Global Energy Landscape: Time for Renewables?

Ricardo Raineri

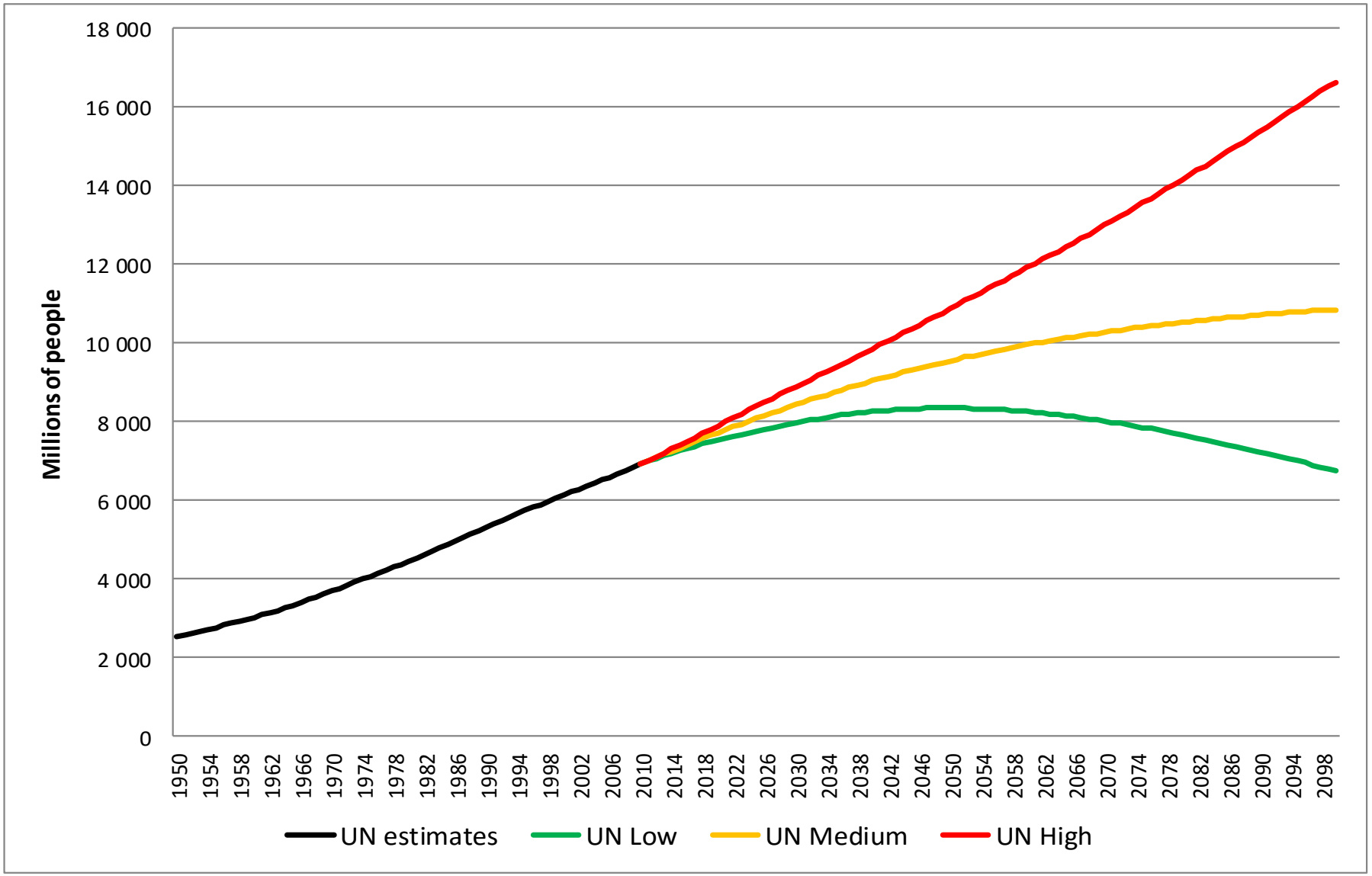
rraineri@ricardoraineri.com

Pontificia Universidad Católica de Chile

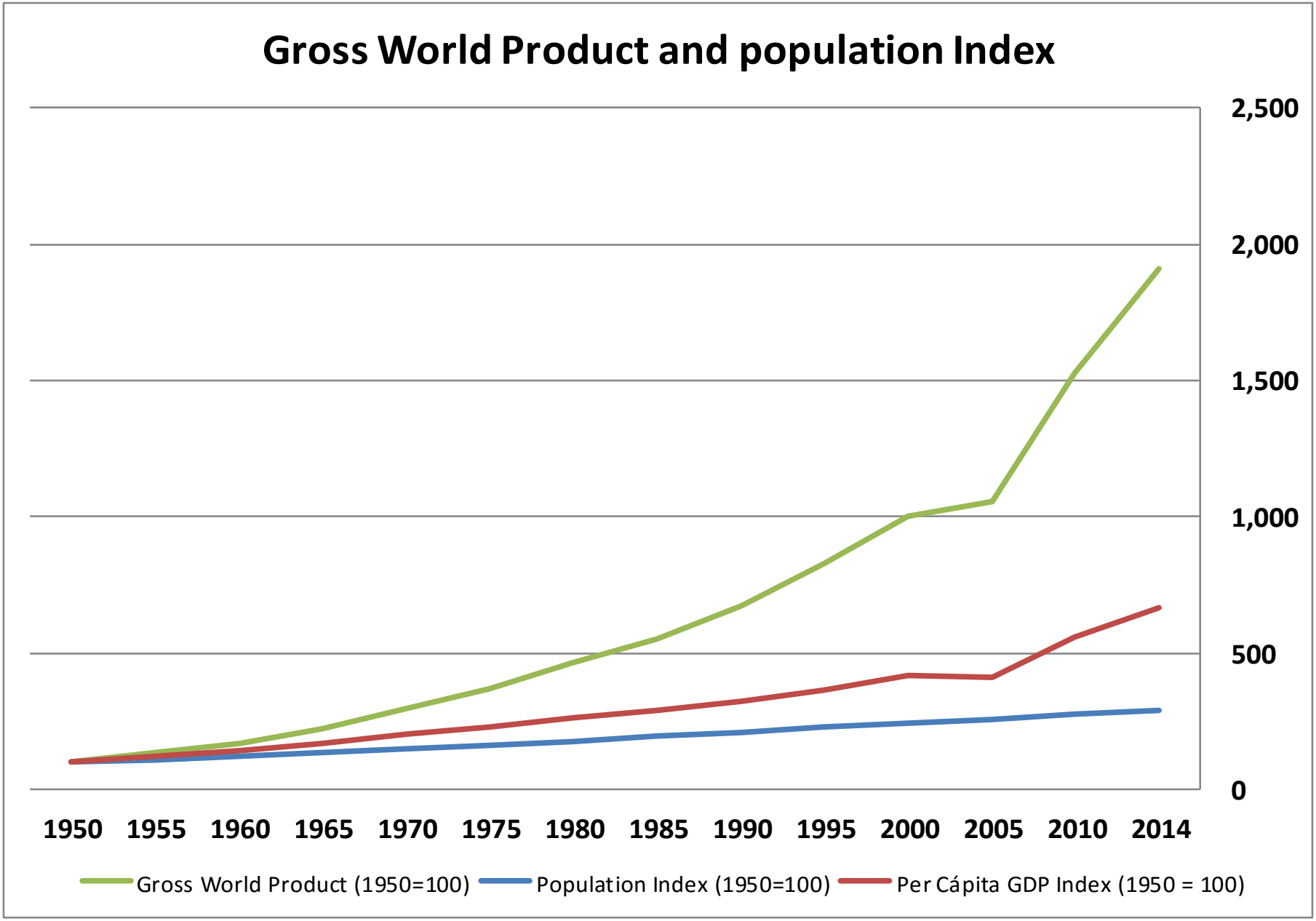
April 8, 2016

Economic and Energy Trends

Population and the Economy

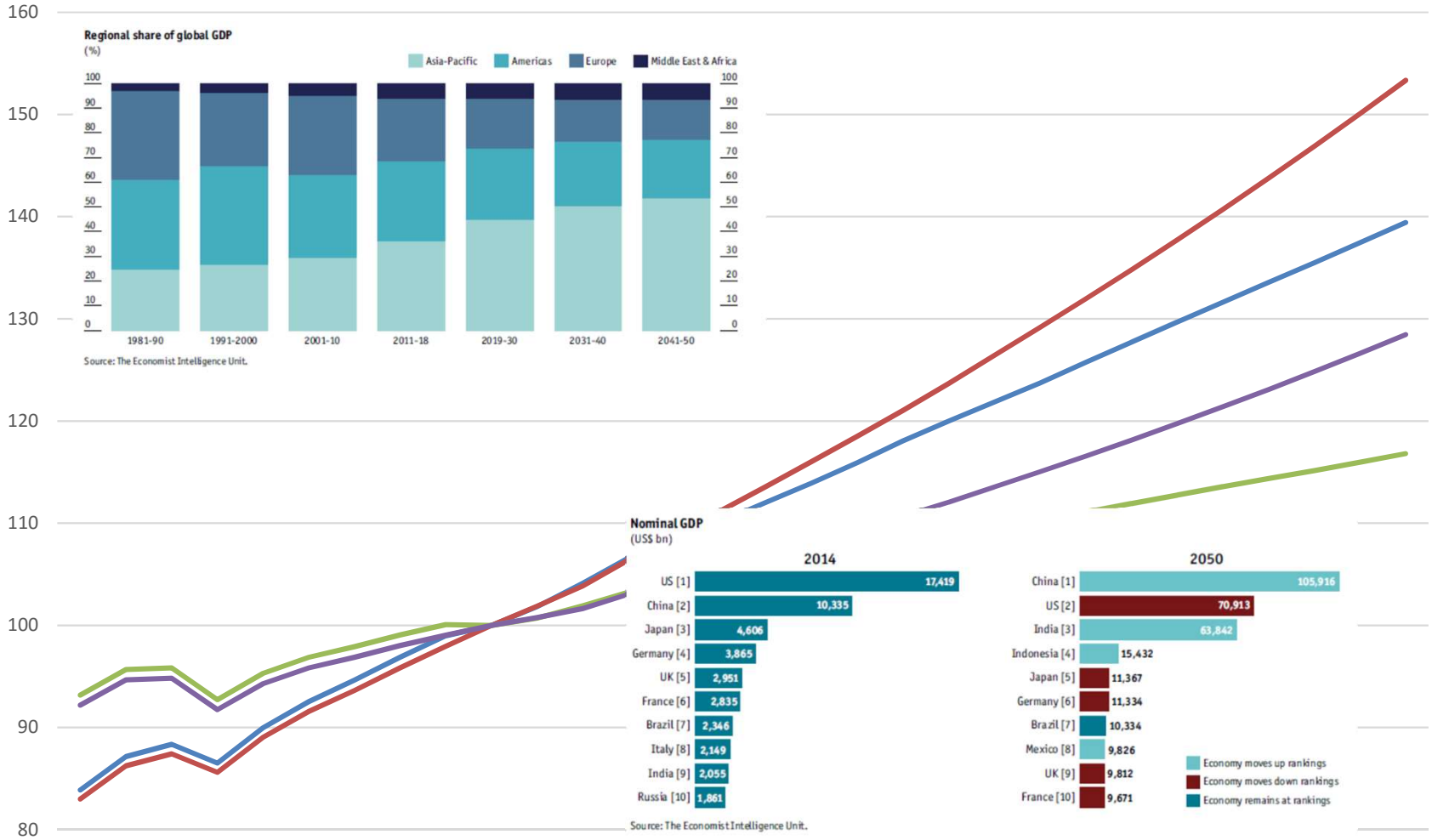


Population and the Economy

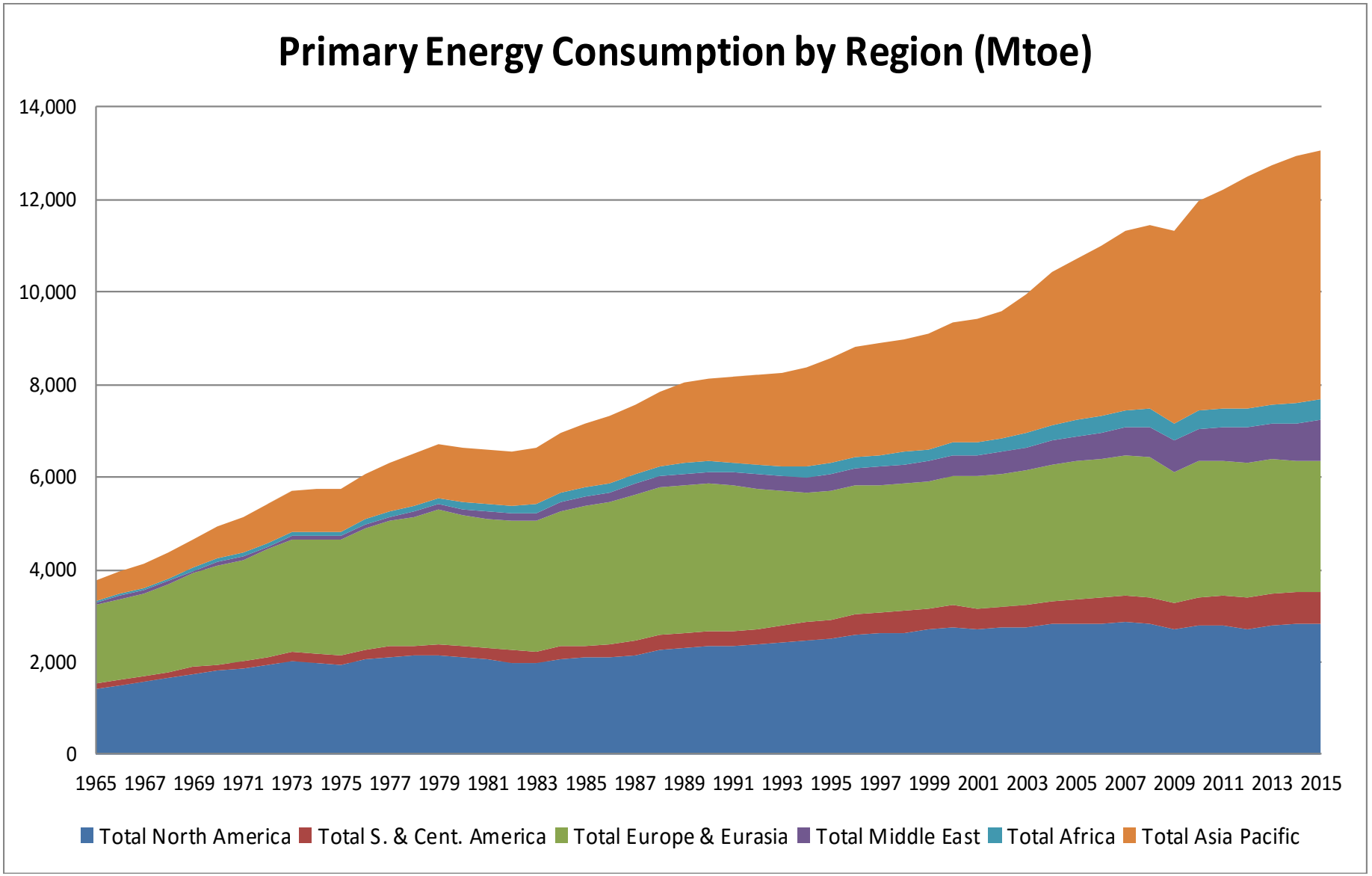


Population and the Economy

World GDP and Per Capita Index 20015 =100, 2006-2035



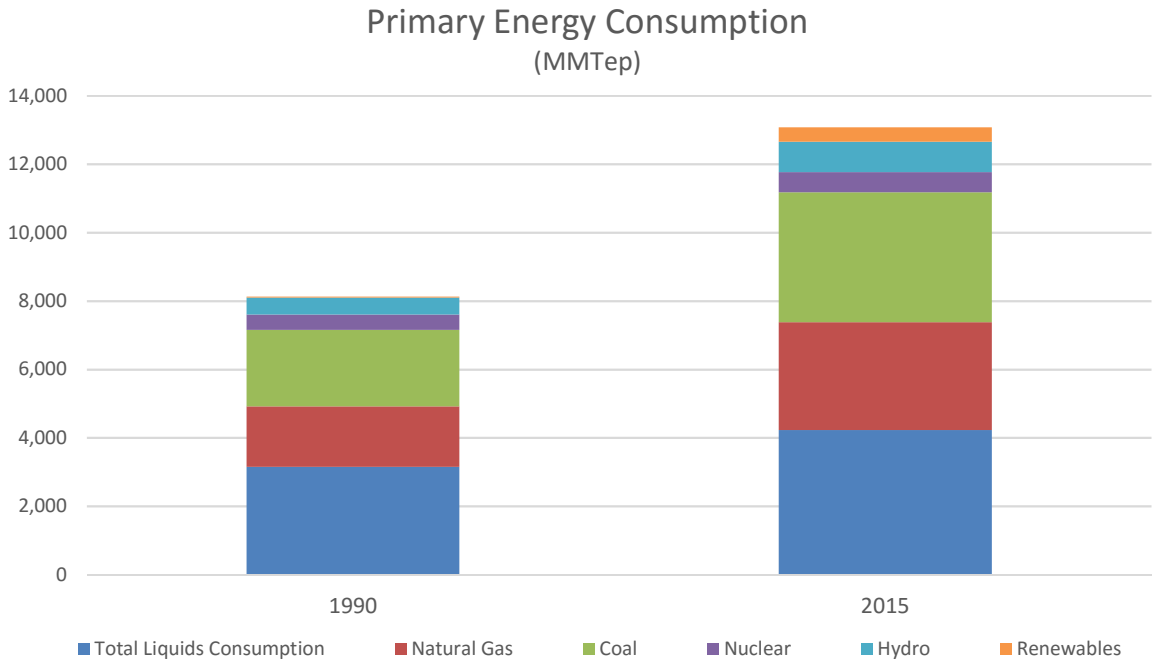
Primary Energy

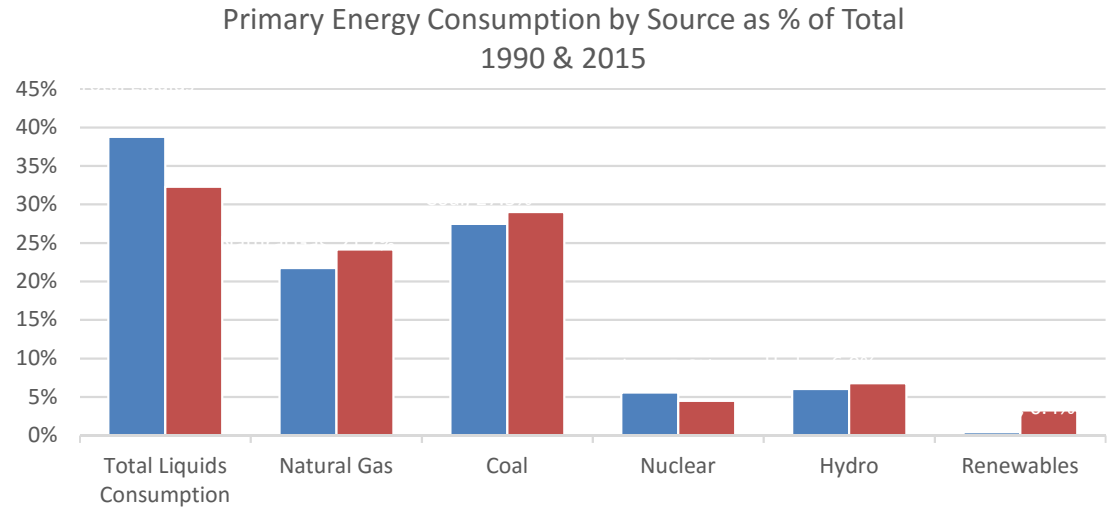


Ricardo Raineri

With BP data

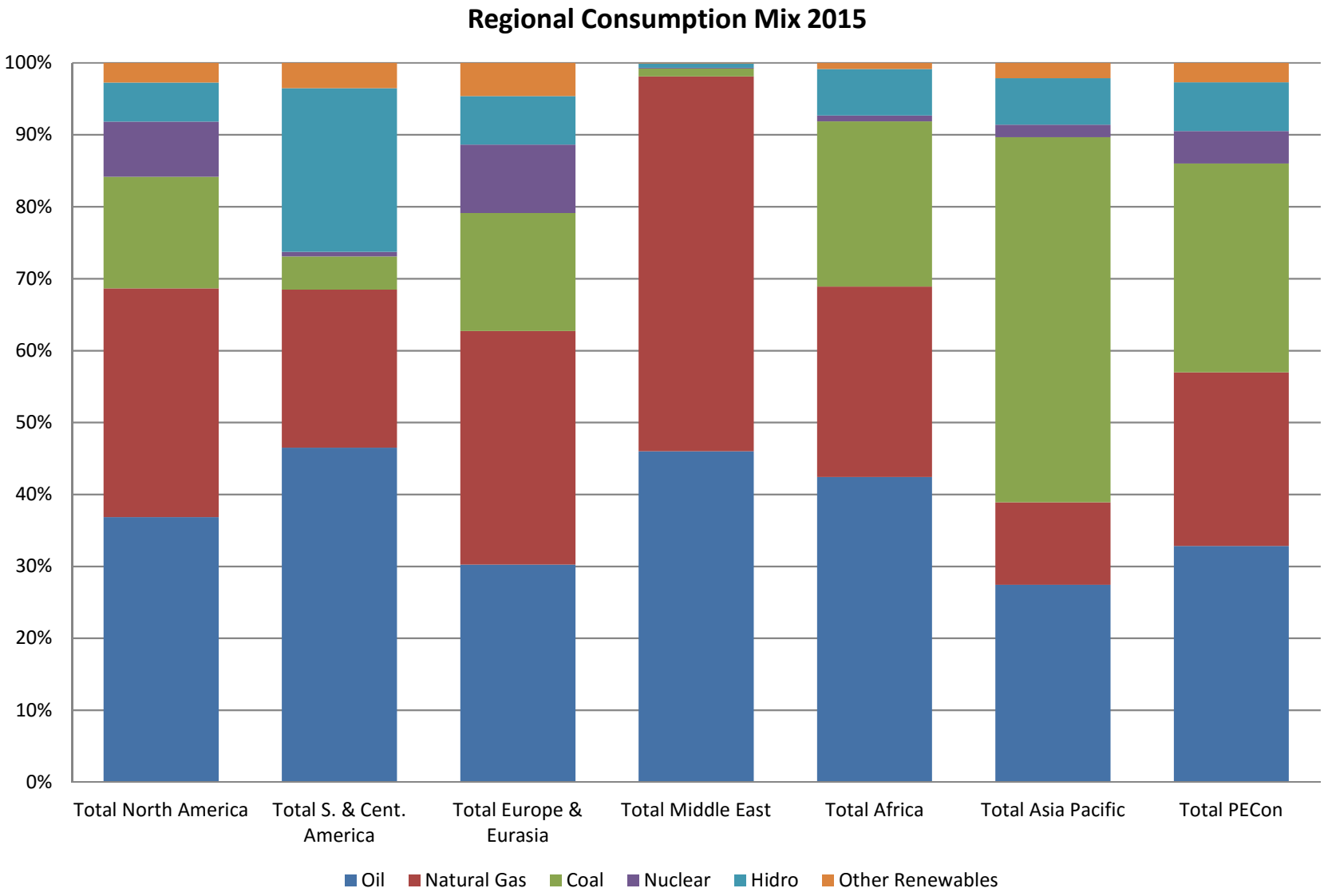
Primary Energy



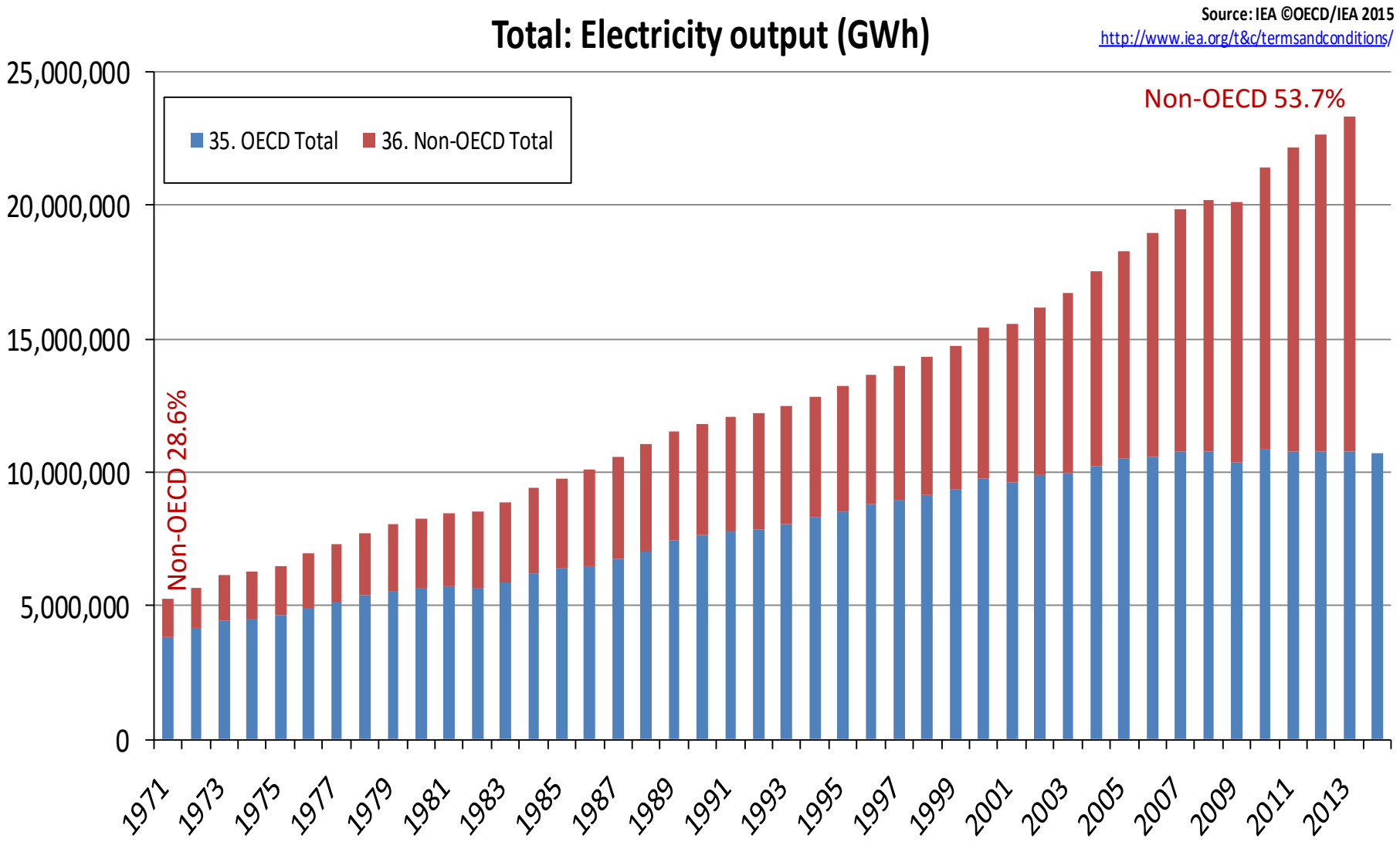


With BP data

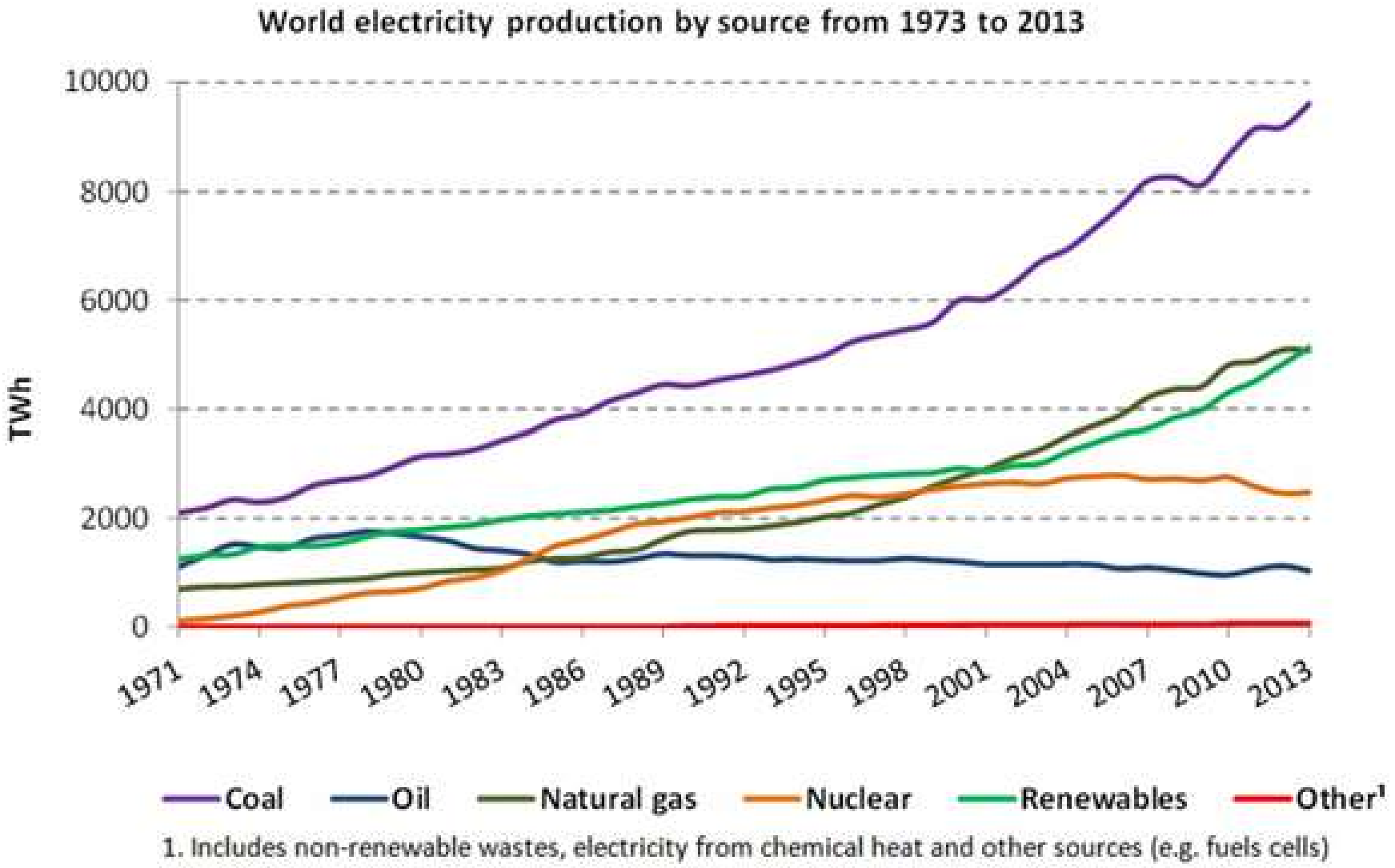
Primary Energy



Total Electricity Output: OECD and Non-ECD

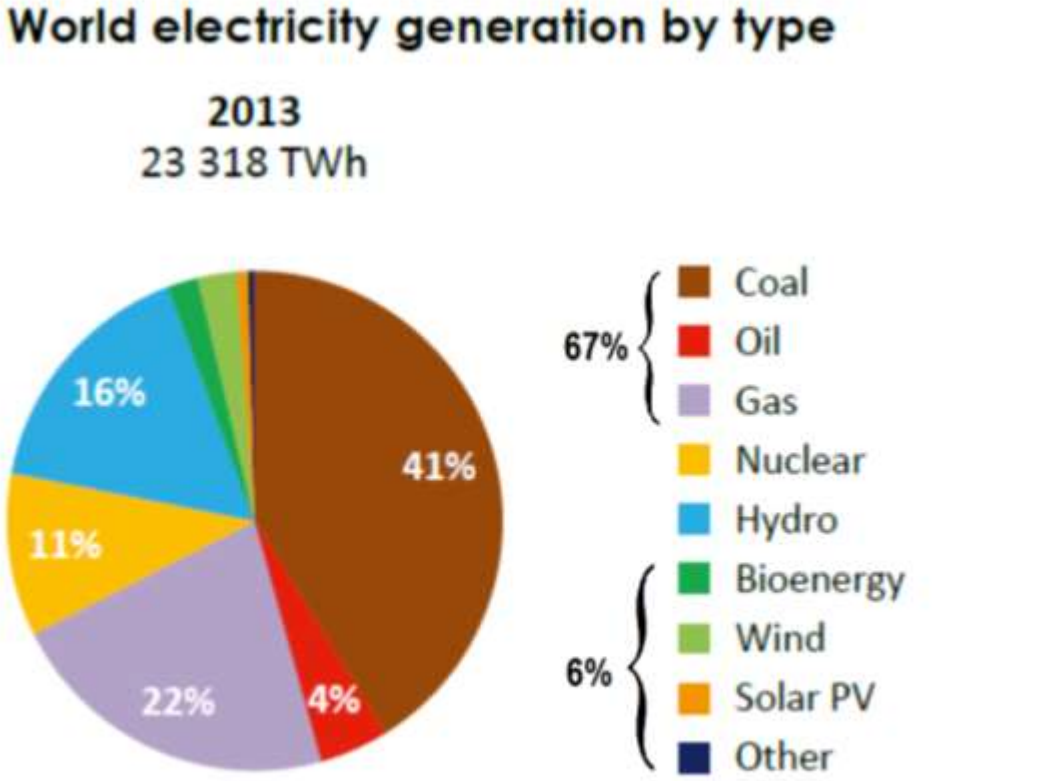


Electricity Generation by Source



IEA

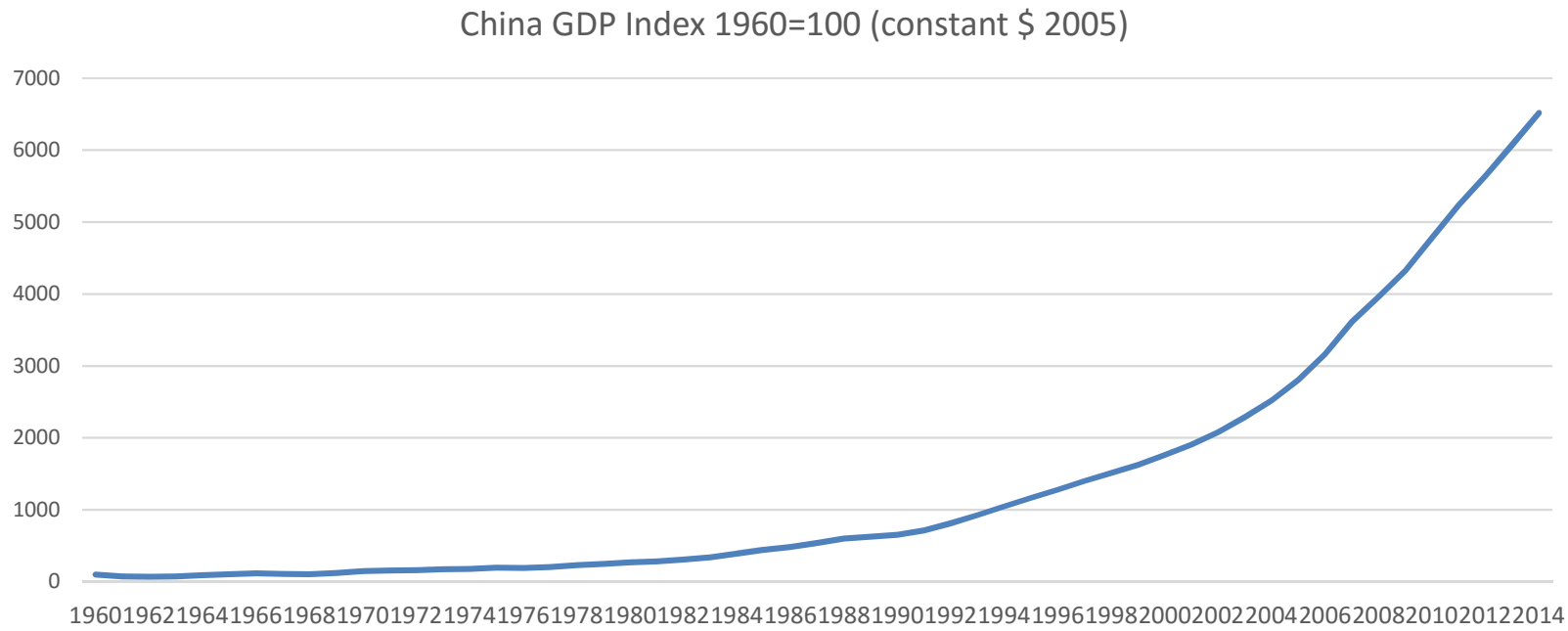
World Electricity Generation by Type



Note: Other includes geothermal, concentrating solar power and marine.

