Water Heaters for Grid Energy Storage in the Northwest

Presentation to ACEEE Hot Water Forum

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Flink Energy Consulting

- Helping clients with the transition away from fossil fuels since 2014.
- Past clients:
  - Bonneville Environmental Foundation
  - Ecofys
  - Energy Trust of Oregon
  - Idaho Conservation League
  - Oregon Environmental Council
  - OSEIA
  - Oregon Wave Energy Trust
  - Physicians for Social Responsibility
  - Renewable Northwest
  - Union of Concerned Scientists
  - Utah Clean Energy
  - Vaisala

Why Energy Storage?

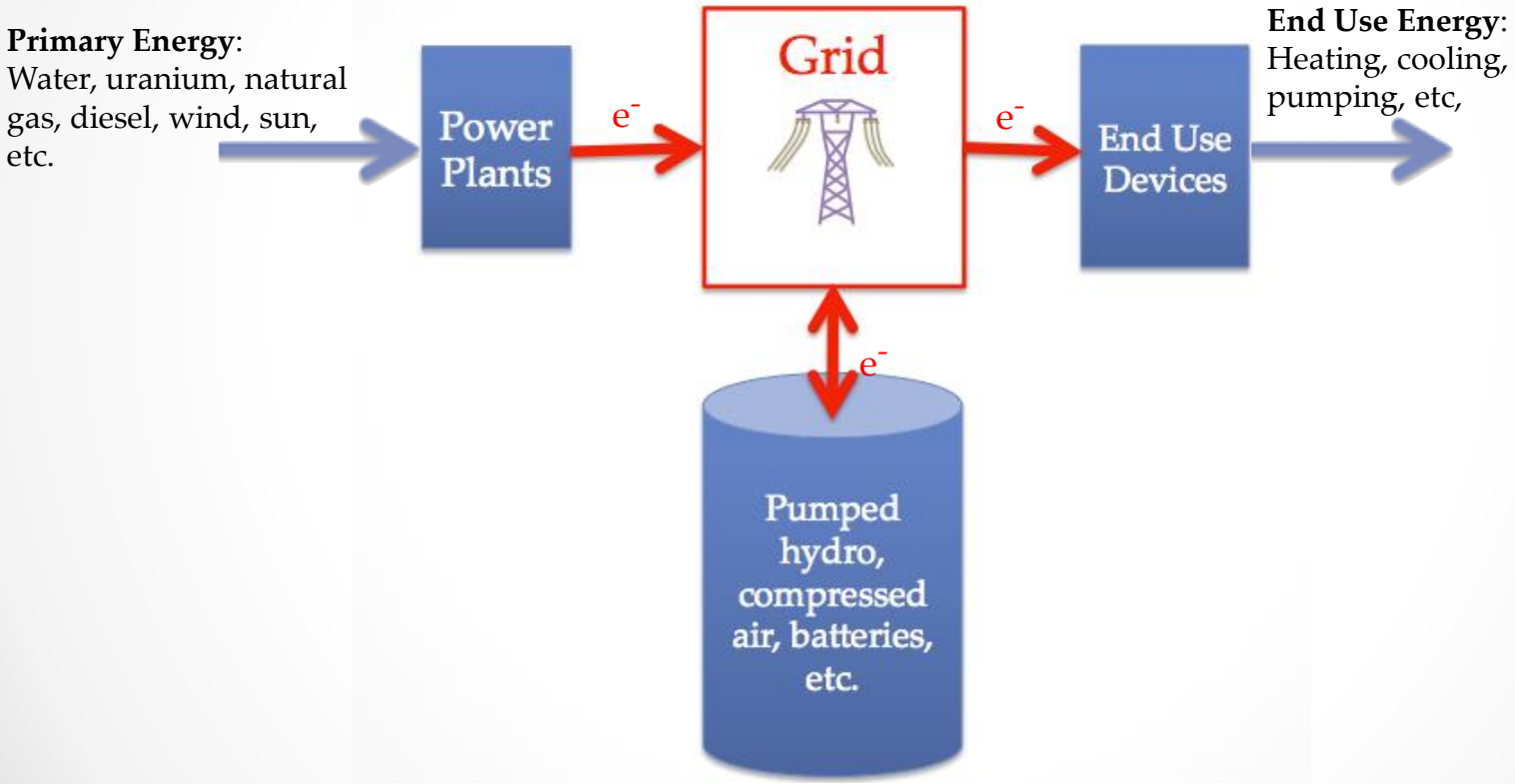
- Crucial for matching power generation to demand.
- Increasingly important for integrating renewables.

