Distributed Energy Resources in the Pacific Northwest

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Distribution Utility of the Future

Distribution utilities will no longer just supply electric energy to customers, but will plan for, coordinate, and manage the flow of electric energy to, from, and between customers.

Northwest Power Act

*Priority shall be given: first, to **conservation;** second, to **renewable resources;** third, to generating resources **utilizing waste heat or generating resources of high fuel conversion efficiency**; and fourth, to all other resources.*

"Electric power" means electric peaking capacity, or electric energy, or both.

"system cost" means an estimate of all direct costs of a measure or resource over its effective life, including, if applicable, the cost of distribution and transmission to the consumer and, among other factors, waste disposal
costs, end-of-cycle costs, and fuel costs (including projected increases), and such quantifiable environmental costs and benefits.

https://www.nwcouncil.org/reports/poweract/

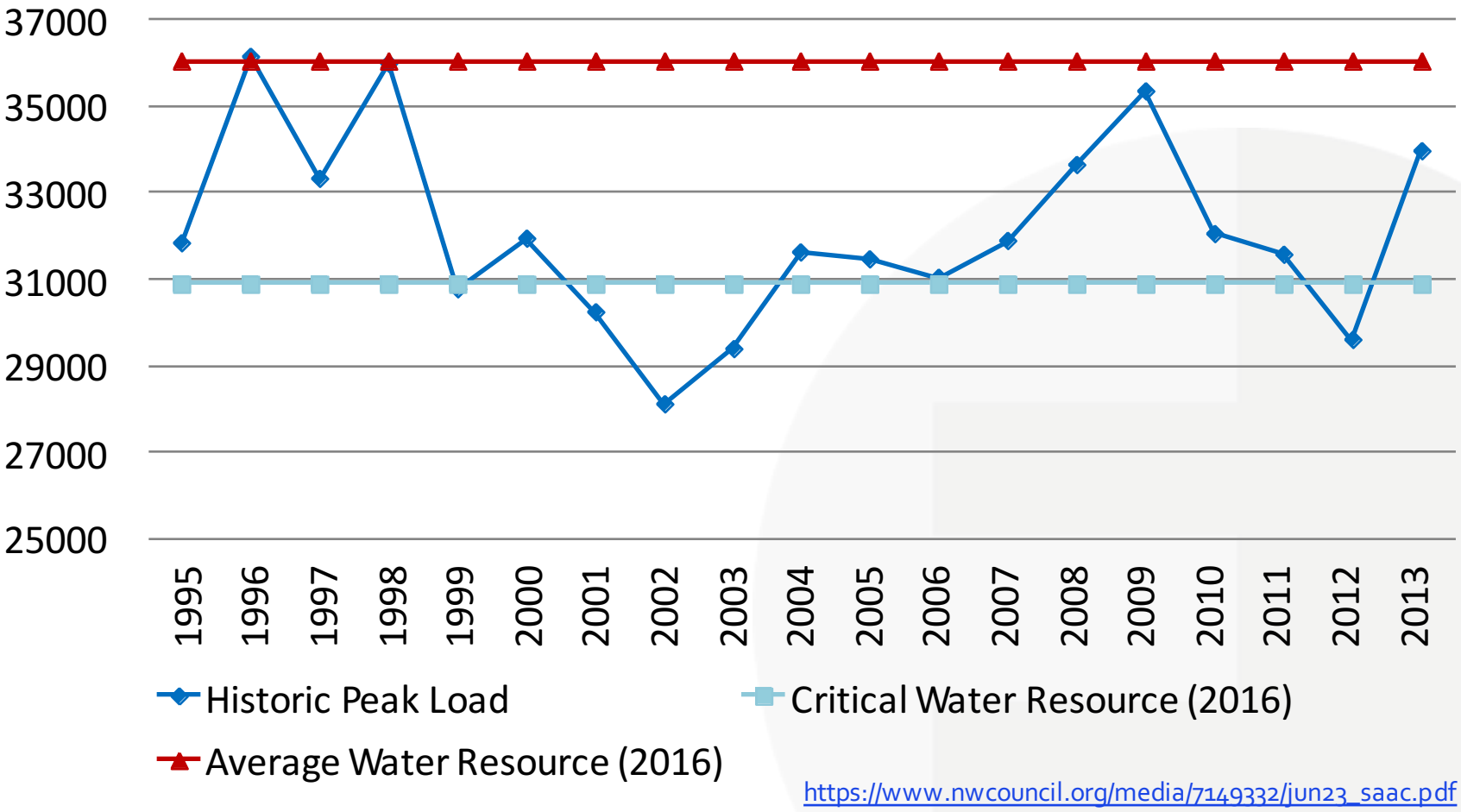
Steps Toward the Future

- Is Elon Musk the utility of the future?
  - Utility business models in transition
    Large Supply-Side Capex >>>> Grid Modernization, Reliability, IT
  - "Every feeder is a snowflake"
  - DER value: Location, Location, Location
    Battle: Utility Integration Cost vs. DER Value
  - Technology (trade allies and vendors) and Customers
    Utility Roadmaps: pilot>demo>scale
- Legislative actions that work
  - Value of solar DER >>> DRP
  - Distribution Resources Planning (CA AB327, WA 2045)
  - Rate Strategies (reflect Utility costs, customer preference)
  - Combined Heat and Power (WA E2SHB 1095, OR SB 844)
  - Support (Mandate) Standards (OpenADR, IEEE1547)
  - Demand Response follows Energy Efficiency (NPCC 7th Plan)

Capacity and Energy

Capacity (dispatchable)	Energy (variable)
Capacity DSM (aka Demand Response)	**Energy DSM (aka Energy Efficiency)**
Energy Storage (Customer, Utility)	**Solar**
Dispatched Generation	**Wind**
Electric Vehicle Charging	
Combined Heat & Power	
Smart Inverter services (e.g., VAR Support)	

