

International Energy Outlook 2016



For
Schlumberger
June 23, 2016 | Cambridge, MA

By
Adam Sieminski, Administrator

Key findings in the IEO2016 Reference case

- World energy consumption increases from 549 quadrillion Btu in 2012 to 629 quadrillion Btu in 2020 and then to 815 quadrillion Btu in 2040, a 48% increase (1.4%/year). Non-OECD Asia (including China and India) account for more than half of the increase.
- The industrial sector continues to account for the largest share of delivered energy consumption; the world industrial sector still consumes over half of global delivered energy in 2040.
- Renewable energy is the world's fastest-growing energy source, increasing by 2.6%/year; nuclear energy grows by 2.3%/year, from 4% of the global total in 2012 to 6% in 2040. Fossil fuels continue to supply more than three-fourths of world energy use in 2040.

Key findings in the IEO2016 Reference case (continued)

- Among the fossil fuels, natural gas grows the fastest. Coal use plateaus in the mid-term as China's economic shifts to services and worldwide policies to limit coal use intensify. By 2030, natural gas surpasses coal as the world's second largest energy source.
- In 2012, coal provided 40% of the world's total net electricity generation. By 2040, coal, natural gas, and renewable energy sources (including hydro) provide roughly equal shares (28-29%) of world generation.
- With current policies and regulations, worldwide energy-related carbon dioxide emissions rise from about 32 billion metric tons (mt) in 2012 to 36 billion mt in 2020, 39 billion mt in 2030, and 43 billion mt in 2040, a 34% increase relative to 2012.

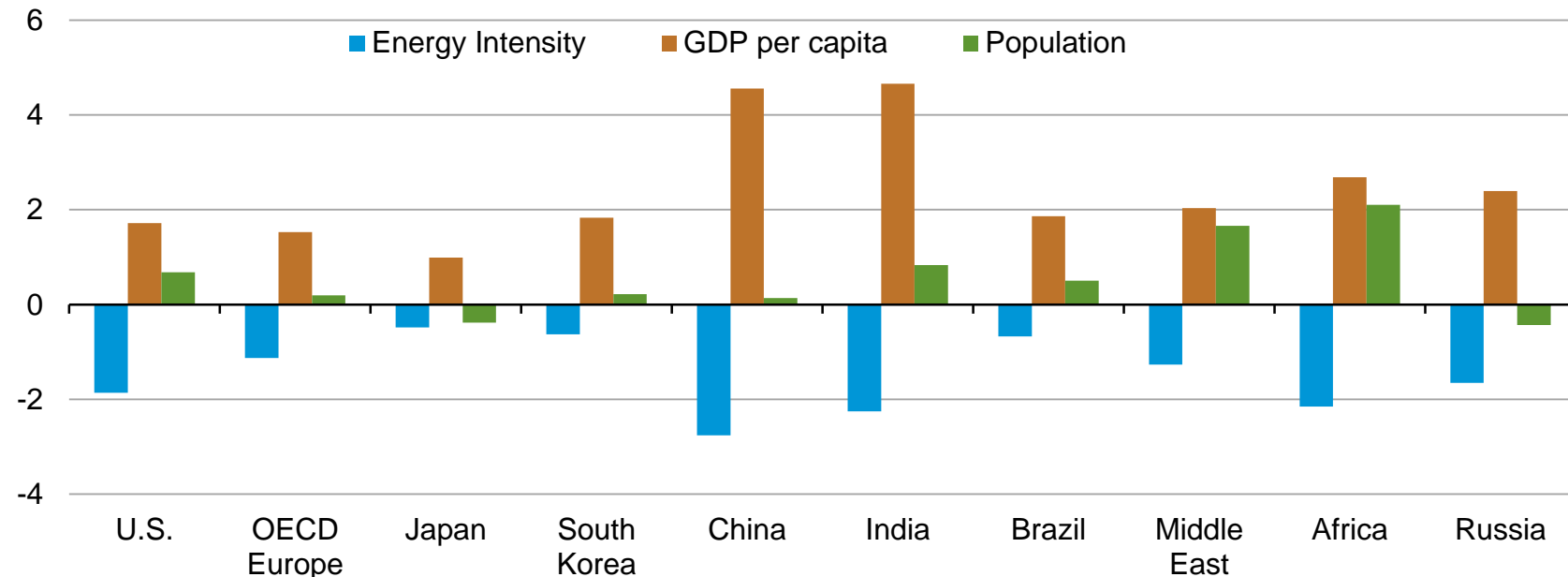
Many global issues increase uncertainty...

- Economic growth in key economies (China, Brazil, Russia, among others)
- Implementation and strength of climate policies
- Technology improvement rates (both supply and demand)
- Future of nuclear generating capacity
- Geopolitical events

Economic activity and population drive increases in energy use; energy intensity (E/GDP) improvements moderate this trend

average annual percent change (2012–40)

percent per year

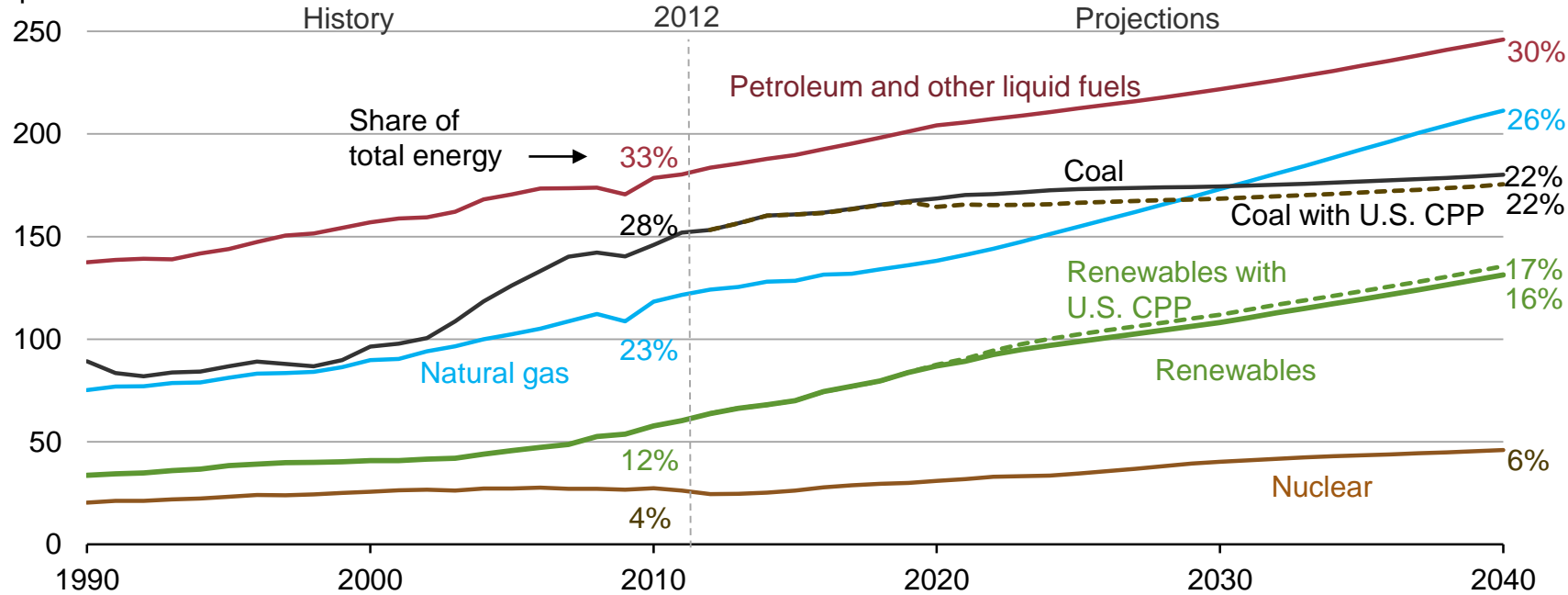


Source: EIA, *International Energy Outlook 2016*

Renewables grow fastest, coal use plateaus, natural gas surpasses coal by 2030, and oil maintains its leading share

world energy consumption

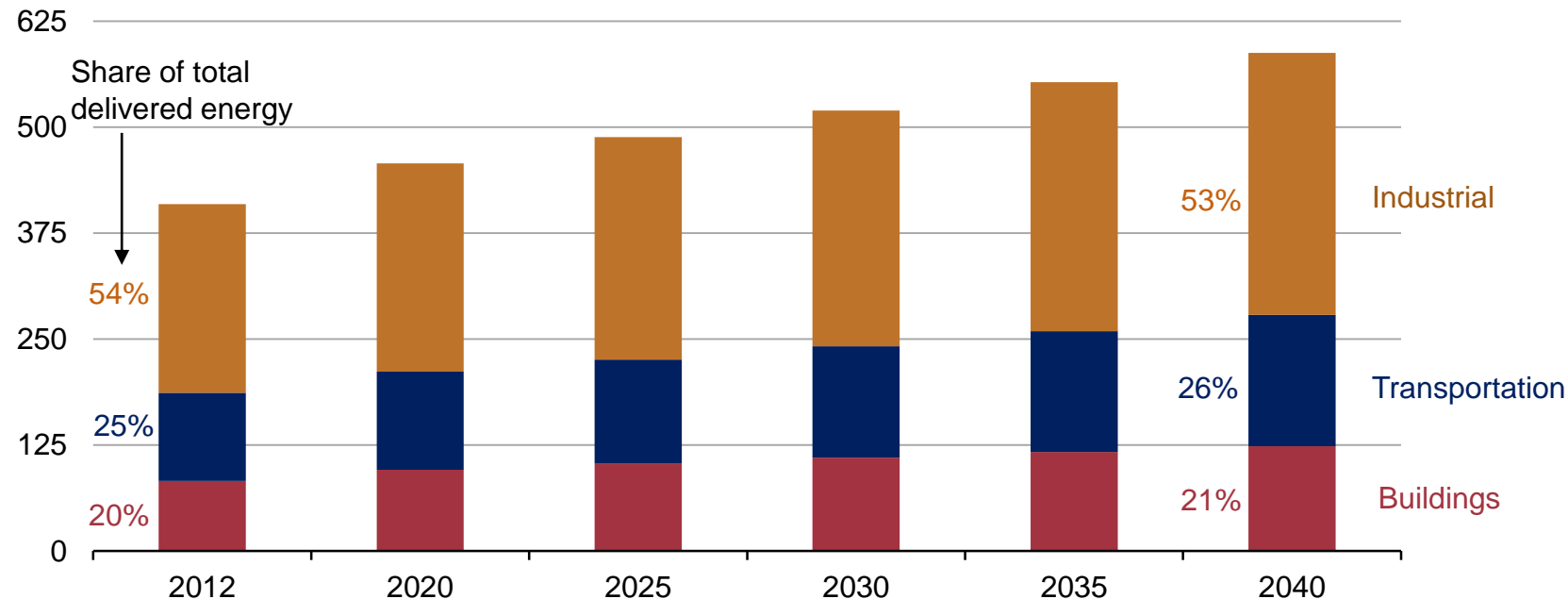
quadrillion Btu



Source: EIA, International Energy Outlook 2016 and EIA, Analysis of the Impacts of the Clean Power Plan (May 2015)

