The Development of Generation IV Systems for Commercial Deployment

Utility-Informed Perspectives

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Context for GEN IV Deployment: Uncertainty

- What will the price of natural gas be?

- What will the price of carbon be?

- What will the technology competition be?
  - Natural gas with carbon capture and sequestration (CCS)?
  - Renewables with grid-scale energy storage?

- “Unknown unknowns” (i.e., the next shale gas)
What will it take to commercialize advanced reactors?

- Technologies that are:
  - mature (demonstration)
  - compelling (new attributes and capabilities)
  - competitive (cost and value)

- Customers who:
  - understand (informed and engaged)
  - believe (evidence of performance)
  - need (business case)
Compelling … Worth Risk of Adopting New Technology

- Inherent safety
- Robust, competitive, sustainable economics
- Scalable, dispatchable, zero carbon energy
- Diversified products and market access
- Flexible operation
- Secure fuel supply

Options must offer dominant solutions for dispatchable, energy dense and non-emitting generation.
Limited Competitiveness of Nuclear: U.S. Example
EPRI REGEN-US Modeling

Future by default:

- Low natural gas prices dominate picture
- Renewables fail to penetrate in many regions
- Gap from increasing demand and retirements is filled by NGCC
Competitiveness from Cost, Revenue and Policy Improvements

- Competitiveness of nuclear impacted by nature of markets and competing technologies
- Without policy and with *reference gas prices*, levels below $4,000/kW are required for nuclear deployment
- Additions driven by improvements in cost, revenue (value), and policy support

**Reference Gas Prices**

<table>
<thead>
<tr>
<th>No Policy + High Gas Prices</th>
<th>$15/t-CO₂ Tax</th>
<th>$15/MWh</th>
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<tbody>
<tr>
<td>No Policy</td>
<td>$5/MWh</td>
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<td>Expanded RPS with Credit for Nuclear</td>
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**Additional Revenue Streams ($15/MWh)**

- Nuclear Capital Costs ($/kW): $5,000/kW, $4,000/kW, $3,000/kW, $2,000/kW
Closing

- Technology developers need to understand customers and markets for their products

- Customers and other primary stakeholders:
  - have an interest in understanding technology landscape and horizon
  - have a role to play early in design process

- Advanced reactors must offer compelling options to compete
  - with other technology solutions
  - within uncertain and changing energy markets