Perspectives on Strategic Energy Analysis: The Quadrennial Energy Review

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PM on the Quadrennial Energy Review

THE WHITE HOUSE

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For Immediate Release

January 9, 2014

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

SUBJECT: Establishing a Quadrennial Energy Review

Affordable, clean, and secure energy and energy services are essential for improving U.S. economic productivity, enhancing our quality of life, protecting our environment, and ensuring our Nation's security. Achieving these goals requires a comprehensive and integrated energy strategy resulting from interagency dialogue and active engagement of external stakeholders. To help the Federal Government better meet this responsibility, I am directing the undertaking of a Quadrennial Energy Review.

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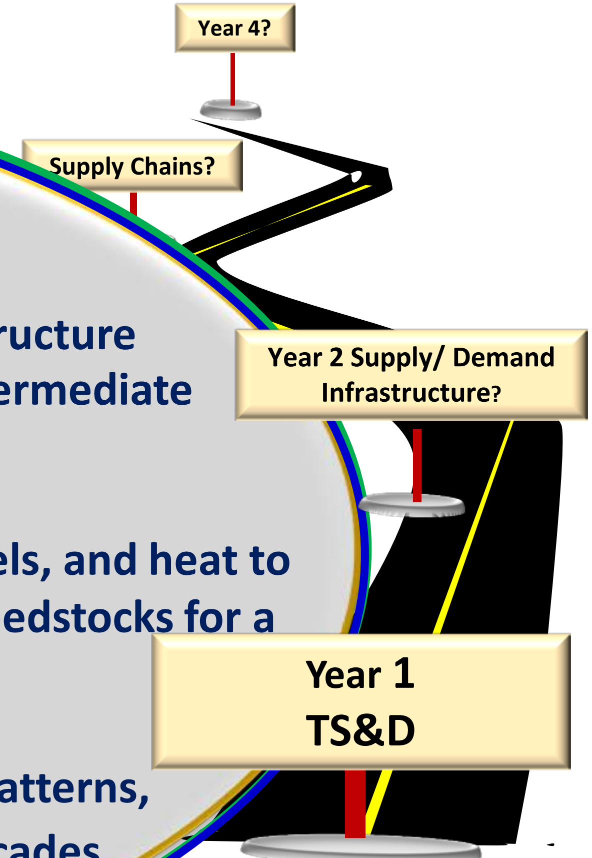
President Barack Obama
January 9, 2014

QER is a 4 year Roadmap:
Year One Will Focus on TS&D Infrastructure



TRANSMISSION, STORAGE &DISTRIBUTION

- The initial QER exercise will focus on TS&D -- infrastructure that links energy supplies, carriers, or by-products to intermediate and end users, or waste disposal sites
- TS&D networks help deliver electricity, transportation fuels, and heat to industry and 300 million consumers every day and provide feedstocks for a large range of products
- These infrastructures tend to set supply and end use patterns, policies, investments and practices in place for decades

Why Focus on Infrastructure?

- Periods of sustained American economic advancement have been supported by enabling infrastructures –canals, railroads, dams/irrigation, highways
- Energy infrastructures play essential roles in American prosperity, creating competitive advantage via low cost supplies and feedstocks
- The longevity and high costs of energy infrastructure mean that decisions made today will strongly influence our energy mix for much of the 21st century

- Vulnerabilities are increasing. A modernized, robust, resilient infrastructure is in the public interest
- Transforming and modernizing energy infrastructure faces significant challenges, warrants federal policy

Proposed TS&D Systems to Cover

TRANSMISSION, STORAGE & DISTRIBUTION INFRASTRUCTURE:

Links energy supplies, carriers, or by-products to intermediate and end users, or waste disposal sites

Electricity
- High-voltage transmission lines and substations
- Distribution lines
- All electric grid-related infrastructure, ancillary services, "smart-grid" and metering technologies
- Distributed generation technologies
- Transformer supply chain
- Electricity storage
- Vehicle fueling

Coal transport
- Rail, truck, barge transport
- Export terminals

Biofuel
- Vehicle fueling

Solar
- Grid Interconnection
- Distributed technologies

Hydrogen
- Pipelines
- Vehicle fueling

Natural Gas
- Natural gas gathering lines (production-stage or processing-stage)
- Interstate pipelines
- Natural gas storage facilities
- Processing facilities (including processing at production sites)
- Local distribution systems
- LNG production/storage facilities (including export terminals)
- Vehicle fueling
- LPG distribution

Oil/Petroleum Products
- Crude oil pipelines
- Crude oil and products import and export terminals
- Truck and rail systems that transport crude oil from production sites to ports of refineries
- Oil refineries
- Oil and fuel storage facilities
- Strategic Petroleum Reserve
- Rail, truck ,barge, pipelines systems to transport refined product to consumers
- Fuel terminals and vehicle fueling stations

Nuclear
- Uranium Processing Facilities
- Road/Ship/Rail Transport of Fuel

Carbon dioxide
- Pipelines
- Compressors
- Storage facilities

Biomass
- Transport of Raw Feedstock
- Feedstock Processing
- Derived Product Transport
- Derived Product Distribution

Wind
- Grid Interconnection

Limitations of Current System

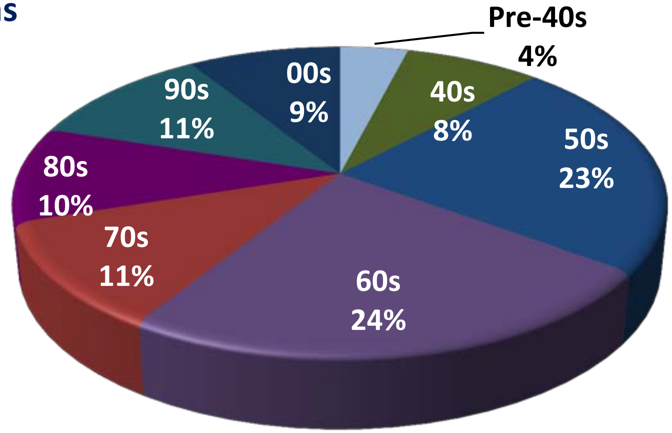
Age: Over 50% of the nation's gas transmission and gathering pipelines were constructed in the 1940s, 1950's and 1960's

