Natural Gas Outlook of U.S. to 2050

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Contents

Introduction

Natural gas was the United States' largest source of energy consumption, representing 21.4 percent of global demand in 2019. The natural gas demand of U.S. is almost 68 percent larger than the second largest consumption country (Russia). The total consumption of United States in 2019 is 31 trillion cubic feet, with a growth rate of 3.12%.

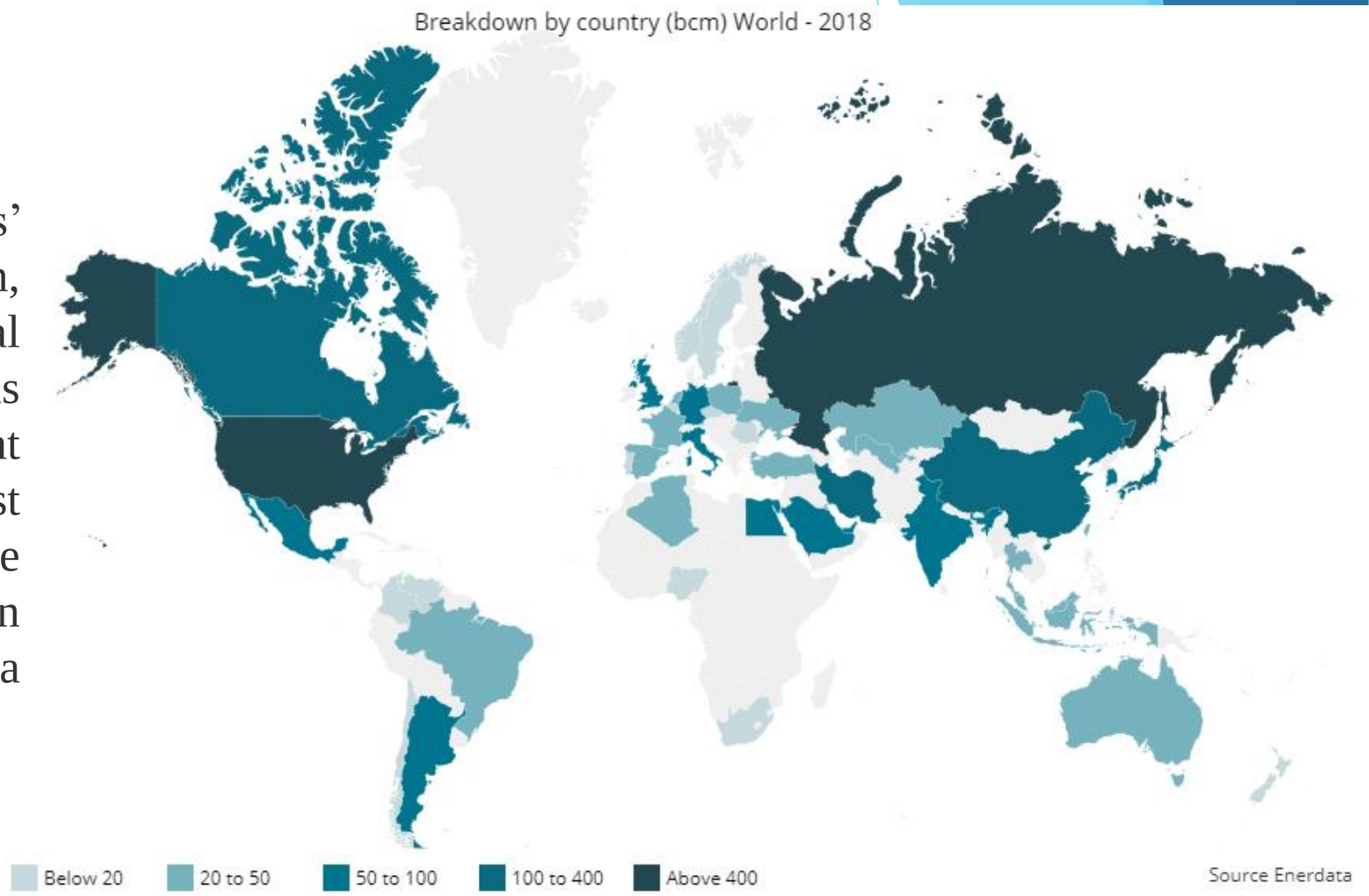


Figure 1. Global demand breakdown by country (unit: bcm)
Source: Enerdata

Natural Gas Consumption

- Today's residential and commercial markets are dominated by natural gas and electricity, which together meet 85-90% of the energy needs of U.S. homes and commercial businesses.