PNW Needs Flexible Capacity (MW)



https://www.nwcouncil.org/media/7149332/jun23_saac.pdf

DER Drivers in PNWER

- Cost declines in solar, storage, and smart grid
  - 40% decline since 2011, Panels $1.31/Watt to $.50/Watt (peaker is $1.2/Watt not including fuel)
  - Import tariffs on Chinese solar will slow the steep decline, but decline will continue.
  - $.038/kWh 20 year solar PPA for NV Energy
  - Tesla's gigafactory to reduce Li-ion battery cost
  - Smart building management systems, thermostats, water heaters, motor load, VFDs
- Customer Expectations
  - Lower costs, reliability, and environmental concern
- Economic Development
  - PNW: Solar Jobs > 6,000. Energy Efficiency > 15,000 jobs
- Reliability
  - 90% of outages is on distribution system. (200GW of backup power in US)
  - PNW requirement for flexible capacity
- Reduced rates
  - Avoid costs for Transmission, Distribution, Generation, etc.
  - *1990s Puget Sound Reliability: voltage support, targeted EE*

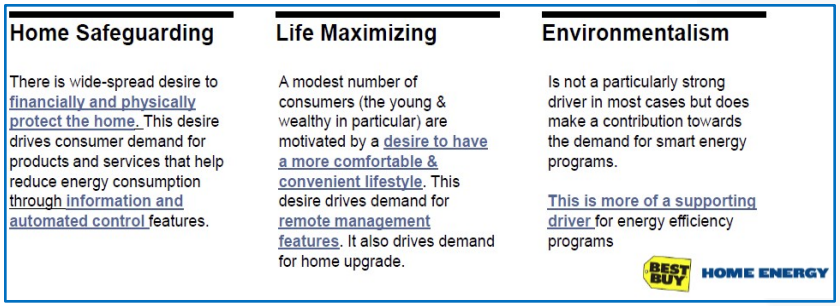
Customers are looking for reliability, self generation, and environmental stewardship.

Customer desire for self-reliance increasing

- **E&Y**: **33%** of the multi-national firms are expected to meet a greater share of their energy needs through **self-generation over the next five years**

- **Navigant**: nearly **75%** of surveyed **residential customers** have "**concerns about the impact electricity costs** have on their monthly budgets, and **63%** are interested in **managing energy used in their homes**"

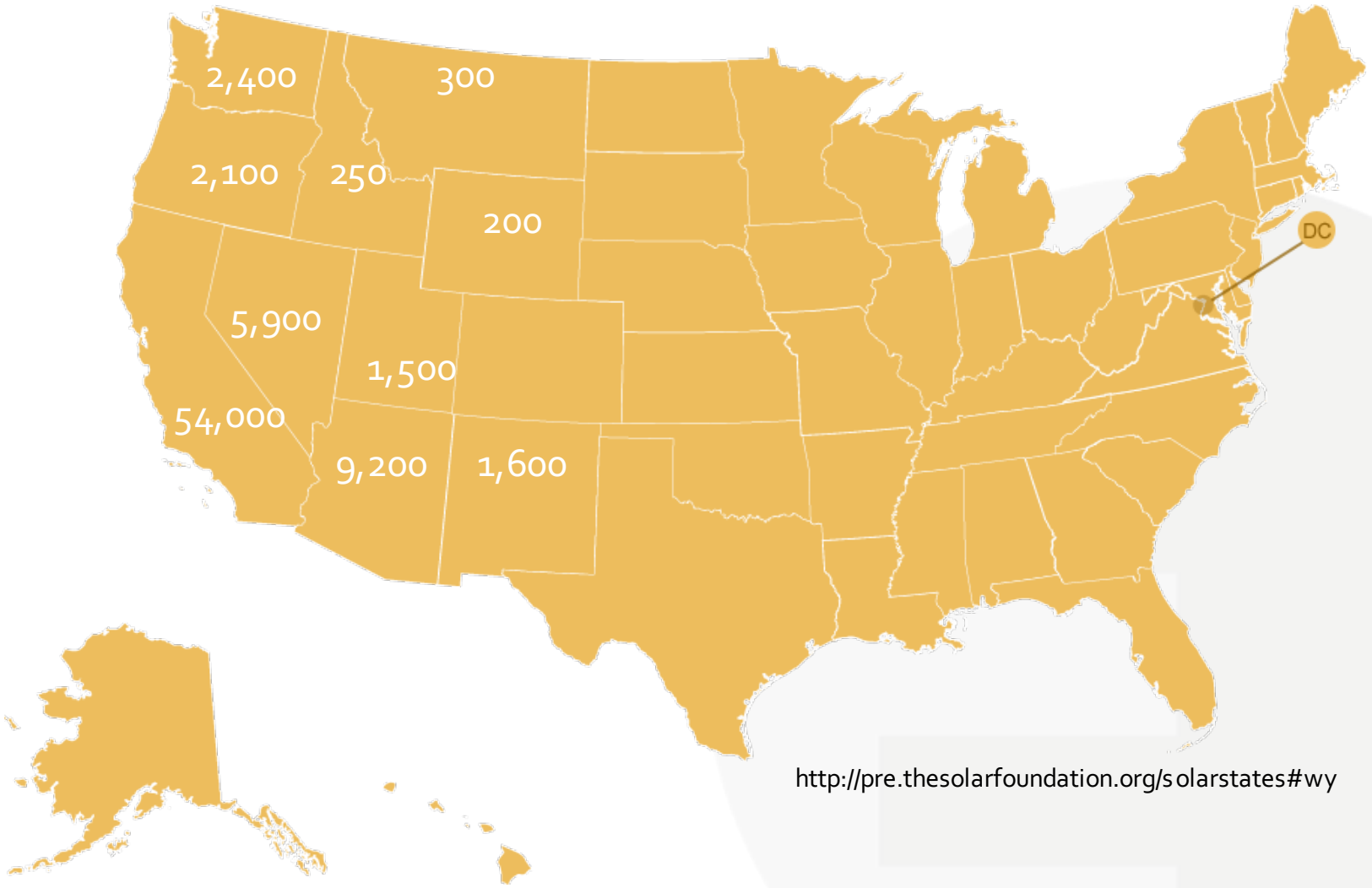
- **Best Buy**: **36% of residential** customers desire to "financiall and physically protect the home" (Home Safeguarding persona)



