Interconnection Working Group

National Grid New England Energy Storage Schedules

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New England

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New England

Top States for Solar per Sq-Mi

Rank	State
1	*Rhode Island*
2	New Jersey
3	*Massachusetts*
4	Connecticut
5	California

Connections

	CY22	CY21
State	Capacity (MW)	Capacity (MW)
MA	231.38	241.82
RI	73.18	105.42
Total	**304.56**	**347.23**

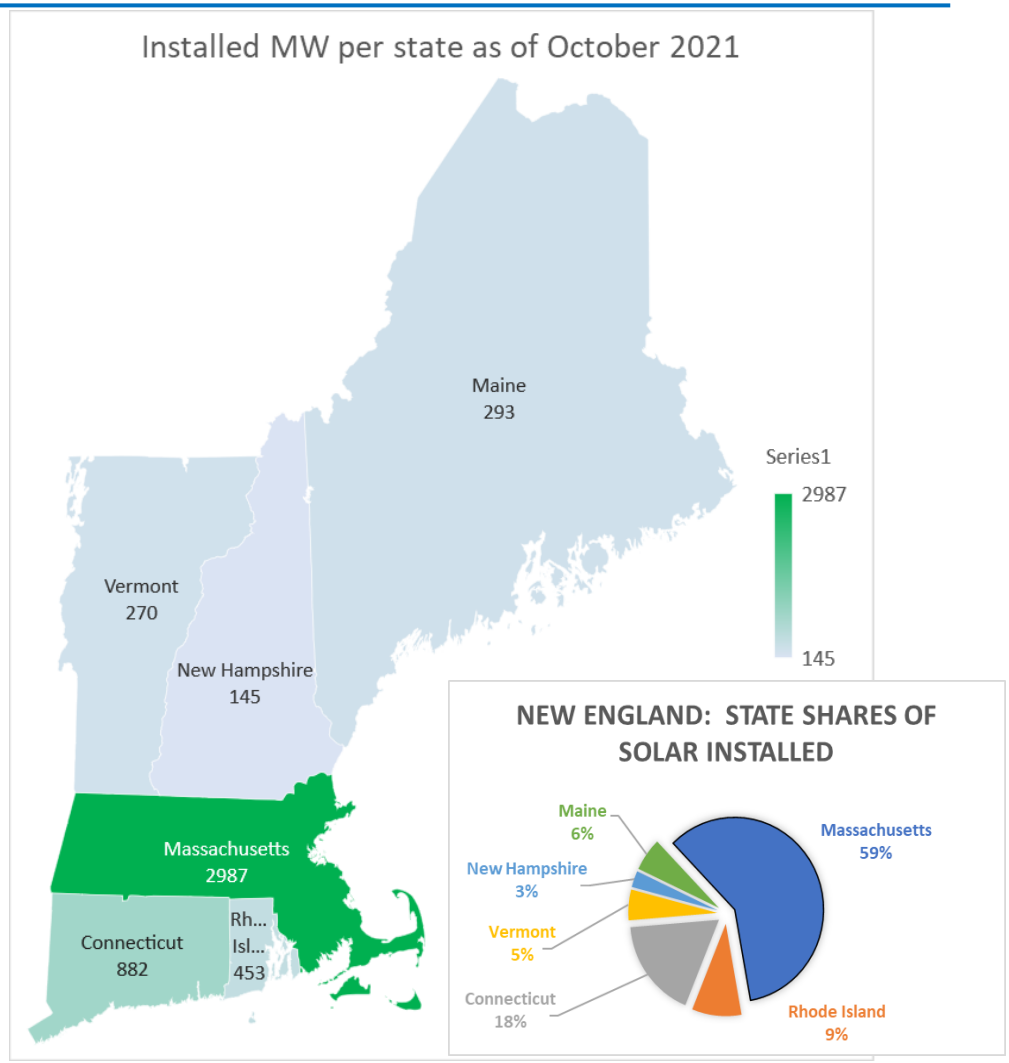
Total Solar Installations between 2010 and Q2-2020

