ET Summit 2023

CalNEXT

ENERGIZING CALIFORNIA'S FUTURE

Presented by

ETCC EMERGING TECHNOLOGIES COORDINATING COUNCIL

Intro and Overview of CalNEXT

1:20-1:35 PM PT

Cassidee Kido, Energy Solutions

CalNEXT ENERGIZING CALIFORNIA'S FUTURE

Energy Solutions

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aesc alternative energy systems consulting

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TRC

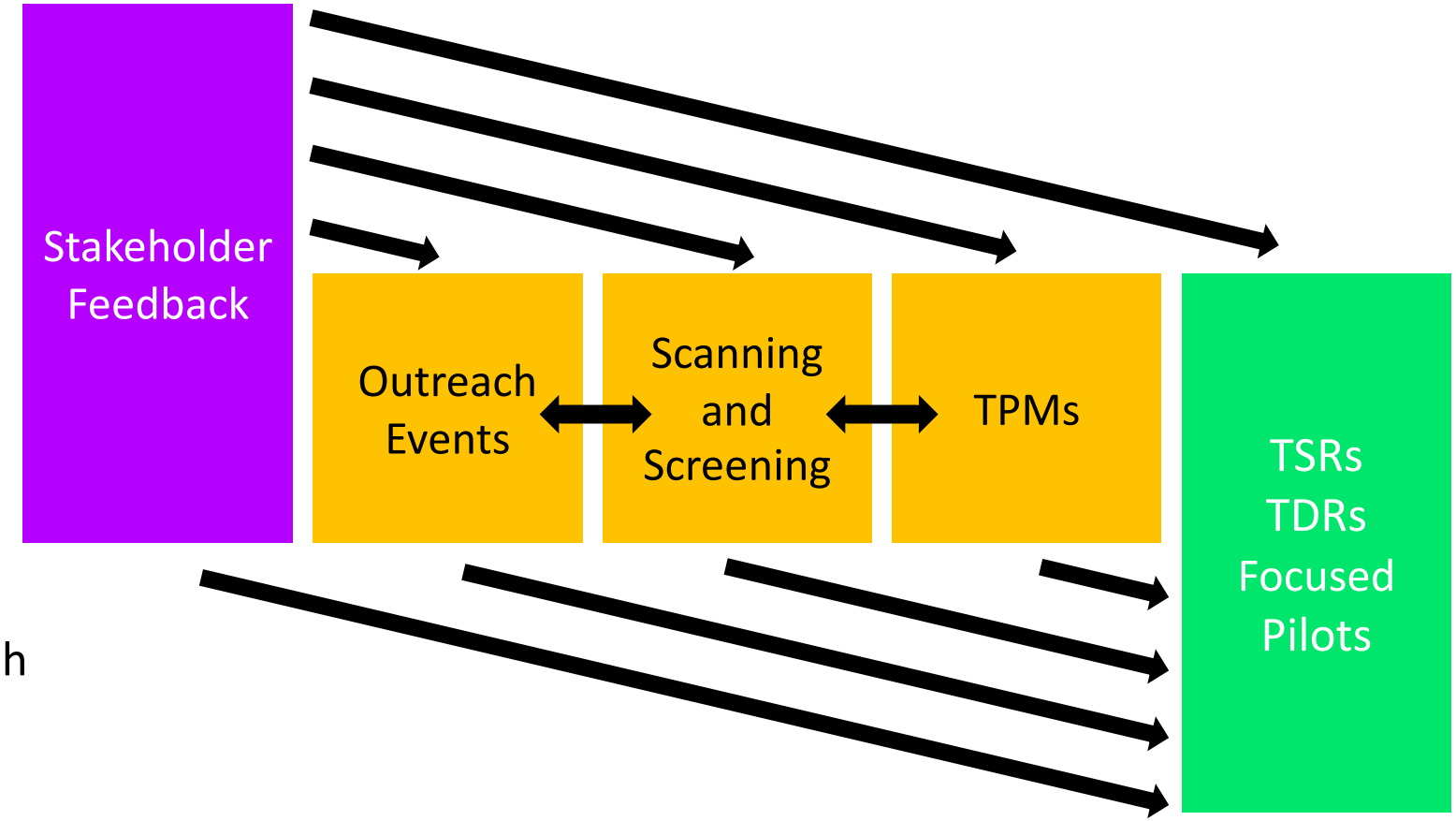
UCDAVIS UNIVERSITY OF CALIFORNIA

Technology Priority Maps (TPMs):

- HVAC
- Plug Loads and Appliances
- Water Heating
- Lighting
- Process Loads
- Whole Building

Project Types:

- Technology Support Research (TSR)
- Technology Development Research (TDR)
- Focused Pilots



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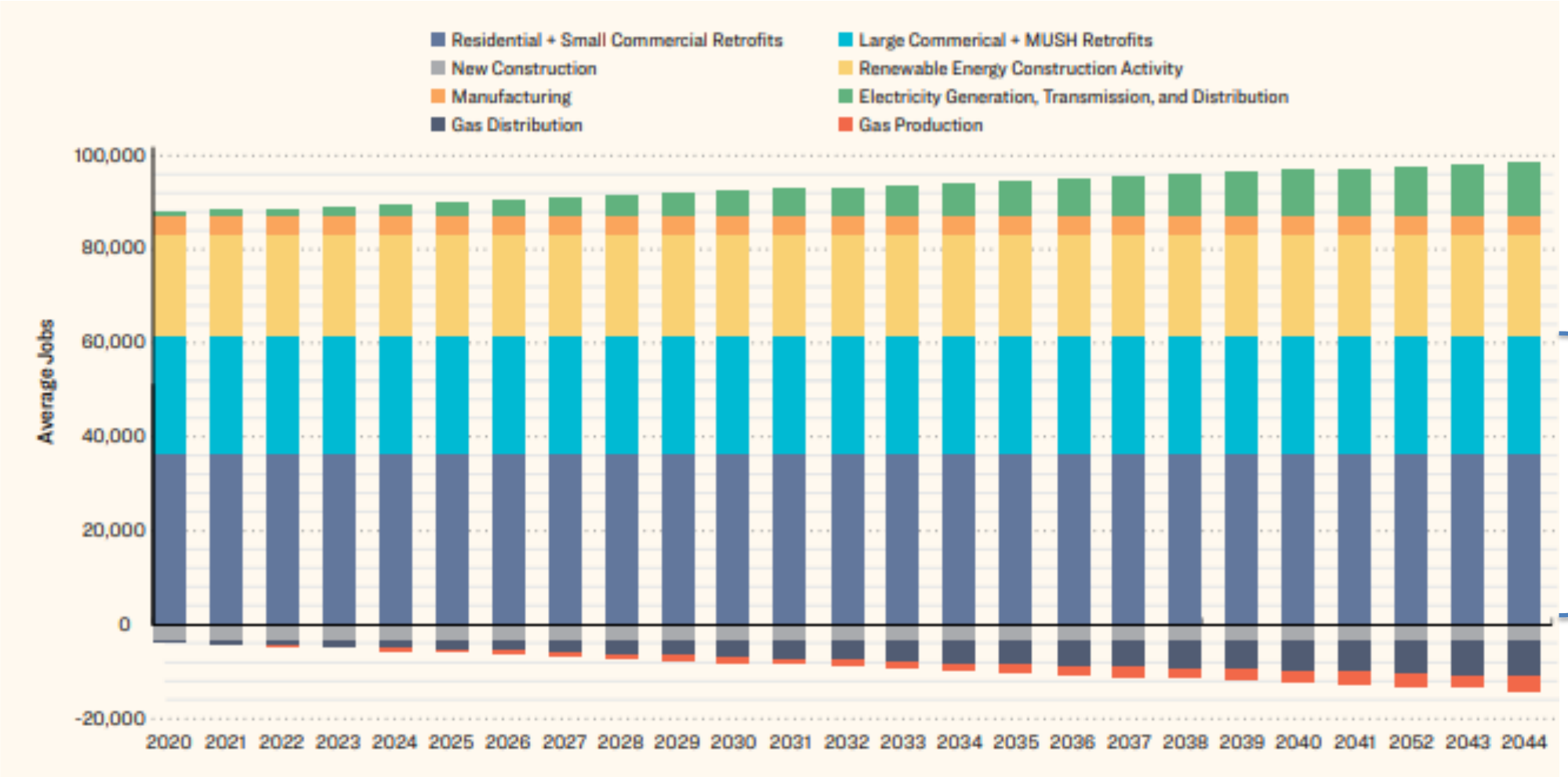
Workforce Development and Infrastructure

