IOWA ENERGY PLAN

APPENDIX A:
Acknowledgements

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Prepared by Inova Energy Group

December 21, 2016

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APPENDIX B:
Summary and Highlights from Energy Forums

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Prepared by Inova Energy Group

May, 2016

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I. OVERVIEW

In an effort to provide opportunities for interested stakeholders and members of the public to provide suggestions and ideas that will be considered in the development of the Iowa Energy Plan the Iowa Economic Development Authority (IEDA), in collaboration with the Iowa Department of Transportation, held six public forums in March and April 2016. Citizens were encouraged to come, meet the plan development team, and provide thoughts and opinions.

The forums followed an open house format with informational exhibits and project team members available for one-on-one discussions with attendees. An informational presentation about the energy plan and the planning process was given at each meeting, approximately one-half hour after the meeting start time. After the presentation attendees were encouraged to break out into four main groups to engage in a facilitated discussion around each of the four pillars that serve as the foundation of the Iowa Energy Plan:

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

The objectives of the energy forums were:

- To **communicate the plan development process** to the public and allow questions to be asked of the development team.
- To **share initial findings from an assessment of Iowa's Energy Position** that was prepared by the plan development team, as a means of informing the public of the current status of energy in Iowa.
- To **allow the public to communicate suggestions and ideas** on the plan development process, goals for the plan, and implementation strategies.
- To **identify areas of interest and/or concern** in various regions of the state, **as well as energy-related best practices** and case studies.

Attendees received several informational handouts and comment cards. They were also encouraged to submit comments in writing, either through the comment cards or via the Plan's website. All materials distributed during the forums are available on www.iowaenergyplan.org.

This report includes a summary of meeting attendance and highlights of the energy forum discussions.

II. MEETING LOGISTICS

The forums were held at the locations and venues identified below:

AMES – TUESDAY, MARCH 29,
5:30 P.M. TO 7:30 P.M.
Iowa State University (Iowa State Center), Scheman Building, Room 204
1805 Center Dr., Ames, IA 50011

STORM LAKE – WEDNESDAY MARCH 30,
5:30 P.M. TO 7:30 P.M.
Buena Vista University, Dows Conference Center
610 W 4th St., Storm Lake, IA 50588

COUNCIL BLUFFS – THURSDAY, MARCH 31,
5:30 P.M. TO 7:30 P.M.
Iowa Western Community College
Looft Hall Conference Center. Room 006
2700 College Rd., Council Bluffs, IA 51503

OTTUMWA – TUESDAY APRIL 12,
5:30 P.M. TO 7:30 P.M.
Indian Hills Community College - The Formal Lounge (Building C)
525 Grandview Ave., Ottumwa, IA 52501

CEDAR RAPIDS/MARION – WEDNESDAY, APRIL 13,
6:00 P.M. TO 8:00 P.M.
Kirkwood Community College Training and Outreach Center
3375 Armar Dr., Marion, IA 52302

DUBUQUE/PEOSTA – THURSDAY APRIL 14,
5:30 P.M. TO 7:30 P.M.
Northeast Iowa Community College – Conference Center 1 and 4
8342 NICC Dr., Peosta, IA 52068

III. MEETING ATTENDANCE

A total of 217 members of the public and Working Group members attended the energy forums. Some individuals participated in more than one session.

Table 1. Attendance to Public Meetings

Iowa Institution	Public	Working Group Members	Total
Ames – March 29th	54	9	63
Storm Lake – March 30th	15	5	20
Council Bluffs – March 31st	29	3	32
Ottumwa – April 12th	16	5	21
Cedar Rapids/Marion – April 13th	47	10	57
Dubuque/Peosta – April 14th	21	3	24
Total (Includes Repeat Participants)	**182**	**36**	**217**

IV. DISCUSSION TOPICS

The following are topics and issues that were brought up during the energy forum discussions; they are compiled from facilitator notes across the six public forums. Topics are organized by each of the foundational pillars established for the planning process but are not presented in any particular order.

Topics Discussed - Economic Development and Energy Careers

- Opportunities for research and development:
  - Miscanthus grass as a source of cellulosic ethanol
  - Algae to biofuels
  - Use of biomass to generate energy
  - Batteries/storage
  - Compressed Air Energy Storage (CAES)
  - Electric vehicles
  - Small Modular Reactors
  - Value added products from biofuel production
- Relationship between the biochemical industry and energy
- Economic impact of biofuels (ethanol, biodiesel, renewable natural gas)
- Economic impact of propane including year round use
- Government leading by example
- Public education needs
- Workforce development challenges (training, aging workforce, educational requirements)

- Two-year degree opportunities for students
- Financial incentives for energy production (planning, wind, solar, biofuels)
- Use of mandates vs. incentives
- Impact of tax credits on technology
- Barriers to using tax credits
- Natural gas production form agricultural waste (manure)
- Natural gas recovery from landfills
- Soil as resource for carbon capture and also economic development
- Understanding that housing and labor are part of the use of economic development as well as energy
- Low cost and reliable energy to expand existing and attract new industries
- Prefer incentives over mandates
- Iowa's strength is production and exports which require infrastructure
- Incentivize smaller projects that meet local demand and work with existing infrastructure vs large projects that require infrastructure for export
- Landowner rights

Topics Discussed - Energy Efficiency and Conservation

- Energy reliability and affordability
- Energy efficiency for new homes
- Exploring non-energy benefits associated with the plan
- Residential energy efficiency for low-income customers
- Utility incentive programs
- Concept of life cycle cost analysis
- Capacity building and financing for energy efficiency
- Making energy efficiency visible to the consumer through demonstration projects
- Energy efficiency as lost revenue
- Access to capital

Topics Discussed - Iowa's Energy Resources

- Energy storage maintaining reliability
- Wind generation forecasting (small and large wind projects)
- Energy sources and need for a diverse mix
    - Propane
    - Wind
    - Solar
    - Hydrogen
    - Renewable natural gas
    - Biomass
    - Small nuclear
    - Fossil fuels
    - Micro hydro
- Need for public education

- Solar energy opportunities for Iowa (distributed and utility scale; use on residences and businesses, agricultural facilities and community solar gardens)
- Need to determine fair value of energy resources and the cost to share access to energy resources
- End user tax for all energy sources vs. carbon tax
- Stranded assets with conversion to renewable energy or as part of federal mandates
- Climate concerns
- Pump storage
- Natural gas availability for competing uses: heating, transportation fuel and electric generation
- Need to understand value of all energy resources and transmission infrastructure
- Need for consistency between utilities and local permitting jurisdictions for installation of distributed generation
- Increasing production of renewable energy vs importing energy if lower cost

Topics Discussed - Transportation & Infrastructure

- Transmission lines
    - Replacement of aging infrastructure
    - New infrastructure in underserved areas (for wind)
    - Reliability through RTO or nationally
- Solar panels in the roadway right of way and converting roads to work as solar collectors
- Railroad opportunities for freight and passenger rail corridors
- Ride sharing education and programs
- Large scale storage (propane, natural gas, electricity) for reliability, energy assurance and security
- Concern for smog/excessive vehicle idling
- Electric vehicles
- Multimodal transportation (intermodal connections/facilities)
- Public and rapid bus transit along strategic corridors
- Shortage of natural gas pipelines
    - Access and capacity constraints especially in the northwest region of the state
    - Replacement of aging pipelines
    - Need for regional solutions or public / private partnerships
- Landowner compensation for construction of infrastructure
- Benefits of exporting resources
- Micro grids as reliability or energy security
- Areas to explore in terms of fuels and fueling include:
    - Incentives for alternative fuels
    - Hydrogen fueled vehicles as a long-term opportunity
    - Propane

    - Compressed natural gas
    - Vehicles with engines tuned to burn higher levels of ethanol
- Desire for decreasing vehicle miles traveled to reduce carbon emissions and need to build additional roads
- Infrastructure should serve Iowa not be built to pass energy through the state (rail, pipeline, transmission)
- Building out, upgrading, and long term maintenance of grid infrastructure to reliably, efficiently move energy in and out and served as back up for intermittent resources.
- Relationship between freight and pipelines (movement of energy) and safety - need for smaller pipelines
- Concern for siting infrastructure in the correct location (lessening impact to farmland)
- Concern for useful life of energy infrastructure and removal/restoration
- Lack of support for moving feedstock to anaerobic digester

V. COMMENTS RECEIVED FROM THE PUBLIC

A total of 35 public comments were received through April 30, 2016 via comment forms distributed during the energy forums and the energy plan website. Below are high-level highlights of the comments submitted listed in no particular order.

- Consistent policy for distributed generation and opportunity for individuals to generate renewables through net metering.
- Need for additional research and development around use of biomass for electricity generation.
- Updating the electric grid.
- Biogas as an untapped energy source.
- Electric vehicles and their infrastructure as an opportunity for Iowa.
- Opposition to large pipeline infrastructure for fossil fuel transportation.
- Support for solar and wind as distributed generation options instead of large- scale options.
- Support for utility-owned solar energy.
- Support for energy efficiency and conservation as a means of reducing waste.
- Incentives for energy efficiency.
- Concerns about pipeline capacity issues for natural gas.
- Nuclear power as a clean energy source.
- Public education on the need for investment in the future.
- Support for biodiesel.
- Promotion and support of ethanol through advertising and outreach.
- Need for more alternative fueling stations including biodiesel, ethanol, propane and electric vehicles.
- Environmental impacts of corn ethanol.

- Alcohol engines for commercial trucks to replace or reduce diesel fuel.
- Hazard mitigation planning.
- High speed rail.
- Research and development opportunities for carbon dioxide as well as carbon dioxide extraction and sequestration from power generation.
- Need for a value of solar study.
- Environmental externalities (costs and benefits) should be considered when making decisions.
- Make energy investment opportunities available to diverse stakeholders.
- Property rights should be an important part of the plan.
- Concern for global warming and climate change.
- Additional opportunities for wind energy in Iowa.
- Emphasis on personal mobility and not just commercial/freight transit.
- Encourage sales of Iowa generated renewable energy through rule making that allows transmission of power out of Iowa.
- Maintaining biodiversity as we build the energy infrastructure should be a balanced priority.
- Consider intermittency of renewable energy resources.
- Converting alternative solid fuel materials from waste streams into a fuel source.

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APPENDIX C:
Iowa's Energy Profile: Energy Supply and Demand and Sector Employment Analysis

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Prepared by TEConomy Partners, LLC

July 20, 2016

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I. INTRODUCTION

This report, produced by TEConomy Partners, LLC addresses a component of the Task 1 deliverable of the Iowa Energy Plan – defined as providing an "assessment of current and future energy supply and demand in Iowa." The report, goes further, however, to examine the structure of the energy industry in Iowa and its role in employment and job growth within the state.

The report presented herein represents just one early component of a larger scale comprehensive Iowa Energy Plan, and will be followed up by TEConomy Partners' next phase of work in evaluating strengths, weaknesses, opportunities and threats (SWOT analysis) for Iowa in energy[1], and an assessment of energy research and development (R&D) and innovation core competencies in the state.

Led by the Iowa Economic Development Authority and the Iowa Department of Transportation, and comprising a working committee of stakeholders and citizens from across Iowa, support for the project is provided by a consulting team comprising Inova Energy Group, LLC (Inova) as the lead consultant, together with specialized project support from Elevate Energy (Elevate) and TEConomy Partners, LLC (TEConomy).

ENERGY AS AN ECONOMIC ENGINE

The State of Iowa has identified "energy" as an area of strategic importance to the state economy and for economic development. As shown in Figure 1, global and U.S. demand for energy and fuels, in all their forms, is unlikely to abate. Global demand projections indicate that more energy, in all its forms, will be needed to meet worldwide demand projections.

1 This evaluation will not be a separate report but incorporated in other reports.

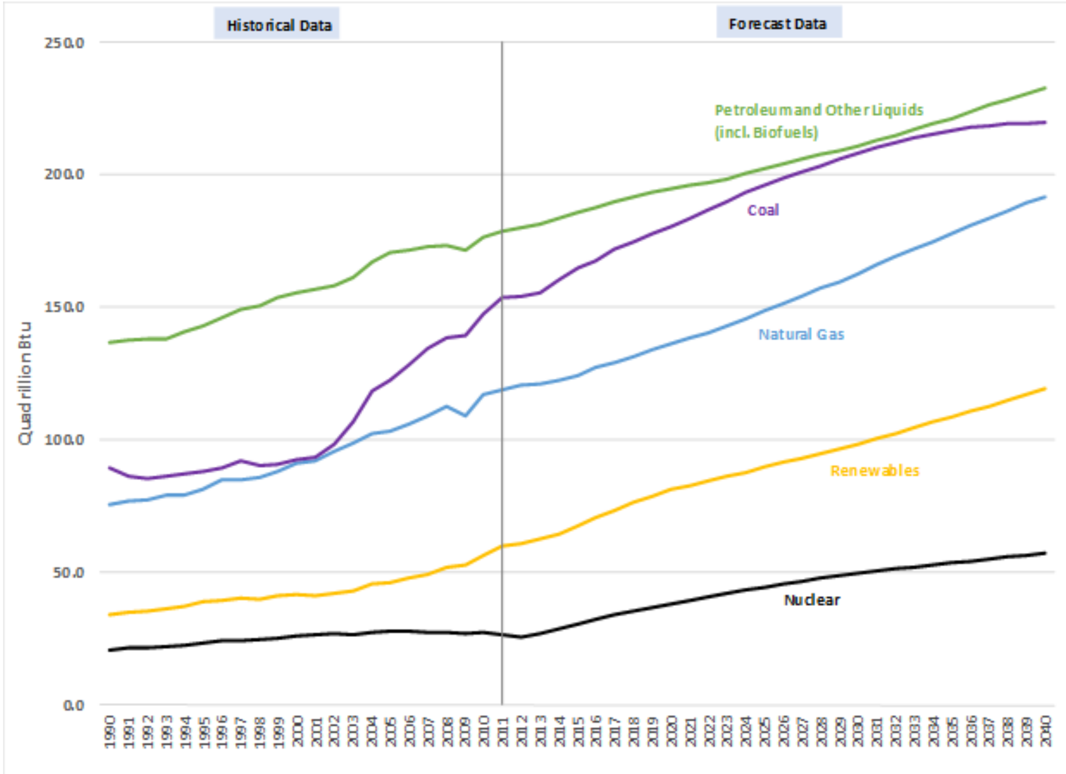

Figure 1. Global Energy Demand, Recent Trends and Predictions by Source

Source: U.S. Energy Information Administration (EIA) International Energy Statistics database (as of November 2012). More recent data does exist yet as the EIA is changing its data release process. The next is likely to be published in the second quarter or 2016.

Domestically, U.S. economic growth projections, in combination with other actors such as energy-efficiency measures and changing production profiles, lead to a much flatter projection for growth. In the U.S. natural gas and renewables are projected to see a rise in energy demand while most other sources are flat. Between 2016 and 2040, the U.S. Energy Information Administration projects overall U.S. demand to increase 7.1%.

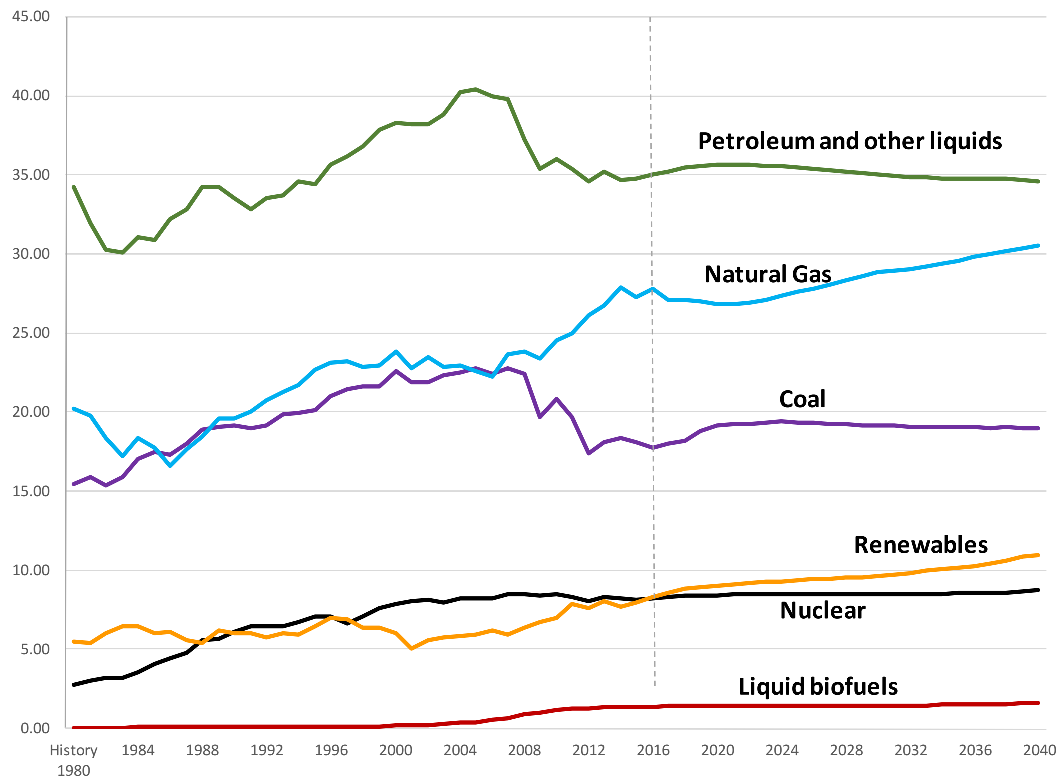

Figure 2. U.S. Energy Demand, Recent Trends and Predictions by Source

Both developed and developing nation economies depend on energy to power economic and societal activity. Because the demand for energy is assured moving into the future, energy may be seen as providing a relatively secure asset for those nations, regions and states having robust energy resources or the infrastructure and know-how needed to drive the further development of energy technologies and solutions to meet global and domestic needs.

Energy is, however, a highly dynamic sector that is influenced by both global and local economic trends, and also by strategic concerns over dependence on foreign fuel imports, environmental concerns over emissions, and the policy decisions of governments. In addition, energy extraction, conversion and generation, distribution and use represent an integrated value-chain with substantial opportunities for advanced technology deployment and innovation. Opportunities for technology-based economic development exist for those states able to attract and grow R&D activity and innovation commercialization in energy and energy-related technologies.

There are, therefore, multiple pathways that a state may follow in pursuing energy-based economic development:

- A state may exploit its natural fuel assets (such as oil, gas or biomass) to generate cost-effective power to give industry and commerce a competitive advantage.

- A state may export unrefined fuels or energy or it may further convert fuels into higher value-added liquid fuels, chemicals or materials for export.
- A state may build a robust R&D sector focused on academic and commercial research in energy and associated technologies, attracting-in external research funds.
- A state may build a significant manufacturing sector producing technologies for resource discovery, resource extraction, energy generation, energy transmission, and energy conservation. It may leverage its research assets to develop new energy products, technologies and services for sale in the domestic and international marketplace.
- A state may seek to undertake energy conservation and efficiency measures in order to increase energy resource availability for export, reduce energy imports, lessen environmental impacts of energy consumption, and generate jobs in providing energy efficiency services and products.

Iowa, in seeking to develop a statewide energy strategy, is interested in examining all of the above. The State seeks to have a detailed profile developed of energy's role in the Iowa economy, to identify trends likely to affect the impact of energy on the Iowa economy, to understand the key assets of the state in terms of the energy value chain, and potential opportunities to generate technology-based economic development through R&D and commercialization of energy innovations. The State is also seeking to identify opportunities to conserve energy and reduce any negative externalities associated with energy development, generation or use.

The State of Iowa recognizes that the energy sector is a highly important sector and resource for the state, and seeks to enhance the sector further to grow the Iowa economy. There is an energy sector momentum in Iowa upon which to build – with the renewable energy story, in particular, being a stand-out performer. The growth of the biofuels industry in Iowa, together with substantial growth in wind energy (in terms of both energy generation and technology/systems manufacturing), are very much indicative of the ability of the energy sector to generate new businesses, wealth, jobs and government revenues in the State. Iowa now seeks to further refine its approach to energy-based economic development and energy-sector efficiencies through the development of a formal statewide energy strategy. The State recognizes that achieving the full-realization of energy economic development promise in the State will require a prioritization of strategic activities and investments, backed by a robust understanding of energy assets, opportunities and challenges in the State, thus serving to guide State actions. To advance effective public and private actions in Iowa focused on energy, it is critical for the State and key stakeholders to have reliable information, identifying the near term growth opportunities in energy development for Iowa, together with a detailed and objective understanding of its assets and gaps. Based on this objective analysis a strategic action plan can then be developed to promote the growth and development of specific energy-based platforms most likely to generate economic growth for the State.

TEConomy Partners, LLC is responsible for major elements of the Iowa Energy Plan work pertaining to development of a quantitative understanding of Iowa’s current position in energy, producing projections for energy sector development under potential development scenarios, and analyzing strengths, weaknesses, opportunities, and threats (SWOT) focused on energy resources and infrastructure, the current energy industry in Iowa, the energy sector workforce, and R&D and innovation within the energy sector and associated fields.

This report represents an introductory white paper focused on defining the energy sector in Iowa and summarizing key quantitative data regarding the current status of energy supply, demand, and the key components of the energy value-chain within the State.

DEFINING THE ENERGY SECTOR

In performing this analysis, TEConomy Partners has deployed a definition of the energy sector which is quite broad, encompassing a wide range of energy and energy-related subsectors across the energy value chain. Figure 2 shows the general structure of this value chain divided into three principal paths:

- The energy production and distribution value chain
- The development and production of energy technologies and associated services
- The supporting assets and infrastructure that influence the effectiveness of a state for energy sector activities and development (energy business location factors).

Development of a comprehensive energy strategy requires consideration be given to the evaluation of conditions, assets, business trends, etc. associated with the key elements depicted on Figure 2. Clearly the energy sector is not geographically uniform across the United States, and some states will have significant assets in some areas but not in others. Iowa, for example, has relatively limited in-state fossil fuel resources, but does have substantial natural resources available for energy generation in terms of wind and biomass. Similarly, the R&D base and industry base and their associated core competencies varies geographically, and analysis is thus required to determine assets within Iowa. The overall strategy to be developed by Inova Energy Group, their subcontractor Elevate Energy, and TEConomy Partners will address key elements pertaining to the energy value chain and energy industry and innovation ecosystem within Iowa.

Assessing any economic sector, including the energy sector,first requires that it be defined. TEConomy Partners has developed an industry definition of the energy sector which comprises individual detailed, 6-digit North American Industrial Classification System (NAICS) industry sectors with these then aggregated into related groups (called “energy subsectors”). Table 1 lists the NAICS included in the analysis of the energy industry.

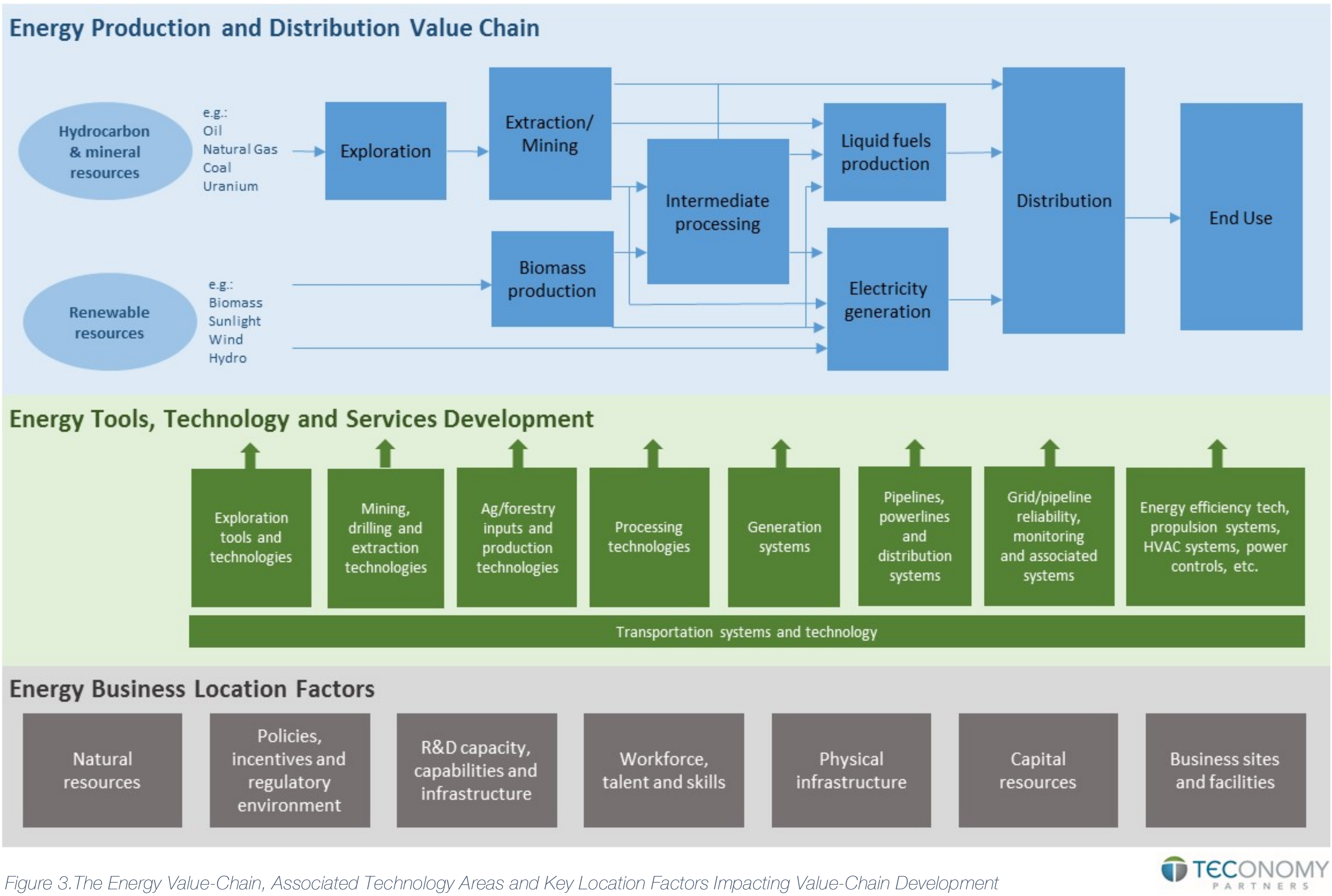

Figure 3.The Energy Value-Chain, Associated Technology Areas and Key Location Factors Impacting Value-Chain Development

STRUCTURE OF THIS REPORT

This white paper is structured as follows:

- First Iowa's economy and basic demographics are presented to provide the reader with context regarding the size of the economy, state population and other characteristics.
- Second, TEConomy Partners presents an assessment of the energy sector's economic development profile in the State in terms of employment across the industry as defined in Table 1 and outlines which sectors are growing or declining in importance as defined by employment volume.
- Third, an assessment is provided of employment compensation in the energy sector versus other sectors of the Iowa economy.
- Fourth, data is presented on energy supply in Iowa and the types of energy generated. Data are also provided for the states adjoining Iowa to, again, help place data in context.
- Fifth, data is provided profiling the consumption of energy by energy type in the State. Data are also provided for the states adjoining Iowa.
- Sixth, some preliminary scenarios are presented regarding the future energy profile in the state extrapolating from recent trends. *It should be noted that only relatively simplistic scenarios are shown in this white paper, and more detailed and sophisticated scenario projections will be made as more research is completed as needed to develop the energy plan.*

Table 1. Industry NAICS Codes Included in Definition of Energy Sector in Iowa and Subsectors to which these NAICS are Assigned

NAICS Code	Industry Title	Energy Subsector
325190	Other Organic Chemicals	Biodiesel Production
325193	Ethyl Alcohol Manufacturing	Ethanol Production
211111	Crude Petroleum and Natural Gas Extraction	Extraction/Resource Development
211112	Natural Gas Liquid Extraction	Extraction/Resource Development
212111	Bituminous Coal and Lignite Surface Mining	Extraction/Resource Development
213111	Drilling Oil and Gas Wells	Extraction/Resource Development
213112	Support Activities for Oil and Gas Operations	Extraction/Resource Development
213113	Support Activities for Coal Mining	Extraction/Resource Development
424710	Petroleum Bulk Stations and Terminals	Petroleum Products & Wholesale
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)	Petroleum Products & Wholesale

NAICS Code	Industry Title	Energy Subsector
454311	Heating Oil Dealers	Petroleum Products & Wholesale
454312	Liquefied Petroleum Gas (Bottled Gas) Dealers	Petroleum Products & Wholesale
454319	Other Fuel Dealers	Petroleum Products & Wholesale
333611	Turbine and Turbine Generator Set Units Manufacturing	Other Renewable Energy & Storage
335911	Storage Battery Manufacturing	Other Renewable Energy & Storage
335912	Primary Battery Manufacturing	Other Renewable Energy & Storage
221111	Hydroelectric Power Generation	Power Generation
221112	Fossil Fuel Electric Power Generation	Power Generation
221113	Nuclear Electric Power Generation	Power Generation
221119	Other Electric Power Generation	Power Generation
221121	Electric Bulk Power Transmission and Control	Power Transmission/Distribution
221122	Electric Power Distribution	Power Transmission/Distribution
221210	Natural Gas Distribution	Power Transmission/Distribution
221330	Steam and Air Conditioning Supply	Power Transmission/Distribution
237120	Oil and Gas Pipeline and Related Structures Construction	Power Transmission/Distribution
237130	Power/Communication Line and Related Structures Construction	Power Transmission/Distribution
335311	Power, Distribution, and Specialty Transformer Manufacturing	Power Transmission/Distribution
486110	Pipeline Transportation of Crude Oil	Power Transmission/Distribution
486210	Pipeline Transportation of Natural Gas	Power Transmission/Distribution
486910	Pipeline Transportation of Refined Petroleum Products	Power Transmission/Distribution
486990	All Other Pipeline Transportation	Power Transmission/Distribution
324110	Petroleum Refineries	Refineries

Note: The Other Renewable Energy and Storage subsector only includes NAICS sectors where a dominant proportion of the sector is involved in energy-related activities. For example, NAICS: 334413 - Semiconductor and related device manufacturing includes solar photovoltaic cells, but the vast majority of employment and output in this sector is related to computer-related components, not renewable energy technology.

IOWA IN A NATIONAL SOCIO-ECONOMIC CONTEXT

The following statistics serve to highlight the size and structure of the Iowa economy.

Table 2. Contextual Statistics

Data Variable	Iowa Statistics	Context
Land area	55,857 square miles	Iowa comprises 1.58% of the U.S. total area of 3,531,905 square miles
Population Estimate, July 1, 2015,	3,123,899	Iowa comprises 0.97% of the total U.S. population which is 321,418,820
Population, percent change - April 1, 2010 to July 1, 2015	2.5% growth	U.S. saw 4.1% growth. (Iowa's population has grown at only 61% of the national rate)
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% (Iowa has a higher labor force participation rate than the nation)
Median household income (in 2014 dollars)	$52,716	U.S. median household income is $53,482. So Iowa's is just slightly lower than the national figure.
Total employer establishments, 2013	80,581	U.S. has 7,488,353 employer establishments. Iowa has 1.08% of the national number, about in line with Iowa's percent of U.S. population.
Unemployment rate (April 2015)	3.8%	U.S. rate was 5.5%. Iowa is performing better on unemployment that the nation, with a rate 31% lower than the nation.
Total Private Sector Employment	1,280,079 jobs	Iowa accounts for 1.1% of the U.S. total private sector employment in 2014.
Total Manufacturing Employment	216,834 jobs	Iowa accounts for 1.8% of the U.S. total manufacturing employment in 2014.
Total Gross State Output (chained 2009 real dollars)	$152.6 billion	Iowa accounts for 1.0% of U.S. GDP in 2014.

II. ENERGY SUPPLY AND DEMAND IN IOWA

An energy strategy needs a starting point, a baseline measure of the energy sector in Iowa against which expectations for growth can be set and metrics for measuring development progress calibrated. TEConomy Partners accessed a broad range of information and data resources in order to develop a data-driven assessment of Iowa's current energy profile.[2]

IOWA'S ENERGY PROFILE - PRODUCTION

Iowa is a net importer of energy, consuming more than double the amount of energy than it produces (see Table 3). Based on this energy balance, Iowa is effectively importing more raw energy than it produces.

Table 3. Iowa Total Energy Consumption and Production, 2013

Total Energy	Iowa Consumption	Iowa Production	Difference (Importation)
	1,516.5 trillion Btu	730.5 trillion Btu	786 trillion Btu

Source: Data from U.S. Energy Information Administration

While clearly Iowa is not yet one of them, there are several U.S. states that have total production that exceeds total consumption (net energy exporting states), including: Alaska; Colorado; Kentucky; Louisiana; Montana; New Mexico; North Dakota; Oklahoma; Texas; Utah; West Virginia, and Wyoming. Each of these exporting states benefits from significant reserves of fossil fuels, something Iowa lacks. From an economic development standpoint, it may be concluded that:

Conclusion 1: Iowa currently consumes more raw energy than it produces, and also imports more raw energy than it produces. Thus, from a basic economic policy standpoint, increasing energy production in Iowa will enhance Iowa's balance of trade and benefit the Iowa economy. Similarly, investments in energy efficiency will have benefits in terms of lowering the leakage of funds outside of the state that pay for imported energy.

2 Data for the following tables and figures in Chapter II are from the U.S. Energy Information Administrations, State Energy Data Systems (SEDS) database, 2000-2013 (most currently available).

In terms of energy production, Iowa has a significantly less diversified production profile than the U.S. overall. As shown on Figure 3, Iowa's production of energy (defined as energy produced from domestic Iowa assets – i.e. not imported coal, natural gas, fuel oil, etc.) comprised three primary production sources: Biomass feedstocks for ethanol (68%), renewable energy except ethanol (24%) and nuclear power (8%). The clear difference between Iowa and the U.S. overall is attributable to the lack of fossil fuel resources in Iowa – whereas for the U.S. overall domestically produced feedstocks of coal, natural gas and crude oil dominate the production profile.

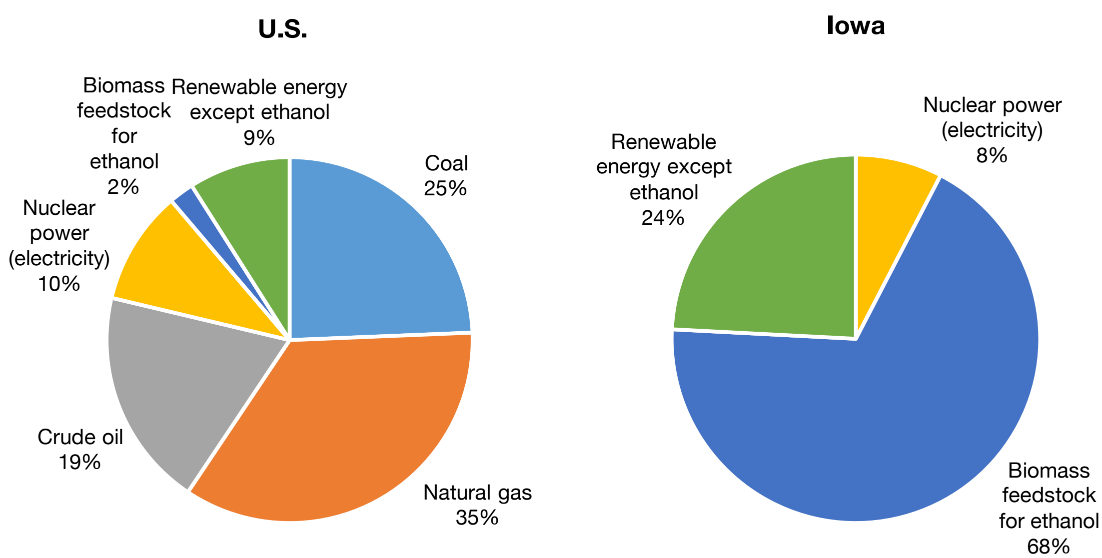

Figure 4. Production Share (Btu) by Major Source Category, 2013

In terms of total energy production, Iowa currently produces 0.9% of U.S. production—a lower amount than might be expected given that Iowa comprises 1.58% of total U.S. land area. Again, this results from the land in Iowa not overlaying significant fossil fuel deposits.

It is clear, however, that investment in renewable energy production has provided an important boost in net Iowa energy production. Without the use of Iowa biomass, wind, and to a lesser degree hydro, resources, Iowa's production versus consumption energy balance would be substantially worse.

Conclusion 2: Without a significant base of fossil resources, Iowa has to currently import more than twice the raw energy than it produces. Investment in renewable energy has, however, improved the balance of energy equation.

In terms of electricity generation, Iowa produced 56,853,000 Megawatt-hours (MWh) in 2014 (See Table 4) with the largest proportion of this electricity production coming from coal-fired power plants (59.3% of Iowa's electricity production). The next highest proportion of generated electricity within Iowa comes from renewable wind power (28.7%) and nuclear power which generated 7.3% of Iowa's electricity production in 2014.

It should be noted that total electric power generation in Iowa has increased significantly since 2001. As Table 4 shows, in 2001 total utility-scale production of electricity in the state totaled 40,659,000 MWh which grew to 56,853,000 MWh in 2014 (an increase in production of 16,194,000 MWh, or 39.8%). Total electricity produced by coal decreased 2.69% over this time period – dropping from 34,665,000 MWh in 2001 to 33,733,000 MWh in 2014. The growth in total electricity generation in Iowa between 2001 and 2014 has been almost primarily driven by the growth in wind generation which rose from 488,000 MWh in 2001 to 16,307,000 MWh in 2014, a 3,241.6% increase. Some other electric power generation sources saw gains in production between 2001 and 2014. Natural gas-powered electricity generation grew by 131.5% while biomass grew by 155.8%. Petroleum liquids declined, but pet coke increased substantially, and nuclear saw moderate percent gains.

Table 4. Iowa Annual Electricity Generation, Change in Generation Mix 2001-2014 (Megawatt-hours)

Electricity Generation Source[3]	2001 Megawatt-hours of Production	2014 Megawatt-hours of Production	Percent Change 2001-2014	Percent of 2014 Iowa Electricity Generated by this Source
TOTAL	40,659,000	56,875,000	39.9%	100.0%
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	104,000	266,000	155.8%	0.47%
Petroleum 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	--	0.00%

Source: Data from U.S. Energy Information Administration

Conclusion 3: Since 2001 Iowa has increased its electric power generation by 39.9%. The vast majority of this new generation has come in the form of renewable wind power. The net effect has been a significant decrease in the overall percentage of Iowa's electricity generated by fossil fuels which declined from 87% in 2001 to 62% in 2014.

Renewables-based electricity generation has been rising dramatically in Iowa, comprising 17,473,000 MWh of generation in 2014 (30.7% of the State's electricity production). The majority of the renewables production is wind generated (93.3% or renewables generation). The changing face of electric power generation in Iowa is well illustrated by the fact that in 2001 just 1.2% of Iowa's electricity was generated by wind (with 85.3% generated by imported coal), whereas in 2014 wind generated 28.67% of Iowa electricity (and coal dropped to 59.31%).

[3] Includes both utility scale plants and IPP/CHP electricity generation, plus distributed solar. U.S. Energy Information Administration.

IOWA'S ENERGY PROFILE - CONSUMPTION

Just as Iowa's energy production profile differs from that of the U.S. overall, so does Iowa's energy consumption. Iowa's economy is more industrially-intensive than the U.S. economy overall, and this is reflected in the fact that Iowa accounts for 2.4% of industrial energy consumption in the U.S. but comprises only 0.97% of the U.S. population. It is predominantly Iowa's strong industrial economy, which includes agriculture and biofuels production in addition to manufacturing, that accounts for Iowa's energy consumption profile looking different to that of the U.S. overall. Iowa's three largest manufacturing industries are machinery, food and beverages, and chemicals. Taken together these three industries account for almost two-thirds of Iowa's manufacturing gross domestic product (GDP). Iowa consistently ranks among the top 10 states in the nation in share of GDP from manufacturing. Transportation is the state's second largest energy-consuming sector.

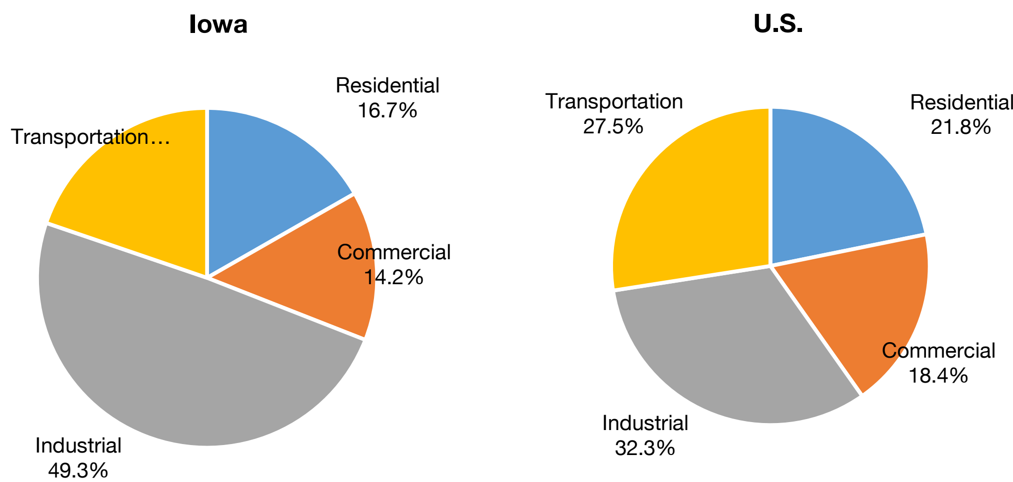

Figure 5. Consumption (Btu) Share by End Use Sector, 2013

Table 5. Energy Consumption Metrics by End Use Sector, 2013

	Iowa			U.S.	
Sector	**2013 Consumption (Billion Btu)**	**Percent Change, 2000-2013**	**2013 Share of U.S.**	**2013 Consumption (Billion Btu)**	**Percent Change, 2000-2013**
Residential	253,709	7.1%	1.2%	21,181,996	3.9%
Commercial	215,696	24.8%	1.2%	17,894,337	4.2%
Industrial	747,332	46.3%	2.4%	31,378,925	-9.5%
Transportation	299,747	10.5%	1.1%	26,689,441	0.5%
Total Energy Consumption	**1,516,483**	**27.2%**	**1.6%**	**97,144,709**	**-1.7%**

Conclusion 4: Iowa, with a more industrial economy than the U.S. overall sees "industry" (which includes agriculture as well as manufacturing) consuming considerably more power as a percentage of State consumption.

It should be noted that Iowa industry overall has been growing faster than energy consumption in Iowa's industrial sector. In other words, the industrial sector of the Iowa economy is becoming less energy intensive over time, or more energy efficient in its operations.

Examining consumption data by energy source again reveals a consumption profile quite different to that of the United States overall (Figure 5 and Table 6). Iowa uses renewable energy to a much greater degree than the nation does overall, and also uses more coal. It is less reliant than the U.S. overall in the use of natural gas, gasoline and other petroleum, and nuclear power.

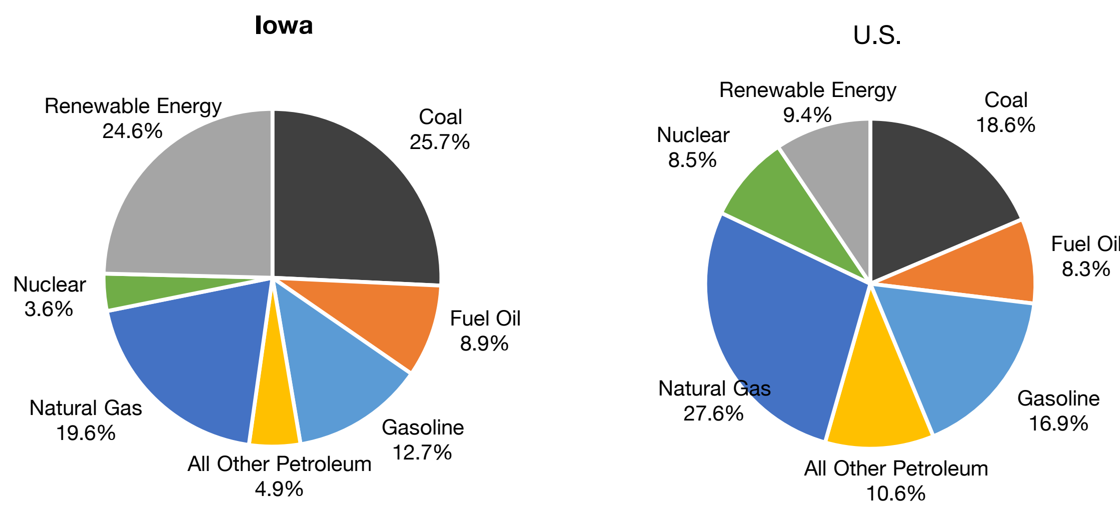

Figure 6. Consumption (Btu) Share by Major Source Category, 2013

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

Table 5. Energy Consumption Metrics by Major Energy Category, 2013

	Iowa			U.S.	
Major Energy Category	**2013 Consumption (Billion Btu)**	**Percent Change, 2000-2013**	**2013 Share of U.S.**	**2013 Consumption (Billion Btu)**	**Percent Change, 2000-2013**
Coal	402.4	-9.8%	2.2%	18,038.8	-20.1%
Fuel Oil	138.9	23.9%	1.7%	8,066.4	1.8%
Gasoline	198.7	3.7%	1.2%	16,338.6	1.1%
All Other Petroleum	76.5	-18.2%	0.7%	10,323.2	-27.2%
Natural Gas	306.5	50.9%	1.1%	26,801.8	12.5%
Nuclear	55.6	19.7%	0.7%	8,244.4	4.9%
Renewable Energy	384.7	376.5%	4.2%	9,147.6	49.8%
Net Interstate Flow of Electricity (Export)	(46.8)	354.1%	N/A	N/A	N/A
Total Energy Consumption	**1,516.5**	**27.2%**	**1.6%**	**97,144.7**	**-1.7%**

To provide additional context to Iowa' s changing portfolio of energy consumption, Figure 6 profiles the consumption mix in terms of the share of Iowa's total consumption for four years—the starting year of the analysis (2000), the pre-recession peak (2007), the beginning of the economic expansion (2010) and the most current data (2013). These data also include the context of Net Interstate Flow Electricity where Iowa was as an importer of electricity in 2000 and 2007, but a net exporter of electricity in 2010 and 2013.

