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Climate Change and Work: Politics and Power

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Abstract

Climate warming is the fundamental challenge of our time, not only because it will radically transform our natural environment but also because it will redefine jobs and livelihoods. This article builds an interpretive bridge for understanding the political consequences of how climate change pressures will affect work, production, and technology. We organize this review along three themes: commodification and the processes through which costs and resources are made visible; the production of knowledge and the politics of representing the future; and just transitions and how to distribute the costs and the opportunities of change equitably. These themes all address the ways that the dominance of the market—both in rhetoric and in policy—eclipses the materiality of economic production and social exchange. Together, however, the three themes also allow us to contemplate new political and institutional actions for tackling the twinned challenges of mitigating climate change and safeguarding our livelihoods.

INTRODUCTION

Climate warming is the fundamental challenge of our time, not only because it will radically transform our natural environment but also because it will redefine jobs and livelihoods. Beyond immediate job displacement caused by acute climate disasters, there are longer-term employment consequences caused by climate change, including the relocation of production, threats to agriculture and food security, the disruption of infrastructure networks, and recurring devastation to coastal and inland communities. These interconnected environment–employment changes will cause significant, likely existential, disruptions to economic life and natural ecology, and will also strain and even fracture the broader political and social systems that the field of political science is meant to help us understand and navigate.

Against this backdrop, the political science literature exploring the relationship between climate change and the future of work is worryingly thin. Certainly, political science has engaged with the politics of climate change, including political negotiations involved in climate change mitigation and adaptation, making up for an early shortfall in this area (Javeline 2014, Keohane 2015). Likewise, the field has explored the impact of rapid technological change on worker voice and on the formation of political coalitions for job creation. But research at the intersection of these two subject areas is largely missing, and because of this gap, we are less equipped to understand the political consequences of the ways that climate change pressures will affect work, production, and technology. We are also hamstrung in our ability to identify and interpret the political movements that emerge in response to these changes.

The gap between these two strands of political science research reflects a deeper tendency in the discipline, as well as in the broader social science literature, to divide nature from society. The tendency is to define "nature" as the natural environment, with "society," alternatively termed culture or economy, swelling to encompass the multiple expressions of human action, social coordination, and economic production (Latour 2017). Nature is generally cast as a passive stage upon which human activity unfolds. It is reduced to a public good to be used, protected, and governed for social and economic ends (Lövbrand et al. 2015). In this framing, people act on nature, studying it, manipulating it, and extracting its resources, and politics is the method through which society decides how to act on nature (Moore 2015).

While the conceptual divide between nature and society has arguably stalled scholarly analysis of climate change effects on the politics of work and economic production, a growing wave of political protests and progressive policy initiatives has called out the interactions between these two areas. Many of these actions have framed saving the planet and saving jobs as synergistic priorities and have demanded that climate policy and economic initiatives push toward greater equality and opportunity (Brecher 2018). The yellow vest protests in France are an illustration of this trend, with thousands of workers taking to the streets in response to a hefty carbon tax on diesel fuel. Although the protests have been violent and chaotic, they have raised critical questions about policy actions that intensify inequities by failing to align gains for the environment with protections for workers. Many yellow vest protestors reject widening economic inequality and regressive economic and fiscal policy, and they have paired their demands for the revitalization of working-class communities where manufacturing employment has been hollowed out by automation with calls for inclusive green investment (Kinniburgh 2019).

In the United States, the Green New Deal proposed by Democrats in Congress has also linked climate change policy with the political interests of workers. Green New Deal advocates are seeking to place technological adoption, job creation, and worker voice at the core of a national strategy to move toward a net-zero carbon emissions economy (Pollin 2019). Their efforts have sparked an unprecedented wave of political debate about climate change policy and channeled

the sentiments of a growing proportion of US voters who view climate change as a threat to their economic futures.

The representation of climate change policy and job creation as complementary has been met, quite predictably, with an equally pronounced backlash. Some of this resistance is fueled by climate skepticism and undeniable acts of corporate greed. But other political responses are more nuanced—and some are led by worker advocates who genuinely fear environmental policy will encroach on economic planning in ways that will leave frontline workers most at peril (Stevis 2018). These groups have mobilized to defend jobs against the threat to livelihoods that they view environmental action as compounding. In a move reminiscent of labor responses to green growth plans in Europe in the 2000s (Hampton 2015), the AFL-CIO (American Federation of Labor–Congress of Industrial Organizations), which is the largest confederation of labor unions in the United States, has come out in opposition to the Green New Deal, arguing that it does not take into account the interests of workers and does not specify measures to ensure that the dislocation caused by a move to new infrastructure and technologies is shared equally: "We will not stand by and allow threats to our members' jobs and their families' standard of living [to] go unanswered," wrote the AFL-CIO in a letter to the congressional authors of the Green New Deal (Irfan 2019). Populist political movements have leveraged this blue-collar resistance to take an especially strident position against climate change action, calling out environmental action, especially regulation and taxation, as yet another instance of the global elites advancing their interests at the expense of the working class and of local communities (McCarthy 2019).

Resolving this debate requires more than just presenting climate change action and job creation as natural allies. What is required is an interpretive bridge that draws together common tensions over equity, political voice, and the power to shape the future. Without this kind of conceptual alignment, these political debates ultimately end up reifying the same split between nature and society that divides scholarship on climate change policy from examinations of economic responses to technological change.

