

# The Changing Energy Landscape

and its impact  
on economic  
development in  
America



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*International Economic  
Development Council*

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# I. The changing energy landscape

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The story of American economic development is also the story of energy. The fortunes of communities have risen and fallen as new technology has unleashed growth and old methods have lost competitiveness. This reality continues to play out, with major implications for rural communities, regions, cities and states.

*The Changing Energy Landscape and its Impact on Economic Development in America*, a report from IEDC's Economic Development Research Partners, takes stock of these seismic trends and looks beyond the horizon toward America's energy future. *The Changing Energy Landscape* is divided into four chapters focused on coal, nuclear, oil and natural gas, and renewable energy.

Long the cornerstone of America's energy market, coal's gradual decline, and the fortunes of communities dependent on mining jobs, have seized national headlines and the attention of policymakers. What many perceive as a sudden downturn has in fact been a slow and steady decline for more than two decades. At least 21 states are coping with job losses and disinvestment as this once-dominant energy source falls out of favor. This includes not just rural Appalachia but places from Illinois to Wyoming. For energy-rich communities that did not need a true economic development office for decades, the foremost priority now is to diversify, and diversify fast. Retraining the displaced coal workforce remains a stubborn challenge, but many initiatives are showing promise.

More than any other factor, it's the fracking revolution that is most responsible for coal's eroding market share. What has been bad news for coal communities has been good news for shale regions, which are now in boom times. Thanks to hydraulic fracturing technology, these communities are also struggling to keep up with explosive growth and the sudden stress placed on public services. Fracking has unlocked previously unreachable oil and natural gas deposits, further solidifying the United States as a world energy power and inching it ever closer to energy independence. The paper discusses methods oil-rich states are using to create and refine trust funds that help communities weather price drops for this ever-volatile commodity.

While the decline of coal has dominated national attention, there's a quieter crisis on the horizon for another kind of energy community – those with nuclear power plants. American nuclear reactors are aging, and in addition to requiring costly renovations, many are losing ground to cheaper energy providers, namely natural gas. A nuclear plant closure presents challenges far beyond the loss of a typical primary employer. Reactors are usually located in rural areas, and account for a large share of surrounding communities' highest-paying jobs. And because the property must house radioactive waste for many years, redeveloping the site is not possible. And unlike, say, a military base closure, there's no federal agency to come in and help.

"Nobody owns this problem," said Adam Grinold, executive director of the Brattleboro Development Credit Corporation in Vermont, at IEDC's FED Forum in March. It fell on Grinold and his organization to champion diversification efforts after the closure of the Vermont Yankee Nuclear Power Plant. Luckily, his organization anticipated the closure years in advance and had a strategy in place. Grinold cautioned other nuclear communities to "plan early, plan loudly, and implement, implement, implement."

This report closes with a look at the rise of renewable energy. Although green energy accounts for just 10 percent of U.S. electricity generation today, it is growing fast, representing half of all capacity additions. By 2040, it is estimated that renewable energy will account for half of all U.S. electricity capacity. The country's fastest growing jobs are in wind turbine maintenance and solar installation, and manufacturing jobs in the sector are expanding too, creating opportunities for workers at both ends of the education spectrum. Increasingly, corporations are seeking renewable energy access when making location decisions, both for cost-saving and corporate social responsibility reasons. Communities that can meet this demand are gaining competitiveness in business attraction.

### **Solutions-focused case studies**

Economic developers are rising to the challenges and opportunities stemming from the changing energy landscape. This report highlights strategies used by states and local communities to manage growth and diversify in the face of declining industries. Just a few of the stories from across America include:

- *Appalachian Sky, a tri-state industrial network is retraining out-of-work coal miners for jobs in aerospace manufacturing.*
- *As an early mover in wind energy, Iowa has become a hotbed for data centers, as environmentally conscious tech companies gobble up renewable-powered real estate.*
- *SoloWorks in New Mexico is removing geographic barriers to job access by connecting rural communities to nationwide remote work opportunities.*
- *Buffalo, New York, is reimagining its manufacturing past in a cleaner image, with the United States' first net-zero emissions industrial park.*
- *In South Texas, the Eagle Ford Shale Community Development Program is creating a playbook for energy communities struggling to provide housing and services for a booming population.*
- *In Arlington, Virginia, an article on a local news site about the county's LEED Platinum green energy certification saw a spike in Internet page views from a specific location: Amazon's headquarters in Seattle. Northern Virginia is a finalist in the location search for the company's second headquarters.*

## II. Coal as a cornerstone

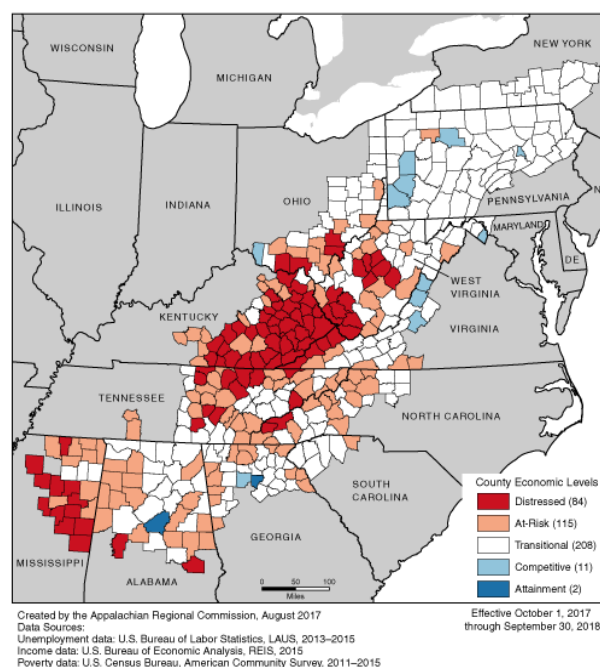
Coal holds a unique place as both a cultural and economic cornerstone for several American regions. For decades, coal mines and coal-fired power plants, as well as the transportation and logistics networks that service them, have employed generations of families and brought economic prosperity to their communities. Coal became essential to economic security and was fundamentally incorporated into the pride and cultural heritage of many communities.

The longest-standing communities that have economically benefitted from coal are in and around the Appalachia region, notably Kentucky and West Virginia, as well as Indiana, Illinois, Maryland, Missouri, Ohio, Pennsylvania, Tennessee, and Virginia, to varying degrees (*see Coal Communities in Appalachia*). Coal communities in the West, notably Wyoming, as well as Colorado, Idaho, Montana, New Mexico, North Dakota, South Dakota, and Utah have all considered coal a primary industry. States that have benefitted from coal's secondary economic impacts include Mississippi, Louisiana, and Texas. Each of these 21 states has faced economic and social impacts due to the decline of the coal industry.

It is easy to understand why the decline of coal has brought turbulence to many American communities. It has impacted businesses of all sizes, eliminating jobs and contributing to persistent poverty, community tension, and in some cases, resistance to adopting new forms of energy. These impacts present numerous challenges to community leaders and economic developers who are working to revive local and regional economies. Out of necessity, economic diversification efforts have become a core practice for many economic developers.

### ***Coal Communities in Appalachia***

Source: Appalachian Regional Commission



## *Understanding the decline of coal*

U.S. energy production faced tumultuous changes over the last 15 years, many of which heralded the decline of coal as a primary energy product. Competing resources such as natural gas and renewable energy are transforming the energy market. Their lower production costs threaten higher-cost coal producers. The rise of natural gas has especially contributed to coal's decline, as businesses adopt this more cost-effective power source.

Additionally, global changes in demand and regulatory policies have changed the energy landscape. International demand for coal is expected to remain stagnant over the next five years, as large countries including China and India increasingly prioritize other energy sources. The largest global coal consumer, China has begun to decrease its coal output to reduce air pollution. Additionally, the building boom in China has slowed significantly, reducing the country's demand for steel, a coal-intensive product.<sup>1</sup>

Concerns over climate change have shifted consumption away from coal-generated energy, with many nations pledging to reduce coal use in accordance with the Paris Climate Agreement.<sup>2</sup> The Barak Obama Administration's 2015 Clean Power Plan set emissions-reduction targets for American coal-fired power plants, which led to intense pressure on coal producers.<sup>3</sup> These dynamics all contributed to the destabilization of the coal industry and coal-dependent communities.

Historically, coal dominated the American energy market. However, negative trends in the coal industry have considerably reduced its role in electricity generation. Between 2000 and 2008, coal accounted for approximately 50 percent of U.S. electricity generation.<sup>4</sup> By 2016, just 30 percent of electricity was produced by coal. Natural gas, which has eclipsed coal as the nation's leading energy source, is responsible for 34 percent of power generation.<sup>5</sup>

In 2015, the Appalachian Basin's coal production was 40 percent less than its 2010 to 2014 annual averages.<sup>6</sup> Market values for West Virginia coal producers have declined by as much as 92 percent.<sup>7</sup> In Eastern Kentucky, coal mining has faced a steady 25-year decline, resulting in a 79 percent decrease from peak production. Consequently, coal employment fell by 27 percent between 2005 and 2015, most significantly affecting Central Appalachia.<sup>8</sup> Coal-dependent communities face significant socioeconomic challenges in the wake of these changes. Several coal states deserve mention below.

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<sup>1</sup> Nina Chestney, "[Growth in global coal demand subdued over next five years: IEA](#)," *Reuters*, December 18, 2017.

<sup>2</sup> James Van Nostrand, "[Why the U.S. Coal Industry and Its Jobs Are Not Coming Back](#)," *Yale Environment 360*, December 1, 2016.

<sup>3</sup> Janet McCabe, "[Clean Power Plan: Power Plant Compliance and State Goals](#)," U.S. Environmental Protection Agency Blog, August 4, 2015.

<sup>4</sup> Charles D Kolstad, "What Is Killing the US Coal Industry?," Stanford Institute for Economic Policy Research, March 2017. <https://siepr.stanford.edu/research/publications/what-killing-us-coal-industry>

<sup>5</sup> "[Total Energy](#)," U.S. Energy Information Administration, 2018.

<sup>6</sup> James Van Nostrand, "[Why the U.S. Coal Industry and Its Jobs Are Not Coming Back](#)," *Yale Environment 360*, December 1, 2016.

<sup>7</sup> Worland, Justin, "[Coal's Last Kick](#)," *Time Magazine*.

<sup>8</sup> Eric Bowen et al, "[An Overview of the Coal Economy in Appalachia](#)," West Virginia University, January 2018.

### *America's largest producer – Wyoming*

Despite a population of just 600,000, Wyoming is a major energy player. In 2016, the Cowboy State topped the list, accounted for 41 percent of all U.S. coal production. Wyoming's economic situation is unique, as the federal government owns approximately half of the state's land, including its major tourist destinations.<sup>9</sup> Tourism and mineral extraction are the state's main economic drivers. Natural attractions like Yellow Stone National Park draws millions of visitors each year and significantly contribute to state revenues. Mineral taxes, however, are the state's main source of income, benefiting from Wyoming's productive coal and oil industries.<sup>10</sup> Although the state ranks highly on several socioeconomic indicators, including an education system ranked 12<sup>th</sup> nationally, Wyoming's economy trails behind most of the country. It ranked 41<sup>st</sup> according to McKinsey.<sup>11</sup> Wyoming's job market suffers due to declining coal production and unsteady oil prices, with state employment growth ranked 49<sup>th</sup> in the country.<sup>12</sup>

Wyoming has faced economic hardship in recent years with closures of major coal plants, resulting in thousands of layoffs. Arch Coal and Peabody Energy, owners of America's two largest coal mines, declared bankruptcy in 2016, cutting some 2,500 jobs in the Town of Gillette (pop. 32,000) alone.<sup>13</sup> Like many other Wyoming coal communities, Gillette is now dealing with a population exodus.

Additionally, many communities face devaluation of industries and real estate. Campbell County, for example, lost \$1.1 billion in its value assessment after a \$700 million decline in the local coal industry.<sup>14</sup> The state government is also experiencing considerable losses in tax revenue from coal producers and their employees. In 2017, Wyoming lost \$157 million in the face of declining coal production.<sup>15</sup> To diversify its economy, the state is investing heavily in public education through the University of Wyoming and other structural initiatives to improve the economy.<sup>16</sup>

### *Economic history based on coal – West Virginia & Kentucky*

West Virginia is the nation's oldest and second largest coal producer, providing 11 percent of U.S. coal in 2016.<sup>17</sup> The state's economy depends heavily on mineral extraction and falling coal production has led to significant socioeconomic challenges. West Virginia's economy currently ranks 49<sup>th</sup>, with one of the

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<sup>9</sup> "[Best States for Business: Wyoming](#)," *Forbes*, November 2017.

<sup>10</sup> Allen Best, "[The challenge of job losses in coal communities](#)," *Mountain Town News*, June 2017.

<sup>11</sup> "[Best States: Wyoming](#)," *U.S. News & World Report*.

<sup>12</sup> *Ibid.*

<sup>13</sup> Alan Propp, "[Beyond the Coal Boom: Powder River Basin Residents Look to a Diversified Future](#)," Stanford University, March 6, 2017.

<sup>14</sup> "[Wyoming county sees a \\$1.1B drop in assessed valuation](#)," *Casper Star Tribune*, June 29, 2017.

<sup>15</sup> Alan Greenblatt, "[In Life After Coal, Appalachia Attempts to Reinvent Itself](#)," *Governing*, December 2016.

<sup>16</sup> Allen Best, "[The challenge of job losses in coal communities](#)," *Mountain Town News*, June 2017.

<sup>17</sup> "Where the United States gets its coal," U.S. Energy Information Administration, December 18, 2017. [www.eia.gov/energyexplained/index.cfm?page=coal\\_where](http://www.eia.gov/energyexplained/index.cfm?page=coal_where)

highest unemployment rates in the nation, the second lowest median household income, and the lowest job growth rating.<sup>18</sup>

Many communities in West Virginia have struggled to stay afloat as coal mines close and previously well-paying jobs have disappeared. Absent economic diversification, these communities have continued to depend on at-risk industries and faced continued employment losses. Two counties, Mingo and Boone, are designated as “depressed” by the Appalachian Regional Commission (ARC), its



**A coal mine in West Virginia**

Source: [Michigan Radio](#) / Creative Commons License [CC BY-NC 2.0](#)

most severe classification of economic distress.<sup>19</sup> The State of West Virginia; federal agencies including the ARC and U.S. Economic Development Administration (EDA); U.S. Department of Labor; many businesses and utilities such as American Electric Power; as well as local, regional, and national nonprofit organizations are working to help revitalize coal-impacted communities.<sup>20</sup>

Kentucky is the third largest coal producer in the U.S., supplying six percent of the nation’s coal in 2016.<sup>21</sup> Kentucky has been more successful in economic diversification efforts, drawing upon manufacturing, aerospace, primary metals and services in addition to its coal production. Nevertheless, the state still lags on several socioeconomic indicators. Kentucky ranks 40<sup>th</sup> overall in economic performance, with low job growth rates, high unemployment, and one of the nation’s highest poverty rates. Kentucky also ranks 41<sup>st</sup> in higher education, with lower rates of overall educational attainment.<sup>22</sup>

Coal production in Kentucky hit a 35-year low in 2016.<sup>23</sup> Eastern Kentucky, where there is a higher concentration of mines, has felt considerable economic challenges in the wake of coal’s decline. Since 2001, the number of mining jobs dropped from 30,000 to less than 4,000.<sup>24</sup> ARC designates five Eastern Kentucky communities as depressed: Harlan, Leslie, Martin, Pike, and Perry counties.<sup>25</sup>

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<sup>18</sup> “[Best States: West Virginia](#),” *U.S. News & World Report*.

<sup>19</sup> Randall Jackson et al, “[An Economic Analysis of the Appalachian Coal Industry Ecosystem](#),” West Virginia University, January 2018.

<sup>20</sup> See Appendix for a list of federal resources.

<sup>21</sup> “[Where the United States gets its coal](#),” U.S. Energy Information Administration, December 18, 2017.

<sup>22</sup> “[Best States: Kentucky](#),” *U.S. News & World Report*.

<sup>23</sup> Alan Greenblatt, “[In Life After Coal, Appalachia Attempts to Reinvent Itself](#),” *Governing*, December 2016.

<sup>24</sup> *Ibid*.

<sup>25</sup> Randall Jackson et al, “[An Economic Analysis of the Appalachian Coal Industry Ecosystem](#),” West Virginia University, January 2018.



As in West Virginia, public and private organizations are working in pursuit of economic diversification and both short- and long-term recovery and economic resilience strategies.

### *Coal-fired power plants*

In recent years, coal-fired power plants have closed across the U.S. at unprecedented rates due to a combination of economic and regulatory factors, with more closures to come. As the economic competitiveness of coal has declined, plants have collectively laid off thousands of workers across the nation and retooled or closed. Rising coal prices and falling electricity prices, along with reduced productivity, have made it difficult for many coal-powered plants to sustain previous revenue levels. Additionally, sluggish electricity demand has made less-efficient energy sources, such as coal, less attractive than lower-priced natural gas.<sup>26</sup> Changing regulatory policies have also contributed to plant closures. The 2015 Clean Power Plan set emissions reduction targets for power plants, placing further pressure on struggling facilities.<sup>27</sup>

Many of the plants slated for closure are smaller, older and less productive, as 88 percent of all coal-fired capacity was built between 1950 and 1990.<sup>28</sup> The average capacity factor of coal generators dropped from 73 percent to 53 percent between 2008 and 2016.<sup>29</sup> More than 420 coal plants closed from 2010 to 2017, representing more than 60 gigawatts (GW) of electricity generation, which has primarily been replaced by competing sources -- namely natural gas and renewable energy.<sup>30</sup> Coal-fired power plants representing 21.1 GW of electricity are planned to close by 2020, and an additional loss of 19.3 GW of electricity due to coal plant closures post-2020 is anticipated.<sup>31</sup>

### *Economic development initiatives in coal-impacted communities*

One of the most significant problems facing coal-impacted communities is a lack of economic diversity. When economies are dependent on a single industry, they are highly vulnerable to price changes, market shifts, and competing technologies. With the decline of their traditional economic mainstay, many coal communities have faced high rates of poverty, drug abuse, and educational deficits. These losses have had significant multiplier effects on small businesses, which have suffered from less local spending as well-salaried jobs have vanished. Furthermore, coal's decline is felt throughout supply chains, as industries that have provided goods directly and indirectly to coal companies have also suffered.<sup>32</sup>

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<sup>26</sup> Jason Bordoff, "[Can Coal Make a Comeback?](#)," Columbia University School of International and Public Affairs Center on Global Energy Policy, April 25, 2017.

<sup>27</sup> Janet McCabe, "[Clean Power Plan: Power Plant Compliance and State Goals](#)," U.S. Environmental Protection Agency Blog, August 4, 2015.

<sup>28</sup> "[Most coal plants in the United States were built before 1990](#)," U.S. Energy Information Administration, 2017.

<sup>29</sup> "[Electric Power Monthly](#)," U.S. Energy Information Administration, March 23, 2018.

<sup>30</sup> "[Coal-Fired Electricity Generation in the United States and Future Outlook](#)," M.J. Bradley & Associates, August 28, 2017.

<sup>31</sup> Ibid.

<sup>32</sup> Randall Jackson et al, "[An Economic Analysis of the Appalachian Coal Industry Ecosystem](#)," West Virginia University, January 2018.



The decline of a traditional industry means less tax revenues for state and local governments, making it harder to finance economic and workforce development efforts.<sup>33</sup> Nevertheless, public and private sector actors are working in cooperation to revitalize coal communities through economic diversification, workforce training, and business development programs. In many cases after years of relying on a single industry, some coal-impacted communities are employing economic development professionals and programs for the first time. Although there is no “one-size-fits-all” solution, economic developers and community leaders are uncovering best practices to dealing with the losses.

#### Promising economic development practices in coal communities

- Engaging communities more in **economic development strategic planning** and Comprehensive Economic Development Strategies (CEDS)—incorporating visioning, strategies, initiatives and prioritized projects that will support businesses and residents. Such efforts require an analysis of what’s really happening with local and regional economies by the numbers and through community engagement, identifying regional strengths and weaknesses, creating new strategies, initiatives and specific projects—including improving infrastructure—as well as growing partnerships to funnel new resources (both in human capacity and financial support) to help;
- Focusing on **workforce development**, including retraining workers based on identification of transferrable skills, retraining workers for completely different jobs;
- Making additional efforts at **neighborhood and community revitalization** to make home towns more attractive for both existing and new businesses, and retention of workers that may otherwise choose to leave;
- Employing a holistic approach to promoting and nurturing **entrepreneurship and small business development**;
- Undertaking more initiatives to communicate and build relationships with existing businesses to respond more effectively to their needs—a practice known in the economic development profession as **business retention and expansion (BRE)**;
- **Marketing and attracting new businesses and industries** that will bring new jobs to coal-impacted communities.

Below are some examples of communities and regional partners that are undertaking one or more economic diversification and business improvement efforts.

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<sup>33</sup> [“Build a Better Future for Coal Workers and Their Communities,”](#) *The Brookings Institution*, April 25, 2016.

### *Case study: Regional strategy – Appalachian Sky*

Appalachian Sky is an industrial network in a tri-state aerospace region, incorporating workers and businesses in Ohio, Kentucky, and West Virginia. Launched by American Electric Power (AEP) in 2017, the program aims to develop the region into a leading aerospace manufacturing hub. A workforce analysis funded by AEP subsidiary Kentucky Power found that the metalworking skills of former coal miners and steelworkers were highly transferable to the aerospace industry. Appalachian Sky uses this specialized workforce to create a strong regional industrial cluster of aerospace manufacturing and metal companies. The network highlights each state's competitive advantage, leveraging skilled workers, educational institutions, military facilities, infrastructure, low-cost utilities, and existing aerospace industries to create a multi-faceted alliance of workers, employers, and community partners.

The tri-state region is home to more than 150 aerospace industries and service providers. In Ohio, the Southwestern Ohio Aerospace Manufacturing Community promotes business opportunities with original equipment manufacturers (OEMs) and suppliers. Additionally, Ohio is home to the nation's largest Air Force base, Wright-Patterson, which employs more than 27,000 and offers opportunities for aerospace procurement and contracting. Kentucky presents useful aerospace contracting opportunities, especially through the U.S. Department of Defense. In West Virginia, the Huntington Tri-State Airport is an essential commercial and passenger hub, providing transportation infrastructure for businesses of all sizes.

Appalachian Sky brings in partners from across industries. The Ashland Alliance, economic development organizations, and the Morehead Space Science Center, incorporate development-based and academic goals. The Huntington Area Development Council also brings in different types of organizations, including the regional airport, economic development organizations, and public institutions. Regionally, One East Kentucky contributes additional airports and economic development organizations, while also partnering with the Morehead Space Science Center. Transportation needs are further satisfied by the Southern Ohio Port Authority, which works with the Greater Portsmouth Airport and JobsOhio, a statewide economic development organization. Appalachian Sky's diverse partnerships ensure that many different goals and needs are addressed, creating an economically resilient region.

The program has already attracted new businesses to the region. In April 2017, Braidy Industries announced plans to build a \$1.3 billion aluminum rolling plant within the Kentucky Power service area. The site is expected to provide approximately 1,000 temporary construction jobs and 550 permanent manufacturing jobs upon opening in 2020.<sup>34</sup>

In the face of coal-related economic decline, networks such as Appalachian Sky help diversify economies and create new sources of regional strength. Strategically targeting areas of competitive advantage, these networks identify and build upon existing assets while also creating new economic opportunities. Appalachian Sky also demonstrates how to successfully bring many different stakeholders into one project. Its network draws on partners in economic development, as well as both public and private industry leaders including aerospace companies, research institutions, and utility providers. These

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<sup>34</sup> ["Supporting Appalachia,"](#) American Electric Power.

diverse organizations can unite under the common goal of growing the regional economy, each contributing essential skills, knowledge, and services.

### *The coal workforce*

As mines and coal-fired power plants have downsized, closed or retooled, thousands of workers across America with specialized skills have lost their jobs. Many have had a difficult time earning equivalent salaries and benefits, either from an inability to find alternative employment within their commuting radius, a lack of skills or education relevant to other jobs, or other issues related to market demand.

Many workforce development programs in coal communities focus on job search support and retraining aimed at reducing the skills gap and enabling unemployed workers to re-enter the job market after gaining additional education. For example, Kentucky Teleworks and the Kentucky POWER Dislocated Worker Grants aim to connect rural workers and employers through internet-based programs. This has required funding for both the installation of broadband internet where it previously did not exist and for workers to receive training in new information technology (IT) roles.<sup>35</sup> The joint aim of these programs is to enhance regional connectivity, and to employ workers directly in building the requisite infrastructure.

### *Case study: Removing geographical barriers – SoloWorks, New Mexico*

Technology enables people to work from anywhere, and SoloWorks is a program that aims to bridge the gap between New Mexico's remote workers and national employers. SoloWorks identifies residents to participate in full-time remote work and provides training services. The program removes locational disadvantages for anyone who can learn to work online.

SoloWorks primarily targets remote workers, or "Solopreneurs," and entry-level job seekers, drawing from three main sources: W2 employees, 1099 contractors, and aspiring entrepreneurs. After participants receive training, the program places workers with one of its many partner employers. Employees can choose to work from home, but SoloWorks also provides co-working spaces. As participants gain experience, SoloWorks helps them advance to higher-paying jobs.

