

# *International Energy Outlook 2017*



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*for*

*Center for Strategic and International Studies*

*September 14, 2017 | Washington, DC*

*by*

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# Key takeaways: IEO2017 Reference case

- World energy consumption increases from 575 quadrillion Btu in 2015 to 736 quadrillion Btu in 2040, a 28% increase
- More than 60% of the increase in energy consumption by 2040 comes from non-OECD Asia, which includes China and India
- Even though demand in the residential and transportation sectors grows more rapidly, the industrial sector still accounts for over 50% of delivered energy consumption in 2040
- Transportation energy use rises by nearly 30% between 2015 and 2040 with almost all of the growth occurring in non-OECD regions

## Key takeaways: IEO2017 Reference case (continued)

- Renewable energy is the world's fastest-growing energy source, increasing an average 2.3%/year between 2015 and 2040
- Fossil fuels remain dominant, supplying 77% of the world's energy consumption in 2040
- Natural gas is the fastest growing fossil fuel with global consumption increasing an average 1.4%/year between 2015 and 2040
- Coal use remains flat over the projection period as declines in China are largely offset by increases in India and other parts of Asia
- World energy-related carbon dioxide emissions are projected to grow an average 0.6%/year between 2015 and 2040, far below the 1.3%/year growth from 1990 to 2015

# Overview

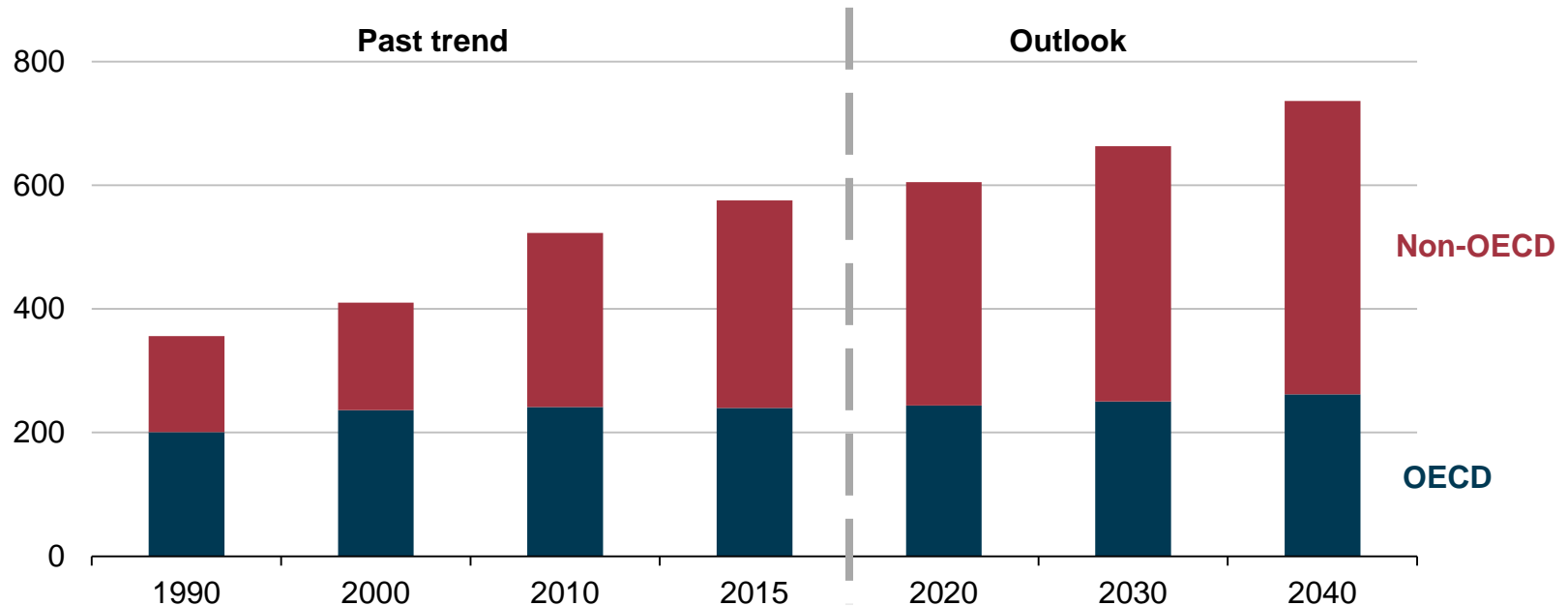
## IEO2017 addresses the uncertainty inherent in energy projections by developing side cases focusing on overall energy consumption

- The effects of assumptions about economic growth on energy consumption are addressed in the High and Low Economic Growth cases. World gross domestic product increases by 3.3%/year from 2015 to 2040 in the High Economic Growth case and by 2.7%/year in the Low Economic Growth case, compared with 3.0%/year in the Reference case
- The High and Low Oil Price cases address the uncertainty associated with the trajectory of world energy prices. In the Low Oil Price case, the price of North Sea Brent crude in 2016 dollars reaches \$43/barrel by 2040, compared with \$109/barrel in the Reference case and \$226/barrel in the High Oil Price case
- Although the graphics in this presentation focus on projections through 2040, this IEO is the first projection to include model results through 2050, which are available on the IEO page of the EIA website; EIA welcomes feedback on the assumptions and results over the period of 2040–50

# World energy consumption rises 28% between 2015 and 2040 in the Reference case with most of the increase occurring in non-OECD countries

## World energy consumption

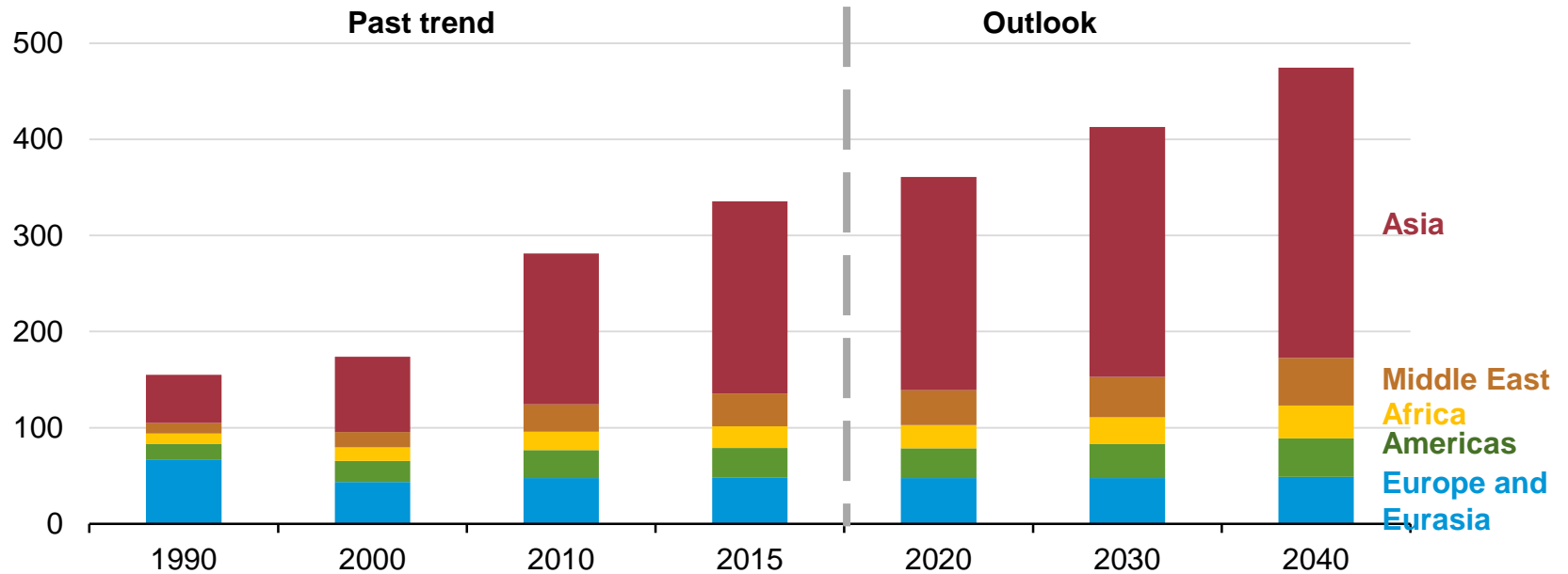
quadrillion Btu



Source: EIA, *International Energy Outlook 2017*

# Asia accounts for most of the increase in energy use in non-OECD regions in the Reference case

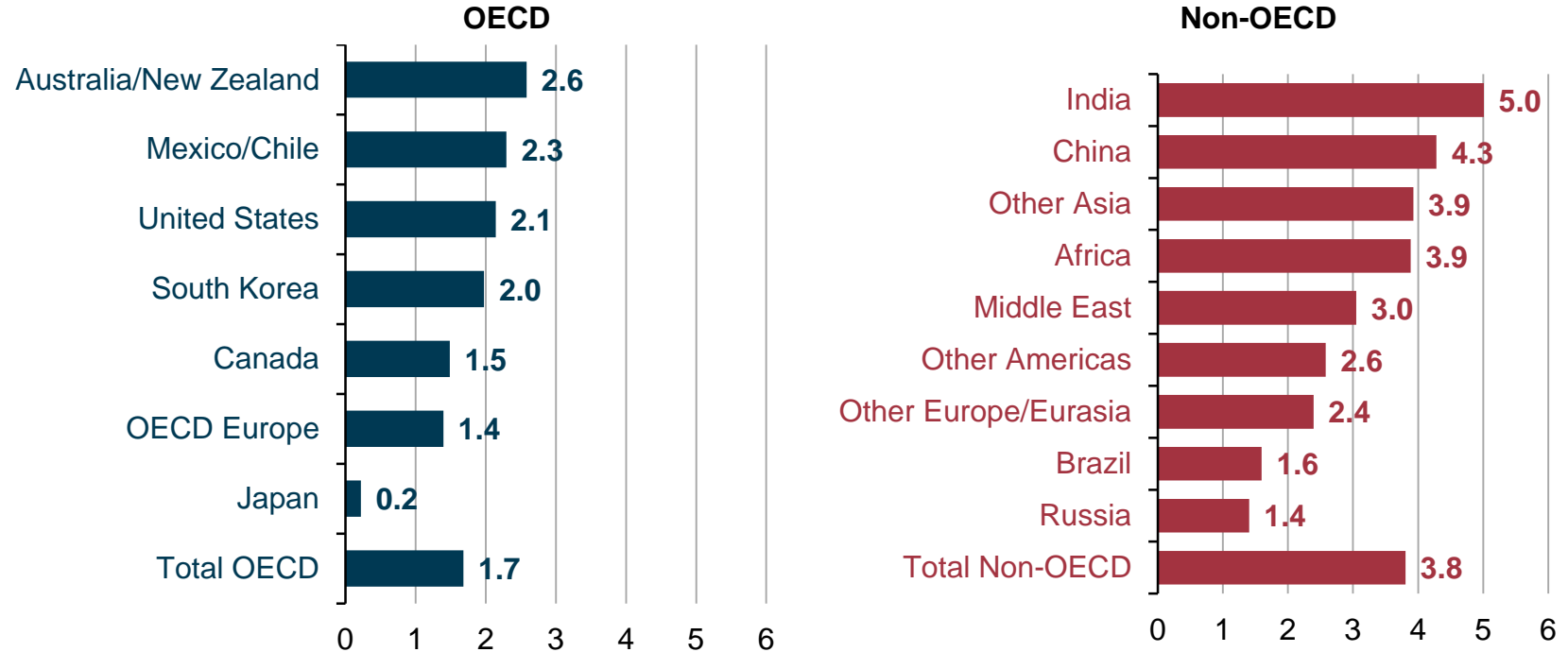
**Non-OECD energy consumption by region**  
quadrillion Btu



