

AAPG Energy Opportunities

August, 2018

Energy, Carbon and Poverty

Seeking the Radical Middle



Scott W. Tinker



The Dilemma

Most people do not know how
electricity is made or where
gasoline comes from.

But... they think they do!

The Narrative

Renewables and batteries are
“clean” and “good”
Fossil energy and nuclear are
“dirty and “bad”...

Outline

- ❖ Energy
- ❖ Carbon
- ❖ Poverty
- ❖ Radical Middle

Energy Security

Affordable

Cost: per unit of energy

Price Volatility: stable or fluctuating

Infrastructure: cost to build the plant

Available

Access: substantial resources

Reliable

Intermittent: source consistent or variable

Safe: natural/human causes

Sustainable

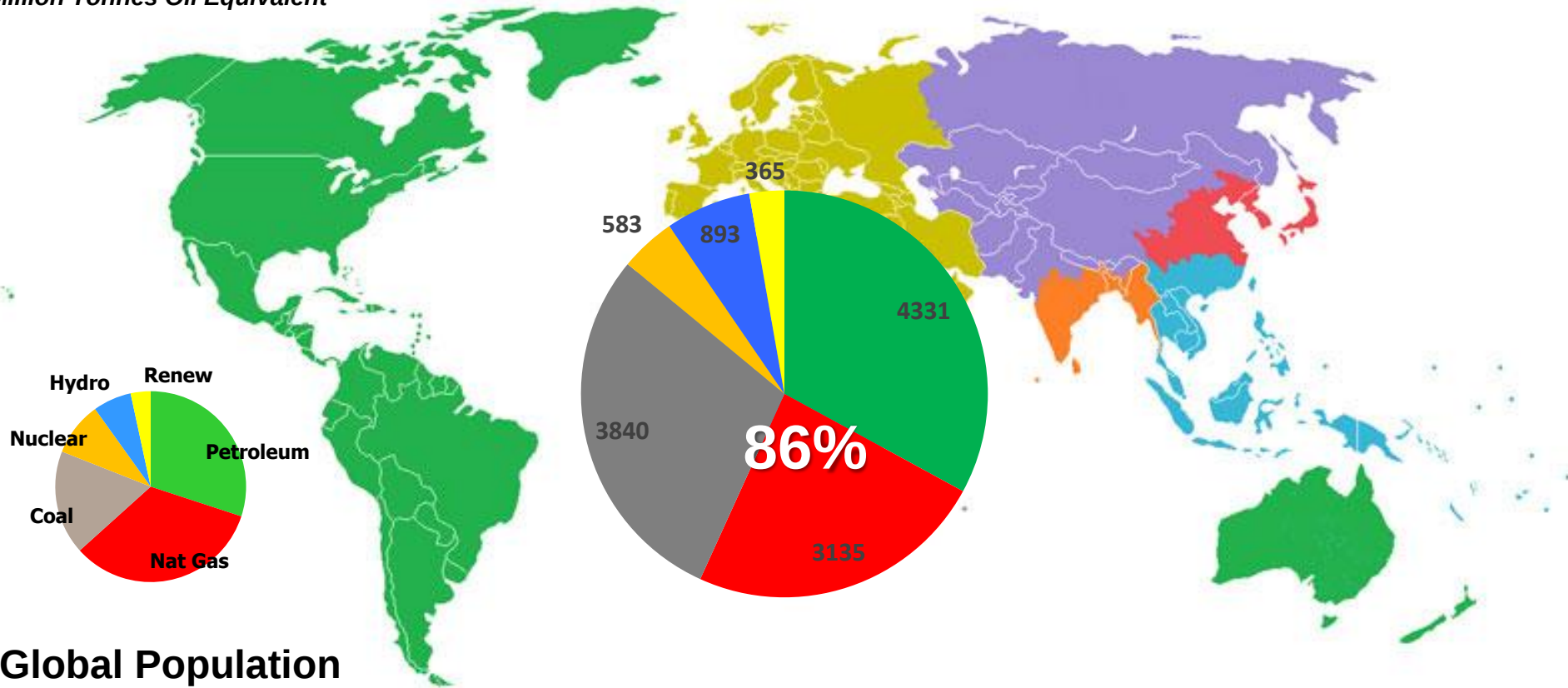
Clean: air and atmospheric emissions

Dense: energy per area, weight and volume

Dry: fresh water use/risk

The Global Energy Mix

Million Tonnes Oil Equivalent

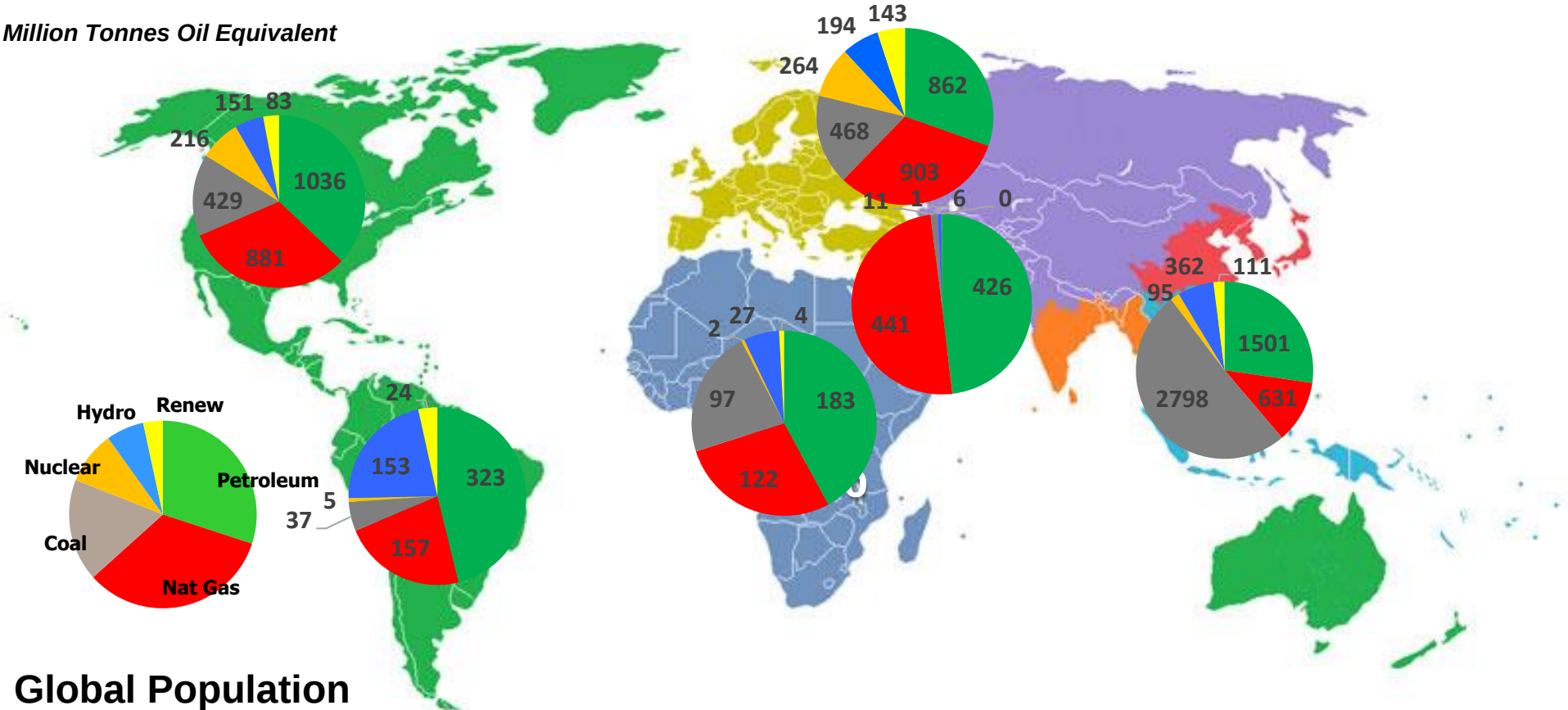


Global Population

Each color on the map represents ~ 1 billion people

The Global Energy Mix

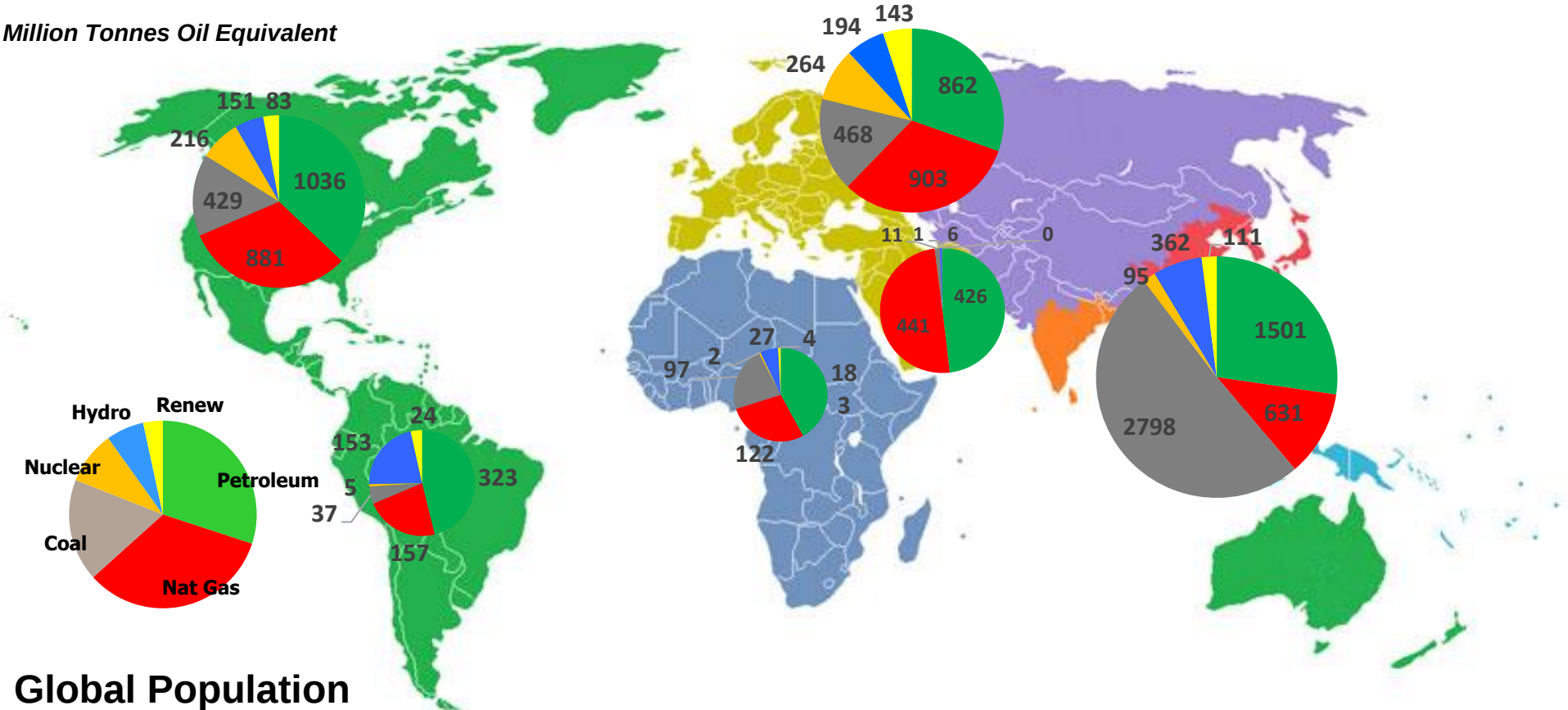
Million Tonnes Oil Equivalent



Global Population
Each color on the map represents ~ 1 billion people

Global Energy Demand

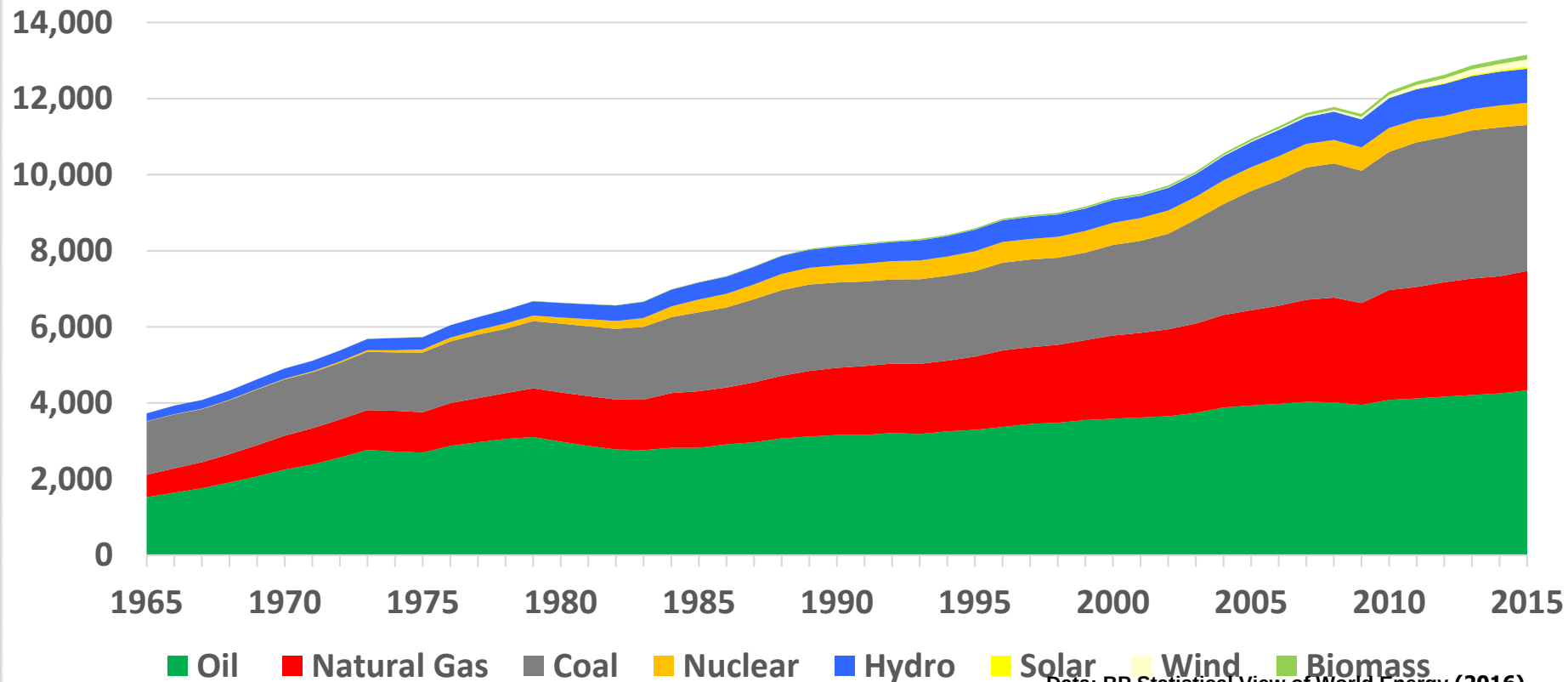
Million Tonnes Oil Equivalent



Global Population
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Global Energy Mix

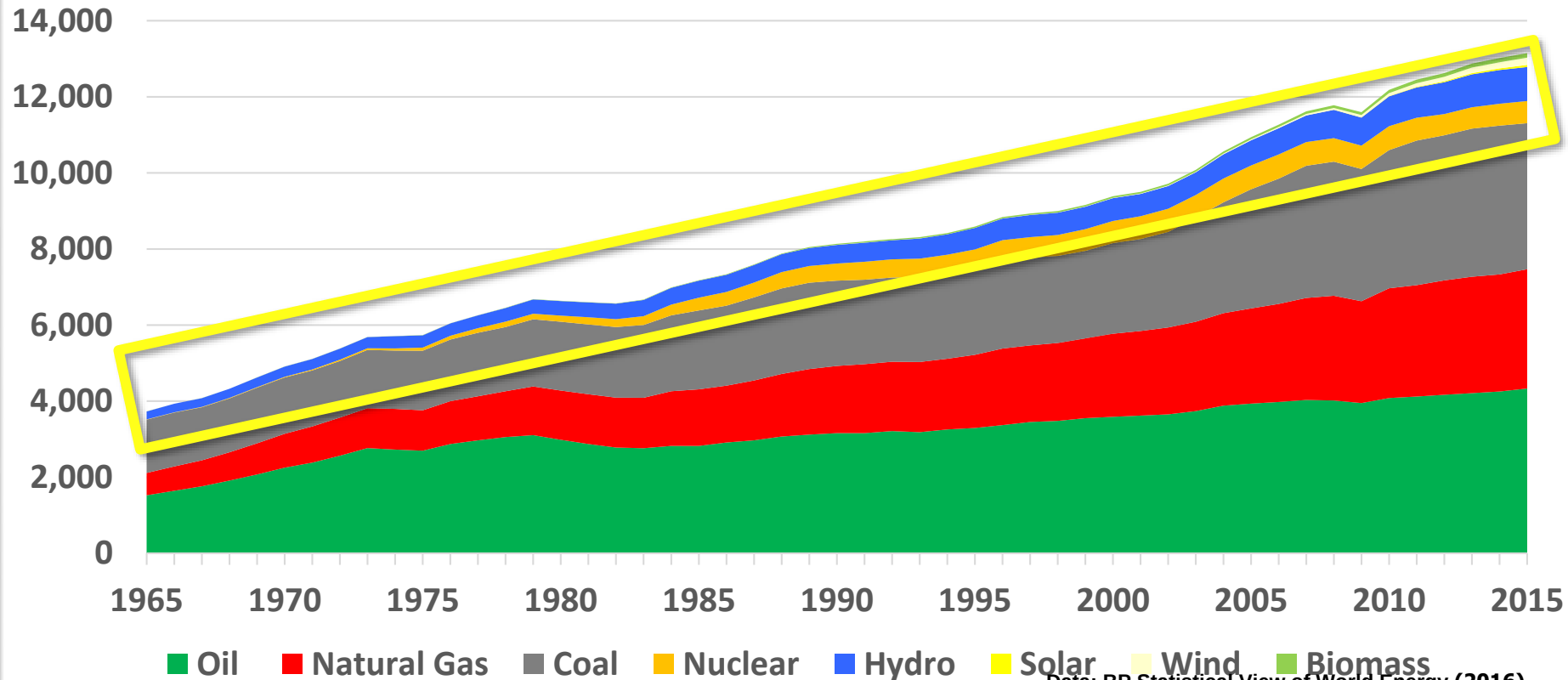
Global Energy Consumption (MTOE)



Data: BP Statistical View of World Energy (2016)

Global Energy Mix

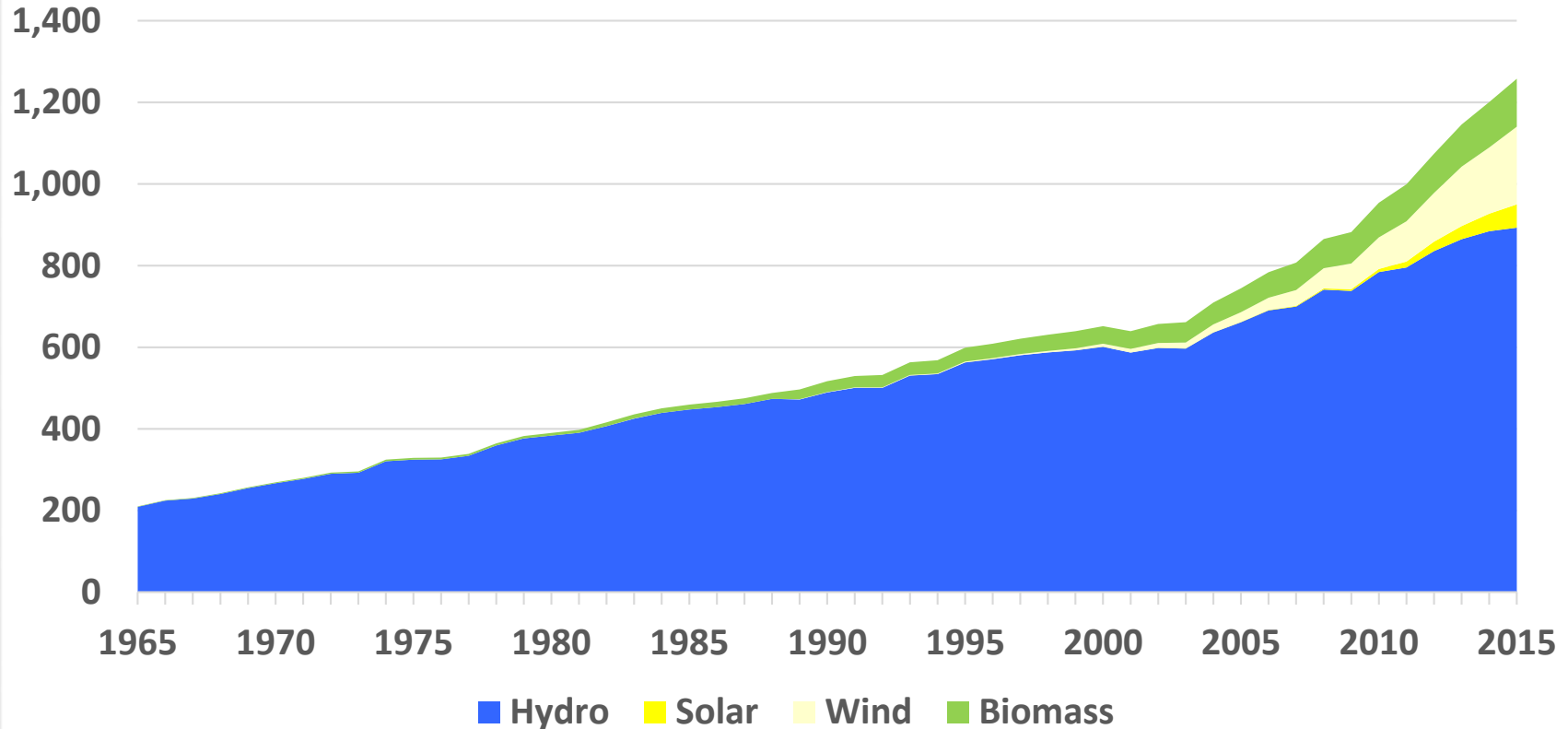
Global Energy Consumption (MTOE)



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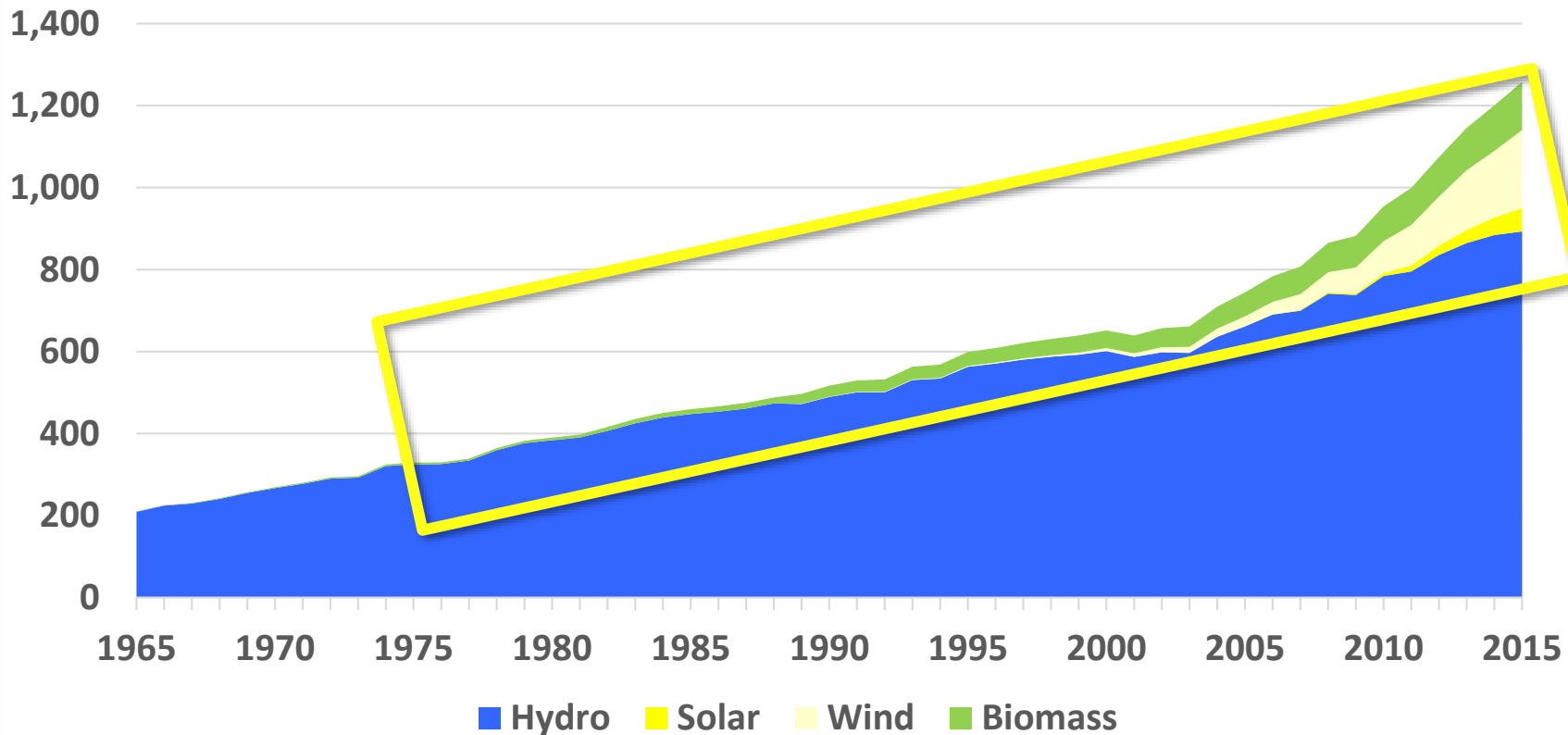
Renewable Consumption (MTOE)



Data: BP Statistical View of World Energy (2016)

Global Energy Mix

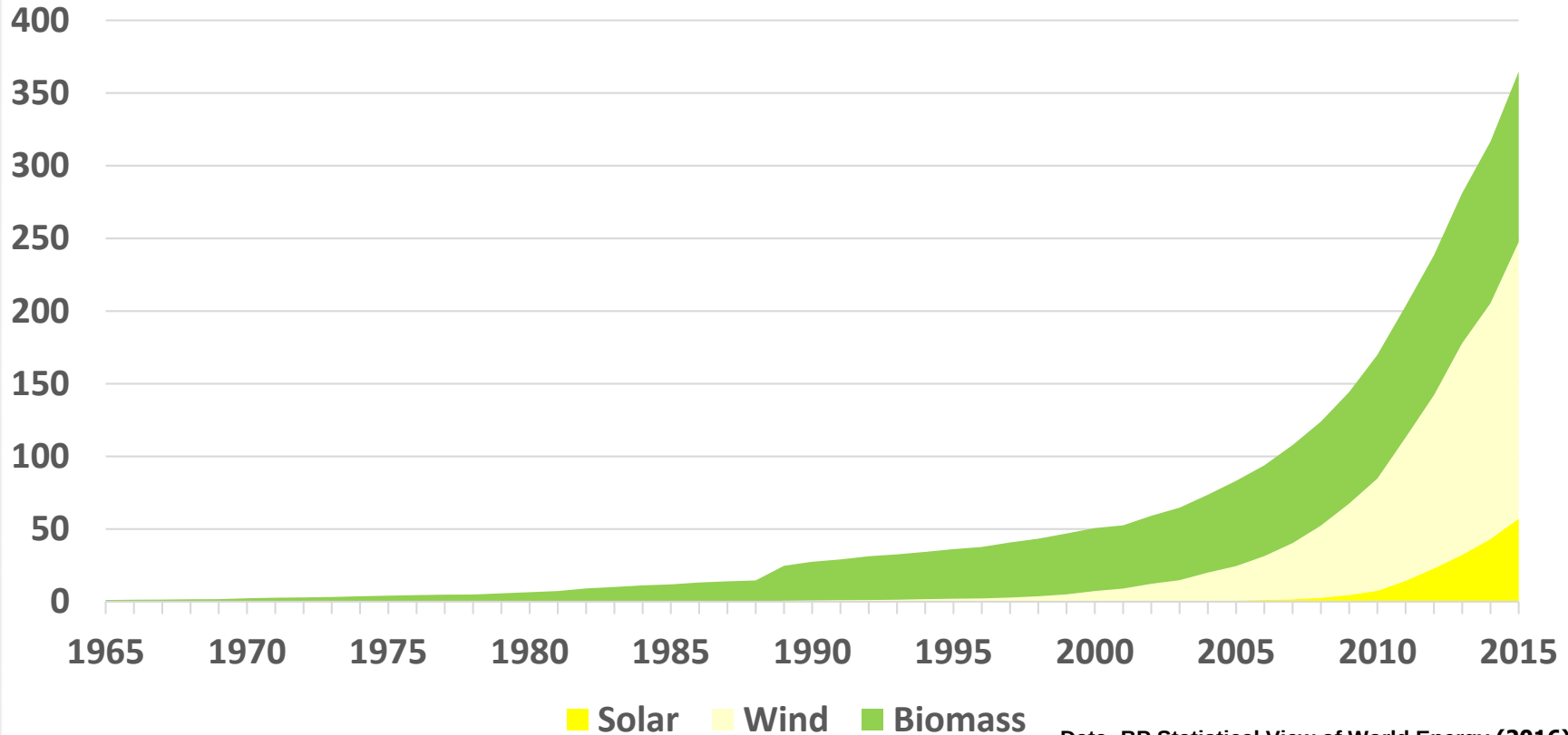
Renewable Consumption (MTOE)



Data: BP Statistical View of World Energy (2016)