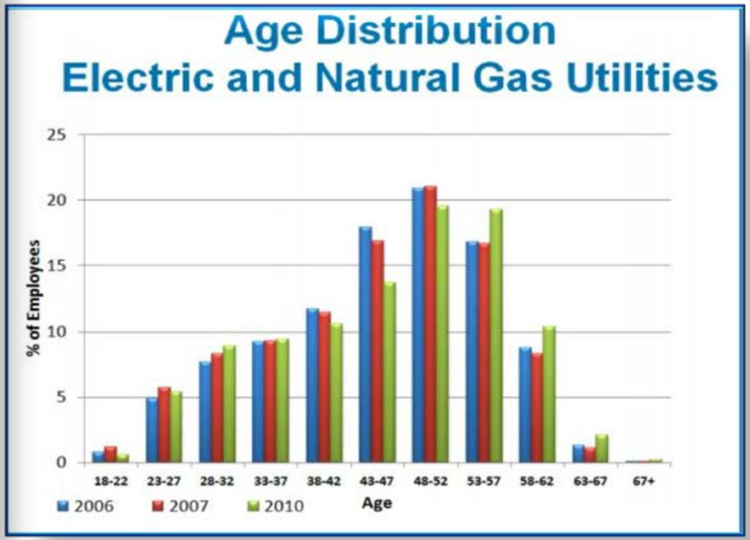
Cost: EEI estimates that by 2030, we will need to at total investment of $1.5 trillion to $2.0 trillion by the electric utility industry. Natural gas infrastructure investment needed: $19.2 billion/ yr. by 2030.

Supply/demand Shifts: The lack of pipeline infrastructures for associated gas in the Bakken has resulted in large-scale flaring of this gas, in amount sufficient to be seen from space.

Workforce: over 60% of the workers in areas like electric and gas utilities are likely to retire or leave the industry within a decade

Age by decade of gas gathering/ transmission lines





Age Distribution of Gas/Electric Utility Employees

Infrastructure Vulnerabilities Are Growing

Climate Change: weather related power outages have increased from 5-20 each year in the mid-1990s to 50-100 per year in the last five years.

Physical Threats: There were three highly visible attacks on grid infrastructure in 2013. Supply chains for key components of grid infrastructure are not robust.

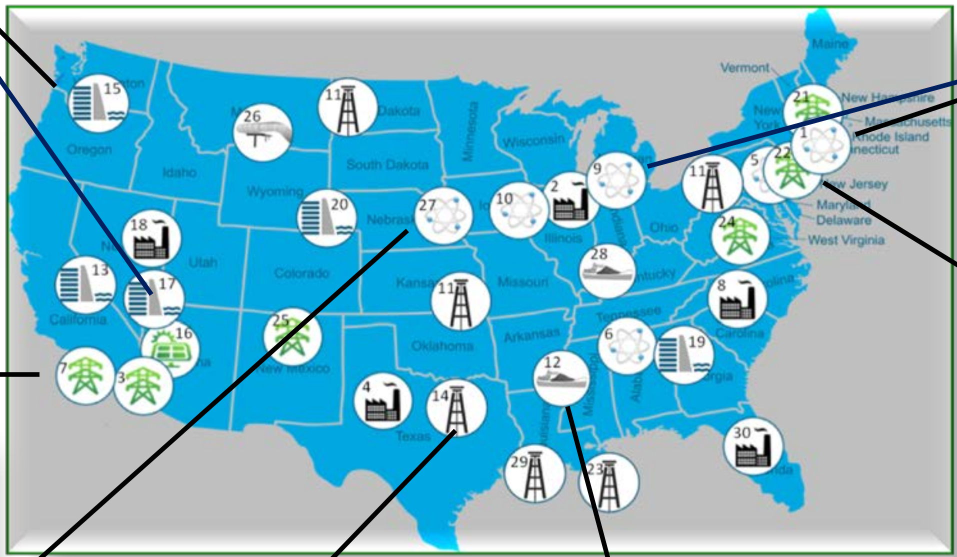
Cyber-security: 53% of all cyber-attacks from October 2012 to May 2013 were on energy installations.

Interdependencies: The interdependencies of the electric and fuel infrastructures (e.g., as seen in Superstorm Sandy) greatly complicated system management, as well as emergency response and recovery. Similar interdependencies with energy and water, energy and food, etc.

Recent Events Illustrate U.S. Energy Sector Vulnerability to Climatic Conditions

Lower water levels: Reduced hydropower

Wildfires: Damaged transmission lines



Cooling water intake or discharge too hot: Shutdown and reduced generation from power plants

