Energy Information Report 2010

In its 2007 Session, the Iowa General Assembly passed, and Governor Culver signed into law, extensive and far-reaching state energy policy legislation. This legislation created the Iowa Office of Energy Independence and the Iowa Power Fund. It also required a report to be issued each year detailing:

- The historical use and distribution of energy in Iowa.
- The growth rate of energy consumption in Iowa, including rates of growth for each energy source.
- A projection of Iowa's energy needs through the year 2025 at a minimum.
- The impact of meeting Iowa's energy needs on the economy of the state, including the impact of energy production and use on greenhouse gas emissions.
- An evaluation of renewable energy sources, including the current and future technological potential for such sources.

Much of the energy information for this report has been derived from the on-line resources of the Energy Information Administration (EIA) of the United States Department of Energy (USDOE). The EIA provides policy-independent data, forecasts and analyses on energy production, stored supplies, consumption and prices. For complete, economy-wide information, the most recent data available is for the year 2007. For some energy sectors, more current data is available from EIA and other sources and, when available, such information has been included in this report.

Historical Use and Distribution of Energy in Iowa

Understanding Energy Use in Iowa

There are 3 key questions that must be answered to understand both current and historical use and distribution of energy in Iowa:

- How much energy do we use?
- How is that energy generated?
- How do we use the energy?

This report will also put these questions in a historical context as well as offering comparisons with national data, where that comparison is useful to understanding Iowa's energy situation.

Many factors can influence energy use and fuel mix. Trends in energy use in Iowa and the U.S. as a whole closely follow periods of economic expansion and contraction. Current EIA estimates predict that, once the numbers are in, all types of fuels will show a decline in use during 2008 and 2009.

Energy use is also tied very clearly to price signals. As the price of oil climbed during 2007, vehicle miles traveled decreased as people looked to alternatives such as public transportation, car pooling and simply making fewer car trips.

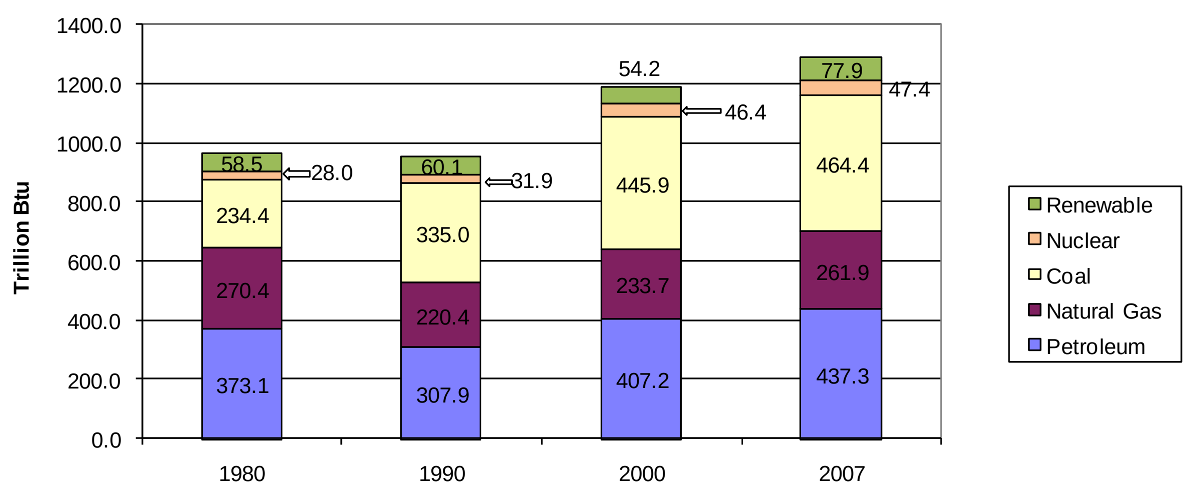
Energy use in total as well as the mix can be influenced by policy, such as the production tax credit for wind, the federal Renewable Fuels Standard and carbon-limiting regimes that have been implemented in several regions of the U.S.

Finally, advances in technology can lead to changes in fuel consumption patterns. As certain technologies become better and cheaper, they become a more economical choice and take a more dominant role in the energy mix.

How much energy do we use?

Graph 1 illustrates Iowa's energy use and fuel mix for 1980 through 2007. The EIA data shows that energy use in Iowa grew by 22.7% between 1980 and 2007 for a strong general upward trend. Table 1 shows the specific data on total energy use and the rate of change over the time period displayed in Graph 1. Energy use declined 8.8% between 1980 and 1990, increased 25% between 1990 and 2000 and increased an additional 7.6% between 2000 and 2007.

Graph 1: Iowa Primary Energy Consumption by Fuel Type 1980 - 2007



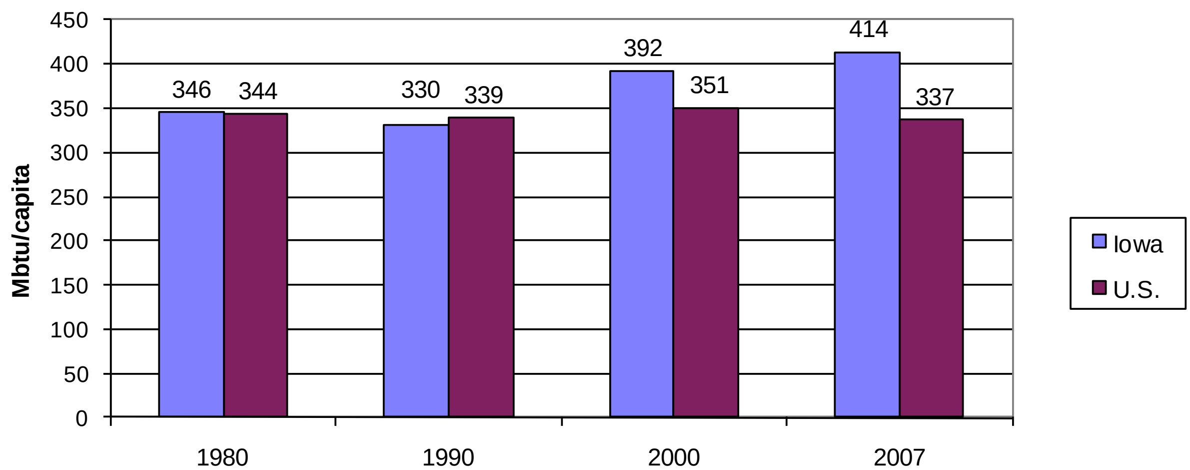
Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

Table 1: Total Iowa Energy Consumption, 1980-2007

	1980	1990	2000	2007
Total Energy Consumption*	1,007.1	918.6	1,148.3	1,235.3
Change from Previous Period	N/A	-8.8%	25.0%	7.6%
* Total is different from Graph 1 because it includes EIA adjustment factors not shown on the graph.				

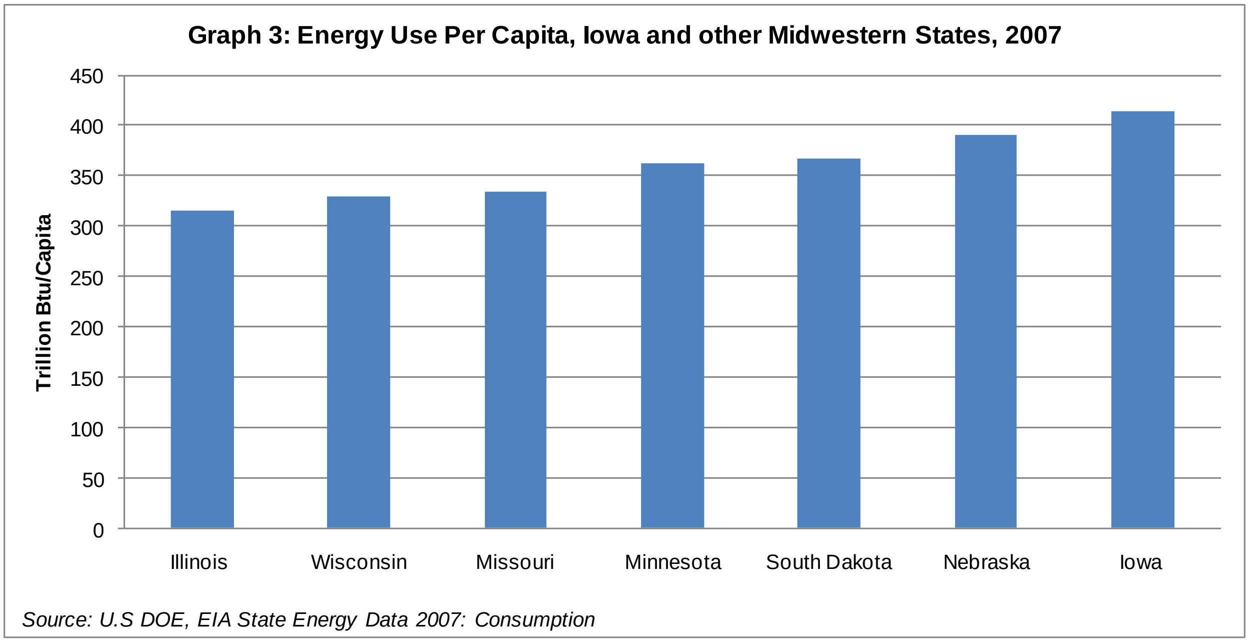
Energy use per capita is another useful way to measure Iowa's energy use. In 2007, Iowa ranked 30th both in terms of population and Gross State Product, but 13th in energy use per capita. Graph 2 compares national per capita energy use with Iowa's per capita energy use over time. For each person in Iowa in 2007, 414 Btu of power was consumed. The national average was 337 Btu per person. The gap between Iowa and the rest of the country on this measure has grown steadily since 1980.

Graph 2: Iowa and U.S. Primary Energy Consumption per Capita, 1980-2007



Sources: U.S. DOE, EIA, State Energy Data 2007: Consumption; U.S. Census Bureau Population Estimates

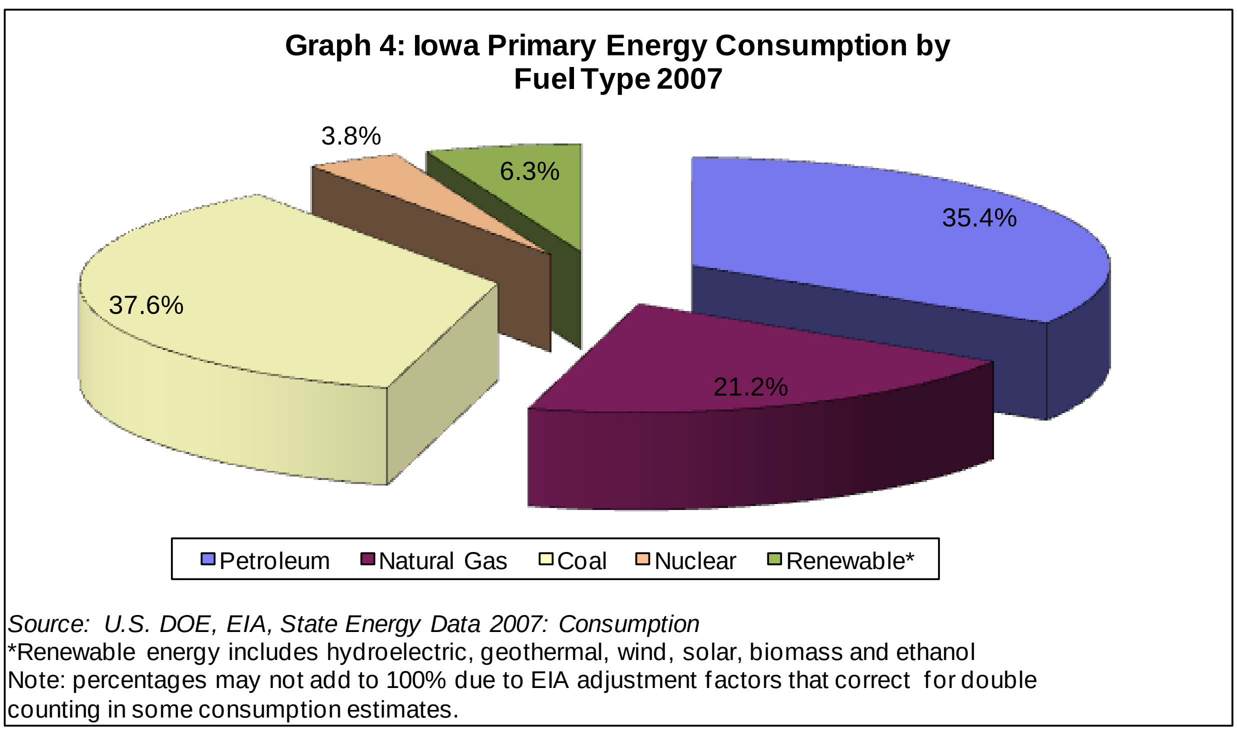
It is also useful to compare this statistic within the Midwest. Illinois has the lowest total per capita energy use and Iowa the highest. (Graph 3)



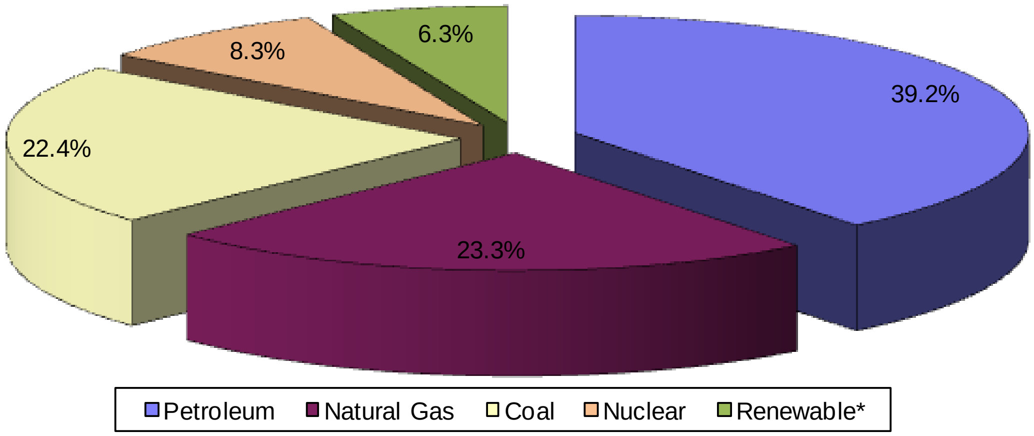
Iowa's energy use per capita and use per unit of economic output is discussed in greater detail in the sections of this report dealing with the economics of Iowa's energy needs.

Where does Iowa's energy come from?

While energy use in Iowa, both overall and per capita, has trended generally upward since 1980, the fuel mix has been less predictable. The fuel mix supporting Iowa's 2007 energy consumption is displayed in percentage terms in Graph 3. Graph 4 breaks down U.S. energy consumption for comparison.



Graph 5: U.S. Primary Energy Consumption by Fuel Type 2007



Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

*Renewable energy includes hydroelectric, geothermal, wind, solar, biomass and ethanol

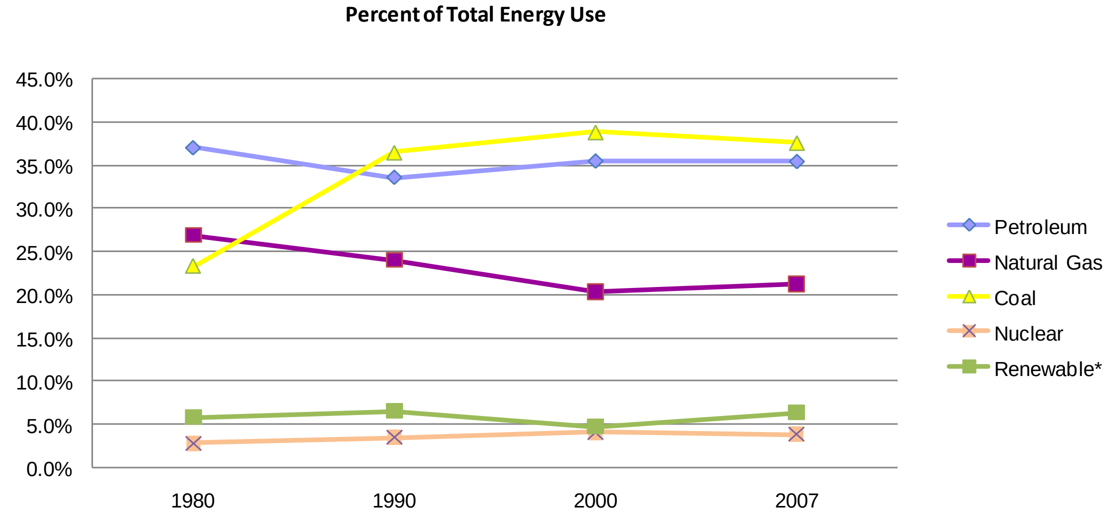
Note: percentages may not add to 100% due to EIA adjustment factors to corrects for double counting in someconsumption estimates.

Of particular note:

- The role of **coal** in Iowa, which makes up a significantly larger proportion of the energy mix in the state than it does in the U.S. as a whole.
- In Iowa, **nuclear energy** contributes less than half what it does in the nation generally.
- **Renewable energy** consumption in Iowa matched the national numbers.

Graph 6 and Table 2 show how the mix of energy resources that power the state has changed between 1980 and 2007.

Graph 6: Change in Iowa Primary Energy Consumption by Fuel Type, 1980-2007



Source: U.S. DOE, EIA, State Energy Data 2007: Consumption
*Renewable Energy includes hydroelectric, geothermal, wind, solar, biomass and ethanol

Table 2: Percent Change in Iowa Primary Energy Consumption by Fuel Type 1980 - 2007

Fuel	1980-1990	1990-2000	2000-2007	1980-2007
Petroleum	-17.5%	32.3%	7.4%	17.2%
Natural Gas	-18.5%	6.0%	12.1%	-3.1%
Coal	42.9%	33.1%	4.1%	98.1%
Nuclear	13.9%	45.5%	2.2%	69.3%
Renewable	2.7%	-9.8%	43.7%	33.2%
Total	-8.8%	25.0%	7.6%	22.7%

Source: U.S. DOE, EIA, State Energy Data 2007: Consumption, Table 7.

