influences on Vestas Labor Practices

As discussed, many people in leadership throughout Vestas’ North American operations were Danish. Over time, however, company leadership became more American. Today, most operations in North America are overseen by US citizens, even if more significant strategic decisions across the GPN still require final approval in Denmark (I25).

With more Americans assuming management positions, workplace governance similarly shifted. Local operations increasingly took on more American characteristics consistent with other US manufacturing operations in terms of not just benefits, but the structure of the workplace itself (I15; I24). One insider attributed this to a shift in company culture at their facility (I17).

For this individual, they discussed how management began making cuts to people's vacation time during periods of increased production. They also described wrongful, retaliatory firings when people expressed dissidence or displeasure with working conditions (I17). Going as far back as 2016, they also expressed frustration with a classification system that assigned workers various labels that accorded them with different wage levels and expectations. For my interlocutor, they saw this tier system as a way for the company to reward employees they liked and punish those they did not (I17).

To my mind, the tier system echoes classic managerial control techniques that tie classification to incentives to increase the rate of absolute surplus value extracted, explored in great length by labor process theorists like Harry Braverman (1974). In effect, Vestas' use of schemes of this sort does not reflect skill differentials so much, but acts to reinforce managerial power over the labor process through the provision of rewards in a system of competition; that is, do the job how we want and we will increase your rank and pay. These systems also reinforce the commonsensical notion of individualism pervasive throughout the US that tells people they can make their lives better through hard work and competition (i.e., rising the ranks). Of course, this can come at the expense of associational power. The pervasiveness of this ideology was felt so keenly that my interlocutor described conditions of *quiescence* (see Gaventa 1982) on the shop floor. They resigned themselves to the reality that they could not trust their co-workers with their opinions about the company or how they would prefer things to be run (I17).

Over time, the intensity of the work also increased, particularly during the early days of the COVID-19 Pandemic. Although no immediate layoffs occurred (i.e., production continued), the pace of work increased with reductions to days off and overtime a common occurrence (I17). Three plausible explanations exist, each linked to one another for how we understand shifts to labor control regime dynamics, but with the added wrinkle of a global health crisis.

First, attendance policy understandably shifted due to the pandemic. Company leadership told employees not to show up to work if they were sick (I17). Of course, fewer employees showed up to work, which intensified conditions for those who did. Some workers “took advantage” of the policy, which impacted everyone else (I17). As a result, the length of working shifts increased and days off shrank.

A second explanation connects with the expansion of unemployed workers in the early 2020s, linked to the Pandemic, that also played a disciplinary function in shifting the labor regime dynamics between capital and labor. As observed by Marx (1867 [1976]),

“The over-work of the employed part of the working class swells the ranks of its reserves, while, conversely, the greater pressure that the reserve by its competition exerts on the employed workers forces them to submit to over-work and subjects them to the dictates of capital. The condemnation of one part of the working class to enforced idleness by the over-work of the other part, and *vice versa*, becomes a means of enriching the individual capitalists, and accelerates at the same time the production of the industrial reserve army on a scale corresponding with the progress of social accumulation” (789).

In other words, as unemployment rose in response to the pandemic, hitting 11.6% in places like Pueblo in June of 2020, that created labor market conditions which companies could use to increase the rate of exploitation on the job. In a labor regime setting like Colorado and the US more broadly, one in which health care depends on employment, Vestas and other companies can leverage this

backdrop to induce more intense working conditions on the shop floor. Despite the hazards of working during a pandemic, it is equally if not more hazardous to live through a pandemic without health care coverage or wages to secure housing.⁸⁷

Elsewhere in Vestas's production network, wind technicians noted similar dynamics. Contracted workers with Vestas observed that when it came to scheduling, their days were longer than their contract stipulated (I39). Even though eight-hour days were meant to be the standard for this unit, they frequently worked more than eight-hours and a greater number of days than expected. Part of this had to do with added pressure on crews as the company had not backfilled roles when other wind technicians departed (I39). In that same interview, they believed that when Vestas signed contracts with different power producers between 2008 and 2012, the company did not effectively factor in inflationary costs, including those brought about by the pandemic (39). As a result, Vestas may be responding to these inflationary pressures by not hiring new people and increasing the intensity of work for those who retained their contract.

Third, the increasing intensity of work could have stemmed from heightened market demand for Vestas built turbines and anticipated restructuring of Vestas operations. In February of 2021, Vestas announced 450 job cuts across Colorado locations, closing blade operations at the Brighton facility and announcing the layoff of 15% of workers at the Pueblo Tower location (Associated Press 2021). One interviewee believed that they had been planning on these cuts for some time (I17). They initially

⁸⁷ While it may be true that some businesses struggled to hire workers during the pandemic, this shows how influential the social welfare regime is in the US. For the first time in a long time, the federal government offered a taste at what a more sufficient (if still insufficiently robust) social welfare net might look like. It does, however, complicate the argument I am making about how broader changes in political economy influence changes to the labor regime.

attributed the increasing intensity of work to the pandemic, but later reflected on how the company hired a “headhunter” who helped achieve staff cuts and “bring in new talent” before entering into the process of consolidation and restructuring (I17). It is possible, therefore, that the increasing intensity of work was intended to weed people out; get them to quit before doing the layoffs. After all, if someone quits rather than getting fired, they generally do not receive unemployment benefits or a separation package from the company.

What does this tell us about the nature of green jobs and climate jobs? I believe the crucial takeaway is this: renewable energy firms, even ones that come from more socially progressive countries like Denmark, operate under the same logics of competition as other companies. When embedded in different localities, they will adapt to the surrounding environment. Although Vestas sites have a global character, the local labor regime—constituted by an assemblage of institutional constraints, local historical conditions—exerts a powerful influence not only in attracting companies to particular places, but also conditioning how companies interact with labor in those localities. The result are green jobs and climate jobs that may offer some ecological benefits in helping reduce climate emissions (putting aside other ecological issues), but that do less within the social processes of work to correct or enhance worker autonomy and security. Green jobs in these facilities remain alienated.

These local labor regimes, however, exist alongside others in different parts of the production network. To better appreciate the multi-sited nature of Vestas operations, we can zoom out to the macro-scale to situate how Vestas and other transnational wind energy companies pursue restructuring in their production networks and, by extension, the mediating influence this has on local labor regimes.

Structural Reorganization and 'Spatial Fixes' in Global Wind Production Networks

The increasing “Americanness” of Vestas operations in terms of the intensity of the labor process and associated benefits and its consequent influence on the labor regime for manufacturing work has a great deal to do with processes of circulation. In the US, but also abroad, renewable energy companies—both owner-operators and OEMs—have historically relied on the presence of tax credits to support these technologies (Christophers 2024). Although it may be true that the cost of producing wind and other renewables has dropped through technological improvements and other efficiencies, profitability of the enterprise remains tied to state support in many ways. It is not a coincidence that the passage of the Inflation Reduction Act (IRA) included provisions to renew the country’s renewable energy tax credit.

Companies like Vestas who provide parts necessary for wind plants must navigate a landscape of uncertainty as to whether certain policies will engender an environment necessary for more widespread renewable energy adoption. As I argued in Chapter 8, companies may choose to shed certain activities and to specialize in others to reconsolidate their enterprise to enhance surplus value, which is precisely what Vestas chose to do.

Vestas sold its Pueblo tower plant to the South Korean firm CS Wind to focus on wind blade production. According to a press release by the company, they moved tower production responsibilities to CS Wind to enable a greater volume of output through the sale of the facility to a company, CS Wind, that specializes in this practice (Vestas 2021). Vestas secured an agreed upon volume of tower parts from the factory to secure its domestic supply chain in North America. CS

Wind took over the Pueblo plant, fulfilling orders for Vestas and other OEMs through a multi-brand strategy. However, the plant continues to produce towers for Vestas primarily (I22).

Considering global changes in Vestas' production network, the sale of the tower plant to CS Wind likely represented a decision by Vestas to free up capital to make other changes. After the sale of the tower plant to CS wind, Vestas reinvested \$40 million into both the Windsor and Brighton facilities in 2023 (Jenikson 2024), likely doing so to take advantage of the increased demand for Vestas' V163 onshore turbines whose production increased with the introduction of the IRA in 2022. In August of 2024, Vestas cut jobs from its Ringkøbing plant in Denmark that helps produce nacelles, hubs and drivetrains for onshore wind turbines, doing so after cutting 157 jobs in Jutland, Denmark earlier that year. In a statement, Vestas noted it did so to ramp up production efforts in Colorado, calculating that the US market would be more profitable than that in Europe (Jenikson 2024).

Considering changes in both Colorado and Denmark, the sale of the Pueblo facility to CS wind indicates a shift towards higher value add activities (like producing wind blades and nacelles), which require a greater degree of specialization than do building cylindrical tower segments. The reconsolidation of the enterprise through subcontracting to CS Wind also enabled Vestas to maintain its position as a leading firm within wind energy GPNs by shedding some of the more significant labor and infrastructural costs associated with the production of a large volume of turbine tower segments that do not generate the same potential for profit. There are, after all, only so many ways to manufacture a cylindrical tower segment and move it. In this fashion, local labor regimes in which Colorado workers are embedded act as a disciplinary force on other parts of the production network in Europe.

Similarly, subcontractors in other parts of North America shape and discipline workers in Colorado. US based firm TPI Composites owns several facilities that produce wind blades. Of relevance to our discussion is the TPI Composites blade plant in Ciudad Juarez, Mexico that produces Vestas turbine blades and services the same market as the Colorado factories. Indeed, one interviewee noted that despite Trump's hostility to wind energy, some workers at their facility were grateful that the unilaterally imposed tariffs offered a measure of insulation from the pressure they felt in Mexico (I41). They believed that the tariffs would increase the import duties on wind blades crossing into North America, which would allow them to maintain a competitive edge over the Jaurez plant.

However, TPI composites recently filed bankruptcy in late 2025. Vestas, who had previously used TPI as a subcontractor, subsequently provided a cash advance to ensure continued blade production, in addition to maneuvers to acquire TPI's assets in Mexico (Energywatch 2025; Weathergaurd Wind 2026). Here we can see how spatial competition within the GPN acts as a disciplining mechanism, with the Mexico blade factory located in a position with proximal access to North, South, and Central American markets that influences how workers think about the security of their jobs.

As it relates to the earlier discussion on unionization in Vestas facilities, or lack thereof, these spatial dynamics illustrate how the logic of competition across space becomes internalized among workers. Theoretically, it also demonstrates how local labor regimes are mutually constituted by the larger GPN and the other nodes of production that exist within it. More specifically, other nodes condition the forms of agency individual and collective workers feel available to them. As it relates to my central argument, the takeaway is this. Renewable energy systems, under their current model, do not resolve these conditions of spatial competition and this limits their potential to contribute to eco-social forms of living.

Competition from China

We can further understand Vestas' decisions according to structural tendencies that put capitals-in-competition within and across countries that downgrade the labor process (Brand and Wissen 2018). Relevant to Vestas and renewable energy production, workforce reductions in Denmark and Europe to focus on North American operations may be interpreted in light of pressure emanating from Chinese OEMs like Goldwind, Envision, and Mingyang. Although Chinese companies were not the impetus for the initial move into the US, their continued interest in the US, despite the federal administration's hostility to renewables, can be attributed to the meteoric rise of Chinese OEMs. Although it is true that Chinese firms have market share (both in dollars invested and gigawatts produced) that largely fulfill orders in domestic markets, they are increasingly moving outside of China into the Middle East, India, Latin America, and even Europe.

Several industry insiders with whom I spoke discounted that Chinese built turbines influenced the American market for wind power (I6; I32), but there was some disagreement on this point. Some saw little threat from Chinese manufacturing, believing Chinese built turbines were not on par, in terms of quality, with turbines manufactured in the US and Europe (I32). Others instead suggested that Chinese companies were in the driver's seat when it came to technological innovations in wind turbine manufacturing and project development, especially the increasing scale of both onshore and offshore built turbines (I6), which may similarly pressure European OEMs to follow suit. For our purposes, China's influence is not so much related to direct Chinese competition in North America, but instead seen in how Vestas and other European firms like Nordex and Siemens-Gamesa perceive the importance of American markets.