Intense storms: Disrupted power generation and oil and gas operations

Flooding: Impacts on inland power plants

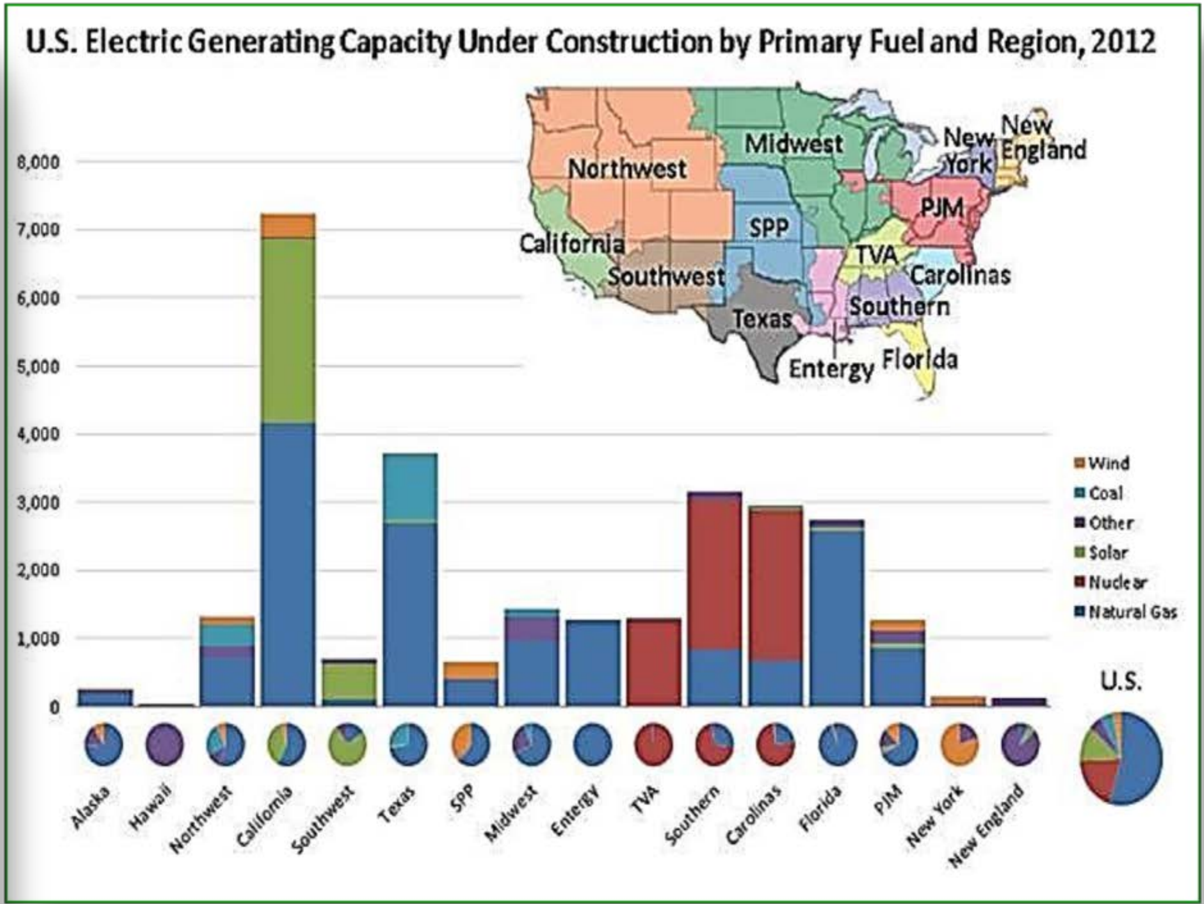
Water restrictions due to drought: Limiting shale gas and power production

Lower river levels: Restricted barge transportation of coal and petroleum products

Regional Differences in New Generation Capacity

- In 2012, natural gas was the most common fuel source for expanding generation capacity under construction.
- Southwestern states saw the majority of solar expansion, while wind development occurred in SPP/Midwest/NY/Northeast.
- Recent nuclear developments have occurred exclusively in the Southeast.
- The average new generation unit size was much larger in Southeast than in other regions of the country.

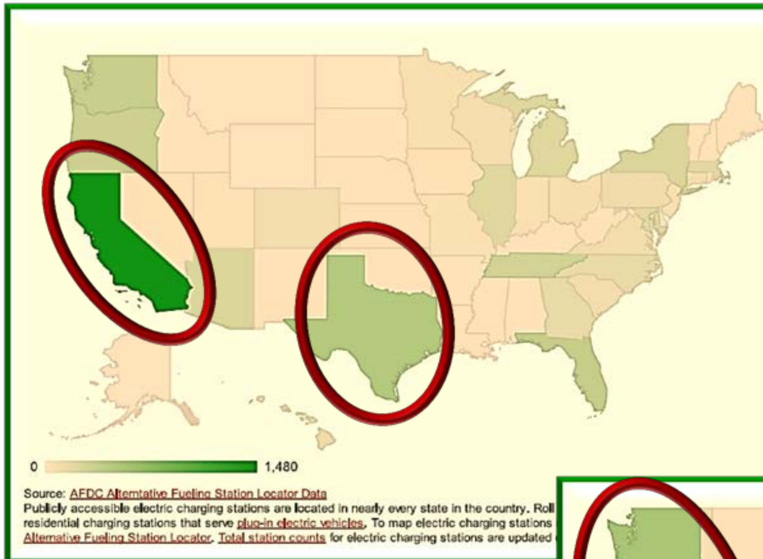
solar natural gas wind nuclear



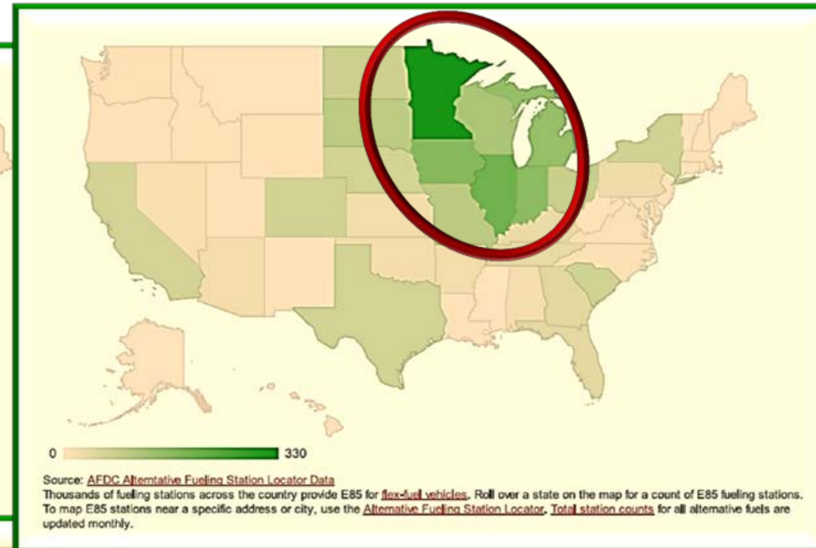
Sources: EEI, *Historical Statistics of the Electric Utility Industry*, EIA *Electric Power Annual*, Consumer price index, Bureau of Labor Statistics.

