The emerging economic, environmental, and geopolitical implications of changing U.S. energy trade

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Two goals today

1. Understand how and why US energy trade is changing
2. Identify emerging challenges for industry, governments, and society
Global Energy Trade is Highly Interconnected

Source: Carbon Brief https://www.carbonbrief.org/mapped-the-global-coal-trade
What does “energy trade” mean?

- Commodities**
  - Primarily hydrocarbons
  - Biomass
  - Uranium
  - Electricity
- Supply chain
  - Raw, processed, or manufactured products used in energy fuel cycles
- Services
- Technology
- People
- Institutions
* Reprocessing of spent nuclear fuel, including mixed-oxide (MOX) fuel, is not practiced in the United States.

Note: The NRC has no regulatory role in mining uranium.

As of June 2017
Clean Energy Supply Chains
Balancing the ‘Energy Trilemma’

**Energy Security**
The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.

**Energy Equity**
Accessibility and affordability of energy supply across the population.

**Environmental Sustainability**
Encompasses the achievement of supply and demand side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

Great news! The US will finally be energy independent

- “Under my presidency, we will accomplish a complete American energy independence. Complete. Complete.” – Candidate Trump, May 2016
- “True energy independence is finally within our grasp.” – Department of Energy Secretary Perry, July 2018
- “America is closer to energy independence than we’ve been in decades.” – President Obama, January 2014
Or will it?

- The US is not energy independent yet
  - Still a net importer of energy on a btu basis
  - Projections of net exports are still years away
  - Net zero exports != energy independence
- Energy independence is not a meaningful goal
- Energy independence generally refers to commodities, not supply chains, labor, technology, or ideas
The Economics of Falling Net Imports

- In regulated market economies, energy decisions are ultimately driven by a combination of specific policies and market outcomes.
- Falling net imports today are caused by (in approximate order of importance):
  - US vehicle efficiency standards (CAFE)
  - The “light” shale revolution
    - Decreasing net oil imports
    - Increasing net natural gas exports
  - Growing domestic renewable energy
  - Policy moves to facilitate the net importer to net exporter transfer
The Shale Revolution is Light…
Market Shares of Gross Imports Changing
An Energy Interdependent Continent?

On a net basis, Canadian electricity supplies about 1.5% of US annual electricity demand.

Electricity trade is concentrated near the Eastern side of the border.

Canadian electricity imports are ESSENTIAL to operating NE and NY’s grids.
2017 U.S. Exports of LNG by Destination Country

Exports By Destination Country

Note: Only includes shipments by vessel. Excludes shipments by truck.

Source: EIA, NGI calculations
Key Export Projects

- **Ongoing LNG terminal wave**
  - Significant number (~15% of annual demand) operating or otherwise post FID
  - Another 30 Bcf/day of proposed facilities are in the pipeline, many FIDs due soon

- **Coal terminal proposals**
  - Despite low domestic prices and falling demand, global coal markets are saturated
  - Washington State EIA

- **Cross-border electricity and natural gas connections for both Canada and Mexico**
  - Transmission lines connecting Canadian hydro to New York or New England are especially contentious due to local siting concerns
  - Mexican energy reform is creating opportunities for exports, particularly from Texas

- **Saudi Arabia competition for reactor supplier**
  - Shopping globally across all major nuclear suppliers
  - Key sticking point for the US is Saudi insistence on reprocessing
  - US-based private multi-nationals versus state-owned enterprises
Environmental Implications of Growing Gross Exports

- **Domestically**
  - Shifts in imports or exports changes prices which shift dispatch
  - Upstream production is necessary, with attendant local impacts
  - Export facilities can have large site impacts, requiring EIAs and/or Presidential Permits

- **In importing countries**
  - Import facility and supporting infrastructure required (often newly constructed)
  - Depends on energy import and how it impacts domestic mix

- **Globally**
  - Aggregate of domestic and importer environmental impacts
  - To lesser degree, also include second-order effects from global market impacts

- Because we don’t have global governance and environmental regulations, energy trade can lead to divergent emissions outcomes
Bounding the Environmental Impacts of LNG Exports

- Series of three studies (AG + BS)
  - 1st: Benchmarking US coal and natural gas fleets
  - 2nd: US liquefied natural gas (LNG) exports: Boom or bust for the global climate?
  - 3rd: Carbon pathways in the global gas market
  - Findings: it depends!

- Coal
  - Comment on “Environmental Implications of United States Coal Exports: A Comparative Life Cycle Assessment of Future Power System Scenarios” by AG
  - Almost unequivocally bad
Benchmarking the Domestic Fleets

- **US coal fleet (graphic)**
  - Old
  - Highly inefficient
  - Variations in non-combustion emissions
- **US natural gas fleet**
  - Relatively new
  - On average, efficient
  - Newest units are hyper-efficient
  - Lower CO2 and LAPs
- **Coal-to-gas shifting**
  - Driven by shale
  - Generally targets the least efficient coal plants (by HR and CO2e)
Boom or Bust for Global Climate?

**Japan**
- **Power**
- **Industrial**
- **Other**

**Consumption by Sector**
- Consumption 2012 (TCF): 5.02
- Net Imports: 4.68

**South Korea**
- **Power**
- **Industrial**
- **Other**

**Consumption by Sector**
- Consumption 2012 (TCF): 1.50
- Net Imports: 1.48

**China**
- **Power**
- **Industrial**
- **Other**

**Consumption by Sector**
- Consumption 2012 (TCF): 4.35
- Net Imports: 0.68

**India**
- **Power**
- **Industrial**
- **Other**

**Consumption by Sector**
- Consumption 2012 (TCF): 2.26
- Net Imports: 0.54

**Identified LNG Applications**
- **Electricity**
- Coal
- Nuclear
- Oil
- Wind
- Solar
- Additional

- **Energy**
- Coal
- Additional
Global Carbon Pathways for Gas

mtCO$_2$e

Global | Stateless | Importer | US

Lower NG use | NG by wind | NG by solar | NG by nuclear | New NG | NG by coal | India Coal | Japan Coal | SK Coal | China Coal | Japan Oil | NG for nuclear | NG for solar | NG for wind | Additional Energy | Transit | Low Bound | High Bound | Low Bound | High Bound | Low Bound | High Bound
Geopolitics of a new global energy trade

- Oil trade is shifting considerably
  - Instead of 1 dominant demand source (the US), there are more sources of demand globally
  - US participation in global oil trade increasing
  - Questions about the future of OPEC’s pricing power
  - No significant climate restraints
- LNG trade is booming
  - US primed to become dominant supplier
  - US addition leading to global spot marketing versus legacy oil-tied long term contracts
- Low carbon trade (RE, storage, nuclear) is growing, highly interdependent
- Other types of energy trade will become increasingly competitive
- “Energy dominance” agenda threatened by tariff wars
Shale: A Challenge to OPEC?

Estimated petroleum and natural gas hydrocarbon production in selected countries

- Quadrillion British thermal units
- Million barrels per day of oil equivalent

- United States
- Russia
- Saudi Arabia

Year:
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
China’s emerging oil security issues