Companies like Vestas feel pressure from China in Europe (just as the solar industry did before), which can help perhaps explain why, despite the bellicosity and hostility of the Trump Administration to renewables, both Vestas and Siemens-Gamesa continue to see the US as an important market moving forward. In Q3 of 2025, onshore wind orders in both the US and Europe comprised the bulk of Vestas' manufacturing orders (Jenkinson 2025). Moreover, the increasing appetite for power generation of any kind, partially driven by AI data centers, has contributed to continual wind turbine production even though companies and utilities signing PPAs with wind developers do not actively promote or advertise these things as they once did (I42). Perhaps Vestas and other wind companies hope to weather the storm and ride out the Trump Administration like a bad fever, with the hopes that they can maintain market share if China begins to cut into their profit margins in Europe.

Understanding Trade Union Reticence Towards Renewables

Shifting gears between these broader GPN dynamics and what we have learned about how the local wind energy regime formed and changed over time, we can better understand the skepticism some trade unions express towards renewables.

When Vestas initially came to the state, trade unions expressed excitement at the prospects of a new industry (I10; I21). However, after the two aforementioned attempts at unionization failed, many have soured on Vestas and the renewable energy industry more generally. More specifically, they expressed frustration with what they see as a double standard when comparing how Vestas operates in the US and Europe (I10; I11; I14 I26). As one person put it:

"So, this isn't limited to Vestas, but they'll operate one way in Europe and then another way in the United States. When I used to be with (redacted) I saw companies do this all the time. And labor has not been able to successfully organize their plants, for a variety of reasons, depending on who

you ask. Anyway, I think it would be a lot more palatable if, you know, these sectors were unionized. Like, if there was a prevailing wage for solar and apprenticeship requirements that could actually support a family being in some of these positions” (110).

These feelings are heightened when some of the remaining bastions of labor power in the private sector exist in declining industries like coal, which are being phased out through a combination of economic factors and state mandates.

Discussed earlier in this dissertation, renewable energy jobs, taken in the aggregate, offer fewer benefits and pay compared to positions in fossil fuels (Brecher 2018; Sicotte et al. 2022). Fossil fuel jobs, meanwhile, are socially corrective but ecologically harmful to both the surrounding local community and the planetary biome. The goal, of course, is to make jobs more robust along both social *and* ecological dimensions.

It is important to recognize, however, fossil fuel workers and those in other industries *made these jobs socially corrective jobs through labor agitation*. That renewable energies are layered on top of these histories plays an important role in how trade unionists perceive them. If it appears that they contribute to the continued erosion of past gains, rightly or wrongly, that fosters contempt.

Trade unions are not wholly uniform, of course. As Todd Vachon (2023) shows, they may hold a range of positions towards decarbonization and environmental issues more broadly. Some hold a position of strong support, others opposition, and a whole gambit of positions in between. Vachon’s work largely focuses on trade unions in the Northeastern US, but his findings are true in the Colorado and Western context more broadly. Some Colorado unions support coal and other heavily polluting industries (consider, for example, United Steel Workers, Local 12-477 who work at the Suncor Refining facility) mostly for the jobs it provides their union members. Meanwhile different locals of the United

Mine Workers of America across Colorado and the Navajo Nation must similarly navigate how changes to the power grid impact their membership—something which has grown increasingly complex with the potential expansion of AI data centers and renewed interest in nuclear energy mining and project developments.

At the same time, Local 111 of the International Brotherhood of Electrical Workers sees potential in renewable energy systems like solar and wind, which require skills their members have. In response, they have stood up a pathways program to train people through apprenticeships to enter positions in renewable energy and energy efficiency related projects (Llanes 2025).

For our purposes, the local labor regime or wind energy in Colorado is perhaps best characterized as a hybrid form. It combines Jamie Peck's (2016) social workfare regime with Mark Anner's (2015) market-controlled labor regime. By attaching healthcare to employment (i.e., social reproduction), this influences worker agency and corresponding forms of contestation. It does so by binding access to healthcare to the receipt of wages for an employer. As I detailed earlier, this is a concrete instantiation of capital's "mute compulsion" that governs people's actions by inserting an abstracted form of economic power into people's ability to reproduce themselves (Mau 2023). Critically, that is reinforced at the macro-scale across GPNs that puts nodes of production in competition with one another, which further tamps down enthusiasm for more overt or contentious forms of labor agency. Crucially, the state plays an essential role in enabling these conditions, generating laws and practices that foster inter-worker competition, which shapes the ideational waters both workers and management swim in.

Discussion

When Vestas arrived in Colorado, it did not 'import' a Danish model of labor relations. Operations began with a somewhat paternalistic style of management, which provides a legitimating function to keep unions out of the workplace. Over time, it began to adopt management practices more consistent with a market-oriented labor control regime (see Anner 2015).⁸⁸ More generally, the lesson is that labor regimes for renewable energy are not created 'ex nihilo'. They are layered on top of existing strata of socio-historical relations that constitutes both the legal apparatus that exists, and the socio-spatial imaginary of how people, including trade unions, think about the prospects of the energy transition.

Crucially, local institutions structure labor regimes in particular ways, which influences how companies operate, including when a European company comes to the US (Human Rights Watch 2012). With respect to social processes in the eco-social typology, I suggest that a diffuse form of power suffuses the way in which the labor regime coalesces within wind energy manufacturing in the US and that influences how workers think about the prospects of organizing and forms of agency they have available to them. Employers like Vestas legitimize their operations and the lack of workplace autonomy through language and practices consistent with paternalism. Again, this is nothing new. We understand this through both history and theorization. *The consequential takeaway is its reproduction in a new industry.*

⁸⁸ As a reminder, my focus on Vestas is not to single it out as uniquely bad or good among renewable energy companies. Indeed, based on the interviews I conducted, workers have a better opinion of Vestas than of other, comparable companies. Instead, my focus on Vestas stems from its historic role in the wind energy sector as a, "a personification of economic categories, the bearers of particular class-relations and interests" (Marx 1867 [1976]: 92).

Beyond political institutions and history, labor regimes for wind are also impacted by spatial competition and structural transformation within GPNs. As we saw in the last chapter, localities exist, in some sense, as collective workers develop strategies to resolve contradictions that exist for the locality as a whole. They do so through the creation of institutional environments intended to attract capital, which partially depend on the manufacture of different labor regimes conducive for capital enterprise. In this chapter, we saw more clearly the way in which global GPNs respond to imperatives of profitability in a way that leads to a continual restructuring of the production network and, by extension, adjustments to labor regimes. Once again, these conditions of spatial competition influence the management strategies a company chooses to adopt—strategies that tie into the institutional configuration of a labor regime. In this case, we see the formation of a relatively paternalistic management style that changed over time due to exogenous shocks in the market and broader GPN dynamics.

Consequently, when transnational firms like Vestas come to Colorado and adapt to the local setting in a way that further weakens trade union power, frustration and resentment results. The hesitancy of trade unions towards renewables is, therefore, not only due to job losses. It is also about the continued erosion of labor power in the energy sector in a way that reinforces capital's structural power and common-sense expectations of work that trend towards greater precarity and limited autonomy. Understood from this perspective, the reticence of trade unions to renewables makes a great deal of sense.

Opportunities for Change?

Despite some of these challenges, trade unions and groups like Blue Green Alliance and, more recently, Climate Jobs Colorado have successfully lobbied the Colorado General Assembly, and those in other states, to pursue legislation to upgrade labor's prospects in the transition. For instance, SB 23-292 titled, "Labor Requirements For Energy Sector Construction" mandates the construction of clean energy projects with prevailing wage requirements, in addition to the establishment of apprenticeship opportunities (Hansen et al. 2023). As previously discussed, local unions are also looking to create apprenticeship programs to help facilitate union positions within the renewable energy sector too. Of course, it is still possible that a "prevailing wage" does not actually provide family sustaining wages, if the prevailing wage in an area is already suppressed. At the same time, however, while these advance efforts to make the processes of green and climate jobs better or "socially corrective", they do less to consider the outputs or uses of these jobs. For instance, these same groups lobbied and helped to pass legislation that made nuclear energy a "clean energy" in the state (Valdez et al. 2025).

Trade unions and other groups also helped pass HB 19-1314, which established the state's Office of Just Transition. The legislation recognizes coal community's historic role in Colorado's economic fortunes, but also the need to shift away from these ecologically harmful forms of work. Critically important, the legislation recognizes that the sphere of social reproduction, in US society, depends on access to a job. The introduction of legislation that recognizes this basic fact could perhaps help to plant the seed for more socially and ecologically corrective forms of work that humanize work activities, doing so through working time reduction and improvements in the provision of social

welfare support, weakening the mute compulsion capital wields to govern the workplace across labor regimes at multiple spatial scales.

Returning, then to the notion of GJ/CJ, I think it safe to say that we—those of us who identify with the cause of labor and the environment—are limiting our horizons to what we feel is politically feasible. Access to jobs, in of themselves, do not constitute a transition to a genuinely ecologically or socially just society.

We are seeing retrenchment and ascendance in fervent nationalism across the world. As a result, the political and policy landscape for the expansion of GJ/CJ has grown increasingly tenuous in the US with the election of Donald Trump. Other parts of the world, take Europe for instance, show signs of shifting away from GJ/CJ in the face of heightened global tensions. They take resources away from responding to ecological issues and instead invest them into militarization (European Parliament 2025). Given the rapidly shifting landscape, now is a time to advance more radical and transformative ideas of what could or *should be*, not to replicate those systems that brought us to the brink in the first place. This takes us into the realm of ideas about the future of green and climate jobs.⁸⁹

⁸⁹ After the dissertation is complete, this is the next project I plan to take on. I will take the responses I have concerning GJ/CJ and the prospects of transition and produce several papers about how people in “green” sectors like wind and solar are thinking about what the future of work could look like. As part of this, I will interview those in the solar industry, as well as in fossil fuel sectors to get their sense of “GJ/CJ”. I then plan to classify responses according to their respective positionality, sector, and demographics to see what ideas and patterns emerge, including how the labor process itself conditions the way people think about GJ/CJ.

CHAPTER 11: YESTERDAY'S VALUES, TOMORROW'S INDUSTRY

"A century ago, Marx could validly argue that the alternatives to socialism are barbarism. Harsh as the worst of these alternatives may be, society could at least expect to recover from them. Today the situation has become far more serious. The ecological crisis of our time has graduated society's alternative to a more decisive level of futuristic choices. Either we will create an ecotopia based on ecological principles, or we will simply go under as a species. In my view this is not apocalyptic ranting—it is a scientific judgment validated daily by the very law of the prevailing society" – (Murray Bookchin 1980: 70-71).

As you may have surmised at this point, it is not so much renewable energies or other technologies that produce subpar green jobs, but the larger social relations in which they are embedded. That is to say, "the very law of the prevailing society" produces their inadequacy. To show this, I used LRA in conjunction with an eco-social typology of green and climate jobs to develop my critique.

I suppose the cliff notes version of my dissertation goes something like this: contemporary renewable energies matured during a period of heightened neoliberalism and that, unfortunately, turned what might otherwise be an emancipatory technology into yet another cog in the machine of global capital. While that is the synopsis, it does not cover the full scope of what is at stake. Please indulge me with the space for a polemic of sorts.

I have made continuous allusions to the importance of material conditions—for workers, companies, government officials, and the like—to our politics. Discussions of the future of work, one that often includes green and climate jobs, often treat workers as if they were abstractions or widgets.

Not only does this do a disservice to working people, but it limits our political horizons. The inability of many policymakers and pundits to grapple with these material issues and associated consequences means life's already difficult challenges may become far more onerous as existing systems and structures further entrench themselves. Meanwhile, the inability of many academics and practitioners in the energy and environmental space to recognize work's centrality to people's lives and its role in shaping our politics does little to gainsay the psychological, social, and political consequences of alienation. These conditions provide kindling for authoritarian leaders to make claims on power.

