



DISRUPTION IN THE ENERGY INDUSTRY

NATIONAL RURAL ECONOMIC DEVELOPERS CONFERENCE
NOVEMBER 7-9, 2018 | ST. PETERSBURG, FL

THE WORLD'S LEADING LOCATION STRATEGISTS



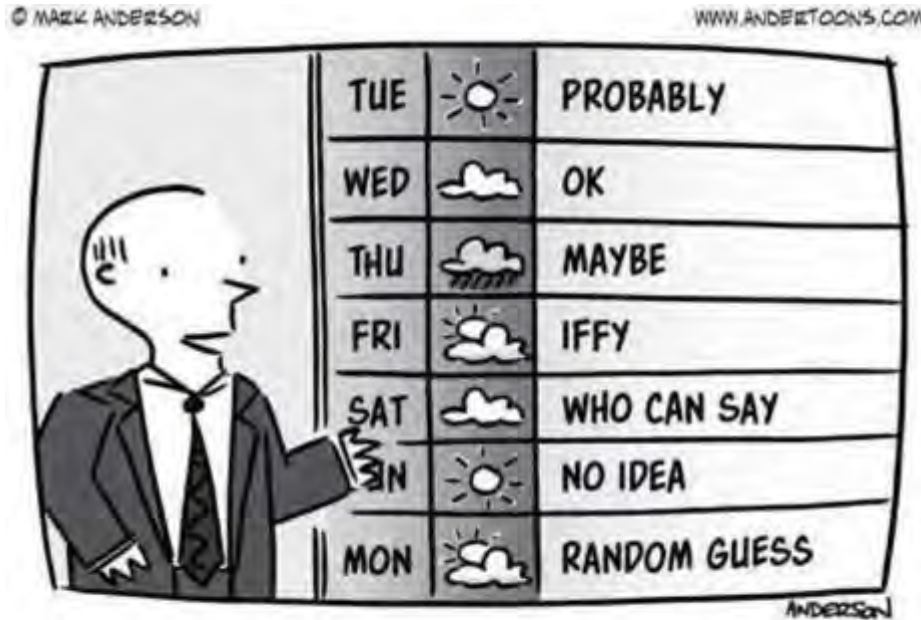
Energy is the world's largest industry

How we produce, distribute, and use energy is an engine of the global economy and a part of every economic developer's portfolio.

\$1.8 trillion was invested world wide on energy projects in 2017. This number is expected to rise year-over-year through 2035.



One thing is constant – Change



"And now the 7-day forecast..."

Two approaches to dealing with disruption in the energy industry:

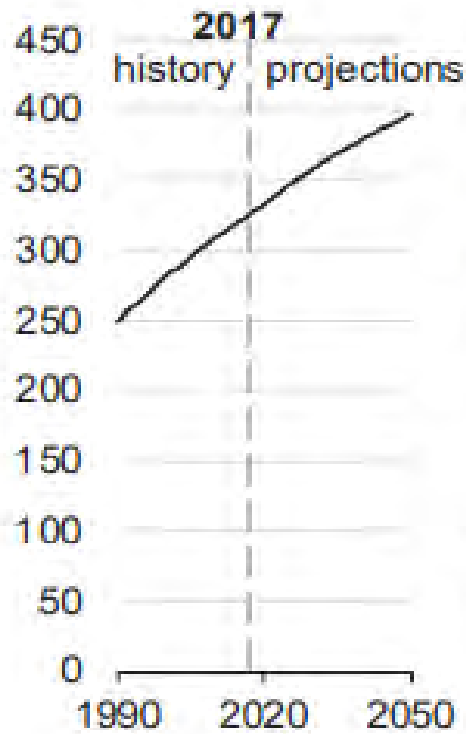
1. Serendipity – react when it comes
2. Continuously monitor trends – be strategic