Alternative Fuel Stations: Significant Regional Variation

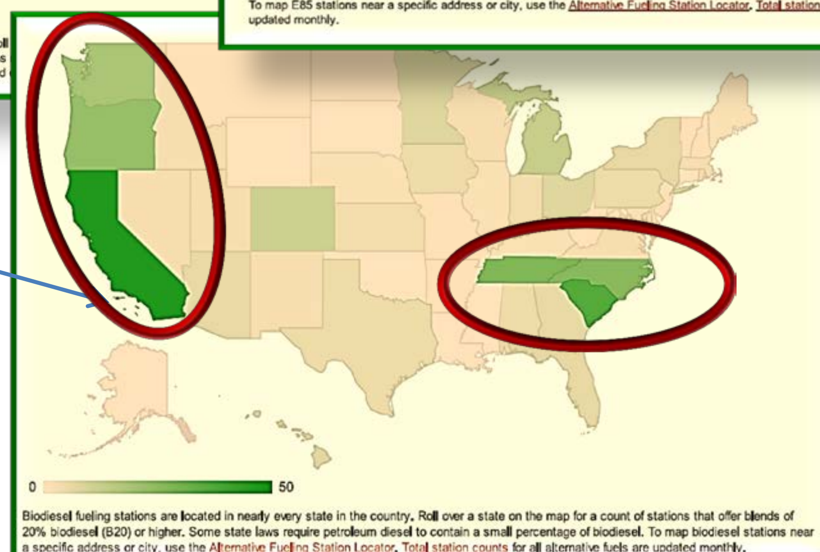
EV Charging Stations



E85 Stations

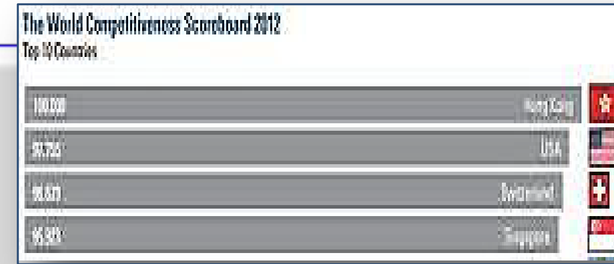


Note low numbers: highest is 47 stations in California



Biodiesel Stations

National Energy Goals



Economic Competitiveness: Energy infrastructure should enable the nation to, under a level playing field and fair and transparent market conditions, produce goods and services which meet the test of international markets while simultaneously maintaining and expanding jobs and the real incomes of the American people over the longer term. Energy infrastructures should enable new architectures to stimulate energy efficiency, new economic transaction, and new consumer services.

Environmental Responsibility: Energy infrastructure systems should take into consideration a full accounting (on a life-cycle basis) of environmental costs and benefits in order to minimize their environmental footprint.

Energy Security: Energy Infrastructure should be minimally vulnerable to the majority of disruptions in supply and mitigate impacts, including economic impacts, of disruptions by recovering quickly or with use of reserve stocks. Energy security should support overall national security.

Desirable Characteristics, 2030

A minimal-environmental footprint. Energy systems should be designed, constructed, operated and decommissioned in a manner that is low carbon, and with minimal impact to water quality and quantity; and minimize the land use footprint, impact on biological resources, and toxic emissions.

Affordability. Ensures system costs and needs are balanced with the ability of users to pay. (Note three potential balancing points: overall system costs, system needs/benefits, and system cost allocation). Also, estimating avoided costs can be more complex than for simple levelized costs – calculations require tools to simulate the operation of the power system with and without any project under consideration.

QER: Will provide four year planning horizon to enable these energy infrastructure characteristics in 2030.

Robustness. A robust energy system will continue to perform its functions under diverse policies and market conditions, and has its operations only marginally affected by external or internal events. Sub characteristics of robustness include:

- *Reliability.* Sturdy and dependable, not prone to breakdowns from internal causes (e.g. due to component failures);
- *Resiliency.* The ability to withstand small to moderate disturbances without loss of service, to maintain minimum service during severe disturbances, and to quickly return to normal service after a disturbance.

Flexibility. Energy infrastructure that accommodates change in response to new and/or unexpected internal or external system drivers. Sub-characteristics of flexibility included:

- *Extensibility.* The ability to extend into new capabilities, beyond those required when the system first becomes operational.
- *Interoperability.* The ability to interact and connect with a wide variety of systems and sub-systems both in and outside of the energy sector.
- *Optionality.* Provides infrastructures or features of infrastructures that would allow users to maximize value under future unforeseen circumstances.

Scalability. Energy infrastructure should be able to be sized to meet a range of demand levels. Systems can be scalable by being replicable, modular, and/or enlargeable.

