LA100 Equity Strategies
Steering Committee Meeting #17
March 29, 2023

Los Angeles Department of Water & Power (LADWP) Project Leads

Simon Zewdu
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LA100 Equity Strategies Oversight
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Agenda

Start Time	Item
10:00 a.m.	Welcome, Meeting Purpose and Agenda Overview
10:05 a.m.	Air Quality and Health: Preliminary Results (NREL and UCLA)
10:45 a.m.	Local Solar and Storage
11:05 a.m.	Energy Atlas and Panel Upgrades
11:45 a.m.	LADWP Wrap Up and Next Steps
12:00 p.m.	Adjourn

Our Guide for Productive Meetings

- *Raise your hand* to join the conversation (less chat entries, more talking)
- Help to make sure that everyone has *equal time* to contribute
- Keep input *concise* and *focused* so that others have time to participate
- *Actively listen* to others to understand their perspectives
- *Offer ideas* to address others' questions and concerns

Steering Committee Roster

Organization	Representative
Alliance of River Communities (ARC)	Vincent Montalvo
City of LA Climate Emergency Mobilization Office (CEMO)	Marta Segura, Rebecca Guerra
Climate Resolve	Jonathan Parfrey, Bryn Lindblad
Community Build, Inc.	Robert Sausedo
DWP-NC MOU Oversight Committee	Tony Wilkinson, Jack Humphreville
Enterprise Community Partners	Jimar Wilson, Michael Claproth
Esperanza Community Housing Corporation	Nancy Halpern Ibrahim
Los Angeles Alliance for a New Economy (LAANE)	Kameron Hurt, Estuardo Mazariegos
Move LA	Denny Zane, Eli Lipmen
Pacific Asian Consortium in Employment (PACE)	Celia Andrade, Susan Apeles
Pacoima Beautiful	Veronica Padilla Campos, Melisa Walk
RePower LA	Michele Hasson, Roselyn Tovar
The South Los Angeles Transit Empowerment Zone (SLATE-Z)	Zahirah Mann, April Sandifer
South LA Alliance of Neighborhood Councils	Thryeris Mason
Strategic Concepts in Organizing and Policy Education (SCOPE)	Agustín Cabrera, Tiffany Wong

Steering Committee Agendas

Tentative Schedule

4/19/23
#18
	• Preliminary results and strategies discussion:
	  • Rates & Affordability (NREL)
	  • Universal access to safe and comfortable homes
	  • Grid Reliability and Resilience
	• Jobs (UCLA)

5/17/23	• Equity Strategies Summary (NREL & UCLA) • Next Steps Discussion (for LADWP & Steering Committee)

Air Quality and Health

Preliminary Results and Discussion

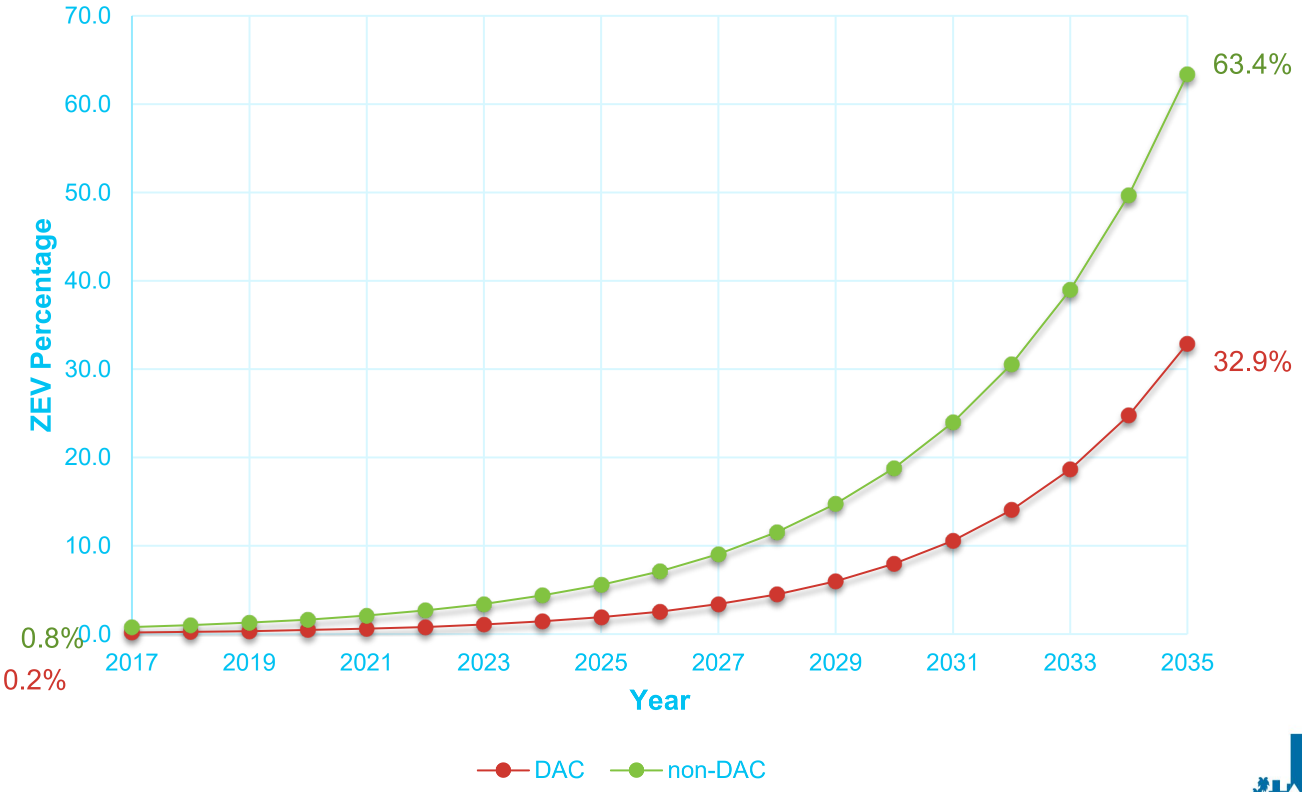
Yifang Zhu, UCLA

Task Order Overview

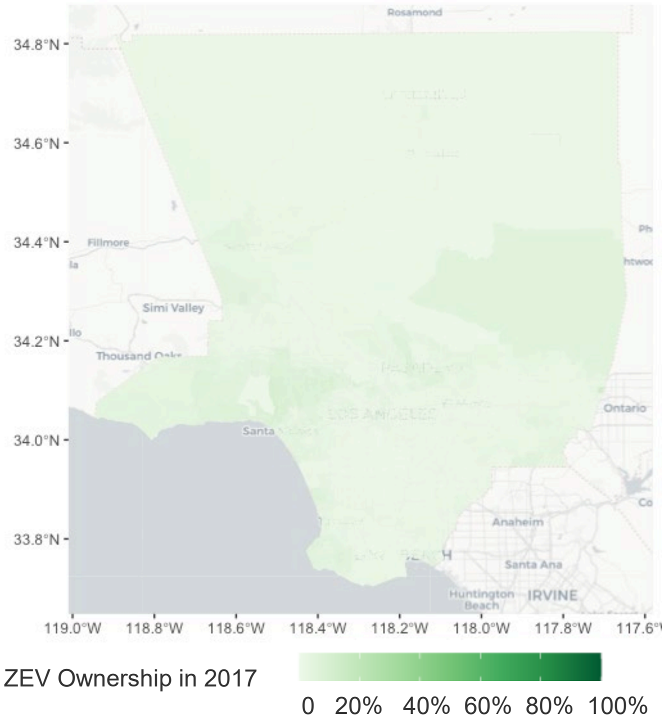
- Investigate the potential **environmental** and **public health** benefits of zero-emission vehicles (ZEVs) especially among disadvantaged communities (DAC)
  - Simulate ZEV travels using agent-based travel demand model
  - Project $PM_{2.5}$ and O_3 concentrations using 1 km x 1 km WRF-Chem model
  - Assess health benefits using ethnic and racial-specific exposure-response functions

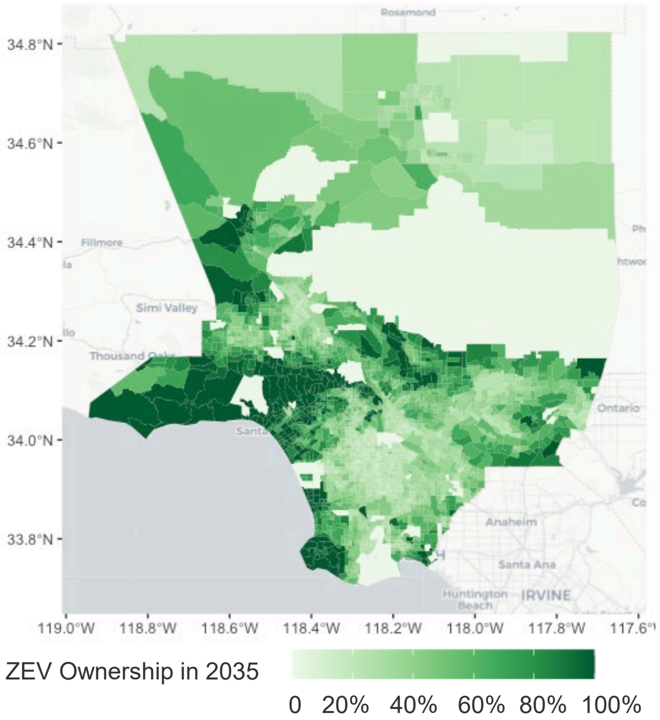
- In addition to the 2017 **Base** scenario, three scenarios are modeled
  - 2035 **Disparity**: ZEV adoptions are **not** equally distributed in the city of LA
  - 2035 **Equity**: ZEV adoptions are equally distributed in the city of LA
  - 2035 Mobile Source Strategy (**MSS**): more emission reduction in trucks and off-road equipment

Average ZEV Percentage in DAC and non-DAC



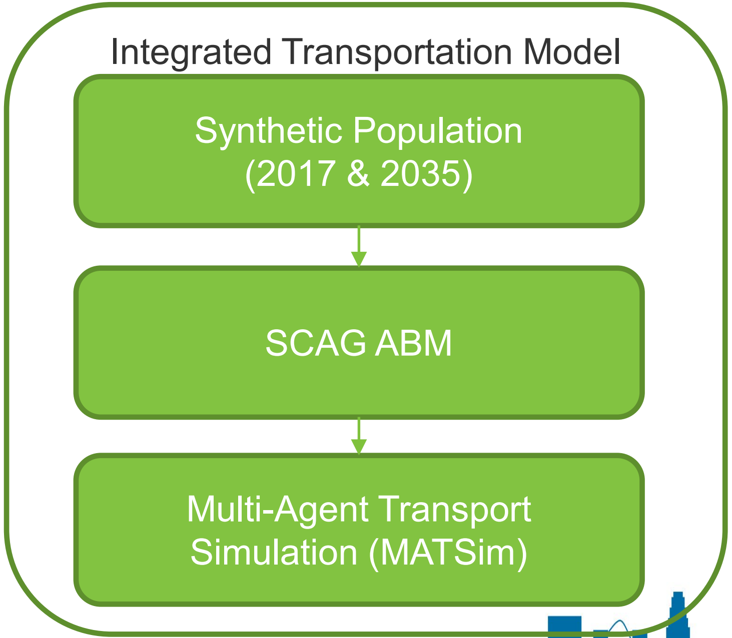
ZEV Percentage Map in 2017 and 2035



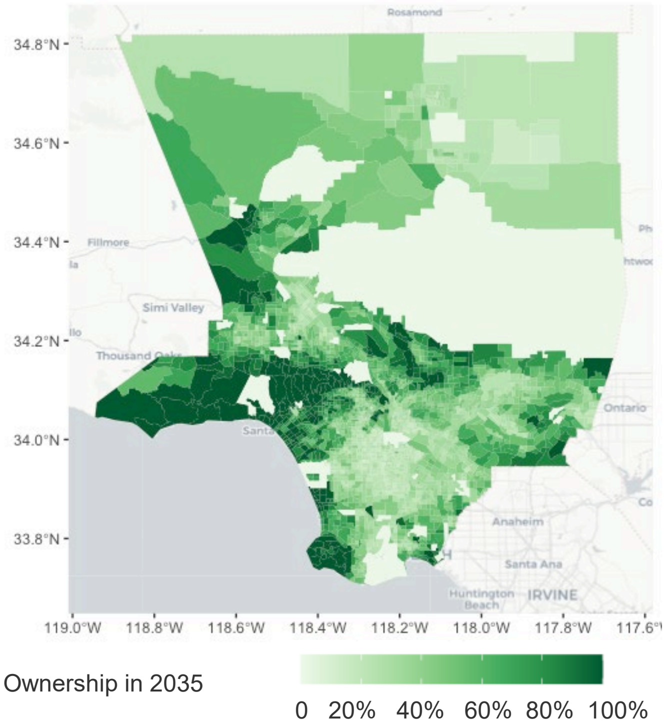


Integrated Transportation Model

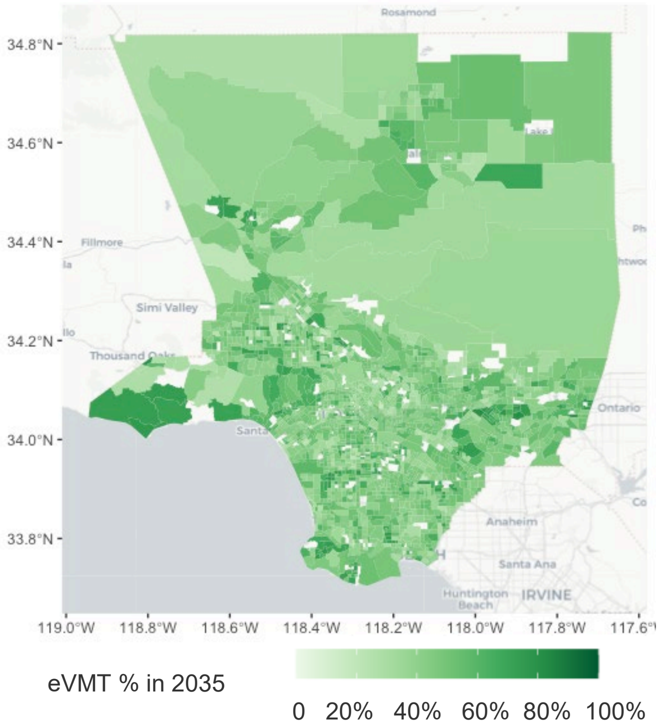
- An integrated transportation model was developed for Los Angeles County, which simulates the dynamic interactions between travel demand and supply
  - Activity-based travel demand model from Southern California Association of Governments (SCAG)
  - Agent-based multimodal (ABM) simulation model