Home Safeguarding	Life Maximizing	Environmentalism
There is wide-spread desire to financially and physically protect the home. This desire drives consumer demand for products and services that help reduce energy consumption through information and automated control features.	A modest number of consumers (the young & wealthy in particular) are motivated by a desire to have a more comfortable & convenient lifestyle. This desire drives demand for remote management features. It also drives demand for home upgrade.	Is not a particularly strong driver in most cases but does make a contribution towards the demand for smart energy programs. This is more of a supporting driver for energy efficiency programs

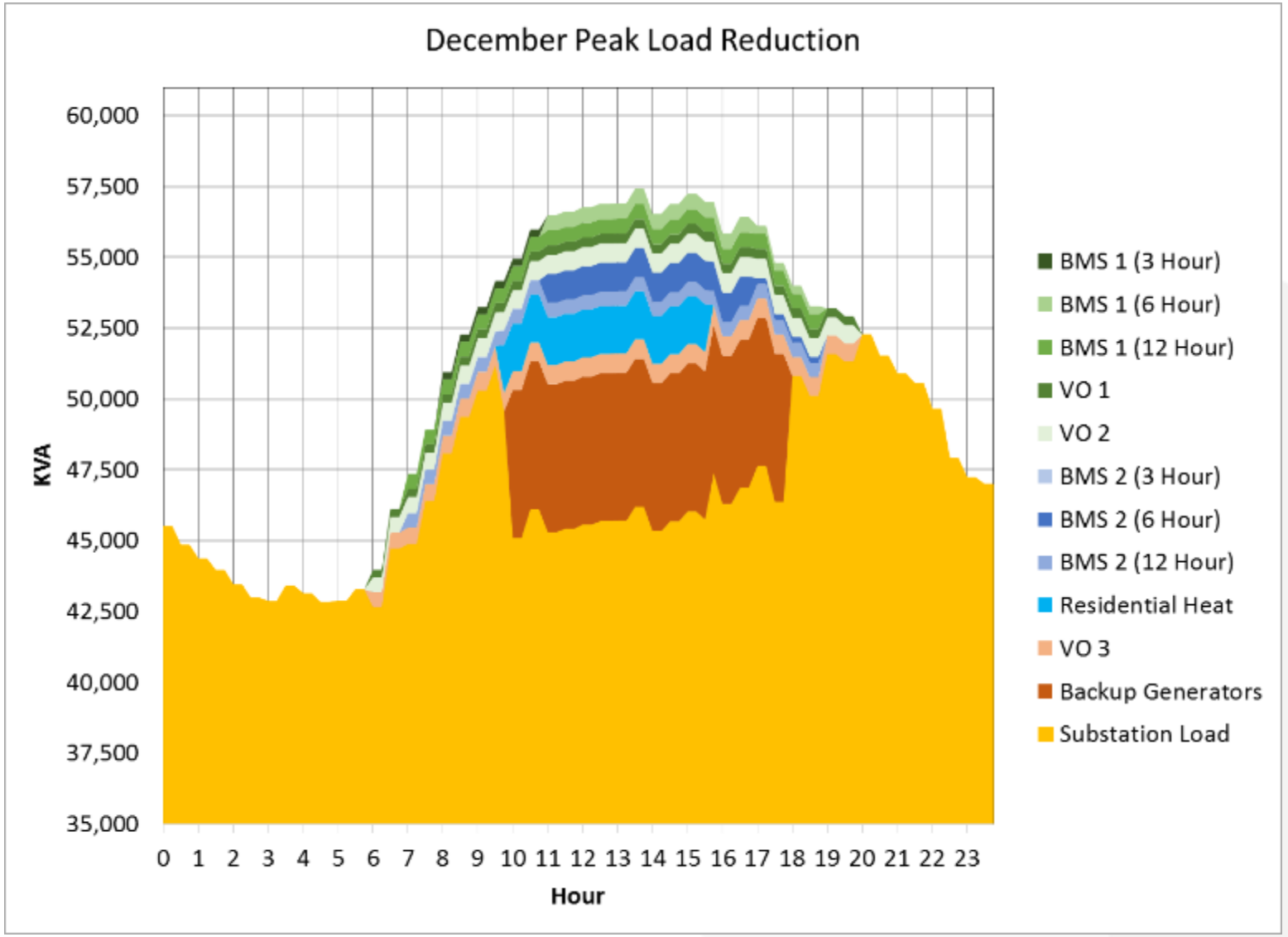
BEST BUY HOME ENERGY

>5,000 Solar Jobs in PNW
>15,000 Energy Efficiency Jobs in PNW

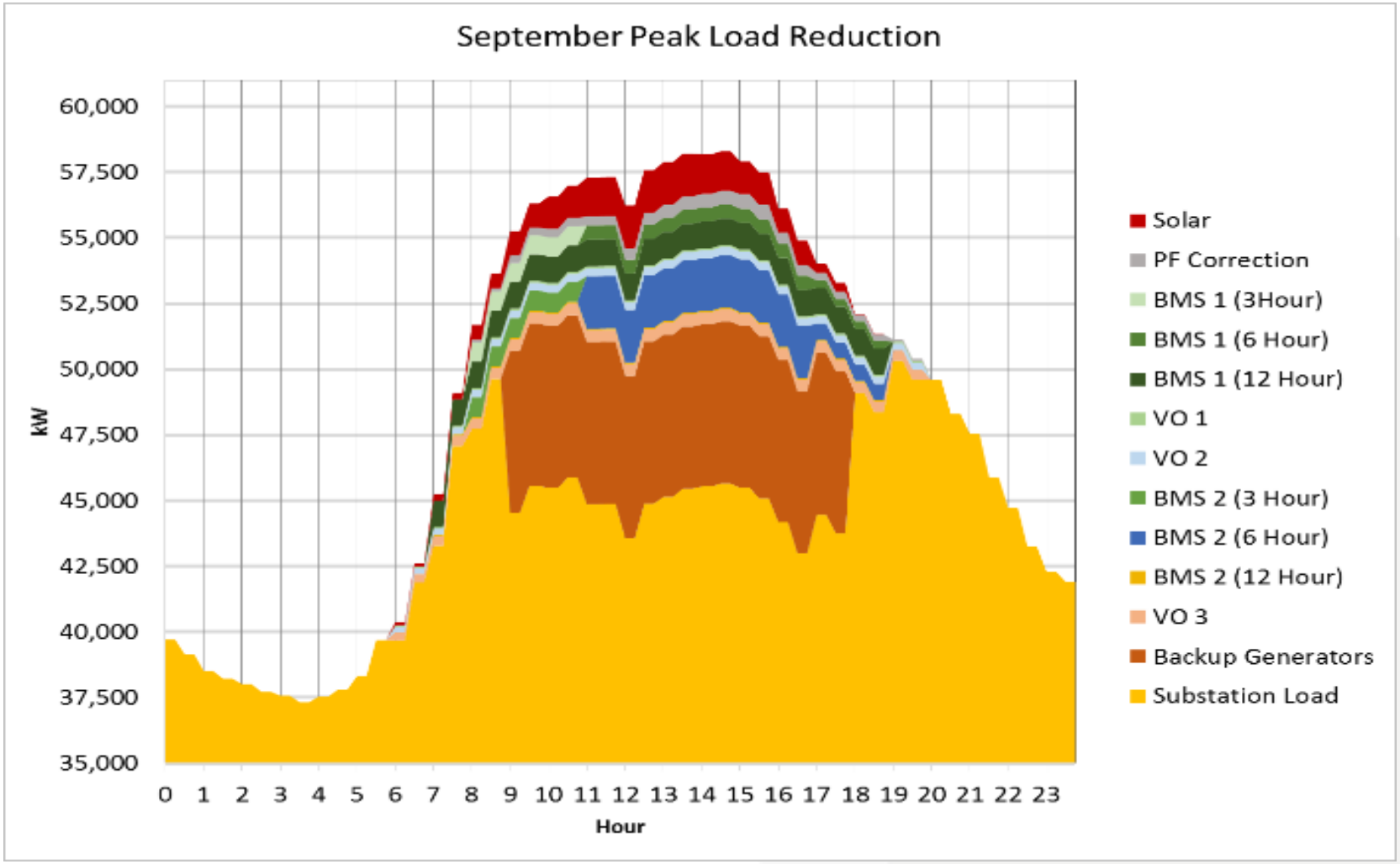


