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The Roosevelt Project

A New Deal for Employment, Energy, and Environment

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A New Deal for Employment, Energy, and Environment

September 2020

About the Roosevelt Project

The Roosevelt Project takes a multidisciplinary approach to examine the transitional challenges associated with progress toward a deeply decarbonized U.S. economy. The project aims to chart a path forward through the transition that minimizes worker and community dislocations and enables at-risk communities to sustain employment levels by taking advantage of the economic opportunities present for regional economic development. The first phase of the project involves an assessment of crosscutting topics related to the transition, which is represented in this document. The second phase of the project involves developing regional action plans for individual Case Studies, working with local partners on the ground in specific transition contexts. The project was initiated by former Secretary of Energy, Ernest J. Moniz, and engages a breadth of MIT and Harvard faculty and researchers across academic domains including Economics, Engineering, Sociology, Urban Studies and Planning, and Political Science.

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Executive Summary

Advocates for addressing climate change point to the urgency of accelerating a low-carbon energy transition and the benefits that can accrue to the national economy and global environment. However, the attendant dislocations for workers and communities present formidable headwinds and have not been addressed adequately with clear policy analysis or achievable programmatic action steps. Without intervention, the economic effects of the transition to deep decarbonization will be distributed unevenly across economic sectors, industries and geographies as some business activities and technologies phase out, and new ones emerge. As a result, the extent of the dislocations resulting from the transition will depend on how it is managed by local, state, and federal governments along with their private sector partners. The Roosevelt Project applies an interdisciplinary framework to this transition with the goal of developing a set of policy priorities that promote high quality job growth, minimize worker and community dislocation and harness the benefits of energy innovation for regional economic development.

The process toward deep decarbonization has already begun in most parts of the United States, with dislocations already visible in some regions. Momentum will build as the economics of carbon-free energy-sources improve.

Recognizing that regional benefits and attendant dislocations stemming from the transition will be geographically concentrated is a fundamental precursor to effective policy intervention. There are several key drivers to the variance in projected transition outcomes across regions:

- Geographical variation across institutional capabilities including economic capacity, specifically focusing on variance in regional expertise, capabilities, assets, and government resources;
- Variation in natural resource potential across geographies;
- Variation in household carbon footprints;
- Variation in climate risks.

In addition to these structural realities, the ability of different regions and communities to manage economic transition is highly variant. An assessment of the literature surrounding industrial transitions highlights the local social fabric, human capital, business and policy environments as critical capabilities for engagement in transition. Through adequate planning, communities can build on these capacities and enable a successful transition. Moreover, preparation for transition at the regional level not only increases the possibility of local benefits, but it also broadens support for increasingly ambitious climate policy at the national level.

Creating an Environment for a Successful Transition

The Roosevelt Project highlights two core findings in consideration of the transition to deep decarbonization.

1. The extraordinary diversity in ground conditions across the United States with respect to natural resources, economic capabilities, demographic diversity, and climate risks, requires that policy, economic, social, and technical solutions that drive the transition must be regionally applied and account for local assets and capabilities. Such a comprehensive approach is required because of complementarities across those capabilities. Static, uni-levered interventions often fail to provide the desired outcome.

2. Policymakers must confront all four critical regional capacities, including the local social fabric, human capital, business and policy environments, simultaneously to build a socio-economic system that is resilient to industrial transformation.

The Roosevelt Project concludes with a set of policy proposals for different levels of government that, as a whole embody, these two core findings.

Recommendations Related to Regional Policymaking

- Understand local competitive advantage. Knowledge around a community's specific skillsets and an understanding of the importance of geography is paramount to managing a transition (Peluso et al. 2020).
- Build ties between core institutions. Nearly every example of post-industrial success we investigated in this report benefited from a robust structure of communication and trust between local actors (Gallagher and Glasmeier 2020).
- Leverage economic development corporations and public-private partnerships with caution. Economic development corporations and public-private partnerships feature heavily in the current study of positive progress during transitions. However, these institutions must be monitored, as the business tax incentives they often promote are highly susceptible to policy capture and misuse (Peluso et al. 2020).
- Formulate and implement evaluation procedures that incorporate explicit assessment of the distributive consequences of changes in economic conditions. Past large-scale federal programs that aimed to transition regions and cities from old to new steady states, have had unintended consequences and have in some cases exacerbated long standing inequities. Future institutional responses to economic dislocation or disruption must include specific funding for monitoring and evaluation, with the requirement that results are disseminated, and programs are adapted accordingly (Gallagher and Glasmeier 2020).
- Encourage citizen participation, including grassroots actors with local knowledge, in planning and implementation to foster long-term ownership of change. Evidence shows that putting beneficiaries at the center of programming improves inter-agency cooperation by fostering a "problem-centered" approach that breaks from past agency-by-agency programming priorities (Gallagher and Glasmeier 2020).

Recommendations Related to Federal Policy

- Public policy should promote programs and incentives to build capabilities required for transitional opportunities, while minimizing the personal dislocation of existing and legacy industrial workforces. A few examples of programs that could support this goal include an Energy Efficiency Retraining and Deployment program, the creation of an Energy Transition Adjustment Assistance program modeled after the Trade Adjustment Assistance program, expanding support for construction unions and their apprenticeship programs, restoring advanced energy manufacturing tax credits, and expanding the nation's innovation infrastructure.
- It is clear that the transition to deep decarbonization will require a form of an economy-wide price on carbon, and that a price on carbon will have distributive effects across regional economies. Green and Knittel (2020)

explore those effects in great detail. They find that, under standard assumptions, the most socially equitable approach to pricing carbon is through a tax and dividend approach. Green and Knittel (2020) states that, unlike a sectoral approach that regulates carbon in the automotive, manufacturing or electricity industries separately, a carbon tax enables efficient competition among substitute technologies, and provides revenue that can then be distributed to regions and people most affected by the transition. Some of those revenues might subsequently be used to build local institutional competencies, protect energy-intensive-trade-exposed manufacturing, support local workforce development and training programs, provide capital to jump-start entrepreneurial activity, and finance new climate related infrastructure.

Recommendations Related to Infrastructure

- Structure governmental infrastructure support programs specifically to provide tangible long-term benefits toward decarbonization. Consider other political needs, such as providing equitable assistance and easily accessible jobs (Hsu and Ulama 2020).
- Utilize energy infrastructure and energy efficiency investments and finance structures as a key economic development tool for regional transition planning and the development of domestic supply chains (Foster et al. 2020).

Recommendations Related to Building Innovative Communities

- Interventions must address critical gaps in a transition region, and there are often multiple gaps. As a result, multi-competency interventions are likely to be more successful compared to those focused on a single competency. Single-competency interventions, by contrast, have more limited impact because unaddressed gaps can eventually prevent success, while leaving the intervention vulnerable to cancellation (Karplus et al. 2020).
- Interventions that foster development of multiple, distributed competencies simultaneously but in a coordinated manner could lead to more durable and successful outcomes. Approaches must therefore be highly tailored, based on a thorough understanding of a region's pre-existing competencies and gaps (Karplus et al. 2020).

1. Preface

". . . We're going to have to straddle between the world as it is and the world as we want it to be, and build that bridge . . . that's when we can start creating political coalitions that will listen to us, because we're actually recognizing that some people have some real concerns about what this transition is going to do to them, to their pocketbook, and we've got to make sure that they feel like they're being heard in this whole process."

—President Barack Obama
South Lawn Panel Discussion on Climate Change
October 3, 2016

Transitioning the United States economy toward deep decarbonization will have unequally distributed effects, positive and negative, across socio-economic groups, geographies and economic sectors. The concerns of workers and communities adversely affected by the transition must inform the discussion around decarbonization, associated policy changes and institutional development. The goal of the Roosevelt Project is to provide an analytical basis for charting a path to a low carbon economy in a way that promotes high quality job growth, minimizes worker and community dislocation, and harnesses the benefits of energy technologies for regional economic development.

The Roosevelt Project derives its name from three prominent figures in American history: Theodore Roosevelt for his stewardship of the environment during his presidency, protecting over 230 million acres of public land; Franklin Roosevelt for embodying a commitment to expanding the middle class in response to the Great Depression and developing America's infrastructure in the New Deal through a variety of programs including the Tennessee Valley Authority, Works Progress Administration, and the Bonneville Power Administration, among others; and Eleanor Roosevelt for her staunch support of social justice issues, through such activities as chairing the UN Commission on Human Rights and overseeing the development of the Universal Declaration of Human Rights. This project looks to combine the legacies of these three titans of American history to develop policy priorities and an action plan that will enable us to move beyond the false choice of economic growth or environmental security.

In our work, we do not strive to provide a prescriptive set of policies to usher in the transition to decarbonization or promote a particular suite of technologies. Rather, the goal is to be suggestive about actions that federal, state and a range of local actors can take in advance of the transition to protect vulnerable populations, industries and economies writ large. The underlying premise of this project is that by creating appropriate community level transition strategies, we can engender more support for the transition writ large. Thus, we can create a feedback mechanism that opens up the political space to a suite of policies that accelerate the energy transition essential for the well-being of future generations.

