Energy Storage

Brought to you by

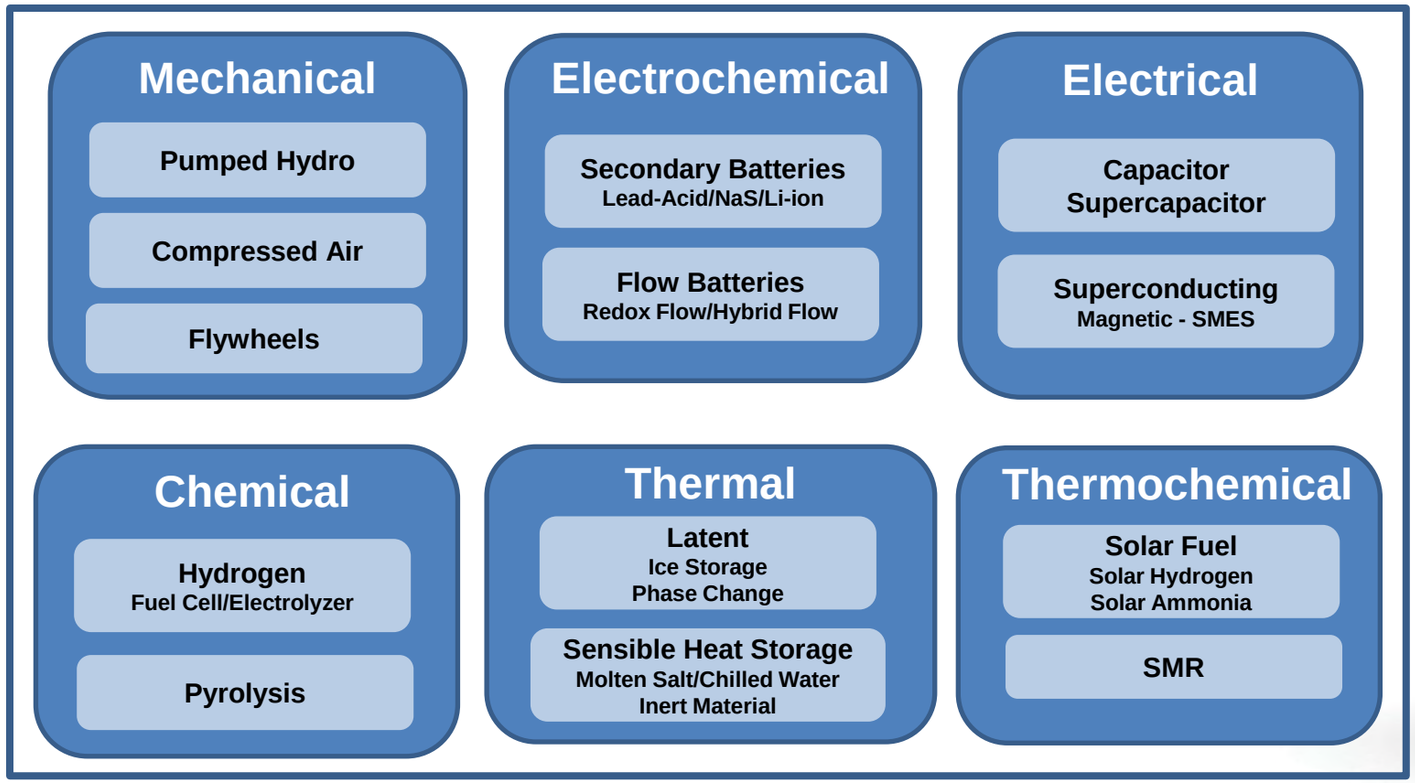
GOLDEN STATE ENERGY

A solid-state battery is an electrical battery that uses a solid electrolyte for ionic conductions between the electrodes, instead of the liquid or gel polymer electrolytes found in conventional batteries. Solid-state batteries offer much higher energy density than the typical lithium-ion or lithium polymer batteries.

Golden State Energy

Introduces Solid-State & Thermal Energy Storage

Forms of Energy Storage



Energy Storage—A Trillion-Dollar Holy Grail

Long-Duration Energy Storage is often called the Holy Grail of Clean Energy.

It is the linchpin technology that will allow the economy to truly run off intermittent renewable energy sources and backup power after grid disruptions.

The Hybrid Solution

PEM Fuel Cell & Solid-State Battery Backup

RELIABLE

Relied on by telecom and mission-critical government applications for modern, resilient networks and security. Altergy fuel cells provide uninterrupted power during severe storms where legacy systems failed.

PROVEN

With more than 8.3 million watts deployed and 32 million operational hours logged, Altergy fuel cells have provided continuous power while the grid has failed during routine outages, severe weather, and prolonged public safety shutdowns.

LOWEST COST

Altergy fuel cells can reduce the total cost of ownership for backup power solutions by up to 50 percent over a ten-year period compared to legacy technologies.

CLEAN

Altergy fuel cells have been certified by the California Air Resources Board to produce zero-emissions at the source and can help reduce your carbon footprint and sustainability goals.

Solid-State Energy Storage & Thermal Energy Storage

Commercial
Residential
Industrial
Government

Solar
Utilities
Wind
Mining

Conventional Lithium Battery Problems

Safety Issues

When damaged, lithium-ion can and does catch fire or explodes in a cascading catastrophic event. The smoke from lithium battery fires is extremely toxic to both wildlife and people.

Environmental

Lithium extraction uses approximately 500,000 gallons of water for every metric ton of lithium extracted. Toxic chemicals used to process lithium cause air, land and water pollution.

Usability Challenges

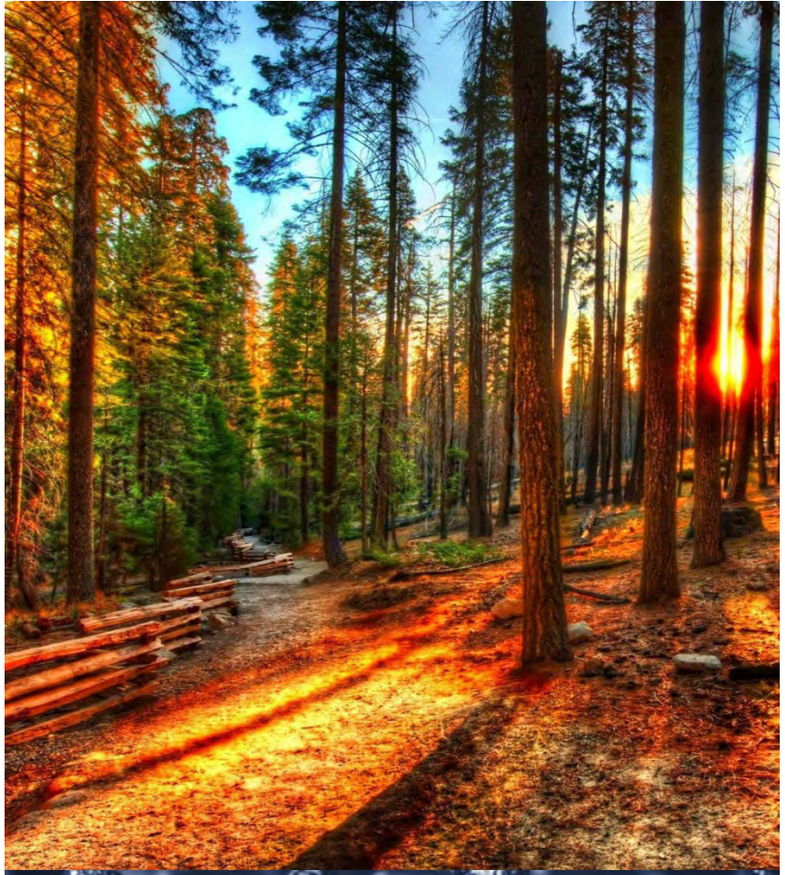
Most batteries require frequent recharge. Users must wait a considerable amount of time before use. This creates challenges for those requiring instant access to power.