Source: EIA, *International Energy Outlook 2017*

# Economic growth—a major driver of energy demand—is greater on average in non-OECD countries

Average annual percent change in real GDP by region, 2015-40



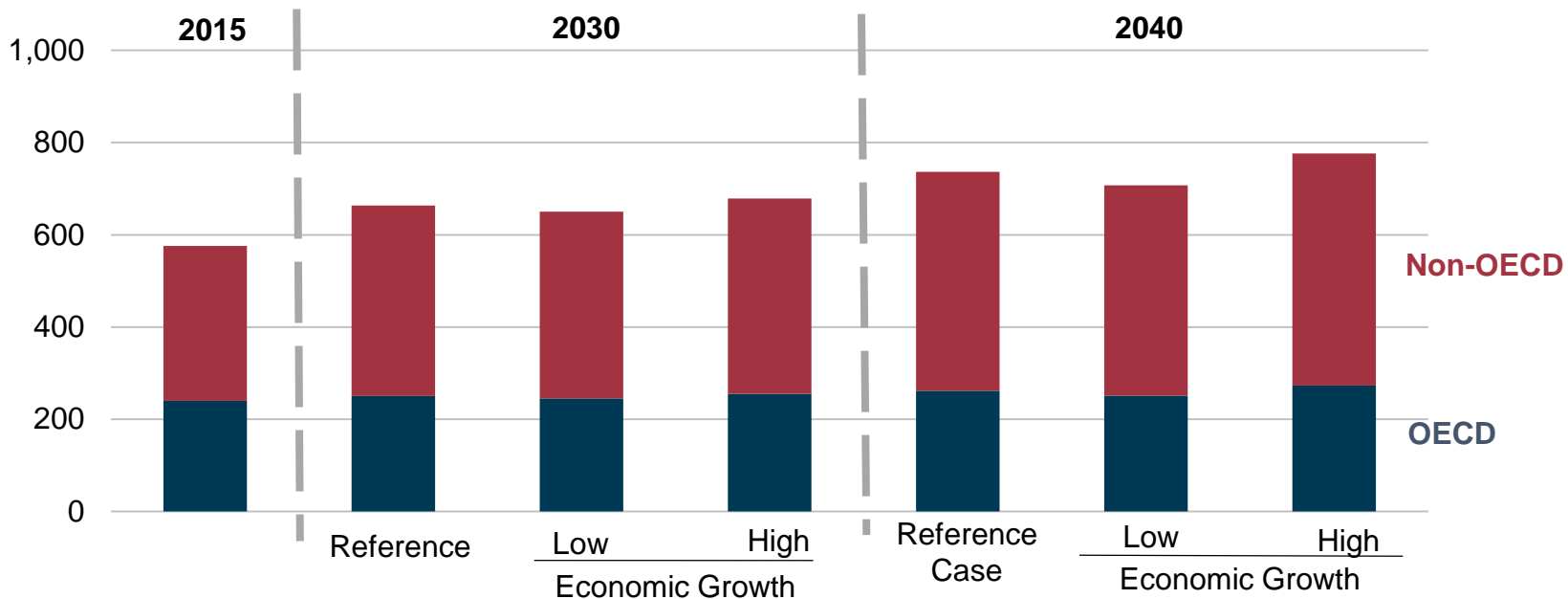
Source: EIA and Oxford Economic Model (March 2017)



# Energy consumption varies across the High and Low Economic Growth cases

## World energy consumption in three economic growth cases

quadrillion Btu

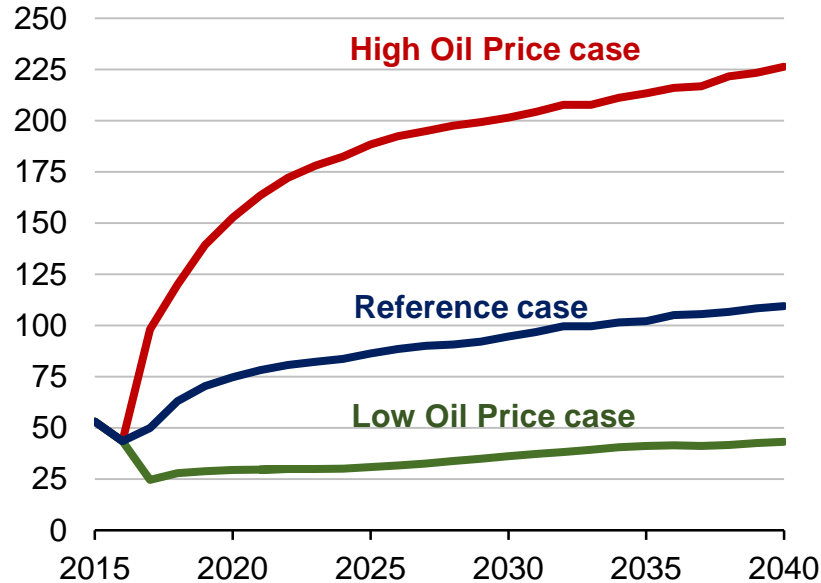


Source: EIA, International Energy Outlook 2017

# Future oil prices are another key source of uncertainty in the projections

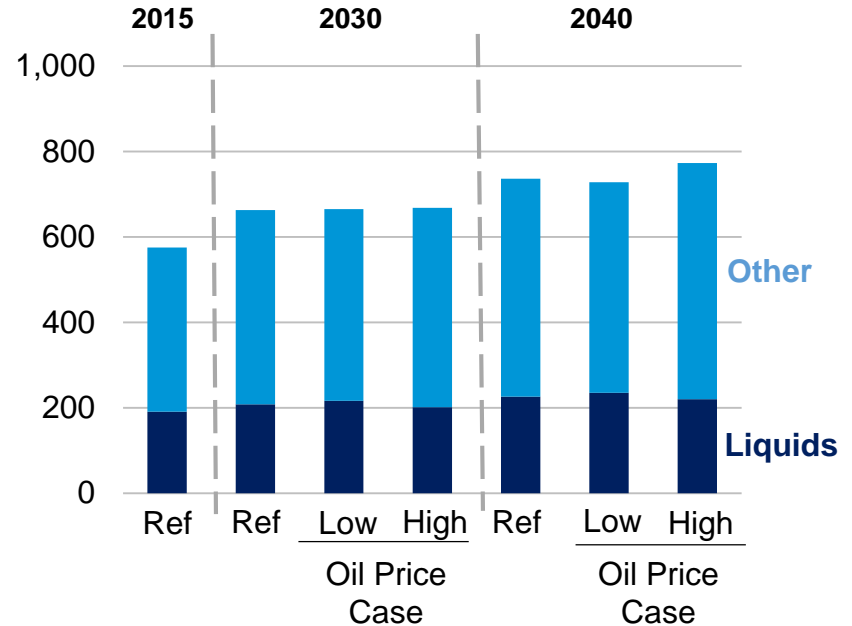
## World oil prices in three cases

real 2016 dollars per barrel



## World energy consumption in three cases

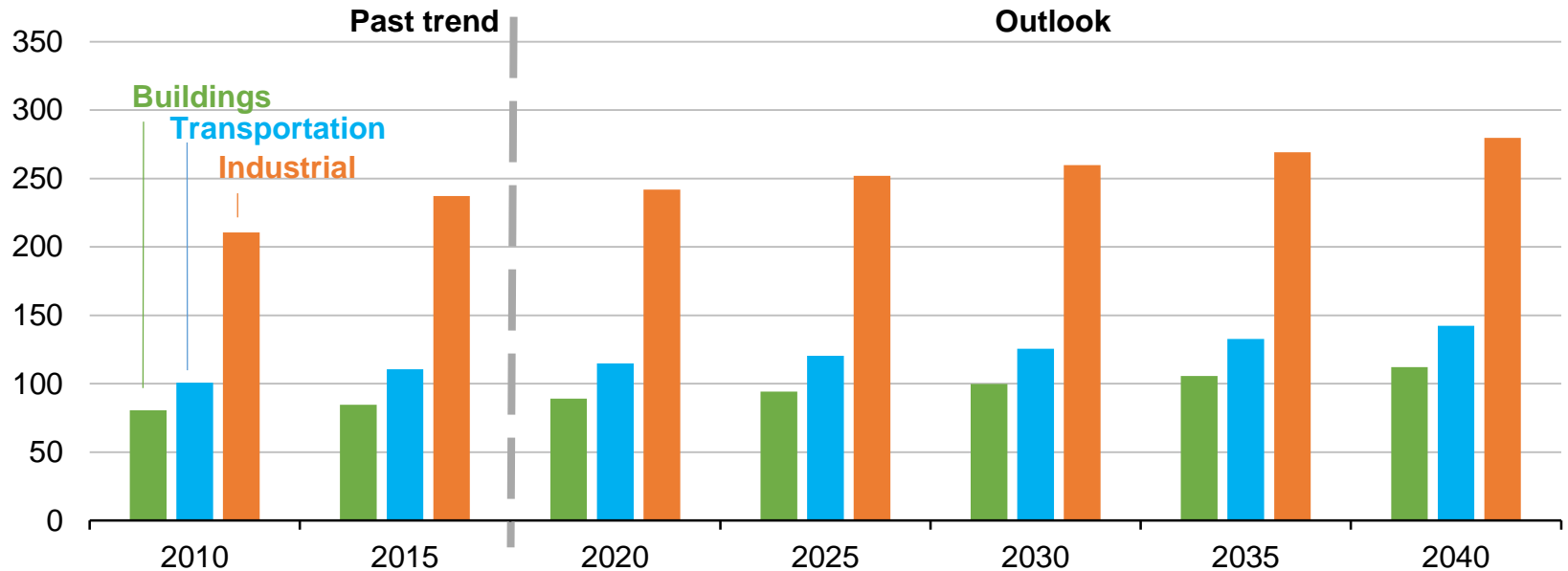
quadrillion Btu



Source: EIA, International Energy Outlook 2017

# The industrial sector continues to account for the largest share of energy consumption through 2040 in the Reference case

**World energy consumption by end-use sector**  
quadrillion Btu

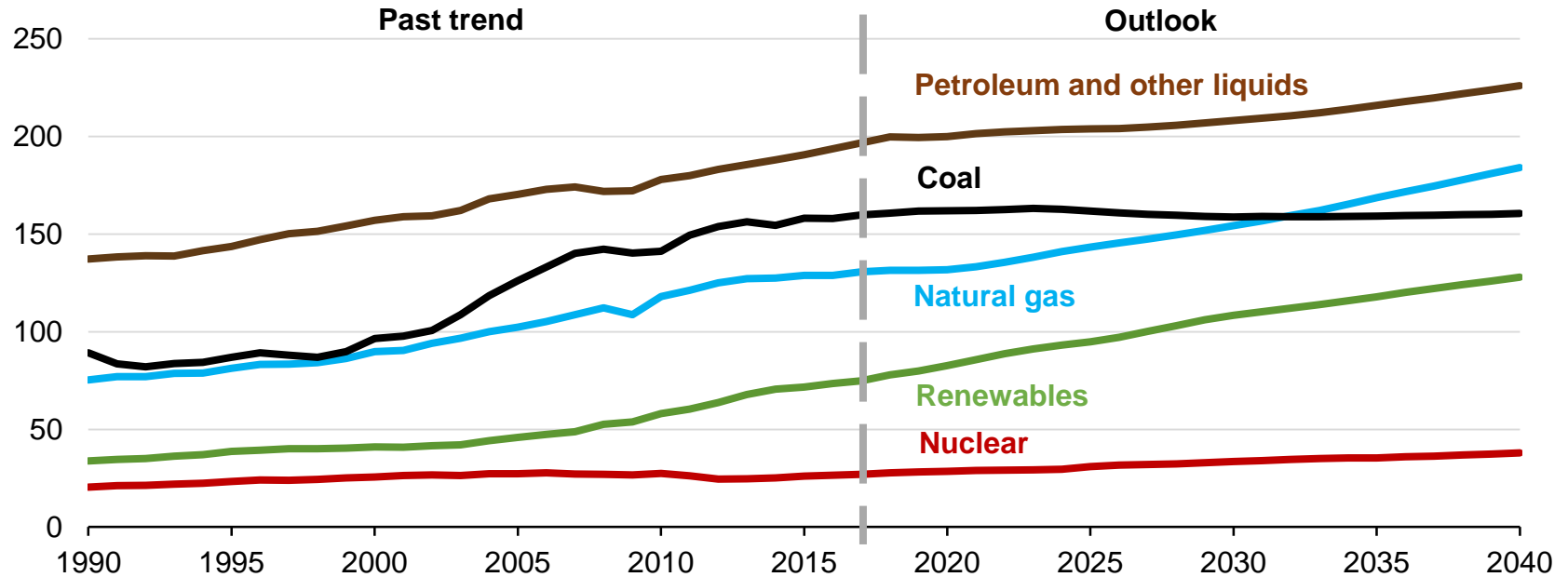


Source: EIA, *International Energy Outlook 2017*

# Energy consumption increases over the projection for all fuels other than coal in the Reference case with renewables being the fastest-growing energy source

