

Use Cases and Applications for Long Duration Energy Storage

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Clean Energy Goals

- EERE drives research, development, *deployment and demonstration* of innovative technologies, systems, and practices to:
 1. Achieve 100% clean energy economy with net-zero emissions no later than 2050
 2. Benefit all Americans



Benefits of Long-Duration Energy Storage

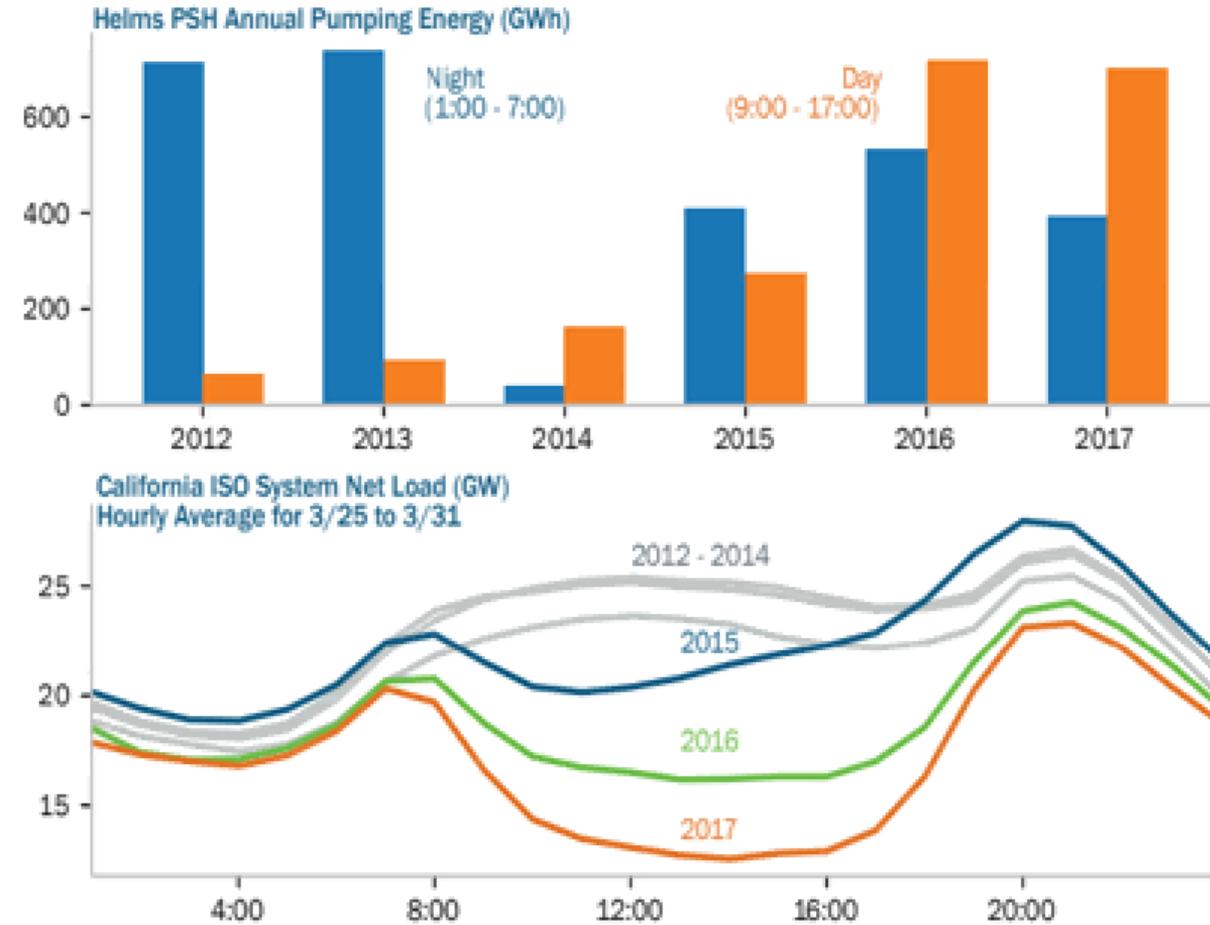
- Gives grid operators flexibility to balance supply and demand
- Enables both systems and facility resilience
- Supports increased penetrations of renewable and clean energy technologies
- Enables the decarbonization of the industrial sector



Pumped Storage Hydropower

- PSH accounts for ~22 GW / 550 GWh (93%) of US grid-scale energy storage
- PSH operations are changing! PSH provides flexible storage to balance variable renewables
- DOE-WPTO's [HydroWIREs Initiative](#) valuation studies and R&D