1:36-2:35 PM PT

Tim Minezaki, Energy Solutions

Workforce Challenges in Electrification

- Both policymakers and technologists have been rapidly moving toward building decarbonization to meet the State of CA's ambitious climate goals.
- Electrification of existing buildings in the State of CA by 2045 is estimated to add 60,000 jobs in the building trades alone.
- Simultaneously, there's been an ongoing worker shortage in trades



42,000 to 80,600 new jobs in existing building electrification

Source: California Building Decarbonization – Workforce Needs and Recommendations (2019) (UCLA Luskin Center for Innovation)

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Air Conditioning | Heating | Refrigeration
theNEWS

HVAC CONTRACTING | NEWS | BUSINESS MANAGEMENT

A 'Gray Tsunami' Is Hitting the HVACR Industry

Older techs are retiring in droves, but finding ways to keep them around could be beneficial

Ongoing Problem

While the labor shortage has been a problem for years, the pandemic definitely made it worse. That can be seen in the labor-force participation rate (PDF), which was 63.3% pre-pandemic and as of March 2022, was only 62.4%. While the entire labor force is smaller than it used to be, the issue is even more severe in construction, said Anirban Basu, chief economist of Associated Builders and Contractors (ABC) at Construction Executive's 2022 Q1 Construction Economic Update and Forecast webinar.

That's because the construction industry workforce tends to be a bit older than the overall workforce, said Basu, as baby boomers have played a larger part in industries like construction and manufacturing. And at the beginning of the pandemic, they started retiring in droves, often due to health concerns.

FEWER WORKERS: The entire labor force is smaller than it used to be pre-pandemic, but the issue is even more severe in construction. (Courtesy of Professional HVAC/R Services Inc.)

"These are often our finest construction workers, and they have been in the industry for decades," he said. "They have honed their craft over the course of decades, and they're committed to the mission. They take enormous pride in working with equipment. They take enormous pride in seeing tangible outcomes for their efforts. These are people who took shop class in high school, and they learned early in life to love working with their hands and minds at the same time. But many of them are now retired or retiring. And so we are left with the younger generation to fill available job openings. Recently there have been about 400,000 available unfilled jobs in the U.S. construction industry. The U.S. is searching for talent, high and wide."

Electric Infrastructure Needs: Current & Future

- Data from TECH Clean CA found less than 10 percent of homes need panel upgrades for Heat Pump Water Heaters and less than 4 percent need them for HVAC Space Heating.
- As buildings continue to electrify more and more end-uses, electrical infrastructure is expected to be more constrained.

Product Group	Panel Upgrades	Homes Requiring Upgrade, %	Total Homes
HPWH	181	9.7%	1,873
HVAC	370	3.9%	9,541
Total	**551**	**4.8%**	**11,414**

How can new technologies help address these challenges?

- CalNEXT is researching new solutions to address these challenges and hopefully bring them into future utility programs.
- Today you'll hear details of a few projects under implementation by CalNEXT and we'll also look into other areas we see opportunities.

Market and Technical Evaluation of Multifamily In-Unit Heat Pumps

Chris Badger / Project Lead

HVAC TPM

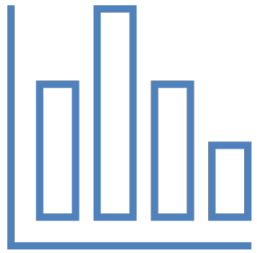
High-Efficiency HVAC Heat Pumps / 110V Heat Pumps

Technology Support Research

Why Focus on In-Unit Heat Pump Options

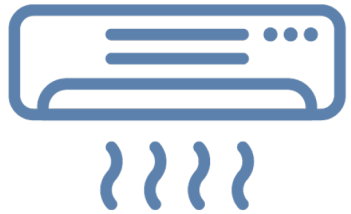
- CA multifamily buildings ~ 560k units with room A/C and 1.8M with no A/C
- Urgent need for equitable cooling and replacement of aging wall-hung gas/electric furnaces
- DIY options to reduce burden of limited capacity of HVAC contractors
- Building specific limitations on outdoor equipment
- Increase heat pump affordability for lower income households

Project Components



Data analysis of market size, building typology, and geographic distribution.

Interview manufacturers and multifamily stakeholders on barriers and technology solutions.



Evaluation of in-unit heat pumps (energy savings, installation type, test procedures, and specifications).

(R)Evolution of In-Unit Heat Pumps

Single-packaged
Vertical Heat Pump

Packaged Window
Heat Pump

Packaged Terminal
Heat Pump

- New packaged heat pump solutions
  - Address installation & affordability gaps
  - Offer cold climate, heat recovery, and alternative mounting options
  - Plug-in 120V options address electrical panel/service limitations

Modeled Savings for In-Unit Heat Pumps

	Baseline						Improved
	Gas Heat (67 AFUE)			Electric Heat (100% Eff)			
	With Cooling		No Cooling	With Cooling		No Cooling	
	9.8 EER	11 EER		9.8 EER	11 EER		
Total Energy (Mbtu)	60.0	59.4	49.5	50.1	49.5	41.1	38.7
% energy savings	35%	35%	22%	23%	22%	6%	
Utility Cost ($)	1,825	1,785	1,388	2,759	2,719	2,182	1,998
% cost savings	-10%	-12%	-44%	28%	27%	8%	
% emissions savings	35%	34%	21%	23%	22%	6%	

- Modeled energy performance an in-unit heat pump replacement of conventional gas and electric furnaces with/without cooling
- Up to 35% reduction in energy use and emissions

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Defining a Pathway for In-Unit Heat Pumps

- Limitations and gaps in existing federal standards, test procedures and voluntary specifications (e.g. CEE and ENERGY STAR®)
- Need for lab testing & in-situ performance evaluations to inform specification development

