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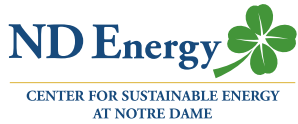
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Strategy for the Future: Energy Transition, Competitiveness and the Future Midwest

Craig A. Hart



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Report prepared for the Pulte Institute for Global Development, part of the Keough School of Global Affairs and ND Energy, University of Notre Dame

3150 Jenkins Nanovic Hall
Notre Dame, Indiana 46556
(574) 631-2940
Website: pulte.nd.edu
Email: globaldevelopment@nd.edu

Craig Hart
© 2020 Craig A. Hart
Email: craighart@alum.mit.edu

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The Pulte Institute for Global Development and the Center for Sustainable Energy at Notre Dame invited me to spend several weeks at the University of Notre Dame campus to participate in its Policy and Practice Visiting Associates Program to prepare this white paper on a topic of my choosing that reflected the Institute's themes of sustainability and equality, drawing on my expertise in energy and China. Taking advantage of location, I chose to write on the Midwest's energy transition and its implications for the competitiveness of traditional and emerging industries. I focused on the automotive and transportation industry, which remains an iconic industry important to the economy and which is rapidly evolving due to hybrid and electrification technologies. South Bend proved a fitting base for this study. Close to Detroit and Indianapolis, facilitating visits with industry and state government, South Bend also lost its industrial leadership due to changing technology, once being the home of Studebaker, which folded in the 1960s, textile factories and a domestic pocket watch industry. South Bend now seeks to recreate itself as an innovation hub fostering new industries through partnerships with local government, universities and the private sector.

Timing also favored this study in light of current regional policy debates. At the time of writing this study, energy and industrial policy are very much on the minds of politicians, employers and citizens in Indiana, Michigan, and Ohio. Ontario, which is also part of the Midwest's industrial ecosystem, is also taking aggressive steps at addressing greenhouse gas emissions and energy transition. During my research, a local power generator, Vectren Energy, proposed to close several coal-fired power generation units, replacing them with natural gas and renewable energy, and Indiana's other investor-owned utilities soon followed as low natural gas prices and the projected continuation of declining costs of renewables challenge the economics of older coal plants, making coal uneconomical. Significantly, the transition these utilities propose would reduce their greenhouse gas emissions to levels mandated by the scientific findings of the Intergovernmental Panel on Climate Change to avoid dangerous climate shifts by mid-century. Although these proposals triggered a regulatory battle in the statehouse and before the Indiana Utilities Regulatory Commission, the future direction of utilities in the region is emerging,

dictated by economics, not politics.

In the midst of this transition and an international trade war, Midwest industry - which represents a large portion of America's national industrial base - is concerned about its competitiveness. Competition from low-cost foreign producers, principally from Asia, threatens local production facilities and jobs. China in particular invests heavily in next generation technologies with an eye to dominating international exports, emerging as a dominant player in both rail transport and the automotive industries, including electric vehicles, autonomous driving, and battery technologies. China's penetration into these sectors justifiably concerns Midwest producers.

Ordinary citizens are also concerned about their futures, particularly about the stability of their jobs, the local economy, and threats from foreign competition.

Also, while writing this study, Midwesterners are observing changes in their natural environment. The Midwest experienced another season of deadly and costly hurricanes in 2019, compounded by heavy precipitation in 2016, 2018 and 2019 that caused flooding in the region. Wet seasons have alternated with periods of extreme drought, most recently the 2010-2013 drought that affected the entire country. Flying into South Bend over flooded fields, farmers had only been able to plant less than half the corn crop, and almost two thirds of those seeds had failed to sprout due to due to the weather (Briscoe, 2019). The weather was impacting farmers much more greatly than the trade sanctions imposed on China that dominated public dialogue.

These changes in the environment have caused growing concern among the region's youth about the future of the region in their own lifetime. A nascent but potentially powerful youth movement is forming that demands action at all levels of government.

In the midst of growing awareness, politicians and government institutions at the national, state and local levels are failing to take action or only taking fragmented actions. The U.S. Environmental Protection Agency in 2018 proposed the Affordable Clean Energy (ACE) rules to replace the 2015 Clean Power Plan, which would have required states to reduce greenhouse gas emissions from the electricity sector estimated at roughly a third of 2005 levels by 2030 using various advanced technologies.¹ In contrast,

¹The Clean Power Plan was stayed by the Supreme Court pending challenges that the plan exceeded the authority of the agency and thus never went into effect.

ACE only requires existing plants to make energy efficiency improvements reflecting the “best system of emissions reduction” without forcing adoption of new technologies or switching fuels. ACE also eliminates the prior plan’s requirements that states set targets for greenhouse gas emissions reductions (See U.S. Environmental Protection Agency, 2019).

As analyzed in this report, the nation and its constituent regions lack institutional mechanisms that scale to the challenge presented by economic development in the face of international competition, changing technology and climate change. The institutions that exist are limited, either by politics, geographic jurisdiction, authority to make decisions, or ability to finance solutions. New approaches are needed that work within the national and regional political framework, and are explored in this report.

Transitioning the Midwest inevitably means transitioning the nation. The goods and services produced in the Midwest are exported to the rest of the country and the world. Conversely, the Midwest buys inputs for its production, making it an important consumer exerting influence on other regions through supply chains. To achieve transition, the Midwest must be embedded within a larger support system that generates both supply and demand for clean energy technologies that the region both consumers and producers. Strengthening national industry requires maintaining a critical mass of industrial, manufacturing, and technological capacity located in the United States that dominate high value nodes of global supply chains in their sectors.

Yet, while the nation must transition together if the transition is to succeed, the approach each region and state takes will differ. Although the Midwest must overcome significant challenges to strengthen its competitive position in the process, the region has an abundance of advantages in its communities and universities, which are described in some detail in this study.

One of the few requirements of the Pulte Institute for Global Development was that this paper should consider international aspects of the selected topic, in particular drawing on my experience working as a practitioner and academic in China. Beyond the obvious competition in trade, lessons that we could glean from China are of particular interest, which are discussed at appropriate points in the paper.

One of the lessons drawn from China is that the United States possesses distinct advantages in the transparency and openness of its political and legal system and the operation of competitive markets, all based on rule of law principles. Transitioning the Midwest towards an environmentally and economically sustainable growth model requires the private sector to play the central role, supported by government policy, communities and universities. In short, we should build on our strengths in our transition.

Towards these development goals, this report proposes these primary actions:

- Establish an inter-governmental coordination body promoting pro-environment development policies across the Midwest
- Educate elected leaders, industry and the public in a neutral and non-partisan manner
- Adopt pro-development/pro-environmental policies to grow the private sector and stable jobs
- Promote investment in local clean technology industries
- Plan for and incentivize investment in adaptation of infrastructure and regional agriculture

The recommendations are proposed for the region as a whole and are intended for both state and community levels. Citizens, communities, businesses and universities are already collaborating along these lines. Greater engagement among states working as a region would catalyze achievement of these goals.

ACKNOWLEDGEMENTS

The Pulte Institute for Global Development, part of the Keough School of Global Affairs and the Center for Sustainable Energy at Notre Dame provided funding and logistical support for this report under the Pulte Institute Policy and Practice Visiting Associates Program. Michael Sweikar, Executive Director of the Institute, extended a warm welcome and the support of the Institute and its staff. Subhash Shinde of the Center for Sustainable Energy at Notre Dame co-funded this study and facilitated contacts within and outside the University for interviews. Edward Jurkovic facilitated the programmatic and administrative aspects of my visit and organized meetings with Notre Dame faculty, state and municipal officials, and industry, helping ensure my time on the ground was effectively spent. Paul Perrin edited this report, providing his valuable insight throughout the process. Tom Purekal, Alan Hamlet and I co-authored a separate policy brief on the need for the Midwest to step up adaptation efforts and the political barriers to doing so. As explained in the foreword, the Institute gave me wide latitude to select and develop the topic of this report, for which I am particularly grateful.

