NEBRASKA ENERGY OFFICE

Annual Report 2016

NEBRASKA

Good Life. Great Energy.

NEBRASKA

Good Life. Great Energy.

Pete Ricketts, Governor

February 14, 2017

Patrick J. O'Donnell
Clerk of the Legislature
Room 2018, State Capitol
Lincoln, NE 68508

Dear Mr. O'Donnell:

Enclosed is the Nebraska Energy Office's Annual Report for Fiscal year 2015-2016 as required by Nebraska State Statutes, Section 81-1607, and (R.S. 2012). A copy of the Annual Report has also been posted at the agency's website at: http://www.neo.ne.gov/annual_rept/NEOAnnualReport.pdf .

Sincerely,

David L. Bracht
Director

David Bracht, Director
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Nebraska Energy Office

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Trends and Needs

Nebraska State Capitol foyer dome tile ceiling.

The vision of the Nebraska Energy Office is to provide leadership that maximizes the benefits of energy efficiency and renewable energy through communications, outreach, technology and partnerships.

The mission of the Nebraska Energy Office is to promote the efficient, economic and environmentally responsible use of energy. The agency's principles are that we value teamwork, are customer oriented and are committed to excellence, creativity and innovation.

The Energy Office accomplishes this mission by administering innovative programs, implementing projects and services that inform, educate and involve energy consumers and decision makers. The Energy Office also collects essential statistical energy data and is the State's lead Agency responsible for developing recommended responses during energy related emergencies.

Goals:

- ❖ Expand opportunities to implement energy efficient projects through partnerships and collaborations.
- ❖ Develop and administer programs that promote efficient uses of energy resources in everyday lives.
- ❖ Support economic development activities including sustainable existing state businesses and attracting new energy investment to the state.
- ❖ Support a broad energy portfolio that meets the state's energy needs in a reliable, clean, cost-effective manner and integrates renewable options.
- ❖ Continue the compilation and analysis of energy statistics and information that identify emerging trends related to energy supply, demand and conservation.
- ❖ Provide objective perspectives on energy policy to the public and elected officials.

The Programs

The Nebraska Energy Office operates several different annually-funded federal and state programs. These programs are:

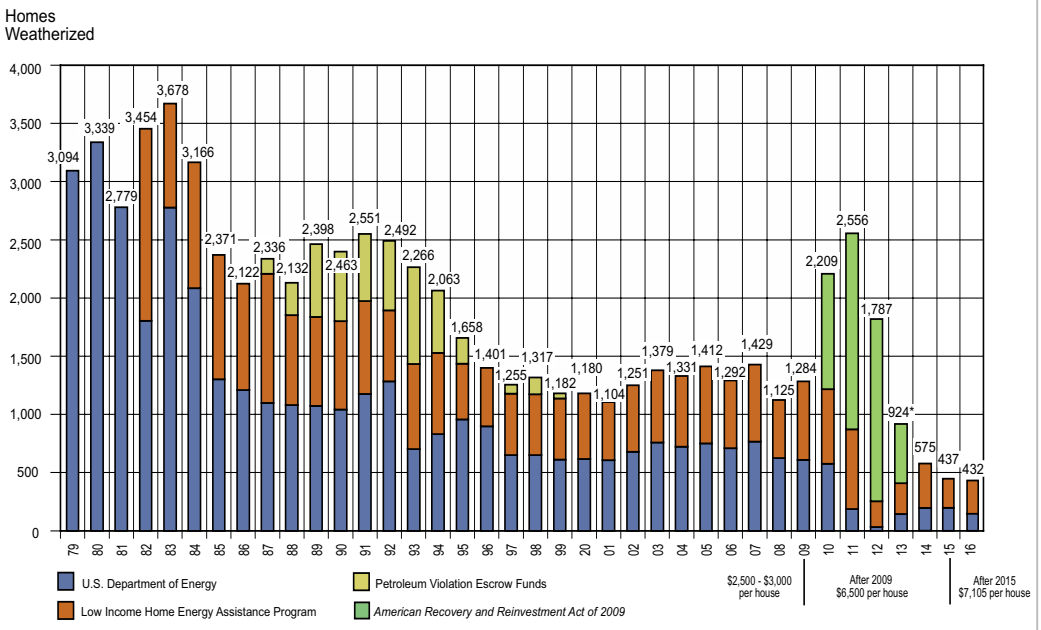
- ❖ Weatherization Assistance Program
- ❖ State Energy Program and special projects
- ❖ State Heating Oil and Propane Program
- ❖ Oil overcharge-funded activities, primarily Dollar and Energy Saving Loans
- ❖ Statutorily-required state activities such as data collection and reporting.

An overview of the 2015-2016 financial activity appears at the end of this section. The period covered by this report is from July 1, 2015 to June 30, 2016, except where noted.

Weatherization Assistance Program

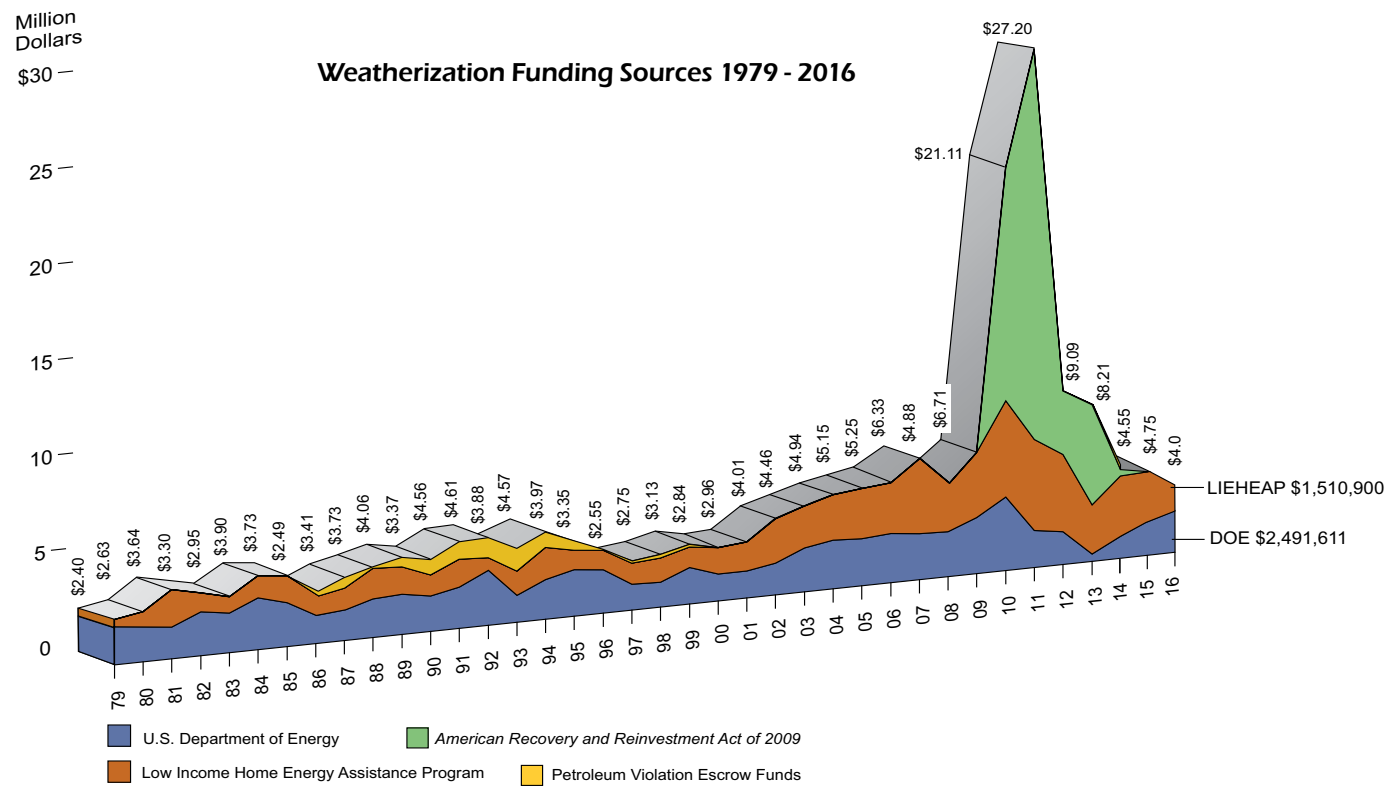
The Energy Office administers the federally-funded program for weatherizing homes to save energy and money for those with limited incomes. The agency is responsible for inspecting the homes that are weatherized and for monitoring the sub-grantees, primarily community action agencies, that are responsible for the home weatherization improvements. Community action agency crews or private contractors are responsible for completing the work on the homes. The Energy Office staff inspects a minimum of 30 percent of all completed homes to ensure the quality of work performed.

Number of Homes Weatherized by Source of Funds, 1979 - 2016



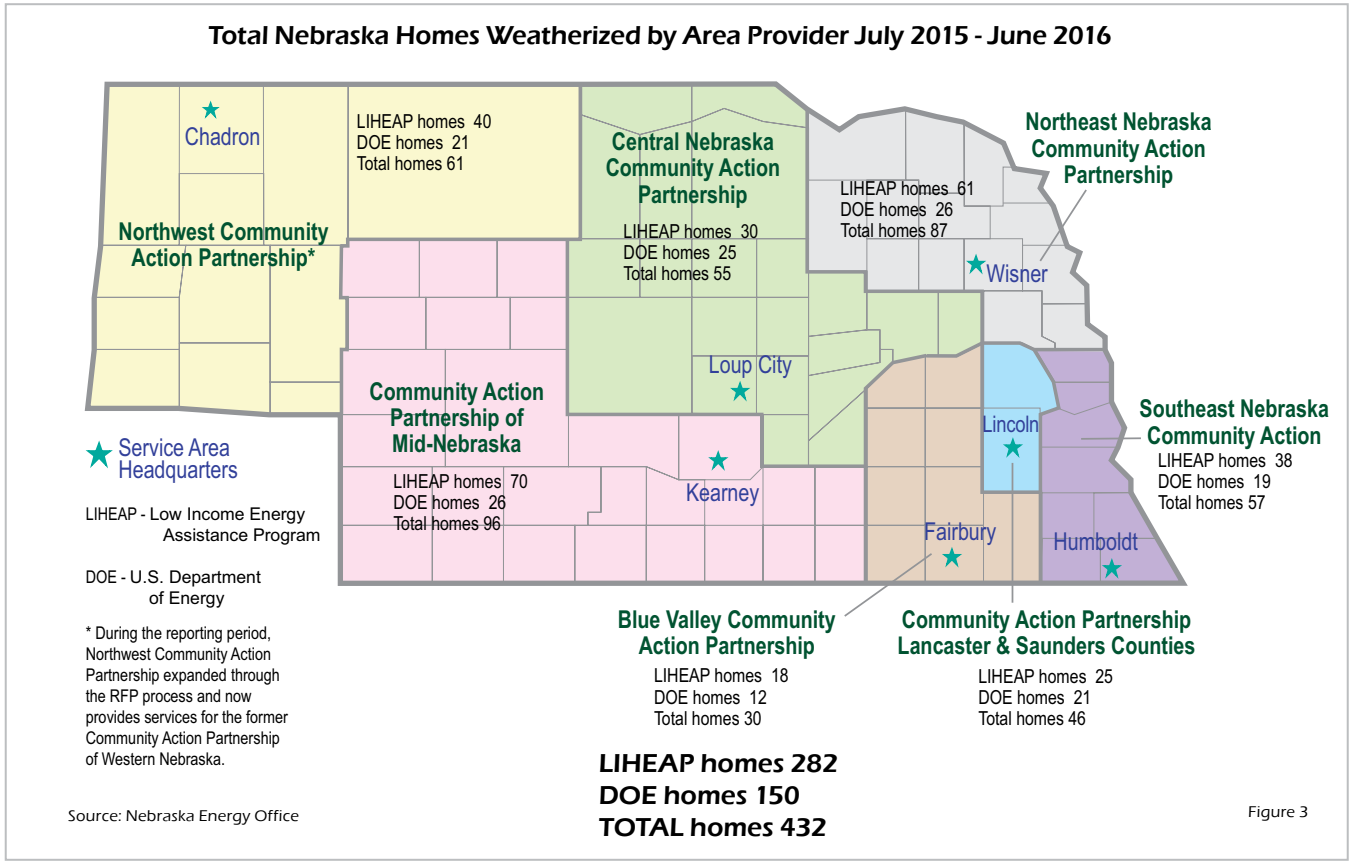
Source: Nebraska Energy Office

Figure 1



Source: Nebraska Energy Office

Figure 2



Source: Nebraska Energy Office

Figure 3

The Weatherization Assistance Program received funding from two sources during the reporting period:

- $1,510,900 from the Low-Income Home Energy Assistance Program. Annually, the Nebraska Department of Health and Human Services transfers a portion of the funds received to pay utility bills to the agency to weatherize homes so that the need for utility bill paying assistance is reduced or eliminated.
- $2,491,611 from the U.S. Department of Energy's Weatherization Assistance Program.

More about how these funds have been spent throughout the state are in figure 3.

Between 2015-2016, 432 homes were weatherized with these funds as illustrated in figure 3.

The types of improvements may vary based on an analysis of the home and averages between $4,000 and $7,105 per home, excluding the cost of health and safety improvements such as furnace repairs. Prior to mid-2009, the average amount spent on homes ranged from $2,500 to $3,000. The average cost of a home is set by the U.S. Department of Energy. The kinds of improvements made to homes vary by the home type: frame, mobile or multi-family. In a frame home, the most common improvements generally are: adding insulation to attics and walls, insulating box sill areas and crawl spaces, replacing or repairing the furnace, and replacing a primary door. In mobile homes, the most frequent improvements are: replacing a primary door, replacing a primary window, replacing or repairing the furnace, insulating the underbelly and replacing or repairing the water heater. In multi-family homes, the two most common improvements are: adding insulation to the attic and replacing a primary window. Most homes that are weatherized also receive low-cost improvements such as caulking, weatherstripping, pipe wrap and, in some instances, water heater jackets.

Since the Weatherization Assistance Program began in 1979, $199.43 million has been spent to make energy efficiency improvements in 68,445

"The kinds of improvements made to homes vary by the home type: frame, mobile or multi-family."

Nebraska Energy Office Investment in the Weatherization Assistance Program October 2015 - September 2016	
NEO Investment (federal funds)	$1,455,004
Energy Impacts	
Electric Dollar Savings	$162,410
Natural Gas Dollar Savings	$629,410
Annual Total Dollar Savings	$791,625
Present Discount Value of Future Savings	$780,337
Economic Impacts	
Output	$1,041,605
Value-Added	$698,760
Labor Income	$671,804
Job-Years	19.76
Environmental Impacts (Pounds)	
Carbon Dioxide (CO2)	10,715,931
Sulfur Dioxide (SO2)	13,711
Nitrogen Oxide (NOX)	14,013
Particulate Matter < 2.5 micro-meters (PM2.5)	238.63
Volatile Organic Compounds (VOC)	527.20
Particulate Matter < 10 micro-meters (PM10)	382.67

Source: Nebraska Energy Office

Figure 4

homes. In 2010, maximum household income levels were revised to 200 percent of the federal poverty guidelines, making free home weatherization available to thousands more Nebraskans than in prior years.

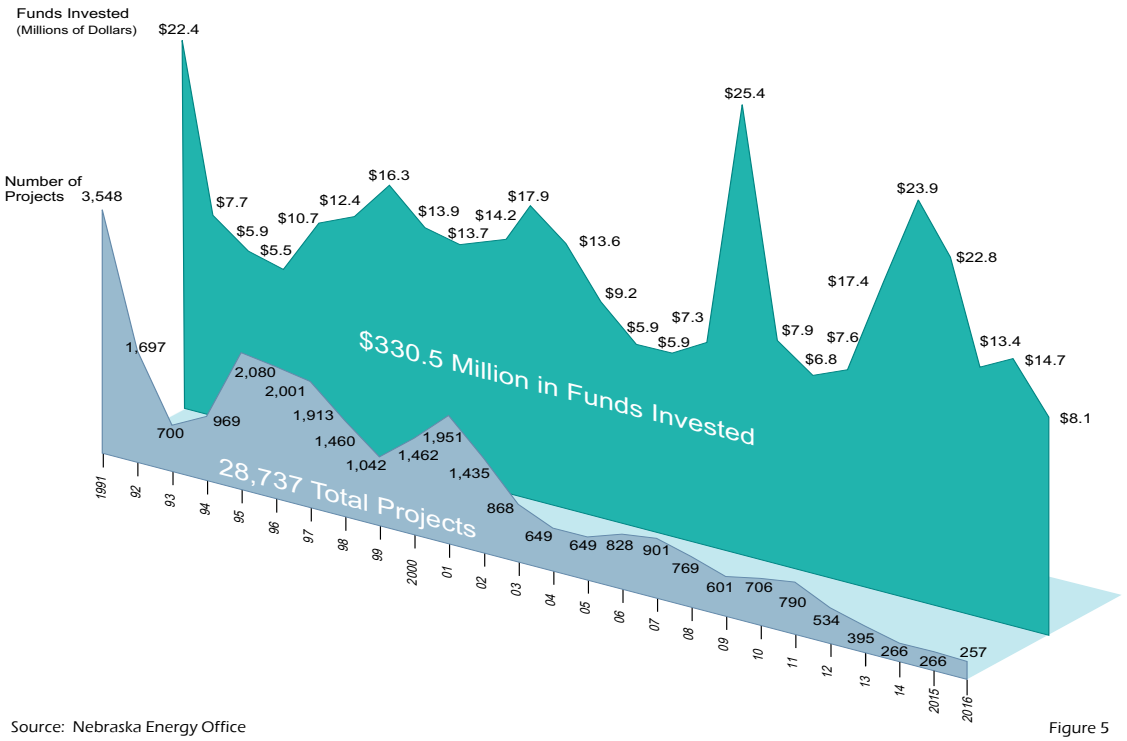
Energy savings resulting from the energy efficiency improvements made to homes typically last 20 years or longer and most have a one year payback. Conservatively, estimated energy savings for the 40 years total $114 million. In 2012, an extensive analysis quantified the energy, economic and environmental benefits of the Weatherization Assistance Program and these quantifiers are used today to determine the impact on the program.