ZEV Ownership vs. electric Vehicle Miles Traveled (eVMT)% in 2035

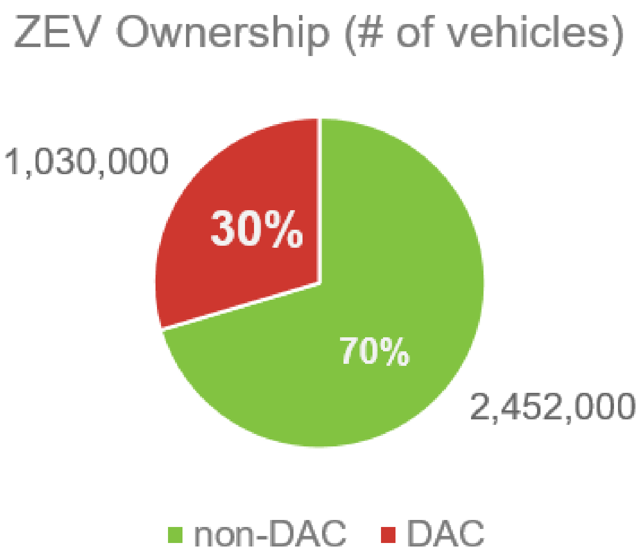


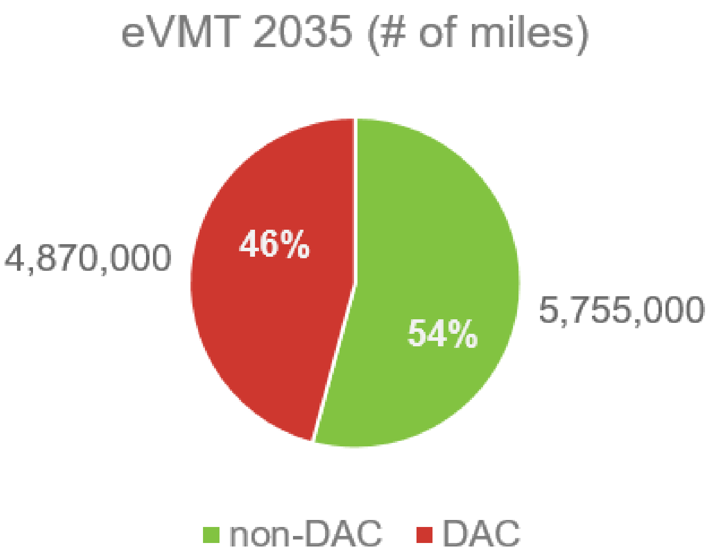
ZEV Ownership in 2035



eVMT % in 2035

ZEV Numbers vs. eVMT in 2035 for DAC and non-DAC





Scenarios

	Scenario 1	Scenario 2	Scenario 3
Name	2035 **Disparity**	2035 **Equity**	2035 **MSS**
Energy Profile	LA100 Early & No Biofuel – 100% Clean Energy		
	On-road Transportation Electrification Profile		
Light-duty	50%	50%	50%
Medium-duty	15%	15%	**22%**
Heavy-duty	19%	19%	**39%**
School and urban buses	100%	100%	100%
	On-road Transportation Emission Spatial Distribution		
Passenger Vehicle Medium-duty Heavy-duty School and urban buses	Emission reduction map based on (1) ZEV ownership and (2) the MATSim simulated trips	Equally distributed	Equally distributed
	ZEV Fleet Profile (LDV / MDV / HDV)		
PHEV	25% / 0% / 0%		
BEV	67% / 100% / 100%		
FCEV	8% / 100% / 100%		
	Off-road Transportation		
	EMFAC 2035 Original	EMFAC 2035 Original	MSS
	Oil & Gas Industry		
Demand Reduction	Scale down based on ZEV population		

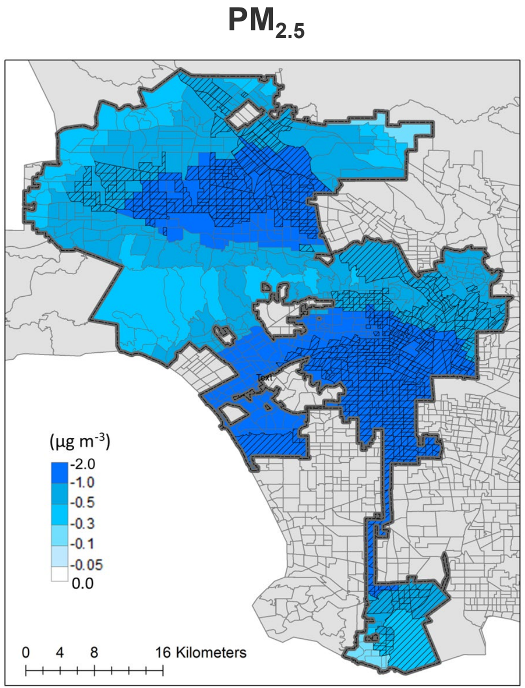
MSS: Mobile Source Strategy
PHEV: Plug-in Hybrid Electric Vehicle
BEV: Battery Electric Vehicle
FCEV: Fuel-cell Electric Vehicle
LDV: Light-duty Vehicle
MDV: Medium-duty Vehicle
HDV: Heavy-duty Vehicle

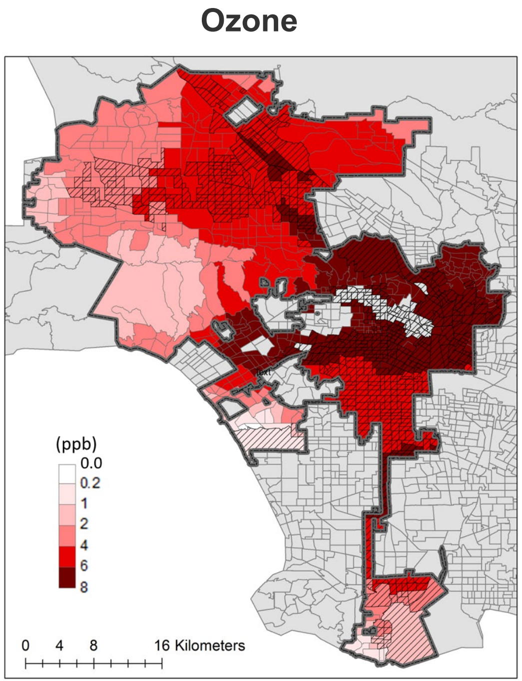
LA County Emission Inventory Change (2017 vs. 2035)

Scenarios	CO	NH_3	NOx	PM_{10}	$PM_{2.5}$	ROG	SOx
Base - 2017 (tons / day)	1000	46	270	89	33	304	13
Disparity – 2035 (tons / day)	452	47	143	89	32	217	12
MSS - 2035 (tons / day)	431	46	101	89	31	216	12
Scenario Comparison							
(Disparity-Base)/ BASE	-55%	1.5%	-47%	0.6%	-5.7%	-28%	-4.0%
(MSS-Disparity)/ Disparity	-4.5%	-1.3%	-29%	-0.3%	-1.6%	-0.4%	-0.8%

CO=Carbon Monoxide, NH_3=Ammonia, NOx= Nitrogen Oxides, PM=Particulate Matter
ROG=Reactive Organic Gases, SOx=Sulfur Oxides

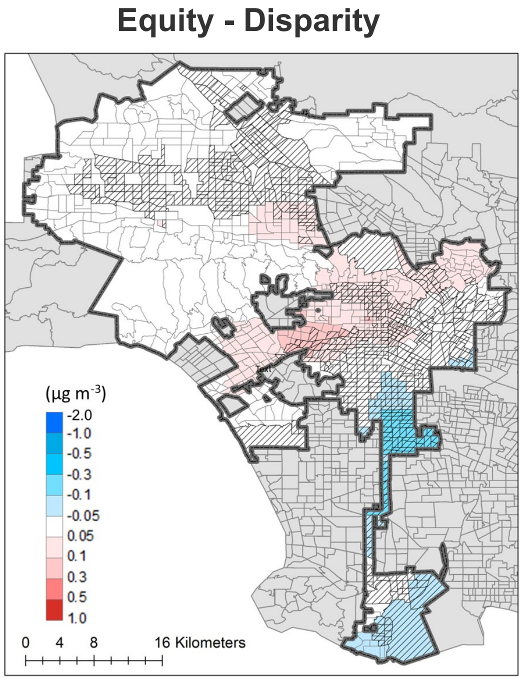
Results: Pollutant Changes from 2017 to 2035

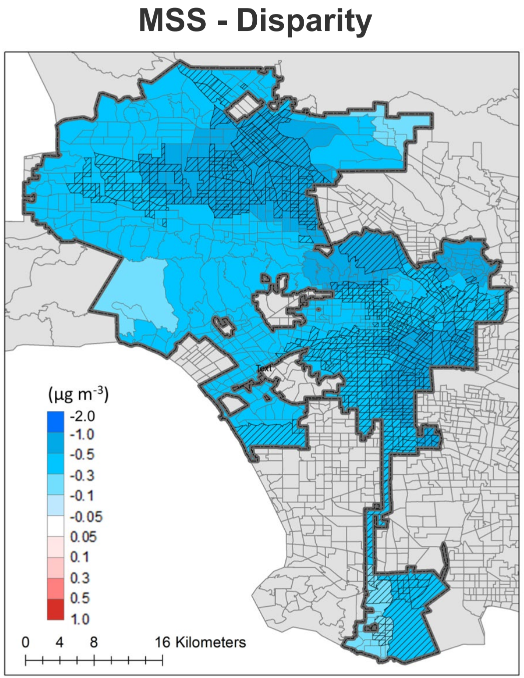




- $PM_{2.5}$ reduces from 11.5 to 10.6 µg/m^3 (-7.4%)
- Ozone increases from 38 to 42 ppb (+12.0%) due to NOx reduction

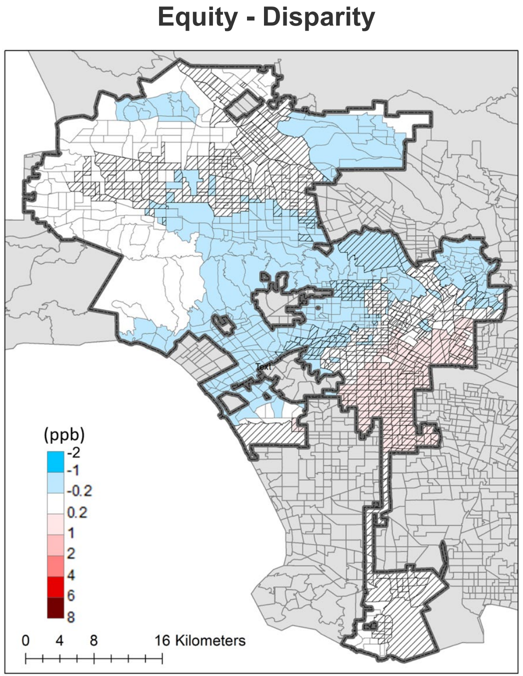
Results: $PM_{2.5}$ in Different Scenarios

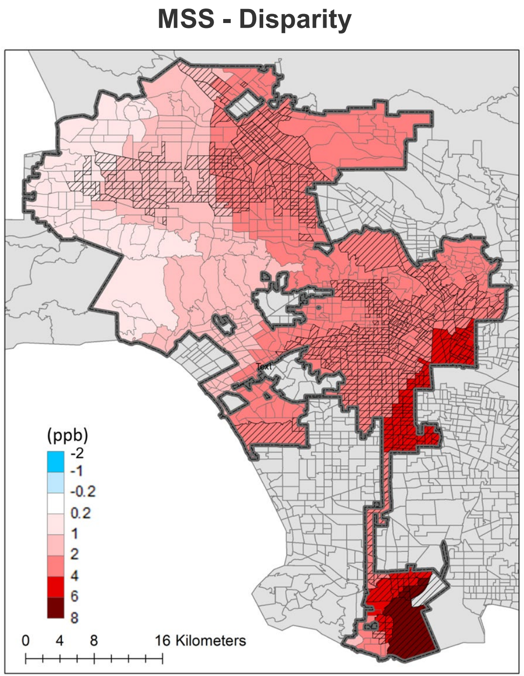




- Minor changes between the Equity and Disparity scenarios
- More medium- and heavy- duty vehicle electrification and off-road emission reduction lead to more $PM_{2.5}$ reduction in the MSS scenario

Results: Ozone in Different Scenarios

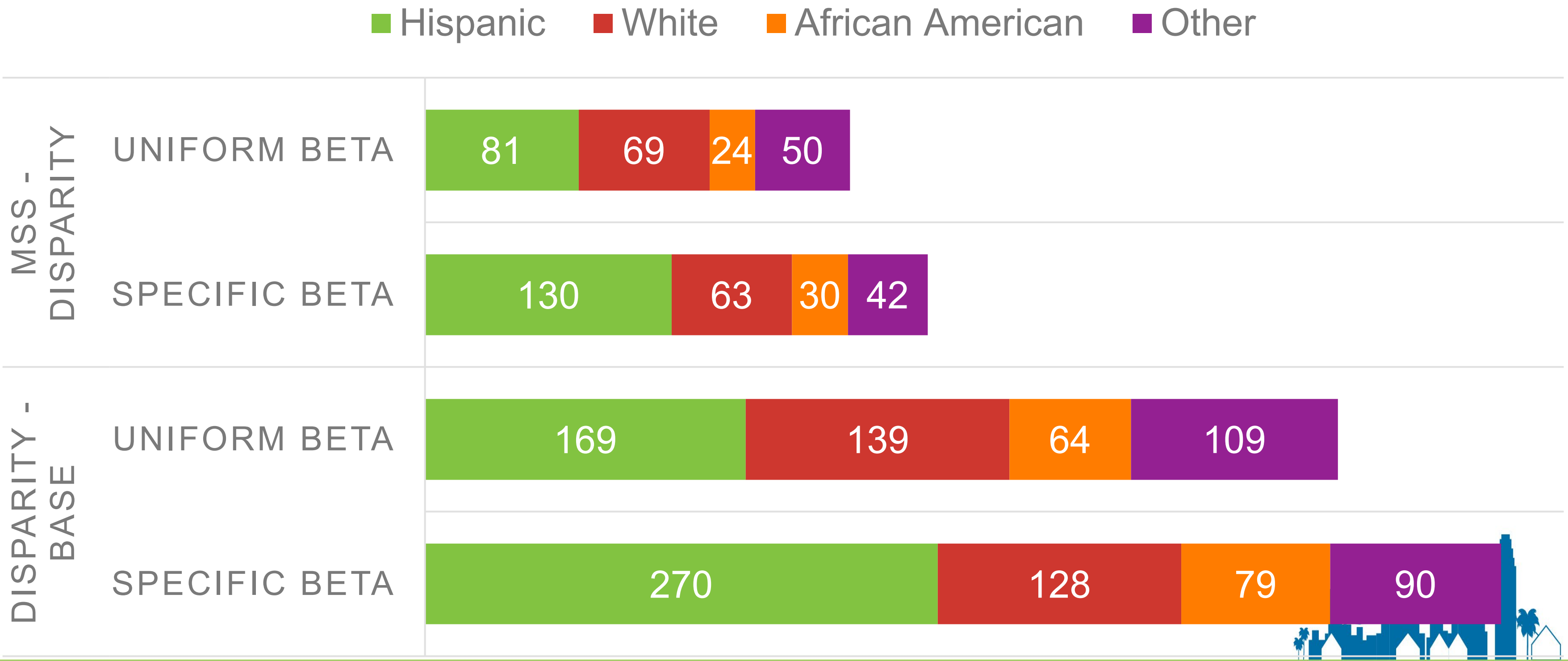




- Minor changes between the Equity and Disparity scenarios
- Ozone further increases from 42 to 45 ppb (+6.0 %) with more NOx reductions in the MSS scenario