SoloWorks is a collaborative employment project, spearheaded by four organizations: CELab is a nonprofit think tank in Albuquerque focused on economic and workforce development; DigitalWorks promotes economic development through broadband technology, connecting remote workers and partner employers; CirclesUSA helps employ impoverished community members through mentorship and training programs; and FatPipe ABQ provides co-working space, incubates businesses, and coaches entrepreneurs. SoloWorks also partners with more than 70 national employers to place workers.<sup>36</sup>

SoloWorks follows seven steps: marketing, screening, admittance, training, placement, earning, and thriving. It is designed to follow five different program models to flexibly accommodate the needs of

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<sup>35</sup> Adija Manley and Christina Simeone, "[Revitalizing Coal Communities: A Review of Strategies to Assist Coal Communities in a Challenging Economy](#)," University of Pennsylvania, Kleinman Center for Energy Policy, December 20, 2016.

<sup>36</sup> "[SoloWorks](#)," CELab,

different types of workers. When the program spreads to new locations, it goes through 13 principal stages:

1. Community assessment
2. Dedicated facility (broadband, workspaces)
3. Training proctor and site manager
4. Funding for startup costs
5. Community partnerships
6. Marketing strategy
7. Screening and Testing
8. Training of proctor (by DigitalWorks)
9. Center rules
10. Job placement module
11. Solopreneur module
12. Entry-level module
13. Retention and advancement

SoloWorks also incorporates community ecosystem building, working to create an environment where employees can thrive. This involves connecting workers and employers with resources like advancement counseling, career development, co-working space, IT support, daycare, healthcare, incentives, shared business services, and concierge services.

SoloWorks is still in its development stages and received public funding in 2016 from the New Mexico Economic Development Department (NMEDD) which helped set the stage. In 2017, NMEDD created 775 rural jobs and it aims to create 1,200 jobs annually over the next three years. NMEDD's success is encouraging, but more time and data are needed to shed light on the program's strengths and weaknesses. Current estimates suggest SoloWorks is successfully creating economic base jobs and has the potential to be one of the most cost-effective means of doing so.

"The SoloWorks model can be replicated in other areas where rural workers need more opportunities to connect with employers, such as the many communities currently suffering from coal-related economic decline in Eastern Kentucky and West Virginia," said Mark Lautman, founder of CELab. He continued to say "This publicly funded model which we originally developed to retrain and connect former coal workers to remote employers can potentially ease the economic impacts of coal's decline and contribute to positive economic development and job creation in these communities."

### ***Brownfield redevelopment and infrastructure investment***

Brownfield redevelopment programs, both publicly and privately initiated, reclaim and reuse land from abandoned coal mines and coal-fired power plants, as well as other real estate left polluted or vacant due to changes in the energy sector. In coal communities, these efforts have often gone together with business attraction efforts, which require financing and technical assistance. Such sites may also be attractive for existing business expansions and entrepreneurs.

For example, in Mingo County, West Virginia, regional and local partners are working together to develop reclaimed land for agricultural production. The Health and Innovation Food Hub, part of the area's Regional Economic Diversification Project, provides mentorship and business incubation services to encourage the agriculture industry.<sup>37</sup>

Additionally, business development in coal communities relies on enhanced connectivity to outside markets and businesses. Since many rural communities lack the infrastructure and technology to connect through the internet, broadband development is essential to education for residents and businesses. One public program, KentuckyWired, is building fiber optic cable throughout the state. The program's strategy is to build enough broadband infrastructure to attract public and private organizations to finish the "last mile" that connects homes and businesses.

### *Case study: Utility companies as partners – American Electric Power*

With access to infrastructure, funding, and resources, utility companies present a reliable source of economic development support, especially in communities working to transition away from coal-based economies. American Electric Power's (AEP) economic development efforts show how utility providers can help communities navigate difficult transitions.

Through cross-industry partnerships and community programs, AEP's economic development program brought 124 projects and more than 18,000 jobs to its service area in 2016.<sup>38</sup> AEP also funds a range of initiatives in Appalachia, including fiber optics equipment for technical colleges, water feasibility studies, and manufacturing job retention programs.<sup>39</sup>

The company also helped mitigate job losses and tax-base reductions resulting from the closure of seven coal-fired power plants. Some affected employees elected to retire, but many were offered similar jobs at other plants or opted to retrain as mechanics to serve AEP's transmission network.<sup>40</sup>

AEP also developed financial incentives to encourage companies to repurpose retired coal plants. The Big Sandy Plant in Inez, Kentucky, for example, will be partially converted into a natural gas plant and partially redeveloped as an industrial park.<sup>41</sup>

Many coal plants also present advantageous features for other industries, such as riverfront accessibility and highway and rail connections. For instance, Tanners Creek, a retired AEP coal plant in Indiana, is being evaluated as a potential port site.<sup>42</sup> AEP sold the site to a brownfield redevelopment firm, which will take responsibility for the three- to five-year environmental remediation process. AEP also sold its

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<sup>37</sup> Adija Manley and Christina Simeone, "[Revitalizing Coal Communities: A Review of Strategies to Assist Coal Communities in a Challenging Economy](#)," University of Pennsylvania, Kleinman Center for Energy Policy, December 20, 2016.

<sup>38</sup> "[A National Leader in Economic Development](#)," American Electric Power Economic Development.

<sup>39</sup> "[Supporting Appalachia](#)," American Electric Power.

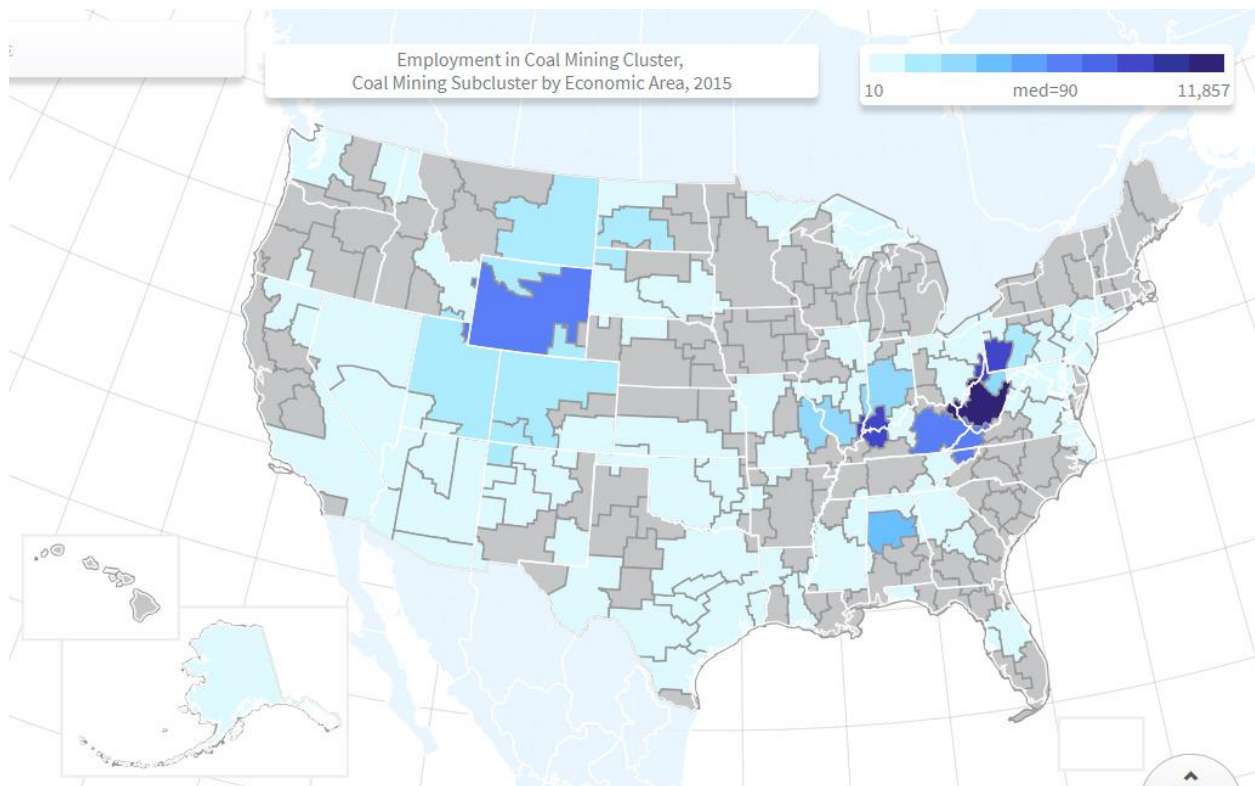
<sup>40</sup> Lee Buchsbaum, "[Supporting Coal Power Plant Workers Through Plant Closures](#)," *POWER Magazine*, June 1, 2016.

<sup>41</sup> The Associated Press, "[Kentucky Power converts Big Sandy coal plant to natural gas](#)," WSAZ NewsChannel 3, June 28, 2016.

<sup>42</sup> Thomas Overton, "[Second Life for an Indiana Coal Plant—as an Inland Port](#)," *POWER Magazine*, October 24, 2016.

retired Kammer Plant in West Virginia, which is being marketed as a petrochemical manufacturing zone to transform the Ohio River into a new “plastic belt.”<sup>43</sup>

“Though plant closures can have devastating effects on local coal communities, AEP’s investment in economic development grants and encouragement of site repurposing shows how utilities can participate in community-wide efforts to recover and grow,” said Mark James, Vice President of Economic and Business Development at AEP. “It’s the smart thing to do. Investing in development not only helps communities to recover and thrive; it also benefits AEP.”



Source: [U.S. Cluster Mapping Project](#), Institute for Strategy and Competitiveness, Harvard Business School. [Data Sources](#)

<sup>43</sup> Casey Junkins, “[Frontier Industrial Continues Redevelopment at Marshall County Plant Site](#),” *The Intelligencer*, April 2, 2017.

### III. Nuclear energy: headed for change

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Like the coal industry, nuclear power faces an uncertain future amid a changing energy landscape. The nuclear industry, too, faces the problem of age, with additional economic pressure caused by the rise of natural gas and renewables. Once hailed as the energy of the future, plant construction faltered in the late 1980s as environmental concerns, nuclear accidents, and increased regulation made the process more expensive. As a result, the nuclear infrastructure that is responsible for 19 percent of the United States' electricity needs is aging. Today, the average nuclear plant is almost 40 years old.<sup>44</sup> Although the Nuclear Regulatory Commission (NRC) has been flexible in granting license extensions, the regulatory process is quite complex and the ability for opponents to slow down the process is an ever-present threat. Additionally, it is questionable whether all currently operating plants will be granted further extensions. By renewal time, they will be 60 years old or older. Therefore, there is a threat of a “cliff” for nuclear plant closures in the coming decades. It is possible that the problem is even more serious, as many plants may not make it to the end of their regulatory life.



In recent years there has been a noticeable increase in the number of nuclear plant closures due to economic issues, politics, or damage. Since 2012, five plants were permanently shut down.<sup>45</sup> Nine additional plant announced they will close over the next eight years due to changing economic factors.<sup>46</sup> Many more economically vulnerable plants are likely to announce closures over the next few years.<sup>47</sup> Smaller plants with only a single reactor are especially vulnerable, as they cannot achieve economies of scale equivalent to multi-reactor plants. The main driver of these closures is competing forms of energy, with market liberalization and abundant natural gas reducing prices.

The decline of nuclear power is concerning for communities for many reasons. Because nuclear plants are generally in rural areas and are larger than other power plants, they represent a significant source of

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<sup>44</sup> [“List of Power Reactor Units,”](#) United States Nuclear Regulatory Commission, December 5, 2017.

<sup>45</sup> The five plants that were shut down are: Crystal River, FL, Fort Calhoun, NE, Kewaunee, WI, San Onofre, CA, and Vermont Yankee, VT.

<sup>46</sup> As of February 2018, the nine plants that have announced closures over the next eight years are: Devis-Besse, OH, Diablo Canyon, CA, Hope Creek, NJ, Indian Point, NY, Oyster Creek, NJ, Pilgrim, MA, Perry, OH, Salem, NJ, and Three Mile Island, PA.

<sup>47</sup> Mark Cooper, [“Renaissance in Reverse: Competition Pushes Aging U.S Nuclear Reactors to the Brink of Economic Abandonment,”](#) The Day Publishing Company, July 18, 2013.



jobs for the surrounding regions. Nuclear power jobs also pay considerably higher wages than other rural jobs, which further magnifies the impact of closures.

Although the decommissioning process provides jobs, they are typically temporary and lower-paying. It is forecasted that most closed nuclear plants will likely be placed in “safe storage” (SAFSTOR), where they are essentially mothballed, requiring minimal labor until “decontamination” (DECON) begins up to 55 years later.<sup>48</sup> The patterns experienced by many communities near closed power plants follow familiar themes: falling property values, higher unemployment, reduced budgets, higher taxes, and stagnation.

Thus far, communities that experience plant closures see negative economic impacts as a result. Zion, Illinois experienced an unexpected plant closure 20 years ago and is still struggling with many business closures and low population growth. Likewise, Vernon, Vermont, which lost the Vermont Yankee plant in 2014, experienced a large shock to its budget and a drastic drop in home values.



***Zion plant's spent fuel storage pad 15 years after closure.***

Source: [Larry Darling](#) / Creative Commons License [CC BY 2.0](#)

Even when there is plenty of time to prepare for a shutdown, the question of funding is a major issue. Although utilities are required to maintain trust funds for the decommissioning of each nuclear reactor, the money cannot be used for economic revitalization. If communities are aware of this early on and plan accordingly, local regulators can address this issue prior to plant closure by creating a trust fund for economic development to help mitigate the loss of jobs and tax revenue.

Some trends show promise. For example, new reactor designs collectively known as “small module reactors” (SMR) that are smaller than traditional reactors and capable of being stacked for flexible and efficient operation. The small size of the reactors makes them easy to transport, and they are manufactured as an off-the-shelf design, rather than constructed on site. The SMRs also offer safety benefits and reduce the impact of an accidents. These improved reactors could meet electrical needs and generate employment in rural communities. However, with smaller reactors already struggling in today’s deregulated energy market, the economics of SMRs remains unproven.

New techniques offer potentially shorter decommissioning timeframes. The Vermont Yankee Nuclear Power Plant in Vernon, for example, originally planned to commence dismantling the plant after 50 years of storage. However, there is a proposal before the Nuclear Regulatory Commission (NRC), the federal body that regulates nuclear plants, to sell the facility to a demolition company to complete the task by 2030.<sup>49</sup> This would create more job opportunities in the short-term and allow the land occupied

<sup>48</sup> “[Backgrounder on Decommissioning Nuclear Power Plants](#),” United States Nuclear Regulatory Commission, May 14, 2015.

<sup>49</sup> “[Vermont reactor dismantling accelerated to 2021; GE Hitachi joins forces with Southern Nuclear](#),” *Nuclear Energy Insider*, November 15, 2016.



by the site to be reused earlier.<sup>50</sup> As plants are usually situated on large bodies of water and offer access to electrical transmission, the land can be valuable for industrial reuse. This is complicated by the current lack of a federal plan for long-term storage of nuclear waste, as former nuclear plants must store their own waste onsite even after decommissioning is completed, which hinders land release and reduces value.

### *Plant closures: A looming problem?*

America's nuclear power plants are aging, representing a major challenge for regional generation capacity, and most especially for the communities that host these facilities. However, the economics of the plants have the potential to force plant closures much sooner. This has occurred due to a combination of factors, such as increased regulations following the 2011 Fukushima disaster in Japan. However, it is primarily driven by market forces. A surplus of low-cost natural gas produced by the fracking revolution and flat energy demand has driven the price of electricity to near-historic lows in some regions. Lower prices undermine the economic case for operating nuclear plants and make it especially difficult for operators to justify the expense of refueling and making upgrades, especially in aging plants that have less time available in their useful life to recoup costs.

The key problem is that the premise of nuclear power, inexpensive and zero-emission electricity generation, has been undermined by increasing regulation and aging infrastructure. Although nuclear power plants have low fuel costs, operation and maintenance expenses are much higher than fossil-fuel plants. This is compounded by the fact that nuclear power plants require long periods of downtime for refueling. Additionally, payrolls at nuclear facilities are considerably higher than at other sources because they require more and higher-skilled workers. The average nuclear plant employs approximately 900 people, compared to about 200 for a similarly sized coal-fired plant.<sup>51</sup> Maintenance costs are also high due to the ever-present challenge of radiation, safety procedures, and expensive infrastructure.

In the late 2000s, the San Onofre Nuclear Generating Station near San Clemente, California, replaced the steam generators in its two reactors for a total cost of \$780 million.<sup>52</sup> But in 2012, radioactive leaks were discovered in one of the replacement generators, and due to the high cost of repairs, utility operator Southern California Edison decided to retire both reactors.<sup>53</sup>

The Crystal River 3 Nuclear Power Plant in Florida faced a similar fate, when operator Progress Energy estimated repairs would range from \$1.5 to \$3.4 billion. Economically infeasible to repair, the reactor was forced to close after 32 years of operation.

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<sup>50</sup> Guy Page, "[Earlier decommissioning of Vermont Yankee has multiple benefits](#)," Ethan Allen Institute.

<sup>51</sup> Johnathan Cooper, "[The Pilgrim Nuclear Power Station Study](#)," University of Massachusetts Amherst, February 2016.

<sup>52</sup> Abby Sewell and Ken Bensinger, "[How San Onofre's new steam generators sealed nuclear plant's fate](#)," *Los Angeles Times*, July 13, 2013.

<sup>53</sup> Steven Mufson, "[San Onofre nuclear power plant to shut down](#)," *The Washington Post*, June 7, 2013.

At the same time, deregulation has significantly changed the energy market over the past two decades. A large percentage of the U.S.'s nuclear reactors operate in a deregulated energy market, so-called "merchant reactors," and sell their electricity at the market rate. As the price of electricity has fallen due to flat energy demand and inexpensive natural gas, many nuclear reactors have been forced to sell their power at below market rates. The Three Mile Island Nuclear Generating Station in Middletown, Pennsylvania, which was made infamous by the 1979 nuclear accident, has been unprofitable since 2013 and unable to sell its power since 2015. It will close in 2019.

These trends are likely to continue. Although natural gas has exhibited price volatility greater than coal, the fracking boom is anticipated to grow. Additionally, extreme cost reductions in solar and wind energy, along with subsidies, mean that renewable energy will continue to put pressure on the operating margins of nuclear plants.<sup>54</sup> Nuclear plants are particularly vulnerable to low electricity prices, as their costs are fixed. Whereas coal plants can respond to temporary price drops by producing less, nuclear plants do not have that capability. The cost of operating a reactor at any power level, even temporarily shut down, is essentially the same. For this reason, any nuclear reactor that sells in a deregulated state, which is approximately 31 percent of American plants, is vulnerable to premature closure.<sup>55</sup>

Another contributor to the closure of plants is local opposition. Due to safety concerns, nuclear power plants attract strong opposition from environmental groups, increasing the cost of recertifying nuclear reactors for extended licenses. The NRC public comment process has offered opportunities for opponents to slow down the process, which was a major factor in the decision to permanently retire California's San Onofre Nuclear Generating Station.

State government opposition has also caused premature closures of nuclear power plants. Although local governments typically support nuclear plants, state opposition is common, which complicates the regulatory landscape. The NRC has prime jurisdiction over nuclear energy, but state agencies can attach additional regulations that complicate operations. For example, the State of New York has long opposed the Indian Point Energy Center due to its proximity to New York City, which contributed to the decision to close it in 2021.<sup>56</sup> New Jersey's Oyster Creek Nuclear Generating Plant, the oldest power plant in the U.S., also announced in February 2018 that it would close later in the year, in part due to state pressure.<sup>57</sup> But state regulators play an important role in post-closure, as they can incentivize utilities to support local economic development efforts, rather than focusing solely on decommissioning sites.

Japan's Fukushima disaster resulted in additional regulation by the Nuclear Regulatory Commission after an analysis showed U.S. reactors were at similar risk. This scrutiny adds to nuclear plants' operating and

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<sup>54</sup> ["The Power to Change: Solar and Wind Cost Reduction Potential to 2025,"](#) International Renewable Energy Agency, June 2016.

<sup>55</sup> ["Nuclear Plants in Regulated and Deregulated States,"](#) Nuclear Energy Institute, July 2015.

<sup>56</sup> Tracy Marc, ["Entergy Announces Indian Point Closing,"](#) American Nuclear Society, January 9, 2017.

<sup>57</sup> Alex N. Gecan, and Erik Larsen, ["Nation's oldest nuke plant to close ahead of schedule,"](#) *USA Today*, February 2, 2018.

maintenance budgets, as well as requiring additional capital outlays as they add new equipment and procedures.<sup>58</sup>

Ultimately, these factors undermine the business case for nuclear generation, and the trend is likely to continue. With more nuclear power plant closures likely in the future, communities are beginning to evaluate the vulnerability of nuclear power plants and the potential economic impacts of closures to regional communities.

### *What economic developers can do*

**Planning is key to minimizing the impact of a premature shutdown.** To get ahead of this difficult issue, communities should evaluate the vulnerability of a plant to shutdown and communities should develop basic assessments to understand economic impacts, even if closure has not been announced. Consider that even small nuclear power plant closures can have a \$500 million annual impact. Planning is a regional consideration, and surrounding communities should pool resources to collaborate on a comprehensive plan.

**It is also important to understand the different modes of decommissioning, as they have a large influence on both employment levels and how long decommissioning takes.**<sup>59</sup> The reactor is defueled, and the removed fuel is placed into the spent fuel pool for cooling for four to five years before it is placed into dry storage. Afterward, either immediate dismantling (DECON) occurs or the reactor is placed into long-term storage (SAFSTOR). Under DECON, the site is normally returned to greenfield status in approximately six to 10 years. SAFSTOR is essentially delayed decontamination, and involves the long-term storage of the plant to allow radioactivity to decay before beginning the decontamination. The main functions during SAFSTOR are spent fuel management, security, and monitoring. Under NRC rules, the utility can place a shutdown reactor into SAFSTOR for over 50 years prior to conducting decontamination. The third decommissioning mode, entombing (ENTOMB), is unlikely to be used, and is omitted from this report.

For economic reasons, safe storage (SAFSTOR) is the most likely decommissioning mode. SAFSTOR allows radioactive products to decay, reducing the risk of decontamination to workers. Utilities are required to maintain a nuclear decommissioning trust (NDT) fund to finance decommissioning activities by law. However, current estimates suggest that most plants' NDTs are insufficient to cover decommissioning.<sup>60</sup> Utilities are permitted



***The Zion plant in Illinois spent more than 12 years in SAFSTOR after it closed.***

Source: [Mike Steele](#) / Creative Commons License [CC BY 2.0](#)

<sup>58</sup> [“Nuclear safety upgrades post-Fukushima cost \\$47 billion,”](#) S&P Global Platts, March 29, 2016.

<sup>59</sup> [“Decommissioning Nuclear Power Plants,”](#) United States Nuclear Regulatory Commission.

<sup>60</sup> [“2017 Nuclear Decommissioning Funding Study,”](#) Callan Institute, 2017.

to place a reactor into SAFSTOR and allow the trust fund to accumulate before commencing decontamination. Due to the high cost of decommissioning and the general insufficiency of current NDTs, economic developers should expect that most reactor decommissioning, especially those that close prematurely, will use at least a partial SAFSTOR.

Employment levels during SAFSTOR are much lower than in an operating plant, and it is estimated that 50 percent of staff will be laid off during decommissioning. The remainder is laid off in phases. Once the spent fuel has been moved to dry storage, about four to five years post-shutdown, only 30 to 50 employees are required.<sup>61</sup> Decontamination employs approximately 80 percent of the workers of a functioning plant, however, it is mostly short-term contract work.

**Another issue with nuclear decommissioning is the question of what to do with spent fuel.** Spent fuel is fuel removed from the reactor due to the buildup of various radioactive products that preclude its continued use. The current industry practice is to place it into a spent fuel pool for three to five years to allow it cool before it is placed into metal or concrete “dry” storage. But spent nuclear fuel storage has been mired in politics. A long-running plan to build a permanent waste facility in Yucca Mountain, Nevada, was delayed indefinitely under the Obama Administration, which means the Department of Energy (DOE) is unable to accept spent fuel waste.<sup>62</sup> However, the DOE is evaluating proposals for a consolidated interim storage facility in Texas or New Mexico. These projects could be online by as early as 2021, but transportation of existing waste will take many years. Generation IV reactors, which may come online in the 2030s, have the potential to reuse some existing waste, but for the time being, utility operators are responsible for storing spent fuel.<sup>63</sup> But for the time being, utility operators are responsible for storing spent fuel and due to NRC regulations, the only place that utilities can do this is at the power plant sites themselves. Therefore, nuclear communities are forced to host independent spent fuel storage installations (ISFSIs) onsite after decommissioning.

Except for the minimal tax payments on the ISFSIs, host communities receive no payment for hosting this fuel. ISFSIs makes it difficult for the land to be reused, as the site is perceived as a nuclear waste dump. The utility must absorb the costs of maintaining spent fuel, and because this money comes out of the NDT, the start of decontamination may be delayed. Although at this time these costs can be recovered by the federal government, the process is costly, lengthy, and can involve litigation. Additionally, not all costs are recoverable.<sup>64</sup> Even if a permanent storage site opened in 2018, under current plans it is estimated that at least some fuel will remain at closed plants until the 2050s. This is because the DOE prioritizes removal of the oldest spent fuel, rather than prioritizing fuel at decommissioned sites.<sup>65</sup>

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<sup>61</sup> Chris Wamser and T. Michael Twomey, Entergy, “[Nuclear Decommissioning Citizen Advisory Panel](#),” Battleboro Union High School, September 25, 2014.