The Roosevelt Project takes a multidisciplinary approach to assessing the unique challenges posed by the transition to deep decarbonization and the opportunities for intervention from both public and private stakeholders to accelerate and facilitate the transition. To that end, we commissioned nine individual white papers on crosscutting topics related to this transition:

- Assessing the Role of Public Policy in Industrial Transitions: How Distinct Regional Contexts Inform Comprehensive Planning (Peluso, Kearney, and Lester, 2020)
- Social Impacts of Energy Transition (Beckfield, Evrard, Sampson, and Waters, 2020)
- Distributed Effects of Climate Policy: A Machine Learning Approach (Green and Knittel, 2020)
- Building the Energy Infrastructure Necessary for Deep Decarbonization throughout the United States (Hsu and Ulama, 2020)
- Public Attitudes on Energy and the Climate (Ansolabehere, Thom, and Tingley, 2020)
- Just Institutions for Deep Decarbonization? Essential Lessons from 20th Century Regional Economic and Industrial Transitions in the United States (Gallagher and Glasmeier, 2020)
- Energy Workforce Development in the 21st Century (Foster, Nabahe, and Ng, 2020)
- Energy and Manufacturing in the United States (Foster, Nabahe, and Ng, 2020)
- Fostering Innovative Growth in Regions Exposed to Low Carbon Transition (Karplus, Kearney, and Pawar, 2020)

There is deep complexity underpinning the economic and social conditions on the ground in different regions of the United States, and understanding those complexities is fundamental to making meaningful, region-specific policy proposals. As a result, with this report, we are not endeavoring to create a full set of policy recommendations for the U.S. nor for regional, state and local organizations. Rather, our focus is on creating a framework for thinking about the types of policies and activities that can be deployed conditional on the factors on the ground. More nuance will follow in the next phase of the Roosevelt Project that develops implementation plans for four specific regions: the Industrial Heartland, Southwestern Pennsylvania, the Gulf Coast, and New Mexico. We will work with local partners in those communities to develop effective transition plans that are specific to those regions. That phase of the project should be complete in 2021.

Finally, over the last couple of months, COVID-19 has swept its way across the United States, upending the economy and encouraging us to reconsider our relationship with the natural world. At the Roosevelt Project, we are developing action plans for communities to deal with substantial industrial upheaval, particularly in the context of forthcoming energy transitions. However, it is those same communities of working-class, low-income, non-college educated Americans that are in many ways bearing the economic burden of this present crisis. Though the impetus for dislocation may be different, the need to support these at-risk communities persists. Whether it is in responding to the dislocation caused by industrial transition or in managing the economic upheaval from a pandemic, the need to create opportunities for dislocated workers and communities must remain front and center.

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2. Introduction

In 2015, the world coalesced behind the goal of addressing climate change by limiting global temperature increases to 2° C or less. The Paris Agreement established the goal of reducing greenhouse gas emissions by 80 percent by 2050. In the years following, scientists and policymakers have advocated for even more ambitious targets limiting temperature increases to 1.5° C or transitioning to net zero economies. Although progress toward these goals over the last five years has been limited, global policymakers, scientists and business leaders have proposed a wide array of measures to confront climate change. Key among them is a large-scale rebuilding of our global energy system, encompassing the electricity, transportation, industrial and buildings sectors. While an expansive body of academic work has explored the technological and policy pathways necessary to create a decarbonized future, the inevitable dislocations for workers and communities and regional economic disruptions have not been addressed adequately. The central question of this work is how the transition to deep decarbonization can be managed so as to reduce the uneven impacts on different parts of society.

Moreover, the issues of employment, energy and environment are playing out against a complicated set of changes affecting workers. Income inequality has grown significantly over the last three decades, with median U.S. incomes stagnant despite substantial productivity gains (Levy and Temin 2007). Though recent years have seen modest wage growth (2.6% in 2017 and 2.8% in 2018), inflation adjusted wage growth remains sluggish (1%). Globalization and technological advances are widely accepted as important drivers of this stagnant development. As such, increasing application of automation, robotics and artificial intelligence may exacerbate this pattern.

Public policy also plays a role in the economic dislocation that has occurred over this period. Levy and Temin (2007) have argued that a range of policy and institutional changes that supported relative wage equality starting in the 1930s with President Roosevelt's New Deal and extending for more than a generation past World War II—such as government-supported organized labor-management relations, progressive tax structures, civil rights legislation, and strong minimum wage strategies—have been weakened since the early 1980s. Challenges to that social pattern have further eroded worker job security, a trend that was reinforced by a complex set of policy, regulatory and technological changes. The COVID-19 pandemic reignited the debate about delivery of health care to the population as a whole.

Most importantly, these challenges are not attenuating, but rather they are projected to intensify. For instance, the speed of technological advances in autonomous vehicles pressures workers (drivers) even as it offers near-term efficiencies, safety and new services in the economy as a whole. The impacts of change are also unevenly distributed geographically, negatively affecting regions of the country that are heavily dependent on natural resource economies while positively affecting others.

In this context, the economic effects of a transition to deep decarbonization will be distributed unevenly and inequitably across sectors and, importantly, regions, as some economic activities and technologies phase out and new ones emerge.

2.1 A Regional Approach

The study begins with the examination of existing conditions on the ground. The benefits and attendant dislocations stemming from the transition will reflect substantial geographical variation across institutional capabilities, economic capabilities and exposure to climate risks. Ultimately, the geographical variation in the effects of the transition to deep decarbonization requires that solutions to climate issues need to be curated for regional economies.

Geographical variation across institutional capabilities: the Roosevelt Project explores variation in economic capacity, specifically focusing on variance in regional expertise, capabilities and assets. Of particular importance to this topic is the variance across those economic realities that could be exposed as consequences of public policy, for example, energy-intensive trade-exposed (EITE) manufacturing (Foster et al. 2020). Economic capabilities that enable regions and communities to transition their economies to sure footing, such as innovation capacity and corresponding new business and/or new industry creation are also important (Karplus et al. 2020). EITE manufacturing is highly concentrated in the Gulf Coast and Industrial Midwest. Regions with significant extractive industry presence are less innovative across a broad range of indicators.

Variation in resource potential across geographies: There is also significant variance across the United States in regional options for replacing existing fossil fuel resources with renewable resources, and the match between those places with existing resources and those places with new renewable resources is imperfect (Hsu and Ulama, 2020). This serves as an unfortunate headwind for transition because it creates very clear distributive effects between winning and losing regions.

Variation in household carbon footprints: There is considerable variation in household carbon footprint as a result of income and geography (urban/rural). Green and Knittel (2020) explore carbon footprints across the United States. Carbon footprints in rural communities exceed those of suburban and metropolitan areas. Average footprints are 25.5 tons per year per household in rural areas, but 24.1 and 20.1 tons in suburban and urban areas, respectively. Households in the bottom income quintile have about 40% smaller footprints than the top income quintile, which generate 27.4 tons on average (for emissions related to home heating, electricity, personal vehicle transportation, and consumer products and services). While low-income households have smaller footprints, the carbon intensity per dollar of income in the bottom quintile is about five times higher than in the top quintile—importantly, this means that low-income households would feel the effects of a carbon price more than wealthier households, all else equal. Without mitigating these effects, we can anticipate political headwinds to the energy transition.

Variation in Climate Risks: Distributional effects from the transition to deep decarbonization could occur, as well, as a result of variance in exposure to climate risk. Hsu and Ulama (2020) explored the geography of specific climate change risks including sea level rise, cyclones, heat stress, water stress, and extreme rainfall. These risks pose threats to local infrastructure, capabilities, and budgets, as well as public health and safety, all of which make the prospect of dealing with the energy transition more challenging.

In sum, these sources of variance are important to consider as policymakers consider the appropriate public response. The transition should be managed at

the regional level by actors who have local knowledge of the unique economic attributes and frictions of their communities.

2.2 Moving Forward

The report begins with a review of lessons learned from prior industrial transitions, described in greater detail in Peluso, Kearney and Lester (2020). This extensive literature shows that there are four key capacities that need to be nurtured together to enable successful community transition in the face of industrial change:

- Human Capital
- Business Environment
- Policy Environment
- Social Fabric of the Community.

Subsequent sections of this report focus on these factors in the context of the energy transition.

At this stage, our findings are general and the complexity to what is happening in each region of the United States need to be understood in order to suggest meaningful priorities and implementation plans. Accordingly, the Roosevelt Project will continue after publication of this report to consider four case studies of regions in the United States: Southwestern Pennsylvania, the Industrial Heartland, the Gulf Coast (Louisiana and Southeast Texas), and New Mexico—regions with highly variant economic realities that are all positioned to be impacted by the transition to deep decarbonization. The Roosevelt Project will collaborate with local partners in each region to develop elements of a transition implementation plan that simultaneously moves toward a deeply decarbonized future while advancing the interests of the people and communities most at risk from that transition.

Many of the threads to be woven together in this report have decadal and longer time scales: climate change impacts; mitigation and adaptation; major business and capital commitments required for a low-carbon economy; education and training opportunities; policies and institutions for addressing decreasing social mobility and rising inequality. Yet, disruptions to workers and communities can be quite sudden when economic conditions change—even when aggregate changes are in slow motion—and they often occur with little warning, motivating preparatory action in the very near term.