Global Energy Mix

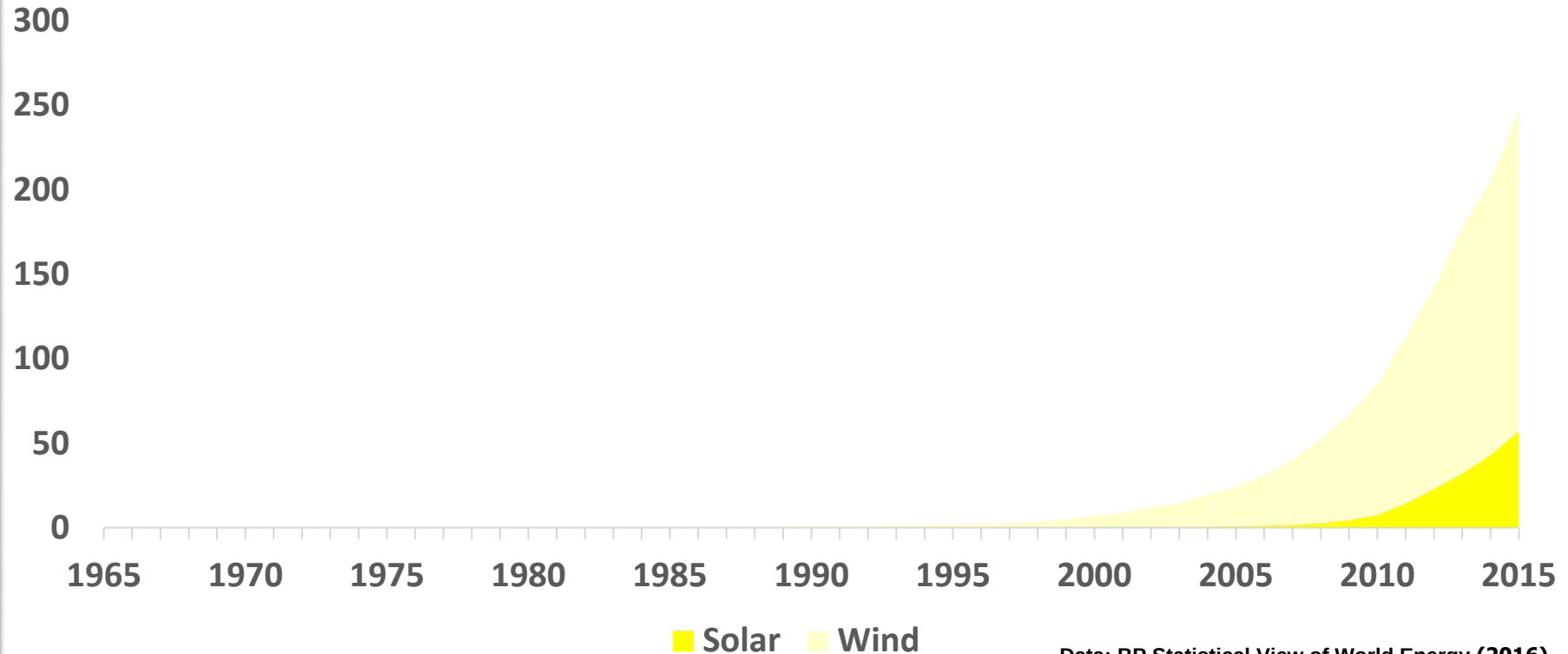
Renewable Consumption (MTOE)



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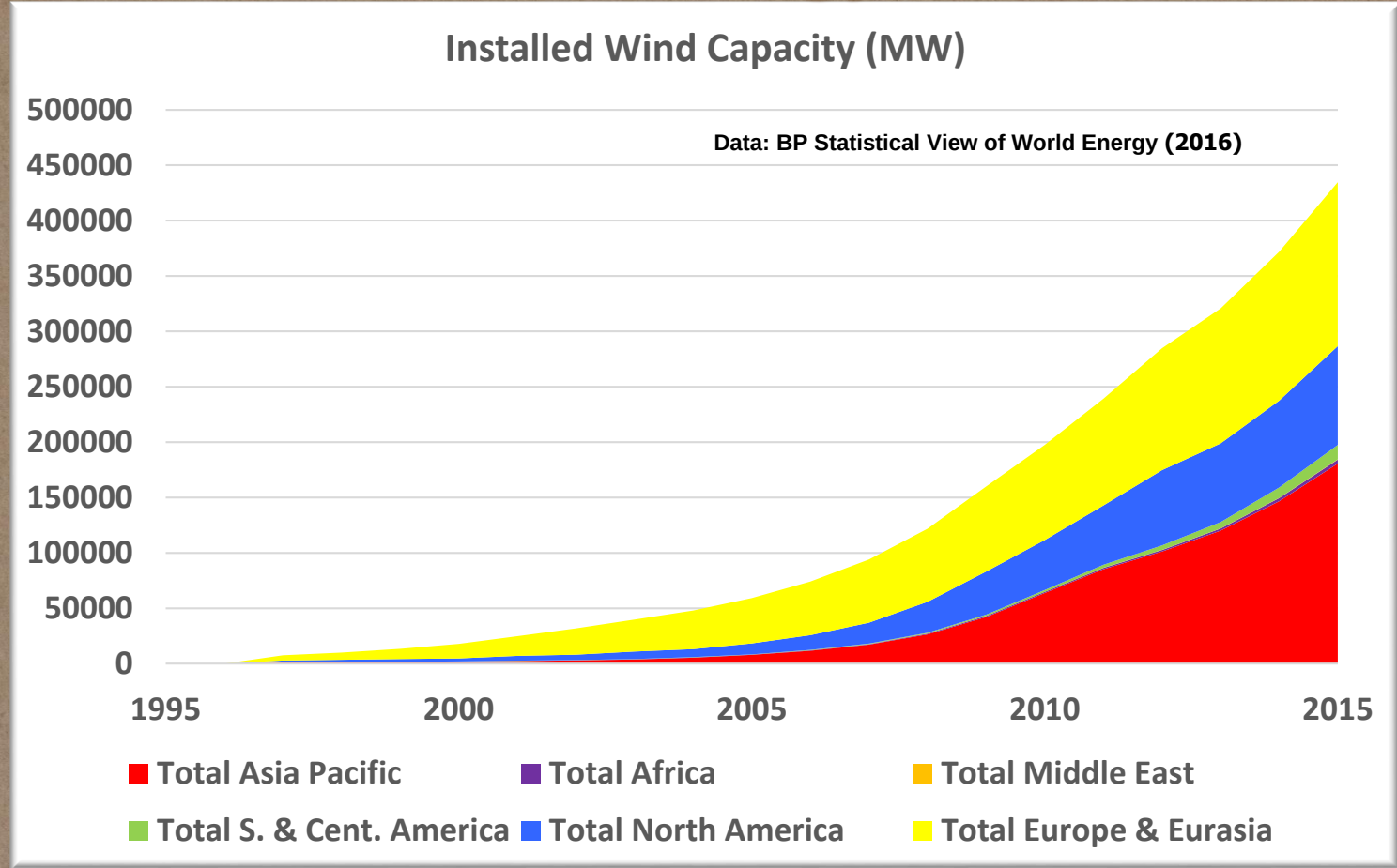
Global Energy Mix

Renewable Consumption (MTOE)



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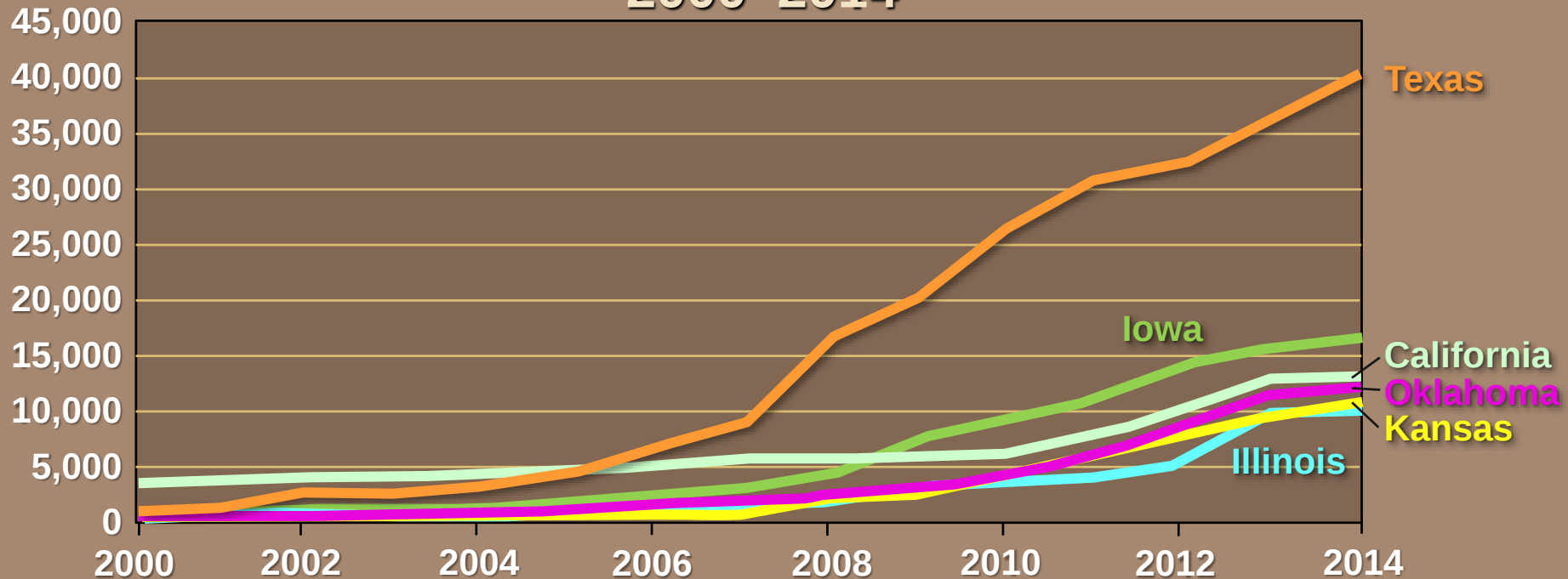
Global Energy Mix



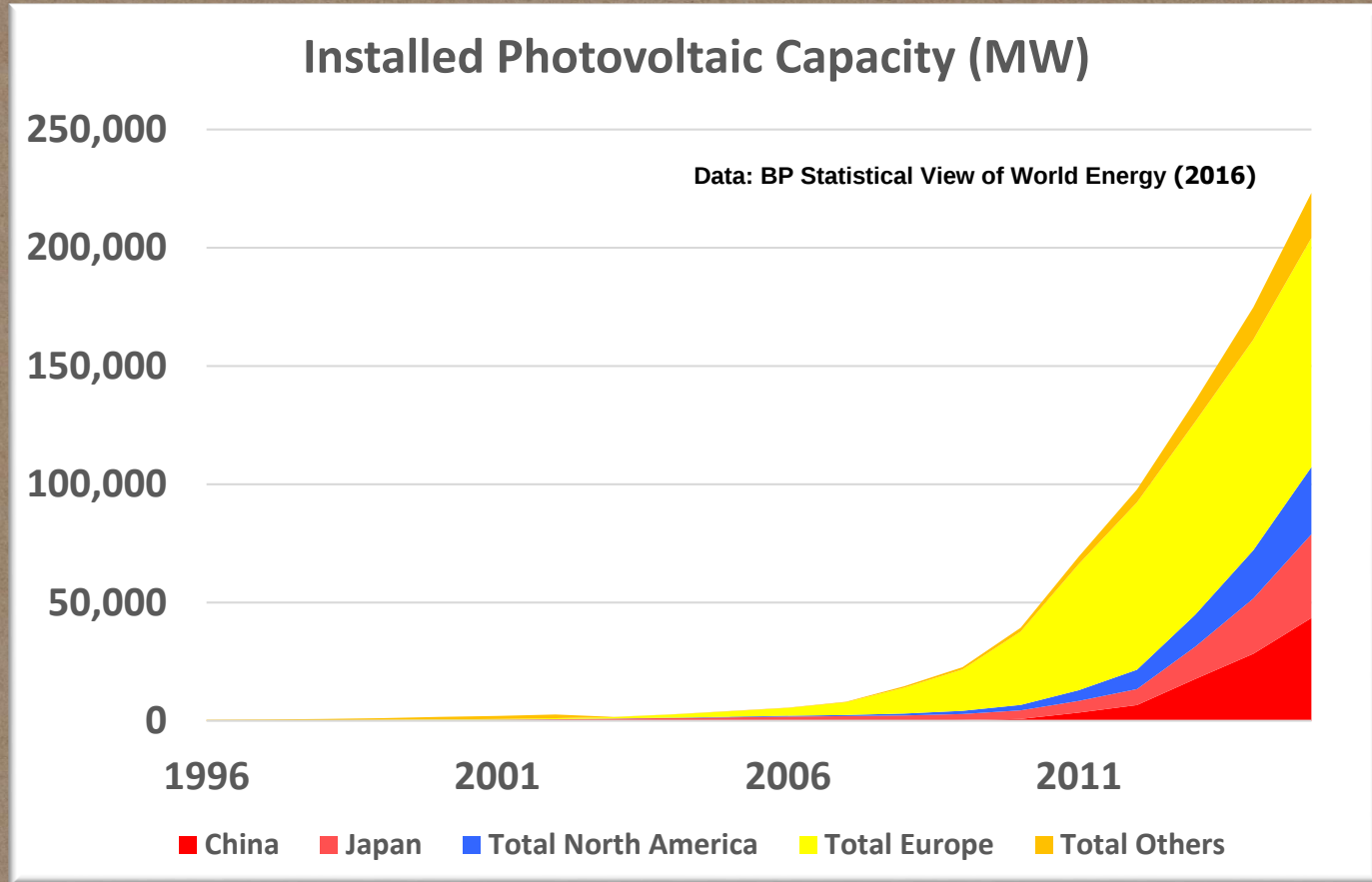
Global Energy Mix

Growth in U.S. Wind Generation 2000–2014

Million Kwh

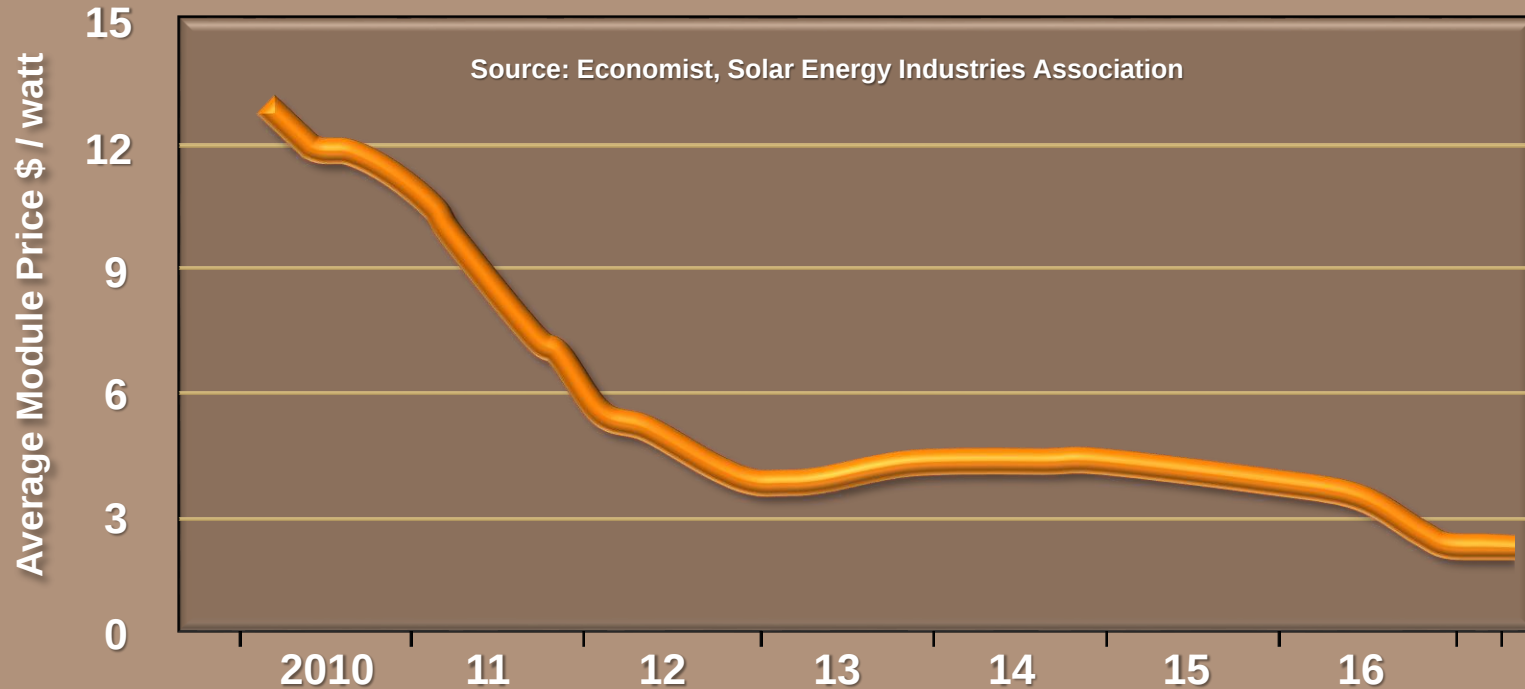


Global Energy Mix



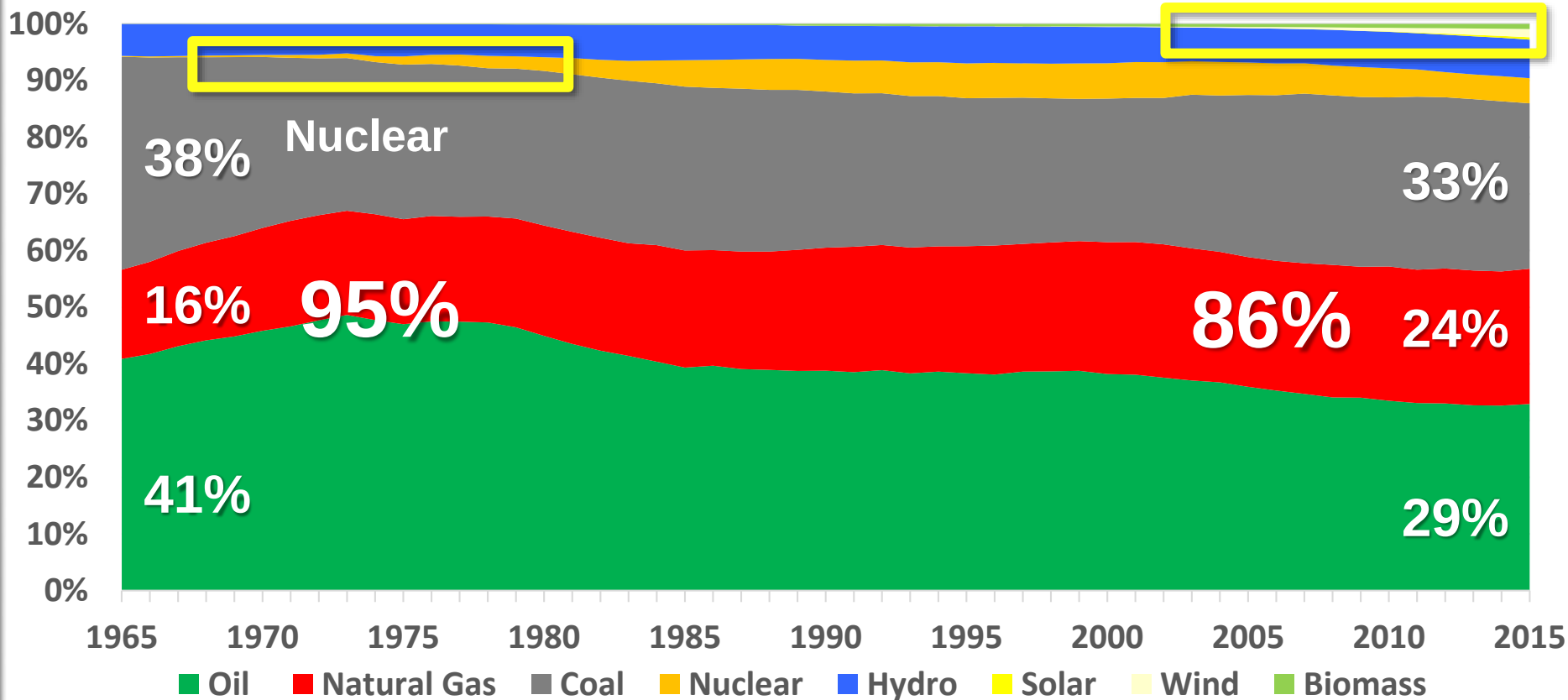
Global Energy Mix

United States Solar photovoltaics

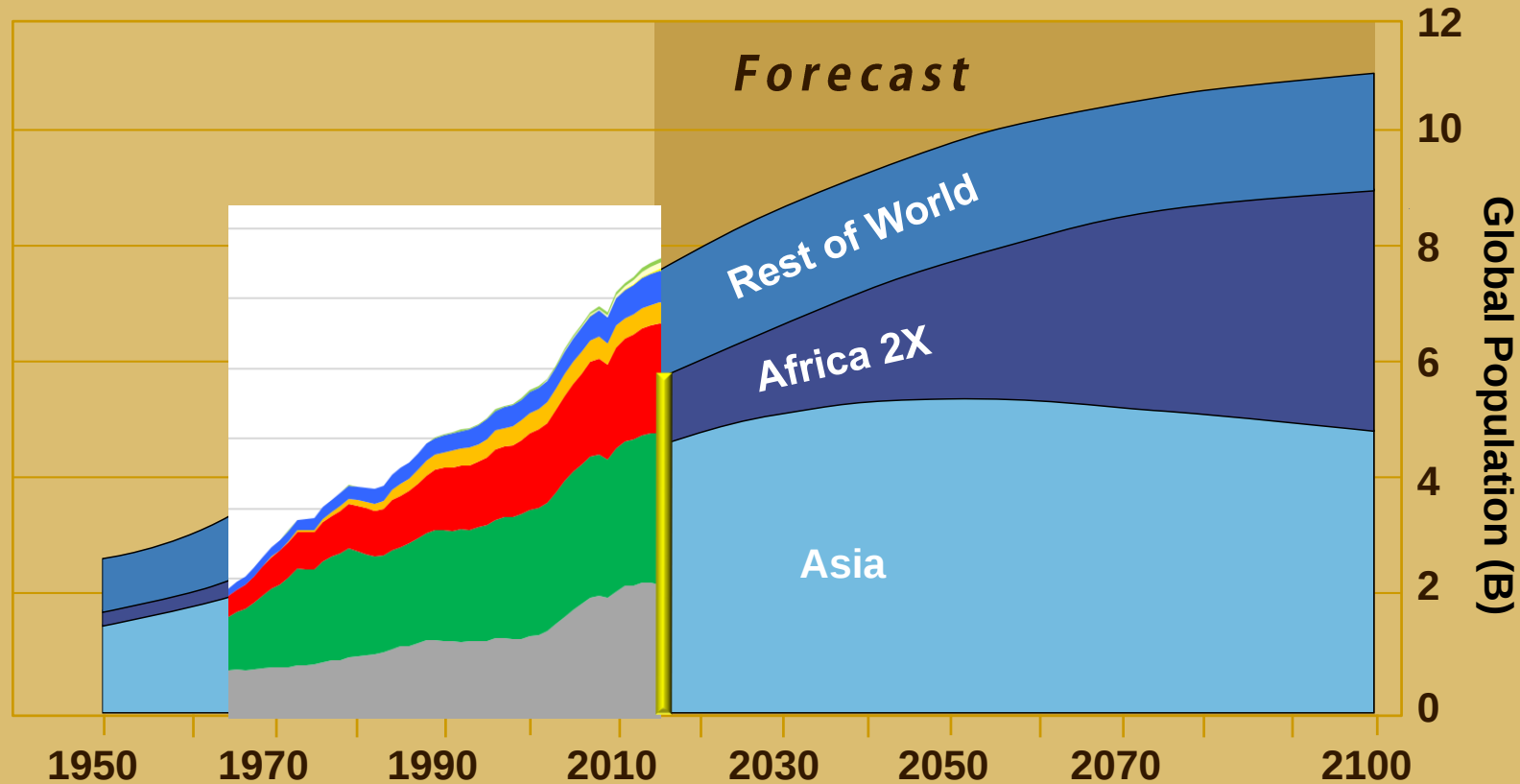


Global Energy Mix

Global Energy Consumption Mix



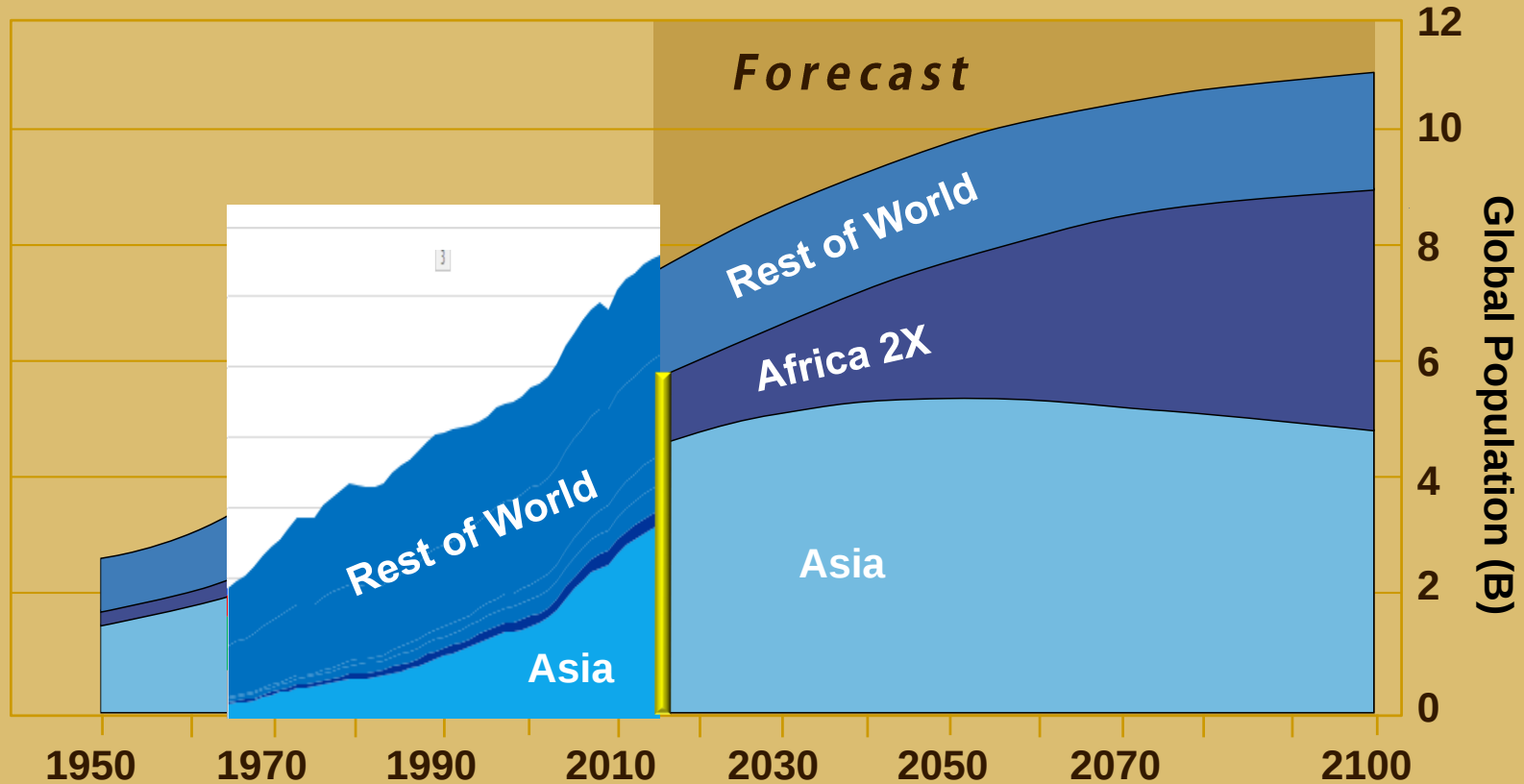
Population and Energy



Data: BP Statistical View of World Energy (2016)

