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Resource planning and operational requirements for the advanced grid: Demand Response Potential Studies

NASEO EMAP Workshop
Presented to the Nevada Governor's Office of Energy

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Agenda

- Analytical Options for DR Potential Studies
  - Program Performance
  - Technical Performance
  - End-use Performance
- California's DR Potential Study
  - Need of the Grid in 2025
  - DR Service Types
  - Framework and Analysis
  - Results: Deep Dive
    - Shed DR service type
    - Shift DR service type

Nevada's statewide energy planning and demand side resources initiative

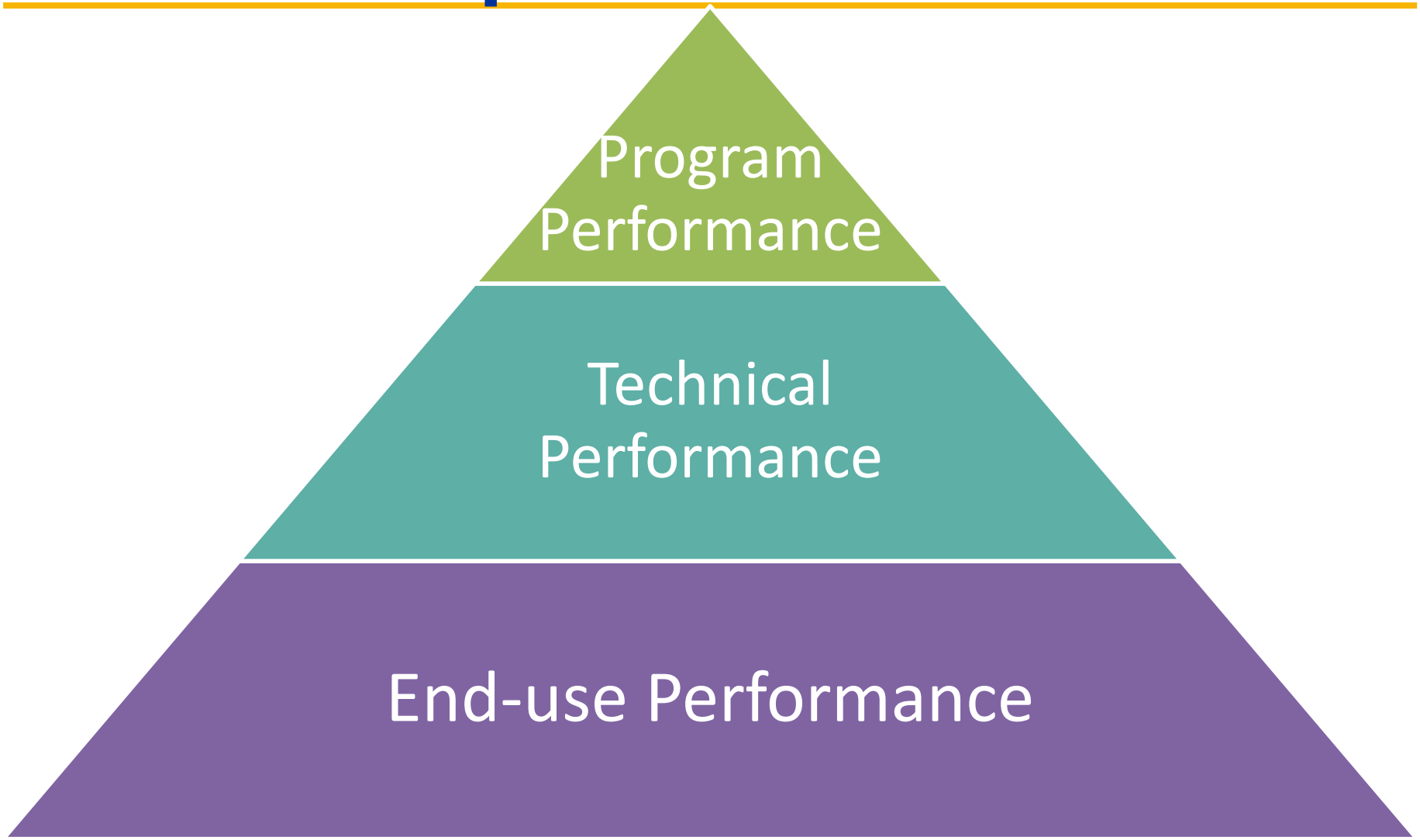
- Conducting a baseline assessment of Nevada's energy landscape to inform an extensive electric system modernization roadmap effort
  - Interest in conducting a DR Potential Study to evaluate demand side resources
- Objectives include advancing electricity system and related energy infrastructure modernization, resilience, and affordability
  - Diversifying supply side and demand side resource mix
- Can draw upon initiatives/research undertaken in other states to inform resource planning needs and operational requirements
  - Specifically, CPUC "Order Instituting Rulemaking to Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements" (13-09-011)

Analytical Options for DR Potential Studies

DR vs. EE Potential Studies

Demand Response	Energy Efficiency
• Action must be taken by customers, or automatically by devices, in response to a system event or signal • Customers are recruited for limited terms and offered the program via outreach • Constraints on how often the program can be dispatched & end use availability • Lack of standards for devices and measurement • Benefit streams for DR are not equal in all hours • Incentives for participation vary across service providers and energy markets	• Assumed lifetime provides a relatively predictable stream of energy benefits from fixed equipment under regular operation • Incentives paid through upstream, midstream, or downstream payments • Energy Star standards, building codes • Incentives are paid based on energy savings (typically from Energy Star rating)