Grand Coulee Dam and Reservoir

Lake Roosevelt behind Grand Coulee Dam stores enough energy to sustain BPA load for nearly **four weeks**.

What is Energy Storage?

- Technologies that absorb electric power, and return (some of) it to the power grid at a later time.



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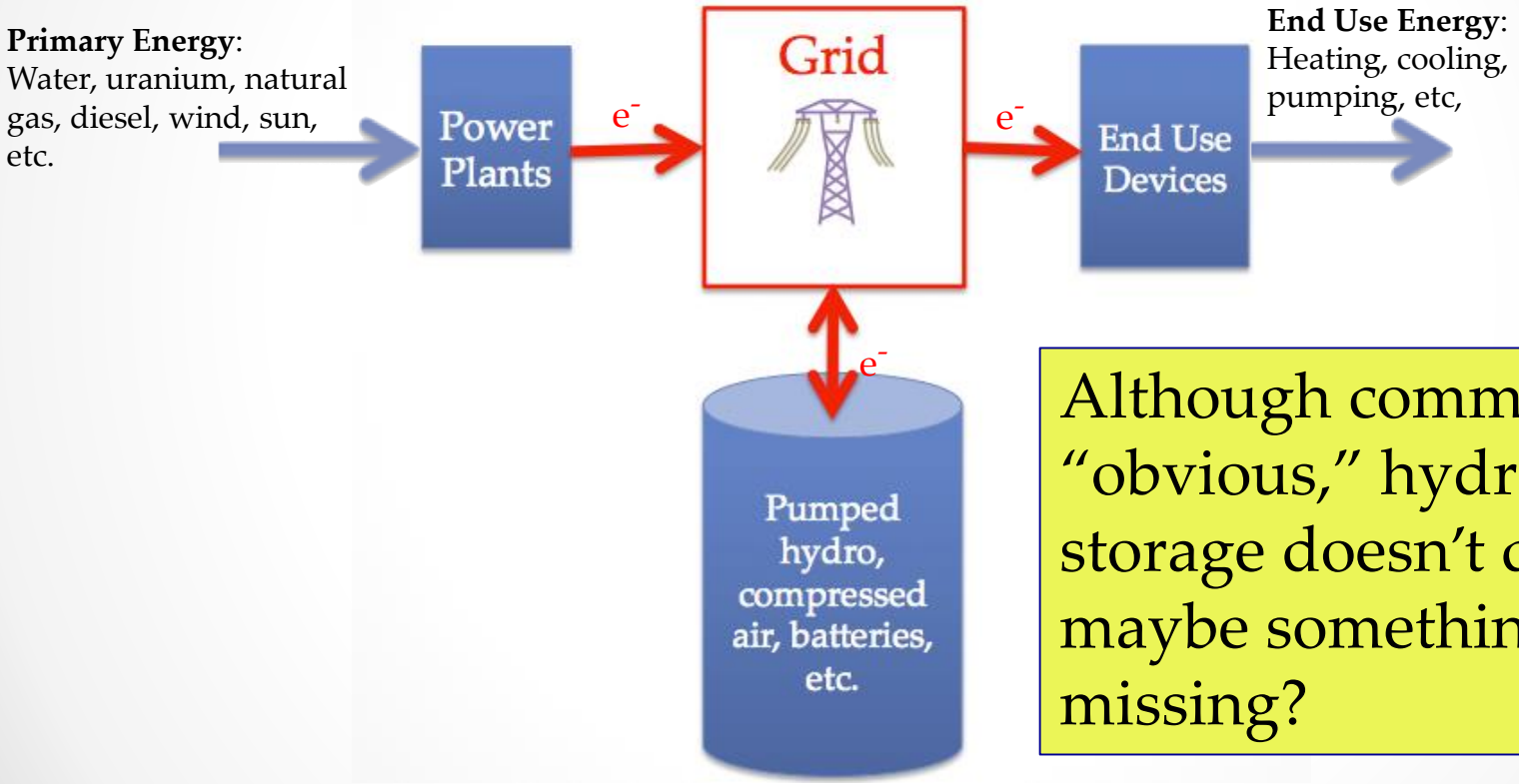
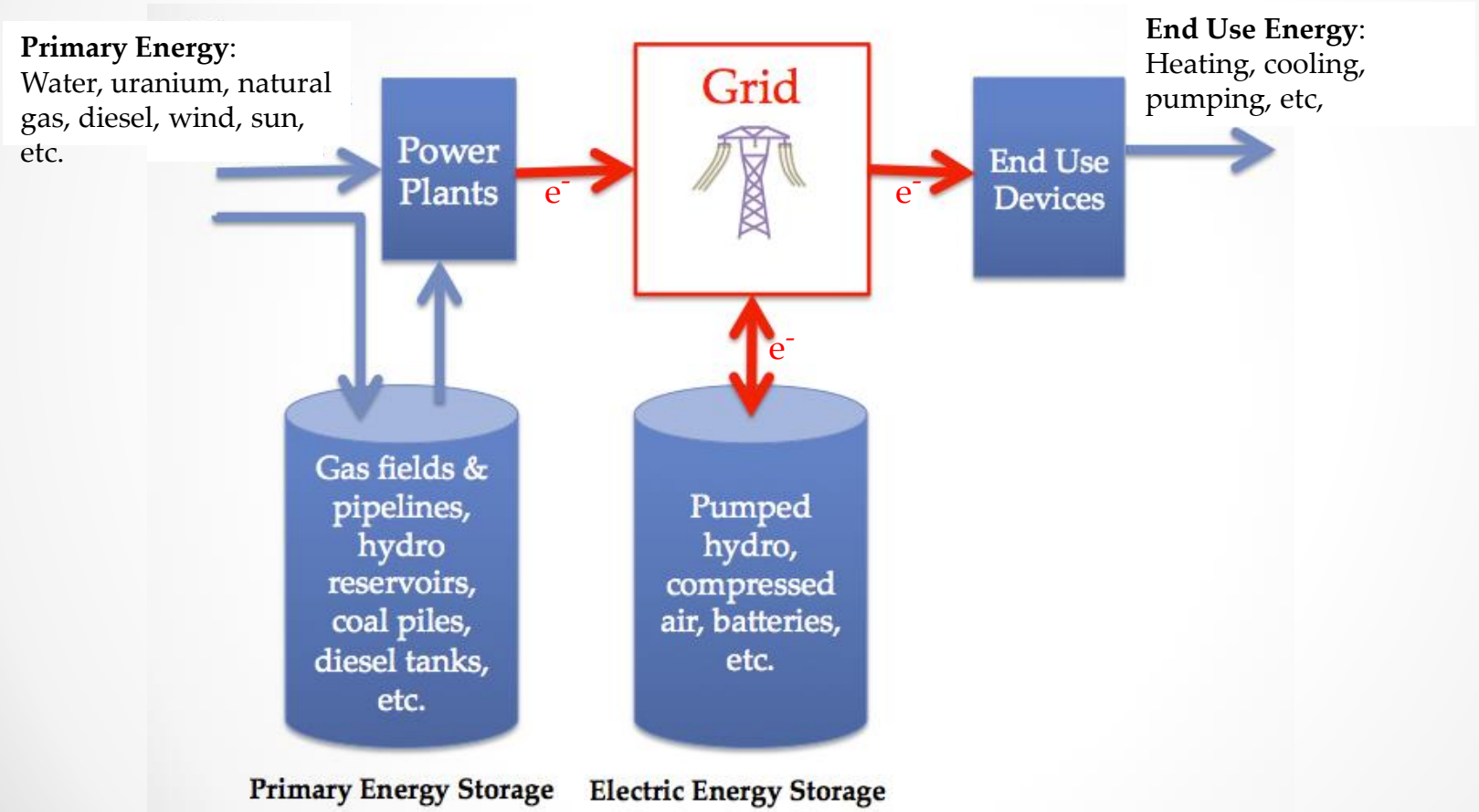