Source: From the UN, as appeared in *The Economist*, August 23, 2014

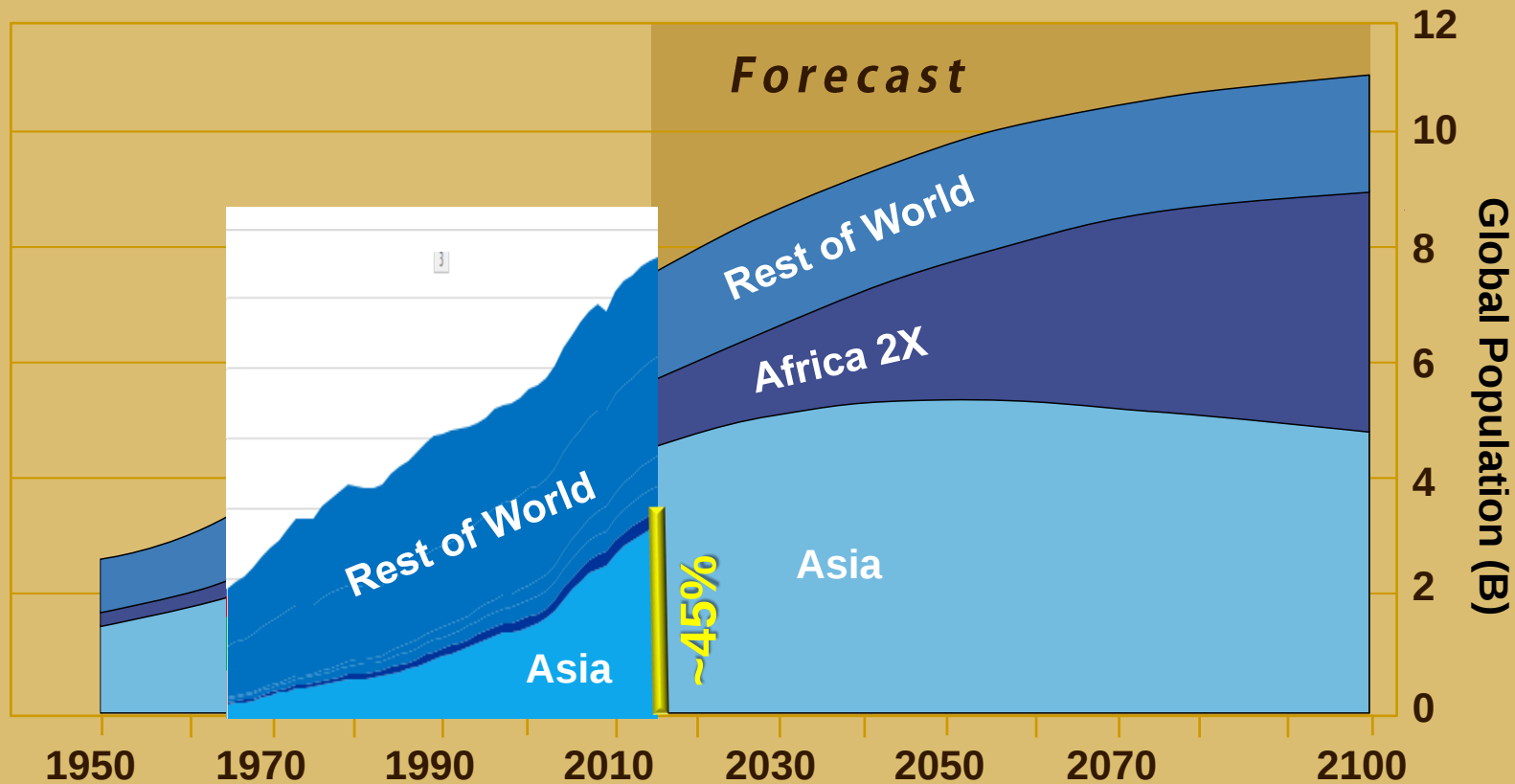
Population and Energy



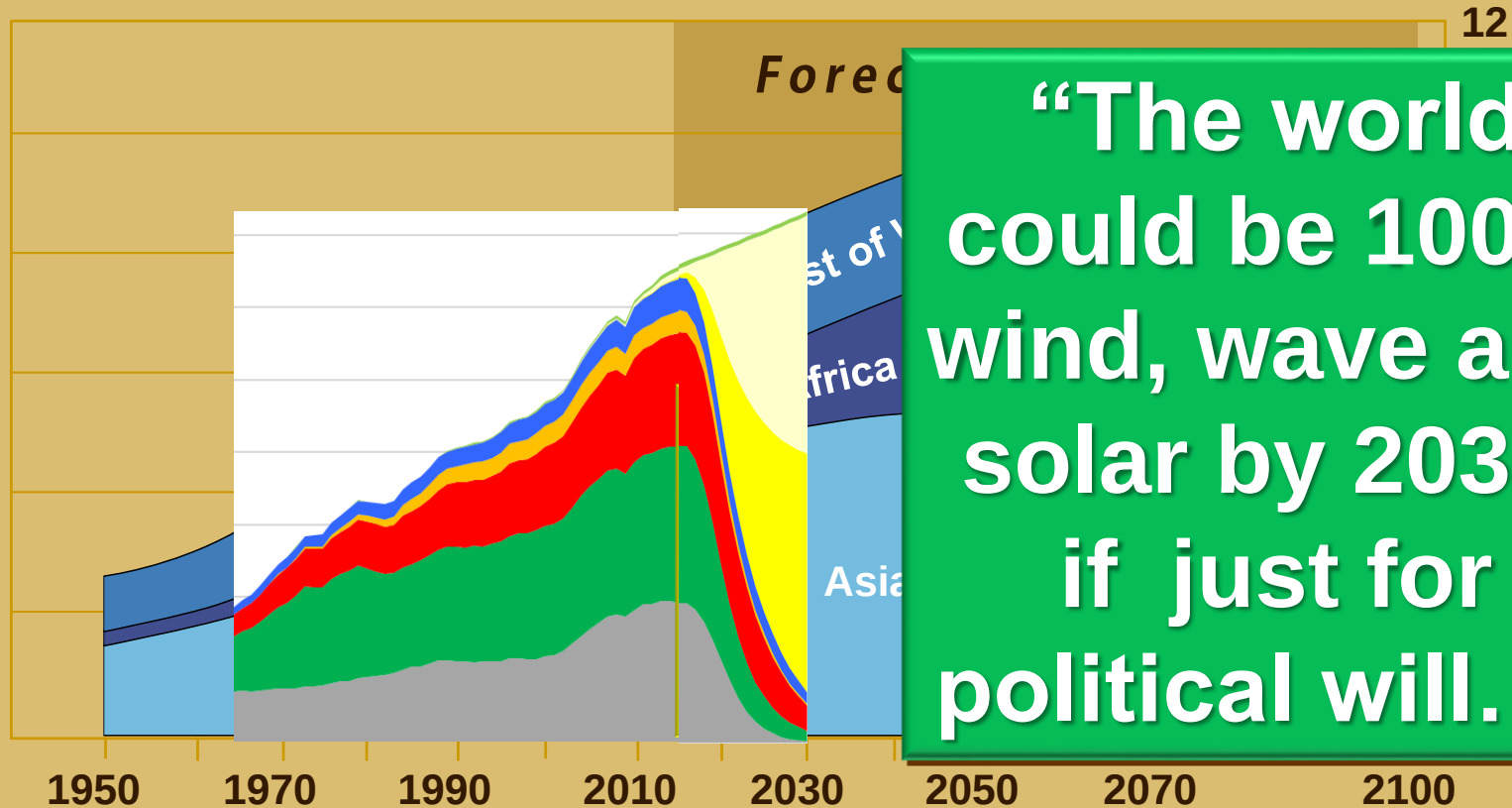
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Population and Energy

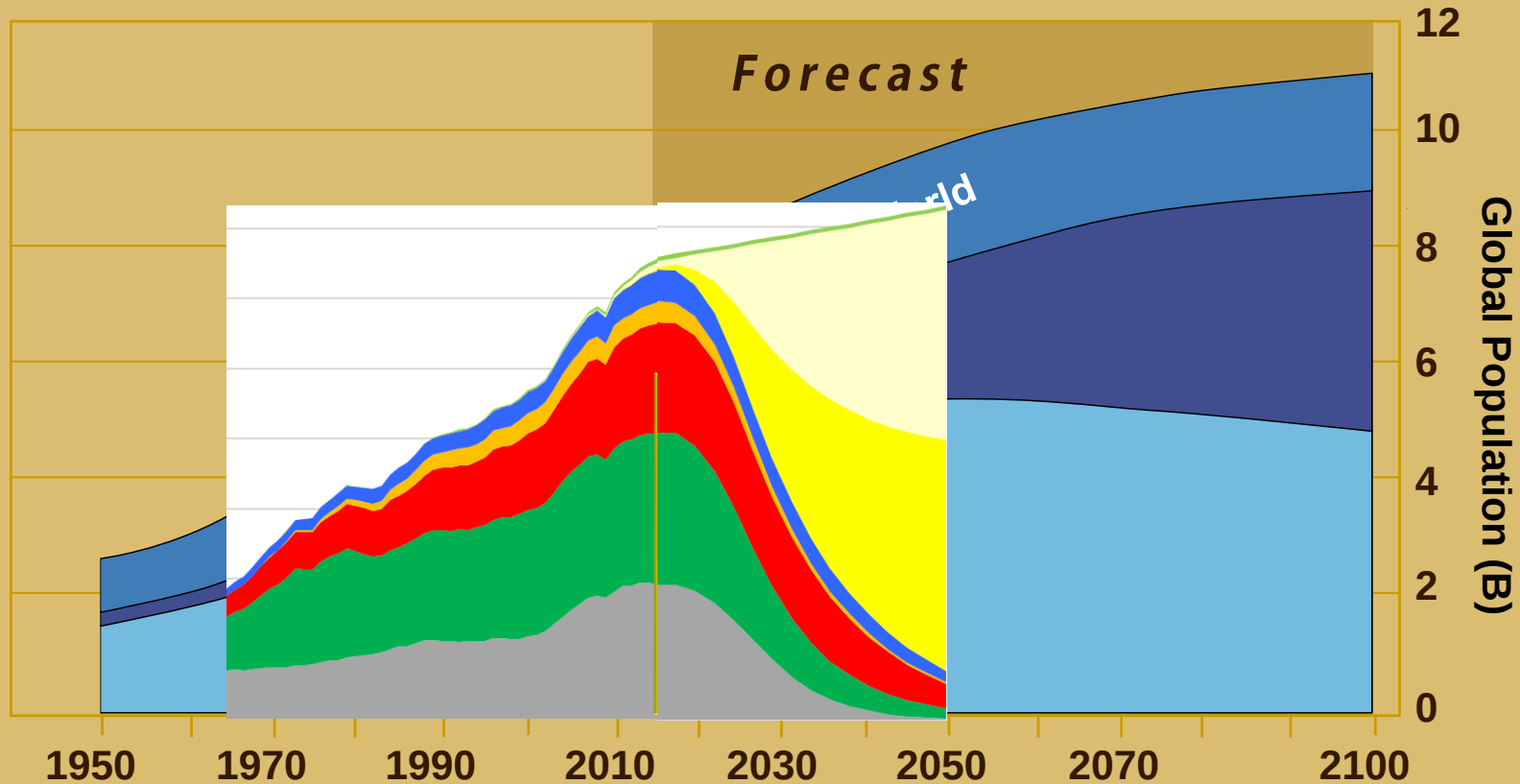


Population and Energy



**“The world
could be 100%
wind, wave and
solar by 2030,
if just for
political will...”**

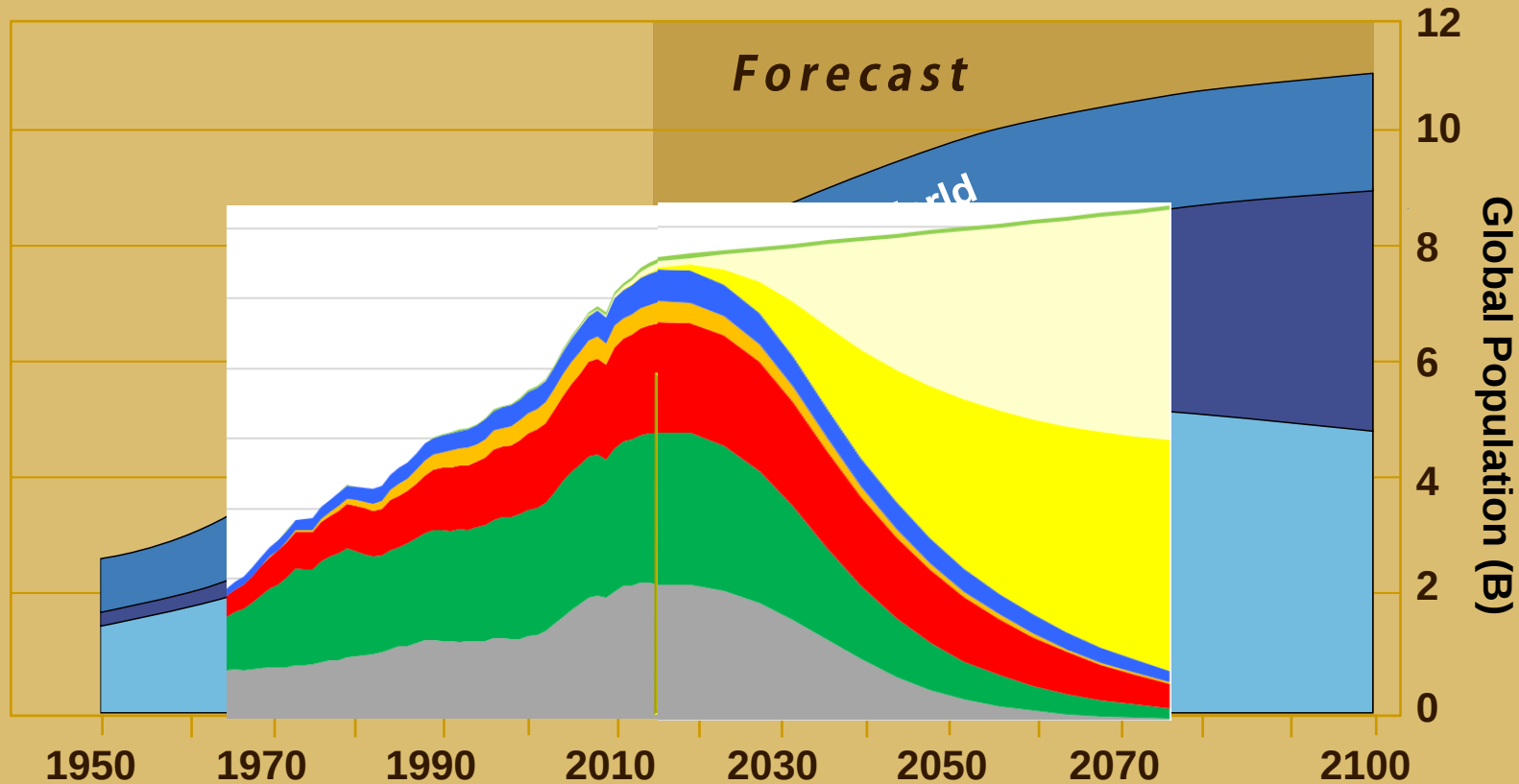
Population and Energy



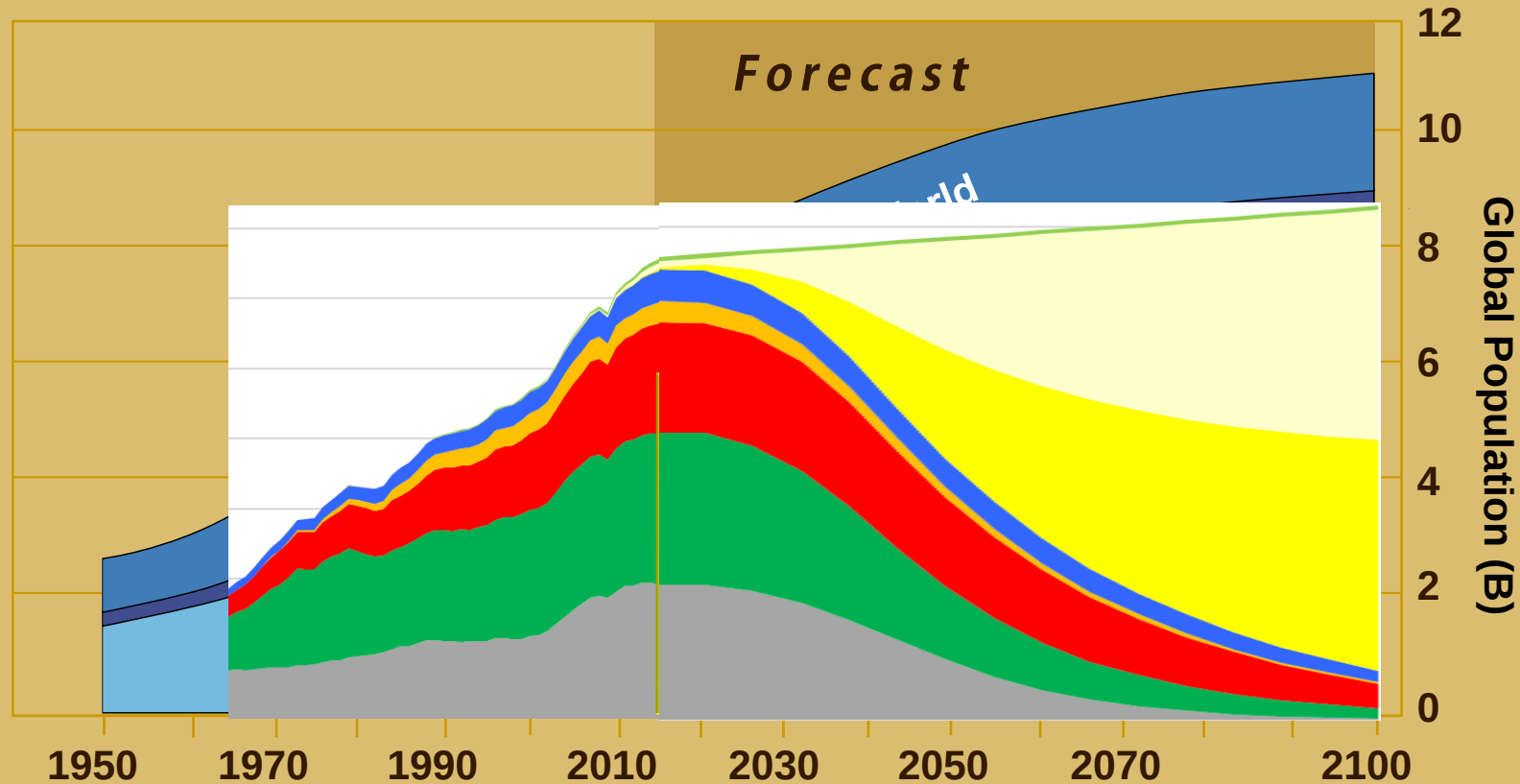
Data: BP Statistical View of World Energy (2016)

Source: From the UN, as appeared in *The Economist*, August 23, 2014

Population and Energy



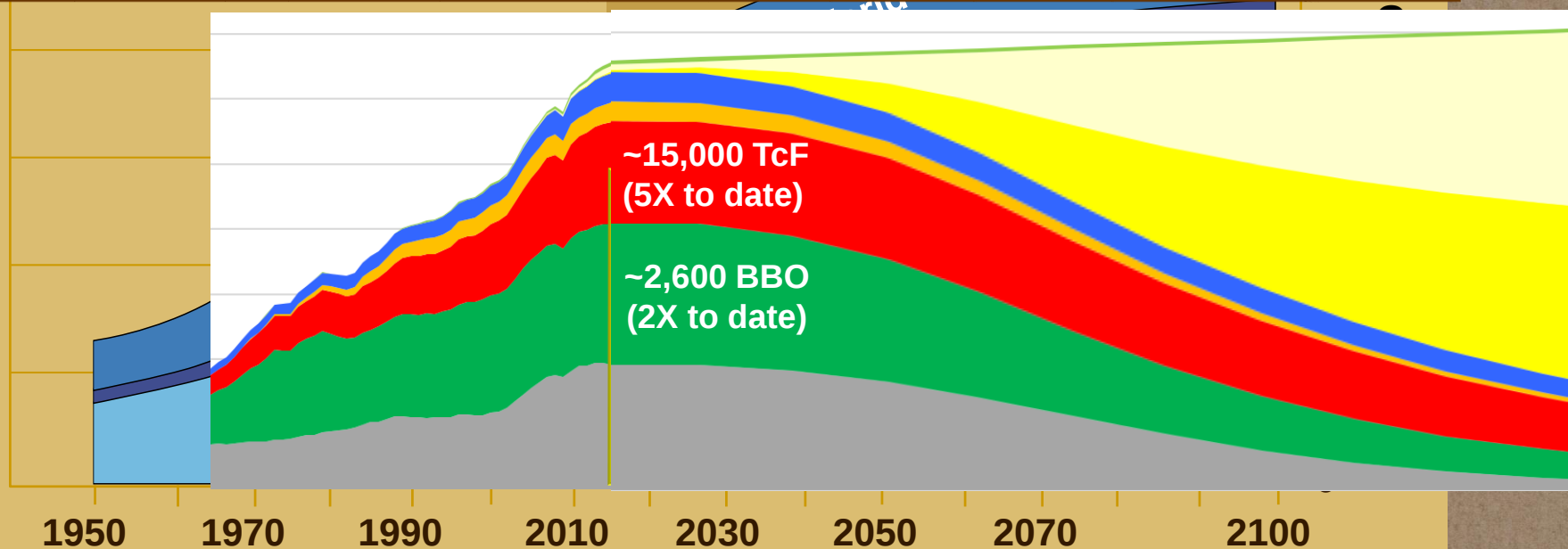
Population and Energy



Population and Energy

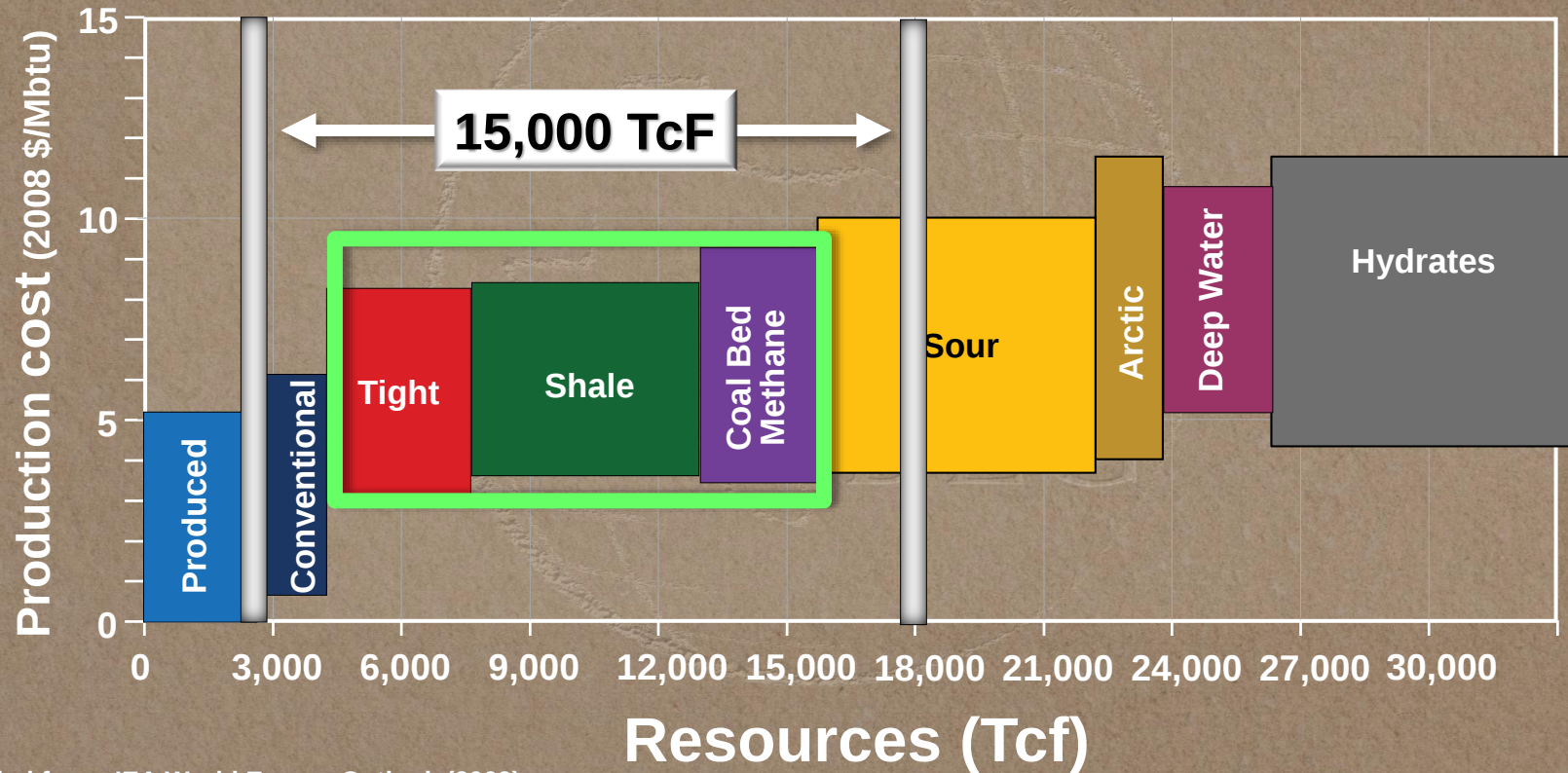
Are there affordable, available, reliable and sustainable:

- fossil energy and nuclear resources to meet this demand?
- renewable energy resources to meet this demand?



Natural Gas Cost of Supply

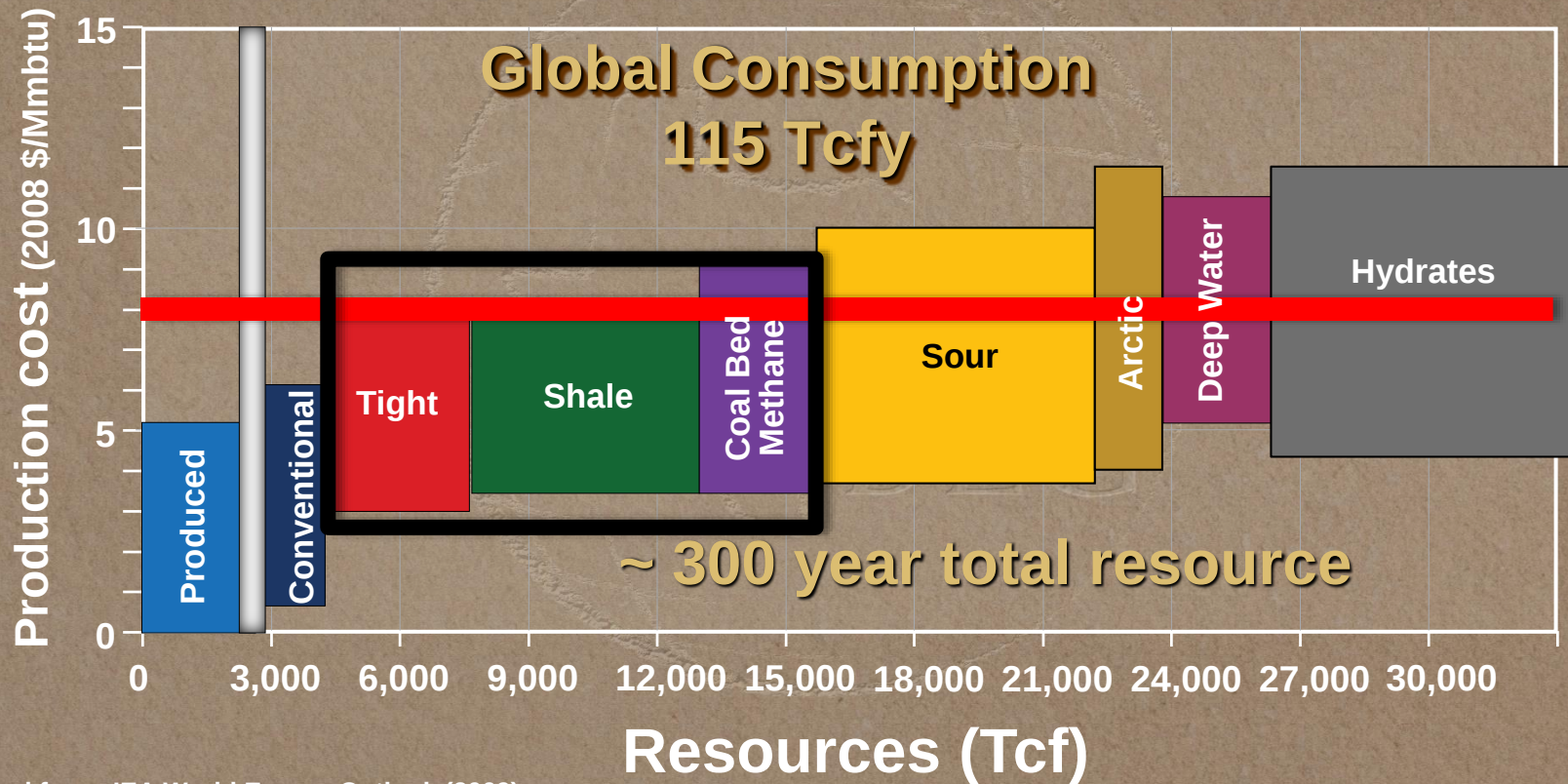
Resources v. Cost



Modified from: IEA World Energy Outlook (2009)

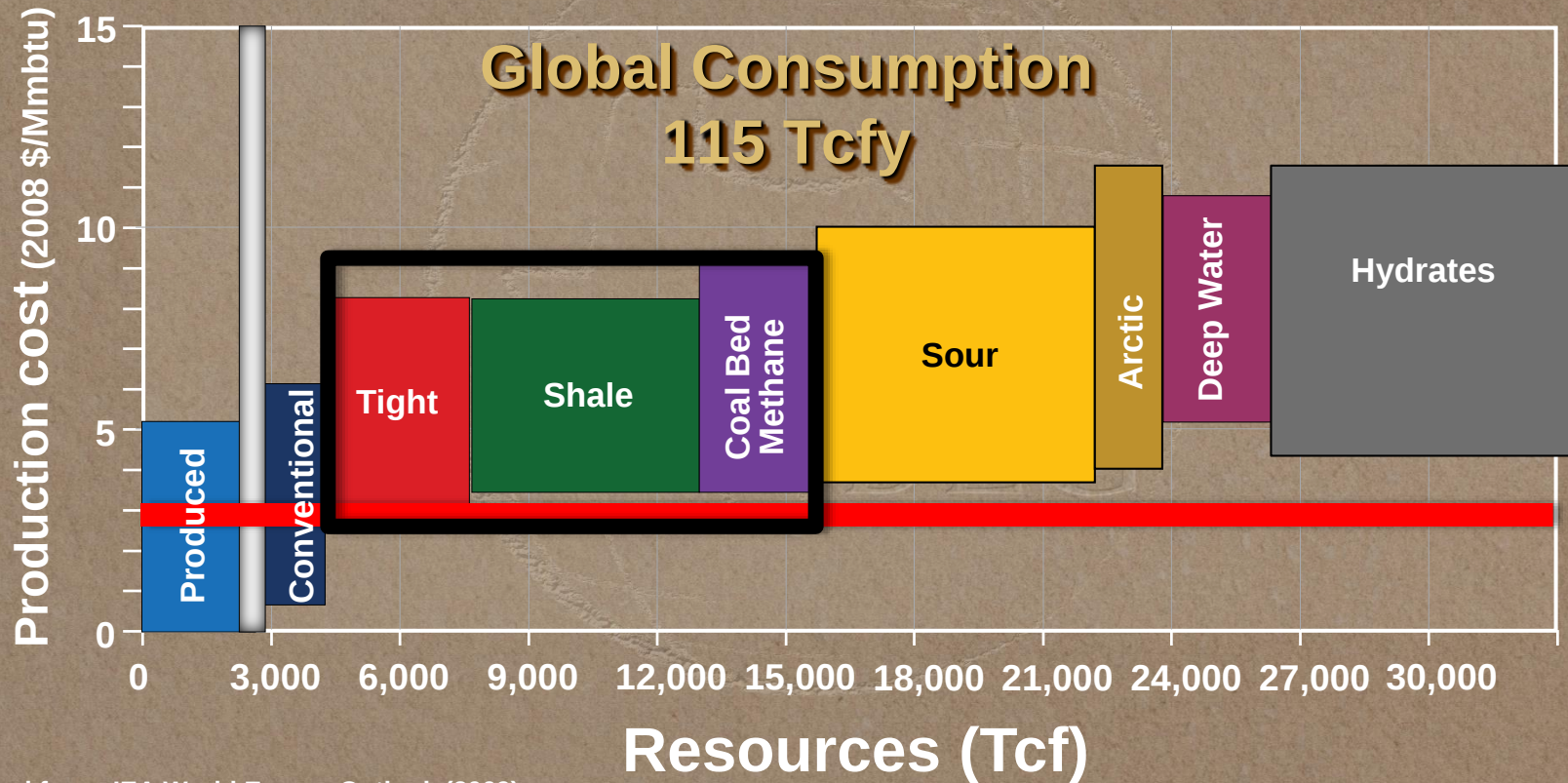
Natural Gas Cost of Supply

Resources v. Cost



Natural Gas Cost of Supply

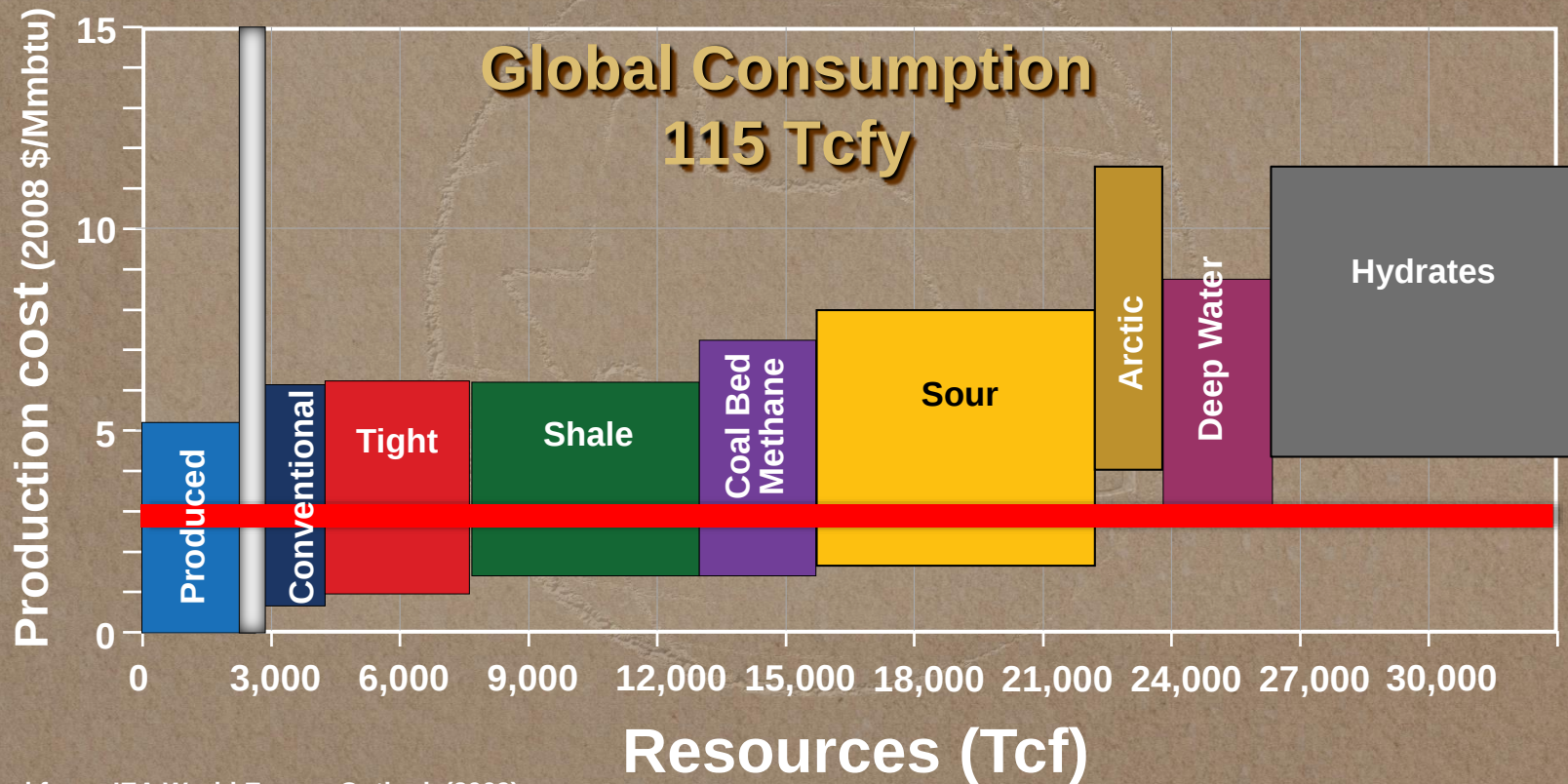
Resources v. Cost



Modified from: IEA World Energy Outlook (2009)

