Geopolitics of the Energy Transition
A focus on oil and gas

Alberta Climate Summit
September 26, 2018

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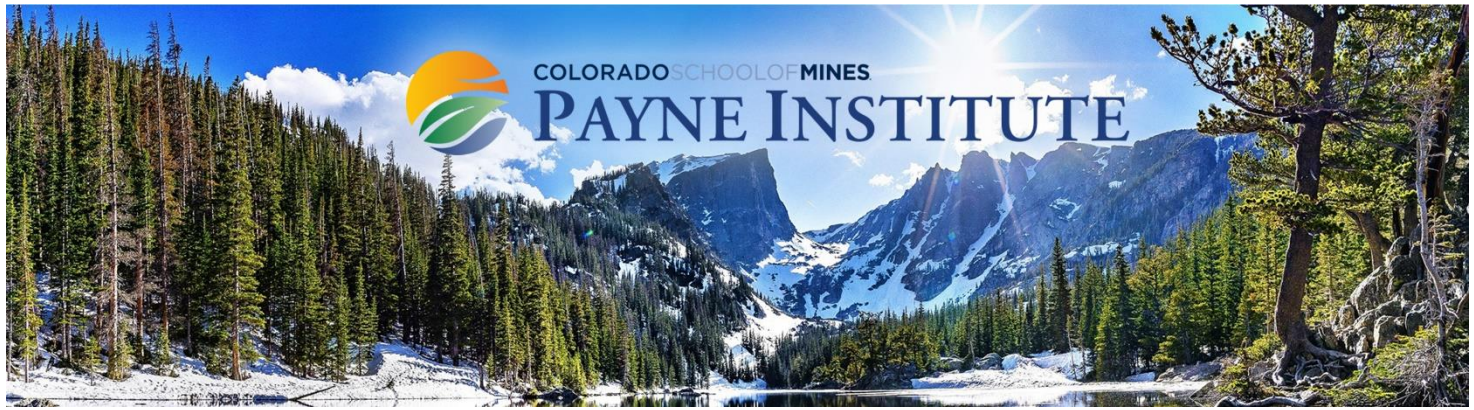
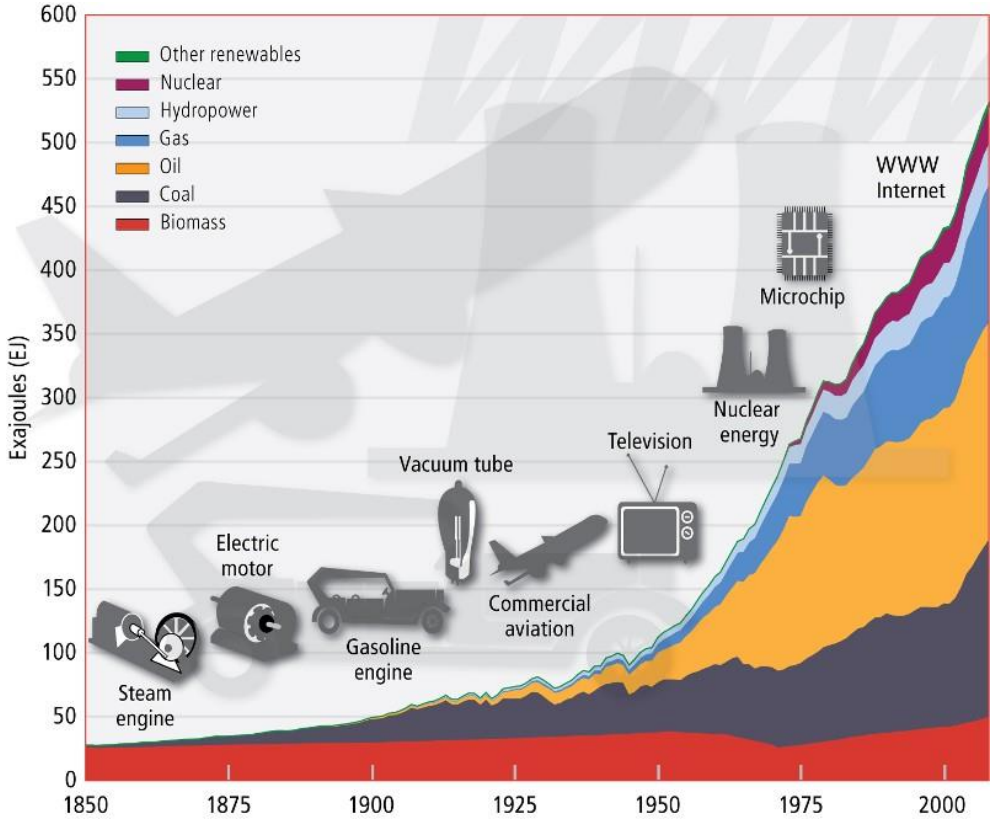


Of policy curves, triangles, and asymmetry

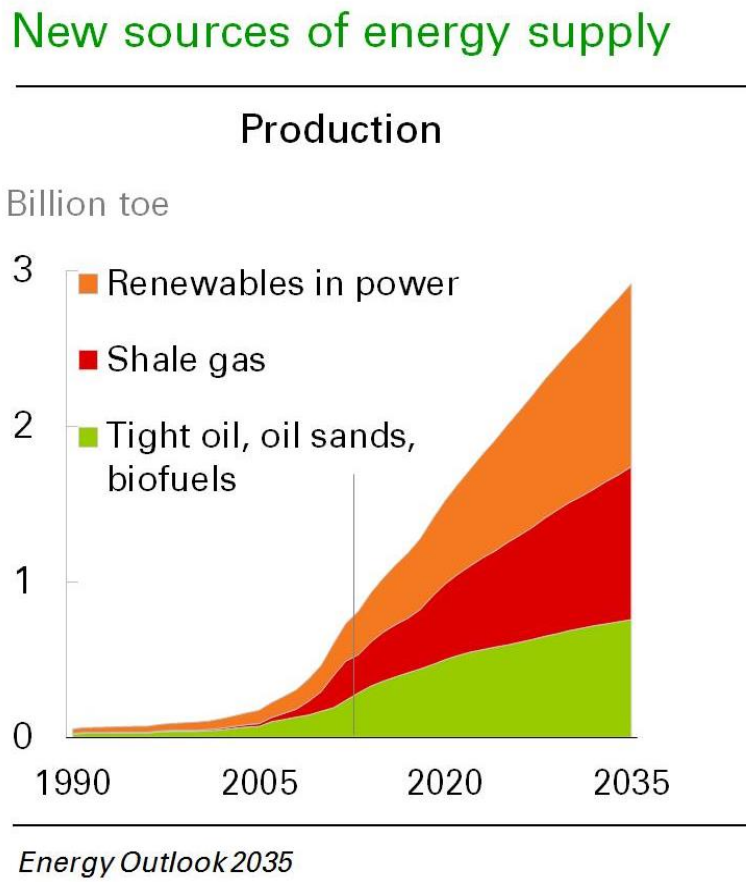
Energy is eternal delight

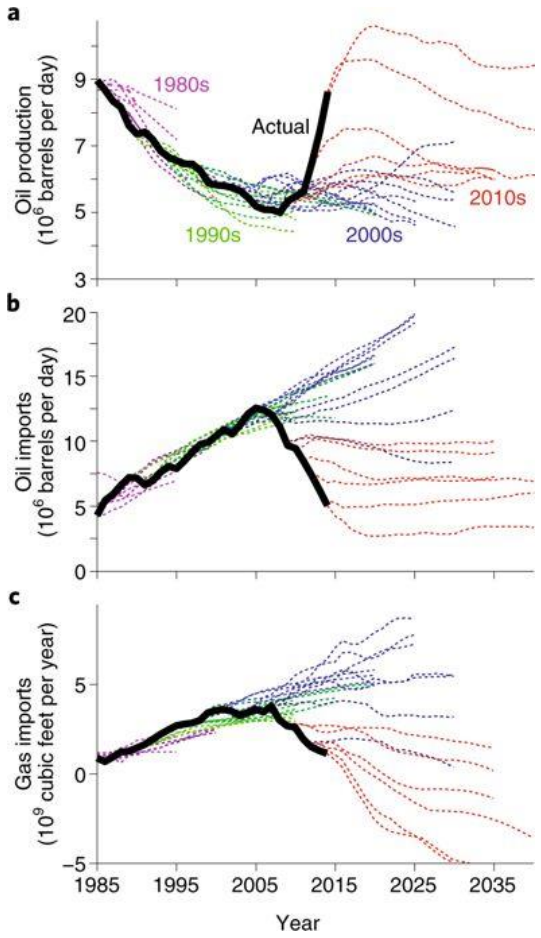
William Blake, The Marriage of Heaven and Hell, 1793