## World energy consumption by energy source

quadrillion Btu

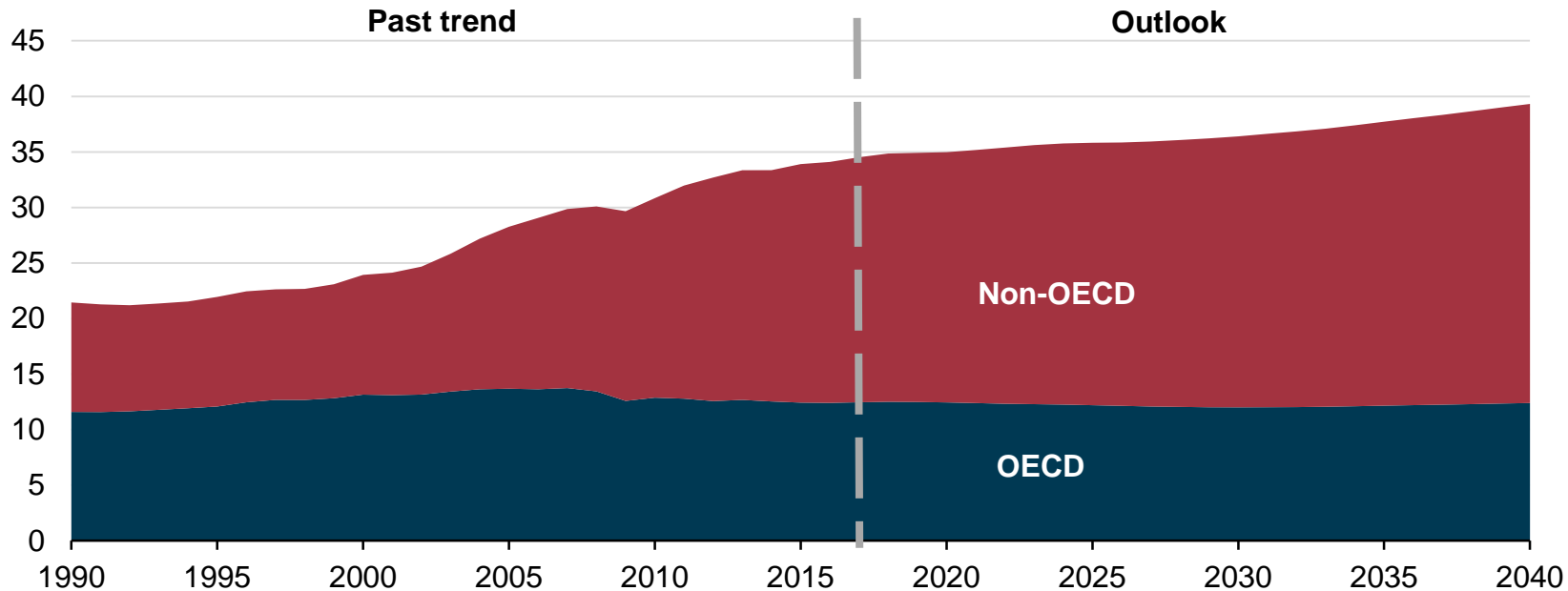


Source: EIA, International Energy Outlook 2017

# Energy-related CO2 emissions rise by 25% in the non-OECD countries, but they remain relatively flat in the OECD countries

## World energy-related CO2 emissions

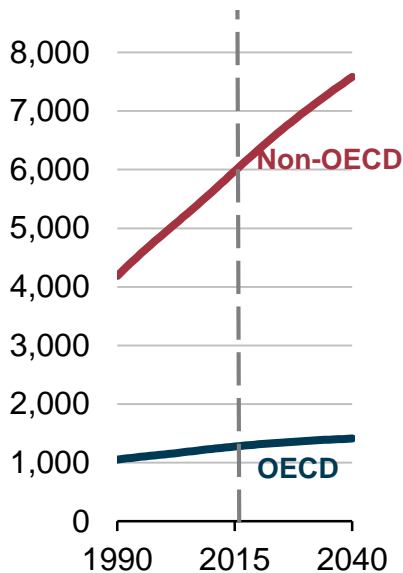
billion metric tons



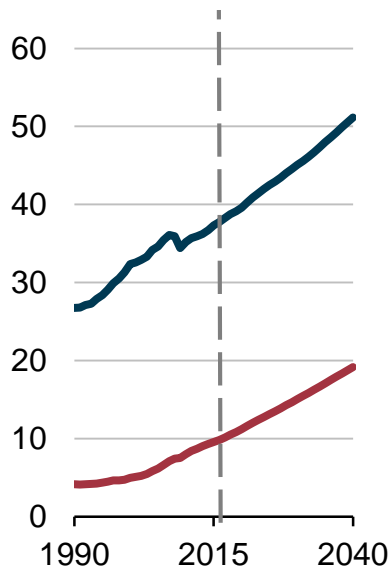
Source: EIA, International Energy Outlook 2017

# Although population and per capita output continue to rise, energy and carbon intensity are projected to continue to fall in the Reference case

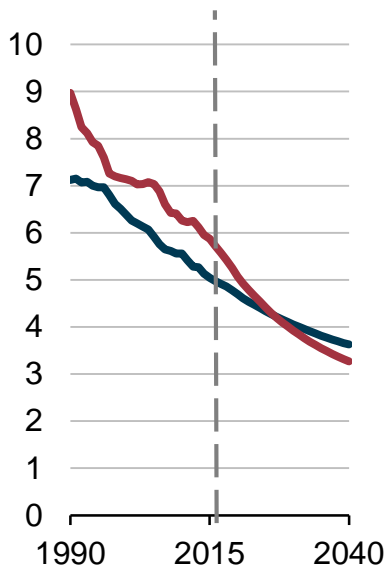
**Population**  
million people



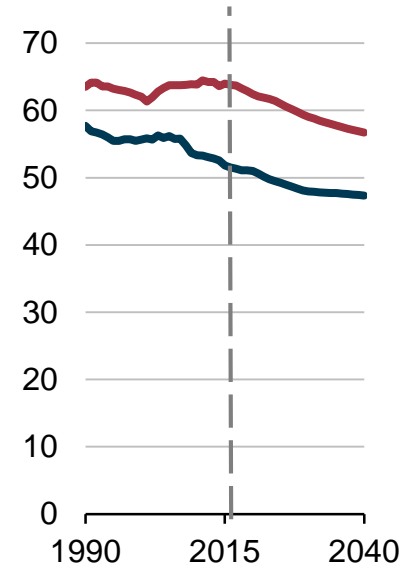
**Per capita gross domestic product**  
thousand dollars



**Energy intensity**  
thousand Btu per dollar



**Carbon intensity**  
metric tons CO2 per billion Btu

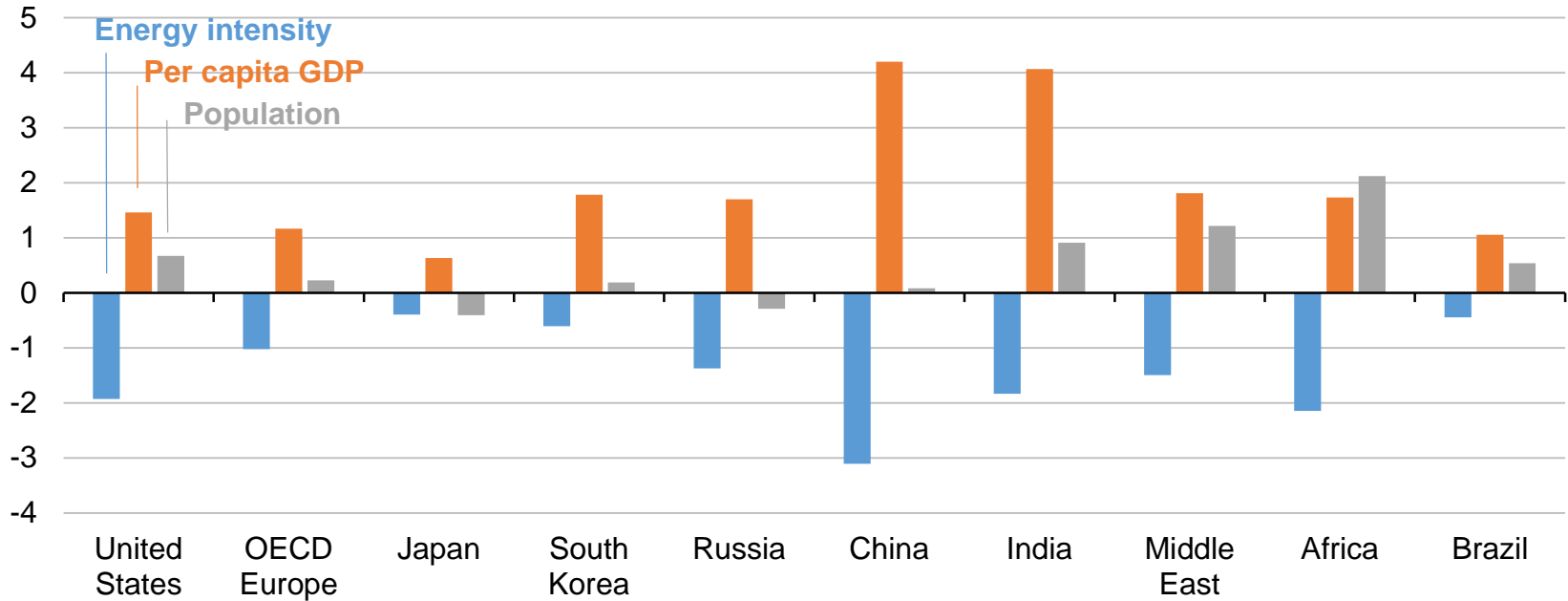


Source: EIA, *International Energy Outlook 2017*

# Income and population growth heavily influence energy demand, but improvements in energy intensity can offset associated increases in energy consumption

## Energy intensity, per capita GDP, and population growth in selected regions

average annual percent change, 2015-40



Source: EIA, International Energy Outlook 2017

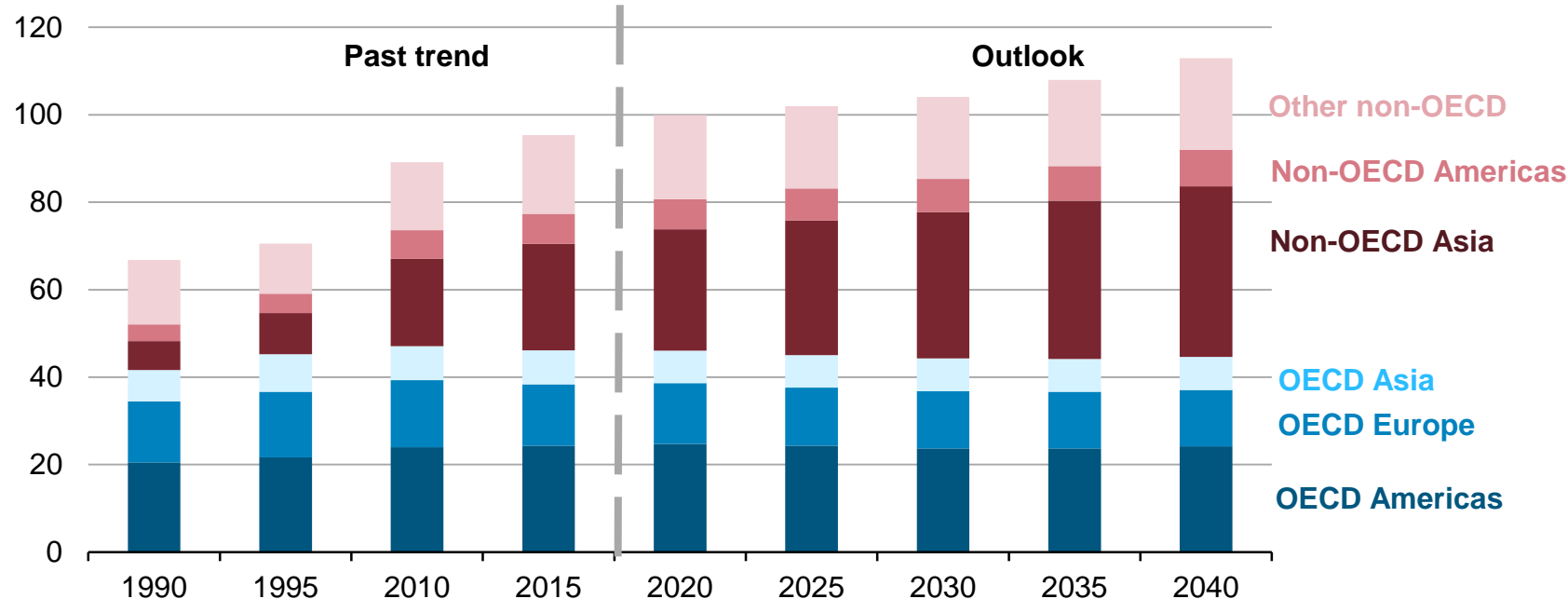
# Liquid fuels markets



# Petroleum and other liquid fuels consumption grows by 18% between 2015 and 2040 in the Reference case because of growth in non-OECD regions

