



# Energy Outlook: A View to 2040

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This presentation includes forward-looking statements. Actual future conditions (including economic conditions, energy demand, and energy supply) could differ materially due to changes in technology, the development of new supply sources, political events, demographic changes, and other factors discussed herein and under the heading "Factors Affecting Future Results" in the Investors section of our website at: [www.exxonmobil.com](http://www.exxonmobil.com). The information provided includes ExxonMobil's internal estimates and forecasts based upon internal data and analyses as well as publically-available information from external sources including the International Energy Agency. This material is not to be used or reproduced without the permission of Exxon Mobil Corporation. All rights reserved.

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# Energy Outlook Development

A light gray world map is centered in the background of the slide. The map shows the outlines of continents and countries. Overlaid on the map is the text '100 countries' in a large, bold, blue font. The number '100' is positioned above the word 'countries'.

**100  
countries**

# Energy Outlook Development

**15 demand sectors**

Residential

Chemicals

Commercial

Asphalt

Lt. Transportation

Lubricants

Hvy. Transportation

Flaring

Aviation

Energy Industry

Marine

Agriculture

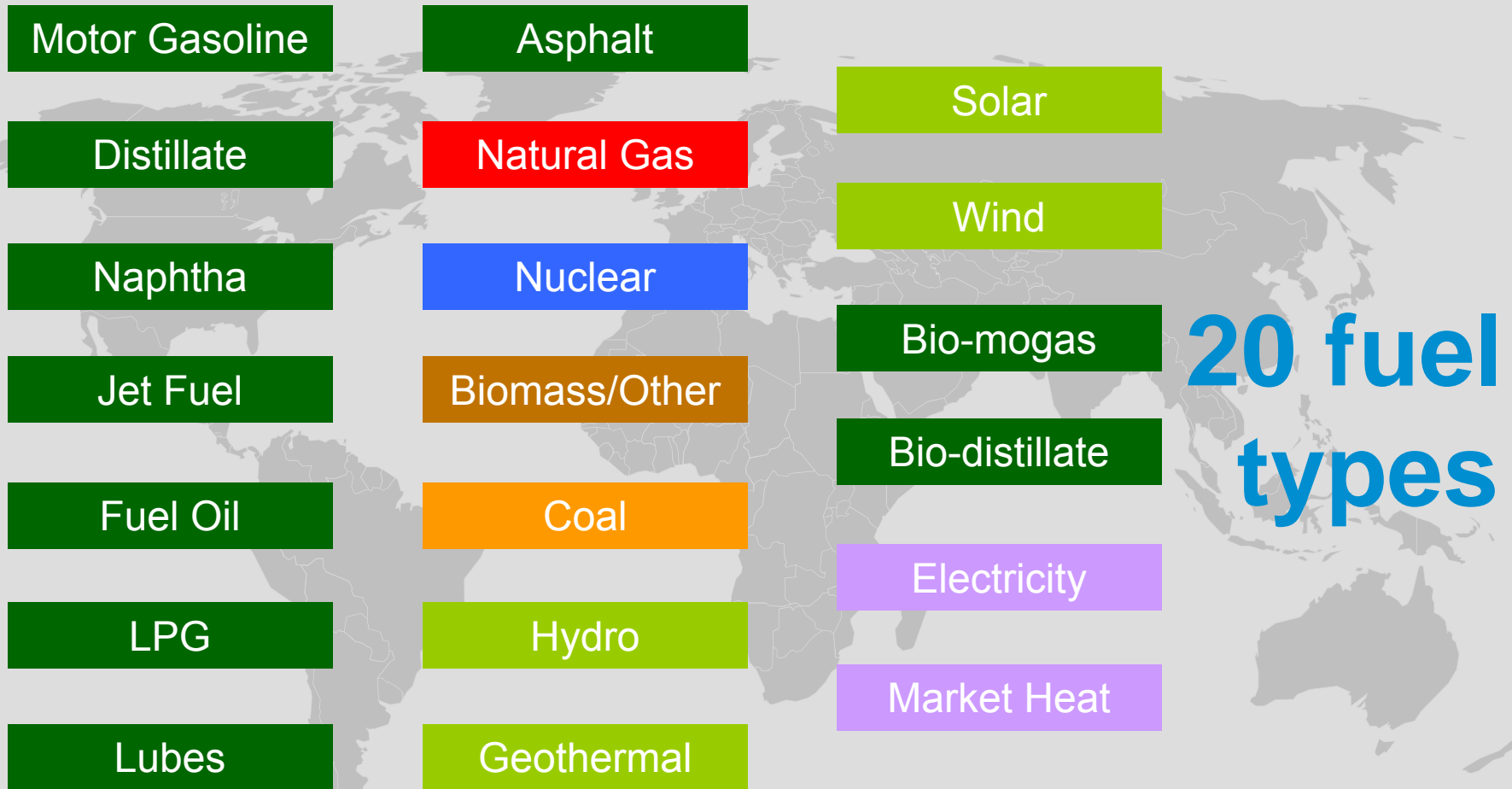
Rail

Heavy Industry

Power Generation

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# Energy Outlook Development