Kipp Coddington at the University of Wyoming suggested I focus on the changing market for coal, commented on an earlier draft of this report, and hosted my first public presentation of this study. I am indebted to Kipp for his collegueship over many years.

Therese Dorau, Director of the City of South Bend's Office of Sustainability, shared her perspectives on the city's sustainability challenges and introduced me to state and local environmental leaders, helping me better understand the Midwest's environmental movement.

An Atlantic Council study tour on economic development to Pittsburgh and Detroit in 2012 informed this work and served as a starting point for interviews in Detroit. I am grateful to Daniel Bennett at the Atlantic Council for inviting me to participate in that study tour.

For this study, I conducted interviews principally in Indiana and Michigan with over 40 regional stakeholders working in government, industry, academia, and civil-society organizations. The 2019 Notre Dame Future of Work conference hosted by the Pulte Institute for Global Development provided further opportunities for discussions and exchange of ideas, particularly on the jobs aspect of my topic. I am grateful to those who shared their insights in interviews and written correspondence.

ABOUT THE AUTHOR

Craig A. Hart is the Executive Director of Pace Energy & Climate Center at Pace University's Haub School of Law, a lecturer at Johns Hopkins University's Energy Policy and Climate program, and senior fellow at the Atlantic Council's Global Energy Center. Mr. Hart advises governments, project developers, lenders and investors in conventional energy, renewable energy and carbon management projects and regulation in Asia, the Americas, Africa, and the Middle East. He holds a J.D. and B.A. from the University of California at Berkeley, an M.A. from New York University, and a Ph.D. from the Massachusetts Institute of Technology.

Note: *The views expressed in this report are those of the author and do not necessarily represent those of the Pulte Institute for Global Development.*

MIDWEST'S CHALLENGES AND NATIONAL GOALS

The Midwest region, accounting for almost 40 percent of United States coal consumption (U.S. Energy Administration, 2019) and home to a dominant share of the nation's industrial capacity, faces complex challenges in transitioning from carbon-intensive energy and industry to greater sustainability while growing its economy and expanding job opportunities. The success of the region as an industrial hub is essential in achieving national goals of protecting and positioning American industry for future growth.

The Midwest is undergoing a transition away from coal, led by electricity generators at a time when its industrial future is being challenged. The prices of natural gas and renewables have reduced significantly over the past decade, and renewable energy is expected to further decrease in price, making these fuel sources more attractive than coal going forward.

The Midwest transitioning away from coal is essential to the United States reigning in greenhouse gas emissions, and will show leadership for other coal-intensive regions, particularly the Southern United States.

The transition away from coal presents challenges and opportunities for the Midwest. Employment opportunities must be preserved and grown during this transition. Jobs dependent on a shrinking coal industry must be replaced.

This paper evaluates how the Midwest can shape its future by embracing this energy transition and exploiting the opportunities that clean energy presents for strengthening the region's industrial position.

LESSONS FROM CHINA AS COMPETITOR

Asia generally has emerged as an important low-cost manufacturing region. China in particular threatens United States manufacturing, as China's highly sophisticated government protects and promotes the interests of its state enterprises. To respond to the competition presented by China, it is essential to understand their approach to advancing Chinese industry, and to counter, emulate or collaborate as appropriate given the United States' political and economic system.

In considering lessons that China might teach the United States, one must consider the two countries in context. Although Chinese competition induces concerns among Americans, the United States has certain highly

significant advantages. First, the United States in general, and the Midwest in particular, is relatively transparent, highly participatory, and as a result possesses a mechanism for combatting corruption. An open society, independent media, and the relative abundance of publicly available information are also enormous advantages of the United States, as are freedoms of movement of labor and capital and relatively open competitive markets. Americans are entitled to organize civil organizations and to vote, thereby holding politicians accountable, whereas China's citizens lack the ability to vote, organize or even express their views freely, and thus lack agency for political action. Local community initiatives described in this report that have spurred action in the Midwest are simply not possible in China. Similarly, the ability to protect the interests of workers, citizens and one's own community from environmental harm is severely constrained in China, perhaps even impossible given China's single party political system, legal system and central planning apparatus. These conditions in the United States are often overlooked, but represent enormous advantages in competing with China.

China, on the other hand, does possess certain strengths. As previously noted, China engages in extensive central planning that features highly developed and well-funded R&D and industrial policy. China effectively deploys its educational and research institutions in supporting industry. Central planning also enables greater regional planning and coordination. Importantly, it promotes state industry aggressively, employing the full range of policy instruments to protect its domestic market and expand its penetration into global markets (Hart et al., 2019). Finally, in the plus category, China's government recognizes its priorities to lift its citizens out of poverty. The United States also has significant poverty problems, although it is more circumspect in addressing this challenge. We could benefit from the Chinese perspective and focus on poverty from a regional development perspective.

In learning from these aspects of China's approach to economic development, it is important to draw both positive and negative lessons. China's expanding research and development funding, while in many aspects highly effective, is part of an economy-wide system of subsidies that distorts incentives among economic actors, weakens transparency and undermines the operation of its nascent markets. Subsidies have also led to the overcapacity of Chinese industry, soaring debt and crushing inequality, all unsustainable, placing China's future at risk. As a result of subsidies and other government controls over business

activity, free, competitive markets do not exist in China, with exceptions primarily limited to consumer goods and services (Hart et al., 2019; Hart, 2019).

Similarly, China's highly developed regional planning comes at the expense of local government autonomy, citizen's rights and the ability to protect one's community from environmental and other harms. As a result, China is heavily polluted, posing risks to human health and the economy, which its citizens, while critical of these conditions, are largely compelled to accept. Also, Chinese government support for climate policy, which is often lauded internationally, must be evaluated in light of China's continuing expansion of highly polluting industry and coal-fired power generation. Importantly, China's polluting industrial policies most strongly harm the poor, undermining government's ostensible concern for the most vulnerable and underserved classes of Chinese society. In short, lessons from China should be carefully drawn, and we should learn from them in order to avoid the pitfalls they have encountered.

MIDWEST ENERGY TRANSITION

Coal is in retreat in the Midwest. Driven by low natural gas prices and the declining cost of renewables, cleaner forms of energy are now successfully competing with coal on a cost basis. The prospect of a return to stricter environmental regulation in future administrations at the national level further tips the balance in favor of clean energy.

As renewables and storage are expected to further decrease in cost, utilities are opting to shutter their coal plants and shift increasing amounts of their power generation to natural gas and renewables, principally to wind and solar. Hydropower and geothermal also can potentially play an increasing role in the Midwest, as these resources are presently underutilized (MIT, 2006; U.S. Department of Energy, 2018).

In Indiana, the transition away from coal towards clean energy was decided not by any political body, but rather by economics. Four of the state's five large investor-owned utilities have announced their plans to shift away from coal, with the final utility expected to follow suit. In 2016, Vectren Energy, which serves southern Indiana, filed its Integrated Resource Plan (IRP) -- a state mandated plan that utilities must update every three years -- proposing to close three coal-fired power generation units representing 580 MW of capacity and older gas fired units, replacing them with a 844 MW combined cycle natural gas unit and renewable energy generation. Vectren's proposed plan would reduce its greenhouse gas emissions by almost 60

percent of 2005 levels by 2024 (Vectren, 2016). Although Vectren's proposed combined cycle natural gas plant was rejected by the Indiana Utilities Regulatory Commission (IURC) citing concerns that rapidly advancing technology change could render such a large-scale, long-lived asset uneconomic, forcing the utility to revise its plans or further justify the natural gas plant, the Vectren IRP signaled that coal is no longer the low cost fuel of the Midwest.