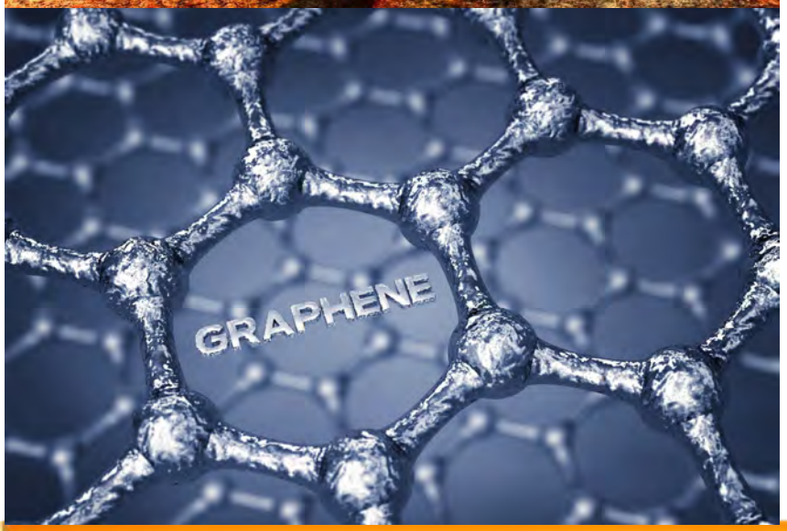
Increasing Cost

Demand for lithium is expected to reach 4.5 million tons by 2030. The global lithium shortage continues to drive prices up. The cost of lithium-ion has risen 88% since 2019.

Limited Lifespan

Lithium-ion batteries lose their effectiveness each time they're charged. They only last for 500 charge/discharge cycles & require replacement every 3-5 years.





The PSTG Nano Graphene Difference

Non-Flammable

Using Graphene allows us to create a much safer and effective power solution. During testing, our Nano Graphene Supercapacitor sustained significant damage and continued to operate with no loss of power..

95% Recyclable

Comprised entirely of carbon, Graphene is highly sustainable. Our solution integrates with green technologies like grid power, wind and solar. After use, our Nano Graphene

High Speed Charging

PSTG's Solution charges and discharges extremely fast. This solution allows for "touch and go" charging in minutes. It is ideal for use with electric vehicles, UAV's, forklifts, golf carts and ground support equipment at airports.

Cost Savings

New production techniques are making Graphene more accessible and reducing its cost significantly. Our Nano Graphene Solution delivers impressive results for the same cost as less effective lithium-ion solutions.

40 Times the Lifespan

Lithium-ion batteries lose their effectiveness each time they're charged. They only last for 500 charge/discharge cycles & require replacement every 3-5 years.

Faster Charge Time Performance

There’s finally an option that provides high performance, a super fast charge and the long-range that our customers require. Graphene Battery Solutions provide unlimited charges and long-lasting power. They charge in minutes and store more power. The Solid-State battery has a potential lifespan of up to sixty years! Graphene is also biodegradable and more sustainable than lithium, making it your eco-friendly choice.

2-40’ **Thermal Energy Storage** Containers per Carousel

30-Year Life, Heavily Insulated, Very Low Maintenance

0.04% Thermal Loss/24 hours

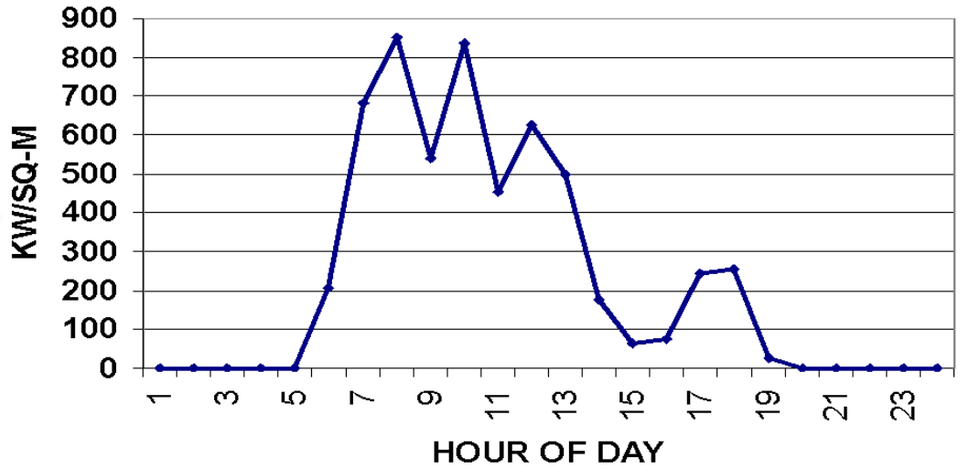
CPF TES charged to 2000^{0}F delivers highest storage efficiency are discharged at centralized boiler temperatures. The 1090C injected to the Turbine Generator Injection point. Our control system provides the mixtures to accommodate this characteristic of the turbine.

Capacity Factor is a measure of how much energy is produced by a plant compared with its maximum output. It is measured as a percentage, generally by dividing the total energy produced during some period of time by the amount of energy the plant would have produced if it ran at full output during that time.