As total energy consumption grows, shares by end-use sector remain relatively unchanged

world delivered energy consumption by end-use sector
quadrillion Btu

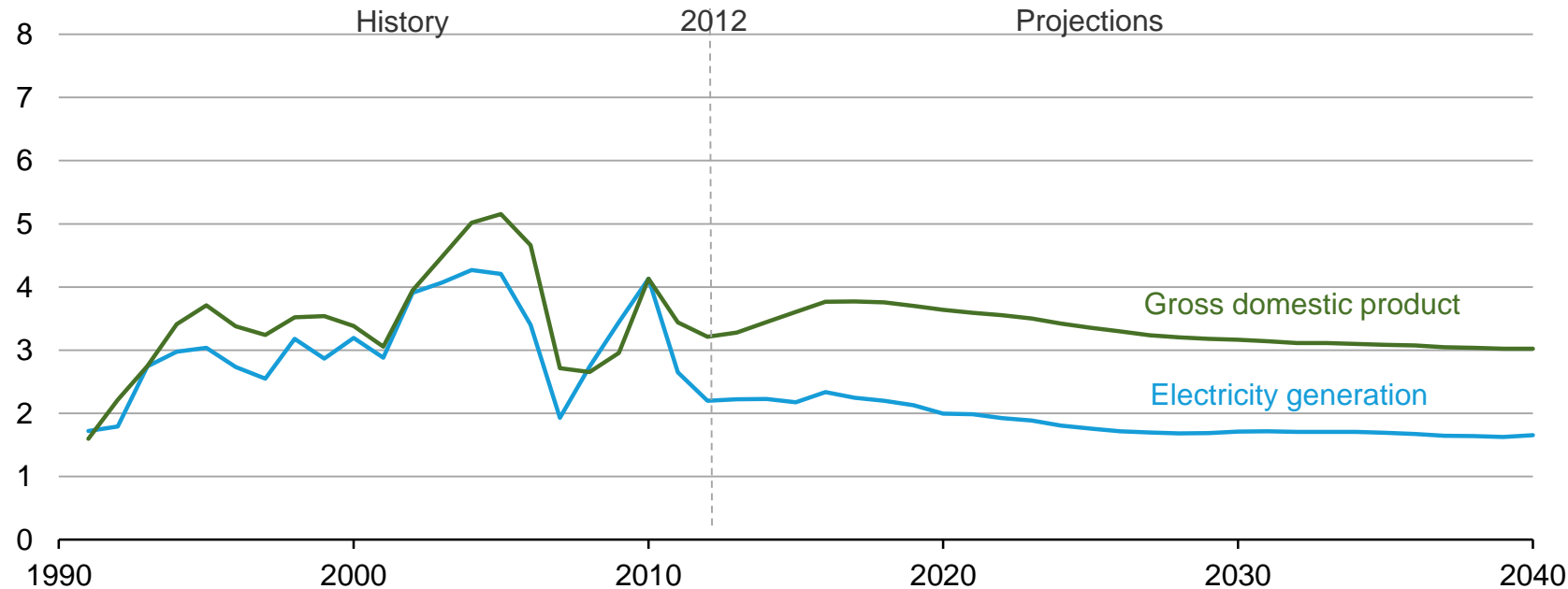


Source: EIA, International Energy Outlook 2016

Economic growth drives electricity demand; electricity use grows at a faster rate than other delivered energy, but slower than GDP

world GDP and net electricity generation

percent growth (rolling average of 3-year periods)

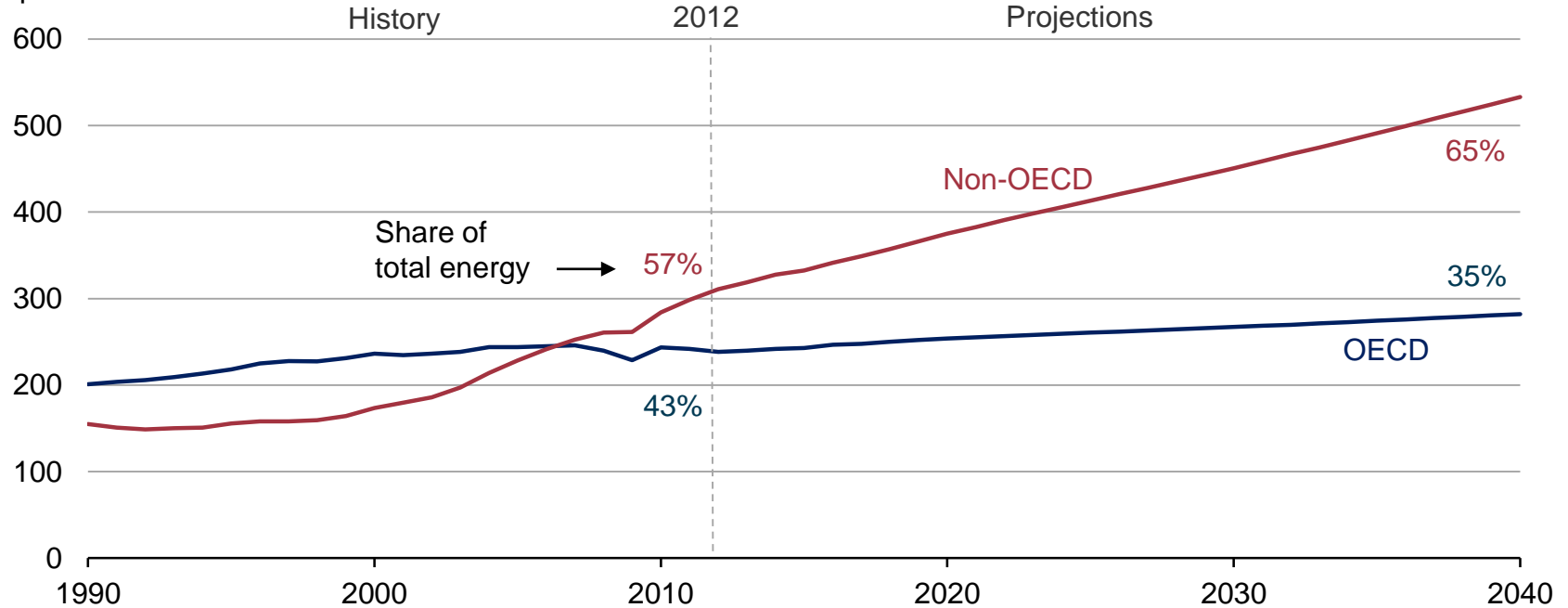


Source: EIA, International Energy Outlook 2016

Non-OECD nations drive the increase in total energy use

world energy consumption

quadrillion Btu

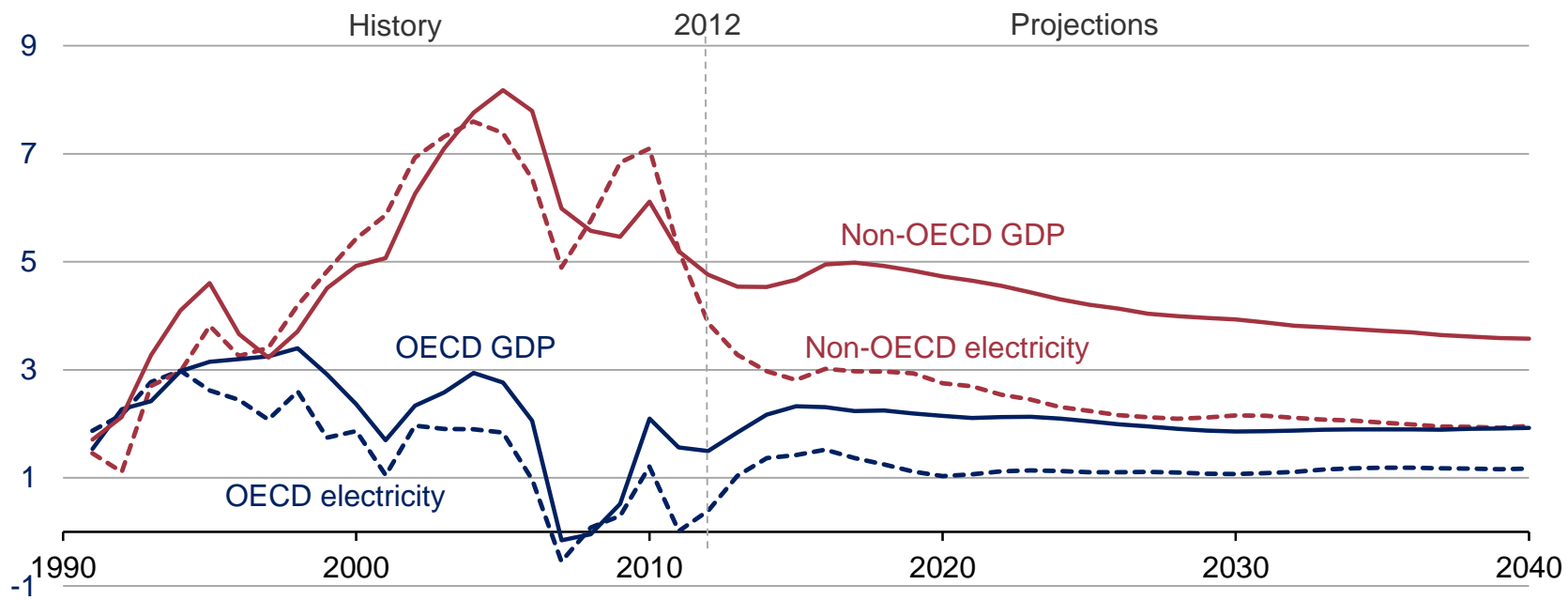


Source: EIA, International Energy Outlook 2016

Special Focus on Electricity Markets and Renewables

GDP drives electricity demand growth, but the electricity growth rate compared to the GDP growth rate becomes smaller over time

world GDP and net electricity generation
percent growth (rolling average of 3-year periods)