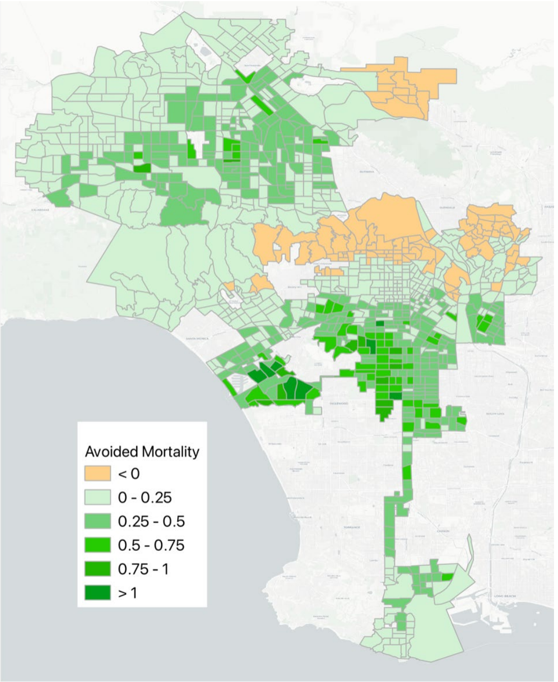
Results: Health Benefits Might be Underestimated

$PM_{2.5}$ AVOIDED MORTALITY BY RACIAL/ETHNIC GROUPS

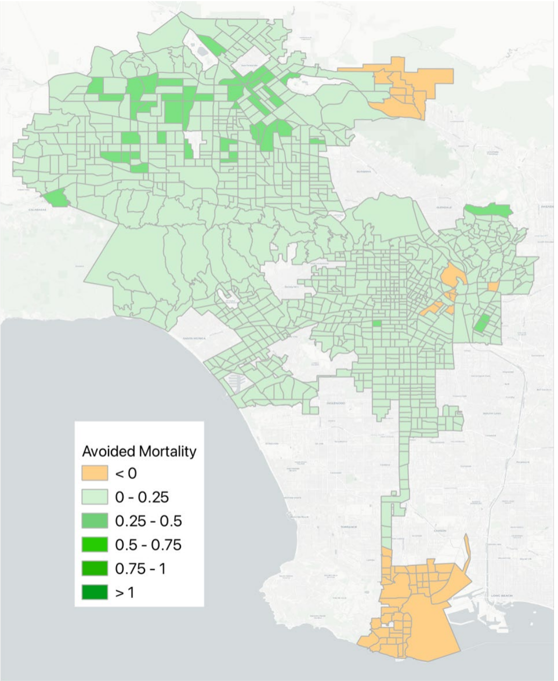


Results: Total Avoided Deaths ($PM_{2.5}$ + O_3)

Disparity - Base



MSS - Disparity



- A total of 330 deaths were avoided
- Ozone increase is the main driver for areas with negative values

Summary: Air Quality and Public Health

- Vehicle electrification reduces $PM_{2.5}$ that can lead to **improved health** outcomes for both disadvantaged and non-disadvantaged communities
- Electrifying **medium- and heavy-duty** trucks will bring more health benefits than light-duty vehicles
- The use of ethnic and racial-specific exposure-response functions can help reveal **greater health benefits**, particularly for the Hispanic population, than previously estimated
- To reduce ozone, it is crucial to **further reduce NOx** and reduce **volatile organic compounds** in parallel with $PM_{2.5}$ and NOx reduction

Questions and Feedback

Air Quality and Health

Preliminary Results and Discussion

Garvin Heath, National Renewable Energy Laboratory (NREL)
Vikram Ravi, NREL
Yun Li, NREL

Equity Strategy Modeling & Analysis

NREL is conducting modeling, analysis, and strategy development along prioritized pathways:	
Affordability	Low-income energy bill affordability.
Housing	Universal access to safe and comfortable home temperatures.
	Housing weatherization and resilience to extreme events.
Solar & Storage	Improved access to solar and storage for multifamily residents and renters.
	Equitable community solar access and benefits.
Transportation Electrification	Equitable transportation electrification – electric vehicles (EVs), charging, and multimodal.
Grid Reliability & Resilience	Distribution grid upgrades to enable equitable solar, storage, and EV adoption and resilience.
Air Quality & Health	Truck electrification for improved air quality and health outcomes.

This presentation covers the highlighted pathway.

Community Guidance

Guidance from the LA100 Equity Strategies Steering Committee, listening sessions with community-based organizations and community members, and community meetings included the following:

- Ensure investment in communities that have had the most pollution burden.
- Reduce pollution from traffic and low-income delivery workers, incentivize local goods movement to be cleaner, powered by green power, work with companies to upgrade fleets to EVs for clean air overall and for workers.
- Focus on cleaning up pollution from the Port (e.g., freight traffic), LAX, South LA and Pacoima.
- Provide community access to air quality measurement tools (citizen science).

Wilmington, Harbor Resident:
"Since I have been here, three generations, half of my family has died from cancer. As young as 34 years old. From breast cancer, lung cancer, liver cancer, kidney cancer. With people that don't even drink or smoke…I know that the refineries have an issue. **The contaminants from the trucks and the containers, from the breaks. They have a black soot in our community.** And in that black soot, who knows what that's giving us? …And you wake up in the morning, your car is full of that stuff. You wipe your car down and your rag is black. Or it's inside your house."

Steering Committee member:
"Provide more green power to electrify the transportation sector to get health benefits. Particulate matter largely comes from transportation."

LADWP Commercial EV Charging Incentives

by Product & Rebate Type

Program	Which communities disproportionately benefited from incentives?				
	Non-DAC/DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/Mostly Hispanic	Mostly Owners/Renters	Above/Below Median Income*
Commercial New Charger**	Non-DAC		Non-Hispanic	Renters	Above
Direct Current Fast Charger	No statistically significant difference				

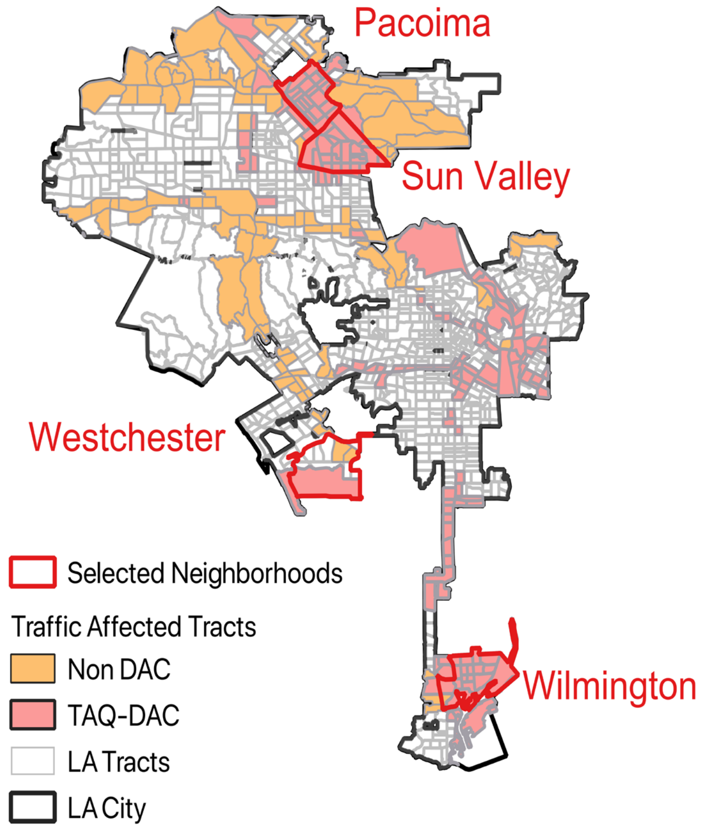
Median income: $73,100 annual salary (2019)
DAC = disadvantaged community as defined by SB 535

LADWP Commercial new charger incentives are limited to light duty vehicles and were disproportionately distributed to non-disadvantaged (non-DAC), non-Hispanic, renter, and wealthier neighborhoods.

LADWP medium- and heavy-duty EV charging rebates of up to $125k could not be analyzed due to an insufficient population size of 6 incentives.

**While the Commercial New Charger (Level 2) incentive was $1,000 more for locations in DACs ($5,000), rebates disproportionately went to locations in non-DACs.

Focus Communities for Air Quality and Health Analysis



- We devised a methodology inspired by CalEnviroScreen to identify DAC tracts affected by traffic air quality (TAQ-DACs).
- Traffic-impacted non-DAC tracts were also identified for statistical comparison.
- South LA being added as an additional area selected for detailed analysis.

Truck Electrification for Improved Air Quality and Health Outcomes

Garvin Heath, NREL

Vikram Ravi, NREL

Yun Li, NREL

Truck Electrification: Why is it important?

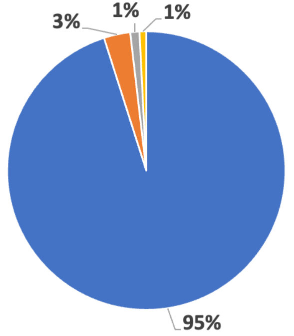
Key findings:

- Heavy-duty trucks represented 5% of vehicles yet generated 51% of on-road nitrogen oxides (NOx) emissions in the LA area* in 2022
- Heavy Heavy-duty trucks were 1% of vehicles and generated 32% of on-road NOx emissions.

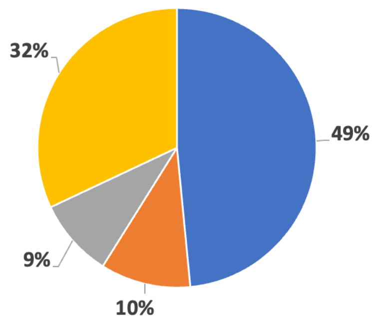
Heavy-duty truck categories (Class 2b-8: 8,501 lbs. and over):

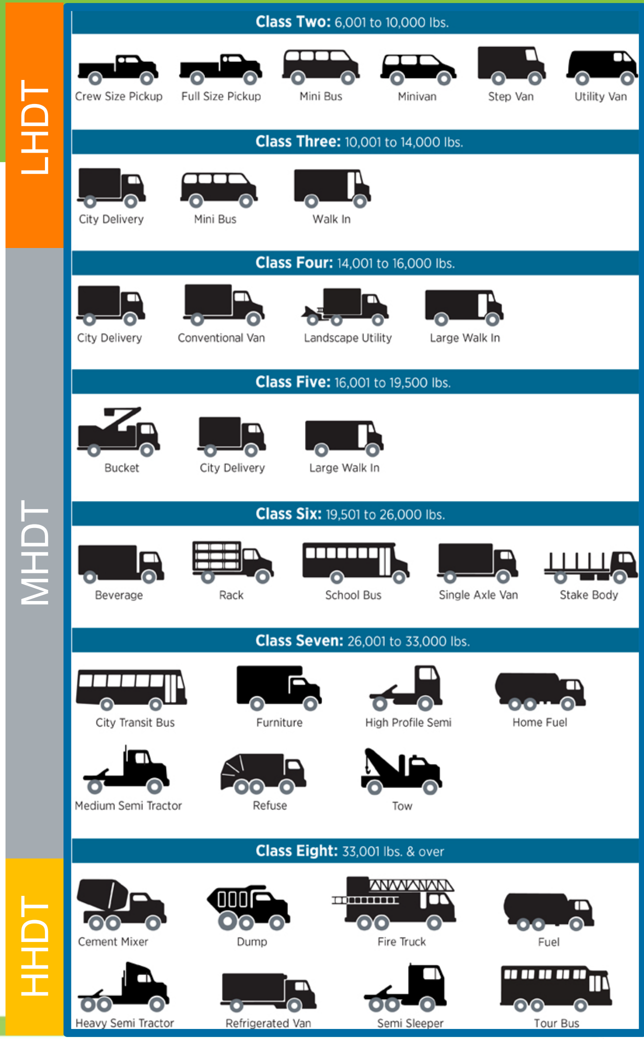
- Light heavy-duty truck (LHDT, Class 2b-3)
- Medium heavy-duty truck (MHDT, Class 4-7)
- Heavy heavy-duty truck (HHDT, Class 8)

On-Road Motor Vehicle Population



Daily On-Road Motor Vehicle NOx emissions

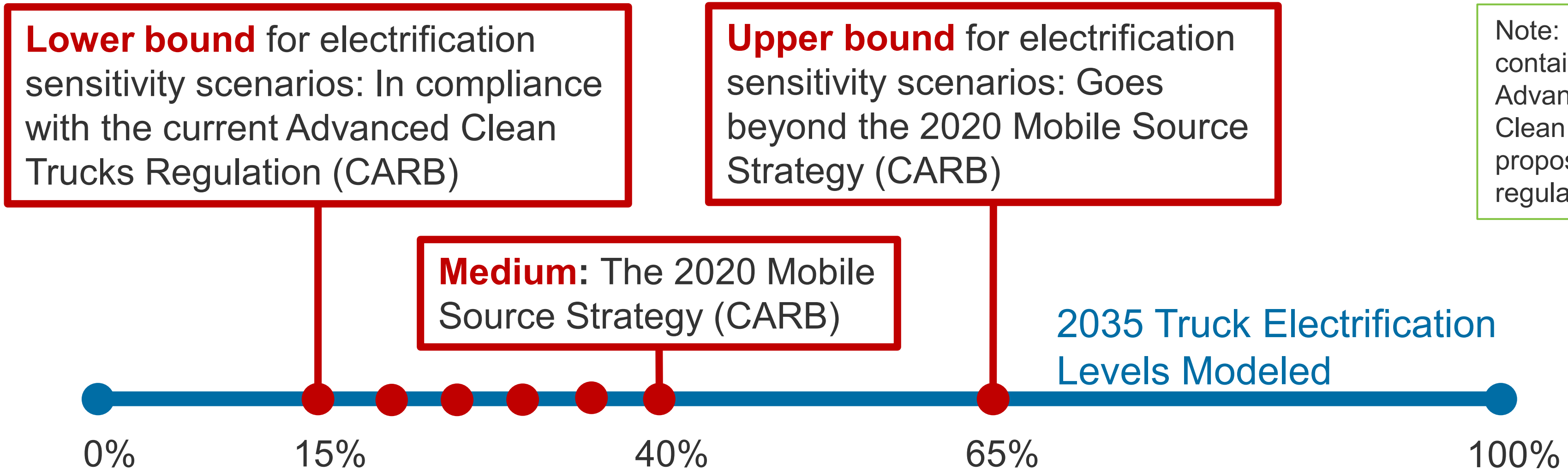




* Based on California Air Resource Board (CARB) Emission FACtor (EMFAC2021) model for LA (South Coast sub-area) for 2022

Truck Electrification: Scenarios

- NREL modeled multiple truck electrification scenarios in 2035.
  - Electrification levels tested for each of the three HDT category:
    - 15%, 20%, 25%, 30%, 35%, 40%, 65%



