STOEL RIVES LLP

Energy Generation and the Role of Bioenergy

Presented by:
Kevin Johnson
Foth 2018 Workshop
Keller Golf Course
May 16, 2018

About Stoel Rives LLP

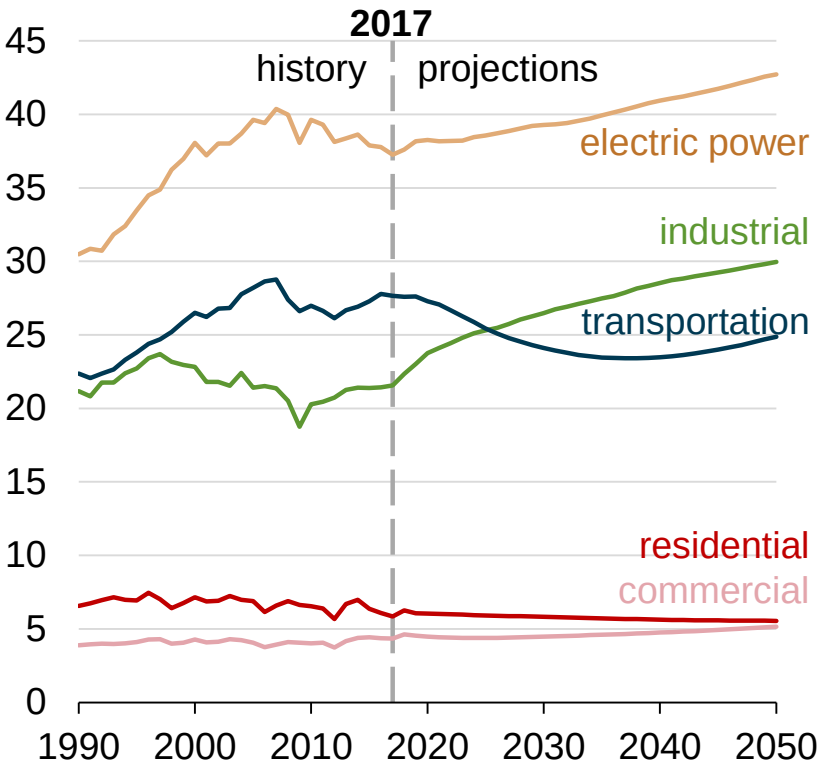
- Full service law firm of about 400 attorneys
- 10 offices in 7 states
- One of the largest energy, natural resources, and environmental practice groups
- Minneapolis office has 25 attorneys, majority focused on energy, natural resources and environmental law

OVERVIEW

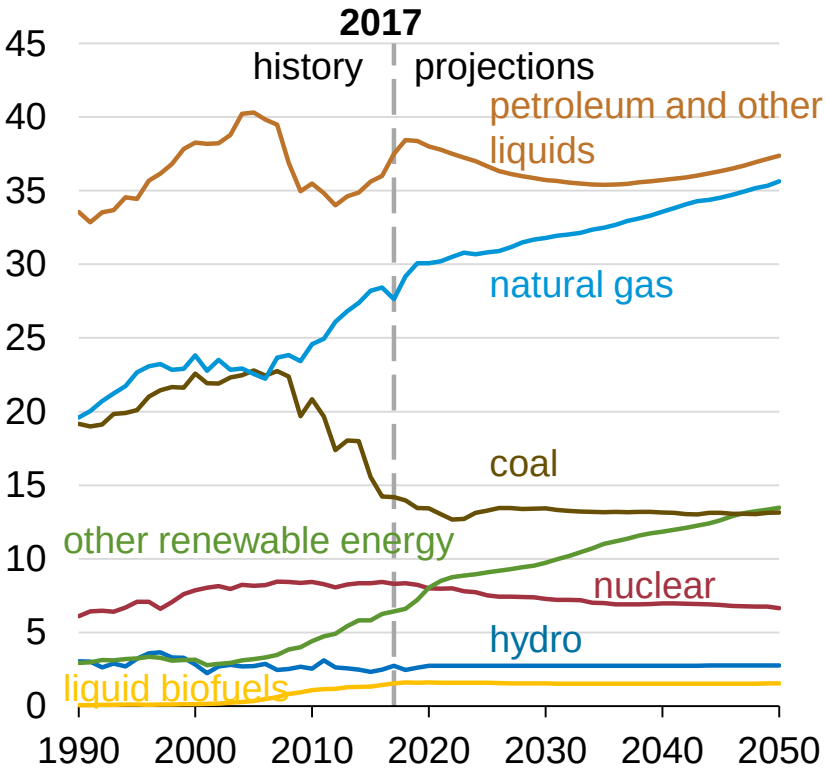
- U.S. energy picture
- Minnesota energy picture
- Carbon minimization under pressure
- Utilities under pressure
- Bioenergy under pressure
- Interaction with Waste Management Technologies

PROJECTED FUEL MIX OF U.S. ENERGY CONSUMPTION

Energy consumption by sector
quadrillion British thermal units



Energy consumption by fuel
quadrillion British thermal units



Source: U.S. Energy Information Administration #AEO2018 Reference case

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U.S. Electricity generation by source, amount, and share of total in 2017

Energy source	Billion kWh	Share of total
Total - all sources	4,015	
Fossil fuels (total)	2,495	62.7%
Natural gas	1,273	31.7%
Coal	1,208	30.1%
Petroleum (total)	21	0.5%
Petroleum liquids	13	0.3%
Petroleum coke	9	0.2%
Other gases	14	0.4%
Nuclear	805	20.0%
Renewables (total)	687	17.1%
Hydropower	300	7.5%
Wind	254	6.3%

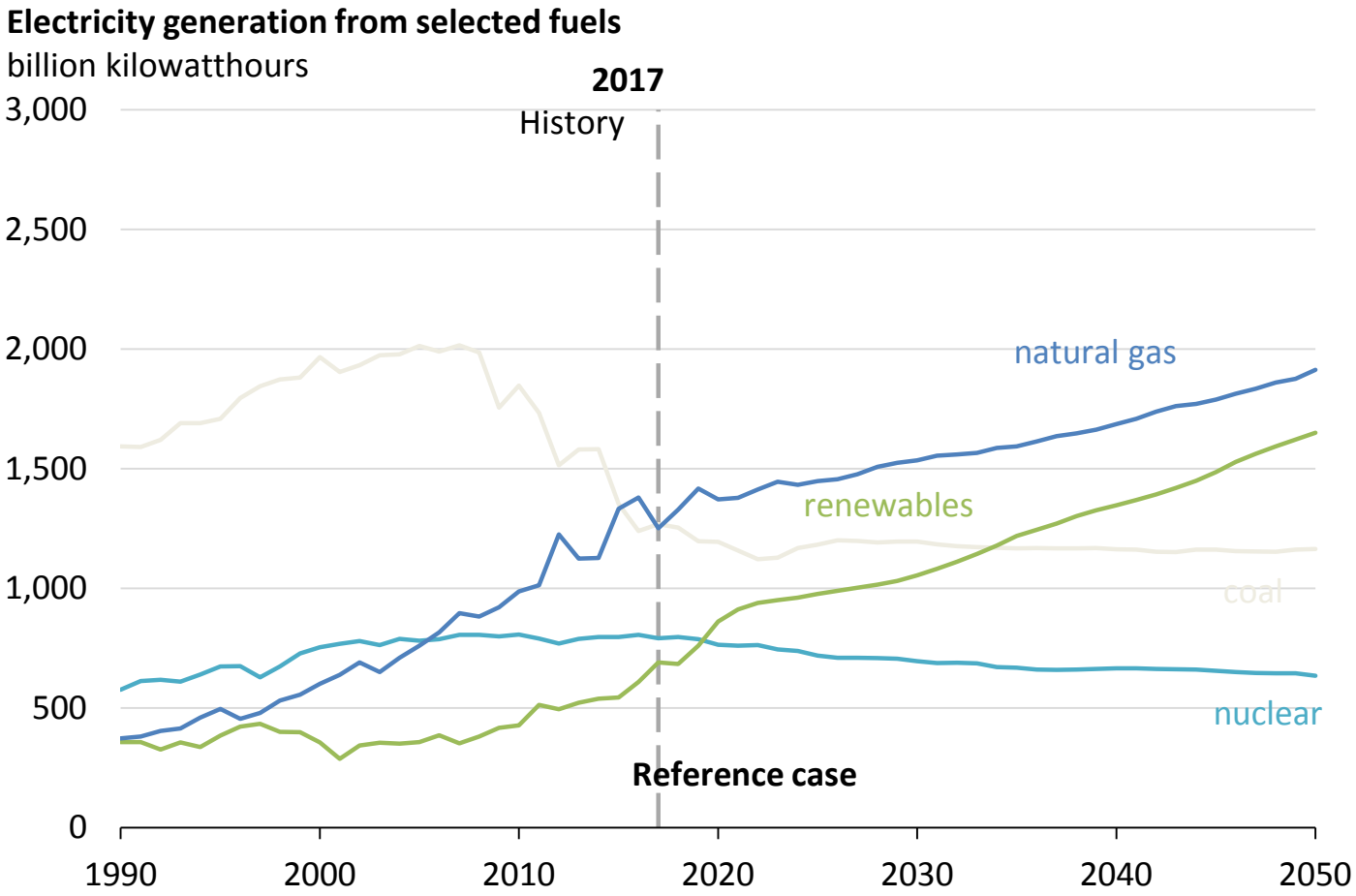
Source: U.S. Energy Information Administration , State Energy Data System

U.S. ELECTRICITY GENERATION BY SOURCE, AMOUNT, AND SHARE OF TOTAL IN 2017 (continued)

Energy source	Billion kWh	Share of total
Biomass (total)	64	1.6%
Wood	43	1.1%
Landfill gas	11	0.3%
Municipal solid waste (biogenic)	7	0.2%
Other biomass waste	3	0.1%
Solar (total)	53	1.3%
Photovoltaic	50	1.2%
Solar thermal	3	0.1%
Geothermal	16	0.4%
Pumped storage hydropower[3]	-6	-0.2%
Other sources	13	0.3%

