IOWA ENERGY PLAN

EXECUTIVE SUMMARY

Collaborate locally.
Grow sustainably.
Lead nationally.

December 2016

IOWA ENERGY PLAN IS A JOINT INITIATIVE BETWEEN

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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.

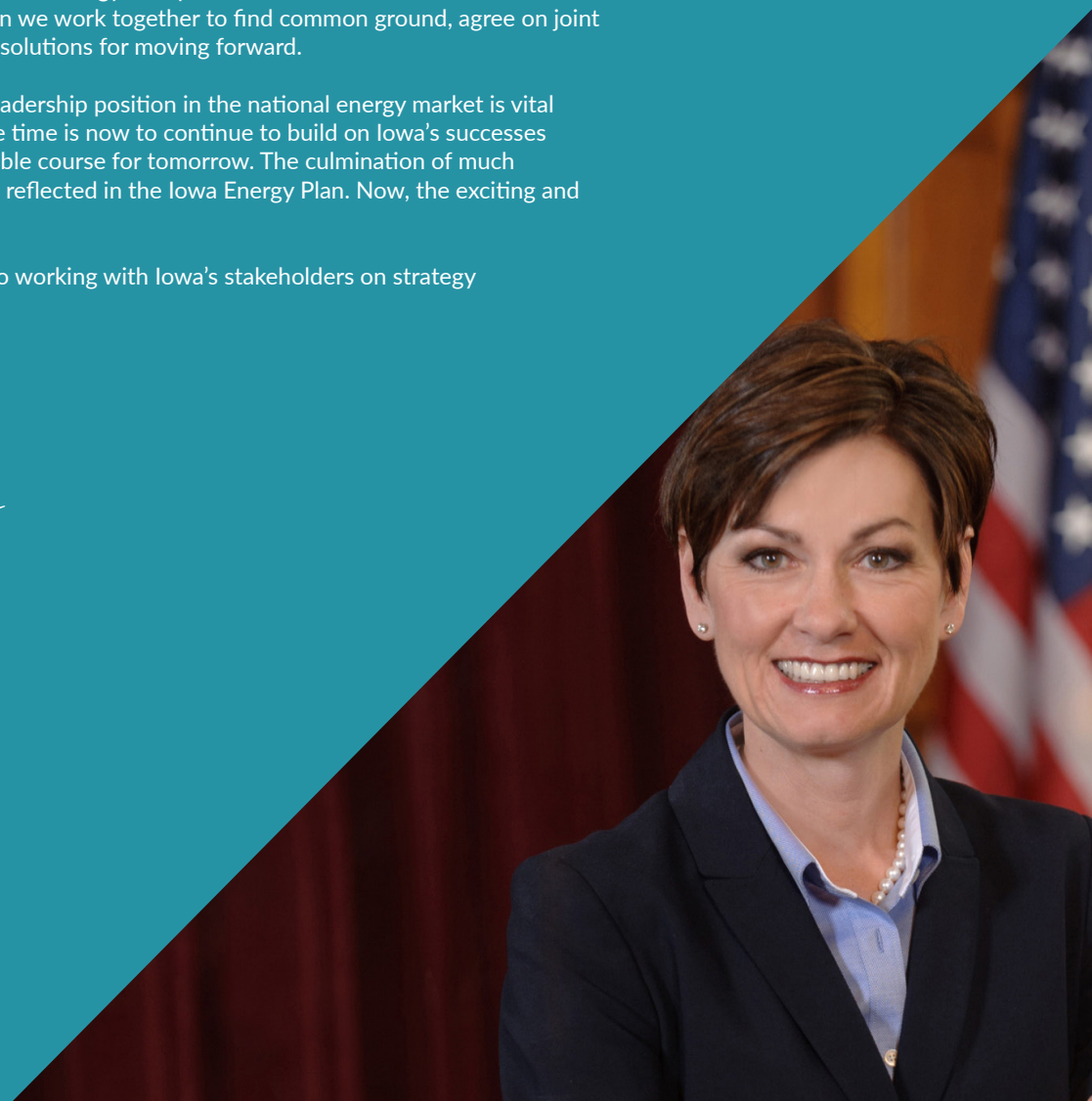
Ensuring that our state remains in a leadership position in the national energy market is vital for the future growth of our state. The time is now to continue to build on Iowa's successes by charting a sustainable and predictable course for tomorrow. The culmination of much collaboration amongst stakeholders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

Kim Reynolds
Lieutenant Governor
State of Iowa



Over the years, Iowa's leadership has recognized that the state is uniquely positioned to become a national leader in the energy space. From the abundant wind that ripples the plains, ample agricultural material to produce biofuels like ethanol and biodiesel, supportive policies that encourage innovation and a diverse group of stakeholders willing to engage in productive conversation – the climate in Iowa is ripe for collaboration to capitalize on its energy advantages.