Beginning in January 2014, data from Weatherization Assistance Program activities were entered into the database. The energy, economic and environmental benefits from October 2015 through September 2016 are illustrated in Figure 4.

Dollar and Energy Saving Loans

The Dollar and Energy Saving Loan program was initially capitalized with Oil Overcharge Funds, later augmented with *American Recovery and Reinvestment Act* funds and is continually recharged with loan repayments from borrowers.

The Energy Office, in conjunction with 296 eligible Nebraska lending institutions at 957



Source: Nebraska Energy Office

Figure 5

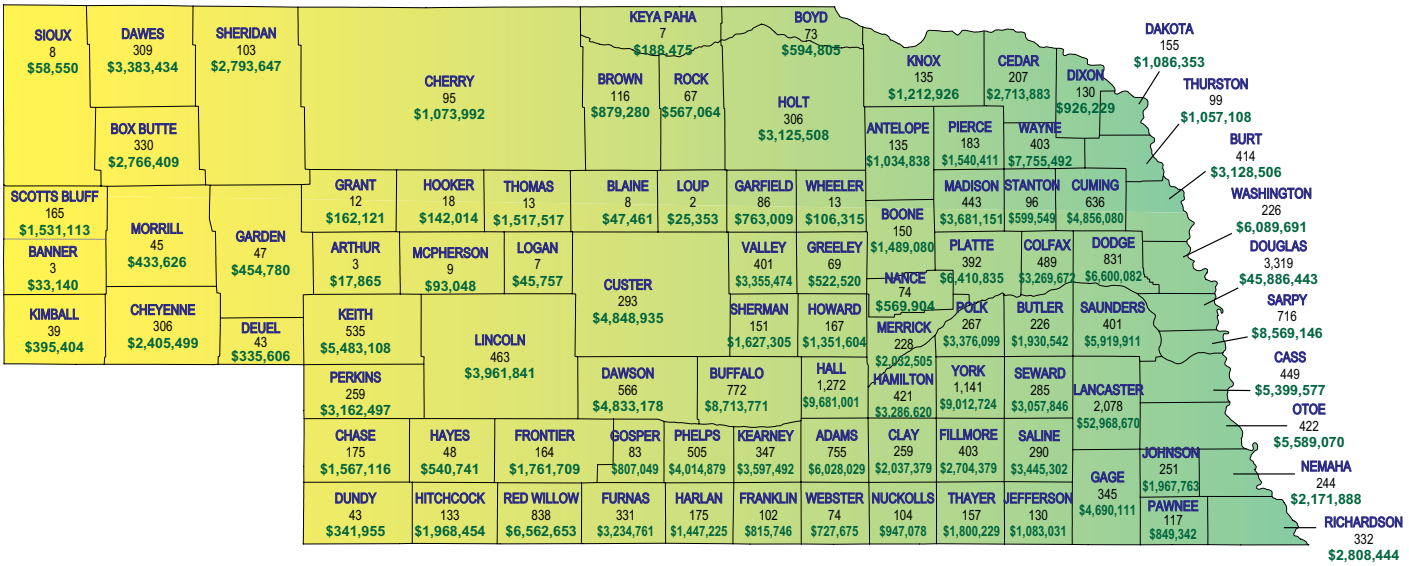
locations, continues to transform the energy market through access to statewide reduced interest rate loans. Energy efficiency, renewable energy and waste minimization projects in all sectors can be financed. Focus has been on homes, businesses and operating systems, alternative fuel vehicles, fueling facilities and equipment, wind and solar installations, telecommunications equipment, ENERGY STAR® certified home appliances and ENERGY STAR® five star plus homes. Interest rates could range from 2.5 to 5.0 percent during 2015-2016 depending on the project eligible for financing and the lender, and one percent for schools willing to benchmark energy consumption through the life of the loan.

In March 2009, Nebraska Public Power District added $500,000 — and provided a second $500,000 in January 2010 — to the agency's Dollar and Energy Saving Loan program to finance 1.5 percent loans for air source, ground water or ground coupled heat pumps, qualifying thermostats and back-up natural gas or propane furnaces with a 95 AFUE rating or higher for the utility's retail and wholesale customers. More information about these loans may be found at the Energy Office's website (www.neo.ne.gov/loan/loans1.5.htm).

From March 1990 to June 30, 2016, 28,737 energy saving projects totaling more than $330.5 million have been financed using low-interest loans from the Energy Office and participating lenders and funds from borrowers including any non-eligible improvements. More than $157.01 million of the $330.5 million has come from the agency's revolving loan fund. The state's participating lenders provided more than $125.01 million. The balance, more than $48.5 million, was spent by the borrowers for the remaining cost of eligible improvements along with any non-eligible related items.

Loans have financed projects in all of the state's 93 counties as illustrated in Figure 6. Douglas

Dollar and Energy Saving Loan Projects, Number of Projects by County and Total Dollar Amount of Projects as of June 30, 2016



Source: Nebraska Energy Office

Figure 6

County with 3,319 projects totaling $45.9 million tops the list with the most projects. Lancaster County co-anchors the top spot with the most dollars invested at $53.0 million, albeit on fewer projects — only 2,078. Looking at a regional perspective, the Third Congressional District leads with 14,441 projects; First Congressional District with 10,128 projects still totaling and the Second Congressional District with 4,168 projects.

During this reporting period, 257 new projects totaling $8.13 million were financed. The number of energy efficiency projects financed since 1990 are shown in Figure 5 and total 28,737.

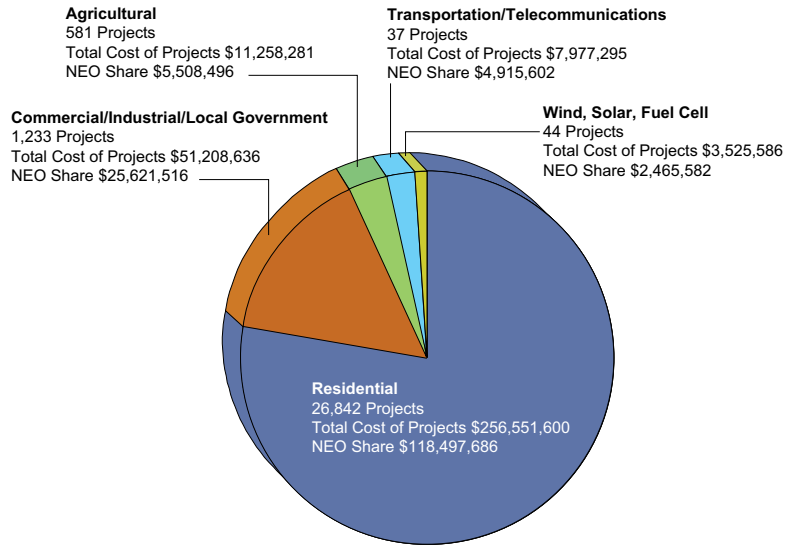
Figure 7 quantifies loans in five different areas: residential, commercial/industrial/local government, agricultural, transportation/telecommunications, wind, solar and fuel cells. The number of projects by category and the total cost in each category also appear in Figure 7. Several of the largest categories are detailed as follows:

Residential

More than 93.4 percent of all the energy efficiency projects financed with loans from the agency are for homes of Nebraskans. More than 75.47 percent of NEO funds from all categories — $118.5 million — has been used to finance residential energy saving improvements such as replacement of inefficient furnaces, air conditioners and heat pumps, replacement of windows and doors and insulation of walls and ceilings. New energy efficient housing construction is also included in the category. Since 1990, 26,842 residential energy efficiency projects have been undertaken by Nebraskans using loan program funds.

"From March 1990 to June 30, 2016, 28,737 energy saving projects totaling more than $330.52 million have been financed with low-interest loans from the Energy Office and participating lenders..."

Total NEO Funds Invested In Types of Dollar and Energy Saving Loan Projects as of June 30, 2016



TOTALS
28,737 Projects
Cost of Projects $330,521,398
NEO Share $157,008,882

Source: Nebraska Energy Office

Figure 7

Commercial/Industrial/Local Government

More than 15.49 percent of funds from all categories — $51.21 million — has been used to make building and system improvements in 1,233 projects since 1990, ranking second-highest among all loan areas. Typical improvements in this category include replacement of heating and cooling equipment, installation of insulation, lighting upgrades and replacement of doors and windows.

Agricultural

Improvements in agricultural equipment and systems rank third in the use of low-interest financing. More than 3.41 percent of all improvement funding — $11.26 million — has been used to finance projects such as low-pressure irrigation systems, replacement of irrigation pumps and motors, replacement of grain dryers and well modifications. Since 1990, 581 projects have been financed with $5.51 million from the Energy Office, $5.37 million from participating lenders and over $383,000 from borrowers.

Energy, Economic and Environmental Impacts

In 2012, a study analyzing the energy, economic and environmental impacts of Residential Dollar and Energy Saving Loans was completed by the University of Nebraska - Lincoln. Beginning in January 2014, data from Residential Dollar and Energy Saving Loans has been entered into the database. The energy, economic and environmental benefits of these loans from July 1, 2015 through June 30, 2016 are illustrated in Figure 8 below.

Residential Dollar and Energy Saving Loans July, 2015 - June, 2016	
Investment	$3,351,094
Residential Projects	234
Energy Impacts	
Electric Energy Savings (kWhs)	84,378
Natural Gas Energy Savings (therms)	43,911
Present Discount Value of Future Savings	$881,404
Present Day Value Economic Impacts	
Output	$3,228,029
Value-Added	$1,919,456
Labor Income	$1,420,823
Job-Years	36.54
Emissions Reductions (Pounds All Years)	
Carbon Dioxide (CO2)	11,931,009
Sulfur Dioxide (SO2)	9,326
Nitrogen Oxide (NOX)	13,256
Particulate Matter < 2.5 micro-meters (PM2.5)	162
Volatile Organic Compounds (VOC)	358
Particulate Matter < 10 micro-meters (PM10)	260
Total Present Discount Value of Environmental, Comfort, Health and Safety	$776,349

Source: Nebraska Energy Office

Figure 8

State Energy Program Formula Grant

In 2015-2016, Nebraska received $393,120 for this federally-funded effort and supplied $78,624 in state funds from oil and natural gas severance taxes, as required 20 percent matching funds. These funds are used to provide energy efficiency services to consumers and other small energy users, and include the publication of this *Annual Report* and the *Nebraska Energy Quarterly* as well as maintenance of the state's energy database (neo.ne.gov/statshtml/index3c.html) and agency website (neo.ne.gov).

These funds also provide program support for a wide array of activities that include energy supply shortage tracking and management and emergency preparedness, education and information, Dollar and Energy Saving Loan operations, support of renewable energy activities and residential and commercial building energy efficiency activities.

Building Energy Codes Compliance Collaborative

In March 2013, the Energy Office established a Building Energy Codes Compliance Collaborative, using existing agency funding. The Collaborative is a group of more than 25 members that represent state and local governments, homebuilders, utilities, architects, home energy raters, suppliers, banks, and advocacy groups including Midwest Energy Efficiency Alliance and the Nebraska League of Municipalities.

"The Building Energy Codes Compliance Collaborative presented eight "Energy Code 101" sessions to various organizations detailing the importance and benefits of building energy codes, as well as Nebraska Energy Code provisions."

It's activities included:

- Developed a brochure for consumers explaining the Nebraska Energy Code and requirements;
- Presented eight "Energy Code 101" sessions to various organizations detailing the importance and benefits of building energy codes, as well as Nebraska Energy Code provisions; and
- Provided testimony at a Legislative Interim Study hearing of the Urban Affairs Committee on the mechanics of the Nebraska Energy Code and compliance issues.

Nebraska Wind and Solar Conference

Since 2008, the Nebraska Energy Office has partnered with stakeholders interested in wind and solar energy to produce a state-wide Wind and Solar Conference. Agency staff members develop and execute communications for the conference including news release development, and distribution and active social media promotion. They also help to develop conference content including selection of speakers and topics; host an educational booth about services provided by the agency, and assist with IT equipment and services. The November 2016 conference was held in Lincoln, Nebraska and hosted over 350 attendees.

National Association of State Energy Officials

Participation in National Association of State Energy Officials (NASEO) programs is also included under the State Energy Program. The agency also participates in NASEO webinars and conference calls, and attends national and regional NASEO meetings and conferences concerning energy issues.

"Between September 2015 and September 2016, the Energy Office began its 14th year of participation in the U.S. Department of Energy's State Heating Oil and Propane Program."

Nebraska Energy Efficiency Partnership

The Nebraska Energy Office is a founding member of the Nebraska Energy Efficiency Partnership (NEEP), which includes representatives from Nebraska's three largest electric utilities: Omaha Public Power District, Nebraska Public Power District and Lincoln Electric System as well as the Nebraska Municipal Power Pool. The group meets to share knowledge, program ideas and other information including Demand Side Management programs for electric utility customers.

State Energy Program Competitive Funding

Energy Reduction at Municipal Waste Water Plants

The Energy Office is collaborating with the University of Nebraska-Lincoln and the Nebraska Department of Environmental Quality for this U.S. Department of Energy cooperative agreement to address energy efficiency in local government waste water treatment facilities. The U.S. Department of Energy awarded $273,330 in December 2015 and it was matched with $54,666 of state funds. The project is scheduled for completion December 31, 2018.

Tasks for this award include:

- Collection and evaluation of energy use data from wastewater plants in communities with a population of 10,000 or less;
- Further analysis of 60 to 100 of the plants, including an on-site visit, and
- Technical and financial assistance to at least 24 of the lowest performing plants, enabling the achievement of 20 percent or better in savings.

Access Ethanol Nebraska

The U.S. Department of Agriculture awarded a $2.85 million Biofuel Infrastructure Partnership grant to the Energy Office to establish a public-private partnership with the Nebraska Corn Board (Corn Board), Nebraska Ethanol Board (Ethanol Board) and Nebraska Department of Agriculture (NDA) to add 80 new blender pumps across the state of Nebraska, allowing greater access to ethanol for Nebraskans and out of state visitors. The grant requires a dollar for dollar match from the state, private industry and foundations, and was fulfilled with funds will from the Nebraska Corn Board through the state corn checkoff funds paid by Nebraska corn farmers and from the Nebraska Environmental Trust approved funding of $500,000 for each of the next two years. Matching funds will also come from Legislative Bill 581 (LB 581) passed by the Nebraska Unicameral in 2015, which allows for some ethanol infrastructure; contributions made by individual ethanol plants and "Prime the Pump;" a non-profit organized and funded by the ethanol industry to improve ethanol infrastructure.

State Heating Oil and Propane Program

Between September 2015 and September 2016, the Energy Office began its 14th year of participation in the U.S. Department of Energy's State Heating Oil and Propane Program. This activity collects price information from a sampling of Nebraska suppliers selected by the Energy Information Administration from October through March which in turn, is shared with the Energy Information Administration and then posted on the agency's website (www.neo.ne.gov/statshtml/86.html and www.neo.ne.gov/statshtml/87.html).

U.S. Department of Energy provided a grant of $6,000 for this activity which is required to be matched one-for-one using state cash funds. By the end of the reporting period, all funds were expended and the project was completed.

Oil Overcharge Funds

Beginning in 1982, Nebraska received oil overcharge — or petroleum violation escrow — funds as a result of several court actions against oil companies that overcharged their customers during the period of federal price controls from 1973 to 1981. Since direct restitution to injured consumers was not practical, the courts ordered the money be distributed to the states and used, within parameters established by the courts and a federal regulator, to fund energy assistance and efficiency programs. The final petroleum violation escrow payment from the U.S. Department of Energy to the Energy Office was received September 7, 2007.

The Legislature and the U.S. Department of Energy require the Energy Office to annually report on the disposition of these funds. A Nebraska Energy Settlement Fund Summary of activities and expenditures is detailed in Figure 9.