Regulations, Standards, Industry Listings					
Equipment Type	**Applicable Federal Regulation**	**Performance Metrics**	**AHRI Testing Standard**	**CEE Listing**	**NEEP Listing**
Window AC / HP	10 CFR §430 Subpart B Appendix F	CEER, Capacity	N/A	No	No
SPVAC/ SPVHP	10 CFR §431.96 Appendix G/G1	EER, COP, IEER, Capacity	AHRI 390	Yes	Yes
PTAC / PTHP	10 CFR §431.96 Paragraph (g)	EER, COP, Capacity	AHRI 310/380	Yes	Yes

- Project Final Report – Due October 2023
- Path Forward
  - Emerging “Micro” Heat Pumps: Testing and Heating Performance Metrics (CalNEXT)
  - Consortium Energy Efficiency 2023 Super Room Conditioner Initiative
  - New York Clean Heat for All Challenge

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Technology Priority Maps (TPMs)

Tim Minezaki

Workforce & Infrastructure Challenges

HVAC, Water Heating, and Whole Building TPMs

Technology Priority Maps

Technology Priority Maps Overview

Technology Priority Maps (TPMs) define what topics CalNEXT is most interested in researching and aim to provide actionable guidance to prospective research teams.

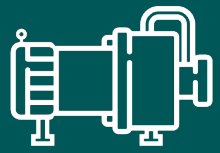
Whole Buildings

Water Heating

HVAC

Lighting

Appliances & Plug Loads



Process Loads

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HVAC TPM

How can we to reduce complexity and cost of Advanced Controls?

Are “Micro” heat pumps ready for prime time?

Can new digital tools help ensure quality installations by contractors?

2023 Technology Research Areas	Role	Priority
High-Efficiency HVAC Heat Pumps	LEAD	HIGH
Scalable HVAC Controls Deployment	LEAD	HIGH
Hybrid or Fully Compressor-less HVAC	LEAD	HIGH
Heat Pump Market Development	LEAD	HIGH
HVAC Design for Decarbonization	LEAD	HIGH
Scalable Thermal Storage	LEAD	HIGH
110V/120V Heat Pumps	LEAD	HIGH
Installation, Operations & Maintenance	LEAD	MEDIUM
Refrigerant Management & Low GWP Transition	COLLABORATE	MEDIUM

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Water Heating TPM

Where can 110V/120V products address electrification barriers?

How can software tools and design guides support trades?

2022 Technology Research Areas	Role	Priority	
Residential-Duty Water Heaters	LEAD	HIGH	+
Commercial-Duty Water Heaters	LEAD	HIGH	+
Grid Integration & Market Intervention	LEAD	MEDIUM	+
Alternative Design Strategies	LEAD	MEDIUM	+

Whole Building TPM

How can smart panels, circuit-sharing devices, and other load management strategies support electrification?

Can high-quality all-electric manufactured housing be a solution for California?

2022 Technology Research Areas	Role	Priority
Integrated Systems	LEAD	HIGH
Electrical Infrastructure	LEAD	HIGH
Design & Construction	LEAD	HIGH
Operational Performance	LEAD	MEDIUM
Envelope	COLLABORATE	MEDIUM
Community Scale Strategies	OBSERVE	LOW

- Our latest TPMs are published on our website at Calnext.com/resources

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Emergency Replacement Heat Pump Water Heater Market Study

Chris Badger / Project Lead

Water Heating

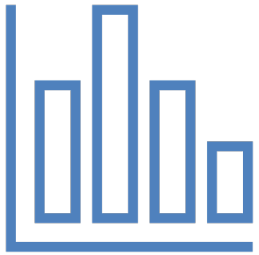
Residential-Duty Water Heaters

Technology Support Research

Emergency Replacements – The Elephant in the Water Heater Closet

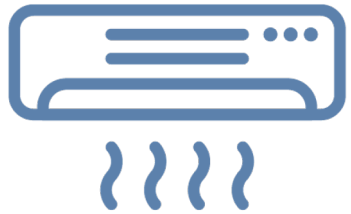
- Emergency replacements represent up to 90 percent of water heater installations
- Increased cost, complexity, and installation time limit HPWH conversions
- Electrical contractor and permitting requirements prevent same day hot water restoration by a plumbing service technician
- How can understanding contractor and customer decisions and introduction of new technology, training, and installation practices increase HPWH conversions

Project Components



Track contractor water heater installation and customer engagement data.

Interview plumbing contractors and customers on emergency replacement decision paths.



Test alternative technology and processes impact on HPWH conversion rates.

Tracking Emergency Replacement Decisions

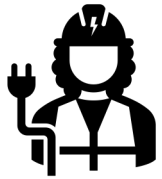
Water Heater Emergency Replacement

SITE BARRIERS

Location, electrical service needs, space limitations, water usage

Cost, rebate processes, permitting, electrical contractor, staff capacity

PROCESS BARRIERS



SAME DAY HOT WATER OPTIONS

"Like-for-like", 120V HPWH (dedicated/shared), 240V HPWH, gas loaner

HPWH Conversions – Tracking Success

- TECH Clean California 2021 Quick Start Grant
  - Gas loaner pilot project tested temporary bridge for HPWH installs
  - Increase in gas to HPWH conversions from 1% to over 17% (127 gas loaners)
  - Post-project conversions increased to over 50% with 120V HPWH option
- Tracking contractor conversion rates vs. customer site and contractor process data

- Project – In Process
- Resources
  - TECH Public Reporting Barnett Plumbing (techcleanca.com)
  - TECH Public Reporting New Buildings Institute (techcleanca.com)

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Q&A

Coordination Efforts with other Programs and Initiatives

2:36-2:51 PM PT

Cal TF Coordination and Collaboration

Greg Barker

Emerging Technologies projects that encompass

Emerging Market Practices

Emerging Program Designs

Emerging Portfolio Needs

CalNEXT Technology Transfer Relationships

Official Source and Standard for Deemed Measure Data
Provides clear measure data framework for CalNEXT activities

eTRM

Maintains Deemed Measure data in eTRM
Knowledge of needs of IOUs, POUs, CCAs, and RENs

IOU/POU Engineers

Coordinate Measure Engineering and eTRM submittals
Manages update process for program cycles

Efficiency Program Implementers

Depend on eTRM measures for program success
Includes IOUs, Statewide Program Implementers, RENs, CCAs

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CalNEXT Collaborations

eTRM

CALIFORNIA TECHNICAL FORUM

IOU/POU Engineers

Efficiency Program Implementers

Evaluating project concepts and ET-to-measure processes with Cal TF engineering staff

Sharing eTRM measure ideas with the Cal TF Measure Screening Committee

Fast Tracking Deemed Measure project approvals for DEER update timelines

Review stakeholder needs with IOU Engineers and Program Implementers

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CalNEXT Outcomes

1. ET22SWE0036 - Heat Pump Water Heater (HPWH) Sizing

   "Providing incentives for non-like-for-like hot water tank retrofits is a critical step towards meeting California's decarbonization goals."

   - CalNEXT project was initiated in early 2022 and completed in December 2022
   - Measure updates were completed in eTRM in Spring 2023 to allow tank upsizing common with conversion from gas to HPWH

2. ET23SWE0024 - Heat Pump Baseline Systems Assessment Project

   Will suggest new eTRM measure offerings for Heat Pump HVAC systems. These offer both heating and cooling, so new baselines are needed outside existing HVAC deemed measure offerings.