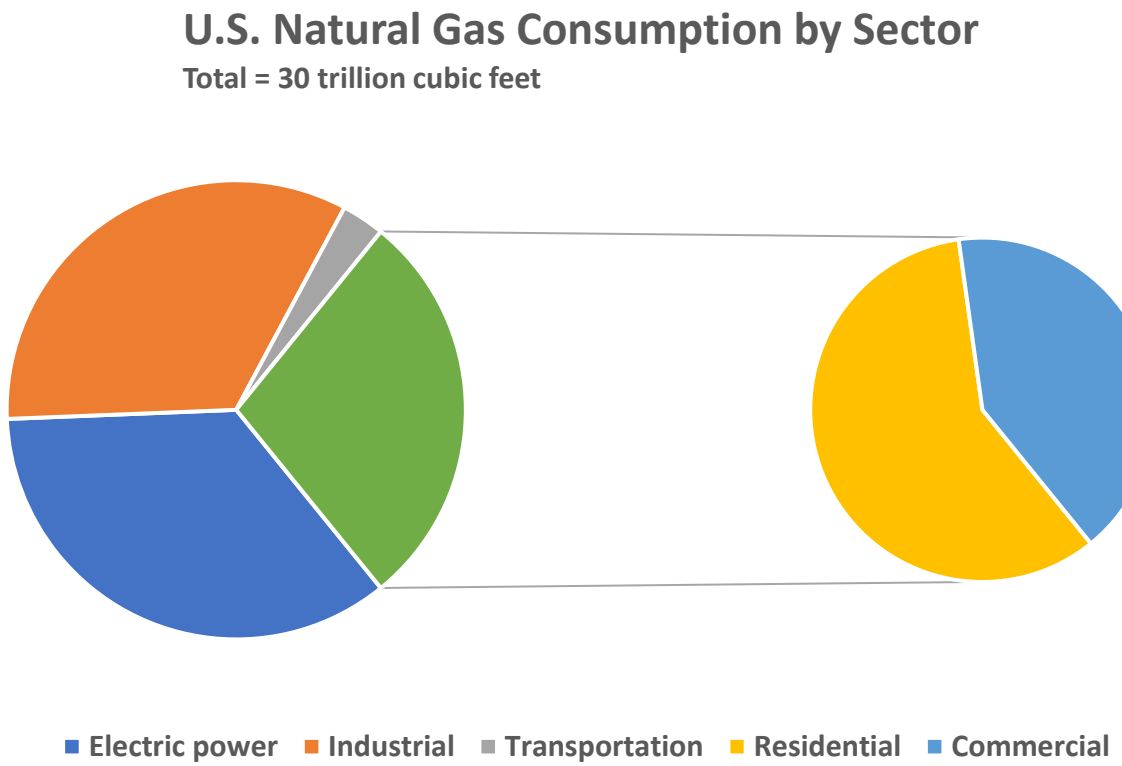


Figure 2. Gas consumption by sector in United States (unit: Tcf)
Source: Energy Information Administration

Residential and Commercial Use of Natural Gas

- The **residential sector** uses natural gas to heat buildings and water, to cook, and to dry clothes. About half of the homes in the United States use natural gas for these purposes. In 2018, the residential sector accounted for about 17% of total U.S. natural gas consumption, and natural gas was the source of about 24% of the U.S. residential sector's total energy consumption.
- The **commercial sector** uses natural gas to heat buildings and water, to operate refrigeration and cooling equipment, to cook, to dry clothes, and to provide outdoor lighting. Some consumers in the commercial sector also use natural gas as a fuel in combined heat and power systems. In 2018, the commercial sector accounted for about 12% of total U.S. natural gas consumption, and natural gas was the source of about 19% of the U.S. commercial sector's total energy consumption.

