2022 Annual State Energy Report

NEBRASKA

DEPT. OF ENVIRONMENT AND ENERGY

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Introduction

The Nebraska Department of Environment and Energy (NDEE) had another successful year administering the State Energy Program (SEP) and the Weatherization Assistance Program (WAP). This Annual Energy Report gives an overview of these energy programs and others along with a current view of Nebraska's energy profile and energy supply, demand and conservation efforts for fiscal year 2022.

In addition to administering the long-standing and successful Dollar and Energy Saving Loan and WAP programs and the Nebraska State Energy Code, NDEE also took part in the State Energy Program's Nebraska Energy Security Initiative, which helps state emergency managers ensure energy resiliency during an emergency.

Dollar and Energy Saving Loan Program
The Dollar and Energy Saving Loan Program has helped tens of thousands of Nebraska residents, local businesses, school districts, and municipalities make their homes and buildings more energy efficient. In turn, these projects have helped loan recipients reduce their energy bills by providing low-cost financing for energy efficient equipment and improvements.

Since the inception of the program in 1990, the DESL program has helped finance over 30,000 energy saving projects with the total cost of all improvements financed totaling over $385.5 million.

DESL project highlights for fiscal year 2022 include:

- Lighting and heating, ventilation, and air conditioning (HVAC) projects for three public school districts totaling over $1.7 million, including a $1.2 million project for Wynot Public Schools.
- Seventeen new solar installations totaling over 715 peak kilowatt hours, including six largescale agricultural projects and three commercial projects totaling over $1.2 million.
- A new energy efficient home in Gibbon totaling $265,000.
- Insulation for a renovation project in downtown Emerson totaling $32,000.

Weather Assistance Program
The Weatherization Assistance Program provides funding for low-income families to weatherize their homes and reduce their energy bills. Between July 1, 2021, and June 30, 2022, 340 homes were weatherized across the state, helping to reduce the energy burden for low-income Nebraskans.

Nebraska Energy Security Initiative
In the first half of 2022, NDEE developed Local Energy Security Plans for eight Planning, Exercising, and Training (PET) regions in Nebraska. The plans aid local officials and emergency managers by increasing their jurisdictions' energy resiliency. The plans identify regional energy suppliers, primary contacts, and key assets; and the plans develop an energy assurance crisis communications protocol. The plans' development is part of the U.S. DOE State Energy Program's Nebraska Energy Security Initiative to address assurance and security concepts within the existing framework of emergency management and homeland security.

This Annual Energy Report contains additional information about the DESL and WAP programs, as well as information on Nebraska's energy supply and demand trends by sector (agricultural, commercial, electric power, industrial, residential and transportation). Statute requires NDEE to submit separate reports on environmental and energy issues. This report addresses the energy requirement.

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 three sources:

- $3,212,492 from the Low-Income Home Energy Assistance Program (LIHEAP)
- $3,019,814 from the U.S. Department of Energy's (DOE) Weatherization Assistance Program
- $100,000 from State General Funds

The Nebraska Department of Health and Human Services annually transfers 10% 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 $600,000 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, 2021, and June 30, 2022, 388 homes were weatherized and 144 HCRRA units were completed with these funds.

Energy and Assistance Division Investment in the Weatherization Assistance Program July 2021- June 2022	
Investment (federal Funds)	$ 1,593,430
Energy Impacts	
Electric Dollar Savings (present discounted value)	$ 120,525
Natural Gas Dollar Savings (present discounted value)	$ 471,878
Annual Total Dollar Savings	$ 592,403
Present Discount Value of Future Savings	$ 613,065
Economic Impacts	
Output	$ 1,247,187
Value-Added	$ 802,688
Labor Income	$ 702,488
Job-Years	19.41
Air Emission Pollutant Reductions (Pounds)	
Carbon Dioxide (CO2)	7,949,433.41
Sulfer Dioxide (SO2)	10,112.53
Nitrogen Oxide (NOX)	10,372.11
Particulate Matter <2.5 micro-meters (PM2.5)	176.00
Volatile Organic Compounds (VOC)	388.84
Particulate Matter < 10 micro meters (PM10)	282.24

Figure 1 *NDEE*

The types of improvements made through the weatherization program are determined based on the energy audit analysis completed on each home and the type of home construction. Weatherization costs per house averages between $5,000 and $8,000 per home, excluding the cost of health and safety improvements such as furnace repairs or replacements. 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). 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, $225 million has been spent to make energy efficiency improvements in 70,714 homes.

Total Nebraska Homes Weatherized by Area Providers
July 2021 - June 2022

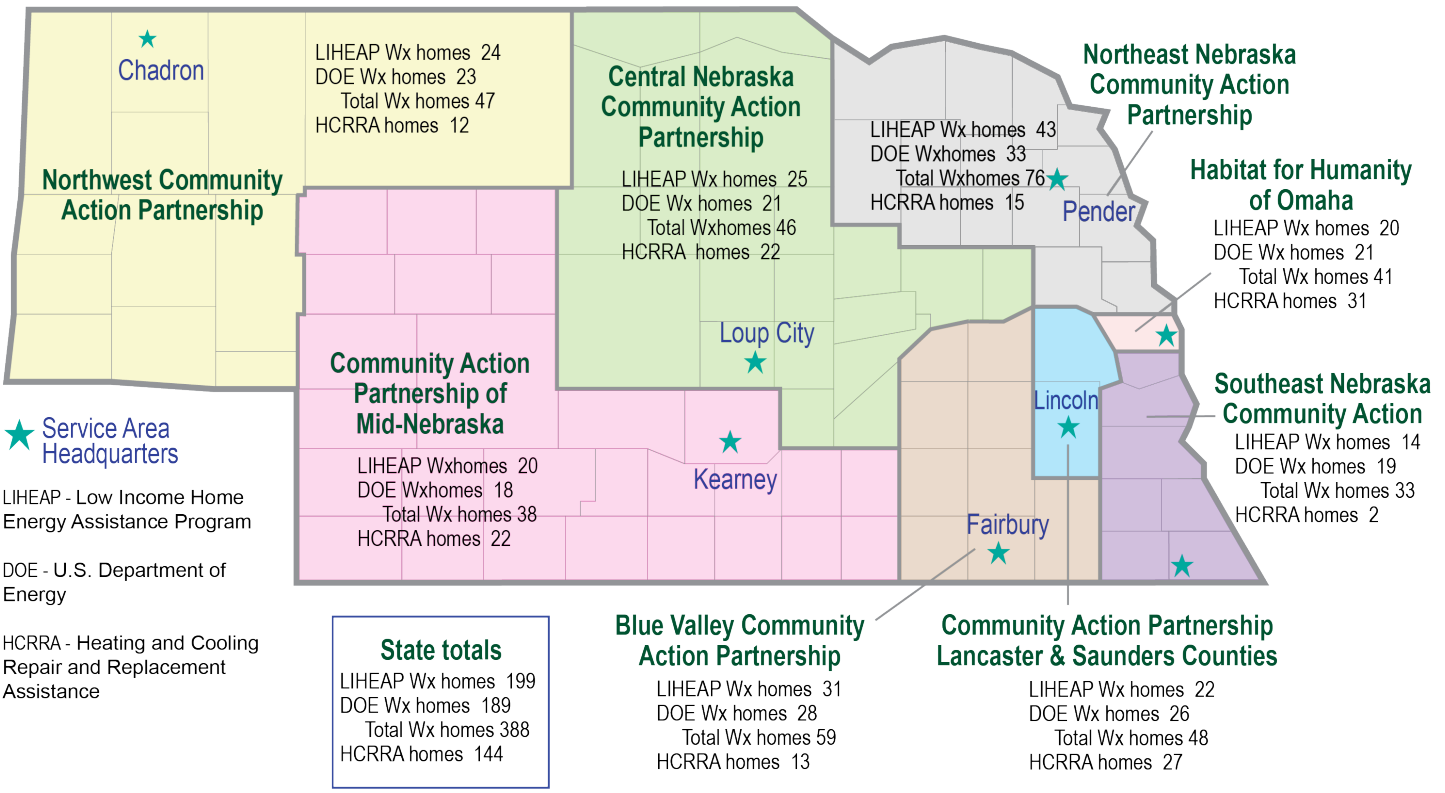


Figure 2 *NDEE*

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 2021-2022, depending on the project eligible for financing.

DESL Total Dollars Invested
(millions of dollars) 2014-2022

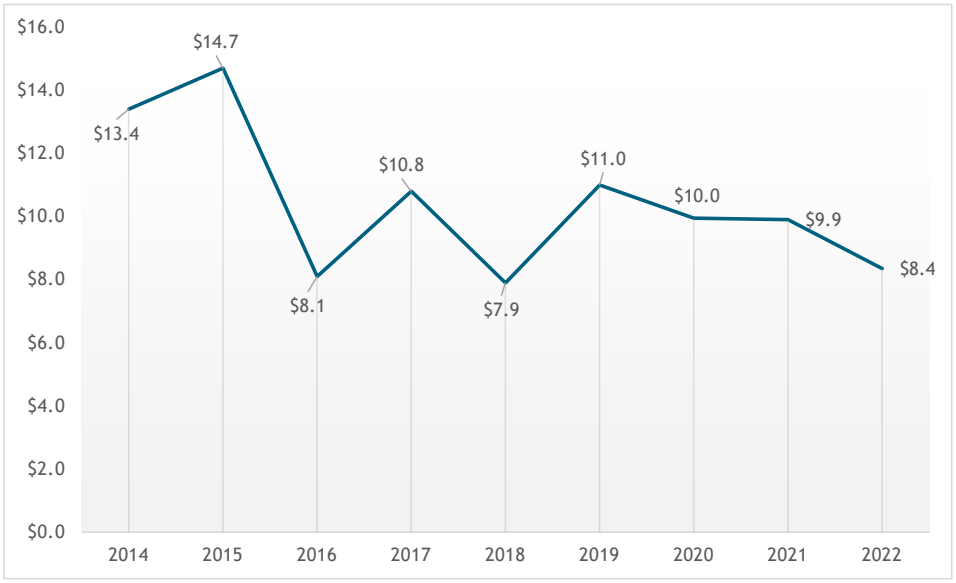


Figure 3 *NDEE*

The Nebraska Public Power District provided $500,000 to the agency's DESL Program in both March 2009 and January 2010. These funds were provided to finance 1.5% loans for air source, groundwater 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.