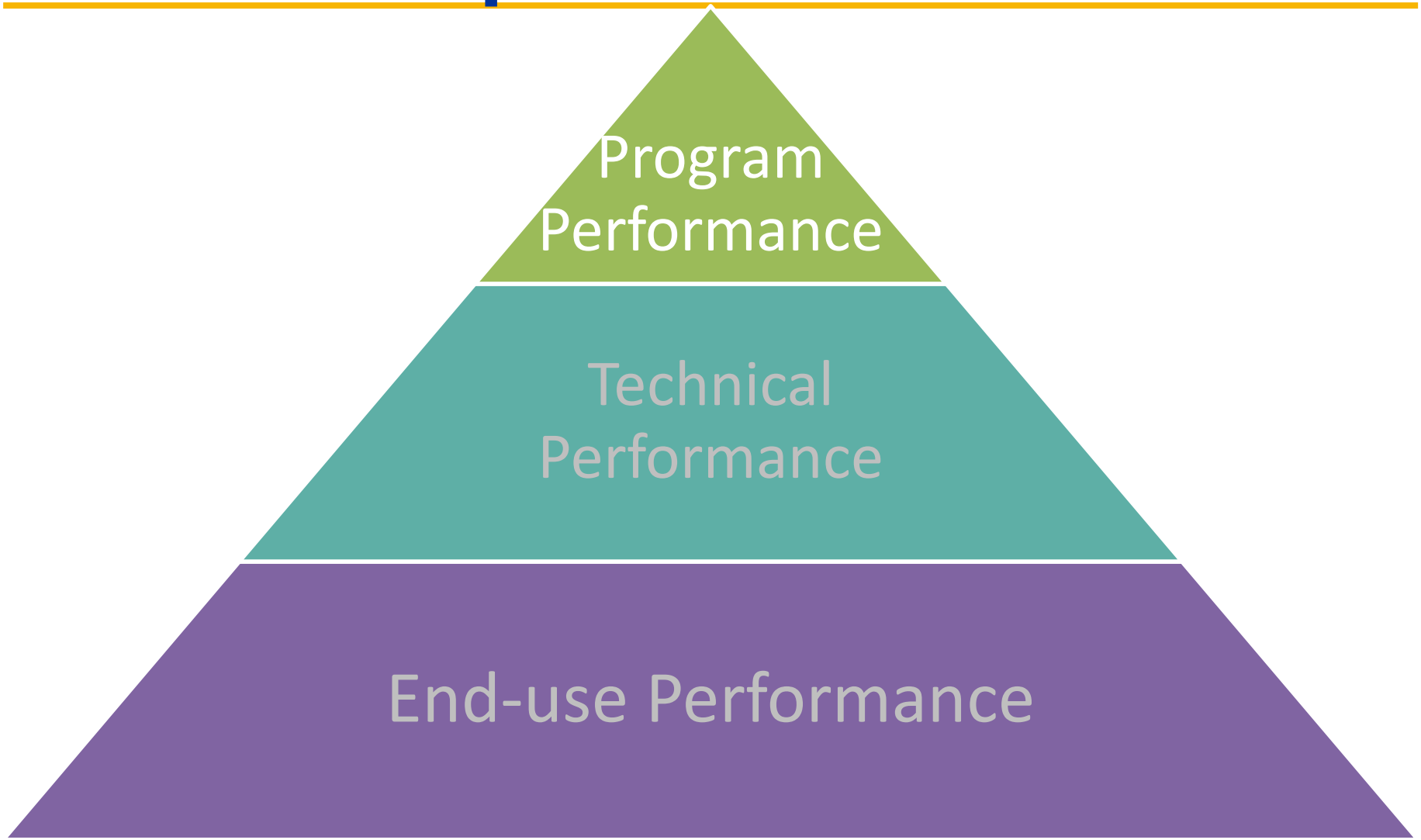
Methods for Estimating Demand Response Potential



Characterization of Methodologies

- Data input requirements: *What kinds of data are required to perform the analysis?*
- Computation time/resources: *What resources are required for computation?*
- Duration of study: *Approximately how many months to complete the study?*
- Robustness of results: *How accurate and granular are the results?*
- Scope of the analysis: What *is included in the scope?*
- Cost for the research: *What is the range of costs for the study?*