Natural Gas Cost of Supply

Resources v. Cost



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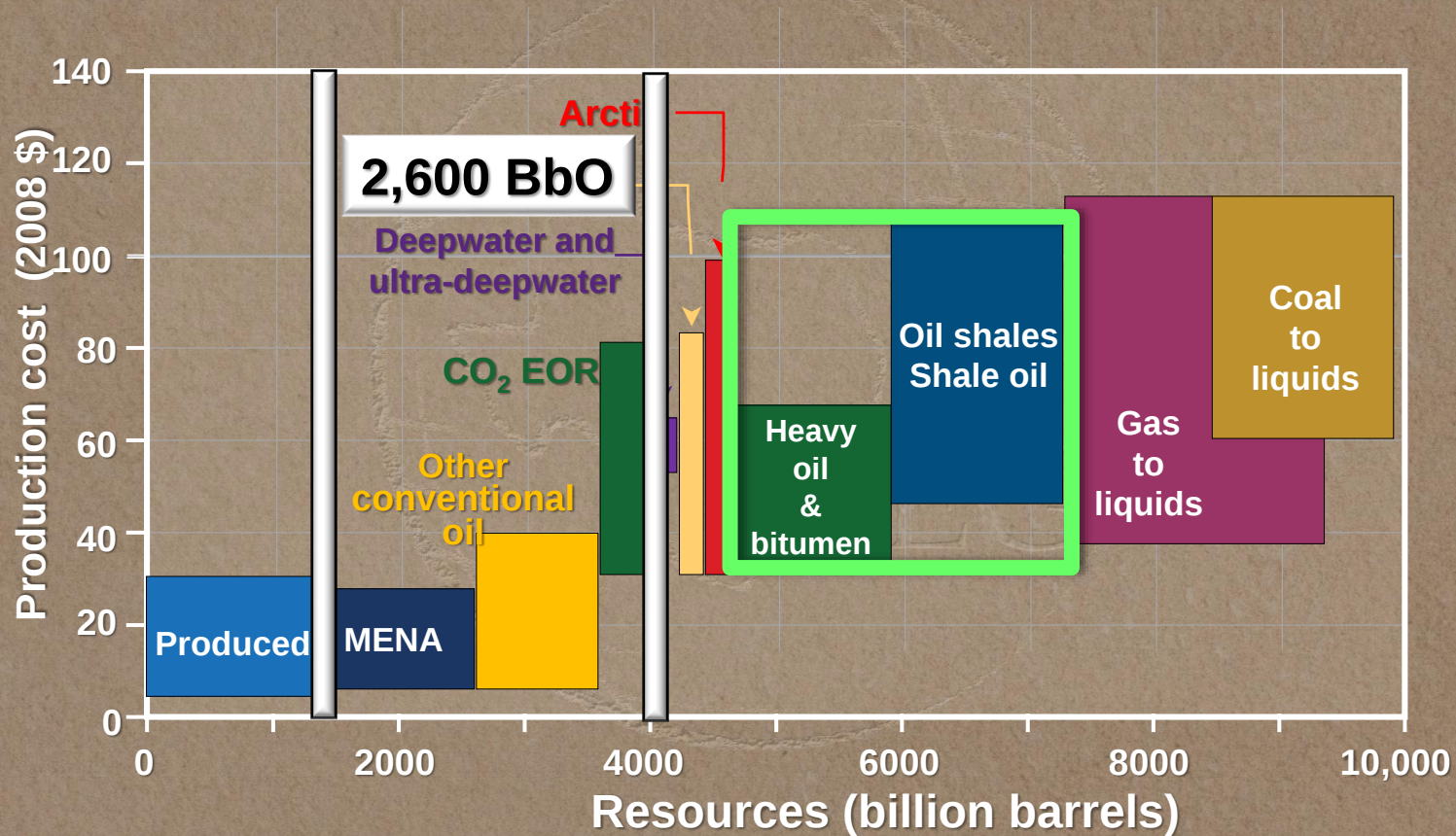
Natural Gas Cost of Supply

Resources v. Cost

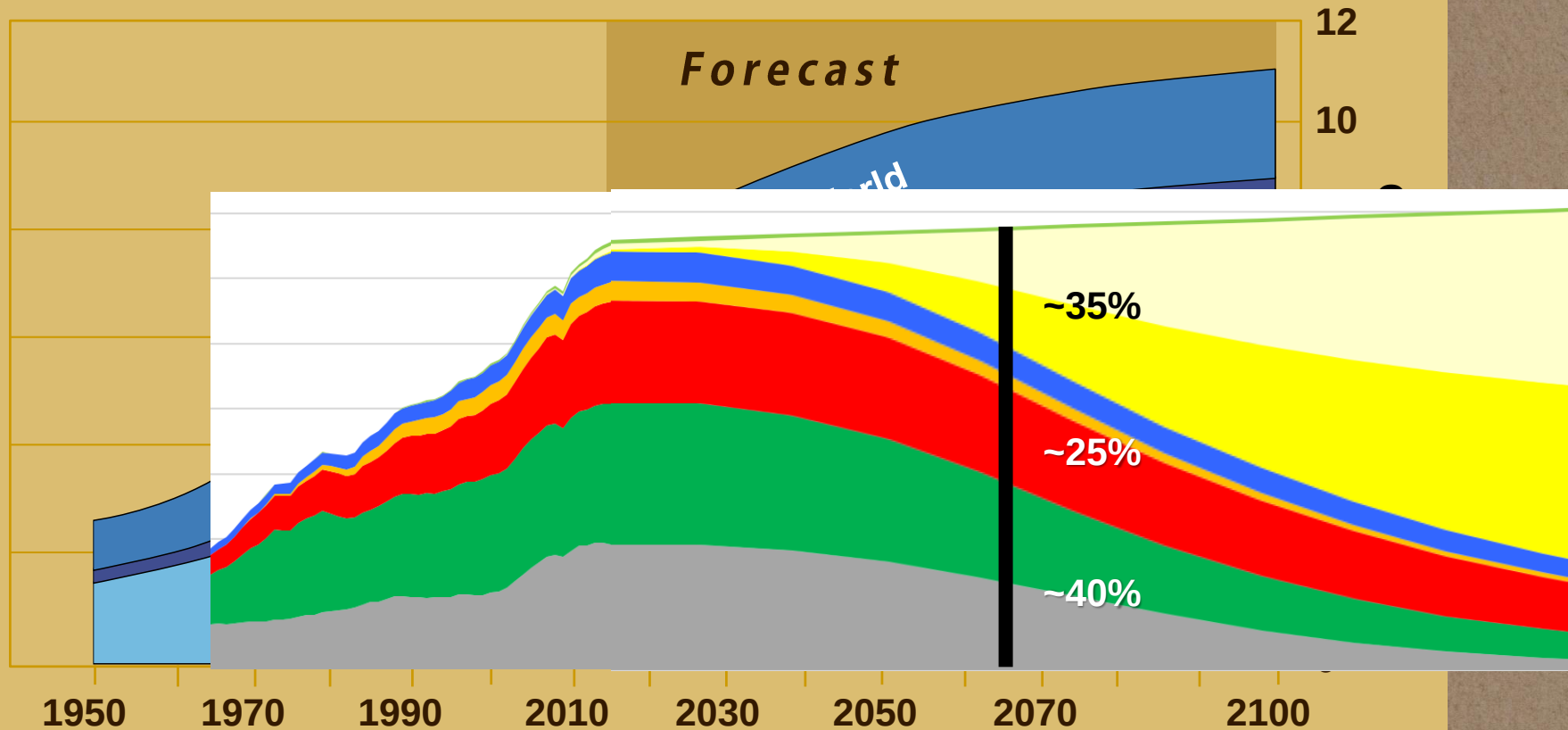
**Reserves are a function of
Price, Cost, Technology,
Policy and Demand**

Oil Cost of Supply

Resources and Cost

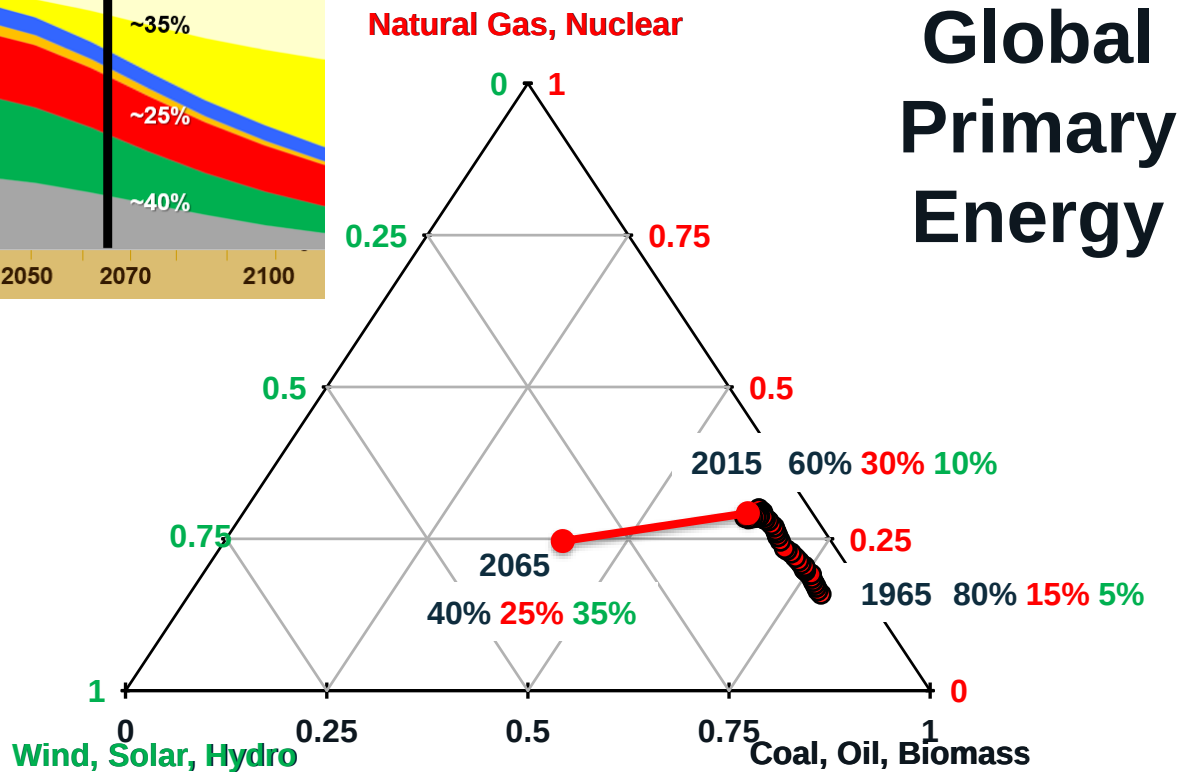
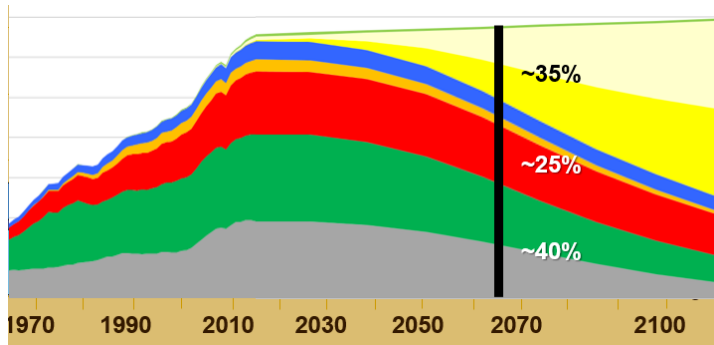


Population and Energy

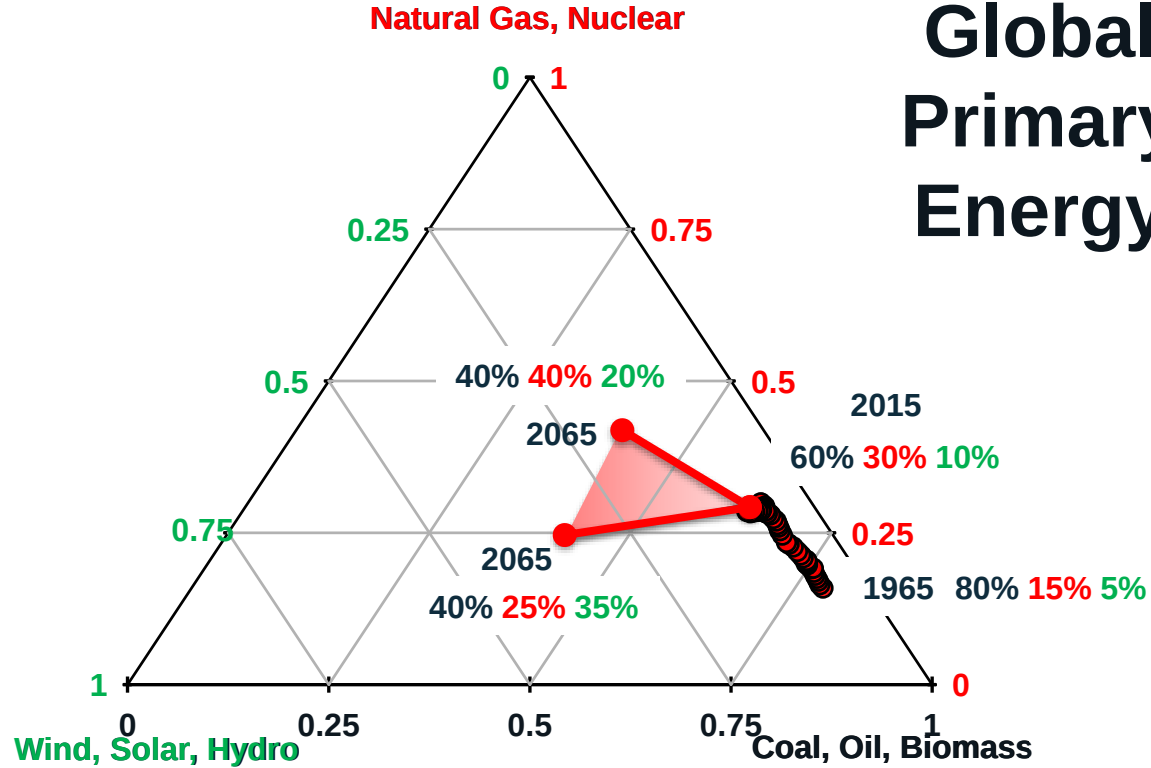


Data: BP Statistical View of World Energy (2016)

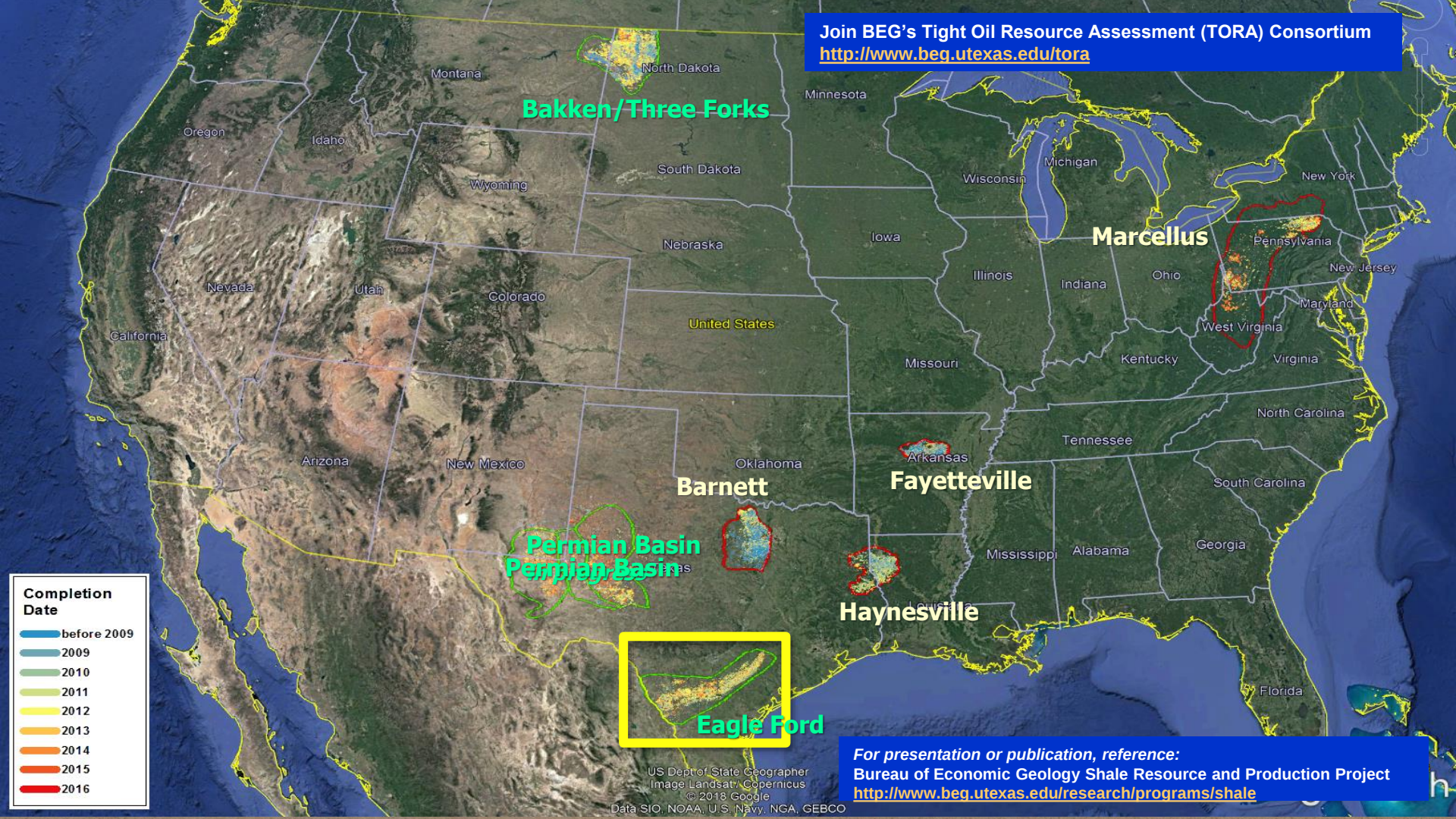
Source: From the UN, as appeared in *The Economist*, August 23, 2014



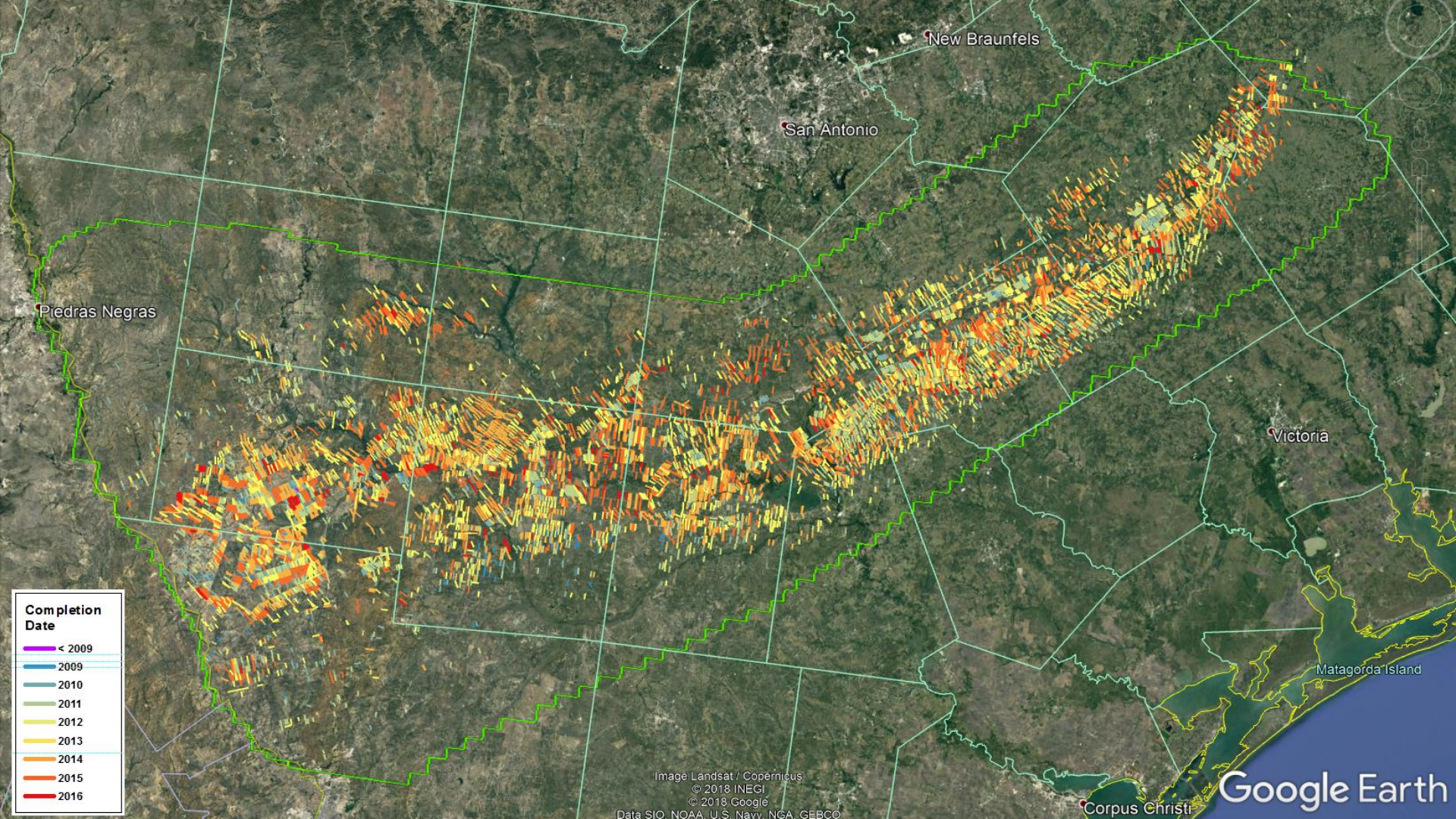
Global Primary Energy



Join BEG's Tight Oil Resource Assessment (TORA) Consortium
<http://www.beg.utexas.edu/tora>



For presentation or publication, reference:
Bureau of Economic Geology Shale Resource and Production Project
<http://www.beg.utexas.edu/research/programs/shale>