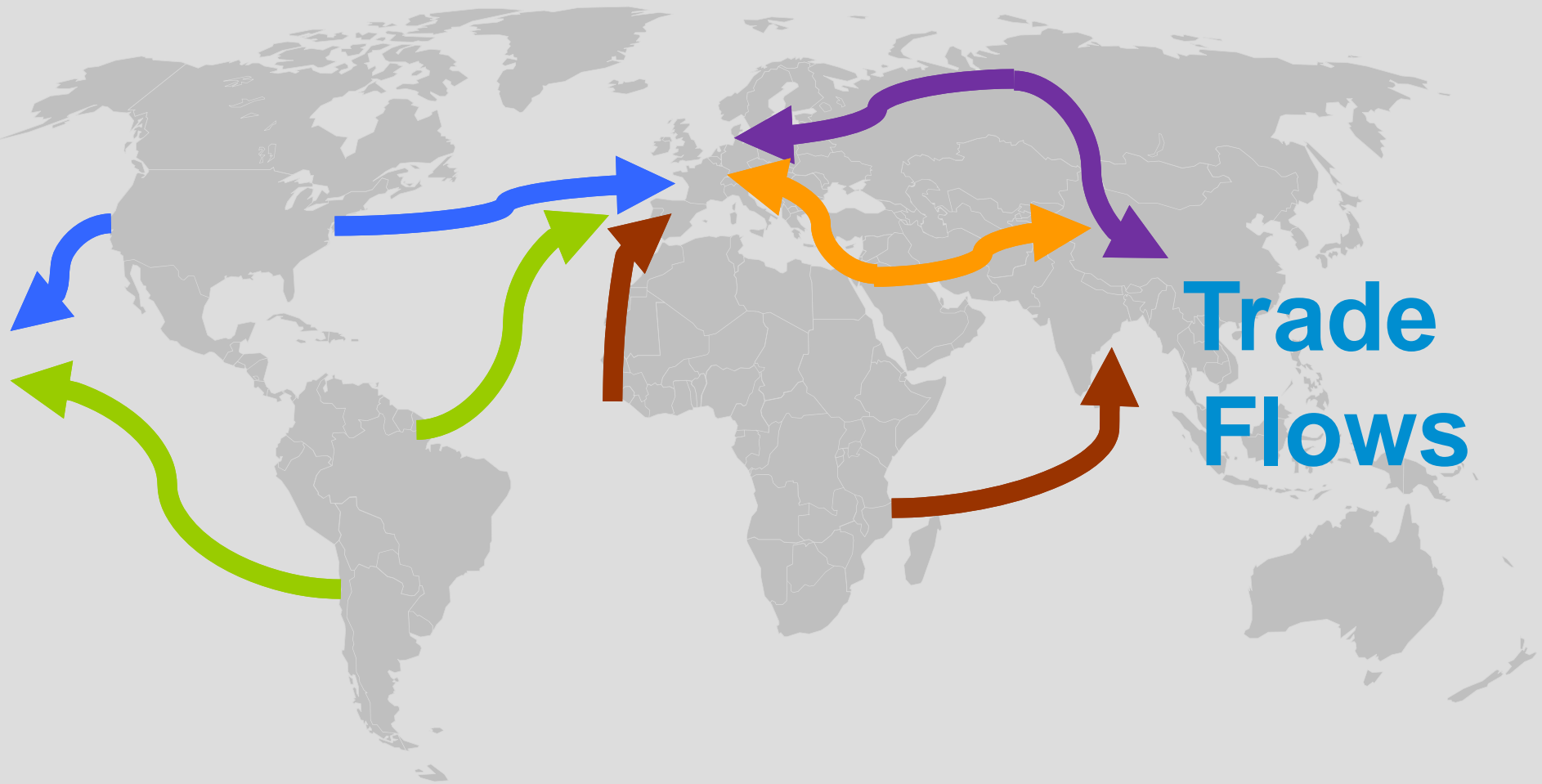


# Energy Outlook Development



## Technology & Policy

# Energy Outlook Development

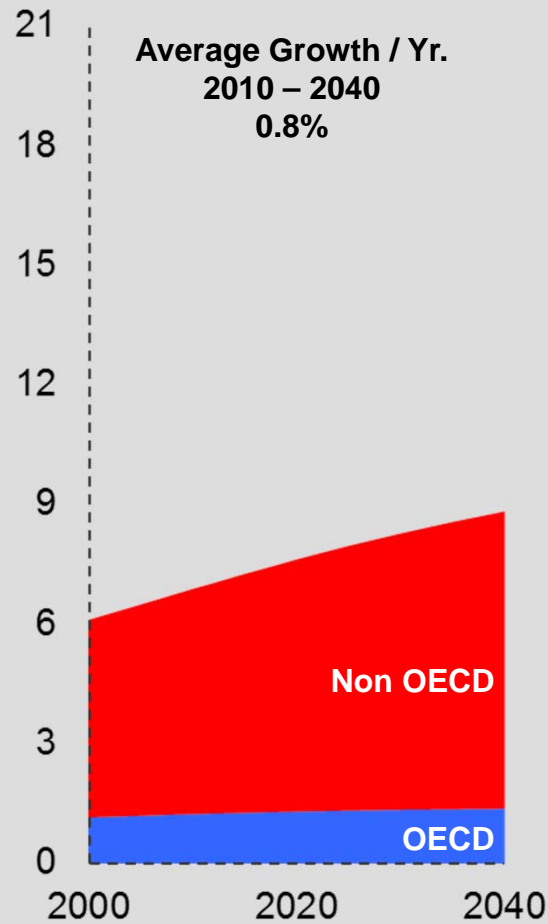


Trade  
Flows

# Global Progress Drives Demand

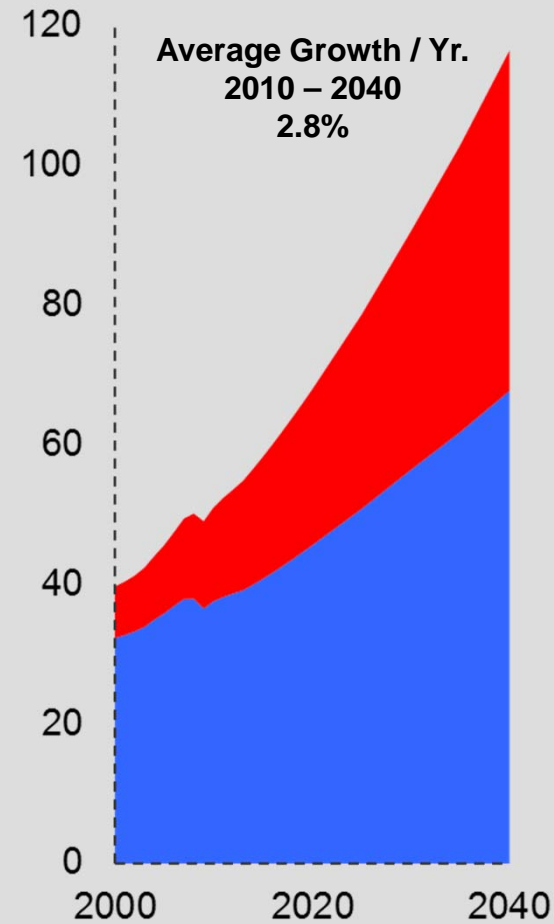
## Population

Billion



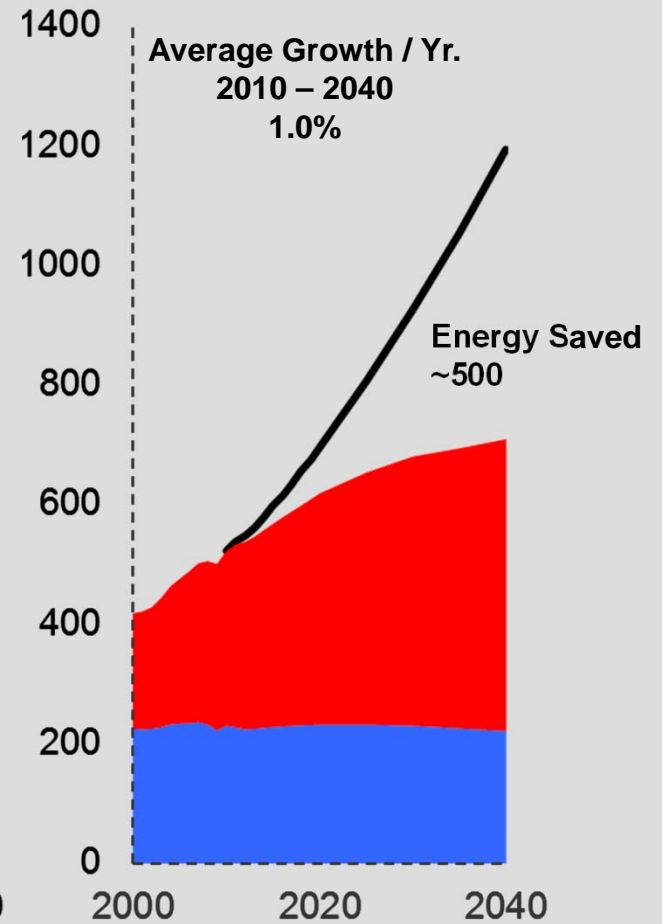
## GDP

Trillion 2005\$



## Energy Demand

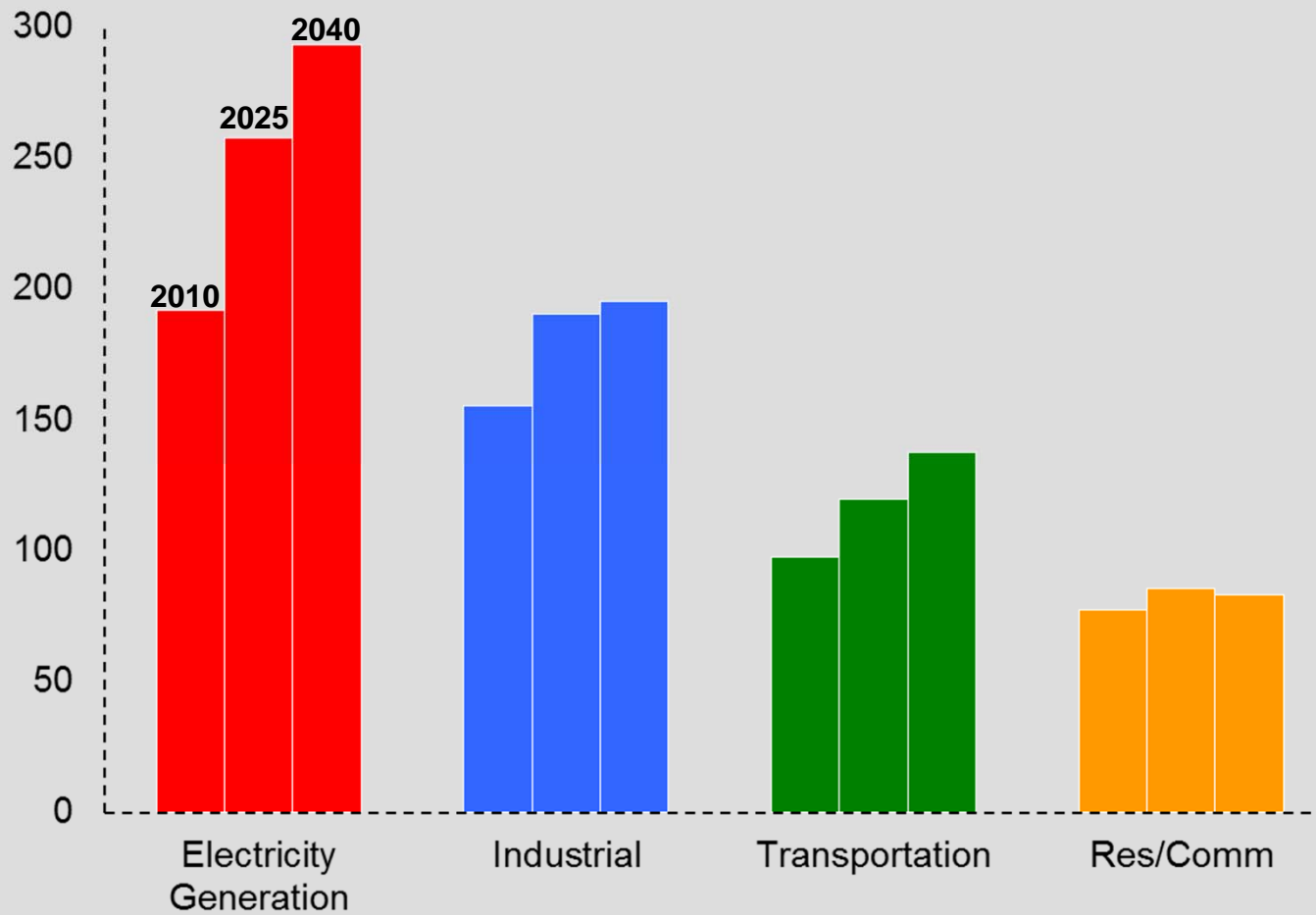
Quadrillion BTUs



# Electricity Generation Leads Growth

## Energy Demand by Sector

Quadrillion BTUs







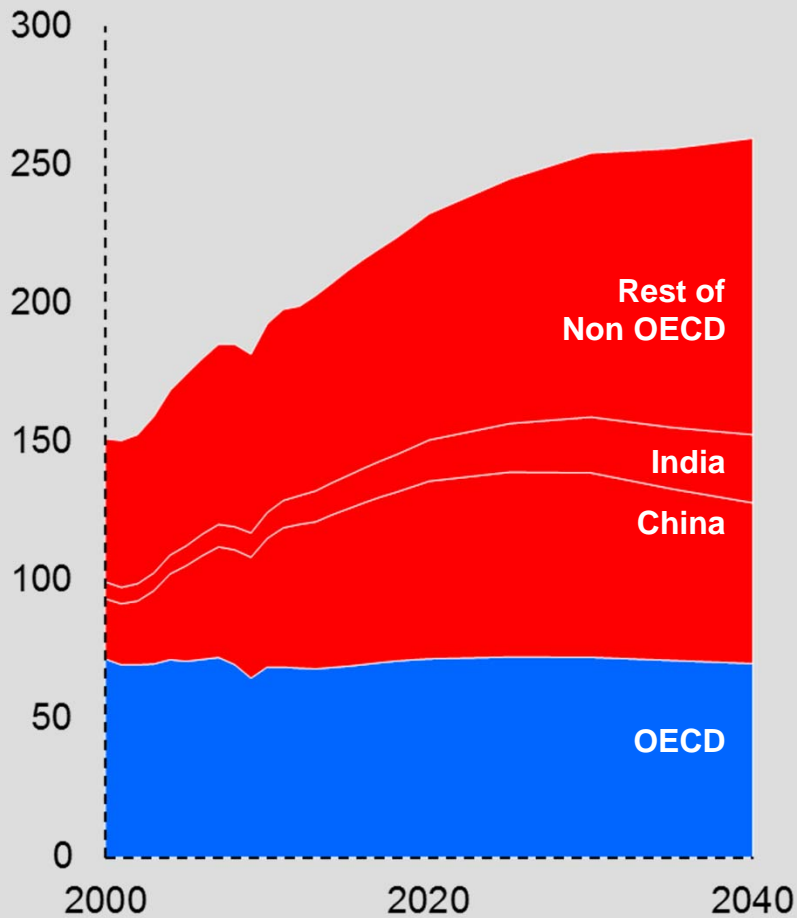
Industrial



# Industrial Energy Demand

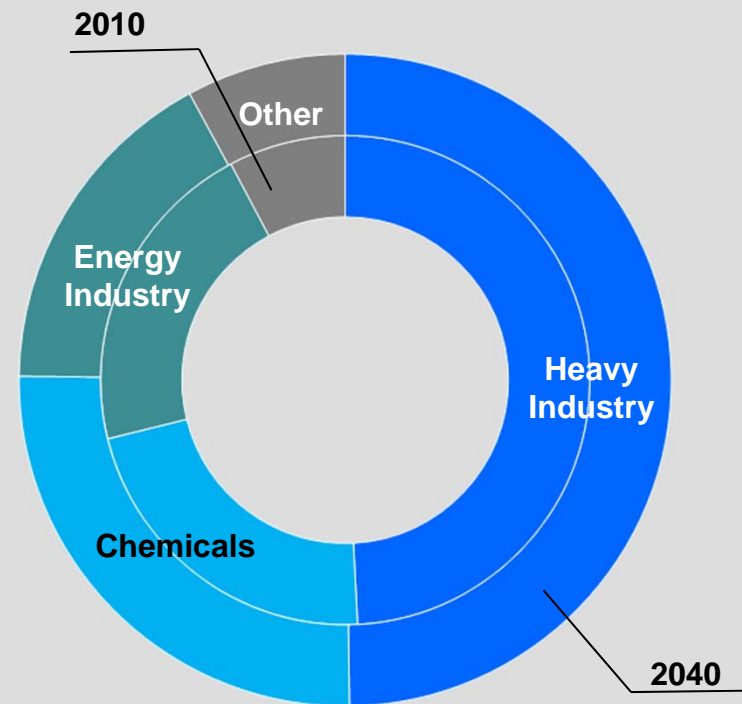
## By Region

Quadrillion BTUs



## By Sector

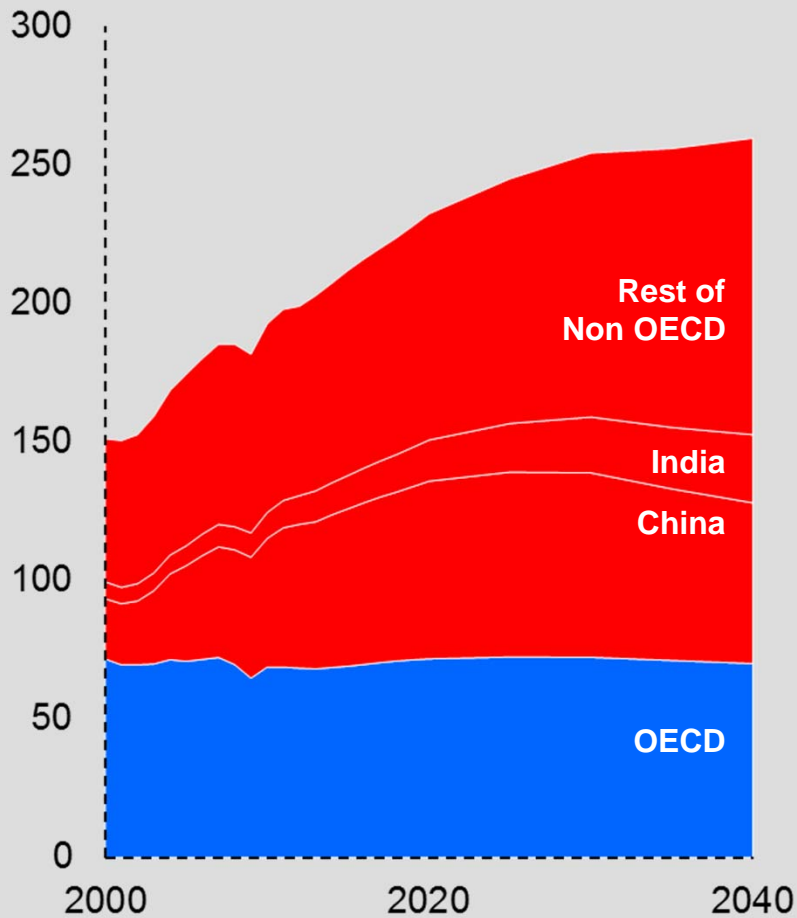
Percent Share



# Industrial Energy Demand

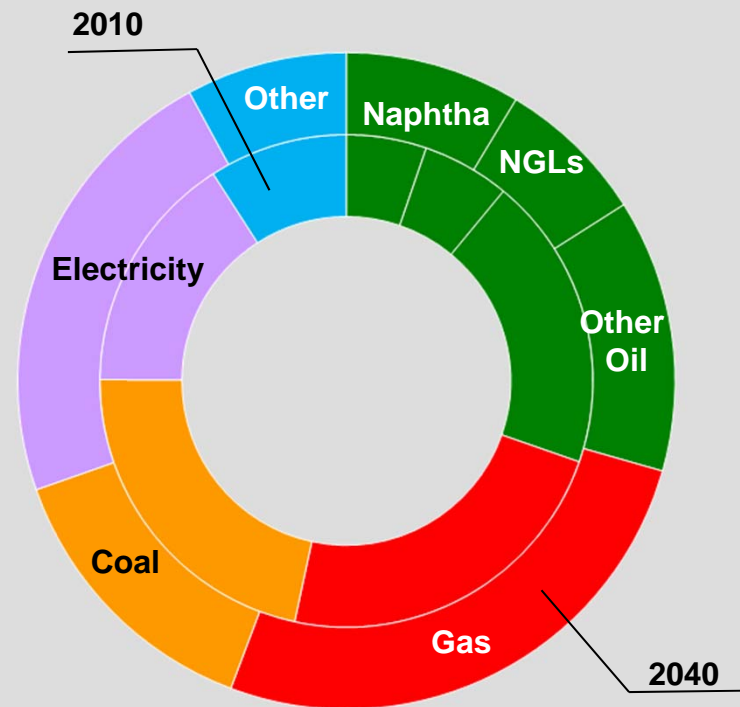
## By Region

Quadrillion BTUs



## By Fuel

Percent Share





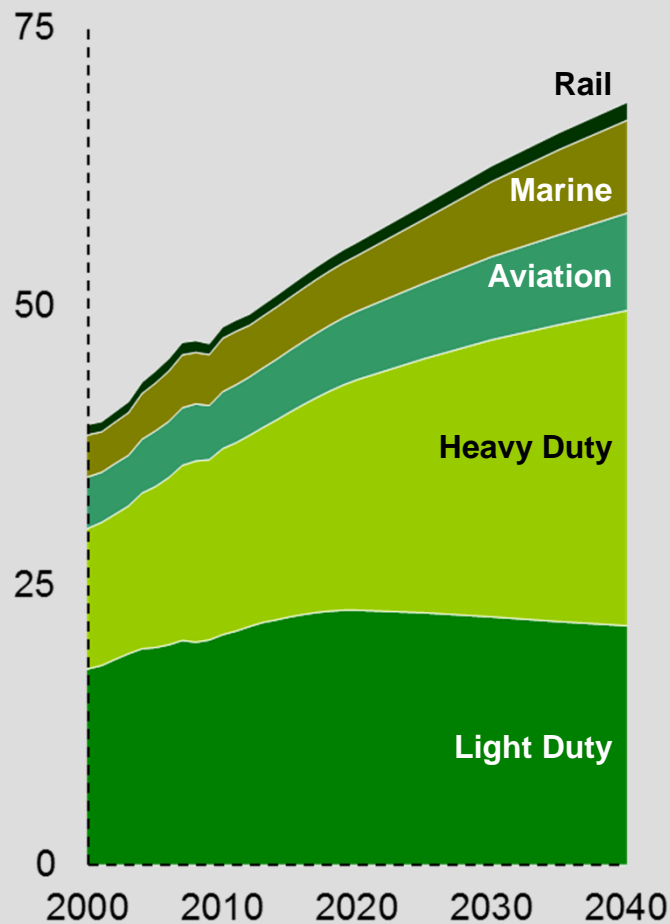