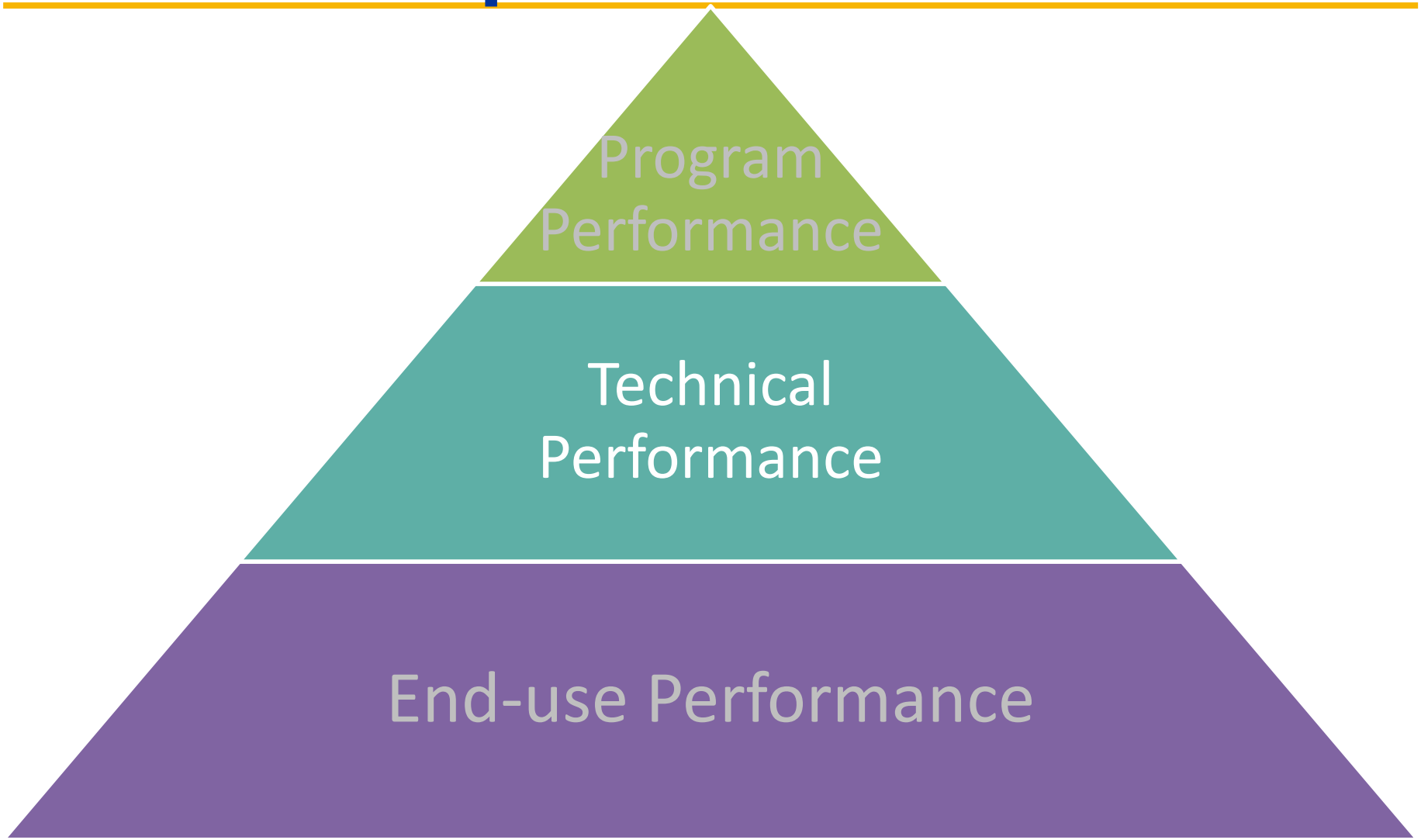
Methods for Estimating Demand Response Potential



Estimating Potential: *Program Performance Approach*

- Data inputs: *Regulatory DR filings, FERC Potential Study, energy forecasts, etc.*
- Computation time/resources: *Low*
- Duration of study: *4-6 months*
- Robustness of results: *Estimates are extrapolations from existing programs. Typically annual estimates.*
- Scope of the analysis: *Includes technical and market potential, but typically does not include economic valuation of DR resources. Focus is often on capacity markets.*
- Cost for the research: *Under $500k, w/o econ. analysis*

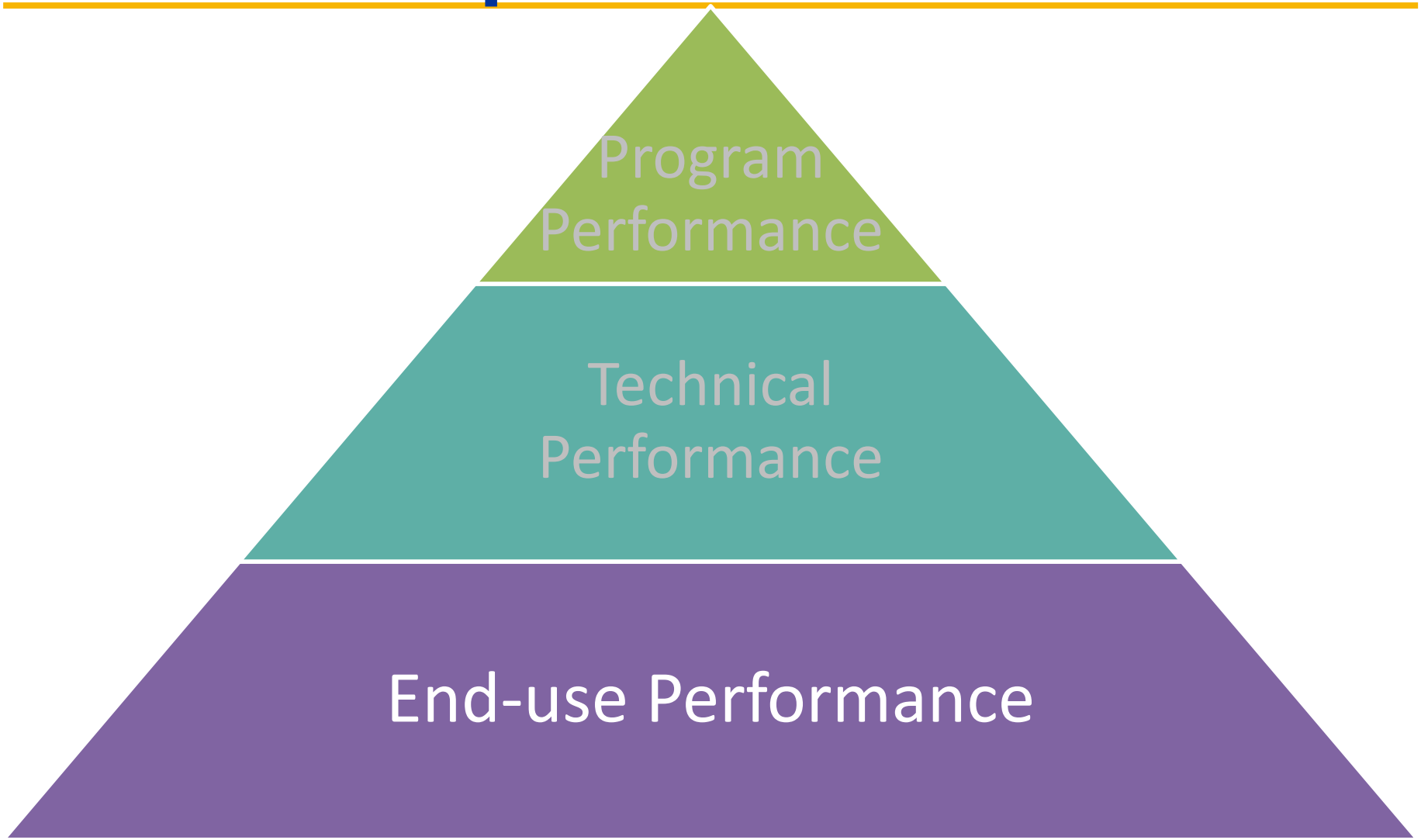
Methods for Estimating Demand Response Potential