Our goal in this review is to begin to build such an interpretive bridge, one that can span the conceptual divide between nature and society in the political science literature in the hope of providing a stronger basis for political initiatives and policy efforts to link climate change and the future of work and livelihoods. To this end, we identify themes addressed both in political science research on climate change and in political science research on the future of work. Some of the themes do not cross the divide between these two literatures and instead run concurrently across each of the two camps. But because they are common to both, they offer clear points of tangency for guiding future research to link climate change and the future of work. They are structural trusses for a conceptual bridge between these two research areas; when used in concert, these thematic trusses can share the load of the bridge itself, as well as the added weight of all those crossing it.

We identify three shared themes within the respective literatures on climate change and on the future of work. First, we discuss commodification and the processes through which costs and resources are made visible. Next, we consider the production of knowledge and the politics of representing the future. Finally, we take up just transitions and how to distribute the costs and the opportunities of change equitably. These themes address how the dominance of the market—in rhetoric and in policy—eclipses the materiality of economic production and social exchange. Specifically, they contemplate how the market has made the use of natural systems in economic production seem inevitable, and how its hegemony has made questions about the threat that the human transformation of the natural environment poses to livelihoods, now and in the future, seem intemperate and marginal. By challenging existing market narratives, these themes open

up a space for us to contemplate new political and institutional actions for tackling the twinned challenges of mitigating climate change and safeguarding livelihoods. Taken together, they draw attention to the need for research that rematerializes the market and the need for a politics that recenters the natural environment on which our modern life depends.

COMMODIFICATION AND THE POLITICS OF PRICING

The first theme we identify as being common to both the political science scholarship on climate change and the discipline's examination of the future of work is the politics of commodification and pricing. Both areas of scholarship point to commodification—the transformation of things or attributes into economic goods that can be marketed and acquired for money—as the mechanism through which nature and labor are made visible in capitalist systems. They note that once nature or labor are assigned exchange values—prices—they are pulled out of the flow of organic processes and turned into stand-alone goods or production inputs. They are redefined as resources that are bounded and fixed, and that can, as a result, be priced and traded in a market system. In this way, natural processes are hauled over the line between nature and society, and thrust into the socially constructed market. Decomposing plant life becomes petroleum, sold by the barrel, and human creativity and embodied cognition become labor, paid for by the hour or the piece (Mitchell 2011). When they are turned into economic goods, these processes are radically simplified; some attributes are priced in the market, and others are rendered invisible and thus difficult to defend (Paterson 2014).

In the political science literature on climate change, reflections on the politics of commodification have emerged primarily in analyses of carbon markets. Carbon markets are markets where emissions allowances are traded. These arrangements are the dominant policy response for limiting greenhouse gas emissions (Pearse & Böhm 2014); in 2008, there were 46 national or subnational compliance carbon markets in operation around the world covering an estimated 15% of global carbon emissions, with more trading systems under consideration as part of the Paris Agreement (World Bank Group 2018). The political science literature on emissions trading and its political consequences is substantial, especially relative to analyses of other mitigation and adaptation policies, and its breadth reflects both the expanding coverage of emissions trading and the high stakes attached to its effectiveness (Stephan & Paterson 2012).

A substream of this literature has looked specifically at the political processes through which carbon emissions—the ongoing production and release of carbon dioxide gases into the atmosphere and their interaction with the environment—were recast as tradable commodities to begin with (Ervine 2014, Spash 2010). As analysts of this transformation explain, the invention of carbon emissions as a commodity required reducing the complex, dynamic, and nonlinear planetary warming effects of greenhouse gases to a flat economic externality that could be internalized through commodification (MacKenzie 2009). This process turned incompletely understood ecological processes into a set price, assessed based on the measurable cost of ecological damage to specific economic actors and pointedly not based on damage to the earth.

The creation of emissions as a commodity was driven by a network of regulatory, business, and financial interests that allied to push against nascent government attempts to curb carbon emissions. Meckling (2011a), in his account of the political negotiations to set up basic infrastructure for carbon markets, documents the muscular role of the International Climate Change Partnership, a strategic coalition of large oil and chemical companies, in pushing for market mechanisms of climate change mitigation. Paterson & Stripple (2012) round out the story with their description of the political jockeying by which climate science and commodity models were inserted into the international Kyoto Protocol negotiations. Scientific understandings available in

the 1980s and 1990s about the harm of greenhouse gas emissions *in the aggregate* were divided up and stamped onto newly invented individual carbon units, defined in the Marrakesh accords that followed close on the heels of Kyoto as a metric ton of carbon dioxide equivalent. Cumulative and exponential damage was transposed onto discrete carbon units and made fungible in this way. What this construct made possible was not the trading in actual greenhouse gas emissions but rather the monetized right to cause environmental damage, with the cost of carbon units determined by demand for the legal ability to cause climate change at a given moment in time. This fiction allowed carbon markets to support the trade of emissions that had not yet happened. In the cap-and-trade structure, entities with rights to pollute that they had not used, as well as entities that reduced emissions, sequestered carbon (through forest plantations for example), or avoided the destruction of a carbon sink (by preventing deforestation), could sell their rights to release carbon into the atmosphere to polluting actors (Stephan 2012).