1300 kWh-e @ ~1090^{0}C (each)

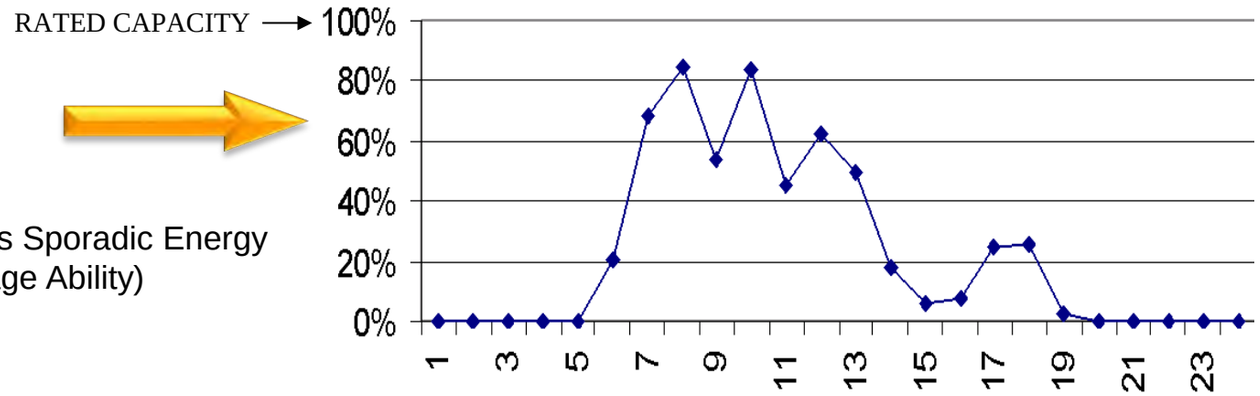
GSE Advantage

On 10 April 1990 at Daggett, California Direct Sunlight Measured Hourly

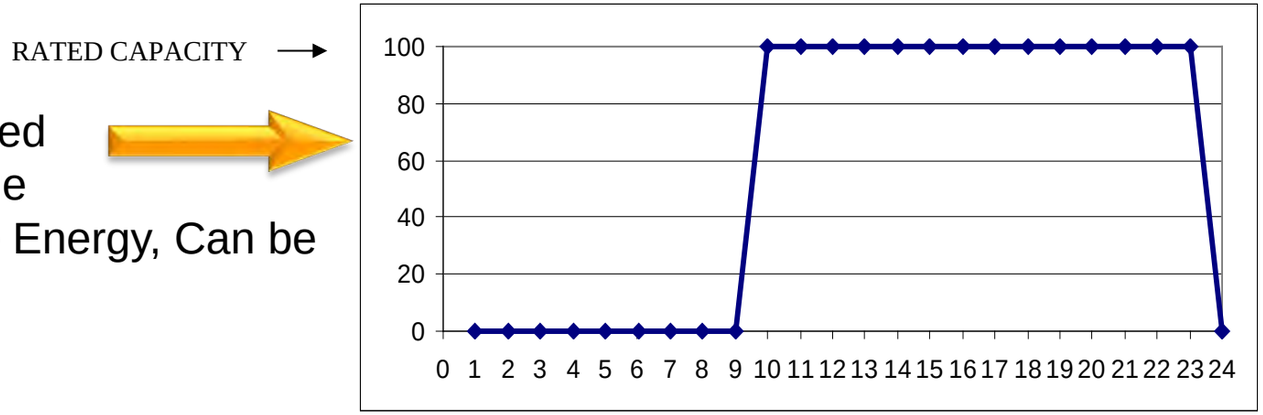


PV & Dish-Stirling Would Have Performed Like This

(These Technologies are Classified as Sporadic Energy Sources Due to Lack of Energy Storage Ability)



GSE Would Have Performed Like This Due to the Unique Ability to Collect and Store Energy, Can be Dispatched On Demand



* Annual electric energy is based on direct sun data measured hourly for the year 1990 in Daggett, California

Solid-State Energy Storage

Brought to you by

Golden State Energy

- GSE manufactures and sells tried and tested disruptive solid-state batteries through an exclusive, worldwide agreement with our American manufacturing partner.
- A solid-state battery uses solid electrodes & solid-state electrolyte monomer instead of liquid or polymer gel electrolytes, yielding proven results.
- Revolutionary and Innovative Technology
- Safe: Non-explosive, Non-Toxic and Non-Flammable
- Recyclable, Upcyclable and Sustainable
- Superior Technical Performance in Temperature and Output
- Democratizing Energy Storage with Affordable Long-Term Solution
- Verified Technical Performance
- GSE has formed a strategic alliance with a wholly owned subsidiary of a top 10 U.S. Bank to finance Solid-State Battery sales up $10 Billion in customer financing.
- Production Capacity for 2025: 5 GWh Energy Storage Systems

Capacity: 1500Ah

Capacity: 750Ah

A Disruptive Global Pattern ...

It is happening:

A massive shift to the electrification of things in most every part of our lives.

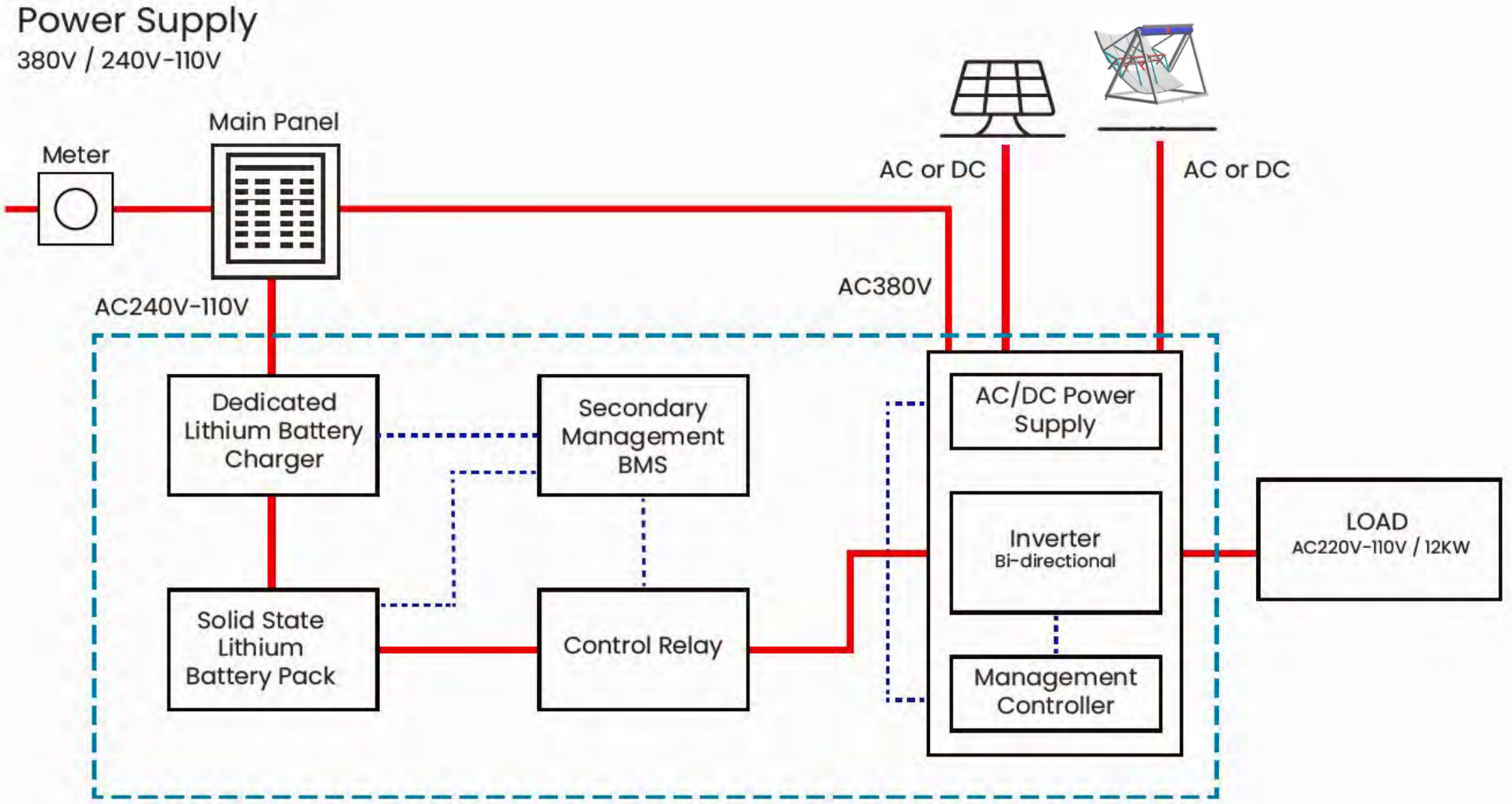
Thermal Energy Storage and Solid-State batteries are the answer to global deployment of the electrification of things.