There are several noteworthy trends:

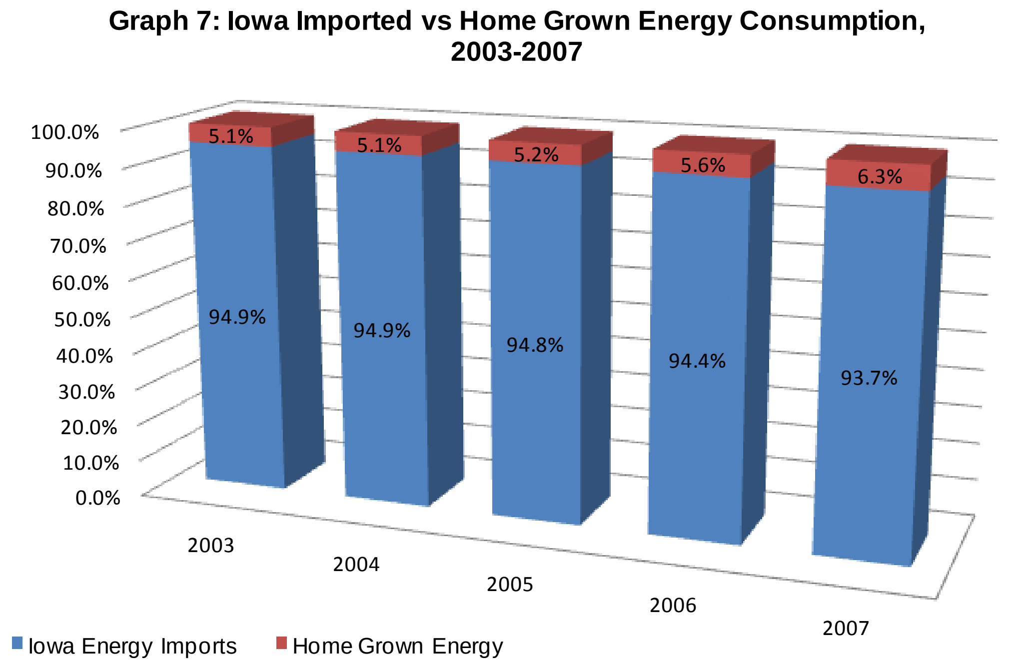
- Between 1980 and 2007, use of **coal** has nearly doubled, both in terms of BTU power and as a percent of Iowa's power mix. Coal use reached a new peak in 2007, after declining between 2000 and 2006.
- **Natural gas** use has declined as a percentage of overall energy use in Iowa since 1980, but its total use has risen along with energy use in the 1990-2007 time period. (Table 1)
- **Petroleum** has maintained a relatively steady position in Iowa's fuel mix, accounting for around 35% of our energy use since 1980. Although its use declined in the 80s at a rate similar to the decline of natural gas, its comeback has been much more impressive, as its overall growth rate between 1980 and 2007 was 17.2%.

- **Renewable energy** use dropped between 1990 and 2000, mainly due to decreased use of biomass. The large growth in renewable energy between 2000 and 2007 can largely be attributed to ethanol and wind energy.

- Although **nuclear energy** makes up quite a small portion of Iowa's energy consumption, its use has grown by 68% since 1980.

Iowa's Energy Balance

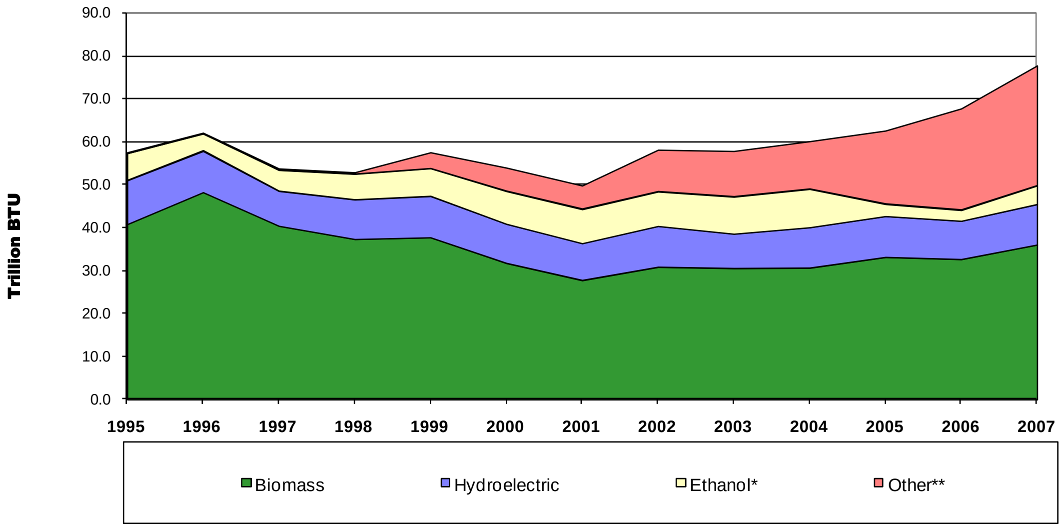
It follows that Iowa's current reliance on fossil energy sources also means that Iowa continues to rely heavily on energy imported from other states and nations (Graph 7).



Source: U.S. DOE, EIA State Energy Data 2007: Consumption
*Home Grown Energy includes biomass, hydroelectric power, ethanol, geothermal, solar and wind power.
** Iowa imported energy includes petroleum, coal, natural gas, and nuclear power.

The EIA estimates that 93.7% of energy consumed in Iowa in 2007 was produced from resources coming from outside the state. Homegrown energy consumption has increased slowly over the past 5 years from 5.1% in 2003 to 6.3% in 2007. Increase consumption of wind energy is almost solely responsible for this increase, as Graph 8 illustrates.

Graph 8: Composition of Renewable Energy Consumption in Iowa, 1995-2006



Source: U.S. DOE, EIA, State Energy Data 2006: Consumption.
*There is discontinuity in data between 2004 and 2005 because EIA changed estimation methodology.
**"Other" includes wind, photovoltaic, geothermal and solar thermal energy.

Iowa's "energy balance" - the amount of "domestic" energy consumed out of the total used - is an important measure of progress toward the goal of energy independence. (Graph 9)

While the majority of the energy consumed in Iowa still comes from out-of-state resources, it is important to note that Iowa's **production of homegrown energy has grown rapidly** in the last decade. Wind production has increased from 185 MWhs in 1997 to 2.8 million MWhs in 2007.

How does Iowa use Energy?

The EIA breaks down how we use energy into four sectors: the residential, industrial, commercial and transportation sectors. The Iowa industrial sector, which includes agriculture, is the largest user of energy in Iowa, accounting for 39.9% of all energy consumed in 2007. (Table 3) The next highest energy-using sector is transportation with a 25.6% share. Residential energy use was 19.0%, and the commercial sector used 15.6% of all energy consumed in Iowa in 2007.

Table 3: Iowa Energy Use by Economic Sector, 1980 - 2007

	1980		1990		2000		2007	
Sector	Trillion Btu	%	Trillion Btu	%	Trillion Btu	%	Trillion Btu	%
Residential	241.2	23.9%	197.9	21.5%	226.3	19.7%	234.5	19.0%
Commercial	125.7	12.5%	131.0	14.3%	167.1	14.6%	192.4	15.6%
Industrial	402.2	39.9%	354.0	38.5%	483.4	42.1%	492.2	39.9%
Transportation	238.0	23.6%	235.7	25.7%	271.3	23.6%	316	25.6%
Total	1,007.1		918.6		1,148.1		1,235.1	

Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

The commercial and transportation sectors have increased their energy as a proportion of Iowa's total consumption, while the industrial sector has remained fairly steady and the residential sector's energy use has declined.

Table 4: U.S. Primary Energy Consumption by Economic Sector, 1980 - 2007

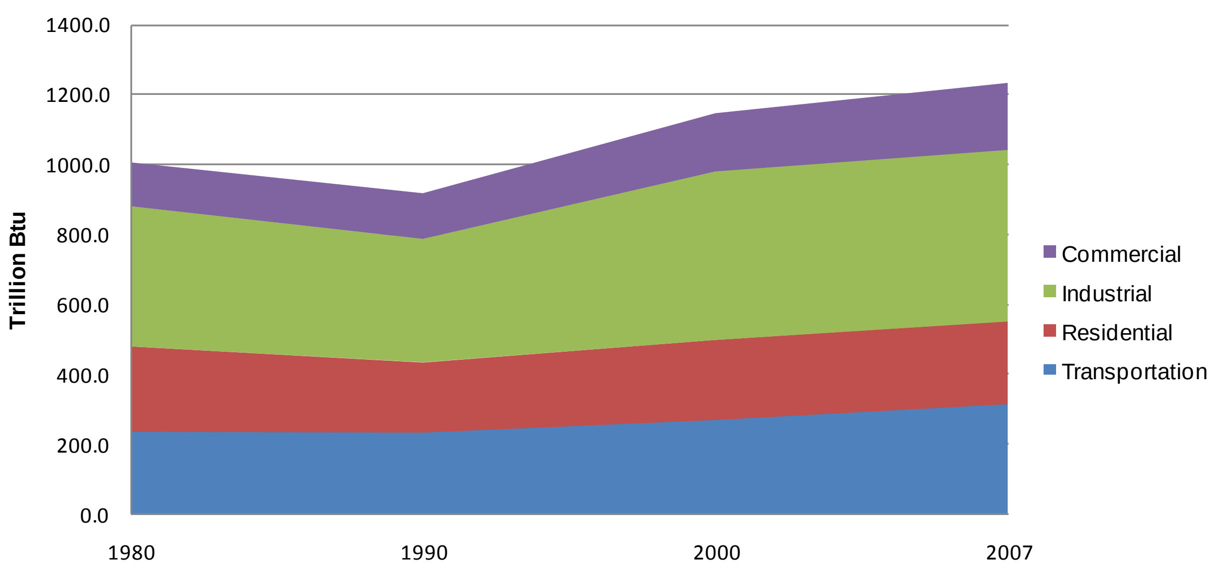
	Residential	Commercial	Industrial	Transportation
1980	20.2%	13.5%	41.1%	25.2%
1990	20.1%	15.7%	37.7%	26.5%
2000	20.7%	17.4%	33.2%	26.6%
2007	21.3%	18.0%	32.0%	28.7%

Source: U.S. DOE, EIA, Annual Energy Review 2007

In 2007, Iowa's residential and commercial sectors consumed relative less energy than those sectors consumed in the U.S. as a whole. Iowa's transportation and industrial sectors consumed a relatively larger proportion of total energy than the U.S. average. (Table 4)

In absolute terms, Iowa's energy consumption has increased in every sector except the residential sector in the 1980-2007 timeframe. (Graph 10 and Table 5) The commercial sector in Iowa has increased its energy use more than any other sector, using 53% more energy in 2007 than in 1980.

Graph 9: Iowa Primary Energy Use by Sector, 1980-2007

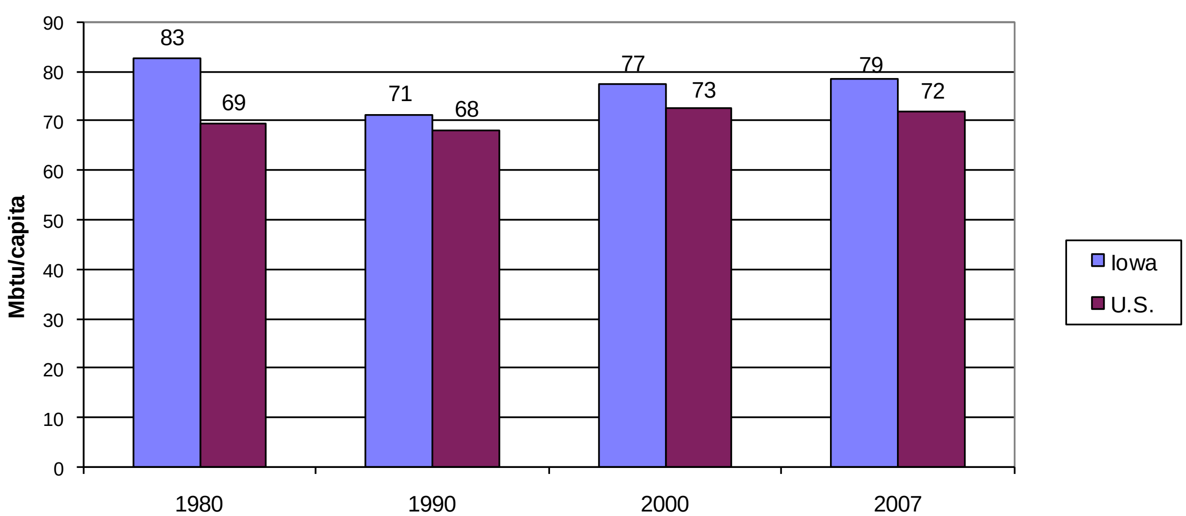


Source: U.S. DOE, EIA, State Energy Data 2006: Consumption

Table 5: Iowa and U.S. Energy Consumption Growth by Sector, 1980-2007		
	Iowa	U.S.
Residential	-2.8%	37.0%
Commercial	53.1%	73.1%
Industrial	22.4%	1.1%
Transportation	32.8%	47.7%
Total	22.6%	29.8%
Source: U.S. DOE, EIA Annual Energy Review, 2007		

Iowa's energy consumption has grown at a much slower rate than the nation as a whole in every sector except industrial use. Iowa's residential use is especially notable when viewed in terms of overall use and compared to the U.S. as a whole. However, it is also important to break down the residential data further to understand it better. Residential use in Iowa decreased by nearly 18% between 1980 and 1990, then grew by nearly that same amount between 1990 and 2007.

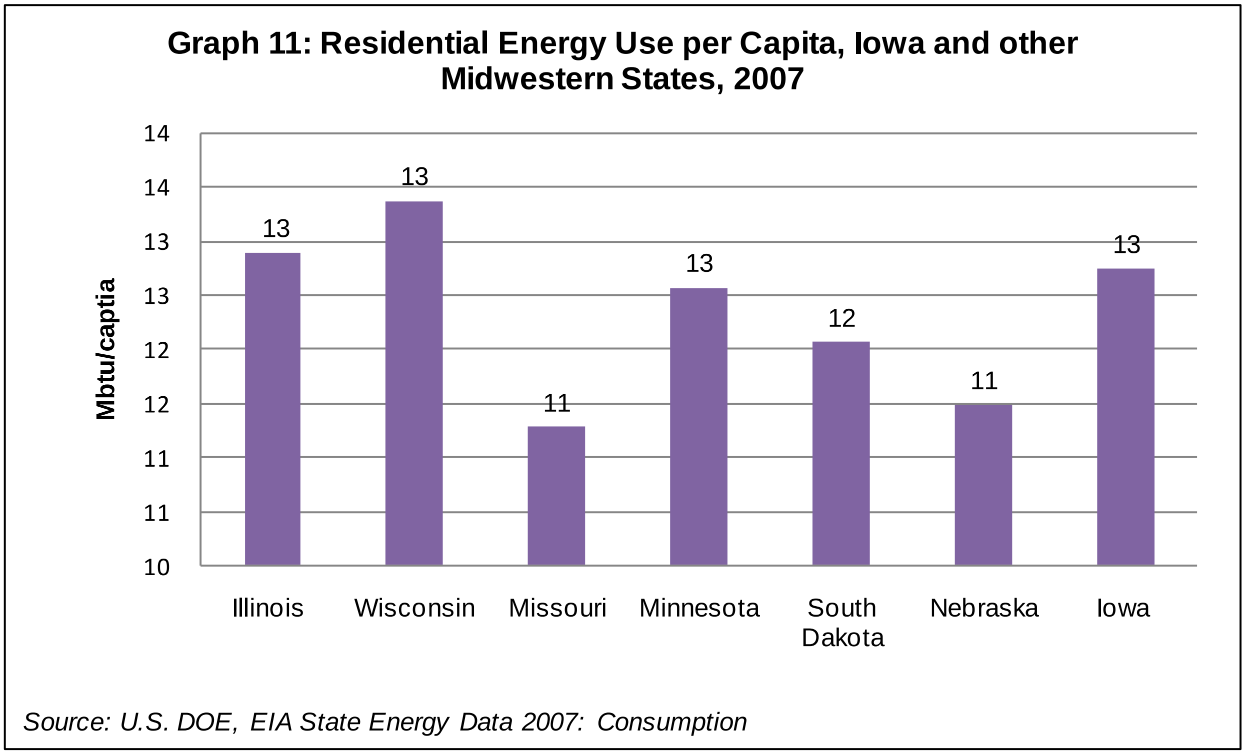
Graph 10: Iowa and U.S. Residential Energy Consumption per Capita, 1980-2007



Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

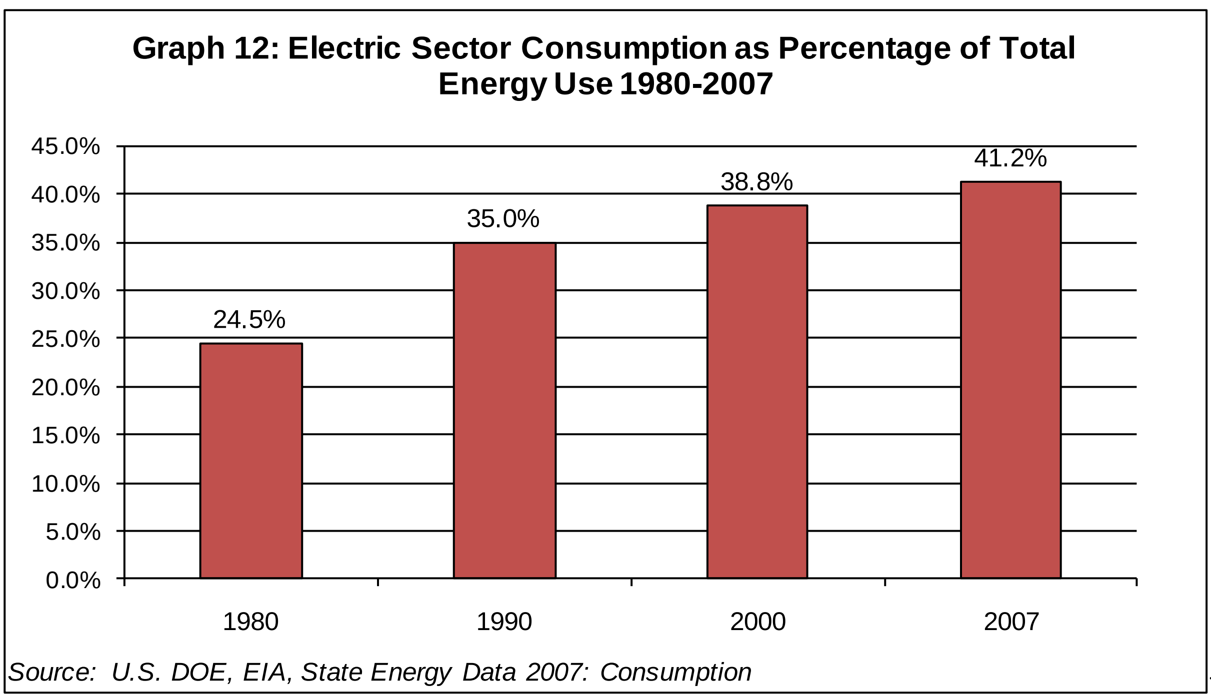
Iowa's per capita residential energy use dropped dramatically between 1980 and 1990, while the U.S. average dropped only a small amount. From 1990 onward, national residential use per capita has remained at a fairly steady level while Iowa's use has increased by about 11%. Graph 11 illustrates the growing gap between Iowa and U.S. per capita energy use in the residential sector since 1990.

