Catalyzing Regional Energy Transitions: Improving Conditions for Inflation Reduction Act Implementation in Central Appalachia and Texas

HARVARD Kennedy School
MOSSAVAR-RAHMANI CENTER
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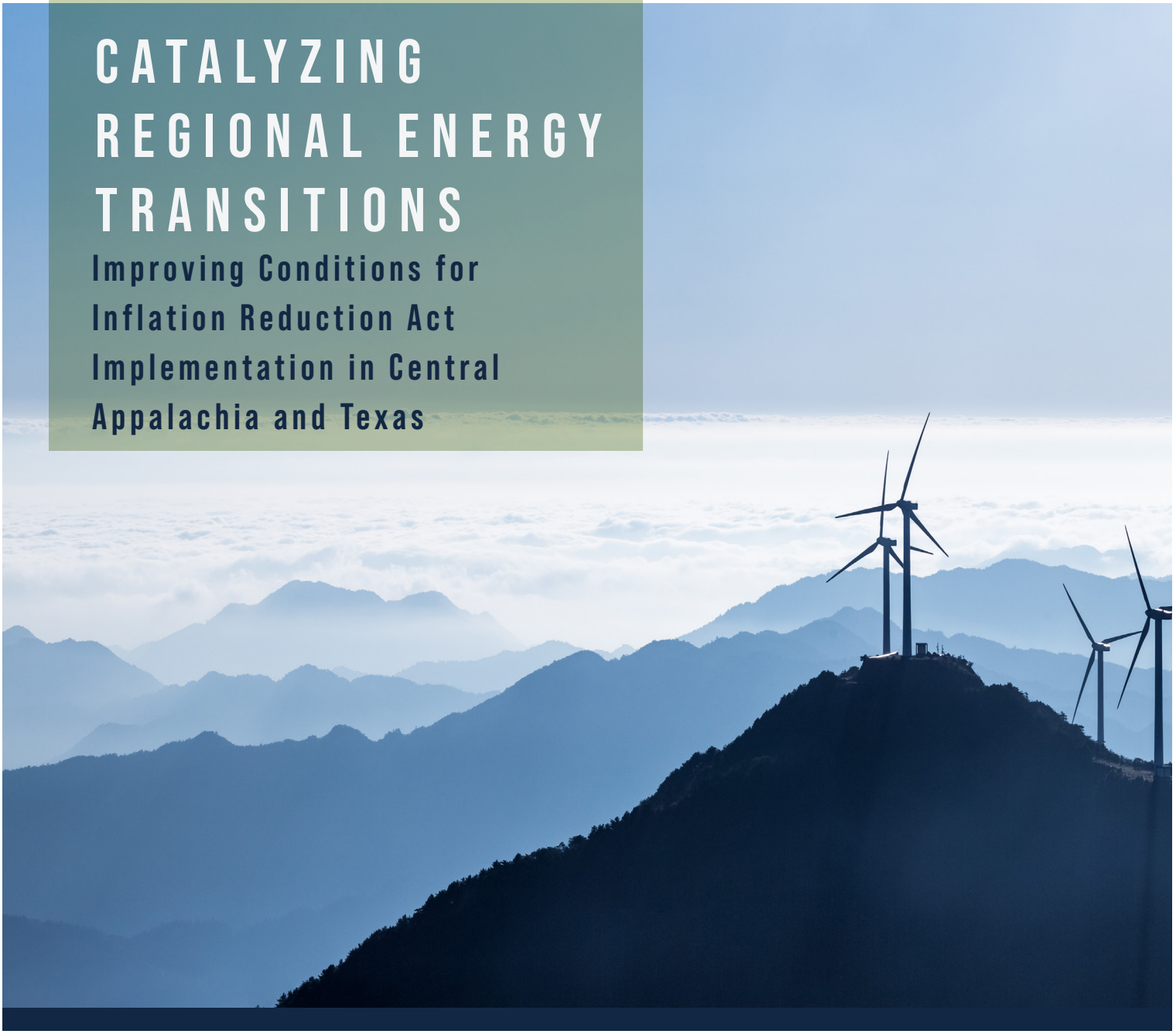
HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT

CATALYZING REGIONAL ENERGY TRANSITIONS

Improving Conditions for Inflation Reduction Act Implementation in Central Appalachia and Texas



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EXECUTIVE SUMMARY

Last year's passage of the Inflation Reduction Act (H.R.5376) was a historic commitment by the United States toward achieving its climate goal of reducing greenhouse gas emissions by 50 to 52 percent below 2005 levels by 2030. The bill unlocks an unprecedented $369 billion toward accelerating the clean energy transition. Not only will this funding enable massive deployment of renewables and help jump start new clean technology industries, it also presents a significant opportunity to support economic growth and development.

As the future of the clean energy economy begins to take shape, including every region in the U.S. is paramount to achieving the nation's climate goals while ensuring a just and equitable transition. Breakthrough Energy is one of the leading investors and policy advocates in the clean technology space. Their U.S. Policy and Advocacy team served as the client for this Policy Analysis Exercise, which investigates policy options that organizations like Breakthrough Energy can pursue to catalyze the clean energy transition.

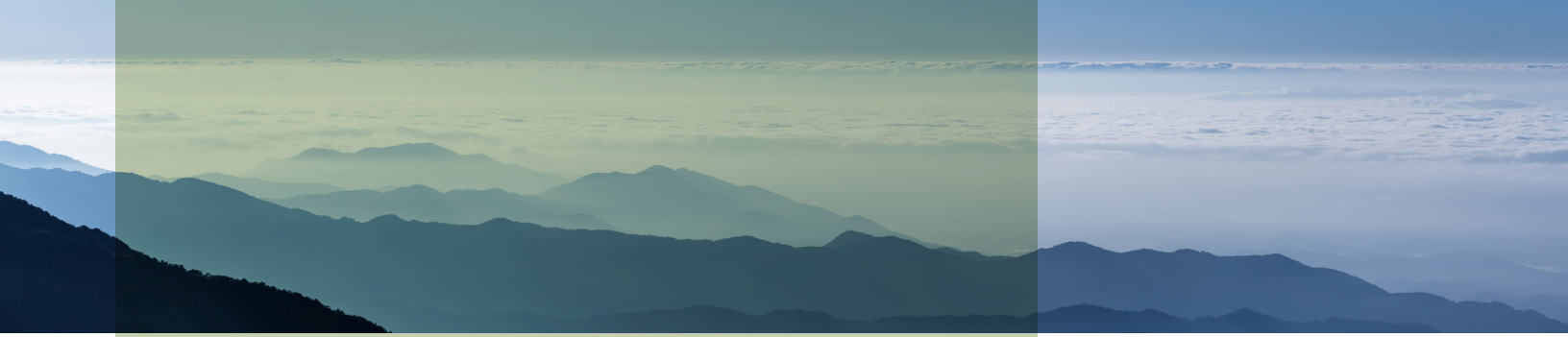
This report focuses on two regions of particular interest: Appalachia and Texas. Both regions have played an important role in the history of U.S. energy production, and are well positioned to become leaders in decarbonizing the U.S. economy. Appalachian organizations, state and local governments, and communities can build upon early momentum in attracting cleantech manufacturing companies to scale a booming regional industry. Meanwhile, Texas is positioned to become a U.S. and global leader in producing and defining the future clean hydrogen economy. To realize this potential, however, each region will have to overcome barriers.

This report presents the evidence and recommendations for creating a fertile economic and political landscape to grow clean energy industries in Appalachia and Texas. These findings were developed through an extensive exercise of literature review, stakeholder mapping, and interviews. We use inductive reason to draw patterns and findings across critical stakeholders, including state and local government officials, advocacy and non-profit organizations, leading renewables developers and technology companies, and policy experts.

Through this work, we uncover five key tensions that present implementation challenges, as they reveal dichotomous, competing perspectives and priorities surrounding the transition. We also develop a set of enabling criteria to unlock paths forward through these barriers in Appalachia and Texas. Finally, we develop and present five core recommendations that can be undertaken by our client and policy advocacy organizations of all kinds. These recommendations serve as tools in a toolbox to support a holistic energy transition, rather than as a single, prescriptive solution.

Our recommendations include:

1. Invest in capacity building
2. Government and private sector summits
3. Public information campaigns for hydrogen *(Regional focus: Texas)*
4. Bridge the capital funding gap *(Regional focus: Appalachia)*
5. Support local entrepreneurship accelerators *(Regional focus: Appalachia)*



1. INTRODUCTION

1.1 Context

On August 16, 2022, President Joseph R. Biden signed into law the largest climate spending package in United States history through the passage of the Inflation Reduction Act of 2022 (IRA), unlocking roughly $369 billion in clean energy incentives for the next decade. The U.S. Department of Energy's (DOE) preliminary assessment estimates that the IRA will help drive 2030 economy-wide greenhouse gas (GHG) emissions down to 40 percent below 2005 levels.[1] This marks significant progress towards the achievement of President Biden's stated climate goal to reduce U.S. GHG emissions by 50 to 52 percent below 2005 levels by 2030.[2] The IRA climate provisions—made up largely of subsidies—provide a means for the U.S. to accelerate its clean energy transition while supporting domestic industry, energy communities, and economic growth.

A complex web of private, public, and nonprofit actors at the federal, state, and local levels will be engaged in implementing the IRA's climate-related provisions. The clean energy transition will have ripple effects on state and local economies, employment, environmental conservation, and beyond.

On behalf of our client, this report explores strategies to maximize uptake and overcome implementation challenges of energy-related provisions in the IRA within Appalachia and Texas.

ABOUT THE CLIENT: BREAKTHROUGH ENERGY

Breakthrough Energy was founded in 2015 to help develop and scale critical climate solutions to reduce global GHG emissions to net-zero by 2050. The organization pursues this goal in a comprehensive manner through a network of partnerships and programs, including the Breakthrough Energy Ventures, Catalyst, Fellows, and Policy & Advocacy verticals.

This report is written on behalf of Breakthrough Energy's U.S. Policy & Advocacy (USPA) team. USPA "develops, advocates, and lobbies for smart policies that public- and private-sector leaders can implement to get to zero by 2050."[3] After advocating for energy-related policies within the IRA, USPA now seeks to ensure the benefits of this new law can be best recognized through effective implementation.

1.2 Problem Definition

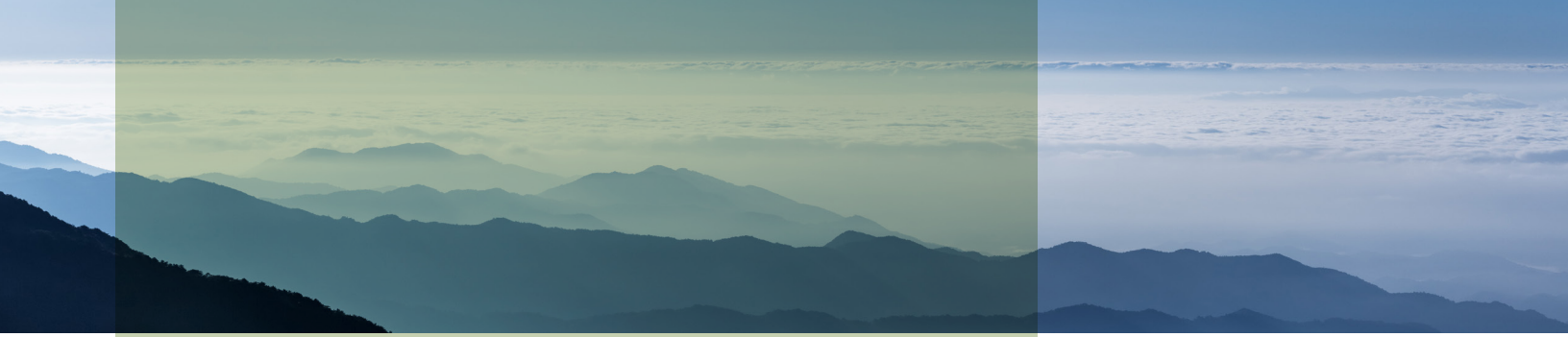
This report investigates ways to accelerate the implementation of IRA-related clean energy projects in two regions of interest: **Appalachia** and **Texas**. For both regions, the clean energy transition presents significant opportunities for growth and economic prosperity. At the same time, many obstacles will need to be overcome for these regions to take full advantage of the billions of dollars this bill unlocks.

Appalachia has a long history as an energy producing region but has been adversely impacted by past energy transitions. As a largely extractives-based economy affected by boom-and-bust cycles, Appalachia has struggled with economic and social challenges for generations—particularly as the coal industry has declined over the last five decades. The national goal to mitigate and adapt to climate change presents a new opportunity for economic revitalization of the region as a clean energy manufacturing hub for the country. To harness this potential, Appalachia will need to overcome challenges to attract clean energy industry players and access capital.

Texas plays an important role as an energy supplier for the U.S. and the world. The state has some of the largest oil and gas production in the country, while also leading on renewable energy generation. The burgeoning green hydrogen sector has already begun to take root in Texas and is set for massive growth in the coming years catalyzed by the high-value IRA subsidies for investment and production. Texas will need to find ways to respond to the demands of the growing industry and support its residents in understanding the role green hydrogen can play in the clean energy economy at home and beyond.

Given these needs and opportunities, this report seeks to answer three guiding research questions:

1. What are the **greatest opportunities** related to the energy transition in Appalachia and hydrogen development in Texas provided by newly enacted provisions in the IRA?
2. What are the **primary obstacles** to implementation in these regions, and why do these obstacles exist?
3. How can policy advocates most **effectively intervene** to overcome these obstacles?



2. METHODOLOGY

To conduct this analysis, we began by creating a research tree to identify the overarching areas of focus for the investigation (see below). The tree assists in identifying key stakeholders involved in the implementation process, as well as areas for desktop research and literature review. Our research approach stems from four key categories: federal government, regional political engagement, the private sector, and media.

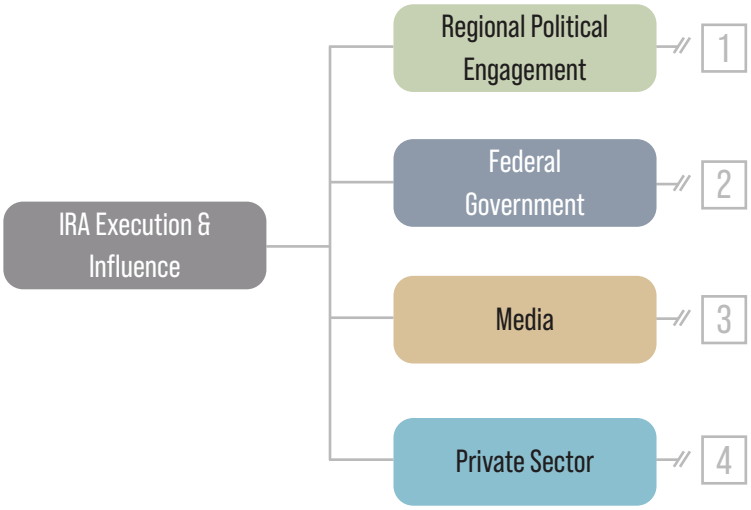
Based on the four areas of research above, we broke down each category into multiple levels to identify the components most important to this work. In this process we also considered how each of the branches and nodes aligned to the intervention tools available (see Section 6) and the potential for collaboration and influence.

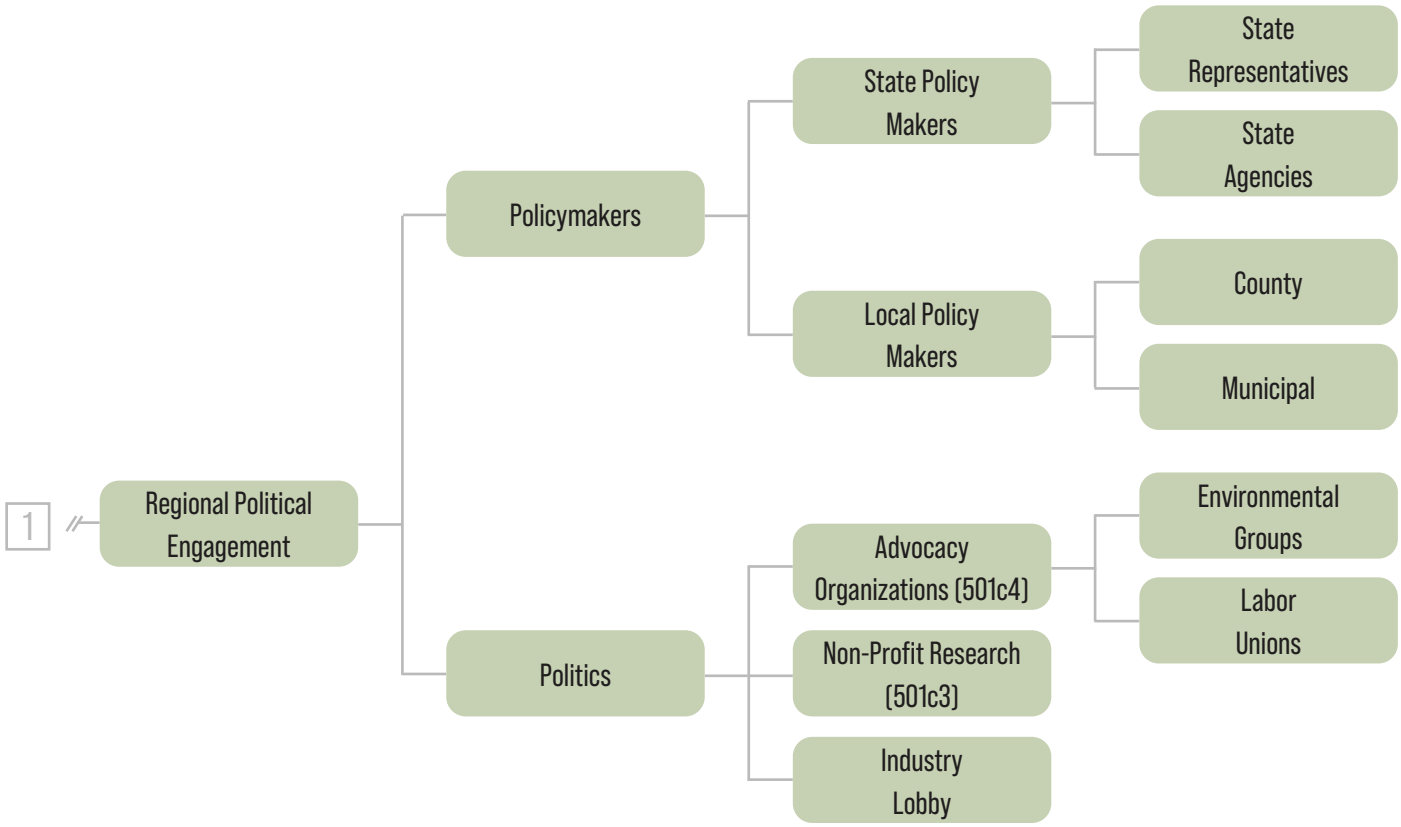
Using this research tree as a project map, we then engaged in two primary forms of research. First, we conducted a sweeping desktop research exercise. This included reviewing dozens of academic studies, think tank and other organizational publications, media and news, and legislative texts. This process enabled us to build up a foundation of knowledge about both the IRA climate provisions as well as broader implementation challenges, regional contexts, and past lessons learned from similar bills.