Gas
Tcf

Oil
Bbbl

Original In-Place **3100** 450

Tech. Recoverable **700** 27

Production to date **70** 5

Horizontal wells to date ~75,000

Future wells (base case) ~500,000

Gas

Oil

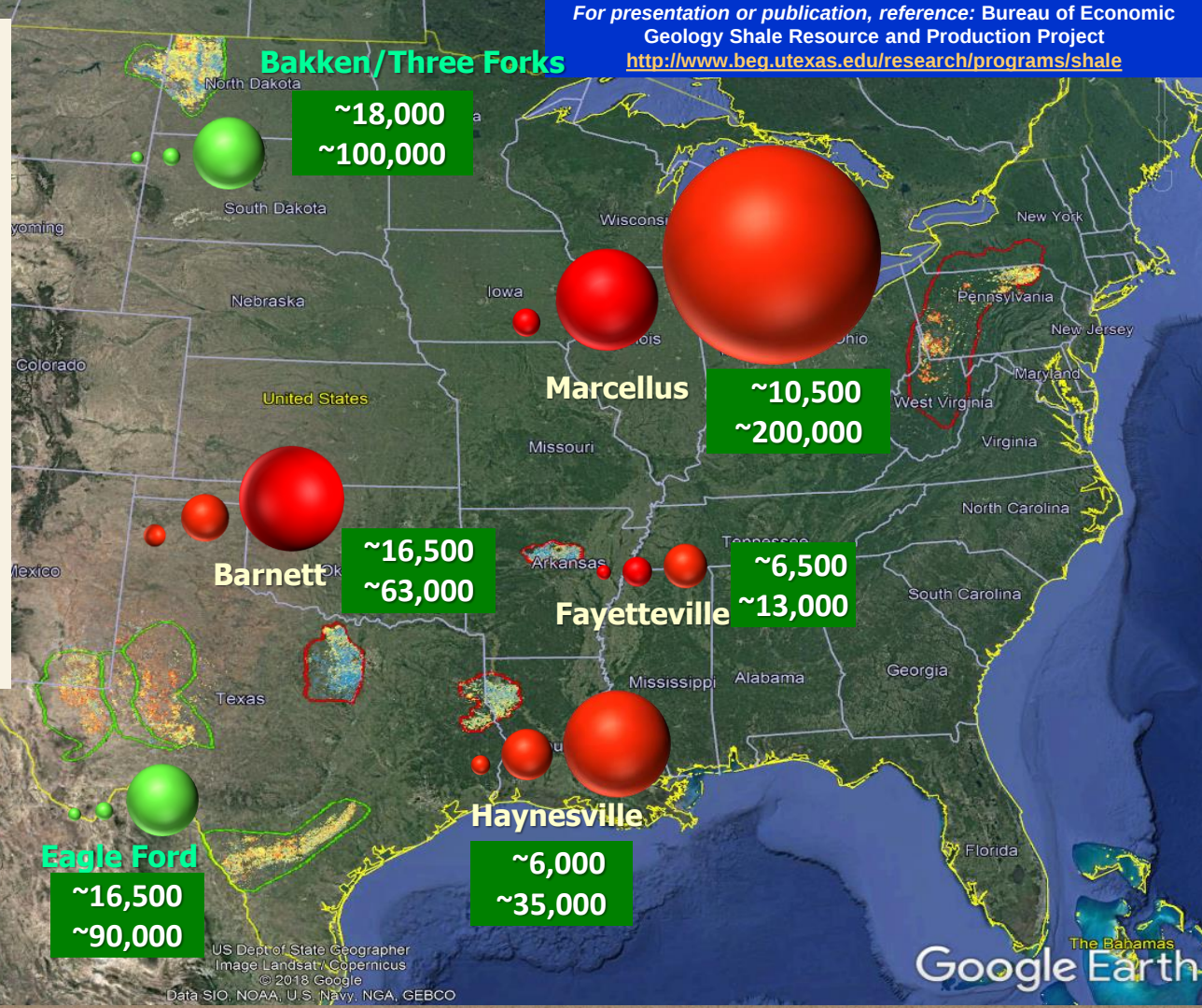
**Resource-
in-Place**

TRR

**Produced
to-date**



**Completion
Date**



Gas
Tcf

Oil
Bbbl

Original In-Place **3100** 450

Tech. Recoverable **700** 27

Production to date **70** 5

Horizontal wells to date ~75,000

Future wells (base case) ~500,000

Bakken/Three Forks

~18,000

~100,000

Recovery to Date

2% of the natural gas
1% of the oil

Gas

Oil

**Resource-
in-Place**

TRR

**Produced
to-date**

**Completion
Date**

before 2009
2009
2010
2011
2012
2013
2014
2015
2016

Eagle Ford

~16,500

~90,000

Haynesville

~6,000

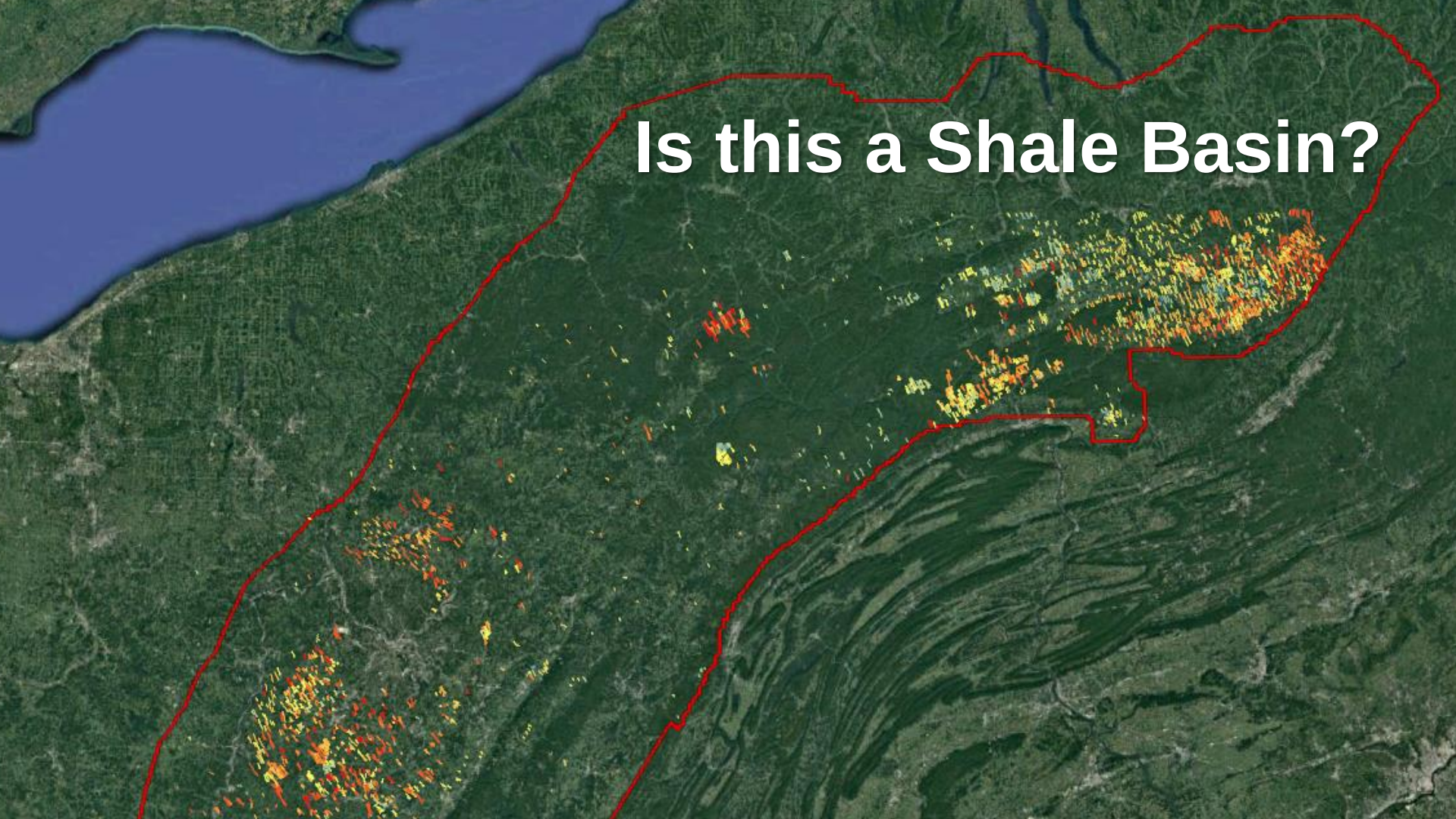
~35,000

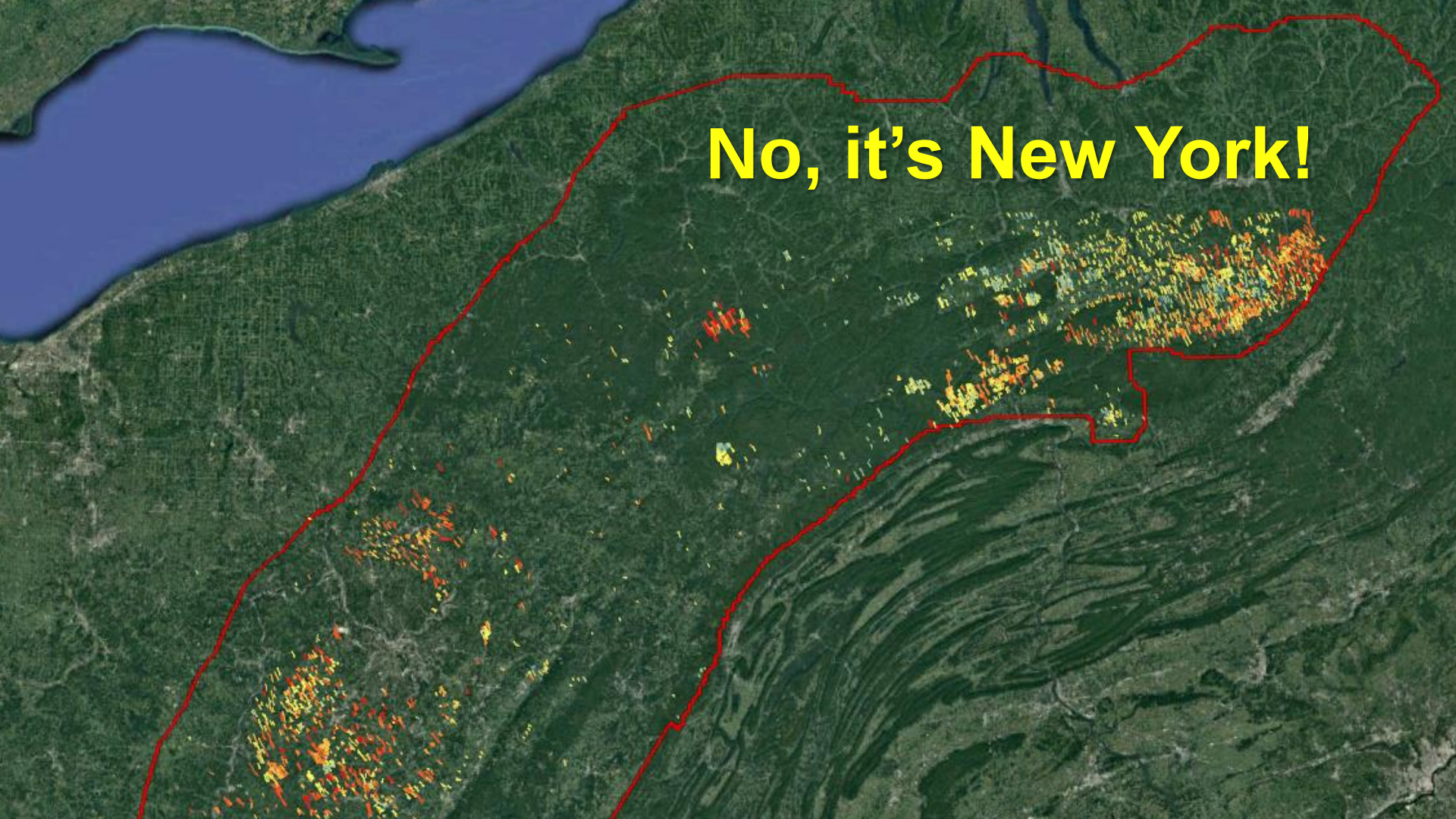
Environmental Impact

Coal, Oil, Natural Gas

- Mining and Manufacturing *Land, Water, Emissions*
- Drilling and Completion: *Land, Water*
- Transportation: *Pipelines, Trucks, Ships, Rail*
- Refining and Petrochemicals: *Emissions*
- Combustion: *Vehicle and Power Plant Emissions*

Is this a Shale Basin?



A satellite map of New York State with a red outline. The state is filled with green, representing forested land. In the top left corner, there is a large blue area representing a body of water. Scattered across the state, particularly in the eastern and southern parts, are numerous small, colored dots in yellow, orange, and red. These dots appear to be data points or markers. The text "No, it's New York!" is written in yellow, bold, sans-serif font in the upper right quadrant of the state.

No, it's New York!

Environmental Impact

Renewables and Batteries

- Mining and Processing *Land, Water, Emissions*
- Manufacturing: *Turbines, Panels, Batteries*
- Production: *Land for “Farms”*
- Transmission: *Electricity*
- Disposal: *Landfill*

Energy

Key Points

- Fossil energy demand remains strong, and resources are vast
- Wind and solar are a small component of the mix but growing quickly in some regions
- No form of energy, at scale, is without environmental impact

Outline

- ❖ Energy
- ❖ Carbon
- ❖ Poverty
- ❖ Radical Middle

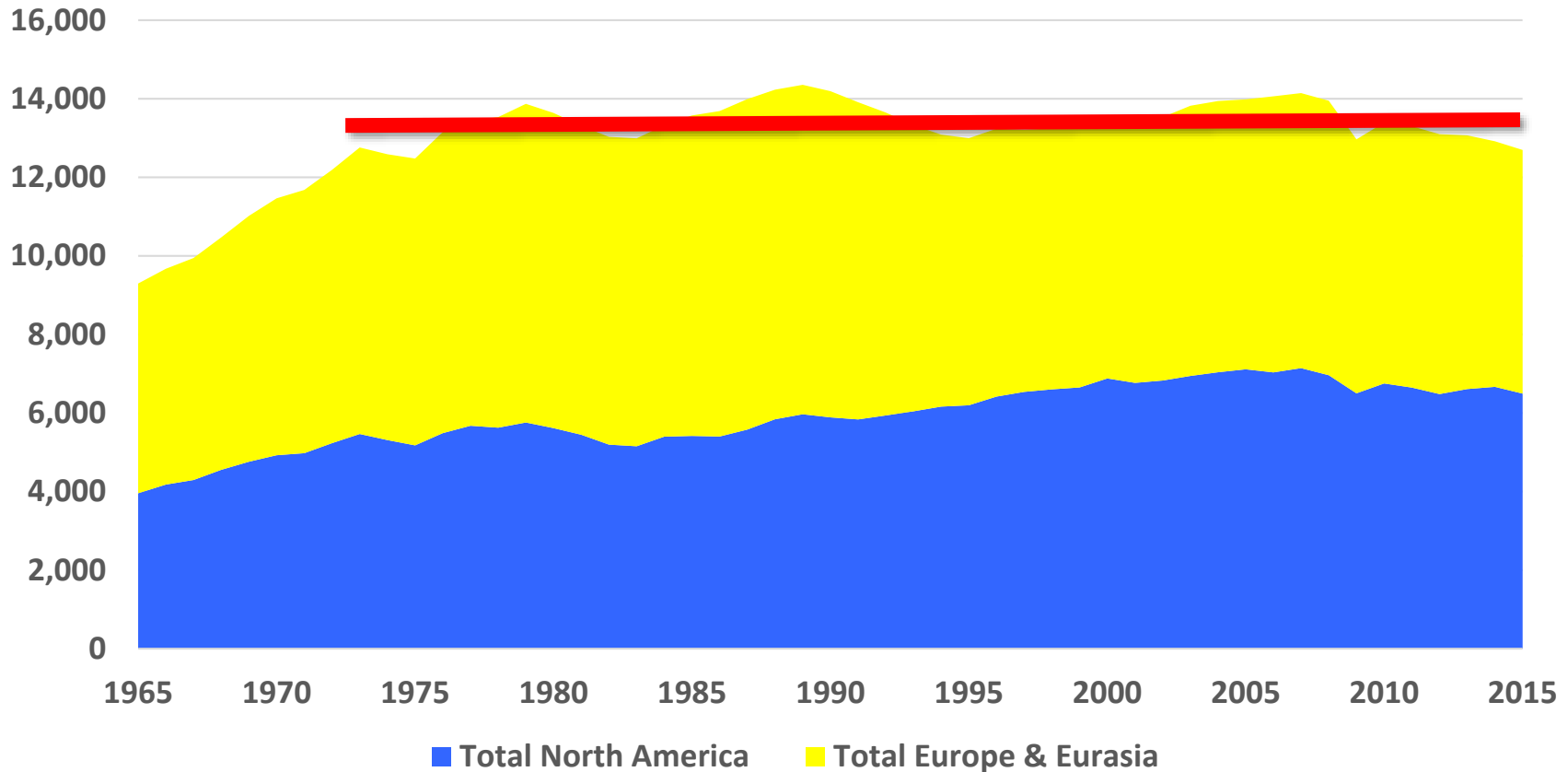


Yogi...

“In theory there ain’t no difference between theory and practice, but in practice there is.”

CO₂ Emissions

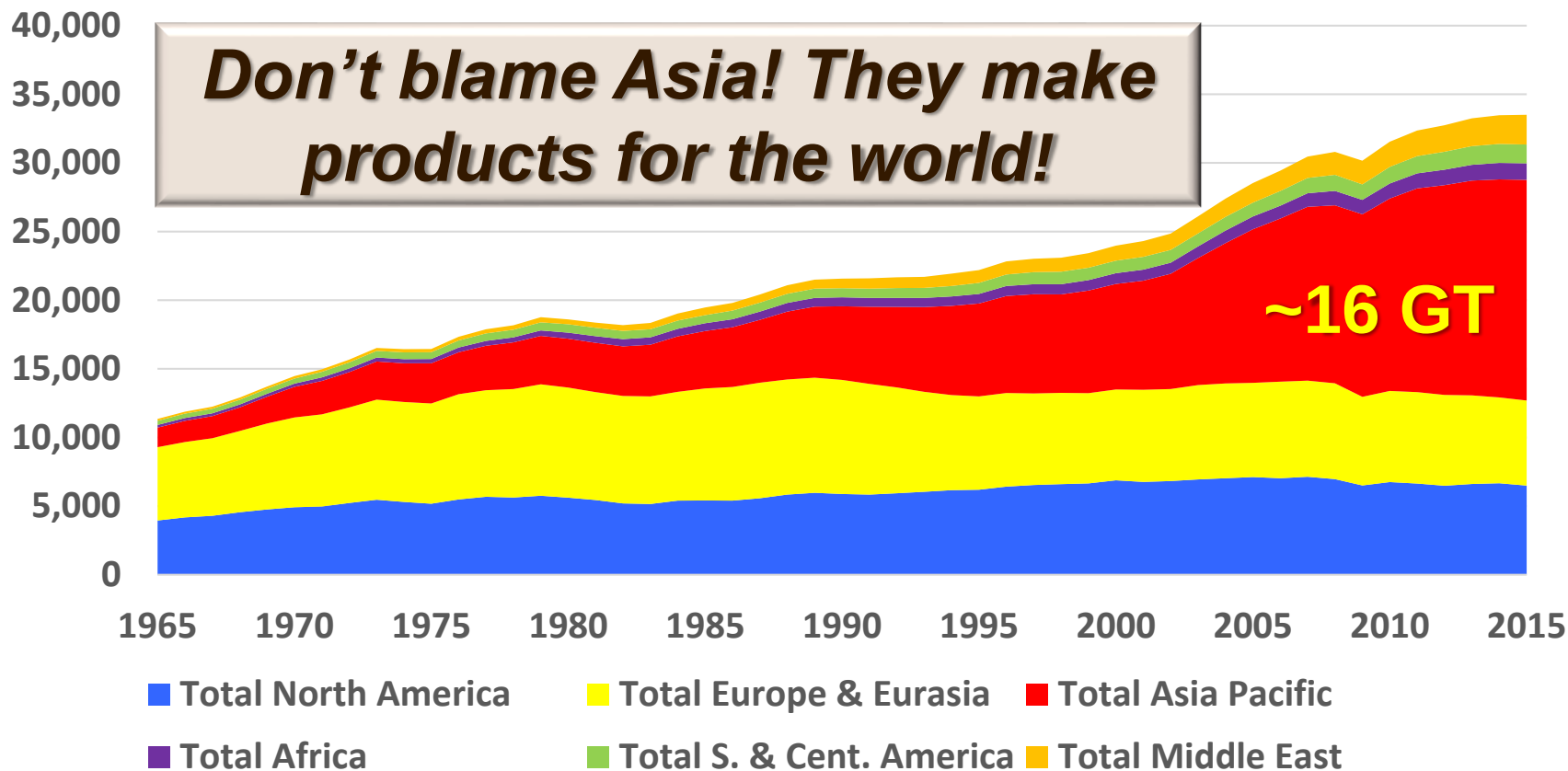
CO₂ Emissions (Million Tonnes)



Data: BP Statistical View of World Energy (2016)

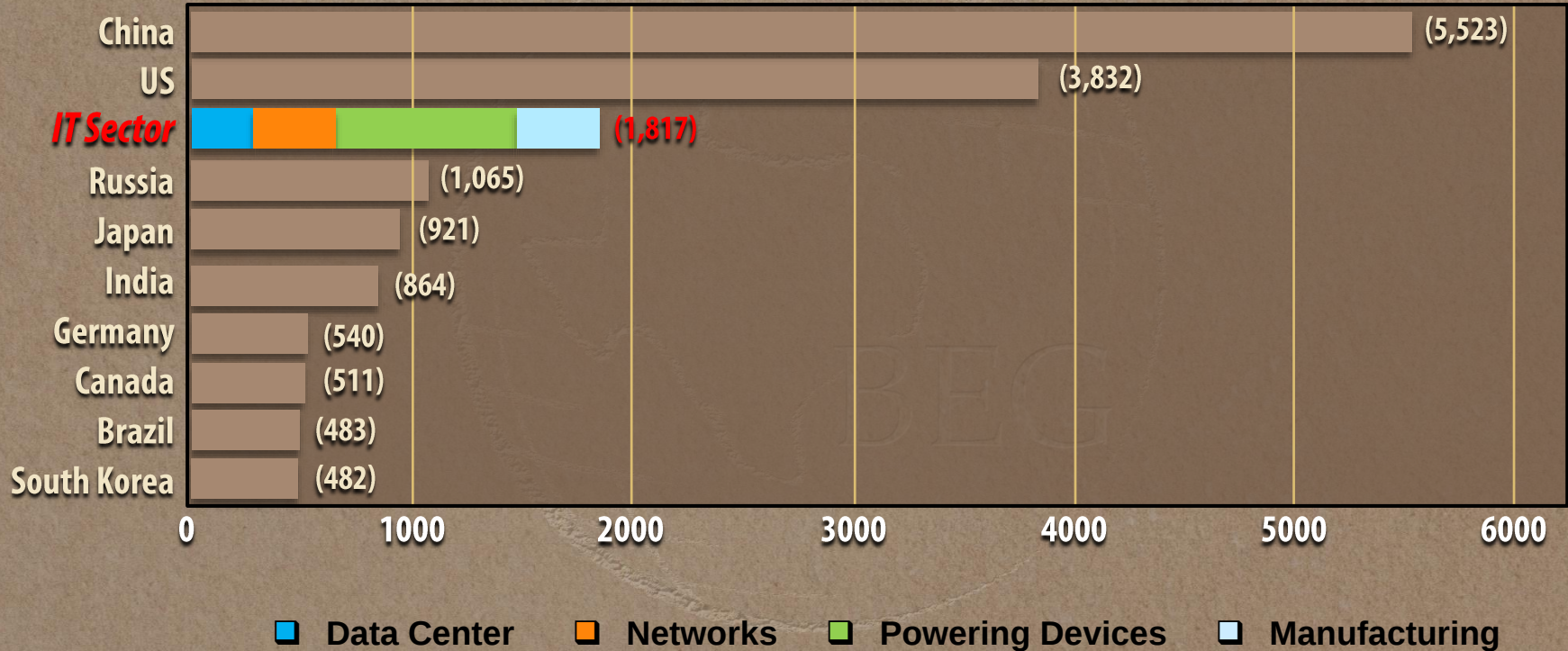
CO₂ Emissions

CO₂ Emissions (Million Tonnes)



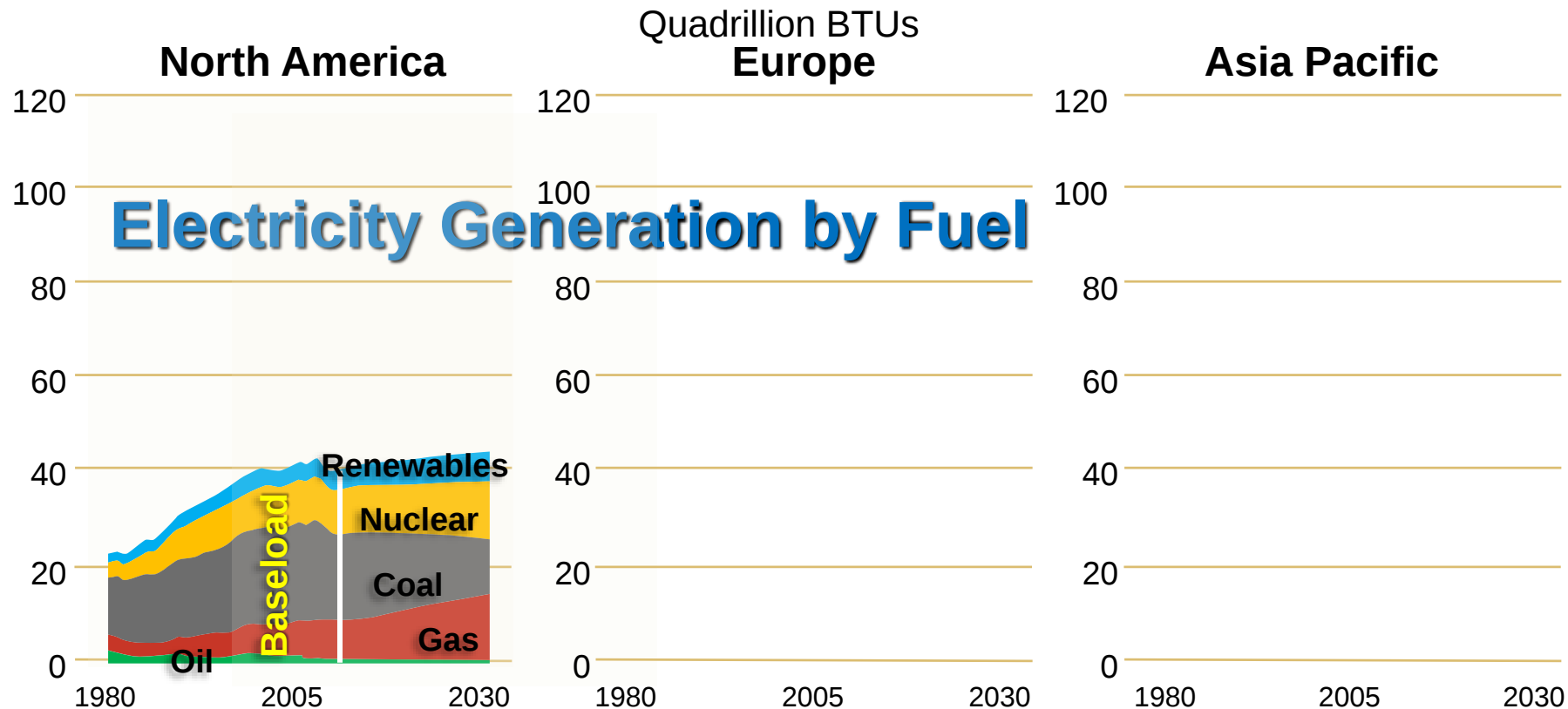
Electricity Use

(2012: Billion KwH)



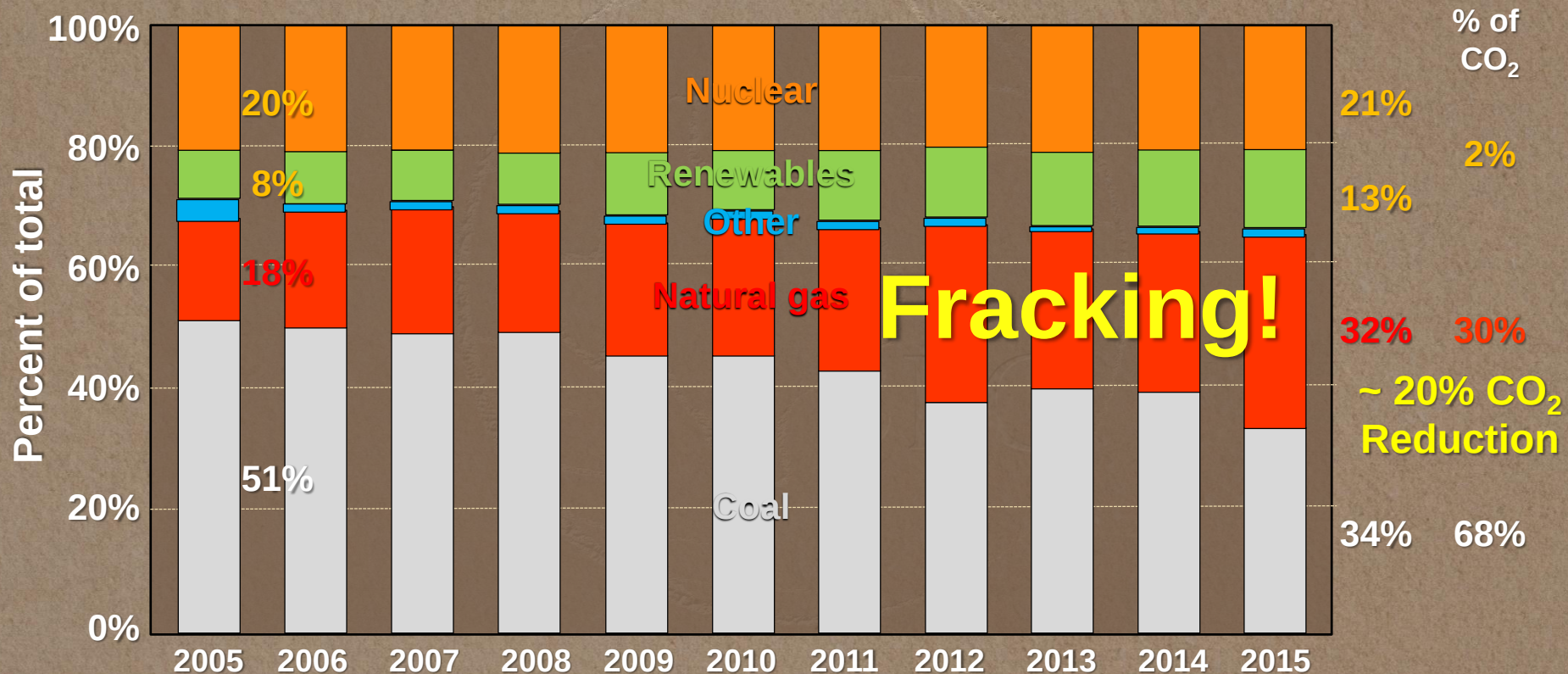
Source: Emerging Trends in Electricity Consumption for Consumer ICT, Peter Corcoran and Andres Andrae (2013) and CIA World Factbook. China/Russia/Canada figures are from 2014.

The Future Electricity Mix

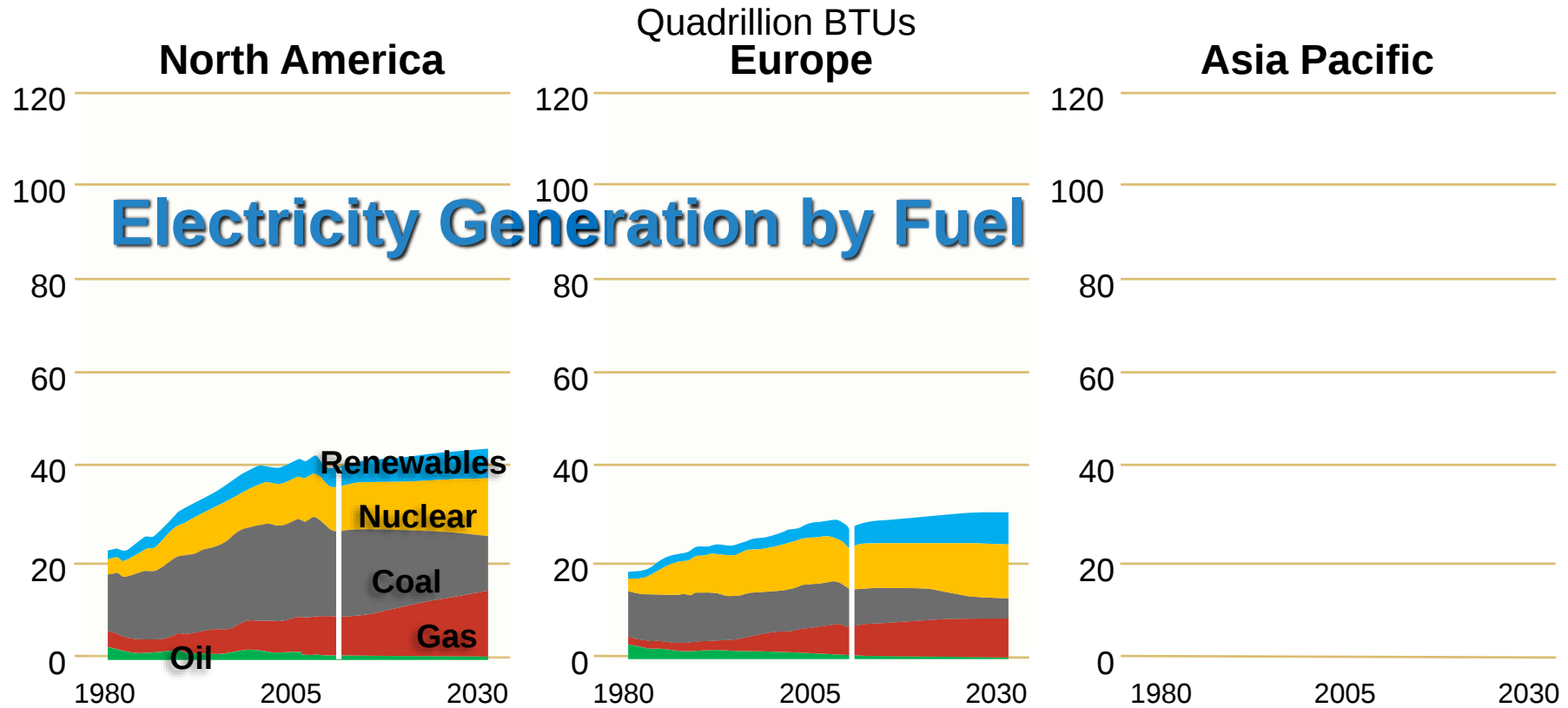


ExxonMobil Corporation, 2010, The outlook for energy: a view to 2030: ExxonMobil report, 53 p.

