EIA: “Electricity Industry in Transition”

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Powerful trends shaping the nature of electricity

DECARBONIZATION

By 2026, **RENEWABLES will represent 40%** of global **installed generation capacity***

IMPACT

- Growing share of renewables an increasing challenge to the traditional power system model

DIGITIZATION

EXPONENTIAL GROWTH of **connected devices** & **smart sensors**

IMPACT

- Real time decision making becomes possible … new software solutions open breakthrough optimization

DECENTRALIZATION

GROWING PENETRATION of **Distributed Energy Resources**

IMPACT

- End users become active actors of the power system (‘pro-sumer’) … growing grid complexity

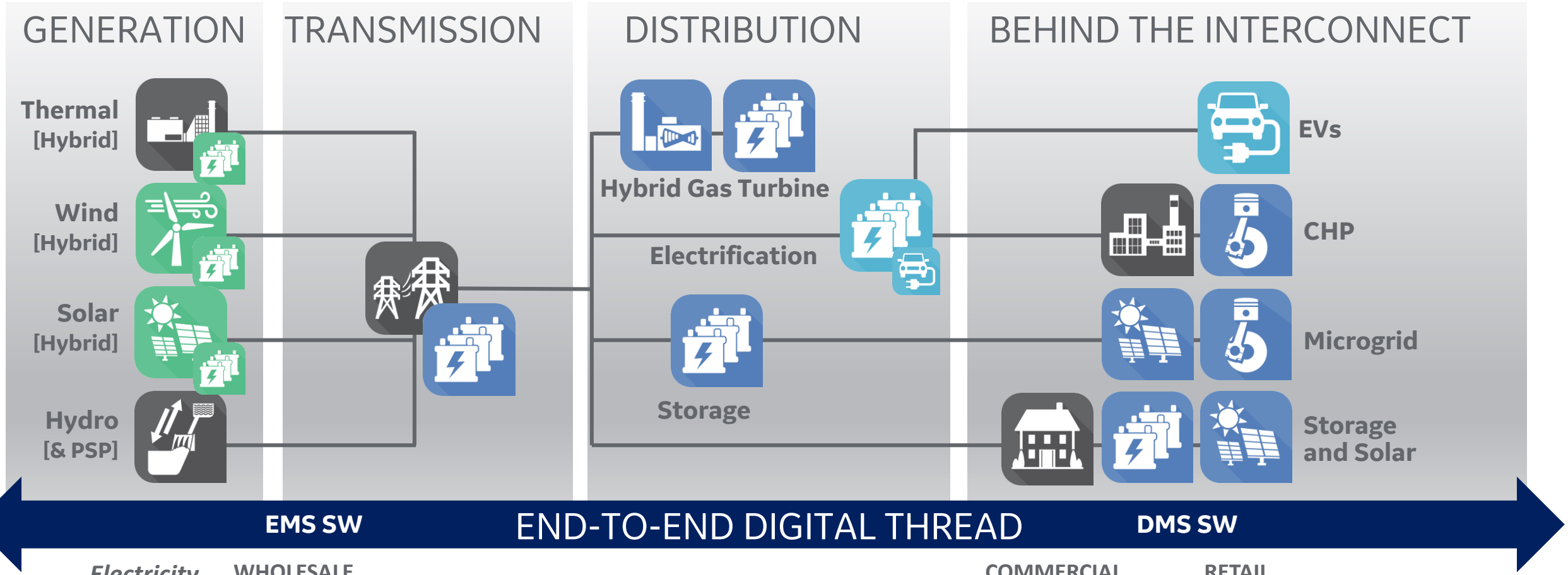
ELECTRIFICATION 2.0

ELECTRIFICATION OF ENERGY-INTENSIVE USES

IMPACT

- Step increase in electricity consumption … accelerating Decentralization

Evolving Electricity Network



Electricity Price (¢/kWh):

WHOLESALE
US: ¢3-¢6

COMMERCIAL
NE: ¢15

RETAIL
Germany: ¢30
Hawaii: ¢24
CA: ¢15

Enabling system benefits: lower cost, lower emissions, higher reliability, more resilient

Microgrids and Distributed Energy

Philadelphia Navy Yard microgrid

THE NAVY YARD ELECTRIC UTILITY

Grid Modernization

- Smart meters, communications, microgrid management & DERMS
- Optimize consumption efficiency & environmental footprint

On-site Generation

- 10 MW substation with PECO tie-ins
- 6 MW natural gas peak shaver/back up power
- 1 MW on-site solar generation

Customer Benefits

↓ Capex **↓ Opex**

↑ Resilience **↑ Local Capacity** **Economic Development**

Enable local load growth in congested area without expanding city infrastructure

GE'S 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

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

15 MW / 60 MWh Solar Hybrid Reservoir Solution

TYPICAL **RESERVOIR APPLICATIONS**

Integrated Hybrid Solution Applications

POWER

ENERGY

	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: Optimize 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 wind 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.	✓	✓	

✓ Primary Benefit
○ Typical use case

TYPICAL **RESERVOIR APPLICATIONS**

Standalone Applications

POWER

ENERGY

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

✓ Primary use case

○ Typical use case

Conclusions

The power grid is becoming increasingly diverse

Energy Storage + Distributed Energy can support grid

Existing assets will be important facilitator of system change

New business models & market structures are critical