GSE's private manufacturer is the first company to offer mass produced, safe and sustainable, solid—state batteries in the Western World.

The future of energy storage has arrived. The democratization of energy storage is possible now.

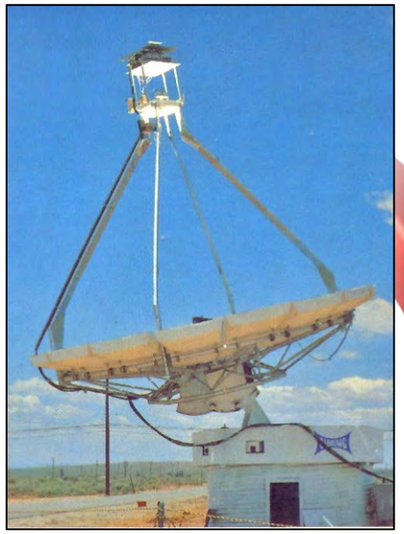
Solid-State Energy Storage

TYPICAL SYSTEM LAYOUT

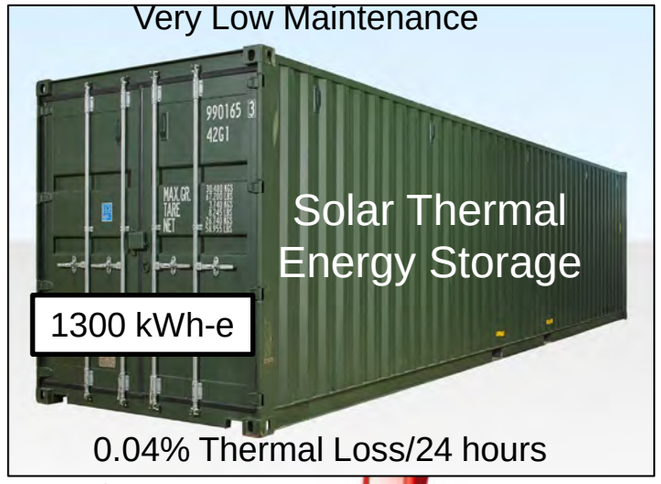


Note: The system is equal to or greater than either the national standards, regional standards or client standards.

Thermal Energy Storage

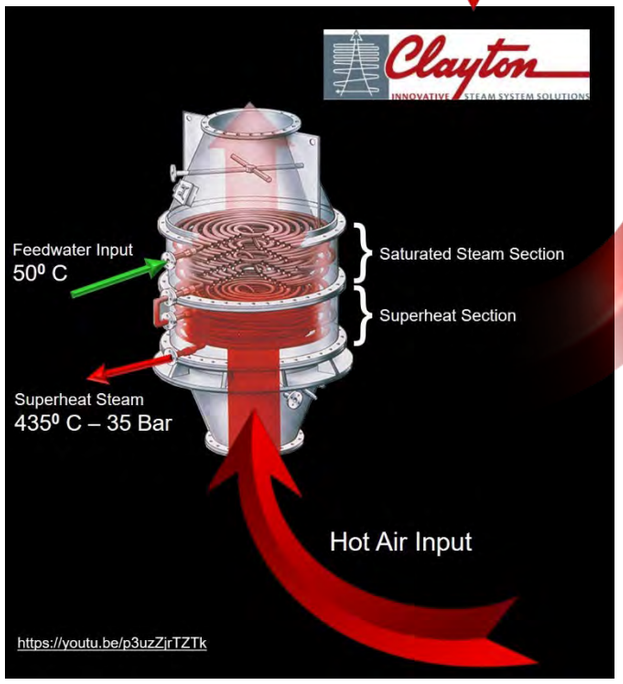


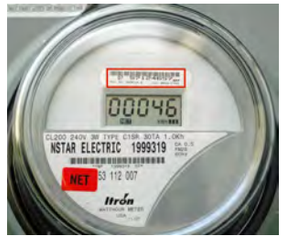
30-Year Life, Heavily Insulated,
Very Low Maintenance



0.04% Thermal Loss/24 hours

CPF TES charged to 2000^{0}F delivers highest storage efficiency are discharged at centralized boiler temperatures. The 1090C steam is injected to the Turbine Generator Injection point. Our control system provides the mixtures to accommodate this characteristic of the steam turbine. Unlimited charge/discharge cycles.





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COMPETITIVE OVERVIEW

GSE **Advantage:** Highest Full Charge Cycles in the World

”

Our battery technology provides unlimited cycles of full charges and an unlimited amount of shallow charges.

GSE Solid-State batteries are 100% recyclable, up-cyclable and sustainable.

GSE **Advantage:** Ultra-Low & Ultra-High Temperatures

”

The battery operates at much wider temperature ranges than the competition with excellent performance at low and high temperatures. The temperature ranges between -40℃ (-40°F) and 70℃(158°F).

GSE Advantage: Total Lower Cost of Ownership

The **GSE** thermal energy storage & solid-state battery's cycle life is guaranteed for 25 years, the design life is 30 to 35 years, and the annual charge retention rate is more than 96%, far exceeding the world's current capability.

Currently the competition annual retention rates averages ~82%.

The total cost of ownership is 34%+ lower than the competition.

GSE **Advantage:** Highest Safety

”

GSE energy storage solutions do not require cooling systems. There is no thermal runoff, extending the life of the battery and reducing total operational costs. The TES system is of inert material.

The internal resistance of the core is no more than 0.2 milliohms. The core does not heat, increasing safety. The core is in the solid structure resulting in no leakage combustion.

