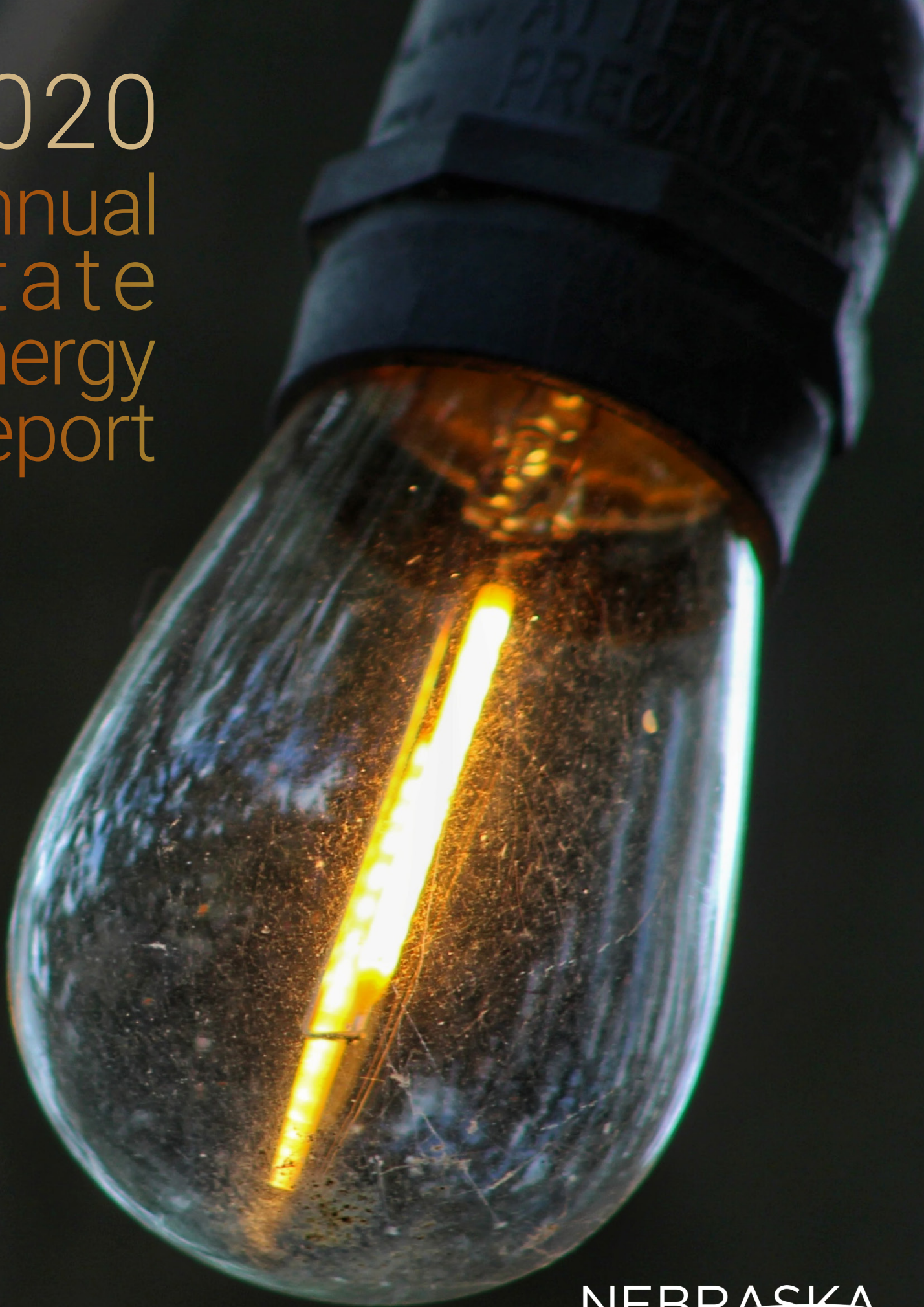


# 2020 Annual State Energy Report



# Table of Contents

<b>Letter from the Director</b> .....	3
<b>The Programs</b> .....	4
Weatherization Assistance Program .....	4
Dollar and Energy Saving Loans Program.....	5
State Energy Formula Grants.....	9
Energy Codes and Compliance Collaborative .....	9
Nebraska Wind and Solar Conference .....	9
National Association of State Energy Officials .....	9
Nebraska Energy Efficiency Partnership .....	10
State Energy Program Competitive Funding.....	10
Renewable Fuels .....	10
Infrastructure Program.....	10
Nebraska Initiative .....	10
Benchmarking and Beyond.....	10
State Heating Oil and Propane Program.....	11
Oil Overcharge Funds.....	11
Financial Activity.....	12
<b>Trends and Needs</b> .....	13
Statewide Energy.....	13
Agriculture Sector.....	16
Industrial Sector.....	19
Commercial Sector.....	21
Residential Sector.....	24
Transportation Sector.....	26
Electric Power Sector.....	29
<b>Conclusion</b> .....	31

# Letter from the Director

Dear citizens of Nebraska,

This annual report marks the first full year that the Nebraska Energy Office (NEO) and the Nebraska Department of Environmental Quality (NDEQ) have been merged as the Nebraska Department of Environment and Energy (NDEE).

And it has been a memorable year. Teammates from the former NEO and NDEQ have come together with the goal of providing the best service possible for Nebraskans. Throughout this fiscal year, the agency has taken on a strategic planning process and has continued to fulfill its duties, despite the challenges caused by the COVID-19 pandemic.

NDEE began strategic planning in August 2019. This effort has led to renewed vision and mission statements and has provided the agency with a compass going into the future. NDEE has also created goals for improvement, both for day-to-day work and long-term strategic tasks. This will provide the means for the agency to be more intentional and proactive in how it meets Nebraskans' needs.



NDEE has also shown how it is able to adapt in difficult circumstances. COVID-19 has created many challenges, but the agency has been creative in how it overcomes those obstacles. In April, most of NDEE's nearly 200 team members began working from home, while a smaller team worked from the office to complete essential support tasks. In early July, the agency came back to the office and in December, NDEE moved to its permanent home at 245 Fallbrook Boulevard.

During this time, NDEE's Energy and Assistance Division continued to ensure its programs were available to Nebraskans. In 2020, the Dollar and Energy Savings Loan program was able to participate in 389 loans for 394 total energy projects. Of the total \$9.3 million loaned, NDEE provided roughly \$7 million. The Weatherization Assistance Program was able to invest more than \$1.6 million in federal funds to help Nebraskans with low incomes save money by weatherizing their homes. These programs are important under normal circumstances, and they're especially important during the pandemic, when many are facing financial hardships. I am proud of the EAD team for continuing this good work.

This first year as the NDEE has been successful, and I look forward to seeing the continuous improvements our team makes together. Statute requires NDEE to submit separate reports on environmental and energy issues. This report addresses the energy requirement. Previous annual reports can be found on the agency's website at: <https://neo.ne.gov/info/pubs/pubs.html>.

Sincerely,

A handwritten signature in black ink, appearing to read "Jim Macy". The signature is fluid and cursive, written over a white background.

Jim Macy  
NDEE Director

**Vision:** Everyone living, working, and enjoying a healthy Nebraska environment.

**Mission:** To protect and improve human health, the environment, and energy resources. We will accomplish this through assessing, assisting, inspecting, educating, enforcing, funding, monitoring, permitting, and restoring.

# The Programs

## Weatherization Assistance Program

The Nebraska Department of Environment and Energy's (NDEE) Energy and Assistance Division (EAD) administers the Weatherization Assistance Program. This federally funded program weatherizes homes for those with limited incomes so they can save energy and money. The agency is responsible for inspecting the homes that are weatherized and for monitoring the sub-grantees—primarily community action agencies and one non-profit agency—that are responsible for the home weatherization improvements. Sub-grantee crews or private contractors are responsible for completing the work on the homes. The EAD staff inspects a minimum of 10-15% of all completed homes to ensure the quality of work performed.

The Weatherization Assistance Program received funding from two sources:

- \$2,600,000 from the Low-Income Home Energy Assistance Program (LIHEAP)
- \$2,853,612 from the U.S. Department of Energy's (DOE) Weatherization Assistance Program

The Nebraska Department of Health and Human Services annually transfers a portion of the LIHEAP funds they receive to the EAD, which are allocated to seven Community Action Partnership agencies and one non-profit agency to weatherize homes. The EAD also received an additional \$500,000 from LIHEAP to use for Heating and Cooling Repair and Replacement (HCRRA). By putting this program under the Weatherization Assistance Program, the EAD is able to offer an additional service where Nebraskans with low-incomes can repair, or possibly replace, their heating and cooling system. More about LIHEAP and DOE funds and how they have been spent throughout the state are in Figure 2. Between 2019 and 2020, 339 homes were weatherized and 114 HCRRA units were completed with these funds.

The types of improvements made through the weatherization program vary based on an energy audit analysis of the home. Improvement costs average between \$5,000 and \$7,500 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 per home is set by the DOE annually based on the Consumer Price Index (CPI). The kinds of improvements made to homes vary by the home type: frame, mobile or multi-family.

In homes, the most common improvements generally are:

- Adding insulation
- Replacing and repairing furnaces
- Reducing air leakage
- Installing high efficiency lighting
- Insulating water heater tanks and pipes
- Repairing cracked windows

Since the Weatherization Assistance Program began in 1977, \$218 million has been spent to make energy efficiency improvements in 70,072 homes.

Energy and Assistance Division Investment in the Weatherization Assistance Program July 2019 - June 2020	
Investment in Weatherized Homes (federal funds)	\$ 1,629,892.45
<b>Energy Impacts</b>	
Electric Dollar Savings (present discounted value)	\$ 110,376.00
Natural Gas Dollar Savings (present discounted value)	\$ 532,101.00
Annual Total Dollar Savings	\$ 642,477.00
Present Discount Value of Future Savings	\$ 646,106.00
<b>Economic Impacts</b>	
Output	\$ 1,272,878.00
Value-Added	\$ 830,934.00
Labor Income	\$ 731,154.00
Job-Years	20.30
<b>Air Emission Pollutant Reductions (Pounds)</b>	
Carbon Dioxide (CO2)	8,591,576.00
Sulfur Dioxide (SO2)	9,108.13
Nitrogen Oxide (NOX)	10,490.80
Particulate Matter <2.5 micro-meters (PM2.5)	158.39
Volatile Organic Compounds (VOC)	349.93
Particulate Matter < 10 micro meters (PM10)	254.00

Figure 1

NDEE

# Total Nebraska Homes Weatherized by Area Providers July 2019 - June 2020

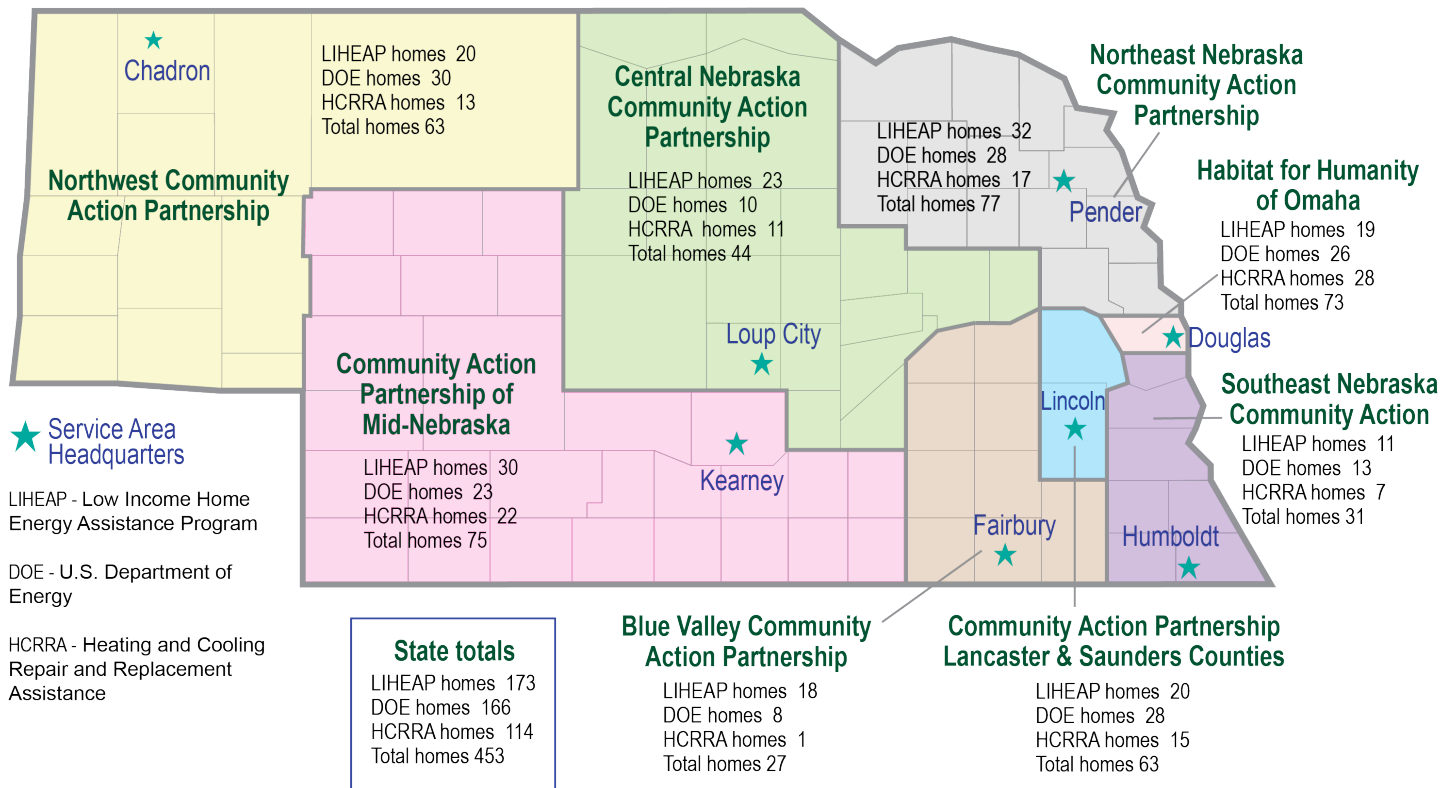


Figure 2

NDEE

## Dollar and Energy Saving Loans Program

The Dollar and Energy Saving Loans Program (DESL) was initially capitalized with Oil Overcharge Funds, later augmented with American Recovery and Reinvestment Act Funds, and is continually re-charged with loan repayments from borrowers.

The Department of Environment and Energy, in conjunction with over 200 eligible Nebraska lending institutions at more than 900 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 ranged from 1% to 5% during 2019-2020, depending on the project eligible for financing. Additionally, schools willing to benchmark energy consumption through the life of the loan were offered 1% interest.