# Transportation



# Transportation Demand

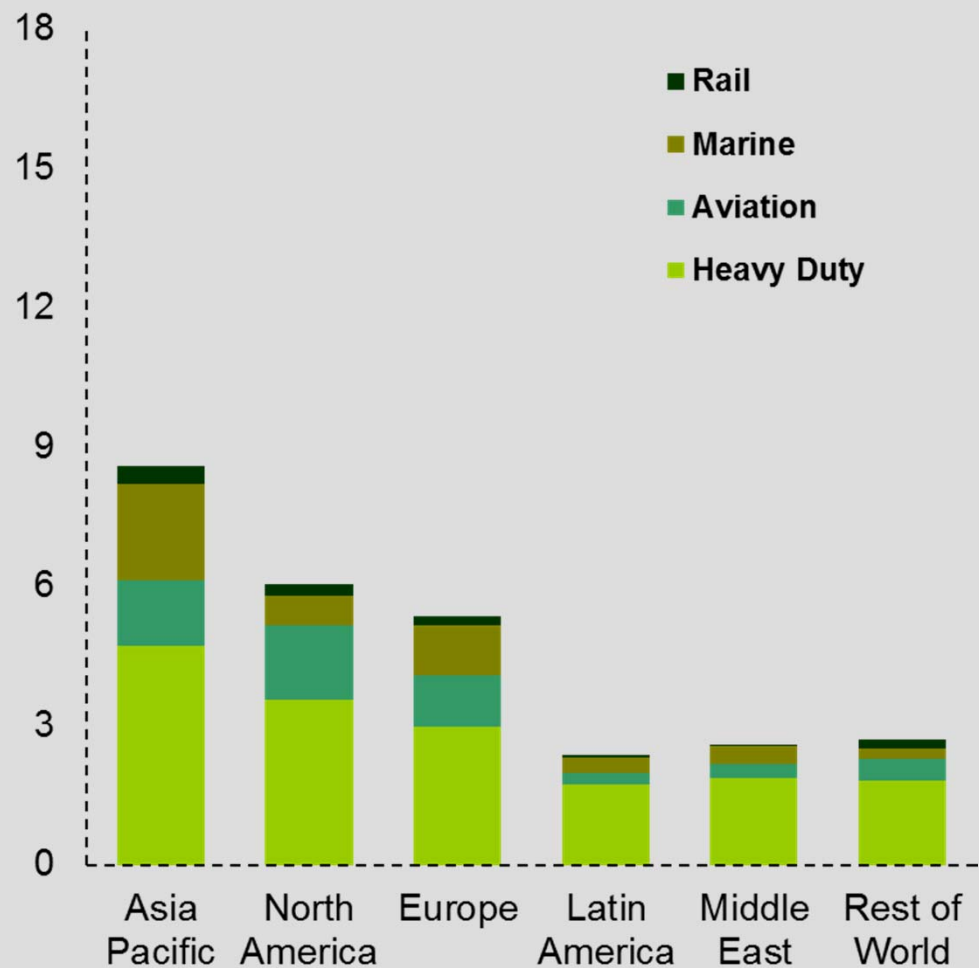
Sector Demand

MBDOE



Commercial Transportation by Region - 2010

MBDOE

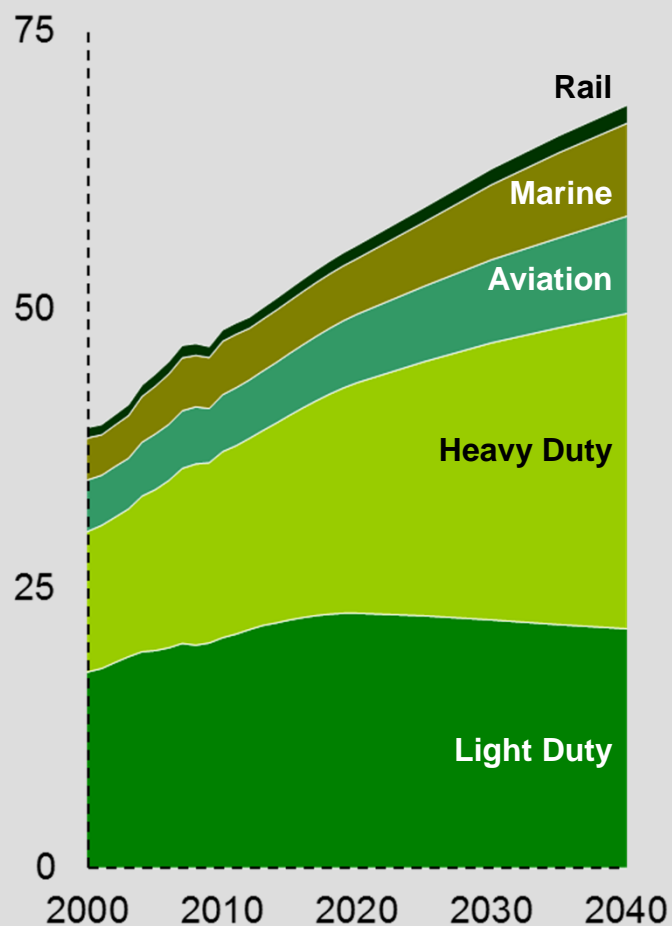




# Transportation Demand

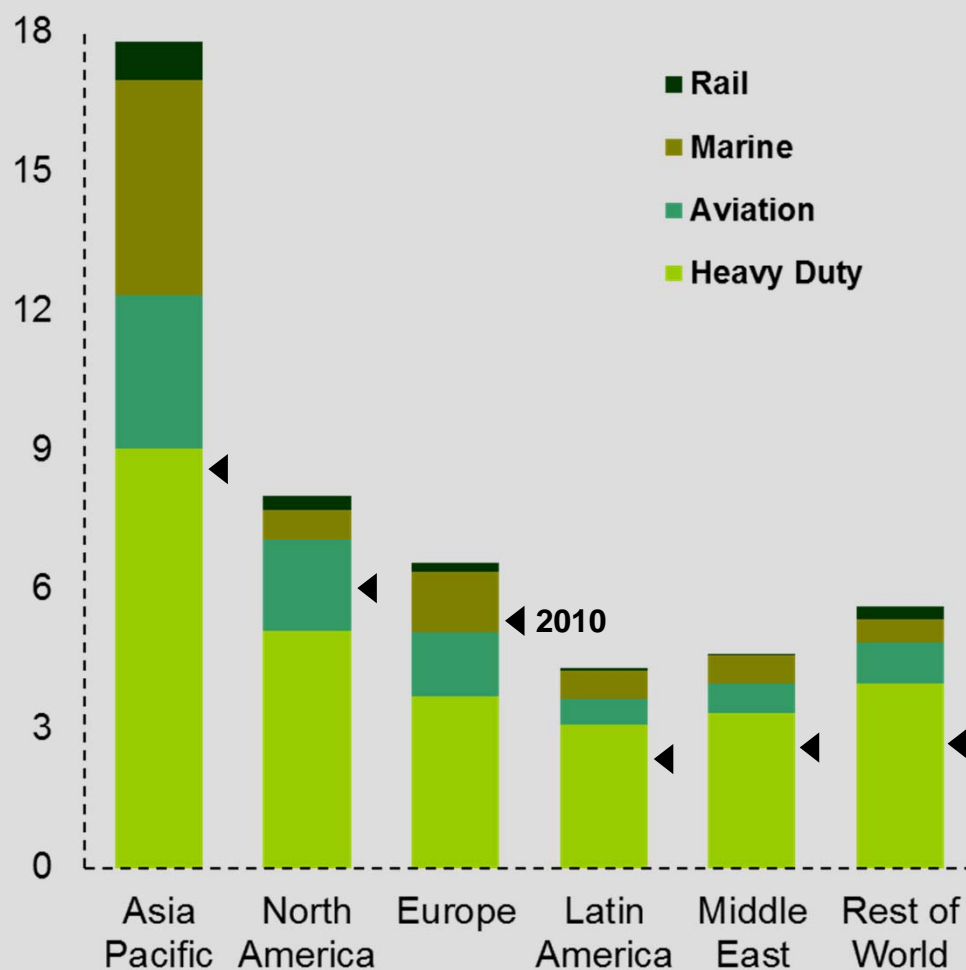
Sector Demand

MBDOE



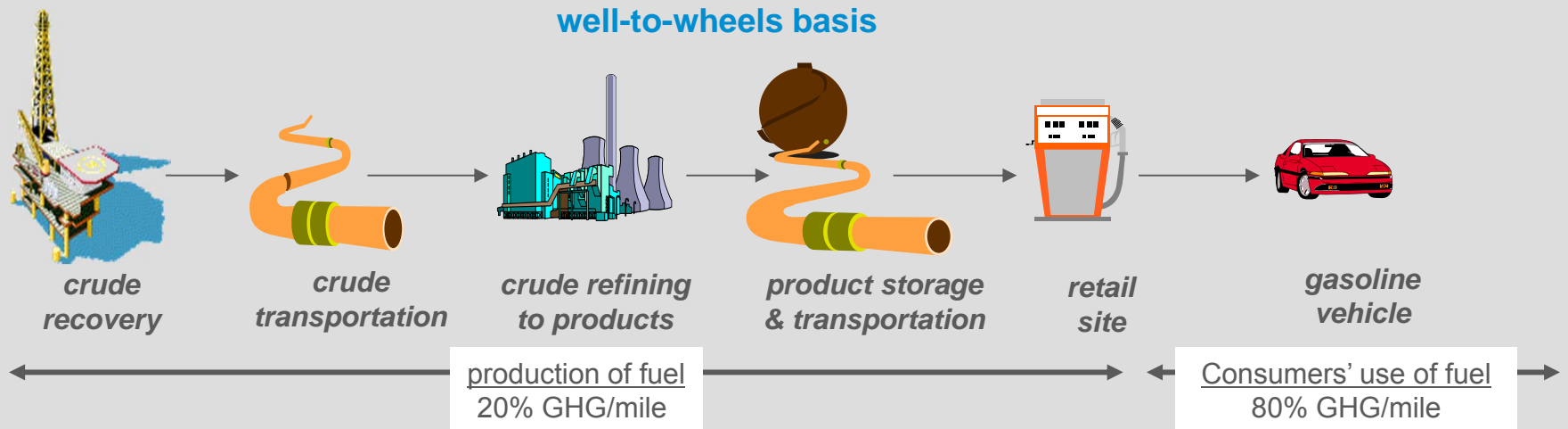
Commercial Transportation by Region - 2040

MBDOE



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# Technologies for Light Duty Transport



## technologies for fuel production

### shorter-term

- energy efficiency
- flare reduction
- cogeneration

### longer-term

- second generation bio-fuels
- Carbon Capture and Storage (CCS)

## technologies for consumers' use of fuel

### shorter-term

- conventional vehicle technology improvements
  - engines (e.g. adv. lubricants); efficient transmissions
  - others (e.g. tire liners, low weight plastics)
- advanced vehicles
  - hybrid (e.g. lithium ion battery materials)
  - advanced diesel
  - CNG