NIPSCO followed in 2018, filing its IRP proposing to retire all of its 2,094 MW of coal-fired power plants by 2028, maintain its natural gas and hydro plants, and expand its wind, solar, energy storage and demand side management capacity. Under its plan, NIPSCO will reduce its greenhouse gas emissions by 90 percent by 2028, exactly the kind of reductions needed to achieve global greenhouse gas emissions targets according to the IPCC, which require complete decarbonization by mid-century. The NIPSCO IRP also projects 99 percent reduction in water withdrawal and discharge, and the elimination of SO₂, NO_x, mercury and coal ash emissions (NIPSCO, 2018).

Most importantly, NIPSCO supported its IRP by citing bids they had received demonstrating that wind, solar, and solar plus energy storage were the lowest cost options available. Each of these technologies alone were determined to be lower cost than maintaining existing coal-fired plants or constructing new natural gas-fired power plants (NIPSCO, 2018).

The Vectren and NIPSCO analyses concluded that natural gas and renewables are cost-effective now, providing the strongest indicator of the future direction of the industry. Their conclusions are backed up by the state's own projections prepared by the State Utilities Forecasting Group housed at Purdue University and funded by the Indiana Utility Regulatory Commission. Purdue's resources planning model forecasts Indiana's future electricity demand and the least cost method of meeting that demand. A linked finance and rates model is then used to predict electricity rates. The 2017 model run showed natural gas was the most economic resource based on a 20-year project, using 2016 prices (State Utility Forecasting Group, 2017). Since the 2017 run, wind and solar have come down in price, with wind already priced competitively and solar expected to make further significant reductions (Murray, 2019). In particular, further reductions in the cost of solar, which comes on at peak daytime periods, would greatly impact the analysis towards renewables. Also, the model presently does not include energy storage, which is already rapidly declining in price.

Although the economics between renewables and

natural gas is evolving, what is clear is that coal is comparatively uneconomic in the view of utilities and is falling further behind. It is unlikely utilities will build any new coal-fired plants. For existing units, their economics are marginal at best, some days dispatching, some not. Significantly, because Purdue's forecasts are based on short-term marginal costs, they do not take into account plant upgrades required by environmental regulation, aging plants, or any other event that would make coal plants even less economically competitive.

Given economics is driving the transition, Indiana's other utilities are followed with their own plans to close coal plants. Indiana Michigan (I&M, an AEP company) and Duke filed IRPs that contemplate almost complete closure of their coal-fired generation. I&M's preferred scenario aggressively phases out coal generation, replacing coal plants with the same technologies as the others plus short-term market purchases. Similarly, Duke's preferred scenario calls for a moderate transition that cuts coal power generation by two thirds by 2036, also replacing coal with gas, solar, wind, and energy efficiency. Only Duke's new Edwardsport integrated gasification combined cycle (IGCC) plant was not considered for closure under their plan.

Indiana's neighboring states are experiencing the same transition. In mid-2018, Michigan's Consumers Energy announced plans to close all five of its coal-fired power plants by 2023, to be replaced with heavy investment in cleaner technologies, particularly solar. Similarly, DTE announced in March 2019 that it will reduce its carbon emissions by 80 percent by 2040 through phasing out coal-fired plants and replacing them with natural gas, wind and solar.

Coal plant closures have also been announced recently in Illinois, Kentucky, Ohio, and indeed throughout the entire nation. Since 2010, over 664 coal-fired generating units in 43 states - accounting for almost 126 GW of capacity - have closed or announced plans to close by 2030 (ACCCE, 2019).

Although regulation varies from state to state, the trends described above are generally reflective of power generation economics, as suggested by the large numbers of plant closures countrywide. For states with competitive electricity markets, market pricing further disfavors building large plants that are capital intensive, as these jurisdictions offer less certainty of return on new builds. This too tends to favor smaller, less capital-intensive renewables, which also have less risk of becoming stranded assets. In short, the transition away from coal and towards renewables is irreversible.

Coal's Response

Predictably, the Vectren and NIPSCO IRPs faced challenges by various groups, most importantly the coal industry. Coal lobbyists attempted to persuade the Indiana state legislature to place a moratorium on the construction of large power plants of any kind, in order to prevent further loss of market share to natural gas plants.

The gambit failed, and in the process coal lost its most important allies - the utilities sector and local industry generally. Utilities are powerful in Indiana. According to research by the Citizens Action Coalition, utilities accounted for \$1 out of every \$4 contributed to political candidates in the state. Utilities lobby the state house, mayors, chambers of commerce at state and local levels, as well as the Indiana Economic Development Corporation, send volunteers, and engage in philanthropy (Personal communications, June 7, 2019). Given their economic power, presence and technical expertise, elected officials and their appointees generally support utilities. With the loss of the utilities as allies, the coal industry also lost the support of the legislature and business. The Indiana Chamber of Commerce also opposed the moratorium, aligning the state's most important industry stakeholders with the utilities, effectively green lighting an energy transition (Indiana Chamber of Commerce, 2019).

The coal industry claims that coal remains the lowest cost generation option and that it is acting in the interests of consumers. However, the analyses by Vectren, NIPSCO and other utilities phasing out their coal generation counter these claims, especially when environmental compliance costs are taken into account.

The coal industry also claims that its opposition to the closure of coal plants is to protect jobs, predominantly mining jobs, and that they are good stewards of the environment. These claims are belied by the growing number of coal companies that have filed for bankruptcy relief, seeking to cast off their obligations to fund employee pension plans and environmental remediation obligations (See Macey and Salovaara, 2019).

A Post-Coal Plan for Coal Miners

For Indiana, in the most extreme case, only Duke's new Edwardsport IGCC facility will remain in operation, and all of the state's other coal plants will be closed. If this occurs, Indiana coal could lose roughly 90 percent of its present market (Personal communications, Indiana Coal Council, June 13, 2019).

According to the U.S. Energy Information Administration, Indiana has 2,790 underground and surface coal miners concentrated in three rural counties in the south of the state. Nationally, the U.S. has roughly 53,000 miners (U.S. Energy Information Administration, 2019). Indiana miners earn an average annual income of roughly \$90,000 plus benefits, a very high wage for Indiana (Personal communications, Indiana Coal Council, June 13, 2019). In contrast, solar employs over 3,100 workers and wind between 2,000 to 3,000 workers in the state of Indiana, and both sectors are among the fastest growing in the energy sector (The Solar Foundation, 2019 and the American Wind Energy Association, 2019). While mining companies' administrative staff will possess more easily transferable skills, the miners will likely find securing other employment more difficult, and likely at lower wages. However, wind and solar are poised to generate more jobs in Indiana and across the country and would benefit from the skills miners possess working with heavy equipment.

After its attempt to pass a moratorium on construction of large new power plants in the state of Indiana failed in spring 2019, the coal industry appears to be employing a lobbying strategy to relax regulation, oppose action on climate change, and encourage communities to block wind projects.² Threatening job losses without presenting any solutions for a future beyond coal is not merely a lobbying tactic, it employs a formidable psychological strategy - fear.

The future direction of the power sector and the region is now clear. Economics are dictating transition, which lobbying efforts may delay but cannot change. With the direction clear, the region should accelerate the development of a business plan that will not only adapt to the transition, but also transform the energy transition into an opportunity to revitalize the Midwest's economy and grow jobs.