   - CalNEXT project was initiated in June 2023
   - Final report is expected in December 2023 to inform eTRM updates due in Spring 2024

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CalMTA Coordination and Collaboration

Marisa Lee

Coordination Efforts with

other Programs and Initiatives

Market Transformation Partners

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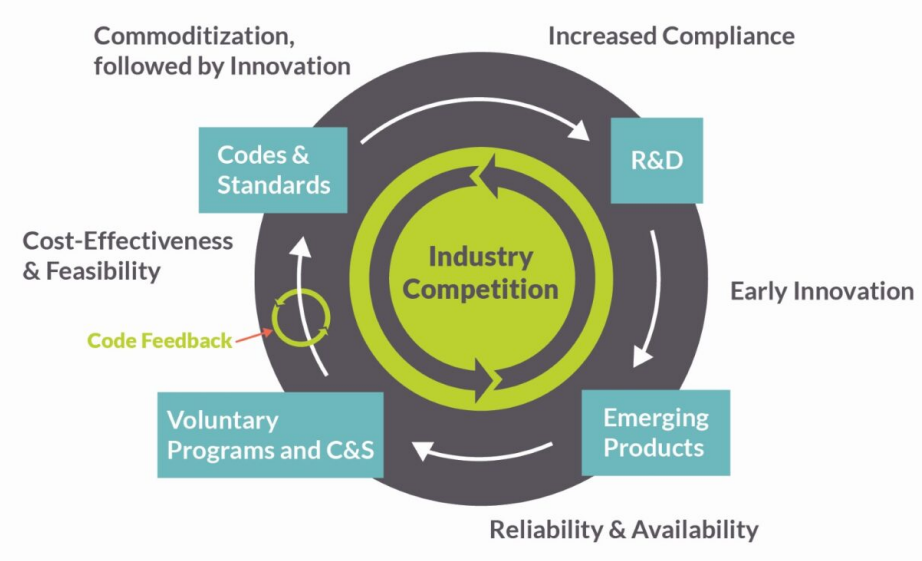
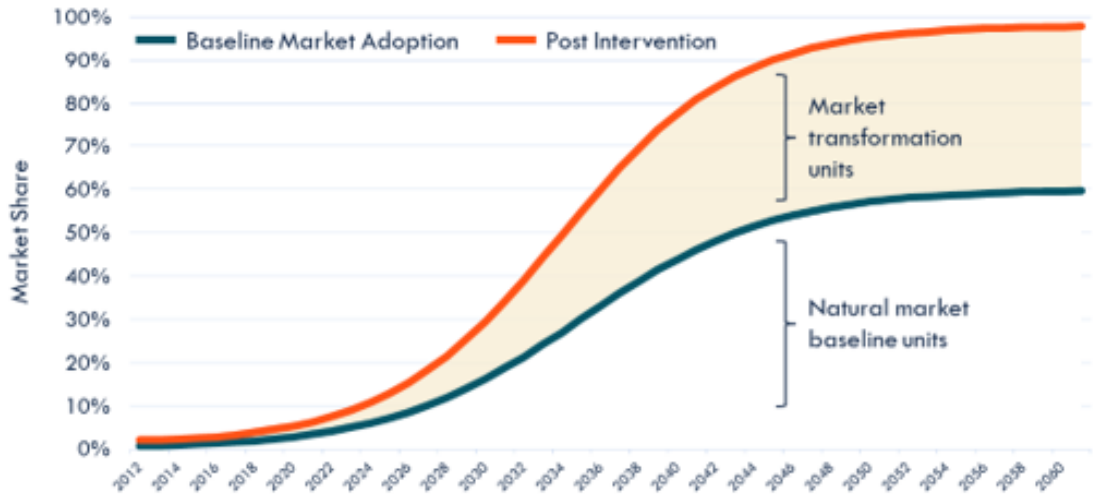
CalMTA