Energy efficiency is a change component

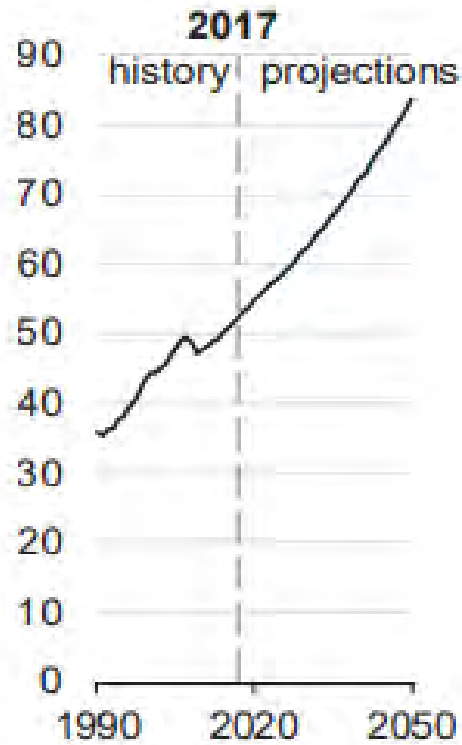
POPULATION UP

U.S. population
million people



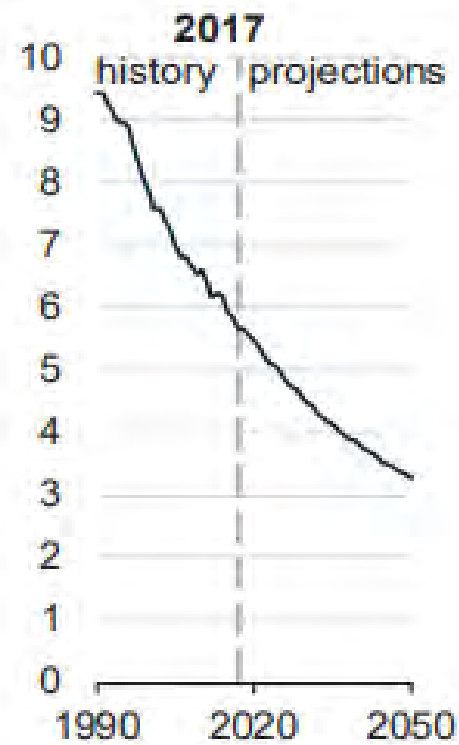
GDP UP

GDP per capita
thousand dollars
per person



ENERGY INPUT DOWN

Energy intensity
thousand British thermal
units per dollar



Source: U.S. Energy Information Administration

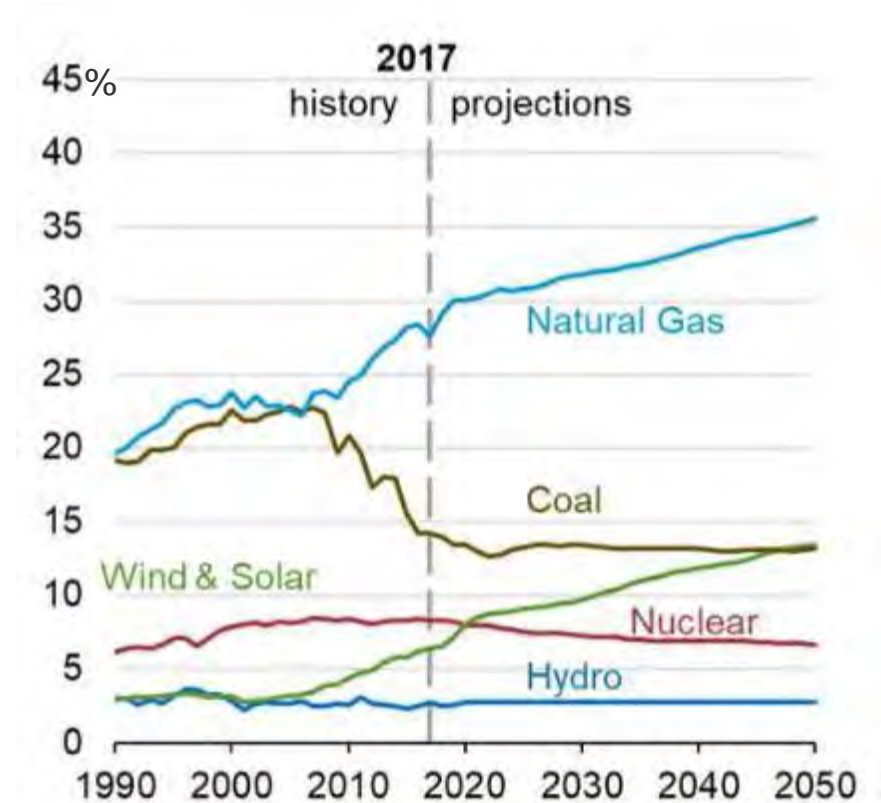
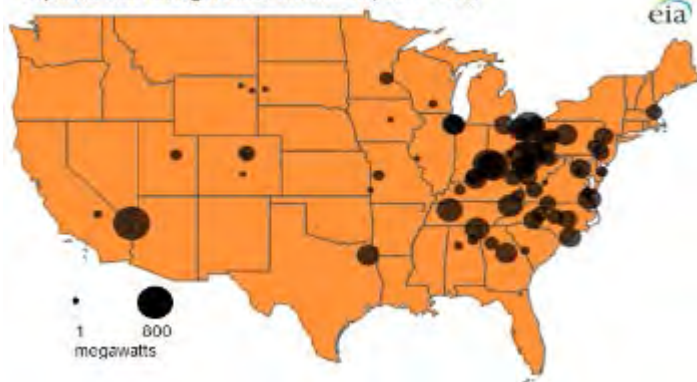


Future mix of electric power production

Coal's steady decline

- 47% of units, 22% of capacity
50+ years old
- 860 of 1466 units and 116 of 339 GWs retired 2011-2016
- 13 GW to retire in 2018

Reported Coal-fired generator retirements, 2012 - 2016



Backers say there's still time to save Ohio's nuclear plants

TOLEDO — A group backed by the owner of Ohio's two nuclear plants is taking another run at persuading state lawmakers to come up with a lifeline for the plants, which

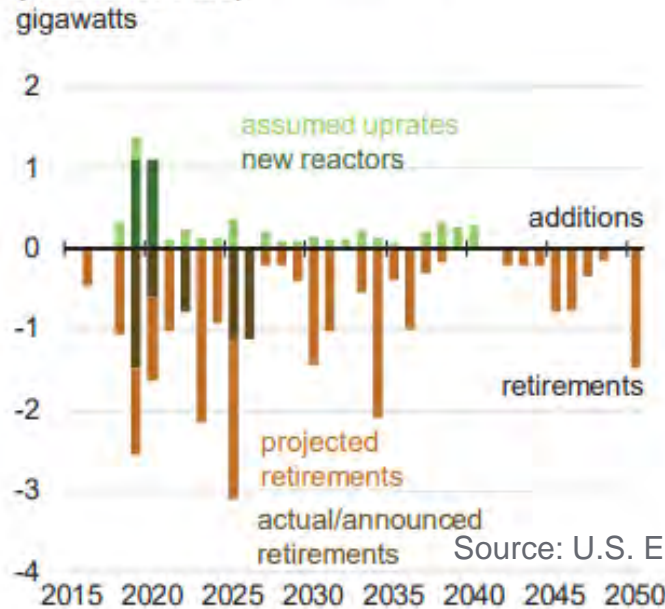
But opponents argue that a financial rescue for the plants could increase electricity rates across the state.

Many of the nation's aging nuclear reactors are becoming endangered because they are expensive to operate and maintain and are struggling to compete with cheaper natural gas plants and renewable energy.

New York, New Jersey and Illinois have responded by giving out billion-dollar bailouts that will be paid by ratepayers to stop unprofitable nuclear plants from closing prematurely.



Year-over-year nuclear capacity changes (Reference case)



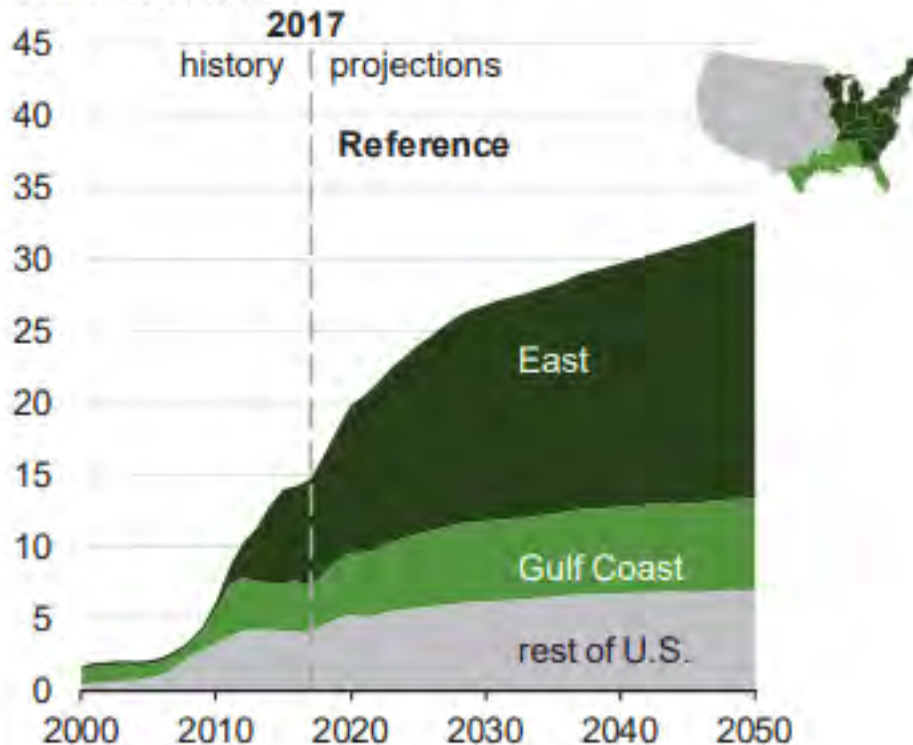
NuScale's Small Modular Nuclear Reactor Passes Biggest Hurdle Yet (5/15/18)