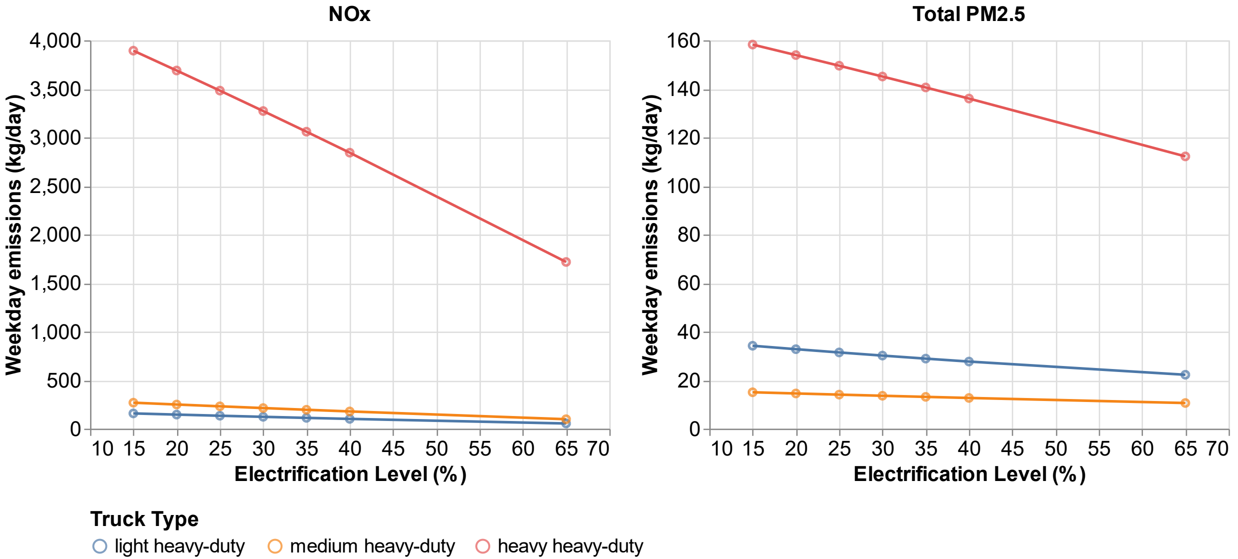
Note: MSS contains an Advanced Clean Fleet proposed regulation

- The UCLA team modeled two additional scenarios, which NREL also models:
  - UCLA Equity Scenario: LHDT – 15.6%; MHDT & HHDT – 19.6%
  - UCLA Equity Mobile Source Strategy (Equity MSS) Scenario: LHDT – 22%; MHDT & HHDT – 39%

Truck Electrification Air Quality Impacts: Emissions

Key Findings:

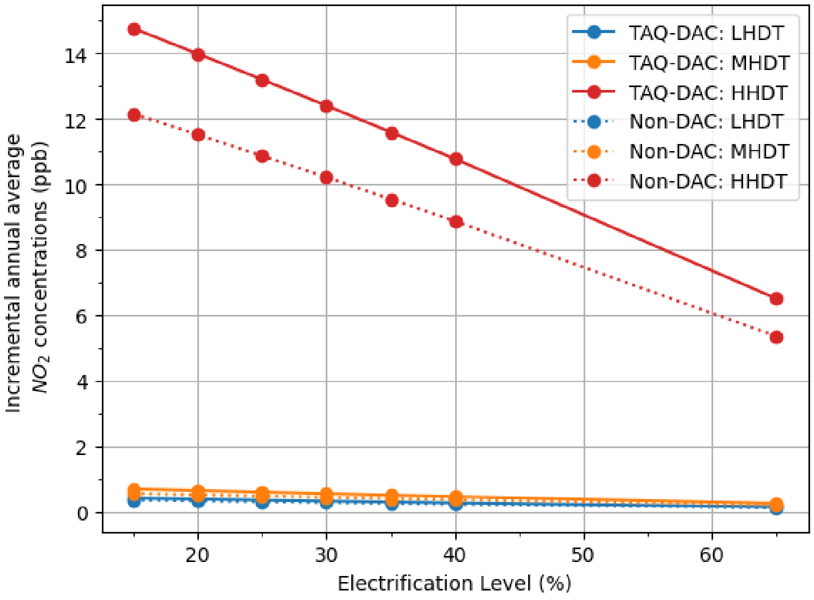
- Both NOx and $PM_{2.5}$ pollution decrease linearly as fleet electrification increases
- NO_x decrease is greater than $PM_{2.5}$ decrease
  - $PM_{2.5}$ brake and tire wear emissions are reduced but not eliminated with electrification.
- Electrification of heavy heavy-duty trucks (e.g., large construction vehicles, cement mixers, and 18-wheelers) provide the greatest emissions reductions.

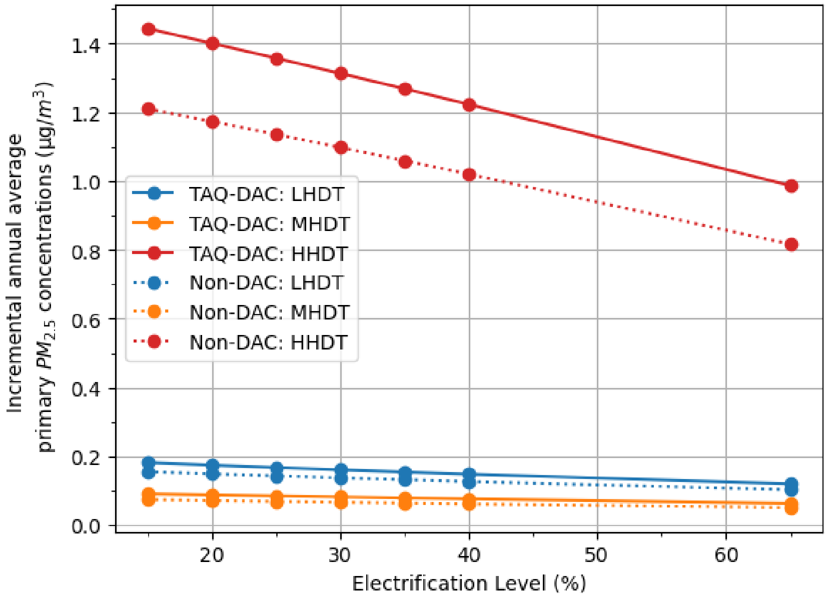


NO_x and particulate matter ($PM_{2.5}$) emissions for three heavy-duty truck categories based on emission factors from EMFAC 2021 (CARB) and activity data from SCAG regional travel demand modeling

Truck Electrification Air Quality Impacts by DAC Status: Concentration

Preliminary Results





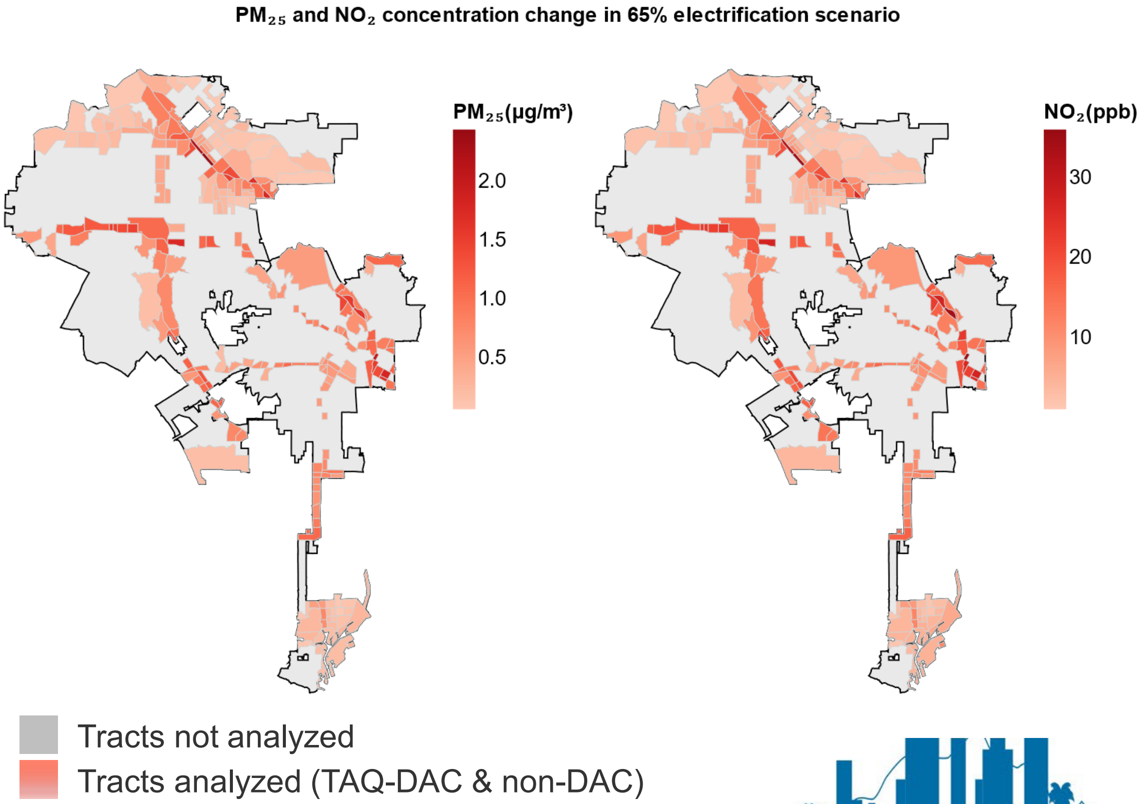
Key Findings:
- Both NO_2 and $PM_{2.5}$ concentrations decrease linearly as fleet electrification increases.
- TAQ-DACs benefit slightly more than traffic-affected non-DACs from greater fleet electrification.

Air Quality Improvements from Truck Electrification: Where

Preliminary Results

Key findings: In a 65% truck electrification by 2035 scenario:

- The largest pollutant concentration reductions occur in tracts located closet to freeways, including:
  - I-5, I-10, I-405, and US 101
- Regions such as LAX and the Port do not see as large a reduction in concentrations of $PM_{2.5}$ or NO_2 from truck electrification.



Equity Strategies

Truck Electrification

Baseline Equity

- The $63.7 million LADWP Commercial New Charger incentives were only available to light-duty vehicles and disproportionately distributed to non-disadvantaged, non-Hispanic, renter, and wealthier neighborhoods.
- 58% of DACs have percentile scores > 75 for either ‘traffic impacts’ or ‘diesel PM’ – two transportation related indicators in CalEnviroScreen.
  - 32% of DAC tracts have both these indicators > 75th percentile.
- Trucks account for more than 50% of on-road transportation emissions and 27% of total NOx emissions in LA while having only 5% of vehicle population

Community Solutions Guidance

- Electrify trucks to reduce pollution and provide health benefits.
- Set up low-income communities for EV infrastructure.
- Focus on cleaning up pollution from the Port (e.g., freight traffic), LAX, South LA, and Pacoima.

Modeling & Analysis Key Findings

- Electrification of heavy heavy-duty trucks results in approximately 5x the NOx pollution reduction compared to light- and medium-trucks.
- The I-5, I-10, I-405 and US 101 freeways are “hot spots” for traffic air quality impacts in LA.
- Benefits to air quality and health increase at the same rate with each increment of additional electrification of vehicles, with benefits for DACs slightly greater than for non-DACs especially for heavy-heavy trucks

Equity Strategies

- Prioritize charging infrastructure incentives and EV purchasing incentives for heavy-duty trucks, especially when replacing older model, higher emitting vehicles.
- Incentivize and locate charging infrastructure by working with city/regional agencies to understand where heavy duty trucks would ideally be charged, especially those servicing Ports and LAX.
- Revisit the MDHD-PEV goals of 4,000 by 2025 and 12,000 by 2035 and add associated MHDV charging infrastructure goals [NREL to add in findings: translation into y% of sales and Z MW new load by 2035].
- Collaborate with city agencies to support city HHDT fleet (e.g., fire trucks) electrification and charging infrastructure.

Questions and Feedback

Solar and Storage

Preliminary Results and Discussion

Ashok Sekar, National Renewable Energy Laboratory (NREL)
Paritosh Das, NREL
Ashreeta Prasanna, NREL

Equity Strategy Modeling & Analysis

NREL is conducting modeling, analysis, and strategy development along prioritized pathways:	
Affordability	Low-income energy bill affordability.
Housing	Universal access to safe and comfortable home temperatures.
	Housing weatherization and resilience to extreme events.
Solar & Storage	Improved access to solar and storage for multifamily residents and renters.
	Equitable community solar access and benefits.
Transportation Electrification	Equitable transportation electrification – electric vehicles (EVs), charging, and multimodal.
Grid Reliability & Resilience	Distribution grid upgrades to enable equitable solar, storage, and EV adoption and resilience.
Air Quality & Health	Truck electrification for improved air quality and health outcomes.

This presentation covers the highlighted pathway.

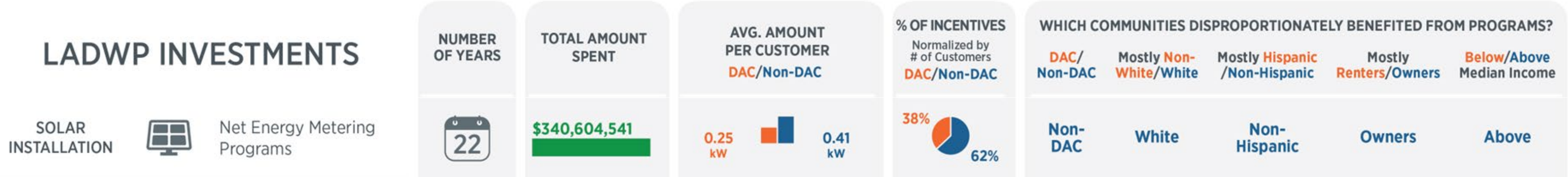
Community Guidance – Solar Equity

- Address the cost of rooftop solar.
- Foster community solar access by:
  - Addressing barriers to program participation
  - Providing information on solar developers
- Address mistrust/misunderstandings through customized and accessible information on
  - Investments and payback periods, and
  - Rooftop solar and community solar – with benefits tailored to each community's specific needs.
- Develop tailored strategies that address renter and homeowner issues to protect community members from displacement, i.e., from gentrification.
- Use equitable solar solutions for low- and moderate-income Angelenos that maintain and improve their homes towards a clean energy transition.

Baseline Solar Equity Analysis

Jane Lockshin, NREL

LADWP Solar & Storage Incentive Investments



Analysis of Los Angeles Department of Water and Power (LADWP) net energy metering programs indicate 62% of incentives went to households in non-disadvantaged communities (non-DACs).

$341 million in LADWP solar incentives over 22 years disproportionately benefited predominantly White, non-Hispanic, home-owning, and wealthier neighborhoods.

Number of Households Receiving Benefits from Solar Installation Programs

Program	Which communities disproportionately benefited from incentives?				
	Non-DAC/DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/Mostly Hispanic	Mostly Owners/Renters	Above/Below Median Income*
Feed-In Tariff (FiT)	No statistically significant difference				
Net Metering (NEM and Solar Incentive Program)	Non-DAC	Mostly White	Mostly Non-Hispanic	Owners	Above
Rooftops Lease Agreement (Solar Rooftops Program)	No statistically significant difference				

**Median income: $73,100 annual salary (2019)*

Solar incentive programs with a **statistically significant difference** in the **communities receiving benefits** between the socio-demographic metrics are marked in **blue** or **gold**. Unmarked boxes indicate no statistically significant difference.

Solar Capacity (kW)

Is *capacity* subsidized by LADWP **solar installation programs** equally distributed across **household types**?