3. The Labor Transition

Two divergent trends in U.S. labor markets over the last thirty years have exacerbated the challenge associated with the transition to a decarbonized economy. One trend is characterized by the rise of a college-educated, urban workforce focused on the technology, information, service and finance industries and well equipped to function in an inter-reliant global economy. These workers comprise over 30 percent of the active labor force. The other trend is characterized by a less educated, older workforce whose economic stability is increasingly threatened by the rise of globalization, improved logistics, and supply chain integration.

Without careful planning, the value of unskilled and semi-skilled labor may continue to decline across a range of economic sectors, including manufacturing, mining, and some service sectors (e.g., hospitality). Continued technological advancements like artificial intelligence and process automation may continue to displace low skilled jobs. Further, declining unionization rates in the private sector may accelerate existing economic instability and further strain workers impacted by the COVID-19 pandemic.

Without action, already unstable workforce sectors could be devastated, and cause ripple effects across other sectors. Any amount of planning can mitigate the extent of harm across the country. To examine various such scenarios, Foster et al. (2020) conducted quantitative and qualitative analysis to highlight potential outcomes for American workers. Quantitative analyses included workforce demographics and projections from the 2020 US Energy and Employment Report. Qualitative results were derived from case studies of historical government programs and large-scale infrastructure projects. Interviews with company human resource and management departments and unions informed conclusions on workforce trends in the short- to medium-term.

3.1 The Energy Workforce

In 2019, the U.S. energy, energy efficiency, and motor vehicles sectors employed over 8.27 million Americans, 5.6 percent of the U.S. workforce (Foster et al. 2020). Of those workers, 5.8 million Americans work directly in energy in four major sectors—Fuels; Electric Power Generation (EPG); Transmission, Distribution, and Storage (TDS); and Energy Efficiency (EE). As a portion of the U.S. labor force, energy is relatively small, comprising only 3.9 percent of the overall U.S. workforce (149 million in 2020). By comparison, the health care workforce represents 13.7 percent and retail 10.8 percent (Foster et al. 2020).

Despite the relatively small workforce, employment in these four energy sectors and motor vehicles (closely aligned to energy sectors because of its energy consumption) grew by 12.4 percent from 2015 to 2019, well outpacing the general economy's employment growth rate (6 percent). In that period the U.S. economy garnered nearly 915,000 new energy, energy efficiency and motor vehicles jobs, representing more than 10.7 percent of all new employment (Foster et al. 2020). This growth underscores the potential positive role that the energy sector can play in the future by creating jobs and addressing social equity issues during an economic transition.

As shown in the table below, the four key energy sectors contain workers across eight major industrial classifications:

Table 1. USEER 2020 employment, values only account direct employment. Indirect jobs in energy-related supply chains or retail sales jobs related to energy such as gasoline stations are not included.

Total	Construction	Professional Services	Manufacturing	Utilities	Wholesale Trade	Mining & Extraction	Agriculture & Forestry	Other
Fuels	20,409	170,514	247,336	–	137,677	535,210	35,616	2,131
EPG	242,462	182,688	101.065	183,565	74,906	–	–	43,134
TDS	498,841	134,306	85,469	417,660	231,185	–	–	16,183
EE	1,323,444	499,261	325,255	–	186,824	–	–	44,111
Total	**2,085,156**	**986,769**	**758,125**	**601,225**	**630,592**	**535,210**	**35,616**	**91,059**

Overall, the energy workforce is more diverse at 74% white and 26% racial minorities versus 78% and 22% nationally, although African Americans are underrepresented at 8%. These sectors also offer better worker protections with higher unionization rates than the US workforce as a whole (Foster et al. 2020). As potentially negative distributional effects of decarbonization loom, policymakers should keep that diversity and protection in mind. The best paid employees in the energy sector at all skill levels work in the utility industry, two-thirds of whose employees are in Transmission, Distribution, and Storage, the most highly unionized segment.

These characteristics are critical to highlight as decarbonization will threaten specific sectors. Strides made to diversify the workforce and increase worker protections and wages could be at risk. It is also important to examine how energy transition investments affect specific sectors of the workforce to see if the current workforce training system is stressed by such expansions. For example, the construction sector, which employed approximately 7 million workers in 2019, could see substantial expansion in some parts of the country if the transition to decarbonization spurs major infrastructure buildout. That expansion may be within the realm of expected cyclical expansion and contraction—the construction workforce has vacillated widely in the period during and after the Great Recession (BLS-QCEW.) Another sector that might experience a significant influx of employees is the utility sector. In March 2019 (BLS-QCEW), the gas and electric utility sector employed 497,000—any further expansion would require expanded training systems to prepare employees for potential new transmission, distribution and storage construction.

However, other regions of the country could experience corresponding contractions of employment as a result of technology shifts. Preliminary modeling exercises have identified over 1.645 million jobs in current fossil fuel production, transmission, distribution and electricity generation that will be at risk during an energy transition with 60 percent of those jobs located in just ten states. Job multiplier estimates of sustained investments in renewable energy, energy efficiency and infrastructure could replace a portion of those jobs; however, variances in geographic locations and skills' requirements remain as challenges.

4. Understanding Past Transitions in the Context of Decarbonization

A broad literature investigates how communities experience industrial transitions. The literature highlights four major domains that determine community health when faced with industrial transition: human capital, business landscape, policy environment and social fabric. Each domain contains multiple societal attributes that affect community outcomes. The social fabric domain, for example, embodies the socio-demographic makeup of a region, and specific indicators include demographic makeup, existence of public-private partnerships, strength of community ties, and impact of union presence, among others. A region's social fabric may drive success in a way distinct from its business landscape (Peluso et al. 2020). Of course, these domains overlap, and entail many complementarities. We describe these four factors in greater detail below.

Human Capital, as a domain, reflects specific levels of knowledge or capability in any population, and measures how that knowledge induces action, innovation, or paralysis. The study of historical human capital is crucial to anticipating a community's outcomes. As such, economic and development literatures have long viewed human capital as a foundational indicator.

Simon and Nardinelli's 2000 paper on human capital and urban growth cements prevailing wisdom in the field: cities that begin with a more knowledgeable population tend to perform better economically in the long run. Notably, such "knowledge spillovers" are generally limited to a specific metro area—knowledge is most productive in the region where it is acquired.

Simon and Nardinelli point out that the importance of human capital is mutable in the short term—they use the 1920s automobile industrial boom as an example—but confirm that human capital drives growth in the long run. Further aligned with our discussion of industrial transitions, they find that human capital is economically more consequential in manufacturing cities than non-manufacturing cities, though there may be reason to believe that this relationship may have evolved since 2000, particularly in consideration of new growth hubs such as Silicon Valley or Kendall Square, where technology and innovation serve as the backbone of the local economies. While Simon and Nardinelli deal primarily with knowledge attainment as a metric, a wide variety of other indicators measure human capital, including social insurance programs, union strength, and university presence (Peluso et al. 2020).

Business Landscape measures the strength of private actors, their ties to other regional players, and regional support for building and sustaining business. Among other elements, this domain observes the proliferation of public-private and private-private partnerships, industrial diversification, key drivers of industry location, state and regional business incentives, the effect of union presence, and the presence of foreign firms (Peluso et al. 2020).

One example of a key factor driving industrial location, and indicative of regional business landscape, is low cost energy. Historical literature shows that low regional energy costs consistently drive new industrial development. As early as 1983, Carlton found that energy costs motivate business location. More recently, Kahn and Mansur (2013) found that energy-intensive industries (the backbone of a manufacturing-based economy) locate in counties with low electricity prices. This trend continues, as large data centers that sustain the proliferation of Big

Tech routinely locate in counties with low electricity prices. This serves as one key decision companies make within complex regional business landscapes (Peluso et al. 2020).

Policy Environment encompasses past, present, and future government and company initiatives at all levels: local, state, federal, and international. Importantly, in addition to covering the policy environment, concerned with tangible structures for policymaking, this category often overlaps with discussion of the regional political environment. Understanding a specific policy environment is crucial to developing impactful and feasible transition program.

Neumann (2018) describes the impact of urban branding campaigns on city perception, using 1970s New York and 1980s Pittsburgh to demonstrate programs where public officials collaborated to reimagine post-transition spaces. Neumann (2018) writes that "Pittsburgh's post-industrial rebranding was a triumph," and her story serves as an example of a policy environment that enabled successful post-industrial growth and diversification. Urban branding, of this style, represents a relatively smaller policy lever that leaders might use to target areas in need of revitalization.

While we can easily measure the impact of this program, many broader ranging policies lack such clarity. Take, for example, the controversy over tax incentives. Some studies show that state fortunes are not well correlated with state business incentives. The literature on such incentives is variable, and indicates that policymakers should act with caution when implementing them (Peluso et al. 2020). Urban branding campaigns and business tax incentives both contribute to a region's intricate policy environment.

Social Fabric defines the socio-political context of a region. Social fabric indicators tend to reflect social and institutional influences at a regional level that are otherwise unseen, for example, community networks that encourage local town meeting attendance. Understanding regional social fabric is critical to structuring policy with respect to social and cultural context. This domain includes the nature of actor networks, cultural norms, the magnitude of public-private partnerships, key demographic markers (racial, economic, religious, etc.) and historical union involvement.