Natural Gas Century...favors East, SE, SW



Shale gas production by region
trillion cubic feet



Gas drives investment

- Cheap energy for industry
- Natural gas electric plants



- Natural gas crackers

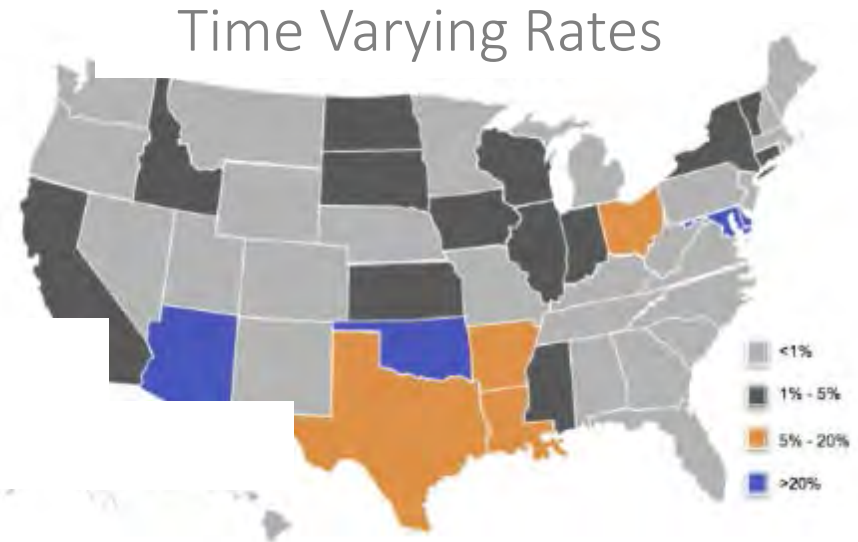
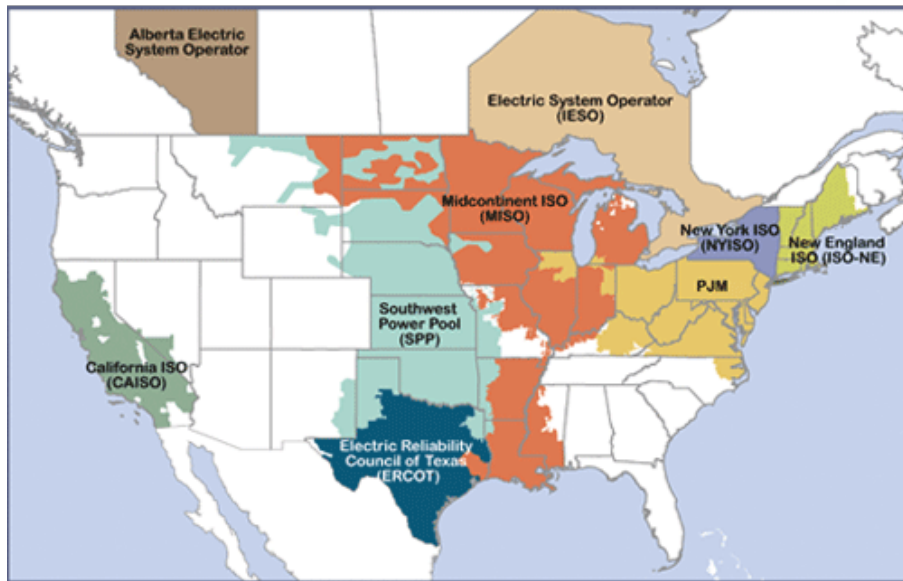


U.S. Energy Information Administration



Who will benefit from the shifting electric power landscape?

Corporate Investments - to be guided by availability of efficient, cost effective, reliable, **innovative**, and sustainable electric energy. MISO is the leader in support of the new energy economy.



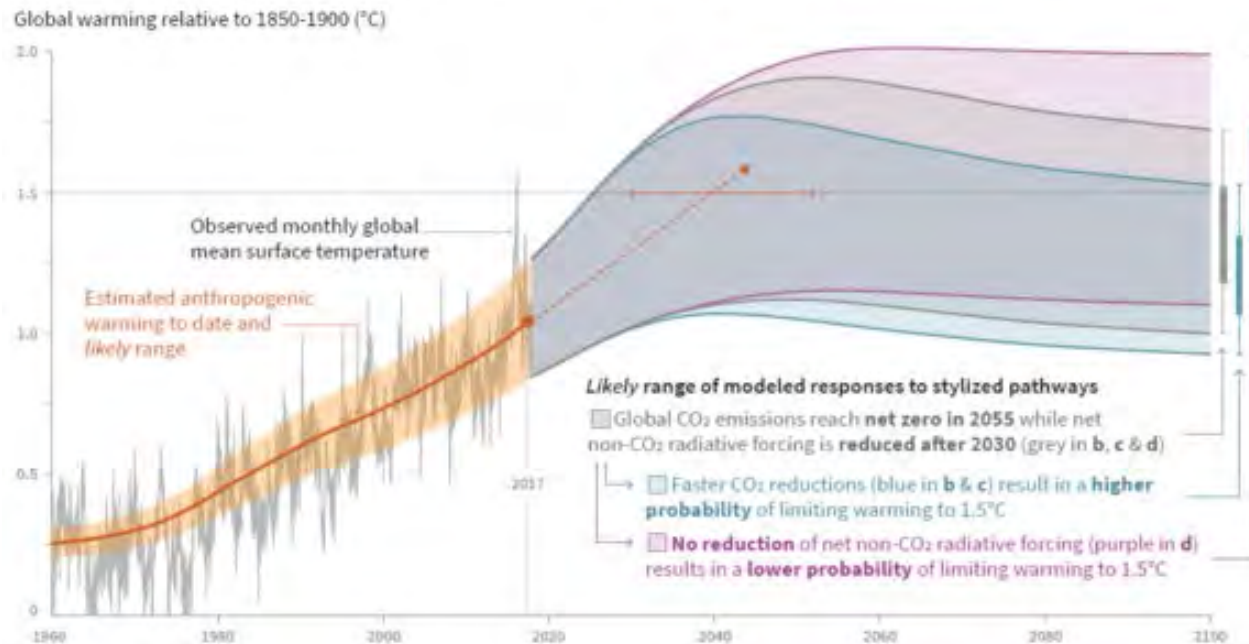
ComEd Hourly Energy Prices - 2017	
Average 12:00 AM to 6:00 AM (cents/kWh) =	2.01 ¢
Max (cents/kWh) =	74.0 ¢
Min (cents/kWh) =	-16.2 ¢