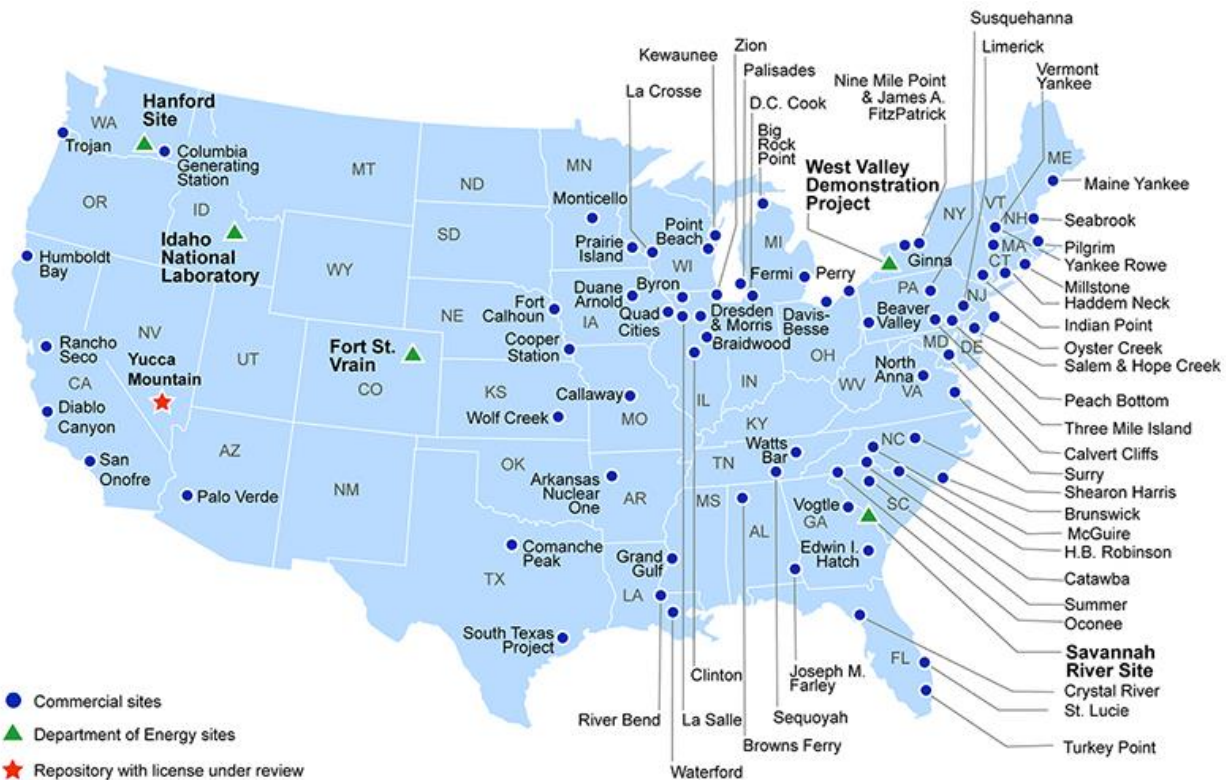
<sup>62</sup> “[Disposal of High-Level Nuclear Waste](#),” U.S. Government Accountability Office.

<sup>63</sup> Louise Lerner, “[Nuclear fuel recycling could offer plentiful energy](#),” Argonne National Laboratory, June 22, 2012.

<sup>64</sup> Mark Fahey, “[How the Department of Energy became a major taxpayer liability](#),” CNBC, October 10, 2016.

<sup>65</sup> “[Pilgrim Station Phase Two: Community Guidebook for Closure](#),” Institute for Nuclear Host Communities, October 22, 2016.

## Nuclear Energy Sites



Source: U.S. Government Accountability Office

**It is important to anticipate the loss of tax revenue along with high-paying jobs.** Generally, nuclear power workers earn two or three times the state average wage.<sup>66</sup> Even a small plant is estimated to generate \$400 million in economic benefits annually and contributes \$50 to \$80 million in annual payroll. Despite accounting for less than one percent of U.S. power plants, nuclear plants account for 37 percent of all jobs in electricity generation and 42 percent of industry wages.<sup>67</sup> Many laid-off workers are likely to move rather than taking pay cuts to remain in the area, which can also lead to a decline in property values. Because nuclear plants employ many high-skilled, high-paid workers in rural areas, the effects of a closure are comparatively larger than other types of plant closures.

**Communities facing closures, and even those where a closure has not been announced, should identify economic diversification opportunities as early as possible through a strategic planning process.** Considering the outsized influence nuclear power plants have on the local economy, all communities located near nuclear power plants should participate in the process. The planning process

<sup>66</sup> “[May 2017 National Industry-Specific Occupational Employment and Wage Estimates: NAICS 221113 – Nuclear Electric Power Generation](#)” United States Department of Labor, March 30, 2018.

<sup>67</sup> Jonathan Cooper and Jen Stromsten, Institute for Nuclear Host Communities, “[The Social and Economic Impacts of Nuclear Power Plant Closures](#),” Cortlandt Manor, New York, April 26, 2017.

should identify the area's natural advantages and explore ways to reuse the plant site. In this planning process it is important to understand the area occupied by the decommissioned plant itself will not be released for at least 10 years, and likely longer.

However, despite all the planning and brainstorming, economic developers are likely to run into one key problem—funding. Although the NRC and U.S. Environmental Protection Agency have oversight over the disposal of radioactive and toxic materials, neither agency is tasked with economic recovery. Even on a state level, support for nuclear host communities may not be available, leaving local communities to coo with plant closures on their own. Available grants are often time-limited, which precludes the long-term planning that an orderly transition requires. **Therefore, it is essential for community leaders to work together with states early on to create programs that address financing shortfalls.**

Responding to a nuclear plant closure, like losing any large industry, is a challenge for both local communities and the region. Any new industry the community identifies to take its place is unlikely to equal a nuclear plant's contribution to the economy. However, when nuclear plant closures are anticipated early and managed carefully in collaboration with regional, state, and federal partners, impacts can be mitigated through thoughtful planning, positive political engagement, and pursuing best practices learned from other places that endured closures. Below is a summary of recommendations for economic developers and community leaders.



### Actions for economic developers and community leaders

- Undertake **economic impact studies**;
- Create or update **economic development strategic plans** on a regional basis to identify and align growth opportunities;
- **Engage the regional utility** about the decommissioning process and convey concerns of the local community. Utilities are aware of their environmental and economic responsibilities and will likely be receptive to open dialogue. Communities should highlight to the utility the strong preference for a DECON rather than SAFSTOR decommissioning process. The goal of any agreement with the utility should be to reduce the economic shock of closure, for instance by gradually reducing tax payments and employment.
- Form a **community engagement panel (CEP)**. Although not required by law, and usually without authority, a CEP is a formal channel to provide open communication, public involvement and education on decommissioning issues. CEPs have been used in several decommissions in New England, and were regarded highly by both utilities and communities.
- **Stabilize tax receipts** to reduce uncertainty and lessen the shock of plant closure. Local governments can negotiate agreements with utilities to continue paying taxes post-shutdown. However, property taxes can be paid out of the nuclear decommissioning trust (NDT), which may delay decontamination and site release.
- Consider creating a **trust fund**, much like the NDT, but for economic development purposes post-closure. If established early in the process, trusts can grow to a significant amount.
- **Partner with other communities and regional EDOs** to pool resources and share data.
- **Engage state and county governments for funding and regulatory support**, especially to smooth out the post shutdown impact. Particularly, disseminate information about job losses and economic impact of a closure to relevant state authorities.
- **Apply for Federal grants and stage grants as much as possible**. The U.S. Economic Development Administration and the U.S. Department of Agriculture offer some applicable grants, and states may have comparable programs (*see Appendix*).

### Case study: Vermont Yankee

Vermont Yankee (VY) is a defueled boiling-water reactor located in the Town of Vernon (pop. 2,200) in Southeastern Vermont. VY is located near the border of Massachusetts and New Hampshire, drawing its 600 employees equally from each state and some from Massachusetts, which posed a unique challenge to its closure. It is estimated that the plant contributed \$500 million to the local economy annually and directly or indirectly created 1,220 jobs.<sup>68</sup>

<sup>68</sup> [“Economic Impacts of the Vermont Yankee Closure,”](#) UMass Donahue Institute, December 2014.

In 2014, after 42 years of operation, the VY reactor was shut down.<sup>69</sup> VY was the proverbial “canary in the coal mine,” as one of the first in a spate of closures and planned closures nationally. Market deregulation in 2001 and low-priced natural gas made it harder for VY to turn a profit. In 2013, the decision was made to close the plant at the end of the fuel cycle. Communities surrounding the plant had approximately 16 months of warning and because the state government opposed the plant, communities in the region studied this eventuality prior to the closure announcement.

For example, Windham Regional Commission’s 2012 *Resiliency Action Plan for the Town of Vernon in Preparation for the Eventual Closure of the Vermont Yankee Nuclear Power Station* stated that the town was very economically dependent on the plant.<sup>70</sup> The report identified that Vernon received 48 percent of its tax receipts from the plant. Fortunately, a large portion came from a switchyard on the site that would still be operational if the plant closed.

About 80 of Vernon’s 800 houses were owned by VY employees and because many workers were expected to move away post-closure, the report predicted a resulting substantial decrease in property values. The final aspect of the report addressed the potential decommissioning mode, and assessed whether plant operator Entergy would have adequate funds in its NDT to decommission the plant. Its conclusion was that the NDT was inadequate, and that Entergy would most likely put the plant into SAFSTOR to allow the NDT to increase in value.



**Vermont Yankee in 2014. Note the VELCO Switchyards and the dry cask storage.**

Source: Google Earth.

Unfortunately, much of the predictions in the Windham Regional Commission (WRC) report proved accurate. About 30 houses were placed on the market around the time of the closure, which led to a 25 percent drop in market value.<sup>71</sup> Prior to the closure, the average wage of VY employees was \$105,000, 2.8 times the average for Southeastern Vermont.<sup>72</sup> VY laid off approximately half of its employees at

<sup>69</sup> Matthew L. Wald, “[Vermont Yankee Plant to Close Next Year as the Nuclear Industry Retrenches](#),” *The New York Times*, August 27, 2013.

<sup>70</sup> Chris Campany et al, “[Resiliency Action Plan for the Town of Vernon in Preparation for the Eventual Closure of the Vermont Yankee Nuclear Power Station](#),” Windham Regional Commission, June 22, 2012.

<sup>71</sup> Bruce Parker, “[Battleboro housing market dives as Vermont Yankee exits region](#),” *The Government Watchdog*, August 10, 2015.

<sup>72</sup> “[Annual Report: Vermont](#),” U.S. Economic Development Administration, 2015.



closure and let go even more in the following years. Additionally, the report accurately predicted the plant's energy would go into SAFSTOR, which will last until at least 2068 when decontamination begins.

In early 2017, a deal was announced to sell the plant to Northstar, a demolition company. Northstar later collaborated with French nuclear giant Areva, recently renamed Orano, to decommission the plant on an accelerated timetable.<sup>73</sup> Northstar estimates it will complete wet fuel management two years earlier than the Entergy plan and will have decontamination finished by 2030 using advanced deconstruction techniques. As this plan offers site reuse much earlier, it has received the enthusiastic support of local economic developers.<sup>74</sup> However, the plan has been criticized by environmental groups and concerned citizens who doubt the financial and technical ability of Northstar to implement the



***Vermont Yankee. The cylindrical structures in the foreground are the cooling towers, the boxy structure in the middle is the reactor building.***

Source: [Wikimedia Commons](#) / Nuclear Regulatory Commission.

accelerated plan.<sup>75</sup> The sale is pending approval following an ongoing evaluation by the NRC and the state. The plan may still leave the VY site with an ISFSI for an indefinite period, making site repurposing difficult due to the site's small size.

Vernon's budget was severely impacted by the closure. For a town that never had funding issues previously, mostly due to the plant's tax receipts, the closure created a severe economic shock. In response, Entergy and Vernon negotiated a new tax agreement in 2016 that gradually reduced payments from \$750,000 in 2016 to \$400,000 in 2020. While this has reduced the shock to the town's budget, it is considerably lower

than the \$1.1 million the plant paid when it was operating.<sup>76</sup> Therefore, Vernon must make hard choices about what services it offers residents.

However, it is not all bad news, and according to Bob Spencer, Chairman of the Vernon Planning Commission, Vernon is beginning to stabilize. "If we knew we would be in this position four years ago when we found out the plant would close, I think we'd be pretty happy," Spencer said.<sup>77</sup>

Vernon is currently updating its 2013 Town Plan, which was written in response to the 2012 Resiliency Action Plan. A key component of the plan involves leveraging the community's well-capitalized

<sup>73</sup> Mike Faher, "[UPDATED: Entergy to sell Vermont Yankee to NorthStar](#)," *VT Digger*, November 8, 2016.

<sup>74</sup> Adam Grinold, "[Adam Grinold: Vernon needs our support to build its post-VY future](#)," *Brattleboro Reformer*, January 19, 2018.

<sup>75</sup> Sandy Levine, "[Cleaning Up Vermont Yankee Nuclear Power Plant](#)," *Conservation Law Foundation*, August 30, 2017.

<sup>76</sup> "[Entergy Reaches \\$3M Tax Agreement with Vernon](#)," *Exchange Monitor*, May 26, 2016.

<sup>77</sup> Bob Spencer, Vernon Planning Commission, phone interview, January 2018.

amenities, including a modern recreational center and popular library, to attract new residents desiring a “mountain change.” In addition, Vernon offers a unique school-choice program that offers up to \$19,000 for eligible children to attend any number of schools, including private schools, in the tri-state area. Ultimately, considering the scale of nuclear plants, communities such as Vernon lack the resources and capacity to manage such a transition. Thus, regional cooperation on long-term economic development strategies is essential for small communities like Vernon.

The planning process began with the Southeastern Vermont Economic Development Strategies (SeVEDS), which produced the *Windham County Post-VY Economic Mitigation and Growth* report in 2012. This report, which predated the closure announcement, identified potential impacts to the local economy if VY closed, and suggested mitigation and growth strategies. The report notes VY was the largest employer in Windham County, providing 2 percent of jobs and 5 percent of income, and estimated the loss in tax revenue and economic production. Suggested strategies included creation of a Special Economic Development Zone, attracting new residents, consolidating services, and marketing the region. The *Windham County Post-VY* report was also used to engage the Vermont legislature and state agencies. This information provided a greater awareness among the state regulators of the issues facing the community, and most likely influenced the decision to negotiate with Entergy for specific funds for economic development.

Under the deal struck with the State of Vermont to allow the closure, Entergy agreed to make several payments, including setting \$10 million aside for economic development under the new Windham County Economic Development Program (WCEDP). This money must be spent in Windham County, even though Franklin County, MA, and Cheshire County, NH, were also greatly impacted by the closure. Securing these funds was aided by effective use of the *Windham County Post-VY* report, underscoring the importance of having this information available before a plant closes, as that is when media coverage is greatest.

The disbursement of these funds was initially challenging. In the first year of operation, just \$814,000 of the available \$1 million was used due to a lack of “transformational new jobs and economic opportunity” in the applications.<sup>78</sup> One rejected application was a proposal for a business incubator in Vernon. In response, the program was retooled to provide more regional input and participation, which included better alignment with the region’s Comprehensive Economic Development Strategy (CEDS). The Battleboro Development Credit Corporation (BDCC) received a grant to market the program, assist applicants in improving the quality of proposals, and navigate the approval process.<sup>79</sup> As a result, the improved program successfully disbursed \$4.7 million as a mixture of low-interest loans and grants.<sup>80</sup> The impact of this funding to date has been \$38 million in projected economic growth, with 85 percent in the private sector, and 773 projected jobs.<sup>81</sup> Nonprofits are eligible for grants, and businesses can

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<sup>78</sup> Michael Faher, “[Vernon, state clash on grant request](#),” *Battleboro Reformer*, January 7, 2015.

<sup>79</sup> “[Windham County Economic Development Program Re-Launch](#),” Southeastern Vermont Economic Development Strategies, 2015.

<sup>80</sup> “[Windham County Economic Development Program](#),” Agency of Commerce and Community Development, 2017.

<sup>81</sup> Jen Stromsten, Battleboro Development Credit Corporation, phone interview, March 2018.

receive loans. Companies across the Windham region involved in performing arts, agriculture, tourism, and advanced manufacturing have received entrepreneurial loans under the program. Still, Vernon-based initiatives have not received any funding, leaving some in the community feeling that they may have missed their opportunity.

The BDCC, WRC, and their counterparties at Franklin Council of Governments in Massachusetts and the Southwest Regional Planning Commission in New Hampshire have been the drivers behind much of the post-VY economic development planning. Recognizing the widespread impacts of the closure, the three counties banded together in 2014 to identify new strategies to develop the region. Impacts of VY's closure were studied in Franklin County, MA. The Monadnock Economic Development Corporation in New Hampshire received a \$350,000 grant from Entergy, which it used to create a small business loan fund in association with a local chamber of commerce.<sup>82</sup> The BDCC received an EDA grant, matched with WCEDP funding, to develop green building products and service sectors across this region, which created the Ecovation Hub, a network of green economy assets. Additionally, the BDCC and partner counties shared an EDA grant to compare their CEDSs and better collaborate across state lines. Going forward, all parties affected by the VY closure have committed to continued collaborative planning.

The work undertaken by these multiple entities is an important example of the long-run planning required to respond to a nuclear plant closure. In 2016, the economic developers who responded to the closure collaborated on a report about the experience of the tri-state region. *When People and Money Leave (and the Plant Stays)* offers lessons learned to assist future economic developers and their community leaders.<sup>83</sup>

***Case study: Understanding the issues for long-term planning – Pilgrim Nuclear Power Station, Plymouth, Massachusetts***

The Pilgrim Nuclear Power Station is a boiling-water reactor located in Plymouth, Massachusetts, which was commissioned in 1972. In 1999, Massachusetts deregulated electricity generation and the plant was sold to Entergy, which was the first sale of a publicly-owned nuclear reactor to a private entity. Pilgrim has been beset by repeated safety issues, and in recent years, was among the NRC's worst-performing reactors. In October 2015, Entergy announced that Pilgrim would close in 2019 due to low electricity prices and upgrades.<sup>84</sup>

A 2011 report by Moody's on Pilgrim's vulnerability prompted the University of Massachusetts at Amherst and government partners to publish a report called *The Pilgrim Nuclear Power Station Study: A Socioeconomic Analysis and Closure Transition Guide Book*.<sup>85</sup>

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<sup>82</sup> Jess Atwood, Franklin Regional Council of Governments, phone interview, February 2016.

<sup>83</sup> "[When People and Money Leave \(and the Plant Stays\) – Lessons Learned from the Closure of the Vermont Yankee Power Station A Tri-Region Experience](#)," Brattleboro Development Credit Corporation, Brattleboro, Vermont, October 14, 2016.

<sup>84</sup> Johnathan Cooper, "[The Pilgrim Nuclear Power Station Study: A Socioeconomic Analysis and Closure Transition Guide Book](#)," University of Massachusetts Amherst, February 2016.

<sup>85</sup> Ibid.

The report details a study of Pilgrim's economic contribution to Plymouth and Barnstable counties. It found that 85 percent of Pilgrim's 586 employees live in either county and Pilgrim's annual payroll was approximately \$55 million as of February 2015. Pilgrim employed 2.5 percent of Plymouth's workforce, representing 5.3 percent of employee income.<sup>86</sup> The Town of Plymouth received \$10.3 million in 2014 through a payment in lieu of taxes (PILOT) agreement with the plant. Property taxes paid by Pilgrim workers are estimated at \$953,000, representing six percent of Plymouth's FY 2015 budget. Though not as critical to its local economy as Vermont Yankee to Vernon, VT, Pilgrim is nonetheless a major economic contributor to Plymouth and the region.

The Old Colony Planning Council (OCOP), the Plymouth planning department, and Plymouth Regional Economic Development Foundation underwent a review process to look at challenges and local strengths, culminating in a report called *Pilgrim Nuclear Study Phase II: A Community Guidebook to Closure Response*.<sup>87</sup> The *Phase II* report offers another strong example of comprehensive planning for nuclear plant closure.

Massachusetts passed legislation establishing a 21-member Nuclear Decommissioning Citizens Advisory Panel in 2016. Though it lacks direct authority over the closure, it represents important stakeholders including representatives of relevant state departments, town selectmen, OCOP representatives, and members selected by Entergy. Local governments also convened several working groups to raise public awareness and engage with Entergy over the future of the PILOT. With one year until Pilgrim's closure, localities are also applying for EDA grants to support the transition.

Despite rigorous planning, Pilgrim's closure will still challenge Plymouth and surrounding counties. As in the case of Vermont Yankee, funding is an issue. Reliable funding is hard to come by because there is no federal or state agency with responsibility for economic development post-shutdown. What funding is available is significantly less than what the plant contributes, making economic diversification a priority.

Compared to other communities losing power plants, Plymouth and surrounding counties believe that they are in a better position because the area is densely populated and had a diverse economy. Plymouth receives 6 percent of its tax receipts from Pilgrim, compared to the 48 percent Vernon received from Vermont Yankee. In addition, Plymouth planned for this scenario for several years, while Vernon only had 16 months to plan, which is still more warning than many communities receive. Overall, Plymouth and surrounding counties appear well-positioned to weather the closure.

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<sup>86</sup> Johnathan Cooper, "[The Pilgrim Nuclear Power Station Study: A Socioeconomic Analysis and Closure Transition Guide Book](#)," University of Massachusetts Amherst, February 2016.

<sup>87</sup> "[Pilgrim Station Phase Two: Community Guidebook for Closure](#)," Institute for Nuclear Host Communities, October 22, 2016.

*Case study: Crises inspires cross-community consultation – Diablo Canyon, California*

The Diablo Canyon Power Plant is a twin reactor power station located in San Luis Obispo County on California's Central Coast. Diablo Canyon is significantly larger than most plants affected by premature closure.

In 2016, Diablo Canyon's operator Pacific Gas & Electric (PG&E) announced it would not seek a NRC license extension and will shut down the reactors once they reach the end of their license periods in 2024 and 2025.<sup>88</sup>

Even in a county of 250,000, the closure of Diablo Canyon is expected to create a formidable shock. The plant employs approximately 1,500 and pays an average salary of \$96,000, 1.5 times the average income in the county.<sup>89</sup> The plant contributes \$1.2 billion in local economic output.<sup>90</sup> Because Diablo Canyon is the last nuclear power plant in California, most of its workers are expected to leave the state. There is additional uncertainty around the mode of decommissioning. The Diablo National Decommissioning Trusts estimates it is \$1 billion short on the cost of decommission, which may make SAFSTOR necessary.



**Diablo Canyon in 2017**

Source: Google Earth.

The closure is encouraging jurisdictions to better engage one another. The Economic Vitality Corporation (EVC) of San Luis Obispo County is spearheading an effort to build a cross-city structure to help fund and support its work throughout the process.<sup>91</sup> As in other cases, the EVC has found there is not much guidance or financial support from federal or state agencies. "It's a big change for the community," said Michael Manchak, President & CEO of the EVC. "It's just like a military base closure, except when a [military] base closes, there's a lot of support and assistance, as well as congressional

<sup>88</sup> "Joint Proposal," Pacific Gas & Electric Company, 2016.

<sup>89</sup> Dr. Kenneth D. Riener et al, "The Local Economic Impacts of Decommissioning the Diablo Canyon Nuclear Power Plant," Pacific Gas & Electric Company, March 2013.

<sup>90</sup> Kenneth D. Patrick Mayeda and Dr. Kenneth D. Riener, "Economic Benefits of Diablo Canyon Power Plant," Pacific Gas & Electric Company, June 2013.

<sup>91</sup> Michael Manchak, Economic Vitality Corporation, phone interview, February 2018.



hearings. With a nuclear power plant closure, there's not much of anything. We were even told there's no playbook."

In response, economic developers and planners are building a regional support structure across city and county lines. EVC staff have also become experts on grant applications, and recently received a one from the Economic Development Administration to assist with planning. Additionally, the EVC works with local colleges and business partners on an apprenticeship program designed to attract technology companies to the area.<sup>92</sup> The goal is to develop an advanced manufacturing cluster and place 1,000 apprentices by the time the plant closes in 2025.

Another aspect the EVC team is keen to evaluate is the social impact of the closure. "PG&E has made a lot of charitable contributions to our community and that is something that we are worried will end when the plant shuts down," said Loreli Cappel of the EVC. In 2017, PG&E contributed more than \$1 million to 120 nonprofits located in San Luis Obispo and Santa Barbara counties, and employees donated \$508,000.<sup>93</sup> The EVC advises not to neglect the loss of charitable giving when conducting an impact analysis.

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<sup>92</sup> Kaytlyn Leslie, "[This new program will train you to work in tech — and pay you too](#)," *The Tribune*, June 1, 2017.

<sup>93</sup> "[Diablo Canyon Power Plant](#)," Pacific Gas & Electric Company.

## IV. Oil and natural gas

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Oil has long been essential to America's economic success. After World War II, the oil industry became especially important to geopolitics, as global stability depended on political and economic balance between major oil producers.<sup>94</sup> Today, the U.S. is both a major oil producer and consumer, and in recent years, changes in the nation's oil production have caused shifts in pricing dynamics.

As a net importer of oil, the U.S. relies on foreign suppliers. However, with increased domestic production, America has become a more significant exporter, increasing its leverage and reducing dependence on foreign producers. Now exporting up to 10 million barrels per day,<sup>95</sup> the U.S. has reached its lowest oil import levels in 20 years.<sup>96</sup> This is feeding hope that America will one day achieve energy independence.<sup>97</sup> Clearly increasing domestic oil production and reducing imports also makes the U.S. economy more resilient and less vulnerable to price shocks.