Discussion around social fabric indicators is nuanced as evidenced by the study of their influence public-private partnerships. In the context of Pittsburgh steel, Giarratani and Houston (1989) wrote that while public-private partnerships can be a useful tool for spurring economic growth, they divert attention from efforts to shape government-led development policy in the face of economic decline. In Pittsburgh, public-private partnerships drove growth when measured by traditional quantitative indicators, but it is unclear if they improved livelihoods on a more qualitative scale (e.g., happiness, perception of mobility), and whether those mixed outcomes were a result of lack of attention to existing social fabric.

Armstrong (2019) reinforces the importance of governmental understanding of social fabric—he asserts that industrial policy is most successful when state governments work to convene and monitor local actor coalitions. To develop this argument, he compares the trajectories of Pittsburgh, PA and Cleveland, OH following manufacturing decline. Armstrong (2019) argues that Pittsburgh flourished due to an intentional effort by the Pennsylvania state government to convene and monitor a coalition of empowered research universities to design a detailed local economic development strategy. In contrast, the Ohio state

government worked against a group of strong industrial incumbents in Cleveland who captured state attempts at development policy, and obstructed further change.

Complementarities. Naturally, there exist complementarities across these four domains of activity. For example, business incentives sit neatly at the intersection of the business landscape and policy environment domains. In the sections to follow, certain topics discussed in the commissioned Roosevelt Project papers cut across all four of the key domains. In particular, the roles of unions, infrastructure, innovation and entrepreneurship operate at the intersection of these categories. We will address relevant components within each domain as they arise.

Importantly, when we talk about innovation and entrepreneurship, we focus on high-growth, innovation-driven, "opportunity" entrepreneurship, distinguishing it from often smaller-scale, low-growth "necessity" entrepreneurship. Successful innovation can involve new technology, better management practices, and supportive regulation. In the context of a transition, we do not discuss innovation and entrepreneurship as a solution for employees who will be dislocated, but rather as an opportunity for the formation of new industries that could eventually be a key source of employment going forward (Karplus, Kearney and Pawar, 2020).

We investigate the approaching transition to deep decarbonization and organize this paper through the lens of these attributes. However, before progressing, it is important to think about exactly what we mean by a "successful transition."

4.1 Considering "Success"

Sociological understanding of the energy transition draws on concepts and measures dating back to analytical and critical approaches to industrialization. An overarching insight from foundational and later works is that macroscopic changes like energy transitions affect people through social structures: we can think of social structure as a prism that refracts economic forces into unequal outcomes depending upon social networks, communities, organizations, race, class, and gender.

In the context of the energy transition where we know more about what we are transitioning away from than what we are transitioning toward, the social-historical record offers no perfect parallels. Yet, our ongoing energy transition can be conceptualized as a case of macroscopic economic change. Beckfield et al. (2020) summarize measurable social impacts of industrial transitions, listed below.

Social Impact Measures

- Emigration
- Homicide
- Suicide
- Poverty
- Urbanization
- Population Health
- Identity
- Feeling Moral Worth

The quality and quantity of employment is central in the literature on social impacts of macroscopic external perturbations, or major external drivers of regional change. Also critical to what social impacts are realized from unemployment and misemployment are social resources such as collective efficacy, social networks, public goods such as welfare supports, schools, nongovernmental organizations like churches and social clubs, and the power and recognition people feel in positive social identity (Beckfield et al. 2020).

Research on the social impacts of deindustrialization and boomtowns gone bust in the United States finds that social impacts cluster into the categories of household effects, community fiscal effects, social demography, crime, community and identity. Therefore, in the sections that follow, we focus not only on the economic assets that communities bring to bear to weather transitions, but also critical social elements within a community.

5. Building Social Fabric for Vulnerable Communities

Experienced policymakers and planners are aware that societal support is critical to creating the conditions for successfully managing a transition. A region's social context strongly influences the nature of a transition's development. It also influences the extent to which diverse voices participate in goal setting and whether the positive outcomes of a successful transition are equitably distributed. Across the Roosevelt Project, our analysis aligns on several recommendations for facilitating a transition with distinct regional context in mind.

The Roosevelt Project studies the creation and promulgation of a social fabric through a set of case studies and in-depth literature reviews aimed at socio-political, -economic, and -technical factors that shape a transition. Across several analyses, we looked at key historical transitions in Pittsburgh, the Pacific Northwest, and other industrial regions. We also explored the diverse regional social factors at play for major energy and infrastructure programs. Sections 5.1 through 5.5 explore some key challenges and opportunities faced when integrating responsible policy with respect to social fabric.

5.1 Government Oversight of Local Actor Networks

We found that empowering local level actors via government programs could mitigate distributive inequities. A just transition relies on careful prioritization and planning to lessen inequitable outcomes (Gallagher and Glasmeier 2020). Armstrong (2019) urges a strong role for state governments in convening actors to confront industrial transition and to monitor their collaborative performance.

Explicit efforts to (1) convene, (2) monitor and evaluate, and (3) correct course during program implementation offer the best chance of pursuing a successful transition.

Contemporary planning literature suggests that governments should ensure a meaningful role (e.g. in local siting or workforce programs) for all interested stakeholders, including frontline workers in the fossil fuel industry, affected communities, and local environmental justice groups. Governments that convene representative stakeholder groups are better able to assess circumstances on the ground, and to shape policy with social fabric in mind (Peluso et al. 2020). The absence of any major party or dominance of another, can lead to policy capture and emerge into unintended consequences. Consider the case of Cleveland, Ohio following the downturn of the steel industry in the late 1980s. Armstrong (2019) shows that a too-powerful set of private actors monopolized attempts at economic development, community organizations were largely ignored, and the city saw little resulting development.

Future responses to economic disruption must also include specific funding for monitoring and evaluation, with the requirement that results are disseminated, and programs are adapted accordingly. None of the programs studied by Gallagher and Glasmeier (2020) included comprehensive tools to monitor and evaluate fiscal and socioeconomic outcomes. The lack of such learning mechanisms makes it challenging to assess the quality of programming and to structure adaptive management strategies. Particularly in the case of the post-timber transition in the Pacific Northwest, the federal program designed to improve economic wellbeing (The Northwest Forest Plan) saw no systematic program analysis until years after implementation. Record keeping and analysis differed across state and federal

agencies, making it difficult to monitor and evaluate initiative success and further, to correct course (Gallagher and Glasmeier 2020).

5.2 Government Intervention & Discrimination

Government efforts to support workers and regions in transition have, at times, worsened instead of improved social cohesion. This was particularly prevalent in a set of programs pioneered by the New Deal. The Department of Agriculture (USDA), for instance, formed a long-running set of rural economic development administrations designed to address chronic rural poverty. However, African American farmers, in particular, were denied access to federal loans and subsidies, resulting in many losing their farms and homes. This failure was ultimately acknowledged in Pigford v. Glickman (1999), in which a Federal District Court Judge approved a settlement for thousands of farmers in one of the largest civil rights class action settlements in the nation's history (Gallagher and Glasmeier 2020). The Tennessee Valley Authority (TVA), too, delivered positive outcomes for some at the expense of others. While the program's initial mandate was to elevate regional farmers via "grassroots democracy," critics argue that TVA bowed to powerful white planters at the expense of more impoverished, African American, smallholder farmers (Boyce 2004). Policymakers should be alert to the risk of new initiatives aligning with existing racial and class patterns and, consequently, furthering inequity. **Involving diverse voices from civil society organizations could mitigate the risk of perpetuating racial and class injustices.**

5.3 Public Infrastructure Programs

Infrastructure systems are technological and physical artifacts deeply embedded in their spatial, social, and geographical contexts. The extraction of fossil fuels and the corresponding growth in energy infrastructure both shaped and were shaped by a landscape of distinct socio-economic realities across regions. Energy resources and their accompanying infrastructure are foundational to varied regional social fabrics. Programs like the New Deal and the American Recovery and Reinvestment Act (ARRA) offer lessons on how national infrastructure policies wrestled with a diverse array of regional social fabrics. In both the New Deal and the ARRA programs, a recurring and important debate was whether these stimulus programs should invest in "people," by spurring labor-intensive job creation in the short term, or in "projects," by capital-intensive infrastructure investments with long-term benefits (Hsu and Ulama 2020). This debate is being revived today in the context of the coronavirus-induced recession.

Two major New Deal building programs, the Public Works Administration (PWA) and the Works Progress Administration (WPA), took fundamentally different approaches to engaging local communities. PWA dealt primarily with heavy construction and large-scale building, relying on private contractors to build projects like Boulder Dam. PWA's initial concern was project speed, while simultaneously avoiding projects that might construe favoritism in selection. PWA's resulting organization divided the country into seven regions, spurring debate around the role of local governments and labor unions, and spurring negative reactions by local leaders, who viewed the program as the encroachment of a disconnected federal body. After two years, the PWA faced a surge of criticism—critics said it failed to directly employ individuals at a quick enough pace or large enough scale. As a result, the subsequent WPA prioritized short-term labor-intensive projects with no private contracting and worked

closely with state and local governments to put as many people to work as quickly as possible (Hsu and Ulama 2020).

The history of the PWA and WPA tells an important story about the importance of recognizing distinct regional socio-economic landscapes, and their accompanying local and state governments. During dislocation events, successful public infrastructure programs should allow local leaders to serve the unique needs of their communities and regions. Thus, local leaders can share the burden of decision-making on "people" versus "projects" to align with the immediate needs of the region.

