IOWA ENERGY PLAN

Collaborate locally.
Grow sustainably.
Lead nationally.

December 2016

IOWA ENERGY PLAN IS A JOINT INITIATIVE BETWEEN

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Acknowledgements

The Iowa Economic Development Authority and the Iowa Department of Transportation recognize and thank the following individuals and organizations that contributed their time and expertise in the development of the Iowa Energy Plan:

- The Iowa Partnership for Economic Progress board members for their leadership and vision in guiding Iowa to its new energy future;
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A complete list of the Iowa Partnership for Economic Progress board and working group members is included as **Appendix A** of this plan.

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The Iowa Energy Plan was developed for the Iowa Economic Development Authority and the Iowa Department of Transportation by Inova Energy Group, LLC with specialized project support from Elevate Energy and TEConomy Partners, LLC.

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Smarter energy use for all

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A Message from Lieutenant Governor Kim Reynolds

Iowa recognizes and has identified energy as a key resource and area of strategic importance to the state's economy and economic development efforts. Iowa is already a national leader in wind energy and biodiesel and ethanol production. State leaders want to ensure that we continue to lead well into the future. One way to make that happen is to develop a statewide, comprehensive energy plan that outlines clear goals and strategies to keep energy costs low and further facilitate economic development.

I am proud to have chaired our statewide energy planning effort, along with leadership support from board members of the Iowa Partnership for Economic Progress, and representatives from the Iowa Economic Development Authority and Iowa Department of Transportation. The plan solidifies Iowa's place as a global trailblazer for energy initiatives. Creation of the statewide energy plan will keep Iowa at the forefront of energy policy and will allow our state to develop a forward path for the future.

Iowans have been extremely supportive of this effort to take a comprehensive look at our current and future energy needs and options. Six public forums were held around the state, with hundreds of Iowans participating, and another 48 Iowans served on working groups to help identify potential strategies that could become important parts of Iowa's energy future.

The collaboration experienced in the Iowa Energy Plan process is not unusual in Iowa. We know that the results are always better when we work together to find common ground, agree on joint priorities and partner to find the best solutions for moving forward.

Ensuring that our state remains in a leadership position in the national energy market is vital for the future growth of our state. The time is now to continue to build on Iowa's successes by charting a sustainable and predictable course for tomorrow. The culmination of much collaboration amongst stakeholders is reflected in the Iowa Energy Plan. Now, the exciting and impactful work begins!

The Governor's office looks forward to working with Iowa's stakeholders on strategy implementation.

Sincerely,

Kim Reynolds
Lieutenant Governor
State of Iowa

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List of Acronyms

- Advanced meter infrastructure (AMI)
- Carbon dioxide (CO_2)
- City Energy Management Program (CEMP)
- Combined heat and power (CHP)
- Community Development Block Grant (CDBG)
- Critical Materials Institute (CMI)
- Electric vehicle (EV)
- Energy Assurance Plan (EAP)
- Gross Domestic Product (GDP)
- Heating, ventilation and air conditioning (HVAC)
- High octane fuel vehicles (HOFV)
- International Energy Conservation Code (IECC)
- Iowa Association of Electric Cooperatives (IAEC)
- Iowa Association of Municipal Utilities (IAMU)
- Iowa Department of Administrative Services (DAS)
- Iowa Department of Agriculture and Land Stewardship (IDALS)
- Iowa Department of Education (DE)
- Iowa Department of Human Rights (DHR)
- Iowa Department of Natural Resources (DNR)
- Iowa Department of Public Safety (DPS)
- Iowa Department of Transportation (Iowa DOT)
- Iowa Economic Development Authority (IEDA)
- Iowa Finance Authority (IFA)
- Iowa Homeland Security and Emergency Management Department (HSEMD)
- Iowa Office of Consumer Advocate (OCA)
- Iowa Partnership for Economic Progress (IPEP)
- Iowa Public Buildings Benchmarking Program (B3)
- Iowa Utilities Board (IUB)
- Leadership in Energy and Environmental Design (LEED)
- Low Income Home Energy Assistance Program (LIHEAP)
- Low Income Weatherization Assistance Program (LIWAP)
- Megawatt (MW)
- North American Industry Classification System (NAICS)
- Notice of Intent (NOI)
- Office of the Chief Information Officer (OCIO)
- Qualified Allocation Plan (QAP)
- Qualified Energy Conservation Bond (QECB)
- Renewable Fuels Infrastructure Program (RFIP)
- Renewable portfolio standard (RPS)
- Small Business Innovation Research Program (SBIR)
- Small Business Technology Transfer Program (STTR)
- State energy offices (SEOs)
- U.S. Department of Energy (DOE)
- U.S. Environmental Protection Agency (EPA)

Introduction

Purpose of the Plan

The constantly changing energy sector is, and will continue to be, a defining challenge for policymakers. State governments must constantly evaluate and consider energy-related opportunities and threats to be able to ensure increased economic activity and improved environmental quality while protecting the health, safety, and welfare of its citizens.

States develop strategic and comprehensive plans to ensure that they meet future energy needs and create energy economic opportunities in today's changing energy landscape. Effective energy planning efforts address energy supply and demand challenges, ensure reliable and affordable energy supply, minimize costs, maximize production benefits, and target opportunities to support economic development. State energy plans also help identify and design a pathway to a prosperous energy future that capitalizes on a state's resources, infrastructure, and workforce talent to promote a healthy economy and environment.

For the past 25 years, the state of Iowa has focused its strategic planning efforts to meet the energy needs of the state while enhancing the state's economic livelihood. Through these efforts Iowa has positioned itself as a national leader in renewable energy, biofuels, and energy efficiency while creating thousands of new jobs and investing in research and development for new technologies. Most importantly, these efforts have maintained the affordability of energy for Iowa's residents and businesses.

Iowa's position as an energy leader has never been more secure. With abundant renewable energy resources combined with a strong history of public and private support, Iowa has become a national leader in the clean energy economy. Iowa currently produces more of its energy from wind than any other state and ranks second in the amount of wind energy capacity installed. Indeed, several record-breaking wind energy projects were announced this year and the state has seen growth in solar energy. Iowa also leads the nation in biofuels production and continues to invest in ethanol and biodiesel projects. Research is being undertaken on how to further utilize biomass resources and produce clean energy from these sources, ensuring we maximize all opportunities to bolster our energy leadership. Bipartisan support for numerous energy policies has helped to keep energy affordable and attract new investment in the state's economy while positively impacting communities through job creation and additional tax revenues.

Building upon these successes, the Iowa Energy Plan (Plan) establishes a clear vision, guiding principles, realistic objectives, and actionable strategies that will guide decision making over the next ten years. The plan first describes the state's energy landscape including how energy is produced, how energy is consumed, and how energy prices impact Iowa's economy. The plan presents a series of objectives and corresponding strategies that will place Iowa on a path toward a sustainable energy future. The Iowa Energy Plan is meant to be a framework for action that is regularly revised, updated, and integrated into established planning and budgeting processes. With this framework in place affordable, clean, reliable, and sustainable energy will continue to be commonplace in Iowa.

The Iowa Energy Plan was developed under the leadership of Lieutenant Governor Kim Reynolds and the Iowa Partnership for Economic Progress (IPEP) board members. The Iowa Economic Development Authority (IEDA) and the Iowa Department of Transportation (Iowa DOT) led the development of this plan and were supported by a consulting team led by Inova Energy Group, LLC with specialized project support from Elevate Energy and TEConomy Partners, LLC.

Methodology for Plan Development

The process to develop the Iowa Energy Plan involved several research and analytical tasks as well as a comprehensive effort to engage stakeholders representing energy, environmental, agricultural, educational, and business interests, as well as members of the public. To help organize the actionable components of the plan and structure stakeholder input, four foundational pillars were identified and established. The following pillars represent and describe the strategic areas of focus of the Plan:

Energy Pillars

- Economic Development and Energy Careers
- Energy Efficiency and Conservation
- Iowa's Energy Resources
- Transportation and Infrastructure

Stakeholder Engagement

As part of the Iowa Energy Plan's stakeholder engagement effort, six public forums were held throughout Iowa in March and April 2016 to provide members of the public with an opportunity to share input. These forums also helped the development team better understand how energy supply and costs impact citizens and businesses. The team also obtained input on what resources, programs, and policies should be developed to meet future energy needs. The plan development team further engaged the public through a solicitation of comments via the plan's dedicated website. A summary of comments received from the public during the energy forums and the plan development process is included as **Appendix B**.

To leverage local expertise from a variety of disciplines and industries 48 individuals were selected through an application process to form four working groups (**Appendix A**). These working groups were aligned with the strategic energy pillars identified as integral to the development of the Plan, and members met over a six-month period to provide input to help shape the recommended objectives and strategies.

The plan development team also met with representatives from Iowa's state government agencies and statewide organizations to ensure proper coordination of efforts and alignment of priorities. These meetings helped obtain a better understanding of the success factors of several energy-related policies and programs.

Analytical Review

The plan development team also completed several analytical tasks such as assessing current and future energy supply and demand in Iowa, evaluating the energy workforce and career opportunities, examining existing energy policies and programs, and assessing the potential economic and environmental impacts of proposed strategies. Insights and key findings from these tasks are incorporated in the content presented throughout the Iowa Energy Plan. A complete review of the analysis is provided in the following appendices:

- APPENDIX C: Iowa's Energy Profile: Energy Supply and Demand and Sector Employment Analysis
- APPENDIX D: Assessment of Iowa's Energy Position: Geographic Analysis
- APPENDIX E: Iowa Energy Workforce Assessment
- APPENDIX F: Energy Policy Inventory
- APPENDIX G: Iowa Energy Research and Development Core Competencies and Opportunities for Energy-Based Economic Development

Iowa's Energy Landscape

Overview

Global projections indicate that more energy, in all forms, will be needed to meet growing energy demand, and as shown in **Figure 1**, global and U.S. demand for energy is unlikely to abate. Because of future demand, access to energy resources will be a tremendous economic advantage for those nations, regions, and states with the infrastructure and capabilities to further develop energy technologies and solutions.

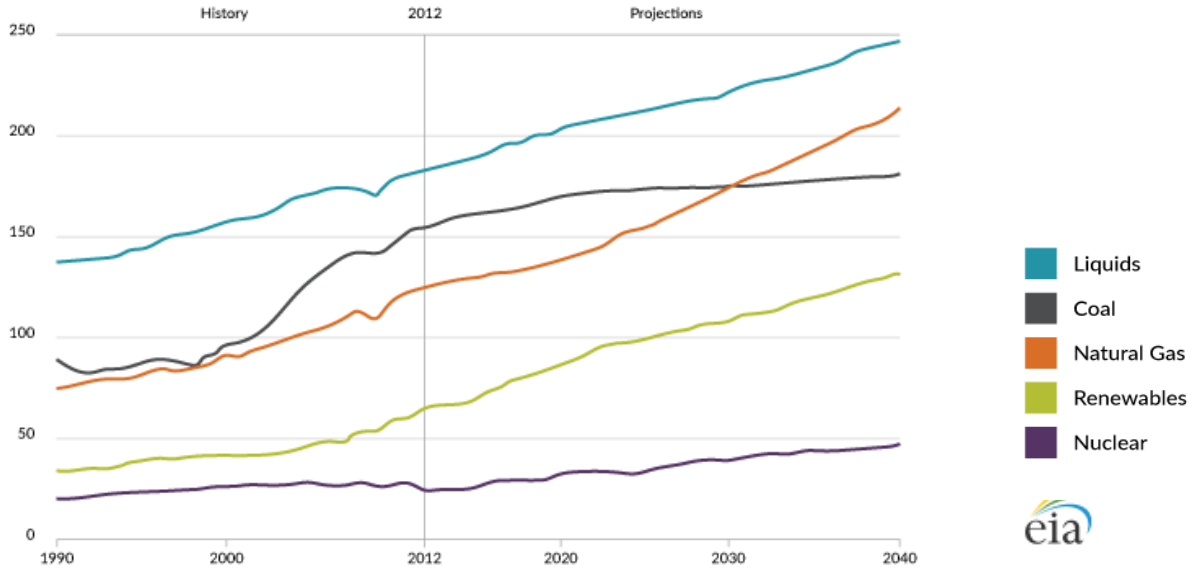

Figure 1. Global Energy Consumption, Recent Trends and Predictions by Source, 1990-2040. In Quadrillion BTUs.

Source: U.S. Energy Information Administration (2016, May 11). International Energy Outlook 2016.

Energy is a central part of Iowa's economy and, in fact, the state has identified "energy" as an area of strategic importance for economic development. Iowa has repeatedly demonstrated a commitment to advancing new energy technologies and has invested in research opportunities to further explore applications for its local energy resources.

There is an energy sector momentum in Iowa upon which to build – with the renewable energy story being a stand-out performer. The tremendous growth of Iowa's biofuels and wind energy industries underscore the opportunity for Iowa's energy sector to generate new businesses, wealth, rewarding careers, and government revenues in the state.

Note: The majority of the information contained in this section was originated in the white paper Iowa's Energy Profile: Energy Supply and Demand and Sector Employment Analysis included as Appendix C to this plan and produced by TEConomy Partners, LLC.

The construction of wind farms has attracted nearly $12 billion of investment into Iowa's economy and wind could create an additional $50 million in property tax revenue by 2020. These added resources fund schools, lower taxes, and fix roads.

Iowa's renewable energy landscape is robust, with an extensive history of performance, policies, and regulations that continue to support growth. Iowa made an early commitment to renewable energy by becoming the first state in the nation to establish a renewable portfolio standard (RPS) and continued its leadership with the "advanced ratemaking statutes", which provided regulatory certainty regarding building baseload generation, encouraged the development of transmission resources as a way to encourage economic development, eliminated the prohibition of investor-owned utility ownership of renewable energy facilities.

This year, Iowa became the first state in the nation to generate over 35 percent of its annual electricity from wind resources and Governor Terry Branstad has set an informal target of obtaining 40 percent of the state's energy from wind power by 2020.[1] In addition, Iowa's electric utilities have shown a commitment to harnessing more wind energy by announcing major investments to grow their percentage of wind energy generation in Iowa.

Iowa is currently the largest producer of ethanol and biodiesel in the country and is investing resources to produce next-generation biofuels, such as cellulosic ethanol. The state has also enabled value-added opportunities for a variety of bioenergy inputs including corn, soybeans, and switchgrass. The use of dried distiller grains, a by-product of ethanol production, has provided producers with a reliable feed stock for animal farm operations.

Finally, in the last five years, Iowa has seen growth in solar energy driven by decreasing prices of solar panels, supportive policies, and a commitment from investor-owned, municipal utilities and rural electric cooperatives, to the development of community solar projects and utility-scale solar farms.

As a result of the state's commitment to renewable energy and its low energy prices, Iowa has attracted major tech companies to the state including Google, Microsoft, and Facebook.

In addition to the state's success with renewable energy, Iowa has long been considered a national leader in energy efficiency with comprehensive energy efficiency programs in place since 1992. The Iowa Utilities Board (IUB) has determined that for the period spanning 2009-2013, the state saved approximately 1.4 percent of retail electricity sales through the implementation of energy efficiency programs, while returning $2-$3 in benefits for every dollar invested.[2] At the same time, Iowa's investor-owned utilities have maintained some of the highest customer satisfaction scores in the U.S. and have consistently ranked at the top of the list for Midwestern utilities.[3] These energy efficiency programs have increased consumer and business knowledge of energy efficiency, resulted in countless projects being completed, and have provided additional opportunities for investment.

While Iowa has continued to invest in clean energy technologies the state continues to benefit from some of the lowest energy costs in the nation. In 2016, Iowa was ranked as the third least expensive state overall for energy prices[4] and the ninth least expensive state for electricity prices.[5] This is particularly evident for the industrial sector, where manufacturers and processing plants benefit from electric rates that are 19 percent below the national average.[6]

Iowa's economy is dependent on a robust and diverse transportation system to move products globally. This transportation system has long provided the state's businesses a competitive advantage[7] and Iowa has made great strides to ensure transportation efficiency by developing responsible road construction plans,[8] enhancing mass transit programs, and identifying methods to optimize the supply chain and transportation of fuels within the state.[9]

Photo Credit: Alliant Energy

Table 1. Contextual Statistics

Data Variable	Iowa Statistics	Context
Land Area	55,857 square miles	1.58% of the total U.S. area
Population Estimate (July 1, 2015)	3,123,899	0.97% of the total U.S. population
Population, percent change (April 1, 2010 to July 1, 2015)	2.5% growth	4.1% U.S. growth over same period
Labor Force Participation Rate (in civilian labor force, total, percent of population age 16 years+, 2010-2014)	67.9%	U.S. rate is 63.5%
Median household income (2015)[1]	$54,736	U.S. median household income is $55,775
Total employer establishments (2013)	80,581	Iowa has 1.08% of the national number
Unemployment rate (September 2016)[2]	4.2%	U.S. rate was 5.0%
Total Private Sector Employment	1,280,079 jobs	Iowa accounts for 1.1% of the U.S. total private sector employment in 2014
Toal Manufacturing Employment (September 2016)[3]	211,500 jobs	Iowa accounts for 1.7% of the U.S. total manufacturing employment in 2014
Toral Gross State Output (2015)[4]	$171.5 billion	Iowa accounts for 1.0% of U.S. GDP in 2015

Sources:

(1) American Community Survey. (2015). Retrieved from: http://www.census.gov/programs-surveys/acs/
(2) National Conference of State Legislatures. (2016, November 4). Retrieved from: http://www.ncsl.org/research/labor-and-employment/national-employment-monthly-update.aspx
(3) Bureau of Labor Statistics. Retrieved from: http://data.bls.gov/timeseries/CES3000000001
(4) U.S. Department of Commerce, Bureau of Economic Analysis. (2016, July 27). Retrieved from: http://www.bea.gov/iTable/drilldown.cfm?reqid=70&stepnum=11&AreaTypeKeyGdp=5&GeoFipsGdp=XX&ClassKeyGdp=NAICS&ComponentKey=200&IndustryKey=1&YearGdp=2015Q2&YearGdpBegin=-1&YearGdpEnd=-1&UnitOfMeasureKeyGdp=Levels&RankKeyGdp=1&Drill=1&nRange=5

Energy Production

Iowa is a net importer of energy consuming more than double the amount of energy that it produces (**Table 2**). Currently the petroleum, coal, and natural gas that are consumed in the state must be imported, and overall, Iowa has an energy production profile that is less diverse than the U.S. overall. As shown in **Figure 2**, Iowa's production of energy (defined as energy produced from domestic Iowa assets – i.e., not imported coal, natural gas, fuel oil, etc.) is comprised of three primary production sources: biomass feedstocks for ethanol (68 percent), renewable energy except ethanol (24 percent), and nuclear power (8 percent). Without the state's renewable energy production, Iowa's energy import imbalance would be much greater.

Table 2. Iowa Total Energy Consumption and Production in Trillion Btus, 2014.

Total Energy (Trillion BTUs)	Iowa Consumption	Iowa Production	Difference (Importation)
	1,542	757	758

Source: U.S. Energy Information Administration. (2016, October 20). State Profile and Energy Estimates. Retrieved from: https://www.eia.gov/state/data.cfm?sid=IA#EnergyIndicators

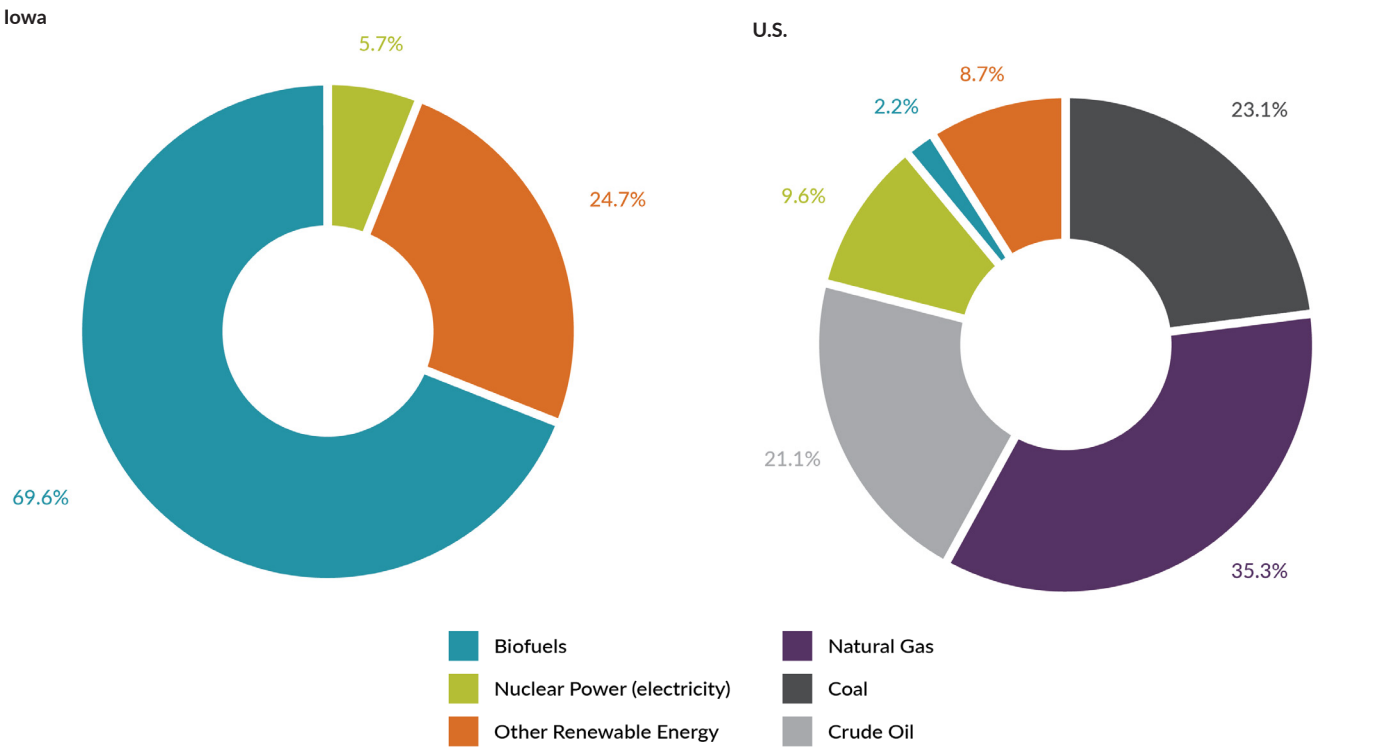

Figure 2. Production Share (Btu) by Major Source Category, 2014.

Source: U.S. Energy Information Administration. (2016, June 29). State Energy Data System. Retrieved from: https://www.eia.gov/state/seds/seds-data-complete.cfm#Production

Iowa is a national leader in renewable energy production – ranking first in the percentage of energy produced coming from wind, ranking second in the amount of electricity generated from wind, and leading the country in production of ethanol and biodiesel.

It is important to highlight that Iowa does have significant renewable energy resources and while in 1980 Iowans imported virtually all the energy they required, investments in renewable energy and energy efficiency have substantially reduced the energy imports, created local employment opportunities, and increased energy security. These investments have allowed Iowa to become a national leader in clean energy. The state's wind resource is ranked seventh in the nation and the state has harnessed that resource to produce over 35 percent of its electricity.[10] Iowa is the nation's largest producer of ethanol, with 43 operating ethanol plants that accounted for 27 percent of U.S. output in 2015. Similarly, Iowa is also the nation's largest producer of biodiesel, with nine operating biodiesel plants that accounted for 19 percent of U.S. output in 2015.

In terms of electricity production, in 2015, Iowa still relied primarily on coal-fired power plants to generate most its electricity (52.6 percent), with the state's five largest power plants by capacity being all coal-fired.[11] However, substantial investments are being made by the state's utilities to replace or convert several older coal power plants to natural gas as they have become outdated and expensive to operate. For example, Alliant Energy is currently building a new 650 MW combined cycle natural gas plant near Marshalltown which will be operational in 2017.[12] Electricity generated from wind follows accounting for 35 percent of production[13] and the state's only nuclear plant, Duane Arnold, generates approximately nine percent of the state's electricity.[14] However, as shown in **Table 3**, in the last 15 years, Iowa's electricity generation profile has changed dramatically with generation of electricity from wind resources increasing over 3,000 percent, and a 25 percent reduction in the generation of electricity from fossil fuels.

Table 3. Iowa Annual Electricity Generation, Change in Generation Mix 2001-2014 (Megawatt-hours)

Electricity Generation Source	2001 Megawatt-hours of Production	2014 Megawatt-hours of Production	Percent Change 2001-2014	Percent of 2014 Iowa Electricity Generated by this Source
Coal	34,665,000	33,733,000	-2.7%	59.31%
Wind	488,000	16,307,000	3,241.6%	28.67%
Nuclear	3,853,000	4,152,000	7.8%	7.30%
Natural Gas	593,000	1,373,000	131.5%	2.41%
Hydroelectric (Conventional)	845,000	879,000	4.0%	1.55%
Biomass	104,00	266,000	155.8%	0.47%
Pertoleum Liquids	99,000	59,000	-40.4%	0.10%
Petroleum Coke	4,000	85,000	2,025%	0.15%
Solar (All - Distributed and Utility)	0	21,000	--	0.04%
Other	8,000	0	--	0.0%
TOTAL	**40,659,000**	**56,875,000**	**39.9%**	**100.0%**

Source: U.S. Energy Information Administration (2016).
Includes both utility scale plants and IPP/CHP electricity generation, plus distributed solar.

Note: Petroleum Coke production: No information was available from the source due to the large increase of the percentage of petroleum coke use. However, fuel grade petroleum coke can substitute for steam coal in some power plant boilers which may be a contributing factor for this increase.

Iowa's energy generation mix will continue to change as the state's utilities announce plans to invest in additional, or alternative, generation that relies on Iowa's renewable energy resources. For example, Alliant Energy has announced plans to add 500 MW of wind energy capacity in Iowa which amounts to a $1 billion investment in the next five years.[15] Similarly, MidAmerican Energy will add up to 2,000 MW of wind energy capacity through a $3.6 billion investment, which will amount to a significant step in realizing the company's vision of 100 percent renewable energy for customers in the state.[16] The project has the potential to create $12.5 million per year in property tax payments, $18 million per year in landowner payments, and $48 million per year in state and local expenditures and represents the largest economic development project in the state's history. Both investor-owned utilities are also implementing pilot projects and establishing research and development initiatives for other renewable energy technologies.

Through 2050 wind could help Iowans save over $3.5 billion on their electricity bills, on top of another nearly $4.7 billion saved from protection against conventional fuel price spikes.[17]

While other renewable sources currently contribute a small percentage to the overall electricity generation, their importance continues to grow. Biomass currently contributes only a limited amount to the state's electricity generation; this value has grown by 155.8 percent since 2001. Similarly, with 55 percent of days being sunny annually, the state has the potential for increased electricity generation from solar.[18]

Energy Consumption

Just as Iowa's energy production profile differs from that of the U.S. overall, so too does Iowa's energy consumption. Iowa's economy is more industrially intensive than the overall U.S. economy. This is reflected in the fact that Iowa accounts for 2.4 percent of industrial energy consumption overall, but comprises only 0.97 percent of the U.S. population. Iowa's strong industrial economy, which includes agriculture, biofuels production, and manufacturing contributes to Iowa's energy consumption profile in comparison to other states.

Overall, energy continues to be one of Iowa's largest expenditures. During the past five years, Iowa has invested an average of $15.5 billion per year on energy, which amounts to almost $6,000 per person.[19] To put this in perspective, more than ten cents of every dollar made in Iowa is invested on energy — 25 percent higher than the national average.

As indicated in **Figure 3**, in Iowa, the industrial sector (including agricultural producers) consumes about 50 percent of the energy used in the state. Transportation is the state's second largest energy-consuming sector, accounting for 20 percent of energy use. The residential sector, where the majority of households heat with natural gas, and the commercial sector together account for less than one-third of the state's end-use consumption combined.[20]

Due to its energy-intensive economy, on a per capita basis Iowa ranks fifth in the country in terms of energy consumption, highlighting the importance of a robust energy policy that allows the state to support demand while maintaining low energy prices.