http://pre.thesolarfoundation.org/solarstates#wy

Campus DER for 69kVA Substations



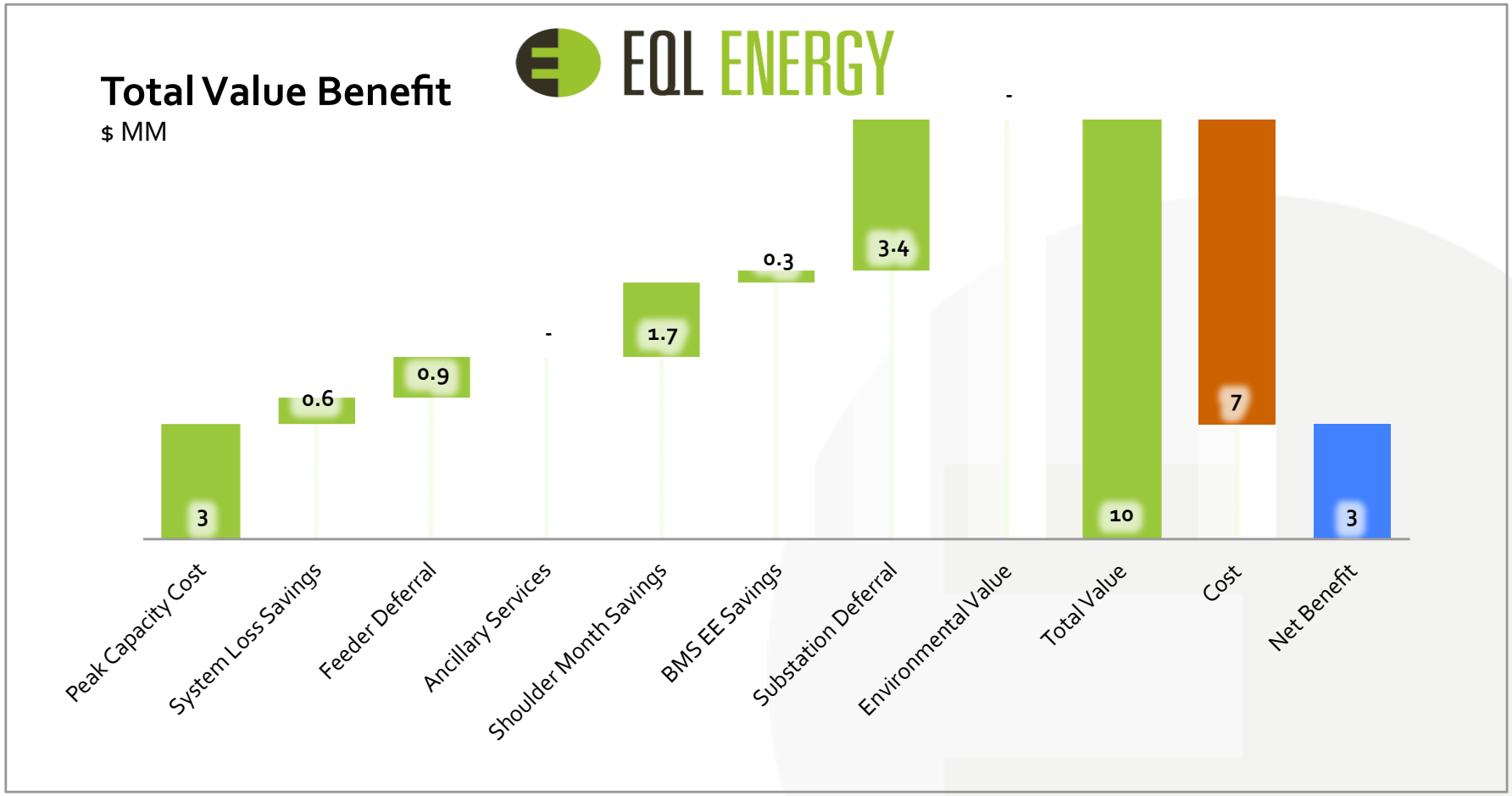
DER for two 69kVA Substations



BMS Measures

Measure	Winter KVA Shed Level 1	Winter KVA Shed Level 2	Summer KVA Shed Level 1	Summer KVA Shed Level 2
Command to Low Speed	4		4	
Command VFD to 50% cfm	0	12	0	12
Convert to Variable Flow Loop	0		0	
Curtail Radiant System	8		8	
Disable Fan Coil Unit Fans	0	0	0	0
Install VFD on Lab Exhaust Fans	83	0	83	0
Lock-Out Elevators	0	120	0	120
Lock-Out EV Chargers	50	0	50	0
Pre-Cool Ice Rink	0	500	0	500
Reduce dP Setpoint	19	0	9	0
Reduce Duct Static Pressure Set Point	321	0	321	0
Reduce Velocity Pressure	9	0	9	0
Remove Bypass Flow Control to dP	11	0	11	0
Shut Off AHU	11	117	11	117
Shut Off Chiller	0	66	0	949
Shut Off DW Booster Pumps	71	0	71	0
Shut Off Electric Boiler	40	0	40	0
Shut Off Heat Pumps	0	108	0	0