Second, we simultaneously worked to identify the names and positions of key stakeholders within each branch of the research tree. We conducted 30-minute to 1-hour interviews in-person and via Zoom with 33 stakeholders from across these identified spheres of influence. Each interview included specialized questions based the actor's resources, motivations, and position with respect to IRA implementation processes. We concluded each interview by asking the interviewee if they had recommendations of other stakeholders and actors who would help inform our research—colloquially referred to as the "snowball" method of qualitative interviewing. This process allowed us to organically broaden our stakeholder map without prescriptive assumptions.

We employed inductive reasoning to draw broad findings from observations and make meaning of patterns between critical details—such as the Internal Revenue Service rulemaking processes or project siting approaches by battery manufacturers. This method enabled us to understand how an entangled web of stakeholders with diverse perspectives, incentives, and resources can be strategically engaged.

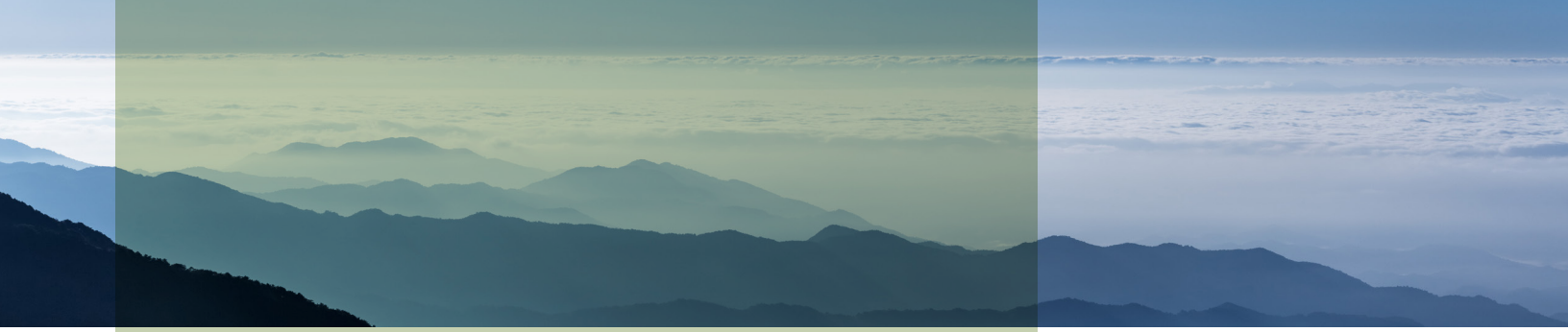
As the research evolved, we developed a list of key criteria (see Section 5.2) for which our recommendations aim to fulfill. The criteria were developed based on recurring themes in both our interviews and desktop research as we began to identify persistent gaps and obstacles to IRA implementation. These served as the foundation for our recommendations, which were formalized through additional case studies, literature review, and subsequent interviews. Through this process we were able to produce the key recommendations and supporting evidence outlined in Section 7.


IRA Execution & Influence
Regional Political Engagement
1
Federal Government
2
Media
3
Private Sector
4


1
Regional Political Engagement
Policymakers
State Policy Makers
State Representatives
State Agencies
Local Policy Makers
County
Municipal
Politics
Advocacy Organizations (501c4)
Environmental Groups
Labor Unions
Non-Profit Research (501c3)
Industry Lobby


2
Federal Government
Executive
Environmental Protection Agency
Dept. of Energy
Grant Funding
Technology
Community Engagement
Dept. of the Treasury
Internal Revenue Service
Community Engagement
Legislative
House Ways and Means
Senate Finance
Energy and Commerce
3
Media
Channels
Owned Media
Social
Newsroom
Website
Owned Publications
Earned Media
National Publications
Regional/Local Publications
Paid Media
Advertising
Education Campaigns
Personalities
Local Influencers/ Trusted Individuals
Organizations


4
Private Sector
Utilities
Transmission and Distribution
Interconnection
Energy Planning
Demand Forecasts
Renewable Energy Portfolio Stnds.
Technology Providers & OEMs
Technical Needs
Energy Grid Interconnection
Resources and Supply Chain
Workforce Needs
Installation
O&M
Financial Needs
Capital Investment
Market Development
Technology Types
Solar
Onshore Wind
Electric Vehicles
Investment Needs
Investment Needs
De-Risking Tools



3. OVERVIEW OF THE IRA

3.1 Introduction and Bill Purpose

The Inflation Reduction Act (H.R.5376)[4] is the single largest climate spending package enacted by any country, ever. To develop a strategy for implementing IRA-subsidized projects at the regional and local levels, it is important to understand both the context around the bill's passage as well as the specific mechanics of the provisions and rules governing the IRA's incentive packages.

The bill appropriates funds and establishes tax provisions for roughly $369 billion in government funding over the next 10 years. The subsidy-based model means that the actual amount spent could vary significantly over the decade. Prior to passage of the IRA, the federal government passed two other pieces of interrelated legislation: the Infrastructure Investment and Jobs Act (H.R.3684, "IIJA" also known as the Bipartisan Infrastructure Law)[5] and the Chips and Science Act (H.R. 4246).[6] In its analysis of the interplay between the three bills, RMI describes how each bill targets a different piece of the value chain: [7]

- **Chips and Science Act as the "brains"** based on the $54 billion in authorizations it promises for research and development to accelerate innovation in the clean technology ("cleantech") space. This includes basic energy research; funding programs such as ARPA-E to support commercialization of new technologies; and establishment of a new Directorate for Technology, Innovation and Partnerships at the National Science Foundation.
- **The IIJA as the "backbone"** in providing the $98 billion toward underlying infrastructure necessary for the clean energy transition, such as connectivity, transmission infrastructure, and supply chain scaling (within a much larger infrastructure spending bill). It also includes investing in applied innovation and grant funding for clean energy demonstration projects.
- **The IRA as the "engine"**, investing $360+ billion in demand-pull measures (i.e. subsidies) to accelerate secure investment in scaling cleantech to across the country.

Taken together, these three major pieces of legislation represent a new chapter in America's commitment to address climate change. Importantly, the IRA and two other bills are intended to be a catalyst for the private sector: leveraging the federal incentives to unlock potentially $1 trillion or more in associated private and public investment.[8] By offering investment and production tax credits, the federal government is helping reduce project cost, bridge the capital gap, and ensure financial feasibility.

One challenge with this model, however, is that the onus is on the private sector to invest in projects in order for the IRA money to flow. These subsidies fit into existing capital stacks rather than fund projects on their own. To what scale and how quickly companies respond to the IRA incentives will have a major impact on the ability to maximize their value and achieve climate goals.

Upon the law's enactment, various federal agencies have been developing the rules for implementation. Chief among these is the U.S. Department of the Treasury ("Treasury"), which wields significant authority through the tax code given that most of the IRA uses tax expenditures as its approach to subsidies, and the rest takes the form of grants as the subsidy instrument. (This arrangement is in part a function of the bill's passage through the budget reconciliation process.) Treasury and the Internal Revenue Service (IRS) are currently in the process of defining the specific tax rules related to each of the sections, which range from new responsibilities and oversight assigned to the IRS, to the highly anticipated interpretation of "energy communities" (see below). While Treasury has been holding public engagement processes that seek to "engage a broad spectrum of taxpayers and stakeholders to inform guidance and rulemaking,"[9] some major regional stakeholders have expressed frustration with the lack of access into the process.[10]

Based on multiple conversations with Treasury, this process remains ongoing and is being held as highly confidential until the official rules are published (anticipated for later this year). Fortunately, foreseeing the time needed to write these new rules, the authors of the IRA included an extension of many of the preexisting tax credits through 2024, which allows the industry to continue accessing these resources prior to release of the new rules.

EXEMPLIFYING THE ROLE OF TREASURY AND THE IRS

To illustrate the role that Treasury is playing and the importance of the rulemaking process to the IRA, one salient example being debated in the public sphere is the classification of green hydrogen for the 45V tax credit.[11] While the IRA is clear on its incentive structure—assigning subsidy thresholds by carbon intensity of the hydrogen produced (see Appendix A)—the bill makes no mention of how that carbon intensity and life cycle emissions are to be calculated.

Two broad camps within the green hydrogen industry have voiced significant disagreement on the issue. Both want to be able to apply renewable energy certificates (RECs) toward offsetting the emissions of hydrogen produced using grid electricity, but they lack consensus around how these RECs should be accounted for:

- The first group argues that hydrogen developers should be allowed to purchase RECs with no geographic restrictions and be required to match net clean energy production on a monthly or annual basis. BP, Shell, and NextEra Energy are three of the biggest proponents of this approach, with NextEra CEO Rebecca Kujawa claiming, "If you end up having an uneconomic green hydrogen product relative to alternatives, there will be no market adoption… It's truly an industry that is either waiting to get off the ground or will be dead on arrival, depending on what the Treasury ultimately determines."[12]
- The second group seeks a stricter accounting mechanism, wherein hydrogen producers should have to procure RECs located in the same region as the project and prove renewable energy matching on an hour-by-hour basis. Two of the primary firms arguing for this more stringent approach are Vestas and Intersect Power. Without this mechanism, they argue, producers cannot make valid claims to be providing low carbon intensity hydrogen, particularly in areas with directory grids.

Ultimately, the debate will be settled by the tax rules being drafted by Treasury and the IRS. Their decision will result in the difference of billions of dollars in subsidies.

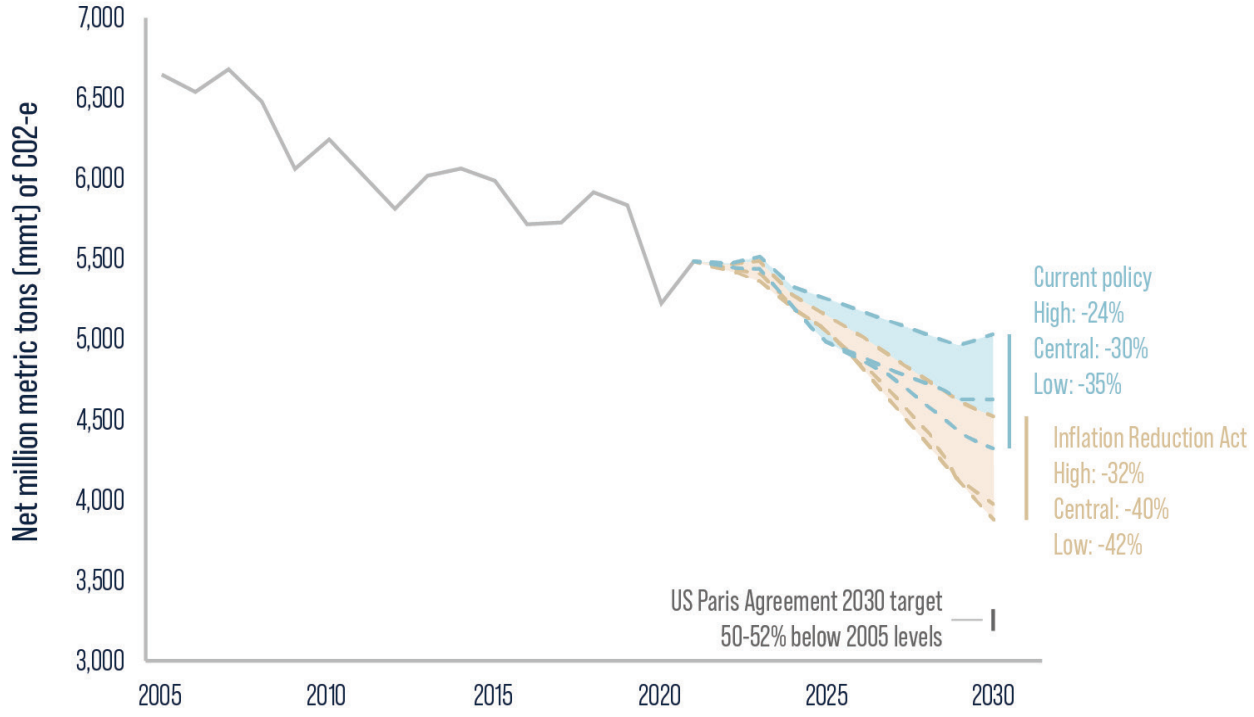


Figure 1: Projected U.S. greenhouse gas emissions to 2030 with and without the IRA[13]

3.2 Climate Change Outcomes

From a macro perspective, the IRA puts the U.S. well on its way toward meeting the nation's climate goals. One of the most quoted impact analyses was conducted by Rhodium Group,[14] which finds that the IRA will reduce U.S. GHG emissions to 32-42% below 2005 levels by 2030—a major improvement from the pre-IRA expectation of 24-35% reduction by 2030 (see Figure 1 above).

In addition to the GHG emission reductions, the IRA is projected to have major positive impacts on domestic economic, environmental, human health, and energy transition indicators. Analysis by Third Way finds that the IRA will create close to 500,000 new clean energy-related jobs by 2050, with **job growth in every state** by 2030 with the greatest near-term growth in the Midwest.[15] A separate analysis by Bluegreen Alliance finds that when including indirect jobs that support the clean energy supply chains, that number could increase to as high as 9 million jobs over the next decade.[16] In examining the health effects of the IRA, Resources for the Future found that the bill will save $12-$22 billion in monetized health benefits from reduced air pollution, saving thousands of lives per year.[17]

Beyond these factors, the IRA paves the way for a major acceleration of the cleantech sector in the coming years. This presents new investment opportunities, better and more equitable access to clean energy-related technologies, and economic development opportunities for communities across the country.

3.3 Changing the Clean Energy Investment Landscape

Prior to the IRA, the U.S. clean energy sector was primarily supported by a series of short-term tax credits aimed at specific technologies. Recognizing this as a problem, lawmakers authored the IRA to **extend these tax credits for 10 years**—through at least 2032—providing a much higher degree of long-term certainty to investors and developers.

Starting in 2024, the extended technology-based tax credits (Section 45 and Section 48) will be replaced with new **technology-neutral** credits (45Y and 48E).[18] With these technology-neutral credits, projects qualify based on whether they generate electricity with zero or negative GHG emissions, regardless of the specific technology employed. The change presents a new opportunity for commercializing a broad range of emerging technologies, greatly diversifying the tools available for decarbonizing the U.S. economy.

Another major change with the IRA is the introduction of **direct pay and transferability**. Prior to the IRA, project owners and developers that lacked the tax liability were often unable to monetize the value of the tax credits, leaving unclaimed value on the table and reducing commercial viability and financial payoff.[19] One workaround to this challenge was to incorporate tax equity, which adds an additional layer of complexity to project financing with more players involved. The new IRA credits allow for a **direct pay** option, through which tax exempt entities (such as municipal, state, or Tribal governments) can receive applicable tax credits as direct payments from the IRS.[20] The new tax credits also allow for **transferability**: the option to monetize credits by transferring them to an entity with a greater tax liability. These two new refundable monetization mechanisms will unlock access to much-needed federal incentives for all kinds of new entities, including non-profit organizations, small- and medium-sized cities, and tribal governments.

3.4 Energy Communities and Low-Income Designations

In addition to domestic manufacturing, the IRA also includes several credit bonuses for projects located in "energy communities," low-income communities, Tribal lands, and—for applicable projects—on low-income residential buildings or as part of a low-income economic benefit project. This is a key strategy employed by the legislation to spur investment in these targeted communities; leveraging the massive investment unlocked by the IRA to support local economic growth and development.