Estimating Potential: *Technical Performance Approach*

- Data input requirements: *Generic load profiles, engineering estimates for end uses, weather/climate zone data, energy market parameters*
- Computation time/resources: *High*
- Duration of study: *6-12 months*
- Robustness of results: *Very robust technical potential.*
- Scope of the analysis: *Technical potential included. May not include market and economic valuation for DR resources*
- Cost for the research: *Approximately $500k - $1M*

Methods for Estimating Demand Response Potential



Estimating Potential: *End-use Performance Approach*

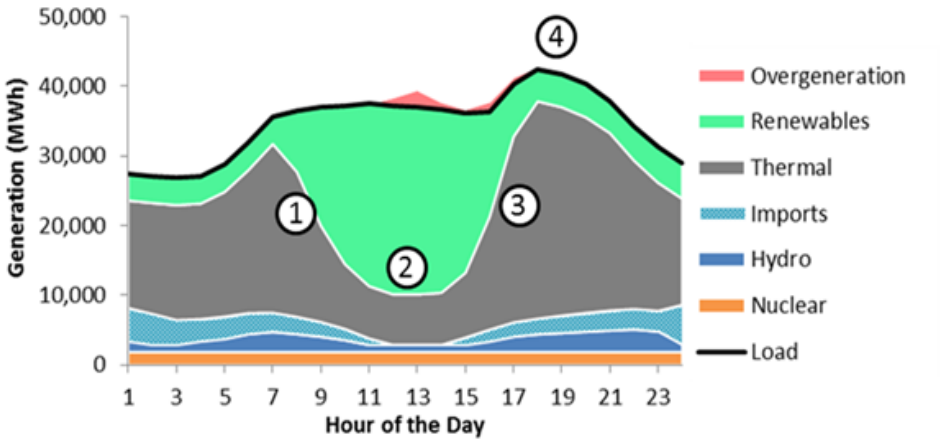
- Data input requirements: *Very granular data requirements- e.g. AMI interval data, utility marketing/enrollment data, demographic data, energy forecasts, renewables & weather data, etc.*
- Computation time/resources: *Very High*
- Duration of study: *9-18 months*
- Robustness of results: *Robust and granular technical, market, economic estimates*
- Scope of the analysis: *Cost competitive DR, market potential by end use/enabling tech, and hourly DR technical potential*
- Cost for the research: *Approximately $1M - $2M*

California Demand Response Potential Study

CA's DR Potential Study Objectives

- Evaluate the potential for DR to meet California's resource planning needs and operational requirements
- Provide analysis to support DR policy based on a bottom-up DR potential model
  - Specifically, CPUC "Order Instituting Rulemaking to Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements" (13-09-011)
- Identify opportunities for DR products and programs to assist in meeting long-term clean energy goals
- Phase 1 examined conventional DR- April 1, 2016
- Phase 2 examined fast and flexible DR service types- Nov.14, 2016

Defining the needs of the Grid: Flexibility planning challenges for 50% RPS



1. Downward Ramping

Thermal resources operating to serve loads at night must be ramped downward and potentially shut down to make room for a significant influx of solar energy after the sun rises.

2. Minimum Generation

Overgeneration may occur during hours with high renewable production. A system with more flexibility to reduce thermal generation will incur less overgeneration.

3. Upward Ramping

Thermal resources must ramp up quickly and new units may be required to start up to meet a high net peak demand that occurs shortly after sundown.

4. Peaking capability

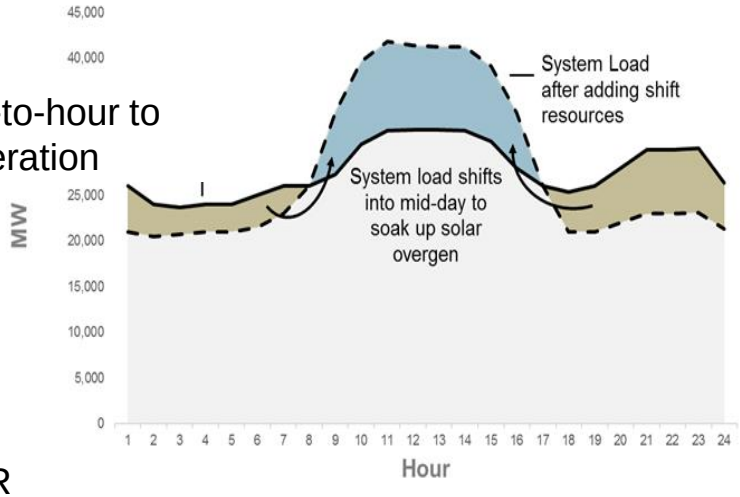
The system will need enough resources to meet the highest peak loads with sufficient reliability.