Once one recognizes the future is powered by cleaner energy, the first barrier is thinking beyond coal. Helping coal miners save money towards retirement in the twilight years of the industry would be a good first step followed by promoting development of new industry in affected areas. BitSource, a company that teaches miners how to code software, is one example of how coal miners have found new work and helped develop a post-coal economy. Their motto - "Coal miners are tech workers who get

dirty" - bridges the difficult issue of identity that, along with compensation and benefits, is implicated in any loss of a job to a new industry. Economic transition is challenging, yet the region can look to others to learn from their experience as they transition - notably Pittsburgh's transition away from steel, described below.

BUSINESS PROPOSITION FOR PRO-ENVIRONMENT DEVELOPMENT POLICIES

The Midwest has long maintained a pro-business stance. However, at times, the region has been slow to respond to changing industrial and economic trends, and as a result has trailed in the rapid evolution of technology and the globalization of supply chains.

Today, energy technologies are rapidly changing, with implications for all sectors of the Midwest economy. In particular, the power generation sector and the transportation sector are both undergoing transformational change. In little over a decade, the transportation sector has experienced the introduction of hybrid technology, the integration of smart IT with vehicle hardware and sharing economy applications, development of autonomous vehicles powered by AI, and the early beginnings of the electrification of the entire transport sector. Significantly, China has claimed a leadership position in new technologies for autonomous vehicles and electrification, such as improved battery technologies.

Electrification and AI will profoundly transform traditional Midwest industry. Automotive supply chains run throughout the country, centered in the Midwest. Twenty-six states host automotive assembly or parts plants, twenty-two of which are clustered in the Midwest, South and East (MarkLines, 2019). Steel, aluminum, glass, engines and other components are manufactured in at least half a dozen Midwest states. Eighteen automotive original equipment manufacturers are based in the Detroit region alone. These include the "Big Three" as well as startups like Rivian, Chinese companies Changyang, SAIC and SF Motors, the Indian company Mahindra, and well-established Japanese and Korean companies.

In turn, electrification of the transport sector will require upgrading the power grid through remote monitoring capabilities and automation in order to enhance its reliability, integrate intermittent and distributed renewables generation, ensure greater resilience, and

²For example, proponents of coal-fired generation may align with Indiana Wind Watch, a self-funded volunteer organization, which opposes wind projects throughout the state of Indiana at the county level, and endorses/opposes candidates in local elections based on their positions on wind development.

enable demand response and other efficiency measures.

These IT and AI technologies employed in the transport sector will be central to upgrading and modernizing the power grid. Achieving critical capabilities in these technologies will produce synergies enabling the Midwest or its competitors to emerge as leaders in the next generation of technology. By mastering clusters of technologies, network effects help ensure that the region maintains a dominant position in these industries. To accomplish this, an ecosystem of supporting policy must be established.

Transitioning the Midwest inevitably means transitioning the nation. The goods and services produced in the Midwest are exported to the rest of the country and the world. The standards California sets for automobiles directly influence demand for and the technologies of vehicles produced in the Midwest and globally. The Midwest is also a consumer of inputs that will support other regions through supply chains. For example, as a major consumer of coal, the Midwest's transition away from coal will force other regions to transform their own economies as coal producers within and outside the region gradually lose an important customer.

Integrating renewables and demand response into the grid will be significant challenges, requiring upgrading the grid with new technologies and enhancing its cyber security, but these challenges also present opportunities that reward those who solve these problems through innovation. Thus, the shift away from coal will generate demand not only for renewables, but also IT and AI technologies, which will be the basis of the future power and transportation sectors. These goods and services can be produced in the Midwest. The energy transition will create opportunities for transforming the region by modernizing both the power grid and the public transportation systems.

Studies focusing on the Chicago region have found that public transit investments yield anywhere from \$1.21 to over \$3.00 per \$1 invested, enhancing real estate values and spurring job growth, particularly along rail transit corridors. Expanding transit enhances the economic resiliency of communities in a downturn, and promotes inclusive economic development by enabling a broader portion of the population to participate in the region's economy by providing them access to jobs (Metropolitan Planning Commission, 2019)

Investing in Midwest cities will also generate wealth.

Real estate values have been one of the key drivers of wealth in the United States, some economists claiming that it accounts for virtually all wealth accumulation of households (Rognlie, 2015). Midwestern and Southern cities that have been hollowed out by the loss of industry and creeping suburban sprawl have missed out or even lost in much of that wealth generation.

This connectivity would not only revitalize the region by making its residents more mobile and hopefully wealthier, it can also create demand for these technologies domestically, generating opportunities for businesses. Opportunities for developing mobility technologies powered by electrification would generate business opportunities that can grow local supply chains built on Midwest capabilities.

Enhancing access to cities and ports is a development strategy with thousands of years of history. In America, transportation has evolved from horse, to shipping through the St. Lawrence Seaway, to laying rail track from coast to coast, ultimately to a national system of highways. More recently, linking cities via high speed rail and enabling mobility for workers have been a key driver of China's phenomenal growth these past several decades, providing access to markets, lowering the overall costs of production, and enabling China to capture international markets (Yan and Hua, 2004). The United States must update its transportation network to remain competitive.

Beyond these measures, certain core industries like steel, iron, chemicals, and refineries should upgrade their operations and enhance their environmental performance. This will promote innovation and advanced industries in environmental goods and services, which represent a rapidly growing economic sector (European Environment Agency, 2018). Recognizing that polluted communities cannot prosper in the long term, Pittsburgh and Detroit both demonstrated that cleaning up their environment and transforming underutilized infrastructure into green spaces can drive economic redevelopment (Personal Communications, Allegheny Conference, January 11, 2012).

Some will argue that enhanced environmental performance will burden industry. But, competing on low cost or poor environmental conditions is not a winning strategy. Asking the American worker to work and live in a polluted environment in a bid to compete with low-cost labor in developing countries invites a race to the bottom in technologically backward industries. Regulation can be

³BitSource's website is <https://www.thereisafuture.org/plan> (Accessed June 17, 2019).

reasonable and practical, and protect the environment.

Economic development strategies should promote investment in knowledge-based industries, which in turn promote efficiency, investment in their people, high value research and testing facilities, and advanced manufacturing. Investment should promote industries that will employ area graduates, train workers to build advanced skills, and attract new recruits to come to the region. This investment should aim to rebuild critical core skills in the workforce that will ensure the Midwest's position as a high value producer in the global supply chain.

The Midwest's universities and local military facilities can support communities and the private sector in this transition. Universities not only educate - they have the potential to facilitate partnerships with industry through research and investments in new technologies and projects that the private sector may not take on. Universities can tolerate longer payback horizons and greater risks inherent in basic and applied research, justifying them on the basis of research and educational mandates. They can also provide seed funding for faculty and student research that can generate licensable intellectual property and incubate startup companies. Universities adopting liberal intellectual property policies tend to be more successful in creating startups, generating deeper partnerships that ultimately grow their endowments (The Economist Intelligence Unit, 2017). Universities increasingly establish funds to invest their endowment and/or partner with venture finance to support startup companies to commercialization. These investments will naturally follow research priorities, thus the transition to cleaner energy and advanced technologies generate business opportunities and job potential in the local region (Personal Communications, University of Notre Dame Office of Economic Development, May 31, 2019).

Military bases throughout the Midwest also present opportunities for collaboration and business generation. The military prioritizes operational resiliency and thus has hosted cutting edge projects in smart and micro grids through collaboration with the private sector and research institutions. Military bases have become a major consumer of renewable energy to support self-sufficiency. Military renewable and micro grid projects support communities, businesses and jobs growth for skilled workers in the construction and maintenance trades (See Merchant, 2018 for the role of the military in renewable and micro grid development).

