Creating Our Future: Meeting the Electricity Technology Challenge

Steven Specker
President and CEO
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The Electricity Technology Challenge

• Defining the Challenge

• Understanding the Challenge

• Meeting the Challenge
Defining the Technology Challenge

- **De-carbonize the electricity infrastructure**
- **Meet binding economy-wide CO₂ reduction targets**
- **Provide reliable, affordable, and environmentally responsible electricity to consumers**

*Two Key Metrics: CO₂ Emissions and Cost of Electricity*
The CO₂ Challenge

Assumed Economy-wide CO₂ Reduction Target

- **Historical Emissions**
- **U.S. Electric Sector**
- **Remainder of U.S. Economy**

- **2005 = 5982 mmT CO₂**
- **2012 = 3% below 2005 (5803 mmT CO₂)**
- **2020 = 17% below 2005 (4965 mmT CO₂)**
- **2030 = 42% below 2005 (3470 mmT CO₂)**
- **2050 = 83% below 2005 (1017 mmT CO₂)**

- **Waxman-Markey goals as of July 14, 2009**

**80% Reduction in CO₂ emissions from 1990**
The Cost Challenge

U.S. Retail Price of Electricity

Flat real electricity prices for past 40 years… what about the next 40 years?

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The Electricity Technology Challenge

- Defining the Challenge
- Understanding the Challenge
- Meeting the Challenge
# 2009 Prism Technology Targets

<table>
<thead>
<tr>
<th>Technology</th>
<th>EIA AEO Base Case</th>
<th>EPRI Prism Target</th>
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<tbody>
<tr>
<td>Efficiency</td>
<td>Load Growth ~ +0.95%/yr</td>
<td>8% Additional Consumption Reduction by 2030</td>
</tr>
<tr>
<td>T&amp;D Efficiency</td>
<td>None</td>
<td>20% Reduction in T&amp;D Losses by 2030</td>
</tr>
<tr>
<td>Renewables</td>
<td>60 GWe by 2030</td>
<td>135 GWe by 2030 (15% of generation)</td>
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<tr>
<td>Nuclear</td>
<td>12.5 GWe New Build by 2030</td>
<td>No Retirements; 10 GWe New Build by 2020; 64 GWe New Build by 2030</td>
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<tr>
<td>Fossil Efficiency</td>
<td>40% New Coal, 54% New NGCCs by 2030</td>
<td>+3% Efficiency for 75 GWe Existing Fleet; 49% New Coal; 70% New NGCCs by 2030</td>
</tr>
<tr>
<td>CCS</td>
<td>None</td>
<td>90% Capture for All New Coal + NGCC After 2020; Retrofits for 60 GWe Existing Fleet</td>
</tr>
<tr>
<td>Electric Transportation</td>
<td>None</td>
<td>PHEVs by 2010; 40% New Vehicle Share by 2025; 3x Current Non-Road Use by 2030</td>
</tr>
<tr>
<td>Electro-technologies</td>
<td>None</td>
<td>Replace ~4.5% Direct Fossil Use by 2030</td>
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</table>
41% reduction in 2030 from 2005 level is technically feasible using a full portfolio of technologies
Technology Portfolios

Two Technology Portfolios Modeled with MERGE

• Full Portfolio
  • Coal and Gas CCS available
  • Accelerated end-use efficiency
  • PEV’s can expand
  • Nuclear production can expand

• Limited Portfolio
  • No CO₂ capture and storage (CCS)
  • No plug-in electric vehicles (PEV’s)
  • Nuclear generation remains at existing levels
Prism technical potential approximates MERGE results for economy-wide 80% reduction in 2050 from 1990 levels.
MERGE U.S. Electric Generation Deployment

Limited Portfolio
- Demand with No Policy
- Demand Reduction
- Coal
- New CCS
- Oil
- Hydro
- Biomass
- Retrofit
- Gas
- Nuclear
- Wind
- Solar

Full Portfolio
- Demand Reduction
- Biomass
- Wind
- Hydro
- Gas
- Nuclear
- New Coal + CCS
- CCS Retrofit
- Coal
- Gas
- Nuclear
- CCS

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MERGE CO₂ Price Results

> $50/MT CO₂ by 2020 for either portfolio

Limited Portfolio

Full Portfolio

$/metric ton CO₂ (2007$)
Substantial increases in the cost of electricity

- Limited Portfolio
- Full Portfolio

2007 U.S. Average Wholesale Electricity Cost

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Technology Insight – Energy Efficiency

Aggressive energy efficiency needed with either portfolio

Limited Portfolio

Full Portfolio

Demand Reduction

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Technology Insight - Renewables

Renewables > 20% by 2030 with either portfolio

Limited Portfolio

Full Portfolio

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Gas expands rapidly 2010-20 if uncertainty exists regarding availability of new nuclear and CCS post 2020.
Technology Insight - Gas

Tightener 2020 reduction target accelerates gas 2010-20

Historical Emissions

Remainder of Economy

Electric Sector

Assumed Economy-wide CO₂ Reduction Target

Billion tons CO₂

MERGE Economy-wide CO₂ emissions

MERGE Electric Sector CO₂ Emissions

Full
Limited

Full
Limited
Technology Insight – Gas

High cost to meet 2050 reduction target with 50%+ gas in generation mix

MERGE Projections 2020-2050

Limited Portfolio

Full Portfolio

Decarbonization
Remarkably different futures…and only 20 years away!

**Generation Mix and Electricity Cost** in 2030

- **Limited Portfolio**
  - +90% COE*
- **Full Portfolio**
  - +50% COE*

*Cost of electricity increase relative to 2007*

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Generation Mix and Electricity Cost* in 2050

Totally different futures in 2050

Limited Portfolio

- Biomass
- Wind
- Nuclear
- Hydro

+210% COE*

Full Portfolio

- Biomass
- Wind
- Nuclear
- Coal + CCS
- Gas

+80% COE*

* Cost of electricity increase relative to 2007

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The Electricity Technology Challenge

• Defining the Challenge

• Understanding the Challenge

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Meeting the Challenge

✓ De-carbonize the electricity infrastructure

✓ Meet binding economy-wide CO\textsubscript{2} reduction targets

- Provide reliable, affordable, and environmentally responsible electricity to consumers

**CO\textsubscript{2} Reduction Targets Can be Met … The Challenge is Affordability**
Meeting the Challenge

$\$/MWh (2007$)

2007 U.S. Average Wholesale Electricity Cost

Limited Portfolio

Technology Actions based on meeting the Prism technology targets

RD&D and Deployment Challenge

Full Portfolio

Technology Innovation to de-carbonize while achieving a cost of electricity near today’s level

Innovation Challenge

2020 2030 2040 2050
Electricity policy and technology actions over the next decade will to a great extent shape the electricity future of 2050

Which Future Are You Creating?

Decarbonization