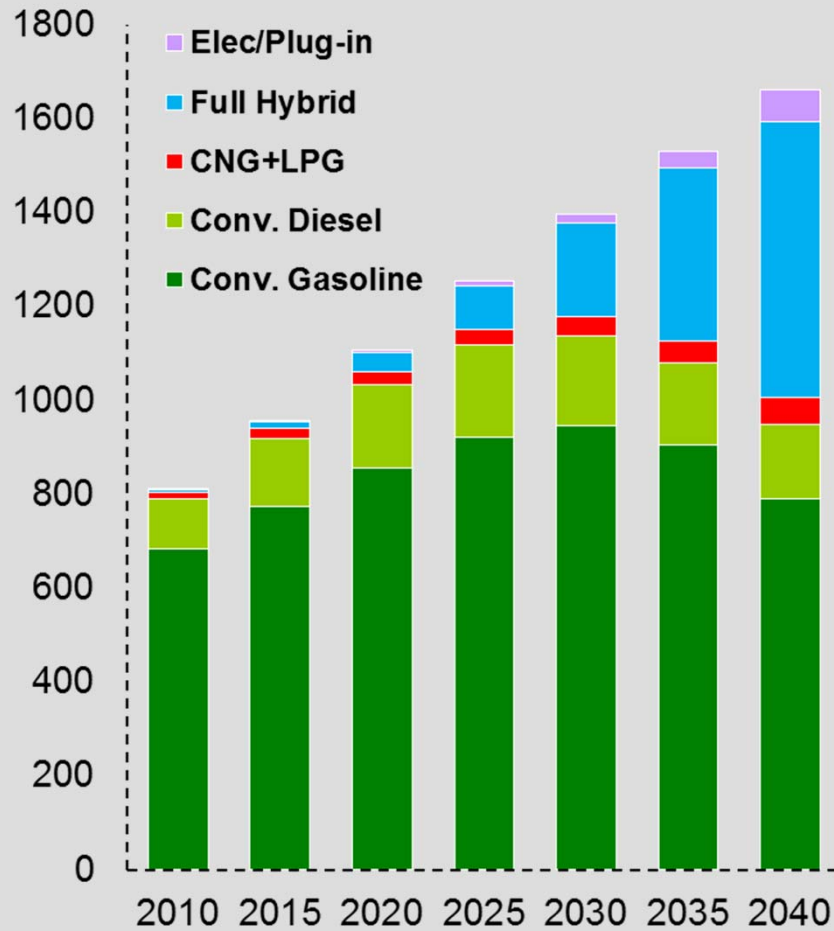
### longer-term

- breakthrough vehicles
  - “HCCI” or “CAI”; fuel cell (e.g. on-board H<sub>2</sub> generator)
  - plug-in hybrid and EV (e.g. lithium ion battery materials)