We have seen the story play out before. Social relations of neoliberalism have rooted themselves in various aspects of a new energy economy. It presents itself in the continued valorization of capitalist marketplaces, competition in the energy sector, and the continued pursuit of surplus value, all of which produces practices like subcontracting and workplace fissuring that worsen green jobs. Neoliberalism legitimizes the existing order of social relations, premised on an understanding of "freedom" in its negative conception—freedom for the right of people, including capital, to pursue wealth free from the fetters of oversight and regulation. Not only does this limit the potential of these new technological forms, but they continue to enact these "relations of relationlessness" (Jaeggi 2014) that serve to channel wealth into the hands of a very small slice of humanity at the expense of the security of many people and species who occupy this planet.

My criticism echoes many eminent critics of neoliberalism (see, for example, David Harvey 2007: 36-37; Wendy Brown 2017), taking us back to the work of Karl Polanyi. He discussed how capitalism and associated ideologies that espoused the supposed virtues of disembedded markets then contributed to the horrors of first half of the twentieth century writing, "The congenital weakness of nineteenth-century society was not that it was industrial but that it was a market society," (1944: 258),

going on to argue that, "We cannot achieve the freedom we seek, unless we comprehend the true significance of freedom in a complex society" (262).

The 2026 war between the US, Iran, and Israel offers a window into what happens to a country, the US, twisted by vapid idolatry of individualism with little concern for others. The historian Norman Ware wrote that labor activists in the 19th and early part of the 20th century had warned against what he described as, "the new spirit of the age: gain wealth, forgetting all but self" (Ware 1990[1924]: 25). What Polanyi did was to recast this spirit in historical and ideational terms, discussing how market-based liberalism, in its ostensible respect for the "free-market", inevitably bent towards authoritarianism and fascism. As Polanyi pointed out, if the teleology of the economic system is to create profits, not peace and freedom, politics would forgo the latter as these could not be institutionalized for that is not its principle function (263). Today as before, today's capitalist elite, exemplified by some of the solipsistic and unreflective elites of Silicon Valley, have signed a deal with proverbial devils.

Despite the present bleakness, periods of disjuncture like these also represent opportunities for "new" ideas to come about. The Great Depression, in combination with labor agitation, created the window for a more egalitarian form of capitalism to develop through things like the New Deal, which were later extended to other parts of the world through the Bretton Woods System. These were momentous, but also partial and limited efforts that did not facilitate universal freedom, but instead continued to concentrate on selections of humanity, rather than the whole. The 1973 Oil Crises also created a rupture in the political economic system, including to energy systems, through which neoliberal ideas and a hegemonic countermovement to the new social, ecological, and decolonization movements of the 1960s sought to fill. It may seem unlikely to live in a world liberated

from the hegemony of capital as a social relation, but it is in moments like the one we occupy today where radical ideas about political change, in this case involving energy and work, may come to be thinkable and, perhaps in retrospect, inevitable.

I say all this not to sententiously herald the coming of a new future. Rather, I wish to reiterate, against a broader backdrop, that there is much at stake for how we think about green and climate jobs, both conceptually and empirically, and what pathway the energy transition ultimately takes. History influences the future, but those potential pathways are contingent. In Chapter 3, I offered a glimpse of this in action by constructing a history of labor-environmentalism and its linkage to ideas about “green” and “climate” jobs in the US. I showed that there is a decades long history of these terms, anchored in a centuries long history of labor and environmental relations.

Although many have similarly recognized the potential for changes in the present moment (see Klein 2014; Luce 2022; Calhoun and Fong 2022; Ordower and Zafir 2024), fewer have endeavored to systematically map *what these jobs actually look like for the people who occupy them and what social relations create these outcomes*. It is one thing to prognosticate on the potential that green and climate jobs have for the environment and the economy and quite another to map their actual conditions. In so doing, I have shown how many of the same mechanisms and ideas that generated today’s interlocking crises, notably the valorization of profit over people and ecology, the same things that early labor advocates struggled against, continue to reproduce themselves in the expanding renewable energy sector.

We cannot rely on existing systems or structures within global production networks and electricity markets to deliver eco-social futures premised on politics of connection and regeneration.

In particular, I argued that the hegemony of capitals-in-competition continues to govern outcomes that condition what green jobs and climate jobs look like for workers in important ways. In our period of multiple overlapping and increasingly dangerous crises, now is the time for more radical ideas and action.

Renewable energies are still one of the foremost technologies for us to achieve a shift away from fossil fuels. However, as many pages in this dissertation show, exploitation exists on a spectrum and the uncouth dictums of profit curb human rights in the workplace. Second, despite the rapid technological advances that have helped make renewable energies more competitive, their true potential remains locked behind a pay wall. As Bret Christophers (2024) argues, that is because we are expecting market mechanisms to deliver a smooth transition. Where he argues that this slows the adoption of renewable energy technologies, I argue that the systems of competition associated with renewable energy GPNs worsen the conditions of work in these expanding sectors. Not only does this slow the energy transition, but it forecloses the realization of radical, eco-social futures premised on politics of connection, regeneration, and solidarity.

Unpacking the “Black Box” of Renewable Energy Production

Having identified some of the structures and systems that produce wind energy labor regimes at multiple scales, I developed a systematic critique of “green capitalism”. As implied above, I hope that my dissertation, in its own way, can help frame the issue at hand and create space for alternative social relations to emerge.

As Chapter 2’s synthetic analysis demonstrates, there are compelling reasons to be skeptical of an energy transition’s potential to meaningfully improve the lives of workers across the globe. That

raises the question as to why it is that newly created green and climate jobs are, in fact, not as socially or ecologically desirable as they should be. There is, however, a tendency to conflate the potential of new green technologies with social relations in which they are embedded (i.e., capitalism). As I have stated several times, I do not believe that these technologies are themselves exploitative. Nevertheless, there are reasons to be skeptical of “green” and “climate” based jobs that frame themselves as socially corrective antidotes to existing social relations.

Like Dustin Mulvaney (2013), I believe we need to “unpack the black box” of energy production, to understand what mediates social relations of work. He focuses on solar energy production, but his use of the “black box” analogy is appropriate. Like Marx before him, he implores us to look inside the hidden abode of production that obscures social and ecological relations that give rise to certain outputs. It is by unpacking these social relations that we are then better positioned to not only understand what shapes these conditions, but what things might be done to improve the outcomes we see.

Where Mulvaney focused on solar power, I instead focused my attention on wind. Although this dissertation is US centric, even “Colorado” and “Front Range” centric, I nevertheless believe the proceeding pages offer important insights into the more general form of green capitalist enterprise that, while occupying a particular setting, nevertheless reflect more general tendencies of this mode of production. These relations comprise differentiated labor regimes that ultimately mediate and shape the conditions of labor exploitation we see, which makes green and climate jobs less socially and ecologically desirable than they should be, especially in comparison with the range of possibilities that might otherwise exist.

In this respect, these pages contain important lessons for not just US or Colorado policy, but for other parts of the world striving for more just ecological and social relations in this period of transition. For instance, conditions of competition with energy production networks parlay into practices like subcontracting, temporary hiring, and other hallmarks of a fissured workplace (see Weil 2014), that suppresses job quality. Under such conditions, perhaps the best these can strive for are those I designate as socially and ecologically “corrective” according to my typology. They do not constitute a genuine transformation of political economy. So long as these systems attempt to operate within the same logic(s) that have long governed the power sector, the build out of renewable energies will be slowed and the quality of these jobs will be marginal. Both of these outcomes jeopardize a shift away from fossil fuels.

I did not focus on Vestas to paint them as a particularly “good” or “bad” company. Indeed, several interlocutors noted that the company was, by and large, preferable to other OEMs in the wind energy space with respect to things like safety (I28; I38; I39). Instead, as I detailed in Chapter 6, Vestas occupies an important position in the renewable energy industry and, once again, serves as a proxy for more general abstract relations between capital and labor across renewable energy production networks.

I used the eco-social typology in combination with the labor regime analysis framework to develop a systematic picture of how wind energy production networks operate, and the myriad actors, institutions, and associated politics that constitute labor regimes that govern workplaces where “green” and “climate” jobs exist. In this, we can understand renewable energy capitals just as they are, not how we wish them to be. In doing so, I have also shown how these companies are plagued by the same issues and periods of crisis that befall other industries. As a result, they rely on the same

business practices that have, and will continue, to exploit both workers and ecology in pursuit of surplus value accumulation.

To expand on this, spatial dynamics of global and regional competition reinforce competitive logics that becomes internalized by both workers and companies. Theoretically, it demonstrates how local labor regimes are mutually constituted by the larger GPN and the other nodes of production that exist within it. More specifically, other nodes condition the forms of agency individual and collective workers feel available to them.

As it relates to my central argument, the takeaway is this. Renewable energy systems, under their current model, do not resolve these conditions of spatial competition and this limits their potential to contribute to eco-social forms of living. Critically, offices of the state at multiple levels of government play an essential role in this reality. In some instances, they have worked alongside capital or for its interests to manufacture institutions hostile to labor that shape associated labor regimes that govern the capital-labor relationship in the workplace in important ways. These are themselves anchored in historical relations that shape consequent labor regimes, which may attract capital investments to resolve contradictions for the broader community, in line with the theorization of Jamie Gough (2014).

The way labor regimes for renewable shape GJ/CJ requires attendant changes to law and policy. There are any number of ways to do so, which range from adjustments to social welfare provisions, to better protections for labor rights and standards in the workplace. However, as I have argued, it also requires addressing global, regional, and local relations of competition between workers across space. Of course, these projects are not mutually exclusive, but are internally related to one another, with

local policies and politics shaping local labor regimes in response to the macro-scale structures of competition. These are in turn shaped by what happens in localities, which shapes the evolution of GPNs.

I have suggested one avenue to challenge capital exists in the energy sector. As I discussed in Chapter 8, state PUCs ostensibly oversee rate making decisions and the build out of electricity in the energy sector. However, private investor-owned utilities have a great deal of power. That power owes to the opaqueness of their operations, allowing them to structure the production and distribution of electricity in a way that ultimately serves shareholder interests (i.e., electricity production and consumption for the purposes of profit). Crucially, this is treated as common sense by many of the people with whom I spoke, which serves to legitimize existing practices.

Along these lines, I also discussed the working lives of wind energy technicians, flagging some of the unique attributes of their work, and attached to ideas about the labor process itself, which acts in a contradictory manner that simultaneously constrains associational power between workers, but may also be leveraged in future organizing efforts. Their organization is critical because of their structural importance to the industry and the ability of project owners to continue to deliver wind energy power.

Reproduction of Capitalist and Colonial Practices in the Energy Transition

In Chapter 2, I detailed how neocolonial practices have embedded themselves in this period of “energy transition”. Since I published that work, the number of articles that cover social and ecological downsides in the transition have exploded. In each case, the basic takeaways remain salient in that we see the externalization of harms from parts of the Global North to the South (e.g. Sovacool 2021; Brock et al. 2021; Brand and Wissen 2018), land grabbing (Dunlap 2020; Knuth et al. 2022); differential

impacts across gender (Stock and Birkenholtz 2020); violations of labor rights and standards (Davidson 2023), and degradation of wildlife and ecosystems (Avila 2018).⁹⁰ As I argued, many of these studies focus on upstream and downstream processes of production, focusing on the externalities of mining and deposition of materials. Although these are critical, it leaves many stages of production less attended to.

Many of the studies I reference in Chapter 2 come from a wide range of disciplines, but perhaps none more so than Political Ecology, which exists as a “discipline across disciplines” that seeks to understand the myriad ways in which humans order themselves vis-à-vis the environment, but especially how power influences these interactions during the ordering process. Although many of the cases referenced in my review are local in nature, together they show a larger pattern of systematic exploitation that shows how, to greater and lesser extents, communities across the world receive promises of “clean” power and related jobs only to have the rugs pulled out from underneath them.