United Nation's Intergovernmental Panel on Climate Change Report September 2018



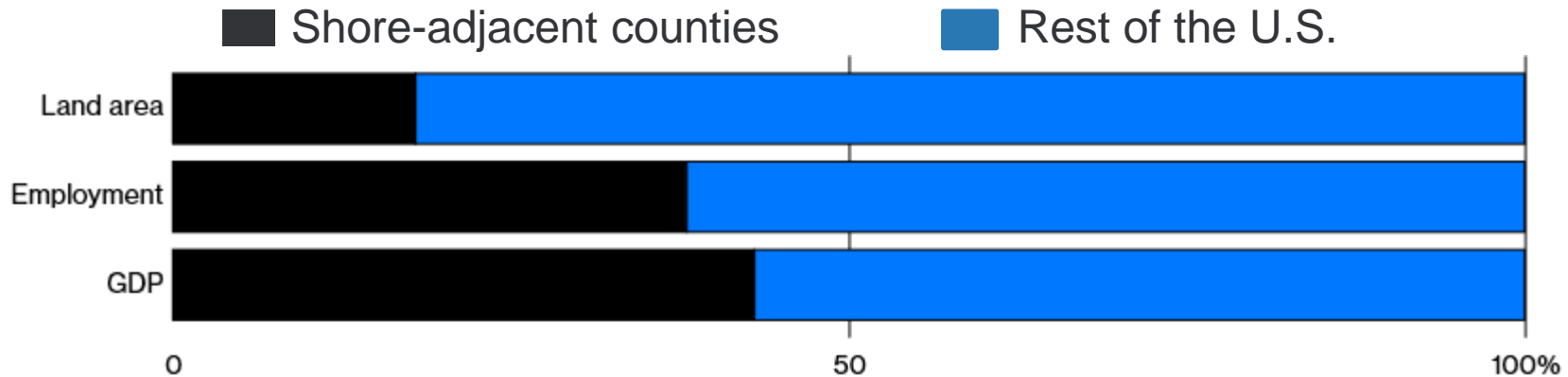
“Investment of \$2.4 trillion is needed annually through 2035 to avoid catastrophic damage from climate change (\$1.8 trillion was invested in 2017, down 2 percent).”

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways





Climate disruption creates investment opportunities



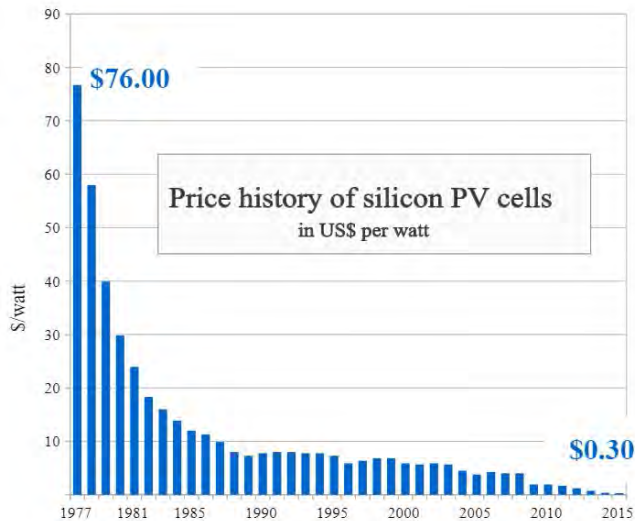
With record hurricanes, floods, high temperatures, and wildfires...hedge funds and pension plans are investing:

- Storm and flood protection along the coast
- Desalination plants in drought-prone regions
- New approaches to agriculture
- Land far from the ocean and rising seas - shift real estate demand
- Severe weather resistant building systems



Tariffs on Solar Panels

- 30 % tariff imposed on January 22, 2018 – adds \$.05 per watt to equipment costs, 2 % to installed cost
- The tariff will have a declining benefit for U.S. investment. The cost of solar installations has been falling 2-6 % per year. Long-term advantages for US production will erode before a US plant can be fully amortized.



Source: Bloomberg New Energy Finance & pv.energytrend.com

- Jinko Solar (China) announced plans for \$410 MM solar plant on January 31 in Florida (Jacksonville), to employ 800

Cryptocurrency



- Blockchain - a digitized, decentralized, public ledger of transactions
- Cryptocurrency mining is the process by which transactions are verified and added to the public ledger (the blockchain)
- Crypto mining operations are similar to data centers (big electric demand, favorable load characteristics, but no redundancy)
- They create virtually no jobs nor economic development spinoff
- Environmental stewards look unfavorably on crypto mining



- The silver lining? It puts BLOCKCHAIN capability in your community. We all know what that means?

Under construction: Data center or crypto mining?



Disruption from distributed energy, energy storage, light weight materials



- Growing number of dual purpose products that combine functions – solar shingles, solar building panels, solar roads
- After market for lithium-ion car and bus batteries – good for 7 to 10 years after off the road – grid and distributed energy uses
- Home storage systems – charge when power is cheap – requires time of use pricing
- Carbon fiber production technology will soon deliver low cost carbon fiber to vehicle manufacturers - significantly reduce energy consumption in cars, trucks, ships, etc.