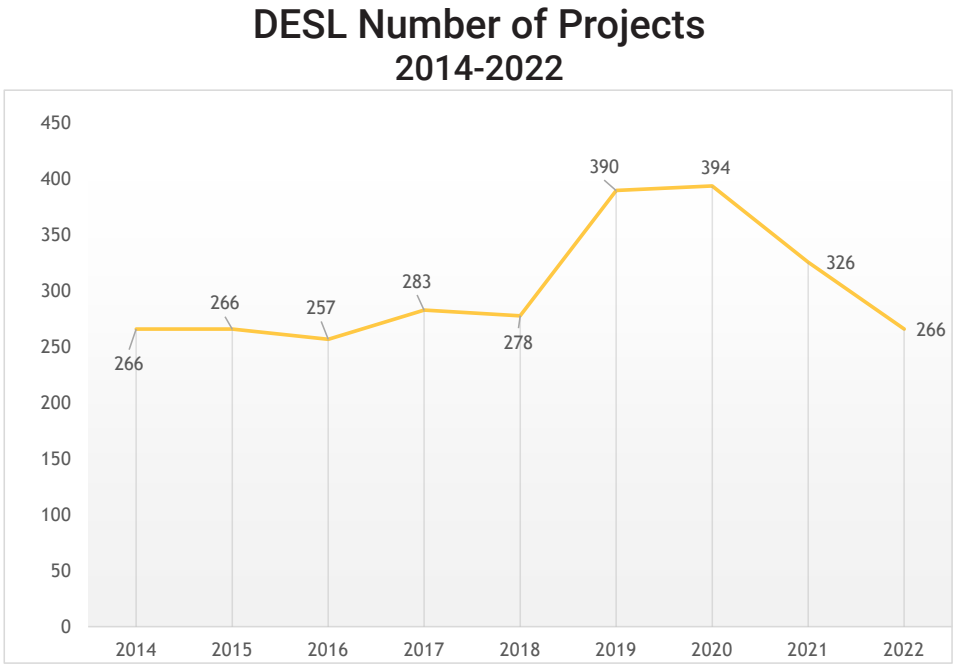


Figure 4 *NDEE*

From March 1990 to June 30, 2022, 30,663 energy saving projects totaling more than $385.5 million have been financed using low-interest loans from participating lenders and NDEE. More than $192.7 million of the $385.5 million has come from the agency's revolving loan fund. The state's participating lenders provided more than $139 million. The balance, more than $53 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 3,476 projects totaling more than $52.97 million, tops the list with the most projects. Lancaster County co-anchors the top spot with the most dollars invested at over $63 million, albeit on fewer projects—2,461. Nebraska's congressional districts saw the following number of projects:

First Congressional District — 10,785
Second Congressional District — 4,373
Third Congressional District — 15,504

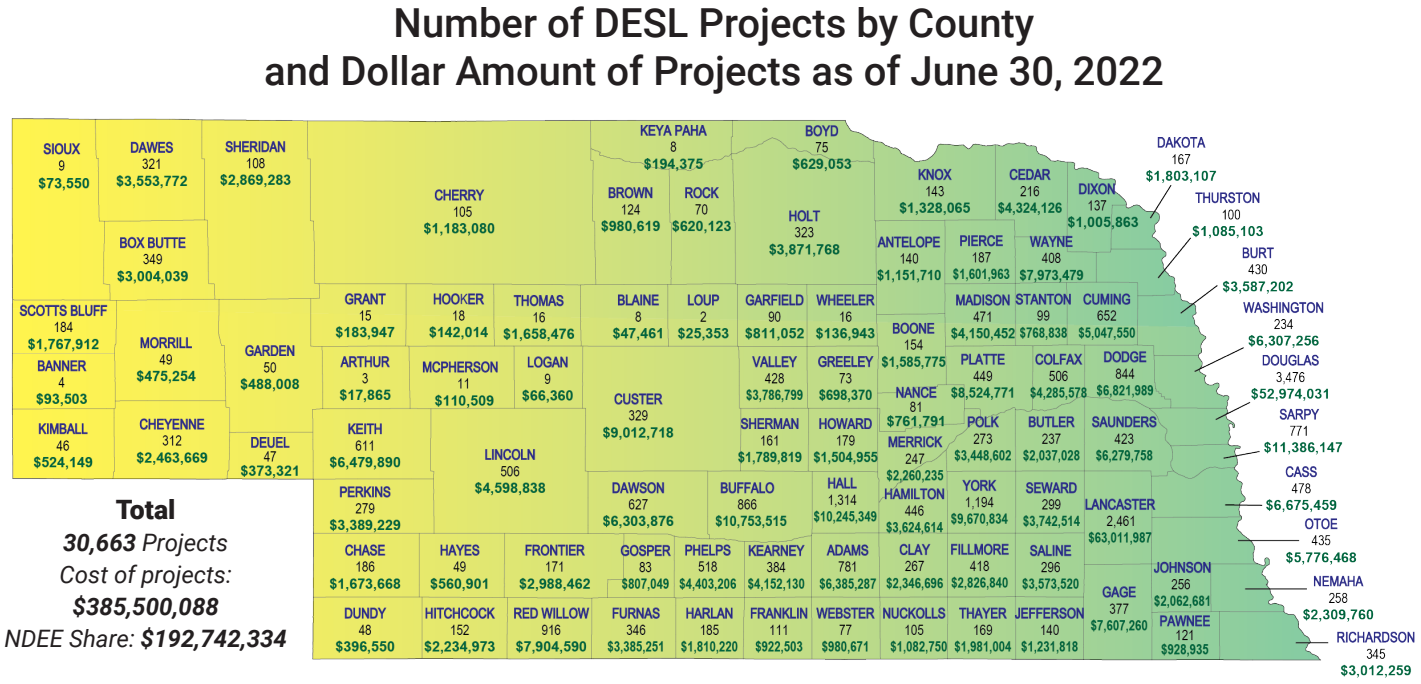
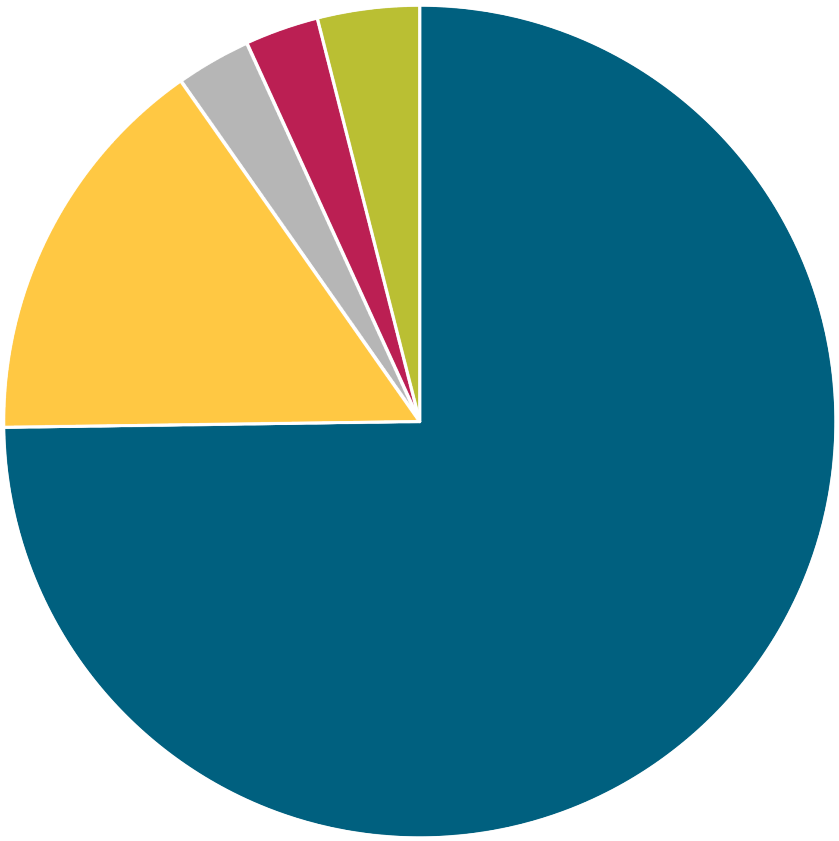


Figure 5 *NDEE*

Total DESL Funds Invested by Project Category
as of June 30, 2022



Total
Total costs of projects: **$385,500,087**
NDEE Share: **$192,742,334**
30,663 Projects

Residential
Total costs of projects: $288.266,918
NDEE Share: $137,144,851
28,516 Projects

Commercial/Industrial/ Local Government
Total costs of projects: $59,684,010
NDEE Share: $32,903,250
1,330 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: $15,274,335
NDEE Share: $10,216,853
193 Projects

Figure 6 *NDEE*

During this reporting period, 266 new projects totaling $8.35 million were financed. The number of energy efficiency projects financed since 1990 are shown in Figure 5 and total 30,663.

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 93% of all energy efficiency projects financed with loans from the agency. More than 71% of NDEE funds from all categories—$137.14 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, 28,516 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—$59.68 million—has been used to make building and system improvements in 1,330 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—$15.27 million—has been used for 193 wind, solar and fuel systems projects since 1990, ranking third highest among all loan 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. Just under 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 116 projects since 2017.

Residential Dollar and Energy Saving Loans July 2021 - June 2022	
Investment	$2,990,298
Residential Projects	225
Energy Impacts	
Electric Energy Savings (kWhs)	45,978
Natural Gas Energy Savings (therms)	37,830
Present Discount Value of Future Savings	$741,663
Present Day Value Economic Impacts	
Output	$2,752,016
Value-Added	$1,654,462
Labor Income	$1,212,155
Job-Years	31
Air Emission Pollutant Reductions (Pounds All Years)	
Carbon Dioxide (CO2)	10,409,670
Sulfur Dioxide (SO2)	4,322
Nitrogen Oxide (NOX)	10,060
Particulate Matter <2.5 micro-meters (PM2.5)	75
Volatile Organic Compounds (VOC)	165
Particulate Matter < 10 micro-meters (PM1.0)	120
Total Present Discount Value of Environmental, Comfort, Health and Safety	$635,694

Figure 7 *NDEE*

Alternate Fuel/ Telecommunications
Since 1990, nearly 3% of funds from all categories—$11.02 million—has been used for 43 alternative fuel and telecommunications projects, ranking fifth highest among all loan areas. Typical improvements in this category include conversions to 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, 2021, through June 30, 2022, are illustrated in Figure 7.

State Energy Formula Grants

In 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. (NDEE is correcting the 2021 Energy Annual Report by including State Energy Formula Grants for FY2020 here. In FY2020, NDEE received $577,510 in federal funds and supplied $115,502 in state 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 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 2022, Collaborative activities included assessing and reviewing other energy code compliance initiatives/projects in the Midwest region for beneficial replication in Nebraska.

NDEE also collaborated with the Midwest Energy Efficiency Alliance to develop educational opportunities in the Nebraska Energy Codes Training Program to provide members of the state's construction industry with a better understanding of the changes in the new state energy code, as well as help improve their understanding of the cost and savings impacts associated with Nebraska's adoption of the 2018 International Energy Conservation Code. These opportunities were expanded beyond virtual seminars to in-person classes and trainings. This included hands-on training with a variety of testing equipment, including building envelope testing and duct leakage testing. This was done with the goal of increasing the number of skilled individuals to perform these newly required tests in the field.

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 15th annual Wind and Solar Conference and Exhibition on October 25 and 26, 2022. 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. This year's conference attracted over 350 attendees, 28 exhibitors, and featured 54 speakers and moderators from the wind and solar industries.

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 Heating Oil and Propane Program

Between September 2021 and September 2022, the NDEE began its 20th 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. This sample 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 $6,755 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, 2022				
	Exxon	Stripper Well	Diamond Shamrock	Total
Funds Received	$15,504,944	$15,680,564	$359,172	$31,544,680
Interest Earned and Miscellaneous Income***	$13,463,599	$11,938,996	$265,919	$25,668,514
Total	**$28,968,543**	**$27,619,560**	**$625,091**	**$57,213,194**
Funds Budgeted	$28,968,543	$27,619,560	$625,091	$57,213,194
Low Income Designated	$0	$0	$0	$0
Uncommitted Balance	$0	$0	$0	$0

***Amount reported in prior SFY adjusted in the cumulative amount

Figure 8 *NDEE*

Financial Activity

Total energy-related expenditures for the year were $11,667,596, an increase of 4.9% from the previous year.

Energy loans accounted for 48.1% of expenditures, aid payments accounted for 42.6%, and the remaining 9.3% of expenditures were for salaries and operations.

Of the funding for these expenditures, 35.8% came from the Oil Overcharge Funds, 61.3% from federal funds, and 2.9% from state and other funds.

