Leapfrogging Technology Transforms Ecosystems

Difficult to predict the pace of change
A Lot Can Happen In 10 Years

Source: GE
Trends Disrupting the Power Sector from Generation to T&D

**DECARBONIZATION**

- Generation is becoming difficult to forecast & variable
- Grid stability, congestion volatility on electricity markets

78% of the 9000 GW+ of new generation forecast to be built by 2040 will be renewable

**DIGITIZATION**

- Allowing decision making based on dynamic and nodal prices

Total software revenue to hit $3.3 trillion by 2025

**DECENTRALIZATION**

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

Annual installed capacity of distributed energy resources is expected to reach 530 GW by 2026
The evolution of Grid Scale Energy Storage at GE

- **2011**: Low load factor - 2/3 services, Sub-components modularity, Sustained by one-off feed-in events
- **2016**: Co-located BESS - Topped up usage stack, First automated black-start, Partial integration with Generation control
- **2017**: Thermal Hybrid - Enhanced Generation, Savings on LCOE & water, Fully integrated system (HW & Control)
- **2018**: Reservoir - Design to install, 2 blocks modularity, AC and DC coupling & integration

- Layers in the BESS value stack
- Efficiency delivering grid stability
- Optimization of existing assets
- Shifting to better system efficiency
Blackstart and Frequency Regulation

Grid restoration black start capability, Traditional power plant hybridized

Most Utilized Battery System in the World

- Modified Battery Storage hardware and controls after commissioning 33 MW, 20MWh facility
- Enable automatic transition to grid islanding, creating microgrid to start the gas turbine
- Providing emergency black start for Imperial Irrigation District, California, 44MW of CCGT power plant
Innovation of the year 2017

A GE gas turbine fleet to be hybridized

World’s First Battery-Gas Turbine Hybrid

- Helps meet immediate energy needs in California
- Enhances flexibility, reliability and response time to customer's energy demands
- Allows more effective use of renewables and faster response to changing demands
- Reduces environmental impact and cost for Southern California Edison’s operations and its customers
Break through in the UK

Partnership with Arenko for Grid Services

3rd Largest System in UK, only Fully Merchant

- Fully merchant system ... integrated energy trading software with energy storage controls
- Participate in UK ancillary services market ... 420ms activation time
- 41MW Customized design in pre-existing building