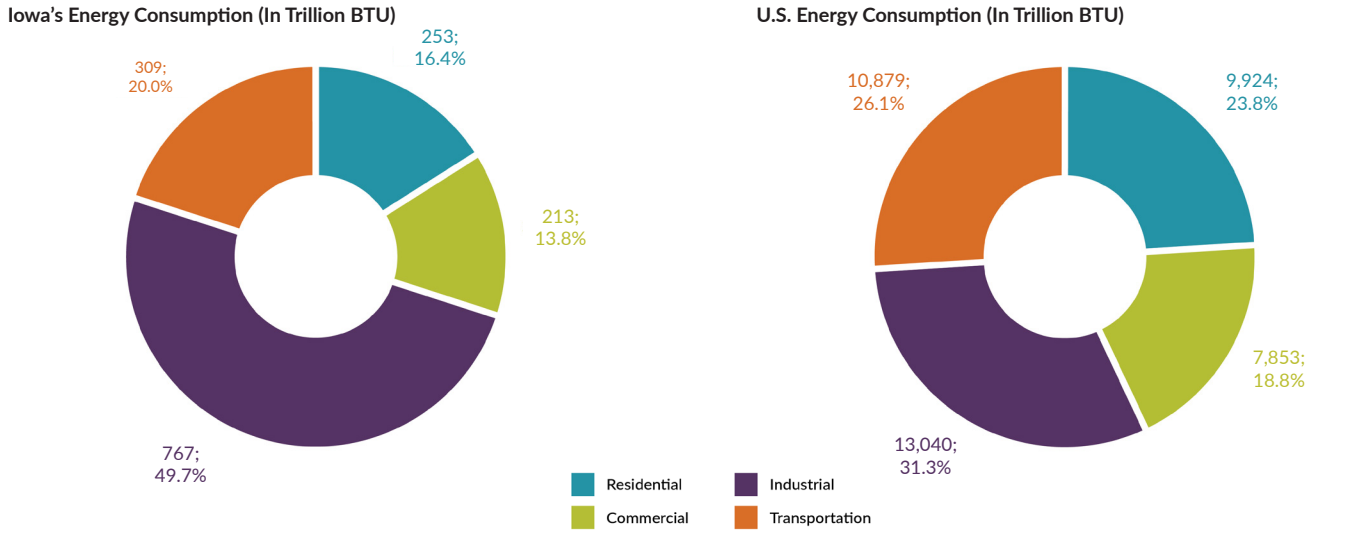

Figure 3. Iowa's Energy Consumption (Trillion Btu) Share by End Use Sector, 2014.

Source: U.S. Energy Information Administration. Iowa State Profile and Energy Estimates. Retrieved from: http://www.eia.gov/state/?sid=IA#tabs-2

Examining consumption data by energy source again reveals a consumption profile different than the U.S. **Figure 4** shows that Iowa uses renewable energy and coal to a much greater degree than the nation. In addition, Iowa is less reliant than the U.S. overall in the use of natural gas, gasoline, other petroleum, and nuclear power. These trends are expected to change consistent with the production changes that occurring in the state.

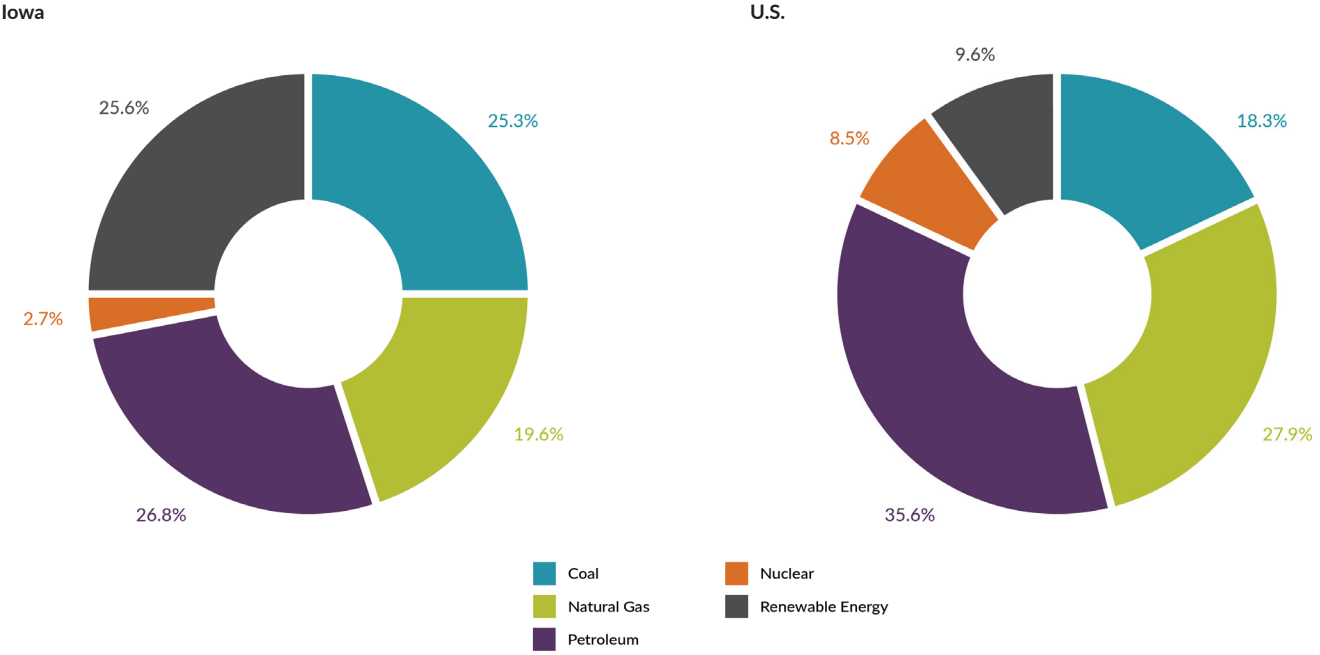

Figure 4. Consumption (Btu) Share by Major Source Category, 2014

Source: U.S. Energy Information Administration. (2016, June). State Energy Data System. Retrieved from: http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_btu_1.html&sid=US

Note: Shares do not account for Net Interstate Flow of Electricity (Exports)

Energy as a Key Employer in Iowa

Iowa's "renewable energy and storage" and "ethanol production" energy subsectors are specialized and growing, far outpacing average national growth rates and providing an opportunity to create jobs.

The Iowa energy sector has seen significant net growth in employment since 2001, performing at the same level as the U.S. energy sector and outperforming Iowa's overall private sector. In 2014 Iowa's energy sector employed approximately 16,292 individuals (1.3 percent of the state's total private sector labor force) in 849 business establishments, and the sector has seen employment growth of 22.2 percent between 2001-2014.[21] In addition, the energy sector in Iowa pays higher wages in comparison to the overall private sector in the state while also providing the sort of high quality, family-sustaining jobs that economic developers seek to grow.

Iowa's energy sector has been a significant job generator, far outpacing overall private sector growth in the state. Iowa wind power industry supports up to 6,000 well-paying positions in nearly a dozen manufacturing facilities across Iowa that build wind-related parts and materials.[22]

Employment in Iowa is highly concentrated among several key energy subsectors. More than 40 percent of the total energy sector's employment is in power transmission and distribution. Additionally, four subsectors - ethanol production, other renewable energy and storage, power generation, and biodiesel production are rising to the level of state "specializations." These subsectors have been significant new job generators between 2001 and 2014. Notably, employment from biodiesel production grew by 310.4 percent, and employment from other renewable energy and storage has grown by 143.6 percent since 2001. Ethanol production has truly emerged as a significant state industrial sector growing by 3,838 percent from 2001 to reach 1,845 jobs in 2014. In all three cases, these sectors far outpaced growth rates in those subsectors nationwide.

Table 4. Performance of Large & Specialized Detailed Iowa Energy Sectors, 2001 - 2014

Energy Subsector	NAICS Description	Establishments		Employment	
		Number, 2014	Growth, 2001-2014	Jobs, 2014	Growth, 2001-2014
Ethanol Production	Ethyl Alcohol Manufacturing (325193)	40	1100.0%	1,845	3,838.6%
Other Renewable Energy and Storage	Turbine and Turbine Generator Set Units Manufacturing (333611)	8	220.0%	1,896	728.5%
Power Generation	Fossil Fuel Electric Power Generation (221112)	77	-33.0%	1,759	-24.7%
Power Transmission/ Distribution	Electric Power Distribution (221122)	145	17.6%	2,846	-19.2%
	Power/ Communication Line and Related Structures Construction (237130)	158	41.1%	2,202	112.8%

Source: TEConomy Partners analysis of Bureau of Labor Statistics, QCEW data and enhanced file from IMPLAN.

Iowa's Policy Framework

Iowa has a substantial body of law and regulation that impacts energy production, delivery and use in the state that ultimately serves to promote affordable, reliable and sustainable energy systems in a manner that has been proactive and forward-thinking. The state's policy framework is a complex and intricate network of rules and regulations with a multitude of local, regional, and federal involvement. While the IEDA houses the state's energy office and is primarily responsible for administrating energy-related federal funds and programs, other state agencies have energy-related responsibilities that require coordination in efforts and communication.

For example:

- Iowa Department of Transportation manages the state's public infrastructure network on which energy resources are transported and used as well as the Congestion Mitigation and Air Quality improvement funds;
- Iowa Utilities Board regulates the safe and reliable delivery of services, as well as rates of electric, natural gas, water and telecommunication providers;
- Iowa Department of Human Rights is responsible for administering federal funds for low-income home weatherization programs;
- Iowa Department of Agriculture and Land Stewardship runs the Renewable Fuels Infrastructure Program;
- Iowa Department of Natural Resources has oversight over several compliance programs related to the generation of energy and the storage and transportation of energy resources, as well as non-regulatory assistance to facility operators to make positive environmental impacts including energy efficiency;
- Iowa Department of Revenue has purview over tax credit and tax exemption programs that benefit certain energy-related technologies and fuels, such as solar and biofuels;
- Iowa Finance Authority offers a variety of programs to assist in community development, including the issuance of tax-exempt bonds, providing low cost funds for drinking water and wastewater facilities in Iowa; and
- Iowa Department of Public Safety is responsible for the oversight and enforcement of the International Energy Conservation Code.

Additional information on the state energy policies and the agencies that are responsible for implementing them is available as **Appendix F** to the Iowa Energy Plan.

In 1983, Iowa was the first state in the country to adopt a RPS laying the cornerstone for renewable energy success in the state. The RPS had a combined capacity goal of 105 MW for the state's two investor-owned utilities; by 2015 the state had over 5,700 MW of wind energy alone installed, far surpassing the original goal established. Since 2004, all electric utilities operating in Iowa are required to offer green power options to their customers.[23] Starting in 2005, the state has also been implementing renewable energy tax credit programs that are supplementary to those offered at the federal level.

In 2008, the IUB established energy efficiency standards for each regulated utility in the state. Senate file 2386, enacted in 2008, directed gas and electric municipal and rural electric cooperative untilities to establish energy efficiency goals. From 2009 to 2013 utility companies spent over $750 million in energy efficiency investments, and their plans for 2014 to 2018 forecast closer to $950 million in additional investment.

In the 2015 legislative session, two incentives were passed to support biofuel production. First, Senate File 257 extended the ethanol-blended fuel tax incentive through June 30, 2020 which was scheduled to expire in June 2015. Second, a fuel tax incentive for biodiesel at 11 percent or greater blends was approved. The incentive took effect on July 1, 2015 and provides for those higher biodiesel blends to be taxed at a lower rate than other diesel and lower biodiesel blends. This incentive also expires June 30, 2020.

Iowa continued to build upon and strengthen its energy framework in 2016 with the addition of new policies. In March 2016, the legislature approved a tax credit that will encourage the production of renewable chemicals benefiting Iowa's renewable fuels industry, which makes products such as ethanol and biodiesel from farm crops and crop residue. In July 2016, the IUB issued an order directing Iowa's two largest investor-owned utilities to expand renewable energy opportunities in Iowa by allowing all customer classes to net meter while doubling of the previously established net metering cap. Also, during the 2016 legislative session, the Iowa Legislature passed House File 2468, which provides for a ten percent standalone tax credit for residential installations of geothermal heat pumps in lieu of federal tax credits.

The Path Forward

A vision statement and guiding principles for the plan were developed through consultation with the plan's leadership and development teams, and review and input from working group members and numerous stakeholders. The vision statement represents the collective understanding of Iowa's ideal future in terms of its energy use and resources. The vision considers a planning horizon of ten years.

Vision Statement

Iowa is committed to the development of an affordable, reliable and sustainable energy system that maximizes economic benefits for our state.

We will continue to embrace energy efficiency, a mix of energy resources, infrastructure, and technologies to position all of Iowa – both rural and urban – for future growth.

As a clean energy leader, our efforts will drive innovation, foster research and development, create business and career opportunities and promote environmental stewardship.

Building upon the vision statement, a series of guiding principles were developed to provide a foundational basis for the recommendations outlined in the Iowa Energy Plan. **Action taken by the state, or its policy makers, should be consistent with the plan's vision and guiding principles**

Photo Credit: City of Dubuque

Guiding Principles

The objectives and strategies put forth in the Iowa Energy Plan will:

- Foster long-term energy affordability and price stability for Iowa's residents and businesses.
- Increase the reliability, resiliency, safety and security of Iowa's energy systems and infrastructure.
- Stimulate research and development of new and emerging energy technologies and systems.
- Provide predictability by encouraging long-term actions, policies and initiatives.
- Expand opportunities for access to resources, technologies, fuels and programs throughout Iowa in a manner that results in a fair and balanced outcome for all customers.
- Seek diversity in the resources that supply energy to and within Iowa while preserving fair and reasonable costs for customers.
- Support alternative energy resources, technology, and fuel commercialization in proven, cost-effective applications.
- Encourage sector-based workforce development and educational activities that build clear pathways to rewarding energy careers.
- Promote the protection of the environment and Iowa's natural resources.

Portfolio of Recommendations

To help realize the vision established for the Iowa Energy Plan, objectives and associated strategies were developed in consultation with numerous stakeholders. These objectives and strategies were established with the vision statement's 10-year planning horizon in mind, and were organized around each of the four foundational pillars of the plan. There is a recognition, however, that not every strategy is perfectly aligned with a single energy pillar, but rather involves actions and results that cut-across some, or all, of these domains. This is particularly true of the plan's focus areas which are found in each pillar.

While consisting of several strategic recommendations, each objective is meant to address a specific near-term opportunity for Iowa to make further progress in achieving the plan's vision. In addition, the strategies included in this plan represent actions that are the means to accomplish a given objective. Essentially, these components address two simple questions: "What do we want to accomplish?" and "How are we going to realize the vision established for the plan?"

A total of 15 objectives and 45 strategies spanning the pillars are the culmination of all planning and analysis efforts. The pillars begin on page 18. Collectively, they propose a balanced approach to encourage economic development throughout all areas of the state across all of Iowa's energy sectors, while emphasizing environmentally friendly practices.

This plan will be a living document that retains its strategic importance over time, rather than providing just a simple snapshot from today's vantage point. Therefore, the strategies included in this plan will be updated frequently to ensure that they truly reflect the state's current energy market realities.

The four energy pillars with their corresponding objectives are depicted in **Figure 5**.

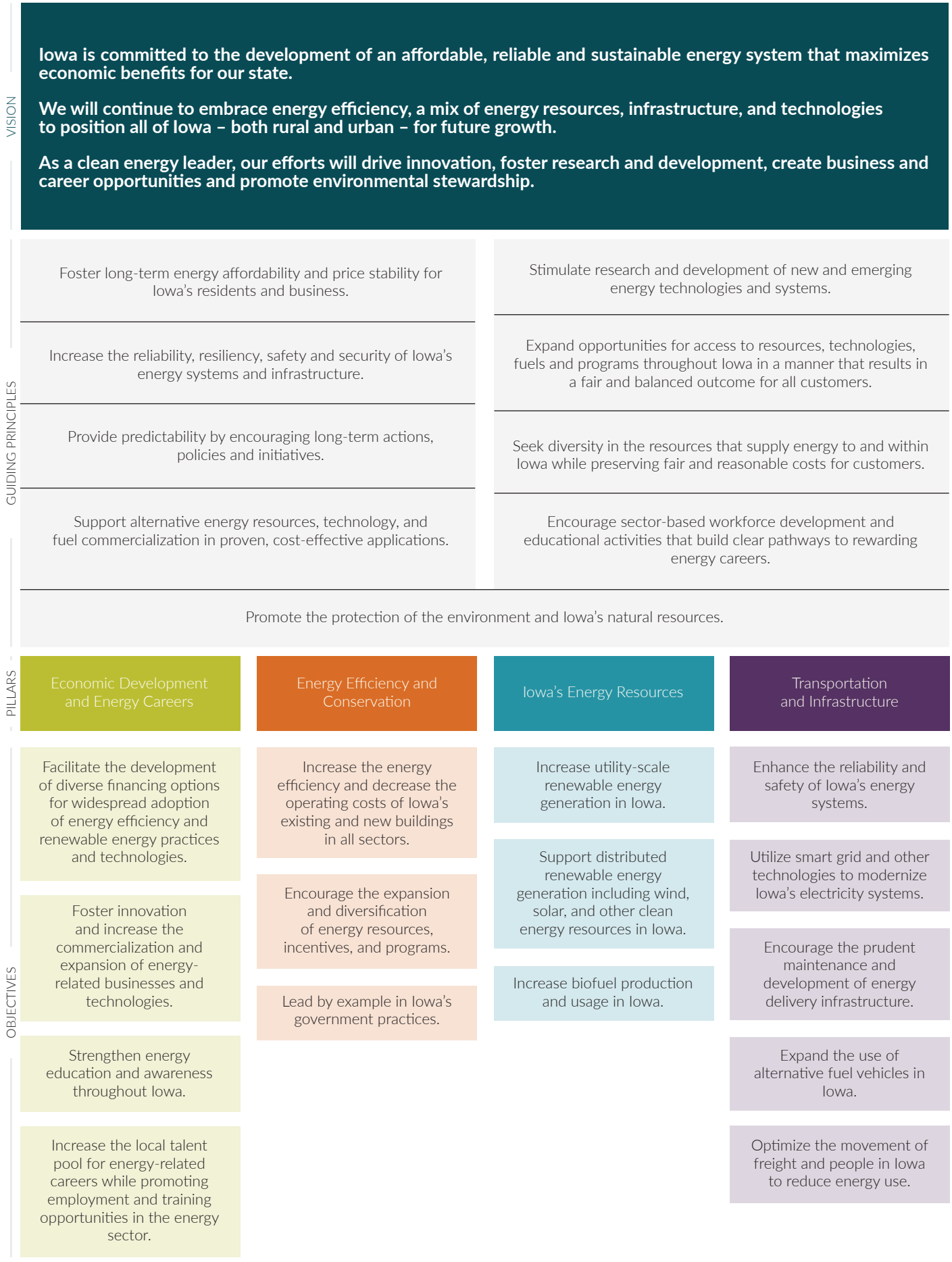

Figure 5. Iowa Energy Plan Organizational Structure and Portfolio of Objectives

Environmental and Economic Impact Assessment

In an effort to determine the potential environmental, energy system, and economic impacts of each strategy, a qualitative assessment was completed by the plan's consultant partners. It should be noted, however, that this assessment represents a first step in evaluating the potential impacts of each strategy and the plan development team recommends that additional investigations or detailed economic modeling be undertaken, where appropriate.

The tables contained within the introduction of each pillar area (**Tables 5, 6, 7, and 8**) include a high-level overview comparison of potential direct impacts of the strategies recommended within that pillar. The focus is on direct impacts, which are those impacts that occur through direct interaction of an activity with an environmental or economic component. Indirect impacts are those that are not a direct result of the activity and that occur later in time or location; a result of implementing a strategy implementation group recommendation, for example. It is not possible to quantify indirect impacts for several strategies but the background discussions for the strategies do include a discussion of expected outcomes resulting from the ultimate actions advanced from the strategies. For example, a strategy implementation group recommendation that results in construction of a project.

The table for each pillar visually attempts to represent the economic, environmental, and energy system impacts of each strategy. For these tables, impacts were assessed for environmental and public health impacts, economic impacts, and energy system impacts, and are denoted with the following symbols:

^ Positive direct impact
v Negative direct impact
-- Neutral impact
● Unknown impact

Environmental and public health impacts: Fossil fuel-based energy generation has been at the center of affordable and reliable energy in Iowa. However, Iowa has been transitioning to more renewable resources on the in the electric generation sector and more biofuels in the transportation sector, including ethanol and biofuels. Further, energy, water, and land systems interact in many ways, with either positive or negative impacts resulting from these interactions. The preliminary environmental and public health assessments performed for this plan were primarily based on the following causations:

- Changes in the amount of emissions of air pollutants such as ozone, carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, and lead.
- Energy practices can impact water quality and quantity. In most power plants, water produces the steam that spins the electricity-generating turbines. Refining transportation fuels requires water, as does producing fuels, for example, extracting petroleum, or growing crops for biofuels.[25]
- Technologies and decisions related to both conventional and alternative energy sources can impact land use. Some new energy technologies, for example wind and solar, require more land coverage than others if deployed broadly, putting them in competition with other land uses.
- Changes in air and water quality can impact public health.

Economic impacts: Economic vitality and well-being depend upon affordable, safe, reliable and sustainable energy. The energy sector can create broad and diverse economic benefits that vary considerably across economic sectors and over time. The preliminary economic assessment was based on the following economic principles:

- Energy initiatives create temporary, short-term jobs as well as long-term jobs. Because an initiative can generate both employment gains and losses, and because employment effects are likely to vary over time, it is important to assess strategies not only in terms of the quantity of jobs created or eliminated, but also on the potential type, duration, and distribution of jobs across the state's economic sectors and geographic regions.
- New business attraction can be advanced through low cost, reliable energy, efficient operations, sophisticated workforce training, investment in new technologies, and increased cost effectiveness.
- Energy or technology exports to other states can impact state output and gross state product. Energy initiatives can stimulate new investments and spending within the energy sector.
- Increased leadership in innovative technology, research and development can result from energy-related decisions and programs. To the extent that the strategies proposed further any of the key research and development platforms identified in **Appendix G**, they were assessed as having positive impacts in this area.

Energy system impacts: Clean energy initiatives can help protect energy producers and consumers from the costs of adding new capacity to the system and from energy supply disruptions, volatile energy prices, and other reliability and security risks. The following four energy system factors were used to assess the potential impacts of recommended strategies on overall energy infrastructure and systems.

- Energy initiatives can result in avoided costs for infrastructure owners, such as the delayed or avoided need to build new generation. Investments resulting from customer-sited renewables and distributed generation can have a positive impact when aligned with transmission and distribution infrastructure.
- To the extent that recommended strategies improve Iowa's energy reliability and security they were marked as having positive impacts. Reliability is defined as the ability to meet the energy needs of end-use customers, even when unexpected natural or man-made events occur.
- Affordable energy rates and/or reduced wholesale market clearing prices can result from certain decisions made around policies and projects. In the case of this assessment, affordability was evaluated from the perspective of the end-user and was considered for all fuels.
- Recommended strategies can enhance the diversification of Iowa's energy portfolio through the investment in new technologies and the generation of energy through a variety of resources including traditional and renewable can lead to greater energy security for the state.

Photo Credit: Missouri River Energy Services

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Economic Development and Energy Careers

Economic Development and Energy Careers

Today Iowa is in an enviable position in terms of its ability to integrate renewable power while offering long-term energy affordability, reliability, and stability with some of the lowest energy costs in the nation. This has made the state attractive for businesses especially those in the manufacturing sector. Iowa has become even more attractive due to its growing renewable energy sector for companies whose sustainability plans include the use of renewable energy. For example, as a leader in affordable wind energy, companies with high-energy needs, such as those needing major data centers now call Iowa home. Facebook and Microsoft have joined Google in choosing to locate their data campuses in the state. These companies have provided new "green jobs", millions of dollars of economic development, and set the state for growth in the energy space by continued capitalization of low cost renewable and alternative energy options.

Iowa companies and its citizens continue to express a desire for affordable and reliable energy as well as more renewable energy options. In 2016, MidAmerican Energy announced a wind energy investment of $3.6 billion marking the largest renewable energy economic development projects in Iowa's history. Additionally, Alliant Energy announced a $1 billion wind investment contributing to the renewable growth in the state.

This success has been and will continue to be achieved through strategic commitments and investments along with innovative state and federal polices and tax credits. When combined, Iowans and the companies who call it home enjoy continued low energy costs, and increasing renewable energy and diversity. IEDA will utilize this strategic advantage to attract new businesses and new citizens seeking to call Iowa home.

It will be important to continue collaboration and partnerships among industry, educational and government partners in identifying energy sector occupational needs and laying out a pathway to ensure there are skilled and trained professionals to meet Iowa's future energy labor force needs.

Going forward, the objectives and strategies in this pillar will play an important role in achieving the guiding principles set forth in the Iowa Energy Plan.

Focus Areas of the Pillar

As identified through the planning process, themes were brought forward that could positively impact Iowa's energy economy. These themes, or objectives, were further developed into strategies. Within this pillar, two focus areas with multiple strategies stood out due to their potential impact on Iowa's economy. These include: technology-based economic development through innovation in research and development, commercialization and manufacturing of energy technologies including energy storage advancement; and second energy sector collaboration and partnerships to ensure Iowa meets its future energy workforce needs.

Focus Areas

- Technology-based Research and Development
- Workforce Development

Technology-based Research and Development

The state will remain at the forefront of the ever-evolving energy sector by fostering research, development, and commercialization of innovative energy technologies and emerging job opportunities. For example, nearly a dozen wind manufacturing facilities are located across the state providing excellent local job opportunities, often in rural areas, while serving the growing demand for renewable energy production. Iowa has the opportunity to build upon the wind energy model for expanded economic and job growth.

Iowa offers a strong research and development foundation from state universities along with federal energy labs such as the Ames National Laboratory. Combined with innovative product and technology manufacturers and collaborative state and private partnerships, Iowa has potential to develop and bring to market new energy technologies that are vital to strengthening the state's energy economy over the next decade and beyond. With proven start-up to commercial success stories, Iowa can attract emerging early stage companies to bring their innovative intellectual ideas and pilot projects to the state as well as to attract established companies and manufacturers to relocate to the state.

One area of opportunity is to address energy storage and transportation challenges to create a more resilient and efficient energy grid. These challenges can be overcome through the development and collaborative support of creative pilot projects that include multiple emerging technologies and programs to address needs including grid resiliency, load leveling, and backup power. When locally sourced, these pilot projects can lead the way for more jobs and additional economic impact to ensure Iowa meets its future energy workforce needs.

Workforce Development

During the energy planning process, utility, industry, educational, and workforce stakeholders indicated the need to identify Iowa's energy sector workforce needs and to develop partnerships, such as Future Ready Iowa, to ensure the state is able to attract and train professionals to meet the state's future energy force needs.

Developing and maintaining a technology-driven industry sector like energy requires a robust education and workforce pipeline to produce the right mix of skills and the right volume of trainees to match industry demand.[26]

In particular, planning participants communicated that with an aging energy workforce, it is anticipated that there will be a shortage of available and trained workers for the utility industry. There was also recognition that not only with the changing energy production portfolio from traditional to renewable resources but also with rapidly advancing technologies, the workforce to service this ever-evolving energy sector will need education and training on both traditional and renewable energy generation assets along with emerging technologies.