Oil presents both opportunities and challenges for the economies of four petroleum-rich regions: Bakken (Montana, North Dakota), Eagle Ford (Texas), Permian (New Mexico, Texas), and Niobrara-Codell (Colorado, Wyoming).<sup>98</sup> Revenues provide opportunities for regional infrastructure development and population growth. However, states and localities have no control over volatile prices in a global market. It is difficult to establish predictive and responsive tax systems that can account for these fluctuations. Additionally, increased demands for infrastructure development to serve both growing industries and populations puts pressure on local budgets, which are not always able to capture oil revenues as effectively as state governments. It is a difficult task for community leaders at the local, regional, and state levels to work together to determine how to equitably collect revenues and buffer against price changes in vulnerable communities. However, when appropriately captured and allocated, oil revenues can fund significant infrastructure and economic development efforts that benefit businesses and residents.

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<sup>94</sup> History.com Staff, "[Oil Industry](#)," History.com, 2010.

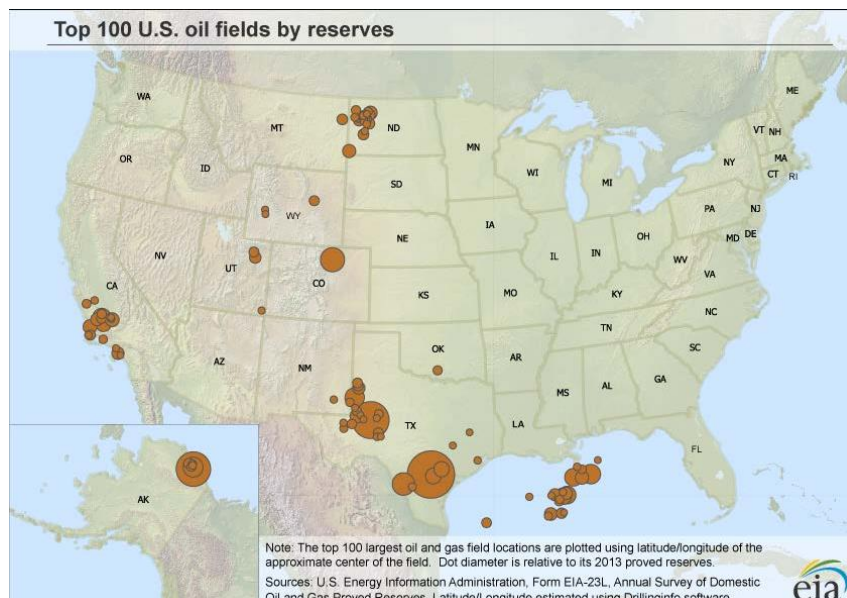
<sup>95</sup> Jessica Summers, "[Shale Sends U.S. Oil Output Past Historic 10 Million-Barrel Mark](#)," *Bloomberg*, January 31, 2018.

<sup>96</sup> "[Oil Dependence and U.S. Foreign Policy](#)," Council on Foreign Relations, 2017.

<sup>97</sup> "[The U.S. Shale Revolution](#)," The University of Texas at Austin Robert Strauss Center.

<sup>98</sup> Ibid.

## *Innovation brings the Shale Revolution*



Source: U.S. Energy Information Administration

The most significant factor in the nation's oil boom is innovation in extraction technologies. Hydraulic fracturing and horizontal drilling have enhanced access to "tight" oil and natural gas reserves, while also increasing productivity. The "shale revolution" has greatly reduced American dependence on foreign energy producers, while increasing employment and revenues for domestic producers.

Shale production added 169,000 jobs between 2010 and 2012, and employment in extraction industries grew 10 times faster than overall U.S. employment.<sup>99</sup>

The "Shale Revolution" has brought other measurable benefits such as the ability to buffer against other disruptions. When Hurricane Harvey struck the Gulf Coast in 2017, some 22 percent of total U.S. oil refining capacity was temporarily knocked offline. Several companies suspended hydraulic fracturing activities as well.<sup>100</sup> While prices went up temporarily, America's considerable oil surplus ensured stability in the face of these setbacks. The shale revolution had already shifted U.S. dependence away from Gulf Coast-based oil supplies, which added to the industry's ability to withstand regional natural disasters without serious damage or long-term effects on total production capacity.

Along with opportunities, a variety of factors have created significant impacts on these regions where the economy is heavily reliant on oil extraction and related industries. After years of heightened oil production, America's producers faced significant challenges when the global oil prices dropped in 2014. By early 2016, oil prices had fallen from more than \$100 per barrel to less than \$30.<sup>101</sup> Low demand, combined with increased supply and coupled with the nation's booming shale production contributed to a glut in the global supply.<sup>102</sup>

<sup>99</sup> Ibid.

<sup>100</sup> Ellen R. Wald, "[Hurricane Harvey Impacts Crude Oil and Gasoline: What You Need to Know](#)," *Forbes*, August 29, 2018.

<sup>101</sup> Clifford Krauss, "[Oil Prices: What to Make of the Volatility](#)," *The New York Times*, June 14, 2017.

<sup>102</sup> Robert J. Samuelson, "[Key facts about the great oil crash of 2014](#)," *The Washington Post*, December 3, 2014.

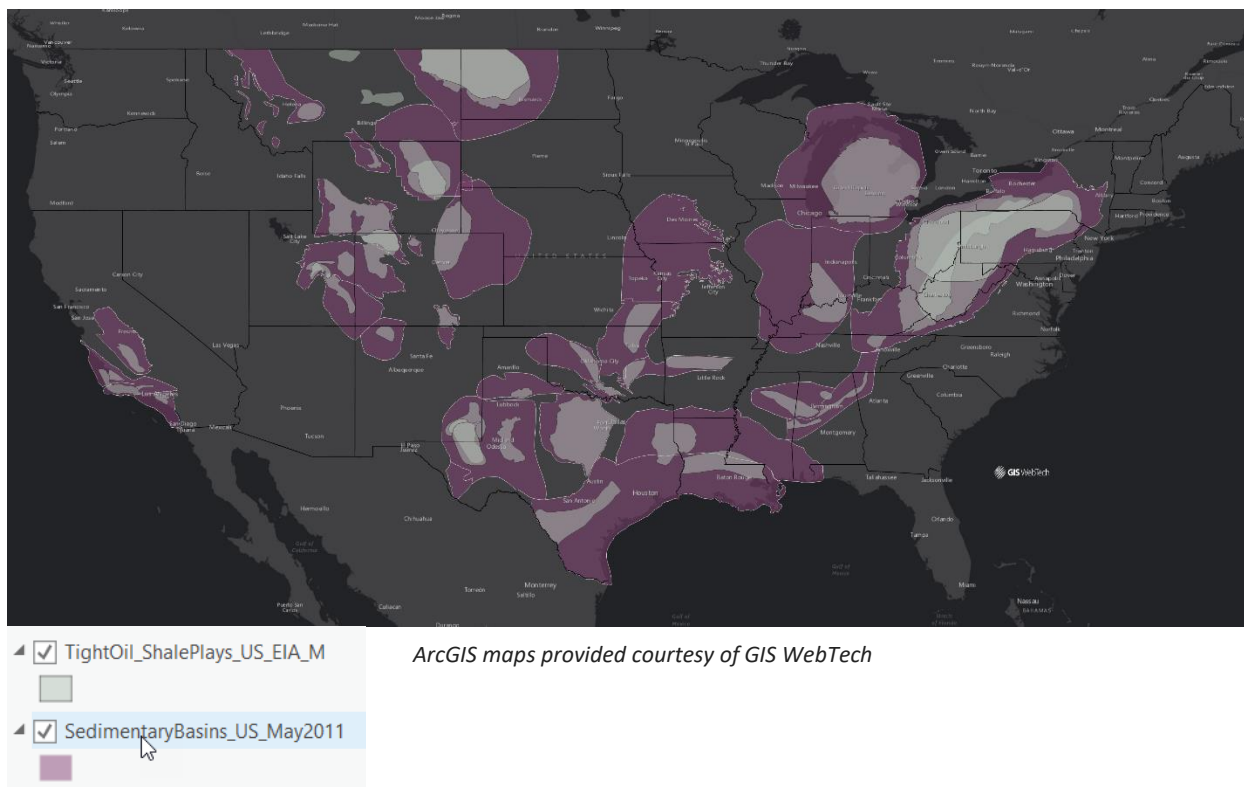


Rather than driving shale oil producers out of business, however, the challenges of staying competitive have pushed technical and productivity advancements. As of 2014, most producers were able to break even at \$50 per barrel.<sup>103</sup> Prices in 2018 currently hover around \$65 per barrel, but analysts predict an uneven future for oil prices as technological developments and the exploration of new reserves continue to disrupt global markets.<sup>104</sup>

### *The rise of natural gas through hydraulic fracturing (fracking)*

Natural gas is becoming increasingly competitive, as global demand is growing from countries seeking cleaner energy sources following the Paris Climate Accord. From the International Energy Agency's (IEA) World Energy Outlook 2017, the U.S. is expected to emerge as the world's largest liquid natural gas (LNG) exporter by the mid-2020s. According to the Energy Information Agency's (EIA) 2017 Annual Energy Outlook, the increase in natural gas production is largely coming from the eastern states in the Marcellus and Utica shale plays. Secondary gas production from Eagle Ford and Haynesville along the Gulf Coast is also expected but is projected to taper off beyond 2030. Taking into consideration a glut in supply, this puts communities that produce natural gas in a pre-emptive position before a possible second fracking boom and bust cycle.

### **Shale Plays**



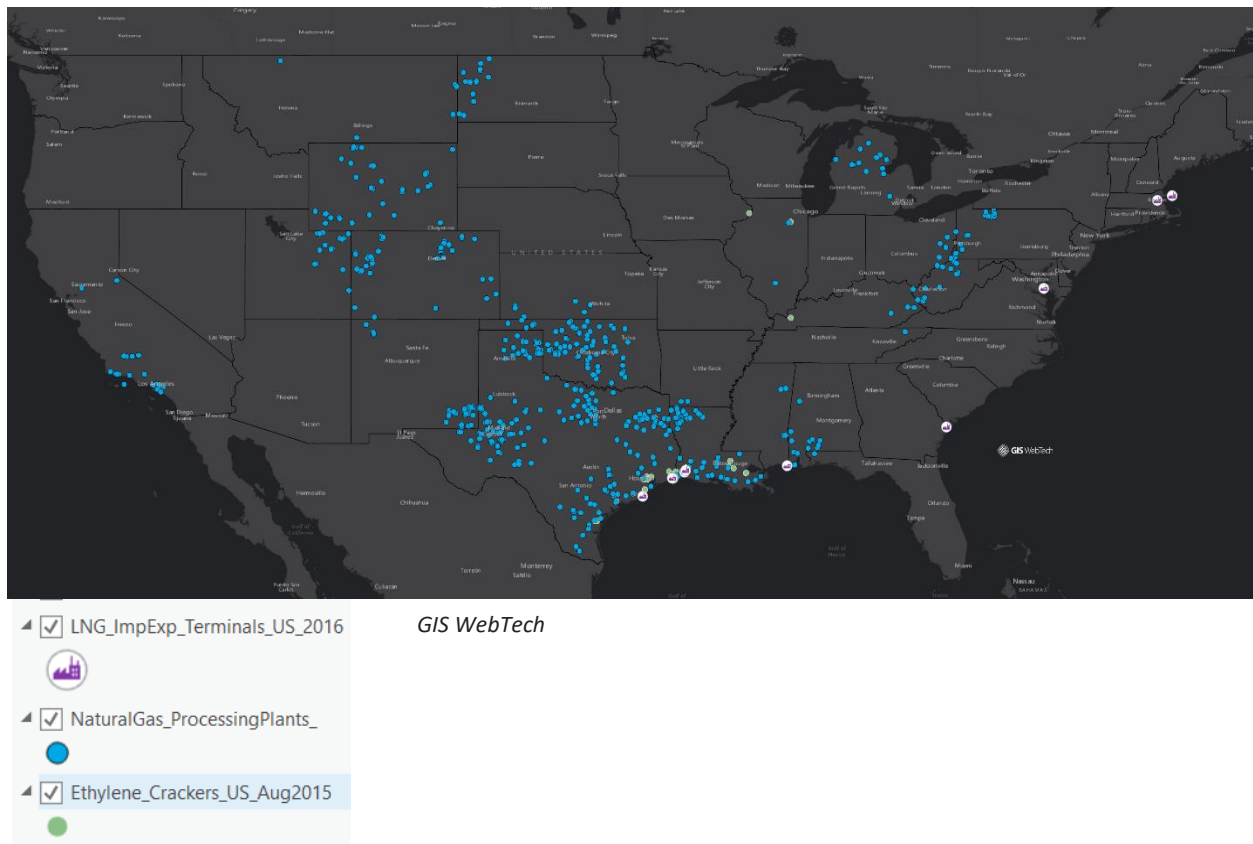
<sup>103</sup> Nick Butler, "[The second shale revolution](#)," *The Financial Times*, 2017.

<sup>104</sup> Clifford Krauss, "[Oil Prices: What to Make of the Volatility](#)," *The New York Times*, June 14, 2017.

From 2010 to 2016, natural gas increased its share of U.S. energy generation from 23 percent to 33 percent.<sup>105</sup> Today, Fracking provides over 67 percent of the total natural gas output, with output from the wells increasing by 1,472 percent since 2000.<sup>106</sup> A driver of this growth has been significant investment into fracking wells and the discovery of shale in the Appalachian Basin, the Bakken formation in Montana and North Dakota, and formations in Texas and New Mexico.

Fracking involves injecting a high-pressure mixture of water, chemicals and sand from a wellbore to push against rock (often shale) until fracturing occurs, which releases hydrocarbons into the wellbore for collection.<sup>107</sup> Wastewater is produced in the process.

### ***Natural Gas Processing Plants, Ethylene Crackers, and LNG Export Terminals***



<sup>105</sup> Rob DiDonna, Energy Ventures Analysis, “[Coal – Natural Gas Competition: The Current State if Play – Impact on System Dispatch](#),” U.S. Energy Information Administration, Washington, DC, 2017.

<sup>106</sup> “[Today in Energy: Hydraulically fractured wells to provide two-thirds of U.S. natural gas production](#),” U.S. Energy Information Administration, May 5, 2016.

<sup>107</sup> Ibid.

Despite the economic benefits and energy independence that fracking offers, this is a process that has encountered strong opposition from some consumers, as well as state and local governments. The opposition is rooted in concerns over the potential environmental and health impacts of fracking. The impact on water quality and potential for contamination is a key concern among those opposed to fracking. These concerns have led several states, notably New York and Maryland, to ban fracking outright. These states are concerned about frack fluid, which is used to break the rock and keep the breach open, potentially polluting waterways. Those who support fracking accuse those opposed of exaggerating the risks and effects on seismic activity.<sup>108</sup> The EPA has oversight of fracking fluid and fracking companies are required to follow the provisions of the Clean Water Act and the Safe Drinking Water Act in addition to any state laws.<sup>109</sup>

### *What's driving demand?*

There are several factors that have driven natural gas demand, ranging from economic reasons to cleaner energy generation. The primary cause behind natural gas demand has been massive investments into shale gas fracking that have substantial decreases in cost of extraction due to improvements in horizontal drilling technology and expert assessments of gas availability in the Appalachian region with the Marcellus shale.<sup>110</sup> This has been due to a combination of substantial decreases in costs of extraction due to improvements in horizontal drilling technology<sup>111</sup> and expert assessments of gas availability in the Appalachian region with the Marcellus shale.<sup>112</sup> These factors have rapidly increased production, leading to a supply glut that has depressed prices and increased natural gas competitiveness relative to coal.<sup>113</sup>

Other reasons for the rise of natural gas has been its recognition as a relatively clean source of energy when combusted in a new natural gas power plant. Natural gas has 50 to 60 percent less carbon dioxide emissions compared to coal used in a new coal plant.<sup>114</sup> As a result, natural gas is a more efficient source of fossil fuel, given insignificant leakages.<sup>115</sup>

### *Liquefaction increasing exports*

Liquid natural gas (LNG) has allowed large volumes of gas to be exported internationally. Developed in the 1800s, the liquefaction process enabled transportation of natural gas to areas otherwise unreachable by pipelines.<sup>116</sup> Gas is delivered to liquefaction terminals through pipelines, before being treated to remove water and impurities. Excess heavy gases such as propane and butane are then removed and often sold to other industries.<sup>117</sup> The remaining gas is then cooled, turning it into liquid,

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<sup>108</sup> Thomas Wheatley, "[Opposition to fracking in Maryland is anti-science](#)," *The Washington Post*, March 3, 2017.

<sup>109</sup> "[Regulations and Exemptions](#)," Tip of the Mitt Watershed Council.

<sup>110</sup> "[Coal Declining Due to Economics, Not Regulation](#)," Federal Reserve Bank of St. Louis, December 7, 2017.

<sup>111</sup> Ernest Scheyder, "[Undaunted by oil bust, financiers pour billions into U.S. shale](#)," *Reuters*, April 17, 2017.

<sup>112</sup> "[America's shale firms don't give a frack about financial returns](#)," *The Economist*, March 25, 2017.

<sup>113</sup> "[Coal Declining Due to Economics, Not Regulation](#)," Federal Reserve Bank of St. Louis, December 7, 2017.

<sup>114</sup> "[Environmental Impacts of Natural Gas](#)," Union of Concerned Scientists.

<sup>115</sup> Adam Dove, "[Is replacing coal with natural gas actually good for the climate?](#)" *Phys.org*, November 17, 2016.

<sup>116</sup> "[Natural Gas Explained: Liquefied Natural Gas](#)," U.S. Energy Information Administration, April 25, 2017.

<sup>117</sup> "[LNG and Liquefaction](#)," Cameron LNG.

which occupies 600 times less space. On arrival at the destination, the LNG is warmed back to a gaseous state and delivered to customers through pipelines.<sup>118</sup>

LNG plants are made up of trains, liquefaction facilities used to cool natural gas for ship transport.<sup>119</sup> In Louisiana, Sabine Pass currently consists of four trains, with a fifth under construction. Its total capacity for LNG production is 3.5 billion cubic feet per day (Bcf/d).<sup>120</sup> As exports are projected to increase through the 2020s, liquefaction facilities are expected to be increasingly utilized, potentially averaging 79 percent in 2018. Factors affecting this include weather-related disruptions, demand fluctuations, seasonality in import markets, production schedules and maintenance of facilities. Currently, exports are limited by liquefaction capacity.<sup>121</sup>

The U.S. Energy Information Administration projects global LNG trade will grow seven times faster than piped gas and will account for half the gas trade by 2035, up from 32 percent today.<sup>122</sup> Projections show that the GDP gain from increasing LNG exports could be between \$7 and \$20 billion annually from 2026 to 2040.<sup>123</sup>

Beginning in 2017, the U.S. became a net exporter of natural gas. Current LNG export terminals include the Sabine Pass terminal in Louisiana and the Dominion Energy Cove Point in Maryland.<sup>124</sup> At least five more are expected to open in the coming years, with two in Texas, and one each in Louisiana and Georgia. Helping growth of U.S. LNG trade is the increase in number of floating storage and re-gasification units (FSRUs), which can convert LNG into gas ready for consumption/distribution. They override the need for expensive LNG import terminals and are substantially more mobile.<sup>125</sup>

In 2016, some 92 percent of U.S. natural gas exports were done through pipelines to Mexico and Canada, receiving 64 percent and 36 percent of pipeline exports respectively.<sup>126</sup> Pipeline exports to Mexico tripled between 2010 and 2016. Mexican gas consumption is up 22 percent, while production is down 11 percent. Drivers of Mexican natural gas demand includes overall economic growth, the displacement of oil with gas, and an expanding manufacturing sector.<sup>127</sup> Although Canada receives pipeline exports, they produce more than they consume. Some Canadian imports are in fact gas originally produced in Canada, but then imported into the U.S. and then re-exported. This is due to Canadian pipeline constraints, making this a cost-effective transportation method.<sup>128</sup>

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<sup>118</sup> [“liquefied natural gas \(LNG\),”](#) Chevron Corporation.

<sup>119</sup> Reuters Staff, [“Fourth train complete at Cheniere's Sabine Pass LNG plant,”](#) *Reuters*, October 13, 2017.

<sup>120</sup> [“Today in Energy: U.S. liquefied natural gas exports have increased as new facilities come online,”](#) U.S. Energy Information Administration, December 7, 2017.

<sup>121</sup> Charles K. Ebinger, [“The Full Story on Natural Gas Exports,”](#) *The Brookings Institution*, January 17, 2012.

<sup>122</sup> [“A global view of gas – in maps and charts,”](#) BP, October 24, 2017.

<sup>123</sup> [“The Macroeconomic Impact of Increasing U.S. LNG Exports,”](#) U.S. Department of Energy, October 29, 2015.

<sup>124</sup> Naureen S. Malik, [“U.S. Becomes a Net Gas Exporter for the First Time in 60 Years,”](#) *Bloomberg*, January 11, 2018.

<sup>125</sup> Nick Cunningham, [“Is the liquid natural gas glut real?”](#) *USA Today*, November 25, 2017.

<sup>126</sup> [“Natural Gas Explained: Natural Gas Imports and Exports,”](#) U.S. Energy Information Administration, April 25, 2017.

<sup>127</sup> Jude Clemente, [“The U.S. Natural Gas Export Boom Means Pipelines and LNG,”](#) *Forbes*, May 8, 2016.

<sup>128</sup> Michael Ratner, Paul W. Parfomak, Linda Luther, and Ian F. Fergusson, [“U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes,”](#) Federation of American Scientists, January 28, 2015.

The Natural Gas Act mandated that the Department of Energy cannot approve exports of gas to countries not under Free Trade Agreements unless it is deemed in the public interest.<sup>129</sup> In 2017, proposals to weaken LNG export restrictions have arisen as an area of contention between gas producers and domestic gas-dependent manufacturing. This is due to fears that increased exports may increase domestic gas prices, thus harming manufacturing competitiveness.<sup>130</sup> However, it is possible that added benefits of higher GDP, trade, jobs, could offset this effect. According to the Department of Energy, the higher real GDP effect dominates.<sup>131</sup>

Most LNG sold worldwide is under long term fixed contracts indexed to oil prices. U.S. natural gas prices are market-based, creating a price differential between the oil indexed price and the U.S. price.

### *Combined heat and power*

Combined heat and power (CHP) provides another opportunity for businesses to capitalize on natural gas. Two-thirds of energy used to generate electricity is wasted in the form of heat discharged to the atmosphere. Additional electricity is wasted in the distribution process. CHP captures the heat that would have been wasted to provide thermal energy for space heating, cooling, hot water and industrial processes. CHP can achieve efficiencies over 80 percent.<sup>132</sup> The most commonly used CHP system involves an electric generator such as a gas turbine being used in conjunction with a waste heat exchanger, which recovers excess heat or exhaust gas from the generator to create steam or hot water. CHP is most applicable for facilities that experience consistent electric and thermal loads. These include hospitals, schools, recreational facilities, industrial facilities, hotels, and nursing homes. Currently, many private companies view CHP as too risky due to large upfront capital costs. Organizations with facilities that may benefit from CHP are primarily focused on their core business—hospitals on patients, schools on students.

### *Chemical manufacturing*

The abundance and affordability of shale natural gas has led to a boom in the chemical manufacturing industry, leading to \$185 billion worth of planned or completed capital investment across the U.S.<sup>133</sup> After experiencing a decline in the mid-2000s due to severe manufacturing overcapacity in the 1990s,<sup>134</sup> U.S. chemical manufacturers have benefitted from substantial cost advantages due to the gas supply glut caused by the fracking boom. This has resulted in the reshoring of some manufacturers. Additionally, 63 percent of announced investments have been from global firms<sup>135</sup> from countries

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<sup>129</sup> [“Should the U.S. Limit Exports of Natural Gas?”](#) *The Wall Street Journal*, November 13, 2017.

<sup>130</sup> Baker Institute, [“An Abundance of Riches? US Natural Gas, Manufacturing and LNG Exports,”](#) *Forbes*, July 5, 2017.

<sup>131</sup> Michael Ratner, Paul W. Parfomak, Linda Luther, and Ian F. Fergusson, [“U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes,”](#) Federation of American Scientists, January 28, 2015.

<sup>132</sup> [“What Is CHP?”](#) United States Environmental Protection Agency, March 1, 2018.

<sup>133</sup> [“U.S. Chemical Investment Linked to Shale Gas: \\$185 Billion and Counting,”](#) American Chemistry, December 2017.

<sup>134</sup> Reid Frazier, [“How Shale Gas is Fueling a Spinoff Industry in Petrochemicals,”](#) *The Allegheny Front*, April 7, 2017.

<sup>135</sup> [“U.S. Chemical Investment Linked to Shale Gas: \\$185 Billion and Counting,”](#) American Chemistry, December 2017.

ranging from South Africa to Saudi Arabia.<sup>136</sup> CEO Chet Thompson of the American Fuel & Petrochemical Manufacturers trade association stated an expected 20 percent growth in ethylene production and 60 percent increase in petrochemical exports by 2020.<sup>137</sup>

Natural gas is a key input for the manufacture of chemical compounds such as methanol and ethylene. This is done by processing gas in crackers, which heat, separate and distill gas molecules. Methanol is in turn used as an energy source through fuel blending or biodiesels, as well as a component of acetic acid, formaldehyde and methyl methacrylate (a component of LCD screens).<sup>138</sup> Ethylene is the key ingredient in the manufacture of polyethylene plastics. Natural gas is also used to create ammonia for the manufacture of synthetic nitrogen fertilizers.<sup>139</sup> Due to the wide-ranging uses of natural gas byproducts, the low prices are driving dynamic effects with spillovers across agriculture, construction, technology and automotive manufacturing, among others.