Financial Activity

Total Energy office expenditures for the year were $11,673,877, a decrease of 30.9 percent. Energy loans accounted for 51.2 percent of expenditures, aid payments accounted for 35.1 percent and the remaining 13.7 percent of expenditures were for salaries and operations.

Of the funding for these expenditures, 49.6 percent came from Oil Overcharge funds, 45.4 percent from federal funds, and five percent from state and other funds.

A complete listing of expenditures by category is illustrated in Figure 9.

Oil Overcharge Fund activity during the reporting period is located on page 5 of this report.

How funds were spent by source is illustrated in Figure 10.

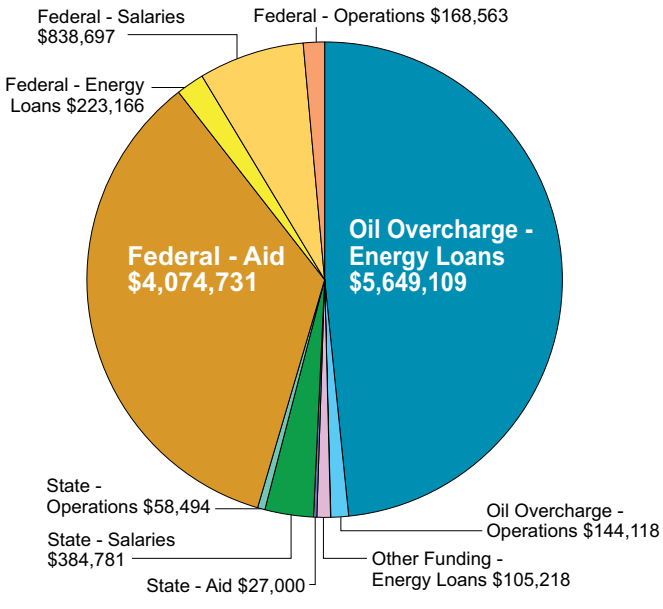
Nebraska Energy Settlement Fund
Summary of Exxon, Stripper Well and Diamond Shamrock
Oil Overcharge Funds as of June 30, 2015

	Exxon	Stripper Well	Diamond Shamrock	Total
Funds Received	$15,504,944	$15,674,042	$359,172	$31,538,158
Interest Earned and Miscellaneous Income	$12,639,886	$11,379,860	$258,833	$24,278,579
Total	$28,114,830	$27,053,902	$618,005	$55,786,737
Funds Budgeted	$28,114,830	$26,694,264	$618,005	$55,427,099
Low Income Designated	$0	$16,194	$0	$16,194
Uncommitted Balance	$0	$343,444	$0	$343,444

Source: Nebraska Energy Office

Figure 9

How Funds Were Spent by Source
July 1, 2015 - June 30, 2016



Total $11,673,877

Source: Nebraska Energy Office

Figure 10

State Capitol Legislative Chamber.

Nebraska Revised Statutes 81-1607

(1) On or before February 15 of each year, the Director of the State Energy Office shall transmit to the Governor, Clerk of the Legislature and State Library Commission a comprehensive report designed to identify emerging trends related to energy supply, demand, and conservation and to specify the level of statewide energy need within the following sectors: Agricultural, commercial, residential, industrial, transportation, utilities, government, and any other sector that the director determines to be useful.

(2) The report shall include, but not be limited to:

(a) An assessment of the state's energy resources, including examination of the current energy supplies and any feasible alternative sources;

(b) The estimated reduction in annual energy consumption resulting from various energy conservation measures;

(c) The status of the office's ongoing studies;

(d) Recommendations to the Governor and the Legislature for administrative and legislative actions to accomplish the purposes of sections 70-625, 70-704, 81-161, 81-1602, 81-1606, and 81-1607; and

(e) The use of funds disbursed during the previous year under sections 81-1635 to 81-1641. The use of such funds shall be reported each year until the funds are completely disbursed and all contractual obligations have expired or otherwise terminated.

Nebraska Energy Trends and Needs

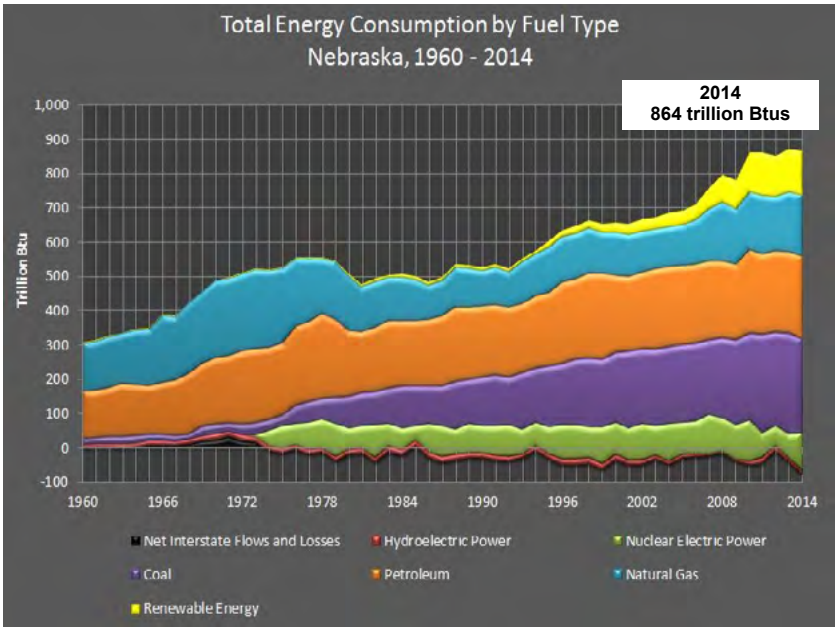
The Nebraska Energy Office tracks trends in different energy sectors as part of its mission. These trends can forecast future energy use. In all cases, the most current energy data available from all sources has been used in the *Annual Report*. Energy statistical data required by statute to be maintained by the Energy Office can be found on the agency's website at http://www.neo.ne.gov/statshtml/index3c.html . Much of the information included in this report is obtained from the U.S. Department of Energy's Energy Information Administration. Data referred to or include in the charts and graphs reflect the most current data available at the time of publication.

State-Wide Energy Need and Cost

Need

2014. Nebraska's total energy consumption in 2014 was 864 trillion British thermal units (Btus), a decrease of 7.5 trillion Btus — or 0.9 percent, from 2013 to 2014. A British thermal unit is a standard measure of heat energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level. Overall, the use of all fuel types increased. Among all the states, Nebraska ranked 19th lowest in total energy consumption in the nation in 2014. Based on energy consumption per capita, Nebraska ranked 7th highest in the country among the states. According to the U.S. Department of Energy, Nebraska's per capita energy consumption is high because of its energy-intensive industrial sector, led by food processing and chemical manufacturing. The chart on page 12 shows Nebraska's consumption per capita compared to the average U.S. per capita consumption.

1960-2014. Energy use over the past 54 years has changed markedly. Overall, total energy consumption has more than doubled from 308.3 trillion Btus in 1960 to 864 trillion Btus in 2014.



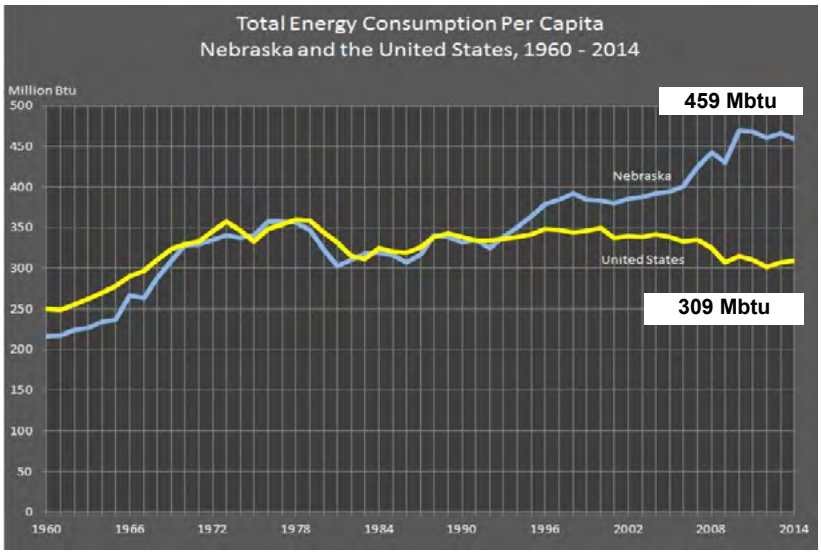
Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

- Coal use has increased more than twelvefold from 20 trillion Btus to 276.54 trillion Btus between 1960 and 2014 — a decrease of 16.42 trillion Btus from 2013. Peak use of coal was reached in 2013, surpassing the high set in 2011. Virtually all of this growth is attributable to coal used to generate electricity.

State-Wide Energy Need and Cost

"Diesel fuel consumption more than quadrupled from 24.1 trillion Btus in 1960 to 110.63 trillion Btus in 2014."

- Natural gas consumption has increased and declined at different times during the 54 years from 140.4 trillion Btus in 1960 to 179.15 trillion Btus in 2014. Natural gas consumption peaked in 1973 at 230.7 trillion Btus. The rise, fall and recent rise in consumption of natural gas is a result of increased equipment efficiency, fewer homes using natural gas as a primary heating source, electric utilities using natural gas for peak power production and use by ethanol plants.
- Use of petroleum products nearly doubled over the past 54 years from 136.1 trillion Btus in 1960 to 236.26 trillion Btus in 2014. Gasoline and distillate fuel oil — primarily diesel fuel — comprise the bulk of refined petroleum products consumed. Both types of refined petroleum products increased between 1960 and 2014. Diesel fuel consumption more than quadrupled from 24.1 trillion Btus in 1960 to 110.63 trillion Btus in 2014. This increase is attributable to increased trucking and agricultural use. Gasoline consumption only increased by less than a quarter during the period from 78.7 trillion Btus in 1960 to 100.29 trillion Btus in 2014. Gasoline consumption peaked in 1978 at 115.9 trillion Btus, just before the second Oil Price Shock. Changes in gasoline consumption can be traced to increased fuel efficiency of vehicles, relative lack of population growth and incremental changes in miles traveled annually. Motor vehicle miles traveled increased from 12.0 billion miles a year in 1978 to 20.23 billion miles a year in 2015, maintaining peak rises every year since 2010. Overall, petroleum consumption peaked in 1978 at 246.6 trillion Btus.
- Nuclear power was not generated commercially in the state until 1973-1974. Nuclear consumption has increased significantly over the period, rising from 6.5 (1973) and 44.6 (1974) trillion Btus to 105.66 trillion Btus in 2014. Nuclear consumption peaked in 2007 at 115.7 trillion Btus.
- Renewable energy consumption from 1960 to 2013, rose and fell over the decades from 13.4 trillion Btus in 1960 to 140.87 trillion Btus in 2014. Energy production from renewables peaked in 2011. Between 1960 and 1994, the primary renewable energy source was hydropower. Beginning in 1995, biofuels — ethanol — production began and continued to soar, initially equaling hydropower production. By 2000, biofuels production began to double the amount of hydropower generated. By 2014, 69.74 percent of all renewable energy produced in that year came from biofuels, 7.29 percent from hydroelectric power, 11.69 percent from wind and 3.06 percent from wood and wood waste. Very minor amounts came from geothermal and solar.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC.
Nebraska Energy Office, Lincoln, NE.

State-Wide Energy Need and Cost

Cost

2014. Nebraska's total energy expenditures increased 0.7 percent to $10.3 billion in 2014, an increase of $7.0 million over 2013. Expenditure increases were reported in wood & waste, natural gas and nuclear. Expenditures for coal and petroleum decreased.

Among the states, Nebraska ranked 36th in energy expenditures in 2014. Petroleum products in 2014 accounted for 63 percent of all energy expenditures, 10.9 percent of expenditures went for natural gas, 3.8 percent for coal, 0.78 percent on nuclear fuel and 0.15 percent for renewable energy. On a per capita basis, Nebraska ranked ninth in energy expenditures among the states at $5,486 in 2014, a slight decrease from 2013. North Dakota ranked first with a per capita expenditure of $11,094. Florida ranked last with a per capita energy expenditure of $3,336. The United States' average of energy expenditures per capita in 2014 was $4,374.

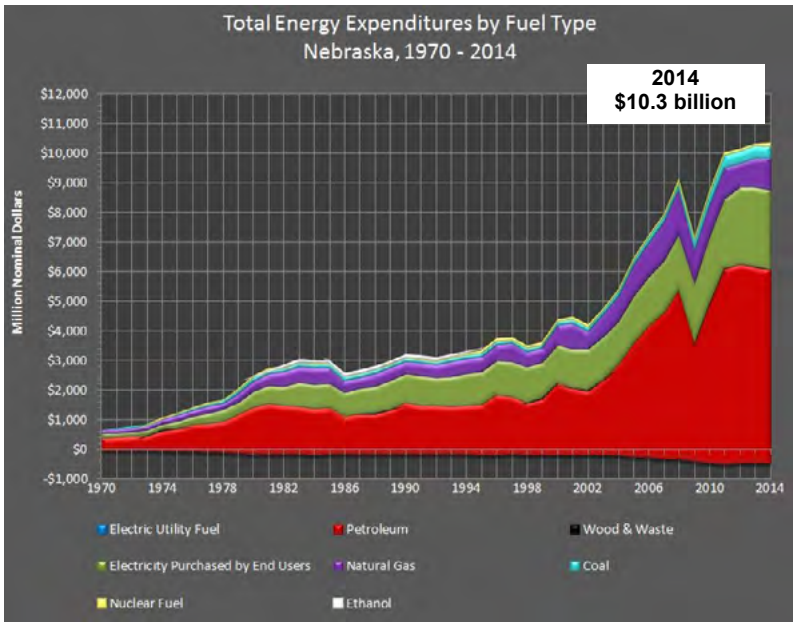
2014 prices for different types of energy, as compared to the other 49 states and the District of Columbia, shows that Nebraskans paid the 49th lowest price for coal in the nation at $1.43 (measured in nominal dollars per million British thermal units). Maine paid the highest at $4.89 per million Btus. At the other extreme, Nebraskans paid the 17th highest price for petroleum at $26.87 in nominal dollars per million British thermal units. Prices in 2014 for natural gas in Nebraska were $6.54 in nominal dollars per million British thermal units and ranked 43rd when compared to other states. Retail electricity prices in the state were $25.91 in nominal dollars per million British thermal units, ranking 38th. The price for motor gasoline in Nebraska, which include ethanol-blended fuels, was $27.59 in nominal dollars per million British thermal units placed the state at 27th among the states.

Looking at the prices differently and in more common units of measurement, in 2014 Nebraska average prices by fuel type:

- Residential electricity: 10.41 cents per kilowatt-hour
- Residential natural gas: $8.22 per billion cubic feet

1970-2014. Total energy expenditures in 1970 were $667.8 million and increased by nearly fifteen-fold 44 years later in 2014 to $10.32 billion. The peak in expenditures was reached in 2014. Peak expenditures by specific fuel types were reached as follows:

- Coal, $437.9 million in 2011
- Natural gas, $1.565 billion in 2008
- Nuclear, $81.0 million in 2014
- Petroleum, $6.710 billion in 2012



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

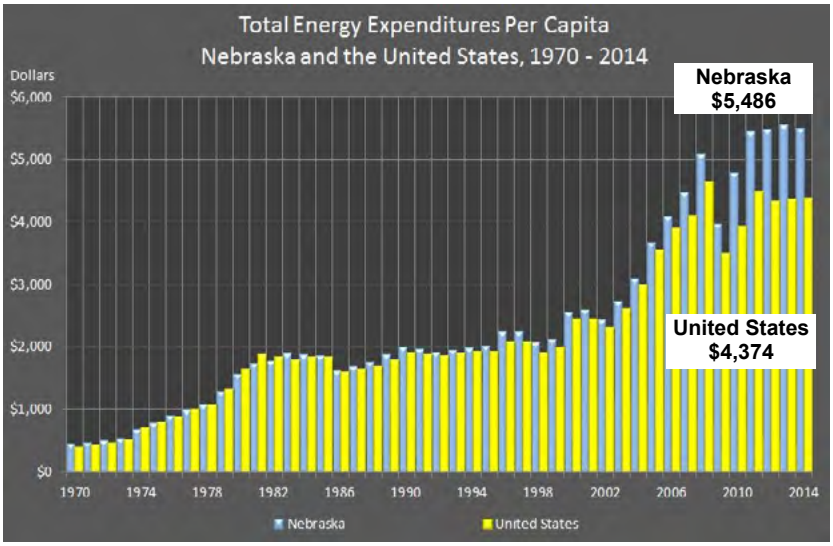
State-Wide Energy Need and Cost

"Looking deeper into the data, one finds a surge of energy consumption in the industrial sector. In Nebraska, that sector includes agriculture."

