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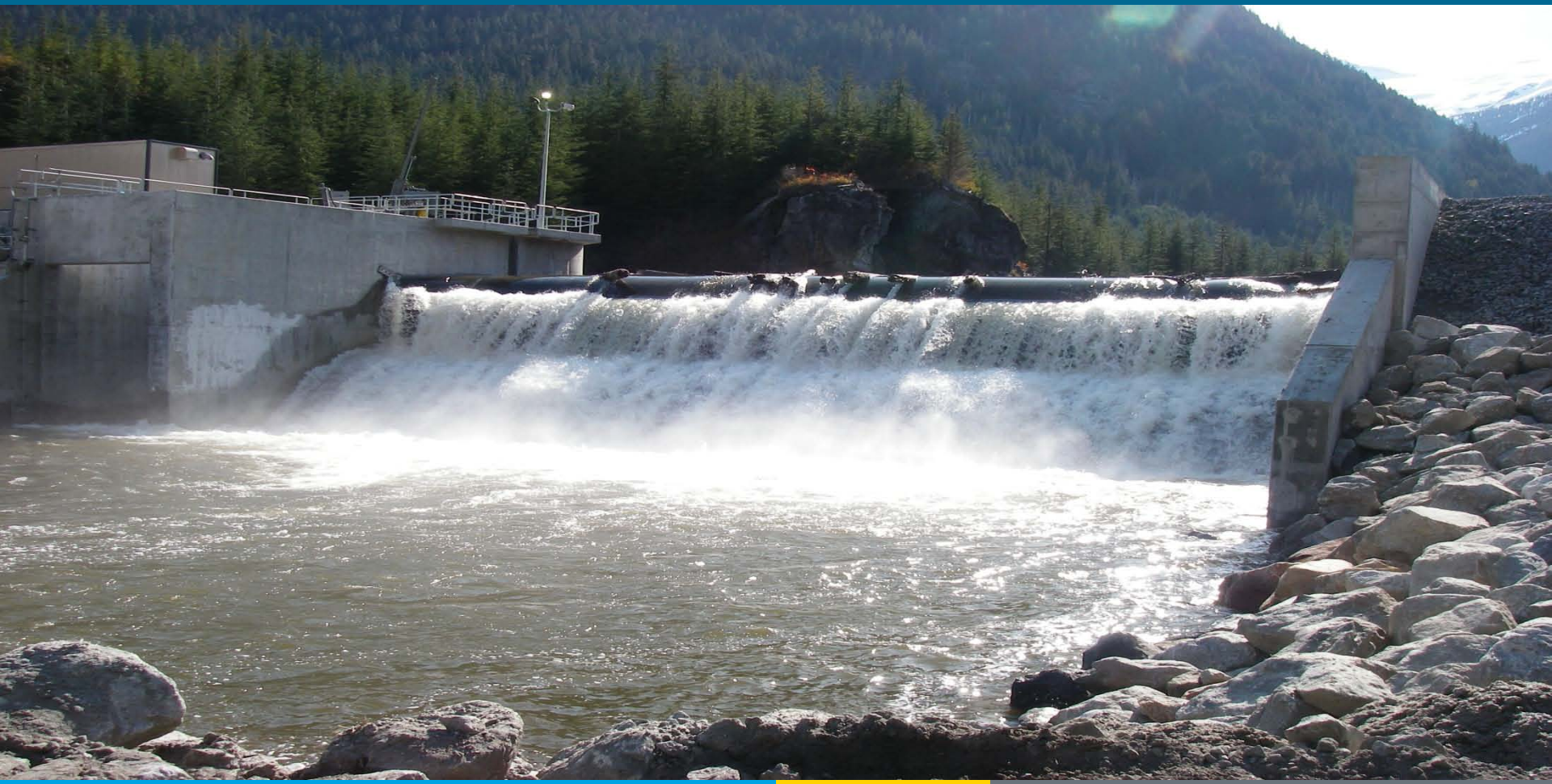