In March 2009, Nebraska Public Power District added \$500,000—and provided a second \$500,000 in January 2010—to the agency’s DESL Program to finance 1.5% loans for air source, ground water or ground coupled heat pumps, qualifying thermostats and back-up natural gas or propane furnaces with a 95 Annualized Fuel Utilization Efficiency (AFUE) rating or higher for the utility’s retail and wholesale customers. More information about these loans may be found at NDEE’s website, [neo.ne.gov/programs/loans/loans.html](http://neo.ne.gov/programs/loans/loans.html).

From March 1990 to June 30, 2020, 30,081 energy saving projects totaling more than \$369.7 million have been financed using low-interest loans from participating lenders and NDEE. More than \$183.8 million of the \$369.7 million has come from the agency’s revolving loan fund. The state’s participating lenders provided more than \$138.6 million. The balance, more than \$47.3 million, was spent by the borrowers for the remain-

ing 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 5. Douglas County, with 3,421 projects totaling \$51.36 million, tops the list with the most projects. Lancaster County co-anchors the top spot with the most dollars invested at \$61.28 million, albeit on fewer projects—2,366. Nebraska's congressional districts saw the following number of projects:

- First Congressional District – 10,623
- Second Congressional District – 4,297
- Third Congressional District – 15,161

During this reporting period, 394 new projects totaling \$9.95 million were financed. The number of energy efficiency projects financed since 1990 are shown in Figure 5 and total 30,081.

Figure 6 quantifies loans in five different areas: residential; commercial/industrial/local government; agricultural; transportation/telecommunications; and wind and solar. It also provides the number of projects by category and the total cost in each category. Several of the largest categories are detailed as follows:

### Residential

Nebraskans' homes make up more than 93.1% of all energy efficiency projects financed with loans from the agency. More than 72.69% of NDEE funds from all categories—\$132.3 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, 28,000 residential energy efficiency projects have been undertaken by Nebraskans using loan program funds.

### Commercial/Industrial/Local Government

More than 14.75% of funds from all categories—\$54.55 million—has been used to make building and system improvements in 1,312 projects since 1990, ranking second-highest among all loans areas. Typical improvements in this category include replacement of heating and cooling equipment, installation of insulation, lighting upgrades and replacement of doors and windows.

## DESL Total Dollars Invested (millions of dollars) 2009-2019



Figure 3

NDEE

## DESL Number of Projects 2009-2019

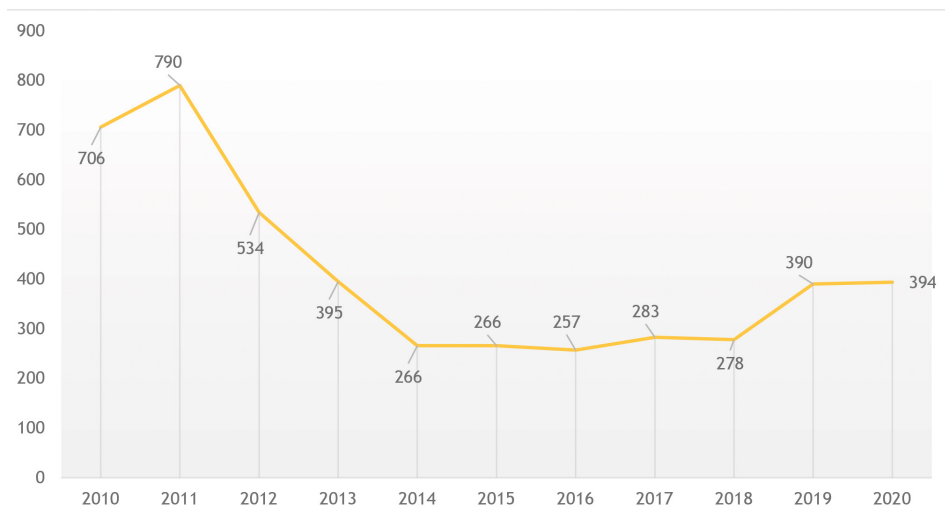


Figure 4

NDEE

# Number of DESL Projects by County and Dollar Amount of Projects as of June 30, 2020

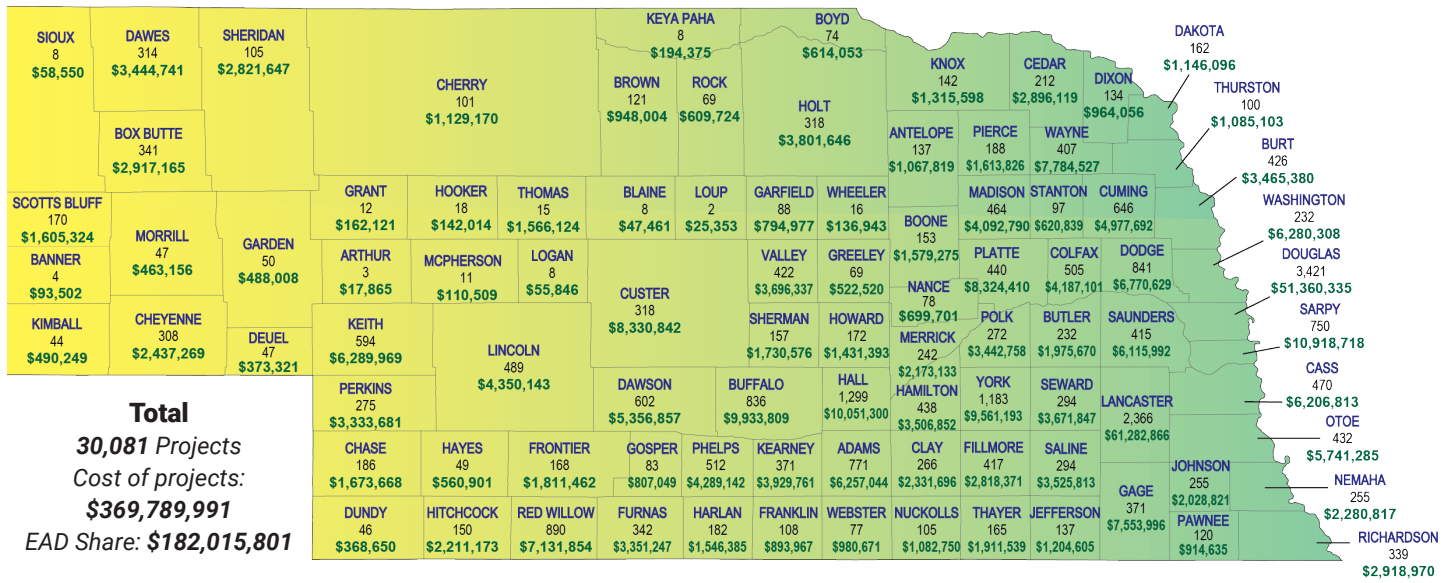


Figure 5

NDEE

# Total DESL Funds Invested by Project Category as of June 30, 2020

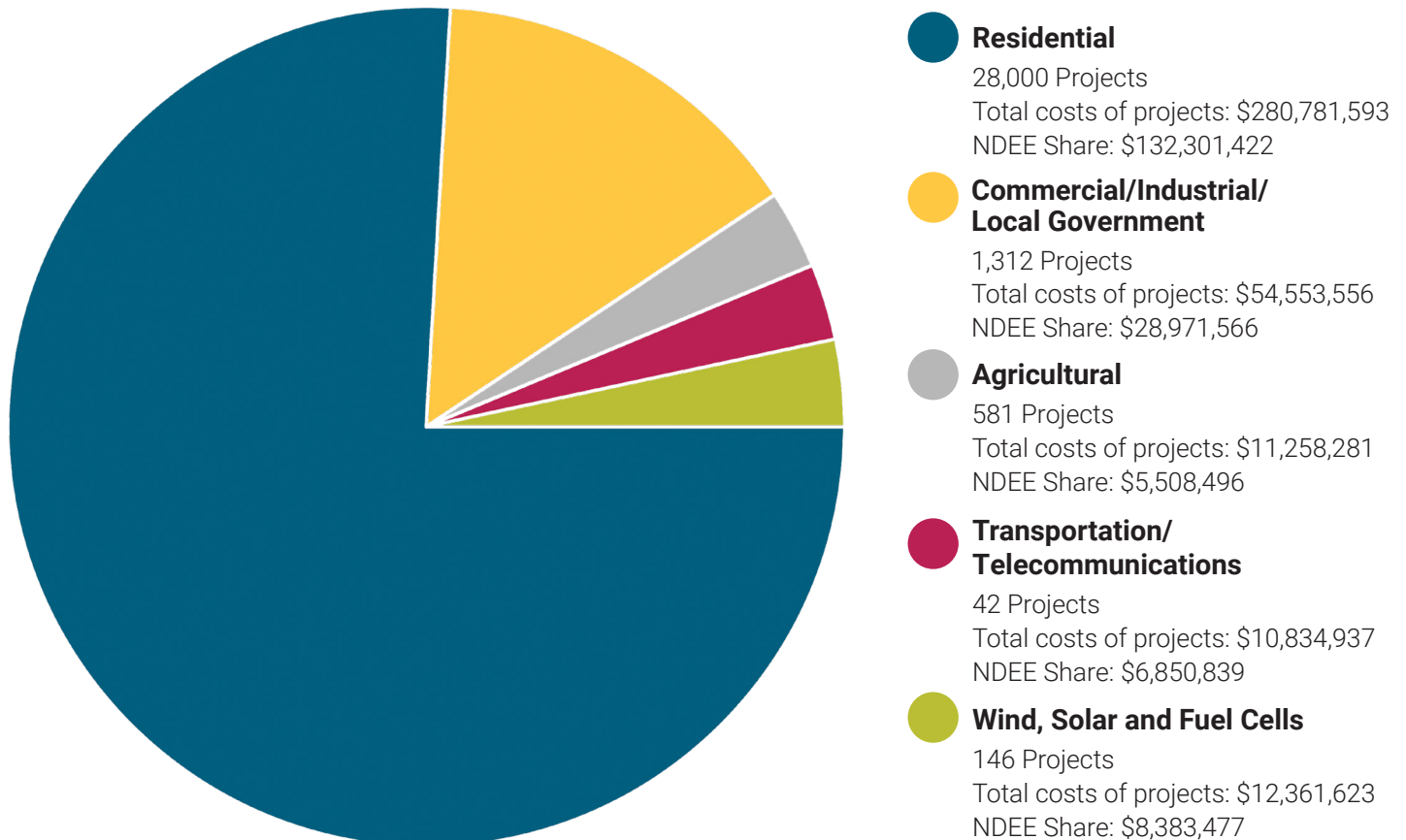


Figure 6

NDEE

## Wind, Solar and Fuel Cell Systems

Roughly 3.34% of funds from all categories—\$12.36 million—has been used for 146 wind, solar and fuel systems projects since 1990, ranking third-highest among all loans areas. Typical improvements in this category include photovoltaic systems, solar hot water and wind.

## Agricultural

Improvements in agricultural equipment and systems rank fourth in the use of low-interest financing. More than 3.04% of all improvement funding—\$11.26million—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 NDEE, \$5.37 million from participating lenders and over \$383,000 from borrowers.

These efforts are complemented by NDEE’s Clean Diesel Rebate Program, which provides rebates to replace diesel irrigation engines with all-electric equipment. This program is funded by grants from the U.S. Environmental Protection Agency, has completed 62 projects since 2017 with rebates totaling over \$907,644 and \$977,000 for recipients.

Residential Dollar and Energy Saving Loans July 2019 - June 2020	
Investment	\$4,922,667
Residential Projects	351
Energy Impacts	
Electric Energy Savings (kWhs)	143,345
Natural Gas Energy Savings (therms)	65,780
Present Discount Value of Future Savings	\$1,338,715
Present Day Value Economic Impacts	
Output	\$4,632,817
Value-Added	\$2,763,630
Labor Income	\$2,057,674
Job-Years	53
Air Emission Pollutant Reductions (Pounds All Years)	
Carbon Dioxide (CO2)	18,069,052
Sulfur Dioxide (SO2)	14,401
Nitrogen Oxide (NOX)	20,186
Particulate Matter <2.5 micro-meters (PM2.5)	250
Volatile Organic Compounds (VOC)	552
Particulate Matter < 10 micro-meters (PM1.0)	401
Total Present Discount Value of Environmental, Comfort, Health and Safety	\$1,175,746

Figure 7

NDEE

## Alternate Fuel/Telecommunications

Since 1990, 2.93% of funds from all categories—\$10.83 million—has been used for 42 alternative fuel and telecommunications projects, ranking fifth-highest among all loans areas. Typical improvements in this category include dedicated alternative fueled vehicles, fueling equipment, alternative fuel facilities, network access equipment, video products and audio conferencing.

## Energy, Economic and Environmental Impacts

In 2012, a study analyzing the energy, economic and environmental impacts of Residential DESL was completed by the University of Nebraska-Lincoln. Beginning January 2014, data from Residential DESL has been entered into the database. The energy, economic and environmental benefits of these loans from July 1, 2019, through June 30, 2020, are illustrated in Figure 7.



# State Energy Formula Grants

In 2019-2020, Nebraska received \$577,510 for this federally-funded effort and supplied \$115,502 in state funds from oil and natural gas severance taxes as required 20% 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 (<http://neo.ne.gov/programs/stats/stats.html>) and agency website ([neo.ne.gov](http://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; DESL operations; support of renewable energy activities; and residential and commercial building energy efficiency activities.

## Energy Codes and Compliance Collaborative

The Energy Codes Compliance Collaborative was established in 2013 to help building owners, inspectors and industry representatives monitor, evaluate and ensure compliance with the Nebraska Energy Code requirements. Collaborative members include representatives of state and local governments, home builders, utilities, architects, home energy raters, suppliers, banks and advocacy groups including Midwest Energy Efficiency Alliance and the Nebraska League of Municipalities. In 2020, Collaborative activities included:

- Collaborating with the Nebraska/Iowa/Illinois (Zone 5) National Commercial Buildings Energy Code Field Study
- Working with the state's construction industry partners in their understanding of the cost and savings impacts associated with Nebraska's adoption of the 2018 International Energy Conservation Code
- Assessing and reviewing other energy code compliance initiatives/projects in the Midwest region for beneficial replication in Nebraska
- Providing educational opportunities to members of the state's construction industry to help ensure their buildings comply with the updated energy code.

## Nebraska Wind and Solar Conference

Since 2008, the agency has partnered with many stakeholders interested in wind and solar energy to produce a statewide Wind and Solar Conference. Agency staff members help develop and execute communications for the conference, including news release development and distribution and social media promotion. Given the remarkable growth of both solar and wind energy generation in Nebraska, the conference is an ideal venue for NDEE staff to provide education and learn about solar and wind energy and the interdependencies of all energy and environmental issues.