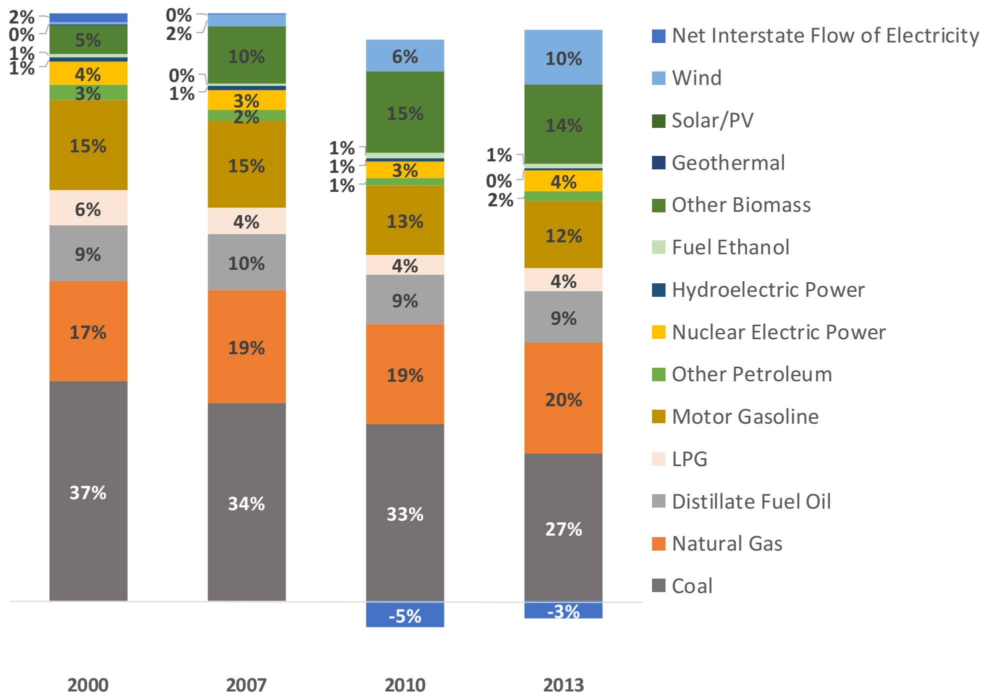

Figure 7. Iowa Energy Consumption Share (Btu) by Major Source, Select Years

Conclusion 5: Iowa differs in its energy consumption versus the U.S. overall in terms of using renewables and coal considerably more than average and other major fossil fuel resources (natural gas and petroleum/gasoline) less.

Iowa's expenditure profile in terms of the use of energy in the State is not all that different than that of the U.S. overall (Figure 7). The main difference, again, is that Iowa spends a higher percent of its total energy dollars on industrial use (25.5%) versus the nation (17%).

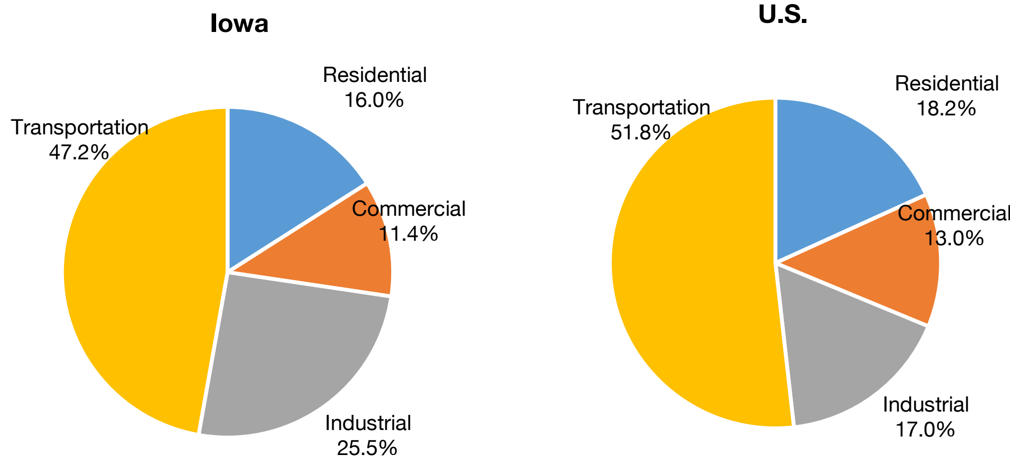

Figure 8. Energy Expenditures Share ($ millions) by End Use Sector, 2013

Table 6. Energy Expenditure Metrics by End Use Sector, 2013

	Iowa			U.S.	
Sector	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**	**Share of U.S.**	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**
Residential	$2,755.5	51.8%	1.1%	$250,457.4	61.3%
Commercial	$1,965.2	88.9%	1.1%	$179,359.6	58.1%
Industrial	$4,395.5	90.3%	1.9%	$233,272.3	65.3%
Transportation	$8,149.2	169.8%	1.1%	$712,216.5	156.2%
Total Energy Expenditures	**$17,265.4**	**110.9%**	**1.3%**	**$,1375,305.9**	**100.0%**

Between 2000 and 2013 Iowa saw its total expenditures on fuels increase at a somewhat faster rate than the U.S. overall – with Iowa expenditures increasing 129.9% versus the nation's 119.9%. The expenditure categories seeing the largest percent expenditure increases were fuel oil (249.5%), biomass (wood and waste, 229.3%) and motor gasoline (148.6%). Expenditures on each of these three energy sources increased at a rate higher than they did in the nation overall. Iowa's expenditures on retail electricity did not increase much more than they did nationally (increasing 62.8% versus 60.7% in the nation). Overall, expenditures in Iowa for energy increased 10.9% more than they did for the nation overall between 2000 and 2013.

Table 7. Energy Expenditure Metrics by Major Energy Category, 2013

	Iowa			U.S.	
Major Energy Category	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**	**2013 Share of U.S.**	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**
Primary Use Fuels	**$13,490.4**	**129.9%**	**1.3%**	**$1,003,224.6**	**119.9%**
Coal	$178.7	85.2%	2.6%	$6,765.4	85.1%
Natural gas	$1,988.7	38.9%	1.7%	$114,752.9	20.8%
Motor gasoline	$5,580.8	148.6%	1.2%	$467,337.6	143.2%
Fuel oil	$3,735.7	249.5%	1.7%	$220,156.5	185.9%
Liquefied petroleum gases (LPG or propane)	$1,398.4	85.2%	2.5%	$55,690.0	99.1%
All other petroleum products (except Gasoline, Fuel Oil, LPG)	$575.6	121.1%	0.4%	$131,898.7	129.6%
Biomass (Wood and waste)	$32.6	229.3%	0.5%	$6,779.9	136.4%
Retail Electricity -- All Fuels & Sources incl. Nuclear and Renewable	**$3,775.0**	**62.8%**	**1.0%**	**$372,081.3**	**60.7%**
Total Energy Expenditures	**$17,265.4**	**110.9%**	**1.3%**	**$1,375,305.9**	**100.0%**

Note: Primary use captures the expenditures on fuels put to direct use. The use of these fuels for electricity generation is captured within the Retail Electricity category.

Conclusion 6: Iowa's total energy expenditures for energy have increased at a rate 10.9% over expenditures in the nation between 2000 and 2013.

IOWA'S ELECTRICITY PROFILE

In terms of electricity consumption, Iowa's industrial sector consumes a considerably higher percent (42% of all electricity in the State) than does the nation overall (26.3%).

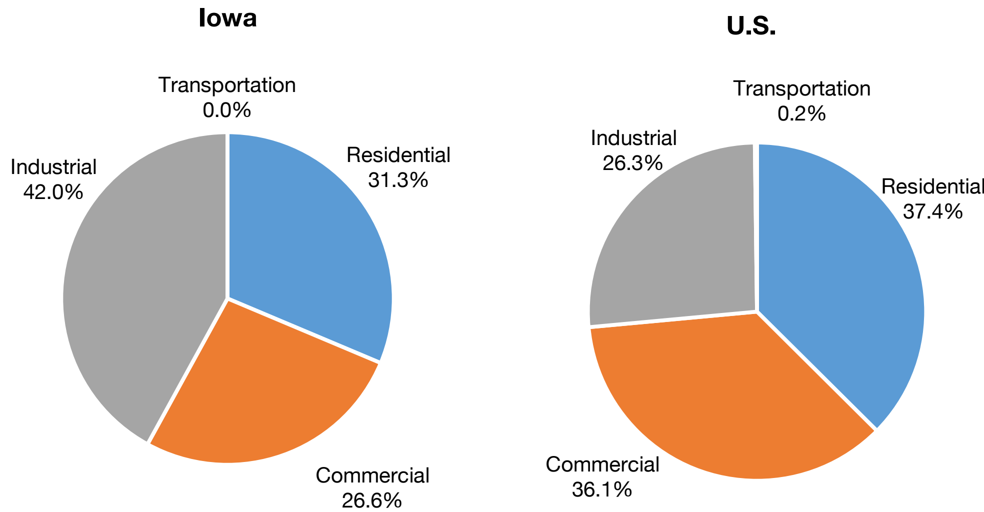

Figure 9. Electricity Consumption (Btu) by End Use Sector, 2013

Table 8. Electricity Consumption Metrics by End Use Sector, 2013

	Iowa			U.S.	
Sector	2013 Consumption (Billion Btu)	Percent Change, 2000-2013	2013 Share of U.S.	2013 Consumption (Billion Btu)	Percent Change, 2000-2013
Residential	50,004	21.8%	1.1%	4,759,464	17.0%
Commercial	42,510	25.4%	0.9%	4,586,432	15.9%
Industrial	67,020	14.7%	2.0%	3,338,133	-8.1%
Transportation	0	0.0%	0.0%	26,017	41.7%
Total Energy Consumption	**159,534**	**19.6%**	**1.3%**	**12,710,046**	**8.9%**

A similar situation holds in overall electricity expenditures (Figure 9 and Table 10).

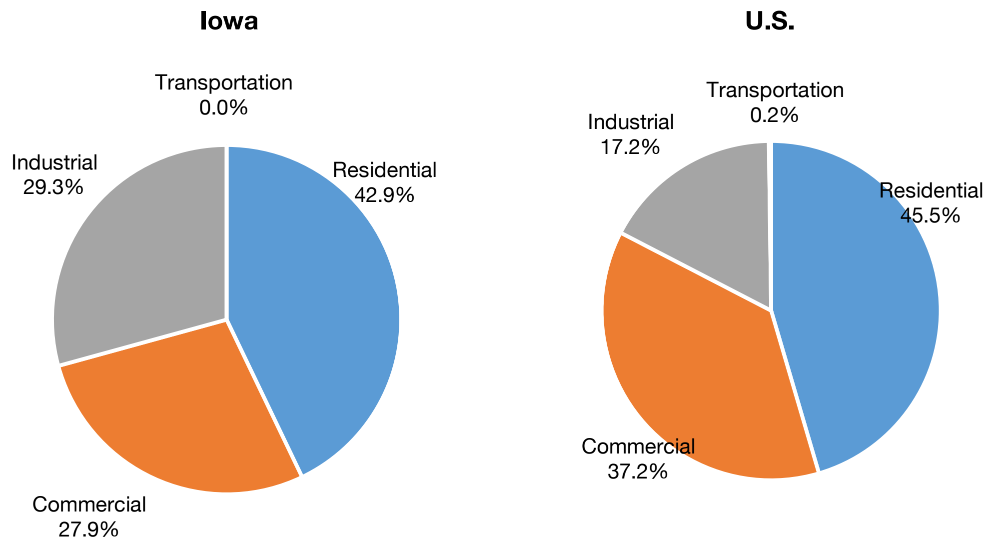

Figure 10. Electricity Expenditures by Sector, 2013

Table 9. Electricity Expenditures by Sector, 2013

	Iowa			U.S.	
Sector	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**	**2013 Share of U.S.**	**2013 Expenditures ($ millions)**	**Percent Change, 2000-2013**
Residential	$1,618.7	60.7%	1.0%	$169,112.6	72.2%
Commercial	$1,051.5	62.7%	0.8%	$138,229.1	62.4%
Industrial	$1,104.8	66.0%	1.7%	$63,934.9	33.6%
Transportation	$0.0	0.0%	0.0%	$804.8	111.6%
Total Electricity Expenditures	**$3,775.0**	**62.8%**	**1.0%**	**$372,081.3**	**60.7%**

IOWA'S ENERGY PROFILE IN COMPARISON TO SURROUNDING STATES

Comparing Iowa's energy consumption to national overall statistics provides a useful perspective, but so too does comparing Iowa's energy consumption to the six states that border Iowa: Minnesota; Wisconsin; Illinois; Missouri; South Dakota, and Nebraska. By comparing these North Central U.S. states to Iowa, perspective can be gained on how Iowa differs in energy consumption versus similar surrounding states.

It should, of course, be noted that these seven states are not all the same in terms of their fundamental natural energy resources. Several contain significant fossil fuel resources (primarily coal, but also natural gas and crude oil) – whereas Iowa does not. Similarly, differences in topography, hydrology, soils and meteorological conditions mean differing potentials for renewable energy production and in-state consumption.

Table 11 presents the overall summary statistics for Iowa and the benchmark states. Obviously, given significantly different population sizes total consumption varies significantly – so data have been normalized by TEConomy Partners in terms of consumption per capita and total energy consumption as a percent of state GDP, for more appropriate comparisons.

Table 10. Energy Consumption, Iowa and Benchmark States, 2013

State	Total Energy Consumption (Million Btu)	Rank	Total Energy Consumption (Million Btu) per Capita	Rank	Energy Consumption Intensity of GSP*	Rank
Iowa	**1,516,483**	**24**	**490**	**5**	**9.98**	**11**
Illinois	4,011,485	4	311	25	5.96	31
Minnesota	1,859,790	18	343	18	6.54	28
Missouri	1,857,005	19	307	26	7.21	22
Nebraska	871,805	33	466	7	8.85	18
South Dakota	390,367	45	462	8	9.86	13
Wisconsin	1,804,018	21	314	24	5.38	38

*Note: Energy Consumption Intensity of GSP is calculated as total energy consumption as percent of current-dollar GDP.

The benchmark data show that Iowa has the highest consumption of energy per capita among the benchmark states (where the range runs from a low of 311 million Btu per capita in Illinois, to Iowa's high of 490). Iowa similarly has the highest energy consumption intensity as measured by energy consumption as a percent of GDP. These high normalized ranks largely reflect the significant industrial-oriented energy consumption within Iowa.

Table 12 examines statistics for the benchmark states in terms of energy expenditures. Again, Iowa has the highest expenditures per capita on energy ($5,583.30 per capita for 2013). In terms of energy expenditure intensity, South Dakota has the highest (10.54) closely followed by Iowa at (10.35).

Table 11. Energy Expenditures, Iowa and Benchmark States, 2013

State	Total Energy Expenditures ($ million)	Rank	Total Energy Expenditures per Capita (S)	Rank	Energy Expenditure Intensity of GSP*	Rank
Iowa	**$17,265.4**	**28**	**$5,583.3**	**7**	**10.35**	**20**
Illinois	$49,296.6	7	$3,824.2	39	6.80	43
Minnesota	$24,689.5	20	$4,553.5	22	8.03	35
Missouri	$26,721.7	17	$4,420.5	25	9.65	24
Nebraska	$10,293.8	35	$5,507.7	9	9.41	25
South Dakota	$4,708.9	47	$5,569.3	8	10.54	18
Wisconsin	$24,715.9	19	$4,303.7	30	8.68	30

*Note: Energy Expenditure Intensity of GSP is calculated as total energy expenditures as percent of current-dollar GDP.

Conclusion 7: For Iowa, undertaking a state energy strategy is particularly important since energy consumption and expenditure per capita is higher than it is in surrounding states, as is (generally) the intensity of energy use as measured as a percentage of state GDP.

Appendix A provides further detail on comparative consumption of specific energy resources across Iowa and the benchmark states. Benchmark profiles are provided for:

- Coal
- Natural Gas
- Petroleum
- Motor Gasoline
- Fuel Oil
- Propane
- Nuclear
- Renewable Fuels (with break-outs for wind, biomass and ethanol).

III. ENERGY AS A KEY EMPLOYER IN IOWA

IOWA'S EMPLOYMENT GROWTH, SIZE AND SPECIALIZATION IN ENERGY SUB-SECTORS

As discussed in Chapter I, TEConomy Partners uses a fairly broad definition of energy and energy-related sectors of the economy (see Table 1). The definition not only includes industry sectors engaged in extracting energy resources, generating power, or distributing and retailing power, but also includes the many related industry sectors that provide tools, technologies and services to the energy industry or to consumers of energy. In effect, the definition used captures and breaks-out the key components of the energy sector value-chain.

Examining Iowa's energy profile in terms of this value-chain and the jobs it generates in the state is important, and generating a baseline profile of employment and employment trends across the energy value-chain is a key starting point for strategic planning.

Table 1 shows the full complement of 32 NAICS used to define the overall energy sector in Iowa. TEConomy Partners assigned each of these individual NAICS to one of eight subsectors for analysis purposes:

- Biodiesel Production
- Ethanol Production
- Extraction and Resource Development
- Other Renewable Energy and Storage
- Petroleum Products and Wholesale
- Power Transmission and Distribution
- Power Generation
- Refineries.

Table 13 summarizes most recently available establishment and employment data (2014) for these eight subsectors and also shows for comparison total private sector and total manufacturing employment. In total, the Iowa energy sector consists of 849 establishments, with a combined employment of 16,292 (1.3% of the state's total private sector labor force).

The overall energy sector currently is relatively under-concentrated in Iowa and therefore not seen as a state "specialization" since the location quotient (LQ)[4] for this

4 Location quotients (LQs) are a standard measure of the concentration of a particular industry in a region relative to the nation. The LQ is the share of total state or regional employment in the particular industry divided by the share of total industry employment in the nation. An LQ greater than 1.0 for a particular industry indicates that the region has a greater relative concentration, whereas an LQ less than 1.0 signifies a relative underrepresentation. An LQ greater than

level of energy employment reaches only 0.78 (a state specialization, as designated by TEConomy, requires an LQ of 1.2 or higher). At an LQ of 0.78, the energy sector in Iowa employs approximately 22% fewer workers than would be expected, given the energy sector's overall share of employment in the national economy.

Table 12. Iowa Establishments, Employment and Location Quotients for the Total Energy Sector and Individual Subsectors, 2014

Energy Subsector	Iowa Establishments 2014	Iowa Employment 2014	Iowa Location Quotient 2014	Iowa Employment % Change 2001–14	U.S. Employment % Change 2001–14
Total Energy Sector	**849**	**16,292**	**0.78**	**22.2%**	**18.6%**
Power Transmission/ Distribution[5]	428	7,011	0.88	-2.8%	25.6%
Other Renewable Energy & Storage	12	2,606	4.42	143.6%	-7.7%
Power Generation	99	2,520	1.41	-5.1%	-42.3%
Ethanol Production	40	1,845	15.71	3838.6%	225.1%
Petroleum Products & Wholesale	242	1,699	0.88	-22.3%	-20.5%
Biodiesel Production	14	550	1.37	310.4%	-5.2%
Refineries	3	39	0.05	254.5%	-7.6%
Extraction/Resource Development	11	22	0.00	161.7%	91.7%
Total Private Sector[6]	**93,351**	**1,280,079**	**1.00**	**6.5%**	**5.5%**
Total Manufacturing	**4,048**	**216,834**	**1.61**	**-10.0%**	**-25.8%**

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

While the overall energy sector in Iowa is not a state specialization (as measured by location quotient) this should not obscure the fact that employment is highly concentrated among several key energy subsectors, with four—ethanol production (LQ=15.71), other renewable energy & storage (LQ=4.42), power generation (LQ=1.41), and biodiesel production (LQ=1.37) all rising to the level of state "specializations."

Several of the subsectors have been significant new job generators for Iowa over the assessed time period of 2001 through 2014. Overall the energy sector in Iowa employs 16,292 personnel and increased employment by 22.2% between 2001-2014, larger than the growth seen nationally. Notably, biodiesel production grew by 310.4% and other renewable energy and storage grew employment by 143.6% over this time period (also reaching 2,606 jobs in 2014) while ethanol production truly

1.20 denotes employment concentration significantly above the national average. In this analysis, regional specializations are defined by LQs of 1.20 or greater.

[5] Sub-sectors shown comprise the individual NAICS listed on Table 1.

[6] This category, for comparison purposes shows all private sector jobs in the state (i.e. not just those in the energy sector).

emerged as a state industry sector growing by 3,838% to reach 1,845 jobs. In all three cases, these sectors far outpaced growth rates in those subsectors within the nation overall.

Conclusion 8: Though the energy sector overall is a currently not a specialized industry for Iowa, distinct niches (subsectors) exist within Iowa that are specialized and do show significant growth. In addition, the energy sector has been a significant job generator, far outpacing overall private sector growth in the state.

Overall, employment growth in Iowa's energy sector, benchmarked against national employment growth, has performed as well as the nation overall, and far out-performed average private sector industry growth in the state. Structural changes in the energy industry led to declines in the early 2000's in Iowa and the U.S. overall. After this structural decline, the energy sectors' employment began a steady period of growth, for both Iowa and the U.S., with the exception of slight employment declines during the recessionary period between 2007–2010 (Figure 10). It should be noted that Iowa's energy sector actually only experienced one employment decline (2010). Between 2010 and 2014, a period of economic expansion, energy sector employment in Iowa grew 14.9% compared to 16.5% growth nationally (this in part due to steeper recessionary declines in the U.S. energy sector).

Conclusion 9: 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.

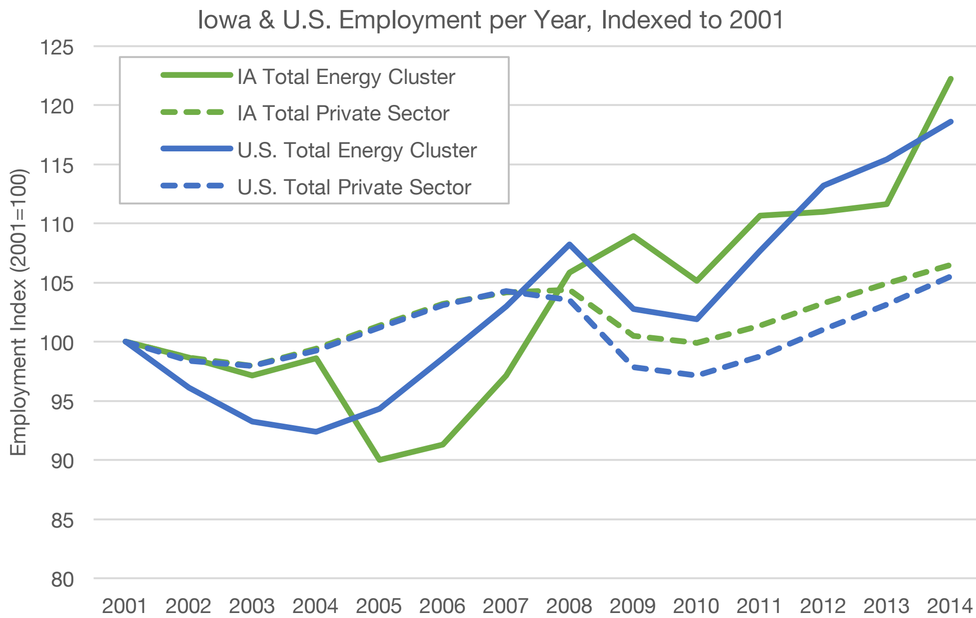

Figure 11. Total Energy Sector Employment Trends for Iowa and the U.S. for 2001 through 2014

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

By analyzing the individual energy subsectors' location quotients and comparative employment growth rates versus the nation, it is possible to see which energy subsectors are performing most strongly for Iowa. The bubble chart (Figure 11) is divided into four quadrants with quadrants to the right of the vertical axis in the center of the chart representing areas of employment growth over the time period evaluated (2001–2014) and the quadrants to the left containing sectors that saw employment decline. Quadrants above the horizontal line represent state specialization industries, defined by their location quotient being greater than 1.0. Clearly, the ideal place from a state perspective for a subsector to be is the upper right quadrant (specialized and growing), while the bottom right quadrant represents promising areas in which the state is experiencing growth, but not yet achieved specialization status. The size of each bubble is proportional to the level of employment in that energy subsector.

As Figure 11 shows, the Iowa energy sector currently contains two robust **"star"** energy subsectors that are both specialized and growing, these being "other renewable energy and storage" (2,606 employees in 2014) and "ethanol production" (1,845 employees in 2014). The "power generation" subsector is also a state specialization for Iowa, but experienced employment declines over the 2001–2014 period (2,520 employees in 2014). Overall, the significant size of the "power transmission/distribution" sector is apparent, but this subsector has held at slightly below the national average specialization with a slight employment decline during the period.

Two subsectors "extraction/resource development" and "refineries" while considered to be **emerging potential** quadrant have significant growth rates due to extremely small 2001 employment. It should also be noted that while the state "refineries" subsector includes 39 employees; it is highly likely that these three refinery establishments are actually involved in petrochemical-related refining not energy-related production.

Conclusion 10: Within the energy sector two subsectors related to renewable energy – "ethanol production" and "other renewable energy & storage" are the high performing subsectors for Iowa. However, more than 40% of the total energy sector's employment is in power transmission/distribution.

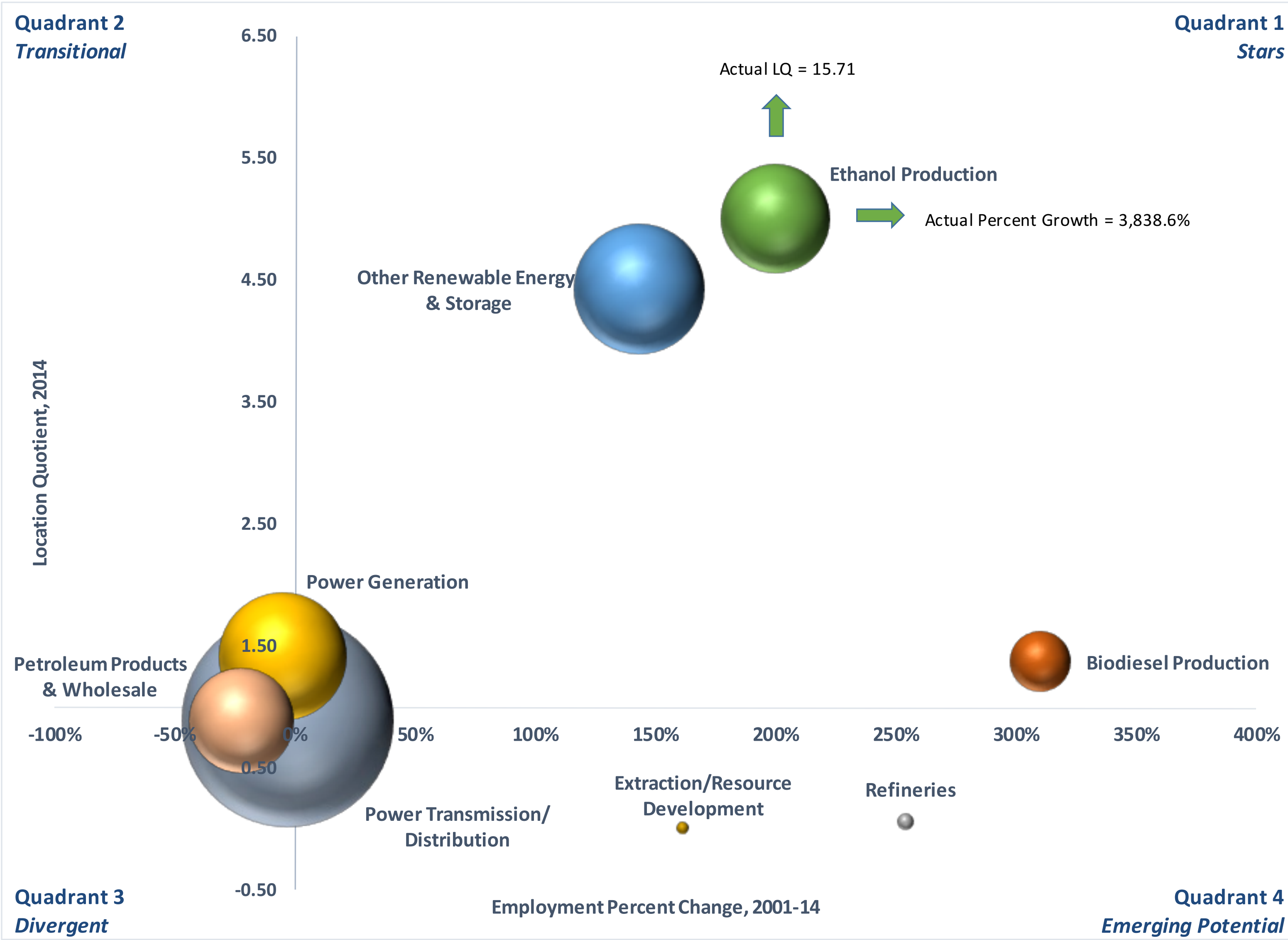

Figure 12. Iowa Energy Employment Size, Growth, and Degree of Specialization (LQ) by Subsector, for 2001-2014

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

In breaking the data down to a finer level of granularity, it is evident that five of the 32 energy NAICS industries are large (> 1,000 jobs) and specialized (LQ>1.2), with three of these five also exhibiting substantial employment growth (Table 14). These five industry components account for two-thirds of the total Iowa energy sectors' employment in 2014.[7] The significant growth of the state ethyl alcohol (ethanol) production is clearly evident, as well as significant growth in the manufacture of turbine and turbine generator sets used in a variety of energy-related applications from wind turbines, to hydroelectric turbines, to turbines sets used in other power generation applications.

Table 13. Performance of Large & Specialized Detailed Iowa Energy Sectors, 2001 - 2014

Energy Subsector	NAICS Description	Establishments		Employment		Location Quotient (LQ) 2014
		Number, 2014	Growth, 2001-2014	Jobs, 2014	Growth, 2001-2014	
Ethanol Production	Ethyl Alcohol Manufacturing (325193)	40	1100.0%	1,845	3838.6%	15.71
Other Renewable Energy & Storage	Turbine and Turbine Generator Set Units Manufacturing (333611)	8	220.0%	1,896	728.5%	6.37
Power Generation	Fossil Fuel Electric Power Generation (221112)	77	-33.0%	1,759	-24.7%	1.60
Power Transmission/ Distribution	Electric Power Distribution (221122)	145	17.6%	2,846	-19.2%	1.26
	Power/Communication Line and Related Structures Construction (237130)	158	41.1%	2,202	112.8%	1.20

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

Of the 31 NAICS energy and energy-related industries captured in the broad energy definition, Iowa currently has employment in 23. Each of these industries, each of the eight energy subsectors, and the overall Iowa energy sector are analyzed according to the **Industry Targeting Analysis** graphic (Figure 12) which divides these industries into relative performance categories based on their performance on location quotients, growth or decline in employment, and growth or decline in employment share versus the nation. The results of this targeting analysis are shown in Table 15.

7 It should be noted, that within the limitations placed on this analysis by the nature of the North American Industrial Classification System (NAICS) there is a strong likelihood of energy-related employment also spread throughout a variety of additional NAICS codes, which are not primarily energy-related in nature. For example, a company making foam insulation, would be included within a broader plastics-related NAICS code that includes substantial non-energy-related employment.

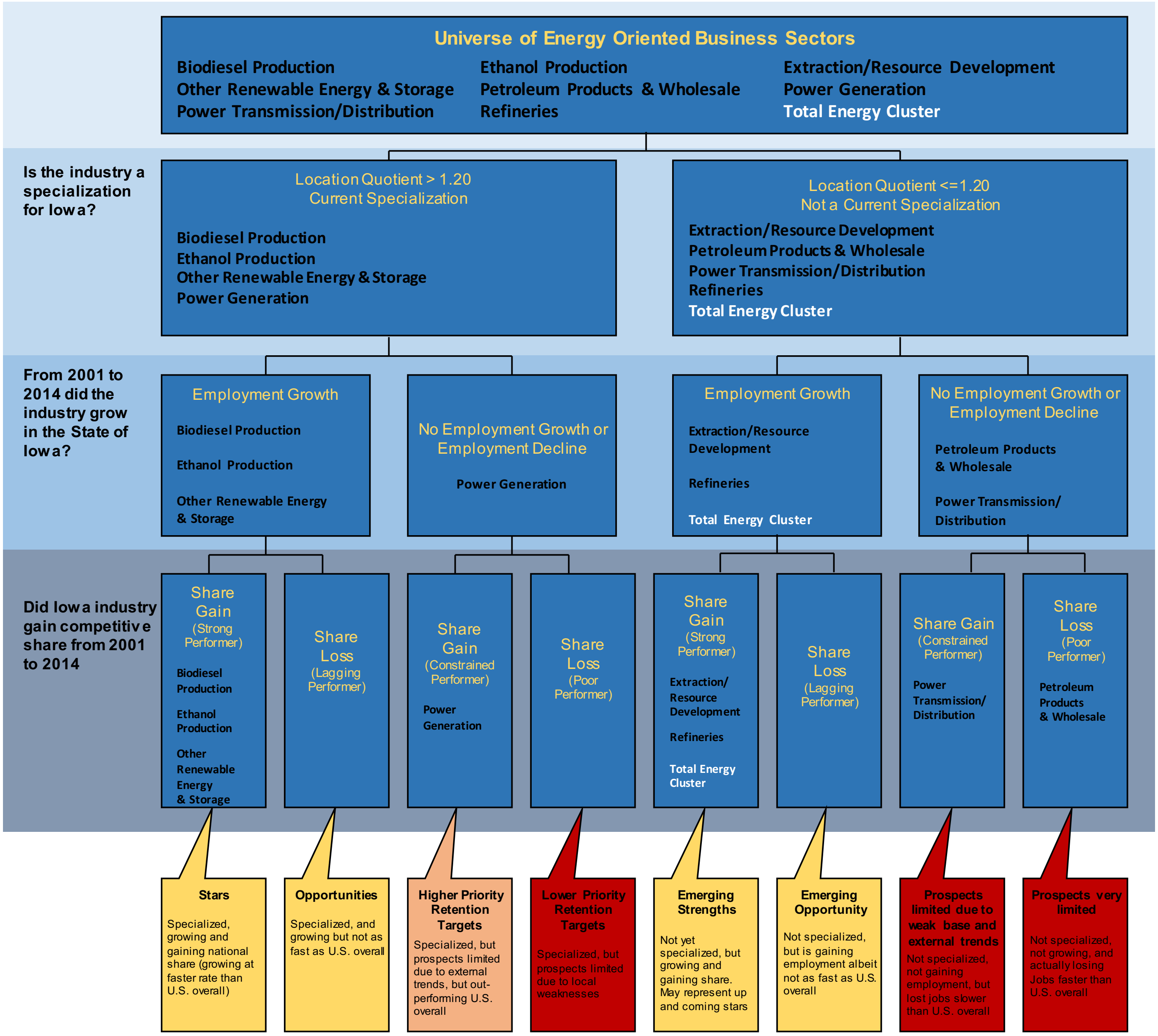

Figure 13. Industry Targeting Analysis for Iowa Energy Sector and Subsectors

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

EMPLOYMENT COMPENSATION IN THE IOWA ENERGY SECTOR

A goal of economic developers is not just to help promote the creation of jobs, but also to particularly encourage the generation of "high quality" jobs—jobs paying above average, family-sustaining wage levels. Bureau of Labor Statistics data confirm that Iowa energy jobs indeed are high-quality—paying a 2014 average annual wage of $73,412 in 2014 which is considerably higher than the state's average private sector wage of $41,964. Jobs in Iowa's power generation and power transmission/distribution energy subsectors are particularly high paying, with an average of $102,264 and $80,135 respectively. In fact, all eight of Iowa's energy subsectors pay at or above the state's average annual wage.

Table 14. Targeting Analysis of Iowa's Energy Sector, Subsectors, and NAICS-level Industry

NAICS Description	Iowa Industry Specialization	Iowa Industry Growth	Iowa Gained Competitive Share	Target Status
Biodiesel Production	**Current Specialization**	**Employment Growth**	**Share Gain**	**Stars**
Other Organic Chemical Manufacturing	Current Specialization	Employment Growth	Share Gain	Stars
Ethanol Production	**Current Specialization**	**Employment Growth**	**Share Gain**	**Stars**
Ethyl Alcohol Manufacturing	Current Specialization	Employment Growth	Share Gain	Stars
Extraction/Resource Development	**Not a Current Specialization**	**Employment Growth**	**Share Gain**	**Emerging Strengths**
Drilling Oil and Gas Wells	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Support Activities for Oil and Gas Operations	Not a Current Specialization	Employment Decline	Share Loss	Emerging Opportunity
Support Activities for Coal Mining	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Other Renewable Energy & Storage	**Current Specialization**	**Employment Growth**	**Share Gain**	**Stars**
Turbine and Turbine Generator Set Units Mfg.	Current Specialization	Employment Growth	Share Gain	Stars
Storage Battery Manufacturing	Current Specialization	Employment Decline	Share Gain	Higher Priority Retention Targets
Primary Battery Manufacturing	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Petroleum Products & Wholesale	**Not a Current Specialization**	**Employment Decline**	**Share Loss**	**Prospects Very Limited**
Petroleum Bulk Stations and Terminals	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Petroleum and Petroleum Products Wholesalers	Current Specialization	Employment Decline	Share Loss	Lower Priority Retention Targets
Heating Oil Dealers	Not a Current Specialization	Employment Decline	Share Loss	Prospects Very Limited
Liquefied Petroleum Gas (Bottled Gas) Dealers	Not a Current Specialization	Employment Decline	Share Loss	Prospects Very Limited

NAICS Description	Iowa Industry Specialization	Iowa Industry Growth	Iowa Gained Competitive Share	Target Status
Power Generation	**Current Specialization**	**Employment Decline**	**Share Gain**	**Higher Priority Retention Targets**
Hydroelectric Power Generation	Not a Current Specialization	Employment Decline	Share Loss	Prospects Very Limited
Fossil Fuel Electric Power Generation	Current Specialization	Employment Decline	Share Gain	Higher Priority Retention Targets
Nuclear Electric Power Generation	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Other Electric Power Generation	Current Specialization	Employment Growth	Share Gain	Stars
Power Transmission/Distribution	**Not a Current Specialization**	**Employment Decline**	**Share Loss**	**Prospects Limited**
Electric Bulk Power Transmission and Control	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Electric Power Distribution	Current Specialization	Employment Decline	Share Gain	Higher Priority Retention Targets
Natural Gas Distribution	Not a Current Specialization	Employment Decline	Share Loss	Prospects Very Limited
Oil/Gas Pipeline and Related Structures Const.	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Power/Communication Line and Related Structures Const.	Current Specialization	Employment Growth	Share Gain	Stars
Pipeline Transport. of Natural Gas	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Pipeline Transport. of Refined Petroleum Products	Not a Current Specialization	Employment Decline	Share Loss	Prospects Very Limited
Refineries	**Not a Current Specialization**	**Employment Growth**	**Share Gain**	**Emerging Strengths**
Petroleum Refineries	Not a Current Specialization	Employment Growth	Share Gain	Emerging Strengths
Total Energy Sector	**Not a Current Specialization**	**Employment Growth**	**Share Gain**	**Emerging Strengths**

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

From an economic development marketing perspective pay levels in Iowa are still considerably below those for the national economy overall. That is, employers do not pay as much in Iowa for labor as in other U.S. locations on average—Iowa energy wages, on average, are only 76% of the national level. Differences in wages can reflect the composition of the industry sector and the skill sets in demand, the costs of living and doing business, the value-added within an industry compared with other regions, and many other reasons.

Table 15. Average Wages for Select Iowa and U.S. Industries, 2014

Industry Sector, Subsector, or Sector	Iowa Average Wages, 2014	U.S. Average Wages, 2014	Iowa Wage Share of U.S. Wage
Power Generation	*$102,264*	*$111,298*	*92%*
Power Transmission/Distribution	*$80,135*	*$87,232*	*92%*
Management of Companies & Enterprises	$77,959	$112,868	69%
Biodiesel Production	*$77,954*	*$93,063*	*84%*
Total Energy Sector	*$73,254*	*$96,468*	*76%*
Finance & Insurance	$68,456	$97,373	70%
Professional, Scientific, & Technical Services	$60,472	$86,391	70%
Refineries	*$60,158*	*$132,020*	*46%*
Wholesale Trade	$58,766	$71,043	83%
Manufacturing	$54,418	$62,977	86%
Construction	$51,934	$55,040	94%
Extraction/Resource Development	*$51,191*	*$109,875*	*47%*
Information	$50,764	$90,804	56%
Other Renewable Energy & Storage	*$49,907*	*$73,100*	*68%*
Petroleum Products & Wholesale	*$45,693*	*$63,903*	*72%*
Real Estate & Rental & Leasing	$42,762	$51,808	83%
Transportation & Warehousing	$42,047	$48,720	86%
Ethanol Production	*$41,964*	*$74,758*	*56%*
Total Private Sector	$41,964	$51,298	82%
Health Care & Social Assistance	$39,605	$45,859	86%
Agriculture, Forestry, Fishing & Hunting	$37,113	$30,625	121%
Retail Trade	$24,673	$28,743	86%
Arts, Entertainment, & Recreation	$17,540	$34,856	50%

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

Conclusion 11: The energy sector in Iowa pays higher wages in comparison to the private sector overall in the state. It provides the sort of high quality, family-sustaining jobs that economic developers seek to grow.

LABOR PRODUCTIVITY IN THE IOWA ENERGY SECTOR

Comparing the productivity of a state sector to its national level provides insights into whether the state industry is more or less competitive. Higher levels of productivity compared to the nation mean that for each job more economic output is generated suggesting that a local industry is better able to make use of advances in technology to produce goods and services and is able to produce more complex, higher value products.

In terms of labor productivity in the energy sector, measured by value-added per worker[8], Iowa lags behind the nation. Latest data, for 2014 (Table 17), shows that the energy sector in Iowa produces $193,326 in value-added activity per employee, versus $263,028 for the nation.[9] Thus Iowa's energy productivity level runs at about 74% of the national level. However, taking into account the fact that Iowa energy wages are, on average, only 76% of the national level it is evident that the Iowa workforce is effectively still good value for money.

Table 16. Value-Added per Worker in the Energy Sector 2014—Iowa Compared to the U.S.

Industry Sector	Iowa Productivity, 2014	U.S. Productivity, 2014	Iowa Productivity Share of U.S. Productivity
Energy Sector	$193,326	$263,028	74%
Total Private Sector	$88,548	$93,915	94%

Source: TEConomy Partners analysis of IMPLAN Input/Output Model for Iowa and the U.S.

It is also clear from these high dollar values that the energy sector, in general, is highly capital intensive—i.e., it is an industry in which the infrastructure required to produce its product (ethanol production equipment, power stations, distribution infrastructure, etc.) require high levels of investment in comparison to the total number of jobs generated. This is evidenced by the fact that the energy sector produces $193,326 in value-added per worker in Iowa, versus just $88,548 per worker in the private sector

8 Value-added represents the difference between an industry's total output and the cost of its intermediate inputs; a measure of the sector's contribution to GSP. A significant component of value-added is worker wages. The measure of value-added per employee is often used as a measure of overall industry productivity.

9 Some industries do not map directly 1:1 from NAICS to the IMPLAN model-specific industry sectors and therefore some are left out of this analysis as including the full IMPLAN sector would be overly inclusive (e.g., Energy-related sectors in Wholesale and Retail are not included in this calculation).

on average. In highly capital intensive industries, relative wage rates for workers can be a relatively minor location factor and, in this regard, the comparatively lower levels of wages paid in the energy sector in Iowa may not be a particularly strong comparative advantage.

Productivity varies widely across the various energy subsectors, with power generation having the largest value-added per employee in both Iowa and the U.S., $508,765 and $546,474, respectively—again indicating the extreme capital intensity of this subsector. Important for Iowa is that ethanol production productivity, as measured by value-added per employee, reached $309,805 in 2014, compared to the U.S. level of $253,645.

Conclusion 12: While overall Iowa energy wages and productivity levels are lower than the national average for the sector, the relationship between wages and productivity is slightly better than the national average and key subsectors offer significant competitive advantage and opportunities.

IV. PRELIMINARY SCENARIOS FOR ENERGY CHANGE IN IOWA

INITIAL SCENARIO DEVELOPMENT

The ultimate goal of these Iowa energy scenarios is to establish a future path for energy development activities in the State. This initial set of scenarios are developed to provide a basic "baseline" perspective of recent energy performance, measured by consumption (demand) and production (supply) and how even a simple continuation of this performance will alter Iowa's future energy landscape, and how choices, strategies, and actions developed as part of the Iowa Energy Plan can alter Iowa's energy future.

This initial set of scenarios will be updated, modified, and replaced using additional and "to be collected" information from the state's energy stakeholders through both interviews and working group perspectives, leading to a final set of scenarios that plot potential energy futures for Iowa as needed for the energy plan. These initial scenarios provide forecasts for the major energy fuel-related groups of coal, natural gas, petroleum (oil), nuclear, and renewable (including hydro-electric, geothermal, biomass, solar, etc.) as well as total energy consumption and a composite of the combined five fuel-related groups.

Scenario I: Continuation of Decade-plus Trends

The first scenario shows previous Iowa energy consumption from 2000 through 2013 (shaded area) and then extends this consumption performance, based upon the calculated compound annual growth rate (CAGR) of this performance to 2025 (Figure 13).

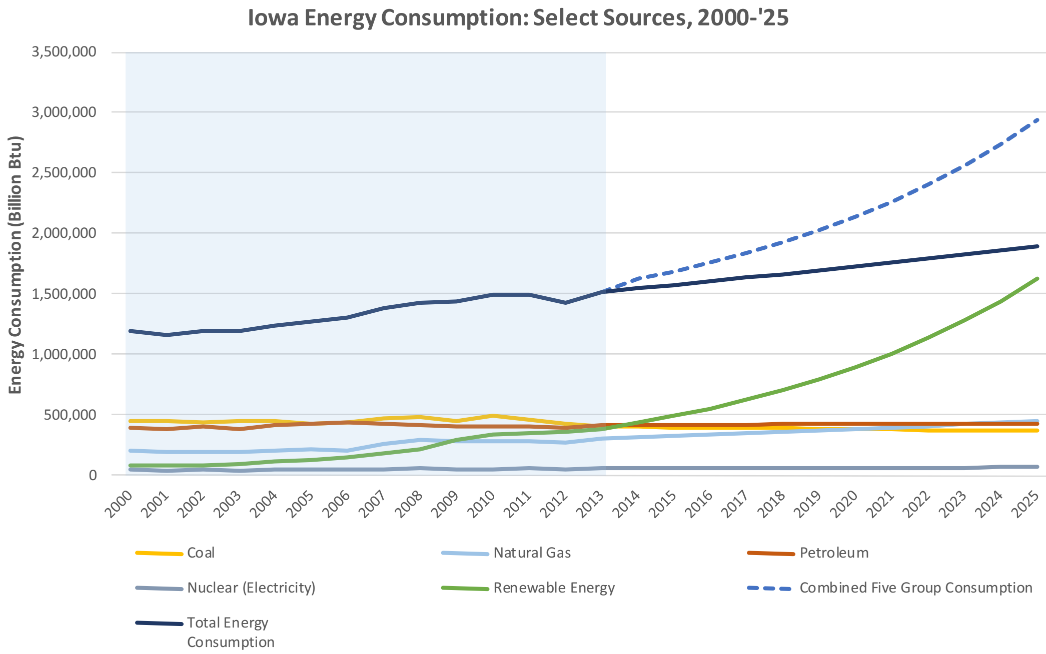

Figure 14. Iowa Energy Consumption Forecast to 2025 at 2000-2013 CAGR

Source: TEConomy Partners analysis of U.S. Energy Information Administration data for Iowa.

Note: CAGR = Compound Annual Growth Rate.