# Light Duty Vehicle Efficiency

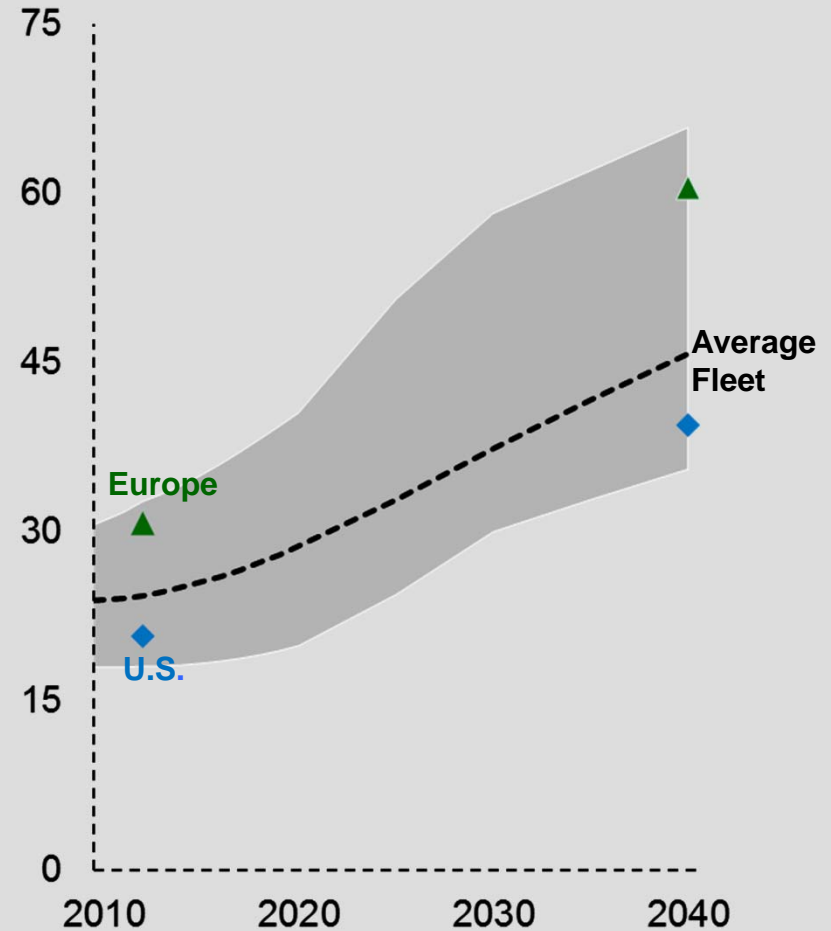
## Car Fleet by Type

Million Cars



## Range of Average Vehicle Efficiency

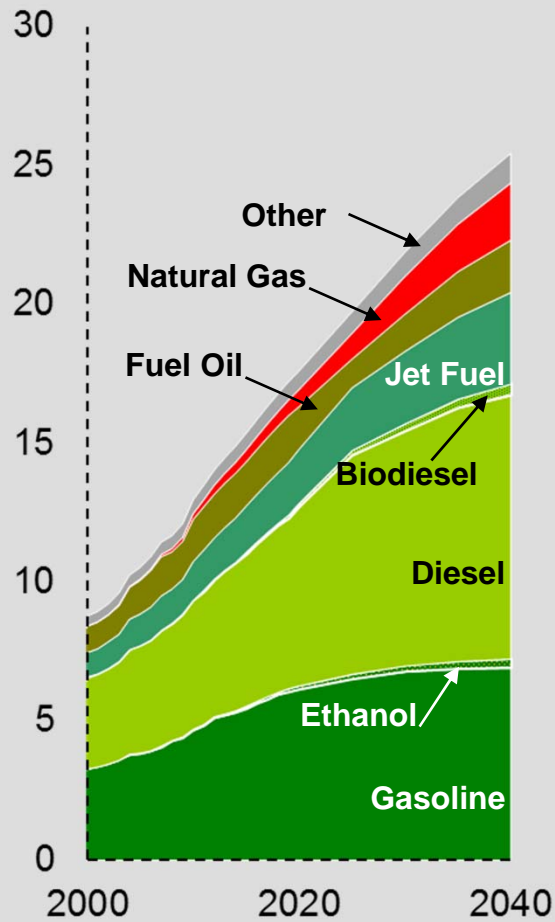
On-Road Miles per Gallon



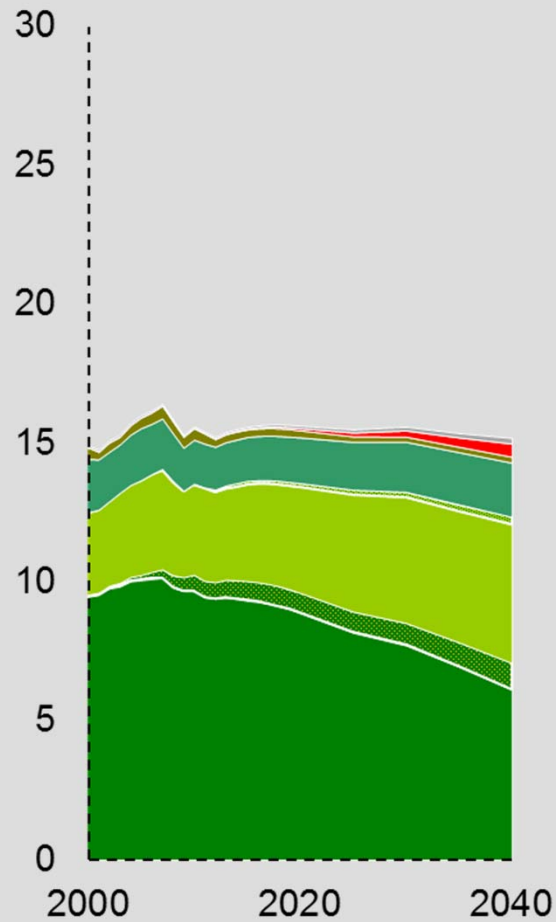


# Transportation Fuel Mix by Region

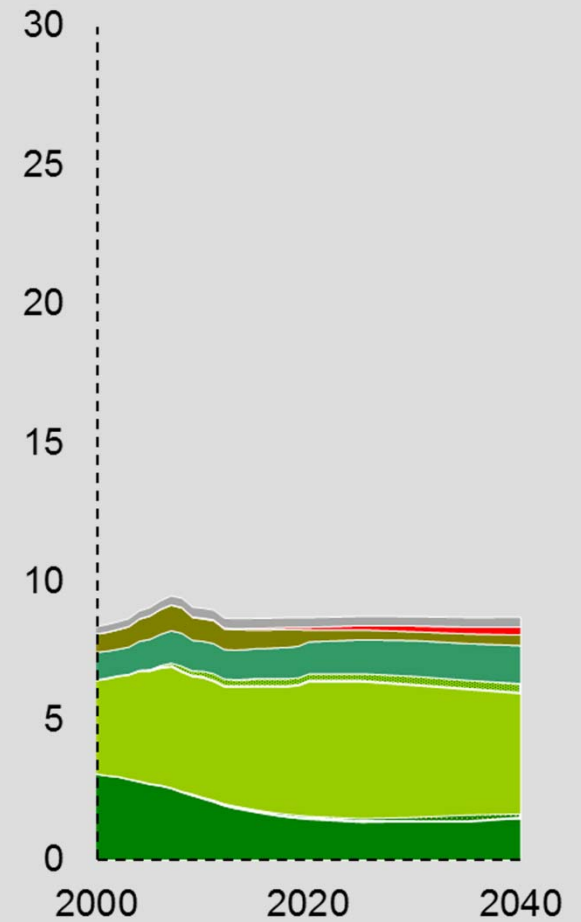
Asia Pacific  
MBDOE



North America  
MBDOE

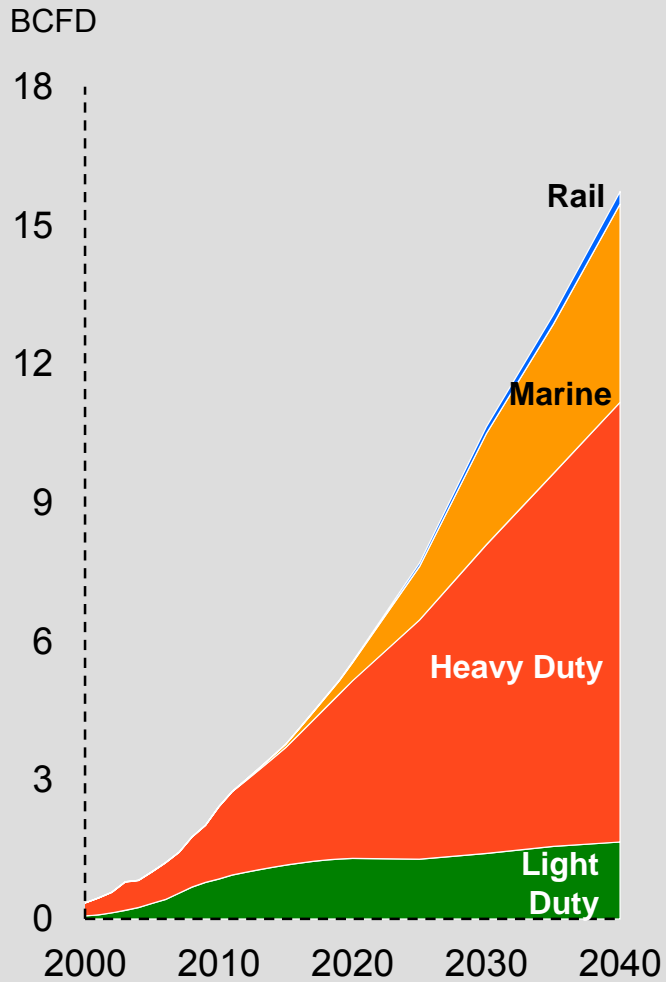


Europe  
MBDOE

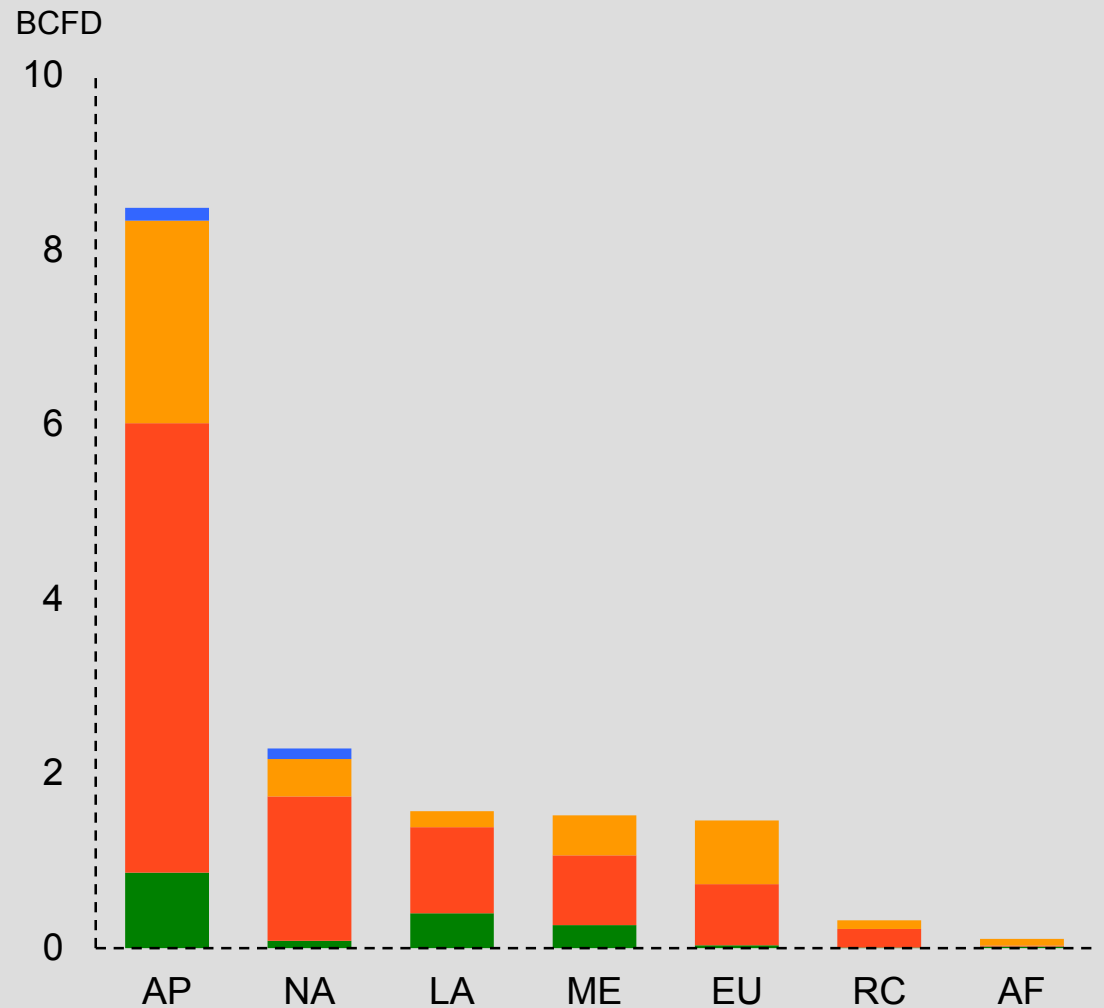


# Natural Gas Into Transportation

By Sector



2040 by Region





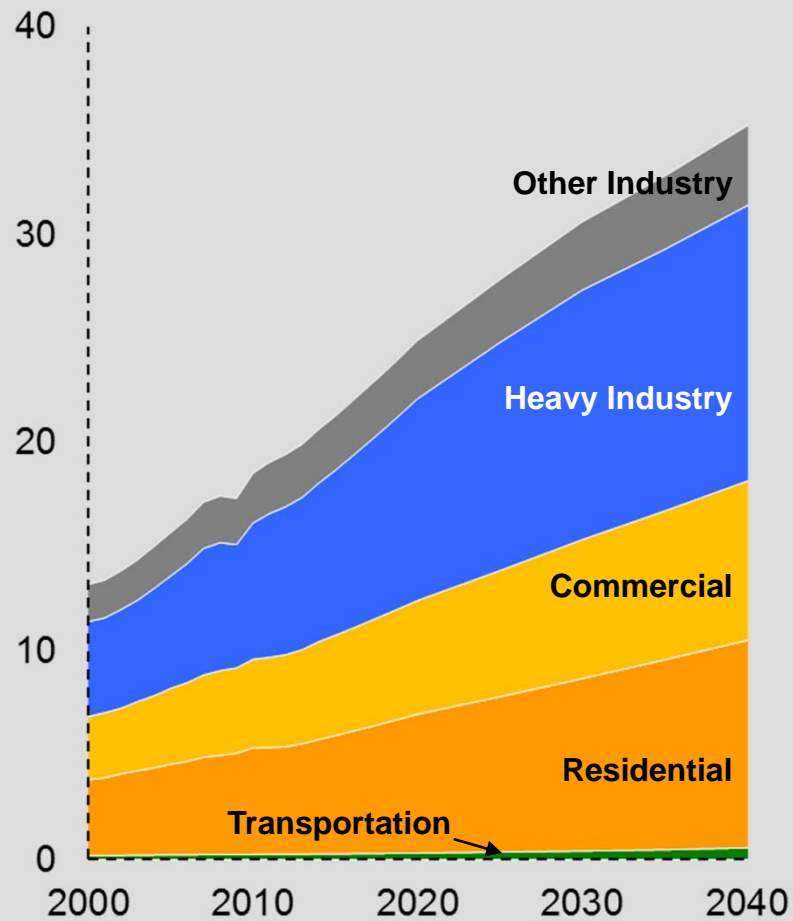
# Electricity generation



# Electricity Demand

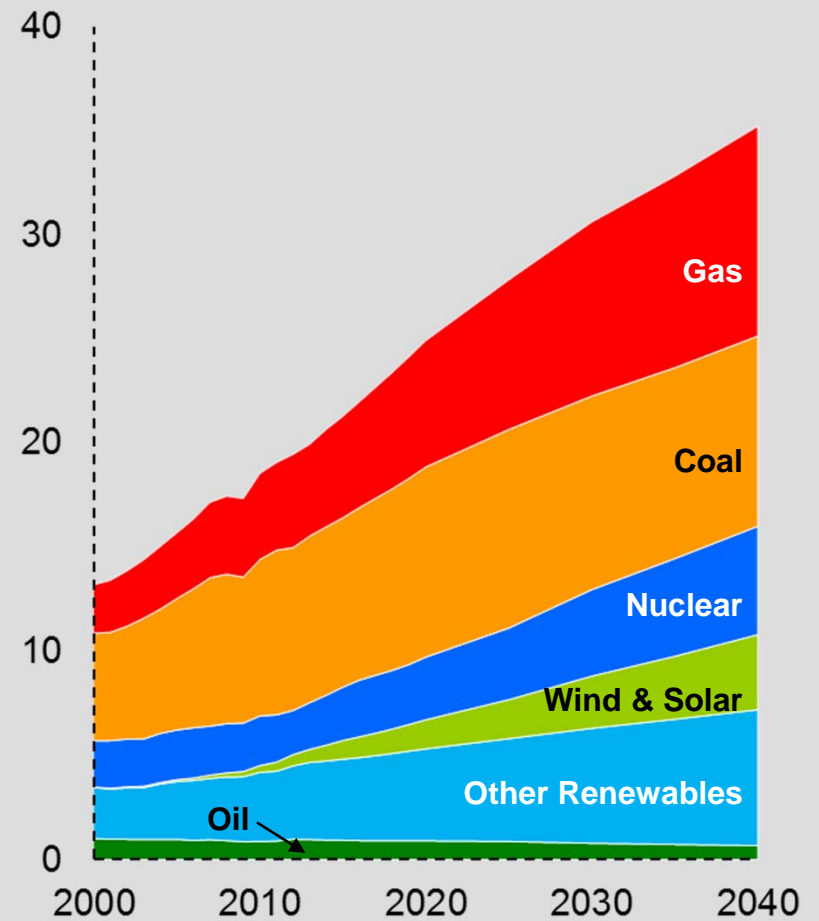
## Global Electrical Demand by Sector

Thousand TWh



