Integrating Utility and Consumer Goals for Synergistic Benefits

2019 Getting to Zero Conference, Session 5

Integrating Utility and Customer Needs:

The Value of Grid-interactive Efficient Buildings

TIERRA
Resource Consultants, LLC

10 October 2019

About Tierra Resource Consultants, LLC

TIERRA
Resource Consultants, LLC

- Founded in 2013; based in Walnut Creek, California
- Multidisciplinary energy and sustainability consulting engineering firm serving clients across North America
- Tierra's consultants each leverage over three decades of energy industry experience
- Expertise includes engineering, economics, finance, strategy, resource planning and regulatory compliance
- Clients include:
  - Electric and gas utilities
  - Regulatory and governmental agencies
  - Industry research and advocacy groups
  - Energy service companies
  - Private sector companies
  - Design and construction firms

Integrating Utility and Consumer Goals for Synergistic Benefits

Tierra Resource Consultants, LLC

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LEARNING OBJECTIVES:

1. Expand scope from one ZNE/ZNC building to portfolio and grid to address multiple goals →
    a. Decarbonization
    b. Electric system reliability and resource management
    c. Energy system resilience
    d. Cost reduction goals for consumers and utilities
2. Impacts of energy use + carbon reduction efforts on load shapes + demand management
3. Understand importance of utility avoided costs in ZNE/ZNC program planning
4. Assess optimal mix of the following strategies to achieve goals →
    a. Efficiency
    b. On-site renewable generation
    c. Demand management and battery storage
    d. Building/transportation electrification
    e. Integration with the electric grid

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ASU climate neutrality commitments

Arizona State University

1. **Reach climate neutrality by 2025 (buildings) and 2035 (w/ transportation)**
2. **Attract students, professors, funding, and research**
3. **Create a new model to demonstrate how to reach climate neutrality**
4. **Achieve goals with transparency, best value assurance, and partnership**

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Over 10 years – EPCs and PPAs were leveraged to reduce ASU capital requirements by 75%

AMERESCO

ASU Arizona State University

Resulting energy and GHG emissions savings:

- 98.5 GWh/year
- 1.4 million therms/year
- 77,247 tonnes CO_2e/year

ARIZONA STATE UNIVERSITY: PROJECTS COMPLETED BY AMERESCO (2004-2013)	Year	Project Cost (USD)	EPC (3rd Party Funds)	Institutional Capital (ASU Funds)	PPA (3rd Party Funds)
Energy Performance Contract (EPC), Phase 1	2004	$ 39,942,154	$ 39,942,154		
Boiler & Burner Replacement	2006	$ 2,600,000		$ 2,600,000	
Combined Heat and Power Plant	2006	$ 44,696,000		$ 44,696,000	
Cooling Tower Replacement	2007	$ 1,500,000		$ 1,500,000	
Energy Performance Contract (EPC), Phase 2	2007	$ 40,600,000	$ 40,600,000		
Central Plant and Utility Distribution System	2008	$ 15,800,000		$ 15,800,000	
Solar PV Phase II / 6.24 MW	2009	$ 52,427,939			$ 52,427,939
Solar PV Phases III & IV / 3.66 MW	2011	$ 22,179,159			$ 22,179,159
Solar PV Phases VI and VII / 2.83 MW	2012	$ 15,959,810			$ 15,959,810
Solar Thermal Phase V / 2 MW	2012	$ 10,800,000			$ 10,800,000
Solar PV Phase V / 901 kW	2012	$ 7,171,188			$ 7,171,188
Solar PV Phase VIII / 1.3 MW	2013	$ 7,594,749			$ 7,594,749
HVAC Upgrades	2013	$ 824,363		$ 824,363	
Total Dollars Invested (USD)		**$ 262,095,362**	**$ 80,542,154**	**$ 65,420,363**	**$ 116,132,845**
Percentage of Total Dollars Invested			**31%**	**25%**	**44%**

Achieving aggressive GHG reduction goals requires financial creativity and "capital stacking":

- EPCs
- PPAs
- Maintenance funds
- Grants
- Incentives
- Partnerships
- Cap and Trade Programs
- Etc.…

