Costs of Retrofitting vs. Replacing Coal-Fired Power Plants to Comply with New Air Pollution Control Rules

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Overview

Existing Coal Fleet

- 1,032 Units
- 332 GW

Retirements Due to Upcoming Air Rules

- 30 GW to 100 GW Projected
- McIlvaine Projections:
  - Best Case: 294 Units/32.5 GW
  - Worst Case: 564 Units/101.0 GW
- How will lost capacity be replaced?

Study to Determine Costs and Environmental Benefits

- Replacing Existing Units with New Ultra-supercritical rather than Retiring or Retrofitting
- Three Scenarios: 10%, 20%, 30% Replaced with USC
- Similar to Retirement Projections: 33 GW, 67 GW, 100 GW
Aging Coal Plants

**Average Age of Coal-Fired Power Plants**

- **Typical Depreciation Life Span**: 40 years
- **US**: 43 years
- **Europe**: 27 years
- **Japan**: 21 years
- **China**: 12 years
Inefficient Coal Plants

Efficiency of Coal-Fired Boilers

<table>
<thead>
<tr>
<th>Type</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Average</td>
<td>32.5</td>
</tr>
<tr>
<td>Subcritical</td>
<td>36.8</td>
</tr>
<tr>
<td>Supercritical</td>
<td>39.3</td>
</tr>
<tr>
<td>Ultra Supercritical</td>
<td>44.1</td>
</tr>
</tbody>
</table>
Out of Date Coal Plants

Percentage of Existing Coal-Fired Units with Air Pollution Control Devices

- FGD: 60%
- SCR: 20%
- Fabric Filters: 30%
- ACI: 10%
Benefits of Replacing Old Units

Environmental Benefit:
Replacing 10% of Existing Coal Capacity
with USC with Air Pollution Equipment

Percentage Reduction in Emissions

- SO2
- NOx
- PM
- Hg
- CO2
# Replacement Scenarios

## Coal Fleet Replacement Scenarios

<table>
<thead>
<tr>
<th>Coal Fleet Replacement Scenarios</th>
<th>Units Replaced</th>
<th>Percentage of Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of Units</td>
<td>Capacity (MW)</td>
</tr>
<tr>
<td>10% Replaced</td>
<td>286</td>
<td>30,900</td>
</tr>
<tr>
<td>20% Replaced</td>
<td>493</td>
<td>68,200</td>
</tr>
<tr>
<td>30% Replaced</td>
<td>564</td>
<td>101,000</td>
</tr>
</tbody>
</table>

Based on:
- Size of Unit (MW)
- Age of unit
- Whether the unit has FGD and, if so, age of scrubber
- Whether the unit has SCR
<table>
<thead>
<tr>
<th>Control Device</th>
<th>Cost $/kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet FGD</td>
<td>$200-500</td>
</tr>
<tr>
<td>In-furnace NOx</td>
<td>$35-50</td>
</tr>
<tr>
<td>Post-combustion NOx</td>
<td>$100-400</td>
</tr>
<tr>
<td>Fabric Filters</td>
<td>$75-500</td>
</tr>
<tr>
<td>Activated Carbon Injection</td>
<td>$10-30</td>
</tr>
</tbody>
</table>
Cost of Retrofitting Existing Units

Capital Costs of Retrofitting of Existing Coal Plants to Comply with New Air Pollution Rulemakings

- 10% Replacement Scenario: $226.8 Billion
- 20% Replacement Scenario: $165.5 Billion
- 30% Replacement Scenario: $136.6 Billion

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Cost of New Coal Units

Capital Costs for New USC Units

- 10% Replacement Scenario
- 20% Replacement Scenario
- 30% Replacement Scenario

Capital Costs, Billion $
Cost of Replacing Old Coal Plants with New Ones

Total Capital Investment Through 2020

- 10% Replaced: $90.5 billion
- 20% Replaced: $138.0 billion
- 30% Replaced: $281.0 billion

- Total Capital Cost for Retrofitting Existing Units (Bil $)
- Total Capital Cost for New Units (Bil $)