This scenario depicts a continuation of the extreme growth in renewable energy consumption within the state over the 2000-2013 period, and what consumption values for this energy source would look like in the unlikely case that all five energy groups continued on their historical path. In this scenario renewable energy consumption's substantial growth (CAGR=12.8%) along with relatively flat growth or slight declines in the remaining fuel groups show the combined growth would far surpass overall projected total energy consumption growth.

Scenario II: Continuation of More Recent Trends

The second scenario (Figure 14) shows a similar forecast approach, but only uses the truncated recent period, 2010-2013, to establish the historical CAGR rate for the forecast. This more recent growth rate eliminates some of the extremely high growth periods in the early 2000's as the renewable energy sector began developing in Iowa.

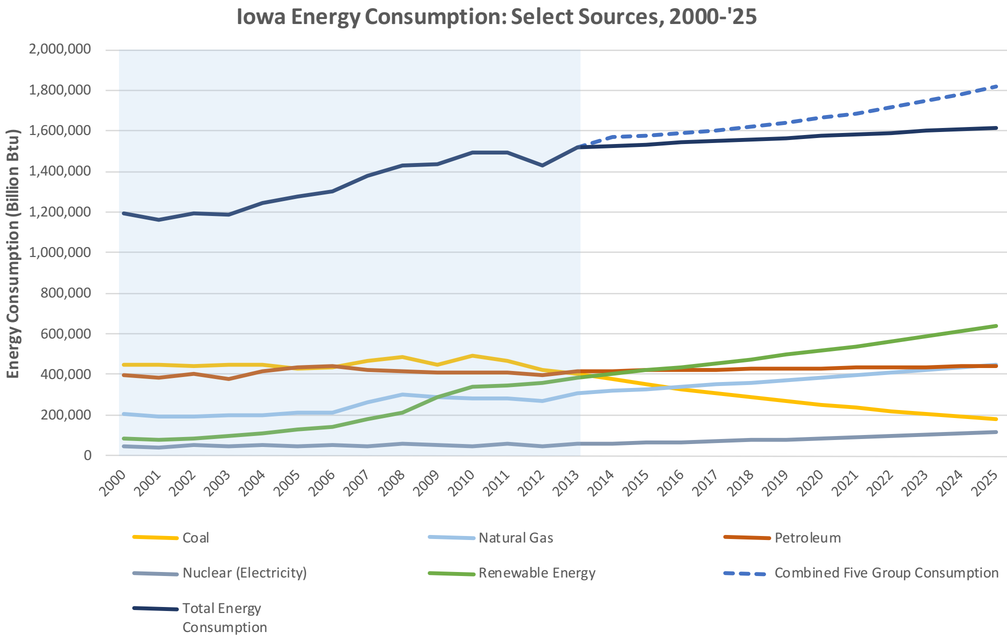

Figure 15. Iowa Energy Consumption Forecast to 2025 at 2010-1013 CAGR.

Source: TEConomy Partners analysis of U.S. Energy Information Administration data for Iowa.

Even with the CAGR focused on the most recent period, the renewable energy sector continues a significant CAGR of 4.3% per year. This lessened growth rate in renewable energy is combined with a now more pronounced decline in coal consumption (CAGR from 2000-2013 = -0.8%; CAGR from 2010-2013 = -6.6%), to bring the combined five group consumption forecast much closer to total energy consumption forecast, yet it still exceeds it by 200,000 Billion Btu.

Scenario III: National EIA Forecasts

The third initial scenario (Figure 15) replaces Iowa consumption forecast CAGRs, built upon Iowa historical consumption data, with a forecast built upon an existing U.S. EIA forecast for the West North Central region that is a component of their Annual Energy Outlook (AEO).[10] In their AEO, the U.S. EIA forecasts energy consumption in a mostly similar context to the year 2040.[11] For the purposes of this scenario, a CAGR was calculated from the AEO West North Central forecast for the years 2013-2025 to coincide with the previous scenarios.

In this scenario, total energy consumption is forecast to grow at a CAGR of less than 1.0% similar to Scenario II. With Scenario III's forecast built upon the structured

[10] The West North Central Region is defined as Iowa, Missouri, Missouri, Kansas, Nebraska, South Dakota, North Dakota, and Minnesota.

[11] Some slight definitional differences exist between the AEO categories and U.S. EIA SEDS data used for the base Iowa consumption data from 2000-2013. At the broad energy groups used in these basic scenarios the differences are negligible.

forecast of the AEO the developed CAGR lead to a combination of the five energy groups equaling the total energy consumption forecast.[12]

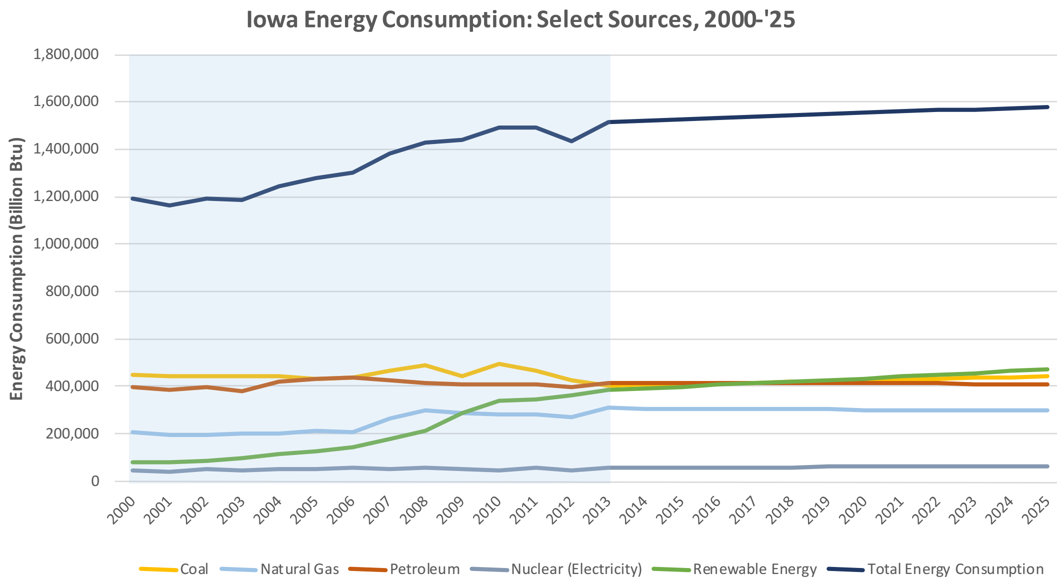

Figure 16. Iowa Energy Consumption Forecast to 2025 at U.S. EIA AEO Forecast 2013-2025 CAGR.

Source: TEConomy Partners analysis of U.S. Energy Information Administration data for Iowa and Annual Energy Outlook data for the West North Central Region (which includes Iowa).

Scenario IV: Production Forecast

The fourth scenario (Figure 16) depicts Iowa historical production from 2000-2013 in the three areas in which Iowa currently produces energy—nuclear energy production, other renewable energy (electricity) production, and ethanol production. Three forecasts are developed for each source—a CAGR based upon Iowa's historical 2000-2013 production (IA CAGR '00-'13), a CAGR based upon Iowa's historical 2010-2013 production (IA CAGR '10-'13), and a CAGR based upon overall U.S. 2010-2013 production (U.S. CAGR '10-'13).

[12] For purposes of these baseline, illustrative scenarios, the forecast years do not take into account net energy loss and import/export considerations.

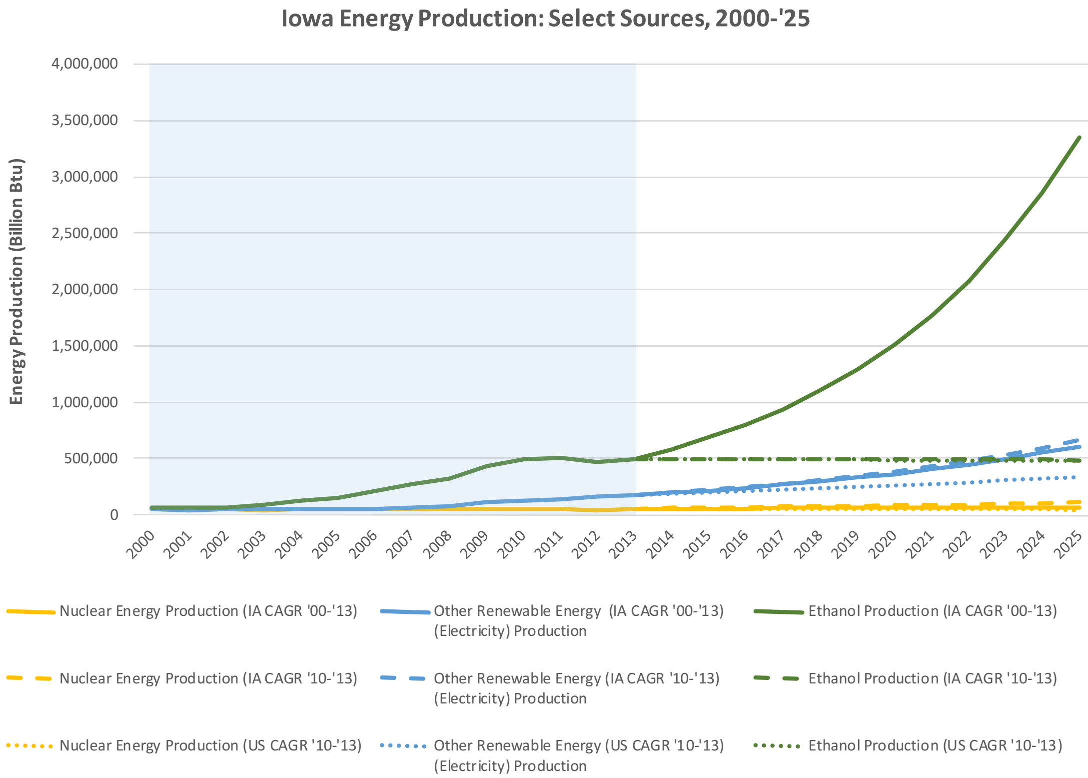

Figure 17. Iowa Energy Production Forecast to 2025, Various Projected Growth Rates.

Source: TEConomy Partners analysis of U.S. Energy Information Administration data for Iowa and the U.S.

What is most surprising when examining Scenario IV is that with the exception of the ethanol production forecast based upon the 2000-2013 CAGR, the future production forecasts are very similar, with the U.S.-based forecast for other renewable energy slightly lower.

SCENARIO DEVELOPMENT NEXT STEPS

As described, these scenarios capture the Iowa energy-consumption data contained within this white paper and develops simple, baseline scenarios to begin the discussion of Iowa's energy future. Additional scenarios will be developed and shared with stakeholders and working groups as additional data is gathered, the project progresses and information pertaining to potential viable scenarios is received.

At a minimum the next wave of scenarios will begin to explore key variables, opportunities, and policy initiatives and will include, among others:

- Understanding existing planned capacity and generation changes within Iowa on both production and consumption.
- Role of the Clean Power Plan and its potential impacts on both generation capacity and energy availability.
- Renewable Portfolio Standard-influenced portfolio changes.
- Continued manufacturing expansion on consumption mix.
- Reconciling differences and distinctions between consumption and demand forecasts.

Thoughts on how these factors will weigh on and impact the scenarios for Iowa's energy future will be brought to light through the on-going efforts of this project.

APPENDIX A: PERFORMANCE COMPARISON BY ENERGY CATEGORY – IOWA AND SURROUNDING BENCHMARK STATES

Data for the following tables and figures in Chapter II are from the U.S. Energy Information Administrations, State Energy Data Systems (SEDS) database, 2000-2013 (most currently available).

COAL DEMAND PROFILE

Table A1. Coal Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**402,402**	**17**	**-9.8%**	**14**	**$736.5**	**22**	**$1.83**	**46**
Illinois	1,026,925	5	1.0%	7	$2,128.4	6	$2.07	38
Minnesota	267,695	27	-28.4%	27	$566.5	30	$2.12	33
Missouri	806,549	7	17.1%	3	$1,553.0	12	$1.93	43
Nebraska	292,956	25	41.6%	1	$423.1	31	$1.44	49
South Dakota	34,246	40	-32.3%	29	$71.2	42	$2.08	35
Wisconsin	454,554	15	-8.9%	13	$1,108.9	14	$2.44	28
U.S. Totals	**18,038,771**		**-20.1%**		**$45,516.6**		**$2.52**	

NATURAL GAS DEMAND PROFILE

Table A2. Natural Gas Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**306,460**	**25**	**50.9%**	**12**	**$2,045.7**	**23**	**$6.32**	**33**
Illinois	1,063,690	7	2.3%	35	$7,260.8	5	$7.20	18
Minnesota	478,810	16	30.3%	24	$2,426.4	20	$6.26	35
Missouri	281,486	30	-2.3%	41	$1,811.0	28	$8.80	8
Nebraska	179,610	38	41.1%	20	$994.6	36	$5.78	43
South Dakota	84,527	44	121.8%	2	$462.0	46	$6.04	40
Wisconsin	450,169	18	13.2%	30	$2,997.3	17	$6.72	26
U.S. Totals	**26,801,763**		**12.5%**		**$151,704.5**		**$6.44**	

PETROLEUM DEMAND PROFILE

Table A3. Petroleum Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**427,080**	**29**	**5.5%**	**10**	**$11,314.3**	**28**	**$26.49**	**37**
Illinois	1,234,444	6	-4.1%	20	$30,305.9	6	$27.05	26
Minnesota	608,922	18	-10.2%	32	$15,509.3	19	$27.30	23
Missouri	632,148	17	-6.8%	25	$16,735.4	17	$26.47	39
Nebraska	238,966	37	6.3%	8	$6,601.2	35	$27.62	17
South Dakota	117,362	47	-0.6%	15	$3,167.8	47	$26.99	28
Wisconsin	525,625	23	-13.0%	38	$14,433.9	21	$27.68	15
U.S. Totals	**35,820,042**		**-6.7%**		**$878,115.6**		**$26.11**	

MOTOR GASOLINE DEMAND PROFILE

Table A4. Gasoline Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**198,722**	**28**	**3.7%**	**19**	**$5,580.8**	**28**	**$28.08**	**33**
Illinois	559,961	8	-10.5%	48	$16,001.8	7	$28.58	29
Minnesota	304,634	22	-4.4%	39	$8,798.4	20	$28.88	25
Missouri	368,645	14	-4.3%	38	$10,047.2	15	$27.25	47
Nebraska	103,043	37	-3.4%	37	$2,973.3	37	$28.85	26
South Dakota	53,510	45	-0.4%	29	$1,555.0	45	$29.06	22
Wisconsin	295,970	23	-2.5%	33	$8,731.2	21	$29.50	14
U.S. Totals	**16,338,562**		**1.1%**		**$467,337.6**		**$28.60**	

FUEL OIL DEMAND PROFILE

Table A5. Fuel Oil Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**138,913**	**24**	**23.9%**	**10**	**$3,759.6**	**25**	**$27.06**	**40**
Illinois	267,542	7	7.1%	20	$7,400.9	7	$27.67	19
Minnesota	157,153	20	8.7%	18	$4,368.3	20	$27.80	15
Missouri	172,049	14	2.6%	24	$4,660.4	14	$27.09	39
Nebraska	110,112	32	26.7%	7	$3,001.0	32	$27.25	35
South Dakota	45,907	45	30.7%	5	$1,238.4	45	$26.98	41
Wisconsin	139,116	23	-18.4%	42	$3,893.2	23	$27.99	8
U.S. Totals	**8,066,422**		**1.8%**		**$221,442.4**		**$27.46**	

PROPANE DEMAND PROFILE

Table A6. LPG (Propane) Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**63,297**	**5**	**-11.2%**	**29**	**$1,398.4**	**7**	**$22.09**	**47**
Illinois	84,791	3	15.8%	16	$1,899.3	3	$22.47	44
Minnesota	36,575	9	-0.4%	24	$853.4	11	$23.40	37
Missouri	30,742	13	-23.9%	38	$706.4	15	$22.98	41
Nebraska	12,338	27	-12.9%	31	$288.9	29	$23.42	36
South Dakota	7,523	40	-23.1%	36	$175.4	41	$23.32	38
Wisconsin	36,388	10	-12.7%	30	$814.6	12	$22.39	45
U.S. Totals	**3,166,737**		**7.5%**		**$55,690.0**		**$17.61**	

NUCLEAR ENERGY DEMAND PROFILE

Table A7. Nuclear Energy Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013		Expenditures ($ Millions)		Price ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**55,597**	**29**	**19.7%**	**5**	**$46.5**	**29**	**$0.84**	**7**
Illinois	1014,926	1	8.8%	8	$820.8	1	$0.81	14
Minnesota	111,885	24	-17.2%	26	$108.5	21	$0.97	2
Missouri	87,428	26	-16.1%	25	$78.7	24	$0.90	5
Nebraska	71,736	28	-20.3%	28	$60.0	27	$0.84	7
South Dakota	0	32		N/A	$0.0	32	$0.00	32
Wisconsin	121,994	21	1.6%	21	$93.5	22	$0.77	19
U.S. Totals	**8,244,433**		**4.9%**		**$6,522.6**		**$0.79**	

Note: 19 states and the District of Columbia have no direct production/consumption of nuclear power. These regions are all ranked at 32. Consumption metrics based on Nuclear energy consumed for electricity generation, total

BIOMASS DEMAND PROFILE

Table A8. Biomass Consumption, Expenditures, and Price by Benchmark State

	Consumption (Billion Btu)		Consumption Change, 2000-2013		Expenditures* ($ Millions)		Price* ($ per Million Btu)	
State	Metric	State Rank	Metric	State Rank	Metric	State Rank	Metric	State Rank
Iowa	**227,581**	**4**	**244.1%**	**8**	**$35.7**	**37**	**$6.08**	**17**
Illinois	136,667	11	43.0%	32	$92.5	29	$6.04	18
Minnesota	148,410	9	70.1%	21	$170.7	18	$3.51	35
Missouri	71,291	25	319.7%	6	$135.6	23	$11.36	10
Nebraska	107,101	21	281.9%	7	$15.2	43	$7.53	12
South Dakota	61,432	28	1209.0%	1	$8.7	49	$11.67	9
Wisconsin	133,836	12	40.7%	33	$227.9	16	$4.18	31
U.S. Totals	**4,464,695**		**48.4%**		**$7,834.0**		**$3.79**	

*Note: *These biomass figures represent the "values" of all biomass including the consumption of biomass that is ultimately converted to other energy products including ethanol.*

For the following, renewable energy-specific tables expenditure and price information is unavailable from the SEDS as these sources do not have "fuel-related" expenditures and all feed into the overall electricity pool (grid) from a price consideration, at this level of data availability. Further efforts to examine "green power pricing" and other RPS-related impacts is on-going.

RENEWABLE ENERGY DEMAND PROFILE

Table A9. Total Renewable Energy Consumption by Benchmark State

	Consumption (Billion Btu)		Consumption Percent Change, 2000-2013	
State	Metric	State Rank	Metric	State Rank
Iowa	**384,690**	**6**	**376.5%**	**3**
Illinois	234,642	10	140.2%	15
Minnesota	233,732	11	123.3%	16
Missouri	94,515	33	305.7%	5
Nebraska	136,286	25	212.0%	12
South Dakota	127,714	27	101.3%	18
Wisconsin	168,986	17	46.0%	31
U.S. Totals	**9,147,633**		**49.8%**	

WIND ENERGY DEMAND PROFILE

Table A10. Wind (Renewable Energy) Consumption by Benchmark State

	Consumption (Billion Btu)		Consumption Change, 2000-2013	
State	Metric	State Rank	Metric	State Rank
Iowa	**148,538**	**2**	**143,501**	**2**
Illinois	91,834	5	91,834	4
Minnesota	78,797	7	71,406	7
Missouri	11,133	24	11,133	24
Nebraska	17,191	20	17,191	20
South Dakota	25,643	17	25,643	17
Wisconsin	14,864	22	14,836	22
U.S. Totals	**1,601,359**		**1,544,302**	

Iowa was one of only 11 states registering any wind energy consumption in 2000. In 2013, 39 states registered wind energy consumption.

Iowa accounts for 9.3% of U.S. wind consumption in 2013 and accounts for 9.3% of the increase in U.S. consumption from 2000 to 2013.

ETHANOL DEMAND PROFILE

A11. Ethanol (Renewable Energy) Consumption by Benchmark State

	Consumption (Billion Btu)		Consumption Change, 2000-2013	
State	**Metric**	**State Rank**	**Metric**	**State Rank**
Iowa	**12,926**	**28**	**5,236**	**37**
Illinois	39,470	7	15,514	23
Minnesota	25,491	15	6,105	34
Missouri	21,436	19	19,021	18
Nebraska	5,586	40	2,837	46
South Dakota	3,731	43	1,806	49
Wisconsin	20,706	21	17,998	20
U.S. Totals	**1,091,826**		**955,293**	

Iowa was one of 34 states with ethanol consumption in 2000. By 2013, all 50 states and the District of Columbia had some level of ethanol consumption.

Iowa accounts for only 1.2% of U.S. ethanol consumption in 2013 and 0.5% of the change in total ethanol consumption from 2000 to 2013.

Overall U.S. ethanol consumption increased by 700% from 2000 to 2013.

IOWA ENERGY PLAN

APPENDIX D:
Assessment of Iowa's Energy Position: Geographic Analysis

Collaborate locally.
Grow sustainably.
Lead nationally.

IOWA ENERGY PLAN IS A JOINT INITIATIVE BETWEEN IOWA economic development | IOWA DOT

Prepared by TEConomy Partners, LLC.

June 7, 2016.

TECONOMY
PARTNERS LLC
Innovating Tommorow's Economic Landscape

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I. POWER PLANTS IN IOWA BY CAPACITY

A. Introduction

This report is issued as an addendum to TEConomy Partners LLC report of February 2016 titled "*White Paper: Preliminary Assessment of Iowa's Energy Position*." Multiple reviewers and working group members requested further detail than was contained in the original White Paper regarding the structure and geography of Iowa's power generation and energy infrastructure system. This addendum to the report provides:

- An overview of the largest power generation plants in Iowa and their city/county locations
- Summary data for all power plants in the state divided by their primary fuel source
- Additional information on energy infrastructure in regards to major electricity transmission lines, pipelines, and overall resource potentials in Iowa for wind, solar and solid biomass.

The U.S. Energy Information Administration's "Energy Mapping System" is the primary source of the information, with custom analysis and reporting developed by TEConomy Partners, LLC.

B. Power Plants with Total Net Summer Capacity >500 MW

The largest power plants in Iowa, those with over 500 MW of generation, all use conventional fossil fuels (primarily coal) except for the Duane Arnold nuclear power plant in Cerro Gordo county.

Table 1. Power Plants by Capacity

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total Net Summer Capacity
Walter Scott Jr Energy Center	MidAmerican Energy Co	Council Bluffs	Pottawattamie	Electric Utility	Conventional Steam Coal	**Coal**	**1,517.3 MW**
George Neal North	MidAmerican Energy Co	Sergeant Bluff	Woodbury	Electric Utility	Conventional Steam Coal	**Coal**	**918 MW**
Ottumwa	Interstate Power and Light Co	Ottumwa	Wapello	Electric Utility	Conventional Steam Coal	**Coal**	**746.3 MW**
Louisa	MidAmerican Energy Co	Muscatine	Louisa	Electric Utility	Conventional Steam Coal	**Coal**	**746.2 MW**
George Neal South	MidAmerican Energy Co	Salix	Woodbury	Electric Utility	Conventional Steam Coal	**Coal**	**644 MW**
Duane Arnold Energy Center	NextEra Energy Duane Arnold LLC	Palo	Linn	IPP Non-CHP	Nuclear	**Nuclear**	**601.4 MW**
Emery Station	Interstate Power and Light Co	Clear Lake	Cerro Gordo	Electric Utility	Natural Gas Fired Combined Cycle	**Natural Gas**	**515 MW**

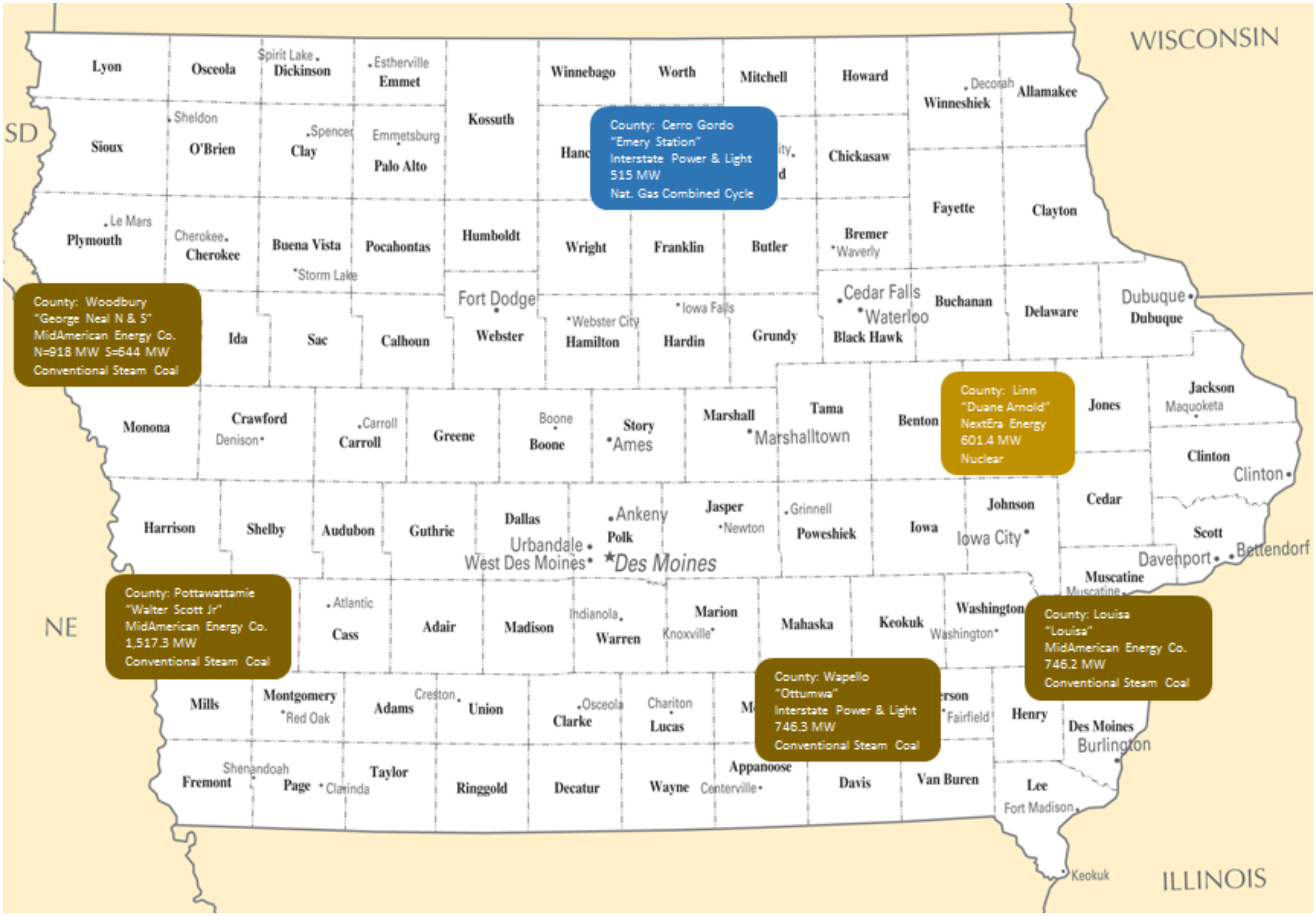


Figure 1. County Locations of the Largest Power Generating Plants in Iowa (>500 MW)

C. Plants with Total Net Summer Capacity 250-500 MW

In the second largest generation capacity category (plants with between 250-500MW) Iowa's leadership in wind power generation comes into play with more than half the plants in this category now being wind power operations.

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Greater Des Moines	MidAmerican Energy Co	Pleasant Hill	Polk	Electric Utility	Natural Gas Fired Combined Cycle	**Natural Gas**	**492.6 MW**
Plant Code: 58883	MidAmerican Energy Co Utility ID: 12341	Primghar	O'Brien	Electric Utility	Onshore Wind Turbine	**Wind**	**448.3 MW**
Plant Code: 57501	MidAmerican Energy Co	Massena	Cass	Electric Utility	Onshore Wind Turbine	**Wind**	**443.9 MW**
Plant Code: 56797	Utility ID: 55992	McIntire	Mitchell	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**300 MW**
Archer Daniels Midland Cedar Rapids	Archer Daniels Midland Co	Cedar Rapids	Linn	Industrial CHP	Conventional Steam Coal	**Coal**	**260 MW**
Plant Code: 56501	MidAmerican Energy Co	Fonda	Pocahontas	Electric Utility	Onshore Wind Turbine	**Wind**	**286.4 MW**
Burlington (IA)	Interstate Power and Light Co	Burlington	Des Moines	Electric Utility	Conventional Steam Coal; Natural Gas Fired Combustion Turbine;	**Coal**	**268.3 MW** **Coal = 210 MW, Natural Gas = 58.3 MW**

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Plant Code: 58884	MidAmerican Energy Co	Otho	Webster	Electric Utility	Onshore Wind Turbine	**Wind**	**251 MW**

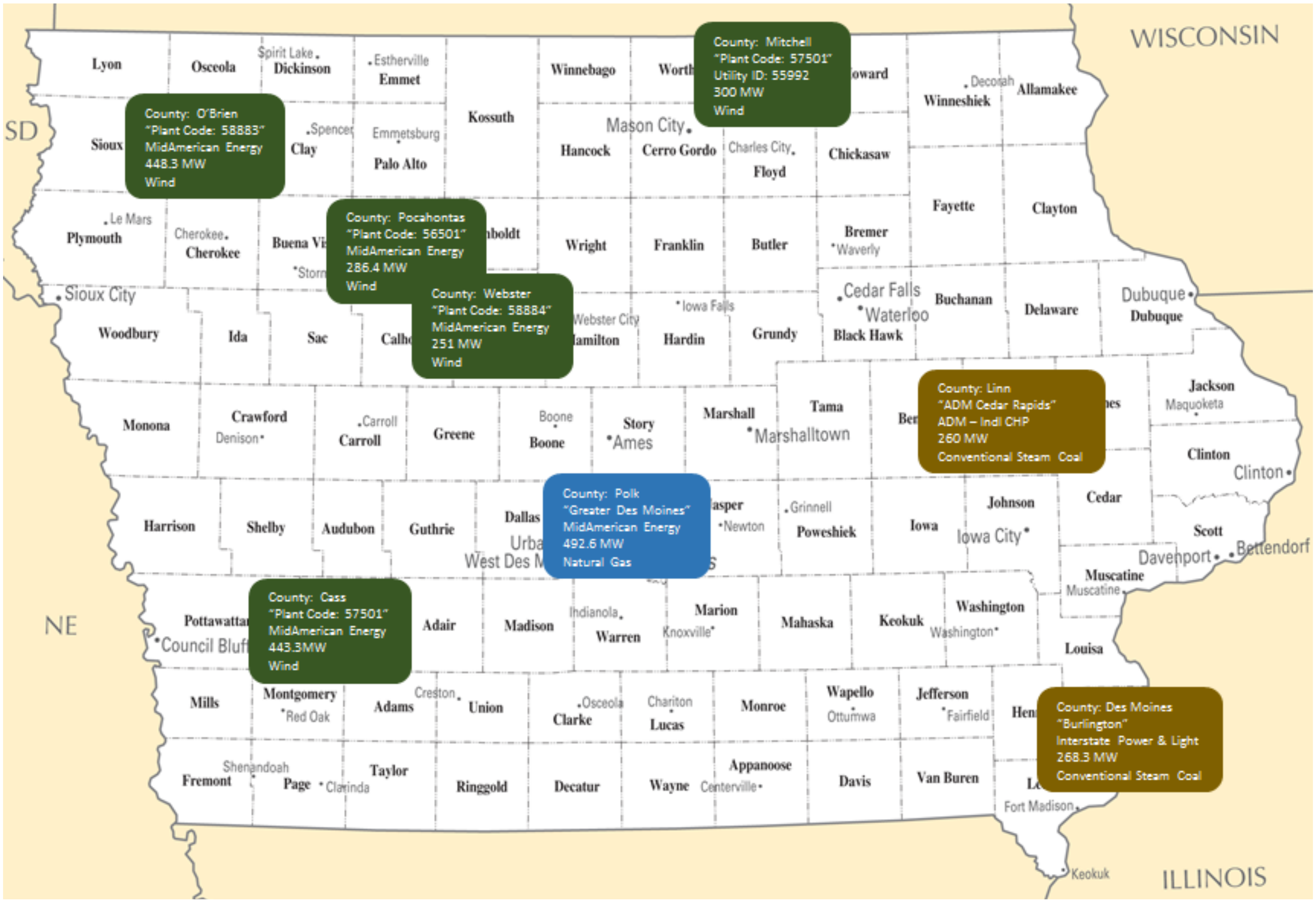


Figure 2. County Locations of Power Generating Plants in Iowa with Between 250-500 MW Capacity

D. Plants with Total Net Summer Capacity 100-249 MW

The third category of major power plants in Iowa contains plants with a capacity of between 100 and 249.9 MW of generation. Again, the strength of wind power generation in Iowa is evident with 20 out of the 35 plants listed using wind power. Natural gas is the next most used with eight plants out of the 35, followed by coal with five.

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Lansing	Interstate Power and Light Co. Utility ID: 9417	Lansing	Allamakee	Electric Utility	Conventional Steam Coal	**Coal**	**249.4 MW**
Muscatine Plant #1	Board of Water Electric & Communications	Muscatine	Muscatine	Electric Utility	Conventional Steam Coal	**Coal**	**230.7 MW**
Milton L Kapp	Interstate Power and Light Co	Clinton	Clinton	Electric Utility	Natural Gas Steam Turbine	**Natural Gas**	**204.1 MW**
Plant Code: 56252	MidAmerican Energy Co	Blairsburg	Hamilton	Electric Utility	Onshore Wind Turbine	**Wind**	**200 MW**
Plant Code: 57873	MidAmerican Energy Co	Adair	Guthrie	Electric Utility	Onshore Wind Turbine	**Wind**	**200 MW**
Plant Code: 56925	Utility ID: 56124	Britt	Hancock	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**200 MW**
Plant Code: 56355	Utility ID: 9417	Iowa Falls	Franklin	Electric Utility	Onshore Wind Turbine	**Wind**	**199.7 MW**
Electrifarm	MidAmerican Energy Co	Waterloo	Black Hawk	Electric Utility	Natural Gas Fired Combustion Turbine	**Natural Gas**	**195.1 MW**
Archer Daniels Midland Clinton	Archer Daniels Midland Co	Clinton	Clinton	Industrial CHP	Conventional Steam Coal	**Coal**	**180 MW**

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Plant Code: 56251	MidAmerican Energy Co	Schaller	Buena Vista	Electric Utility	Onshore Wind Turbine	**Wind**	**175.5 MW**
Plant Code: 56810	MidAmerican Energy Co	Adair	Adair	Electric Utility	Onshore Wind Turbine	**Wind**	**174.8 MW**
Prairie Creek	Interstate Power and Light Co. Utility ID: 9417	Cedar Rapids	Linn	Electric Utility	Conventional Steam Coal	**Coal**	**164.2 MW**
Plant Code: 56765	Utility ID: 15399	Kensett	Worth	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**160 MW**
Pleasant Hill	MidAmerican Energy Co	Pleasant Hill	Polk	Electric Utility	Natural Gas Fired Combustion Turbine	**Natural Gas**	**160 MW**
Marshall-town	Interstate Power and Light Co	Marshall-town	Marshall	Electric Utility	Petroleum Liquids	**Petrol-eum**	**154.5 MW**
Plant Code: 56811	MidAmerican Energy Co	Walnut	Pottawa-ttamie	Electric Utility	Onshore Wind Turbine	**Wind**	**153 MW**
Plant Code: 57874	MidAmerican Energy Co	Marshall-town	Marshall	Electric Utility	Onshore Wind Turbine	**Wind**	**150.2 MW**
Plant Code: 56809	MidAmerican Energy Co	Carroll	Carroll	Electric Utility	Onshore Wind Turbine	**Wind**	**150 MW**
Plant Code: 57469	Utility ID: 56787	Zearing	Hardin	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**150 MW**
Plant Code: 56923	Utility ID: 56123	Britt	Hancock	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**150 MW**

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Sycamore (IA)	MidAmerican Energy Co	Johnston	Polk	Electric Utility	Natural Gas Fired Combustion Turbine	**Natural Gas**	**148.5 MW**
Plant Code: 58886	MidAmerican Energy Co	Wellsburg	Grundy	Electric Utility	Onshore Wind Turbine	**Wind**	**140.8 MW**
Keokuk	Union Electric Co - (MO)	Keokuk	Lee	Electric Utility	Conventional Hydroelectric	**Hydro**	**140.5 MW**
Exira	Western Minnesota Municipal Power Agency	Brayton	Audubon	Electric Utility	Natural Gas Fired Combustion Turbine	**Natural Gas**	**139.5 MW**
Riverside	MidAmerican Energy Co	Bettendorf	Scott	Electric Utility	Conventional Steam Coal	**Coal**	**125 MW**
Plant Code: 57500	MidAmerican Energy Co	Laurel	Marshall	Electric Utility	Onshore Wind Turbine	**Wind**	**119.6 MW**
Plant Code: 58885	MidAmerican Energy Co	Macksburg	Madison	Electric Utility	Onshore Wind Turbine	**Wind**	**119.6 MW**
River Hills	MidAmerican Energy Co	Des Moines	Polk	Electric Utility	Natural Gas Fired Combustion Turbine	**Natural Gas**	**116.9 MW**
Earl F Wisdom	Corn Belt Power Coop	Spencer	Clay	Electric Utility	Natural Gas Fired Combustion Turbine; Natural Gas Steam Turbine.	**Natural Gas**	**113.5 MW**

Plant	Operator	City	County	Sector	Technology	Primary Fuel	Total net Summer Capacity
Sutherland	Interstate Power and Light Co	Marshall-town	Marshall	Electric Utility	Natural Gas Steam Turbine	**Natural Gas**	**110.7 MW**
Plant Code: 54793	Utility ID: 34505	Alta	Buena Vista	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**109.4 MW**
Plant Code: 57875	MidAmerican Energy Co	Adair	Adair	Electric Utility	Onshore Wind Turbine	**Wind**	**101.2 MW**
Plant Code: 57609	Utility ID: 15399	Schleswig	Crawford	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**100 MW**
Plant Code: 56645	Utility ID: 55901	Harris	Osceola	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**100 MW**
Plant Code: 57111	Utility ID: 56419	Lake Park	Dickinson	IPP Non-CHP	Onshore Wind Turbine	**Wind**	**100 MW**

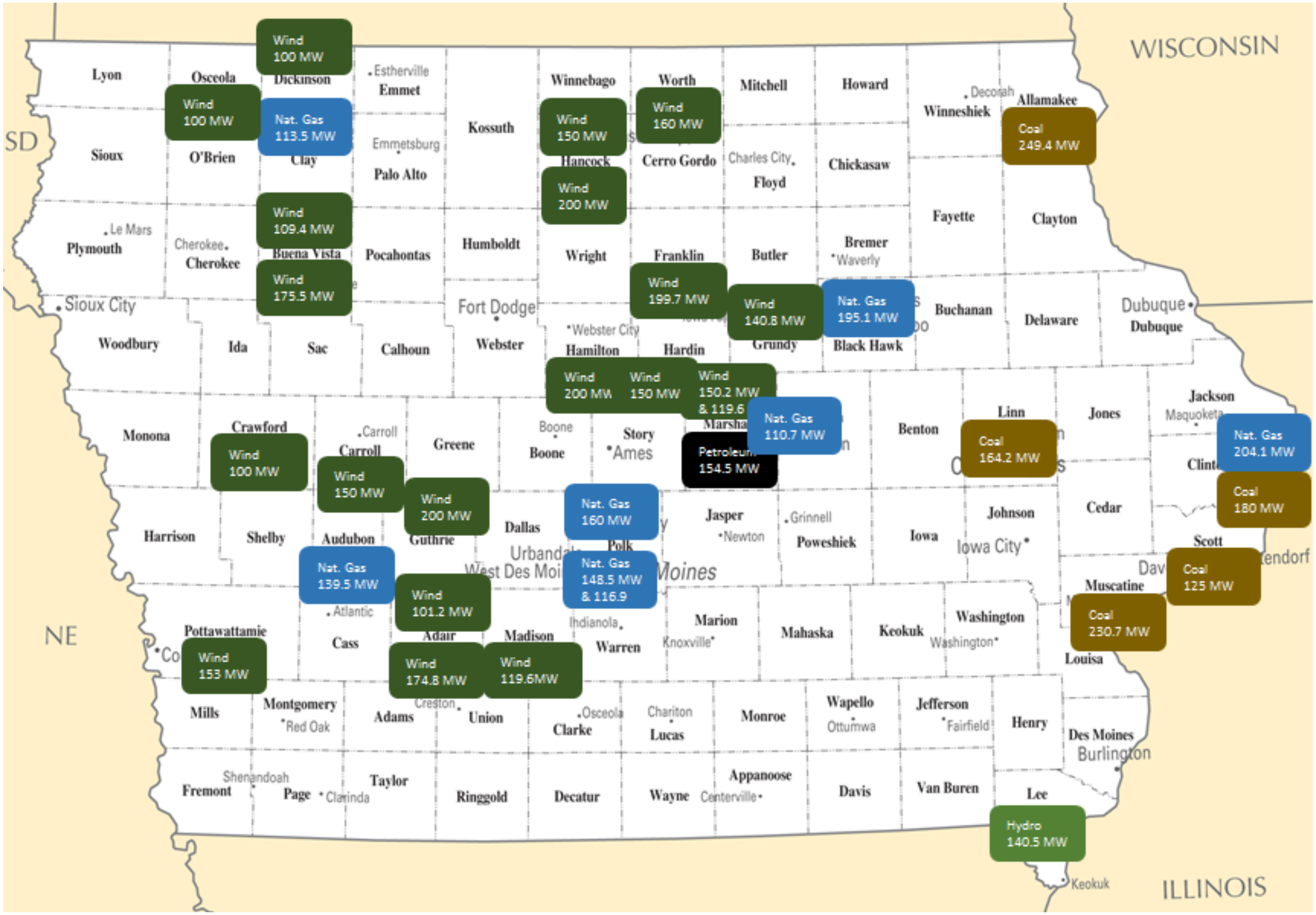


Figure 3. County Locations of Power Generating Plants in Iowa with Between 100-249.9 MW Capacity

II. POWER PLANTS BY PRIMARY FUEL

Primary Fuel	Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
Coal	18	6,252.1	1,517.3	7.5	347.3
Wind	67	5,409.7	448.3	0.7	80.7
Natural Gas	28	2,602.4	515	1	92.9
Petroleum	94	1,443.6	300	0.9	15.4
Nuclear	1	601.4	601.4	601.4	601.4
Hydro	4	258.4	140.5	1.2	64.6
Biomass	5	23.2	11.2	1	4.6
Solar	0	0	0	0	0
Geothermal	0	0	0	0	0
TOTAL	**217**	**16,590.8**	--	--	--

A. Coal

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
18	6,252.1	1,517.3	7.5	347.3

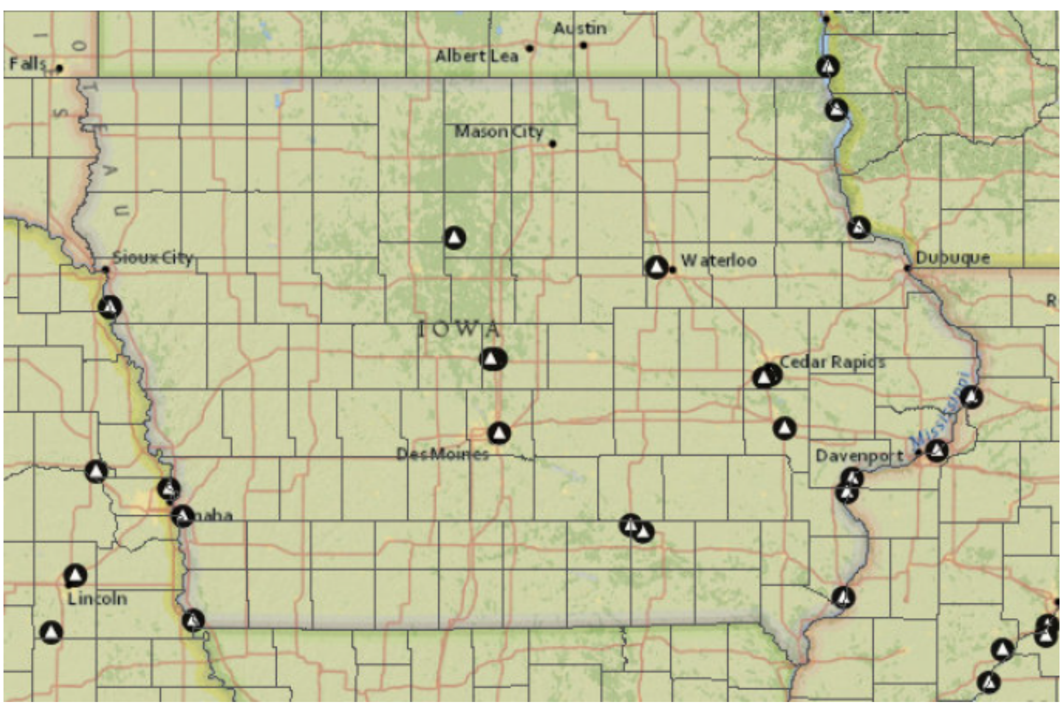


Figure 4. Power Generation Plants Using Coal as the Primary Fuel in Iowa and Adjacent Areas
Source: United States Energy Information Administration – U.S. Energy Mapping System.