Determining The Role of Technology R&D in Deploying Hydropower

April 23, 2013

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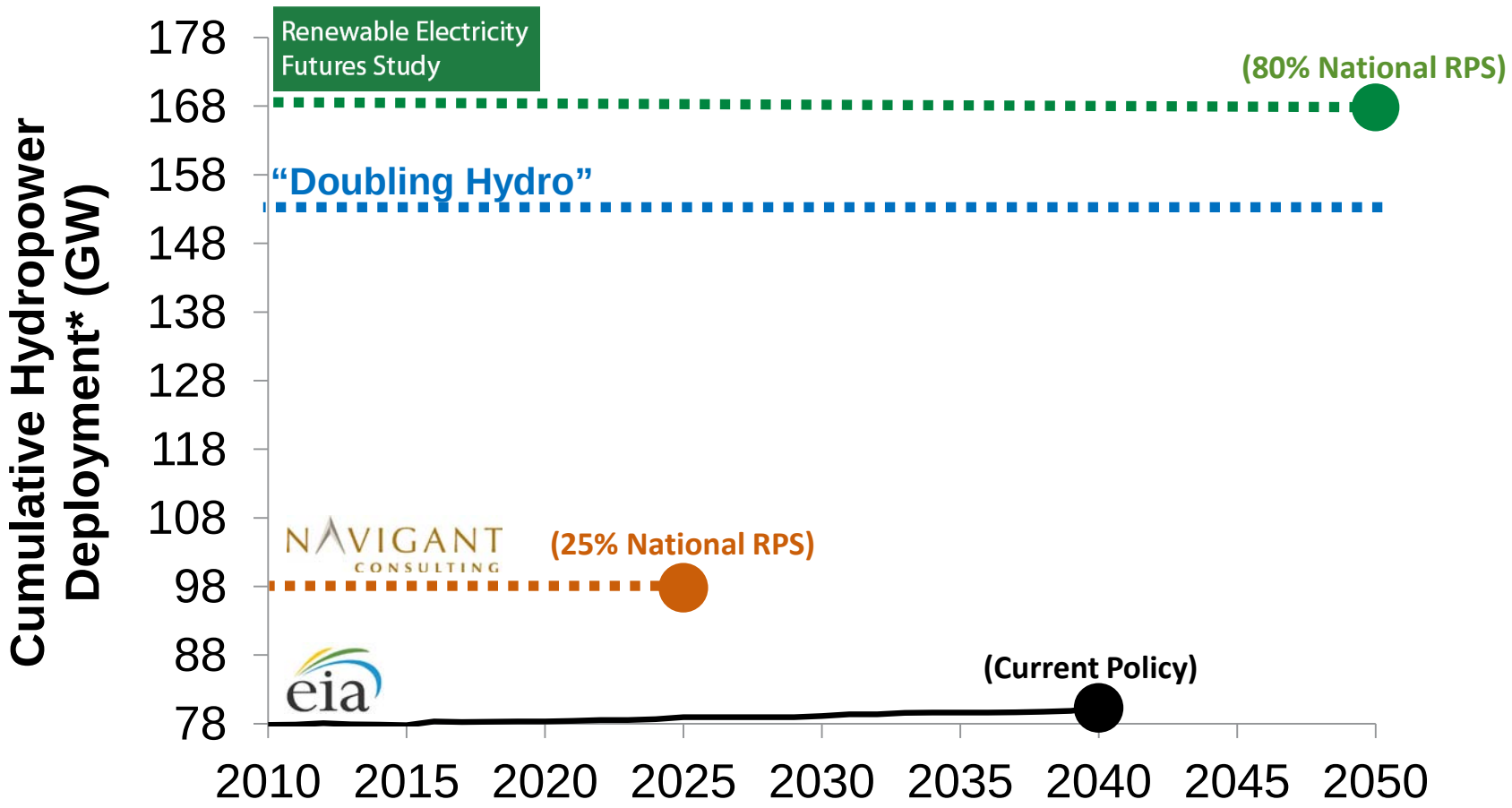
Key Questions/Topics

- The role of technology development in facilitating the deployment of hydropower
- The role of national-scale analysis in prioritizing and communicating technology R&D
- A framework for thinking about the scope, scale, and timeline for developing new technologies

Selected Hydropower Growth Scenarios



*All study targets are approximate and have been adjusted to exclude marine and hydrokinetic technologies and pumped storage

Hydropower Deployment: Why Model?

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- "All models are wrong but some are useful"
- Approximate real-world electricity market decision making

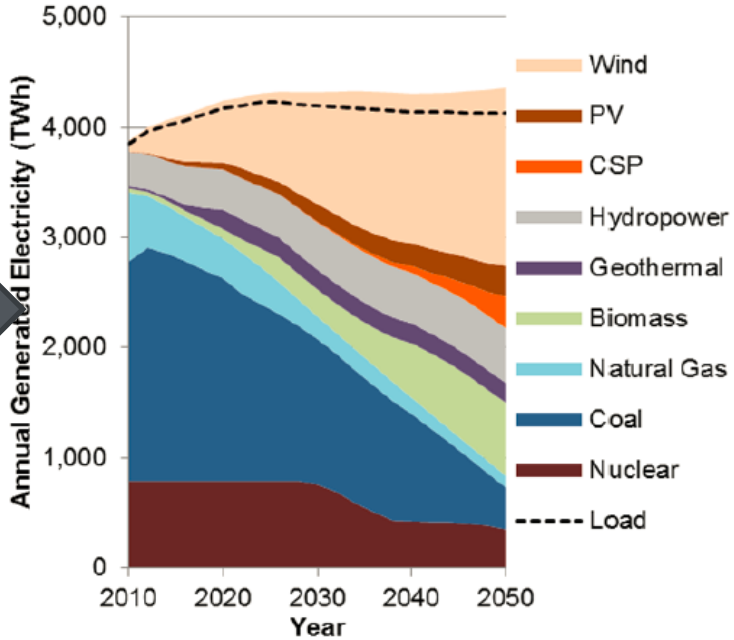
Policies, prices, technology costs, etc

Cost, Performance and Availability of Hydropower

Energy Systems Models

NREL ReEDS Model

EIA NEMS Model



NREL REF 80% Renewable – ITI Scenario Annual Generation

Hydropower Deployment: Through Policy

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- From REF modeling, we see that RPS can be effective
- From the wind experience, the PTC is instrumental
- But, policy is uncertain and volatile