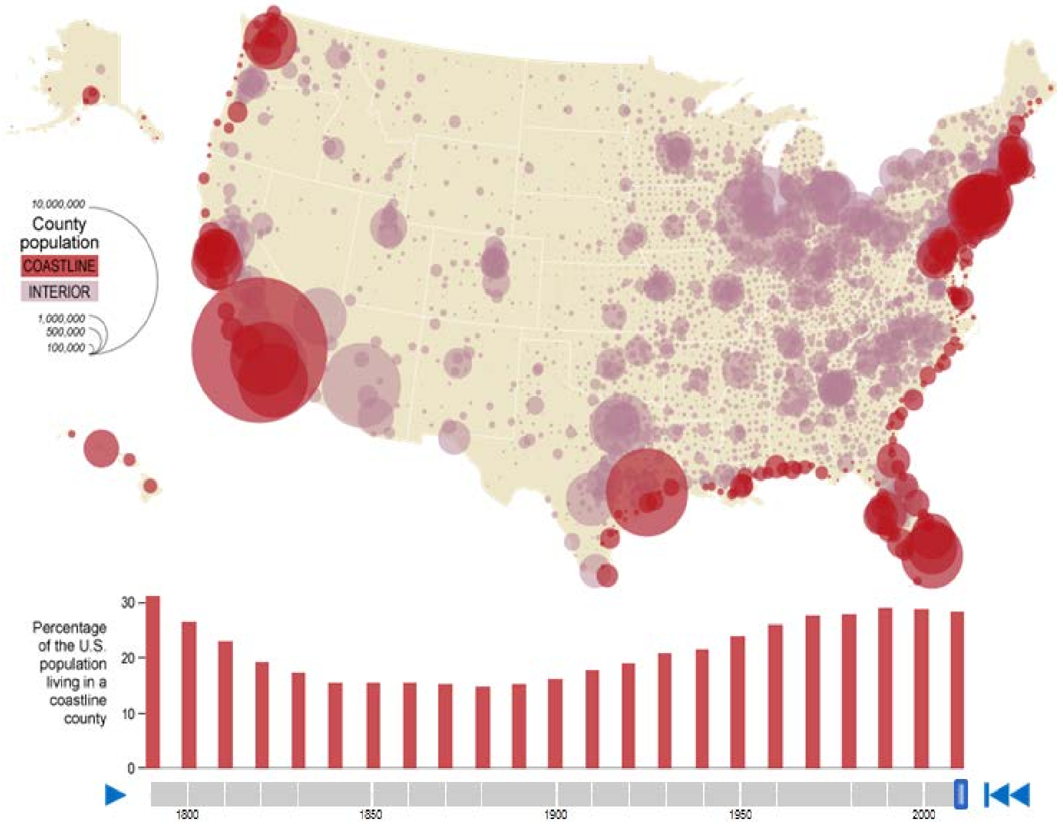
QER Analysis Process

Policy Goals → Baseline and Scenarios → System and Policy Options → Policy Analysis → Recommendations

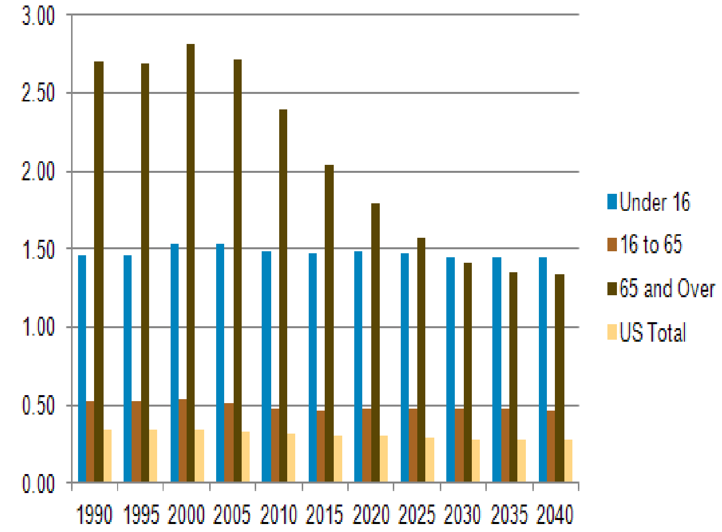
- **Develop Vision Statement (done)**
- **QER baseline and scenario analysis**
  - a. Baseline
    1. Prepare baseline reports on the state of systems (Literature & Analytic Review)
    2. Establish reference case (proposed: AEO 2014, with fine tuning)
  - b. Assess the Reference Case against the metrics and vision
  - c. Perform sensitivity analyses on the reference case: compare infrastructure needs
  - d. Perform scenario analysis, including:
    1. Storyline scenarios
    2. Event-driven analyses
- **Craft policy alternatives**
- **Policy analysis**
- **Make policy recommendations, including executive actions, legislative proposals, recommended further research**

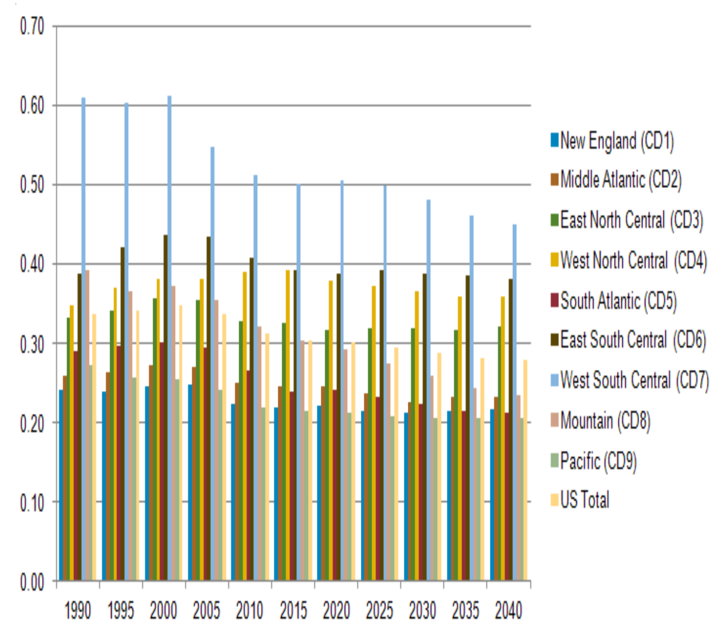
Baseline - Demographics

Population
(source: Census Bureau)



