

Distributed Energy Technologies at Duke Energy

Adam Nygaard, October 19, 2018

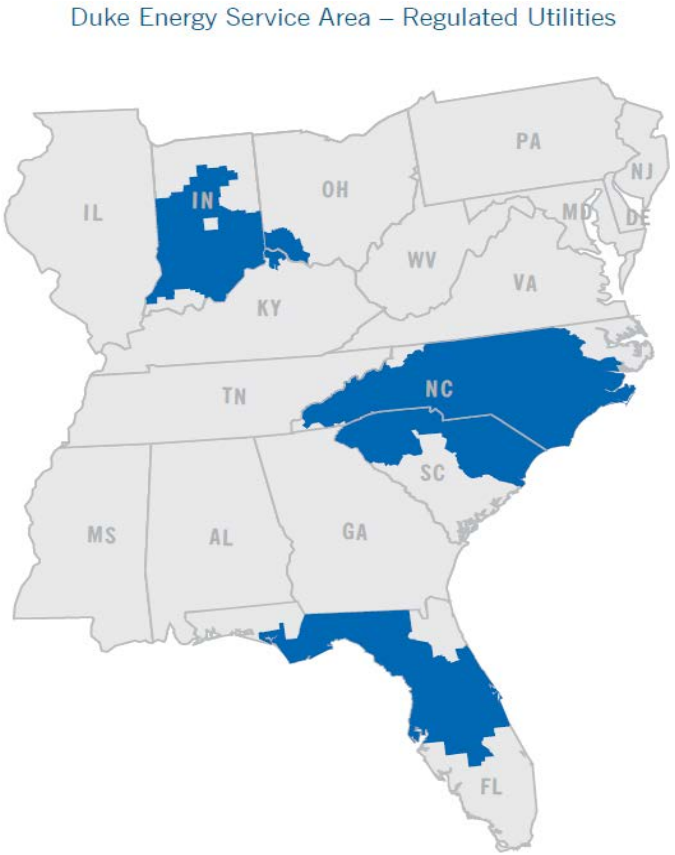
Who is Duke Energy?

Regulated Footprint:

- 114 Years in Service
- 7.6 Million electric customers in 6 states
- 1.6 Million natural gas customers
- ~50 GW of generating capacity

Duke Energy Florida:

- 1.8 Million electric customers
- Almost 10,000 MW of generating capacity



Expanding Storage Across Our Regulated Footprint

Duke Energy Indiana:

- 10 MW approved
  - Nabb and Camp Atterbury Projects

Duke Energy Ohio:

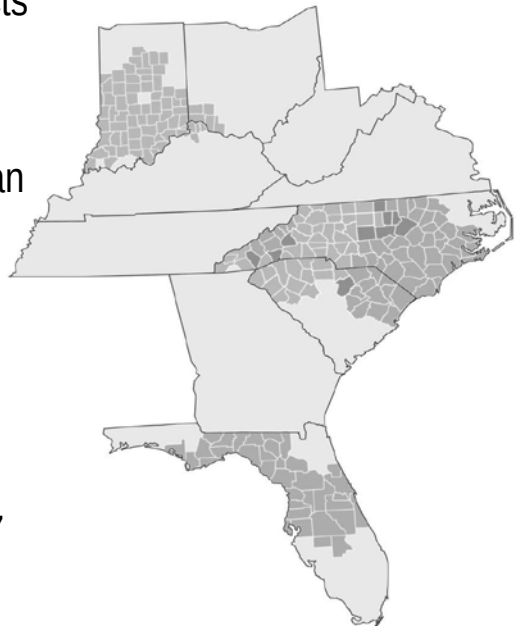
- 10 MW pilot filed in Electric Security Plan

Duke Energy Kentucky:

- 2 MW annually per 2018 IRP

Duke Energy Florida

- 50 MW pilot approved by FPSC in 2017



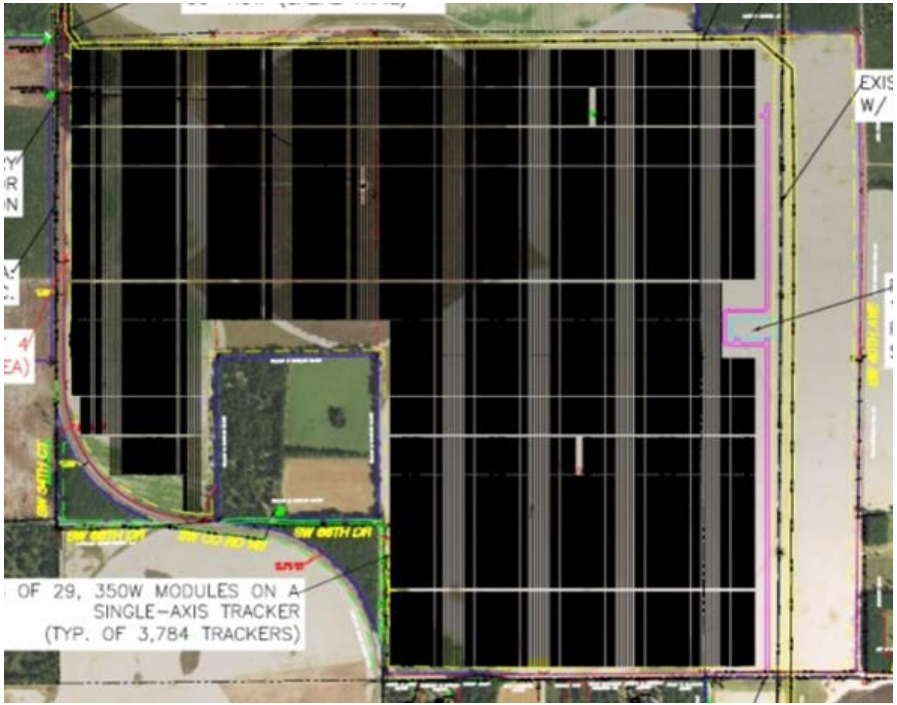
Duke Energy Carolinas/Duke Energy Progress:

- ~300MW in the Carolinas IRP

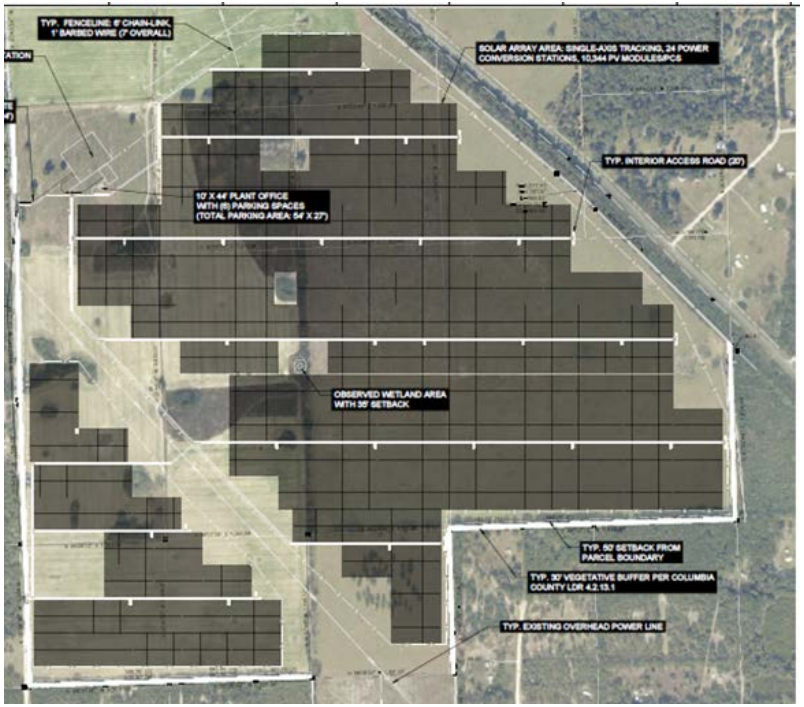
Announced to Date:

- 95 kWh Mt. Sterling Microgrid (commissioned in 2017)
  - 4 MW Hot Springs
  - 9 MW Rock Hill