Compared to other Midwestern states, however, Iowa compares a bit more favorably on this metric. Iowa's per capita residential energy use in 2007 was higher than Missouri, Minnesota, South Dakota and Nebraska, but lower than Illinois and Wisconsin. (Graph 12)

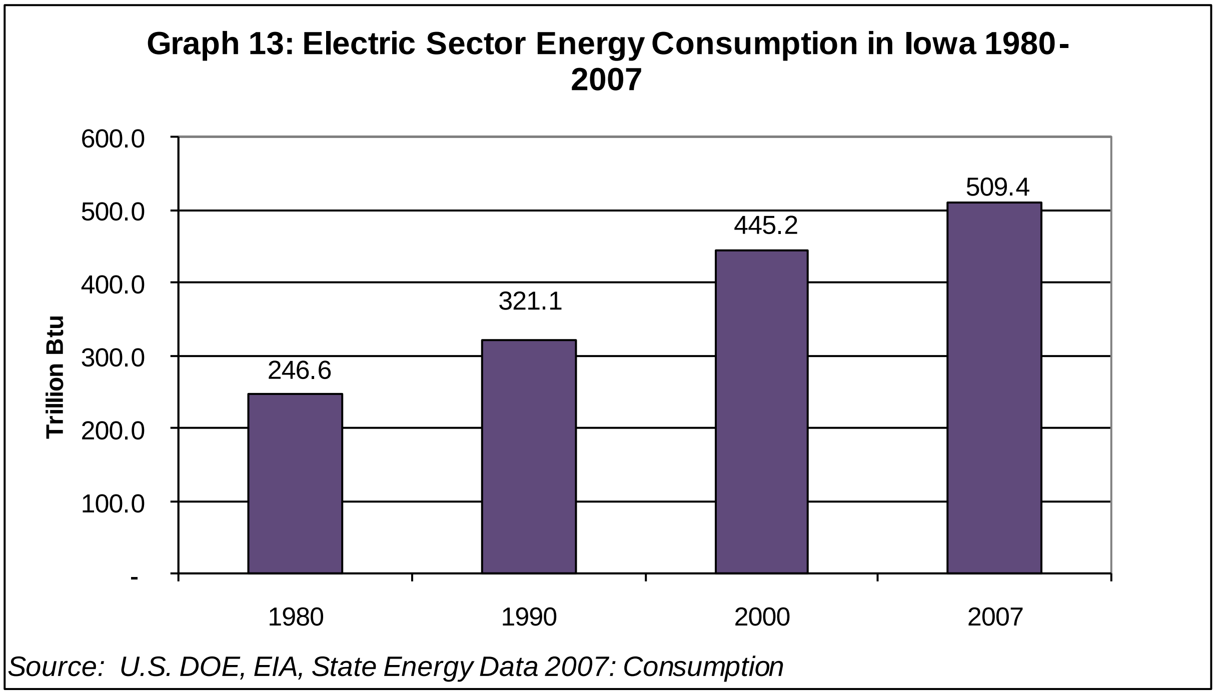


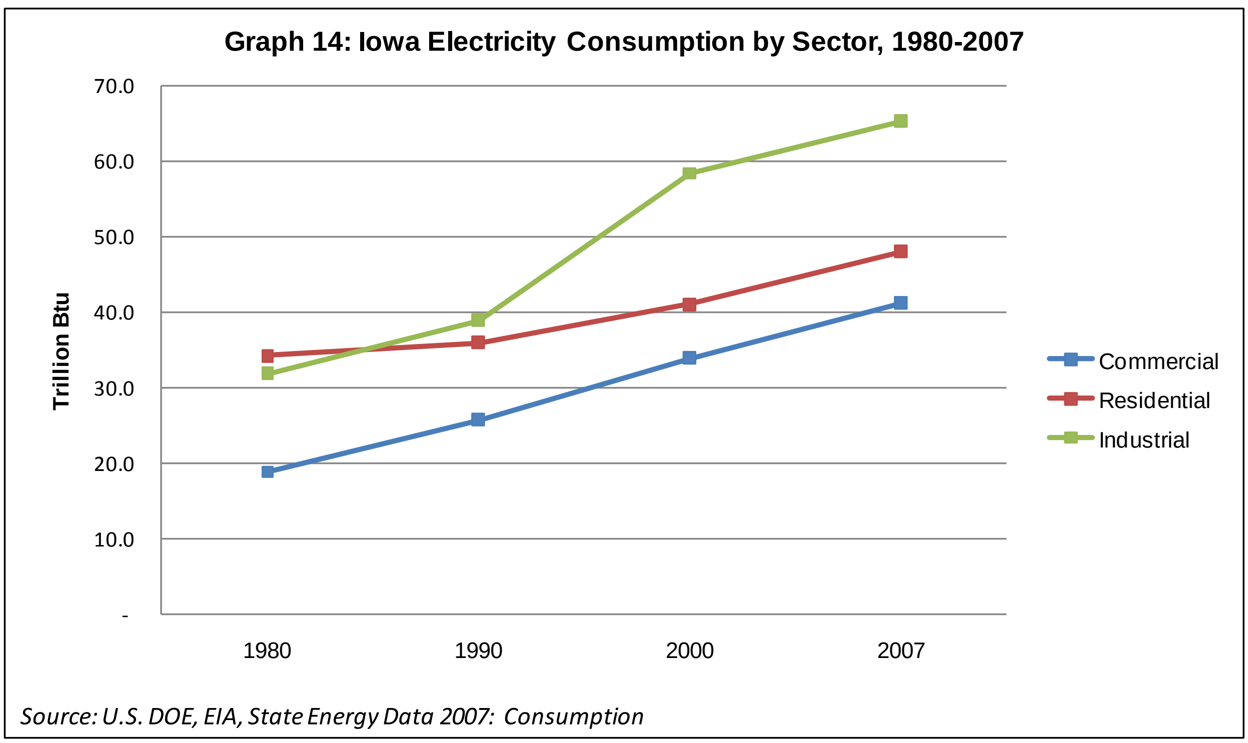
Iowa's Electric Sector

In 2007, about 41% of energy consumed in Iowa took the form of electricity. That percentage has been increasing since 1980. (Graph 13)



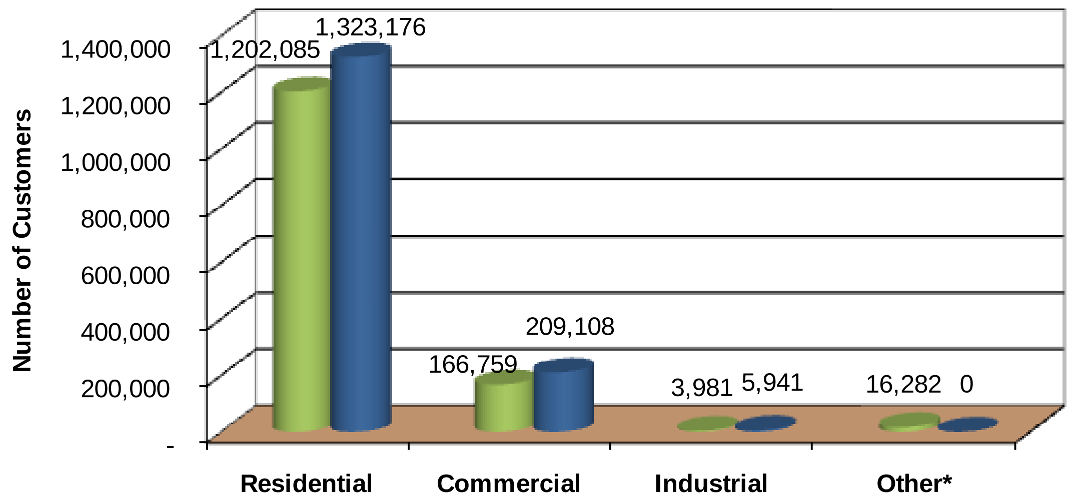
Total Iowa electricity consumption has also risen over time, by about 107% or 3.4% per year.(Graph 14)





The rise in electric consumption has been driven by demand in the commercial and industrial sectors. Between 1980 and 2007, electricity consumption in the commercial sector rose by nearly 120% and use in the industrial sector grew by 105%. Graph 15 illustrates Iowa's electricity consumption by sector for 1980 to 2007. The transportation sector in Iowa does not use any electricity, so only the commercial, residential and industrial sectors are displayed.

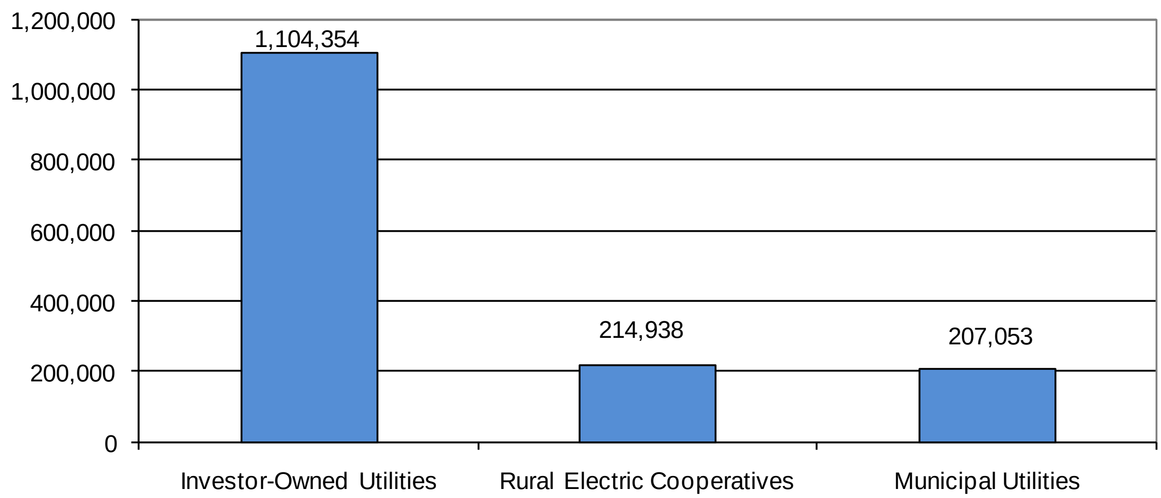
Graph 15: Electricity End Users in Iowa by Customer Class, 1997 and 2007



Source: U.S. DOE, EIA, Electric Sales, Revenue, and Average Price 2007
*"Other" category was eliminated in 2003 and use in this category (mostly publicly-owned buildings and systems) was re-distributed to other categories.

Utilities generally view those they serve in terms of "customer classes," including charging different rates to these different types of customers. The largest customer class in Iowa is residential electricity users. The number of customers in all classes has increased over time, though growth in industrial customers has led the way, increasing by nearly 50% between 1997 and 2007. (Graph 16)

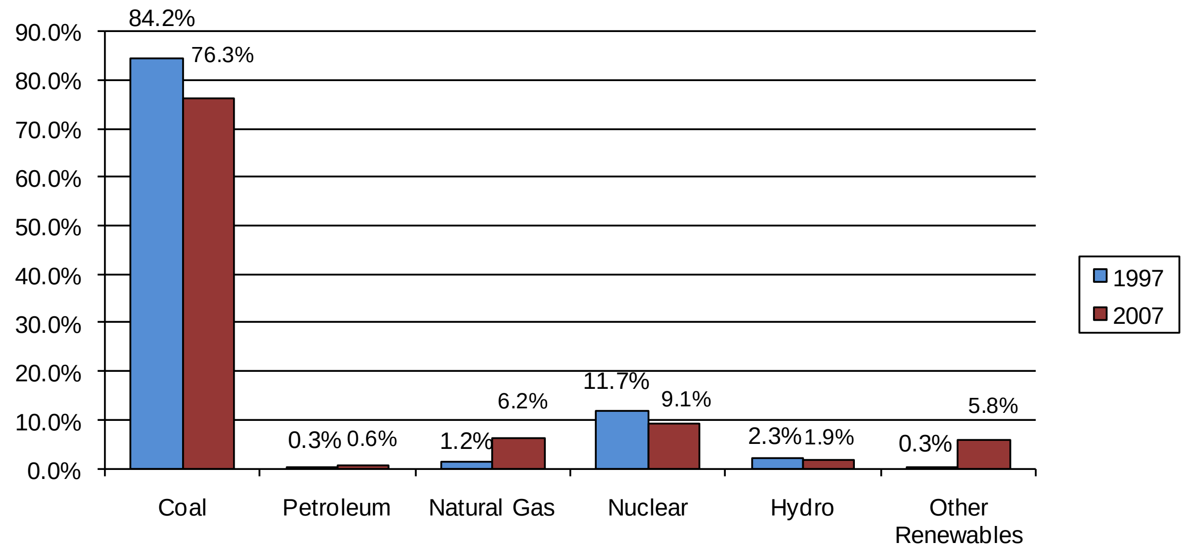
Graph 16: Number of Iowa Electricity Retail Customers by Utility Type, 2007



Source: U.S. DOE, EIA, Iowa Electricity Profile 2007

The very large majority of electric customers in Iowa are served by Investor-Owned Utilities, or IOUs. The IOUs in Iowa that sell electricity include MidAmerican Energy and Alliant Energy (or Interstate Power and Light). The other types of electricity providers in the state are municipally-operated utilities and electric co-operatives. (Graph 17) The IOUs are for-profit businesses, with rates that are regulated by the Iowa Utilities Board (IUB). The municipals are non-profit, government entities and the co-ops owned by their membership and both types of utilities set their own electric rates.

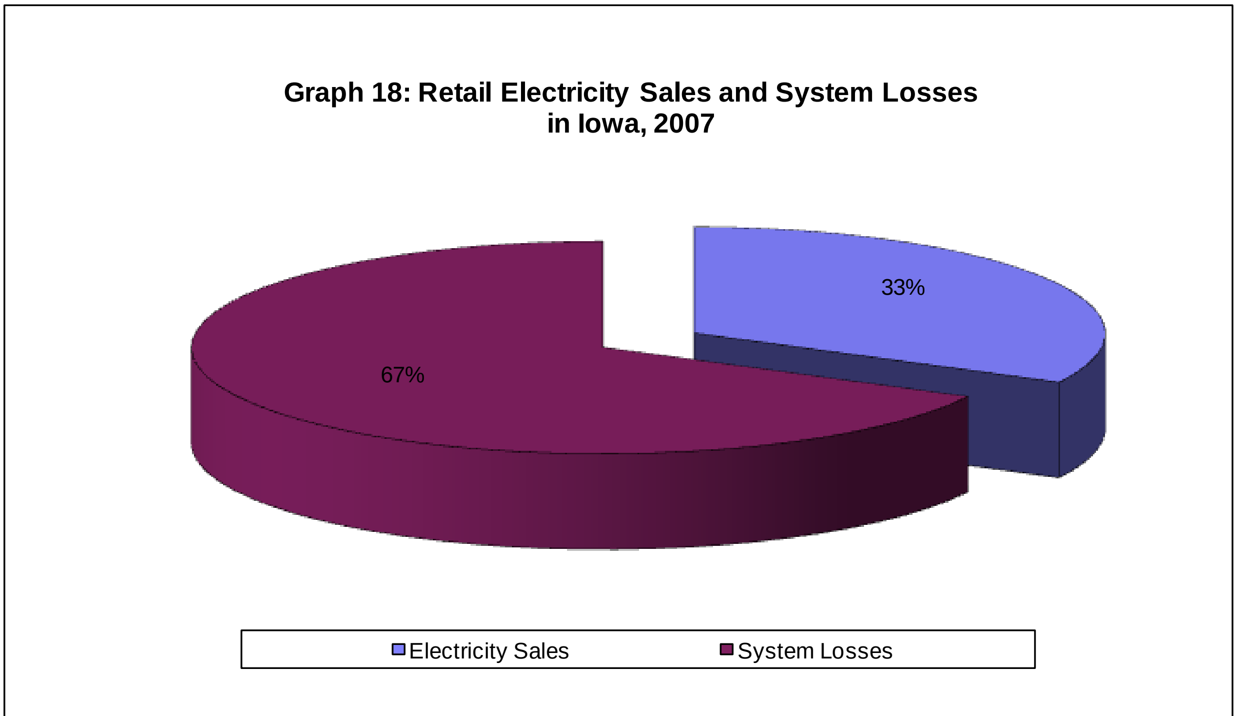
Graph 17: Iowa Net Electric Generation by Fuel Type, 1997 and 2007



Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

Electricity generation in Iowa is heavily coal-based. Natural gas and renewable generation has increased over the last 10 years, as use of coal has decreased. However, Iowa still relies on coal for more than three quarters of electric generation in the state.