Source: IEA

The Role of Energy in the Industrial Revolution and Modern Economic Growth



With 200 years data, for the Swedish economy show that the expansion of energy services was the most important factor explaining growth until the second half of the 20th century when labor-augmenting technical change becomes paramount. Additionally, the model can explain, the historical decline in the energy cost share seen in the Swedish data, which appears to be a typical feature of economic development.

The Role of Energy in the Industrial Revolution and Modern Economic Growth
David I. Stern and Astrid Kander
The Energy Journal, Vol 33, No. 3 pg. 125-152, 2012

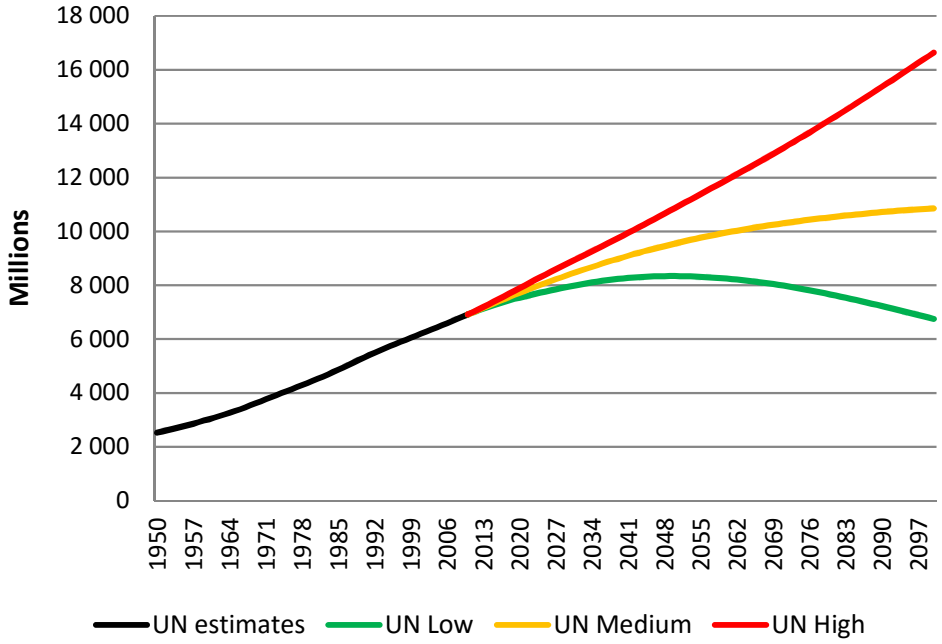
Ricardo Raineri

Population and the Economy

- **Reduction in poverty levels globally**: Across the planet, the number of people living in extreme poverty has dropped by more than half since 1990, when 1,908 million people lived on under $1.25 a day, or 43,1% of world population, compared to 836 million in 2015, or 11,4% of global population, according to the UN.

