

2021 Annual State Energy Report

NEBRASKA
Good Life. Great Resources.

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Letter from the Director

Dear citizens of Nebraska,

2021 was an exciting year for the Nebraska Department of Environment and Energy. On July 1, 2021, NDEE celebrated its 50th year as a state agency and welcomed the Drinking Water, Environmental Safety, and Water Well Standards programs from the Department of Health and Human Services to NDEE.



The agency has also celebrated its first full year in its new Fallbrook location and one year since its internal reorganization. NDEE also continues to implement its strategic plan, first developed in 2019, to continually improve the agency and its service to our customers.

NDEE began operating out of its new Fallbrook location on December 2, 2020. Before this move, the agency was spread out across four locations in Lincoln: the Atrium building on 'N' Street, 1111 Lincoln Mall, the Executive Building near the Capitol, and the Van Dorn Complex on south 8th Street.

Now, NDEE's 250 Lincoln-based teammates are all working out of the same office. The building also includes storage space for petroleum remediation equipment, a surface water testing lab, and a hearing room. Having our team members and equipment in one area improves the agency's teamwork and efficiency.

Along with the agency's move, NDEE also underwent an organizational staffing change. The new office space accommodated this reorganization, which has helped the agency better serve the regulated community by reflecting its needs.

Previously, NDEE was organized by media – air, land, water, and energy. The reorganization allows the agency to be more focused on its functions – Inspection & Compliance, Planning & Aid, Permitting & Engineering, Drinking Water & Groundwater, and Monitoring & Remediation. Because NDEE's energy programs mostly provide grants and loans, they are housed under the Planning & Aid Division, which provides funding, grants, and loans to a variety of important projects across the state.

NDEE continued its strategic planning efforts throughout 2021 as a more intentional way for the agency to operate. This planning affects both internal and external components of NDEE's functions. Internally, the plan helps teammates work more efficiently while focusing on the future and process improvement. Externally, it enables NDEE to take a proactive approach to serving Nebraskans by planning and allocating resources as needed.

Highlights of the 2020 and 2021 Strategic Plan accomplishments include:

- Credentialing Project – online renewal of licenses/certificates with acceptance of online credit card payments. Communication within the agency has been on point with multiple teams working on this project.
- Social Media – use of social media in a way that helps market the agency's brand and creates communication with the public. The agency has used Twitter to communicate on summits, energy conservation, environmental awareness, grants/aid, and vacant positions.
- Financial Reviews with Division Administrators – creates awareness of financial issues and allows time for planning to solve those issues.
- Staff Retention – employee of the month, fun committee, and optional flexible schedules were all recently implemented. The Executive Team continues to work on the structure of job shadowing and mentoring.

NDEE's Executive Team has opted for a 5-year strategic plan, which expires on September 30, 2024, instead of creating single year plans. Progress is reviewed quarterly by the Executive Team. Since October 1, 2019, the agency has completed a total of 20 high and medium priority tasks, with 11 in progress and 21 still pending.

With our new building, reorganization and strategic plan in place, NDEE has already seen improvements and is well positioned to continue that trend. I look forward to seeing what the agency and my teammates will accomplish next.

Statute requires NDEE to submit separate reports on environmental and energy issues. This report addresses the energy requirement.

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

The Programs

Weatherization Assistance Program

The Nebraska Department of Environment and Energy’s (NDEE) Planning and Aid Division 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. NDEE 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:

- \$2,610,000 from the Low-Income Home Energy Assistance Program (LIHEAP)
- \$3,159,918 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 it receives to NDEE, which are allocated to seven Community Action Partnership agencies and one non-profit agency to weatherize homes. NDEE received \$500,000 from LIHEAP to use for Heating and Cooling Repair and Replacement (HCRRA). By putting this program under the Weatherization Assistance Program, NDEE 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 July 1, 2020, and June 30, 2021, 346 homes were weatherized and 110 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, \$220 million has been spent to make energy efficiency improvements in 70,326 homes.

Energy and Assistance Division Investment in the Weatherization Assistance Program July 2020 - June 2021	
Investment (federal Funds)	\$ 1,423,065
Energy Impacts	
Electric Dollar Savings (present discounted value)	\$ 107,175
Natural Gas Dollar Savings (present discounted value)	\$ 456,677
Annual Total Dollar Savings	\$ 563,852
Present Discount Value of Future Savings	\$ 584,562
Economic Impacts	
Output	\$ 1,099,620
Value-Added	\$ 715,163
Labor Income	\$ 632,840
Job-Years	17.63
Air Emission Pollutant Reductions (Pounds)	
Carbon Dioxide (CO2)	7,550,154.85
Sulfur Dioxide (SO2)	8,854.79
Nitrogen Oxide (NOX)	9,555.07
Particulate Matter <2.5 micro-meters (PM2.5)	340.36
Volatile Organic Compounds (VOC)	154.06
Particulate Matter < 10 micro meters (PM10)	247.05

Figure 1 NDEE

Total Nebraska Homes Weatherized by Area Providers July 2020 - June 2021

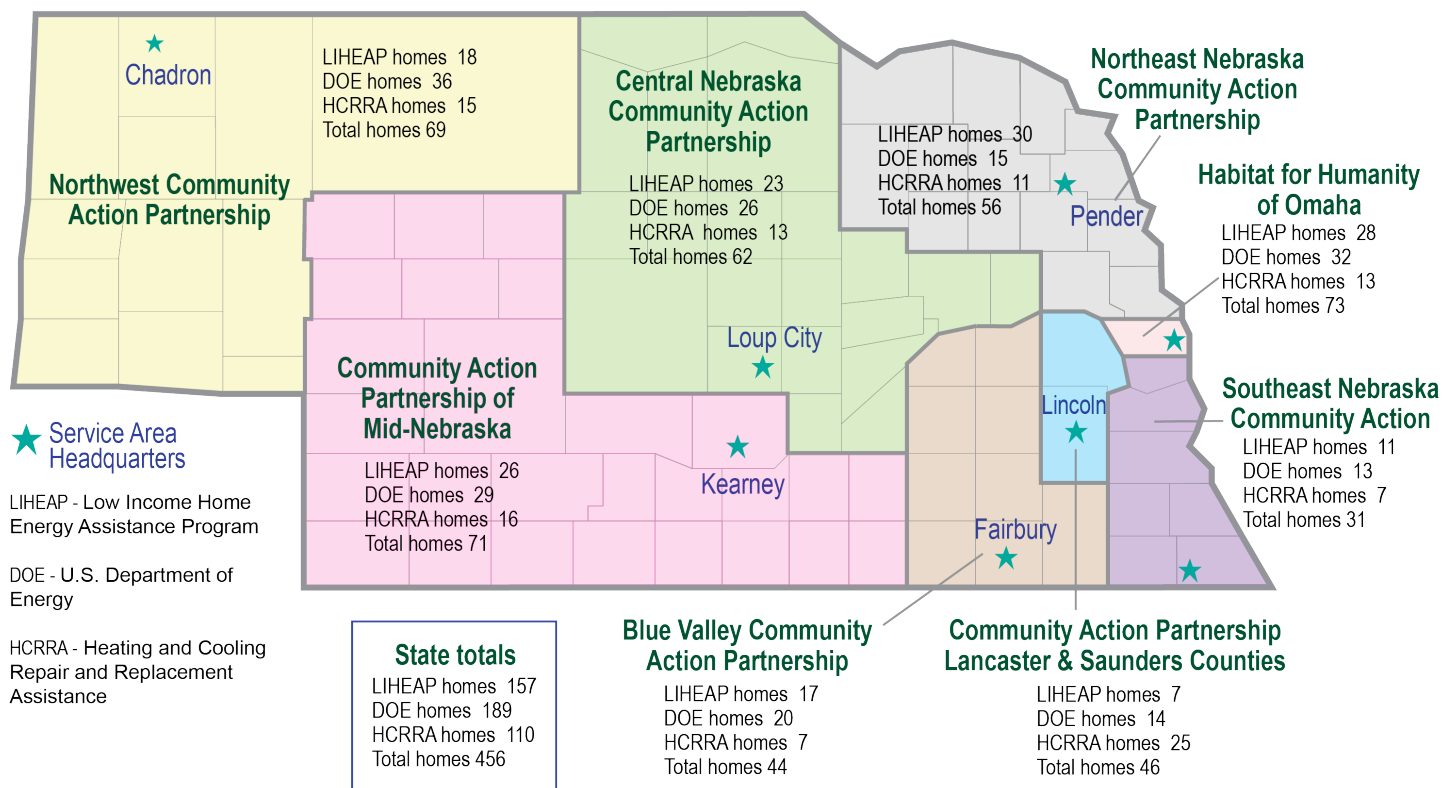


Figure 2

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.

NDEE, 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 2020-2021, depending on the project eligible for financing. Additionally, schools willing to benchmark energy consumption through the life of the loan were offered 1% interest.

DESL Total Dollars Invested (millions of dollars) 2010-2021

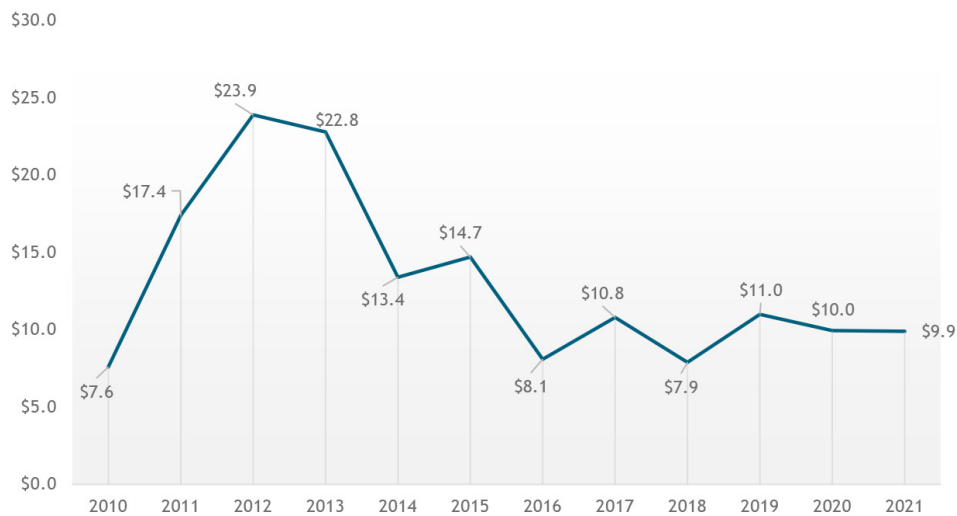


Figure 3

NDEE

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, <https://neo.ne.gov/programs/loans/inf/loans1-5.html>.

From March 1990 to June 30, 2021, 30,399 energy saving projects totaling more than \$377 million have been financed using low-interest loans from participating lenders and NDEE. More than \$187 million of the \$377 million has come from the agency’s revolving loan fund. The state’s participating lenders provided more than \$190 million. The balance, more than \$52.9 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 5. Douglas County, with 3,451 projects totaling \$51.74 million, tops the list with the most projects. Lancaster County co-anchors the top spot with the most dollars invested at \$62.34 million, albeit on fewer projects—2,421. Nebraska’s congressional districts saw the following number of projects:

- First Congressional District — 10,714
- Second Congressional District — 4,340
- Third Congressional District — 15,345

During this reporting period, 326 new projects totaling \$9.926 million were financed. The number of energy efficiency projects financed since 1990 are shown in Figure 5 and total 30,399.