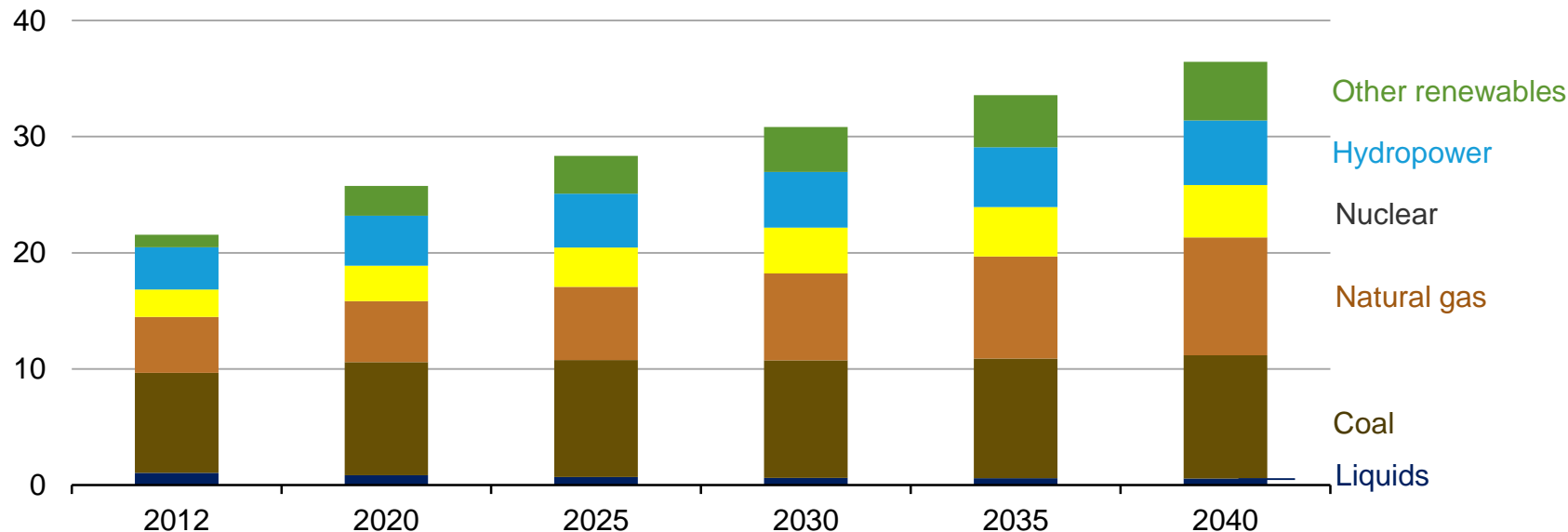


Source: EIA, International Energy Outlook 2016

Renewables (with hydro), natural gas, and coal all contribute roughly the same amount of global net electricity generation in 2040

world net electricity generation by source

trillion kilowatthours

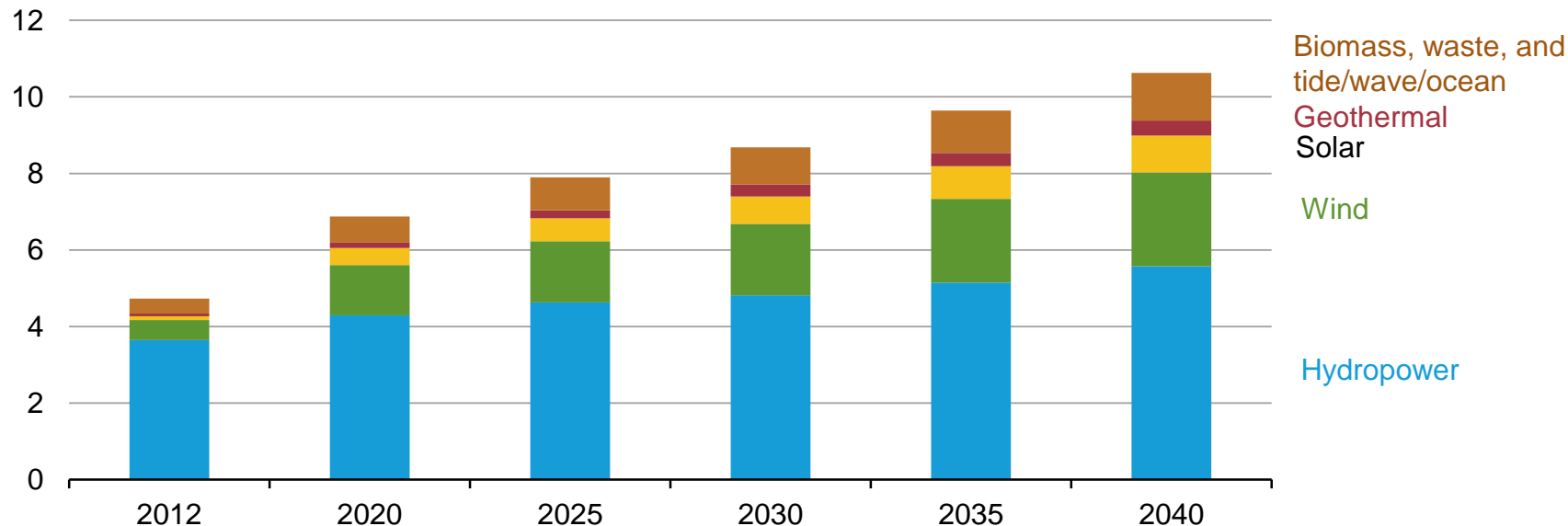


Source: EIA, International Energy Outlook 2016

Wind and hydropower each account for one third of the increase in renewable generation; solar is fastest-growing (8.3%/year)

world net electricity generation from renewable energy by source

trillion kilowatthours

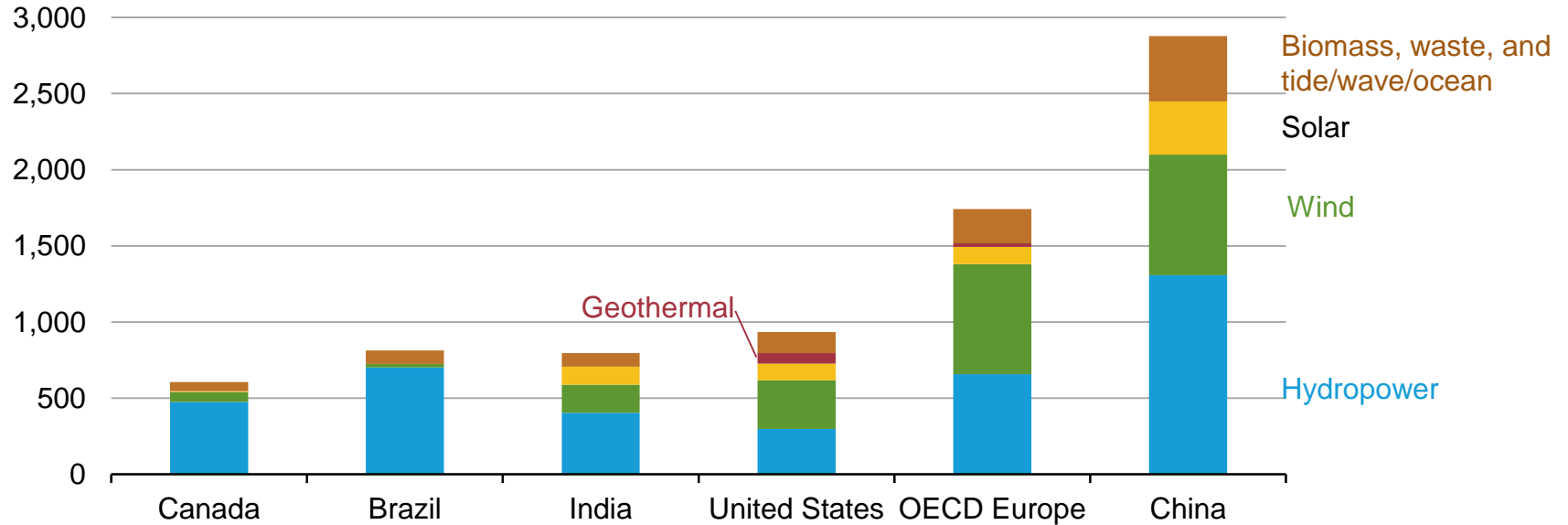


Source: EIA, International Energy Outlook 2016

Geographically, the scale and fuel mix of renewable generation in 2040 varies widely

renewable net electricity generation by selected country and country grouping, 2040

billion kilowatthours



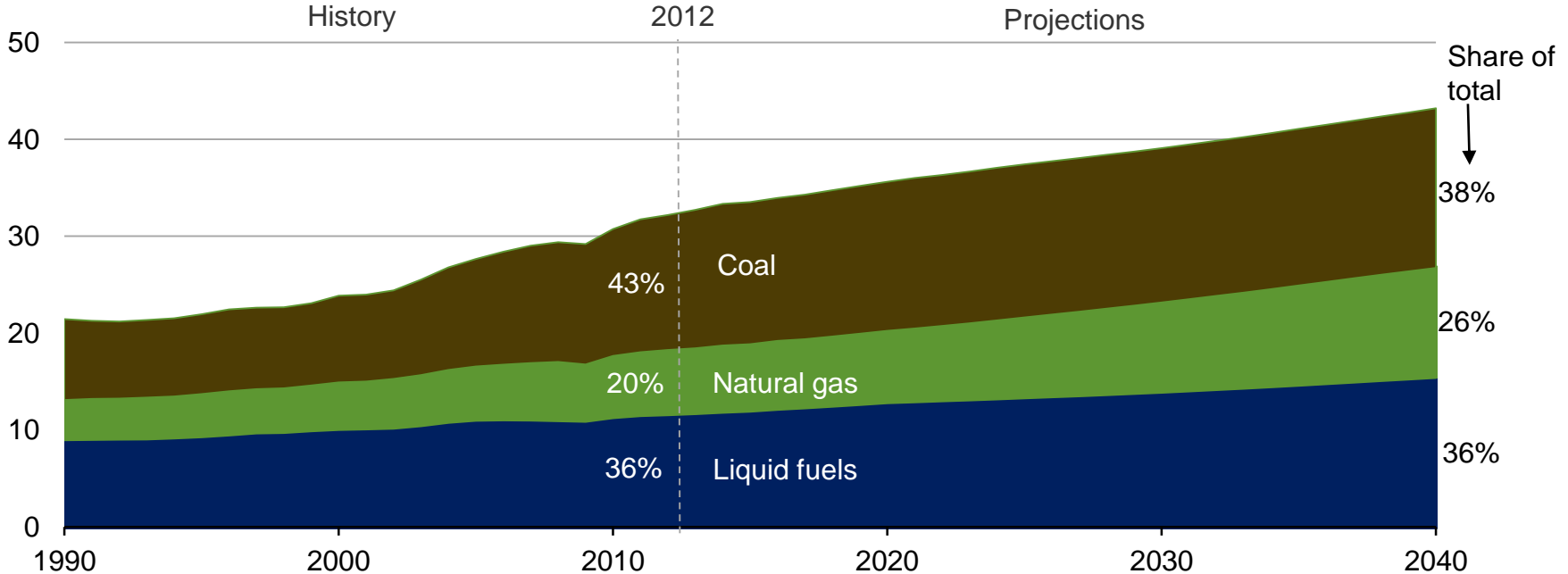
Source: EIA, International Energy Outlook 2016

