

# Energy Storage Systems

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# What is an Energy Storage System?

- Energy storage plays a role in transporting, storing and allowing energy to be converted easily into other mediums.
- Energy storage can be categorized into the different form's energy is stored.
- Types: Electric battery, Thermal energy storage, mechanical, chemical, pump storage, biological organic, hydrogen.

# Why energy systems are important?

- Enhances energy such as in performance, reliability, convenience, efficiency and environmental impacts.
- Useful for storing and providing energy during low and peak demands.
- Without energy storage, transportation, saving and bridging gaps within power consumption and available energy would not possible.

# Electric Battery

- Device that stores chemical energy and releases electrical energy.
- Three main component, two terminals of different materials and the electrolyte.
- Battery capacity is amount of energy a battery can hold, measured by Amp \* hour.

# Types of Batteries

- Two different types Primary and Secondary batteries.
- Primary batteries are single use
  - Ex. Alkaline and Zinc carbon batteries
- Secondary batteries can be recharged
  - Ex. Nickel metal hydride, lithium ion, lead acid batteries

# Uses

- Batteries are used in cars, electronics, energy storage.
- Batteries are versatile ranging from many types and sizes.



Fairbanks Alaska's backup battery with 13,760 nickel-cadmium cells

[www.https://bloximages.newyork1.vip.townnews.com/newsminer.com/content/tncms/assets/v3/editorial/e/4d/e4de0ce8-195d-5020-8f49-f36f8b301597/50f720448ded3.image.jpgnewsminer.com/gvea-s-fairbanks-battery-bank-keeps-lights-on/article\\_a24d94cd-b48a-5f0d-9124-9b10552282e3.html](https://bloximages.newyork1.vip.townnews.com/newsminer.com/content/tncms/assets/v3/editorial/e/4d/e4de0ce8-195d-5020-8f49-f36f8b301597/50f720448ded3.image.jpgnewsminer.com/gvea-s-fairbanks-battery-bank-keeps-lights-on/article_a24d94cd-b48a-5f0d-9124-9b10552282e3.html)

# Advantages

- Converting electric energy to mechanical energy is more efficient than a heat engine.
- Easy to store excess electric energy
- Easy to transport

# Disadvantages

- Low energy density
- Batteries self-discharge
- Limited lifetime in rechargeable batteries – reduction in capacity per charge
- Composed of harmful chemicals.



# Thermal Energy Storage (TES)

- Is the storage of thermal energy at above or below ambient temperature.

## Two types

- Sensible TES is stores by changing material temperature
  - Ex heating up water
- Latent TES is by changing the phase of the material
  - Ex storing water as ice

# Uses

- TES have a wide range of duration and used in cycles, daily weekly, seasonal storage.
- Characterized by capacity power, efficiency, storage period, charge and discharge
- Underground TES use earth's stable underground temperature to insulate or store

# Uses

- Space and water heating, air-conditioning and other industrial thermal processes.
- Examples are hot water storage tanks, ice storage for air conditioning, molten salt and aquifers.



# Advantages

- Convenient in space heating/cooling
- Environmentally friendly when paired with renewable energy
- Can be paired with heat pumps to produce mechanical energy



# Disadvantages

- Requires good insulation
- Low thermal energy reduces heat pump efficiency
- Size limits application

# Flywheels

- Flywheels store energy via rotational kinetic energy in a cylindrical large mass.
- Have quick charge and discharge and operate in a vacuum.
- Magnetic bearing in flywheels can increase its efficiencies.
- Most advantageous form of mechanical energy

# Uses

- Transportation vehicles, providing large amounts of energy at a given time.