The 13th Annual Nebraska Wind and Solar Conference scheduled for November 9-10, 2020, was postponed due to COVID-19 restrictions and health risks. However, the Nebraska Wind and Solar Conference is working to bring virtual sessions in 2021 to provide updates on what is happening in Nebraska's renewable energy industry.

## National Association of State Energy Officials

Participation in the National Association of State Energy Officials (NASEO) programs is also included in the State Energy Program. The agency participates in NASEO webinars and conference calls, and attends national and regional NASEO meetings and conferences concerning energy issues. Over the past year, NDEE staff have been active in panels associated with agricultural and rural issues and have presented on the collaborative efforts that preceded the successful adoption of the 2018 International Energy Conservation Code.

## Nebraska Energy Efficiency Partnership

The then-Nebraska Energy Office was a founding member of the Nebraska Energy Efficiency Partnership (NEEP), which includes representatives from Nebraska's three largest electric utilities—Lincoln Electric System, Nebraska Public Power District and Omaha Public Power District—as well as the Municipal Energy Agency of Nebraska. NEEP meets to share knowledge, program ideas and other information related to making the most efficient use possible of Nebraska's energy resources. Because of the value that has come from NEEP meetings, a second, similar group is now forming—the Nebraska Solar and Storage Partnership. The development of solar energy and related storage, primarily batteries, is incredibly dynamic and keeping up with related developments will require a group effort.

## State Energy Program Competitive Funding

### Renewable Fuels Infrastructure Program

From 2016 to 2019, the EAD staff administered the Access Ethanol Nebraska program that provided \$2.285 million in funds to support the installation of 88 high-blend ethanol pumps at 22 retail locations across the state. LB 585, enacted by the legislature in 2019, provided a second round of blender pump installations. Eventually, with the support of the Nebraska Environmental Trust, NDEE will administer the Renewable Fuels Infrastructure Program over the next three years. Funds should be sufficient to support an additional 66 high-blend ethanol pumps, with a priority for presently underserved areas. Increased use of advanced biofuels can have a positive impact on air quality across the state. Reducing harmful air pollutants with cleaner burning ethanol blends will help our environment.



*NDEE's Renewable Fuels Infrastructure Program aims to increase the use of biofuels across the state by providing rebates for high-blend ethanol pumps and related infrastructure at retail locations.*

### Nebraska Initiative Benchmarking and Beyond

The Nebraska Initiative-Benchmarking and Beyond (NIBB) is a cooperative agreement between the U.S. Department of Energy (U.S. DOE) and NDEE with a goal to have all applicable Nebraska state government buildings benchmarked in the Environmental Protection Agency's ENERGY STAR® Portfolio Manager. NIBB is also tasked with providing recommendations for a state building benchmarking policy, training for state government building operators, building energy use data collection training for university interns and developing a benchmarking curriculum for middle and high school teachers and their students.

Since 2018, NDEE's Energy and Assistance Division has benchmarked 2,471 Nebraska state government buildings as part of the EPA's ENERGY STAR Portfolio Management System. This accounts for 62% of the entire state's listing of 3,818 properties as of 2015 for 12 state agencies. In addition, with NIBB's partnership with the University of Nebraska Omaha (UNO), a benchmarking curriculum for middle and high school students is now being piloted in Lincoln Public Schools.

Accomplishments for the Nebraska Initiative-Benchmarking award included:

- Completed Building Operator Certification training for nine state facility managers at University of Nebraska Kearney
- Revised NDEE’s Energy, Economic and Environmental Impact Tool to analyze public/commercial buildings by the University of Nebraska-Lincoln Bureau of Business Research,
- Completed one additional benchmarking training for university interns and two state facility managers, and
- Developed recommendations to encourage future state benchmarking efforts.

In 2020 Nebraska Initiative Benchmarking and Beyond revised its program objectives for the continuation of its work through 2021. The tasks to be completed through the extension of this project include:

- Complete a beta test of the Impact Tool for several different building types recognized by the EPA’s ENERGY STAR Portfolio Manager with the University of Nebraska-Lincoln Bureau of Business Research
- Place the Initiative’s benchmarking curriculum in Nebraska high schools and middle schools with the development of several tutorial aids for the curriculum, in collaboration with the Nebraska Green Schools program.

## State Heating Oil and Propane Program

Between September 2019 and September 2020, the NDEE began its 18th year of participation in the U.S. Department of Energy’s (DOE) State Heating Oil and Propane Program.

For this program, staff collected heating oil and propane price information October through March from a sampling of Nebraska suppliers. The sampling of Nebraska suppliers was selected by the DOE’s Energy Information Administration (EIA). The price information was shared with the EIA and then posted on the NDEE’s website (<https://neo.ne.gov/programs/stats/inf/86.html> and <https://neo.ne.gov/programs/stats/inf/87.html>).

The DOE provided a grant of \$6,442 for this program, which was 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 customers was not practical, the courts ordered the money be distributed using a system of indirect restitution. The funds were provided to the states and used, within parameters established by the courts and a federal regulator, to fund energy assistance and efficiency programs.

Nebraska Energy Settlement Fund Summary of Exxon, Stripper Well and Diamond Shamrock Oil Overcharge Funds as of June 30, 2020				
	Exxon	Stripper Well	Diamond Shamrock	Total
Funds Received	\$15,504,944	\$15,680,564	\$359,172	\$31,544,680
Interest Earned and Miscellaneous Income	\$13,246,917	\$11,754,422	\$264,050	\$25,265,389
Total	\$28,751,861	\$27,434,986	\$623,222	\$56,810,069
Funds Budgeted	\$28,751,861	\$27,019,387	\$623,222	\$56,394,470
Low Income Designated		\$18,075		\$18,075
Uncommitted Balance		\$397,524		\$397,524

Figure 8

NDEE

These funds were used for several purposes throughout the agency. Most notably, the funds helped create the DESL Program. Since the beginning of the DESL program, the agency has provided more than \$33 million in loans, and Nebraska is one of the few states that continues to revolve these funds into additional loans. The final petroleum violation escrow payment from the U.S. Department of Energy to the then-Nebraska Energy Office was received March 28, 2017.

The Legislature and the DOE require annual reports on the disposition of these funds. This report, specifically the DESL explanation above and Figure 8, which shows a Nebraska Energy Settlement Fund summary of activities, fulfill this requirement.

## Financial Activity

Total energy-related expenditures for the year were \$12,092,525, a decrease of 15.8%. Two factors may have contributed to this decrease. The first is an increase in aid used in response to flooding in 2019, and the second is a decrease of aid utilized in 2020 because of the COVID-19 pandemic.

Energy loans accounted for 56.5% of expenditures, aid payments accounted for 32.3% and the remaining 11.2% of expenditures were for salaries and operations.

Of the funding for these expenditures, 41.1% came from the Oil Overcharge Funds, 55.7% from federal funds and 3.2% from state and other funds.

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

### How Funds Were Spent by Source July 1, 2019 - June 30, 2020

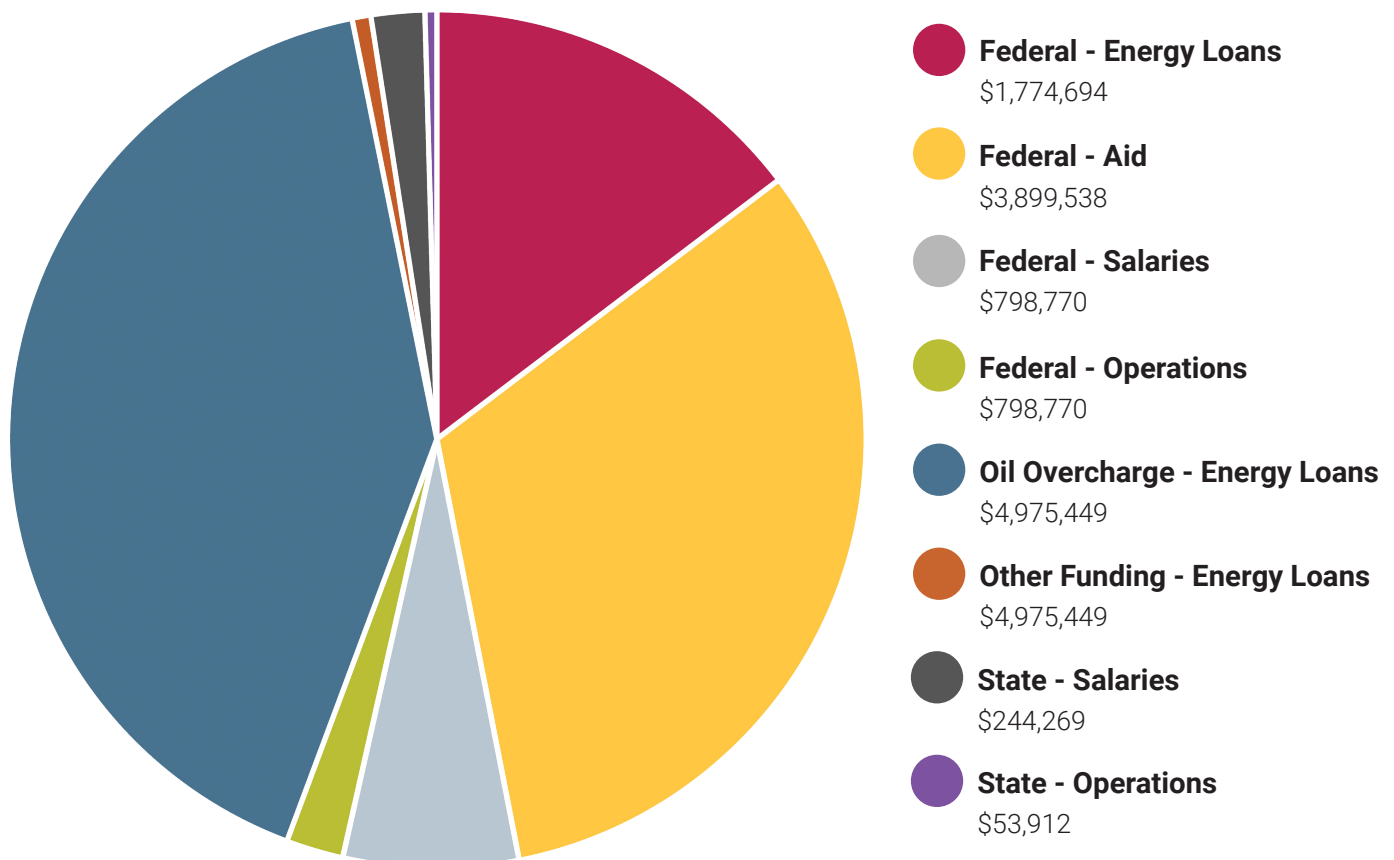


Figure 9

NDEE

# Trends and Needs

## Statewide Energy

According to the Energy Information Administration (EIA), Nebraska's total energy consumption in 2018 was 915 trillion British thermal units (Btu), an increase of 38.5 trillion Btu—or 4.4%—from 2017 to 2018. (A Btu 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.) Data referred to or included in the figures reflect the most current data available at the time of publication.

Five types of energy sources comprised the energy that Nebraska consumed in 2018 as seen in Figure 10:

- Coal – 28%
- Petroleum (and products) – 25%
- Natural gas – 21%
- Renewable energy – 20%
- Nuclear power – 6%

From 2017 to 2018, the use of natural gas, petroleum, renewable energy and coal increased, while the use of nuclear power decreased.

Nebraska is the only state that generates electricity entirely by publicly owned power systems. According to EIA, as of 2018, the statewide average electricity price is the 15th-lowest rate in the country at 9.02 cents per kilowatt-hour (kWh), based on the latest federal figures.

Figure 11 shows the amount of energy that Nebraska consumed in each sector in 2018:

- Industrial – 42.30%
- Transportation – 23.22%
- Residential – 18.35%
- Commercial – 16.13%