Policies, prices, technology costs, etc

Cost, Performance and Availability of Hydropower

Energy Systems Models

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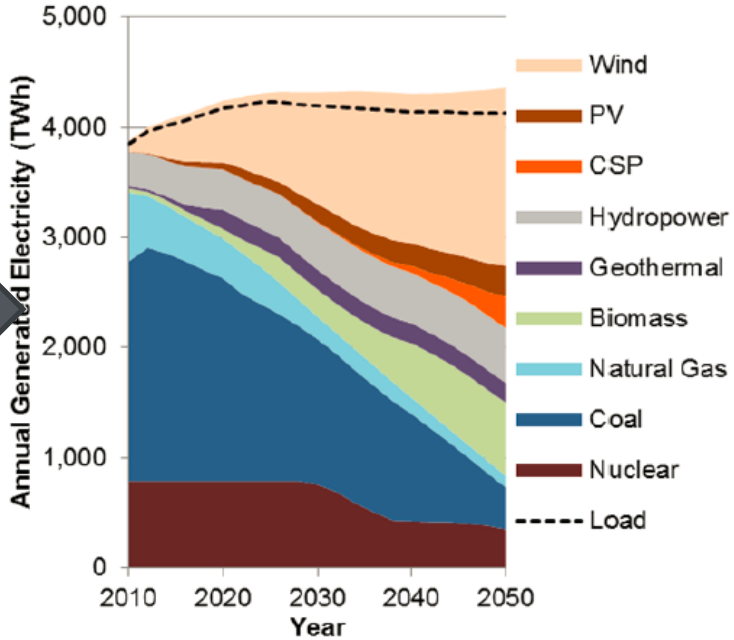

NREL REF 80% Renewable – ITI Scenario Annual Generation

Hydropower Deployment: From Technology Innovation

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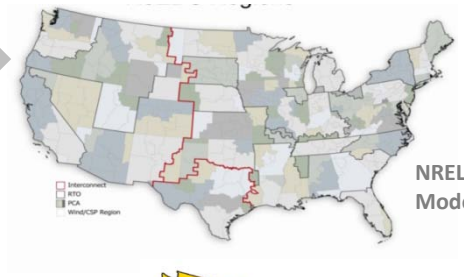
- How much do cost reductions facilitate deployment?
- How much cost reduction is necessary to reach a goal?