The definition of an "energy community" has been a significant source of uncertainty since the passage of the IRA, given the major additional value of unlocking the tax credit bonus. The primary goal of the provision is to support those communities

INVESTMENT TAX CREDIT VS. PRODUCTION TAX CREDIT

In keeping with the clean energy subsidy models employed prior to the IRA, many provisions within the bill include two distinct types of tax credits that developers can choose between. By providing the option, project owners and developers have the choice of whether to reduce their capital expenditures at the outset of a project or to receive revenue for production after the project is in place.

Investment Tax Credit (ITC)

ITCs provide a one-time federal income tax credit based on the dollar amount of the capital investment. This is intended to reduce the upfront cost of implementing a project. ITCs are typically earned when the project or equipment is placed into service (rather than at project initiation).

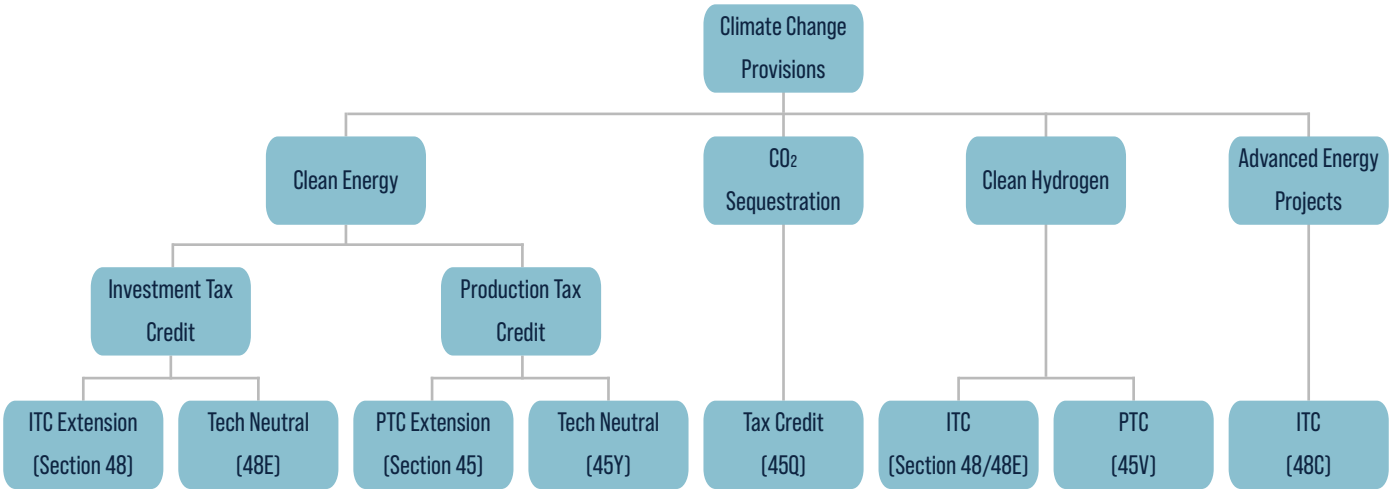
Production Tax Credit (PTC)

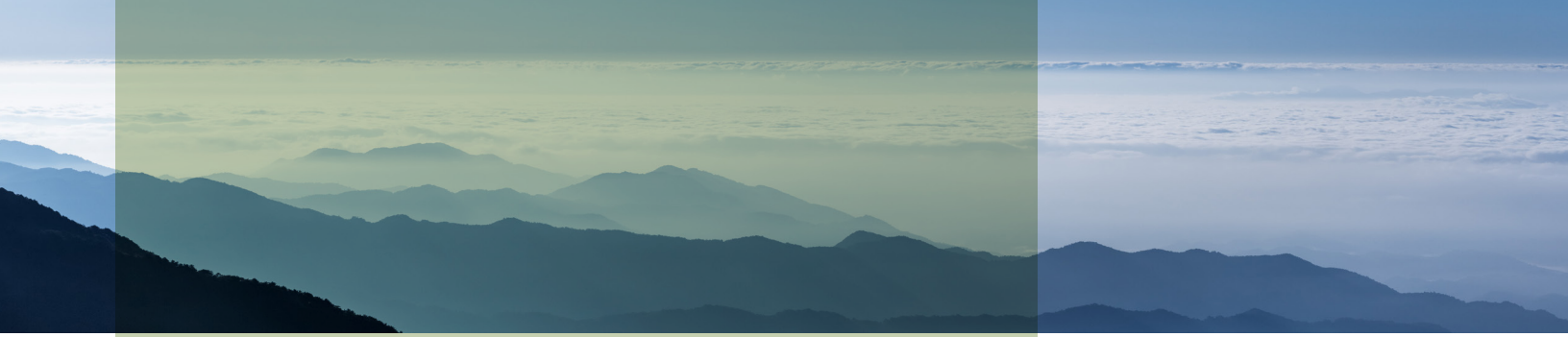
PTCs are set federal income tax credits to be claimed based on the volume of production, such as per kWh of electricity or kg of hydrogen. The PTC is typically available for 10 years from the date the facility begins production.

negatively impacted by the energy transition away from fossil fuels. According to a recent analysis by RFF, however, the term "energy community" as currently written covers roughly 42-50% of U.S. land area.[21] This is an unwieldy proportion that fails to specifically target fossil fuel communities and, as written, can vary spatially over time. Treasury is still in the process of formulating the precise definition of energy communities, which will have major implications on IRA subsidy availability across the country.

3.5 IRA Climate-Related Incentives

The IRA is a broad piece of legislation that includes a range of provisions that address climate change, healthcare spending, tax code overhauls, and deficit reduction, among other things. The IRA will play different roles in different regions over time. In keeping with the focus of this report, we highlight the provisions related specifically to clean energy, including clean energy generation, hydrogen, manufacturing, and CO_2 sequestration. Some of the most relevant provisions to this work are visualized below (for more details, see Appendix A):





4. REGIONAL CONTEXT & REVIEW

4.1 Appalachia

Appalachia is a diverse and storied region of the U.S. that incorporates part or all of 13 states, 423 counties, and 206,000 square miles spanning from New York to Mississippi.[22] The region includes roughly 26.1 million residents and three federally recognized/ five state recognized Native American Tribal Communities. While this research focuses primarily on northern and central Appalachia (including areas of Pennsylvania, West Virginia, Virginia, and Ohio), understanding the broader regional history and context is critical to developing successful clean energy transition and related economic development interventions. As a region with a long history in energy production, Appalachia is uniquely positioned to become a national hub in supporting the clean energy transition.

Regional History

Appalachia has a strong energy producing heritage that continues to be a key part of the region's identity. Throughout the 19th and 20th centuries, the Appalachian region was the primary producer of U.S. coal[23] and has played an increasingly important role in natural gas production in recent decades. As a primarily extractives-based economy, Appalachia is particularly exposed to boom-and-bust cycles which have outsized local impacts compared to the broader U.S. economy. Since the 1970s, these boom-and-bust cycles—combined with the more recent market-driven decline in coal—have led to a reinforcing feedback loop for negative socioeconomic indicators.

The U.S. coal industry, and Appalachia in particular, has been hit by two major demand shocks that are important to understanding the region's current political and economic context. The first shock occurred in the late twentieth century. Oil prices spiked in the 1970s, leading to a boom for cheaper coal. This was followed by a sharp drop in oil prices in the 1980s, which flipped demand and caused a bust in the U.S. coal sector.[24] The second shock came in the late-2000s and early-2010s as natural gas production in the U.S. experienced rapid growth due to a new generation of hydraulic fracturing and

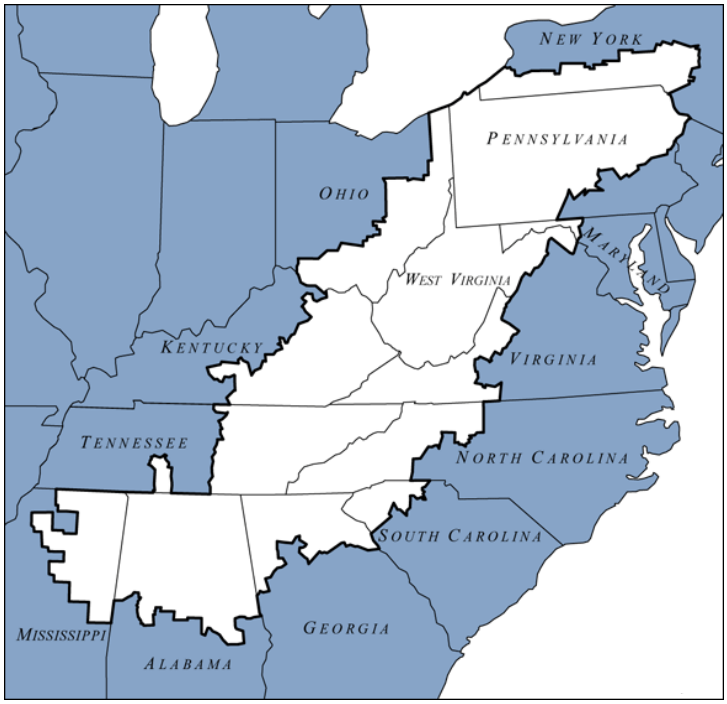


Figure 2: The Appalachia region[25]

"For over 150 years, the Appalachian region has provided the cheap energy that has powered the nation to become an industrial giant and build a middle class. At the same time, the enormous wealth pulled from the hills of Appalachia largely enriched other parts of the country while leaving environmental degradation and persistent poverty in its wake."

-Ohio River Valley Institute[35]

extraction technologies.[26] Since then, the U.S. coal industry has continued to decline, driven primarily by cheaper energy alternatives of natural gas and renewables.

As Gordon Hanson explains in a recent paper, "Because coal production is so spatially agglomerated, the shock that resulted from its decline was highly localized."[27] The coal mining industry today represents only a very small proportion of total U.S. workers (roughly 41,100 total employees as of the start of 2023, or just over one-fiftieth of one percent of the civilian labor force[28]), but local impacts are outsized due to the industry's geographic concentration and the role coal mining plays as an anchor of local economies and culture.

Over recent decades, the resulting outmigration and persistent economic loss has led to what Harvard researcher Eleanor Krause deems an "accumulation of disadvantage":[29] communities stuck in this cycle of aggregating disadvantage are less economically resilient and less able to adapt to contemporary shocks like the clean energy transition.

Political Environment

Over the same period since the 1970s, and especially since the 2010s coal shock, the region has seen a significant political shift from pro-union Democrats to pro-business Republicans. As a region highly dependent on the extractive fossil fuel industry, environmental regulations (and by extension climate change regulations) are particularly salient compared to other issues.[30] Industry and environmental

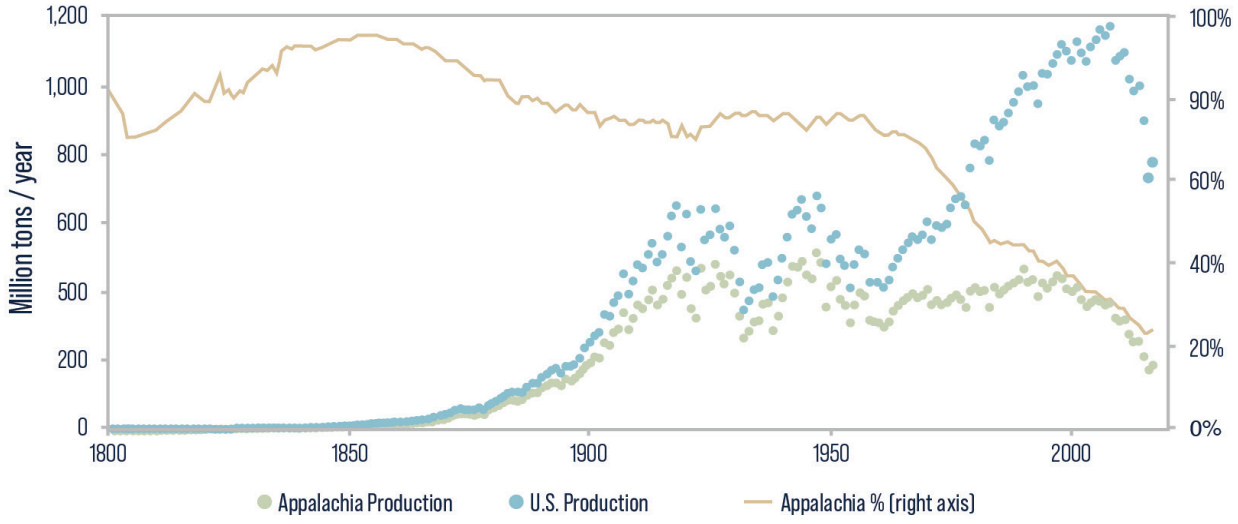


Figure 3: Appalachian coal production has been losing its share of total U.S. production for decades. Period 1800-2017 shown[31]

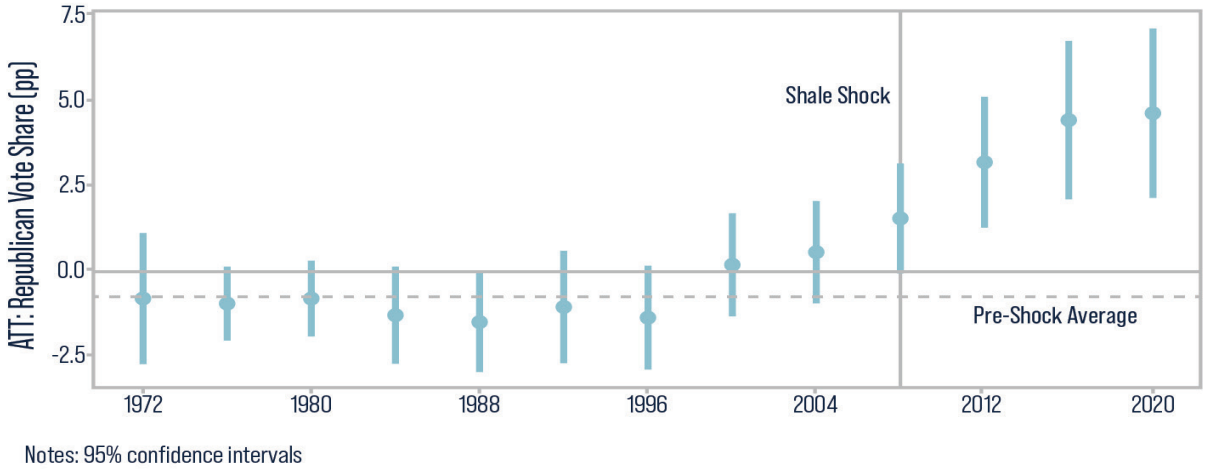


Figure 4: A shifting political landscape, illustrating a growing Republican presidential vote share following the late-2000s/early-2010s coal shock[32]

advocates have been pitted against each other, both in practice and perception. This manifests in a common perspective that there is an inherent trade-off between protecting the environment versus protecting jobs and industry.

Within the context of this partisan political shift, effective engagement should address the priorities of the workers, communities, and businesses in the region. At its core, messaging should be focused on job creation and economic growth, and de-emphasize issues of climate change and environmental protection. This sentiment was echoed across nearly all interviewees working in the region—including politicians, state and local officials, non-profit and advocacy representatives, and even clean energy manufacturers. Empirical studies have also confirmed that coupling climate policy with workforce assistance increases support.[33]

In addition, the credibility of the messenger plays a critical role in the willingness of communities to accept and act upon information. Based on interviews, this credibility comes first and foremost from being an Appalachian insider versus outsider, even above the politics of Democrat versus Republican.

Energy Transition Opportunities

Appalachia's rich energy history and opportunity for economic development uniquely positions it within the U.S. to become a leader in the clean energy transition. A recent study by the Rocky Mountain Institute (RMI), titled *Appalachia Poised to Become Clean Energy Country,*[34] found that the region could see the greatest economic benefits of anywhere in the country from wind and solar development over the period 2021-2030.* This includes direct payment benefits that accrue to local communities through local taxes, land lease payments, and employee wages (primarily for construction, operations, and maintenance).

To realize this opportunity, Appalachia requires both the enabling infrastructure and sufficient capital investment to meet the needs of the energy transition. First, to attract and service clean energy investments, the region needs to grow its physical

* Note that this finding is based on an aggressive decarbonization model that includes achieving a 90% carbon-free grid by 2035

and social infrastructure. This includes building and improving infrastructure such as roads and highways, airports, the electricity grid, and more, which will require investment from the public sector and public-private partnerships. Second, the region will need access to the capital required to implement climate- and energy-related projects. This will likely come from a combination of inbound private-sector investment and federal grants and incentives, including IRA subsidies. With sufficient resources, Appalachia is poised to play an important role in the next generation of the clean energy economy.