Solar Update: 150 MW of 700 MW Announced

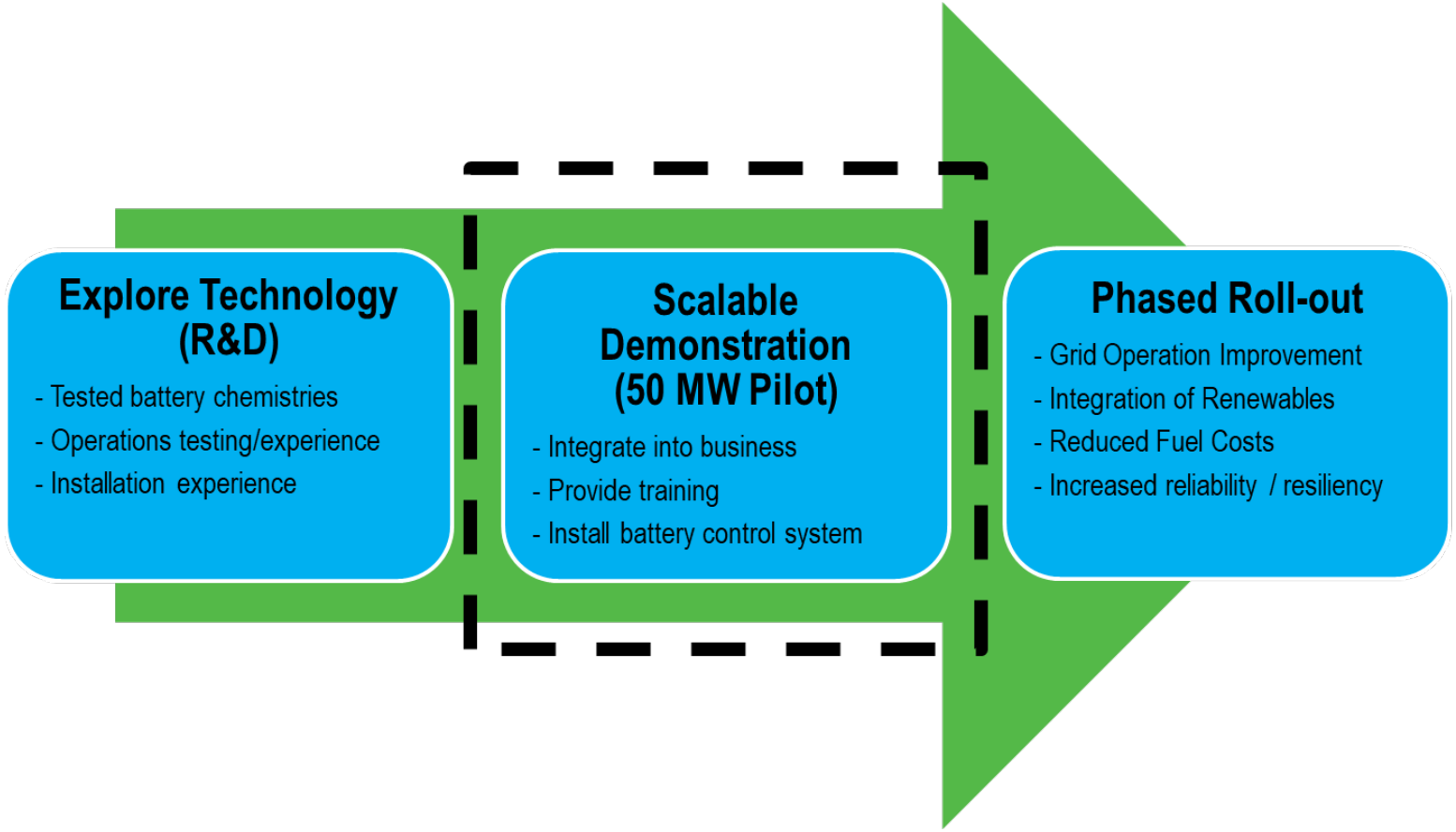


74.9 MW Hamilton Solar

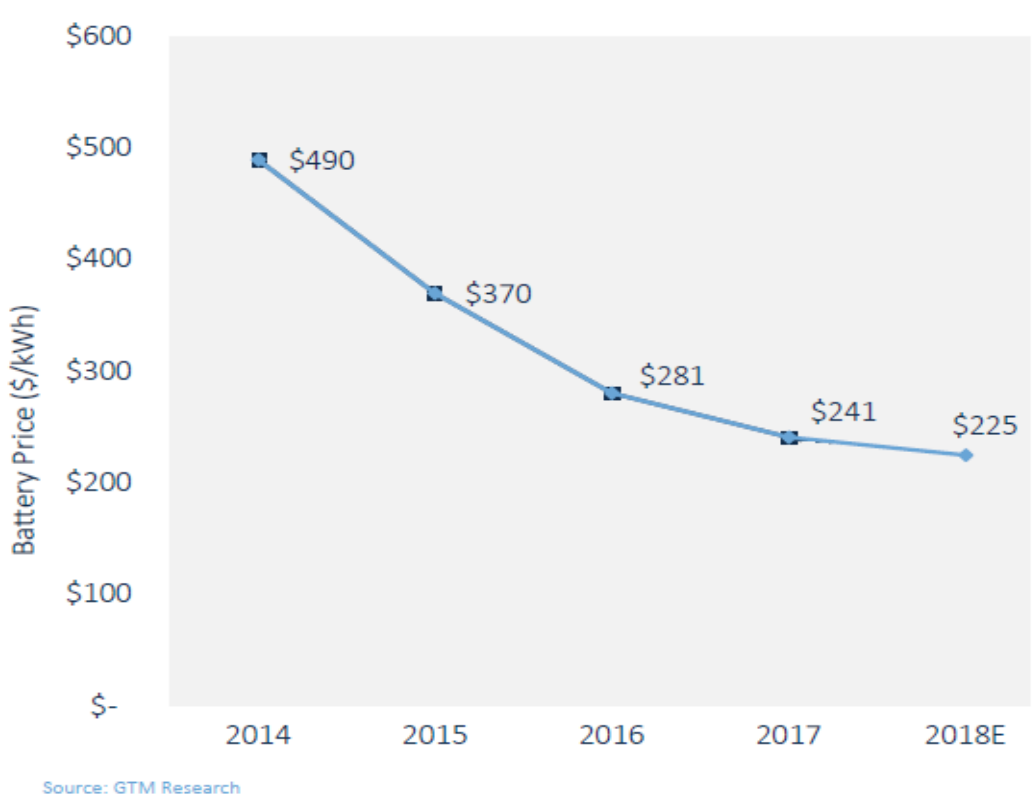