The percentage share of personal income has not varied much: In 1970, 11.8 percent was spent on energy and in 2014, 11.5 percent was spent on energy. The peak percentage occurred in 1980 at 17.1 percent.

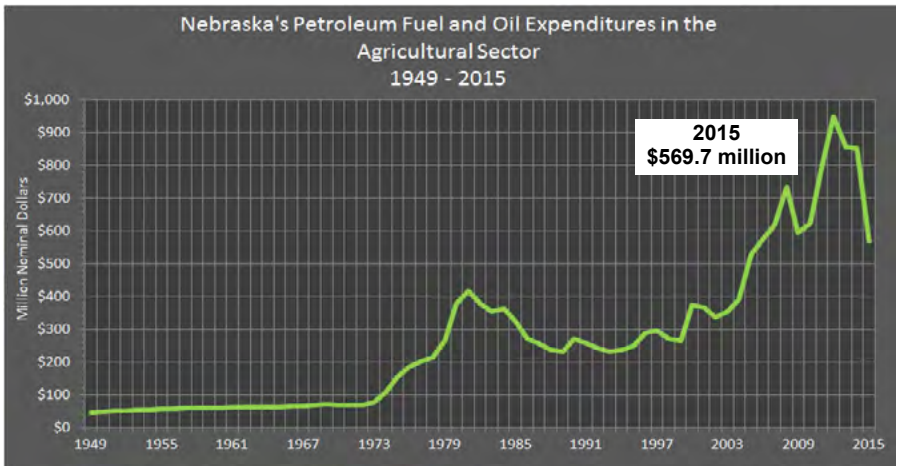
- Coal expenditures increased from $9.8 million in 1970 to $395.5 million in 2014; a steady decrease since 2011.
- Natural gas expenditures increased ten-fold from $104.1 million in 1970 to $1,125.0 million in 2014.
- Petroleum expenditures also increased more than sixteen-fold from $405.7 million in 1970 to $6.517 billion in 2014.
- Nuclear expenditures soared from $1.1 million in 1973 — the first partial year of operation of one of the state's two nuclear plants — to $81 million in 2014.
- Electricity purchased by end users totaled $170.3 million in 1970 and rose to $2.671 billion in 2014.

In comparing total energy consumption per capita between Nebraska and the United States between 1960 and 2014 shows that during the first decade, Nebraska's per capita energy consumption was considerably less than the nation's. Over the next several decades and prior to 1994, Nebraska and the nation were somewhat parallel in per capita energy consumption, seesawing back and forth. After 1994, and through 2014, a chasm opened and widened as the state's per capita energy consumption vastly outpaced that of the nation. Why? For the most part, the state's population showed little growth during this period. Nebraskans' individual energy use likely paralleled that of other Americans. What happened in Nebraska beginning in 1994 that sparked a growing increase in per capita energy consumption? Looking deeper into the data, one finds a surge of energy consumption in the industrial sector. In Nebraska, that sector includes agriculture. Looking at ethanol production in 1994, only 78.9 million gallons of ethanol were produced. By September 2016, 2.1 billion gallons of ethanol were being produced in the state, which is 14 percent of the nation's capacity of 15.2 billion gallons. Ethanol facilities use both electricity and natural gas in considerable volumes. The state's agricultural producers also changed what was planted. More than 727 million, or 43 percent of Nebraska's 1.692 billion bushels of corn produced, went into production for ethanol. Corn under irrigation is a more energy intensive crop than soybeans, wheat or grain sorghum as several recent studies have noted.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Agricultural



Sources: United States Department of Agriculture. Nebraska Energy Office, Lincoln, NE.

Agricultural

According to the U.S. Department of Agriculture National Agricultural Statistics Service, there were 48,700 farms and ranches on 45.2 million acres in Nebraska in 2015 encompassing about 92 percent of the state's total land area. The average farm size contained 928 acres. According to the Nebraska Department of Natural Resources well database, as of November 2016, Nebraska had 96,393 active irrigation wells supplying water to nearly 8.3 million acres of cropland and pasture. Approximately 64 percent of total cropland in Nebraska was irrigated.

Agricultural energy data is aggregated with other data in the industrial sector. As such, separate agricultural energy data is not always available on a consistent or annual basis.

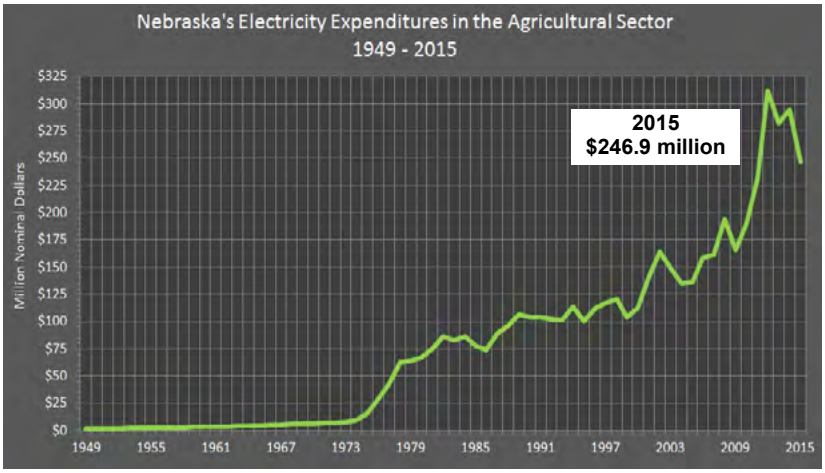
Energy Supply

Energy supplies for the state's agricultural sector have been met. Over the years, any energy supply problems have been limited to infrequent shortfalls of petroleum products or fertilizer — reliant on energy inputs — usually during periods of peak demand or energy shortfalls because of worldwide demand.

In the summer of 2012, a unique situation arose for a very small number of the state's irrigators that use electricity. The state's drought forced growers to irrigate to a greater extent than ever before. As a result, some growers were briefly "shed" by electrical utilities around July 4, 2012, to protect the integrity of the energy infrastructure. Since that episode, the large utility supplier has upgraded local transmission lines and acquired mobile generators to forestall that problem from happening again.

Demand

As indicated earlier in this section, energy demand information for the agricultural sector is not available on a consistent or annual basis. One of the primary tracking tools, the Census of Agriculture, is only



Sources: United States Department of Agriculture. Nebraska Energy Office, Lincoln, NE.

Agricultural

"In 1966, only 3.1 million acres were irrigated, but by 2014, nearly 8.3 million acres were under irrigation."

conducted every five years, so the 2012 census of Agriculture was released this year. However, yearly information provided by the USDA Statistics Service is more current. National energy databases commingle agricultural demand with data from the industrial sector.

Conservation

As with most consumer behavior, high fuel costs or limited availability of energy resources induces demand for efficiency practices in this sector. Historically, when natural gas prices have reached record highs, farmers alter practices such as when and how much anhydrous ammonia fertilizer — a natural gas product — is used. High diesel prices have motivated farmers to adopt conservation tillage practices, resulting in reduced cultivation on crop land, and to switch from using natural gas, diesel and propane to electricity to power irrigation systems.

As energy costs have increased, the state's agricultural producers — with assistance from the agricultural extension agents and research — have adopted a variety of practices that have reduced energy use: conservation tillage and irrigation efficiency improvements, scheduling and load management, and soil moisture measurement practices. For example, the Nebraska Energy Office provides low-cost financing for irrigation efficiency projects that demonstrate energy savings such as low-pressure pivots and replacement pumps and motors. Low-interest Dollar and Energy Saving Loans have also been used to finance grain dryers, no-till equipment, dairy vacuum pumps and related agricultural equipment. Over the past number of years, U.S. Department of Agriculture's Rural Energy for America Program grants have partially financed hundreds of irrigation efficiency improvements that also included switching fuel sources from diesel, propane and natural gas to electricity. As long as federal funding remains available and fossil fuel prices remain high or fluctuate dramatically, this trend in irrigation is likely to continue.

In 2010, the U.S. Department of Agriculture estimated that seven percent of the total cash production expenses were for energy, directly or indirectly.

Since the 1970s, farm energy consumption has fallen 26 percent as farm output has increased 63 percent due to the adoption of energy conservation practices.

Energy Need

Energy need in the ag sector can be influenced by the cost of inputs which are a significant factor in modern farming. Over the decades, farms have increased in size and energy has replaced labor, allowing fewer people to produce larger harvests of agricultural goods. Another long-term trend has been the increase in irrigation. In 1966, only 3.1 million acres were irrigated, but by 2014, nearly

Agricultural

8.3 million acres were under irrigation. As ethanol production in the state has grown, so has the amount of corn needed as a feedstock. In 2015, an estimated 35 percent of the nation's corn crop was utilized in ethanol production. Corn requires ten inches of evapotranspiration to produce the first bushel — the highest of all the crops grown in the state. As a result, any rainfall shortage is made up from irrigation which requires an energy input. The fuel used to power irrigation pumps in 2013 was diverse (2008 figures in parentheses): electricity, 55 percent (52 percent); diesel, 26 percent (31 percent); natural gas, 10 percent (11 percent); propane, 7 percent (5 percent) and gasoline/ethanol, 0.2 percent (less than one percent). The fuel shifts over the past five years show the near ten percent increase in electricity came at the expense of natural gas, diesel and propane.

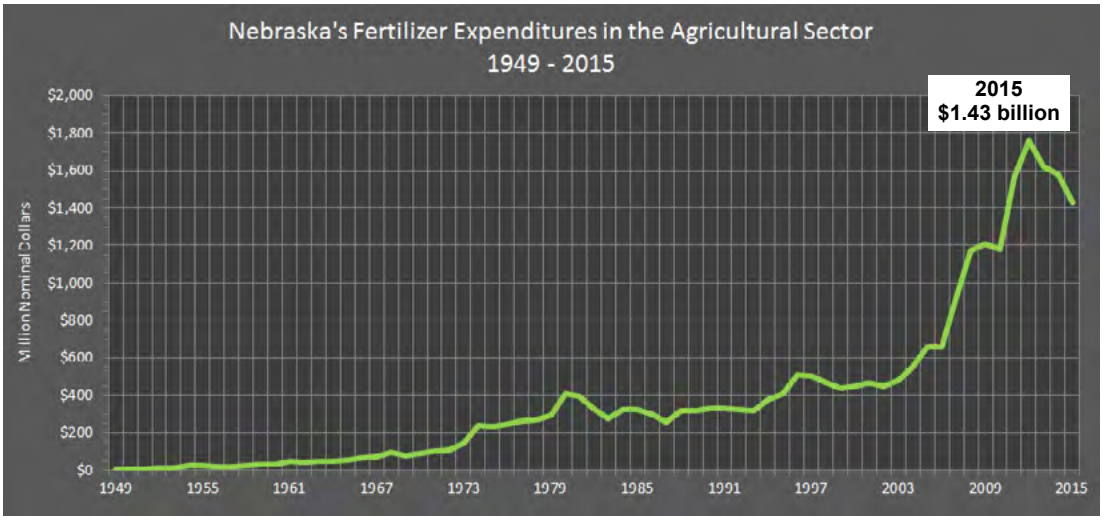
Energy Cost

According to the U.S. Department of Agriculture, Nebraska farm expenditures in 2015 were as follows:

- $1.43 billion for fertilizer, a 9.5 percent decrease from 2014. Peak expenditures for fertilizers used in agriculture occurred in 2012.
- $569.7 million for fuel and oil, a 33.1 percent decrease from 2014. Peak expenditures for fuel and oil in agriculture occurred in 2012.
- Electricity expenditures in 2015 totaled $246.9 million, a 16.1 percent decrease from 2014. A record high was set in 2012 at $312.3 million.

Since 1949, Nebraska's fuel and oil, electricity and fertilizer expenditures by the agricultural sector have been tracked. Between 1949 and 1973-1974, energy prices were stable and showed mostly marginal increases over time. However, after the impact of the first Oil Price Shock in the early 1970s, agricultural energy expenditures deviated markedly from historic patterns, becoming far more erratic and costlier.

- Fertilizer expenditures in the state have shown the most substantial change between 1949 and 2015, rising from $2.1 million to $1.43 billion. The increase in the cost of fertilizer and the impact of oil prices is illustrated between 1973 and 1974,



Sources: United States Department of Agriculture. Nebraska Energy Office, Lincoln, NE.

Agricultural

"Fuel substitution, or conversion to other types of fuel, is very difficult for this sector to utilize without costly changes in equipment."

when expenditures in 1973 totaled $142.6 million and only a year later totaled $239.9 million. Since 2004, except for 2008-2009, fertilizer expenditures have increased at least $100 million a year, and between 2006 and 2008 increased $260 million. Fertilizer prices declined in 2010 but reversed in 2011 with a 33 percent increase. From 2013 to 2015, fertilizer expenditures decreased each year to a total of $1.43 billion.

- Fuel and oil expenditures decreased to $569.7 million in 2015, which was a 33.1 percent decrease from 2014 expenditures of $851 million. A record high was set in 2012 at $948.0 million. In 1949, fuel and oil expenditures totaled only $47.5 million. Between 1973 and 1975, fuel and oil expenditures nearly doubled from $78.5 million to $155.8 million, and increased more than two and half times by 1981 when expenditures totaled $416.7 million. What followed was a two-decades-long period of declines with periods of stability and incremental rises beginning in 2000. That changed in 2005 when expenditures leaped more than $135 million in one year. After that, expenses continued to rise, peaking in 2012 at more than $948.0 million.
- Electricity expenditures in agriculture are marginal, compared to petroleum-based inputs. Its primary use is for irrigation, and the trend is for less fossil fuel-powered irrigation. An increasing number of growers who use irrigation are fuel switching from diesel, propane and natural gas to electricity, in part, because of its price stability and favorable cost structure. In 1949, only $1.6 million was spent for electricity. The peak year for expenditures occurred in 2012 when $312.3 million was spent. Expenditures in 2015 decreased to $246.9 million from 294.4 million in 2014, or a 16.1 percent decrease. The impact of timely and sufficient rainfall — negating the need for irrigation — can be seen in the dramatic decline in expenditures from 2008 to 2009, a drop of nearly 15 percent. In 2011, less timely rainfall resulted in a 22 percent increase from 2010, rising from $190.8 million to $232.0 million.
- Diesel fuel, the workhorse of the petroleum-based inputs in agriculture, illustrates the volatility of the petroleum fuel prices. Records since 1990 for *"Agricultural Prices for Bulk Delivery of Diesel Fuel in the Northern Plains"* tell the story of a cheap fuel that increasingly became more expensive. In 1990, diesel prices were just $0.78 a gallon (excluding federal and state excise taxes and road taxes). From 1990 to 2002, prices were very uniform, fluctuating within a narrow price band of $0.67 to $1.02 a gallon. Between 2003 and 2008, prices rose inexorably from $1.16 to $3.54 a gallon, tripling in price in six years. Prices in 2008, 2009, 2010 and 2011 have illustrated the extreme price volatility of the fuel: $3.54, $1.66, $2.50 and $3.49 a gallon, respectively. Prices in 2014 were $3.46 a gallon. Prices for diesel in agriculture peaked in 2012 at $3.64 a gallon. After 2014, recording of diesel fuel prices was discontinued.
- Records in the "*Agricultural Prices for Bulk Delivery of Propane in the Northern Plains*" show a very inexpensive fuel priced at $0.47 a gallon (excluding state road taxes) in 1990 quadrupling in price to $1.89 a gallon in 2012, a 23 year period. Propane prices decreased slightly to $1.66 in 2013 and increased in 2014 to $1.76. After 2014, recording of propane prices was discontinued. Prices for propane in agriculture peaked in 2008 at $1.97 a gallon.

Fuel substitution, or conversion to other types of fuel, is very difficult for this sector to utilize without costly changes in equipment. Agricultural and residential sectors may be the least able to engage in fuel substitution.

Commercial

Commercial

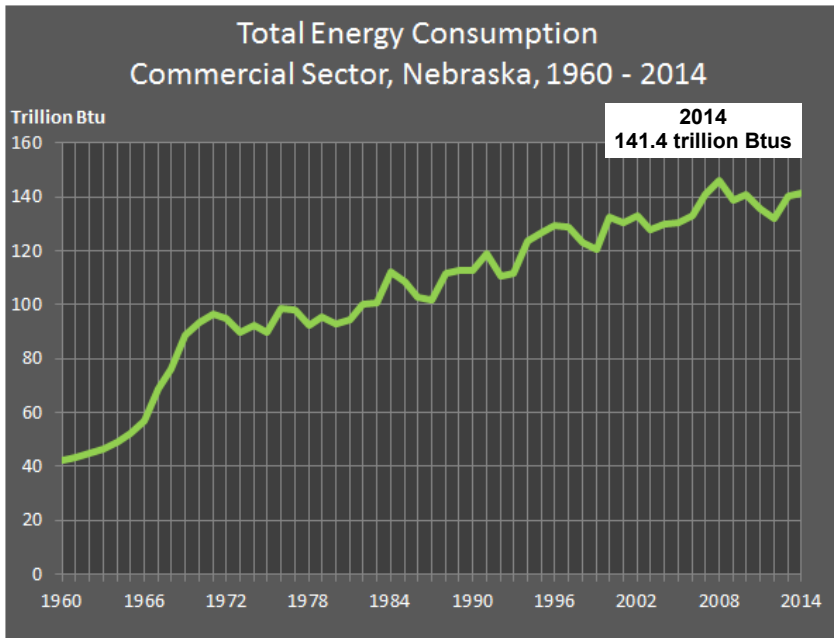
"For 54 years, natural gas and electricity have remained the top two fuel types used in the commercial sector."