Chemical manufacturing firms choose strategic plant locations, with most existing clusters in the Gulf Coast states of Texas and Louisiana. Louisiana has experienced huge investments in Ascension Parish, which is close to the Haynesville-Bossier Shale. Clusters are also emerging in Pennsylvania, West Virginia, Kentucky, and Ohio, due to their proximity to natural gas from the Appalachian Basin and Marcellus Shale.

### *Impact on jobs*

In an aggregate study of fracking in the U.S., researchers found that each additional million dollars of new oil and gas production caused an \$80,000 increase in salaries income and 0.85 new jobs within a given county.<sup>140</sup> Some \$31,000 of the increase in salaries was from spillovers to workers in other industries. However, at a state level, manufacturing and government salaries both decreased. This suggests a ‘natural resource curse’, where the growth in natural resources crowds out other sectors, leading to lower long-run growth compared to otherwise equal economies less dependent on natural resources.

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<sup>136</sup> Jack Kaskey, “[U.S. Chemicals Are Rocketing Back](#),” *Bloomberg*, November 3, 2017.

<sup>137</sup> United States Energy Association 14<sup>th</sup> Annual State of the Industry Forum, Washington, DC, January 18, 2018.

<sup>138</sup> “[Methanex Reshoring: Implications for Gas Producers GeoPark, Chesapeake, And Painted Pony](#),” *Seeking Alpha*, December 6, 2017.

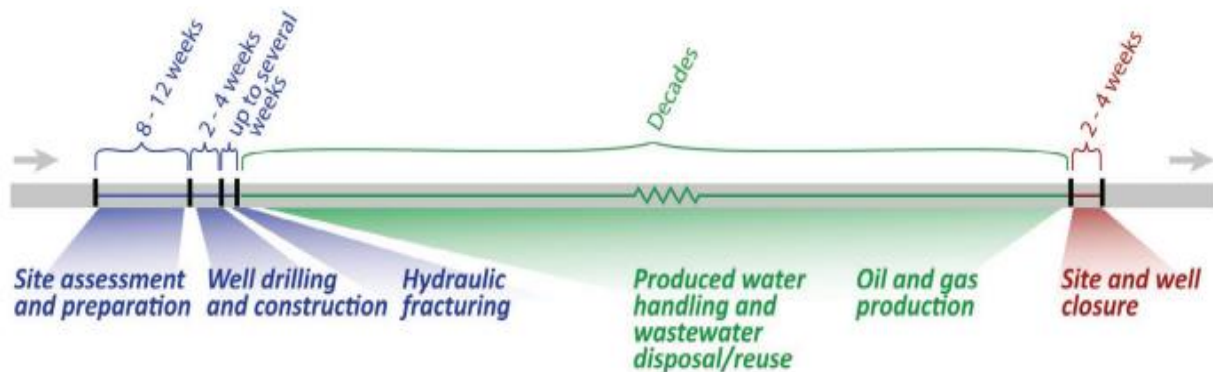
<sup>139</sup> Tom Philpott, “[The Surprising Connection Between Food and Fracking](#),” *Mother Jones and the Foundation for National Progress*, January 30, 2013.

<sup>140</sup> James Feyrer, Erin T. Mansur, and Bruce Sacerdote, “[Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution](#),” *American Economic Review*, April 2017.



According to a 2016 study by Kelsey, Partridge and White, fracking contributed varying amounts of employment depending on the stages of drilling in Pennsylvania. They outlined the basic stages of fracking as:

1. Initial exploration/land acquisition (18 percent of employment)
2. Drilling and construction of supporting infrastructure (80 percent of employment)
3. Drilling and filling in supporting supply chain (2 percent of employment)
4. Mature stage of production (most of workforce relocating)



***General timeline and summary of activities at a hydraulically fractured oil or gas production well***

*Source: U.S. Environmental Protection Agency*

This cycle in turn causes economic growth spikes due to the rapid increase in jobs, not to mention possible rapid loss of jobs when production eases. Resource-driven economic growth may not lead to long-term economic growth.

***Vulnerability through boom and bust cycles***

In states where oil revenues have failed to buffer against price shocks, communities have faced many challenges, including how to weather shortfalls in tax revenues and population losses. Like their counterparts in coal-dependent regions, these states and their economic developers have found it necessary to pursue economic diversification strategies. Some have also undertaken place-based initiatives and a myriad of other programs to retain local businesses and improve the quality of life.

According to a Duke University study, most local governments experienced net positive gains in their local finances with oil and natural gas extraction. A research team from Duke visited 21 oil and gas producing regions across 16 states and interviewed over 200 local government officials in their data collection process. They found that many communities have also experienced significant challenges arising from dependence on oil and gas taxation for revenue.



Counties that levied taxes on oil and gas property naturally experienced strong increases in property tax receipts.<sup>141</sup> States such as Montana, North Dakota, and Pennsylvania that do not permit taxation on oil and gas property have relied on allocation of state taxes and fees on oil and gas production. Municipalities often saw increases in their sales tax revenue from oil and gas industry growth due to population growth as well as local cluster development. Sharp increases in local government revenue have also resulted from leasing county-owned or city-owned land for oil and gas production. The table below outlines major local government revenue sources associated with oil and gas development.

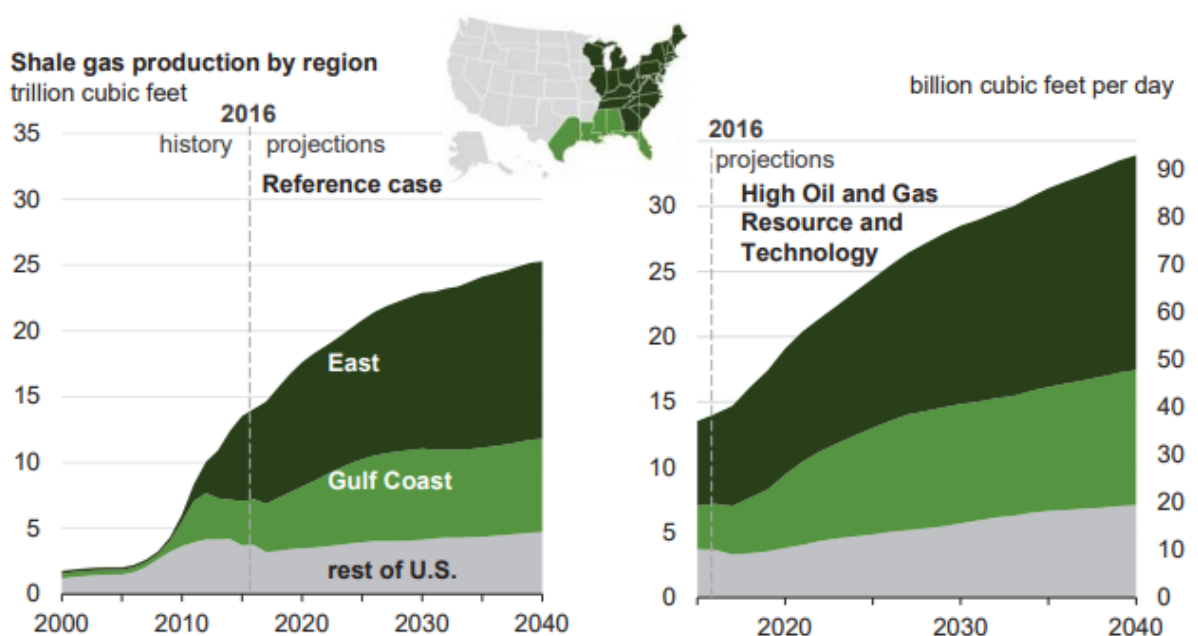
<b><i>Revenue instrument</i></b>	<b><i>Deployed by</i></b>	<b><i>Basis for revenue</i></b>	<b><i>Allocated to</i></b>
<b><i>Severance tax</i></b>	<i>State</i>	<i>Value or volume of oil/gas production, number of wells drilled</i>	<i>Varies by state</i>
<b><i>Lease payments</i></b>	<i>Federal, state, county, municipalities</i>	<i>Negotiated lease terms and royalties</i>	<i>State, county, municipalities</i>
<b><i>Property taxes</i></b>	<i>County, municipalities</i>	<i>Value of oil/gas property (definitions vary by state)</i>	<i>County, municipalities</i>
<b><i>Sales tax</i></b>	<i>State, county, municipalities</i>	<i>Value of sales (rates vary by locality) affected by oil- and gas-related economic activity</i>	<i>State, county, municipalities</i>
<b><i>In-kind</i></b>	<i>County, municipalities</i>	<i>Negotiated agreements or donations</i>	<i>County, municipalities</i>

The most commonly experienced costs associated with hydraulic fracturing across the 16 most important oil and gas states are described in the table below. Most rural communities reported challenges with road maintenance and repairs, often only meeting demands after the oil and gas boom subsided.<sup>142</sup>

<sup>141</sup> Daniel Raimi and Richard G. Newell, “[Dunn County and Watford City, North Dakota: A case study of the fiscal effects of Bakken shale development](#),” Duke University Energy Initiative, May 2016.

<sup>142</sup> Ibid.

<i>Service provided</i>	<i>Provided by</i>	<i>Proximity to oil/gas industry</i>
<b>Road maintenance and repairs</b>	County, municipalities	Increased heavy truck traffic
<b>Sewer and water services</b>	Municipalities	Industry-driven increases in population
<b>Police, EMS, fire</b>	County, municipalities	Oil and gas accidents, equipment, training
<b>Staff costs/workforce retention</b>	County, municipalities	Population growth, greater labor demand



Source: U.S. Energy Information Administration

The ‘Unconventional Hydrocarbon Problem Triangle’, created by Murphy et al (2018)<sup>143</sup>, explains the problem cycle experienced by many rural boomtowns. First, the resource boom strains local labor supply that lowers labor productivity in other important businesses and public services. Oil and gas producers then need to seek temporary non-local labor while offering high wages that lead to higher labor costs for non-oil related businesses and public services. The influx of workers increases demand for already strained public services and other businesses. They may also cause an over-demand in housing, leading to challenges for population retention for long-term families who may struggle with

<sup>143</sup> Trey Murphy, Christian Brannstrom, Matthew Fry, and Michael Ewers, “[Economic-Development Stakeholder Perspectives on Boomtown Dynamics in the Eagle Ford Shale, Texas](#),” Wiley Online Library, October 13, 2016.

elevated rent and housing prices. The shortfall in goods and services then compounds in a lower quality of life, which may further be undermined by long commutes caused by road damage.

In addition, the Duke University study found that public-private initiatives across regions could ease the challenges and costs experienced by many communities. In communities that struggle with meeting oil/gas infrastructure demands, for example, collaboration with oil/gas producers in such necessities as road repairs can help lower costs through in-kind transfers.

### ***Economic development advice from rural Pennsylvania<sup>144</sup>***

“Oil and gas development is not a panacea for local economies,” says a 2016 study in rural Pennsylvania conducted by Kelsey, Partridge and White. The research pointed to the fact that the finite extractive nature of fracking means that it is not a conducive long-run economic development strategy. Minimizing long-run impact is essential for paving the way towards adjustments post-boom. Below is some advice to economic developers and community leader:

- **Use revenues from royalty payments, impact fees, tax receipts to finance long-run investments that strengthen the community post-drilling.**
- **Long-run financial commitments should be avoided, such as those for infrastructure.** Pay as you go models are preferable.
- **Attempt to maintain a diversified economy.** Safeguard important environmental and community assets and amenities and protect them from harm during boom. They are often foundational elements of the local economy and are key to maintaining a good local quality-of-life.
- **Ensure that hidden costs of resource extraction are adequately compensated.** Regulations (taxes and fees) should be designed such that marginal costs equal marginal benefits and that all negative externalities caused by pollution and congestion are compensated. By excusing the energy industry from paying external costs, communities would shift costs onto other sectors of the local economy and citizens, therefore diminishing quality of life and lowering overall competitiveness.
- **Harness additional wealth creation and economic activity from energy development** into permanent advantages.
- **Short-term financial boosts should be put towards economic diversification to improve resilience** in times of commodity downswings.
- **Harness boom periods as opportunities for business attraction** due to **highly positive short-term agglomeration benefits.** This will also help improve resilience.
- **Severance taxes should be set such that revenues are invested in public infrastructure, human capital development, and environmental enhancement.** Severance taxes should also fund a permanent trust fund that may be used by the state to assist local governments.

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<sup>144</sup> Timothy W. Kelsey, Mark D. Partridge, and Nancy E. White, “[Unconventional Gas and Oil Development in the United States: Economic Experience and Policy Issues](#)” Oxford Index, April 2016.

- **Invest strategically in workforce development.** Providing training programs that equip residents with skills needed for drilling operations would boost employment and reduce the need to bring transitory, non-local labor that may otherwise undermine social cohesion. However, there is also the risk of losing some population who follow the drilling activity, or having entrepreneurs providing trucking support lose business during the bust.
- **Strengthen the capacity of local governments to understand** and manage this activity.
- **Increase the transparency** of local government and governance institutions.

### *Case study: America's oil powerhouse – Texas*

The oil industry is central to the economy of Texas. More than half of the nation's oil rigs are in the Permian Basin. The Eagle Ford shale region is home to the nation's second highest concentration of rigs. In 2017, Texas had 451 operating oil rigs.<sup>145</sup> Texas produces over one-third of U.S. crude oil and provides 30 percent of the nation's refining capacity.<sup>146</sup>

Overall, the shale revolution has positively impacted the Texas economy. One study estimates the economic impact in the 21-county Eagle Ford shale area to be \$87 billion in 2012, showing a \$26 billion increase from 2008.<sup>147</sup> In 2012, the state collected \$12 billion in tax revenue from oil and gas interests, up \$4.6 billion from 2010.<sup>148</sup> These industries also prove somewhat resilient to price shocks. Even during the global price collapse, Texas still collected higher revenues than before the shale revolution.<sup>149</sup> However, rig counts hit all-time lows during the 2014 downturn, and Texas oil companies faced cut backs and productivity losses.<sup>150</sup> But production quickly recovered, and the Eagle Ford shale area increased employment since the downturn, with more than 80 rigs now in operation.<sup>151</sup>

Turbulent revenues after the 2014 downturn also significantly affected oil communities. Limits on property taxes coupled with less oil revenue left multiple counties struggling to keep up with the infrastructure demands of the industry.<sup>152</sup> Texas law limits growth in county property tax revenue to around eight percent annually, so during shale booms when property values rise, local lawmakers must choose between lowering taxes or keeping rates steady to increase revenue.<sup>153</sup> When valuations fall during price drops, lawmakers face the opposite decision: raise taxes to keep revenue steady, or keep rates the same and see a dramatic fall in revenue.<sup>154</sup> Many communities struggle to anticipate and

<sup>145</sup> Jordan Blum, "[Drilling rig count grows, despite Texas dip](#)," *Houston Chronicle*, September 29, 2017.

<sup>146</sup> "[Texas State Energy Profile](#)," U.S. Energy Information Administration, January 18, 2018.

<sup>147</sup> "[Economic Impact of the Eagle Ford Shale](#)," The University of Texas at San Antonio Center for Community and Business Research, September 2014.

<sup>148</sup> Kate Galbraith, "[State's Shale Boom Has Major Impact on Budget](#)," *The Texas Tribune*, April 30, 2013.

<sup>149</sup> Kathryn Cargo, "[Oil, gas industry is backbone of Texas economy](#)," *Victoria Advocate*, June 25, 2017.

<sup>150</sup> Jordan Blum, "[Drilling rig count grows, despite Texas dip](#)," *Houston Chronicle*, September 29, 2017.

<sup>151</sup> Kathryn Cargo, "[Oil prices increase, leading to more production](#)," *Victoria Advocate*, December 17, 2017.

<sup>152</sup> Daniel Raimi, "[Managing Revenues through a Downturn in Texas's Eagle Ford Shale](#)," *Resources for the Future*, January 30, 2017.

<sup>153</sup> Ibid.

<sup>154</sup> Ibid.

prepare for revenue volatility while maintaining the ability to sustain the infrastructure investment necessary to support shale extraction.

### *Living through the boom: North Dakota*

While shale booms bring opportunities for economic growth, sudden increases in population and uncertainty in oil prices can produce challenges for shale regions. One such area, the Bakken shale region in North Dakota, demonstrates the externalities of growing oil production.

The Bakken shale region is a rural area with a small, thinly-spread population, with just 5.6 residents per square mile.<sup>155</sup> After shale extraction took off in 2005, growing from two to 15 percent of North Dakota's GDP, development in Bakken helped double the state economy between 2005 and 2015. With increased revenues from oil and gas mining, however, Bakken faced new fiscal and development challenges. A lack of adequate infrastructure made it difficult to keep up with a rapidly growing population. North Dakota lacked the housing and workforce to support sudden, large-scale industrial development, and the state was caught off guard by quickly increasing demand for services and infrastructure expansion. The demands of doubling and tripling populations attracted to huge new industries placed significant financial pressure on local governments.

To address these challenges, the state government passed a series of bills to help channel funding to communities struggling to keep up with industrial development. Although North Dakota law limits the rates that local communities can collect through property taxes, the state government enjoyed significant revenue growth between 2004 and 2014. To reallocate these revenues, the state senate provided surge funding of \$1.1 billion for local and state infrastructure needs. Other bills reformulated gross production tax revenue allocation to provide more for local governments and stabilize tax rates during oil price changes.<sup>156</sup>

### *Strategic planning for economic diversification at the local level – Wyoming*

Wyoming's economy is heavily dependent on its extraction and energy industries, which supply 60 to 70 percent of state revenues.<sup>157</sup> Already affected by coal's ongoing decline, the state faces additional insecurity in the face of turbulent oil prices. Falling oil prices have brought on bankruptcies and layoffs throughout the state over the last five years.<sup>158</sup> With prices gradually recovering, however, Wyoming is

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<sup>155</sup> Daniel Raimi and Richard G. Newell, "[Dunn County and Watford City, North Dakota: A case study of the fiscal effects of Bakken shale development](#)", Duke University Energy Initiative, 2016.

<sup>156</sup> Ibid.

<sup>157</sup> Jack Healey, "[In Wyoming, Hard Times Return as Energy Prices Slump](#)," *The New York Times*, April 12, 2016.

<sup>158</sup> Ibid.

seeing growth in oil rig operation, increasing from eight to 26 in the last year.<sup>159</sup> Oil and gas employment is also experiencing its first increase since 2015.<sup>160</sup>

In Wyoming, communities are working to revitalize local economies in the wake of oil price changes, compounded by the negative effects of coal's decline. The importance of retaining workers and their families has been emphasized in many revitalization efforts. In Gillette, this plays into value-based planning for economic development, focusing on development efforts to improve infrastructure and quality of life. For example, city planners are developing safer transportation routes between neighborhoods and public facilities, although job losses have reduced funding capacity.<sup>161</sup>

In Rock Springs, planners are looking for other economic opportunities beyond extractive industries, such as outdoor recreation. The city's location on the way to Yellowstone National Park makes it an ideal spot to tap into the tourism sector. In Casper, city planners and economic developers are focused on revitalization through downtown development and quality of life improvements.<sup>162</sup>

In North Dakota, 30 percent of the total revenues from oil and gas are transferred to the North Dakota Legacy Fund, proposed in 2009 and created in 2010. These funds can start to be expended as of July 31, 2017, if two-thirds of each house of the Legislative Assembly authorizes it. As of December 2017, the fund has accumulated \$4.16 billion.

North Dakota's proactive approach to oil-related challenges shows how states can take advantage of increased revenues from oil production to address development needs at the local level. However, uncertainty remains for many communities. While states can help mitigate fiscal impacts, factors such as population changes and oil price fluctuation make forecasting and planning difficult.

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<sup>159</sup> Heather Richards, "[In a snap shot, Wyoming energy industries steady after rocky decline](#)," *Casper Star Tribune*, April 26, 2017.

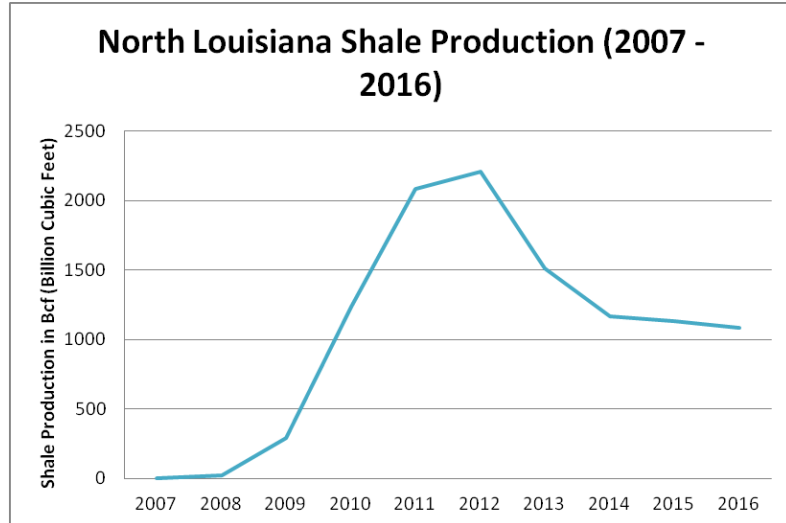
<sup>160</sup> Heather Richards, "[The Powder River Basin is poised for growth when oil prices rise. But what will it mean for jobs?](#)," *Casper Star Tribune*, June 17, 2017.

<sup>161</sup> Heather Richards, "[As Wyoming's economy slows, city planners consider future development](#)," *Casper Star Tribune*, September 26, 2016.

<sup>162</sup> Ibid.

### Case study: North Louisiana and the Haynesville Shale<sup>163</sup>

In North Louisiana, the impacts of the Haynesville gas shale boom were large. According to Scott Martinez, President of the North Louisiana Economic Partnership (NLEP), the fracking boom “hit every socioeconomic stratum in North Louisiana, from restaurant workers, to bankers and attorneys”. The spillovers caused by the boom resulted in huge growth in sectors such as construction, hospitality and numerous other oil and gas support



industries. The influx of investment also facilitated rapid advancements in technology, increasing drilling productivity and improving production efficiency. Another key benefit was strong growth in philanthropic contributions, driven by drilling companies. An example of this is BHP Billiton’s construction of YMCA of Northwestern Louisiana, which opened in March 2017.<sup>164</sup>

The peak of the boom saw strong benefits for parish government finances. Caddo Parish experienced a doubling of sales tax revenues from \$7.3 million in 2007 to \$14.5 million in 2009 and continued to climb through 2012.<sup>165</sup> Royalties and leasing bonuses were a stronger revenue source for Caddo Parish, with royalties averaging \$1 million per month from 2009 to 2010. Through this, Caddo put aside \$100 million in reserves. Similarly, DeSoto Parish saw strong sales tax growth, increasing from \$5.3 million in 2007 to \$26 million per year in 2010 and 2011. Royalties were lower relative to Caddo Parish, reaching a peak of \$3 million in the same years, although property taxes on oil and gas-related properties led to revenue gains of \$11 million in 2012, up from \$4 million in 2007. Using some of these oil and gas revenues, DeSoto Parish decided to invest heavily in improving education, which helped raise the school system from 45<sup>th</sup> out of 70 systems in 2010, to ninth in 2017.<sup>166</sup>

Both parishes experienced minor road damage costs from heavy truck traffic, although agreements were created with gas well operators to help with road maintenance, with some repairing roads after the construction of a well. During the peak of drilling, workforce retention was problematic for those working in road and bridge crews due to their highly transferrable experience with heavy machinery.

<sup>163</sup> Scott Martinez, North Louisiana Economic Partnership, phone interview, March 2018.

<sup>164</sup> Seth Dickerson, “[New Shreveport YMCA opening set for Saturday](#),” *Shreveport Times*, March 16, 2017.

<sup>165</sup> Daniel Raimi and Richard G. Newell, “[Shale Public Finance: Local government revenues and costs associated with oil and gas development](#),” Duke University Energy Initiative, May 2014.

<sup>166</sup> Segann March “[DeSoto Schools purchases land for further development](#),” *Shreveport Times*, February 9, 2017.



However, as production declined from 2012 to 2014, many oil- and gas-related sectors also dissipated. Hotels in the region were hit especially hard, as the investments made during the boom turned into idle assets, leaving high levels of debt. Martinez noted that “energy economies have historically been boom/bust,” and North Louisiana’s experience was no different. As a result, economic diversification has been a priority. The NLEP, which encompasses 14 parishes created a strategic plan with IT, technology, advanced manufacturing and petrochemical manufacturing set as target industries. In the IT sector alone, 4,000 jobs have been created by their business attraction efforts, with many tied to air force bases in the region and cybersecurity.

For many of these industries, industry partnerships with educational institutions played a key role. In 2012, German manufacturer Benteler Steel announced a \$975 million steel and tube mill at the Port of Caddo-Bossier.<sup>167</sup> Benteler Steel provides steel tubes to automotive and oil and gas sectors. As part of their efforts, the company also invested \$23 million in a training facility on the campus of Bossier Parish Community College, so that students could gain experience from using specialized manufacturing machinery. This created a robust and targeted workforce development system for manufacturing jobs.

