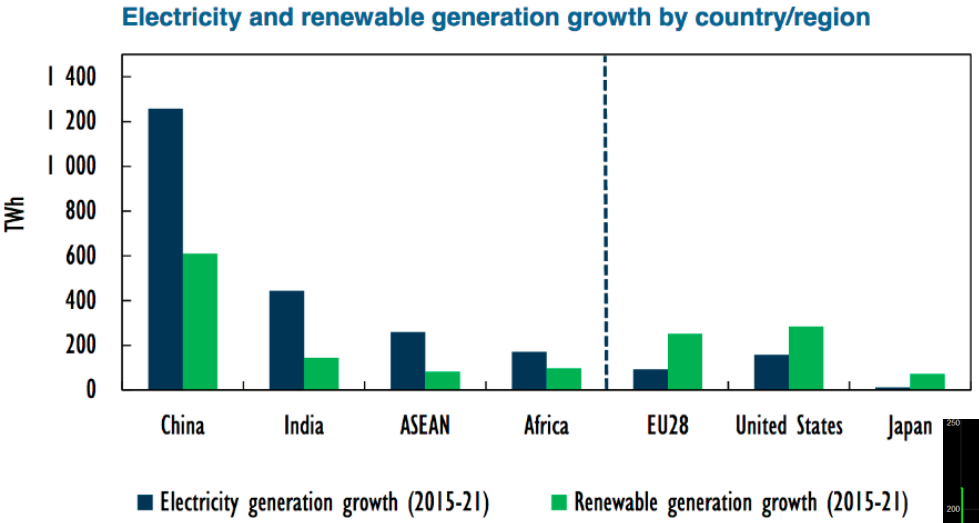
CAPER Senior Design Project

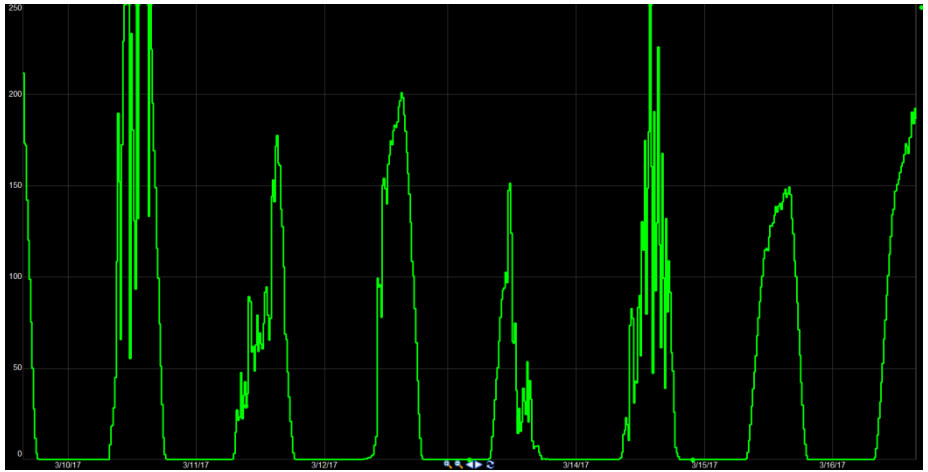
Problem Statement

DUKE ENERGY®

