

GE Power



RESERVOIR SOLUTIONS

Flexible, modular
Energy Storage Solutions
unlocking value across the
electricity network



TRENDS DISRUPTING THE POWER SECTOR FROM GENERATION TO T&D



DECARBONIZATION

By 2040, **RENEWABLES** will represent **30%** of global net electricity ... or more?

IMPACT

- Generation is becoming difficult to forecast & variable
- Grid stability, Congestion Volatility on electricity markets



DIGITIZATION

GROWING THE NUMBER of connected devices & smart sensors

IMPACT

- Allowing decision making based on dynamic and nodal prices



DECENTRALIZATION

GROWING PENETRATION of distributed resources (renewable, storage, efficient devices)

IMPACT

- End user becomes an active actor of the power system ('prosumer')
- Growing complexity of distribution grids



ELECTRIFICATION in energy ecosystem

ELECTRIFICATION OF ENERGY USES, transport (EVs) and heating

IMPACT

- Growth of Electricity demand, and an acceleration of decentralization of the power sector



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WHY ENERGY STORAGE?

A battery energy storage solution offers new application flexibility and unlocks new business value across the energy value chain.

Energy storage supports diverse applications including firming renewable production, stabilizing the electrical grid, controlling energy flow, optimizing asset operation and creating new revenue by delivering:



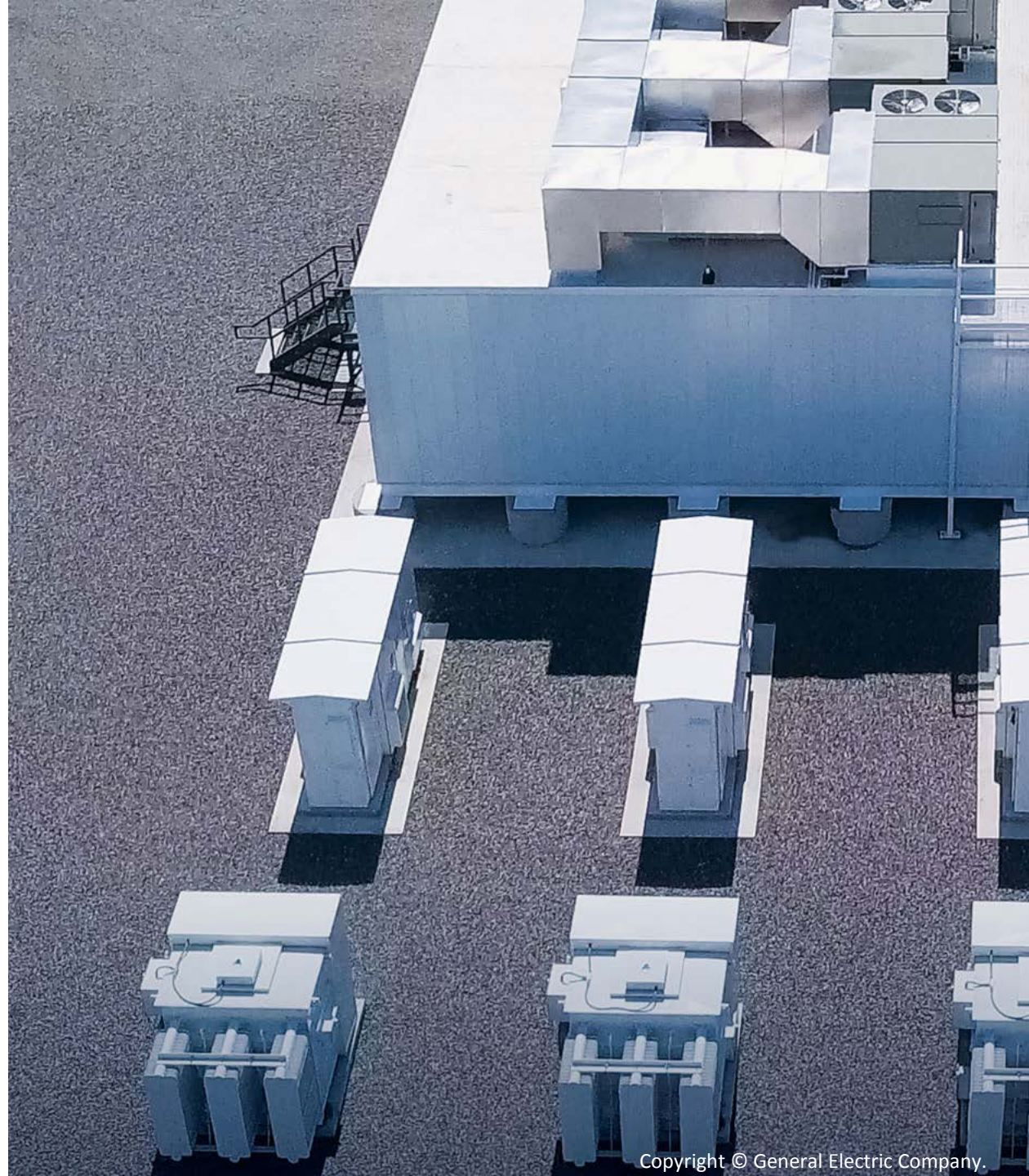
Active Power Services

- Frequency regulation
- Frequency response
- Peak shaving/firming
- Remote power commands
- Ramp rate control
- Curtailment avoidance
- Scheduled dispatch/shifting
- Scheduled power commands
- State of charge management
- Islanding
- Black start



Reactive Power Services

- Voltage control
- Voltage droop
- Power factor control
- VAR control



GE SOLUTION

GE's Reservoir is a flexible, compact energy storage solution for AC or DC coupled systems. The Reservoir solution combines GE's advanced technologies and expertise in plant controls, power electronics, battery management systems and electrical balance of plant – all backed by GE's performance guarantees.