Descriptive Statistics

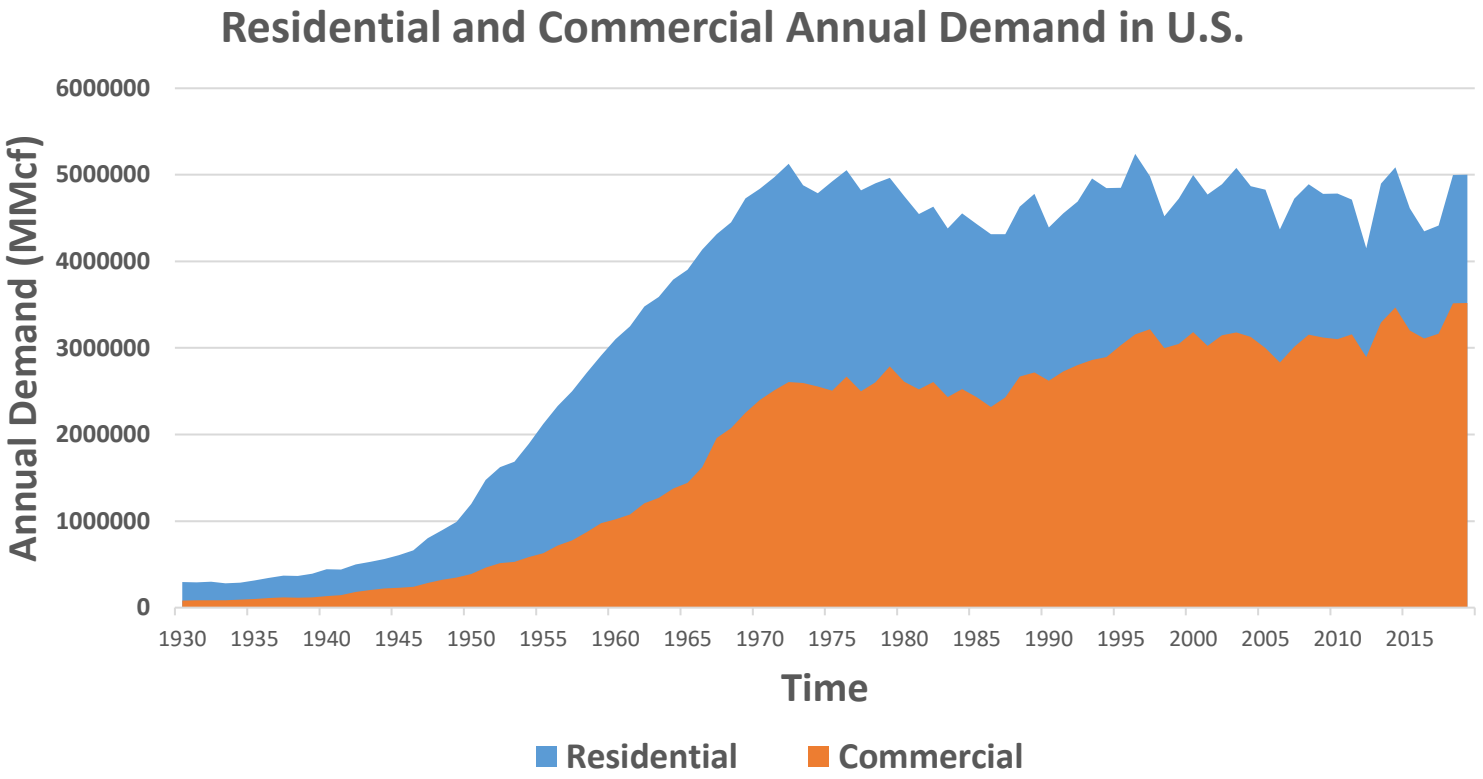


Figure 3: Annual Demand of Natural Gas
Source: Energy Information Administration

Annual Price

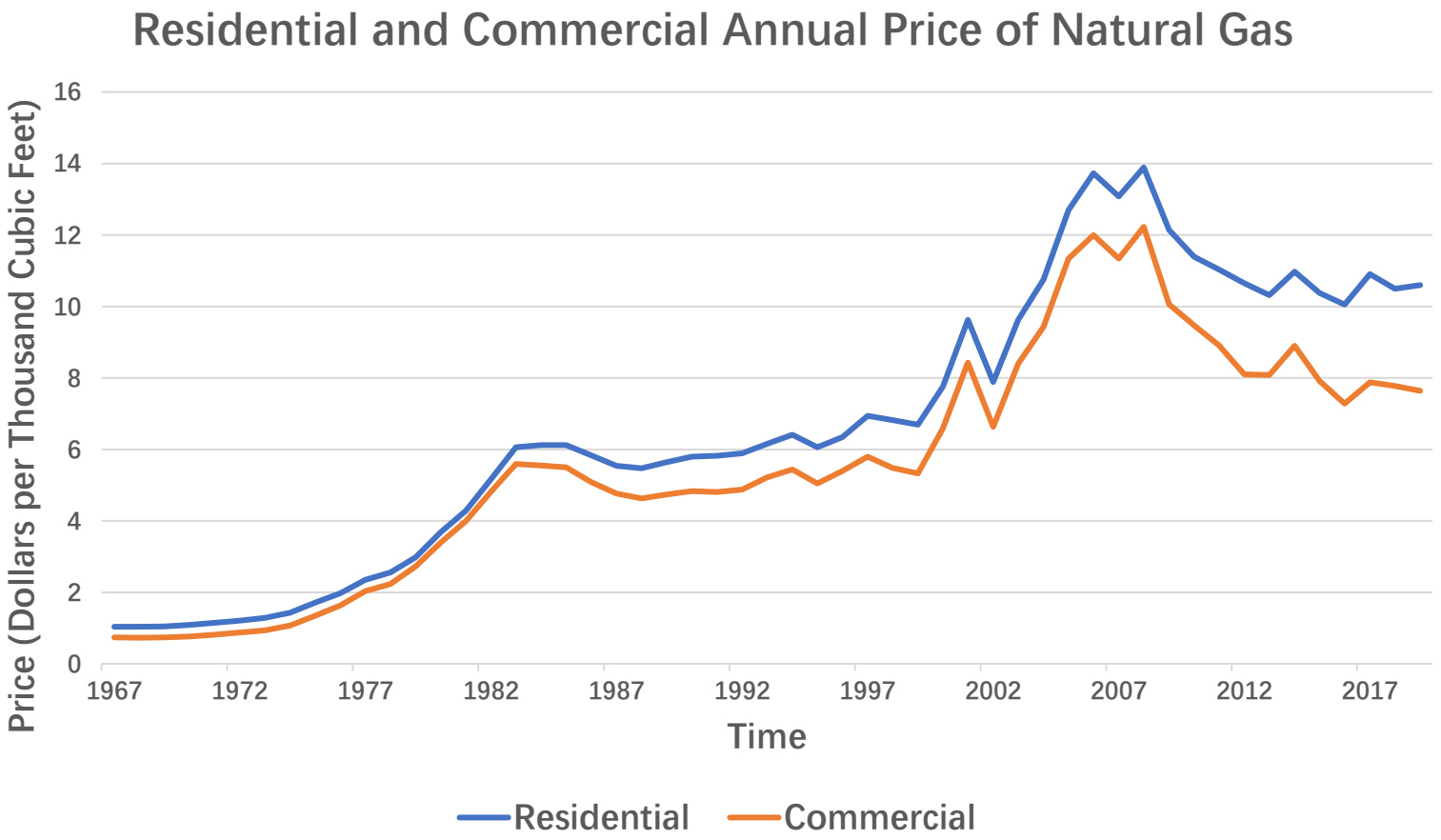


Figure 4: Annual Average price of Natural Gas in United States
Source: Energy Information Administration