Growth of Renewables

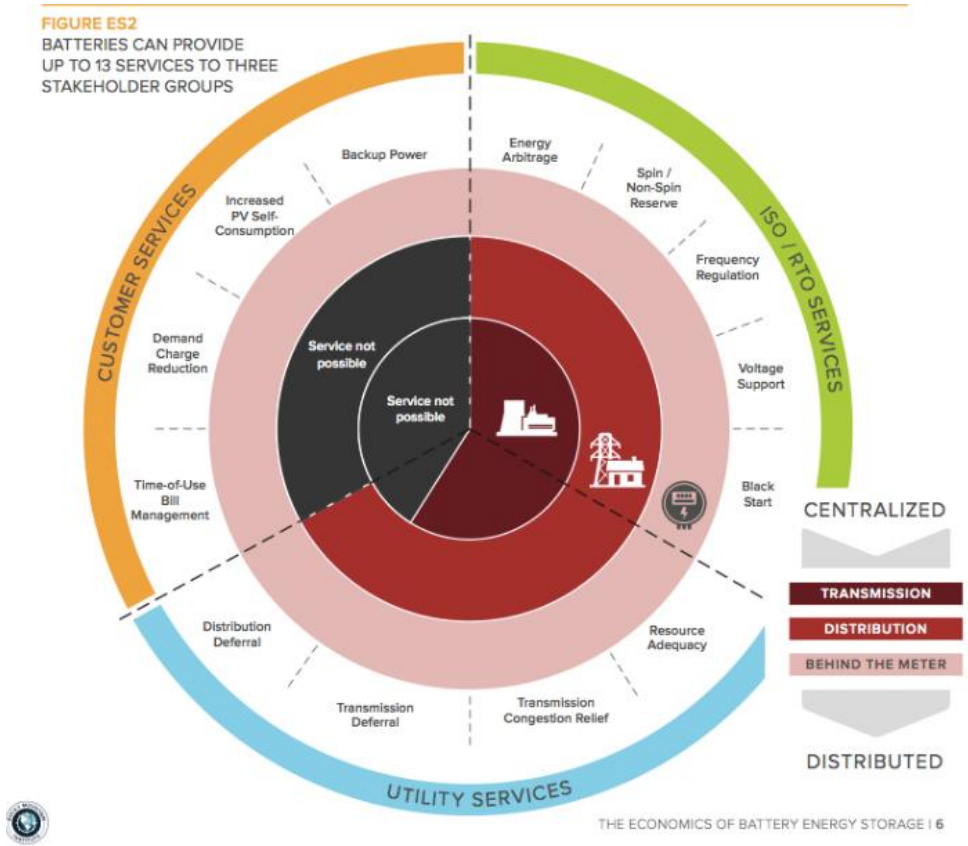


Source: Total electricity generation from World Energy Outlook 2016, forthcoming.