- 1.1 billion people – almost the population of India – don't have access to electricity, 2.9 billion have to rely on wood or other biomass to cook and heat their homes. About 80% of those without access to modern energy live in rural areas.

World Demographic Projections 1950-2100 (UN)



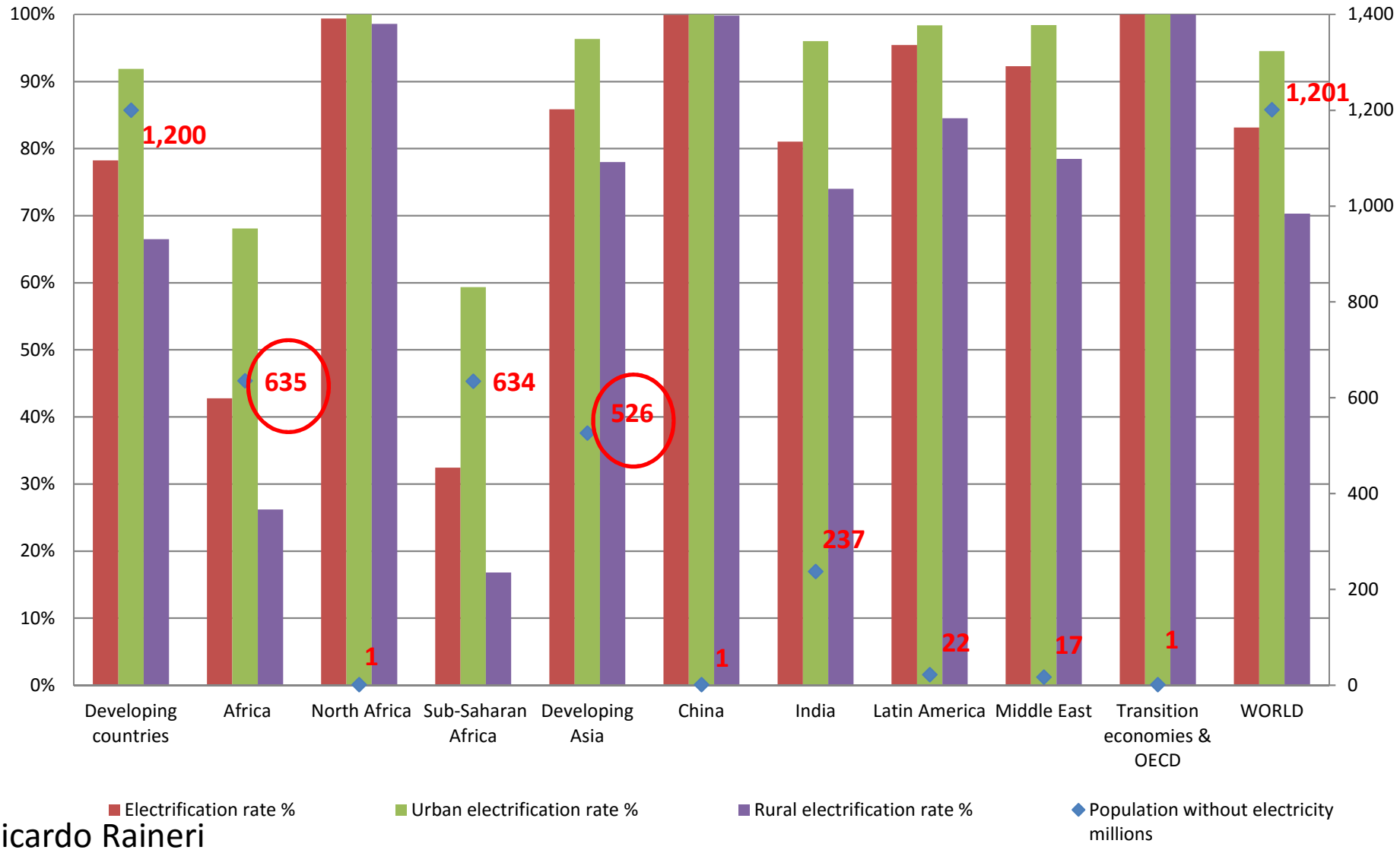
A huge appetite for energy: we are more and the modern economy is addicted to energy.

Ricardo Raineri

Energy Access by Regions

Electricity Access in 2013 - Regional Aggregates

SOURCE: IEA, World Energy Outlook 2015



Ricardo Raineri

SE4ALL

In September 2011, UN Secretary-General Ban Ki-moon shared his vision for making sustainable energy for all a reality by 2030, and launched SE4ALL initiative.

UN's Sustainable Energy for All initiative. Primary goals by 2030:

1. achieving universal energy access, including electricity and modern cooking fuels
2. doubling the annual rate of energy efficiency, from 1.3% to 2.6% per annum
3. doubling the share of renewable power in the global energy mix, from 18% to 36%

On 21 December 2012, United Nations General Assembly Declares 2014-2024 Decade of Sustainable Energy for All (IEA estimates US$ 50billion the annual investment to achieve SE4ALL in 2030)

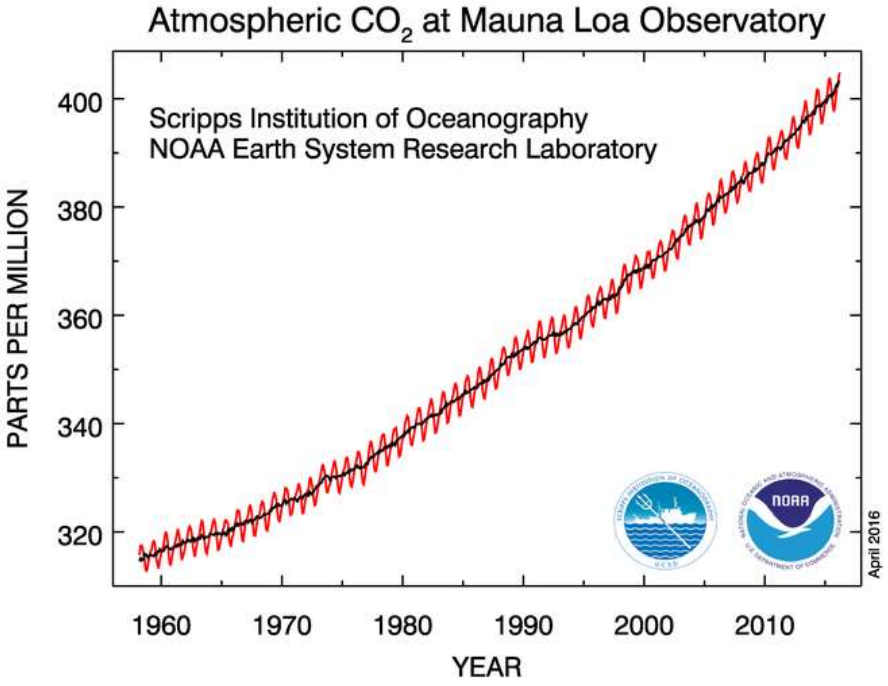
- **Flagship Programmes**
  - **Global Energy Efficiency Accelerator Platform**
  - **Country Actions**
  - **High Impact Opportunities**

2015 is the year when countries shaped a new development agenda and reach a new global agreement on climate change

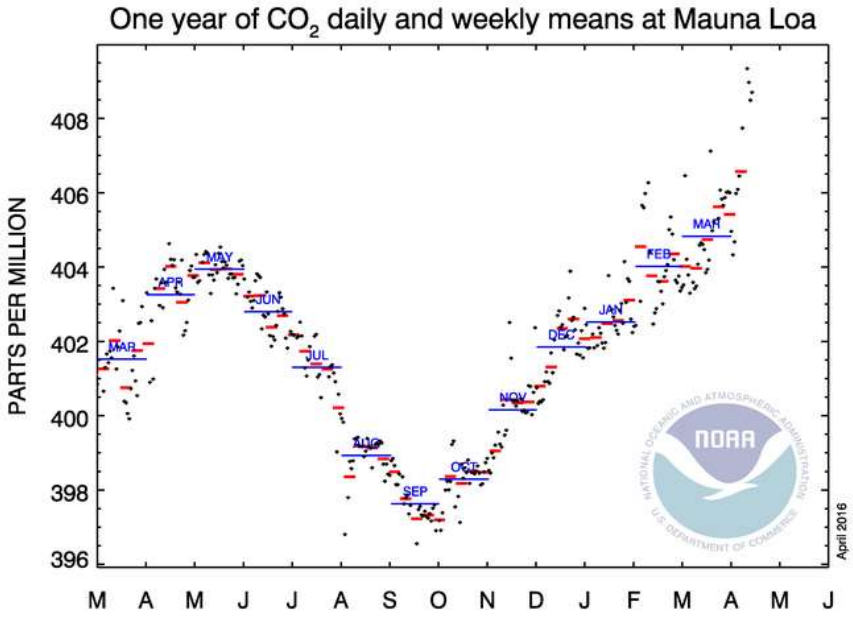
Ricardo Raineri

Among Side Effects

Kelling Curve



Stabilizing greenhouse gas concentrations at 450 ppm would only result in a 50% likelihood of limiting global warming to 2 °C



The Carbon Budget

With current emission rates (2014), the remaining 'quota' to surpass 2°C of global warming will be used up in around 30 years (one generation)

Preliminary weekly (red line), monthly (blue line) and daily (black points) averages at Mauna Loa for the last year.

COP 21

Recognizes the urgency of containing climate disruption that threatens our way of life, COP21 (Conference of Paris 2015).

A voluntary international agreement to come into force in 2020, whose objective is to carry changes needed to achieve the objective C ° + 2

The agreement must respect the principle of differentiation (not all countries are equally responsible for climate disruption) and common legal standards.

INDCs - Intended Nationally Determined Contributions

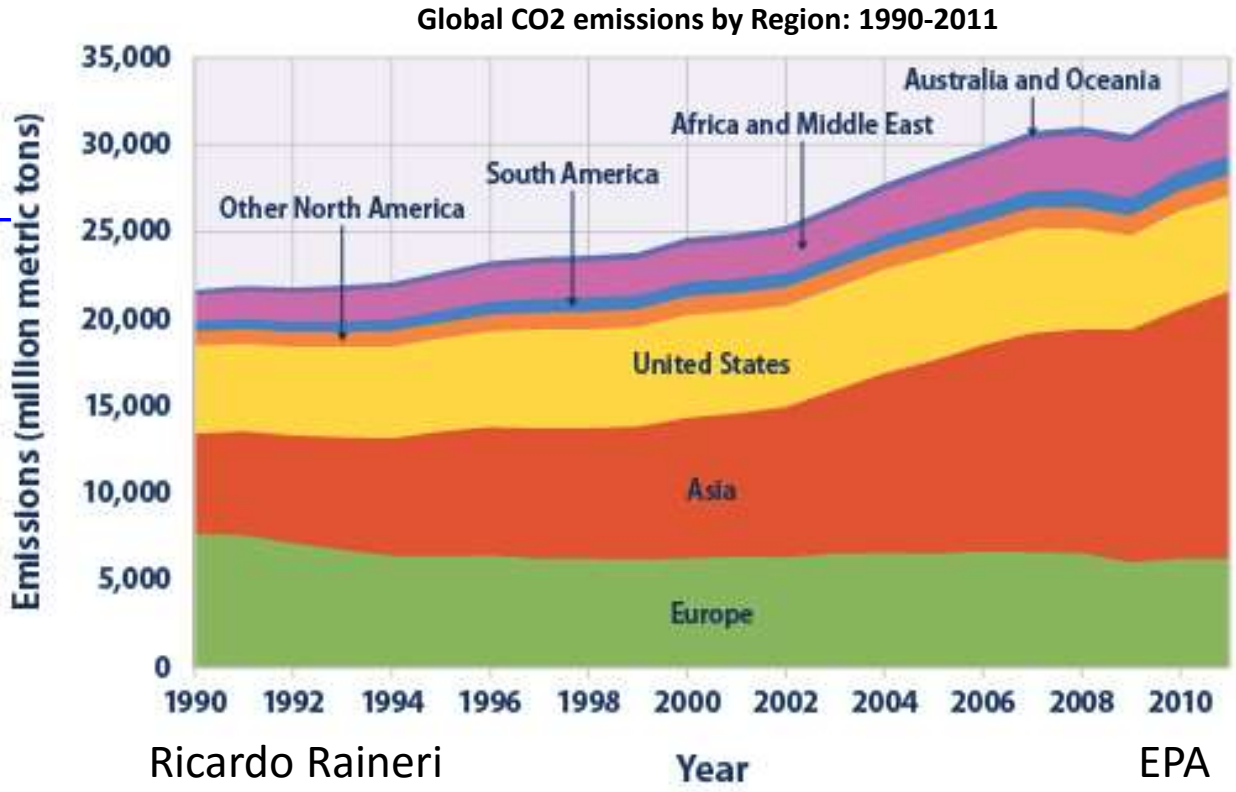
April 22, 2016

http://unfccc.int/focus/indc_portal/items/8766.php

WRI

C2ES

Carbon Pricing Is Expanding: Initiatives Now Valued at Nearly $50 Billion



Ricardo Raineri

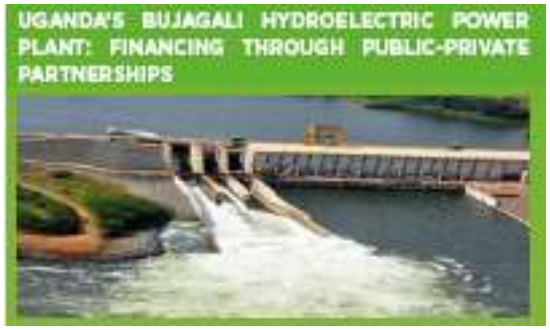
EPA

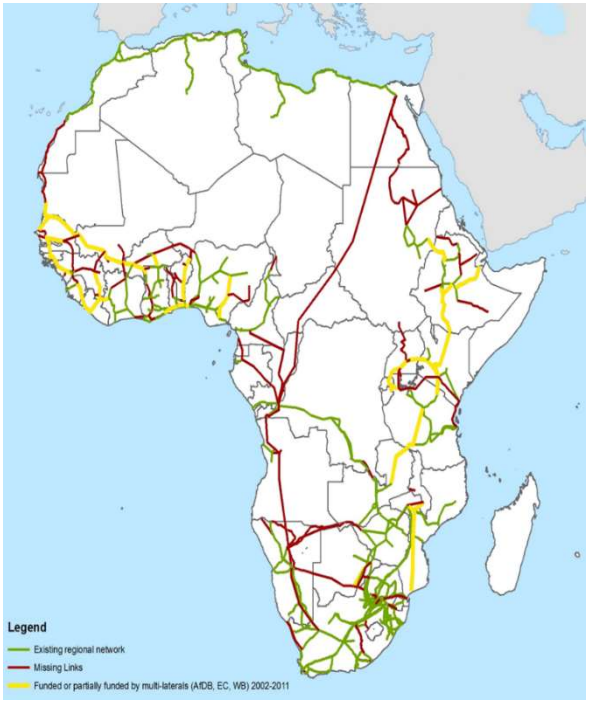
Opportunity

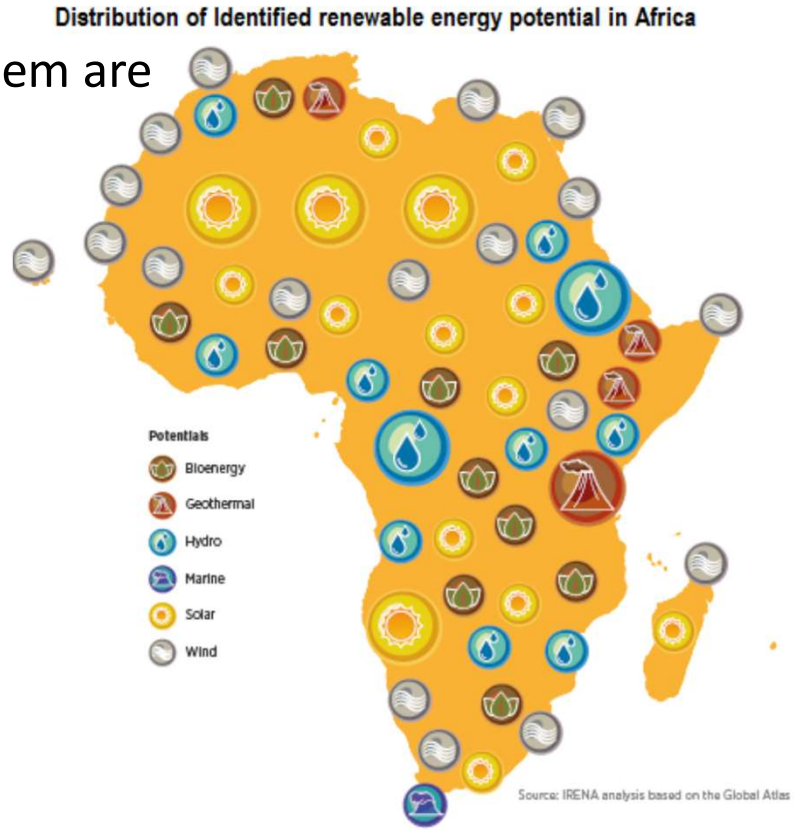
- Energy Access
  - As a source of energy access in isolated areas with mini grids and stand alone systems
  - Productive and agricultural activities

Opportunity

- As part of on grid solutions
  - Projects that take advantage of economies of scale for household and industrial use
  - To improve reliability as distributed generation
  - As base load as long as electricity transmission and intermittency problem are appropriately managed

