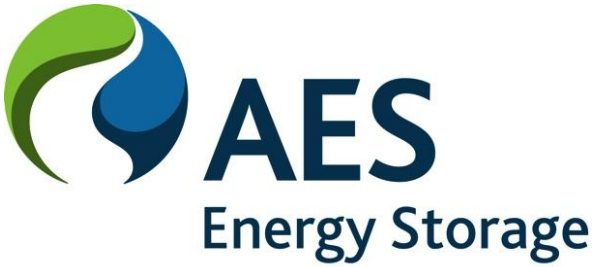
Energy Storage in Resource Planning & Procurement

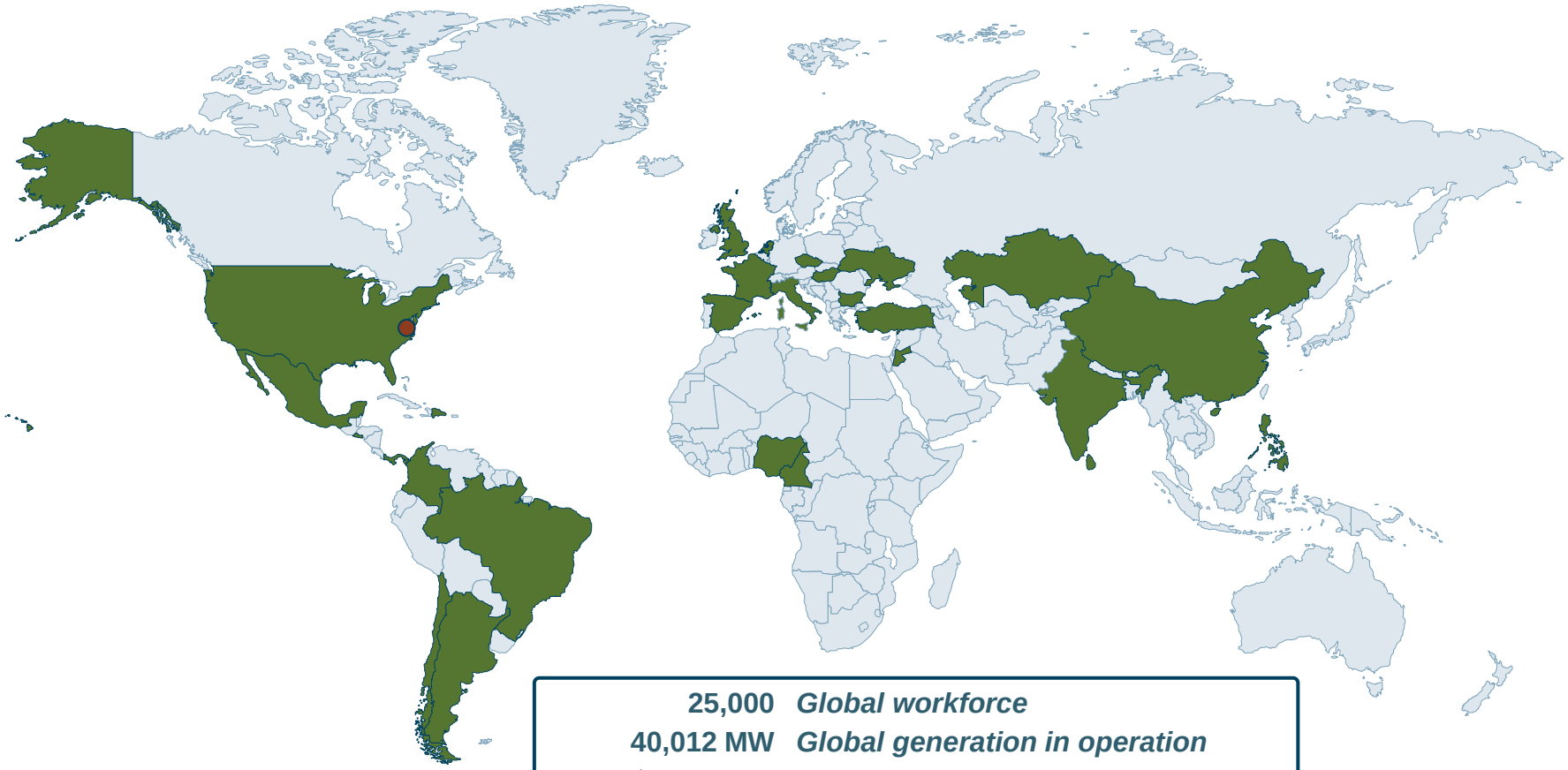
NARUC Staff Subcommittee on Energy Resources and the Environment

July 2013 - Denver



AES operates power facilities in 25 countries.

Our mission is to improve lives by providing safe, reliable and sustainable energy solutions in every market we serve.



25,000	***Global workforce***
40,012 MW	***Global generation in operation***
$18 Billion	***2012 Revenue***

Key AES Headquarters AES Operations

AES has deployed over 150 MW of flexible battery energy storage resources.