DESL Number of Projects 2010-2021

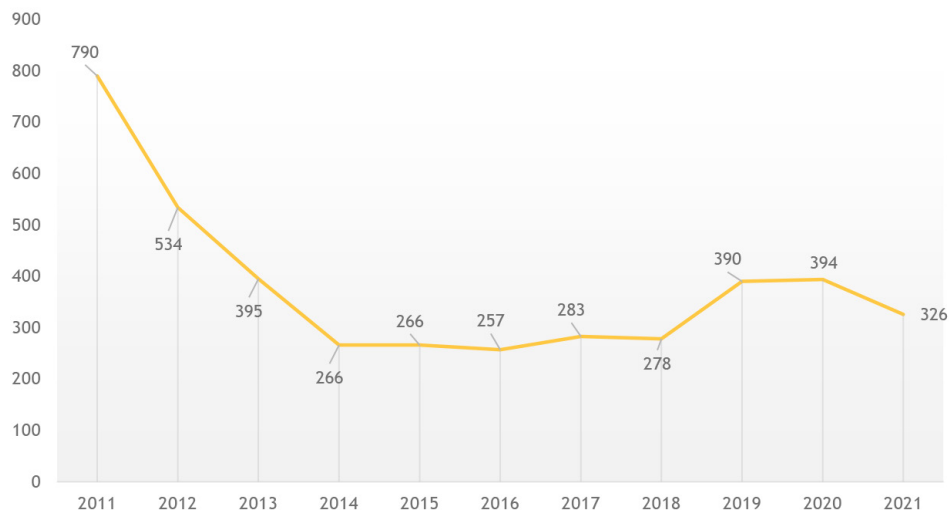


Figure 4

NDEE

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

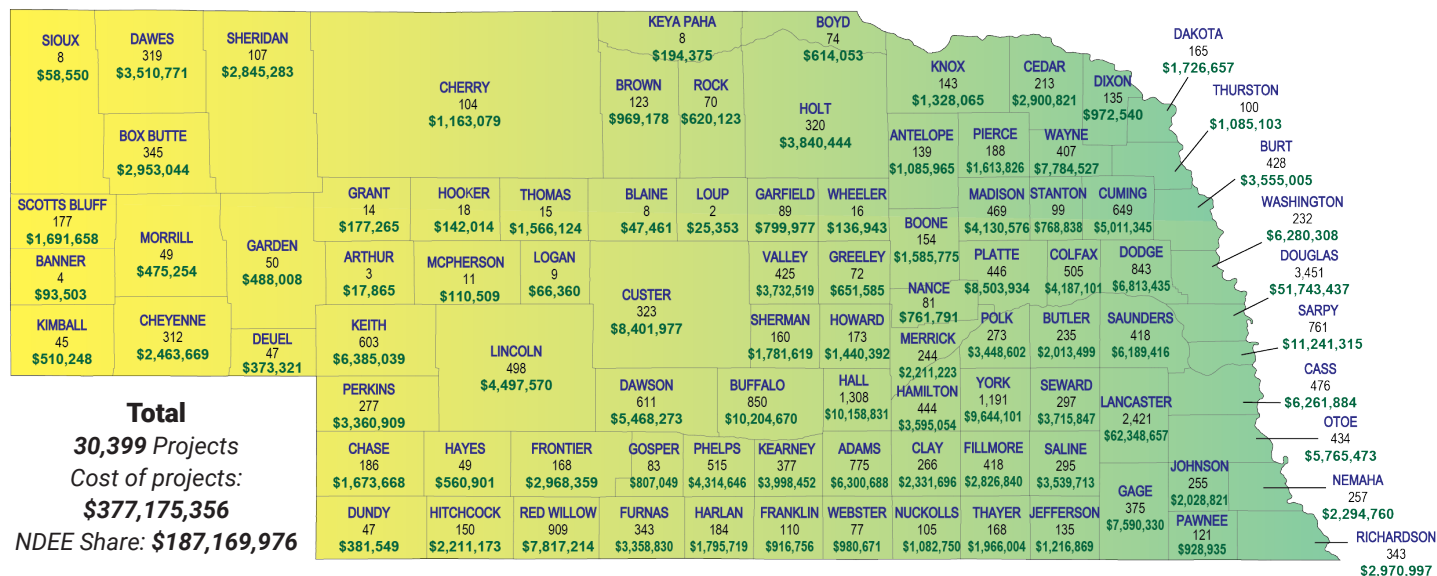
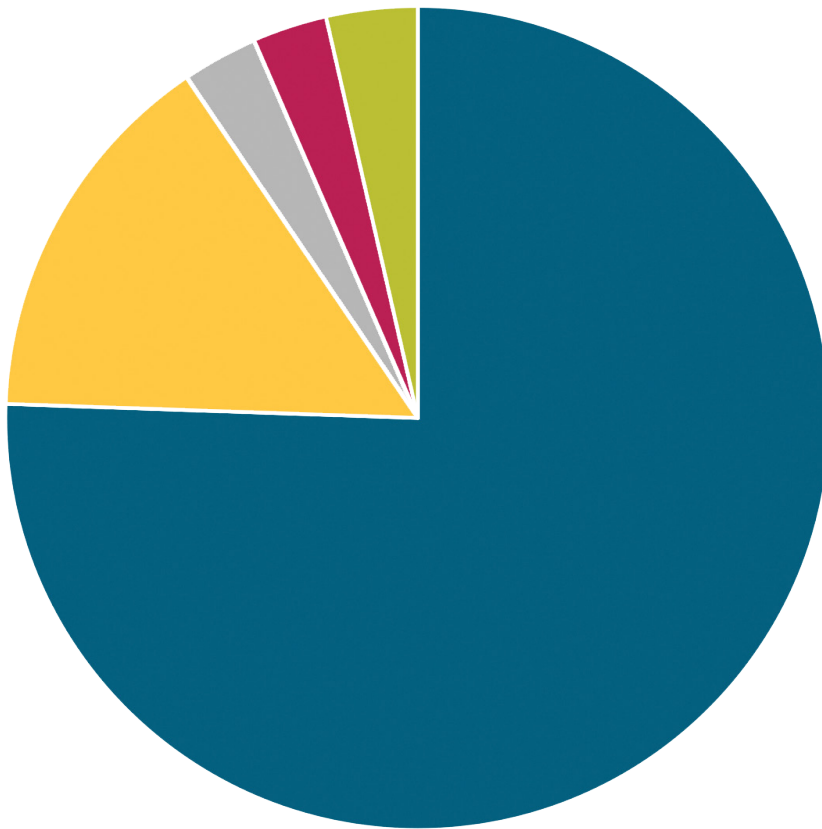


Figure 5

NDEE

Total DESL Funds Invested by Project Category as of June 30, 2021



Total

Total costs of projects: \$377,175,356
NDEE Share: \$187,169,976
30,399 Projects

Residential

Total costs of projects: \$284,933,191
NDEE Share: \$134,911,250
28,283 Projects

Commercial/Industrial/Local Government

Total costs of projects: \$56,463,153
NDEE Share: \$30,679,780
1,320 Projects

Agricultural

Total costs of projects: \$11,258,281
NDEE Share: \$5,508,496
581 Projects

Transportation/Telecommunications

Total costs of projects: \$11,016,542
NDEE Share: \$6,968,883
43 Projects

Wind, Solar and Fuel Cells

Total costs of projects: \$13,504,207
NDEE Share: \$9,101,567
172 Projects

Figure 6

NDEE

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% of all energy efficiency projects financed with loans from the agency. More than 76% of NDEE funds from all categories—\$134.9 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, 28,283 residential energy efficiency projects have been undertaken by Nebraskans using loan program funds.

Commercial/Industrial/Local Government

More than 15% of funds from all categories—\$56.46 million—has been used to make building and system improvements in 1,320 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.

Wind, Solar and Fuel Cell Systems

Roughly 4% of funds from all categories—\$13.5 million—has been used for 172 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% 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 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, which is funded by grants from the U.S. Environmental Protection Agency, has completed 100 projects since 2017.

Alternate Fuel/ Telecommunications

Since 1990, 3% of funds from all categories—\$11.02 million—has been used for 43 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, 2020, through June 30, 2021, are illustrated in Figure 7.

State Energy Formula Grants

In 2020-2021, Nebraska received \$578,540 for this federally-funded effort and supplied \$115,708 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).

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 Energy Saving Loan (DESL) operations; support of renewable energy activities; and residential and commercial building energy efficiency activities.

Energy Impacts	
Electric Energy Savings (kWhs)	57,458
Natural Gas Energy Savings (therms)	47,995
Present Discount Value of Future Savings	\$952,120
Present Day Value Economic Impacts	
Output	\$3,399,621
Value-Added	\$2,049,994
Labor Income	\$1,506,453
Job-Years	39
Air Emission Pollutant Reductions (Pounds All Years)	
Carbon Dioxide (CO2)	13,418,251
Sulfur Dioxide (SO2)	5,652
Nitrogen Oxide (NOX)	12,999
Particulate Matter <2.5 micro-meters (PM2.5)	98
Volatile Organic Compounds (VOC)	216
Particulate Matter < 10 micro-meters (PM1.0)	156
Total Present Discount Value of Environmental, Comfort, Health and Safety	\$809,834

Figure 7

NDEE

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 2021, Collaborative activities included:

- Collaborating with the Nebraska/Iowa/Illinois (Zone 5) National Commercial Buildings Energy Code Field Study
- Assessing and reviewing other energy code compliance initiatives/projects in the Midwest region for beneficial replication in Nebraska.
- Collaborating with the Midwest Energy Efficiency Alliance to provide educational opportunities in the Nebraska Energy Codes Training Program to help provide members of the state's construction industry with a better understanding of the changes in the newly adopted state energy code, as well as helping to improve their understanding of the cost and savings impacts associated with Nebraska's adoption of the 2018 International Energy Conservation 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.

NDEE participated the 14th annual Wind and Solar Conference and Exhibition on November 8 and 9, 2021. The Wind and Solar Conference provides information on wind and solar development in Nebraska. It organizes sessions and workshops for speakers and moderators to provide the latest information on the industry. Attendees include public power representatives, private sector developers, public officials, landowners, environmental interests, wildlife interests, and the public at large.

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.

National 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.

State Energy Program Competitive Funding

Renewable Fuels Infrastructure Program

From 2016 to 2019, the Energy 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. This was funded through the USDA Biofuels Infrastructure Program. LB 585, enacted by the legislature in 2019, provided a second round of blender pump installations. Since then, NDEE has not received any additional funding to administer the Renewable Fuels Infrastructure Program.

In 2021, NDEE administered the Access Ethanol Nebraska program by providing to the U.S. Department of Agriculture (USDA) the 2020 Fuel Volume and Sales report for the 22 retail locations that received funding for the installation of 88 high ethanol pumps across the state. NDEE staff also assisted Nebraska fuel retailers who sought funding from the USDA's Higher Blends Infrastructure Incentive Program.



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.

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.

In 2021, NDEE staff provided a summary of the NIBB project to the Nebraska Department of Administrative Services and will serve in a consultative capacity for any future developments. NDEE staff, as part of its educational outreach, made a presentation on building energy efficiency benchmarking to 100 middle and high school students as part of the Future Problem Solvers seminar at the Central Community College in Hastings, Nebraska.

State Heating Oil and Propane Program

Between September 2020 and September 2021, the NDEE began its 19th year of participation in the U.S. DOE's 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 \$6,597 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.

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.