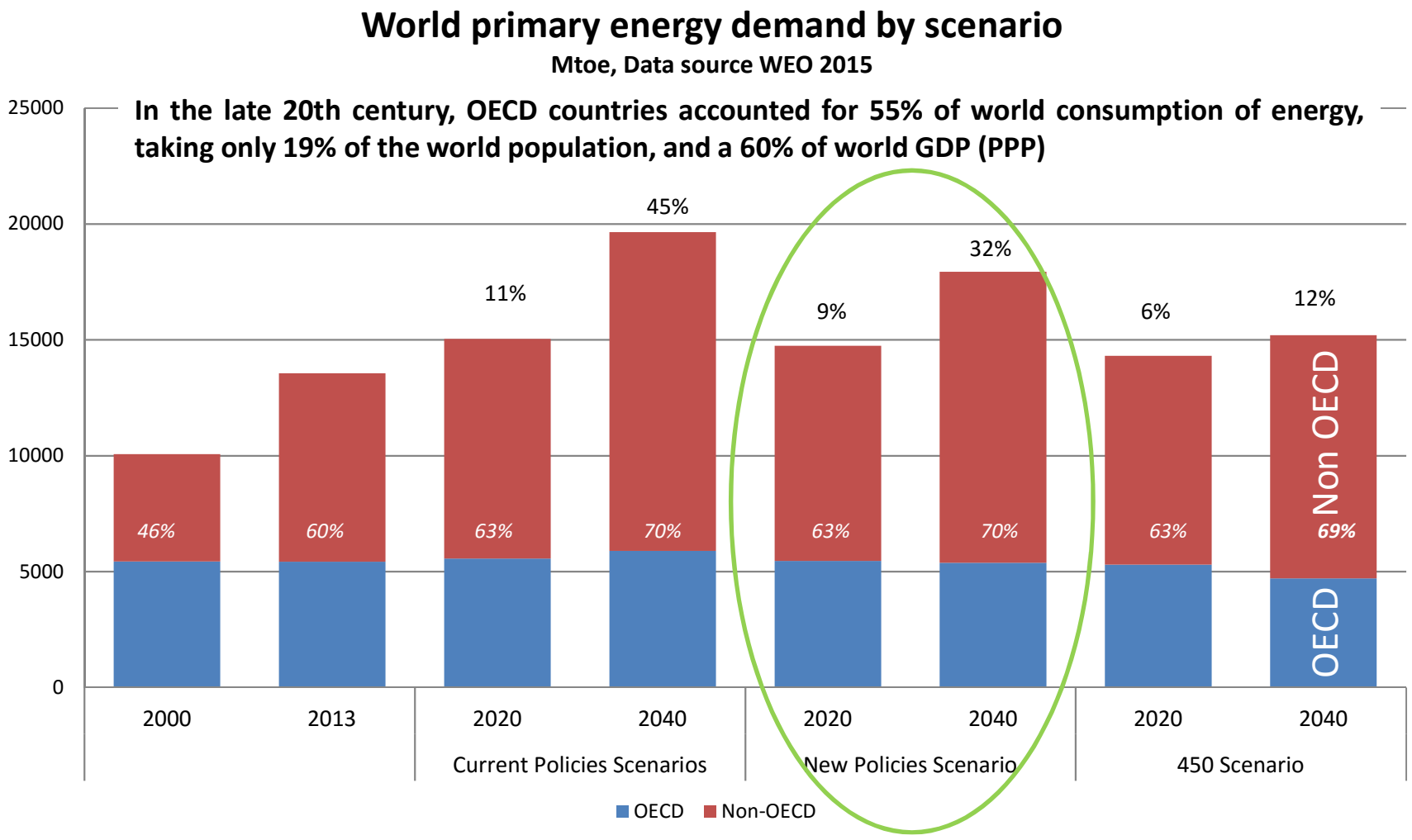






Energy Demand Outlook

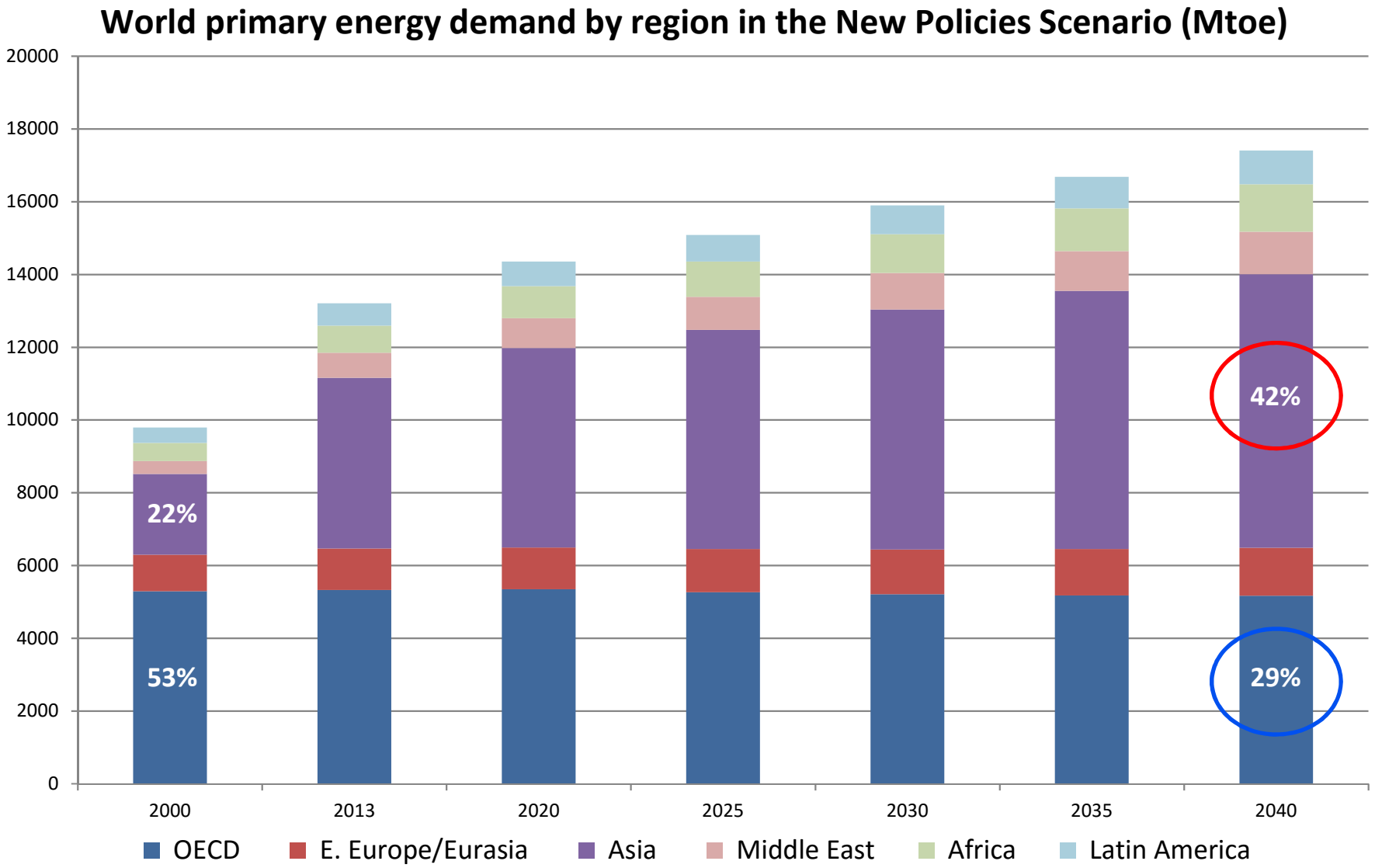
World primary energy demand by scenario



	Current Policies Scenarios		New Policies Scenario		450 Scenario	
	2020	2040	2020	2040	2020	2040
Growth respect 2013	11%	45%	9%	32%	6%	12%
OECD	3%	9%	1%	-1%	-2%	-13%
Non OECD	16%	69%	14%	54%	11%	29%

Ricardo Raineri

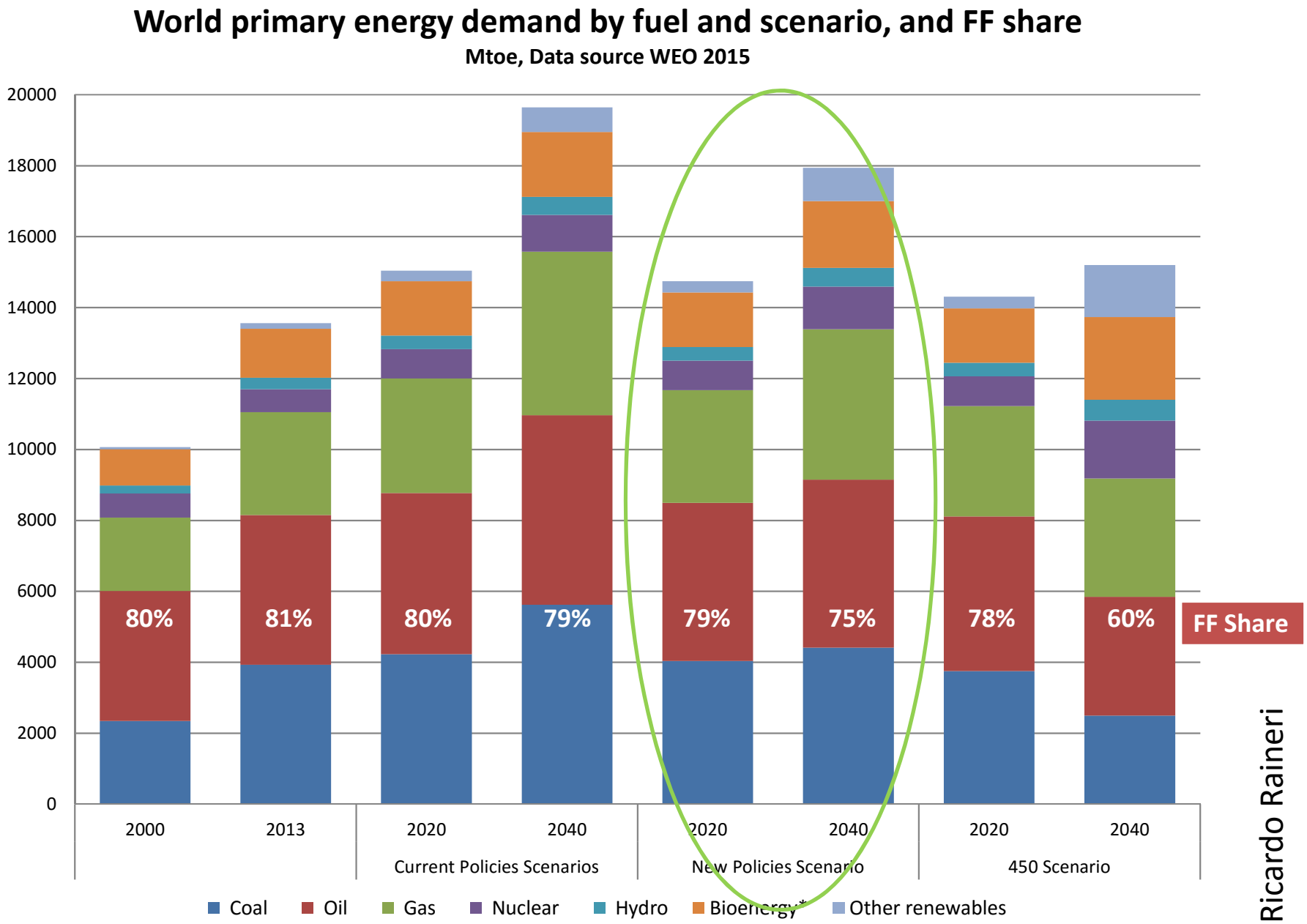
World primary energy demand by region in the New Policies Scenario



Ricardo Raineri

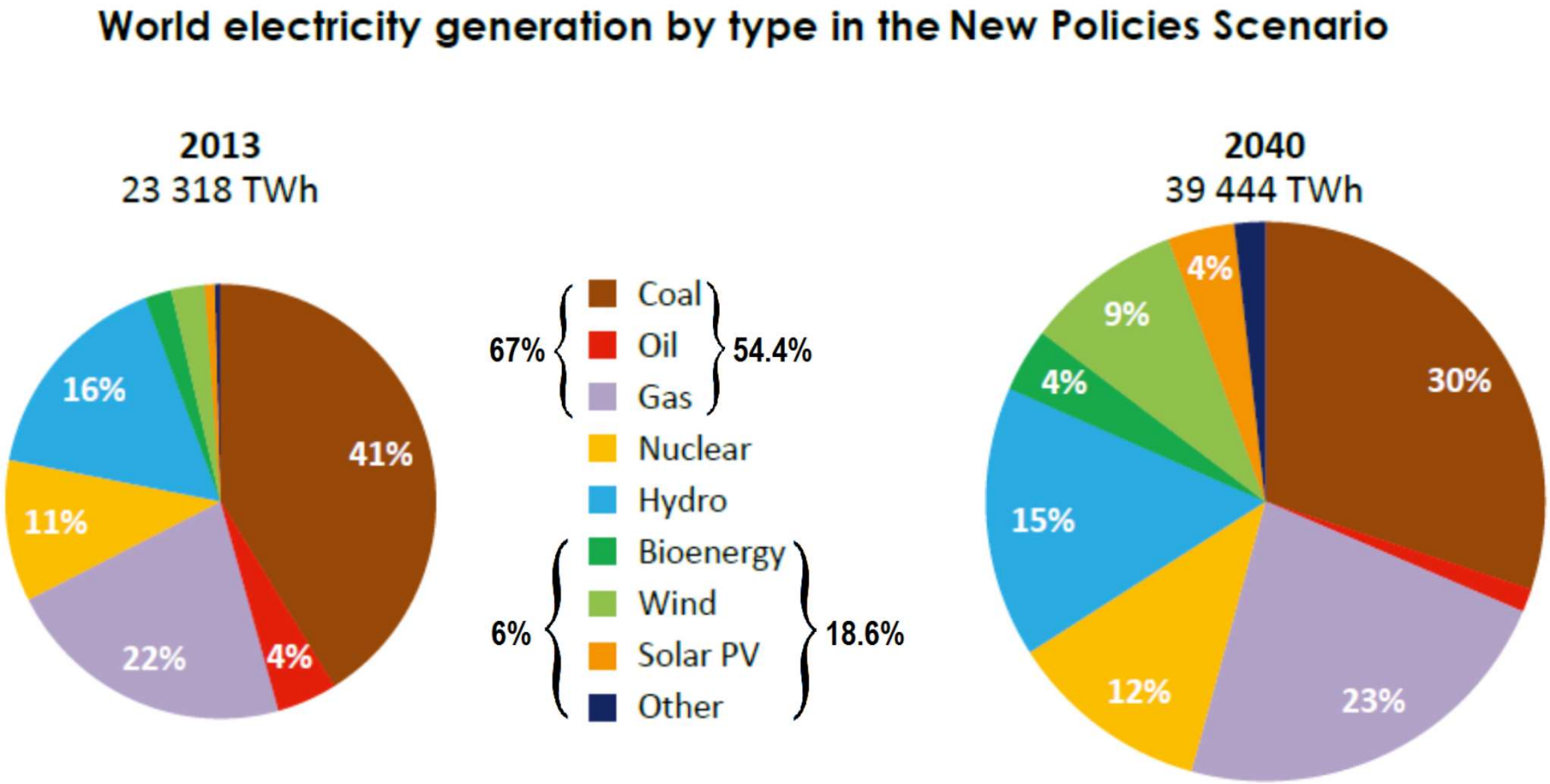
Data source: WEO 2015

World primary energy demand by fuel and scenario



Ricardo Raineri

World Electricity Generation by Type



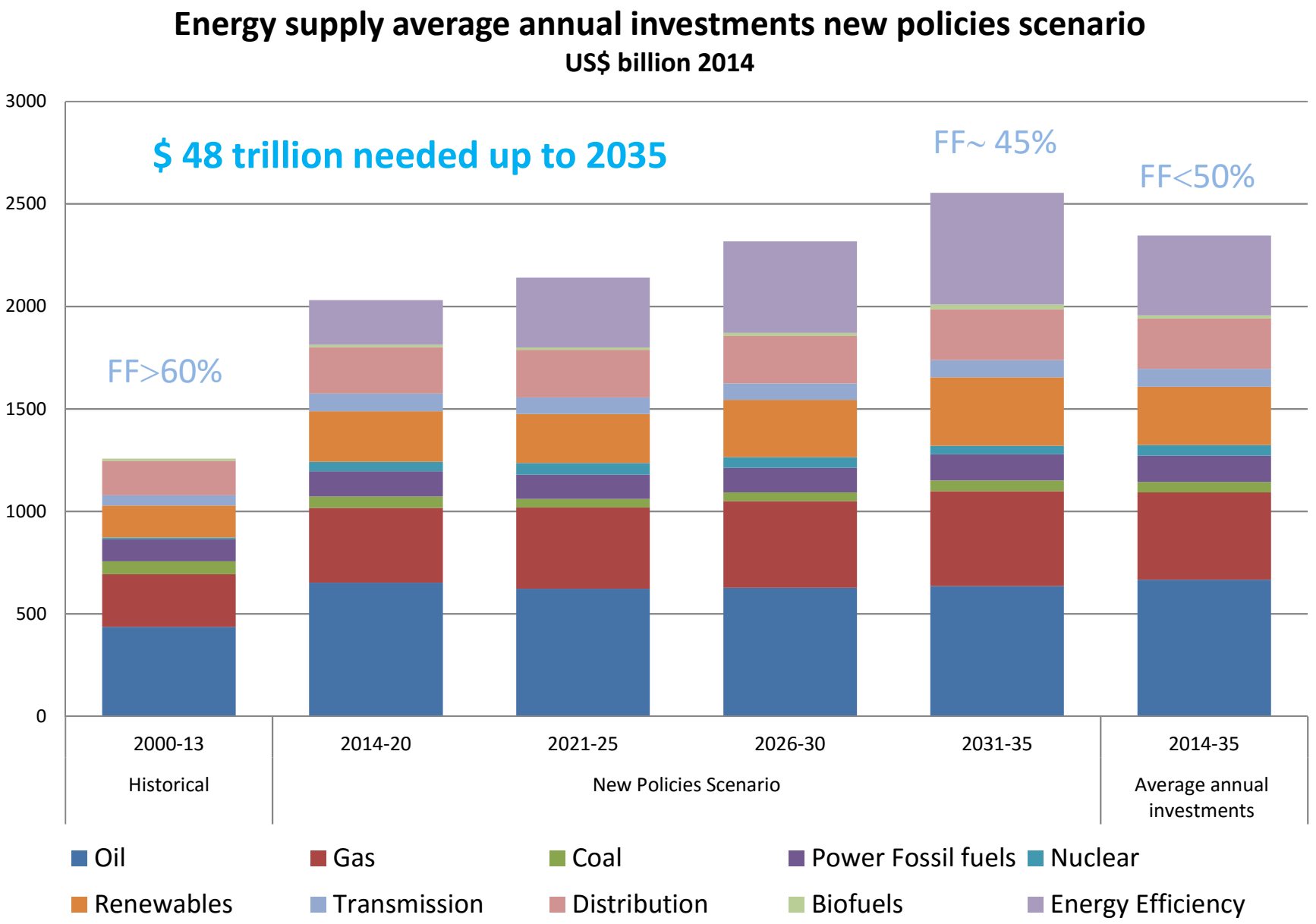
Note: Other includes geothermal, concentrating solar power and marine.