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

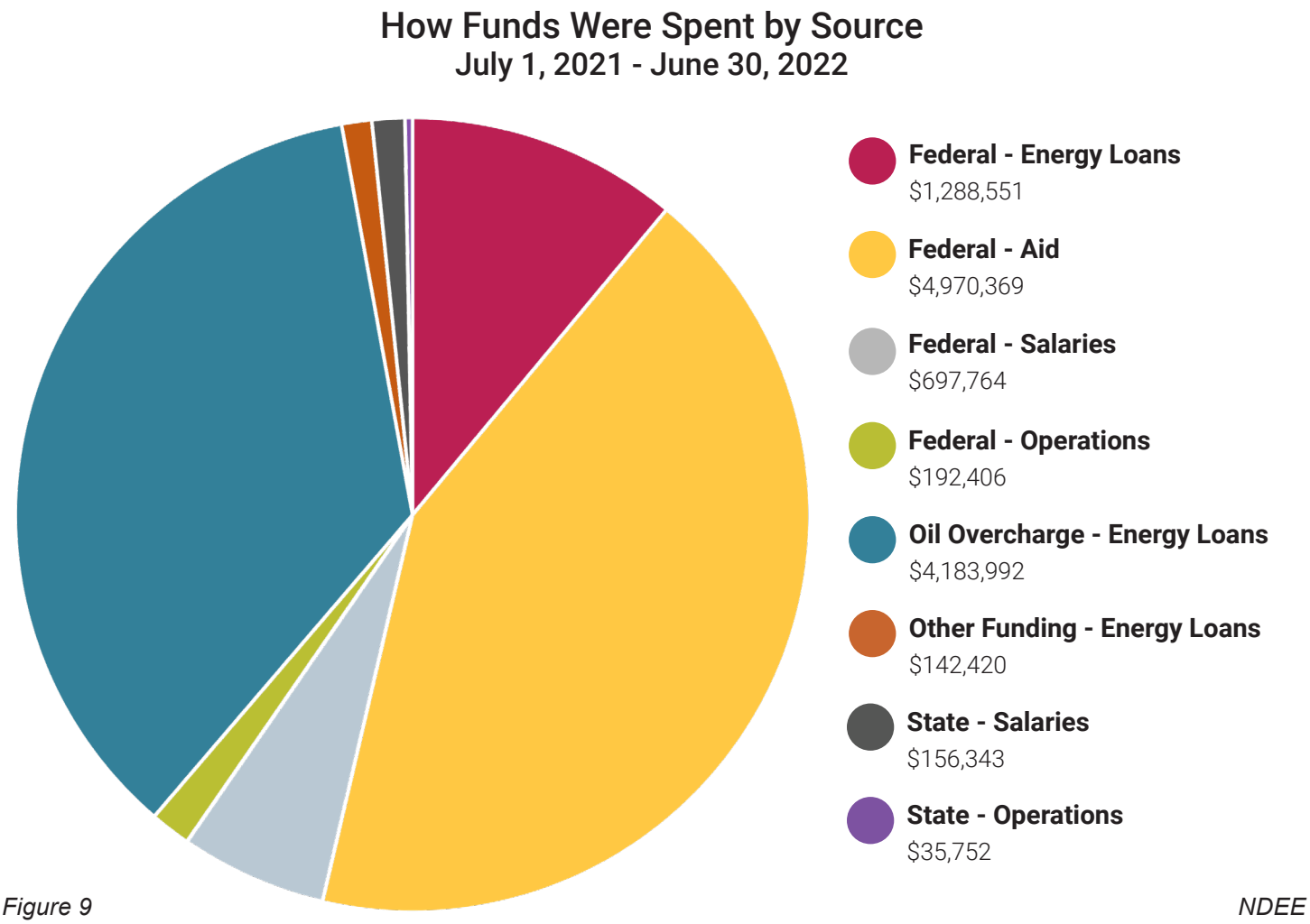


Figure 9 *NDEE*

Trends and Needs

Statewide Energy

According to the Energy Information Administration (EIA), Nebraska's total energy consumption in 2020 was 864 trillion British thermal units (Btu), a decrease of 43.57 trillion Btu—or 4.8%—from 2019 to 2020. (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 2020 as seen in Figure 10:

- Coal — 24%
- Petroleum (and products) — 25%
- Natural gas — 21%
- Renewable energy — 23%
- Nuclear power — 7%

From 2019 to 2020, the use of nuclear power, natural gas, petroleum, coal, and renewable energy decreased.
Nebraska is the only state that generates electricity entirely by publicly owned power systems. According to EIA, as of 2020, the statewide average electricity price is the 12th-lowest rate in the country at 8.97 cents per kilowatt-hour (kWh).

Figure 11 shows the amount of energy that Nebraska consumed in each sector in 2020:

- Industrial — 43%
- Transportation — 22%
- Residential — 19%
- Commercial — 16%

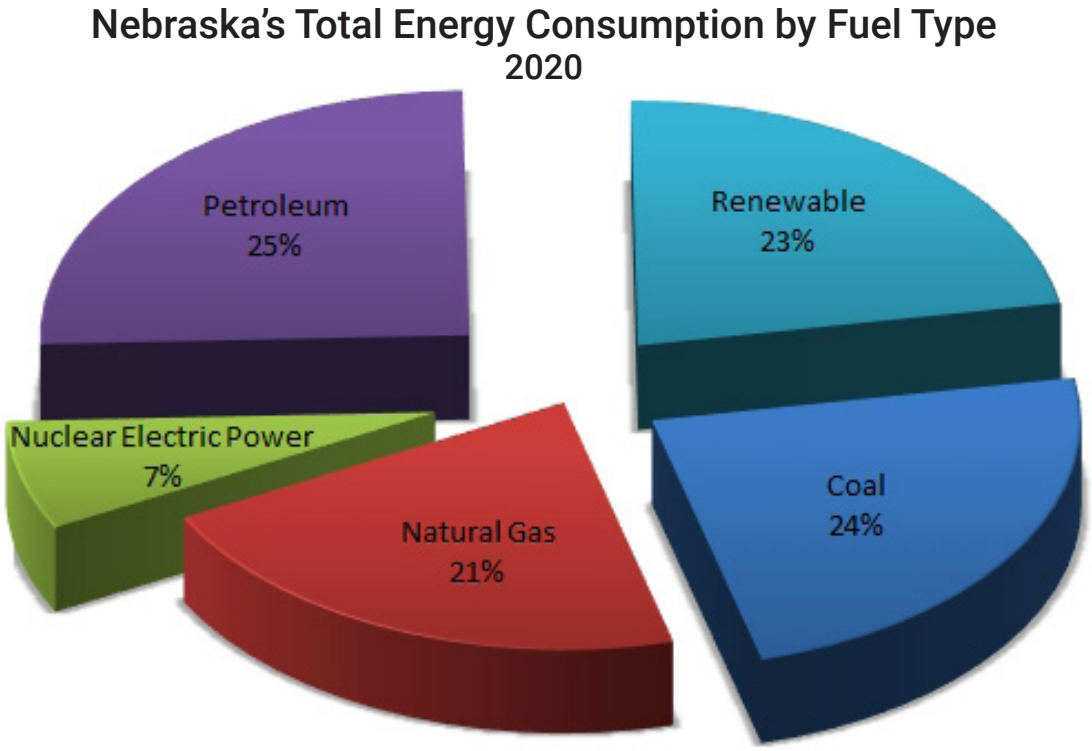


Figure 10 *NDEE/EIA*

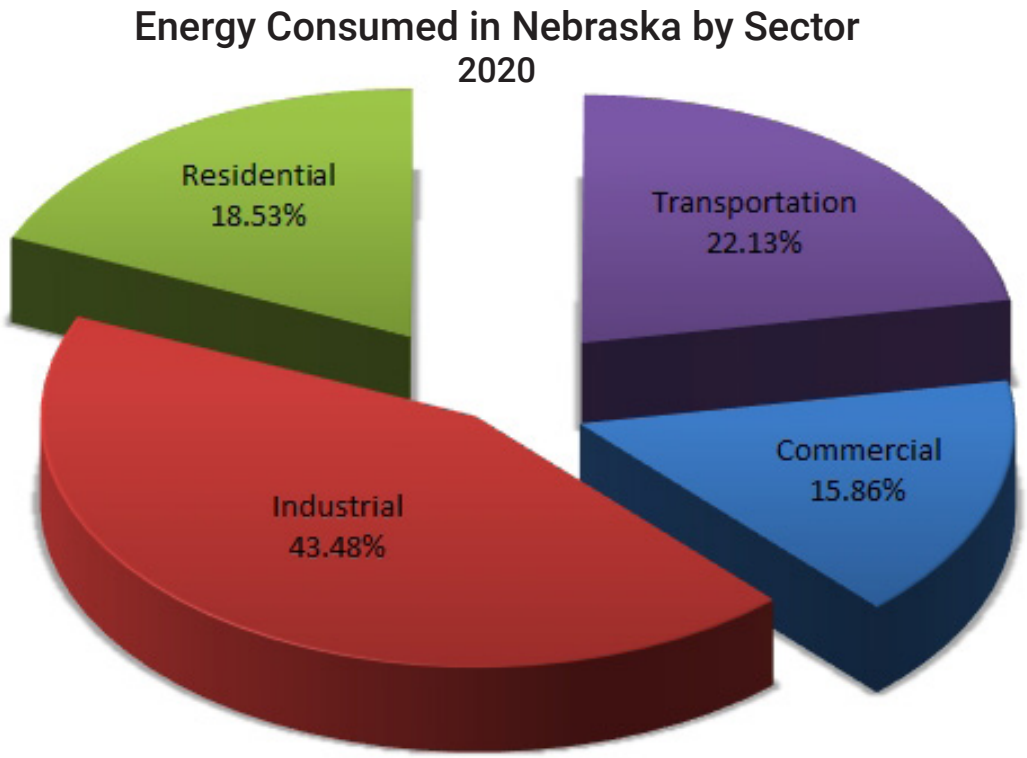


Figure 11 *NDEE/EIA*

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 60 years has changed markedly. Overall, total energy consumption has nearly tripled from 308 trillion Btu in 1960 to 864 trillion Btu in 2020. The first notable change after 1960 was coal use, which increased nearly ten-fold from 20 trillion Btu to 213.75 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.