	Which communities disproportionately benefited from incentives?				
Program	**Non-DAC/DAC**	**Mostly White/ Mostly Non-White**	**Mostly Non-Hispanic/Mostly Hispanic**	Mostly **Owners/Renters**	**Above/Below** Median Income*
Feed-In Tariff (FiT)	No statistically significant difference				
Net Metering (NEM and Solar Incentive Program)	Non-DAC	Mostly White	Mostly Non-Hispanic	Owners	Above
Rooftops Lease Agreement (Solar Rooftops Program)	No statistically significant difference				

**Median income: $73,100 annual salary (2019)*

Solar incentive programs with a **statistically significant difference** in the **amount of installed solar capacity** between the socio-demographic metrics are marked in **blue** or **gold**. Unmarked boxes indicate no statistically significant difference.

Solar Incentive Programs Analyzed

<table>
<tr><th>Solar Incentive Program Description</th><th>Years</th><th>Number of Unique Locations</th><th>Total Number of Records</th><th>Total Dollars</th><th>Notes</th></tr>
<tr><td>Feed-In Tariff Interconnection Agreement (FiT)</td><td>2013–2022</td><td>100</td><td>137</td><td>$90,096,630</td><td>87 MW</td></tr>
<tr><td>Solar Incentive Program (up to 1 MW) (SIP)</td><td>1999–2021</td><td>21,344</td><td>34,551</td><td rowspan="2">$340,000,000</td><td>279 MW installed, customer-owned solar, net energy metering</td></tr>
<tr><td>Net Energy Metering (up to 1 MW) (NEM)</td><td>2016–2021</td><td>16,068</td><td>24,763</td><td>170 MW installed</td></tr>
<tr><td>Solar Rooftops Program Lease Agreement (SRP)</td><td>2017–2020</td><td>32</td><td>32</td><td>$28,920</td><td>20-year lease agreement for single-family homes only</td></tr>
</table>

Did census tracts receive solar incentives proportional to their population*?

**number of households*

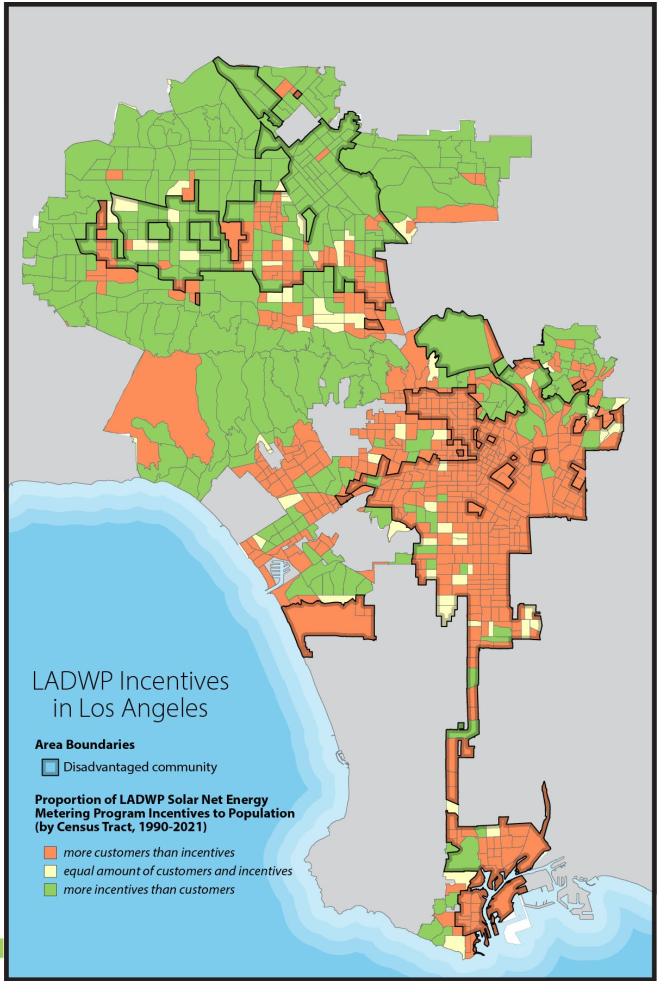
Areas including South LA and the Harbor did not receive solar incentives proportional to their populations.

Tracts where:

- % of households* > % of incentives received**: "more customers than incentives"
- % of incentives received** > % of households*: "more incentives than customers"
- % of incentives received** = % of households*: "equal number of customers and incentives"

*% of households = number of households in a census tract divided by the total number of households
**% of incentives received = number of incentives granted to tract divided by the total number of incentives

Solar Net Energy Metering Programs (NEM and SIP)

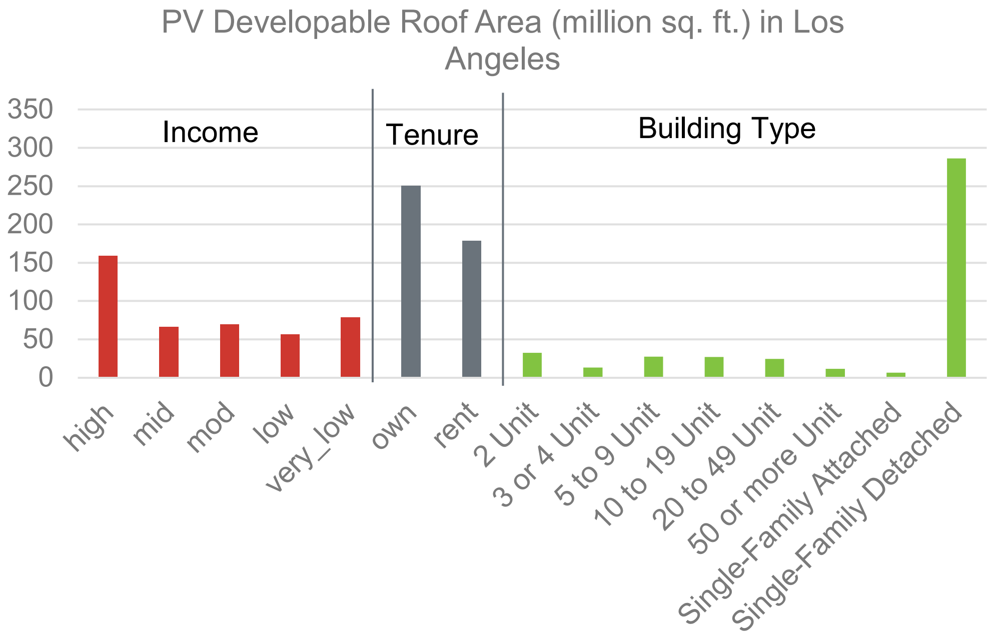


Improved access to solar and storage for multifamily residents and renters

Ashok Sekar, NREL
Paritosh Das, NREL
Ashreeta Prasanna, NREL

Technical Potential of Rooftop Solar

- Total photovoltaic (PV) developable roof area:
  - 430 million sq. ft.
  - Technical capacity of 7.5 GW
- Low- and moderate-income (LMI) households have an aggregate 47% (204 million sq. ft.) of PV developable roof area. This is more than high- and mid- income homes.
- Renters represent 40% (172 million sq. ft.) of PV developable roof top area.
- Multi-family households represent 32% (137 million sq. ft.) of total PV developable roof area.

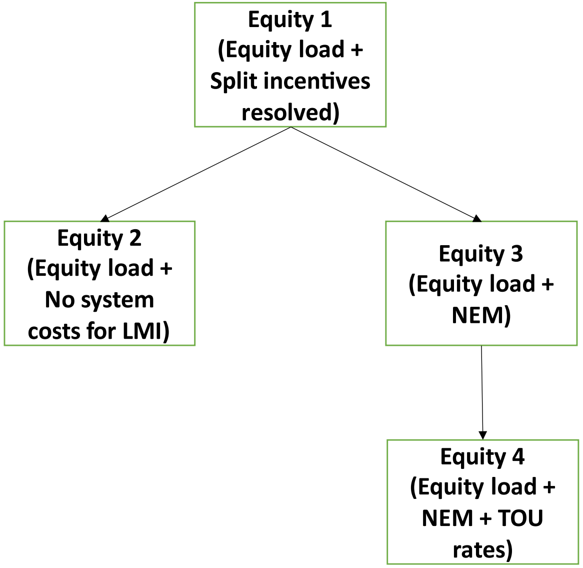


Rooftop Solar Adoption Scenarios

The technical potential for rooftop solar adoption was modeled under multiple scenarios through 2035.
Equity scenario assumes load when there is high energy efficiency uptake in 2035.

Baseline

- *SB100 rate esc.*
- *Tiered rates by zone (no TOU)*
- *Baseline load profile*
- *Discount rates used to vary consumers*
- *Net energy billing*

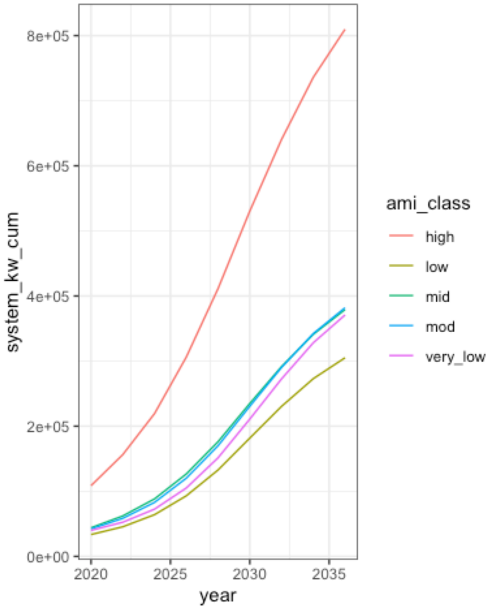


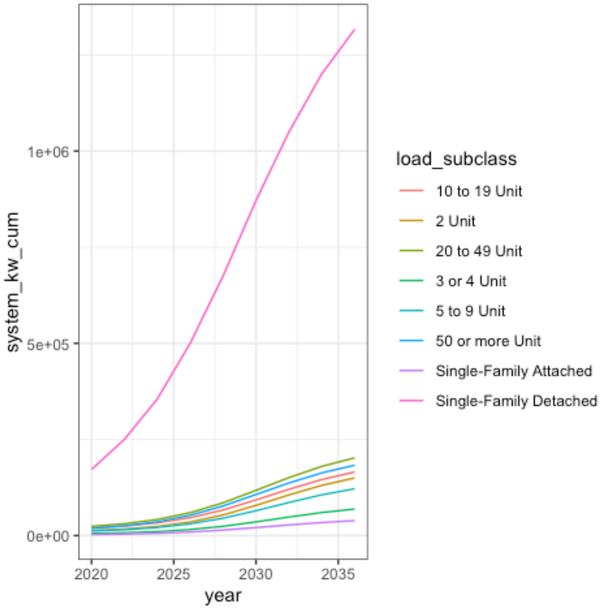
Scenario Name	Load Profile	Split Incentives	Incentives	Compen-sation
Baseline	Baseline	Partially resolved	ITC	Net billing
Equity1	Equity	Resolved	ITC	Net billing
Equity2	Equity	Resolved	ITC and no system cost for LMI	Net billing
Equity3	Equity	Resolved	ITC	Net metering

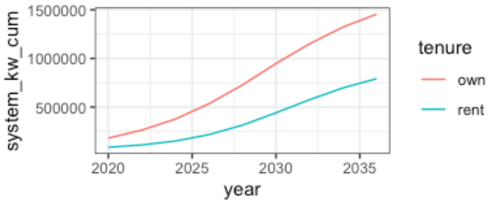
Tariff – Tiered rates assigned by monthly load and zone
Rate Esc. – SB100
Technology cost – Mid Case from ATB 2022
Weighted Average Cost of Capital (WACC): The average expected rate that is paid to finance assets.

Baseline Solar Adoption Projections

- By 2035, total projected rooftop PV adoption in baseline scenario is approx. 2.25 GW.
- The figures show adoption by income (ami_class), building type (load_subclass), and ownership type (tenure).
- Single-family, high income and owners are the highest adopters.
- Modeling projects no economic battery adoption in baseline scenario.

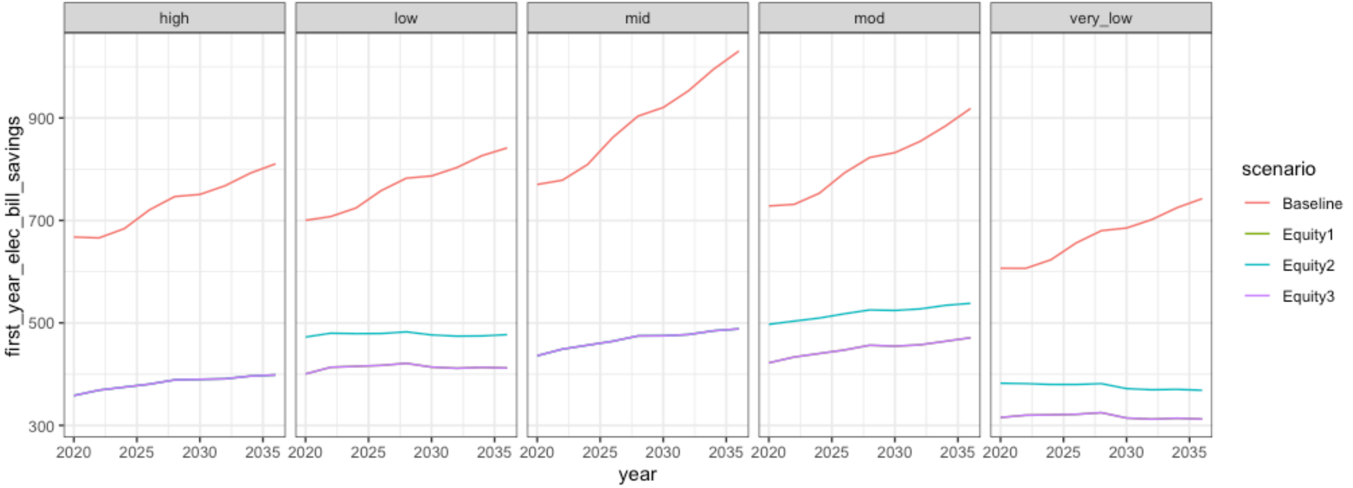






First Year Electricity Bill Savings from PV and Battery Adoption by Income

- First year bill saving represents savings when consumer in a particular year adopt PV or battery system.
- The Baseline scenario has the highest savings compared to the equity because in equity scenario load is lower due to high EE technology adoption by consumers compared to baseline. In other words, savings from energy efficiency upgrades are not included
- 25% increase in annual electricity bill savings for LMI in the equity scenarios (1 & 3 vs. 2) when PV and battery are adopted. Note battery are adopted only in Equity 2 scenario.



Summarized Results from Equity scenarios

Equity Strategies

Equity Strategies

Baseline Equity

- 62% of LADWP net energy metering program incentives went to households in non-disadvantaged communities.
- $341 million in LADWP solar incentives disproportionately benefited predominantly White, non-Hispanic, home-owning, and wealthier neighborhoods.

Community Solutions Guidance

- Address the cost of rooftop solar.
- Provide community solar access.
- Deliver customized information on investments and payback periods to address skepticism about the value of solar.
- Protect residents from predatory solar developers.

Modeling & Analysis Key Findings

- LADWP has significantly high renter, multifamily, and low- and moderate-income households. 64% of all developable roof area.
- 2.25 GW of solar adoption is expected by 2035 with no co-location of batteries in the baseline model. Around 70% of that adoption is from single family owner non-LMI households
- When high adoption of energy efficiency measures are considered, adoption is expected to slow due to reduction in energy consumption
- When the renter/owner split incentive is resolved and solar benefits also flow to renters, solar adoption is increased by 40%.