Energy-related carbon dioxide emissions

Coal remains the world's largest source of energy-related CO2 emissions, but by 2040 its share declines to 38%

world energy-related carbon dioxide emissions

billion metric tons

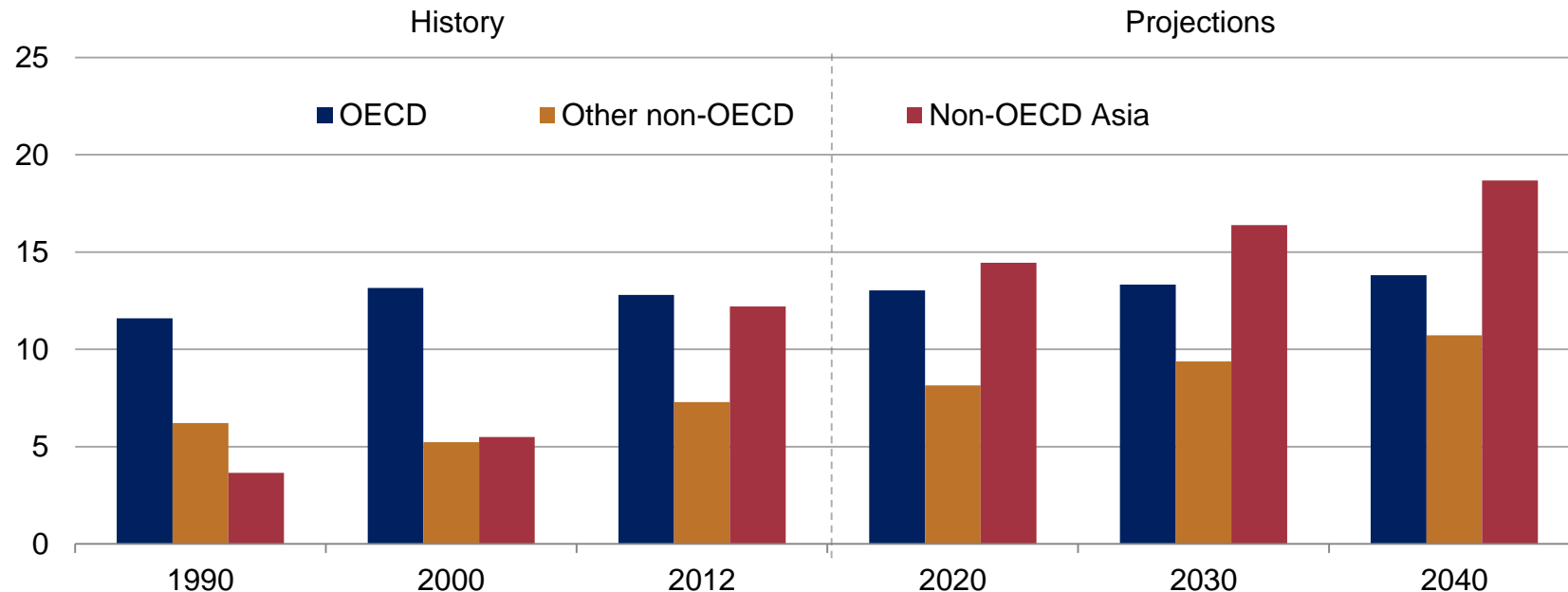


Source: EIA, International Energy Outlook 2016

Non-OECD Asia will account for about 60% of the world increase in energy-related CO2 emissions

world energy-related carbon dioxide emissions

billion metric tons



Source: EIA, International Energy Outlook 2016

For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

Short-Term Energy Outlook | www.eia.gov/steo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

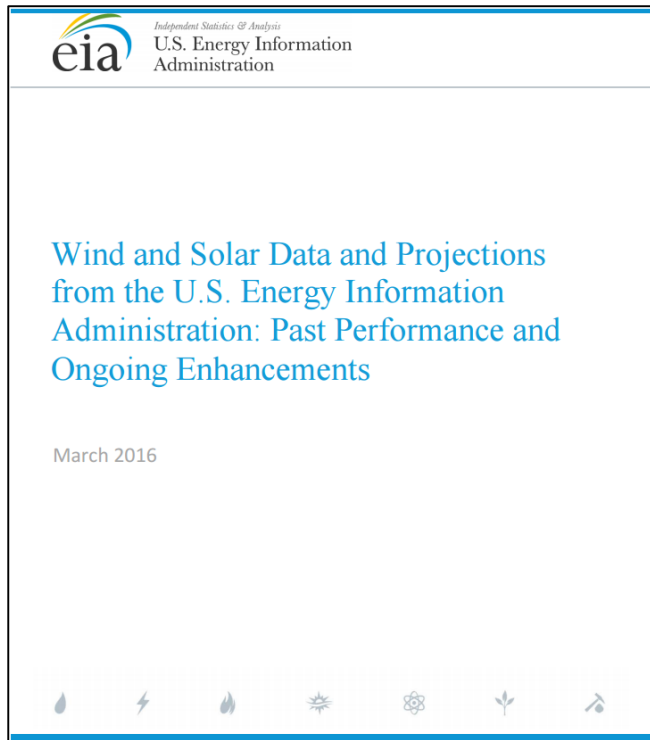
State Energy Profiles | www.eia.gov/state

Drilling Productivity Report | www.eia.gov/petroleum/drilling/

International Energy Portal | www.eia.gov/beta/international/?src=home-b1

Appendix A: U.S. solar and wind

EIA reviews renewable energy costs and historical capacity to improve projections for U.S. Annual Energy Outlook

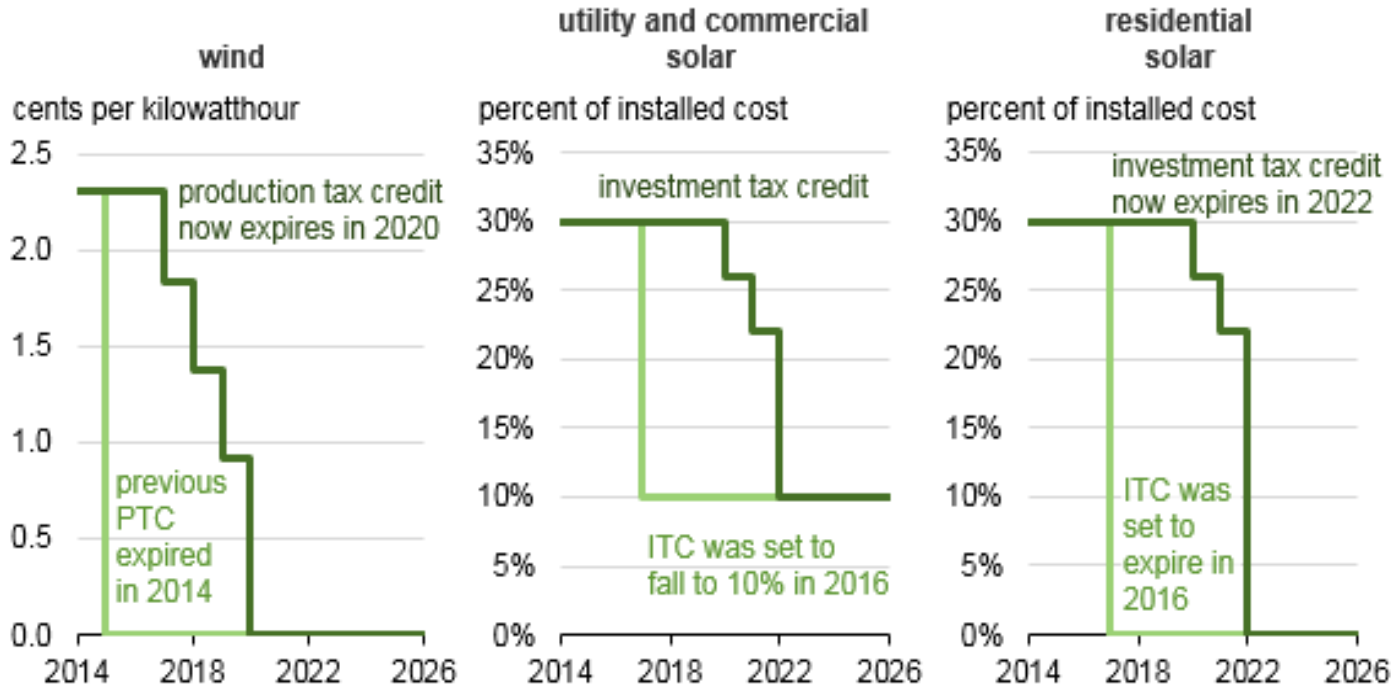


- wind and solar electricity capacity, the latter including both utility-scale solar and distributed photovoltaic (PV), has experienced rapid growth in recent years, increasing by more than 100% and slightly over 900%, respectively, between 2009 and 2015
- given the recent growth rates in wind and solar capacity and generation, EIA follows these technologies closely and is committed to assuring the quality of its data and projections for these sources through regular internal and external reviews

Source: <http://www.eia.gov/forecasts/aeo/supplement/renewable/>

Extension of federal investment and business tax credits helps to drive solar and wind generation capacity in the U.S.