5.4 The Distributive Effects of Climate Risk

Regional variance in exposure to climate risk could generate distributional social effects on top of those deriving from the transition to deep decarbonization, making regional responses to the energy transition more challenging. Hsu and Ulama (2020) explore the geography of specific climate change risks including sea level rise, cyclones, heat stress, water stress, and extreme rainfall. For example, communities in the Southeast region and parts of coastal Mid-Atlantic and the Northeast are at greatest risk for cyclones. Meanwhile, western and southern states such as Nebraska, Kansas, Utah, Texas, and California rank high in vulnerability to water stress. These risks pose threats to local infrastructure, capabilities, and budgets. Further, adaptation to climate emergencies tends to be more challenging for vulnerable populations who are least equipped to confront rapid change (Hsu and Ulama 2020).

5.5 Creating an Environment for Innovation

Efforts to capitalize on innovation in transitioning regions will benefit from considering the local social fabric and relevant cultural norms. Regions with prevailing rules and cultural norms that support and reward new business creation might better spur innovation. Here, informal norms may be even more important than formal rules (or efforts to change them). For example, family expectations and prior employers influence the employment options that individuals consider, or their willingness to transition to new work or sign up for retraining programs. Comfort level in navigating applications for funding sources or technical support from distant sources (e.g. national labs or federal sources) may limit initiative in some communities otherwise able to reap large benefits (Karplus et al. 2020).

6. Human Capital for the Energy Transition

Section 3 explored the state of the energy workforce today with projections for the effects of decarbonization on existing jobs and future workforce needs. In order to capitalize on the energy transition for continued creation in the near and long term, the Roosevelt Project recommends a coordinated expansion of workforce training and infrastructure deployment. Potential threats in an energy transition include mass dislocation in the fossil fuel and electric power generation industries, reversing positive strides made in diversifying the workforce and strengthening worker protections in previous decades.

6.1 Energy Workforce Training Systems

The energy sector engages in the entire spectrum of training programs within the U.S., including apprenticeship, two-year community college certificate programs, as well as 4-year and advanced college degree programs. In 2018, the Bureau of Labor recorded that 585,000 apprentices were registered in the program, a 56 percent increase from 2013, in 23,400 registered apprenticeship programs across the country (Foster et al. 2020). Two particular programs deserve special mention along with several emerging trends.

1. **The Construction industry** makes up roughly 70% of all US registered apprentices. Labor-management negotiated construction apprenticeships are by far the largest portion with over 1,000 training centers in the U.S. These union apprenticeship programs are particularly important for the EE sector since they provide not only the initial two to four-year training programs, but also life-long learning on new technologies.
2. **The Utility industry** also has a commitment to apprenticeship programs and industry-wide collaboration through its decade-long effort with the Center for Energy Workforce Development (CEWD). CEWD is one of the most successful multi-employer efforts to respond to the entire suite of 21st Century workforce challenges, including an aging demographic, new technology deployment, and diversity expansion. CEWD has succeeded by using targeted outreach programs, veterans' recruitment, pre-employment boot camps, new curricula development, a national utility jobs' database, and technology updates.

These training assets provide a foundation for the energy workforce expansion over the next three decades to implement climate solutions. It will scale industry energy efficiency measures, strengthen energy infrastructure, and deploy a wide range of new energy technologies. These programs will also help to address the most vexing workforce problem posed by the transition to a low carbon economy—the transition of employees affected by declining use of fossil fuels. According to the 2019 USEER data, there are currently about 1.6 million Americans who work with the production, processing, transmission, distribution, and storage of fossil fuels and their use for electrical generation. This is a large number of jobs put at risk and does not include other downstream occupations such as the additional 1 million Americans employed in gasoline stations.

The phase out of a large portion of this employment will be challenging for both the individuals and the communities and states where these jobs are concentrated. Currently, at least 60% of these fossil fuel jobs are located in just 10 states: Texas, California, Louisiana, Oklahoma, Pennsylvania, Ohio, Illinois, Florida, Colorado, and West Virginia. While some of these states have large and diverse economies, the

disproportionate economic impacts on the other states will be major, thus making workforce transition planning of strategic importance.

Relying solely on retraining would appear both challenging and inappropriate when the essence of climate policy relies on various forms of government policy-driven investment. One of the clearest opportunities for minimizing stranded workers and communities is to synchronize policy-driven investments in energy efficiency, new energy infrastructure, and new energy technologies with the anticipated phasedowns of fossil fuel utilization. Another approach is building out carbon capture and storage to reduce fossil fuel plant emissions, which utilizes already invested infrastructure and draws on the same skillsets as in the oil industry. The existing training infrastructure of the utility and construction industries provides a high quality, tested, and durable vehicle for managing the ramp-up of new employment for those impacted by declining fossil fuel use. However, such infrastructure is varied across the country with the highest apprenticeship participation rates in Minnesota, Wisconsin, Michigan, Missouri, Illinois, Indiana, Ohio, and Pennsylvania with 11,100 to 20,500 apprenticeships per state. In contrast, states such as Montana, North Dakota, South Dakota, Nebraska, and Oklahoma have only between 400 and 2,000 apprenticeships.

As illustrated in the Great Depression and Great Recession, large economic investments are best carried out at the state and local level with federal guidance and support, allowing elected officials to tailor funding to region specific needs.

6.2 Leveraging Infrastructure for Employment Opportunities

Typically, technological change in a given industry creates disruption in the marketplace that then flows in all directions—through supply chains, upending workforce systems, devaluing existing assets, and fracturing integrated business models. When global markets are added to this mix, the results are highly unpredictable. In the case of the integrated steel industry and the introduction of the electric arc furnace, lower cost domestic technology and international competition collapsed the industry with over 40 bankruptcies in the 1990s, and forced a global reorganization of the industry. Many assets were retired, stranding both workers and communities.

The infrastructure necessary to meet the goals of deep decarbonization requires investment and deployment on timescales and sheer magnitude that has not been experienced in the whole of human history, with various estimates calling for between 3 and 4 TW of new clean electricity generation in the near term to stay within a 2° C carbon budget. While historical evidence suggests that infrastructure often does not function as the most efficient mechanism to create jobs, it is clear that at this scale, the deployment of new infrastructure is an important tool to mitigate the employment effects of the transition to deep decarbonization. These investments will include infrastructure in the following four key areas:

- New renewable resources: A many-multiple growth in the use of solar technologies (both photovoltaic) as well as wind (both on- and offshore) is needed.
- Decarbonized fuels: Existing fossil fuel infrastructure will only be viable if the fuels come from low- or zero-carbon sources, either through carbon-free fuels that can be used in existing systems (so-called ‘drop-in’ fuels); or if carbon

emissions can be captured, used, and stored at the point of combustion; or if carbon can be captured directly from the air.

- Use changes: Fundamental changes are needed in key use sectors such as buildings, industry, and transportation. Changes in these sectors all require increased end-use efficiency, switching to electricity or other decarbonized fuels, and fundamental process or system changes to avoid upstream carbon emissions.
- Transmission systems and carriers: Electricity and hydrogen are likely to serve as the primary delivery vehicles for clean energy, but need much more development of their transmission and storage resources at national, regional, and local scales. In order to enable the use of intermittent renewable resources affected by seasonal variation, drought, weather, and other factors, new and expanded means of storing energy also need to be developed.

Leveraging this build out to support job creation hinges on a few specific regulatory hurdles that must be overcome.

- First, utility-scale renewable siting will require large amounts of land due to lower energy densities.
- Second, decarbonizing the electric power sector will require social, political, economic, and legal policies to prohibit or discourage the use of fossil fuels, limit and/or change the price of greenhouse gas emissions, and address currently stranded generating assets. Achieving decarbonized fuels will require the development of multiple pathways including land use changes and direct regulation of the cultivation processes, among other incentive modifications.
- Third, widespread use of electricity and hydrogen from renewable or low-carbon sources will require the building of new infrastructure and the repurposing of existing infrastructure. In particular, new transmission lines will be needed for solar and wind resources, since the most potential for these resources is concentrated in the Southwest and Midwest, respectively.

Now, with the COVID-19 pandemic forcing another economic slowdown and millions of Americans out of work, economy-wide stimulus investments are also needed. Combining lessons learned from both the New Deal and the American Recovery and Reinvestment Act (ARRA), the Roosevelt Project sees the value in government intervention and rapidly integrating large-scale energy infrastructure projects with the overall stimulus. Importantly though, such new programs need to provide state and local officials with the resources to incentivize, select, and manage the infrastructure projects most viable in their unique circumstances through indirect financial mechanisms. Currently, state and local governments own over half of all fixed infrastructure assets and over 90 percent of all non-defense public infrastructure assets suggesting that funds will allow leaders to serve their community while meeting region specific needs and ensuring project longevity. Simultaneously, in order to deploy infrastructure on this scale, the public sector needs to create indirect financial mechanisms that will attract private investments as discussed in Section 7.