Photo Credit: Iowa Economic Development Authority

Table 5. Economic Development and Energy Careers - Strategy Impacts at a Glance

		Environmental and Public Health Impacts				Economic Impacts				Energy System Impacts			
Objective	**Strategy**	Air	Land	Water	Health	Jobs	Business Attraction	Energy and Technology Exports	Research and Development	Reduced Costs	Reliability	Affordability	Diversification
Facilitate the development of diverse financing options for widespread adoption of energy efficiency and renewable energy practices and technologies.	1.1 Use Iowa's Qualified Energy Conservation Bond Allocation	--	--	--	--	^	●	--	--	--	--	--	--
	1.2 Iowa Lease-Purchase Agreements	--	--	--	--	●	--	--	--	●	●	^	●
	1.3 Solar Tax Credit Independence	^	●	^	^	●	^	--	--	●	●	●	●
	1.4 On-Bill Financing	^	--	^	^	●	●	--	--	^	●	●	●
	1.5 Energy Investment Partnerships/ Green Banks	^	--	^	--	--	^	--	^	--	--	--	--
Foster innovation and increase the commercialization and expansion of energy-related businesses and technologies.	2.1 Energy Storage Advancement	--	--	--	--	^	^	●	^	^	^	^	●
	2.2 Iowa Innovation Acceleration Fund Modifications	--	--	--	--	^	^	--	^	--	--	--	--
	2.3 Increase Technical Assistance Funding for SBIR/STTR Outreach	--	--	--	--	^	^	--	^	--	--	--	--
	2.4 Technology Platform Based Economic Development	--	--	--	--	^	●	--	^	--	--	--	--
	2.5 Business Accelerators and Small Business Support Centers	--	--	--	--	^	^	--	^	--	--	--	--
Strengthen energy education and awareness throughout Iowa.	3.1 Energy Information Clearinghouse	--	--	--	--	^	●	--	^	--	--	--	--
Increase the local talent pool for energy-related careers while promoting employment and training opportunities in the energy sector.	4.1 Accelerate and Elevate Energy Sector Partnership Efforts	--	--	--	--	^	●	●	●	--	--	--	--
	4.2 Build Robust Career Pathways to High-Demand Occupational Needs	^	--	--	--	^	●	●	●	--	--	--	--

^ Positive direct impact
v Negative direct impact
-- Neutral impact
● Unknown impact

Objective 1: Facilitate the development of diverse financing options for widespread adoption of energy efficiency and renewable energy practices and technologies.

Strategy 1.1: Use Iowa's Qualified Energy Conservation Bond Allocation

Background

A Qualified Energy Conservation Bond (QECB) is subsidized by the U.S. Department of the Treasury enabling qualified state and local government issuers to borrow money at attractive rates to fund qualified energy efficiency and renewable energy projects. The Energy Improvement and Extension Act of 2008, enacted in October 2008, authorized the issuance of QECBs and, in 2009, Congress provided $3.2 billion in funding for bond issuance. These funds were allocated to state treasurers based on each state's proportional population.

Iowa received a $31.15 million allocation, a portion of which was made available to large municipalities with a population over 100,000 based on the municipality's percentage of total state population.[27] The Iowa Finance Authority (IFA) has the authority to administer the bonds.

Although many, if not all, of the allowable uses for the bonds align with energy priority areas for the state, to date Iowa has not issued any of the allocated QECB funds. However, approximately 31.4 percent of the total $3.2 billion in funds available have been issued by other state and local governments.[28] Most other states, including surrounding Midwest states, have used all or a percentage of the funds to support a variety of projects ranging from energy efficiency retrofits in buildings to fleet upgrades.[29]

While there is no date by which unused QECB allocations will expire, there is always a risk that Congress will cancel the program and repurpose any unused funds depending on federal priorities and the state of the federal budget.

Recommendations and Next Steps

IFA, in collaboration with IEDA, should seek assistance from the National Association of State Energy Officials around best practices and work to familiarize state and local government officials with QECBs and encourage the utilization of Iowa's bond allocation. In addition, IFA should request the opinion of qualified and experienced bond counsel to identify barriers that have prevented the state from using the funds and determine how to move forward.

Additional Information, Resources, and Case Studies

In 2010, the Kansas Development Finance Authority issued over $17 million in QECBs for efficiency upgrades at Kansas State University. The project utilized an outside energy services company to perform energy audits on the campus, make recommendations, and then perform upgrades which ranged from the installation of energy efficiency lighting to an overhaul of the University's chilled water plant. The bonds were issued with tenors ranging from two to eighteen years with gross interest rates from 1.8 percent to 6.2 percent.[30]

In addition, Saint Louis County, Missouri issued $10.4 million in QECBs to capitalize its Saint Louis County Sustainable and Verifiable Energy Savings residential energy upgrade loan program. Under this program, owner-occupied single family homes can borrow up to $15,000 for eligible energy improvements at a 3.5 percent interest rate with terms up to ten years.[31] The program successfully financed over 250 residential energy efficiency and solar energy projects in 2011.

Strategy 1.2: Iowa Lease-Purchase Agreements

Background

Leasing energy-using technologies is a common and cost-effective way for state and local governments to implement energy efficiency upgrades. Through these agreements, governments can borrow money to pay for the upfront costs of a project and then use the savings generated by the energy efficiency project to repay the loan.

One of the most common lease arrangements used by state and local governments is a tax-exempt lease-purchase agreement, also known as a municipal lease. These agreements presume that the government entity will retain full ownership of the assets after the term of the lease expires or after the equipment has been fully repaid. Although the financing terms of lease-purchase agreements may extend up to 20 years, they are typically shorter than 12 years and are limited to the expected useful life of the equipment.[32]

The Iowa Treasurer's Office has sole authority to enter into lease-purchase financing agreements on behalf of state agencies.[33] A financing agreement for energy conservation measures or energy management improvements is subject to the requirements of Iowa Code 7D.34 which include a determination that energy cost savings will allow the state to recover project costs within six years. The most recent energy-related lease-purchase financing was done in 2010 for the Department of Administrative Services in the amount of $2.1 million.

Recommendations and Next Steps

IEDA should investigate the reason why lease-purchase agreements are not being utilized for energy-related improvements and determine where the use of this tool would be beneficial for state agencies. This assessment should be done in partnership with the Iowa Treasurer's Office.

Additional Information, Resources, and Case Studies

In 2009, the state of Washington's Centralia School District pulled together several sources of funding to make $1.3 million in facilities improvements that reduced the school district's energy and water usage.[34] The district financed much of the project through the state's low-cost Local Option Capital Asset Lending program, which aggregates lease-purchase financing demand from public entities across the state. Because of this initial experience, Centralia School District continues to invest in projects that reduce their energy use. For example, in 2012, they initiated a $1.5 million project to complete more lighting replacements, water conservation upgrades, and to replace the heating and pumping systems at the district's pool using financing from the program to fund part of the work.

Strategy 1.3: Solar Tax Credit Independence

Background

Tax incentives have long been used to enhance the financial viability of renewable energy projects by lowering cost barriers for project developers. Several tax credits exist at the federal level to encourage the adoption of clean energy technologies, and Iowa has offered complementary state tax credits for those technologies that have high potential in the state.

In 2012, Iowa enacted the Solar Energy System Tax Credit administered by the Iowa Department of Revenue, which allows individuals to claim a state tax credit worth 60 percent of the Federal Investment Tax Credit (ITC) for solar energy technologies[35] and corporations to claim a state tax credit worth 50 percent of the Federal ITC.[36]

Over the first four years of the Solar Energy System Tax Credit existence, over $11 million were issued for 1,821 different solar energy projects in Iowa, including installations in 92 different counties.[37] Awards made to date total over $85 million in solar energy system investments by Iowans and have driven growth of this industry.

A challenge with federal tax credits is the uncertainty associated with their timeframe and extensions which require congressional action. Since the federal solar tax credits were created in 2005 there have been extensions passed in 2006, 2008, and 2015. The last of these extensions stretched the Federal ITC for solar energy through 2021, thereby creating some level of certainty in the marketplace, however the extension also established a gradual reduction of the amount of the credit each year.[38]

Because Iowa's tax credits for solar technologies are tied to the federal credits, they experience the same pattern of extensions and corresponding uncertainty. Linking state tax credits to the federal ones is unique to Iowa and Vermont. Experience has proven that when these credits are close to expiring, the marketplace reacts negatively and, as a result, other states have chosen to control tax incentives independently of what occurs at the federal level.[39]

Recommendations and Next Steps

Iowa should modify the state's existing Solar Energy System Tax Credit so that it becomes independent of the federal tax credits, thereby providing more certainty regarding the eligibility timeframe and criteria. This action would allow the state the flexibility to establish and modify tax credit incentives in a way that is appropriate for Iowa's solar potential, market demand, and industry conditions.

Additional Information, Resources, and Case Studies

According to the Database of State Incentives for Renewables and Efficiency, as of September 2016, a total of 21 states have at least one corporate tax credit for renewable energy technologies and 16 states have at least one tax credit for individuals.

State tax investment credits typically range from 10-35 percent of installed cost for both non-residential and residential solar technologies. To help spread the benefit further, states establish a cap for the maximum amount of money an individual can receive, which typically ranges from $1,000-$10,000 for individuals. States usually establish annual budgets ranging from $1 million to $3 million and tax credits are awarded on a first-come, first served-basis until all the money is allocated. To provide a level of certainty to the market, these incentives are typically made available for periods of three to five years at a time.

Strategy 1.4: On-Bill Financing

Background

Energy efficiency retrofits in our built environment can result in significant monetary and energy savings for both building owners and building occupants. However, the high upfront costs associated with some energy efficiency improvements continue to be a barrier to implementation.

On-bill financing can help address this barrier by providing convenient access to funding through a customer's utility bill. Utilities in at least 23 states have implemented, or are about to implement, on-bill financing programs. Additionally, many states have policies to support adoption, or have acted to explore the feasibility of these programs.[40] Although utilities typically have offered on-bill financing to facilitate energy efficiency improvements, this approach can also be used help finance the installation of solar arrays or other on-site renewable energy technologies.

Establishing on-bill financing programs can yield many positive impacts to the state's energy system. For instance, by facilitating financing of energy efficiency upgrades and removing initial barriers to project implementation, end-users can move forward with projects that would otherwise not be implemented. This can be particularly beneficial for programs that focus on rural and underserved customers. Consumer savings generated from energy efficiency projects often result in a surplus above the amount of on-bill loan repayments. This can also lead to positive impacts such as avoided costs for both electric consumers and utilities and an increased penetration rate of energy efficiency and renewables technologies onto the electric grid. On-bill financing also has the potential to lead to increased jobs for companies performing energy efficiency upgrades.

The risk of default on loans made through on-bill financing programs is relatively low, thus mitigating any concerns about widespread negative economic impacts to utilities because of consumer behavior. Challenges can exist, however, in the upfront implementation of these programs.

Recommendations and Next Steps

Entities such as the Iowa Office of Consumer Advocate (OCA), should encourage all Iowa utilities, both rate-regulated and non-regulated, to explore the interest and feasibility of establishing on-bill financing programs in their service areas. Iowa Code section 476.6 currently gives the IUB the authority to require regulated utilities to offer financing for cost-effective energy efficiency improvements. However, there is no legislation establishing a framework for utilities to follow in developing consistent on-bill financing programs.

Additional Information, Resources, and Case Studies

In Iowa, some utilities have implemented on-bill financing pilot programs or have taken steps to investigate their ability to offer customers on-bill financing solutions. For example, the municipal utility of Bloomfield is funding a pilot program to help homeowners pay for energy efficiency upgrades.[41] In addition, the Cedar Falls and Woodbine utilities provide some upfront financing to their customers, and Black Hills Energy offers on-bill financing for high-efficiency home heating equipment, such as boilers and furnaces, for residential, gas utility customers.[42]

To ensure that low-and-moderate income customers can access these programs, utilities can consider using bill payment history, in addition to more standard measures of credit, to qualify customers.

Strategy 1.5: Energy Investment Partnerships/Green Banks

Background

Iowans have benefited from federal government programs that provide grants and tax incentives in support of energy efficiency and renewable energy, as well as from state appropriations that support additional tax credits, subsidies, and loan programs. However, Iowa has not yet developed long-term mechanisms to finance clean energy projects in a way that does not depend significantly on government budgets.

Green Banks, also referred to as Energy Investment Partnerships, are a way for the state to leverage public and private investment to provide another option to state-only funding . Green Banks are public-private partnerships that are established to make available low-cost financing for different types of clean energy projects. Rather than relying solely on grants and public funds, Green Banks are capitalized by leveraging private dollars against limited public funds. The purpose of a Green Bank is to offer different financing instruments such as loans, leases, and credit enhancements to project developers for eligible, commercially viable technologies. Many Green Banks are also structured to offer technical assistance to provide education and information on technologies and options for adoption.

Through Green Banks public dollars can go farther. Because public dollars are lent and repaid, the same public dollar can be recycled and used to draw in more private dollars again in the future.[44]

A Green Bank could be an engine for economic growth and job creation in Iowa's energy industry, and could remove barriers to adoption of certain technologies. The types of economic benefits of a Green Bank structure are expected to be similar to those observed from other best practice models that promote clean energy technology financing.

Recommendations and Next Steps

Interested stakeholders should convene meeting to discuss the potential opportunities associated with establishing an Iowa Green Bank. The meetings could include individuals from the public and private sector with policy, financial, and technological experience surrounding investments in clean energy.

While no legislative action is needed to convene workshops, if the state decides to move forward with the establishment of a Green Bank, authorization would be needed from the legislature to form the Green Bank and to allow it to raise private funds, issue special obligations, and utilize financial tools to finance the deployment of clean energy technologies.

Additional Information, Resources, and Case Studies

Connecticut was the first state in the country to create a Green Bank in 2011, and is the standard for Green Bank establishment. Connecticut's Green Bank seeded a $5 million solar loan fund in 2013[45] and four years later, the Green Bank facilitated $365 million in total clean energy investment.

Programs across the country are proving how Green Banks can leverage public dollars to increase clean energy investments. Currently, the following states have established Green Banks either at the state, county, or city level: Connecticut, New York, Florida, New Jersey, Ohio, Oregon, Hawaii, California, Maryland, Rhode Island.[46]

Through issuing bonds, authorities in Connecticut and New York have sold clean energy loan portfolios on the secondary market. Florida's nonprofit Solar and Energy Loan Fund has leveraged private dollars into clean energy loans for low and moderate income individuals. Other states have provided credit enhancements to private lenders, who in turn have financed clean energy projects directly.[47]

Objective 2: Foster innovation and increase the commercialization and expansion of energy-related businesses and technologies.

Strategy 2.1: Energy Storage Advancement

Background

Energy storage has long been utilized to stockpile energy in the form of fuel for later use. Technology is well advanced in the fields of gas and liquid fuel storage, for example pumped hydroelectric storage, thermal storage, and compressed air technologies are fully commercialized. Other types of energy storage, primarily focused on the storage of electricity, such as superconducting magnetic energy storage, flywheels, capacitors, and batteries are still maturing in terms of their technology as well as their functions. In recent years, energy storage has particularly emerged as an integral component to a resilient and efficient electric grid.

As Iowa's electric system evolves, there is a greater need for energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization functions that are most effectively provided by electric energy storage. Establishing a robust network of energy storage infrastructure could complement Iowa's existing clean energy generation resources, allowing for effective storage of surplus energy generated for use in meeting peak consumption and smoothing load burdens on the existing grid. These technologies are especially important for helping to store excess generation from Iowa's numerous wind generation resources which typically operate best in daylight hours and are more inactive at night. Similarly, effective energy storage solutions can help smooth out peak consumption periods and aid utilities in managing demand load during key times at both local and grid-wide scales. These technologies thus serve as a key complement to renewables and distributed generation solutions by helping to increase reliability and power quality.

In addition to the potential benefits provided to Iowa's electric grid, construction and operation of energy storage facilities would directly provide local jobs, with the potential to provide additional jobs and economic output for manufacturing of the components required to assemble the system if they are also sourced locally. Deployment of energy storage also has the potential to lower utility rates for consumers and lower costs to utilities by lessening the need for utilities to ensure reliability through purchasing costlier short-term capacity from other sources.

Many energy storage technologies are not yet scaled to grid-wide deployment or require specific environmental conditions, as evidenced by past efforts to identify compatible geological sites for a compressed air storage facility in Iowa. In addition, the prohibitive upfront costs of current technologies become a limiting factor for full-scale deployment and even some pilot projects. Ultimately, the application of a specific storage technology will depend on the scale of the project, the geography of an area, costs associated with implementation, and how fast technology advances. For these reasons, investing in research and commercialization of storage technologies will be required to benefit Iowa's electrical system in the near term.

Due to the research capacity at major innovation centers located in Iowa, primarily through Ames National Laboratory, the state is positioned to become a leader in storage technology research and development. The Ames Lab Critical Materials Institute is a U.S. Department of Energy (DOE)-designated Energy Innovation Hub that is working to find viable and ideally domestically-produced alternatives for rare earth materials used in energy storage applications. In just two years, the Critical Materials Institute has generated 35 invention disclosures and submitted ten patent applications. Energy storage-related research at Iowa State University is also an emerging area of capability, with a focus on grid storage and bioconversion technologies and several faculty members have been added in recent years to build out research capacity. More information on Iowa's research and development core competencies and opportunities is available in **Appendix G**.

Recommendations and Next Steps

The state of Iowa should coordinate resources to advance the research and development of energy storage technologies. The IEDA should champion this strategy along with academic, utility, private sector, and government partners. In addition, coordination should occur through a series of meetings with key stakeholders, the potential development of a plan of action that identifies common priorities and focusing on the use of pilot projects to conduct the research. Some examples of pilot projects that can be implemented include the use of energy storage for substations in rural areas, applications of electric vehicles (EVs) to serve as decentralized energy storage sites, or improving technological advances in mechanical equipment such as water heaters.

Iowa has a history of supporting the important role of pilot projects in conducting field-tested research for advancing energy technologies. Maintaining the climate of acceptance and openness for actively piloting new approaches will be critical to ensuring ongoing innovation activity can occur at multiple scales, with local electric co-ops conducting small pilot projects highly tailored to local needs and larger utilities submitting pilot projects for regulatory approval. Regulators are currently very open to pilots and understand they play a critical role in the integration of new research applications into the existing energy framework. Coordination efforts should seek to identify a set of guidelines and best practices for pilot project models that can streamline regulatory processes and better link rural energy storage projects with larger industry or utility projects.

This strategy focuses on advancing energy storage technologies through an emphasis on collaborative and coordinated research and development. Advancing energy storage will be particularly critical in furthering permitting the full implementation of other strategies included within this plan. For example, advances in energy storage may enhance the efficiency of Iowa's existing investment in renewables and intermittent power generation systems, and create additional applications of EVs.

Additional Information, Resources, and Case Studies

In 2010, the state of New York established the New York Battery and Energy Storage Technology[48] Consortium to position the state as a global leader in energy storage technology, including applications in transportation, grid storage, and power electronics. The membership of the consortium is diverse and includes manufacturers, academic institutions, utilities, technology and materials developers, startups, government entities, engineering firms, systems integrators, and end-users. The organization serves as an expert resource to energy storage-related companies by providing access to financing, research capabilities, potential partners, technology developers, manufacturers, and other private sector and government resources.

In 2008, a pilot study was successfully conducted by the University of Delaware in partnership with industry by using EVs to demonstrate a technology known as vehicle-to-grid.[49] This is based on the use of batteries to not only provide energy for the vehicle, but to serve as a new energy storage resource for the electricity grid.

In addition, the DOE established the Joint Center for Energy Storage Research, an Energy Innovation Hub with public and private components. This public-private research partnership integrates government, academic, and industrial researchers from many disciplines to overcome critical scientific and technical barriers and create breakthrough energy storage technology. The Joint Center is led by the DOE's Argonne National Laboratory with partners including national leaders in science and engineering from academia, industry, and national laboratories.[50]

Strategy 2.2: Iowa Innovation Acceleration Fund Modifications

Background

The Iowa Innovation Acceleration Fund, administered by IEDA, promotes the formation and growth of businesses that engage in the transfer of technology into competitive, profitable companies that create high paying jobs.[51] The fund provides financing to eligible businesses through two program components that correspond to different stages of growth for investment-grade, high-growth enterprises.

The IEDA has established a series of North American Industry Classification System (NAICS) codes that determine the industries that are eligible to receive support through the fund. However, businesses operating in the energy field are not currently included and therefore cannot take advantage of the fund.

Recommendations and Next Steps

The IEDA, working with the Iowa Innovation Council, should modify the eligibility criteria of the Iowa Innovation Acceleration Fund to include NAICS codes that support energy work.[ii]

Additional Information, Resources, and Case Studies

The National Incubator Initiative for Clean Energy enables U.S. companies with new clean energy technologies and business models to enter the marketplace or reach commercial readiness faster than before. The initiative has established a national network of more than 19 different incubators and supporting organizations. Known as the Incubatenergy Network, its members are working together to share best practices and build connections to support entrepreneurs that are driving innovation in clean energy sectors across the nation.

The NextEnergy Center in Detroit, Michigan and its partner, the Clean Energy Trust in Chicago, Illinois, have received federal support to establish a program that allows startups and entrepreneurs access to a robust set of testing and demonstration facilities in both Michigan and Illinois.[52] These two innovation centers will support the development of new, commercially viable companies and industry tech-teaming partnerships through a newly established Energy and Transportation program that encourages companies to engage directly with potential customers.

[ii]Refer to Appendix C: Iowa's Energy Profile: Energy Supply and Demand and Sector Employment Analysis – Table 1 for a list of NAICS Codes included in the definition of Energy Sector.

Strategy 2.3: Increase Technical Assistance Funding for SBIR/STTR Outreach

Background

The Small Business Innovation Research (SBIR) program is a highly competitive federal program offered through the Small Business Administration. The SBIR program's mission is to support scientific excellence and technological innovation through the investment of research funds applied to critical areas to strengthen the national economy.[53]

The Small Business Technology Transfer (STTR) is another federal program that provides funding opportunities around innovation research and development.[54] Central to the program is the expansion of public/private sector partnerships to include joint venture opportunities for small businesses and nonprofit research institutions. The most important role of the STTR is to bridge the gap between performance of basic science and commercialization of any resulting technological innovations.

The Iowa Innovation Corporation, with delegated authority from IEDA, manages both the SBIR and STTR programs at the state level. In Iowa, these programs are specifically designed to increase the rate of successful grant applications from innovative businesses and research institutions that are seeking federal grants through the SBIR/STTR programs. Historically, Iowa's research businesses have shown a low level of performance versus other major Midwest states in terms of securing SBIR/STTR federal grants. In fact, for the 16-year period covering 2000-2015, only South Dakota received less in SBIR/STTR funding than Iowa.

To increase the success rate of Iowa's businesses and research institutions applying for federal funds, the Iowa Innovation Corporation provides proposal idea review assistance and third-party proposal development assistance. In addition, the Corporation provides financial assistance up to a $25,000 matching commitment on Phase I awards that establish the technical merit, feasibility, and commercial potential of the proposed projects.

Iowa's SBIR and STTR programs are a critical component in early stage technology-based economic development across many STEM industries. The programs provide resources to increase the probability of federal funded awards for Iowa's research institutions and provide a significant incentive for early-stage companies to bring their innovative intellectual property to Iowa. Ultimately, the programs have the potential to result in increased employment and innovative development at emerging companies.

Recommendations and Next Steps

In July 2016, changes in the Iowa Code became effective allowing changes in the technical assistance and matching cap for the SBIR/STTR programs. IEDA, in partnership with the Iowa Innovation Corporation, should continue making the necessary administrative rule and procedure updates to increase the current $25,000 technical assistance and matching commitment cap to further support innovative small businesses in Iowa seeking federal support. In addition, the Iowa Innovation Corporation should identify additional opportunities to support Iowa-based research institutions seeking funding through the SBIR/STTR programs.

Strategy 2.4: Technology Platform Based Economic Development

Background

Investing in the research, development, and commercialization of new technologies will keep Iowa at the forefront of the new energy economy and to develop new markets and job opportunities throughout the next decade.

Iowa has long shown a commitment to new technologies by investing in research and development activities. For example, in 1990 the General Assembly instituted the Iowa Energy Center to conduct and sponsor research on energy efficiency and conservation that improves the environmental, social and economic well-being of Iowans; minimizes the environmental impact of existing energy production and consumption; and reduces the need to add new power plants.[55] Last year, the Iowa Energy Center funded over $2.3 million in external awards, which contributed to the issuance of a couple of patents, and several journal publications.[56] In addition, as mentioned previously, Iowa hosts one of the DOE's 13 national laboratories: the Ames Laboratory. The Ames Lab is a DOE Energy Innovation Hub funded at up to $120 million over five years,[57] and is particularly important to the Iowa Energy Plan because its research focuses on materials used in modern clean energy technologies.

Iowa's research and development efforts in the energy space are recognized at the national level. Between 2011 and 2016, Iowa institutions recorded 468 research publications in the "Energy and Fuels" category, representing 1.4 percent of all publications nationally in this field. This is higher than would be expected given that total research and development spending in Iowa is circa 0.8 percent of national spending. An additional 1,069 publications have been identified under other disciplines but are energy-related.[58]

It is worth noting that in 2010 the National Science Foundation awarded a $20 million grant to Iowa to build research capacity in the renewable energy and energy efficiency field. Called the Experimental Program to Stimulate Competitive Research project, this initiative ran from 2011 through 2016 and focused on four main platforms: bioenergy, wind energy, energy utilization, and energy policy. The project was a joint effort by Iowa's Regent Universities: the University of Iowa, the University of Northern Iowa, and Iowa State University.[59]

While many advances are being made to promote the development and commercialization of new technologies, a challenge can be the lack of a coordinated approach that allows the public and private sectors to share intellectual capital, and work towards a common goal. In addition, resources are needed to help bridge the gap between pure research and commercialization of these technologies.

Recommendations and Next Steps

Iowa should establish an implementation group focused on identifying and prioritizing collaboration between research entities, developing solutions that connect investors and developers of new technologies, and developing policies and programs that advance research discoveries towards commercialization. The implementation group could be coordinated by IEDA with individuals from public and private sector participating, including representatives from Regent Universities and the Iowa Energy Center.

Implementation group activities should be targeted to address the research and development platforms that are most promising for Iowa and have the greatest potential for commercialization, as identified in **Appendix G** and discussed in the pillars of the Iowa Energy Plan:

- Renewable electricity generation and distribution
- Biomass conversion
- Grid management and resilience
- Energy efficiency
- Energy materials and systems manufacturing

Strategy 2.5: Business Accelerators and Small Business Support Centers

Background

Iowa recognizes that its small businesses are key to lasting economic development and has historically worked diligently to support diverse small business growth and entrepreneurship across the state. One example of an existing program that supports small businesses is the Targeted Small Business program, which is designed to help women, individuals with minority status, service-connected disabled veterans, and individuals with disabilities overcome some of the hurdles to start or grow a small business in Iowa. Businesses that qualify for this program have access to start-up loans, certification, and procurement opportunities.

Across the state, other business accelerators exist to support Iowa's entrepreneurial community. The Iowa Startup Alliance, Iowa Startup Accelerator, Research Park at Iowa State University, John Pappajohn Entrepreneurial Centers, and the BioVentures Center at the University of Iowa are only a few of the already-established accelerators and resources available.

There are many opportunities to continue to support Iowa's small businesses and entrepreneurs through coordination between these existing business accelerators. Adding information and support specifically around clean energy opportunities would greatly benefit this industry. Some ways that Iowa can continue to support clean energy businesses include working with business accelerators, identifying credit and lending opportunities, and developing certifications and training programs that are specific to energy-related businesses and technologies.

Recommendations and Next Steps

To assist small businesses and startups involved in energy-related fields, IEDA, working through the Iowa Innovation Corporation's framework, should foster coordination between existing educational institutions and business accelerators to share information and resources specific to energy. Further, Iowa should increase outreach regarding available programs and incentives that support small business and entrepreneurial networks in adopting energy efficient practices that save energy and improve bottom lines.

Additional Information, Resources, and Case Studies

The U.S. Small Business Administration offers several resources, including grants and financing, that can help Iowa's small businesses adopt energy efficient practices.

The Energy Foundry is a non-profit that helps fund and incubate Illinois-based companies that operate in the energy space. The Energy Foundry offers venture capital and includes tools and relationships for venture firms to grow their companies. The Energy Foundry was initially funded through the state's two large utilities, and then it recruited additional venture capital to support additional projects.

The Austin Technology Incubator is one of the longest-established energy and clean technology accelerators in the United States.

The USDA Rural Energy for America Program is an important resource to improve energy performance for Iowa small businesses and add renewable energy capacity.

Photo Credit: Bioeconomy Institute, Iowa State University

Objective 3: Strengthen energy education and awareness throughout Iowa.