Source: IEA

Investments

Ricardo Raineri

Energy Supply Average Annual Investments



Source: Data from IEA World Energy Investment Outlook

Ricardo Raineri

Second Annual Sustainable Energy for All Forum
"Financing Sustainable Energy for All"

Access Investment US$ 13.1 billion

Annual global investment—actual and required (US$ billion)					
	Electrification	Cooking	Energy efficiency	Renewable energy	Total
Actual for 2012 2013	9 12.7	0.1 0.4	130	258	397 401
Required to 2030	45	4.4	560	442 - 650	1051 - 1259
Gap	**36** **32.3**	**4.3** **4.0**	**430**	**184 – 392**	**654 – 862** **650 - 858**
Source: Global Tracking Framework 2015, WBG-ESMAP-IEA, and own estimates update					

Annual Investment Gap to meet SE4All initiative by 2030:
$ 650 – 858 billion per year

Ricardo Raineri

Challenges and Opportunities

Low Oil Price

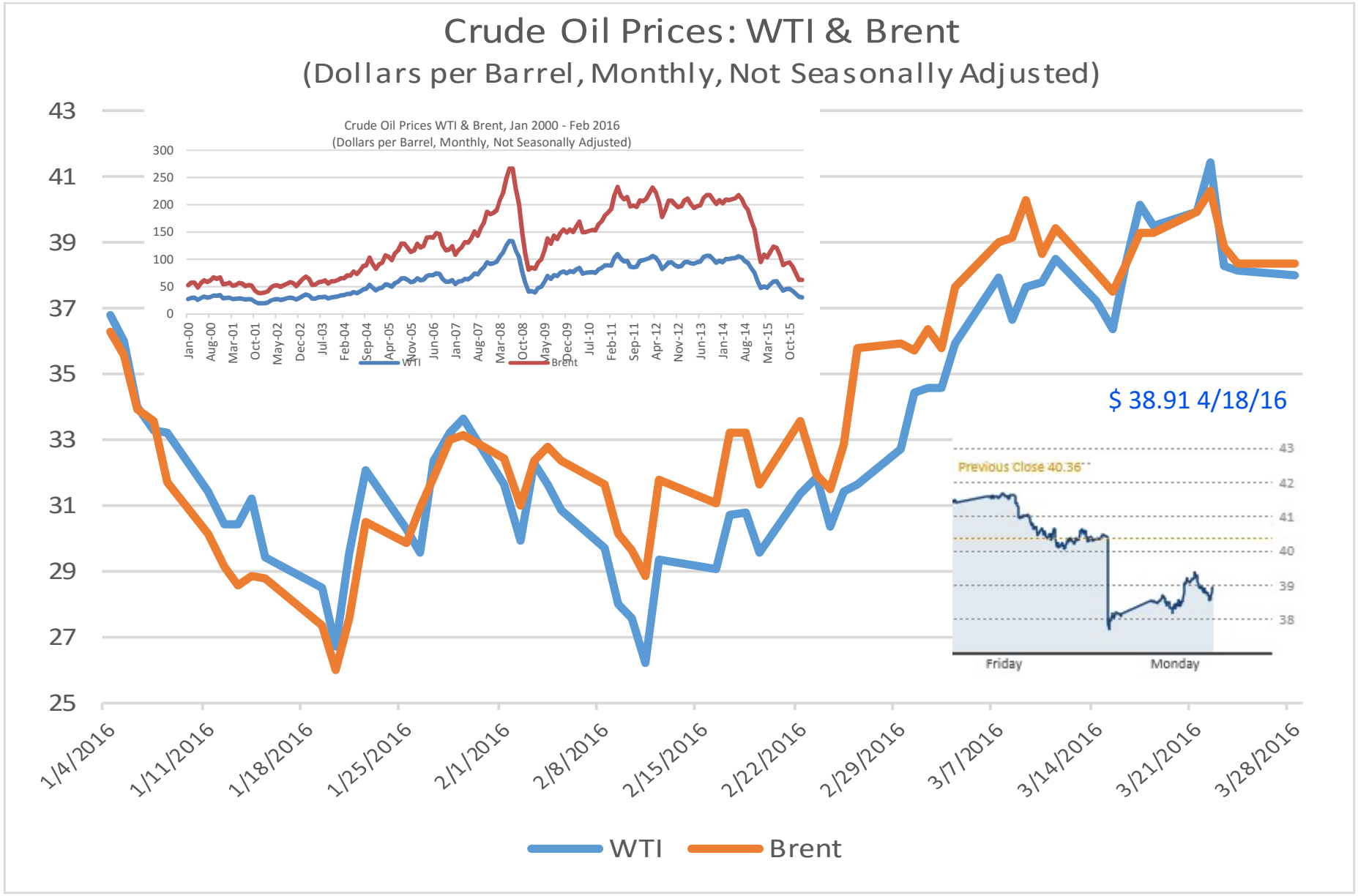
OPEC meeting ends without deal on oil production freeze

17 Apr 2016: World's big oil producers fail to agree on output cap to stabilize prices after months of uncertainty.

Nigerian Oil Minister Emmanuel Ibe Kachikwu said at the end of the meeting that the parties would meet again in June for further talks

The failure by oil-rich nations to freeze output hit crude prices Monday but, in the longer-term, oil is likely to keep recovering as many companies, particularly U.S. shale producers, scale back production plans