Policies, prices, technology costs, etc

Cost, Performance and Availability of Hydropower

Energy Systems Models



NREL ReEDS Model

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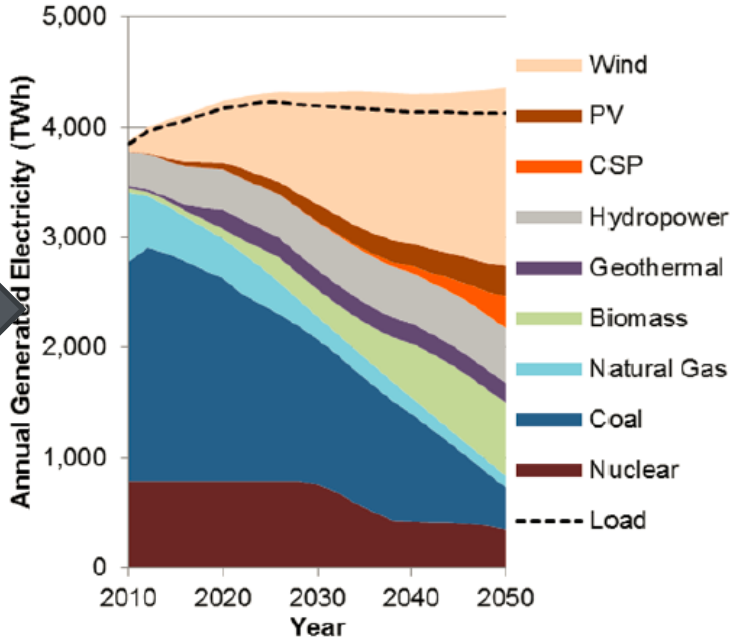
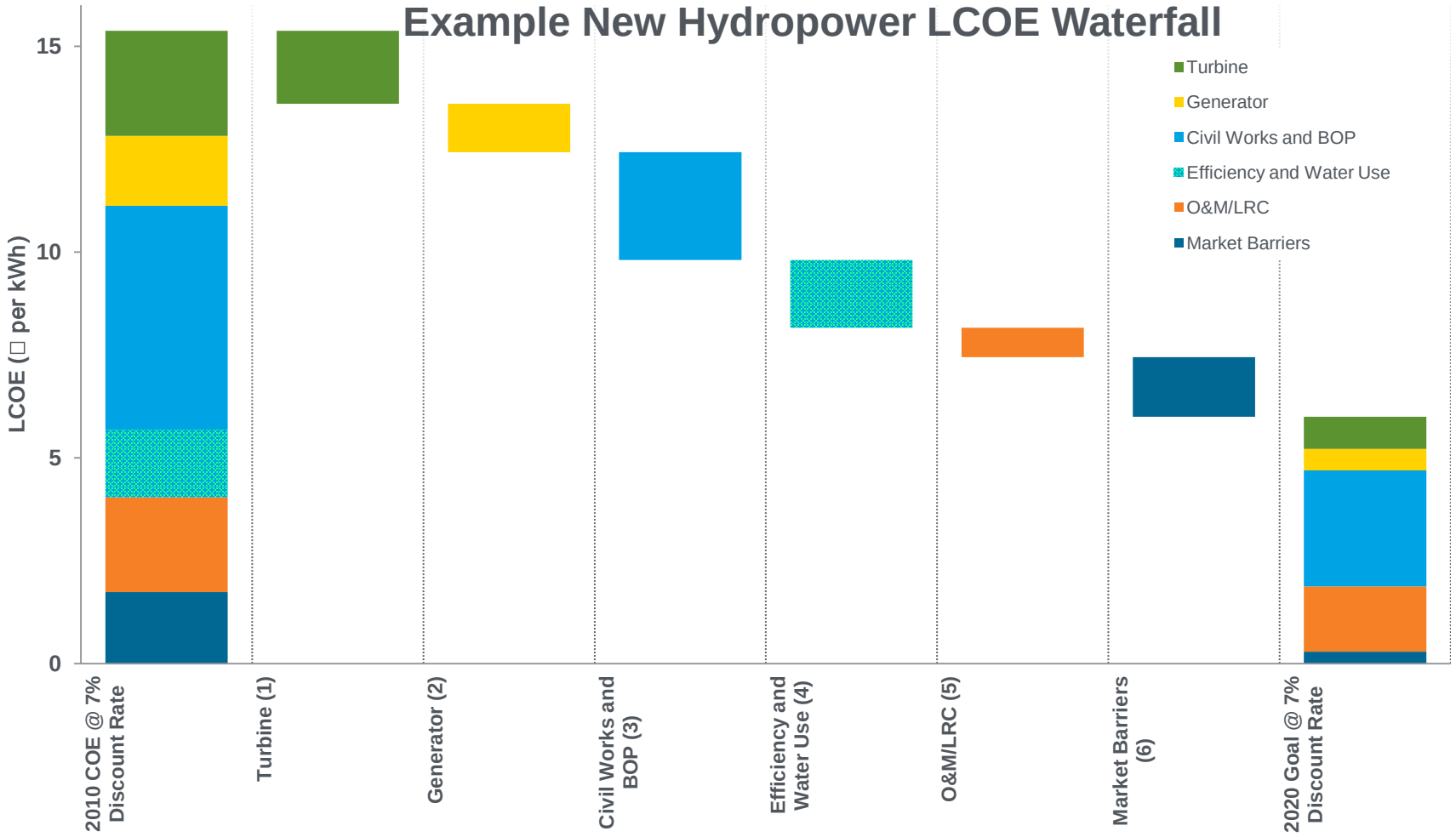
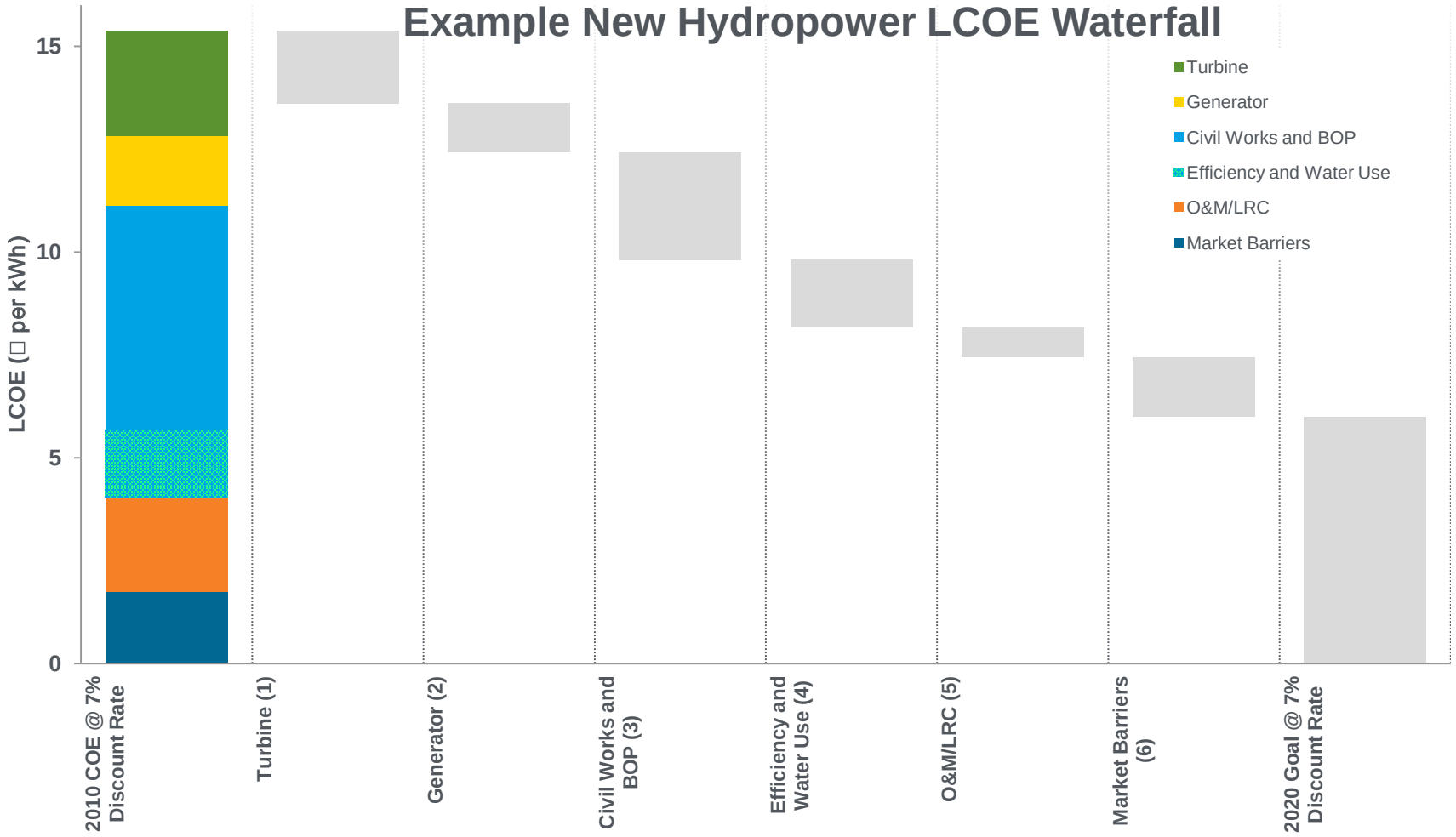


