Energy Storage: When and Where ?

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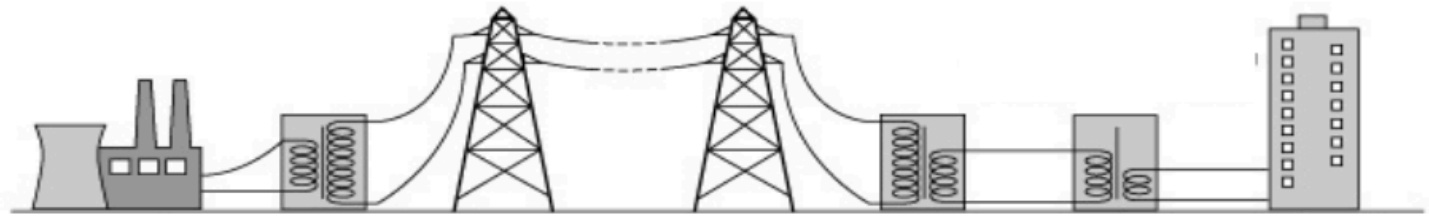
Market for energy storage ??

Lux Research, March 2012, LRSGI-R-11-1

Topics

- Location, Location, Location
- Why the PNW blows for storage
- Markets that value storage
- Storage and Examples

Location



Bulk storage

Substation storage

Distributed/demand-Side storage

Wholesale Arbitrage (S,D)
Peaking power
Frequency regulation
Ancillary Services
VER integration

Defer upgrades (PAC)
VAR Support
Distributed Resources

Peak reduction
Retail arbitrage
EV Car (20x value)
* Frequency regulation
* Ancillary Services

Alternatives to Storage- PNW

- FCRPS
- Natural Gas CTs $1,200/kW, dispatchable, ROE (PGE example)
- Dynamic Voltage Regulation

1. Improved wind forecasting
2. Intra-hour scheduling
3. Wind integration Self Supply Pilot >> buying hydro reserves
4. NW Power Pool Combined Reserve Task Force
5. 3rd party balancing reserves (reserves ~ nat gas opportunity cost)
6. WSPP Ancillary Service Schedule Filing
7. Energy Imbalance Market (EIM) CAISO-PacifiCorp
8. Dynamic Transfer Capabilities
9. Shut down 1,1150 MW Nuclear plant every spring
10. Demand Response/Energy Storage

* 1-10 from Wind Energy Task Force 6/6/11

more than batteries

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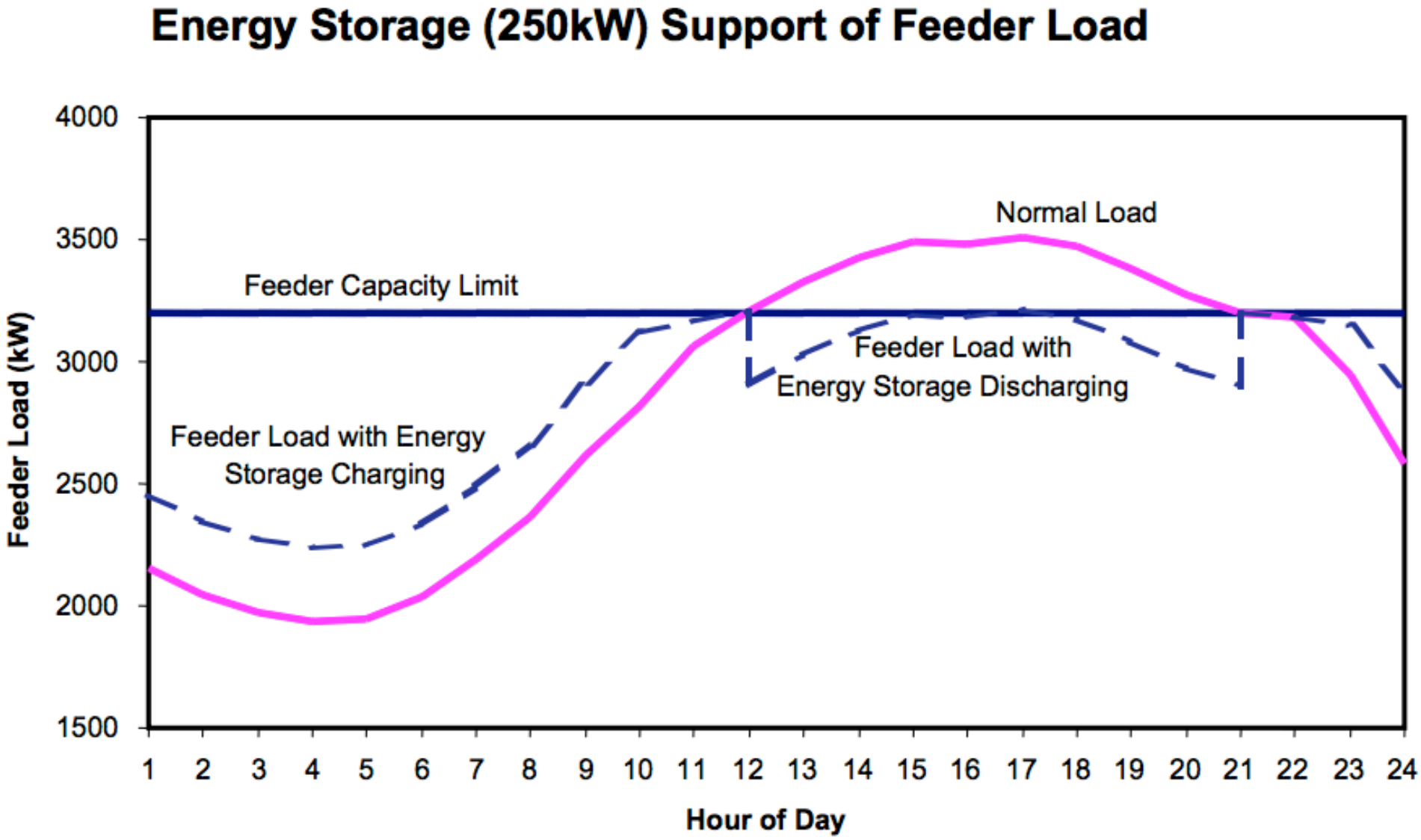
Method	Type of Storage	Value	Regional	$/kW	Notes
Fossil Fuels	Gas Combustion Turbine	S, D, H	PGE Port Westward	$1,200	
Gravity	Pumped Hydro	S, D, H	Banks Lake	$2,050	
	ARES (Rail)	S, D, H	SCE demo	$800	
Mechanical	CAES	S, D, H	PG&E demo		
Photosynthesis	Biomass	S	PGE Arundo		
End Use Thermal	Cold Storage or HVAC	D, P	Logix Controls, ICE	$200-$1200	
Gen Thermal	Turbine Inlet Chilling	D, P	TAS Energy	$450	VA, PA
	Molten Salt, with CSP	D	SolarReserve	$4,000	PG&E150 MW ppa
Chemical	Batteries (Li-Ion)	D, H	Snohomish, PGE		$, flammable
	Flow battery (VRB)	D, H	VRB Power (PAC)	$4,000	
	Flow Battery (all iron)	H	ESS		Early stage