DR Service Types

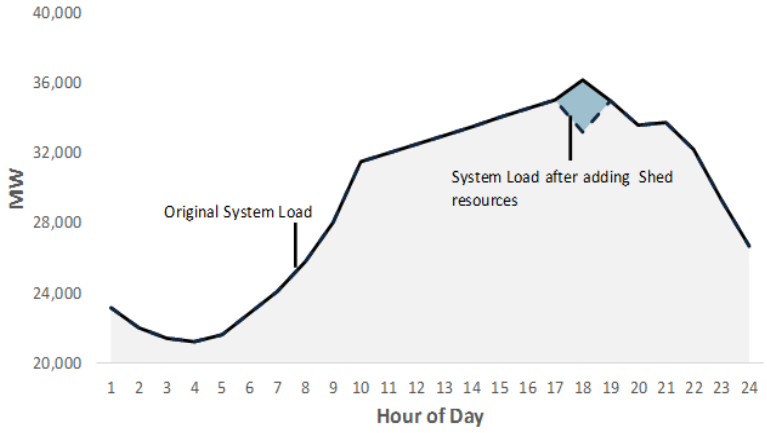
Service Type	Description	Grid Service Products/Related Terms	Analysis Unit	**Shape** (TOU/CPP) Included in service type analysis?
Shift	Demand timing shift (day-to-day)	Flexible ramping DR (avoid/reduce ramps), Energy market price smoothing	kWh-year	Yes
Shed	Peak load curtailment (occasional)	CAISO Proxy Demand Resources/Reliability DR Resources; Conventional DR, Local Capacity DR, Distribution System DR, RA Capacity, Operating Reserves	kW-year	Yes
Shimmy	Fast demand response	Regulation, load following, ancillary services	kW-year	No

DR Service Types Providing for Grid Needs

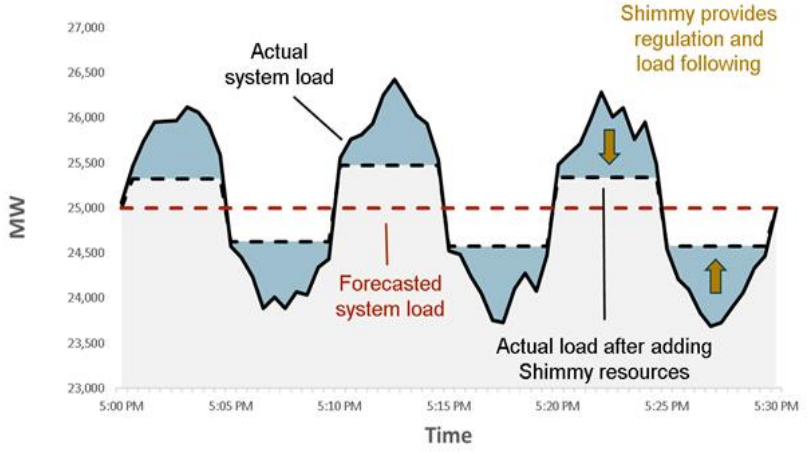
Shift: Shifting load from hour-to-hour to alleviate curtailment/overgeneration