This transition implementing advanced technologies in

power and transport is already progressing. Michigan is positioning itself in advanced vehicles with electrification and AI, led by GM, Ford and Fiat Chrysler Automobiles heavily investing in R&D centers in the region. However, the competition is rapidly catching up. Chinese company BYD has won the contract to build out Indianapolis' and other American cities' electric bus fleets and install wireless charging infrastructure using equipment manufactured in China, giving a foreign firm a competitive advantage in new technologies.

A DECADE TO ACT

Munro & Associates, an engineering consulting firm specializing in the automotive and aerospace sectors, estimates that within a decade China will be well ahead of the United States if we do not step up our electrification efforts.

We are in some ways already playing catch up. Our technology may be better at the moment, but China is aggressively deploying new technologies in their own cities and ours. They are demonstrating that the "build it and they will come" strategy produces competitive advantage. Instead of playing catch up in conventional engines, they aim to leapfrog us and other competitors to lead in next generation technologies.

China's commitment to developing advanced technologies is deep and broad. The state provides generous R&D funding, the most aggressive policy support of any country, and they invest heavily internationally to find opportunities for state-backed firms to acquire and implement technology. In 2019, China increased its spending on R&D to 2.5 percent of GDP, rapidly approaching levels of the United States at almost 2.8 percent of GDP (Ng and Cai, 2019).

Importantly, Chinese electric vehicle policies are now a leading driver of international auto manufacturing electrification efforts. In 2018, China introduced a requirement that all manufacturers producing or importing vehicles domestically produce a certain portion of their production as electric vehicles (EV). The EV production quota, initially set at 10 percent for 2019, increases to 12 percent by 2020, calculated based on overall conventional fleet fuel efficiency and vehicle characteristics including range, energy efficiency, and fuel cell rated power. EV Credits are tradable among manufacturers against their EV targets or can be used against corporate average fuel consumption credit targets (International Council on Clean Transportation, 2018). This policy forces companies to transfer technologies to China, promotes Chinese R&D,

and accelerates China's ability to shape the future of these technologies. As a result of these and other clean energy policies, many foreign companies are shifting advanced transportation and energy R&D capabilities to China.

Ironically, America's automakers are investing in electrification in large part due to China's EV sales quotas. Each of GM, Ford and Fiat Chrysler sell more cars in China than in the United States. Chinese policy is driving their response, as China is already the world's largest automotive market with room to grow.

China's leadership in transportation electrification technologies will enable it to capture greater market share, ultimately displacing others in controlling intellectual property and the direction of technology development.

China also seeks to cement its technology leadership through setting technical standards. Enabled by its large and rapidly growing market, and a population of early adopters, taking a leadership position in newly emerging technologies provides it with early opportunities to establish its own standards, to which foreign suppliers must build to enter China's market. Chinese standards will also be exported to markets in which Chinese technologies are widely adopted, thus potentially placing American companies at a disadvantage in the future in many rapidly growing markets of the developing world.

China's investment in clean energy technology is so profound that Chinese companies have turned American cities into a proving ground for its technologies. As previously noted, BYD, the Chinese automaker with a large investment in electric vehicles, won the contract to provide electric buses and install wireless charging infrastructure for Indiana's capital city Indianapolis. BYD's building the public transport infrastructure in the heart of America's automotive supply chain should raise concern among American companies. BYD has also won bids in Atlanta and the state of Georgia, Southern California and Albuquerque. The opportunity to build these systems in major American cities provides BYD with invaluable experience testing its equipment and building its credentials as it competes for projects outside China, aiming to become the global leader in electrified transport.

MODELS FOR REGIONAL DEVELOPMENT

While the nation must transition together if the transition is to succeed, the approach each region takes will differ. California and New York are not meaningful examples for the Midwest, the South, or the Rockies. Higher land and housing prices, differences in labor force, and focus on technology and finance have made California

and New York less competitive for heavy industry. Their politicians do not represent America's manufacturing base, and probably do not understand manufacturing in the same way it is understood in the Midwest or other regions. Thus, approaches taken by California and New York may not readily offer solutions appropriate to the Midwest and other regions, yet as we have discussed, all regions remain important to each other, as they are part of the larger national ecosystem to advance pro-environment development.

Also, importantly, the culture of the Midwest differs from the coastal states, which also must factor into approaches to transition. An industrial economy requires the stability essential for long-term investment in manufacturing plant and equipment. Silicon Valley's business plan, predicated upon relatively few investments succeeding while the vast majority fail (an 80/20 fail success rate is common lore - the actual percentage is likely unknown), or Wall Street's lack of a tangible product or transparency won't work in the Midwest. Interviews revealed Midwestern antipathy for a business model that concentrates on selling stock rather than an actual product. Midwestern industrial workers demand and deserve stability in their work, and industry requires some stability when so many other competitive factors are in flux. Midwest politicians understand this and will resist anything that places jobs at risk.

Fortunately, the Midwest has examples of transition to advanced manufacturing closer to home to look to and build upon. Pittsburgh is a leading example, being followed by Detroit and others.

In the 1970s, Pittsburgh along with other rustbelt cities began to lose its steel industry to Asia, principally to Japan and Korea. By the late 1980s, 75 percent of Pittsburgh's steel mills had closed and it had lost roughly the same percentage of corporate headquarters (Dietrich, 2008). Pittsburgh lost roughly one third of its jobs as a result. When steel and supporting industries departed, they left a legacy of heavily polluted soil and water, and deep inequality and poverty.

Starting in the 1980s, Pittsburgh sought to transition, and in the 1990s it set an ambitious new agenda, refocusing itself away from the polluting lower value industries of the past. It aimed to rebuild itself focusing on four major areas: education and workforce development, regional development, civic organization, and public governance. Through regional stakeholder partnerships coordinated by the Allegheny Conference, a forum for public and private leadership in the region, it further evolved its strategy into the 2000s seeking to establish itself as a leader in advanced manufacturing, healthcare, energy, financial and

business services, information technology, and education. By diversifying across several key industries, Pittsburgh has become more resilient to a changing competitive environment. Given its emphasis on the knowledge economy, Pittsburgh's development authority places a priority on creating job opportunities across educational and income segments (Personal Communications, Allegheny Conference, January 11, 2012).

A key element of Pittsburgh's strategy was building alliances with industry and local universities. Carnegie Mellon University and the University of Pittsburgh supported the region's transition by supplying expertise, attracting young people to come to Pittsburgh to study and later to work, and collaborating with industry. The alliance unleashed a virtuous cycle. As Pittsburgh became an increasingly desirable place to live, these universities became increasingly competitive in attracting faculty and students, enabling them to win research grants, expanding their own capabilities, educational mission, and hiring. The alliance helped reverse decades of depopulation, capital flight and de-industrialization that have plagued Midwest cities and towns. These municipal-university-industry collaborations became a model under the Obama Administration's "Smart Cities" initiative. These alliances deliver tangible economic benefits. Cities that are co-located with universities and colleges are more prosperous (See Rao and Mulloth, 2016).

Pittsburgh is now revitalizing its economy and cleaning up its environment after a long history of polluting heavy industry, economic decline and enervating poverty. The city has overcome problems similar to those now facing the Midwest generally, while sharing similar economic and political profiles.

Following Pittsburgh's example, Detroit is in the process of revitalizing itself, raising itself from the largest municipal bankruptcy in United States history in the early 2010s. As described in greater detail below, Detroit aims to restore its position as an innovation hub for American industry and manufacturing, investing heavily in mobility technologies led by GM, Ford and Fiat Chrysler Automobiles, information technologies, and real estate development revitalizing the downtown's infrastructure as well as its green spaces.

Both cities transitioned to pro-environment development only after facing crisis. Thus, they not only provide a model for development, their examples also teach to begin transitioning when future trends become clear, cutting off the potential for crisis.