Where this review raises questions about the character and trajectory of the transition, my analysis and focus on wind energy shows that these processes are not simply confined to the “peripheries” of the global economy as they are typically geographically conceived. Rather, even parts of the “Global North” have elements of the “South” within them. That, in itself, is hardly revelatory, and has long been demonstrated by environmental justice activists and related theorists. The value in my analysis is in

⁹⁰ We are now seeing increasing impacts resulting from the expansion of the “tech-nuclear nexus” in which the expansion of data centers with AI is conjoined with the expansion of nuclear energies and consequent pursuit of more uranium mining (Keeler and Otjen 2026).

showing, empirically, the way in which these processes are being reproduced in industries critical for decarbonization. I show how this works in several Chapters.

In Chapter 8, I described how hierarchy emerges on renewable energy projects and the way this can produce a permanent underclass of workers. The production of this class is interlinked with industry practices, which relies on temporary hiring and subcontracting to provide the necessary number of workers on a project to fulfill the obligations of a contract. Because labor is often the easiest place for companies to increase absolute surplus value, the intensity of work increases. That many workers in these positions are from marginalized communities is hardly incidental. Their weakened position makes it more difficult to demand more robust social protections. Consequently, it is the conditions of competition that exist in the energy sector—both within and between renewable energy capitals—that informs the practices of leading firms to use subcontracting and temporary hiring agencies to hire workers. And these parts of the network have little incentive to help these workers move into “higher tier” positions as they rely on these workers and affiliated networks to meet the obligations of their contracts and skim what money they can from the lead firm. Thus, it is the cascading effect of competition that drives the outcomes we see. Like other industries, a labyrinthine web of different businesses and actors helps make the circuits of capital flow and each circuit is enabled by different levels of labor exploitation and nature’s appropriation. That complexity serves to obscure the “black box” of renewable energy production by insulating states and investor-owned enterprises from the consequences of the system they have manufactured.

I extended my more general argument in Chapter 9 by focusing on Vestas. I explained how Vestas came to locate its manufacturing operations in Colorado. As part of this, I elaborated how past historical relations informed the company’s locational decision. These processes and associated social

relations leave a “social-residential life” that can reinforce class, gender, or ethnic relations that arise in production (Gough et al. 2006). More specifically, I showed how renewable energy capitals *consciously leverage* past cycles of deindustrialization and social divisions in their locational decisions. Conversely, and in line with the theorization of Jamie Gough (2014), states and associated localities operate as local capitalisms to resolve the “contradictions of the locality as a whole” which, in this case, entails weakening organized labor’s ability to resist capital through institutionally mediated structural faults in potential organizing capacity. As I argued, this has played a crucial role in shaping the labor regime that governs renewable energy outcomes at both local and national levels. Related to the labor regime, I also elaborated the importance that “worker loyalty” played in Vestas’ investment decision. From the standpoint of capital, the decision to locate to Colorado not only had to do with its industrial legacy, proximal location to available wind energy markets, and friendly “business minded” bureaucracy, but also the company’s belief that it could more easily both leverage and preserve the value of its investments. As I argued, this takes on racialized and class-based components based on perceived attributes of collectivities of workers. Related to this, but in a more benign fashion, Vestas management also believed that the workforce at NREL, and the potential for value add, could also aid in its enterprise. Regardless, the takeaway is, again, an amoral calculus continues to guide corporate decisions that are wholly oriented towards the accumulation of surplus value. Thus, the enterprise of wind manufacturing has less to do with the potential uses of wind energy to cut carbon emissions and associated benefits and more to do with finding a production location suitable for the extraction of surplus value. The resulting consequence are jobs that, at best, rise to the level of “socially” corrective within the typology.

Although present through the dissertation, Chapter 10 brings into starker relief the spatiotemporal relations that shape green and climate jobs in important ways. As part of this, I emphasized Vestas paternalistic management style to legitimize their business practices that keep unions out of the workplace. This is combined with spatial disciplining that exerts pressure on workers across the production network. I described how workers in the US act as a disciplining mechanism on wind manufacturing workers in Europe. That disciplining is due to the acrimonious relations between capital and labor in places like Colorado that have resulted in the passage of laws like (but not limited to) the Colorado Labor Peace Act and Taft Hartley that influence labor regimes in important ways. Once again, these laws and the associated regime take on racialized aspects as governments, often working in concert with capital, pass laws to limit cross-worker solidarity that establishes a social division of labor through the manufacture of difference. Meanwhile workers in Mexico similarly act to discipline workers in the US as part of a global division of labor. I do not wish to suggest that workers in each country fulfill an *essential* function to capital, rather that workers (and managers) are aware—both consciously and subconsciously—of operations across the production network and this creates the ideational terrain that constrains more overt declarations of worker power and agency.

The resolution to these conditions of competition does not exist in building walls between countries or vilifying other people. Instead, the answer will rely on the establishment of cross-coalition movements for solidarity between workers both within and across borders to resist these practices of competition. By becoming explicitly aware of one another, we may better enable ourselves to find common cause, resonance, and solidarity in one another's struggles. That is to say, we must challenge the way in which capital, even in green forms, renders the world and associated relations as an abstraction. In Chapter 3 I showed how latent potential for such actions exist in the US, but other

authors take this further to show how alter-globalization movements have built alliances between labor and environmental groups across borders (Bresnihan and Milner 2023). In both cases, it is the elevation of ideas beyond colonialism and capitalism, two sides of the same coin, that are necessary to move us towards more socially and ecologically just and regenerative futures.

Throughout the chapters, however, I stressed how multiple actors, structures, and institutions help to comprise and maintain labor regimes. On the whole, however, there is a distinct ideational component whereby green and climate jobs, including their radical potential, are both maintained and constrained by particular ideas about the labor process. These ideas attach to beliefs about the role work plays in our lives, which is reinforced by our day-to-day practice of living, which requires us to labor for the receipt of wages to survive. This is the “mute compulsion” of economic power that subjects us to conditions not of our own choosing (Mau 2023). Where that describes the general and diffuse form of power that governs the workplace, I suggest it takes on its own characteristics in the renewable energy sector.

When examining the work performed by wind technicians, contradictory ideas about brotherhood play an important role that shapes internal dynamics of their work. Ideas like these at once enable the extraction of greater surplus value through the intensification of work, including by offloading safety responsibilities to individuals rather than a company (i.e., I must be my brother’s keeper). Similarly, ideas about brotherhood and those associated familial associations may be wielded by companies to keep “outside” groups like unions out of the workplace. And yet, these ideas may also offer a staging ground for autonomy and collective agency to push back against these very same dynamics. Thus, we see how the contradictions of capital not only create fissures between workers, but are riven through our very consciousness.

By “unpacking” the black box of renewables, we are left with a somewhat sobering conclusion. Green jobs and climate jobs, as currently constituted, do not fundamentally alter work or how people perceive their jobs. Green and climate jobs are not nearly so desirable as they should be—for the environment, for society, and for workers themselves. In their current guise, they may raise to the level of ecologically corrective, or even enhancing with respect to outputs and processes—to greater or lesser degrees according to the uses of wind energy. However, when we look at the social dimensions of work, the processes are not desirable as we should like. So long as these remain with the labor regimes they do, these jobs will remain marginal, alienating, and incapable of contributing to an eco-social future.

Theoretical Contributions

Methodological Innovation

Although the importance of spatial and temporal dimensions and globalized social relations have long been understood by labor regime researchers, I showcase how a relational understanding of local labor regimes, one anchored in the historical memory of place and the broader dynamics of GPNs, informs their development and the consequent jobs that result. Here the contribution is subtle, but no less important. By situating labor regime analysis both spatially and historically, we can better appreciate how labor agency depends on past periods of industrialization and deindustrialization, in line with the theorization of Doreen Massey (1995[1984]; 1995) and Dimitris Stevis (2022). Beverley Silver (2003) made a similar point in their seminal work, *Forces of Labor*, writing that it is necessary to have “an understanding of *relational processes among “cases” on a world scale across both time and space...*” (26). In this, she calls for attentiveness to both direct and indirect relational processes to better

explain the outcomes of the labor movement in different times and places. I adapted a similar logic, but add some methodological nuance through the application of Riofrancos (2021) language of “sites” and “siting” to better conceptually map how labor processes, both globally and locally, do not exist as demarcated, freestanding islands, but are vitally interlinked with one another. In this, my work makes progress on the so-called “connectivity gap” for how to understand the way labor processes at the point of production connect with global political economy (Taylor et al. 2013: 5).

I have also taken this relational logic and incorporated it into the eco-social typology. Not only does this help ground it into real world conditions, but it helps to advance discussions about green jobs and climate jobs that tend to treat them in a vacuum, rather than consider the broader political economy of which they are a part. Politically, this helps ensure we do not don “blinders” when considering various jobs, which would obscure how benefits to one group may depend on the externalization of harms to other people and places. As I have argued, we must attend to ecological, social, spatial and temporal dimensions when assessing forms of work and how different labor regimes condition the labor process.

A new spatial fix?

Another theoretical contribution I make is by elaborating how the manufacture and evolution of local labor regimes represent a form of ‘spatial fix’. This takes place in two ways.

First, leading firms in a GPN not only move their geographic locations to maximize profitability, but restructure local operations to ensure continued profitability. The spatial component to this ‘fix’ entails an appreciation for conditions of competition across a GPN that puts workers into relation with one another (see Gough 2010). Consequently, localities and local capitalisms may seek to resolve

contradictions from the production process by manufacturing distinct local labor regimes to attract capital investments. The circulation of capital throughout a GPN in the form of investments and divestments results in the upgrading of some production spaces, like the Windsor blade facility, but that depends on social downgrading elsewhere—in this case in Denmark. Again, this returns us to the importance of attending to the labor process as *sites*, not cases, that are mutually constituted across space and time.

While this dynamic has been observed before, I further emphasize how this evolves over time. Companies begin to modify their management practices in a way that comports with other production processes in each local setting. The precise mechanism this occurs requires further elaboration.

Additionally, another form of a ‘spatial fix’ occurs when a global TNC chooses a location for its regional corporate headquarters. In Chapter 9 and 10, Vestas located its North American headquarters in Portland rather than in the manufacturing base of Colorado. I suggest the reason for doing so has less to do with simple “preferences” of management of certain styles of living over others, but more to do with helping managers better consider production sites as spaces of abstraction. The resulting consequence of this distance is how capital managers can insulate themselves from social and ecological costs of structural adjustment decisions.

Ideational Components of Labor Regimes

In my analysis of the development of labor regimes at both local and national levels and their consequent influence on labor processes for green and climate jobs, I flagged the importance *ideas* play in maintaining the labor regime. Given the expansion of more contingent and highly mobile

work, this has important ramifications for future labor regime analyses in other industries. That ideas may both liberate and constrain work has important political and analytical implications, especially in the maintenance of work in areas free from management oversight.

In particular, I describe how ecological influences on the labor regime—that confront both workers and capital—mutually constitute distinct ideational terrain for how workers perceive their jobs according to the particularities and settings of work. These trace to a combination of the industry’s history and distinct socioecological materialities that interact with institutional settings in important ways. More specifically, ecological dimensions of onshore wind energy at once heighten the intensity of labor exploitation but also create spaces away from management that could conceivably lend themselves to future organizing—something that may be particularly true for wind technicians who have more structural power in the capital-labor relationship by virtue of their skills in a constrained labor market where it is difficult for wind companies to hire people with these skills.

Taken together, economic transformation towards eco-social futures, therefore, takes us back to thinkers like Karl Marx and Polanyi, who implore us to, in different ways, demystify the relationship between work and the associated values it produces. The typology advanced earlier in Chapter 4 may help us to better achieve that aim, both practically and conceptually. My application of labor regime analysis helped to clarify how imbricated labor regimes produce and reproduce the outcomes we see in the sector. In so doing, I advanced “siting” and a relational logic to better show social relations across space and time and how these result in particular social relations of green jobs. Taken together, I show green and climate jobs as they are, not how we wish them to be. As part of this, however, I also show that these are contingent social relations, and that they can be made otherwise.

Recommendations

To ensure this work offers not only theoretic utility, but practical guidance to whom it applies (i.e., workers in “green” jobs), I wish to advance a series of recommendations. These include thoughts on policy, but also insights shared with me by my interlocuters.