Strategy 3.1: Energy Information Clearinghouse

Background

Throughout the Iowa Energy Plan development process, the need for accurate, current, and comprehensive information about energy technologies, programs, and opportunities was identified as a common theme by numerous stakeholders. Organized information is key to improving uptake in clean energy opportunities available to the public such as incentives for energy efficiency upgrades, and distributed generation technologies. It is also critical to provide a representation of Iowa's variety of energy-related workshops, training programs, professional certificates and licenses, and educational opportunities for individuals.

Currently, consumers face several barriers when trying to obtain information about energy resources and technologies in Iowa. First, there are multiple sources of information that consumers need to sort through to draw conclusions and make decisions. Second, many of these sources may be outdated or even biased in their recommendations. Third, some information is highly technical and therefore difficult for the public to understand. And finally, individuals are oftentimes constrained in their availability of time and resources to perform an extensive search for information.

Recommendations and Next Steps

To assist in providing a reliable and centralized source of energy information to the public, IEDA should establish an energy information clearinghouse which would serve as a single resource for energy information, programs, training opportunities, education, and resources. In particular, the clearinghouse should include an Energy Careers Training and Education Directory that will allow employers to connect with programs that provide training in the energy sector, and individuals to become aware of resources available to them. This directory should directly tie to the Future Ready Iowa initiative, which aims to build Iowa's talent pipeline for the careers of today and tomorrow.

IEDA will develop and maintain a dedicated website with accurate and up to date information. Critical to the development of the clearinghouse will be establishing a continuous cycle of user feedback and outcomes tracking to further clarify the economic value proposition of developing the repository.

Additional Information, Resources, and Case Studies

Some examples of similar directories of energy-related information include:

- The State of Arizona Bureau of Land Management houses a web-based clearing house for renewable energy resources.
- The Colorado Energy Office maintains a comprehensive website of state programs and initiatives.
- The New England Clean Energy Careers Training and Education Directory is an online resource that helps connect energy efficiency and renewable energy industry professionals, job seekers, and students with education and training opportunities throughout the region.
- The Heating, Ventilation and Air Conditioning (HVAC) System Adjustment and Verified Efficiency program is a utility led initiative that drives HVAC installers to receive additional training to improve equipment sizing and installation. Utilities incentivize the training by requiring it for HVAC contractors to receive higher rebate amounts. The HVAC SAVE website also is a resource for homeowners to find HVAC SAVE-certified installers.

Objective 4: Increase the local talent pool for energy-related careers while promoting employment and training opportunities in the energy sector.

Strategy 4.1: Accelerate and Elevate Energy Sector Partnership Efforts

Background

State Energy Workforce Consortia are established in 35 states and represent a collaboration of the energy industry, education, and workforce system to focus upon the needs and development of a pipeline of workers for the energy industry. These organizations are supported at the national level by the Center for Energy Workforce Development, a non-profit consortium of electric, natural gas, and nuclear utilities and their associations. The Center was formed to help utilities develop solutions in anticipation of a workforce shortage for the utility industry.

Iowa recognizes the importance of bringing together energy companies, education partners, workforce systems, and relevant governmental agencies to implement actions that address the immediate and future workforce needs of Iowa's energy economy. During the fall of 2016, a diverse mix of stakeholders met to establish an Iowa Energy Workforce Consortium with the intent of developing a strategic workforce plan for Iowa's energy industry.

Recommendations and Next Steps

The state of Iowa should continue to support efforts such as the establishment of the Iowa Energy Workforce Consortium as an example of energy sector partnerships. Iowa should continue to identify high-demand energy sector occupational needs, and determine ways to clearly communicate those needs to education and training providers. This should be done by leveraging established state partnerships and programs such as Future Ready Iowa, the Iowa Department of Education's (DE) Sector Partnership Advisory Council, and the DE's Pathways for Academic Career and Employment program.

Strategy 4.2: Build Robust Career Pathways to High-Demand Occupational Needs

Background

Earlier this year, DOE released the first U.S. Energy and Employment Report, an annual analysis of how changes in America's energy profile are affecting national employment in multiple energy sectors.[60] The report found several energy industries with projected increases in new jobs. For example, the energy efficiency sector predicted hiring rates of 14 percent in 2016, or almost 260,000 new hires, while solar energy firms predicted 15 percent job growth over the next year. Yet, even as there seems to be opportunity for job growth in many energy sectors, over 70 percent of all employers surveyed found it "difficult or very difficult" to hire new employees with skills needed for the position.

Iowa is hard at work at closing the skill gap and has implemented numerous statewide initiatives to build robust career pathways to high-demand occupational needs. Some of these initiatives include: Future Ready Iowa, Skilled Iowa, Home Base Iowa, the Governor's STEM Advisory Council,

and the Iowa Apprenticeship and Job Training Act which was signed into law in May 2014 to help young workers to receive training without having to take on student debt.[61] In addition, Iowa has launched several targeted workforce development and education initiatives ranging from growing the number of apprenticeships available to creating the most extensive teacher-leadership system in the nation.[62]

Iowa's 15 community colleges have been particularly critical in ensuring the preparation of technical workers to meet future industry needs. From an occupational standpoint, seven of the top ten programs offered by community colleges are mechanical, engineering or production-related in nature, and therefore assist in building a pipeline of skilled workers for the energy industry.[63] Some community colleges also offer specialized programs that are specifically targeted to the clean energy industry. For example, Iowa Lakes Community College offers a Wind Energy and Turbine Technology program, Iowa Western Community College offers an Associate of Applied Science degree in Sustainable Energy, Northeast Iowa Community College has a Wind Turbine Repair Technician program, Kirkwood Community College offers an Energy Production and Distribution Technologies program, Indian Hills Community College has an Electrical and Renewable Energy Technology program, to name a few.

To keep building a pipeline of skilled workers, it is important to provide opportunities for high school-level students to enroll in college coursework. Iowa state has succeeded at this and in fact is the national leader in concurrent enrollment, allowing high school students to jump start their professional education, while saving some money and reducing student debt.[64] A report released by the DE shows that the number of jointly enrolled high school students rose to a record high of 42,996 in fiscal year 2014. In other words, approximately one in four community college students is also a high school student.[65]

Continued support for energy-related training and apprenticeship programs can lead to positive impacts for the state's energy system indirectly as higher skilled workers enter Iowa's energy labor force over time. Systematic collaboration efforts across industry and education providers is necessary to improve early exposure to energy-related career skills, and could result in increases in employment since energy firms will be better able to find qualified candidates with applied knowledge. Other business attraction, innovation, or skilled labor export impacts can also occur as a result of a more highly skilled workforce.

Recommendations and Next Steps

The IEDA, DE, and Iowa Workforce Development, should continue to support Iowa's existing training and trade apprenticeship programs and should work to identify additional opportunities for building career pathways in the energy sector. Continued collaboration amongst labor, energy employers, educational institutions, and state agency partners can ensure that energy-related workforce needs are identified and that skilled and trained professionals are being prepared to meet Iowa's future energy labor force demands.

Additional Information, Resources, and Case Studies

Get into Energy is a national initiative of the Center for Energy Workforce Development to build awareness among students, parents, teachers, guidance counselors and others about the career opportunities available in the energy industry.

PG&E's PowerPathway™ is an industry-led initiative that aims to develop a pipeline of skilled workers in California. The initiative led to the development of a 12-week Bridge to Apprentice/Utility Worker program which prepares workers for a career as a Utility Worker or Line Worker. The course includes technical skills, soft skills, and physical conditioning.

The Michigan Energy Workforce Development Consortium includes more than 30 representatives from industry, workforce, labor, education, state government, and veterans' organizations that works to embed energy curriculum into their class offerings, so students can earn industry-recognized credentials that are transferable among the colleges.

The North America's Building Trades Unions and the American Council for an Energy-Efficient Economy have teamed up to create an apprenticeship program centered around investments in renewable energy. As the economy moves toward energy efficiency, both parties see opportunity in the energy conservation policies that are starting to take root in the manufacturing, industrial, and power sectors.

Energy Efficiency and Conservation

Energy Efficiency and Conservation

As energy demand in Iowa and across the country continues to rise, energy efficiency and conservation strategies will play an important role in meeting demand. The Energy Efficiency and Conservation pillar focuses on objectives and strategies that encourage efficient energy use.

Energy efficiency is often referred to as a "least cost resource," meaning that it is the single most cost-effective tools within an energy portfolio. On the production-side, increased energy efficiency can result in reduced costs associated with the generation, transmission, and distribution of electricity or natural gas. On the consumer-side, energy efficiency improvements have the potential to generate customer savings that can be reinvested to further fund energy system upgrades. This in turn leads to further savings. A major result of energy efficiency programs is that they generate a sustained cycle of circumvented costs, and as such lower energy prices. These types of projects also tend to result in reinvestment of local dollars in local jobs and industries.

For decades, promoting energy efficiency has been a focus in Iowa. One example of early leadership was in 1990 when the Iowa General Assembly created the Iowa Energy Center. Among other activities, the Iowa Energy Center conducts and sponsors energy efficiency research. Leading by example, the Iowa Utility Industry, in partnership with IEDA and the Iowa Energy Center, offer programs like the Iowa B3 Public Buildings Benchmarking Program[66] that encourages Iowa's biggest energy users, its public buildings, to focus on becoming more energy efficient while saving money and energy in the process. To date, 128 Iowa organizations have benchmarked 2,324 buildings using the B3 tool. These organizations have identified over $22 million in potential energy savings. It is efforts and programs like this, along with a state focus to be efficient, that gives Iowa a #15 ranking on the latest 2016 State Energy Efficiency Scorecard released by the American Council for an Energy-Efficient Economy (ACEEE).

There is a growing emphasis within the state and the energy efficiency programs to further expand programing to underserved areas, including some rural areas and for vulnerable populations such as low-income residents and the elderly. Energy efficiency initiatives that aid underserved areas and vulnerable populations can help reduce energy losses due to lack of appropriate weatherization, address safety concerns during Iowa's cold winter months, and overall, increase the resiliency of communities.

Increasing the deployment of energy efficiency activities not only makes economic sense, but also has strong support from Iowans (97 percent according to a 2014 poll).[67] Thus, strategies within this pillar are intended to build on Iowa's leadership, and to maximize economic benefits for the state all the while promoting environmental stewardship of Iowa's natural resources.

Focus Areas

- Supporting Rural and Underserved Areas and Populations

Supporting Rural and Underserved Areas and Populations

One focus area that emerged during the planning process was the need for Iowa to better support small cities in rural and underserved areas and vulnerable populations through opportunities for greater access to energy efficiency expertise, training, and programs to better realize the benefits of energy efficiency.

Iowa is served by a combination of investor-owned utilities, electric cooperatives, and municipal utilities. The size and type of energy efficiency programs offered by each varies throughout the state from large, robust programs to simple programs to no programs. A challenge not unique to Iowa is the need for dedicated energy professionals with energy expertise to identify and implement energy efficiency programs within a utility or to help communities take advantage of existing programs outside a utility – refer to **Section: The Path Forward; Economic Development and Energy Careers** to see energy career recommendations. This challenge is most often seen in communities where there may be limited paid staff to assist with programs in the community or at the utility. The situation is intensified because it is difficult to implement programs with low population densities that lack the financial resources to implement energy efficiency programs where building stock is often older and less efficient. While the affected are often rural small cities, a similar situation may exist in more urban communities with larger vulnerable populations and/or a disproportionate number of older less efficient buildings that endure a higher burden from increased energy costs. Often building owners or residents do not have enough capital or expertise to make energy efficiency improvements. Thus, the economic benefit and cost savings of decreased energy demand can be more significant to these areas.

Electric cooperatives and municipal utilities work with their generation and transmission cooperatives to design and offer programs that meet their customers' needs. However, many smaller municipalities and unincorporated communities do not have the financial or technical resources to focus on energy efficiency and conservation program development and implementation. Iowa's rural populations served by these entities are often dispersed, making program delivery extremely difficult. Some areas might not have access to the same energy efficiency materials or products available in more dense areas. Additionally, some programs that work in an urban area may not work in a rural

area because, for example, customers use rural areas often use propane for heating rather than natural gas or electricity most used in urban communities.

During the energy planning process, forum participants noted the need for expanded energy program support for rural and underserved communities. There is an opportunity to address this concern by building upon successes from the recent IEDA-led, federally funded, City Energy Management Program (CEMP) pilot project. CEMP allowed IEDA to make energy professionals available to work with Iowa communities in identifying and implementing energy efficiency projects in city owned buildings, exterior lighting, and water/wastewater facilities. The 19 pilot communities received one-on-one energy technical assistance in determining energy priorities, reviewing building operation and maintenance procedures, and ultimately developing an action plan for implementing energy efficiency projects.[68] In all, 135 projects were completed during the twenty-month program, resulting in: more than 2,000,000 kilowatt hours saved annually; 38,000 therms natural gas saved annually; 1,560 metric ton reduction in greenhouse gases; and approximately $169,000 saved on city utility bills.

Pilot programs which further makes dedicated professionals available to provide on-site, energy technical assistance to rural and underserved communities in the state are an effective way to improve access to energy efficiency programs in rural and underserved areas in the state.

Photo Credit: City of Dubuque

Table 6. Energy Efficiency and Conservation - Strategy Impacts at a Glance

		Environmental and Public Health Impacts				Economic Impacts				Energy System Impacts			
Objective	**Strategy**	Air	Land	Water	Health	Jobs	Business Attraction	Energy and Technology Exports	Research and Development	Avoided Costs	Reliability	Affordability	Diversification
Increase the energy efficiency and decrease the operating costs of Iowa's existing and new buildings in all sectors.	1.1 Benchmark Industrial Utility Rates to Similar States	--	--	--	--	●	●	●	●	●	●	●	●
	1.2 Benchmark Industrial Sector Ratepayer Program Contributions	--	--	--	--	●	●	●	●	●	●	●	●
	1.3 Reinvest Public Building Energy Savings in Infrastructure	^	--	--	^	●	●	●	●	●	●	●	●
	1.4 Combined Heat and Power Opportunity Analysis	^	^	--	^	●	●	●	^	^	^	●	^
	1.5 Improve Building Energy Code Compliance	^	--	--	^	●	●	●	●	●	●	●	●
Encourage the expansion and diversification of energy resources, incentives, and programs.	2.1 Support Energy Efficiency Efforts in Underserved Areas	^	--	--	^	●	●	●	●	^	^	^	●
	2.2 Foster Collaboration between State Energy Office and Iowa Energy Center	--	--	--	--	^	●	^	^	●	●	●	^
	2.3 Low Income Housing Tax Credit	^	--	^	^	●	●	--	--	^	●	^	●
	2.4 Connect and Leverage Iowa's Energy Assistance Programs	^	--	--	^	●	●	--	--	^	●	^	●
	2.5 Heating Fuel Assistance	--	--	--	^	●	--	--	--	●	^	^	^
Lead by example in Iowa's government practices.	3.1 Public Building Benchmarking Program (B3) Expansion	^	--	--	^	●	●	--	●	●	●	●	●
	3.2 High Performance Leasing	^	--	^	^	●	●	●	●	^	●	^	--

^ Positive direct impact
v Negative direct impact
-- Neutral impact
● Unknown impact

Objective 1: Increase the energy efficiency and decrease the operating costs of Iowa's existing and new buildings in all sectors.

Strategy 1.1: Benchmark Industrial Utility Rates to Similar States

Background

Given that Iowa often competes with neighboring states to be the home of new and expanding businesses, it is critically important that the utility rates paid by Iowa businesses, especially those with energy-intensive operations, remain competitive. Comparative advantages on utility rates may be a persuasive tool to attract businesses to Iowa, especially as manufacturing industries become more reliant on energy as a fundamental cost driver of operations due to continued automation and less reliance on traditional sources of labor. Major technology companies cite low-cost energy and access to renewably sourced energy for decisions to locate in Iowa, indicating that low rates remain one of the reasons for Iowa's continued growth in science and technology industries.

Recommendations and Next Steps

The IEDA, working with appropriate stakeholders and IUB staff, should complete a benchmarking study on a biennial basis to compare the regional gas and electric utility rates and rate structures that apply to Iowa businesses in comparison to a select group of peer states. Because utility rates are often difficult to compare across states, IEDA may consider modeling a set of typical businesses and circumstances, and estimating the total energy cost that would apply to their operations in Iowa when compared to the benchmarking states. It will be important to factor the unique differences between states and their associated utility services.

For utility costs and rate structures, regular benchmarking of peer states, both in terms of energy usage as well as leadership in innovative energy affordability and renewables technologies, is a critical requirement for determining sound economic strategies and policies grounded in data-driven findings which would improve Iowa's competitiveness in regional markets.

Strategy 1.2: Benchmark Industrial Sector Ratepayer Program Contributions

Background

In 2008, Iowa enacted Senate Bill 2386, which required IUB to create electricity and natural gas efficiency standards that are applicable to all rate-regulated utilities. Utilities that are not rate-regulated were required to establish their own energy efficiency goals. Based on this requirement, utilities have developed energy efficiency programs that provide information and financial assistance to all customer classes. The cost of these programs is recovered by utilities through cost-recovery factors on each customer's bill.

In some states, energy-intensive and large manufacturing customers have expressed concerns that their contributions to energy programs are disproportionate when compared to other customer classes, meaning they pay a larger dollar amount than they might use. As an acknowledgment of the significant changes in how energy is produced and used, particularly by its industrial customers, as well as a response to their concern of disproportionate program costs, some states have chosen to include self-direct or opt-out options for industrial customers. Self-direct programs allow qualifying industrial customers to use the dollars that would otherwise be paid to a utility as part of the cost-recovery fee for energy efficiency investments at their own facilities. Under this approach industrial customers are still obligated to spend money and deliver energy savings, either on a project-by- project basis, or over a certain amount of time. In contrast, opt-out options permit large energy users to completely opt-out of these programs and stop their contributions. While the opt-out approach may resolve the concern on the end-user side, the impacts to energy efficiency programs can be significant and result in all other utility system customers having to pay more.[70]

In Iowa, similar apprehensions exist from large energy users and options for redesign of the program structure have been previously explored. While mechanisms for program modifications have been discussed in Iowa, there remains concern that energy program costs impact the competiveness of Iowa's largest energy users in comparison to neighboring states that have passed opt-out provisions or have lower overall program contribution costs. For example, if the playing field is not level from state to state or utility system to utility system, Iowa's largest customers may perceive that they are paying more, or indeed pay more for energy than they would elsewhere and therefore may consider relocating their operations. The loss of these customers and Iowa's inability to attract new, large customers would be detrimental to the local economy and economic development prospects.

With so much uncertainty surrounding the impact of ratepayer program contributions by industrial customers in Iowa to their business costs and Iowa's economic competitiveness, a benchmarking effort and corresponding analysis would allow for proper, future decision making to avoid energy leakage.[iii]

Recommendations and Next Steps

The IEDA, working in partnership with representatives of the state's industrial customers and other appropriate stakeholders, should investigate and benchmark the energy efficiency program contributions made by Iowa's large industrial users to similar utility customers in other Midwestern states. It will be important to factor the unique differences between states and their associated utility services. The comparative analysis would occur biannually, and would consider all elements of energy rates as well as anticipated rate increases, and would showcase best practices to ensure fairness in the treatment of different customer classes, while maintaining Iowa's economic competitiveness. If the benchmarking shows Iowa is at a completive disadvantage compared to other states, the state should evaluate options to improve competiveness in regional markets.

[iii]Leakage is the phenomenon whereby increased regulations intended to curb greenhouse gas (GHG) emissions result in increased energy rates on energy-intensive, trade-exposed (EITE) production processes that drive those EITE processes to jurisdictions with lower price and more tolerant GHG emission regimes resulting in a matched pair of harmful, unintended consequences: loss of jobs and economic growth potential in the regulated jurisdiction; and increased production in less regulated jurisdiction that results in higher overall global GHG emissions than would have been the case prior to increase in regulation. See: "Measuring Leakage Risk", Fowlie, Reguant and Ryan, May 2016 prepared for California Air Resource Board.

Strategy 1.3: Reinvest Public Building Energy Savings in Infrastructure

Background

State governments operate numerous facilities including office buildings, public schools, colleges, and universities– the energy costs of which can account for as much as 10 percent of a typical government's annual operating budget.[71] For this reason, energy conservation improvements in public facilities can lead to significant cost savings, while allowing government to lead by example and inspire additional projects within the private sector.

State and local government entities face several challenges when looking at options for financing energy efficiency and renewable energy projects at public buildings. Across the nation, government budgets tend to be limited and agencies must undergo a prioritization process to determine where to spend their budget, which oftentimes makes energy efficiency projects compete against other agency-critical missions. Another challenge that governments face is that due to their lack of tax liability they are ineligible to take advantage of existing tax credits. Similarly, federal grants that may be available for state or local public facility improvements are limited and intermittent in nature. Sometimes, when a specific public building retrofit project is financially viable, many state and local governments have difficulty in accessing the long-term, low-cost financing with which to fund projects or bring them to scale. Several stakeholders including state agencies and those that work with and for state agencies noted these similar concerns for Iowa.

In addition, even when state entities can secure funding to implement energy efficiency and renewable energy projects there can be several limitations that prevent them from reinvesting the energy savings achieved into additional energy conservation improvements. Specifically, since these types of projects translate to a reduction to energy costs, which are often classified as operational expenses, there can be a perception that the agency no longer needs the same level of expenditures and therefore, the next-cycle budget could be reduced. Having the ability to reinvest the dollars saved through energy conservation improvements into additional energy-saving projects would increase the benefits and provide benefits to taxpayers as well.

Recommendations and Next Steps

Interested state agencies and budgetary and legislative members should explore the feasibility of providing state governmental entities, including public schools, with the authority to reinvest dollars that are saved through the implementation of energy efficiency and renewable energy projects, into further clean energy improvements. This process would, in a sense, enable state entities to pay for the energy efficiency improvements and renewable energy projects through the savings that are generated.

While no legislative action is needed to convene the implementation group, if a recommendation of the implementation group included revising budgetary rules legislative action would be required.

Strategy 1.4: Combined Heat and Power Opportunity Analysis

Background

Combined heat and power (CHP) systems, also known as cogeneration, generate electricity and useful thermal energy in a single, integrated system. CHP is not a technology, but rather an approach to applying heat and power technologies. Through this approach, heat that is normally wasted in conventional power generation can be recovered as useful energy, thus avoiding the losses that would otherwise be incurred from separate generation of heat and power. While the conventional method of producing usable heat and power separately has a typical combined efficiency of 45 percent, CHP systems can operate at efficiency levels greater than 80 percent.

The diversity in fuel inputs sets CHP apart from other energy technologies. For example, some CHP systems in Iowa are powered by biogas generated through the processing of waste streams including animal manure or high strength industrial food processing wastes. Energy crops have also been demonstrated to be a viable fuel source for CHP systems. Currently, the DOE CHP database lists 34 sites in Iowa with CHP installations with a total installed capacity of over 500 MW.[iv] The food processing industry in Iowa accounts for the largest percentage of the total CHP installed capacity, followed by college and university campuses. In addition, several biogas systems operate at municipal wastewater treatment facilities or landfills though these are generally smaller in capacity.[72]

Increased deployment of CHP systems can lead to higher energy reliability by providing on-site generation that can operate at much higher efficiency levels than traditional systems. Increased usage of CHP systems can also help to diversify Iowa energy generation sources by incorporating the use of thermal energy into power consumption profiles. In addition, CHP technologies can result in avoided costs of generation for utilities and the associated energy losses incurred in the transmission and distribution of electricity. The cost-benefit tradeoff of current generation CHP technologies, however, can only be analyzed on a case-by-case basis due to the high levels of customization required for each installation.

Although the expansion of CHP systems has the potential to generate jobs and economic growth through construction and operation of facilities, the magnitude of these effects is not known in advance of implementation. One key issue affecting the value proposition of CHP systems is the cost of maintaining ongoing connections to the power grid and the way in which utilities treat systems financially as parts of an integrated energy system.

Recommendations and Next Steps

The IEDA should establish a collaboration platform between CHP stakeholders including the DOE Midwest CHP Technical Assistance Partnerships and Iowa's utilities to further explore the potential opportunities and barriers associated with CHP in Iowa. This effort should include

[iv]Note that the database is not current and some listed industrial CHP systems have been taken out of service in recent years.

an exploration of the resiliency value of CHP and current challenges associated with interconnection of these technologies to the grid and result in the identification of best practices and program models that would allow for expanded CHP development.

Additional Information, Resources, and Case Studies

The IEDA Combined Heat and Power Resource Guide provides detailed information on CHP systems as well as compiled information on available incentives and technical assistance resources.

As a distributed generation source, CHP can play a significant role in ensuring continuous power supply. CHP systems located on research university sites with critical power needs, such as the University of Iowa's Oakdale campus district energy system which was recently upgraded, provide examples of best practice operation in parallel with the electrical grid.

Strategy 1.5: Improve Building Energy Code Compliance

Background

Construction of buildings that includes and accounts for energy efficiency because inefficient new construction can lead to higher energy usage over a building's entire lifespan, a period often greater than 50 years. Lifecycle implications can include higher costs and increased use of resources if energy efficient materials are not included. Although a building can be retrofitted after construction to incorporate more energy efficient technologies, this approach is often more costly than the alternative of initially building a structure with energy efficiency in mind.[73]

Building energy codes save money for residential and commercial building owners and renters by establishing construction standards that result in greater levels of energy efficiency. These codes establish minimum energy efficiency and conservation requirements for a building's envelope (insulation, windows and air sealing), mechanical equipment, and lighting for new construction or major renovations. Model energy codes are updated every three years to incorporate continual improvements in building efficiency.[74]

Iowa has adopted an amended version of the International Energy Conservation Code (IECC), a model published by the International Code Council, for both residential and commercial construction.

The state energy code is reviewed on a three-year code cycle corresponding to publication of the IECC. The Iowa Building Advisory Council, a seven-member body appointed by the Governor, oversees the development of building energy codes in Iowa. All suggested code revisions are processed through the state administrative rule-making process involving publication, public comments, and public hearings. The current energy code for both residential and commercial buildings in Iowa is the IECC 2012 and the state is currently reviewing the 2015 version.[75]

Establishing and maintaining mechanisms to ensure energy code compliance is necessary to achieve greater energy savings, reduced costs, and higher building resale values.[76] In fact, to realize the full benefits associated with building energy codes it is important to ensure that compliance verification is carried through. While Iowa has been proactive in updating statewide building energy codes, the state, like most others, struggles with code compliance because the local jurisdictions often lack sufficient resources to support compliance activities, such as inspections and trainings, at the community or county level.

Recommendations and Next Steps

Building energy code compliance can be enhanced when a state agency, utility, or other entity actively supports local governments in their efforts to enforce established codes. DPS, should work with local jurisdictions, utilities and other energy stakeholders to identify sources for long-term monetary support and resources for ongoing energy code education and training of local inspectors.

Additional Information, Resources, and Case Studies

The DOE Building Energy Code Project has produced a collection of innovative materials and tools to help the building industry achieve, document, and verify compliance with energy codes. It has also developed methodologies and tools to help state and local jurisdictions measure and report energy code compliance, and provides technical assistance to help address compliance challenges.

Commonwealth Edison, Ameren Illinois Company, Nicor Gas, the Illinois Department of Commerce and Economic Opportunity, and North Shore Gas recently collaborated on a project aimed at establishing a widespread code compliance program in Illinois. The effort, entitled CANDI after the names of participating utilities and agencies, credits utilities with energy savings for code compliance activities as part of their energy efficiency programs. A consistent, statewide approach was established for measuring code compliance, converting compliance rates into energy usage and savings, attributing measured energy savings to energy programs, and allocating costs among the utilities. This new and collaborative approach is expected to significantly increase code compliance rates.[77]

Objective 2: Encourage the expansion and diversification of energy resources, incentives, and programs.

Strategy 2.1: Support Energy Efficiency Efforts in Underserved Areas

Background

According to the 2010 U.S. Census approximately 36 percent of Iowa's population is considered rural. In addition, data shows that the overall population density of the state is roughly under 55 people per square mile, which is the 14th lowest in the country. Across the U.S. rural areas have higher rates of poverty and economic disparity, when compared to more urban areas, as well as lower per capita income and disproportionate elderly and veteran populations. Rural areas also tend to have building stock that is older and less energy-efficient than in populated centers.