AES Energy Storage

Customers: pjm, bhpbilliton, SQM, KGHM POLSKA MIEDŹ S.A., Teck

Chile

AES Carina @ IPL
World's first grid
Lithium-ion battery
Feb 2008

24 MW Los Andes, Chile
2009

40 MW Angamos, Chile
2012

40 MW Cochrane
Announced
2015 COD

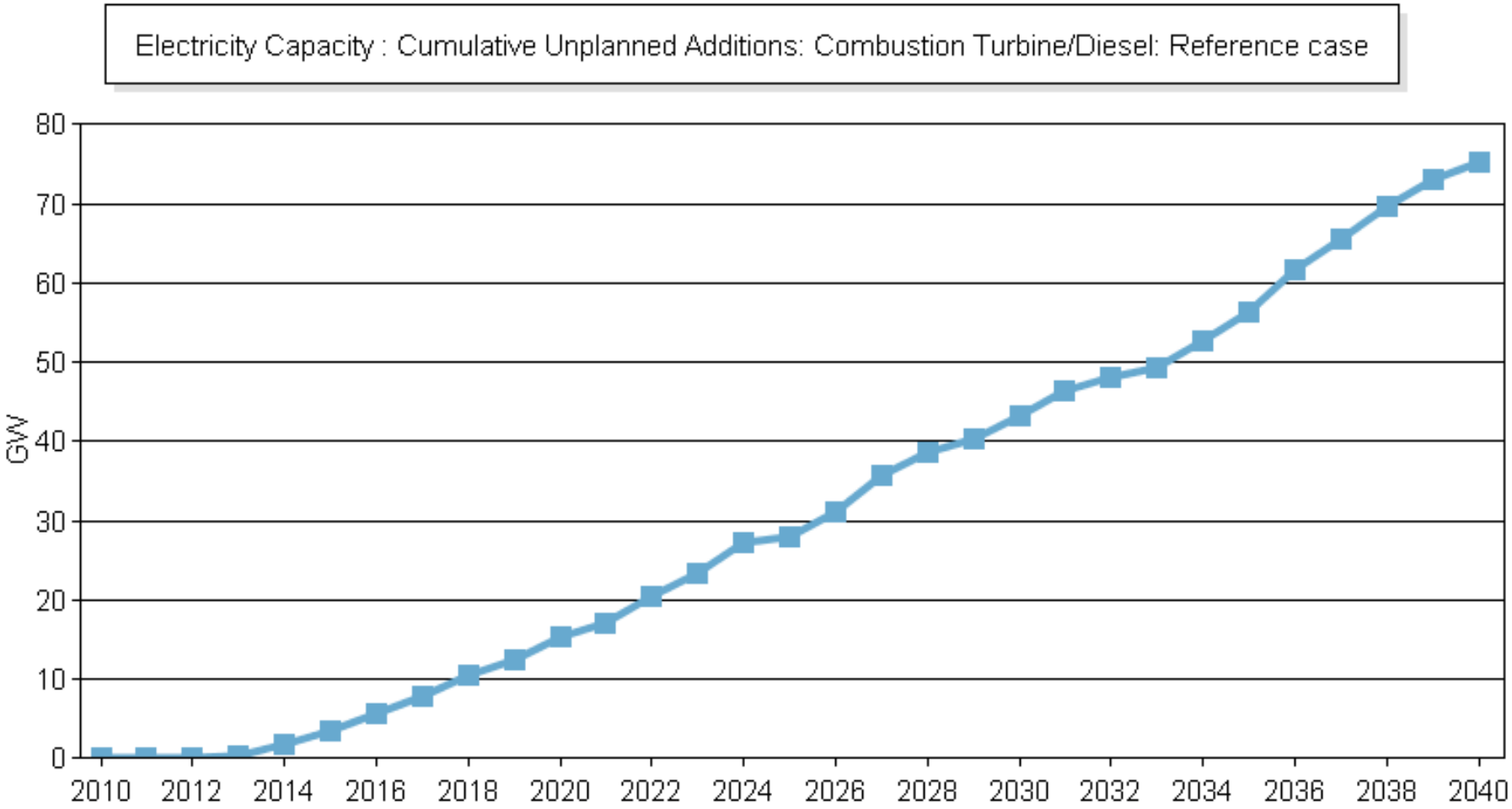
USA

16 MW Johnson City, NY
2010

64 MW Laurel Mtn, WV
2011

40 MW Tait
Dayton, OH
2013 COD

The U.S. is projected to add 70 GW of new peaking resources (40 GW in next 15 years.)



Independent Statistics & Analysis
U.S. Energy Information Administration

Gigwatts of peaking generation are being built with a premium paid for operational flexibility.

2013: 800 MW plant in California

2011: 600 MW plant in Arizona

2013: 500 MW plant in California

2013: Groundbreaking for 220 MW plant in Oregon

Proposed energy storage procurement targets are achievable and modest relative to CT builds.