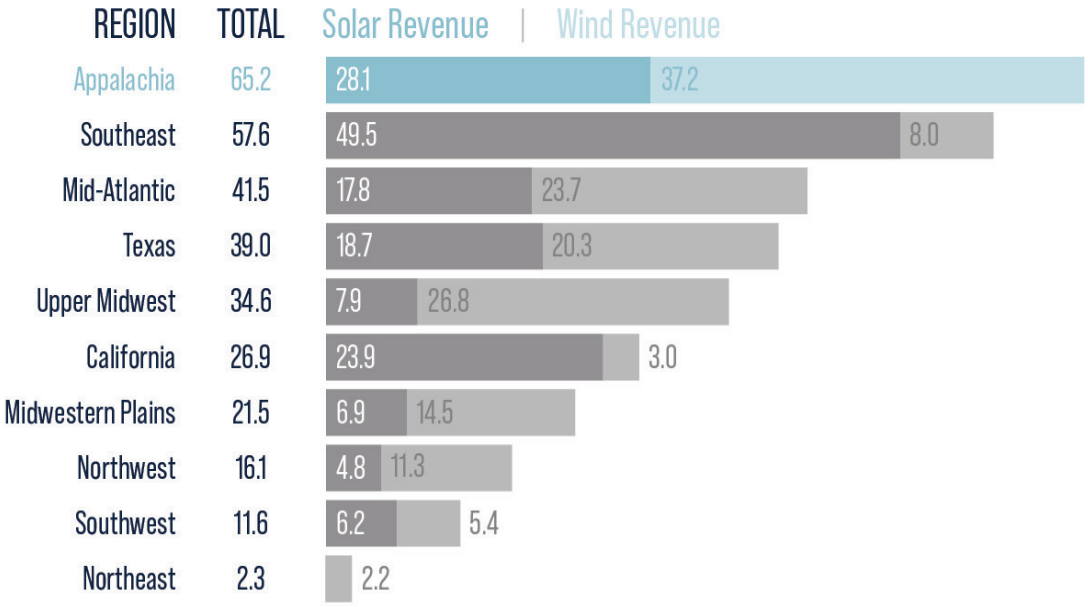


Figure 5: RMI modeled economic benefits of solar and wind investment by region, based on 90% carbon-free grid by 2035 (an aggressive decarbinzation model)[36]

4.2 Texas

Like Appalachia, Texas has a long history as an energy producing state. Texas is currently the top producer of crude oil and natural gas in the U.S., accounting for 43% and 25% of domestic production, respectively. The state also has 32% of the country's refining capacity split across 31 petroleum refiners. Beyond fossil fuels, however, Texas has also led the nation on wind power generation for 16 years in a row, with 26% of U.S. wind capacity as of 2021. Texas is also currently a leader in the nascent hydrogen economy.[37] The combination of an energy-friendly political and social setting along with a lower regulatory environment relative to other states provides a strong foundation for Texas to become a leader in the clean energy economy.

Political Environment

The Texas political environment surrounding clean energy is complicated. On one hand, the state is more friendly than most to energy infrastructure. Across a range of interviews with academic institutions, non-profit organizations, and a major clean energy developer, there was clear consensus that permitting and constructing new energy infrastructure such as transmission interconnections and pipelines was more streamlined in Texas than most other U.S. states.

At the same time, the current legislature and state agencies are taking actions to disadvantage renewables and boost fossil fuel-based electricity generation. Following the 2021 winter storm blackouts, Texas legislators leaned heavily on the state's renewables as the primary point of failure (a claim that erroneously omits the much larger failure of fossil fuel-based generation that also occurred due to the cold and various other issues).[38] They introduced legislation that would burden intermittent generators to pay for "ancillary services" to account for output variability.[39] While most of the 2021-2022 legislation died in committee or was left pending,[40,41,42] the anti-renewables tilt was clear. That theme has continued in 2023. In March 2023 state lawmakers released a series of senate bills that seek to increase deployment and financial incentives for dispatchable generators (e.g. natural gas-fired generators) while discouraging the development of renewables in the name of grid reliability.[43,44]

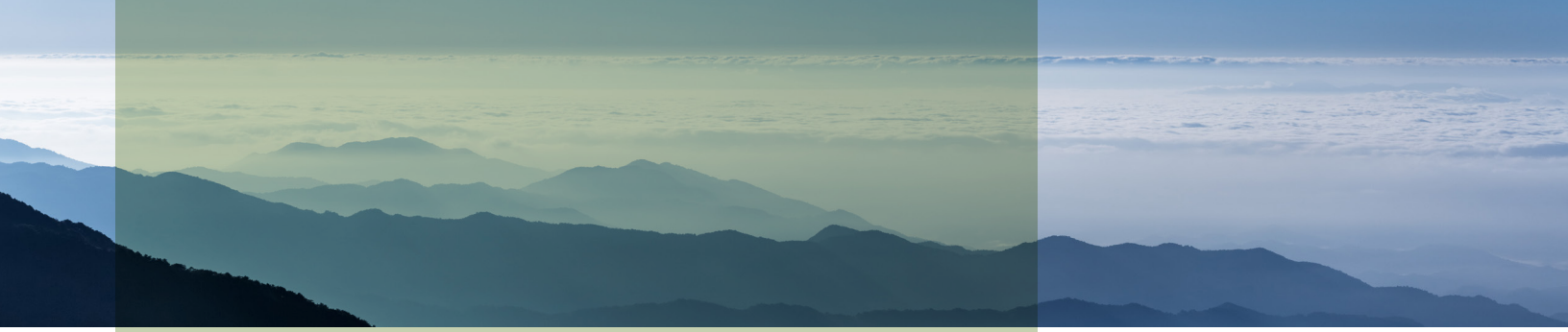
Energy Transition Opportunities

Texas and the broader Gulf Coast region have a well-established history in hydrogen production. More than a quarter of today's total U.S. hydrogen demand, roughly 3 megatons H_2 per year, is currently used for ammonia, methanol, and petrochemical refineries on the Gulf Coast.[45] The region also hosts roughly 50 percent of the country's existing hydrogen production capacity and almost the entirety of the nation's dedicated hydrogen pipeline infrastructure, approximately 1,600 miles long. Air Products, one of the major producers in the region, owns the world's largest hydrogen supply pipeline network (more than 600 miles of pipeline between the Houston Ship Channel and New Orleans) and more than 20 hydrogen plants.

In addition to existing hydrogen infrastructure, Texas has a strong set of natural and technological resources that can help support expanded production. Some experts suggest that salt caverns, which are partly used to house much of the U.S. Strategic Petroleum Reserve, could be a key asset for effectively storing hydrogen.[46] The state also boasts more than 26% of the country's wind generating capacity, 10% of installed solar PV, and 10% of installed grid battery capacity; all of which can support clean hydrogen from renewable or grid-powered electrolysis. This renewable energy progress in Texas largely emanates from competitive market structures, federal tax expenditures, and low-barriers for building transmission from windy regions to load centers, rather than from dedicated renewable energy policies. These same market structures will likely benefit clean hydrogen going forward.

Texas also offers a strong off-taker environment for hydrogen. Many oil and gas companies that currently consume hydrogen are looking for ways to reduce their carbon footprints, which stimulates growth in demand for clean hydrogen. This creates a strong regional market in which suppliers can quickly scale, rather than the need to create a new market of off-takers from scratch.

Looking forward to supplying hydrogen beyond the Gulf Coast region to global markets, the state's port infrastructure is well equipped. The Port of Houston is the largest port by tonnage in the U.S., and six of the 10 largest ports in the U.S. sit on the Gulf. Most are already, or could easily be, connected to the existing hydrogen pipeline networks and are equipped with the infrastructure to store, liquefy, and load gases onto vessels (noting that hydrogen will require additional infrastructure adjustments and investments). In sum, the region is primed to take advantage of the growing interest in clean hydrogen.



5. FINDINGS & ANALYSIS

5.1 Tensions

By exploring the perspectives of stakeholders and a wide range of studies, we find that undertaking the U.S. energy transition presents an adaptive challenge: the problem is tied to deeper existing patterns, the solution requires new learning, the responsibility to act lies with those affected by the challenge itself (i.e. stakeholders who are part of both the problem and solution, such as governments, businesses, and communities), and obstacles to success include differing, deeply held values and priorities.

Our work uncovered five key tensions that present implementation challenges regarding the IRA's energy and climate provisions, revealing dichotomous perspectives and priorities surrounding the transition. Understanding these tensions is critical to navigating the complexities, risks, and uncertainties around IRA implementation.

FIVE KEY TENSIONS

Climate Urgency *vs.* **"Moving at the Speed of Trust"**

National Decarbonization *vs.* **Regional and State Decarbonization**

Energy Transition *vs.* **Economic Development**

Scaling Up *vs.* **Maintaining Local Ownership**

Regional Competition *vs.* **Regional Collaboration**

Climate Urgency vs. "Moving at the Speed of Trust"

The seven-year time horizon for the Biden Administration's GHG reduction goal requires rapid deployment of clean energy technologies at an unprecedented scale. The goal is underpinned by the strongest scientific consensus, including from leading academic institutions and think tanks, the International Energy Agency, and in the IPCC's recently released Sixth Assessment Report (AR6) that describes "a rapidly closing window of opportunity to secure a livable and sustainable future for all."[47]

At the same time, past energy and manufacturing transitions have left large swaths of the country behind, causing decades of location-based economic inequities. These communities are now justifiably skeptical of yet another energy transition, which if poorly executed could exacerbate regional inequality and deepen existing wounds. As a result, effective community engagement requires, "moving at the speed of trust"—a common refrain repeated by community leaders, advocacy organizations, and federal officials.

"If fossil-dependent communities don't have pathways going forward through the transition, they may be more likely to resist the transition," shared Daniel Raimi, Director of the Equity in the Energy Transition Initiative at Resources for the Future.[48] When it comes to developing commercial-scale clean energy resources, local communities have the power to significantly slow or stop projects by utilizing process tools like environmental reviews, local ballot measures, and zoning code interpretations. This is evidenced in the siting of renewables and transmission, which has become a major sticking point in the transition. On the other hand, if communities feel integrated into the process and realize local benefits from development projects, they can be effective allies in forwarding progress.

Community engagement experts at DOE have spent years building relationships with community allies and have found that trust can be broken more quickly than it can be built. Successful community engagement efforts by DOE have necessitated a sustained effort that requires extensive time, resources, and intentionality.

> ***"Fear is a major motivator in politics, no question. But if fear around climate change comes at the expense of people thinking they're going to lose their way of life, their livelihood, their job, it creates backlash."***
>
> ***-Joe Kennedy, Former Congressman and Founder of Groundwork Project[49]***

This tension between climate urgency versus taking the time to build community trust and buy-in requires balance, and there is no prescriptive model that fits each community. Certain steps can be taken to help mitigate this tension, including engaging with community members starting at the earliest stages of a project, working through trusted and integrated community partners, employing commitment mechanisms for local benefits that will result from development projects, and providing agency to grassroots stakeholders in project planning processes.

National Decarbonization vs. Regional and State Decarbonization

At a national level, the U.S. is more equipped to pursue a holistic energy transition than at a siloed regional or state level. Resources at this scale are much more fungible. For example—baring transmission barriers—it is possible to consider how areas of abundant renewable resources like the windy Midwest and sunny southwestern states (Figure 6 and Figure 7) can provide power to the load centers in the northeast. It is also easier to consider the movement of talent and capital to where it is needed most. This is important for considering the growth of new industrial sectors and regions, such as the emerging 'battery belt' for producing EV batteries[50] or the strategic siting of hydrogen hubs. National-level decarbonization also allows for coordinated transition efforts across states and unlocking large-scale funding opportunities that states or regions alone might struggle to muster.

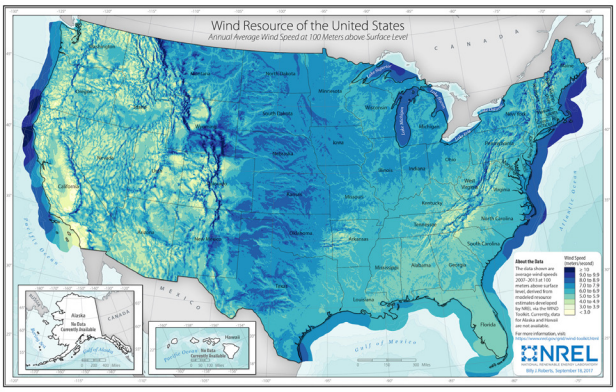


Figure 6: U.S. wind speed at 100-meter above surface level[57]

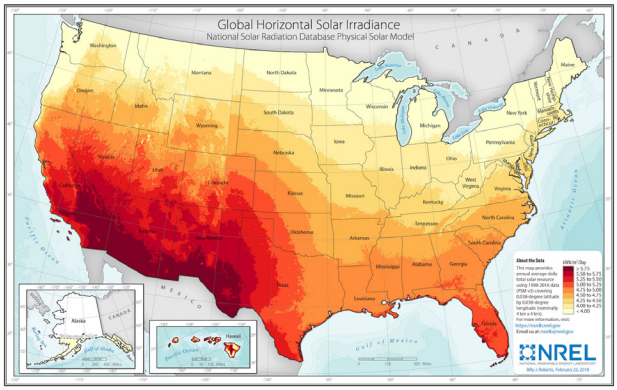


Figure 7: U.S. annual solar resource, measured in global horizontal irradiance (GHI)[58]

In contrast, regions and states are incentivized to focus their efforts more internally and are constrained by the resources and authority within their boundaries. Renewable energy generation is limited to the natural endowment of the state (much like fossil fuels, though less concentrated). Manufacturing capacity and workforce skills can be limited by the industries that have historically been present. For example, when the shale boom in the late-2000s/early-2010s reached Appalachia, the jobs first went primarily to out-of-state workers due to lags in workforce training for resident workers.

This mismatch in resources and perspectives between national versus regional and state strategies can often lead to misalignment of policy outcomes. One common example is interstate transmission. While critical to both the reliable function of the energy grid and decarbonization, interstate transmission is routinely blocked by individual states along the route. This was the case with the New England Clean Energy Connect. This transmission line project to bring clean Quebec hydro power to Massachusetts has been mired by a Maine ballot measure and legal disputes, despite permits being issued and hundreds of millions of dollars already being spent.[51,52] To mitigate this risk of misalignment, regional collaboration between states should be encouraged and successes showcased.

Energy Transition vs. Local Economic Development

Appalachia and Texas both boast rich energy-producing legacies—a narrative that reverberates throughout the regions as they consider their place in the clean energy economy. While certain

IRA provisions encourage clean energy-related industries to enter and expand in these regions, this does not necessarily go hand-in-hand with the best path forward for local and regional economic development goals.

"In my view, it's morally right and politically important that fossil-dependent communities have pathways going forward through the energy transition."

-Daniel Raimi, Director of the Equity in the Energy Transition Initiative, Resources for the Future[59]

Renewable developments like solar and wind farms might create short-term construction jobs but ultimately lack long-term regional employment benefits. This causes financial gains to accrue to those who own the capital stock rather than the workers. As Representative Sean Casten (D-IL) said, "the clean energy transition has the capacity to pull wealth away from energy-producing areas to energy-consuming ones."[53] Daniel Raimi of RFF notes the importance of carefully considering how to build fossil-dependent communities' futures within the broader future of the nation's energy production ecosystem: "The energy communities of today don't need to be the energy communities of tomorrow. They need to transition to something, but it doesn't have to be energy."[54]

As the IRA's energy community designations drive site selection, risks emerge of political discord and inequitable outcomes stemming from industry development being at odds with local economic development. Balancing community benefits and needs becomes increasingly important to maintain community buy-in and promote an economically robust transition. Especially in Appalachia, communities remember the extractive nature of past industry presence, and building trust to secure community backing for to new industry is difficult. As Jacob Hannah of Coalfield Development puts it, "We aren't just the place you can take dirty jobs."[55]

Threading the needle between addressing challenges of decarbonization and addressing challenges of regional joblessness is a critical tension that must be addressed to get projects off the ground.

Scaling Up vs. Maintaining Local Ownership

The 2020s have seen an unprecedented windfall of federal funding provided to the nation. The U.S. Government Accountability Office estimates Covid-relief funding authorized during 2020 and 2021 totaled $4.6 trillion.[56] This pandemic recovery windfall was followed by a slurry of additional spending bills signed into law by the Biden Administration—including the CHIPS and Science Act, the IIJA, and the IRA—providing hundreds of billions of dollars of investment in the form of funding to states, competitive grants, and subsidies.

To meet the moment, many states and organizations have been pushing the upper bounds of their capacity to fulfill grant proposals, implement projects, and track the opportunities on the table. Chelsea Barnes of Appalachian Voices, a nonprofit with the mission of advancing a just transition to a generative and equitable clean energy economy, has witnessed this firsthand in her work with Appalachian communities. "It is incredibly difficult for local governments and disadvantaged communities to get these grants," she

said.[60] Appalachian Voices has worked to streamline Requests for Information (RFIs) and Requests for Proposals (RFPs) to decrease the administrative burdens of navigating these processes. The issue is echoed in nearby Pennsylvania where staffing shortages at the Pennsylvania Department of Environmental Protection leave staff struggling to keep up with incoming permit applications.

Agencies such as DOE and the Appalachian Regional Commission have robust programs to provide technical assistance grants and resources to address these issues, but challenges remain. Anisha Steephen, Advisor to the Counselor for Racial Equity at the U.S. Department of Treasury, said, "Looking at the history of community development, we ask the private sector and private actors to do a lot of work for us. This builds the wealth of the actors, not of the communities."[61]

Federal agencies such as DOE and Treasury are working to maintain local ownership and input through community engagement work. But those efforts can at times stretch already strapped public and nonprofit workers even thinner. "County Commissioners working three jobs are being asked to come to too many community engagement meetings and don't have the time or personnel to engage," said Courtney Haynes with DOE's Office of Clean Energy Demonstrations in an interview.[62] In this way, efforts to strengthen local ownership can have the opposite effect when local representatives lack the support, time, and resources necessary to engage.