A challenge not unique to Iowa, is that rural communities often do not have the capital and technical resources, including dedicated personnel, required to improve their building stock by identifying energy efficiency opportunities, prioritizing projects, and performing improvements. This challenge has been overcome in the past by governmental entities sharing resources and expertise in these underserved areas.

One such example of governmental entities sharing resources to overcome the challenges inherent in underserved areas is the Iowa City Energy Management Program (CEMP) pilot project. The CEMP was established in 2014, with assistance from a grant from the DOE, to provide one-on-one customized assistance to municipalities through the shared use of a regional energy manager. Because of the pilot, 19 Iowa cities, including eight Iowa municipal utility communities, received technical assistance that ranged from the establishment of energy reduction goals and development of energy action plans, to the identification and implementation of cost-effective energy efficiency projects.

The CEMP model could be replicated and expanded to continue to provide the necessary expertise to local governments in Iowa to reduce the energy usage in operations and to deliver energy programs that would support the residents and business in rural Iowa to reduce energy usage. Professionally trained staff could assist communities in undertaking retrofit and renovation projects that would increase long-term energy affordability.

Another model that could be adopted is funding dedicated staff. The Iowa Association of Municipal Utilities (IAMU) currently has a three-year contract with the Iowa Department of Natural Resources (DNR) to fund one full-time equivalent position to help small communities maintain their water systems. A similar model could be used to fund one full-time equivalent position at IAMU and/or the Iowa Association of Electric Cooperatives (IAEC) to provide energy expertise for rural and underserved communities.

Increasing the knowledge base available to advise on best practices for energy efficiency standards, building codes and materials, and priority targets for upgrades at homes and businesses has the potential to alleviate stresses on the electrical grid in underserved areas, and allow further reinvestment of savings by utilities and property owners in energy efficient investments.

Recommendations and Next Steps

The IEDA should fund a pilot project that makes available dedicated professionals to provide on-site, energy technical assistance to rural and underserved communities in the state. The pilot could focus primarily on program establishment and best practices to facilitate access to customers in these communities, enabling them to participate in energy efficiency efforts via robust education and streamlined access to resources. This project could be supported with federal DOE funding, and undertaken in collaboration with critical stakeholders such as the IAMU, the IAEC, municipalities in underserved areas of the state, and investor-owned utilities.

Strategy 2.2: Foster Collaboration Between the State Energy Office and the Iowa Energy Center

Background

State energy offices (SEOs) were originally formed in response to the energy crisis of the early 1970s. Since then, these offices have evolved to become important change agents by advancing practical energy policies and supporting energy technology research, demonstration, and deployment. Working in partnership with the private sector, SEOs strive to accelerate energy-related economic development and enhance environmental quality through energy solutions that address state-specific needs. The SEOs' work is generally performed under the direction of governors or legislatures, and is funded by both state and federal appropriations.

The Iowa Energy Office, housed within IEDA, works to create long-term economic growth opportunities in Iowa through technical and financial assistance to the private sector. These efforts are directed through energy efficiency improvements, investments in clean energy and biofuels, and by supporting sound energy policies.

In 1990, through the passage of the Iowa Energy Efficiency Act, the Iowa Energy Center was created as a separate entity from the Iowa Energy Office. Each year, the Energy Center receives core funding through an assessment on the intrastate revenues of Iowa's gas and electric utilities. These ratepayer monies flow to the Iowa Energy Center and are used to fund staff salaries, operational expenses, and energy research, information, and outreach initiatives. More specifically, the Iowa Energy Center's vision, as stated in their 2015 annual report, is to: "…[support] economic development, environmental sustainability, and social well-being in Iowa through energy innovation, education, and entrepreneurship. We provide Iowans with reliable, objective information on energy and efficiency options."[78]

While both entities have similar missions, the scope of the Iowa Energy Office is broader than that of the Iowa Energy Center. This overlap presents opportunities for improved coordination, clarification of roles, and alignment of initiatives at both entities.

Recommendations and Next Steps

A series of coordination discussions should be held between key personnel and leadership of both organizations to identify any existing overlaps, and to determine the best path moving forward. These meetings may result in clarifications to organizational missions and the establishment of a formalized process for collaboration. In addition, as the current structure of the Iowa Energy Center has limited oversight outside of Iowa State University, the recommended coordination may improve transparency in how Iowa ratepayer funds are used.

Strategy 2.3: Low Income Housing Tax Credit

Background

The Federal Tax Reform Act of 1986 created a Housing Tax Credit for project owners to invest in rental housing units for individuals and families with fixed or limited incomes. Rather than a direct federal subsidy, the Housing Tax Credit provides a dollar-for-dollar reduction to offset an owner's federal tax liability on ordinary income for a 10-year period. Tax credit interest may be syndicated or sold to generate equity for the developments, thus reducing the necessary mortgage financing and providing more affordable terms for developers.

Since 1986, IFA has been the allocating agency for the Housing Tax Credit for the state of Iowa. Over the past 30 years, IFA has helped fund nearly 21,000 housing units in more than 580 projects located in 83 counties throughout Iowa. IFA allocates the Housing Tax Credits using specified criteria including several items intended to improve the energy efficiency of affordable housing developments.[79]

By tying the Housing Tax Credit to energy efficiency requirements, the available subsidies are directed to more energy efficient buildings. IFA has incorporated several mechanisms that require and encourage the use of energy efficient systems and materials. The 2017 Qualified Allocation Plan (QAP), which is the mechanism by which IFA awards tax credits, contains several areas that address energy efficiency. The requirements include:

- An energy consultant is a required mandatory member of the development team to ensure that the project meets the energy efficiency rating required for each project after completion.
- New construction projects must meet or exceed Energy Star 3.0 prescriptive standards and receive a Home Energy Rating Systems (HERS) Index of 70 or less from a certified rater.
- Existing buildings are required to meet the standards laid out in the IECC. The building's energy efficiency is verified by an energy audit.

The 2017 QAP provides incentives for projects to exceed the above baseline energy requirements in the form of points. All requirements are verified by an energy consultant.

Recommendations and Next Steps

IFA should continue to require all affordable units constructed or rehabilitated to meet a higher level of energy efficiency. Further, the IFA should engage tax credit applicants and low income housing advocates to communicate the energy efficiency enhancements to the 2017 QAP.

Strategy 2.4: Connect and Leverage Iowa's Energy Assistance Programs

Background

The Low Income Home Energy Assistance Program (LIHEAP) is a federal program that assists low-income households, particularly those that use a high proportion of their household income to pay for energy, in meeting their immediate home energy needs and paying utility bills.

In addition to the assistance provided by LIHEAP in meeting short-term energy needs, the federal Low Income Weatherization Assistance Program (LIWAP) offers low-income customers a longer-term solution based on home weatherization improvements. The LIWAP program makes the homes of low-income clients more energy efficient, thereby reducing the households' energy bills. Because oftentimes these energy efficiency improvements can make indoor temperatures more comfortable and increase indoor air quality, it also results in improved health and safety for occupants. In Iowa, both assistance programs have been in effect since the early 1980s and are currently administered by the Iowa Department of Human Rights (DHR) in accordance with DOE rules and regulations.

Iowa's LIHEAP program is funded by a block grant from the U.S. Department of Health and Human Services. In 2014, the grant totaled $46.3 million. The program is designed to help eligible low-income Iowa households in the payment of their residential heating costs for the winter heating season. The state contracts with community action agencies throughout Iowa for local program delivery. If accepted into the program, the LIHEAP payment is made on behalf of the low-income customer directly to energy suppliers of natural gas, electricity, liquid propane, fuel oil, wood, and coal.

During program year 2016, Iowa's LIWAP had nearly $13.5 million available in funding. A household is considered eligible for assistance under Iowa's LIWAP program if the household is receiving Supplemental Security Income or Family Investment Program Assistance, regardless of income, or if the household's annual income is below 200 percent of the poverty level, as established by the Office of Management and Budget. Iowans can apply to the LIWAP program through local community action agencies.

Both the LIHEAP and LIWAP State Plans submitted annually to the respective federal agencies are specifically coordinated between the programs. Each plan contains elements addressing coordination with the other, including the coordination of program rules and policies, shared funding, joint client applications and joint eligibility determination. Applicants are required to complete only one application for both programs, cross referrals between programs are made automatically, and both programs share the same database of client information. In addition, coordination of the programs is enhanced by sharing the same sub grantees that administer both programs locally in nearly all counties in Iowa.

Both the LIHEAP and LIWAP programs have historically leveraged the federal funds for additional federal and private funds, including federal LIHEAP leveraging grants, Telephone Lifeline funding, utility customer contribution funds, and weatherization funding from investor-owned utilities.

Recommendations and Next Steps

The DHR and local community action agencies charged with program implementation should build upon the achievements in collaboration amongst its stakeholders and in leveraging both federal and utility resources. Further, state partners should explore program coverage to ensure that Iowa's most vulnerable population has access to reliable and affordable energy.

Additional Information, Resources, and Case Studies

Alliant Energy has an energy efficiency program that serves the population at 200-300 percent federal poverty level. These households often require assistance but are ineligible to participate in LIHEAP and LIWAP in accordance with federal rules. Iowa should consider evaluating Alliant Energy's model to ensure that all customers in this income range regardless of the utility they are served by have access to electric and natural gas efficiency programs, and that certain populations are not excluded from participation. It will be important to ensure that additional customer classes are not adversely impacted.

IEDA administers the federal Community Development Block Grant (CDBG) program which includes a housing fund. The main goal of the CDBG program is to "develop viable communities by providing decent housing and suitable living environments and expanding economic opportunities, principally for persons of low and moderate incomes." There is an opportunity for IEDA and the DHR to discuss how the CDBG housing fund and its efforts to improve single-family owner-occupied homes can be leveraged with the LIHEAP and LIWAP programs.

Strategy 2.5: Heating Fuel Assistance

Background

Iowans benefit from some of the lowest cost propane prices in the United States,[80] just short of $1.00 per gallon on average over the 2015-2016 heating season, and while prices are subject to change, this is far below the national average of $1.98 per gallon.[81] This makes propane a relatively affordable source of energy in Iowa. In addition, some parts of the state do not have sufficient coverage of natural gas lines, and therefore rural residents and small towns primarily use propane for heating their homes. More than one-eighth of Iowa's households heat their homes with propane, almost triple the national average.[82]

Despite low local propane prices, low-income customers oftentimes have difficulty paying for heating fuel either because distribution companies require a credit check for new customers, or because they cannot afford to fill a full propane tank at one time. This barrier becomes particularly critical in winter time, when families depend on this fuel to heat their homes. In recent years, the LIHEAP program has worked to address this issue by pre-purchasing propane from distribution companies prior to the heating season. The current program commitment is $3.5 million in pre-purchased propane.

LIHEAP assistance in pre-purchasing propane prior to the heating season is positive progress. However, solutions and support for customers who may not be eligible for LIHEAP assistance could benefit by further coordination amongst state agency and industry partners.

Recommendations and Next Steps

IEDA should work with the DHR and the propane industry to help develop solutions that ensure low-income customers have easier and reliable access to heating fuel. Other stakeholders that may also be included in this effort are the OCA and the Iowa Community Action Association.

Photo Credit: Stock Photo.

Objective 3: Lead by example in Iowa's government practices.

Strategy 3.1: Public Building Benchmarking Program (B3) Expansion

Background

Understanding how buildings consume energy over time is an initial step in making decisions that result in more efficient energy usage. Energy benchmarking is a tool that can be used to compare a building's performance over time, or to compare performance within and between peer groups.[83]

Iowa's B3 Public Buildings Benchmarking Program is an online benchmarking platform designed for facility managers of Iowa's public buildings. Participation in the program is voluntary and applies only to publicly owned buildings. Since 2011, the B3 Public Benchmarking Program has helped increase the energy awareness of facility managers, while tracking energy consumption and measuring building performance against other similar or more efficient buildings. The program also helps building owners target opportunities for significant energy saving by identifying actions to improve their building's efficiency.

128 Iowa organizations benchmark 2,324 buildings using the Iowa Public Buildings Benchmarking Program tool. These organizations have identified over $22 million in potential energy savings.[84]

Recommendations and Next Steps

The IEDA should work to expand the B3 to engage additional building owners and operators by increasing coordination with other existing programs such as the Main Street Iowa program. In addition, public entities that receive state grants to support building operations and maintenance should be encouraged to participate in the program.

Additional Information, Resources, and Case Studies

The Guide to State and Local Energy Performance Regulations, Version 3.0, prepared by CBRE and Institute for Market Transformation, serves as a summary of the energy-related regulatory mandates in each jurisdiction.

The Benefits of Benchmarking Building Energy Performance is a report published by the Institute for Market Transformation that highlights the positive results that can be achieved through benchmarking and transparency policies.

Examples of statewide benchmarking ordinances include the California Benchmarking Ordinance and the Washington Benchmarking Ordinance.

Strategy 3.2: High Performance Leasing

Background

Typical building lease terms do not allow property owners to pass-through the costs associated with building improvements to the tenant. For example, if a heating system in a building breaks down, the property owner is obligated to pay for its repair but cannot raise rent to cover the costs of the project. Because of this, property owners are only encouraged to meet minimum requirements to keep energy systems working, and therefore pass on opportunities to install higher-cost, but more energy-efficient equipment that could result in additional operational savings for the tenant.

At the same time a tenant pays the utility bills it leaves the owner without an incentive to reduce operating costs by undertaking capital improvement projects. A high-performance lease is designed to bridge these barriers by incorporating benefit and cost-sharing practices into lease terms that are acceptable to both parties. In other words, high performance leasing enables landlords and tenants to share in the cost of those improvements, while also sharing the financial benefits from energy efficiency investments.

High-performance leasing can be packaged with other energy efficiency policies and practices to achieve even greater savings. For example, these types of leases are oftentimes combined with benchmarking policies, rating and disclosure efforts, retro-commissioning, and broader energy management programs.

Recommendations and Next Steps

The IEDA, working closely with the Iowa Department of Administrative Services (DAS), will encourage high-performance leasing for buildings leased for state use. The cost of energy efficiency improvements and their associated energy savings should be factored when assessing individual state facilities. As a starting point, these agencies should develop model lease language that can be used as new leases are negotiated.

Additional Information, Resources, and Case Studies

In 2010 the Building Owners and Managers Association updated its Green Lease Guide to Commercial Lease: Guide to Sustainable and Energy Efficient Leasing for High-Performance Building. The updates included enforceable tenant responsibilities; pass-through provisions; and green certification notations for ENERGY STAR®, Leadership in Energy and Environmental Design (LEED), and Green Building Institute rating points. This guide, and others like it, may serve as models as Iowa state government entities investigate utilizing high performance leases for public buildings.

Photo Credit: Iowa Department of Transportation

Iowa's Energy Resources

Iowa Energy Resources

Iowa is a national leader in wind energy production and began integrating other alternative energy sources into its portfolio. As noted in the report, more than 35 percent of Iowa's electricity is produced from utility-scale wind energy and the utility-scale use of solar energy is growing creating value to the state. The changing utility-scale energy landscape has provided new income streams through lease payments. For example, growers across the state are receiving lease payments to house wind turbines on the land while still able to farm the land eliminating the competition between energy and agriculture. New energy projects, such as wind farms, bring much needed income into local economies while at the same time diversifying the energy mix and providing a valuable electricity generation asset.

Biofuels have also played a critical role in Iowa's economy. The state is the leading producer of starch-based ethanol, cellulosic ethanol and biodiesel production. Biorefineries have helped to create demand for crops such as corn and soybeans stimulating the state's agricultural economy while providing a more climate-friendly alternative to petroleum-based fuels.

Although renewables are gaining market share, the majority of electricity in the U.S. is generated using natural gas and coal and going forward these two resources will remain important for energy production affordability and reliability as the availability of renewable energy resources grow. Stakeholders noted the role renewable energy will play going forward but acknowledged the need for a diverse energy portfolio that includes natural gas and coal. While MidAmerican Energy is continuing to make investments in renewables, coal and natural gas are also part generation mix, 31 percent and 16 percent, respectively.[85] Alliant Energy is continuing to invest substantially in the conversion to natural gas and the addition of wind and solar energy to its portfolio (For more detail refer to **Section: Iowa's Energy Landscape; Energy Production**). Municipal utilities and rural electric cooperatives while also maintaining fossil fuels in their generation mix have invested in community solar and wind projects and are assisting customers with distributed energy investments.

For example, one of the state's largest community-owned solar projects, developed by Cedar Falls Utilities went online in April 2016. The 1,500-kilowatt (kW) solar array was split into units of 170 watts (W) per unit and purchased by both Cedar Falls Utilities' customers and businesses. One key element of the success of the project, which sold out, was the affordable cost of each unit. This year nearly a dozen Iowa electric cooperatives are plans to add solar energy to their generation portfolios. Iowa is also seeing a growth in community-owned wind projects. One of the first of this type of wind project was completed in 2001 and is owned by the Spirit Lake School District. Over the last decade, more than a dozen community-wind projects have gone online in rural communities across Iowa. An advantage of the community-owned renewable energy model is that it allows community-members to participate in the development and have access to renewable energy that would otherwise not be available.

There are several challenges identified by stakeholders that must be overcome to continue the transition to renewable energy. Participants expressed concern over adequately handling stranded generation assets as the state makes larger investments in clean energy. Utilities are seeking to minimize stranded assests and investments in traditional generation in order to keep electricity rates low and stable. Another issue that arose was that of the net metering component in a distributed energy system. Net metering is a system in which a renewable energy generator, such as rooftop solar panels, are connected to a public-utility power grid and surplus power is transferred onto the grid, allowing customers to offset the cost of power utilized by the utility. In July 2016, IUB issued a net metering order that addressed meter caps for all customer classes, and annual crediting for a period of three years. This enables IUB to collect data regarding how utility tariffs are working. IEDA will continue to work with the utilities and IUB on issues including those of transition and distributed generation.

Discussions during the development of the plan also included the role that can be played by hydroelectric and nuclear energy. Iowa has one nuclear power plant and the Iowa Energy Plan working groups made the decision that although nuclear power provides benefits as part of the existing portfolio, federal regulatory and cost constraints keep nuclear power from playing a greater role in the near-term. A 2012 study by the Department of Energy found that Iowa ranked tenth in the nation for hydropower potential. Missouri River Energy Services is currently constructing a facility at Lake Red Rock, but neither additional opportunities nor strategies were brought forward during the stakeholder process. As new technologies emerge or economic factors change, these energy sources may be evaluated as the Iowa Energy Plan evolves.

A final discussion relevant to Iowa's energy resources, and in particular, the generation of electricity, is the Clean Power Plan (CPP). On August 3, 2015, the EPA finalized its CPP rule, requiring a 32 percent reduction in U.S. carbon dioxide (CO_2) emissions by 2030. The rule requires existing fossil-fuel-fired power plants to reduce their carbon footprint, setting performance rates for carbon emissions from steam and natural gas combined cycle units.[86] On February 2016, the U.S. Supreme Court granted a stay of the CPP. It is uncertain when the litigation will be resolved and if the CPP will move forward with implementation. Although Iowa seems poised to meet the carbon emission reduction goals established for the state due to early investments in clean energy sources, energy efficiency advancements, and replacement of older, coal-fired plants with more efficient fuel sources, state leaders have paused stakeholder engagement and potential implementation planning until there is greater certainty from the judiciary. If future action is required, it will be addressed accordingly in plan updates and in conjunction with the IUB and DNR.

The energy landscape is changing across the country and in Iowa. The objectives and strategies under this pillar are designed to guide the investments and leadership of the state of Iowa as it continues to grow its energy resources, helping Iowa remain a leader by investing in a new clean energy economy through support of existing industry and natural resources.

Focus Areas of the Pillar

Within this pillar, participants highlighted connections between agriculture and biomass and their importance for rural economic development. Data analysis performed during the planning process confirmed that biomass has the potential to have an impact on Iowa's energy economy. As such, biomass has emerged as a focus area for the Iowa's Energy Resources pillar, building on Iowa's strength in available feedstock resources, workforce, and research in the area.

Focus Areas

- Biomass Potential

Biomass

Biomass is organic material from plants and animals and it can be utilized to produce bioenergy, biofuels and bio based products such as biochemicals and bioproducts that can replace fossil-based equivalents. Biomass electricity, or bioenergy using biomass can be produced in two ways. First, it can be directly combusted from organic materials or converted into a pellet form and combined with plastics for combustion. Second, it can be produced by combusting biogas that has been collected from decomposing organic matter to power a turbine, similar to natural gas. Biogas collected and processed can be used directly as a heat source or in liquid form as a transportation biofuel. Alternatively, biofuels are produced through chemical, biochemical, or thermal processes.

In Iowa the use of biomass to produce electricity directly or to produce biogas remains an untapped potential and abundant resource. By 2030, it is projected that Iowa will lead the nation with 31 million tons in crop residue productions and manure that can be utilized for bioenergy.

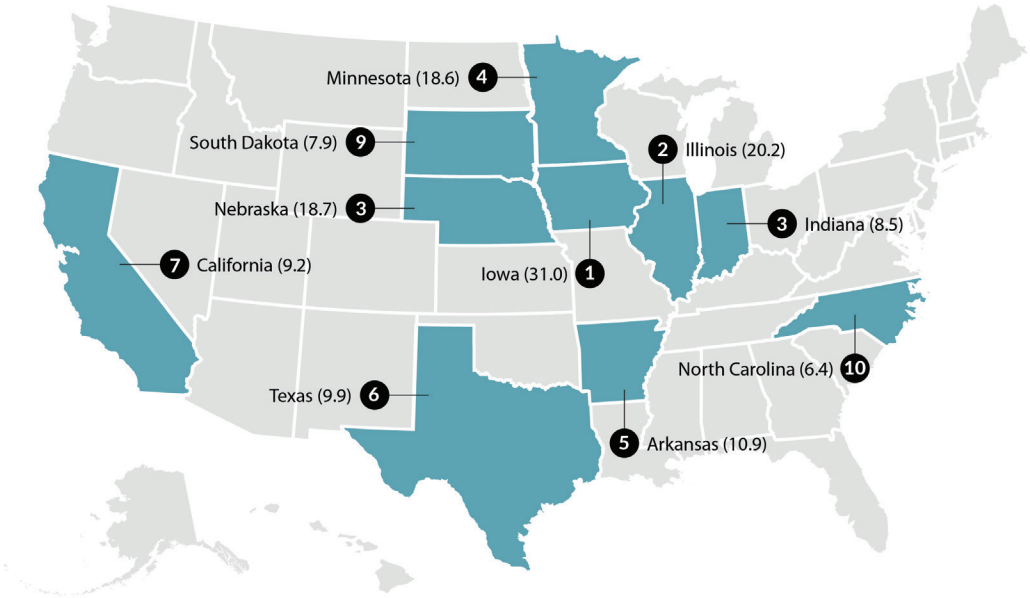

Figure 6. Top 10 States as Sources of Crop Residues and Manure for Bioenergy, 2030 (Million Metric Tons)

Source: Adapted form UCS 2030
Note: Figures expressed in million metric tons of dry biomass weight.

There are numerous benefits of using biomass for energy production. From an economic perspective, investments in biomass to energy will reduce wastewater disposal costs, increase revenue to farmers, reduce fuel costs, and attract new investments while supporting job creation. Biomass to energy projects have numerous environmental benefits as well including improved water quality from reduced nutrient runoff, increased crop diversity and improved soil health from planning perennials and cover crops, and improved air quality from renewable power generation through cleaner burning transportation fuels.

Expansion of biomass generation facilities within Iowa can lead to increased employment and economic activity in both the industries that supply the raw biological product inputs to biomass generation activities as well as industries involved in the construction and operation of new biomass facilities.

As one example of economic potential in the biomass space, it is estimated that, in our state, a typical anaerobic digester associated with a municipal wastewater treatment facility will require an investment of $17.6 million and result in a total economic output of $158 million over a 20-year project life. A digester in an agricultural setting could potentially result in $69.5 million in economic output with an initial investment of $8 million. Long-term job creation would average nine jobs per project and Iowa has the anticipated biomass potential to support a digester in every county of the state.[87]

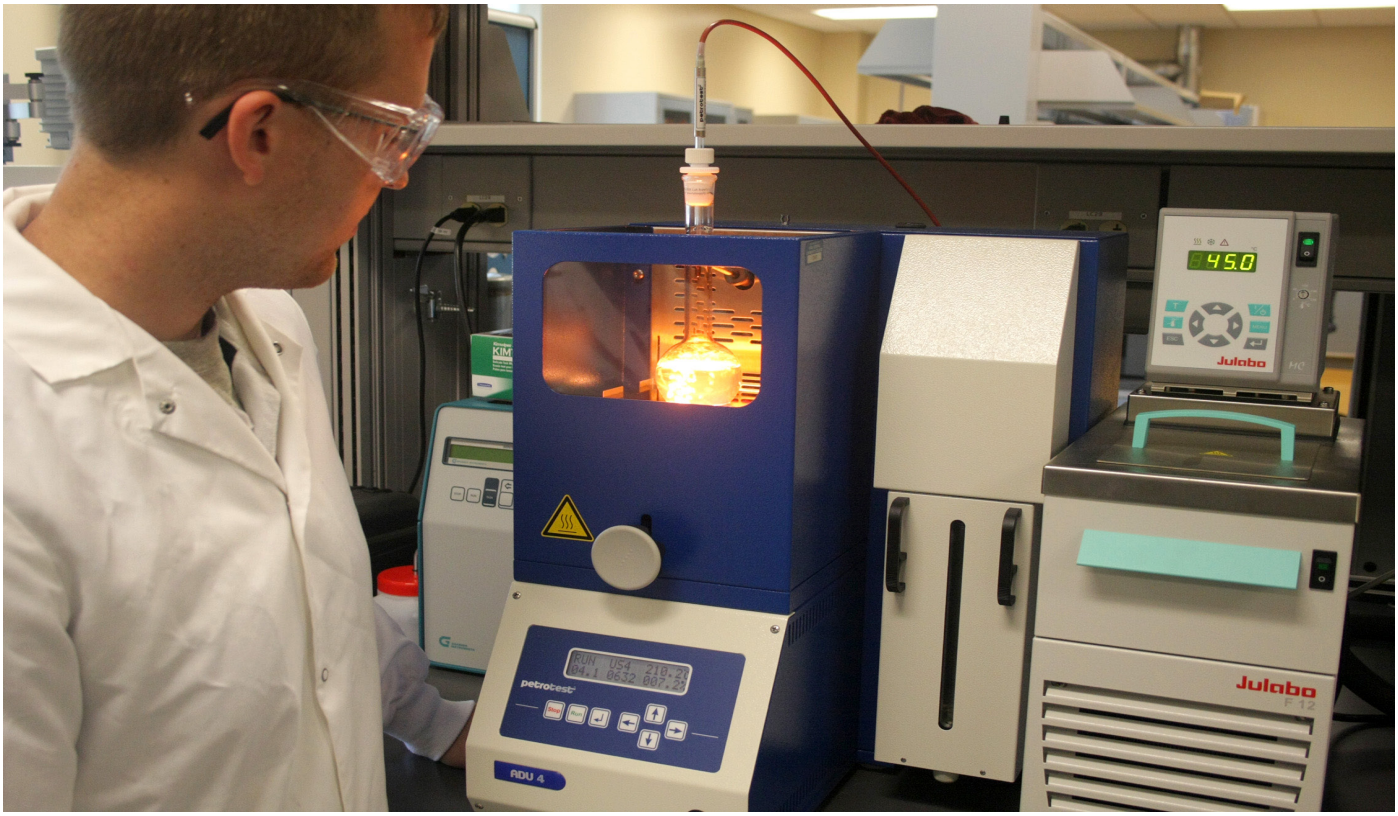

Photo Credit: Greater Fort Dodge Growth Alliance

The **Iowa Energy R&D Core Competencies and Opportunities for Energy-Based Economic Development White Paper (Appendix G)** identified several energy-based economic development opportunities for Iowa around biofuels, including livestock waste-to-biogas projects, development of modular biopower systems for distributed generation, and value-added chemicals from biofeedstocks. According to the American Biogas Council (ABC), Iowa is ranked #8 in the country for methane production potential for biogas sources. ABC also reports that there is a potential for more than 1,140 new projects that could be developed based on the estimated amount of available organic material. Should all of these projects come to fruition, the construction phase would generate $3.4 billion in capital investment, and create 28,500 short-term construction jobs, 2,280 long-term jobs along with hundreds of indirect jobs. These biogas systems could have the ability to produce enough electricity to generate 1.8 billion kilowatt-hour or power 158,722 homes each year.