2013: 800 MW plant in California

+

2013: 500 MW plant in California

= Total MW proposed energy storage procurement target in California across three utilities by 2020.

Energy storage provides more flexibility and value than traditional peaking generation.

50 MW

Gas Peaker

- out of merit generation
- significant standby costs
- standby emissions

minutes to dispatch

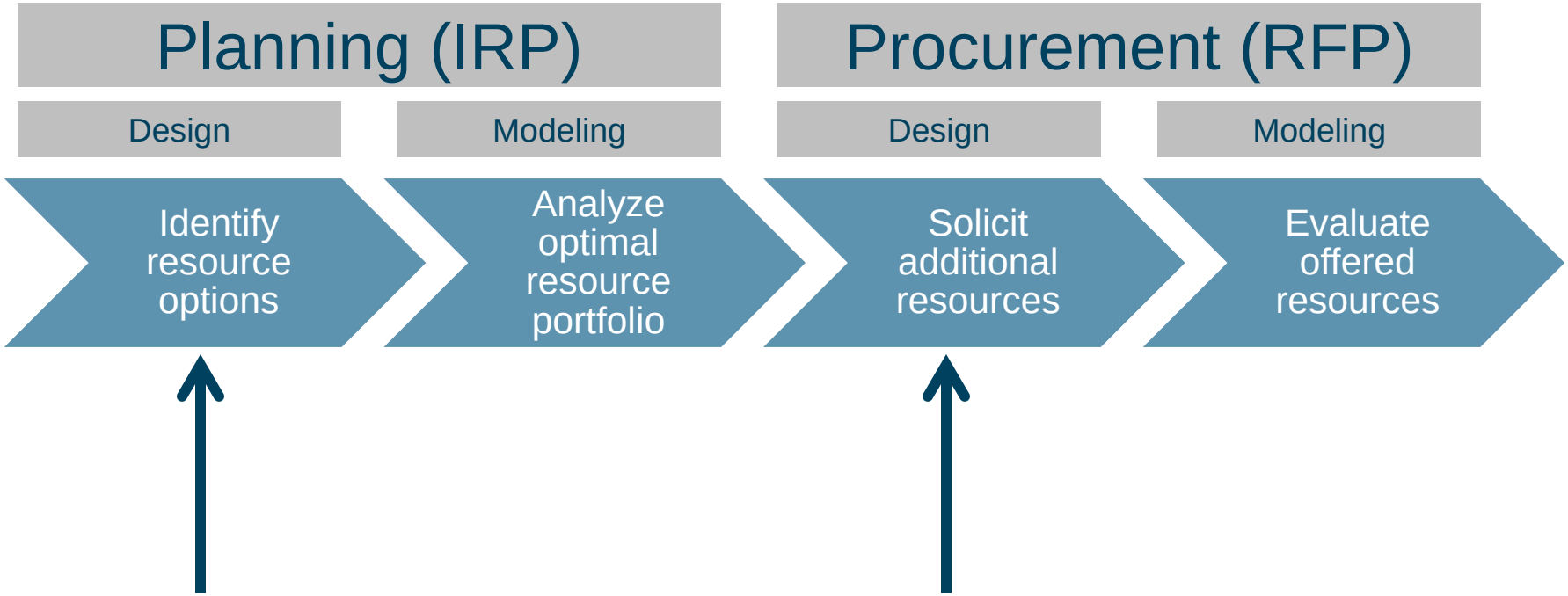
50 MW

Storage Unit

- 0 direct emissions
- low standby costs

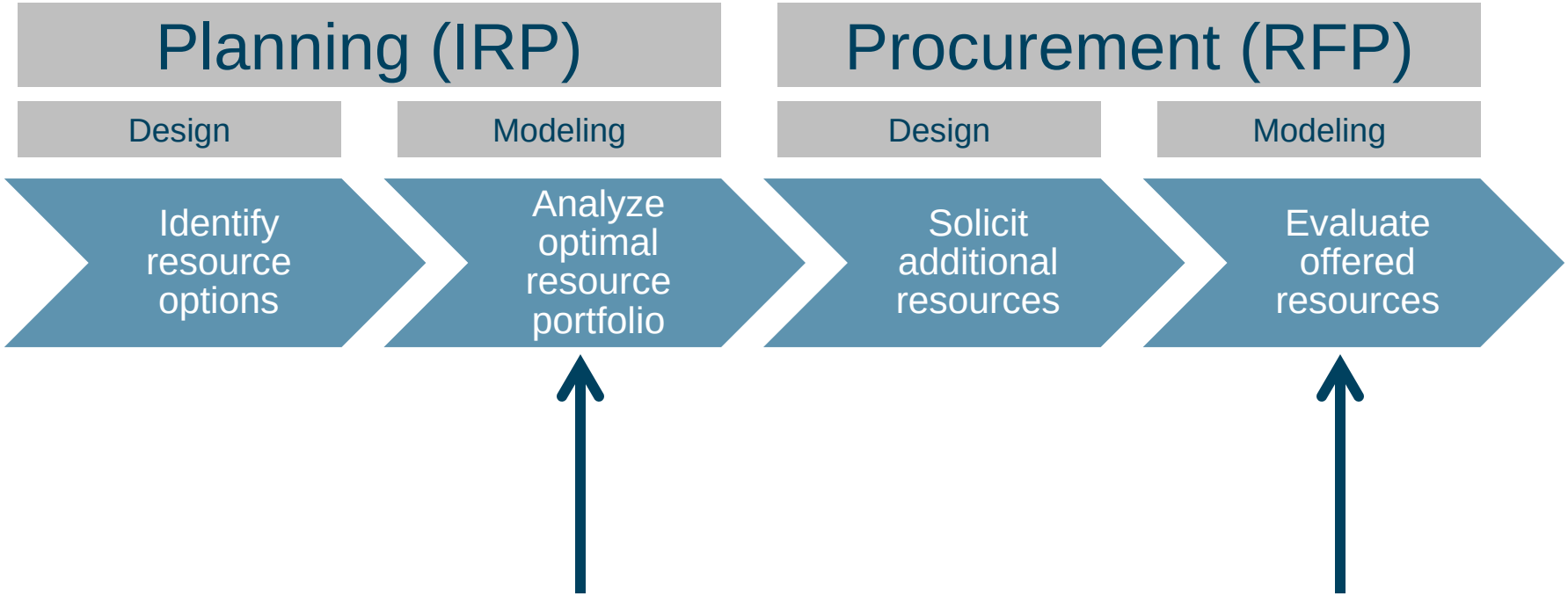
seconds to dispatch

How can states and utilities incorporate energy storage into resource planning and procurement?



- ☑ Include storage as a resource option in Integrated Resource Planning.
  - ☑ Utility
  - ☑ Commission
- ☑ Hold procurement solicitations open to energy storage.
  - ☑ Utility
  - ☑ Stakeholders
  - ☑ Commission or legislature