Nebraska Energy Settlement Fund				
Summary of Exxon, Stripper Well and Diamond Shamrock				
Oil Overcharge Funds as of June 30, 2021				
	Exxon	Stripper Well	Diamond Shamrock	Total
Funds Received	\$15,504,944	\$15,680,564	\$359,172	\$31,544,680
Interest Earned and Miscellaneous Income	\$15,344,789	\$13,852,294	\$264,999	\$29,462,081
Total	\$30,849,733	\$29,532,858	\$624,171	\$61,006,761
Funds Budgeted	\$30,849,733	\$29,532,858	\$624,171	\$61,006,761
Low Income Designated	\$0	\$0	\$0	\$0
Uncommitted Balance	\$0	\$0	\$0	\$0

Figure 8

NDEE

Financial Activity

Total energy-related expenditures for the year were \$11,123,325, a decrease of 8.0% from the previous year. The COVID-19 pandemic was a contributing factor.

Energy loans accounted for 56.8% of expenditures, aid payments accounted for 30.5%, and the remaining 12.8% of expenditures were for salaries and operations.

Of the funding for these expenditures, 35.2% came from the Oil Overcharge Funds, 61.9% from federal funds and 2.8% 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, 2020 - June 30, 2021

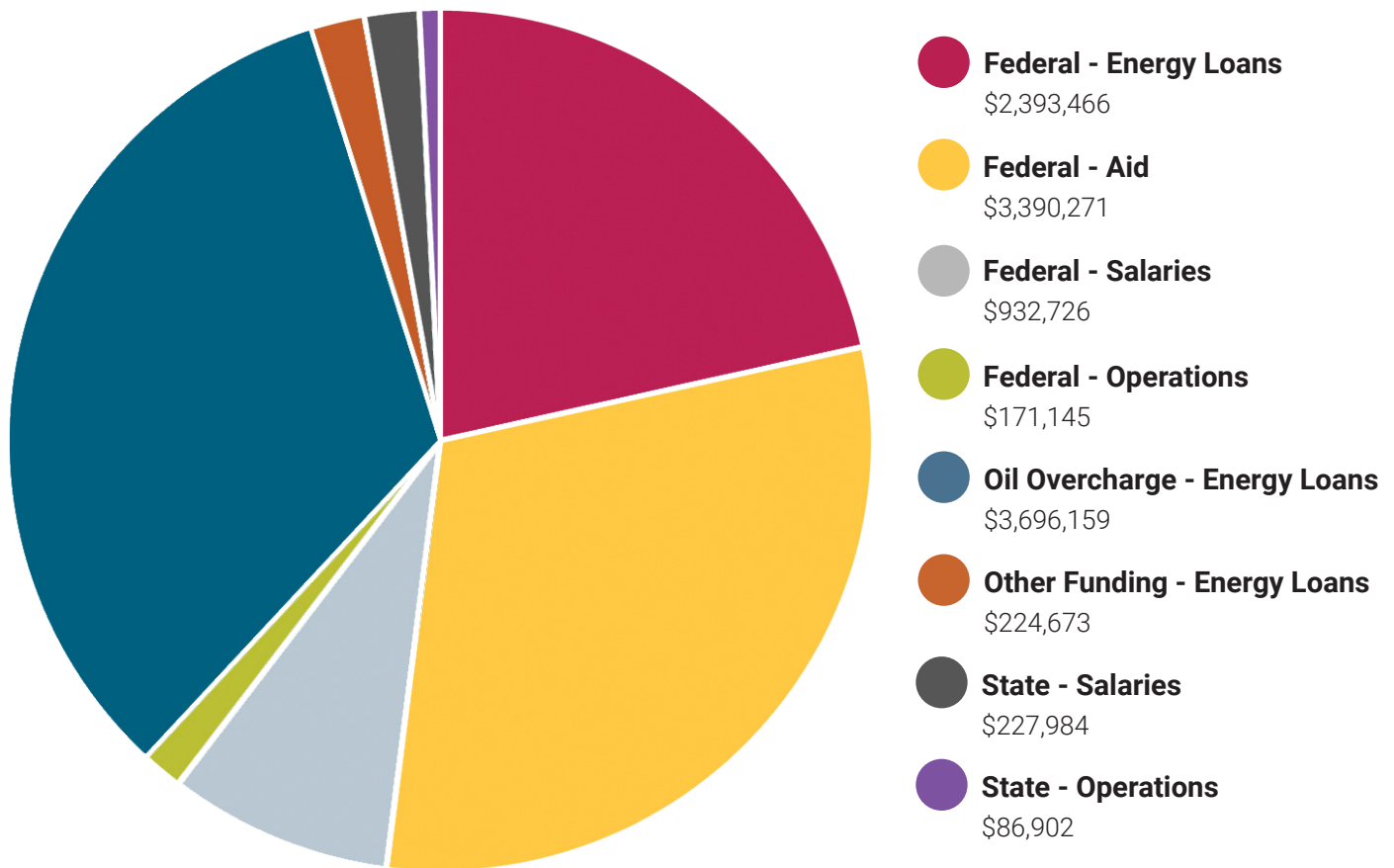


Figure 9

NDEE

Trends and Needs

Statewide Energy

According to the Energy Information Administration (EIA), Nebraska's total energy consumption in 2019 was 901 trillion British thermal units (Btu), a decrease of 2.19 trillion Btu—or 0.2%—from 2018 to 2019. (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 2019 as seen in Figure 10:

- Coal — 25%
- Petroleum (and products) — 25%
- Natural gas — 21%
- Renewable energy — 21%
- Nuclear power — 8%

From 2018 to 2019, the use of nuclear power, natural gas, petroleum, and renewable energy increased, while the use of coal decreased.

Nebraska is the only state that generates electricity entirely by publicly owned power systems. According to EIA, as of 2019, the statewide average electricity price is the 16th-lowest rate in the country at 9.08 cents per kilowatt-hour (kWh).

Figure 11 shows the amount of energy that Nebraska consumed in each sector in 2019:

- Industrial — 42%
- Transportation — 23%
- Residential — 19%
- Commercial — 16%

Nebraska's Total Energy Consumption by Fuel Type 2019

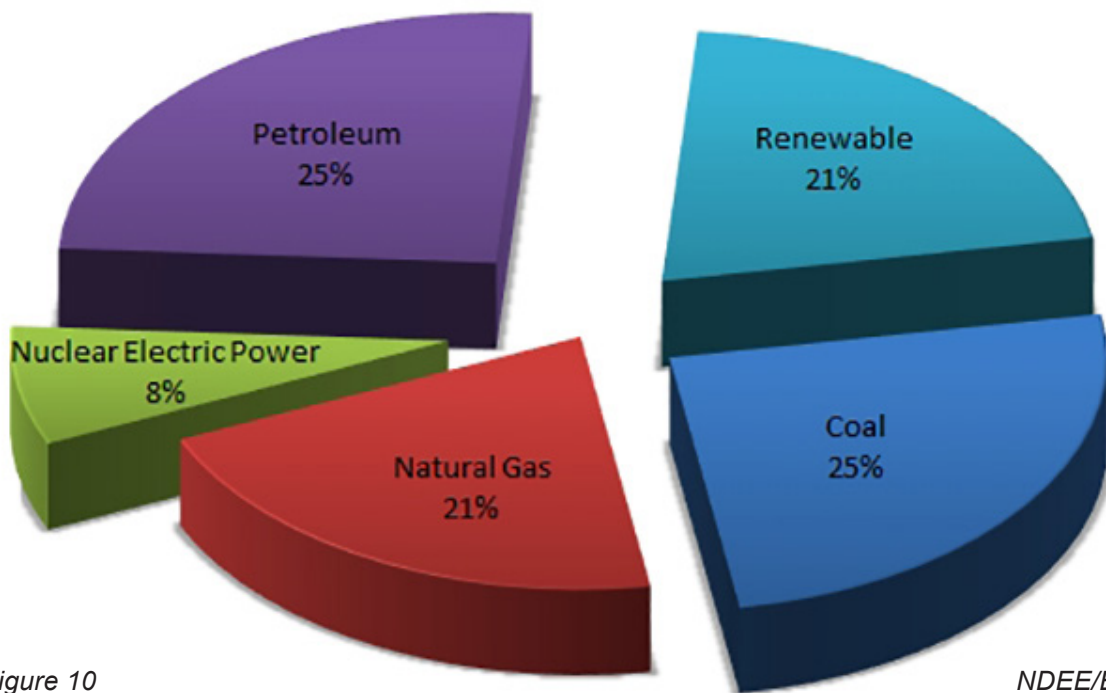


Figure 10

NDEE/EIA

Energy Consumed in Nebraska by Sector 2019

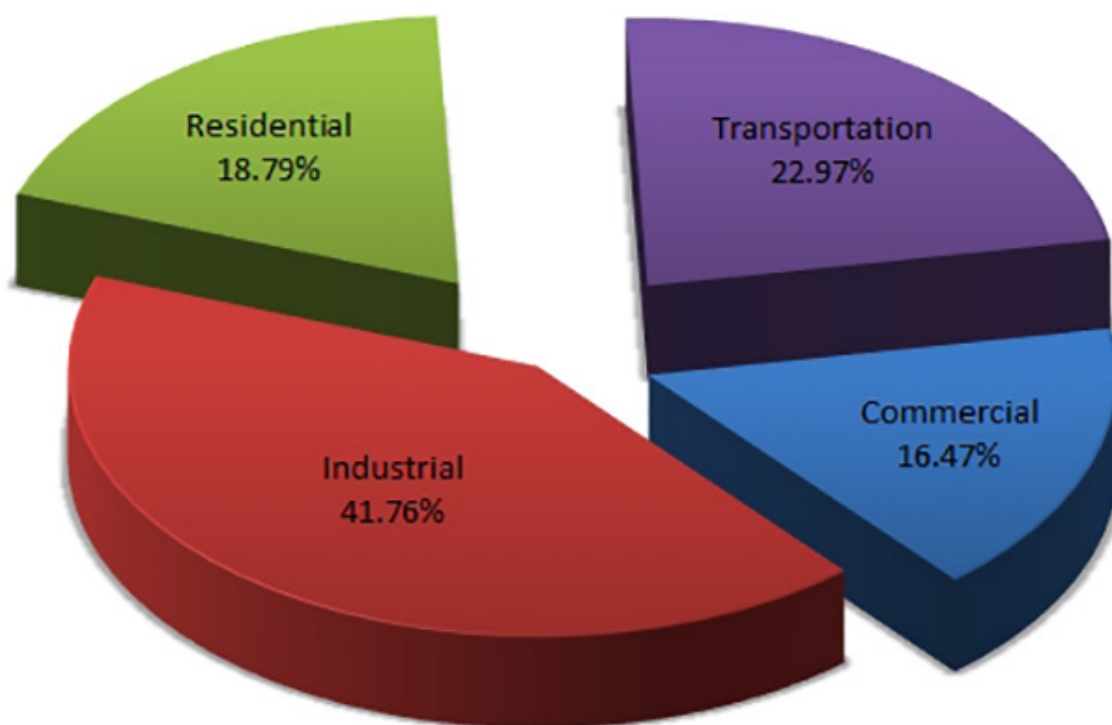


Figure 11

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 59 years has changed markedly. Overall, total energy consumption has nearly tripled from 308 trillion Btu in 1960 to 901 trillion Btu in 2019. The first notable change after 1960 was coal use, which increased nearly thirteen-fold from 20 trillion Btu to 240.4 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 198.8 trillion Btu in 2019. 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 59 years from 136.0 trillion Btu in 1960 to 241.9 trillion Btu in 2019. 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 2019. Gasoline increased by 23.6 trillion Btu, and diesel fuel increased by 93.8 trillion Btu.