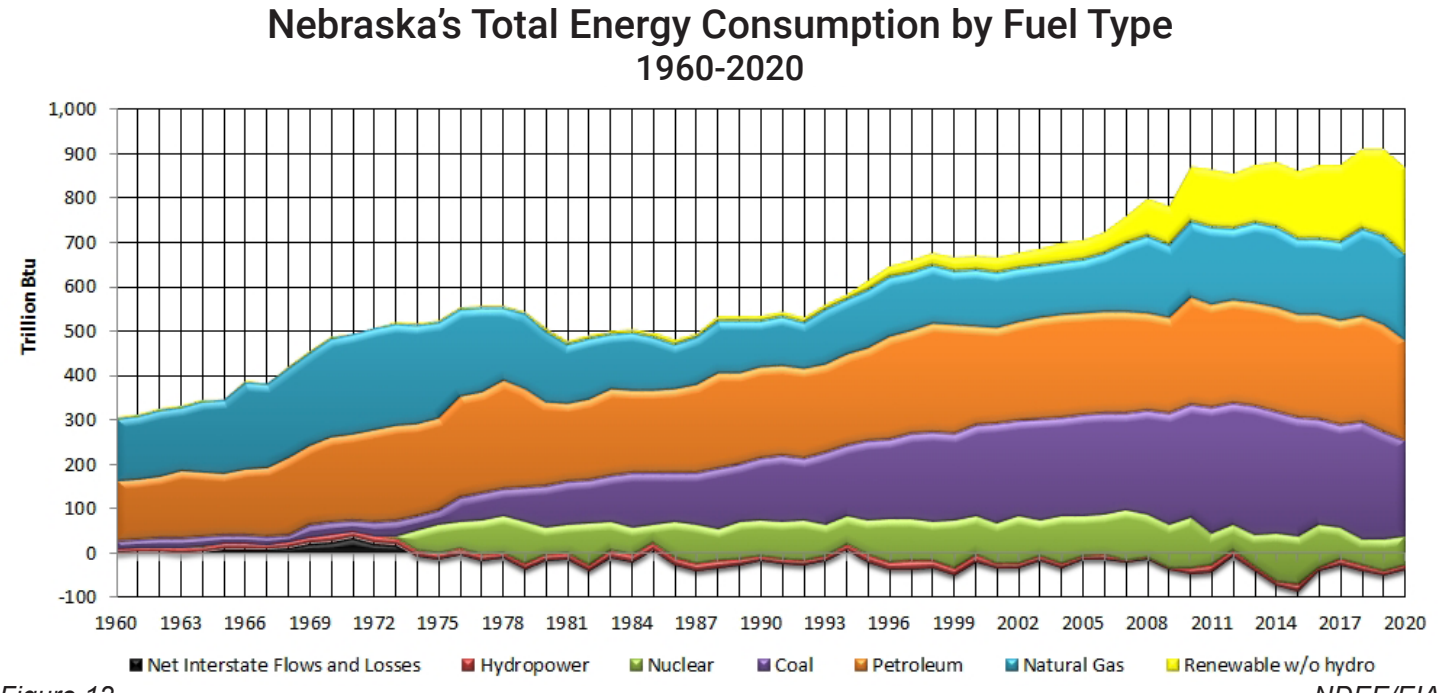


Figure 12 *NDEE/EIA*

Natural gas consumption has varied through the years. Overall, it has grown from 140.4 trillion Btu in 1960 to 192.8 trillion Btu in 2020. 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 60 years from 136.0 trillion Btu in 1960 to 228.5 trillion Btu in 2020. 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 2020. Gasoline increased by 15.0 trillion Btu, and diesel fuel increased by 89.4 trillion Btu.

Diesel fuel consumption increased nearly five times from 24.2 trillion Btu in 1960 to 113.6 trillion Btu in 2020. Gasoline consumption increased from 78.8 trillion Btu in 1960 to 93.8 trillion Btu in 2020. 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 21.533 billion miles in 2021, 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 64.6 trillion Btu in 2020. Nuclear consumption peaked in 2007 at 115.8 trillion Btu. However, nuclear energy generation decreased for three consecutive years when Omaha Public Power District'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 202.9 trillion Btu in 2020 (Figure 12). Energy pro- duction 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 hy- dropower produced. In 2020, the total amount of renewable energy produced included (Figure 13):

- Biofuels — 51.32%
- Wind —39.41%
- Hydroelectric power —6.01%
- Wood and wood waste —2.33%
- Geothermal —0.60%
- Solar —0.33%

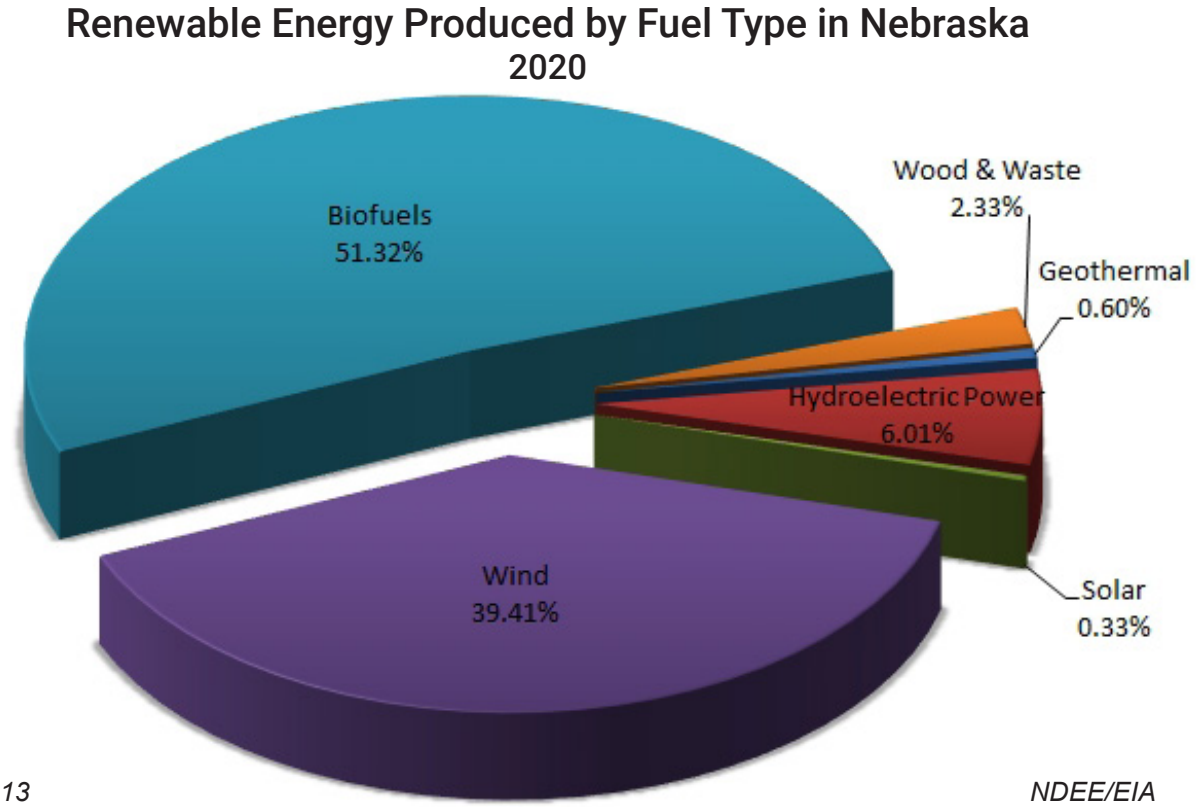


Figure 13 *NDEE/EIA*

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.

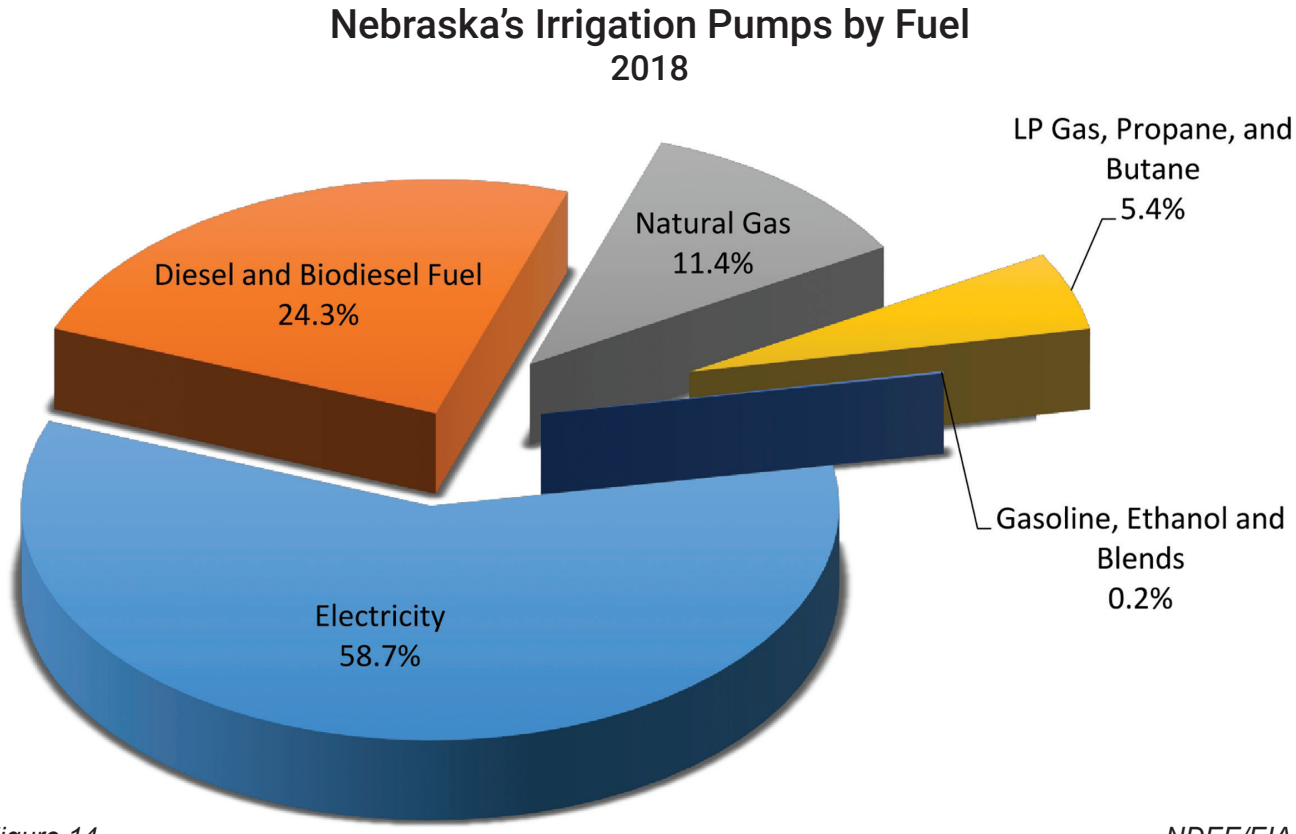


Figure 14 *NDEE/EIA*

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.

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).

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).

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 that can assist Nebraska's irrigators who want to switch from diesel to electric power. This program, made possible by the U.S. Environmental Protection Agency (EPA) Clean Diesel Program and funds from the Volkswagen diesel emissions settlement, 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 December 2022, 116 diesel-to-electric conversions were completed and 13 were near completion. These conversions will reduce annual air pollutant emissions by 54.7 tons of nitrogen oxide and 17.7 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. 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.

According to Area Development, a magazine that covers corporate site selection, energy availability and cost consistently rank in the top 10 needs or considerations for businesses that are looking for a new place to expand. With businesses increasingly looking toward renewable energy, electric utilities across the state work with customers and prospects to address their needs involving on-site solutions, rates, or other offerings.

For example, OPPD offers its Rate 261M, which allows large energy users market rate energy pricing via the Southwest Power Pool. When Facebook decided to build a data center in Papillion, OPPD helped them navigate a power purchase agreement to buy wind energy from Dixon County, which helps Facebook reach its 100% renewable energy goal. These economic decisions can also help utilities fulfill their missions and achieve many of their strategic directives.

New innovated technologies and processes aiming to provide solutions to the energy transition towards decarbonization are developing within the State. One example are Carbon Capture and Sequestration (CCS) projects. CCS is an approach to reducing emissions of carbon dioxide (CO_2) and other greenhouse gases from large industrial sources such as coal-fired power plants and ethanol plants. Several financial incentives are available to facilities willing to invest in CCS, such as Internal Revenue Service Section 45Q that provides a tax credit to facilities based on the number of tons of CO_2 sequestered or injected for enhanced oil recovery. In May 2021 the State of Nebraska signed into law LB650 , the Nebraska Geologic Storage of Carbon Dioxide Act, which establishes the legal and regulatory framework for potential carbon sequestration projects in the state.

The large number of bioethanol plants in Nebraska and the adjoining states and their low cost of carbon capture make this an attractive target for CCS. CCS has the potential to extend the life and reduce the carbon footprint of fossil-fuel power generating plants and provide an economic benefit to the ethanol industry in Nebraska.

Another example in new technologies is Monolith in Hallam, Nebraska. In 2016, Monolith broke ground for a first-of-its-kind commercial carbon black facility. According to Monolith, "The state offered abundant natural gas reserves, a central shipping location and a unique partnership with the Nebraska Public Power District (NPPD)." Monolith is producing commercially viable, affordable Clean Hydrogen today. And, as renewable natural gas becomes more available, Monolith will be producing carbon-negative hydrogen.