How can states and utilities incorporate energy storage into resource planning and procurement?



☑ Comprehensively model the benefits of energy storage.

Resource Planning

Examples of energy storage in IRP:

- ✓ Hawaii
- ✓ Washington

✓ The Hawaii Electric Companies modeled energy storage as a supply-side resource option in their 2013 IRP.

Supply-Side Resource Options

- Battery Energy Storage:
- Daily Peaking (10 MW:90 minute discharge duration)
  - Spinning Reserve (25 MW:30 minute discharge duration)
  - Frequency Regulation (25 MW:15 minute discharge duration)

Hawaiian Electric Companies

2013 Integrated Resource Planning Report

18 June 2013

Chapter 7: Resource Options
Supply-Side Resource Options

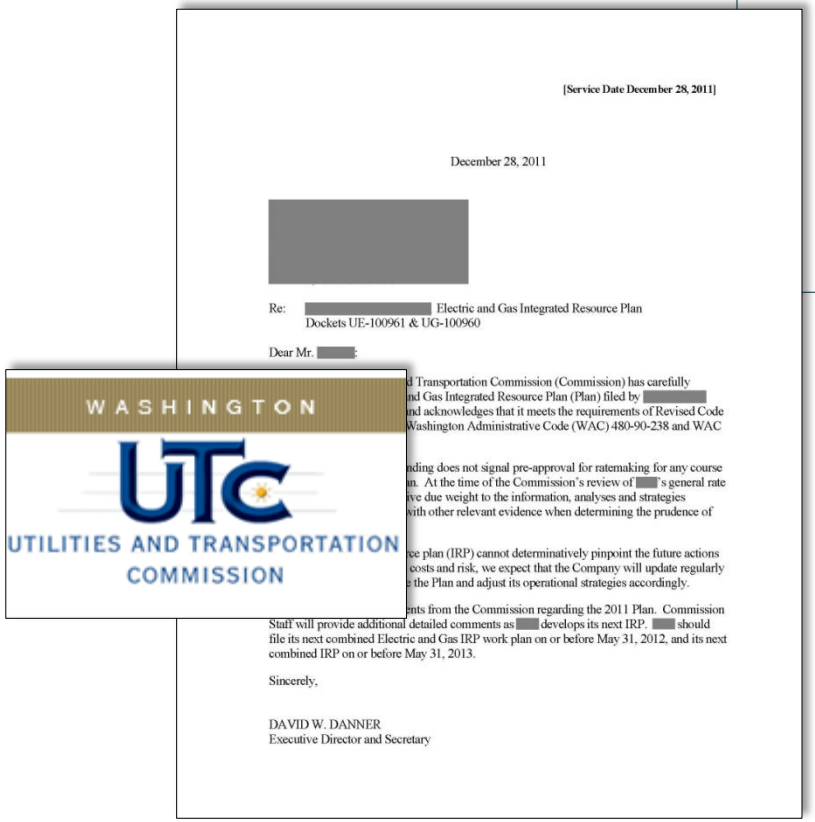
Supply-Side Resource Options

The following technologies were evaluated as part of 2013 IRP:

- Large Turbine Onshore Wind (30 and 10 megawatt [MW] blocks, 2.3 MW turbines)
- Small Scale Onshore Wind (600 kW turbines, phased development up to 6 MW)
- Offshore Wind (100 MW blocks)
- Solar Photovoltaic (PV):
- Residential (2 kilowatts [kW])
- Large Rooftop (100 kW)
- Ground Mounted (1 MW blocks)
- Solar Thermal (Trough, 50 MW)
- Geothermal (new and existing sites [25 MW])
- Ocean Wave (2016 [750 kW] and 2020 [15 MW] systems)
- Ocean Thermal Energy Conversion (OTEC) (10 MW)
- Biomass Combustion (Banagrass, 25 MW)
- Biomass Conversion at Puna Generating Station (Eucalyptus, 13 MW)
- Waste-to-Energy (WTE) (municipal solid waste [MSW] mass burn, 8 MW)
- Fuel Cell (phosphoric acid using natural gas fuel, 400 kW)
- Battery Energy Storage:
- Daily Peaking (10 MW:90 minute discharge duration)
  - Spinning Reserve (25 MW:30 minute discharge duration)
  - Frequency Regulation (25 MW:15 minute discharge duration)
- Reciprocating Engines, Biodiesel:
  - 1x0 Wartsila 18V46 (16.7 MW)
  - 1x0 Wartsila 12V32 (5 MW)
  - 6x0 Wartsila 18V46 (100.2 MW)
- Simple Cycle Combustion Turbines, Biodiesel:
  - 1x0 GE LM2500 (21.1 MW)
  - 1x0 GE LM6000 (41.9 MW)
  - 1x0 GE LMS100 PA (90.8 MW)
- Combined Cycle Combustion Turbines, Biodiesel:
  - 2x1 GE LM2500 (63.2 MW)
  - 1x1 GE LM6000 PG (58.8 MW)
- Simple Cycle Combustion Turbines, Natural Gas:
  - 1x1 GE LM6000 PG (58.3 MW)
  - 1x0 GE LMS100 PA (95.2 MW)

Hawaii PUC Docket #2012-0036

✓ The Washington UTC requested that utilities include energy storage as a resource option in their next IRP.



[Service Date December 28, 2011]

December 28, 2011

[redacted]

Re: [redacted] Electric and Gas Integrated Resource Plan
Dockets UE-100961 & UG-100960

Dear Mr. [redacted]:

[redacted] Transportation Commission (Commission) has carefully
[redacted] Gas Integrated Resource Plan (Plan) filed by [redacted]
[redacted] and acknowledges that it meets the requirements of Revised Code
Washington Administrative Code (WAC) 480-90-238 and WAC

[redacted] does not signal pre-approval for ratemaking for any course
[redacted]. At the time of the Commission's review of [redacted]'s general rate
[redacted] due weight to the information, analyses and strategies
[redacted] with other relevant evidence when determining the prudence of

[redacted] plan (IRP) cannot determinatively pinpoint the future actions
[redacted] costs and risk, we expect that the Company will update regularly
[redacted] the Plan and adjust its operational strategies accordingly.

[redacted] from the Commission regarding the 2011 Plan. Commission
Staff will provide additional detailed comments as [redacted] develops its next IRP. [redacted] should
file its next combined Electric and Gas IRP work plan on or before May 31, 2012, and its next
combined IRP on or before May 31, 2013.

Sincerely,

DAVID W. DANNER
Executive Director and Secretary

WASHINGTON
UTC
UTILITIES AND TRANSPORTATION COMMISSION

"[T]he Company does not include any discussion of the various types of electric storage technologies in its Plan… But we believe that the Company's next IRP would be well served by a discussion of electric storage technologies... "

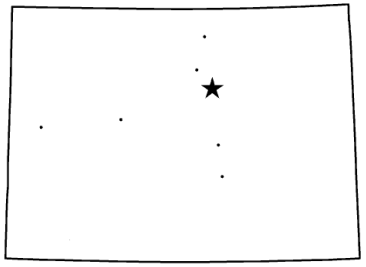
Washington UTC Docket #UE-100961

Procurement

Examples of energy storage in procurement:

- ✓ Colorado
- ✓ Oregon
- ✓ California

✓ Xcel/PSCo included energy storage as a resource option that can participate in a RFP for dispatchable resources