#### ***Case study: Calvert County and Dominion Cove Point, Maryland<sup>168</sup>***

Fracking has been a contentious issue in Maryland over concern for its potential health and environmental consequences. The Western Maryland panhandle lies above part of the Marcellus Shale.<sup>169</sup> In January 2015, a moratorium on fracking<sup>170</sup> was implemented until fall 2017.<sup>171</sup> Before the expiration of the moratorium, a bill was signed banning fracking in the state in April 2017. This reaction contrasts with neighboring states Pennsylvania and West Virginia, which have both been highly active with fracking in the Marcellus shale.<sup>172</sup>

Despite the fracking ban, investment in gas pipelines and LNG facilities has nonetheless occurred in Southern Maryland. In December 2017, Calvert County announced the completion of a \$4 billion project at the Dominion Cove Point LNG terminal.<sup>173</sup> Dominion Cove Point is the only LNG import terminal in the mid-Atlantic and has started exporting natural gas fracked from Pennsylvania and West Virginia.<sup>174</sup> Dominion Energy is an energy producer and transporter headquartered in Richmond, Virginia, with a customer base of over 6 million.<sup>175</sup>

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<sup>167</sup> KSLA Staff, “[Operations begin at Benteler Steel Tube mill](#),” KSLA News 12, October 7, 2015.

<sup>168</sup> Kelly Slagle, phone interview, February 26, 2018.

<sup>169</sup> Sarah G. Rasmussen, Brian S. Schwartz, and Joan A. Casey, “[Fracking and health: What we know from Pennsylvania’s natural gas boom](#)” *The Conversation*, August 25, 2016.

<sup>170</sup> “[Maryland bans Fracking](#),” *The Hill*, June 1, 2015.

<sup>171</sup> Josh Hicks, “[A new fracking fight is brewing in Maryland](#),” *The Washington Post*, April 11, 2016.

<sup>172</sup> “[Maryland bans Fracking](#),” *The Hill*, June 1, 2015.

<sup>173</sup> Susan Phillips, “[Dominion’s Cove Point plant preparing to export LNG](#),” *StateImpact Pennsylvania*, December 27, 2017.

<sup>174</sup> “[Maryland](#),” U.S. Energy Information Administration, July 20, 2017.

<sup>175</sup> “[Who We Are](#),” Dominion Energy.

Planning for the project began in the mid-2000s because of Dominion Energy's already strong community presence, the strategic location of Calvert County in the mid-Atlantic region, and convenient pre-existing pipeline infrastructure. In 2006, Calvert County made an agreement with the state legislature for a pilot personal property tax program for Dominion Energy Cove Point, with a 42 percent tax credit estimated at \$5 million from July 1, 2023 to June 30, 2032 for new and repurposed equipment.<sup>176</sup> According to Kelly Slagle, director of the Calvert County Department of Economic Development, the tax incentive offered greater enticement to Dominion Energy for moving forward with construction. The first payment from the pilot tax program for the 2018 fiscal year was \$25 million, with future tax payments expected to range between \$35.8 million to \$48.8 million over the next five years.<sup>177</sup>

Throughout the process, Calvert County adopted an underlying philosophy of transparency, openness and communication with the community. As they were "cognizant of the delicate balance between corporate presence and the environment," Calvert County sought to manage community concerns well in advance of construction. Dominion also recognized the importance of clearly communicating fracking by explaining its advantages and disadvantages to the community. This helped build community confidence in future proposals, which were then communicated in open community meetings held a year in advance of the project's construction.

The County also collaborated with Dominion Energy to set up [www.onecovepoint.com](http://www.onecovepoint.com), which "became the main information pipeline for the community". In addition to notice advisories and quarterly project newsletters, the website contained constant updates for opportunities for local businesses to assist Dominion in construction. Prior to construction, there was also a system that allowed local businesses to pre-register with Dominion the services they could offer.

According to Mrs. Slagle, "no other project has stretched our economic development skill set and knowledge as much as [the Dominion Energy Cove Point Project]." Challenges in planning included identifying an off-site laydown area and managing considerations of an environmental buffer. At times, leasing properties from community members was needed to send equipment for construction. In addressing infrastructure concerns, the project team consisted of representatives responsible for the state highway, permitting, zoning as well as Department of Environment and public works personnel. This project team established consistent monthly meetings long before submitting any permit applications, ensuring that all parties could comprehensively address and negotiate any concerns. This in turn enabled a smooth application process. Additionally, Dominion Energy bore the cost of new roads that would be shared by residents. In Slagle's view, "[Dominion Energy was] easing burdens as much as [it] could," going so far as to occasionally check-in with residents near the construction site. When it became clear that the new roads needed to be widened, Dominion Energy also quickly responded to the concerns.

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<sup>176</sup> DanDan Zhou, "[Dominion's export facility beings producing LNG](#)," *The Calvert Recorder*, February 5, 2018.

<sup>177</sup> Ibid.

Looking forward, Calvert County acknowledges the need for economic diversification as it understands its dependence on tax revenues from the Calvert Cliffs Nuclear Power Plant and Dominion Energy Cove Point. Although the County is a bedroom community for the federal government due to its proximity to naval bases and Washington, DC, its other main industries include tourism, manufacturing and aquaculture.

In the immediate future, the County is looking to meet Dominion Energy's ongoing needs by attracting spin-off businesses, as well as satisfying their workforce needs. Due to the County's strong energy sector, they are heavily dependent on workers with engineering skills. To that end, a '2-in-2' program has been established through a partnership between the College of Southern Maryland and the University of Maryland. This program allows students to graduate with an automatic paid energy internship to incentivize students to remain working in South Maryland and has seen students graduate into \$60,000 to \$70,000 incomes in local jobs.

### *State-level approach to weathering booms: First wave funds<sup>178</sup>*

Predating first wave funds by more than a century are the Texas permanent trust funds which were established in 1854. These funds are financed by oil and mineral royalties and have been resilient over time with few constitutional amendments altering them. Inspired by Texas, the "first wave" of permanent trust funds was created in Alaska, New Mexico, and Wyoming during an oil boom from 1974 to 1986. The drivers behind these funds were:

- **Resource curse aversion.** Prior state experiences with boom-bust cycles served as cautionary tales.
- **Fiscal conservatism.** States viewed trust funds as ways to prevent irresponsible short-term spending.
- **Public resource ownership.** This was a concern particularly in Alaska, with its state constitution calling for the legislature to "provide for the utilization, development and conservation of all natural resources belonging to the state... for the maximum benefit of the public."

First wave funds have generally remained consistent with few structural adjustments. Two key factors that have enabled resilience include:

- **Constituency building.** The Alaska Permanent Fund is built into the state's Constitution and acts as a general fund that provides annual dividends to its citizens based on oil revenues. This fund has seen little change since it first began in 1976, surviving several fiscal crises such as oil price drops, and has not been used in economic diversification efforts. In comparison, the trust funds of Montana, Wyoming, and New Mexico supplement government spending programs such as education, and generally lack constituencies comparable to Alaska's.

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<sup>178</sup> Barry G. Rabe and Rachel L. Hampton, "[Trusting in the future: The re-emergence of state trust funds in the shale era](#)," University of Michigan, October 1, 2016.

- **Protection from federal intervention.** The constitutionality of levying severance taxes to build permanent trust funds was settled by a 1980 Supreme Court decision in *Commonwealth Edison v. Montana*, which upheld Montana’s ability to levy higher taxes and found no violation of the federal Commerce Clause.

### *Second wave funds*<sup>179</sup>

The second wave of permanent trust funds occurred from 2010 to 2015 in North Dakota, Utah and West Virginia. Both North Dakota and Utah learned from shortcomings with their first-wave funds. Created in 1997, North Dakota’s fund experienced frequent raids to finance short-term spending, so a better-protected Legacy Fund was created in 2010. Utah’s 2008 fund was built from a constitutional amendment which stated that contributions were only voluntary, but a more reliable funding mechanism was created in its 2012 Permanent State Trust Fund.

North Dakota’s Legacy Fund is financed by 30 percent of all oil and gas severance taxes.<sup>180</sup> The severance tax rates amount to 11.5 percent of extracted oil value due to overlapping severance taxes: the 1953 Oil and Gas Production Tax and the 1981 Oil Extraction Tax. The principal of the Fund is then invested by the Retirement and Investment Office at the direction of the State Investment Board (SIB), which has transparent investment targets and a clear strategic investment plan.<sup>181</sup> Most of the remaining severance tax revenues have been allocated towards other funds that address environmental oversight costs and rehabilitation expenditures. These include the State Disaster Relief Fund, the Oil and Gas Impact Fund, the North Dakota Heritage Fund, the Resources Trust Fund, and funds targeting research and development in renewable energy.

Policymakers have argued that while this “bucket strategy” may see shifting funds for various purposes, it has deterred short-term spending while supporting economic stability and predictability. Utah’s trust fund functions in an anticipatory way, learning from past fluctuations in the state’s oil and gas development. Utah anticipated the possibility of future shale development, which has now come to fruition in Utah, Colorado, and Wyoming.

Second-wave funds learned from and made improvements upon first-wave funds. For its trust fund, North Dakota evaluated Alaska and Wyoming’s funds, taking note of the effectiveness of their structures, oversight, mechanisms for routing revenues, and rigorous investment strategies. North Dakota also avoided Alaska’s dividend model, noting its inability to use the money for long-term diversification. North Dakota also looked internationally, influenced by Norway’s Government Pension Fund Global (GPF), the largest sovereign wealth fund in the world valued at \$1.03 trillion. North

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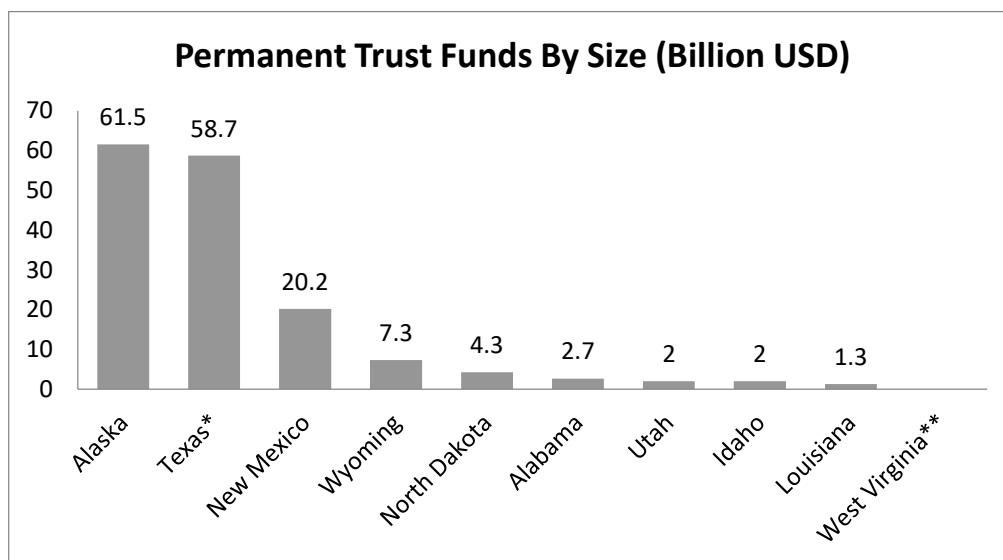
<sup>179</sup> Ibid.

<sup>180</sup> “[North Dakota Government Funds](#),” The Office of North Dakota State Treasurer, March 28, 2018.

<sup>181</sup> “[State Investment Board](#),” North Dakota Retirement and Investment Office.

Dakotan policymakers attended GPFG briefings in Norway and hosted Norwegian officials for consultations.

But North Dakota's Legacy Fund is not without threats. As of June 2017, funds from the interest and principal may now be spent, though the use of the principal requires a two-thirds vote from both houses of the legislature. In addition, the principal expended may not exceed 15 percent during a biennium.<sup>182</sup> In the 2017 to 2019 budget cycle, \$200 million in legacy fund interest has been allocated, but the budget remains in a deficit and has caused debate among lawmakers.<sup>183</sup> In the 2017 to 2019 budget cycle \$200 million of Legacy Fund interest has been allocated for expenditure, but the budget remains in a deficit, causing some debate.<sup>184</sup> Although the Legacy Fund has experienced stability due to continued principal investment, challenges to long-term stewardship are expected to continue, as the temptation to use the money for short-term needs remains.



**\*Texas includes both the Permanent School Fund (\$37.7 billion) and the Permanent University Fund (\$21 billion),**

**\*\*West Virginia's fund is too young to measure.**

Source: Sovereign Wealth Fund Institute <https://www.swfinstitute.org/sovereign-wealth-fund-rankings/>, and the University of Texas Investment Management Company <https://www.utimco.org/Funds/Endowment/PUF/PUFSemiAnnual201712.pdf>

<sup>182</sup> "[North Dakota Government Funds](#)," The Office of North Dakota State Treasurer, March 28, 2018.

<sup>183</sup> Ibid.

<sup>184</sup> John Hageman, "[Burgum: North Dakota's budget future is not 'risk-free'](#)", *The Bismarck Tribune*, January 23, 2018.

### *Five Guidelines for resilient permanent trust funds*

By examining the strengths of various permanent trust funds, Devashree Saha and Mark Muro of The Brookings Institution created five guidelines for resilient trust funds.<sup>185</sup>

1. Establish an effective governance framework.
2. Define the fund's revenue source, deposit, and withdrawal rule.
3. Design the investment strategy.
4. Seize the opportunity to invest fund earnings in economic transformation.
5. Formulate explicit disclosure and transparency standards.

### *Storage and pipeline issues for natural gas*

After extraction, natural gas is commonly stored underground and then transported to processing plants through a gathering system of pipelines. Two important considerations of the underground site are the total capacity for storage and the deliverability rate or the rate at which inventory can be withdrawn. Interstate pipeline companies rely on underground storage to balance loads and handle supply management. Storage exists to modulate the naturally occurring seasonality in natural gas. Formerly, the large seasonal price differential incentivized companies to profit from price movements by investing in gas storage. But low-price levels caused by the current gas supply glut have diminished the value of storage as a tool to mitigate price risks, leading to the cancellation or delay of many storage projects. As renewable energy continues to grow, demand for greater gas storage may occur as gas becomes an important baseload generator.

Currently, there are over 400 storage facilities in the U.S., with the majority owned by pipeline companies or distribution companies. Gas storage has reached or surpassed 80 percent of maximum inventory levels in almost all U.S. regions.<sup>186</sup> After processing, natural gas is transported through long-distance transmission pipelines which may be interstate or intrastate. Pipelines have two main types: distribution and main line or transport pipelines, which can either be buried or run above ground. In recent years, pipeline construction has become a contentious issue for some communities. Objections to pipelines include:

- Concerns over methane leaks and its function as a greenhouse gas
- Damage to landscape / disposal of overburden
- Threat to public safety
- Lower home values
- Aesthetically displeasing

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<sup>185</sup>Devashree Saha and Mark Muro, "[Permanent Trust Funds: Funding Economic Change with Fracking Revenues](#)," *The Brookings Institution*, April 2016.

<sup>186</sup>Hua Fang, Anthony Ciatto, and Frank Brock, "[U.S. Natural Gas Storage Capacity and Utilization Outlook](#)," Oak Ridge National Laboratory, July 19, 2016.

In New York State, ongoing pipeline issues are occurring. Several measures blocking pipelines have been signed into law, which some argue increases the likelihood of a “gas crisis.”<sup>187</sup> Pipelines that have been blocked include Northern Access 2016 and the Millennium Pipeline Project, the ban on the latter now overturned by FERC.<sup>188</sup> Opposition to pipelines in New York has consequences for New England as the region finds itself cut off from the gas plays south of New York State.

Pipeline issues have become more pronounced during times of high gas usage. Cold periods highlight the price volatility of natural gas due to its dual use as both electrical generation and heating. Hardest hit by spikes have been manufacturers which are forced to buy gas at the spot prices.

### ***State-level programs***

Natural resource booms create rapid increases in revenue across all levels of government from property, sales, and severance taxes. But along with revenue growth comes more demand for public services, and the boom and bust cycle makes long-term planning difficult. In response, many oil- and gas-rich states have created permanent trust funds.<sup>189</sup> Trust funds are state-owned investment vehicles with a variety of asset classes, such as stocks, bonds, real estate, private equity, and hedge funds. The investment income is used for strategic, long-term use. They are much like endowments, but only the earnings and investment gains from the funds may be used. Expenditure of the principal is usually prohibited, unless granted by legislative approval or constitutional amendment.<sup>190</sup>

Governments look to maintain predictable and reliable revenue sources dependent on oil and gas-related revenues. Policies to mitigate the effects of volatile oil and gas prices included investing in diversification and workforce development. To complement reliable revenue sources, flexible funding mechanisms are also encouraged. An example of flexible funding is the Utah Permanent Community Impact Fund Board, which distributes loans and grants to jurisdictions affected by mineral resource development on federal land. These loans and grants are then used for a variety of projects, including infrastructure, water and property development (<https://jobs.utah.gov/housing/cib/index.html>).

### ***Case study: The Eagle Ford Shale Community Development Program – Texas***

Launched in 2012, the Eagle Ford Shale Community Development Program (EFSCDP) was a three-year project headed by the Institute for Economic Development at the University of Texas at San Antonio.<sup>191</sup> Funded by the U.S. Economic Development Administration, this program provided services, research, and workshops for south Texas communities coping with challenges and opportunities relating to the Eagle Ford shale boom. The region was dealing with population shifts, infrastructure demands, and volatile revenue streams. The EFSCDP helped communities navigate these changes.

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<sup>187</sup> “[WSJ Harpoons NY Gov Cuomo for His ‘Blockade’ of Natural Gas](#),” *Marcellus Drilling News*, August 24, 2017.

<sup>188</sup> Scott DiSavino, “[Natgas pipeline builders hail U.S. okay of blocked New York project](#),” *Reuters*, September 20, 2017.

<sup>189</sup> Pennsylvania and Ohio do not have permanent trust funds, though these states are heavily invested in the shale boom.

<sup>190</sup> Devashree Saha and Mark Muro, “[Permanent Trust Funds: Funding Economic Change with Fracking Revenues](#),” *The Brookings Institution*, April 2016.

<sup>191</sup> [Eagle Ford Shale Community Development Program](#).



The EFSCDP set out a “strategically sequenced” approach:

1. **Assessment:** Community outreach and evaluation.
2. **Research:** Economic base analysis, gap analysis, feasibility studies, and targeted industry studies.
3. **Capacity building:** Visioning and goal-setting; strategically sequenced economic development; international trade; and leadership development.
4. **Planning goals:** Community planning, vision and strategic planning, financial and business planning.
5. **Implementation:** Management consulting, strategic plan development, facilitation of workforce development, contracting, and technology services.

One of the EFSCDP’s main projects was a two-year housing study, *The Other Side of Eagle Ford Shale*. It was funded by the U.S. Department of Housing and Urban Development (HUD). This study explored the increased demand for housing, construction, amenities, and services in Zavala, Dimmit, and LaSalle counties in response to an influx of oil field workers. A housing shortage caused prices to rise and pushed homeownership out of reach for many residents of these counties, which already lacked quality affordable housing.

Although the EFSCDP’s funding was exhausted in 2016, the program’s workshops and studies helped establish a baseline understanding of oil’s impacts on the Eagle Ford Shale region. This also helped local leaders prioritize and plan economic development activities.<sup>192</sup> Programs that offer research and training services to local leaders struggling with the impacts of oil-based economic changes help communities transition through volatile periods of growth. Partnerships between local academic institutions and community leadership create opportunities for education, strategic development, and equitable growth through times of change.

***Case study: Working with state partners to overcome infrastructure challenges – Hampton Roads, Virginia***

With its shipping channels that are the deepest on the U.S. East Coast, interstate highway systems, military facilities, tourist attractions, and skilled workforce, Hampton Roads is well-positioned for growth. As federal spending in the region has declined over the years, the business attraction efforts of Hampton Roads Economic Development Alliance have become increasingly important. Energy cost, capacity and reliability are paramount for business location decisions, particularly in energy-intensive industries such as manufacturing.

While prices of natural gas are currently inexpensive, Hampton Roads’ two interstate pipelines are decades old and already running at full capacity. Improvements to this essential infrastructure will require hundreds of millions of dollars in investment.<sup>193</sup> Without such improvements, the essential

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<sup>192</sup> Sergio Chapa, “[Depleted funds pauses program that helped Eagle Ford towns diversify their economies](#),” *San Antonio Business Journal*, June 8, 2016.

<sup>193</sup> “[Virginia Port Authority Comprehensive Annual Report for Fiscal Year Ended June 30, 2014](#),” The Port of Virginia. “The Case for the Atlantic Coast Pipeline,” E&E News, 2016. [https://www.eenews.net/assets/2016/09/12/document\\_gw\\_05.pdf](https://www.eenews.net/assets/2016/09/12/document_gw_05.pdf).

supply of natural gas will otherwise remain inaccessible to residents and businesses. In fact, in cold weather, Virginia Natural Gas has often been forced to cut off industrial customers to ensure homes are heated.

In December 2016, Virginia competed on three unnamed business attraction projects that needed natural gas, with one described by Governor Terry McAuliffe as “gigantic,”<sup>194</sup> emphasizing “tremendous interest across Southeast Virginia for advanced manufacturing.”<sup>195</sup> The projects were tied to the \$5.1 billion, 600-mile Atlantic Coast Pipeline, which was approved in January 2018 and will run through West Virginia, Virginia and North Carolina. Due to permitting delays, however, the project cost is expected to increase to \$6 billion.<sup>196</sup>

Opposition to the pipeline has focused on environmental concerns as well as skepticism about levels of natural gas demand.<sup>197</sup> As a result, there is a \$58 million Memorandum of Understanding in place between the pipeline consortium and the Governor to mitigate environmental impacts of the pipeline.<sup>198</sup>

Job creation for all three states of the pipeline is projected at 13,000. Expected benefits of the pipeline in Virginia alone include 8,000 construction jobs and property tax benefits for every locality that it will cross. For example, non-metropolitan Southampton County is expected to receive \$4 million between 2018 and 2025, and rural Suffolk is expected to gain \$6 million in the same period.<sup>199</sup>

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<sup>194</sup> Michael Martz, “[McAuliffe doubles down on pipeline support, hints at economic prospects](#),” *Richmond Times-Dispatch*, December 15, 2016.

<sup>195</sup> Michael Martz, “[Virginia Natural Gas playing with big boys in Atlantic Coast Pipeline debate](#),” *Richmond Times-Dispatch*, July 30, 2016.

<sup>196</sup> The Associated Press, “[Atlantic Coast Pipeline Cost Expected To Increase By \\$1.5B](#),” Chem.Info, February 27, 2018.

<sup>197</sup> “[Risky and Unnecessary Natural Gas Pipelines Threaten Our Region](#),” Southern Environmental Law Center.

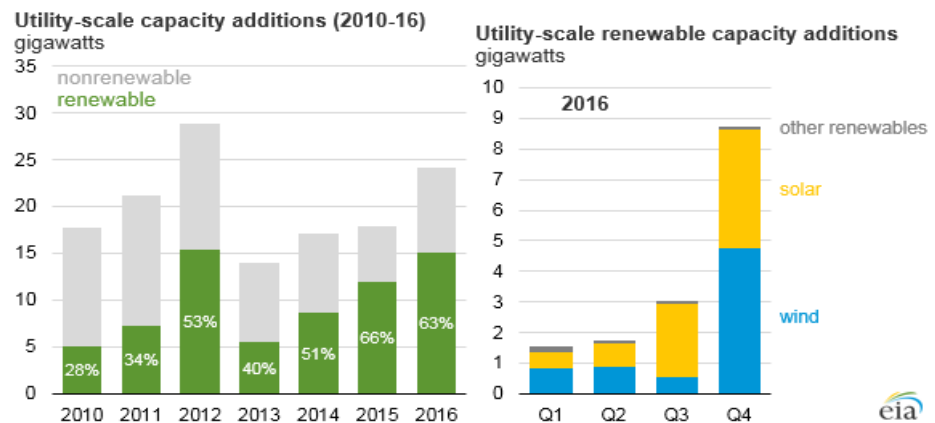
<sup>198</sup> The Associated Press, “[Virginia signs \\$58M deal with Atlantic Coast Pipeline](#),” WSET ABC 13, February 2, 2018.

<sup>199</sup> Theresa Beale, “[Hampton Roads economy needs the Atlantic Coast Pipeline](#),” *The Tidewater News*, December 21, 2016.

## V. Renewable energy

The U.S. economy is undergoing a rapid transition from fossil fuels to renewable energy sources. How economic developers manage this transition will determine whether communities thrive or are left behind in the new energy age. Though renewable energy accounts for just 10 percent of U.S. energy consumption, it represents more than half of capacity additions. U.S. clean energy investment in 2017 totaled \$56.9 billion<sup>200</sup> while global investment doubled that of coal and gas combined.<sup>201</sup> By 2040, it is expected that more than half the world's electricity will come from renewable sources, primarily wind and solar.<sup>202</sup>

Green energy and renewable energy are often used synonymously, and though they often overlap, there is a slight difference in meaning. According to the Environmental Protection Agency, green power is a subset of renewable



energy and represents those renewable energy resources and technologies that provide the highest environmental benefit,” and includes solar, wind, geothermal, biogas, eligible biomass, and low-impact small hydroelectric sources. Renewable energy comes from “resources that rely on fuel sources that restore themselves over short periods of time and do not diminish,” and can mean any energy derived from the sun, wind, moving water, organic plant and waste material (eligible biomass), and the earth's heat (geothermal).<sup>203</sup>

### *Solar and wind are booming*

The transition to renewables will have transformative impacts on local economies. Wind power is projected to drive \$85 billion in economic activity between 2017 and 2020,<sup>204</sup> with one new turbine built every two hours.<sup>205</sup> Solar photovoltaic (PV) cell installations are also beating growth forecasts year after

<sup>200</sup> Joshua S. Hill, “BNEF Predicts 107 Gigawatts of Solar in 2018 & \$330 Billion in Clean Energy Investment, Again!” *Clean Technica*, January 18, 2018.

<sup>201</sup> “Capturing the sun: The economics of solar investment,” EY, 2016.