Regional Competition vs. Regional Collaboration

States tend to compete with one another for economic development opportunities, often perceiving it as a zero-sum game against regional neighbors. This emphasis on development within the state can leave opportunities for synergies and collaboration with nearby states underutilized. On top of this challenge, many state and local level agencies face staffing and resource shortages that increase barriers to regional collaboration.

> ***"Competition can be good. Local communities engaged in competition can make federal dollars go further. But with competition, there will always be a loser."***
>
> ***-Professor Catherine Wolfram, Former Deputy Assistant Secretary for Climate & Energy Economics, U.S. Department of the Treasury[63]***

Collaboration between neighboring states and municipalities can unlock new economic and development opportunities that do not exist when localities act in a vacuum. Regional industry clusters both enhance productivity and spur innovation, as firm productivity increases with overall industry scale. On the economic development front, regional collaboration promotes knowledge spillovers, labor pooling around specialized skills, and input-output linkages. For energy developers, increased regional collaboration can bring important infrastructure to a region that increases capacity for energy manufacturing and generation—like improved intraregional roads, airports, ports, transmission lines, and more.

Some public policy elements of the energy transition risk decreasing incentives for collaboration by pushing forward winners and losers. For example, as DOE draws nearer to selecting winning proposals for the Regional Clean Hydrogen Hub program funded by IIJA, there is a risk of "losers" feeling more distrustful of the federal government and of increased

intraregional competition. This risks reinforcing a sentiment that the federal government is falling short of delivering benefits to local communities, and may make communities less willing to engage in the future.

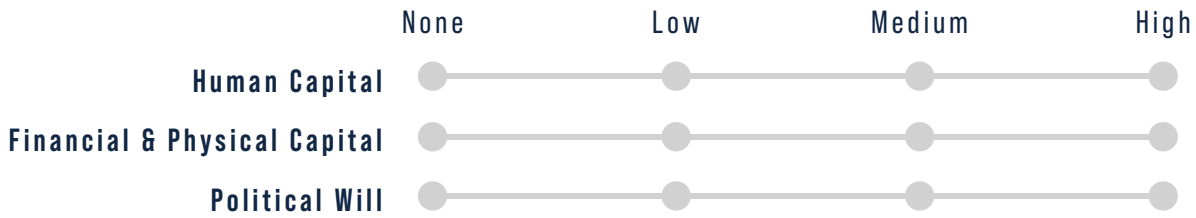
5.2 Recommendation Criteria

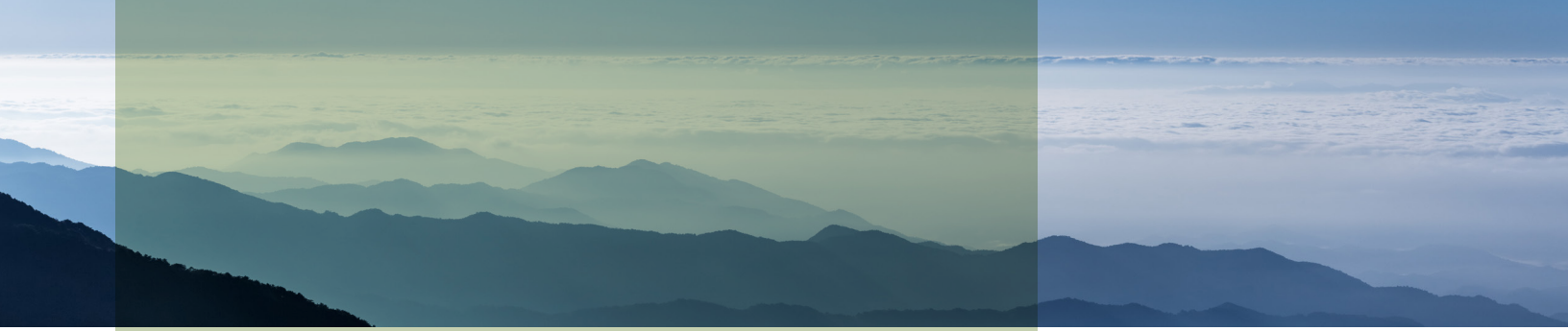
Striking a balance between the five key tensions identified above is critical to managing risks and uncertainties to stakeholders of all kinds affected by the energy transition. This ranges from private developers, to elected officials, to people who live and work in the regions—some for generations. Effective interventions to optimize the uptake of IRA provisions should manage the dichotomies presented between these tensions by employing strategies that address three key criteria:

1. Development of Regional **Human Capital**
2. Improvement of Access to **Financial and Physical Capital**
3. Increase in Regional **Political Will**

Each of these three criteria lean into and affect one another, like a three-legged stool. All three should be present to create a fertile environment for engaging with the energy transition. At the same time, each of the these criteria builds upon the other, creating an emergence where the individual contributions of each component sum to something greater when all three are present. Because of this interdependency, all three should be weighted equally to foster an effective energy transition.

The recommendations in the following section are based on addressing specific parts of these criteria. We rank each recommendation's impact on the three criteria from low to high, using the scoring thermometer below. For a detailed criteria-scoring matrix for each recommendation, see Appendix D.

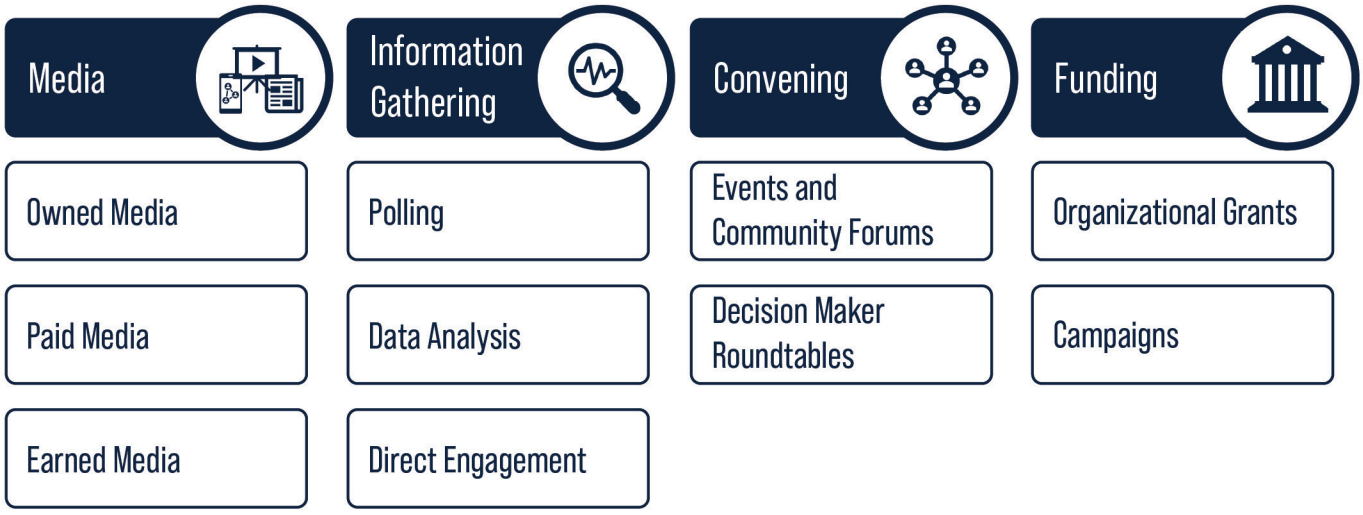


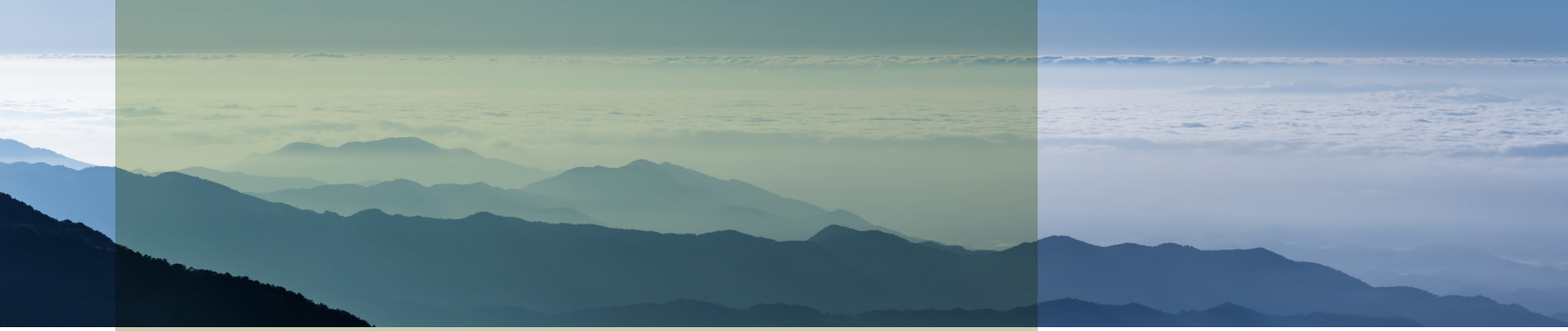


6. INTERVENTION TOOLS

When it comes to advancing the uptake of clean energy projects, there is a broad set of intervention tools that will be important in communicating with stakeholders and accelerating implementation of IRA-related projects in the two regions. These tools in general have proven successful across a range of contexts and campaigns to date. Each of the recommendations in Section 7 below have been developed with these tools in mind to ensure that the recommendations exist within organizational capabilities. Intervention tools fall broadly within four categories: media, information gathering, convening, and funding.

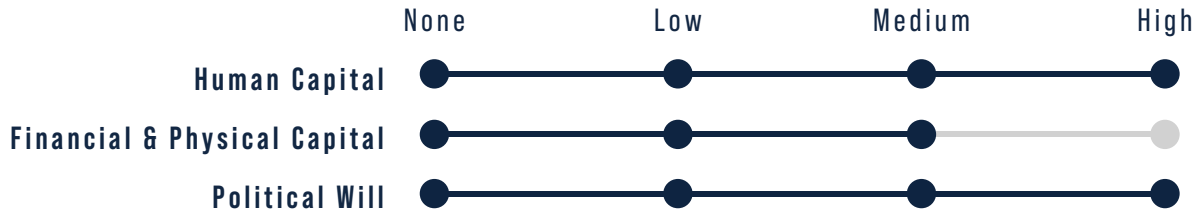
For a more detailed discussion of intervention tools and their applications, see Appendix C.





7. RECOMMENDATIONS

RECOMMENDATION 1A: Invest in Workforce Capacity



Background

The launch of development projects in both regions presents an opportunity for job creation, but a skilled workforce is required to fill the estimated 9 million new jobs the IRA will create over the next decade.[64] Two problems emerge when existing regional workforces lack the skills necessitated by entering firms. First, local workers can become displaced, extracting wealth creation from communities and increasing political risks. Second, firms lack the human capital necessary to maximize the potential of new developments. Neeraj Bhat, Chief Product Office of AES Corporation, explained, "It's very hard to get the number of workers needed to deliver projects at the magnitude that IRA will enable."[65] Workforce development initiatives to train and transition workers to meet the skill requirements of the energy transition can produce wins for both firms and communities.

In the House version of the legislation[66] passed in November 2021, significant investments in workforce development were included to meet the new wave of in-demand jobs anticipated from the unprecedented investments in clean energy development. As the result of tense political negotiations, these provisions were ultimately removed from the final version of the bill. These investments had included:

- $5 billion to the U.S. Department of Education to support community college and industry partnerships
- $5 billion to the U.S. Department of Labor to support competitive grants for workforce development organizations, employers, and training providers to fund industry partnerships
- $4.3 billion of investments in workforce development for climate-related occupations

"Jobs are huge. The need for jobs in these areas are significant and dramatic."

-Neeraj Bhat, Chief Product Officer of Clean Energy, AES Corporation[67]

Recommendation: Support and expand in-demand job training programs for dislocated, transitioning, and new workers through partnerships with industry employers and institutions of higher education.

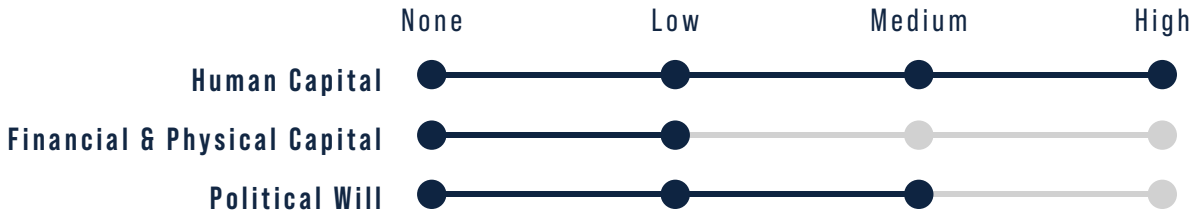
Application

Organizations can begin taking up the work to fill this critical workforce development gap. A success story of this missing piece is found in Coalfield Development—a nonprofit with the mission of incubating and investing in well-paying employment social enterprises and facilitating growth for people facing barriers to employment. Coalfield has implemented a wraparound professional development program for individuals facing barriers to employment. The program is intended to prepare regional workers for the ensuing energy transition by utilizing an on-the-job model to train community members with in-demand workforce skills.

External organizations can increase the efficacy of IRA energy provisions by supplementing workforce development efforts like those being conducted by Coalfield. Organizations can gain credibility by working through trusted community partners, such as community colleges and existing local organizations. They can also link training programs with industry partners launching development projects in the region.

> ***"You can't just bring in new technology and push out the folks who are the stewards of the region. People take time to learn and grow and evolve, and it's always worth it."[68]***
>
> ***-Jacob Hannah, Coalfield Development***

RECOMMENDATION 1B: Invest in Building Organizational Capacity



Background

In addition to the workforce capacity issues identified above, our research also uncovered critical organizational capacity issues. Understaffed and under-resourced organizations (such as state agencies, advocacy organizations, and local officials) are limited in their ability to respond to federal funding opportunities and engage with the clean energy transition. This includes, for example, the high fixed costs and personnel needs of responding to federal grants. Though the federal government has invested resources in expanding community engagement efforts, busy local organizations can become overly saturated with requests, especially

when federal efforts are fragmented. This can lead to a bias in favor of scale, often boxing out smaller localities and organizations that are doing innovative, integrated work from accessing opportunities. Their work could be integral to the transition if they have the capacity to take advantage of resources on the table.

Recommendation: Build upon technical assistance programs to provide logistical capacity support to cities, non-profits, small developers, etc. Fund local organizations and institutions focused on capacity building and develop scalable solutions for streamlining capacity needs, such as online databases.

Application

From interviews across the nonprofit and public sectors, our research has shown that small- and mid-sized organizations lack the internal capacity to seek out and obtain funding. On the other hand, federal funding opportunities often exclude entities that are too small for investment to make economic sense (see the benefits of direct pay and transferability in Section 3.3). To maximize the impact of local institutions in the energy transition, organizations should undertake initiatives to reduce the high fixed cost of engagement. The following case study highlights a roadmap for successful capacity building through coalition building.

"You have really innovative organizations with strong capabilities operating on the ground, and the federal government does not always have the ability to harness their capacity."

-Professor Gordon Hanson, Peter Wertheim Professor in Urban Policy at Harvard Kennedy School[69]

CASE STUDY: ACT NOW COALITION

What Happened

In February of 2022, the Appalachian Climate Technologies Coalition ("ACT Now") was launched in West Virginia. This historic coalition, led by the non-profit Coalfield Development, unites partners across sectors and industries to catalyze clean energy development in the region and establish West Virginia as a global leader in climate resilience.

The ACT Now Coalition is robust and historic, as its members represent stakeholders from nearly every facet of the energy transition, including institutions of higher education, innovative non-profit organizations, businesses, and municipalities. Members include West Virginia's two largest cities (the City of Huntington and the City of Charleston) as well as the state's two largest research universities (West Virginia University and Marshall University).

CASE STUDY: ACT NOW COALITION (CONTINUED)

Through coordination across sectors, ACT Now is taking on eight extended projects to engage in an equity-focused, system-wide approach to West Virginia's energy transition journey. The four initiatives supporting construction projects across the region include:

- **GROW Now Workforce Initiative** to train, place, and retain a new climate resilient workforce
- **Community + Business Resilience** to promote entrepreneurship and community planning
- **RePower Appalachia** to expand renewable energy and create "green collar" jobs
- **Sustainable Mine Lands** to bring innovative new approaches to reclaim mine lands and sequester carbon

> *"With so much funding on the table, there's a lack of people to pull it down and do it right. The onus is on us, and we're working from the bottom up."*
>
> *-Jacob Hannah, Coalfield Development*[70]

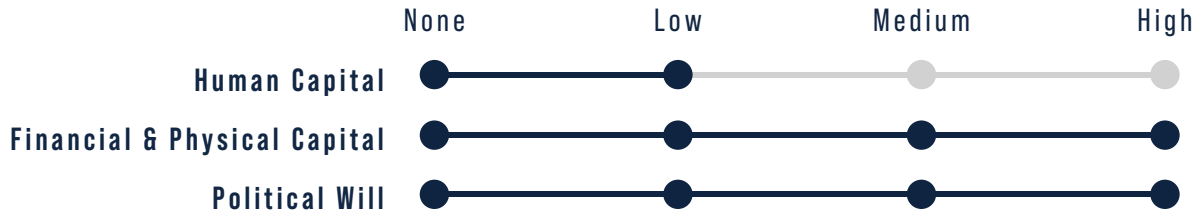
Why It Matters

Through the broad, holistic scope of the coalition, ACT Now was selected as one of 60 finalists to secure a competitive Build Back Better Regional Challenge (BBBRC) grant of $500,000 in December 2021. ACT Now went on to become one of 21 winners of the BBBRC and received an additional $62.8 million, funded by President Biden's American Rescue Plan and administered by the U.S. Commerce Department's Economic Development Administration (EDA).