Monthly Demand

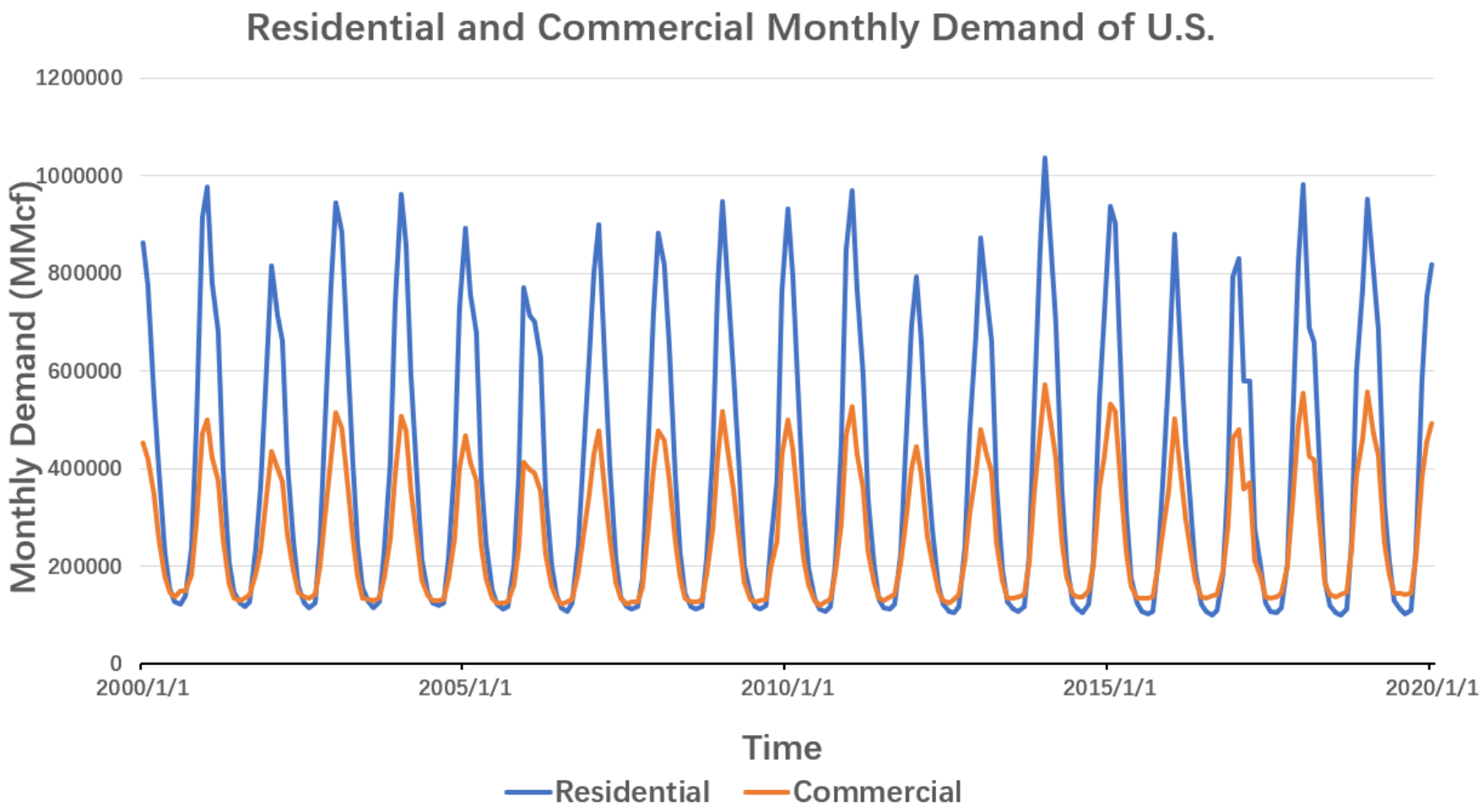


Figure 5: Monthly Average demand of Natural Gas
Source: Energy Information Administration