<sup>202</sup> Nathaniel Bullard, “Investing Trillions in Electricity’s Sunny Future,” *Bloomberg*, June 16, 2017.

<sup>203</sup> “What is Green Power?” United States Environmental Protection Agency.

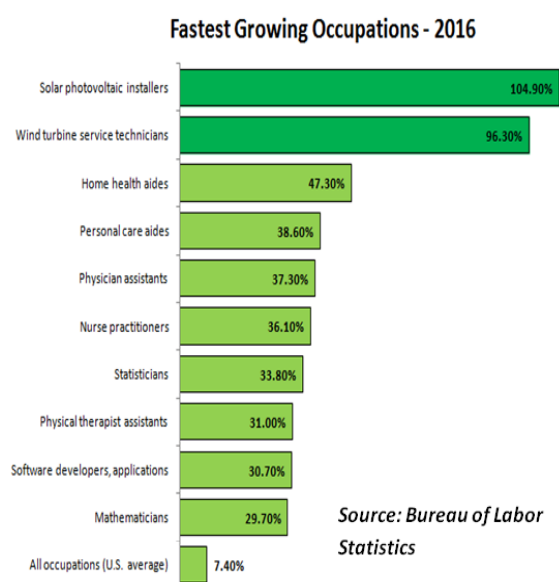
<sup>204</sup> “Economic Development Impacts of Wind Projects: Jobs and Economic Impacts Resulting from U.S. Wind Projects 2017-2020,” Navigant, March 2017.

<sup>205</sup> “Small businesses seize opportunities in renewable energy,” ICIC.

year, with 9.5 gigawatts of new capacity added in 2016, and a projected tripling of industry size within four years.<sup>206</sup>

### Impact on job creation

The growth of renewable energy has created thousands of new jobs, both directly in manufacturing and installation and indirectly throughout supply chains. Solar industry employment grew 25 percent in



2016, employing 260,000 people, while an additional 114,000 worked at least part-time for solar firms.<sup>207</sup>

Though manufacturing efficiencies and imports have reduced the number of jobs per megawatt as the industry has grown, total direct and indirect solar jobs are still expected to soar as high as 748,000 by 2025.<sup>208</sup>

Wind power employment grew even faster at a rate of 32 percent in 2016, reaching a total of 102,500 employees. This figure could reach 248,000 by 2020.<sup>209</sup>

The rapid employment surge in both industries has wind turbine technician and solar cell installation ranked as America's two fastest-growing jobs, and the wider industry is adding jobs at a rate 12-times faster than the overall economy. The benefits of this jobs

boom are diffuse—the renewable energy sector is creating jobs in all 50 states and employs women and veterans at a higher rate than the fossil fuel industry<sup>210</sup>. Together, wind and solar industry employment outnumbers coal employment in 40 states.<sup>211</sup>

The net employment effect of wind and solar energy is difficult to estimate. Although the rise of renewable energy has led to corresponding job losses in the fossil fuel industry, the higher labor intensity of wind and solar will result in a net job increase—up to 486,000 by 2030, according to a Deutsche Bank study.<sup>212</sup> However, not all jobs are expected to be permanent. Only 40 percent of these net additions will be long-term operations and maintenance jobs—a significant figure, but less impressive than during the peak construction period. Induced spending must also be factored in. Low-

<sup>206</sup> Mike Munsell, "[U.S. Solar Market Has Record-Breaking Year, Total Market Poised to Triple in Next 5 Years](#)," *Green Tech Media*, March 9, 2017.

<sup>207</sup> "[2017 U.S. Energy and Employment Report](#)," United States Department of Energy, 2017.

<sup>208</sup> "[Solar Photovoltaic Economic Development: Building and Growing a Local PV Industry](#)," U.S. Department of Energy: Energy Efficiency & Renewable Energy, August 2011.

<sup>209</sup> "[Economic Development Impacts of Wind Projects: Jobs and Economic Impacts Resulting from U.S. Wind Projects 2017-2020](#)," Navigant, March 2017.

<sup>210</sup> "[2017 U.S. Energy and Employment Report](#)," United States Department of Energy, 2017.

<sup>211</sup> John Rogers, "[Solar and Wind vs. Coal: Who's the Biggest Job Creator in Your State?](#)," Union of Concerned Scientists, June 27, 2017.

<sup>212</sup> "[Repowering America: Creating Jobs](#)," Deutsche Bank Group, October 2011.

skilled jobs in wind and solar tend to pay a living wage, with even maintenance workers earning 7 percent more in the renewable sector than in coal.<sup>213</sup> Top managers and engineers may earn less than in other energy sectors, but the overall income gains from the renewable transition lead to more spending and creation of additional jobs through multiplier effects. Lower household energy costs also drive this trend.<sup>214</sup>

### *Business demand for green energy*

Several factors are driving renewable energy demand. Technological advances, increased supply, and government incentives have driven down the cost of a previously expensive energy source that is now competitive with conventional fossil fuels. The price of solar modules fell between 65 and 70 percent from 2009 to 2013, while wind turbine costs fell by 30 percent.<sup>215</sup> Regardless of environmental concerns, businesses will pursue sustainable energy if it allows them to reduce costs. The volatility of fossil fuel prices also increases the attractiveness of renewable energy as a reliable alternative.<sup>216</sup> Other factors contributing to business demand are the opportunities for brand-building as more firms take on sustainability as a corporate value. For example, Walmart, the country's largest private employer, has pledged to reduce its carbon emissions by a gigaton.<sup>217</sup>

In 2017, some 13 percent of Fortune 100 companies had renewable power purchase arrangements (PPAs), and 63 percent had sustainability targets, compared to just 1.6 percent and 39 percent, respectively, among Fortune 500 companies.<sup>218</sup> The concentration of contracts among top firms indicates some of the challenges facing corporate sustainable energy demand. Although PPAs, which are the most common corporate renewable arrangement, allow companies to save on their energy bills, they are inherently complex to navigate. A typical PPA has a 10- to 20-year contract directly with the owner of a renewable source at a below-market rate. Regulatory friction makes negotiating PPAs difficult, while fluctuations in fossil fuel prices make lengthy fixed-price contracts too risky for some companies.<sup>219</sup> Some firms instead opt to own or contract renewable assets on-site, but this practice requires a large initial capital investment and forgoes the security offered through the grid.<sup>220</sup>

The challenges involved with both PPAs and on-site assets are more easily navigated by America's largest corporations with in-house legal counsel. Coalitions such as the Renewable Energy Buyers Alliance, founded in 2016 by the World Resources Institute, are helping solve these challenges by aggregating buyer demand and facilitating transactions.<sup>221</sup> Other purchasing mechanisms, such as green

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<sup>213</sup> Edward P. Louie and Joshua M. Pearce, "[Retraining Investment for U.S. Transition from Coal to Solar Photovoltaic Employment](#)," *Energy Economics*, 2016.

<sup>214</sup> "[Spurring Local Economic Development with Clean Energy Investments: Lessons from the Field](#)," U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, November 2013.

<sup>215</sup> "[Rethinking energy: towards a new power system](#)," Global CCS Institute, September 28, 2014.

<sup>216</sup> Manish Bapna, "[Corporate Demand for Renewable Energy Could Rock the Grid](#)," *Forbes*, June 21, 2016.

<sup>217</sup> Julia Pyper, "[The Latest Trends in Corporate Renewable Energy Procurement](#)," *Green Tech Media*, June 30, 2017.

<sup>218</sup> Ibid.

<sup>219</sup> "[Small and medium-sized businesses are the next wave of opportunities in renewable energy](#)," Deloitte.

<sup>220</sup> Nichola Groom, "[America's hungriest wind and solar power users: big companies](#)," *Reuters*, June 21, 2017.

<sup>221</sup> [Renewable Energy Buyers Alliance](#), 2016.

tariffs, through which frameworks established between utility providers and regulators can be applied to multiple firms, seek to satisfy energy demands of an increasingly broad range of large and small companies.<sup>222</sup> Though these measures are promising, there is plenty of room for economic developers to innovate and simplify systems to assist smaller companies.

### ***Community demand for green energy***

Community initiatives are driving sustainable energy consumption around the country. At the same time, many are finding it be a boon for economic development.

Studies show the public is eager to adopt clean energy sources and protect the environment. More than 80 percent of Americans are in favor of expanding renewable energy production, and more than 50 percent oppose the expansion of coal mining, nuclear plants, and fracking.<sup>223</sup> Yet despite the enthusiasm, interest falls rapidly when consumers discover that prices may go up. An additional \$25 in yearly energy expenditure was enough to reduce the percentage of those favoring renewables by 13 percent.<sup>224</sup> Ensuring energy remains affordable will need to be a goal for policymakers setting sustainability targets.

Though the issue remains divisive, many jurisdictions are moving forward with renewable energy initiatives. Overall, state-led clean energy investment exceeded \$2.7 billion from 2007 to 2017.<sup>225</sup> California's air emissions program, established in 2013, is one of the world's most ambitious.<sup>226</sup> The state's impressive solar capacity generated enough power in the spring of 2017 to provide more than half the state's electricity needs for a few hours; the excess supply was enough to send wholesale prices negative.<sup>227</sup>



Source: [U.S. Department of Energy](#)

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<sup>222</sup> [“Small and medium-sized businesses are the next wave of opportunities in renewable energy,”](#) Deloitte.

<sup>223</sup> Cary Funk and Brian Kennedy, [“The Politics of Climate,”](#) Pew Research Center, October 4, 2016.

<sup>224</sup> Sarah B. Mills, Barry G. Rabe and Christopher Borick, [“Issues in Energy and Environmental Policy: Widespread Public Support for Renewable Energy Mandates Despite Proposed Rollbacks,”](#) University of Michigan Gerald R. Ford School of Public Policy, June 2015.

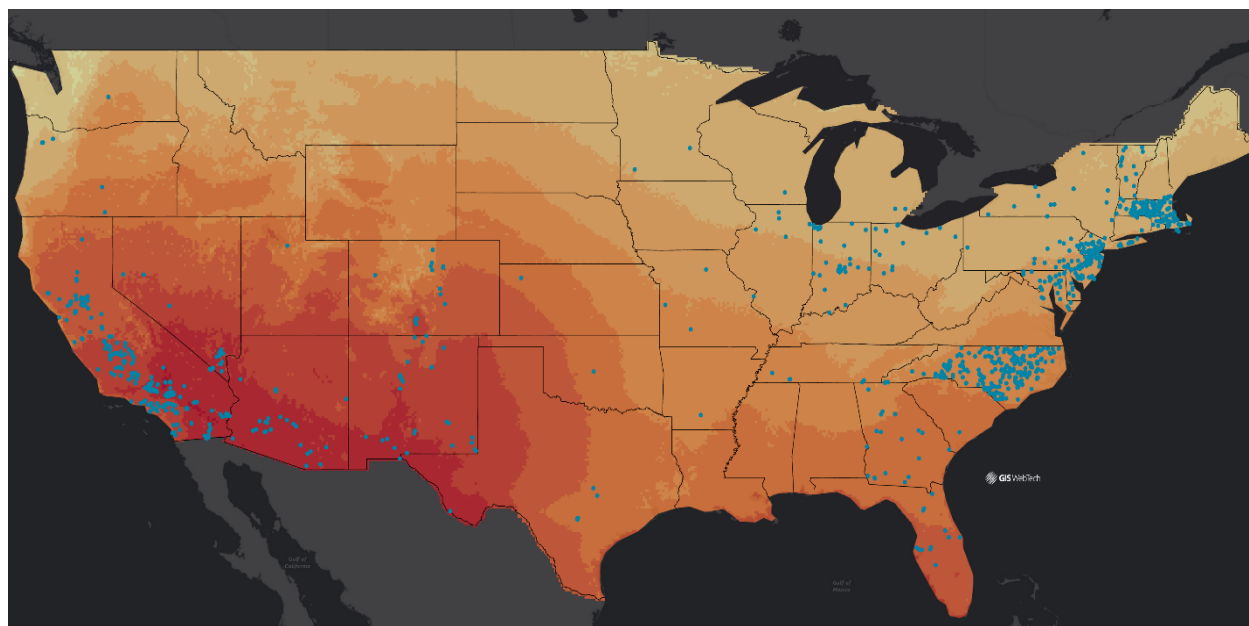
<sup>225</sup> Lewis Milford, Mark Muro, Jessica Morey, Devashree Saha and Mark Sinclair, [“Leveraging State Clean Energy Funds for Economic Development,”](#) *The Brookings Institution*, January 11, 2012.

<sup>226</sup> Katie Fehrenbacher, [“Climate goals: inside California’s effort to over haul its ambitious emissions plan,”](#) *The Guardian*, June 20, 2017.

<sup>227</sup> Ibid.

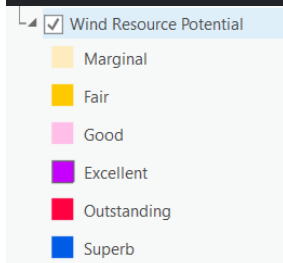
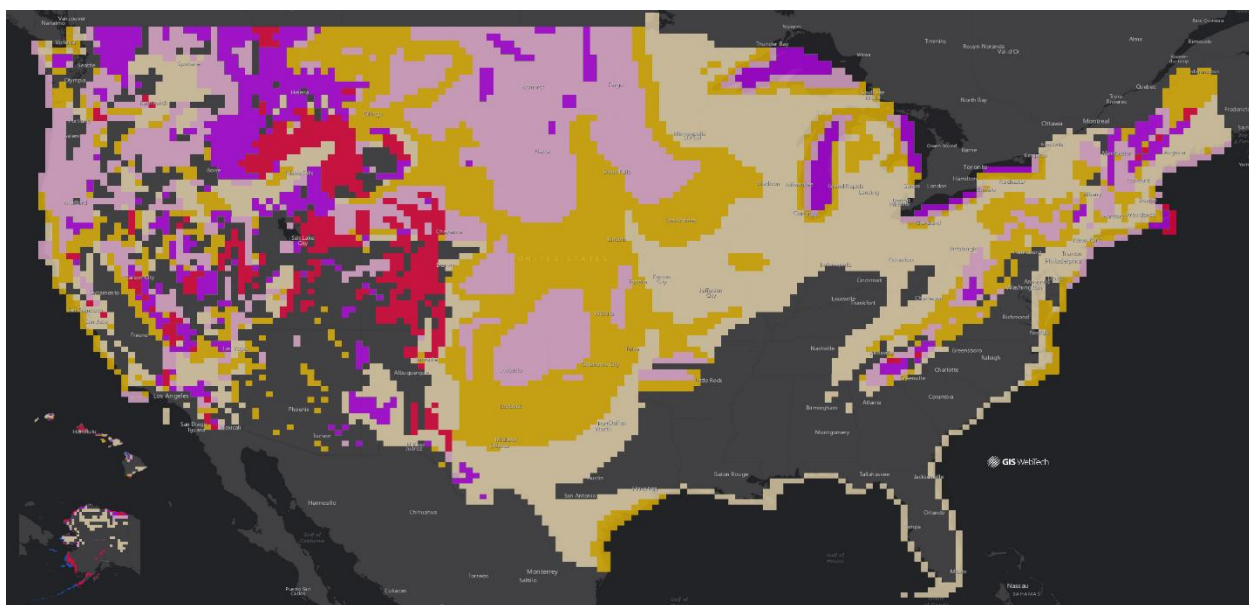


## Solar Energy Installations



GIS WebTech

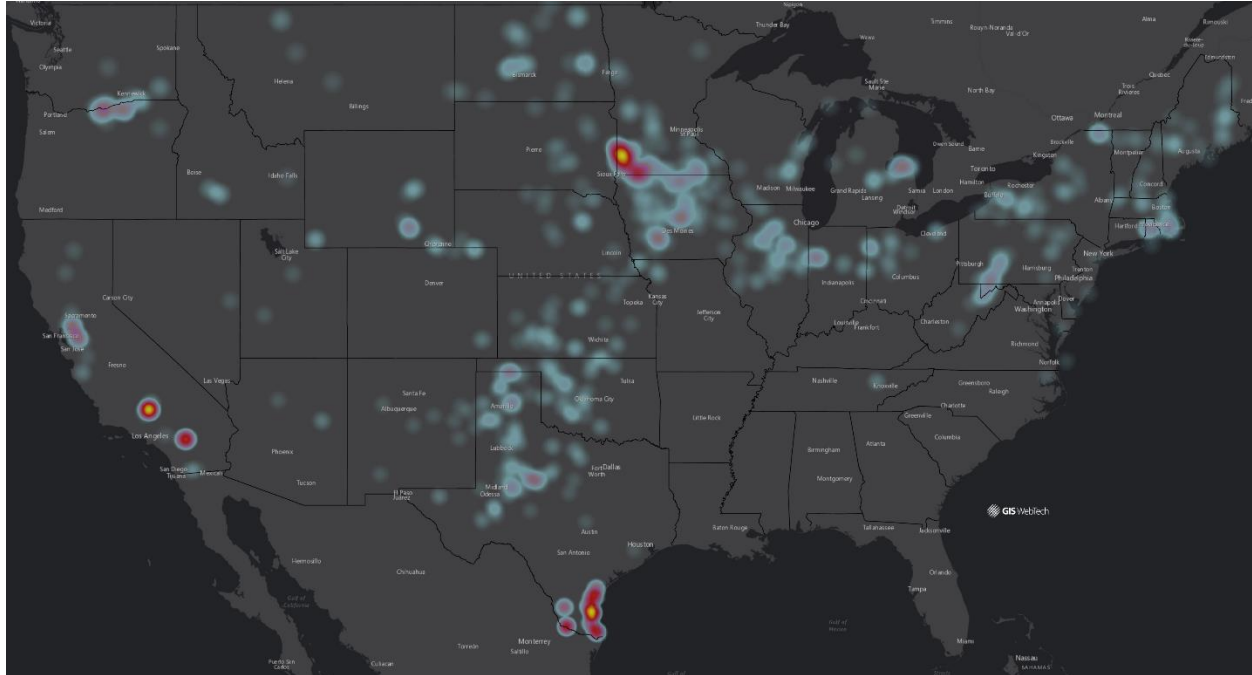
## Wind Energy Capacity



GIS WebTech



## Wind Energy Installations



GIS WebTech

### *Case study: Arlington County, Virginia's Community Energy Plan<sup>228</sup>*

Arlington County sits across the Potomac River from Washington, DC. Arlington has long recognized the importance of sustainability and environmentally oriented economic planning as part of its community values. To gain a better understanding of energy-based challenges and opportunities, the county's Community Energy and Sustainability (CES) Task Force conducted town hall meetings and targeted stakeholder engagement to gather information on energy use within the community. The task force used this information, coupled with a greenhouse emissions baseline inventory, to create a comprehensive report on energy conditions, resulting in the creation of Arlington's Community Energy Plan (CEP), adopted in June 2013. The CEP aims to fundamentally change energy use in Arlington, laying out strategies to reduce costs, generate local renewable energy, and reach a 75 percent carbon footprint reduction by 2050. Accordingly, the plan targets six goals:<sup>229</sup>

**Goal 1:** Increase the energy and operational efficiency of all buildings.

**Goal 2:** Increase local energy supply and distribution efficiency in Arlington using district energy.

**Goal 3:** Increase locally generated energy supply through the use of renewable energy options.

**Goal 4:** Refine and expand transportation infrastructure and operations enhancements.

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<sup>228</sup> "[Community Energy Plan: An Element of Arlington County's Comprehensive Plan Adopted – June, 2013](#)," Arlington County, Virginia, June 2013.

<sup>229</sup> Ibid

**Goal 5:** Integrate CEP goals into all county government activities.

**Goal 6:** Advocate and support personal action through behavior changes and effective education.

Arlington's CEP won the 2014 National Planning Achievement Award in Environmental Planning from the American Planning Association. The county was the first in the nation to receive the U.S. Green Building Council's (USGBC) Platinum certification under its LEED for Communities program in December 2017.<sup>230</sup> The USGBC credited Arlington's goal-setting and long-term environmental strategies for the recognition, calling Arlington a "sustainable and resilient urban environment that has long-proven success in reducing greenhouse gas emissions, managing storm water, ensuring economic prosperity, and focusing on education, affordable housing, health, and safety for residents and businesses."<sup>231</sup>

Additionally, Arlington appears to have caught the attention of Amazon during its search for a second headquarters. An article from February 2018 detailing the county's USGBC Platinum award saw a major spike in visits originating from an Amazon internal website.<sup>232</sup> Arlington is currently vying to host Amazon's "HQ2," and some have speculated this means the county is a frontrunner.

### *Community commitments to sustainability*

Other communities have enacted similar sustainability initiatives to Arlington. In Grand Rapids, Michigan, there are plans to reach 100 percent renewable energy usage by 2020 by investing heavily in solar power.<sup>233</sup> The San Diego, California, city government has set the same goal, with a 2035 deadline.<sup>234</sup> In contrast, West Virginia repealed its renewable energy standard in 2015,<sup>235</sup> although recent community solar initiatives by nonprofit Solar Holler indicate some willingness to engage in renewable energy practices at the local level.<sup>236</sup>

Atlanta, Los Angeles, New York City, Pittsburgh, and Salt Lake City were among the first cities to declare that they would at least satisfy, if not exceed, the United Nations' Paris Agreement climate targets.<sup>237</sup>

Local communities are increasingly willing to finance clean energy projects with municipal bonds, and community development financial institutions also are entering this space. While several smaller communities, including Burlington, Vermont, and Aspen, Colorado, have already reached 100 percent renewable usage, most cities are far from reaching their targets. Due to this, it is likely that local

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<sup>230</sup> ["Arlington Earns Nation's First LEED For Communities Platinum Certification,"](#) U.S. Green Building Council, December 19, 2017.

<sup>231</sup> Chris Teale, ["County Wins Top Environmental Award from U.S. Green Building Council,"](#) ARLnow, December 20, 2017.

<sup>232</sup> ARLnow.com, ["EXCLUSIVE: Amazon Employees Are Very Interested in a Particular Article About Arlington,"](#) ARLnow, February 20, 2018.

<sup>233</sup> Lindsey Smith, ["Grand Rapids officials making progress on 2020 renewables goal,"](#) Michigan Radio, February 14, 2013.

<sup>234</sup> ["Environmental Services: Sustainable Community Program,"](#) The City of San Diego.

<sup>235</sup> John Light, ["Score one for ALEC: West Virginia is first state to repeal a renewable energy standard,"](#) Grist Magazine, February 5, 2015.

<sup>236</sup> Diane Cardwell, ["What's Up in Coal Country: Alternative-Energy Jobs,"](#) The New York Times, September 30, 2017.

<sup>237</sup> Hiroko Tabuchi and Henry Fountain, ["Bucking Trump, These Cities, States and Companies Commit to Paris Accord,"](#) The New York Times, June 1, 2017.

initiatives to pursue sustainable energy projects will result in faster growth of renewable consumption than would be predicted based on federal policy goals alone.

### *Policy uncertainty*

Though falling costs, corporate sustainability goals, and community initiatives have resulted in soaring demand for wind and solar power, a portion of renewable energy's competitiveness is due to government subsidies and incentives, such as tax exemptions. This leaves the sector vulnerable to shifts in policy. A new tariff on solar cell imports announced in January 2018 provides a clear example. To promote domestic manufacturing, the federal government



Source: [U.S. Department of Energy](#)

announced a 30 percent duty on imported solar equipment.<sup>238</sup> Though it may improve the competitiveness of American solar panel manufacturers, it could also create negative industry-wide impacts for the renewable sector. Estimates suggest up to 1,200 manufacturing jobs could be created by the move, yet the Solar Energy Industries Association estimates a net loss of 23,000 jobs industry-wide resulting from slower demand.<sup>239</sup> As the solar industry relies on imports for 80 percent of its equipment, the tariff is predicted to create an 11 percent drop in the growth of installations. Although the tariff is set to drop by 5 percent each year before disappearing in 2021, it will certainly impact the trajectory of solar power.<sup>240</sup>

The solar investment tax credit (ITC) is another area of uncertainty. Currently, companies and individuals receive a 30 percent income tax credit for investing in solar projects, with rates gradually falling beginning in 2019 before being phased out for residents in 2021 and producers in 2024.<sup>241</sup> Many predicted a crash in solar demand if the scheme had been phased out beginning in 2016, as was originally intended. Historically, the possibility of tax credit expiration also resulted in significant wind investment volatility.<sup>242</sup> Despite this, solar and wind are becoming increasingly cost-competitive with fossil fuels.<sup>243</sup> Factoring in subsidies, they reached price parity with natural gas in December 2016.<sup>244</sup>

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<sup>238</sup> Brian Eckhouse, Ari Natter and Chris Martin, "[Trump's Tariffs on Solar Mark Biggest Blow to Renewables Yet](#)," *Bloomberg*, January 23, 2018.

<sup>239</sup> Salvador Rizzo, "[Trump says solar tariff will create 'a lot more of jobs.' But it could wipe out many more](#)," *The Washington Post*, January 29, 2018.

<sup>240</sup> Joshua Rhodes, "[Solar Tariff Is A Direct Hit To Fastest-Growing Jobs In U.S.](#)," *Forbes*, January 23, 2018.

<sup>241</sup> Chris Nelder and Mark Silberg, "[Congress extends the renewable investment tax credit: What now](#)," *GreenBiz*, December 28, 2015.

<sup>242</sup> "[Fickle Winds](#)," Rocky Mountain Institute, February 26, 2014.

<sup>243</sup> "[Capturing the sun: The economics of solar investment](#)," EY, 2016.

<sup>244</sup> "[Lazard's Levelized Cost of Energy Analysis—Version 10.0](#)," Lazard, December 2016.