Lessons Learned

- Coalfield Development's **deep roots in the state provided them with the credibility** necessary to unite and maintain a broad, expansive coalition.
- By **acting as a united front,** the organizations in the ACT Now Coalition were able to secure funding that would have been inaccessible to them as individual actors, while creating a holistic strategy for green energy development in the state. The coalition strategy strengthens the state's access to human capital and financial capital, while minimizing political backlash.
- Many organizations struggle to have the bandwidth to manage existing grants while undergoing rigorous, competitive processes to secure new funding opportunities. Much of the **onus remains on entities on the ground** to take advantage of these opportunities, and coalitions can be an effective net to catch those opportunities.

RECOMMENDATION 2: Government and Private Sector Summits



Background

A persistent disconnect exists between government and the private sector in the clean energy space. Elected representatives and regulators can benefit from increased awareness on emerging technologies, innovative project approaches, and early stage companies that they might be in a position to support. This can be a particularly important opportunity when these emerging technologies and companies sit within a representative's own district. Based on interviews with federal and state representatives, busy government officials often rely on private entities to take the initiative in coming to visit and showcase their work. Companies with greater resources have more capacity to seek face time and build relationships with elected officials. This often results in legislation and regulation that favors the status quo and incumbent firms. Entrepreneurs and startups can be less well-positioned to take advantage of newly passed legislation and miss windows of opportunity for influence.

On the other hand, some private sector entities—particularly in the startup space—can view government as an impediment to innovation rather than a potential partner. This can be understandable, particularly given the high level of regulation in the energy sector that risk averse governments and system operators see as necessary to ensure reliability. New energy technologies can take decades to reach market production, in part because of the regulatory hurdles on the path to commercialization. As a result, cleantech startups often neglect building relationships with their government representatives, missing out on potentially supportive partnerships and are left to fight the status quo energy sector on their own.

Recommendation: Support summits and roundtable meetings that bring together government officials and cleantech entrepreneurs to promote dialogue and collaboration.

Application

Former Congressman Joe Kennedy shared a success story of a 2022 summit that brought together 20 Massachusetts-based technology CEOs with state and national lawmakers to share their work and build relationships.[71] As a result, partnerships were formed culminating in the representatives sending letters of support for federal grant applications the startups were pursuing. Replicating a similar model in Appalachia and Texas, entrepreneurs and businesses can showcase their technologies to officials to explain the benefits and what the opportunities for support could be. Government officials can work to understand what policies can be put in place and which actions can be taken to support these new businesses.

These roundtables can also be extended to other stakeholders. Emily Eyster at the Pennsylvania Senate Environmental Resources & Energy Committee shared in an interview that state agencies can sometimes struggle to connect with their counterparts in neighboring states.[72] In regions like Appalachia, using summits to also bring together these agencies can help foster regional collaboration and scale outcomes beyond a single state's capabilities.

CASE STUDY: OUR NEXT ENERGY (ONE) BATTERY MANUFACTURING FACILITY IN JACKSON COUNTY, WEST VIRGINIA

Figure 8: Rendering of future ONE battery manufacturing facility[78]

What Happened

Our Next Energy (ONE), a Michigan-based energy storage company, has announced plans to build a $22 billion utility-scale battery manufacturing facility in Jackson County, West Virginia. The facility is part of a larger 2,000 acre, $500 million industrial hub being developed by Berkshire Hathaway Energy (BHE) Renewables that broke ground in March 2023.[73] ONE's utility-scale Aries Grid batteries will initially be paired with solar to enable a 100% renewable energy powered titanium smelting facility to be run by BHE's Precision Castparts Corp (PCC). Production is expected to start in 2025.

The project was first sparked from a letter sent by West Virginia State Senator Glenn Jeffries to Warren Buffet, Chairman & CEO of Berkshire Hathaway. After receiving the letter, BHE reached out to Sen. Jeffries and worked with state representatives and the West Virginia Economic Development Authority (EDA) to find and secure the Ravenswood site. Once purchased from the EDA, BHE moved forward with planning the industrial hub and eventually bringing ONE on as a battery manufacturing partner.

CASE STUDY: OUR NEXT ENERGY (ONE) BATTERY MANUFACTURING FACILITY IN JACKSON COUNTY, WEST VIRGINIA (CONTINUED)

Why It Matters

West Virginia elected officials at the state and federal level have been important allies for both BHE and ONE. Upon announcement of the battery manufacturing facility, Governor Jim Justice declared: "Today's announcement is a proud day for all West Virginians," adding the facility "enables hard working West Virginians to continue their legacy producing America's energy."[74] Similar sentiment was shared by U.S. Senators Shelley Capito and Joe Manchin, who said, "Our state is just beginning to realize the benefits of the Inflation Reduction Act and Bipartisan Infrastructure Law, and I can't wait to see the Mountain State continue our legacy as America's energy powerhouse."[75]

The project also builds upon West Virginia's legacy as an energy producing state. Sen. Jeffries, who has since been appointed Chairman of the Senate Economic Development Committee, said, "Since pick-axes first struck coal in 1810 in Wheeling—energy has always been the lifeblood of Appalachia."[76] He added that building a coalition of government stakeholders was important in realizing the project. "After I sent the letter, I started getting legislators involved, officials involved, and we put together a team."

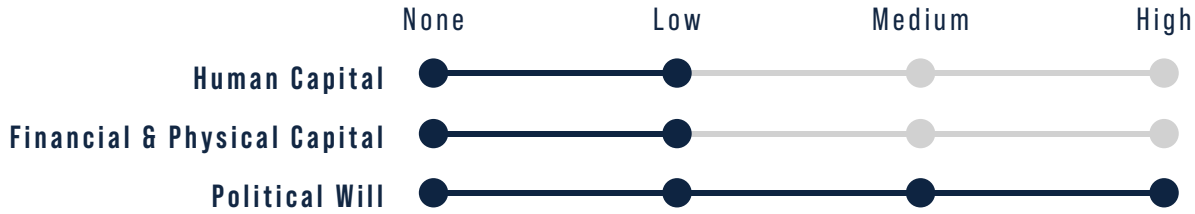
> *"That's what we're looking for. We're looking for jobs."*
>
> *-West Virginia State Senator Glenn Jeffries*[79]

Lessons Learned

- Across local media and embedded in announcements by elected officials is a key **focus on jobs and investment**. The West Virginia Press Association exemplified this with its top-line: "Media Advisor: Project adds more jobs and investment with ONE's Aries Grid Factory."[77]
- The **partnership between business and government** was a key enabler for this project. Collaboration between the two groups started at the very earliest stages of project conception and has continued to grow among stakeholders on both sides.
- The idea was **notably home-grown**; emerging from West Virginia's interest in economic development rather than top-down investment decisions by an external party.

Regional Focus: Texas

RECOMMENDATION 3: Public Information Campaigns for Hydrogen



Background

A January 2023 poll conducted by the Hobby School of Public Affairs at the University of Houston found that 54% of Texans favor expanding U.S. reliance on hydrogen power plants as an energy source, as compared to 17% who favor *reducing* U.S. reliance on hydrogen power plants.[80] This support is notably bipartisan, with 58% of Republicans and 57% of Democrats in favor of hydrogen expansion. Texans with a high school degree or below are significantly less likely to favor the expansion of reliance on hydrogen power plants as compared to those with higher levels of educational attainment.

This poll reinforces expert opinion found in interviews. The overarching public sentiment towards energy production in Texas provides the foundation for a favorable political environment for pushing forward hydrogen development projects. But given that the industry is relatively nascent compared to well-established oil and natural gas sectors in the state, the public narrative that will dominate upcoming hydrogen development projects remains largely unwritten. Hugh Daigle, Associate Professor of Petroleum and Geosystems Engineering at the University of Texas, explains that the narrative gap provides both an opportunity and risk for the future of hydrogen development in the state. "When there aren't enough details out there, it's easy for messaging to get twisted and harmed," he said.[81]

> *"To most people, the impact that clean hydrogen can have in addressing climate change is unclear. And those most impacted by the development of clean hydrogen hubs often don't even know they should be part of the discussion."*
>
> *-Brett Perlman, Center for Houston's Future[84]*

Recommendation: Organizations should support and employ a coalition-based model to disseminate a coherent, people-centered message around the benefits of building a hydrogen economy in the state to raise public awareness.

Application

Stakeholders interested in constructing a positive narrative around hydrogen development in Texas can take away key lessons from the political discourse around the fossil fuel transition in Appalachia. Studies highlighting the importance of delivering messages from a place of credibility (see Figure 9 below) demonstrate how minor adjustments in message can result in major impacts on public opinion.[82] For example, one study found that when

given information about the market-driven decline of coal, people are more willing to support workforce programs for clean energy. This study identified an 11% positive shift in respondents' support for clean energy workforce programs in the region.[83]

Further community- and individual-level message testing research is needed to understand what messages most clearly convey the benefits of building out a hydrogen economy in Texas and resonate most strongly with Texas residents.

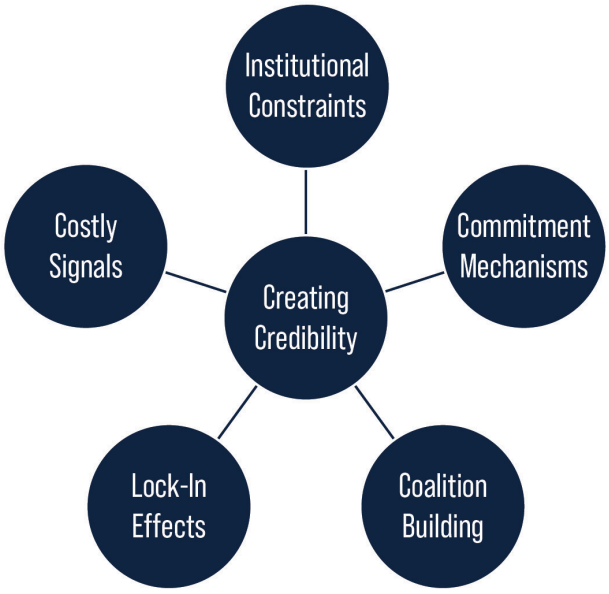
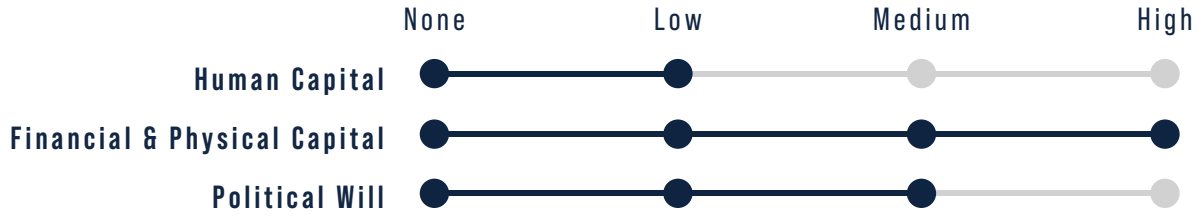


Figure 9: Strategies for creating credibility[94]

Regional Focus: Appalachia

RECOMMENDATION 4: Bridge the Capital Funding Gap



Background

Through the introduction of direct pay and transferability—as described in Section 3.3—the IRA has made significant strides in broadening the monetization potential for entities that previously were unable to use credits due to lack of tax liability or required tax equity agreements. Entities such as municipal authorities, non-profit organizations, and rural electric co-ops can now use these new credit delivery mechanisms to take advantage of clean energy subsidies more readily. As the Treasury's Assistant Secretary for Tax Policy, Lily Batchelder, wrote, these mechanisms will, "expand the reach of the credits, allowing more projects to be built

"There are financial capacity issues for getting projects off the ground. [The transition] needs organizations with: The capabilities to initiate a project, the ability to finance the cost gap, and the ability to access tax credits to their fullest."

-Anisha Steephen, U.S. Department of the Treasury[93]

more quickly and in more places... [acting] as a force multiplier for companies and enable communities, startups, and nonprofits to access the credits."[85]

While the incentives themselves are now more accessible, getting access to subsidies is not cost-free. Both investment and production tax credits fit into an existing capital stack to make projects more financially feasible. But neither serves to bridge the upfront capital gap that is required to take advantage of these credits in the first place. High fixed costs mean that more profitable and larger firms will be first in line to take advantage of the IRA subsidies, while smaller organizations with fewer financing options will be unable to meet the capital requirements for initiating a project.

Recommendation: Provide access to affordable or concessionary capital for small- and medium-sized entities looking to develop clean energy projects.

Application

Many clean energy projects that lack access to upfront capital can end up being profitable once the generation or manufacturing assets are operational and able to take advantage of the ITCs or PTCs. Offering accessible financing through grants or low-interest loans can catalyze major project uptake and enable a much broader set of actors to develop clean energy technologies. Setting up funds and institutions that can provide affordable capital across the Appalachia region is paramount to accelerating the transition.

Green banks are one such institution. These mission-drive institutions focus on financing clean energy projects, typically for proven, lower-risk technologies such as wind and solar. Green banks take an active role in seeking and financing clean energy transition projects in contrast to the more passive approach by traditional financial institutions that simply make capital available.[86] There are currently 21

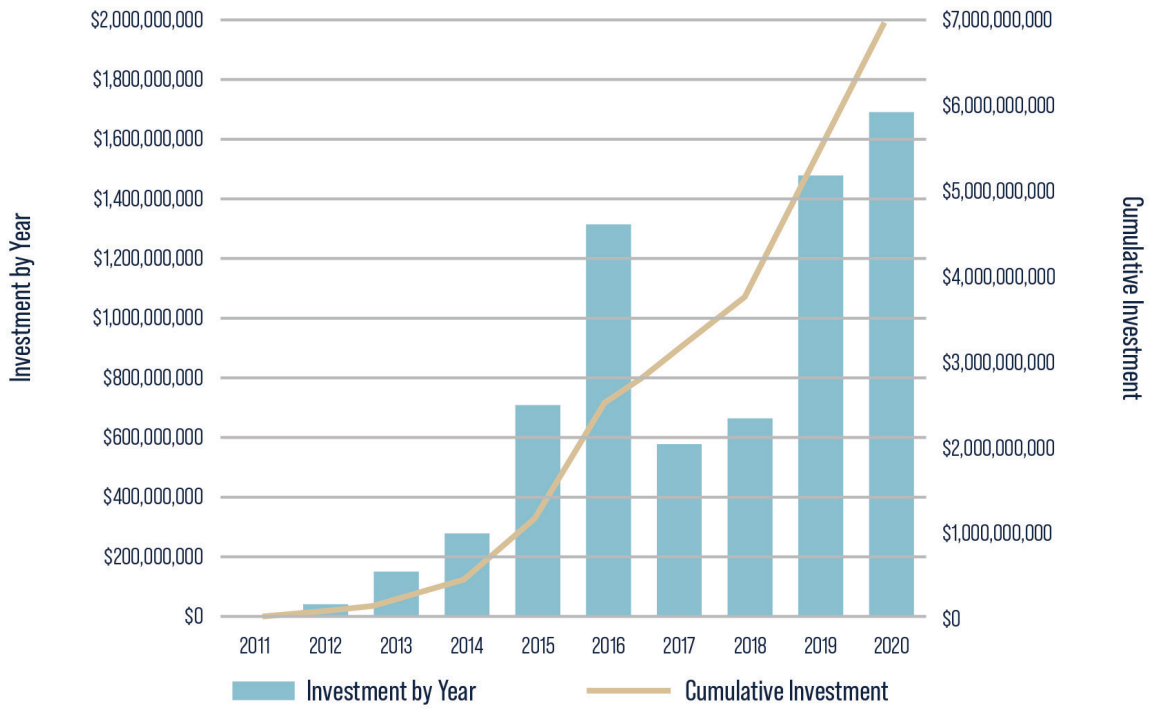


Figure 10: Cumulative and annual investment by U.S. green banks[87]

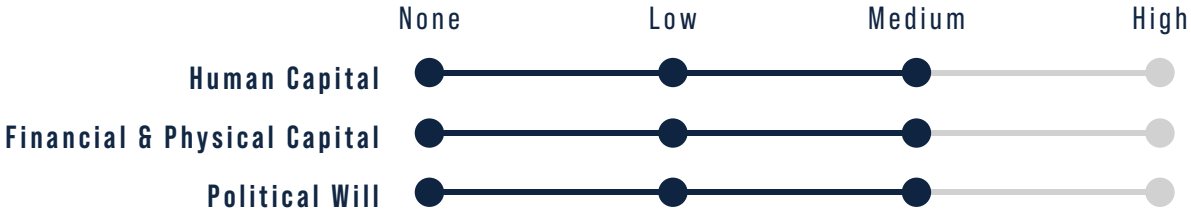
green banks in the U.S., which cumulatively deployed roughly $7 billion in clean energy investments over the period 2011-2020.[88] Within and around the Appalachia region, several green banks have been established including the Montgomery County Green Bank, the DC Green Bank, and the North Carolina Clean Energy Fund. As part of the IRA, the federal Greenhouse Gas Reduction Fund (GHGRF) was established and funded with $27 billion. Through the EPA, the fund will provide $7 billion directly to cities and states to support with the deployment clean energy technologies in low-income and disadvantaged communities. The other $20 billion will be made available to non-profit organizations that operate as green banks.[89]

A second option would be for mission-driven private sector investors to provide a form of patient capital at concessionary rates for small- and medium-scale project developers. In line with the growing use of debt finance models from institutions such as DOE's Loan Programs Office[90] and catalytic equity from Breakthrough Energy Catalyst[91] to fund large-scale innovative clean projects and companies, similar practices could be used with a focus on regional decarbonization and clean energy manufacturing. This would enable entities like city governments and non-profit coalitions to access the funding needed to initiate a project while still committing to paying back the financed amount over time.