List of power generation plants in Iowa using coal as the primary fuel (sorted in order of total net summer generating capacity

Plant Name: Walter Scott Jr Energy Center
Plant Code: 1082
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Council Bluffs
County: Pottawattamie
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 1,517.3 MW
Net Summer Capacity by Energy Source: Coal = 1517.3 MW

Plant Name: George Neal North
Plant Code: 1091
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Sergeant Bluff
County: Woodbury
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 918 MW
Net Summer Capacity by Energy Source: Coal = 918 MW

Plant Name: Ottumwa
Plant Code: 6254
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Ottumwa
County: Wapello
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 746.3 MW
Net Summer Capacity by Energy Source: Coal = 746.3 MW

Plant Name: Louisa
Plant Code: 6664
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Muscatine
County: Louisa
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 746.2 MW
Net Summer Capacity by Energy Source: Coal = 746.2 MW

Plant Name: George Neal South
Plant Code: 7343
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Salix
County: Woodbury
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 644 MW
Net Summer Capacity by Energy Source: Coal = 644 MW

Plant Name: Burlington (IA)
Plant Code: 1104
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Burlington
County: Des Moines
Sector: Electric Utility
Technology: Conventional Steam Coal; Natural Gas Fired Combustion Turbine;
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 268.3 MW
Net Summer Capacity by Energy Source: Coal = 210 MW, Natural Gas = 58.3 MW

Plant Name: Archer Daniels Midland Cedar Rapids
Plant Code: 10864
Utility Name: Archer Daniels Midland Co
Utility ID: 772
City: Cedar Rapids
County: Linn
Sector: Industrial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 260 MW
Net Summer Capacity by Energy Source: Coal = 260 MW

Plant Name: Lansing
Plant Code: 1047
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Lansing
County: Allamakee
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 249.4 MW
Net Summer Capacity by Energy Source: Coal = 249.4 MW

Plant Name: Muscatine Plant #1
Plant Code: 1167
Utility Name: Board of Water Electric & Communications
Utility ID: 13143
City: Muscatine
County: Muscatine
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 230.7 MW
Net Summer Capacity by Energy Source: Coal = 230.7 MW

Plant Name: Archer Daniels Midland Clinton
Plant Code: 10860
Utility Name: Archer Daniels Midland Co
Utility ID: 772
City: Clinton
County: Clinton
Sector: Industrial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 180 MW
Net Summer Capacity by Energy Source: Coal = 180 MW

Plant Name: Prairie Creek
Plant Code: 1073
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Cedar Rapids
County: Linn
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 164.2 MW
Net Summer Capacity by Energy Source: Coal = 164.2 MW

Plant Name: Riverside
Plant Code: 1081
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Bettendorf
County: Scott
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 125 MW
Net Summer Capacity by Energy Source: Coal = 125 MW

Plant Name: Ames Electric Services Power Plant
Plant Code: 1122
Utility Name: City of Ames - (IA)
Utility ID: 554
City: Ames
County: Story
Sector: Electric Utility
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 105.4 MW
Net Summer Capacity by Energy Source: Coal = 105.4 MW

Plant Name: Cargill Corn Milling Division
Plant Code: 10855
Utility Name: Cargill Inc North America Sweetners
Utility ID: 3106
City: Eddyville
County: Monroe
Sector: Industrial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 36.7 MW

Plant Name: University of Iowa Main Power Plant
Plant Code: 54775
Utility Name: University of Iowa
Utility ID: 19539
City: Iowa City
County: Johnson
Sector: Commercial CHP
Technology: Conventional Steam Coal; Natural Gas Internal Combustion Engine; Petroleum Liquids
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 30.7 MW
Net Summer Capacity by Energy Source: Coal = 21 MW, Natural Gas = 8 MW, Petroleum = 1.7 MW

Plant Name: AG Processing Inc
Plant Code: 10223
Utility Name: Ag Processing Inc
Utility ID: 109
City: Eagle Grove
County: Wright
Sector: Industrial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 8.5 MW
Net Summer Capacity by Energy Source: Coal = 8.5 MW

Plant Name: Archer Daniels Midland Des Moines
Plant Code: 10861
Utility Name: Archer Daniels Midland Co
Utility ID: 772
City: Des Moines
County: Polk
Sector: Industrial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 7.9 MW
Net Summer Capacity by Energy Source: Coal = 7.9 MW

Plant Name: University of Northern Iowa
Plant Code: 50088
Utility Name: University of Northern Iowa
Utility ID: 21223
City: Cedar Falls
County: Black Hawk
Sector: Commercial CHP
Technology: Conventional Steam Coal
Data Period: 201511
Primary Fuel: coal
Total Net Summer Capacity: 7.5 MW
Net Summer Capacity by Energy Source: Coal = 7.5 MW

B. Wind

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
67	5,409.7	448.3	0.7	80.7

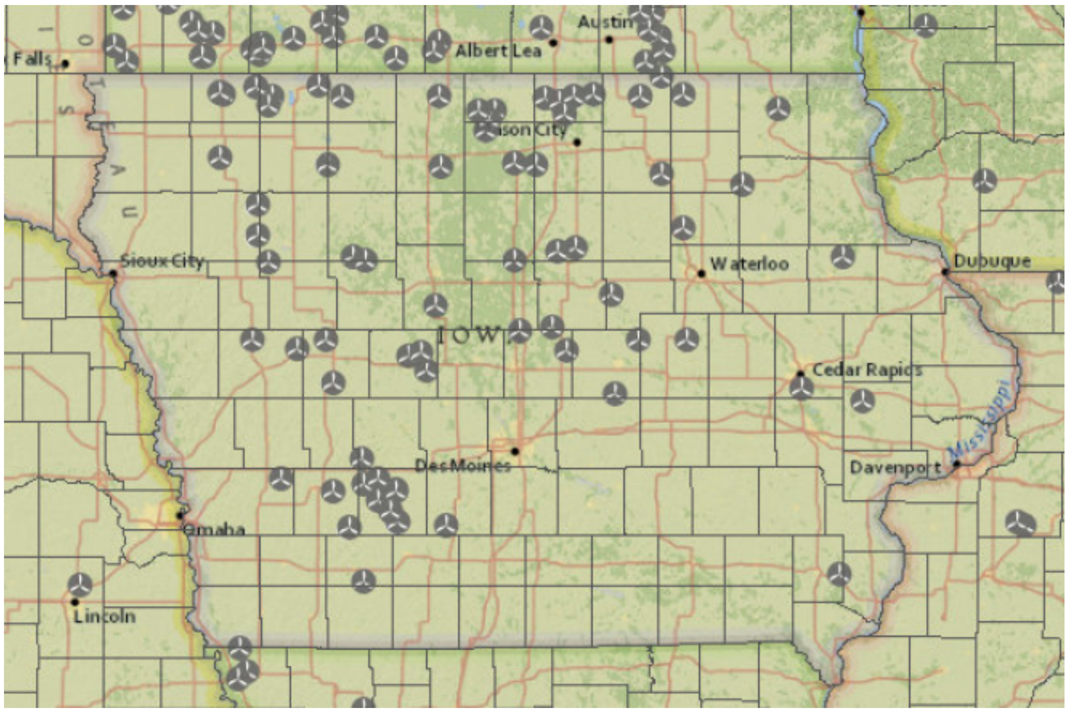


Figure 5. Power Generation Plants Using Wind as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using wind as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name:
Plant Code: 58883
Utility Name:
Utility ID: 12341
City: Primghar
County: O'Brien
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 448.3 MW
Net Summer Capacity by Energy Source: Wind = 448.3 MW

Plant Name:
Plant Code: 57501
Utility Name:
Utility ID: 12341
City: Massena
County: Cass
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 443.9 MW
Net Summer Capacity by Energy Source: Wind = 443.9 MW

Plant Name:
Plant Code: 56501
Utility Name:
Utility ID: 12341
City: Fonda
County: Pocahontas
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 286.4 MW
Net Summer Capacity by Energy Source: Wind = 286.4 MW

Plant Name:
Plant Code: 58884
Utility Name:
Utility ID: 12341
City: Otho
County: Webster
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 251 MW
Net Summer Capacity by Energy Source: Wind = 251 MW

Plant Name:
Plant Code: 56252
Utility Name:
Utility ID: 12341
City: Blairsburg
County: Hamilton
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 200 MW
Net Summer Capacity by Energy Source: Wind = 200 MW

Plant Name:
Plant Code: 57873
Utility Name:
Utility ID: 12341
City: Adair
County: Guthrie
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 200 MW
Net Summer Capacity by Energy Source: Wind = 200 MW

Plant Name:
Plant Code: 56925
Utility Name:
Utility ID: 56124
City: Britt
County: Hancock
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 200 MW
Net Summer Capacity by Energy Source: Wind = 200 MW

Plant Name:
Plant Code: 56355
Utility Name:
Utility ID: 9417
City: Iowa Falls
County: Franklin
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 199.7 MW
Net Summer Capacity by Energy Source: Wind = 199.7 MW

Plant Name:
Plant Code: 56251
Utility Name:
Utility ID: 12341
City: Schaller
County: Buena Vista
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 175.5 MW
Net Summer Capacity by Energy Source: Wind = 175.5 MW

Plant Name:
Plant Code: 56810
Utility Name:
Utility ID: 12341
City: Adair
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 174.8 MW
Net Summer Capacity by Energy Source: Wind = 174.8 MW

Plant Name:
Plant Code: 56811
Utility Name:
Utility ID: 12341
City: Walnut
County: Pottawattamie
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 153 MW
Net Summer Capacity by Energy Source: Wind = 153 MW

Plant Name:
Plant Code: 57874
Utility Name:
Utility ID: 12341
City: Marshalltown
County: Marshall
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 150.2 MW
Net Summer Capacity by Energy Source: Wind = 150.2 MW

Plant Name:
Plant Code: 56809
Utility Name:
Utility ID: 12341
City: Carroll
County: Carroll
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 150 MW
Net Summer Capacity by Energy Source: Wind = 150 MW

Plant Name:
Plant Code: 57469
Utility Name:
Utility ID: 56787
City: Zearing
County: Hardin
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 150 MW
Net Summer Capacity by Energy Source: Wind = 150 MW

Plant Name:
Plant Code: 56923
Utility Name:
Utility ID: 56123
City: Britt
County: Hancock
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 150 MW
Net Summer Capacity by Energy Source: Wind = 150 MW

Plant Name:
Plant Code: 58886
Utility Name:
Utility ID: 12341
City: Wellsburg
County: Grundy
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 140.8 MW
Net Summer Capacity by Energy Source: Wind = 140.8 MW

Plant Name:
Plant Code: 57500
Utility Name:
Utility ID: 12341
City: Laurel
County: Marshall
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 119.6 MW
Net Summer Capacity by Energy Source: Wind = 119.6 MW

Plant Name:
Plant Code: 58885
Utility Name:
Utility ID: 12341
City: Macksburg
County: Madison
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 119.6 MW
Net Summer Capacity by Energy Source: Wind = 119.6 MW

Plant Name:
Plant Code: 54793
Utility Name:
Utility ID: 34505
City: Alta
County: Buena Vista
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 109.4 MW
Net Summer Capacity by Energy Source: Wind = 109.4 MW

Plant Name:
Plant Code: 57875
Utility Name:
Utility ID: 12341
City: Adair
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 101.2 MW
Net Summer Capacity by Energy Source: Wind = 101.2 MW

Plant Name:
Plant Code: 57609
Utility Name:
Utility ID: 15399
City: Schleswig
County: Crawford
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 100 MW
Net Summer Capacity by Energy Source: Wind = 100 MW

Plant Name:
Plant Code: 56645
Utility Name:
Utility ID: 55901
City: Harris
County: Osceola
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 100 MW
Net Summer Capacity by Energy Source: Wind = 100 MW

Plant Name:
Plant Code: 57111
Utility Name:
Utility ID: 56419
City: Lake Park
County: Dickinson
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 100 MW
Net Summer Capacity by Energy Source: Wind = 100 MW

Plant Name:
Plant Code: 56379
Utility Name:
Utility ID: 12341
City: Westside
County: Carroll
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 99 MW
Net Summer Capacity by Energy Source: Wind = 99 MW

Plant Name:
Plant Code: 57844
Utility Name:
Utility ID: 57171
City: Iowa Falls
County: Franklin
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 99 MW
Net Summer Capacity by Energy Source: Wind = 99 MW

Plant Name:
Plant Code: 56010
Utility Name:
Utility ID: 6850
City: Garner
County: Hancock
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 98 MW
Net Summer Capacity by Energy Source: Wind = 98 MW

Plant Name:
Plant Code: 55287
Utility Name:
Utility ID: 59496
City: Alta
County: Buena Vista
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 80.2 MW
Net Summer Capacity by Energy Source: Wind = 80.2 MW

Plant Name:
Plant Code: 56383
Utility Name:
Utility ID: 15399
City: Kensett
County: Worth
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 80 MW
Net Summer Capacity by Energy Source: Wind = 80 MW

Plant Name:
Plant Code: 55804
Utility Name:
Utility ID: 13808
City: Joice
County: Worth
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 80 MW
Net Summer Capacity by Energy Source: Wind = 80 MW

Plant Name:
Plant Code: 57976
Utility Name:
Utility ID: 56482
City: Pomeroy
County: Pocahontas
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 80 MW
Net Summer Capacity by Energy Source: Wind = 80 MW

Plant Name:
Plant Code: 56677
Utility Name:
Utility ID: 12341
City: Charles City
County: Floyd
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 75 MW
Net Summer Capacity by Energy Source: Wind = 75 MW

Plant Name:
Plant Code: 57468
Utility Name:
Utility ID: 56786
City: Britt
County: Winnebago
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 66 MW
Net Summer Capacity by Energy Source: Wind = 66 MW

Plant Name:
Plant Code: 57830
Utility Name:
Utility ID: 57149
City: Grand Junction
County: Greene
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 50 MW
Net Summer Capacity by Energy Source: Wind = 50 MW

Plant Name:
Plant Code: 59637
Utility Name:
Utility ID: 12341
City: Corning
County: Adams
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 46.9 MW
Net Summer Capacity by Energy Source: Wind = 46.9 MW

Plant Name:
Plant Code: 56172
Utility Name:
Utility ID: 15399
City: Lake Park
County: Dickinson
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 43.5 MW
Net Summer Capacity by Energy Source: Wind = 43.5 MW

Plant Name:
Plant Code: 55816
Utility Name:
Utility ID: 8294
City: Garner
County: Cerro Gordo
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 42 MW
Net Summer Capacity by Energy Source: Wind = 42 MW

Plant Name:
Plant Code: 57417
Utility Name:
Utility ID: 56744
City: Greeley
County: Delaware
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 40.8 MW
Net Summer Capacity by Energy Source: Wind = 40.8 MW

Plant Name:
Plant Code: 57832
Utility Name:
Utility ID: 57150
City: Sumner
County: Bremer
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 34 MW
Net Summer Capacity by Energy Source: Wind = 34 MW

Plant Name:
Plant Code: 56831
Utility Name:
Utility ID: 20860
City: Riceville
County: Howard
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 29 MW
Net Summer Capacity by Energy Source: Wind = 29 MW

Plant Name:
Plant Code: 56859
Utility Name:
Utility ID: 34505
City: Ruthven
County: Palo Alto
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 21 MW
Net Summer Capacity by Energy Source: Wind = 21 MW

Plant Name:
Plant Code: 59071
Utility Name:
Utility ID: 56990
City: Templeton
County: Carroll
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 20 MW
Net Summer Capacity by Energy Source: Wind = 20 MW

Plant Name:
Plant Code: 56764
Utility Name:
Utility ID: 15399
City: Forest City
County: Winnebago
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 20 MW
Net Summer Capacity by Energy Source: Wind = 20 MW

Plant Name:
Plant Code: 56860
Utility Name:
Utility ID: 34505
City: Jefferson
County: Greene
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 14.7 MW
Net Summer Capacity by Energy Source: Wind = 14.7 MW

Plant Name:
Plant Code: 57251
Utility Name:
Utility ID: 9425
City: Lakota
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 10.5 MW
Net Summer Capacity by Energy Source: Wind = 10.5 MW

Plant Name:
Plant Code: 57252
Utility Name:
Utility ID: 9425
City: Superior
County: Dickinson
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 10.5 MW
Net Summer Capacity by Energy Source: Wind = 10.5 MW

Plant Name:
Plant Code: 58444
Utility Name:
Utility ID: 58439
City: Dana
County: Greene
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 8 MW
Net Summer Capacity by Energy Source: Wind = 8 MW

Plant Name:
Plant Code: 58044
Utility Name:
Utility ID: 57416
City: Mechanicsville
County: Cedar
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 4.5 MW
Net Summer Capacity by Energy Source: Wind = 4.5 MW

Plant Name:
Plant Code: 56386
Utility Name:
Utility ID: 11479
City: Kensett
County: Worth
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 3.4 MW
Net Summer Capacity by Energy Source: Wind = 3.4 MW

Plant Name:
Plant Code: 57214
Utility Name:
Utility ID: 20214
City: Waverly
County: Bremer
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 2.7 MW
Net Summer Capacity by Energy Source: Wind = 2.7 MW

Plant Name:
Plant Code: 7966
Utility Name:
Utility ID: 309
City: Algona
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 2.3 MW
Net Summer Capacity by Energy Source: Wind = 2.3 MW

Plant Name:
Plant Code: 56216
Utility Name:
Utility ID: 56599
City: Allendorf
County: Osceola
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 2 MW
Net Summer Capacity by Energy Source: Wind = 2 MW

Plant Name:
Plant Code: 58407
Utility Name:
Utility ID: 58389
City: Decorah
County: Winneshiek
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58071
Utility Name:
Utility ID: 57444
City: Northwoods
County: Worth
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58089
Utility Name:
Utility ID: 57444
City: Manly
County: Worth
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58457
Utility Name:
Utility ID: 58445
City: Fontanelle
County: Adair
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58458
Utility Name:
Utility ID: 58446
City: Greenfield
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Code: 58456
Utility Name:
Utility ID: 58444
City: Orient
County: Adair
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58461
Utility Name:
Utility ID: 58449
City: Wiota
County: Cass
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Wind = 1.6 MW

Plant Name:
Plant Code: 58038
Utility Name:
Utility ID: 57409
City: Little Cedar
County: Mitchell
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 58414
Utility Name:
Utility ID: 13468
City: New London
County: Henry
State: Iowa
Sector: Electric Utility
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 58932
Utility Name:
Utility ID: 58797
City: Traer
County: Tama
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 57631
Utility Name:
Utility ID: 56962
City: Greenfield
County: Adair
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 57632
Utility Name:
Utility ID: 56961
City: Orient
County: Adair
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 58927
Utility Name:
Utility ID: 58795
City: Story City
County: Story
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.5 MW
Net Summer Capacity by Energy Source: Wind = 1.5 MW

Plant Name:
Plant Code: 56215
Utility Name:
Utility ID: 57202
City: Allendorf
County: Osceola
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1.4 MW
Net Summer Capacity by Energy Source: Wind = 1.4 MW

Plant Name:
Plant Code: 57257
Utility Name:
Utility ID: 56617
City: Estherville
County: Emmet
State: Iowa
Sector: Commercial Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 1 MW
Net Summer Capacity by Energy Source: Wind = 1 MW

Plant Name:
Plant Code: 59735
Utility Name:
Utility ID: 59504
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 0.7 MW
Net Summer Capacity by Energy Source: Wind = 0.7 MW

C. Natural Gas

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
28	2,602.4	515	1	92.9

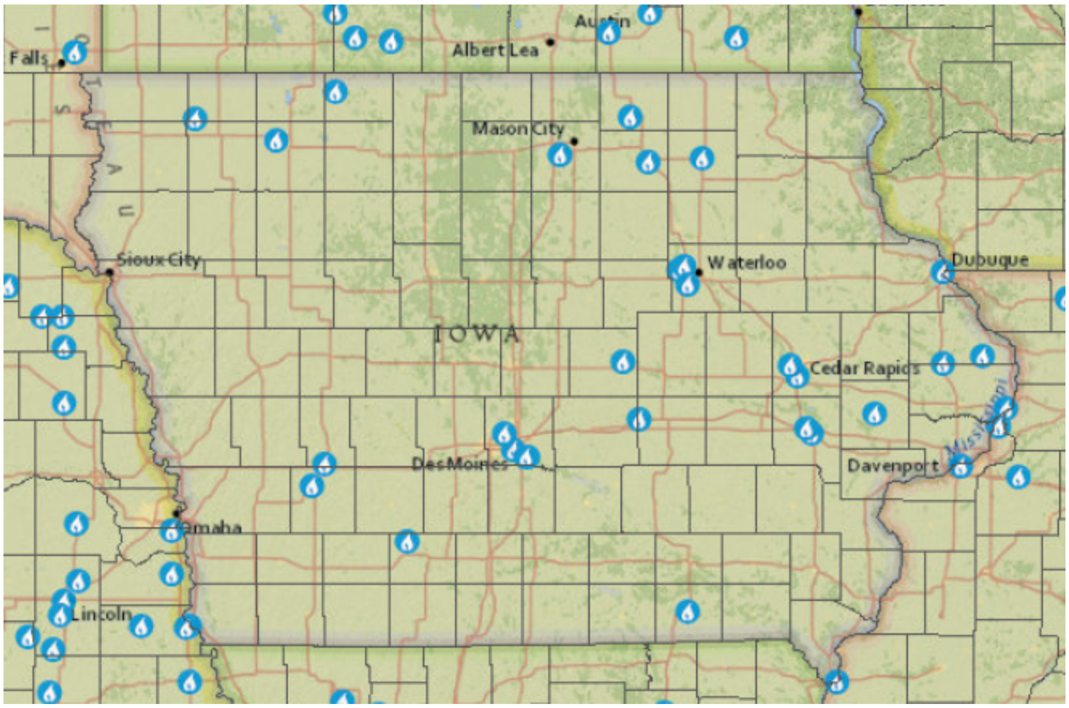


Figure 6. Power Generation Plants Using Natural Gas as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using natural gas as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name: Emery Station
Plant Code: 8031
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Clear Lake
County: Cerro Gordo
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combined Cycle
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 515 MW
Net Summer Capacity by Energy Source: Natural Gas = 515 MW

Plant Name: Greater Des Moines
Plant Code: 7985
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Pleasant Hill
County: Polk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combined Cycle
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 492.6 MW
Net Summer Capacity by Energy Source: Natural Gas = 492.6 MW

Plant Name: Milton L Kapp
Plant Code: 1048
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Clinton
County: Clinton
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Steam Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 204.1 MW
Net Summer Capacity by Energy Source: Natural Gas = 204.1 MW

Plant Name: Electrifarm
Plant Code: 6063
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Waterloo
County: Black Hawk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 195.1 MW
Net Summer Capacity by Energy Source: Natural Gas = 195.1 MW

Plant Name: Pleasant Hill
Plant Code: 7145
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Pleasant Hill
County: Polk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 160 MW
Net Summer Capacity by Energy Source: Natural Gas = 160 MW

Plant Name: Sycamore (IA)
Plant Code: 8029
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Johnston
County: Polk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 148.5 MW
Net Summer Capacity by Energy Source: Natural Gas = 148.5 MW

Plant Name: Exira
Plant Code: 56013
Utility Name: Western Minnesota Mun Pwr Agny
Utility ID: 20421
City: Brayton
County: Audubon
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 139.5 MW
Net Summer Capacity by Energy Source: Natural Gas = 139.5 MW

Plant Name: River Hills
Plant Code: 1084
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Des Moines
County: Polk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 116.9 MW
Net Summer Capacity by Energy Source: Natural Gas = 116.9 MW

Plant Name: Sutherland
Plant Code: 1077
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Marshalltown
County: Marshall
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Steam Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 110.7 MW
Net Summer Capacity by Energy Source: Natural Gas = 110.7 MW

Plant Name: Roquette America
Plant Code: 57953
Utility Name: Roquette America
Utility ID: 57332
City: Keokuk
County: Lee
State: Iowa
Sector: Industrial CHP
Technology: Natural Gas Fired Combined Cycle; Petroleum Coke;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 80 MW
Net Summer Capacity by Energy Source: Natural Gas = 48 MW, Petroleum = 32 MW

Plant Name: Summit Lake
Plant Code: 1206
Utility Name: Central Iowa Power Cooperative
Utility ID: 3258
City: Creston
County: Union
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combined Cycle
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 75.4 MW
Net Summer Capacity by Energy Source: Natural Gas = 75.4 MW

Plant Name: Dubuque
Plant Code: 1046
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Dubuque
County: Dubuque
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Steam Turbine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 71.8 MW

Plant Name: Streeter Station
Plant Code: 1131
Utility Name: Cedar Falls Utilities
Utility ID: 3203
City: Cedar Falls
County: Hawk Black
State: Iowa
Sector: Electric Utility
Technology: Conventional Steam Coal; Natural Gas Steam Turbine;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 49.4 MW
Net Summer Capacity by Energy Source: Coal = 15.7 MW, Natural Gas = 33.7 MW

Plant Name: Grinnell
Plant Code: 7137
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Grinnell
County: Poweshiek
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 44.4 MW
Net Summer Capacity by Energy Source: Natural Gas = 44.4 MW

Plant Name: Merle Parr
Plant Code: 1097
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Charles City
County: Floyd
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 32.6 MW
Net Summer Capacity by Energy Source: Natural Gas = 32.6 MW

Plant Name: Gas Turbine (IA)
Plant Code: 1130
Utility Name: Cedar Falls Utilities
Utility ID: 3203
City: Cedar Falls
County: Black Hawk
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 34 MW
Net Summer Capacity by Energy Source: Natural Gas = 34 MW

Plant Name: Maquoketa 1
Plant Code: 1162
Utility Name: City of Maquoketa - (IA)
Utility ID: 11611
City: Maquoketa
County: Jackson
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 22 MW
Net Summer Capacity by Energy Source: Natural Gas = 16.9 MW, Petroleum = 5.1 MW

Plant Name: New Hampton
Plant Code: 1168
Utility Name: City of New Hampton - (IA)
Utility ID: 13444
City: New Hampton
County: Chickasaw
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 24.1 MW

Plant Name: Osage (IA)
Plant Code: 1172
Utility Name: City of Osage - (IA)
Utility ID: 14201
City: Osage
County: Mitchell
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids; Onshore Wind Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 16.8 MW

Plant Name: Red Cedar
Plant Code: 7595
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Cedar Rapids
County: Linn
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 13.9 MW
Net Summer Capacity by Energy Source: Natural Gas = 13.9 MW

Plant Name: Atlantic
Plant Code: 1124
Utility Name: Atlantic Municipal Utilities
Utility ID: 965
City: Atlantic
County: Cass
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 13.8 MW
Net Summer Capacity by Energy Source: Natural Gas = 9.8 MW, Petroleum = 4 MW

Plant Name: Estherville
Plant Code: 1137
Utility Name: City of Estherville - (IA)
Utility ID: 5998
City: Estherville
County: Emmet
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 13.7 MW
Net Summer Capacity by Energy Source: Natural Gas = 12.6 MW, Petroleum = 1.1 MW

Plant Name: Tipton
Plant Code: 8106
Utility Name: City of Tipton - (IA)
Utility ID: 18947
City: Tipton
County: Cedar
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 8.7 MW
Net Summer Capacity by Energy Source: Natural Gas = 4.4 MW, Petroleum = 4.3 MW

Plant Name: Bloomfield
Plant Code: 1127
Utility Name: City of Bloomfield - (IA)
Utility ID: 1869
City: Bloomfield
County: Davis
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 6.9 MW
Net Summer Capacity by Energy Source: Natural Gas = 6.5 MW, Petroleum = 0.4 MW

Plant Name: Otter Creek Ethanol Poet - Ashton
Plant Code: 58138
Utility Name: Otter Creek Ethanol LLC - Poet Ashton
Utility ID: 58093
City: Ashton
County: Osceola
State: Iowa
Sector: Industrial CHP
Technology: Natural Gas Fired Combustion Turbine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 5.5 MW
Net Summer Capacity by Energy Source: Natural Gas = 5.5 MW

Plant Name: Preston (IA)
Plant Code: 1176
Utility Name: City of Preston
Utility ID: 15349
City: Preston
County: Jackson
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 3.2 MW
Net Summer Capacity by Energy Source: Natural Gas = 1.8 MW, Petroleum = 1.4 MW

Plant Name: Oakdale Renewable Energy Plant
Plant Code: 57672
Utility Name: University of Iowa
Utility ID: 19539
City: Coralville
County: Johnson
State: Iowa
Sector: Commercial Non-CHP
Technology: Natural Gas Internal Combustion Engine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 2.8 MW
Net Summer Capacity by Energy Source: Natural Gas = 2.8 MW

Plant Name: Alliant SBG 9802 Toyota
Plant Code: 56073
Utility Name: Industrial Energy Applications In
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Natural Gas Internal Combustion Engine
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 1 MW
Net Summer Capacity by Energy Source: Natural Gas = 1 MW

D. Petroleum

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
94	1,443.6	300	0.9	15.4

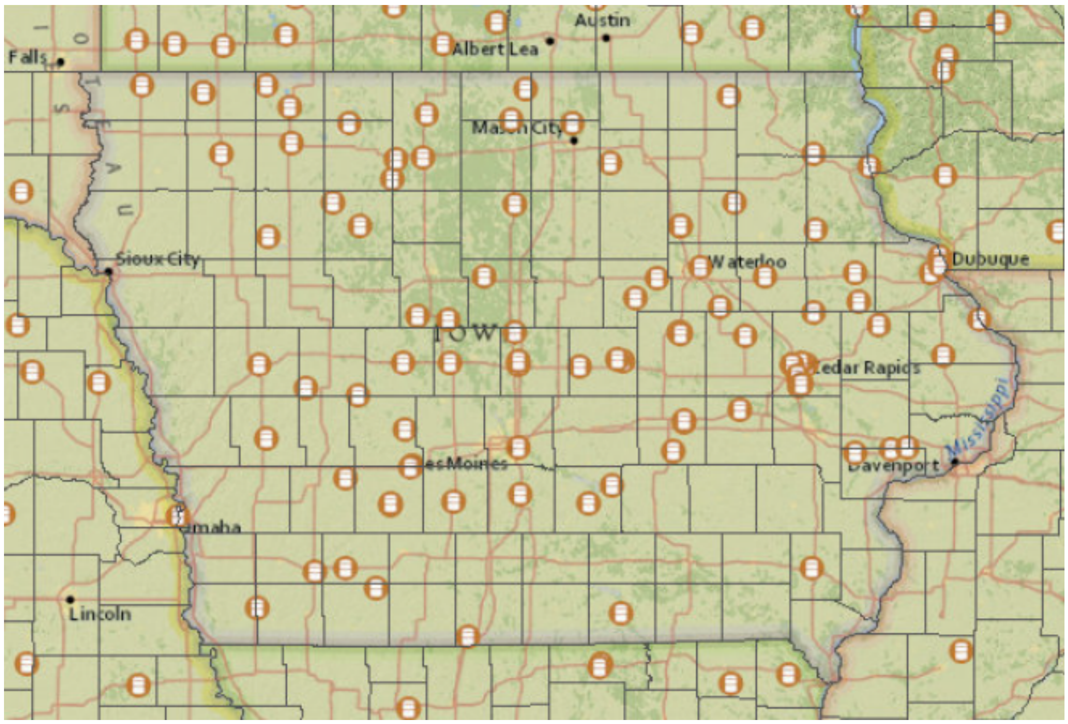


Figure 7. Power Generation Plants Using Petroleum as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using petroleum as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name:
Plant Code: 56797
Utility Name:
Utility ID: 55992
City: McIntire
County: Mitchell
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 300 MW
Net Summer Capacity by Energy Source: Wind = 300 MW

Plant Name:
Plant Code: 56765
Utility Name:
Utility ID: 15399
City: Kensett
County: Worth
State: Iowa
Sector: IPP Non-CHP
Technology: Onshore Wind Turbine
Data Period: August 2014
Primary Fuel: wind
Total Net Summer Capacity: 160 MW
Net Summer Capacity by Energy Source: Wind = 160 MW

Plant Name: Marshalltown
Plant Code: 1068
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Marshalltown
County: Marshall
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 154.5 MW
Net Summer Capacity by Energy Source: Petroleum = 154.5 MW

Plant Name: Lime Creek
Plant Code: 7155
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Mason City
County: Cerro Gordo
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 71.3 MW
Net Summer Capacity by Energy Source: Petroleum = 71.3 MW

Plant Name: Centerville
Plant Code: 1105
Utility Name: Interstate Power and Light Co
Utility ID: 9417
City: Centerville
County: Appanoose
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 53.2 MW
Net Summer Capacity by Energy Source: Petroleum = 53.2 MW

Plant Name: Indianola
Plant Code: 1150
Utility Name: Indianola Municipal Utilities
Utility ID: 9275
City: Indianola
County: Warren
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 51.2 MW
Net Summer Capacity by Energy Source: Petroleum = 51.2 MW

Plant Name: Ames GT
Plant Code: 6463
Utility Name: City of Ames - (IA)
Utility ID: 554
City: Ames
County: Story
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 37.2 MW
Net Summer Capacity by Energy Source: Petroleum = 37.2 MW

Plant Name: Pella Peaking
Plant Code: 7971
Utility Name: City of Pella - (IA)
Utility ID: 14645
City: Pella
County: Marion
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 25.2 MW
Net Summer Capacity by Energy Source: Petroleum = 25.2 MW

Plant Name: Waverly Municipal Electric North Plant
Plant Code: 6554
Utility Name: Waverly Municipal Elec Utility
Utility ID: 20214
City: Waverly
County: Bremer
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 25.1 MW
Net Summer Capacity by Energy Source: Natural Gas = 10.9 MW, Petroleum = 14.2 MW

Plant Name: Mt Pleasant
Plant Code: 1166
Utility Name: City of Mt Pleasant - (IA)
Utility ID: 13038
City: Mt Pleasant
County: Henry
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 24 MW
Net Summer Capacity by Energy Source: Petroleum = 24 MW

Plant Name: Forest City Light Plant
Plant Code: 1138
Utility Name: City of Forest City- (IA)
Utility ID: 6579
City: Forest City
County: Winnebago
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 21.2 MW
Net Summer Capacity by Energy Source: Petroleum = 21.2 MW

Plant Name: Webster City
Plant Code: 1198
Utility Name: City of Webster City - (IA)
Utility ID: 20259
City: Webster City
County: Hamilton
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 20.7 MW
Net Summer Capacity by Energy Source: Petroleum = 20.7 MW

Plant Name: Shenandoah
Plant Code: 7850
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Shenandoah
County: Page
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 20 MW
Net Summer Capacity by Energy Source: Petroleum = 20 MW

Plant Name: Lake Mills
Plant Code: 1154
Utility Name: City of Lake Mills
Utility ID: 10606
City: Lake Mills
County: Winnebago
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 18.5 MW
Net Summer Capacity by Energy Source: Petroleum = 18.5 MW

Plant Name: Waterloo Lundquist
Plant Code: 7851
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Waterloo
County: Black Hawk
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 18 MW
Net Summer Capacity by Energy Source: Petroleum = 18 MW

Plant Name: Spencer Gas Turbine
Plant Code: 1186
Utility Name: City of Spencer - (IA)
Utility ID: 17783
City: Spencer
County: Clay
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 17 MW
Net Summer Capacity by Energy Source: Petroleum = 17 MW

Plant Name: Vinton
Plant Code: 1194
Utility Name: City of Vinton - (IA)
Utility ID: 19865
City: Vinton
County: Benton
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 17.1 MW
Net Summer Capacity by Energy Source: Petroleum = 17.1 MW

Plant Name: NCAH Central Utility Plant
Plant Code: 58265
Utility Name: National Centers for Animal Health
Utility ID: 58247
City: Ames
County: Story
State: Iowa
Sector: Commercial CHP
Technology: Natural Gas Fired Combustion Turbine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 16.5 MW
Net Summer Capacity by Energy Source: Natural Gas = 4 MW, Petroleum = 12.5 MW

Plant Name: Algona
Plant Code: 1120
Utility Name: City of Algona - (IA)
Utility ID: 309
City: Algona
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 16.1 MW
Net Summer Capacity by Energy Source: Petroleum = 16.1 MW

Plant Name: Alliant SBD 9106 Rockwell CR
Plant Code: 54717
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 16 MW
Net Summer Capacity by Energy Source: Petroleum = 16 MW

Plant Name: Knoxville Industrial
Plant Code: 7849
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Knoxville
County: Marion
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 16 MW
Net Summer Capacity by Energy Source: Petroleum = 16 MW

Plant Name: West Liberty
Plant Code: 1200
Utility Name: City of West Liberty - (IA)
Utility ID: 20380
City: West Liberty
County: Muscatine
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 14.8 MW
Net Summer Capacity by Energy Source: Petroleum = 14.8 MW

Plant Name: Winterset
Plant Code: 1203
Utility Name: City of Winterset - (IA)
Utility ID: 20835
City: Winterset
County: Madison
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 13.6 MW
Net Summer Capacity by Energy Source: Petroleum = 13.6 MW

Plant Name: Story City
Plant Code: 1188
Utility Name: City of Story City - (IA)
Utility ID: 18177
City: Story City
County: Story
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 13.5 MW
Net Summer Capacity by Energy Source: Petroleum = 13.5 MW

Plant Name: Alliant SBD 9107 JBS USA
Plant Code: 54715
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Marshalltown
County: Marshall
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 11.4 MW
Net Summer Capacity by Energy Source: Petroleum = 11.4 MW

Plant Name: Lamoni Municipal Utilities
Plant Code: 1155
Utility Name: City of Lamoni - (IA)
Utility ID: 10650
City: Lamoni
County: Decatur
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 10 MW
Net Summer Capacity by Energy Source: Petroleum = 10 MW

Plant Name: Montezuma
Plant Code: 1165
Utility Name: City of Montezuma - (IA)
Utility ID: 12839
City: Montezuma
County: Poweshiek
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 9.4 MW
Net Summer Capacity by Energy Source: Natural Gas = 3.9 MW, Petroleum = 5.5 MW

Plant Name: Wilton
Plant Code: 1202
Utility Name: City of Wilton
Utility ID: 20789
City: Wilton
County: Muscatine
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 9.2 MW
Net Summer Capacity by Energy Source: Petroleum = 9.2 MW

Plant Name: Grundy Center City Light Plant
Plant Code: 1145
Utility Name: Grundy Center Mun Light & Power
Utility ID: 7743
City: Grundy Center
County: Grundy
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 8.7 MW
Net Summer Capacity by Energy Source: Petroleum = 8.7 MW

Plant Name: John Deere Dubuque Works
Plant Code: 54414
Utility Name: John Deere Dubuque Works
Utility ID: 9765
City: Dubuque
County: Dubuque
State: Iowa
Sector: Industrial Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 8.4 MW
Net Summer Capacity by Energy Source: Petroleum = 8.4 MW

Plant Name: Laurens
Plant Code: 1157
Utility Name: City of Laurens - (IA)
Utility ID: 10769
City: Laurens
County: Pocahontas
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 8.3 MW
Net Summer Capacity by Energy Source: Petroleum = 8.3 MW

Plant Name: North
Plant Code: 7856
Utility Name: City of Greenfield - (IA)
Utility ID: 7626
City: Greenfield
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 8 MW
Net Summer Capacity by Energy Source: Petroleum = 8 MW

Plant Name: Manning
Plant Code: 1160
Utility Name: City of Manning
Utility ID: 11581
City: Manning
County: Carroll
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 7.9 MW
Net Summer Capacity by Energy Source: Petroleum = 7.9 MW

Plant Name: Bellevue
Plant Code: 1126
Utility Name: City of Bellevue - (IA)
Utility ID: 1515
City: Bellevue
County: Jackson
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 7.5 MW
Net Summer Capacity by Energy Source: Petroleum = 7.5 MW

Plant Name: Corning
Plant Code: 1134
Utility Name: City of Corning - (IA)
Utility ID: 4375
City: Corning
County: Adams
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.8 MW
Net Summer Capacity by Energy Source: Petroleum = 6.8 MW

Plant Name: Milford
Plant Code: 1164
Utility Name: City of Milford - (IA)
Utility ID: 12541
City: Milford
County: Dickinson
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.5 MW
Net Summer Capacity by Energy Source: Petroleum = 6.5 MW

Plant Name: State Center
Plant Code: 1187
Utility Name: City of State Center - (IA)
Utility ID: 18014
City: State Center
County: Marshall
State: Iowa
Sector: Electric Utility
Technology: Natural Gas Internal Combustion Engine; Petroleum Liquids;
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.3 MW
Net Summer Capacity by Energy Source: Natural Gas = 2.5 MW, Petroleum = 3.8 MW

Plant Name: Durant
Plant Code: 6220
Utility Name: City of Durant - (IA)
Utility ID: 5529
City: Durant
County: Cedar
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.5 MW
Net Summer Capacity by Energy Source: Petroleum = 6.5 MW

Plant Name: West Bend
Plant Code: 1199
Utility Name: City of West Bend
Utility ID: 20364
City: West Bent
County: Palo Alto
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.4 MW
Net Summer Capacity by Energy Source: Petroleum = 6.4 MW

Plant Name: Alliant SBD0201 Penford Produc
Plant Code: 55996
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 6.1 MW
Net Summer Capacity by Energy Source: Petroleum = 6.1 MW

Plant Name: Alliant SBD 9203 Profol
Plant Code: 54719
Utility Name: American Profol Incorporated
Utility ID: 56189
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.6 MW
Net Summer Capacity by Energy Source: Petroleum = 5.6 MW

Plant Name: Alliant SBD 8602 Marion Sub
Plant Code: 54716
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Marion
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.6 MW
Net Summer Capacity by Energy Source: Petroleum = 5.6 MW

Plant Name: Sumner
Plant Code: 1191
Utility Name: City of Sumner - (IA)
Utility ID: 18301
City: Sumner
County: Bremer
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.5 MW
Net Summer Capacity by Energy Source: Petroleum = 5.5 MW

Plant Name: Greenfield
Plant Code: 1144
Utility Name: City of Greenfield - (IA)
Utility ID: 7626
City: Greenfield
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.5 MW
Net Summer Capacity by Energy Source: Petroleum = 5.5 MW

Plant Code: 54968
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Belmond
County: Wright
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.4 MW
Net Summer Capacity by Energy Source: Petroleum = 5.4 MW

Plant Name: La Porte
Plant Code: 1156
Utility Name: La Porte City Utilities
Utility ID: 10542
City: La Porte City
County: Black Hawk
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.4 MW
Net Summer Capacity by Energy Source: Petroleum = 5.4 MW

Plant Name: Coon Rapids II
Plant Code: 7847
Utility Name: City of Coon Rapids
Utility ID: 4305
City: Coon Rapids
County: Carroll
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.1 MW
Net Summer Capacity by Energy Source: Petroleum = 5.1 MW

Plant Name: Maquoketa 2
Plant Code: 7921
Utility Name: City of Maquoketa - (IA)
Utility ID: 11611
City: Maquoketa
County: Jackson
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 5.1 MW
Net Summer Capacity by Energy Source: Petroleum = 5.1 MW

Plant Name: Cascade
Plant Code: 1129
Utility Name: Cascade Municipal Utilities
Utility ID: 3137
City: Cascade
County: Jones
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.9 MW
Net Summer Capacity by Energy Source: Petroleum = 4.9 MW

Plant Name: Sibley One
Plant Code: 1184
Utility Name: City of Sibley - (IA)
Utility ID: 17141
City: Sibley
County: Osceola
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.8 MW
Net Summer Capacity by Energy Source: Petroleum = 4.8 MW

Plant Name: Panora
Plant Code: 7584
Utility Name: City of Panora - (IA)
Utility ID: 14433
City: Panora
County: Guthrie
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.5 MW
Net Summer Capacity by Energy Source: Petroleum = 4.5 MW

Plant Name: Bancroft
Plant Code: 1125
Utility Name: Bancroft Municipal Utilities
Utility ID: 1172
City: Bancroft
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.1 MW
Net Summer Capacity by Energy Source: Petroleum = 4.1 MW

Plant Name: Bancroft
Plant Code: 1125
Utility Name: Bancroft Municipal Utilities
Utility ID: 1172
City: Bancroft
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.1 MW
Net Summer Capacity by Energy Source: Petroleum = 4.1 MW

Plant Name: Alliant SBD 9403 Aegon DC
Plant Code: 54929
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4.1 MW
Net Summer Capacity by Energy Source: Petroleum = 4.1 MW

Plant Name: Villisca Municipal Power Plant
Plant Code: 1193
Utility Name: City of Villisca - (IA)
Utility ID: 19843
City: Villisca
County: Montgomery
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: Lenox
Plant Code: 1158
Utility Name: City of Lenox - (IA)
Utility ID: 10908
City: Lenox
County: Taylor
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: Gilliam South
Plant Code: 7857
Utility Name: City of Stuart - (IA)
Utility ID: 18231
City: Stuart
County: Adair
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: Ogden
Plant Code: 1169
Utility Name: City of Ogden - (IA)
Utility ID: 13990
City: Ogden
County: Boone
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: Lake Park
Plant Code: 1153
Utility Name: City of Lake Park - (IA)
Utility ID: 10608
City: Lake Park
County: Dickinson
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: Traer East
Plant Code: 56025
Utility Name: City of Traer - (IA)
Utility ID: 19062
City: Tracer
County: Tama
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 4 MW
Net Summer Capacity by Energy Source: Petroleum = 4 MW

Plant Name: West Diesel Generation Unit
Plant Code: 56517
Utility Name: City of Pocahontas - (IA)
Utility ID: 15180
City: Pocahontas
County: Pocahontas
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.8 MW
Net Summer Capacity by Energy Source: Petroleum = 3.8 MW

Plant Name: Hopkinton
Plant Code: 8108
Utility Name: City of Hopkinton - (IA)
Utility ID: 8847
City: Hopkinton
County: Delaware
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.8 MW
Net Summer Capacity by Energy Source: Petroleum = 3.8 MW

Plant Name: Traer Main
Plant Code: 1192
Utility Name: City of Traer - (IA)
Utility ID: 19062
City: Traer
County: Tama
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.7 MW
Net Summer Capacity by Energy Source: Petroleum = 3.7 MW

Plant Name: Graettinger
Plant Code: 1142
Utility Name: City of Graettinger - (IA)
Utility ID: 7443
City: Graettinger
County: Palo Alto
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.6 MW
Net Summer Capacity by Energy Source: Petroleum = 3.6 MW

Plant Name: South Strawberry
Plant Code: 7926
Utility Name: City of Strawberry Point
Utility ID: 18204
City: Strawberry Point
County: Clayton
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.6 MW
Net Summer Capacity by Energy Source: Petroleum = 3.6 MW

Plant Name: Alliant SBD 8601 Quad Graphics
Plant Code: 54720
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Marengo
County: Iowa
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.6 MW
Net Summer Capacity by Energy Source: Petroleum = 3.6 MW

Plant Name: Harlan
Plant Code: 1146
Utility Name: Harlan Municipal Utilities - (IA)
Utility ID: 8122
City: Harlan
County: Shelby
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.2 MW
Net Summer Capacity by Energy Source: Petroleum = 3.2 MW

Plant Name: Coggon
Plant Code: 1132
Utility Name: City of Coggon - (IA)
Utility ID: 3900
City: Coggon
County: Linn
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.2 MW
Net Summer Capacity by Energy Source: Petroleum = 3.2 MW

Plant Name: Alliant SBD 9205 A Y McDonald
Plant Code: 54710
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Dubuque
County: Dubuque
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.1 MW
Net Summer Capacity by Energy Source: Petroleum = 3.1 MW

Plant Name: Alliant SBD 8501 Aegon LI
Plant Code: 54714
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 3.1 MW
Net Summer Capacity by Energy Source: Petroleum = 3.1 MW

Plant Name: Rockford
Plant Code: 1180
Utility Name: City of Rockford- (IA)
Utility ID: 16211
City: Rockford
County: Floyd
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.9 MW
Net Summer Capacity by Energy Source: Petroleum = 2.9 MW

Plant Name: Alliant SBD 9301 Prairie Farms
Plant Code: 54735
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Dubuque
County: Dubuque
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.9 MW
Net Summer Capacity by Energy Source: Petroleum = 2.9 MW

Plant Name: Anita
Plant Code: 1123
Utility Name: City of Anita - (IA)
Utility ID: 682
City: Anita
County: Cass
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.7 MW
Net Summer Capacity by Energy Source: Petroleum = 2.7 MW