EPC = Energy Performance Contract
PPA = Power Purchase Agreement

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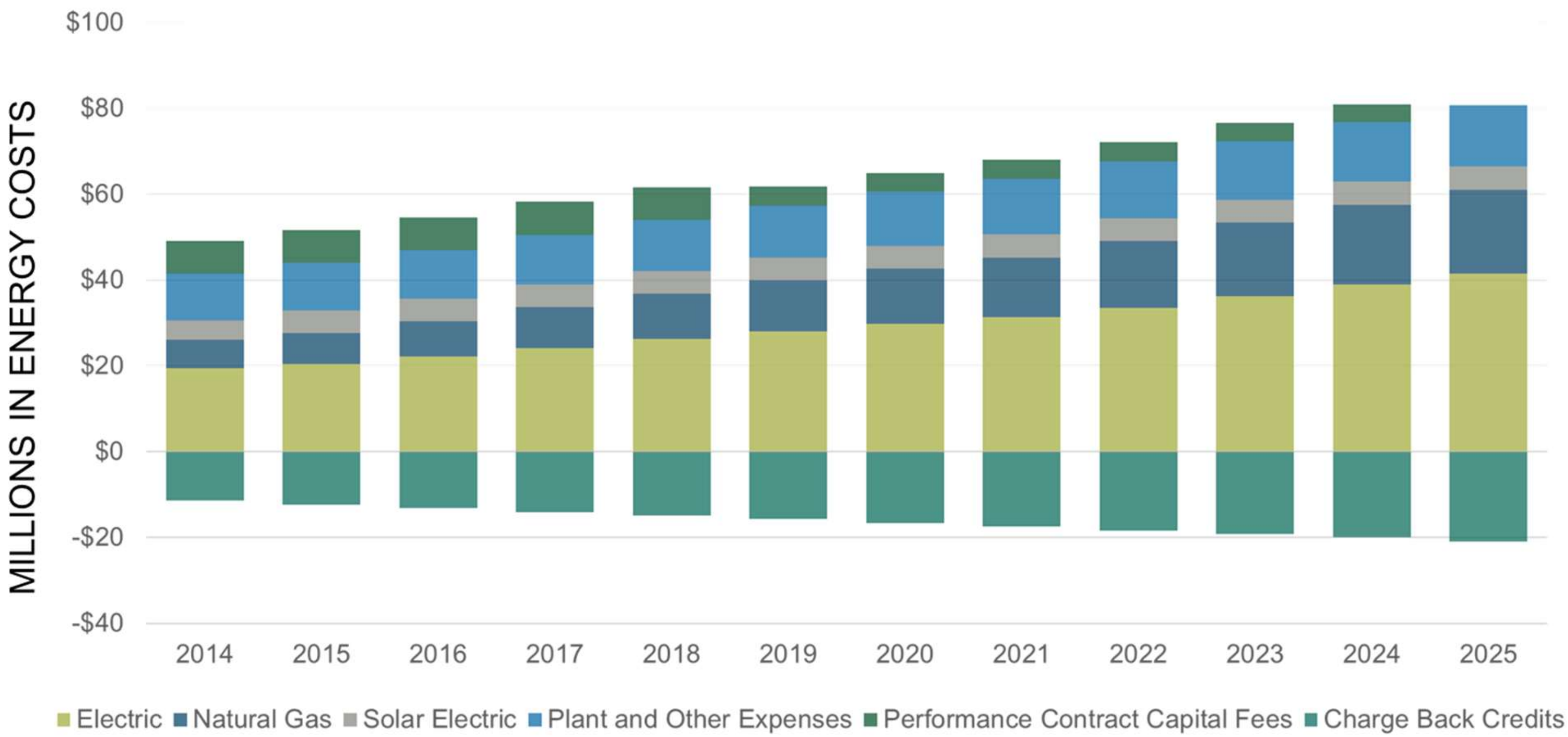
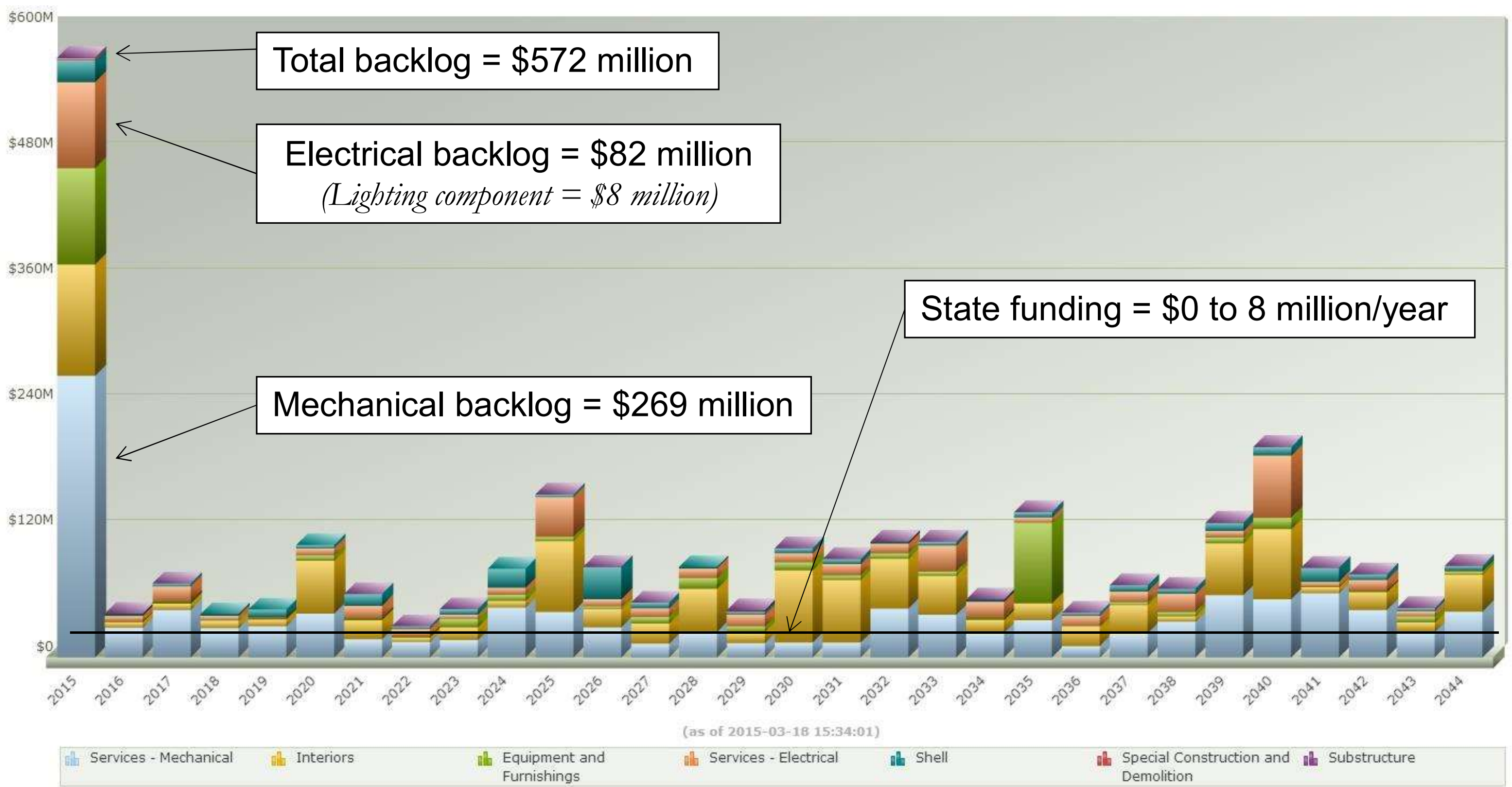
BAU forecast of ASU energy costs - $555M from 2014-2025



Backlog of deferred maintenance: cost by discipline (2015)

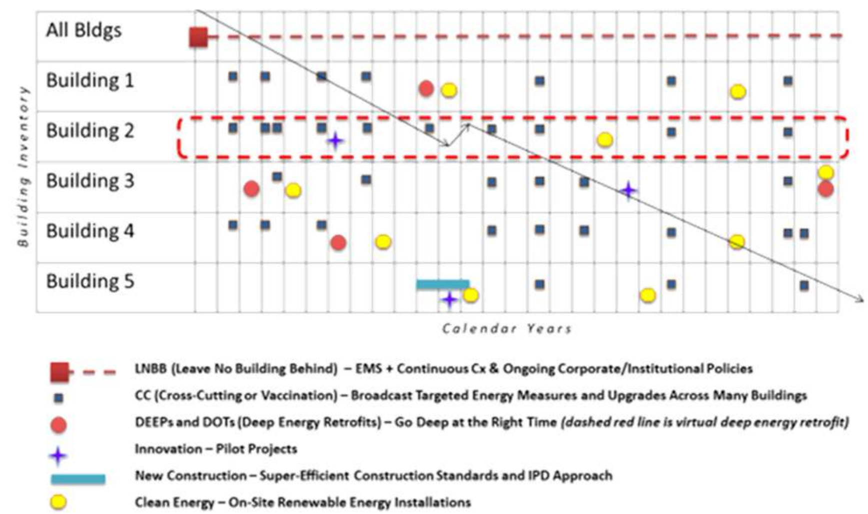
Over 60% of backlog is related to energy-using electrical & mechanical equipment.