Shut Off Heat Recovery	0	146	0	0
Shut Off HR Chiller	0	191	0	0
Shut Off Lights	220	0	220	0
Shut Off Pump	12	21	12	21
Temperature Setback	68	0	274	117
Tune VFD Controls	22	0	22	0
Totals	949	1281	1145	1836

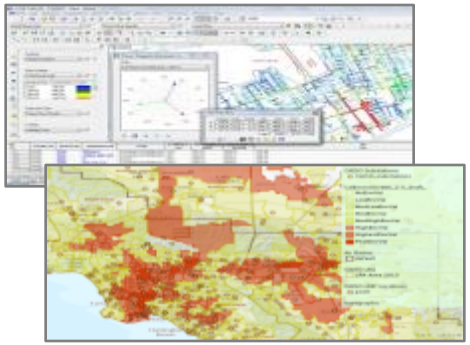
NPV of Substation Capacity DSM

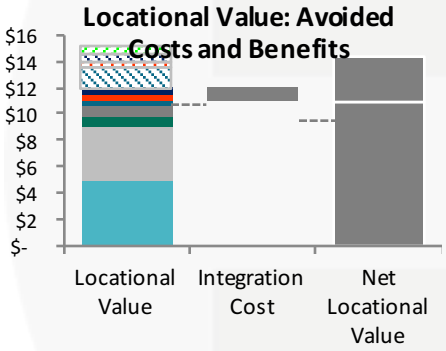


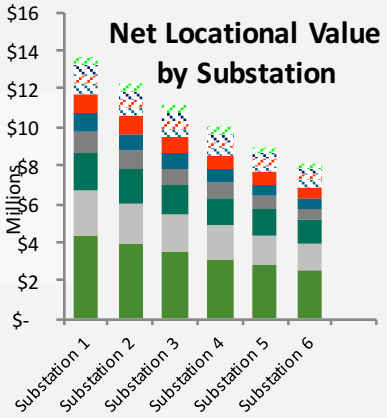
Distribution Resource Planning (DRP)

- Purpose is for distribution planning to **include DER** energy capacity, “smart” capabilities, energy efficiency, and market incentives during long-term distribution planning
- These factors would then be balanced against the **avoided costs** of “”traditional” distribution planning

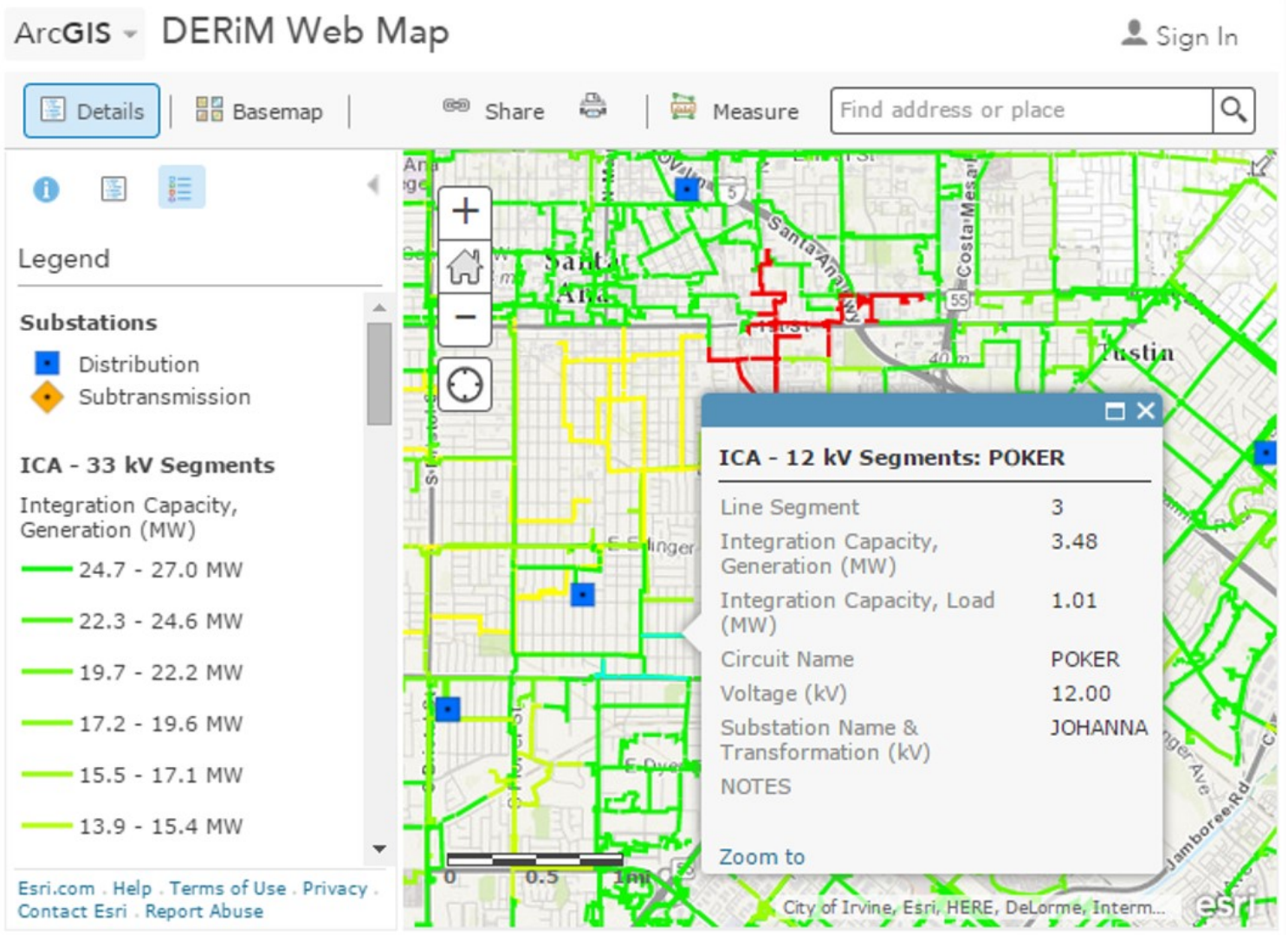
Identify DPA & Substations → **Perform Planning Analyses** → **Calculate Locational Net Value** → **Rank Substations by Locational Net Value**





