"Distributed Bulk" Storage!

The Future of Batteries in Grid Applications

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Where are We Coming from? - Challenges

- Utilities had no energy storage choice but pump-hydros
- It would take almost a decade to decide investing on one
- It would take about a decade to build one
- Too slow for area regulation and some other ancillary services
- Little backup value when T&D lines were severed
- Its down time had severe impact on grid operation

These challenges are still mostly valid with today's central storage options

Why is Energy Storage Moving to the Gird Edge ?

1. Commercial Drivers

- End User Incentives
- Vendor Incentives
- Synergy with Smartgrids
- Other Factors

2. Higher Incentives for Government Funding

- Issues of National Interest

What is Driving Storage to the Grid Edge?

End User Incentives:

- Easier to get management approval to start a project
- Compatible with Smart Grid initiatives
- Closer to distributed generation (renewable)
- Buffering EV charging impacts on Distribution circuits
- Improved service reliability (backup power closer to customers)
- Speed & ease of “plug-n-play” deployment
- Geological and Permitting Challenges (none or little)
- Down time of unit is a lesser concern (low maintenance)

What is Driving Storage to the Grid Edge?

Vendor Incentives:

- Much easier to sell to a new user (easier project approval)
- More cost competitive (mostly factory-assembled)
- Synergy with electric transportation batteries (lower cost)
- Easier maintenance (or replacement)

What is Driving Storage to the Grid Edge?

Synergy with Smartgrids:

- Smartgrid has passed the disillusionment stage & is happening
- Hierarchy of communication & control is being established
- It has inherent synergy with distributed resources
- Distributed storage fits smartgrid and enhances it

What is Driving Storage to the Grid Edge?

Other Factors:

- MARKET - Rapid growth of renewables at customer sites
- REGULATORY – FERC (order 745) is allowing participation of distributed resources (storage) in ancillary services
- TECHNOLOGY

  Emergence of aggregated “Distributed Inverters”

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Government Incentives for Funding

Distributed Storage is closer to issues of National Interest:

- Through enabling Renewables & EV:
  - Less Fossil Fuel
  - Less Oil Import
  - Cleaner Environment
- Through enhancing the Grid / Smartgrid
  - Efficiency
  - Reliability
  - Stability
  - Security

Would Central Storage still Make Sense ?

- **YES for Pumped Hydro and CAES type units**
  - Still the lowest cost storage devices
  - Still **the best option** over 100MW, 1000MWh

- **No for Electrochemical Batteries**
  - Battery cells are small & stacking has many challenges
  - There is a ***better option*** for batteries

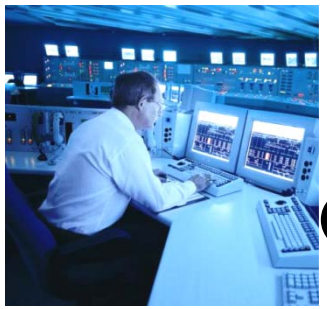
"Distributed Bulk" Storage !

Aggregation of Distributed Storage Units

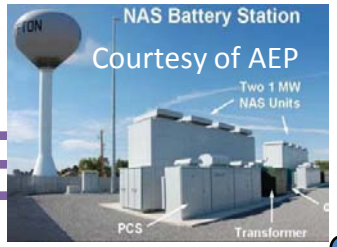
- **Realizing Distributed *Benefits***
- **Exercising Central *Control***

Where are We Going To ? – More Values

"Distributed Bulk" Storage



Central Dispatch
1000's MW

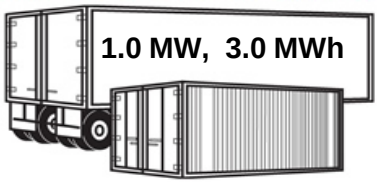


10's MW

MW

kW

Smart Grid Infrastructure



Questions?

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