Take advantage of disruption

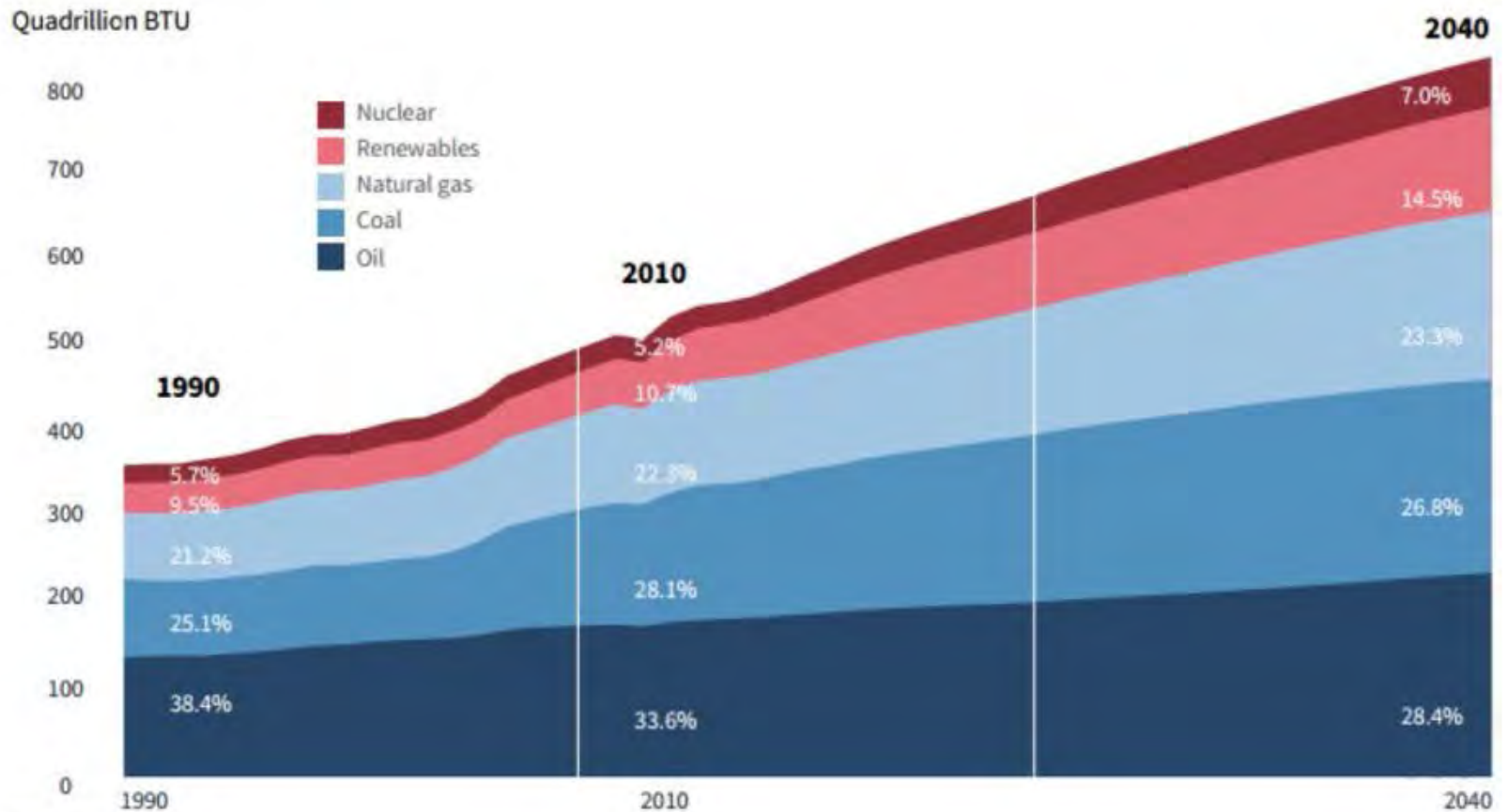
1. The mix of electric power generation will continue to shift from coal and nuclear to natural gas and renewables
2. Climate change will stimulate expenditures in new products and infrastructure
3. Distributed generation will grow in importance (tariffs will have no long term impact on growth of solar)
4. Grid and localized energy storage will grow to be important
5. Regions that embrace the new generation mix and offer innovative programs for serving consumers will be best aligned with industry retention and expansion opportunities
6. Cryptocurrency – go cautiously. But remember – its BLOCKCHAIN?