## Petroleum and other liquids consumption

million barrels per day

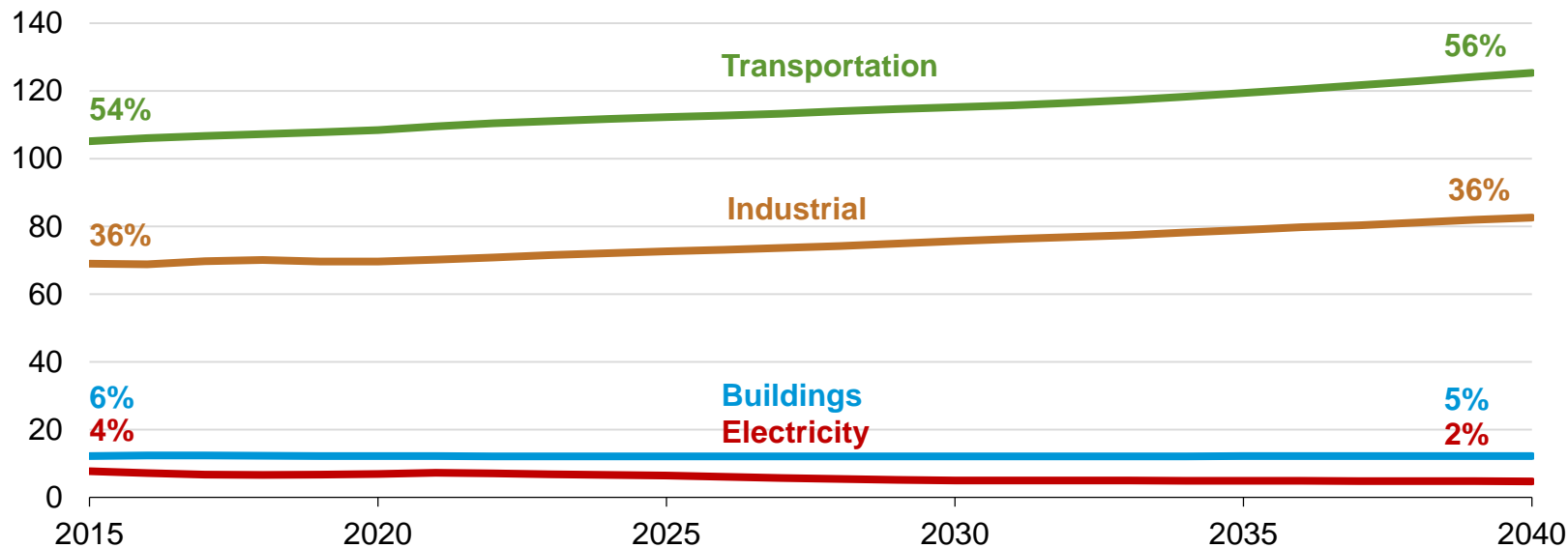


Source: EIA, International Energy Outlook 2017

# Sectoral shares of world liquids use hold relatively constant in the Reference case even as total consumption increases

## Refined petroleum and other liquids consumption by end-use sector

quadrillion Btu



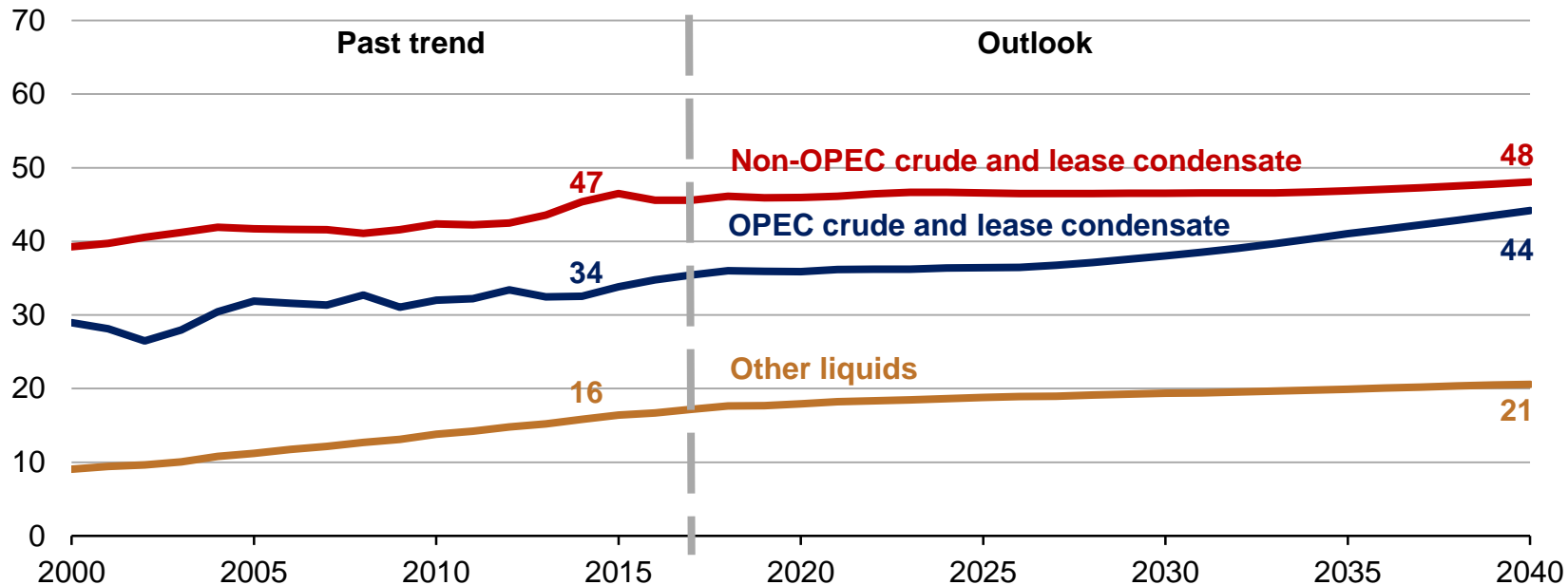
**Note:** Percentages express a sector's liquids consumption compared to total use of these fuels across all end uses.

Source: EIA, *International Energy Outlook 2017*

# Liquid fuel supplies increase from 2015 to 2040 with most of the growth occurring in OPEC crude oil and lease condensate