Weather issues

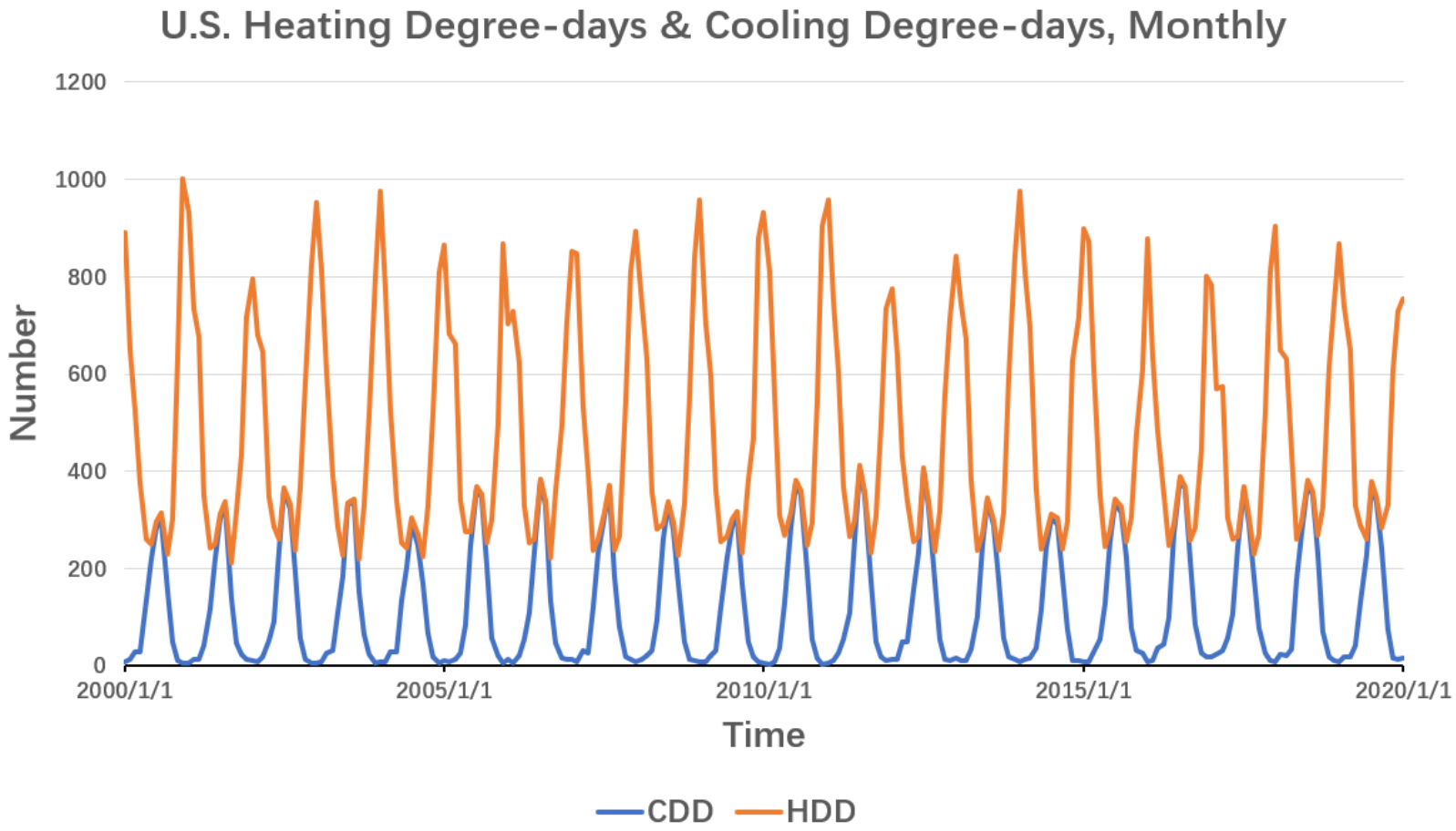


Figure 6: Monthly HDD and CDD data in United States
Source: Energy Information Administration

Macro and Demographic Variables

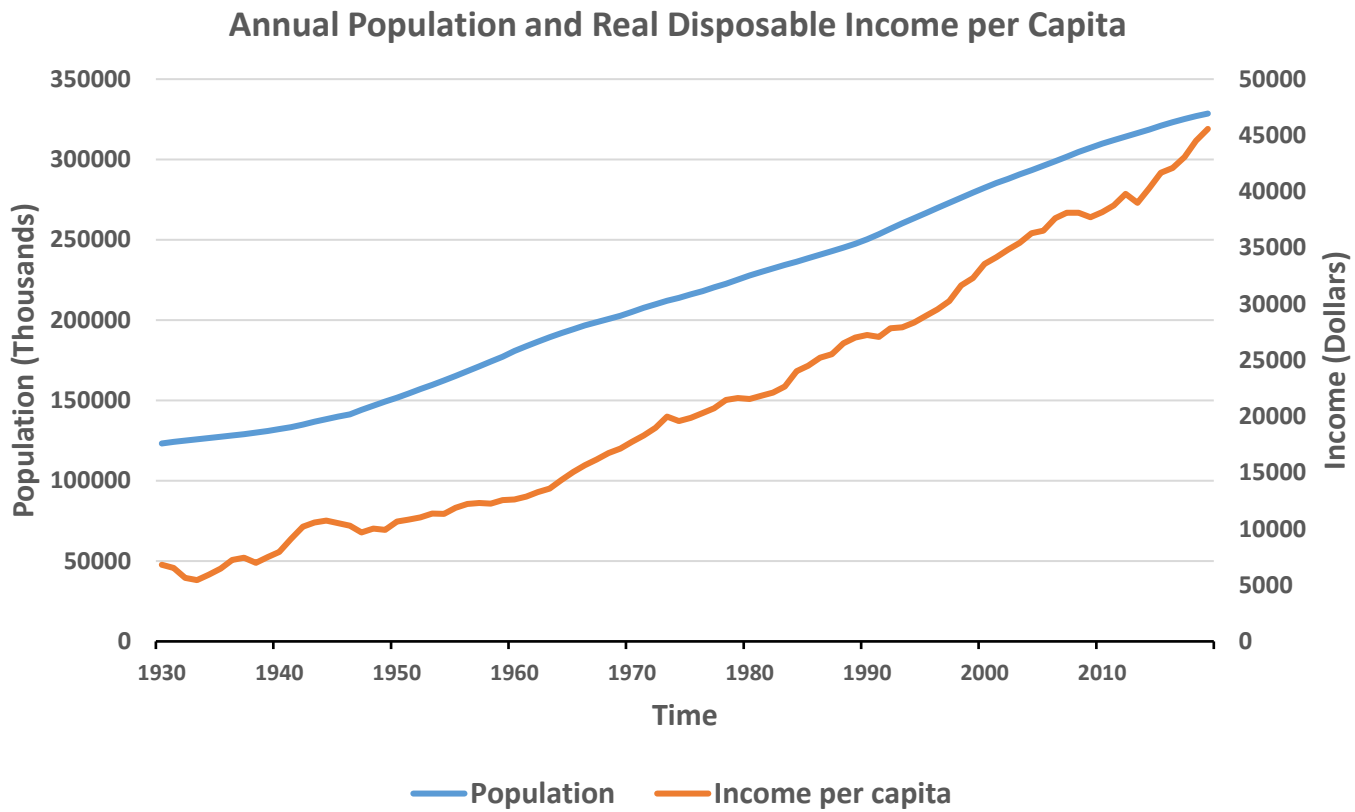


Figure 7: Annual Data Visualization of Macro and Demographic Variables
Source: U.S. Bureau of Economic Analysis

Model

- Residential Demand:

$$\ln(demand) = \beta_0 + \beta_1 \ln(Price) + \beta_2 \ln(Income) + \beta_3\ HDD + \beta_4\ Population + \ u$$

- Commercial Demand:

$$\ln(demand) = \beta_0 + \beta_1 \ln(Price) + \beta_2 \ln(Income) + \beta_3\ HDD + \beta_4\ CDD + \beta_5\ Population + \ u$$