Equity Strategy

- Designing programs to benefit low- and moderate-income customers enables these customers to achieve 25% bill savings.
- Designing solar programs to enable renters to benefit from rooftop solar will increase adoption substantially.

Residential Panel Upgrade Analysis

UCLA

LA100 EQUITY STRATEGIES

Future Panel Upgrade Requirements for Residential Electrification

Eric D. Fournier, CCSC

LA DWP

NREL Transforming ENERGY

UCLA

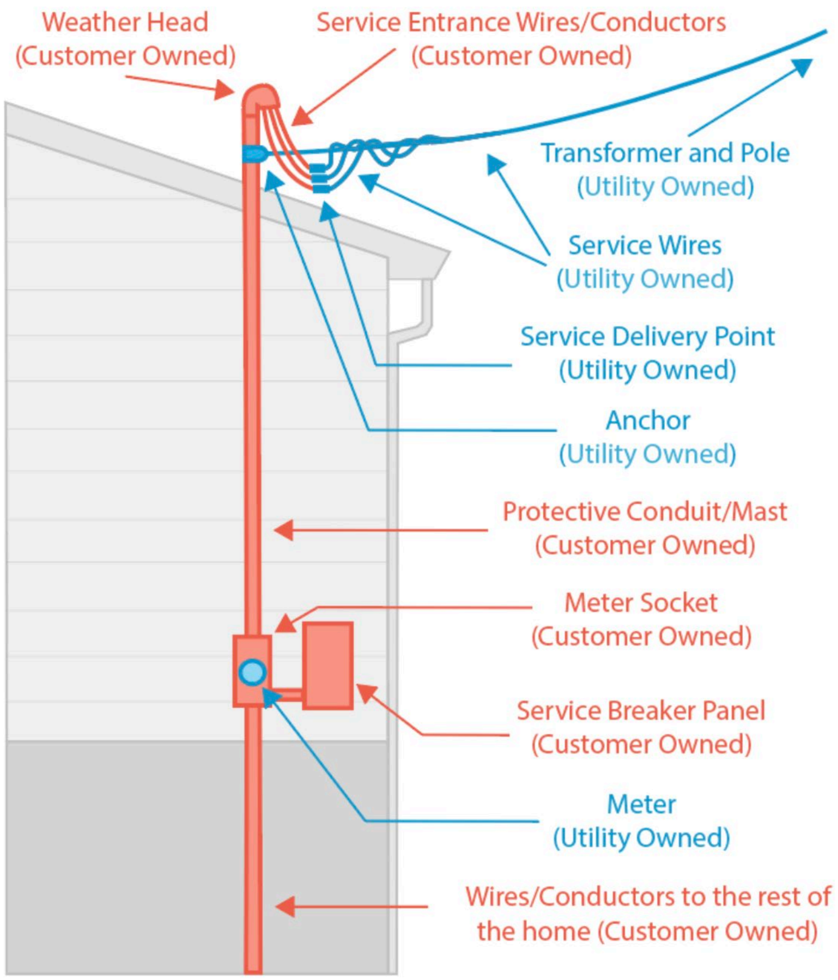
Electric Service Panels

(a.k.a. ”Load Centers”)

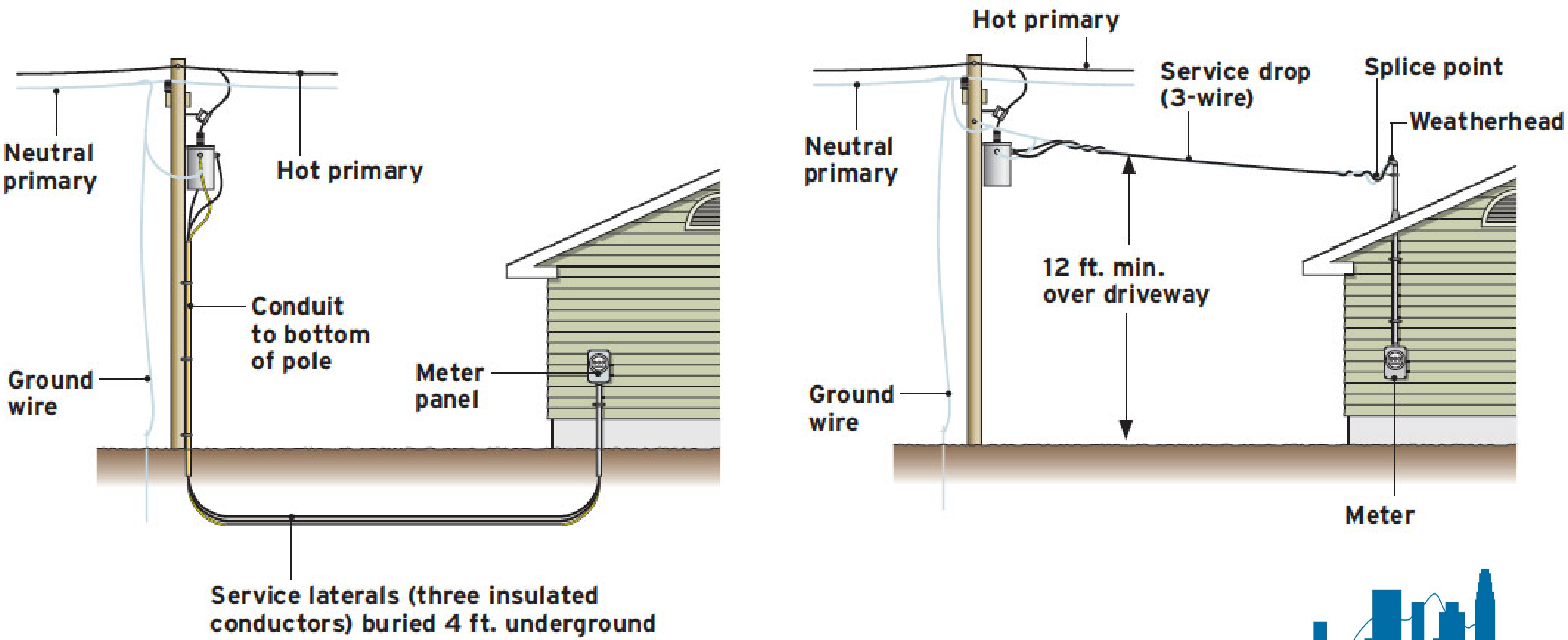
These are pieces of customer owned hardware that physically interconnect to utility owned distribution system infrastructure.

Customer vs. Utility Owned Equipment

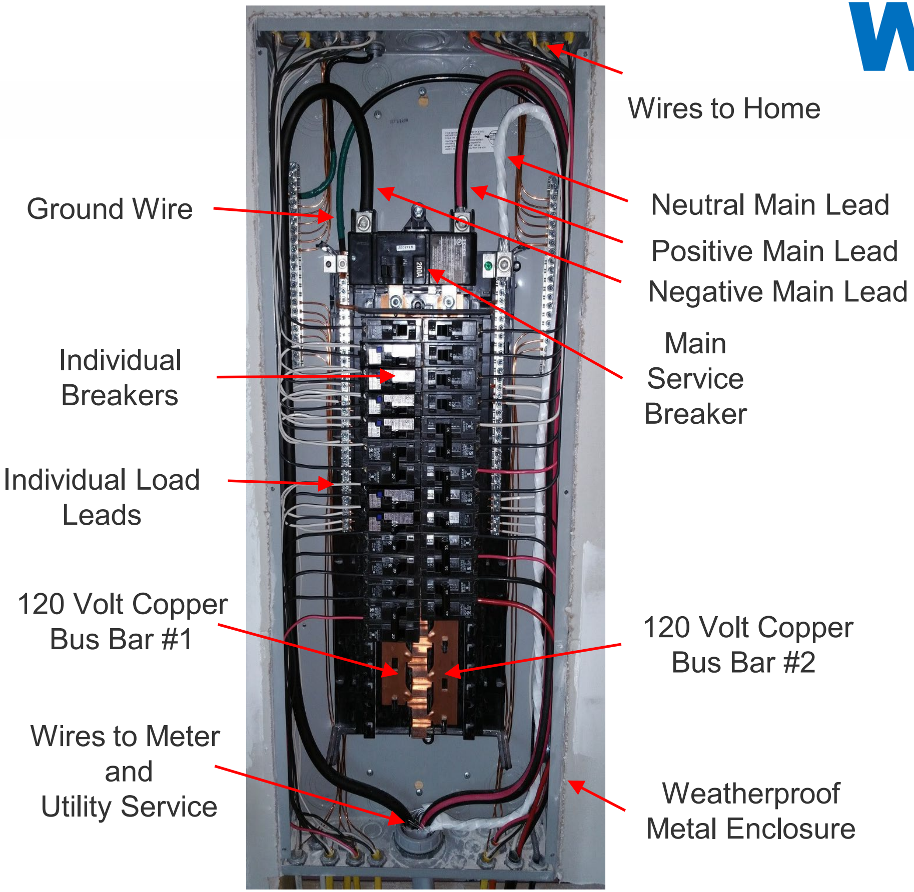
The volume of electricity that can be consumed within a structure (i.e., its service capacity) is jointly determined by the capabilities of BOTH the utility owned distribution system hardware and the customer owned load center hardware which serve it.

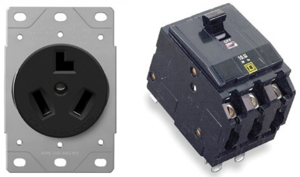


Below ground vs. above ground service



What is in a panel?





220/240 Volt Outlets &
30/60 Amp Breakers

110/120 Volt Outlets &
15 Amp Breakers

Each tenant has their own dedicated meter and sub-panel to manage the circuits that service the loads in their unit.

Multi-Family

Context

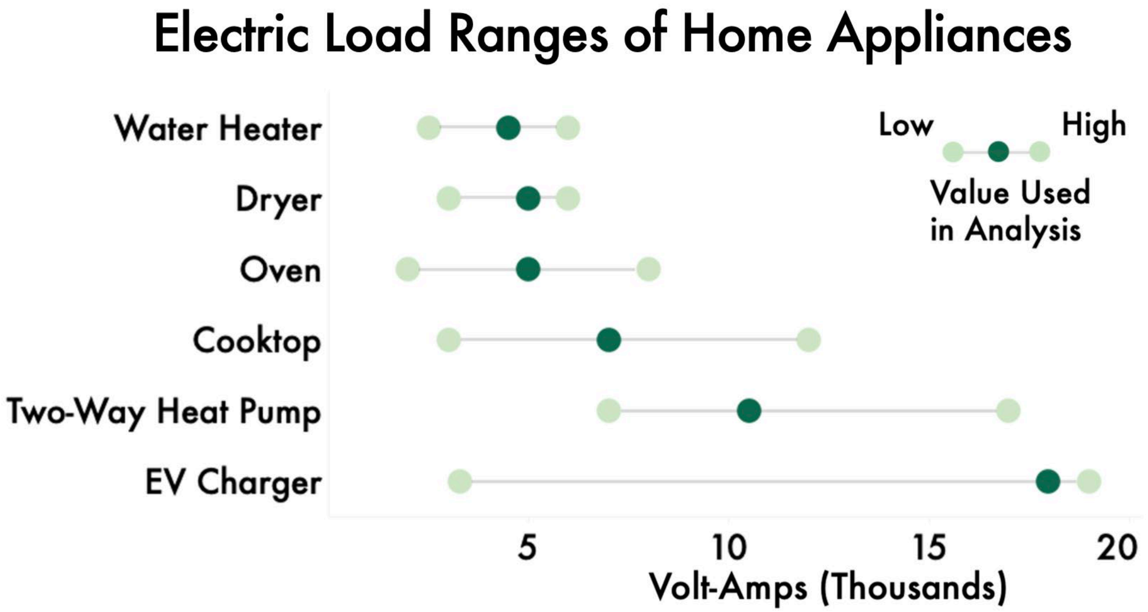
Multi-family buildings also often have communal loads – such as for lighting and plug outlets in common areas. These can be separately metered but may meet at a common load center. Or not. There are many more possible configuration options in the multi-family context.

The picture can't be displayed.

Q: How Much Panel Capacity is Needed to Support Different Electric Appliances?

A: It depends on many factors. Partial electrification is possible without panel upgrades in many cases. But full electrification of a home, plus the addition of on-site EV charging, will typically require more service capacity than most older buildings have available.

Previous Work

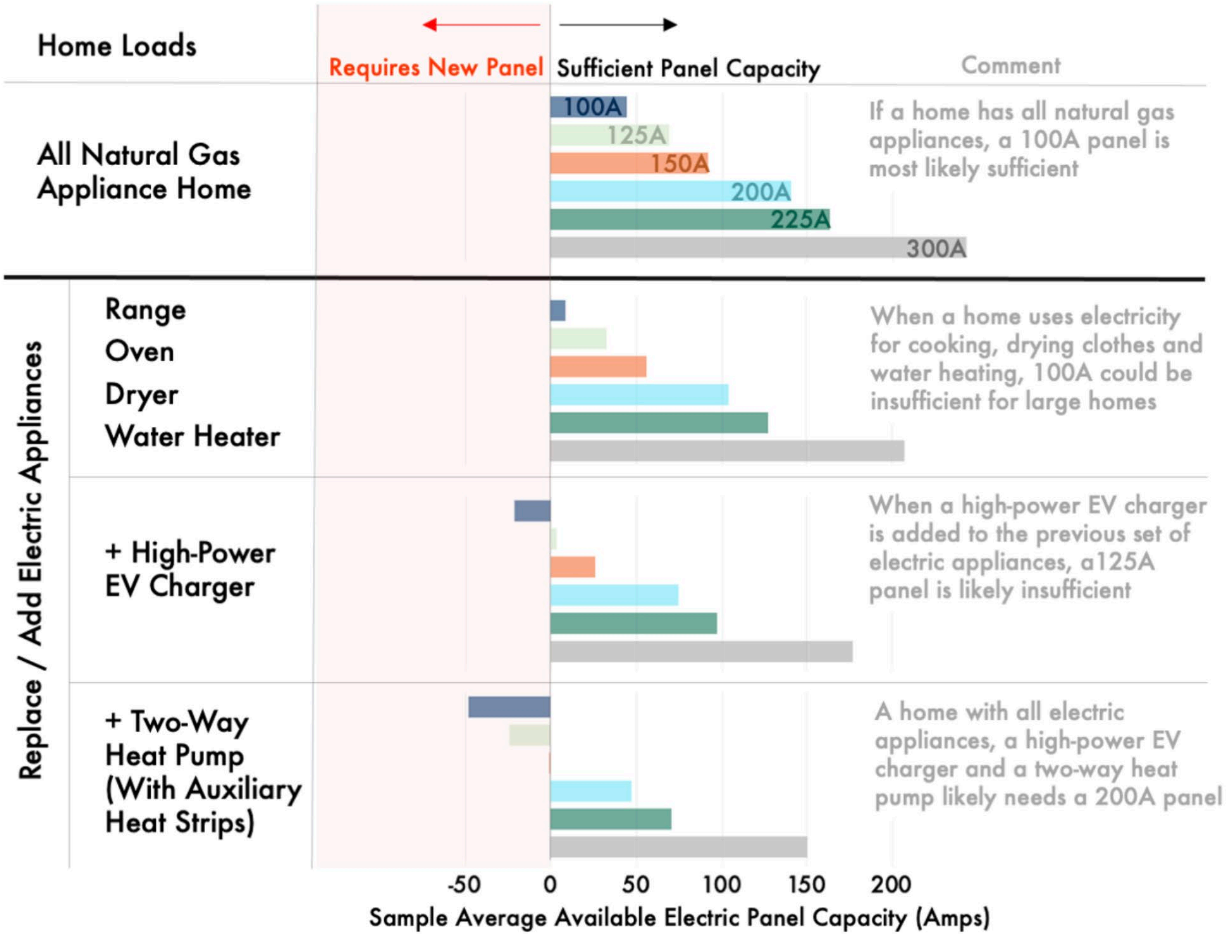


This figure comes from a recent Pecan Street report on panel upgrade requirements for residential electrification.