74.9 MW Columbia Solar

Energy Storage Update: Deploying 50 MW by 2021



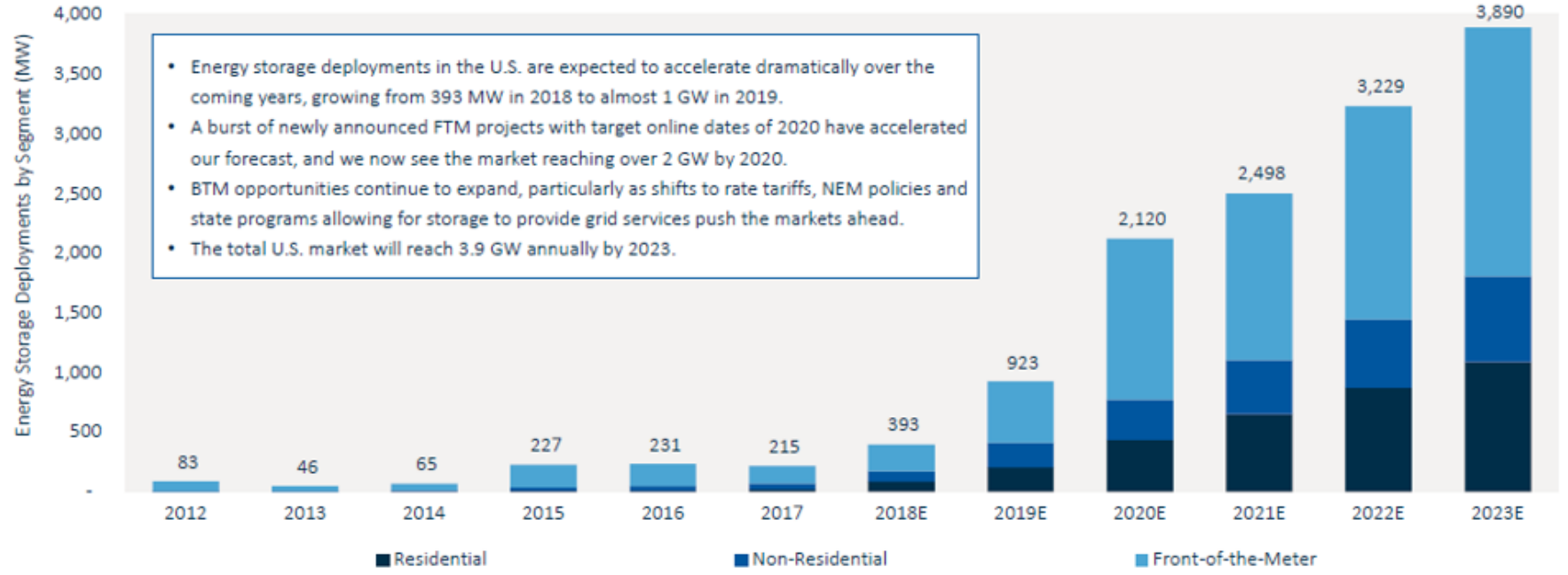
Energy Storage Market Overview