POWER
CONVERSION

BATTERY
MANAGEMENT

PURPOSE BUILT
ENCLOSURES

RESERVOIR
CONTROL UNIT

MV
TRANSFORMER

MV
SWITCHGEAR

CONSULTING &
SERVICES

SOFTWARE
SUITE



GE RESERVOIR STORAGE UNIT . . . Up to 4MWh Capacity

Enhanced to reduce installation cost and shorten project schedule

**UP TO 15% EXTENDED BATTERY LIFE
UTILIZING PROPRIETARY BLADE
PROTECTION UNITS**

**UP TO 50% REDUCED
CONSTRUCTION TIME WITH FACTORY
BUILT & TESTED SOLUTION**

**IMPROVE SAFETY BY REDUCING FAULT
CURRENT BY UP TO 5X**

**ENABLE UP TO 50% MORE SOLAR ENERGY
SALES WITH ENHANCED PV TO INVERTER
LOADING RATIO**

15 MW / 60 MWh Solar Hybrid Reservoir Solution

Reservoir Storage Unit: Large Energy Application (1.2 MW / 4 MWh)

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GE APPROACH

GE's broad portfolio of Reservoir Solutions can be tailored to the operational needs enabling, efficient and cost-effective storage distribution and utilization of energy where and when it's needed most.



Our approach results in an investment grade business case that provides the basis of project planning and financing

UNLOCKING NEW BUSINESS VALUE WITH GE'S RESERVOIR ENERGY STORAGE SOLUTION



Improve Financial Performance

Monetize assets through new revenue streams, increased asset utilization, improved yield, and reduced operating costs.



Increase Renewables Integration

Improve integration and maximize utilization of the energy generated from photovoltaics (PV) and wind turbines.



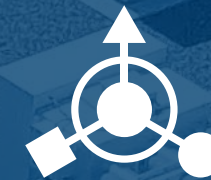
Optimize Electrical Grid

Defer upgrades, relieve congestion, control voltage, provide reserves and ancillary services, and improve reliability with backup power and black start functionality.



Reduce Energy Costs

Commercial and industrial end users can mitigate demand charges, optimize differential (Time of Day) energy prices, and benefit from additional onsite PV generation.



Develop Microgrids

Create a new and more flexible grid by locally integrating renewable generation and smart devices with energy storage and real-time communication.

TYPICAL RESERVOIR APPLICATIONS

Standalone Applications



Generation



Transmission



Distribution

<p>Voltage Regulation Compensate anomalies or disturbances (e.g., voltage magnitude, harmonics, etc.) by sending reactive energy into system.</p>			✓
<p>Frequency Response Provide fast regulation of grid frequency to balance supply and demand.</p>		✓	
<p>Frequency Regulation Provide regulation of grid frequency to balance supply and demand based on signals sent by the grid operator.</p>	✓		
<p>Renewable Integration Balance the local excesses or deficits of renewable generation caused by rapid weather fluctuations.</p>			✓
<p>Black Start Energize part of the generation asset without outside assistance after a blackout.</p>	✓	✓	
<p>Back-Up Store energy to maintain service continuity and grid resilience in the event of an outage.</p>			✓
<p>Peak Management Reduce grid capacity needs during peak periods with local storage.</p>		✓	✓
<p>Shifting Buy or produce electricity at low price (off-peak) to store and sell at peak price.</p>	✓		
<p>Capacity Store renewable energy production for peak and base load consumption.</p>	✓	✓	



TYPICAL RESERVOIR APPLICATIONS

Integrated Hybrid Solution Applications



Solar



Wind



Thermal

	Solar	Wind	Thermal
Synthetic Inertia Compensate losses of grid inertia caused by high renewable penetration.			✓
Frequency Regulation Provide fast regulation of grid frequency to balance supply and demand.	✓	✓	✓
Firming Prevent undesirable short-duration effects from rapid fluctuations in solar generation due to intermittency and weather conditions.	✓	✓	
Improved Operations Improved management by enhancing thermal generation fleet operation and costs.			✓
Contingency Reserve Provide fast ramp-rate to meet grid requirement for online dispatch within a short delay of operating reserve.			✓
Curtailment Avoidance Avoid output curtailment at certain times, preventing loss of energy production.	✓	✓	
Dispatchable Control solar generation at request of power grid operators or according to market needs.	✓	✓	