## Global Electrical Demand by Fuel

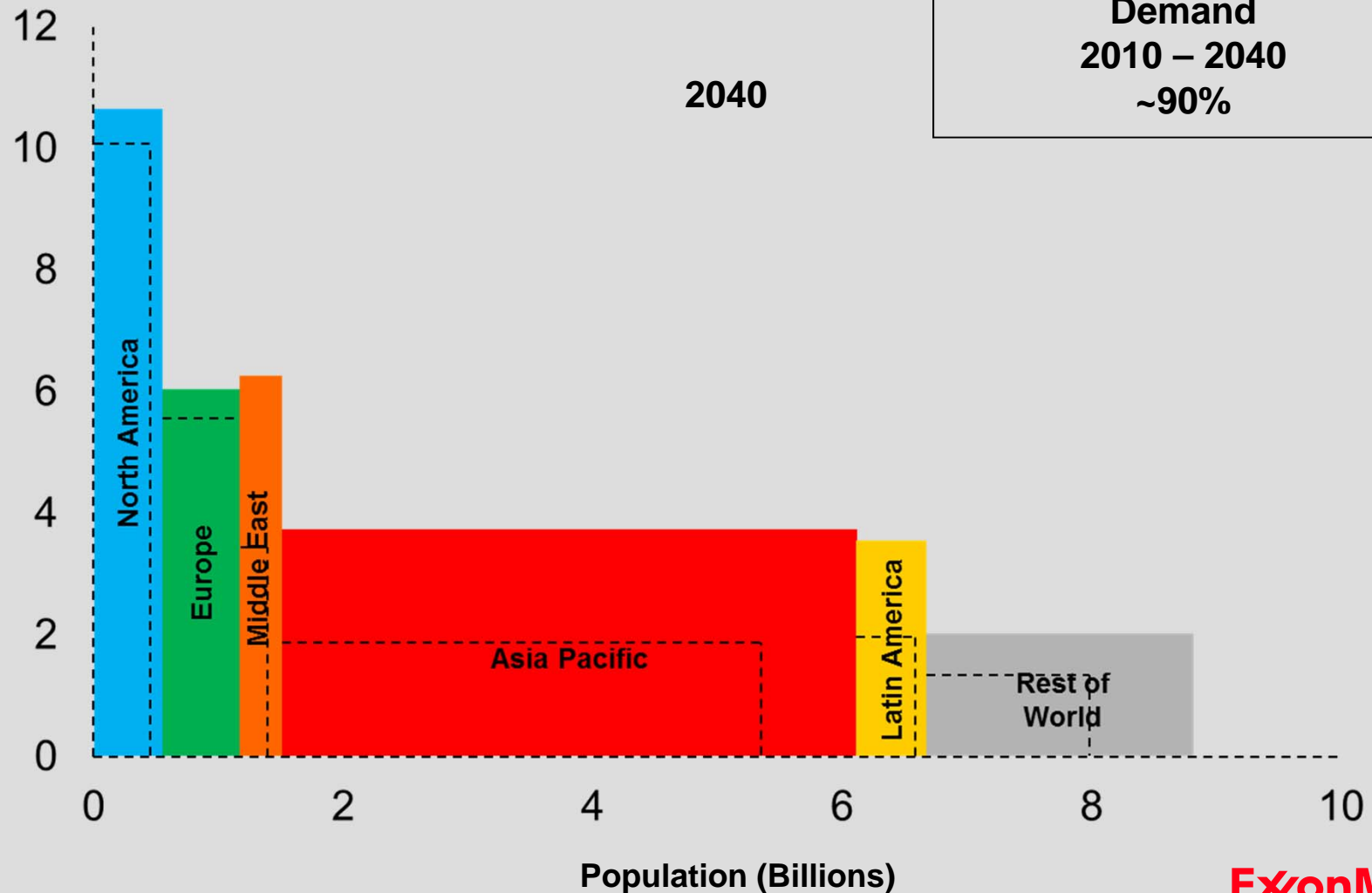
Thousand TWh



# Electricity Use by Region

## Electricity Use

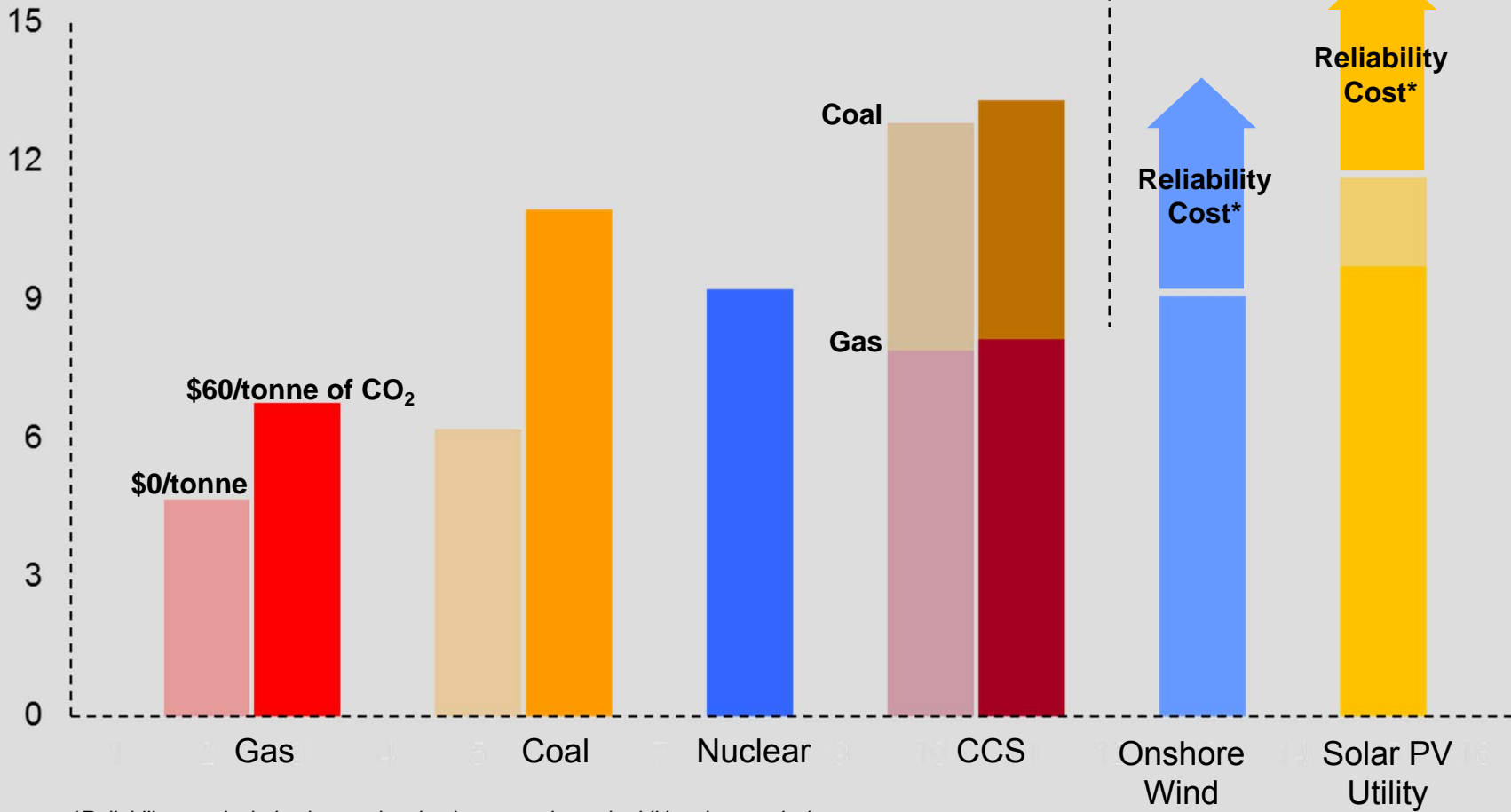
1000 KWh per Capita



# Economic Choices for U.S. Electricity

## Plant Cost, Startup 2030

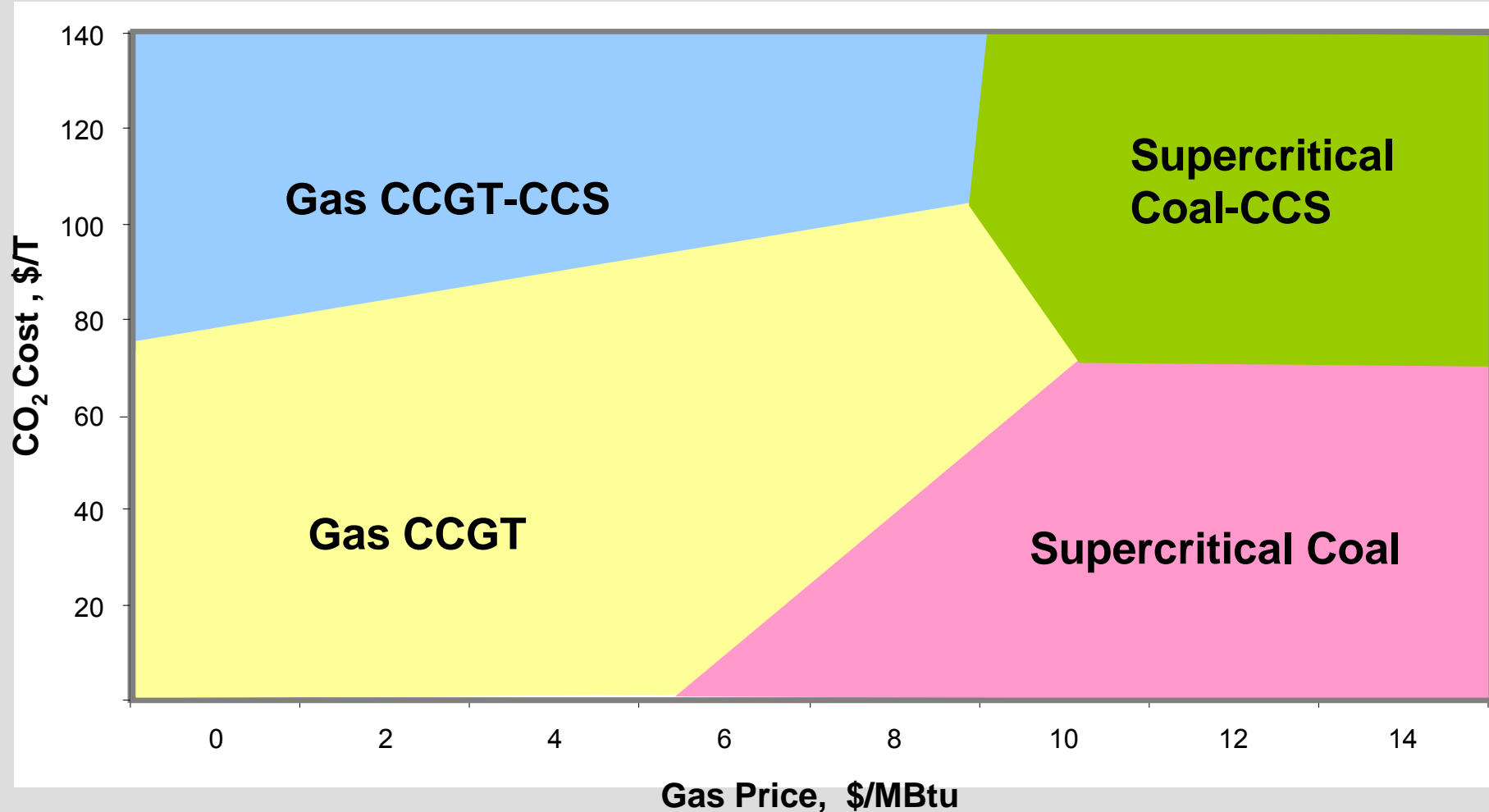
2013 cents/kWh



\*Reliability cost includes integration, backup capacity and additional transmission costs.

# CCS Use for Power Generation

Least Cost Generation Technology Zones



Source: Society of Petroleum Engineering, SPE-139716-PA

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# Emissions

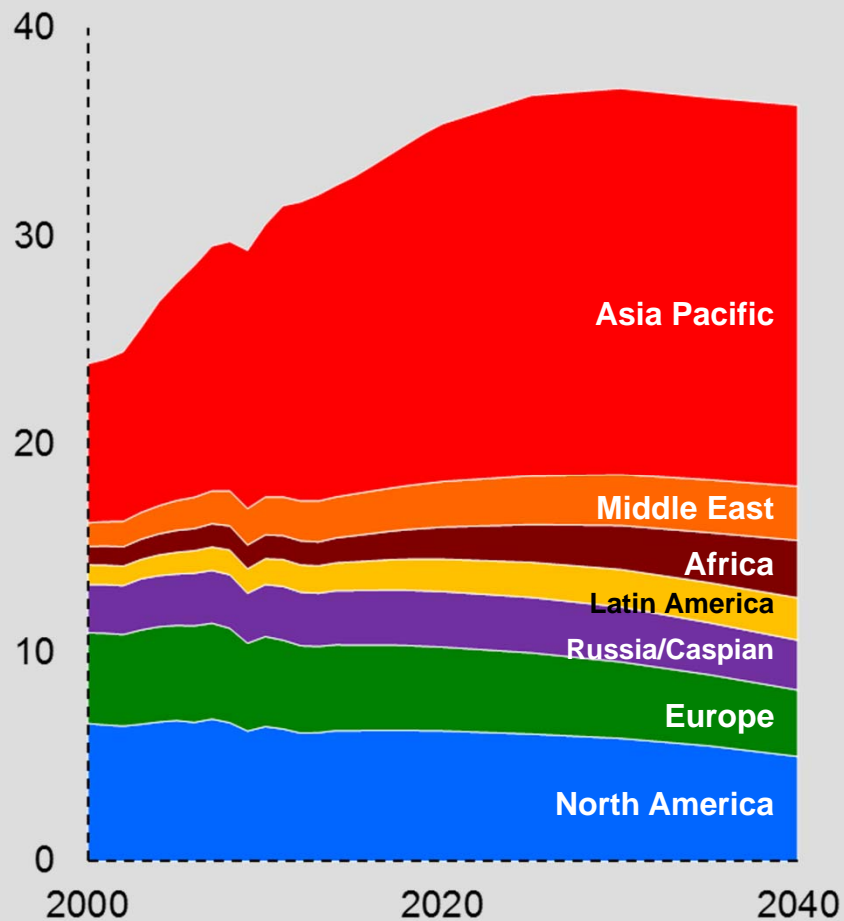




# CO<sub>2</sub> Emissions Plateau

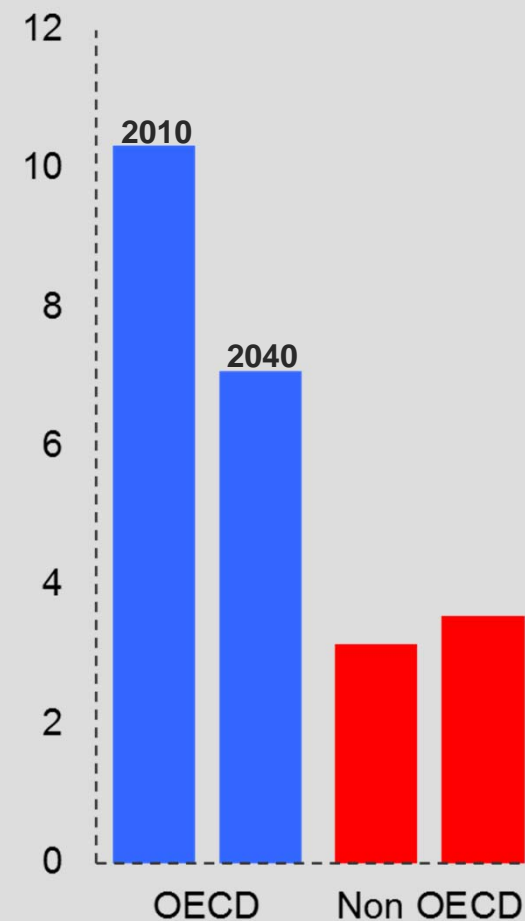
## Energy-Related CO<sub>2</sub> Emissions by Region