Source: GTM Research

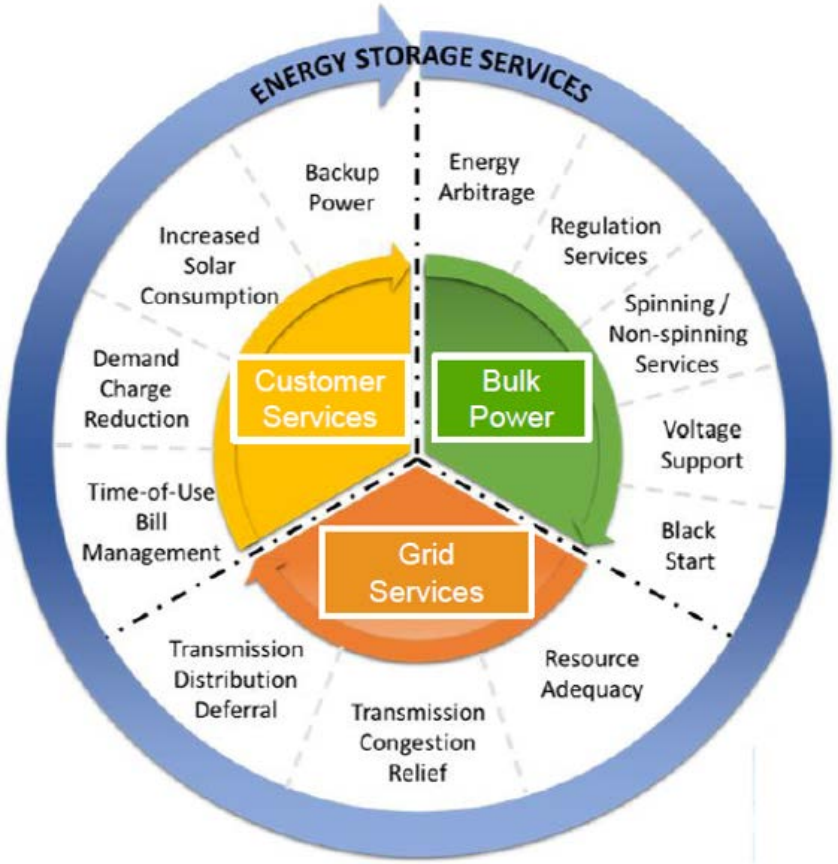
Energy Storage Market Overview

U.S. Annual Energy Storage Deployment Forecast, 2012-2023E (MW)