Shed: Peak shed DR



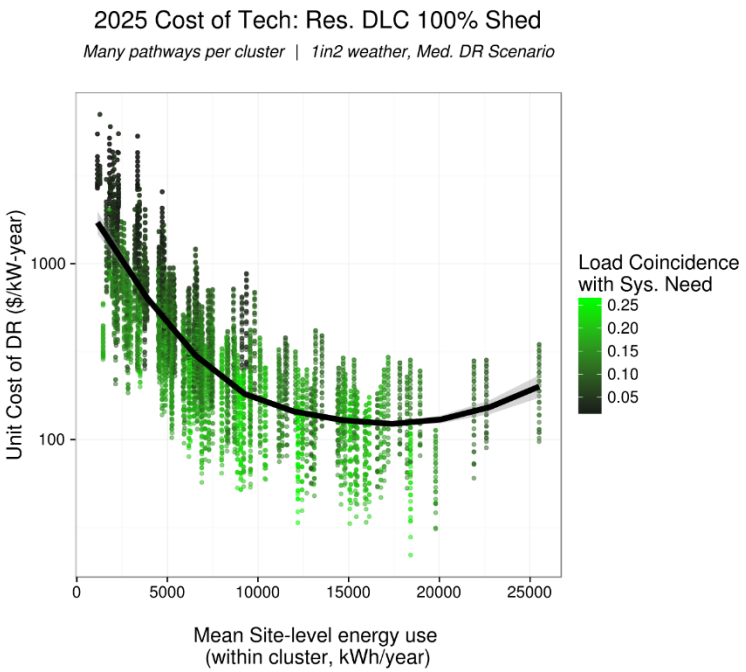
Shimmy: Load-following & regulation DR



Analysis: Modeling Demand Response End Uses and Enabling Technology

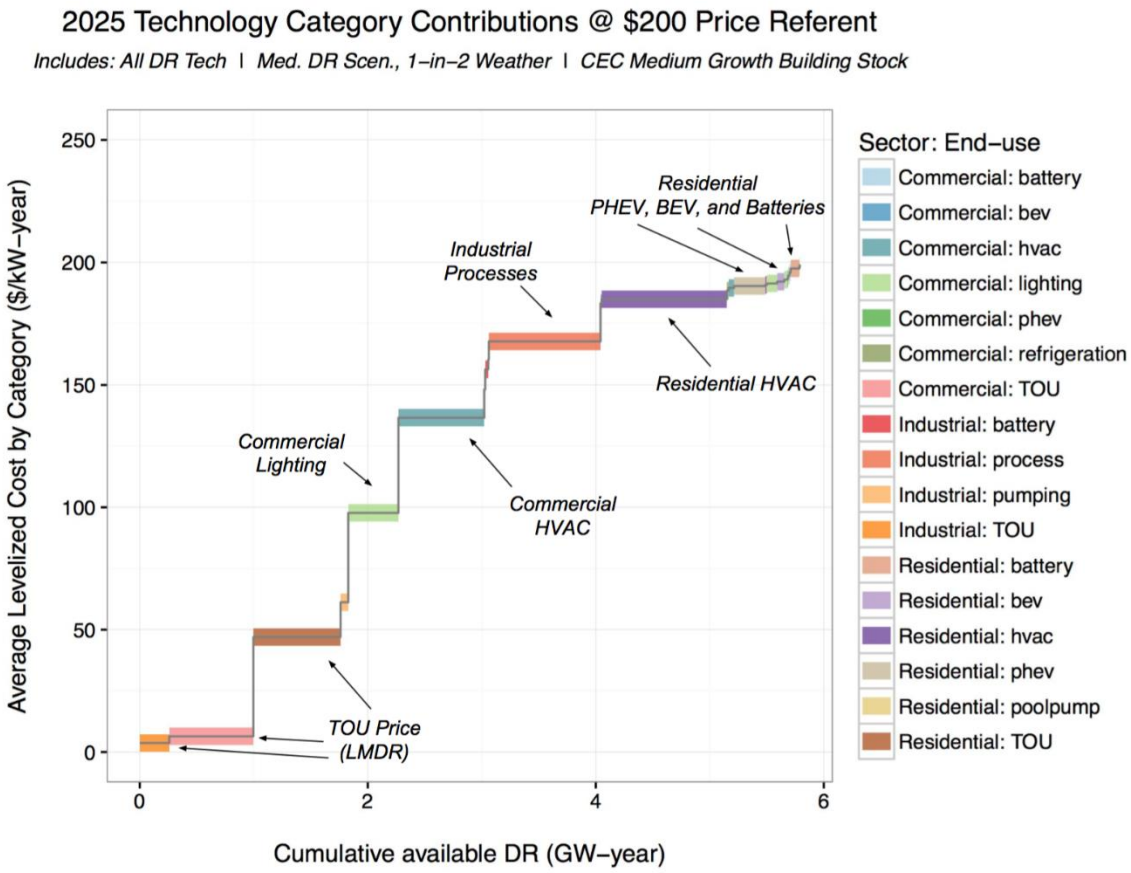
Bottom up methodology utilized 250k AMI load profiles & basic demographics from 11 million customers.

- DR technology costs & shed capabilities modeled
- Includes coincident weather & renewable generation
- Leverages the benefit of granular data models

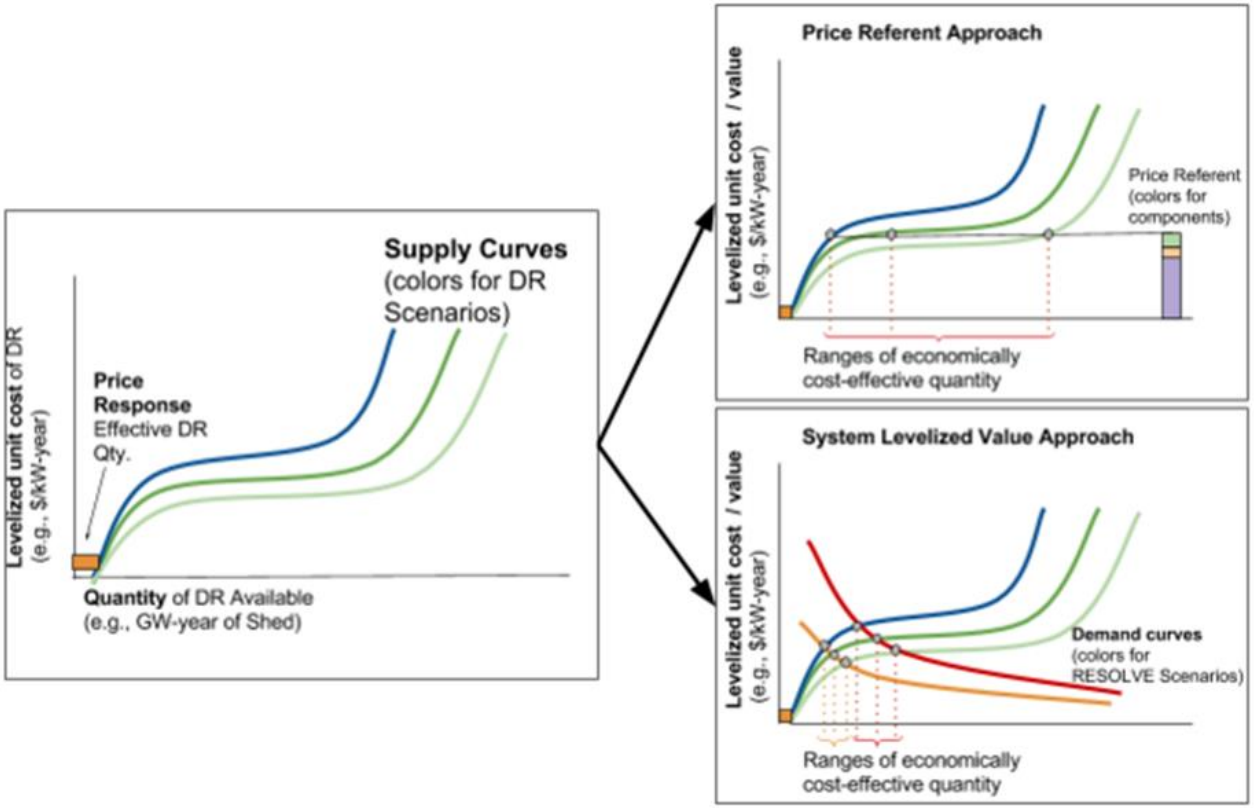


Sector	End-Use	Enabling Technology Summary
All	Battery-electric & plug-in hybrid vehicles	Level 1 & Level 2 charging interruption
	Behind-the-meter batteries	Automated DR (Auto-DR).
Commercial	HVAC	Depending on site size, energy management system Auto-DR, DLC & PCT.
	Lighting	A range of luminaire, zonal & standard control options.
	Refrigerated warehouses	Auto-DR
Industrial	Processes & large facilities	Automated and manual load shedding & process interruption.
	Agricultural & municipal pumping	Manual, DLC & Auto-DR
	Data centers	Manual DR
	Wastewater treatment	Automated & manual DR