POLITICAL BARRIERS AND POLICY FAILURES

Midwestern state legislatures have been slow to recognize the opportunities presented by energy transition and the risks posed by failure to act on climate change. At best, their inaction has left these issues to citizens and municipalities to resolve.

Whereas dozens of other states have adopted ambitious renewable energy portfolio standards that have proven highly effective in advancing renewables, Indiana has adopted a low 10 percent renewable energy guideline that is non-binding on utilities (National Conference of State Legislatures, 2020). No utilities have yet volunteered to commit to generate 10 percent of their power from renewables under this guideline (Personal communications, June 7, 2019). The low voluntary guideline has in turn undermined any market for Indiana's renewable energy credits, weakening incentives for business and households to invest in renewable energy.

Beyond inaction, the Indiana state legislature has proven antagonistic to pro-environment development policies. Indiana's SB 309 (2017) capped the benefits of net metering required to be offered by investor-owned utilities, reducing the original 30-year period available to projects completed before December 31, 2017, and thereafter for projects initiated before July 1, 2022, to only receive net metering benefits up to July 1, 2032. In capping net metering, the legislature responded to utilities lobbying to control energy production to protect their regulated approved return on infrastructure and prevent diminution of their revenue stream. Yet, this comes at a cost to innovation in grid infrastructure, integration of renewables and demand response, and potential costs savings in meeting demand at peak periods.

Worse, neighboring Ohio's lower chamber had approved a bill named the "Ohio Clean Air Program" at the time of writing, which critics charge subsidizes money-losing nuclear and coal-fired power plants and eliminates or lowers policy support for renewables (Funk, 2019).

While Midwest state legislatures appear to be ignoring energy and climate challenges facing the region, there is at least one group that is thinking about these issues - the region's youth. Inspired by a youth climate movement started in Eugene, Oregon, elementary school children successfully lobbied the Indianapolis City Council in the early 2010s to take action on climate change, resulting in adoption of a non-binding resolution. In 2017, a coalition of 3rd graders to high school students followed their Indianapolis peers and lobbied the South Bend City Council demanding action

on the climate crisis. In spring 2019, the council passed a resolution requiring a climate action plan, and urged the students to continue attending budget meetings to ensure that the plan is funded and meaningfully implemented. That same day, Evansville passed its own resolution. The city of Goshen, a conservative community, followed South Bend and Evansville within a few days.

While students initiated the movement and presented their own ideas when giving testimony to officials, local community organizations and schools facilitated the youth movement. The region's youth, community organizations, schools and universities will be critical in educating not only the public, but also its political and business leaders (Personal Communications, June 5, 2019).

ENERGY TRANSITION AND JOBS GROWTH THROUGH PRO-ENVIRONMENT DEVELOPMENT

Large and small cities throughout the Midwest are increasingly turning to cleaner industry. Large cities like Detroit that lead the way toward electrification of the automobile serve as anchors for the region, enabling smaller cities to attract parts of the supply chain. The process generates network effects as original equipment manufacturers located within a region attract Tier 1 then Tier 2 suppliers, and the various testing and analytics support functions that want to be close to their customers (Personal Communications, City of Auburn Hills, June 3, 2019).

Small cities that commit resources to support business can develop their niche within larger regional supply chains. Smaller cities enjoy a significant cost advantage over the larger cities due to lower costs for land, labor and general cost of living. Due to their simpler structures and relative ease of access to decision makers, smaller cities can also be easier environments to do business than larger cities like Chicago and Detroit, especially if they proactively enable pro-development business and projects. For example, South Bend seeks to make decisions rapidly, and communicate throughout the process to private sector stakeholders, in an effort to eliminate the bureaucracy and delay associated with larger cities. South Bend turned the post-financial crisis into opportunity by contributing land and empty buildings to collaborative efforts. The attitude of the city to "operate at the speed of business" fostered an entrepreneurial spirit that in turn enables innovation.

The City of Auburn Hills in Michigan also serves as an excellent example of how urban planning implemented through thoughtfully executed city permitting supports pro-environment development. The City of Auburn Hills,

located in the Detroit environs just past Pontiac, has been highly successful in attracting heavy industry back to the region, including major companies like Fiat Chrysler Automobiles. Auburn Hills's strategy exploits the network effects of attracting higher-level manufacturers within supply chains: once a major company locates to Auburn Hills, its suppliers will want to locate close to them. Auburn Hills takes this a step further. They pro-actively seek to help locate facilities within one of their 22 industrial parks. Within the framework of its zoning regulations, the city promotes the highest value and best use of land, implicitly producing both economically and environmentally optimal outcomes. Permitting decisions are made by bringing all city departments together, ensuring the proposed business operations will be appropriate and supported by health, safety and environmental services. City regulations limit industrial activity to a certain percentage or location of the property to contain environmental effects like noise, thereby ensuring that its development parks are attractive to all businesses, and naturally tending towards cleaner, best practice manufacturing techniques. The stakeholder approach also streamlines the permitting process. If a proposed facility is legal but not optimal for the proposed business, the city will work with the developer to find a better location. Conversely, if a proposed use is not permitted under current regulations but makes sense, the city will help pursue variances. The key here is the city does not take a passive approach - it sees itself as a partner to developers and pro-actively seeks solutions with them.

Midwest cities that host universities have further advantages as they can help attract skilled talent and sponsor joint research with private firms. Joint research programs between universities and the private sector may also engage with municipalities to solve local problems. These have spawned startups, opportunities for licensing of intellectual property, and sometimes even ready-made customers. For example, South Bend has been a "beta customer" for almost a dozen startup businesses incubated by local universities in the health, safety and environmental services space. Notre Dame alone counts roughly 80 active startups that it has incubated over the past few years, all of which have a technology angle (Personal Communications, University of Notre Dame Office of Economic Development, May 31, 2019).

University investment in collaborative partnerships and local venture incubators have filled financing gaps that have become increasingly apparent as cities and towns throughout the Midwest and other regions seek to foster innovation hubs. An estimated 75 percent of venture

finance is invested in Boston, New York and the Silicon Valley (Feloni, 2018). Initiatives like the Rise of the Rest Seed Fund, which invests in startups in the Midwest, South, and Rockies, seeks not only to reverse that trend, but also to reap superior returns in the process.

To support pro-environment development, government programs should help leverage private finance. Government financing programs should scale to community needs. Small to modest loans or loan guarantees can assist local businesses in expanding and growing jobs. Yet, as described further below, U.S. federal programs that assist in clean energy development have largely failed to support small businesses. As a result, state and municipalities have an important role to play in promoting financing programs to support local pro-environment development.

At the federal, state and local levels, a wide range of explicitly pro-environment development policies are available. Many are budget neutral; other more aggressive policies require public funding. Examples include:

- Policies that strengthen environmental standards and require greener production techniques and products;
- Mandatory state targets for renewable energy;
- Guaranteed interconnection and robust net metering for renewables;
- Regional renewable assessment and energy planning;
- Standards requiring integration of solar in public buildings and new buildings;
- Financing measures including funds for renewable energy development;
- R&D grants;
- Demonstration project support;
- Tax breaks;
- Government procurement policies favoring local manufacturing; and
- Purchasing support for locally produced equipment.

GOVERNMENTS AND MARKETS

Although this report has focused primarily on the role of local and state stakeholders, the federal government has an important role to play in supporting energy transition and competitiveness. The federal government funds research and development of advanced technologies for energy and manufacturing, supports financing to business through the tax code, lends to next generation projects, disseminates information about best practices, and purchases goods and services.