Although electricity is a very handy carrier of usable energy, its generation and distribution leaves something to be desired in terms of efficiency. Only around one-third of the Btu inputs into an electric generation facility actually make it through to the end user, with most of the remaining energy lost as heat in the combustion process. (Graph 19)

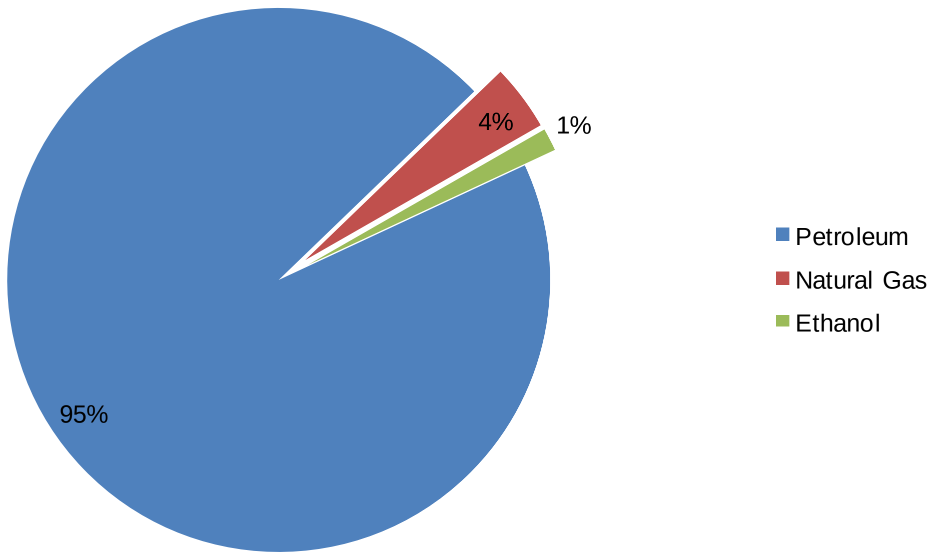


Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

Iowa's Transportation Sector

Predictably, energy use in Iowa's transportation sector is dominated by petroleum. (Graph 20) Natural gas and ethanol are the two other fuels that make an appearance, and together they make up 5% of energy consumed in Iowa's transportation sector. More data on total energy consumption in the transportation sector can be found in Tables 3 and 4 of this report.

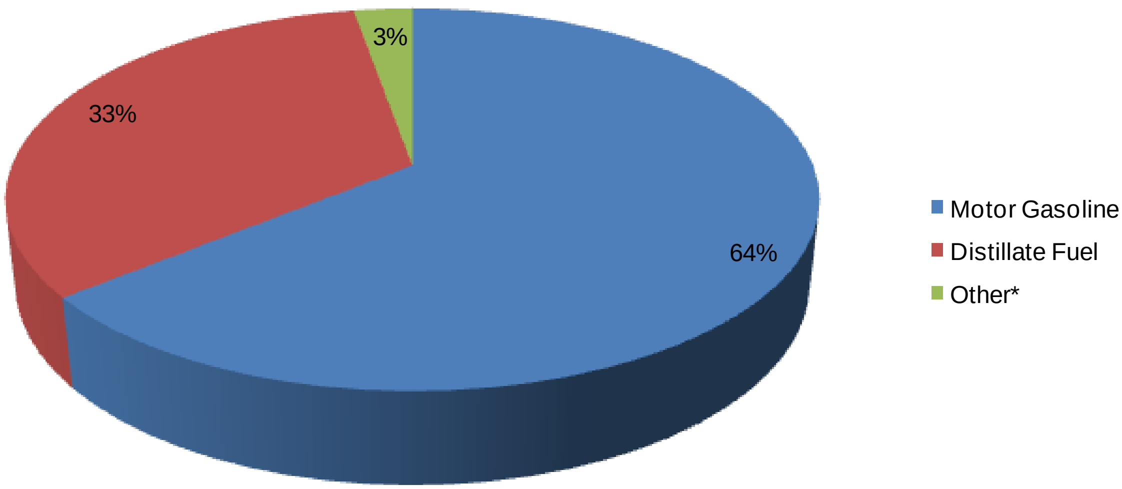
Graph 19: Iowa Transportation Sector Energy Consumption, 2007



Source: U.S. DOE, EIA, State Energy Data 2007: Consumption

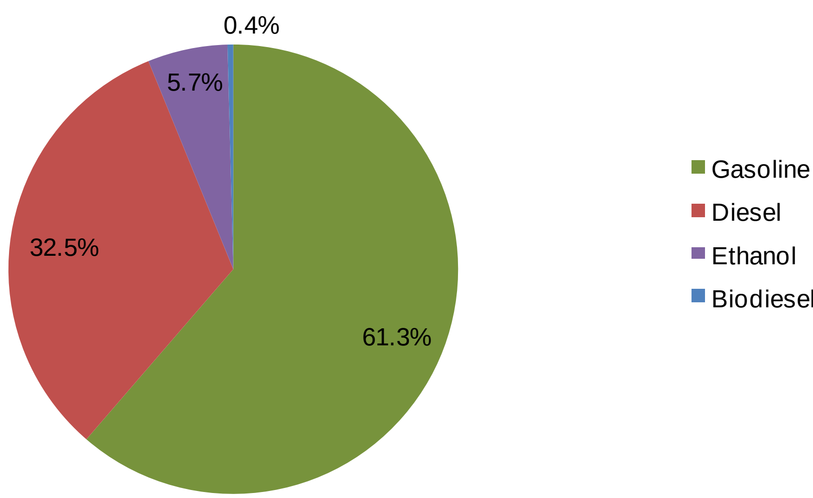
The petroleum consumed in the state is about two-thirds gasoline and one-third distillate fuel (diesel). (Graph 21)

Graph 20: Petroleum Consumption in Iowa's Transportation Sector, 2007



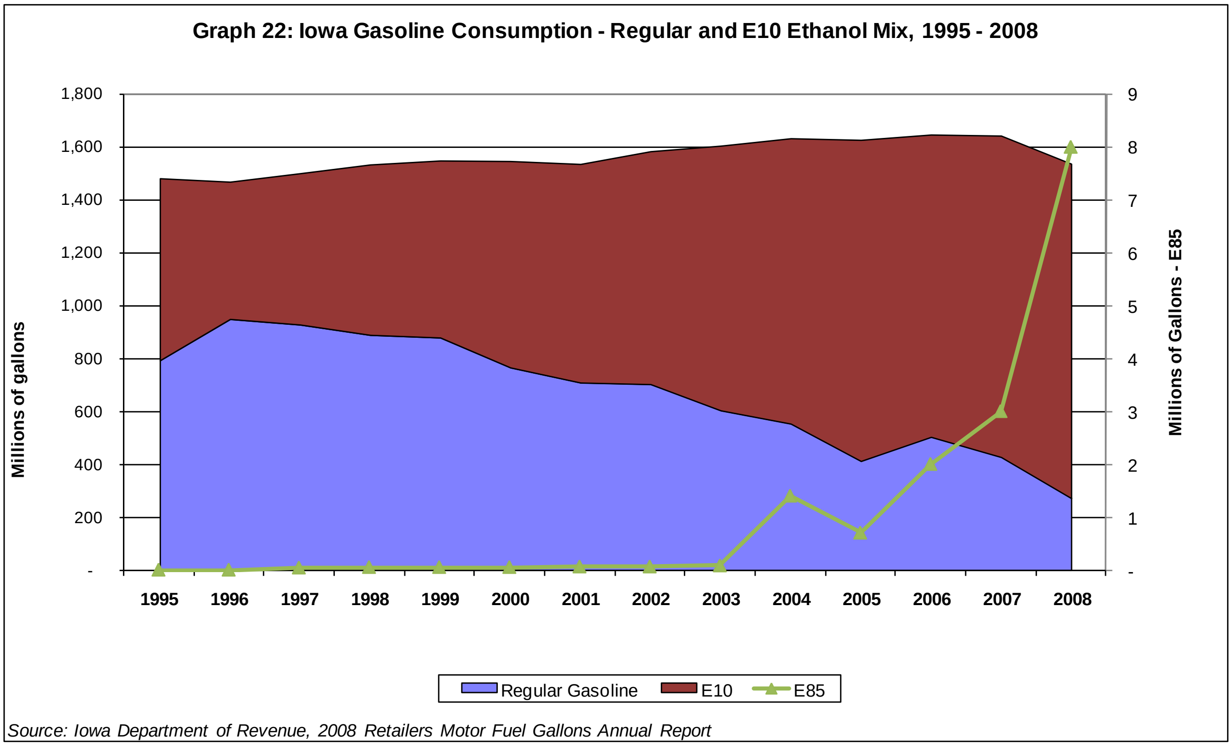
Source: U.S. DOE, EIA, State Energy Data 2007: Consumption
*Other includes aviation, gasoline, jet fuel, LPG and lubricants.

Graph 21: Consumption of Biodiesel and Ethanol in Iowa, 2008



Source: Iowa Department of Revenue, 2008 Retailers Motor Fuel Gallons Annual Report

An analysis by the Iowa Department of Revenue, released in April 2009, estimated consumption of renewable fuels in the state through reporting from retail and wholesale fuel operations. The report found that 82.3% of gasoline-type fuel was blended at either the E10 or E85 level. The percentage of clear (on-road) diesel fuel blended at some level with biodiesel was 33.7% while 14.4% of dyed (off-road) diesel was blended with biodiesel. The component of gasoline and diesel-type fuel consumption in Iowa that was pure biofuel was about 6%. (Graph22) Ethanol-blended gasoline has increased as a share of Iowa gasoline sales over the past 13 years, with E10 increasing steadily over the decade while E85 experienced the largest increase between 2005 and 2008. (Graph 23)



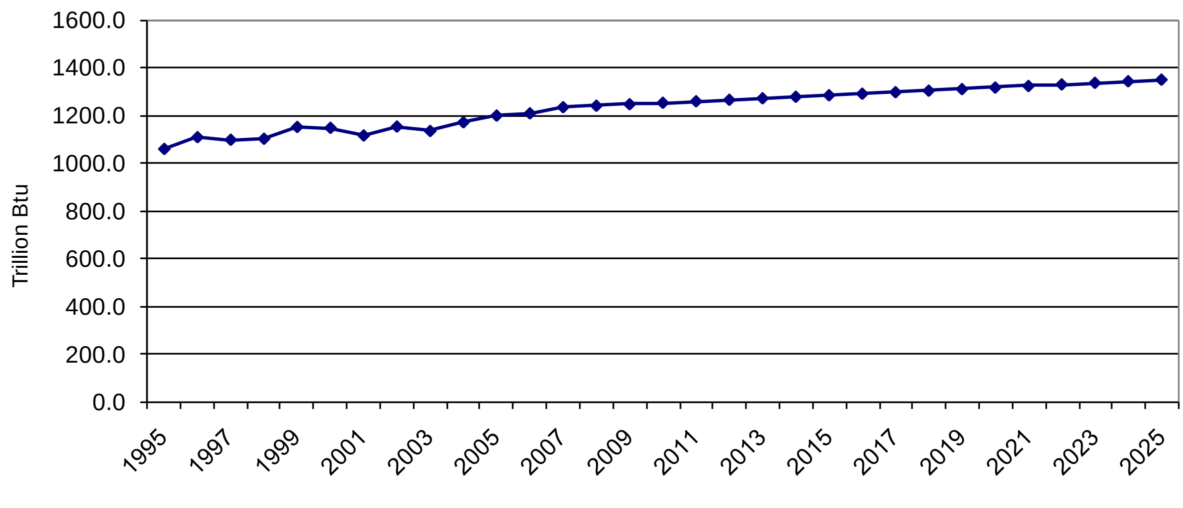
Projecting Iowa's Future Energy Needs

It is important to be aware that the precision and usefulness of long-term energy projections is often quite low. Estimates are based on business as usual, since it is nearly impossible to predict how demographic, technological, economic and political factors will shape future energy consumption and generation patterns. Even very recent events, such as the economic recession and subsequent funding through energy programs in the American Recovery and Reinvestment Act may have altered the path of projections in way that hasn't yet been quantified. The policies detailed in Iowa's Energy Independence plan are also designed to alter these projections from business as usual so that, when we reach the 2025 target. Each year, Iowa hopes to see these projections change as we bring the state closer to the goals of energy independence.

Recent EIA energy projections through 2030 for the U.S. as a whole predict slow growth of energy-intensive industries, such as chemical production and food processing. The EIA also projects a decline in energy use per dollar of gross domestic product (GDP). Petroleum projections by the EIA predict that efficiency gains will drive down consumption of petroleum as a percentage of GDP. The range of oil prices used in their projections range from $50 to $200 per barrel in 2030. The EIA projects an increasing share of liquid fuels will come from unconventional sources, such as biofuels Canadian oil sands. If oil prices are low, the EIA projects less than 10% of liquid fuels will be unconventional. This increases to around 20% in the high oil price scenario.

The EIA projects that total energy consumption will increase by 0.5% per year in the 2007-2030 timeframe. Between their 2008 and 2009 reports, the EIA reduced their projection from 0.7% per year to 0.5% due to the expanded scale and slow recovery projections of the current economic recession. Graph 23 illustrates how that growth rate would apply to Iowa's energy consumption. A 0.5% annual growth rate would mean an increase in energy consumption in Iowa of 12.6% in the 20-year span between 2005 and 2025. This growth rate is would be a very significant reduction from the 33% growth in energy consumption that took place in Iowa between 1985 and 2005.

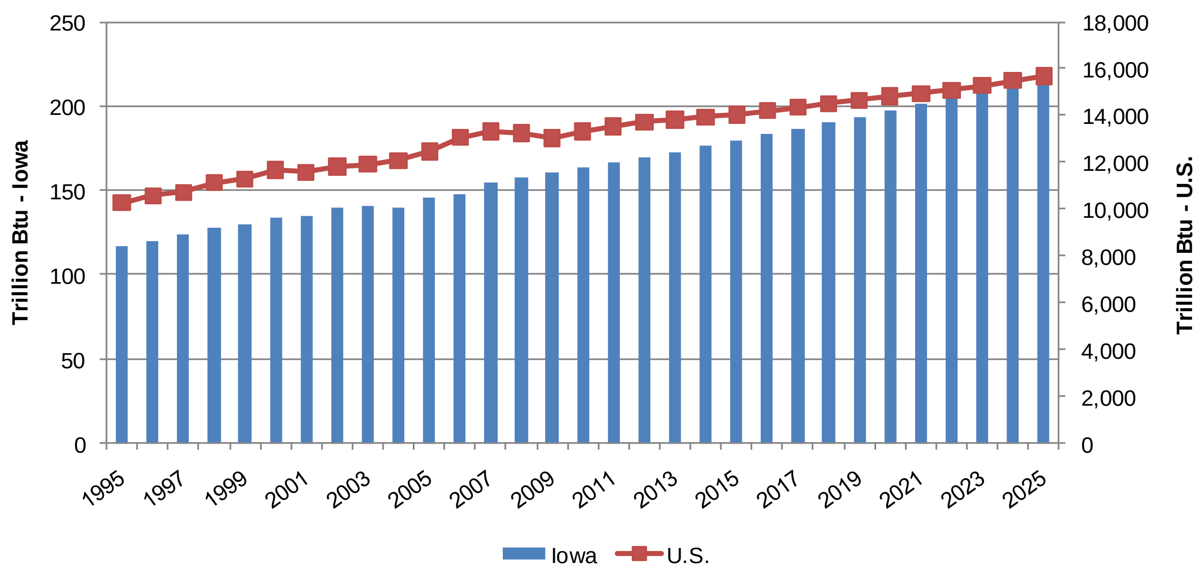
Graph 23: Iowa Total Energy Consumption Growth Projection through 2025



Source: DOE, EIA Annual Energy Outlook 2009 with Projections to 2030

The EIA projects that consumption of electricity in the U.S. will increase by 1.0% per year. The Center for Climate Strategies, on behalf of the Iowa Climate Change Advisory Council, projected that Iowa's electricity demand will increase by 1.9% per year through 2050. (Graph 24)

Graph 24: Iowa and U.S. Projected Energy Use through 2025



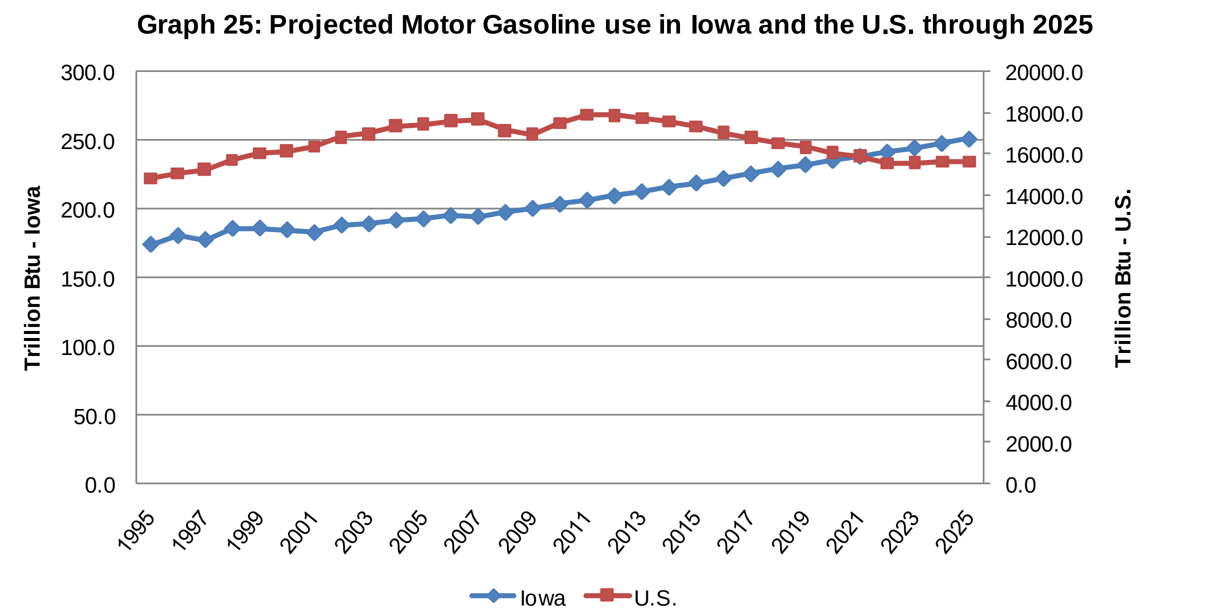
Sources: U.S. DOE, EIA Annual Energy Outlook 2009; State Energy Data 2009: Consumption; Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025

This means that the EIA is projecting that energy use will shift to electricity, away from other forms of energy, such as liquid fuels. (Graph 23) The U.S. growth rate would mean a 26% increase in electricity consumption between 2005 and 2025. The Iowa rate of growth would result in an overall growth rate of 50% during the same 20-year time span. However, a simulation run by staff at the Great Plains Institute for Sustainable Development (GPISD) on the Energy Choice Simulator model, developed to evaluate policy options for the Midwestern Governor's Association's Energy and Climate Stewardship Roadmap, projected that Iowa's electricity demand will increase by 24% between 2005 and 2025, an average of 1.1% per year.[1] This very large difference in projections for the state supports the disclaimer heading this section that future energy demand is very difficult to predict.

