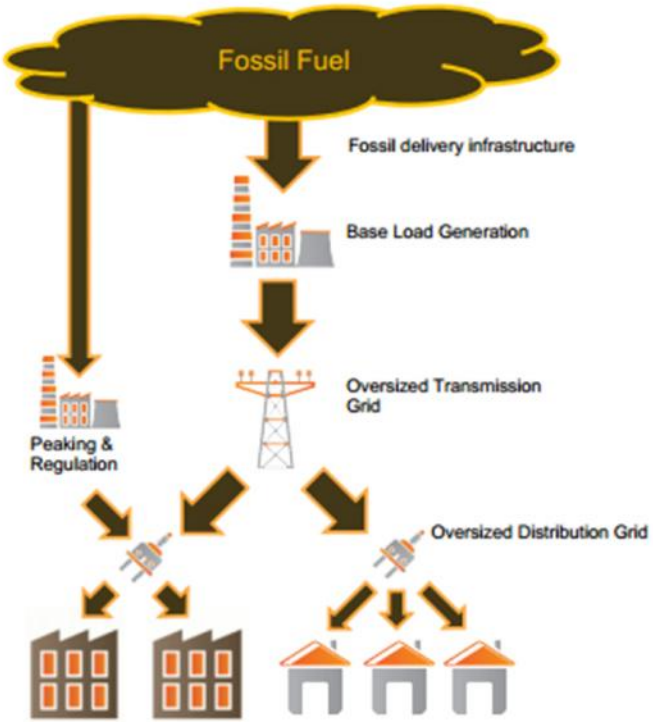
Energy storage enables greater overall system efficiency … and a cleaner, smarter grid

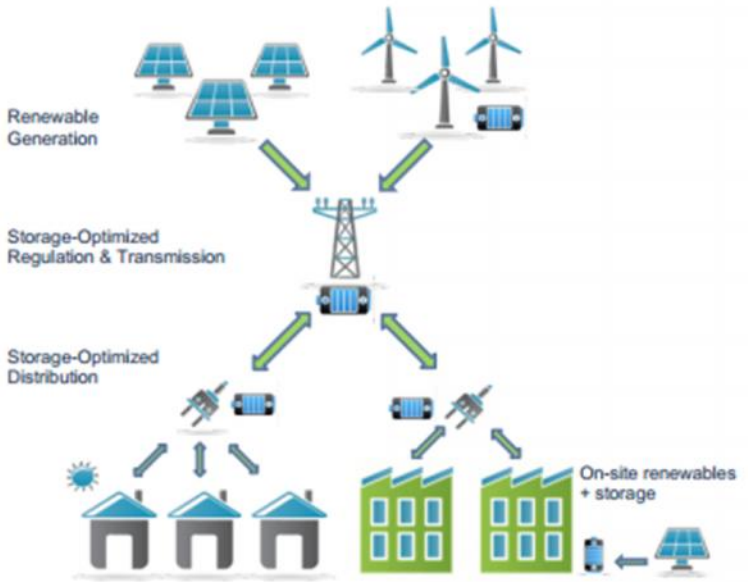
Current Grid Infrastructure

- Built for load and generation peaks that occur only a few times per year
- Massive fossil storage required



Future Grid Infrastructure

- Strategic buffers level generation and load, reducing Mura (unevenness) and Muri (overburden)[1]
- Result: more efficient & reliable electrical system



1. The approach is similar to Heijunka in the Toyota Production System, which levels production schedules in order to reduce overall waste

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Energy Storage Is A Very Broad Asset Class

Technology Classes	Energy Storage Examples	
Chemical Storage	**Sodium Sulfur Battery** •Electrical energy is stored for later use in chemical form. Existing battery technologies are being improved, and new battery technologies are becoming available. •Example: 34 MW Sodium Sulfur Battery — 51 MW wind farm, Japan (NGK)	
Thermal Storage	**Ice Storage** •Air conditioners create ice at night, when power rates are low. This stored ice then runs a cooling system during the afternoon, when power costs are highest and the power grid is most stressed. •Example: 12 kW Thermal Storage — Napa Community College (Ice Energy)	
Mechanical Storage	**High Speed Flywheel** •Flywheels convert electrical energy to kinetic energy, then back again very rapidly. Flywheels are ideal for power conditioning and short-term storage. •Example: 3 MW Mechanical Storage for Ancillary Services — NE ISO (Beacon Power)	
Bulk Mechanical Storage	**Below Ground Compressed Air** •Electricity is used to compress air into small or large modular storage tanks or a large underground cavern. The compressed air is used to spin turbines when electricity is needed. •Example: 115 MW Compressed Air Energy Storage — McIntosh, Alabama	
Bulk Gravitational Storage	**Pumped Hydro** •Excess electricity is used to pump water uphill into a reservoir. When power is needed, the water can run down through turbines, much like a traditional hydroelectric dam. •Example: 1,532 MW Pumped Hydro — TVA's Raccoon Mountain	

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Energy Storage Enables Multiple Value Streams

If the full range of benefits were considered, energy storage would be cost effective in many applications today

Customer	+	Utility	+	System Operator	+	Society
• Reduced energy and demand costs • Emergency back up • Demand response • Improved reliability		• Load leveling • T&D relief / deferral • Improved power quality • Reduce peak gen. and spinning reserve needs		• Ancillary services • Grid integration • Improved grid reliability & security		• More renewables • Fewer emissions • Healthier climate • More jobs

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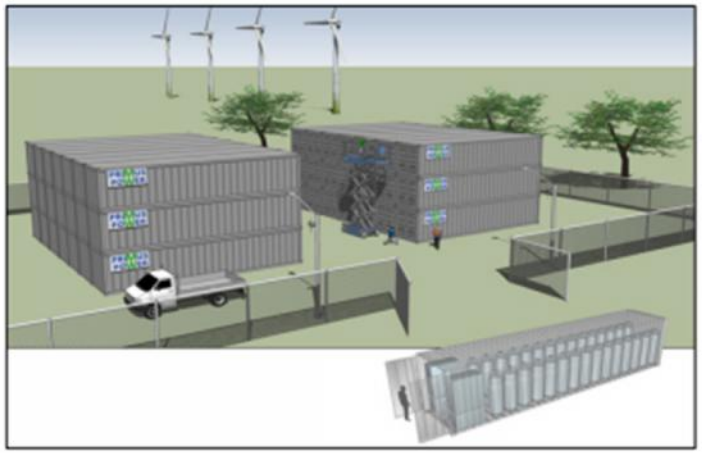
Examples of Advanced Energy Storage Projects:

12 kW Thermal Storage – Napa Community College (Ice Energy)



25 MW Flow Battery for Peaking & Wind Firming – MID (Primus Power)

3 MW Mechanical Storage for A/S – NE ISO (Beacon Power)

1MW Lithium Titanate Battery for A/S –PJM (Altairnano)

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Examples of Advanced Energy Storage Projects:

5 MW Thermal Storage – LA Community College (Calmac)

115 MW Compressed Air Energy Storage

1 MWh Battery in Maui, Hi (Xtreme Power)

2 MW Li-Ion Battery for A/S – AES (A123)

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