Federal financial support for modernizing manufacturing will be essential to achieving competitiveness. Yet, the federal government has not done well in scaling financing down to the level of small and medium size businesses. The federal government lacks the capacity and skills to operate at the micro scale, which in turn tends to concentrate rather than diversify risk and support (author's observations based on his own efforts to secure financing for small-scale solar clients). The Department of Energy's \$535 million loan guarantee to Solyndra under the American Recovery and Reinvestment Act of 2009 illustrates the problems of the federal government's limitations as a financial partner. These loans were too large, too risky, not properly vetted, and failed to diversify and spread investment. When Solyndra filed for bankruptcy in 2011, the federal government's losses under its loan guarantees correctly called into question the approach of the federal government to high risk ventures.

The federal government should structure programs so that financing is available to small- and medium-size businesses, from technology development through commercialization, achieving support to a greater diversity of companies and communities. In contrast to loan guarantees in the hundreds of millions of dollars, geared to achieve targets for disbursing funds, micro finance programs should ensure that funding is available to small businesses throughout the nation that need fairly modest amounts of support to grow and generate jobs.

If necessary, to downscale support, the federal government can act through states, municipal governments, universities and research organizations, and the private sector. These stakeholders are often better equipped to invest in and transition their regions and communities. Programs should also ensure that funding is available to second tier cities and towns. A "winner take all" model is not appropriate, too risky, and not likely to successfully identify the most innovative companies.

Importantly, our competition aggressively supports renewables and advanced technologies through enabling policies and funding. China captured a dominant share of global wind and solar photovoltaic production by requiring domestic content as a condition of support and through preferential subsidies, government procurement programs and intellectual property policies. While China's central government is in the process of withdrawing wind and solar subsidies, it is simultaneously launching new subsidies and technology localization strategies promoting indigenous development of other low-carbon energy industries, such as nuclear, electric vehicles, and smart grid

technologies (Hart, 2019).

Beyond funding, the federal government must lead in supporting institutional solutions to energy transition and competitiveness. Where state legislatures are paralyzed by local politics and municipalities are too fragmented, the federal government can coordinate regional approaches to development, particularly for projects that involve multiple states. Power grid and transportation systems modernization are two examples where the federal government is uniquely positioned to facilitate upgrading infrastructure. Leadership and the power of government to establish direction, organize regional coalitions, and mobilize resources to support transition will be essential to overcoming jurisdictional barriers. Needed institutional initiatives go beyond federal technology development efforts that are essential, but alone not adequate (For example, see Department of Energy technology initiatives for grid modernization, transport modernization, and fuel cells development).

Indiana's own Regional Cities Initiative provides an example scalable to the national level. The Regional Cities Initiative required communities throughout Indiana to organize as regional economic development coalitions in order to compete for state funding for development projects that were best advanced jointly by several communities on a regional basis. By requiring municipalities to cooperate, the initiative was designed to advance solutions to community development that could not have been achieved through the fragmented efforts of individual municipalities.

The federal government should also work to ensure regulation attracts and supports business. Regulation should be reasonable, balancing commercial and environmental considerations, and it should be designed to reduce risk and foster desired outcomes. Where requirements are burdensome without serving the goals of protecting the environment, promoting competitiveness or other important policy purpose, the regulation should be reviewed and streamlined. This requires a balance that should not abandon jobs or the environment.

DEEPER SOCIAL CHALLENGES

The challenges facing the Midwest and the country in energy transition and competitiveness have deep roots implicating traditional social and economic development issues that reach back decades and well beyond the narrow scope of energy policy.

Many cities and towns in the Midwest remain at risk of depopulation due to lower birth rates and migration outward. Depopulation makes it difficult for businesses to

recruit workers. It hollows out the tax base, compounded by the further loss of capital as businesses move or shut down.

Lifeless cities breed poverty, which in turn spawns underfunded schools, tough neighborhoods, ultimately breeding crime, and invites drug abuse as an escape from despair. Dangerous streets and widespread drug dependency make for a poor environment for families and businesses to thrive. All have become acute problems for American cities.

The problems of depopulation, capital flight, unsafe neighborhoods, communities falling into depression and substance abuse have yet even deeper causes. A history of racism and persistent inequality have divided and held back these communities. The cost is seen in unemployment, lost business, and diminished tax collections, yet remains immeasurable in its totality. Such conditions not only impose unquantifiable costs on society generally, but from a competitiveness perspective, are highly disruptive to labor relations and supply chains, pushing industry away and worsening the plight of our cities. These challenges must also be overcome for the sake of competitiveness, if not decency.

Many of the problems facing Midwestern cities and towns are illustrated by Detroit. Solutions developed by Detroit will be lessons for the region. Detroit's decline was largely self-inflicted. Racial tensions date back at least to the early 1900s. Depopulation and de facto segregation was probably as much to blame as the automobile for bankrupting the electric streetcars that operated within Detroit and many other major Midwestern cities. Without transportation, two communities lived separately, fostering distrust and fear, undermining a sense of community. Add to this mix the prevalence of guns in America, resulting in violence by police and citizens (See Moyer, 2017).

Mismanagement exacerbated these problems. Detroit is large and fragmented. The cities of Boston and San Francisco could both fit within Detroit city limits with room to spare. Over such a large expanse, the population dropped from 1.8 million in 1950 to less than 675,000 residents in 2017. The broader Detroit metropolitan area comprises 11 counties, each headed by powerful executives that are fiercely independent of each other, though more collaboration is occurring in the wake of the bankruptcy. Four of these counties are economically powerful, whereas two counties do not even have mass transit. With uneven tax bases, an excessive number of municipalities and school districts, the fragmentation of government and duplication of functions further reduce the efficiency of

government and the availability of scarce resources for poorer regions. Depopulation and an eroding tax base have allowed the city's infrastructure - roads, bridges, sewer, and telecommunications - to fall into disrepair.

The future of a city can be seen in its children. According to the Skillman Foundation's State of the Detroit Child Report, only 15 percent of Detroit students met standards for third grade English and only 12 percent achieved third grade math scores. An overwhelming 92 percent of students scored below college readiness proficiency level on the SAT assessments in all subjects. Roughly half (48.2 %) of children belong to households below the poverty line. Over half of high school graduates do not enroll in college within six months of graduation.

As a result, the Midwest increasingly depends on skilled and working immigrants to maintain communities and the tax base. For Detroit, 30 percent of high school graduates from 2008 to 2028 are expected to be immigrants (Personal communications, Ned Staebler, June 11, 2019). Immigration policy therefore also becomes a critical issue to urban renewal in the Midwest and, by extension, competitiveness, particularly for large cities like Detroit. Without new businesses and capable workers coming to the region, the Midwest atrophies.

The federal government can and should do more to address the poverty and education deficits for these cities to thrive and to support the Midwest's place in global supply chains. For any city or town, economic development requires that education and health care are affordable, and people are safe (See National League of Cities, 2018, surveying education, health care and safety as perennially among the top issues for American cities). Providing affordable education will be essential to preparing future generations of Americans to play their role in an evolving, knowledge-based economy. The current cost of higher education resulting in unsustainable levels of student debt prevents individuals from pursuing careers of choice or indentures their future, undermining national competitiveness. Affordable education also may be the most effective way to combat poverty and enhance the diversity of participation in a knowledge economy across ethnic, gender and income groups.

There are solutions to the education crisis. New York and Rhode Island are offering tuition waivers for students who commit to remaining in the state post-graduation, recovering the cost of education through the tax base. Ultimately the cost of education must come down. In response to the student debt crisis, Purdue University, one of the nation's leading research universities in the science,

technology, engineering and mathematics (STEM) fields, has reduced the cost of its education through cost cutting and new revenue generation measures. The only university in the country to do so, it has frozen tuition through 2021 and reduced the cost of room and board, reducing the total cost of a Purdue education by 2021 to less than the cost in 2012. Purdue is also among the universities experimenting with innovative financing of education, such as private investors funding tuition in exchange for a share of graduates' income after graduation under "income sharing" agreements (Purdue University, 2019).