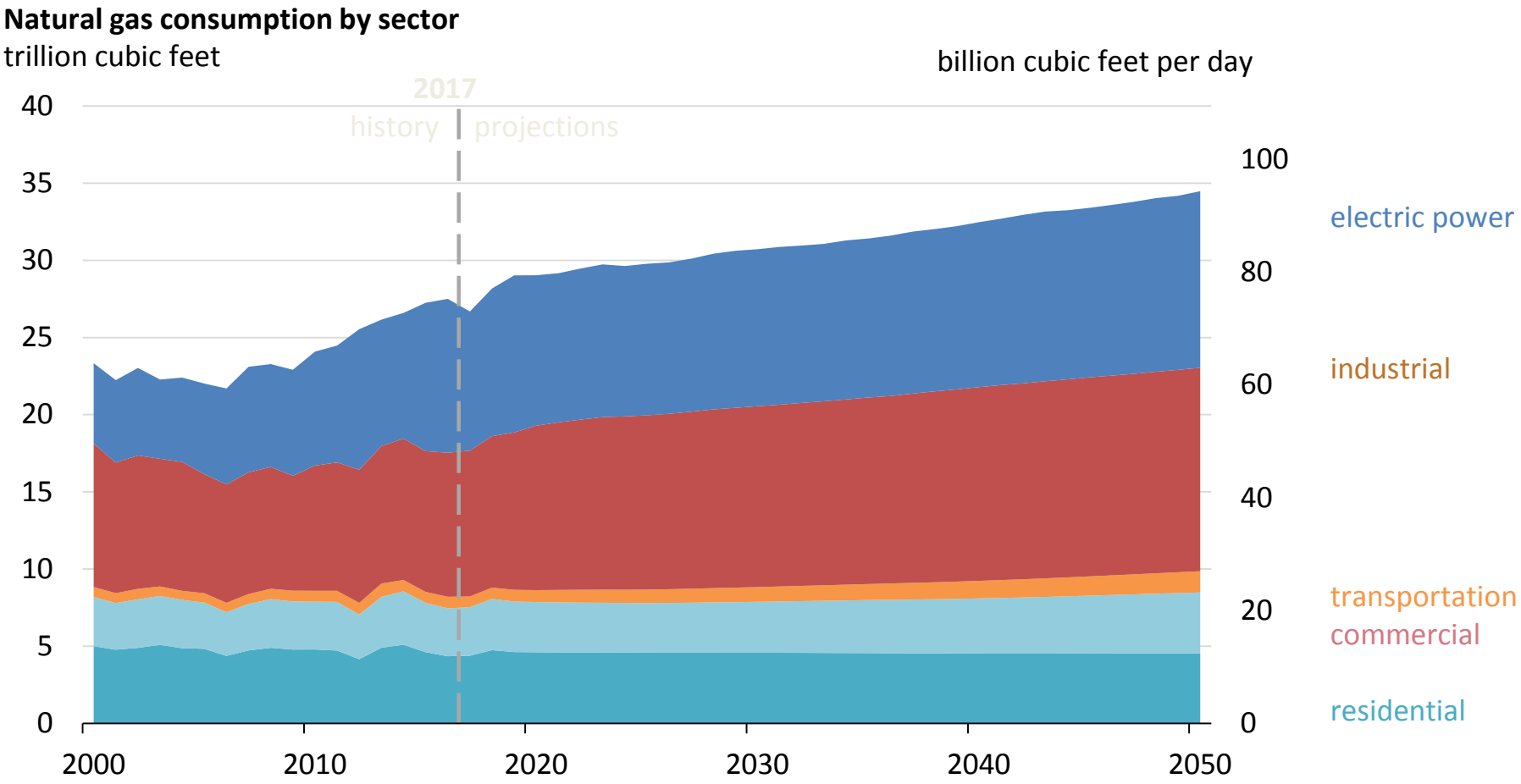
Source: U.S. Energy Information Administration , State Energy Data System

PROJECTED MIX OF CERTAIN ELECTRICITY GENERATION TECHNOLOGIES



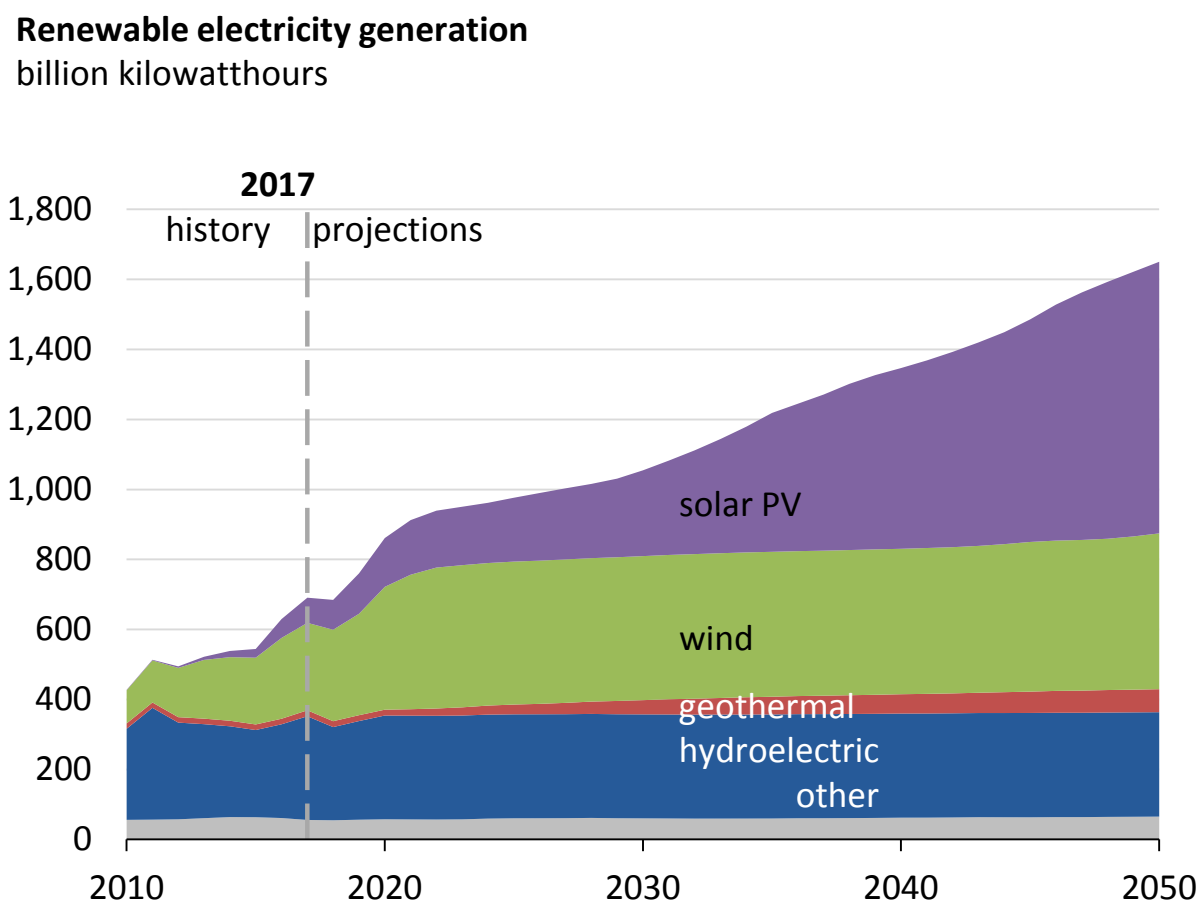
Source: U.S. Energy Information Administration #AEO2018

Industrial and Electric Power Demand Drives Natural Gas Consumption Growth



Source: U.S. Energy Information Administration #AEO2018

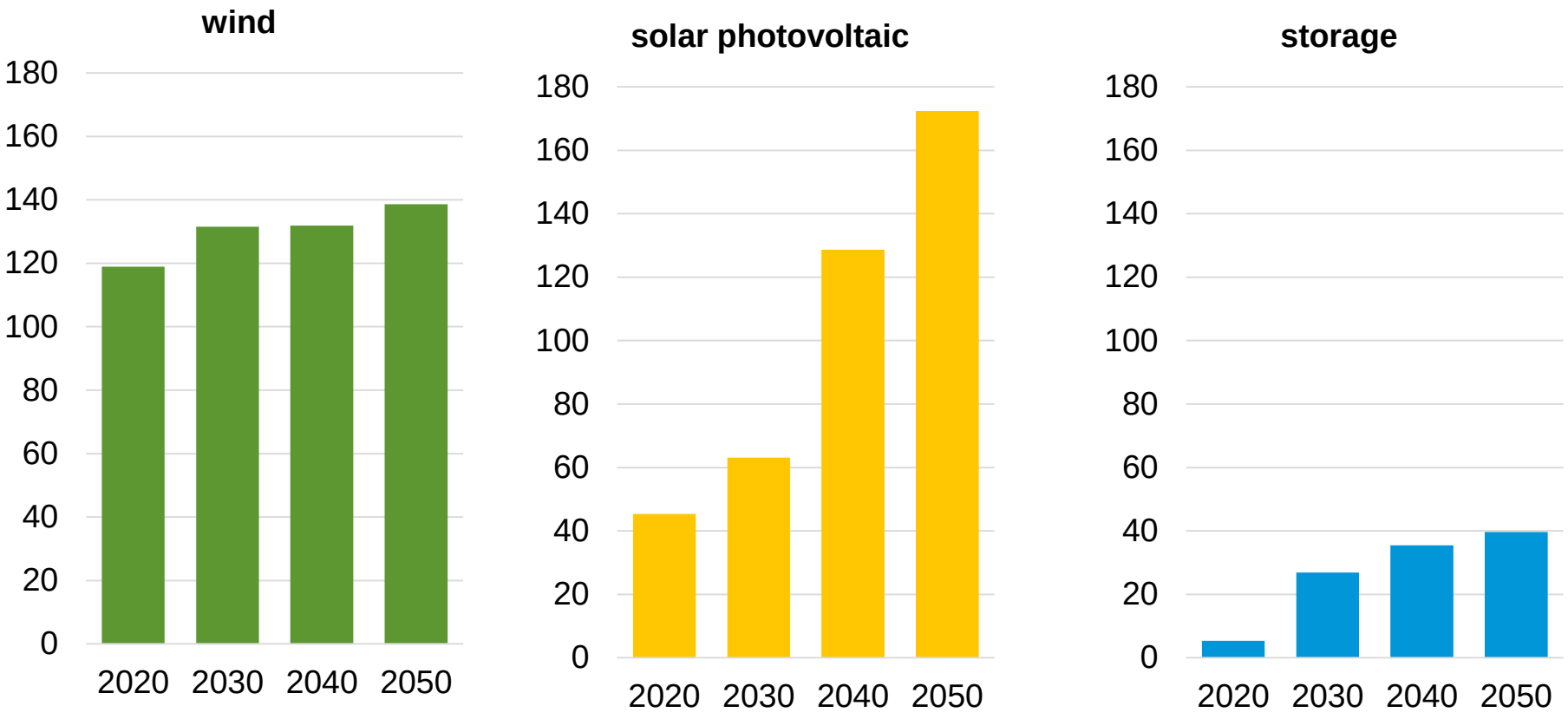
GENERATION FROM RENEWABLE SOURCES GROWS, LED BY GROWTH IN WIND AND SOLAR



Source: U.S. Energy Information Administration #AEO2018

INCREASING WIND AND SOLAR CAPACITY ADDITIONS

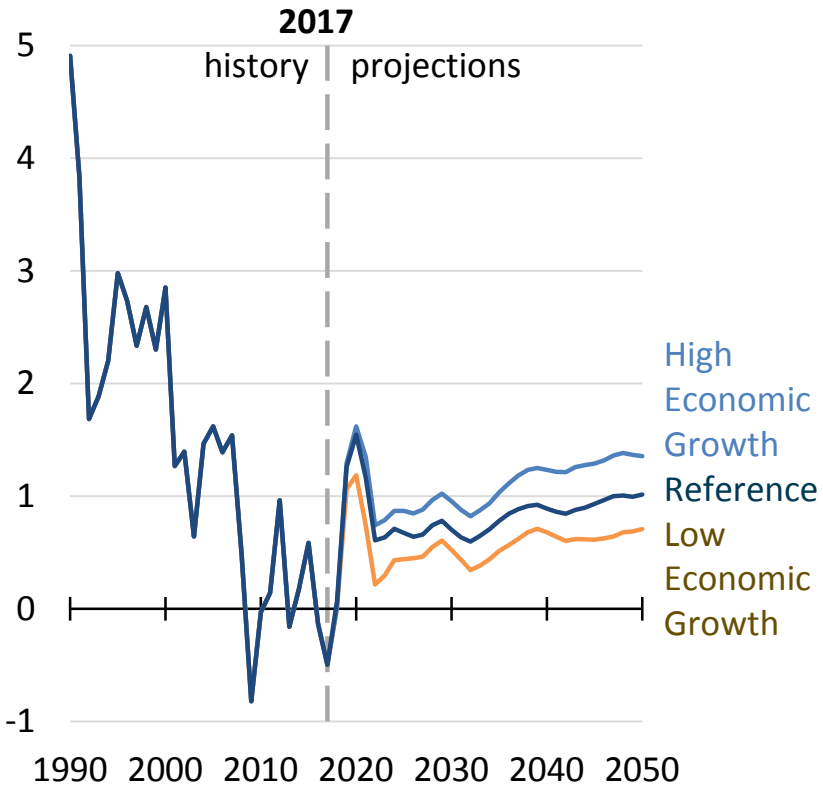
Utility-scale wind, solar, and storage operating capacity
gigawatts