***Notes**: S=Seasonal, D=Daily, H=Hourly, P=Peak only*

PacifiCorpTransmission Support



California 2020 load profile

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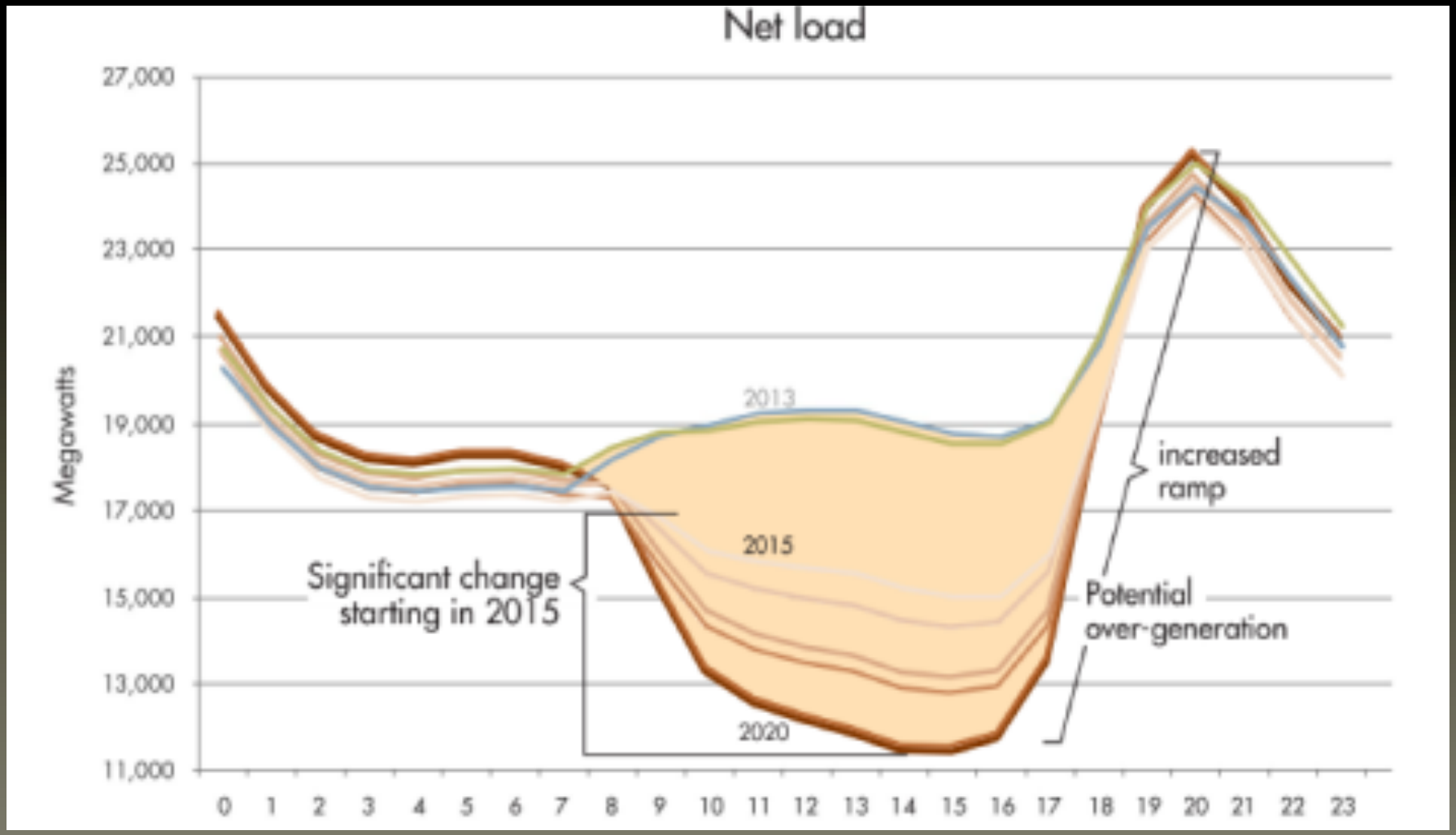