# Advantages

- Reduce energy consumption in vehicles
- Can release large amounts of energy
- No capacity loss when recharging
- Easy to identify energy stored
- Can operate at any temperature range
- No environmental impact of hazardous materials
- Kinetic energy to electrical energy is efficient



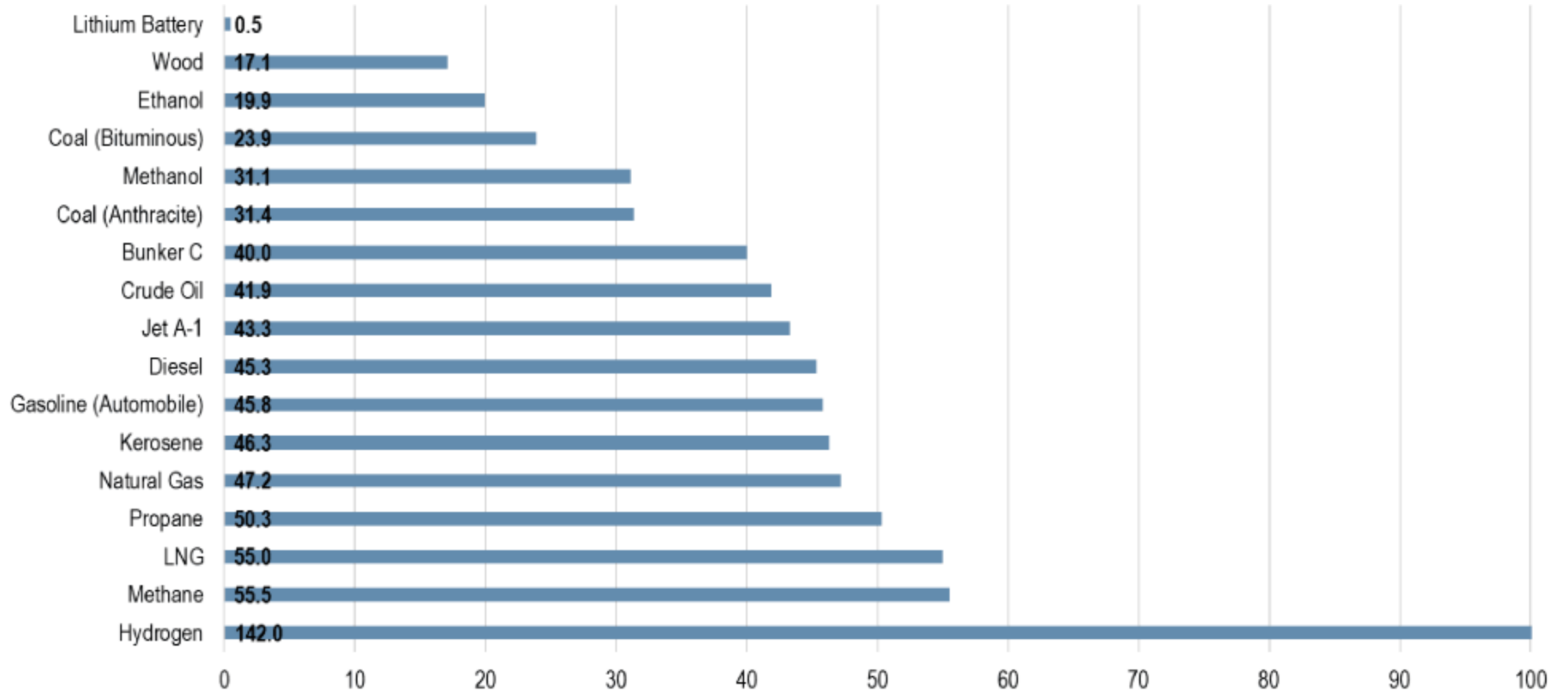
# Disadvantages

- Fixed size limits application
- Can break
- Bulky due to containment vessel
- Friction in traditional bearing increases energy losses

# Energy Storage as a whole

- Infrastructure, manufacturing is expensive.
- Implementing ESS raises costs on renewable technology.
- Low energy density compared to fossil fuels