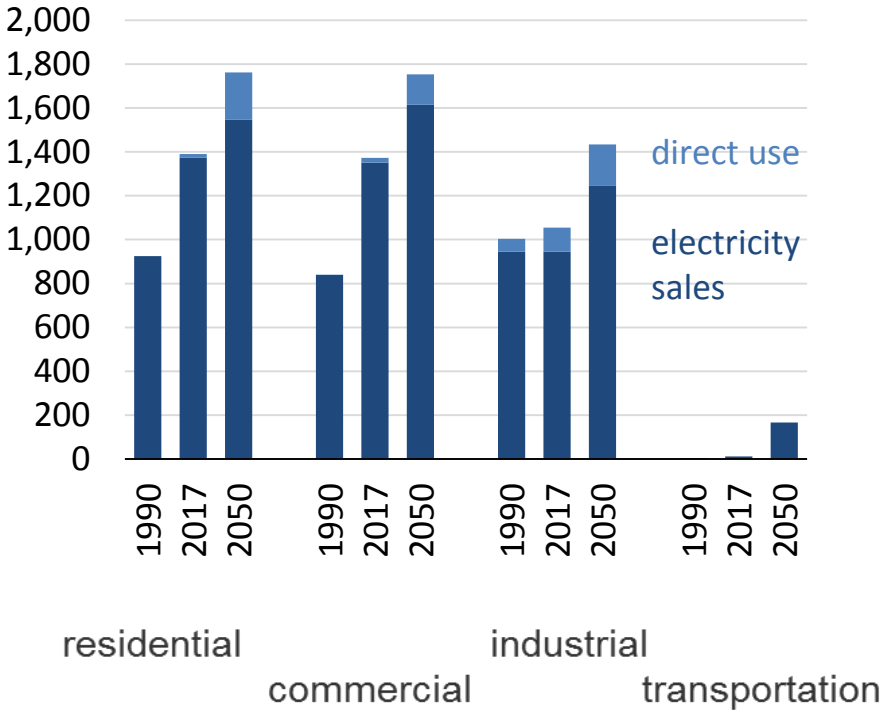
Source: U.S. Energy Information Administration #AEO2018

After Decades of Slowing Growth, Electricity Use is Expected to Grow Steadily Through 2050

Electricity use growth rate
percent growth (three-year rolling average)



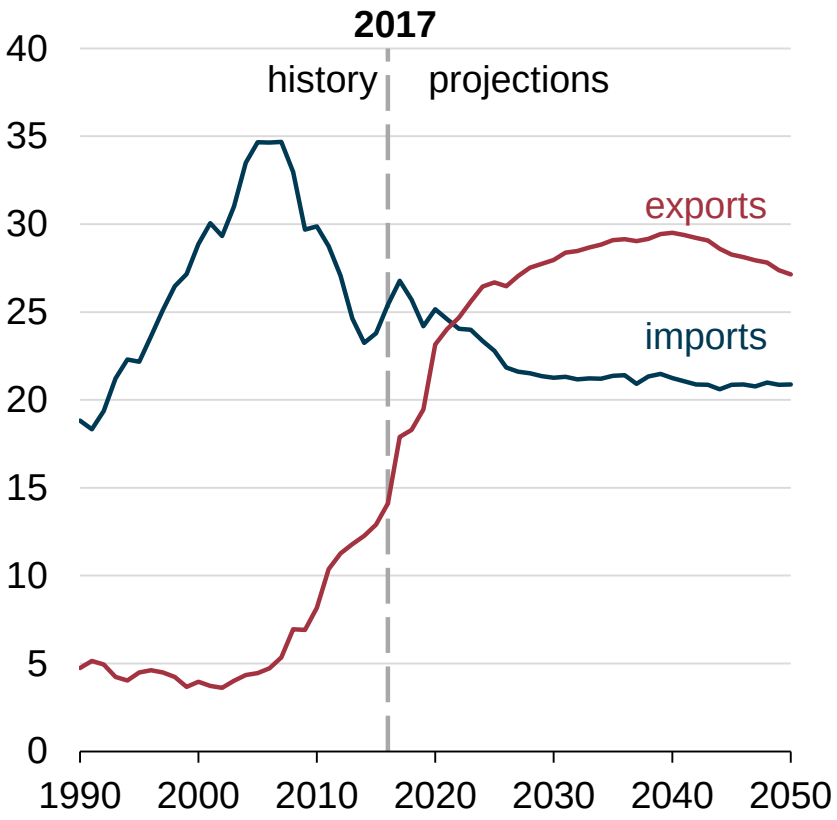
Electricity use by end-use demand sector
billion kilowatthours



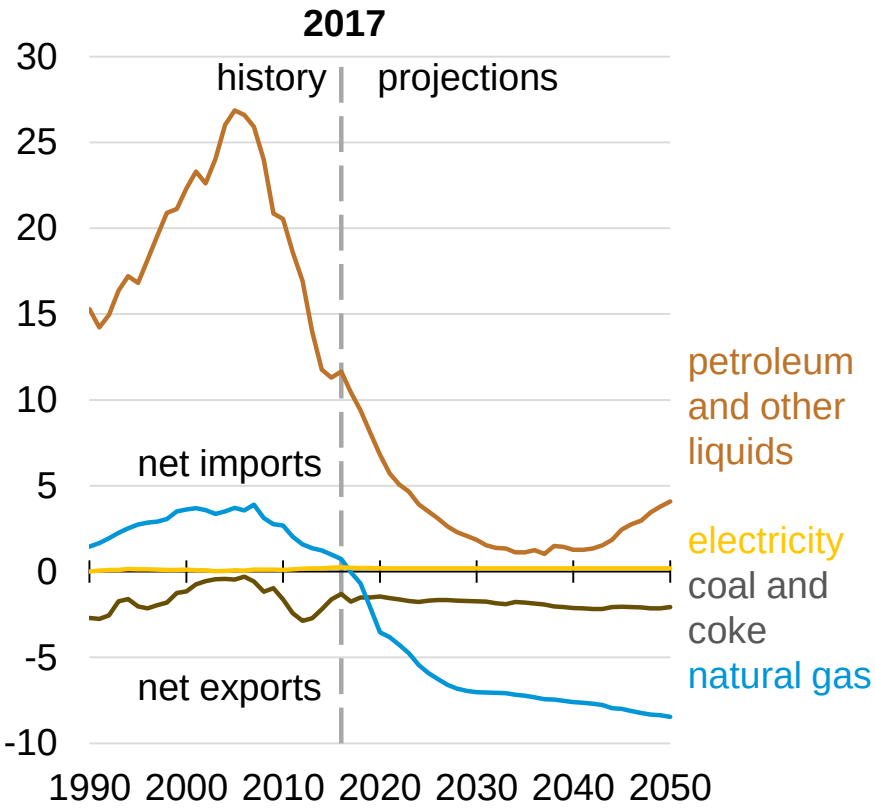
Source: U.S. Energy Information Administration #AEO2018

UNITED STATES BECOMES A NET ENERGY EXPORTER

Energy trade
quadrillion British thermal units



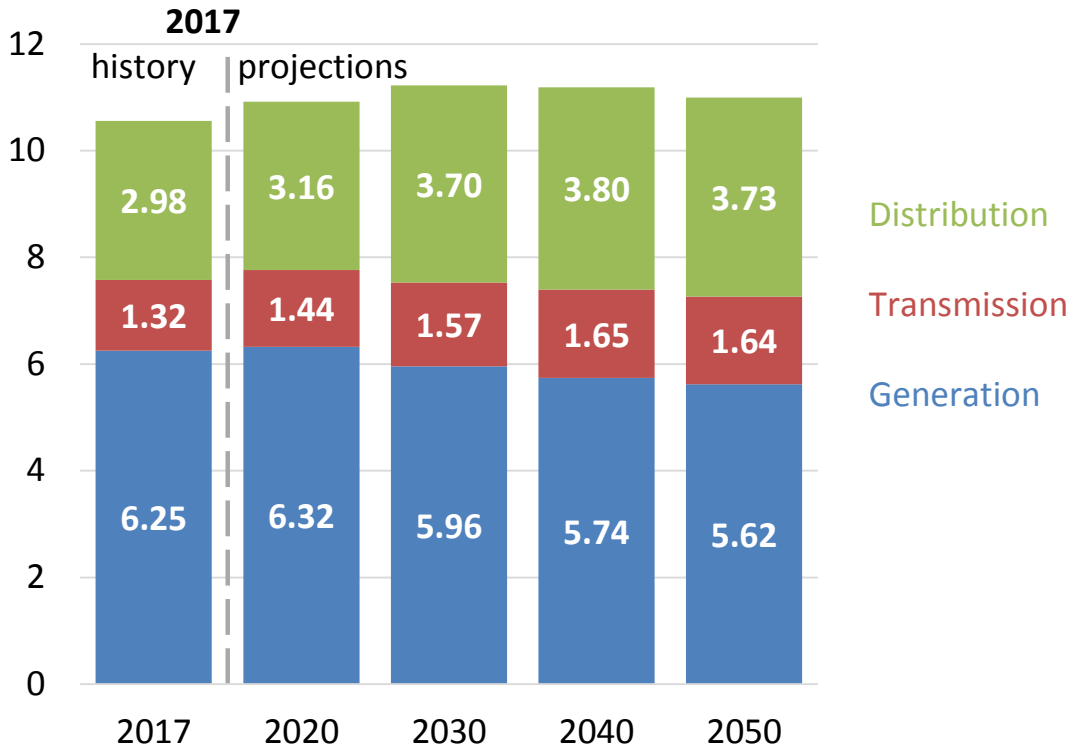
Net energy trade
quadrillion British thermal units