PUBLIC SERVICE COMPANY OF COLORADO

2013
All-Source Solicitation

Dispatchable Resources
Request for Proposals

Xcel Energy

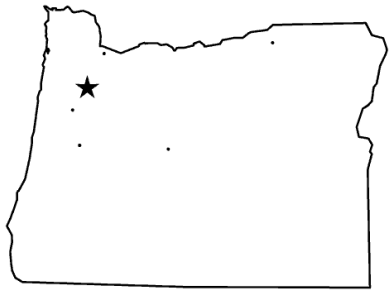
March 2013

Table 1. Example Resource Types for the Various RFPs

RFP Document	Resource Types
2013 Dispatchable Resources RFP	• Simple cycle gas turbines • Combined cycle gas turbines • Stand-alone storage projects
2013 Semi-Dispatchable Renewable Capacity Resources RFP	• Solar thermal with thermal storage or fuel back-up • Any other intermittent resource with storage or fuel backup
2013 Renewable Resources RFP	• Wind • Solar without storage or fuel backup • Hydroelectric • Geothermal • Biomass • Recycled Energy

Colorado PUC Docket #11A-869E

✓ Portland General included energy storage as a RFP resource option in response to stakeholder comment.



BEFORE THE

PUBLIC UTILITY COMMISSION OF OREGON

In the Matter of PORTLAND GENERAL ELECTRIC Request for Proposals for Capacity and Baseload Resources.	UM 1535 NORTHWEST AND INTERMOUNTAIN POWER PRODUCERS COALITION'S COMMENTS

"PGE's RFP should allow for broader use of technologies and alternatives that might meet its needs.

…

"NIPPC also suggests that PGE consider flexible capacity bids backed by grid-scale battery-based energy storage."

Portland General Electric Co.

REQUEST FOR PROPOSALS

Power Supply Resources

June 8, 2012

PGE

BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

UM 1535

In the Matter of

PORTLAND GENERAL ELECTRIC COMPANY

Request for Proposals for Capacity & Baseload Energy Resources

REPLY COMMENTS OF PORTLAND GENERAL ELECTRIC

"PGE will consider bids backed by battery technology."

Oregon PUC Docket #UM 1535

✓ The California PUC is implementing a statutory requirement to consider energy storage procurement targets.

ALJ/DMG/rs6 **Date of Issuance 2/13/2013**

Decision 13-02-015 February 13, 2013

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.

Rulemaking 12-03-014 (Filed March 22, 2012)

DECISION AUTHORIZING LONG-TERM PROCUREMENT FOR LOCAL CAPACITY REQUIREMENTS

SCE shall procure between 1400 and 1800 MW of capacity to meet local capacity requirements by 2021.

…

"At least 50 MW of capacity must be procured from energy storage resources."

California PUC Rulemaking #12-03-014

CAP/sbf/oma 6/10/2013

FILED
06-10-13
09:47 AM

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Pursuant to Assembly Bill 2514 to Consider the Adoption of Procurement Targets for Viable and Cost-Effective Energy Storage Systems.

Rulemaking 10-12-007 (Filed December 16, 2010)

ASSIGNED COMMISSIONER'S RULING PROPOSING STORAGE PROCUREMENT TARGETS AND MECHANISMS AND NOTICING ALL-PARTY MEETING

– Initial Proposed Energy Storage Procurement Targets (in MW)

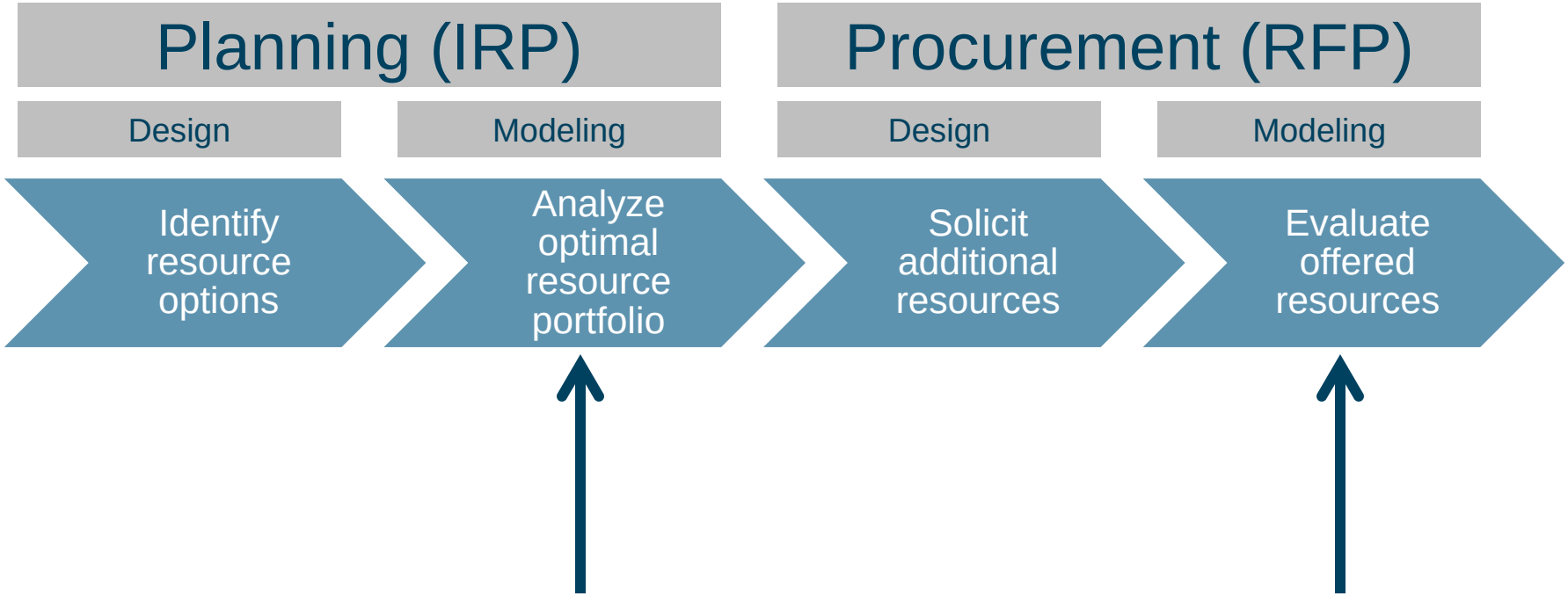
ase category, by utility	2014	2016	2018	2020	Total
l - all 3 utilities	200	270	365	490	1,325