While carbon emissions units were invented as commodities that could be issued by governments and then be traded and priced in an international market, the value of the new units was determined primarily by the political networks and institutional mechanisms that initially brought them into financial markets and into business calculations. Paterson (2012) and Lohmann (2010), for example, document the role of financial institutions, including major banks and investment houses in London and New York and multilateral institutions like the World Bank, in creating financial institutions to allow for emissions trading, and in shaping the regulatory structures that governments established to regulate those markets. These structures built upon the same securities and derivatives instruments used to commodify other forms of market risk, such as mortgages, and yielded similar profits for large financial institutions (Layfield 2013). Others have documented the political efforts by fossil fuel companies, utilities, and manufacturing companies to shape how emissions are calculated and to press for free or discounted emissions rights (Meckling 2011b). In some contexts, including the European Union and Australia, companies' carbon credit handouts amounted to significant government subsidies for polluting industries, and many companies parlayed them into windfall profits, even selling excess carbon credits that they had secured from government to smaller or less energy-intensive firms, which had not received government support (Lo & Spash 2012, Pearse 2016, Sovacool 2011).

Creating commodified carbon emissions and the infrastructure for trading and valuing them depends on a set of erasures. Carbon trading requires that carbon emissions be separated out of production and evaluated independently of the processes that produce them. As a result, it makes no difference in carbon markets whether emissions are produced by coal-fired power plants in industrialized urban centers or by the charcoal ovens of rural households in the Global South (Lovell & Liverman 2010); to carbon markets, these mechanisms are functionally indistinguishable because their only salient characteristic is the number of carbon emissions units they represent. Consequently, development programs, including programs that deliver gas cooking stoves for health and income reasons, can be reframed as lucrative carbon offset programs. Many programs were redefined in this way, and were monetized as investments that generated internationally tradable carbon credits. When the economic systems and production practices that generate carbon are ignored, the equity implications of those systems and practices are also sidestepped (Bumpus 2011). It does not matter, in other words, if the process that produces carbon emissions increases the wellbeing of a poor community or if it inflates the corporate dividends to wealthy shareholders issued by big oil; a carbon emissions unit is a carbon emissions unit.

Moreover, because international finance, with its injection of capital, has supercharged carbon trading, attention to monetized carbon output has eclipsed the ways in which production processes, even carbon-neutral ones, often exploit and deplete other natural resources, including freshwater, wildlife, and myriad ecological services (Bachram 2004). In some cases, the impact on

these resources may sharply accentuate climate change effects and may drastically limit possibilities for adaptation to global warming (Boyd 2009).

Carbon trading has also galvanized new forms of economic and ecological exploitation and displacement. The invention of carbon offsets—the commodified credit for emissions reductions achieved by one party that can be purchased and used to compensate for the emissions of another party—has led to patterns of unjust development that scholars and advocates have called green-grabbing. This term covers activities including appropriating community land to create forest plantations for carbon credits, depleting water tables to irrigate lines of tree shoots, or abrogating traditional land tenure rights to enclose vast stretches as ecological preserves and carbon banks (Corson & MacDonald 2012, Fairhead et al. 2012, Rocheleau 2015). The valuation of resources for carbon emissions credits pulled ecological spaces away from ecological processes, dragging them over the line from nature to society: Wetlands and forests are now marketed as carbon sinks, and stretches of ocean are redefined as the platform for a new blue economy (McAfee 2014). As circles of commodification centered on carbon emissions trading expanded outward, they crowded out alternative strategies for climate change mitigation and adaptation. They have also narrowed the space for the political debates and consensus needed to support those strategies (Felli 2015, McAfee 2012, Pearse & Böhm 2014).

Shifting to the political science literature on work and workers, we again find that processes of commodification are a central concern. However, because the construction of labor as a tradable commodity is well established and has been well examined by historical political economists, contemporary scholarship focuses less on the mechanisms of commodification and more on the political processes through which the value of labor is assessed.

The primary vehicle for assigning a value to labor is through wages. Decades of research on historical and contemporary wage trends show that this valuation is profoundly mediated by the relative political power of labor and the kind of political mobilization that workers are able to enact (Goldfield 1989, Hertel-Fernandez 2018, Hicks & Swank 1992). Labor unions have been the focus of analyses of this effect (Ahlquist 2017). Research on unions in the United States, for example, has shown that they produce a higher minimum wage for their members than nonunionized workers are able to obtain, on the order of 10–30% for men (Gittleman & Kleiner 2015, Rosenfeld 2014). Likewise, studies demonstrate that unions have important implications for economy-wide valuations of work, even for work completed by nonunion workers (Farber 2005, Pontusson 2013). Unionization has generally led to a more compressed overall wage distribution and less inequality. Studies tracing the impact of declining unionization rates in the United States, which dropped from about 21% in 1977 to 11% in 2007, have documented this relationship, attributing 30% of the growth in private sector wage inequality for men and 20% for women over this period to weakening union density (Western & Rosenfeld 2011). Analyses of other national contexts have found similar results (Card et al. 2004, Christensen & Wibbels 2014).

Research on the politics of wage valuation shows that the price of labor in the market, like the valuation of carbon emissions units, depends on a series of erasures. This research has focused on types of effort that are required of workers to complete their jobs but that remain unacknowledged and uncompensated by their employers. One example is Hochschild's (1983) path-breaking work on emotional labor, which she defines as the production of emotional states in oneself and others required as part of employment. More expansive definitions of uncompensated labor are found in the framing of biocapitalism (Fumagalli 2011), which considers not only emotional and relational labor but also the biological faculties of workers, such as the embodied ability to move and act in changing physical contexts. These analyses and others not only record the kinds of labor for which employers have not paid their workers (Green & Riddell 2003) but also point to the practices of erasure—both at the worksite and in the broader economy—that have allowed employers to use

these forms of labor without assigning a market value to them (Steinberg & Figart 1999). Through these practices employers express their power, both at the worksite and in the broader economy, to discount certain forms of effort from which they benefit.