Source: U.S. Energy Information Administration #AEO2018

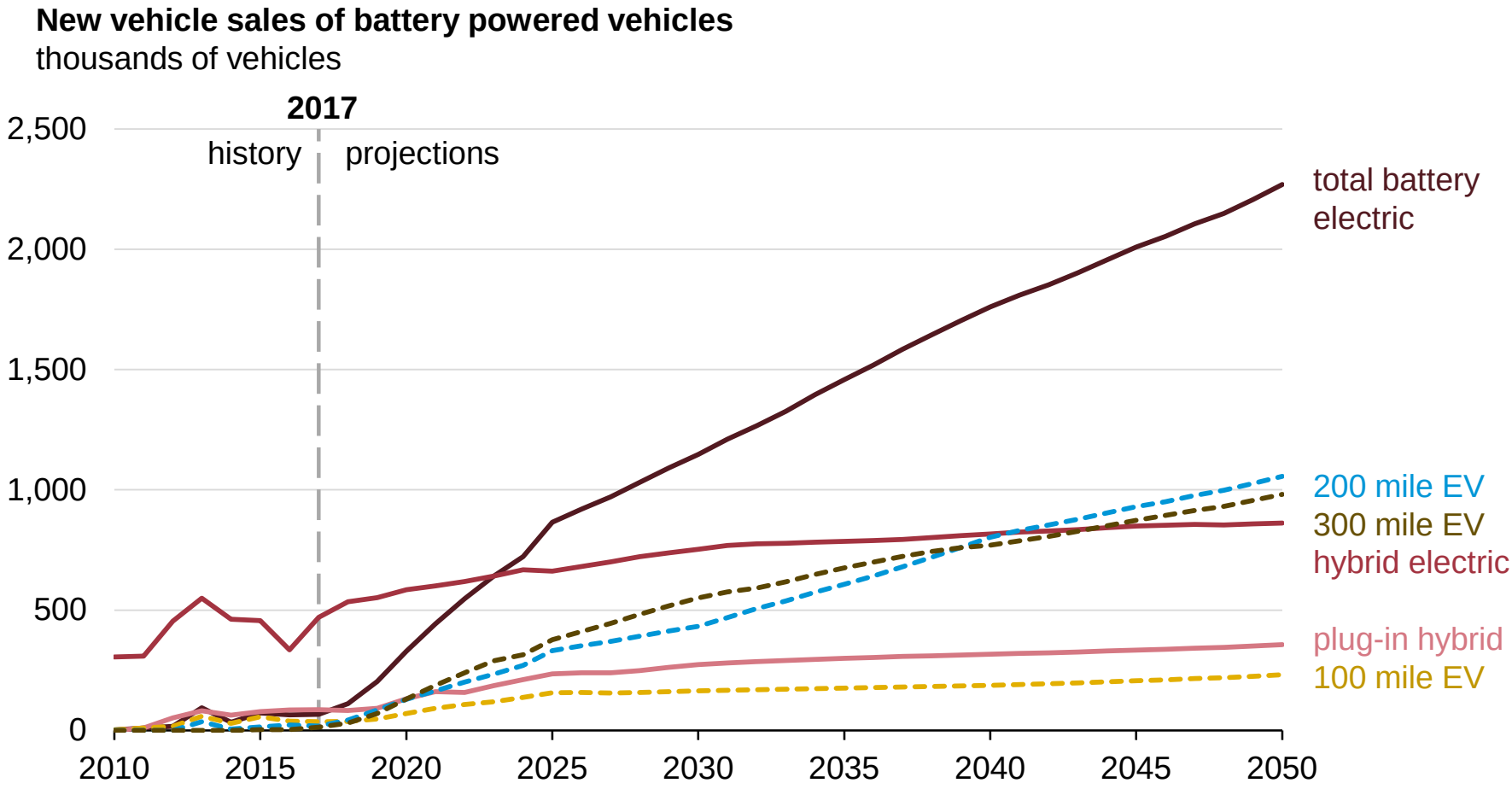
Electricity Prices Remain Flat, with Falling Generation Costs Offset by Increasing Transmission and Distribution Costs

Electricity prices by service category
2017 cents per kilowatthour



Source: U.S. Energy Information Administration #AEO2018

Sales of Electric and Plug-In Hybrid Electric Light-Duty Vehicles Increase



Source: U.S. Energy Information Administration #AEO2018

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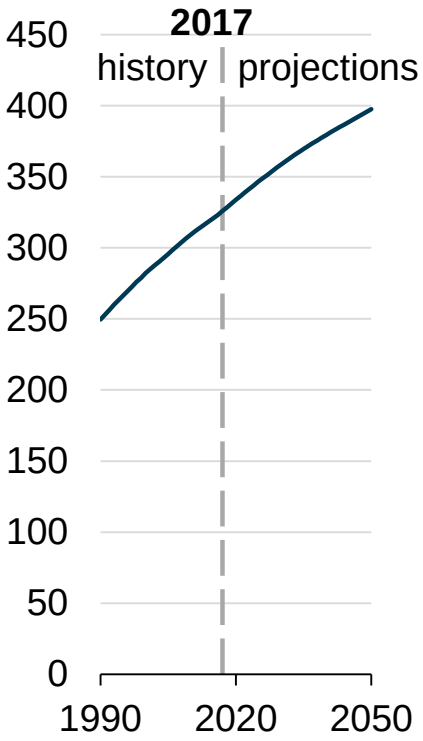
GLOBAL CO_2 LEVELS

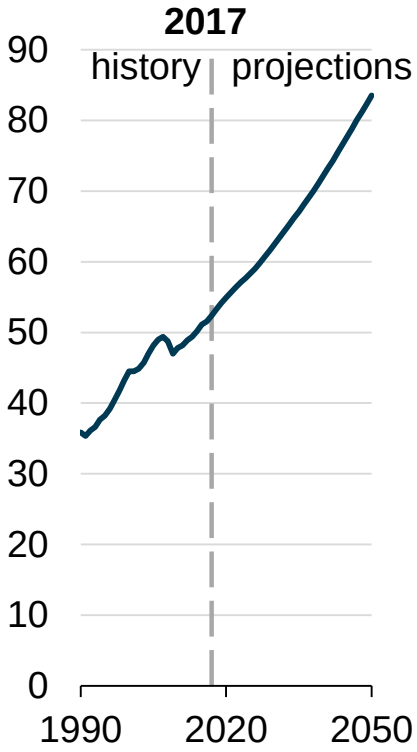
- In April 2018, CO_2 averaged over 410 PPM for the first time
- 2013 marked the first time levels surpassed 400 PPM
- The April 2018 level is higher than any point in the last 800,000 years
- 2017 increase was 1.4 PPM after 3 years of holding steady
- Increased emissions from China, India and Indonesia
- Renewables are growing; but not fast enough
- Slight increase in coal in 2017
- Increasing SUV sales
- Less focus on efficiency

Population and Economic Output Per Capita Continue Rising; Energy and Carbon Intensity Decrease

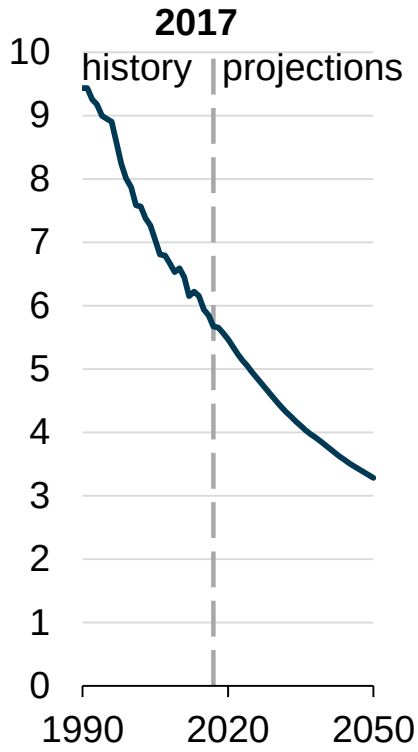
U.S. population
million people



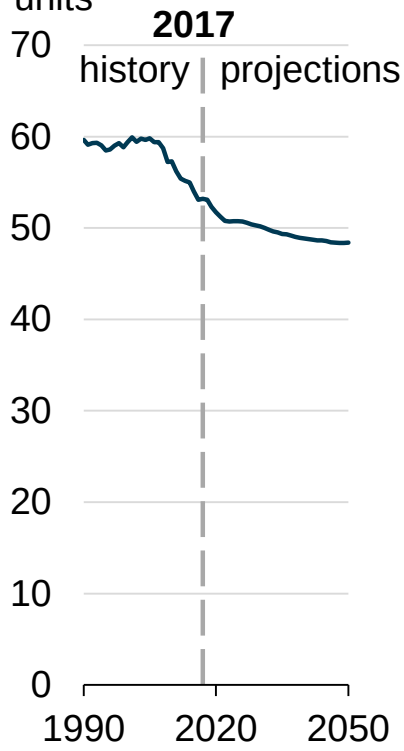
GDP per capita
thousand dollars per person



Energy intensity
thousand British thermal units per dollar



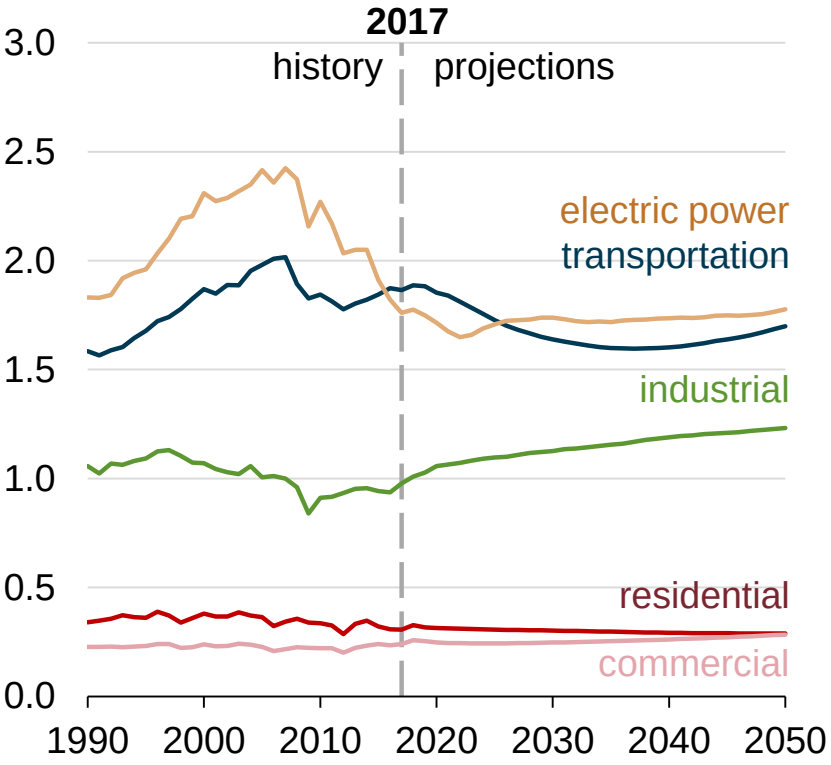
Carbon intensity
metric tons CO2 per billion British thermal units



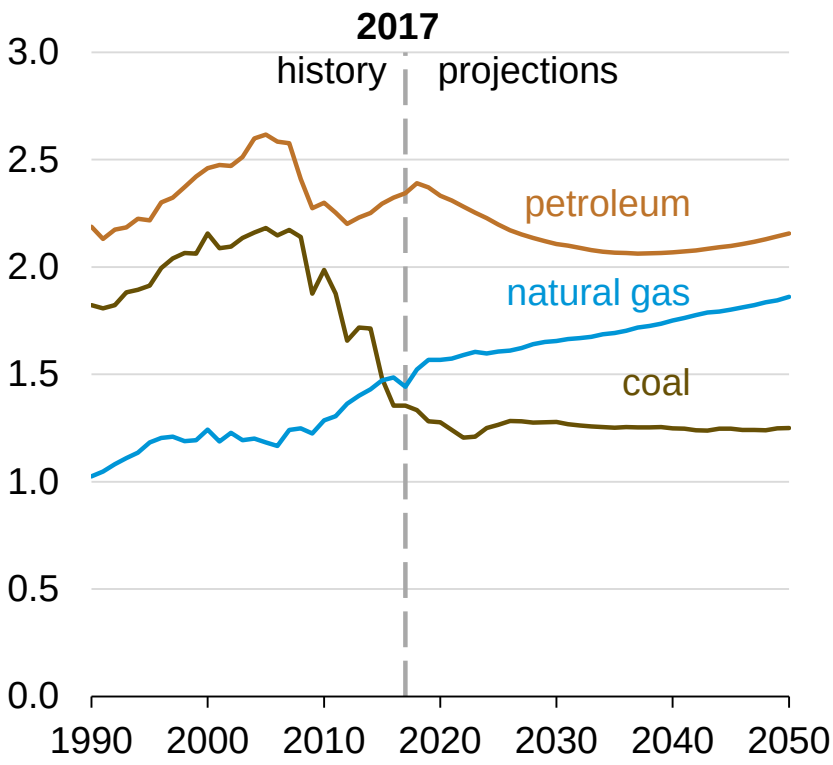
Source: U.S. Energy Information Administration #AEO2018

PROJECTED ENERGY-RELATED CARBON DIOXIDE EMISSIONS

Energy-related carbon dioxide emissions by sector
billion metric tons of carbon dioxide



Energy-related carbon dioxide emissions by fuel
billion metric tons of carbon dioxide