- Total Demand:

$$\ln(demand) = \beta_0 + \beta_1 \ln(Price) + \beta_2 \ln(Income) + \beta_3\ HDD + \beta_4\ CDD + \beta_5\ Population + \ u$$

Regression Results

	Residential	Commercial	Total
(Intercept)	-4.48**	-7.32**	-6.69*
ln($Price$)	-0.09***	-0.07***	-0.13***
ln($Income$)	0.81***	1.05***	1.16**
Population	-6.29E-06***	-5.68E-06**	-5.13E-06*
HDD	0.00019***	0.00013***	0.00012**
CDD	NA	-0.00012	3.66E-05**
R-square	0.9673	0.5938	0.8252

Forecasting

Autoregressive Integrated Moving Average Models (ARIMA)

ARIMA(1,1,0): $$y_t = u + y_{t-1} + \varphi(y_{t-1} - y_{t-2})$$

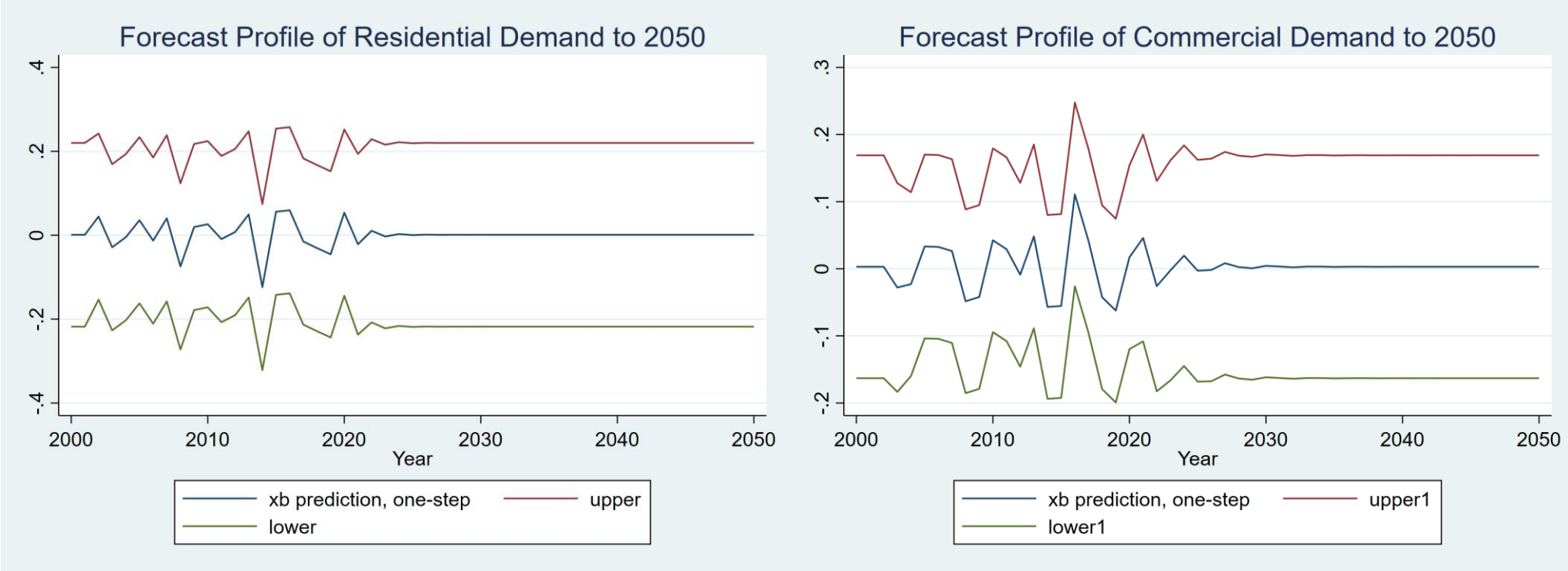
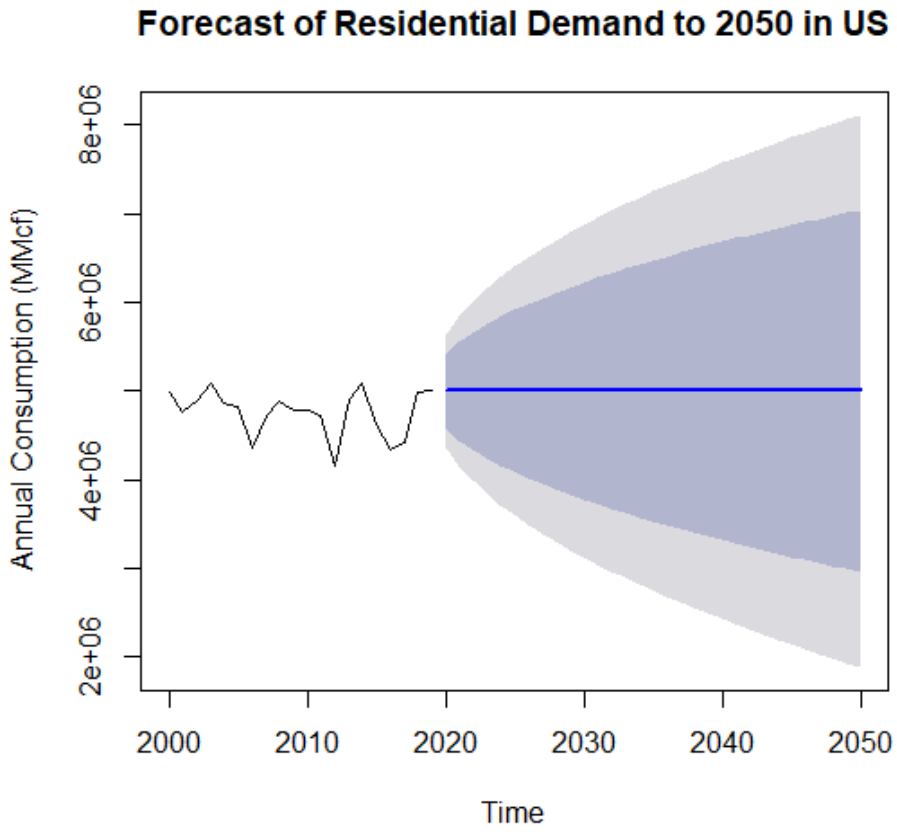