## Nebraska's Total Energy Consumption by Fuel Type 2018

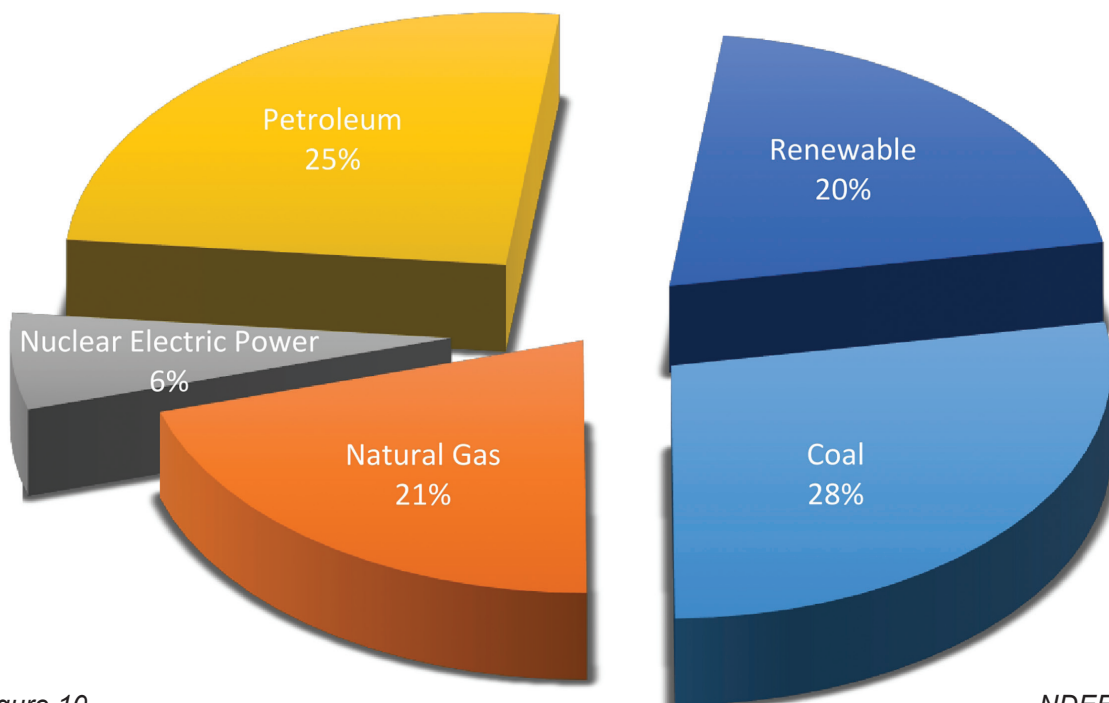


Figure 10

NDEE/EIA

## Energy Consumed in Nebraska by Sector 2018

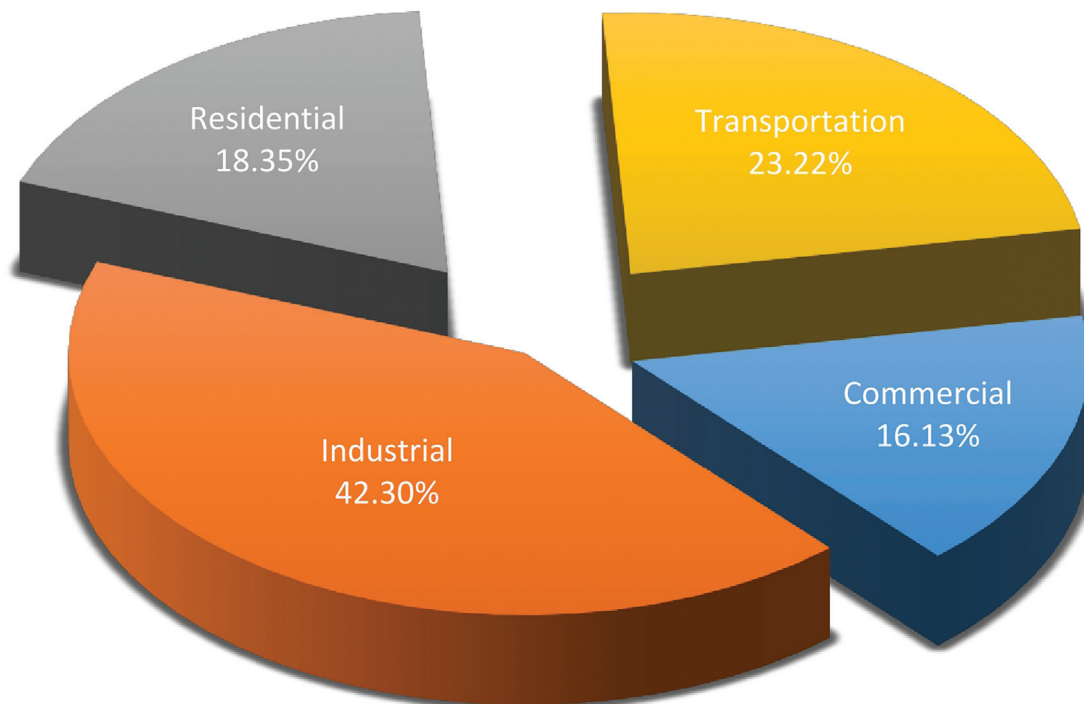


Figure 11

NDEE/EIA

## Resource Assessment

### State Energy Consumption Over Time

The EIA has collected data on energy consumption since 1960. As shown in Figure 12, energy use over the past 58 years has changed markedly. Overall, total energy consumption has nearly tripled from 308 trillion Btu in 1960 to 915 trillion Btu in 2018. The first notable change after 1960 was coal use, which increased thirteen-fold from 20 trillion Btu to 264.1 trillion Btu. Peak use of coal occurred in 2013, when it reached 292.96 trillion Btu. Virtually all of this growth is due to the generation of electricity. Coal use is now on the decline as more efforts are made to rely on carbon-free sources of energy. Nebraska's public power system continues to provide electricity from all sources of energy at economical rates.

Natural gas consumption has varied through the years. Overall, it has grown from 140.4 trillion Btu in 1960 to 196.4 trillion Btu in 2018. Natural gas consumption peaked in 1973 at 230.8 trillion Btu. The variation in consumption of natural gas is, in part, a result of increased equipment efficiency, electric utilities using natural gas for peak power production, and greater availability and use by the industrial sector.

Petroleum product use is another notable change. It nearly doubled over the past 58 years from 136.0 trillion Btu in 1960 to 242.3 trillion Btu in 2018. Overall, petroleum consumption peaked in 1978 at 246.4 trillion Btu. 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 2018. Gasoline increased by 23.6 trillion Btu, and diesel fuel increased by 90.7 trillion Btu.

Diesel fuel consumption more than quadrupled from 24.2 trillion Btu in 1960 to 114.8 trillion Btu in 2018. Gasoline consumption increased from 78.8 trillion Btu in 1960 to 102.4 trillion Btu in 2018. Gasoline consumption peaked in 1978 at 116.0 trillion Btu. Changes in gasoline consumption can be traced primarily to improved fuel efficiency of vehicles. Motor vehicle miles traveled increased from 12 billion miles a year in 1978 to 20.996 billion miles a year in 2018, continuing peak rises every year from 2012 to 2017, according to the Nebraska Department of Transportation.

The last change of note is the use of nuclear power. Nuclear power was first generated in 1973. Nuclear consumption has increased significantly, rising from 6.5 trillion Btu in 1973 to 58.9 trillion Btu in 2018. Nuclear consumption peaked in 2007 at 115.8 trillion Btu. However, nuclear energy generation has decreased since Omaha Public Power District's (OPPD) Fort Calhoun Nuclear Station, a 478 MW power plant, was shut down on October 24, 2016.

### Feasible Alternative Energy Sources

Renewable energy consumption grew from 13.4 trillion Btu in 1960 to 193.6 trillion Btu in 2018 (Figure 12). Energy production from renewables peaked in 2018. Between 1960 and 1994, the primary renewable energy source was hydropower.

In 1995, biofuel—ethanol—achieved equity with hydropower. By 2000, biofuel production was double the amount of hydropower produced. In 2018, the total amount of renewable energy produced included (Figure 13):

- Biofuels – 63.33%
- Wind – 26.51%
- Hydroelectric power – 6.6%
- Wood and wood waste – 2.73%
- Geothermal – 0.64%
- Solar – 0.19%

## Nebraska's Total Energy Consumption by Fuel Type 1960-2018

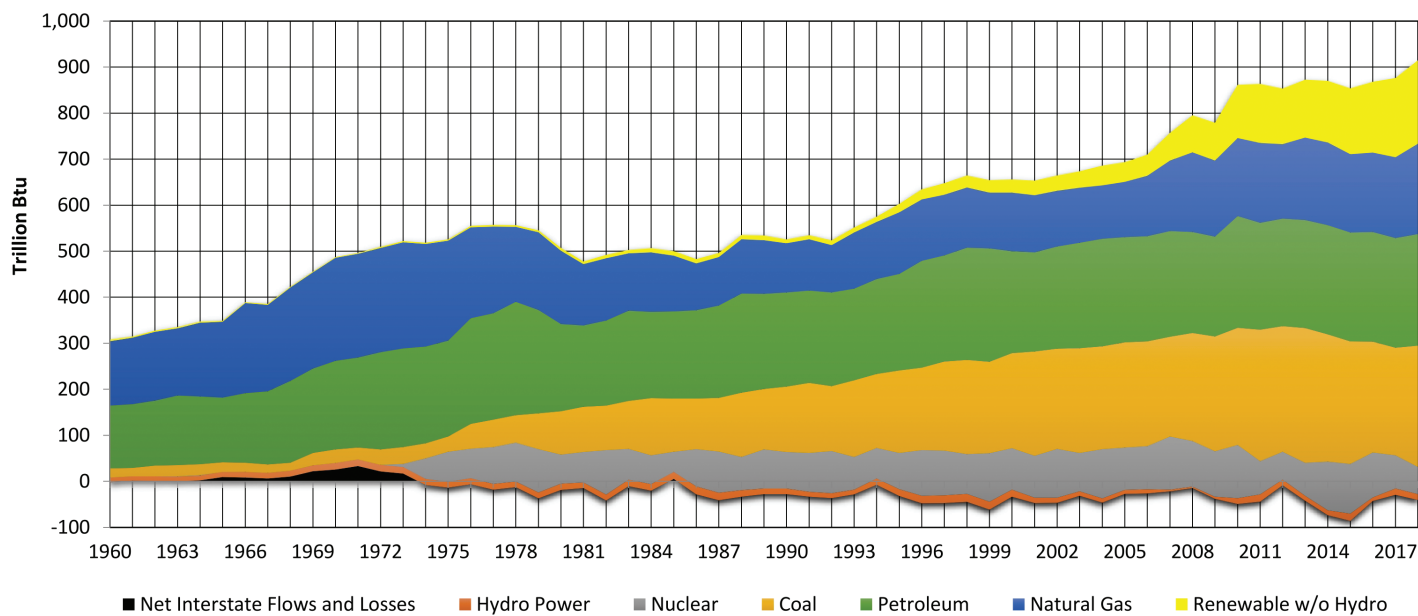


Figure 12

NDEE/EIA

## Renewable Energy Produced by Fuel Type in Nebraska 2018

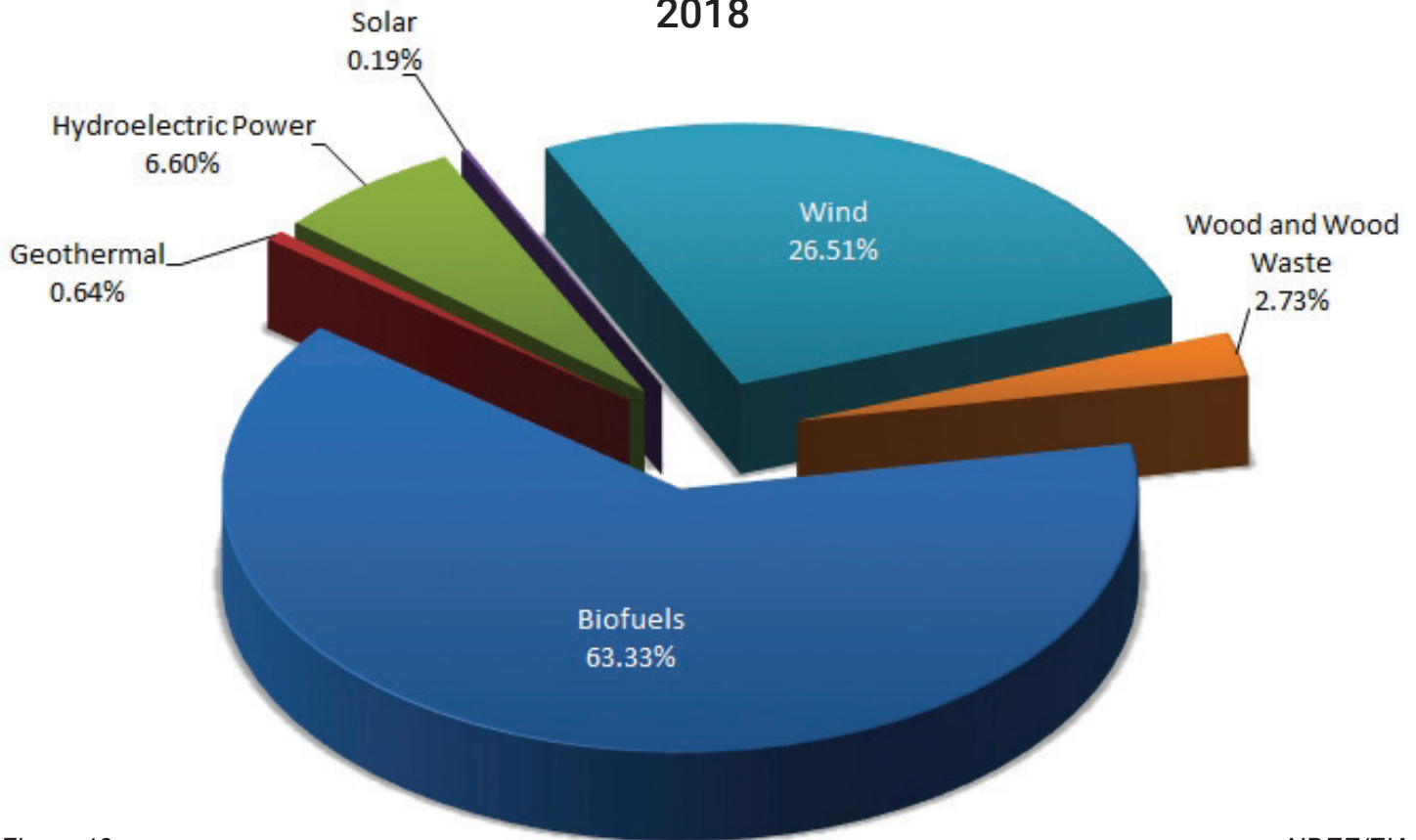


Figure 13

NDEE/EIA

## Agriculture Sector

Agriculture is Nebraska's number one industry. For purposes of the annual report, it is important to examine the agricultural sector individually, but it should be noted that the Energy Information Administration (EIA) statistics combine agriculture into the broad industrial sector. In addition to the agricultural information from EIA, NDEE also utilized USDA information, particularly the Census of Agriculture and the National Agricultural Statistics Service.

In 2019, fuel accounted for 3.4% of total farm production expenditures in the U.S. Additional agricultural energy is expended indirectly by activities like transporting seed, feed and fertilizer to farms and ranches and transporting livestock, wheat and corn to markets. A large amount of energy is also used to manufacture farm inputs such as nitrogen fertilizer and pesticides and processing livestock feeds.

## Energy Supply

Energy needs for the state's agricultural sector have been met, though over the years, transportation issues have caused limited and infrequent shortfalls in petroleum products. For example, the bomb cyclone in the spring of 2019 damaged bridges and disrupted fuel supplies to rural areas.

Similarly, in 2019, there was a temporary interruption in the propane supply because of high demand for the product in Iowa, where it is used to dry high-moisture corn. This demand taxed the propane delivery system, and while there was sufficient supply at the national level, transport issues resulted in shortages in Iowa. Iowa suppliers were forced to go to adjacent states, including Nebraska, for propane supplies.



Transportation difficulties are not limited to petroleum products—electricity also faces transmission obstacles. Electric transmission is vital to Nebraska’s agricultural sector because it is used for irrigation (Figure 14), and while Nebraska has sufficient electric generation capacity, there are times when the transmission system is tested. This is most evident in times of natural disasters when storms destroy parts of the transmission system or when there’s unusually high demand in local areas.

For example, in 2012, record drought, along with electrical demand for irrigation in north-central Nebraska, taxed the Nebraska Public Power District (NPPD) transmission system. To ensure their customers had reliable electrical supply for irrigation engines, NPPD relied on mobile diesel generators. Since then, NPPD has initiated a number of transmission system additions and upgrades for continued reliability in the north-central region of the state.

The agriculture sector represents an existing and potential source of energy for Nebraska. Biofuels, particularly ethanol, have and will continue to significantly decrease the nation’s reliance on foreign sources of energy for our transportation needs.

Renewable natural gas could be a largely untapped source of energy in Nebraska’s livestock industry. The University of Nebraska, NPPD, the former Nebraska Department of Environmental Quality, Nebraska Organic Waste Energy, Nebraska Cattlemen and the Nebraska Department of Agriculture examined the state’s cattle, pork, dairy and poultry industries in 2011. That examination led to an estimate that Nebraska’s combined livestock operations could produce enough methane to generate 95.4 megawatts (MW) of electricity—enough to provide electricity for 8% of the households in the state, or produce renewable natural gas equivalent to 41.9 million gallons of gasoline, which is enough for 78,500 vehicles annually. These are projected figures and there are a number of challenges to capturing the renewable natural gas from livestock operations, primarily the initial capital costs of constructing the facilities.