There are multiple innovative biogas pilot projects underway. For example Chevron, in partnership with Iowa State's BioCentury Research Farm, is developing and demonstrating an advanced biorenewables technology known as solvent liquefaction. The technology converts biomass, such as wood chips or pellets, into a bio-oil that can be processed into renewable fuels, biochemicals or biochar, a product that can enrich soils and help to offset CO_2 emissions.

Supporting private investment in biomass energy projects will also enable more effective translational deployment of innovative biomass technologies to occur by accelerating funding access for early stage companies as well as enabling more established companies to deploy new ventures or expand current projects in biomass-related markets.

Table 7. Iowa's Energy Resources - Strategy Impacts at a Glance

		Environmental and Public Health Impacts				Economic Impacts				Energy System Impacts			
Objective	**Strategy**	Air	Land	Water	Health	Jobs	Business Attraction	Energy and Technology Exports	Research and Development	Reduced Costs	Reliability	Affordability	Diversification
Increase utility-scale renewable energy generation in Iowa.	1.1 Biomass Energy Implementation Group	●	●	●	●	●	●	●	^	●	●	●	^
	1.2 Adopt Renewable Energy Goals	^	●	^	^	●	●	●	●	^	●	●	^
Support distributed renewable energy generation including wind, solar, and other clean energy resources in Iowa.	2.1 Local Policy Best Practice Models	^	●	●	^	^	●	--	●	●	●	●	^
	2.2 28E Sharing Agreements	^	--	--	^	●	●	--	●	^	--	^	●
Increase biofuel production and usage in Iowa.	3.1 Renewable Fuels Infrastructure Program	^	●	●	^	^	^	●	^	●	●	^	^
	3.2 Demonstration of High Octane Fuel Vehicles	^	--	--	--	●	●	●	●	●	●	●	●

^ Positive direct impact
v Negative direct impact
-- Neutral impact
● Unknown impact

Objective 1: Increase utility-scale renewable energy generation in Iowa.

Strategy 1.1: Biomass Energy Implementation Group

Background

Biomass is organic material from plants and animals that can be utilized as fuel for producing renewable energy as depicted in **Figure 7**.

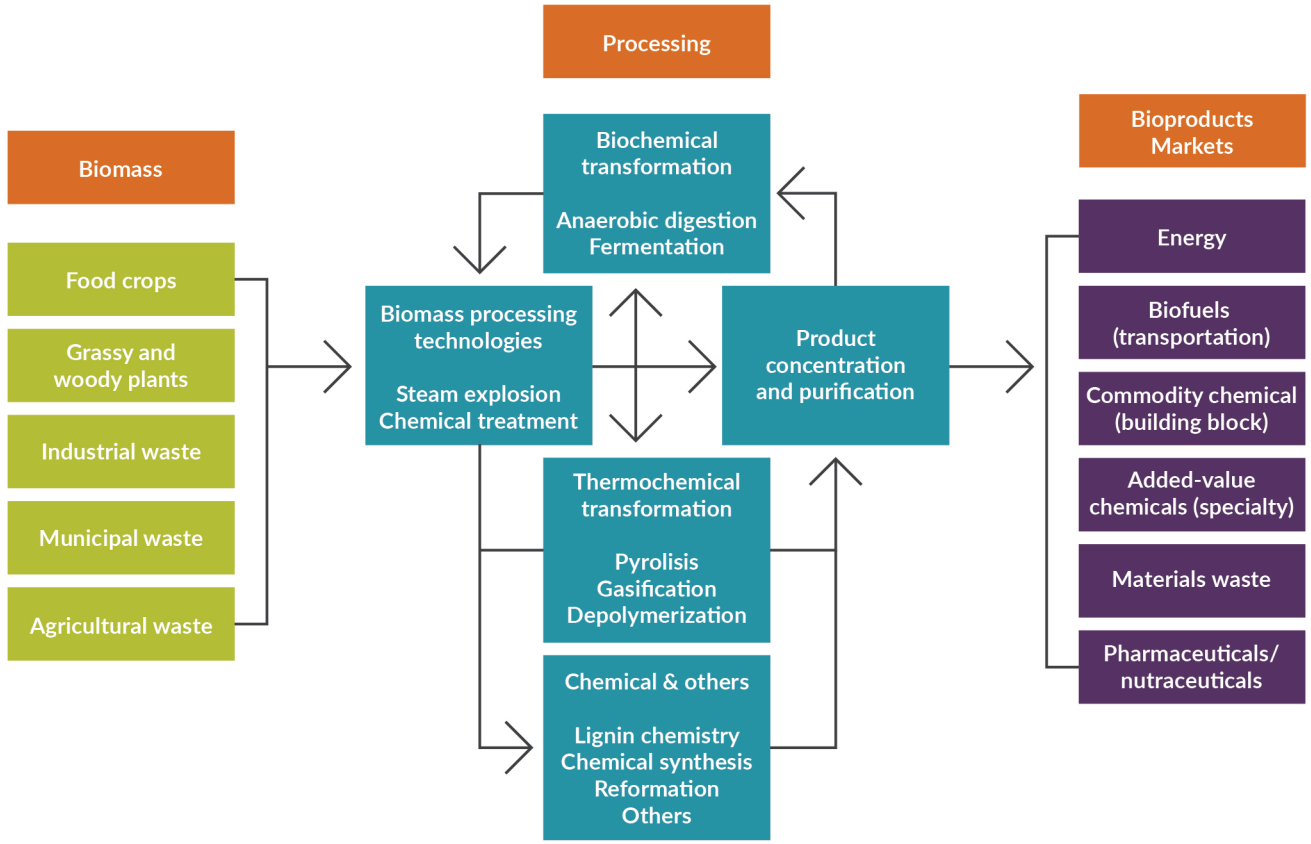

Figure 7. Benefits of Biomass to Fuel Projects

Source: Adapted from Woody Biomass Properties. (2013, July 31). Retrieved from: http://articles.extension.org/pages/26517/woody-biomass-properties

With significant agricultural resources and policies that have promoted the development of biomass-to-energy projects, including substantial investments in biofuel production (see Strategy 3.1 and 3.2 in this pillar). Advancements have also occurred in the direct combustion of biomass to generate electricity and the use of conversion technologies to generate biogas. The state's universities have also made great efforts in the co-firing of biomass with coal. As noted in the key focus of this pillar there is still potential to expand production of this resource.

Some examples of efforts that are currently underway include:

- The Iowa Energy Center's Biomass Energy Conversion facility hosts several projects that aim to demonstrate how biomass fuels can be used to generate electricity, heat and valuable byproducts.
- The University of Iowa and Iowa State University have partnered on a miscanthus pilot project that is designed to produce 25 percent of the required renewable energy needed to satisfy University of Iowa's 2020 goal of 40 percent renewable energy.
- In 2015 the Tallgrass Prairie Center at the University of Northern Iowa released a final report for its Prairie Power Project. The project studied biomass production of four different native species seed mixes over three different soil types on non-prime agricultural land on a production scale over five years.[89]
- The University of Iowa's power plant has been burning a mix of oat hulls and coal for more than a decade. The University has found a 50-50 oat hulls-coal mix, when compared to burning only coal, reduced fossil CO_2 emissions by 40 percent and significantly reduced the release of particulate matter, hazardous substances, and heavy metals.[90]
- The Iowa Biogas Assessment Model is an economic analysis tool integrated with a geographic information system that aims to provide users with an overview of raw materials available in Iowa for biogas production and the economic potential of producing biogas.
- Researchers from Iowa State's University's Bioeconomy Institute are investigating a new technology for converting biomass into biofuels and chemicals.
- Iowa has taken great strides in the production of cellulosic ethanol through the innovative process invented at Quad County Corn Processors where corn kernel fiber is converted to ethanol and POET-DSM's Project Liberty facility in Emmetsburg, Iowa.

Expanding biomass generation as a part of the overall portfolio of Iowa's energy system will increase the diversity of energy resources available to meet the state's energy demand. Although some studies show that biomass can have greater energy affordability than petroleum products, affordability benefits from the expansion of biomass generation in the state have the potential to be offset by other factors that may impact the cost effectiveness of different components of Iowa's energy mix. In other words, it is unclear what the net effect on energy costs might be over the long term from the expansion of biomass generation assets. Iowa has a track record of businesses and regulators that are open to pilots and developing strategies for how biogas and biomass generation options can be integrated into the existing energy framework, this often places the state in a first-mover position that may involve establishing the first benchmarks for utility-scale best practices.

Further expansion of biomass generation facilities within Iowa can lead to increased employment and economic activity in both the industries that supply the raw biological product inputs to biomass generation activities as well as industries involved in the construction and operation of new biomass facilities. Installation and operation of new biomass generation plants can create short-term employment for construction and equipment manufacturing firms followed by longer-term employment involved in the operation of plants as well as increased economic activity around transportation and biomass storage and pre-treatment services. Increased demand for raw biomass inputs to new generation facilities may cause business growth in agricultural and other by-products businesses that supply such material. Further study is required to understand whether that demand could be met by unused surplus materials in the state. Additional economic impacts involving the attraction of biomass-related technology firms to the state could be positive on the availability for storage or export, but these effects are less easily determined.

The energy balance ratio for corn-based ethanol has been found to be 4.0 (4 BTU of ethanol for 1 BTU of energy input) for areas like Iowa that use the lowest corn energy, market wet distilled grains to local livestock industry, and sell ethanol locally along interstate highway corridors.[91]

With significant agricultural resources, established biofuel refining facilities, significant research capabilities, and numerous businesses operating in this space, Iowa is well positioned to lead the way in the next generation of biomass-to-energy technologies. As described previously, Iowa is a national leader in the production of starch-based ethanol, and given initial research and development efforts from the state's universities and research centers, Iowa is well positioned to continue development of next generation biofuels, value-added products, and other innovative technologies.

Recommendations and Next Steps

One of the research and development platforms identified in the development of the Iowa Energy Plan **(Appendix G)** is Biomass Conversion, which is focused on the conversion of Iowa's abundant supply of biomass, especially cellulosic biomass, into liquid fuels and high value-added chemicals. In line with this platform, the state should establish an

implementation group focused on exploring further opportunities for the conversion of biomass to energy.

The implementation group would identify the various markets, associated business cases, and potential barriers for biomass-to-energy expansion in Iowa. The group would be charged with coordinating existing biomass-to-energy efforts and initiatives, aligning financial support mechanisms, developing solutions to remove barriers, and expanding the overall use of biomass resources to produce energy. In addition, the implementation group would evaluate financial models that could provide financial support for biomass-to-energy projects that would accelerate its deployment in Iowa.

The IEDA will champion this strategy in partnership with numerous stakeholders including private sector businesses, local and state government entities, utilities, and Iowa's state universities.

Additional Information, Resources, and Case Studies

Several states around the country have formed working groups focused on identifying opportunities for biomass to energy:

- The Illinois Biomass Working Group is a collaborative network comprised of farmers, businesses, universities, and public agencies that meet to share information and collaborate to advance biomass energy in Illinois. The group helps link farmers and businesses of many types to form complete biomass supply chains and to promote collaborative efforts among the private sector, public researchers, and regulators.
- The Northeast Biomass Thermal Working Group is a coalition of biomass thermal advocates committed to advance the use of biomass for heating and CHP in the northeastern United States.
- The Indiana Biomass Energy Working Group is a consortium of stakeholders from the industry, state and federal government, trade organizations, universities and members of the public working together to foster the growth of a viable renewable energy industry. This is done through educational programming and networking among stakeholders.

Strategy 1.2: Adopt Renewable Energy Goals

Background

With vast natural resources, Iowa has long been a national leader in renewable energy generation and in fact was the first state in the nation to establish a goal for renewable energy by adopting a RPS in 1983. The RPS had a goal of establishing 105 MW of wind energy generation in the state, and due to a combination of progressive policies this goal was quickly surpassed. In addition, in 2006, Iowa adopted the most aggressive Renewable Fuel Standard in the country, requiring 25 percent of motor fuel sold in Iowa to be replaced with ethanol or biodiesel by January 1, 2020.

Encouraging Iowa's production of renewable energy and renewable biofuels can result in reduced burning of fossil fuels and therefore increased air quality and improved public health. For example, in 2012 wind energy in Iowa displaced about 84.7 million metric tons of CO_2. In addition, encouraging biofuels and renewable energy enables greater diversity in the state energy portfolio, and can lead to a variety of economic benefits ranging from increases in employment and business volume from locally sourced projects, better local access to new alternative fuels, land-use lease economic impacts for land owners, and economic growth in industry and supporting supply chain.

Setting renewable energy targets for certain generation sources, such as wind, biomass, solar, geothermal, and hydroelectric capacity, enables greater diversity in the state energy portfolio through construction and long term operation of alternative energy generation and delivery infrastructure. Meeting renewable energy generation targets for certain renewable energy types, such as those outlined in EPA's Wind Vision report for wind installation capacity, is expected to lead to long-term utility rate savings and increased grid stability.

Given that short-term rate increases can have significant negative effects on business attraction and retention as well as productivity in energy-use intensive industries such as manufacturing, the effect of any projected utility rate increases should be evaluated along with any mitigation programs. In addition, a dramatic increase in the level of renewable energy generation capacity as a result of mandated targets for the state's energy mix also has the potential to result in the unintended side effect of increasing stranded energy assets which would result in negative impacts for energy-related industries and utilities as they incur losses from writing off or devaluating legacy infrastructure (coal and other hydrocarbon resources are particularly vulnerable to becoming stranded as a result of renewables adoption). Careful consideration of policies and programs to moderate the economic implications

of renewables replacement of legacy assets should be undertaken to prevent negative externalities, optimize the ability to repurpose existing assets, and address concerns of vulnerable stakeholders.

Recommendations and Next Steps

Iowa is among the most progressive states in the country in terms of renewable energy generation and, given its vast availability of wind, solar, and biomass resources, it is well positioned to achieve aggressive clean energy goals within the next 15 to 20 years. As reflected by the input received from the Iowa Energy Plan working group members and from the public, it is recommended that Iowa adopt voluntary, non-binding targets for renewable energy generation to continue its renewable energy success. The goals should be sensitive to the risk of jobs leakage, and allow for excess renewable energy resources to be sold and moved through the regional transmission organization's footprint. The goals could be adopted through a variety of pathways.

In addition, it is recommended that Iowa assess the State's current Renewable Fuel Standard for opportunities to expand to other clean alternative fuels, as well as improving the reporting and data accuracy on its implementation. The state should also consider providing an incentive for compliance.

Additional Information, Resources, and Case Studies

During the last two years, several states have announced aggressive clean energy targets with the goals of increasing energy security, reducing emissions, diversifying each state's generation portfolio, and promoting economic development. In June 2015, Hawaii became the first state in the country to set a 100 percent renewable energy goal in the power sector by 2045[93] - the most aggressive energy target in the country. This announcement was closely followed by California Governor's approval of a climate change bill that requires that the state generate half of its electricity from renewable sources by 2030 while doubling energy efficiency in existing buildings.[94] Oregon[95] and New York,[96] as well as the District of Columbia,[97] all established renewable energy standards during the summer of 2016 that require 50 percent of their electricity generation be from renewable energy sources within the next 15 to 25 years. To date, no Midwestern states have announced equally aggressive targets but remain committed to reaching 20 to 30 percent levels of renewable energy generation.

Photo Credit: Iowa Farm Bureau

Objective 2: Support distributed renewable energy generation including wind, solar, and other clean energy resources in Iowa.

Strategy 2.1: Local Policy Best Practice Models

Background

Local conditions, such as zoning codes and subdivision regulations, can have a significant impact on the ability of residents and businesses to install distributed generation renewable energy resources. While some communities are acknowledging the potential of these localized resources, they are not always familiar with national best practices and the impact that local regulations and ordinances can have on project implementation.

Local governments in Iowa are seeing increased interest in renewable energy installations including solar, wind, and biomass and, thus, must address land uses in their codes and regulations. Three consistent areas that local governments should address are: land use conflicts and nuisance considerations, protecting access to renewable energy resources, and encouraging appropriate renewable energy development through local policies such as climate protection or sustainability goals.

Identifying how local, distributed renewable energy development can benefit a community will help decision-makers determine how distributed resources and investments can best be integrated into a community that balances and protects competing resource development with community needs. The Iowa Code, for example, grants municipalities the right to issue ordinances prohibiting subdivisions from including restrictive covenants that limit the use of solar collectors.

Recommendations and Next Steps

The IEDA should establish a collaborative effort with local governments to discuss and develop model templates for localized policies for Iowa communities to refer to if interested in growth in wind, solar, biomass, and hydropower development. The effort should engage numerous stakeholders such as utilities, distributed generation developers, the Iowa Solar Energy Trade Association, other Iowa renewable energy advocates, and large potential users of distributed generation.

Additional Information, Resources, and Case Studies

Local ordinances that permit the development of distributed generation projects have clear definitions of renewable energy resources, as well as defined goals that help users (both planning commission and community members) understand why the community is developing and administering regulation.

For solar energy technologies, model ordinances are predicated on the concept that a solar resource has definable characteristics that are affected by local land use decisions and regulation. In addition, local development regulations that are "solar ready" have the following characteristics: all the types of solar land uses that the community is likely to see; result in an as-of-right solar installation opportunity for at least accessory use solar and where possible for principal use solar development; and balance between solar resources and other valuable local resources (trees, soil, historic resources) in the development process.

The Iowa Energy Center Solar PV Guide is designed to provide information and resources to residents that are looking to install solar photovoltaic energy systems in their homes. The guide includes factors that consumers should consider when deciding, a description of solar energy technologies, and recommendations for conducting research and following through steps for system installation.

Strategy 2.2: 28E Sharing Agreements

Background

The purpose of 28E Sharing Agreements, as established by the Iowa Code section 28E, is to allow state and local governments in Iowa to make efficient use of their powers by enabling them to provide joint services and facilities with other agencies and to cooperate in other ways of mutual advantage. For example, these agreements are currently used by state and local agencies to share facilities and other infrastructure.

In Iowa, Dillion's Rule is applied to the state and local governing authority meaning that if a power is not explicitly stated, the action cannot be undertaken. Schools, for example, have not been given explicit authority to enter into 28E sharing agreements with other agencies and nonprofits, and are therefore unable to pursue joint renewable energy and energy-efficiency projects.

Allowing agreements between multiple agencies, these entities could allow them to pursue financially viable projects that cannot be currently be undertaken by one entity alone thus providing benefits to all the parties involved.

Recommendations and Next Steps

The state of Iowa should specifically allow 28E sharing agreements between schools and nonprofits for the development of wind and solar projects as well as other renewable power generation and energy efficiency projects. In addition, determine if the current 28E Sharing Agreement structure needs adjustments to allow for shared renewable energy for both school districts and local governments.

Photo Credit: Alliant Energy

Objective 3: Increase biofuel production and usage in Iowa.

Strategy 3.1: Renewable Fuels Infrastructure Program

Background

Iowa has made progress in developing biofuels. First generation biofuels have been important economic drivers for the state of Iowa. As previously mentioned, Iowa leads the nation in ethanol production with more than one-fourth of the nation's total production capacity. Iowa's plentiful cornfields provide the feedstock for most of the state's 47 ethanol plants, which include three cellulosic ethanol plants that use agricultural waste, either corn stover or corn kernel fiber as feedstock. A fourth cellulosic ethanol plant uses municipal solid waste as a feedstock.[98] Iowa also has about a dozen biodiesel plants with a combined productive capacity of more than 330 million gallons per year, and lead the nation in biodiesel production.

Ethanol production alone in Iowa accounts for $2.253 billion per year in GDP and supports more than 8,693 jobs through the state's economy.[99]

Increasing availability of higher blends of ethanol and biodiesel requires infrastructure upgrades and modifications, including storage and fueling dispensers. Iowa has a history of providing support for ethanol and biodiesel through tax incentives and programs, which has resulted in expanded, cost-effective choices for consumers. The Iowa Renewable Fuels Infrastructure Program (RFIP) has been providing grants since 2006 and is managed by the Iowa Department of Agriculture and Land Stewardship (IDALS).[100] Because of this program, retail fueling sites have increased access to biofuels for consumers and owners of fuel terminals have added storage of biodiesel (B99 and B100) to expand the wholesale market and distribution.

Funds for the RFIP were primarily obtained from a state fund which received statutory appropriations through collection of an Environmental Protection Charge, a fee associated with the sale of gasoline. Funding for the RFIP from the Environmental Protection Charge expires at end of 2016, leaving the RFIP within the Iowa Code, but without a committed and permanent source of funding.

Periodically, other sources of funding are available to support infrastructure but the funding sources are not consistent or permanent. For example, in October 2015, Iowa was one of 21 states to receive funding from the U.S. Department of Agriculture's Biofuels Infrastructure Program to increase access to higher ethanol blends through the installation of blender pumps and tanks. Through this grant Iowa received $5 million and leveraged state and private dollars for statewide projects. Additional funds might be available through this program in the future, which may help to continue the success of the RFIP.

Recommendations and Next Steps

Renewable fuels industry stakeholders should lead an effort to identify the potential funding sources in consultation with state officials and agencies including Iowa DOT, IDALS, and IEDA, as well as retail fuel industry stakeholders. This effort should begin with meetings convened with the key stakeholders to discuss demand for the program, associated financial needs, and funding strategies. Any proposals for state and federal funding should be coupled with strategies to leverage private funding.

Additional Information, Resources, and Case Studies

The American Lung Association in Illinois administers an E85 Infrastructure Grant Program designed to increase the number of public E85 refueling sites throughout Illinois. The program provides grants for blender pump and dispenser installation and was developed in partnership with the Illinois Corn Growers Association and Illinois Department of Commerce and Economic Opportunity.

The Indiana Flex Fuel Pump Program administered by the Indiana Corn Marketing Council offers fuel retailers grants toward the purchase of a flex fuel pump, hardware and storage tank or the conversion of an existing pump to a blender pump. The program was supported by fuel dispenser manufacturer Dresser Wayne, through equipment discounts to fuel retailers that qualify for the grants.

California's Motor Vehicle Registration Fee Program provides funding for projects that reduce air pollution from on- and off-road vehicles, including incentives to develop alternative fueling infrastructure.

The Colorado Corn Blender Pump Program provides funding assistance for each qualified station dispensing mid-level ethanol blends. Projects must meet the application requirements and receive approval from Colorado Corn and the Colorado Department of Oil and Public Safety.

Strategy 3.2: Demonstration of High Octane Fuel Vehicles

Background

As fuel economy standards have become increasingly more stringent, the need for automakers to develop innovative technologies to remain compliant has been amplified. Iowa, rich with ethanol resources, has an opportunity to help the auto industry meet its fuel economy targets, while furthering state economic gains.

The fuel industry currently uses additives to raise gasoline's octane rating from about 70 to 87 for regular gasoline and 91 for premium gasoline. While a complex set of technical and regulatory constraints limit the combinations of additives that can be used in gasoline, automakers have determined that using high octane fuels in optimized internal combustion engines can increase engine efficiency, maximize fuel economy, and reduce emissions. As a result automakers are calling for a considerable increase in the octane rating of regular gasoline.

Over the last decade, ethanol has become a major high-octane fuel additive because by itself, ethanol has an octane rating of 109. Ethanol as a vehicle fuel has three primary uses: E10 blend accepted in any vehicle, E15 for vehicles as approved for model years of 2001 or newer, and higher blends up to E85 for Flex Fuel Vehicles. High-octane fuel vehicles (HOFVs) are a new type of vehicle undergoing research and development, designed to efficiently use a high-octane ethanol blend of between E20 and E40, which would allow for increased mileage efficiency and help facilitate compliance with increasingly stringent federal fuel economy and emissions standards in the 2017-2025 timeframe.

While research to determine the exact property requirements for high octane fuels is still ongoing, most researchers believe it will be comprised of 20 percent to 40 percent ethanol because blends in this range have characteristics that allow an optimized engine to be much more efficient than current engines. High-octane fuel could represent a growing new market for the ethanol industry. Bringing these vehicles into the market is key for ethanol to remain on the forefront of emerging market trends and Iowa can play a key role in making this happen.

Recommendations and Next Steps

An ethanol industry-led task force should be established to facilitate the development of a pilot program to demonstrate the real world benefits of HOFVs. The task force could include fleet management personnel, representatives from the major U.S. automakers, third-party automotive engineering firms, fuel retailers who currently operate blender pumps, fuel blenders/marketers, ethanol producers, and appropriate agencies, including IEDA, Iowa DOT, IDALS, DAS, and DNR. The task force should determine strategies to overcoming regulatory and related barriers for the purposes of this type of pilot project.

In addition, a pilot program could be established to analyze the benefits of HOFVs in a manner that is controlled, yet reflective of real world driving conditions. The performance of these vehicles could be closely monitored and documented, which would provide valuable proof of concept data and information to auto manufacturers, fuel producers, regulators, and others.

Additional Information, Resources, and Case Studies

Exploring the synergies between ethanol, engines and powertrains has been part of the DOE's Co-Optima Initiative, which has convened national laboratories, universities, and industries to guide research and development in this area.

Additionally, a High-Octane Mid-Level Ethanol Blend Market Assessment conducted by the National Renewable Energy Lab has identified key barriers that need to be addressed including logistical, regulatory, economic and behavioral barriers. This assessment also has identified the stakeholders and decision-makers necessary for overcoming these barriers.

The American Council for an Energy Efficient Economy has a State and Local Policy Database that lists policies that target the use of more efficient vehicles for state fleets.

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Transportation and Infrastructure

Transportation and Infrastructure

The transportation and infrastructure pillar is the broadest and far reaching of the four pillars focusing on the connected systems - pipelines, electric grid, alternative fuel infrastructure, and roads, highways, rails, and waterways that move energy, freight, and people within and across the state. Iowans rely on this transportation and infrastructure network every day. Iowa is well served by a robust system of:

- Over 100,000 miles of roadways, including two major north to south (Interstate 35 and Interstate 29) and east to west interstate route (Interstate 80), U.S. routes, state routes, and farm to market roads.[101]
- Six Class I (national scale), one Class II (regional), and 11 Class III (local) firms operate Iowa's rail network, including two passenger routes by Amtrak.
- Two navigable waterways – Mississippi and Missouri Rivers.
- Electrical transmission and distribution infrastructure serving two investor-owned utilities, 136 municipal utilities, and 44 electric cooperatives.[102]
- Natural gas pipelines, including five major interstate pipelines.

The efficient movement of goods and people is foundational to the state's economy. The direct relationship between transportation and energy is the reason why the IEDA and Iowa DOT partnered to complete the Iowa Energy Plan. The transportation sector is a large consumer of energy, and the safe and efficient transportation of energy products and components (e.g., biofuels, crude oil, wind turbines, etc.) is vitally important to the state of Iowa and the nation. Iowa DOT has undertaken several initiatives in the recent years related to the transportation–energy nexus:

- Iowa Statewide Freight Transportation Network Optimization (2016)
- Optimizing the Propane Supply Chain in the State of Iowa (2016)
- Crude Oil and Biofuels Rail Transportation Study (2016)

In addition to these studies, IEDA and Iowa DOT are actively engaged with other state agency partners and the energy stakeholders in supporting programs and activities related to renewable fuel infrastructure, electric vehicle charging corridors, energy assurance, and other energy-related programs.

Transportation and energy infrastructure, while enabling a high quality of modern life, also provides the foundation of the state's economy. The system enables Iowans to produce products and sell them around the country and around the globe. New technologies and economic development opportunities, reductions in energy usage, the optimization of Iowa's energy resources, and the development of new energy sources all play an important role in how Iowa prioritizes and maintains these critical systems.

The objectives and strategies under this pillar are intended to support the continued development of efficient and effective energy and transportation infrastructure that is critical to advancing our state's energy goals and this Plan.

Focus Areas of the Pillar

Unlike the other pillars, multiple focus areas arose during the planning process that warranted further evaluation and analysis related to transportation and infrastructure. These areas provide the backbone for many of the other pillar focus areas. Under this pillar, the need to build out natural gas for economic development in constrained areas, modernizing the electric grid and continuing to build out alternative fuel infrastructure are at the forefront.