Plant Name: Stuart (IA)
Plant Code: 1190
Utility Name: City of Stuart - (IA)
Utility ID: 18231
City: Stuart
County: Guthrie
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.7 MW
Net Summer Capacity by Energy Source: Petroleum = 2.7 MW

Plant Name: Rock Rapids
Plant Code: 1181
Utility Name: Rock Rapids Municipal Utility
Utility ID: 16206
City: Rock Rapids
County: Lyon
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.5 MW
Net Summer Capacity by Energy Source: Petroleum = 2.5 MW

Plant Name: Gowrie
Plant Code: 1141
Utility Name: Gowrie Municipal Utilities
Utility ID: 7424
City: Gowrie
County: Webster
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.2 MW
Net Summer Capacity by Energy Source: Petroleum = 2.2 MW

Plant Name: Dike City Power Plant
Plant Code: 56194
Utility Name: City of Dike
Utility ID: 5155
City: Dike
County: Grundy
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.2 MW
Net Summer Capacity by Energy Source: Petroleum = 2.2 MW

Plant Name: Alliant SBD 9201 Norplex
Plant Code: 54712
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Postville
County: Allamakee
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2.1 MW
Net Summer Capacity by Energy Source: Petroleum = 2.1 MW

Plant Name: McGregor
Plant Code: 1163
Utility Name: City of McGregor- (IA)
Utility ID: 12114
City: McGregor
County: Clayton
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2 MW
Net Summer Capacity by Energy Source: Petroleum = 2 MW

Plant Name: Brooklyn
Plant Code: 1128
Utility Name: City of Brooklyn - (IA)
Utility ID: 2287
City: Brooklyn
County: Poweshiek
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2 MW
Net Summer Capacity by Energy Source: Petroleum = 2 MW

Plant Name: Anderson Erickson
Plant Code: 56138
Utility Name: MidAmerican Energy Co
Utility ID: 12341
City: Des Moines
County: Polk
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 2 MW
Net Summer Capacity by Energy Source: Petroleum = 2 MW

Plant Name: West Receiving
Plant Code: 7853
Utility Name: City of Denison - (IA)
Utility ID: 5056
City: Denison
County: Crawford
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.8 MW
Net Summer Capacity by Energy Source: Petroleum = 1.8 MW

Plant Name: Dayton (IA)
Plant Code: 1135
Utility Name: City of Dayton - (IA)
Utility ID: 4919
City: Dayton
County: Webster
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.8 MW
Net Summer Capacity by Energy Source: Petroleum = 1.8 MW

Plant Name: Brooklyn City North Plant
Plant Code: 7922
Utility Name: City of Brooklyn - (IA)
Utility ID: 2287
City: Brooklyn
County: Poweshiek
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.8 MW
Net Summer Capacity by Energy Source: Petroleum = 1.8 MW

Plant Name: Traer South
Plant Code: 7920
Utility Name: City of Traer - (IA)
Utility ID: 19062
City: Traer
County: Tama
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.8 MW
Net Summer Capacity by Energy Source: Petroleum = 1.8 MW

Plant Name: Earlville
Plant Code: 7865
Utility Name: City of Earlville - (IA)
Utility ID: 5563
City: Earlville
County: Delaware
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.8 MW
Net Summer Capacity by Energy Source: Petroleum = 1.8 MW

Plant Name: Grand Junction
Plant Code: 1143
Utility Name: City of Grand Junction - (IA)
Utility ID: 7486
City: Grand Junction
County: Greene
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Petroleum = 1.6 MW

Plant Name: Alliant SBD 9206 Donaldson
Plant Code: 54718
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cresco
County: Howard
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Petroleum = 1.6 MW

Plant Name: Primghar
Plant Code: 1177
Utility Name: City of Primghar - (IA)
Utility ID: 15377
City: Primghar
County: O'Brien
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.4 MW
Net Summer Capacity by Energy Source: Petroleum = 1.4 MW

Plant Name: Alliant SBD 9302 Aegon NP
Plant Code: 54967
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.2 MW
Net Summer Capacity by Energy Source: Petroleum = 1.2 MW

Plant Name: Whittemore
Plant Code: 1201
Utility Name: City of Whittemore - (IA)
Utility ID: 20604
City: Whittemore
County: Kossuth
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.1 MW
Net Summer Capacity by Energy Source: Petroleum = 1.1 MW

Plant Name: Alliant SBD 9901 GE Capital
Plant Code: 56074
Utility Name: Industrial Energy Applications Inc
Utility ID: 361
City: Cedar Rapids
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1.1 MW
Net Summer Capacity by Energy Source: Petroleum = 1.1 MW

Plant Name: Sibley No Two
Plant Code: 7060
Utility Name: City of Sibley - (IA)
Utility ID: 17141
City: Sibley
County: Osceola
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 1 MW
Net Summer Capacity by Energy Source: Petroleum = 1 MW

Plant Name: Alta Municipal Utilities
Plant Code: 1121
Utility Name: City of Alta - (IA)
Utility ID: 405
City: Alta
County: Buena Vista
State: Iowa
Sector: Electric Utility
Technology: Petroleum Liquids
Data Period: 201511
Primary Fuel: petroleum
Total Net Summer Capacity: 0.9 MW
Net Summer Capacity by Energy Source: Petroleum = 0.9 MW

E. Nuclear

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
1	601.4	601.4	601.4	601.4

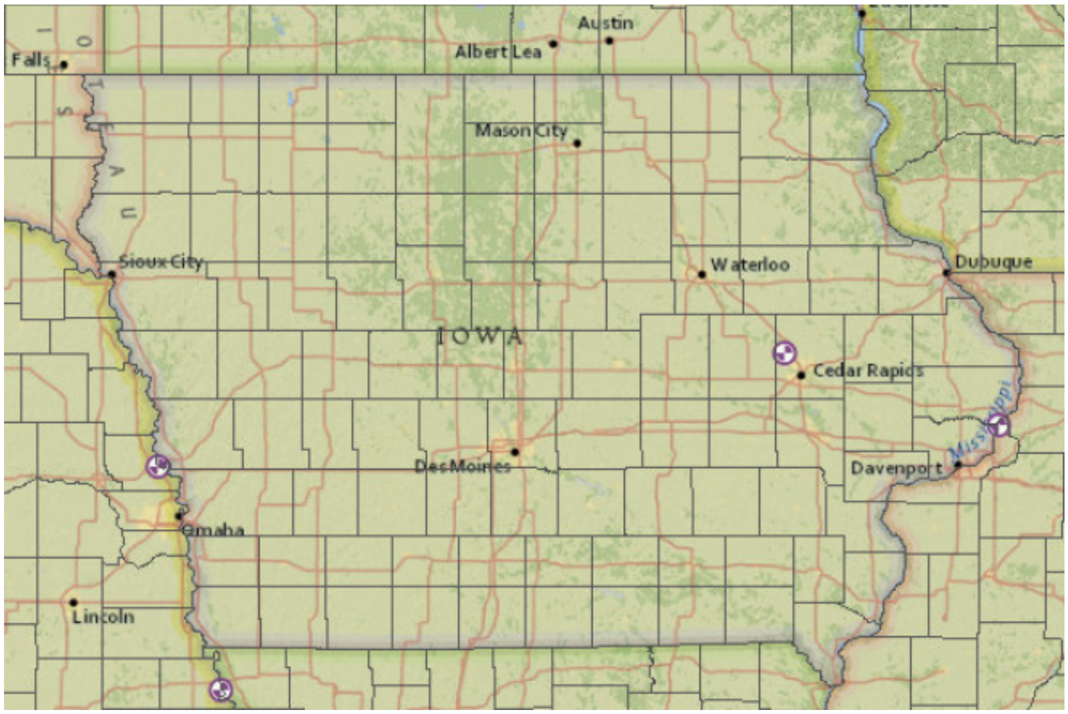


Figure 8. Power Generation Plants Using Nuclear Fuel as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using nuclear fuel as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name: Duane Arnold Energy Center
Plant Code: 1060
Utility Name: NextEra Energy Duane Arnold LLC
Utility ID: 55269
City: Palo
County: Linn
State: Iowa
Sector: IPP Non-CHP
Technology: Nuclear
Data Period: 201511
Primary Fuel: nuclear
Total Net Summer Capacity: 601.4 MW
Net Summer Capacity by Energy Source: Nuclear = 601.4 MW

F. Hydroelectric

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
4	258.4	140.5	1.2	64.6

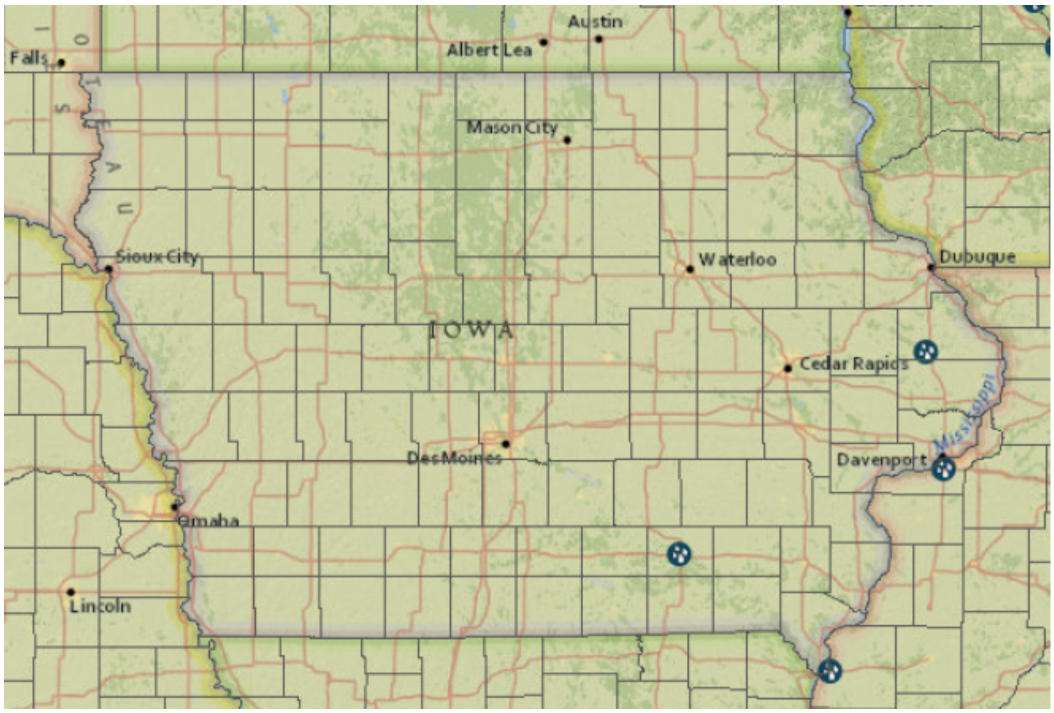


Figure 9. Power Generation Plants Using Hydro as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using hydro as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name: Keokuk
Plant Code: 1109
Utility Name: Union Electric Co - (MO)
Utility ID: 19436
City: Keokuk
County: Lee
Sector: Electric Utility
Technology: Conventional Hydroelectric
Data Period: 201511
Primary Fuel: hydroelectric
Total Net Summer Capacity: 140.5 MW
Net Summer Capacity by Energy Source: Hydroelectric = 140.5 MW

Plant Name: Earl F Wisdom
Plant Code: 1217
Utility Name: Corn Belt Power Coop
Utility ID: 4363
City: Spencer
County: Clay
Sector: Electric Utility
Technology: Natural Gas Fired Combustion Turbine; Natural Gas Steam Turbine;
Data Period: 201511
Primary Fuel: natural gas
Total Net Summer Capacity: 113.5 MW
Net Summer Capacity by Energy Source: Natural Gas = 113.5 MW

Plant Name: Ottumwa City of
Plant Code: 1173
Utility Name: Ottumwa City of
Utility ID: 14236
City: Ottumwa
County: Wapello
Sector: Electric Utility
Technology: Conventional Hydroelectric
Data Period: 201511
Primary Fuel: hydroelectric
Total Net Summer Capacity: 3.2 MW
Net Summer Capacity by Energy Source: Hydroelectric = 3.2 MW

Plant Name: Iowa Hydro LLC
Plant Code: 1067
Utility Name: Renewable World Energies LLC
Utility ID: 58149
City: Maquoketa
County: Jackson
Sector: IPP Non-CHP
Technology: Conventional Hydroelectric
Data Period: 201511
Primary Fuel: hydroelectric
Total Net Summer Capacity: 1.2 MW
Net Summer Capacity by Energy Source: Hydroelectric = 1.2 MW

G. Biomass

Count	Total (MW)	Maximum (MW)	Minimum (MW)	Average (MW)
5	23.2	11.2	1	4.6

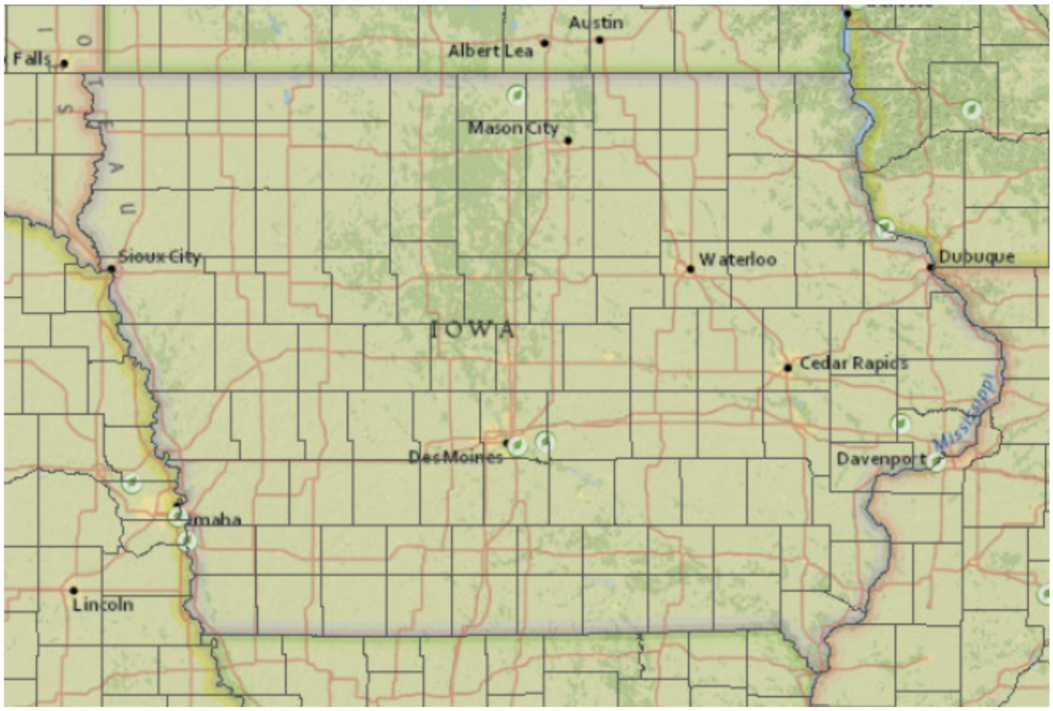


Figure 10. Power Generation Plants Using Biomass as the Primary Fuel in Iowa and Adjacent Areas. Source: United States Energy Information Administration – U.S. Energy Mapping System

List of power generation plants in Iowa using biomass as the primary fuel (sorted in order of total net summer generating capacity)

Plant Name: Metro Methane Recovery Facility
Plant Code: 54700
Utility Name: WM Renewable Energy LLC
Utility ID: 54842
City: Mitchellville
County: Polk
Sector: IPP Non-CHP
Technology: Landfill Gas
Data Period: 201511
Primary Fuel: biomass
Total Net Summer Capacity: 11.2 MW
Net Summer Capacity by Energy Source: Biomass = 11.2 MW

Plant Name: Lake Mills Gas Recovery
Plant Code: 56521
Utility Name: WM Renewable Energy LLC
Utility ID: 54842
City: Lake Mills
County: Winnebago
Sector: IPP Non-CHP
Technology: Landfill Gas
Data Period: 201511
Primary Fuel: biomass
Total Net Summer Capacity: 4.8 MW
Net Summer Capacity by Energy Source: Biomass = 4.8 MW

Plant Name: Des Moines Wastewater Reclamation Facility
Plant Code: 50932
Utility Name: Des Moines Metro WRF
Utility ID: 5089
City: Des Moines
County: Polk
Sector: Commercial CHP
Technology: Other Waste Biomass
Data Period: 201511
Primary Fuel: biomass
Total Net Summer Capacity: 4.6 MW
Net Summer Capacity by Energy Source: Biomass = 4.6 MW

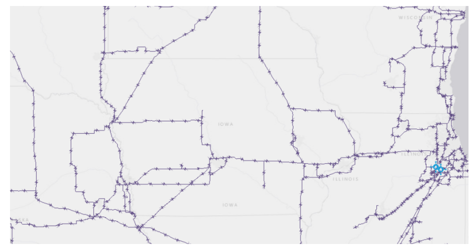
Plant Name: Davenport Water Pollution Control Plant
Plant Code: 55035
Utility Name: Davenport City of
Utility ID: 29729
City: Davenport
County: Scott
Sector: Commercial CHP
Technology: Other Waste Biomass
Data Period: 201511
Primary Fuel: biomass
Total Net Summer Capacity: 1.6 MW
Net Summer Capacity by Energy Source: Biomass = 1.6 MW

Plant Name: AgriReNew
Plant Code: 59181
Utility Name: AgriReNew
Utility ID: 58986
City: Stockton
County: Scott
Sector: IPP CHP
Technology: Other Waste Biomass
Data Period: 201511
Primary Fuel: biomass
Total Net Summer Capacity: 1 MW
Net Summer Capacity by Energy Source: Biomass = 1 MW

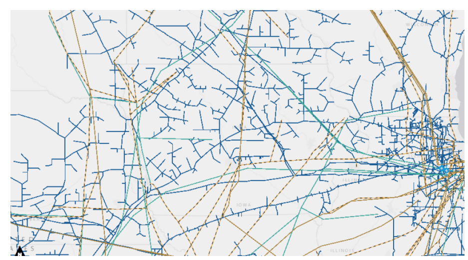
II. OTHER GEOGRAPHIC INFORMATION ON ENERGY INFRASTRUCTURE

The U.S. Energy Information Administration's U.S. Energy Mapping System contains a broad range of data on major energy infrastructure and resources that can be overlain on regional/state base maps. The maps on the following pages provide summaries of information useful to the development of the Iowa Energy Plan, including:

A. Major electricity transmission lines (≥ 345kV)



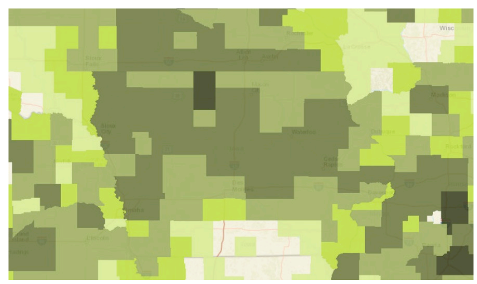
B. Pipelines



C. Wind resource potential

D. Solar (photovoltaic) resource potential

E. Solid biomass resources



A. Major Electricity Transmission Lines

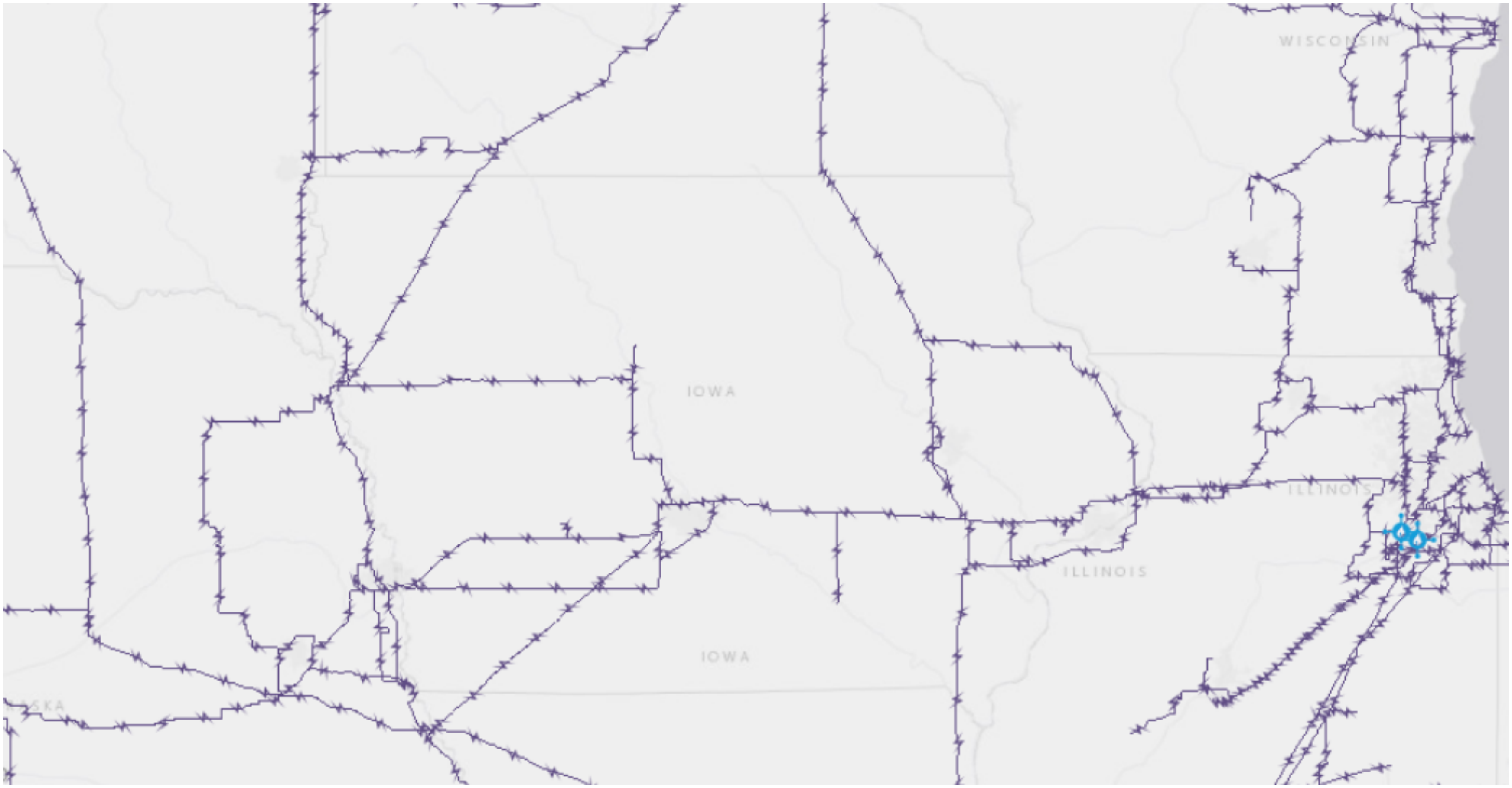
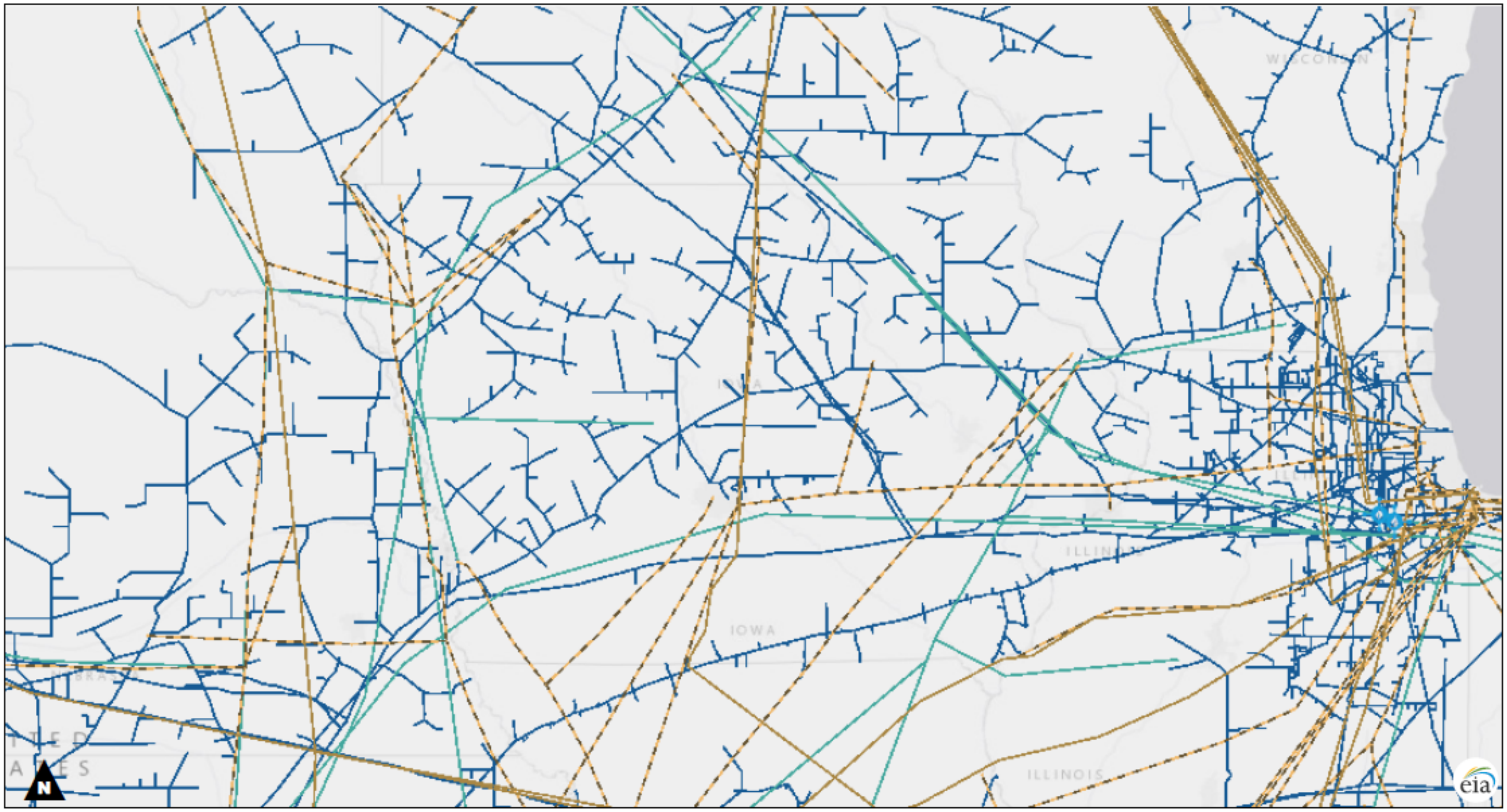


Figure 11. Electricity transmission lines of ≥ 345kV
Source: United States Energy Information Administration – U.S. Energy Mapping System

B. Pipelines



Credits: layer3 : Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community; State Layers :

0 15 30 60 Miles

- Natural Gas Market Hub (z)
- Crude Oil Pipeline (z)
- Petroleum Product Pipeline (z)
- HGL Pipeline (z)
- Natural Gas Inter/Intrastate Pipeline (z)

C. Wind Resource Potential

0 15 30 60 Miles

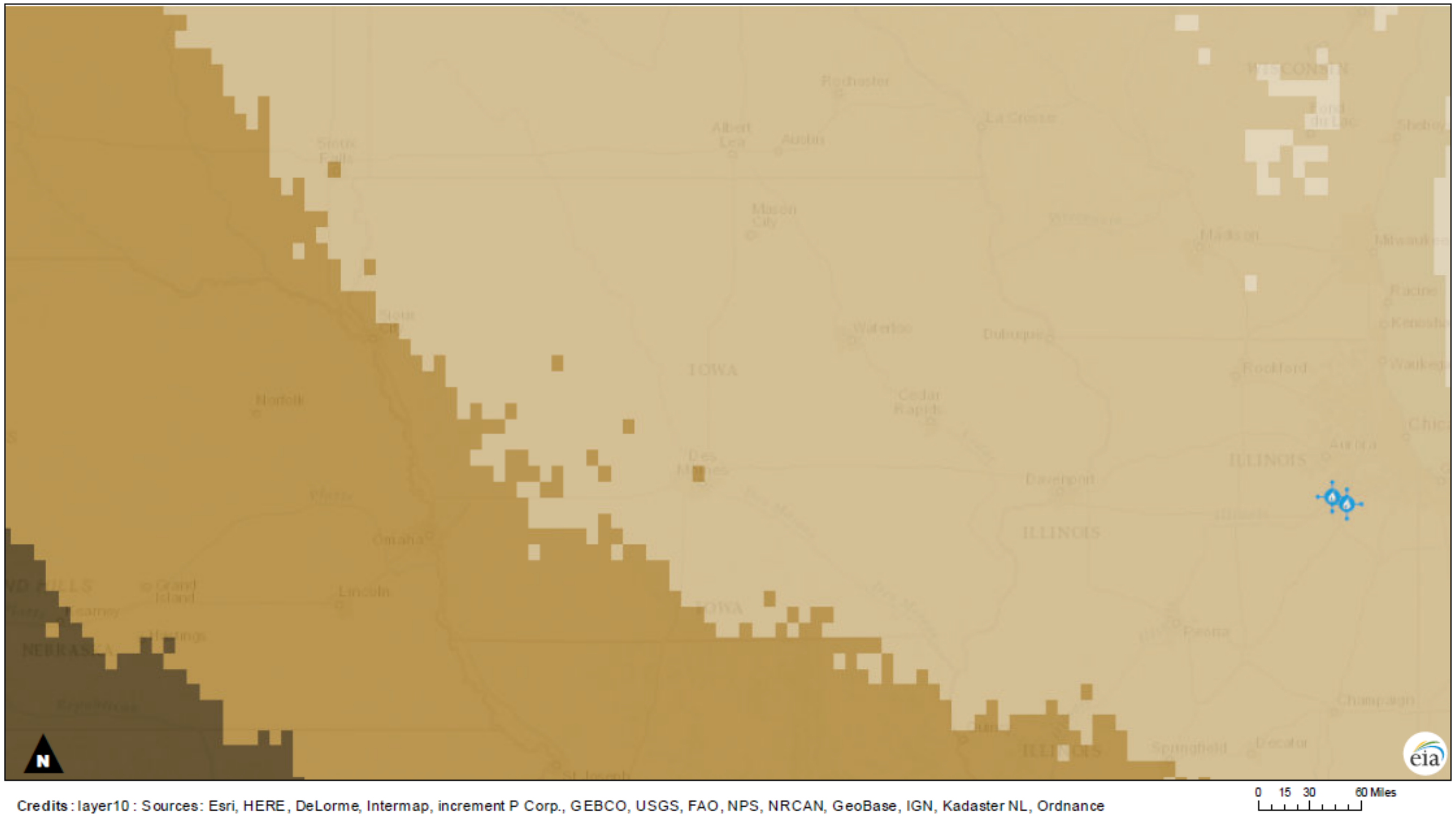
Credits: State Layers : ; layer9 : Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Natural Gas Market Hub (z)

On Shore 50 Meter Tower Wind Potential

- 7 Superb On Shore Wind Potential
- 6 Outstanding
- 5 Excellent
- 4 Good
- 3 Fair
- 2 Marginal
- 1 Poor

D. Solar Potential (Photovoltaic)



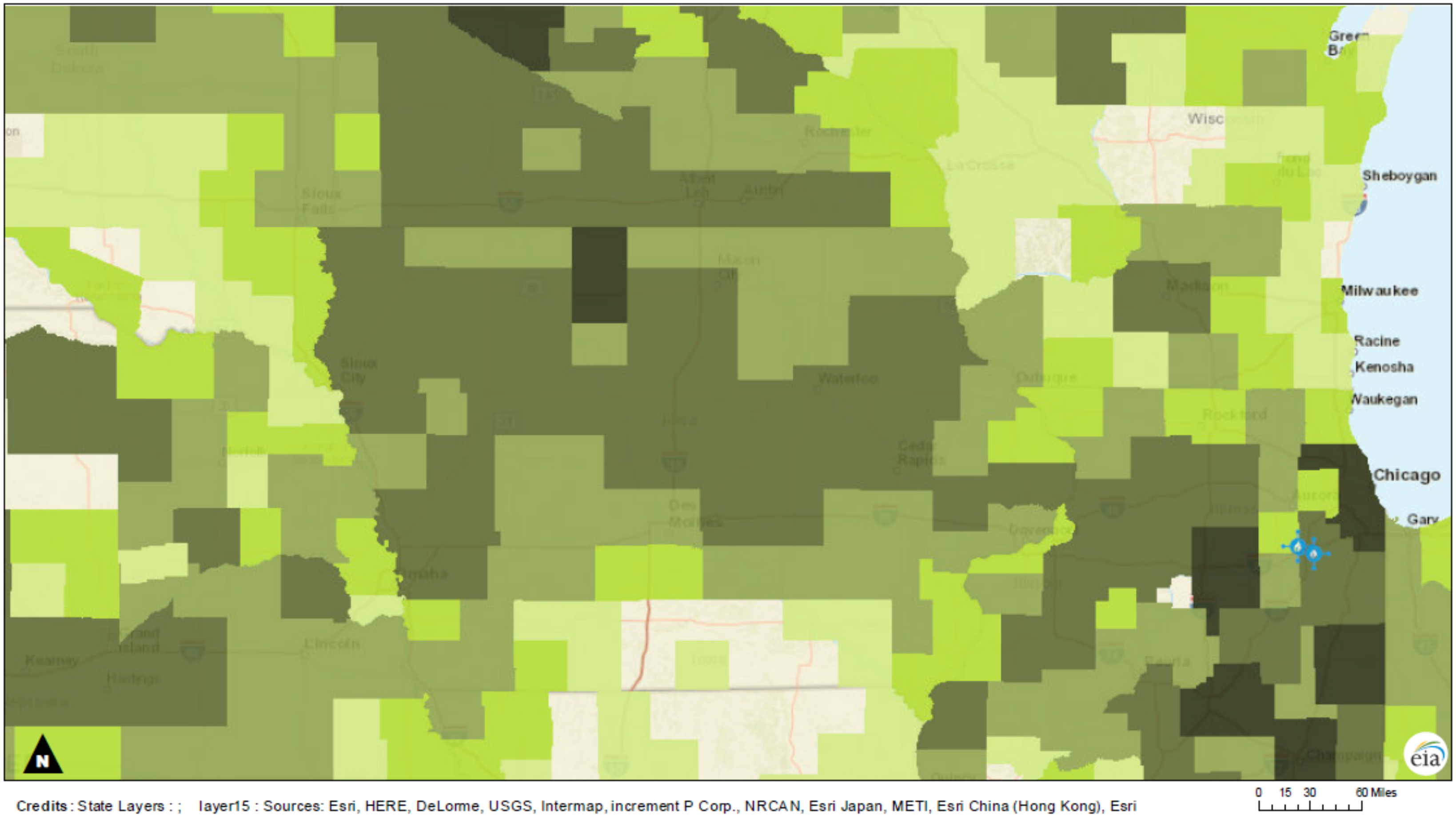
Credits : layer10 : Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community; State Layers :

Natural Gas Market Hub (z)

Photovoltaic Solar Potential

- 5.93 to 7.03 kWh/m2/Day PV Solar Potential
- 5.21 to 5.92
- 4.78 to 5.2
- 4.35 to 4.77
- 2.19 to 4.34

E. Solid Biomass Resources



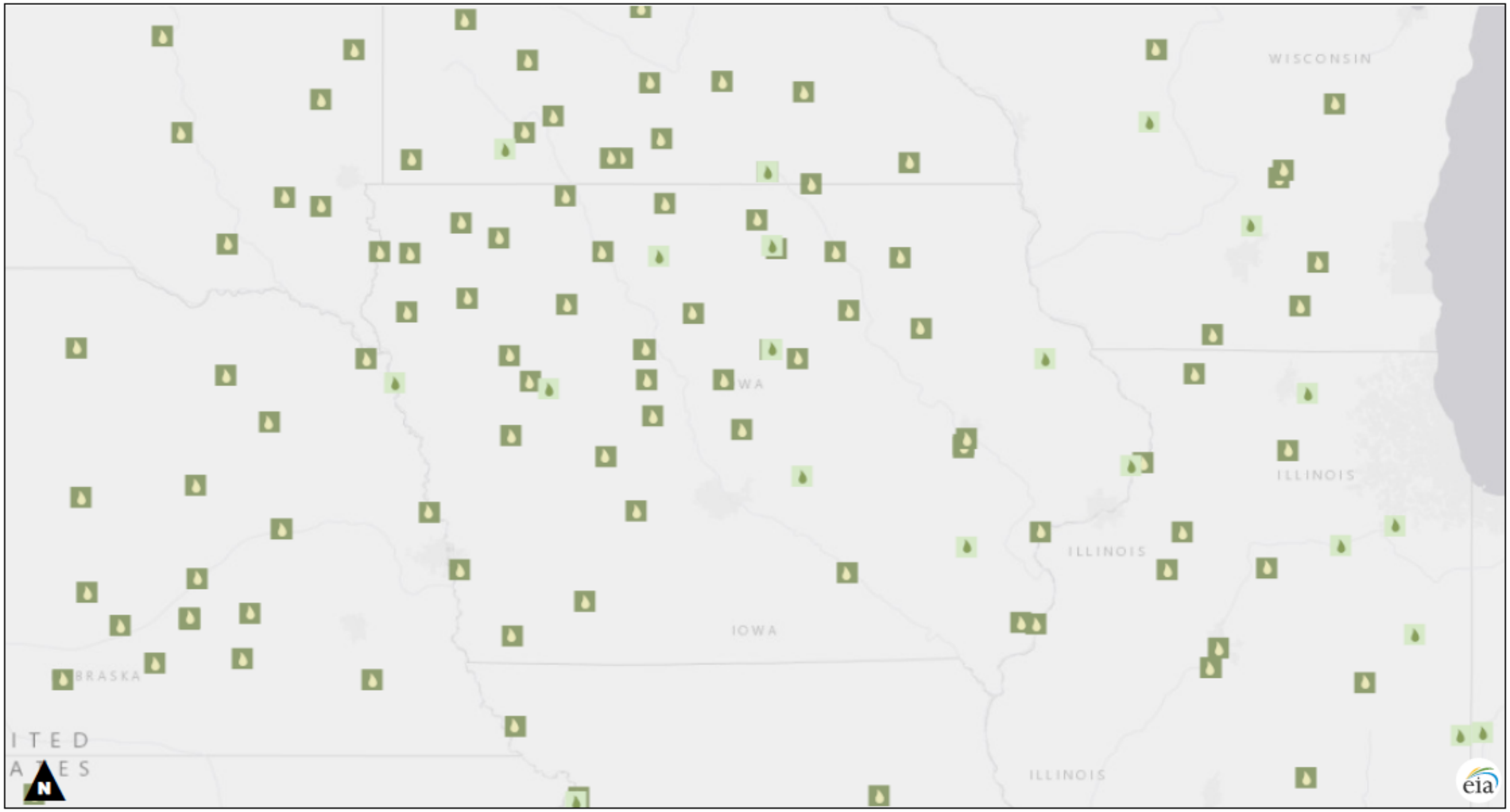
Credits: State Layers : ; layer15 : Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Natural Gas Market Hub (z)

Solid Biomass Resources

- > 500 thousand tonnes/year Solid Biomass
- 250 - 500
- 150 - 250
- 100 - 150
- 50 - 100

F. Ethanol and Biodiesel Plants



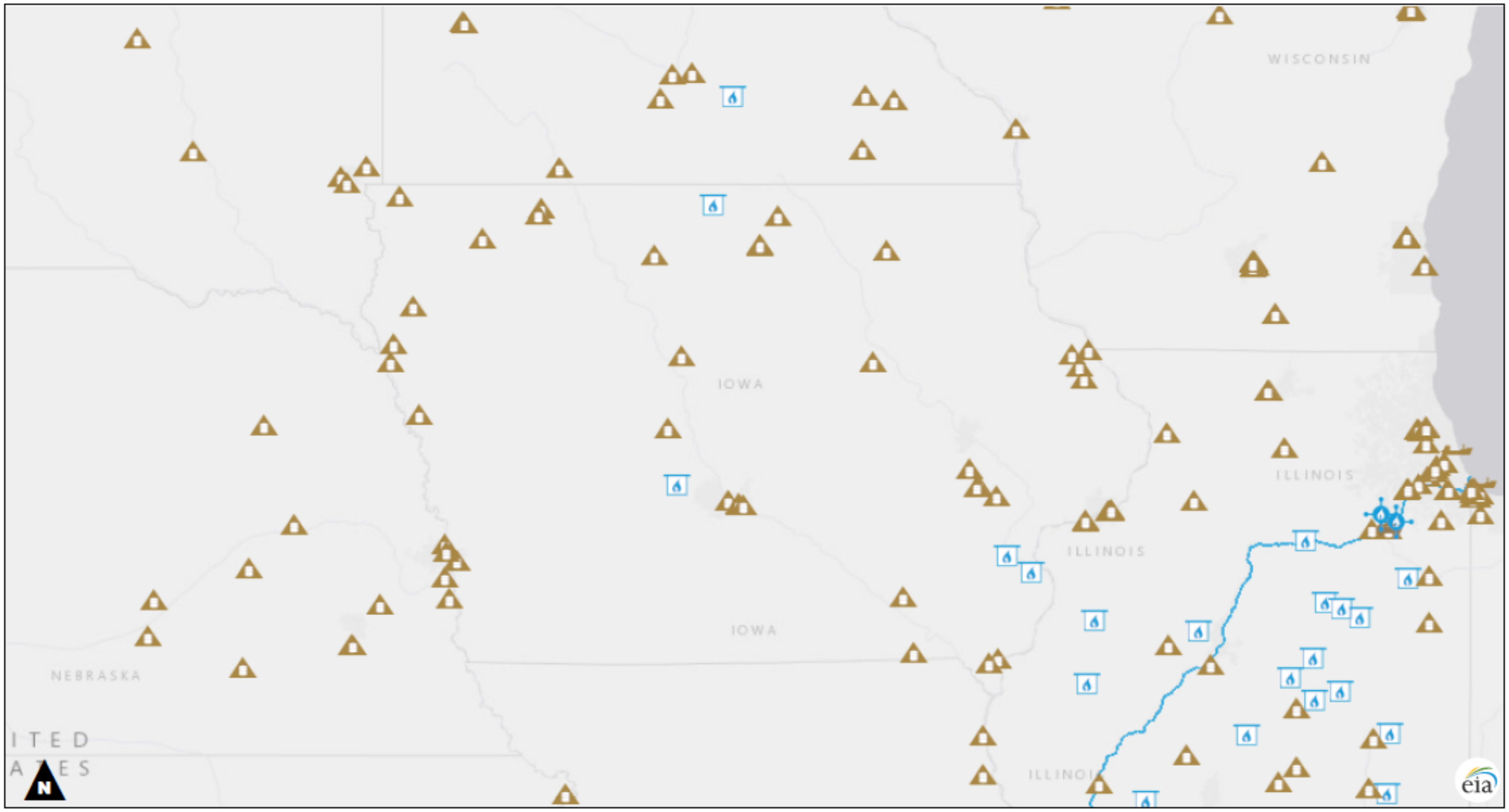
Credits: layer3 : Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community; State Layers :

0 15 30 60 Miles

Biodiesel Plant

Ethanol Plant

G. Other Energy Infrastructure



Credits: layer3 : Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community; State Layers :

0 15 30 60 Miles

- Natural Gas Market Hub (z)
- Crude Oil Rail Terminal
- Petroleum Product Terminal
- Petroleum Port
- Natural Gas Underground Storage (z)
- LNG Import/Export Terminal
- Northeast Petroleum Reserve
- Strategic Petroleum Reserve
- Waterway for Petroleum Movement

IOWA ENERGY PLAN

APPENDIX E:
Iowa Energy Workforce Assessment

Collaborate locally.
Grow sustainably.
Lead nationally.

IOWA ENERGY PLAN IS A JOINT INITIATIVE BETWEEN
IOWA economic development | IOWA DOT

Prepared by TEConomy Partners, LLC.

July 20, 2016

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A. INTRODUCTION

This report is one in a series of reports, produced by TEConomy Partners LLC to inform working group and stakeholder deliberations in developing the Iowa Energy Plan. Other reports in the series and analysis have focused on: an analysis of energy supply and demand and total employment in the energy sector in Iowa; strengths, weaknesses, opportunities and threats (SWOT) of Iowa in relation to energy; and a detailed assessment of in-state energy R&D core competencies and identification of "platforms" for energy-based economic development. This report focuses on summarizing workforce and energy-related occupations projections in relation to Iowa's energy sector.

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

The necessary skills and educational requirements can vary significantly across an individual energy sector, but it is clear that specialized training is required to develop, deploy, manufacturer and maintain energy-related technologies and critical infrastructure for efficient production and distribution.

Developing, retaining, and attracting talent each raise distinct challenges based on workforce demand and factors such as geographical location (which in the energy industry sector can be especially challenging given the rural and remote locations of widespread infrastructure). While the nuances of specific workforce dynamics, ground truths and experiences of employers, educators and other workforce developers come through in the interviews conducted for this study, the project team has supplemented information covered in the SWOT interviews with a quantitative assessment of the recent and projected demand for "primary" energy-related occupations in Iowa.

B. ANALYTICAL APPROACH

A two-pronged approach was undertaken to identify key occupations primarily related to the energy sector in Iowa:

- First, the project team reviewed detailed occupational job descriptions and titles to identify jobs most clearly and directly related to the energy sector and its primary functions.
- Second, the team utilized Iowa and U.S.-specific industry "staffing patterns" data that detail the occupational make-up of an industry utilizing the NAICS-defined industry structure developed by TEConomy and reported in the energy supply and demand white paper report. By examining those occupations most utilized by energy industry employers, a robust understanding of actual hiring across the industry can be developed.

There are key caveats and/or limitations to understand with respect to this approach including:

- There are a number of primary energy-related occupations for which Iowa may have some employment but it is too small for the Bureau of Labor Statistics(BLS) to disclose. BLS only provides estimates of employment from the occupational surveys when employment is estimated to be at least 30 jobs.
    - For example, BLS does not have estimates for Iowa's nuclear engineers and nuclear technicians, likely because they number fewer than 30.
    - Likewise, an occupational code now exists for Solar Photovoltaic Installers but no employment estimate is provided for Iowa.
    - While these occupations were certainly identified, for these reasons they are not included in the assessment developed here.[1]
- In addition, there are large employment areas that might be considered "secondary" to the industry from an occupational perspective where the job classifications do not signal a primary designation within energy. For example, utility companies and wind turbine blade manufacturers employ large numbers of workers in managerial, sales, IT, customer services, and administrative positions, and these are critical to their effective operations, but are not included here as these positions are so large in number and employed across numerous (indeed most) industries in Iowa.

C. RESEARCH FINDINGS – OCCUPATIONAL DEMAND TRENDS

The TEConomy project team identified 15 key occupations that fit the primary designation described above, and have published employment values in Iowa for 2015. Table 1 presents these occupations, their employment levels, recent employment trends during the economic expansion, and the concentration of these jobs in Iowa relative to the national average is presented as a Location Quotient (LQ). Location quotients measure the degree of job concentration within a state or region relative to the nation.[2] A state LQ above 1.0 represents a greater concentration than the national average. When the LQ is significantly above average, 1.20 or greater, the state is said to have a "*specialization*" in the occupation.