IIASA, Nakicenovic

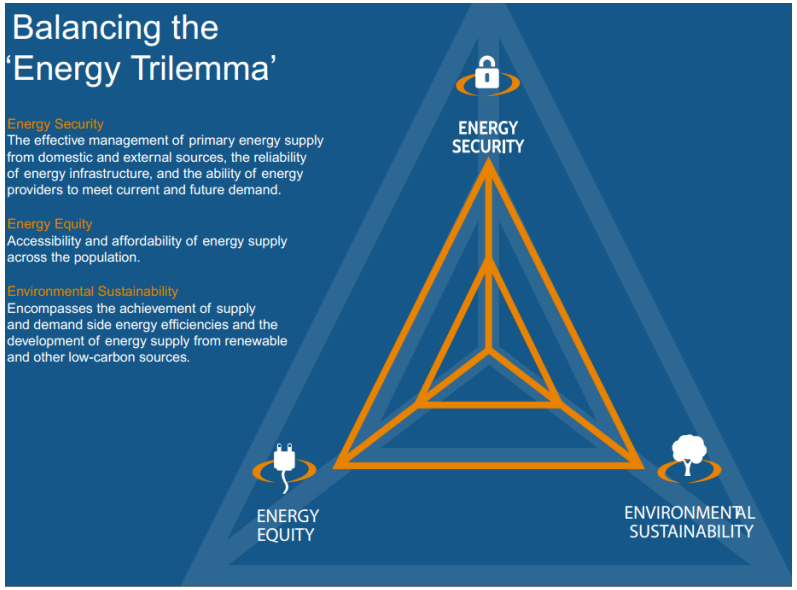
Tough for policy and regulations to keep up with curves like this



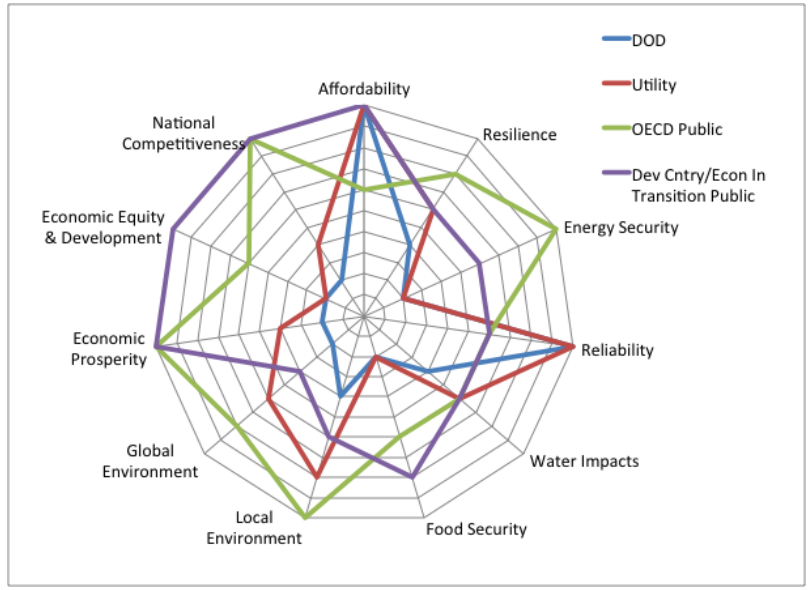


BP, Davis, S. Nature, 2018

Policy considerations no longer a triangle

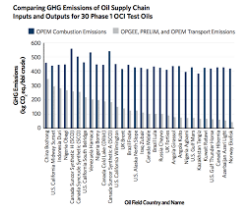


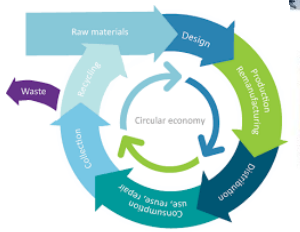
WEC, Trilemma



- Changing priorities
- Energy reliability and resiliency concerns
- Energy security considerations
- Quality of life requirements
- Water and food security
- Global market implications
- Increased access to natural gas resources
- Economics of renewables
- Environmental concerns
- Aging infrastructure.

In the news….just one week





(At least) seven contours

While the climate change impacts of the transition are being well-monitored, less so are other energy-related considerations.

(1) institutional shifts in the influence and membership of multilateral organizations like the Organization of Petroleum Exporting Countries (OPEC) and the International Energy Agency (IEA);

(2) the accelerating growth of trade in natural gas either through new international pipelines or via a rapidly expanding market for liquefied natural gas (LNG);

(3) the supply chain of cutting-edge clean edge technologies and their trade;

(4) issues of cybersecurity that are growing in importance with the rise of interconnected systems and new forms of metering and system operations;

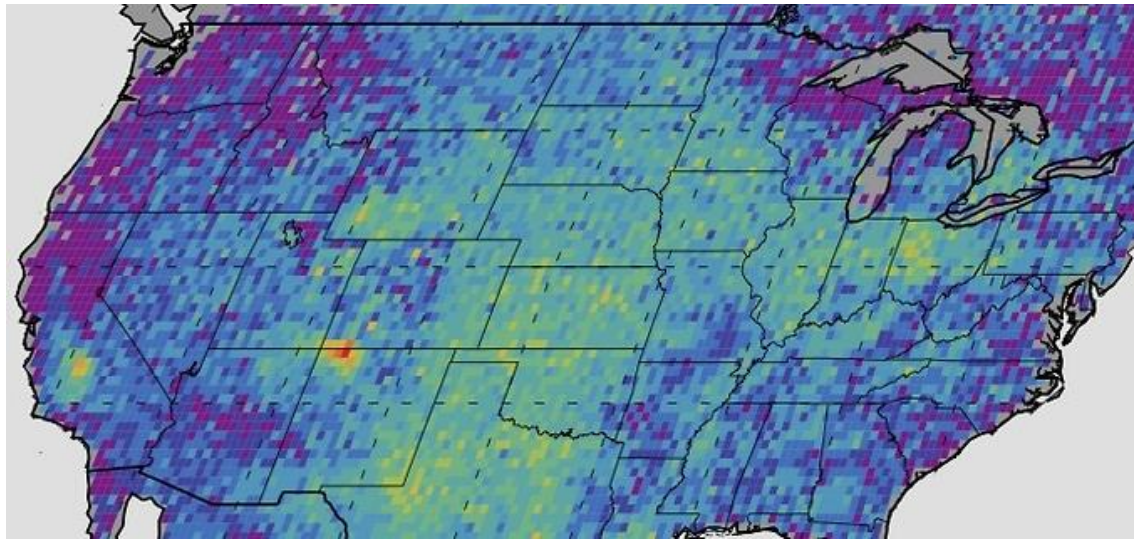
(5) the changing landscape for conflict and other minerals due to these changes in technologies and their deployment in large numbers;

(6) the growing regional power interconnection in electricity grids from the Belt and Road to East Africa; and

(7) Lingering energy poverty and the demand for provision of quality and affordable energy services to billions of people and businesses. It is clear that these areas go well beyond technology.

