



Quadrennial Technology Review 2015

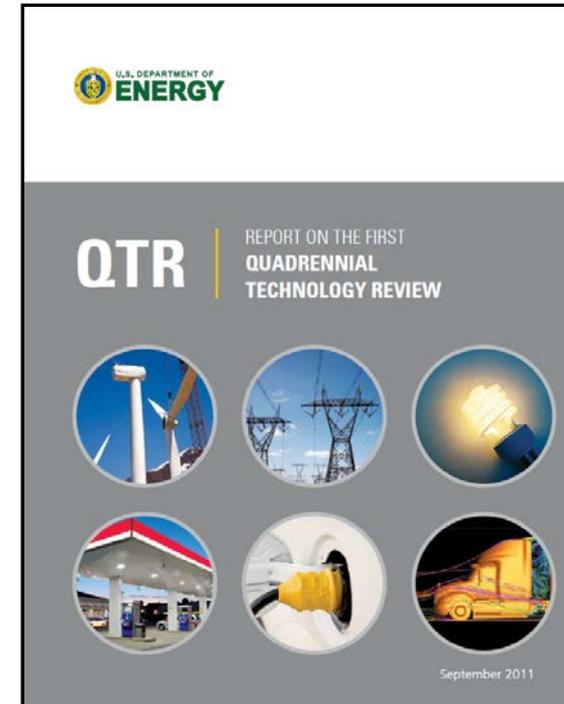
Briefing Background

2014 Carbon Capture 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**-- given the observed damaging impacts to date and the increasingly serious damage projected with continued 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.**

Notional QTR Draft Chapters

Introduction

Executive Summary

Energy Challenges

What has changed since QTR 2011

Energy Systems and Strategies

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

Emerging Markets and U.S. Competitiveness

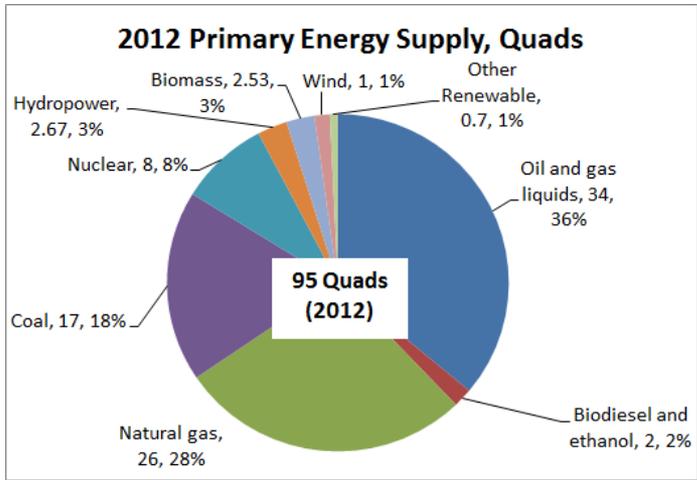
Accelerating Science and Energy RDD&D and Technology Transfer

Action Agenda and Conclusions

Technology Assessments

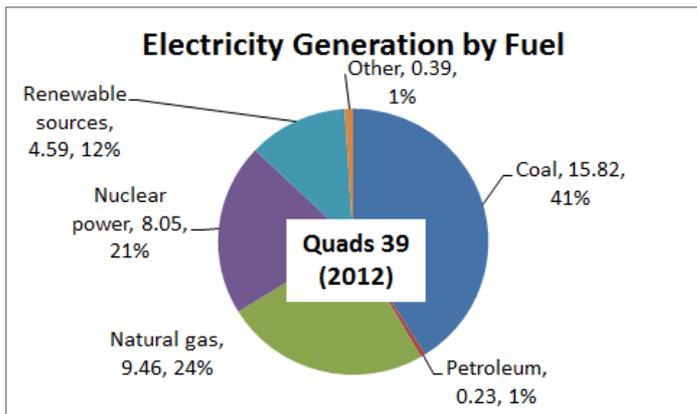
Accelerating Impacts

Possible Energy Supplies and Technologies R&D



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

- **Subsurface Engineering R&D: Intelligent wellbores; Permeability Manipulation**
- **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

