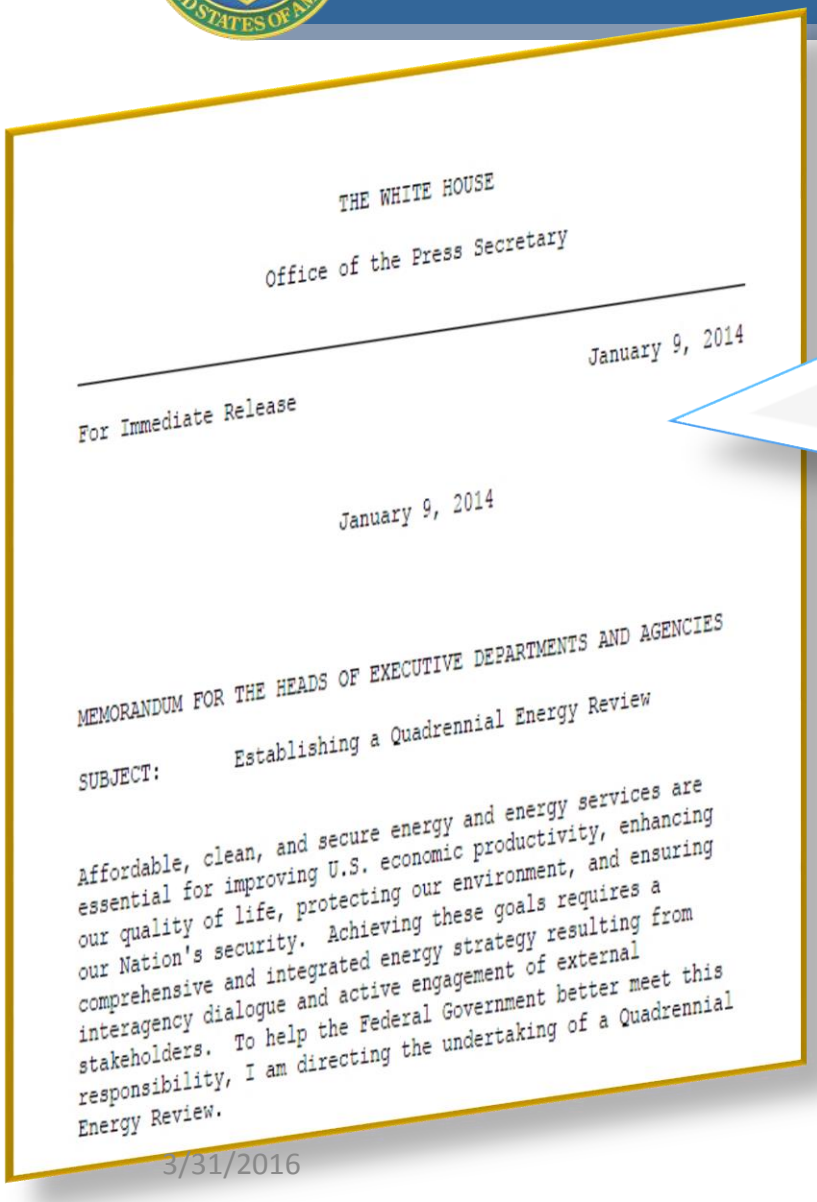
Energy Policy and Systems Analysis (EPSA)

March 17, 2016

QER 1.2 – DOE Electricity Advisory Committee

QER Background and Process



THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release

January 9, 2014

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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.

- Presidential Memorandum stated the Administration will conduct a Quadrennial Energy Review to be led by the White House Domestic Policy Council and Office of Science and Technology Policy
- Process involves the engagement of multiple federal agencies and outside stakeholders
- Supported by a Secretariat established at the Department of Energy
- Enables the federal government to translate policy goals into a set of analytically based, integrated actions for proposed investments over a four-year planning horizon

QER Process -General

Stakeholder Engagement

- Stakeholder meetings
- Stakeholder comments
- Technical workshops
- Regular briefings

Analysis

- Baselines
- Scenarios and modeling
- Analysis of disruptive events
- Synthesis of available work

Interagency Collaboration

- Technical expertise
- Data, studies, analysis
- Interim and final product reviews

QER 1.1: Transmission, Storage and Distribution Infrastructure

Why Transmission, Storage and Distribution Infrastructure in QER 1.1?

