Quadrennial Technology Review 2015

Briefing Background

2014 Carbon Storage Program Review Meeting

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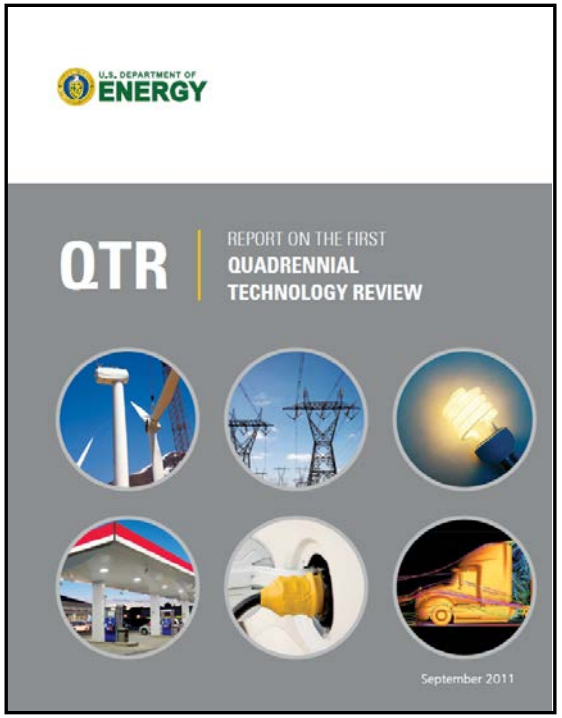
Origins of the Quadrennial Technology Review

- The President's Council of Advisors on Science and Technology identified in 2010 a need for a government-wide Federal energy policy—the Quadrennial Energy Review (QER), with a review of DOE's work on technology —the Quadrennial Technology Review (QTR)—as one component.
  - The first QTR was published in 2011.
- The President called for an interagency QER in January 2014.
- Secretary Moniz requested a new QTR in parallel with the QER.
- The QTR is focused on DOE R&D, whereas the QER is focused on infrastructure and on government-wide energy policy this year. The QTR and QER are being done in parallel and are complementary.



Changes in the Energy Landscape Since QTR-2011

- New urgency in addressing our energy challenges, particularly carbon emissions.
- The need for resiliency and robustness to extreme weather and other events.
- Dramatic changes in unconventional fossil fuel production, with impacts on other energy supply and end-use sectors.
- Rapid cost reductions and market penetration for renewables.
- New opportunities for nuclear power, but shadows from Fukushima.
- Rapid changes in the electricity sector now beginning.
- Advances in electrification of transportation.
- Improvements in Buildings and Industry efficiency.
- New emphasis on manufacturing and competitiveness.
- Fading distinction between electricity suppliers and customers.
- Initial large-scale, integrated CCS demonstration plants beginning to come on line.

The Quadrennial Technology Review 2015

- **Goal: Frame the R&D implications of the energy-linked challenges that we face and the scale, scope, and time frame for response.**
- **Contents:**
  - **Assessments to identify/evaluate the most important technology R&D opportunities over the next 5-10 years.**
  - **Uses systems frameworks to evaluate the power, buildings, industry, and transportation sectors.**
  - **Examines enabling science of DOE's portfolio out to 2030.**
  - **Examines manufacturing issues in depth.**
- **Will strategically engage:**
  - **Department of Energy and National Lab Scientists and Engineers;**
  - **Industry, Academia, and other Experts;**
  - **Stakeholders.**
- **Will inform DOE's R&D agenda and budgets, and drive the rebalancing and reinvigoration of the R&D Portfolio.**
- **Provide the common vision for the R&D path forward.**

The QTR will contribute to the Climate Action Plan and the all-of-the-above strategy

Notional QTR Draft Chapters

Introduction

Executive Summary

- Energy Challenges
- What has changed since QTR 2011
- Energy Systems and Strategies