Source: GTM Research

Energy Storage Uses

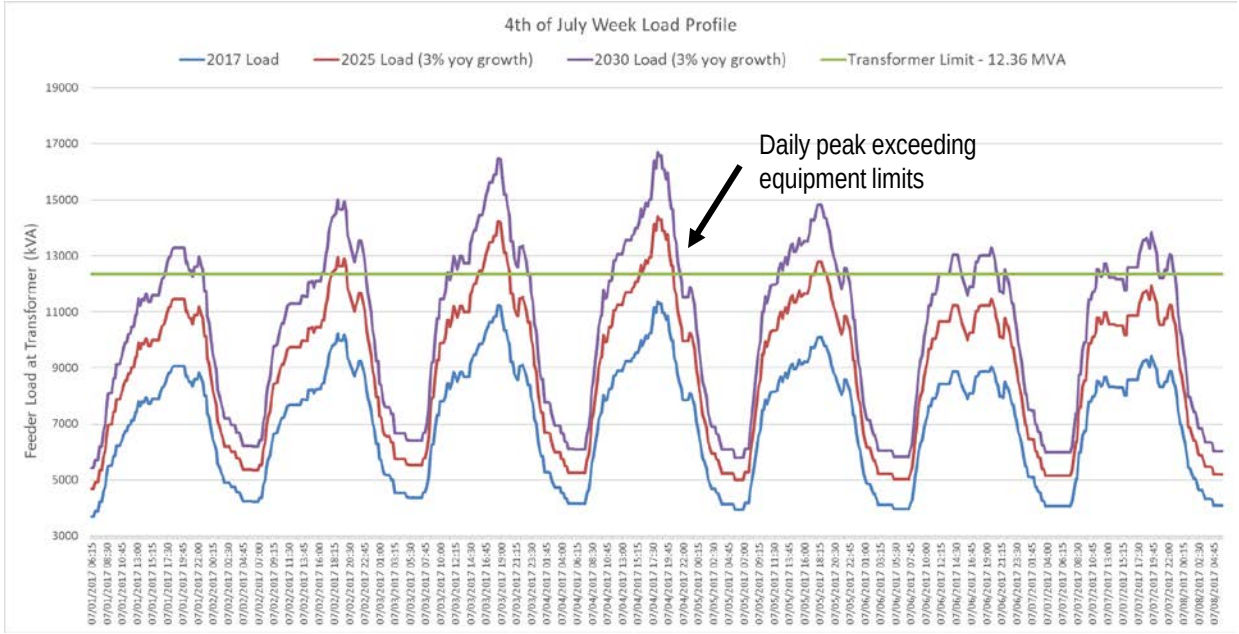


Primary Drivers:

1) T&D Elimination
2) Solar + Storage
3) Critical Facility Back Up

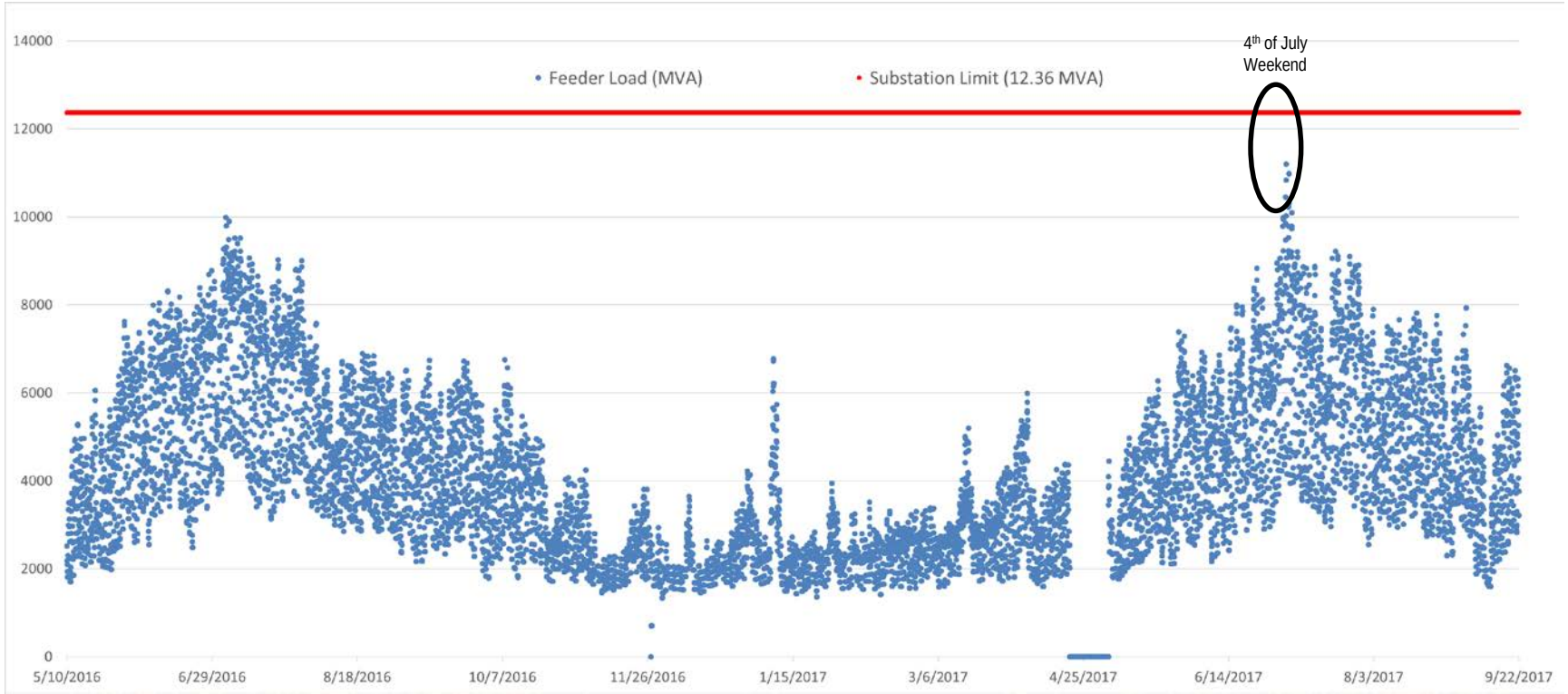
Use Case #1: Distribution Investment Deferral/Elimination