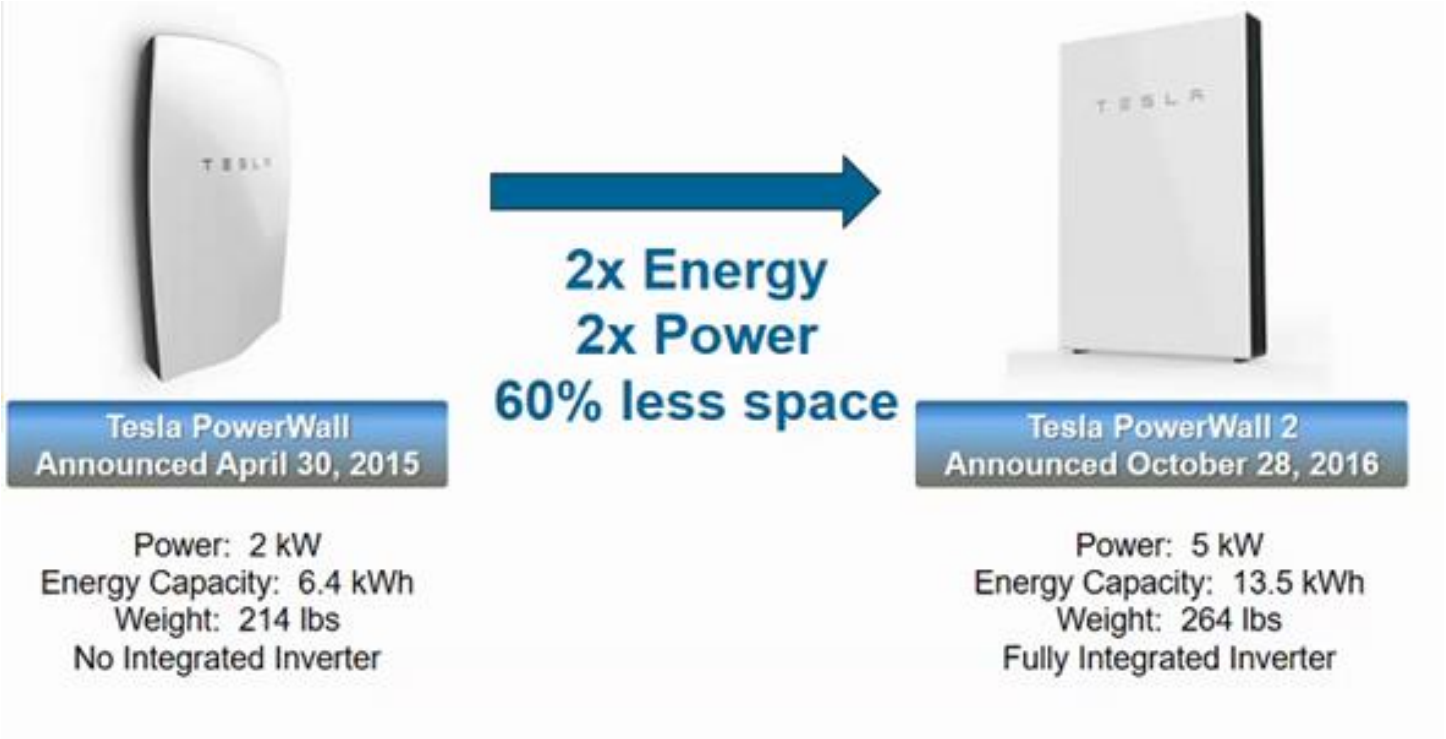


Current State of Energy Storage

- Technical Challenges
  - Reliability
  - Efficiency
  - Performance
- Economic Challenges
  - Project Cost
  - Optimizing of Stacked Benefits
- Regulatory Challenges
  - ISO Markets
  - Valuation of Multiple Benefits



Energy Storage Viability



Source: EPRI

Duke's Experience with Energy Storage

36 MW / 24 MWh
Lithium Ion - West Texas

300 kW / 307 kWh
Ultra Caps/Aquious Hybrid Ion - Mt. Holly, NC

75 kW / 42 kWh
Lithium Titanate - Indianapolis, IN (Carmel)

250 kW / 750 kWh
Lithium Polymer - Charlotte, NC

25 kW / 25 kWh
Lithium Ion - Charlotte, NC

200 kW / 500 kWh
Lithium Iron Phosphate - Charlotte, NC

2 MW / 725 kWh Lithium Titanate
2 MW / 800 kWh Lithium Ion
Beckjord Station – New Richmond, OH

USF Tesla
System
200 kW Li Ion

Problem Statement

- Given a Duke Energy circuit, find the optimal location for a 1 MW/2 MWh energy storage system and a 2 MW solar facility
- Value streams may include:
  - Line loss reduction
  - Reduction in regulator tap operations
  - Voltage profile improvement
  - Equipment upgrade deferral
  - Solar hosting capacity increase
- Energy Storage applications may include:
  - Solar smoothing/firming
  - Peak load shaving
  - Voltage Support
  - Energy Arbitrage

Deliverables

- Spring Semester
  - Research and choose energy storage applications
  - Model Duke Energy distribution circuit and create baseline power flow
  - Review energy storage technologies and select optimal storage for price/performance
  - Add solar and selected energy storage to the distribution circuit model
  - Apply energy storage application to the circuit simulation
- Fall Semester
  - Evaluate economic performance of energy storage application at initial location
  - Optimize location of the energy storage along the distribution circuit
  - Evaluate economic impact of the energy storage system, using the power flow baseline as a comparison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