- Highly capital intensive
- Long-lived at the decadal scale
- "Connective tissue" of energy systems
- Decisions made today will strongly influence energy mix for much of the 21st century

QER TS&D chapters included

Resilience, Reliability, Safety and Asset Security
Modernizing the Electric Grid
Modernizing US Energy Security Infrastructure
Integrating North American Energy Markets
Workforce
Siting and Permitting
Shared Transportation

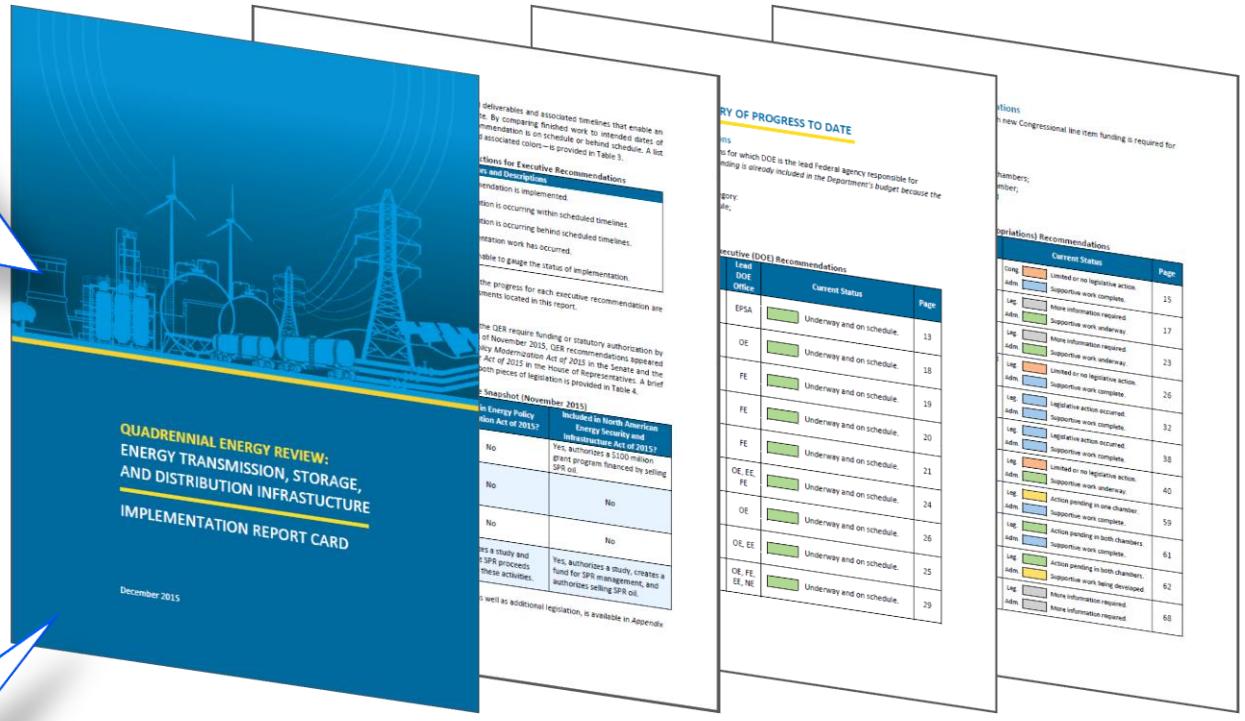
QER 1.1 Implementation of 63 Recommendations

Implementation Breakdown:

- Executive Action (White House)
  - DOE – 35
  - Other Federal Agencies – 10
- Legislative Action (Congress)
  - New Appropriation – 13
  - New Statute – 5

Highlights:

- *3 recommendations are complete*
- $2 billion to modernize the Strategic Petroleum Reserve



QER 1.1 Implementation Report Card

- Detailed analysis of all 63 recommendations
- Shows where additional work is required

Current Work on QER 1.1 and 1.2

QER 1.1 TS&D Implementation

- Energy bill
- Appropriations
- Transportation bill
- Interagency/DOE work

QER 1.2 Electricity: Scoping

- Baselines
- National labs, consultants
- Framing documents
- Stakeholder consultations