Replacement could yield energy savings that could then be leveraged to fund other investments, which could further reduce GHG emissions.



Take a comprehensive, integrated approach to transition ASU's building portfolio to greater energy efficiency

- Portfolio strategy at ASU
  - Leveraged existing knowledge, audits, interviews
  - Assessed assets, technical potential
  - Proposed NZE / near-NZE for all new buildings
    - Visited NREL to tour ESIF and to identify process changes for performance-based building delivery
  - Strategies:
    - Continuous commissioning (CCx)
    - Cross-cutting measures (CC)
    - Deep energy retrofits (DEEP)
    - Deep energy retrofits over time (DOT)
    - On-site renewables (REN)
  - Calculated potential energy efficiency improvements
  - Targeted level of efficiency improvement:
    - 28% better than baseline
    - 37% better than baseline



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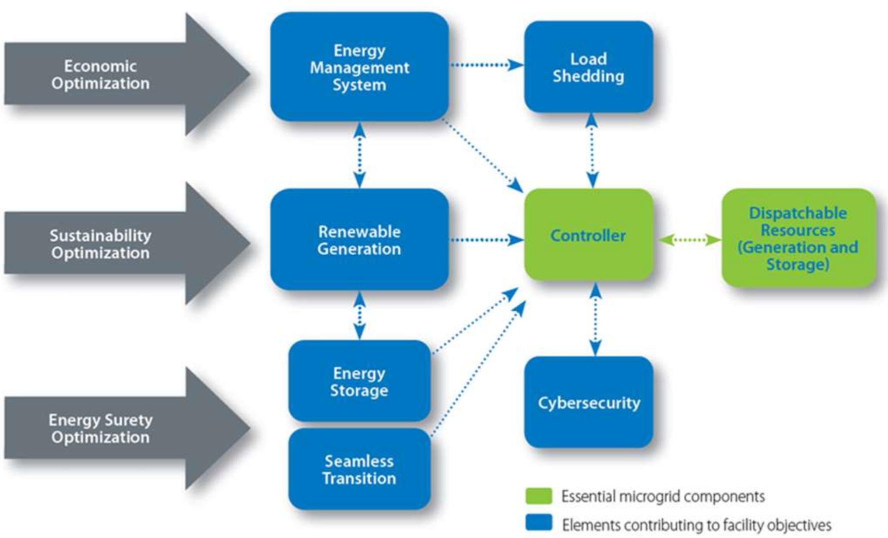
Leverage microgrids to achieve utility and customer goals

- Customer Objectives
  - Improve grid reliability, redundancy, resiliency, and flexibility
  - Gain experience designing and operating a microgrid
  - Discover associated capital and O&M requirements
  - Learn how microgrids can be used to reduce carbon emissions
  - Reduce energy costs, if appropriate
  - Learn about smart grids, DR, DER, renewable energy use and storage
  - Offer unique demonstration projects to benefit research and education goals

Microgrid Elements to Support Objectives



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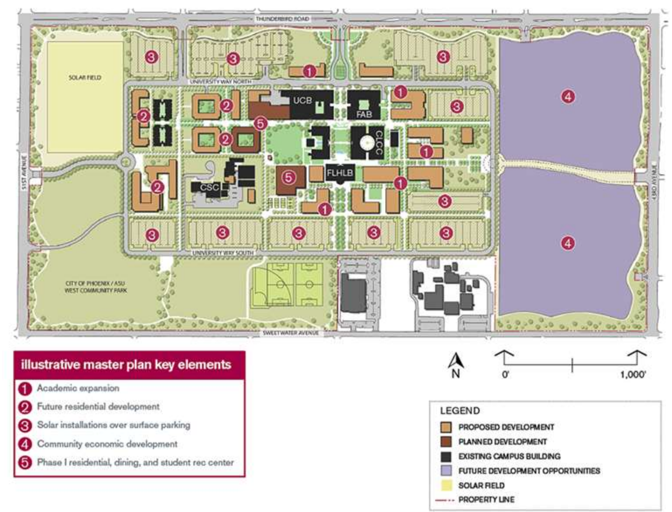

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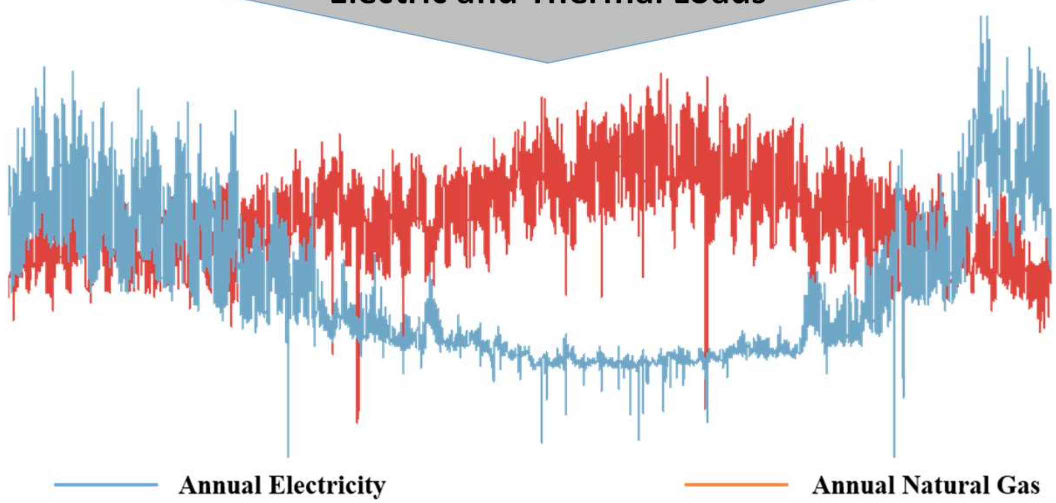
Leverage mix of tools and technologies to find the least-cost, grid-integrated approach to NZE/NZC

