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Implementing Energy Storage Program Guidelines

May 9, 2016

Commission Agenda for Utility Presentations

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Utility presentations to address the following questions

a. Near-term – viable and beneficial applications of energy storage in your service territory and technologies for those applications? Multi-application opportunities?

b. Longer-term – applications of energy storage in your service territory and technologies to use for those applications?

c. As of today, what projects are you contemplating and likely to propose under HB 2193?

d. As of today, how will you evaluate the costs and benefits to ratepayers, utilities, and the general public?

e. How should the Commission rank and evaluate the proposed projects, and which criteria should be used?

f. How strongly should the Commission encourage investment for different applications or in different types of storage systems? Is diversity preferable – or should the focus be on testing and developing specific uses and technologies over others?

g. HB 2193 requires that each proposal include an evaluation of the potential to store energy in the company's system. How will you go about evaluating storage potential?

Principles for Evaluating Utility Proposals (e. and f.)

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- Validated learning
    - require hypothesis before implementation and regular evaluations after implementation to ensure on-going and systematic learning
- Scalability
    - position utilities to effectively scale approaches if they prove beneficial
- Cost-effectiveness
    - consider costs and risks in a rapidly evolving marketplace
- Diversity
    - encourage the consideration and pursuit of a number of different approaches for energy storage

Possible Storage Locations (c.)

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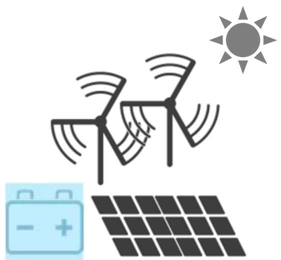
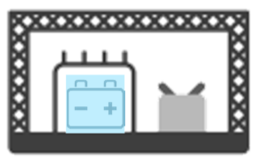
Energy storage can be deployed at diverse locations and be enabled to operate to support multiple use cases

Generation Facilities	Transmission System	At Substation	Distribution Feeder	Customer Premises
				In front of the meter / Behind the meter 
			Salem Smart Power Center	
Future Investigation		Investigating in UM 1751		

Locational and Application Diversity (a. and b.)

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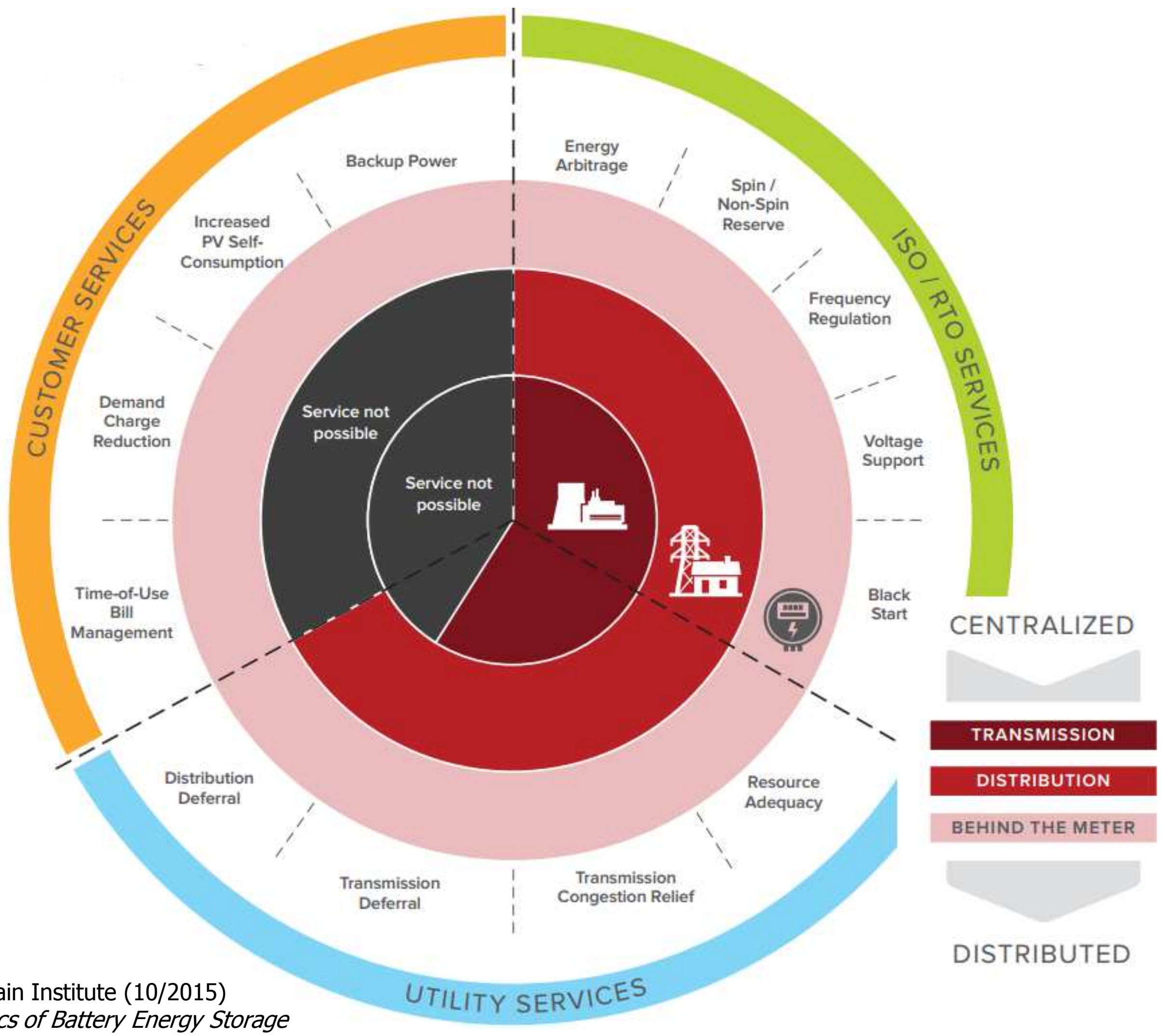
Energy storage can be used for multiple use cases, though not necessarily simultaneously