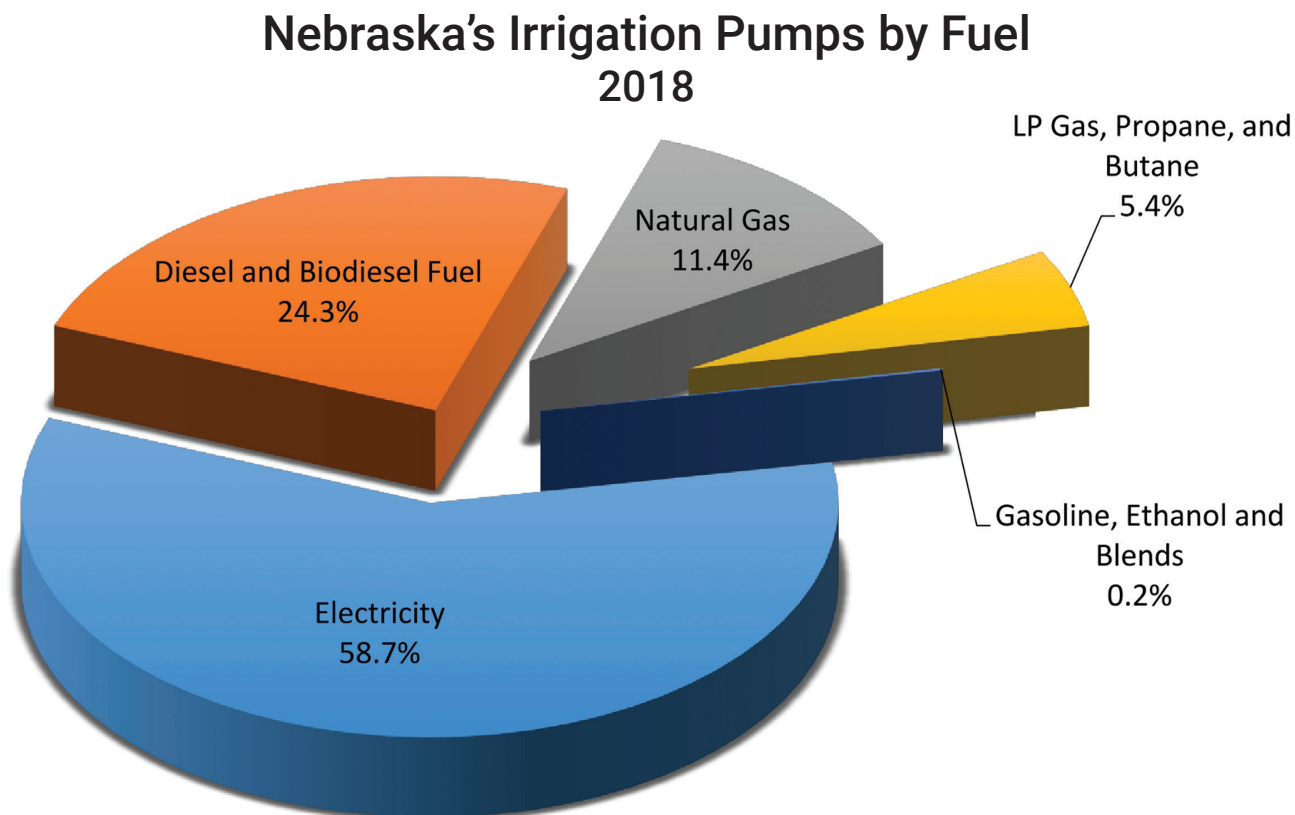


Figure 14

NDEE/EIA

## Energy Demand

Over the decades, farms have increased in size; and while energy has replaced labor, energy consumption has decreased in part because of more efficient equipment. These changes have allowed fewer people to produce larger harvests.

Energy needs in the agricultural sector account for a significant portion of production costs. Diesel is a critical factor in agricultural energy demand, mainly because it is used in planting and harvesting. Another source of energy demand is Nebraska producers' dependence on irrigation, which has increased with time and contributed significantly to Nebraska's larger harvests.

In 1966, 3.1 million acres in Nebraska were irrigated; in 2018, that number was 7.7 million acres. The availability of irrigation has contributed to the growth of Nebraska's ethanol industry. Corn requires 10 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 replaced with irrigation, which requires an energy input.

According to the USDA 2018 Irrigation and Water Management Survey, the fuel used to power irrigation pumps was diverse across Nebraska (Figure 14):

- electricity – 58.7%
- diesel – 24.3%
- natural gas – 11.4%
- propane – 5.4%
- gasoline/ethanol – 0.2%

The decline in the use of diesel and propane has led to a 6% increase in electricity.

NDEE provides rebates that can assist Nebraska's irrigators who want to switch from diesel to electric power. Funds for the rebate program come from the U.S. Environmental Protection Agency and from the Volkswagen diesel emissions settlement. As of June 2020, this program has provided funds to complete 67 diesel-to-electric conversions, which will reduce annual air pollutant emissions by 17.9 tons of nitrogen oxides and 5.7 tons of carbon monoxide.

## Conservation

As energy costs have increased, the state's agricultural producers, with assistance from Nebraska Extension agents and university research, have adopted a variety of practices that have reduced energy use. Examples include conservation tillage, which reduces the use of equipment; scheduling and load management; monitoring soil moisture for more efficient irrigation; and switching from fossil fuels to electricity to power irrigation systems.

NDEE provides rebates, made possible by the U.S. Environmental Protection Agency (EPA) Clean Diesel Program and funds from the Volkswagen diesel emissions settlement, that can assist Nebraska's irrigators who want to switch from diesel to electric power. This program reimburses 60% of the cost of conversion, including the electric motor, installing the motor and connecting it to electrical service. As of June 2020, 67 diesel-to-electric conversions were completed or were near completion. These conversions will reduce annual air pollutant emissions by 17.9 tons of nitrogen oxide and 5.7 tons of carbon monoxide.



*Nebraska irrigated 7.7 million acres in 2018—more than double the 3.1 million acres irrigated in 1966. Diesel and electricity power most of the irrigation in the state (Figure 14).*

# Industrial Sector

The industrial sector includes manufacturing, construction, mining, forestry and agricultural operations. Because the EIA includes agricultural information in the industrial sector, there is an overlap in data between the annual report's agricultural and industrial sections.

This sector relies on more diverse fuel types than the other sectors of the economy. Coal, electricity, natural gas, renewable energy and a variety of petroleum products are utilized in industrial sector operations.

Renewable energy is playing an increasingly important role in the industrial sector as businesses are seeking to reduce their carbon footprint. One example is the Facebook data center in Papillion. The data center went into operation in June 2019, and a primary reason Facebook located in Nebraska was the state's reliable supply of renewable energy. As such, Facebook has committed to using 100% renewable energy and is buying wind power from OPPD.

Similarly, Google has totally relied on renewable energy since 2017. The company is building a \$600 million data center in Papillion and will join seven other data centers in Sarpy County. The Google data center will require the equivalent of 100,000 households-worth of power, which OPPD will be able to accommodate with wind power. Nebraska, ranking as eighth in the country in terms of wind power potential, appeals to industries with carbon reduction goals.

## Nebraska's Net Energy Consumption by Fuel Type in the Industrial Sector 2018

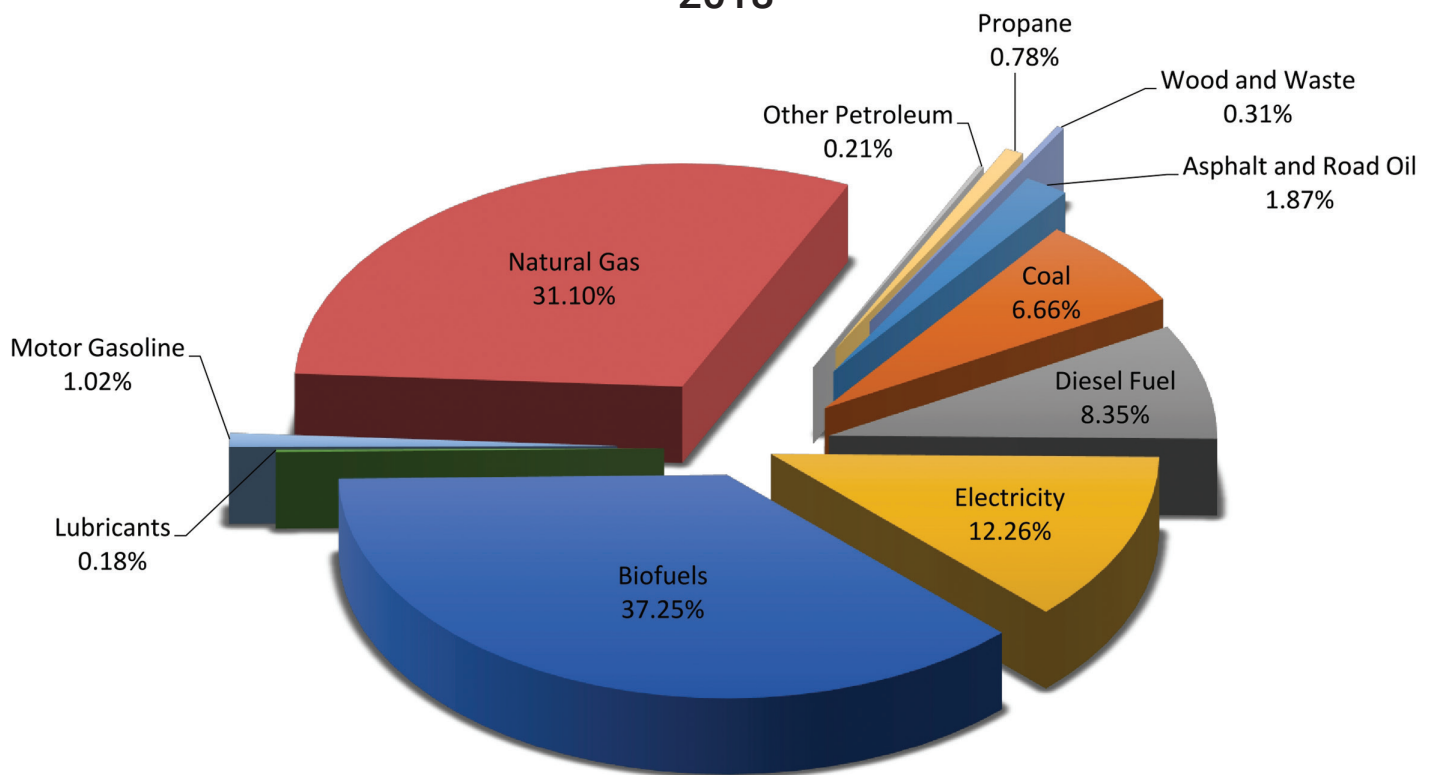


Figure 15

NDEE/EIA

# Nebraska's Net Energy Consumption by Fuel Type in the Industrial Sector 1960-2018

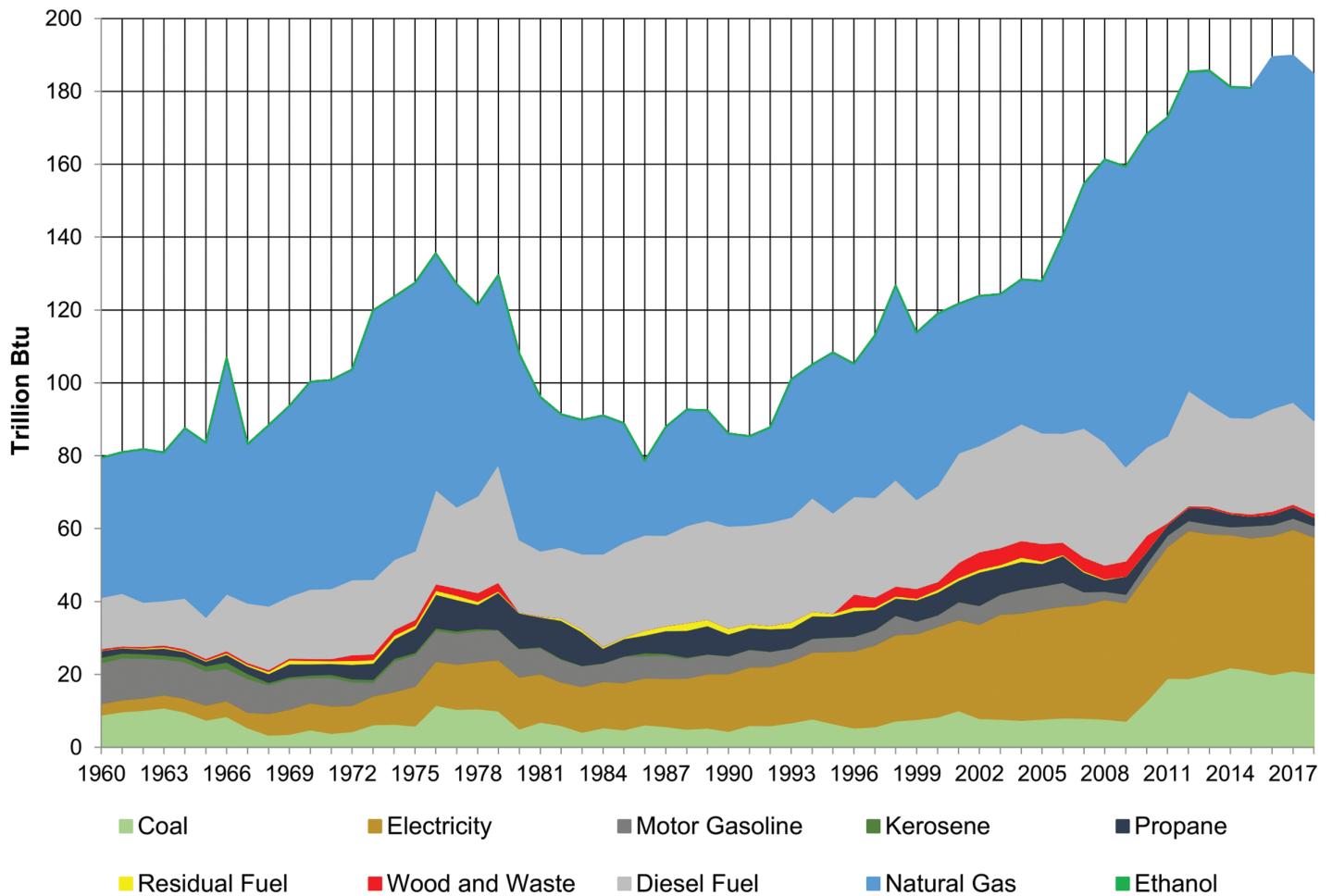


Figure 16

NDEE/EIA

## Energy Supply

As shown in Figure 15, biofuels, coal, electricity, natural gas and petroleum products met nearly all of the industrial sector's energy needs in 2018. Petroleum products included diesel fuel, propane, lubricants, motor gasoline and other products. Supplies of these fuel types have been readily available to industrial users.