Source: CalNEXT / Energy Solutions

Source: CalMTA / Resource Innovations

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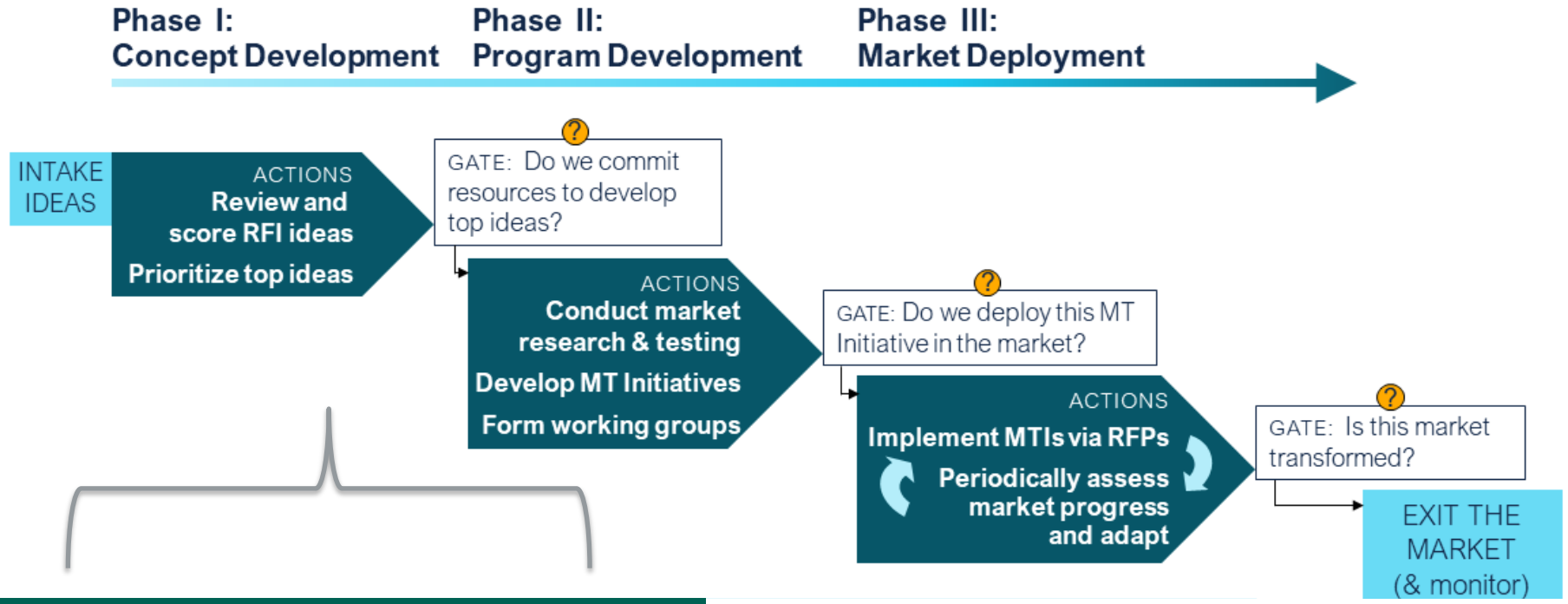
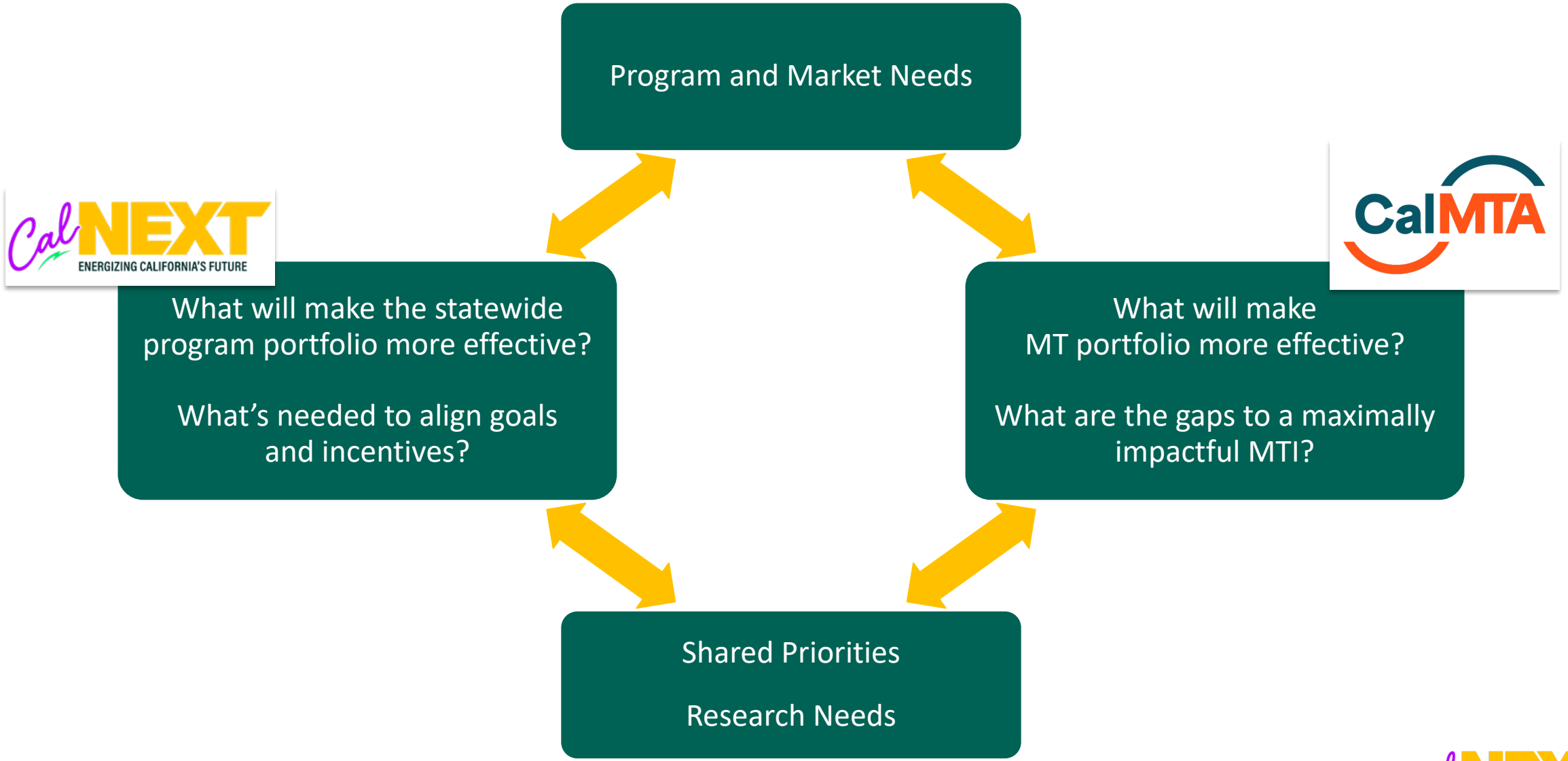
Strengths and Strategies

Project	CalNEXT ENERGIZING CALIFORNIA'S FUTURE	CalMTA
Selection	• Quarterly • Ongoing (Fast Track)	• Multi-phased development
Length	• 6-18 months	• Multi-year
Criteria	• Program criteria • TPMs (updated yearly) • Tech Transfer • EE Program Need	• Program criteria • MT Advisory Board • Existing EE Programs • Market Engagement

Supporting the CalMTA Process



- Market Research & Characterization
- Energy Modeling
- Technology Testing & Demonstration
- Focused Pilots
- ISP
- Workpapers
- Measure Package Development


Program and Market Needs
What will make the statewide program portfolio more effective?
What's needed to align goals and incentives?
What will make MT portfolio more effective?
What are the gaps to a maximally impactful MTI?
Shared Priorities
Research Needs

More info

- CalNEXT Insights into the CalNEXT Project Selection Process
  - Link to Slides
  - Link to Recording
- CalMTA MTI Development Process
  - Selection Criteria

Acknowledgement: Thank you to Elaine Miller and Stacey Hobart at CalMTA

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Q&A

CalNEXT Projects Outside of Summit Initiatives

2:52-3:20 PM PT

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Advanced Multifamily EV Load Management System