Tax credits for wind and solar technologies (2014-26)



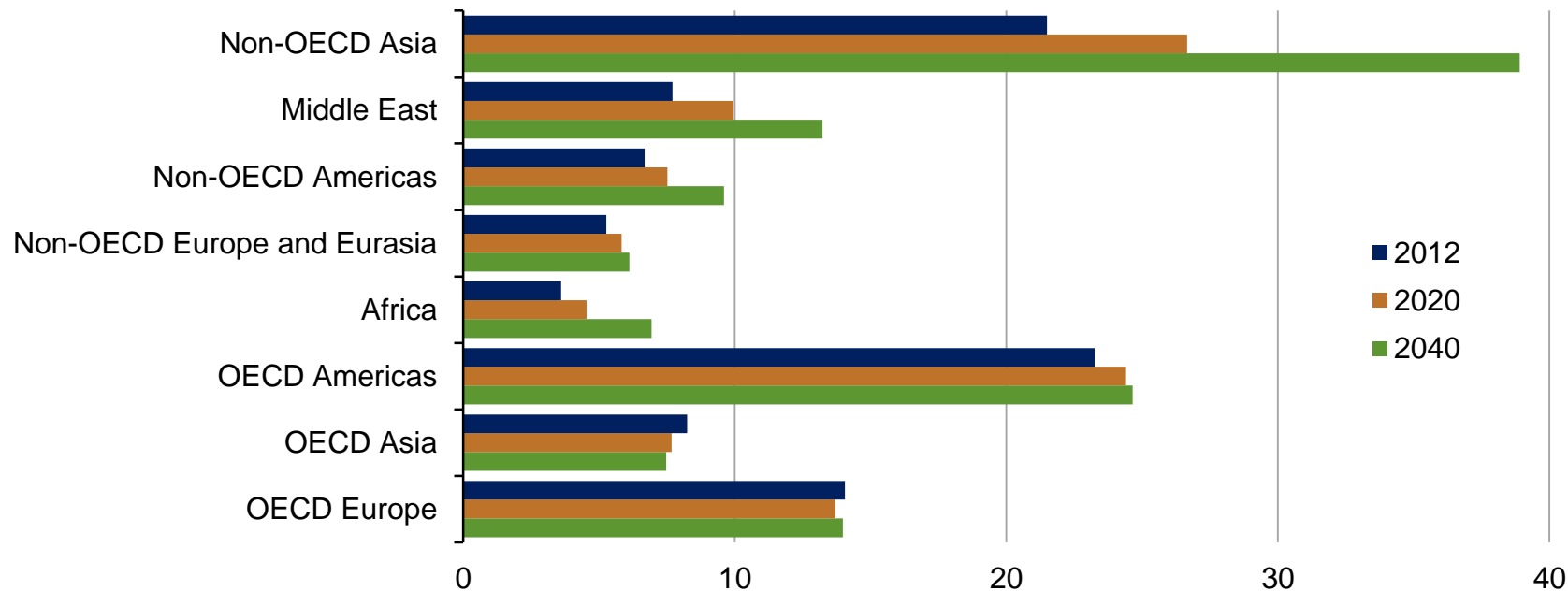
Source: <http://www.eia.gov/todayinenergy/detail.cfm?id=26492>

Appendix B:

International liquid fuels markets

Most of the growth in world oil consumption occurs in the non-OECD regions — especially Asia

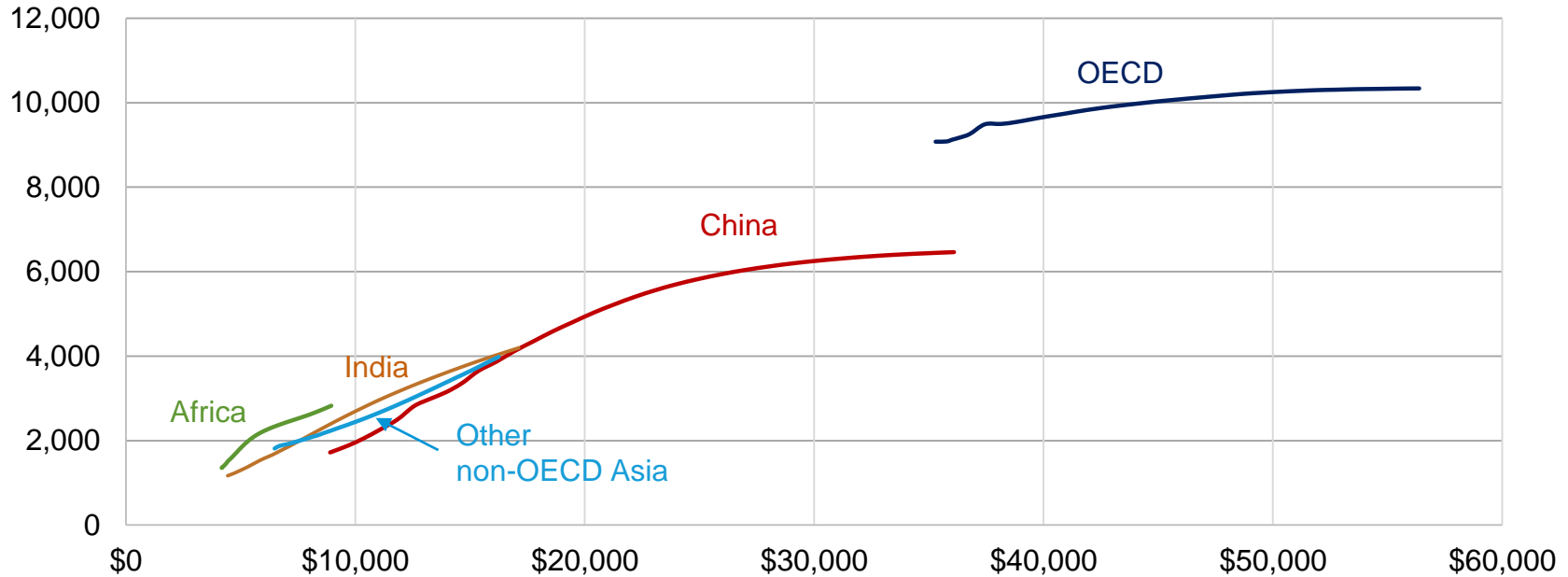
world petroleum and other liquid fuels consumption
million barrels per day



Source: EIA, *International Energy Outlook 2016*

Passenger-miles per person will rise as GDP per capita grows; travel growth is largely outside the OECD

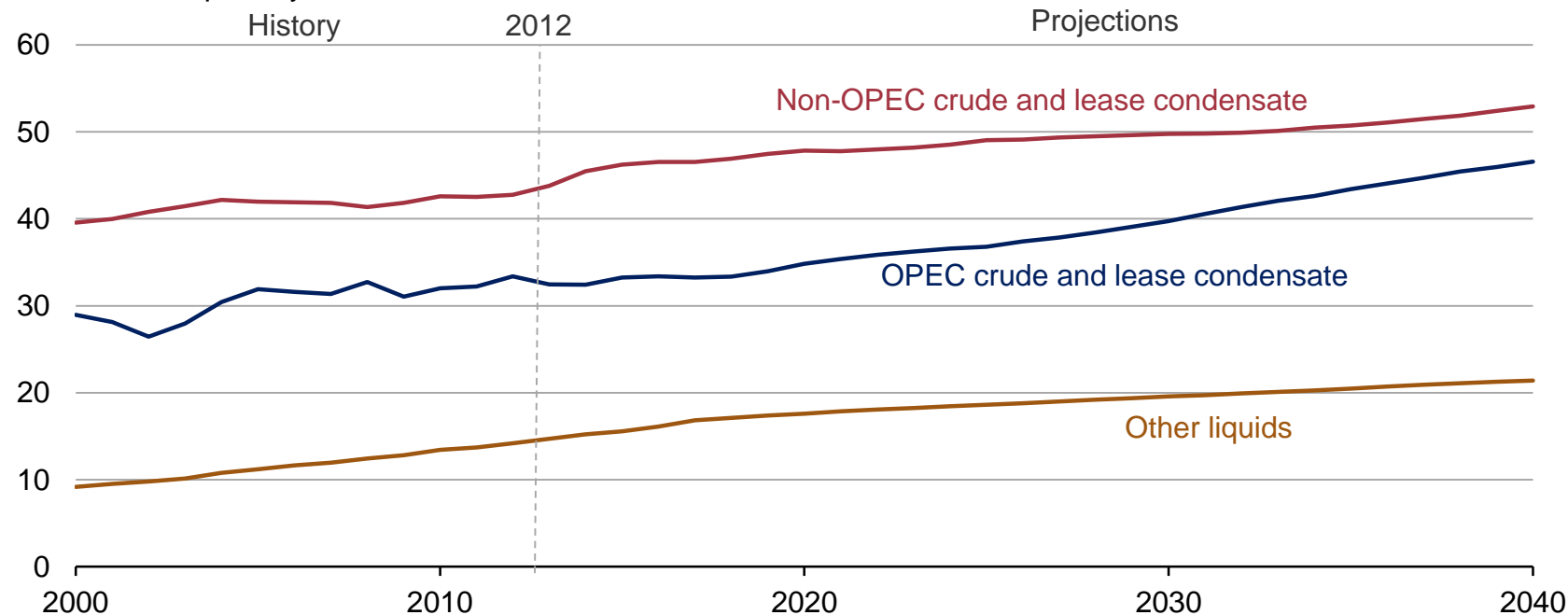
passenger-miles per capita (left-axis) and GDP per capita (horizontal-axis) for selected country groupings 2010–40



Source: EIA, *International Energy Outlook 2016*

Liquid fuels supplies from both OPEC and non-OPEC producers increase through 2040