The commercial sector, which includes non-manufacturing business establishments, closely parallels consumer energy use and economic activity in the state. Energy use by local, state and federal governments is also included in this sector.

Energy Supply

2014. The long-standing use of two fuel types — natural gas and electricity — in this sector continued in 2014. Nearly 95 percent of all fuel used in the commercial sector was supplied by these two fuel types. Supplies of both types of fuel have been sufficient to meet this sector's energy needs. The only disruptions have been to weather-related electric transmission issues.

1960-2014. For 54 years, natural gas and electricity have remained the top two fuel types used in the commercial sector. Trends indicate that the long dominance of natural gas has ended and a period of near parity between the two fuel types is likely into the near future.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC.
Nebraska Energy Office, Lincoln, NE

Demand

2014. Since 2008, the commercial sector's energy demand as a percentage of total energy consumption in the state had dropped about 0.5 percent a year from 18.2 percent in 2008 to 16 percent in 2014. In 2014, 141.4 trillion British thermal units of energy were consumed in the sector, up 1.1 trillion British thermal units of energy from 2013, an increase of nearly one percent.

1960-2014. When data collection began in 1960, the commercial sector demand was 42.16 trillion British thermal units, less than one-third of the amount of energy used in this sector in 2014. The peak year of demand in this sector was 2008 when consumption reached 145.8 trillion British thermal units.

Conservation

Efforts to conserve energy use tend to be economically driven, especially when fuel prices rise above historic levels. Reduced energy use often results from economic downturns in the larger economy. For example, energy use in this sector declined by almost 10 trillion British thermal units from 1991-1992, which paralleled a national recession. The economic decline that started in late 2008 and continued in 2009, shows a similar decline in energy use in this sector because of economic conditions. Despite a small decline in 2012, demand increased in 2013 but stayed steady in 2014.

Energy Need

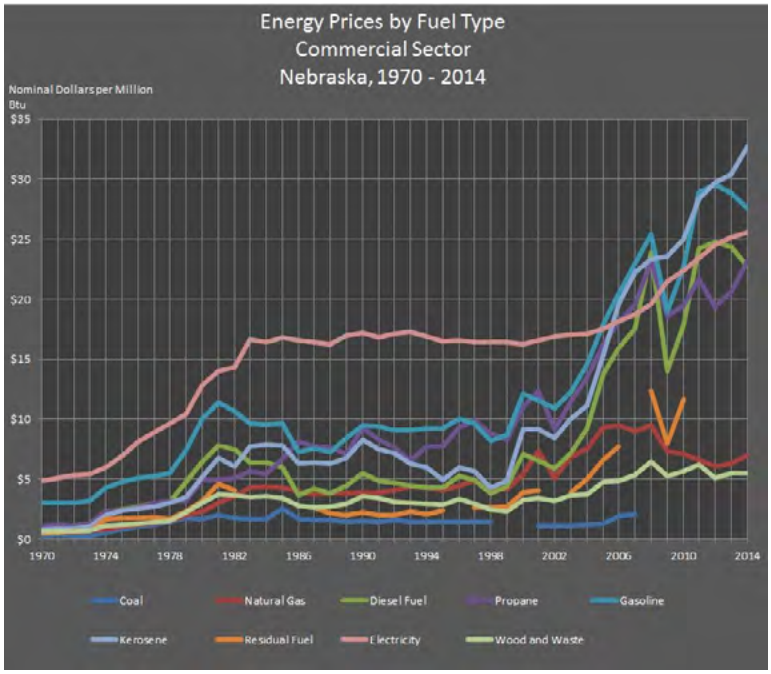
Since the primary needs of the commercial sector are confined to readily available supplies of natural gas and electricity, no issues relating to energy need are foreseen since supplies of both fuel types are ample.

Energy Cost

2014. Energy prices for the two primary fuel sources — natural gas and electricity — moved in the same direction in 2014. Natural gas prices increased from $6.26 (measured in nominal dollars per million British thermal units) in 2013 to $7.00 in 2014. Electricity prices increased from $25.21 (measured in nominal dollars per million British thermal units) in 2013 to $25.58 in 2014. The annual average increased from $15.90 (measured in nominal dollars per million British thermal units) in 2013 to $16.38 in 2014.

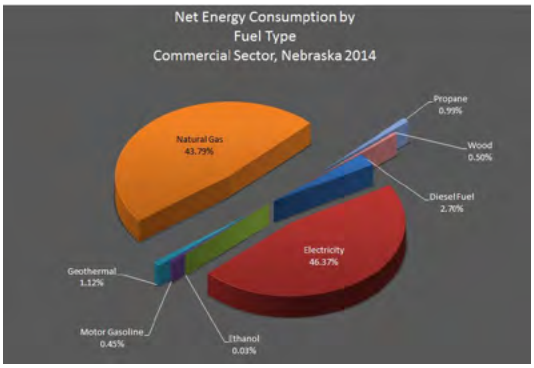
Commercial

1970-2014. One factor of need is price. A commercial business' need for energy can differ markedly if the price of energy doubles in a short period of time. Expenditures in the commercial sector have changed markedly over the 44 year period. In 1970, the commercial sector's energy expenditures totaled $88.4 million (in nominal dollars) and in 2014 it totaled $1,137.1 million (in nominal dollars) surpassing the previous peak year for expenditures for this sector in 2013 at $1.090.7 billion (in nominal dollars), a 12-fold increase over the decades-long reporting period.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Historical expenditure trends for the two primary fuels used in the commercial sector have followed a predictable upward path: electricity expenditures totaled $58.3 million in nominal dollars in 1970 and increased to $831.3 million in 2014; natural gas expenditures totaled $24.7 million in nominal dollars in 1970 and increased to $235.6 million in 2014. Electricity expenditures in 2014 were nearly three-quarters of all money spent in the commercial sector, with natural gas comprising about 21 percent. Nominal percentages of wood & waste, diesel fuel, motor gasoline and propane comprised the remaining expenditures.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE

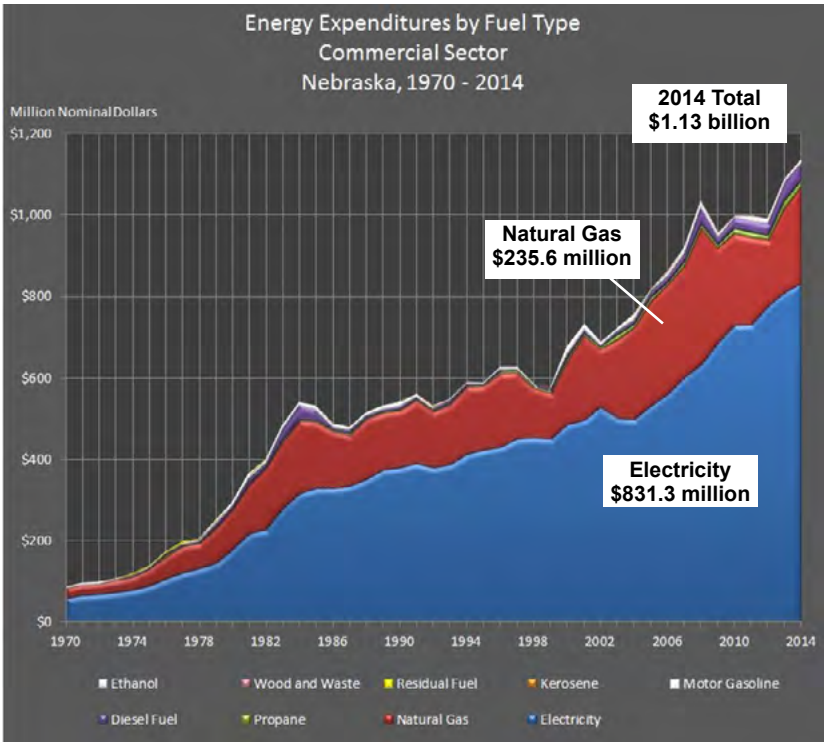
Residential

Residential

Energy Supply

2014. In 2014, nearly half (49.6 percent) of the residential sector's energy needs were met by natural gas. Thirty-eight and nine-tenths percent (38.9%) of the energy consumed in the residential sector was electricity, 7.6 percent were petroleum products, and 4.0 percent was renewable energy.

Residential use of energy is primarily for home heating, water heating, air conditioning, refrigeration, cooking, clothes drying, and lighting. Electricity service is available statewide, and natural gas service is available to a majority of the state's residents, but many small communities do not have natural gas service due to lack of infrastructure.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

1960-2014. Supply trends and fuel types used in the residential sector have not changed substantially over 54 years of data collection.

Demand

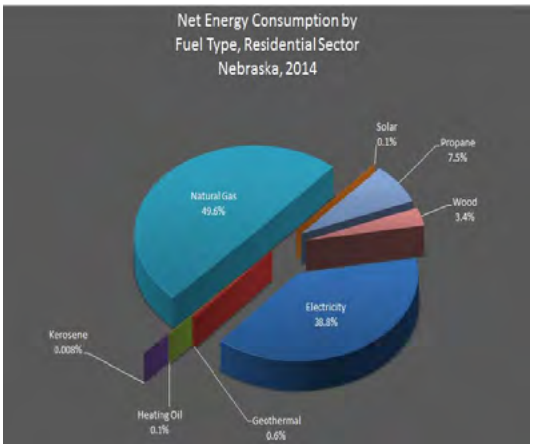
2014. Nineteen percent or 163 trillion British thermal units of the state's total energy demand was consumed in the residential sector in 2014. During 2014 demand decreased 0.3 percent to 163 trillion British thermal units, from 163.5 trillion British thermal units in 2013. Natural gas use increased 2.8 percent from 2013, petroleum use decreased 9.1 percent, electricity use decreased 0.34 percent, renewable energy use remained nearly the same from 2013, and coal consumption remained at a level low enough to round to zero.

1960-2014. Total energy consumption in 1960 in the residential sector was 78.54 trillion British thermal units, of which slightly more than half — 40.87 trillion British thermal units came from natural gas. By 2014, the total energy consumption in this sector was 163.03 trillion British thermal units, down 0.51 trillion British thermal units from 2013. Natural gas consumption showed a measurable increase in 2014 to 43.69 trillion British thermal units, up from 42.51 trillion British thermal units in 2013.

Changes in how and how much this sector uses energy becomes clear over the 54 year span. In 1960, electricity use totaled only 6.51 trillion British thermal units, but by 2014 electricity demand totaled 34.21 trillion British thermal units. Natural gas demand was 40.87 trillion British thermal units in 1960, peaked at 60.86 trillion British thermal units in 1972 and generally declined by about a third until recently. Propane demand in 1960 was 7.49 trillion British thermal units, and was 6.6 trillion British thermal units in 2014, a decrease of 0.66 trillion British thermal units over 2013. Electric system line losses are accounting for a larger share of the energy used in this sector as electrical use increases. In 1960, electrical line losses

Residential

accounted for 16.09 trillion British thermal units, but by 2014 amounted to 74.90 trillion British thermal units, 46.3 percent of all the energy used in this sector in 2014.



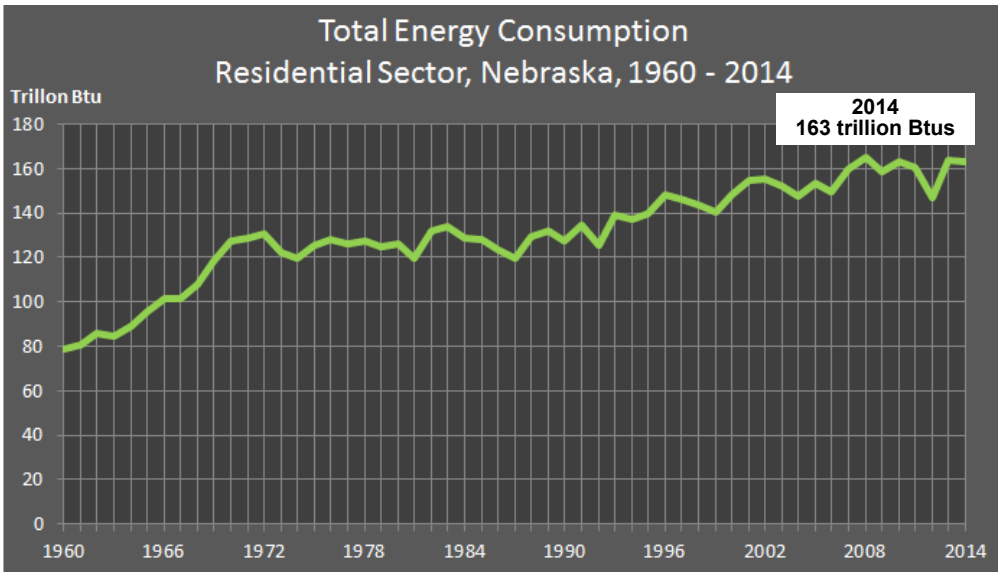
Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Conservation

Conservation in the residential sector is influenced by price, weather and efficiency actions. Like most sectors, residential users are extremely responsive to dramatic price rises. Increases in the price of natural gas, at various times over the decades, have resulted in reduced average annual consumption. Higher than normal heating bills have propelled homeowners to make energy saving improvements such as replacing aged furnaces with new efficient models or efficient electric heat pumps, adding insulation and replacing windows and doors with more energy efficient ones. One of the simplest reactions by people to higher energy bills is to adjust the thermostat which can also result in savings.

Energy Need

2014. In 2014, prices for the two primary fuel types in the residential sector, natural gas and electricity, increased compared to 2013 levels. Specifically, natural gas increased from $8.10 in nominal dollars per million British thermal units in 2013 to $8.44 in 2014. Electricity increased from $30.23 in nominal dollars per million British thermal units in 2013 to $30.48 in 2014. The annual average increased from $18.52 in nominal dollars per million British thermal units in 2013 to $18.83 in 2014. Among the states, Nebraska ranked 9th lowest in natural gas prices in 2014 at $6.54 measured in nominal dollars per million British thermal units and 14th lowest in retail electricity prices at $25.91 in nominal dollars per million British thermal units.

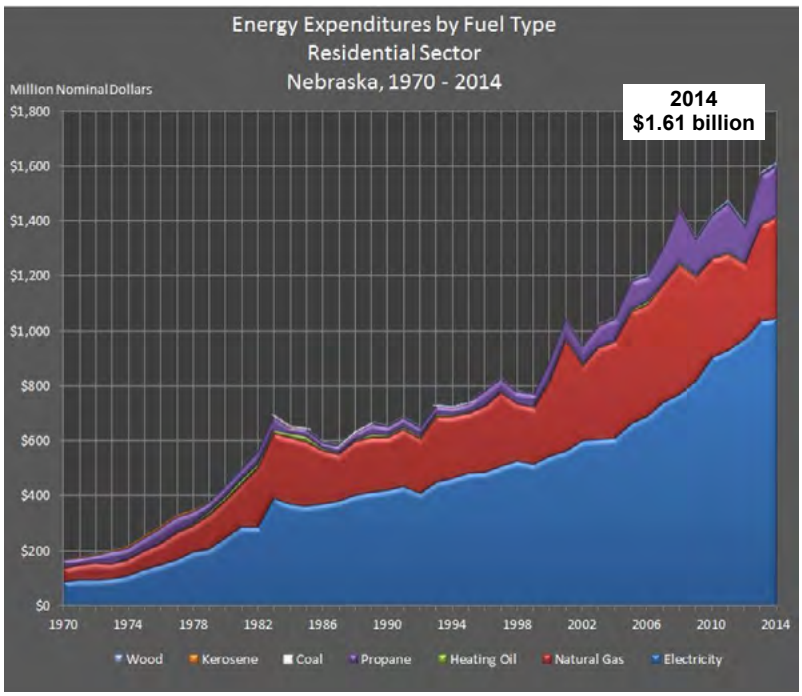


Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE

Using more common measurements, residential natural gas prices in September 2016 were $15.62 a thousand cubic foot and ranked 30th — or in the bottom half — of the states. Residential electricity prices in September 2016 were 12.34 cents a kilowatt hour, ranking 27th lowest among all states.

Residential

"A household's energy needs can differ considerably if the price of a necessary fuel increases dramatically in a short period of time."