Figure 8: Forecast of Residential and Commercial Demand of Natural Gas to 2050 (Forecast in lagged log form)

Forecasting



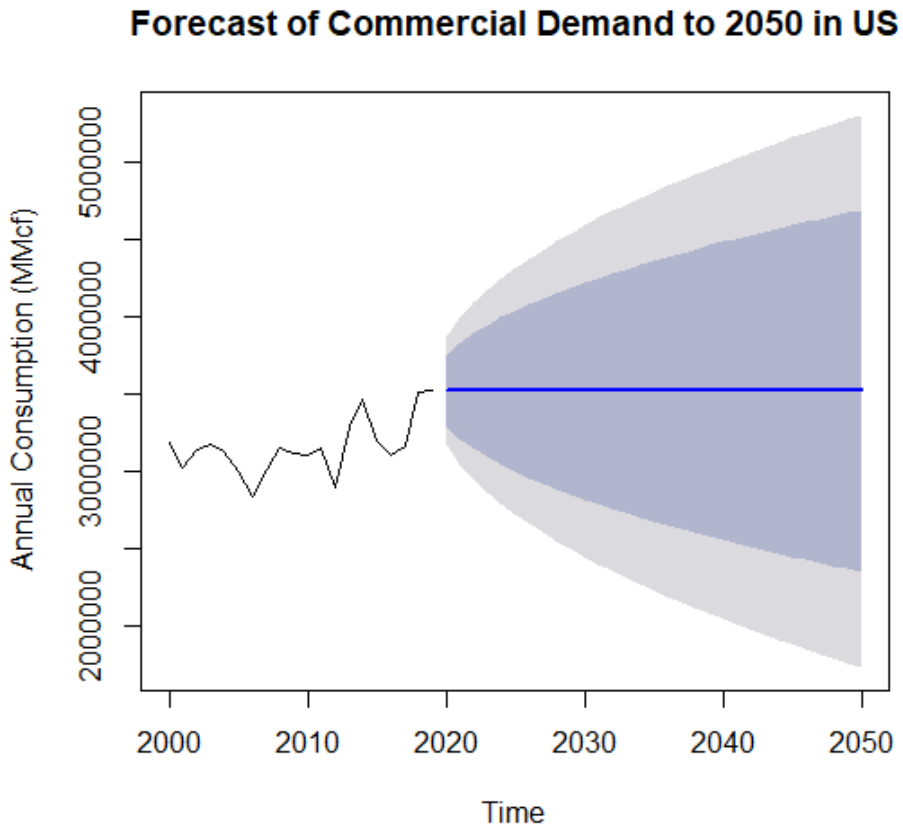
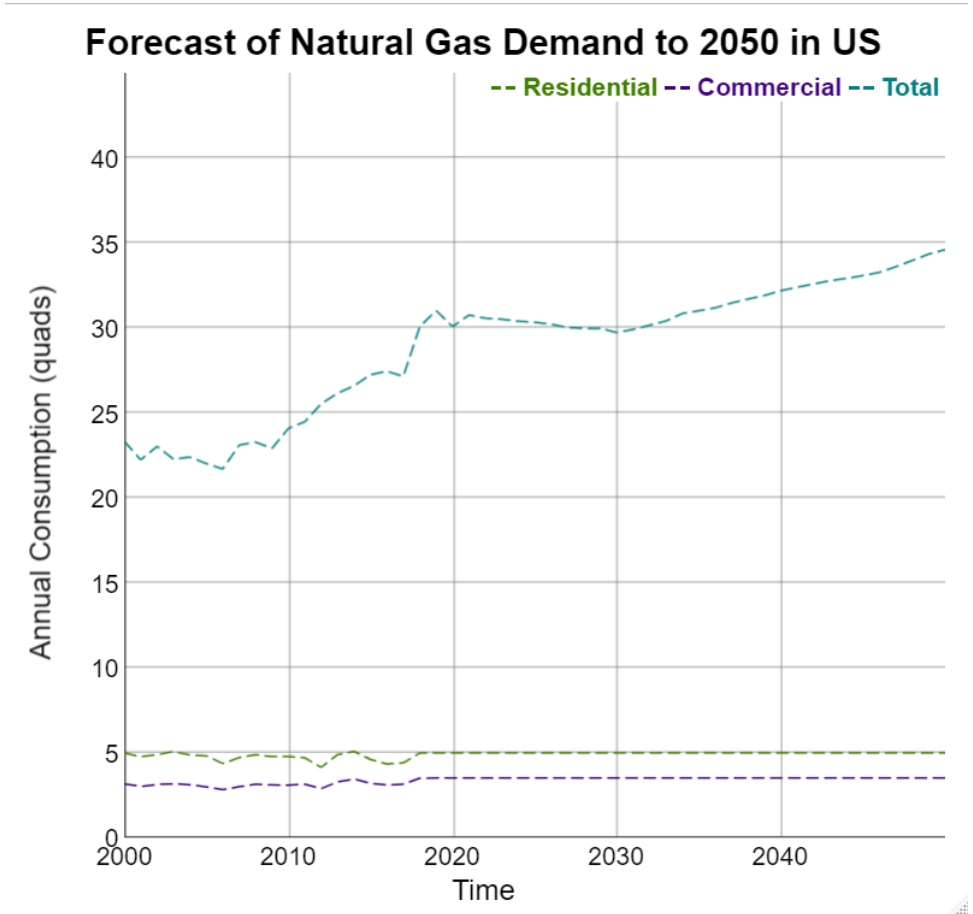