[1] In addition to the two examples listed here, this also includes: Wellhead Pumpers; Pump Operators, Except Wellhead Pumpers; Nuclear Engineers; Petroleum Engineers.

[2] Location quotients (LQs) are a standard measure of the concentration of a particular industry in a region relative to the nation. The LQ is the share of total state or regional employment in the particular industry divided by the share of total industry employment in the nation. An LQ greater than 1.0 for a particular industry indicates that the region has a greater relative concentration, whereas an LQ less than 1.0 signifies a relative underrepresentation. An LQ greater than 1.20 denotes employment concentration significantly above the national average. In this analysis, regional specializations are defined by LQs of 1.20 or greater.

Table 1. Summary Employment Metrics for Key Energy-Related Occupations in Iowa, 2015

Occupation	Iowa Employment, 2015	Percent Change, 2010-15	Location Quotient, 2015
Total, All Occupations	1,526,950	6.1%	1.00
Electrical Power-Line Installers and Repairers	1,940	13.5%	1.52
Electrical Engineers	1,300	6.6%	0.66
Electrical and Electronics Engineering Technicians	920	-22.0%	0.60
Power Plant Operators	760	-11.6%	1.83
Control and Valve Installers and Repairers	600	33.3%	1.27
Stationary Engineers and Boiler Operators	340	21.4%	0.89
Meter Readers, Utilities	310	-34.0%	0.80
Wind Turbine Service Technicians	240	n/a	5.49
Gas Plant Operators	230	-30.3%	1.24
Chemical Engineers	170	-10.5%	0.48
Power Distributors and Dispatchers	170	142.9%	1.33
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	110	-60.7%	0.43
Biochemists and Biophysicists	90	50.0%	0.26
Petroleum Pump System Operators, Refinery Operators, and Gaugers	60	-50.0%	0.13
Gas Compressor and Gas Pumping Station Operators*	60	n/a	1.14

Source: TEConomy Partners analysis of Bureau of Labor Statistics, Occupational Employment Statistics.

*Note: N/A = Not available. *Employment and LQ data for this occupation are for 2014, the latest year available.*

Iowa has "specialized" employment concentrations in six of the 15 energy-related occupations where its concentration of jobs in these occupations exceeds the national average by 20 percent or more (a location quotient of 1.20 or greater). Having a disproportionately higher concentration signals an occupation that is highly utilized and a skills niche that is important to the state and its industry composition. These specialized occupational groups include:

- Wind Turbine Service Technicians (LQ is 5.49)
- Power Plant Operators (LQ is 1.83)
- Electrical Power-Line Installers and Repairers (LQ is 1.52)
- Power Distributors and Dispatchers (LQ is 1.33)
- Control and Valve Installers and Repairers (LQ is 1.27)
- Gas Plant Operators (LQ is 1.24).

The employment dynamics are plotted using a "bubble" chart (Figure 1) to show performance and relative position of each occupation across three variables—

employment size (size of the bubble), employment growth or loss (horizontal axis position), and relative employment concentration (using location quotients plotted on the vertical axis). Figure 1 shows the position of each occupation based on these characteristics, with the quadrant in which it lies helping to characterize its performance. For example, those occupations in quadrant 1 might be thought of as statewide “stars” as they are both growing and have an above-average concentration in Iowa relative to the national average (a LQ greater than 1.0).

Six of the occupations have demonstrated strong growth during the economic recovery with substantial demand evident for power distributors and dispatchers; biochemists and biophysicists; control and valve installers and repairers; and stationary engineers/boiler operators. The largest two occupational groups—electrical power-line installers/repairers and electrical engineers—have each added employment as well during the 5-year recovery period shown here.

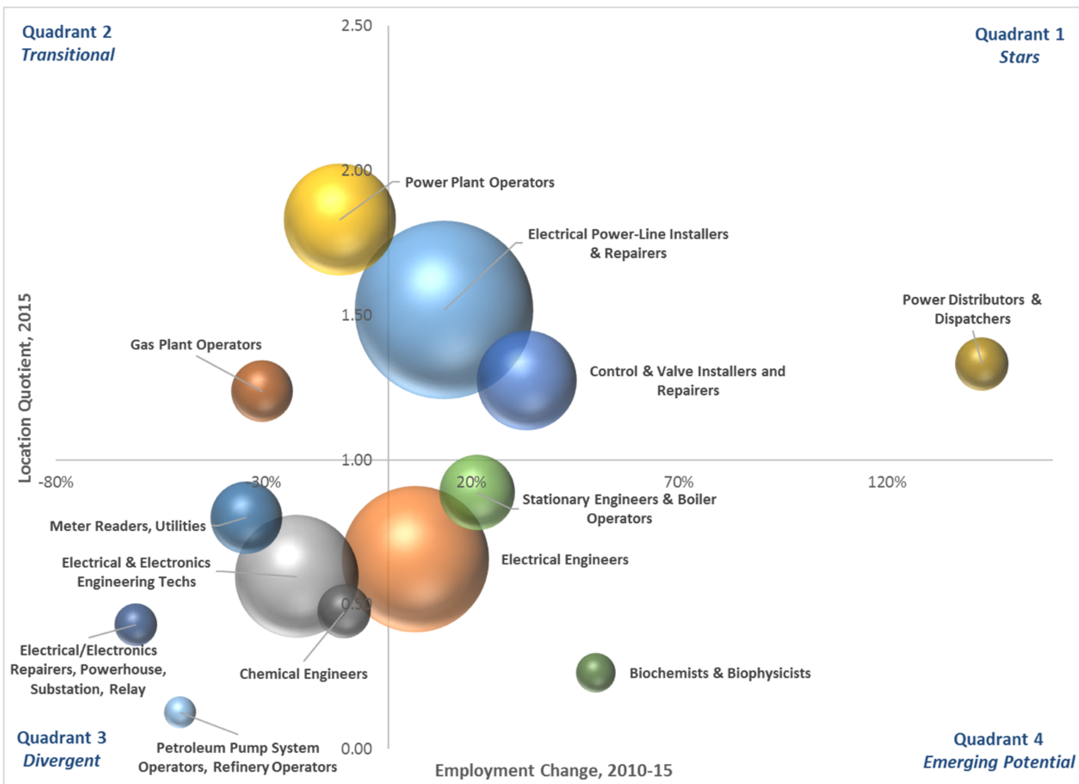

Figure 1. Energy-related Occupations in Iowa—Employment Size, Trends, and Concentration, 2015

Note: not shown are data for Wind Turbine Service Technicians and for Gas Compressor and Gas Pumping Station Operators as there are no estimates available for 2010 with which to calculate a trend.

A particularly useful comparison of recent demand for these occupational skills is to relate Iowa's trend in performance against that of the nation as a whole. It can be seen on Figure 2 that Iowa's recent trend shows not only growth, but also growth that exceeds that for the U.S. – the state is essentially gaining market share in this profession. Figure 2 shows the employment trend by occupational group for both Iowa and the U.S.

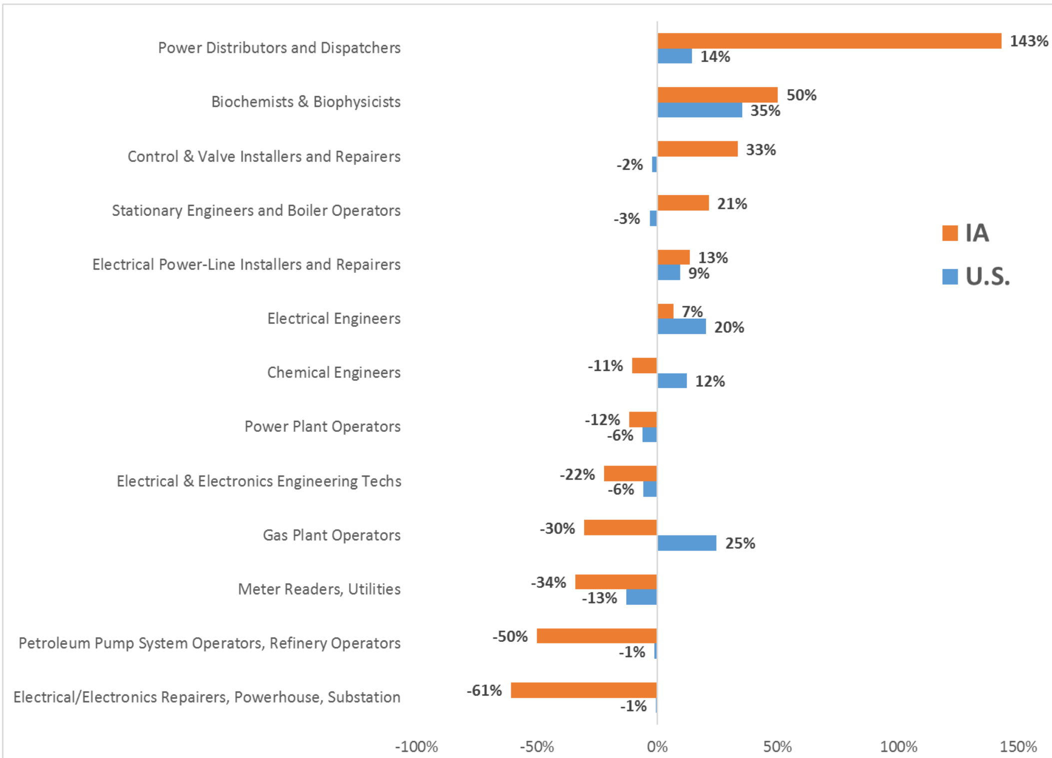

Figure 2. Employment Trends in Energy-related Occupations, Iowa and U.S. 2010-15

Iowa stands out in selected occupational groups where recent job growth exceeds that for the nation, and hence the state is gaining in its "market share" with respect to these skills and talent base. From Figure 2 it can be seen that in Iowa there have been employment gains exceeding those for the U.S. in:

- Power Distributors and Dispatchers
- Biochemists and Biophysicists
- Control and Valve Installers and Repairers
- Stationary Engineers and Boiler Operators
- Electrical Power-Line Installers and Repairers.

D. RESEARCH FINDINGS – EMPLOYMENT PROJECTIONS

In terms of future demand, Iowa Workforce Development (IWD) calculates projected annual demands for occupations over a 10-year period, with the projections currently out to 2022. What is important to recognize is the need for workers to fill not only new jobs created but also to fill employer needs for "replacements" as workers retire or otherwise leave the labor force, or leave a specific occupation. It was noted in SWOT interviews that this is a challenge for multiple companies in the Iowa energy sector. While IWD has not developed projections for each of the detailed energy-related occupations, Figure 3 includes available data for five. These illustrate the importance for replacement workers in these lines of work as most, if not all of the need, for these occupations is projected to be on a replacement basis. This signals an aging workforce in these occupational groups and must be a key consideration in assessing demand into the future and being prepared for retirements.

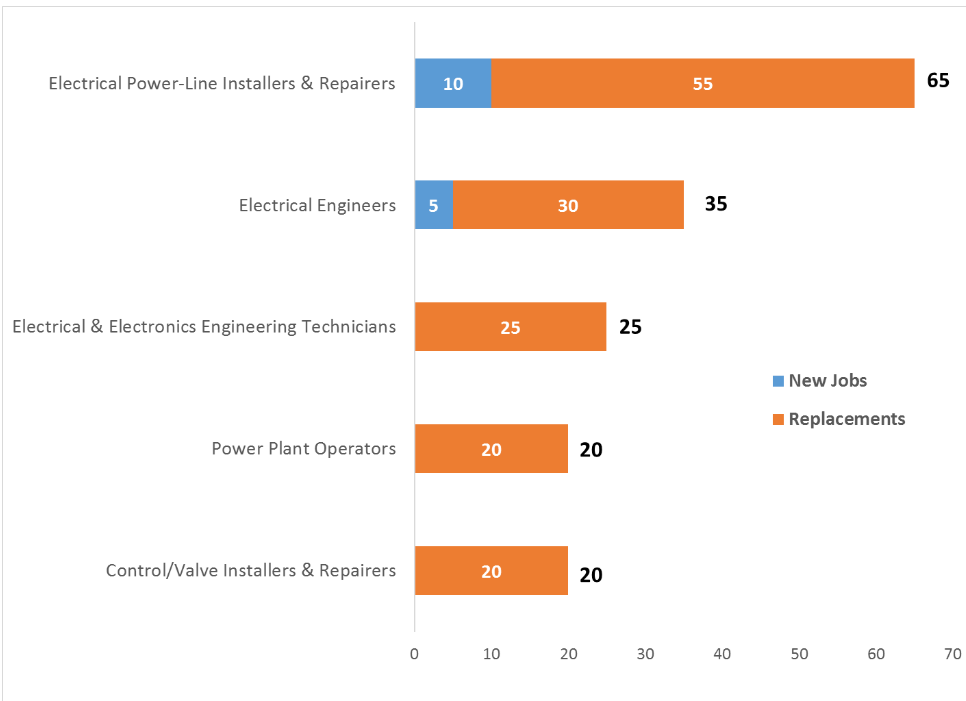

Figure 3. Projected Annual Job Openings in Iowa by Type of Opening, 2012-22

Source: Iowa Workforce Development.

E. RESEARCH FINDINGS – EDUCATION AND TRAINING REQUIREMENTS

In preparing a workforce for energy-related positions, both BLS and IWD provide information on the education and training typically required for entry into the occupation as well as job competency. Among the energy-related occupations profiled the educational requirements can vary considerably and reflect the need for attention at all levels of the educational pipeline from K-12 through Doctoral programs. While much of this workforce, particularly in the operator and repair positions, requires a high school diploma, there is a recognition that moderate to longer-term on the job training is key to truly gaining expertise in these fields. Apprenticeships and other job training programs often serve these training needs beyond the K-12 and postsecondary education systems. It should be noted that interviewees in industry noted that just having a high school diploma is not enough – people need to be job ready and instilled with a work ethic.

Beyond just the primary energy-related occupations profiled in this section, there are further workforce and talent needs for Iowa's energy sector and many of these areas require four-year degrees and higher, including in management, IT, technical sales, and engineering areas.

Table 2. Education and Training Requirements for Key Energy-related Occupations

Energy-related Occupations	Typical education needed for entry	Typical on-the-job training needed to attain competency in the occupation
Control and valve installers and repairers, except mechanical door	High school diploma or equivalent	Moderate-term on-the-job training
Electrical power-line installers and repairers	High school diploma or equivalent	Long-term on-the-job training
Gas compressor and gas pumping station operators	High school diploma or equivalent	Moderate-term on-the-job training
Gas plant operators	High school diploma or equivalent	Long-term on-the-job training
Meter readers, utilities	High school diploma or equivalent	Short-term on-the-job training
Petroleum pump system operators, refinery operators, and gaugers	High school diploma or equivalent	Long-term on-the-job training
Power distributors and dispatchers	High school diploma or equivalent	Long-term on-the-job training
Power plant operators	High school diploma or equivalent	Long-term on-the-job training
Stationary engineers and boiler operators	High school diploma or equivalent	Long-term on-the-job training
Electrical and electronics repairers, powerhouse, substation, and relay	Postsecondary nondegree award	Long-term on-the-job training
Wind turbine service technicians	Some college, no degree	Long-term on-the-job training
Electrical and electronics engineering technicians	Associate's degree	None
Chemical engineers	Bachelor's degree	None
Electrical engineers	Bachelor's degree	None
Biochemists and biophysicists	Doctoral or professional degree	None

Source: U.S. Bureau of Labor Statistics, Employment Projections program.

As Iowa considers its current position and future strategic plans in the energy sector, it is critical to devote considerable attention to the available workforce as well as the workforce that is currently being developed to ensure a viable, innovation-driven industry going forward. In many states, including Iowa, attention to workforce development, retention, incumbent worker training, and attraction/recruitment of top talent are all key facets of a robust and complete workforce strategy. While there are a wide range of occupational demands beyond those identified here as primary, this assessment is intended to focus attention on key areas of expertise and need for the industry that are specific to energy.

IOWA ENERGY PLAN

APPENDIX F:
Energy Policy Inventory

Collaborate locally.
Grow sustainably.
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IOWA economic development | IOWA DOT

Prepared by Elevate Energy with Support from Inova Energy Group

December 21, 2016

ELEVATE ENERGY
Smarter energy use for all

INOVA ENERGY GROUP

ENERGY POLICY INVENTORY

Iowa has a substantial body of law and regulation that impacts how energy is generated, distributed, transmitted and used in the state. To assist the Iowa Economic Development Authority in administering the energy planning process, Elevate Energy, a nonprofit focused on smarter energy use for all and member of the Inova Energy Group team, created an inventory of Iowa's existing energy use policies, goals and strategies. The identification of policies included in the inventory was guided by a review of the Iowa Code and Administrative Rules and by related discussions with state agencies, working group members, and the public.

The inventory is divided into State policies (Table 1) and federal policies (Table 2). Since Iowa has a large number of energy policies, some policies have been grouped together to keep the length of the inventory manageable. This inventory has been used as a baseline to shape the strategies recommended throughout the Iowa Energy Plan.

Table 1. State Energy-Related Policies and Programs

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
1	Alternative Energy Law	The Alternative Energy Production law requires MidAmerican Energy and Interstate Power and Light to own or to contract for a total of 105 megawatts (MW) of renewable generation, at rates set by the Iowa Utilities Board (IUB).	1/1/83	Iowa Utilities Board	Solar, Wind, Small Hydroelectric, Biomass, Municipal Solid Waste, Landfill Gas, Anaerobic Digestion	Investor-Owned Utilities	Renewable Portfolio Standard	Iowa Code §§ 476.43, 476.44	199 IAC 15.11(1)		
2	Interconnection Standards	Interconnection standards for rate-regulated utilities apply to distributed generation facilities of up to 10 MW that are not subject to the interconnection requirements of the Federal Energy Regulatory Commission (FERC), the Midwest Independent Transmission System Operator, Inc. (MISO), or the Mid-Continent Area Power Pool (MAPP). A distributed generation facility includes qualifying facilities (QFs) under the U.S. Public Utilities Regulatory Policy Act (PURPA) and alternative energy production (AEP) facilities, which are electricity generation facilities that derive at least 75% of their energy input from solar, wind, waste management, resource recovery, refuse-derived fuel, agricultural crops or residues, or wood burning, as well as dam-based hydroelectric facilities. HF 548 (passed in 2015) provided new rules on safety, specifically the visibility of a disconnect device.	5/1/10	Iowa Utilities Board	Solar, Wind, Hydroelectric, Biomass, Geothermal, Municipal Solid Waste, Landfill Gas, Anaerobic Digestion, Combined Heat and Power (CHP)	All Customers, Investor-Owned Utilities, Linn Co. Renewable Electricity Co-op	Regulation	Iowa Code § 476.6(A)	199 IAC 15.10 199 IAC 45	H.F. 548	Docket No. NOI-2014-0001
2.1	Safety of Distributed Electric Generation Facilities	The bill requires the IUB to adopt administrative rules requiring distributed generation facilities installed after the effective date to have a disconnection device that is easily visible and adjacent to the electric meter. Customers must also notify local fire departments of the location of the distributed generation facility and associated disconnection device.	7/1/15	Iowa Utilities Board	DG	All customers	Regulation	HF 548			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
3	Net metering	Iowa's statutes do not explicitly authorize the IUB to mandate net metering, but this authority is implicit through the board's enforcement of PURPA and Iowa Code § 476.41 et seq. Iowa's net-metering sub rule, adopted by the IUB in July 1984, applies to customers that generate electricity using alternate energy production facilities. Net metering is available to customers of Iowa's two investor-owned utilities, MidAmerican Energy and Interstate Power and Light (IPL). MidAmerican Energy and IPL limit individual systems to 500 kilowatts (kW). Customers that have an on-site renewable energy system through an existing third-party power purchase agreement are not eligible for net metering. IPL also limits net metering to customers on the Residential, Farm, or General Service rate schedules, so customers on the Large General Service rate schedule (i.e., customers using more than 20,000 kWh per month) are ineligible to net meter. The IUB has docketed two new net metering tariffs, filed by MidAmerican Energy and IPL, in Docket Nos. TF-2016-0321 and TF-2016-0323.	7/1/84	Iowa Utilities Board	Solar, Wind, Hydroelectric, Biomass, Municipal Solid Waste	All Customers, Investor-Owned Utilities	Net Metering	Iowa Code §476.41-476.45	199 IAC 15.11(5)	PURPA (1978)	NOI-2014-0001
4	Alternative Energy Revolving Loan Program (AERLP)	The AERLP provides low-interest loans to individuals and organizations that seek to build renewable energy production facilities in Iowa. Successful applicants receive a low-interest loan that consists of a combination of AERLP and lender-provided funds. The AERLP provides 50% of the total loan at 0% interest rate up to a maximum of $1,000,000. Rural electric cooperatives and municipal utilities are limited to one loan every two years with a maximum loan of $500,000. The remainder of the loan is provided by a lender at market rate.	1/26/96	Iowa Energy Center	Solar, Wind, Hydro, Biomass, Landfill Gas	All Customers, All Utilities	Loan Program	Iowa Code § 476.46			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
5	Lease purchase agreements	Iowa's Treasurer's office offers the ability for state agencies to use lease purchase agreements to purchase energy related equipment. Requires aggregate payback of <6 years	1980s	State Treasurer	n/a	State agencies	Financing	Iowa Code §12.28			
6	Advanced ratemaking procedures	In determining the applicable ratemaking principles, the board shall not be limited to traditional ratemaking principles or traditional cost recovery mechanisms. Among the principles and mechanisms the board may consider, the board has the authority to approve ratemaking principles proposed by a rate-regulated public utility that provide for reasonable restrictions		Iowa Utilities Board	n/a	Investor-owned utilities	Regulation	Iowa Code §476.53			
7	Energy assurance planning	Every two years, Iowa prepares a state energy assurance plan to address the protection of its critical energy infrastructure. Responsibility for this plan is shared between the IUC, the State Energy Office at the Iowa Economic Development Authority (IEDA), and the Department of Homeland Security and Emergency Management.		IUB, IEDA, Dept. of Homeland Security, others.	n/a		Regulation	Iowa Code §§ 473, generally.			
8	Renewable Energy Production Tax Credit	Iowa has two production tax credit programs for renewable energy facilities. An eligible facility can qualify for only one of the two credits: (1) $0.015/kWh for facilities of less than 60MW nameplate capacity (IA Code § 476C) or, (2) $0.01/kWh for 2-30 MW facilities or smaller facilities at schools and hospitals (IA Code § 476B). The tax credit lasts for 10 years after facility begins producing energy.	6/15/05	Iowa Utilities Board	Solar, Wind, Hydroelectric, Biomass, Municipal Solid Waste, Landfill Gas, Anaerobic Digestion, CHP, Hydrogen	Commercial, Industrial, Agricultural Customers	Corporate Tax Credit	Iowa Code §§ 476B, 476C.	199 IAC 15.18 - 15.21	701 IAC 42.27	
9	Sales Tax Exemption - Renewable Energy Equipment	Iowa exempts solar, wind, and hydroelectric equipment from the state sales tax, which is 6%.	Wind - 1993, Solar 7/1/2006, Hydro - 2013	Iowa Department of Revenue	Solar, Wind, Hydroelectric	All Customers	Sales Tax Exemption	Iowa Code §§ 423.3(54)(wind and hydro); 423.3(90)(solar)			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
10.1	Geothermal Tax Credit	Geothermal heat pumps installed on residential property in Iowa are eligible for a tax credit equal to 10% of the expenditures on geothermal heat pump equipment in the given year. Credit in excess of the tax payer's liability may be carried forward for up to 10 years. The credit applies to systems installed beginning Jan. 1, 2017.	1/1/17	Iowa Department of Revenue	Geothermal heat pumps	Residential	Personal Tax Credit	Iowa Code § 422.10A	701 IAC 42.47		
10.2	Solar Energy System Tax Credit	Individuals and corporations may claim a state tax credit worth 60% of the Federal Investment Tax Credit, which is set at 30% of installed costs (60% * 30% = 18%). Each taxpayer may claim up to $5,000 for residential systems and $20,000 for commercial systems, and excess credits may be carried over for up to 10 years. The total amount of tax credit is limited to $4.5 M / year, with $1 M reserved for residential systems.	1/1/12	Iowa Department of Revenue	Solar	Commercial	Corporate Tax Credit, Personal Tax Credit	Iowa Code § 422.11L	701 IAC 42.48		
11.1	Local Option - Special Assessment of Wind Energy Devices	Any city or county in Iowa may pass an ordinance assessing wind energy conversion equipment at a special valuation for property tax purposes, beginning at 0% of the net acquisition cost in the first assessment year and increasing annually by five percentage points to a maximum of 30% of the net acquisition cost in the 7th and succeeding years.	1/1/94	Iowa Department of Natural Resources	Wind	All Customers	Property Tax Incentive	Iowa Code § 427B.26	701 IAC 80.13		
11.2	Cogeneration Replacement Tax Exemption	New cogeneration facilities are exempt from replacement tax by means of a credit.	1/1/10	Iowa Department of Revenue / Local Assessors	Electric Cogeneration Facilities	Commercial	Corporate Tax Credit	Iowa Code § 437A.16A			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
11.3	Energy Replacement Generation Tax Exemption	Iowa exempts self-generators, landfill gas, and wind from a replacement generation tax of $0.0006 per kilowatt-hour (kWh) on electricity generated within the state. This tax is imposed in lieu of a property tax on generation facilities. There is a reduced rate for large hydroelectric.	2008	Iowa Department of Revenue	Wind, Hydroelectric, Landfill Gas	Electric Generators	Corporate Tax Exemption	Iowa Code § 437A.6			
11.4	Methane Gas Conversion Property Tax Exemption	Iowa exempts methane gas conversion property from property tax. Projects may claim the exemption for 10 years, except projects at publicly-owned sanitary landfills.	1/1/2008 (retroactive)	Iowa Department of Revenue	Biomass, Landfill Gas, Anaerobic Digestion	All Customers	Property Tax Incentive	Iowa Code § 427.1(29)			
11.5	Property Tax Exemption for Renewable Energy Systems	The market value added to a property by a solar or wind energy system is exempt from Iowa property tax for five full assessment years.	1/1/78	Iowa Department of Revenue	Solar, Wind	All Customers	Property Tax Incentive	Iowa Code § 441.21(8)			
12	Energy Bank Revolving Loan Program	IEDA in partnership with the Iowa Area Development Group (IADG) offers Iowa businesses and industries a low-interest financing option for energy efficiency improvements, renewable energy projects, energy management, and implementation plans. The establishment of the IADG Energy Bank Revolving Loan Fund is intended to provide an ongoing source of low interest financing for the implementation of cost-effective projects that will save energy and money, improve facilities and processes, and enhance job creation and profitability.	2013	IEDA, IADG	Solar, Wind, Hydroelectric	Commercial, Industrial	Loan Program			ARRA	IADG Program
13	Mandatory Utility Green Power Option	All Iowa-based electric utilities must offer green power options that allow customers to make voluntary contributions to support the development of renewable energy sources in Iowa. Utilities must file program plans and tariffs with the IUB; however, the filings for non-rate-regulated utilities are intended to be for informational purposes only.	1/1/04	Iowa Utilities Board	Solar, Wind, Hydroelectric, Biomass, Municipal Solid Waste	All Utilities	Regulation	Iowa Code § 476.47			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
14	Small Wind Innovation Zone Program and Model Ordinance	In May 2009 the Iowa Legislature created the Small Wind Innovation Zone Program, which allows any city, county, or other political subdivision to create small wind innovation zones that promote small wind production. In order to qualify for the designation, the city must adopt the Small Wind Innovation Zone Model Ordinance and also establish an expedited approval process for small wind energy systems. System owners must also enter into a model interconnection agreement with an electric utility.	5/1/09	Any sub-division of the State (i.e. city, county, township)	Wind	All Utilities	Regulation	Iowa Code §476.48	199 IAC 15.22		
15	Solar Easements	Iowa's solar access easement provision allows for access to sunlight to operate a solar energy system. Those who are unable to obtain a voluntary solar easement from a property owner may apply to the solar access regulatory board for an order granting a solar access easement if the relevant city council or county board of supervisors has created such a board. If a board does not exist, the matter is referred to the local district court. Iowa code also grants municipalities the right to issue ordinances prohibiting subdivisions from including restrictive covenants that limit the use of solar collectors.	1/1/00	Solar access regulatory board (if applicable) or local district court	Solar	All customers	Regulation	Iowa Code § 564A			
16	Electric Generation Facility Certificate	Iowa's code and Administrative rules contain provisions for determining if and where electric generation facilities may be built by regulated utilities in Iowa.	1977	Iowa Utilities Board	Wind, Solar	Electric utilities	Regulation	Iowa Code §§ 476A	199 IAC 24.1 et seq		

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17	Renewable Fuel Standard (RFS)	In 2006, Iowa adopted the most aggressive RFS in the country. The RFS requires 25% of motor fuel sold in Iowa to be replaced with biofuels (ethanol or biodiesel) by January 1, 2020. Beginning in 2009, retailers that meet the RFS schedule, which requires them to sell a certain percentage of renewable fuels as part of their total gasoline sales, will be eligible for an ethanol promotion tax credit.	Enacted 2006; Effective 2009	Dept. of Revenue (collects reports)	Biodiesel, Ethanol	Commercial	Regulation	Iowa Code 452A.33	701 IAC 67.27	HF 2754	
18	Renewable Fuels Infrastructure Program	Reimbursement can be for 50% of the costs for specific components of a project with a three-year commitment required to sell certain renewable fuels. A five year commitment to store and sell renewable fuels and install certain equipment can result in up to 70% reimbursement for specific equipment or installation costs	Enacted 2005; Effective 2006	Iowa Department of Agriculture and Land Stewardship (IDALS), IEDA	Biodiesel, Ethanol	Commercial (Retail)	Grant program	Iowa Code §159A.15			
19	Sales Tax Exemption - Energy	Iowa exempts electricity, natural gas, and metered fuels such as propane and heating oil, from the state sales tax, which is 6%.	Phased in fully in 2006	Iowa Department of Revenue	n/a	Residential Customers	Sales Tax Exemption	Iowa Code § 423.3(84)			
20	Gas Tax	Raises the state's fuel tax and provides, but provides a partial (3 cent) exemption for biodiesel blended fuel classified as B-11 or higher	Enacted 2/25/2015; Effective 3/1/2015	Department of Transportation	Biodiesel	All Customers	Tax	Iowa Code §452A.3		SF 257	
21	Biobutanol Extension	A bill for an act relating to renewable fuels, by providing for biobutanol and biobutanol blended gasoline, modifying the rate of the E-15 plus gasoline promotion tax credit and extending provisions for a biodiesel production refund, and including effective date and retroactive applicability provisions. (Formerly SF 2333.)	5/21/2014; Expires 2017 & 2018	IDALS	Biodiesel (Specifically Biobutanol)	Transportation	Tax Credit/Refund	Iowa Code §159.A, 214, 422.11	701 IAC 42.46	SF 2344	
22	Fuel Mix and Emissions Disclosure	Rate-regulated electric utilities must annually disclose the fuel mix of its electricity production and the associated sulfur dioxide, nitrogen oxide, and carbon dioxide emissions.	1/1/04	Iowa Utilities Board	n/a	All Utilities	Regulation		199 IAC 15.17(5)		

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23	Underground storage tanks	Iowa Department of Natural Resources (DNR) regulates underground storage tanks to prevent and detect leaking.	1985	Department of Natural Resources	biofuels		Regulation	Iowa Code §§455B.471-488			IA DNR UST Resources Page
24.1	State-owned vehicle assignments	Vehicles are assigned to maximize the average passenger miles per gallon.		All Iowa State Agencies	Energy Efficiency	State Government	Regulation	Iowa Code §§ 8A.361, 8A.362	11 IAC 103.4		
24.2	State-owned vehicle fuel economy requirements	State vehicle fleet purchases must meet or exceed average fuel economy for the relevant model year.		Department of Administrative Services	Energy Efficiency	State Government	Regulation	Iowa Code § 8A.362			
24.3	State-owned vehicle fueling	Users of state-owned vehicles are required to use gasahol, and drivers of flex-fuel vehicles are required to use E85 unless it is unavailable, in which case they should not fill the tank more than necessary to reach an E85 station. Agencies using biodiesel vehicles must to use biodiesel whenever available.		All Iowa State Agencies	Biofuels	State Government	Regulation	Iowa Code § 8A.362	11 IAC 103.16		
25	Emergency energy regulation, including fuel reservations	IEDA has authority, on the President's or Governor's emergency proclamation, to regulate the distribution of energy supplies.	1986	IEDA, IDALS	biofuels	All sectors	Regulation	Iowa Code §§473.8-10			
26	Emergency regulation waivers	The Governor may waive the hours of service requirements for truck drivers in case of an emergency, such as a propane or liquid fuel shortage or pipeline disruption. The decision must be made in consultation with IDALS and other agencies. Also, the Governor may waive air quality regulations preventing older generators from being used in case of an emergency. The decision must be made in consultation with others, including U.S. EPA.	1981	Governor's Office, in consultation with IDALS and other agencies.	Biofuels	All sectors	Regulation	Iowa Code §29C.6			
27	Utility Energy Efficiency Standard	The IUB approves and oversees electric and natural gas energy savings standards for rate-regulated utilities. Municipal and cooperative utilities file energy efficiency plans. All utilities submit annual reports to the IUB. Iowa Code § 476.63 requires consultation with IEDA.	Various	Iowa Utilities Board	Various energy efficiency measures	All utilities	Energy Efficiency Standard	Iowa Code §§ 476.6 (13, 17)	199 IAC Chapters 35 and 36		

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
28	Building Energy Code	The State Building Code Commissioner adopts rules via the Building Code Advisory Council and in consultation with the Economic Development Authority. Effective June 1, 2014, the 2012 International Energy Conservation Code (IECC) was adopted as the code for commercial and residential buildings with some amendments. Iowa is in the process of considering adoption of the 2015 IECC.	IA Code: 2006 2012 IECC adopted in 2014.	Iowa State Building Commissioner	n/a	Residential, Commercial	Building Energy Code	Iowa §§ Code 103A et seq.			IA Department of Public Safety's Building Energy Codes Summary
29	Building Energy Management Program and Fund	IEDA provides technical assistance and financing to state and local government, schools, and nonprofits to help them reduce energy consumption or costs or use renewable and alternative energy.	1986	IEDA	Solar, Wind, Hydroelectric, Biomass, Municipal Solid Waste, Landfill Gas, Anaerobic Digestion, CHP, Hydrogen	State Government	Regulation, Loan Program	Iowa Code §§ 473.19, 473.19A			
30	B3 Public Building Benchmarking Program	A voluntary program that aims to identify buildings that are the best candidates for energy audit investigations and cost-effective improvements and to manage energy consumption over time. Currently, the program serves over 2000 public buildings in Iowa cities, counties, public schools, community colleges, higher education, and state agencies	2011	IEDA	Energy efficiency	Public Buildings				ARRA	
31	Weatherization Assistance Program	The Iowa Department of Human Rights administers federal funds and funding from utilities to local agencies who provide weatherization services, training and guidance.	1980	Iowa Department of Human Rights	Energy efficiency	Residential	Assistance Program				Iowa Dept of Human Rights WAP Summary
32	Low-Income Home Energy Assistance Program (LIHEAP)	Iowa allows 15% of federal LIHEAP funds to be used for weatherization.	1981	Iowa Department of Human Rights	n/a	Residential Customers	Assistance Program				IA Department of Human Rights LIHEAP Summary Page

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33	Energy efficient lighting requirement	All public utility owned exterior flood lighting shall be as energy efficient as high pressure sodium lighting or better.	1989	Iowa Utilities Board		Public Utilities	Regulation	Iowa Code § 476.62	199 IAC 36.8		
34	Purchasing requirements for energy-consuming products	Life cycle cost and energy efficiency must be included in purchasing criteria for the Department of Administrative Services and institutions under the control of the Board of Regents, IA Department of Transportation, Department for the Blind, and other state agencies.	2003	Dept. of Administrative Services, Board of Regents, Dept. of Transportation, Dept. for the Blind	n/a	State Government	Regulation	Iowa Code § 8A.311(19)			
35	Qualified Allocation Plan for LIHTC Properties	Iowa's Finance Authority allocates Low Income Housing Tax Credits using criteria in its Qualified Allocation Plan (QAP), which is updated annually. Iowa's QAP includes a number of criteria intended to improve the energy efficiency of affordable housing.	2015	Iowa Finance Authority	Energy efficiency	Affordable Housing Developers	Regulation			Final 2016 IA QAP	
36.1	Peak Load Energy Conservation	The IUB is allowed to promulgate rules to require or authorize a public utility to establish peak load management procedures.		Iowa Utilities Board	n/a	Public Utilities	Regulation	Iowa Code § 476.17	199 IAC 20.11		
36.2	Customer notification of peaks in electricity demand	Electric utilities must formulate and implement plans, educate customers, and report on efforts to reduce peak demand.	5/20/15	Iowa Utilities Board	n/a	Utilities	Regulation	Iowa Code § 476.17	199 IAC 20.11		
37	Energy City Designation Program	IEDA can designate Energy Cities as a means of encouraging cities to develop and implement innovative energy efficiency programs.	2007	IEDA	Various energy efficiency measures	State Government	Regulation	Iowa Code § 473.41			
38	Performance Contracting	At a minimum, it is not clear that Iowa's procurement laws allow its state agencies to use performance contracting for energy efficiency projects.	Various	Department of Administrative Services	n/a	State agencies	Regulation		11 IAC 117-120		

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39	On-Bill Financing (OBF)	No statewide legislation exists to require or otherwise structure an OBF program; however certain utilities are implementing on their own. Iowa code 476.6 gives the IUB the authority to require regulated utilities to offer financing for cost-effective energy efficiency improvements	Bloomfield Pilot implemented 10/7/2015	Currently: Utilities; Future: Iowa Utilities Board	Energy efficiency	All Customers	Financing	Iowa Code §476.6			
40.1	Electric transmission lines	Iowa's Code and Administrative rules contain provisions for the ownership and construction of electric transmission lines, with particular provisions related to crossing railroads and roads and eminent domain.	Various	Iowa Utilities Board	n/a	Utilities	Regulation	Iowa Code §§ 478.1 et seq	199 IAC 11 et seq.		
40.2	Eminent Domain for electric transmission	Takings under eminent domain require a public hearing with written notice prescribed by the IUB. The IUB grants powers of condemnation as needed when granting a franchise. There are restrictions on condemning homestead sites, cemeteries, orchards, and schoolhouses for purposes of erecting electric substations. If unused, the right of way reverts to the owner of the property from which the right of way was taken.	2000	Iowa Utilities Board	n/a	Utilities	Regulation	Iowa Code §478.6, §478.15			
41.1	Pipelines and underground natural gas storage	Pipelines and Underground gas storage in Iowa are regulated by the IUB. The IUB must approve construction and land restoration and oversees safety conditions of these facilities. The IUB also may grant imminent domain rights in a process similar to electric transmission lines.	1988	Iowa Utilities Board	n/a	Natural Gas Suppliers	Regulation	Iowa Code §§ 479.1 et seq			
41.2	Eminent Domain for natural gas pipelines	The IUB may grant imminent domain rights in a process similar to electric transmission lines.	1995	Iowa Utilities Board	n/a	Natural Gas Suppliers	Regulation	Iowa Code § 479.24			
42	Interstate natural gas pipelines	The IUB may act as agent for the federal government in determining compliance with interstate natural gas pipeline standards within the boundaries of Iowa.	2005	Iowa Utilities Board	n/a	Interstate Natural Gas Pipelines	Regulation	Iowa Code §§ 479A.1 et seq			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
43.1	Hazardous Liquid Pipelines and Storage Facilities	Hazardous liquids are defined to include various petroleum products, coal slurries, anhydrous ammonia, liquid fertilizers, and liquefied carbon dioxide. Hazardous Liquids Pipelines and Underground gas storage in Iowa are regulated by the IUB. The IUB must approve construction and oversees safety conditions of these facilities. The IUB also may grant imminent domain rights in a process similar to electric transmission lines.	1995	Iowa Utilities Board	n/a	Hazardous Liquid Pipelines	Regulation	Iowa Code §§ 479B.1 et seq	199 IAC 13.1 et seq		
43.2	Eminent Domain for hazardous liquid pipelines	The IUB also may grant imminent domain rights for hazardous liquids pipelines in a process similar to electric transmission lines.	1995	Iowa Utilities Board	n/a	Hazardous Liquid Pipelines	Regulation	Iowa Code §479B.16			
44	Sovereign Lands Permitting Authority	The Iowa DNR is responsible to manage construction activities on state-owned or –managed lands, and may grant easements to utilities.	Various	Department of Natural Resources	n/a	Utilities, Pipeline Developers	Regulation	Iowa Code §§461A.4, 461A.25			
45	State Revolving Fund	The Fund provides financial assistance to public water systems (Drinking Water Revolving Loan Fund) and wastewater systems (Clean Water Revolving Loan Fund) for the design and construction of facilities to ensure public health and the provision of safe and adequate drinking water.	1988	Department of Natural Resources	n/a	Various	Regulation	Iowa Code §§455B.291-299	567 IAC 44	Clean Water Act	

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
46	Water Permitting (Ethanol Plants)	Permits required include those for water withdrawal, well siting and construction, water treatment plant construction and water system operation. Additionally, an operator of the system must meet state certification requirements. Well siting requires an on-site survey of the area, which can take 1-2 weeks. The water withdrawal permit requires 45 to 60 days, because public notification is required during that permitting process. Once the design and specifications of the project (including a completed viability assessment) are submitted by a professional engineer licensed in Iowa, the construction permit is routinely issued within 1-2 weeks. After the system is constructed and inspected, the operation permit is typically issued within 1-2 weeks.	1985; various additions & updates	Department of Natural Resources	Ethanol	Manufacturing	Regulation	Iowa Code 455B.263	567 IAC 52.10		Water Rights & Planning Allocation - 2010
47	Renewable Chemical Production Tax Credit	A 5 cent per pound tax credit designed to encourage producers of ethanol and biodiesel to invest in new technology to extract chemicals from biomass for use in consumer products. An eligible business that has been operation in Iowa for <5 years would could claim a max credit of $1 million. For eligible businesses in operation in the state for > 5 years, the max credit would be $500,000. The legislation specifies no more than $10 million would be allocated to the incentive program in each fiscal year.	April 6, 2016	IEDA	Biochemicals	Renewable Chemical Producers	Tax Credit			SF 2300	
48	Life Cycle Cost Analysis of Public Facilities	Life cycle cost analysis is required in the design phase of construction or renovation of state facilities and must include energy use analysis.	1/1/80	Agency responsible for construction	n/a	State Government	Regulation	Iowa Code §§ 470.1, et. seq.			
49	Physical plant and equipment local levy (PPEL)	The school board may annually certify a regular PPEL in an amount up to 33 cents per thousand dollars of assessed valuation. Voters may authorize a PPEL for a period not exceeding ten years and in an amount not exceeding $1.34 per thousand dollars of assessed valuation.		Department of Education	n/a	Schools	Financing	Iowa Code §298.2-3	IAC Chapters 281-98		

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50	Professional licensing	The State Division of Banking's Professional Licensing Division provides administrative assistance to Boards that control licensing and continuing education requirements of architects, engineers, landscape architects, and real estate appraisers.	Various	Division of Banking	n/a	All sectors	Other		193 IAC 1		
51	Commissions on under-served populations	The Department of Human Rights hosts the following Commissions, who have an interest in energy issues: Commission on the Status of African-Americans, Commission of Asian and Pacific-Islander Affairs, Commission of Deaf Services, Latino Affairs Commission, Commission of Persons with Disabilities, Commission of Native American Affairs, Commission on the Status of Women.	Various	Department of Human Rights	n/a	All sectors	Other				Links to Commission web pages
52	Wildlife takings	The DNR is responsible for regulating takings of threatened and endangered species and other wildlife, including migratory waterfowl, under a variety of state and federal laws. This could affect any siting of energy-related infrastructure, both above and below ground.	Various	Department of Natural Resources	n/a	Utilities, Pipeline Developers	Regulation	Iowa Code §§481A et seq.; Iowa Code §§481B et seq.		Federal Migratory Bird Treaty Act, Endangered Species Act, and Bald Eagle and Golden Eagle Protection Act	
53	Decorative gas lamps	Prohibition against selling decorative gas lamps made before Dec. 31, 1978. Also required an IUB determination that sale was in public interest.	1989	Iowa Utilities Board	n/a	Natural gas suppliers	Regulation	Iowa Code § 478A.7			
54	Assigned Service Territories	The IUB may establish exclusive service territories for electric utilities.	5/30/05	Iowa Utilities Board	n/a	All sectors	Regulation	Iowa Code § 476.25			

Table 2. Federal Energy-Related Policies and Programs

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
1	Clean Power Plan	Establishes state specific interim (2022-2029) and final (2030) emissions reductions goals. Iowa's final goal is 1,283 pounds per MWh. The goals can be achieved via a rate or mass-based compliance plan.	Enacted 2015; Effective 2022	U.S. EPA & Iowa DNR	All	Electric-generating units	Regulation	TBD	Clean Air Act Section 111(d)	CPP Final Rule	U.S. EPA Clean Air Act Summary Page
2	Green Banks Program	Less of a specific program than an initiative, the U.S. Department of Energy (DOE) released a report in December 2015 highlighting Green Bank activities in certain states to illustrate the benefits. DOE plans to launch a webinar series & provide additional resources to assist states in developing Green Banks in 2016. The Global Green Banks Network was announced at COP21	12/7/15; 2016	U.S. DOE	All		Financing				DOE Energy Investment Partnerships
3	Renewable Electricity Production Tax Credit	The federal renewable electricity production tax credit is a per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources.	1992 (enacted). Extended multiple times. Now expires 1/1/17.	Internal Revenue Service	Wind, Geothermal, Biomass, Hydroelectric, Landfill Gas, Waste to energy, Energy efficiency	Commercial, Industrial	Tax Credit				US Department of Energy PTC Summary Page
4.1	Business Energy Investment Tax Credit	30% tax credit for solar, fuel cells, small wind; 10% for geothermal, micro turbines and CHP.	2013 / Extended through 2016	Internal Revenue Service	Solar, Fuel Cells, Wind, Geothermal, CHP	Commercial, Industrial, Utility, Agricultural	Tax Credit	26 USC 48			
4.2	Residential Renewable Energy Tax Credit	A taxpayer may claim a credit of 30% of cost for system serving a dwelling in the U.S.	2005 / Expires 12/31/16.	Internal Revenue Service	Solar, Wind, Geothermal	Residential	Tax Credit	26 USC 25D			US Department of Energy Residential Renewable Energy Tax Credit Summary