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

1970-2014. Price is a factor determining energy need. A household's energy needs can differ considerably if the price of a necessary fuel increases dramatically in a short period of time. The energy needs of the residential sector come from two major fuel types: natural gas and electricity. Those needs are likely to be determined in predictable ways: severity of winter and summer weather conditions and price volatility. In several of the first years of the 21st century, winter weather that was colder than normal, combined with high gas prices to lower demand by residential users. In 2000-2001, residential natural gas prices rose from $6.40 to $8.57 in nominal dollars per million British thermal units. Between 2002 and 2008 natural gas prices in the residential sector rose dramatically — from $6.13 in nominal dollars per British thermal unit to $10.99 in 2008 — a rise of 45 percent in six years and peaked at $11.169 in nominal dollars per British thermal unit in 2006. As a result, consumers replaced inefficient heating equipment with high-efficiency models reducing energy consumption and switched fuels from natural gas to electricity by installing an efficient heat pump.

In the 44 years since records have been kept, residential electricity prices have increased from $6.21 in 1970 to $30.48 in nominal dollars per million British thermal units in 2014, more than quadrupling in price. Residential natural gas prices have risen from 84 cents in 1970 to $8.44 in nominal dollars per million British thermal units in 2014 a ten-fold increase in 44 years, surpassing the price rise in electricity prices. The annual average has also risen from $1.83 in 1970 to $18.83 in nominal dollars per million British thermal units in 2014.

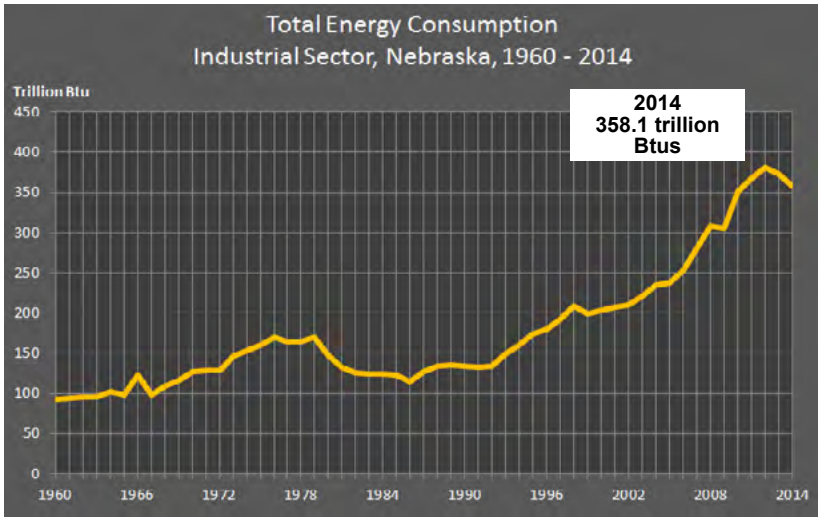
Annual residential energy expenditures totaled $170.0 million in 1970. By 2014, total expenditures had risen to $1.613 billion, a more than nine-fold increase.

Between 1970 and 2014, the number of occupied housing units in the state rose from 473,721 to 740,765, a 56.37 percent increase over 44 years. Of that, 60 percent or 444,310 units, used utility gas as their home heating source; 30 percent or 219,061 units used electricity, and 8.0 percent or 56,850 units used propane.

Industrial

Industrial

The industrial sector includes manufacturing, construction, mining, forestry and agricultural operations including irrigation. This sector relies on more diverse fuel types than the other sectors of the economy. Natural gas, renewable energy, electricity, coal and a variety of petroleum products — gasoline, asphalt, road oil, propane and diesel — are the fuel types utilized in industrial sector operations.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Energy Supply

2014. In 2014, nearly all of the industrial sector's energy needs were met by natural gas, electricity, petroleum products, and coal. Petroleum products that were consumed included diesel fuel, asphalt and road oil, propane, and motor gasoline.

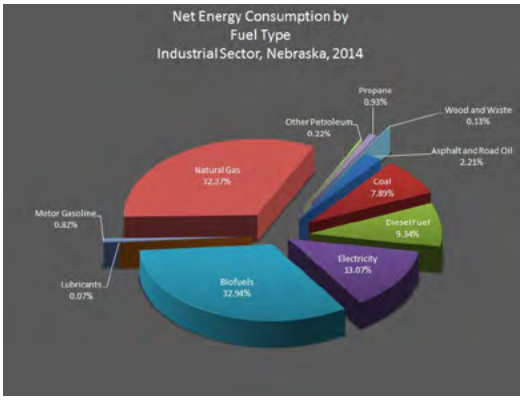
Supplies of these fuel types have been readily available to industrial users.

1960-2014. Trends in fuel types used in the industrial sector illustrate the dynamic needs of this sector and how industries can switch fuel types over time. The emergence of new industries such as ethanol plants can also alter fuel use patterns. For example, natural gas use in 1960 was 38.27 trillion British thermal units and soared in 1973 to 73.72 trillion British thermal units. Subsequent energy price spikes and other factors reduced natural gas consumption to 19.88 trillion British thermal units by 1986. Natural gas has fluctuated considerably since then. A new historical peak occurred in 2013 at 91.08 trillion British thermal units.

Consumption of distillate fuel nearly doubled from 1960 to 2014, rising from 14.01 trillion British thermal units to 25.99 trillion British thermal units. Motor gasoline consumption dropped by nearly 77 percent between 1960 and 2014 from 11.27 trillion British thermal units in 1960 to 2.288 trillion British thermal units in 2014. The growing use of electricity in this sector is demonstrated by the nearly thirteen-fold increase from 3.03 trillion British thermal units in 1960 to 36.40 in 2014.

Demand

2014. Nearly half of the state's total energy consumption — 42 percent or 358.1 trillion British thermal units — was consumed by the industrial sector in 2014. The decrease in industrial sector energy consumption in 2014 was 14 percent.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Industrial

1960-2014. In 1960, the industrial sector was the second largest energy user after transportation, 93.0 trillion British thermal units to 94.2 trillion British thermal units, respectively. Industrial sector energy consumption surpassed the transportation sector in 1993. By 2014, the industrial sector was the largest energy using sector at 358.1 trillion British thermal units, surpassing the transportation sector by 156.4 trillion British thermal units.

Conservation

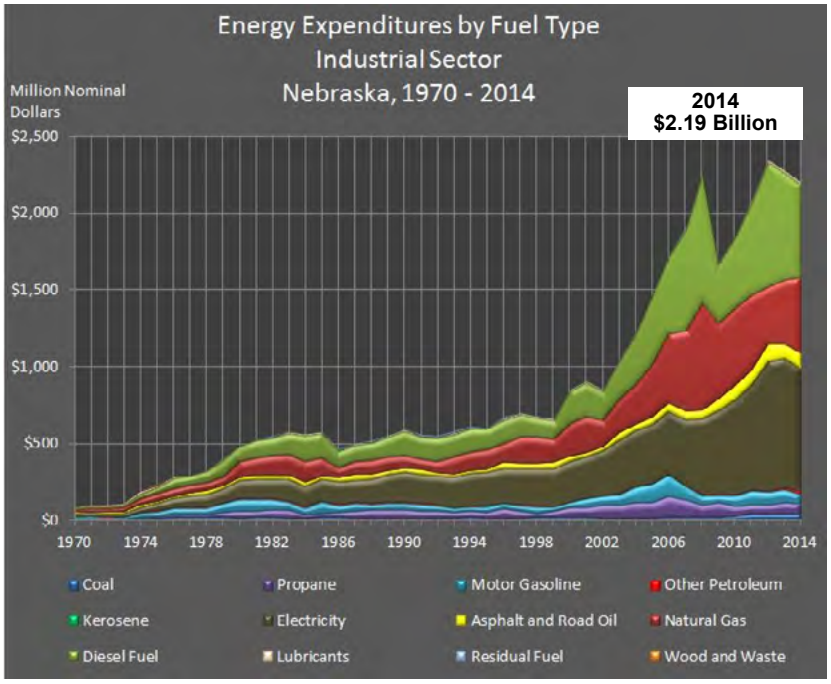
The industrial sector is more pre-disposed to making energy efficient system, lighting and building improvements than other sectors. If energy costs are a significant factor — and rising — industrial sector users are likely to find ways to reduce the costs and impacts of energy on their operations. The roller coaster consumption of natural gas over the past 54 years is an indicator of the impact of conservation of use, fuel switching and the impact of new industries.

Energy Need

Energy need in the industrial sector is subject to the ebb and flow of the business cycle and national, regional and local economic trends which can cause a spike or reduction in energy need and demand. The surge in ethanol production in the state added to this sector's growing energy needs for electricity and natural gas. The phenomenal growth in the renewable energy category — which includes ethanol, ethanol coproducts, and wood and wood waste — is the story of the rise of ethanol production in Nebraska.

2014. Price can be a need-altering factor in the industrial sector, which is more adept at fuel switching and conservation practices than other sectors. This can be seen when an increasing number of farmers who use irrigation are fuel switching from diesel, propane, and natural gas to electricity due in part to price stability and favorable cost structure. In 2014, the industrial sector spent $2.19 billion for energy, a decrease of $73.4 million in nominal dollars or a 3.24 percent decrease from 2013.

1970-2014. In 1970, the industrial sector spent $92.4 million in nominal dollars, 13.8 percent of total energy expenditures for all sectors. In 1970, industrial sector energy spending ranked third among the four sectors. By 2014, industrial sector expenditures of $2.19 billion in nominal dollars had risen to 21.2 percent among all sectors, and ranked second after transportation among energy-using sectors.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

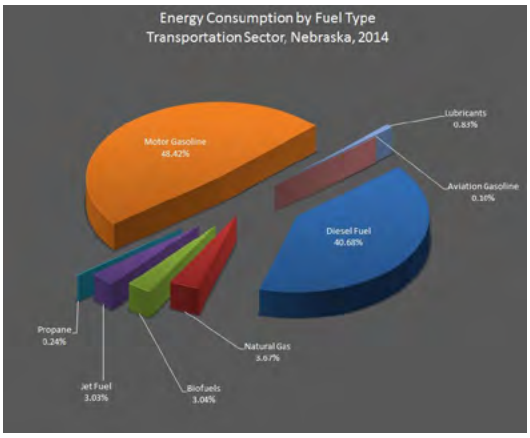
Energy Cost

In 1999, expenditures in the industrial sector totaled only $661.2 million in nominal dollars. Since then, spending in the industrial sector has increased by more than $1.533 billion in nominal dollars. In 2014, the industrial sector spent $797.1 million for electricity, $604.9 million for diesel fuel, $494.3 million for natural gas, $67.1 million for motor gasoline, $61.5 million for propane, $96.2 million for asphalt and road oil, $40.1 million for coal, $18.7 million for other petroleum products, $13.7 million for lubricants, $0.3 million for wood and waste, and $0.1 million for kerosene. Annual average prices between 1999 and 2014 rose from $5.33 in nominal dollars per million British thermal units to $11.74.

Transportation

Transportation

Traditional methods of transportation such as public and private vehicles, railroads, aircraft and boats are included in the transportation sector as well as energy used to transport oil and natural gas through pipelines.



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Energy Supply

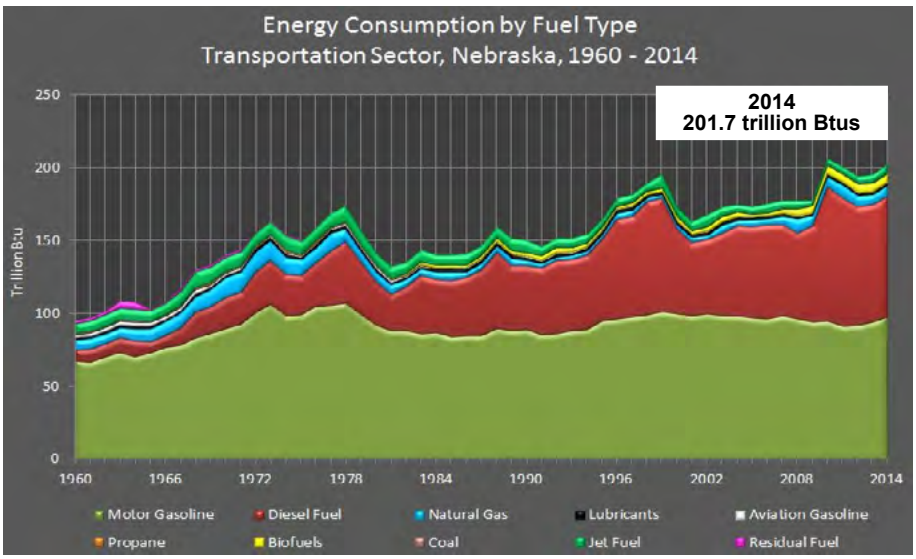
2014. In 2014, 94 percent of energy used — 188.21 trillion British thermal units in the transportation sector — was in the form of petroleum products, especially distillate oil (e.g. diesel) and gasoline. The next two fuel types used of any consequence in 2014 were natural gas at 7.40 trillion British thermal units and biofuels at 6.13 trillion British thermal units.

Generally, supplies of these fuel types have been readily available to transportation users.

1960-2014. Trends in fuel types used in the transportation sector illustrate the static nature of this sector and how modes of transportation have changed little since record-keeping began in 1960. The transportation sector was nearly totally dependent upon petroleum-based fuels in 1960 and remained nearly as dependent in 2014. The changes that occurred in the 54 year period primarily related to increased fuel use. Renewable fuel, specifically ethanol, use began marginally in 1981 at 0.27 trillion British thermal units and hit a new historical peak of 6.130 trillion British thermal units in 2014. Ethanol use in 2014 increased by 13.56 percent or 0.73 trillion British thermal units over 2013. Diesel fuel use in 1960 was 8.16 trillion British thermal units, declined to 58.87 trillion British thermal units in 2008, and peaked at 91.432 trillion British thermal units in 2010. Diesel fuel use increased in 2014 to 82.07 trillion British thermal units from 79.64 trillion British thermal units in 2013. Motor gasoline use in 1960 was 67.07 trillion British thermal units, peaked in 1978 at 106.77 trillion British thermal units, declined by 2013 to 79.63 trillion British thermal units, and started to rise again in 2014 to 97.683 trillion British thermal units.

Demand

2014. More than a fifth — specifically 23 percent of the state's total energy consumption — 201.7 trillion British thermal units — was used in the



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Transportation

"The number of vehicles registered in the state has risen from 1.09 million in 1970 to 2.34 million in 2014"

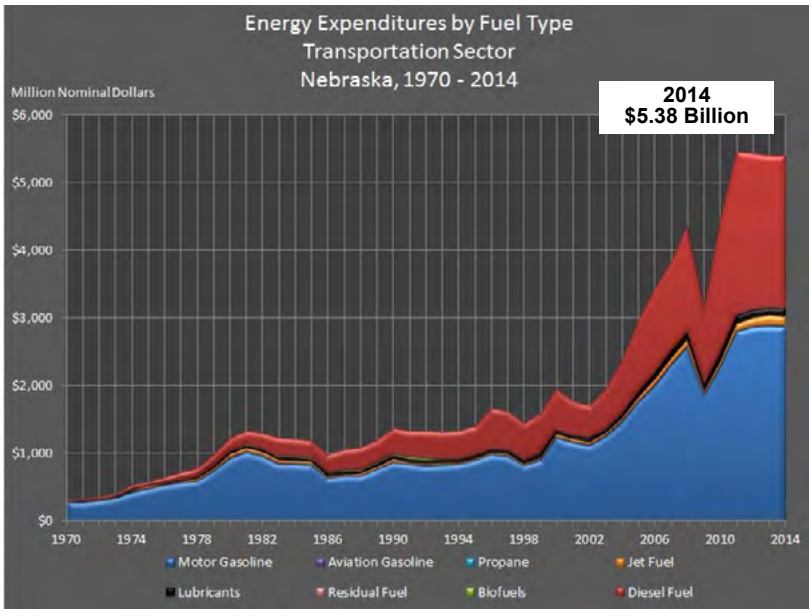
transportation sector in 2014. The increase in demand from 2013 to 2014 totaled seven trillion British thermal units, an increase of 3.6 percent.

1960-2014. In 1960, the transportation sector was the largest energy using sector at 94.2 trillion British thermal units, 30.5 percent of consumption in all sectors. By 2014, the transportation sector had been eclipsed as the largest energy using sector by the industrial sector.

The number of vehicles registered in the state has risen from 1.09 million in 1970 to 2.34 million in 2014, according to the Nebraska Department of Motor Vehicles.

In 2014, 2.1 billion gallons of ethanol was produced in Nebraska. On a yearly basis, about three percent of ethanol produced in Nebraska is consumed in the state as transportation fuel.

After mid-September, 2014, refiners began to supply 84-octane gas to eastern Nebraska terminals in lieu of the minimum 87-octane gas required by law. In the western quarter of the state, where 85-octane is the standard because of higher elevations, refiners supply 82-octane gasoline. Refiners continue to supply 91-octane premium gasoline to Nebraska terminals. This action was initiated by refiners in response to the Renewable Fuel Standard, a federal law requiring renewable fuels in the country's fuel mix. Nebraska and Iowa are among the last states to see this practice implemented. Local suppliers are using either ethanol or premium gasoline to increase the octane levels to state-required minimums.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Conservation

The transportation sector is particularly resistant to conservation efforts. Over the decades, a variety of approaches by the state and federal governments have been tried to make this sector less dependent upon petroleum products: mandated Corporate Average Fuel Efficiency standards, reduced highway speed limits, introduction of efficiency technology in vehicles, lighter weight vehicles and ethanol-blended fuels.