In 1983, Governor Terry Branstad signed into law the nation's first renewable portfolio standard (RPS). The law required the state's rate-regulated utilities to purchase a certain amount of renewable energy. In the early 2000s, policymakers in Iowa recognized the state was at a crossroads concerning the amount of available baseload generation. In response, a new law known as the "advanced ratemaking statute" was passed and then expanded, which provided regulatory certainty regarding building baseload generation, encouraged the development of transmission resources as a way to encourage economic development and eliminated the prohibition of investor-owned utility ownership of renewable energy facilities.

Because of these progressive policies, Iowa is now a national leader in the wind energy industry. Iowa currently generates 35.8 percent of its electricity from wind power, generating enough electricity to power the equivalent of more than 1.6 million average U.S. households. The growth and development of renewable energy provides Iowa with a unique and unmatched economic advantage. The ability to attract and retain businesses due to the renewable resources Iowa offers, places the state on the world map for new economic opportunities.

The constantly changing energy sector is, and will continue to be, a challenge for policymakers. The status quo is not an option. To build upon Iowa's energy sector momentum and to explore opportunities for expanded economic growth, in 2015, Governor Branstad and Lt. Governor Kim Reynolds announced the development of a comprehensive state energy plan. The Iowa Energy Plan was created to provide a clear path to ensure Iowans have access to affordable, reliable, clean energy, while recognizing energy's strategic importance to Iowa's economy. It solidifies Iowa's place as a global trailblazer for energy initiatives.

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 iowaenergyplan.org.

To leverage local expertise from a variety of disciplines and industries, 48 individuals were selected through an application process to form four working groups. 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.

The Path Forward

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:

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

A vision statement and guiding principles for the plan were developed through consultation with the plan's leadership and development teams, 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 10 years.

Portfolio of Recommendations

A total of 15 objectives and 45 strategies make up the Iowa Energy Plan. Together, these objectives and strategies propose a balanced approach to encourage growth in all of Iowa's energy sectors while emphasizing sustainable practices, economic development throughout the state, and supporting the research and development required to keep Iowa on the leading edge of energy innovation.

Key Focus Areas

Further, and as identified during the planning process, key themes were identified that could positively impact Iowa's energy economy. Examples include:

- Energy Workforce Development – ensuring that Iowa is able to attract and train professionals to meet the state's future energy needs.

- Technology-based Research and Development – further building upon Iowa's R&D strengths from its state universities, combined with innovative manufacturers' and collaborative state and private partnerships to develop and bring to market new energy technologies, such as energy storage pilot projects.

- Supporting Rural and Underserved Areas and Populations - the need for Iowa to further support rural and underserved areas and vulnerable populations through opportunities for greater access to energy efficiency expertise, training, programs and cyber security preparedness for small utilities.

- Natural Gas Expansion - a need was identified to support the expansion of natural gas build out to rural communities where its absence is a limiting factor to economic development activities.

- Iowa's Biomass Potential – as a productive agricultural state, Iowa has great potential to benefit economically and environmentally by further realizing the value-added attributes of biomass in the development of bioenergy, biofuels, biochemicals, etc.

- Alternative Fuel Vehicles - as fuel economy standards have become increasingly more stringent, the need for automakers to embrace diversification of transportation fuels and vehicles has been amplified. Iowa, rich with ethanol and biodiesel resources, has an opportunity to help the auto industry meet its fuel economy targets, while furthering state economic gains.

  A growing electric vehicle (EV) market and a build out of its charging infrastructure would positively impact Iowa's economy by attracting businesses and individuals who prefer EV transportation options.

- Electric Grid Modernization - as energy infrastructure continues to age, capacity is exceeded and new technologies emerge, electric grid infrastructure stakeholders and industry experts should establish a vision for what the modernized grid should look like for Iowa.

Iowa Energy Plan Organizational Structure and Portfolio of Objectives

VISION

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.

GUIDING PRINCIPLES

- Foster long-term energy affordability and price stability for Iowa's residents and business.
- Increase the reliability, resiliency, safety and security of Iowa's energy systems and infrastructure.
- Provide predictability by encouraging long-term actions, policies and initiatives.
- Support alternative energy resources, technology, and fuel commercialization in proven, cost-effective applications.
- Stimulate research and development of new and emerging energy technologies and systems.
- 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.
- 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.