Conservation and Efficiency | **Solar PV and Solar Thermal** | **Wind Power** | **Biomass** | **Waste-Water Treatment Biogas** | **Energy Storage** | **CHP* and Grid Power**

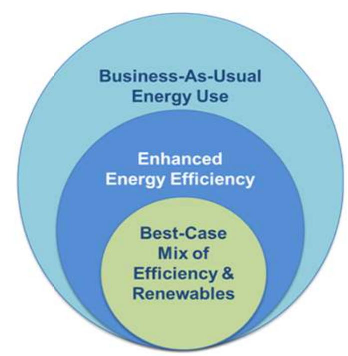
Combined to Meet Annual, Hourly Electric and Thermal Loads

Integrated Approach:

- Conservation
- Efficiency
- Sustainability
- Fuel-Switching
- Reliability
- Resiliency



Model 3 Scenarios for NZE/NZC Performance:



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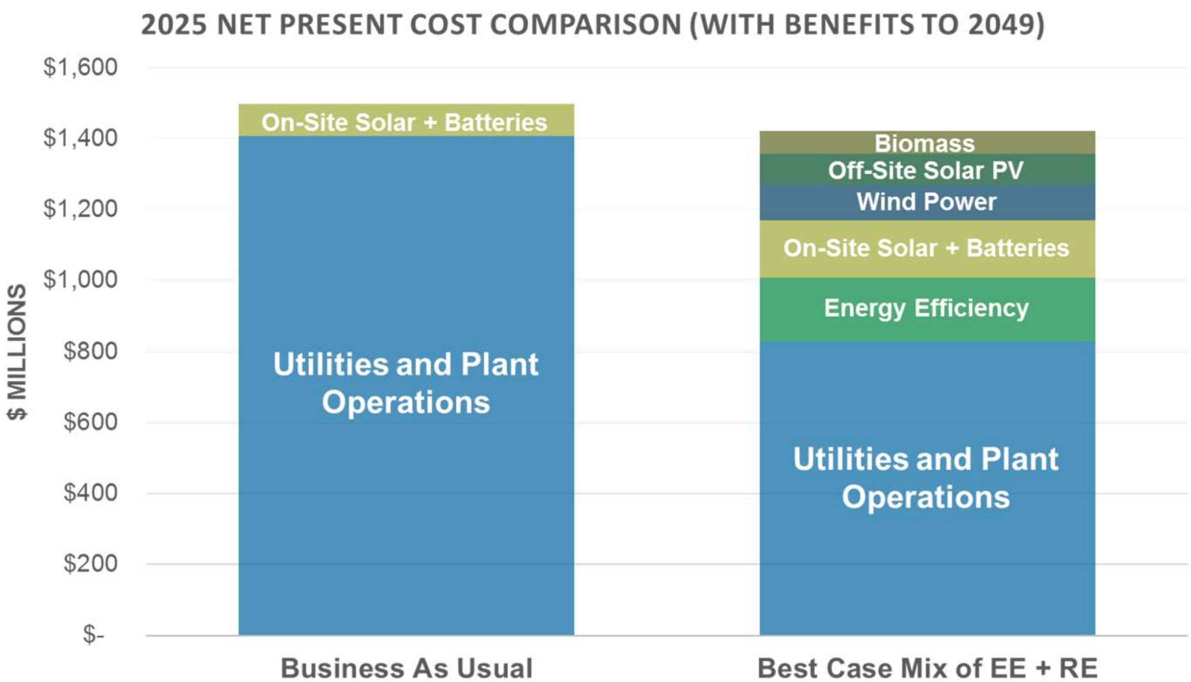
Roadmap components and strategies

Built Environment	Supply & Infrastructure	Transportation	Institutional Initiatives
• Highly-efficient new construction and renovations • Reduce dependence upon natural gas • Implement large, integrated energy upgrade programs	• Increase efficiency • On-site PV & solar thermal • Energy storage • Develop flexible microgrids • Off-site renewables	• Optimize to reduce vehicle miles traveled (VMT) • Move to efficient vehicles • Integrate alternatively-fueled vehicles & microgrid • Offsets for air travel	• GHG Emissions Management System (GEMS) • Enhance sustainable building guidelines • Engagement / behavioral programs • New financing & project delivery mechanisms

Climate neutrality roadmap: integrated approach drives results

Energy efficiency drives the economics of achieving climate neutrality



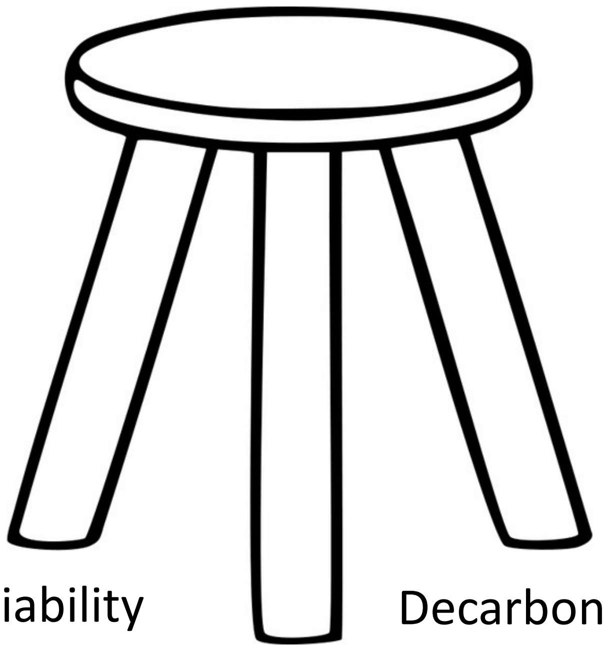
Best Case Mix – Results

Economic Benefits:
- Reduce energy costs
- Reduce deferred maintenance
- Attract students, investment, research
- Improve asset utilization
- Reduce GHG with positive Net Present Value

Social Benefits:
- Position University as a Climate Leader
- Attract other Climate Leader partners
- Lead transition to Low-Carbon Society
- Integrate & drive higher-education mission

Environmental Benefits:
- Achieve significant GHG emissions reductions
- Demonstrate path to low-carbon operations
- Engage other leaders and multiply impact

NZE and Utility Planning Objectives



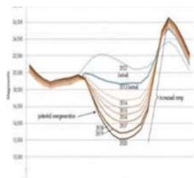
Core principles:

1. Ensuring Affordability
2. Achieving Decarbonization
3. Guaranteeing Grid Reliability

California Customer Choice; An Evaluation of Regulatory Framework Options for an Evolving Electricity Market (The "Green Book"), the California Public Utilities Commission.