GSE **Advantage:** Largest Solid State Cell Capacities in the World

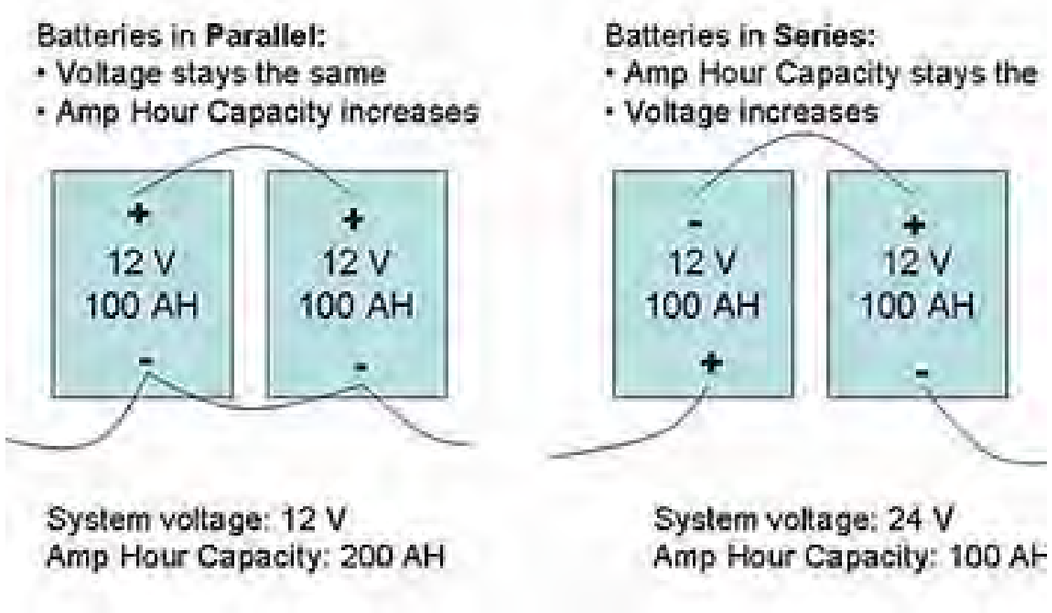
GSE offers large solid state cell capacities in the following configurations:

1000MWh, 2000MWh, 3000MWh, 4000MWh, and 5000MWh

GSE **Advantage:** Superior Battery Management System (BMS)

”

Our battery can be controlled at the cell level while the competition can control only at the system level. The battery can be controlled either in parallel or in a series configuration. The ability to manage at the cell level increases safety, optimization and efficiency.



GSE Energy Storage Features & Benefits Summary

LARGE CAPACITY	Solid State Batteries available in the following capacities: 1000MWh, 2000MWh, 3000MWh, 4000MWh, 5000MWh
LONG-DURATION ENERGY DISCHARGE RATE	GSE solid state batteries discharge over 8 hours at rated power.
FULL CHARGES	Unlimited cycles of full charge. Unlimited amount of shallow charges.
HIGH ENERGY STORAGE EFFICIENCY	No cooling system required. The discharge retention rate is above 96%.
HIGH SAFETY	The internal resistance of the core is no more than 0.2 milliohms; the core does not heat, increasing safety. The core is in the solid structure and there is no leakage combustion.
ULTRA LOW AND HIGH TEMPERATURE	Wide temperature range, good performance at low and high temperatures. The temperature ranges between -40℃ (-40°F) and 70℃ (158°F). For custom orders, temperature range can be increased.
LONG LIFE EXPECTANCY	Guaranteed 25 years, Design Life is 30 to 35 years.
BATTERY MANAGEMENT SYSTEM	The battery can be controlled at cell level. The batteries can be controlled either in parallel or in a series configuration.
TOTAL ENERGY STORAGE SOLUTION	Includes inverter, communications, software, supporting electrical equipment, and installation. BMS to cell level.

Commercial Overview

Unparalleled Safety

Golden State Energy	Current Li-ion Batteries
NON-FLAMMABLE Safe to install in many more locations, including gas stations.	**FLAMMABLE** The battery is flammable, causing electric cars to explode when hit in certain ways. Unsafe chemistry and cell structure. History of being a fire hazard.
NON-EXPLOSIVE Safe and easy to install in industrial locations, including gas stations.	**EXPLOSIVE & OVERHEAT** Needs extensive care in handling. History of explosions. Batteries overheat and explode if charged too quickly
100% RECYCLABLE & NON-TOXIC Safe for Environment. 100% Recyclable. Zero Toxicity. Upcyclable and Sustainable.	**TOXIC** Composed of hazardous chemistry. Needs expensive safe keeping treatment and storage.
NO THERMAL RUNAWAY Zero Thermal runaway, saves operational costs & extends battery life.	**THERMAL RUNAWAY** Affects increased costs and degrades design & efficiency & life of battery.
NO AIR CONDITIONING REQUIRED Zero cost toward cooling infrastructure. Wide temperature operating bandwidth. No cooling system needed.	**AIR CONDITIONING REQUIRED** Extra cost burden to maintain & sustain cooling infrastructure.
SAFE CHARGING Allows unlimited shallow charges, extending battery life.	**UNSAFE CHARGING** Unsafe for shallow charging. Affects performance and safety.
Other Advantages	**Other Disadvantages**
OPERATES UNDER WATER Suitable for underwater service. (Battery core can work underwater but not the entire system.)	**NOT CAPABLE OF WORKING UNDER WATER** Hazardous chemistry risks contamination in underwater service
HIGH SAFETY The internal resistance of the core is no more than 0.2 milliohms; the core does not heat, increasing safety. There is no leakage combustion.	**EXPENSIVE CASING** Composed of liquid chemicals requiring rigid and expensive casing to prevent leakage.

Commercial Overview (cont'd)

Market Industry Leading Performance

Golden State Energy	Current Li-ion Batteries
LONG LIFETIME Allows 11,000 Cycle of Full discharge, excluding unlimited shallow charges. Unlimited amount of shallow charges.	**SHORT LIFETIME** 3000 ~ 6000 Cycles of full charges. Degrades battery life with shallow charges.
LONG LIFE EXPECTANCY Guaranteed 20 years. Design life is 30 to 35 years. Highly economical over extended life span.	**SHORTER LIFE EXPECTANCY** Short life span combined with non-recyclable chemistry is not eco friendly. Estimated at 5- 6 years.
HIGH ENERGY STORAGE EFFICIENCY The discharge retention rate is 97%. No cooling system required, reducing operational costs.	**LOWER ENERGY STORAGE EFFICIENCY** The discharge retention rate is less than 82%. Cooling system required, increasing operational costs.
ULTRA LOW & HIGH TEMPERATURE RANGE The battery operates at much wider temperature ranges between -40°C - 55°C (-40°F to 131°F).	**UNDER PERFORM IN EXTREME TEMPERATURE** The chemicals under perform when temperatures are lower than 0°C (32°F) or higher than 50°C (122°F), limiting the applications.
LONG-DURATION DISCHARGE RATE Amptricity batteries discharge up to 8 hours.	**LOW DURATION DISCHARGE RATE** Batteries discharge over 2-4 hours.
LARGE SOLID STATE BATTERY CAPACITY Available in the following capacities: 1000MWh, 2000MWh, 3000MWh, 4000MWh, 5000MWh. Capacities of between 1000MWh & 5000MWh are available by special order.	**SMALLER BATTERY CAPACITY** Up to 1000Ah
Other Advantages	
CELL LEVEL CONTROL The battery can be controlled at cell level; therefore system will perform at its best efficiency all the time. The batteries can be controlled either in parallel or in a series configuration.	**INCAPABLE OF CELL LEVEL CONTROL FOR MOST** Engineering & architecture is not suitable.
ULTRA HIGH DISCHARGE The maximum continuous discharge rate is more than 180 C Rate.	