PILLARS / OBJECTIVES

Economic Development and Energy Careers	Energy Efficiency and Conservation	Iowa's Energy Resources	Transportation and Infrastructure
Facilitate the development of diverse financing options for widespread adoption of energy efficiency and renewable energy practices and technologies.	Increase the energy efficiency and decrease the operating costs of Iowa's existing and new buildings in all sectors.	Increase utility-scale renewable energy generation in Iowa.	Enhance the reliability and safety of Iowa's energy systems.
Foster innovation and increase the commercialization and expansion of energy-related businesses and technologies.	Encourage the expansion and diversification of energy resources, incentives, and programs.	Support distributed renewable energy generation including wind, solar, and other clean energy resources in Iowa.	Utilize smart grid and other technologies to modernize Iowa's electricity systems.
Strengthen energy education and awareness throughout Iowa.	Lead by example in Iowa's government practices.	Increase biofuel production and usage in Iowa.	Encourage the prudent maintenance and development of energy delivery infrastructure.
Increase the local talent pool for energy-related careers while promoting employment and training opportunities in the energy sector.			Expand the use of alternative fuel vehicles in Iowa.
			Optimize the movement of freight and people in Iowa to reduce energy use.

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 operating 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 in economic development and set the stage for growth in the energy space by continued capitalization of low-cost renewable and alternative energy options.

Photo Credit: Alliant Energy

Focus Areas

- Technology-based Research and Development
- Workforce Development

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. Thanks to both, Iowans and the companies who call it home enjoy continued low energy costs, and increasing renewable energy and diversity. The state utilizes this strategic advantage when attracting new businesses and citizens to the state.

To build on the momentum of the growing energy sector, it will be integral to continue and expand collaborations and partnerships among industries, educational and government partners. Working together, these efforts will help identify industry sector energy needs and assist in the development and deployment of an energy pathway that capitalizes on a skilled and trained workforce to meet Iowa's current and future energy labor needs.

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 – like blade producers TPI Composites in Newton or Siemens in Fort Madison – 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 a 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 startup-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.

An 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.

Workforce

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 Iowa's future energy force needs.

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.

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.

Energy efficiency is often referred to as a "least-cost resource," meaning that it is the single most cost-effective tool 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 are 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 Energy Center conducts and sponsors energy efficiency research. Leading by example, the Iowa Utility Industry, in partnership with Iowa Economic Development Authority (IEDA) and Energy Center, offer programs like the Iowa B3 Public Buildings Benchmarking Program 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.

Focus Area

- Supporting Rural and Underserved Areas and Populations

There is a growing emphasis within the state 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 offer assistance to 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).

Photo Credit: City of Dubuque

Support for Rural and Underserved Areas

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 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 no programs at all. 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. 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 cost. 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 in 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. 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 that make 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.

Iowa's 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 receive lease payments to house wind turbines on their 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. Alliant Energy is continuing to invest substantially in the conversion to natural gas and the addition of wind and solar energy to its portfolio. 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 solar array was split into units of 170 watts per unit and purchased by both Cedar Falls Utilities' customers and businesses. One key element of the success of the project was the affordable cost of each unit. This year nearly a dozen Iowa electric cooperatives are deploying plans to add solar energy to their generation portfolios. Iowa is also seeing a growth in community-owned wind projects. 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.

Focus Area

- Iowa's Biomass Potential

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 assets as the state makes larger investments in clean energy. 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, Iowa Utilities Board (IUB) issued a net metering order that addressed meter caps and annual crediting for all customer classes for a period of three years. This allowed IUB to collect data regarding how utility tariffs are working.

Discussions during the development of the plan also included the role that hydroelectric and nuclear energy can play. Iowa has one nuclear power plant, and the working group decided 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 ranked Iowa

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.

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 U.S. Environmental Protection Agency 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. 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.

The energy landscape is changing across the country and in Iowa. As the state continues to grow its energy resources, remaining a leader by investing in a new clean energy economy through support of existing industry and natural resources, will be essential.

Biomass

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.

Biomass is organic material from plants and animals that can be utilized to produce bioenergy, biofuels and biobased 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 and combusted to power a turbine, similar to coal. 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 fuel. 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.

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. Iowa has the anticipated biomass potential to support a digester in every county of the state.

The Core Competency Report prepared as part of the planning process for Iowa, 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 eighth 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 hours 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 into a bio-oil that can be processed into renewable fuels, biochemcials 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.

Transportation and Infrastructure

The transportation and infrastructure pillar is the most broad 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.
- 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.
- Natural gas pipelines, including five major interstate pipelines.

The efficient movement of goods and people is foundational to the state's economy. 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 Iowa and the nation. Transportation and energy infrastructure, while enabling a high quality of modern life, also provides the foundation of the state's economic system. The system enables Iowans to sell its products around the country and around the globe.

Focus Areas

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

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.

Photo Credit: Growmark

Natural Gas Expansion in Underserved Areas

Natural gas costs are low in Iowa, and therefore offers 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. At this time, slightly more than four-fifths of the natural gas entering Iowa continues on to markets in the Midwest and beyond. Iowa is well positioned with ample natural gas supply access, which isn't the case for other states.

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. 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. 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 is 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. 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 capacity.