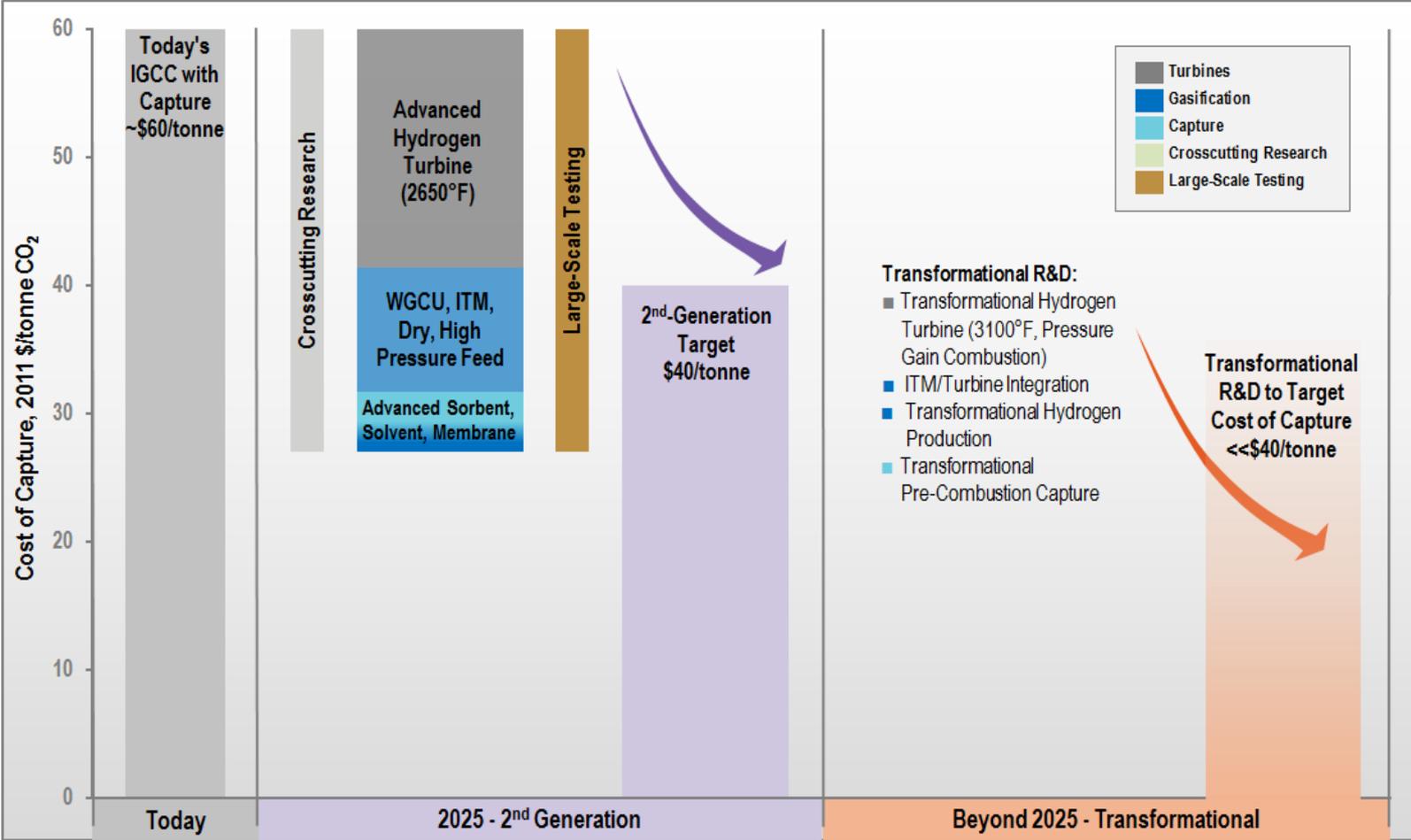
- **Grid Architectures and Concepts**
- **Grid Communications, Control, Operations**
- **Transmission & Distribution Components**
- **Grid Cyber and Physical Security**
- **Integration of Demand-Side Resources and Grid Interfaces**
- **Energy Storage Integration**
- **Enabling Science**

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



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 CO₂ 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 CO₂ Storage

- Core R&D
- Storage Infrastructure – Regional Partnerships

Large-Scale Integrated CCS Projects

Driving Down CCS Cost through CO₂ 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 capture meeting's email list because it is especially important to hear back from knowledgeable groups like this.
- 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