Trends in fuel types used in industry illustrate this sector's dynamic needs and how industries can switch fuel types over time. The emergence of industries such as ethanol plants and data centers can also alter fuel use patterns.

Natural gas use in 1960 was 38.27 trillion Btu and soared in 1973 to 73.73 trillion Btu. Subsequent energy price spikes and other factors reduced natural gas consumption to 20.31 trillion Btu by 1986. Natural gas use has fluctuated since then, and a new historical peak occurred in 2016 at 96.47 trillion Btu.

Consumption of diesel fuel nearly doubled from 1960 to 2018, rising from 14.01 trillion Btu to 25.51 trillion Btu. Gasoline consumption dropped by nearly 72% from 11.27 trillion Btu in 1960 to 3.12 trillion Btu in 2018. Looking at Figure 16, electricity use in this sector increased over twelve-fold from 3.03 trillion Btu in 1960 to 37.44 in 2018.

## Energy Demand

The industrial sector made up 42% (386.9 trillion Btu) of the state's energy consumption in 2018 (Figure 11). Figure 16 shows a 1.5% decrease in consumption between 2017 and 2018.

In 1960, the industrial sector used 92.9 trillion Btu and was the second largest energy user after transportation, which used 94.2 trillion Btu. Industrial sector energy consumption surpassed the transportation sector in 1994 and by 2018, industry was the largest energy-using sector at 386.9 trillion Btu, surpassing the transportation sector by 174.5 trillion Btu.

Overall, energy needs in the industrial sector are subject to the ebb and flow of the business demands. National, regional and local economic trends can also cause spikes or reductions in energy demands. For example, the surge in ethanol production in the state added to the industrial sector's need for electricity and natural gas.

## Conservation

The industrial sector is making lighting, energy efficient systems and building envelope improvements a priority to save costs. A building envelope is the physical separator between the conditioned and unconditioned environment of a building. Reducing a building envelope's heat and air transfer can be accomplished by insulation and sealing and can save energy.

As energy is a significant cost factor, industrial sector users are likely to find ways to reduce the costs on their operations, which therefore impact energy use. The roller coaster that is the consumption of natural gas over the past 58 years (Figure 16) indicates the impact of conservation on fuel use and cost, fuel switching and the impact of new industries.

## Commercial Sector

The commercial sector includes non-manufacturing businesses like hotels, motels, restaurants, wholesale businesses, retail stores and laundries. It also includes service enterprises such as health, social and educational institutions and federal, state and local governments. The commercial sector accounts for fuel used to power streetlights, pumps, bridges and public services. Examples of common uses of energy in this sector include lighting, space heating, water heating, refrigeration, air conditioning and cooking.

## Energy supply

Natural gas and electricity supplied more than 90% of all fuel used in the commercial sector in 2018 (Figure 17), and their supplies have been sufficient to meet this sector's needs. The only disruptions have been because of temporary weather-related electric transmission issues.

Although natural gas and electricity remain the top two fuel types used in the commercial sector, trends indicate the supply of the two are becoming equal (Figure 18).

## Nebraska's Net Energy Consumption by Fuel Type in the Commercial Sector 2018

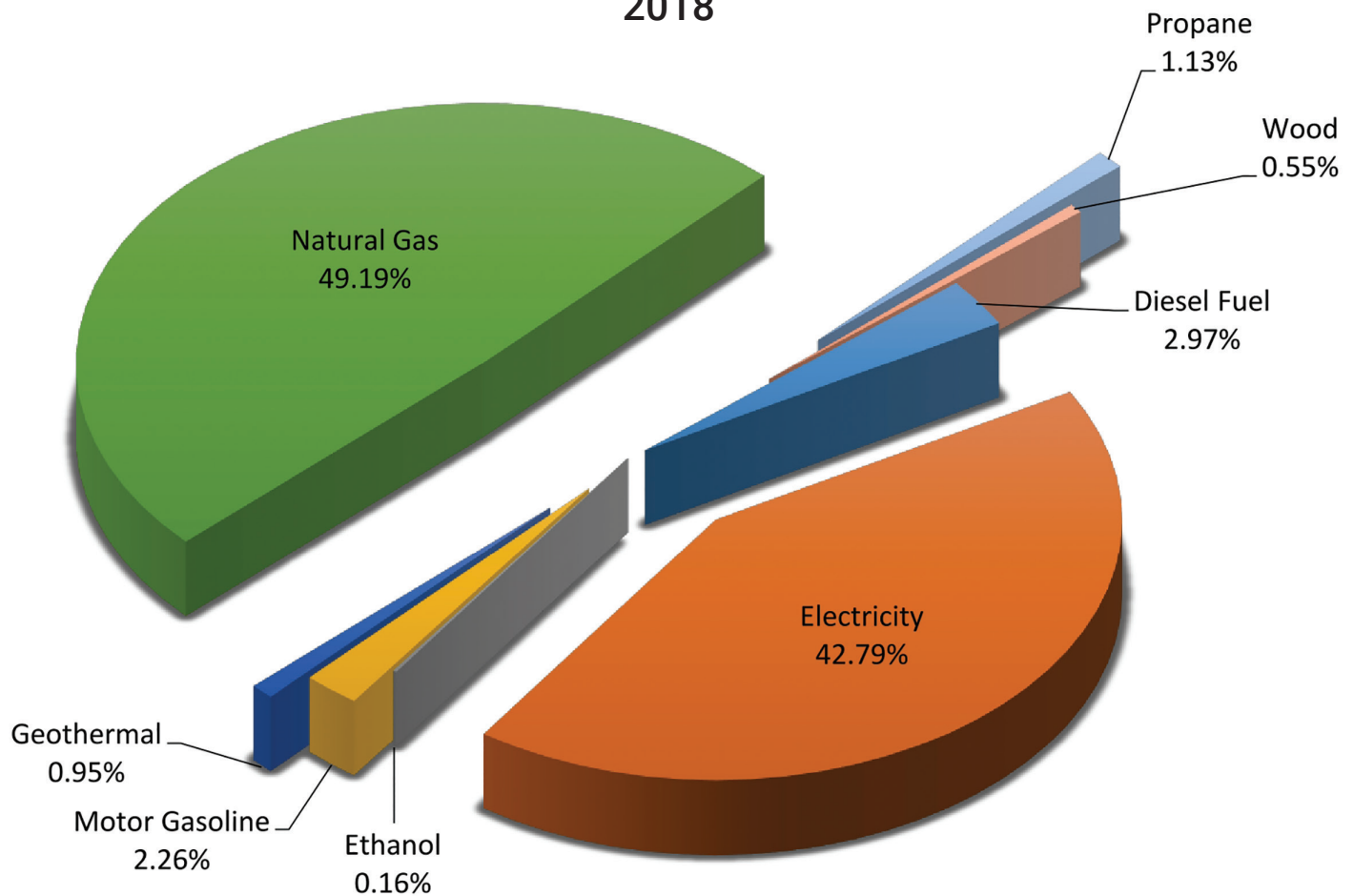


Figure 17

NDEE/EIA

### Energy Demand

According to the EIA, 147.5 trillion Btu of energy were consumed in the sector in 2018, up 9.1% (or 12.3 trillion Btu) from 135.2 trillion Btu in 2017. This sector accounts for 16.13% of the state's energy use (Figure 11).

Figure 18 shows when data collection began in 1960, the commercial sector demand was 42.1 trillion Btu. In 2018, the amount of energy used in this sector more than tripled to 147.5 trillion Btu, also marking the sector's peak energy use.

Energy issues for this sector are not anticipated because there are readily available supplies of both natural gas and electricity—the sector's primary energy sources (Figure 17).

### Conservation

Efforts to conserve energy tend to be driven by economic factors. When fuel prices rise and downturns occur in the economy, energy use is reduced. For example, the economic decline that started in late 2008 and continued in 2009 showed a decline in energy use in this sector.

# Nebraska's Net Energy Consumption by Fuel Type in the Commercial Sector 1960-2018

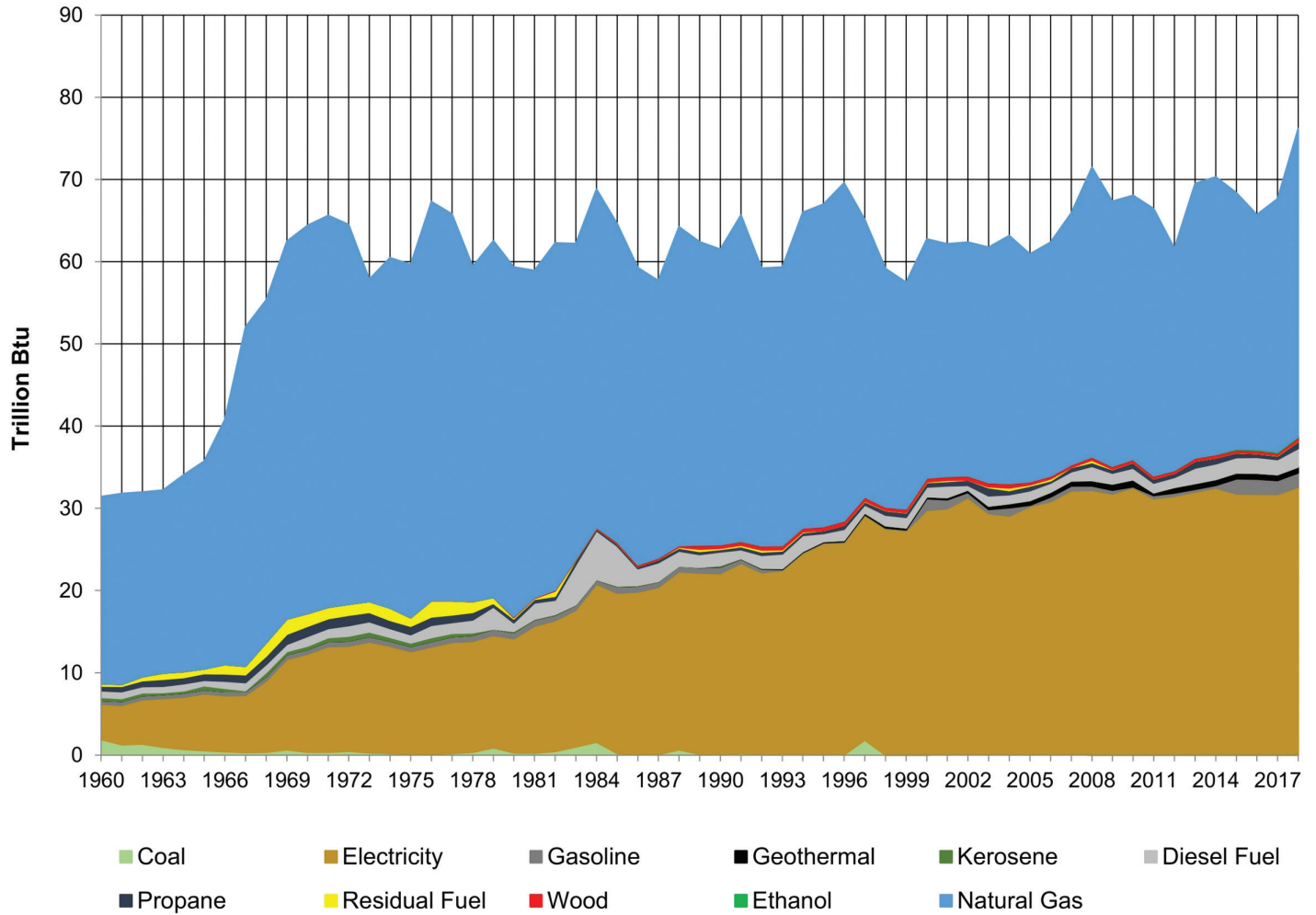


Figure 18

NDEE/EIA

# Residential Sector

The primary uses of energy in the residential sector are for home heating and air conditioning, water heating, refrigeration, cooking, clothes drying and lighting. Energy for these uses are mostly provided by electricity and natural gas.

## Nebraska's Net Energy Consumption by Fuel Type in the Residential Sector 2018

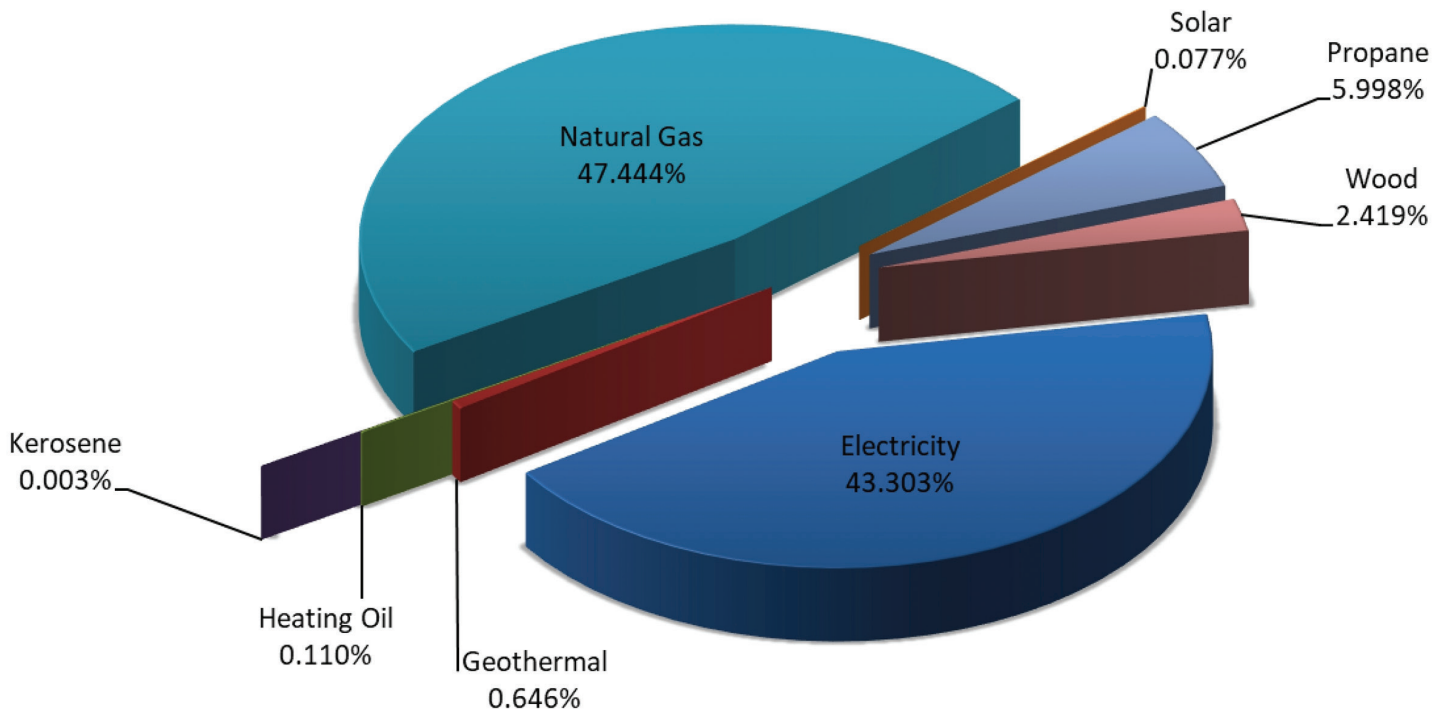


Figure 19

NDEE/EIA

## Energy Supply

As shown in Figure 19, in 2018 the residential sector's energy needs were met by:

- Natural gas – 47.444%
- Electricity – 43.303%
- Petroleum – 6.111%
- Renewable energy – 3.124%

Supply trends and fuel types used in the residential sector have not changed substantially over 58 years of data collection.