Program Design Criteria – A Recent Project Example

Decarbonization



Resiliency & Reliability

Affordable Customer Rates

Economic and Workforce Development

Benefit Low Income and Disadvantaged Communities

Emergency Preparedness

The three-legged stool…

PLUS

- Economic and workforce development

PLUS

- Serving low income and disadvantaged communities

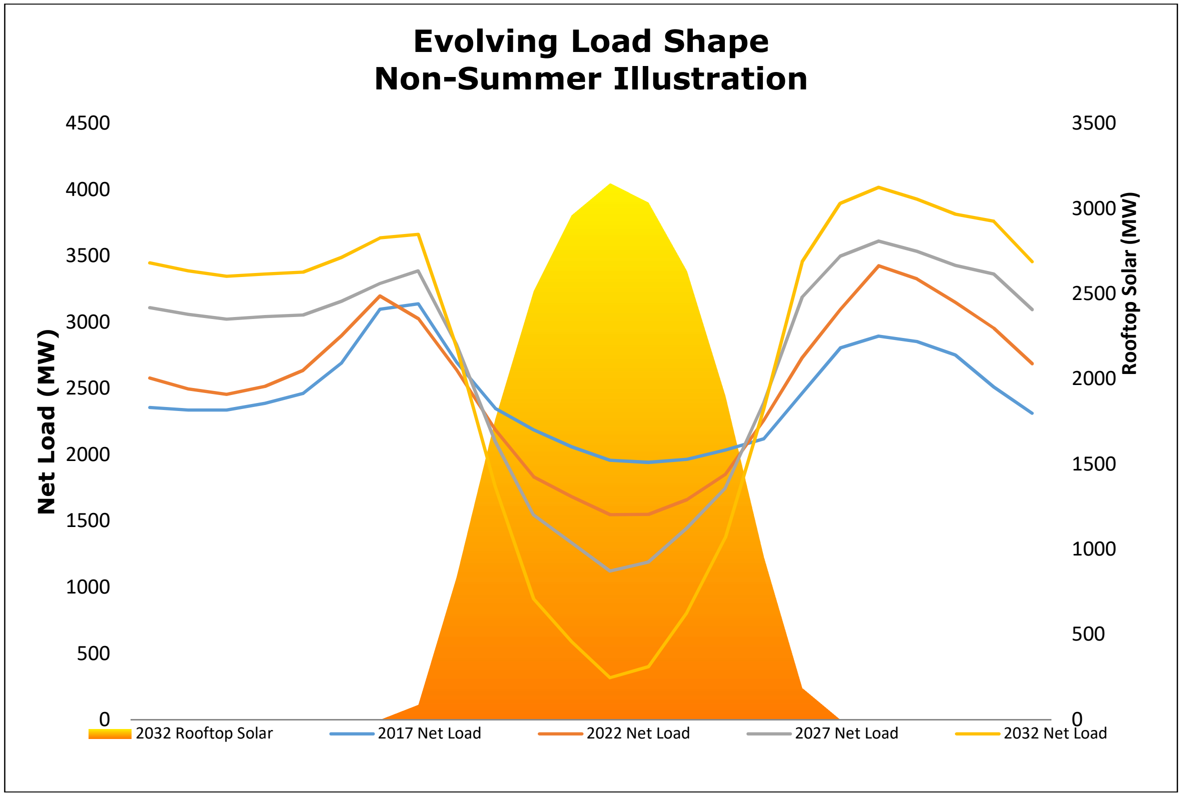
PLUS

- Emergency preparedness

The Utility Challenge (Arizona Example)

Value of energy is <u>not</u> the same for all hours of the year

- Significant reduction in net load during the daytime, non-summer seasons from solar DG
- Low or negatively priced energy during mid-day with more expensive prices ramping to late afternoon/evening