The EIA projects that gasoline use in the U.S. will decline over the next 17 years as small diesel vehicles come into more common use, alternative fuels use increases along with the Federal Renewable Fuel

[1] "Energy Choice Simulator results are critically dependent on assumptions made about highly uncertain variables such as the expected price paths of oil and coal and estimates of growth in demand for electricity and fuel. While the results of the model are therefore useful for illustrating the complexity of economic response to a given policy or policies, they should not be interpreted as predictions about absolute levels of impact unless accompanied by extensive sensitivity analysis around these uncertain but influential variables. This document does not provide such sensitivity analysis, and presents the model results to illustrate the dynamics of the response and the relative impact of policy efforts rather than to predict the absolute magnitude of impact." – Midwest Energy Security and Climate Stewardship Roadmap, 2009, page 7.

Standard and hybrid cars make up an increasing share of the vehicle fleet. However, the Center for Climate Strategies projected that gasoline use in Iowa will increase by 1.5% per year. (Graph 25)



Sources: DOE, EIA 2009 Annual Energy Outlook and StateEnergy Data: Consumption, 2007

If both projections are correct, the result would be a decrease in U.S. gasoline consumption of 10.5% between 2005 and 2025, while gasoline use in Iowa increases by 40% over that time period. The EIA number reflect lower projections due to recently decreasing gas prices, which could account for a portion of the discrepancy between the U.S. and Iowa projections.

The Impact of Meeting Iowa's Energy Needs

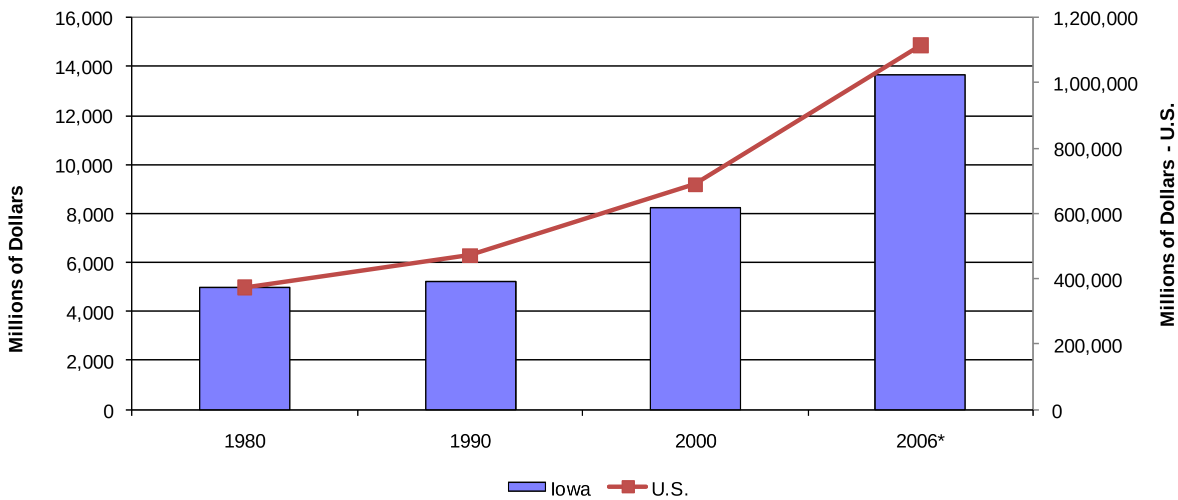
If an analysis of Iowa's projected future energy needs is fraught with uncertainty, determining the economic and environmental impact of meeting those needs is even more questionable. There are many inputs on both sides of the energy balance ledger that could impact Iowa's economy. Status quo thinking about energy ties economic development to growth in energy use. Instead, economic development is really tied to a **critical suite of energy services** that may not necessarily mean increased expenditures on BTU's, but could be expenditures related to energy efficiency, transmission and distributed generation that contribute to Iowa's energy independence and economic prosperity. Increasing expenditures on renewable, Iowa-produced energy could have a positive economic impact on the state. Investments in energy efficiency that reduce overall energy expenditures could also be a positive, increasing consumers' ability to spend money on non-energy goods. The impacts of global warming and likely future greenhouse gas (GHG) regulation bring additional considerations to the equation.

In their 2009 Annual Energy Outlook, the EIA projects that energy expenditures will increase substantially in every sector between now and 2025. This projection is based on business as usual, and the projections for Iowa detailed in the previous section reflect the same premise of continued higher consumption along with higher prices.

Energy Expenditures

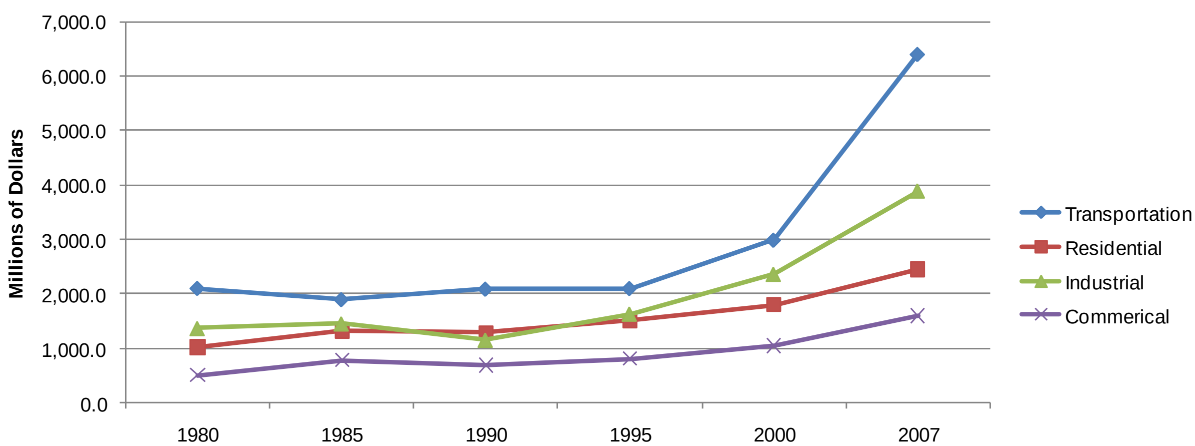
From an historical perspective, Iowa has been largely on track with the nation as a whole in terms of energy expenditures since the 1980s. Although Iowa's energy expenditures grew much more slowly than the U.S. average between 1980 and 1990 due to the farm crisis, they grew by 11.4% per year between 1995 and 2007 while the U.S. averaged a growth rate of 9.7% per year. (Graph 26)

Graph 26: Iowa and U.S. Primary Energy Expenditures 1980-2006



Sources: U.S. DOE, EIA State Energy Data, 2007: Prices and Expenditures and Annual Energy Review 2008
**Note: 2006 is used as a reference year because it is the most current expenditure data available for the U.S. as a whole*

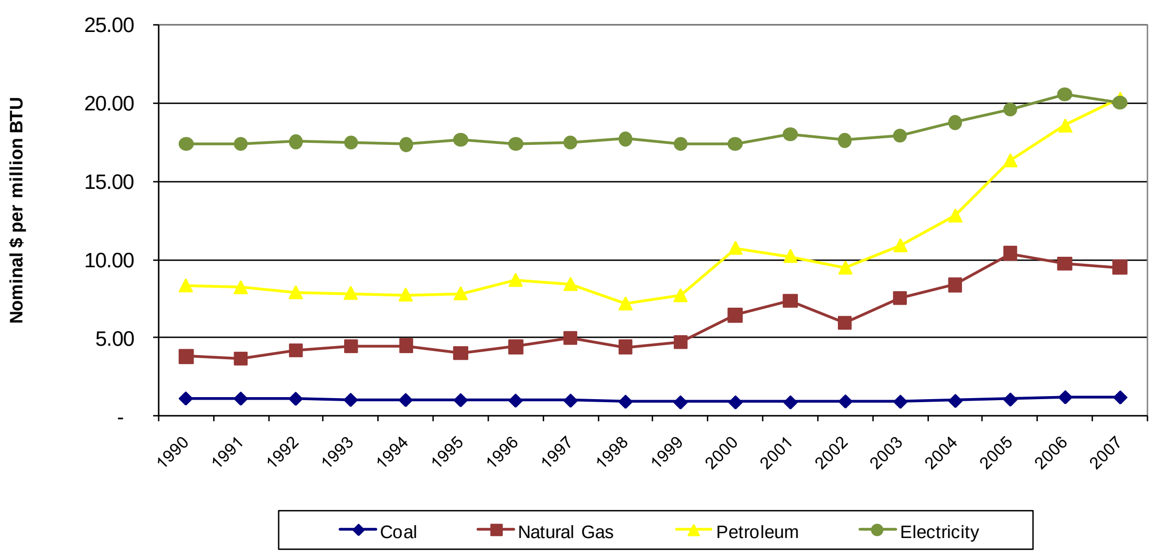
Graph 27: Iowa Energy Expenditures by Sector, 1980 - 2007



Source: U.S. DOE, EIA State Energy Data 2007: Prices and Expenditures

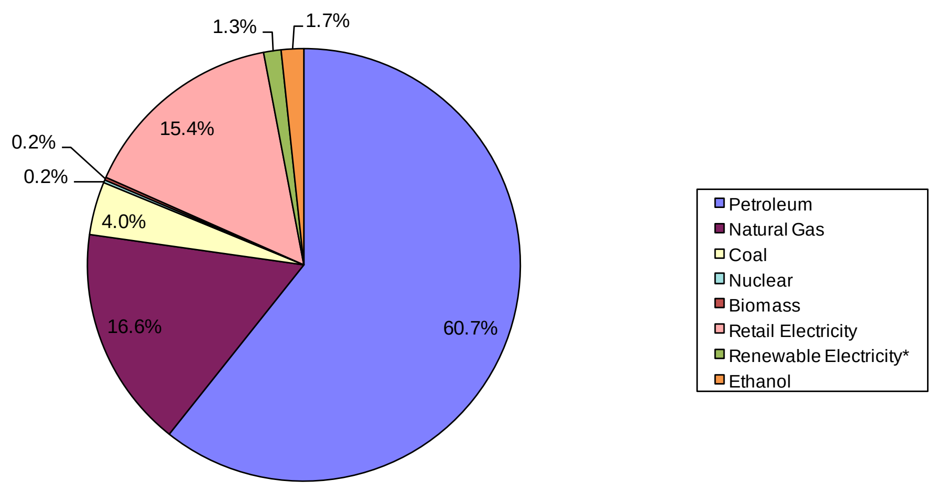
Although transportation was the largest expenditure class throughout the time period examined in Graph 27, it pulled away from the other sectors between 2000 and 2007, increasing by 114% over that time period while the other sectors increased, on average, about 51%. Most of that increase can be explained by higher than normal petroleum prices. (Graph 28) The volatility of energy prices add to the difficulty of projecting the economic impact of meeting Iowa's energy needs.

Graph 28: Iowa Energy Prices 1990-2007



Source: DOE, EIA, State Energy Data 2007: Prices and Expendatures.

Graph 29: Iowa Energy Expenditures by Fuel Source, 2007



Sources: U.S. DOE, EIA State Energy Data, 2007: "Prices and Expenditures" and "Consumption"; Iowa Department of Revenue 2008 Retailers Motor Fuel Gallons annual Report

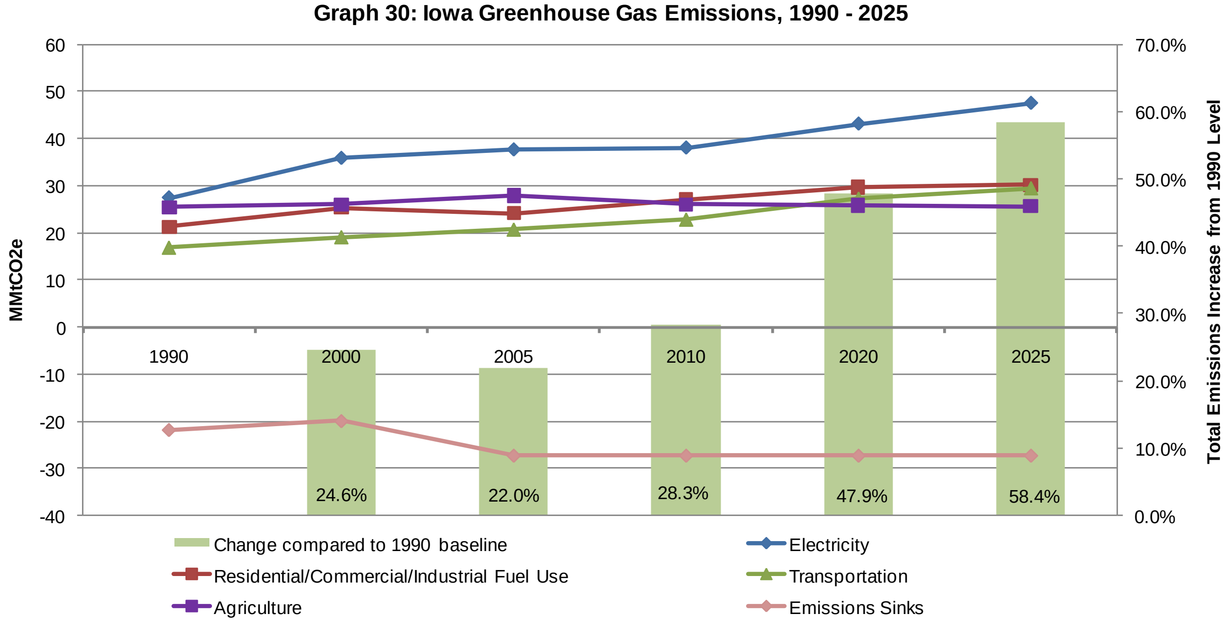
The large majority of funds spent on energy in Iowa go toward purchase of petroleum products. (Graph 29) The next highest expenditure categories are electricity and natural gas, which account for around

17% of energy expenses apiece. Coal expenditures in this data set look small because little coal is used for energy directly – most coal use in the state falls under the electricity category.

Iowa's 2007 energy expenditures totaled $14.3 billion, about 11% of state GDP in that year. If Iowa follows the projected national trend through 2025, expenditures would be expected to be 79% higher: $24.5 billion. This means that, per capita, **energy spending in Iowa would nearly double from $4,577 in 2007 to $8,179 in 2025** while the state's **population is projected to grow by less than 0.2%** over that same time period.

Regulation of greenhouse gas emissions is another variable that will impact future energy production and expenditures. Climate Strategies, on behalf of the Iowa Climate Change Advisory Council, showed Iowa's emissions taking a generally upward trend between 1990 and 2025, except for a slight decrease in emissions between 2000 and 2005. (Graph 32) The gray bars are tied to the right-hand axis, representing the percent increase compared to 1990 levels. Each line represents a major emitter category, except the pink line at the bottom, which represents the estimated carbon sinks in the state, such as soils and trees. The smallest categories of emitters are not represented on the graph, for the purpose of simplification. Those groups are: the fossil fuel industry, industrial processes, and waste management. Together, they represent about 8% of gross emissions, while the 4 categories in the graph capture 92% of emissions. The sectors with the largest emissions profiles will be both most heavily impacted by GHG regulation and have the largest reduction potential.

Graph 30: Iowa Greenhouse Gas Emissions, 1990 - 2025



Source: Final Greenhouse Gas Inventory and Reference Case Projections 1990-2025, Center for Climate Strategies, Iowa Climate Change Advisory Council

Economic Impacts of Iowa's Energy Use and Meeting Future Energy Needs

Iowa faces multiple potential energy futures. Much of what will determine the make-up of future expenditures and their economic impact depends upon regulations and incentives that will shape energy industries and determine technological development for those industries over the coming decades. A series of policy decisions will determine whether Iowa's energy expenditures are recycled into the Iowa economy and produce positive job and wealth impacts or are exported, along with a majority of the economic benefits, to other states or nations.

Energy produced outside of the state, or produced from fuels (like coal and oil) that come from out of state can still have some positive economic benefit when transportation, generation and other infrastructure is located in Iowa and employs Iowans. Daniel Otto and Mark Imerman at Iowa State University issued a study in April of 2006 that estimated the "leakage" of energy expenditures to other states and countries for electricity, natural gas and petroleum.[2] The study found that natural gas accumulates the least benefit in-state, while electricity production keeps the most money in Iowa.

When the leakage rates in the Iowa State study are applied to 2007 EIA energy expenditures, results show that about **$5.25 billion, or 37% of Iowa's energy expenditures, accumulated to economies of other states or countries.** The money Iowans spent on renewable energy including wind, hydropower and ethanol, amounted to a total of $427.6 million. Assuming that all renewable electricity produced in Iowa is consumed here, and that there is no out-of-state leakage related to renewable electricity and ethanol, **using Iowa-based energy resources kept $133.5 million circulating in the state economy** that would have gone elsewhere if it had been used to purchase fossil energy.