Ryan Bird

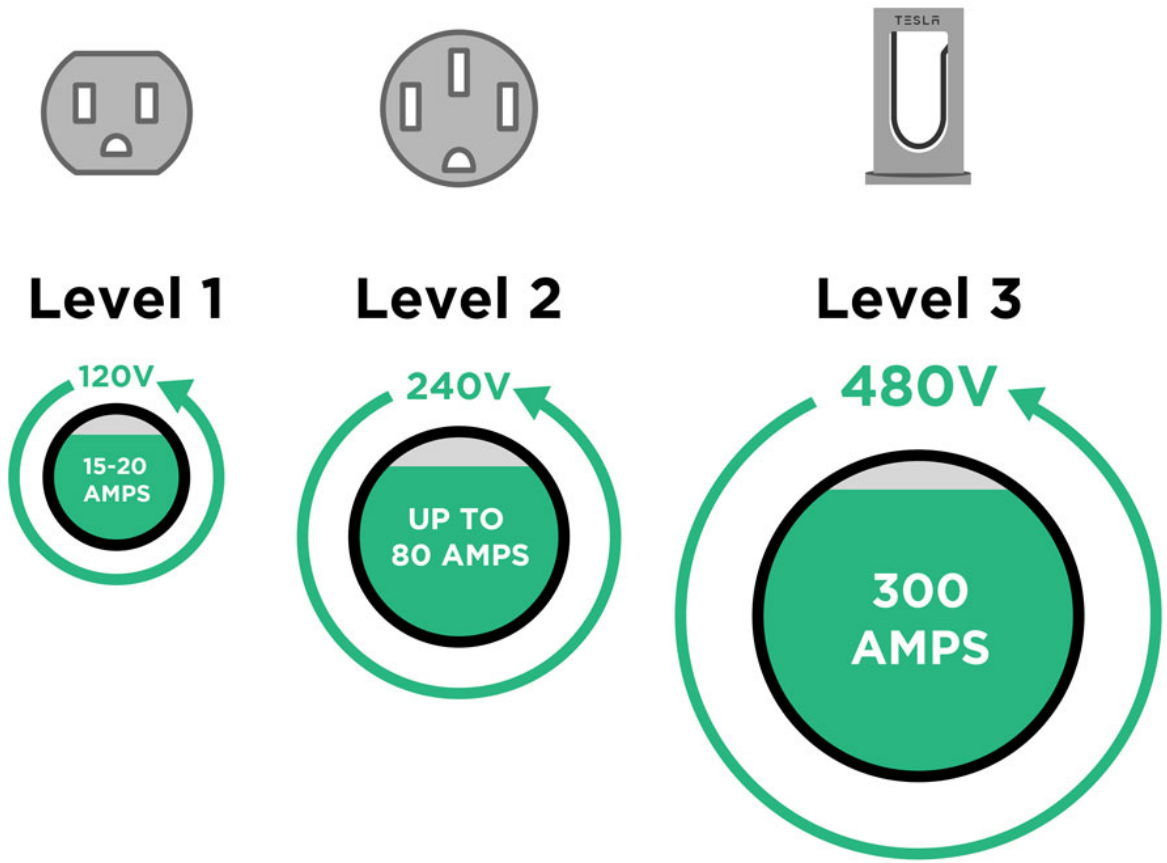
Process Loads & Appliances

Electric Vehicle Supply Equipment

TDR

Why Multifamily EV charging?

- Significantly less EV adoption than single family homes
- Challenging business case with multiple stakeholders
- Most buildings are capacity-constrained, increasing service is extremely expensive and time-consuming
- Traditional L2 solutions are often underutilized and can create tenant conflict



Source: NeoCharge

Deploying GoPowerEV at 4 multifamily sites:

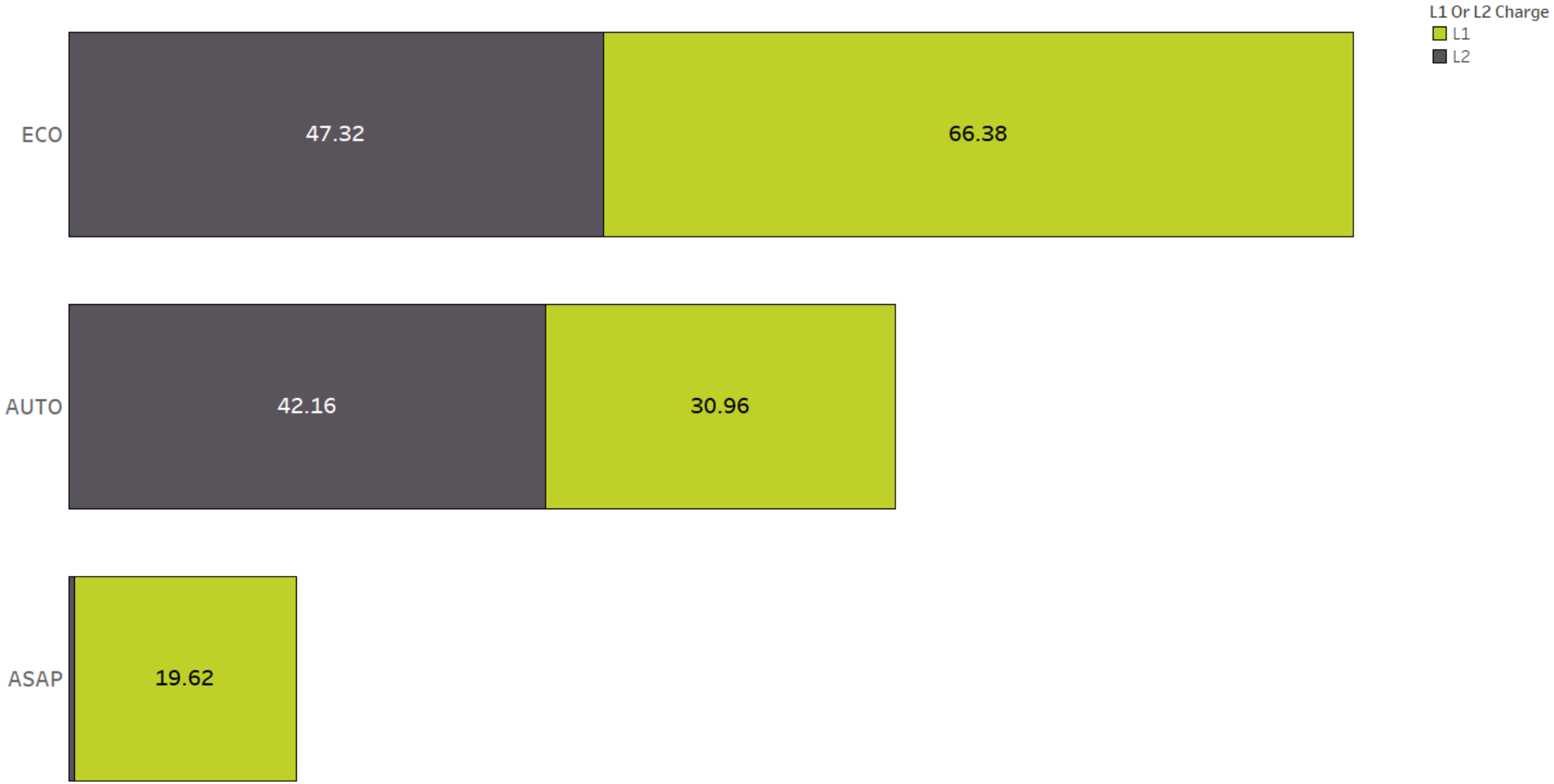
- Dedicated panel for EV charging
- 4-20 GPEV charging bases (minimum 8-12 parking spaces with EV charging access)

GoPowerEV features:

- Access for 2-3 parking spaces on a single 20A circuit
- Wireless mesh network with single gateway helps address WiFi issues
- Easier to maintain than Level 2
- TOU-aligned load shifting
- 3 different modes: Eco, Auto, and ASAP