Diesel fuel consumption increased nearly five times from 24.2 trillion Btu in 1960 to 117.8 trillion Btu in 2019. Gasoline consumption increased from 78.8 trillion Btu in 1960 to 102.4 trillion Btu in 2019. 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 12.029 billion miles in 1978 to peak at 21.262 billion miles in 2019, 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 72.6 trillion Btu in 2019. Nuclear consumption peaked in 2007 at 115.8 trillion Btu. However, nuclear energy generation decreased for three consecutive years when Omaha Public Power Dis-

trict’s (OPPD) Fort Calhoun Nuclear Station, a 478 MW power plant, was shut down on October 24, 2016. In 2019, generation increased 23%, probably due to other power plants offsetting the loss of Fort Calhoun.

Feasible Alternative Energy Sources

Renewable energy consumption grew from 13.4 trillion Btu in 1960 to 199.3 trillion Btu in 2019 (Figure 12). Energy production from renewables peaked in 2019. 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 2019, the total amount of renewable energy produced included (Figure 13):

- Biofuels — 58.18%
- Wind — 32.24%
- Hydroelectric power — 5.99%
- Wood and wood waste — 2.76%
- Geothermal — 0.61%
- Solar — 0.22%

**Nebraska’s Total Energy Consumption by Fuel Type
1960-2019**

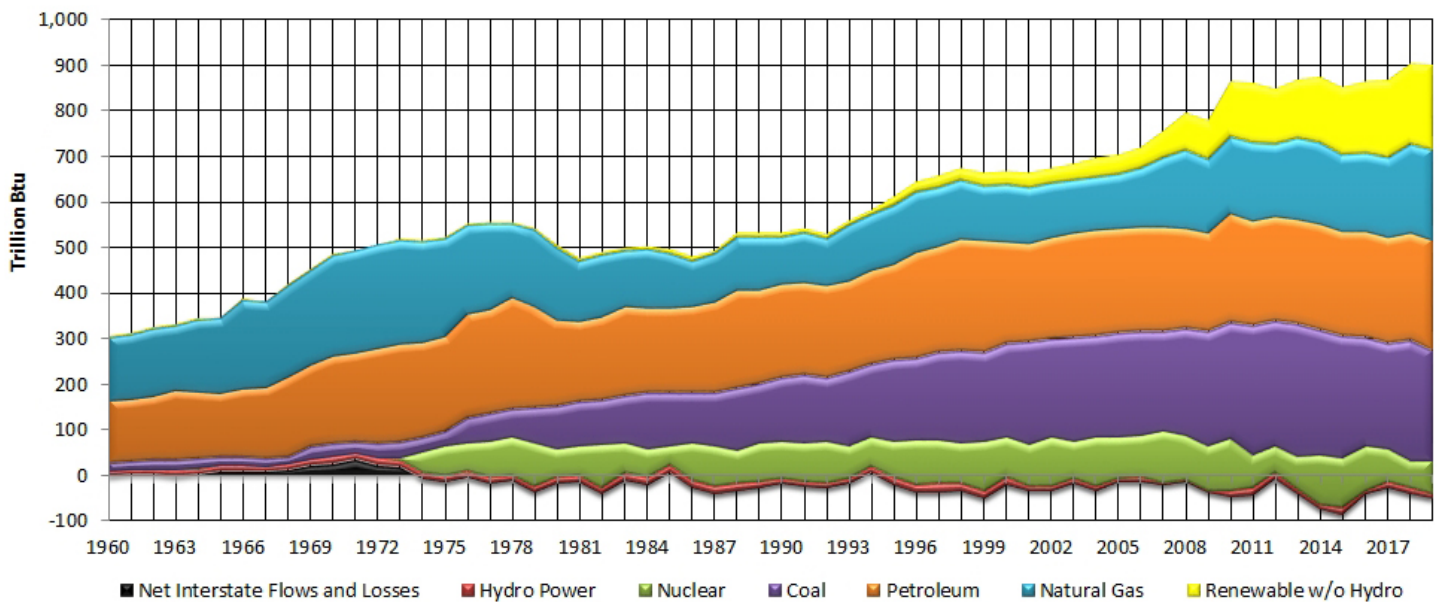
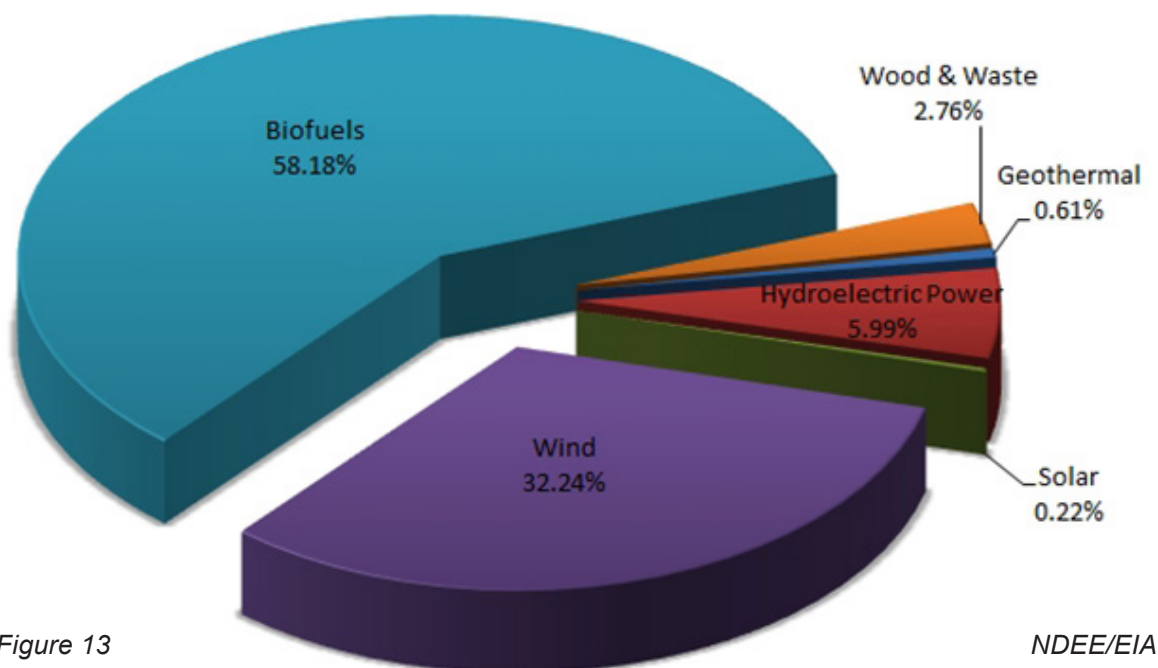


Figure 12

NDEE/EIA

Renewable Energy Produced by Fuel Type in Nebraska 2019



Agricultural 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.

According to the USDA Farm Production Expenditures 2020 Summary, in 2020, fuel accounted for 3.0% of total farm production expenditures in the U.S and 2.3% of total farm production expenditures in Nebraska. 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 then-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.

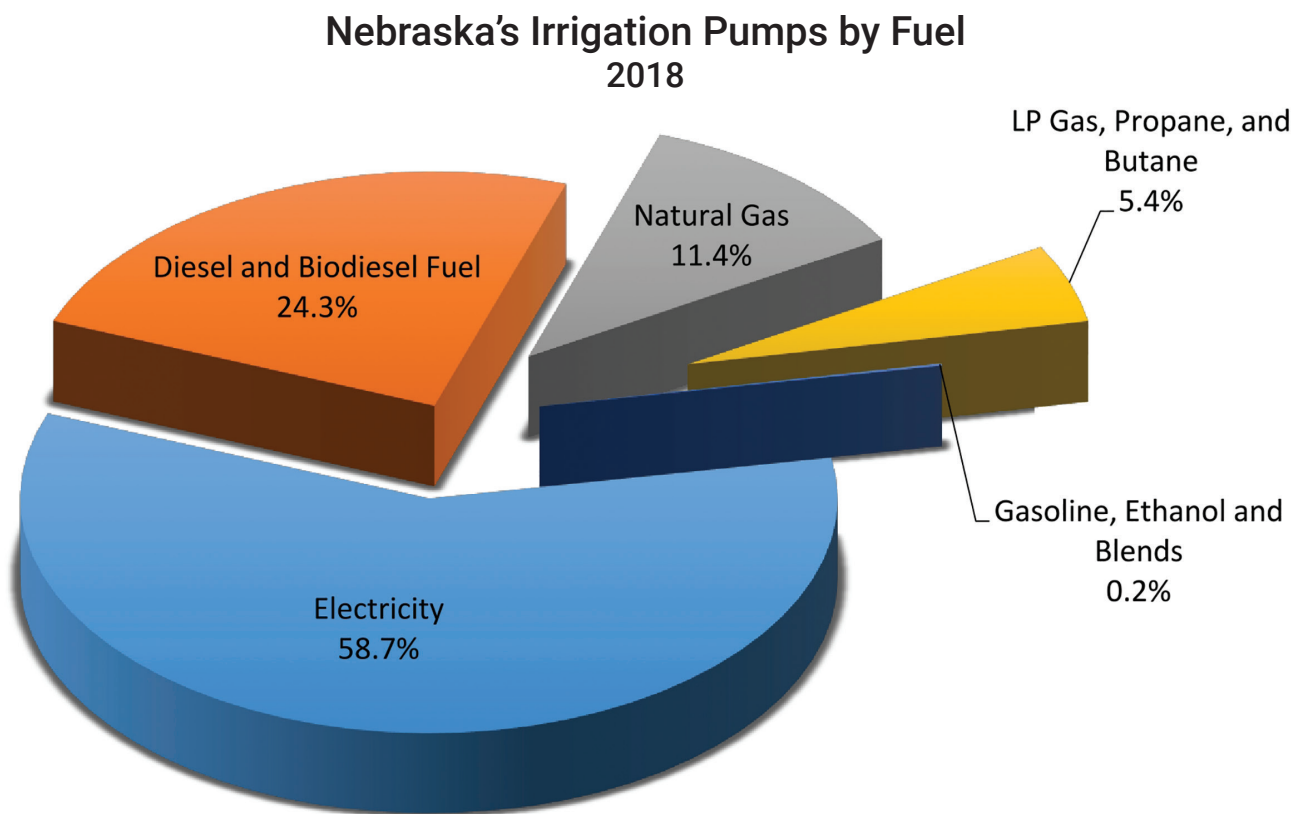


Figure 14

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 fuels equipment 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 2020, that number was 9.35 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 latest 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 use of diesel fuel and propane for irrigation has been declining over the last decade as farmers switch to electric power. Farmers can receive financial aid for these conversions from their local electric utility, through the USDA Rural Energy for America Program, and from NDEE's Clean Diesel Rebate Program (see the next section).



Nebraska irrigated 9.3 million acres in 2018—more than triple the 3.1 million acres irrigated in 1966. Diesel and electricity power most of the irrigation in the state (Figure 14).

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% (up to \$20,000) of the cost of conversion, including the electric motor and other equipment, installing the motor and connecting it to electrical service. As of June 2021, 100 diesel-to-electric conversions were completed or were near completion. These conversions will reduce annual air pollutant emissions by 38.3 tons of nitrogen oxide and 13.1 tons of carbon monoxide.