There are 2 main ways to keep more of the dollars currently spent on energy in the Iowa economy:

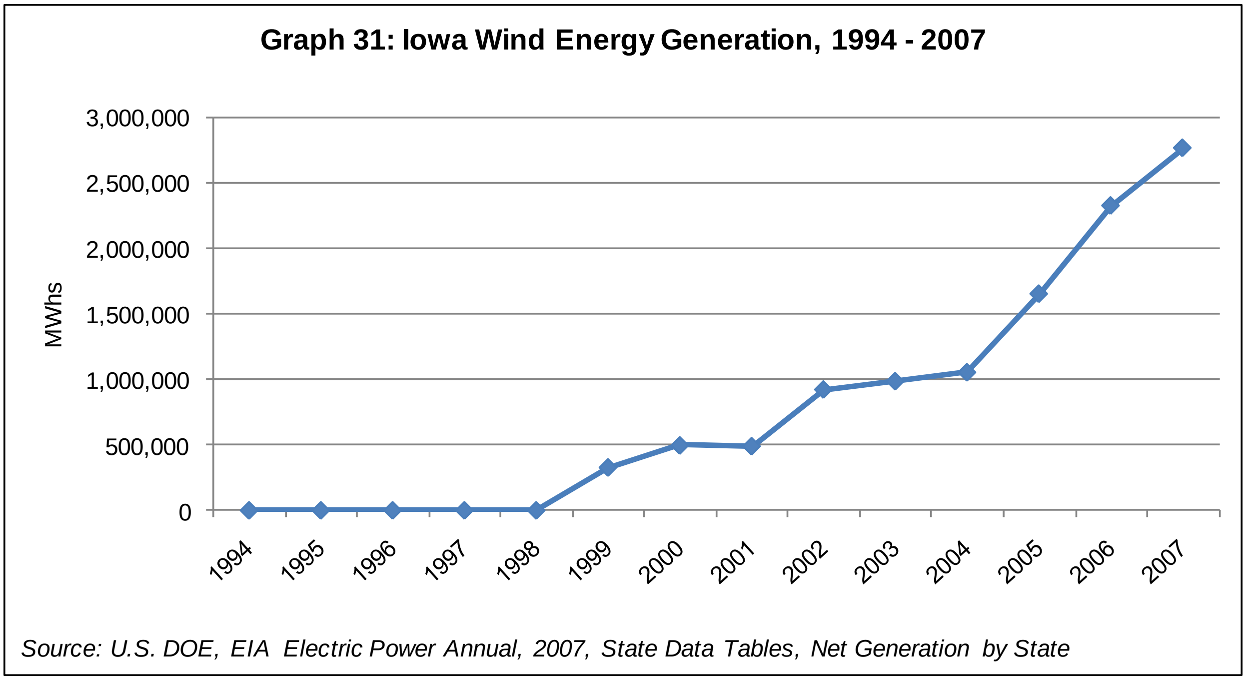
- Increase Iowa's use of in-state energy resources (renewable energy)
- Increase Iowa's overall energy efficiency

Increasing Use of Renewable Energy

Wind Energy

Iowa is the 10th windiest state in the country, with an estimated 551 billion kWhs per year of wind generation potential, according to the American Wind Energy Association (AWEA). The incentive for Iowa's first wind energy development was a 105 MW renewable requirement for the investor-owned utilities (IOUs), enacted in 1983. This level of capacity was met more than 10 years ago. In 2007, Governor Culver established a voluntary goal of 1,000 MW of wind capacity by 2010. As of the 3rd quarter of 2009, the American Wind Energy Association reported that Iowa has 3,053 MW of installed capacity – second in the country, surpassed only by the state of Texas - with 400 MW under construction. Graph 30 shows Iowa's wind energy in terms of MWhs generated since the first turbines went online in 1994.

[2] Otto and Imerman, "Analysis of Energy Supply and Usage in the Iowa Economy," April, 2006, http://www.econ.iastate.edu/research/webpapers/paper_12493_06001.pdf



In 2007, 2.8 million MWHs of wind energy were generated – 5.5% of total electric generation in Iowa that year. **A 2009 report by the Iowa Policy Project estimated that wind energy now comprises about 15% of electric generation in the state.**[3] In November, 2009, the Iowa Utilities Board approved 1,001 additional Megawatts of wind capacity to be built by MidAmerican Energy, the largest current owner of wind capacity in the state.

The Department of Energy's National Wind Power Goal, meeting 20% of national energy needs with wind energy by 2030, sets the goal for Iowa at 20 GW. Development of 10 GW of wind capacity by 202 is an appropriate midterm goal for Iowa. Current and planned wind capacity, with the approved MidAmerican expansion, would move the state to meeting almost 45% of this nearer-term goal. An analysis performed for the state of Iowa by Navigant Consulting at the beginning of 2009 estimates that, with the right incentives, wind power could amount to 62% of total in-State electricity demand by 2025, with a large portion being exported to other states.[4]

Of course, new generation capacity is not free, and building out wind will come at some cost. The Energy Choice Simulator Model projects that a build-out of 10 GW of wind power in Iowa by 2020 would raise electric rates by 9.2%, or 0.83 cents per kWh compared to current rates. (Graph 32)

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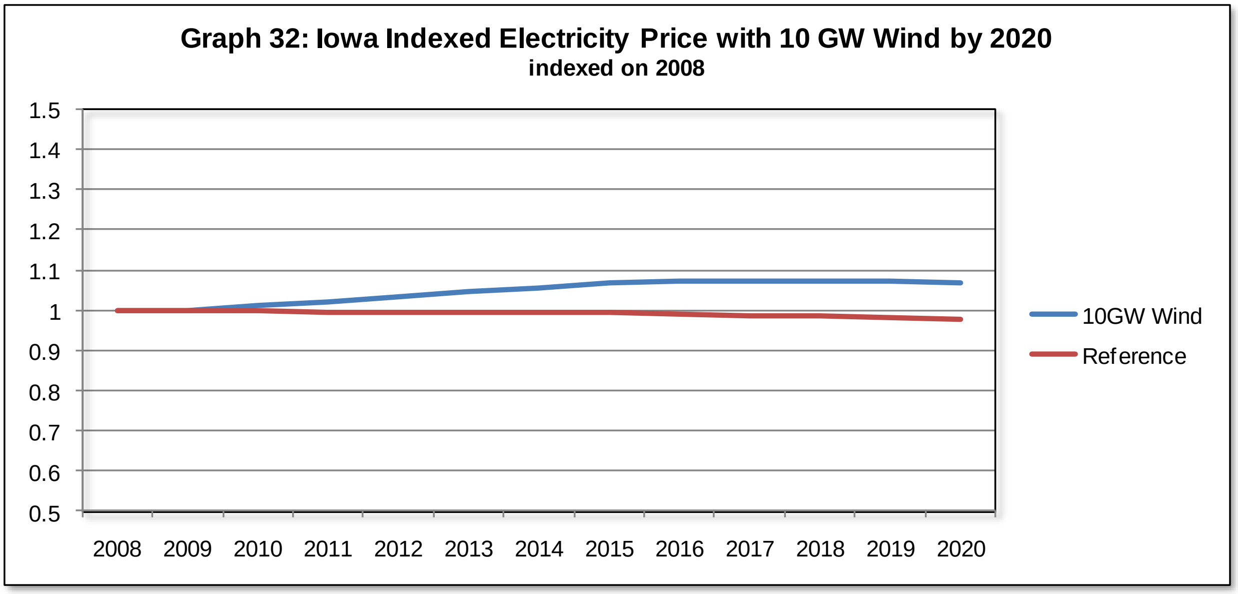
[3] Galuzzo, Teresa, and Osterberg, David, "A Windfall of Green Energy", Publication of the Iowa Policy Project, April, 2009, http://www.iowapolicyproject.org/2009docs/090413-windproduction.pdf

[4] Kinross, Andrew, "Policy/Strategy Option Descriptions Final Report, Presented to Iowa Office of Energy Independence," January 30, 2009.



There are also significant positive economic benefits projected from increasing Iowa's wind energy capacity. Currently, nine wind turbine manufacturers are located in Iowa. Estimates indicate that 2,300 Iowans are employed directly by the wind industry. Two hundred companies in 26 counties are supplying wind turbine components, resulting in increased revenues of $50 million annually. The DOE estimates economic impacts in Iowa, over the 20-year life of the 20 GW goal, to be $21 billion, including $53 million per year in landowner payments and $759 million per year in local economic benefit during the turbines' operation phase. Jobs impacts are estimated at 63,000 construction-phase and 9,000 permanent direct and induced jobs.[5] These job and economic impacts do not include the manufacture of turbines and components locally. An NREL study showed that increasing the local manufacture of turbines and components by as little as 10% can increase economic benefits for a state as much as 58% during construction.[6]

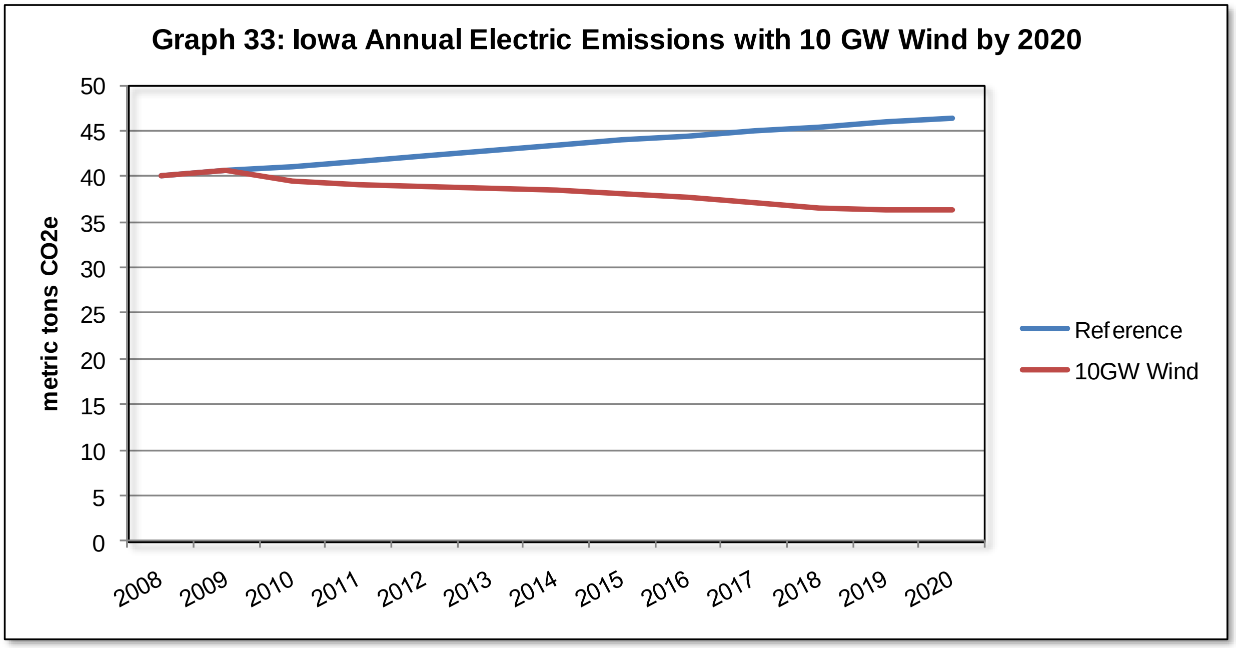
The study performed for the State of Iowa by Navigant Consulting projected cumulative economic benefits of $3.2 billion between 2010 and 2020 as Iowa works toward the 10 GW goal. The Navigant study also projects that wind manufacturing jobs will rise from the current estimated 2,300 jobs to 4,366 between now and 2012. Construction jobs are projected to employ between 500 and 1,000 Iowans between now and 2025, with operations and maintenance jobs employing 174 people in 2010, rising to 436 people in 2020. These are direct jobs and do not include any induced impacts.

Another economic impact of wind energy is price stabilization for natural gas. As more wind energy is produced, demand for natural gas is reduced, making the market more predictable and less prone to price spikes.[7]

The major environmental benefit of increasing wind capacity to 10 GW by 2020 is reduction of greenhouse gas emissions in the electric sector. The Energy Choice Simulator's business as usual

[5] "Wind Energy and Green Jobs", Governors' Wind Energy Coalition, February, 2009.
[6] "Wind Energy and Green Jobs".
[7] "20% Wind Energy by 2030 Report", U.S. DOE, July, 2008, Appendix A

reference case for Iowa projects electric sector emissions will increase by 12.7% between 2010 and 2020. Under the 10 GW scenario, that projection is reduced by 21.7%, for an overall reduction in electricity emissions of 7.8% over this 10-year period. (Graph 33) The 2009 Navigant study predicts even greater reduction in GHGs, projecting that moving toward 10 GW of wind energy would help to avoid an estimated 28% of electricity-related emissions by 2020.



Another environmental benefit of increased wind generation is decreased water usage. Fossil energy generation is water-intensive. If Iowa were to meet the DOE's goal of 20 GW of wind capacity by 2030, Iowa would save 1.64 trillion gallons of water.[8] Wind generation also avoids other negative environmental consequences of fossil electricity, including air pollution with mercury and other heavy metals, the emissions related to extracting and transporting fossil fuels, and the production of toxic slurries and other wastes.

One barrier to increased wind generation in Iowa includes a lack of large transmission lines to carry renewable electricity to major load centers like Chicago. The largest barriers to installation of adequate transmission are determining who pays for new transmission and where that transmission is sited. Another barrier is the lack of consistency in federal incentives for wind. The federal production tax credit (PTC) for wind is typically extended for a limited period of time, creating uncertainty among investors. The PTC was extended for 5 years in the American Recovery and Reinvestment Act of 2009, but many in the wind energy industry would like to see the credit put into the tax code permanently. The need for development of advanced turbine technology to improve capacity and performance is another barrier that must be overcome to fully develop this resource. Finally, wind presents the challenge of balancing

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[8] "Renewable Energy and Economic Potential in Iowa, Kansas, Nebraska, South Dakota," Center for Rural Affairs, August, 2009, http://files.cfra.org/pdf/Renewable-Energy-and-Economic-Potential.pdf

generation and load over time with a resource that is "non-dispatchable," or cannot be readily accessed on-demand.

Solar Energy

Although they are probably the most commonly known form of solar energy, solar photovoltaics (or solar PV - solar cells that produce electricity) are not the only solar technology. Solar thermal technologies, like hot water heaters, are currently both cost-effective and common applications of solar energy. Passive solar building design, which utilizes architecture and materials to control the solar energy entering the building, reduces heating and cooling costs. Solar space heating and cooling is another emerging solar technology application.

However, in 2008 the U.S. Solar Energies Industry Association (SEIA) reported 20,500 systems in the entire U.S., while 1 in 10 households in China used solar water heat. The SEIA reported that at the end of 2008, there were 9,183 MW of solar capacity in the U.S.[9] This included a 58% increase in PV and 40% increase in solar hot water heat compared to 2007. The SEIA also reported that solar manufacturing in the U.S. grew by 60% in 2008, in spite of unfavorable economic conditions overall.

Although the U.S. currently lags Germany, China and Japan in terms of overall solar installations, state-level policies have begun to boost solar installations. The United States is expected to surpass these countries to become the dominant market for solar photovoltaics over the next 4 years, according to a December, 2009 study by GTM Research, a greentech market research firm.[10] The report estimates that demand for grid-connected solar cells will rise by 48% per year between 2008 and 2012. New solar demand will be mostly in the residential and state and local government sectors. Iowa is not among the states expected to lead in PV demand. According to the Database for State Incentives for Renewables and Efficiency (DSIRE) website, 15 of the 16 states that the study projects to be solar development leaders in the near-term have a renewable portfolio standard. Florida is the exception.

A map developed by the National Renewable Energy Laboratory (NREL) provided in the SIEA report illustrates that Iowa has significantly better solar capacity than Germany, current the world leader in solar generation.[11] Solar hot water heaters are becoming more common in Iowa as education about their use expands and more contractors offer sales and installation services. While Iowa universities have undertaken some solar technology development and one home-grown Iowa company, PowerFilm, has emerged as a player in the solar industry, overall, Iowa has not been a leading state in promoting and utilizing solar power.

Improving Iowa's solar status could help Iowa capture the economic benefit of being a center for a high-tech industry, comparable to the engineering, manufacturing, skilled labor and logistics jobs that have followed large-scale wind development into the state. The high end of solar PV development in Iowa

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[9] "U.S. Solar Energy Industry Association 2008 Year in Review," http://www.seia.org/galleries/pdf/2008_Year_in_Review-small.pdf.

[10] Kann, Shayle and Englander, Daniel, "The United States PV Market: Project economics, Policy, Demand and Strategy through 2013," report summary: http://www.gtmresearch.com/report/the-united-states-pv-market-project-economics-policy-demand-and-strategy

[11] http://www.seia.org/galleries/default-file/PVMap_USandGermany.pdf

examined in the Navigant study was 30 MW of installed capacity. At this level, solar PV would generate about 50,000 MWhs of electricity and reduce greenhouse gases by approximately 28,000 tons per year. This is negligible in the context of Iowa's overall electricity generation and greenhouse gas emissions.

Market barriers to adoption of solar have hindered its development. In fact, much of the near-term solar projects and projected solar growth is expected to be utility-scale and/or utility-owned. Although the cost of solar PV has declined steadily since 1998, from $10.5 per W to $7.6 per W in 2007, it remains the most expensive form of new electric generation. The Navigant study done for Iowa estimated the current price of solar PV at $0.42 per kWh, compared to $0.073 for large, land-based wind and between $0.11 and $0.15 for biomass. However, Navigant also projected that the price of solar will fall to $0.13 per kWh by 2025.

Solar energy, similar to wind, is also a resource that is non-dispatchable, requiring that idle base load generation be available to provide stable load when the sun is not shining.

Much of the future economic viability of solar in Iowa will depend upon utility-scale investment, technological advances, government incentives and greenhouse gas regulation that would make the cost of solar competitive with other energy generation.

Biofuels

According to the Iowa Renewable Fuels Association (IRFA), Iowa is first in the national in production of both ethanol and biodiesel, producing 26% of U.S. ethanol and 12% of biodiesel. Ethanol capacity in the state is 3.3 billion gallons per year and biodiesel capacity 325 million gallons. Some of this capacity was idled in the past several years due to high feedstock costs. Most ethanol capacity is again operational, but according to the Iowa biodiesel board, almost 150 million gallons of biodiesel capacity in the state is currently idle and Iowa produced 102 million gallons between October 1st of 2008 and September 30th 2009.