Understanding how much power, and thus panel capacity, an appliance uses is determined by the combination of its voltage and amperage (hence the units "Volt-Amps" here.

Note: to estimate the size of the breaker needed for each appliance type, divide the Volt-Amps values by 240. So here for example, the quoted EV charger load range would imply between a 15-80 Amp breaker.

Previous Work



Here again, this figure comes from the same recent Pecan Street report.

When interpreting these data, it is important to know that most of their study data came from a sample of homes in Texas, which obviously represents a very different residential context from what we have here in Los Angeles.

2019 RASS Data for LADWP

The three end use equipment categories where electrification upgrades are most likely to trigger the need for a panel upgrade include:

1) Heat Pump HVAC Systems (both ducted and mini-split units)

2) Electric Water Heaters (both resistance and heat pump units)

3) Level-2+ Electric Vehicle Chargers

Electrical End Use Equipment Category	LADWP Customer Penetration Rate
Conv. Heat	14%
Heat Pump	**6%**
Aux. Heat	8%
Furnace Fan	46%
Attic Ceiling Fan	1%
Central Air Conditioning	52%
Room AC	29%
Evap. Cooler	9%
Water Heat	**5%**
Solar Water Heat	0%
Dryer	17%
Clothes Washer	62%
Dishwasher	51%
First Refrigerator	100%
Second Refrigerator	20%
Freezer	10%
Pool Pump	7%
Spa	4%
Outdoor Lighting	46%
Range/Oven	36%
TV	65%
Spa Electric Heat	2%
Microwave	82%
Home Office	19%
PC	80%
Well Pump	1%
Electric Vehicle	**6%**
Miscellaneous	100%
Conv. Heat	14%

Q: How Can We Estimate the Existing Capacity of Service Panel Hardware in LA's Housing Stock?

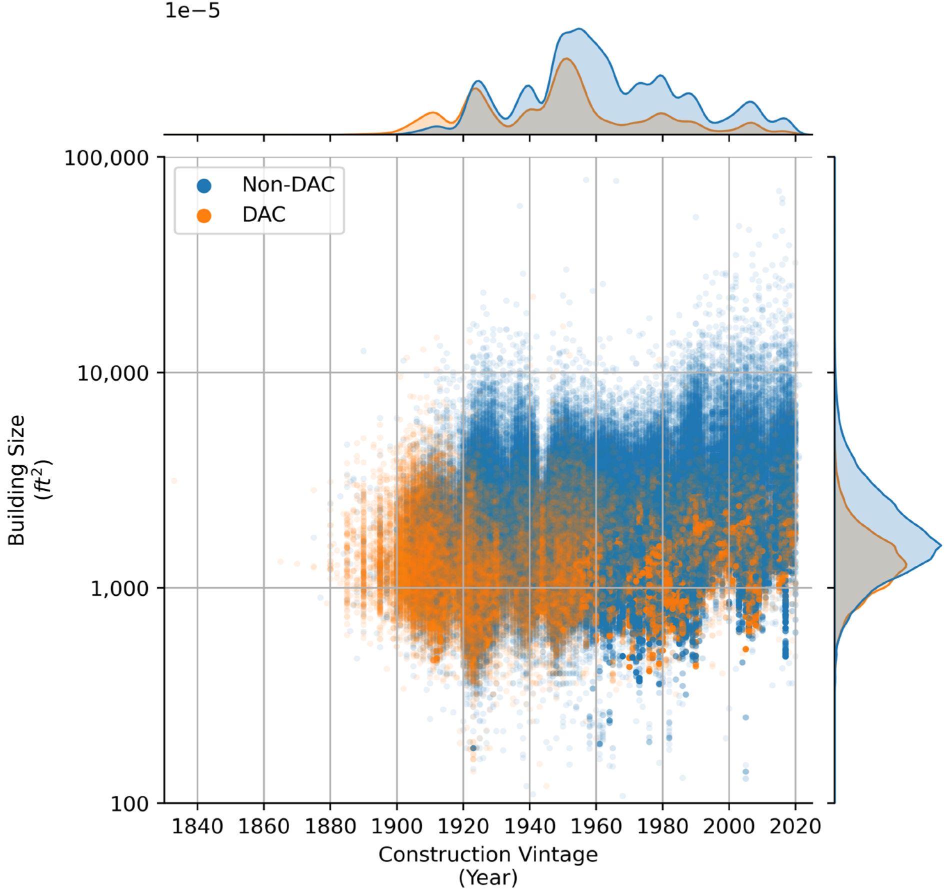
A: The size of a panel is often determined at the time of the building's construction and depends on the number and size of the electrical loads in the structure. Generally, though, panel sizes strongly correlate with the size of a building and the year in which it was built.

Methodology Overview

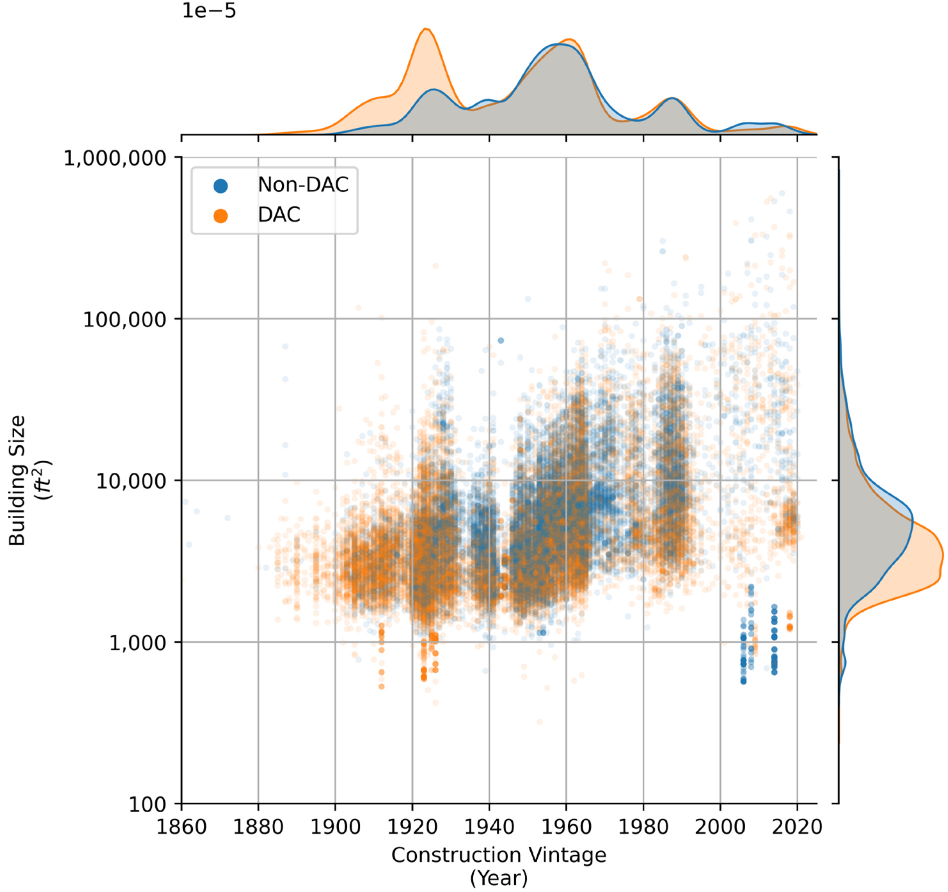
1. Estimate As-Built Service Capacity
2. Identify Historical Permitted Upgrades
3. Infer Antecedent & Unpermitted Upgrades
4. Assign Existing Service Capacity