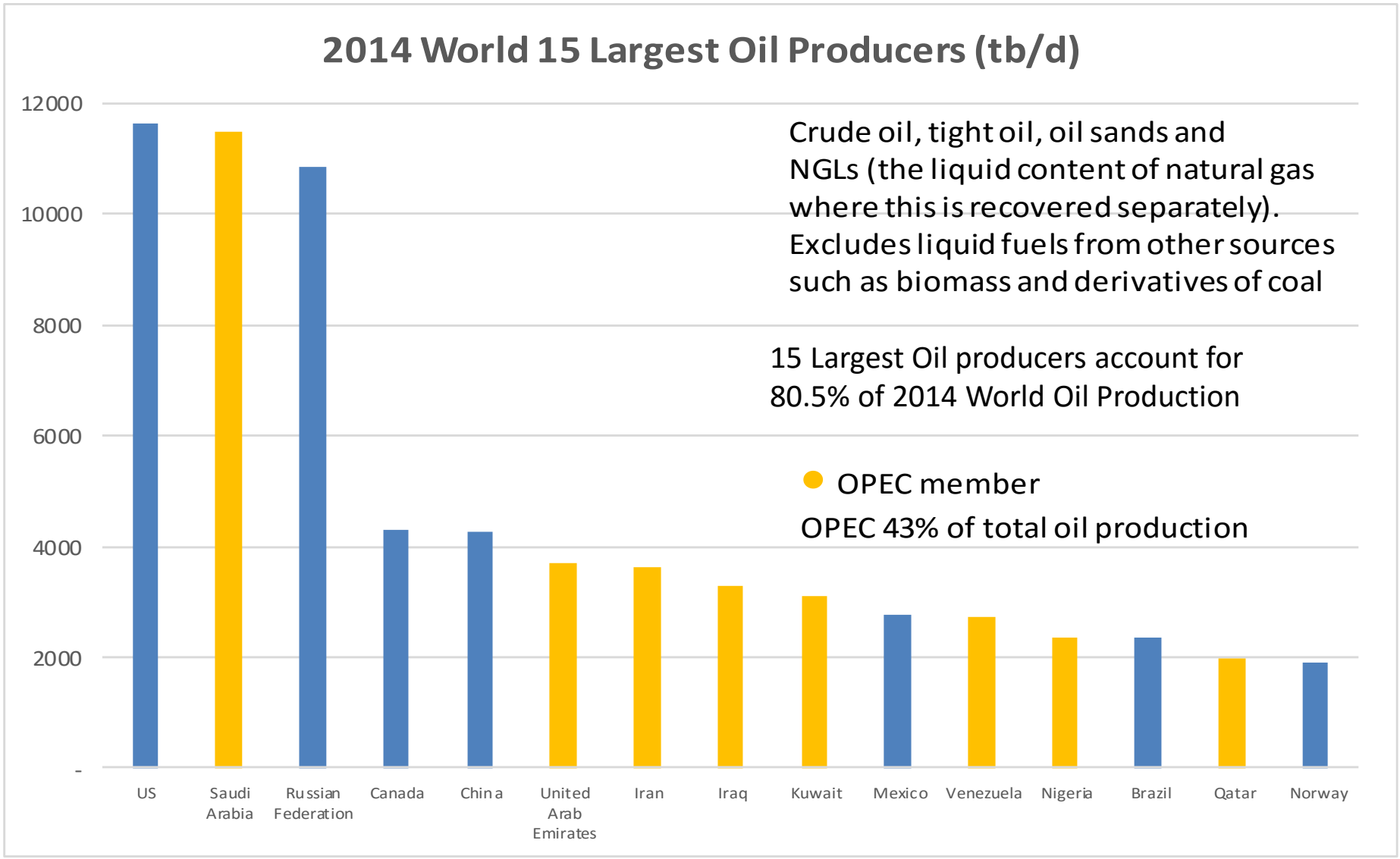
Crude Oil Prices and Risk



Ricardo Raineri

FED Saint Luis

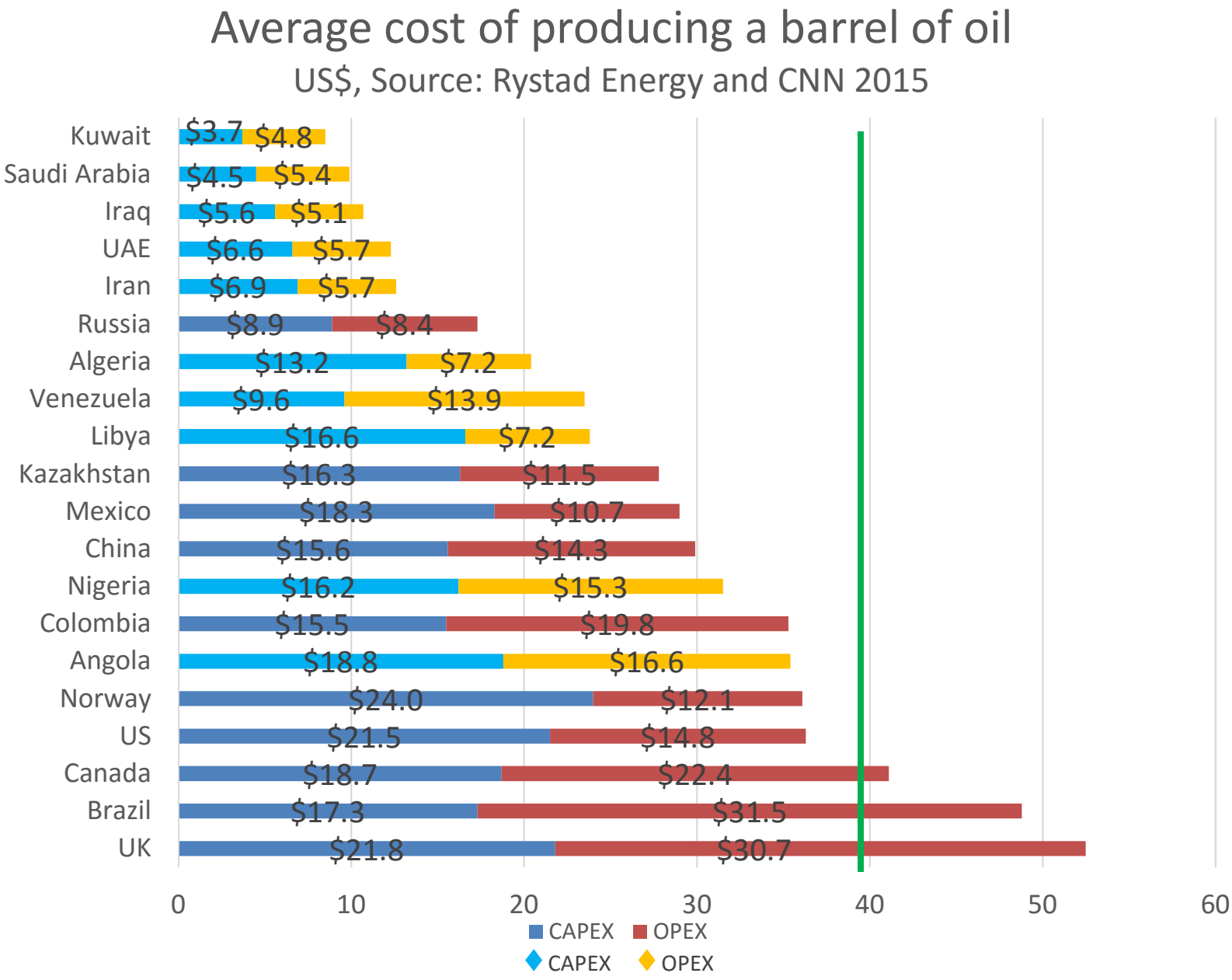
Oil



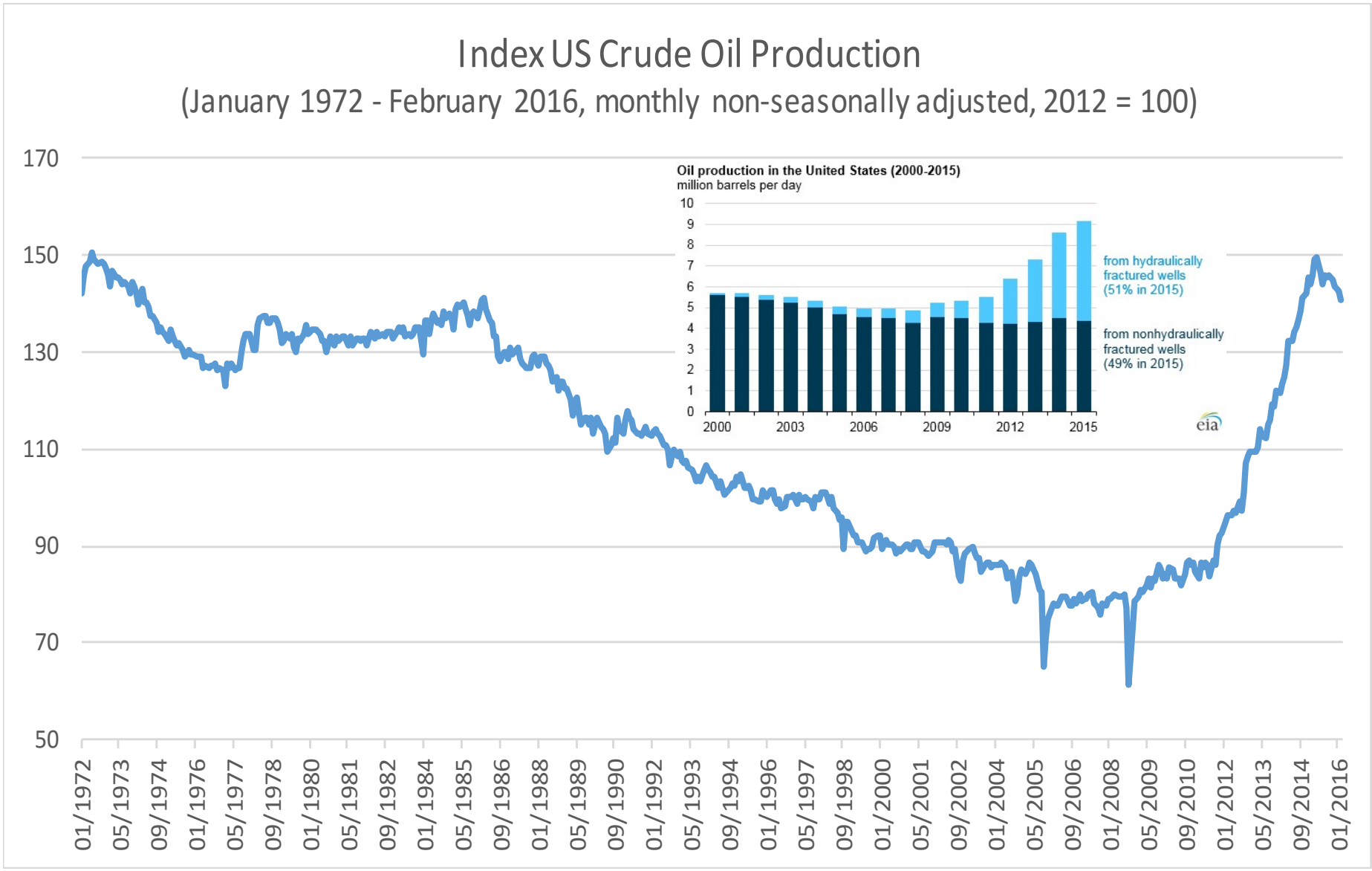
Ricardo Raineri

With BP data

Average Cost of Production

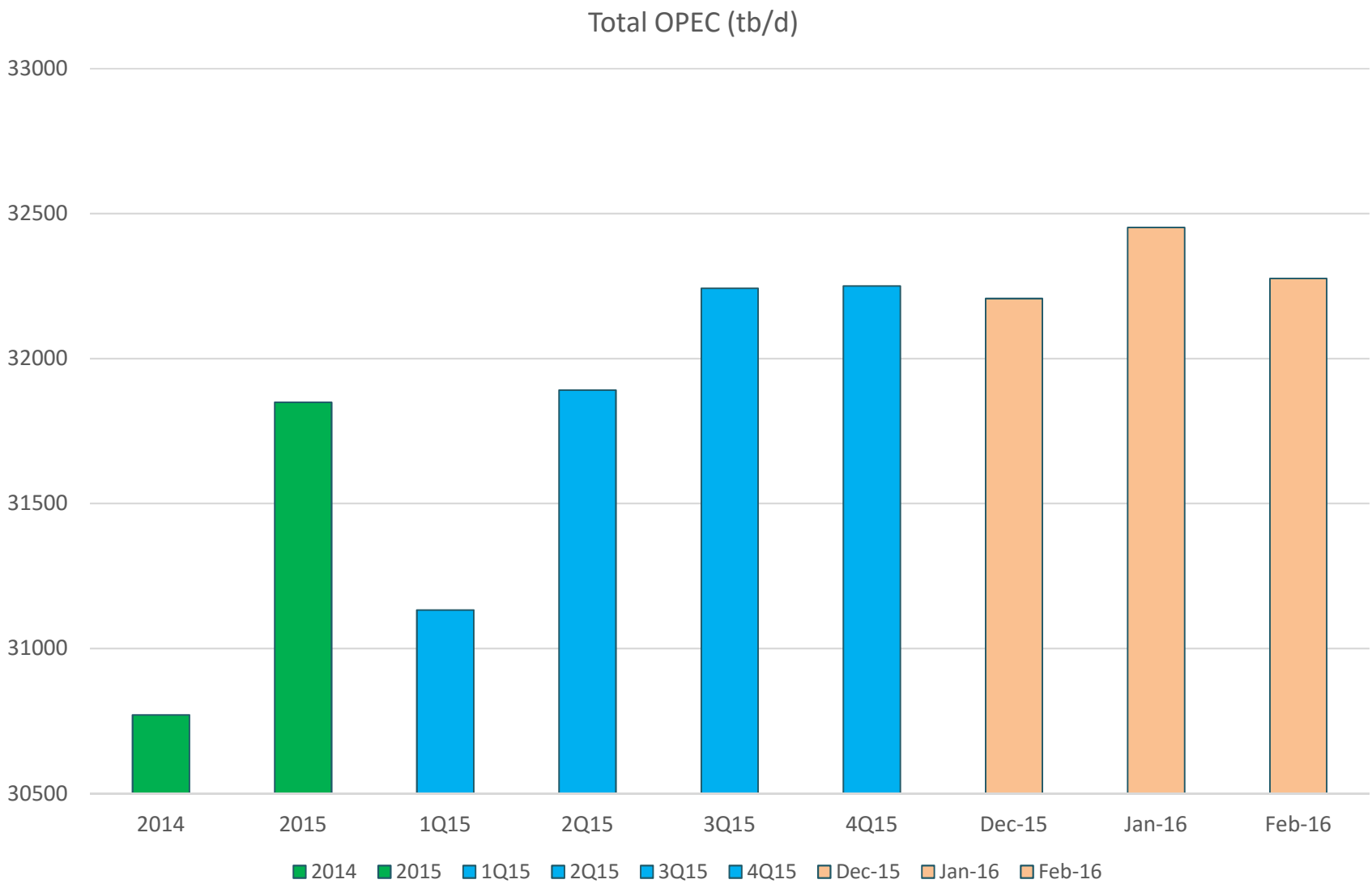


U.S. Oil Production Index

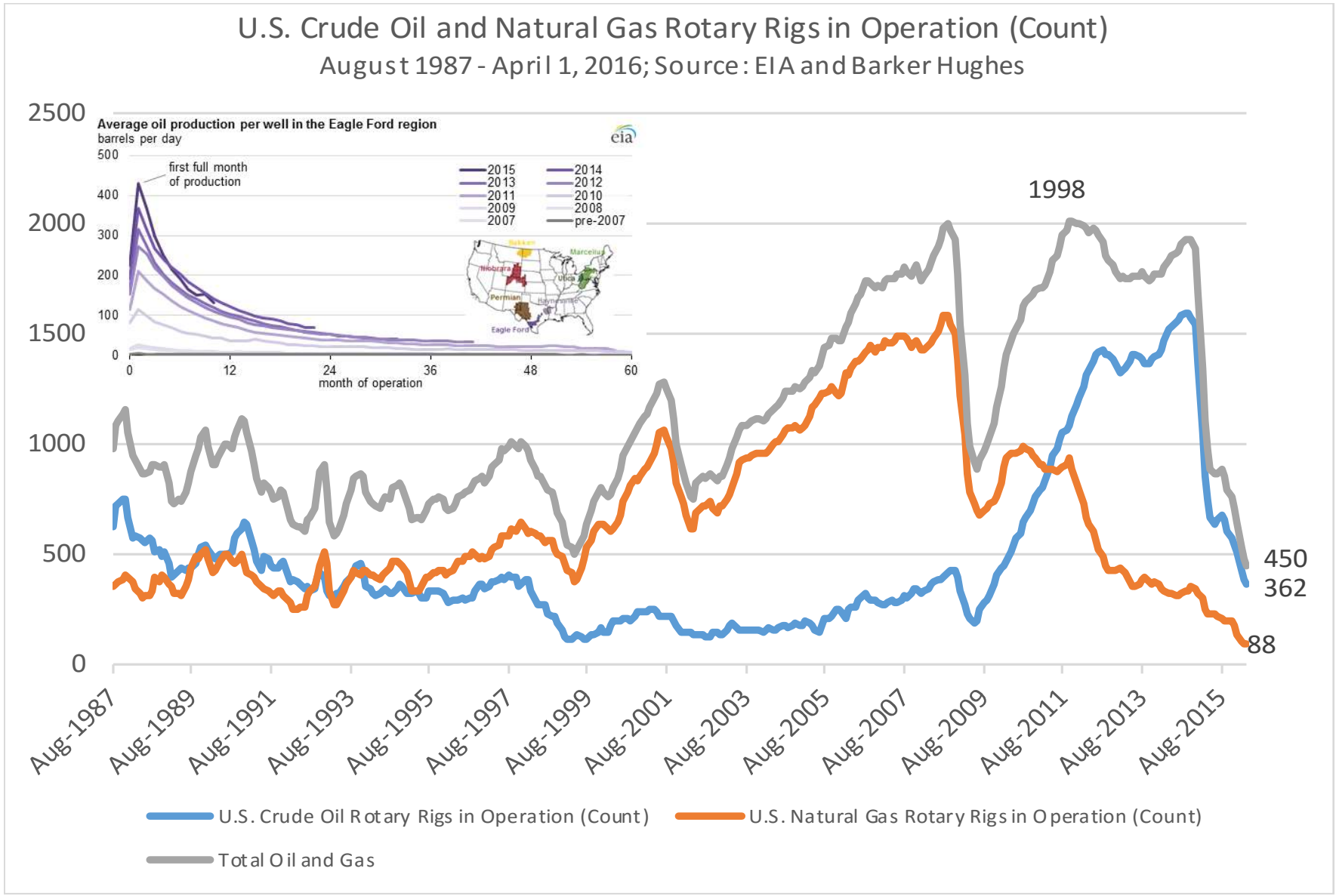


FED Saint Luis

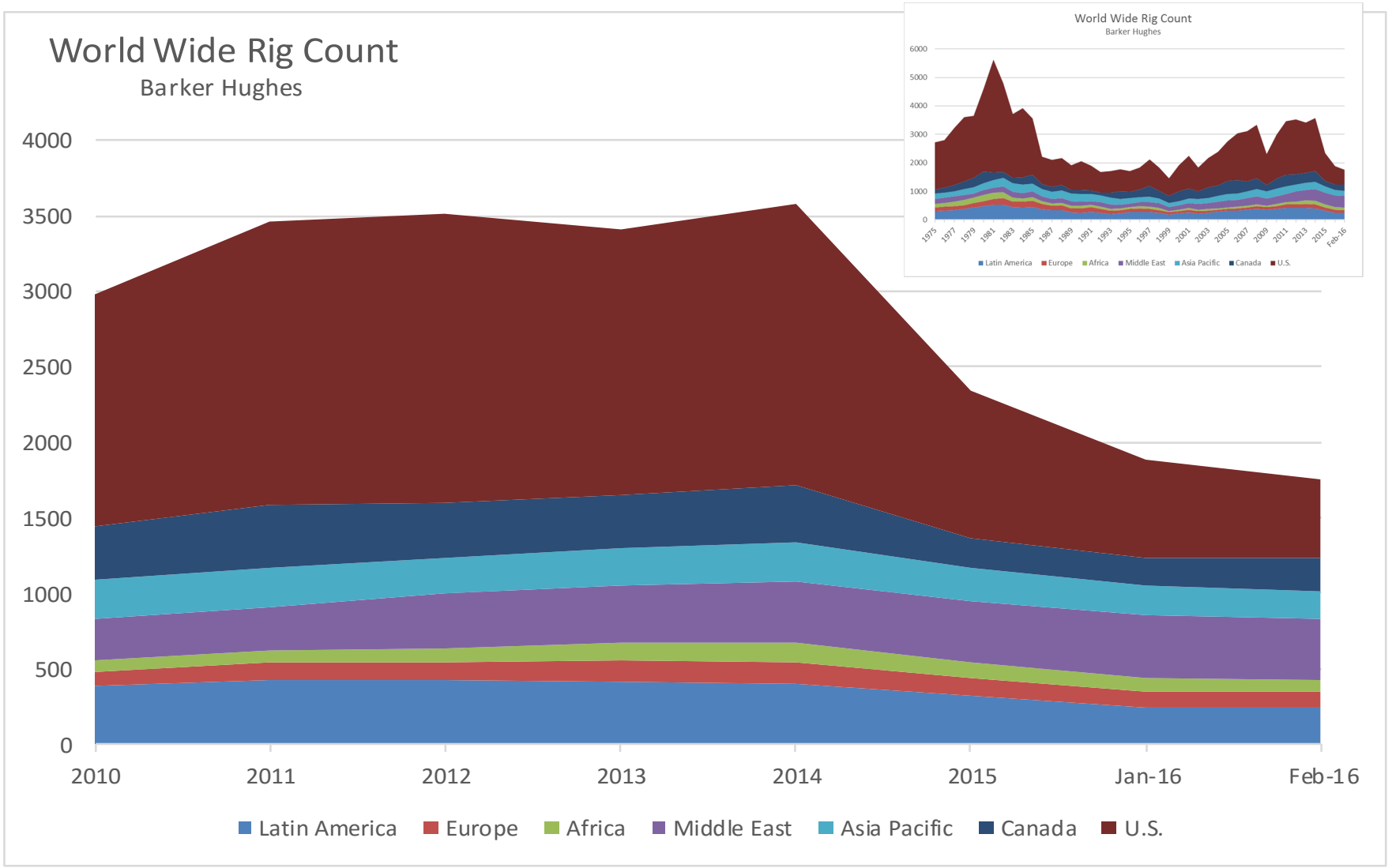
OPEC Oil Supply



U.S. Oil Rig Count

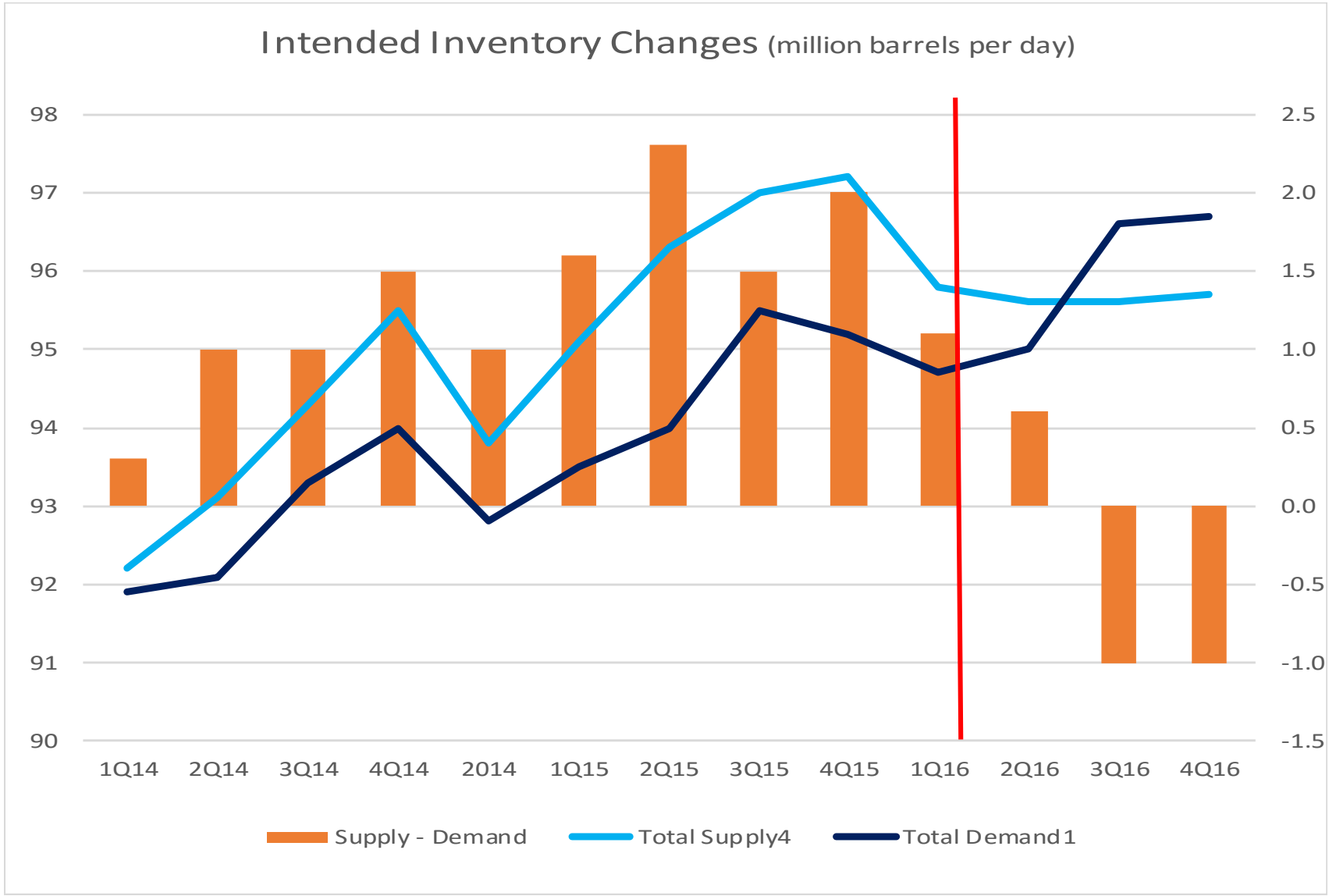


World Oil Rig Count



Baker Hughes does not include the Former Soviet Union countries in their count or totals.

World Oil Supply and Demand 2009-2016



IEA

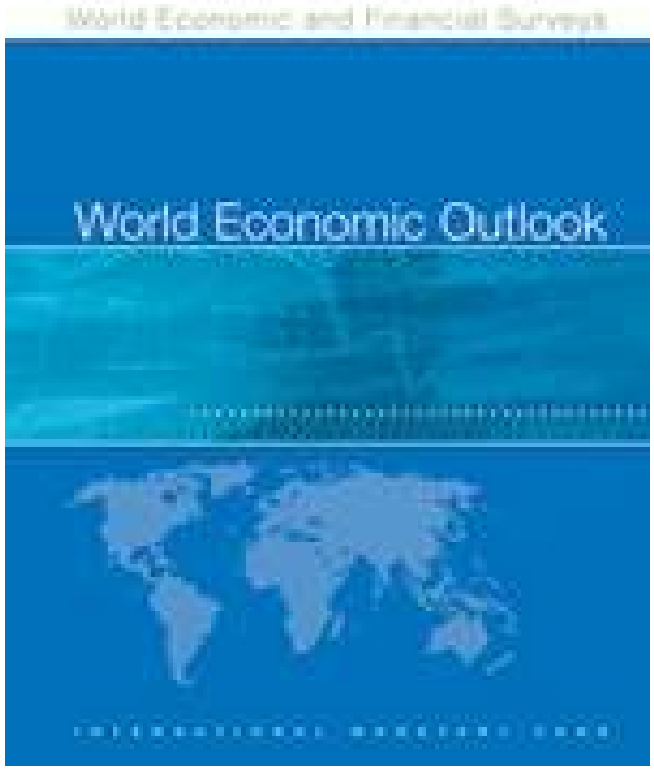
Future oil price WTI January 2017

Fri, Apr 18st-2016 for January 2017

http://www.barchart.com/

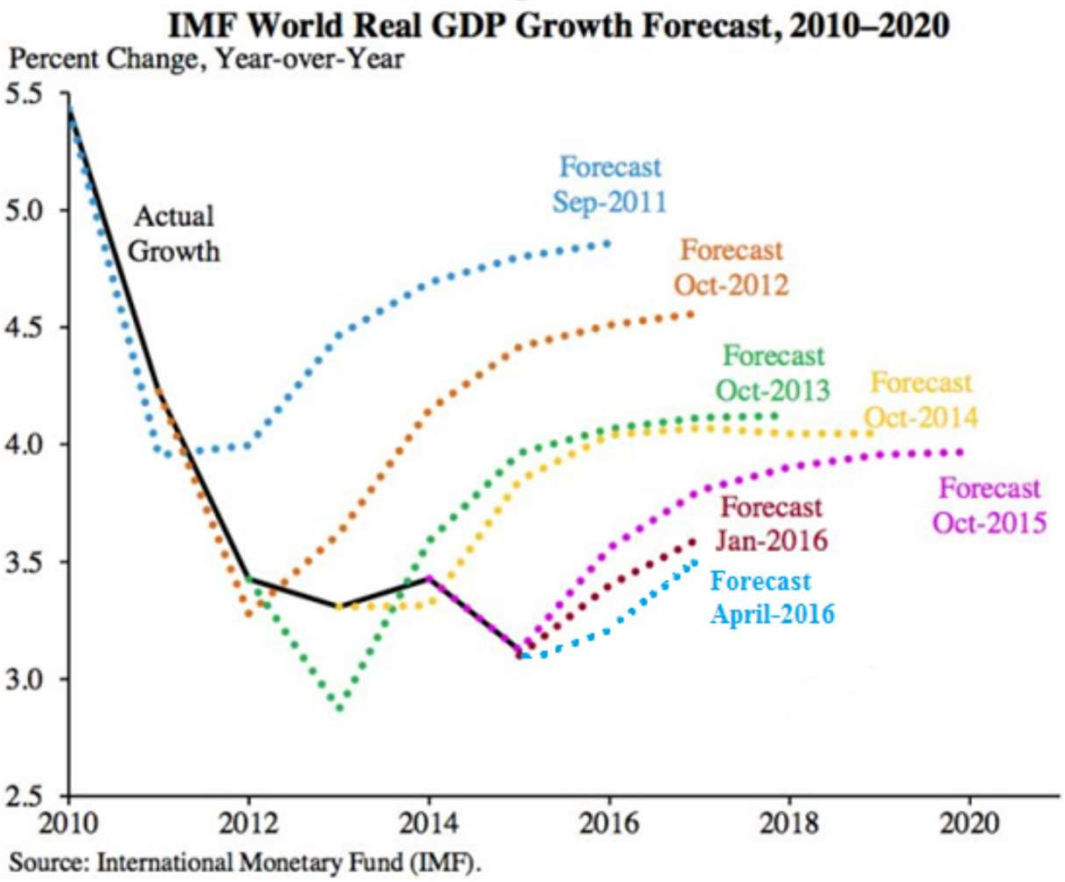
Low Economic Growth

Short Term Economic Growth Forecast



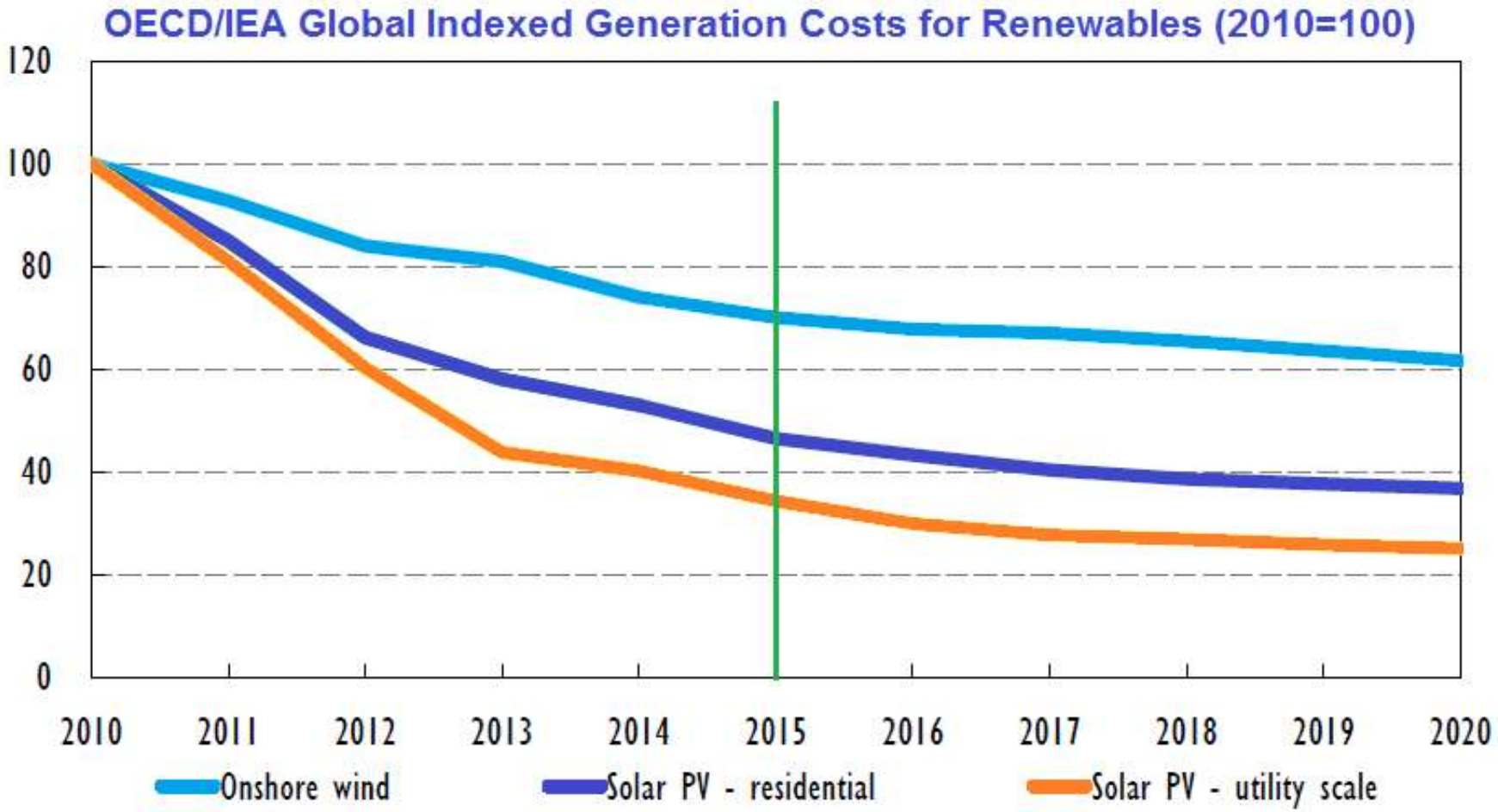
WORLD ECONOMIC OUTLOOK (WEO)
Too Slow for Too Long
April 2016