world production of petroleum and other liquid fuels
million barrels per day

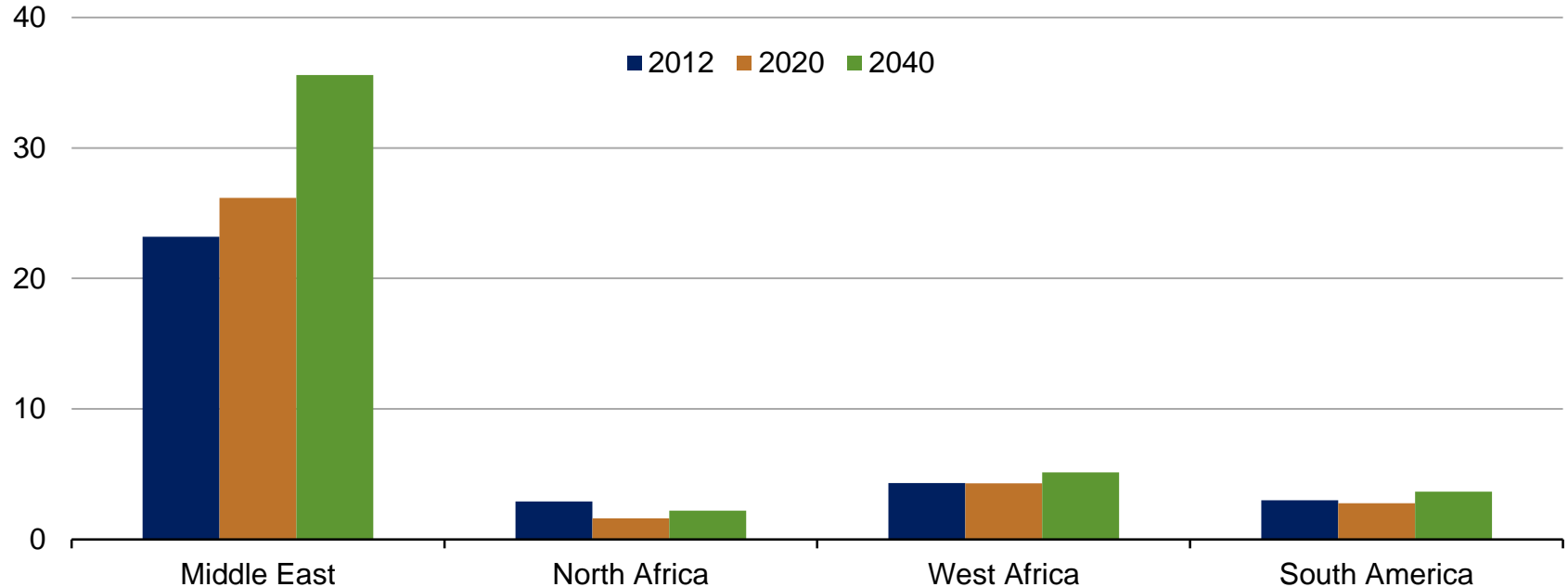


Source: EIA, International Energy Outlook 2016

Growth in OPEC production comes mainly from the Middle East

OPEC crude and lease condensate production

million barrels per day

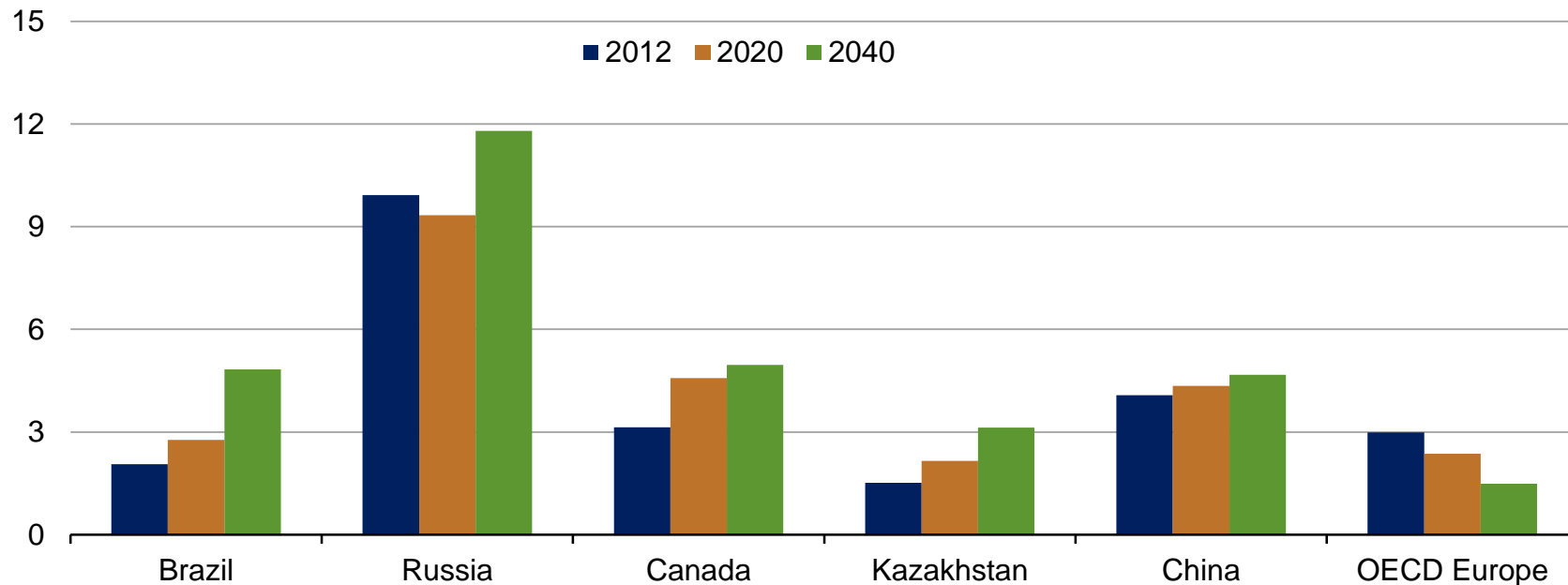


Source: EIA, International Energy Outlook 2016

Increases to non-OPEC oil supplies outside the United States are primarily from Brazil, Russia, Canada, and Kazakhstan

non-OPEC crude and lease condensate production in selected country groupings

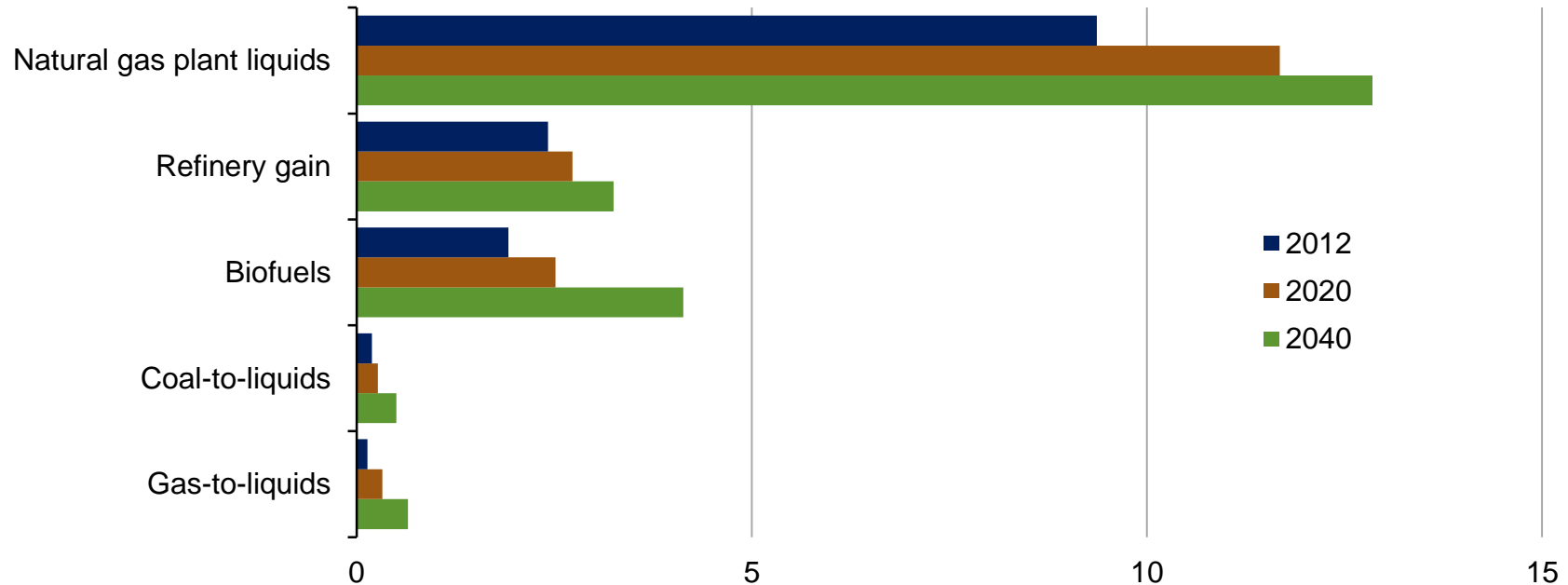
million barrels per day



Source: EIA, International Energy Outlook 2016

The largest components of other liquid fuels are NGPL, refinery gain, and biofuels