Shale Gas: A Driver of the US Energy Revolution and Impacts for Rural ED

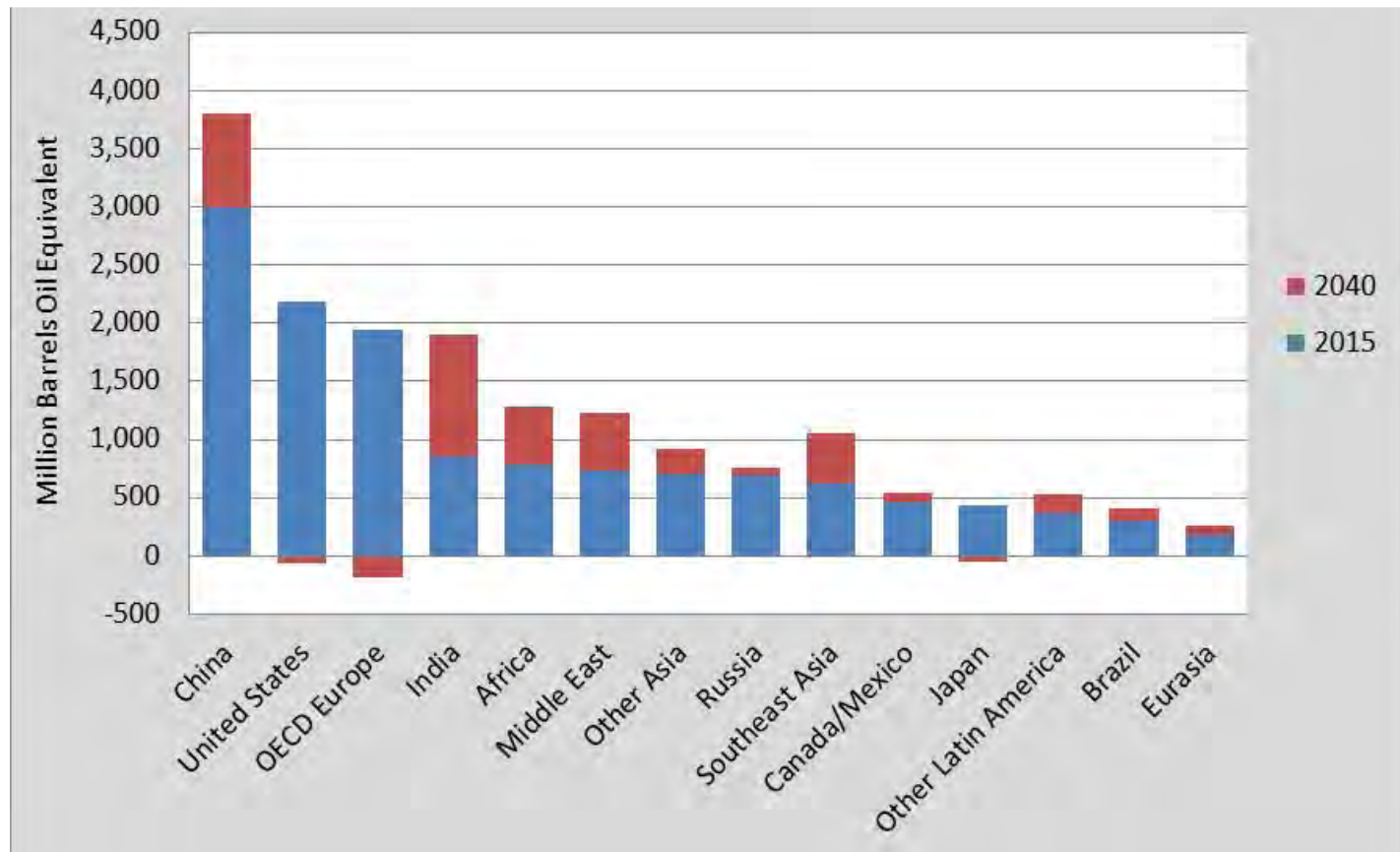


Projected Global Energy Demand



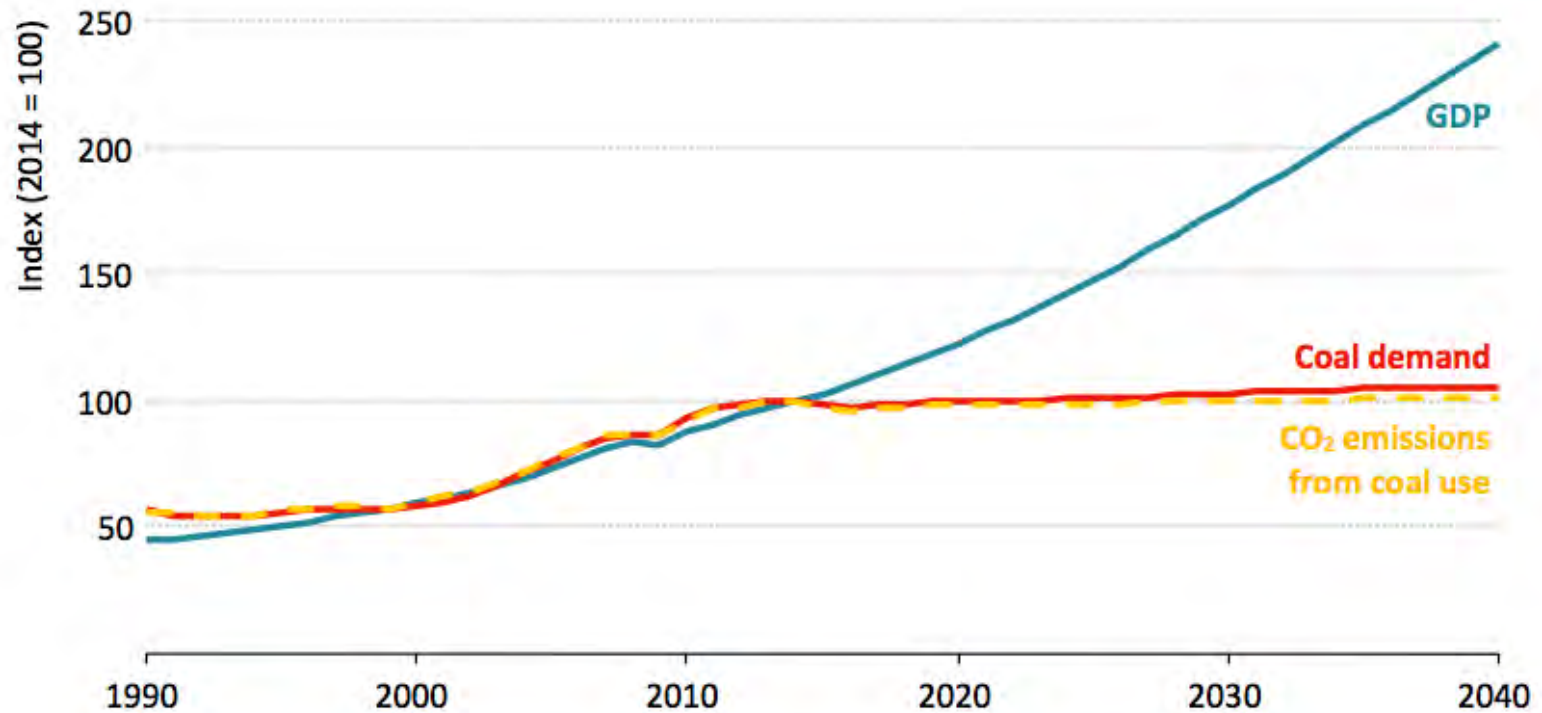