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
5	Rural Energy for America Program (REAP)	REAP provides financial assistance to agricultural producers and rural small businesses in rural America to purchase, install, and construct renewable energy systems, make energy efficiency improvements to non-residential buildings and facilities, use renewable technologies that reduce energy consumption, and participate in energy audits and renewable energy development assistance. These grants are limited to 25% of a proposed project's cost, and a loan guarantee may not exceed $25 million. The combined amount of a grant and loan guarantee must be at least $5,000 (with the grant portion at least $1,500) and may not exceed 75% of the project's cost. In general, a minimum of 20% of the funds available for these incentives will be dedicated to grants of $20,000 or less. In 2015, a total of $63 million in grants and loans was awarded.	2003	U.S. Department of Agriculture	Solar, Wind, Hydro, Geothermal, Anaerobic digestion, Fuel cells, Microturbines, Energy efficiency	Commercial, Government, Agricultural, Institutional	Grant Program	7 USC § 8107		H.R. 8 (American Taxpayer Relief Act of 2012)	
6	Energy Audit and Renewable Energy Development Assistance (EA/REDA) Program	The REAP EA/REDA Program provides assistance to agricultural producers and rural small businesses for energy audits and renewable energy technical assistance including renewable energy site assessments. Applicants must submit separate applications for assistance, limited to one energy audit and one REDA per fiscal year. The maximum aggregate amount of an energy audit and REDA grant in a Federal fiscal year* is $100,000. In 2015, $2 Million in EA/REDA grant funding is available.	Enacted 2/7/2014; Effective 2015	U.S. Department of Agriculture	n/a	Government, Schools, Agricultural, Institutional, Rural electric co-ops	Grant Program	7 USC § 8107	Agricultural Act of 2014 (Public Law No. 113-79)	H.R. 8 (American Taxpayer Relief Act of 2012)	USDA REDA

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
7	Qualified Energy Conservation Bonds	Taxable bonds issued by State or local units of government for certain "qualified conservation purposes" which include expenditures for: (i) reducing energy consumption in publicly-owned buildings by at least 20%, implementing green community programs, the production of electricity from renewable energy resources in rural areas, certain qualified facilities for electricity produced from renewables (wind, biomass, solar, landfill); (ii) research to develop cellulosic ethanol or non-fossil fuels, carbon capture and sequestration, increased efficiency of fossil fuel production, auto battery technology, energy reduction in buildings; (iii) mass commuting facilities; (iv) demonstration projects to commercialize green building technology, conversion of agricultural waste, advanced battery manufacturing, technologies to reduce peak demand; and (v) public education to promote efficiency	2008	Internal Revenue Service; Iowa Finance Authority	Solar, Wind, Biomass, Geothermal, Hydroelectric, Solid Waste, Landfill Gas, Anaerobic Digestion; Energy efficiency	State Government; Local Government	Loan Program		Iowa Executive Order 27	IRS Notice 2012-44	US DOE QECB Primer
8	Renewable Fuel Standard (RFS)	The RFS is a national policy with the goal of replacing the current amount of petroleum-based transportation fuel, heating oil, and jet fuel with renewable fuels. The long-term goal of RFS is the production of 36 billion gallons of fuel. The current authorization of RFS extends fuel production goals through 2017. Obligated parties are refiners and importers of gasoline or diesel fuel. Compliance is achieved by blending biodiesels/biofuels with standard diesel, or by obtaining credits to fulfill the Renewable Volume Obligation. A Renewable ID Number is generated when a producer makes a gallon of renewable fuel, can be assigned to a specific batch of fuel, and can be traded to meet compliance	2005	U.S. EPA, USDA, DOE	Biomass, Cellulosic Biofuel, Advanced biofuel, Renewable fuels	Commercial, Industrial	Regulation			Energy Policy Act of 2005; CAA; EISA	
9	Corporate Average Fuel Economy (CAFE) Standards	Requires automakers to meet sales-weighted average fuel economy for their new vehicle fleet each year.	1975	U.S. EPA; U.S. DOT	n/a	Automakers	Regulation	49 USC 32902			U.S. DOT Summary of CAFE Proposals

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
10	Biorefinery Assistance Program	USDA Rural Development is offering loan guarantees for the development, construction, and retrofitting of commercial-scale biorefineries. Eligible borrowers include individuals, entities, Indian tribes, state or local governments, corporations, farm cooperatives or farm cooperative organizations, associations of agricultural producers, National Laboratories, institutions of higher education, rural electric cooperatives, public power entities, and consortium of any of these types of entities. Financed entities must provide at least 20% of the financing for eligible project costs, and applications for funding must include an independent feasibility study and technical assessment. Eligible project costs include the purchase and installation of equipment, construction or retrofitting costs, permit and licensing fees, working capital, land acquisition, and the costs of financing.	2009	U.S. Department of Agriculture	Biomass, Biofuels, Solid waste, Landfill gas, Renewable chemicals	Commercial, Construction, Utilities, Government, Agricultural, Institutional	Loan Program	7 USC § 8103	7 CFR 4279, Subpart C	H.R. 8 (American Taxpayer Relief Act of 2012)	
11	Repowering Assistance Biorefinery Program	The Repowering Assistance Program provides payments to eligible biorefineries to replace fossil fuels used to produce heat or power to operate the biorefineries with renewable biomass. Reimbursement payments are provided to offset a portion of the costs associated with the conversion of existing fossil fuel systems to renewable biomass fuel systems. Up to 90% of the funds can be utilized during project construction, with the remaining 10% made upon demonstration of successful completion of the project. A maximum of 50% of the total project costs can be reimbursed.	3/14/11	U.S. Department of Agriculture	Biomass, Solid Waste, CHP	Commercial, Construction, Utilities, Government, Agricultural, Institutional	Grant Program	7 USC § 8104		H.R. 8 (American Taxpayer Relief Act of 2012)	USDA Repowering Assistance Program
12	Appliance and Equipment Standards	Provides efficiency standards for over 50 categories of appliances and equipment. Products covered by standards represent about 90% of home energy use, 60% of commercial building use, and 29% of industrial energy use.	1975; various dates for each individual standard.	U.S. DOE	n/a	Appliance and equipment manufacturers	Regulation	42 USC 691 et seq.			U.S. DOE Appliance Standards Program

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
13	Fannie Mae Green Initiative	The Fannie Mae Green Initiative provides owners of multifamily properties (5 or more units) with financing solutions and tools to make smart energy- and water-saving property improvements. Its green financing programs include Green Rewards, Green Preservation Plus, and the Green Building Certification Pricing Break, all of which are eligible for a 10 basis points (0.1%) reduction in the all-in interest rate. All Fannie Mae green loans are securitized as Green Mortgage Backed Securities (Green MBS).	2011, 2015	Fannie Mae	Energy efficiency	Multifamily Residential	Loan Program				FannieMae Multifamily Green Initiative
14	Clean Air Act	The Clean Air Act is a landmark law intended to improve and protect air quality in the U.S. Many of the federal rules located elsewhere within this assessment implement the Clean Air Act.	Enacted 1970; Revised 1977 and 1990.	U.S. EPA	n/a	Electric generation	Regulation	Title 42, Ch. 85 U.S. Code			http://epa.gov/air/caa/pdfs/CAA_Nutshell.pdf
15.1	Clean Water Act	The Clean Water Act is a landmark law intended to improve and protect water quality in the U.S. It establishes the basic structure for regulating discharges of pollutants into public waterways.	1972	U.S. EPA	n/a	State government; Electric generation; Water utilities	Regulation	33 USC 1251 et seq.			US EPA Clean Water Act Summary
15.2	Steam Electric Power Generating Effluent Standards	The standards address wastewater discharges from power plants operating as utilities.	1974. Amended multiple times, most recently with a final rule published 11/3/15.	U.S. EPA	n/a	Electric generation		40 CFR 423			US EPA Steam Effluent Guidelines Summary Page
16	Mercury and Air Toxics Standards (MATS)	MATS limits mercury, acid gases and other toxic emissions from power plants of 25 MW or greater.	2011; 2014	U.S. EPA	n/a	Electric generation	Regulation		MATS rule 40 CFR 60 and 63	US EPA MATS Rule Summary	
17	National Environmental Policy Act (NEPA)	Major projects that are performed by a federal agency, receives federal funding, or is subject to federal permitting, are subject to the requirements of the NEPA. Proposed projects must be evaluated based on the need; possible adverse economic, social, and environmental impacts; and governmental environmental goals.	1969	U.S. Council on Environmental Quality; Agencies Implementing Covered Projects	n/a	All	Regulation	42 USC 4321			

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
18	Carbon Pollution Standards for New, Modified and Reconstructed Power Plants	Amends the electric generating units New Source Performance Standards for modified and reconstructed facilities for greenhouse gas under Clean Air Act section 111(b). Proposes standards to limit emissions of carbon dioxide from affected modified and reconstructed electric utility steam generating units and from natural gas-fired stationary combustion turbines. Natural gas-fired stationary combustion turbines that supply less than one-third of their potential electric output to the grid are not subject to the rule.	2015	U.S. EPA	n/a	Electric generation	Regulation		40 CFR Parts 60, 70, 71 et al		US EPA Summary Page
19.1	National Ambient Air Quality Standards (NAAQS)	The NAAQS apply to air quality in communities, which are determined to either an attainment area (within the air quality limits) or nonattainment area.	1971. Proposed ozone standards revision November 2014. Revised nonattainment area designations expected to be finalized in 2017.	U.S. EPA	n/a	Electric generation	Regulation		40 CFR 50 NAAQS	US EPA NAAQS Rule Summary	
19.2	Cross State Air Pollution Rule (CSAPR)	This rule requires states to reduce power plant emissions that contribute to ozone and/or fine particle pollution in other states.	2011 / 2015	U.S. EPA	n/a	Electric generation	Regulation				US EPA CSAPR Summary
20.1	Resource Conservation and Recovery Act (RCRA)	RCRA regulates solid waste, underground storage tanks, and hazardous waste.	1976; Amended 1984.	U.S. EPA	n/a	Utilities	Regulation	40 USC 239-282		US EPA RCRA Summary Page	
20.2	Coal Ash Rules	Comprehensive requirements for the safe disposal of coal combustion residuals, commonly known as coal ash.	2014	U.S. EPA	n/a	Electric Generation	Regulation		40 CFR 257, 261		US EPA Coal Ash Rule Summary

No.	Policy Name	Description / Highlights	Date of Enactment / Effectiveness	Responsible Agency	Eligible Technologies	Applicable Sectors	Policy Type	Authority (Statute)	Authority (Rule)	Authority (Other)	Active Docket or Program Website
21	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Established Superfund and provided Federal authority to respond to contamination by hazardous chemicals that endanger public health.	1980; Amended 1986.	U.S. EPA	n/a	Federal Government; Industrial Customers; Electric and Natural Gas Utilities	Regulation				US EPA CERCLA Summary
22	Combined Heat and Power (Executive Order)	Calls for increased coordination among federal agencies to promote CHP deployment. Sets a goal of 40 GW of new CHP capacity by 2020.	2012	U.S. EPA; U.S. Dept. of Commerce; U.S. Dept. of Agriculture; U.S. Dept. of Energy	Electric cogeneration facilities	Federal Government; Industrial Customers	Regulation			Executive Order	
23	Congestion Mitigation and Air Quality program (CMAQ)	CMAQ funds surface transportation improvements designed to improve congestion and air quality.		U.S. Department of Transportation	n/a	n/a	Regulation				
24	Low-Income Home Energy Assistance Program (LIHEAP) (Federal)	The federal LIHEAP provides funding to states to administer financial assistance programs for utility customers.	1981	U.S. Dept. of Health and Human Services; Missouri Dept. of Social Services	n/a	Low-income households	Assistance Program	2 USC 8621-8630			US HHS LIHEAP Program website
25	Public Utility Regulatory Practices Act (PURPA)	PURPA includes sections that encourage energy conservation and use of domestic energy supply, among other items.	1978	Implementation left to states	n/a	Electricity	Regulation	Pub. L. 95-617			

IOWA ENERGY PLAN

APPENDIX G:
Iowa Energy Research and Development Core Competencies and Opportunities for Energy-Based Economic Development

Collaborate locally.
Grow sustainably.
Lead nationally.

IOWA ENERGY PLAN IS A JOINT INITIATIVE BETWEEN

Prepared by TEConomy Partners, LLC.

July 20, 2016

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I. INTRODUCTION

Like food and clean water, energy tends to be taken for granted in modern developed societies. We come home, flip a switch and our lights come on. If it is hot or cold outside our HVAC system cools or heats our home or workplace. We turn the ignition key in our car and a battery cranks the starter motor and fuel is injected to power combustion in our automobiles and trucks. We need to travel long distances, and jet engines make that a reality. We need to communicate locally and globally and our electronic devices operating over powered networks and the Internet provides the immediate means to do so. We want to be entertained, so we turn on the TV or our home entertainment system. And so it goes… for almost each and every one of us, at any given time in our lives we are consuming energy while giving little thought to where it comes from and how it gets to us.

It is probably fair to say that most of us give little consideration to energy until: we need to find a place to recharge our phone; a storm knocks our power out temporarily; we need to refill the tank in our car, or it is time to pay the electric or gas bill at the end of the month. What we seldom or ever pay attention to is the vast and hugely complex global and domestic web of infrastructure, networks and systems that surround us every day, moving liquid fuels, gases and electricity from one location to another to meet the needs of individuals, communities and industries. In Iowa, as in all of the U.S. and almost all of the world (outside of primitive societies) energy underpins the fabric of the economy and daily life. Its importance is hard to overstate.

While the use of natural gas, petroleum and electricity has been a ubiquitous part of society and modern economies for more than a century now, they are resources affected by current dynamic forces. Fossil fuel resources are not distributed evenly across the globe, and the geopolitical actions of the locations that produce these fuels very much influence the economies of those that do not. Renewable energy generation potentials are also unevenly distributed, dependent on geographic variations in wind, sunlight, water flow, or the biomass production capacity of the land. Global population growth and rising income levels are such that demand for energy are projected to rise substantially throughout the rest of this century. Worldwide population is projected to increase from 7 billion people in 2010 to 9.3 billion by 2030 (an increase of 2.3 billion, equivalent to doubling the entire current population of China and India). Competition for energy resources and demand for new energy technologies will present both threats and opportunities moving forward. In addition, widespread concern over atmospheric carbon levels and associated effects on climate represent a further dynamic that is having substantial effects on energy markets and the development of alternative technologies.

Energy has become, and will continue to be, a defining challenge for the World and the United States—economically, strategically and environmentally. Every state in the nation needs to be paying attention to its strengths, weaknesses, opportunities and threats in relation to the energy economy. The status quo for energy cannot be taken for granted. Change is upon us and those states and regions that understand, embrace and take advantage of the opportunities that come with change will be well positioned for economic advantage and growth.

Iowa is one of the U.S. states that has staked-out an early leadership role in the new energy economy. Iowa has a limited and low-quality fossil fuel resource base, and thus has historically been highly dependent on power generated from imported fossil fuels. Within the past decade, however, investment in renewable fuels, most notably in wind-power generation and biofuel production, has propelled Iowa to a leadership position in renewable energy production and know-how in these production technologies. The opportunity is for Iowa to further build on its renewable power deployment momentum AND to further its focus on technology-based economic development through innovation and early adoption of new, fast-growth energy technologies. Recognizing the opportunities ahead for Iowa, the State of Iowa, led by the Iowa Economic Development Authority [IEDA] and the Iowa Department of Transportation [DOT], initiated a formal planning process, the Iowa Energy Plan, to guide statewide energy development based on well-researched analysis of opportunities and the input of key stakeholders across the state.

What would an ideal Iowa Energy System and Energy Economy look like? Ideally it would follow these guiding principles:

- 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.
- Seek diversity in the resources that supply energy to and within Iowa.
- Support alternative energy resources, technology, and fuel commercialization in proven, cost-effective applications.
- Encourage sector-based workforce

Iowa is particularly well positioned to lead in the emerging new energy economy. Home to a major federally-funded national energy laboratory (Ames Lab) and research universities engaged in varied energy research there is significant energy R&D activity in the region. A substantial base of energy industry activity also exists in the state—with not only the activities of a diverse base of utilities (investor-owned, rural cooperatives and municipal-owned) but also an expanding base of companies engaged in the development and manufacturing of power generation systems, components and materials, and in products and services related to energy efficiency. Iowa's early leadership position in the production of biofuels and wind-power, provides a proven base of capability and achievement upon which to further build.

This report and additional TEConomy-produced Iowa Energy Plan white papers seek to:

- Identify trends likely to effect the impact of energy on the Iowa economy.
- Understand key assets across the energy value chain.
- Identify opportunities to generate technology-based economic development through R&D and commercialization of energy innovations.
- Identify opportunities to conserve energy and reduce any negative externalities associated with energy development, generation or use.
- Develop an integrated strategy to maximize energy-sector benefits for the Iowa economy.

Through the development of the Iowa Energy Plan it is anticipated that the State of Iowa will be able to realize substantial energy-based economic development benefits along multiple pathways (as illustrated on Figure 1).

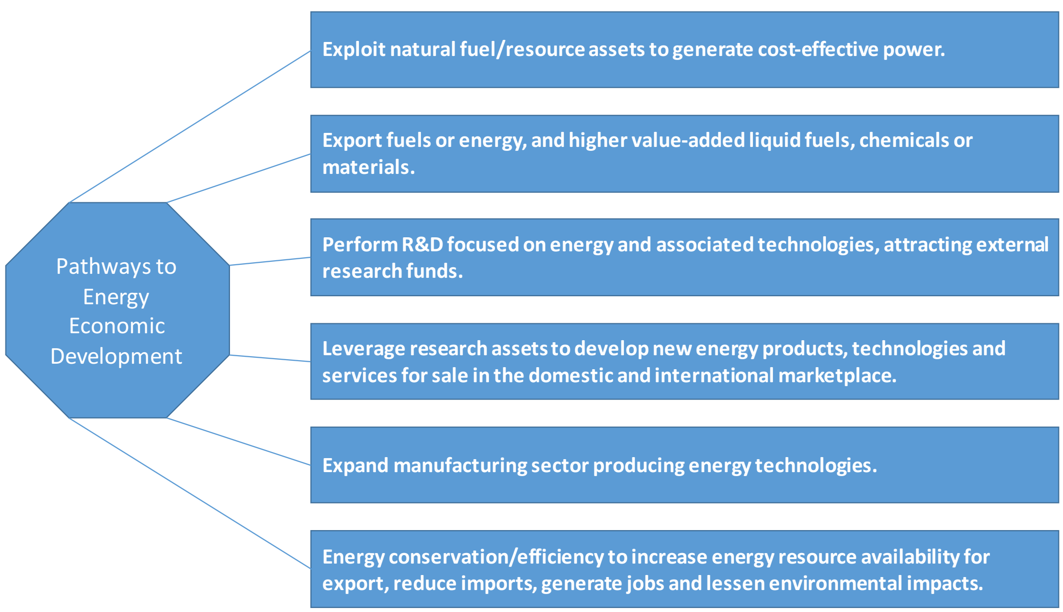


Figure 1. Pathways to Energy-based Economic Development in Iowa

About this Report

This report is part of a series of reports and analysis to inform the development of the full Iowa Energy Plan.

- The first report was titled “White Paper: Preliminary Assessment of Iowa’s Energy Position” and provided statistics on energy supply and consumption trends in the state, and a review of key energy sectors in the state in terms of employment growth and associated economic factors.
- Additional analysis was received through stakeholder interviews to evaluate strengths, weaknesses, opportunities, and threats and organized around each working group classification during the course of the project.

This report incorporates information from the energy position report and SWOT interviews, together with an assessment of R&D competencies in Iowa in relation to energy, to provide a series of recommended “platforms” for Iowa energy-based economic development. A platform represents a major economic development thrust area containing near, mid-term and long-term development opportunities that ideally:

- Have an established or emerging cluster of Iowa businesses with interests in related areas of the energy sector.
- Provide opportunities for ongoing technology, product and service innovations to which Iowa’s commercial, academic and government laboratory research capabilities can be applied.
- Present opportunities for collaborative public/private partnerships to promote shared interests and facilitate the development of a highly favorable operating environment for energy-based economic growth.
- Are associated with a significant potential market with an achievable line-of-sight for the sale of resources, new technologies, services and value-added products.
- Contribute to building and reinforcing key aspects of the “vision and guiding principles” as shown in the text box on page 2.

In examining options for energy-based economic development platforms in Iowa, opportunities across the full energy value chain (Figure 2) have been considered – with the goal being to identify development platforms that serve to reinforce the value-chain, build upon it, and provide ongoing large-scale opportunities for economic growth in Iowa.

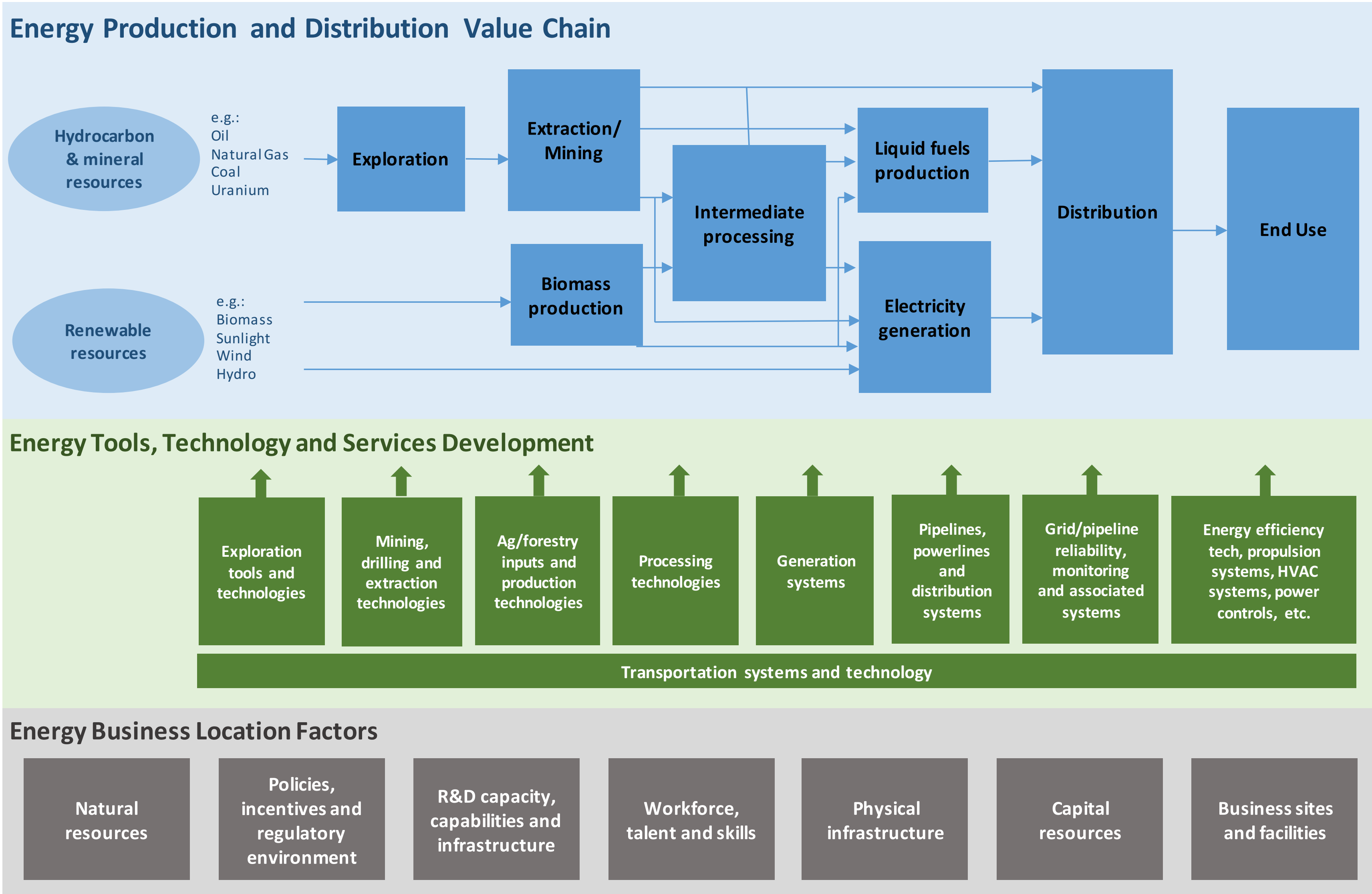


Figure 2. The Energy Value-Chain, Associated Technology Areas and Key Location Factors Impacting Value-Chain Development

II. RESEARCH & DEVELOPMENT (R&D) CORE COMPETENCIES

In today's global knowledge-based economy, competitive advantage is best achieved in an environment that proactively stimulates innovation, knowledge transfer and technology commercialization. Michael Best, a leading scholar of growth and development across regions notes in *The New Competitive Advantage*:[1]

> *Regions can be thought of as developing specialized and distinctive technology capabilities, which give them unique global market opportunities. The successful pursuit of these market opportunities in turn reinforces and advances their unique technological capabilities. Regional specialization results from cumulative technological capability development and the unique combinations and patterns of intra- and inter-firm dynamics that underlie enterprise and regional specialization.*

One of the key elements for creating the potential for technology-based development (including energy-based economic development) is an analysis of the existing research and innovation competencies found within innovation clusters. Within Iowa, in the energy sector as broadly defined, there are multiple organizations and R&D entities with capabilities upon which future economic advances may be built. These include industry R&D groups, higher education, the Ames National Laboratory, and other parties.

Without a strong R&D foundation within universities and research institutions, it is difficult for any state, or nation to initiate or sustain major technology-based industrial development. In the energy technology space it is clear that research universities with engineering colleges, physical sciences research and (increasingly) bio-based product research, are particularly important contributors to basic and applied research in the field, as are, of course, U.S. Department of Energy National Laboratories, such as Ames Lab. Multinational and domestic energy and energy-technology companies also perform very important R&D activities. They are key collaborators for research with other organizations and critical to the commercialization of innovations

Because research is the driving force behind innovation and commercialization in a technology and engineering focused sphere such as energy, and because research core competencies have been shown to be the foundation of technology cluster development, it is imperative that the State of Iowa and key stakeholders in the development of the Iowa Energy Plan have a formal understanding of in-state energy research core competencies. To develop an independent analysis of core

[1] Michael Best. "The New Competitive Advantage: The Renewal of American Industry." Oxford University Press, 2001.

competencies, Iowa retained TEConomy Partners (TEConomy) to perform an independent assessment and evaluation of energy research core competencies and to identify robust energy-based economic development "platforms", with line-of-sight to commercialization and industry relationships.

A. Approach to Identifying Energy R&D Core Competencies

TEConomy identifies research core competencies using both quantitative and qualitative methods.

- Quantitative assessment uses statistical information on extramural grants, publications, and patent activities.
- Qualitative work includes interviews with key administrators, scientists, and researchers across the research drivers found in the R&D-performing institutions.

TEConomy focuses the core competency assessment on the following:

- In which fields of science and technology relevant to energy are the institutions receiving significant levels of funding, especially funding from "gold standard" external sources, such as federal agencies?
- In what energy and associated technology fields do the research institutions demonstrate a substantive and influential record of publication?
- In what energy and associated technology areas are patents and other intellectual property being generated?
- What areas of research are connected to, or have potential for, significant industry relationships?
- What areas of energy research and associated technologies do the subject institutions self-identify as being institutional core competencies and priorities?
- What energy-based economic development opportunities can be identified for Iowa?

Evaluating the answers to these questions, the TEConomy team is able to provide insights into the energy research base, and draw implications as to how these research strengths may best intersect with Iowa's energy industry, associated technological industries and economic base.

Underpinning the successful translation of research strengths into economic development opportunities requires the recognition of the importance of "market-driven" processes (Figure 4). The traditional model of commercialization assumes a "research-driven" pathway. This research-driven commercialization process spans a continuum from basic research leading to a major scientific breakthrough, to applied research leading to product development, and ending with industrial manufacturing and marketing. While that process can and does work in some instances, the shortcomings of the research-driven approach are that it is often divorced from commercialization and product development needs (the voice of the market) and has uncertain line-of-sight to true economic value. The market-driven approach recognizes that commercialization is a highly interactive process involving close ties between research activities and business development activities. Success depends, as the Council on Competitiveness points out, "on a team effort that includes carefully focused research, design for manufacturing, attention to quality and continuous market feedback."[2]

The components of a core competency can ideally bring together basic research, enabling technology, and applied research activities with a "line of sight" that moves seamlessly to address specific needs and market opportunities, and identifies robust technology platforms for generating economic development. Core competency areas that lack this linkage and connection to needs and market opportunities typically offer more limited economic development opportunities.

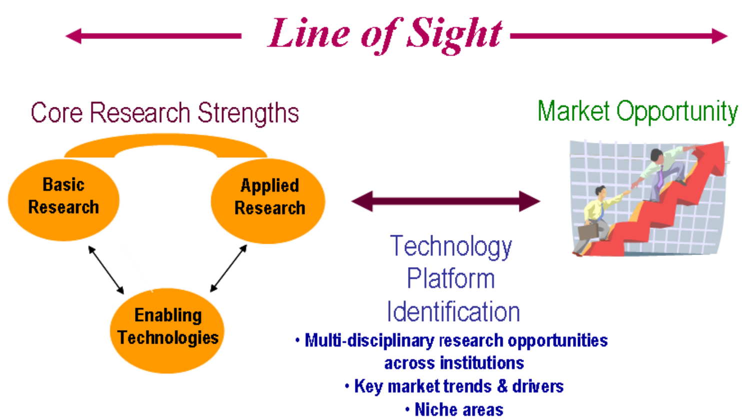


Figure 3. Market Opportunity, Technology Platforms and Core Competency Assessment

Defining Core Competencies

There is no one single source of information that serves to identify core research competencies and focus areas. Rather, a variety of integrated and complementary analyses are required to help identify a state's current position and areas of focus that may lead or contribute to future growth.

In identifying core energy-related research focus areas, TEConomy's objective is to identify those fields where there is a critical mass of activity along with some measure of excellence. This does not mean, however, that other fields of research excellence may not be present within the subject institutions. What it does mean is that these other research strengths are found in relatively limited pockets and so offer more limited opportunities upon which to build—but may still contribute in some manner.

[2] Council on Competitiveness, Picking Up the Pace: The Commercial Challenge to American Innovation (Washington, DC: Council on Competitiveness), pp. 9-10.

Several tests can be used to identify a core competency:

1. Is it a significant source of competitive differentiation? Does it provide the basis for a unique signature?
2. Does it comprise a critical mass of scientists and technologists?
3. Does it transcend a single business? Does it cover a range of businesses, both current and new?
4. Is it challenging for competitors to compete with and imitate?
5. Is there a line-of-sight to knowledge-transfer and commercialization of innovations arising from this R&D focus?

TEConomy's quantitative assessment starts with an in-depth examination of areas of critical mass in energy research and development. This quantitative review uses multiple data resources:

- Analysis of peer reviewed energy-related engineering and science publication statistics
- Analysis of patent/intellectual property generation statistics
- Assessment of SBIR funding and venture funding in associated technology fields in Iowa
- Identification of dedicated university centers or institutes designed to leverage institutionally identified areas of focus and excellence

Core Competencies and State Technology-Based Economic Development

In pursuing future activities, states are learning that research institutions must nurture the development of specialized areas of expertise, or "core competencies". According to Hamel and Prahalad in their widely acclaimed business strategy book, Competing for the Future, "Core competencies are the gateways to future opportunities. Leadership in a core competence represents a potentiality that is released when imaginative new ways of exploiting that core competence are envisioned."

Core competencies are those focused areas where research institutions can bring a critical mass of activity—as measured by research, talent generation, and unique facilities & resources—along with an identified measure of excellence. Also, in the future, it is not just having deep strengths in single disciplines that will matter, but advancing inter-disciplinary fields that can apply technology convergence to addressing key research problems and applications development. As the Chronicle of Higher Education notes, "[interdisciplinary] partnerships are proliferating in academe—and slowly changing the face of science—because they offer the best hope for answering some of the thorniest research subjects."

In addition to the quantitative data, TEConomy Partners personnel also conducted interviews with multiple universities, Ames Lab and industry research leaders to gain additional insights regarding research strengths, opportunities, challenges and future directions. These interviews were supplemented with information from individual researcher and research team web pages and other accessible research resources to add further intelligence to the core competency considerations. TEConomy wishes to thank the participating universities, research institutions and individual researchers who met with the TEConomy analysis team over the course of the project. Institutions, including Iowa Regent Universities and Ames National Laboratory, were extremely helpful in facilitating meetings, hosting TEConomy staff on campus, and providing follow-on information in response to TEConomy inquiries. Similarly, Iowa Energy Plan working group members, together with a broad variety of key energy stakeholder organizations across Iowa contributed substantial information pertaining to research strengths and opportunities within the SWOT interview and worksheet completion process.

B. Core Competencies: Data Findings

1. Publications

Table 1 provides a review of publication data for Iowa institutions for the past five years. Data are provided in the totally energy-focused "Energy and Fuels" category, and for research disciplines that have energy topics contained within their research domain. TEConomy Partners used multiple key search terms to assist in identifying energy-related publishing activity in each of the disciplines – and the results for that search are shown in the column titled "IA Energy Specific Pubs – Key fields". The column to the right, labeled "IA Energy-Related Key Fields, All Pubs" provides the full data for that discipline and it should be noted that many of these publications may not have an energy context. Reflecting this difference, the remaining columns use the "IA Energy Specific Pubs – Key Fields" data as the basis for their calculation.

In the "Energy & Fuels" category, Iowa institutions recorded 468 publications, representing 1.4% of all publications nationally in this field. This is higher than would be expected given that total R&D in Iowa is circa 0.8% of national R&D spending overall. An additional 1,069 publications are captured under other disciplines and flagged by key energy terms. Discipline areas in Iowa in which the publishing shows a high percentage of energy-related publications include "Electrochemistry" (73.6% flagged as energy-related) "Agricultural Engineering" (42.3%), "Chemical Engineering" (37.1%), "Thermodynamics" (37.1%) and "Biotechnology and Applied Microbiology" (19.3%). "Electrical and Electronic Engineering", as would be expected, also has a considerable volume of energy-related publications, with the third highest count of 111 publications over the five-year time period.

Table 1. Iowa Key Energy-Related Research Fields and Comparative Context, 1/2011-3/2016

IA Energy - Key Research Fields	IA Energy Specific Pubs - Key Fields	IA Energy-Related Key Fields, All Pubs	IA Energy Specific Pubs Share of IA Energy Key Field	U.S. Energy-Related Key Fields, All Pubs	IA Energy Key Field Share of U.S. Energy Key Field
Energy & Fuels	468	468	100.0%	32,359	1.4%
Biotechnology & Applied Microbiology	161	833	19.3%	41,331	2.0%
Engineering, Electrical & Electronic	111	1,176	9.4%	129,477	0.9%
Engineering, Chemical	109	294	37.1%	21,270	1.4%
Materials Science, Multidisciplinary	92	972	9.5%	80,614	1.2%
Agricultural Engineering	91	215	42.3%	4,063	5.3%
Chemistry, Physical	80	808	9.9%	62,042	1.3%
Environmental Sciences	80	944	8.5%	56,261	1.7%
Physics, Applied	73	881	8.3%	10,397	8.5%
Chemistry, Multidisciplinary	67	1,555	4.3%	110,954	1.4%
Engineering, Mechanical	47	404	11.6%	33,170	1.2%
Nanoscience & Nanotechnology	43	429	10.0%	44,617	1.0%
Agronomy	40	449	8.9%	10,012	4.5%
Electrochemistry	39	53	73.6%	11,336	0.5%
Thermodynamics	36	97	37.1%	75,788	0.1%

Source: TEConomy Partners analysis of publication data from Thomson Reuters' Web of Science database. Note: Some individual publications can be captured under more than one key research field.

The intensive work of Iowa State University in biofuels and biorenewable processing technologies is evident in the significant number of publications evident in the "Biotechnology & Applied Microbiology", "Chemical Engineering", "Agricultural Engineering" and "Agronomy" fields.

There is also a significant "materials" context evident in these data – not only in terms of "Materials Science" with 92 publications, but also in clearly related areas such as "Nanoscience and Nanotechnology", "Electrochemistry", 'Thermodynamics", and "Applied Physics."

Table 2 shows how Iowa compares to the surrounding Midwest states in the specific "Energy & Fuels" publishing category. It is evident that Iowa performs quite competitively, on a par with Minnesota and Missouri (despite these states being twice the total state population size versus Iowa). Illinois has by far the highest level of publishing in this area, but that is not surprising given both the size of the state and it being home to two DoE national laboratories, the Fermi National Accelerator

Laboratory and Argonne National Laboratory, and multiple Tier 1 research universities. Wisconsin also has a considerably higher volume of publishing in energy and fuels areas than does Iowa.

Table 2. Iowa and Benchmark States Energy & Fuels Research Publications, 1/2011-3/2016

State	Number of Publications
Iowa	**468**
Illinois	1,804
Wisconsin	662
Minnesota	483
Missouri	435
Nebraska	232
South Dakota	206

Source: TEConomy Partners analysis of publication data from Thomson Reuters' Web of Science database.

Further insight as to the nature of important energy-related research taking place in Iowa is provided by reference to the most influential energy publications (as measured by citations) produced by one or more Iowa authors in the past five years. Table 3 lists those paper titles that have received 40 or more citations. Among these 15 high citation impact papers, the Iowa expertise in biorenewable at Iowa State University is evident, with 11 of the 15 papers focused on biorenewables subject matter.

Table 3. Most Cited (40+ Citations) Energy-Related Publications by Iowa Institutional Authors, 1/2011-3/2016

Publication Title	Journal Title	Author(s) Institution	Year	Times Cited	Fields of Research
Biochar and its effects on plant productivity and nutrient cycling: a meta-analysis	GLOBAL CHANGE BIOLOGY BIOENERGY	Iowa State University	2013	122	Agronomy; Biotechnology & Applied Microbiology; Energy & Fuels
Thermopower enhancement in conducting polymer nanocomposites via carrier energy scattering at the organic-inorganic semiconductor interface	ENERGY & ENVIRONMENTAL SCIENCE	Iowa State University	2012	82	Chemistry, Multidisciplinary; Energy & Fuels; Engineering, Chemical; Environmental Sciences
Second generation biofuels: Economics and policies	ENERGY POLICY	Iowa State University	2011	77	Energy & Fuels; Environmental Sciences; Environmental Studies
Effects of torrefaction process parameters on biomass feedstock upgrading	FUEL	Iowa State University	2012	74	Energy & Fuels; Engineering, Chemical
The prediction and diagnosis of wind turbine faults	RENEWABLE ENERGY	University of Iowa	2011	70	Energy & Fuels
Distinguishing primary and secondary reactions of cellulose pyrolysis	BIORESOURCE TECHNOLOGY	Iowa State University	2011	66	Agricultural Engineering; Biotechnology & Applied Microbiology; Energy & Fuels
Criteria to Select Biochars for Field Studies based on Biochar Chemical Properties	BIOENERGY RESEARCH	Iowa State University	2011	62	Energy & Fuels; Environmental Sciences
All-conjugated poly(3-alkylthiophene) diblock copolymer-based bulk heterojunction solar cells with controlled molecular organization and nanoscale morphology	ENERGY & ENVIRONMENTAL SCIENCE	Iowa State University	2011	62	Chemistry, Multidisciplinary; Energy & Fuels; Engineering, Chemical; Environmental Sciences
A review of cellulosic biofuel commercial-scale projects in the United States	BIOFUELS BIOPRODUCTS & BIOREFINING	Iowa State University	2013	55	Biotechnology & Applied Microbiology; Energy & Fuels
Estimating profitability of two biochar production scenarios: slow pyrolysis vs fast pyrolysis	BIOFUELS BIOPRODUCTS & BIOREFINING	Iowa State University	2011	55	Biotechnology & Applied Microbiology; Energy & Fuels
A review of cleaning technologies for biomass-derived syngas	BIOMASS & BIOENERGY	Iowa State University	2013	50	Agricultural Engineering; Biotechnology & Applied Microbiology; Energy & Fuels

Publication Title	Journal Title	Author(s) Institution	Year	Times Cited	Fields of Research
Continuous culture of the microalgae Schizochytrium limacinum on biodiesel-derived crude glycerol for producing docosahexaenoic acid	BIORESOURCE TECHNOLOGY	Iowa State University	2011	48	Agricultural Engineering; Biotechnology & Applied Microbiology; Energy & Fuels
Seasonal dynamics of above- and below-ground biomass and nitrogen partitioning in Miscanthus x giganteus and Panicum virgatum across three growing seasons	GLOBAL CHANGE BIOLOGY BIOENERGY	Iowa State University	2012	46	Agronomy; Biotechnology & Applied Microbiology; Energy & Fuels
Modeling and simulation of compressed air storage in caverns: A case study of the Huntorf plant	APPLIED ENERGY	Iowa State University	2012	45	Energy & Fuels; Engineering, Chemical
Fast pyrolysis of microalgae remnants in a fluidized bed reactor for bio-oil and biochar production	BIORESOURCE TECHNOLOGY	Iowa State University	2013	40	Agricultural Engineering; Biotechnology & Applied Microbiology; Energy & Fuels

Source: TEConomy Partners analysis of publication data from Thomson Reuters' Web of Science database.

National Science Foundation (NSF) funding is one of the gold-standards for academic research and between 2011 and 2015 the NSF shows Iowa institutions receiving 53 awards totaling $36.8 million. 89.4% of the NSF funds were received by Iowa State University (Table 4).

Table 4. NSF Funded Energy-Related Research at Iowa Institutions, 2011-2015

Iowa Institution	Number of Energy-Related Awards	Total, NSF Energy-Related Funding
Coe College	1	$97,010
Eastern Iowa Community College	1	$1,237,526
Indian Hills Community College	2	$653,545
Iowa State University	42	$32,869,669
University of Iowa	6	$1,758,707
University of Northern Iowa	1	$160,015
Grand Total	**53**	**$36,776,472**

Source: TEConomy Partners analysis of NSF grant awards.

A key R&D asset for energy research in Iowa is the U.S. Department of Energy Ames National Laboratory (Ames Lab). At Ames Lab, which is located on the campus of ISU, there are approximately 745 people affiliated with the laboratory either as full- or part-time employees or as Laboratory associates. While one of the smaller national labs, Ames Lab is a specialized center in a number of critically important areas of energy research, including:

- Materials design, synthesis and processing
- Analytical instrumentation design and development
- Materials characterization
- Catalysis
- Computational chemistry
- Condensed matter theory
- Computational materials science
- Materials theory.

Materials for energy applications represent the core of Ames Lab research, and the Lab has world-class materials science research infrastructure and instrumentation for the study, characterization and production of advanced materials.

The Ames Lab also leads the Critical Materials Institute, a DOE Energy Innovation Hub funded at up to $120 million over five years. The Critical Materials Institute is designed to bring together leading researchers from other DOE national laboratories, academia and industry to "develop solutions to domestic shortages of rare-earth materials and other materials critical to U.S. energy security."

2. Interview-Identified R&D Focus Areas in Energy

To better understand the specific areas of institutional R&D focus around energy in Iowa, TEConomy Partners personnel held a series of on-site meetings and interviews at the largest energy R&D performing institutions – at Iowa State University, Ames National Laboratory (on the ISU campus) and the University of Iowa. These interviews highlighted a broad range of research foci at these institutions, with most of these foci being able to be classified in five primary areas:

- Materials for energy applications
- Grid systems and infrastructure
- Biorenewables
- Wind energy
- Energy efficiency.

Primary areas of specialized activity within each of these categories (identified through the interviews and subsequent reference to the institutional websites) are shown on Figure 5. An "other" category is also included for energy-associated research that does not fit into one of the five, or is a cross-cutting strength relevant to multiple themes.

It is evident from these primary areas that there is a significant focus of R&D activity taking place in areas of energy research that relate well to Iowa's energy economy. Work on wind energy and biorenewable energy is complementary to these as important growth sectors in the state. Similarly, R&D in grid systems is relevant in Iowa where the management of the electricity system is under the control of a wide variety of utility types and complicated by the integration of a growing portfolio of intermittent power generating renewable energy assets. Work on energy efficiency appears to focus more on industrial processes, and efficiencies in power systems and refrigeration systems – rather than the work of utilities and other energy efficiency promoters which focus more at the consumer end of the equation. The materials for energy applications research area holds promise for producing novel innovations that may be potentially commercialized in Iowa and for material improvements for important renewable systems (such as windmill blade and turbine components).

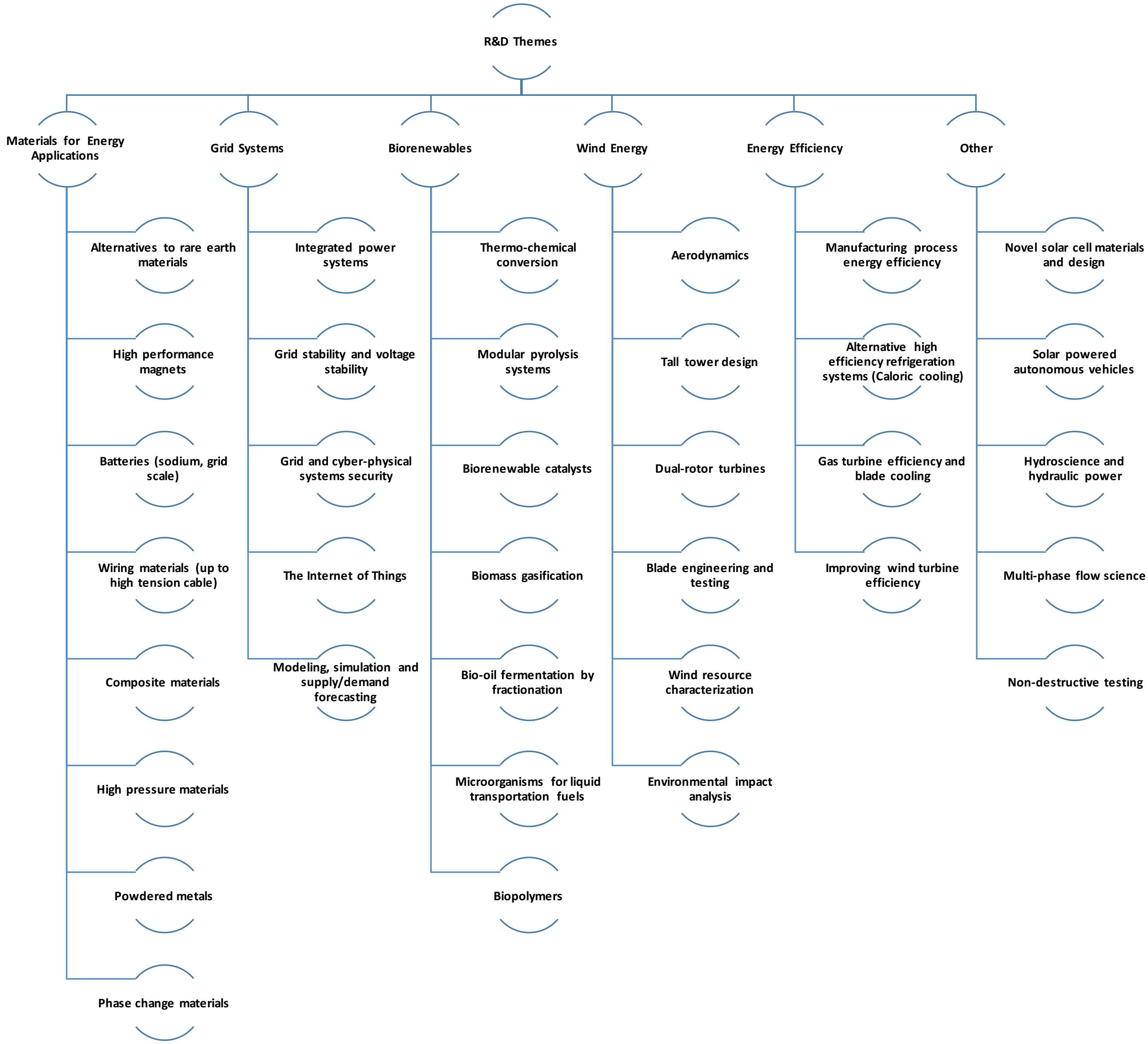


Figure 4. Interview Identified R&D Strength Areas at Ames National Laboratory and Major Energy R&D-performing universities in Iowa

3. Iowa Patent Generation in Energy and Energy-Related Innovations

While publications provide an important indicator of research activity, patents are similarly an excellent metric for understanding innovation output in a state. TEConomy subscribes to patent databases and performed a custom analysis of energy and energy-related patents for Iowa.