Billion Tonnes

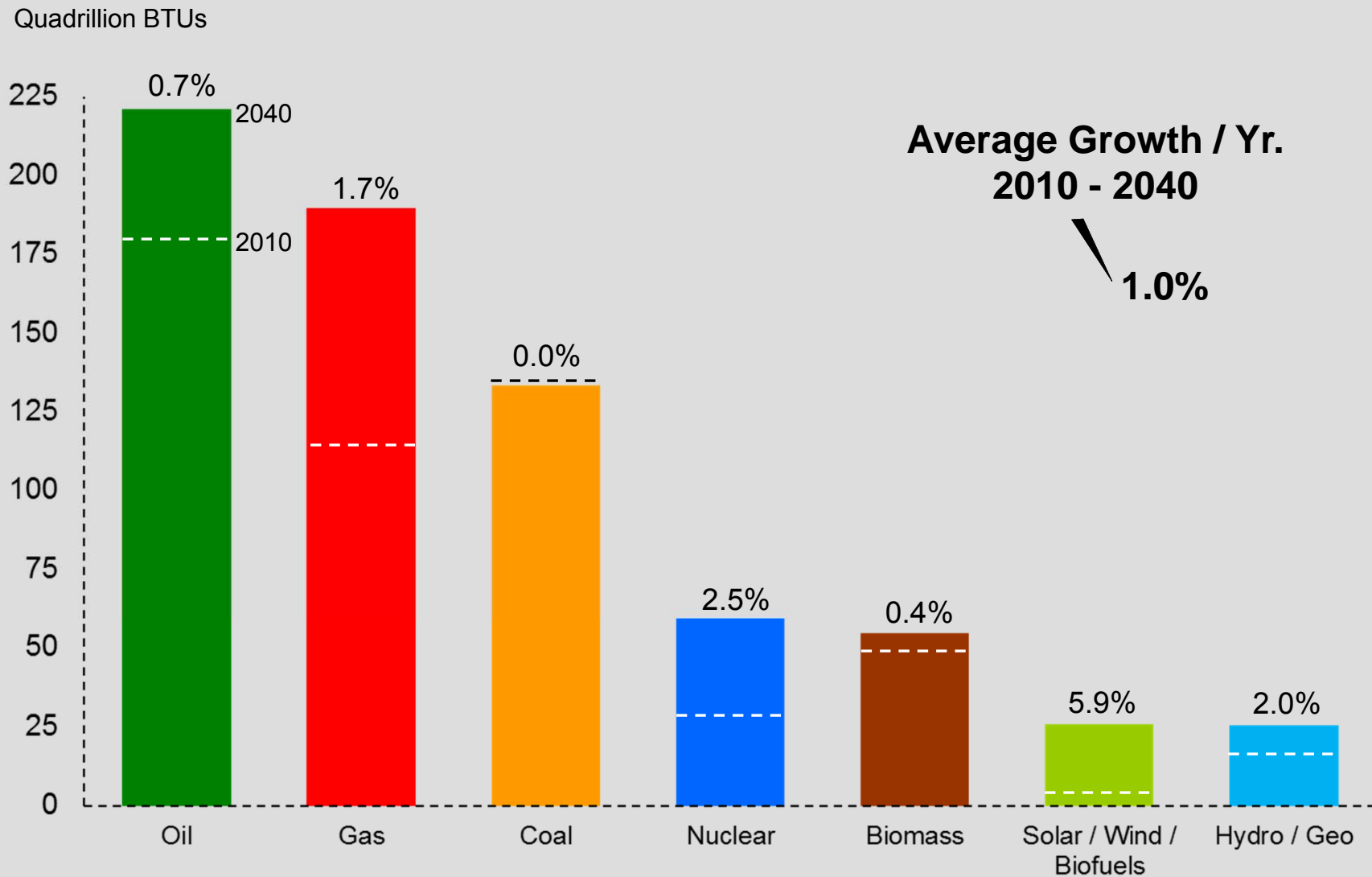


## Emissions per Capita

Tonnes / Person



# Energy Mix Continues to Evolve





Supply

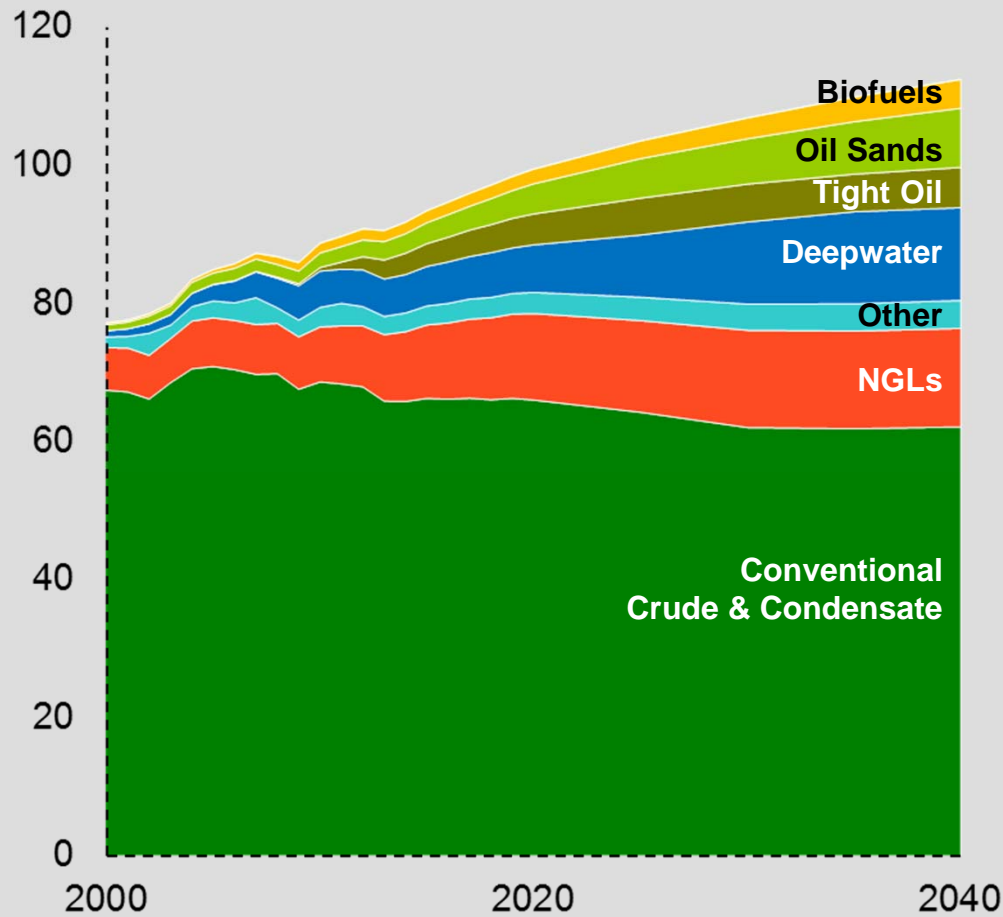




# Liquids Supply

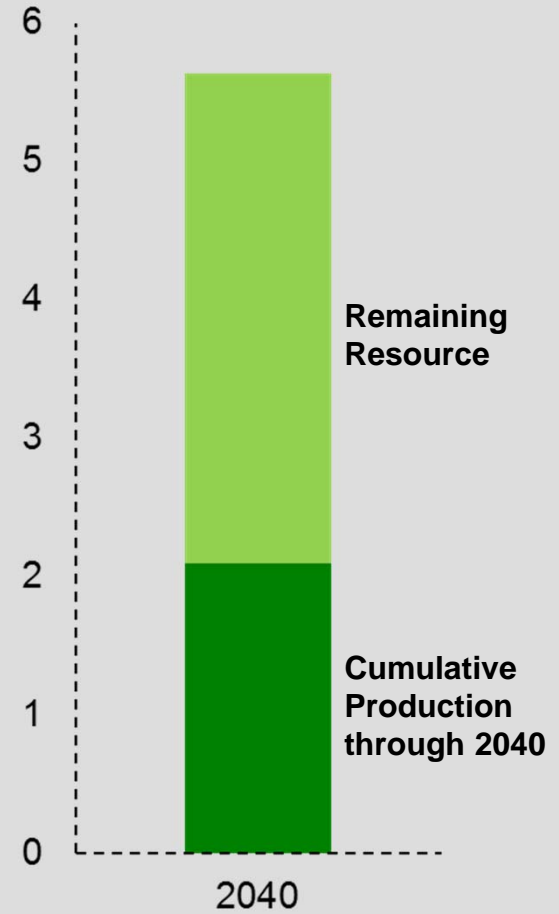
Liquid Supply by Type

MBD OE



Crude and Condensate Resource\*

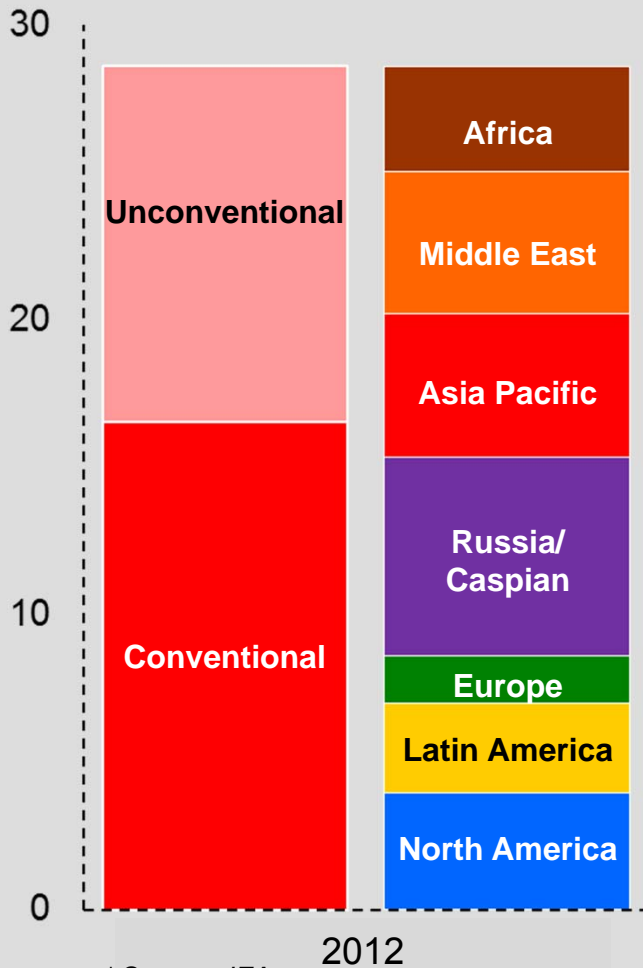
Trillion barrels of oil



\* Source: IEA

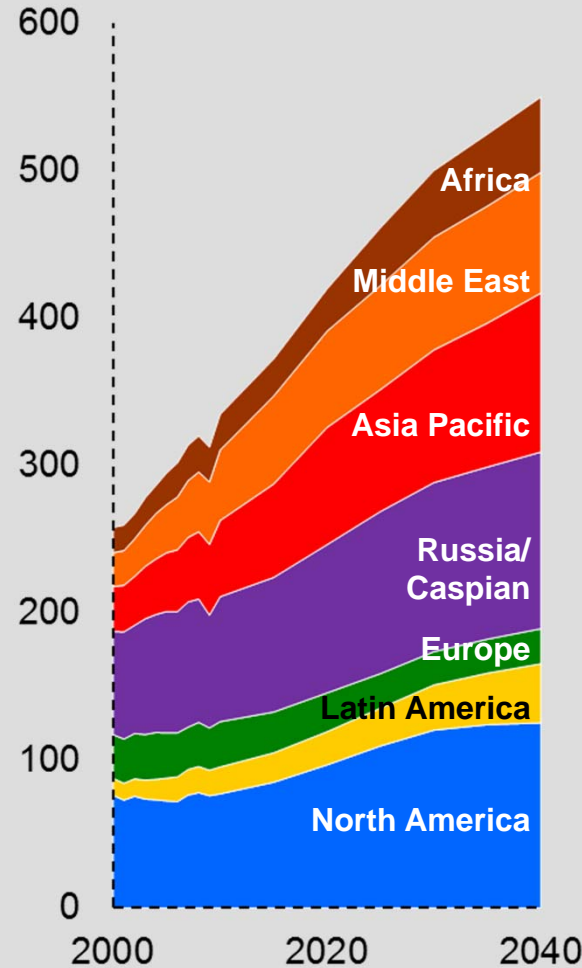
# Gas Resources Abundant; Supply Diversifies