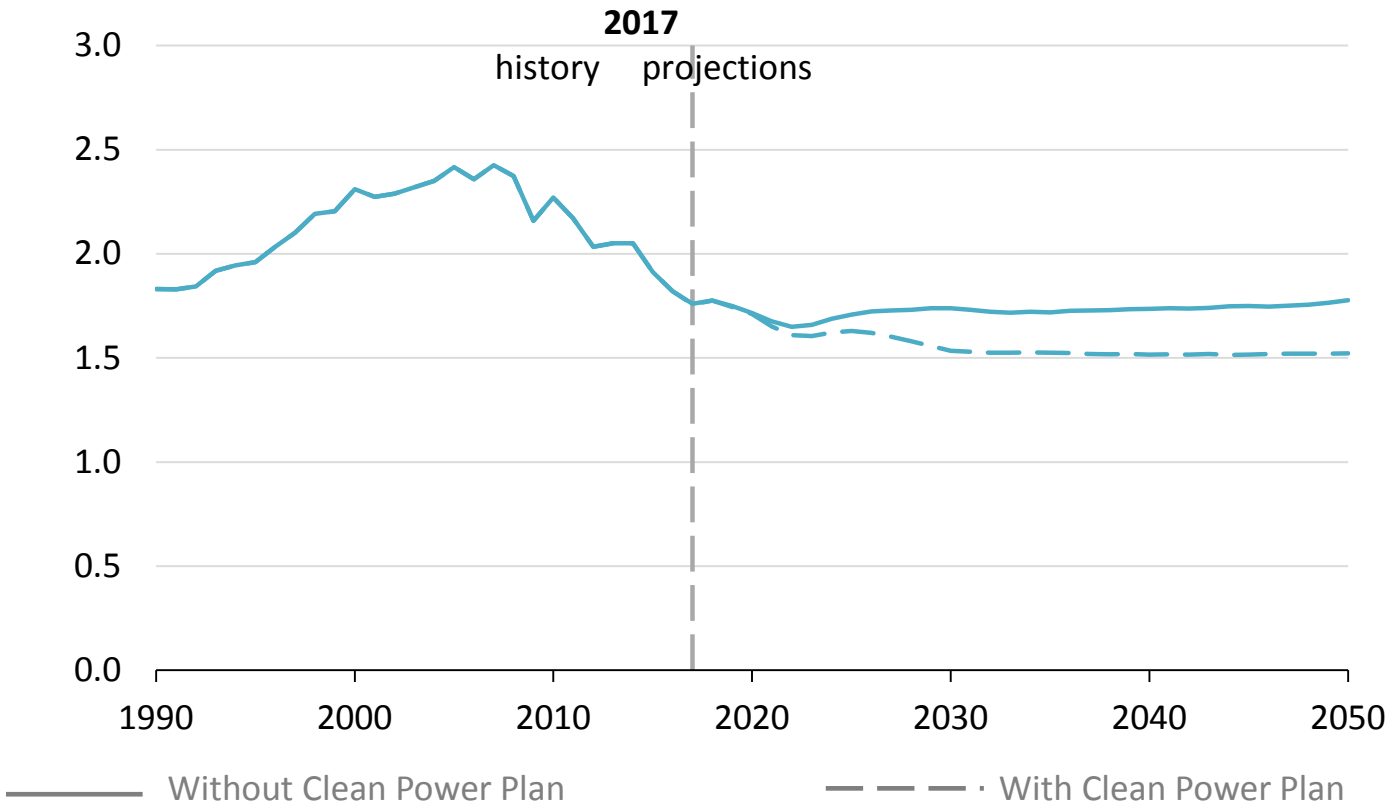
Source: U.S. Energy Information Administration #AEO2018

CLEAN POWER PLAN

- Obama's EPA Plan to reduce CO_2 emissions from existing and new power plants
- Essentially set up a state-by-state process to reduce coal power and increase alternatives and efficiency
- Trump's EPA has proposed repeal, arguing it exceeded statutory authority (beyond the fence)
- Repeal likely effective this year with a more limited replacement (within the fence)

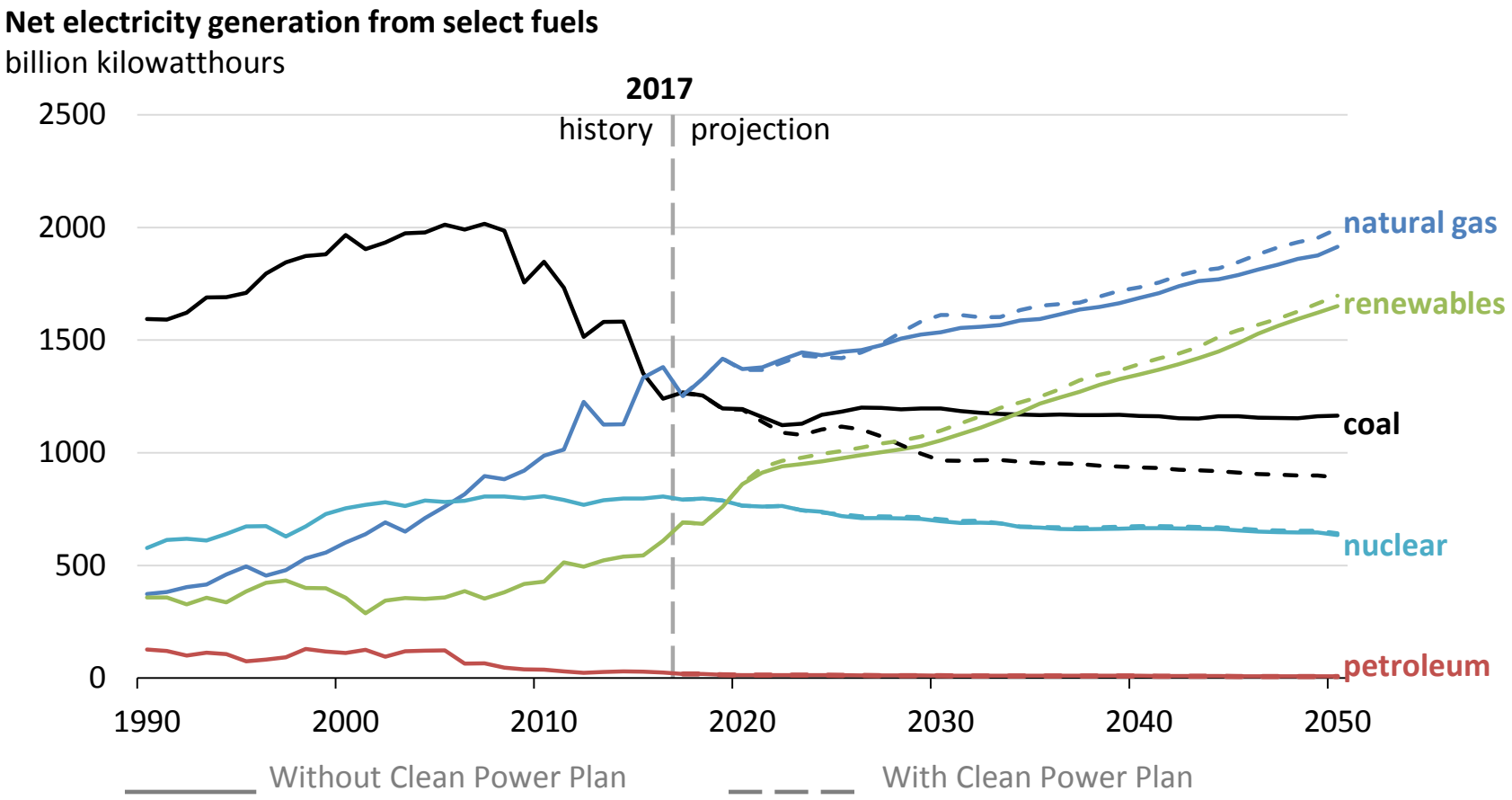
The Projected Effect of the Clean Power Plan on Carbon Dioxide Emissions

Electricity-related carbon dioxide emissions
billion metric tons of carbon dioxide



Source: U.S. Energy Information Administration #AEO2018

COAL-FIRED ELECTRICITY GENERATION REMAINS AT A HIGHER LEVEL WITHOUT THE CLEAN POWER PLAN



Source: U.S. Energy Information Administration #AEO2018

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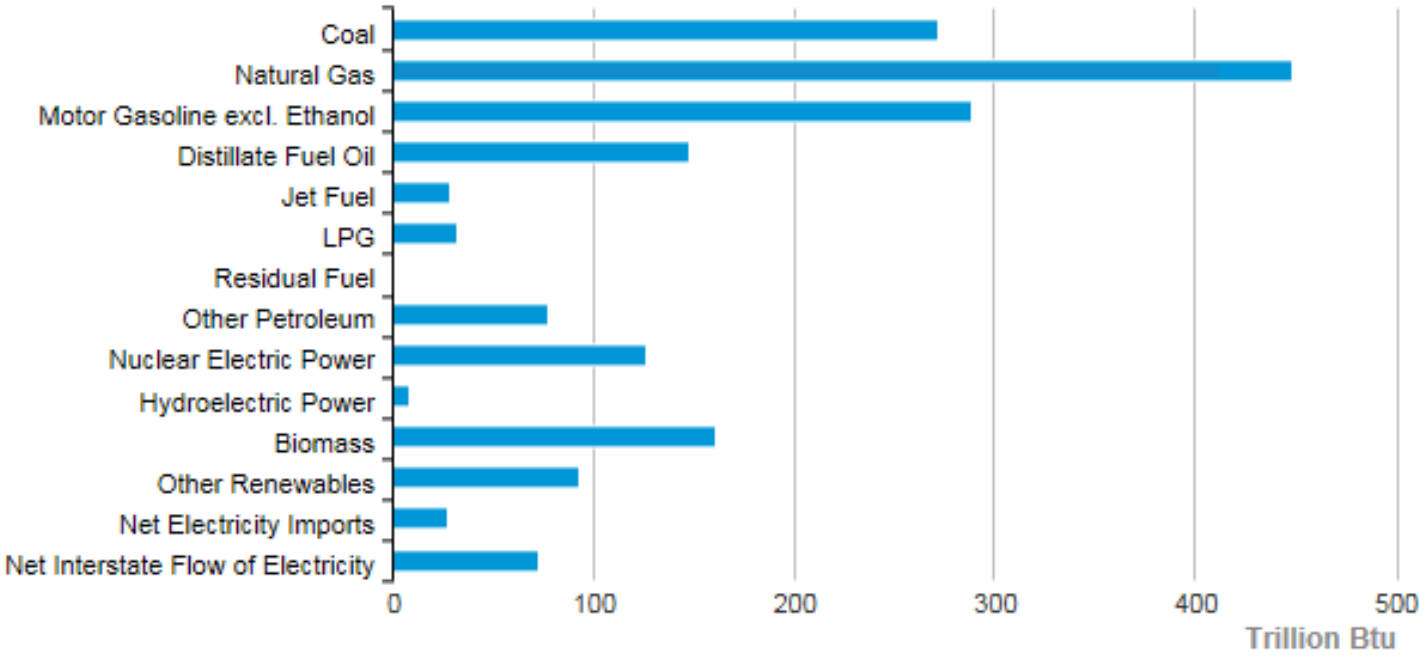
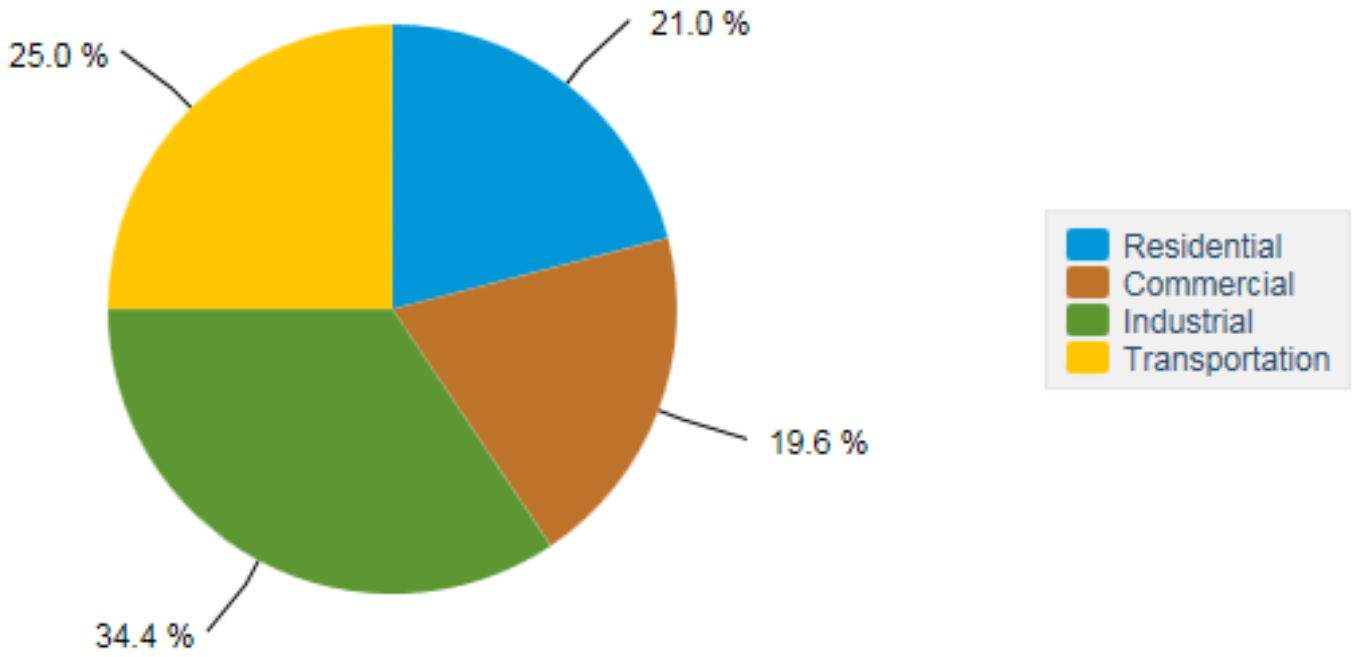
MINNESOTA ENERGY CONSUMPTION ESTIMATES, 2015