Residential

Rank	Utlity	MWdc
1	PGE	*2,530*
2	SCE	*1,861*
3	SDGE	*1,028*
4	APS	*869*
5	PSEG	*750*
6	Duke	*500*
7	*National Grid*	*482*
8	Southern Nevada	*380*
9	Xcel Energy	*372*
10	Eversource	*358*

Non-Residential

Rank	Total Non-residential Solar PV Installed by Utility Territory	MWdc
1	PGE	*1,763*
2	*National Grid*	*1581*
3	Xcel Energy	*1,132*
4	SCE	*934*
5	Eversource	*831*
6	PSEG	*650*
7	JCP&L	*480*
8	SDGE	*322*
9	APS	*291*
10	New York State Electric and Gas	*253*



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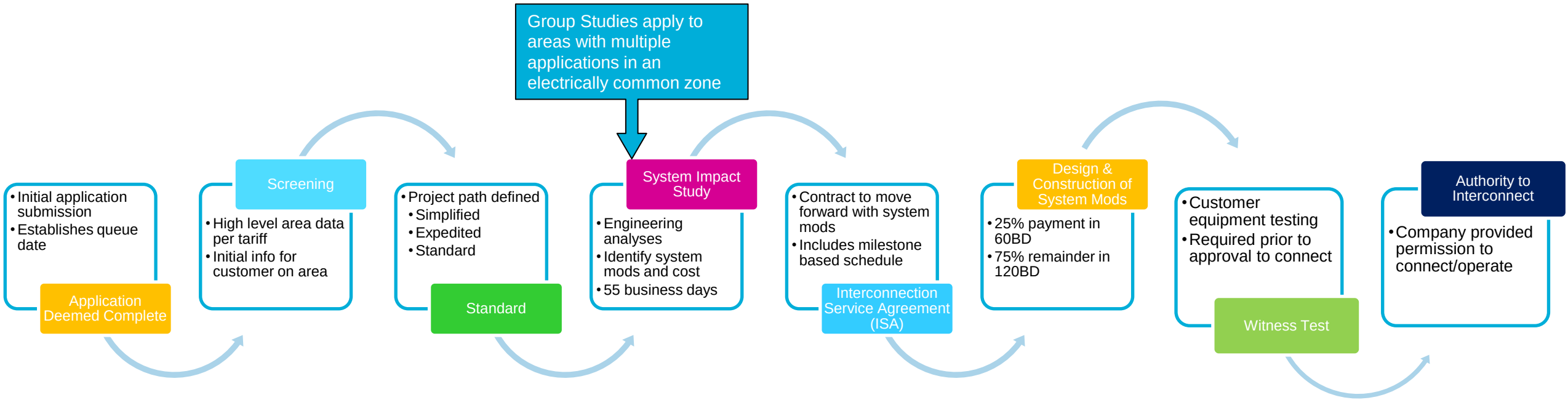
State data from US Energy Information Administration and US Census Bureau

Massachusetts: *DG Process Overview per MDPU 1468*



Study Costs

- *MA avg study cost 2021 = $20,500*
  - *Does not include ASO or Group Study fees*
- *Tariff permitted 55BD*