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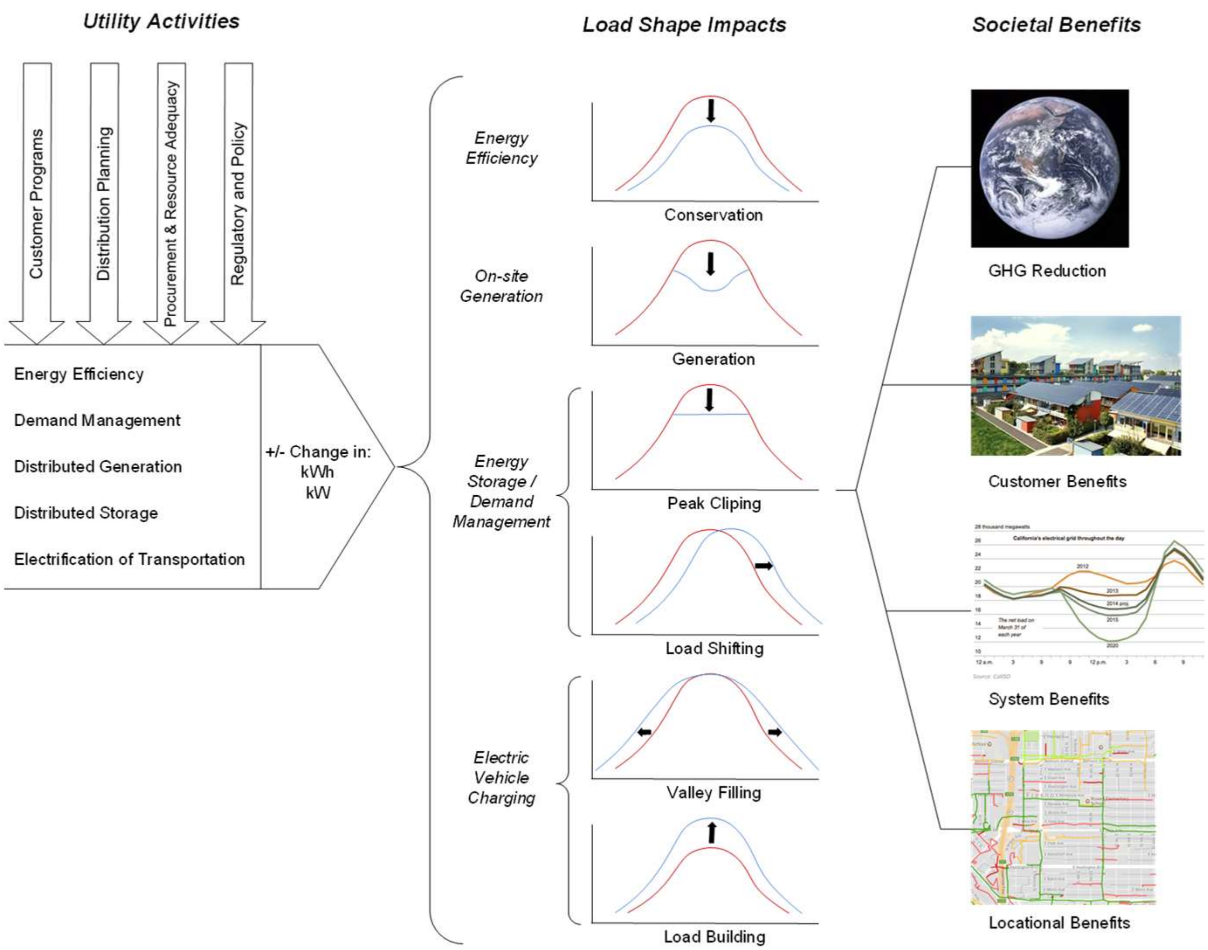
A Balanced Approach to Utility Program Design is Required



- To meet goals, customer-facing utility programs require a balance mix of intervention strategies including EE, DERs, DR, and electrification
- Locational and time dependent benefits come into sharper focus
- Consideration of individual and aggregate load shape impacts is required

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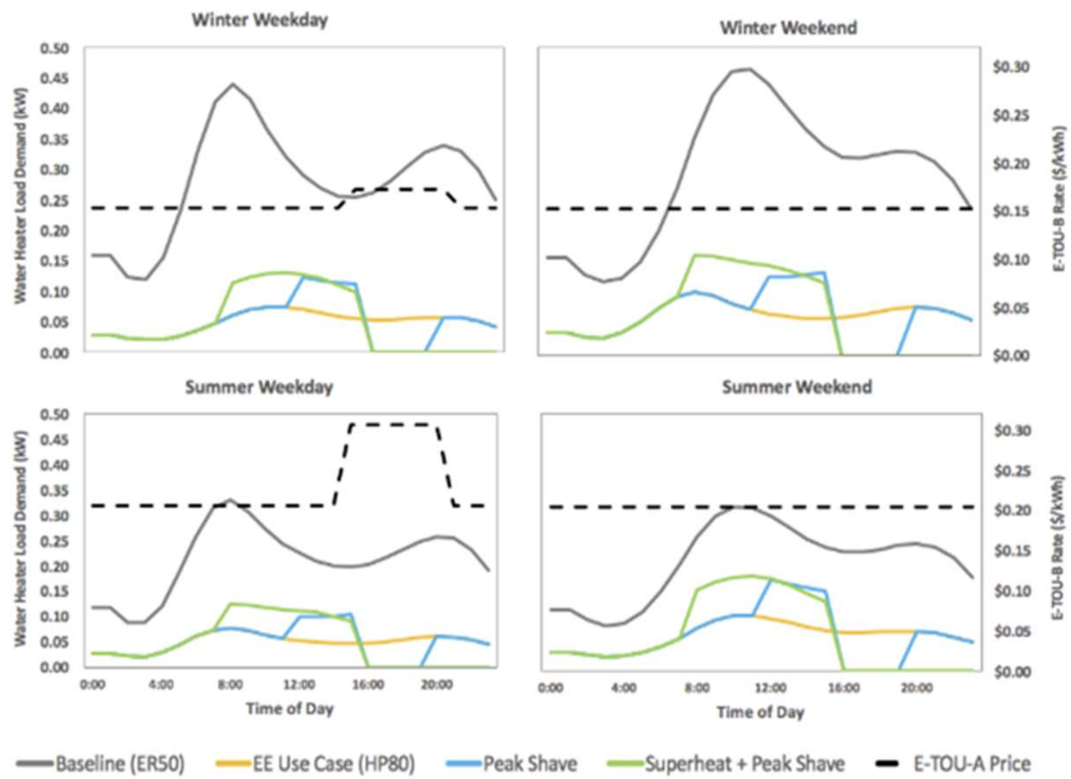
Analyze Hourly DSM/DER Savings Load Shapes

- 8,760 hourly breakdown of average DSM/DER savings impacts by:
  - End use and DSM measure
  - Segment/building type (i.e. dual fuel)
- Mapped to current and potential new DSM/DER programs
- Build savings loads shapes for each measure based on their 8760 hourly load shapes and use cases