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 sixth 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

2019

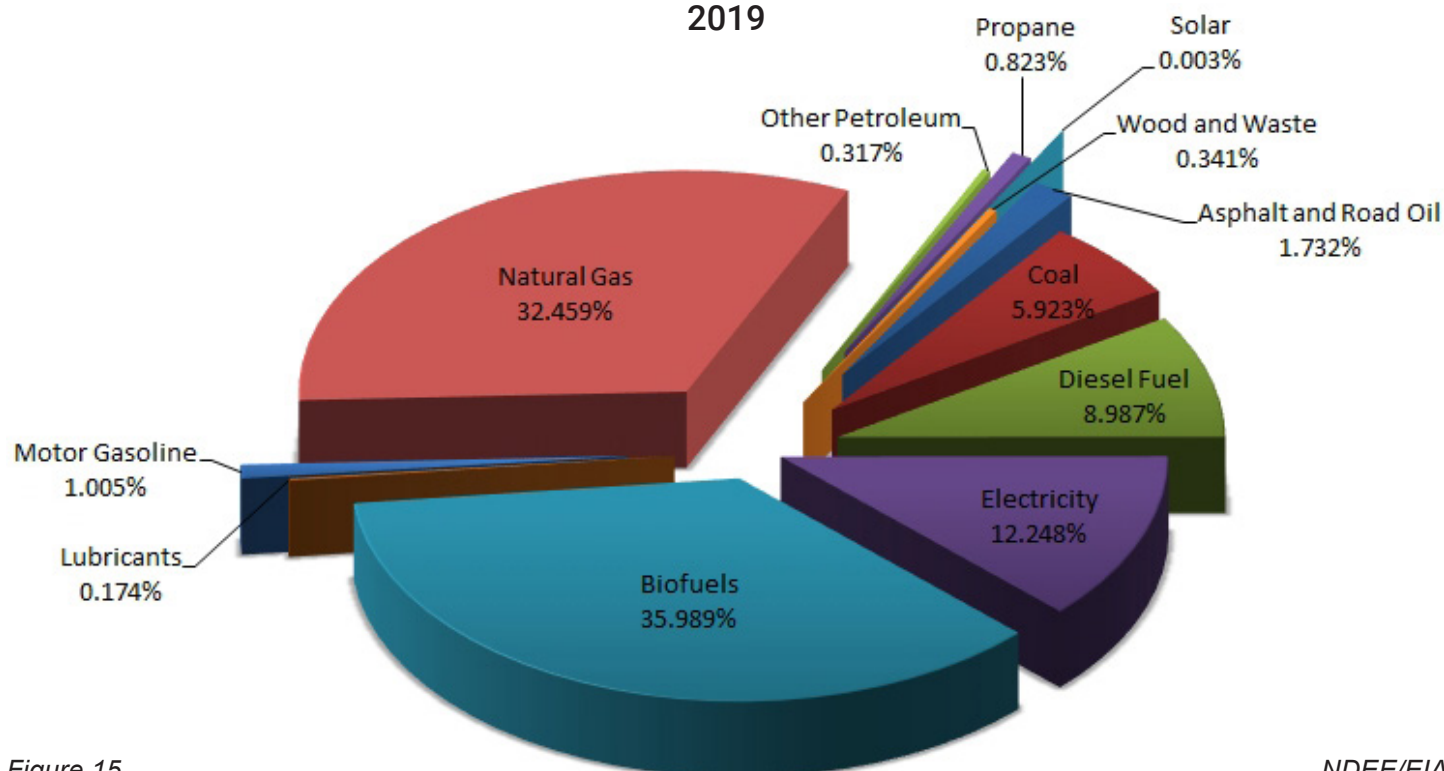


Figure 15

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 2019. 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 19.88 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 2019, rising from 14.01 trillion Btu to 26.59 trillion Btu. Gasoline consumption dropped by nearly 74% from 11.27 trillion Btu in 1960 to 2.97 trillion Btu in 2019. Looking at Figure 16, electricity use in this sector increased nearly twelve-fold from 3.03 trillion Btu in 1960 to 36.23 in 2019.

Energy Demand

The industrial sector made up 42% (376.1 trillion Btu) of the state's energy consumption in 2019 (Figure 11). Figure 16 shows a 1.1% decrease in consumption between 2018 and 2019.

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 in 2019, industrial was the largest energy-using sector at 376.1 trillion Btu, surpassing the transportation sector by 169.2 trillion Btu.

Overall, energy needs in the industrial sector are subject to the ebb and flow of 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.

Nebraska's Net Energy Consumption by Fuel Type in the Industrial Sector 1960-2019

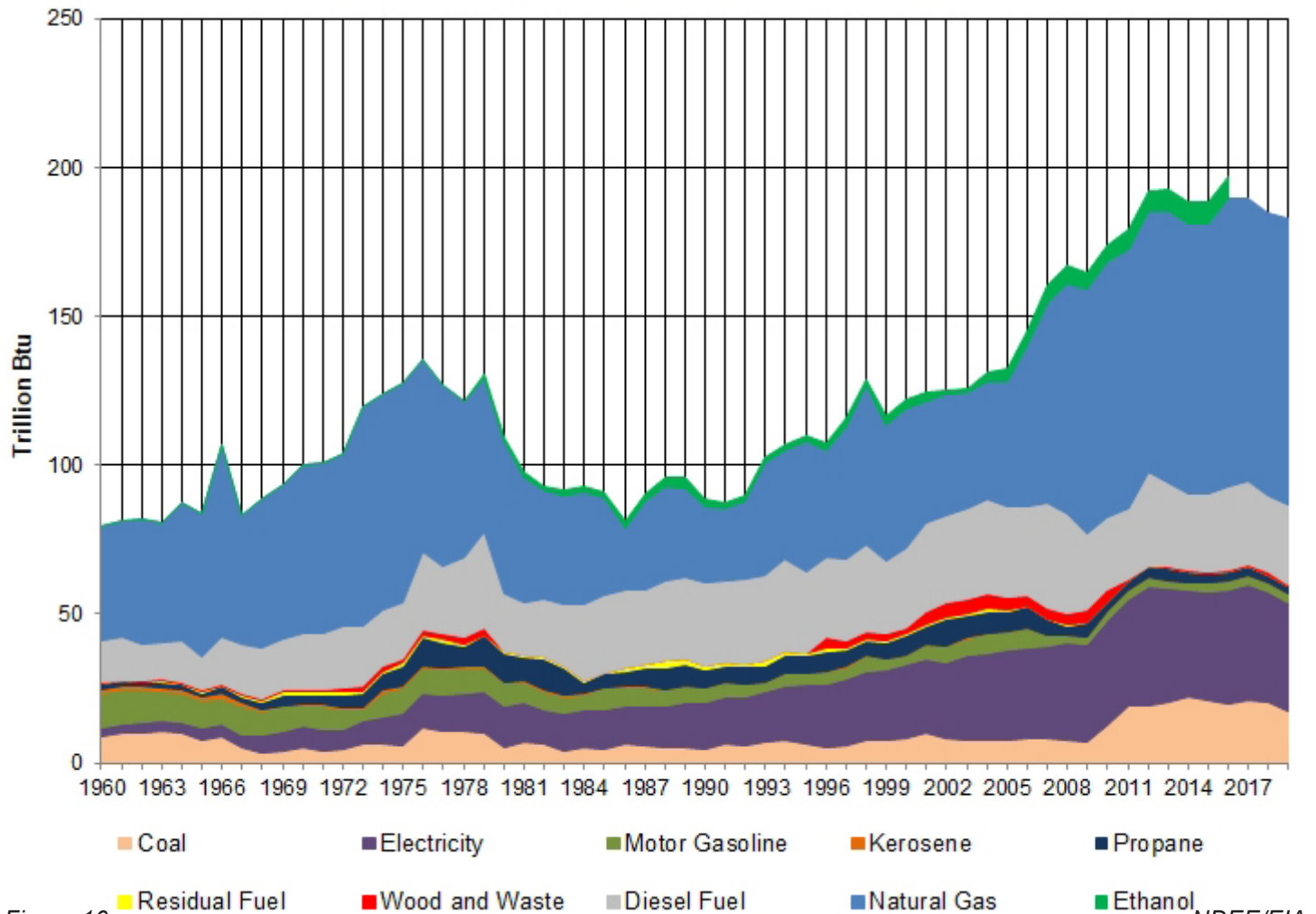


Figure 16

NDEE/EIA

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 59 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 91% of all fuel used in the commercial sector in 2019 (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

2019

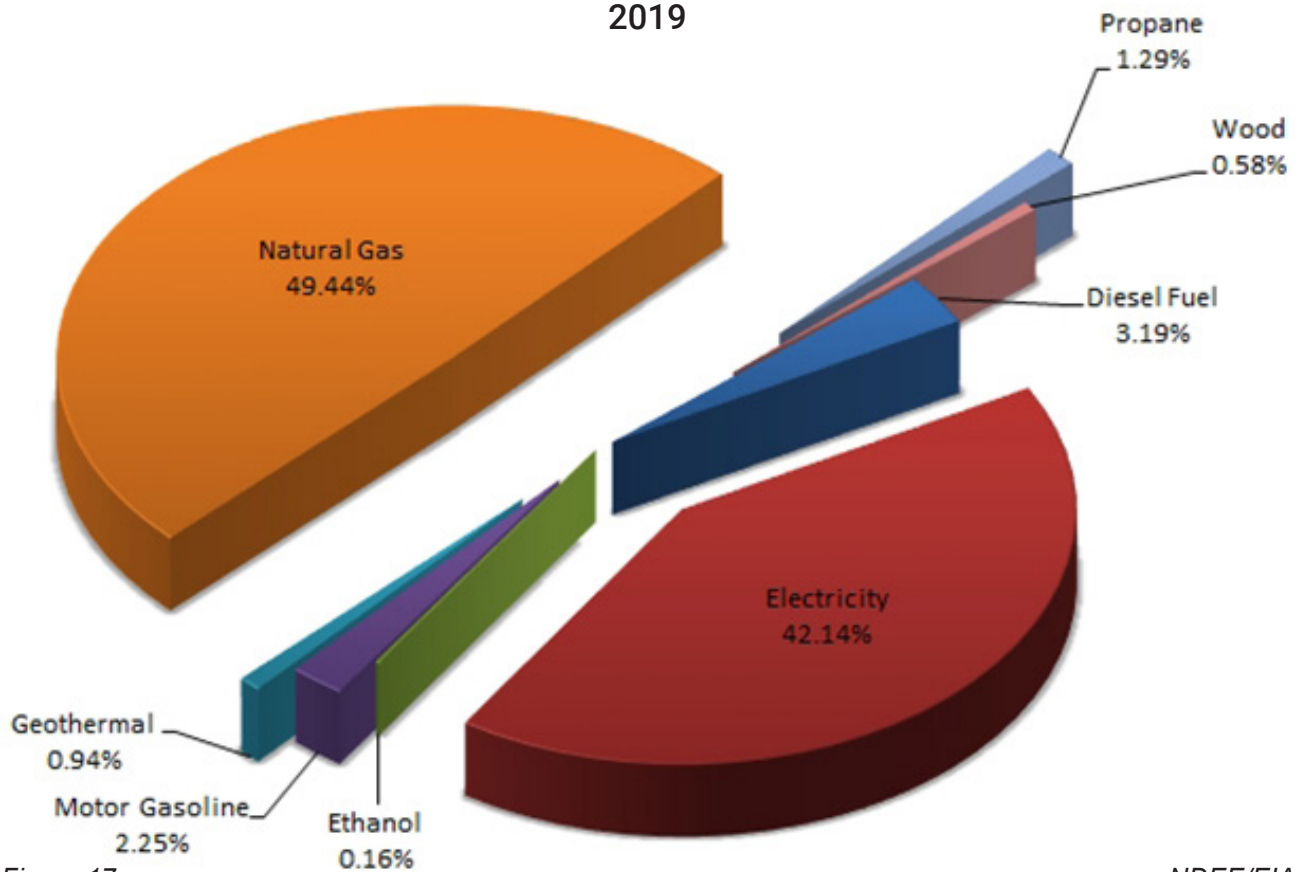


Figure 17

NDEE/EIA

Energy Demand

According to the EIA, 148.3 trillion Btu of energy were consumed in the sector in 2019, up 0.6% (or 0.8 trillion Btu) from 147.5 trillion Btu in 2018. This sector accounts for 16.47% 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 2019, the amount of energy used in this sector more than tripled to 148.3 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
1960-2019**