# Energy Densities



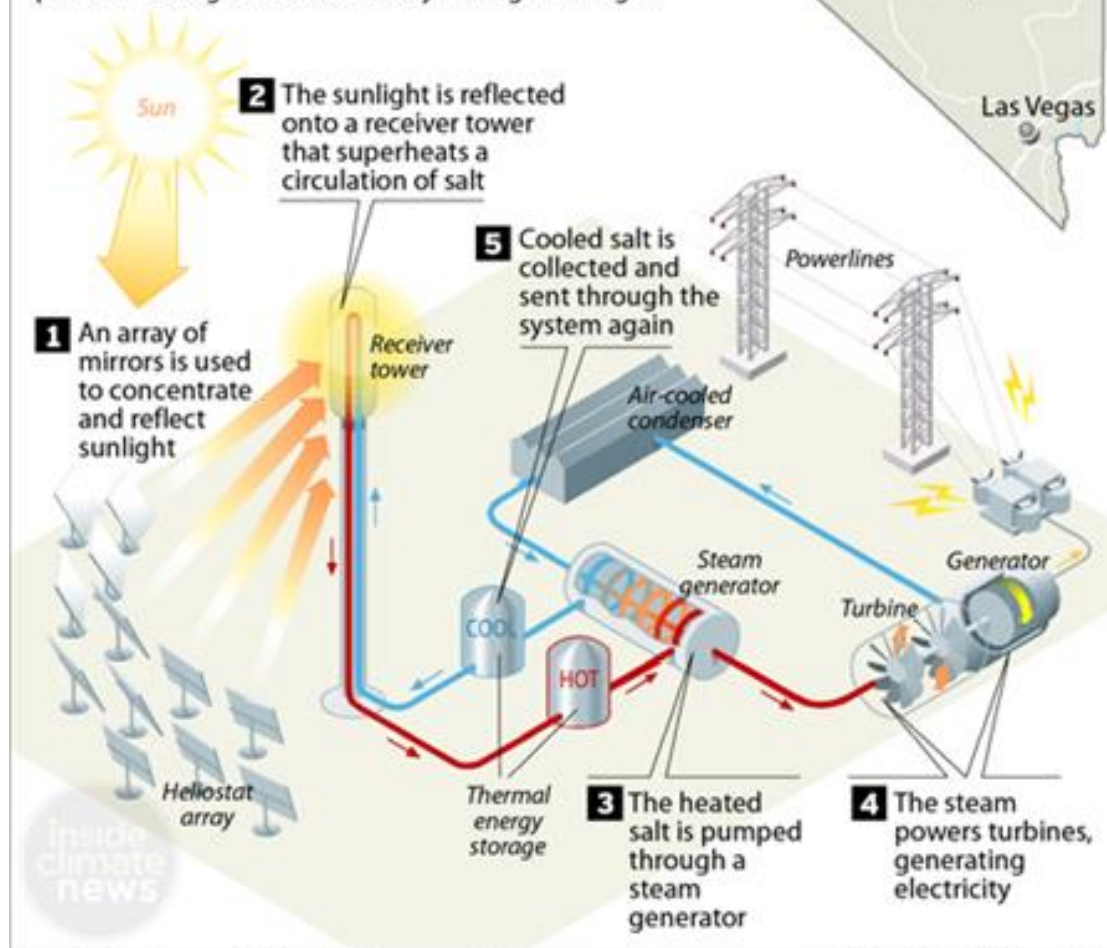
# Solar's Next Big Thing: Storing Energy in Salt

The Crescent Dunes Solar Energy Facility in Nevada, built and operated by SolarReserve, was the world's first utility-scale concentrated solar power (CSP) plant to use molten salt towers to meet the challenge of electricity on demand. As solar prices fall and the need for 24-hour renewable energy rises, the technology is gaining interest.



## CSP MOLTEN SALT PROJECT AT A GLANCE

Molten salt acts as a battery, storing the sun's heat so the plant can also generate electricity through the night.



# Conclusions

- New forms of storage can change the landscape for energy consumption.
- ESS are essential in our transition off fossil fuels.

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