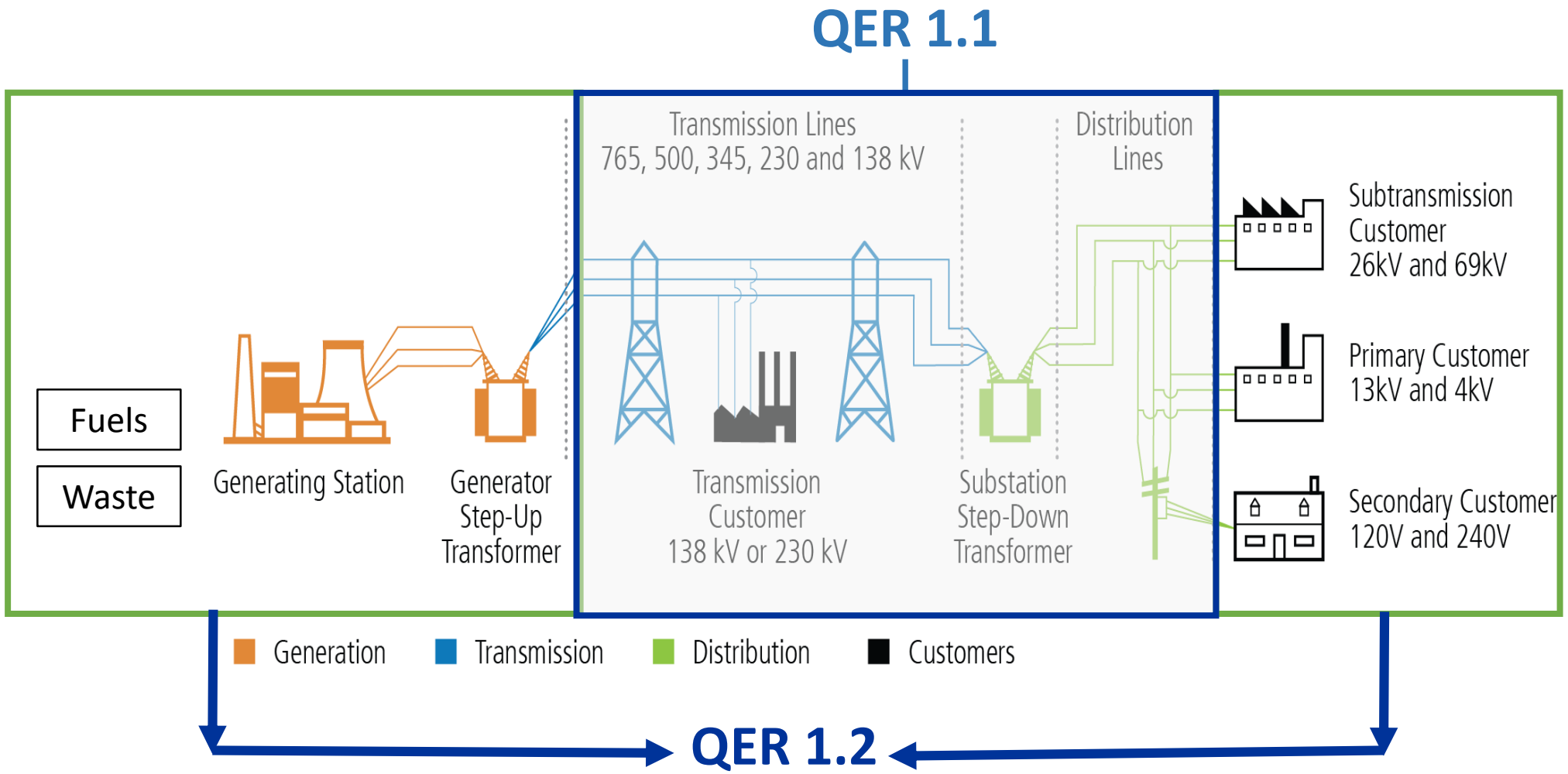
QER 1.2: Electricity Generation to End Use

QER 1.1 documented major transformation of Electricity Sector:

- Changing generation mix
- Low load growth
- Increasing vulnerability to severe weather/climate
- New technologies, services and market entrants
- Cyber/physical threats
- Aging infrastructure and workforce
- Growing overlap between jurisdictions

Given the centrality of electricity to the Nation, this transformation merits a closer examination in the next installment of the QER.