To begin, I was shocked to learn that no OSHA specific guidelines for wind technicians exist. Given the extreme circumstances of this work—remote, at heights, with hazards ranging from elevation to electrocution, all under variable weather conditions—that seemingly begs for a set of standards to be developed to help protect workers on the job. Although OHS safety standards may be insufficient in of themselves, that no specific standards exist outside of those promulgated by the Global Wind Organisation (GWO) does a disservice to workers who occupy these jobs. GWO standards likely represent a form of corporate social responsibility whereby the creation of standards by companies is meant to generate social license to continue operations as they do now. Doing so, however, serves to deflect more rigorous management of the labor process itself. Even with companies like Vestas with comparatively strong safety standards put alongside their peers, trade unionists who have organized wind technicians note how workers feel the need to ignore safety protocols on occasion due to pressures on the job, especially with respect to meeting deadlines (I39). This suggests a systemwide issue that requires *outside* oversight to improve.

My analysis has important lessons for policymakers too, especially with respect to international trade, manufacturing, and production aimed at industrial decarbonization. That companies like Vestas adapt to the settings they are embedded—and that they are attracted to particular labor regimes—suggests that policy makers invested in climate issues more seriously grapple with conditions of spatial

competition that discipline labor. In Polanyian language, we must “re-embed” economic competition and related markets to social constraints. I, of course, believe we must go further than this, but it nevertheless represents a start. That is not to suggest, however, that the unilateral imposition of something like tariffs is the answer. Indeed, I see little hope of centralized federal authority offering a way forward for the next few years.

No, a more adequate response to the realities of spatial relations of global production entails some form of wealth redistribution in society. In this respect, an important axis of political struggle to improve the lives of workers who occupy jobs, green or otherwise, exists in making adjustments to the social sphere of production (social reproduction). Until a genuine social safety net exists for people’s ability to survive, capital’s mute compulsion will continue to dictate the capital-labor relation. Although such a shift would not wholly resolve issues of competition, it would go some way to resolving the spatial competition that exists between workers both inside and outside the US.

Trade unions can play a vital role in elevating awareness of this reality, just as they can help advance progress on environmental issues. To my mind, they can play an important role as educators; to remind people that we have collective power and voice and, critically, *ought to have a say in how the workplace operates and to what purposes its outputs go*. It entails reminding people that most of us are workers and it is we who make political economy function.

Todd Vachon (2023) points out that US labor holds a variety of positions on how to respond to climate issues. That ambivalent posture means some trade unions overtly support climate and environment related issues, some choose not to respond, and others, especially those aligned with fossil fuels, respond with hostility. The latter categories hew more closely to an ethos of “business

unionism”, which weakens the broader movement’s ability to lead on environmental issues. However, their position makes a great deal of sense given waged employment’s centrality to our ability to survive.

To my mind, this returns us to the state as the central arena of contestation. Given the federal administration’s hostile posture towards anything that smacks of progressivism, we should focus our attention at the sub-national level (see also Brecher 2024). In particular, a more direct confrontation with questions of ownership in the production and distribution of electricity is needed (see also Burke and Stephens 2018; Paul 2024). Contemporary society relies on various forms of electric power to enable its survival. As I argued in Chapter 8, Public Utility Commissions and similar bodies ostensibly oversee the power grid in the public’s interest. In reality, however, ratemaking decisions, new energy projects, and planning often appears to be decidedly undemocratic, more so driven by obligations to shareholders than through a more thorough reckoning as to how power is produced and to what uses that power is delivered. To my mind, that makes PUCs and associated systems and structures vital places where coalitions of labor, environment, and social justice organizations may join together to effectuate change for the public interest.⁹¹

⁹¹ Moving forward, I should like to explore this topic in greater detail, both within and across countries—perhaps looking to states in Europe like Denmark in line with the existing logic of this dissertation, or perhaps other states like Mexico that have pursued energy sector reform, reversing trends of neoliberalization (International Trade Administration 2025). In both cases, understanding the role of labor and other social movements is crucial.

What might tomorrow look like?

It is undoubtedly easier to consider what is, than imagine what could be. A general lack of vision for what future societies could look like bedevils contemporary politics.⁹² I mean this quite literally. It appears to me that many of the stories found in today's popular media (art, shows, movies, video games, literature) skew towards *dystopia*, not utopia. With respect to work and workers, I again see a lack of vision for what the future of work might look like. Instead, those visions that do exist trot out futures to be, in one way or another, determined by technological innovation and managerial oversight (Schulze-Cleven and Vachon 2021). In popular media, those futures skew towards worlds rife with miasma, cyber futurism (i.e., "cyberpunk"), or some combination therein where the planet has been sucked dry of its resources and corporations instead now frack the last vestiges of animate life (i.e., people). Given developments in US politics today, it is quite easy to see where the inspiration for such a future derives. That future, however, is hardly set in stone.

Although the typology in Chapter 4 was developed to help me analytically think through different aspects of varied GJ/CJ, I also see it as something that can help the collective "we", those of us invested in the realization of cleaner and more just futures, consider the range of possibility that exists when it comes to the world of work. Despite the bleakness of the times we are living in, changing our politics not only rests in critique, but also in our ability to posit something different. Why can we not pursue a "solarpunk" future instead of a "cyberpunk" one (Thompson 2026)?

⁹² Mark Fisher (2009) famously proclaimed that, "it is easier to imagine the world than the end of capitalism," although Frederic Jameson or Slavoj Žižek are said to be the phrase's progenitors. In any case, the point is how deeply capitalism has shaped our ideas about the future.

A range of possibilities exist for work and workers dependent on the outputs, processes, and associated uses of different work forms. I also made the case that genuine transformation in work and political economy, that is, “regenerative” eco-social forms of work, are those that are “dealienating”. These help reconnect people to their productive capacities and to demystify the relationship that exists between workers and nature.

It (almost) goes without saying, certainly if you have followed the argument up to this point, but we cannot realize regenerative or enhancing eco-social forms of work through practices and policies that simply exist to *make capitalism better and cleaner*. No, the way forward rests in transforming social relations. It asks us to rethink what democracy in the workplace looks like, as well as the role work plays in society. To my mind, this entails the integration and synthesis of diverse thoughts and ideas for how technologies, work, and ecology may generatively interact to create a shift from growth-based political economies to those founded on stewardship and renewal. It is not only technological innovation that matters, but *conceptual innovation* for what we should expect from the sphere of our lives where we spend much, if not most of our time.

What might this look like? Well, we might first turn to André Gorz (1967) and his notion of “non-reformist” reforms (see Cha 2024) to make progress on social issues. These reforms entail modest changes that stage opportunities for more radical shifts. Indeed, the typology that ranges from “corrective” to “regenerative” accommodates the changes to work in this stepwise fashion by offering us a tool to observe how tangible changes to output, process, and uses of work move us in more socially and ecologically progressive directions. Incremental changes to material and lived realities can bring about changes in the ideational structure of society and make way for more radical alternative

political economic arrangements for better and more just futures. Of course, this is easier said than done.

The struggle for unions is central as voice in the workplace plays an important role in what the organization of society looks like. You know this intuitively. Consider how much of your day-to-day routine revolves around how you get to and from work. Through unions workers have a greater say in what these routines should look like, which makes them crucial for elevating demands and making changes to the workplace. In this respect, trade unions can play a key role to achieving social justice on a variety of issues, including the climate (Hampton 2015). Or, taking a longer view, Tony Mazzochi and other trade unionists in the US also centered workers and their voices to address environmental issues, making them potential vessels for environmental change (Obach 2004). However, so long as trade unions believe “green jobs” are “bad”, little can be said to persuade those with jobs in industries actively harmful to the environment to support their members making a switch. As I argued above, that makes the sphere of social reproduction central to broad-based struggle for eco-social change.

At the level of policy, overturning Taft Hartley would be a good place to start. Seeing as how the prospects of this are unlikely, it then might instead make sense for such actions to occur at the level of states. In Colorado, this entails overturning laws like the Colorado Labor Peace Act. However, given the dimensions of spatial competition I have referenced throughout, I see little opportunity for individual states to *all* reject their right to work laws. Instead, the solution may rely on a combination of cross-state solidarity among trade unions and collaboration among state level policy makers. Perhaps the establishment of an interstate compact agreement between states more friendly to unions, led by the major economic powers of New York and California, could establish conditions that stipulate that companies that operate or sell any products within a state must formally respect the

right to collectively organize and that this be overseen by labor departments in the offices of those states. Would this work? Probably not, as it would undoubtedly face legal challenges and run up against federal pre-emptions. Instead, an interstate compact would likely need to rely on monetary incentives and subsidies to induce companies to operate in particular ways. Nevertheless, some way of reckoning with uneven regulatory landscapes for labor (let alone the environment) is necessary within the US, let alone between other countries.

The eco-social potential of renewables

I have made references throughout this dissertation that implicit eco-social potential exists within some renewable energy technologies. Let me summarize my position. First and depending on scale, they are relatively inexpensive to produce and deploy, especially in comparison to something like nuclear energy. Second, and again, unlike nuclear, they are schematically relatively simple, which lends them to more *widespread use* and *control* by more people—that is, they are “open” rather than locking technologies in the parlance of Gorz (1967). Related to this, they can be installed at multiple scales that range from multiple gigawatt power production to distributed applications tailored to a local community or home.

On a more philosophical level, there is something to be said about the nature of the power source itself. With respect to the question of ownership and enclosures, something as ubiquitous and *free* as solar power in the form of radiation or wind should not be the purview of private interests. How is it that some people should profit from the sun? That seems to me a gross injustice and the misappropriation of a natural phenomenon—one that quite literally makes all forms of living on earth possible. Indeed, these technologies have a “vital materiality” that stems from how they harness

power—they do so as aspects of ecology, in some sense, similarly attuned to the rhythms of the biosphere. As Myles Lennon argues, renewables are thus a source of potential livelihood that may help humanity better attune itself to more-than-human nature, helping to demystify, at least at local scales, the vital relationality that exists between our lives and the environment on which we depend (Lennon 2017: 26).

Lennon builds on the work of Larry Lohmann and Nicholas Hildyard (2013) who discuss differences between “Big-E” and “little-e” energy systems. In places like the US, Big-E energy predominates, attributable to the creation of fossil fuel-based capitalism and the associated increase in the ready dispatch of these energies that, at once, increase humanity’s productive capacity, but also intensify the metabolic rift between humanity and nature. Consequently, when renewable energy systems are brought onto the power grid, the expectation is that they comport with the existing logic of “Big-E” energy whereby the goal of grid operators is to simply match energy demand with renewable energy supply (Lohmann and Hildyard 2013: 24). However, this is not the appropriate starting point when it comes to thinking about the potential of these technologies, the power grid, and by extension, the nature of what green and climate jobs might look like.

Renewable energies, while having the potential to provide utility scale grid power, are perhaps better integrated into communities as “little-e” forms of energy. Rather than seeing energy systems as responding to the demands of a generalized “society” like Big-E energy, little-e energy instead seeks to appreciate the differences that exist among communities, how they view energy and how this connects with their lives (see Lohmann and Hildyard 2013: 24). The starting point for the creation of energy systems thus lies not in the hands of energy experts, but within the broader community to conceive of how energy flows intersect with existing eco-social relations connected to the politics of

food, health, familial relations, and religion. In each instance, the question of work is central, as energy becomes understood in a more concrete way as the *capacity to do work*, which should encourage communities and workers to consider questions vital to political economy. To what purposes should we work? How should energy be used to supplement necessary labor? And, related to both, how much should we work to ensure good living?

Erstwhile, many historic forms of work and living were more attuned to such questions. I do not wish to deify historic forms of life and living (slavery and feudalism are hardly emancipatory), but instead suggest that there *is* something valuable in becoming more attuned to seasonality and the specificities of place. For instance, windmills (not turbines), were attuned to the flow of water in the river. Cycles of light and darkness heralded different times of the year for growing food and doing other forms of work. These cycles similarly hold true for both wind and solar power and perhaps suggest a need for work forms more in tune with these rhythms and cycles—working more at some points, but a great deal less in other times. Some advanced experts of renewable energy systems conceptualize how renewable energies like wind and solar vary considerably from conventional fuel sources, especially cast against the views held by fossil fuel and nuclear energy technocrats today (Lennon 2017). In this respect, perhaps the answer to global and local ecological crises do not lie in attempts at plugging renewable energies into conventional “Big-E” forms of energy, but instead appreciating their potential as “little-e” forms of energy that may at once transform energy flows, work, and living. Again, that makes the state, and associated institutions like PUCs, central for the realization of eco-social futures.