Energy Storage Systems

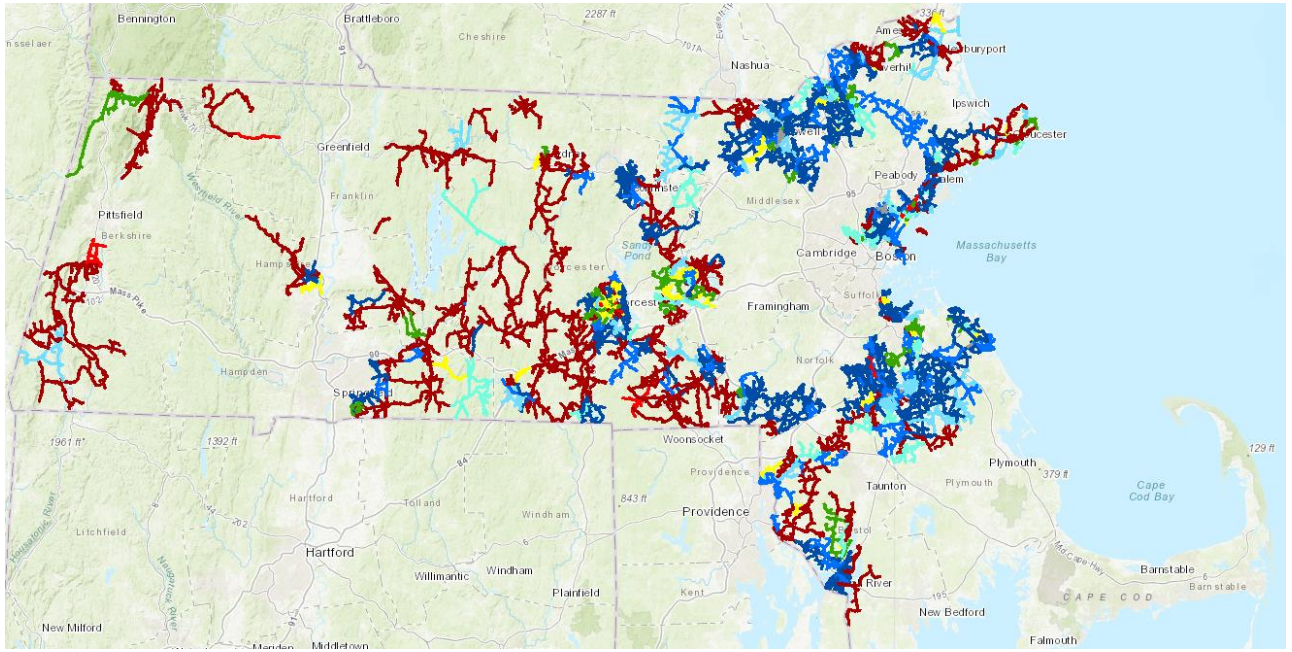
Different from other DER:

- *Increased capability for dispatch/control as compared to other DG*
- *Ability to range from a load asset to a distribution asset*
- *Presents unique challenges to operational and planning activities*

Challenges:

- *Capacity reservation: National Grid must be prepared for worst-case system conditions, preparing for ESS to act as full-load or full-generation at any time*
  - *Day-to-Day Operation: Can limit Control Center flexibility in system switching for restoration efforts or planned outages*
  - *Planning: Similar limitations for area reconfiguration opportunities, leading more quickly to infrastructure investment*