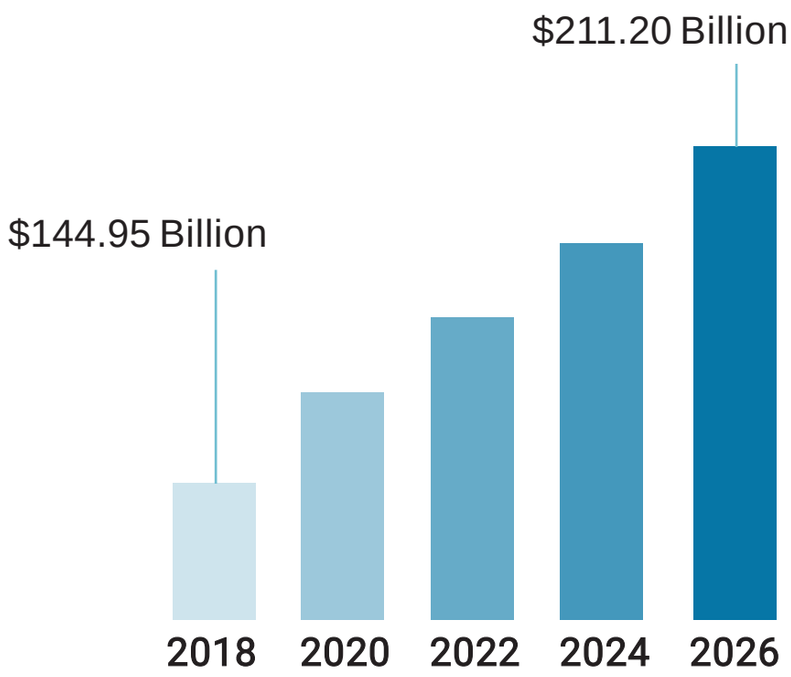
Commercial Overview (cont'd)

Lowest Operating Costs

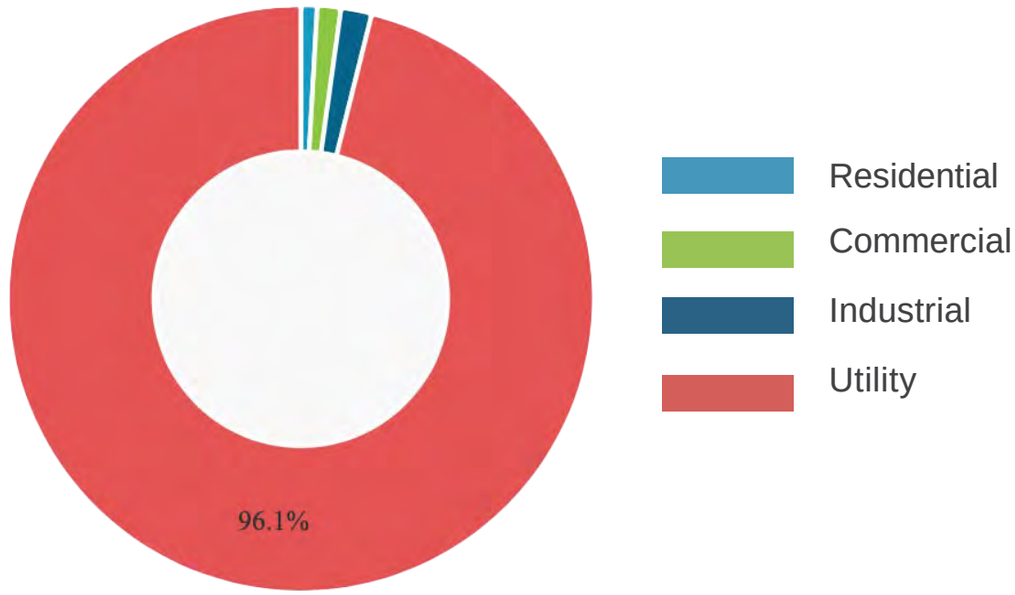
Golden State Energy	Current Li-ion Batteries
NO AIR CONDITIONING REQUIRED Zero cost towards cooling infrastructure.	**AIR CONDITIONING REQUIRED** Extra cost burden to maintain & sustain cooling infrastructure.
SMALLER FOOTPRINT The footprint can vary according to length, width and height based on client specifications.	**LARGE FOOTPRINT** The footprint is higher due to large amount of batteries required. Fire hazard. Non-stackable.
LOWER LAND COSTS Less land required due to smaller footprint. 10 foot container represents 1 MWh Energy Storage System. Stackable.	**HIGH LAND COSTS** The footprint is higher. For example, for 1MWh Energy Storage Systems (ESS) 3 x 40 foot containers. Non-stackable.
LOWER MAINTENANCE COSTS Far less wiring and connection points, reducing maintenance costs.	**HIGH MAINTENANCE COSTS** More wiring and connection points, increasing maintenance costs. AC required for cooling.
LOWER OPERATING COSTS Total operating costs are lowered due to higher energy storage efficiency, no thermal runaway, no AC, etc. No cooling system required.	**HIGH OPERATING COSTS** Total operating costs are higher due to lower energy storage efficiency, thermal runaway, AC requirement, etc.
LOWER INSTALLATION COSTS Fewer batteries required. For example, 1MWh energy storage system needs only 196 single cores in series.	**HIGH INSTALLATION COSTS** More batteries required. For example, for a 1MWh Energy Storage Systems (ESS), more than 10,000 batteries are required.
LOWER INSURANCE COSTS The batteries are non-flammable and non-explosive, insurance costs are lowered.	**HIGH INSURANCE COSTS** Because the batteries are flammable and explosive, insurance costs are increased.
LOWER WEIGHT Lower transportation costs, and reduction of weight in Electric Vehicles (EV).	**HEAVIER WEIGHT** Higher transportation costs, and higher weight in Electric Vehicles (EV).
LONG LIFETIME Unlimited Cycles of full charge. Unlimited amount of shallow charges.	**SHORT LIFETIME** ~3,000 to 6,000 Cycles of full charge /discharge.