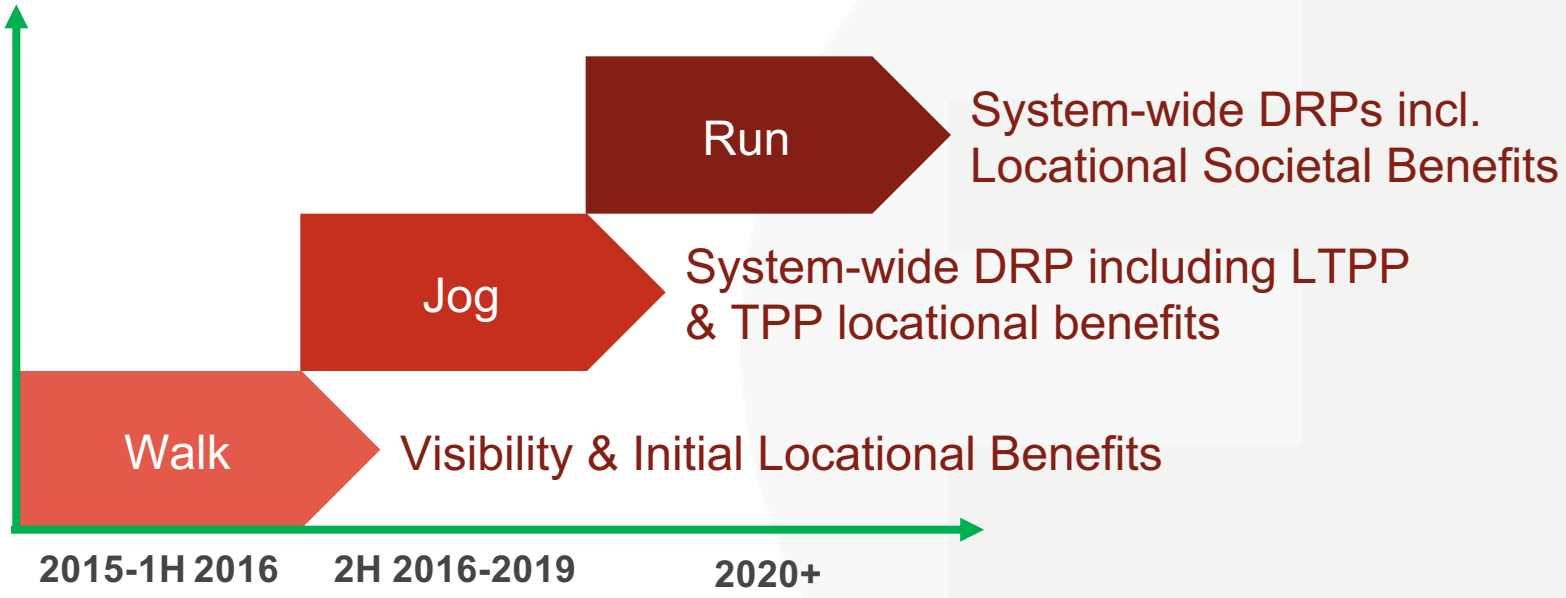


SCE Available Capacity by Line Section



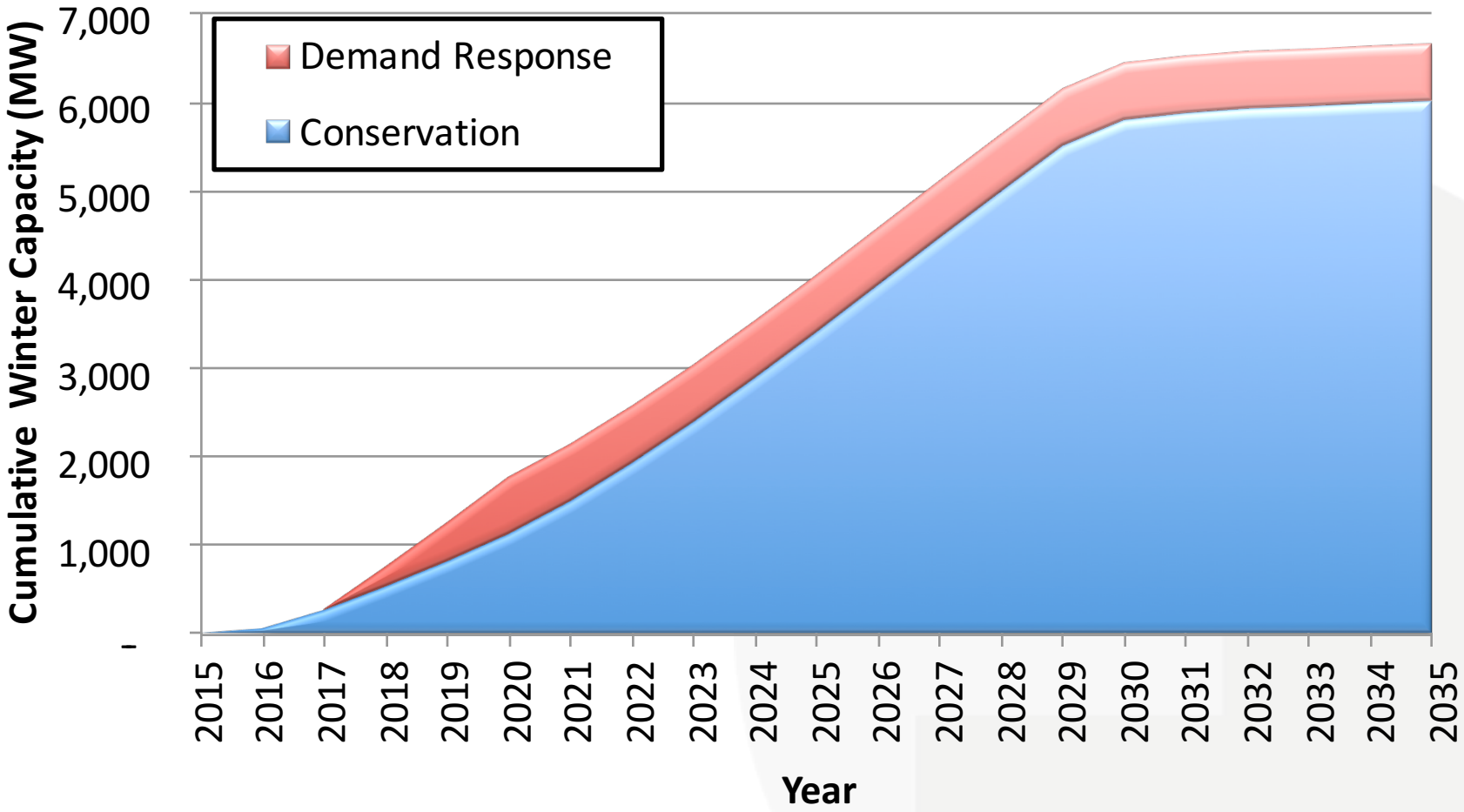
Evolution of DRP Optimal Location Benefits Analysis

- What are the immediate benefit categories that can reasonably be evaluated?