On environmental monitoring

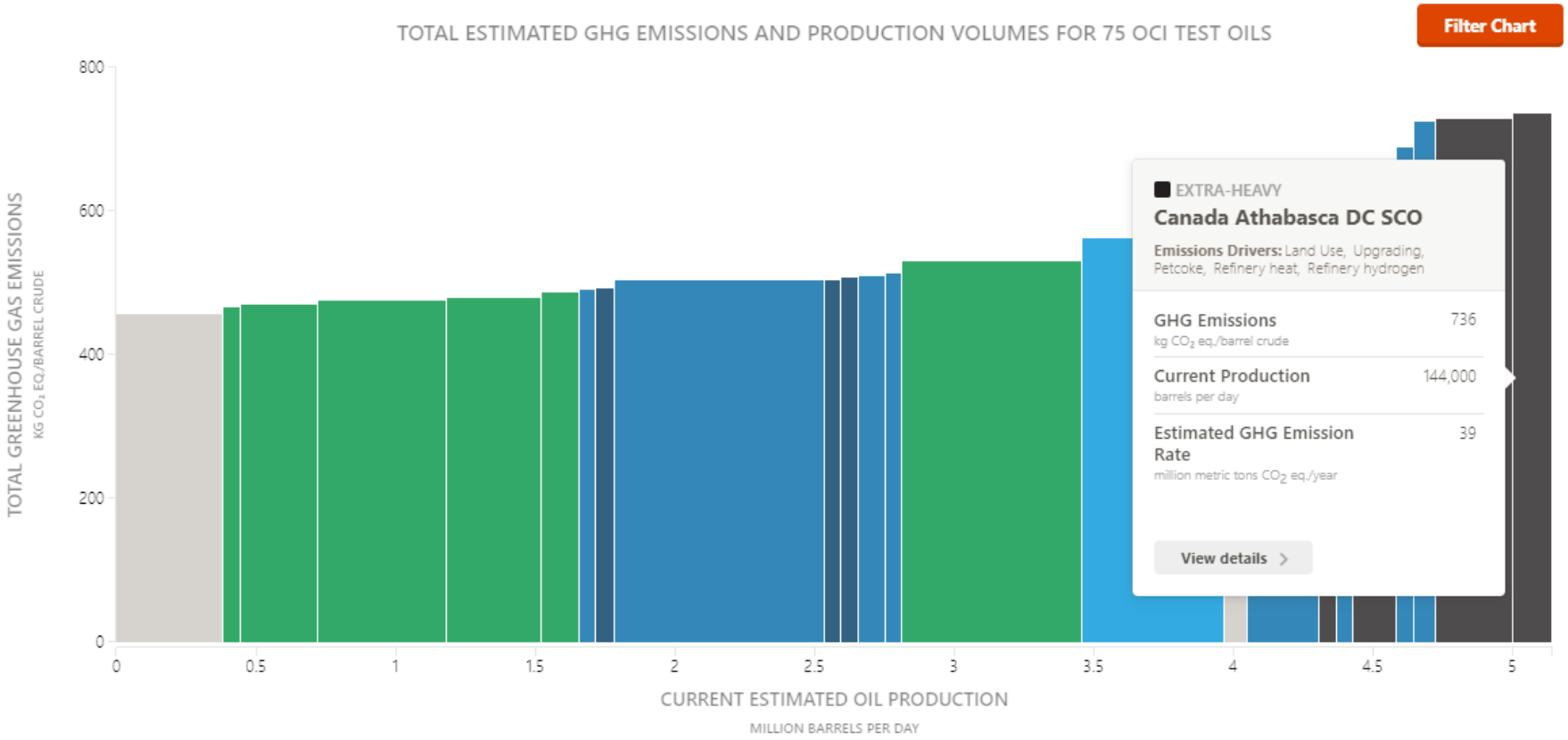
Satellite detection of methane and flaring



NASA/JPL-Caltech/University of Michigan

NOAA, ERG, 2018

Different oil, different emissions



OCI, Carnegie, Gordon, 2018

Oil and climate policy and research

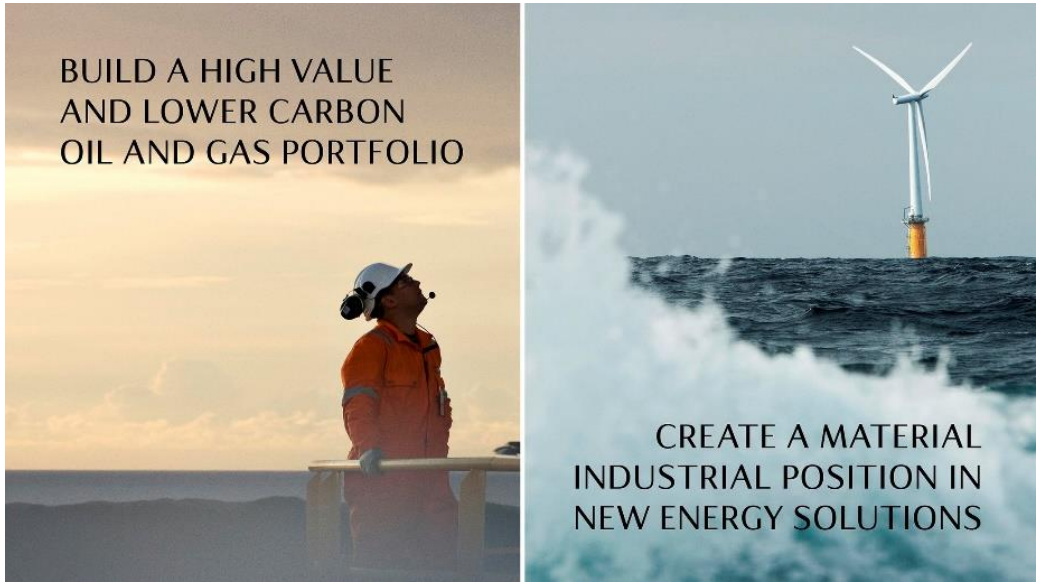
- Canada: Suncor sequester petcoke to reclaim ponds
- China & India: Ban high-sulfur petcoke power generation
- US: Lift crude oil export ban – Congressional testimony
- California: NGOs pressing to stop production of high CI oils

- Canada: *Research Excellence* grants for low CI oil processes
- California: major solar array in oil field applications
- UAE/Saudi: CO_2 injection/sequestration demonstrations