Studies on the introduction of new technologies in an array of worksites and industries have likewise shown that technologies, from the mechanical to the digital, demand additional labor from workers in order to function, and often from the very workers the technology was meant to replace (Mateescu & Elish 2019). These erasures occur across skill and occupational categories. Surgeons find that the use of robotic surgery arms requires significant compensatory labor to make up for shortcomings in the technology (Beane 2019). Retail staff are compelled to train robots and automated systems designed to replace them, yet are also required to provide additional, largely uncompensated, relational and problem-solving work that automation is unable to supply (Harwell 2019). Increasingly, the examination of erasure and the valuing of labor has expanded to consider how industry uses the data it collects on workers as they complete their jobs as a resource to develop further technology. Whether it is biomechanical data collected on the physical movements of workers that is fed into efforts to deepen automation, or information on worker eye movements and attention spans collected for digital platform design (Peruzzini et al. 2018, Toreini et al. 2018), the value derived from workers is not reflected in their wages. Moreover, workers often have no say over how their labor, harvested as data, is packaged and sold (Newman 2017, Sánchez-Monedero & Dencik 2019).

The politics around the commodification of work and the erasures on which it depends, as with the commodification of climate damage, has hemmed in avenues for political contest and sapped broader movements of robust redistributive policies. The view of labor as a tradable good whose value is measured in wages has been so central to the social construction of the market that labor politics is intrinsically tied to the pay workers receive (Goldfield & Bromsen 2013). Political mobilization to advocate for the compensation of tacit skills and the social and biological processes that workers bring to the production process first has had to make those contributions explicit as aspects of labor that can be assessed, valued, and ultimately commodified for a wage (Iskander & Lowe 2010). Similarly, organizers trying to change workplace processes or norms also implicitly have had to make a case that workers are being pressed to contribute labor for which they are not remunerated.

But this emphasis on wages has also meant that other kinds of labor politics have gotten short shrift both in the literature and in public debate. Ahlquist & Levi (2013, p. 43), in their study of the organizing efforts of longshoremen, challenge this emphasis, which, borrowing from Lenin, they define as "economism, a focus on the narrow economic interests bound up in the job." They demonstrate why and when labor organizations will sometimes mobilize to defend "the interests of others," organizing work stoppages and boycotts to protest national foreign policy and to support freedom struggles in locales far removed from their own. They argue that this kind of politics requires a step away from a focus on the labor being commodified and toward mobilization based on broad and expanding definitions of community and wellbeing.

If commodification is the political process by which nature is pulled over the line into society and turned into a tradable good, it is mirrored by an equally political process that ensures that some social dynamics and constructs are pushed back over that line and naturalized. Gender is a stark example. In our review of the literature on climate change policy and the scholarly analysis of work and technological change, we found that neither adequately considers the gendered effect of the pressures they analyze. This is a significant oversight given the empirical evidence suggesting that both climate change and technological job displacement are likely to impact women disproportionately and often severely.

The political assessments about gender and dislocations caused by climate or changes in livelihood tend to equate gender with biological sex. They tend to attribute any disproportionate impacts on women as a product of gender characteristics that are innate, unchanging, and immune to political contest. Women, for example, are represented as inherently vulnerable to climate change and thus likely to suffer greater physical harms or economic penalties than men, or alternatively, as virtuous, because they are supposed to stay closer to home and thus emit less carbon or because they are assumed to be more likely to place themselves in physical danger to care for loved ones in the wake of a climate disaster (Arora-Jonsson 2011). Likewise, women are represented as inherently vulnerable to job loss caused by the introduction of new technology because women are underrepresented in STEM (science, technology, engineering, math) training and jobs and because the proportion of women using digital technology, including the internet, is lower than among men (Wesely & Midgley 2019).

The few empirical studies that have focused on gender find that policy interventions to address climate change or economic dislocation have exacerbated gender inequity, and undermined women's livelihoods in particular. In the global emissions trading system, for example, both the Clean Development Mechanisms and United Nations REDD (Reducing Emissions from Deforestation and Forest Degradation) reforestation projects presume that commodifying labor through wage-paying work is a critical first step in achieving emissions reductions. The initiatives reshape local decisions about the design of economic production and the management of natural resources to that end (Westholm & Arora-Jonsson 2018). Recent evaluations of these projects show that, in the process, these programs disproportionately burden women by cutting off nonmonetized access to natural resources and limiting or banning activities such as foraging or bartering; women in many communities rely on these activities for their livelihoods (Larson et al. 2018). These studies suggest that costs of climate change and climate change policy that women bear may have little to do with their biological sex and everything to do with the way that inequities are encoded in institutions and policy and thus naturalized using gender.

KNOWLEDGE AND THE REPRESENTATION OF THE FUTURE

The commodification of nature and labor as goods that can be measured in prices not only implies the existence of a market but also reflects a particular political construction of that market as self-regulating and unchanging. In other words, it involves the ideological representation of the market as a sphere that is essentially timeless and impervious to social forces—but which itself depends on significant political intervention and deliberate institutional design.

Both the political science scholarship on climate change politics and the discipline's analyses of debates around the future of work examine political efforts to ringfence the market against outside pressures and to project it as unchanged into the future. These have included political attempts to control knowledge about the future and, in particular, to frame future changes as predictable—as disruptions that society can contain and manage. Political scientists show that the political struggle to control the production and dissemination of knowledge about the future is less about what is actually likely to happen and more about claiming the authority and the political power to shape outcomes in the present. Contests over knowledge about the future and how they shape political divisions, alliances, and possibilities is the second theme that is common to both areas of scholarship.