- What are the next logical set (incl. data and tools needed) for system-wide DRPs?



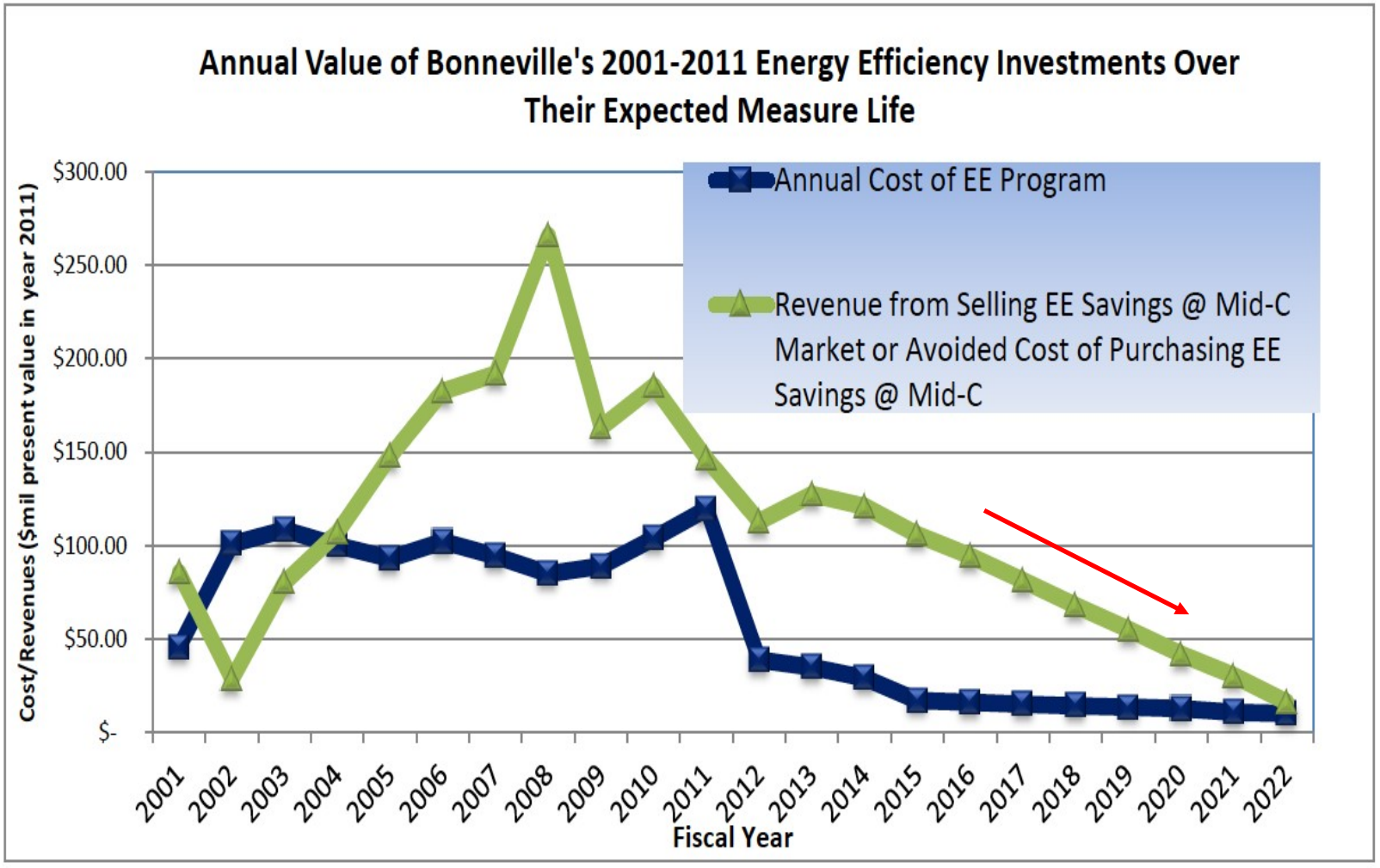
PNW: Conservation and Demand Response Lowest Cost, Lowest Risk