TEConomy used both Common Patent Classification (CPC) categories as well as keyword searches developed by World Intellectual Property Organization (WIPO) around energy technologies, to identify groupings of energy-related patents in Iowa. While there are potentially additional types of energy-related patents being generated in Iowa, it is not possible to build a completely comprehensive catalogue of patents due to the wide variety of applications and technologies encompassed. The patents here represent core energy generation, fuels, and climate change mitigation technologies. The technologies captured by the energy-related patent searches included:

- Power Generation, Distribution, & Storage
- Clean Transportation
- Energy Efficiency & Conservation Technologies
- Biofuels
- Wind Power
- Solar Power
- Hydropower
- Geothermal
- Carbon Capture
- Smart Grid
- Batteries
- Waste-to-Energy
- Fuel Cells
- Hydrogen Production & Storage
- Other Renewable Power and Climate Change Mitigation Technologies

Using the patent searches, Iowa energy-related patents from 2010-2015 were assessed for patents invented in state. The focus was on Iowa invented patents since they represent a more accurate measure of innovation that is generated within Iowa rather than intellectual property that companies "import" as assignees from other states or internationally. In other words, including "assigned" patents could lead to thinking there is more innovation taking place in Iowa than there is, since the actual innovation on the assigned patent occurred elsewhere. Concentrating on patents where the actual invention occurred in Iowa (or with Iowa resident inventors) provides a better understanding of Iowa innovation core competencies.

It should be noted that an Iowa invented patent does not mean that the innovation will necessarily be commercialized in the state – since patents can be licensed to out-of-state entities or bought by out-of-state entities. For energy-related patents, as shown on Table 5, there is an evident a mix between Iowa-invented IP being retained by local Iowa companies or being acquired by companies with out-of-state ownership.

Table 5. Iowa Energy and Energy-related Patents 2010-2015 – Count, Assignee and Number of Forward Citations

Assignee Location	Number of Energy Patents Invented	Number of Forward Citations
Iowa	110	218
Outside Iowa	194	519
Total	**304**	**737**

Source: TEConomy Partners analysis using Thomson Reuter's Thomson Innovation patent analysis database.

Table 6 and Figure 6 show the main energy categories in which Iowa invented patents are classified and shows quite a diverse mix of patent types.

Table 6. Iowa Energy and Energy-related Patents 2010-2015 by Category – Count and Forward Citations

Category	IA Invented Patents	Forward Citations
Power Generation/Distribution/Storage	113	360
Clean Transportation	75	103
Other Renewable Power	61	75
Energy Efficiency and Conservation Technologies	44	53
Biofuels	25	115
Wind	19	88
Smart Grid	7	19
Solar	3	9
Carbon Capture	2	0
Hydropower	2	13
Fuel Cells	1	0
Hydrogen Production	1	1

Source: TEConomy Partners analysis using Thomson Reuter's Thomson Innovation patent analysis database.

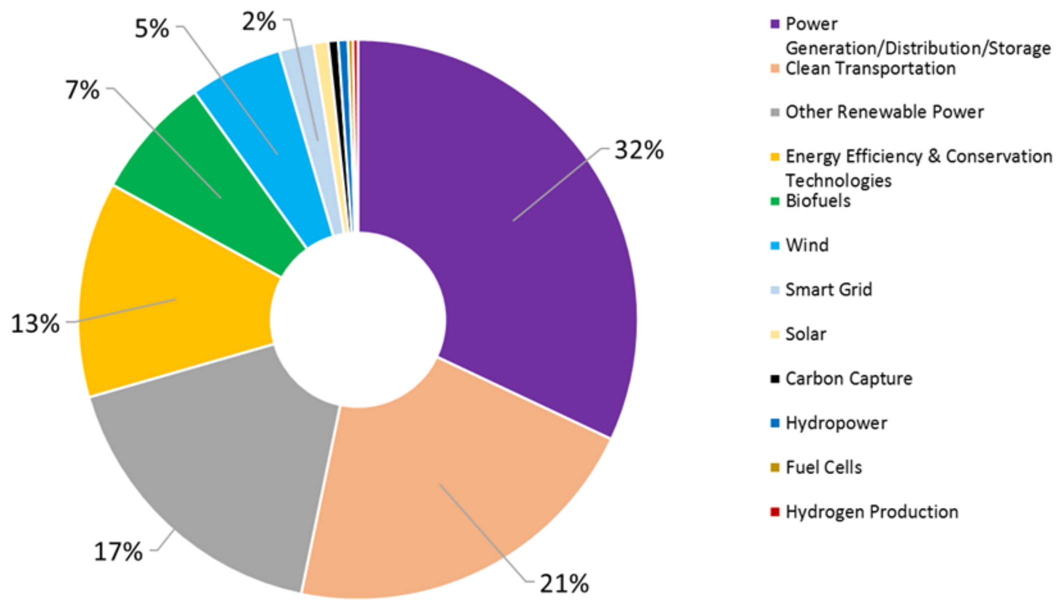


Figure 5. Iowa Energy and Energy-related Patents 2010-2015 by Category – Count and Forward Citations Source: TEConomy Partners analysis using Thomson Reuter's Thomson Innovation patent analysis database.

Table 7 shows the individual companies and institutions that are most active in the Iowa energy and energy-associated innovation space:

Table 7. Companies and Institutions with Largest Number of Energy-Associated Iowa Invented Patents (2010-15)

Assignee Name	Assignee State	Company Focus	Key Energy-Related Patenting Area in IA	Number of IA Invented Patents	Number of Forward Citations
Deere & Company	IL	Manufactures ag, construction, & forestry machinery	Clean Transportation	58	89
Schneider Electric USA Inc.	IL	Energy management & automation technologies	Power Gen/Dist/Storage	28	57
Rockwell Collins Inc.	IA	Avionics and IT systems	Power Gen/Dist/Storage, Energy Efficiency	24	55
ISU Research Foundation Inc.	IA	Public university	Biofuels, Other Renewables	18	95
Whirlpool Corporation	MI	Home appliance manufacturer	Energy Efficiency	11	3
Musco Corporation	IA	Large area & temporary lighting manufacturer	Energy Efficiency	9	17
GYCO Inc.	IA	Process & waste-to-energy engineering	Biofuels	9	17
RF Micro Devices Inc.	NC	Integrated communications circuits	Power Gen/Dist/Storage	8	14
Skyworks Solutions Inc.	MA	Communications semiconductor manufacturer	Power Gen/Dist/Storage	8	12
Broadcom Corporation	CA	Communications semiconductor manufacturer	Power Gen/Dist/Storage, Energy Efficiency	7	49
Cummins Inc.	IN	Engine, filtration, & power generation technologies	Clean Transportation	7	14
University of Missouri	MO	Public university	Carbon Capture, Other Renewables	6	0
Danisco US Inc.	CA	Food production, enzymes, & bioproducts	Other Renewables	5	3
Pioneer Hi Bred International	IA	Genetically modified agricultural products	Other Renewables	4	0
Avello Bioenergy Inc.	IA	Biomass pyrolysis technologies	Biofuels	4	10

Source: TEConomy Partners analysis using Thomson Reuter's Thomson Innovation patent analysis database.

In Figure 7 on the following page, TEConomy Partners provides a graphic summarizing the relative position of Iowa patents by general classification, positioning the patents in performance quadrants as noted in Figure 6:

- Areas of differentiated innovation for a state will ideally have both a high specialization in specific technology areas as demonstrated through experience in patenting as well as having high amounts of forward innovation activity in those areas. Figure 8 shows the relative position of detailed Iowa energy patenting areas in terms of their comparison to national trends on these attributes.
- ***Specialization index (x axis)*** shows how specialized an energy patenting category is in Iowa relative to proportions of US patenting in that area (>1 indicates more specialized relative to US, <1 indicates less specialized)
- ***Forward citation index (y axis)*** shows average rate of forward citations for Iowa patents relative to proportions of forward citations generated in energy areas across all US patents (>1 more forward citations than expected given US trends, <1 fewer forward citations than expected given US trends)
- ***Size of bubbles*** shows quantity of patents in the specific area for Iowa
- ***Color of bubbles*** shows aggregate energy category.

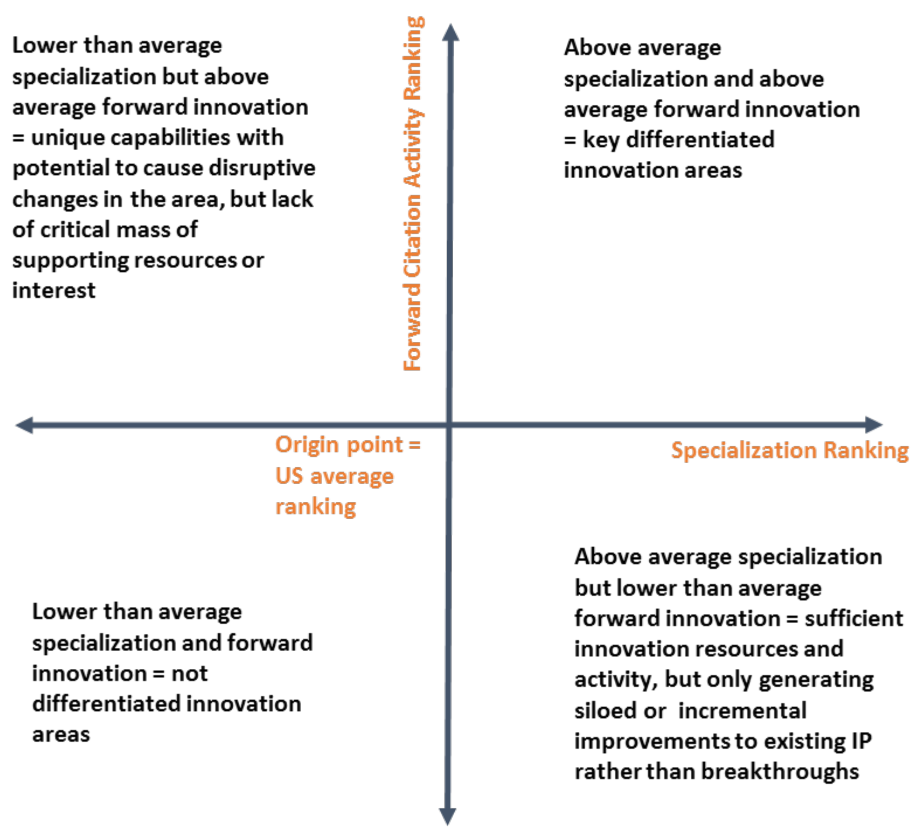


Figure 6. Patent Positioning Quadrant

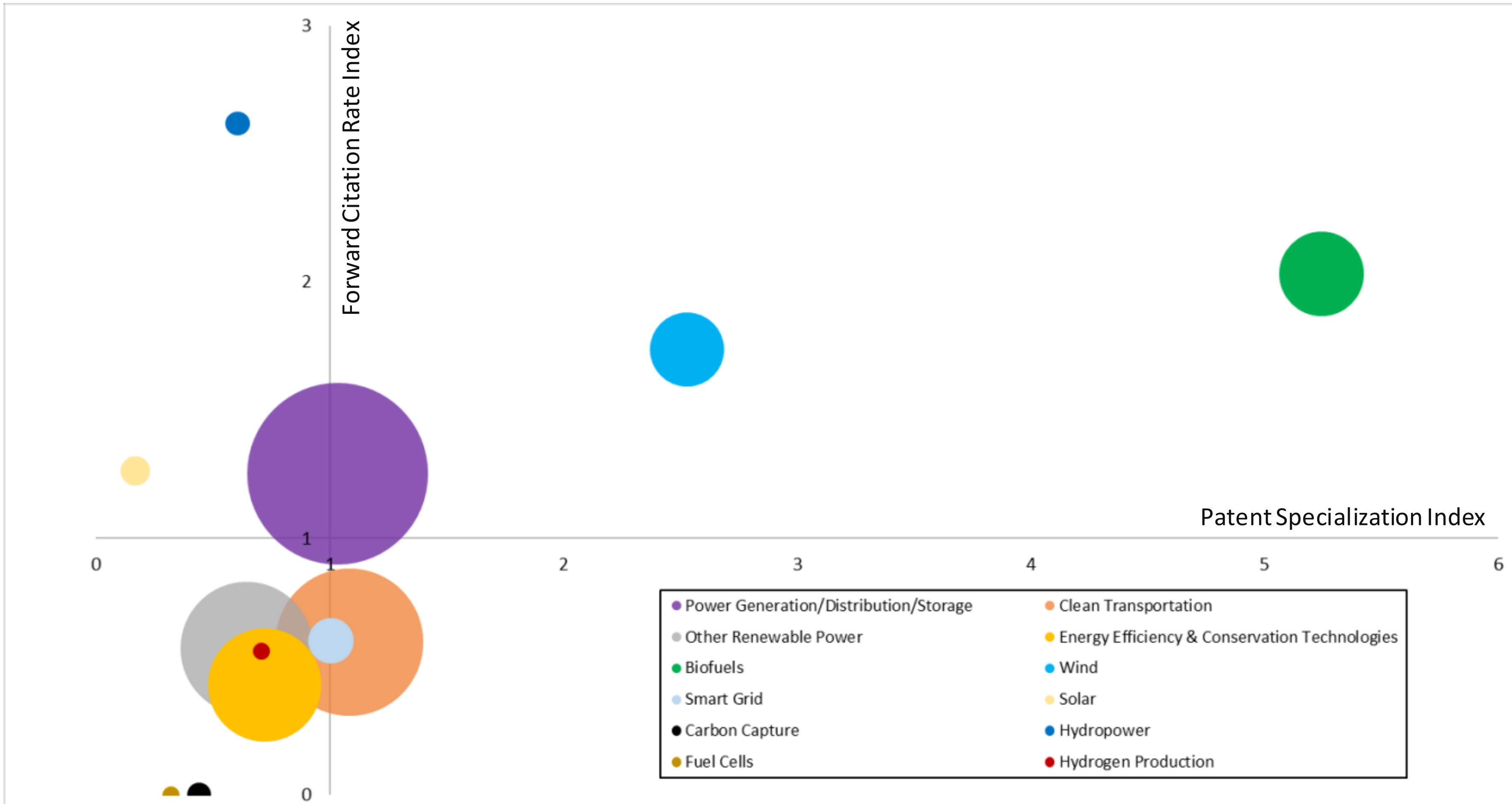


Figure 7. Iowa Patent Innovation Bubble Chart
Source: TEConomy Partners analysis using Thomson Reuter's Thomson Innovation patent analysis database.

Most large areas of Iowa patenting (reflected in the size of the bubble) are in the areas of infrastructure, energy efficiency, and clean transportation but they have low specialization and low forward citation impact relative to the rest of the U.S. – Iowa is not a specialized leader in these areas in terms of intellectual property (IP). This may be indicative of Iowa being a base of operations for these industries but not a hub for research, development and innovation.

Despite relatively low overall patenting numbers, both biofuels and wind power are highly specialized in terms of Iowa IP generation and have strong rates of forward citation. Biofuels is certainly the category that is most notable with a very high level of specialization indicating that Iowa is leading national trends – even though the actual patent number is not particularly large, indicative of this being an area that is not generating a large amount of patenting nationally either. Wind power also has some specialization based around turbine technologies generated by Iowa-based innovators.

4. Venture Investments in New and Expanding Energy Enterprise in Iowa

As research matures resulting in applied innovations, commercialization becomes the next logical step. TEConomy accessed corporate subscriptions to the Thomson Reuter's Thomson One venture capital database and government data to evaluate the level of activity in energy enterprise development in Iowa that has accessed venture funding or secured government SBIR or STTR awards.

Iowa has low levels of venture capital being invested in new energy ventures. Table 8 indicates that in the 16 years (2000 through 2015) only three Iowa energy-related companies received venture capital, with the majority ($22 million out of $26.25 million total) going to just one company Renewable Energy Group, Inc.

Table 8. Energy-Related Venture Capital Investments in Iowa, 2000-2015

Company Name	No. of Deals	Total Equity Invested ($ millions)	Current Status
Renewable Energy Group, Inc.	1	$22.00	Operational; HQ in Ames, IA
Catilin, Inc.	1	$3.00	Bought by Albermarle; IA operations closed
Renewable Fuel Products Inc.	3	$1.25	Operational; Located in Biomass Energy Conversion (BECON) Center
Total, Energy-Related VC Investment in IA Firms	5	$26.25	

Source: TEConomy Partners analysis of Thomson Reuter's Thomson One venture capital database.

It should be noted that generally the energy space has not been a hotbed of venture deals compared to other technology spaces such as IT or medical technology, but it does appear from the regional benchmarks shown in Table 9 that Iowa has not faired particularly well in comparison to surrounding states, especially in terms of the total equity invested.

Table 9. Iowa and Benchmark States Energy-Related Venture Capital Investments, 2000-2015

State	No. of Deals	No. of Companies	Total Equity Invested ($ millions)
Iowa	**5**	**3**	**$26.25**
Illinois	59	15	$449.84
South Dakota	3	1	$294.92
Missouri	15	9	$155.10
Minnesota	22	4	$114.44
Wisconsin	15	6	$97.78
Nebraska	3	3	$12.55

Source: TEConomy Partners analysis of Thomson Reuter's Thomson One venture capital database.

In terms of federal SBIR and STTR awards – which can go to both industry and R&D performing institutions such as universities - (Table 10) Iowa again shows a low level of performance versus other major Midwest states. Only South Dakota received less in SBIR/STTR funding in the 16-year period of 2000-2015, with Iowa having the second lowest number of awards (tied with Nebraska at just eight).

Table 10. Iowa and Benchmark States DOE SBIR and STTR Awards, 2000-2015

State	Number of Firms	Number of SBIR/STTR Awards	Total, SBIR/STTR Funding
Iowa	**6**	**8**	**$2,499,458**
Illinois	47	220	$69,771,238
Minnesota	12	59	$17,372,137
Wisconsin	21	43	$9,880,376
Missouri	11	26	$6,442,826
Nebraska	2	8	$3,699,994
South Dakota	3	4	$1,448,307

Source: TEConomy Partners analysis of data from SBIR.gov

Table 11 shows the individual companies that received the SBIR/STTR awards in Iowa.

Table 11. Iowa Energy-Related SBIR and STTR Awards, All Federal Agencies, 2000-2015

Company	Federal Agency	Phase I		Phase II		Totals	
		Awards	Funding Amount	Awards	Funding Amount	Awards	Funding Amount
Advanced Genome Technologies, LLC	DOE	1	$99,963			1	$99,963
Adv. Renewable Technology Int'l, Inc.	DOE	1	$149,868			1	$149,868
Amjet Turbine Systems, LLC	DOE	1	$149,627	1	$1,000,000	2	$1,149,627
Iowa Thin Film Technologies, Inc.	DOD	2	$219,229			2	$219,229
Molecular Express, Inc.	DOE	1	$100,000			1	$100,000
Northern Microdesign, Inc.	DOE	1	$100,000	1	$750,000	2	$850,000
Oren Consulting Services	USDA	1	$69,443			1	$69,443
Springboard Engineering, Inc.	DOE	1	$150,000			1	$150,000
Grand Total		**9**	**$1,038,130**	**2**	**$1,750,000**	**11**	**$2,788,130**

Source: TEConomy Partners analysis of data from SBIR.gov. Non-DOE awards determined through examination of individual Iowa SBIR/STTR awards.

C. Conclusions from the R&D Core Competencies Analysis

The evaluation of the core competencies by key criteria is summarized on Table 12, including:

- Publishing data
- Patenting data
- Presence of dedicated university research centers or stated as a strategic thrust of research by the institution
- SBIR/STTR and venture funding activity
- Notation regarding whether the competency was raised as such in interviews.

Table 12. Summary of Energy and Associated Discipline Strength Areas by Key Criteria

	Volume of Papers Published	**Patents**	**Dedicated Research Centers or Stated Thrusts**	**SBIR/ STTR or VC Activity**	**Interviews Validated as an Area of R&D Strength or Concentration**
Research Strength Area	Count by Field	Count by Classification	Yes or No (Comments)	Count	Yes or No (Comments)
Materials for Energy Applications	92 Materials Science 43 Nanotech 39 Electro-chemistry 36 Thermodynamics	Not identified individual category, but crosscutting in others	YES Main focus of Ames Lab: • Division of Materials Science and Engineering • Critical Materials Institute • Materials Preparation Center ISU: Lists “Advanced Materials” as a “signature research focus area” for the University: • Center for Catalysis • Center for Nondestructive Testing University of Iowa: • NSF IUCRC Photopolymerization Center • Nanoscience and Nanotechnology Institute	<=1	YES: 8 foci • Rare earth materials • High performance magnets • Batteries • Wiring/cable materials • Composite materials • High pressure materials • Powdered metals • Phase change materials
Grid Systems	111 Electrical and electronic engineering	113 Power generation, distribution and storage. 7 Smart grid	YES. ISU: Lists “Energy Sciences & Engineering” as a “signature research focus area” for the University: • Electric Power Research Center • Power Systems Engineering Research Center • Power Infrastructure Cyber Security Lab Ames Lab: Simulation, Modeling and Decision Science Program	<=1	YES: 5 foci • Integrated power systems • Grid and voltage stability • Grid & cyber-physical systems security • Internet of Things • Modeling/ simulation and forecasting

	Volume of Papers Published	Patents	Dedicated Research Centers or Stated Thrusts	SBIR/ STTR or VC Activity	Interviews Validated as an Area of R&D Strength or Concentration
Biorenewables	Most cited publications are in this area. 161 Biotechnology and Applied Microbiology 109 Chemical Engineering 91 Agricultural Engineering 40 Agronomy	25 Biofuels	YES ISU: Lists "Biorenewable Processes" as a "signature research focus area" for the University: • Bioeconomy Institute • Plant Sciences Institute • Center for Biorenewable Chemicals • Center for Carbon Capturing Crops Ames Lab: Division of Chemical and Biological Sciences University of Iowa: • Center for Biocatalysts and Bioprocessing	>1	YES: 7 foci • Thermo-chemical conversion • Modular pyrolysis systems • Biorenewable catalysts • Biomass gasification • Bio-oil fermentation by fractionation • Microorganisms for liquid transportation fuels • Biopolymers
Wind Energy	Crosscutting (incorporated in "Energy & Fuels" category	19 Wind	YES ISU: Wind Energy Initiative • Wind Energy Manufacturing Lab • Wind Energy Systems Lab • Wind Simulation Testing Lab • Structure Engineering Research Lab	<=1	YES: 6 foci • Aerodynamics • Tall tower design • Dual-rotor turbines • Blade engineering and testing • Wind resource characterization • Environment impact analysis
Energy Efficiency	Crosscutting (probably incorporated in multiple categories	44 Energy efficiency & conservation technologies	YES ISU: Wind Energy Initiative • Iowa Energy Center • Center for Building Energy Research • Institute for Transportation Ames Lab: Major program focus in Caloric Cooling for high efficiency refrigeration.	<=1	YES: 4 foci • Manufacturing process energy efficiency • Alternative high-efficiency cooling (refrigeration) systems • Gas turbine efficiency and blade cooling • Improving wind turbine efficiency

	Volume of Papers Published	Patents	Dedicated Research Centers or Stated Thrusts	SBIR/ STTR or VC Activity	Interviews Validated as an Area of R&D Strength or Concentration
Other…		75 Clean transportation 3 Solar	YES ISU: Computational Fluid Dynamics Center University of Iowa: Hydroscience and Engineering	>1	YES • Novel solar cells • Solar powered autonomous vehicles • Hydroscience and hydraulic power • Non-destructive testing

III. OPPORTUNITIES AND PLATFORMS FOR ENERGY-BASED ECONOMIC DEVELOPMENT IN IOWA

In addition to conducting interviews and databases searches for identification of core competencies, TEConomy Partners also integrated strengths, weaknesses, opportunities, and threats (SWOT) questions into the process. In this chapter, opportunities identified through the SWOT process are highlighted, and these opportunities are integrated with findings from the core competency analysis to suggest focused "platforms" for Iowa to advance to accomplish energy-based economic development.

A. Opportunities Based on Iowa Assets

Through triangulating the findings from existing reports, data and interviews, and the resulting SWOT analysis, multiple energy opportunity areas have been identified for Iowa. As would be expected, not all opportunities are equal—there is variability in the time horizon for potential realization of these opportunities, the scale of the opportunities, and their job and income generation potential for the state. The TEConomy team has identified 30 energy opportunity areas for Iowa, as shown on Table 13.

These 30 opportunity areas vary in potential time-frame for opportunity realization, and fall under six broad "energy group" themes of: transmission and distribution; renewable electric power; biofuels; energy efficiency; R&D-driven innovation and technology commercialization; and an "other" category.

Iowa, however, has multiple opportunities for energy-based economic development in the near-and mid-term time horizons.

Table 13. Listing of Identified Energy-Based Economic Development Opportunities for Iowa

ENERGY GROUP	ENERGY OPPORTUNITY AREA	
	NEAR-TERM (Present–3 years)	MID-TERM (3–8 years)
Transmission and Distribution	• Siting and development planning for strategic power transmission lines for selling power • Improved west to east connectivity for transmission inside Iowa • Siting and development planning for ethanol pipelines	• Development of power transmission lines and start of renewable electric power • Development of ethanol pipelines for more efficient distribution inside and outside Iowa

ENERGY GROUP	ENERGY OPPORTUNITY AREA	
	NEAR-TERM (Present–3 years)	MID-TERM (3–8 years)
Renewable Electric Power	• Increase solar installations (grid scale and distributed/rooftop) • Continue momentum in large-scale wind power development • Explore waste-to-energy project potentials	• Development of river-based hydro-power (if feasible)
Biofuels	• Promote market and infrastructure for higher blends of ethanol • Continue development of next-generation biofuels • Livestock waste-to-biogas projects	• Next-generation biofuels deployment • Development of modular biopower systems for distributed generation • Develop value-added chemicals industry from biofeedstocks
Energy Efficiency	• Increase awareness of existing programs • Enhance EE education activity by all Iowa utilities • Develop certification and training programs for installers and energy efficiency contractors	• Deploy proven smart-grid and advanced energy management technologies as become affordable.
R&D-Driven Innovation and Technology Commercialization	• Development of new components for wind-power • Develop an Advanced Energy Systems Integration Center to coordinate activities in next-generation grid and grid-management technologies • Ongoing development of advanced materials and domestic alternatives to critical materials • Grid-scale energy storage R&D	• Development of manufacturing industries for critical materials and advanced energy materials • Development of alternative biomass feedstocks for biofuels and bio-based products.
Other	• Ongoing attraction of inward investment by industry seeking reliable renewable power • Evaluation of agricultural systems to provide carbon capture/fixing	• Evaluation of next generation nuclear technologies for Iowa • Diversification of infrastructure to support alternatively fueled vehicles • Development of intermodal freight transport facilities.

In the **near-term** (defined as immediate to 3 years out) TEConomy finds there to be several areas of major energy opportunity that Iowa may pursue to enhance job generation and economic development in the state. TEConomy believes areas with the most promise in this time horizon include (Table 14):

Table 14. Summary of Main Opportunity Areas for Energy-Based Economic Development in Iowa

Near-Term Opportunity Area	Description of Opportunity	Job Generation Potential
Strategic power transmission line development	Iowa's ability to generate significant electric power from renewable resources presents opportunities for the state economy to benefit from selling high-demand renewable power. Doing so requires enhanced transmission line capacity.	Major short-term construction job potential. Followed by increasing employment in the production, installation and on-going operations of renewable power generation systems (primarily wind and solar).
Strategic ethanol pipelines	Iowa is the leading producer of ethanol in the nation and projects that serve to increase the efficiency of the industry are important. Currently ethanol is shipped from the site of production to petroleum refineries and blending operations for integration into the gasoline supply chain. Efficiencies can be gained through construction of a pipeline network in the state to link the production chain, and potentially for transporting ethanol to out-of-state locations more efficiently. As next-generation biofuels come online, the demand for the pipeline infrastructure will increase.	Major short-term construction job potential. Followed by increasing employment in the maintenance of pipeline infrastructure. Potential growth in ethanol production jobs through increased efficiency of supply chain.
Promote market and infrastructure for higher blends of ethanol	Auto makers, like Ford and Mercedes, have stated a desire to produce vehicles using highly efficient high-compression engines. These engines require high octane fuel, and the least expensive octane available is ethanol. The development of the market for high compression engines will require infrastructure to be deployed, including blender pumps, at gasoline distribution sites for E15-E85 fuels. It is in Iowa's interest to help promote the development of this market through incentivizing investment in the infrastructure.	Significantly higher ethanol blends have the potential to double or triple the size of the ethanol industry in Iowa.

Near-Term Opportunity Area	Description of Opportunity	Job Generation Potential
Increase solar power installations	Solar energy has seen limited penetration to-date into the Iowa energy mix. There is potential for enhancing renewable energy generation in Iowa through both utility solar projects and distributed/community generation. At current low energy price levels, however, this may become a longer-term play as the payback period for solar projects would likely be quite lengthy.	Significant in sales, installation and maintenance of solar systems – especially distributed solar, which has potential to generate jobs across the state.
Increase wind power installations	Iowa's wind resource is far from fully utilized. The major coming expansion of Mid Americans' wind generation capacity proves this point. In addition to siting more towers on new sites in Iowa there is also the potential to generate increased power from existing geographies using >100-meter-tall towers to access higher level wind, and adoption of novel systems such as dual rotor generators.	Major job potential in wind system manufacturing and construction/installation. Followed by increasing employment in on-going operations and maintenance of wind power systems, and the manufacturing of replacement components
Continue development of next generation biofuels	Iowa's leadership in starch-based ethanol is well-known. However, the long-term promise of ethanol fuel will be realized as processes are improved and commercialized for cellulosic biomass-to-ethanol production. Already Iowa leads in production of cellulosic ethanol, through the innovative process invented at Quad County Corn Processors that converts corn kernel fiber to ethanol and POET's Project Liberty facility in Emmetsburg, IA. Work in industry and at Iowa universities is intensive in this space both for fuels and downstream value-assed chemicals.	The growth of the ethanol industry in Iowa has been a success story, not only in terms of the jobs generated in the direct production and distribution of ethanol, but also in terms of the distributed economic benefits to farmers across the state. The realization of the promise of next generation ethanol will significantly increase the value of currently low-value cellulosic biomass and spur biofuel-based economic development to the next level.

Near-Term Opportunity Area	Description of Opportunity	Job Generation Potential
Waste-to-energy projects	Processes are already in-place and being used, in Iowa, in converting municipal waste to energy (for example in Ames). But penetration of this technology across the state is quite limited at the present time. There is significant opportunity to expand municipal waste-to-energy projects, and there is similarly opportunity for using agricultural waste and processing byproducts in energy generation applications.	Job potential in waste-to-energy system manufacturing and construction/installation. Followed by increasing employment in on-going operations and maintenance of waste-to-energy systems, and the manufacturing of replacement components.
Increase awareness of existing energy efficiency programs	Multiple stakeholders noted that while Iowa has a good leadership position in terms of utilities' programs to enhance energy efficiency there is still substantial room to raise awareness among energy consumers of their options in energy efficiency.	Increased awareness is likely to increase adoption of energy efficiency and conservation tools and technologies – increasing employment opportunities in the production of technologies and the installation of systems and products at homes and businesses.
Develop certification and training programs for installers and energy efficiency contractors	Education and certification programs for major categories of energy efficiency product installations will likely lead to better installations realizing enhanced cost savings and higher consumer confidence and demand for energy efficiency products.	As consumers gain trust in the quality of installation services and realize anticipated savings from properly sized and installed energy efficiency applications it is likely that demand for energy efficiency products will increase together with employment in the installation of energy efficiency products and solutions at consumer sites.
Development of new components for wind-power	Wind power is an important and rapidly growing component of Iowa's electric power generation. Manufacturers of wind energy systems, and R&D institutions, are developing new technologies to improve system performance and harness more power from the available wind resource. Technologies for modular concrete tall-towers, duel rotor systems, blade de-icing systems, early identification of blade stress, etc. are being investigated and developed in Iowa presenting opportunities for new manufactured wind system components and for increasing the efficiency of the wind power generation industry in Iowa	Potential for jobs in research and development, in manufacturing, and in sales, installation and ongoing maintenance of advanced wind power technologies. Potential for the economic advancement of Iowa through significant product exports.

Near-Term Opportunity Area	Description of Opportunity	Job Generation Potential
Develop an Advanced Energy Systems Integration Center to coordinate activities in next-generation grid and grid-management technologies	Iowa has an unusual energy production and distribution system – unusual in terms of the types and varieties of utility systems and in terms of the high penetration of renewable energy production. The management and optimization of such a diverse system presents an opportunity and demand for developing an Advanced Energy Systems Integration Center that would bring together the state, utilities, regional transmission organizations, and major R&D institutions (including Ames Lab and the Regent Universities) to jointly research, develop and pilot existing and new technologies for power management, grid stability, grid security, etc.	Potential for development of grid management and security products and services for commercialization in Iowa. R&D employment also.
Ongoing development of advanced materials and domestic alternatives to critical materials	Ames National Laboratory is the designated energy materials lab of the U.S. Department of Energy. Together with Iowa State University and the University of Iowa, Ames Lab's expertise in materials development, characterization, testing and production gives the state a unique signature capability. Strategic concerns over critical materials sources from overseas, together with the demand for specialized materials to improve energy production, storage and transmission makes this area of expertise a good opportunity area for Iowa. Work in alternative magnet materials, sodium grid scale batteries, high-performance conducting materials, phase-change materials, etc. each have the potential to yield innovations with substantial market potential.	Potentially significant with an opportunity for growing new business ventures to commercialize innovative materials. Examples might include a high-performance magnet production industry, battery production industry, alternative refrigeration industry (using caloric cooling), etc.

Near-Term Opportunity Area	Description of Opportunity	Job Generation Potential
Ongoing attraction of inward invest by industry seeking reliable renewable power	Iowa's existing base of renewable power has already proven important in attracting companies to the state who value clean power. Having power sources that are secure from global fossil fuel supply chain choke-points also carries value. Iowa's energy is low cost and reliable, and the integration of renewable power has been achieved while sustaining reliability and stability. It is an attractive sales point for the state.	The attraction of inward investment projects is highly competitive, but Iowa's renewable energy portfolio provides a relatively differentiated attractor for the state. Projects such as those seen from Facebook, Microsoft and Google show the competitiveness of Iowa in this regard.

B. From Opportunities and Core Competencies to Platforms: Identifying Robust and Scalable Platforms for Energy-Based Economic Development in Iowa

With Iowa having such a diverse variety of R&D core competencies and potential energy opportunities to pursue, it is beneficial to refine and simplify these opportunities into broader development "platforms" around which state and stakeholder partnerships can work to promote energy-based economic development. As noted previously, a "platform" represents a major economic development focus containing near- and mid-term development opportunities that ideally:

- Have an established or emerging cluster of Iowa businesses with interests in related areas of the energy sector.
- Provide opportunities for ongoing technology, product and service innovations to which Iowa's commercial, academic and government laboratory research capabilities can be applied.
- Present opportunities for collaborative public/private partnerships to promote shared interests and facilitate the development of a highly favorable operating environment for platform growth.
- Are associated with a significant potential market with an achievable line-of-sight for the sale of resources, new technologies, services and value-added products.
- Contribute to building and reinforcing key aspects of an "ideal Iowa energy economy" as shown in the text box on page 2.

Based on the above, TEConomy has identified five energy platforms for Iowa that can encompass the majority of the identified opportunity areas. These five platforms are shown on Figure 9 and include:

- **Renewable Electricity Platform:** Focused on the ongoing growth of wind power, and increased attention to be paid to solar PV installations, to generate substantial excess power capacity for export outside of the state of Iowa while meeting the needs and demands internal to the state. The platform also includes development of enhanced transmission line capacity to connect Iowa assets to out-of-state markets.

- **Biomass Conversion Platform:** Focused on the conversion of Iowa's abundant supply of biomass (especially cellulosic biomass) into liquid fuels and high value-added chemicals.
- **Grid Management & Resilience Platform:** Focused on 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.
- **Energy Efficiency Platform:** Advancing best practices in proven energy efficiency strategies and technologies, in combination with the development of new energy efficiency innovations.
- **Energy Materials and Systems Manufacturing Platform:** Building upon Iowa's R&D core competencies in materials and the design and production of energy technologies to advance new manufacturing ventures and help existing companies expand and improve their product lines.

Each of these platforms provides opportunities to realize significant economic development within Iowa, build upon a base of existing assets and knowhow in the state, leverage Iowa resources, and present opportunities for exporting valuable products and services. It is also notable that there are connections between the platforms, whereby work on one will help advance the work of another.

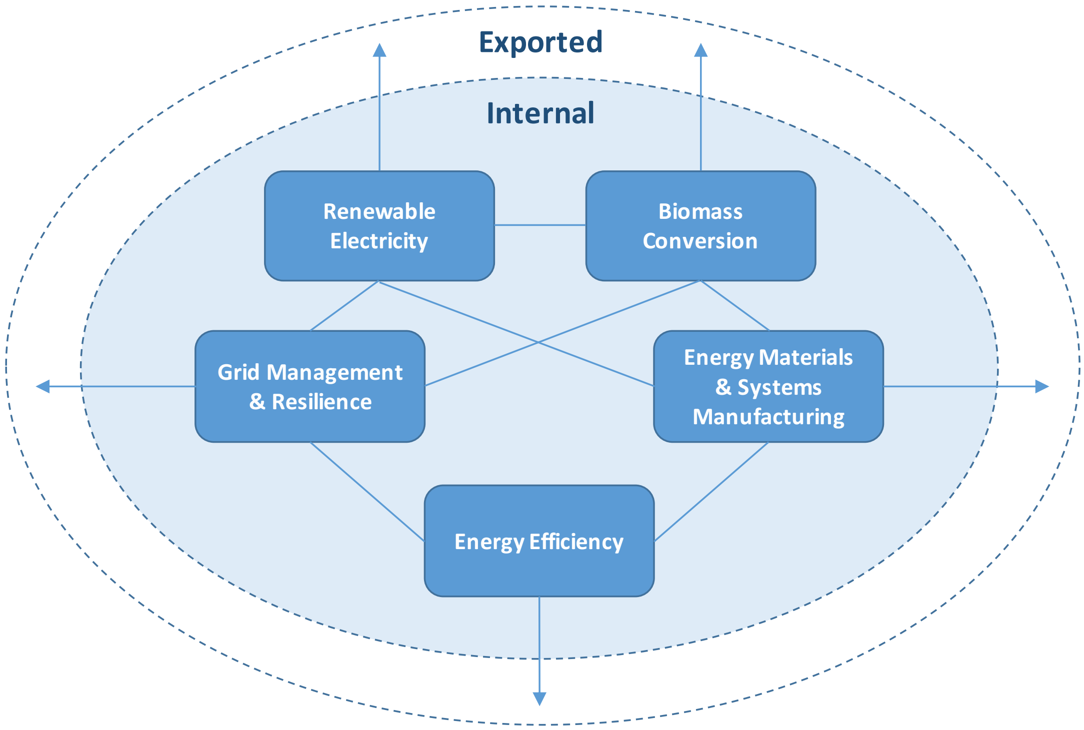


Figure 8. Suggested Platforms for Iowa Energy-Based Economic Development

The five recommended platforms perform well on contributing to the "ideal Iowa energy economy" characteristics noted previously. Table 15 shows TEConomy's qualitative scoring of these platforms against these criteria.

Table 15. Recommended Platform Performance on "Ideal" Iowa Energy Variables

	Renewable Electricity	Biomass Conversion	Grid Management and Resiliency	Energy Efficiency	Energy Materials and Systems Manufacturing
Foster long-term energy affordability and price stability for Iowa's businesses and residents	++	++	+++	+++	++
Increase reliability, resiliency, safety and security of Iowa's energy systems and infrastructure	++	++	+++	++	++

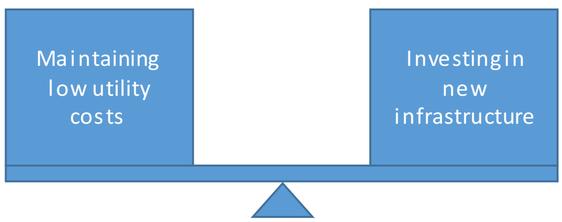
	Renewable Electricity	Biomass Conversion	Grid Management and Resiliency	Energy Efficiency	Energy Materials and Systems Manufacturing
Provide predictability by encouraging long-term actions, policies and initiatives	++	++	++	++	++
Expand opportunities for access to resources, technologies, fuels and programs throughout Iowa	+++	+++	+++	++	++
Seek diversity in the resources that supply energy to and within Iowa	+++	+++	+++	0	0
Support alternative energy resources, technology, and fuel commercialization in proven, cost-effective applications	+++	+++	+++	0	++
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	++	++	++	+++	++

+++ = Strong contributor to achieving this goal
++ = Contributor to achieving this goal
0 = Does not contribute to achieving this goal

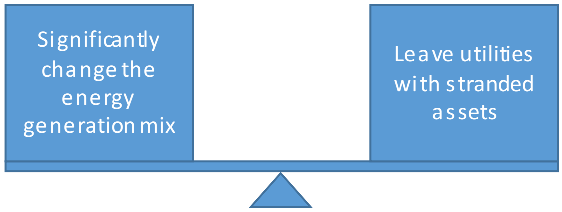
IV. BARRIERS AND CHALLENGES TO REALIZING IOWA'S ENERGY-BASED ECONOMIC DEVELOPMENT POTENTIAL

Changing something as complex and critically important as a state energy system does not come without challenges. A host of complex variables come into play in terms of considering pathways forward and developing an energy plan that optimizes opportunities while balancing potential conflicts and tensions between stakeholders. One way of summarizing challenges is to examine tensions that will need to be balanced in order for energy plan development, and more importantly, implementation of the plan to proceed. A series of graphics and brief narrative descriptions are provided below to highlight some of the key tensions observed.

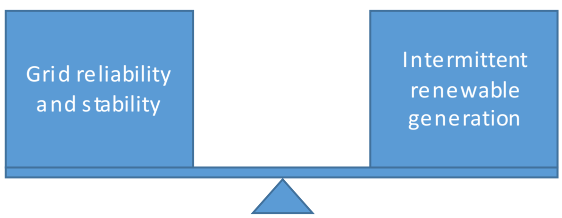
Primary Observed Tensions



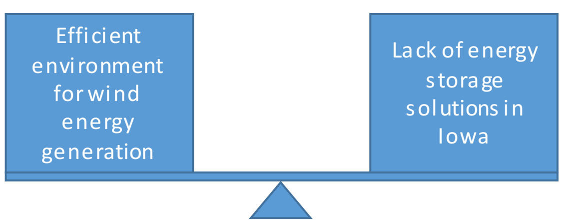
One of the obvious areas in which balance must be struck is in the need to build more transmission and distribution infrastructure for Iowa energy versus the desire to keep energy rates as low as possible for end users. Companies investing in major infrastructure projects need to recapture their investment – and rate increases would be the usual pathway.



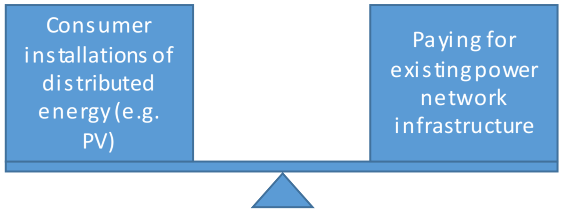
New technologies, federal Clean Power Plan (CPP) imperatives, and other factors make it desirable to change the mix of generating assets in Iowa – particularly away from coal-fired generation to alternative fuels. However, utilities invested in their existing assets (such as coal power plants) under assumptions of being able to recoup their investments over the useful life of the project, and a shifting generation portfolio leaves utilities with the risk of owning costly stranded assets.



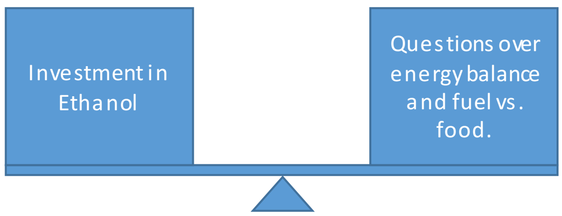
Grid stability and reliability is exceptionally important and it complicates the reliability and stability equation to mix in renewable power such as wind and solar that can experience significant generation variability.



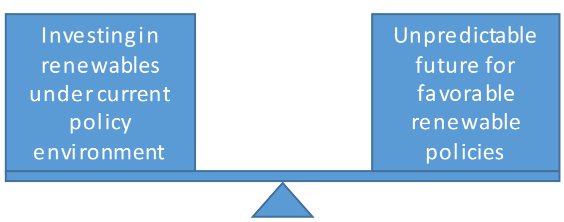
Related to the last tension there is not yet a clear path forward to affordable grid-scale energy storage for Iowa. So, while Iowa has a high performance environment for wind power generation, this performance is not balanced by having power storage solutions to flatten the generation curve.



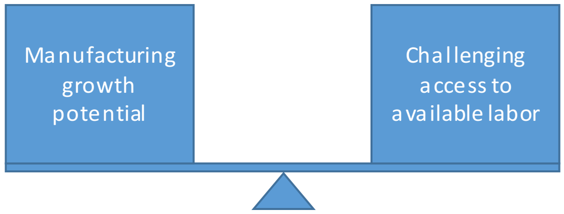
There are tensions inherent in the interest of consumers to install solar PV or other distributed generation technologies and the need for utilities to recoup cost for the connected grid infrastructure. There is also the issue of connecting distributed generation to the grid to sell excess power.



Iowa has benefitted economically from investing in ethanol production in the state – developing an industry that benefits farmers, ethanol producers and consumers. The industry is challenged, however, by questions over the energy balance of corn ethanol and the debate concerning food vs. fuel. Development of affordable commercial-scale cellulosic ethanol processes will significantly ameliorate concerns.



Another challenge affecting the ethanol industry (and other renewable power sectors) is a lack of assured ongoing political support for incentives and policies that help support and reward industry development. Investors have to balance the reward associated with incentives and the risk that an incentive may go away over time.



While there is potential for growing the renewable power industry and manufacturing of energy products, a number of leading manufacturers in Iowa are expressing frustration at being unable to access a job-ready workforce.

As the process advances in developing the Iowa Energy Plan, these tensions will need to be addressed and solutions and compromises found.