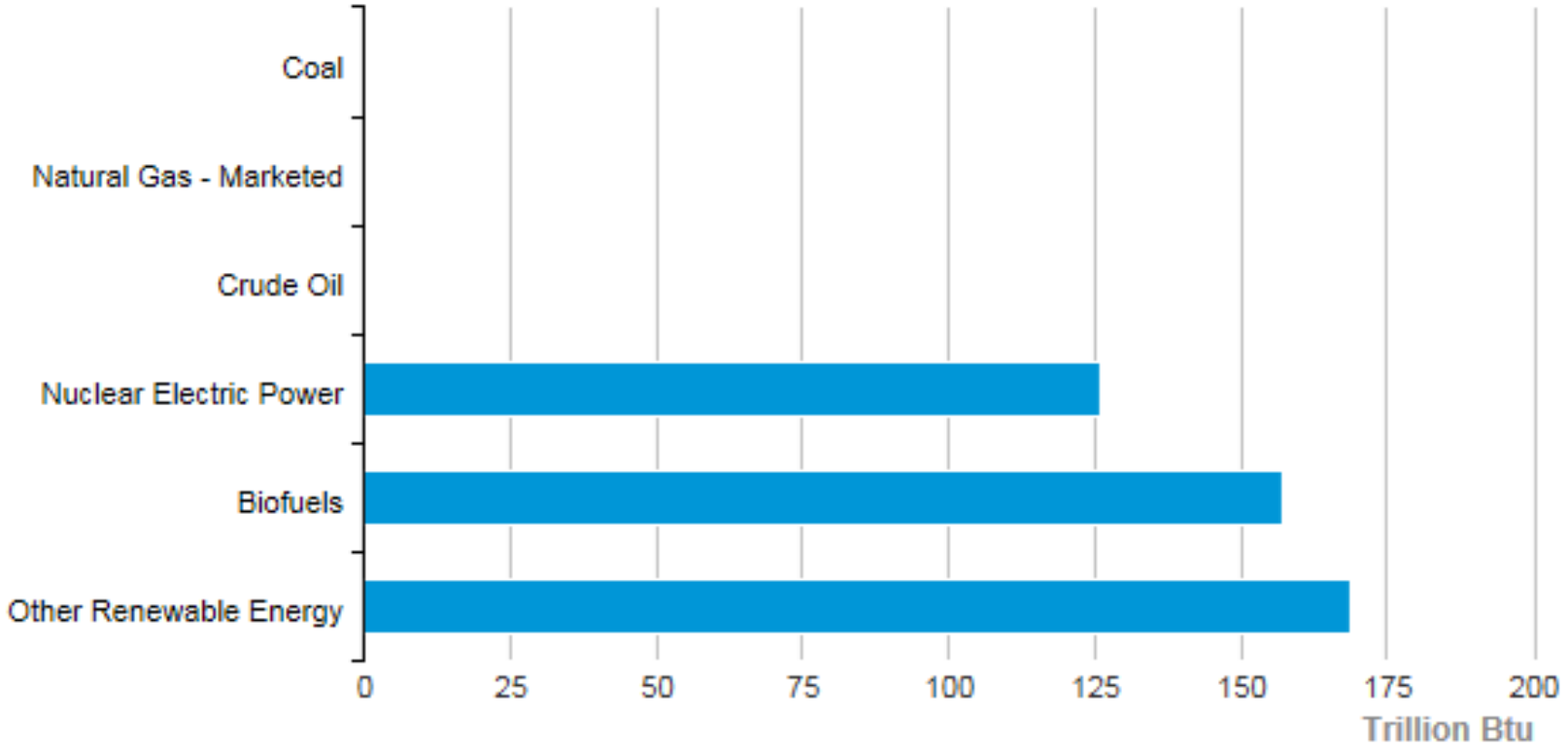
Source: U.S. Energy Information Administration , State Energy Data System

MINNESOTA ENERGY CONSUMPTION BY END-USE SECTOR, 2015



Source: U.S. Energy Information Administration , State Energy Data System

MINNESOTA ENERGY PRODUCTION ESTIMATES, 2015



Source: U.S. Energy Information Administration , State Energy Data System

MINNESOTA FACTS

- In 2017, Minnesota ranked fourth in the nation in ethanol production capacity and fourth in operating production
- The Pine Bend Refinery, the largest oil refinery in Minnesota, is the largest oil refinery located in a non-oil-producing state
- About 39% of utility-scale electricity generation in Minnesota came from coal-fired electric power plants in 2017, down from 49% in 2014

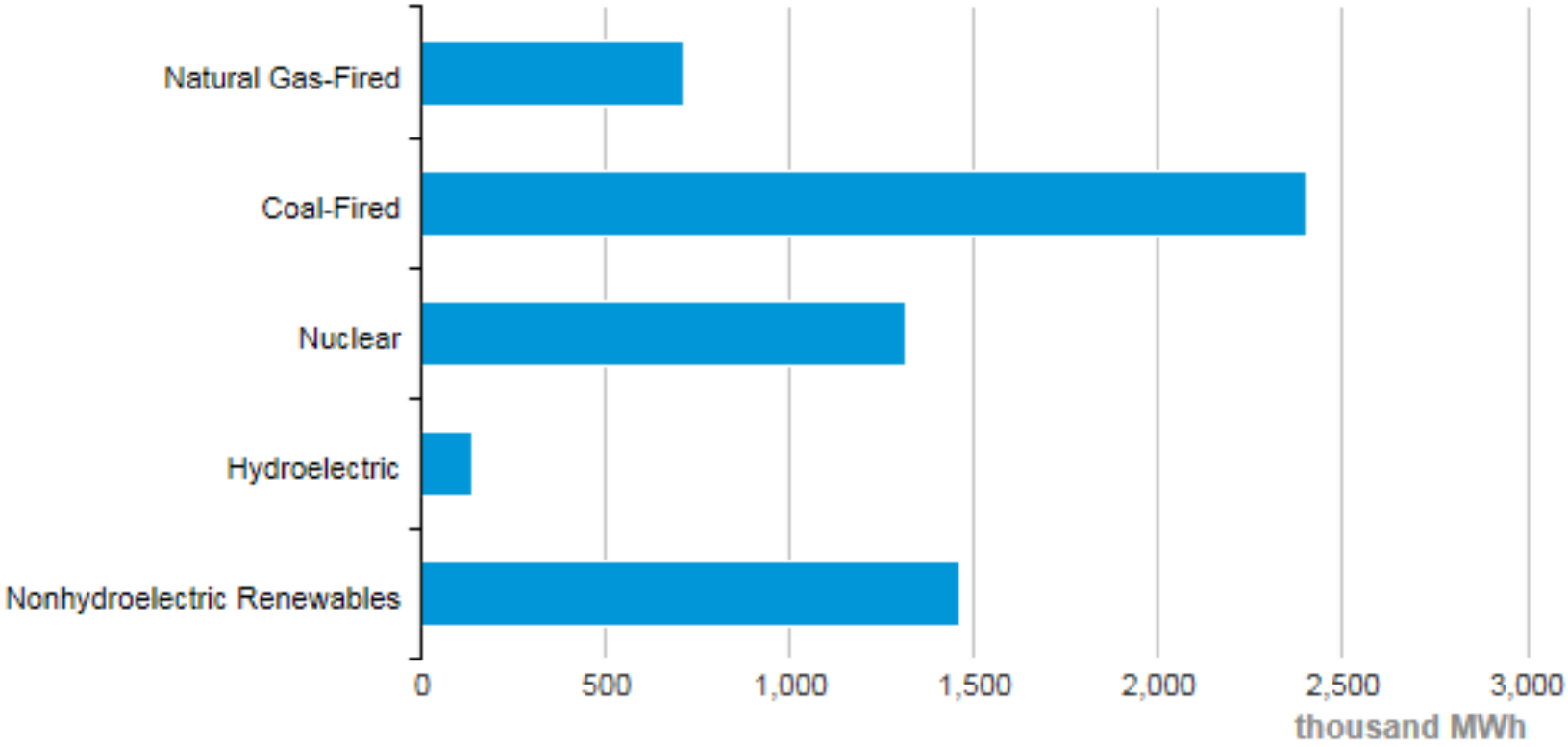
Source: U.S. Energy Information Administration , State Energy Data System

MINNESOTA FACTS (continued)

- Minnesota's two nuclear power plants, Monticello and Prairie Island, accounted for 23% of the state's net electricity generation in 2017
- In 2017, Minnesota ranked eighth in the nation in electricity net generation from wind energy