Energy Intensity
(Source: EIA)

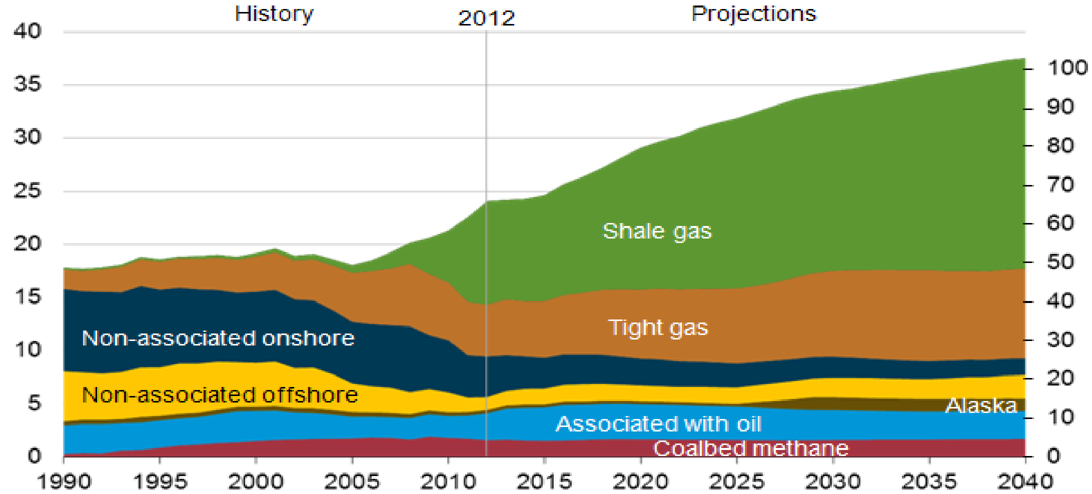




Note: Energy intensity calculated as quadrillion Btu divided by millions of persons

Baseline - Shale Gas

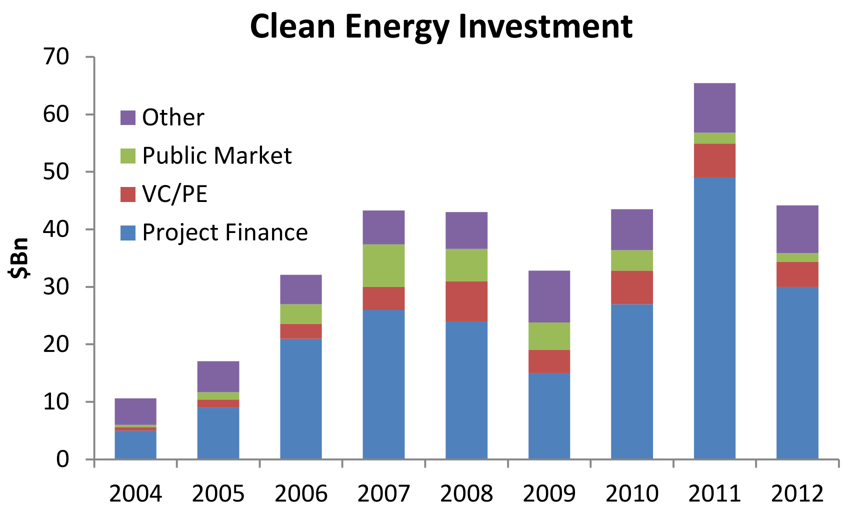
- Huge and growing resource base: The Potential Gas Committee estimates the U.S. has almost 2,700 trillion cubic feet, a 100+ year of supply at current consumption.
- Record natural gas production: U.S. natural gas production rose more than 30% between 2005-2012, almost entirely due to shale gas.



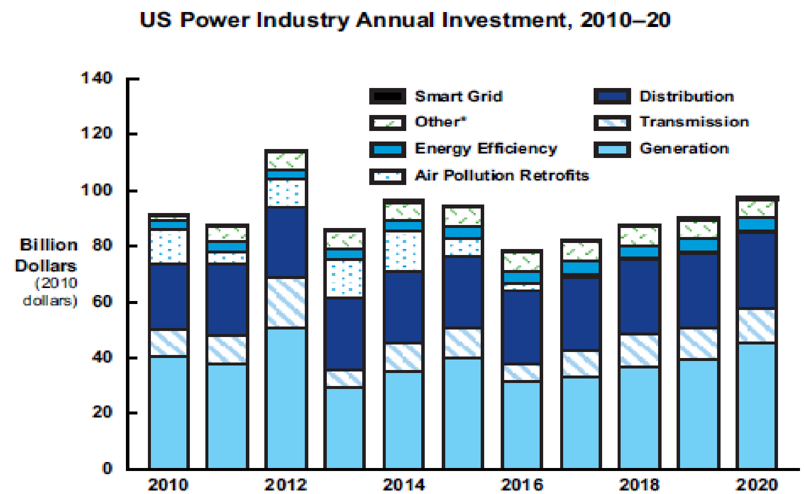
Source: EIA, Annual Energy Outlook 2014 Early Release

- Greater productivity and declining unit costs
- Build-out and reconfiguration of infrastructure to get new gas to market. Some bottlenecks are developing.
- Key T&D infrastructure issues going forward include building out existing pipelines to meet growing demand, LNG exports, changing pipeline utilization and flow patterns, pipeline age and safety, emissions.