Figure 9: Forecast of Residential and Commercial Demand of Natural Gas to 2050 (Real numbers of Forecast))

Comparison to the EIA’ s Prediction



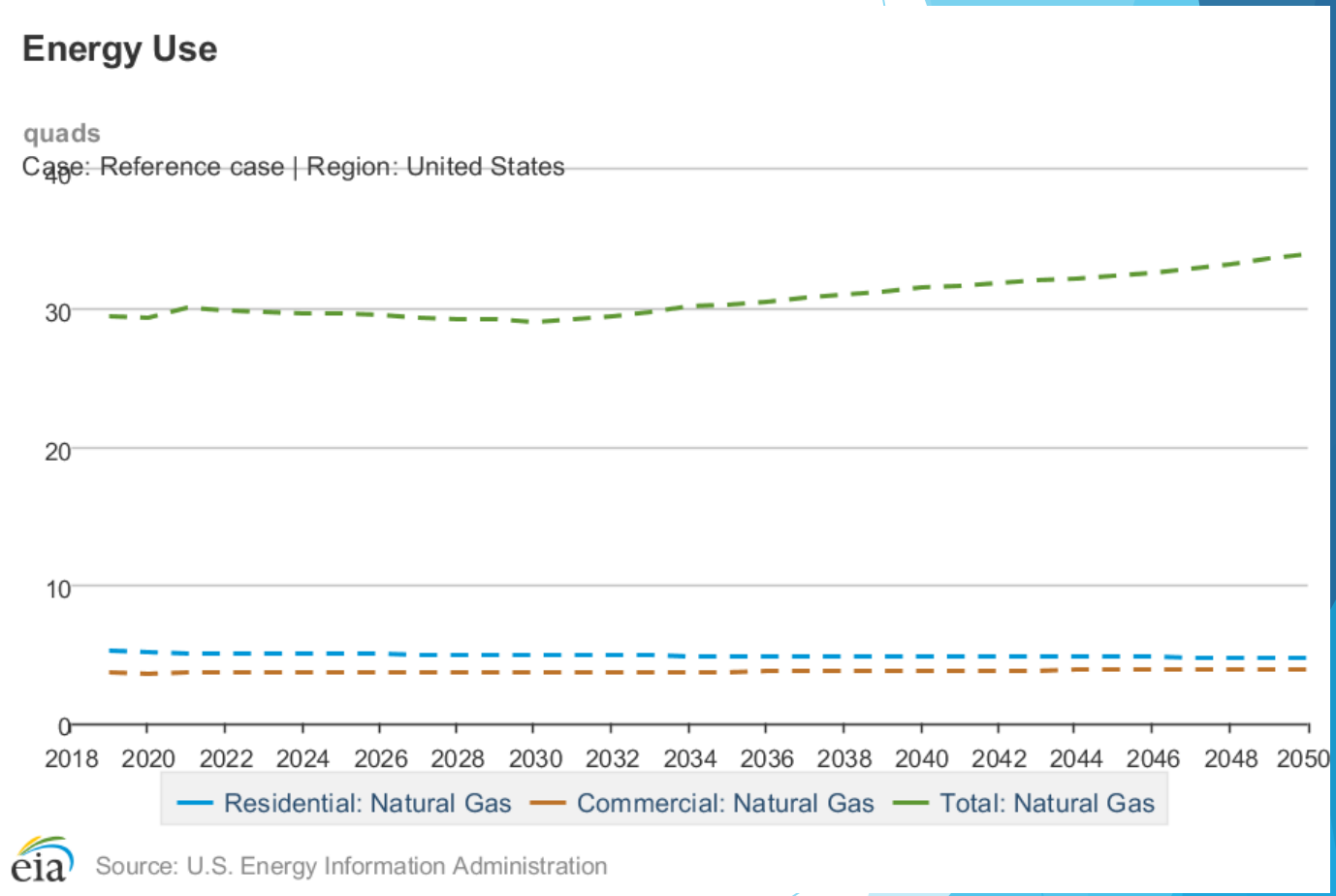


Figure 10: Total/Residential/Commercial Demand Forecast Results and EIA’s Forecast in 2019

Key Findings

- ARIMA(1, 1, 0) model shows that total demand of natural gas in U.S will continue to increase.
- Residential and Commercial demand of natural gas will possibly be almost stable in the upcoming 30 years.
- Regression result shows that price elasticity values are negative and income elasticity values are positive.

The level of income has more effect on demand than that of prices for both sectors and also total demand.

Price elasticity: Total Demand > Residential Demand > Commercial Demand

More for forecasting

- 1. ARIMA model assumes that the already existing trends in natural gas consumption will more or less repeat themselves in the future. Some unanticipated events may also occur and significantly reduce the precision of the forecasts presented here. (COVID19)

- 2. Due to nature of ARIMA modelling and the low elasticities obtained from regression results, present study has only employed net demand data for forecasting. There is an apparent need for further work with more variables, which will make more detailed and accurate understanding of the trends possible.

- 3. Add more variables in the regression model to make it more precise, like humidity, or macro variables like CPI and so on.

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Thank you!