OCI, Carnegie, Gordon, 2018

In which the oil and gas companies transform

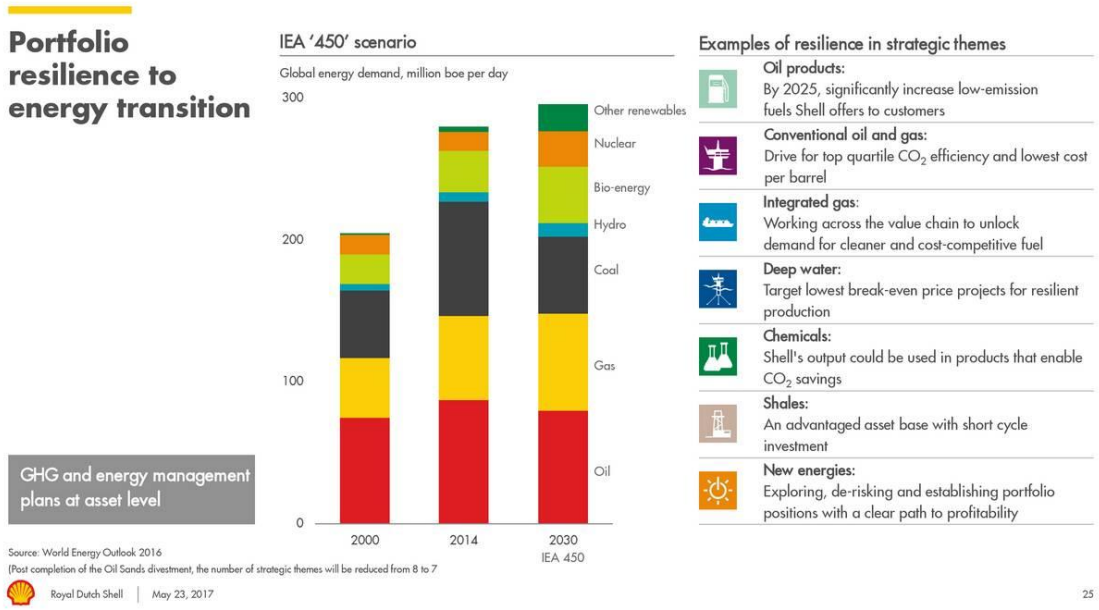
More than Beyond Petroleum this time…



From Oil to Solar: Saudi Arabia Plots a Shift to Renewables

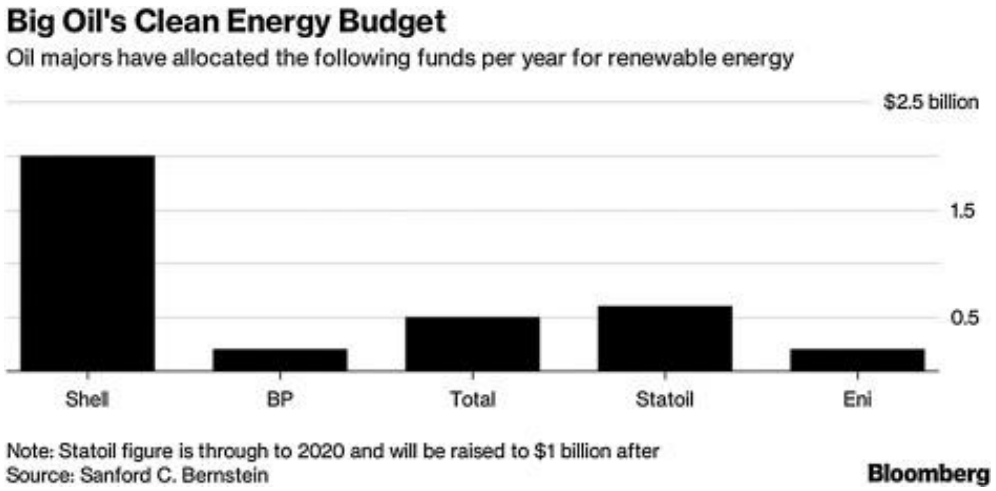
Equinor; NYT

Oil and gas companies are changing



Investments are getting to scale

Degree of diversifying IOC's commercial business operations	Degree to which startups' services are integrated into the investment company's operations	
	Tight	Loose
Passive	Integrating renewable energies into oil and gas production	Venture capitalism
Active	Integrating oil and gas competencies into producing renewable energy	Building vertically integrated value chain in renewable energy



NOCs along a continuum

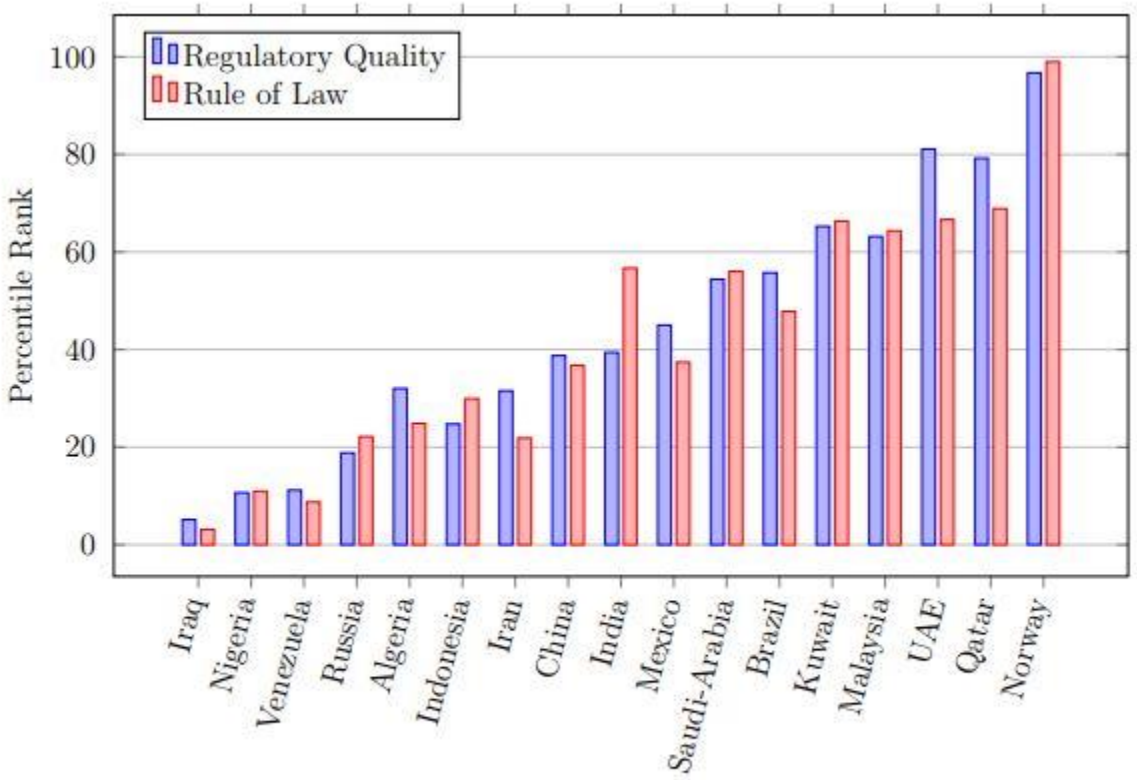
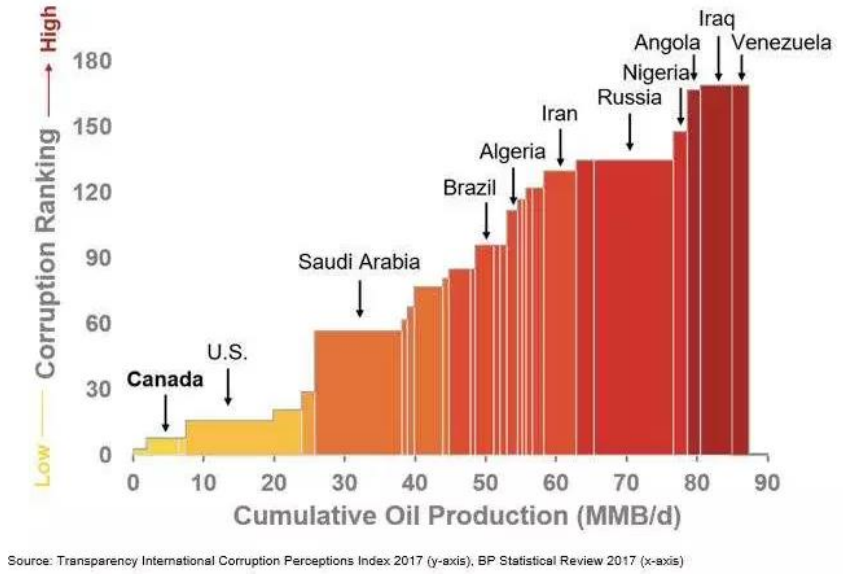


Figure 1: Governance Indicators (Source of data: The World Bank)