Greater emphasis on STEM subjects will unlock job opportunities and be essential for our competitiveness and national security. STEM education will also be essential to making the American workforce and the economy more resilient to the expanding automation of functions in the workplace. The Midwest must address the challenges of automation as part of its competitiveness strategy, as it is the most automated region of the United States due to its automotive industry. The auto industry employs half of the industrial robots in the United States, led by Michigan (12 percent of the nation's total robots), Ohio (8.7 percent), and Indiana (8.3 percent) (Muro, 2017).

Education that broadens workers' skill sets and enhances capabilities that are not easily performed through automation - such as non-routine creative or judgment-oriented tasks that require complex critical thinking and creative problem solving skills - will protect jobs and enhance career satisfaction. As workers increasingly work side by side with automated technologies, education is critical to enable workers to prepare for an evolving workplace. As the pace of technology accelerates and automation and artificial intelligence technologies expand, our commitment to education must also match this challenge. Employment-long learning and skills programs will become essential to keep up with technology.

Similarly, affordable health care is essential to enable individuals to invest in education and pursue jobs that motivate them. The cost of health care should not impoverish individuals, making them unable to pursue their ambitions.

Finally, public safety is essential for cities to be able to attract and retain residents to build the economy. Critically, building trust between city authorities, police and citizens is challenged by gun violence. The City of Cincinnati recognized that its own economic development could only be achieved if, in the words of its mayor, it first fixed the fundamental problem of a "broken social contract" (Cranley, 2019). Racial tension, inequality,

poverty and crime had caused depopulation, capital flight and ultimately de-industrialization in Cincinnati and other cities across the country. Reeling from a spate of police shootings, Cincinnati began its rebuilding journey at the turn of the century by reforming its police force and developing community policing approaches in cooperation with the U.S. Department of Justice. Cincinnati's program has since become a model for the nation (Semuels, 2015). The city has built upon police reform, further expanding its efforts to ensure inclusive economic development through programs that build capacity and certify small businesses and business owned by minorities and women to compete for city bids. Again, according to the city's Mayor, Cincinnati's "intentionality" has proven effective. Reversing decades of urban decay and stagnation requires improving these basic conditions as a threshold condition.

RECOMMENDATIONS

The longer we resist the future, the more time is lost. Time is limited before we are technology followers in the next generation of clean energy power generation and transport technologies. These recommendations are intended to ensure our continued leadership.

Regional Development Coordination Mechanisms

Our most significant challenges to pro-environment development are institutional, not technological. The challenges of transforming the Midwest are greater than the scope and scale of local institutions.

Economic development and enhancing the region's resiliency are most effective when integrating regional approaches. And these initiatives must integrate government, private sector, academic and civic organizations. Although American intellectuals such as Ostrom (1990) pioneered concepts such as regional approaches to solving commons and resource problems, coordinated planning and organization across regions remain highly challenging in the United States, leading to incomplete and fragmented efforts that disadvantage us. For example:

- State legislatures are limited by geography to their own states.
- County and municipal bodies are even more limited geographically.
- Public utility regulatory commissions are limited both to their own state and consider energy issues through

the narrow lens of near- to medium-term electricity prices.

- Transportation planning is conducted by states, cities and the various authorities that regulate, fund, operate, and own the various rail transport systems, though typically not in concert.

A regional coordinating body that can bring together all stakeholders and consider issues broadly is needed to ensure that we seek solutions across states. The Midwestern Governors Association is already an important coordinating body for energy and economic development issues, among others. For upgrading the power grid, organizations like PJM, the regional grid operator for parts of the Midwest and the Mid-Atlantic, has enabled renewables integration through market rules that facilitate access, demand response and energy efficiency, and other clean energy technologies.

The federal government must necessarily play a role in organizing and supporting regional initiatives. The federal government providing a framework and funding for initiatives coordinated through the Midwestern Governors Association and organizations like the Detroit Regional Chamber or the Allegheny Conference should be explored to advance possible models appropriate to the United States.

Capacity Building with Elected Leaders, Industry and the Public

Capacity building among cities throughout the Midwest to help better promote pro-environment development would benefit the entire region. Network and scale effects will generate benefits for communities throughout the Midwest as the region strengthens its position in domestic and global supply chains for clean energy technologies.

Awareness of the threat posed by climate change is growing, however more needs to be done to educate elected officials, industry and the public. The Midwest has a strong tradition of public service, yet elected officials often enter office without the preparation for the heavy challenges presented by energy transition, climate change and economic development.

The region must also demand that the federal government act to support its transition. The paralysis engulfing national politics prevents our national legislators and executive from addressing these threats to competitiveness and rebuilding our industrial base in a comprehensive manner.

The university system continues to be an invaluable resource in educating elected leaders, industry, and the public through executive and continuing education. Community members who are experiencing climate change on their farms and in their neighborhoods could be catalytic for education delivered in a neutral, non-partisan manner.

The youth movement that has proven effective in persuading city councils throughout Indiana and other states to take action on climate change has emerged as a valuable asset in building this capacity.

Scoping Regional Opportunities

A systematic and comprehensive assessment of regional opportunities and resources should be undertaken to evaluate energy transition, climate, and economic development opportunities.

For example, no studies of hydropower or geothermal resources of the Midwest region have been undertaken given recent advances in technology, if ever. Similarly, no economic development assessment spanning the Midwest has been conducted.

Meeting the challenges of the region will require considering all available options. Lack of exploration of options effectively eliminates them as possibilities.

Pro-Environment Development Policies

Pro-environment development is economic development at its core. It is future-oriented, looking to serve the demand for future industries and technologies. It is environmentally

sound development, because that is the direction for the future, and it is the kind of development that does not penalize communities and workers with the hidden costs of pollution. Pro-environment development aims to promote jobs in cleaner, more sustainable enterprises of the future. These companies will enjoy a competitive advantage internationally because they outperform their competitors in environmental and energy efficiency metrics, have superior safety records, and are advantaged in complying with increasingly rigorous compliance standards. Superior performance along these metrics indicates they will be better managed than their peers, which should enhance their profitability.

Regional Adaptation Plan

A strong offensive strategy must be paired with an equally strong defense.

As an agricultural region, increasing volatility and extremes of precipitation and temperature impose heavy costs on the Midwest's agricultural industry. A response that combines reducing greenhouse gas emissions and strengthening the resilience of communities and industries vulnerable to climate risks is urgently needed.

Midwestern research universities like Purdue University, the University of Notre Dame, and the University of Michigan possess the expertise to assist the region's elected officials in developing adaptation and resilience plans. Their expertise should be deployed in addressing this challenge.

ORGANIZATIONS INTERVIEWED

Allegheny Conference

City of Auburn Hills, Manager of Business Development, Community Relations

Automation Alley

Brookings Institution

Citizens Action Coalition

Detroit Regional Chamber

Indiana Chamber of Commerce

Indiana Coal Council

Indiana Office of Energy Development

Indiana Utilities Regulatory Commission

Michiana Area Council of Governments

Munro & Associates

NextEnergy

Purdue University, State Utility Forecasting Group

City of South Bend

TechTown

University of Notre Dame

Department of Economics

Department of Biology

Department of Electrical Engineering

Pulte Institute for Global Development

Kroc Institute for International Peace Studies

Law School

ND Energy

Office of Continuous Improvement

Office of Economic Development

Utilities Department

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pulte.nd.edu

3150 Jenkins Nanovic Halls
Notre Dame, Indiana 46556 USA
(574) 631-2940



globaldevelopment@nd.edu