7. Leveraging American Business to Drive Decarbonization

Leveraging the execution, innovation and financial capabilities of the private sector in the United States is critical to accomplishing a successful transition to deep decarbonization and for ensuring that at-risk communities are able to maneuver the transition with limited dislocation. A region's business landscape manifests in several ways: industrial diversification, public-private partnerships, business incentives, union presence, the presence of foreign firms, and local economic factors such as the costs of doing business. Unlike other transition scenarios, the transition to deep decarbonization presents significant economic opportunity, upon which business can and should capitalize. One example of these opportunities is the deployment of new energy infrastructure, which is covered at length in Section 5: Creating the Policy Environment for a Successful Transition.

In this section, we look at how the business landscape in a given region affects the ability of that region to manage transition conditions. We focus on (1) the cost of doing business, (2) business incentives, (3) innovation & entrepreneurship, and (4) public-private partnerships. Our findings are derived from an assessment of energy intensive industries (Foster et al. 2020), case studies of previous transitions and of the role of innovation (Peluso et al. 2020; Karplus et al. 2020). A large focus is placed on the role of financial mechanisms, economic development corporations, business incentives, public-partnerships and factors for innovative communities as discussed in more detailed reports in Hsu and Ulama (2020), Foster et al. (2020) and Karplus et al. (2020).

7.1 Cost of Doing Business

The impact of high energy costs on industrial location is consistent in the literature across time. In 1983, Carlton found that energy costs have a large impact on business location. More recently, energy-intensive industries that serve as the backbone of a manufacturing-based economy are located in counties with low energy prices, for example coal supplies the low-cost heat necessary in the industrial Midwest (Kahn and Mansur 2013). This trend has continued as data centers required for Big Tech proliferation have routinely located in counties with low electricity prices, for example hydro provides low costs for the Pacific Northwest's data centers (Rareshide 2017).

Historically, in the 19th Century, industrial manufacturing technologies and processes were intertwined with the development of energy systems. Energy production itself created demand for the manufactured goods needed for the production and distribution of energy across all sectors of the economy. Cheap energy and manufacturing co-developed in regions of the U.S. and served as an economic development strategy in emerging economies. However, since 1970, there has been a decline in GDP contribution to the US economy from both energy and manufacturing. In 1967, manufacturing made up 26.9% of GDP and energy 10%. Fast forwarding to 2016, manufacturing had declined by over half to 11% while energy was reduced to 5.6%. It should be noted that real GDP increased more than four times since 1967—so while history illustrates the decoupling of energy and GDP, both have increased over time

Despite its diminished GDP share, the US industrial sector is responsible for over 20 percent of the country's GHG emissions and of that, 70 percent are produced from five energy intensive, trade-exposed industries (EITE's), including aluminum,

cement, chemicals, iron and steel, and pulp and paper. These five sectors utilize high-grade heat for which there are limited, cost-effective alternatives to burning fossil fuels. Moreover, energy use in these sectors is expected to grow by 10% by 2050 (Foster et al. 2020). Together, this presents a situation where, absent innovation in clean energy sources to replace natural gas for the production of high-grade heat, these industries are at risk from both carbon pricing and international competition, the combination of which could be problematic for communities where these industries are located.

Iron & Steel. In 2018, industry output $206 billion directly to the US economy through its offered material and mill services and products as well as 386,700 direct jobs. Since 1990, the US steel industry has decreased its energy intensity by 35 percent and greenhouse gas emissions by 37 percent (American Iron and Steel Institute 2019). More steel is recycled than paper, plastic, aluminum and glass combined every year. Energy intensity is expected to further decrease by 27% by 2040 as primary production shifts to recycled production, also known as secondary production (Foster et al. 2020). EIA estimated that between 1991 to 2010, the US steel industry increased its use of electric arc furnaces from 38 to 61 percent (Foster et al. 2020).

Aluminum. The industry contributes $174 billion to the economy and directly employs 162,000 workers. Transportation makes up 40% of domestic consumption with packaging, building, and electrical uses following behind (USGS Mineral Consumption Survey 2019). North America supplied 26.4 billion pounds of aluminum with 34% of its supply coming from primary domestic production, 37 percent from secondary domestic production, and 27 percent imported in 2016 (The Aluminum Association 2017). With China increasing primary production by 1,500 percent between 2000 and 2017, the American primary aluminum industry has experienced difficulty with 18 of 23 smelters shutting down between 2010 and 2017 (Foster et al. 2020).

Chemicals, Petrochemicals and Refining. With low-cost gas supply, the US chemical industry has dominated the global market and, in turn, contributed significantly to the overall US economy. Value added from chemical product manufacturing has more than doubled in the last 20 years. In 1998, chemical product manufacturing added $181 billion to the economy; today it contributes $378 billion, but American workers have been relatively unaffected by such changes. With increased productivity, employment numbers declined continuously from 1998 through the Great Recession when 48,000 jobs were lost between 2008 and 2009. Since 2011, the chemical industry has added roughly 40,000 jobs for a total current employment of 830,000.

Pulp and Paper. The US is the second largest producer of paper and paperboard products in the world. In 2018, the industry contributed almost $57 billion to the US economy and employed 360,000 American workers with the concentration of production in the South, Northeast, and North Central regions of the country. The pulp and paper industry consumes the third largest portion of energy in the manufacturing sector following chemicals and petroleum refining largely due to the fact that the US is the largest virgin pulp and paper producer, a more energy intensive process. However, massive reductions in energy consumption are possible with updated technology. The DOE Bandwidth Study estimates that 61 percent of energy could be saved by revamping paper production by implementing existing state of the art technology and practices and an additional 20 percent savings if research and

development technology that is being investigated worldwide were implemented as well (Foster et al. 2020).

Cement. Cement production alone contributes 7 percent of global carbon emissions (Harvey 2018). Of the cement used in the US, 87.8 million tons of Portland cement was produced in 2018 across almost 100 plants in the US, resulting in $10.7 billion of company sales (Portland Cement Association 2017). The cement industry employs over 12,000 Americans and contributed over $15 billion to the US economy. Texas, California, Missouri, Florida and Alabama were among the top state producers of cement, comprising almost 50 percent of total US production (USGS Mineral Consumption Survey 2019).

Sixty-eight percent of the jobs in these industries are located in the same 15 states that are home to 60 percent of all fossil fuel jobs and serve to support broad swaths of regional economic prosperity. For example, chemical and petrochemical manufacturing have been concentrated in the Gulf Coast and Midwest. States such as Texas, the country's largest producer of both crude oil and natural gas with $44 billion of chemical exports, will be exposed to significant job loss and economic dislocation with the simultaneous decline of these industries.

Thus, the Roosevelt Project advocates transition policies for existing industries while simultaneously promoting the development of new industries to take the place of those that will phase out. To appropriately balance these efforts, a combination of strategies is critical for success. Leveraging business incentives, strong public-private partnerships, easing access to land and infrastructure siting, and cultivating innovative communities will put a region on a better footing for enduring the transition to deep decarbonization.

7.2 Business Incentives

Business incentives are a critical piece of the puzzle for ensuring that the business landscape within a community is robust. Business incentives are generally designed either to attract new business or to provide cost reduction for all businesses. They include, but are not limited to, tax credits and abatements, zoning assistance, infrastructure improvement, relocation assistance, and grants or loans. Papers across the Roosevelt Project examine the impact of business incentives via demonstrative case studies—Gallagher and Glasmeier (2020) detail incentive use in major federal programs, Hsu and Ulama (2020) study the impact of incentives on an array of public infrastructure development initiatives, and Peluso, Kearney and Lester (2020) outline the related outcomes of four communities reliant on lighting manufacturing.

In all four cases studied by Peluso et al. (2020), economic development corporations are heavily credited with spurring local investment in communities reliant on lighting manufacturing. These organizations serve primarily to incentivize the development of income and profit tax incentives, and in some cases partner with manufacturers to find sources of initial capital. At the local level, cities provided tax incentives for local manufacturing development, while regional economic development corporations credited themselves with making connections between industry and local government to fund expanded manufacturing. Further, firms pursuing new manufacturing in the place of traditional lighting leveraged state-level economic development programs. In each of these communities, economic development corporations serve as a mechanism

to drive policies that promote business incentives and seek to create a business-friendly environment (Peluso et al. 2020).

Experiments with business incentives are widespread, but the literature examining such policies is inconclusive on their community effect. One common business incentive, a corporate tax incentive, is particularly susceptible to policy capture and extremely difficult to implement. While perceived as well-targeted, tax incentives have seen mixed results in terms of encouraging business relocation or incenting economic development (Button 2019). State fortunes are not well correlated with state business incentives, in terms of unemployment, income levels, or future economic growth (Bartik 2017). Further, if a policymaker decides to bet on a business incentive, tax literature is uncertain and conflicting on how best to implement such a policy, and which incentive structures apply best to specific regions (Buss 2001). These types of tax incentives should be reserved to assist early-stage, novel technology companies as they attempt to compete in markets where scale is a key competitive advantage, such that success can be viewed as the future ability to eliminate the tax incentive without limiting the technology or company's viability.

Policymakers may lean on economic development corporations as facilitators of communication or business support, but they must pay close attention to tax incentive programs. Economic development corporations feature heavily in current progress in communities previously dependent on lighting manufacturing. They can provide useful hubs for facilitating strong networks and maintaining the prominence of regional knowledge. However, the work of economic development corporations must be monitored, as the business tax incentives they promote are susceptible to policy capture and misuse (Peluso et al. 2020).