Global Energy Storage Market

Global Advanced Energy Storage Market ($USD), 2018 to 2026

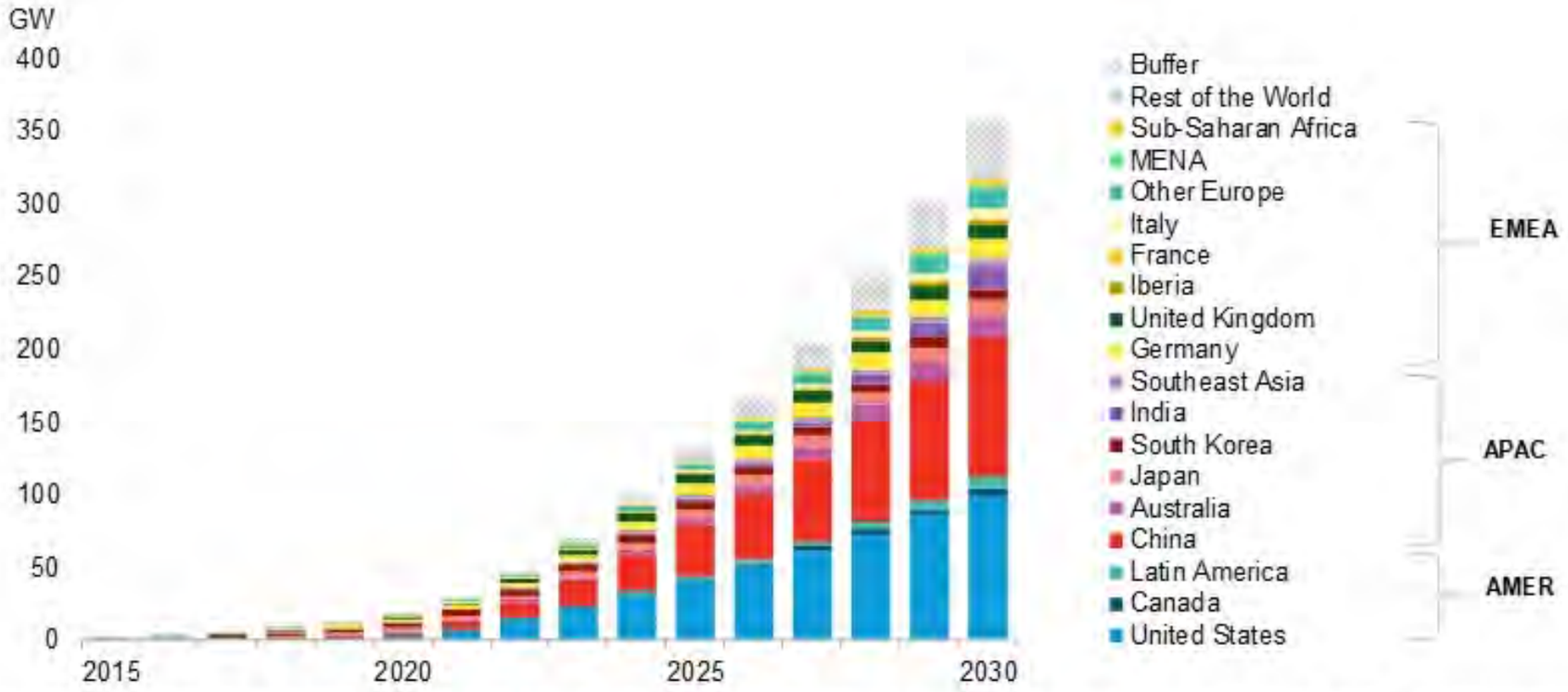


Global Advanced Energy Storage Market Value Share, by Application, 2018



Source: Fortune Business Insights

Global Cumulative Energy Storage Installations



Source: BloombergNEF. Note: MENA = Middle East & North Africa. We order countries according to their region group in this chart. Buffer represents markets we lack in visibility and countries that are likely to exceed their current targets.

BloombergNEF

MENA ENERGY STORAGE MARKET FACTS

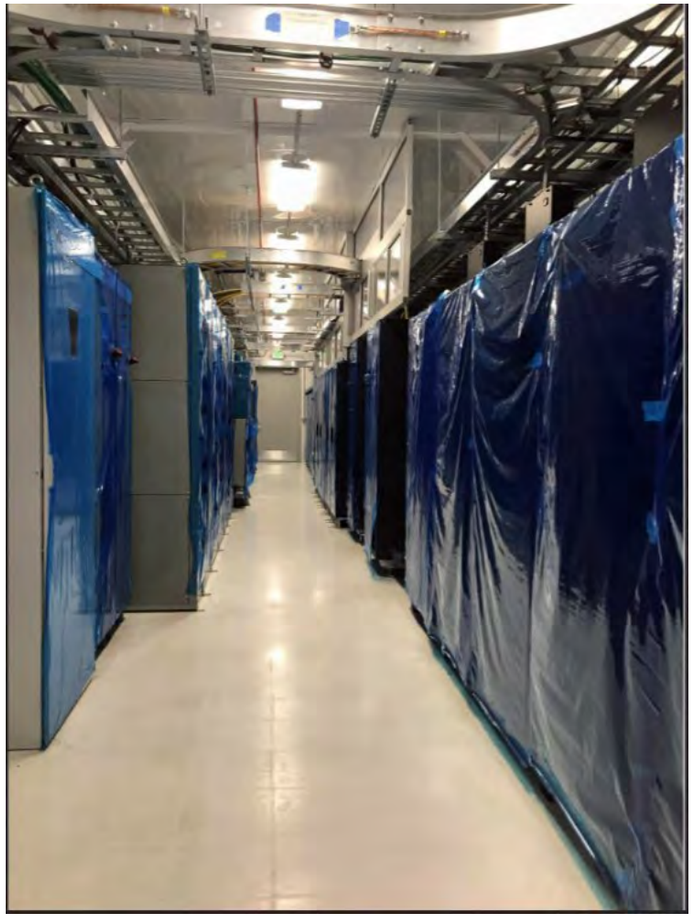
- The Middle-East and Africa battery energy storage system market is expected to grow at a CAGR of over 5.2% during the forecast period 2020-2025.
- Middle-East and Africa battery energy storage market is growing rapidly primarily due to the expansion of renewable energy resources.
- The demand for batteries has increased in Middle-East as a preferred energy storage solution primarily due to technological innovation and reduction of battery costs.
- Major factors driving the market are the increasing levels of renewable energy penetration, demand for reliable and uninterrupted power supply, and aging grid infrastructure.
- The lithium-ion battery segment is expected to be the fastest-growing segment in the Middle-East and Africa battery energy storage system market.

1MWh Energy Storage Solution

Building and Emergency Energy Storage

The system was put into operation in January 2018—implementing demand-side management, peak shaving, and valley filling, emergency reserve, and load efficiency improvement.

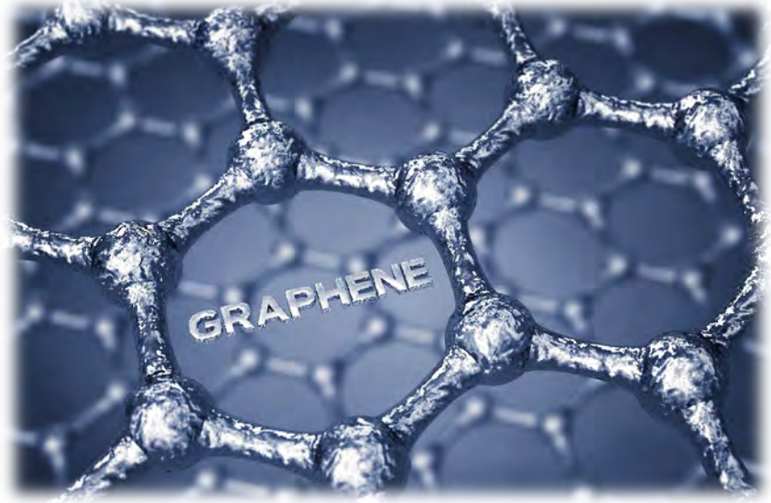
- The 1MWh energy storage systems only contains 196 single cores.
- Configuration method: the system is equipped with a grouping type, which can be expanded by multiples of 375kWh.