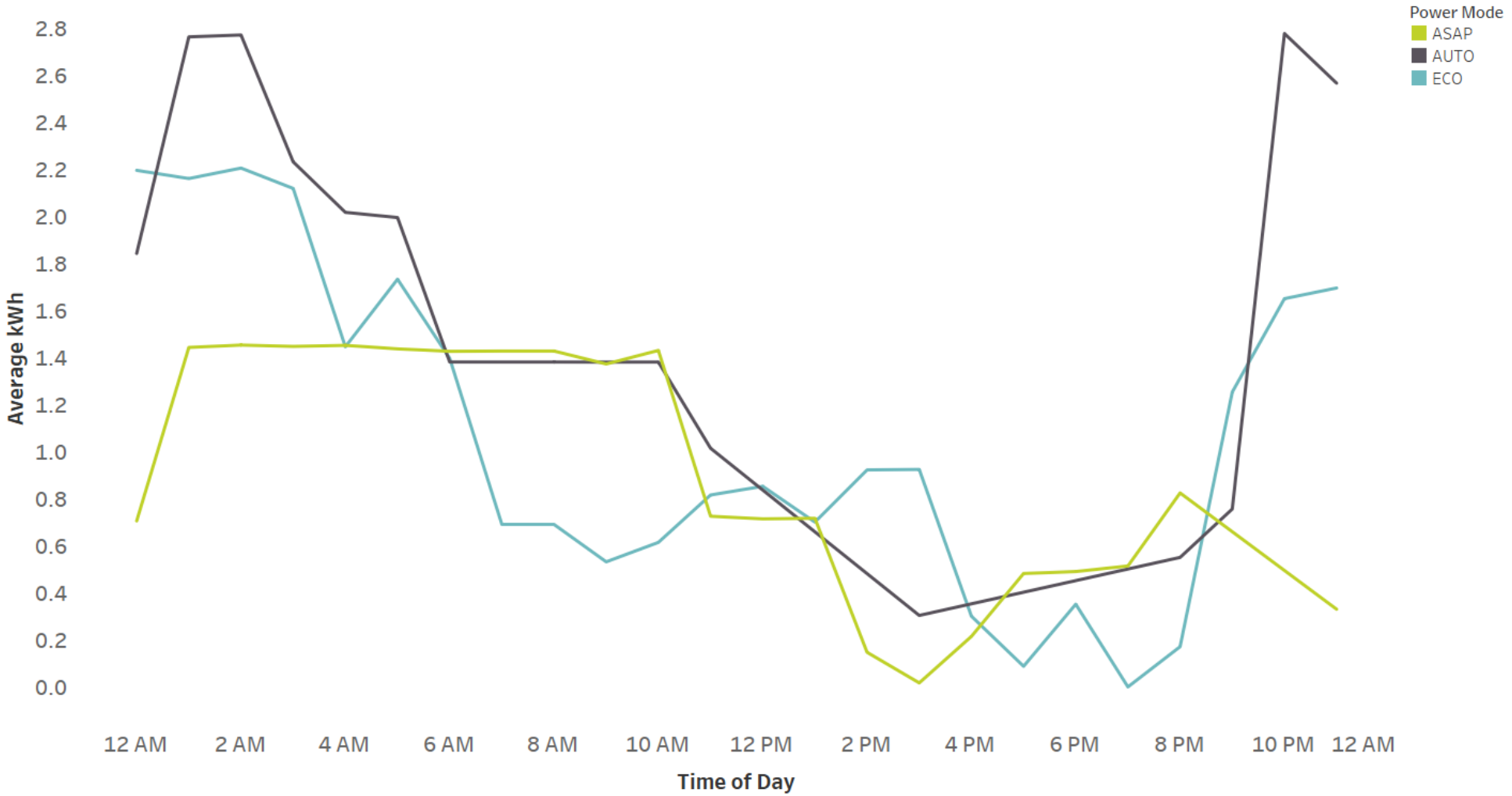
Source: GoPowerEV

Average Range Delivered Per Charge (Miles)



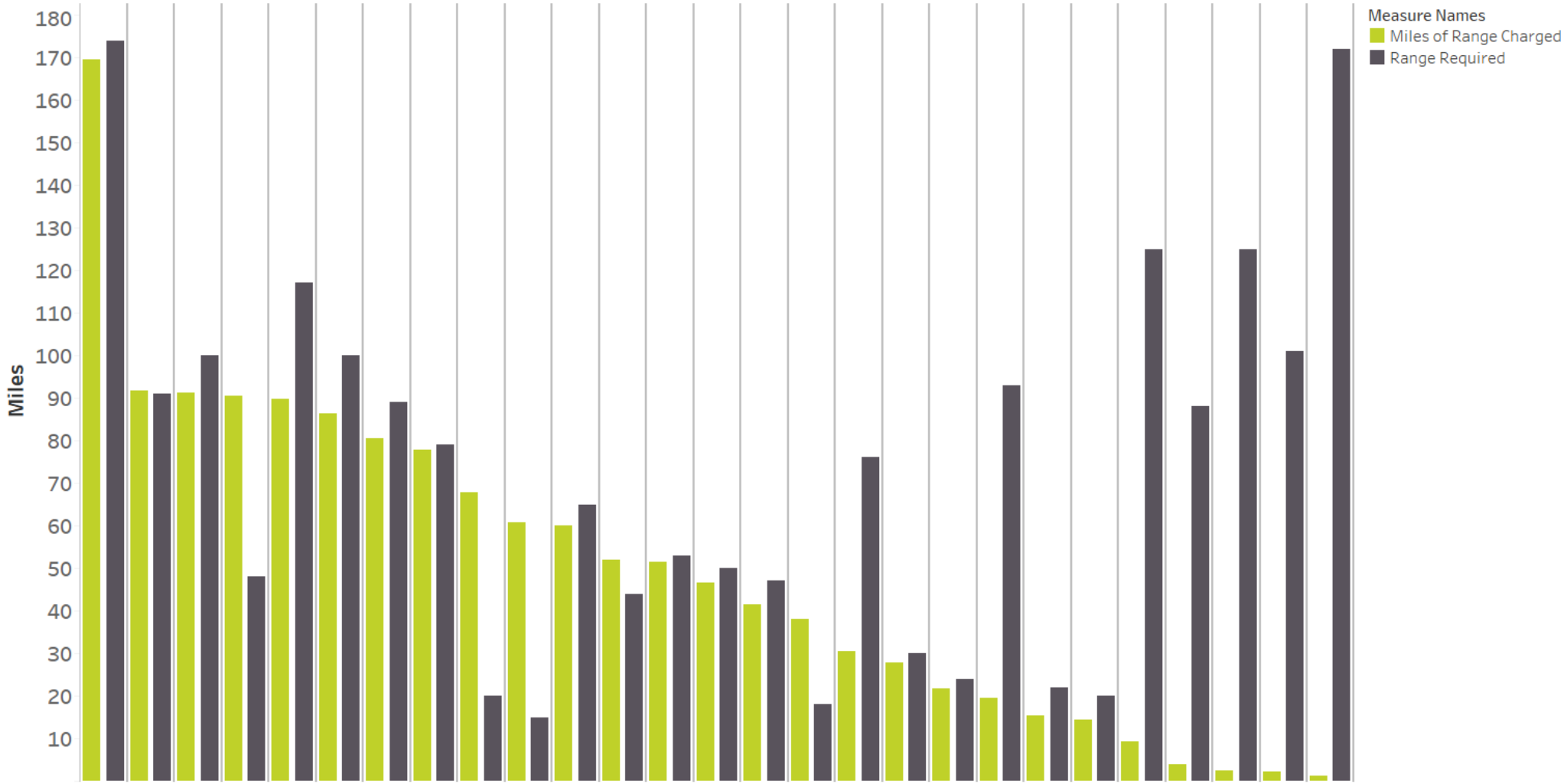
Average of Miles of Range Charged for each Power Mode. Color shows details about L1 Or L2 Charge. The marks are labeled by average of Miles of Range Charged.

Average Charge Curve Per Session (Power Mode)



The trend of Average Kwh for Time Axis Hour. Color shows details about Power Mode. The data is filtered on Session Uuid, which excludes Null and bb6d44bc-eea8-49b0-9a48-a622e9678797. The view is filtered on Average Kwh, which keeps non-Null values only.

Range Charged Vs Required Per Session



Miles of Range Charged and Range Required for each Session Uuid. Color shows details about Miles of Range Charged and Range Required. The view is filtered on Session Uuid, which keeps 27 of 34 members.