## World petroleum and other liquids production

million barrels per day

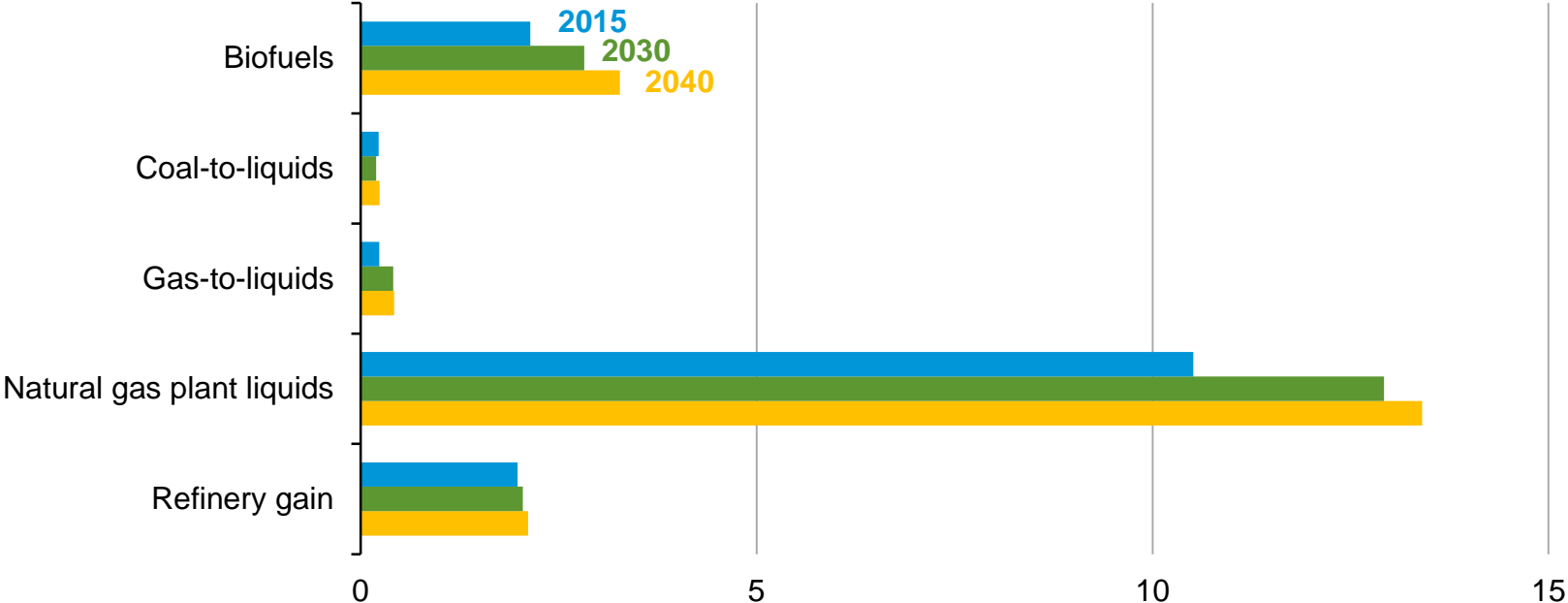


Source: EIA, International Energy Outlook 2017

# Natural gas plant liquids and biofuels account for most of the other liquids supplies

## World other liquids supplies

million barrels per day

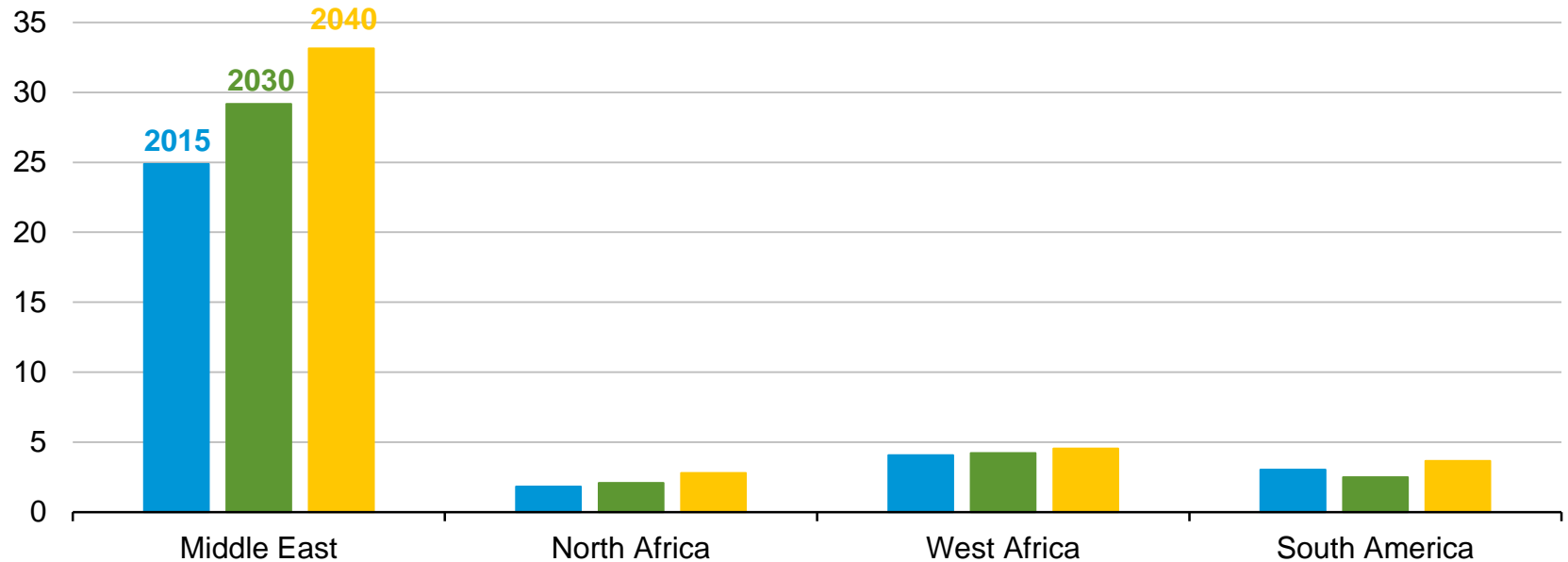


Source: EIA, International Energy Outlook 2017

# OPEC crude oil production increases between 2015 and 2040 with most of the growth occurring in the Middle East

## OPEC crude and lease condensate production by region

million barrels per day

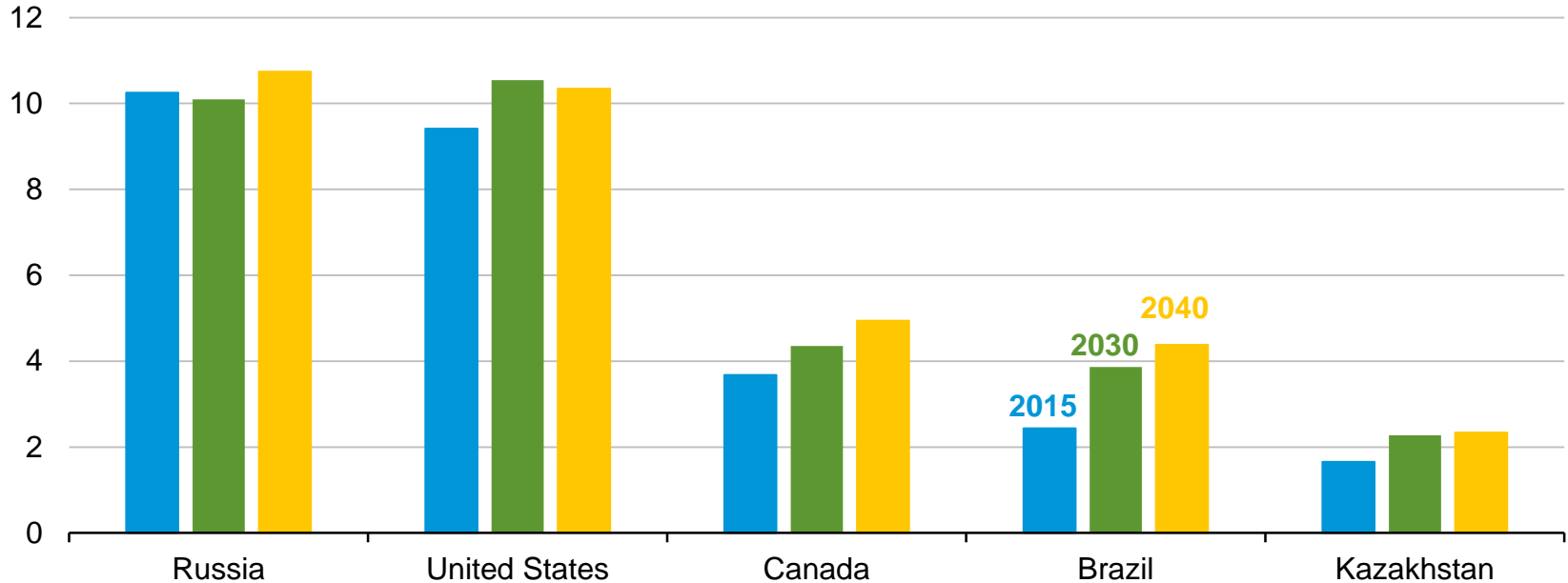


Source: EIA, International Energy Outlook 2017

# Non-OPEC crude oil production increases less than 2% between 2015 and 2040, but growth in Russia, Canada, Brazil, and Kazakhstan increases by 24%

## Crude and lease condensate production

million barrels per day



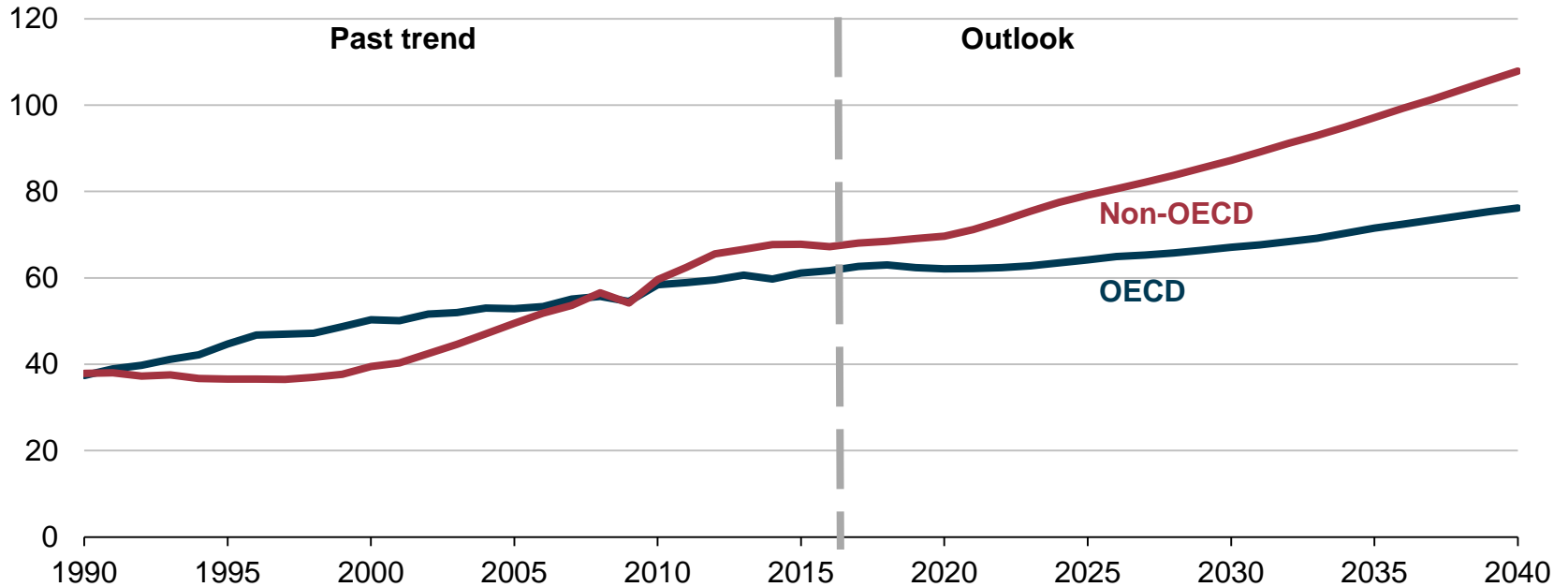
Source: EIA, International Energy Outlook 2017

# Natural gas markets

# World natural gas consumption increases by 43% from 2015 to 2040 in the Reference case largely because of demand growth in non-OECD countries

## World natural gas consumption

trillion cubic feet



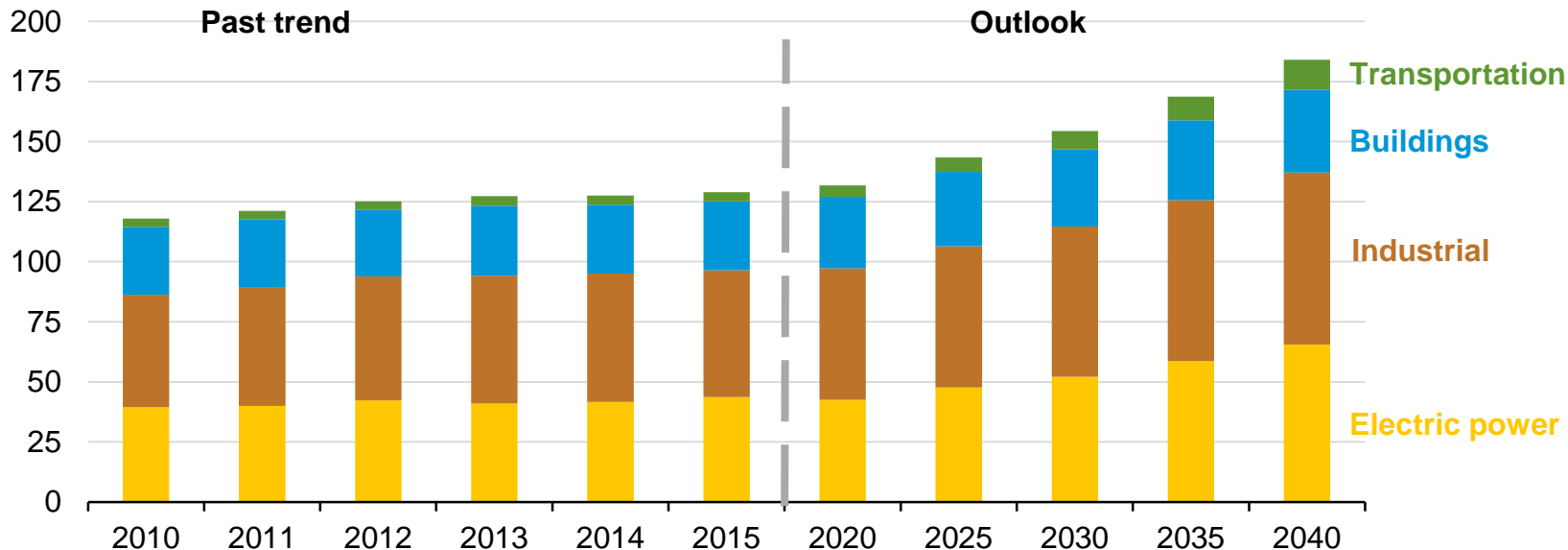
Source: EIA, *International Energy Outlook 2017*



# Power and industrial sectors account for nearly 75% of the increase in natural gas consumption between 2015 and 2040 in the Reference case