7.3 Public-Private Partnerships

Public-private partnerships are "arrangement[s] [where] the private sector is typically contracted to design, build, operate, manage or finance new [projects] and meet government obligations for a set period of time" (Hsu and Ulama 2020). Public-private partnerships are a potential tool for transition, but as a tool that has been successful in some cases and not in others, it needs to be thought through in terms of its applications.

Cases where public-private partnerships have been successful include alleviating labor market turbulence. Gallagher et al. 2020 highlighted several ways that private actors have supported workers. For instance, private auto manufacturers helped workers gain additional training in the face of growing Japanese imports, automation in assembly techniques, and a growing demand for smaller, fuel-efficient cars. Providing training in transferable skills (as opposed to "firm-specific" training) made workers more employable across other occupations or industries. Second, lobbying efforts for companies such as Chrysler resulted in government participation in the company's emergence from bankruptcy and saved an immediate 360,000 jobs. Another recent example is the CARES economic stimulus package passed in late March 2020 that provided small businesses with loans in order to keep workers on payroll.

However, in other cases public-private partnerships have not been successful, such as when state politicians invited a technology training startup based out of Pennsylvania to West Virginia and provided it with space rent-free and funding in

2016. The start-up, Mined Minds, promised to teach West Virginians to write computer code and get them well-paying jobs in the technology sector. Many locals quit their jobs or dropped out of school for the prospect of a stable and lucrative career in tech sector. The start-up failed to deliver on its promises, with only a handful of workers finding employment in programming and most returning to their previous jobs. Other small businesses in Appalachia, including Bitsource in Pineville, Kentucky, have succeeded in transitioning a small number of coal industry professionals to the technology sector. The mixed success, however, reinforces why communities may be wary of outside actors. It continues a trend of outside actors overpromising and under delivering in seeking a quick solution to persistent economic dislocation of struggling workers and communities in the region.

For infrastructure projects, public-private partnerships could potentially play an important role in developing transportation and building projects. In the U.S., many steps in the building of new infrastructure are already met by the private sector. Public-private partnership advocates insist there are potential further benefits to be realized by having a single firm provide multiple steps in an integrated fashion (Hsu and Ulama 2020). However, public-private partnerships have not been particularly successful with infrastructure projects because of a lack of experience with the process, leading to lack of effective oversight, firms strategically exiting from project commitments, and ultimately higher transaction costs. One potential solution to this national lack of experience is to develop a national infrastructure bank to select, finance, and structure specific local construction projects. Advantages of a national infrastructure bank include the ability to select and manage a large number of new projects, to repay loans directly from user fees, and to collaborate with the private sector in other new ways. Additionally, an infrastructure bank could pursue national-level infrastructure goals by coordinating complex and long-term public investments, creating a stable environment for private investments, and assisting local and state governments with technical expertise, coordination, and execution. These actions would support states unable to execute and coordinate large projects because of their limited size. Two possible disadvantages of a national infrastructure bank are (1) the potential risk of capture by industry or particular regions, and (2) unfavorable competition with state and local government infrastructure financing, because state and local governments already borrow at lower rates than the federal government, since state and municipal bonds are exempt from federal income tax.

In summary, public-private partnerships can be effective and serve to protect workers' interests, but, in some instances, need to be further developed or refined in order to become economically efficient. Finally, it is critical for public actors to oversee and select private partners to benefit their constituents through efficient and transparent execution.

7.4 Building Innovative Communities

The antecedents of innovative activity are generally weak in areas exposed to transition, especially in those places with high shares of extractive industry employment. Most metrics of entrepreneurial activity/antecedents, including patents, venture capital funding, federal R&D spending, and a general entrepreneurial quality metric, are negatively correlated with the job share of extractive industries. The negative correlation is the strongest for the measure of venture capital funding; this is perhaps unsurprising as weakness in any one of the major competencies

may undermine a decision to invest. The picture is somewhat more encouraging for areas with high shares of energy-intensive, trade-exposed manufacturing, which offers an opportunity to encourage entrepreneurship that leverages existing local competencies to the benefit of incumbents as well as new entrants.

Understanding the existing business environment is crucial for designing targeted policy interventions. The ability to build innovative and entrepreneurial communities relies on three competencies relevant to the business environment: (1) risk-tolerant sources of financing; (2) a proximate or accessible base of suppliers and/or knowledge inputs for the focal activity; and (3) channels for exchanging information, including coordinating with local stakeholders and marketing to or innovating with prospective customers.

In an example that bridges (2) and (3), large local industrial players can team up with universities to have a meaningful impact on building innovative growth, as in the case of GE and Auburn University. This partnership led to a robust training pipeline and advances in local manufacturing capabilities within GE. Incubators may also play a role in supporting local innovators, but one size does not fit all. Karplus et al. (2020) considered the cases of three incubators: Greentown Labs, Lab-Embedded Entrepreneurship Program (LEEP), and the Elemental Accelerator, and showed how they leveraged their local business context (e.g. private sector/ startups, national laboratory, or military presence) to foster innovative growth. The degree of success or failure was found to be related to the location's positioning within a broader innovation ecosystem, as well as whether or not the accelerator leveraged local resources and connected them more firmly into the network.

8. Creating the Policy Environment for a Successful Transition

As previously mentioned, the transition to deep decarbonization may look different from past industrial transitions, particularly because it will be policy driven. Upfront, this makes the role of public policy critical to how the transition occurs. Second, the transition is economy-wide and therefore will have wide-ranging effects that suggest a positive role for government intervention. Correspondingly, local, state and federal political buy-in will either enable or obstruct successful policy creation in the face of major industrial change.

It is important to note here that a regional policy environment differs from its political environment. Our regional approach to study transitions was motivated by the extraordinary diversity across the United States with respect to natural resources, economic capabilities, and climate risks. The primary goal behind the policy recommendations presented here is to help communities adapt intelligently and efficiently to the array of environmental and economic outcomes that may result from decarbonization. Most importantly, it is critical to creating the political context in which people can reach consensus on these adaptations and feel certain that the path forward resolves any resultant dislocations in a way that improves individual status.

Peluso et al. (2020), Gallagher and Glasmeier (2020) and others explore how various policy environments can serve as conduits for successfully mitigating the effects of transition dislocation. Together, these authors find that specific policy initiatives targeted at building capacity in other domains, e.g. human capital, social fabric and the business landscape, are important for navigating transition. In this section, we (1) discuss the aggregate policy environment within which a transition is taking place, (2) examine the existing political environment and (3) offer a set of policy recommendations to pursue.

8.1 The Need for a Comprehensive Approach

Policymakers must take a comprehensive approach to stakeholders and capacity building in local communities. While we discuss our findings in the context of four domains, the reality is that most policymaking happens at the nexus of all. Static, uni-levered interventions often fail to provide the desired outcome. We observe this in two parts of our work: first in the exploration of past industrial transitions and second in the development of innovative communities. Single-levered policy interventions are likely insufficient when a city, state or region is confronted with an industrial transition. Instead, public policy must address all domains simultaneously, from social fabric to human capital and business environment.

The economic and social conditions on the ground in different regions of the United States are deeply complex, and creating meaningful, region-specific policy proposals relies on foundational understanding of those complexities. As a result, we do not endeavor to create a full set of policy recommendations for the U.S. nor for regional, state and local organizations. Rather, we focus on creating a framework for thinking about deployable policies that respect factors on the ground. The next phase of the Roosevelt Project will develop implementation plans for four specific regions with a nuanced and detail-oriented perspective.

Below, we first present general guidance for policymaking at a regional level, with the recognition that each region faces a unique set of obstacles and opportunities. Second, we outline a suite of policy measures applicable to the

Federal Government that might help mitigate uneven regional effects and are consistent with a broader range of national interests.

As explained at the outset of this paper, policymakers must confront all four domains simultaneously. This is particularly apparent in the influence of the policy environment on the three other domains: social fabric, business environment, and human capital.

Policy initiatives that utilize existing social fabric drive regional success. As discussed earlier, efforts to convene, monitor, and course correct are crucial to the success of economic development programs. Safford (2009) and Armstrong (2019) write about planning initiatives led by the Allegheny Conference on Community Development, which were successfully initiated and monitored by the Pennsylvania state government in response to the decline of Pittsburgh steel. The state utilized the strengths of existing local actors (research universities) to drive community involvement. They then leveraged the initial work of the Allegheny Conference, to foment further economic development programs, learning from previous successes, and adjusting accordingly.

Targeting regional business environments is a common form of policy-making. The Allegheny Conference led the charge on public-private partnerships in Pittsburgh via a rolling set of strategic plans. These regional plans stimulated targeted infrastructure development to enable growth in the city's finance, tech, medical, and service sectors, which eventually led to a more diversified economy.

Finally, policy instruments that influence human capital appear central to success in the face of industrial transitions. In Pittsburgh, the role of research universities as hotbeds of human capital allowed them to serve as central actors in state economic development plans. This led to strong educational outcomes within the city and shepherded a push toward industrial diversification (Peluso et al. 2020).

The economic development plans in Pittsburgh that began with the Allegheny Conference were successful in spurring positive outcomes exactly because they designed their policy environment with their unique social fabric, business environment, and human capital in mind.