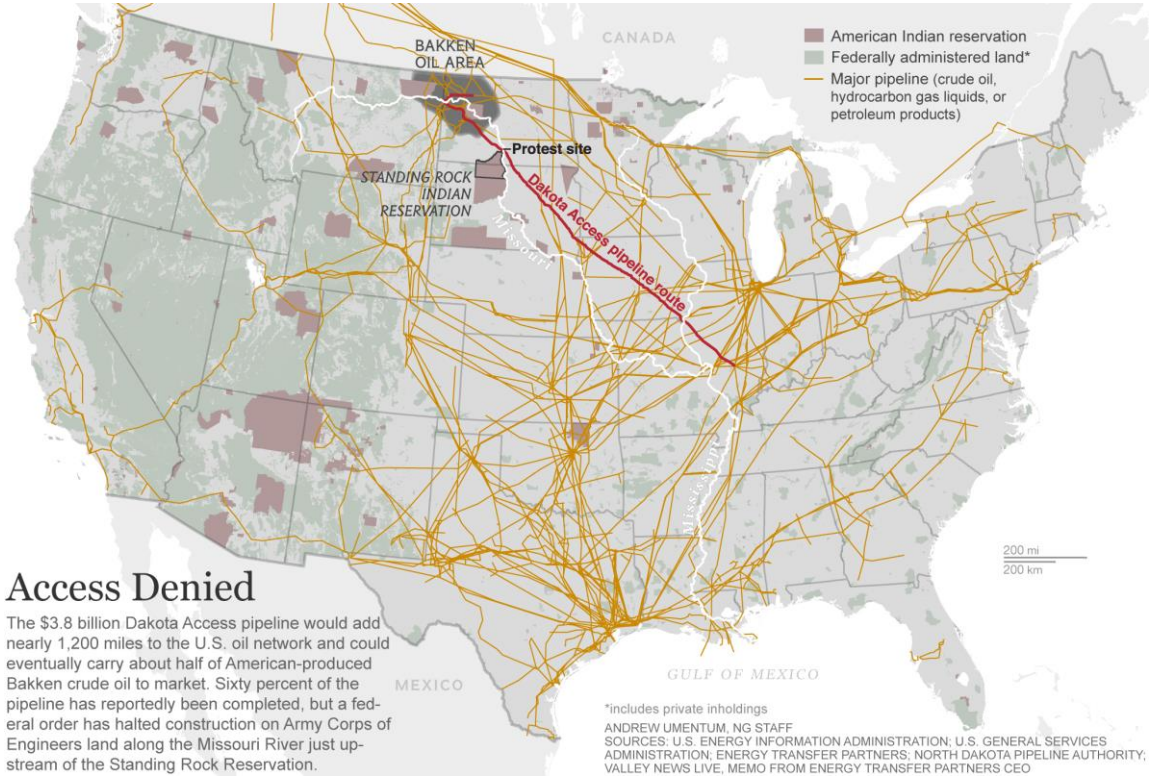
Source: Transparency International Corruption Perceptions Index 2017 (y-axis), BP Statistical Review 2017 (x-axis)