In analyses of politics around climate change policy, political scientists have sought to explain why climate change predictions have been subjected to increasing political debate and public skepticism (Brulle et al. 2012, Jamieson 2014, Leiserowitz et al. 2013). Some scholars have focused on the organizational structures and political alliances that have been forged to discredit scientific

findings of climate change effects, even as consensus among scientists grows increasingly robust. Dunlap & McCright (2011, p. 144) sketch out one of the first comprehensive maps of this political infrastructure, which they describe as a "well-funded, highly complex, and relatively coordinated 'denial machine'," made up of disparate actors bound together by a shared opposition to regulatory intervention. The backbone of this denial machine is a United States–based coalition of representatives of the fossil fuel industry, corporate interests, and conservative foundations, which is fronted by "astroturf" groups designed to make the propaganda churned out to discredit scientific research seem like the voice of a grassroots movement.

Subsequent research on institutional infrastructure of climate change denialism has homed in on specific elements of the denial machine and has analyzed the different strategies that have been deployed to challenge the credibility and construction of climate science. Some of these efforts have been blunt and unsurprising, such as the direct policy results of international oil companies' massive investment in climate change denialism (Farrell 2016, Frumhoff et al. 2015), including ExxonMobil's role in the Trump administration's withdrawal from the Paris Agreement (Grasso 2019). Other effects of the denial machine have been more insidious and more dangerous. Freudenburg & Muselli (2013), for example, show that persistent attacks from the denial machine caused scientists to err on the side of caution when drawing implications from their research. As a result of this caution, the political consensus documents informed by their research, such as assessments issued by the Intergovernmental Panel on Climate Change (IPCC), have consistently understated potential climate change disruptions and impacts.

Institutional investments in climate change denialism have done more than undercut the scientific findings on global warming. Political scientists have found that they have also been remarkably successful in influencing broader political identities. Using public opinion data from ten Gallup surveys from 2001 to 2010, McCright & Dunlap (2011, p. 1167) argue that, in part due to denialist efforts, debates about climate change have stepped away from their scientific basis and have devolved into vehicles for identity expression and into "a form of identity-protective cognition." They find that conservative white males are significantly more likely to espouse climate change denialist views than the American population as a whole, positioning them as important vectors for activist climate change denialism "via their online and offline social networks and through participation in various protest and campaigning events" (McCright & Dunlap 2011, p. 1167). Similar studies in other national contexts, including Norway (Krange et al. 2019) and Australia (Tranter 2017), find analogous correlations between white male identity and a resistance to the scientific consensus about global warming. Political psychologists Hoffarth & Hodson (2016) explore the underlying logic behind identity and climate change denialism, and find that much of the resistance from the political right to climate change is not about jobs or economic security, but stems from a core belief that environmentalists represent a threat to a specific way of life, to its traditions and its customs.

The imbrication of views about climate change in processes of identity construction begins to explain the growing congruence between right-wing populism and climate change denialism. In populist political discourse, climate change policy is represented as an agenda advanced by a liberal, cosmopolitan elite that prioritizes the interests of globalists over the interests of the nation, and certainly over the interests of the people who have felt left behind by globalization and all the phenomena they associate with it, including ethnic diversity and geographic mobility (Lockwood 2018, Pierson & Schickler 2020). Increasingly, political psychologists have found that these differences based on identity and political affiliation shape not just how or whether people vote but also, remarkably, how they perceive and interpret the extreme weather effects of climate change (Cutler 2016, Howe 2018). Research in the United States (Bohr 2017) and United Kingdom (Ogunbode et al. 2019) finds that beliefs about climate change shape the subjective perception of the severity

of climate anomalies, and that these perceptions reinforce existing beliefs about global warming. When climate change denialists experience extreme weather refracted through their belief structures, it only hardens their beliefs that global warming is a political hoax.

While climate change denialism pits "elites" and their scientific expertise against "ordinary people," the corresponding treatment of workers in today's transformative technology industries, namely artificial intelligence, robotics, and quantum computing, privileges the expertise and knowledge contribution of technologists, while casting aside future involvement of most other workers. Technology companies—several with superstar inventors and executives at their helm—perpetuate this inverted knowledge hierarchy, claiming that the technologies they design and support are essential not just for our economic future but for basic human existence (Hard & Jamison 2013, Mazzucato 2015). Some technology entrepreneurs have even pushed the notion of singularity, with the vision that artificial intelligence not only will outsmart human beings in the future but will also become self-aware, exceeding human problem-solving capacity and revealing things that humans cannot possibly envision or create (Harris 2014, Hughes 2012). Some even suggest that this—rather than climate change—will be the greatest threat facing humanity (Kurzweil 2000, 2005).

Of course, there is also a fast-growing volume of popular writings and media reports that recognize the highly disruptive effect of these technologies on contemporary work—with artificial intelligence and related technologies presumed to be on a direct collision course with millions of workers and with catastrophic consequences for those experiencing job loss (Brynjolfsson & McAfee 2014, Ford 2015, Kelly 2017). At least one highly referenced report estimates that close to 50% of workers in some advanced industrial nations will face permanent job displacement, as intelligent machines replace the need for human work in a broad array of both blue- and white-collar occupations and industries (Frey & Osborne 2017). Even as they raise this cautionary flag, these alarmist projections of widespread job loss lend further support for the technologist's idealized vision—a future in which technological innovation is allowed to progress with ease, free from qualification, oversight, or institutionally created constraints.