And yet, there are likely some things that must always have access to some form of electric power. What these are, once again, should be determined by the larger society. To my mind, the most

obvious examples of such a space would be medical or healthcare settings of varying sorts. Other settings might also include community centers, schools, and a sundry of agriculture and food operations that might range from greenhouses to storage facilities. The critical point is that these should have uses that are beneficial to both people and the environment, and that people socially determined what constitutes critical infrastructure for the purposes of equality and cooperation.

In many respects, these ideas have been advanced (and theorized) in greater depth by the social ecologist Murray Bookchin. Bookchin believed in principles of direct democracy and the decentralization of authority to realize the formation of non-hierarchical forms of communal society (i.e., libertarian municipalism). As part of this, he also saw the potential that renewable energy systems like wind and solar had for the realization of this, taking us back to Gorz's thought about the ways in which these technologies were "open" and enabling of such forms of living. His thinking aligns (and informs) what I believe to be more socially and ecologically desirable forms of "green" jobs, those in which work—both human labor and the work associated with energy production—should be used to cultivate and restore healthier eco-systems. In so doing, these should contribute to emancipation of individuals by demystifying their productive capacities and reconnecting them to nature. As Bookchin (1991) argues, such is not a process of "restoration", as the relationship between humanity and nature always existed, but had become obscured through hierarchical organization of societies in various forms. Critical to Bookchin's thought, however, is that social institutions and, by proxy, the technologies that help to construct institutions and norms that enable it to function, operate in ways that promote cooperation, rather than competition. Perhaps along these lines, it feels like achieving what I have described would only appear to be possible in small, decentralized communities that approximate something like what many today would imagine as a commune of sorts.

I do not wish to suggest that these communities would exist as freestanding delimited islands, however. Cutting oneself off from the world hardly seems like a form of cooperation. Instead, decentralized communities would be stitched together across space. Transmission lines would conjoin communities with one another to form a vast tapestry of smaller, decentralized communities, each responsible for the upkeep and maintenance of this infrastructure, which could establish relations of cooperation across space. Perhaps getting here would entail something like a jobs guarantee program to those who wish to make this project possible, something that would exist at the level of states or subnational governance. In this fashion, communities would have some (although not complete) insulation from changes to local weather conditions or when local infrastructure becomes damaged for one reason or another. Although this would appear to suggest some level of centralization is necessary, it could be the case that this is actually a space in which artificial intelligence systems—trained on the collective knowledge of humanity—could have a role to play. These would effectively function as autonomous grid system operators that all communities would have access and oversight on. Because these AI are built by people and trained on our collective knowledge, they would similarly not be owned by any one group. Instead, they would exist to benefit all people, by dispatching electric power as needed to what communities deem most essential. The operation of such a system no doubt requires a great deal of power. Here, perhaps, a data center that “stores” the AI would be cooperatively built and maintained by varied communities, and each would provide some of its renewable energy power to the data center to ensure it runs at different times.

Once again, however, the uses of different economic activities matters a great deal in whether or not associated jobs and political economic platforms are socially or ecologically beneficial.⁹³

There are, no doubt, flaws, contradictions, and counter arguments to the idea I sketched out above. For one, I am already struggling to deal with complexity and scale at this early stage. That is not the point, however. Instead, I wish to suggest that *there are* other ways of doing things, especially if we allow ourselves to rethink what ownership looks like and what the potential uses of these technologies might be when freed from the whims of capital.

Conclusion

At the onset of this dissertation, I began with two questions. First, what are “green” and “climate” jobs and, by proxy, what political economic platforms do they imply? Second and related, why are green jobs and climate jobs associated with critical renewable energy technologies not as socially or ecologically desirable as we should like?

To answer these questions, I have attempted to map out, systematically, the ways in which political institutions, political economic structures, history, geography, and ecology itself shape outcomes of work we see in the renewable energy sector. To make my analysis, I advanced an eco-social typology that provides both a conceptual grounding and a methodological heuristic to assess the extent to

⁹³ I sympathize with the perspective that some folks have towards AI given the associated environmental impacts at macro-scales (UNEP 2024), which is to say nothing about the blatant disregard of laws and peoples by some companies like Elon Musk’s xAI (Hilt 2026), and a sundry of other harmful practices, not all AI types are created equally, however. Although generative AI models have become ubiquitous topic of discussion for many of us, there are other forms of AI that still may yet prove to be quite useful. It is not so much the technology that matters, but the social relations into which they are embedded, and how these technologies may interact with these relations to either liberate or further lock-in conditions of exploitation.

which different social arrangements of work do or do not contribute to genuine eco-social change. That typology offers both the analytical and theoretic point of juxtaposition to assess green and climate jobs in their myriad forms.

I subsequently took this typology and combined it with labor regime analysis as the framework for how to systematically consider the capital-labor relationship and how larger sociopolitical structures, the socioecological indeterminacy of work, and ideas about the work process itself interact through imbricated spheres of production, circulation, social reproduction, and ecology to shape GJ/CJ outcomes in the renewable energy sector. As I argued in a variety of ways, these associated relationships and processes mutually constitute labor regimes at varied spatial scales that shape observed outcomes for workers. These outcomes, unfortunately, do less to emancipate workers, improve livelihoods, and change eco-social relationships between humanity and nature, but instead appear to lock-in existing conditions that make work precarious, ephemeral, and alienating. That's hardly what anyone would call "transformational" or "just".

As I argued, perhaps most vociferously in Chapter 8, but to greater or lesser degrees throughout, conditions of competition inherent to the capitalist mode of production do a great deal to constrain the potential for green jobs to be "corrective" or "enhancing" forms of work, let alone regenerative. Capitalism depends on an incessant need for growth that depends on a continual flow of value to "feed the machine". Where others like Christophers (2024) argues this both slows and limits more widespread adoption of renewable energies, I have shown the more precise mechanisms for how "green" capitalism suppressed job quality.

I also described the way a transnational renewable energy company, Vestas, operates in a way that is consistent with other capitalist enterprises. Indeed, and based on my conversations with many people, Vestas represents the “good” case when it comes to the treatment of workers, at least in the US—a point also made by the Business and Human Rights Research Centre (2025). And yet, even then, it is quite clear that the same amoral calculus that operates in other industries similarly enables these to function and, in so doing, severely limits the actual potential inherent in a period of radical political change. More than that, it plays into the hands of authoritarian leaders who will quite readily disparage these forms of energy for any number of reasons. If people who work for these companies or communities in which they operate see these industries and associated technologies as no different than any other, that will simply breed further animosity and resentment towards “green” activities. Indeed, one interlocuter remarked that hostility towards “green” and “wind” work in some parts of the country is so intense that workers do not feel comfortable wearing their company branded equipment in many communities for fear of drawing their ire (I42).

We cannot answer the gauntlet cast before us by “greening” systems and structures that gave rise to today’s crises. We must stop playing this game of trying to make renewables play by the same rules as other technologies. Instead, we should see the expansion of renewable energy technology as an opportunity for *radical potential and eco-social transformation*. Let us use these relatively open and accessible technologies in a way that is not guided by profit, but instead harnesses the power of the sun to deliver power—both electrical and political—into the hands of people. The sun shines on all of us, after all.

We must reject politics of nihilism to reclaim the things that make life vital and worth living—human security, social connection, and attunement with the environment. It is through the sphere of

work that people transform themselves and the environment, and it is through work that people and associated movements will navigate to get us out of our period of overlapping crises. The choice seems clear to me. We either transform what the processes, outputs, and uses of work look like and to whom it serves, or we resign ourselves to occupy yet another (exceedingly thin) layer in Earth's geological record. An experiment with great promise, but that nevertheless proved to be a dead end.

If Kate Soper (1995: 126) has it right and that we are "biologically underdetermined", meaning that we have no *essential form* for how we organize ourselves, then that suggests what marks us *unique* as a species are the near infinite number of ways in which we might mediate relations with each other and nature. In the face of ecological devastation, there is something to be said for humanity's ability to adapt. Although history certainly influences what we can do, we can choose a different path than the one set before us. Time will tell if we choose it.

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APPENDIX

Webinars

- IndustriAll (2021). Building Union Power in the Renewables Supply Chain. December 9, 2021.
<https://www.industriall-union.org/building-union-power-in-the-renewables-supply-chain>
- U.S. Department of Energy (DOE). 2022. Justice40 Kickoff Webinar, August 17:
https://www.zoomgov.com/w/1607960596?tk=7OJZuFl3f2S7FOCZ_tj6SmpK3EG2_cbdTf8iNJh8VIE.DQMAAAAAX9eIFBZmM0lrSDjhQVNGQ0ZEYmJfV2xLU1ZRAAAAAAAAAAAAAAAAAAAAAA&uuid=WN_iWNo-BuxSDih8XRX79WWVw
- The United Auto Workers Strike and Building Worker Power for a Just Transition:
<https://biologicaldiversity->
[org.zoom.us/j/88622131547?tk=8gB8OVn3Q9zhVq1cX1Uya1hZSWldJ126bNy0Z_ctYu8.DQYAAAUokppWxZBMEtvQnUwcVFQdWt6c3dERk5uNTJRAAAAAAAAAAAAAAAAAAAAAA&uuid=WN_LUDA5jGnRTmOzyNVS9tl2w](https://www.zoom.us/j/88622131547?tk=8gB8OVn3Q9zhVq1cX1Uya1hZSWldJ126bNy0Z_ctYu8.DQYAAAUokppWxZBMEtvQnUwcVFQdWt6c3dERk5uNTJRAAAAAAAAAAAAAAAAAAAAAA&uuid=WN_LUDA5jGnRTmOzyNVS9tl2w), 1/31/2024, Center for Biological Diversity
- Labor Network for Sustainability. 2023. Just Transition for Auto Workers: The Answer to Auto's Race to the Bottom, October 6: <https://www.labor4sustainability.org/strike/just-transition-for-auto-workers-the-answer-to-autos-race-to-the-bottom/>
- GridWorks. 2024. Barriers to Backbone Transmission Development in the West - A Conversation with Rich Glick and Rebecca Wagner. February 8, 2024.
<https://www.youtube.com/watch?v=oCMO-e8rMZc>

- U.S. Department of Energy (DOE). 2024. Benefits and Burdens: Exploring the Role of Community Benefits in Wind Energy Development:
https://nrel.zoomgov.com/join/1615261608?tk=BLiJv8aeT7tKH1COzoelPs-pS-BOBpgK-gsfqvLOKRc.DQYAAAAAYEbvqBYydW9OM1BZcFJ1cW1DVEtkWEpiZEJnAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA&uuid=WN_0oO27QFcRNGF1SUOfaxdfw, WINDexchange, February 28, 2024.
- Labor Network 4 Sustainability. 2025. Green New Deal from Below. January 20, 2025:
<https://www.labor4sustainability.org/articles/green-new-deal-from-below-expands-the-possible/>
- NREL. 2024. Land Based Wind Workforce Network Q4 Meeting. DOE Wind Energy Technologies Office. Aug 14, 2024.

Recruitment Materials

General Recruitment

Dear _____,

Customized text depending on the individual/party/group being contacted.

I would like to interview you/talk with someone in your organization/company for my dissertation, which seeks to better understand and describe worker experiences in renewable energy. As an initial exploration into this area, I am researching wind energy. This study analyzes industry operations and how these intersect with workers' lives. Related to this, the project considers how individuals in the industry interpret and think about "green jobs", "climate jobs", and what sustainable work might look like.

Procedures and Activities

If you agree to participate in the study, you will be asked to take part in a 60 – 90 minutes interview. You may refuse to answer any question during the interview. You determine the extent and depth to which you choose to answer questions. If, at any time, you no longer wish to participate, you may inform me and we can discontinue the interview, at which point I will debrief you.

Who can join this study?

You can participate in this study if...