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 attributes necessary to meet the demands of the 21st century and beyond. 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, 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 and the way these advanced technologies are transmitted, distributed, and managed is rapidly evolving. Another key area for this sector is increased cybersecurity risks.

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 - 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 10 times the line mileage of the transmission grid connecting them.

The age of the existing infrastructure varies. Several lines including the MISO Multi Value Projects 3 and 4, 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. While rural electric cooperatives 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.

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. 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. 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

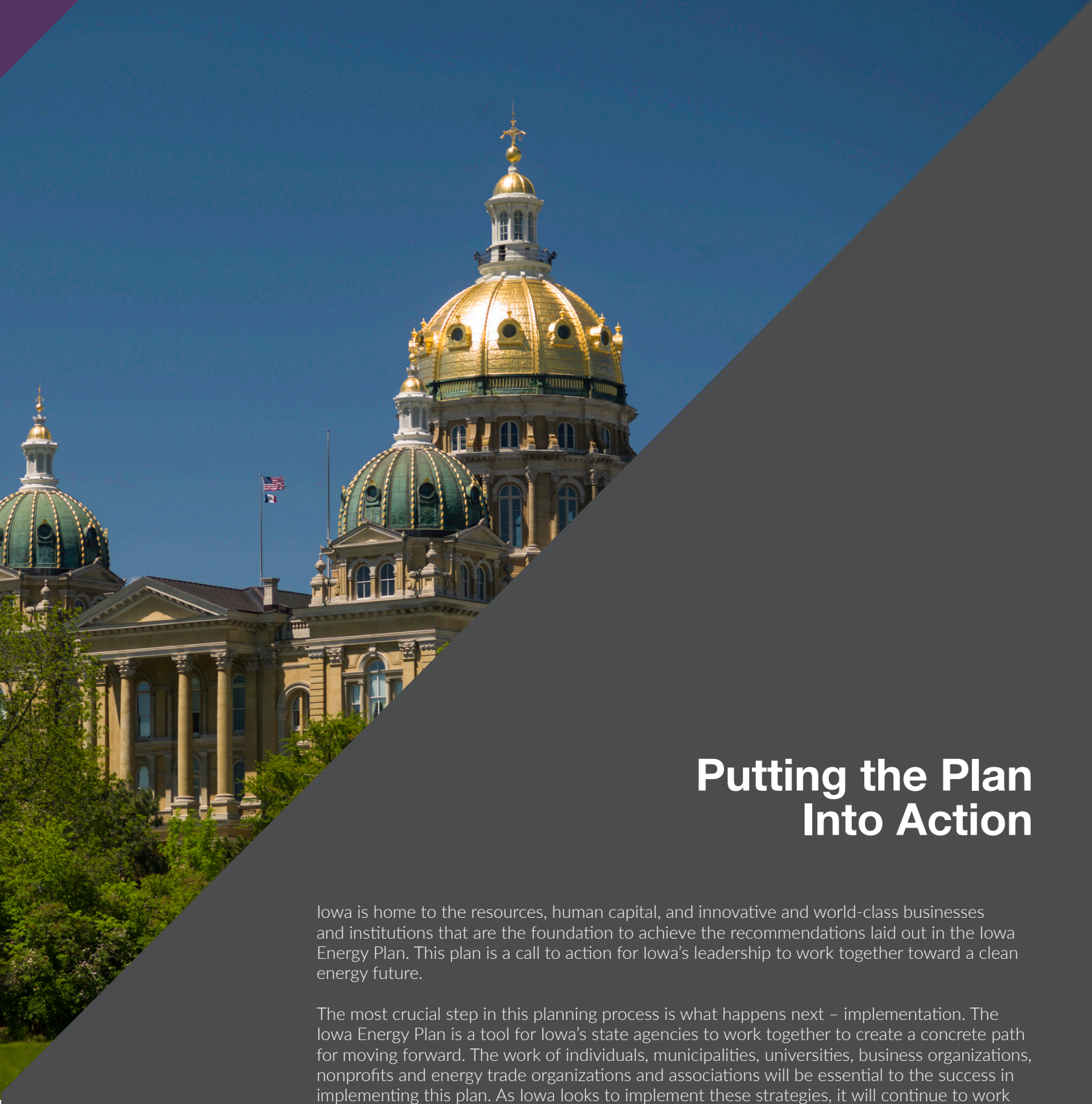
Iowa is the nation's top producer of ethanol and biodiesel and maintains its leadership role by having programs in place to incentivize their use. Consumers and businesses continue to benefit from expanded access to higher blends of ethanol and biodiesel at affordable prices. Diversification of transportation 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, tax incentives for biofuels, the Iowa Clean Cities program, 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 Department of Energy 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. Strategies that help advance Iowa's biofuels 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.

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 run optimally on ethanol is a critical pathway for sustaining industry growth.



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. 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. 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.

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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