

# SWAP020-01: Portable Air Conditioner and Heat Pump From LADWP



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# Presentation Overview

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## Objective:

- Provide overview of Portable Air Conditioner (AC) and Heat Pump (HP) measure package
- Get Cal TF Affirmation

## Agenda:

- Cool LA Initiative
- Measure description and methodology
- Questions and discussion
- Affirmation vote

# Cool LA Initiative



- In July 2022, The Los Angeles Department of Water and Power (LADWP) Board of Commissioners proposed a new ‘Cool LA’ initiative to address extreme heat impacts faced by homeowners and renters when temperatures exceed 90° Fahrenheit and heat indexes (air temperature plus relative humidity) exceed 105° F.
- It includes increased cooling rebates on various types of energy-efficient cooling measures to help LADWP customers overcome the health risks associated with extreme heat.
- LADWP has an array of existing programs that address short-term and long-term climate change induced extreme heat that would be included in the ‘Cool LA’ initiative. These programs help LADWP residential and commercial customers to quickly and easily access current benefits that help them overcome the health risks associated with extreme heat, achieve greater heat mitigation efficiencies, and increased air conditioning system effectiveness.



# Portable AC and HP, Residential

## Overview of Offerings

- A. Portable Air Conditioners
- B. Portable Air Conditioners w/Connected Controls
- C. Portable Heat Pumps
- D. Portable Heat Pumps w/Connected Controls



# Portable AC and HP, Residential

Base Case /  
Measure Case



- Base Case Description
  - Governed by California Appliance Efficiency Standards (Title 20).
  - Defined as a T20 minimum CEER unit for both the NR and NC measures.
- Measure Case Description
  - There is no Energy Star Qualified Products List for portable ACs/HPs.
  - Measure case efficiency is Title 20 Code efficiency (see above) +5%.
  - Based on an analysis of the T20 appliance database, 174 or roughly 16% of all products are eligible for this measure case.
  - *Note that many units on the list use R32 (on EPA Snap List for low GWP).*

# Portable AC and HP, Residential

## Eligibility Requirements



- “Connected” product should have ability to wirelessly connect to a smart home system
- UL Certified from an NRTL
- EPA SNAP refrigerant with GWP less than 1,000 (R-32, aka HCF-32)
- No electric resistance heating
- NR measure must replace existing Portable or Room AC
- Both single and dual duct are eligible

# Portable AC and HP, Residential

## Savings Approach



- ❑ Savings Approach:
  - ❑ Modelled savings from the Energy Plus DEER prototypes.
  - ❑ T20 as used to inform analysis values and supporting energy analysis
  
- ❑ Equipment hardsized, to model improperly sized equipment
  - ❑ Model capacity sized based on ~12 btu/hr per square foot rule of thumb
  
- ❑ Savings normalized per cooling coil tonnage per model
  - ❑ These savings were multiplied by representative cooling capacity (8,000 Btu/hr) to find final savings per unit
  
- ❑ Base Case Model:
  - ❑ ACs: Standard PTAC with only cooling
  - ❑ HPs: Standard PTHP with cooling and heating

# Distribution of Portable AC and HP Capacities

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SACC (Btu/hr)	Title 20 Data			Cost Analysis Data
	AC Qty	HP Qty	AC + HP Qty	AC + HP Qty
4,000	14	0	14	5
5,000	179	14	193	34
6,000	192	27	219	50
7,000	111	18	129	39
<b>8,000</b>	<b>163</b>	<b>125</b>	<b>288</b>	<b>82</b>
9,000	33	34	67	10
10,000	86	76	162	45
11,000	5	0	5	2
12,000	6	8	14	13

- This analysis was used to inform the final savings normalization



# Portable AC and HP, Residential

## Model Approach Capacities



- ❑ PTAC and PTHP systems act similar to Portable AC and HP (zone level)
- ❑ Heating capacity 77% of cooling capacity (online cost research)
  - ❑ [Sample 1](#), [Sample 2](#)
- ❑ Modelled capacity based on 12 btu/hr cooling rule of thumb
  - ❑ MFm and SF in CZ01 encountered errors that required autosizing