Peter Tertzakian

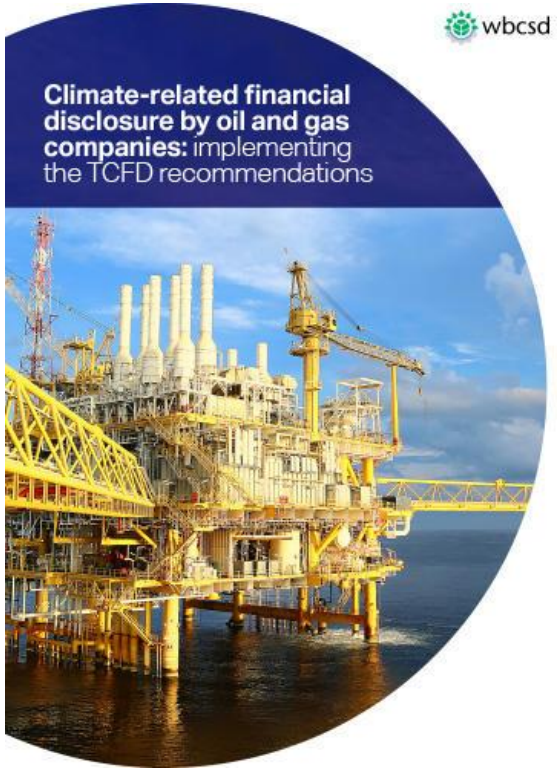
Pressure

Movements and Memes

Social License

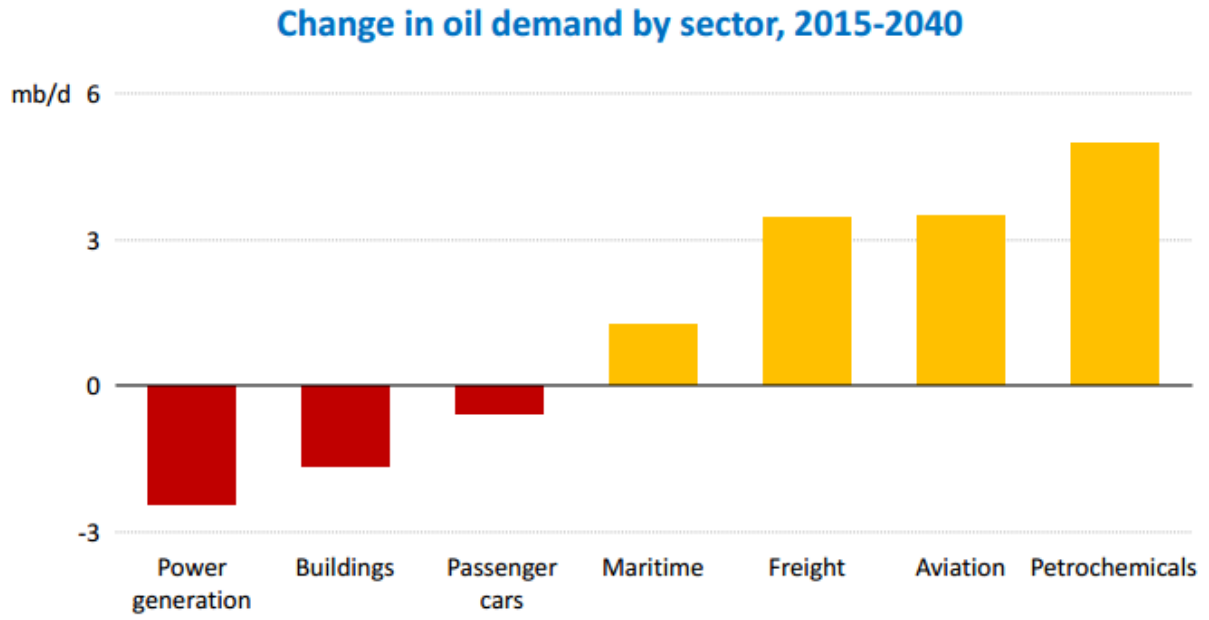


Moving money



If not transport, then…

#ElectrifyEverything

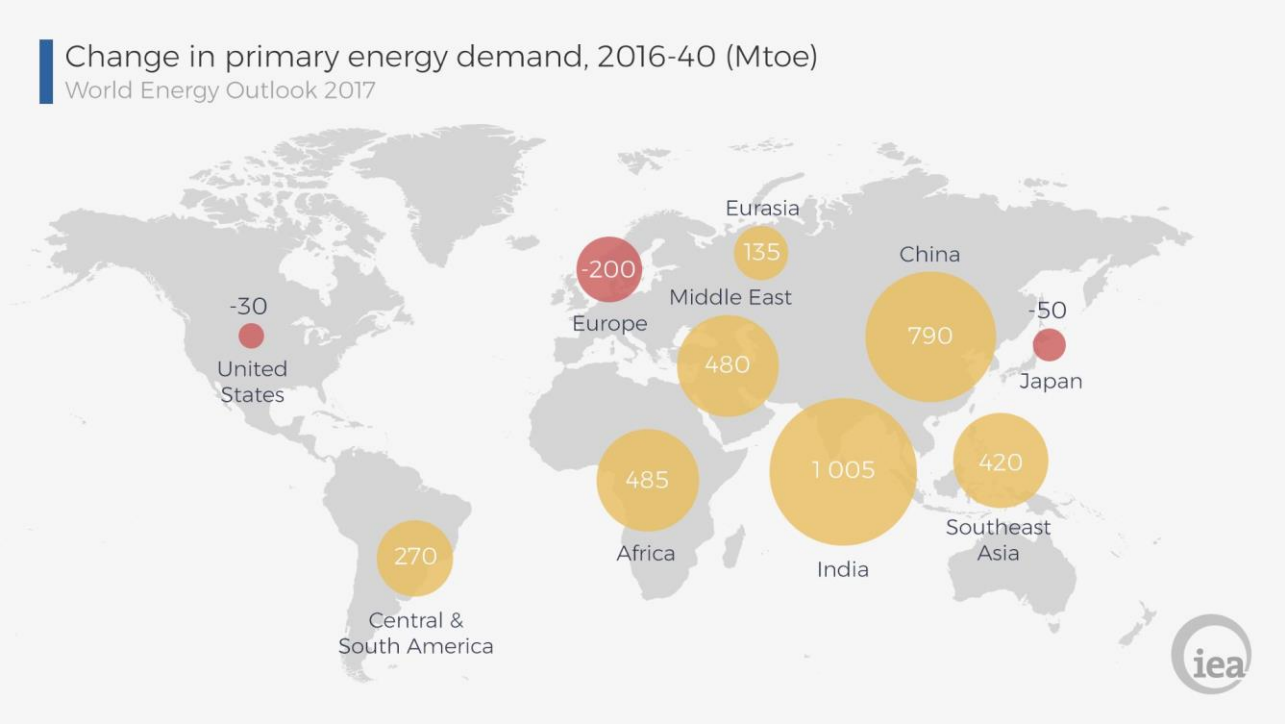


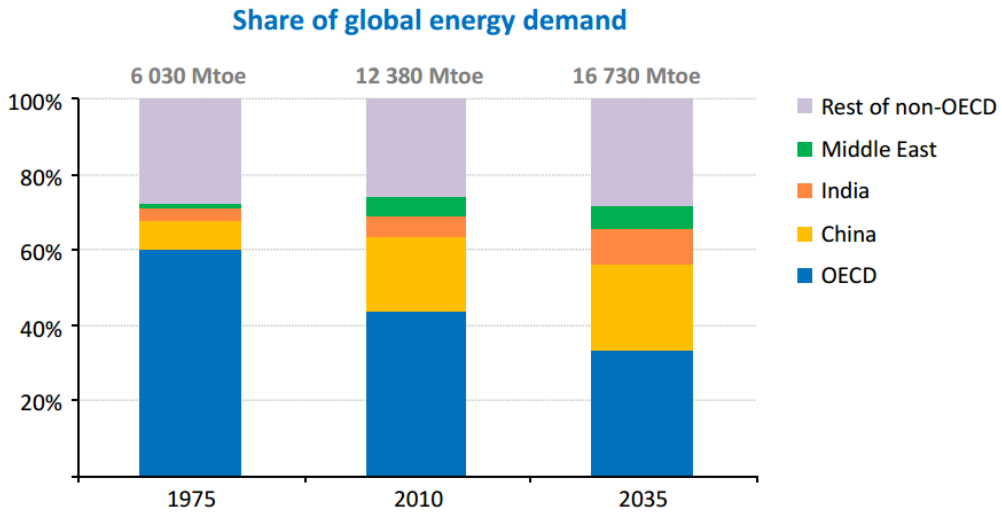
The global car fleet doubles, but efficiency gains, biofuels & electric cars reduce oil demand for passenger cars; growth elsewhere pushes total demand higher

IEA WEO, 2016

The rest (most) of the world

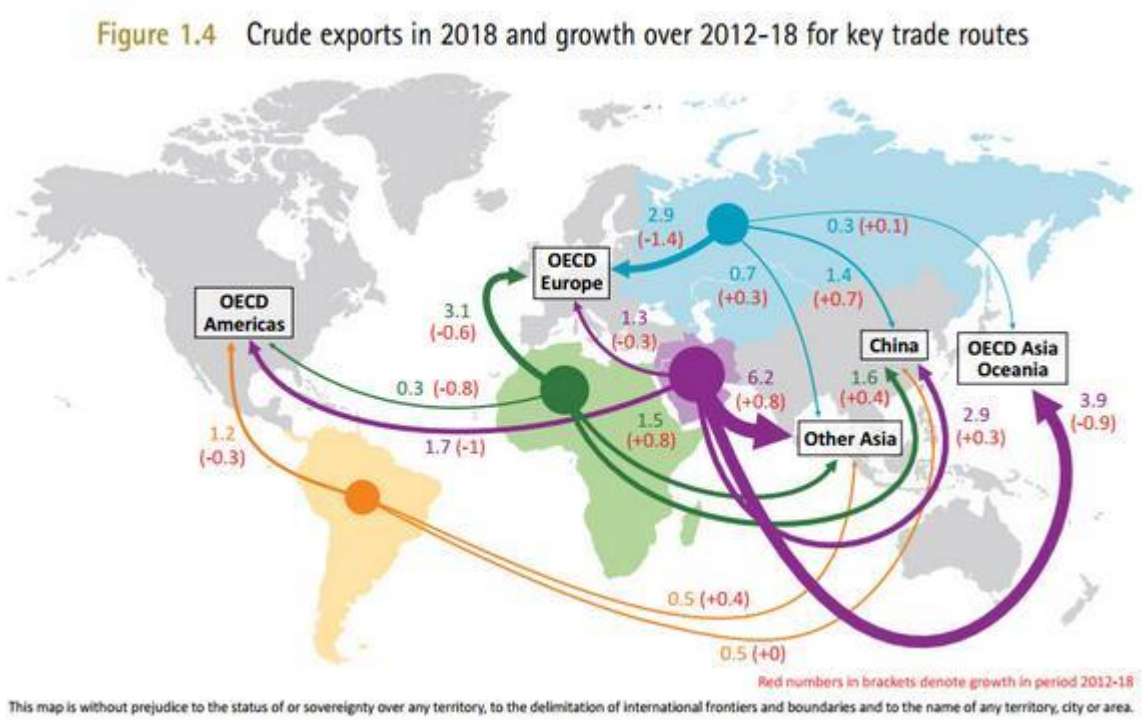
The energy transition is largely a developing country story