These highly publicized claims make the prospect of a jobless future seem so inevitable that they are seeping into the strategies of organized labor. In recent years, United States–based and international unions have launched various "future of work" campaigns to try to forestall the technology-induced economic dislocation (Greve 2017). Some of the most pioneering embed "early warning" requirements into collective bargaining agreements, such as the Culinary Union in Las Vegas, which now requires unionized casinos to give a minimum of six months' notice before implementing a potentially job-destroying technology (Lowe 2019). However, in some cases, unions are turning to the same consultants who churned out initial reports about impending and massive-scale job loss when seeking organizing advice—raising questions about who gets to control the narrative of technological fate and work of the future (Gupta et al. 2018).

But the direction of technological evolution is not yet set in stone, nor is its broader effect on work and society. This open-endedness offers the prospect of deeper academic inquiry to draw out the underlying social and political forces and actions that shape how technology develops and for whose benefit (Street 1992). In her recent book, *The Age of Surveillance Capitalism*, Zuboff (2019) takes aim at large technology companies like Google and Amazon that generate and sell vast quantities of big data, noting the pernicious practices used to track, influence, and profit from online buying habits and social media interactions. As she stresses, these companies commodify data that are freely given—essentially turning all of us into their unpaid workforce. They also take steps to obscure the deeper social and environmental costs of their data mining and manipulation. Kenney & Zysman (2016) contribute to this critique by pointing to the role of venture capitalists in reinforcing technology monopolies. These firms crowd investment toward certain digital

platform firms—think of Uber or Amazon—at the expense of others, thereby ensuring the chosen winners compete in the marketplace, with the secondary effect of amassing considerable power to assert control over policy discourse and ultimately clamp down on state and national regulation (Kenney & Zysman 2016). By strengthening the monopoly power of these platform companies, venture capitalists also choose to support a subset of companies that are notorious for underpaying their workforce as a result of questionable subcontracting arrangements (Weil 2014). Adding further critique, Lazonick & Mazzucato (2013) have called out Apple and other technology firms for their misuse of offshore accounts to avoid taxes and thus evade their social and economic responsibility—by extension harming the very communities and workers whose knowledge and undercompensated input contribute to corporate and individual wealth.

These new insights—while clearly political—have yet to permeate contemporary political science debate. Their absence suggests an opportunity to consider how scholars within the discipline engaged earlier periods of technological transformation. In the late 1970s, the equivalent of today's concern over artificial intelligence involved microprocessing and information technology—both of which could also be used to automate and expedite processes that until then had been done through time- and labor-intensive processes. Political economists reinforced a widely held view at the time that technological automation would result in high rates of job loss. More troublingly, they thought it would also remove the need for human cognition and discretion, and thus strip remaining work of its human essence and its deeper intrinsic value (Edwards 1982, Stone 1974, Zimbalist 1975). This, in turn, raised critical political questions about workplace control, and specifically the degree to which business owners and top-level managers would use new technologies as a tool to further subjugate a vulnerable workforce (Lazonick & Lazonick 1990, Thompson 1995, Zuboff 1988).

However, further research soon complicated this standard narrative of technology versus labor, drawing out stark cross-national differences in how technology was deployed and to whose benefit (Berger & Dore 1996, Dore et al. 1999, Hall & Soskice 2001). Research in Europe and Asia, for example, pointed to alternative models in which workers—including frontline production workers—were instrumental to technology implementation (Florida & Kenney 1990, Lazonick & Lazonick 1990, Piore & Sabel 1984, Thelen 1999). Rather than displacing workers or their skill, employers instead relied on the deep expertise of their workforce to engage, experiment with, and enhance leading-edge technologies. That decision was not simply reflective of employer altruism or enlightenment—rather, it stemmed from a set of national policy decisions and institutional priorities, reinforced through broad-reaching social welfare and workforce development programs that not only reproduced industry skills standards but also guaranteed income security (Thelen 2004).

Of course, these national models were not without fault. Some scholars pointed to cases where goals of continuous technological progress eventually conflicted with structures initially set up to protect and advocate for worker skills. Herrigel & Sabel's (1999) study of Germany in the late 1990s identified emergent "rigidities" within the country's craft-union model as a result of distinct territories of skill and reinforcing structures that increased bargaining power through tight union control of specialized knowledge and expertise. This rigid parsing of skill constrained the uptake of flexible systems of production, because "a broad array of institutionally entrenched actors. . .[stood] to lose a great deal in any move away from the old system" (Herrigel & Sabel 1999, p. 81). But as political scientists and other scholars have widened their research lenses beyond national political and regulatory structures to recognize deeply entrenched production practices and routines, they have also helped to uncover a micropolitics of skill and expertise which remains relevant today (Adler & Borys 1989, Attewell 1990, Burawoy 1982). Understanding this contested terrain of institutional agency and practice, and using a skeptical approach

to technological determinism, has implications for how we might conceptualize the political influence of workers, including the politics of everyday knowledge and skill, in relation to today's pressing social and environmental challenges.

EQUITABLE AND JUST TRANSITIONS

As we indicated above, themes of commodification and knowledge coexist in political science writings but are not currently used to connect discussions of climate change and the future of work. A growing subfield of political science scholarship has begun to integrate these two areas through research on the "just transitions" movement—broadly defined as the effort to build both economic and political power by moving from an extractive to a regenerative economy. In studying this burgeoning social and political movement, scholars are helping to draw attention to the complex and evolving relationship between work and climate. This includes asking the critical question of whether contemporary forms of work can advance environmental standards, or the climate-centered corollary of that question: whether and under what conditions green jobs will be equitable.