California PUC Rulemaking #10-12-007

Modeling

Apply leading practices to decision-making.

What can we do besides getting it on the menu?

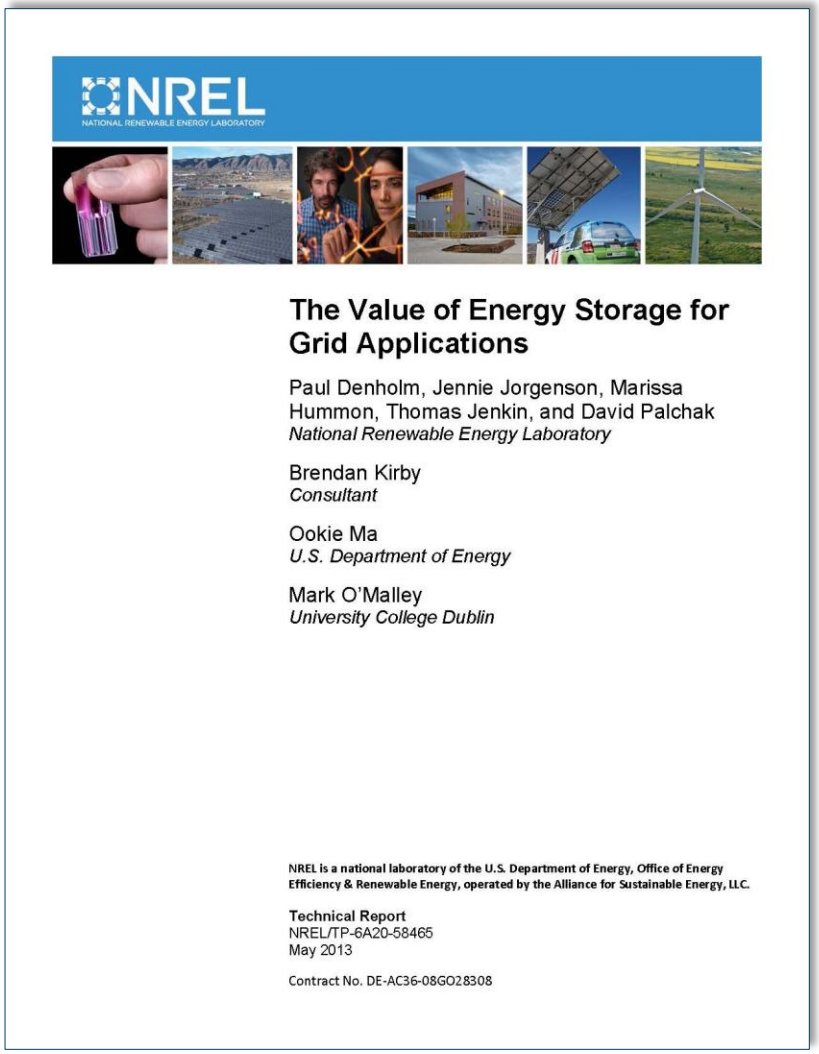


☑ Comprehensively model the benefits of energy storage.

Planning and procurement modeling capabilities lag behind technology-readiness.

- Commercially available modeling tools are to perform resource planning and to evaluate bids/portfolios.
- Gaps remain in how energy storage is evaluated in practice.
- Leading work on energy storage valuation needs to be applied.
  - ESA modeling tools study (in process)
  - National Labs (NREL, PNNL, Sandia)
  - California PUC storage cost-effectiveness studies (EPRI, DNV-KEMA)

Capacity value and external (non-market) benefits contribute to storage cost-effectiveness.