Focus Areas

- Natural Gas Expansion in Underserved Areas
- Electric Grid Modernization
- Alternative Fuel Vehicles

Natural Gas Expansion in Underserved Areas

As noted in **Section: Iowa's Energy Landscape**, natural gas costs are low within the state and therefore an important energy source within the state. It is used for electricity generation, heating, and direct uses in manufacturing. Natural gas delivery is a complex process of production, processing, transportation, distribution, and consumption. While production and processing occur outside of the state, natural gas is transported into and through the state by five interstate pipelines that bring natural gas from Canada and the south and Southwest parts of the country; Iowa has four natural gas storage fields that have a combined capacity of almost 300 billion cubic feet.[103] At this time, slightly more than four-fifths of the natural gas entering Iowa continues on to markets in the Midwest and beyond.[104] Iowa is well positioned with ample natural gas supply access, which is not the case for other states.

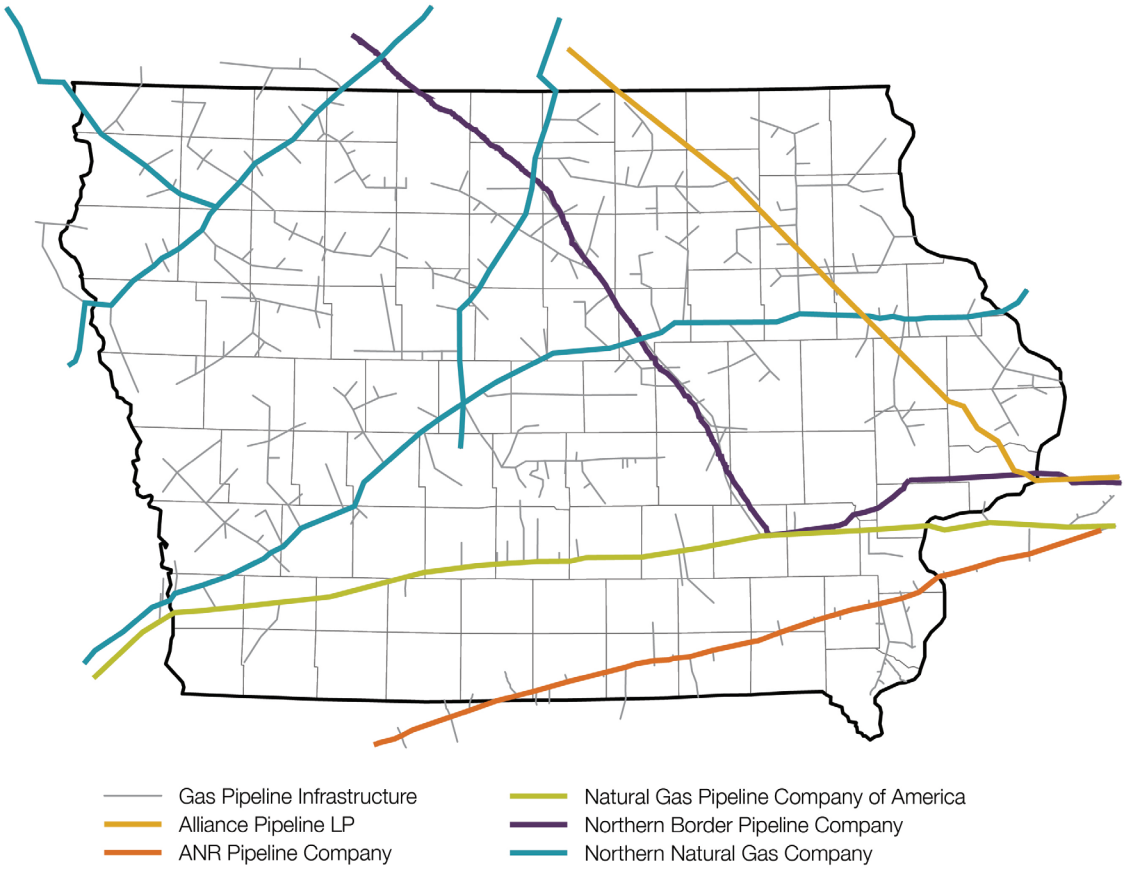

Figure 8. Interstate Pipelines Serving MidAmerican Energy

Despite strong growth of natural gas supply at the national level, many areas in Iowa lack access to natural gas service due to the prohibitive cost and the necessary time to extend existing natural gas pipelines and distribution systems where they do not exist or are capacity limited. These issues are often worse in areas farther from the interstate pipelines. In these areas that are not well served, it is difficult to attract new commercial/industrial activity or expand existing businesses. In some instances these communities have lost out on business opportunities because other out of state sites were selected. Often infrastructure such as roads or water service is built out and extended for industrial parks or site development areas in anticipation of economic development activities. This infrastructure might be paid for by local jurisdictions to serve the communities to increase economic development. While transportation or water services may fall under local jurisdiction or state jurisdiction, natural gas infrastructure and cost recovery is regulated differently.

For several years, Iowa utilities have been working with IUB and the natural gas suppliers to address additional capacity issues, but the limitations have continued to prompt discussions, especially in rural areas of the state that are looking to attract new businesses and manufacturing opportunities to their communities.[v] While capacity has been improved in many areas, one energy intensive manufacturing customer could use all of the additional capacity and still not have enough natural gas available to support its needs. In these areas the intent it not to replace propane as a fuel source, but to expand natural gas where it is a limiting factor to economic development activities.

IUB does allow natural gas utilities to recover investments to extend their distribution systems that are commensurate with the projected revenue from the new customers (typically three times the revenue). These amounts are generally not sufficient to cover the cost of expansion when the infrastructure need is significant and the number of potential customers in a proposed expansion area is small.

[v] Interstate pipeline companies are regulated by the Federal Energy Regulatory Commission (FERC). Because of this structure, the Iowa Utilities Board has no jurisdiction over the interstate pipeline companies[1] however, the IUB and/or the governing boards of municipal utilities do regulate retail natural gas service in the state, including safety and routing[2].

Source: [1] Wright, C., and LaRocca, B. Natural Gas Pipeline Constraints in Iowa. Retrieved from: http://pubs.naruc.org/pub/537736E6-2354-D714-51E9-54D6E984BF83; [2] Harvey, J. (2000, October). Facts Concerning the Natural Gas Industry and Its Regulatory Environment, Nationally and in Iowa. Retrieved from: https://iub.iowa.gov/sites/default/files/files/records_center/reports/NatGasFacts_2000.pdf

Expanding natural gas distribution infrastructure can be cost prohibitive when there is a one or a few customers. Existing customers cannot be adversely affected with rate increases or subsidize the cost of the new infrastructure. Typically new customers are responsible for paying for the cost of new distribution infrastructure. When a customer does not yet exist, it is not possible to pay for the infrastructure under the standard rate recovery structure. For this reason, some rural areas that are trying to attract new economic development opportunities are facing challenges in securing adequate natural gas.

Increasing the availability of natural gas to areas of the state where it is limited helps to diversify the energy options available for business recruitment. Additionally, natural gas infrastructure expansion can create jobs and economic growth within the manufacturing sector of the state.

Electric Grid Modernization

The electric grid powers our daily lives from turning on the lights to running the equipment our jobs require; it is a critical to the economy. The grid has fueled our nation's growth since the early 1900s; however, the grid of today does not have the necessary to meet the demands of the 21st century and beyond.[105] As the technology becomes increasing more advanced and digital, so do the electrical needs of the sectors driving the economy. The way in which power is produced is changing with the proliferation of utility-scale renewable generation, distributed energy resources sometimes called DERs, and energy storage. The increased use of electric vehicles (EVs), smart appliances and technology are changing the way the public desires to use electricity and moving from a one-way system to one that is much more complex. As a result utilities, have been implementing more advanced metering infrastructure (AMI) and the way these advanced technologies are transmitted, distributed, and managed is rapidly evolving. Another key area for this sector is increased cybersecurity risks.[106]

The electric power grid is a system that involves moving power from where it is generated to where it is used. For Iowa, it involves the sale and purchase of electricity within an established region. Iowa is connected to and served by two regional transmission organizations (RTO) - the Midwest Independent System Operator (MISO) and Southwest Power Pool (SPP) that are critical structural components of the electricity grid operations. Utilities in Iowa and in our neighboring states are connected to and supported by this network. Electricity is moved from where it is generated to, from, or within Iowa, and then moved along high-voltage transmission lines to the area needing power. The power is then transformed from a high-voltage to a lower voltage and moved along a system of distribution lines to individual businesses or homes for use. Distribution lines make up the largest network of lines within the state, estimated to contain ten times the line mileage of the transmission grid connecting them.[107]

The age of the existing infrastructure varies. Several lines including the MISO Multi Value Projects 3 and 4,[108] have been more recently constructed or replaced in the last few years while other lines or are more than 50 years old. More than half of the transmission lines reported to IUB are over 30 years old.[109] While RECs and municipalities do not report line totals to IUB, the infrastructure of those utilities also varies in age. Additionally, as new areas of wind or distributed energy are being developed within the state, it is important to identify areas where existing transmission and distribution capacity is limited. As the energy infrastructure continues to age in Iowa and around the nation, capacity is exceeded, and the need for new technologies becomes more apparent. To address these needs many states and utilities are pursuing grid modernization initiatives and adopting smart or advanced technologies. These technologies increase the efficiency, reliability, flexibility, and efficacy of the grid infrastructure in terms of both capacity and operations.

A modernized grid is essential for the prosperity, competitiveness, and innovation of the economy that increasingly relies on high quality power, and must integrate customers and their end-use decisions into grid operations, rather than assuming that "the grid" represents only supply-side actors and decision-makers.

Iowa's rural electric cooperatives have been early implementers of advanced technology, and are leading the way to increased reliability, two-way communication, and load management. As noted in the **White Paper: Iowa Energy R&D Core Competencies and Opportunities for Energy-Based Economic Development**,[110] prepared as part of the planning process and included as **Appendix G** to this document, leveraging the diverse characteristics of the Iowa energy grid in terms of utility types and sizes, renewable generation integration, distributed generation, etc. for the development and testing of grid management technologies and smart grid systems can be an economic pathway for the state. However, upfront costs of building out smart grid initiatives and grid modernization can be a substantial investment posing a challenge for both utilities and regulators because of the pressure to keep rates low.[111] Utilities in Iowa plan for updating and building out infrastructures when and where needed in their service areas. It is neither feasible nor prudent to build out the entire transmission or distribution system simultaneously, but there is a growing recognition that changes are needed sooner than planned to stay ahead of the rapidly changing environment. Therefore, it is important for utilities to work together to establish a vision for what the modernized grid should look like for Iowa, and look at ways to deploy advanced technologies in such a way as to meet the

state's rapidly changing electricity market while deferring infrastructure costs associated with new generation, increasing availability of high quality and reliable power, and supporting direct and indirect employment.

Alternative Fuel Vehicles

Iowa maintains its leadership role for ethanol and biodiesel by being the nation's top producer of these fuels and having programs in place to incentivize their use. The state's leadership has grown as these industries have matured. Consumers and businesses continue to benefit from expanded access to higher blends of ethanol and biodiesel at affordable prices. Diversification of transportation fuels brings energy security, economic advantages, and environmental benefits. According to the Annual Energy Outlook 2016, greenhouse gas emissions are growing more rapidly in the transportation sector than in the utility sector, and the auto industry is working to address this issue along with lowering other tailpipe emissions and increasing fuel economy.

Positioning the state to benefit from changes in the automotive industry and consumer demand requires comprehensive strategies that respond to these changes. Iowa has laid the groundwork for future success through programs like the Renewable Fuels Infrastructure Program housed at IDALS, tax incentives for biofuels, the Iowa Clean Cities program housed at IEDA and designated by the DOE, and the work of numerous stakeholders.

Over the past decade, the price per gallon of gasoline and diesel has fluctuated dramatically. According to the NACS Consumer Fuels Survey, 85 percent of consumers said that fuel prices have some or a great impact on their overall feelings about the economy. This correlation highlights the influence that gas prices have on consumer behavior. Although it is not the only deciding factor, the price of fuel does have an effect on how consumers shop for a vehicle. Alternative fuels can offer more consistent and affordable fuel prices for consumers and businesses with fleets of vehicles.

The DOE estimates that on a life cycle analysis basis - which addresses emissions from production stage to final usage/consumption - greenhouse gas emissions can be reduced up to 40 percent with corn-based ethanol, and up to 108 percent if cellulosic feedstocks are used compared to conventional gasoline production and use.[112] Strategies that help advance Iowa's biofuel industry will lead to higher diversification in available fuel sources for consumers and businesses, and also makes these fuel types more affordable to distribute, resulting in savings for customers and operators of fueling infrastructure.

The options and availability of alternative fuel vehicles is expanding and Iowans are taking advantage of these trends. For example:

- More than 78 percent of the diesel vehicles coming off production lines today are approved for the use of B20 biodiesel blends, and the average biodiesel blend purchased in Iowa reached B11 in 2015.
- Approximately nine percent of Iowans now own a Flex Fuel Vehicle, and there are over 200 stations offering E85 for these vehicles with additional sites dispensing E15 for 2001 and newer vehicles.
- There are 8 compressed natural gas stations in Iowa, with primary users being heavy-duty trucking and refuse companies.
- Propane providers are partnering with school districts to put more propane school buses into their fleets.
- Over 1,000 plug-in electric vehicles are registered in Iowa, and nearly 100 EVs charging stations are publically available.

Many of these developments have come to fruition in just a few short years.

Continued growth in the use of alternative fuel vehicles requires strategic collaborations with the renewable fuels industry, utilities, auto manufacturers, fuel retailers, and related industry stakeholders. This includes incentivizing alternative fueling infrastructure such as biodiesel terminal storage, blender pumps, liquefied propane gas and compressed natural gas stations, and electric vehicle charging stations. Addressing regulatory barriers that impact infrastructure development is key towards fostering successful business models, ensuring safe and smooth implementation. Collaborating with the ethanol industry and auto manufacturers to produce the next generation of highly efficient vehicles to optimally on ethanol is a critical pathway for sustaining industry growth.

Table 8. Transportation and Infrastructure - Strategy Impacts at a Glance

		Environmental and Public Health Impacts				Economic Impacts				Energy System Impacts			
Objective	**Strategy**	Air	Land	Water	Health	Jobs	Business Attraction	Energy and Technology Exports	Research and Development	Reduced Costs	Reliability	Affordability	Diversification
Utilize smart grid and other technologies to modernize Iowa's electricity systems.	1.1 Next Generation Grid Planning	^	--	^	--	●	●	●	●	●	●	●	●
	1.2 Grid Modernization Pilot Projects	^	--	--	^	^	^	--	^	^	^	^	--
Enhance the reliability and safety of Iowa's energy systems.	2.1 Energy Assurance Planning and Emergency Energy Regulation	^	--	--	^	●	●	●	●	^	^	^	●
Encourage the prudent maintenance and development of energy delivery infrastructure.	3.1 Natural Gas Infrastructure Expansion Implementation Group	--	--	--	--	●	●	●	●	●	●	●	^
	3.2 Rail Transportation of Crude Oil and Biofuels	--	--	--	--	^	●	^	--	^	^	--	--
	3.3 Ethanol Pipelines	--	●	●	--	^	●	^	--	●	^	●	^
	3.4 Propane Transportation and Use Improvements	^	--	--	--	●	●	●	●	^	^	^	●
Expand the use of Alternative Fuel Vehicles in Iowa.	4.1 Plan for Electric Vehicle Charging Corridors	^	--	--	^	^	^	●	^	^	^	^	^
	4.2 Alternative Fuel Vehicles Station Code Education	--	--	--	--	--	--	--	^	--	--	--	^
	4.3 Business Model Development for the Electric Vehicle Market	^	--	--	--	●	●	●	●	●	^	●	^
	4.4 Incentives for Alternative Vehicle Fueling Infrastructure	--	--	--	--	●	●	●	●	●	●	●	^
Optimize the movement of freight and people in Iowa to reduce energy use.	5.1 Freight Transportation Optimization	^	--	--	^	●	^	^	^	^	--	--	--
	5.2 Connected and Automated Vehicle Planning	^	^	--	^	^	^	●	^	^	--	^	--
	5.3 Passenger Transportation Optimization	^	--		^	^	^	●	^	^	--	^	--

^ Positive direct impact
v Negative direct impact
-- Neutral impact
● Unknown impact

Objective 1: Utilize smart grid and other technologies to modernize Iowa's electricity systems.

Strategy 1.1: Next Generation Grid Planning

Background

As the nation's energy infrastructure continues to age, capacity is exceeded, and new technologies becomes more apparent, many states and utilities are pursuing grid modernization initiatives. While there is no common definition for what the next generation grid should consist of, there is general consensus from stakeholders involved in modernization efforts that a modern grid will be equipped with technologies including smart meters, information technology, and industrial control systems that can facilitate concurrent sensing and monitoring, more efficient operation and asset optimization, automatic responses to system disturbances and two-way communication between systems.[113]

The modern grid will be more efficient, flexible, distributed, and better able to use more renewable sources of electricity. It will enhance resilience, safety, and security.[114] As a modern grid is developed, there will be impacts to generation, grid operations, markets, customers, utilities, and regulatory models as the grid should include both central and distributed generation sources with a mix of both dispatchable and non-dispatchable resources. As microgrids continue to be developed, they are anticipated to compliment future grid operations. Energy storage is a critical component of system design. Energy storage technologies are anticipated to increase the development of distributed, non-dispatchable resources such as small-scale solar photovoltaic systems.

To handle the complexities associated with the modern grid, operators will need the ability to predict conditions in close to real time using two-way communications from system components as well as sophisticated modeling and estimation capabilities. In some jurisdictions, the distribution grid could become a platform that will enable changes to the retail electric marketplace with wholesale-to-retail transactions and retail-to-wholesale transactions. Real-time communications and end-use devices and equipment will allow for increased automation and greater levels of energy efficiency, conservation, and peak demand reductions. Additionally, more safeguards to mitigate and protect against cyber, physical, and other threats will be critical.[115]

To account for these changes, considerable investment may be required; utility business models and the compensation structure will need to account for infrastructure development costs and may require revisions to account for upgrades depending on how quickly changes are implemented. Additionally, changes to current regulatory models may be required to ensure the modern grid benefits both customers and energy providers. States around the country are actively introducing legislation to address a broad array of smart grid-related issues, thus encouraging smart grid development while working to regulate emerging technologies and to protect consumer interests and concerns. As of the end of 2013 there were at least 61 enacted or pending bills being considered by 21 states.[116]

Iowa utilities have begun smart grid projects that are currently at various stages of implementation. The state has seen progress in AMI installations as well as several demonstration projects for investor-owned, rural electric cooperative, and municipal utilities. For example, the IAMU Smart Grid Demand Response Project comprised eight municipal utilities implementing advanced gird technologies. The project deployed AMI systems, a customer web portal, direct load control switches, programmable communicating thermostats, and a dedicated paging system to support demand response. These smart grid improvements go together with other necessary transmission and distribution system upgrades, which is why most of the projects in Iowa involve a suite of upgrade technologies and are occurring concurrently with general infrastructure upgrades such as new distribution substation construction and overhead wire updates.

Recommendations and Next Steps

Establish an implementation group comprised of electric grid infrastructure stakeholders and industry experts to develop an integrated grid modernization vision and plan for Iowa that includes an assessment of the benefits and costs, clearly defined desirable modern grid capabilities, and strategies to manage risks.

Additional Information, Resources, and Case Studies

The state of Illinois has already made significant progress towards the development of a modern grid with the anticipated deployment of over five million new AMI meters and more than $2 billion of modern grid investments that will be installed through 2018. These investments for customers of Commonwealth Edison and Ameren Illinois, the state's two largest investor-owned utilities, are the result of years of discussion regarding grid modernization and culminated in the Illinois Energy Infrastructure Modernization Act. Because of the law, utilities have the option to recover the costs associated with grid modernization under a new rate structure if they meet specific performance and investment mandates, with penalties for non-performance.[117]

The state of New York's largest utility, Consolidated Edison since 2005 has invested at least $1 billion on infrastructure upgrades and expansions and is in the middle of a four-year, $1 billion storm improvement program to strengthen the grid to prepare for severe weather events such as Hurricane Sandy. This plan for New York City and Westchester County includes advancing smart grid designs to help reduce customer outages, building and installing protective barriers around critical equipment, and redesigning two underground electrical networks.[118]

Strategy 1.2: Grid Modernization Pilot Projects

Background

As Iowa explores opportunities to pursue grid modernization efforts and deploy modern grid technologies, there will be a need to test how various technologies and approaches integrate with Iowa's existing grid systems. Pilot projects provide a means to move forward with modernization efforts in a carefully planned manner, understanding what works best for the various utilities in the state.

Incentivized pilot projects and other utility information sharing efforts can support direct and indirect employment in the industries providing materials and labor for smart grid projects and serve to attract business activity around companies providing state of the art smart grid solutions. Grid modernization efforts can have a positive effect on deferring generation infrastructure costs, increasing availability of high quality power, and producing savings for utilities which can be passed on to consumers. The costs to complete pilot projects will vary depending on scale, and the resulting impacts will also vary depending on the size of the utilities undertaking the projects.

Increased pilot project efforts can also serve to create an innovation hub in the region for utility scale deployment of new smart grid systems and position Iowa in adopting cutting edge grid modernization. Iowa is already a competitive performer regionally in energy-related innovation metrics despite its lower total state population relative to nearby states and can leverage existing research core competencies in advanced materials, grid systems, and energy efficiency towards pilot projects that would further enhance its position.

Recommendations and Next Steps

IEDA and other key stakeholders should encourage a variety of pilot projects through IUB's Notice of Intent (NOI) process to examine modernization of the grid, microgrid and energy storage technologies, load management, cyber-security, and opportunities to enhance resiliency and integration of renewables to the grid. All of Iowa's utilities, including investor-owned, municipal, and electric cooperative utilities, should be allowed to participate in the NOI process for grid modernization pilot projects. In recognition that IUB does not have regulatory authority over municipal and electric cooperative utilities, and should the NOI process be deemed as an unsuitable option for any of their potential pilot projects, then IEDA and other key stakeholders should collaborate with the municipal and electric cooperative utilities to investigate alternative pathways.

Objective 2: Enhance the reliability and safety of Iowa's energy systems.

Strategy 2.1: Energy Assurance Planning and Emergency Energy Regulation

Background

Energy assurance involves a set of policies, actions, and projects that are undertaken to ensure key assets will function and deliver energy services in the event of an emergency. States in collaboration with local and federal government and private industry can work together to reduce risk and vulnerabilities to energy infrastructure, and be prepared to mitigate and recover quickly from energy disruptions. These energy disruptions may vary from natural disasters to system and infrastructure failures, deliberate physical and cyber-attacks, and energy supply and price instability.

In 2012, the state of Iowa created an Energy Assurance Roundtable with agency and sector participation to develop Iowa's Energy Assurance Plan (EAP). The roundtable includes representatives from IUB, Iowa DOT, DNR, Iowa Homeland Security and Emergency Management Department (HSEMD), IEDA, and IDALS. The group meets to discuss relevant issues and is currently considering updates to the plan.

Through conducting supply chain optimization strategy assessments and developing robust energy supply disruption strategies for various energy sources in Iowa, the state can avoid unexpected temporary cost spikes to utilities and consumers during unexpected or emergency situations such as those experienced by propane users in 2013-2014 due to shortages in supply and the sharp price increases which resulted. Proactive, forecast-based planning can reduce the need for utilities to purchase costly short term energy fuels or spot generation capacity to cover crisis periods and prevent negative rate impacts for end consumers. Incorporating results of supply planning exercises into a common core of emergency response action plans shared across various key stakeholder groups can lead to better response times and more accessible reserve stockpiles to address emergency situations that occur.

Conducting energy disruption response and supply chain analysis across the variety of energy sources used in Iowa can help plan for and avoid unexpected losses in revenue for businesses and households due to mismatches in short-term supply and demand and the resulting negative price and sales impacts. In emergency situations, some negative economic impacts resulting from energy disruption may be unavoidable, but effective coordination of energy disruption planning efforts can allow state agencies to minimize the recovery time, which in turn mitigates any long-term damage to the state's economic growth trajectory.

Cybersecurity is an increasingly emerging threat to the security and reliability of the Iowa's energy systems, in particular to the electricity grid. Cyber-attacks can affect utilities of all sizes, causing disruptions and economic losses. Energy production and delivery systems are becoming more advanced as well as technologically and digitally connected. While independent energy owners and operators are responsible for their infrastructure and delivery systems, the state has a role to play in coordinating preparedness activities to minimize risks and vulnerabilities to the critically important energy system.

Recommendations and Next Steps

IEDA, IUB staff, Iowa DOT, HSEMD, IDALS and the Iowa Office of the Chief Information Officer (OCIO) working in partnership with utility representatives and other key stakeholders should continue to collaborate to update the state's existing EAP and synchronize risk management activities, emergency response preparedness efforts, and

cybersecurity. As the state's EAP is updated, the state should identify priority energy sources for developing a supply chain analysis. Using the Propane Supply Chain Study completed in 2016 as a baseline, develop a supply chain analysis procedure and that will be implemented for Iowa's highest priority energy sources. The state should develop guidance regarding the distribution of energy supplies, including the amount of fuel that may be reserved, under various circumstances and build upon the statewide emergency and response coordination procedures so that this authority is effectively exercised. Finally, the state should support efforts to assess and plan for cyber security preparedness with regards to critical energy infrastructure. Electric cooperatives and municipal utilities who may not have access to dedicated cyber security professionals should be the focus of the state's support.

Additional Information, Resources, and Case Studies

The DOE EAP initiative began in August 2009 providing funds to 47 states, the District of Columbia, two territories, and 43 cities to develop or refine their EAPs. Best practices that resulted from this initiative include the following:

- States and cities should review plans and update every one to two years.
- Require annual updates to state, local, and energy industry contact lists.
- Reference the EAP in the state's emergency response plans and as part of any ESF-12 Annex.
- Include energy assurance-specific duties in position descriptions of staff with those responsibilities.
- Require training for new staff and periodic refresher training for existing staff.
- Hold periodic energy exercises in states, and, if possible, multi-state regional exercises.

The National Association of State Energy Officials prepared a report on Petroleum Shortage Supply Management: Options for States. The report includes guidance for states in developing a State Priority End-User Program. The Priority End-User Program is designed to guarantee the availability of necessary supplies of petroleum-based fuels for priority end-users essential to ensure the health, safety, and welfare of the general public. Priority users would include essential service providers determined by the state or other legal authorities.

Because of prolonged power outages and damaged fuel supply systems from Superstorm Sandy in 2012, the New York State Strategic Fuel Reserve was established through the Fuel NY Initiative. The Fuel NY initiative is designed to mitigate disruptions to fuel distribution, and includes access to two fuel reserves in New York State and a gas station back-up generator program at strategic retail fueling stations.

Photo Credit: Stock Photo

Objective 3: Encourage the prudent maintenance and development of energy delivery infrastructure.

Strategy 3.1: Natural Gas Infrastructure Expansion Implementation Group

Background

Natural gas is an important fuel source of energy for Iowans, even though none is produced locally, as it provides energy for electricity generation, heating, and direct uses in manufacturing. Iowa is crossed by four natural gas pipelines that bring natural gas from Canada and the south and southwest parts of the country and play an integral role in delivering gas to Iowa customers. These companies are regulated by the Federal Energy Regulatory Commission. Because of this structure, the IUB has no jurisdiction over the interstate pipeline companies.[120] However, the IUB and/or the governing boards of municipal utilities do regulate retail natural gas service, safety, and routes in the state.[121]

Alliant Energy, Black Hills Energy, and MidAmerican Energy purchase natural gas from one of these four pipelines and then distribute it to their residential, commercial, and industrial customers. While Iowa is well served overall by natural gas infrastructure, there are areas with limited distribution infrastructure. This is particularly evident in the more rural areas of the state including portions of the northwest and central part of the state. In these areas, a distribution pipeline may not exist or an existing distribution pipeline may not have enough capacity to serve additional customers. With these constraints, it is often difficult for these areas to attract new commercial and industrial businesses or for existing businesses to expand their operations.