For most political scientists, a key consideration is the role that labor unions play in supporting a political agenda around both work and climate (Burgmann 2012, Felli 2014, Stevis 2013). As mediating economic institutions, labor unions are not only positioned to shape public discourse around climate but can also affect policy setting at a local, national, and even global scale. Still, as political scientists have noted, the relationship between labor unions and environmental advocacy is evolving and at times highly fraught; more is needed than simply calling on organized labor to officially embrace environmental goals (Barry 2013, Burgmann 2012, Evans & Phelan 2016). Labor leaders have sometimes vehemently opposed calls for stronger environmental regulation, especially if they perceive such changes as a direct threat to job stability and worker livelihood (Stevis 2018). An example, noted above, is the high-profile decision in 2019 by the AFL-CIO to reject the proposed US Green New Deal.

Admittedly, some scholars have questioned the authenticity of this "jobs versus environment" framing. They view it as a false dichotomy that is chiefly constructed by large corporations in order to keep labor support for environmental regulation at bay (Burgmann 2012). But others are sympathetic to worker concerns of job loss, recognizing that today's climate uncertainty necessitates a deep and continuing examination of the future of work, including weighing the potential for regulatory action to end wage employment on a mass scale. Describing this outcome in terms of decommodification, Gough (2010, p. 62) calls for "reducing working hours and commodity purchases, growing the core economy and fostering preventive social behavior, among many other things." With this in mind, some political scientists have proposed widening policy support for a guaranteed basic income, adding this to an ever-expanding environmental tool kit to ease the transition away from wage-dependent forms of work (Bidadanure 2019).

A related area of focused debate is around increased nationalism and concerns over the limited geographic reach of labor-promoting environmental action. Whether advancing a just transition through targeted national regulation or pushing public investment in support of green technology development, scholars note that the resulting gains for workers are likely to be concentrated within specific (often wealthier) regions of the world. Workers in other regions are destined to suffer from more limited environmental protections at the same time they face greater economic vulnerability. In isolation, nationally focused or localized labor campaigns can result in extractive activities being pushed further down the global supply chain and in ways that put worker health and safety within less regulated nations at increasing risk (Felli 2014, Stevis 2018). International labor federations have called attention to this connection, even as many Western-based labor unions

have overlooked international disparities by continuing to focus narrowly on national and local activism (Felli 2014, Stevis 2013). Emphasizing what is at stake, Stevis (2013, p. 191) notes, "just transition strategy, when limited in scale and scope, can be structurally unjust."

The flip side to labor's localism is carbon-leakage—a specific form of capital flight in which large corporations relocate in response to the adoption of environmental regulation, thereby not only intensifying climate inequities by moving extractive activities to weakly regulated nations, but also undermining environmental progress for leading nations willing to take the reins (Felli 2014). At a national level, the departure of footloose corporations might be welcomed as an immediate step toward greening the nation, but when viewed at a global scale, this transient behavior by businesses exacerbates environmental inequality and may compound some of the land enclosures and livelihood disruptions caused by greengrabbing under emissions trading regimes. The inequities caused by these global investment patterns underscore, yet again, the need for cross-regional/cross-national coordination of labor–environment campaigns.

As this review suggests, the relationship between the labor movement and the environment can be tenuous, contradictory, and uneven. To some extent, it matters which side of the technology–regulation spectrum labor unions reside on, and equally what stance corporations are prepared to take, including whether they have the power and capacity to use mobility threats as a further dividing wedge. For some political scientists, the difficulty that labor unions face in mounting effective environmental campaigns reflects the inherent limitations of the capitalist system that undergirds contemporary production relations (Gough 2010). As they see it, the capitalist growth imperative drives corporations to fight against regulatory constraints on outward or upward expansion. Here, the underlying neoliberal agenda that profit-making corporations often espouse—which can also lead to caps on social welfare and state spending, due in part to probusiness taxation policy—means that there are few social protections to support increasingly vulnerable workers. Moreover, in a capitalist system, workers are tethered to wage employment and therefore are less likely to put up a meaningful environmental fight. In this context, the choice between jobs and environment is stark.

With this prospect in mind, some political scientists have advocated for a wholesale transition from capitalism to socialism—removing private capital entirely from the equation and allowing the state to fully control systems of production for the benefit of labor and the environment. From a joint labor–environmental perspective, "the socialist strategy seeks to displace the socio-ecological contradiction into capital itself, by pointing towards the constitution of alternative social relations and, thus, the possibility of democratizing socio-ecological relations in order to fulfil human needs" (Felli 2014, p. 392). But not all political scientists agree that socialism is the best alternative. As some have noted, socialist states have long promoted extractive production processes that are environmentally damaging. Much like their capitalist counterparts, they resisted attempts to reverse their dependence on fossil fuels (Burgmann 2012). Furthermore, few labor unions are lined up behind this purist socialist agenda; those few that are often lack strong connections to rank-and-file workers. As Felli (2014, p. 391) warns, "the socialist strategy still has the flavour of a top-down approach.. . . The possibility of building climate strategies directly from workers' knowledge and class-based experience. . .is essentially ignored."