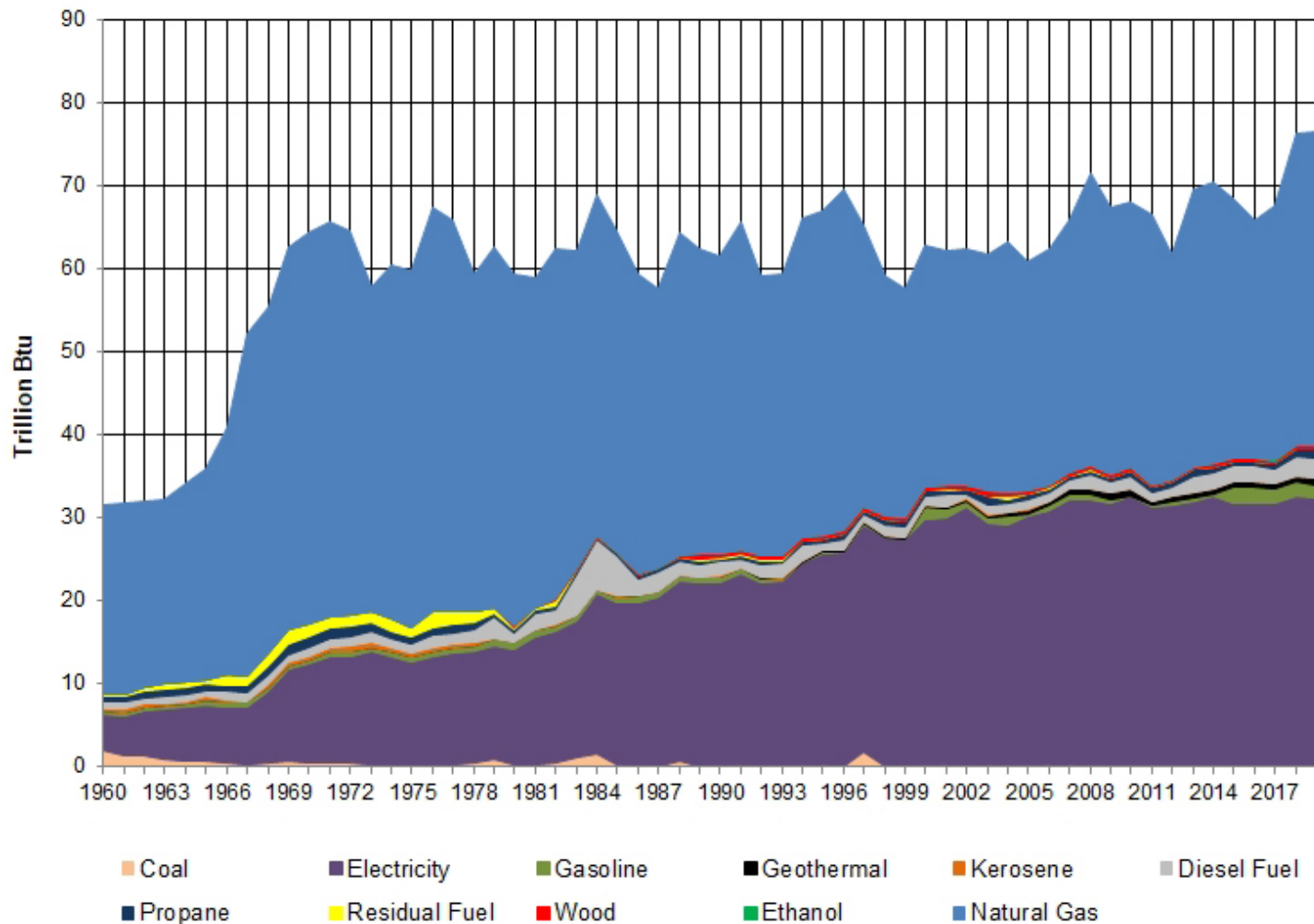


Figure 18

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

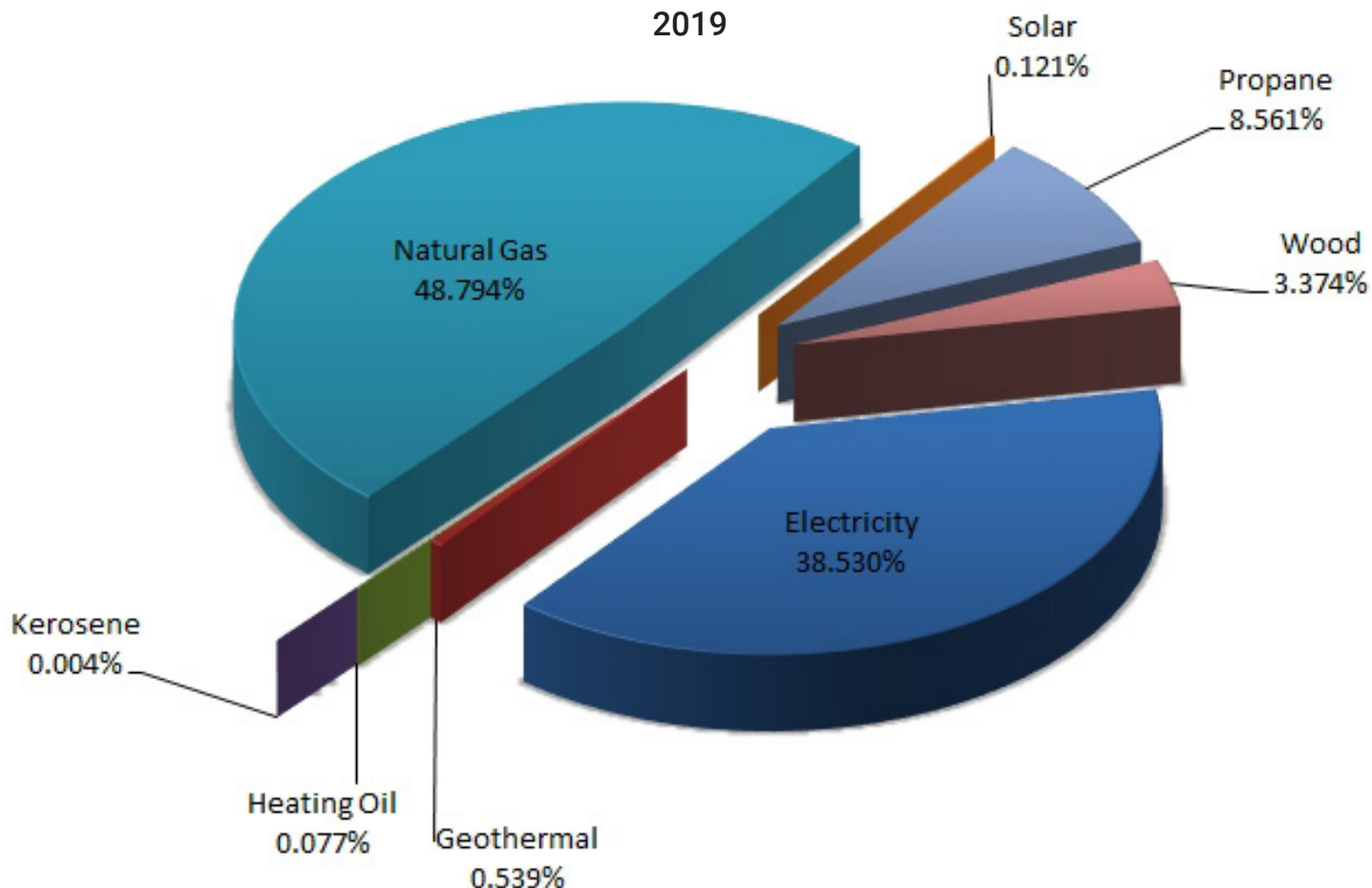


Figure 19

NDEE/EIA

Energy Supply

As shown in Figure 19, in 2019 the residential sector's energy needs were met by:

- Natural gas — 48.794%
- Electricity — 38.530%
- Petroleum — 8.642%
- Renewable energy — 4.034%

Supply trends and fuel types used in the residential sector have not changed substantially over 59 years of data collection.

Energy Demand

In 2019, the residential sector accounted for 19% of the state's total energy demand (Figure 11). Residential demand increased by 0.8% from 167.9 trillion Btu in 2018 to 169.2 trillion Btu in 2019. Petroleum use increased 19.1% from 2018 and renewable energy use increased 8.9%. Natural gas use decreased 0.85% and electricity use decreased 1.0% from 2018. 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.

**Nebraska's Net Energy Consumption by Fuel Type
in the Residential Sector
1960-2019**

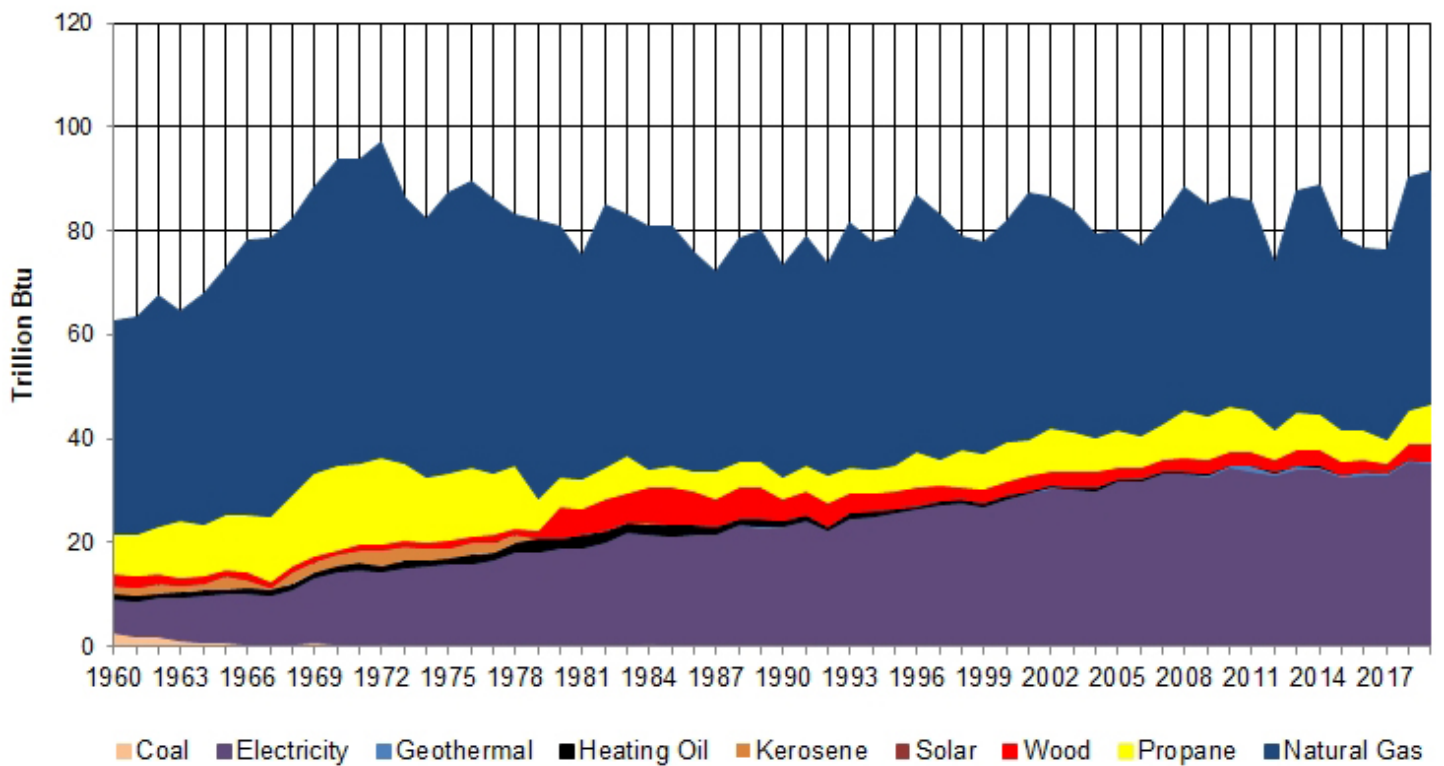


Figure 20

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 2019 (Figure 11).