million barrels per day

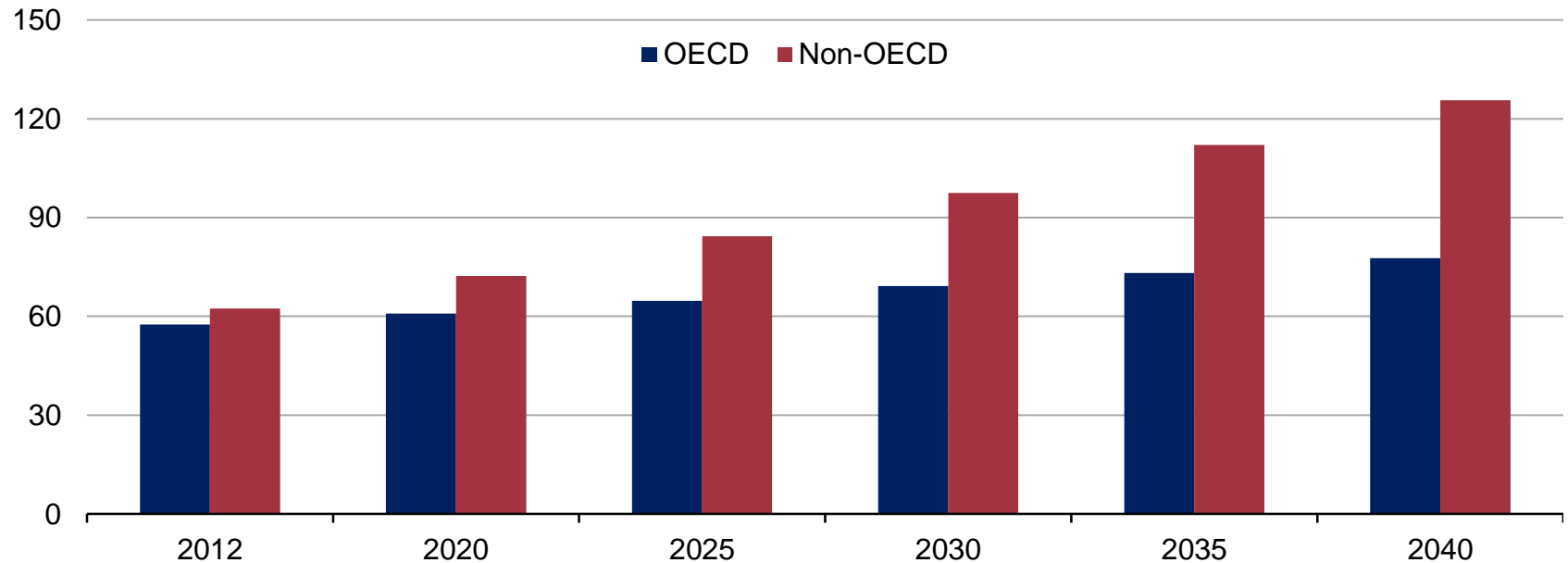


Source: EIA, International Energy Outlook 2016

Appendix C: International natural gas markets

Non-OECD nations will account for 76% of the growth in natural gas consumption

world natural gas consumption
trillion cubic feet

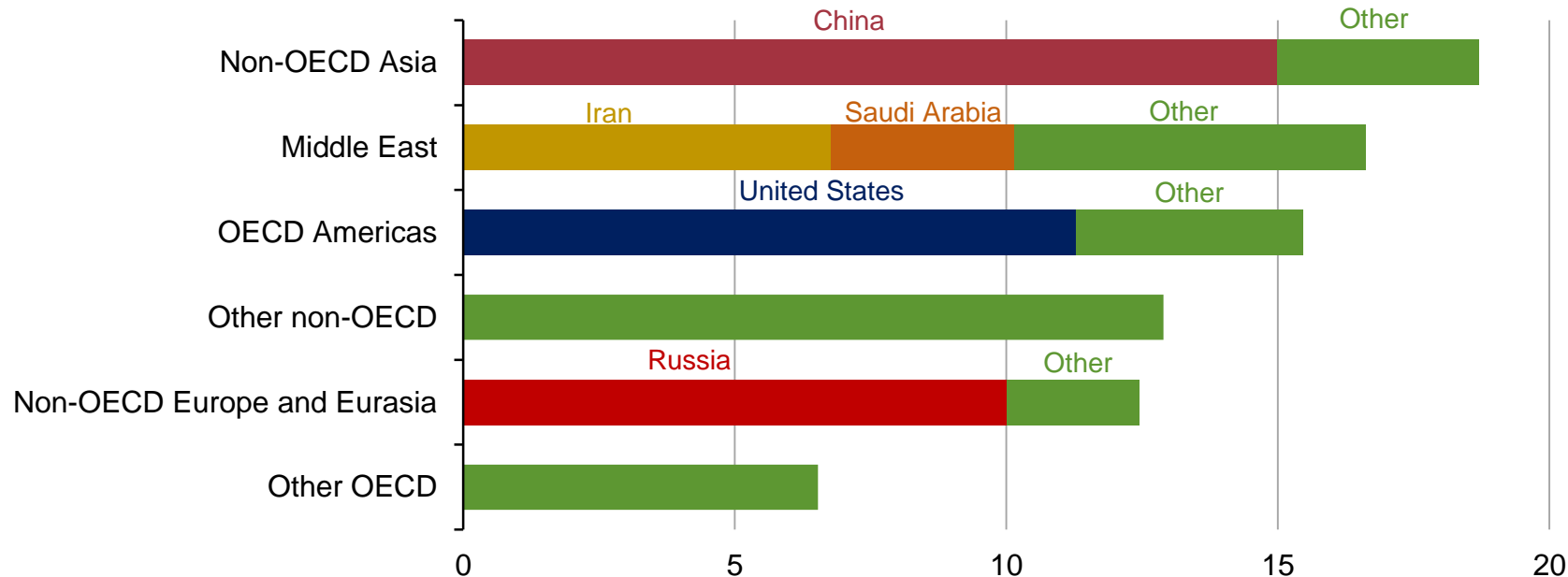


Source: EIA, *International Energy Outlook 2016*

Non-OECD Asia, Middle East, and OECD Americas account for the largest increases in natural gas production

world change in natural gas production, 2012–40

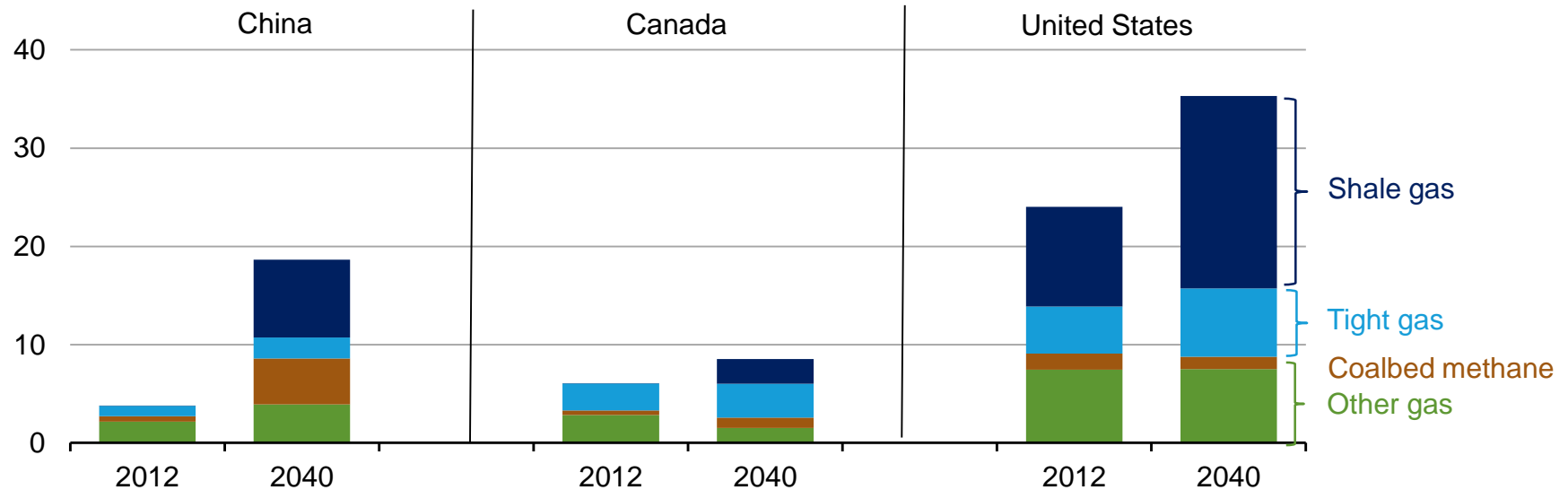
trillion cubic feet



Source: EIA, *International Energy Outlook 2016*

Shale gas, tight gas, and coalbed methane will become increasingly important to gas supplies, not only for the U.S., but also China and Canada

natural gas production by type
trillion cubic feet

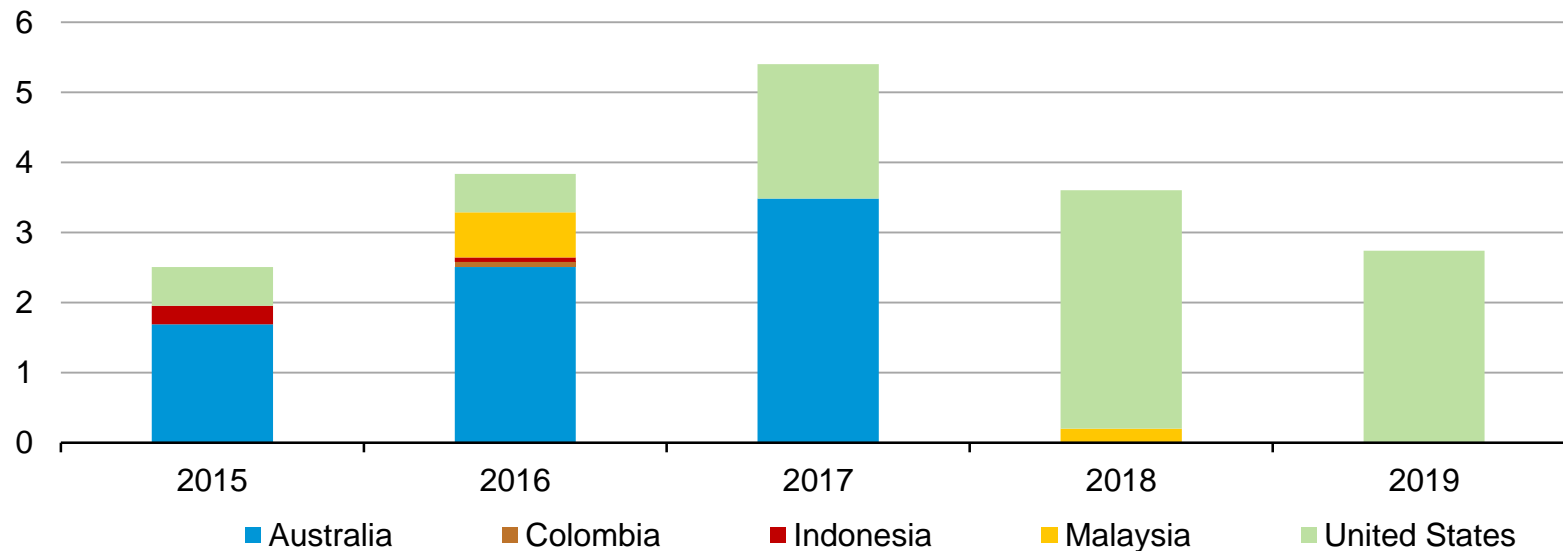


Note: Other natural gas includes natural gas produced from structural and stratigraphic traps (e.g. reservoirs), historically referred to as 'conventional' production.

Source: EIA, International Energy Outlook 2016

Liquefaction capacity additions over the 2015-19 time period will increase global capacity by over 30%

LNG capacity additions
billion cubic feet per day



Note: Capacity additions in 2015-19 include projects currently under construction, and represent nameplate capacity, not adjusted for ramp-up

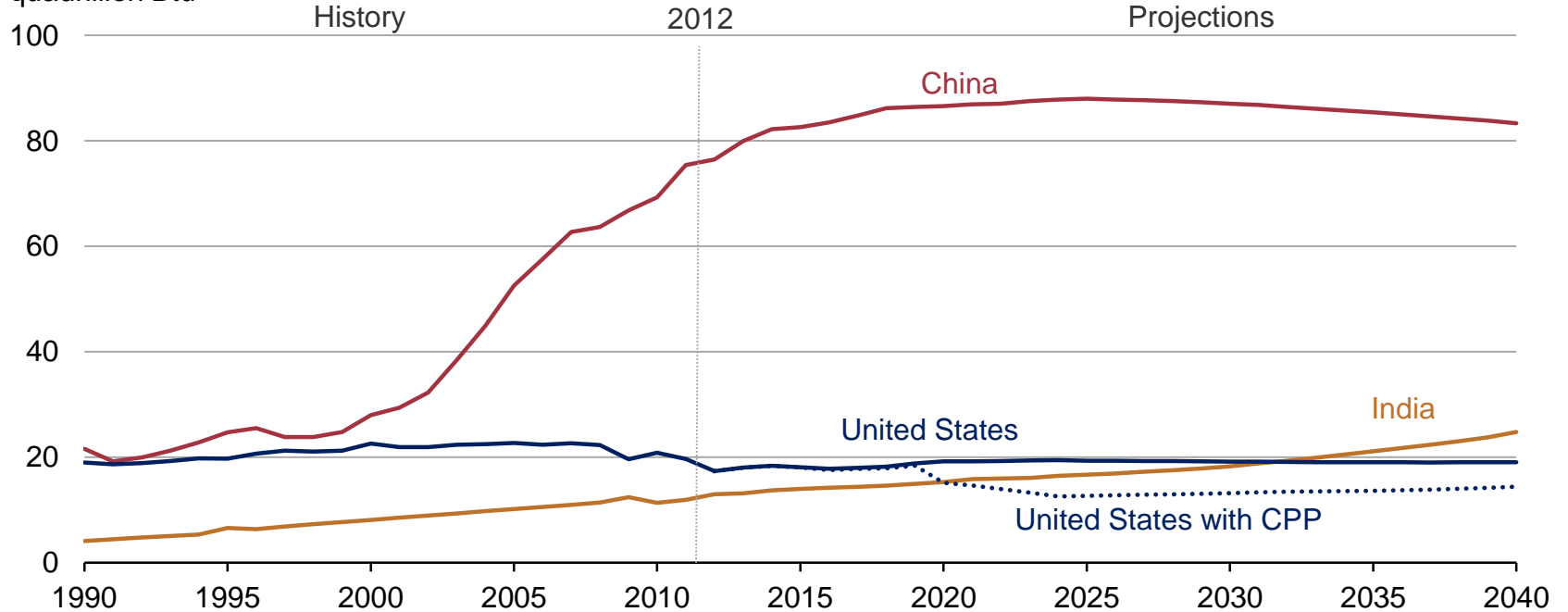
Source: U.S. Energy Information Administration estimates based on trade press