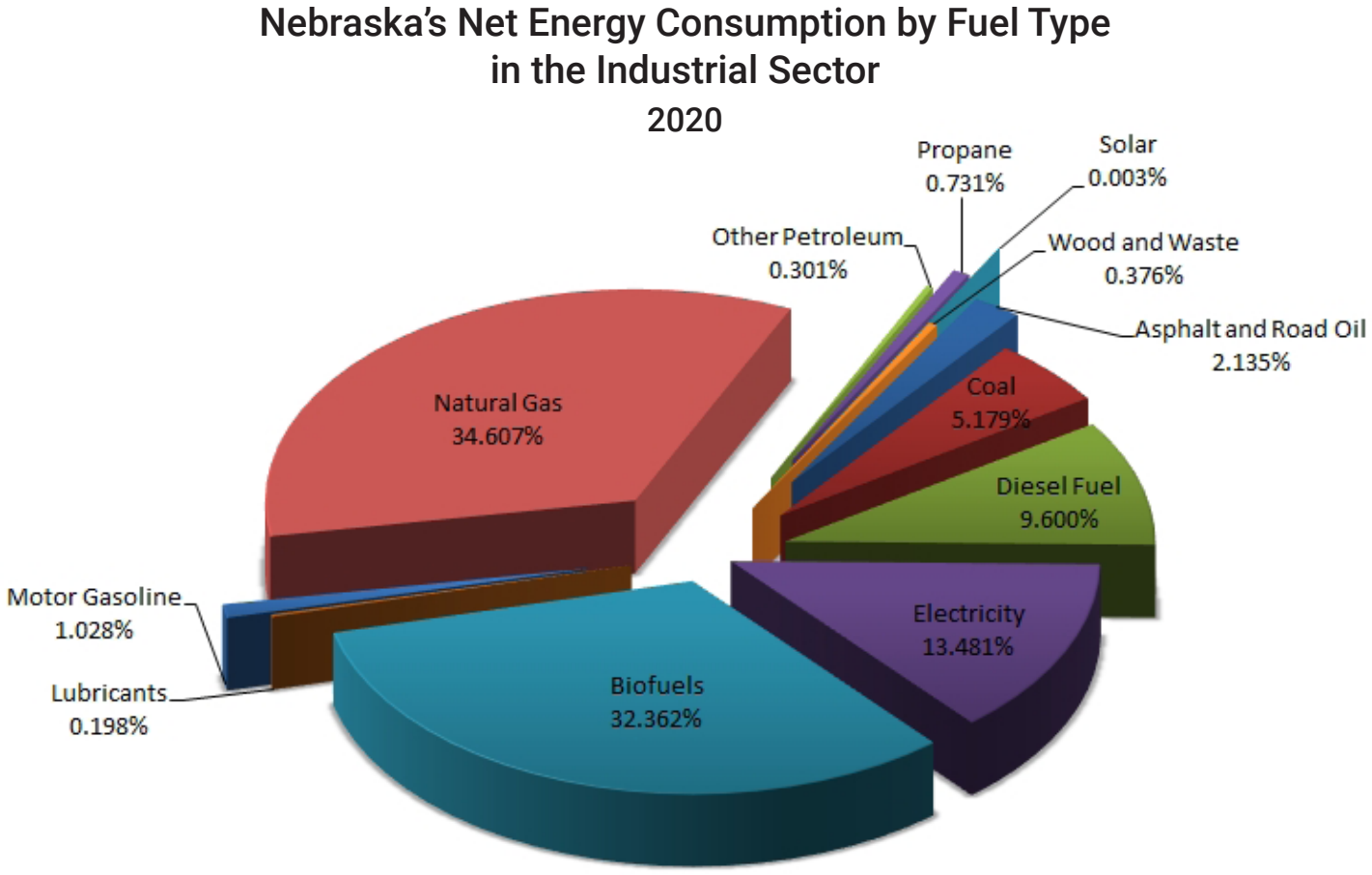


Figure 15 *NDEE/EIA*

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 2020. 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 20.3119.88 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 2020, rising from 14.01 trillion Btu to 28.10 trillion Btu. Gasoline consumption dropped by nearly 73% from 11.27 trillion Btu in 1960 to 3.01 trillion Btu in 2020. Looking at Figure 16, electricity use in this sector increased nearly twelve-fold from 3.03 trillion Btu in 1960 to 39.46 trillion Btu in 2020.

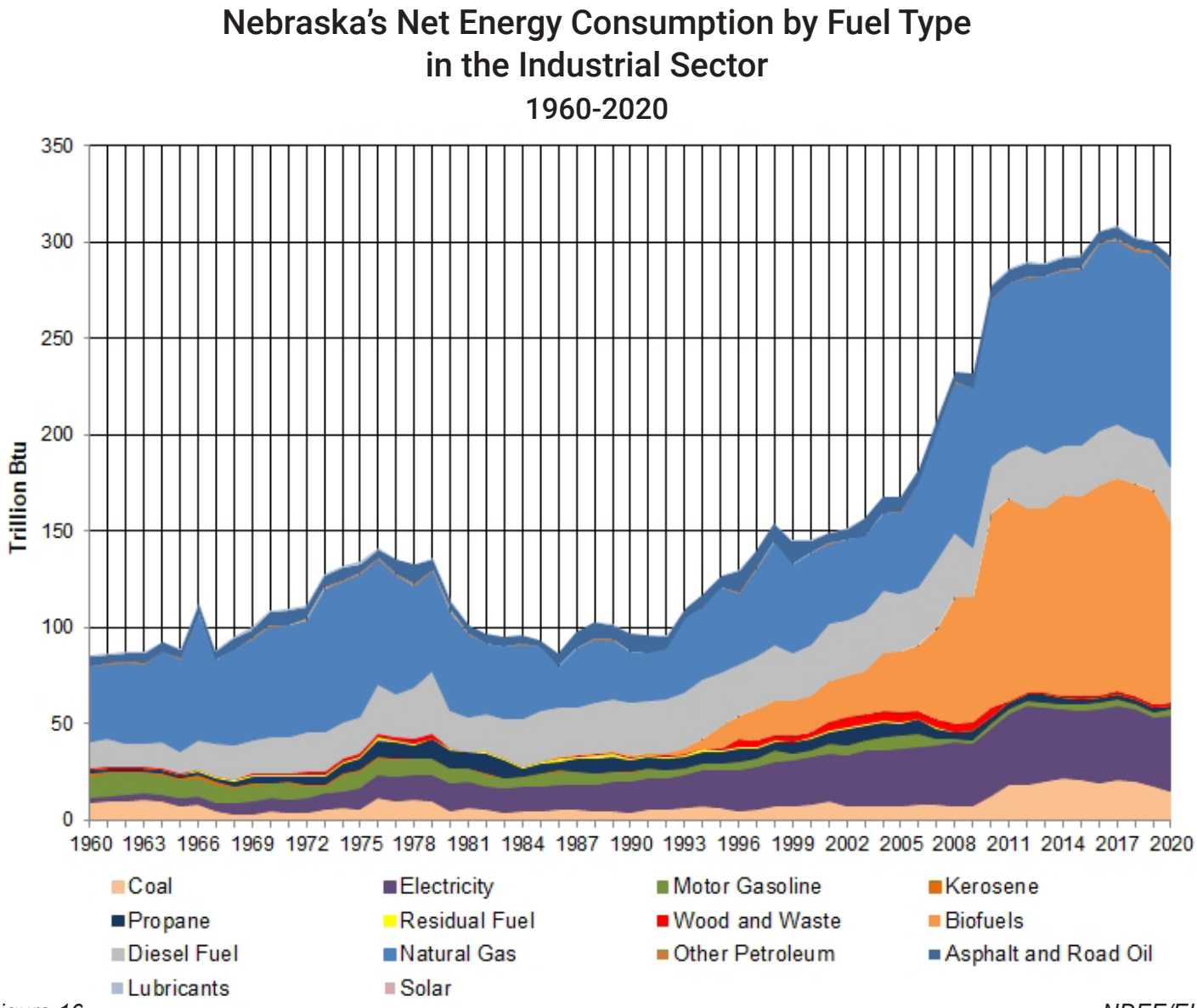


Figure 16 *NDEE/EIA*

Energy Demand

The industrial sector made up 43% (375.6 trillion Btu) of the state's energy consumption in 2020 (Figure 11). Figure 16 shows a 1.4% decrease in consumption between 2019 and 2020.

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 2020, industrial was the largest energy-using sector at 375.6 trillion Btu, surpassing the transportation sector by 184.4 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.

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 60 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.

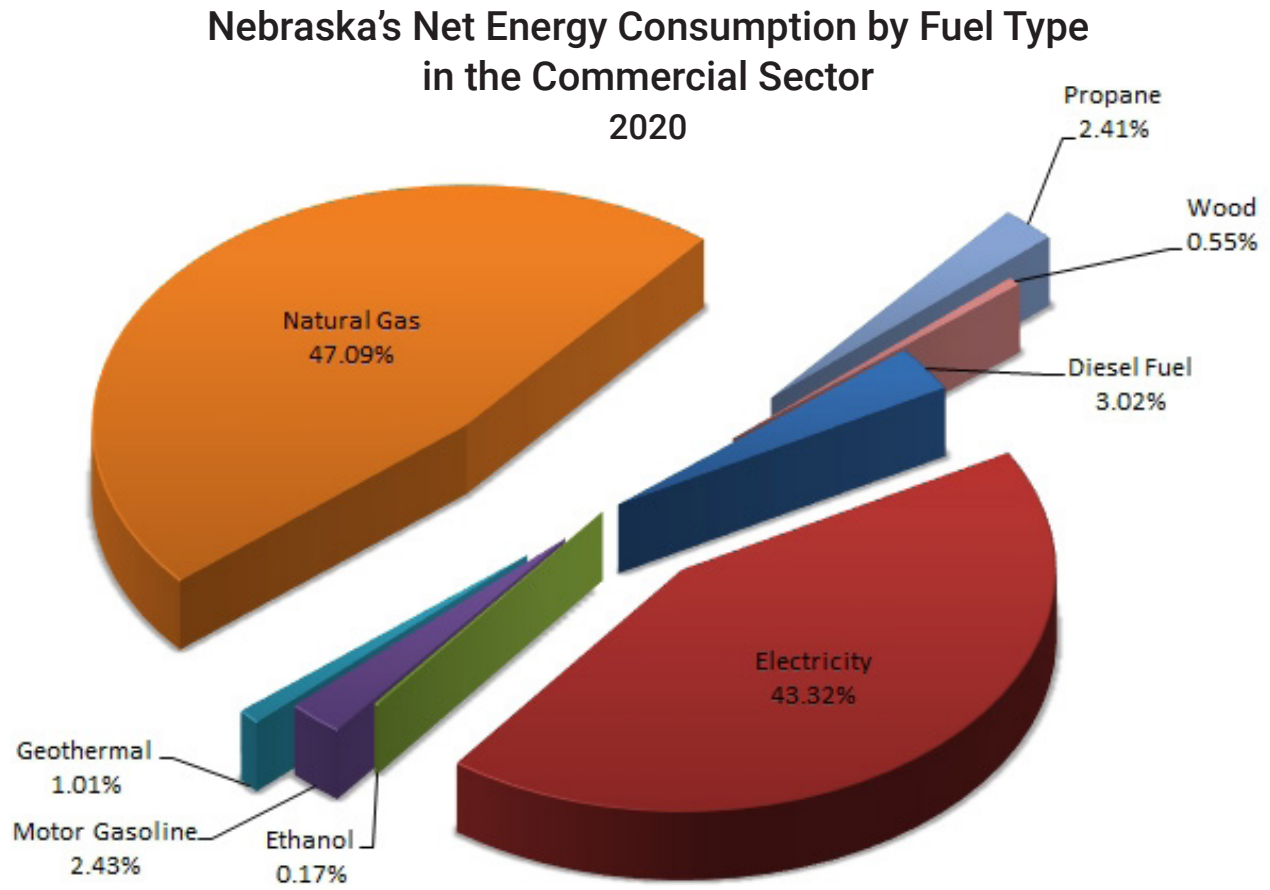


Figure 17 *NDEE/EIA*

Energy Supply

Natural gas and electricity supplied nearly all of the fuel (90.1%) used in the commercial sector in 2020 (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).