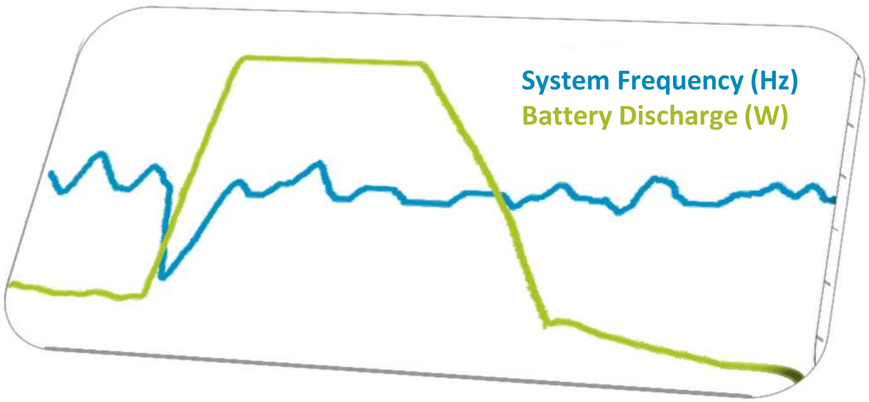
Source: Rocky Mountain Institute (10/2015)
The Economics of Battery Energy Storage

Potential to store energy (g.)

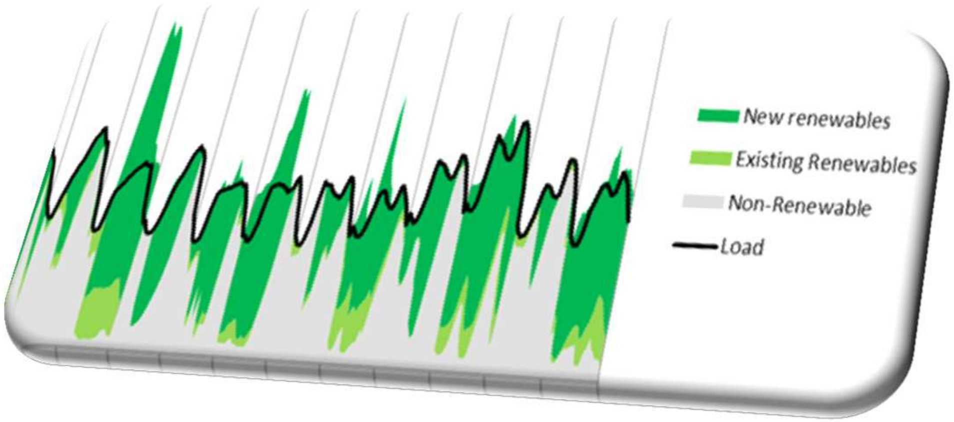
Potential to store energy is dependent on application, technology, and location