Linking QER 1.1 and 1.2



The QER Lens

QER 1.2 will analyze how the electric power system as a whole is evolving, including:

- Integrating new technologies
- Changing market conditions
- Grid operations
- Financing and valuing
- Changing role of the customer

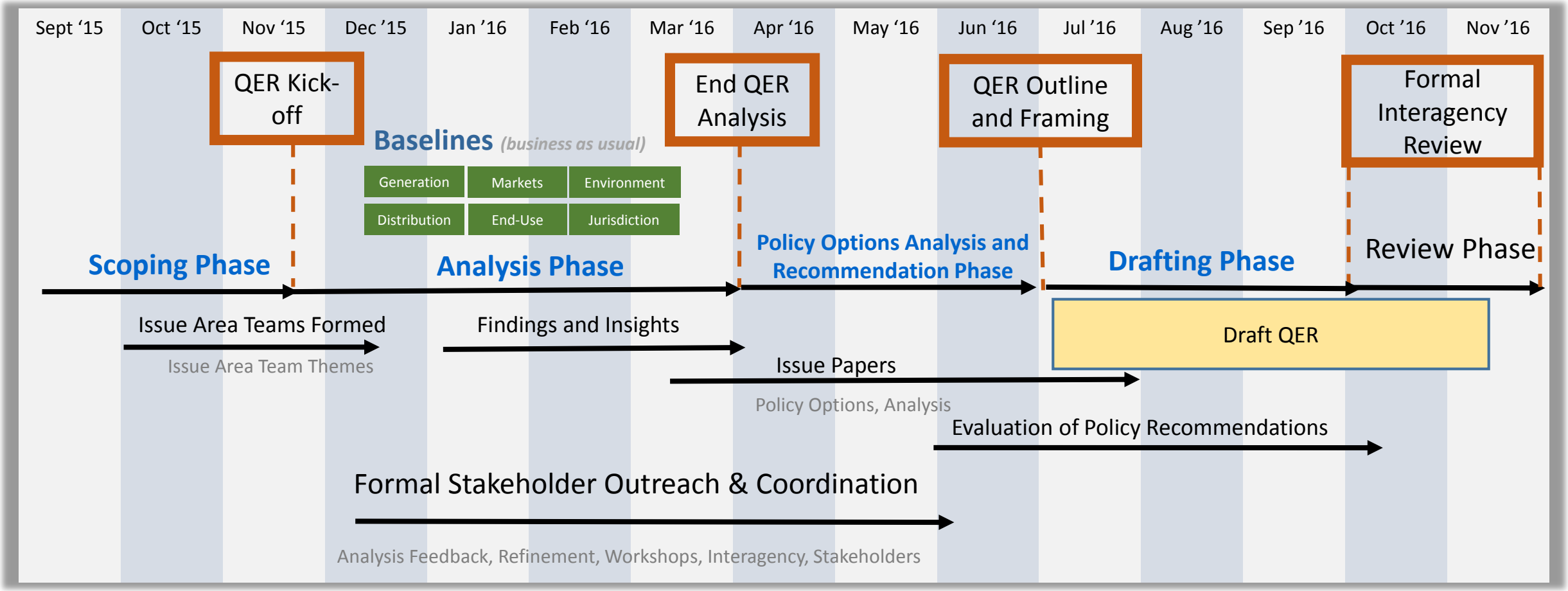
Physical structures and the roles of a range of actors, institutions and industries are being analyzed, vis-à-vis:

- Maintaining reliability of supply
- Ensuring electricity affordability
- Adapting to dramatic changes in technology and services

QER analyses are underway to consider issues such as:

- Fuel choice
- Distributed and centralized generation
- Physical and cyber vulnerabilities
- Federal, state, and local policy direction
- Expectations of residential and commercial consumers
- Reviewing existing and evolving business models for a range of entities, throughout the system

Process Timeline



Final Report Rollout and Release (Nov '16-Jan '17)

Sub-Set of Issues We Anticipate Addressing

I. Electricity consumption and energy efficiency by sector (residential, commercial, industrial, transportation) status, trends and barriers.

- What levels and patterns of electricity consumption exist today and are forecasted for 2040 in the industrial, commercial, residential and transportation sectors?
- What business models and methods of customer engagement have been most successful, or show the most promise, for deploying residential efficiency measures? What is the role of policy in facilitating these models and methods?