**Remaining Recoverable Resource\***  
Thousand TCF

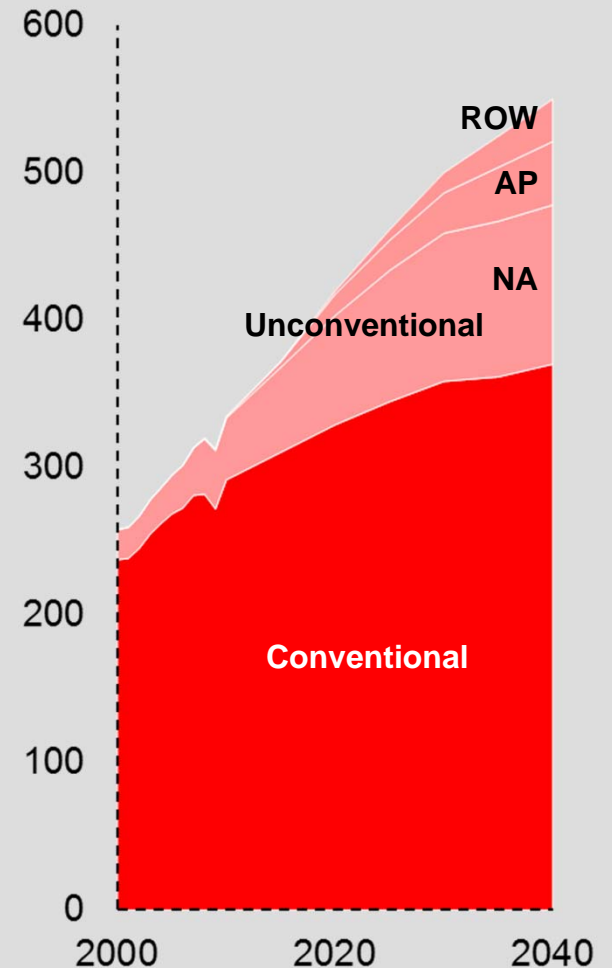


\* Source: IEA

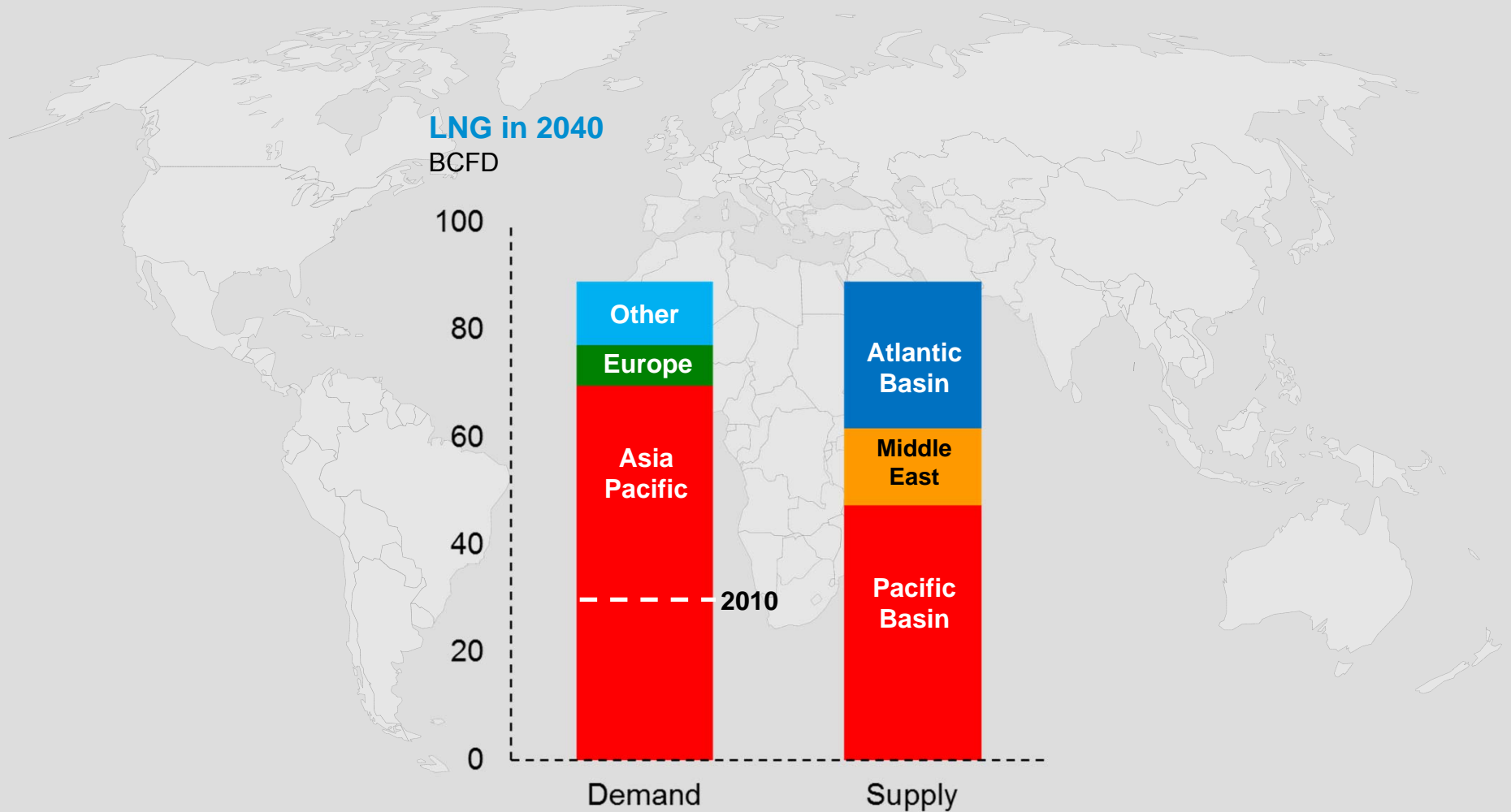
**Gas Production by Region**  
BCFD



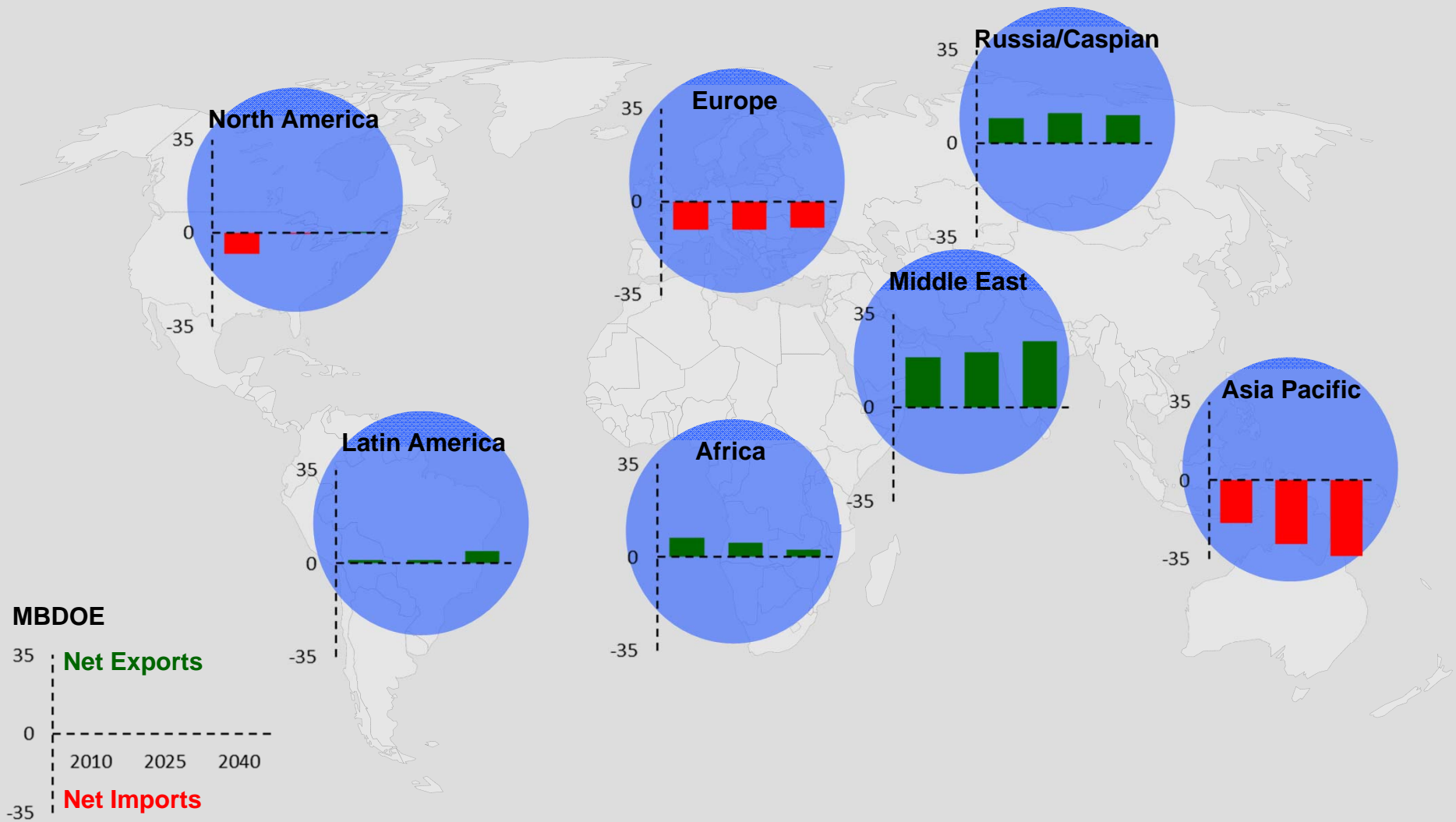
**Gas Production by Type**  
BCFD



# LNG Demand Triples and LNG Supply Diversifies



# Liquids Trade



MBDOE

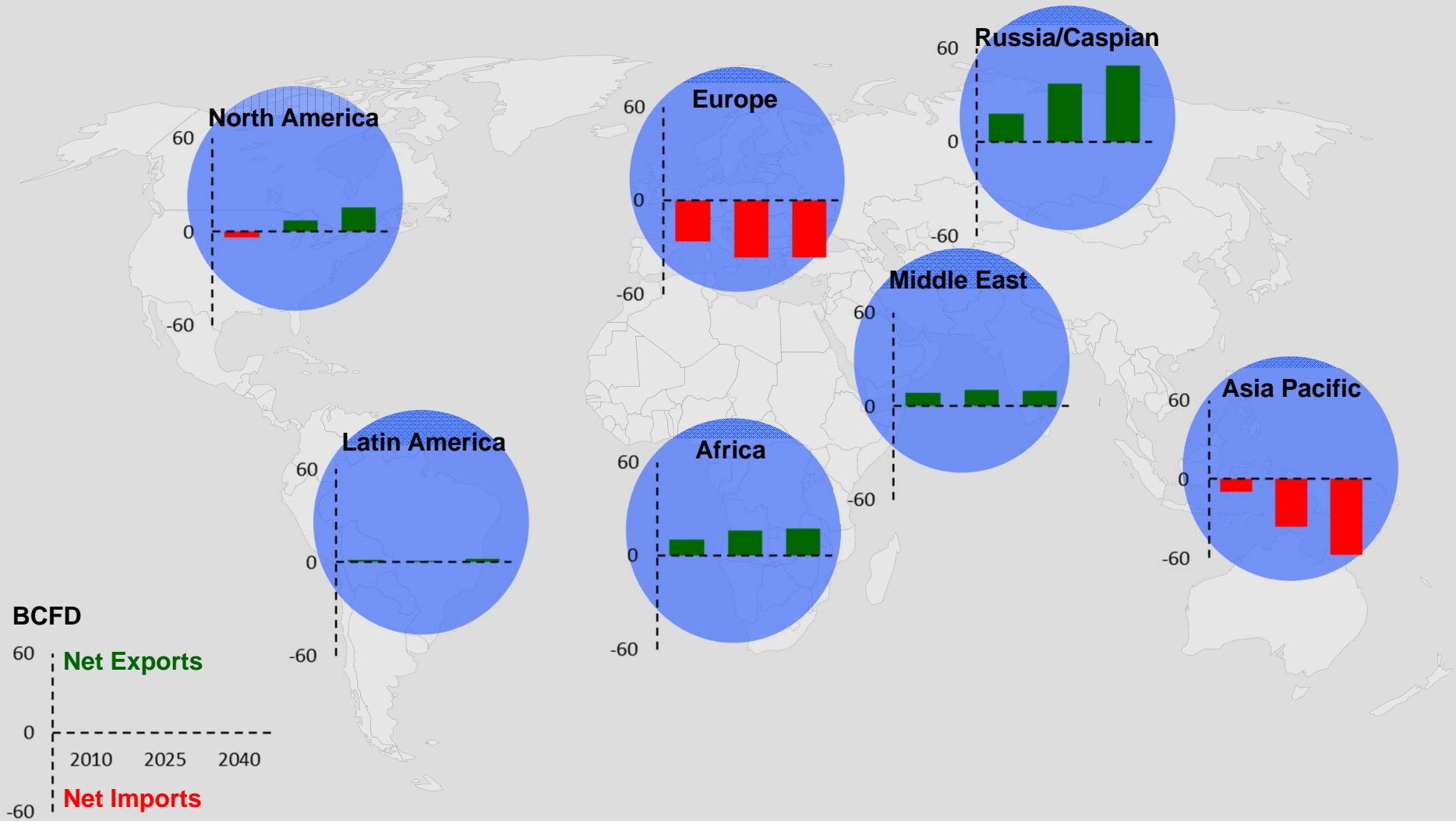
35 **Net Exports**

0  
2010 2025 2040

-35 **Net Imports**

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# Natural Gas Trade

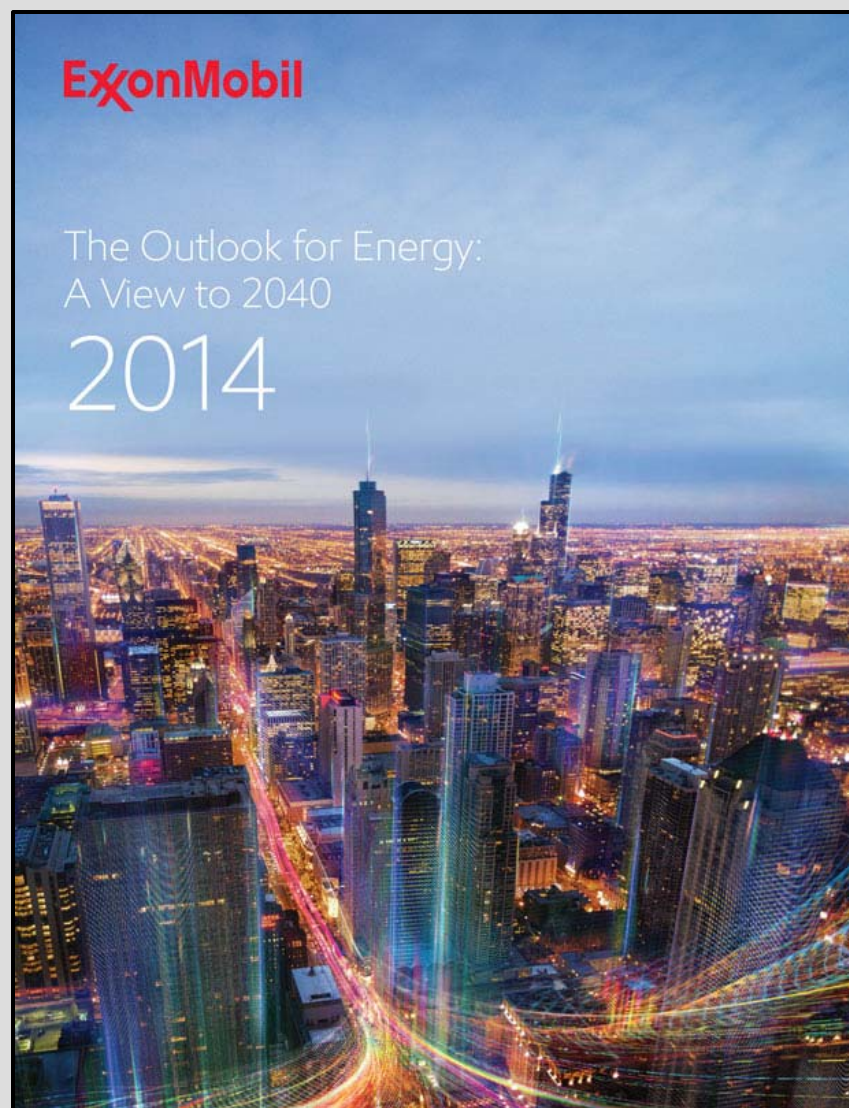




# Technology Evolution Summary

- Technology development requires longer-term focus and is unpredictable
  - Benefits from a portfolio approach; Learning from failure advises future projects
  - May require business model innovation, especially in “new-to-world” applications
  - Sometimes driven by science and technology developments in other unrelated areas
  - Extent, pace, and source of future cost reduction cannot be precisely predicted
    - Unconventional gas – current low costs were not expected a few years ago
    - Batteries – 5x energy density increase in two centuries – another 15x increase = gasoline
- Technologies are likely commercialized in higher value segments before they are used in lower value segments
  - Lithium ion batteries – cell phones > power tools > hybrids > electric vehicles
  - CCS – NG separation/EOR > Power plants/storage > Refineries/storage
  - Butanol: Bio-n-butanol – displaces chemical n-butanol > fuel additive > neat fuel
- Technology evolution typically crosses national boundaries but government funding is frequently driven by desire to create national competitive advantage, E.g. Li-ion battery
  - Lithium ion batteries concept, Whittingham, Exxon Corporate Lab, NJ in 1970s
  - Anode – Yazimi – France/ Cathode – Goodenough – Texas, USA in 1980s
  - Separator Film, Tonen in Japan in 1980s, former Exxon and Mobil Affiliate
  - Li-ion use in consumer devices, cell phone use, Sony in Japan in 1990s
- Global widespread technology adoption is driven by long-term economic fundamentals
- Market driven selection of the solutions will ensure longer-term viability

# Conclusions



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