To that end, our research points to a few specific and generalizable recommendations:

8.2 Recommendations

Recommendations Related to Regional Policymaking

- Understand local competitive advantage. Knowledge around a community's specific skillsets and an understanding of the importance of geography is paramount to managing a transition (Peluso et al. 2020).
- Build ties between core institutions. Nearly every example of post-industrial success we investigated in this report benefitted from a robust structure of communication and trust between local actors (Gallagher and Glasmeier 2020).
- Leverage economic development corporations and public-private partnerships with caution. Economic development corporations and public-private partnerships feature heavily in the current study of positive progress during transitions. However, these institutions must be monitored, as the business tax incentives they often promote are highly susceptible to policy capture and misuse (Peluso et al. 2020).

- Formulate and implement evaluation procedures that incorporate explicit assessment of the distributive consequences of changes in economic conditions. Past large-scale federal programs that aimed to transition regions and cities from old to new steady states, have had unintended consequences and have in some cases exacerbated long standing inequities. Future institutional responses to economic dislocation or disruption must include specific funding for monitoring and evaluation, with the requirement that results are disseminated, and programs are adapted accordingly (Gallagher and Glasmeier 2020).
- Encourage citizen participation, including grassroots actors with local knowledge, in planning and implementation to foster long-term ownership of change. Evidence shows that putting beneficiaries at the center of programming improves inter-agency cooperation by fostering a "problem-centered" approach that breaks from past agency-by-agency programming priorities (Gallagher and Glasmeier 2020).

Recommendations Related to Federal Policy

- Public policy should promote programs and incentives to build capabilities required for transitional opportunities, while minimizing the personal dislocation of existing and legacy industrial workforces. A few examples of programs that could support this goal include an Energy Efficiency Retraining and Deployment program, the creation of an Energy Transition Adjustment Assistance program modeled after the Trade Adjustment Assistance program, expanding support for construction unions and their apprenticeship programs, and expanding the nation's innovation infrastructure.
- It is clear that the transition to deep decarbonization will require a form of an economy-wide price on carbon, and that a price on carbon will have distributive effects across regional economies. Green and Knittel (2020) explore those effects in great detail. They find that, under standard assumptions, the most socially equitable approach to pricing carbon is through a tax and dividend approach. Green and Knittel (2020) states that, unlike a sectoral approach that regulates carbon in the automotive, manufacturing or electricity industries separately, a carbon tax enables efficient competition among substitute technologies, and provides revenue that can then be distributed to regions and people most affected by the transition. Some of those revenues might subsequently be used to build local institutional competencies, protect energy-intensive-trade-exposed manufacturing, support local workforce development and training programs, provide capital to jump-start entrepreneurial activity, and finance new climate related infrastructure.

Recommendations Related to Infrastructure

- Structure governmental infrastructure support programs specifically to provide tangible long-term benefits toward decarbonization. Consider other political needs, such as providing equitable assistance and easily accessible jobs (Hsu and Ulama 2020).
- Utilize energy infrastructure and energy efficiency investments and finance structures as a key economic development tool for regional transition planning and the development of domestic supply chains (Foster et al. 2020).

Recommendations Related to Building Innovative Communities

- Interventions must address critical gaps in a transition region, and there are often multiple gaps. As a result, multi-competency interventions are likely to be more successful compared to those focused on a single competency. Single-competency interventions, by contrast, have more limited impact because unaddressed gaps can eventually prevent success, while leaving the intervention vulnerable to cancellation (Karplus et al. 2020).
- Interventions that foster development of multiple, distributed competencies simultaneously but in a coordinated manner could lead to more durable and successful outcomes. Approaches must therefore be highly tailored, based on a thorough understanding of a region's pre-existing competencies and gaps (Karplus et al. 2020).

9. Conclusion

The process toward deep decarbonization has already begun in most parts of the United States and across many industries, with resulting dislocations visible in some regions. At a national level the U.S. has made considerable progress in the electricity sector, via a resource shift away from coal and toward new renewables and natural gas paired with continued energy efficiency implementation, and emissions have declined throughout the 2000s (Marcy 2017). However, more reductions are required, and as focus shifts to include broad cross-sector change, the U.S. must prepare for a considerable industrial shift.

Momentum will continue to build as the economics of carbon-free energy-sources improve. The question for policy makers today is how to engage this transition directly. Unfortunately, the regional benefits and attendant dislocations stemming from the transition to deep decarbonization will vary, due to multiple factors: institutional capabilities, economic history and capacity, and exposure to climate risks, among others. Focused preparation for transition at the regional level not only increases the possibility of local benefits, but it also broadens support for increasingly ambitious climate policy at the national level. In this paper, we have summarized four areas where policy makers should focus their efforts in the coming years: building social fabric, expanding the capacity of the labor force and business landscape, and seeding a comprehensive policy framework that leverages and builds on those capabilities.

The economic effects of the transition to deep decarbonization will be distributed unevenly across economic sectors and, importantly, regions, as some business activities and technologies phase out and new ones emerge. But, the extent of the dislocations resulting from the transition will depend on how the transition takes place in particular regions. For that reason, the next phase of the Roosevelt Project investigates this transition through the lens of four specific case studies.

- **APPALACHIAN PENNSYLVANIA** faces the ongoing disruption from the decline of coal, with disruption from the potential decline of natural gas. It will also face a moderate risk of heat stress and high risk of extreme rainfall in the years to come, driven by climate change.

  Across Appalachia, coal production has declined by over 45% since 2005, driven by a lack of economic competitiveness and emissions regulation, expected to drop further in the coming years. The region has lost over 33,500 coal jobs since 2011—82% of total U.S. coal job losses. The bulk of those losses are concentrated in just 16 Appalachian counties, including Greene County. Pennsylvania as a whole is home to 9% of the nation's coal jobs. The economic impacts of ongoing decline of coal in Appalachian Pennsylvania have been buffered in part by a boom in natural gas. Pennsylvania has gone from having negligible gas production, as recently as 2008, to producing 19% of the nation's natural gas, today. This boom shows little sign of slowing: Greene County experienced a 33% year-over-year growth in natural gas production in 2019. Without intervention, Appalachian Pennsylvania faces continued, accelerating job losses due to the decline of coal, and the impending decline and uncertain role of natural gas in the future.

- **THE INDUSTRIAL HEARTLAND** case study focuses on Michigan, Ohio, and Indiana and the contained Midwestern motor vehicles manufacturing region. Ohio and Indiana are highly susceptible to future climate damages, particularly with respect to high heat, extreme rainfall, and water stress. Michigan's environmental future is relatively less fraught, but the state could eventually shoulder the burdens of its southern neighbors as they face increasing climate damages. The region's economic future is integrally tied to its motor vehicles manufacturing industry—any future planning should confront rapid changes in that sector accompanied by the electrification of transportation. All three states are densely populated, stand to retire substantial fossil infrastructure, and must consider a transition away from traditional energy sources across all sectors (electricity, transportation & buildings).
- **THE GULF** case study includes counties surrounding the Texas and Louisiana border, a region that contributes substantially to American oil and gas production in the US and its related petrochemical and chemicals' industries. Texas alone is home to 37% of total US crude oil production, 24% total natural gas production, in addition to the most installed wind energy. This region will experience adverse effects due to climate change and potentially experience an economic downturn if decarbonization plans are not designed with economic resilience in mind. Climate change will pose high water stress that will affect agriculture and impact oil and gas production. Rising global temperatures will also increase hurricane and tornado risks. Economic and climate impacts will vary depending on region, but its distributed, unique strengths are accessible to solve such challenges.
- **THE NEW MEXICO** case study focuses on the fossil fuel industry and economic welfare challenges that underrepresented minorities face. As a minority-majority state, 48.5% of the state population identify as Hispanic or Latino and 8.6% as Native American. The state has roughly 21% of individuals living below the poverty line, which is 5.8% more than the national average and is unevenly distributed across regions as illustrated by Los Alamos and McKinley (5.1% and 38.1% below the poverty line, respectively). In the coming years, New Mexico will primarily experience water stress that could potentially impact mining activities as well as the general population. However, New Mexico is home to leading energy research institutions that could further develop technologies that will aid in the future decarbonization efforts, and the state has recently adopted a new set of forward leaning climate and social goals that may be in tension with its legacy fossil fuel industry. New Mexico also has considerable solar generation resources but faces transmission isolation from major population centers.

Our goal in selecting these regions has been to capture regional variance across a number of factors including local economic realities, the timing of the transition, potential technological pathways, and institutional differences. Working with local partners through these case studies, the Roosevelt Project will produce transition action plans for consideration in these regions. Our goal is that these can be broadly generalizable to many regions under similar circumstances.

It is clear from our work thus far that policy makers must take a comprehensive approach to stakeholders and capacity building in local communities. Static, uni-levered interventions often fail to provide the desired outcome. Instead, public policy must address all the domains of transition activity from social fabric to human capital and the business environment. Together, a regional and comprehensive approach to transition planning represents the critical elements of a broad policy framework, and it is within specific regional contexts that the transition issues associated with deep decarbonization must be assessed. It is critical to create the political context in which people can reach consensus on these adaptations and feel certain that the path forward resolves any resultant dislocations in a way that improves individual and community outcomes.

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