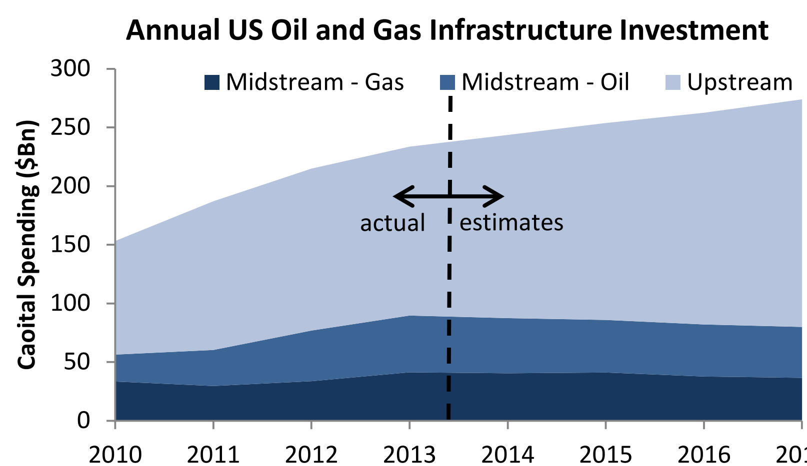
Baseline – US Energy Industry Expenditures



Source: Bloomberg New Energy Finance



Source: IHS CERA, "An Expensive Decade US Power Sector Spending Through 2020 and the Impacts on Retail Rates," 2012.



Sources: Upstream: Barclays, "Global 2014 E&P Spending Outlook North American Spending to Accelerate" December 9th, 2013; Midstream: IHS, "Oil & Natural Gas Transportation & Storage Infrastructure: Status, Trends, & Economic Benefits," December 2013.

Clean Energy Investment (BNEF)

- Significant growth over the past decade through deployment of new technologies, particularly wind and solar
- Current trend relatively flat (including 2013, not shown)

Power (Electricity) (IHS)

- Dominated by generation, distribution, then transmission
- Trend indicates growth over next decade, but with significant uncertainties (not shown)

Oil/Gas (IHS, Barclays)

- Very large increases over past decade (not shown) with significant growth due to build-out of unconventional resources

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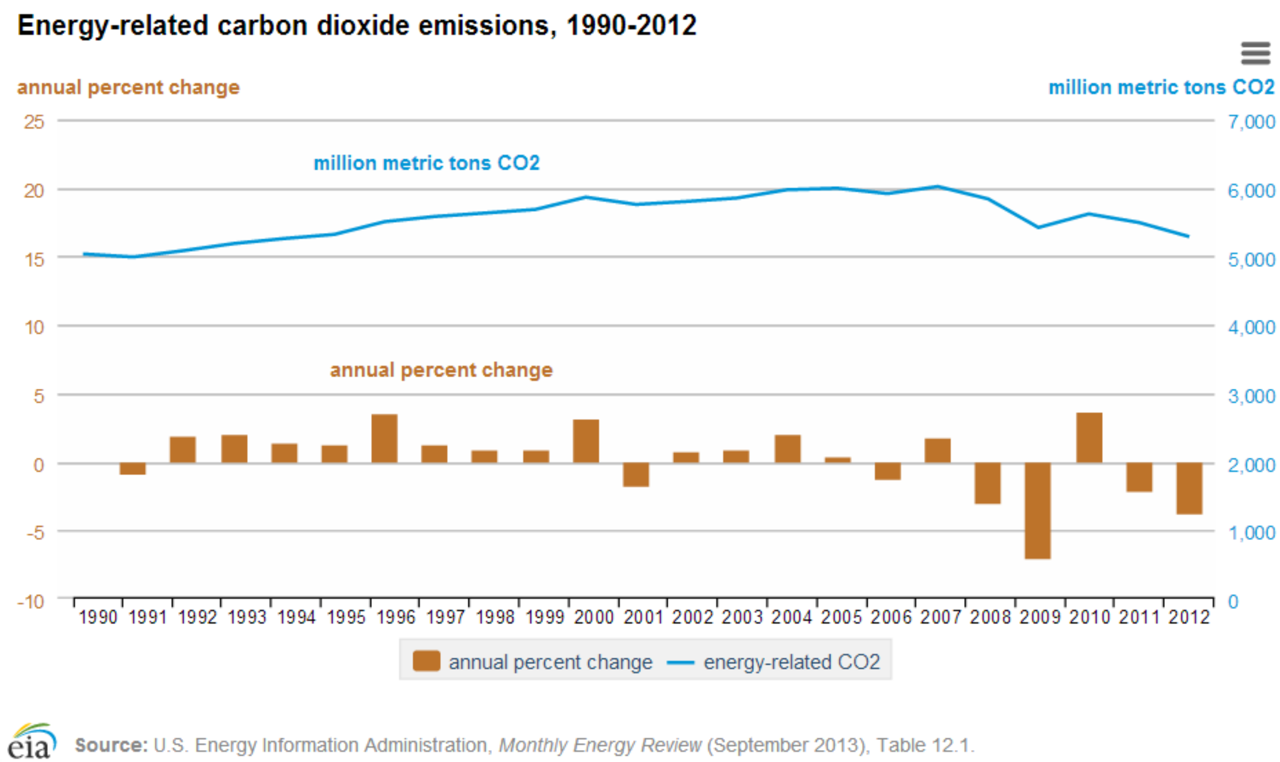
Baseline - Climate and Environment (1)