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- Project In Process
- Recommendations
  - Consider Level 1 and low-power Level 2 solutions for utility EVSE programs
  - Review utility service planning process for EV charging to account for new use case

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Residential Water Heater Sizing Measure Package Support

Marc Fountain & Lake Casco

Content support by Ritesh Nayyar

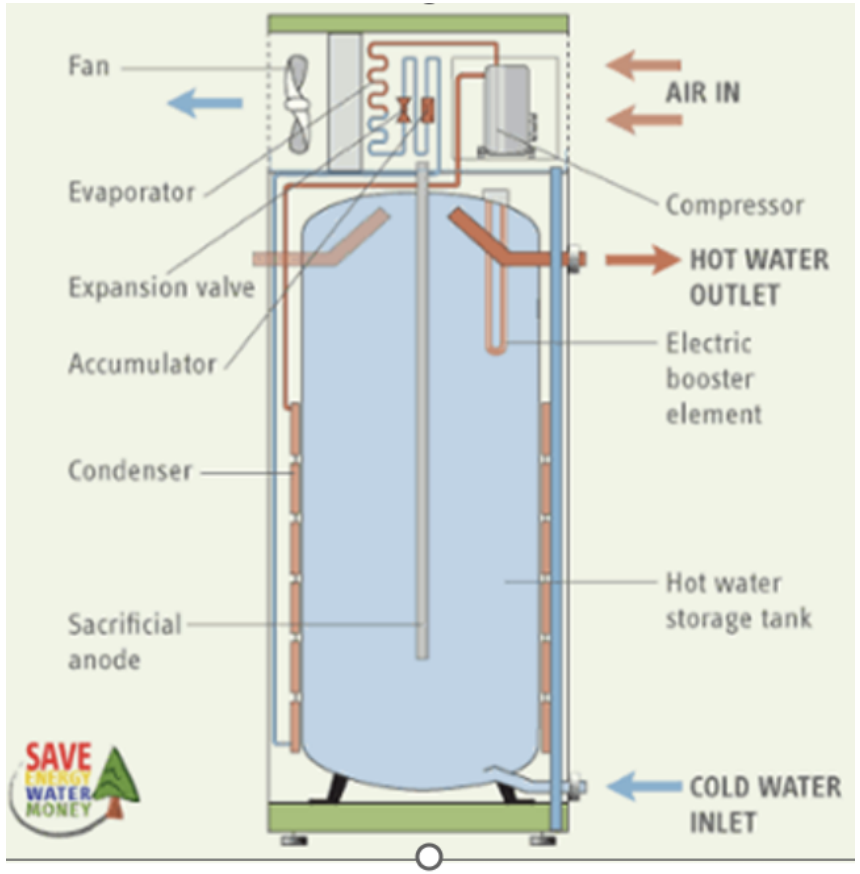
Water heating

Residential

Technology Support Research

Project Summary

- Anecdotal information suggests plumbing contractors upsize heat pump water heater tanks during retrofits
- Incentive program requires like-for-like tank replacement
- Goal: Update measure to allow non-like-for-like tanks to qualify for incentive
- Scope:
  - Modify DEER Water Heater Calculator V5.1
  - Survey plumbing contractors to verify anecdotal information



Source: Energy Vanguard

DEER WHC V5.1

- Different combinations of DEER TechIDs for different existing and upsized replacement tank sizes resulting in new measures available for residential eTRM Measure Packages
- TO NOTE: Both the base and measure technologies already exist in the DWHC as TechIDs
- Currently approved in SWWH025-06 - Heat Pump Water Heater, Residential, Fuel Substitution and available for use for existing building residential programs
- Similar new measures planned for commercial versions of HPWH fuel substitution measure packages for PY2024

Stor_UEF-ElecHP-040gal-3.75UEF

Mobile Home

CZ16

Input Spec	Index		
TechIndex	98	TRUE	FALSE
BldgType	28	DMo	
CZindex	16	CZ16	

Calculate All Results

Technology Parameters		
Type	PkHP	
UEF/EF	3.75	
Fuel	Elec	3413
Volume	40	gallons
Cap	4.50	kW or kBtu/h
RE/TE	N/A	TE for Com. WHs
Draw Pattern	MD-HI	
Tank UA	4.37	Btu/hr-F
Aux W	0.00	watts
Vent W	0.00	watts
Aux Btu	0.00	Btu/hr
Aux Eff	0.00	

HPWH Technology parameters		
HPminT	40	F
HPmaxT	120	F
HPmaxGal	20.0	gallons
COP	3.14	
Frac Resist	0.10	
RE of ER backup	0.98	

Simulation Parameters		
Tamb Profile	DMo	1
Ttank:	135	F
Gal2BtuF	8.2	Btu/gal-F
BldgType Sector	Res	1200
Output Cap	41,125	Btu/hr
Demand Profile:	FALSE	
Load Profile Index:	26	
Storage Cap	24815	Btu/hr

Annual Results

TechIndex	TechID	BldgType	BldgLoc	kWh	kW
98	Stor_UEF-ElecHP-04	DMo	CZ16	2,107	0.14

Sample Measure Offerings

Measure Offering Description	Code/Standard TechID (Base Case)	Measure TechID (Measure Case)
Heat pump water heater, > 55 to ≤ 75 gal, UEF = 3.30 replacing storage natural gas water heater, 40 gal, UEF = 0.64	Stor_UEF-Gas-040gal-HI-0.64UEF	Stor_UEF-ElecHP-065gal-3.30UEF

Using the new updated tool, the following types of replacements would now be available for efficient heat pump water heaters.

- Replacing an existing 40 or 50-gallon natural gas water heater with a 65-gallon HPWH
- Replacing an existing 50 or 60-gallon natural gas water heater with an 80-gallon HPWH

Existing		Replacement	
Size	UEF	Size	UEF
40	0.64	>55 to <=75	3.3
40	0.64	>55 to <=75	3.5
40	0.64	>55 to <=75	3.75
50	0.63	>55 to <=75	3.3
50	0.63	>55 to <=75	3.5
50	0.63	>55 to <=75	3.75
50	0.63	> 75	3.3
50	0.63	> 75	3.5
50	0.63	> 75	3.75
60	0.61	> 75	3.3
60	0.61	> 75	3.5
60	0.61	> 75	3.75

Conclusions:

- 75 percent of contractors upsize the tank when replacing a natural gas water heater with a heat pump water heater
- Retrofits of electric water heaters required a circuit breaker upgrade 50 percent of the time but rarely a panel upgrade
- The most common upgrade is from a natural gas water heater to a heat pump water heater
- Modified DEER WHC allows incentives for existing (and desired!) practice

(N=16, all contractors surveyed had installed a heat pump water heater in the past year. Source: TECH database)

Marc Fountain/Ritesh Nayyar/Lake Casco

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This project was funded by SWEETP
(StateWide Electric Emerging Technologies Program)
or “CalNEXT”

For more information, contact <ckido@energy-solution.com>.

The project report can be found at
<https://calnext.com/wp-content/uploads/2023/02/ET22SWE0036_Residential-Water-Heater-Sizing-Measure-Package-Support_Final-Report.pdf>

Q&A