Building Type	Cooling Capacity	Heating Capacity
Dmo	0.50	0.385
SFm1	1.00	0.77
SFm 2	1.00	0.77
MFm & SFm1/SFm2 in CZ01	Autosized	Autosized

# Portable AC and HP, Residential

Model Approach  
Efficiency



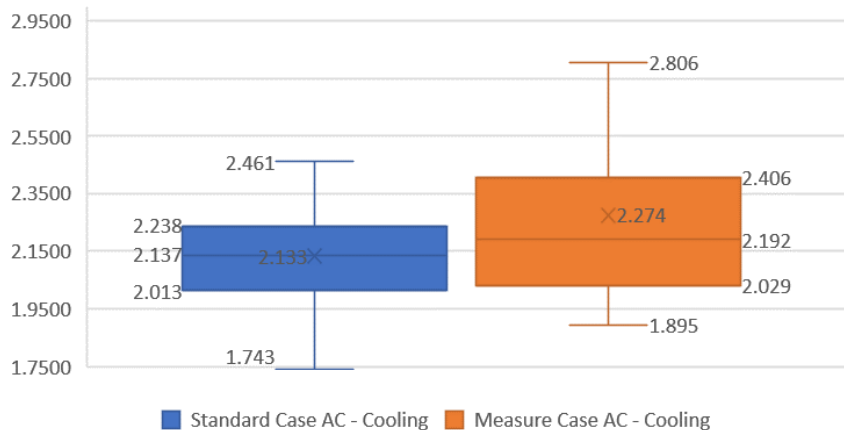
- ❑ Efficiencies were updated based on T20 database analysis
  - ❑ No other parameters were updated
  - ❑ Connected Portable ACs and HPs have same savings as non-connected
  
- ❑ Based on costing/capacity data, heating COP is 77% of cooling COP

Type	AC	HP
Avg. Cooling COP – Standard	2.133	2.266
Avg. Cooling COP – Measure	2.274	2.332
Difference in Cooling COP	6.6%	2.9%
Avg. Heating COP – Standard	N/A	1.745
Avg. Heating COP – Measure	N/A	1.796
Difference in Heating COP	N/A	2.9%

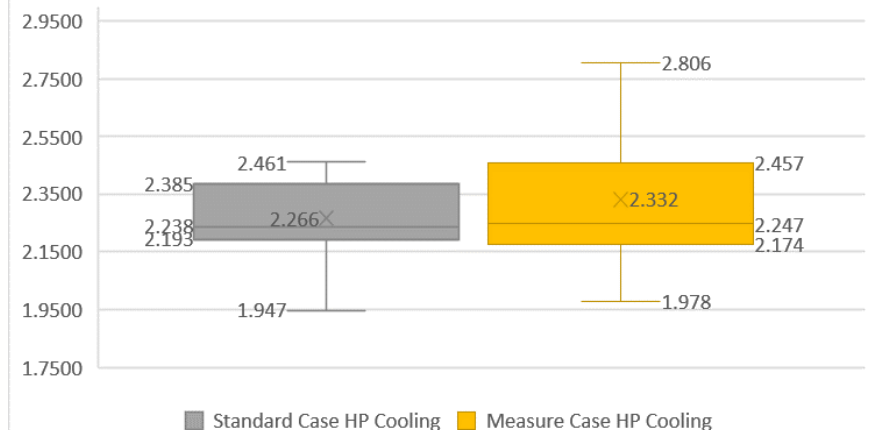
# Portable Air Conditioner and Heat Pump T20 Data Analysis

Type	AC	HP
Avg. Cooling COP – Standard	2.133	2.266
Avg. Cooling COP – Measure	2.274	2.332
Difference in Cooling COP	6.6%	2.9%
Avg. Heating COP – Standard	N/A	1.745
Avg. Heating COP – Measure	N/A	1.796
Difference in Heating COP	N/A	2.9%