Appendix D: Miscellaneous international

Of the world's three largest coal consumers, only India is projected to continue to increase throughout the projection

coal consumption in the US, China, and India

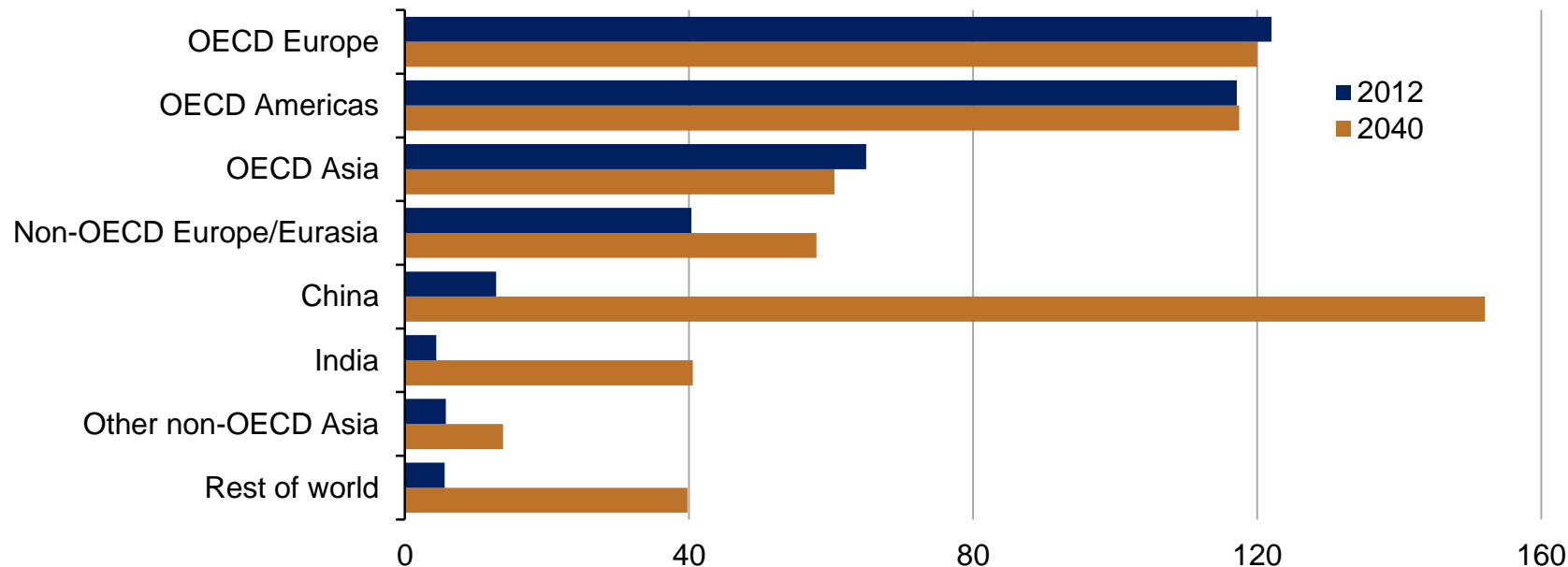
quadrillion Btu



Source: EIA, *International Energy Outlook 2016* and EIA, *Analysis of the Impacts of the Clean Power Plan* (May 2015)

Virtually all of the growth in nuclear power will occur in the non-OECD regions; China accounts for 61% of world nuclear capacity growth

world installed nuclear capacity by region
gigawatts

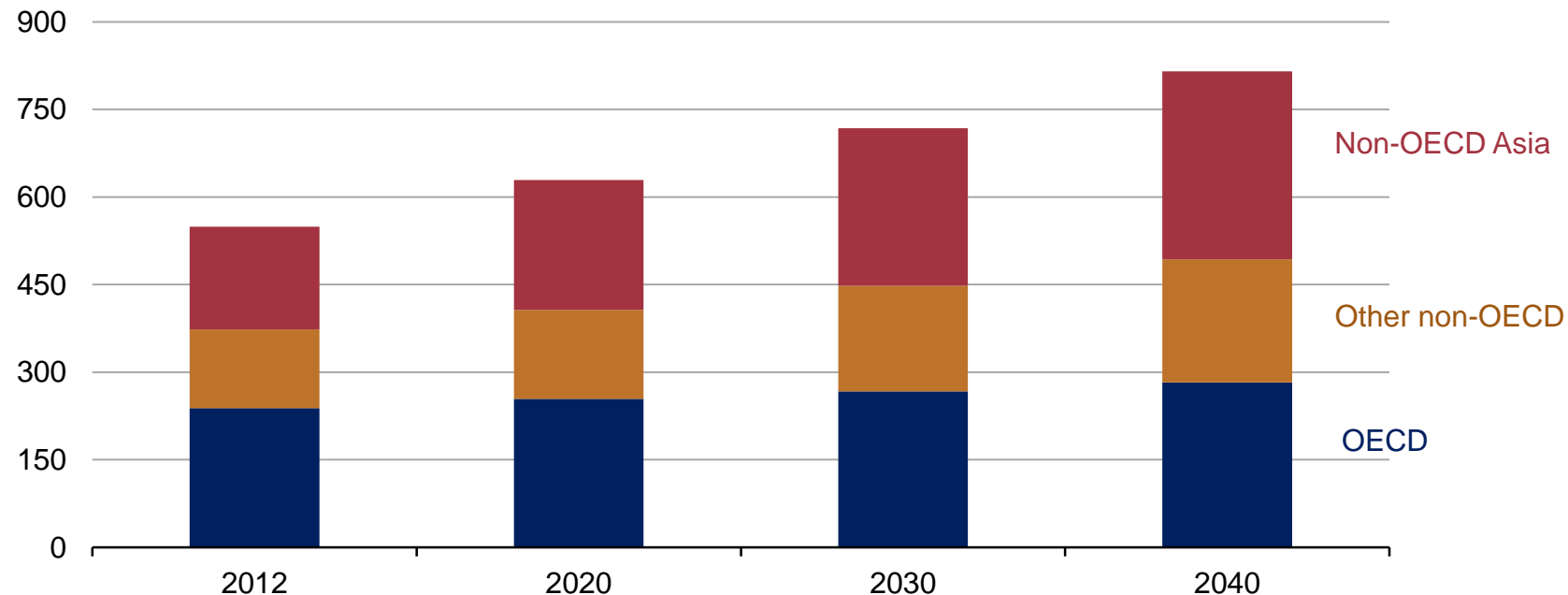


Source: EIA, International Energy Outlook 2016

Non-OECD Asia accounts for 55% of the world increase in energy use

world energy consumption

quadrillion Btu

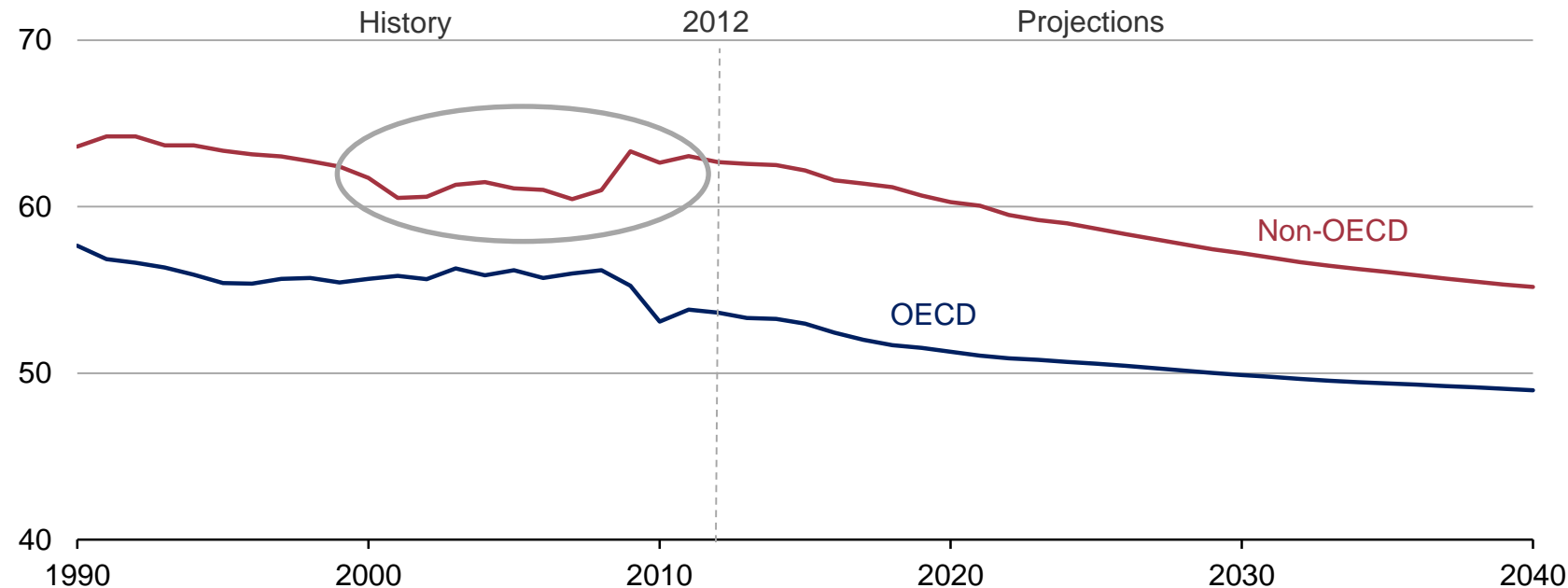


Source: EIA, *International Energy Outlook 2016*

Projected carbon intensity of energy use (CO₂/E) declines through 2040 in both OECD and non-OECD; non-OECD CO₂/E rose over 2000–12

carbon intensity of energy consumption, 1990-2040

kilograms CO₂ per million Btu



Source: EIA, *International Energy Outlook 2016*