Massachusetts Online Hosting Capacity Map

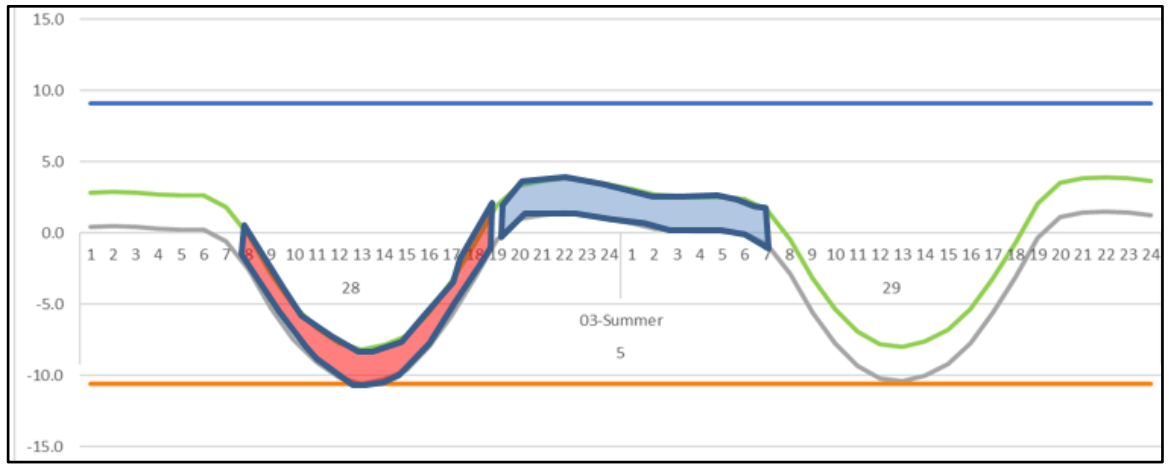


~300MW in Group Studies

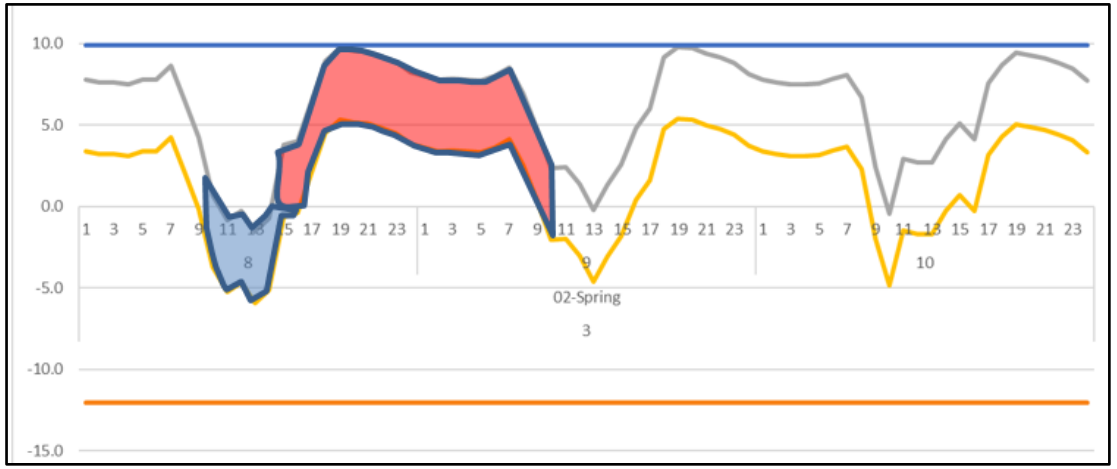
~190MW of which are stand alone ESS

Capacity Reservation: *"Filling Up" Feeders*

ESS as Generation (Discharge Scenario)



ESS as Load (Charge Scenario)



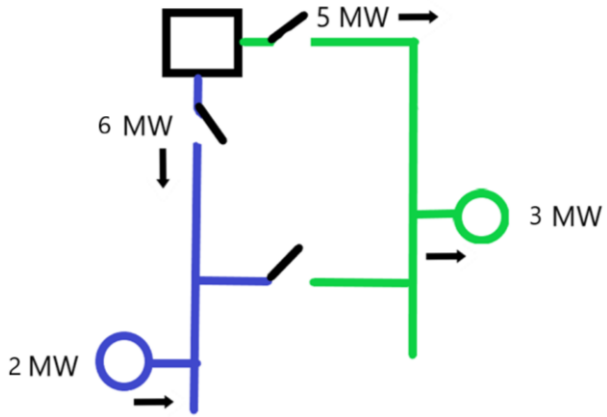
Values

- Load + ESS
- Fdr Fwd Limit
- Fdr Rev Limit
- Load

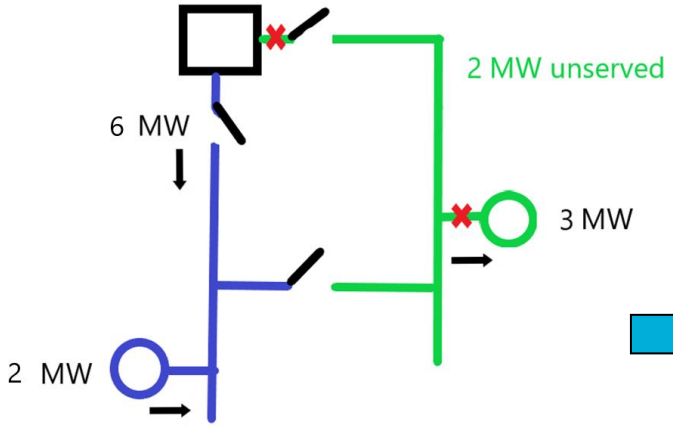
Effects:

- *Long term → Planning – Available feeder and substation capacity reduced, more quickly leading to need for infrastructure investment*
  - *Affects DG customers directly through cost obligation from Impact Studies*
  - *Affects all customers through long term planning*
- *Day to Day → Control Center – Available capacity for switching*

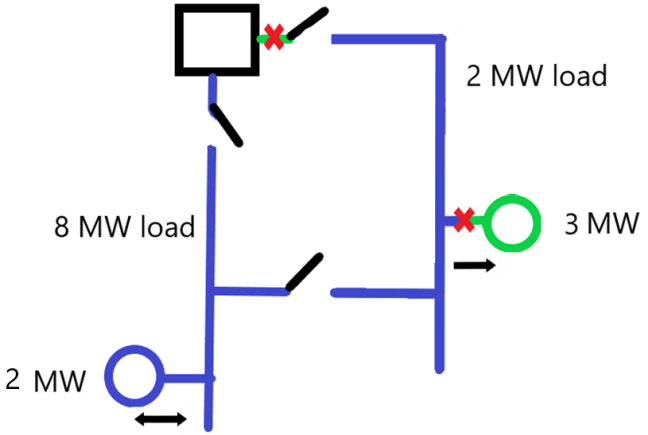
Capacity Reservation: *Switching Example*



- **Both feeders rated for 10 MW**
- **Purple feeder: 6 MW net**
  - 2 MW offset by discharging battery
  - 8 MW of load
- **Green feeder: 5 MW net**
  - 3 MW of charging battery
  - 2 MW of load



- **Purple feeder: 6 MW net**
  - 2 MW offset by discharging battery
  - 8 MW of load
- **Green feeder out of service: 2 MW unserved**
  - 3 MW battery is offline



- **Purple feeder picks up Green feeder:**
  - 2 (Green Fdr) + 8 (Purple Fdr) = 10 MW load
  - 2 MW of battery that could:
    - Continue discharging (feeder load is 8 MW)
    - Stop doing anything (feeder load is 10 MW)
    - Start charging (**feeder load is 12 MW**)

- *Near term → Control Center – Day to day switching and operational flexibility can be limited*
- *Long term → Planning – Available feeder and substation capacity reduced, more quickly leading to need for infrastructure investment*
  - *Affects DG customers directly through cost obligation from Impact Studies*
  - *Affects all customers through long term planning*

Schedule

24-Hour Schedule

- *Predictability and certainty in load/generation behavior*
- *Generally aligning to have ESS act as "reducer"*
- *Slows "feeder filling" challenges – degree of relief on planning and day-to-day system management*
- *More efficient use of available system capacity – overall enabling more projects (qty and MW) online*
- *Curtailment analysis to identify the threshold level at which thermal impacts require system modifications*

National Grid Charge/Discharge Windows

	Charge Window	Discharge Window
Spring	11PM-5PM	5PM-11PM
Summer	11PM-3PM	3PM-11PM
Fall	11PM-4PM	4PM-11PM
Winter	11PM-3PM	3PM-11PM

Pros

- *More manageable integration*
- *More efficient use of available capacity*
- *Slower to large infrastructure upgrades*

Cons

- *Reduced opportunity for ROI from various markets*
- *ISA ability to adjust schedules in the future*