NREL REF 80% Renewable – ITI Scenario Annual Generation

What Future Innovation Is Needed?



Determining Innovation Needs: Establish Baseline Cost



Baseline Cost from a National Perspective

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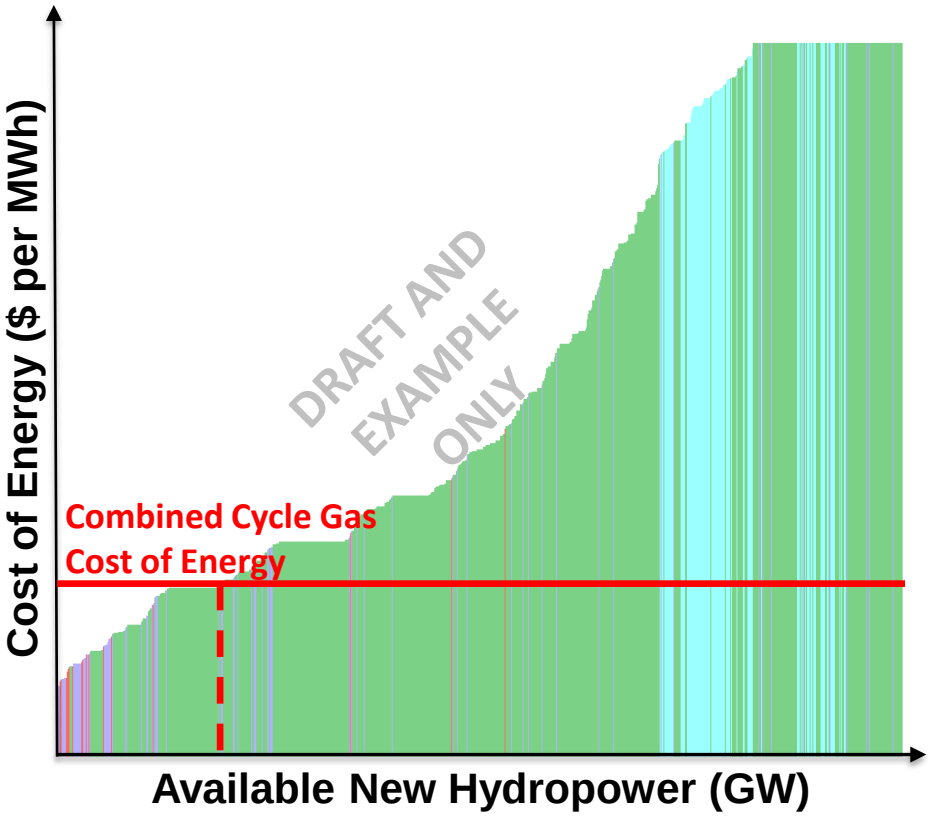
- Systematic treatment of characteristics….
  - Head
  - Flow
  - Regional markets
  - Environmental considerations
  - Distance to Transmission
  - Etc
- … and resource classes:
  - Upgrades
  - Non-Powered Dams
  - New Development