- HB 2193 requires that each proposal include "an evaluation of the potential to store energy in the company's system" @ 3.2.b.
- "Storage potential" is a broad phrase which needs to be contextualized
- PGE plans to assess storage potential through evaluation of applications, technology, and location
  - energy arbitrage and demand shifting
  - ancillary services
  - avoided renewable curtailment
  - generator capacity value
  - locational value
  - other use cases

Potential to store energy for Frequency Response



Potential to store energy to Avoid Renewable Curtailment



Commission evaluation of proposals

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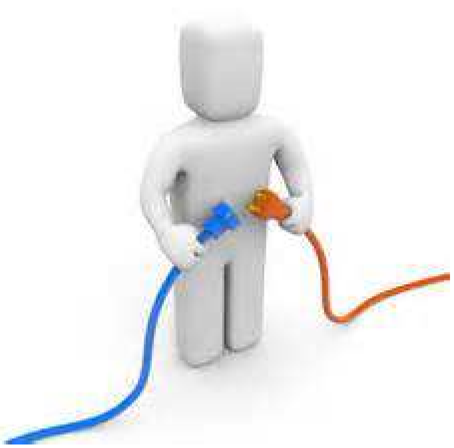
HB 2193 provides guidance for Commission review of proposals

- The Commission shall consider each proposal to determine whether the proposal:
  - is consistent with the Commission guidelines adopted
  - reasonably balances the value for ratepayers and utility operations
  - is in the public interest

Metrics below could be used to inform Commission evaluation:

- Project costs ($/kW)
- Project benefits ($/kW)
- Investment deferral value
- Peak demand generation reduction avoided cost
- Renewables integration savings
- Greenhouse gas emissions reductions
- Reliability metrics improvements
- Portfolio variable power costs reductions
- Additional value (if applicable)
- Commercial operation date (COD)
- Term (year)

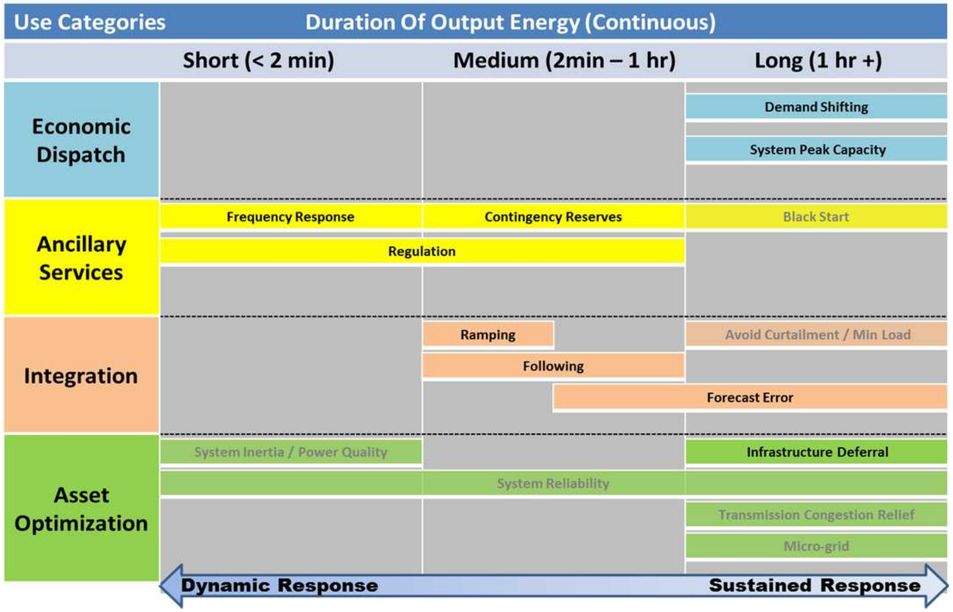
- Technology type
- Self-discharge (MW/hour)
- Ramp rate (charge/discharge, up/down; MW/hour)
- Maximum capacity (charge/discharge, up/down at grid connection point; MW)
- Capital cost ($)
- Customer satisfaction
- Fixed O&M ($/kW-year)
- Variable O&M (for discharging, $/MWh)
- Roundtrip Efficiency (%)
- Maximum cycles (per lifetime, number of cycles)
- Maximum daily switches (charge/discharge per day)



Cost and Benefit Evaluation

Initial analysis will identify value drivers associated with storage, but will not be a definitive cost-benefit analysis