Although common and "obvious," hydro storage doesn't qualify– maybe something is missing?

Expanded Storage Definition

- **Includes hydro and other "primary" energy storage technologies absolutely vital to matching generation and demand.**



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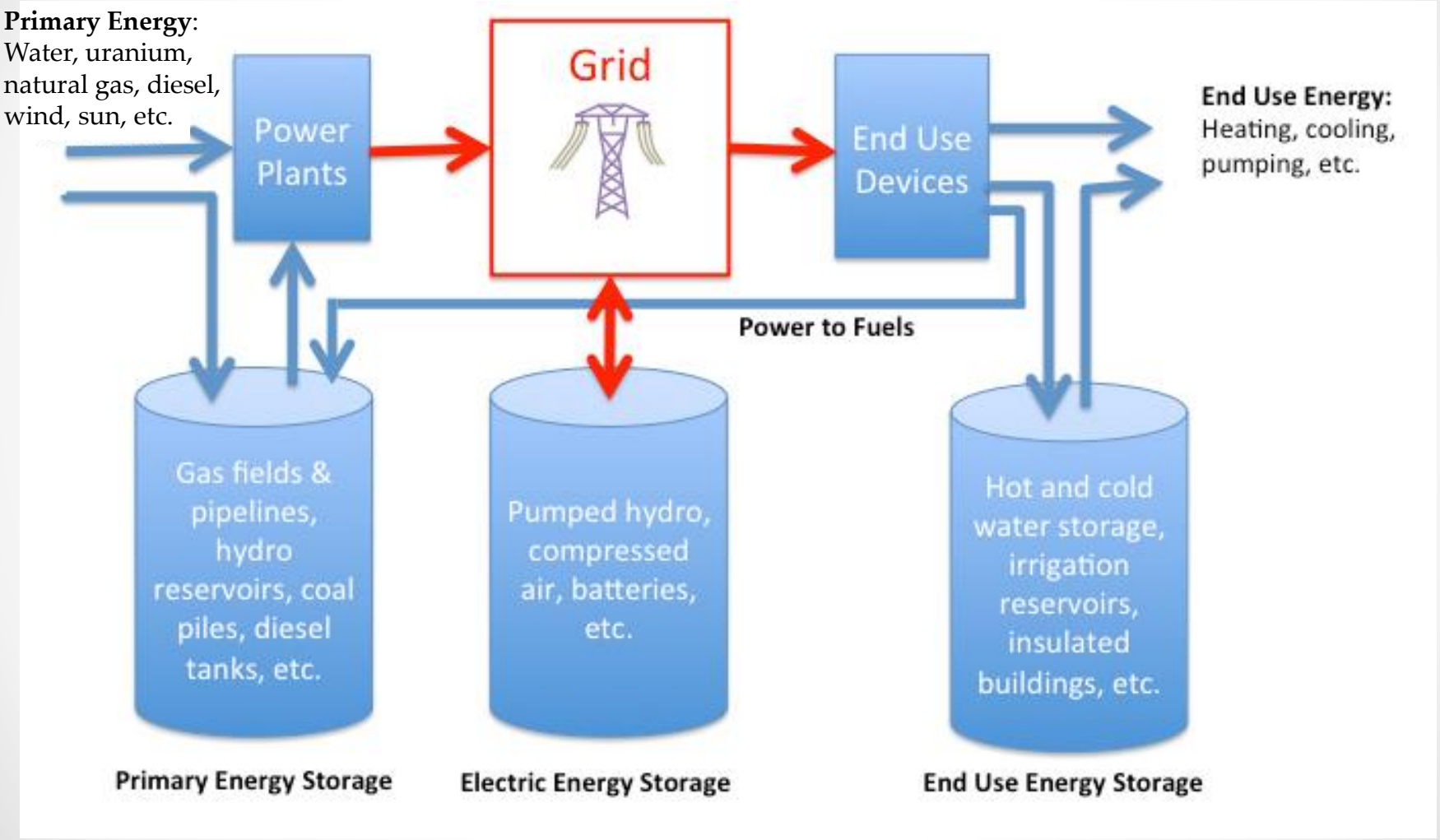
Generalized View of Energy Storage



WHs: Energy Storage or DR?

- Northwest utilities value water heater "demand response" at $10-25 per year on 1-2 year contracts.
- Northwest Utilities have paid $1,400-$18,000 per kWh of energy storage
  - **Water heaters offer at least 1 kWh of grid-available energy storage.**

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Value Propositions

Conventional Water Heater "DR"

- Lower peaking capacity requirements
- Lower contingency reserve requirements

Water Heater Energy Storage

- Lower peaking capacity requirements
- Lower T&D losses
- Lower contingency reserve requirements
- Energy arbitrage
- Regulation reserve
- Load following/flexibility
- Improved load forecasting
- Renewable integration and reduced curtailments
- Reduced load forecast error costs
- More efficient power plant dispatch (fuel & emissions savings)
- Black start support

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The Resource

- Northwest Power and Conservation Council estimates 4 million electric water heaters in the Northwest.

Coincidental Peak Load	Controllable Load	Energy Storage (@1kWh)	Value at $1,400/kWh
2,000 MW	18,000 MW	4,000 MWh	$5.6 billion
(~2 nuclear plants)	(~2 x NW Wind Gen)	(~500 x MESA 2 battery)	

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What is Holding Us Back?

- Perception
  - Today it is perceived as marginally valuable "capacity" (DR)
- Reality
  - Needs to be storage, not just peak shaving
- Policy and Regulation
  - Inclusion with energy storage incentives
  - Regulated utility incentives
- Full Recognition of Storage Value Streams

Thank You!

Avedøre 2 coal plant hot water storage tanks in Copenhagen, Denmark–inspiration for the author's interest in grid storage from hot water.

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