U.S. Electric Generation Shares (2005-15)

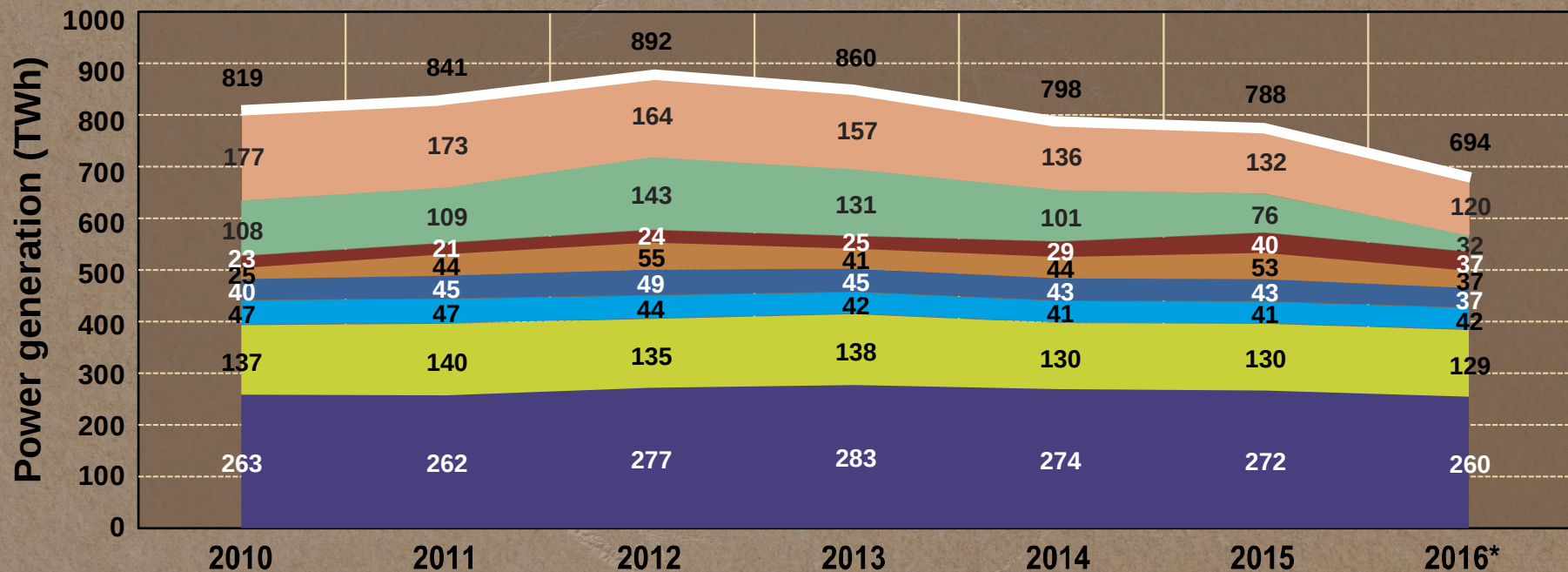


The Future Electricity Mix



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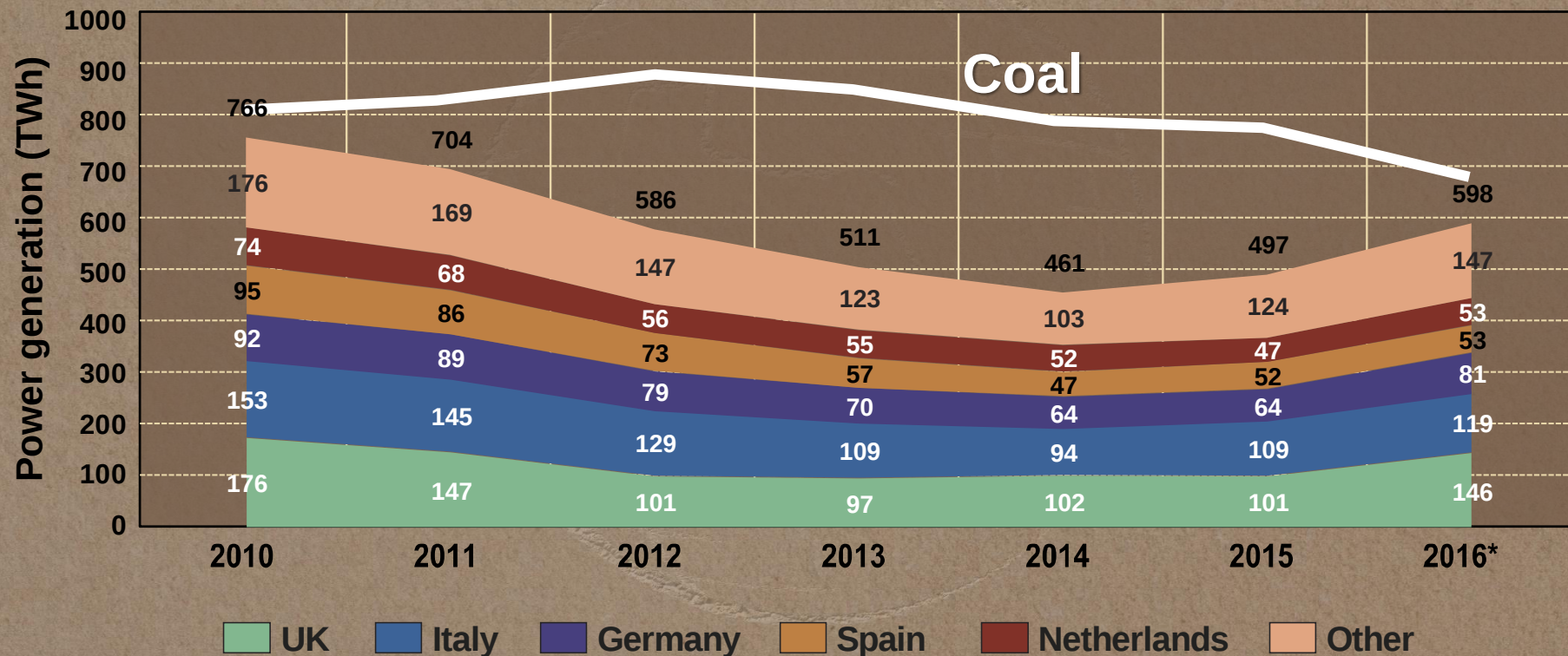
European Coal Generation



Germany Poland Czech Italy Spain Netherlands UK Other

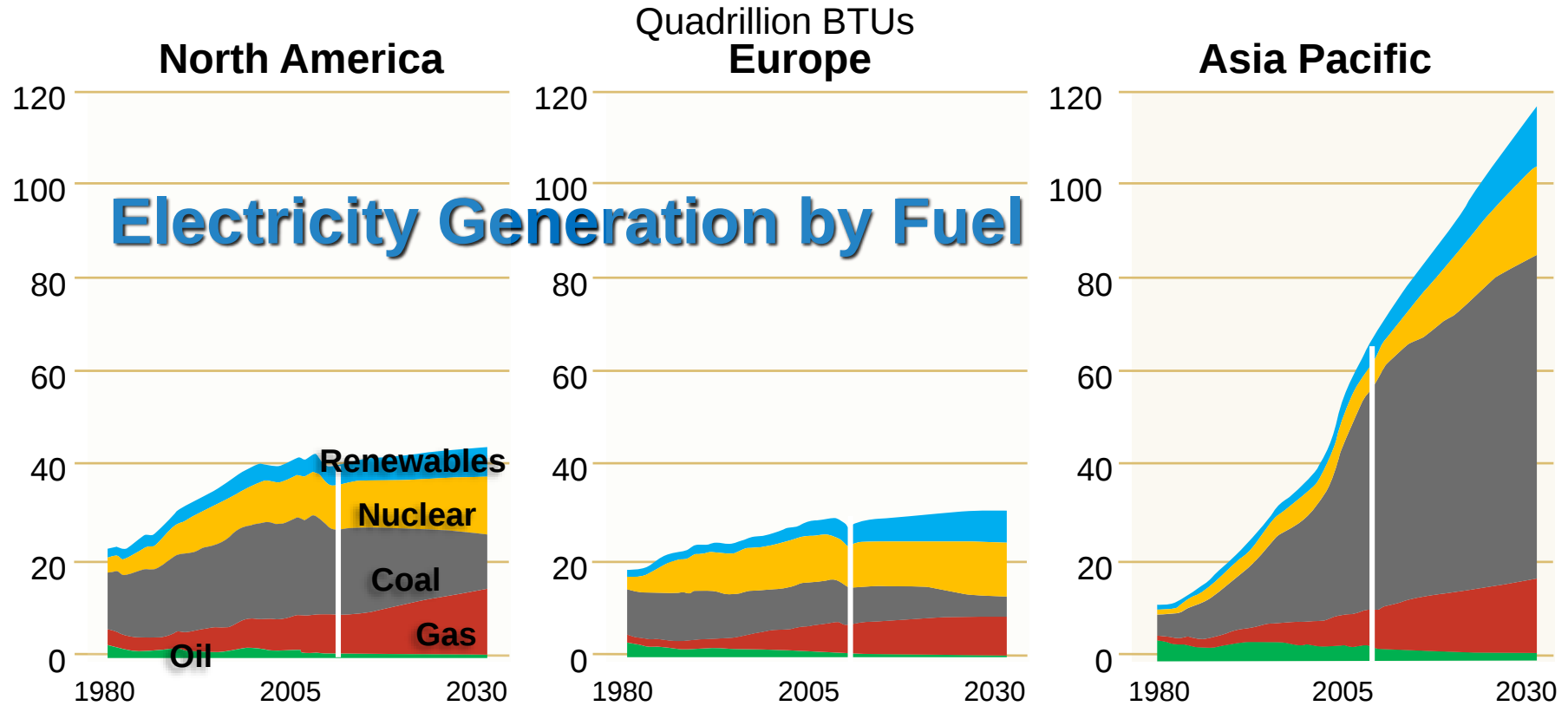
*preliminary

European Natural Gas Power Generation



*preliminary

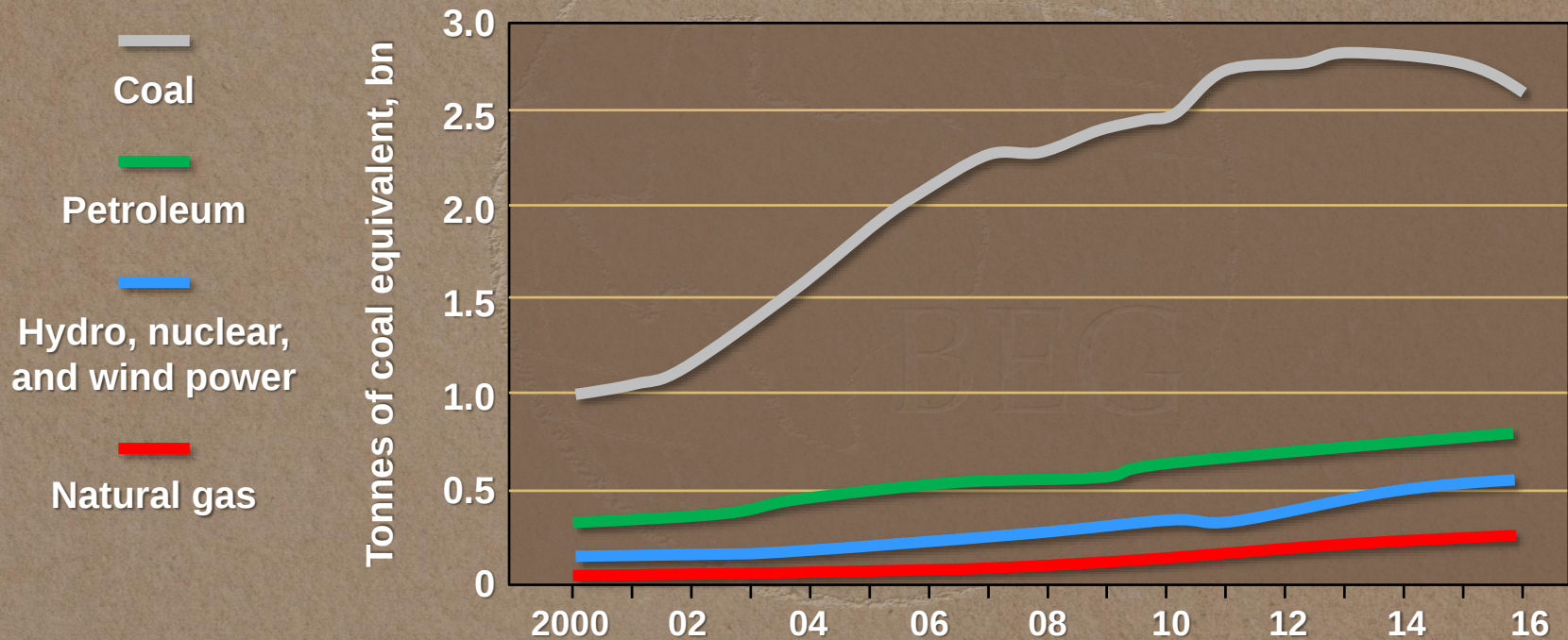
The Future Electricity Mix



ExxonMobil Corporation, 2010, The outlook for energy: a view to 2030: ExxonMobil report, 53 p.

China

Energy Consumption by Fuel Type

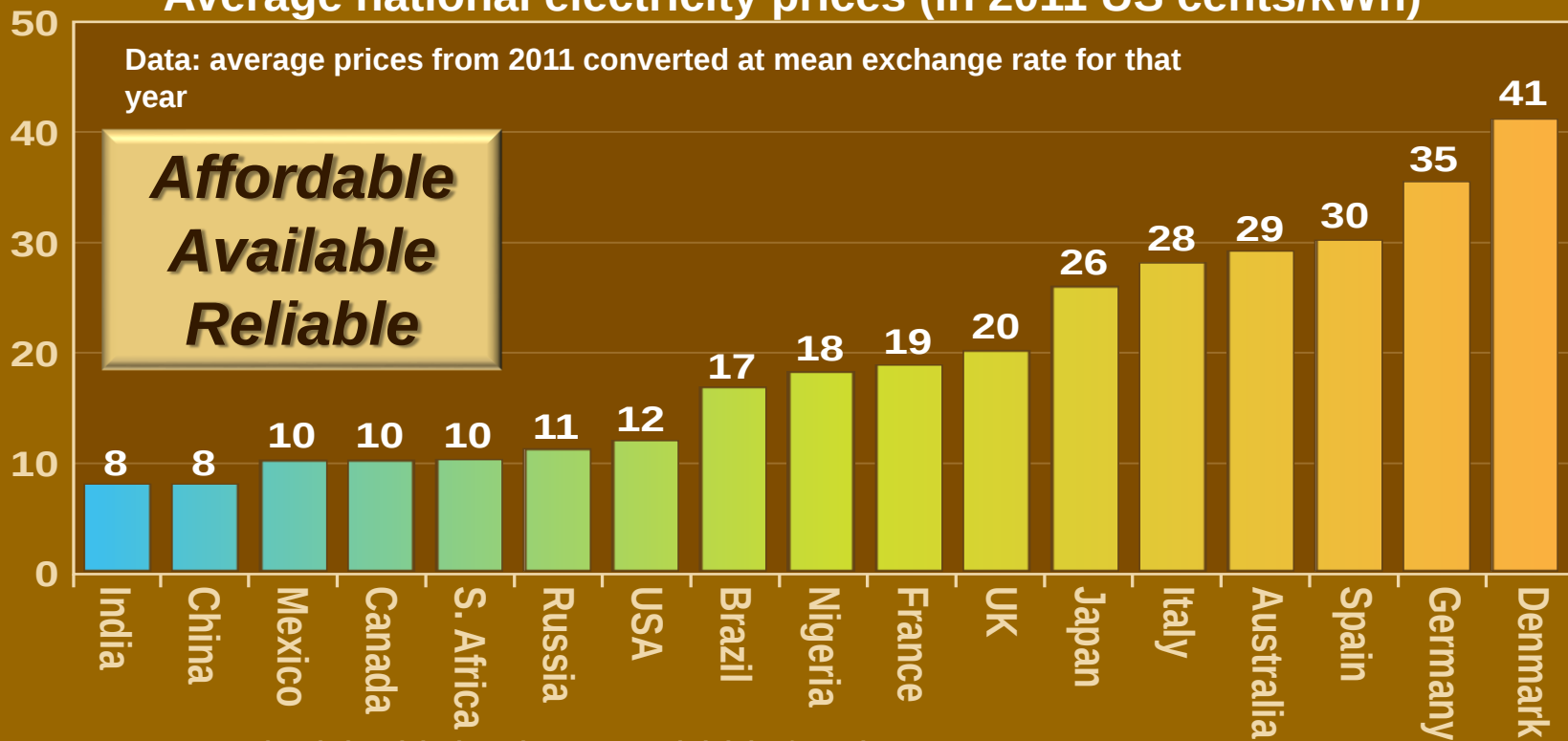


Actual Cost of Electricity

Average national electricity prices (in 2011 US cents/kWh)

Data: average prices from 2011 converted at mean exchange rate for that year

***Affordable
Available
Reliable***

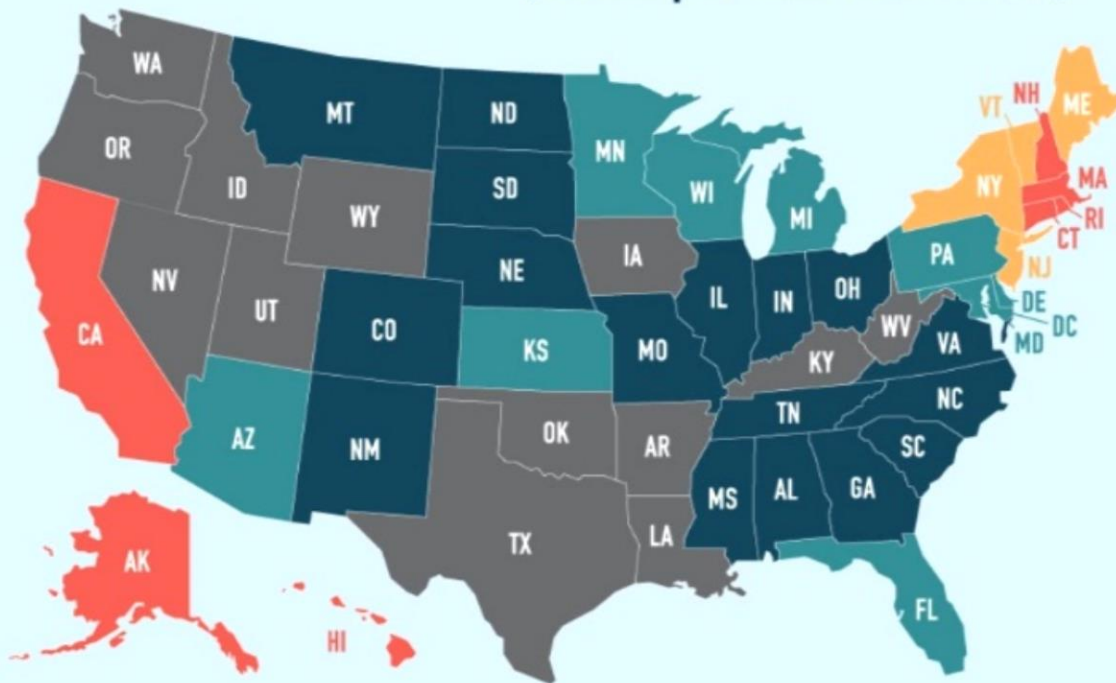


Sources: IEA, EIA, national electricity boards, OANDA, shrinkthatfootprint.com

Actual Cost of Electricity

2017 U.S. Average Electricity Retail Prices

(cents per kilowatt hour)



7.00 to 9.00

9.01 to 10.00

10.01 to 12.00

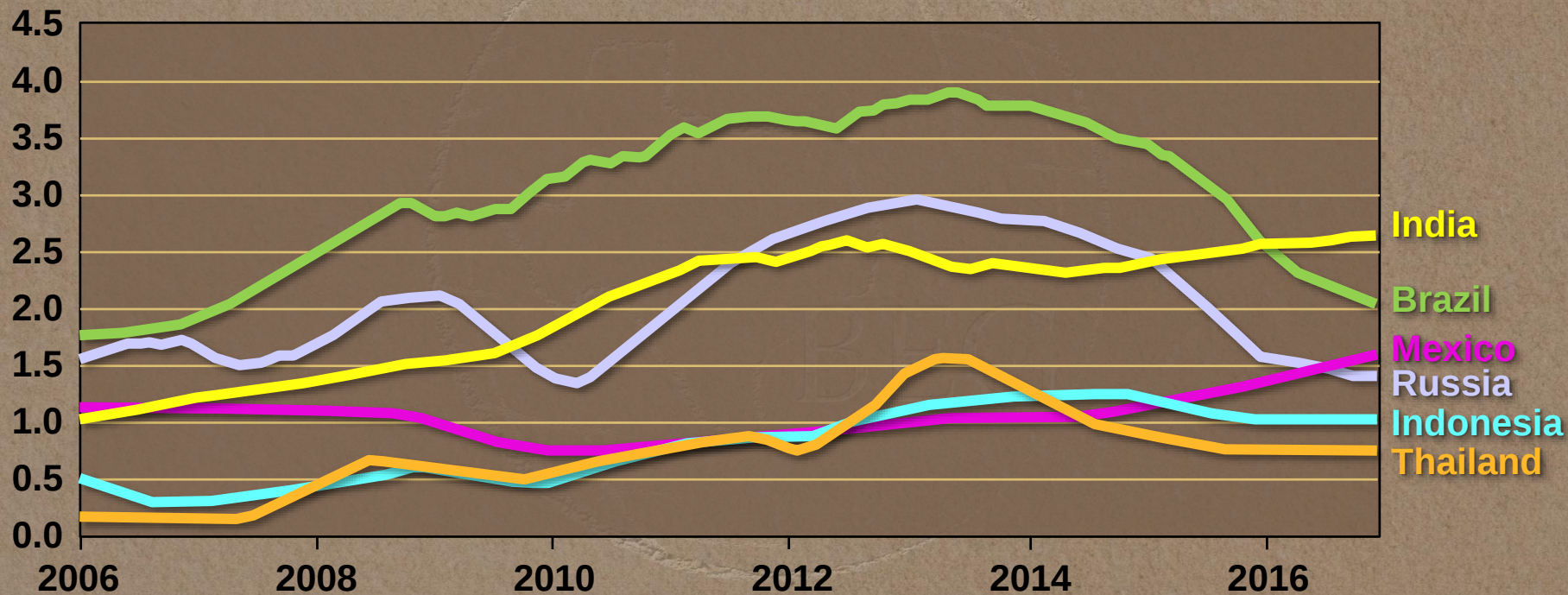
12.01 to 15.00

15.01 and Higher

National Average = 10.54

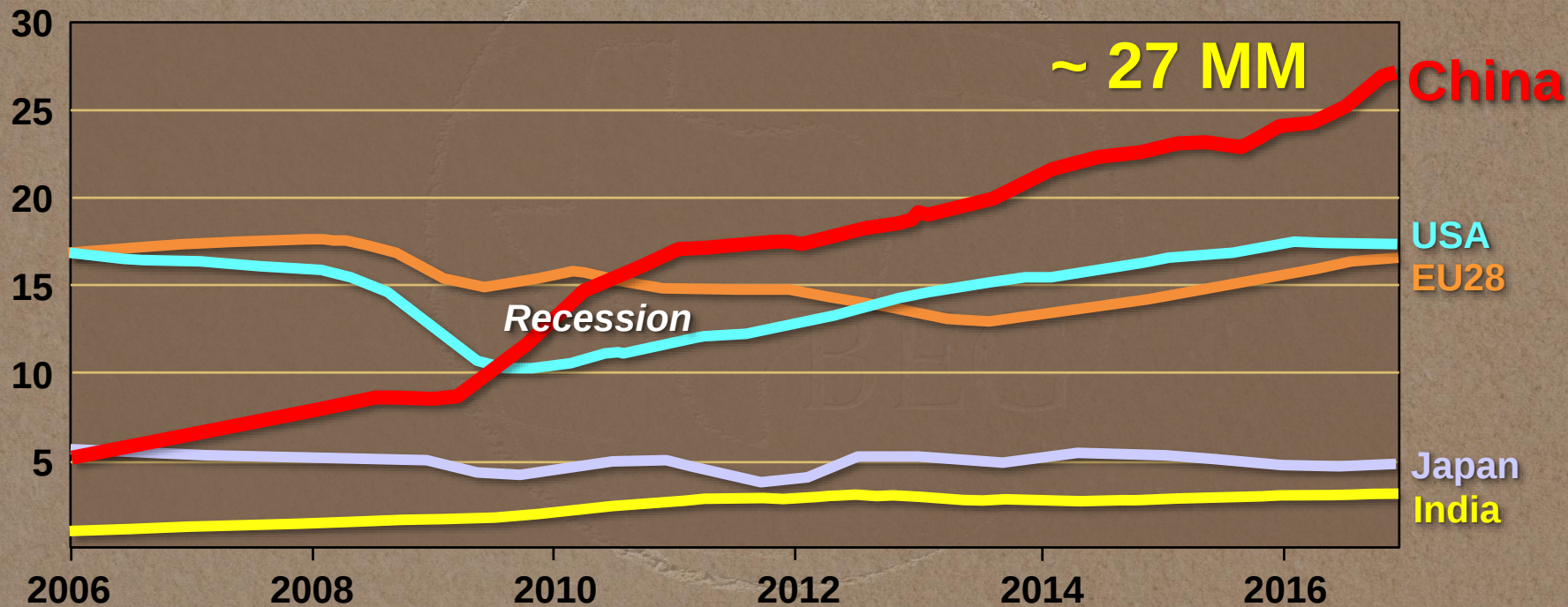
Auto Sales Developing Nations

Rolling 12-month (million)



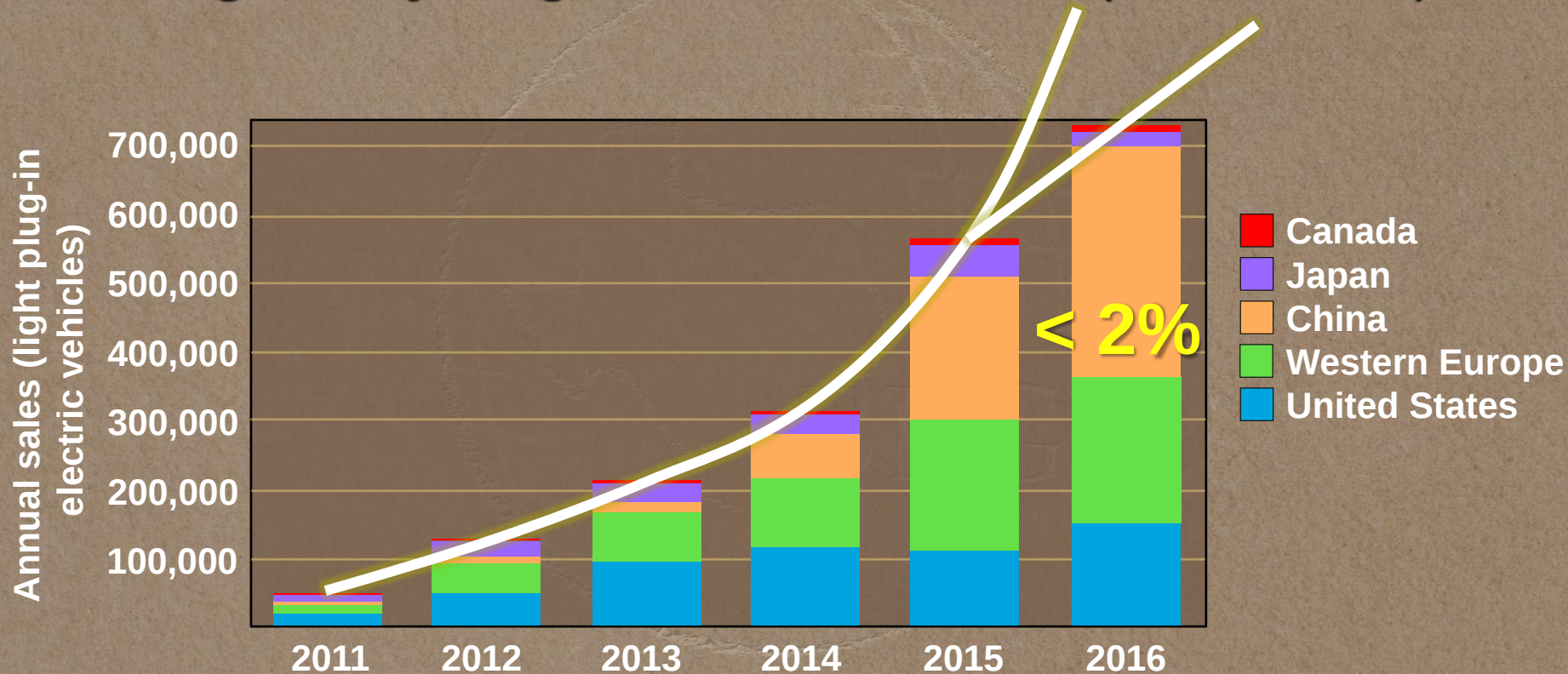
Auto Sales Developed Nations

Rolling 12-month (million)