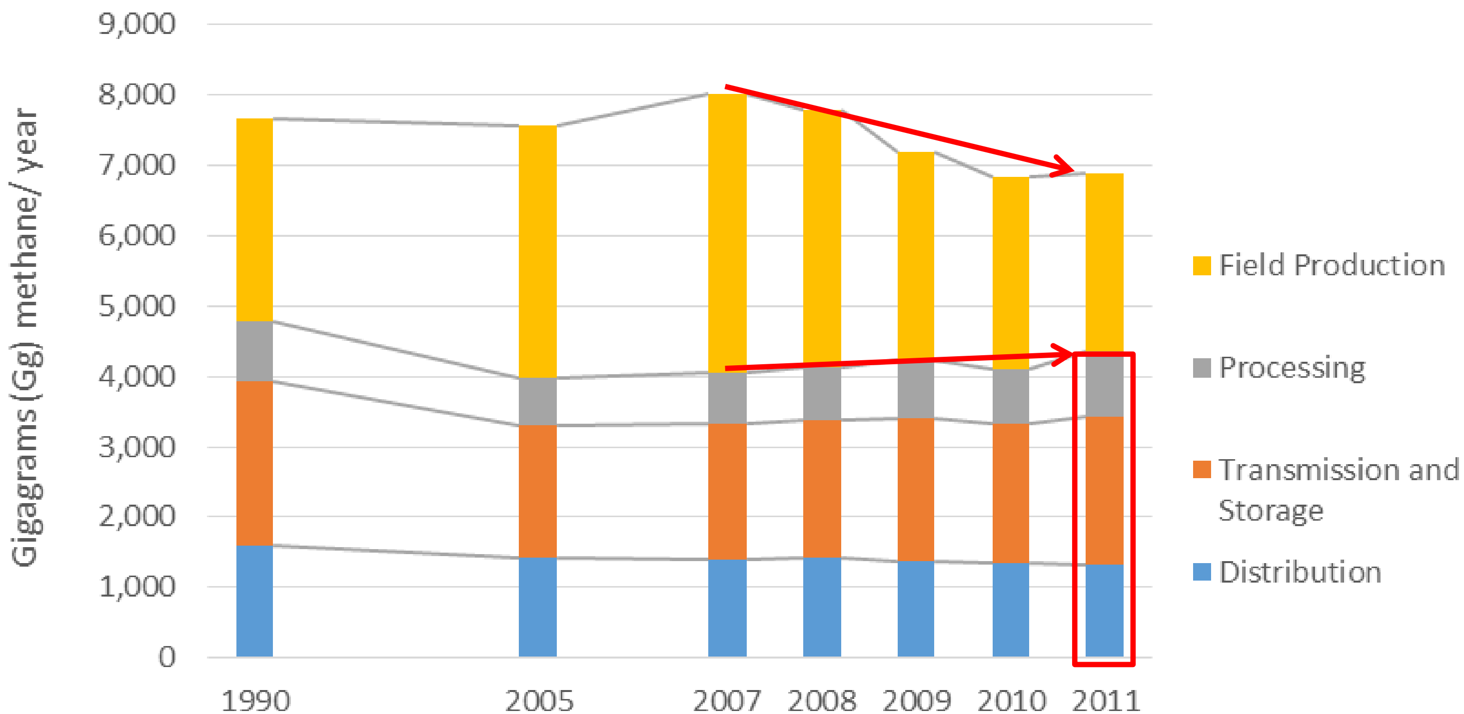
- From 2007 to 2012, energy-related carbon dioxide emissions in the U.S. dropped by 12 percent (up again by 2%, in 2013).
- Major contributing factor was a 13 percent drop in the carbon intensity of the electricity production.
  - Nearly 2/3rds is attributed to a shift from coal to natural gas fired power.
  - 1/3 is the result of a 9-percent increase in non-carbon generation.



Baseline - Climate and Environment (2)

- The largest GHG emissions sources within scope for the QER occur at oil refineries and from natural gas systems. Key sources include CO_2 and methane.
- 2/3^{rds} of methane emissions from natural gas systems occurs downstream of the production-stage.

EPA Inventory of Methane Emissions from U.S. Natural Gas Systems, 2011



Source: EPA Inventory, 2013

Baseline – Regulatory Systems

- National regulation is often impossible or impractical under current law
- Fragmented regulatory and policy systems complicate national-level energy strategy, which leads to regionality
- Market failures often related to the specific sectoral dynamics or business model (not regulation).

Sectoral Federal and State Regulators

	Federal regulators	State regulators
Liquid fuels	(DOT) PHMSA, FRA and EPA (NEPA)	PUCs and safety regulators
Natural gas	(DOT) PHMSA, FERC, and DOE	PUCs and various state regulators
Electricity	FERC, agencies overseeing federal lands and the EPA	PUCs and RTO/ISOs

Analysis/Candidate Scenarios

- ***Analyses of infrastructure in each sector to achieve the high-level economic, environmental, reliability, and resilience goals***

- ***A range of economic scenarios***
  - Annual Energy Outlook (AEO) 2014 reference case
  - Greater degrees of economic challenge (e.g., low GDP growth and high world energy prices)
  - Higher productivity growth (e.g., high GDP growth coupled with stable or declining energy demand).

- ***A range of technology scenarios***
  - Greater direct consumer control of energy systems through rooftop PV, smart grid technology, and other forms of consumer-directed demand management.
  - Low-cost deployment of renewable energy technologies,
  - Low cost of maintaining existing and building new nuclear power plants (e.g., small modular reactors).
  - Low-cost natural gas that allows higher utilization in electricity generation, transport, chemicals, and export, including carbon capture and storage (CCS), as needed
  - Widespread economic deployment of CCS for coal and natural gas .

Interagency Consultation, Stakeholder Engagement

Agency Stakeholders

Agriculture
Defense
Commerce
EPA
HHS
Homeland Security
HUD
Interior
Labor
State
Transportation
Treasury
Veterans Affairs
White House, other

DOE Stakeholders

National Labs
SEAB/PCAST

QER
Co-chaired by
DPC, OSTP

Energy/Science Programs

External Stakeholders

Congress
Industry
NGOs
State, local and tribes
Financial Community
Academia
Public

QER Process: One-Year Plan

Phase 1: Preliminary Work

2 months

Phase 2: Infrastructure Analysis and Engagement

6 months

Phase 3: Policy Analysis and Engagement

6 months

Phase 4: Approval Process

2 months