NREL
NATIONAL RENEWABLE ENERGY LABORATORY

The Value of Energy Storage for Grid Applications

Paul Denholm, Jennie Jorgenson, Marissa Hummon, Thomas Jenkin, and David Palchak
National Renewable Energy Laboratory

Brendan Kirby
Consultant

Ookie Ma
U.S. Department of Energy

Mark O'Malley
University College Dublin

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Technical Report
NREL/TP-6A20-58465
May 2013

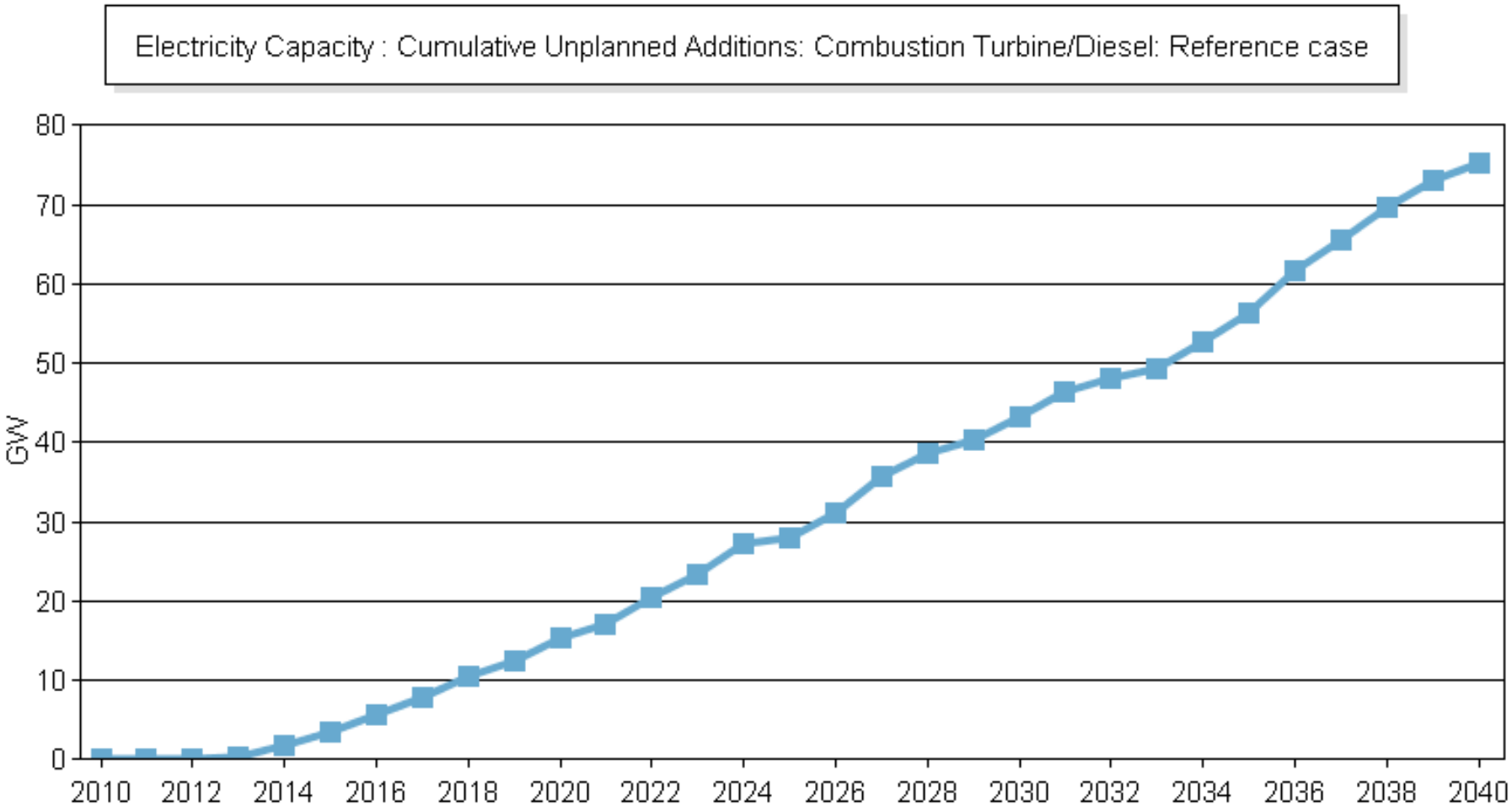
Contract No. DE-AC36-08GO28308

"[P]roduction cost simulations capture only the operational value of a new storage device. The value of system capacity or resource adequacy needs to be calculated separately and combined with the operational value to produce a more complete value of a storage device."

"[T]he net revenue of the storage plant in a market setting is … only about 50% of the reduction in operational costs produced when adding storage to the base system. The combination of incomplete capture of system benefits and price elasticity presents additional challenges to storage devices in restructured markets."

Put energy storage on the menu and evaluate it properly so customers aren't on the hook for this.

AES Energy Storage



eia Independent Statistics & Analysis
U.S. Energy Information Administration