Maturing supply chains, economies of scale, and advanced technologies mean the renewable sector's reliance on government support for competitiveness is fading. With incentives helping drive growth, these trends will continue to bring costs down; however, unsubsidized grid parity is unlikely to be widespread for at least a decade.<sup>245</sup> A premature cessation of tax credits and subsidies could prolong the process of cost decline by reducing market incentives to invest.

### *Issues in transmission*

To prepare aging electrical infrastructure for new forms of energy and its integration into the grid, transmission lines will need to be more flexible, more distributed, and have far greater storage capacity.

Some \$2.1 trillion in investment will be required by 2045 to modernize the U.S. electrical grid and adapt to renewable energy, according to the International Energy Agency.<sup>246</sup> The current grid is designed to supply fluctuating demand for power with the predictable stream of conventional forms of energy.<sup>247</sup> The renewable energy stream, however, is unpredictable. The variability of wind and solar power generation is 100 percent and 70 percent, respectively.<sup>248</sup> Though demand can be predicted based on historic patterns, major events, and seasons, the generative capacity of renewable infrastructure depends on daily weather conditions that are difficult to accurately forecast. The majority of grids, constructed prior to the renewable age, are only designed to handle the much lower intermittency of coal and gas.<sup>249</sup> As a result, fossil fuels remain necessary during outages.

Technology that allows consumers to produce their own power at a home or business is impacting utility markets as well. When consumers generate electricity via solar cells, utility providers sometimes need to raise prices to service their remaining customers. Nevertheless, the rise in price and desire to convert to green energy drives more consumers to pursue their own generation. The cycle continues in a process referred to by the industry as the "utility death spiral."<sup>250</sup>

Several measures could help address the misalignment between current energy infrastructure and new energy sources. First, investment in storage capacity is essential to improving resilience of the grid. Rapidly declining costs suggest that storage could reach cost parity with grid power by the late 2020s, with the industry recording an annual growth rate of 200 percent.<sup>251</sup> Second, grids need to be decentralized and wider-reaching. Insufficient solar power due to inclement weather, for example, could be mitigated by accessing power from another region or using a different source of renewable energy.

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<sup>245</sup> George Given and Marlene Motyka, "[Analysis: Journey to grid parity](#)," Deloitte.

<sup>246</sup> "[United States must grasp opportunity to build sustainable energy system](#)," International Energy Agency, December 18, 2014.

<sup>247</sup> Christopher Joyce, "[Power Grid Must Adapt To Handle Renewable Energy](#)," NPR, March 12, 2012.

<sup>248</sup> "[Integrating Renewable Electricity on the Grid](#)," American Physical Society.

<sup>249</sup> Jacques Leslie, "[The Energy Secretary Is Wrong: The Grid is Ready for Renewables](#)," Yale Environment 360, July 5, 2017.

<sup>250</sup> "[A world turned upside down](#)," *The Economist*, February 25, 2017.

<sup>251</sup> Jacques Leslie, "[The Energy Secretary Is Wrong: The Grid is Ready for Renewables](#)," Yale Environment 360, July 5, 2017.

Demand flexibility measures made possible by new technologies also provide an opportunity for adaptation while potentially reducing consumer power expenditure by up to 40 percent.<sup>252</sup> Advanced smart appliances that monitor their own power use with internet-connected sensors can track energy prices and automatically adjust their consumption.<sup>253</sup> Real-time pricing is another demand management avenue that can help balance the energy market and develop smarter grids.<sup>254</sup>

### *Challenges and opportunities for economic development*

While renewable energy shows promise for many communities, significant challenges still exist.

1. **It may be difficult to integrate solar and wind into the existing economy.** The case studies below provide examples of renewable energy complementing and enhancing local industry; however, renewable installations may conflict with other sectors of the economy. Off-shore wind farms, for example, can disrupt local fishing industries if not carefully planned.<sup>255</sup> The introduction of renewable facilities can also clash with an area's natural beauty. For many rural areas where tourism is a large economic driver, changing the landscape with wind turbines and solar farms may be an unacceptable sacrifice.<sup>256</sup> Local opposition is often a huge barrier for the development of renewable projects.
2. **While advantageous to some, for others, these investments represent job losses in traditional industries, and carry a perceived urbanization threat.** Wind turbines can provide extra income to landowners, but leasing arrangements also come with potential downsides relating to noise, shadow interference, and granting utilities the right to access one's property at all times.<sup>257</sup>
3. **The concept of renewables is positive, but a failure to be transparent about the negative aspects of such investment can harm community trust.** If communities are not consulted regarding initial projects, subsequent projects will face greater opposition. Communities with established consensus-building skills, a track record of successful stakeholder engagement, and a robust governance structure will be well-positioned to take advantage of renewable energy opportunities.<sup>258</sup>
4. **Accessible financing mechanisms must be prioritized if communities are to fully unlock their region's renewable potential.**
5. **Beyond planning and consultation, communities should consider the implications of projects for social equity.**<sup>259</sup> Who are the beneficiaries of renewable energy installation, and where will new revenues flow? The shift toward renewable energy can provide a chance to improve economic inclusiveness among disadvantaged minority groups. However, if windfalls are not

<sup>252</sup> ["The Future of Electricity: New Technologies Transforming the Grid Edge,"](#) World Economic Forum, March 2017.

<sup>253</sup> Jacques Leslie, ["The Energy Secretary Is Wrong: The Grid Is Ready for Renewables,"](#) Yale Environment 360, July 5, 2017.

<sup>254</sup> ["Time Based Rate Programs,"](#) U.S. Department of Energy Office of Electricity Delivery & Energy Reliability.

<sup>255</sup> John Kalish, ["Fisherman Fear Damage From Wind Farms Along The Eastern Seaboard,"](#) NPR, December 4, 2017.

<sup>256</sup> ["Linking Renewable Energy to Rural Development,"](#) Organisation for Economic Co-operation and Development, 2012.

<sup>257</sup> Leah McBride Mensching, ["Wind Energy Isn't a Breeze,"](#) Slate, August 24, 2017.

<sup>258</sup> Adam Blair, Rod Howe, and David Kay, ["Transitioning to Renewable Energy: Development Opportunities and Concerns for Rural New York,"](#) New York State Bar Association Government, Law and Policy Journal, 2013.

<sup>259</sup> Adam Blair, David Kay, and Rod Howe, ["Transitioning to Renewable Energy: Development Opportunities and Concerns for Rural America,"](#) Cornell University Community and Regional Development Institute, July 2011.

shared equitably, and workers are imported rather than trained at home, communities run the risk of exacerbating inequity.

6. **Communities must understand renewable industry job growth within the wider context of changing employment markets.** Future automation of some tasks is likely to dampen the jobs stimulus forecast by renewables boosters.<sup>260</sup> Construction and manufacturing of renewable energy equipment and facilities is labor-intensive, but once capacity additions slow, construction jobs will become less necessary.<sup>261</sup> Manufacturing jobs are likely to be susceptible to automation, as they involve relatively routine tasks.<sup>262</sup> Maintenance and permanent operations jobs also face automation threats.<sup>263</sup> The potential exists to employ displaced fossil fuel workers in the renewable sector, but economic developers should be mindful that such solutions will only be effective in the short-term. Installation jobs require high levels of dexterity that are unlikely to be mechanized soon, but technology is advancing rapidly.<sup>264</sup> Overall, the most stable job creation in wind and solar is in middle management, engineering, and other technical roles, all requiring high levels of education.<sup>265</sup> The permanence of the ‘green jobs boom’ should not be taken as given; longer-term investments in education and training will be necessary to ensure community stability and industry diversity.

#### *Case study: Using incentives as a catalyst for growth in Buffalo, New York*

Following years of deindustrialization, the renewable energy sector is revitalizing the regional economy of Buffalo, New York. Bicycle-filled streets, outdoor concerts, and a skyline awash with cranes all highlight the city’s revival. Young people who once left Buffalo in search of opportunity are returning as the city reaches its lowest unemployment rate in a decade. Collaboration between the local university and state government is breathing new life into former industrial sites by transforming them into solar plants, with a goal of reaching 100 megawatts of installations by 2020. The project will meet up to 50 percent of the power needs for a range of institutions, providing greater price certainty through 10- to 20-year procurement contracts.

Lackawanna, a city within the Buffalo-Niagara Falls metropolitan area, turned an abandoned steel mill on Lake Erie into a 14-turbine wind farm capable of powering 9,000 homes. The 140 temporary jobs created in the construction phase from 2006 to 2012 have given way to five permanent operations and maintenance employees, but the farm delivers \$190,000 in annual state tax and helped reinvigorate the city.

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<sup>260</sup> “[Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation](#),” McKinsey Global Institute, December 2017.

<sup>261</sup> Mark Fulton, Camilla Sharples, and Jake Baker, “[Repowering America: Creating Jobs](#),” Detuche Bank Group, October 2011.

<sup>262</sup> Carl Benedikt Frey and Michael A. Osborne, “[The Future of Employment: How Susceptible are Jobs to Computerisation?](#),” Oxford University, September 17, 2013.

<sup>263</sup> “[Renewable Energy and Jobs: Annual Review 2017](#),” International Renewable Energy Agency, 2017.

<sup>264</sup> Eric Winick, “[Five Jobs That Are Set to Grow in 2018](#),” *MIT Technology Review*, January 8, 2018.

<sup>265</sup> Maria Isabel Blanco and Gloria Rodrigues, “[Direct employment in the wind energy sector: An EU study](#),” *Energy Policy*, 2009.



New York's \$1 billion pledge of tax breaks and grants to the region is driving further investment, with \$750 million in funding committed to equip and build SolarCity's Gigafactory 2, the largest solar manufacturing plant in the Western Hemisphere. SolarCity, a subsidiary of Elon Musk-owned Tesla, provides innovative financing schemes for home roof panels, the solar market's fastest-growing sector. The 1.2 million-square-foot facility, sited at a former Buffalo steel plant, is set to create 500 jobs as production ramps up in 2018.

In exchange for generous funding, the government placed strict demands on the firm. If SolarCity fails to provide 1,460 jobs in its first year of operation, 5,000 jobs in the long term, and \$5 billion in total investment, it will pay a \$41 million annual fee. This helps to hedge some of the project's risk, as the firm is yet to turn a profit in an industry increasingly subject to regulatory pressure. The deal has attracted some controversy and speculation regarding delays, costs, and SolarCity's financial health.

Whatever the project's outcomes, it demonstrates the potential for renewable energy to catalyze investment and revive former industrial zones. An annual business plan competition, 43North, is attracting smaller entrepreneurs to the city as well. As clean energy firms of various sizes cluster together, and skilled labor and supply chains become concentrated, Buffalo could establish itself as a leader in the green economy.

#### *Case study: Harnessing renewable energy to attract high-tech investment in Iowa*

Deriving more than 30 percent of its power from wind sources, Iowa is a leader in renewable energy. Iowa is first in the nation by percentage of generated wind power, and second only to Texas in terms of capacity.<sup>266</sup> Iowa's burgeoning wind sector, which employs about 6,500,<sup>267</sup> gives the state an advantage in data center investments from technology giants.<sup>268</sup> A recently announced Apple data center in Waukee illustrates this trend. The 400,000-square-foot facility will be powered by 100 percent renewable energy from the beginning of its operation. An investment of more than \$1.3 billion, the site is projected to provide 550 construction and operations jobs once complete. Additionally, Apple will purchase more than 2,000 acres of land in Waukee for its data center operations and committed to invest \$100 million in a public improvement fund for the city.<sup>269</sup>

The low cost of power helps Iowa provide a supportive environment for companies with high electricity needs. MidAmerican Energy, an energy firm based in Des Moines, has the ninth lowest utility rates in any regulated power market.<sup>270</sup> MidAmerican Energy's goal is to provide 100 percent renewable energy to its customers and is currently investing \$3.6 billion to generate two gigawatts of wind power.

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<sup>266</sup> "[IOWA: Profile Analysis](#)," U.S. Energy Information Administration, March 15, 2018.

<sup>267</sup> "[Report: Nearly 28,500 Clean Energy Workers in Iowa](#)," Clean Energy Trust and Environmental Entrepreneurs, March 22, 2016.

<sup>268</sup> "[Iowa Energy Plan Executive Summary](#)," Iowa Economic Development Authority and Iowa Department of Transportation, December 2016.

<sup>269</sup> Betsy Lillian, "[Apple's New Iowa Data Center Will Run On 100% Renewable Energy](#)," *Solar Industry Magazine*, August 25, 2017.

<sup>270</sup> "[Our 100% Renewable Vision](#)," MidAmerican Energy Company.



Legislation specifically targeted at data centers also helps. Electricity used by data centers is exempt from the state sales tax, and servers are exempt from property or real estate taxes. Though other states are implementing similar measures, Iowa has a strong head start in wind infrastructure, beginning with an ordinance in 1983. So, when technology companies began demanding renewable-powered data centers in the late 2000s, Iowa was ready to leap in.<sup>271</sup>

These incentives originated in efforts to attract Google to Council Bluffs in 2007, and in 2008 they were modified to accommodate the needs of Microsoft, which brought data centers to West Des Moines, now its largest U.S. data center presence. There, two data center locations total 1.7 million square feet, and a third data center campus that was announced in 2016. In 2013, Facebook purchased land in Altoona to create 1.5 million square feet of data center space. An additional million square feet under construction.<sup>272</sup>

Iowa offers a case study on the benefits of early adoption. With the demand for data centers growing, Iowa has already distinguished itself as a leader in the sector. As other industries develop similar sustainability goals, Iowa attracts even more types of businesses seeking low-cost wind power.

***Case study: Community sustainability for talent retention, business attraction – Fort Collins (CO)***

Renowned for its outdoor lifestyle and natural scenery, Fort Collins' high quality-of-life rankings make it an attractive setting for residents and businesses. Driven by the environmental focus of its community, the city's 2014 Climate Action Plan set goals of reducing greenhouse emissions 100 percent by 2050.<sup>273</sup> Though Colorado has its own state-wide emissions targets, Fort Collins' aspirations are more ambitious. Bold climate targets are in line with the progressive values of many Fort Collins residents, helping the city retain and attract talent.

However, some worried the Climate Action Plan would drive development outside city limits. Instead, companies are investing in Fort Collins and using sustainability targets as a marketing tool. Major employers including Anheuser-Busch have doubled down on sustainability efforts, investing in water conservation and tree planting. Other firms, such as technology company Numerica, have relocated to the city in hopes its forward-thinking reputation will help attract top talent.<sup>274</sup> In fact, one company began investigating a site in a neighboring town, but those plans were dropped after its employees reaffirmed their preference for Fort Collins' lifestyle and sense of community.

The city's ClimateWise program plays a large role in its success. Rather than setting mandatory targets, the voluntary program provides free advisory services and assessments to businesses on how to reduce

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<sup>271</sup> Mike Wiser, "[Wind energy helping power Iowa economy](#)," *The Courier*, November 27, 2011.

<sup>272</sup> "[Data Centers](#)," Greater Des Moines Partnership.

<sup>273</sup> "[2015 Climate Action Plan: Framework](#)," City of Fort Collins, March 2015.

<sup>274</sup> "[Numerica Moves into New Home in Fort Collins](#)," Numerica Corporation, May 19, 2014.

their environmental impact. It also offers badges, free advertising, and other recognition to reward businesses that achieve prescribed sustainability goals.

The city government's triple bottom line approach requires that economic, environmental, and social health is considered throughout the policymaking process.<sup>275</sup> By bringing small businesses on board with climate goals in a voluntary way, the city achieved bottom-up leadership. It's a win-win for the environment and business, which have found that sustainability investments reduce turnover and boost profit margins.<sup>276</sup> Fort Collins' Economic Health Manager SeonAh Kendall advises cities to "start small" when taking on climate action so as not to alienate businesses. Communities should establish attainable goals and focus on selling the long-run benefits of clean energy.

At the state level, Colorado is building a substantial renewables sector, which aims to create more than 62,000 green jobs and 2,000 cleantech businesses. Wind energy is projected to become the state's primary energy source by 2021.<sup>277</sup> Due its implementation of sustainability goals within its vision, Fort Collins is well-positioned to take advantage of further growth in the state's renewable portfolio.

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<sup>275</sup> "[Sustainability Services](#)," City of Fort Collins.

<sup>276</sup> "[Why Small Businesses are Choosing Clean Power](#)," Inspire.

<sup>277</sup> "[What Colorado Business Leaders Say About Governor Hickenlooper's Climate Action](#)," Conservation Colorado, July 13, 2017.

## VI. What economic developers should know

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When considered comprehensively, energy is rapidly changing the economy of the U.S., as well as individual states, regions and local communities. The role of economic developers, working diligently with their community leaders is ever important to helping communities navigate successfully through the changing energy environment. Change is difficult for many communities, whether positive or negative. The intention of this report by IEDC's Economic Development Research partners has been to help communities think through the changes and shorten the learning curve by hearing from others who have experienced similar situations.

### ***Key takeaways***

- Communities and their businesses are exploring many innovative ways to cope with losses and take advantage of opportunities;
- Incentives are being used to attract new businesses and industries, and help in the change of energy production;
- With additional innovation, current challenges in renewable energy will bring even greater opportunity;
- Sound community and economic development planning with a focus on workforce development and economic diversification is a key to resilient economies;
- Communities do not need to deal with challenges on their own. Evolving state and federal programs can help, especially when utilized in a regional approach to economic development. Current federal programs are included in the *Appendix*.

## VII. Appendix

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### *Federal grants and programs for energy*

**Grants.gov** – Grants.gov enables users to search for grants across all federal agencies based on various criteria. Funding Opportunity Announcements (FOAs) are frequently advertised on this site, although most agencies still require submissions through their own designated portals. Most FOAs are competitively awarded. <https://www.grants.gov/>.

**Department of Energy (DOE)** – The Department of Energy is among the largest and most diverse sources of funding from the federal government for energy-related projects. In addition to FOAs through Grants.gov, DOE provides loans and financing for a variety of projects to businesses, local governments, and states. The Office of Energy Efficiency and Renewable Energy, Office of Fossil Energy, and Office of Nuclear Energy are among the prominent departments that provide funding directly to communities. These departments also provide research and technical assistance to communities impacted by changes in the energy sector. The State Energy Program is another resource specifically for state-level funding (including U.S. territories and the District of Columbia). <https://www.energy.gov/energy-economy/funding-financing>.

**Economic Development Administration (EDA)** – A branch of the Department of Commerce, the Economic Development Administration provides funding to coal-impacted communities through its economic development assistance programs (EDAPs). The Comprehensive Economic Development Strategy (CEDS) program aids communities in strategic planning. <https://www.eda.gov/funding-opportunities/>.

**Environmental Protection Agency (EPA)** – The Environmental Protection Agency’s RE-Powering America’s Land Initiative encourages renewable energy development on current and formerly contaminated lands, landfills, and mine sites when such development is aligned with the community’s vision for the site. The initiative identifies the renewable energy potential of these sites and provides other useful resources for communities, developers, industry, state and local governments, or anyone interested in reusing sites for renewable energy development. [https://www.epa.gov/re-powering/learn-more-about-re-powering#what\\_is](https://www.epa.gov/re-powering/learn-more-about-re-powering#what_is). EPA’s Brownfields Program provides technical assistance and grants to assess, remediate, and sustainably redevelop contaminated properties, as well job-training resources. <https://www.epa.gov/brownfields/types-brownfields-grant-funding>. The EPA also has a Clean Energy Finance Tool that helps state and local governments develop a financing program for energy efficiency and clean energy improvements for buildings. <https://www.epa.gov/statelocalenergy/clean-energy-finance-tool>.

**Department of Agriculture (USDA)** – The USDA offers funding to convert older heating sources to cleaner technologies, produce advanced biofuels, install solar panels, build biorefineries, and more. Most funding is available through the Rural Development Office. USDA Rural Development partners with

rural communities to provide technical assistance, business guarantees, and direct financing for energy-related projects and beyond. <https://www.rd.usda.gov/programs-services/all-programs>.

**Appalachian Regional Commission (ARC)** – The Appalachian Regional Commission covers 420 counties and offers grants, loans, and contracts to local governments and nonprofits working in economic development and related programs. The ARC’s POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) initiative assists coal-impacted communities through economic diversification, job retraining, and employment opportunities to attract new investment. [www.arc.gov/funding/POWER.asp](http://www.arc.gov/funding/POWER.asp).

**Delta Regional Authority (DRA)** – The Delta Regional Authority covers 252 counties and parishes in the eight states that form the Mississippi River Delta region. Funding is available through the States’ Economic Development Assistance Program (SEDAP), Community Infrastructure Fund (CIF) and the Public Works and Economic Adjustment Assistance (PWEAA) program. Investments are made in infrastructure, business development, entrepreneurship, and workforce development programs. Coal-impacted communities under DRA’s jurisdiction can use funding in a variety of ways. [dra.gov/funding-programs/investing-in-the-delta/](http://dra.gov/funding-programs/investing-in-the-delta/).

**Bureau of Indian Affairs (BIA)** – The Bureau of Indian Affairs is within the Department of the Interior. The Division of Energy and Mineral Development (DEMD) at BIA assists tribes in exploring and developing energy and mineral resources. The Tribal Energy Development Capacity (TEDC) grant program enables tribes to develop or enhance business and regulatory environments for energy resource development ([hwww.bia.gov/as-ia/ieed/division-energy-and-mineral-development/tedcp](http://hwww.bia.gov/as-ia/ieed/division-energy-and-mineral-development/tedcp)). The Energy and Mineral Development Program (EMDP) helps tribes assess, evaluate, or otherwise promote the productive use or development of energy and mineral resources on Indian lands ([www.bia.gov/as-ia/ieed/division-energy-and-mineral-development/tribal-toolbox/tribal-funding](http://www.bia.gov/as-ia/ieed/division-energy-and-mineral-development/tribal-toolbox/tribal-funding)). Beyond grants, these programs also provide technical assistance for energy development projects. Additionally, the Office of Indian Energy Policy and Programs at the Department of Energy developed an Energy Development Assistance Tool that provides information on federal grants, loans, and technical assistance available from multiple federal agencies to support energy development and deployment in indigenous communities. [www.energy.gov/indianenergy/energy-development-assistance-tool](http://www.energy.gov/indianenergy/energy-development-assistance-tool).

**Bureau of Reclamation (USBR)** – Another Interior Department bureau, USBR’s WaterSMART Water and Energy Efficiency grants provide 50/50 cost share funding to irrigation and water districts, states, tribes, and other entities with water or power delivery authority. Funds can be used in a variety of ways to better manage water resources. [www.usbr.gov/watersmart/weeg/](http://www.usbr.gov/watersmart/weeg/).

**Department of Labor (DOL)** – The Mine Safety and Health Administration (MSHA) distributes grants for training on miners’ health and safety. Grants are made to the state agency responsible for such training. [arlweb.msha.gov/programs/epd4.htm](http://arlweb.msha.gov/programs/epd4.htm).

### *Useful reports and resources to assist with nuclear power plant closures*

Especially since the nuclear power plant issues are so new and currently without solutions, EDRP is offering references to these reports and resources to help communities plan for potential impacts:

- Mark Cooper, “Renaissance in Reverse: Competition Pushes Aging U.S. Nuclear Reactors to the Brink of Economic Abandonment,” Vermont Law School, 2013.
- Chris Campany, Laura Sibilia, Linda Dunleavy, Tim Murphy “When People and Money Leave (and the Plant Stays) – Lessons Learned from the Closure of the Vermont Yankee Power Station: A Tri-Region Experience,” 2016.
- “Economic Impacts of Vermont Yankee Closure,” UMass Donahue Institute, 2014.
- Jonathan Cooper, “The Pilgrim Nuclear Power Station: A socio Economic Transition Analysis and Closure Transition Guide Book,” University of Massachusetts Amherst, 2015.
- Jonathan Cooper and Jennifer Stromsten, “Pilgrim Station Phase II: Community Guidebook for Closure Response,” Institute for Nuclear Host Communities, 2016.
- “The Maine Yankee Decommissioning Advisory Panel a Model for Public Participation in Nuclear Projects,” Main Yankee Decommissioning Advisory Panel, 2005.
- “A Five Year Strategic Plan for Economic Development in Citrus County, Florida,” Citrus County Economic Development Council, 2015.
- “CEDS Comparison Report for the Tri-State Region,” Tri-State Consortium, 2015.
- Geoffrey Haratyk, “Early Nuclear Retirements in Deregulated U.S. Markets: Causes, Implications and Policy Options,” MIT Center for Environmental Policy Research, 2017.
- “Fort Calhoun Comprehensive Plan,” Fort Calhoun County, 2017.
- “Resiliency Action Plan for the Town of Vernon in Preparation for the Eventual Closure of the Vermont Yankee Nuclear Power Station,” Windham Regional Commission,” 2012.
- Mark Berkman “The Economic Impacts of Decommissioning Vermont Yankee: A Comparison of Two Approaches,” Entergy/ Northstar, 2016.
- “Windham County Post-VY Economic Growth and Mitigation,” Post-Vermont Yankee Task Force of the Southeast Vermont Economic Development Strategy Planning Group (SeVEDS), 2012.
- “Economic Impacts of the Vermont Yankee Closure,” UMass Donahue Institute, 2014.

### *Useful links*

- [www.arc.gov/funding/power.asp](http://www.arc.gov/funding/power.asp)
- [www.swrpc.org/VYstudy](http://www.swrpc.org/VYstudy)
- [www.nrc.gov/waste/decommissioning.html](http://www.nrc.gov/waste/decommissioning.html)
- [www.eda.gov/programs/eda-programs/](http://www.eda.gov/programs/eda-programs/)
- [www.rd.usda.gov/](http://www.rd.usda.gov/)



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