Problem: A radial feeder is experiencing very sharp load growth during the July 4th weekend. The peak load is approaching the substation transformer operational limit. Instead of upgrading the substation and feeder, energy storage can be used to serve the peak load. Storage remains useful for other services the remainder of the year, where the upgrades would not be providing value.



Use Case #1: Distribution Investment Deferral/Elimination

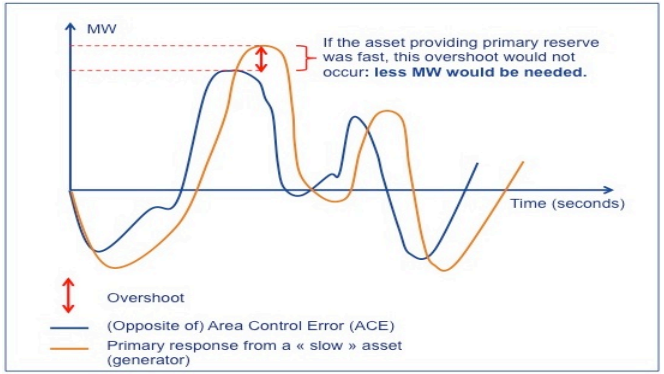
Annual view – Energy Storage can be used to serve other functions the remainder of they year.

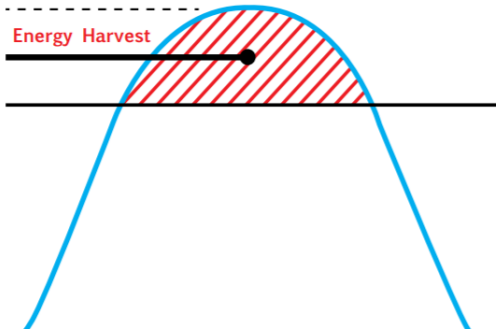


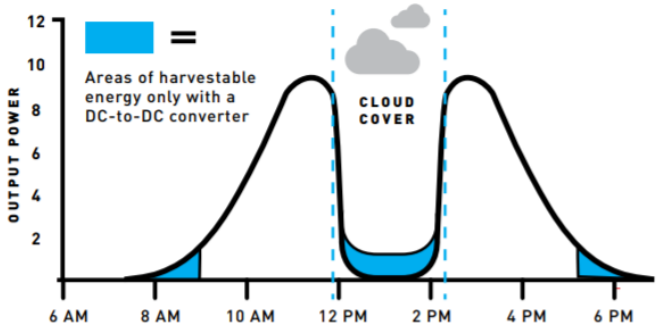
Use Case #2: Storage tied to Solar

Adding storage to solar can offer many benefits:

- Intermittency - Batteries can offer fast-acting response to deal with fluctuations in solar output which can cause issues with frequency to our system
- Ramp Rate – As solar production drops off towards the end of the day, fast ramping resources are needed to meet system load
- Energy Shifting – Energy storage can be used to shift energy production from intermittent resources such as solar to peak times (preventing future solar curtailment)
- Increase PV Capacity – Energy storage can be used to capture solar PV energy that is clipped by inverters due to local interconnection limits. This allows utilities to increase the amount of solar PV that would otherwise be sent to the grid.