Finally, where possible, stacking federal IRA incentives with other existing state and federal funding programs can help multiply the impact and reduce monetary hurdles. For example, the U.S. Department of the Interior's Abandoned Mine Land Economic Revitalization (AMLER) Program makes funding available for the long-term investments that "return legacy coal mining sites to productive uses through economic and community development."[92] Building a solar or wind project, or a clean energy manufacturing facility on a reclaimed mine site could then take advantage of both sources of funding, reducing the expenditure gap and improving financial feasibility of the project. Implementing solutions such as these to bridge this capital gap can play a key role in regional decarbonization and bottom-up clean energy engagement.

Regional Focus: Appalachia

RECOMMENDATION 5: Support Local Entrepreneurship Accelerators



Background

Startup accelerators play an important role in fostering entrepreneurship and equipping early-stage companies with the tools needed to scale. Accelerator programs typically have set schedules ranging from three to six months with a focus on growth and/or market access. They can provide funding, expert mentors, technical resources, training, networking, workspaces, and ultimately an opportunity to pitch to potential investors.[95,96] While the specific impact of accelerators varies by program, location, and industry, studies have found that, "accelerators have a positive impact on regional entrepreneurial ecosystems, particularly with regard to the financing environment."[97] Accelerators play a specific role in the startup ecosystem given their defined program

	Incubators	Angel Investors	Accelerators	Hybrid
Duration	1 to 5 years	Ongoing	3 to 6 months	3 months to 2 years
Cohorts	No	No	Yes	No
Business Model	Rent; nonprofit	Investment	Investment; can also be nonprofit	Investment; can also be nonprofit
Selection	Noncompetitive	Competitive, ongoing	Competitive, cyclical	Competitive, ongoing
Venture Stage	Early or late	Early	Early	Early
Education	Ad hoc, human resources, legal	None	Seminars	Various incubator and accelerator practices
Mentorship	Minimal, tactical	As needed by investor	Intense, by self and others	Staff expert support, some mentoring
Venture Location	On-site	Off-site	On-site	On-site

Figure 11: Four institutions for supporting startups[103]

duration and offerings, but can be complemented by other institutions that support entrepreneurship.

Recommendation: Establish, fund, and support regional business accelerators with an industry focus on cleantech to foster local entrepreneurship and grow a local ecosystem of climate- and energy-focused companies.

Application

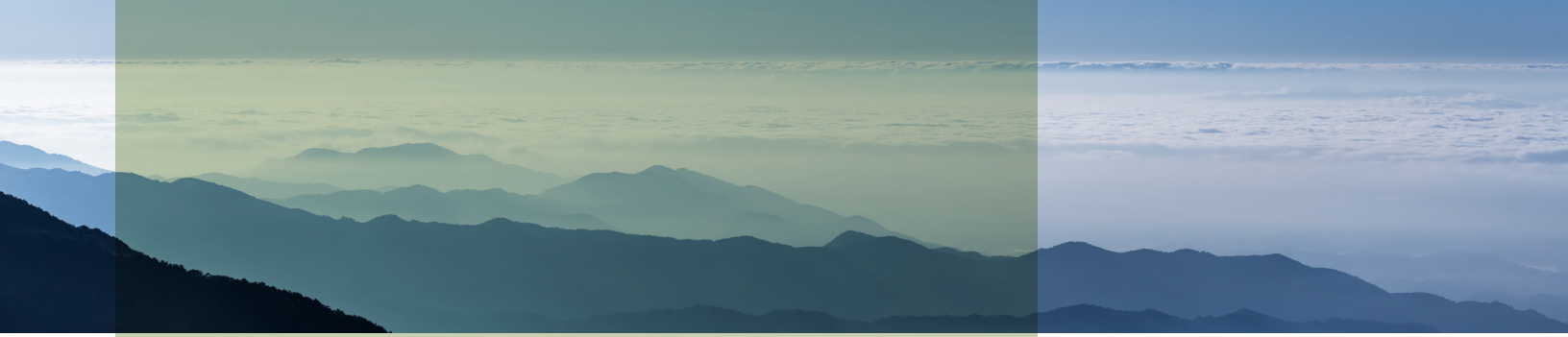
Many models and programs for fostering cleantech startups exist. At the state level, the **Virginia Energy DELTA Lab** (Discovery, Education, Learning & Technology Accelerator) brings together public and private partners to, "leverage previously-mined land as a proving ground for the commercialization and deployment of innovative energy technologies."[98] Funded in large part by a $975,000 grant from AMLER, the program seeks to support innovative new technologies including hydrogen, mine-based geothermal, small modular reactors, and advanced solar and storage. **NYSERDA** (New York State Energy Research and Development Authority) provides another state-level model from New York. The office, "is deploying $800 million over 10 years as direct investments via grants and wraparound commercialization support," which includes six business incubators, entrepreneur-in-residence programs, and more.[99]

At the national level, the **DOE's Community Power Accelerator (CPA)** also provides a useful model. The CPA provides training, tools, and support to help community solar developers get projects "credit ready."[100] This involves defining financing, ownership, subscriber models, and connections to funding sources from investors and philanthropic organizations. Finally, from the private sector side in Appalachia the **Dominion Energy Innovation Center (DEIC)** located in Ashland, VA can serve as a good model for supporting regional entrepreneurship.[101] The DEIC Accelerator focuses on supporting companies in the energy and sustainability space through an 18-week program that includes technical support, marketing and sales advice, finance training, talent development, and more.

As a Harvard Business Review report found: "Metropolitan areas where an accelerator is established subsequently have more seed and early-stage entrepreneurial financing activity, which appears not to be restricted to accelerated startups themselves, but spills over to non-accelerated companies as well—occurring primarily from an increase in investors."[102]

Firms with existing expertise in the cleantech startup space around the country can play an impactful role in growing the Appalachia cleantech sector. This can include bringing best practices and specialized knowledge of cleantech entrepreneurship to the region, as well as industry connections across the wider U.S. cleantech industry. Organizations that have set up successful business accelerators elsewhere in the country can lead or partner to bring similar models to areas of Appalachia that already have burgeoning entrepreneurial ecosystems. Appalachia would greatly benefit from a stronger startup ecosystem that supports new companies such as renewables developers; clean energy technology manufacturers; and engineering, procurement, and construction providers.

While progress has been shown in a growing number of external firms setting up operations in the region, fostering a home-grown cleantech industry with local founders would help strengthen the durability of the clean energy transition in Appalachia.



8. CONCLUSION

The clean energy transition will be one of the greatest challenges of the 21st century. It will require a Homeric rethinking of the nation's energy systems at every level—a system that is deeply embedded in the fabric of our economy and our society.

The Inflation Reduction Act unlocks an unprecedented amount of funding and market certainty to catalyze this transition. To meet the U.S. climate targets and maximize benefits for the greatest public good, it will be crucial to engage every region across the country in the process.

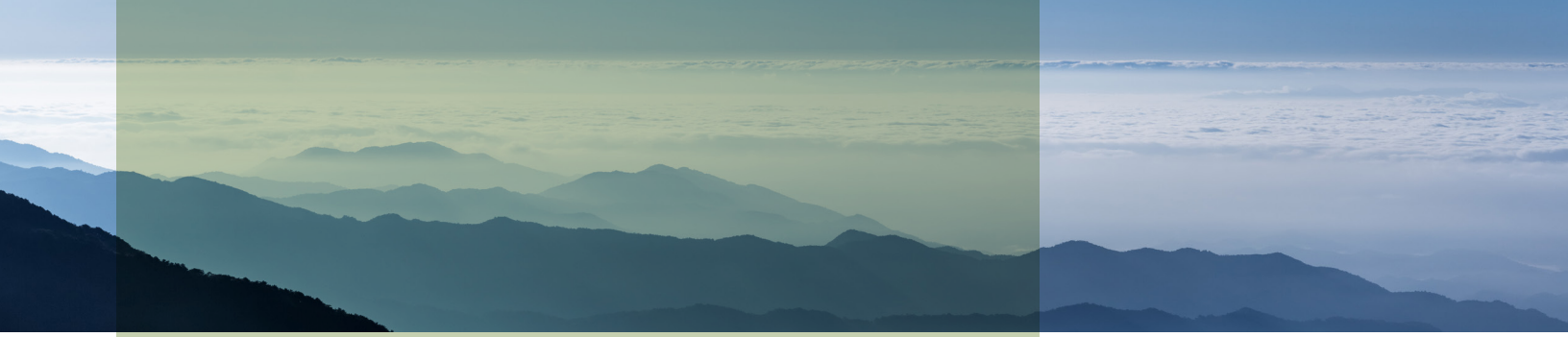
Appalachia and Texas must play important roles in forwarding the energy transition. Both are well positioned to be leading regions in the clean energy economy of the future. The heritage of energy production in both regions runs deep, and already the next generation of renewables, energy storage, hydrogen, and other advanced technologies are taking root.

At the same time, both regions are unique in their histories and contexts. Appalachia has faced intergenerational challenges borne from the boom-and-bust cycles of extractive industry and manufacturing. The clean energy transition presents a new window of opportunity to grow regional wealth and support durable economic development in furtherance of the nation's climate goals. Texas is at the forefront of renewables deployment and the emerging hydrogen industry, but will need support in making sure that the green hydrogen economy can launch and scale without being overshadowed by competing energy priorities.

Through our interviews and analysis conducted for this research, we have unmasked a series of persistent tensions that underpin the complex nature of the energy transition. Tensions such as urgency versus trust or decarbonization versus local economic development, lack a prescriptive solution. **But in identifying these factors and bringing both perspectives to the fore, we can begin to understand how balances can be structured to make progress.** From there, we can outline a roadmap to increase the three main enablers of the transition: human capital, financial and physical capital, and political will.

The recommendations put forth in this report work to address different components of these tensions and criteria, serving as tools in a toolbox to accelerate the clean energy transition rather than as a single, prescribed solution. In implementing these recommendations, either together or individually, it is paramount to engage with these regions as partners in the process, and to work with trusted entities who have established credibility and knowledge from decades of work in these areas.

Meeting the targets to mitigate the worst impacts of climate change will be difficult, but by leveraging a just and inclusive approach, we have the opportunity to unite stakeholders and build momentum for a clean energy future for all.



9. APPENDICES

APPENDIX A: Inflation Reduction Act Climate-Related Provisions

Clean Energy

The IRA clean energy incentives begin with a continuation of the existing, technology-based ITC and PTC programs through the end of 2024. Under these programs the credits are applicable to a specific set of pre-defined energy technologies, including solar, geothermal, wind, etc. This extension helps ensure continuity and access in the near-term while the longer-term program is being defined. Beginning in 2025, the ITC and PTC switch to becoming technology-neutral. This is a new approach to the ITC and PTC program, which enables projects to qualify on an emissions basis so long as they produce electricity with zero or negative GHG emissions.[104] This shift to a technology-neutral approach creates a huge opportunity for innovative new clean energy technologies and processes to qualify.

Production Tax Credits[105]

Section	Credit	Description	Bonuses
45V	Clean Hydrogen	PTC credit depends on the carbon intensity of the hydrogen, with four tiers ranging in emissions from 0.0 to 4.0 kgCO2/kgH2 and corresponding value from $3-$0.06/kgH2	None
45X	Advanced Manufacturing	Covers the production of for solar, wind turbines and offshore wind, inverters, and battery components, along with critical materials needed for such components	None
Section 45	Clean Electricity (Extension)	$0.015 per kWh generated via solar, geothermal, wind, biomass, landfill gas, municipal solid waste, hydropower, and marine and hydrokinetic facilities Ends 2024	10% for domestic manufacturing 10% for facilities in energy communities
45Y	Clean Electricity (New)	"Emission based" technology agnostic, $0.015 per kWh with zero or negative GHG emissions Begins 2025	10% for domestic manufacturing 10% for facilities in energy communities 10% for facilities in low-income communities or tribal land 20% for low-income residential buildings or part of low-income economic benefit project

Investment Tax Credits[106]

Section	Credit	Description	Bonuses
Section 48	Clean Electricity (Extension)	30% for solar, geothermal, fuel cell, microturbine property, small wind, offshore wind, CHP, and waste energy recovery 30% for energy storage, biogas, microgrid controllers, dynamic glass, linear generators 30% for geothermal heat pump 10% for microturbine projects Ends 2024	10% for domestic manufacturing 10% for facilities in energy communities
48E	Clean Electricity (New)	Emissions-based, covering 30% of the investment made available in the year the facility is placed in service Projects greater than 5 MW may include the cost of interconnection in the ITC	10% for domestic manufacturing 10% for facilities in energy communities 10% for facilities in low-income communities or tribal land 20% for low-income residential buildings or part of low-income economic benefit project
48C	Advanced Energy Projects	30% ITC to support domestic manufacturing, production, and recycling of clean energy products Can be applied to low-carbon industrial heat, carbon capture, transport, utilization and storage systems, recycling equipment, energy efficiency, waste reduction	

Clean Hydrogen

There are two key IRA incentives applicable for clean hydrogen projects: 45V (hydrogen PTC and ITC) and 45Q (carbon capture and sequestration tax credit). Projects can choose *either* the PTC or ITC under 45V to support both qualifying fossil fuel-based hydrogen production and electrolysis projects. Both the PTC and ITC are scaled by emissions, ranging from a PTC of \$3.00/kgH_2 for zero-carbon hydrogen, down to \$0.60/kgH_2 for carbon intensity up to 4kgCO_2e/kgH_2 and an ITC from 30% down to 6%.

Carbon Intensity (kgCO2/KGH2)	Maximum Hydrogen PTC Credit (\$/kgH2)
0-0.45	\$3.00
0.45-1.5	\$1.00
1.5-2.5	\$0.75
2.5-4.0	\$0.60

For reference, the following table include emissions rates for different hydrogen production technologies.

	kgCO2e/kgH2	SMR without CCS	SMR with CCS	ATR with CCS	PEM Electrolysis	PEM with PPA
Current Grid Intensity	**2.2 percent leakage**	11.2	2.9	3.8	24.4	0.0
	0.3 percent leakage	9.7	1.3	2.3	24.2	0.0
Zero-Emission Grid	**2.2 percent leakage**	11.1	2.2	2.2	0.0	0.0
	0.3 percent leakage	9.6	0.6	0.7	0.0	0.0

Figure 12: GHG intensities of various hydrogen production technologies[109]

According to an analysis by RFF,[107] in most cases the PTC is more valuable than the ITC primarily because the relative incentive amount is equal across life cycle emissions but improves with capacity factor. For hydrogen producers using carbon capture, utilization, and storage (CCUS) to create blue hydrogen, the 45Q carbon sequestration credit is an alternative option (developers must choose either 45V or 45Q, not both). Because the IRA significantly increases the value of credits for carbon capture, the carbon capture credit 45Q becomes potentially even more valuable as an alternative to the PTC or ITC.

Carbon Capture and Sequestration

Finally, the IRA greatly increases the credit amounts and availability for carbon sequestration projects. Depending on the project type (CCUS, various utilizations of captured CO_2, or DAC with geologic storage), credit values has increased from $35-$50 previously to $60-$180 WITH THE IRA. In addition, the minimum plant size eligibility threshold has been significantly decreased (e.g. from 100,000 tons per year previously to just 1,000 tons per year now). The smaller eligible capture thresholds enable both a broader set of non-utility-scale projects to be built and more small- and medium-enterprise developers to enter the market. Together, these two changes present an real opportunity for scaling the carbon capture industry in the coming years. 45Q includes the following components:[108]

Section	Credit	Type	Description	Eligibility
45Q	Carbon Capture and Utilization	PTC	$60 per ton for carbon captured and used to produce zero/low carbon fuels, chemicals, building materials, or for enhanced oil recovery (EOR)	
45Q	Carbon Capture, Utilization and Storage (CCUS)	PTC	$85 per ton for CCUS at power plants and industrial facilities, with carbon being stored in geological formations	
45Q	Direct Air Capture, Utilization	PTC	$130 per ton for DAC with carbon utilization or EOR	Minimum DAC facility size of 1,000 tons per year
45Q	Direct Air Capture, Storage	PTC	$180 per ton for DAC with permanent storage in geological formations	Minimum DAC facility size of 1,000 tons per year

Defining Energy Communities

"Energy communities" in the IRA are currently defined in three ways:[110]

- **Brownfield sites,** where existing pollution such as industrial waste could hamper future development. The EPA does not have a comprehensive list of such sites but estimates roughly 450,000 brownfields across the country.
- **Coal communities,** which are census tracks in which a coal mine has closed or a coal-fired generating unit* has been retired, and those adjoining census tracks. Census tracks are based on population so vary greatly in geographic size. This definition would cover roughly 14.6% of the U.S. land area and 2.8% of the U.S. population under the closed coal mine designation, and 7.0% of land area and 2.0% of population under coal generator retirements (though that number is likely to grow as more coal plants are taken offline in the coming years).
- **Fossil fuel employment** zones, which use metropolitan/non-metropolitan statistical areas (which range from 157 sq mi to 138,435 sq mi; roughly the size of Germany). These zones are the least defined, given the lack of clear directives on how to measure "direct employment" in fossil fuels, "local tax revenues" related to fossil fuel business, and/or "unemployment rate at or above national average rate for the previous rate"—the latter of which could result in massive swings between eligibility and ineligibility on a monthly basis.