Energy Demand

According to the EIA, 136.9 trillion Btu of energy were consumed in the sector in 2020, down 7.7% (or 11.4 trillion Btu) from 148.3 trillion Btu in 2019. This sector accounts for 16% 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 2020, the amount of energy used in this sector more than tripled to 136.9 trillion Btu. Peak energy use was reached in 2019 at 148.3 trillion Btu.

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).

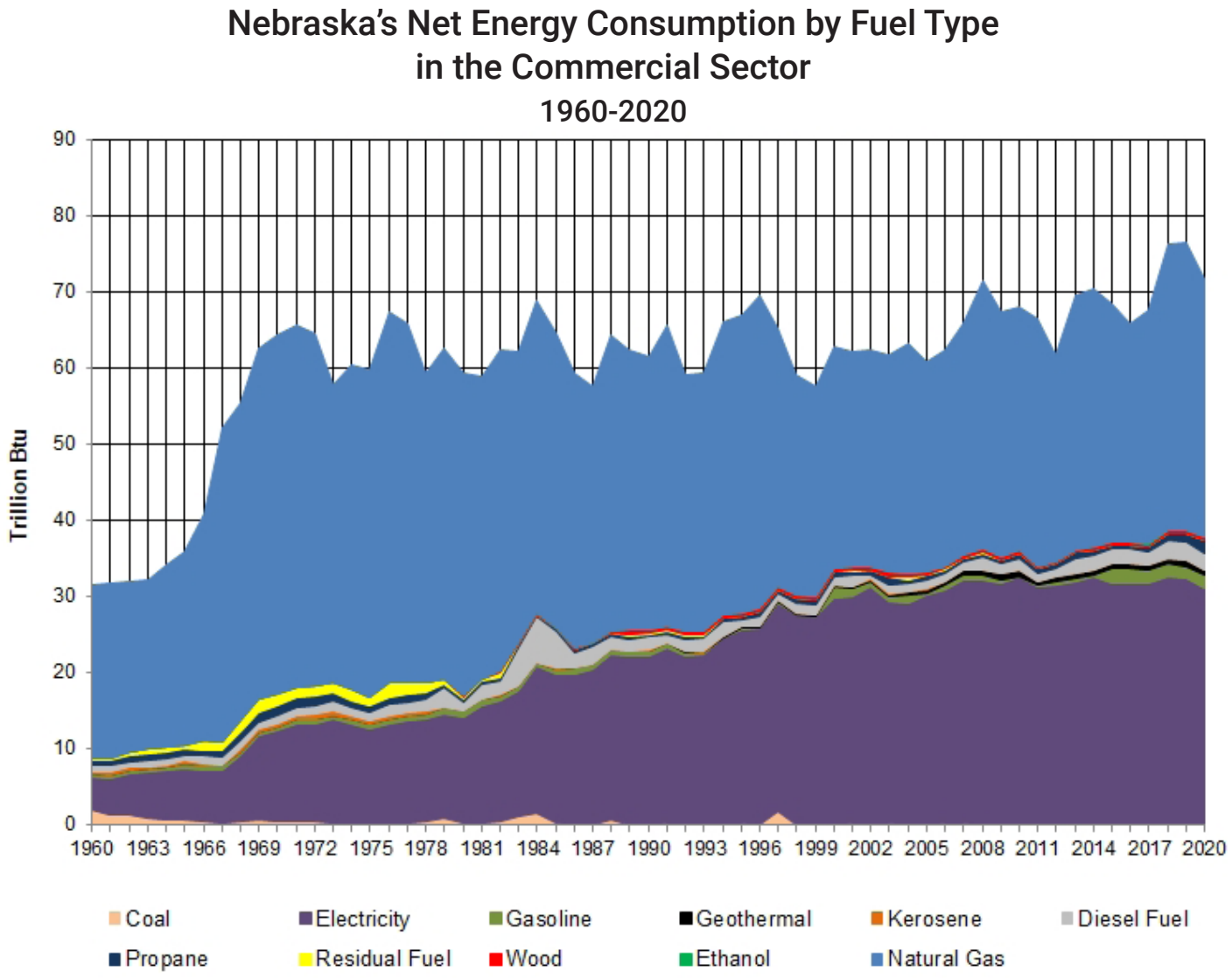


Figure 18 *NDEE/EIA*

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.

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 is mostly provided by natural gas and electricity.

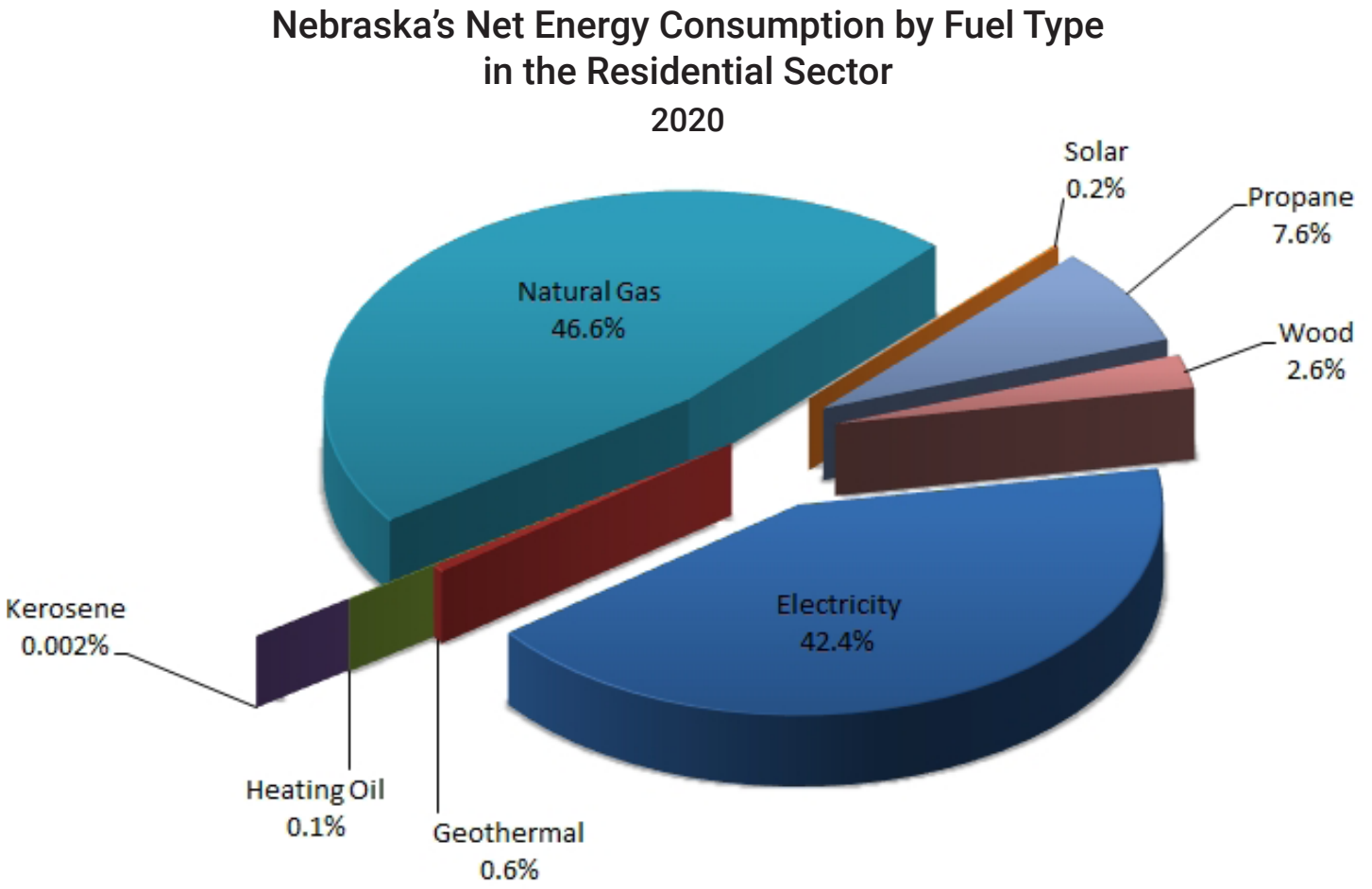


Figure 19 *NDEE/EIA*

Energy Supply

As shown in Figure 19, in 2020 the residential sector's energy needs were met by:

- Natural gas — 46.6%
- Electricity — 42.4%
- Petroleum — 7.7%
- Renewable energy — 3.3%

Supply trends and fuel types used in the residential sector have not changed substantially over 60 years of data collection.

Energy Demand

In 2020, the residential sector accounted for 19% of the state's total energy demand (Figure 11). Residential demand decreased by 5.5% from 169.3 trillion Btu in 2019 to 160.0 trillion Btu in 2020. Petroleum use decreased 17.2% from 2019 and renewable energy use decreased 23.3%. Natural gas use decreased 11.4% and electricity use increased 2.0% from 2019. 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 compelled 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.