Adapted from preliminary ORNL/NREL hydropower supply curve development

Technology Roadmap to Cost-Competitiveness

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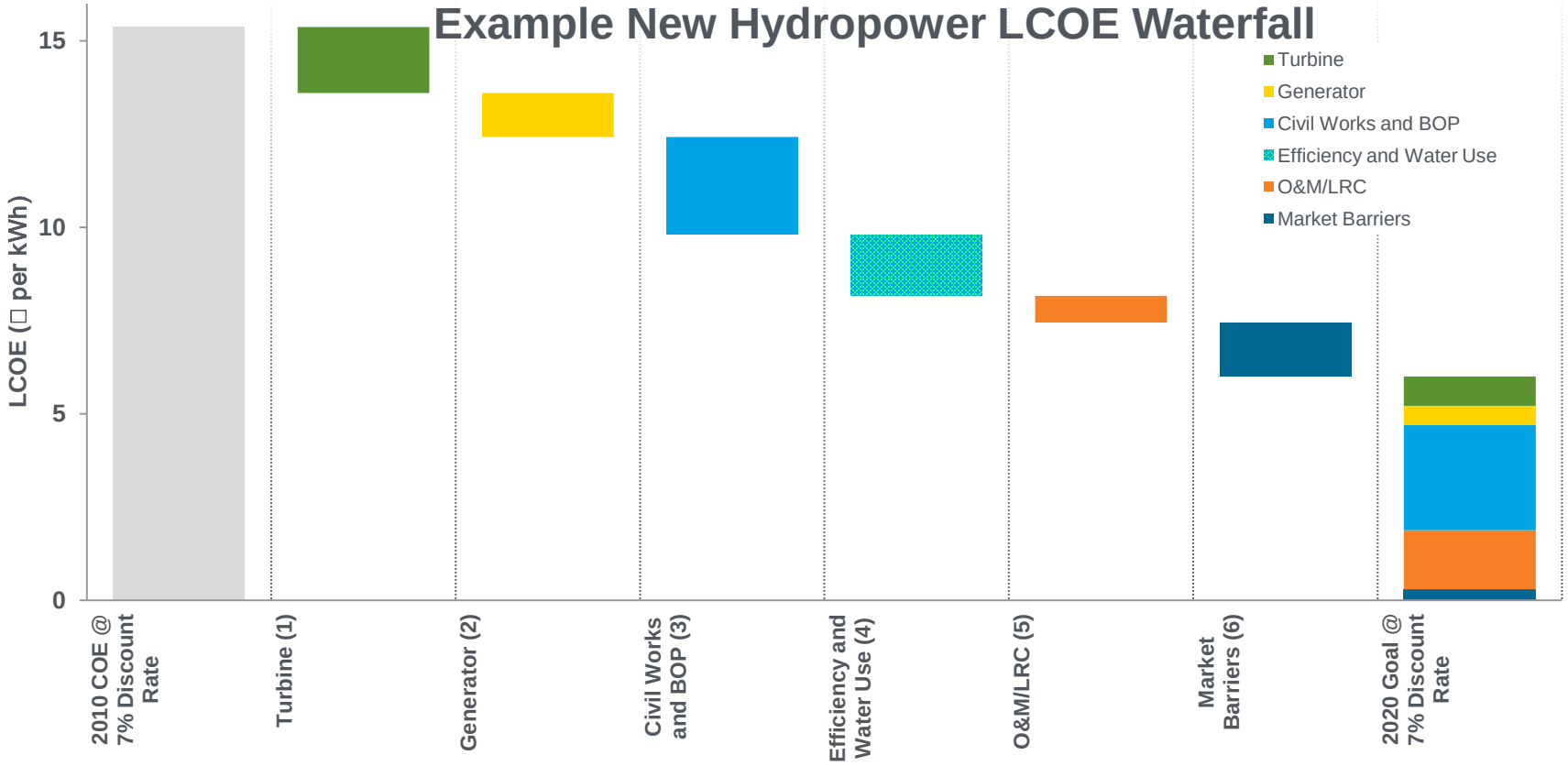
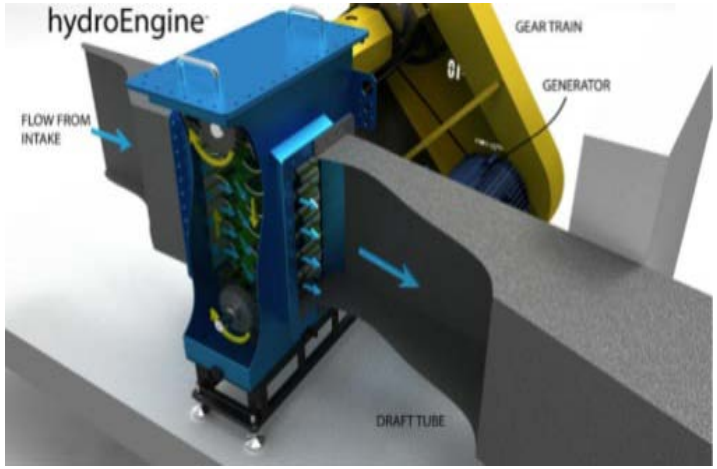
- Innovation in hydropower isn't over…
- …but there is no silver bullet—a portfolio of advancements is necessary