Building additional natural gas infrastructure to overcome these constraints can be costly. Utilities and suppliers have worked under the existing IUB regulations to increase capacity in constrained areas but several are still unable to leverage natural gas to their competitive advantage in recruiting new industries and manufacturing. Both the communities and utilities are interested in working together to find solutions, recognizing the economic benefits of growth and jobs created by attracting new business and expanding existing business in the state.

Recommendations and Next Steps

The IEDA, working in partnership with utilities and local economic development entities, should establish an implementation group to explore ideas for further build out of the natural gas delivery infrastructure in Iowa in rural areas. As a first step, the group would facilitate a mapping exercise of areas that have limited natural gas infrastructure and, as a result, have had economic development activities hindered.

Additional Information, Resources, and Case Studies

The state of Oregon, recognizing the challenges associated with the expansion of natural gas infrastructure, established a working group through legislation that directs the state's Public Utility Commission to study methods by which a public utility that furnishes natural gas may expand service to areas that do not have access to natural gas.[122]

In that study, the group evaluated the numerous issues and presented findings and conclusions on methods by which a natural gas utility may expand its distribution facilities to unserved communities. The group recommended potential changes to distribution expansion policies where existing customers pay for a larger share of the costs of a service extension to increase the amount of revenue to support expansion activities. In addition, the group identified but could not agree upon a series of legislative actions that could provide new sources of revenue for projects.[123]

Strategy 3.2: Rail Transportation of Crude Oil and Biofuels

Background

Iowa has an extensive railway system consisting of over 3,850 miles of railroad. In 2014, that system transported approximately two billion gallons of crude oil. In addition, Iowa produced approximately 26 percent of the nation's ethanol (3.92 billion gallons) in 2015, much of which was moved by rail.[124] The safe movement of these energy products is a critical priority for Iowa.

In 2015, Iowa DOT, in partnership with HSEMD, commissioned the Crude Oil and Biofuels Rail Transportation Study. The study, completed in April 2016, is intended to serve as a tool to assist Iowa's state and local governments to determine the status of risks and vulnerabilities, prevention methods and programs, and preparedness, response, and recovery capabilities for crude oil and biofuels railroad transportation incidents in Iowa. The study identified gaps to assist the development of policies, procedures and actions to further reduce risks and improve emergency response throughout the state.

Improvements to safety and education around various aspects of the rail transportation of crude oil and biofuels proposed by the study will have positive effects on the reliable delivery of these fuels to destinations and reduce the risk of adverse events which have the potential for significant cleanup and mitigation costs. In this way, the proposed strategy enhances safety. In addition, ensuring timely implementation of the recommended improvements and action steps also enables Iowa to continue the ongoing trend of increasing regional and national exports of fuel products via rail without any interruption due to safety or infrastructure aging concerns, and may incentivize further attraction of fuel distribution businesses that want to take advantage of a well-maintained rail system.

Recommendations and Next Steps

With the completion of the Crude Oil and Biofuels Rail Transportation Study, Iowa DOT and other stakeholders should move forward with implementation of the action steps identified. Priority action steps include working with local Emergency Managers to better develop response plans, working with emergency response personnel to ensure adequate training; and, reducing conflict points by eliminating redundant at-grade, railroad-highway crossings.

Strategy 3.3: Ethanol Pipelines

Background

Pipelines tend to be one of the safest, most reliable, and economical ways to transport liquid fuels and petroleum and natural gas supplies are often transported from refineries and other production centers to destinations via pipeline. However, ethanol is not routinely transported via pipelines as there are inherent challenges with transporting this fuel type by pipeline. First, ethanol's affinity for water and solvent properties require the use of a dedicated pipeline or significant cleanup of existing pipelines. In addition, the volume of ethanol being transported must also be great enough to overcome financial hurdles.[125]

During the plan development process, stakeholders noted that short distance pipelines for transporting ethanol should be considered in areas where ethanol is currently being shipped via truck to rail terminals. Additional supply chain and multi-modal analysis would be necessary to determine the economic feasibility of building a pipeline when compared to the costs of truck transport. However, new short-length pipeline capacity has the potential to produce positive energy and transportation system impacts by avoiding less efficient transportation methods and reducing risk of accidents from truck transport as well as diversifying available fuel sources through increased transport and access to biofuels.

Industries providing the goods and services used in construction, inspection, and operation of new short transit ethanol pipelines would receive a short-term increase in jobs and revenue, while the costs of financing the new pipeline would vary in economic impact depending on how the projects are financed either through private investment or public funds. Constructing a robust short-distance ethanol delivery pipeline would potentially have growth impacts on the ethanol producer industry due to cost savings for plant operators from drastic decreases in truck transportation costs from intermediate production points to major rail transportation hubs while at the same time increasing reliability of fuel product transportation. New short-distance capacity could also potentially have other positive economic impacts due to lower volumes of truck traffic on local roads and the resulting decrease in road maintenance expenditures.

Recommendations and Next Steps

Ethanol producers and affected renewable fuels stakeholders should investigate the feasibility and impacts of constructing pipelines along public right-of-way for plants not currently served by rail. The investigation should be done in collaboration with the Iowa DOT to look at supply chain benefits and affected local agencies if pipelines are sited in existing rights-of-way. IUB approvals would also be necessary.

Additional Information, Resources, and Case Studies

In late 2008, Kinder Morgan Energy Partners LP became the first U.S. company to ship a commercial batch of ethanol through its Central Florida Pipeline, an 85-mile stretch between Tampa and Orlando. Kinder Morgan's success is the result of extensive preparation and a $10 million investment to modify the pipeline, which was previously dedicated to gasoline service, so it could handle ethanol. The money was used to clean the pipe, replace ethanol-incompatible equipment, and expand capacity at Kinder Morgan's Orlando terminal so it could handle the shipments.[126]

Photo Credit: Alliant Energy

Strategy 3.4: Propane Transportation and Use Improvements

Background

In the winter of 2013-2014, residential and commercial users of propane in Iowa and other Midwestern states were challenged by a severe propane shortage and sharp price increases driven by:

- Colder than normal winter temperatures that further stressed a depleted propane supply for heating use and increased the cost to consumers;
- Closing of the Cochin pipeline for maintenance, a primary source of supply, for several weeks during peak 2013 demand with permanent reversal in 2014;
- Rail disruptions and lack of truck capacity limiting the ability to replenish inventories; and
- Lower Midwest inventories with an increase in propane exports and propane dehydrogenation demand.

To better predict and proactively respond to similar situations, Iowa DOT and other stakeholders completed a study titled Optimizing the Propane Supply Chain in the State of Iowa in September 2016. The study provided insights into the relative impact of improvement opportunities, as well as recommended actions. Recommendations are currently being implemented to monitor market conditions and infrastructure; communicate and educate the public, incenting behavior change, and incenting infrastructure investments.

Recommendations and Next Steps

The Iowa DOT, IDALS and other stakeholders, including the Iowa Propane Gas Association, should implement the recommendations and action steps from the propane supply chain optimization study. Examples include:

- Research and identify solutions at bulk terminals that would help ease long wait times to fill transports.
- Develop educational initiatives that provide information on the cost savings of filling tanks during the summer prior to the heavy grain drying and heating seasons.
- Require transport companies to run multiple driver shifts rather than extending the hours of service a driver can operate.
- Implement systemic monitoring including establishment of key performance metrics/thresholds that indicate the need for action.
- Convene a joint implementation group of state agencies and industry participants to encourage ongoing knowledge-sharing and communication.

Additional Information, Resources, and Case Studies

The New York Propane Gas Association created a consumer guide to Purchasing and using Propane Gas in New York State.

The National Propane Gas Association published the Propane Supply planning recommendations in 2014.

Objective 4: Expand the use of alternative fuel vehicles in Iowa.

Strategy 4.1: Plan for Electric Vehicle Charging Corridors

Background

Electric vehicles provide a variety of benefits to Iowans, including reduced emissions, energy-efficient and cost-efficient transportation, use of the state's growing renewable energy from the electrical grid, and protection from volatile petroleum prices.[127] In the summer of 2016, the IEDA commissioned a study to assess the current EV market in Iowa, forecast future market conditions and evaluate programs and policies that could potentially help the market meet these projections.[128] The Advancing Iowa's Electric Vehicle Market report indicates that, despite it being early in the market adoption phase, EVs are poised to grow in the coming decades due to the declining costs of batteries and vehicles, an increasing percentage of renewable energy in the state's electricity mix, the expanding number of charging stations, and automobile manufacturers' adherence to fuel economy standards.[129]

Alternative fuels and EVs will play an integral part in the future of America's transportation system," said U.S. Transportation Secretary Anthony Foxx. "We have a duty to help drivers identify routes that will help them refuel and recharge those vehicles and designating these corridors on our highways is a first step.[130]"

The report explored development of electric corridors along Iowa's main traffic routes. A network of charging stations located along interstates would serve the travel corridors with the highest vehicle counts, and would allow EV drivers to confidently and comfortably travel long distances and between communities.

The report identified Interstates 80, 35, 29, and 380 as potential EV charging corridors. It also determined that 19 Level 3[vi]/ DC Fast Charging stations would be needed to develop a full electric highway through the main interstate corridors of Iowa. However, more work is needed to develop a full plan for implementation and bring the corridor to fruition.

Figure 9. Recommended Level 3 EV-charging station locations for an electric highway

Source: Iowa Economic Development Agency. (2016, July). Advancing Iowa's Electric Vehicle Market. Retrieved from: https://www.iowaeconomicdevelopment.com/userdocs/documents/ieda/AdvancingIowasElectricVehicleMarketReport.pdf

[vi] *Direct current (DC) fast-charging equipment, also called Level 3, uses DC rather than AC to enable rapid charging, providing 50–70 miles of range per 20 minutes of charging time.*

The increased implementation EV charging infrastructure could have several positive effects on the state energy system in terms of decreasing the burden on fossil fuel supply of gasoline, increasing reliability of alternative transportation modes, and balancing loads on the electrical grid. Utilities have the ability to increase load without increasing generation facilities through optimizing charging during off-peak times to avoid wasted energy resulting in a net savings for the consumer and increased revenue for utilities. EVs can also mitigate peak loads by using vehicle-to-grid programs to discharge unused vehicle energy onto the grid when it is needed.

Installation of new charging stations and other necessary supporting infrastructure would create positive economic impacts for industries performing any initial construction efforts and continued operation of the charging corridor, and potentially have an indirect jobs effect through attracting businesses and individuals who prefer EV transportation options. Businesses who heavily utilize EVs or specialize in the manufacture, assembly, or distribution of EVs that could be enticed to relocate operations along the charging corridor to take advantage of the beneficial infrastructure. The charging corridor can also attract research efforts and innovative companies through providing a viable testing and product development environment with the necessary conditions to evaluate new technologies, spurring translational research efforts in the EV space and further helping establish Iowa as a regional hub for alternative transportation technologies.

Recommendations and Next Steps

The IEDA in coordination with the Iowa DOT should develop a detailed plan for the development of an EV charging corridor or corridors to enable EV owners, both locally and those visiting Iowa, to charge their vehicles more quickly and facilitate longer distance travel. This strategy is related to **Strategy 4.4: Incentives for Alternative Vehicle Fueling Infrastructure**, under this same objective.

Additional Information, Resources, and Case Studies

The West Coast Electric Highway, a network of Level 3 EV charging stations along Interstate 5 from Baja, California, through the Pacific Northwest, to British Columbia involved coordination among the Washington State Department of Transportation, the Oregon Department of Transportation, and a Governor's Office inter-agency group in California.[132] The West Coast Electric Highway established criteria for its DC fast-charging station locations to establish a consistent EV driving experience along the entire highway.

The Federal Highway Administration is required to designate Alternative Fuel Corridors as specified in the Fixing America's Surface Transportation Act. The first round of designations included Interstate 80 from Omaha, Nebraska to Teaneck, New Jersey, including the segment through Iowa with electricity as one of the specified alternative fuels. The result of this designation is expected to be enhanced coordination among public and private sector stakeholders as well as signage and branding to increase awareness. Additional nominations and designations are expected to take place in future years.[133]

Photo Credit: Stock Photo

Strategy 4.2: Alternative Fuel Vehicles Station Code Education

Background

As alternative fuel vehicles have become more mainstream, standards and codes have been developed to govern the installation of the charging or refueling infrastructure. These codes include National Electrical Code Article 625 for EV charging equipment, National Fire Protection Association 52 for natural gas fueling systems, and National Fire Protection Association 58 for Liquefied Propane Gas fueling facilities. These codes outline safety requirements for alternative fuel vehicle station infrastructure. In addition to safety requirements are states laws and local ordinances can impact where and how alternative fuel vehicle stations are developed and operated.

As the alternative fuel vehicle market expands, the industry will need to work closely with local officials, inspectors, practitioners, and code enforcers to ensure proper knowledge and familiarity with applicable code provisions and regulations. Code officials, inspectors, and local jurisdictions play an important role in helping the alternative fuel vehicle market develop. Permitting processes can occur more swiftly when officials are familiar with the language and intent of the codes. Similarly, facility inspections occur more efficiently when inspectors are familiar with products, installation types, and local ordinance requirements.

Training of code officials and inspectors will improve safety and result in more time-efficient installation of equipment, reduced complexity, and lowered costs to implementing alternative fuel infrastructure.

Recommendations and Next Steps

The DPS and coordination with IEDA should disseminate education and training programs for state and local officials and inspectors on the codes that are applicable to alternative fuel vehicle stations. In addition, the state should look for opportunities to enable interstate cooperation and make consistent technical support available to officials across all state and local agencies. Training programs and workshops can be developed by different entities that may include nonprofit organizations, universities, community colleges, and appropriate state agencies.

Additional Information, Resources, and Case Studies

The DOE Clean Cities Initiative, of which Iowa is a part, has funded projects that addressed a range of community infrastructure and training needs such as providing safety and technical training for fleet operators, mechanics, first responders, and code officials, and streamlining permitting and procurement processes.

The Metropolitan Energy Center in Missouri leveraged a federal Clean Cities grant to support vocational training programs for code officials and fleet managers, including managers at local colleges and technical schools. It also developed a best practices toolbox that resulted from a Codes Conference and Exchange.

The National Alternative Fuels Training Consortium develops curricula and disseminates training about alternative fuels, alternative fuel vehicles, and advanced technology vehicle education, including classroom and online learning formats for code officials.

Strategy 4.3: Business Model Development for the Electric Vehicle Market

Background

There are approximately 1,200 electric vehicles registered in Iowa, a combination of battery electric vehicles which run solely on electricity, and plug-in hybrid electric vehicles that also have an internal combustion engine to use when electricity is depleted. The variety of electric vehicle models available for purchase in the state is more limited than other areas of the country; some EV models are not available. Iowa currently has approximately 100 publically available EV charging stations, most of which are free to use and owned by the property owner. The market for electric vehicles in Iowa is growing yet barriers must be overcome to adequately enable its growth.

In order to further accelerate charging station development, many owners want to recover the cost of the charging infrastructure investment and are considering fee structures or are having the infrastructure owned and maintained by a third-party.

There are many different potential business models for EV charging stations, and the model that will work best depends on the locations and factors such as demand, the partners involved, the capital available, the income/return on investment expectations, local electricity regulations, price of electricity, and the anticipated utilization.

The development of these business models may require addressing potential regulatory issues, short-term and long-

term ownership, and/or revenue structures, and creatively capturing the indirect benefits of hosting a station. For example, EV station owners in Iowa cannot currently collect revenue by the kilowatt hour for the vehicle, yet owners can collect a fee for the parking spot or time-in-use. Another potential issue is determining whether utilities can own and operate public charging stations and under what conditions.

Flexibility in business model development for vehicle sales is necessary to expand access to electric vehicles for consumers. Adequate inventory and incentives for EVs at local dealerships as well as options for consumers to learn about and/or acquire the vehicles will have a positive impact towards increasing sales. Additionally, activities like test drives and electric car sharing programs provide consumers with first-hand experience to help consider whether an EV is right for them.

Recommendations and Next Steps

Ongoing communication and coordination with industry stakeholders is necessary to adequately adapt to changing technologies and the needs of the private sector to be successful. IEDA should support the industry's efforts to facilitate private sector investment and successful business models. The IUB staff should monitor the legal and regulatory issues associated with EV charging stations as the EV industry continues to mature in Iowa.

Additional Information, Resources, and Case Studies

The Center for Climate and Energy Solutions identified business models that, combined with near-term public support, could boost investment in publicly available EV charging. Their publication, Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers, draws on research from a two-year initiative to explore financing mechanisms.[134]

Strategy 4.4: Incentives for Alternative Vehicle Fueling Infrastructure

Background

Iowa has made significant progress with incentivizing ethanol and biodiesel use in the state. The markets for other alternative fuels, including compressed natural gas, liquefied propane gas, and electricity are also being developed to further promote cost-effective and sustainable choices for residents and businesses. However, the up-front cost of installing infrastructure is a barrier to expanding the availability and use of these fuels for consumers and businesses and widespread options are limited.

Incentive programs for alternative fuels infrastructure can aid economic growth in the fuel industries that operate the infrastructure, and create the necessary infrastructure for the end-users to commit to alternative fuels. Using alternative fuels such as propane, natural gas, and electricity can help Iowa's businesses and organizations with vehicle fleets secure more affordable and consistent prices for fuel which can make them more profitable and competitive for some fleets. Alternative fuels incentives can also yield positive externalities for businesses and government. For example, transportation firms that bid on deliveries for products must often deal with sustainability concerns and the use of alternative fuels allows them to meet these requests and potentially opens new markets for them. Public sector operations have also expressed interest in operating alternative fuels vehicle fleets which would allow them to reinvest savings for other priorities.

Recommendations and Next Steps

Alternative fuel industry stakeholders should develop incentive proposals and consult with state officials to recommend incentives that could be in the form of a tax credit or rebate, and should be coupled with strategies to leverage private funding. Consideration should be given to other states' approaches towards alternative fueling infrastructure incentives, as well as the unique factors and needs associated with each alternative fuel.

Additional Information, Resources, and Case Studies

Many utilities across the country, including Alliant Energy in Iowa, are offering incentives for EV charging infrastructure. These incentives, such as the ones proposed in this strategy, are intended to increase the rate of installation of EV charging infrastructure.

The Mid-America Alternative Fuels Corridor Study focuses on fueling stations for compressed and liquefied natural gas, liquefied propane gas, and biodiesel for heavy-duty class 7-8 trucks along interstate highways in Missouri, Kansas, Nebraska, and Iowa. This study collected information on existing stations, known stations planned for completion in 2015, vehicle miles traveled on selected interstates, projections on heavy-duty truck alternative fuel vehicles and

traffic, and signage for stations offering alternative fuels. The study includes recommendations for numbers, locations and types of alternative fueling stations along identified corridors.

Several states have tax credits and rebates for alternative fueling infrastructure tax. A couple of examples include the states of Missouri and Arkansas. Missouri provides a 20 percent tax credit of the costs directly associated with the purchase and installation of any alternative fuel storage and dispensing equipment or EV supply equipment, up to $1,500 for individuals or $20,000 for businesses. Arkansas provides rebates for compressed natural gas, liquefied natural gas, and propane fueling stations in the amount of 75 percent of qualifying costs, up to $400,000.[135]

Several states have used their collaborative purchasing power to boost deployment of emerging alternative fuel and advanced vehicle technologies, most recently for natural gas vehicles and zero emission vehicles.[136]

Photo Credit: Iowa Propane Association

Objective 5: Optimize the movement of freight and people in Iowa to reduce energy use.

Strategy 5.1: Freight Transportation Optimization

Background

Iowa has access to an extensive multimodal transportation system of roads, highways, rail, waterways, and aviation. However, there are opportunities to better and more efficiently use the system to reduce energy use and transportation costs for all users while also supporting new economic development. To accomplish this effort, Iowa DOT and IEDA developed the Iowa Freight Transportation Network Optimization Strategy. This effort, that is the first of its kind in the nation, used a demand-based supply chain network design and an optimization methodology to identify and prioritize investment opportunities, in order to make informed investment decisions that result in lower transportation costs and lower energy costs.

Using optimization tools to determine best practices for multi-model freight movement helps to avoid unnecessary fuel and energy usage reducing the overall cost of transportation and lowering fuel product consumption by providers of transportation services. Optimization strategies do not have other direct impacts on the energy system, but do improve the aggregate reliability of the transportation network as well as increasing responsiveness to demand for transportation services and reducing traffic volume related to those services. Applications of optimization and planning exercises can be used to position Iowa as a key location for innovative transportation solutions and operations, making it attractive for businesses to locate operations and distribution hubs in the state due to lower transportation costs. The ability to move goods more efficiently can also lead to increased exports of goods and services, as cost burdens to businesses for long distance commerce will be lower.

Recommendations and Next Steps

The Iowa DOT and IEDA should implement actions and measures using the freight network optimization strategy and other tools to improve the efficiency of Iowa's multimodal freight transportation network. This should include using existing programs to support intermodal connections to assure freight is moved in the most efficient/low-cost manner; supporting Iowa businesses and industries as they evaluate ways to lower their transportation costs; and, implementing new federal freight programs to address multimodal freight bottlenecks on the system. The Iowa DOT should partner with other jurisdictions, states, and the federal government to identify and implement innovative strategies that improve access to and reliability of transportation on the Missouri and Mississippi River systems.

Additional Information, Resources, and Case Studies

As mentioned above, Iowa set the standard for freight transportation optimization analyses and has been recognized for its efforts by states such as California, and in industry publication like American Shipper.

Strategy 5.2: Connected and Automated Vehicle Planning

Background

The Iowa DOT is in the beginning stages of a transformation in the transportation industry that relies on the development of connected and automated vehicles. Connected vehicles are vehicles that communicate with the driver, other vehicles, and roadside infrastructure, while fully automated vehicles would be labeled as self-driving. There are differing opinions on how quickly this new technology will become mainstream, but it will likely occur sooner than many expect.

The National Highway Traffic Safety Administration issued a policy update for states considering automated vehicles and covered four topics: vehicle performance guidelines, model state policy, the agency's current regulatory tools, and suggestions for possible new regulatory actions. There are currently nine states and Washington DC with policies in place, with numerous others in discussion.

The benefits to these new technologies include large reductions in fatalities, improved energy efficiency, reduced need for new infrastructure, and new opportunities for changes in land use patterns and vehicle ownership. There are, however, challenges associated with how this new technology is transitioned and integrated with the existing infrastructure and vehicles.

Recommendations and Next Steps

The Iowa DOT, in partnership with the University of Iowa, Iowa State University, local jurisdictions, planning agencies, and the private sector should develop a cutting edge, ready-for-implementation platform for connecting and guiding automated vehicles based on a high-definition dynamic mapping, predictive travel modeling and a cloud-based communication network.

The project, called Ignite Iowa, is intended to initially deploy technologies that support automated vehicles regionally along several project locations in Iowa in the Cedar Rapids-Iowa City transportation network. The area will be prepared for deployment in early 2017. Additional funding is being pursued to allow deployment in the Des Moines-Ames metropolitan area including Interstate 35 and Interstate 80 across Iowa.

Additional Information, Resources, and Case Studies

The National Highway Traffic Safety Administration published the Federal Automated Vehicles Policy in September 2016. The policy document helps guide and accelerate the development of advanced automated vehicle safety technologies, including fully self-driving cars. The document is meant to be agency guidance in order to speed the delivery of an initial regulatory framework and best practices to guide manufacturers and other entities in the safe design, development, testing, and deployment of highly automated vehicles.

The American Association of Motor Vehicle Administrators hosts an Autonomous Vehicle Best Practices Working Group with the aim of working with law enforcement, federal agencies and other stakeholders to gather, organize and share information related to the development, design, testing, use and regulation of autonomous vehicles and other emerging vehicle technology. The group is working on the development of a best practices guides to assist member jurisdictions in regulating autonomous vehicles and testing the drivers who operate them.

The National Conference of State Legislators has a database of Autonomous/Self-Driving Vehicles Legislation that has been published at the state level since 2012.

Strategy 5.3: Passenger Transportation Optimization

Background

Iowa has a large road network that provides excellent accessibility and mobility opportunities for those who own a car or have access to public transportation. However, there are challenges to providing access for everyone in a low-cost manner. Some of these challenges include an aging public transit fleet and congested urban corridors that require large investments to increase capacity.

Optimization of passenger transportation options to most efficiently serve the various needs of Iowans can result in avoided energy costs of unnecessary fuel usage and thus make transportation more affordable by passing on energy savings to consumers. In addition, improved passenger transportation efficiency has been shown to have positive effects on industry growth through lessening vehicle congestion and providing cost-effective commuting options for employees. Critical to the ongoing success of meeting demand for passenger transport will be innovative infrastructure and software tools that can address specific local passenger conditions across a distributed transportation grid in a timely and safe manner.

As discussed in the Connected and Automated Vehicle Planning Strategy, there will be transformational changes in how passengers utilize the system in the near future. This includes the utilization of transportation network companies

or providers such as Uber and Lyft and also recognizes a shift away from vehicle ownership to vehicle service subscriptions, in addition to other new technologies.

Recommendations and Next Steps

Iowa DOT should partner with other state agencies, public transit agencies, and stakeholders to identify and implement initiatives to provide passenger transportation options that reduce single-occupant vehicle travel. Ongoing and new initiatives led by Iowa include:

- Continuing to make federal Congestion Mitigation and Air Quality Improvement Funds available for public transit bus replacement and new service.
- Coordinating transportation services through the Iowa Transportation Coordination Council.
- Continuing to partner with stakeholders to implement a new web-based statewide rideshare program (iowarideshare.org) that allows Iowans to find viable commute options including carpool partners, cycling buddies, transit routes, and more.
- Seeking opportunities to address commuting needs along heavily travelled corridors to reduce the need for highway investments and to mitigate traffic challenges during construction.
- Adopting a new bicycle and pedestrian plan to support improved accommodation of bicyclists and pedestrians along the primary highway system.
- Establishing a task force to develop an action plan that assures Iowa is prepared for the shift in how passengers move in the state with the advent of automated and connected vehicles and new models for accessing transportation services.

Additional Information, Resources, and Case Studies

The state of Arkansas is currently completing a planning process to develop a Bike and Pedestrian plan.

In 2014, the state of Illinois released the Illinois Bike Transportation Plan which offers policies, best practices and strategic direction for implementing a sustainable, multimodal transportation system in Illinois.

Minnesota Statewide Bicycle System Plan presents a vision and goals that align with Minnesota GO's 50-year vision for transportation.

Photo Credit: Iowa Department of Transportation

Putting the Plan into Action

Iowa is home to the resources, human capital, and innovative and world-class businesses and institutions that are the foundation to achieve the recommendations laid out in the Iowa Energy Plan. The recommendations included herein have been developed to harness Iowa's assets to provide clean, reliable, and affordable energy for all Iowa residents and businesses. This plan is a call to action for Iowa's leadership to work together toward a clean energy future.

The most crucial step in this planning process is what happens next – implementation. The Iowa Energy Plan is a tool for Iowa's state agencies to work together to create a concrete path for moving forward. Recommendations throughout this plan require coordination and communication between, state agencies, energy stakeholders, and the legislature to ensure timely and efficient implementation. Similarly, state agencies must strive to collaborate with local governments and to encourage them to use this plan as a means for developing and aligning local efforts that highlight the unique resources and priorities of their communities.

The work of individuals, municipalities, universities, business organizations, nonprofits, and energy trade organizations and associations will be essential to the success in implementing this plan. As Iowa looks to implement these strategies, it will continue to work with the private sector in supporting these efforts, and to coordinate and share best practices.

Given the varied nature of the strategies recommended in this plan, there will be a variety of paths and processes to move each strategy forward and achieve the plan's objectives. As part of implementation, more detailed quantitative analysis around costs and benefits will be necessary for some strategies. Performing a more comprehensive economic impact evaluation, while considering environmental impacts, will aid decision-makers in determining how strategies can be implemented in particular around focus areas.

The Iowa Energy Plan does not end here. Rather, this marks the beginning of continued coordination around energy-related efforts. The momentum that came out of the stakeholder process, including the working groups and public forums has set the stage for Iowa to continue its energy success and the Iowa Energy Plan provides a clear pathway for us to lead together into the future.

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