- PGE developing framework to assess system benefits of energy storage across a wide range of use cases
  - energy arbitrage or demand shifting
  - ancillary services (regulation, frequency response, and contingency reserves)
  - renewable integration (forecast error mitigation, subhourly balancing, and renewable curtailment mitigation)
  - generation capacity value, locational benefits (transmission and distribution deferral and transmission reliability)



- Values will be informed by
  - applications
  - technologies
  - locations
  - operational abilities

Technological Diversity

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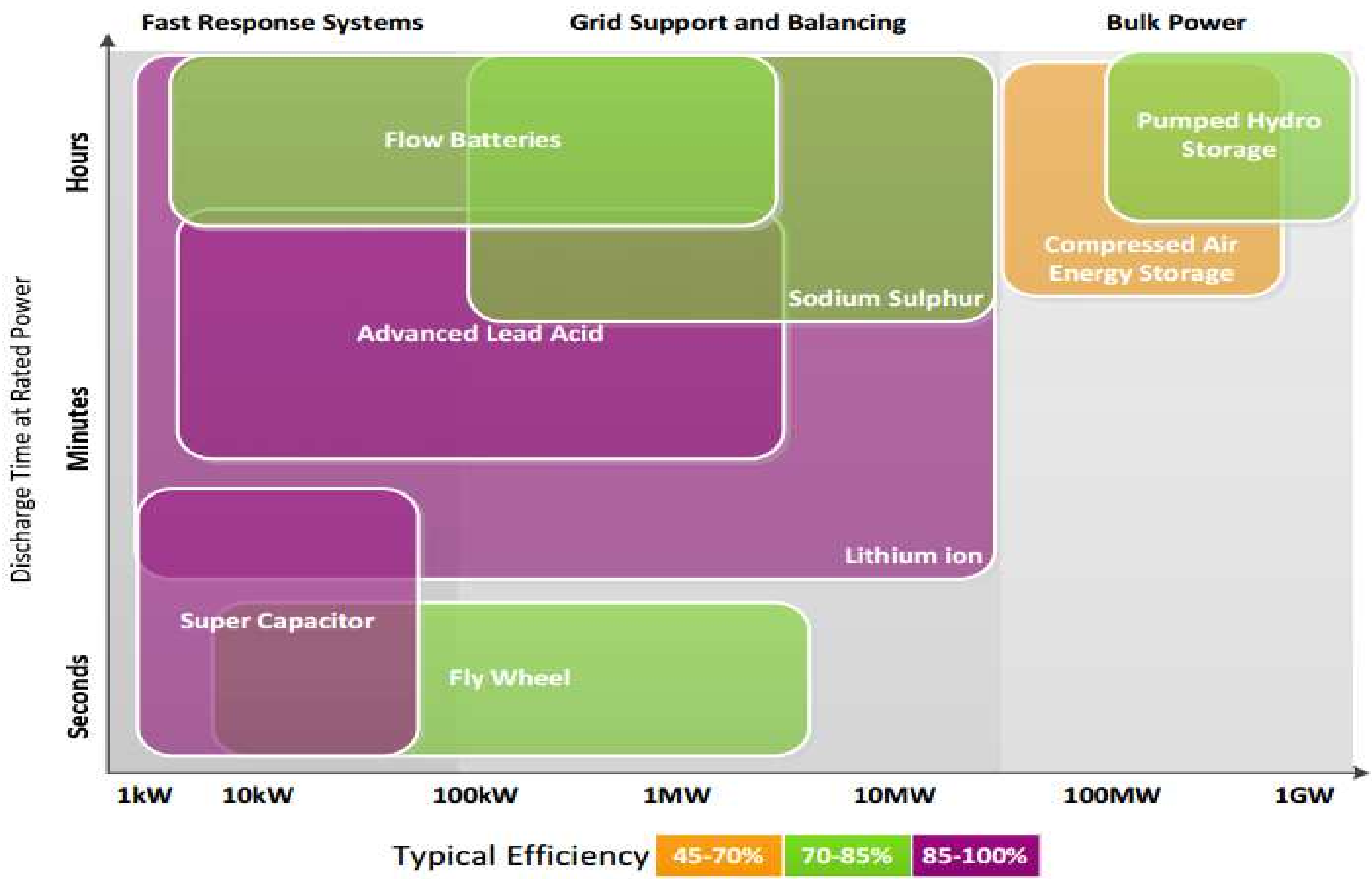
Technologies are available for a range of services and durations



Source: Australian Renewable Energy Agency (7/2015)
Energy Storage Study Funding and Knowledge Sharing Priorities