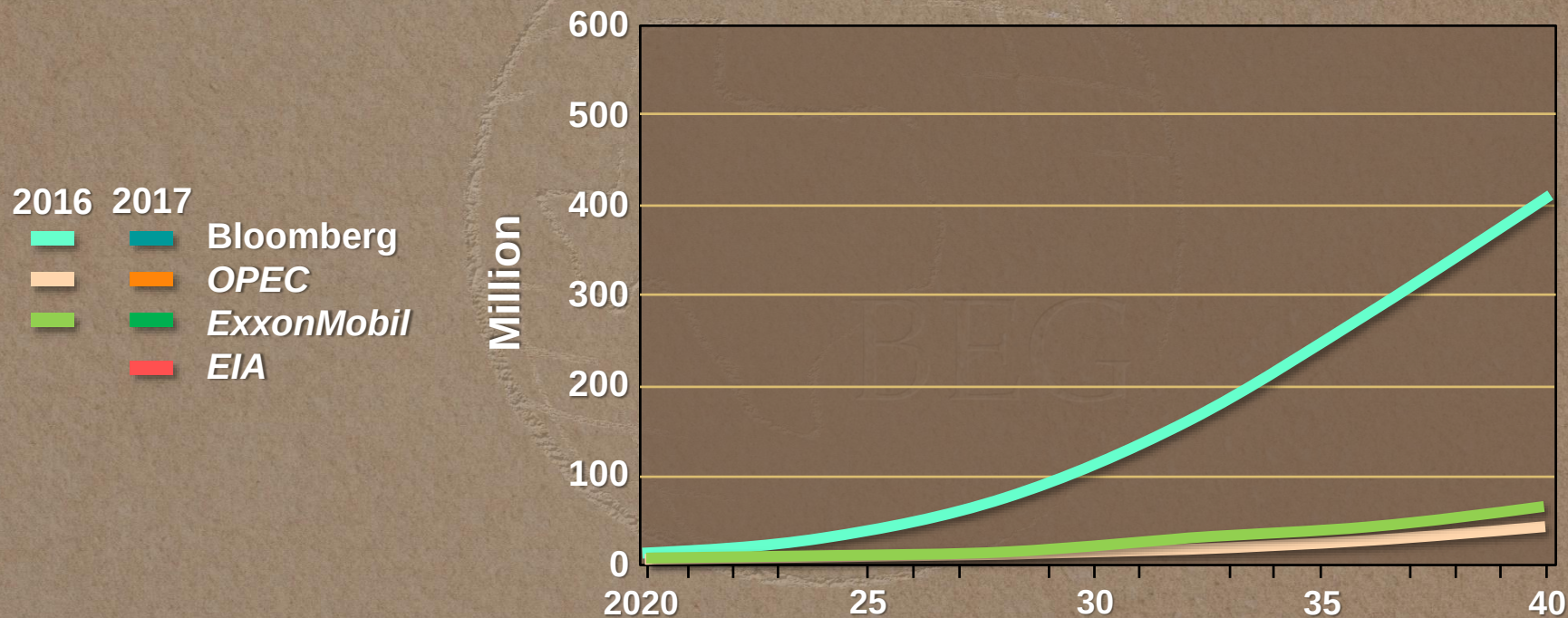


Global Annual Sales

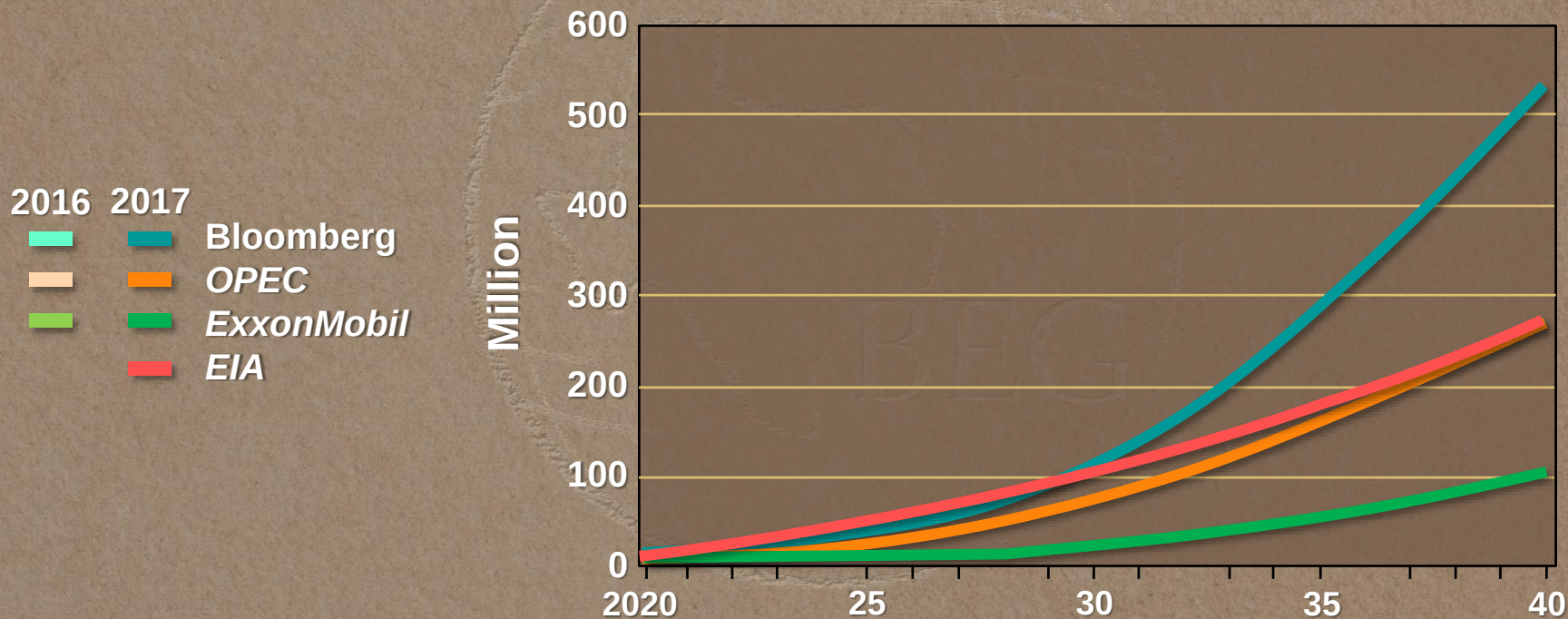
Light-Duty Plug-In Electric Vehicles (2011 – 2016)



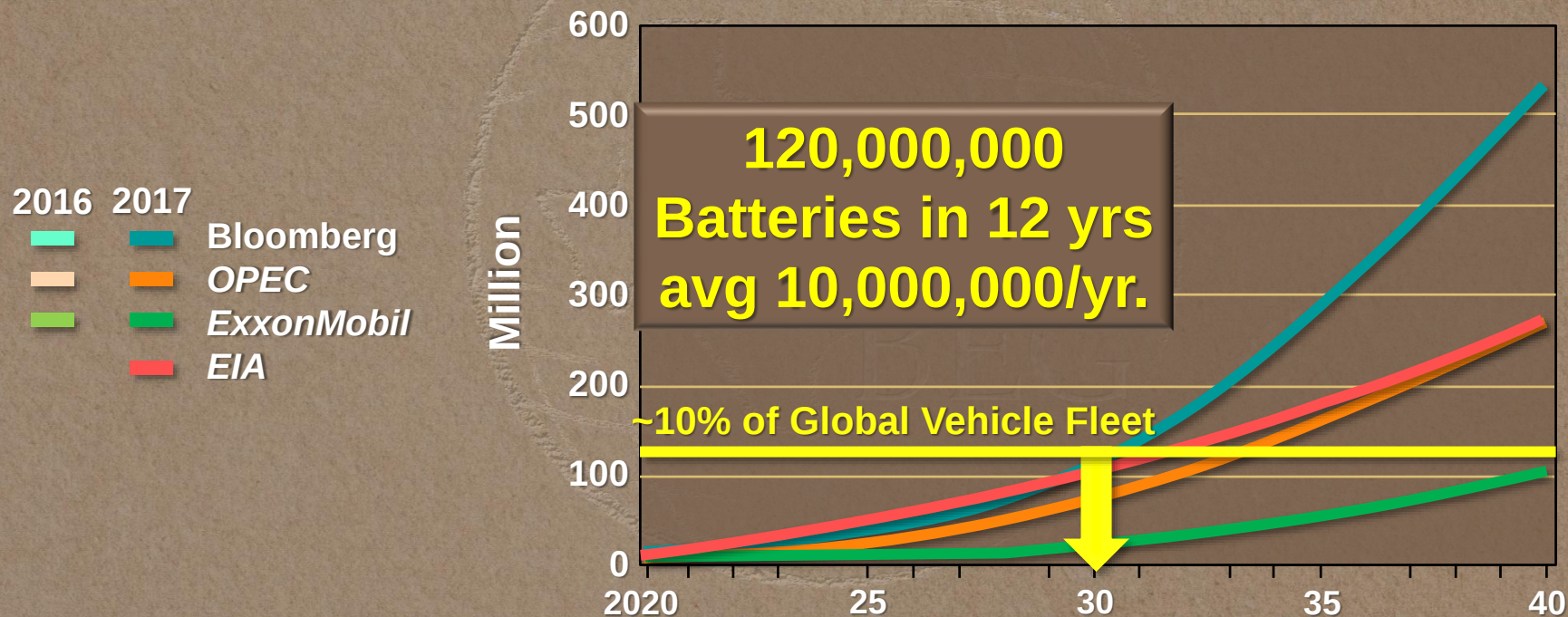
Cumulative Electric-Vehicle Forecasts



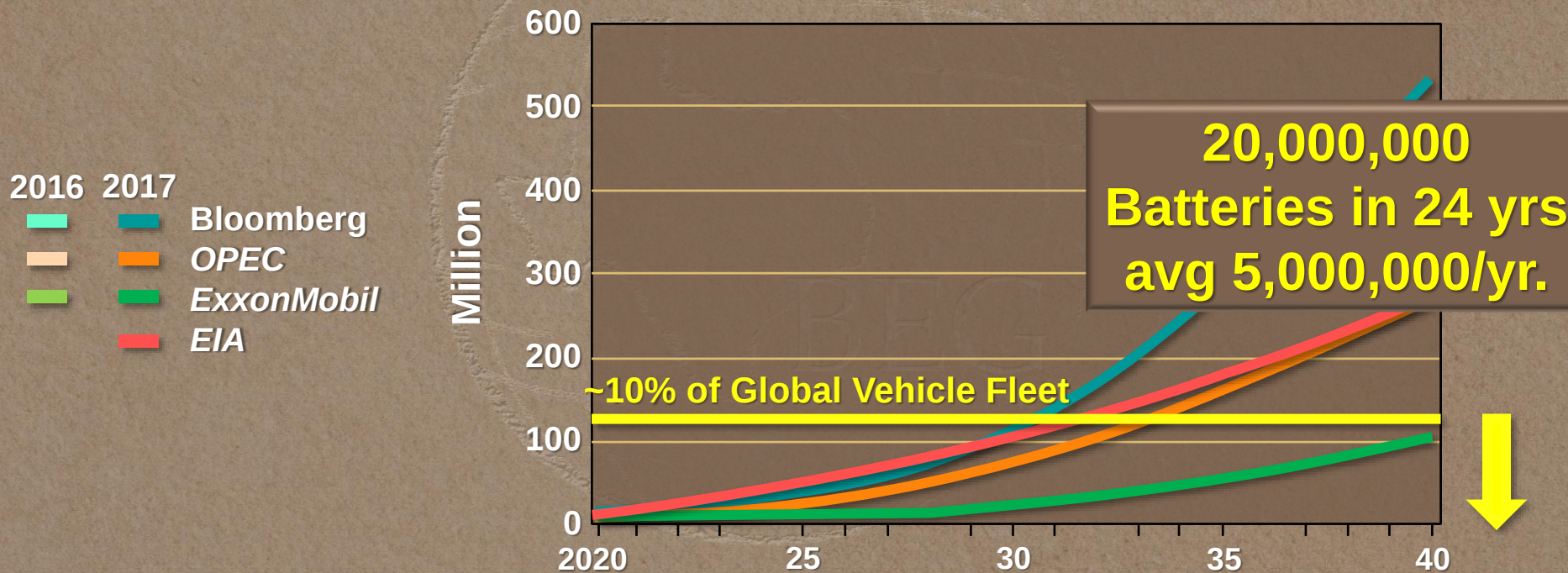
Cumulative Electric-Vehicle Forecasts



Cumulative Electric-Vehicle Forecasts



Cumulative Electric-Vehicle Forecasts



CO₂ Reduction Strategies

- Efficiency
- Coal Substitution
- Carbon Capture and Sequestration
- Atmospheric Removal of Carbon

...Adaptation

Carbon

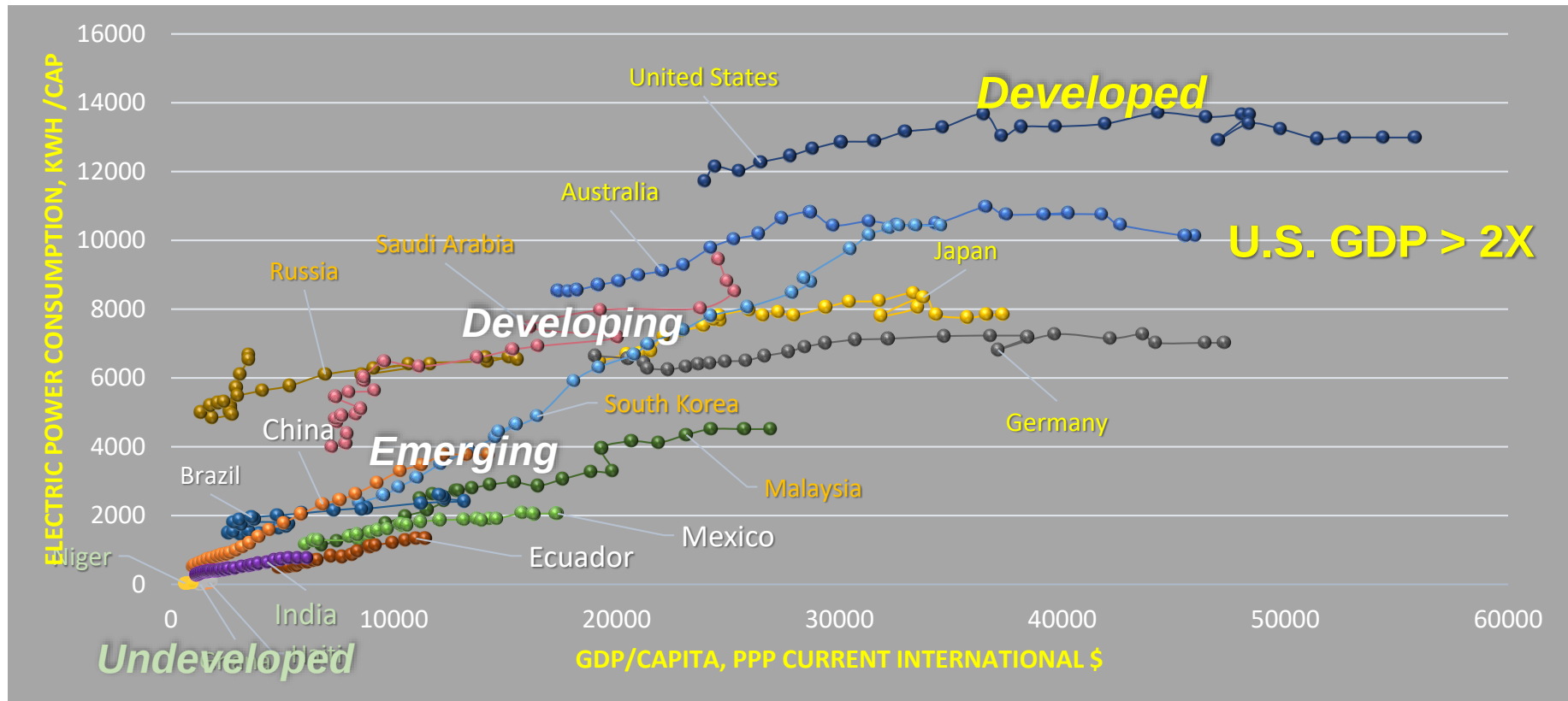
Key Points

- Renewables will grow, but are not enough to reduce CO₂ emissions at scale
- Natural gas and nuclear can reduce CO₂ emissions at scale
 - ✓ Limit methane emissions
- Electric Vehicle growth will not mitigate the demand for liquid petroleum fuels

Outline

- ❖ Energy
- ❖ Carbon
- ❖ Poverty
- ❖ Radical Middle

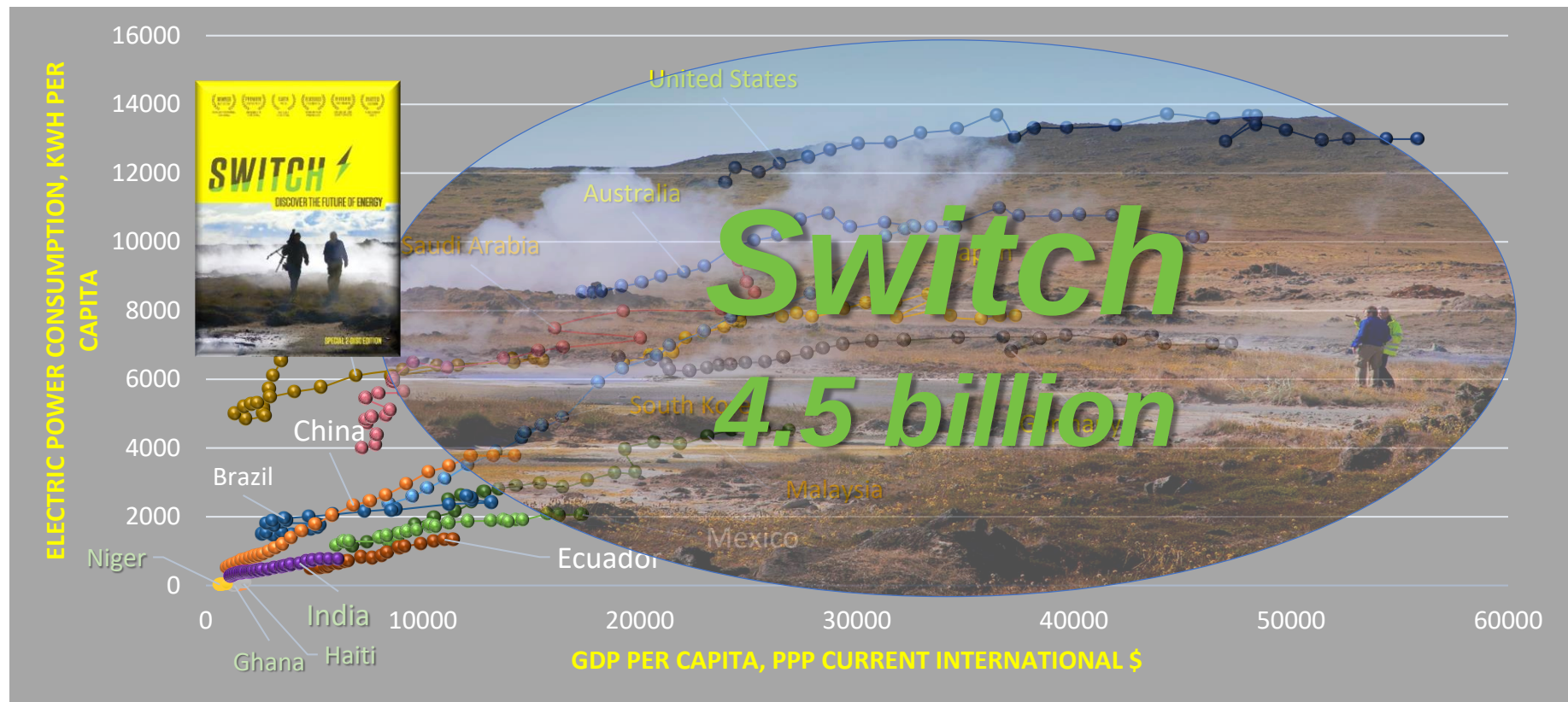
Limited Access to Electricity Restricts Standard of Living



Source: World Bank Databank

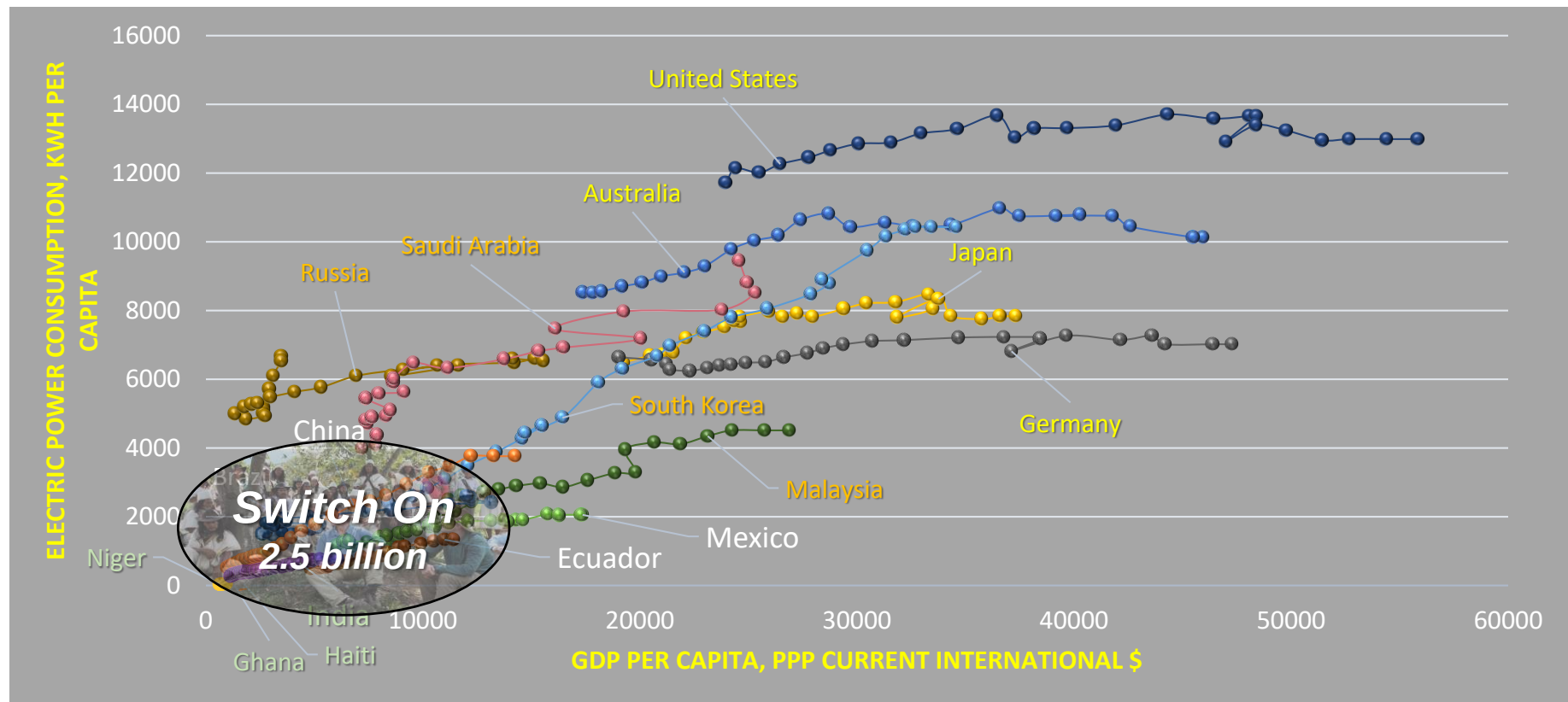


Limited Access to Electricity Propagates Inequality



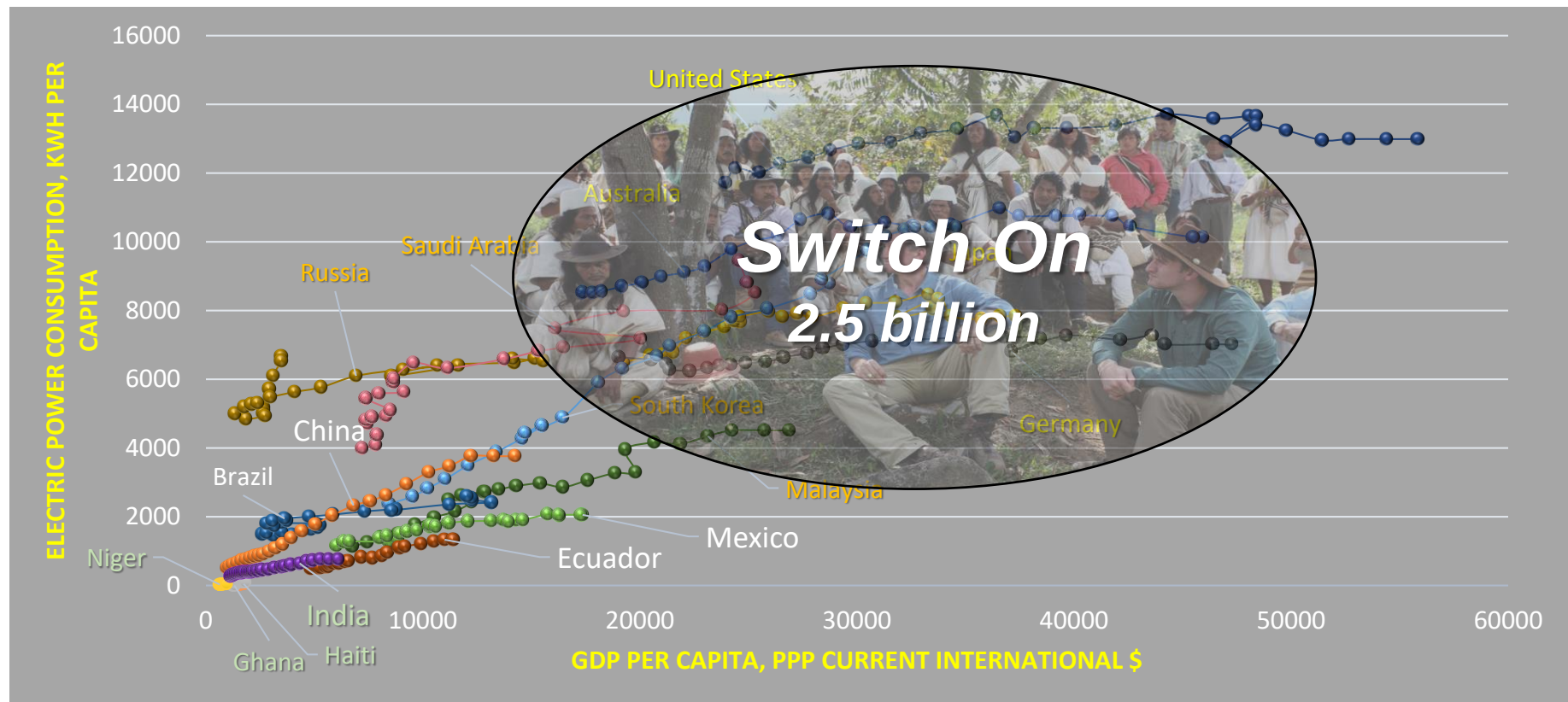
Source: World Bank Databank

Limited Access to Electricity Propagates Inequality



Source: World Bank Databank

Limited Access to Electricity Propagates Inequality



Source: World Bank Databank

It's Time to Educate & Power the People





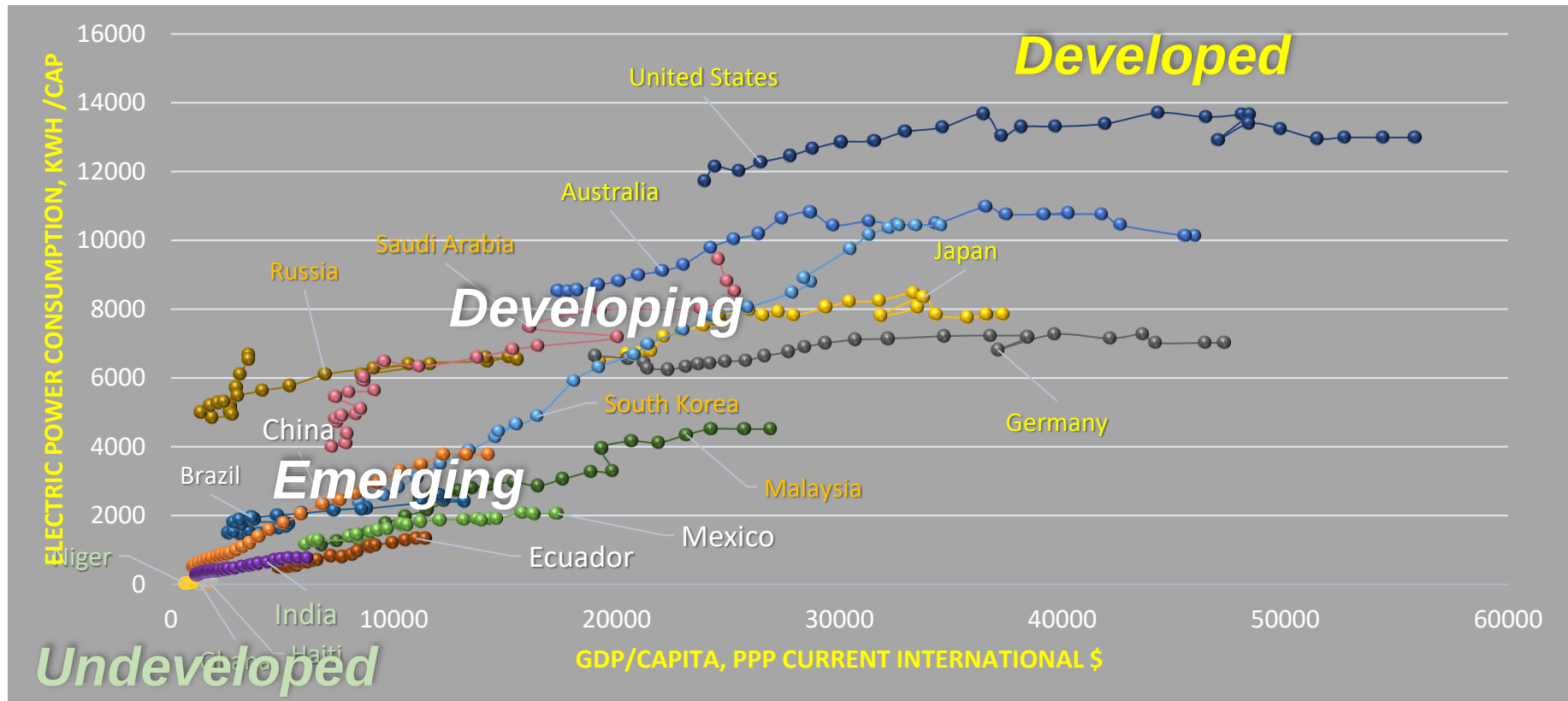


SWITCH ENERGY ALLIANCE

<http://switchon.org>

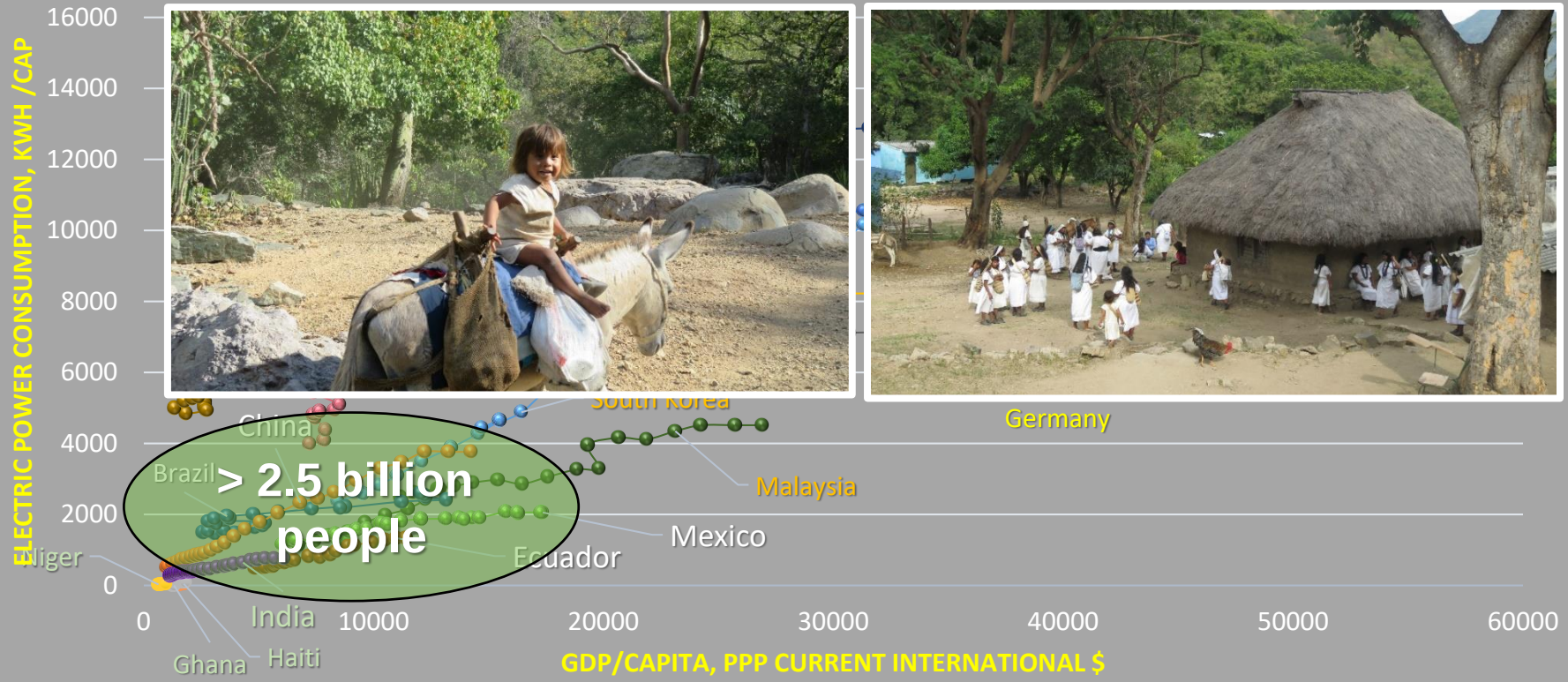


Limited Access to Electricity Restricts Standard of Living



Source: World Bank Databank

Limited Access to Electricity Restricts Standard of Living



Source: World Bank Databank

Electricity and Poverty

Poverty and electricity access in selected developing countries, circles sized by total population