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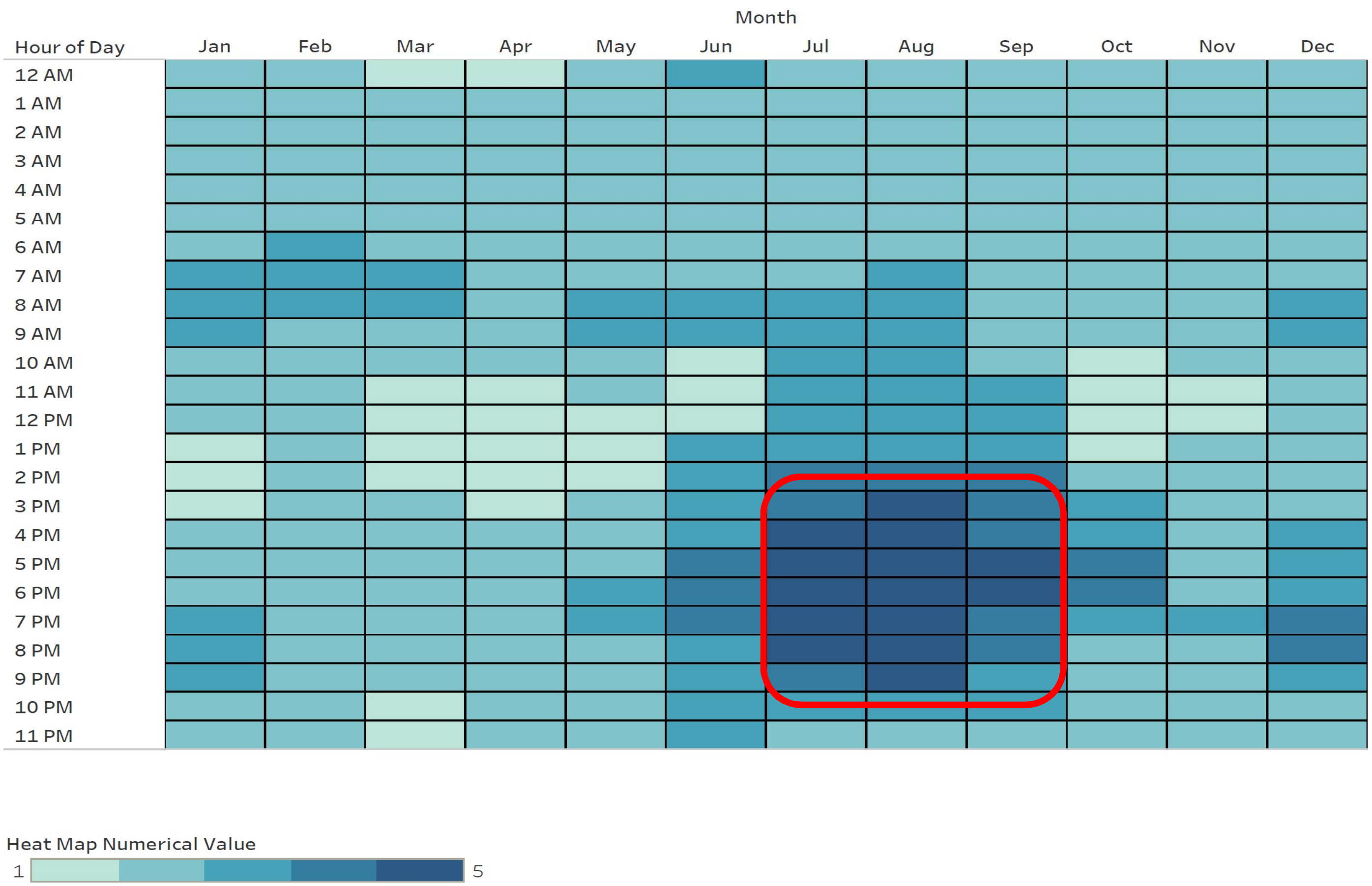
Resource Value - Marginal Cost Heat Map



Darkest shade represents the highest value hours for resource planning and the lightest shade represents the lowest value hours throughout the year.

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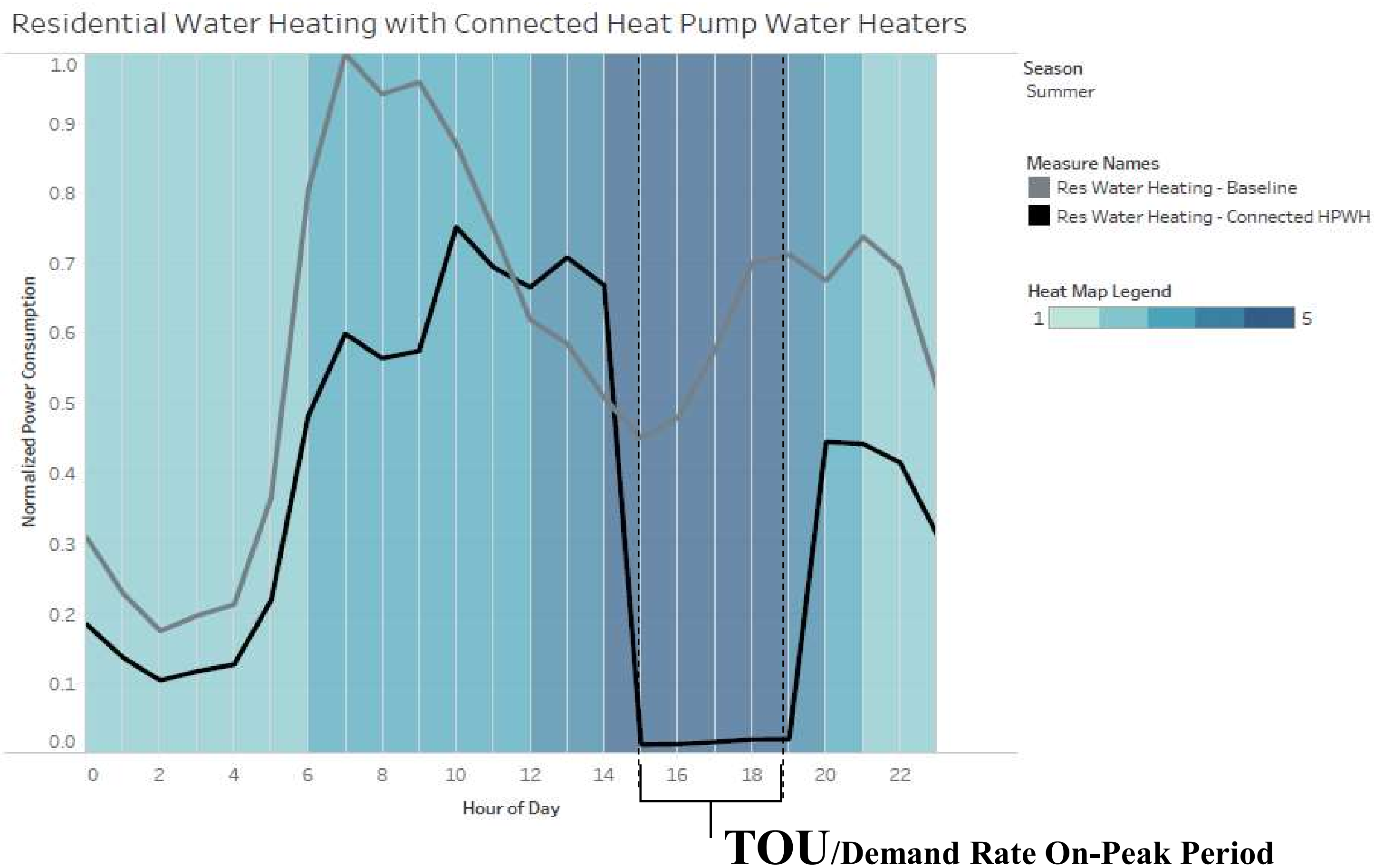
Value of DSM/DER Savings Load Shapes