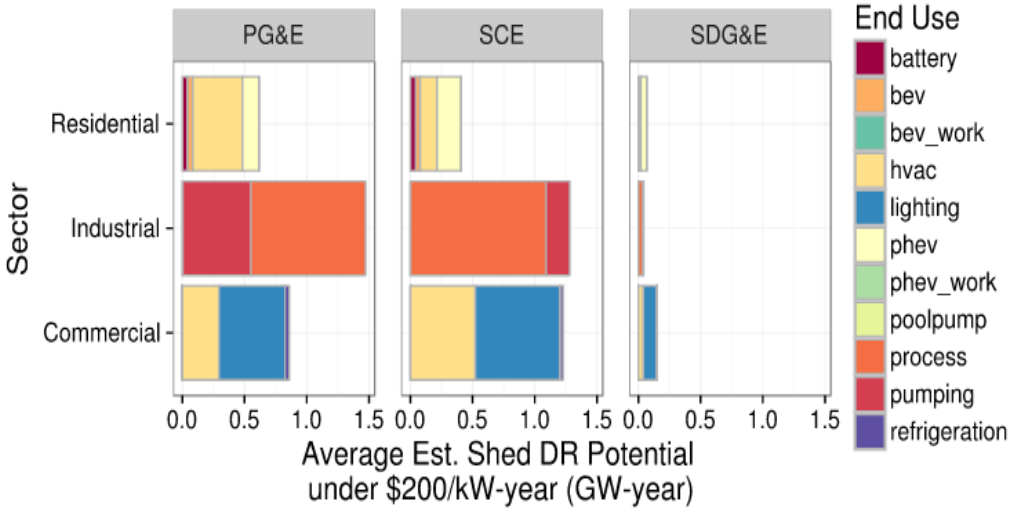
Analysis: Determine the DR Costs and Benefits

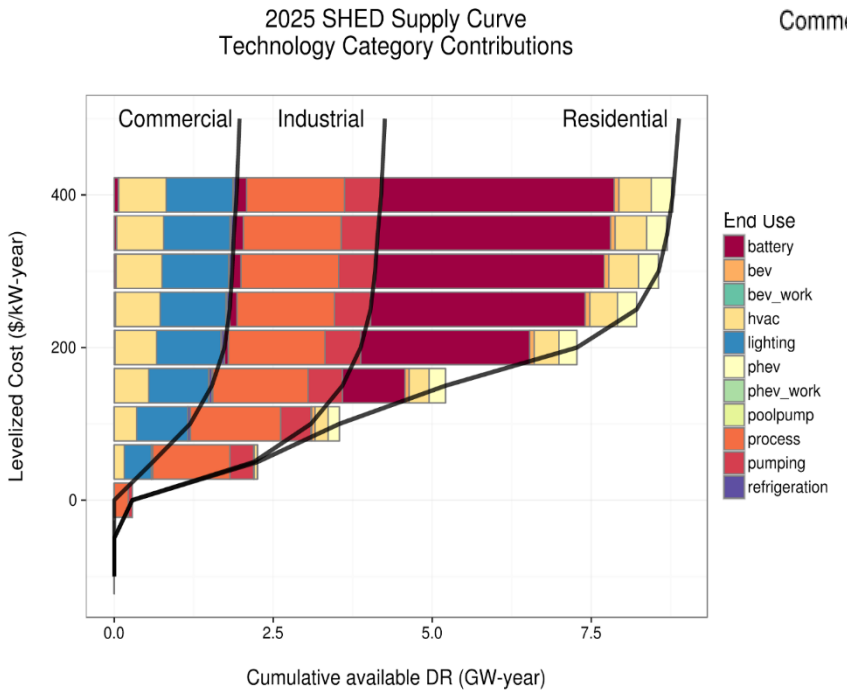


Valuation Framework for DR



Results: Industrial and Commercial sectors provide significant portion of Shed DR resources, based on costs, participation, and performance