Active AC Cooling COP



Active HP Cooling COP

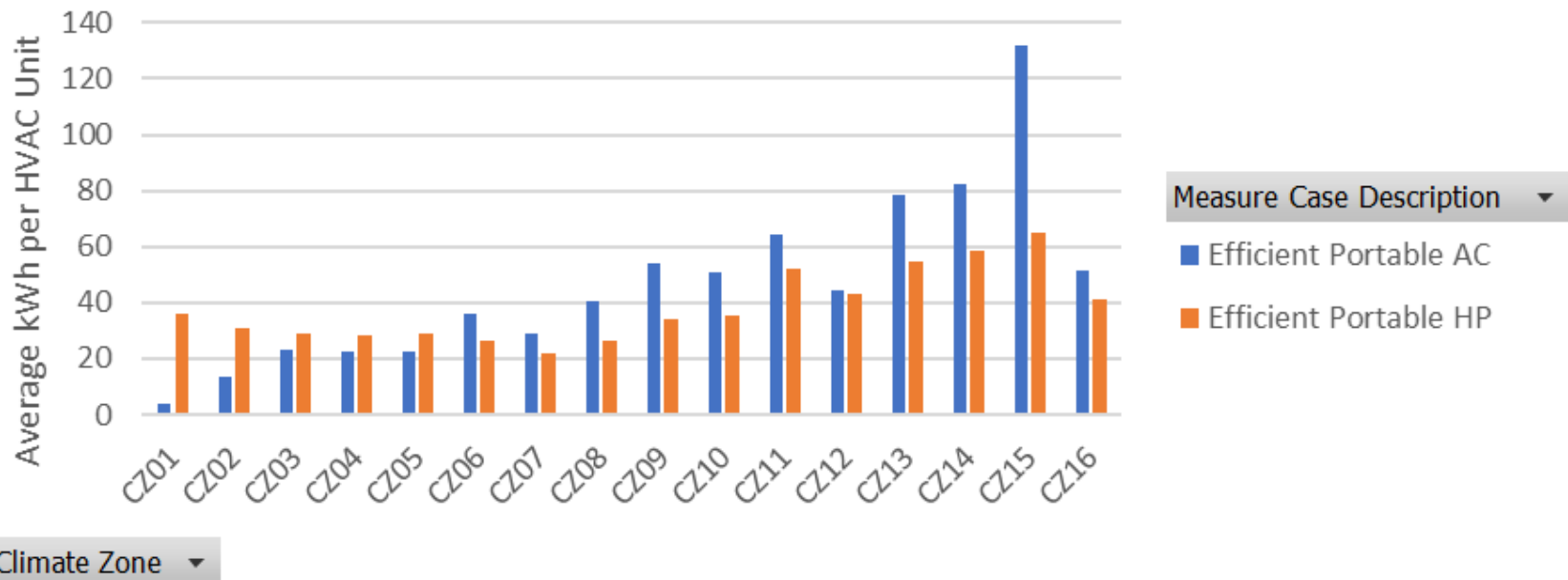


# Portable AC and HP Savings by CZ

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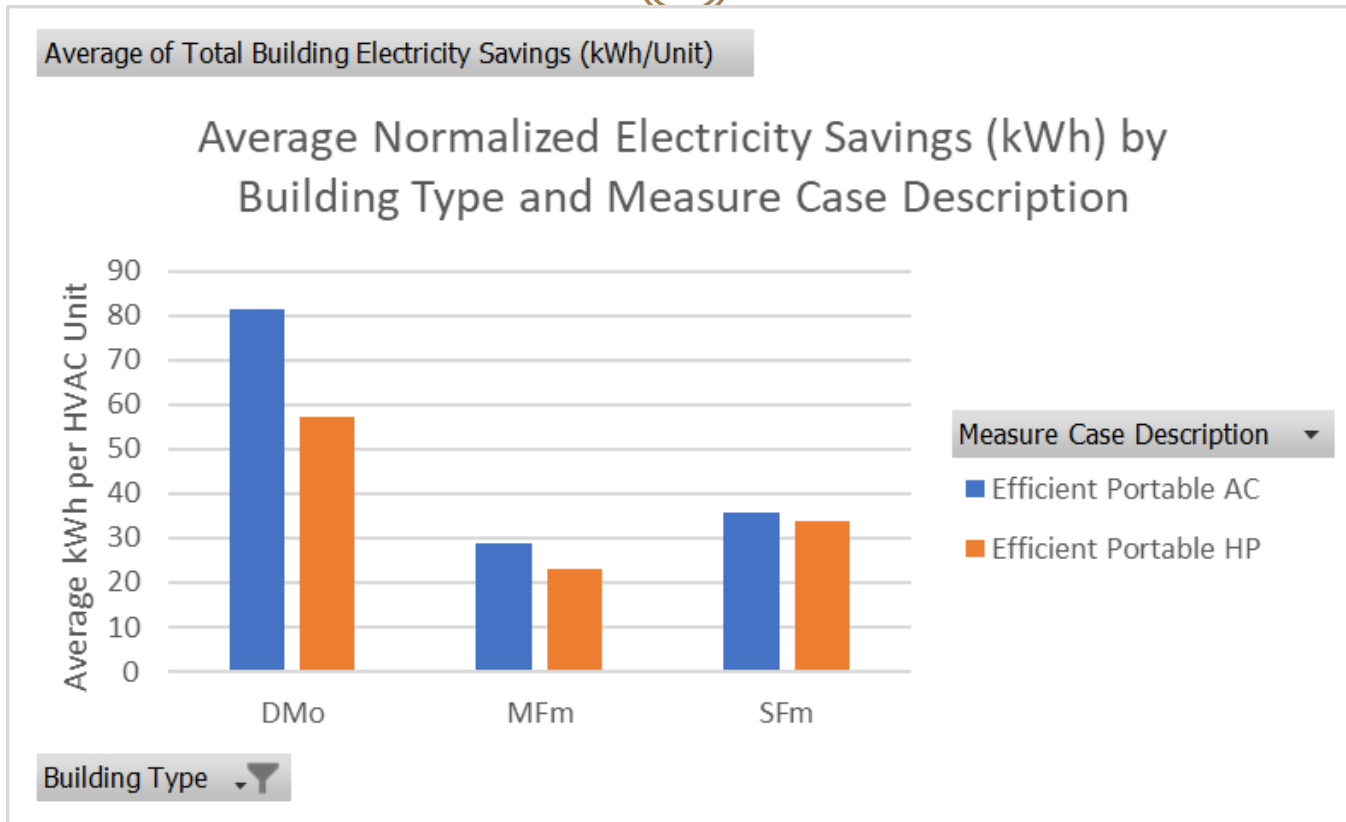
Average of Total Building Electricity Savings (kWh/Unit)

### Average Normalized Electricity Savings (kWh) by Climate Zone and Measure Case Description



# Portable AC and HP Savings by Building Type

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- ❑ Dmo has different code requirements → Different envelope.
- ❑ Ex: Annual cooling load for CZ09
  - ❑ Dmo = 0.367 ton-hr/ft<sup>2</sup>
  - ❑ SFm1 = 0.135 ton-hr/ft<sup>2</sup>

# Portable AC and HP, Residential

## Costs



- ❑ Material from online retailers
  - ❑ Normalized cost by rated SACC
  - ❑ Incremental cost increases (%) calculated separately for connected case and low GWP/measure efficiency case, then combined for each measure
  
- ❑ No Labor, because self installed by homeowners

Unit Type	Material Costs
Portable Air Conditioners	\$543.36
Portable Air Conditioners with Connected Controls	\$611.24
Portable Heat Pumps	\$705.03
Portable Heat Pumps with Connected Controls	\$773.43

# Portable AC and HP, Residential

NEI: Refrigerant  
Avoided Costs,  
LADWP



- ❑ Four new technologies calculated in RACC workbook
  - ❑ Portable AC and HP with R-410A (base case GWP) and Portable AC and HP with R-32 (Measure Case GWP)
  