Study Considerations

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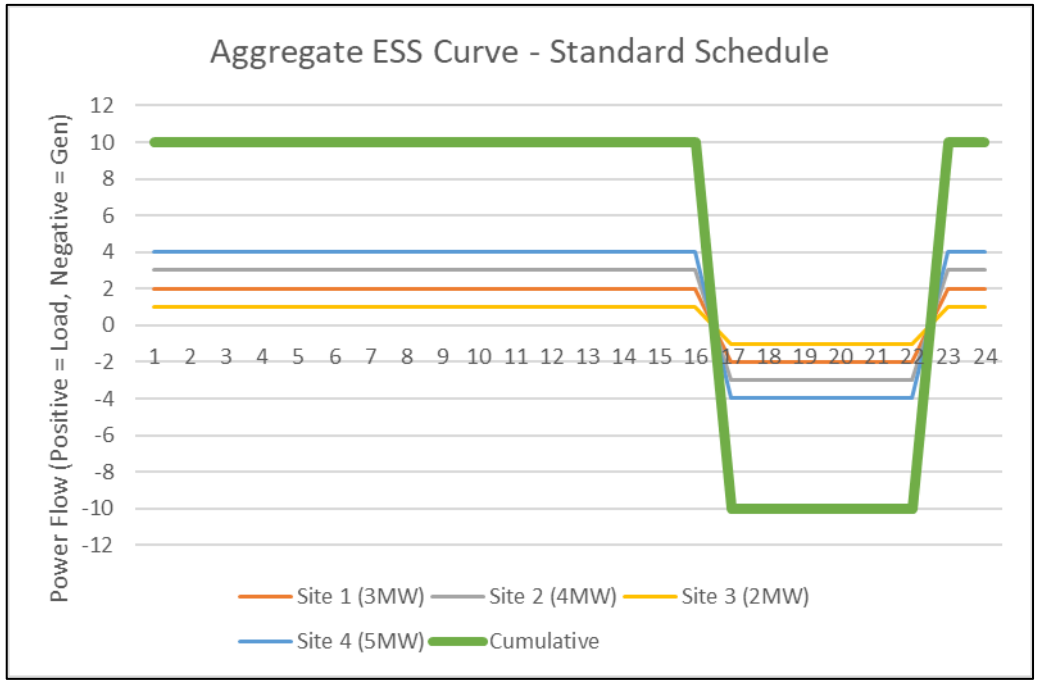