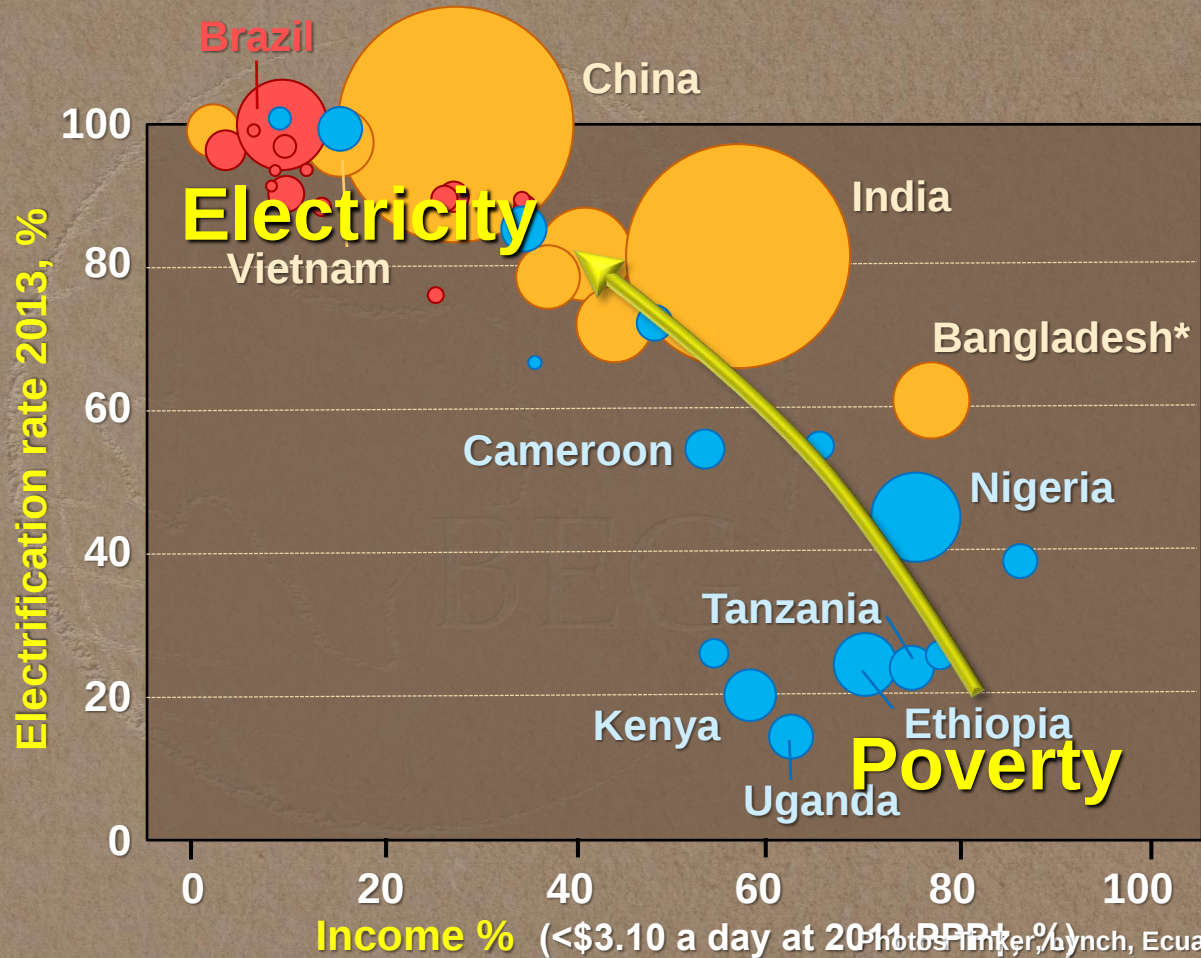
● Africa

● Asia

● Latin America

* Bangladesh uses 2005 PPP and \$2 a day poverty line

† Purchasing power parity



Electricity and Poverty

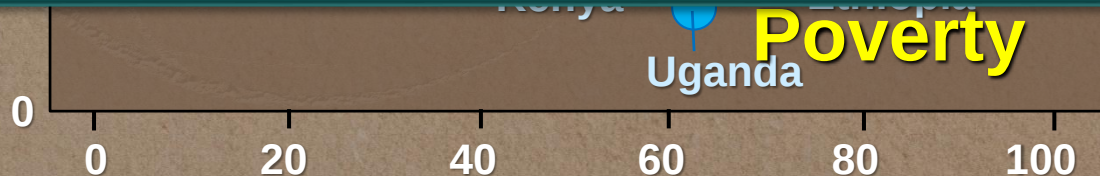
Poverty and electricity access in selected developing countries,



Energy does not end poverty.

Poverty cannot be ended without energy.

a day poverty line
† Purchasing power parity



Income % (<\$3.10 a day at 2011 PPP†, %)

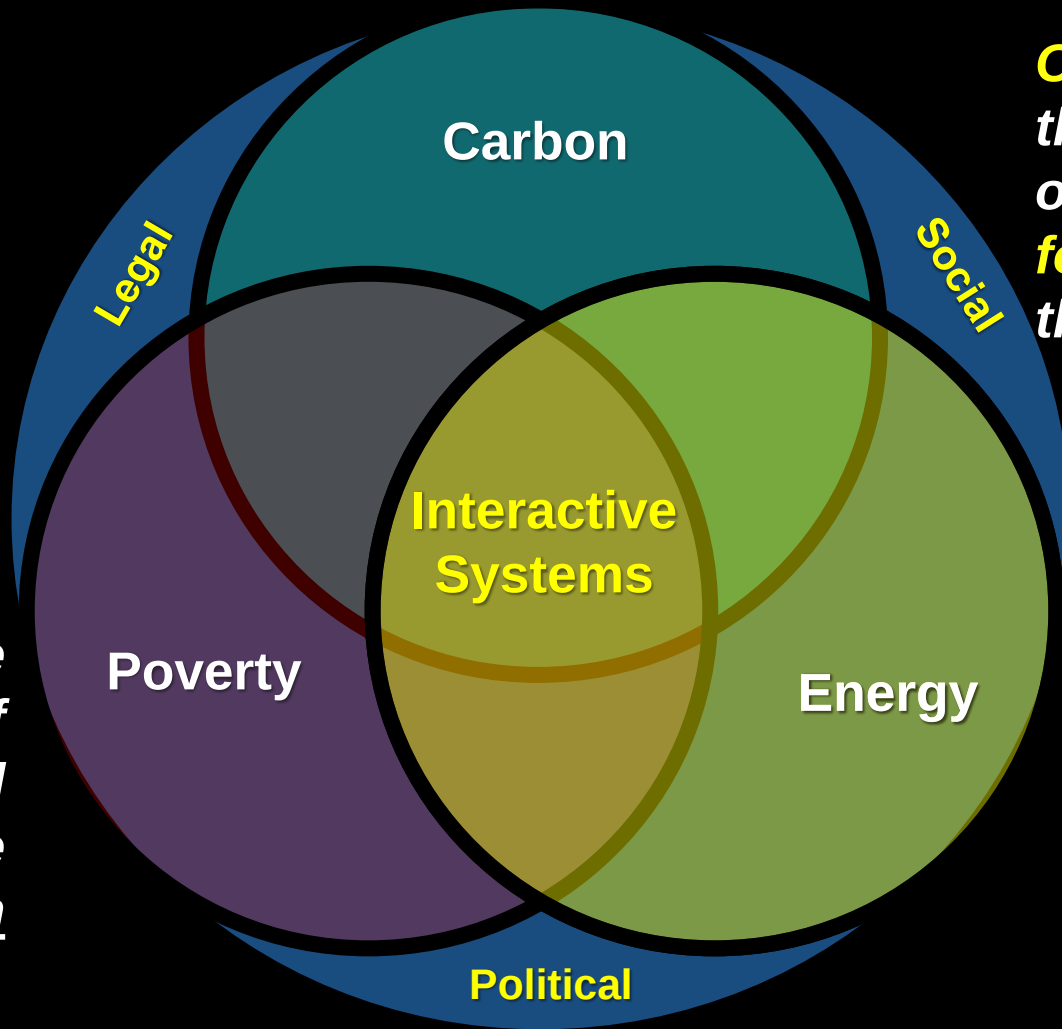
Poverty

Key Points

- Energy underpins modern economies and helps lift the world from poverty
- Energy resources vary by region and nations will use the energy resources that they have to reduce energy poverty

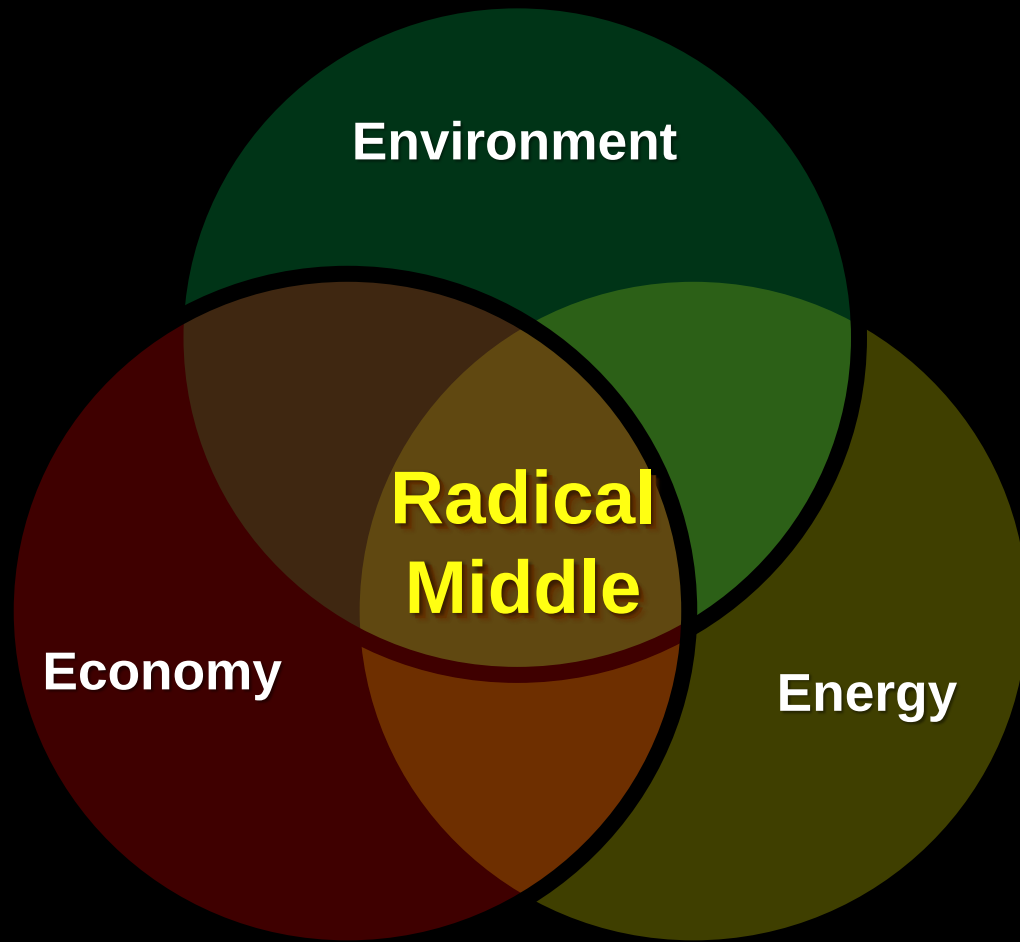
Outline

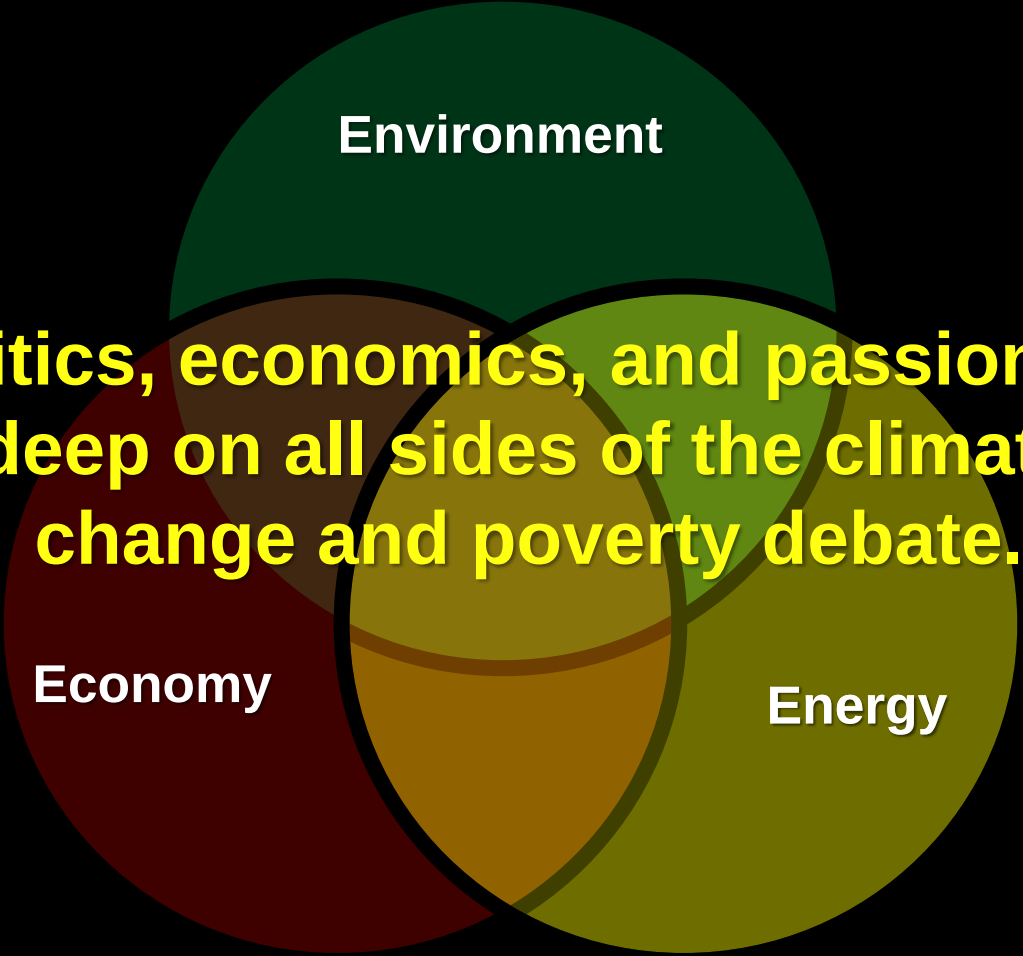
- ❖ Energy
- ❖ Carbon
- ❖ Poverty
- ❖ **Radical Middle**



Climate Change is the major issue of our time, and **fossil fuels** are the problem

Poverty is the major issue of our time, and **fossil fuels** are the solution



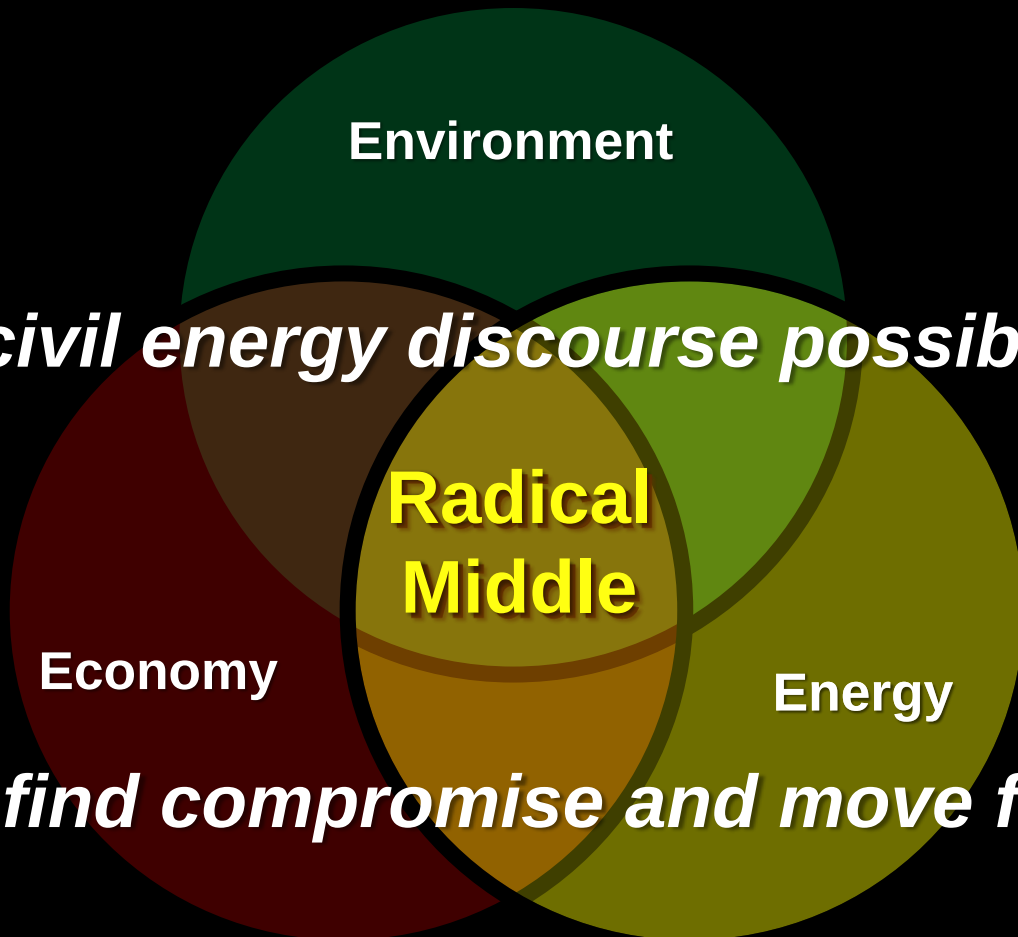


Environment

Politics, economics, and passion run deep on all sides of the climate change and poverty debate.

Economy

Energy



Is civil energy discourse possible?

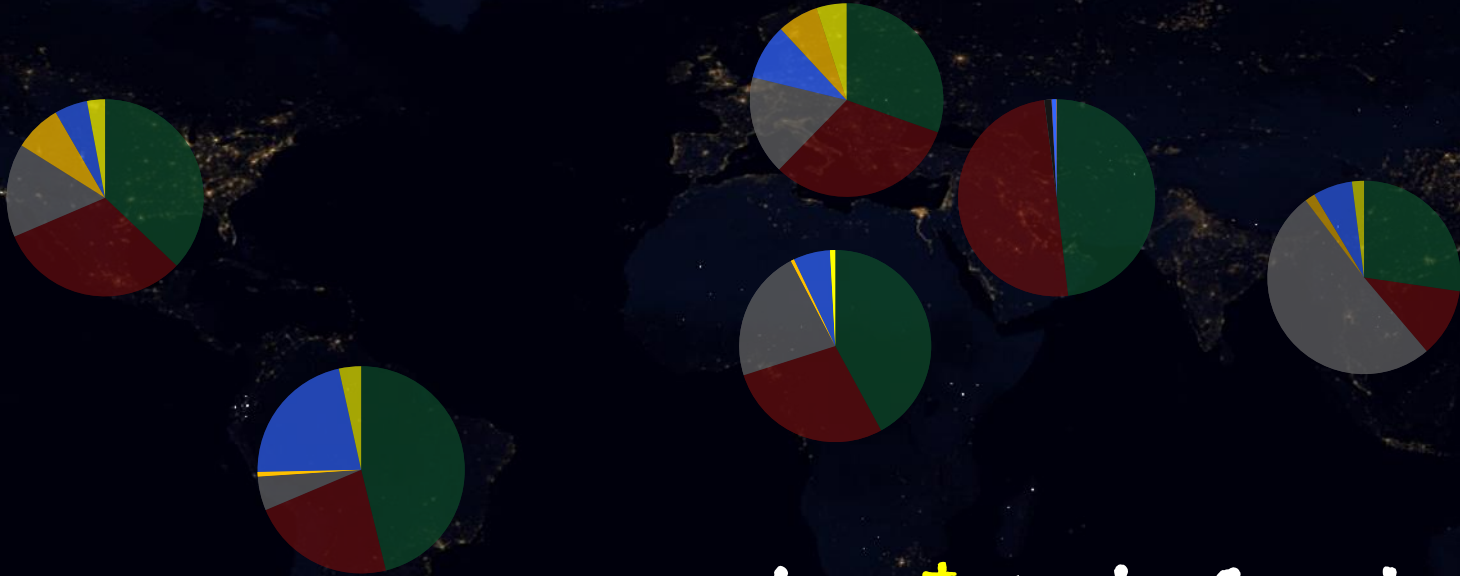
Can we find compromise and move forward?

Towards a Radical Middle

- Understand that no form of energy is perfect
- Focus energy policy on energy security
- Make energy efficiency and energy storage tactical
- Assess the environmental impact of *all* energy
- Recognize energy poverty as a critical challenge

Engage in Energy Education!

There are those who want to.....



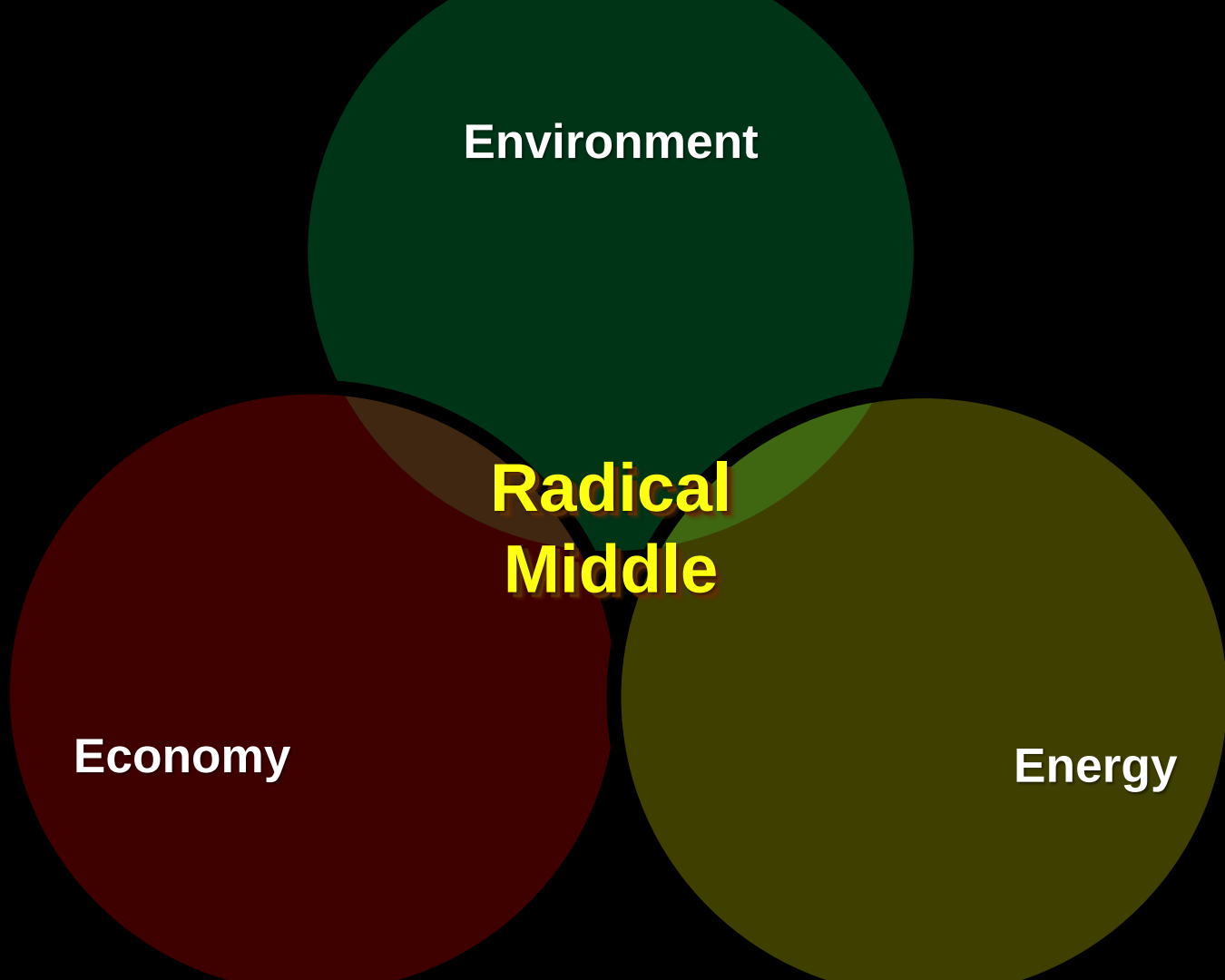
...keep **It** in the Ground.

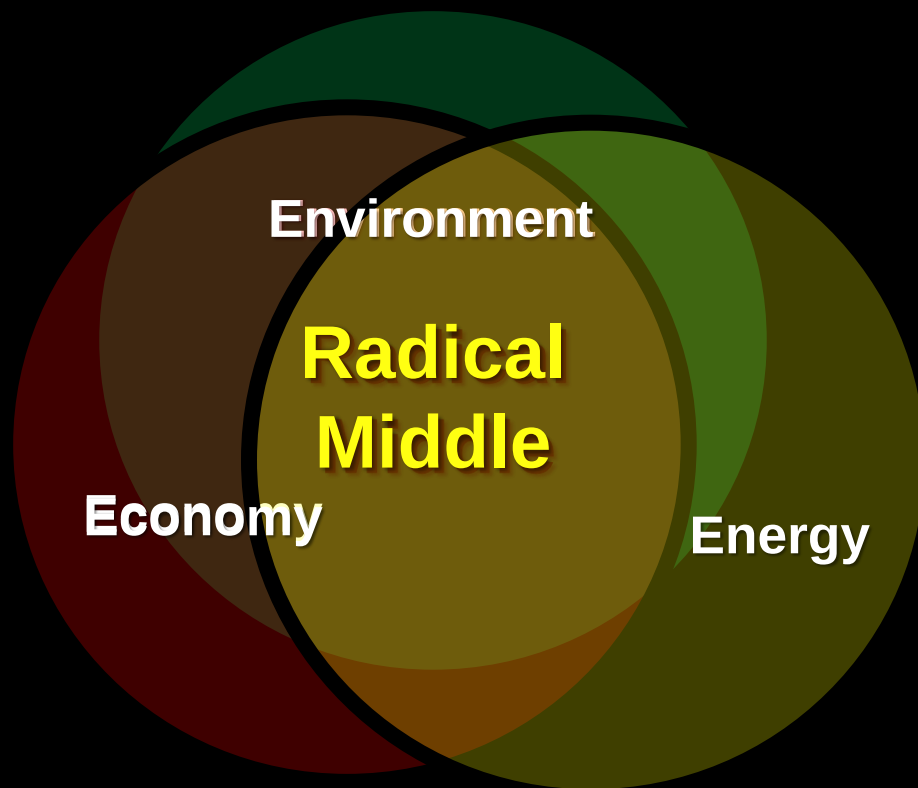


But it will keep *Them* in Poverty.

A world map at night, showing the continents and oceans. The landmasses are dark, and the cities are represented by glowing yellow and orange lights. The map is centered on the Atlantic Ocean, with North and South America on the left and Europe and Africa on the right. The text "Lift Them from Poverty!" is overlaid on the left side of the map.

Lift *Them*
from Poverty!







SWITCH
ENERGY ALLIANCE



Gracias!

Join the Switch Energy Alliance

SwitchOn.org

Inspire an Energy Educated Future