Energy Supply

In 2019, 93% of energy used in transportation—192.37 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 7.58 trillion Btu and biofuels at 6.95 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 2019 (Figure 22).

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

2019

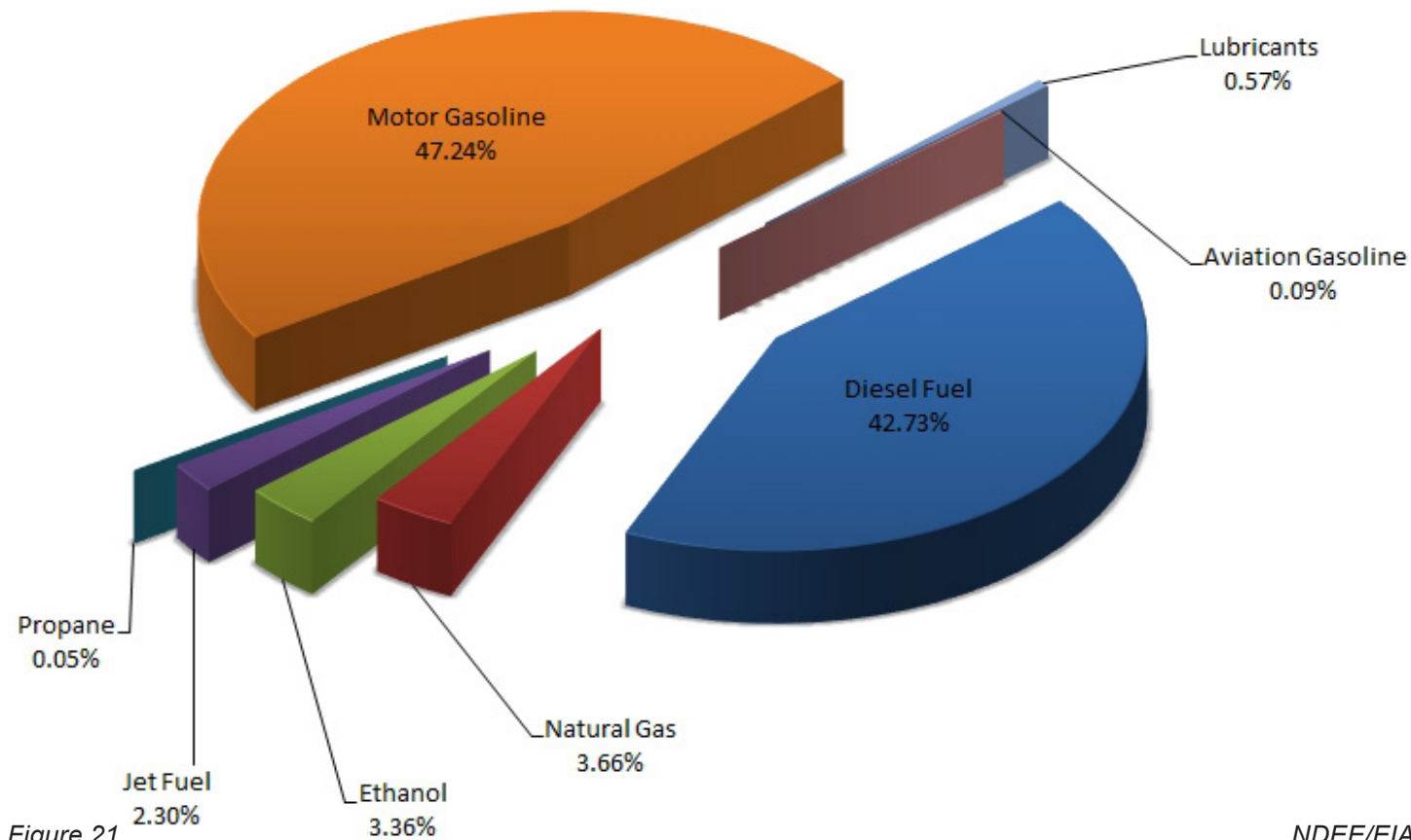


Figure 21

NDEE/EIA

Nebraska's Net Energy Consumption by Fuel Type in the Transportation Sector 1960-2019

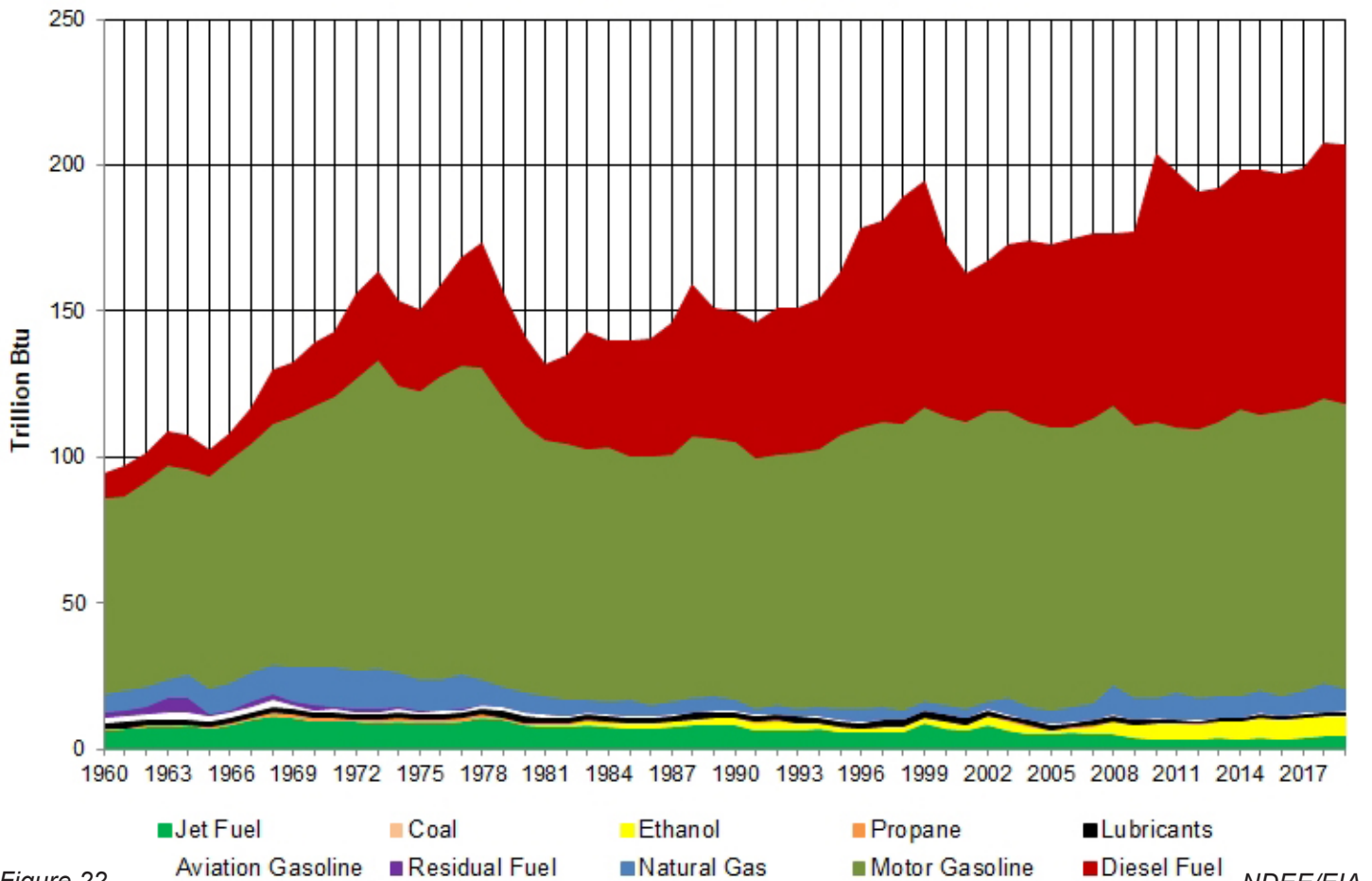


Figure 22

Energy Demand

The transportation sector used 206.9 trillion Btu—nearly one-fourth—of the state’s energy consumption in 2019 (Figure 11). The decrease in demand from 2018 to 2019 totaled 0.27 trillion Btu, a decrease of 0.13%.

In 1960, the transportation sector was the largest energy-using sector at 94.2 trillion Btu, 30.6% of consumption of all sectors. By 2019, the industrial sector eclipsed the transportation sector as the largest energy user.

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 (12.029 billion miles) to 2020 (19.38 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 for Automotive Innovation Electric Vehicle Sales Dashboard, as of September 2021, there were 2,261 battery electric vehicles (BEVs) and 1,814 plug-in hybrid electric vehicles (PHEVs) registered in Nebraska. However, according to the same source, the electric vehicle market share in Nebraska was 0.32% for BEVs and 0.24% for PHEVs in that month.

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 203.8 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 190.6 trillion Btu. Since then, lower prices at the pump have resulted in gradually rising transportation sector demand, reaching 206.9 trillion Btu in 2019.

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.