- ❑ R-410A and R-32 are the only refrigerants identified from product data

BASE CASE DESCRIPTION	REFRIGERANT NPV COSTS – STANDARD BASELINE (USD)	REFRIGERANT NPV COSTS – MEASURE (USD)	UNIT REFRIGERANT BENEFITS (USD)
Portable Air Conditioners	\$46.57	\$15.06	\$31.51
Portable Heat Pumps	\$50.94	\$16.47	\$34.47

# Portable AC and HP, Residential

NEI: GHG  
Reduction,  
LADWP



- ❑ Projections for LADWP specific carbon intensities
- ❑ Calculated MT CO<sub>2</sub>e over lifetime

BASE CASE DESCRIPTION	AVERAGE LIFETIME GHG REDUCTIONS PER UNIT (METRIC TON CO <sub>2</sub> E)	AVERAGE ANNUAL GHG REDUCTIONS OVER LIFETIME PER UNIT (METRIC TON CO <sub>2</sub> E/YR)
Portable Air Conditioners	0.064	0.007
Portable Air Conditioners with Connected Controls	0.064	0.007
Portable Heat Pumps	0.043	0.005
Portable Heat Pumps with Connected Controls	0.043	0.005



# Portable AC and HP, Residential

NEI: ASHRAE 55  
Comfort



- ❑ Comfort analysis using PMV from ASHRAE 55-2020
- ❑ Used Python based [CBE Thermal Comfort Tool](#) developed by UC Berkley Center for the Built Environment
- ❑ Analysis hourly per zone and for summer months only
- ❑ All SFm and Dmo zones, sample of 8 MFm zones
- ❑ Three additional extreme heat event weather files were run for LA CZs projected to 2035, developed by UCLA

# Portable AC and HP, Residential

NEI: ASHRAE 55  
Comfort



- ❑ ASHRAE uses +/-0.5; ISO 7730 uses +/-0.7
- ❑ Counted number of hours w/ PMV >2 (too warm)
- ❑ ASHRAE Thermal Comfort Index

ASHRAE 55-2020 PMV INDEX	SENSATION DESCRIPTION
-3	Cold
-2	Cool
-1	Slightly cool
-0.7	Comfortable
0	Neutral (Comfortable)
+0.7	Comfortable
+1	Slightly warm
+2	Warm
+3	Hot

# Portable AC and HP, Residential

NEI: ASHRAE 55  
Comfort



- ❑ Extracted zone dry bulb, mean radiant temp, and relative humidity

THERMAL COMFORT PARAMETER	VALUE	NOTES
Air speed	0.1 m/s	Typical indoor air speed (ASHRAE)
Clothing level	0.50 clo	Typical summer indoor clothing
	1.00 clo	Typical winter clothing
	0.61 clo	Trousers, long-sleeve shirt (Spring and Fall)
Metabolic Rate	1.0 met	Activity level: Seated, quiet (Table 5-1)

MEASURE DESCRIPTION	BASE CASE DESCRIPTION	% CHANGE IN UNCOMFORTABLE HRS - CZ2022 WEATHER	% CHANGE IN UNCOMFORTABLE HRS - LA100 2035 WEATHER
Efficient Portable Air Conditioners	Standard Portable Air Conditioners	0.00%	0.00%
Efficient Portable Air Conditioners	Home with no cooling	-4.05% (30 days)	-6.23% (46 days)
Efficient Portable Heat Pump	Standard Portable Heat Pump	0.00%	0.00%
Efficient Portable Heat Pump	Home with no cooling or heating	-2.83% (41 days)	-4.10% (60 days)

# Previous Questions

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- Savings reproducibility due to manual controls
- Cost effectiveness concern (TBD)
  - Positive TSB for all, ~\$40-100
  - $AC > 1$  TRC (higher savings, lower cost)
  - $HP < 1$  TRC (lower savings, higher cost)
- Other benefits that could increase TRC include low GWP and load flexibility
  - Included low GWP, connected controls (no benefit calc'd)
- Evaluation risk if the measure is portable
  - LADWP to discuss
- Data collection could be extensive for this type of measure
  - LADWP to discuss

# The End

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- Thank you!
- Questions?
  - Review previously sent in word doc