## Natural gas consumption by sector

quadrillion Btu

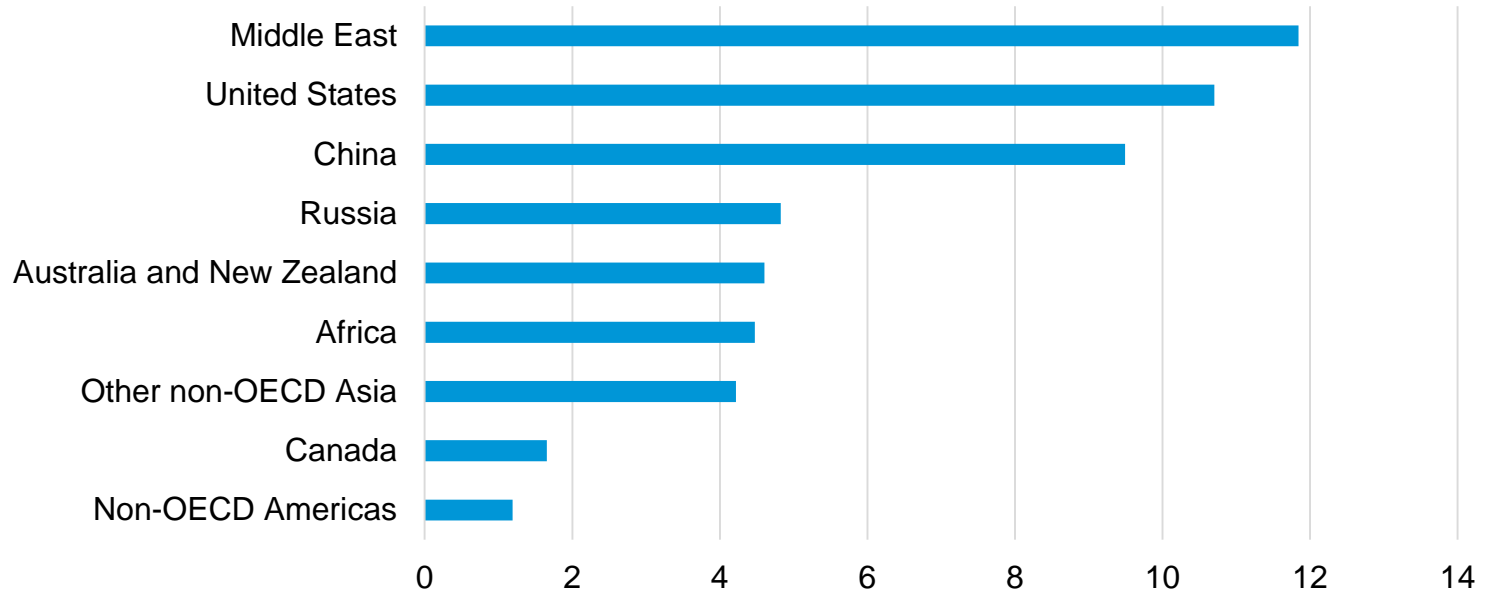


Source: EIA, International Energy Outlook 2017

# Middle East, the United States, and China account for more than 60% of the world increase in natural gas production

## Increase in natural gas production, 2015-40

trillion cubic feet

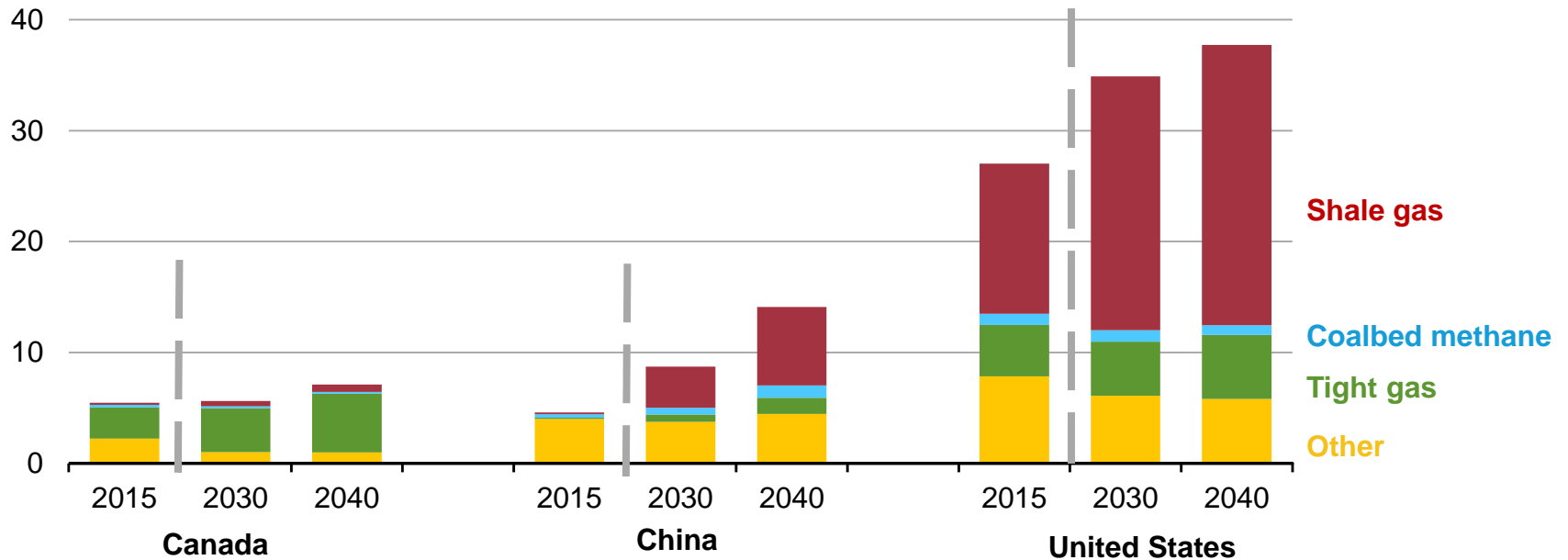


Source: EIA, *International Energy Outlook 2017*

# Shale gas and tight gas become increasingly important to gas supplies, not only for the United States, but also for China and Canada

## Natural gas production

trillion cubic feet

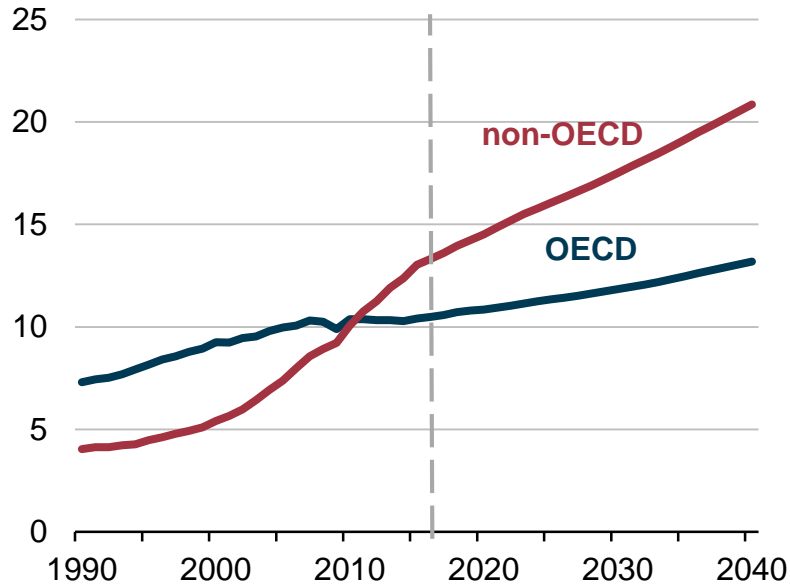


Source: EIA, International Energy Outlook 2017

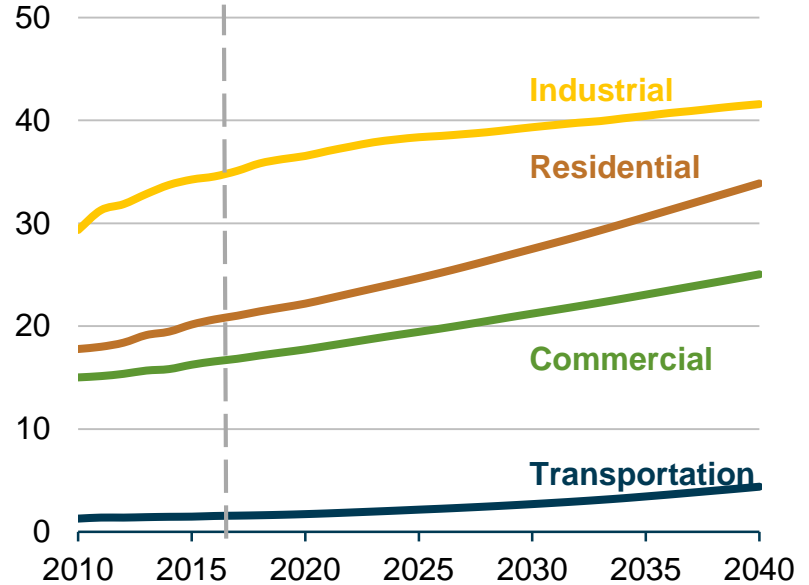
# Electricity markets

# Net electricity generation in non-OECD countries increases twice as fast as in the OECD with building use being a major contributor to growth in the Reference case

**OECD and non-OECD net electricity generation**  
trillion kilowatthours



**World electricity use by sector**  
quadrillion Btu

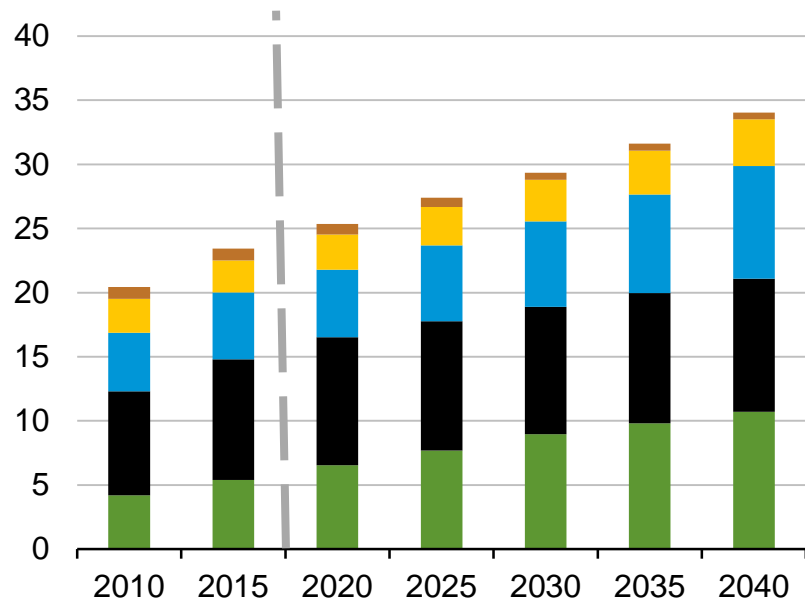


Source: EIA, International Energy Outlook 2017

# In the Reference case, renewables and natural gas provide much of the growth in electricity generation with their combined share of the total rising to 57% in 2040

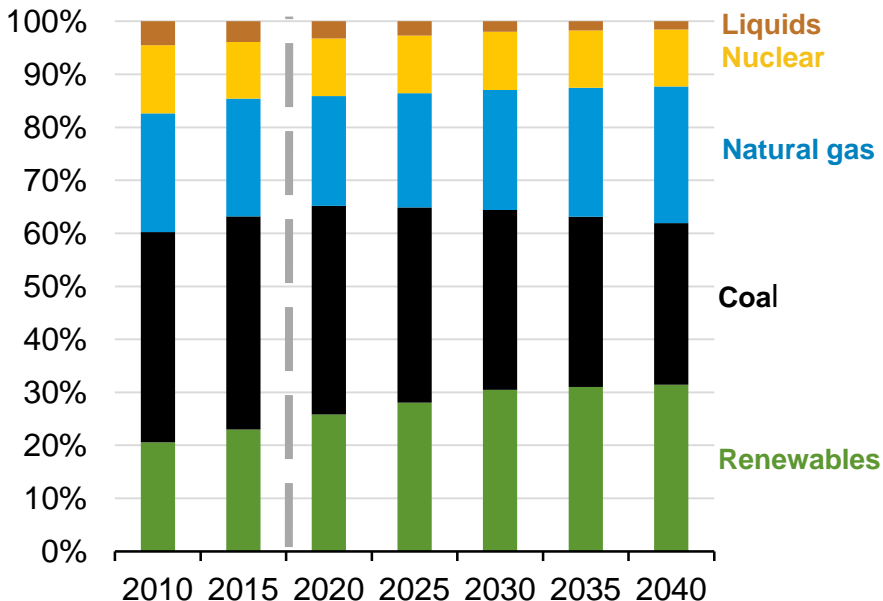
## World electricity generation by fuel

trillion kilowatthours



## Share of net electricity generation

percent

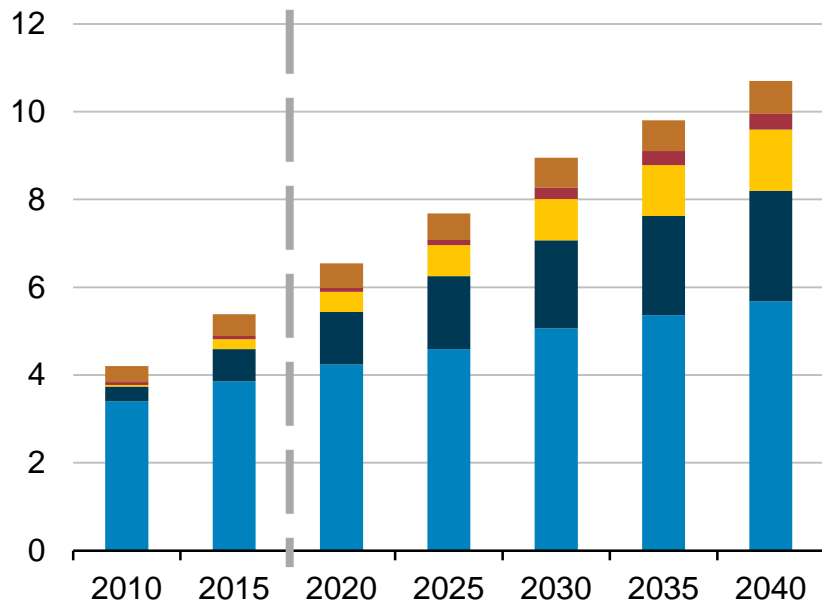


Source: EIA, International Energy Outlook 2017

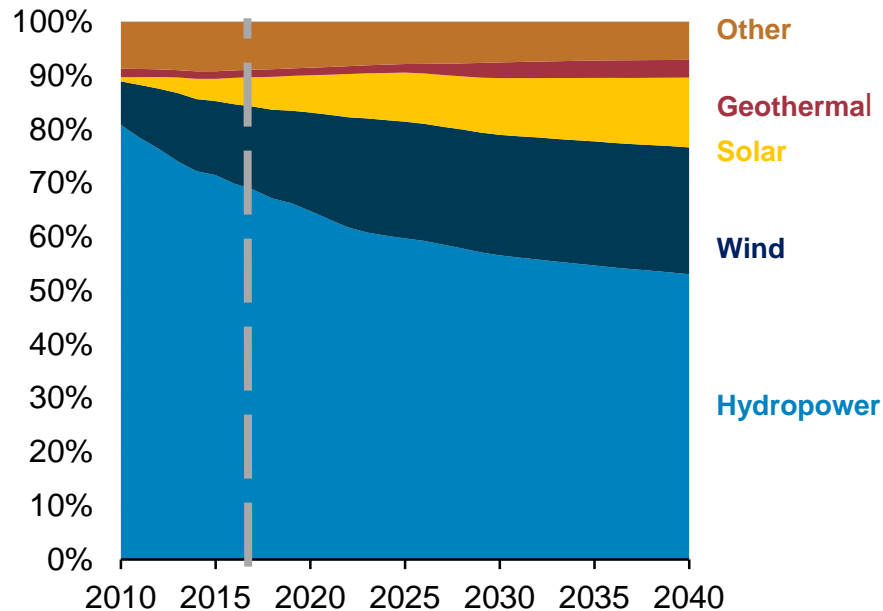
# Wind and solar dominate growth in renewables and represent two-thirds of related capacity additions by 2040