## Energy Demand

In 2018, the residential sector accounted for 18% of the state's total energy demand (Figure 11). Residential demand increased by 14.8% from 146.2 trillion Btu in 2017 to 167.8 trillion Btu in 2018. Petroleum use increased 42% from 2017, renewable energy use increased 40%, natural gas use increased 24% and electricity use increased 7.7% from 2017. Figure 20 provides a visual of this energy use increase.



# Conservation

Price, weather and efficiency improvements influence conservation in the residential sector. Like most sectors, residential users are responsive when price rises. For example, increases in natural gas prices have resulted in reduced average annual consumption over the decades. Higher 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 installing energy efficient windows and doors. Of course, adjusting the thermostat is one of the simplest ways to save money in response to higher energy bills.

When it comes to new housing, updated energy codes also play a role in energy conservation. In 2019, the Nebraska Legislature adopted the 2018 International Energy Conservation Codes (IECC), which has updated residential construction to have more cost-effective energy measures.

An Energy Impact Study, completed by Dr. Amy Musser with Vandemusser Design, compared energy savings between the 2009 IECC and the 2018 IECC. The study showed a 15% average energy savings, with a savings range from \$121 to \$331/year and an average annual savings of \$191. Using a 5% interest rate on a 30-year mortgage, the annual mortgage payment for the additional \$3,000 in energy upgrades construction cost is \$193. This means that the new code can pay for itself in energy savings starting in year one. However, some of the more costly code changes are related to health and safety and do not provide energy savings; these upgrades add approximately \$74 to the annual mortgage payment.

## Nebraska's Net Energy Consumption by Fuel Type in the Residential Sector 1960-2018

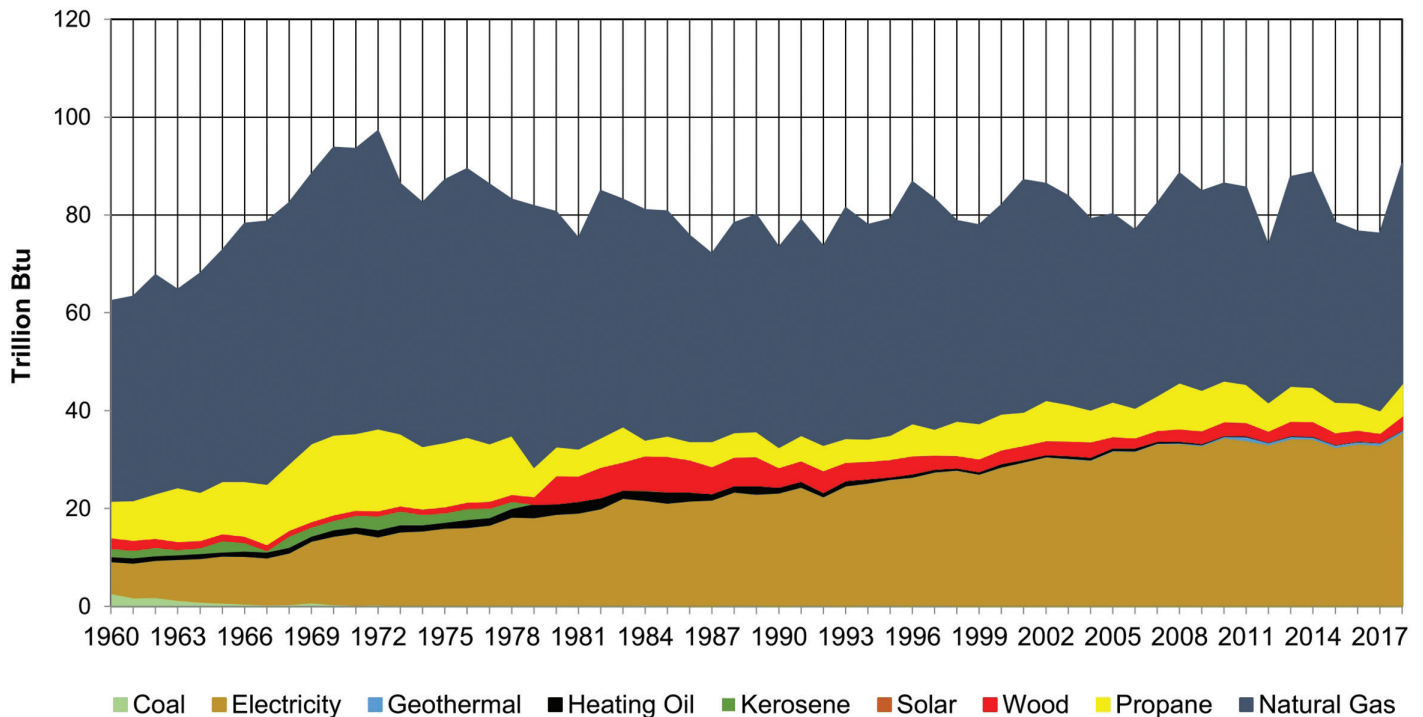


Figure 20

NDEE/EIA

# Transportation Sector

The transportation sector includes traditional methods of transportation, such as public and private vehicles, railroads and aircraft, as well as energy used to transport oil and natural gas through pipelines. Transportation is a challenge in Nebraska, the nation's 17th-largest state; long distances between locations contribute to the energy demands in the transportation sector, accounting for 23% of Nebraska's total energy demand in 2018 (Figure 11).

## Energy Supply

In 2018, 92% of energy used in transportation—195.56 trillion Btu—was in the form of petroleum products, primarily diesel fuel and gasoline (Figure 21). The next two fuel types used in consequential amounts were natural gas at 9.99 trillion Btu and biofuels at 6.82 trillion Btu. Generally, supplies of these fuel types have been readily available to transportation users.

As shown in Figure 22, trends in fuel types used in the transportation sector illustrate the static nature of this sector and how little modes of transportation have changed since record keeping began in 1960. The major overall changes over this period were increased fuel use, the growing share of diesel fuel and the introduction and modest growth of biofuels. However, the expected growth in the use of battery-electric and plug-in hybrid vehicles over the next decade should add electricity as a major additional transportation energy source.

In reviewing the transportation sector's historical energy supply, it was nearly totally dependent on petroleum-based fuels in 1960 and remained just as dependent in 2018 (Figure 22).

## Nebraska's Net Energy Consumption by Fuel Type in the Transportation Sector 2018

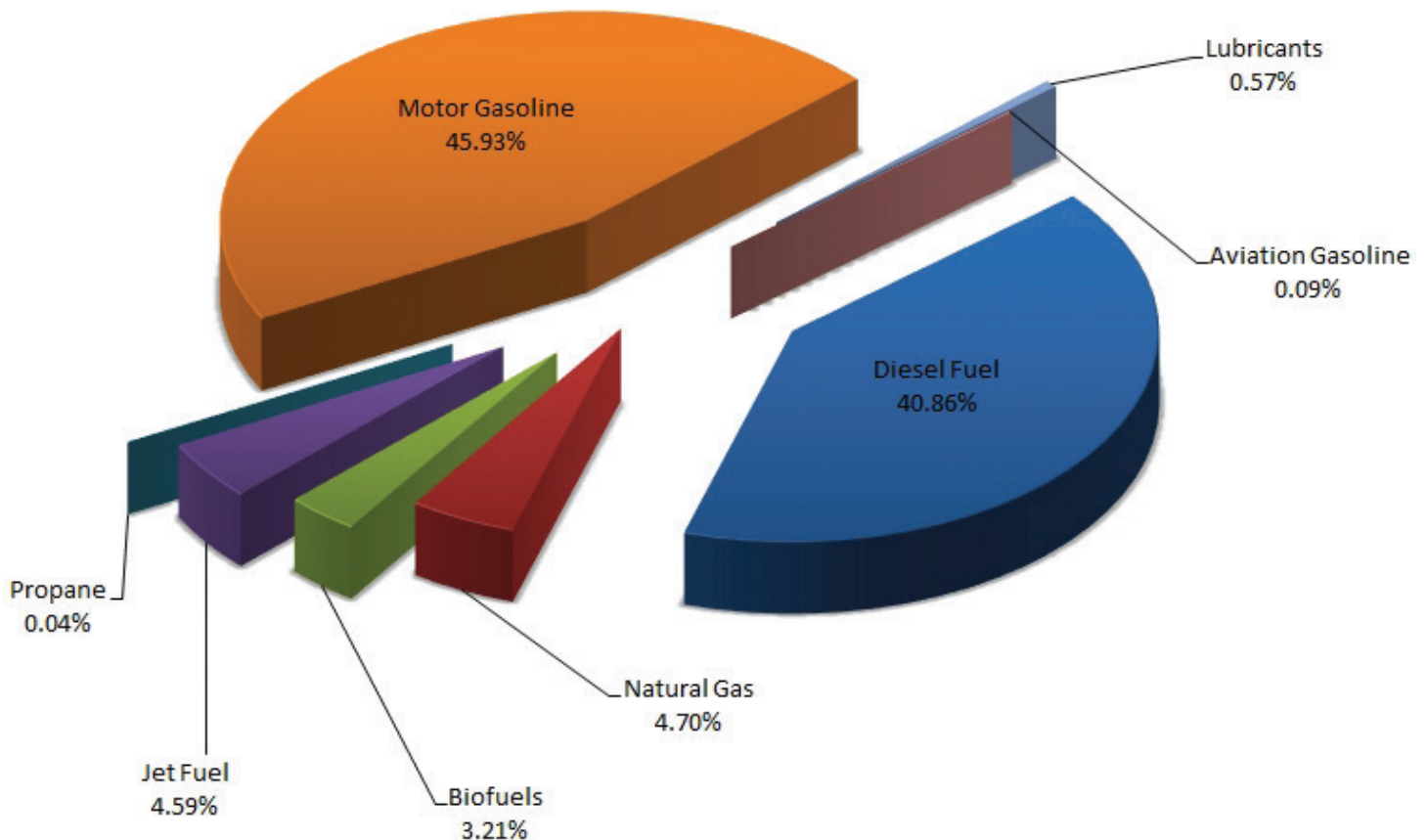


Figure 21

# Nebraska's Net Energy Consumption by Fuel Type in the Transportation Sector 1960-2018

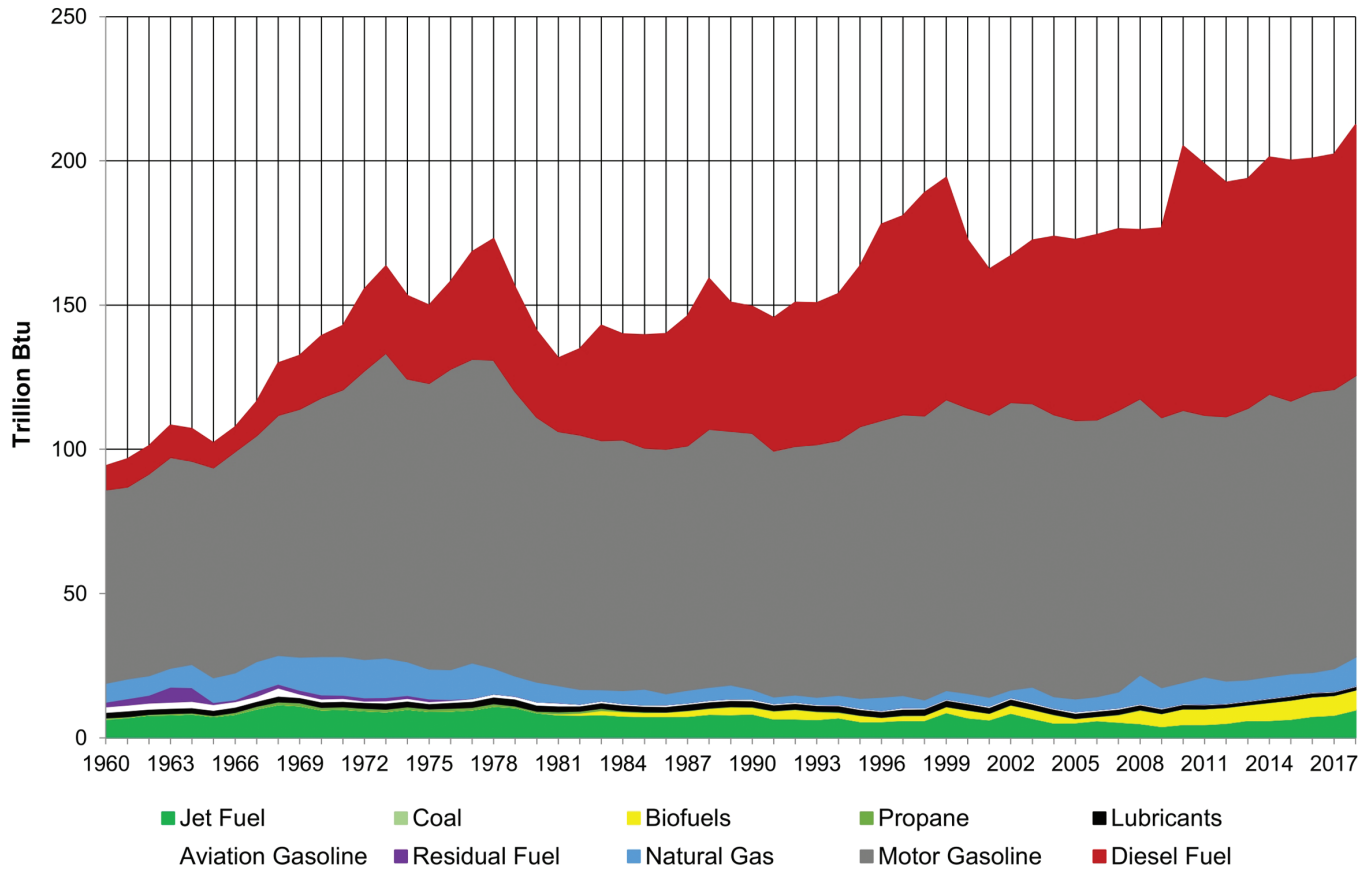


Figure 22

## Energy Demand

The transportation sector used 212.4 trillion Btu—nearly one-fourth—of the state’s energy consumption in 2018 (Figure 11). The increase in demand from 2017 to 2018 totaled 10.14 trillion Btu, an increase of 5%.