US 2013 DR > 28,000 MW

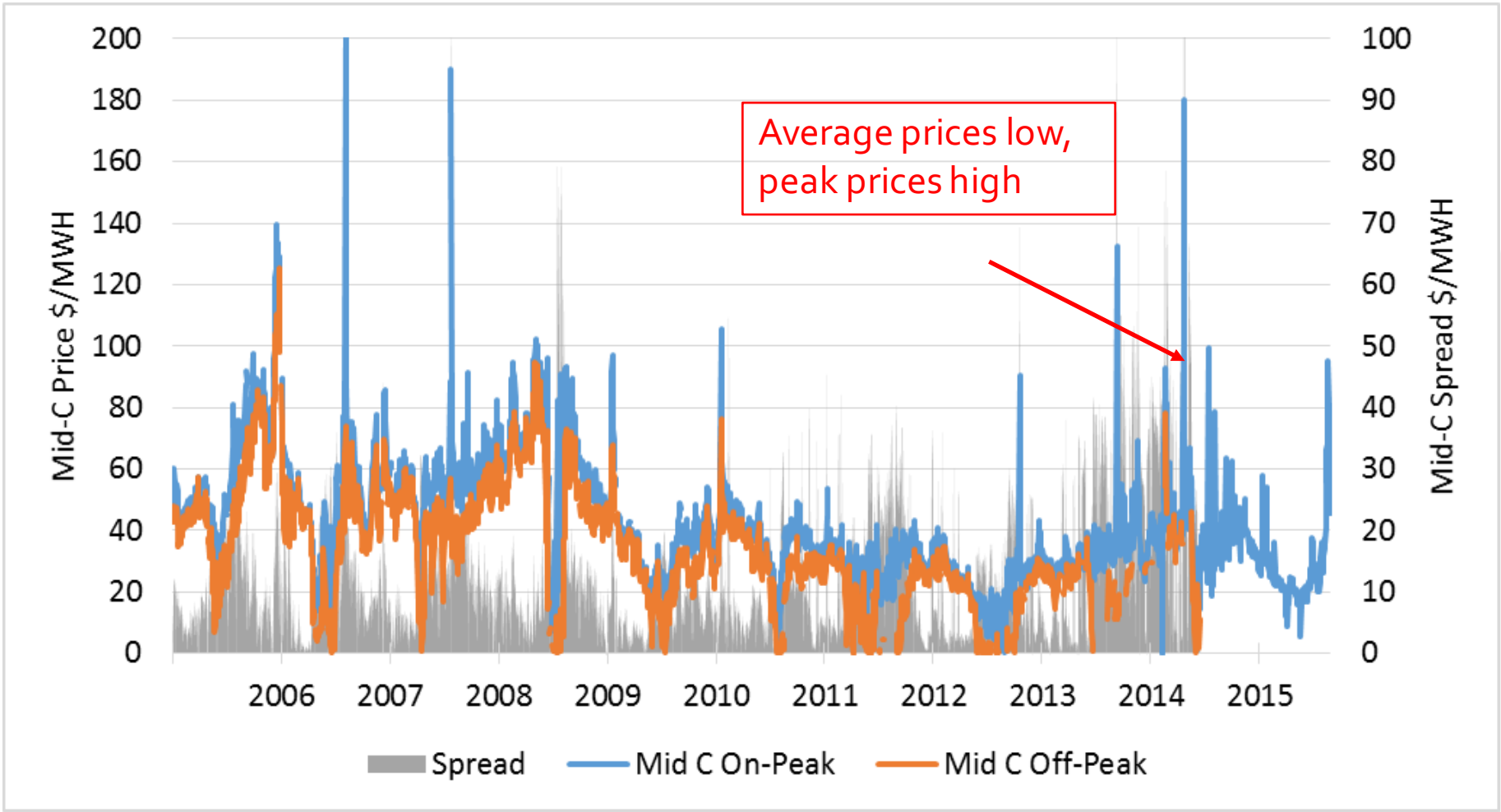


Source: Northwest Power and Conservation Council, Mar. 2015

Energy Efficiency Net Benefit ~$1 Billion for BPA



Focus on Peak Demand Reduction



DER will be 23% of western power by 2022

DER	2022 WECC (MW)[1]	2013 PNW (MW)	2022 PNW Market Potential[2, 3]
Solar (Helena better than Jacksonville FL)	25,000	188	2,300
Combined Heat and Power (CHP)	9,000	15	1,000
Demand Response – Renewable Integration	2,600	0	305
Demand Response – Peak Reduction	4,700	420	1,000
Energy Storage	1,800	5	55
Dispatchable Backup Generators		100	800
Energy Efficiency (amounts not included)			
Total	**43,400**	**713**	**14,660**

1. Source: EQL Energy for Western Interstate Energy Board May 2015,
2. Summary of 2013 TEPPC high DG case, 2013 LBNL
3. http://www.westernenergyboard.org/sptsc/workgroups/dsmwg/webinars/2013/2-HiDSM-DGwebdr.pdf

Stakeholders

- Distribution Utility
- Utility Shareholders
- Regulators
- Ratepayers
- DER owners
- Economic Development
  - (politicians/business associations)
- Solar industry (175,000 employed)
- Cleantech Companies
- Third party DER, Retail energy providers
- Utility Distribution Equipment Vendors
- Concerned Citizens

Summary

- Legislative / Regulatory actions
  - Support Utility Transition in business models
  - Value of ~~solar~~ DER >>> DRP
    - Distribution Resources Planning (CA AB327, WA 2045)
  - Utility Roadmaps - pilot>demo>scale
  - Combined Heat and Power (WA E2SHB 1095, OR SB 844)
  - Support (Mandate) Standards -OpenADR, IEEE1547
  - Obtain Demand Response as we have Energy Efficiency (NPCC 7th Plan)

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Link to Western Interstate Energy Board paper:
Emerging Changes in Electric Distribution Systems in Western States and Provinces

http://westernenergyboard.org/2015/05/final-report-released-by-eql