Questions

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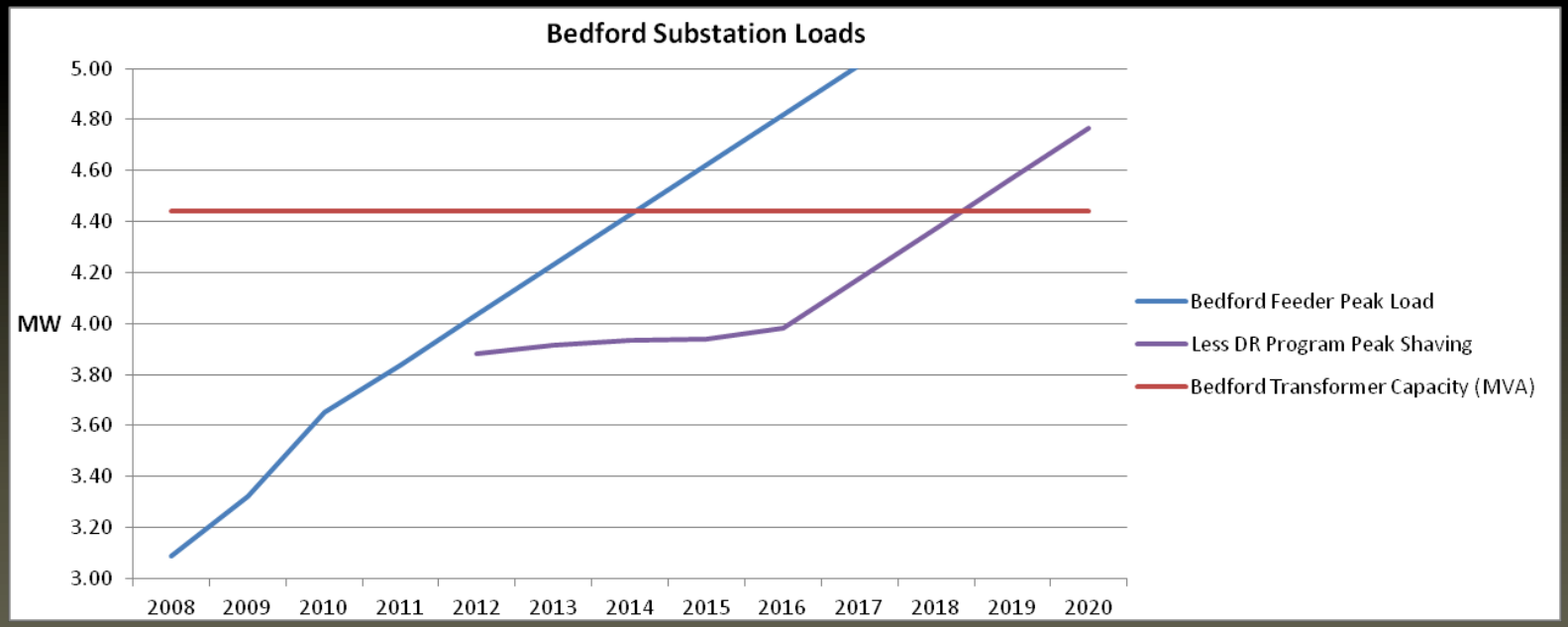
Defer T&D

- NPV of deferring purchase of transformer by 5 years is $135,000, even when DR program has negative NPV



- NPV Program = NPV Deferral + NPV DR costs&benefits
- $135,000 = $152,000 + (-$17,000)