The final definition of energy communities will be delivered by the IRS and will have major implications on IRA subsidy availability across the country.

Focus on Domestic Manufacturing

Unlike past clean energy incentives, the IRA takes on a new approach in favoring U.S. domestic manufacturing; a point that has caused considerable contention among international partners. For several extended and new PTCs and ITCs, as well as credits that cover clean vehicles and other technologies, a 10% credit bonus is applied for projects that meet domestic manufacturing requirements which cover steel, iron, and manufactured components. This controversial provision was an outcome of the fierce political negotiations that preceded the passage of the bill. This bonus will play a key role in supporting the U.S. cleantech industrial sector, and it presents a major opportunity for manufacturing growth in regions like Appalachia and Texas. It is projected to have mixed outcomes for the national and global energy transition at large.† The bonus is extended to manufacturing in the U.S. as well as the 20 countries that have established Free Trade Agreements with the United States.‡

* The use of "generating unit" is important here because most coal-fired power plants have several generating units. This means that only a single generating unit must be retired for the area to qualify, even if the coal-fired power plant is still active.
† The political and international relations debate is complex and evolving and will not be covered in this report.
‡ The U.S. currently has Free Trade Agreements (FTA) with 20 countries listed with the Office of the United States Trade Representative. Notably absent from this list are any European countries, Japan, and other major suppliers of clean energy technologies and components. Negotiations are currently underway for potential waivers for some non-FTA countries.

APPENDIX B: Status of Clean Hydrogen Development

While the rulemaking process for IRA incentive credits are still being formulated by the U.S. Department of Treasury (see Section 4), the Regional Clean Hydrogen Hub program (H_2Hubs) funded by the Infrastructure Investment and Jobs Act has been progressing[111]. Several major hydrogen hub proposals were put forth in Texas, shown in the map below. This includes:

- **HyVelocity Hydrogen Hub**, led by the Center for Houston's Future, GTI Energy, and University of Texas Austin and finance partner LowCarbon America
- **Horizons Clean Hydrogen Hub**, led by the Port of Corpus Christi Authority and finance partner Ares Management
- **Trans Permian Hydrogen Hub**, led by MMEX Resources and corporate partner Siemens Energy
- **Leading in Gulf Coast Hydrogen Transition (LIGH2T)**, led by INEOS, Linde, MPLX, the University of Houston, NREL, and the Southern States Energy Board

As of December 2022, all of them have received a favorable "encourage" notice from DOE and will likely be moving forward with applying by the April 2023 deadline.[112]

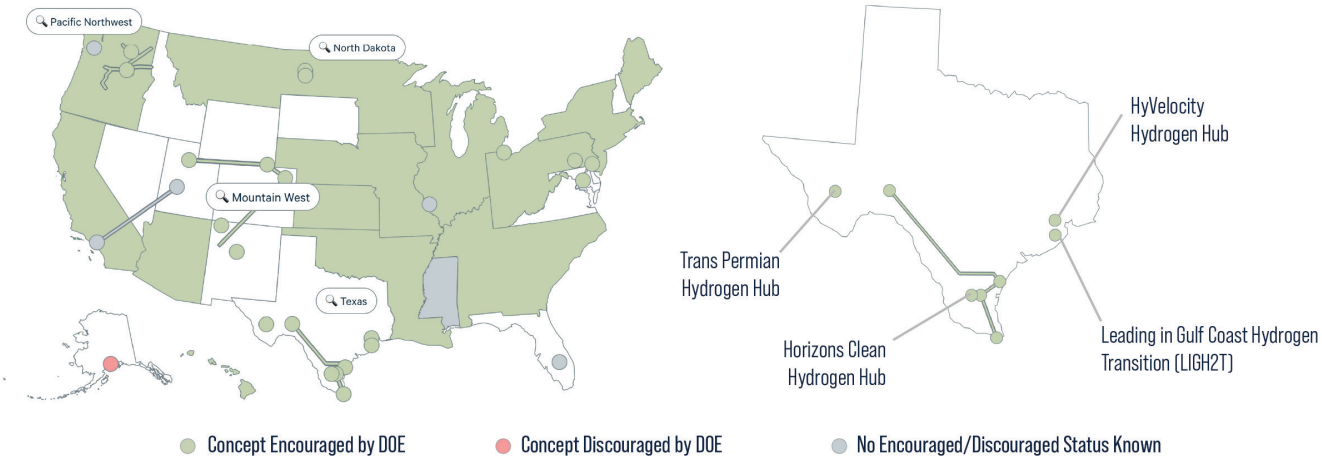


Figure 13: Proposed hydrogen hub projects in the U.S. (green denotes a DOE "Encouragement" status)[115]

In addition to the hubs, several other green hydrogen projects are getting underway. This includes a $4 billion green hydrogen plant in North Texas being developed by AES Corporation and Air Products[113] as well as a $6 billion efuel production facility led by HIF Global, Siemens Energy, and Bechtel that will include a major green hydrogen component.[114] As Treasury solidifies its rules regarding green hydrogen definitions and energy communities (see Section 4), more projects in pre-concept and pre-planning stages are anticipated to move forward quickly.

APPENDIX C: Understanding the Intervention Tools

Media

There are a number of media streams that are important for branding and disseminating information to the public and key stakeholders. This includes **owned media**—channels that organizations can use to publish messaging directly through its own social media, newsroom and newsletters, and website. Owned media has the advantage of being editorially under the control of the organization's team, meaning that any messaging that is deemed important can be shared so long as internal communications teams approve. The limiting factor is trust, insofar as an organization's default audience is reasonably like-minded and the general public beyond this audience may be skeptical or unwilling to engage with branded media. Second, **paid media**, which denotes paid placement such as advertisements and educational programming. This channel can be effective for delivering messages broadly while still retaining editorial control. Finally, and typically most trusted, is **earned media**. Accessing this channel requires earning someone external's approval for a message, such as a journalists, government officials, nonprofit organizations, institutions such as high education, and community leaders. Earned media can carry much higher degrees of trust if delivered through the right messenger. In the context of communication with communities in Appalachia and Texas, earned media will play a key role in maximizing message effectiveness.

Information Gathering

Organizations can also play an important role in gathering information to inform messaging campaigns through tools such as **polling, data analysis,** and **direct stakeholder engagement**. Polling can be useful, for example, to understand local sentiment toward certain projects and initiatives, or to understand the effectiveness of advertising and outreach campaigns. Data analysis is a broad category which can be applied in myriad ways. The Twitter analysis described in Appendix E is one example of applying data analysis to stakeholder mapping. Finally, taking advantage of extensive partner networks in the clean energy sector, firms can engage directly with corporate leaders to gather information about the challenges and opportunities related to project implementation in specific regions.

Convening

Stakeholder convening plays an important role in building consensus and momentum for the kinds of projects that the IRA will support in these regions. Organizations can organize **events and community roundtables** to provide a forum for exchanging thoughts and educational programming at a local level. Given potential biases inherent in an organization's brand (e.g. clean energy focus) and potential trust issues with communities as an outsider organization, it can be more effective to partner or even serve as a behind-the-scenes supporter of events and roundtables hosted by trusted community organizations. In the business sphere, organizations should also take advantage of the unique ability to **convene founders, philanthropists, government officials** and other project stakeholders. In this space external organizations such as leading investors and thought leaders in the decarbonization and public policy space can lend authority to the conversation.

Funding

Grant programs provide a unique opportunity to support local actors who are furthering clean energy transition work. Grants can be provided to non-profit, lobbying, and professional trade organizations operating at the national, regional, and local levels. Grant funding can support activities such as convening and coalition building, education, advocacy, media, polling, and capacity building.

Applying the Tools

Each initiative will include a combination of applying proven engagement frameworks with bespoke planning and execution specific to the region and intended outcome. How the audience wants to be communicated with–and through what lens–will serve to shape the messaging and channels. For example, a trusted community leader speaking about jobs and economic growth benefits presents a different message than a local non-profit discussing business investment opportunities.

Effective messaging is typically limited to three to five core messages to avoid confusion. This is particularly important for more technical topics like green hydrogen where presenting too much information can serve to overload and disengage recipients. These three to five core messages should be repeated consistently and often by a range of figures to maximize impact. Humans rely on what behavioral science dubs the 'availability heuristic,' which is the tendency to use information that can be quickly recalled. This tendency relies on three components that should be considered when designing a messaging campaign: vividness, recency, and repetition. In addition, messaging should be tailored to focus on *values* rather policies, which includes avoiding jargon even as common in the clean tech world as "carbon"—a term with little tangible meaning to everyday life.

APPENDIX D: Recommendation Criteria-Scoring Matrix

	Human Capital	Financial & Physical Capital	Political Will
Recommendation 1A: Invest in Workforce Capacity	**High** Investments in workforce capacity contribute directly to the human capital of each region. This includes closer skills matching to clean energy job needs, plus a more equipped and adaptable workforce.	**Medium** Investing in workforce capacity brings secondary benefits to financial and physical capital, such as helping build the case for outside firms to invest in the region.	**High** A workforce that is more equipped with clean energy-related skills will also be more supportive of policies that encourage job opportunities in the sector.
Recommendation 1B: Investing in Building Organizational Capacity	**High** Supporting the ability of organizations to respond to funding opportunities and engage with stakeholders strengthens the region's ability to govern its own approach to the clean energy transition.	**Low** Organizational capacity building has limited effects on the financial and physical capital of the region.	**Medium** Stronger home-grown organizations and agencies will be able to play a larger role in supporting policies and projects that further the clean energy transition.
Recommendation 2: Government and Private Sector Summits	**Low** Summits focused on government decision makers and corporate leaders have limited impact on the human capital of entities on the ground.	**High** Engagement between government and private sector leaders can play a major role in unlocking financial resources (e.g. grants, loans, outside investment).	**High** A key outcome of convening these stakeholders is improved political will to support cleantech sectors in the region.
Recommendation 3: Public Information Campaigns for Hydrogen	**Low** Information campaigns do little to grow human capital.	**Low** Information campaigns do little to grow financial and physical capital	**High** Information campaigns go a long way toward fostering durable political will. A more informed public on issues like hydrogen can play an important role in supporting expansion of the industry.
Recommendation 4: Bridge the Capital Funding Gap	**Low** Increasing access to capital funding does little to grow human capital.	**High** Increasing the options to access additional capital funding streams plays a major role in delivering much needed financial capital.	**Medium** Reducing or eliminating the capital gap can go a long way in building political support. Projects that can readily access the funding they need to be feasible can be much easier to support politically.
Recommendation 5: Support Local Entrepreneurship Accelerators	**Medium** Accelerators can play an important role in building the human capital of a region specifically related to entrepreneurial skillsets. This supports the founding and scaling of home-grown businesses.	**Medium** Entrepreneurs who go through accelerator programs are more likely to have the tools and networks to access financial capital for building and scaling businesses.	**Medium** A higher prevalence of home-grown cleantech companies, particularly if employing primarily local workers, can improve the political to support for the sector at the local, state, and federal level.

APPENDIX E: Twitter Analysis

To expand our stakeholder search to identify actors that serve as key communication connectors within networks, we conducted an analysis of Twitter activity across Appalachia and Texas specifically related to IRA and climate topics.

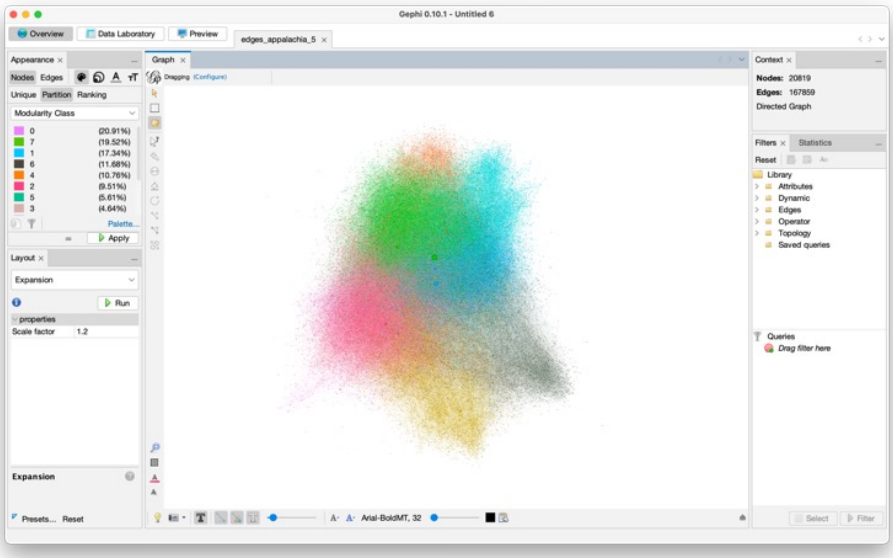


Figure 14: Initial visualization of 5,000 accounts, colored by modularity community

The following steps were taken to conduct the analysis:

Step 1: Identified the following seven relevant Twitter accounts as initial inputs
Appalachian Voices (@AppVoices)
Appalachian Regional Commission (@ARCgov)
Dominion Energy (@DominionEnergy)
UT Energy Institute (@EnergyUT)
The AES Corporation (@TheAESCorp)
Texas Solar Power Association (@txsolarpower)
United Mine Workers (@MineWorkers)

Step 2: Employed a pre-existing Twitter API tool that searched all followers of each of the seven input accounts, scanned their previous 150 tweets for mentions ("@" tags), and gathered a list of all mentioned accounts. The tool repeated this process several times with the subsequent Twitter accounts. In all, the tool scanned more than 165,000 connections across 20,000 Twitter accounts.

Step 3: Extracted the 5,000 more relevant accounts, including nodes (the individual accounts) and edges (connections between accounts) algorithmically organized into seven "modularity communities."

Step 4: Across each modularity community, identified the 50 most active accounts by in-degree (i.e. how many other accounts mentioned the account in their last 150 tweets). Then proceeded to manually filter the 350 most active accounts by relevance to this work. For example, very active and widely followed accounts such as Elon Musk (@elonmusk) and The New York Times (@nytimes) were removed, leaving the top 200 most active, relevant accounts.

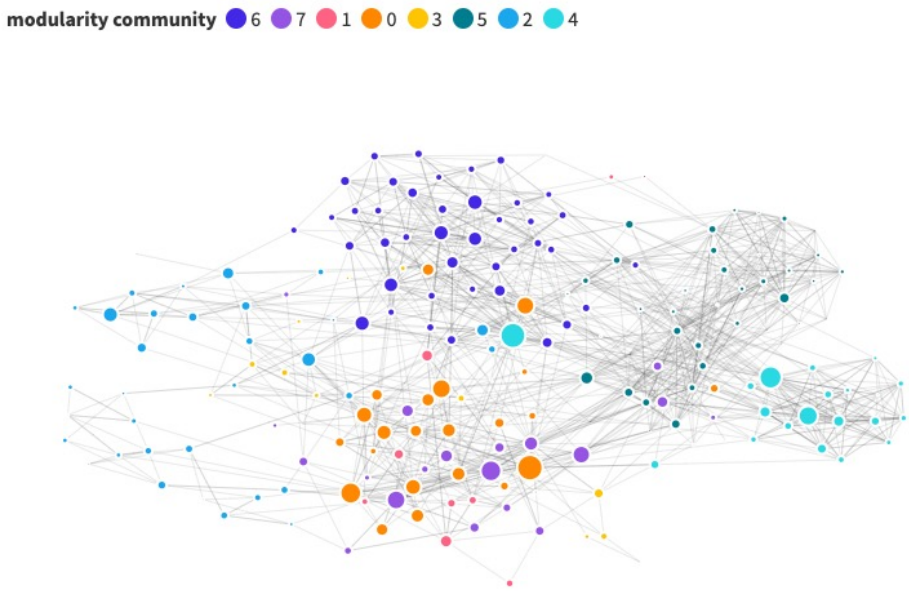


Figure 15: Visualization of the 200 relevant accounts across modularity communities

Step 5: In addition to the list, we used Flourish to create interactive visualizations of the various networks. This enabled us to identify key "bridge" accounts—those organizations and individuals that connected across modularity communities, regions and topics. It also allowed us to look at the key influencers within specific modularity communities.

Figure 16: Examples of key "bridge" organizations across modularity communities

Step 6: Applying this information, we used the analysis to cross-reference the engagement of the several dozen organizations and individuals we conducted interviews with during the course of this project and produced a list of most relevant accounts for further follow up.

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