This tension suggests an opportunity to broaden the political framework and make room for differentiated forms of institutional and collective action. Political scholars have suggested that a critical first step involves unpacking standard binary categories of neoliberal versus socialist states (alternatively, liberal-market versus coordinated-market states)—not just to allow for other political systems and responses, but also to recognize evolving institutional strategies that both accommodate and influence changing political regimes. National case studies of the history of labor unionism in environmental advocacy are particularly helpful in this regard, pointing to historical moments during which labor activists have directly influenced mainstream policy while

also capturing innovative organizing efforts to advance environmental causes during periods of national policy retreat. In Australia, Spain, and to some extent the United Kingdom, labor unions have been in a stronger position to engage national politicians and support labor-friendly political parties (Burgmann 2012, Maria-Tome Gil 2013, Snell & Fairbrother 2013). By contrast, US labor unions have less latitude and focus on incrementally building environmental support across their membership base (Burgmann 2012, Uzzell & Räthzel 2013). Some unions in the United States have made the greatest progress at the subnational level, pushing to replicate successful regulatory models adopted by first-mover states like California (Stevis 2013). The Trump administration's rejection of global climate standards, including the withdrawal of the United States from the Paris Agreement, has only reinforced the need for subnational organizing. Stressing that point, Stevis (2013, p. 192) notes that

> the wait for national and global rules should not justify inactivity and the initiatives of labor environmentalists must be acknowledged. If. . .environmental modernisers are successful in putting in place local, regional or sectoral 'best practices' then the prospects that union environmentalism will survive this conjuncture of opposition to climate legislation and unions rights will be brighter.

These developments point to a need to recognize "variegated" (Brenner et al. 2010) institutional strategies and openings for collective action (see also Block 2019, Stevis 2013), not just within and across nations, but even across different labor networks and laboring communities (unionized or not). As Ostrom (2010, p. 550) astutely observed, writing on environmental collective action, "fortunately, many activities can be undertaken by multiple units at diverse scales that cumulatively make a difference.... [They] facilitate achieving benefits at multiple scales as well as experimentation and learning from experience with diverse policies." The questions then are what this experimentation looks like and to what degree workers are actively engaged in the micropolitics of experiential learning.

An intriguing option referenced by a labor activist is suggestive of one such approach—the involvement of workers in conversion planning to redesign extractive and energy-depleting forms of production into products and services that support both sustainability and social goals. In presenting this option, Swedish automotive worker and labor activist Eric Lars Henriksson (2013) reflects on an earlier proposal, known as the Lucas plan, put forward by labor unions in Great Britain to empower union members to combine their deep knowledge of production, organizational management, and logistics in order to convert a decommissioned World War II aerospace factory. Recognizing the broader significance of this coordinated action for an equitable and just transition, Henriksson (2013, p. 85, emphasis added) notes,

> when faced with plant closures or layoffs unions often respond with demands for replacement jobs, severance packages or retraining. There is nothing wrong with these but they are individual solutions that more or less accept the dissolution of the workers' collective. All union strength comes from keeping the collective united. The idea of converting industry is based on *maintaining* the collective. It is a concrete demand that we can fight for together instead of one by one in the context of an insecure future.

Unfortunately, the famed Lucas plan did not materialize, quite possibly because those involved—including labor leaders—promoted it as a hyperlocal technical, rather than political, solution (Räthzel et al. 2010). By contrast, some forward-looking unions today tether their demands for worker involvement in renewables planning to innovative strategies that also build political power for the wider labor movement. One example is the ongoing climate justice campaign of the

National Union of Metal Workers in South Africa (Satgar 2015). The union and its members use a multipronged approach to break monopoly control of large energy corporations, while also holding public officials accountable to transparent energy pricing through organized protests and coordinated boycotts. As part of that effort, they draw on, and take steps to deepen, frontline worker knowledge to extend opportunities for social ownership and worker involvement in renewable technologies. Their efforts suggest a promising way for other labor activists to build broad-based political support for resilience planning and ultimately for connecting nature and society from global South to North.

MATERIALIZING THE MARKET

In the three thematic areas we explored in this review—commodification, knowledge, and transition—the market looms large. In its shadow, the material and physical processes through which we change the climate and explore new ways to work are often reduced to economic abstractions. As the literature reviewed here shows, the market obscures as much as it reveals. What the market does not appraise, it does not recognize. Labor that is not priced and exchanged and ecological systems that we cannot reduce to dollars and cents remain invisible. Futures that depend on processes that cannot be commodified, and thus that cannot be predicted through the market, are discounted and discredited. This reductionist form of market power renders invisible nonmarket forms of coordination, collective action, and human agency. Importantly, it also makes alternative pathways for political action, especially those built around the interconnections between policy domains, seem overcomplicated and unreasonable, even extremist.

Social scientists have a critical role to play in questioning the all-encompassing view of the market and the dematerialized narrative on which it depends. We need research that not only rematerializes the market but also holds us accountable to the physical landscape and territory upon which modern life unfolds and on which it depends (Latour 2017). This means contemplating a future where the material basis of human society will change drastically, perhaps becoming unrecognizable. It also means analyzing the ways that politics in this age of climate change is material: Political action and political power are consequential for the earth, for social reproduction, and for distribution of material resources. In other words, demands to protect future livelihoods can no longer be separated from discussions of how to protect the earth.

SO HOW DO WE TETHER SOCIETY AND NATURE IN POLITICAL INQUIRY?

A critical start is to recognize that political change is not simply a matter of dismantling large-scale institutional structures or national regimes on which the market seems to depend. Instead, political change is built out of creative actions that challenge and amend institutional practices at multiple scales (Berk & Galvan 2009). Analysis of microprocesses through which institutions are enacted and remade may offer the most promising terrain to explore the materiality of social exchange. The notion that institutions are fixed, all-encompassing, and top-down structures quickly dissolves. At the microinstitutional level, the inevitability of the market also disappears, and instead, institutions are revealed as the product not just of human action, but of human interaction with the earth. The material effects of institutional structures and our engagement with them become visible and tangible, and the possibility of a shared political project for bridging the divide between nature and society while prioritizing equity becomes imaginable.

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Errata

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