II. Distributed energy resources (DER): demand response, distributed generation and distributed energy storage.

- How should DER value streams be assessed from different perspectives—customer, utility and society?
- What are the major barriers to distributed generation deployment, including financial, technical, transactional and distribution system limitations?
- What policies and regulations enable demand response to support variable energy resources at utility scale?

III. Grid Operations and Planning

- How do different system architectures facilitate or inhibit efficient grid evolution?
- What lessons from international experiences with grids operating at high penetration levels of variable energy resources can be translated to U.S. system operations?
- What are the implications of having a hybrid generation system – a mix of centralized and distributed resources – on the grid?

Sub-Set of Issues We Anticipate Addressing

IV. Generation Portfolio, Reliability, Supply Chains, and Equity

- What is the evolution of the generation portfolio?
- What are our reserve margins? What is the availability and need for backup power?
- What policies can be put in place to increase access to rural, low-income communities, and remote communities?

V. Electricity Markets

- What frameworks and metrics can characterize regional markets and degree of market regulation? How have markets performed across different criteria since restructuring?
- How can policy levers be employed to remove barriers in each type of market to facilitate policy goals?
- Are there barriers to cleaner and more efficient generation given cost of capital differences?

VI. Electricity Finance

- How sensitive are costs to inputs (commodity prices, construction costs, technology costs)?
- How do costs change under alternate financial scenarios (interest/debt/capital)?
- What are the end user cost distributions under alternate DG/centralized scenarios?

VII. Electricity Valuation

- How are uncertainty and risk taken into account under electricity valuation practices?
- What value streams do electricity technologies provide to the system that are or are not monetized (and to which stakeholders do they accrue)?
- Do grid operators and policymakers manage tradeoffs among value streams?

Sub-Set of Issues We Anticipate Addressing

VIII. Innovation and Technology

- What are the government, industry, and investor roles across the clean energy innovation spectrum?
- How has technology innovation enabled policy changes (e.g. FERC rules)?
- What level of innovation is required to prudently ensure availability of clean energy capabilities to meet our 2030 and 2050 goals, focusing on the electricity sector, e.g. baseload, storage?

IX. Jurisdiction and Regulations

- How did existing jurisdictional boundaries and policies evolve? What are the authorities for oversight of the electricity system? What are the responsibilities vested at each level? What policy levers that exist at each level?
- Distribution-level planning is becoming increasingly important, DER requires utility planners to achieve better integration of transmission planning and distribution planning and coordination between the Feds and the states. How do wholesale and retail markets complement each other (from a jurisdictional perspective)?

X. Environment

- What are potential generation pathways for meeting the U.S. goals for economy-wide de-carbonization by 2050 and how to plan for a future that achieves deep decarbonization of the energy sector?
- How do the interconnected flows of energy and water compare across states? How are these changing over time? What are the key environmental justice issues that are related to the electric power sector and what policy measures should be taken to minimize impacts to EJ communities?
- What are the key environmental issues that arise in the context of electric infrastructure siting and what policy measures should be taken to minimize these impacts?

Sub-Set of Issues We Anticipate Addressing

XI. Resilience

- What strategies and methods are available to improve the resilience of the electricity system, and how do alternative approaches compare on benefits, costs, and performance?
- How can system resilience be maintained in the face of evolving trends and changing conditions, i.e., increased consumer choice, DER, smart grids, climate change, regional migration, fuel diversity?
- What is the role of the insurance industry?

XII. Security (Physical/Cyber)

- What are the key threats, vulnerabilities, risks and consequences associated with cyber and physical attacks on electricity systems, especially SCADA and ICS? How can we address the threat of EMPs to the grid?
- Have system owners and operators incorporated physical security measures in response to terrorist attacks? How do utilities view cyber threats, e.g. in response to NIST's framework and NERC's cybersecurity standards?
- As the economy is increasingly electrified (including DER), do cyber and physical vulnerabilities change?

XI. North American Integration

- Are there barriers or constraints for continuing integration with Canada's electricity sector? How will new transmission be handled?
- Mexico's electricity sector is less extensively integrated with the United States. Integration is not a current reality, but an objective. How does an analysis of the Canadian border inform policies with Mexico?
- For Canadian hydropower to backstop U.S. electricity, what are the constraints and opportunities?

XIV. Employment and Workforce Development

- What are workforce skills and requirements in context of evolving technology and the environment