The Federal Renewable Fuels Standard (RFS) has been a major driver for ethanol demand. The revised RFS (often called "RFS2") included in the Energy Independence and Security Act of 2007 (EISA 2007) extended the standard through 2022 and added requirements for biodiesel and "advanced" biofuels, including cellulosic ethanol. The requirement for 2009 is 500,000 gallons of biodiesel, 600,000 gallons of advanced biofuels and 10 billion gallons of other renewable fuels, including corn ethanol. Corn ethanol's contribution to the RFS maxes out in 2015 at 15 billion gallons. The biodiesel requirement ramps up to 1 billion gallons starting in 2012 and the requirement for advanced biofuels increases to 21 billion gallons in 2022, for a total of 36 billion gallons of renewable fuels required in that year.

Another major change in the RFS2 was the addition of standards for lifecycle greenhouse gas emissions, including indirect land use change (ILUC). Existing ethanol facilities were "grandfathered" and do not need to meet this requirement. The concept behind ILUC is that increasing demand for crops for fuels increases overall commodity prices, subsequently increasing demand for land to grow these profitable crops and leading to de-forestation in other countries, such as Brazil. The inclusion of ILUC in the lifecycle calculations is highly controversial among both policymakers and scientists. The EPA's draft rules implementing the RFS2 have thus far have not resulted in favorable results for conventional biofuels and the controversy has delayed implementation.

In 2006, the Iowa legislature passed a bill creating a tax incentive structure to increase the sale of biofuels in Iowa. Retailers must sell at least 10% biofuels by volume in 2009, increasing to 25% by 2019 to qualify for the maximum tax benefit.

The Otto and Imerman study on economic leakages related to energy use in Iowa did not specifically calculate the out-of-state leakage from the biofuels industry, but the study did indicate that 55% of the ethanol input stream comes from in-state resources. Similar information was not given for biodiesel production.

There are a variety of comprehensive economic impact analyses related to biofuels in Iowa. The IRFA estimates that biofuels add $12 billion to Iowa GSP and supports 83,000 jobs in the state. A study performed by consultant John Urbanchuk in February, 2008 estimated that, based on 85.4 million gallons of biodiesel production in that year, $655 million was added to the Iowa GSP, 3,751 permanent jobs supported and household income increased by $17.4 million. [12] A February 2007 study by Urbanchuk, commissioned by the IRFA, estimated the total impact of all biofuels production in Iowa to be an addition of $7.3 billion to the Iowa GSP, $1.7 billion in household income and 47,000 jobs.

Meanwhile, a study performed by economist David Swenson at Iowa State University in January of 2008 estimated much more modest impacts. Focusing just on the ethanol industry, Swenson estimated a total job impact of 5,440 jobs.[13]

Although specific economic impact estimates differ significantly, it is clear that biofuels production and expansion continues to bolster the Iowa economy. A number of next-generation biofuels and bioproducts start-ups have also begun to contribute. For example, Poet Energy's Project Liberty in Emmetsburg, Iowa, is in the process of adding capacity to an existing ethanol plant. This new capacity will allow the facility to produce cellulosic ethanol from corn cobs. The current Poet facility employs 40 people. The expansion is expected to add 35 direct jobs and millions of dollars to the economy of the region in farm income and construction materials purchases.

Another positive economic impact of biofuels production was documented in a 2007 study by Xiaodong Du and Dermot Hayes at Iowa State's Center for Agriculture and Rural Development. Their analysis estimated that ethanol use in the Midwest depressed gasoline prices by $0.35 per gallon between 1995 and 2007.[14]

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[12] Urbanchuk, John M., "Impact of the Biodiesel Industry on the Iowa Economy", February 2008, http://www.biodiesel.org/resources/reportsdatabase/reports/gen/20080228_gen386.pdf

[13] Swenson, David, "The Economic Impact of Ethanol Production in Iowa," January, 2009, http://www.econ.iastate.edu/research/webpapers/paper_12865.pdf

[14] Xiaodong and Hayes, "The Impact of Ethanol Production on U.S. and Regional Gasoline Prices and on the Profitability of the U.S. Oil Refinery Industry," April, 2008, http://www.card.iastate.edu/publications/DBS/PDFFiles/08wp467.pdf

Ethanol production has also been shown to have an upward price impact on corn prices in the region directly surrounding the plant. However, national and global commodities markets are much more complex and it is challenging to determine the exact impact of any one change in demand or supply on the overall price of commodities. T. Randall Fortenbery and Hwanil Park from the University of Wisconsin - Madison analyzed quarterly USDA data from 1995 through 2006 in an attempt to determine ethanol's impact on U.S. corn prices. They found that a 1% increase in ethanol production correlated with a 0.16% increase in the price of corn in the short run. They also concluded that, although livestock feed is still the number use of corn in the U.S., increased demand for grain for ethanol was more significant in determining corn prices than increases related to feeding livestock or export demand.[15]

The USDA Economic Research Service (ERS) issued a study in November of 2009 examining the impacts of increased ethanol production on livestock markets and environmental quality. The share of U.S. corn production processed into ethanol has increased from 7.5% of the crop in 2001 to 23.2% in 2008.[16] The 15 billion gallons of ethanol required by EISA 2007 will likely command 35% of U.S. corn production. The ERS study also projects that the RFS will result in land shifting toward corn and soybean production and away from other crops, increasing prices for all commodity crops. Increased corn and soybean prices can negatively impact livestock producers in Iowa. The Midwest supplies 90% of livestock feedgrains in the U.S. About 14% of beef, hog and dairy operations use some biofuels co-products (mostly DDGS) as feed. The use of DDGS for animal feed is expected to increase, and, consequently, the price is expected to rise. High corn prices have already severely impacted the livestock industry, with farrow-to-finish hog operation profits dipping into negative territory starting in November of 2007.[17] Increasing biofuels production is expected to cause a small contraction in the livestock sector overall, but could also have the positive benefit of increasing demand for manure as a nutrient source for corn production.

Potential negative environmental impacts could stem from bringing additional land into agricultural production that may not be suitable, increased use of chemicals like pesticides and nitrogen-based fertilizers and increased greenhouse gas emissions related to energy inputs on new ag lands.

Improving yields or the efficiency of the biofuel conversion processes could mitigate some of these impacts. Other strategies to bolster the positive economic and environmental impact of biofuels in Iowa could include improving the efficiency of biofuels processes, such upping drying efficiency for DDGS, and improving the economic value of biofuels co-products. Using new feedstocks, such as perennial grasses, corn stover and algae could also help to mitigate some demand-driven price increases and negative environmental impacts.

As shown in Graph 23, 82.3% of gasoline sold in Iowa is blended with ethanol at either the E10 or E85 level. There are several barriers to increasing that percentage as well as overall biofuel sales in the state.

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[15] Fortenbery, T. Randall and Park, Hwanil, "The Effect of Ethanol Production on the U.S. National Corn Price," April, 2008, http://www.aae.wisc.edu/renk/library/Effect%20of%20Ethanol%20on%20Corn%20Price.pdf
[16] Malcolm, Scott A., M. Aillery, and M. Weinberg. *Ethanol and a Changing Agricultural Landscape*, Economic Research Report 86, U.S. Dept. of Agriculture, Economic Research Service. Nov. 2009.
[17] Wisner, Robert, "Impact of Ethanol on the Livestock and Poultry Industries," Agricultural Marketing Resource Center Renewable Energy Newsletter, October, 2008.

First, federal regulations limit ethanol blends in conventional engines to 10%. The Environmental Protection Agency (EPA) is currently considering increasing the blend limit to 15%.

A lack of infrastructure for 85% ethanol is another barrier. The Iowa RFA reported that in September of 2009, there were 125 E85 pumps in the state, with 22 of those being "blender pumps" which can dispense any blend of ethanol and gasoline. The Iowa RFA also reported that there are 238 pumps dispensing biodiesel with less than a dozen of those being blender pumps. The EIA reported that there were 5,022 flex-fuel vehicles in Iowa in 2007. A total of about 200,000 vehicles in the state can run on either E85 or biodiesel.

A 2006 analysis from Richard Ginder at Iowa State University exported the major infrastructure limitations for increasing production of ethanol, including crop production inputs and processing infrastructure, tank cars for rail transportation, and suitable transportation infrastructure for DDGS.[18] Shipping infrastructure for ethanol is further complicated by the fact that it cannot be shipped through conventional petroleum pipelines. However, Poet Energy, LLC and Magellan Midstream Partners LP announced in March of 2009 that they are studying the feasibility of building a dedicated ethanol pipeline starting in southeastern South Dakota and picking up product from plants in Iowa, Minnesota, Illinois, Indiana and Ohio for delivery to markets in the northeastern U.S. The pipeline is projected to cost around $3.5 billion. Magellan and Poet are expected to make a decision on whether to move forward with the project by the end of 2009 or early 2010.

Biomass

Iowa produces vast quantities of biomass each year. The largest biomass-based energy production in the state is in the form of biofuels. As Iowa's renewable electricity generation has increased over the last decade, biomass-based electric generation has remained flat. A 2005 NREL study found that Iowa has the best biomass resources of any state in the country, with the greatest amount of crop residues and the third-highest manure methane potential. The Navigant study estimated that Iowa's biomass electricity potential could be as much as 1.86 million MWhs of electricity each year. For comparison, total renewable generation in Iowa in 2007 was 2.9 million MWhs.

Biomass could be used in a variety of energy applications, including: co-firing in existing coal plants, combustion for electricity in dedicated biomass facilities, methane capture and combustion for heat and power and burning biomass in boilers to provide both heat and power to manufacturing facilities, cities or public buildings.

It is likely that in the initial years, agricultural by-products, such as corn stover and manure might be the most common fuels used to produce biomass power in Iowa. Using old materials in a new way will require new harvesting equipment, processing infrastructure and the technologies to perform these tasks. This aspect of biomass energy generation will create jobs in Iowa and the resulting technologies could be exported to other states and countries. Of course, benefits will also accrue to farmers and other landowners who will see new revenues from the sale of biomass materials.

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[18] Ginder, Richard, "Potential Infrastructure Constraints on Ethanol Production in Iowa," November, 2006, http://www.extension.iastate.edu/ag/GinderPresent.indd.pdf

The next generation of biomass power in Iowa could come from perennial biomass crops, such as switchgrass. These crops have the dual benefit of bolstering the Iowa economy and providing superior environmental benefits, including large projected greenhouse gas benefits and improvements to soil and water quality as fewer chemical inputs are required in the production of these crops. Additionally, a new USDA incentive, the Biomass Crop Assistance Program, was included in the 2008 farm bill that will pay farmers to start to grow and bring dedicated biomass crops to market.

Iowa's academic institutions have been leaders in biomass research. Iowa State University in the fall of 2009 opened the BioCentury Research Farm to examine, in part, the cropping, harvesting and processing practices that would be necessary to grow this new generation of energy crops. The University of Iowa has been using biomass byproducts from the Cedar Rapids Quaker Oats plant to provide 80% of the university's heating, cooling and electricity. Research is currently under way at the University of Northern Iowa to determine the best mixes of prairie hay to use for electric generation. These university efforts demonstrate that Iowa is moving to take a leadership role in biomass power.

Competition for valuable land resources will be one barrier to development of a strong biomass energy industry in Iowa. Corn stover does not create the same problem, but may have consequences both for farmers and the environment that must be considered. Corn stover is largely left in the field to enrich the soil and reduce soil erosion and run-off. Research is underway both in Iowa and around the country to determine how much stover can be removed without negative consequences to soil quality.

There are also still some technological barriers to biomass energy generation, including optimization of biomass combustion for electricity, the best way to use biogas as a utility-scale energy resource, and development of pre-processing technologies for biomass densification.

Some biomass energy applications involve a daunting up-front investment. An individual farmer wanting to install a methane digester often does not have the financial resources for such a large investment. However, building a new, biomass-only electric generation facility is estimated to be competitive with the cost of building a new coal or natural gas facility, according to the Navigant study. Co-firing biomass with coal is very inexpensive – only $0.017 per kWh – and would be an economical alternative for early use of biomass energy in Iowa. Table 6 summarizes all the new renewable and fossil electric generation costs discussed in this section.

Table 6: Estimated Levelized Cost of New Generation in Iowa, 2008 - 2025						
	2008		2015		2025	
Biomass Co-Firing	1.7		1.9		2.1	
Landfill Gas	3.6		4.8		5	
Large Land-Based Wind	7.3		7.8		7.6	
Biomass (BIGCC)	15.3		11.1		10.3	
Biomass - Fluid Bed	10.7		11.6		11.7	
Distributed Wind	28.7		25.3		25.3	
PV	42		23		13.6	
	Low	High	Low	High	Low	High
Coal	8.4	16	9.2	16.5	9.9	17.4
Natural Gas	6.5	12.6	6.9	13	7.3	13.3
Nuclear	7.4	8.7	9.7	11.6	11	13.2

Source: Policy/ Strategy Option Descriptions, Final Report, Navigant Consulting, January 2009

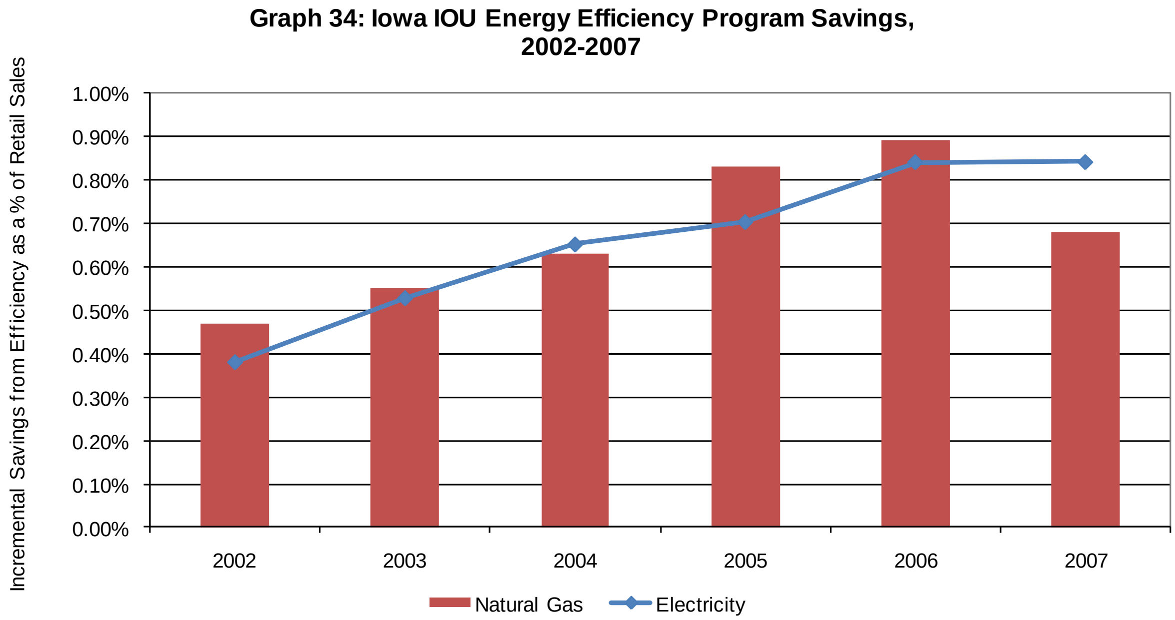
Reducing Iowa's Energy Use

A 2009 report sponsored by Chicago Council on Global Affairs, listed the primary efficiency opportunities in the Midwest as:

- Residential lighting, air conditioning and electronics
- Commercial lighting and equipment
- Industrial efficiency and co-generation, or combined heat and power (CHP)
- Improved vehicle fuel economy[19]

Toward the goal of reducing energy use, Iowa's IOUs are required to provide programs to help consumers reduce their use of both electricity and natural gas. Plans are submitted for approval to the Iowa Utilities Board every 5 years by the IOUs. The efficiency measures must be cost-effective from both the consumer and utility perspective, and the utilities recover related costs for the programs from consumers. Results of these efficiency efforts between 2002 and 2007 are shown in Graph 32.

[19] Livingston, John et al, "Embracing the Future: The Midwest and a New National Energy Policy," 2009, The Chicago Council on Global Affairs, page 46.



Source: Iowa Utilities Board, Report to the Leigslature, January, 2009: Energy Efficiency in Iowa's Electric and Natural Gas Sectors

The IOUs steadily increased the amount of additional electricity saved as a percentage of retail sales each year up through 2006. Program success in percentage terms was flat between 2006 and 2007. Natural gas savings increased each year over the same timeframe, but dropped in 2007.

Consumer-owned utilities (cooperatives and municipal utilities) are required to file energy efficiency plans with the IUB every other year, but those plans are not subject to approval by the IUB. The Iowa Association of Electric Cooperatives's (IAEC's) most recent report on Iowa co-ops' efficiency initiatives showed that the co-op programs saved about 31,000 MWhs of electricity in both 2006 and 2007. Total co-op sales to retail customers amounted to 5.4 million MWhs in 2006 and 5.7 million in 2007. Efficiency reduced energy sales by about 0.58% in 2006 and 0.55% in 2007. The IAEC report projected efficiency savings in 2008 and 2009 of about 40,000 MWhs per year, an increase of about 30% over the 2006 and 2007 levels.