Description	Parameters	Notes
The Capacity of the Energy Storage System	1MWh	Annual charge retention >97%
Rated Charging Power	250KW	
Rated Discharge Power	250KW	Infinite parallel connection of AC measurement
Rated Output Voltage	AC380	
Output Voltage Range	323V~418V	
Rated Output Frequency	50Hz - 60Hz	
Frequency Range	48~62 Hz	
Working Temperature	-40ºC-55ºC (-40ºF-131ºF)	
Output Wiring Mode	Fast interface / fixed interface	DC side, cable or bus
External communications mode	Ethernet RS485	
Overall Size of Battery Cabinet	2380*1925*2110 (mm)	4.4m²
Thermal Management System	Natural heat dissipation	
Container Ports: • Power Port • Distribution Port • Communication • Grounding Port	• 1 Way Direct • 1 Way Direct • 1 Way Ethernet • 1 Way on the spot	

Application Area: It is applied to large-scale industrial energy storage power station, mobile power station, large-scale communiction power supply, data centers, telephone cell sites, border & prison security, navigation, high-speed rail system energy and other fields.

GSE Product Price Range

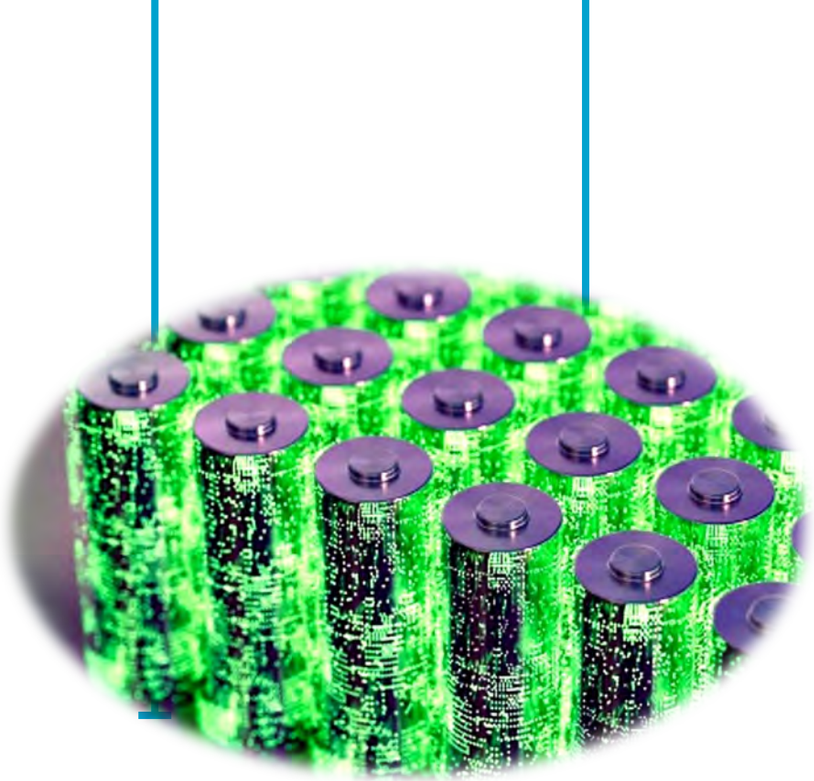


- 1MWh
  - 1MWh
  - 2MWh
  - 3MWh
    - $402,500.00/MWh*
  - 4MWh
  - 5MWh

GSE Advantage: Highest Specific Energy in the World

GSE offers solid state solutions with the highest energy density in the world at>377.55 Wh/Kg.

* *Fully Integrated—In Blocks of 375KWh*, up to 2.5MWh in one container.



OTHER MARKETS & APPLICATIONS

Addressable Markets (Examples)

PRIMARY FOCUS: STATIONARY ENERGY STORAGE SOLUTIONS


Electric Power Plants


Solar Farms


Data Centers


Grocery Stores


Commercial Buildings


Hotels & Motels


Colleges & Universities


Government Buildings


Wind Farms


Residential


Hospitals


Industrial

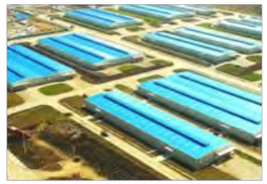

Warehouses


Auto Dealerships


Condominiums


Retail Stores


Mining Operations


Off-Grid Industrial Plants


Senior Care Facilities

Restaurants


Apartments


Amusement & Water Parks


Independent System Operators


Car Washes

Lighting Towers


Cell Sights


Module for Cell Towers

Railroad Crossings


Module for Traffic Signals


uestions
Answers
Questions
& Answers
GSE Energy Storage

Golden State Energy

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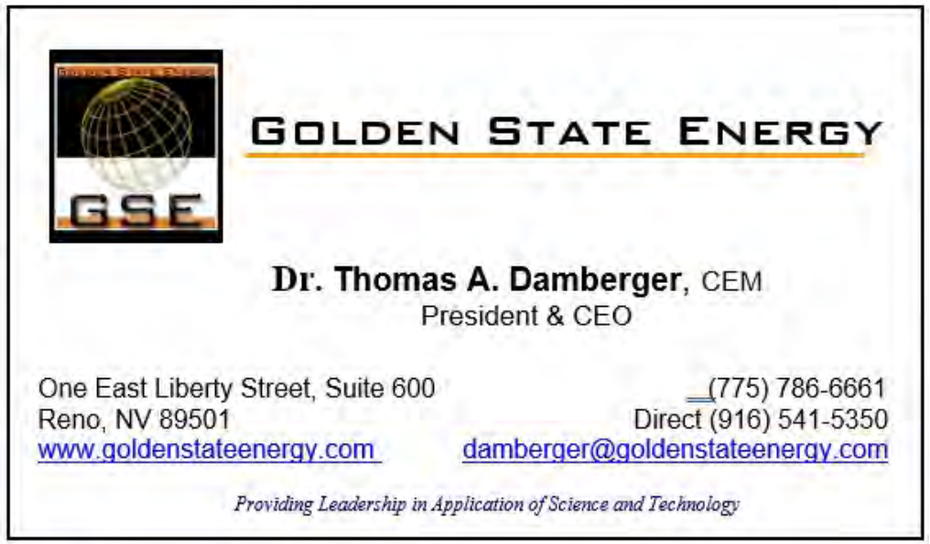

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