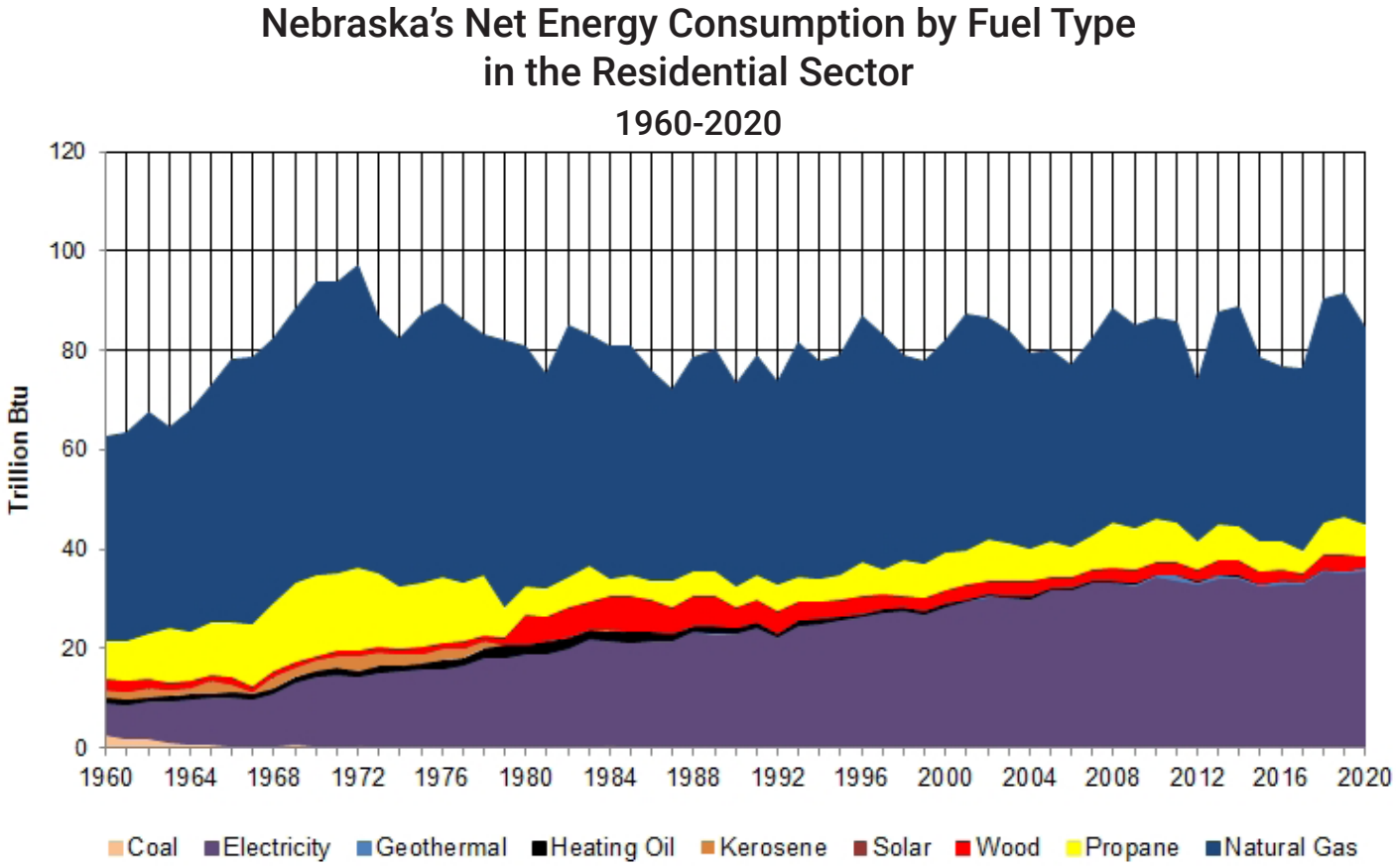


Figure 20 *NDEE/EIA*

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 22% of Nebraska's total energy demand in 2020 (Figure 11).

Energy Supply

In 2020, 93% of energy used in transportation—178.13 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 6.72 trillion Btu and biofuels at 6.31 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 2020 (Figure 22).

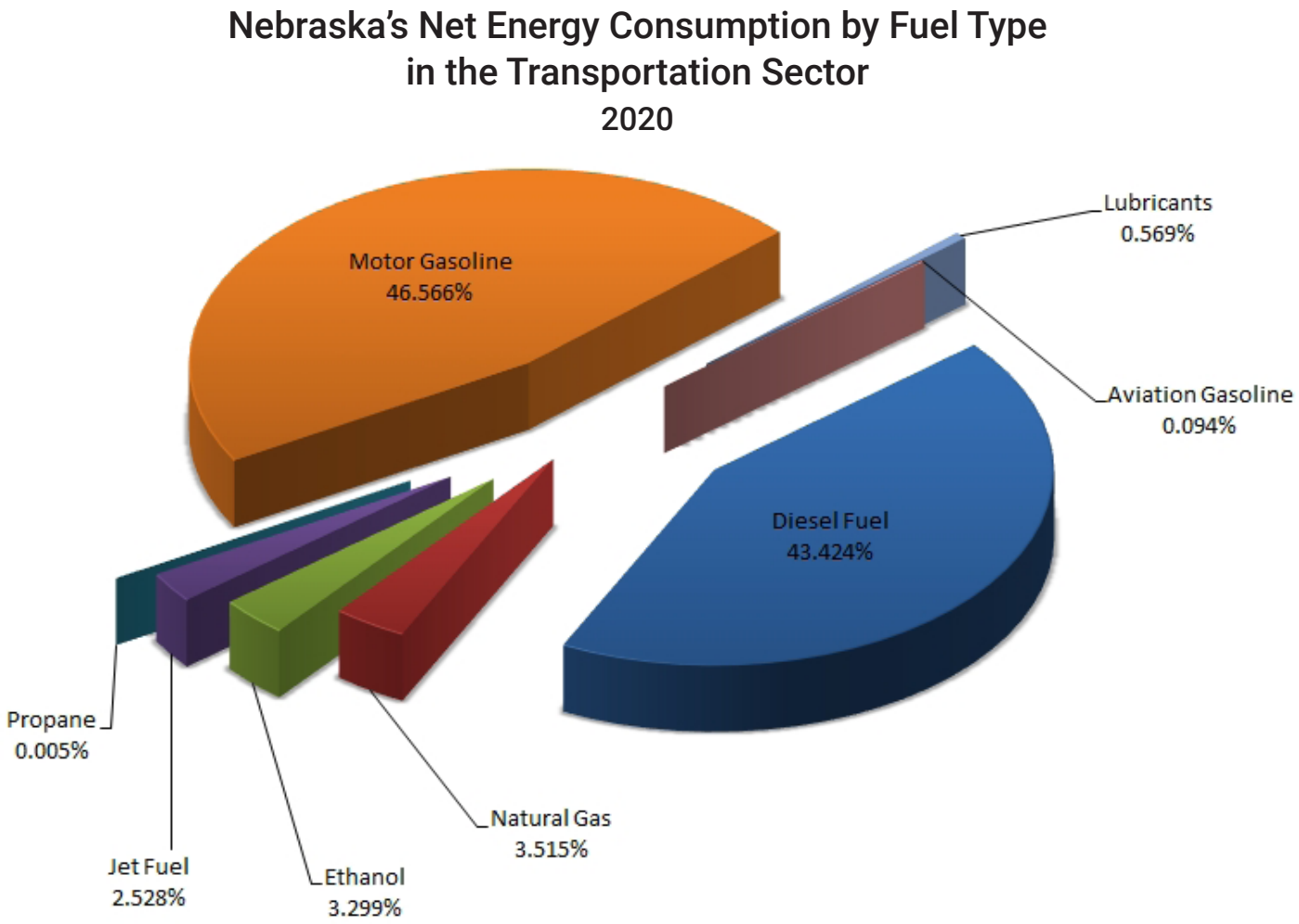


Figure 21 *NDEE/EIA*

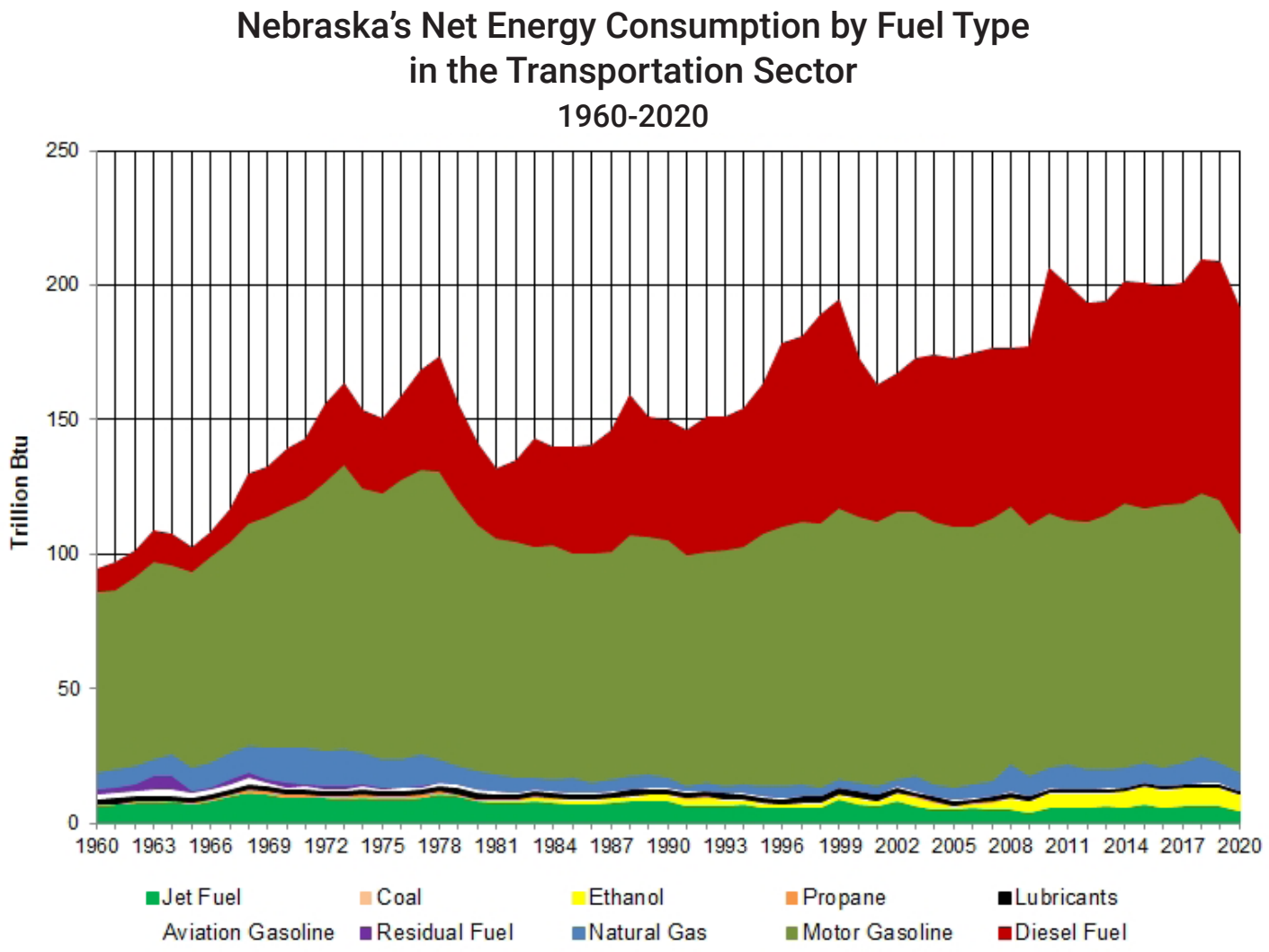


Figure 22 *NDEE/EIA*

Energy Demand

The transportation sector used 191.2 trillion Btu, nearly one-fourth of the state's energy consumption in 2020 (Figure 11). The decrease in demand from 2019 to 2020 totaled 17.59 trillion Btu, a decrease of 8.43%.

In 1960, the transportation sector was the largest energy-using sector at 94.2 trillion Btu, 30.6% of consumption of all sectors. By 2020, 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 2021 (21.53 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 194.2 trillion Btu to 162.4 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 205.0 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 192.5 trillion Btu. Since then, lower prices at the pump have resulted in gradually rising transportation sector demand, reaching 208.8 trillion Btu in 2020.

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.