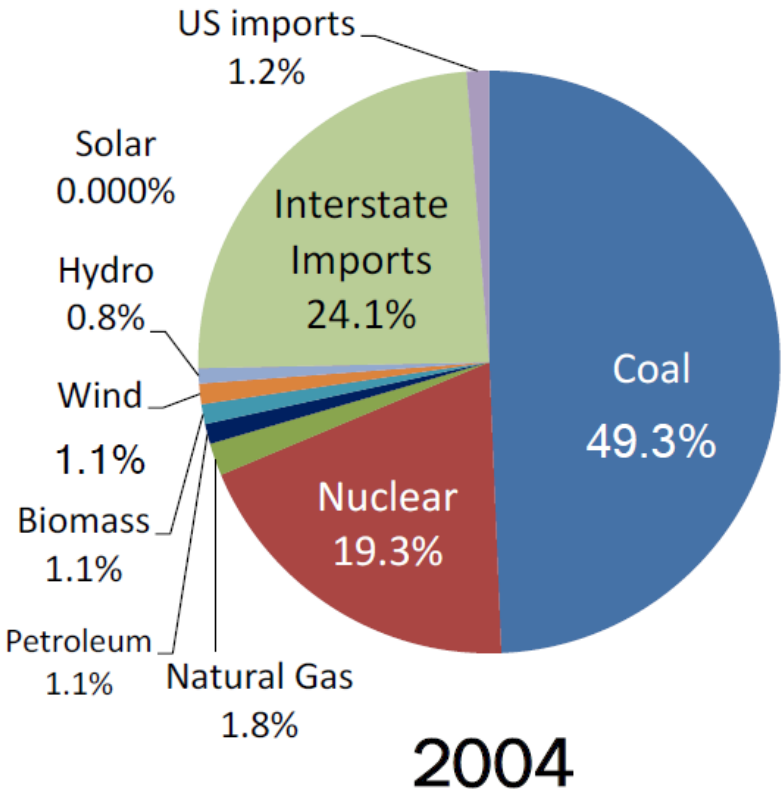
Source: U.S. Energy Information Administration , State Energy Data System

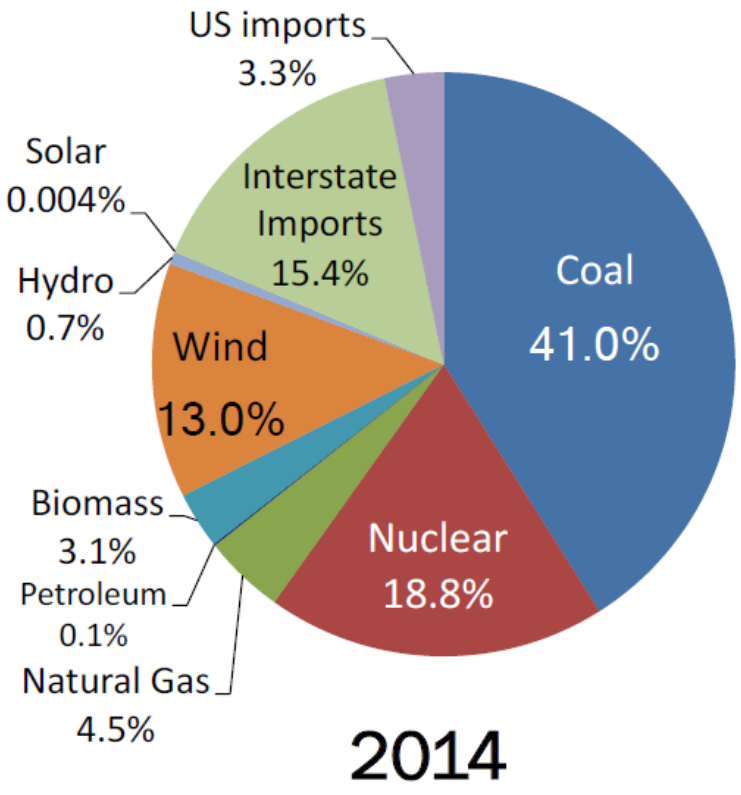
Minnesota Net Electricity Generation by Source, Jan. 2018



Source: U.S. Energy Information Administration , Electric Power Monthly

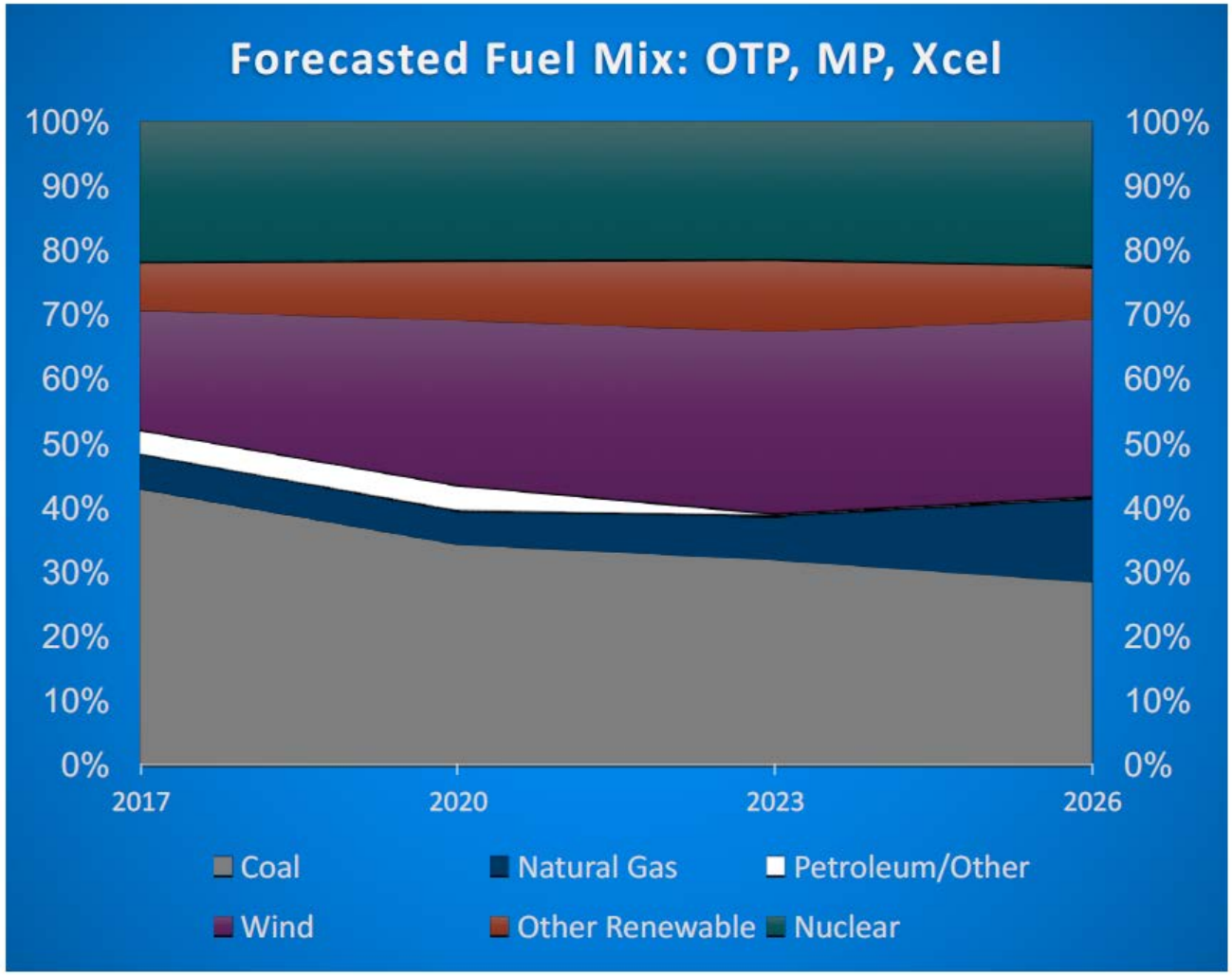
MINNESOTA'S ELECTRICITY CONSUMPTION BY SOURCE





Source: State Energy Data System, Energy Information Administration, U.S. Dept. of Energy

FORECASTED FUEL MIX



Source: Minnesota Energy Office

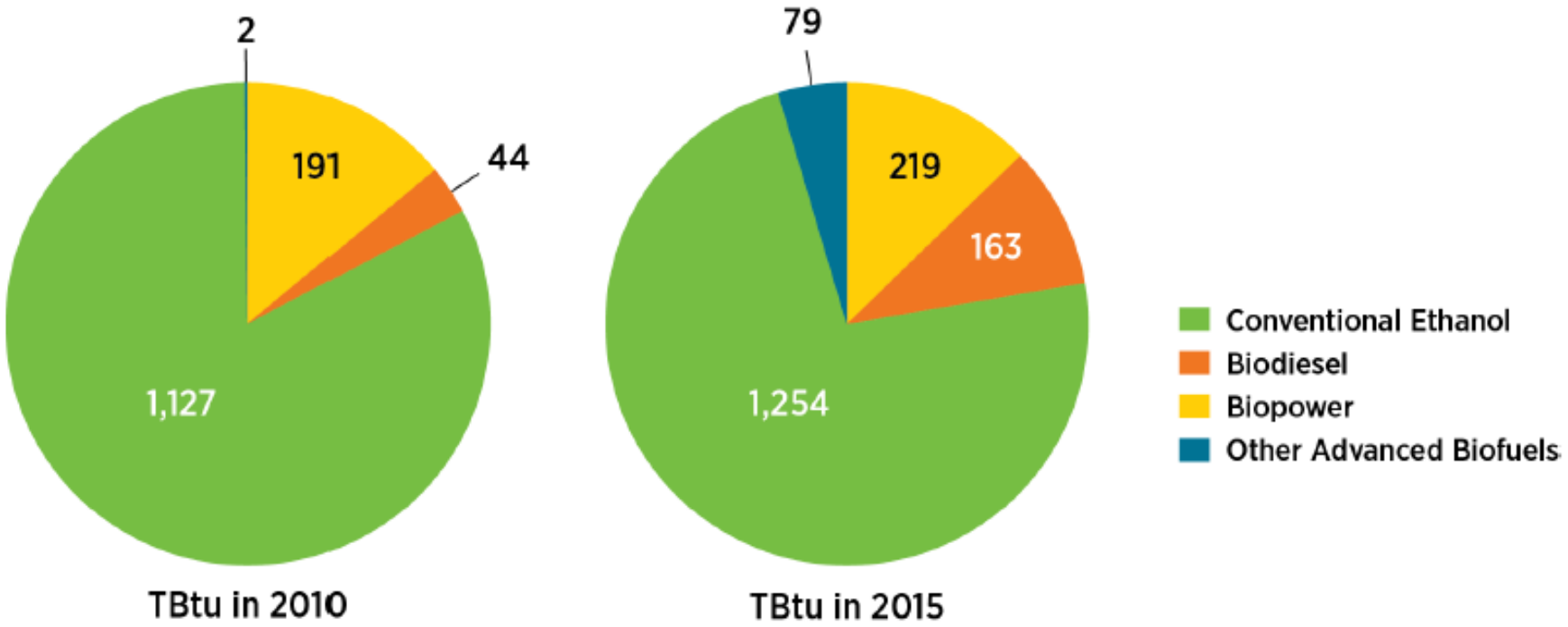
ELECTRIC UTILITIES UNDER PRESSURE

- Reduce CO_2
- Xcel has stated goal of 85% carbon free by 2030
- Hawaii legislation to be carbon neutral by 2045
- Distributed generation pressure
- California to require rooftop solar for all new homes starting in 2020
- Increased net metering goals
- Transition from cost-of-service (capital intensive) regulation to performance-based regulation (rewarded for meeting performance goals)