Global Energy Demand by Region: 2017 & 2040





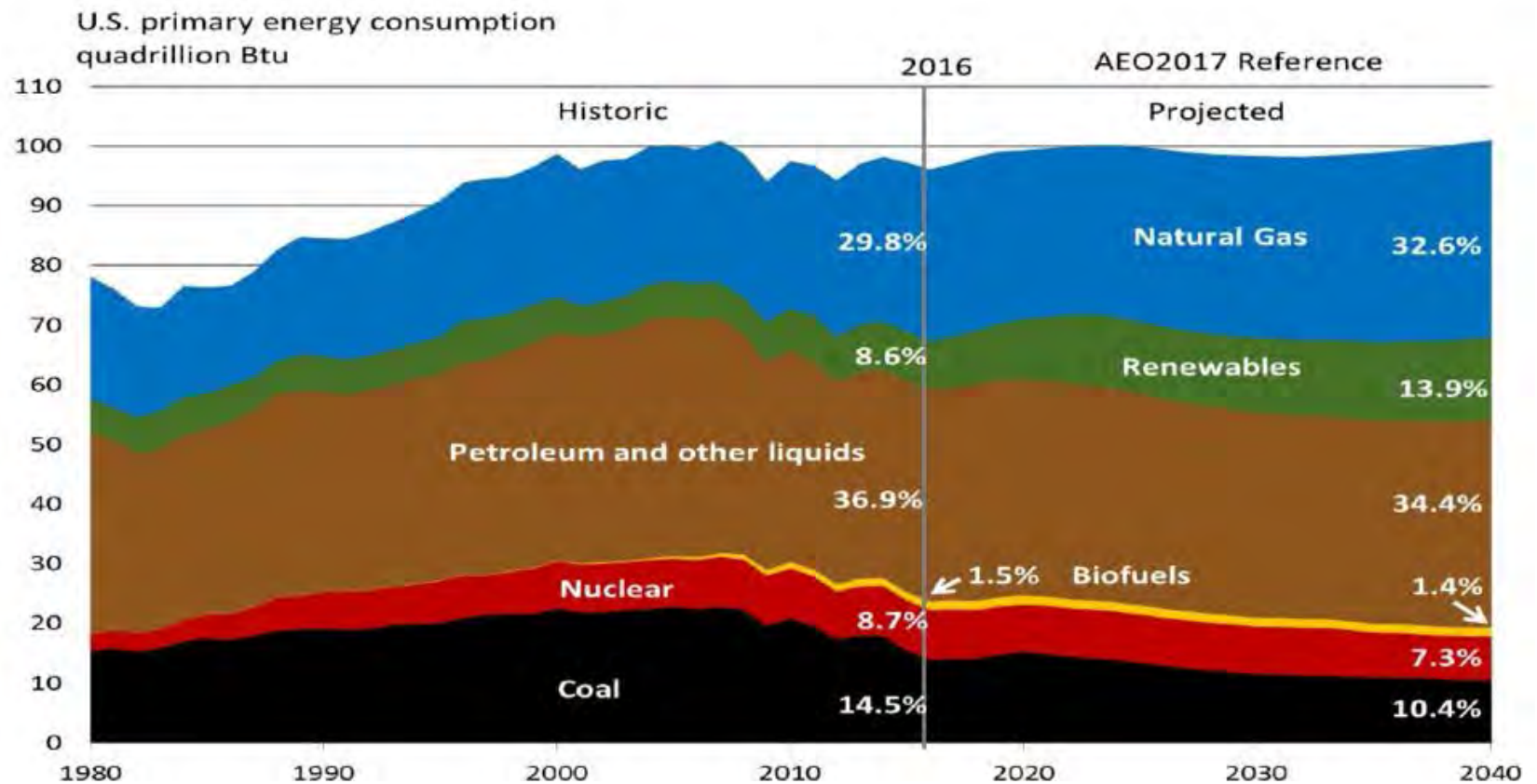
Projected Growth of Global GDP , Coal Demand and CO₂ Emissions from Coal Use