## World net electricity generation from renewable power

trillion kilowatthours



percent share of renewable energy

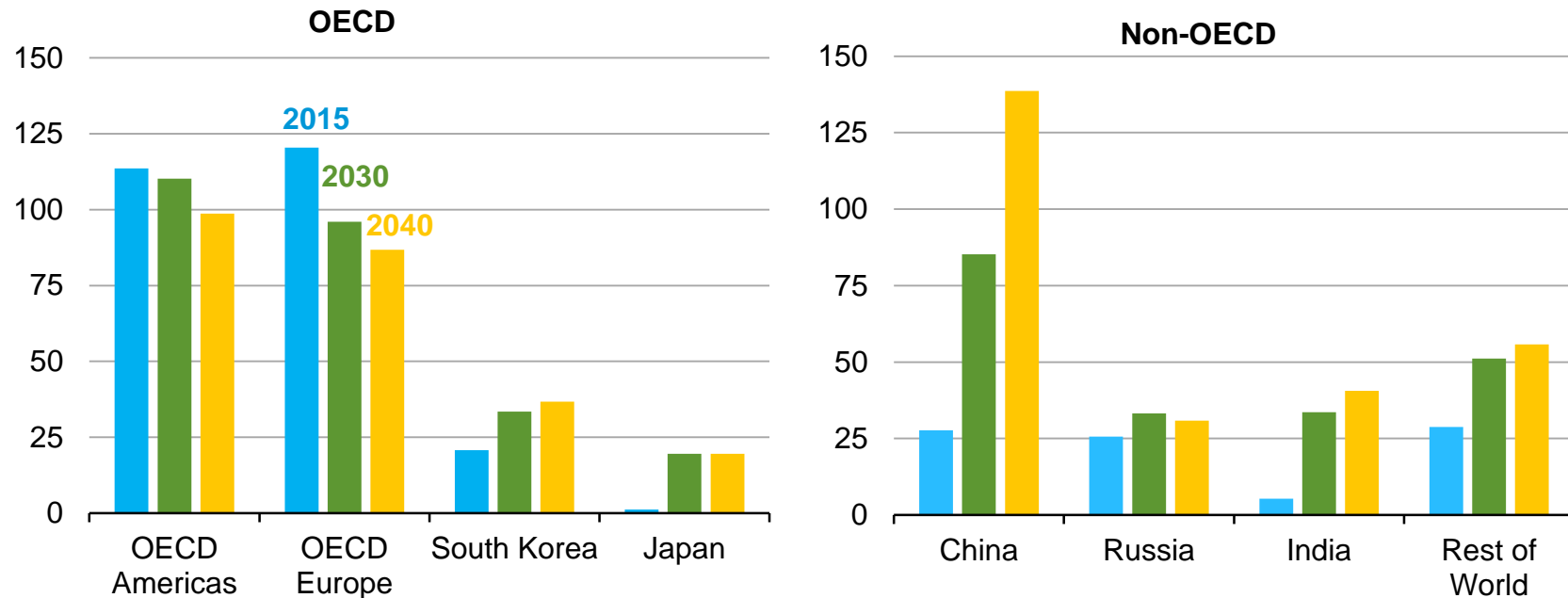


Source: EIA, International Energy Outlook 2017

# China accounts for two-thirds of the net increase in world installed nuclear capacity from 2015 to 2040

## Nuclear electricity generating capacity

gigawatts



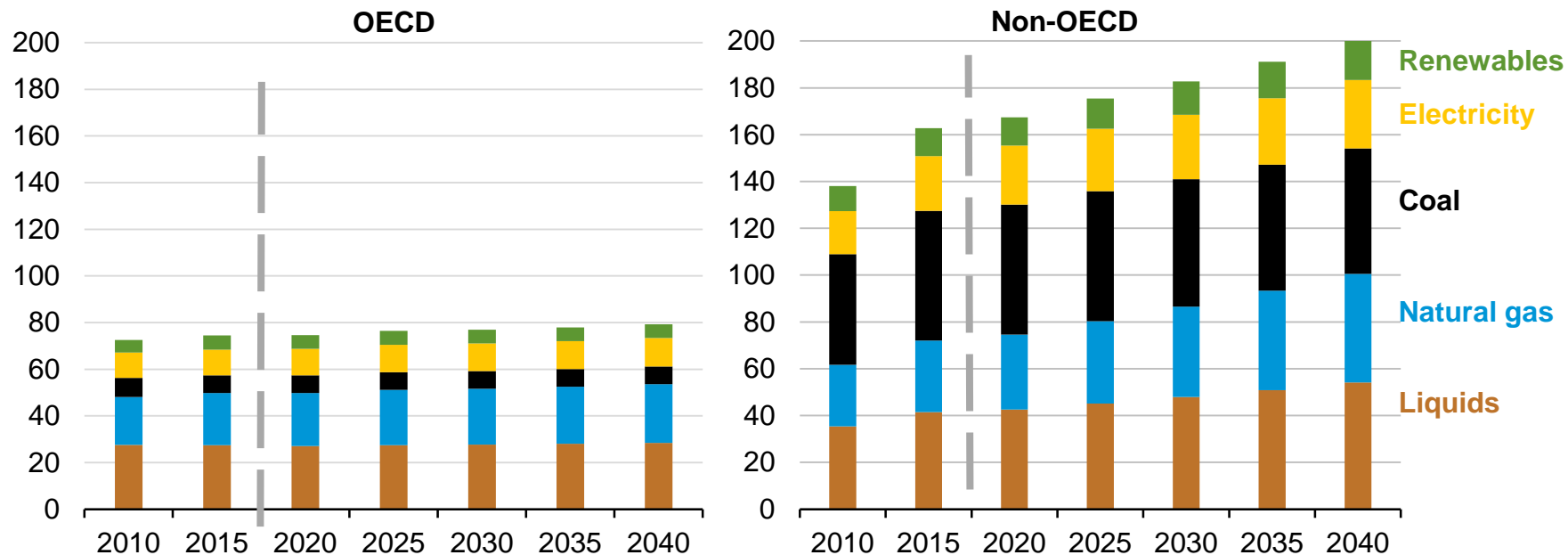
Source: EIA, International Energy Outlook 2017



# Industrial and Buildings

# In non-OECD regions, industrial coal consumption declines slightly as natural gas consumption increases in the Reference case

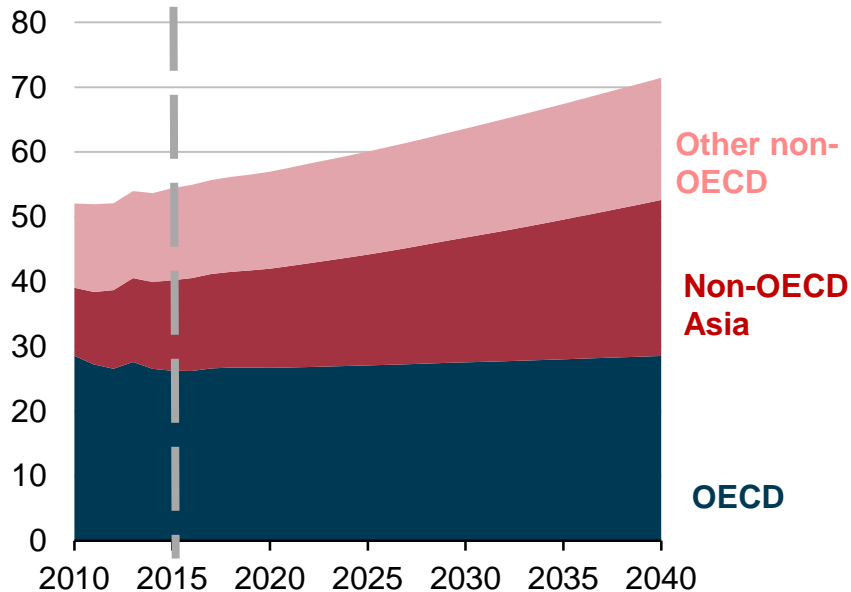
**Industrial energy consumption by fuel**  
quadrillion Btu



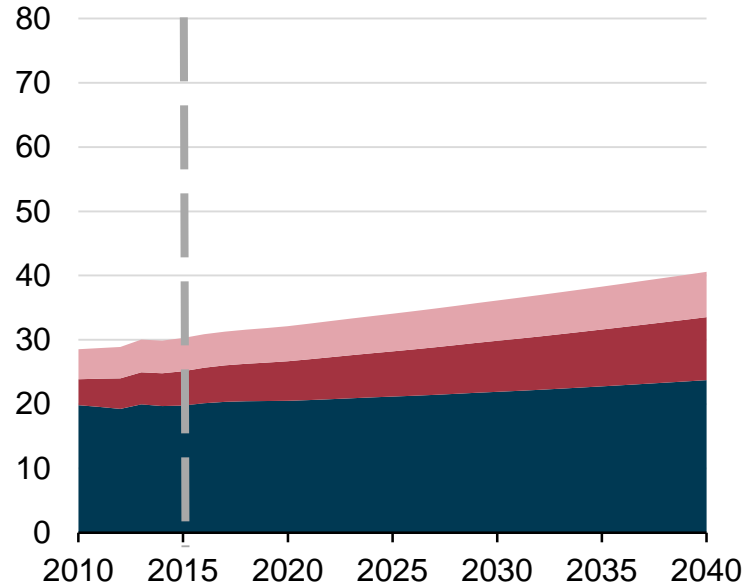
Source: EIA, International Energy Outlook 2017