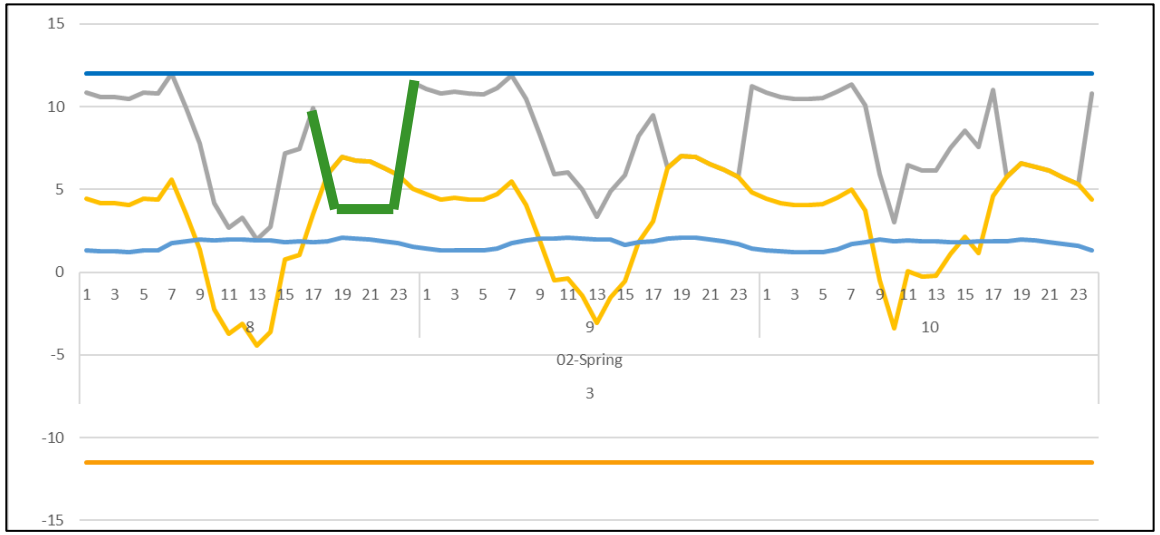

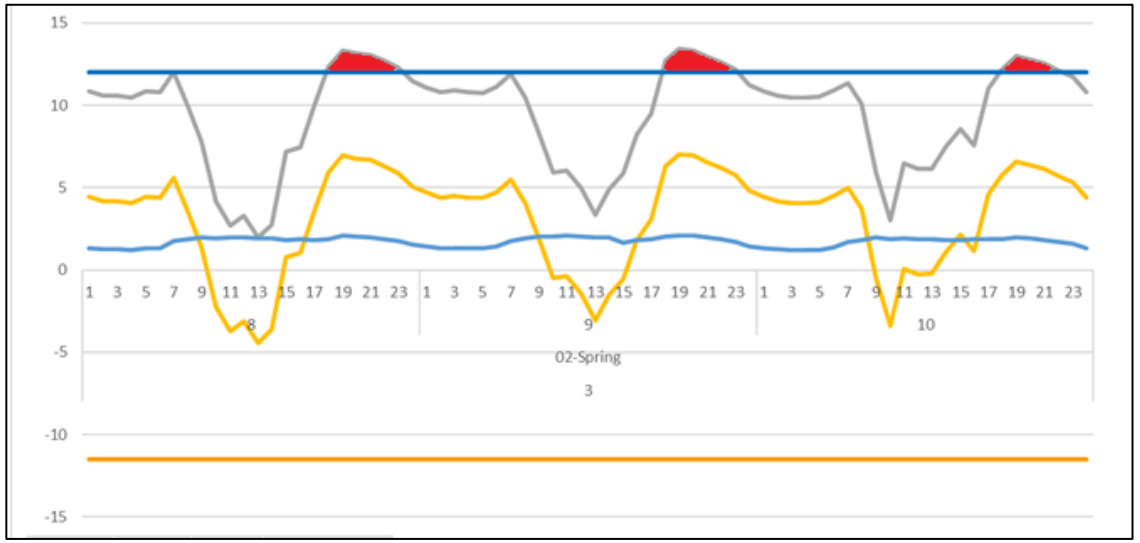

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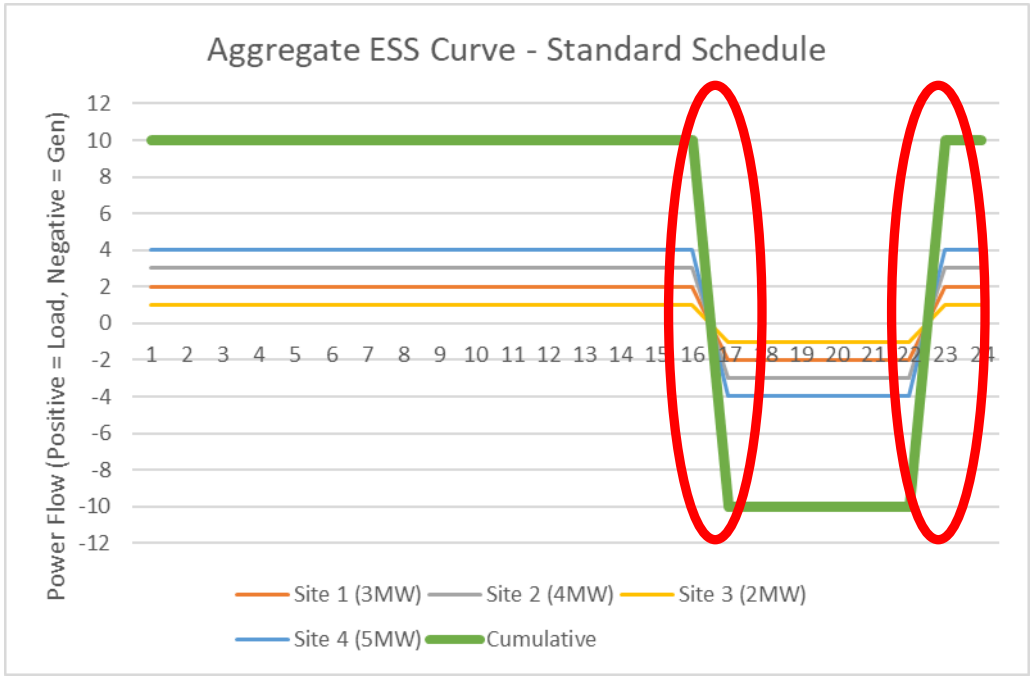