Vehicle Miles Traveled in Nebraska 1978-2020

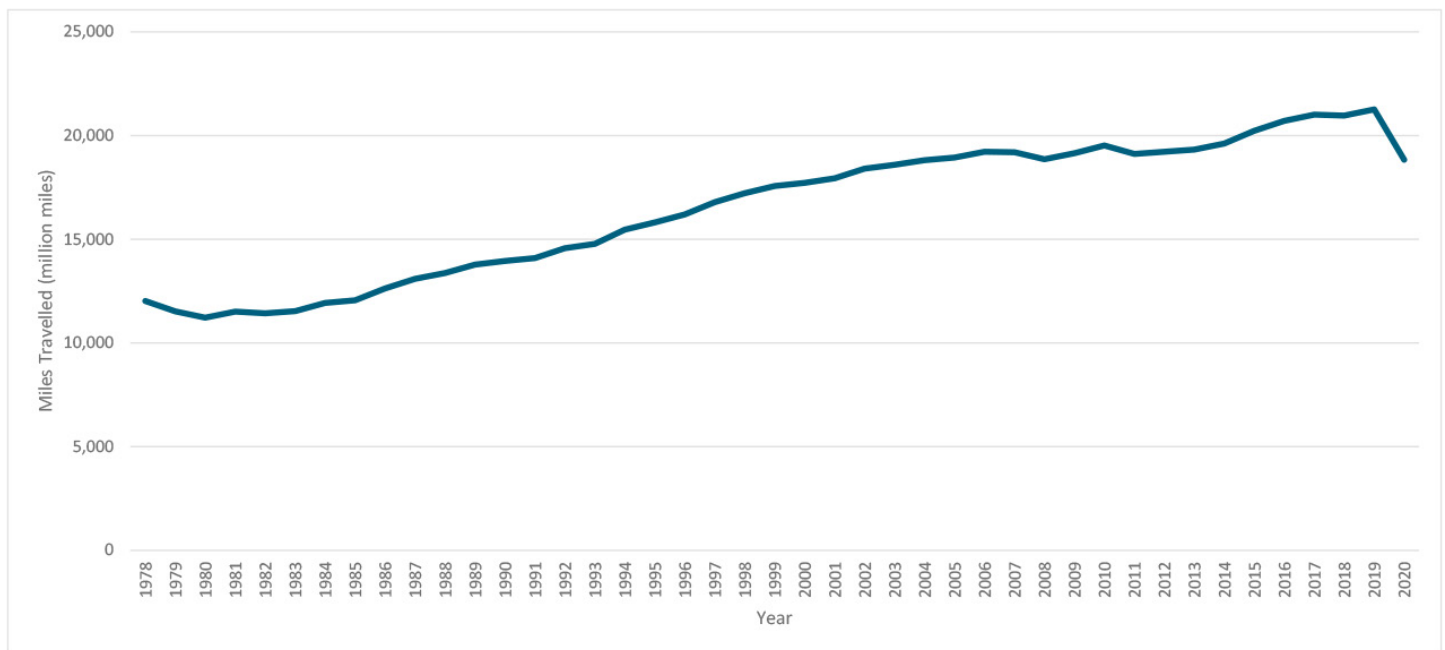


Figure 23

NDEE/Nebraska Department of Transportation

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.

Energy Supply

Looking at Figure 24, in 2019, 58% of the electric power energy feedstocks came from coal. The next most used fuels in this sector were nuclear (18.81%) and wind (16.64%). Two lesser fuel sources supplied nearly all of the remainder:

- hydroelectric power — 3.09%
- natural gas — 3.35%

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. Most of these utilities are members of the Southwest Power Pool (SPP), a regional transmission organization that oversees the electric grid in all or parts of fourteen states stretching from north Texas to North Dakota. Within that area SPP balances electric supply and demand (load-balancing) to ensure that there is sufficient generation to meet current demand and to maintain adequate power reserves. Membership in SPP allows Nebraska utilities to sell excess energy into the market and to share costs of projects that improve the reliability of the grid.

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 59 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.

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

2019

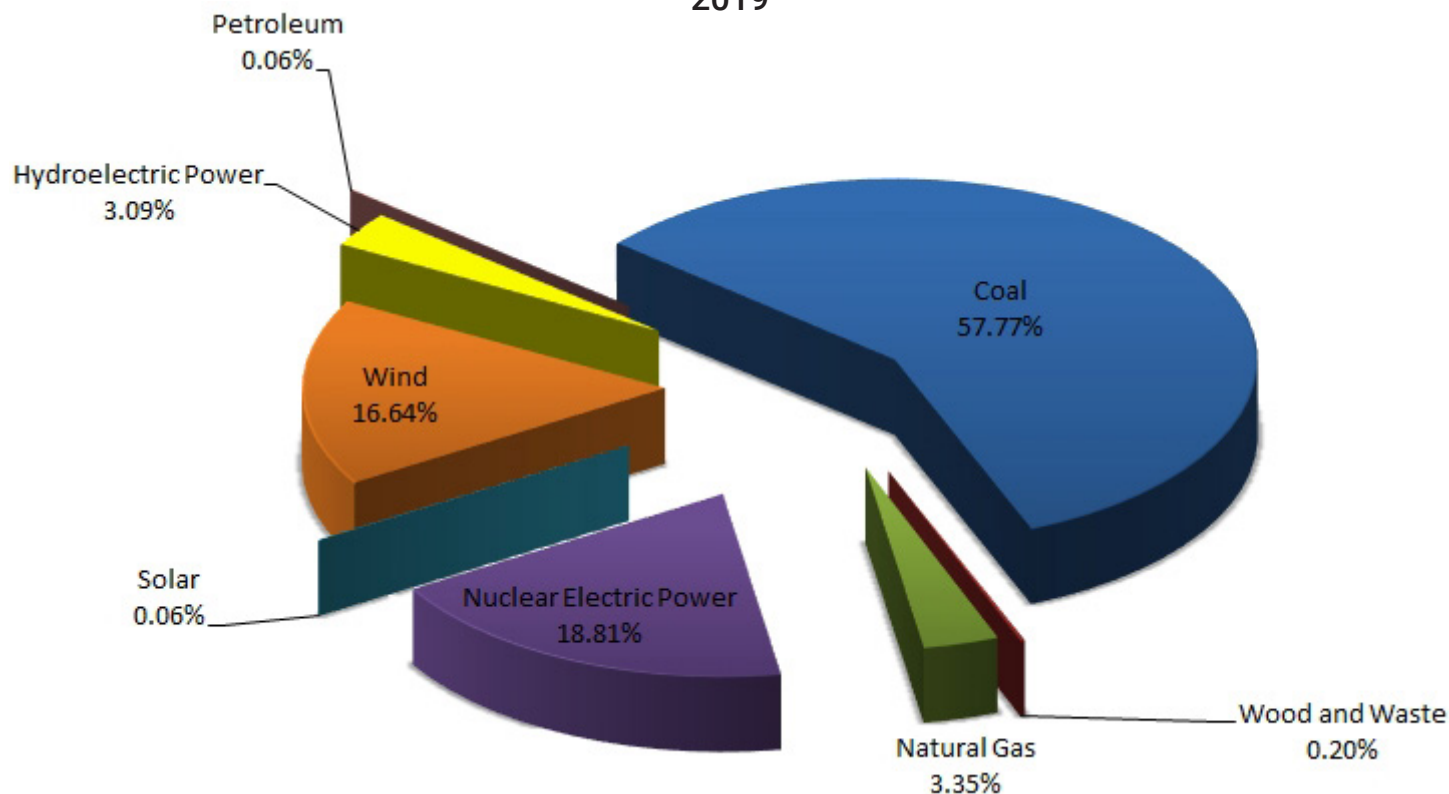


Figure 24

Among the changes in fuel used to generate electricity in 2019 were increased use of wind, petroleum, nuclear, solar energy, and natural gas along with reductions in coal, hydroelectric power, and wood and waste.

The demand in the state's electric power sector in 2019 totaled 385.9 trillion Btu, an increase of 2.5% from 2018 demand.

Electricity purchases generated by hydroelectric power for use by Nebraska utilities from the Western Area Power Administration in 2019 totaled 1.968 billion kWh at an average price of three cents per kWh. The total cost of the power purchased in 2019 was \$57.2 million. In 2019, the amount of power provided from Western Area Power Administration met 6.5% 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 2019, electricity exports varied from a low of 9.4% of generation in 1994 to a high of 26.1% in 2015. In 2019, electricity exports were 18.5% of generation. This was an increase of 2.2% from 2018.

February 2021 Polar Vortex and Rolling Blackouts

A severe winter storm and a southward shift in the polar vortex produced extremely cold temperatures in the central and Midwestern United States from February 14 to 17, 2021. The cold temperatures affected the entire territory of the Southwest Power Pool, led to winter-record electricity demand, and simultaneously reduced the system's capacity to produce electricity. For the first time in its 80-year history, SPP was forced to instruct its member utilities to institute controlled rolling outages to reduce demand and prevent catastrophic system failure. The outages were limited to periods of less than a few hours on February 15 and 16. Some areas of Nebraska experienced these outages, even though Nebraska electric utilities were generating sufficient power to meet local demand.

Electric generating facilities of all types in the southern part of the region were impacted by the cold weather, including fossil fuel plants, nuclear, and wind facilities. Certain generating facilities were not sufficiently weatherized and were unable to operate because of the cold affecting valves, pipes, and other equipment. Natural gas wells and pipelines in Texas and Oklahoma were incapacitated due to the cold, cutting supplies to electric generating stations that rely on natural gas. Some coal-fired plants could not operate because of frozen coal piles. Winds were also light during much of the storm period, reducing wind generation capacity.

SPP and federal regulating commissions have analyzed the February events and have outlined steps to be taken to increase the reliability of the electric grid against future extreme cold weather events.

Nebraska's Net Energy Consumption by Fuel Type in the Electric Power Sector 1960-2019

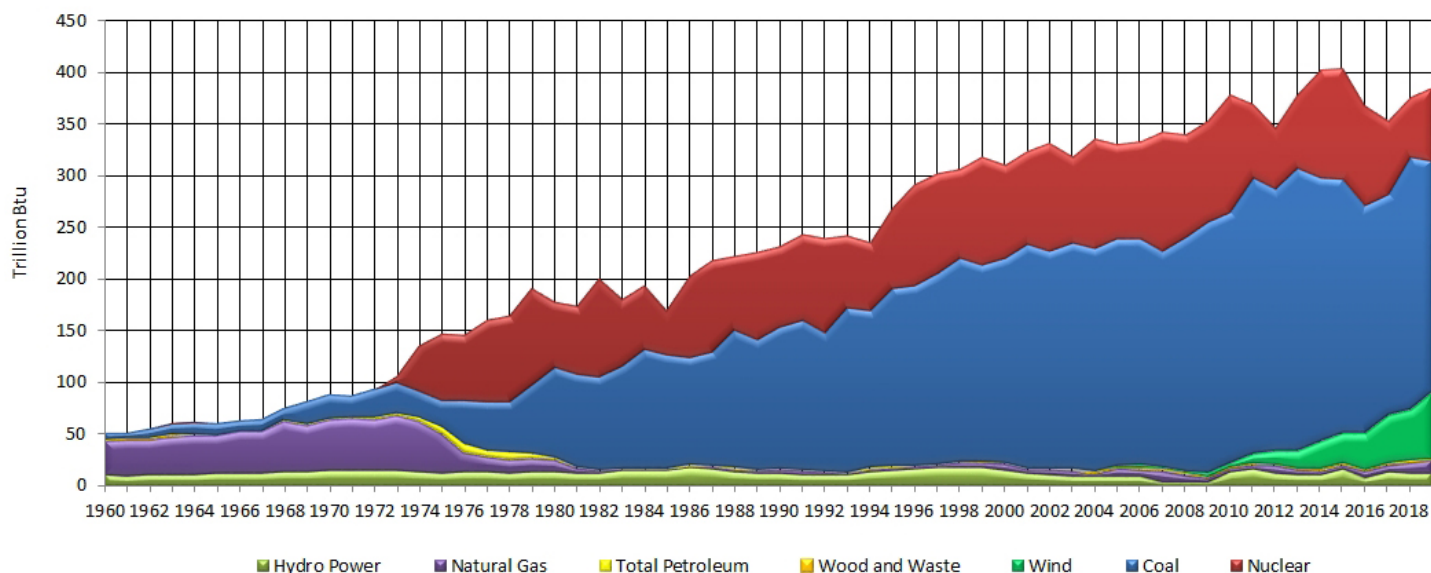


Figure 25

NDEE/EIA

Conclusion

Few areas are changing at the rapid pace of our energy supplies and related demand. Thankfully, Nebraska has maintained a reliable mix of diverse energy resources. Coal, nuclear, natural gas, and renewable resources are all a part of powering our state. 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 199.3 trillion Btu between 1960 and 2019 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 needs 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.