In 1960, the transportation sector was the largest energy-using sector at 94.2 trillion Btu, 30.6% of consumption of all sectors. By 2018, the industrial sector eclipsed the transportation sector as the largest energy-use.

Every year, automotive engineers improve vehicles’ fuel economy, reducing demand for liquid fuels. However, two offsetting trends have increased that demand. The first is the longstanding trend of consumers purchasing sport utility vehicles and pickup trucks, which have lower fuel economy than passenger cars. The second trend is the gradual increase in the number of motor vehicle miles traveled (Figure 23). This annual total has increased nearly every year from 1978 (12.09 billion miles) to 2019 (21.3 billion miles).

Additionally, trends in price and vehicle technology, as well as federal government requirements such as more efficient vehicles, will have an impact on energy use in this sector in the future, leading to declines in consumption. A shift is underway from gasoline-powered vehicles to alternative-powered vehicles that will improve air quality, like electric and hybrid vehicles and fuels like compressed natural gas and high ethanol blends.

According to the Alliance of Automobile Manufacturers Advanced Technology Vehicle Sales Dashboard, as of June 2019, there were 929 battery electric vehicles (BEVs) and 1,146 plug-in hybrid electric vehicles (PHEVs) registered in Nebraska. However, according to the Edison Electric Institute, the electric vehicle market share in Nebraska was 0.17% for BEVs and 0.19% for PHEVs in March 2019.

## Vehicle Miles Traveled in Nebraska 1978-2019

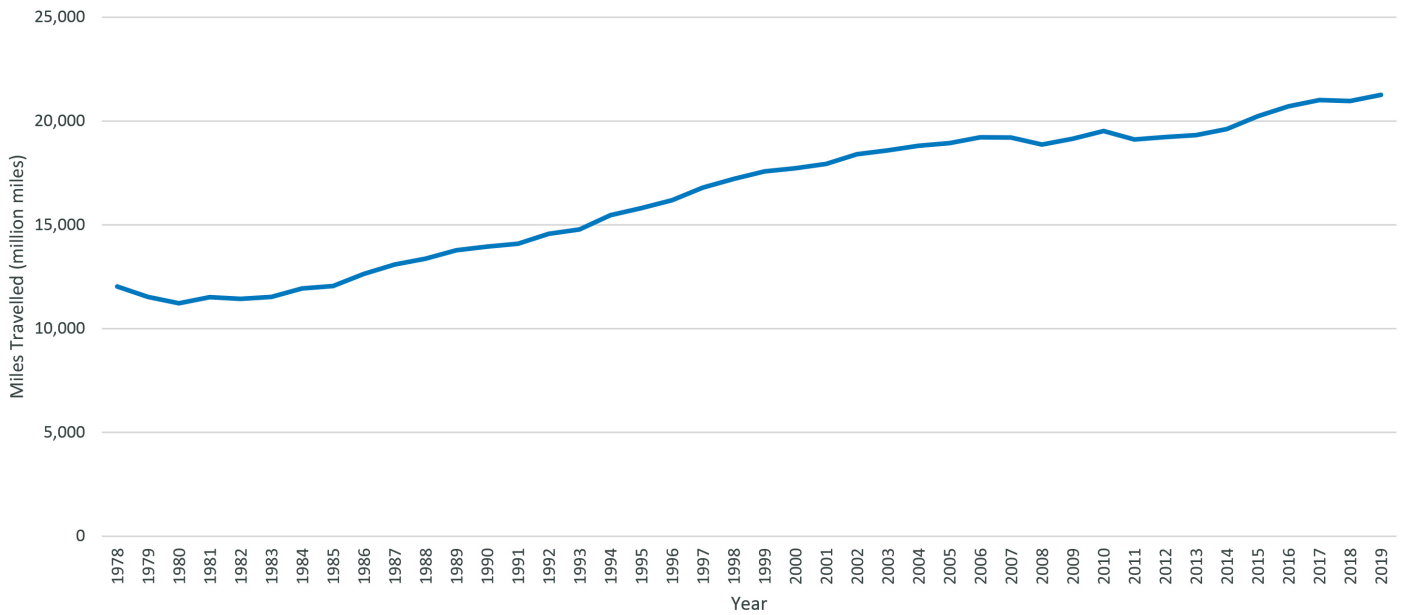


Figure 23

NDEE/Nebraska Department of Transportation

## Conservation

Over the decades, local, state and federal governments have used a variety of measures to make this sector less dependent on petroleum products, including increased reliance on ethanol, mandated Corporate Average Fuel Efficiency standards, the introduction of efficiency technology in vehicles, lighter-weight vehicles and Nebraska Clean-burning Motor Fuel rebates.

Since 1991, fluctuating pump prices for petroleum-based fuels have had a significant impact on demand, which in turn affects energy conservation. The precipitous decline in transportation sector energy use from 1999 to 2001—from 194.4 trillion Btu to 162.6 trillion Btu—was caused by dramatic price increases, demonstrating an elasticity of demand for transportation fuel. After 2001, demand increased gradually then sharply to a peak of 205.7 trillion Btu in 2010 as gasoline prices fell. The low prices were short-lived, however, rising over one dollar per gallon by 2012 as transportation sector demand fell again to 192.9 trillion Btu. Since then, lower prices at the pump have resulted in gradually rising transportation sector demand, reaching 212.4 trillion Btu in 2018.

It should be noted that increased reliance on electric vehicles has the potential to adversely impact the role of biofuels. Conversely, the wide introduction of engines optimized to work with higher ethanol blends may increase reliance on biofuels. These lower-displacement, higher-compression engines would use mid-level ethanol blends (15-40%), offer fuel economy similar to gasoline and, like current blends of ethanol, reduce pollutant emissions.

# Electric Power Sector

The electric power sector consists of facilities that generate electricity primarily for use by the public. Energy is used for the generation, distribution and transmission of electric power.

## Nebraska's Net Energy Consumption by Fuel Type in the Electric Power Sector 2018

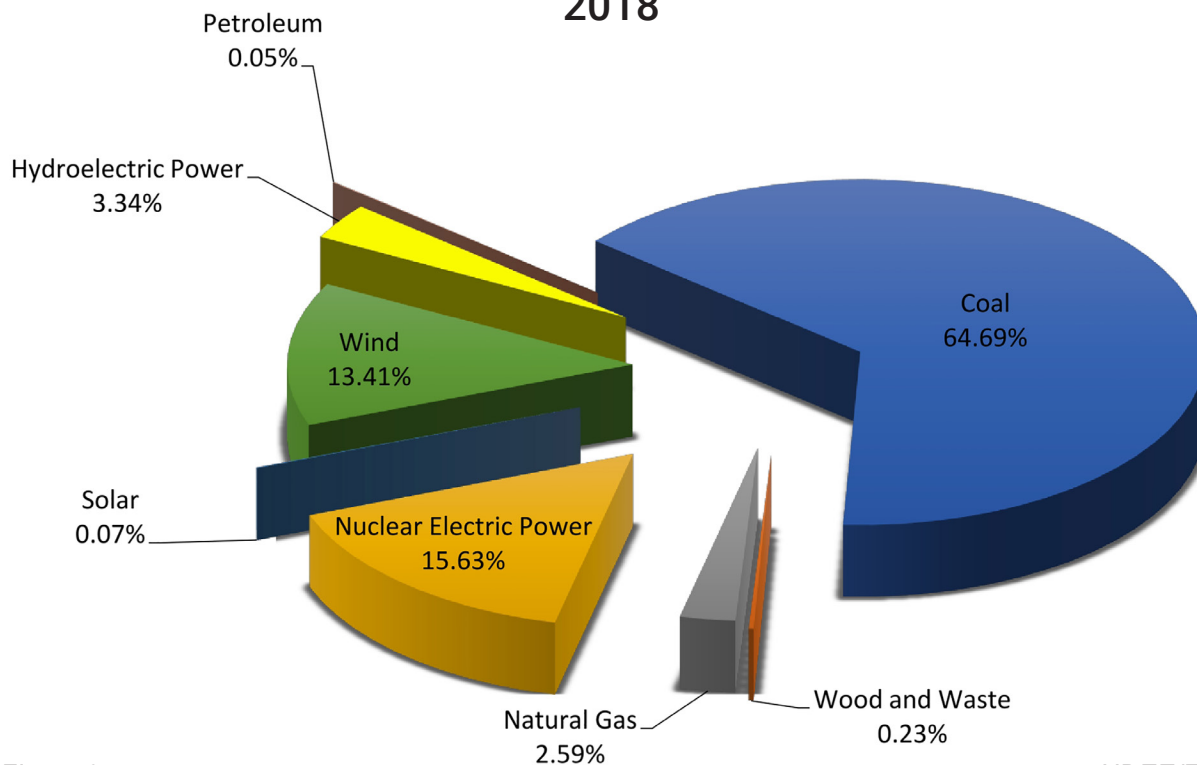


Figure 24

NDEE/EIA

## Energy Supply

Looking at Figure 24, in 2018, 65% of the electric power energy feedstocks came from coal. The next most used fuels in this sector were nuclear (15.63%) and wind (13.41%). Two lesser fuel sources supplied nearly all of the remainder:

- hydroelectric power – 3.34%
- natural gas – 2.59%

Minor amounts came from wood and waste, solar and petroleum.

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

## Energy Demand

As shown in Figure 25, trends in fuel types used by the state's electric utilities illustrate how the industry has evolved over 58 years. In 1960, 63.9% of the electricity generated came from natural gas, with hydroelectric power (20.6%) and coal (12.6%) supplying most of the balance.

Among the changes in fuel used to generate electricity in 2018 were increased use of wind, hydroelectric power, petroleum, coal and natural gas along with reductions in nuclear.

The demand in the state's electric power sector in 2018 totaled 376.6 trillion Btu, an increase of 6.6% from 2017 demand.

Electricity purchases generated by hydroelectric power for use by Nebraska utilities from the Western Area Power Administration in 2018 totaled 1.974 billion kWh at an average price of three cents per kWh. The total cost of the power purchased in 2018 was \$61.8 million. In 2018, the amount of power provided from Western Area Power Administration met 6.4% of the electricity demand in the state.

Nebraska’s electric utilities more than met their customers’ needs while continuing to export electricity to customers outside the state. Between 1990 and 2018, electricity exports varied from a low of 9.4% of generation in 1994 to a high of 26.1% in 2015. In 2018, electricity exports were 16.3% of generation. This was an increase of 2% from 2017.

## Nebraska’s Net Energy Consumption by Fuel Type in the Electric Power Sector 1960-2018

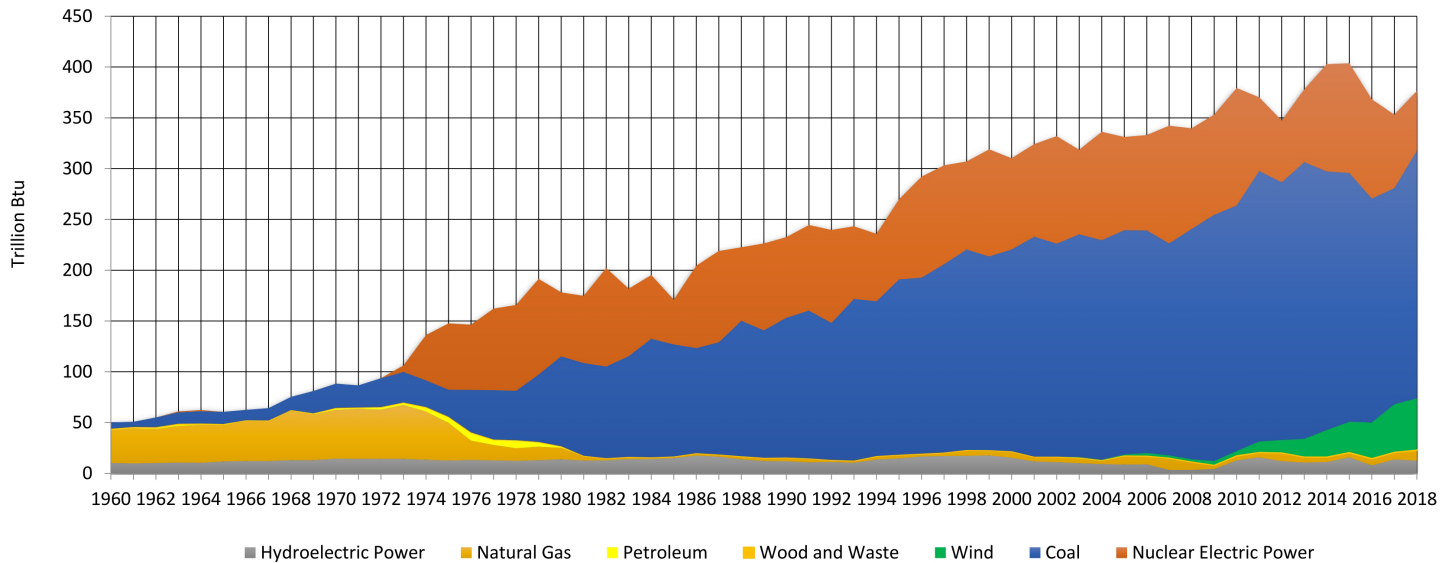


Figure 25

NDEE/EIA

# Conclusion

The graphs and figures shown throughout this report highlight how energy has changed and will continue to change into the future.

For example, renewable energy use has grown from 13.4 to 193.6 trillion Btu between 1960 and 2018 in Nebraska, as stated on page 15. Energy production may continue to shift as businesses, such as tech companies and other large energy users, commit to using 100% renewable energy. In addition to renewable energy, there are also technological advancements and updated energy regulations the energy industry need to consider.

These are changes Nebraska can meet because of its public power system and its abundant energy resources. In response to the example above, the electric power sector mainly uses coal for its energy feedstock (Figure 24). This provides a reliable base of power generation as utilities and consumers begin to rely more on renewable energy, even as overall energy consumption rises.

Through these changes, NDEE will also continue to provide benefits to Nebraskans. The programs described in the first portion of this document can help state residents weatherize their homes, fund energy projects, provide energy efficiency services, provide education on energy codes, build partnerships with utilities and energy innovators and more. These, along with statistics gathered by the agency, can provide Nebraskans with assistance and information regarding energy in the state.