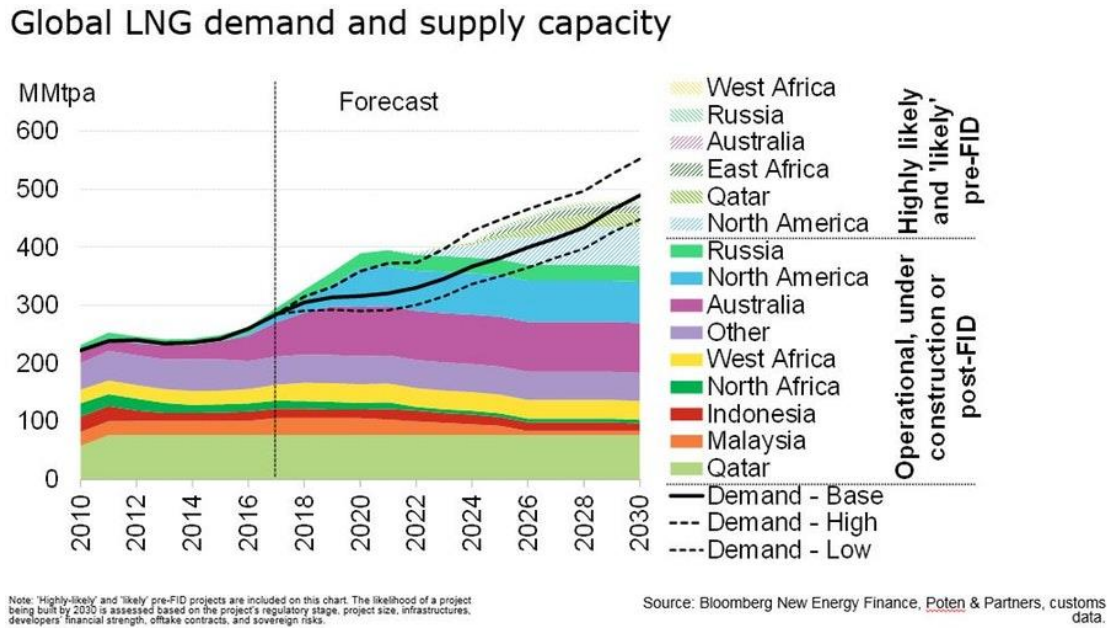




IEA WEO 2017

Changing trade maps for oil and gas





Flaring and planning

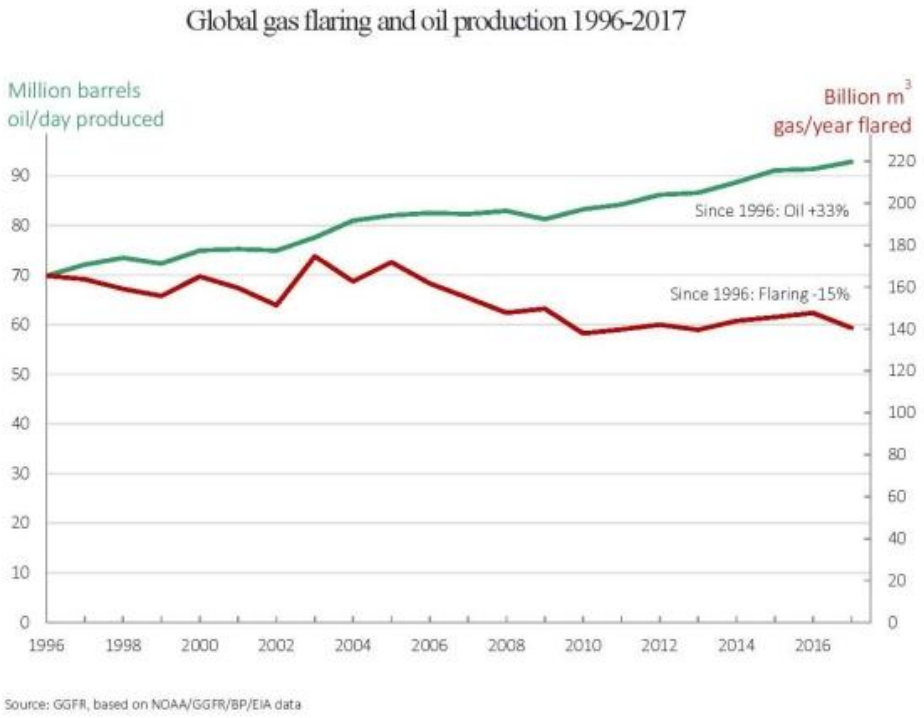
Governments, oil companies, and development institutions around the world are encouraged to endorse the “Zero Routine Flaring by 2030” Initiative.

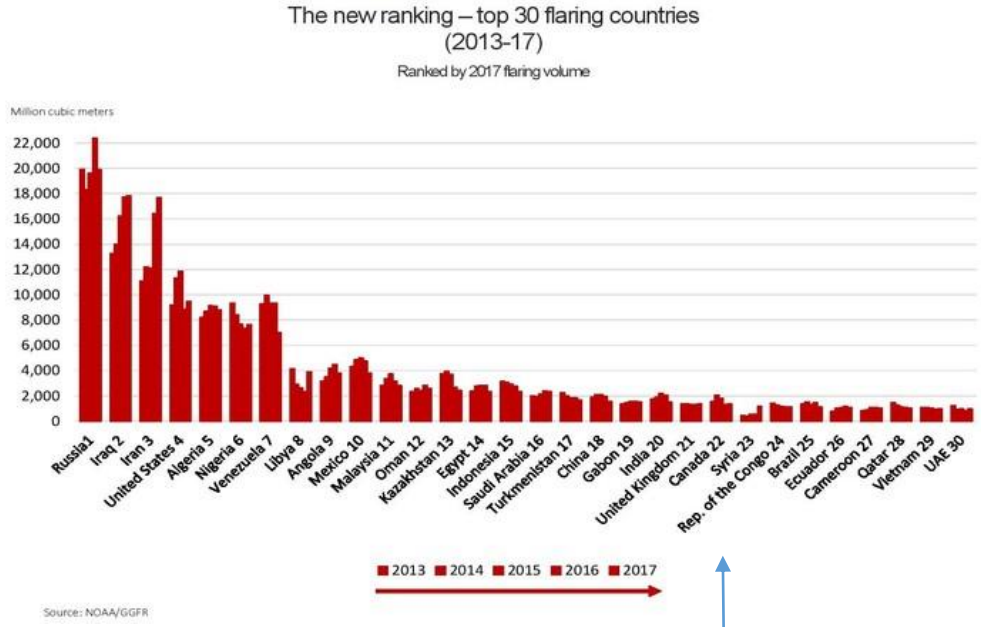
Canada has endorsed.

About 140 billion cubic meters annually. Enough to produce 750 billion kWh power

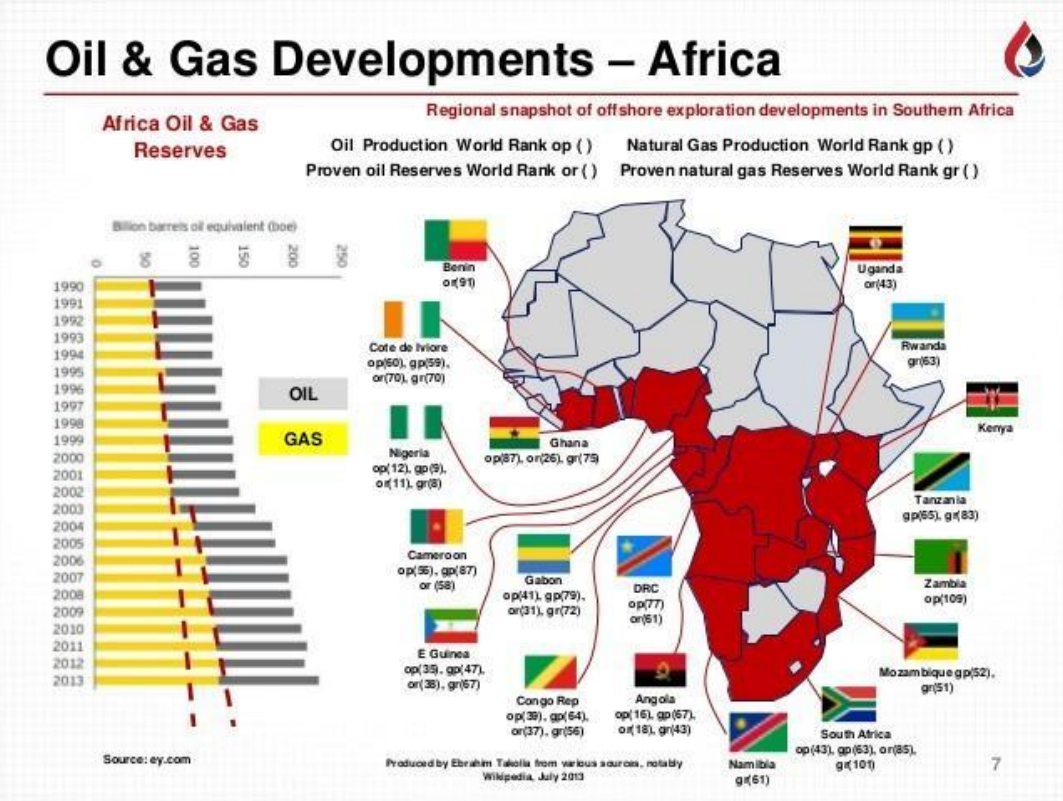
More than the entire power consumption on the African continent currently

#22


Global gas flaring and oil production 1996-2017
Million barrels oil/day produced
Billion m3 gas/year flared
Since 1996: Oil +33%
Since 1996: Flaring -15%
0
10
20
30
40
50
60
70
80
90
0
20
40
60
80
100
120
140
160
180
200
220
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Source: GGFR, based on NOAA/GGFR/BP/EIA data