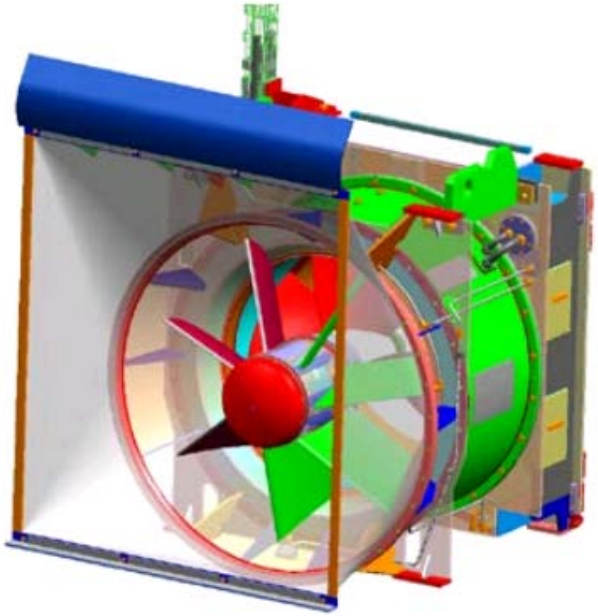


Recent Innovations: Small, Modular Low-head Units

- Advances in efficiency for low-head resource
- Standardization allows for economies of scale



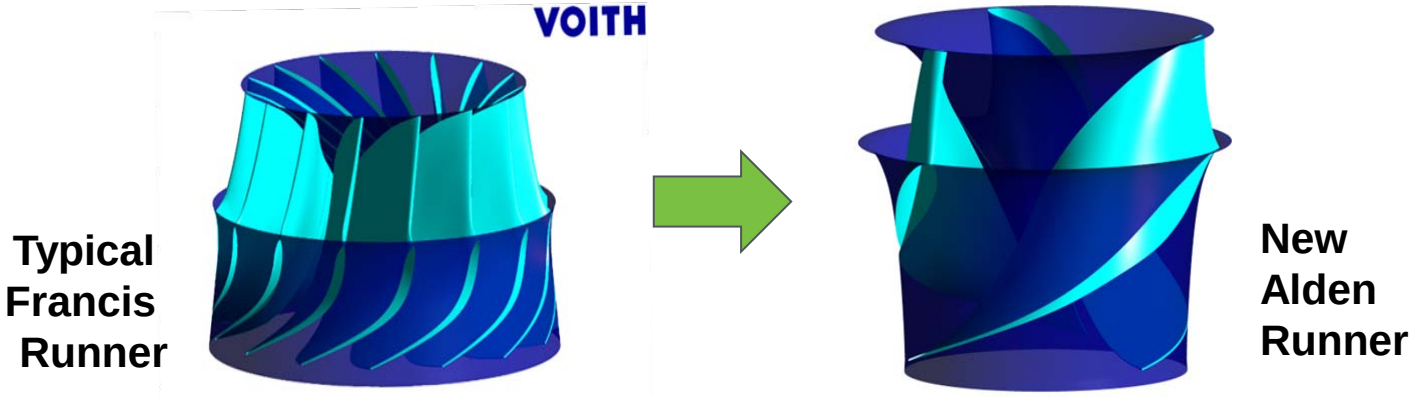
Natel "hydroEngine"



Andritz "StraflowMatrix"