In January, the IMF forecast global growth of 3.4 percent this year, in April it reduced to 3.2%



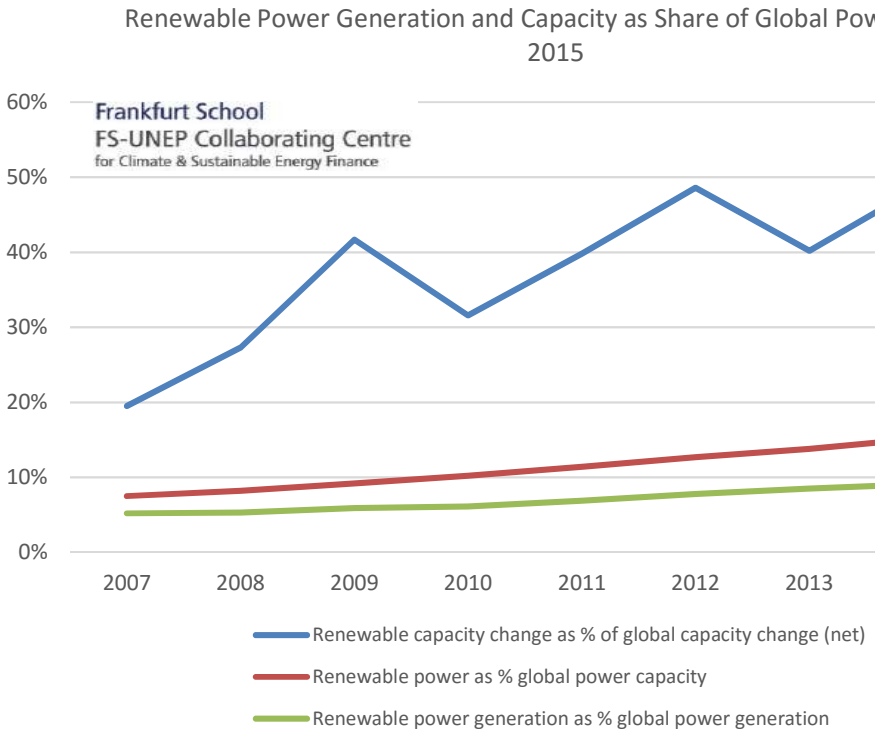
Decreasing Costs

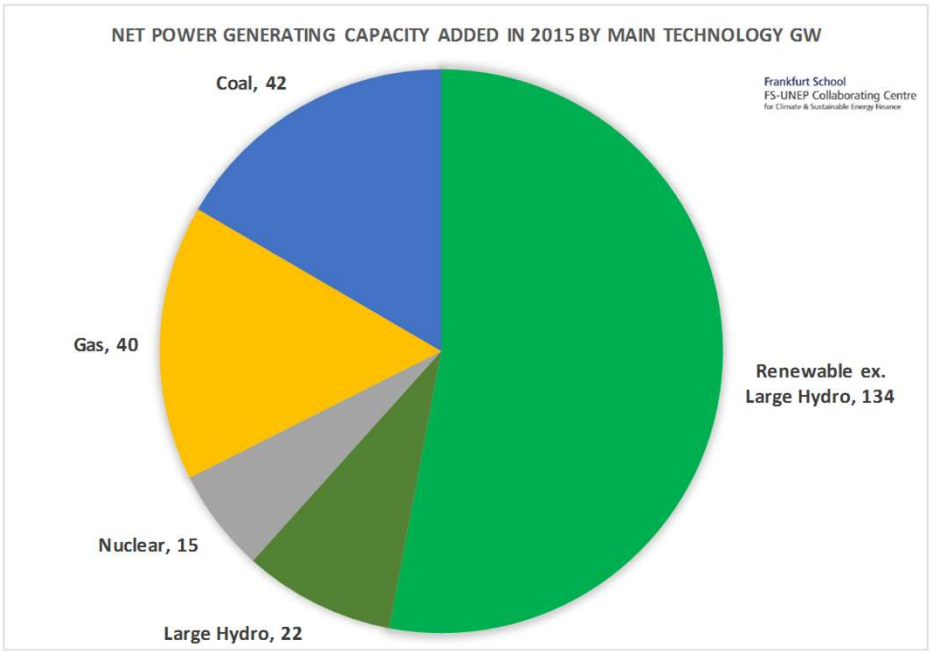
Opportunity: Renewable Energy



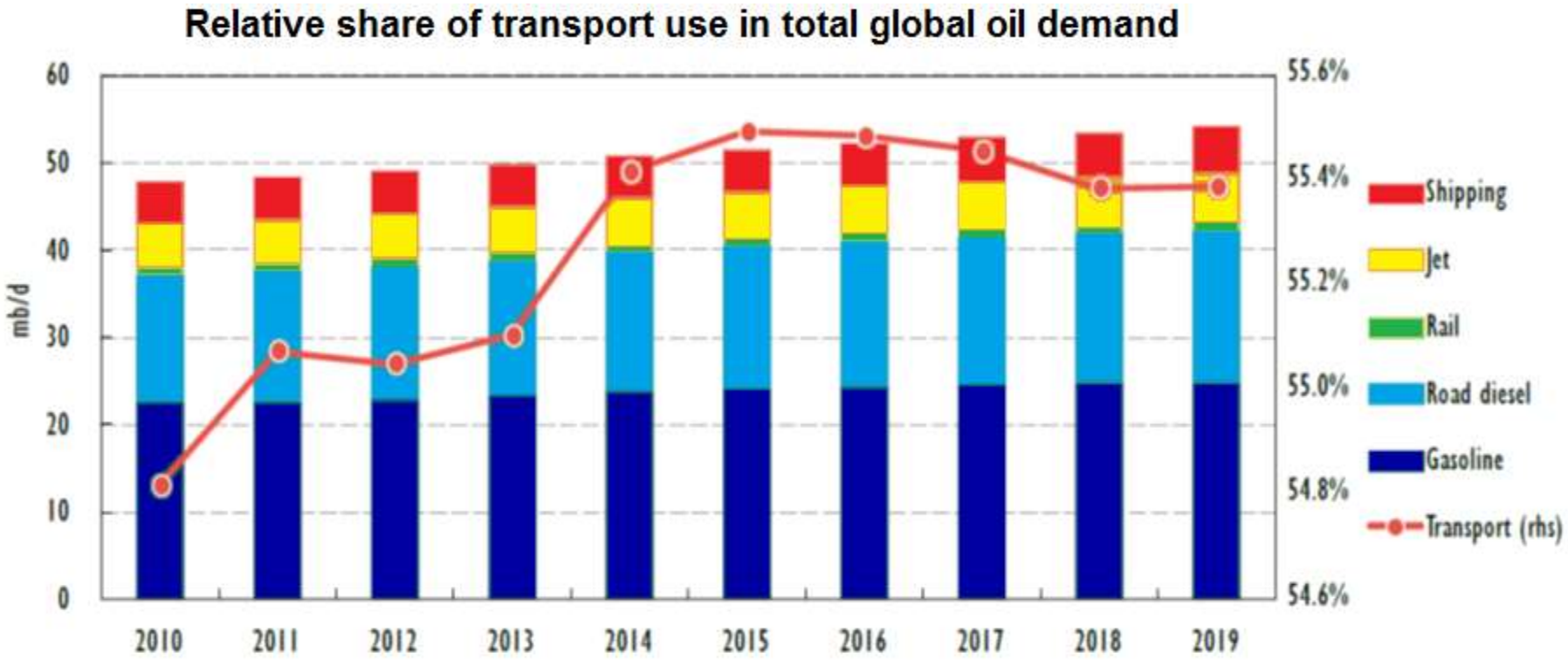
OECD/IEA

Opportunity: Renewable Energy



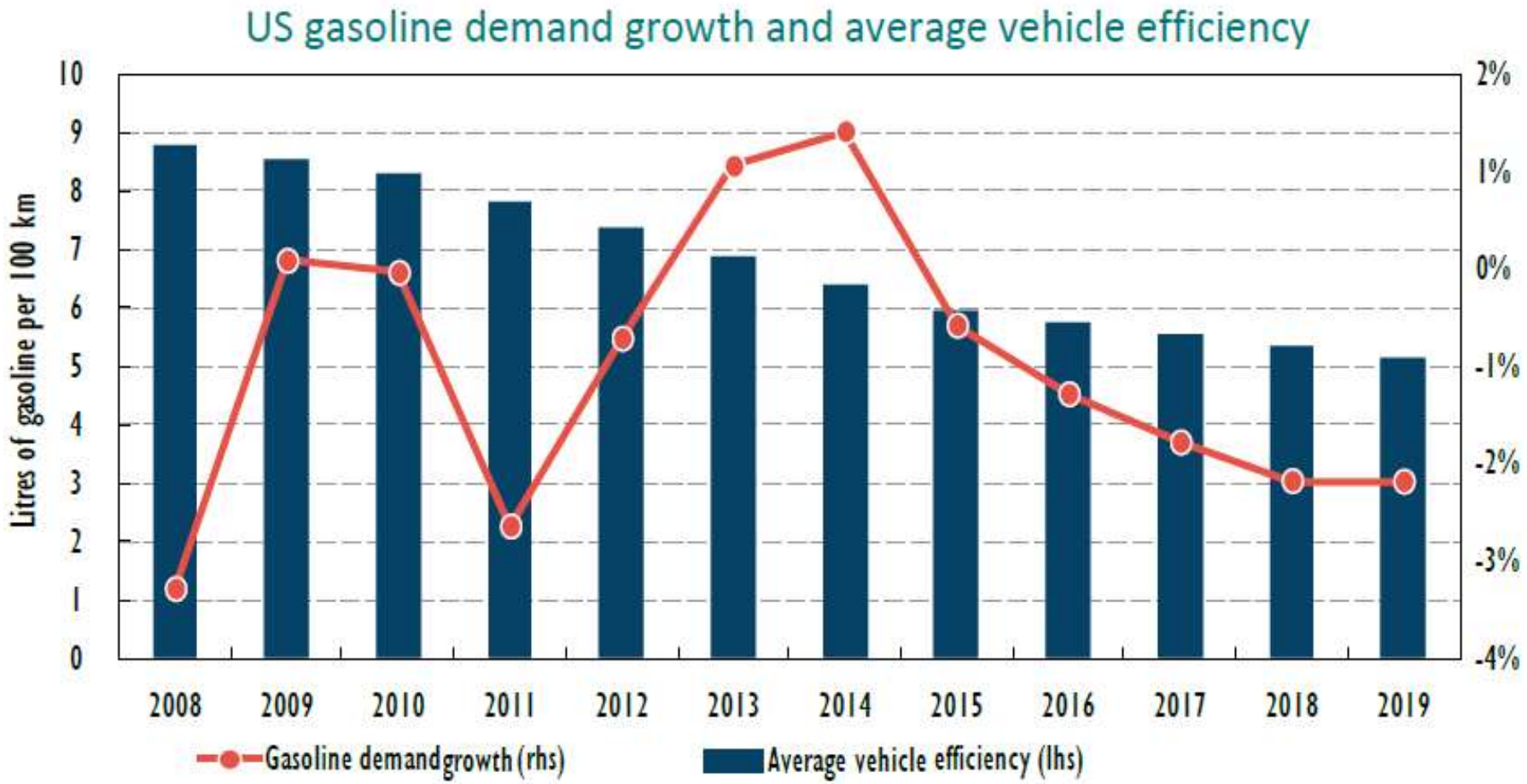


Opportunity: Transport
Relative share of transport use



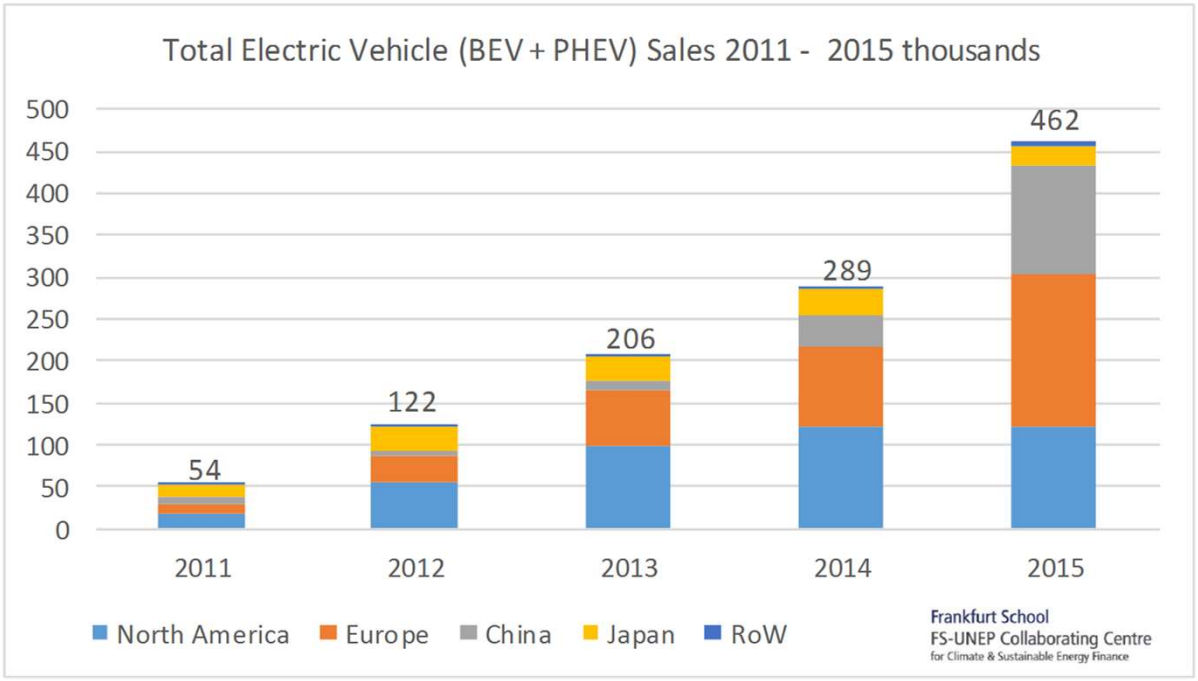
IEA MTOR 2014

But Vehicle Increased Efficiency

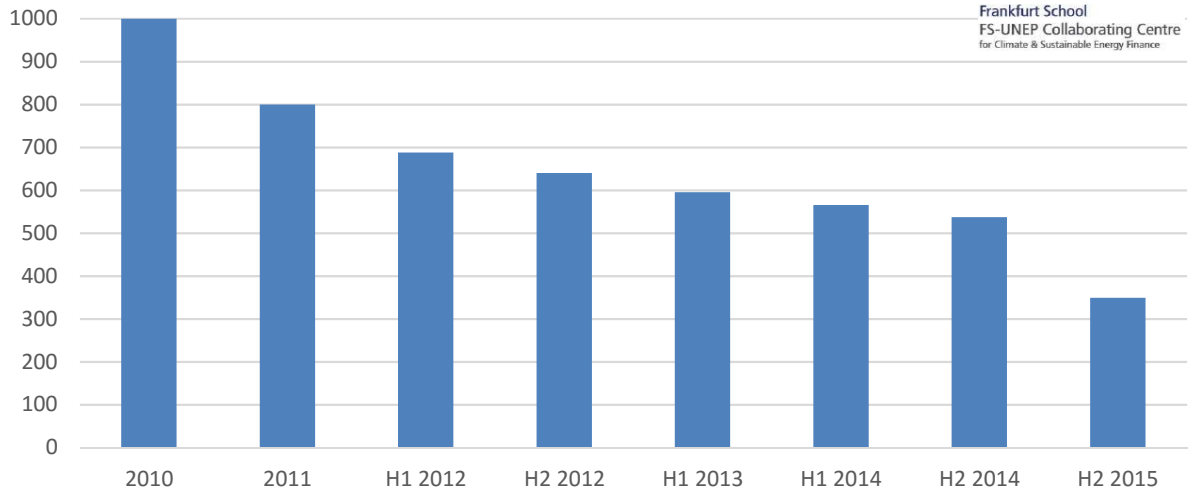


OECD/IEA

Opportunity: Transport



Average EV Battery Costs $ per KWh , 2010 to H2 2015



Opportunity: Civil Society

Social movements with strong preferences and convictions with high capacity of social mobilization

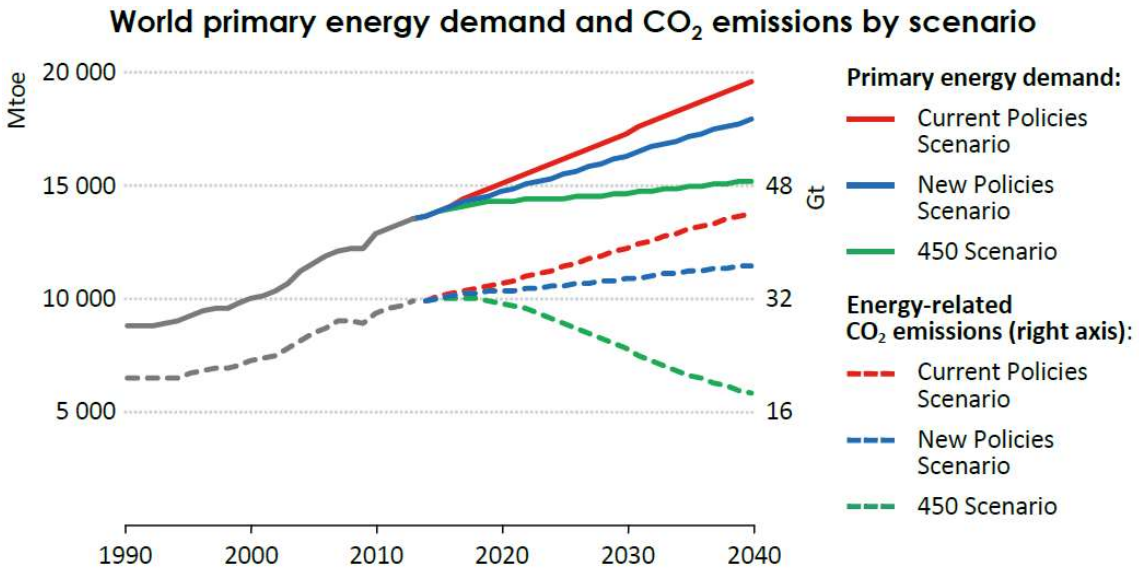
http://avaxnews.net/pictures/147070

https://www.savethearctic.org/en/live/map-blog/back-on-the-esperanza/

Opportunity: Stranded Assets

Energy Darwinism II, **Citigroup (2015) estimated that $100 trillion in fossil fuel assets may already be economically stranded**:

While fossil reserves aren't running out, our ability to burn them without limit may be, due to the fact that atmospheric concentrations of CO2 and equivalents are rapidly approaching the so-called 'carbon budget' – the level that if we go beyond is likely to lead to global warming in excess of the important 2 degrees Celsius level.