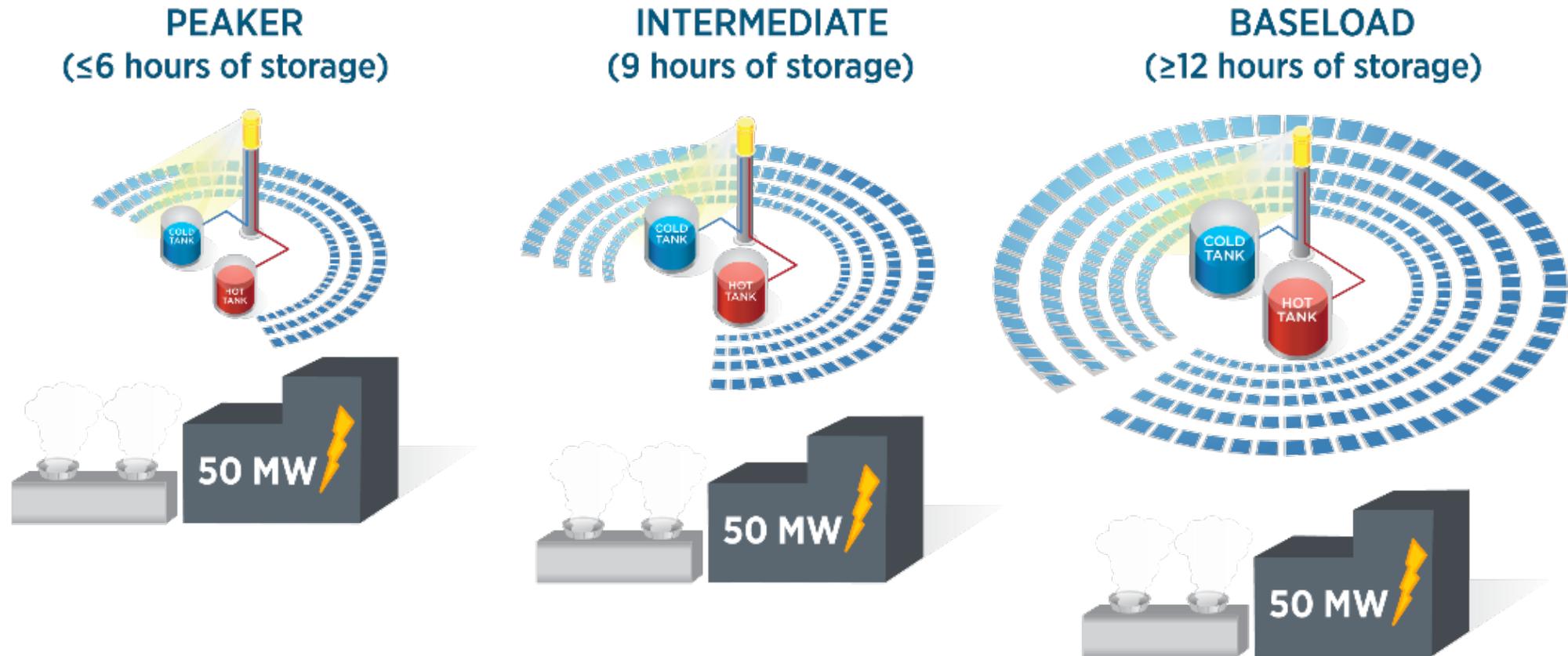
PSH: from day/night arbitrage to storing mid-day solar



Annual pumped energy consumption by Helms PSH vs. CAISO net load in the last week of March (2012-2017)

Concentrating Solar-Thermal Power (CSP) Systems

CSP plants can be configured to meet evolving demands for storage. Increasing the size of the storage tank and solar field provides additional hours of storage.



Battery Technologies

- Batteries are key to grid of the future, EV acceptance and resilience
- Li-ion EV costs decreased more than 80% over the last 10 years
- New battery chemistries like next-gen Li-ion will improve long duration storage



Lithium-Ion Batteries

Energy Storage Grand Challenge Use Cases

- 1. Facilitating an Evolving Grid** – Increasing adoption of renewable and distributed energy resource technologies
- 2. Electrified Mobility** – Decarbonizing the transportation sector
- 3. Remote Communities** – Mitigating high energy costs in coastal and remote communities
- 4. Critical Services** – Ensuring the power stays on
- 5. Interdependent Network Infrastructure** – Ensuring interconnected systems operate properly
- 6. Facility Flexibility** – Optimizing processes, behaviors, or value of facilities

Energy Storage Grand Challenge Use Case Drivers and Targets

Facilitating an Evolving Grid		Electrified Mobility	
Drivers <ul style="list-style-type: none">Increasing adoption of variable resourcesDynamic changes in customer demand	Potential Price Target(s) <ul style="list-style-type: none">\$0.03-\$0.05/kWh levelized cost of storage	Drivers <ul style="list-style-type: none">Lower EV battery manufacturing costs and improved performanceDistribution delivery capacity for fast charging	Potential Price Target(s) <ul style="list-style-type: none">\$80/kWh manufactured cost for battery pack\$104/kw-yr storage capex
Critical Services		Serving Remote Communities	
Drivers <ul style="list-style-type: none">Disaster-related and other power outages	Potential Price Target(s) <ul style="list-style-type: none">\$77/kw-yr for reliability applications\$1392/kw-yr for backup generator offset	Drivers <ul style="list-style-type: none">Electricity premium due to fuel logistics and maintenanceFuel supply disruptions	Potential Price Target(s) <ul style="list-style-type: none">\$65/mwh delivered energy
Interdependent Network Infrastructure		Facility Flexibility, Efficiency, and Value Enhancement	
Drivers <ul style="list-style-type: none">Grid interdependencies mean loss of function and service within these infrastructures can have far-reaching costs and impacts	Potential Price Target(s) <ul style="list-style-type: none">\$77/kw-yr storage capex	Drivers <ul style="list-style-type: none">Enhance the overall facility value to the owner, operator, and the end consumer	Potential Price Target(s) <ul style="list-style-type: none">\$85/kwh, \$52/kw-yr for commercial and residential buildings\$20-\$52/kw-yr for energy intensive facilities