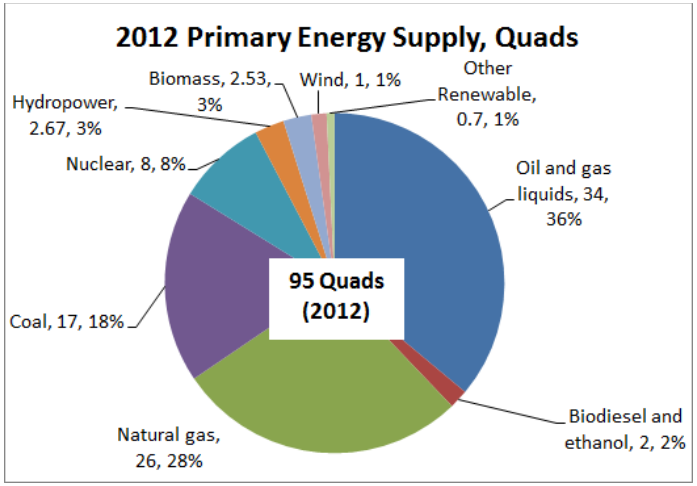
Technology Assessments

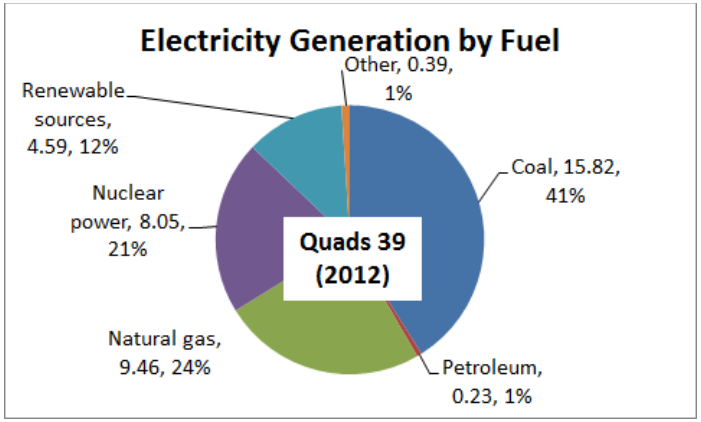
- Advancing Systems and Technologies to Produce Cleaner Fuels
- Enabling Modernization of Electric Power Systems
- Advancing Clean Electric Power Technologies
- Increasing Efficiency of Buildings Systems and Technologies
- Increasing Efficiency and Effectiveness of Industry and Manufacturing
- Advancing Clean Transportation and Vehicle Systems and Technologies
- Enabling Capabilities for Science and Energy

Accelerating Impacts

- Emerging Markets and U.S. Competitiveness
- Accelerating Science and Energy RDD&D and Technology Transfer
- Action Agenda and Conclusions

Possible Energy Supplies and Technologies R&D





Advancing Systems/Technologies for Cleaner Fuels: R&D Opportunities

- Subsurface Engineering R&D
- Unconventional Oil & Gas: shale development; spill prevention; methane hydrates; natural gas transportation, storage, distribution
- Biofuels; Bioproducts
- Hydrogen
- Direct Renewable Energy Fuels
- Water-Energy in Fuels Production
- Enabling Science

Enabling Modernization of Electric Power Systems: R&D Opportunities

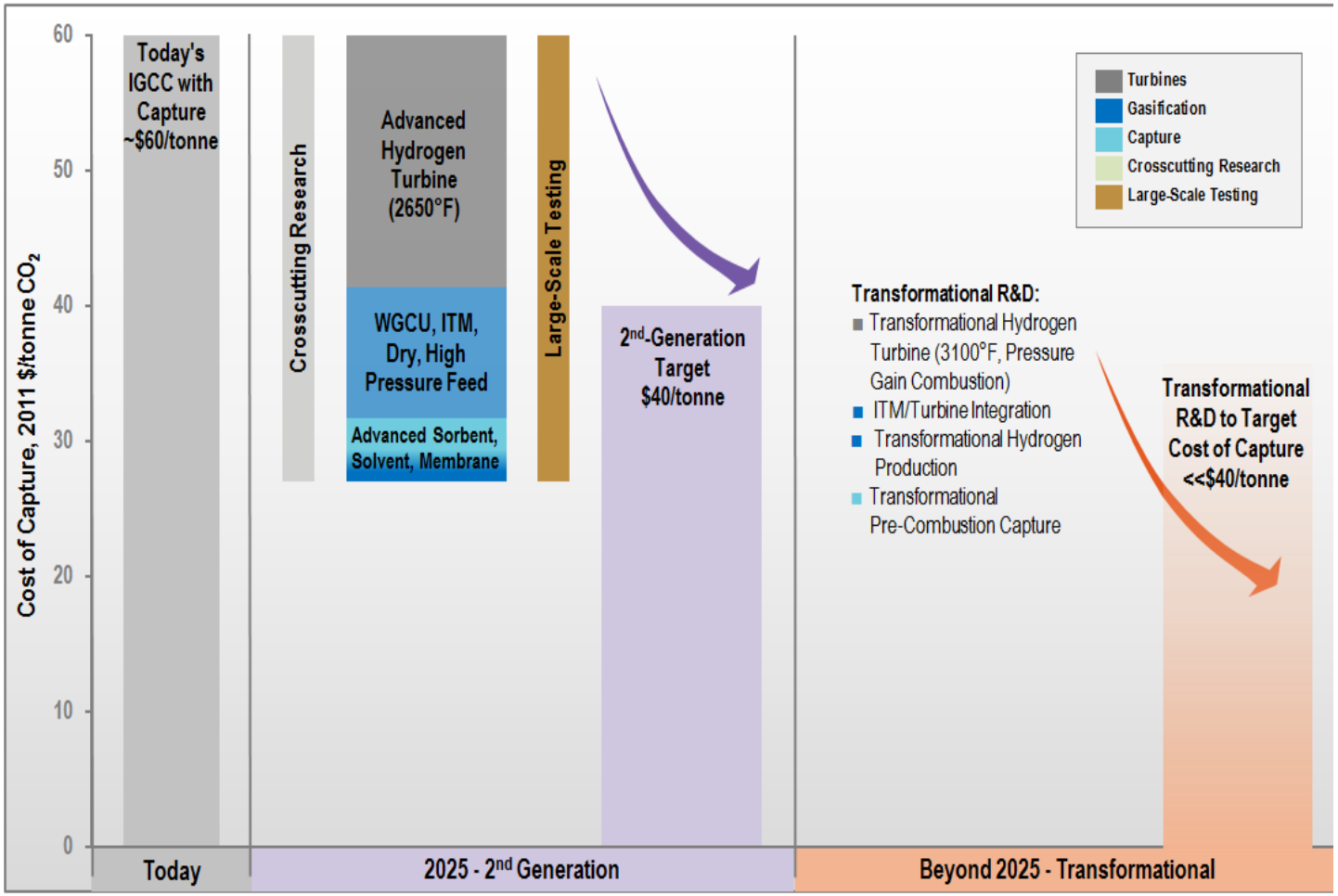
- Grid Architectures and Concepts
- Grid Communications, Control, Operations
- Transmission & Distribution Components
- Grid Cyber and Physical Security
- Integration of Demand-Side Resources and Grid Interfaces
- Energy Storage Integration
- Enabling Science