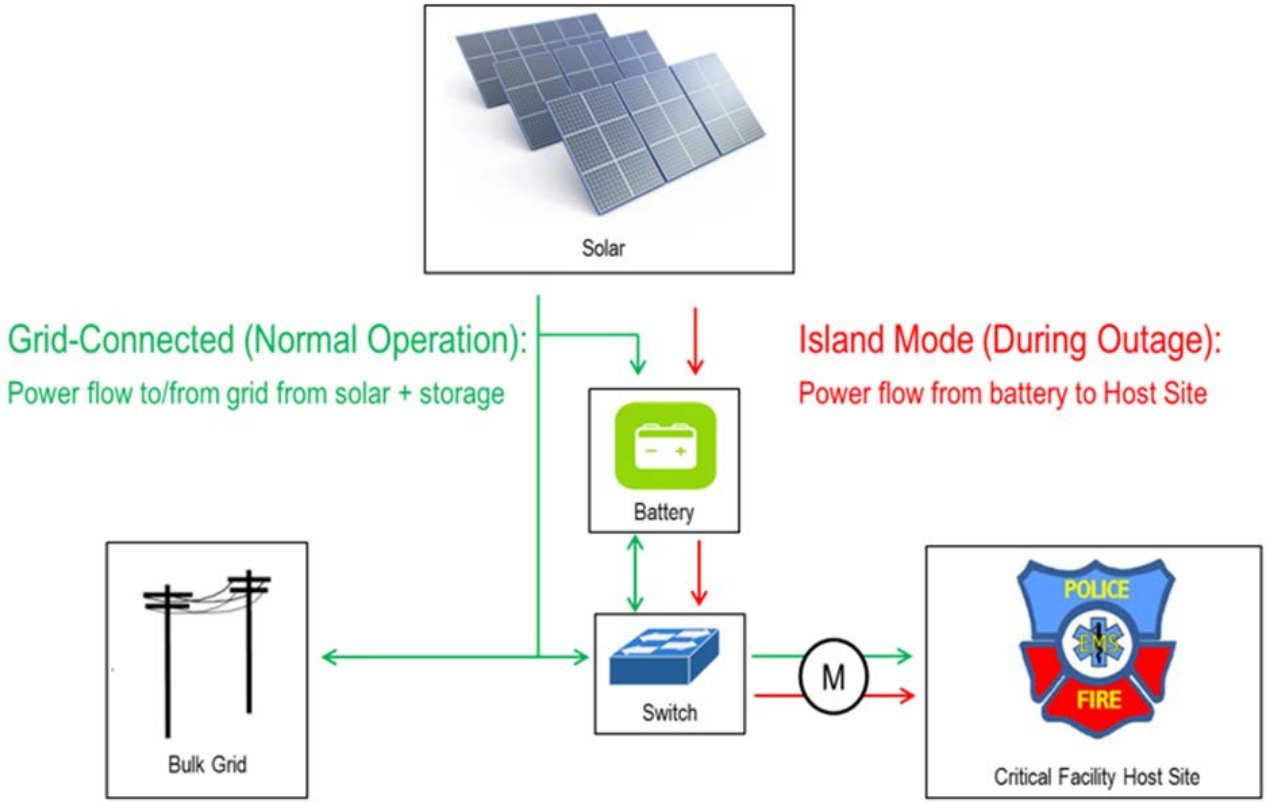






Courtesy: DYNAPOWER

Use Case #3: Critical Facility Backup Power



Short Video featuring McAlpine Storage Project

https://illumination.duke-energy.com/articles/building-a-smarter-energy-grid

Energy Storage Summary

- Energy Storage is fast reaching the tipping point for adoption
- As battery costs continue to decrease, valuable use cases will increase
- Business cases will be developed with stacked benefits across T, D and G
  - Continued focus around strengthening our planning tools and processes will ensure storage values are capture appropriately across T, D and G
- Duke Energy is preparing, as the FL grid operator, to use energy storage in many functions to maximize value to FL customers

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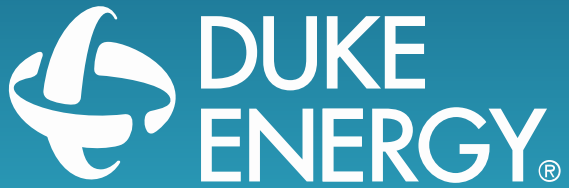
ENGAGE
STAKEHOLDERS

GENERATE
CLEANER ENERGY

MODERNIZE THE
ENERGY GRID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