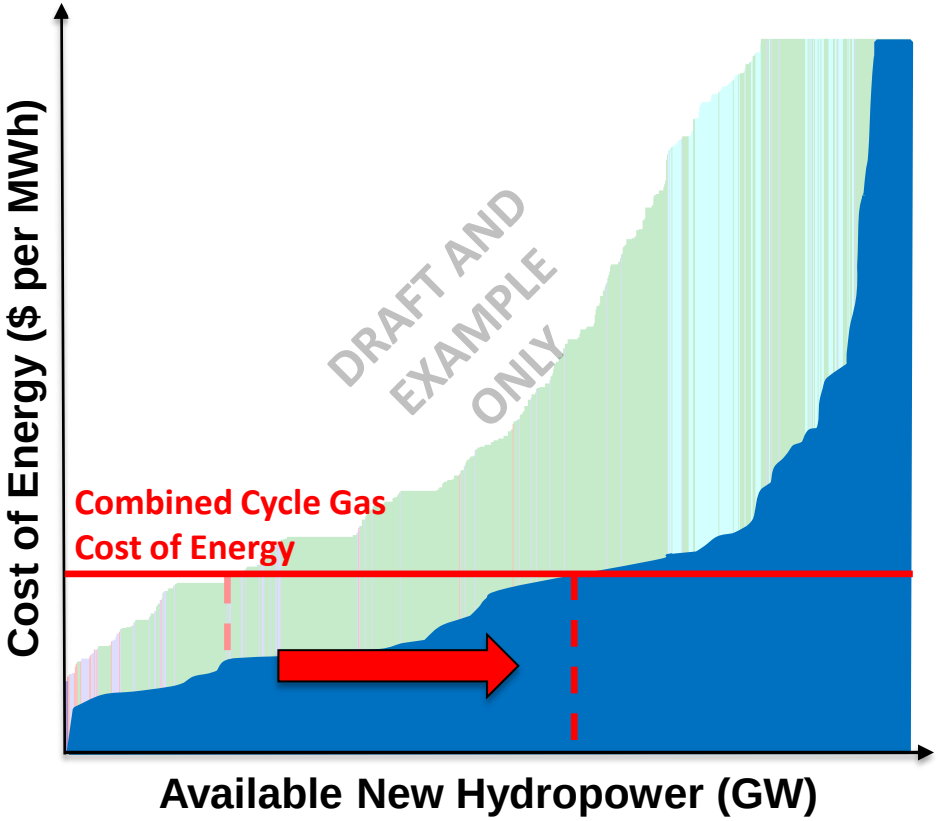
Alden Fish Friendly Turbine

- Continuation of "old" Hydropower Program, a technology a decade in the making.
- 94% Efficient, 94-100% aquatic species survival—a hydraulic turbine can be sustainable!
- Potential mechanism for reducing overall LCOE by increasing generation and reducing env. mitigation costs



Technology Change from a National Perspective

Targeted R&D strategy based on the distribution of environmental and technical attributes of the remaining resource



Adapted from preliminary ORNL/NREL hydropower supply curve development

Assessing the Potential Impacts of R&D

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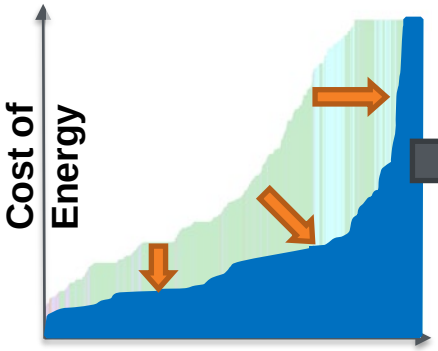
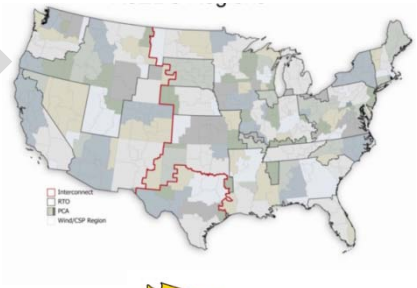
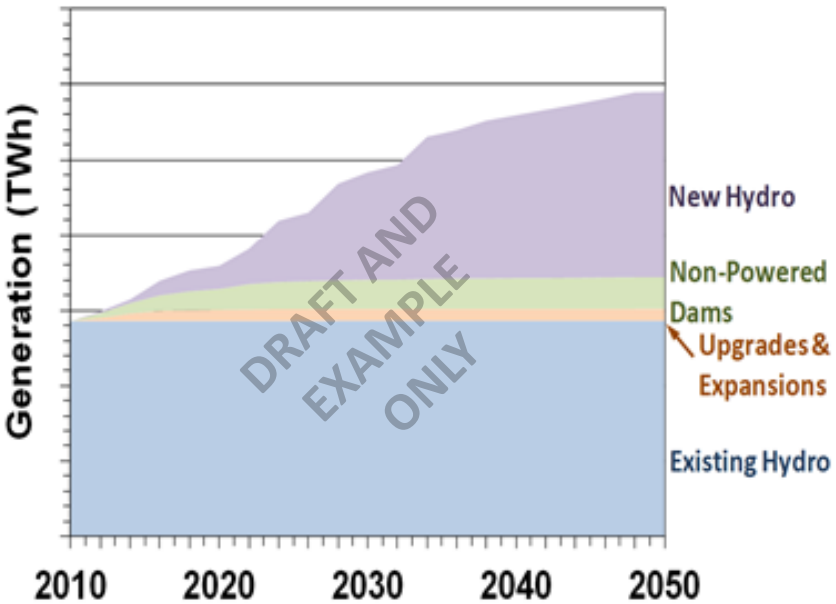
Policies, prices, etc



Energy Systems Models





Adapted from preliminary NREL ReEDS Analysis

To Recap

- Policy important but not sufficient to see near-term, material growth in hydropower

- Broad-based LCOE reduction is essential
  - Detailed understanding of cost
  - National scale evaluation of potential and R&D needs
  - Start thinking about what belongs in a technology roadmap