Trends in this sector — such as sport utility vehicles and large trucks used for personal transportation — have thwarted conservation efforts. However, fuel price rises can induce conservation behavior.

Rising pump prices for petroleum-based fuels since 1999 have had an impact on demand. Peak total energy consumption in this sector was reached in 2010 at 205.7 trillion British thermal units. The precipitous decline in transportation sector use from 1999 to 2000 — from 194.4 trillion British thermal units to 172.8 trillion British thermal units — continued into 2001 and was caused by dramatic price increases. Since 2001 when demand was 162.6 trillion British thermal units, demand marginally inched upwards nearly every year until 2011.

In 2014, total energy consumption in this sector was 188.21 trillion British thermal units; an increase of 6.08 trillion British thermal units or 3.34 percent. This increase occurred in the use of diesel fuel which increased from 79.64 trillion British thermal units in 2013 to 82.07 trillion British thermal units in 2014. Factors causing this increase could be rail and truck shipments, coal supplies from Wyoming and/or increased ethanol shipments crossing the state. Increased use of motor gasoline also contributed, rising from 94.19 trillion British thermal units in 2013 to 97.68 trillion British thermal units in 2014.

Transportation

Energy Need

Trends in price and vehicle technology as well as federal government initiatives such as more efficient vehicles are expected to have an impact on energy use in this sector in the future, leading to declines in consumption. An offsetting trend has been the gradual increase in the number of motor vehicle miles traveled nearly every year since 1979, when the annual total was 11.53 billion miles. By 2014, that figure was 19.612 billion miles traveled.

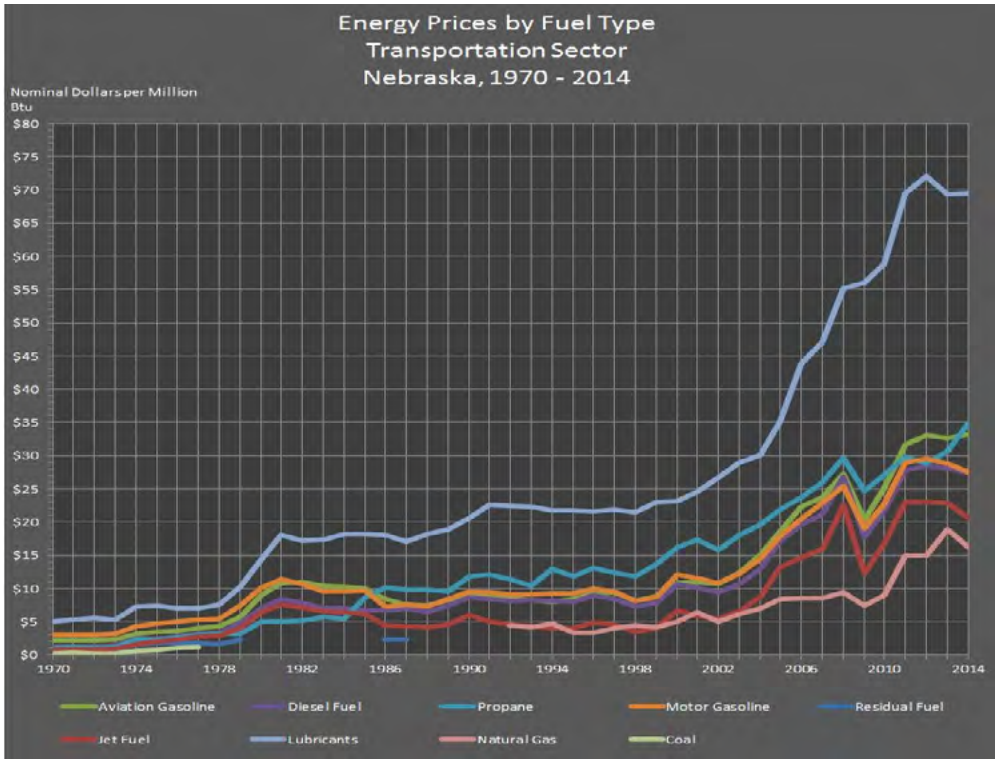
In 2015, the average age of cars in the U.S. was 11.5 years; a historic high was set in 2015. Nebraska's average fleet age may even be higher since traditionally the state has been one of the top five states with older vehicles.

The impact of hybrid, compressed natural gas and electric vehicles is marginal at this time, but could have a significant impact if consumer acceptance of the technologies is high and more infrastructure is developed.

2014. In 2014, the transportation sector spent $5.4 billion in nominal dollars for energy, a slight decrease of $0.5 million in nominal dollars over 2013.

1970-2014. In 1970, the transportation sector spent $3.98 million in nominal dollars, more than 47.5 percent of total energy expenditures for all four end-use sectors, and ranked first. By 2014, transportation sector expenditures of $5.386 billion in nominal dollars had increased to 52.1 percent among all sectors, and still ranked first among the four end-use sectors.

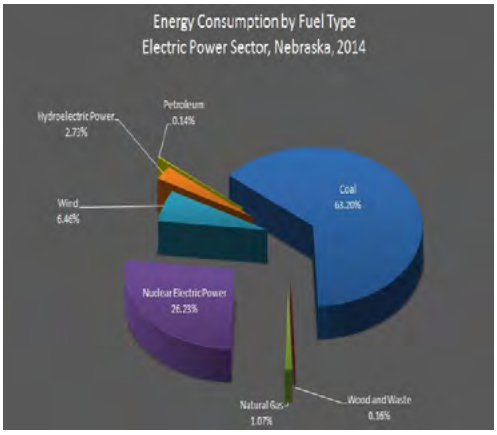
The 44 year span of energy prices in this sector provides dramatic illustrations of the financial impact of petroleum dependency on Nebraskans' wallets. In 1970, diesel fuel was $1.14 in nominal dollars per million British thermal units, but by 2014 diesel fuel was $27.48 per MMBtu. Motor gasoline was $3.03 in nominal dollars per MMBtu in 1970 and $27.59 per MMBtu in 2014.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Electric Utilities

Electric Utilities



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Information in this section consists exclusively of supply, demand, conservation and need by the state's electric utilities.

Energy Supply

2014. In 2014, 63 percent of the electric utilities energy feedstocks came from coal, 254.57 trillion British thermal units out of a total of 402.81 trillion British thermal units. The second most used fuel in this sector, nuclear, supplied nearly 26 percent, 105.66 trillion British thermal units. Three lesser fuel sources supplied nearly all the remainder: hydropower, 2.7 percent, 11.01 trillion British thermal units; wind, 6.46 percent, 26.08 trillion British thermal units; and natural gas, 1.07 percent, 4.33 trillion British thermal units.

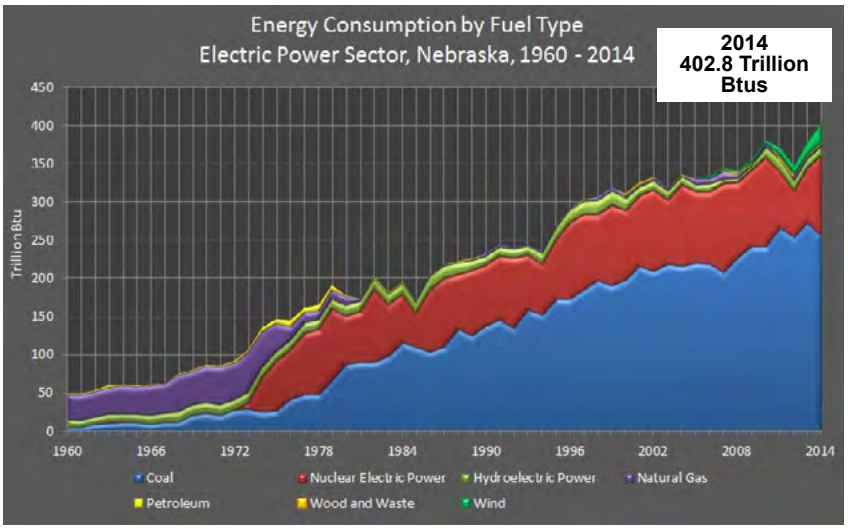
Generally, supplies of these fuel types have been readily available to consumers served by the state's electric utilities.

1960-2014. Trends in fuel types used by the state's electric utilities illustrate how the industry has evolved over 54 years. In 1960, 63.8 percent of the electricity generated came from natural gas, with hydropower (20.54 percent) and coal (21.61 percent) supplying most of the balance. An experimental nuclear reactor was located at Hallam and operated between 1963-1964, but generated only marginal amounts of power before being deactivated. Coal used in this sector peaked in 2013 at 272.66 trillion British thermal units, natural gas used peaked in 1973 at 53.11 trillion British thermal units, nuclear power — which began in 1973 — peaked in 2007 at 115.77 trillion British thermal units, hydropower peaked in 1999 at 17.57 trillion British thermal units and wind use peaked in 2014 at 26.03 trillion British thermal units.

Demand

2014. The demand in the state's electric utility sector in 2014 totaled 402.8 trillion British thermal units, an increase of 6.5 percent, or 24.6 trillion British thermal units, over 2013 demand. Among the changes in fuel used to generate electricity in 2014 were increased use of nuclear, wind and hydropower along with reductions in coal and natural gas.

Electricity purchases generated by hydropower for use by Nebraska utilities from the Western Area Power



Sources: State Energy Data Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

Electric Utilities

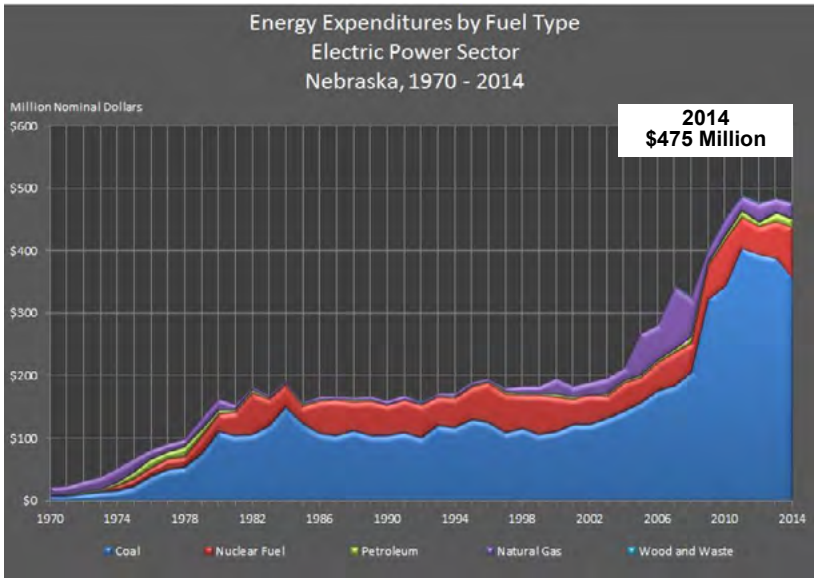
Administration in 2014 totaled 2.008 billion megawatt hours at an average price of four cents per kilowatt hour. The total cost of the power purchased in 2014 was $83.41 million. In 2014, the amount of power provided from Western Area Power Administration met 6.7 percent of the electricity demand in the state

1960-2014. In 1960, the state's electric utilities' demand was 50.2 trillion British thermal units. By 2014, the demand in this sector had increased more than eight-fold from 1960 to 402.8 trillion British thermal units.

Over the 54 year period, only 15 years recorded declines in demand. A number of these declines were marginal; however, larger declines in demand paralleled economic cycles as well as favorable climate periods which affected irrigation and air conditioning use.

Conservation

Energy efficiency efforts in the electric utility sector generally result from technological advances in the generation and transmission of power.



Sources: State Energy Price and Expenditure Report. Energy Information Administration, Washington, DC. Nebraska Energy Office, Lincoln, NE.

One on-going target of efficiency improvements is reducing electricity transmission line losses. While technological breakthroughs can lessen the problem, other improvements can be made. Local utilities estimate standard line loss at seven percent, but in some cases actual losses can be considerably higher — more than double the seven percent — if preventative maintenance is not performed on a regular basis on utility lines. An example of future technologies being developed: The copper wires used in typical transmission lines lose a percentage of the electricity passing through them because of resistance, which causes the wires to heat up. But "superconductive" materials have no resistance, and if they are used to transmit electricity in the future, very little of the electricity will be lost.

Smart grid technology has garnered a great deal of attention. Smart electrical grids and accompanying communications infrastructures enable end-use efficiency and deployment of this technology in Nebraska is just getting underway.

Consumer behavior, also known as demand side management, can be a source of conservation from which the electric utility sector will benefit since the cheapest kilowatt is the one that doesn't have to be produced. For example, Nebraska utilities have been very proactive in the past several years in encouraging Nebraskans to utilize new lighting technologies, especially compact fluorescents and light emitting diodes. Some electric utilities have provided discount coupons, free light bulbs or financial incentives for larger commercial, industrial or governmental operations.

In late 2011, the Nebraska Power Association, with the support of the Nebraska Energy Office and others, issued the *2010 Research & Conservation Report* which documented research, energy efficiency and sustainability efforts of the state's electric utilities and the Energy Office. The *Report* quantified approximately 24 megawatts and 80,000 megawatt hours that were reduced because of utility and agency activities and programs in 2010. A copy of the *Report* is at http://www.neo.ne.gov/reports/2010-NPA-Report.pdf .

Electric Utilities

"Nebraska's electric utilities more than met their customers' needs, continuing to export electricity to customers outside the state."

Energy Need

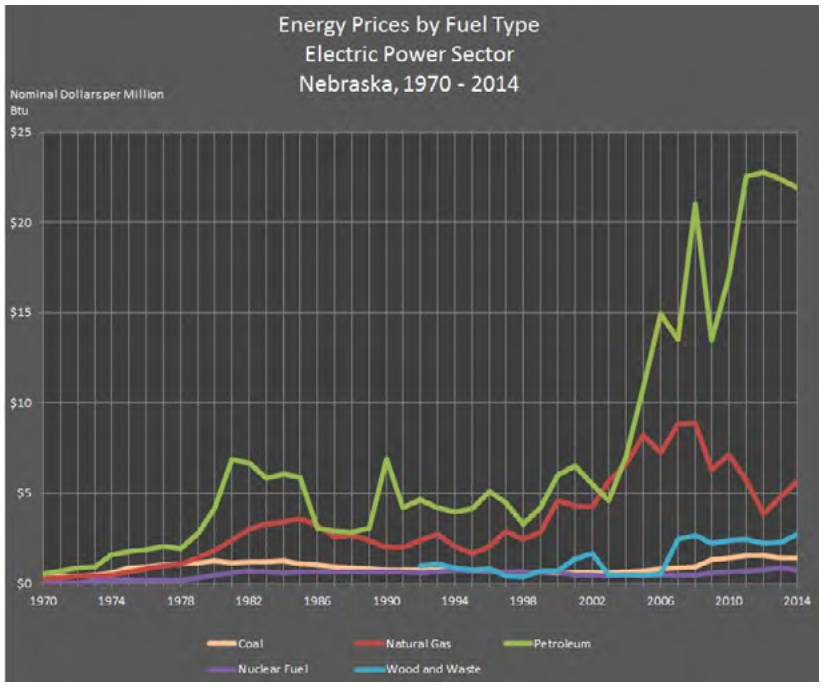
Nebraska's electric utilities more than met their customers' needs, continuing to export electricity to customers outside the state. Between 1990 and 2008, electricity exports varied from a low of 9.4 percent of generation in 1994 to a high of 26.1 percent in 2015, an increase of 2.7 percent from 2014 and an increase of 16.2 percent over 2012, when exports hit a low of 9.9 percent. In 2012, 9.9 percent of the electricity generated in Nebraska was sold for use outside the state's borders, a decrease of 5.2 percent from 2011.

Trends in price as well as efficiency gains — offset by fuel switching by customers — are expected to have an impact on energy use in this sector in the near term. If growth continues in this sector, additional generation will be needed.

2014. In 2014, electric utility sector expenditures totaled $475 million in nominal dollars, a decrease of 1.6 percent from 2013 expenditures.

Nationally in 2015, the statewide average price for all sectors from all electric utilities in Nebraska was the 15th lowest rate in the country at 9.04 cents a kilowatt hour. Nationally, the average price for electricity is 15 percent more than it costs in Nebraska. Hawaii at 26 cents pays the highest, while Washington pays the lowest, 7.41 cents.

1970-2014. In 1970, the electric utility sector spent $22.27 million in nominal dollars, 4.7 percent of what was spent in 2014, $475 million in nominal dollars. In the 44 years since 1970, coal expenditures increased from $8.5 million nominal dollars to $355.5 million nominal dollars in 2014, natural gas from $12.8 million nominal dollars to $24.5 million nominal dollars in 2014, and nuclear fuel from nothing in 1970 to $81 million nominal dollars in 2014. Minimal expenditures were made for petroleum and wood and waste fuels.