Grid interactive HPWH dispatched by a utility program to help reduce early morning (6-9am) and late afternoon (6-9pm) peak demand while shifting energy use into midday hours to "fill the belly of the duck"

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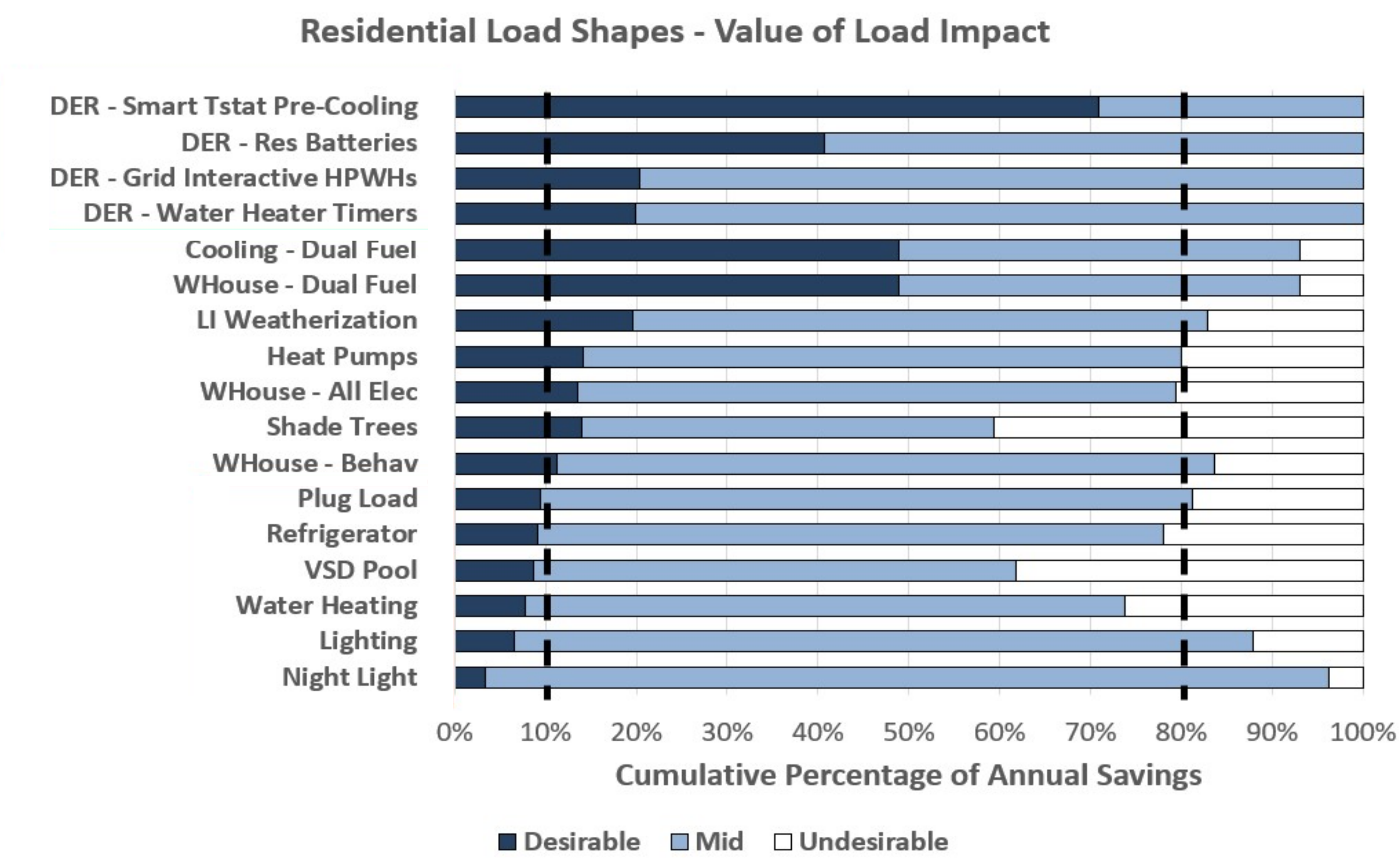
Measures with the Most Beneficial Load Shapes



From a utility resource planning perspective:

- Darkest shade shows percent of the most desirable savings, lightest shade shows least valuable
- Dotted lines show measures that provide <10% of desirable times, or >20% during least valuable.

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An Evolving Utility Sector Paradigm

Current Planning Trend

- A focus on time and locational value of savings
- Time valued EE and DER at targeted hours
- Emphasis on demand management
- What about solar? + storage?
- Planning for electrification

Carbon Free Future

- Continued focus on time and locational value of savings
- EE all the time and lots of it
- As much solar as we can get + storage
- Continued emphasis on smart demand management
- Strategic electrification…how to integrate transportation?

Cost-effectiveness Testing

Which tests to use when?

The California Standard Practice Manual lays out test methods that have been the standard for analyzing the cost-effectiveness of utility programs for decades.

The Total Resource Cost (TRC) Test has been the benchmark standard in CA for **energy efficiency** programs...but was not designed to be used with electrification/DER/decarbonization programs.

The Resource Value Test (RVT) developed by the National Efficiency Screening Project provides a structured but flexible alternative approach to assessing the cost-effectiveness of NZE programs grounded in the utility's policy priorities.

	Participant Cost Test	Rate Impact Measure Test	Total Resource Cost Test	Societal Cost Test	Program Admin. Cost Test	Resource Value Test
Program Admin. Costs						
Incentives/Rebates						
Incr. Supply Costs						
Net Participant Costs						
Bill Increases						
Revenue Loss						
Avoided Costs						
Bill Reductions						
Revenue Gain						
Tax Credits						
Environmental Benefits						
Economic Development						
Reduced Arrearages/Disc.						

Benefits

Costs

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Thank you!

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