# Non-OECD countries drive increases in residential and commercial energy consumption

**Residential sector energy consumption by region**  
quadrillion Btu



**Commercial sector energy consumption by region**  
quadrillion Btu

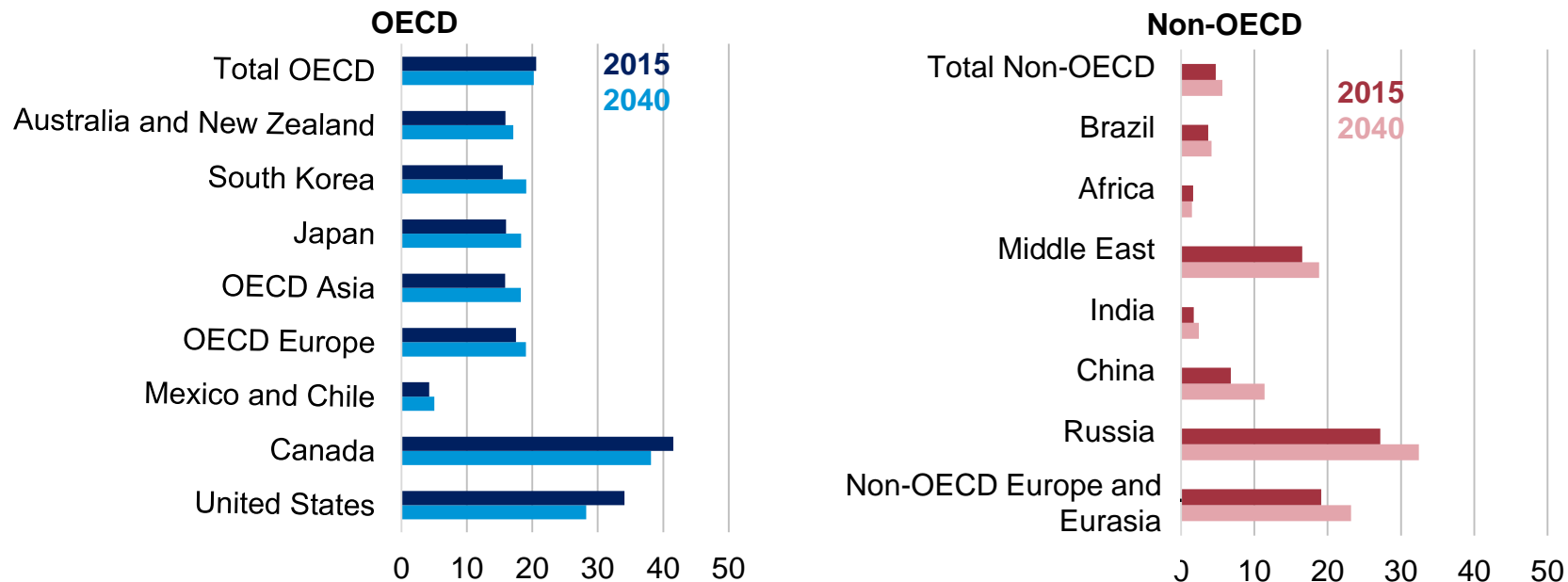


Source: EIA, *International Energy Outlook 2017*

# Per capita residential energy consumption increases in most non-OECD regions

## Residential per capita energy consumption

million Btu per person



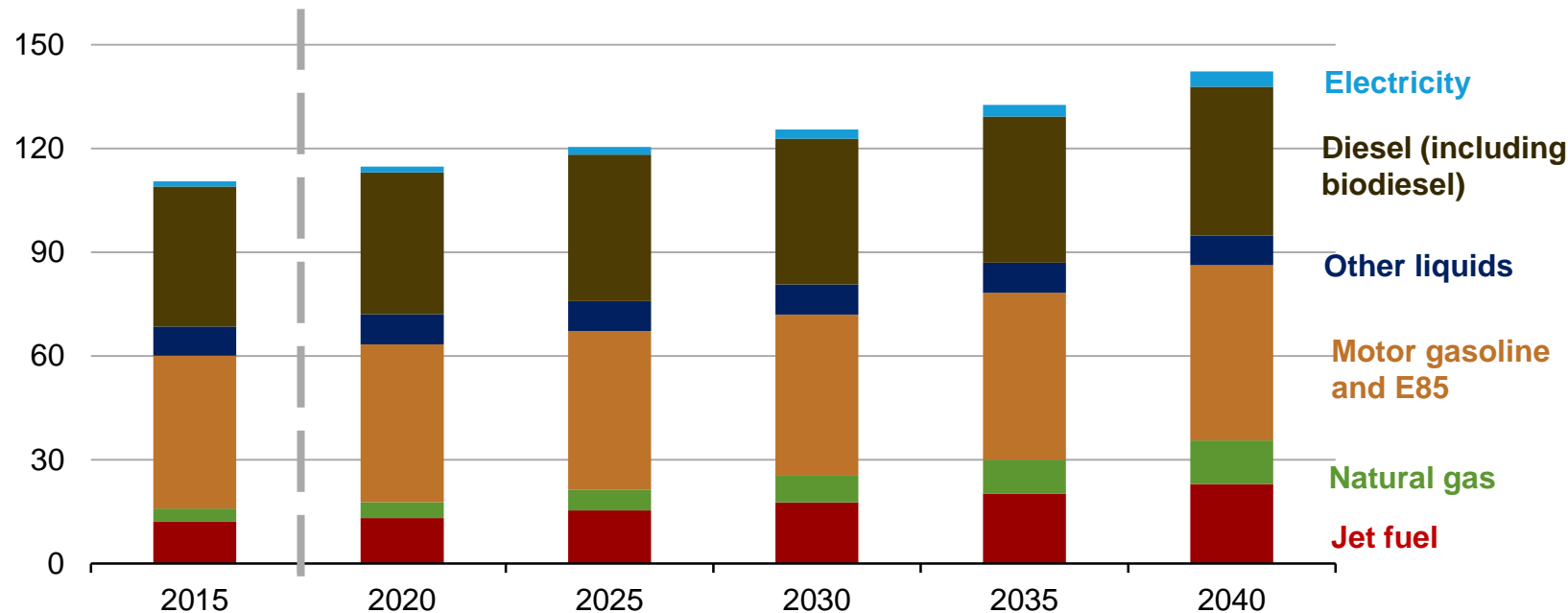
Source: EIA, International Energy Outlook 2017

# Transportation

# Motor gasoline and diesel continue to dominate the transportation fuel mix, but jet fuel, natural gas, and electricity grow fastest in the Reference case

## Transportation sector delivered energy consumption by source

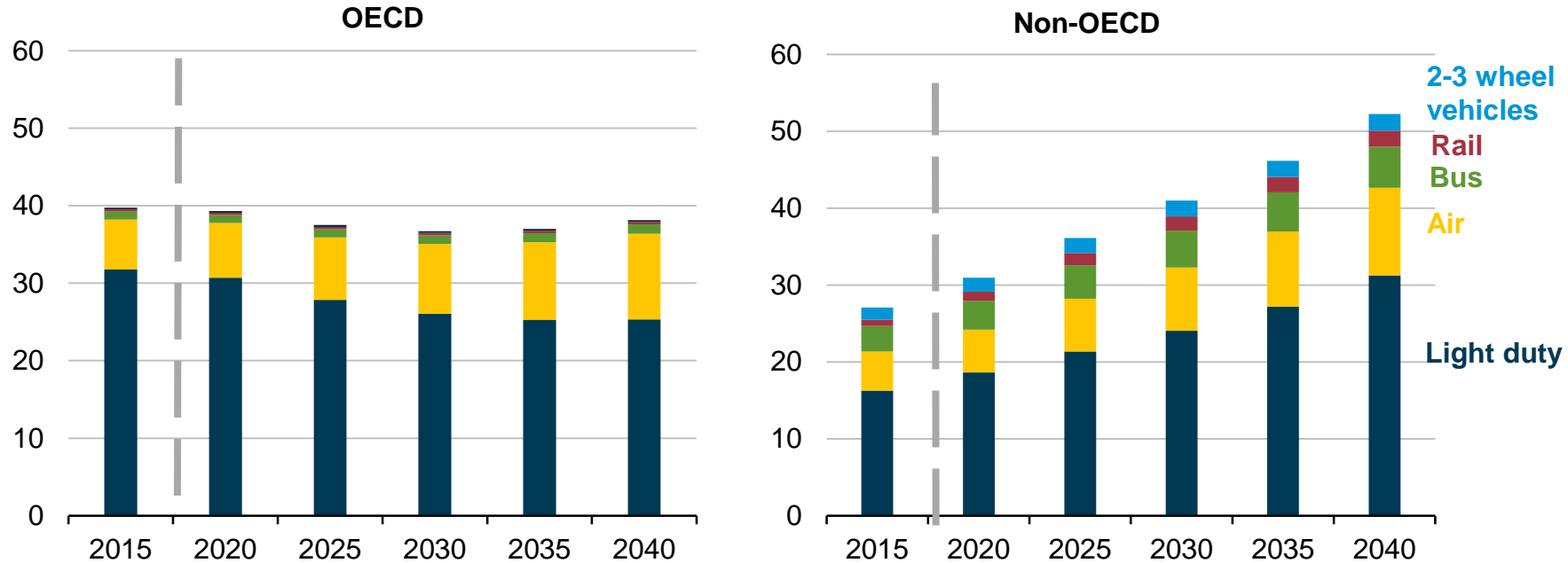
quadrillion Btu



Source: EIA, International Energy Outlook 2017

# In non-OECD countries, light-duty vehicle energy consumption grows rapidly; in OECD countries, portion related to air transportation increases

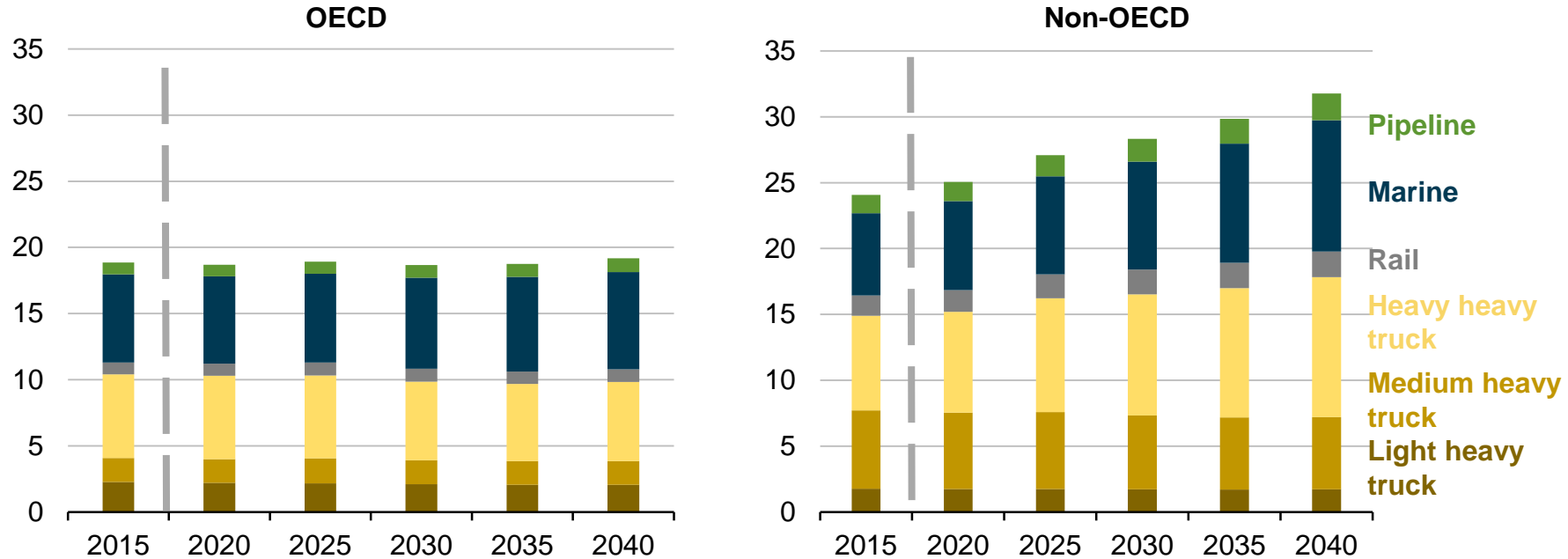
## Passenger transportation energy consumption quadrillion Btu



Source: EIA, International Energy Outlook 2017

# Freight transportation energy consumption remains relatively constant in OECD countries while international marine transportation grows in non-OECD countries

**Freight transportation energy consumption**  
quadrillion Btu



Source: EIA, International Energy Outlook 2017



IEO2017 will feature four Issues in Focus articles which will be released over the next several months

- This year's IEO includes supplementary analyses which discuss particular areas of uncertainty and consider how changing assumptions affect results.
- Two of these articles provide alternative projections by varying assumptions.
  - Transportation and Electric Vehicle Penetration
  - Economic Growth Rates (China and India)
- Two of these articles provide insight on how EIA considers evolving energy markets.
  - Investment in Oil and Gas Resources
  - Paris Climate Agreement

## For more information

U.S. Energy Information Administration home page | [www.eia.gov](http://www.eia.gov)

Short-Term Energy Outlook | [www.eia.gov/steo](http://www.eia.gov/steo)

Annual Energy Outlook | [www.eia.gov/aeo](http://www.eia.gov/aeo)

International Energy Outlook | [www.eia.gov/ieo](http://www.eia.gov/ieo)

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