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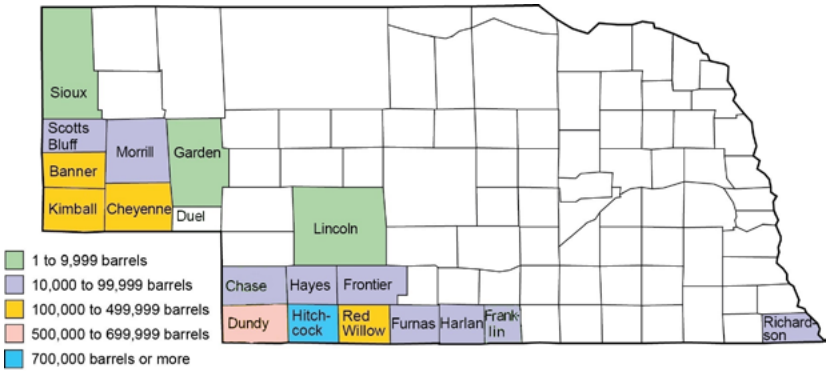
State Energy Resources Assessment

State Energy Resources Assessment



Sources: "Nebraska Oil Activity Summary." Nebraska Oil and Gas Conservation Commission, Sidney, NE. Nebraska Energy Office, Lincoln, NE.

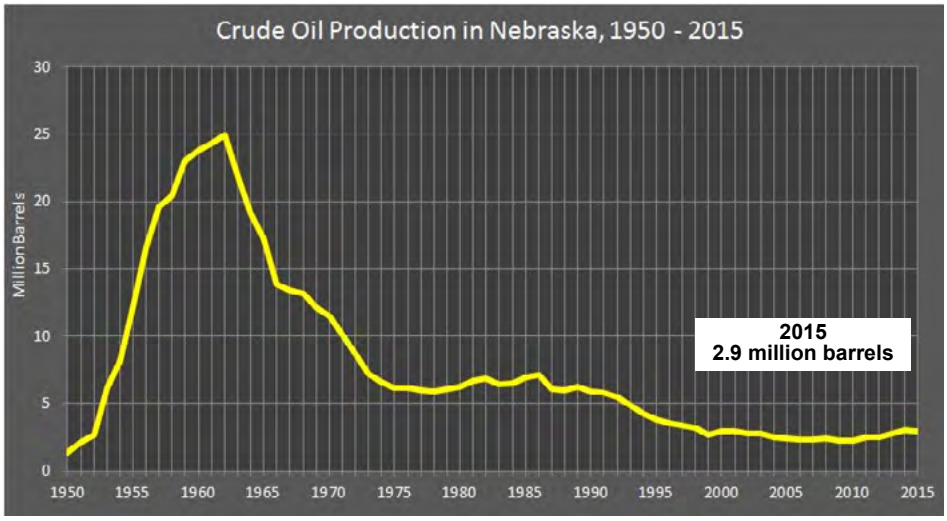
Nebraska is not a state rich in traditional fossil fuel resources. But, the state has respectable solar resources and world-class wind resources.

Oil

Oil has been produced in the state since 1939. Oil production peaked in 1962 at 24.893 million barrels, and has declined precipitously since that time. In 2015, crude oil production in Nebraska was 2.917 million barrels, a decrease of 4.0 percent from 2014 when annual production was 3.038 million, making 2014 the highest level of production since 2003 when production started to decline. Crude oil production began in Nebraska in 1939, but no records were kept prior to 1950. In the 64 year history of reported production, 1962 was the busiest year with over 24.8 million barrels of oil produced. Nationally, Nebraska ranked 21st among the states in oil production in September 2016. In 2014, the Energy Information Administration estimated the state's crude oil reserves — an economic calculation — at 21 million barrels, about 1/10th of one percent of the nation's total crude oil reserves; and at 17 million barrels in 2015.

In 2014 and 2015 respectively, there were 1,340 active oil producing wells in the state. Drilling permits issued for development wells (both oil and natural gas) increased to 129 from 102 in 2013, but fell by 50 percent to 60 in 2015. Drilling permits for exploratory wells increased from 83 in 2013 to 92 in 2014, but fell to 42 in 2015.

Production of oil in the state is concentrated in two areas: the southwest, particularly Hitchcock and Dundy counties and in the Panhandle, especially Kimball County. In 2015, these three counties produced nearly 66 percent of the oil mined in the state. The top five producing counties in 2015 (in rank production order): Hitchcock, Dundy, Kimball, Red Willow and Cheyenne. Production in Hitchcock County decreased



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State Energy Resources Assessment

21 percent from 1,066,267 barrels to 840,635 in 2014 to 2015; increased 26.5 percent in Dundy County from 427,311 barrels to 540,753 in 2014 to 2015 and decreased 4.46 percent in Kimball County from 419,419 barrels to 400,697 in 2014 to 2015.

For the first time since 1998, Duel County produced zero barrels. Production in Chase county doubled from 20,463 barrels in 2014 to 45,818 in 2015.

In 2014, Nebraska's crude oil production represented about 6.6 percent of the petroleum products used in the state that year.

Natural Gas

Natural gas has been produced in Nebraska since 1950. Natural gas production peaked in the state in 1960 at 28.189 billion cubic feet and has declined since that time. There have been several infrequent, yet minor, increases in production over the years. In 2015, natural gas production was 476 million cubic feet, an increase of more than 18.4 percent from 2014.

In 2015, Nebraska's natural gas production represented only .23 percent of the natural gas consumed in the state in that year.

In 2015, Nebraska natural gas production ranked 29th among the 33 producing states, just ahead of Florida.

Beginning in 1977, Nebraska's dry natural gas reserves have been included with a group of miscellaneous states, including Arizona, Idaho, Illinois, Indiana, Maryland, Missouri, Nevada, Oregon, South Dakota, and Tennessee. In 2015, proven reserves had decreased to 123 billion cubic feet from 176 billion cubic feet in 2014. Proven reserves for this group of miscellaneous states peaked in 2011 at 379 billion cubic feet.

Coal

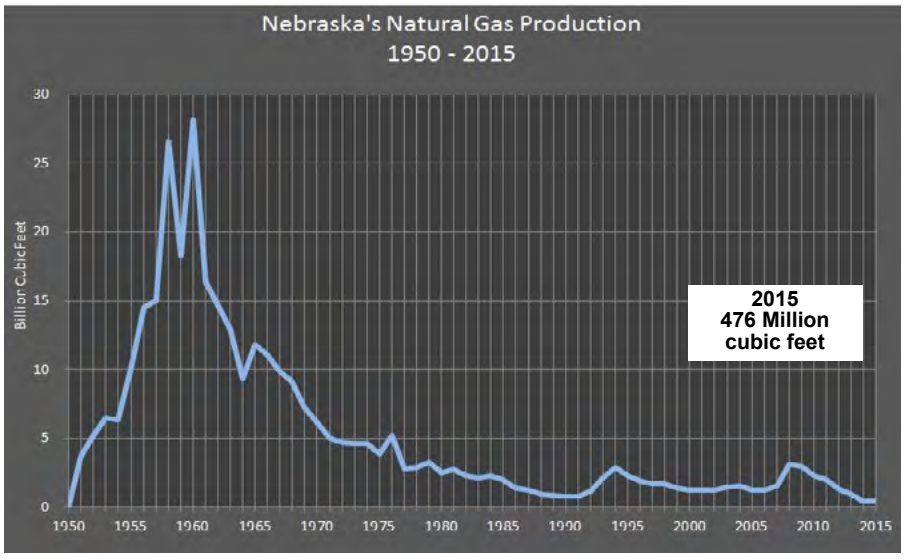
The state's coal resources are insignificant and not economical to mine. However, the state's proximity to low-sulfur coal beds in the Powder River Basin in Wyoming allows Nebraska ready access to coal resources used in the generation of electricity.

Uranium

Uranium has been mined in the state since 1991 at a site near Crawford, but must be sent outside the state's boundaries for processing.

Alternatives

In Nebraska, there are five viable alternate energy sources available: biomass, geothermal, hydropower, solar and wind.



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Nebraska Energy Office, Lincoln, NE.

State Energy Resources Assessment

"In Nebraska, there are five viable alternate energy sources available: biomass, geothermal, hydropower, solar and wind."

In 2014, 15 percent of the state's energy consumption — 140.71 trillion British thermal units out of 938.32 trillion British thermal units — was met using renewable resources according to the Energy Information Administration. Renewable energy use reached a new peak in 2011 at 143.76 trillion British thermal units.

Biodiesel

Commercial scale biodiesel production began in Nebraska in 2006 and production was estimated to be around 2.4 million gallons in 2008. However, the price of soybeans used for feedstock seriously damaged this budding industry in the state in 2008 and both commercial scale plants in Arlington and Scribner closed. The biodiesel plant in Beatrice was operating commercially in summer of 2016. The nameplate capacity is 50 million gallons per year.

Biomass

Biomass includes biodiesel, ethanol, landfill gas, methane and wood and wood waste. Biofuels and biomass accounted for 102.4 trillion British thermal units in 2014 out of 140.71 trillion British thermal units for all renewable energy types, or 72.7 percent.

Ethanol

The growing biomass energy resource in the Nebraska continues to be ethanol that is produced from corn and grain sorghum. Ethanol production began in Nebraska in 1985 when 8.5 million gallons were produced at the state's first ethanol facility in Hastings. According to the Renewable Fuels Association as of September 2016, Nebraska has the second largest ethanol nameplate capacity (2.1 billion gallons) and the second largest ethanol operating production (2.07 billion gallons) in the nation. Approximately 14 percent of the nation's ethanol capacity is in Nebraska's 25 active plants.

Ninety percent of Nebraska's ethanol production goes to U.S. domestic markets, between six and seven percent is exported to other countries and three percent is used by Nebraskans.

The state's Corn Board estimates that 31 percent of Nebraska's corn crop is used in the production of ethanol. The state's Ethanol Board estimates that typically less than one percent of Nebraska's grain sorghum crop is processed for ethanol production.

Ethanol consumption in the state comes mainly in the form of E10 blended gasoline — 10 percent ethanol and 90 percent gasoline. Smaller quantities of E85 — 85 percent ethanol and 15 percent gasoline — are also sold. Ethanol-blended fuel consumption in 2015 was 747.72 million gallons, a decrease of 17 percent from 2014. Ethanol's share of the fuel market in 2015 decreased from 2014 to 85.0 percent in which all fuel sold was an ethanol blend. A record high was set in 2014 at 87 percent.

Geothermal

There are two types of geothermal resources that can be utilized for energy: hydrothermal fluid resources and earth energy. According to the Energy Information Administration, there are two pockets of high-temperature hydrothermal fluid resources in the north central and northern Panhandle of the state. The Geo-Heat Center at the Oregon Institute of Technology has identified nine collocated communities in the state. A collocated community is one being within eight kilometers of a geothermal resource with a temperature of at least 50 degrees Celsius. In Nebraska, the nine towns meeting that standard are located in just four counties: Cheyenne — Brownson, Huntsman, Lodgepole, Ordville, Potter and Sidney; Keya Paha – Burton; Kimball — Kimball; and Scotts Bluff — Gering. Resources in these areas might be suitable for development, but that prognosis appears unlikely in the near term.

State Energy Resources Assessment

"According to the Energy Information Administration, there are two pockets of high-temperature hydrothermal fluid resources in the north central and northern Panhandle of the state."

Earth energy can be used directly to provide heat in a variety of applications, such as geothermal heat pumps and appears to offer Nebraskans the most economical and practical way to utilize this resource. Growth in the use of geothermal heat pumps that can discharge waste heat into the ground in hot weather and extract heat from the ground in cold weather appears strong and is a technology that is being promoted by the state's larger electric utilities.

In 2014, 0.12 percent of the state's total renewable energy consumption — 1.21 trillion British thermal units — came from geothermal resources and was a historic high.

Hydropower

The electricity consumed in Nebraska from hydropower resources came from two sources: the 11 dams in or on the border of the state and from purchases of Western Area Power Administration electricity. Usually the amount of electricity produced is relatively constant from year to year, unless affected by drought conditions or a facility is off line. As the state's energy need continues to grow, less and less of the need will be met by the relative constant amount of hydropower produced.

In 2014, 11.01 trillion British thermal units of hydropower were consumed in Nebraska which accounted for 1.17 percent of all renewable energy consumed that year.

Studies of the state's hydropower resources were conducted in 1981 and again in 1997. For the most part, the studies concluded that nearly all of the potential hydro resources had been developed, and that even under the most optimistic scenarios, less than 150 MW of additional power could be produced from existing or new hydro resources. It appears unlikely that any additional conventional hydropower resources will be developed within the foreseeable future. However, there are indications that micro-hydroelectric dams would be feasible in a number of settings across the state.

Landfill Gas and Methane

A small, but slowly increasing amount of electricity is being generated from methane at landfills: OPPD's Elk City Station; and wastewater sewage facilities: Lincoln's Teresa Street Treatment Plant and Omaha's Missouri River and Papillion Creek Treatment Plants. The city of Lincoln and Lincoln Electric System partnered at the city of Lincoln's Bluff Road Landfill. The plant began commercial operation in January 2014. Other sources include a commercial processor in Butler County and one livestock anaerobic digester in Colfax County. Energy production from biogas resources has been tracked since 1995 when 1.06 million kilowatt hours was produced. In 2015, reporting Nebraska production facilities produced over 100 million kilowatt hours of electricity, an increase of 8.51 percent from 2014.

Solar

According to an assessment by the Energy Information Administration, Nebraska has "good" solar resources, especially in the western part of the state. Nebraska is ranked 13th among the states with great energy potential from solar power, according to the National Renewable Energy Laboratory.

There are two types of solar collectors: concentrating collectors and flat panels. Solar collectors are simply flat panels that can be mounted on a roof or on the ground. Called flat plate collectors, these are typically fixed in a tilted position correlated to the latitude of the location. This allows the collector to best capture the sun. These collectors can use both the direct rays from the sun and reflected light that comes through a cloud or off the ground. Because they use all available sunlight, flat plate collectors are the best choice for many northern states such as Nebraska. For flat plate collectors, Nebraska has good, useful resources throughout the state. For concentrating collectors, Nebraska has useful solar resources, especially in the western region of the state.

State Energy Resources Assessment

"Presently, solar technologies are marginally deployed in great part because it is difficult for solar technologies to be cost competitive with the state's low electric rates."

Presently, solar technologies are marginally deployed in great part because it is difficult for solar technologies to be cost competitive with the state's low electric rates. Where solar does make sense economically are in meeting the needs of cattle ranchers in remote regions where photovoltaic systems are less expensive than installing new transmission lines.

Operational solar panel facilities in the state, including utility scale, community solar and smaller projects, have a total capacity of over eight megawatts. The largest, Lincoln Electric System's solar center, is a 3.6 megawatt project. The smallest are rooftop projects ranging from 5 to three and one-half kilowatts.

In 2014, solar energy accounted for 0.06 trillion British thermal units of all renewable energy consumed in the state.

Wind

The U.S. Department of Energy's Wind Powering America program indicates that Nebraska has wind resources consistent with utility scale production of electricity. Maps of the state's wind resources at different heights are located at http://www.neo.ne.gov/renew/wind.htm as well as a wealth of other wind resources. Other wind energy assessments have suggested the state could produce as much as 7,800 MW of new electricity from wind resources annually. According to data from the National Renewable Energy Laboratory, the state's wind potential is ranked 4th best in the nation by megawatt capacity and 3rd best in the nation by gigawatthour generation. It is estimated that wind power in Nebraska could meet the state's annual electrical needs over 118 times.

In 2015, nearly 3.0 billion kilowatthours were generated by utility scale wind energy in Nebraska. As of September 2015, Nebraska had a total capacity of 882,430 kilowatts. A complete list of sites and generation is available at http://www.neo.ne.gov/statshtml/89.htm .

In the third quarter of 2016, the state ranked 20th among all states with 926 megawatts installed wind energy capacity.

Wood and Wood Waste

Densified biomass fuel, or wood pellets, are produced from biomass by three manufacturing facilities in the state. Nebraska has pellet plants in Gretna, Fremont and Scribner. Pellet production capacity in the state is approximately 30,000 short tons.

In 2016, the U.S. Department of Energy's Energy Information Administration (EIA) began a survey of the facilities in the nation who are manufacturing pellets. EIA collected data from 119 facilities across the nation. Facilities had a total capacity to produce 11.4 million short tons of wood pellets annually and collectively had an equivalent of 2,252 full-time employees. For January 2016, these facilities reported purchasing 1.3 million tons of raw biomass feedstock and producing 0.6 million short tons of pellets. Total sales were 0.5 million short tons. Approximately 31 percent was sold to the domestic market and 69 percent was exported.

Status of Ongoing Studies

No ongoing studies were performed during the reporting period.

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