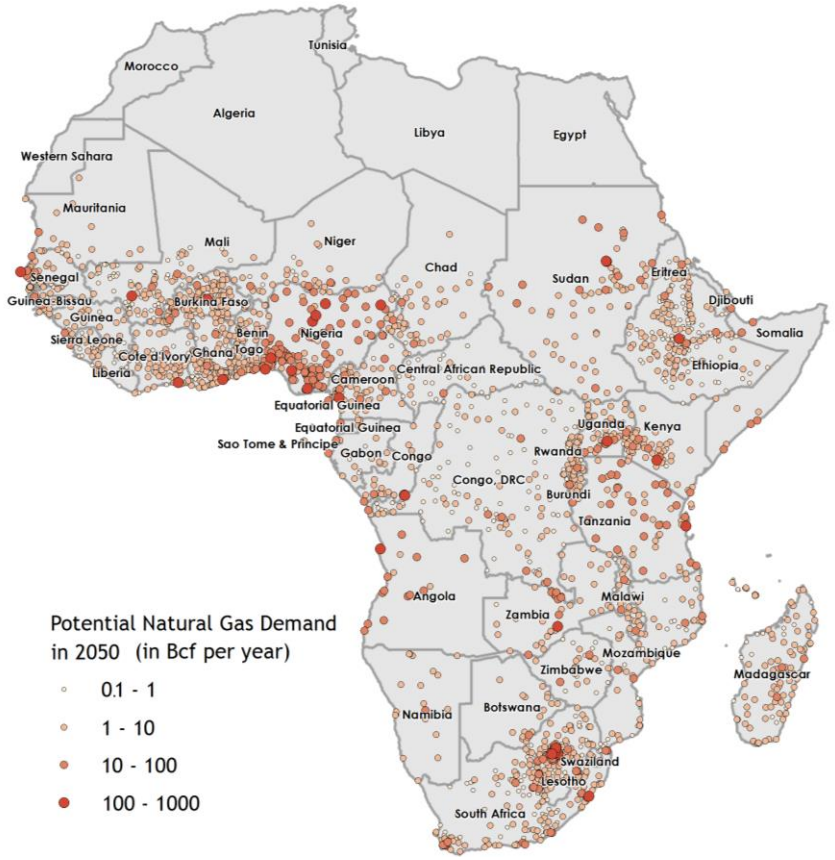

The new ranking – top 30 flaring countries (2013-17)
Ranked by 2017 flaring volume
Million cubic meters
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Russia 1
Iraq 2
Iran 3
United States 4
Algeria 5
Nigeria 6
Venezuela 7
Libya 8
Angola 9
Mexico 10
Malaysia 11
Oman 12
Kazakhstan 13
Egypt 14
Indonesia 15
Saudi Arabia 16
Turkmenistan 17
China 18
Gabon 19
India 20
United Kingdom 21
Canada 22
Syria 23
Rep. of the Congo 24
Brazil 25
Ecuador 26
Cameroon 27
Qatar 28
Vietnam 29
UAE 30
2013
2014
2015
2016
2017
Source: NOAA/GGFR

Opportunity

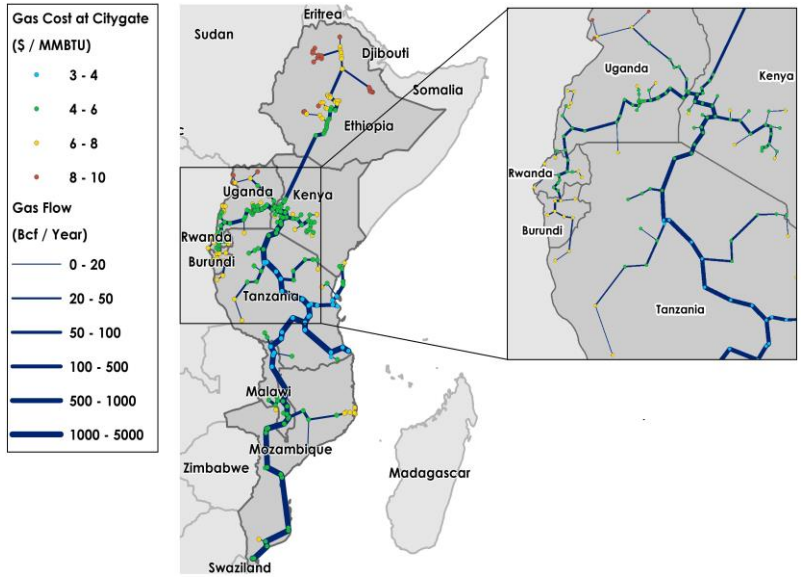


CNODC - China Nigeria	Statoil - Norway Mozambique South Africa	Sinopec - China Angola Cameroon Dijibouti Egypt Ehtiopia Gabon Ghana Nigeria	ENI - Italy Algeria Angola Republic of Congo Egypt Gabon Ghana Kenya Liberia Libya Mozambique Nigeria Tunisia	Exxon - United States Algeria Angola Republic of Congo Egypt Equatorial Guinea Ethiopia Ghana Ivory Coast Kenya Mauritius Morocco Mozambique Nigeria São Tomé and Príncipe Senegal South Africa Tunisia Zambia Zimbabwe
Savannah Petroleum - UK Niger	Petronas - Malaysia Cameroon Mauritania South Africa			
ZPEP - China Ethiopia	Chevron - United States Angola Botswana Republic of Congo Sudan São Tomé and Príncipe	Total - France Botswana Cameroon Gabon Gambia Lesotho Namibia Republic of Congo South Africa		
CNPC - China Sudan				
Anadarko - US Mozambique	British Petroleum - UK Algeria Angola Botswana Egypt Mozambique South Africa Zimbabwe	Royal Dutch Shell - Netherlands Algeria Angola Republic of Congo Egypt Gabon Ghana Kenya Liberia Libya Mozambique Nigeria Tunisia		
Rosneft - Russia Mozambique				
PERENCO - UK Republic of Congo				
ELF - France Cameroon				

Domestic demand and infrastructure?



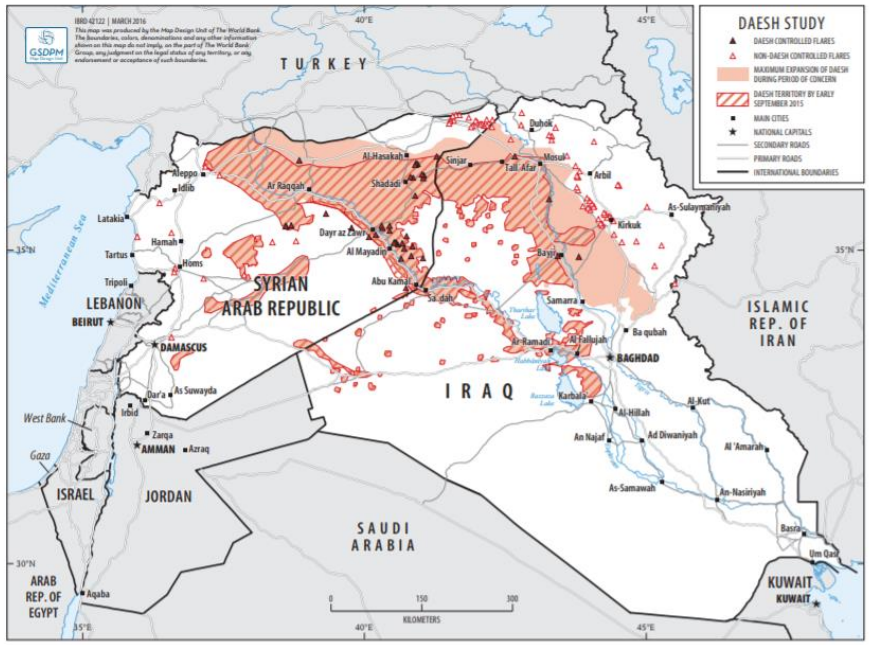
Estimated potential natural gas demand in sub-Saharan Africa by 2050.



Optimal transmission pipeline network and gas cost at city gate for the baseline scenario. Based on the estimated gas demand for 2050 and a gas production cost of $3/MMBtu. It is assumed that 1300 Bcf/year is exported from Matola (Southern Mozambique) to South Africa. The required investment is estimated at $56.7 Billion.

New ways to monitor geopolitics

Figure 1: Iraq and Syria Oil Production, Fields, and Daesh Control, March 2016



World Bank, 2017; Tanktrackers on Twitter

Parting thoughts

Try good stories

- **Role of the oil and gas companies in the energy transition**
  - Enormous technical and expertise
  - Financial acumen and significant funding
  - Global presence
  - Forefront companies are looking carefully at the transition
  - Role in economic development

- **Analogous to the role of minerals and metals in the energy transition**
  - A good story for mining companies
  - Supply for the future of batteries, PV, wind, LEDs, etc.
  - Not as used to working with Public Relations

- **Tying back to Kate's comments**
  - Chemical and materials from carbon…
  - Role of CCUS in power, but also industry
  - Real examples of transitions to natural gas

https://payneinstitute.mines.edu