MINNESOTA PROFILE

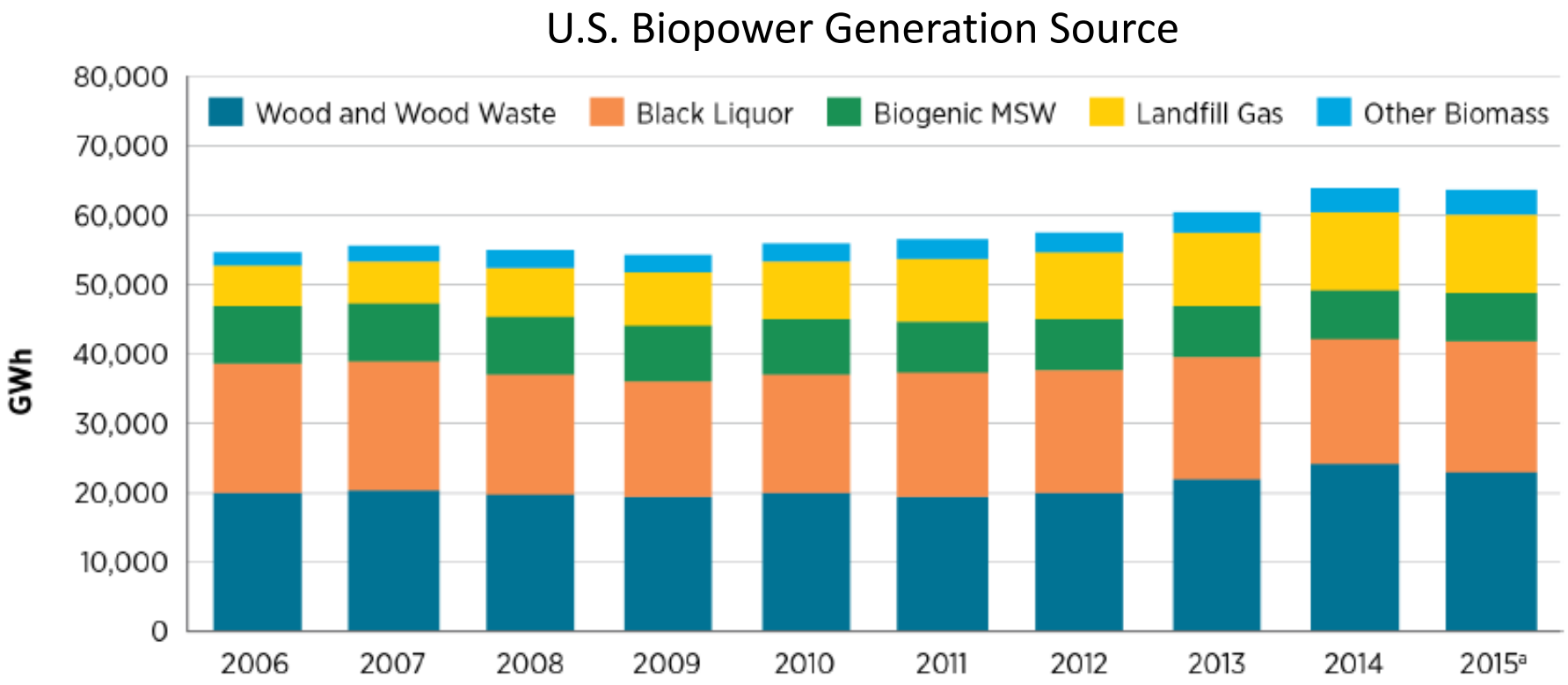
- Significant solar growth
- Huge demand for community solar
- Substantial push on electric vehicles
- Continued coal retirements (Otter Tail, Minnesota Power, Xcel Sherco 1 & 2)
- Role of nuclear (Monticello and Prairie Island) to be decided
- Resource plans from Xcel, Otter Tail, Minnesota Power and Great River Energy due in 2019 (15 year planning horizon)

U.S. BIOENERGY MARKET



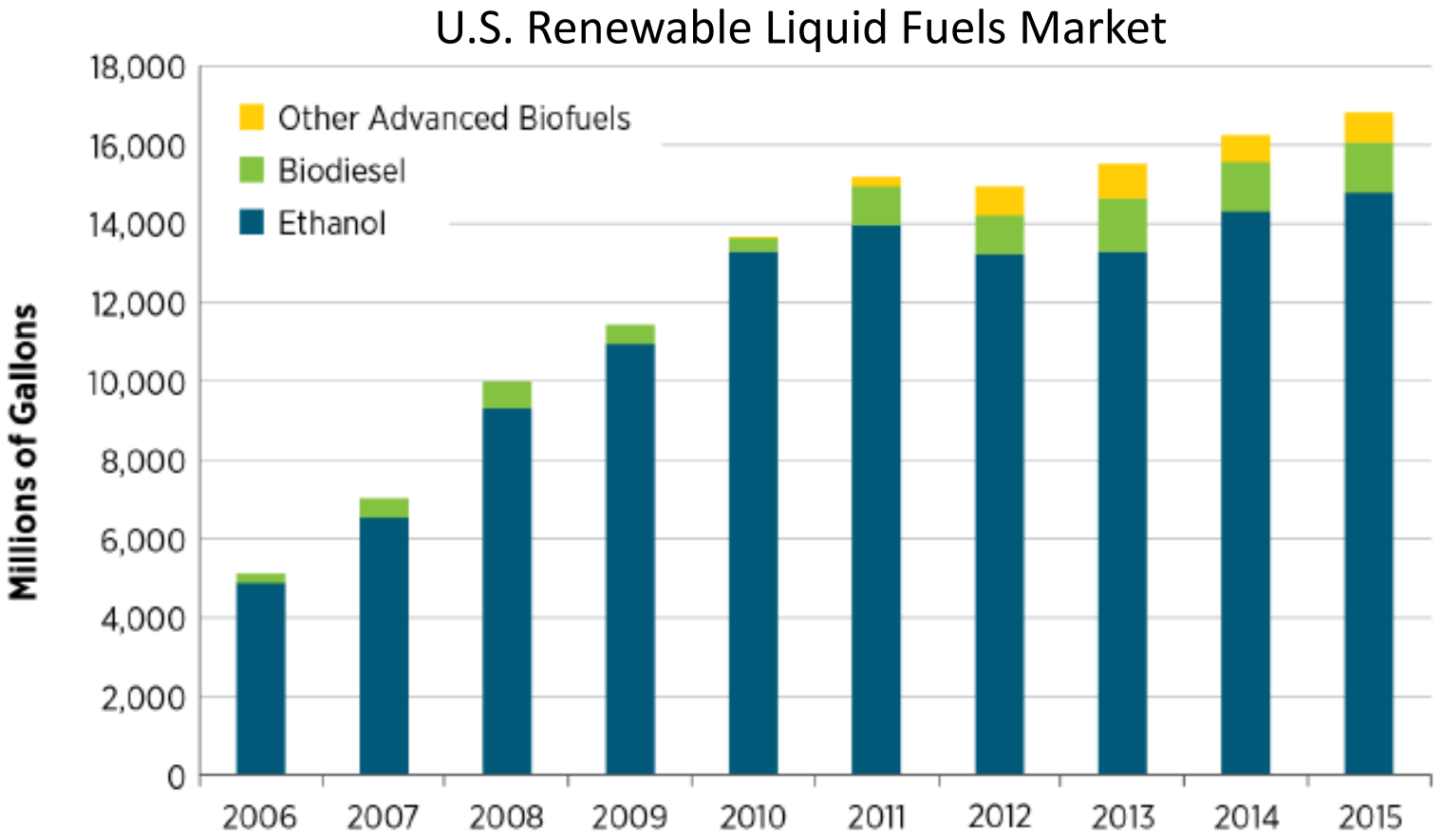
Source: 2015 USDA Bioenergy Market Report

U.S. BIOENERGY MARKET



Source: 2015 USDA Bioenergy Market Report

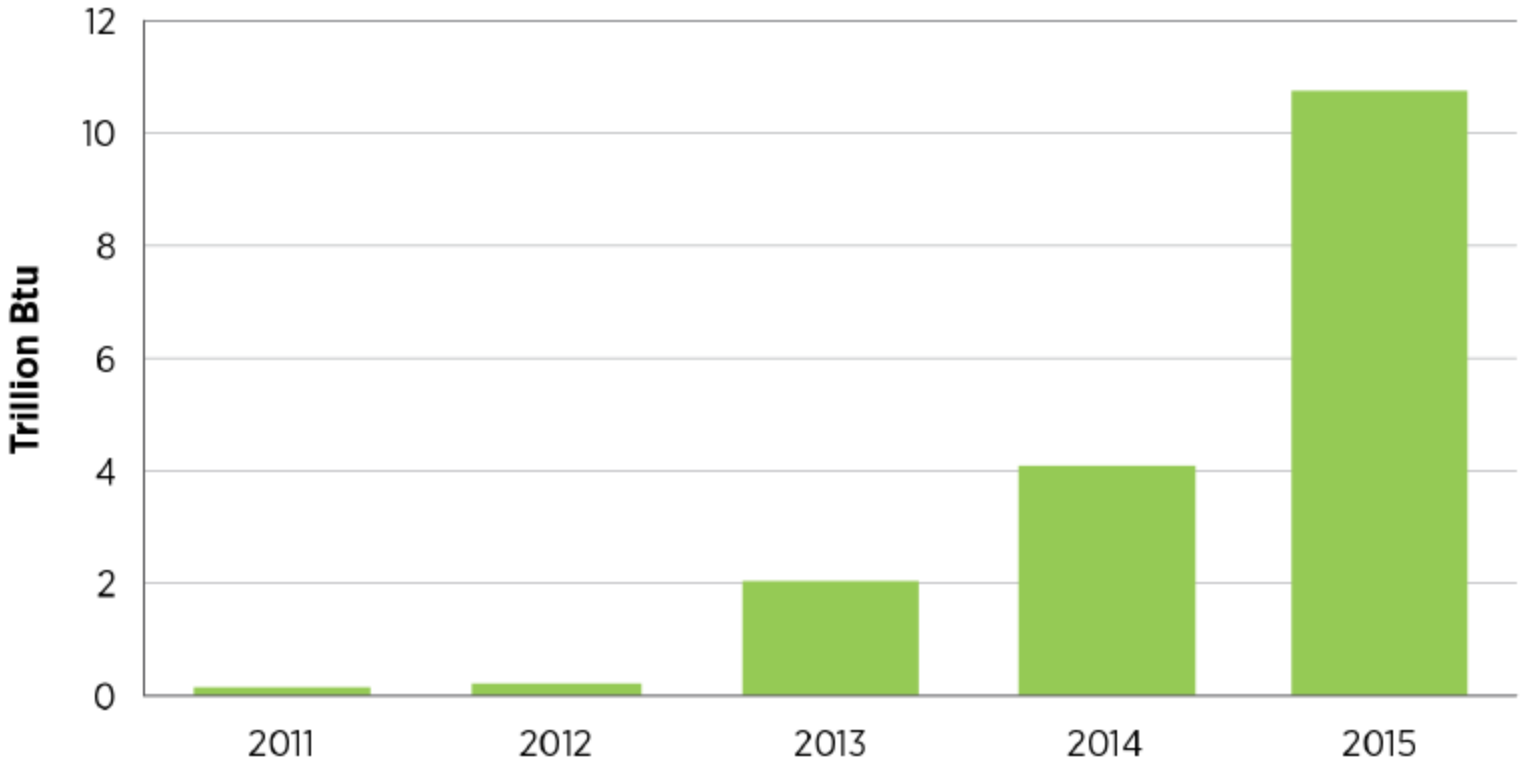
U.S. BIOENERGY MARKET



Source: 2015 USDA Bioenergy Market Report

U.S. BIOENERGY MARKET

U.S. Historical RNG Production for Transportation Under the RFS



Source: 2015 USDA Bioenergy Market Report

Pressure on Bioenergy

- Likely closure of 3 biomass to electricity plants in Minnesota
- Xcel claimed highest cost plants and closure could save $700 Million over 11 years
- Potential reform of federal renewable fuel standards supporting ethanol and advanced biofuels
- Possible deletion of energy section of U.S. Farm Bill
- Potential loss of Great River Energy Refuse-Derived Fuel Plant in Elk River

BRIEF CONCLUSIONS

- Biomass to electricity will continue to be economically challenging in competition with other renewables
- Biogas and biofuels end markets present greater long term potential than biopower
- MSW and organics as feedstock have primary purpose of managing waste; with ability to balance economics through tipping fees
- Further enhanced by public ownership/operation and waste designation (flow control)