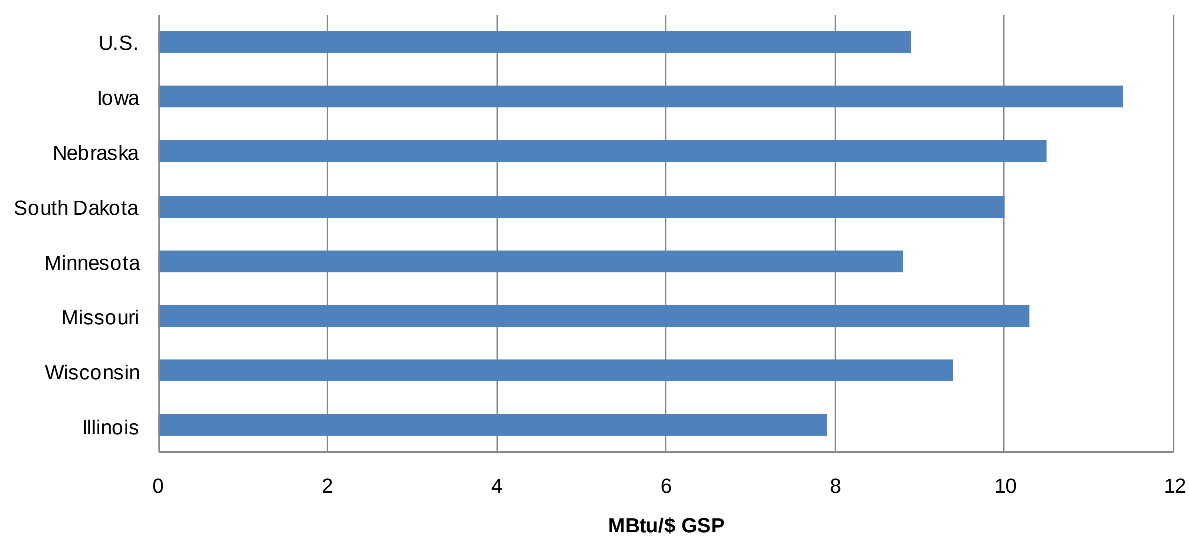
Efficiency data for the Iowa Association of Municipal Utilities was not aggregated for reporting purposes, so is not covered in this report.

Senate File 2386, passed during the 2008 Legislative Session, required consumer-owned utilities to make an initial report on their potential for energy efficiency by January 2009 and a final report by January 2010. The initial report from the municipal utilities found that reducing electricity consumption by 1.1% per year and natural gas consumption by 0.74% per year by 2012 would be an achievable goal. The initial report issued by the Iowa Association of Electric Cooperatives did not offer any initial estimates for potential savings.

In 2007, according to the IUB, Iowa ranked 3rd in the country for per capita spending on energy efficiency programs. (Graphs 11 and 12) However, results showed that Iowa has the highest residential energy use per capita of any state in the Midwest and that Iowa's per capita residential energy use is 9.6% higher than the national average.

Another useful method of comparison is the rate of Gross State Product (or Gross National Product, in the case of the U.S. as a whole) produced per unit of energy utilized in the industrial and commercial sectors. This is often referred to as energy intensity or energy productivity. Although transportation is also a major energy input for business, it is impossible to separate personal and business transportation expenditures, so it is not a part of the comparison in Graph 33.

Graph 35: Energy Use per Dollar Gross State Product in Midwestern States and U.S., 2007



Source: U.S. DOE, EIA State Energy Data 2007: Consumption

In this measure, Iowa is again at the top in terms of energy intensity in the Midwest and compared to the national average. (Graph 33) Iowa's energy use per dollar GSP is 8.6% higher than Missouri, the closest state, 44% higher than Illinois, the most efficient state, and 28% higher than the U.S. average.

The Rocky Mountain Institute (RMI) in January, 2009 released a study comparing the energy productivity (in dollars of GSP her kWh input) of the economies of the 50 U.S. states. The study compared the 40 most energy-intensive states with the top 10 most efficient to find the "energy gap," or the potential savings that could be achieved if the average U.S. energy intensity reached the level of the top 10 states. The study corrected for regional climate considerations and state economic mix. The RMI found that this "productivity gap" amounted to 31% of 2005 energy expenditures across the U.S. According to RMI's analysis, Iowa ranks 32nd among the 50 states in terms of energy productivity, at $3.08 of GSP per kWh input. The average productivity among the top 10 states was $6.30 per kWh.[20] The RMI estimates that, to bring state productivity up to the level of the highest-achieving states within the next 10 years, Iowa would need to increase electric energy efficiency by 2% per year.[21]

[20] http://ert.rmi.org/cgu/index.htm
[21] http://ert.rmi.org/files/documents/CGU.RMI.pdf

There are both economic and technical limitations that determine how much energy efficiency is actually feasible. Iowa's IOUs have historically undertaken efficiency measures with a high cost-to-benefit ratio of around 1-to-2, meaning that for each dollar spent, $2 in energy expenditures was saved. The IAEC in their 2008 filing to the IUB estimated a cost-benefit ratio of 1-to-3.[22]

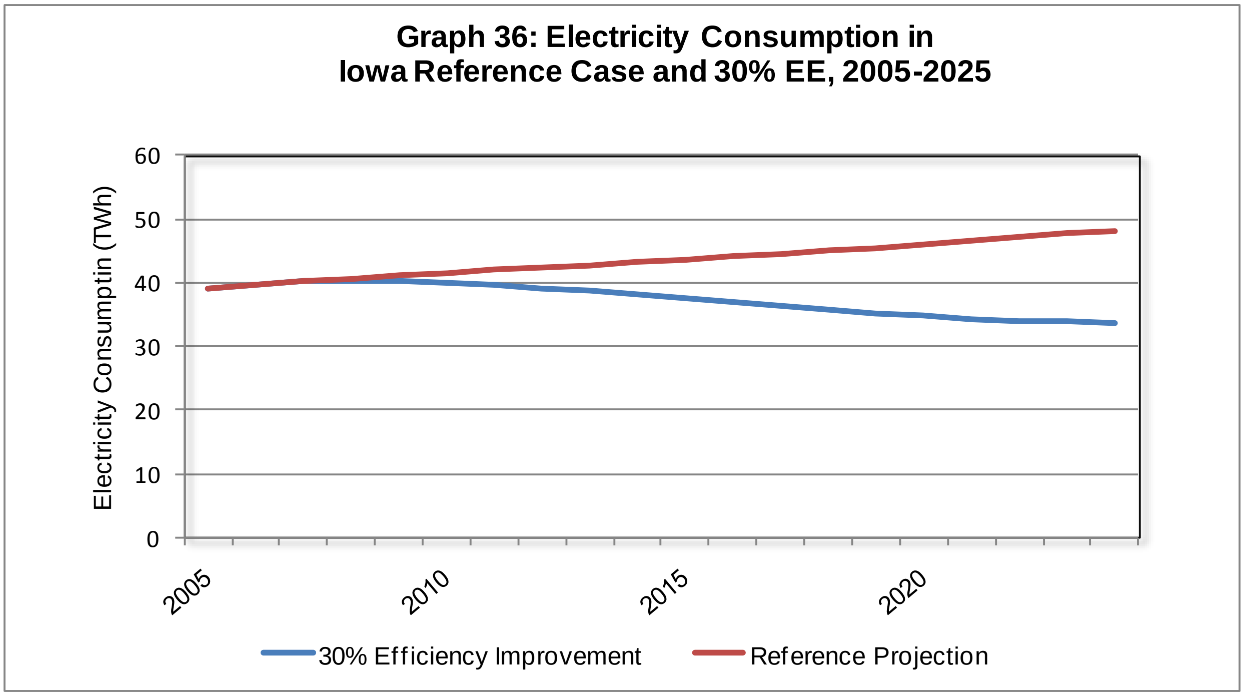
Evaluation of the cost-effectiveness of energy efficiency is changing as a greater emphasis is placed on reducing greenhouse gas emissions and as building new electric generation becomes more expensive. An analysis prepared by the Wisconsin Energy Center and American Council for an Energy Efficient Economy (ACEEE) for the MGA compiled various state studies on energy efficiency potential. The analysis found a range of potential savings of between 0.8 and 1.5% of retail sales per year, which many states are already achieving fairly easily. However, the authors argue that these estimates are conservative for several reasons, including:

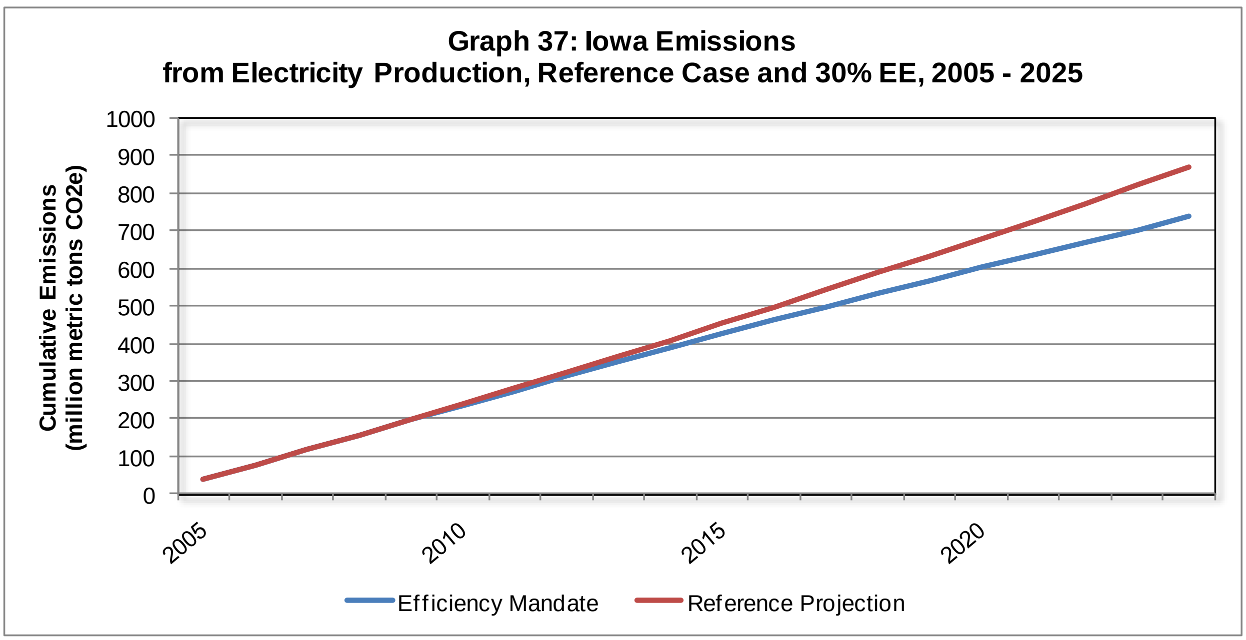
- Many reports do not reflect current increased fuel and new plant construction costs.
- Analyses do not include a price for carbon that would alter cost effectiveness calculations.
- Current estimates rely on current technology availability and pricing, which is necessary but does skew the results in a more conservative direction.
- Most studies include only incremental changes, not integrated, system-wide changes (such as zero- net energy buildings).

The report also argues that energy efficiency programs ought to be evaluated not in terms of how much consumers and utilities can afford, but how much energy efficiency is needed to meet economic and environmental goals, including future load growth and reduction of greenhouse gas emissions.

The Midwestern Governor's Association has called for a 2% increase in energy efficiency savings by 2015, followed by 2% per year incremental savings through 2025. This matches the goal laid out in the Iowa Energy Independence Plan to use efficiency to reduce electricity use by 30% by 2025. A projection produced by the Energy Choice Simulator model projects that this policy would cause energy demand to decline by 15.2% between 2005 and 2025, compared to the business as usual projection of 24% demand growth. (Graph 36)

[22] Goodale, Regi





New plans were approved for all of Iowa's IOUS in the spring of 2009 and implementation of those plans is currently under way. MidAmerican's plan includes a goal to reduce electricity use by 1.5% beginning in 2010 and each year until the plan expires at the end of 2013. They estimate the cost-effectiveness of their overall program to be 2.5 to 1. Alliant's plan ramps up their electric efficiency goal from 0.9% in 2009 to 1.3% efficiency savings in 2013.[23]

[23] http://www.state.ia.us/government/com/util/board_activity/ga_reports.html

Energy efficiency efforts that reduced electricity use by 30% by 2030 would have a significant impact on greenhouse gas emissions, according to projections generated by the Energy Choice Simulator Model (Graph X). In this scenario, emissions are reduced 16% between 2005 and 2025 compared to business as usual. Also, as mentioned previously in this report, increasing Iowa's energy efficiency resource would help to avoid emissions of heavy metals, particulate matter and other pollutants associated with fossil energy generation.

The economic benefits of increasing energy efficiency efforts could be dramatic. A September 2009 study by the American Council for an Energy Efficient Economy (ACEEE) found the cost of electric efficiency in Iowa to be $0.017 per kWh saved.[24] For comparison, a coal plant that was proposed in 2009 by Alliant energy to be built in Marshalltown had a cost basis of between $0.083 and $0.092 per kWh according to a filing by Alliant Energy in the IUB docket evaluating the plant proposal. Other cost estimates for new generation construction can be found in Table 6. A comparison of these costs shows that efficiency efforts are nearly 5 times more cost effective than new coal generation. With future regulation of greenhouse gases likely, this discrepancy is slated to become even more dramatic.

Avoided cost for consumers and utilities is not energy efficiency's only economic benefit. Services, labor and goods are all required to perform energy efficiency upgrades. The study performed by Navigant Consulting recommended a 1.5% per year incremental efficiency savings goal for all utilities (including consumer-owned entities). The study estimated that between 2009 and 2018 this policy would create $136M in private investment, employ 1,353 people and help utilities in the state avoid building 260 MW of new fossil generation.[25] These jobs include occupations like electricians, truck drivers, welders, machinists, roofers, accountants, cashiers, software engineers, civil engineers, construction workers, and energy audit specialists. Because much of this work must be done on-site at facilities and homes, these are jobs that will be maintained in the local area and cannot be moved elsewhere.

The economic value of energy efficiency was clearly endorsed through the incentives in the American Recovery and Reinvestment Act of 2009 (ARRA), which is helping states invest in energy efficiency at unprecedented levels. Iowa received $80.8 million for low-income home weatherization, $40.5 million to fund grants through the State Energy Program and $21.2 million through the Energy Efficiency and Conservation Block Grant program to fund state, city and county investments to reduce energy use.[26] This funding will begin to filter through the Iowa economy in 2010, creating both jobs and investment in durable goods and materials. The ARRA legislation also included the requirement that states adopt the most recent International Energy Conservation Code for buildings and reach 90% compliance with the code within 8 years. The state is also required to work with the Iowa Utilities Board to ensure that utility financial incentives line up with customer incentives to use less energy. This could mean "de-coupling" which involves eliminating the connection between how much money utilities make and how much energy they sell.

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[24] http://aceee.org/pubs/u092.pdf?CFID=4367858&CFTOKEN=31396431
[25] Kinross, Andrew, page 18
[26] Pearson, Beth and Galluzzo, Theresa, "Lighting the Way: How Iowa Can Lead with Energy Funding in Federal Stimulus," May, 2009, Iowa Policy Project.

De-coupling would lower one structural barrier to robust implementation of energy efficiency. There are also market barriers to implementing energy efficiency - either a lack of up-front money available or adequate market incentive to implement efficiency. Finally, there is often not enough information available for consumers or utilities on the most effective energy efficiency measures and associated energy savings impacts.

Greenhouse Gas Regulation and Iowa

At this writing, national leaders are gathering in Copenhagen, Denmark to discuss a new international climate treaty that would commit countries to reduce greenhouse gas emissions to limit the effects of global warming. The U.S. House of Representatives passed a bill in June to regulate GHGs, but the Senate has yet to consider a similar piece of legislation. The Supreme Court declared in 2007 that the EPA must regulate greenhouse gases under the Clean Air Act, and the EPA has begun to move forward with rules that will implement that decision in the absence of legislation.

The Iowa Climate Change Advisory Council's report from 2008 included a full assessment of Iowa's greenhouse gas emissions and the costs of potential solutions. That report is a good resource for detailed analysis on Iowa's current and historical GHG emissions and potential reduction policies.[27]

The impacts of greenhouse gas regulation on the economy of the state are difficult to assess and no one study has looked comprehensively at all factors, including: potential for increased investments in renewable capacity, the lifecycle economic benefits of increased efficiency investments, the potential for on-farm carbon sequestration and methane reduction and the increased cost of energy, among many others. Most national studies on electricity price impacts project modest price increases for electric customers under the cap and trade proposal in the American Clean Energy and Security Act of 2008 (ACES). A study by Bruce Babcock at Iowa State University's Center for Agriculture and Rural Development found that, for agriculture, the bill would likely be mostly a wash for farmers, finding increased input prices and increased net farm income about equally impactful.

Some studies on the potential impacts of climate change in Iowa have been conducted over the past few years. The Union of Concerned Scientists (UCS) issued a study in 2004 projecting that Iowa can expect warmer, dryer summers, significantly warmer winters and more extreme weather events, such as periods of intense precipitation in the winter and spring and longer periods with precipitation during the summer months.[28] The study projects that Iowa's summers will resemble those of northern Kansas, in terms of rainfall and temperature, by 2030 and northwest Mississippi by 2100.

A December 2008 article by Professor Gene Tackle and Don Hoefstrand at Iowa State also laid out predictions for how climate change could impact Iowa. Their results were very similar to those found in the UCS study, including more intense precipitation events, especially in the spring. They also listed more freeze-thaw cycles, and higher day-to-day and year-to-year variability in temperatures. Among

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[27] Strait and Mullen et al, "Final Iowa Greenhouse Gas Inventory and Reference Case Projections, 1990-2025," Center for Climate Strategies, October, 2008, http://www.iaclimatechange.us/ewebeditpro/items/O90F20577.pdf

[28] Moser, Susanne, et al, "Climate Change in the Hawkeye State: Potential Impacts on Iowa Communities and Ecosystems," January, 2004, http://www.ucsusa.org/assets/documents/clean_energy/climate_change_in_iowa_-long-_final-_and_formatted.pdf

many other potential impacts listed in the article, there are two that may directly influence Iowa's movement toward energy independence: reduced wind speeds and reduced solar radiation.[29] Of course, these changes could directly impact the Iowa economy, but it is nearly impossible to predict exactly how.

Conclusion

Reaching the goal of energy independence is within the very real realm of possibility for the state of Iowa. The potential benefits of reaching that goal offer a bright picture of a vibrant future economy for Iowa residents.

[29] Takle, Gene and Hoefstrand, Don, "Climate Change – Impact on Midwestern Agriculture," Agricultural Marketing Resource Center Renewable Energy Newsletter, November/December 2008. http://www.agmrc.org/renewable_energy/climate_change/climate_change__impact_on_midwestern_agriculture.cfm