Advancing Clean Electric Power Technologies: R&D Opportunities

- Carbon Management
- Nuclear Power–SMRs, Fast, Hybrids
- BioPower-CCS
- Concentrating Solar Power
- Supercritical CO2
- CHP/Fuel Cells Distributed Gen.
- Geothermal Power
- Solar Photovoltaic Power
- Water/MHK Power
- Wind Power
- Power Electronics
- Distributed Systems
- Energy Storage Components
- Hybrid Systems
- Energy-Water Technologies

Energy System Integration is a key emphasis.

Possible Elements of the Technology Assessments



Key R&D Opportunities and Impacts on Technology cost.

FE QTR Section

- **CCS will be covered in QTR Chapter: Advancing Clean Electric Power Technologies, and in the Section titled: "Advanced Fossil-Fueled Plants with Carbon Capture and Storage".**
- **Section covers CCS and non-CCS technology improvements related to efficiency and/or capital cost.**
- **A strong effort will be made to keep the QTR report length manageable. This could significantly reduce technology detail.**
- **Links to other documents will provide access to greater detail.**

Current Draft CCS Section Outline

Advanced Fossil-Fueled Plants with Carbon Capture and Storage
Overview
Program Goals and Performance Targets
Program Logic
Driving Down CCS Cost through Improved CO_2 Capture and Power Plant Efficiency - PC-Based Power Plants with CCS - Gasification-Based Power Plants with CCS - CCS for Existing Coal and Natural Gas Power Plants, and Industrial Facilities - Supporting Research (e.g. CCSI)
Demonstrating the Safety and Permanence of CO_2 Storage - Core R&D - Storage Infrastructure – Regional Partnerships
Large-Scale Integrated CCS Projects
Driving Down CCS Cost through CO_2 Utilization and other Value Added Products
Reduce RD&D Cost and Accelerate Deployment Through International Partnerships
Regulations and Supporting Policies

Questions/Comments

- We welcome your questions and comments
- Public review documents may not be available until early 2015
- Final report expected by middle of 2015
- Notice to review the draft will be sent to the storage meeting's email list because it is especially important to hear back from knowledgeable groups.
- The public review will seek input on a variety of questions such as:
  - What are the big R&D opportunities? What is missing from the current QTR list?
  - What are the potential synergies across R&D activities?
  - What should the overall and specific balance be across the portfolio?
  - What are the potential impacts of the particular R&D efforts on our economic, environmental, and security challenges? What are appropriate metrics?
  - What policy issues are driven by the technology being developed?
  - What are the most effective means for technology transfer?
  - What R&D management mechanisms have been most successful in the private sector and should be considered in the public sector?
- If you want to communicate with the QTR team prior to the public review process, emails can be sent to FEQTR2014@hq.doe.gov