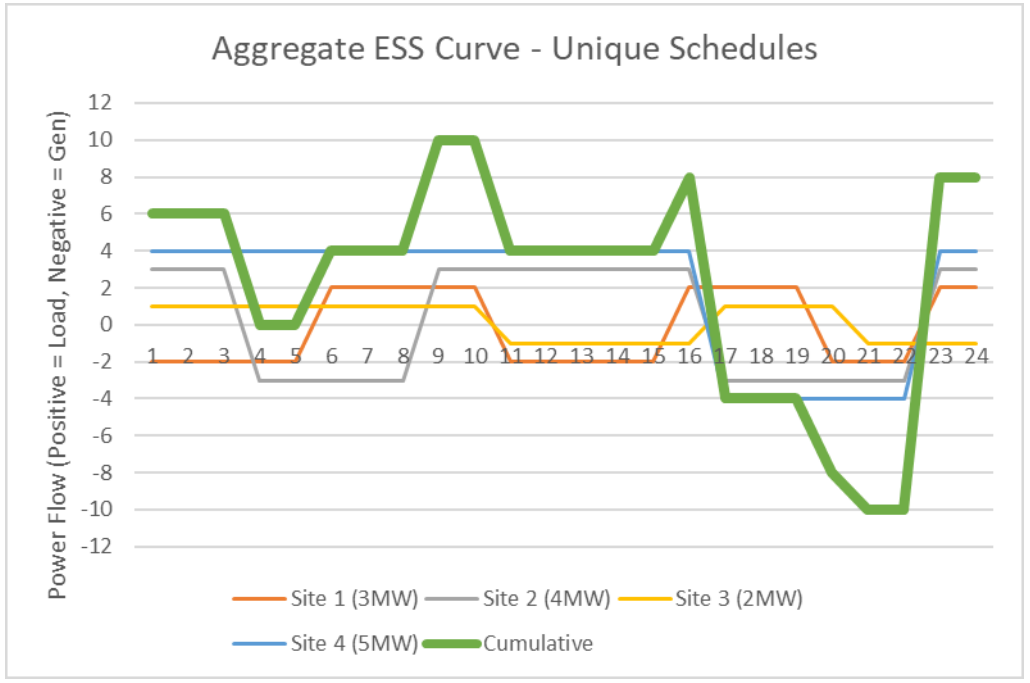

Final Thoughts

Pay to Upgrade

- Based on historic study results, we have seen projects unable to move forward with high system mod costs, which could be the case with unconstrained
- Studying unconstrained with high cost system mod results could reduce overall DG enablement

Contingency scenarios

- Unconstrained, due to unpredictability and need for swift action, customers can expect to be off for duration
- Similar for planned switching, possibility for affected customer to pay for study for alternatives
  - But alternatives may not be available depending on existing system conditions

Schedules Don't Eliminate Challenges

- Schedules enable efficient use of available capacity, enabling more projects per MW
- High penetrated areas will still see need for high scale infrastructure investment

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