- You are at least 18 years old
- You have knowledge of, or work in, the wind energy industry.

Benefits

By participating in this study, you help me and fellow researchers better understand industry activities and how these intersect with the lives of workers. Indirect benefits to participation include an opportunity to share your knowledge of the industry and perspective on what “green jobs” and sustainable employment could look like. These insights may help to inform policies that directly benefit workers in the renewable energy industry.

If you are interested in joining, please contact Brendan.Davidson@colosate.edu or call me at 303-918-3862.

CSU IRB Protocol #6369

Sincerely,

Brendan

Phone script for voice message

Customized text depending on the individual/party/group being contacted.

I am a student at Colorado State University who is researching/studying global production networks, with wind energy as a case study.

I would like to interview you (or someone from your organization) for my research, which seeks to better understand and describe worker experiences in renewable energy. As an initial exploration into this area, I am researching wind energy. This study analyzes industry operations and how these intersect with workers' lives. Related to this, the project considers how individuals in the industry interpret and think about "green jobs", "climate jobs", and what sustainable work might look like.

By participating in this study, you help me and fellow researchers better understand industry activities and how these intersect with the lives of workers. Indirect benefits to participation include an opportunity to share your knowledge of the industry and perspective on what "green jobs" and sustainable employment could look like. These insights may help to inform policies that directly benefit workers in the renewable energy industry.

If you agree to participate in the study, you will be asked to take part in a 60 – 90 minute interview.

If you are interested in participating, please call me back at 303-918-3862 or email me at Brendan.Davidson@colostate.edu, spelled *b r e n d a n period d a v i d s o n* @ colostate.edu.

Please contact Brendan.Davidson@colosate.edu or call me at 303-918-3862.

Worker Recruitment

Dear _____

I would like to speak with you about your experiences working in wind energy manufacturing. My research strives to better understand and describe worker experiences in renewable energy production networks and how these intersect with workers' lives. Related to this, the project also considers how individuals in the industry interpret and think about "green jobs", "climate jobs", and what sustainable work might look like.

Procedures and Activities

If you agree to participate in the study, you will be asked to take part in a 60 – 90 minute interview. You may refuse to answer any question during the interview. You determine the extent and depth to which you choose to answer questions. If, at any time, you no longer wish to participate, you may inform me and we can discontinue the interview, at which point I will debrief you.

Who can join this study?

You can participate in this study if..

- You are at least 18 years old
- You have knowledge of, or work in, renewable energy.

Benefits

By participating in this study, you help me and fellow researchers better understand industry activities and how these intersect with the lives of workers. Indirect benefits to participation include an opportunity to share your knowledge of the industry and perspective on what you hope the future of

work to look like. These insights may help to inform policies that directly benefit workers in the renewable energy industry.

If you are interested in joining, please contact Brendan.Davidson@colosate.edu or call 303-918-3862.

CSU IRB Protocol #6369

Sincerely,

Brendan

Interview Questions

Group 1 (Workers) Interview Questions.

Interview begins with verbal consent script.

Are you ready?

Organization of work

- Can you describe the work you do?
- How were you trained for this job? On the job training? College? Something else?
- How long have you performed this work?
- How are tasks organized among you and your coworkers?
- What does the relationship between workers in different roles look like?
- Do you live close to where you work?
 - o Do you travel as part of your work?
- *Depending on worker:*
 - o Manufacturing: What parts do you manufacture?
 - Where do you get parts from?
 - o Project development and O&M: Do you typically work on small-scale, distributed energy projects, or utility scale projects?
 - o O&M: Do you work for the same company? Are you subcontracted? Do you service an area or travel?

Broader political economy of labor control

- Do you know who owns your company? Is it a foreign firm, or is it domestic?
- Have broader industry trends impacted your work? If so, could you explain?
- Can you describe how the industry operates? How do these operations impact your workplace?
- What groups or actors have the most influence on your activities at work?
- What groups or actors have the most influence on the industry as a whole? Why do suspect that is?
 - o Probe: ask about OEMs, project developers, utilities, utility commissions, state/federal government
- Do you consider or think about workers in other parts of the supply chain
 - o What are the points of connection you have with other workers in the same industry, if any?

Workplace labor regime

- How did you come to occupy your current position?
- Are you an employee of the company, or are you hired as a contractor (*probe, were you recruited through a temporary-hire firm?*).
- Do you think the industry uses its environmental image to recruit workers? If so, what do you think about this practice? Does this influence work conditions in any way?
- Do you work full time, part time, or are you a temporary worker?
 - o How many hours do you work?
- How much autonomy do you have in your role?

- *Probe:* What mechanisms exist for workers to provide input or feedback on operations?
- Approximately how much take home pay do you receive in a year? Below 15K? Between 15 and 25K? Between 25 and 35K? Between 35 and 50K? Greater than 50K? Greater than 100K?
- What benefits do you receive, if any? (*healthcare, retirement*)

Labor rights and standards

- Do you feel safe on the job? Why or why not?
- Do you feel secure within the industry? Why or why not?
- Do you feel that the company/management listens to your concerns? About production, safety, quality of life?
- What forms of collective association are encouraged, if any?
- What safety standards (*union, state, or federal*) impact your work the most? Why?
 - Do safety standards reflect your experience of work in the industry?
- Do you think your expertise and knowledge impact the technologies you work with?
 - *Probe:* Can you provide an example that demonstrates this?

Green jobs and Climate Jobs

- Do you think of yourself as “committed” to the industry? *Is this a job, or more than just a job.*
- Do you think about the environment as part of your job? If so, how?
 - *Probe:* Does the industry discuss the climate or environmental benefits of your work while you are on the job? If yes, how so? *Again, alienation from nature.*
- Have you heard the expression “green job” or “climate job”? What does this mean to you?

- What do you think “green jobs” or “climate jobs” should look like? How does this compare with your existing work?
- Do you see yourself in your work? Get at the question of alienation, “certain feelings (avoiding labour).
- I feel I have enough for me, and my family, to live well? Strongly Agree to Strongly Disagree.
 - o *Probe:* Elaborate
- Are you able to control the pace of work? Alienation, democracy and complete projects as you see it.
- Do you feel connected to other workers in wind? How would you describe your relationships at work?
- What are your thoughts on utility scale versus distributed energy projects? Which of these do you prefer for your community? Why?

Political identity and thoughts on energy work (time permitting, non-essential)

- How would you describe yourself in terms of political identity? (Socialist, very liberal, liberal, liberal-leaning, moderate/middle of the road, libertarian, conservative leaning, conservative, very conservative)
- What benefits does wind energy offer as a profession?
- What trajectory do you anticipate the industry to be on? (Growth? Plateau? Shrink?)
 - o What challenges do you anticipate for the industry?

Demographics

- How old are you? (*record a range*)

- How do you identify (*ethnicity and/or gender*)?
- Where are you from? Are you local, or did you come here for work?
- Do you have dependents? If so, do you feel that you have enough to support them?

Concluding Questions

- Is there anything important about your work or experience that you would like to discuss?
- Do you know of others who would like to participate in an interview?

Thank you for sharing your experiences and time with me!

Debrief

Group 2 (Subject matter experts//elite interviews)

Give some background on self.

Interview begins with verbal consent script.

Are you ready?

Organization of work or the production network

- What relationship do you have with the wind energy industry?
 - o *Probe:* Can you describe to me what your organization/group does?
 - o *Probe:* Can you describe what you do?
- How long have you worked in (or with) the wind energy industry?
- How do project developers, original equipment manufacturers, and utilities interact with one another?
 - o *Probe:* Do project developers or manufacturing and supply firms have more power in production networks? Why?
 - o *Probe:* How do firms decide who or who not to work with? Why do they sell to certain companies and not others?
 - *Probe:* Is subcontracting between suppliers common?
 - *Probe:* What about in project development?
 - *Probe:* What about for turbine technicians?
- Are supply chains buyer driven or supplier driven? Who are the buyers? *Utilities or project developers?*

Broader political economy of labor control

- How does interfirm competition influence company decisions on who to hire or where to hire them, if it does?
- Does the industry favor utility scale projects over distributed scale projects? If so, why do you think this is the case?
- What are the primary ways in which the industry tries to remain competitive and keep costs down?
- What groups or actors have the most influence on the wind industry?
 - o Probe: ask about OEMs, project developers, utilities, utility commissions, state/federal government, regulators
- Who are the most powerful actors within the wind industry? (*OEMs, project developers, utilities*)?
- How have state or federal government policies contributed to changes in the wind workforce?
- What role do private utilities play in influencing wind company decisions?
 - o How have private utilities influenced the trajectory of the industry and the associated workforce?
- What are the primary reasons for an OEM to choose one location and not another for a manufacturing facility?
 - o *Probe:* When do they choose to outsource or subcontract?
 - o *Probe:* Are wages or potential supply chain disruptions more important to companies?
 - o *Probe:* Local incentives or tax breaks?
 - o *Probe:* Does the local labor pool or available training matter? *Social reproduction, subsidizing the industry.*

- *Probe:* How has the change in presidential administrations influenced company decisions, if it has?
- How do supply chain logistics influence the siting of manufacturing facilities or construction of new energy projects?
- How do labor costs factor into siting decisions for new manufacturing facilities? What about project development?
- What role have unions had in shaping the conversation on renewable energy?
 - Have they influenced the way you think about work in the energy sector?
- Do you think the election of Donald Trump will providing a chilling effect on the industry?
 - *Probe:* If/when tax credits for things like prevailing wage or project labor agreement and apprenticeship programs with the IRA are cut, how do you think the industry will respond? Did they matter to begin with?

Workplace labor regime

- How are people typically hired in the industry? How does this differ according to the position and supply chain stage?
 - (probe OEMs/manufacturing, project development/construction, operations and maintenance)
 - (*probe*, are individuals hired as employees, or are they more regularly hired as subcontractors or through temp-hire firms?).
- Why do you suspect there is a “workforce gap” within the wind energy industry?
 - *Probe:* In what segments of the industry is this most pronounced?

- To your knowledge, are most workers full-time employees, part-time employees, or are they hired on a temporary basis? How does this differ across worker categories?
- How are workers typically managed at a manufacturing facility or site?

Labor rights and standards

- What forms of collective association are encouraged in the industry, if any?
 - o Probe: What interactions generally take place between workers and management?
Can see this in online reviews...see HR as simply acting in management's behalf.
- What safety standards (*union, state, or federal*) impact the industry the most? Why?
- Estimates vary on unionization on the industry, but range somewhere between 5% and 15%.

What projects are more likely to be unionized and why? Why aren't there more unionized projects/facilities?

- o Probe: ask about manufacturing, O&M workers, and project development.
- o Probe: scale of project. Utility scale versus distributed scale?

Green jobs and Climate Jobs

- How do you think the industry conceives of its role in responding to environmental issues? Or, is the industry primarily profit driven?
- Have you heard the expression "green job" or "climate job"? What does this mean to you?
- What do you think "green jobs" or "climate jobs" should look like? How does this compare with existing work in the industry?

Political identity and thoughts on energy work (time permitting)

- How would you describe yourself in terms of political identity? (Socialist, very liberal, liberal, liberal-leaning, moderate/middle of the road, libertarian, conservative leaning, conservative, very conservative)
- What benefits does wind energy offer? *Probe*: What benefits does it offer to workers?

Demographics

- How old are you? (*record a range*)
- How do you identify (*ethnicity and/or gender*)?

Concluding Questions

- Is there anything important about your work or experience that you would like to discuss?
- Do you know of others who would like to participate in an interview with me?
- *If applicable*, Do you have any books, documents, or materials that would be helpful for me in better understanding workforce issues in the wind industry?

Thank you for sharing your experiences and time with me!

Group 3 (Local politicians and government workers//elite)

Interview begins with verbal consent script.

Are you ready?

Organization of work

- Can you describe what you do?
- What are your thoughts on renewable energy?
- What relationship do you have with the wind energy industry?
- *If politician*. Discuss the legislation you've passed or implemented related to the wind industry?
 - o *Probe*: How has ____ intersected with the lives of your constituents, especially those employed by the industry?