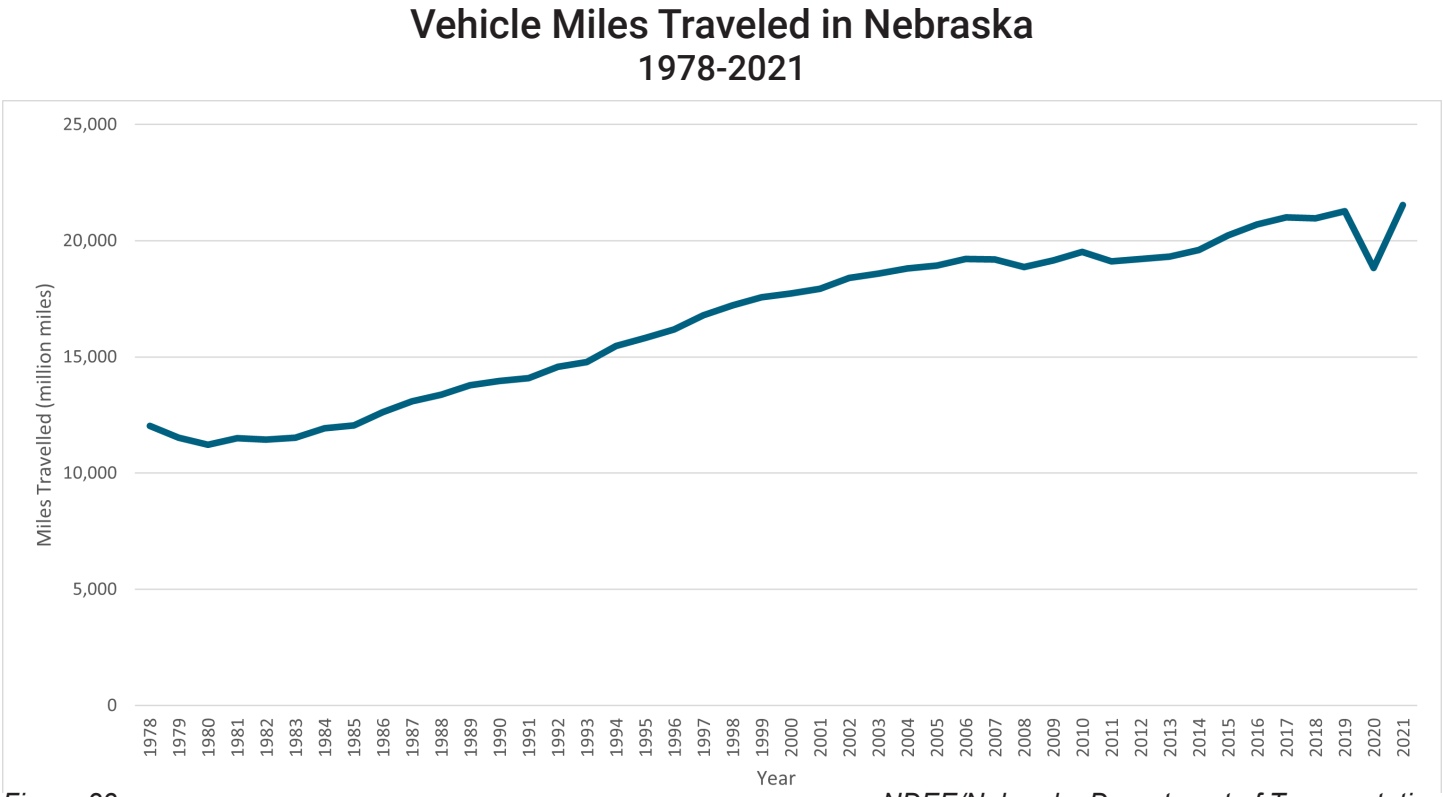


Figure 23 *NDEE/Nebraska Department of Transportation*

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 2020, 53.89% of the electric power energy feedstocks came from coal. The next most used fuels in this sector were nuclear (17.54%) and wind (21.70%). Two lesser fuel sources supplied nearly all of the remainder:

- Hydroelectric power — 3.31%
- Natural gas — 3.14%

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 60 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.

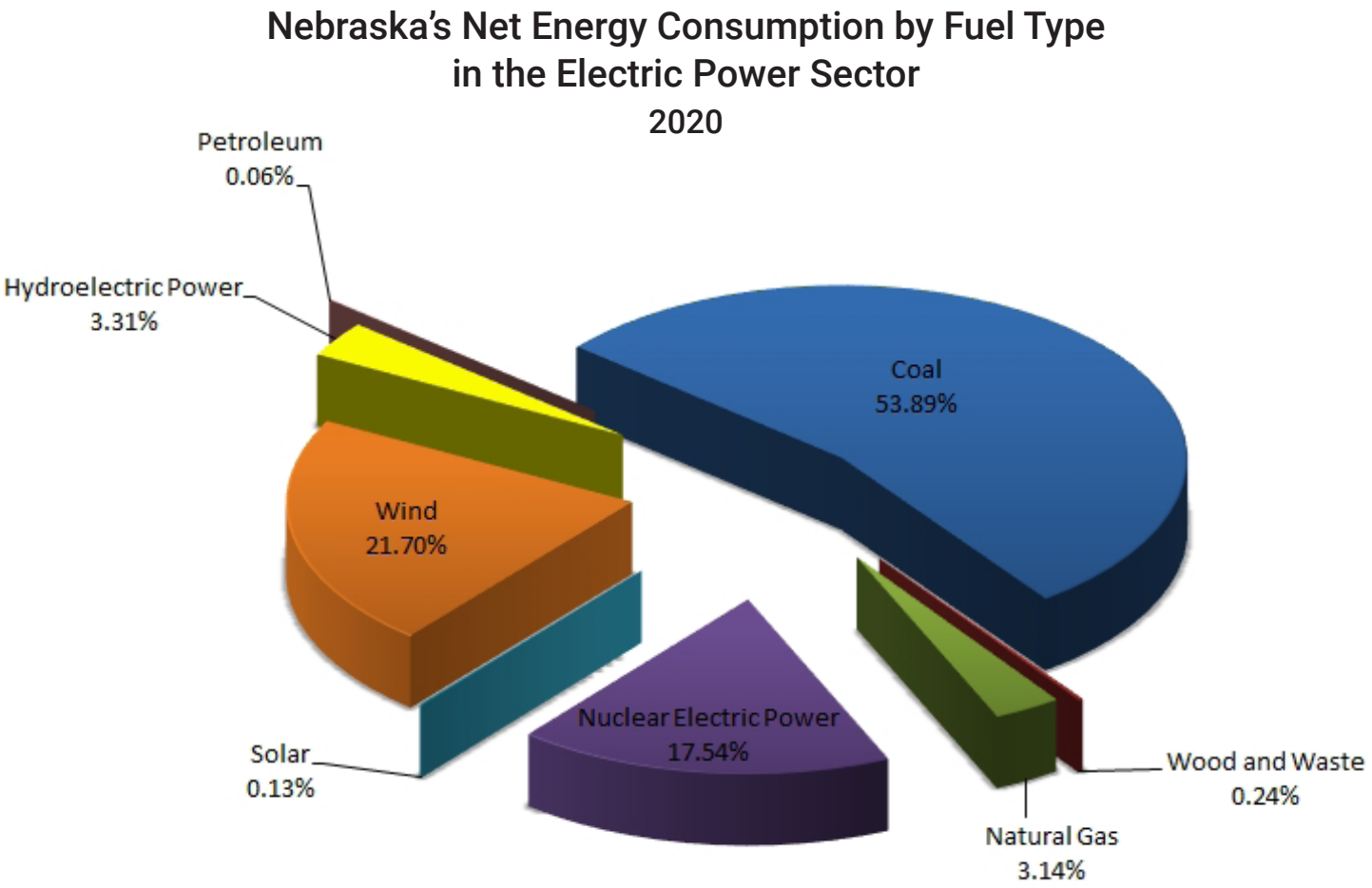


Figure 24 *NDEE/EIA*

Among the changes in fuel used to generate electricity in 2020 were increased use of hydro power, wind, wood and waste, and solar energy along with reductions in coal, natural gas, nuclear, and petroleum.

The demand in the state's electric power sector in 2020 totaled 368.5 trillion Btu, a decrease of 4.5% from 2019 demand.

Electricity purchases generated by hydroelectric power for use by Nebraska utilities from the Western Area Power Administration in 2020 totaled 1.971 billion kWh at an average price of three cents per kWh. The total cost of the power purchased in 2020 was $58.3 million. In 2020, the amount of power provided from Western Area Power Administration met 6.3% 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 2020, electricity exports varied from a low of 9.4% of generation in 1994 to a high of 26.1% in 2015. In 2020, electricity exports were 15.4% of generation. This was a decrease of 16.8% from 2019.

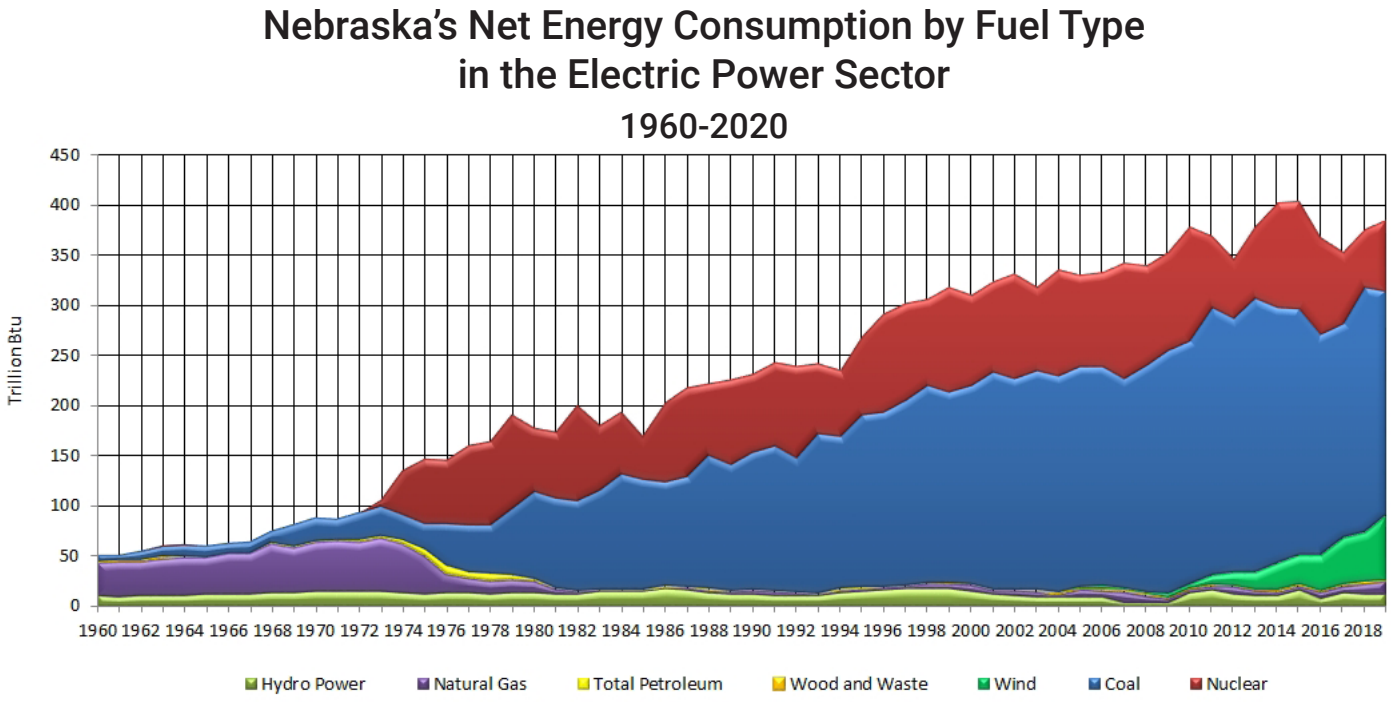


Figure 25 *NDEE/EIA*

Conclusion

The energy landscape in Nebraska, and across the nation, is changing at an astonishingly rapid rate. The U.S. Department of Energy's (DOE) Energy Information Administration (EIA) estimates that as much as 44% of the nation's electrical demand could be met with renewable power by 2050[1]. This change demonstrates efforts to transition from reliance on fossil fuels to a more diverse portfolio of energy sources. The graphs and figures shown throughout this report highlight how energy continues to change.

Nebraska is uniquely positioned to meet the challenges posed by a changing energy environment with its public power system and abundant reliable mix of diverse sources of energy, including coal, biofuels, nuclear, renewable natural gas, solar, and wind.

For example, renewable energy use has grown from 13.4 to 202.9 trillion Btu between 1960 and 2020 in Nebraska, as stated on page 14. 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.

1 https://www.eia.gov/todayinenergy/detail.php?id=51698