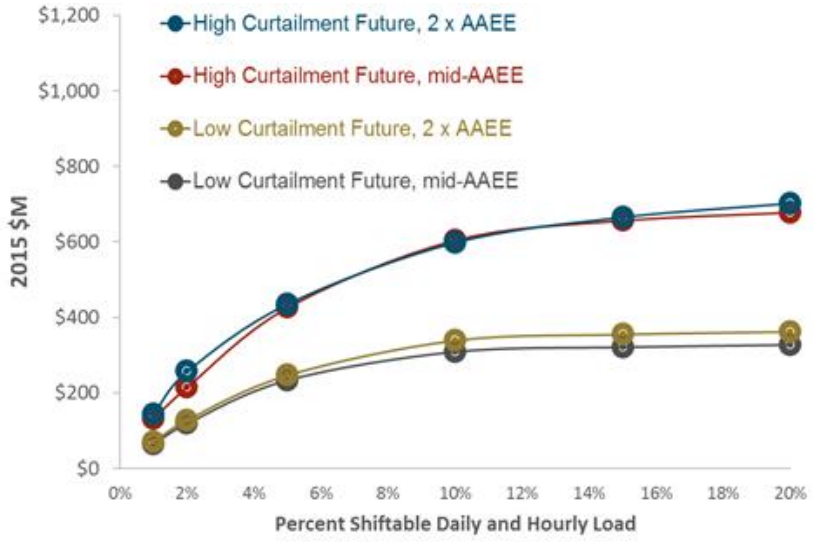


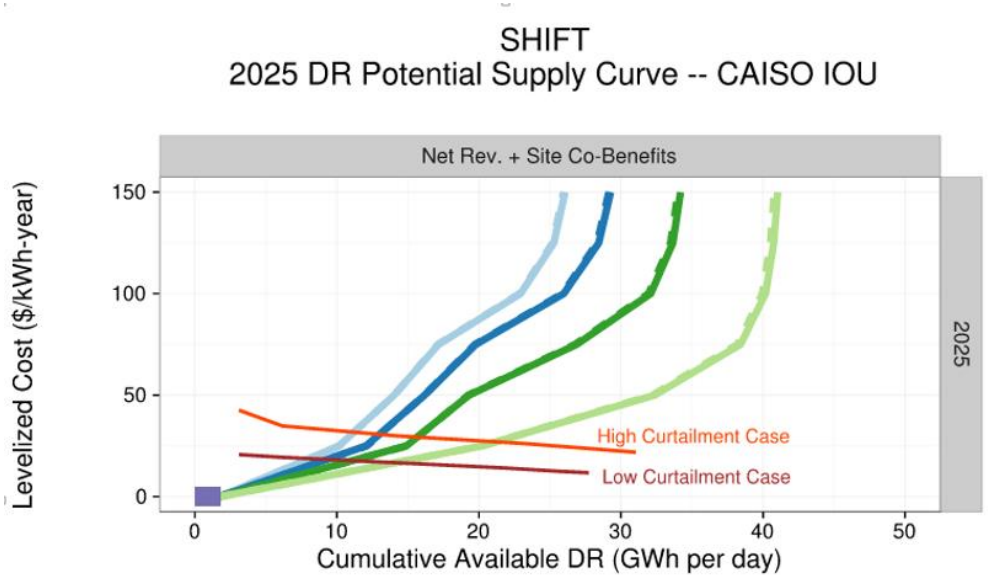


Battery storage can provide flexible and fast DR service, but isn't cost competitive alternative to conventional thermal generators… yet.

Results: High Renewable Penetration Can Increase the Need for Shift DR

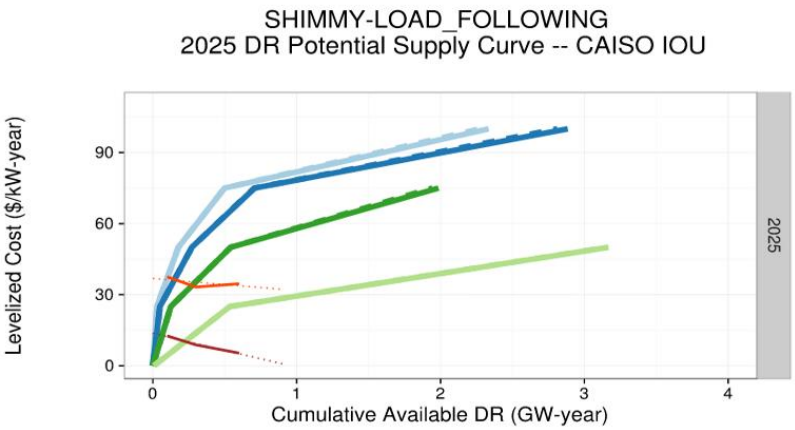
- "Shift" Demand Response that encourages load consumption during the middle of the day to absorb solar generation becomes increasingly valuable for reducing curtailment of renewable resources

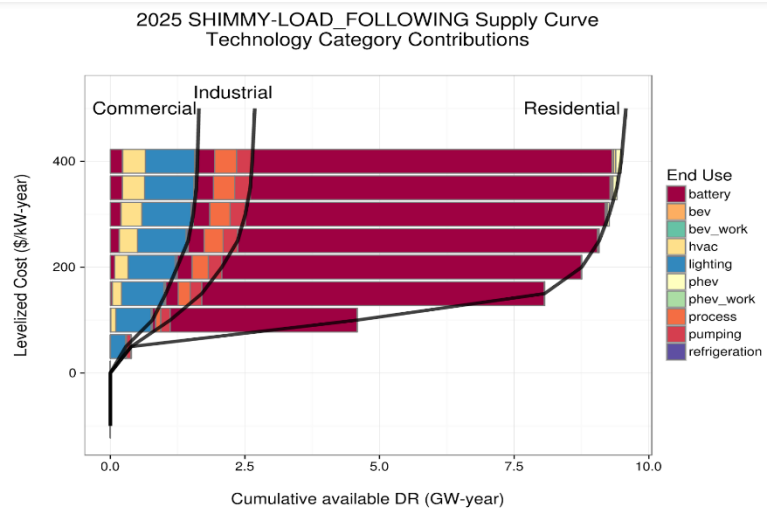


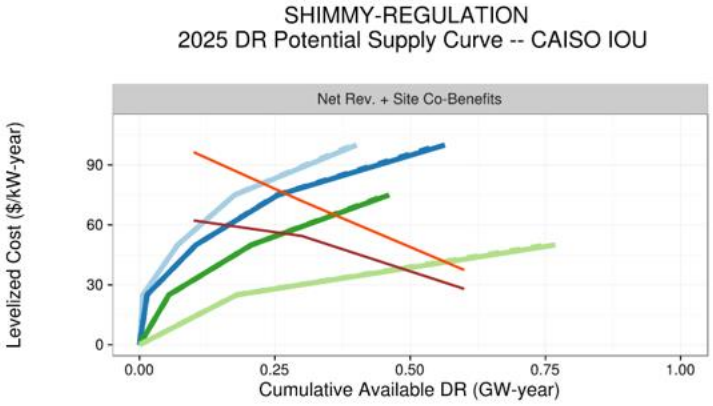


Results: Fast DR that operates on a seconds-to-minutes ("regulation") & minutes-to-hours ("load following") timescales are *Shimmy* resources in CA study

- Regulation services: 300 MW of regulation & load following DR services are cost competitive in the CA market







Concluding Thoughts

- Demand side resource research, such as DR Potential studies, can help inform Nevada's roadmap effort

- Developing integrated energy resource plans that include demand side resources can assist in grid modernization and resilience at the distribution and transmission level

- Understanding how DR can provide grid services and address future energy needs can assist in developing a diversified energy portfolio that includes supply & demand side resources

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Full report and datasets can be found at:
www.cpuc.ca.gov/General.aspx?id=10622

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