Broader political economy of labor control

- What groups or actors have the most influence on the industry?
 - o *Probe*: ask about OEMs, project developers, utilities, utility commissions, state/federal government
- Who are the most powerful actors within the industry? (*OEMs, project developers, utilities, utility commissions*)?
- How have you or your office contributed to renewable energy projects in your jurisdiction?
- What are your thoughts on utility scale versus distributed energy projects? Which of these do you prefer for your community? Why?
- *If a local government*, what role has the industry played in your community?

- *Has the presence of {insert project/facility} had a significant influence? Are the jobs here good jobs? How do your constituents feel about these positions or the presence of the industry?*
- *Specific probe:* How did ____ project or manufacturing facility come about?
 - *Probe:* Were there incentives that helped to attract the project/facility?
- What role have unions had in shaping the conversation on renewable energy?
 - Have they influenced the way you think about work in the energy sector?
- What role do private utilities play in the energy sector?
 - Have they influenced the trajectory of wind energy and the constitution of its workforce?
- Do you think the election of Donald Trump will providing a chilling effect on the industry?

Probe: If prevailing wage or project labor agreement and apprenticeship programs with the IRA are cut, how do you think the industry will respond?

Workplace labor regime

- What are the challenges that you most often hear from your constituents with respect to their working lives?

Labor rights and standards

- Estimates vary on unionization on the industry, but range somewhere between 5% and 15%.
 - What do you think best explains why rates are lower than comparable industries like fossil fuels?

Green jobs and Climate Jobs

- Have you heard the expression “green job” or “climate job”? What does this mean to you?
- What do you think “green jobs” or “climate jobs” should look like? How does this compare with existing work in the industry?
- What do you see as the value of the wind energy to your constituents?

Political identity and thoughts on energy work (time permitting)

- How would you describe yourself in terms of political identity? (Socialist, very liberal, liberal, liberal-leaning, moderate/middle of the road, libertarian, conservative leaning, conservative, very conservative)

Demographics

- How old are you? (*record a range*)
- How do you identify (*ethnicity and/or gender*)?

Concluding Questions

- Is there anything important about your work or experience in the industry that you think we’ve missed?
- Do you know of others I might speak with, or resources I should check out?

Thank you for sharing your experiences and time with me!

Group 4 (Trade unions, labor climate organizations, and collectives of renewable energy workers)

Interview begins with verbal consent script.

Are you ready?

Existing relationship to the industry

- Can you describe what you do as a profession? What about with the union?
- What are your thoughts or impressions of renewable energy?
- Does your union/organization view wind energy favorably? Why or why not?
- What about solar?
- *If applicable*: How long have you worked in (or with) the renewable energy industry? What about wind energy?
- Do you or your members favor small-scale distributed projects, or utility-scale projects? Why?
- Do you think there are potential opportunities for your members in wind? Why or why not?
- Does the temporary nature of project development activities give the union pause to lend the industry support? Why or why not?
- What success, if any, has the union had in organizing manufacturing workers? What about project development? What about operations and maintenance?
 - o *Probe*: What are the challenges to organizing you face? Are there any specific to wind energy? What about renewables more broadly?

Broader political economy of labor control

- Can you describe how the wind industry operates? How do you think these operations impact the way workers operate in the industry?

- In your experience has the industry been accepting union workers? Why?
- What groups or actors have the most influence on setting conditions of work within the industry? *Probe: ask about OEMs, project developers, utilities, utility commissions, state/federal government*
- What role have unions had in shaping the conversation on renewable energy, and wind in-specific? Has your organization had success in winning contracts on renewable energy projects or in renewable energy facilities?
- What role do private utilities play in the sector?
 - o How have they influenced the trajectory of wind energy, the energy transition, and the constitution of its workforce?
- Have prevailing wage and project labor agreement requirements within the IRA led to a boost in the number of contracts received by the union?
 - o Now that the Trump Administration is in power, what do you think will happen?

Workplace labor regime

- What do you understand as the primary ways in which people are hired by the industry? How does this differ according to the position and supply chain stage?
 - o (probe OEMs/manufacturing, project development/construction, operations and maintenance)
 - o (*probe*, are individuals hired as employees, or are they more regularly hired as subcontractors or through temp-hire firms?).
- Why do you suspect there is a “workforce gap” within the wind energy industry?

- In what ways have unions been involved in the industry? *Probe:* Why (or why not)? Is there something specific to wind?
- How would you feel about a Project Labor Agreement with the industry? Do you think a PLA is sufficient?
- Wages are thought to be lower in the renewable energy industry, including in wind, in comparison to conventional energies in the sector. Why do you think this is the case? How does that influence your attitude, or your members' attitudes, towards the industry?
- In what ways has your union been involved with other unions across the world on the issue of environment and renewable energy production, if it has?
 - o *Probe:* What about within wind energy production networks?

Labor rights and standards

- What forms of collective association are encouraged in the industry, if any?
- What safety standards (*union, state, or federal*) impact the industry the most? Why?
- Estimates vary on unionization on the industry, but range somewhere between 5% and 15%.
What projects are more likely to be unionized and why?
 - o *Probe:* ask about manufacturing, O&M workers, and project development.

Green jobs and Climate Jobs

- How does the union think about its role in responding to environmental issues?
 - o *Probe:* Is the principal focus on climate?
- Have you heard the expression "green job" or "climate job"? What does this mean to you?

- What do you think “green jobs” or “climate jobs” should look like? How does this compare with existing work in the industry?
- What value does wind energy provide to your members, or perhaps, even to the community, if any?
- Do you think the renewable energy or wind energy industry uses “greenness” as a form of control? If yes, how so?

Political identity and thoughts on energy work

- How would you describe yourself in terms of political identity? (Socialist, very liberal, liberal, liberal-leaning, moderate/middle of the road, libertarian, conservative leaning, conservative, very conservative)
- Do you think your work informs your political identity?
- What benefits does wind energy offer? *Probe*: What benefits does it offer to workers?

Demographics

- How old are you? (*record a range*)
- How do you identify (*ethnicity and/or gender*)?

Concluding Questions

- Is there anything important about your work or experience in the industry that you think we’ve missed?
- Do you know of others who would like to participate in an interview with me?

Thank you for sharing your experiences and time with me!

Group 5 (Businesses and company representatives of the wind energy industry//elites)

Interview begins with verbal consent script.

Are you ready?

Organization of industry

- Can you describe to me what your business does within the industry?
- Can you describe what you do?
- How long have you worked in (or with) the renewable energy industry? What about in wind?
- *If OEM*, Are you a lead firm or a supplier-based firm? Do lead firms or supplying firms have more of the power in production networks? Why?
- How do firms decide who or who not to work with? Why do they sell to certain companies and not others?
 - o Is subcontracting between suppliers common?
- Are supply chains buyer driven or supplier driven? Who are the buyers? *Utilities or project developers?*
- Is your firm owned or controlled by a foreign entity? If so, who and what country?
- How do project developers, original equipment manufacturers, and utilities all interact with one another?

Broader political economy of labor control

- Describe to me how the industry operates.
- What are some of the most important trends in the wind energy industry right now?
 - o *Probe*: How have these trends impacted companies?

- What groups or actors have the most influence on the industry?
 - o Probe: ask about OEMs, project developers, utilities, utility commissions, state/federal government
- What are the primary ways companies try to stay competitive and to keep costs down?
- Who are the most powerful actors in the industry? (OEMs, project developers, utilities, utility commissions, state/federal government)?
- Have state or federal government contributed to changes in the wind workforce? If so, how?
 - o Probe: Did the IRA or IIJA fundamentally alter how the company does business or choose where to build/manufacture?
 - o Probe: With the new administration in power, how do you think the wind industry will respond?
- What role do private utilities play in the sector? How have they influenced the trajectory of wind energy, the energy transition, and the constitution of its workforce?
- What makes some parts of the country more attractive to buyers and finance than others?
- Supply chain challenges have been a consistent challenge for the industry. How do supply chain logistics influence the siting of manufacturing facilities or construction of new energy projects?
- What are the primary reasons for an OEM to choose one location and not another for a facility?
 - o Probe: Do tax breaks, credits or other incentives weigh into company decision making? If so, how?
 - o Probe: When does your company choose to outsource or subcontract?

- *Probe:* Are wages or the potential for supply chain disruptions more important factors for companies?
- *Probe:* Does the industry operate under a “just in time” model with respect to the availability of parts to build a wind turbine? Or are they made to order?
- Would your company consider a project labor agreement with a union for a project/manufacturing site? Why or why not?

Workplace labor regime

- What does the hiring process typically look like? Does this vary according to position and supply chain stage? If so, can you say how?
 - (probe OEMs/manufacturing, project development/construction, operations and maintenance)
 - (*probe*, are individuals hired as employees, or are they more regularly hired as subcontractors or through temp-hire firms?).
- Why do you suspect there is a “workforce gap” within the wind energy industry? In what segments of the industry is this most pronounced? How has this impacted your hiring practices, if it has?
- Are there wage setting norms in the industry? Are these driven by contracting requirements of lead firms? Do utilities influence this?
- How has the increase in market share of China contributed to changes in industry operations? Will they come to dominate wind like they have solar?
- Do lead firms in GPNs for wind set the prices?

Labor rights and standards

- How does management typically interact with workers?
 - o *Probe:* Through HR or some other mechanism?
- What safety standards (*union, state, or federal*) impact the industry most? Why?
- What about environmental standards?
- Has your company worked within unions to secure workers? Why or why not?
- Does the company consider environmental or labor standards that its affiliates and subcontractors have? If so, how does it oversee these?

Green jobs and Climate Jobs

- How does the industry think about its role in responding to environmental issues?
 - o *Probe:* Is the principal focus on climate?
- Have you heard the expression “green job” or “climate job”? What does this mean to you?
- What do you think “green jobs” or “climate jobs” should look like? How does this compare with existing work in the industry?
- What do you see as the essential value of wind energy?
 - o What about your company’s role within the industry?

Political identity and thoughts on energy work (time permitting)

- How would you describe yourself in terms of political identity? (Socialist, very liberal, liberal, liberal-leaning, moderate/middle of the road, libertarian, conservative leaning, conservative, very conservative)
- Do you think your work informs your political identity?

Demographics

- How old are you? (*record a range*)
- How do you identify (*ethnicity and/or gender*)?

Concluding Questions

- Is there anything important about your work or experience in the industry that you think we've missed?
- Do you know of others who would like to participate in an interview with me? Are there materials or resources that you could share with me you believe would be helpful for my research?

Thank you for sharing your experiences and time with me!

Table of Interviews

ID	Classification (labor, environment, capital, state, SME)	Representative perspective
i1	SME	SME, R&D worker
i2	SME	SME, R&D worker
i3	State, SME	SME, state rep, PUC
i4	labor	worker, project development
i5	capital	SME, Industry, R&D
i6	capital	SME
i7	SME, capital	industry, management, value add, SME
i8	SME	SME, R&D
i9	State	state rep
i10	Labor	trade union, worker
i11	Labor	trade union, worker
i12	Labor	SME
i13	Labor	trade union, advocacy
i14	Labor	trade union, advocacy
i15	Labor, Capital	worker, manufacturer, manager
i16	Labor	worker, manufacturer
i17	Labor	worker, manufacturer
i18	Capital	industry, consultant
i19	Labor, environment	trade union, labor
i20	Labor	worker, wind tech
i21	Labor	trade union, manufacturing
i22	Labor	worker, manufacturing
i23	Capital	industry consultant
i24	State	state rep
i25	Capital	industry, management
i26	Labor, environment	legal professional, labor
i27	Labor	worker, wind tech
i28	Labor	worker, wind tech

i29	Labor	worker, project development
i30	Capital	industry, executive
i31	Capital	industry, lawyer
i32	Capital	industry, executive
i33	Labor	trade union, advocacy
i34	Labor	project development, wind tech
i35	Environment	advocacy, environment
i36	State	state rep, economic development
i37	State	state rep, economic development
i38	Labor	worker, wind tech
i39a	Labor	trade union, wind tech
i39b	Labor	trade union, wind tech
i40	State	workforce development
i41	State	worker, manager, workforce development
i42	Labor	worker, manufacturing