Global coal demand decouples from global GDP, largely due to changes in China



Projected US Energy Demand and Consumption



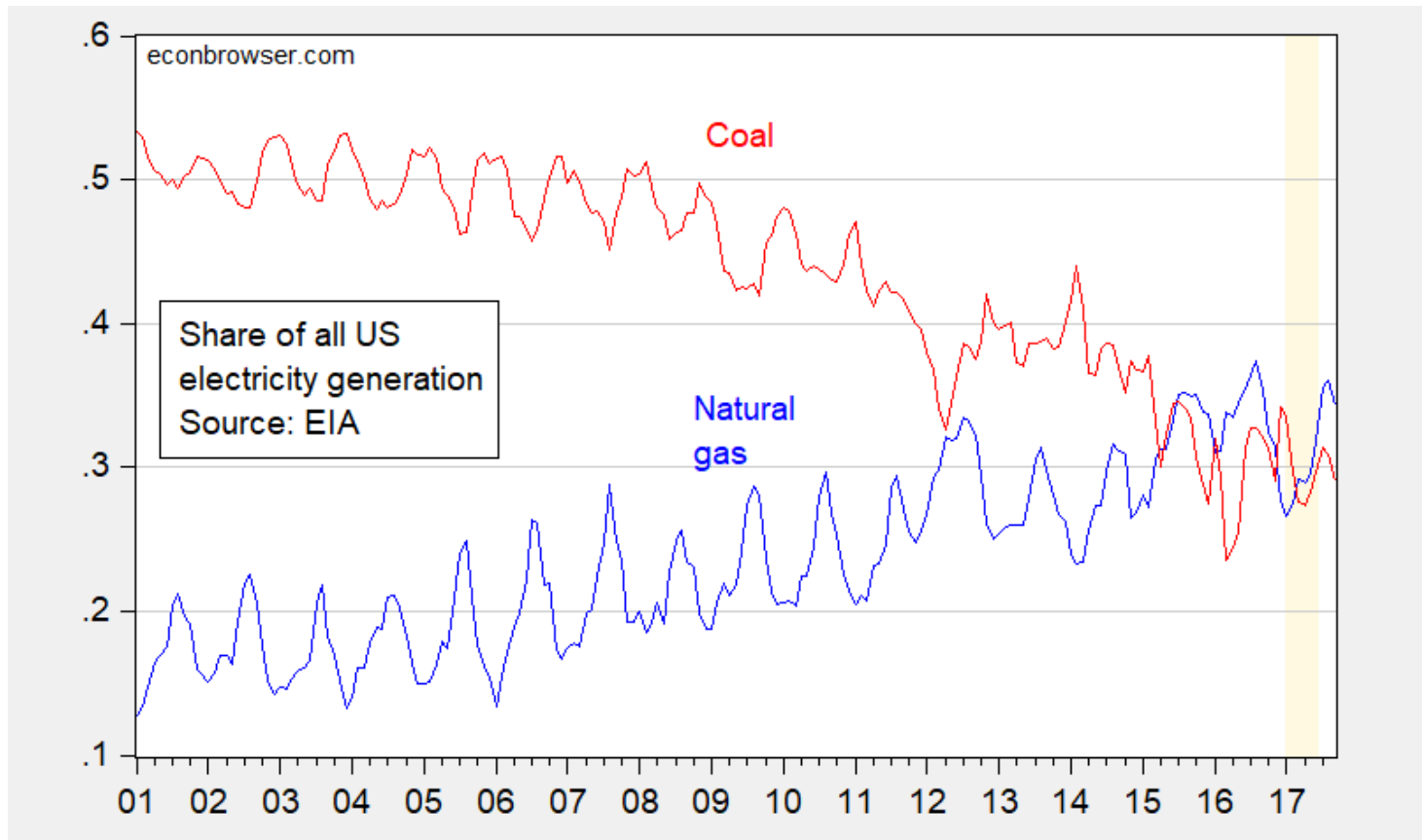


North American Shale Plays





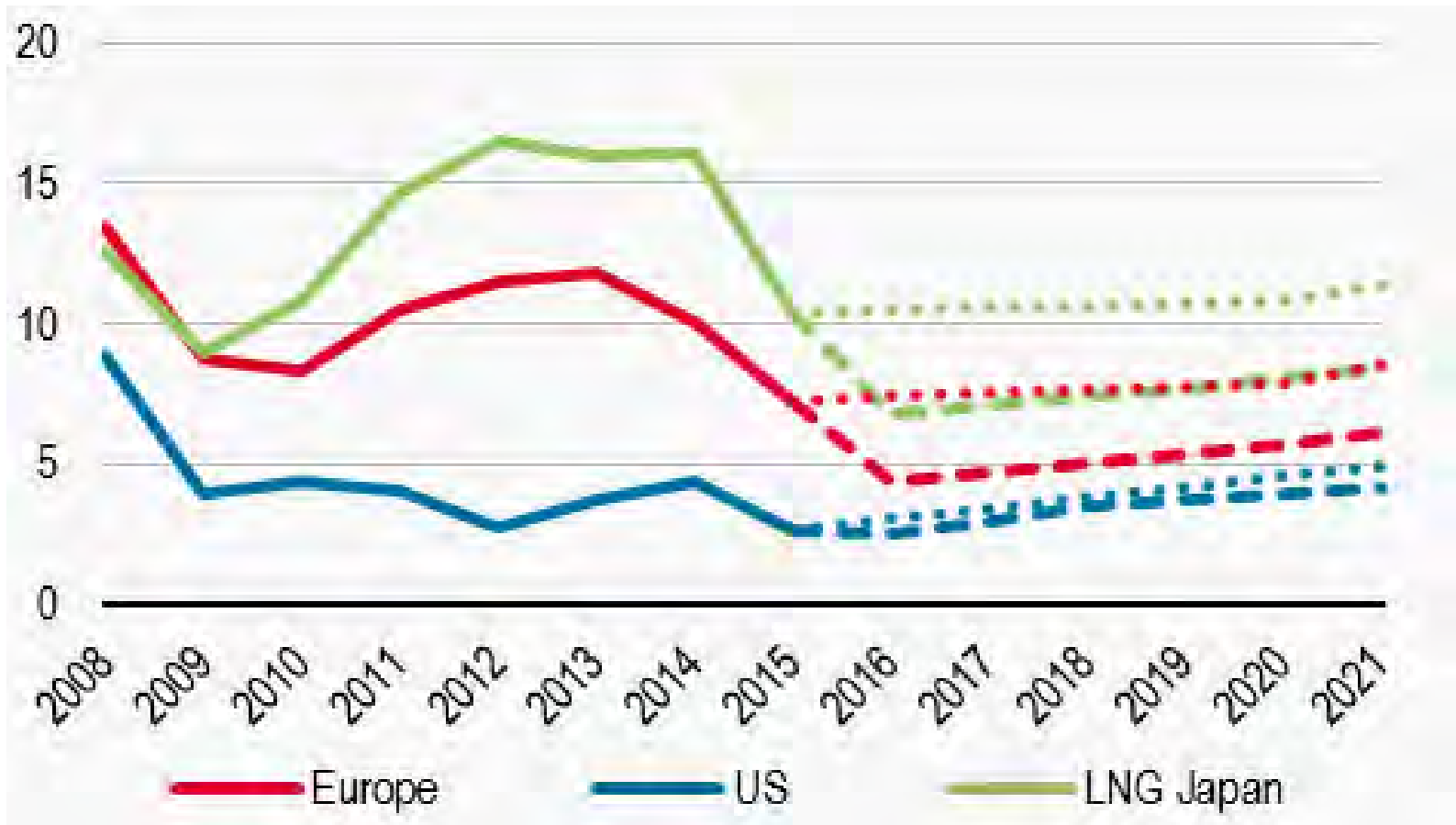
Share of All U.S. Electricity Generation





Gas Price Forecasts

USD per mmbtu, World Bank Prediction (dashed line)
vs IEA (dotted line)





March 2016

**First Chevron
LNG Cargo
Departs for
Japan**



So What Does this Mean to the U.S.-based Rural Economic Developer

- Lower electricity prices and long-term pricing stability providing a competitive advantage
- Potential of large Cap-ex projects in rural areas with gas supply
- More FDI projects
- More downstream projects related to plastics and petrochemical
- More projects supplying materials related to shale gas extraction and export
- Potential funding sources for rural ED



Renewable Energy: How is it Impacting Economic Development?

Facebook 'rolling big-time' on Henrico data center, buoyed by new solar tariff

By MICHAEL MARTZ Richmond Times-Dispatch Jun 22, 2018



Amazon looks to go big on solar, clean energy

Anmar Frangoul

Published 9:02 AM ET Thu, 2 March 2017 | Updated 3:49 PM ET Thu, 2 March 2017



Source: Amazon

Solar rooftop at an Amazon fulfillment center.



Smithfield highlights biogas projects in sustainability report

By Smithfield Foods Inc. | May 12, 2017

Smithfield Foods Inc. recently announced the release of the second installment of its 16th annual sustainability report. The Environment section highlights Smithfield's environmental leadership in key areas, which includes continuing reductions in natural resource demand and the addition of many environmental projects improving business performance and supply chain efficiency.

"As a global food producer, we embrace our unique responsibility to drive positive change across our industry while improving our operating efficiencies and adding new value to our own supply chain," said Stewart Leeth, vice president of regulatory





What you need to know

- What are nearby sources of renewable energy?
- Does your state allow distributed power?
- Can the grid handle new renewable power sources?
- What other infrastructure is required for distribution?
- Are there permit or other regulatory barriers to the use of renewables?
- What power does the state PUC exercise over renewables and rates?



What Smart Communities Do

- Reduced rates of property taxation on renewable energy infrastructure
- Fast track and reduced permit fees for renewable energy infrastructure
- Prepare detailed maps of renewable energy availability (wind, solar)
- Proactive zoning policies to permit renewable energy facilities