WEO 2015

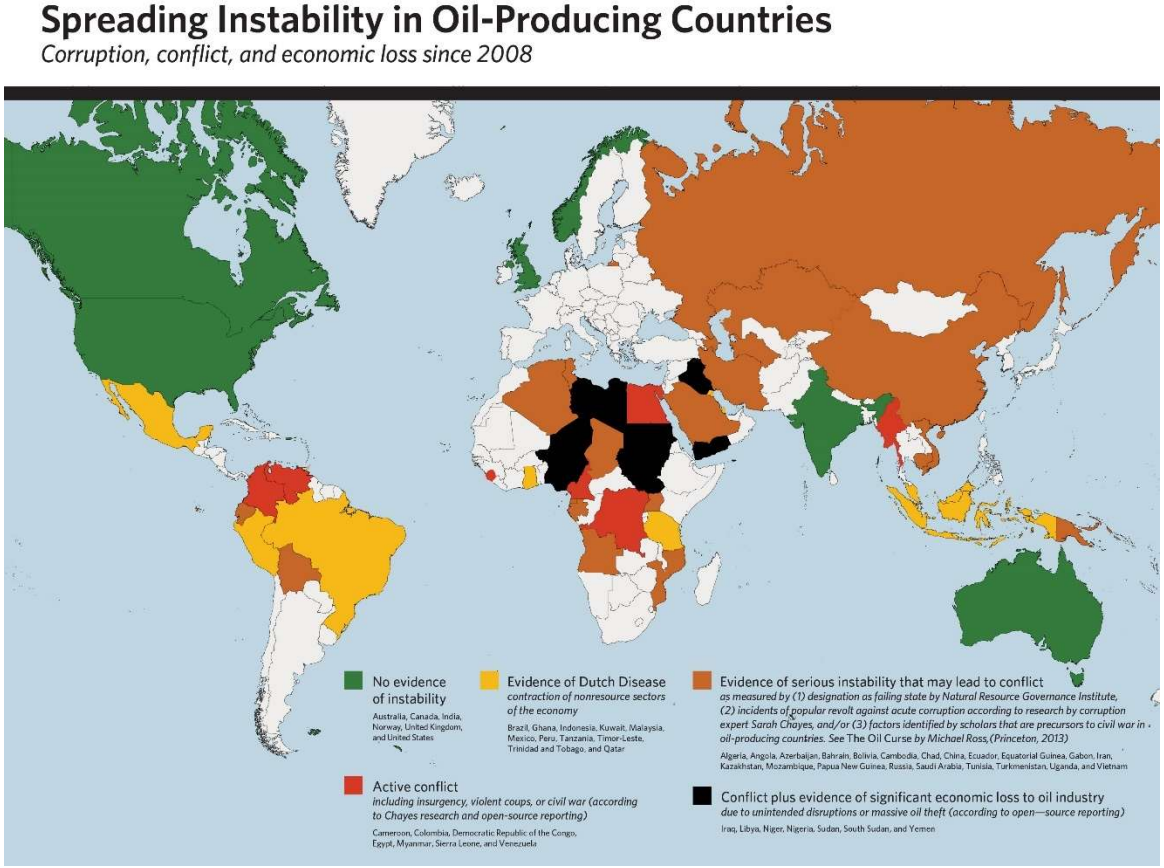
Opportunity: Civil Society

The Oil Curse: A Remedial Role for the Oil Industry

Level of instability mid-2015:
Green "stable"
Yellow "economically dysfunctional"
Orange "risky"
Red "insecure"
Black Highly insecure signifying that oil companies have experienced significant losses due to attacks, conflict, or theft—bunkering.

Over half of oil-producing countries are "orange," indicating significant risk that conditions will change in ways that negatively impact oil operations.

Countries with oil are twice as likely to experience civil war as those without.



SARAH PECK, SARAH CHAYESPaper September 30, 2015

Opportunity: Terrorist and War Events

U.S. Sen. Ron Johnson (R-WI), chairman of the Senate Homeland Security Committee

"our critical infrastructure is vulnerable to cyber-attack, to potential terrorist attack, and we are not taking this threat seriously enough. So it's very concerning."

Terror Attack On Algerian Gas Plant Raising Security Fears For North Africa's Oil And Gas Infrastructure

BY MARIA GALLUCI ON 03/22/16 AT 2:29 PM

A natural gas plant, partially blackened by explosions, is seen on Jan. 31, 2013, in In Amenas, Algeria. Thirty-seven foreign hostages, including 10 Japanese, and 29 Islamic militants died.

HTTP://WWW.IBTIMES.COM/

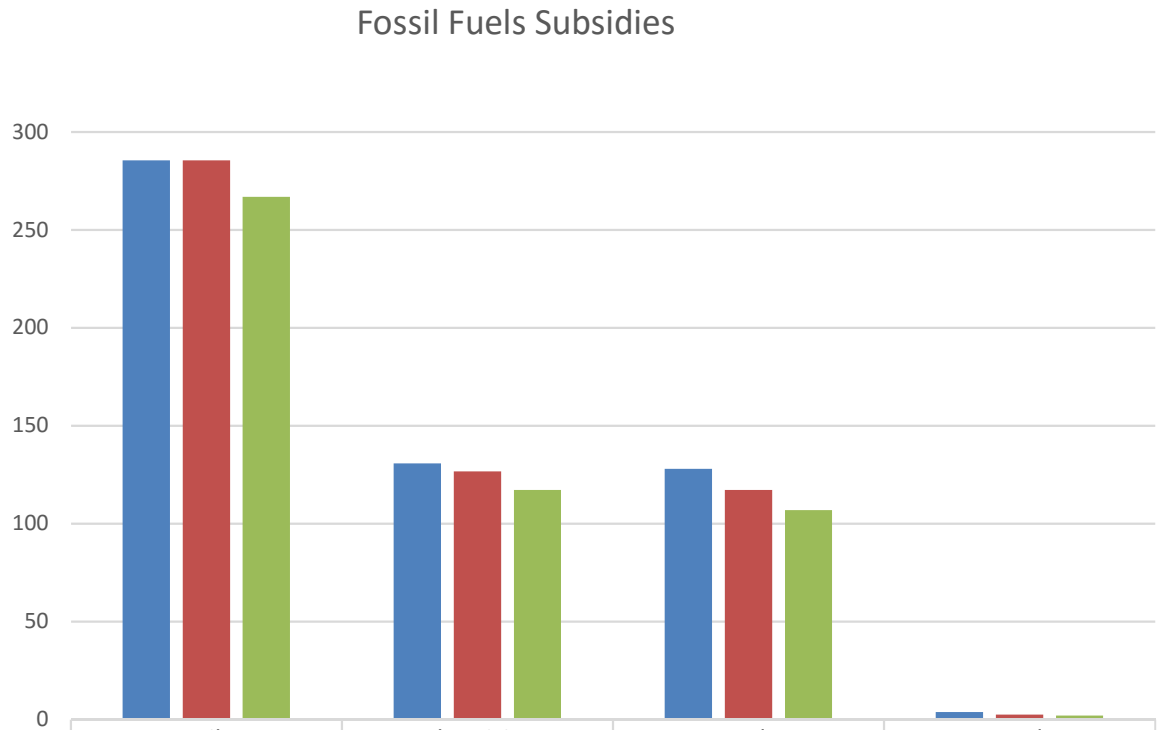
PHOTO: THE ASAHI SHIMBUN VIA GETTY IMAGES

Opportunity: Fossil Fuels Subsidies

Latest IEA estimates indicate that subsidies to fossil fuels worldwide amounted to $ 493,000 million in 2014, $ 39 billion less than the previous year, partly due to lower international energy prices with subsidies on petroleum products account for more than half the total.

Impact on:

- distorted prices
- impact consumption
- impact investment
- Budget deficit
- Increase in emissions
- Disincentive for renewable
- Sustainable development and poverty reduction



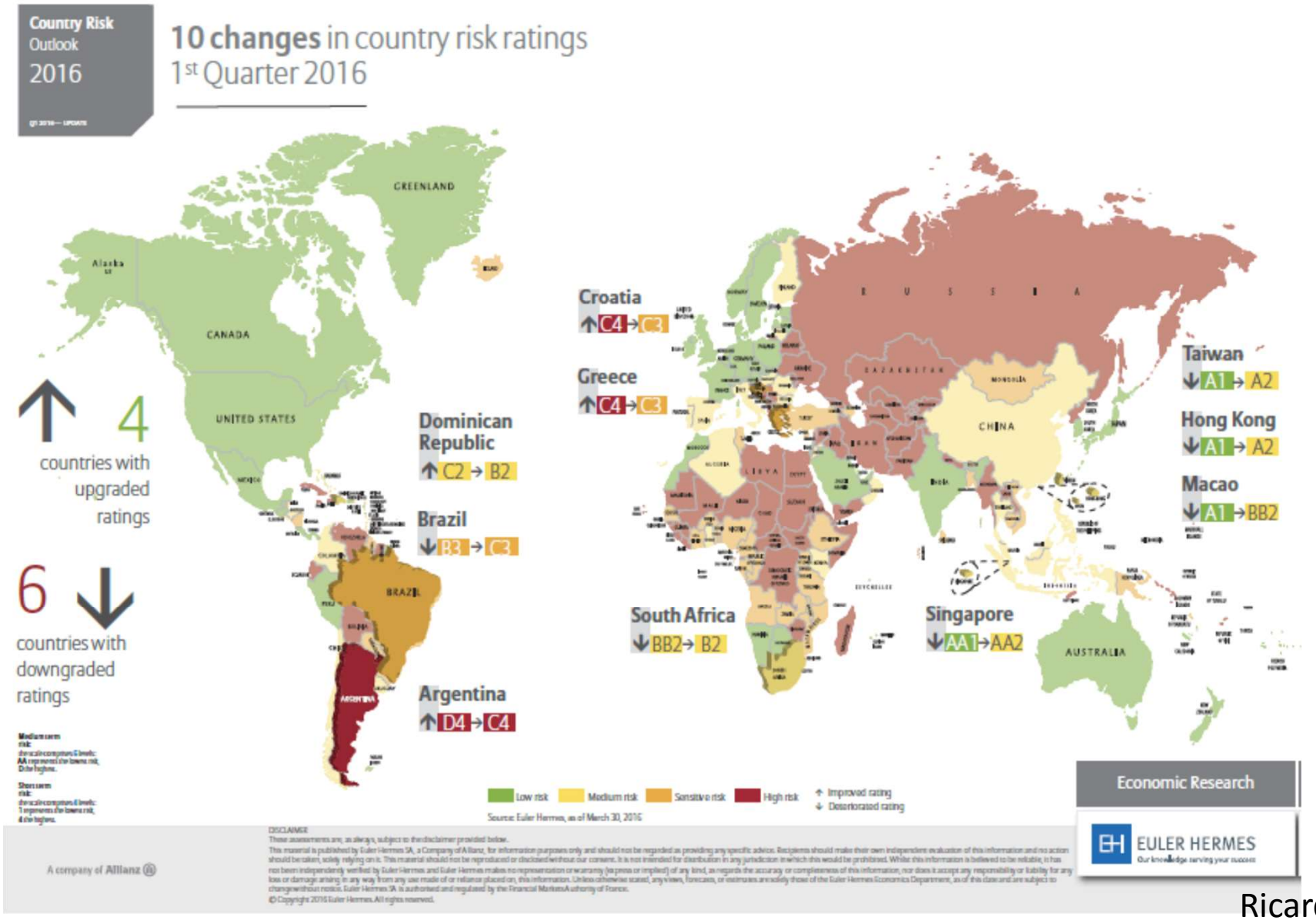
	Oil	Electricity	Natural Gas	Coal
2012 $ 548	285	131	128	4
2013 $ 532	285	127	117	3
2014 $ 493	267	117	107	2

WEO 2014

Investors Risk

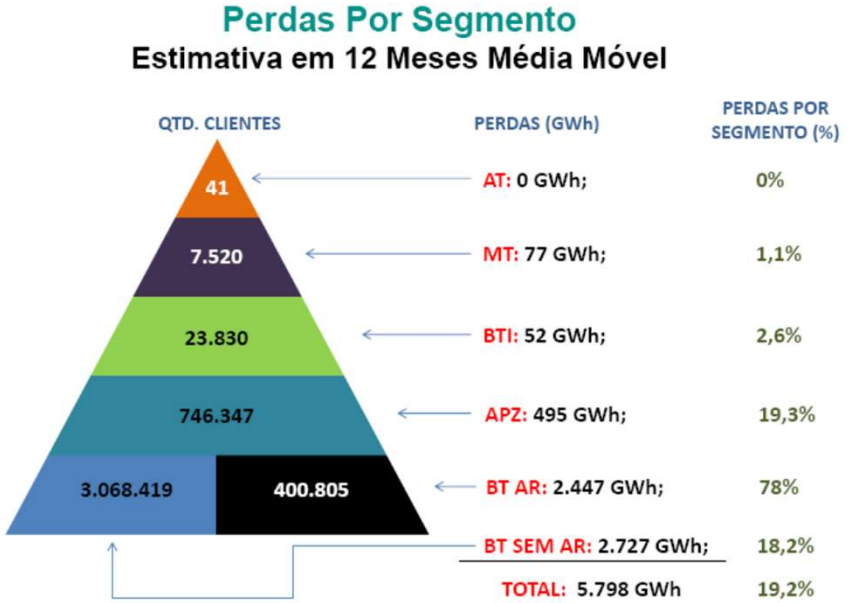
- Risk of non-payment by companies in a given country

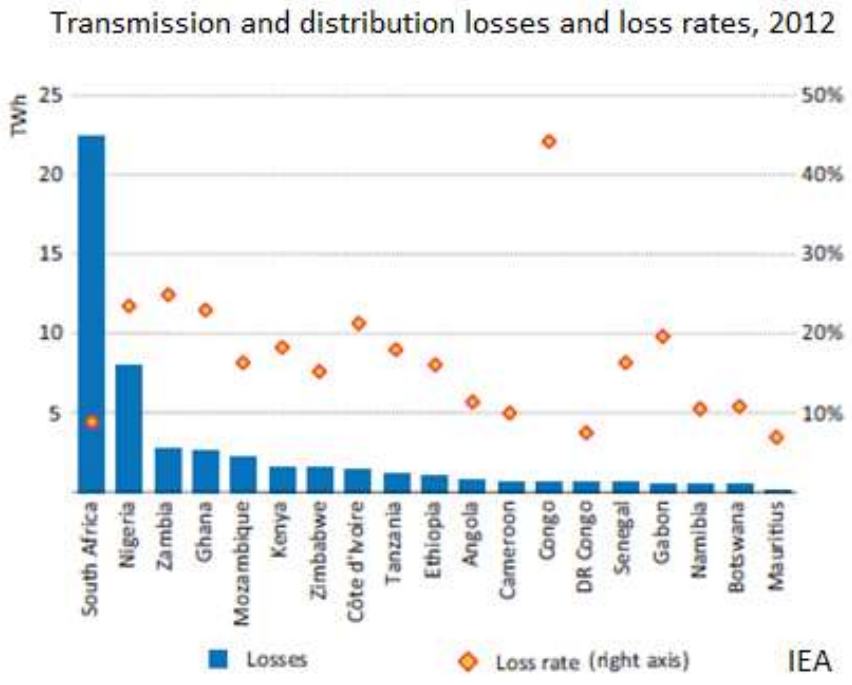
Country Risk



Ricardo Raineri

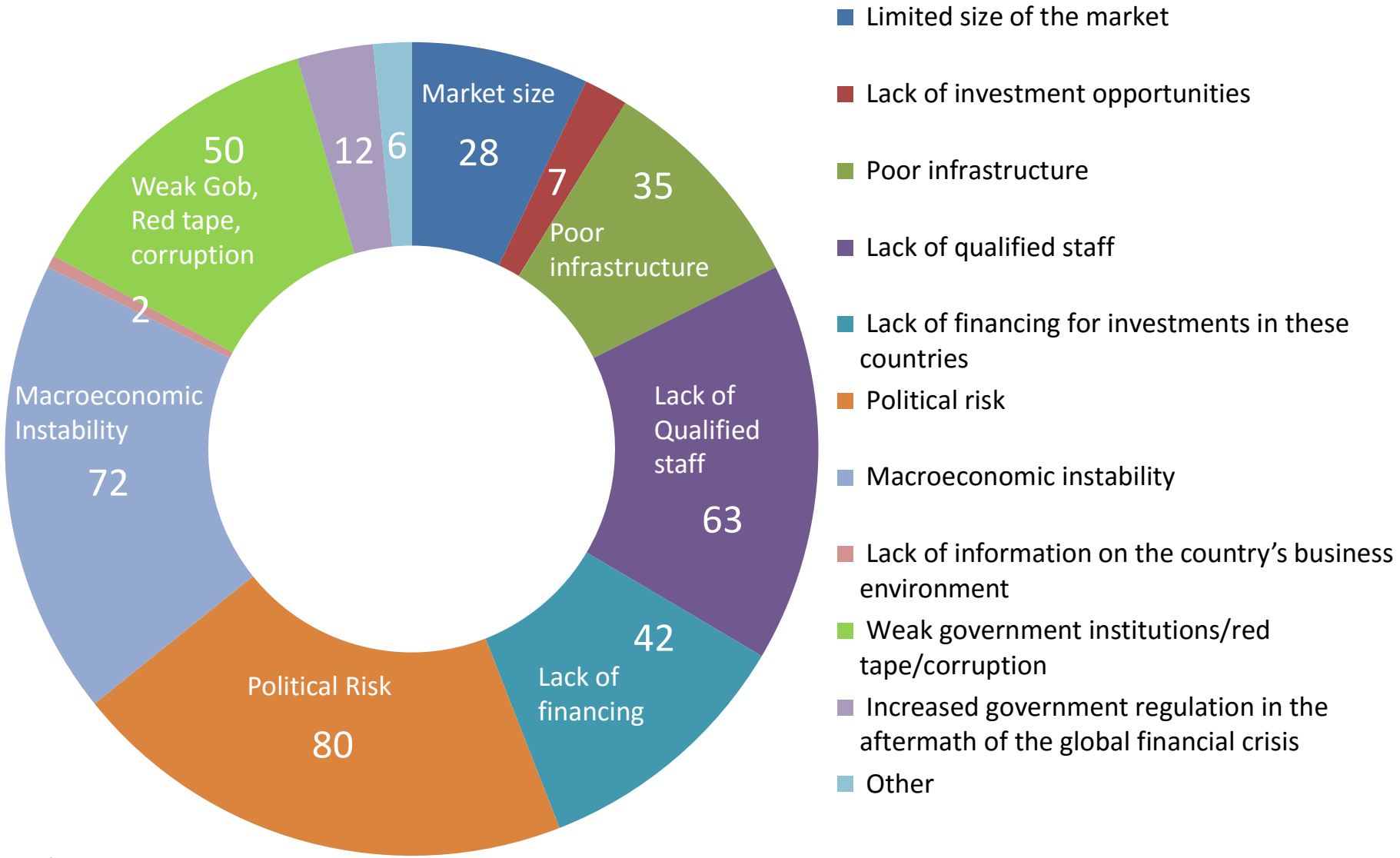
Energy Losses and Bill Payment Risks





Main Constraints to FDI in Developing Countries 2010-2013

Major constraints to foreign investment perceived over the next three years



Ricardo Raineri

Source: MIGA WIPR report 2013, MIGA-EIU Political Risk Survey

The Way Ahead

- Renewables are and will play an increasing role on the energy matrix, which yet will be dominated by FF in the years to come.
- Renewables are becoming increasingly competitive to traditional energy source, and as such, are putting a real threat to FF to become stranded assets
- Main challenges:
  - Intermittency
  - Access to the grid
  - Non Technical energy losses
  - Systems` third parties intervention
  - Bill Payment
  - Access to finance
  - Weathering low FF prices and low economic growth