1

Single-Family Properties



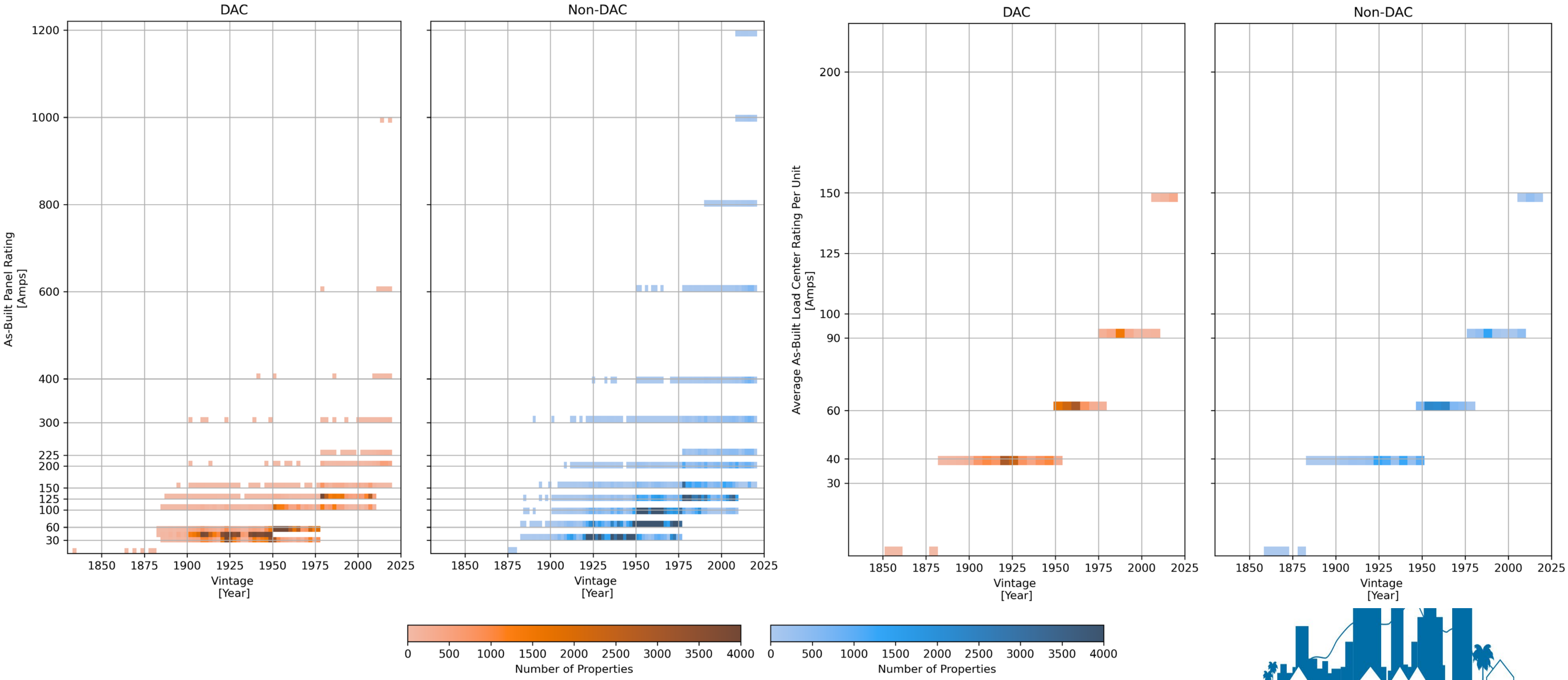
Multi-Family Properties



1 Estimated As-Built Panel Ratings

Single-Family Properties

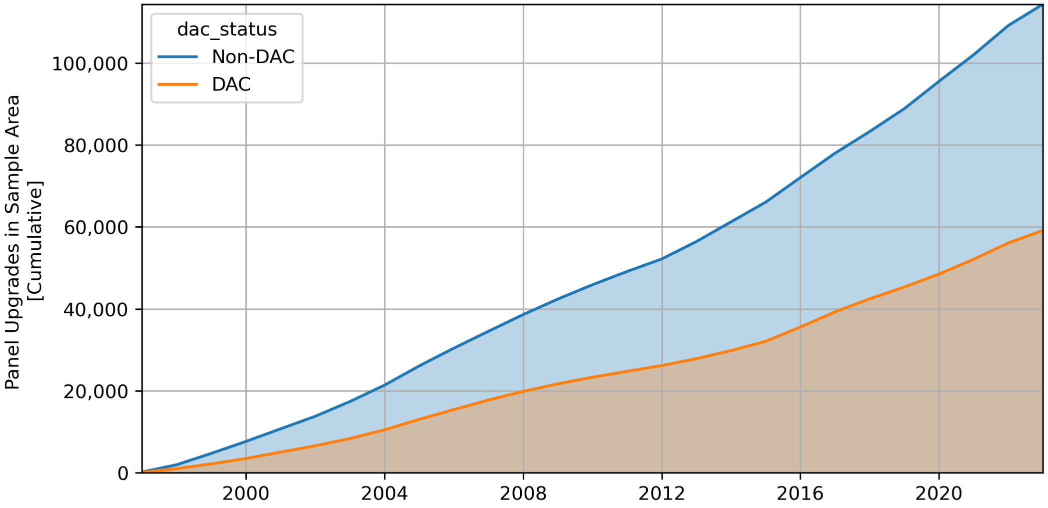
Multi-Family Properties



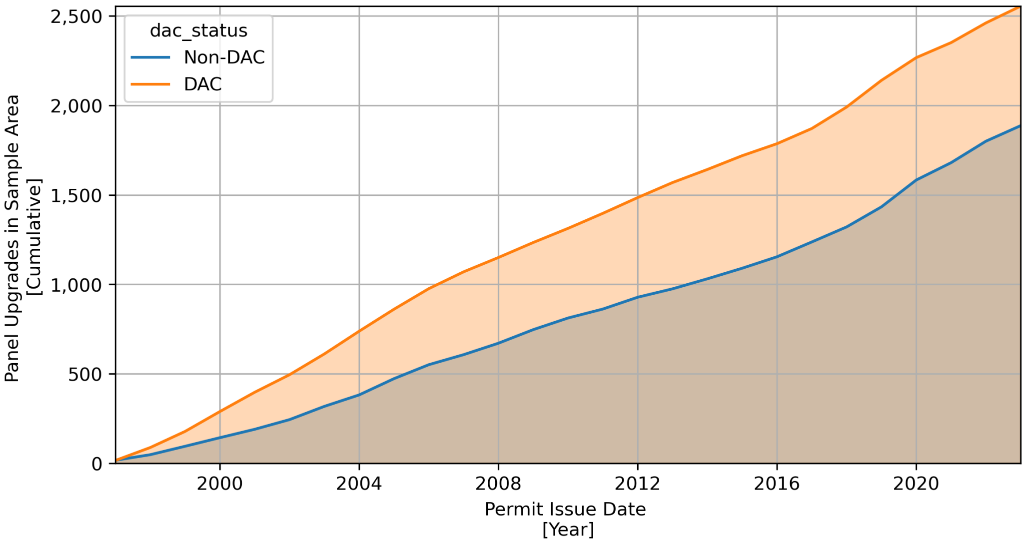
2

Panel Upgrade Permits

Single-Family Properties

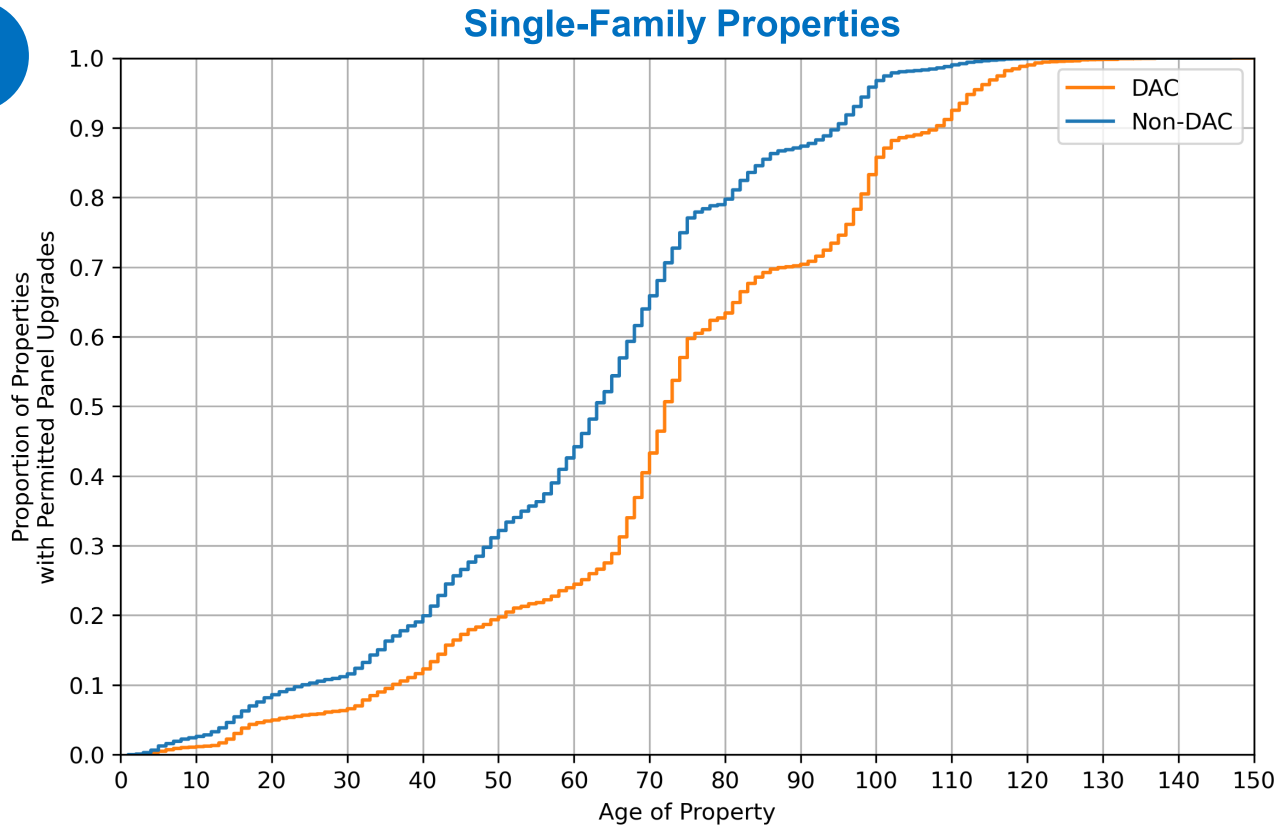


Multi-Family Properties



How Long Before Service Panels are Typically Upgraded?

3

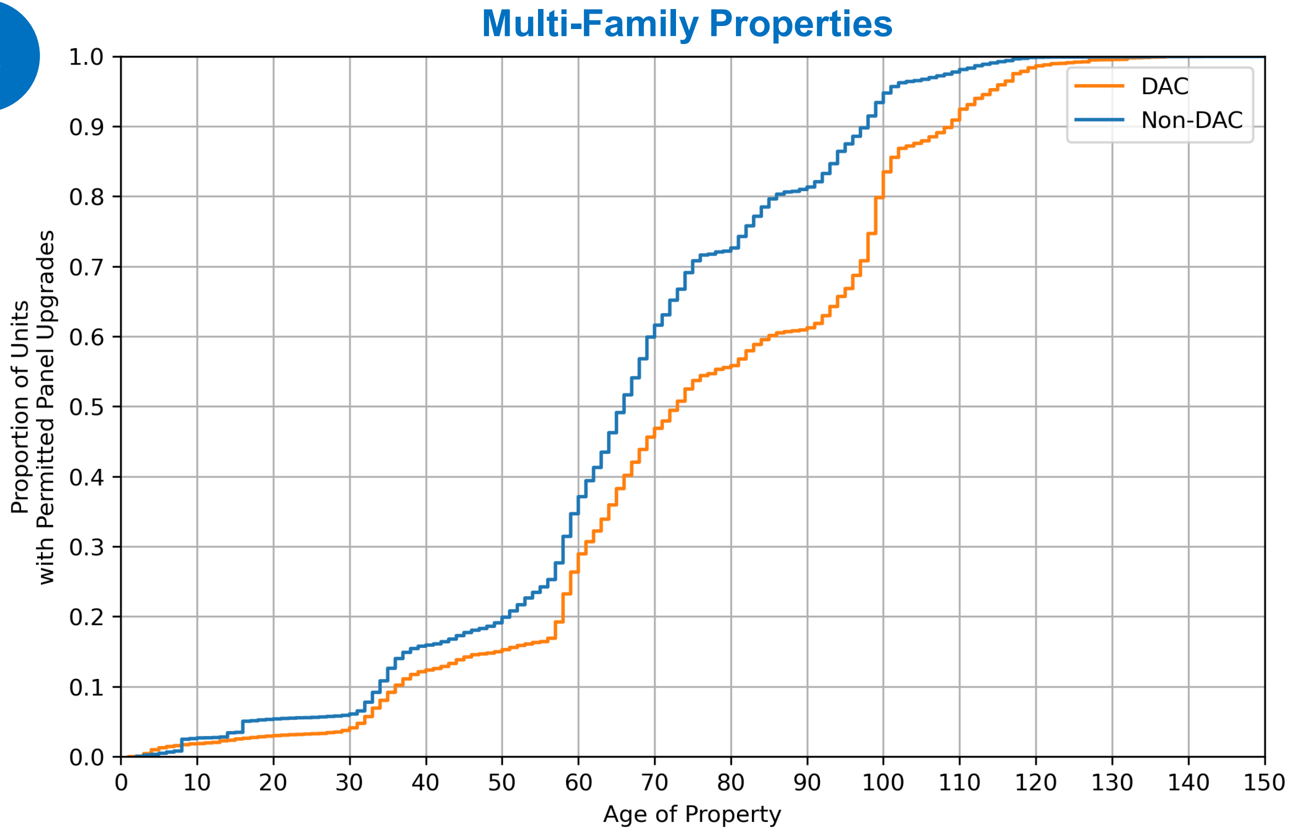


Within non-DAC census tracts, there is a 50% chance of a panel upgrade having already occurred if a property is at least 65 years old.

In DAC census tracts this age increases to 72 years before this same 50% probability threshold is crossed.

How Long Before Service Panels are Typically Upgraded?

3



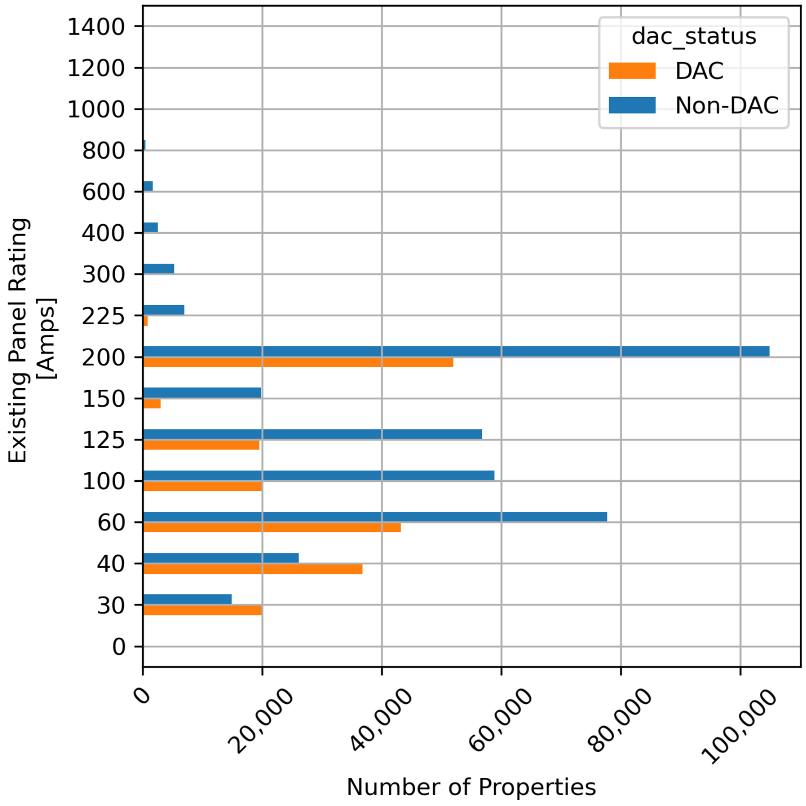
And as this figure shows, within the multi-family context things change even more slowly.

For example, among DAC multi-family properties, a building must reach nearly 75 years old before there is a 50% of it receiving a load center upgrade.

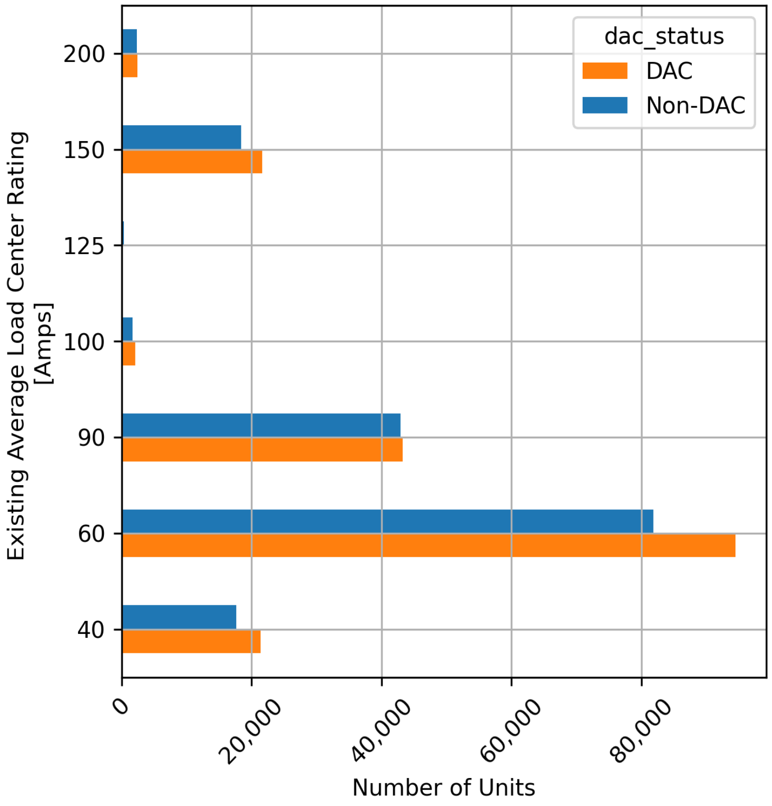
4

Estimated Existing Panel Ratings

Single-Family Properties



Multi-Family Properties



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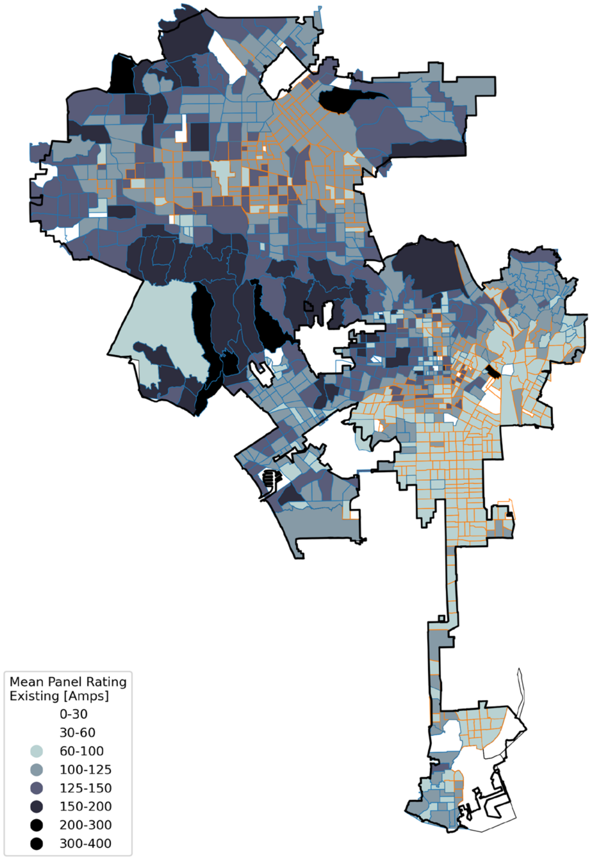
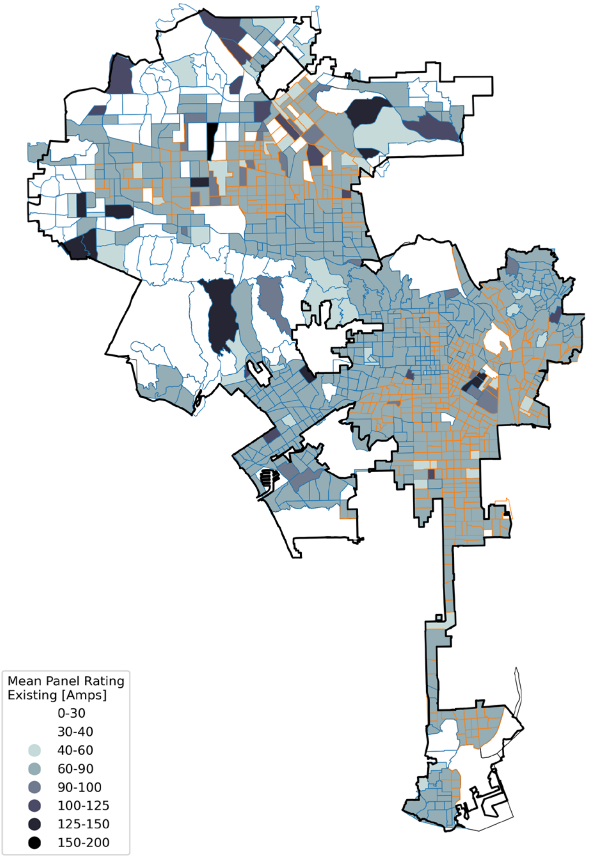
Single-Family Properties



Multi-Family Properties



Estimated Existing Panel Ratings

Q: How Many Panel Upgrades are Likely Going to be Needed?

A: The specific answer is going to depend upon the rate at which different end-uses are electrified and the desirability / availability of low power demand options. However, the expectations are that large numbers of properties will need to be upgraded.

Single-Family Properties

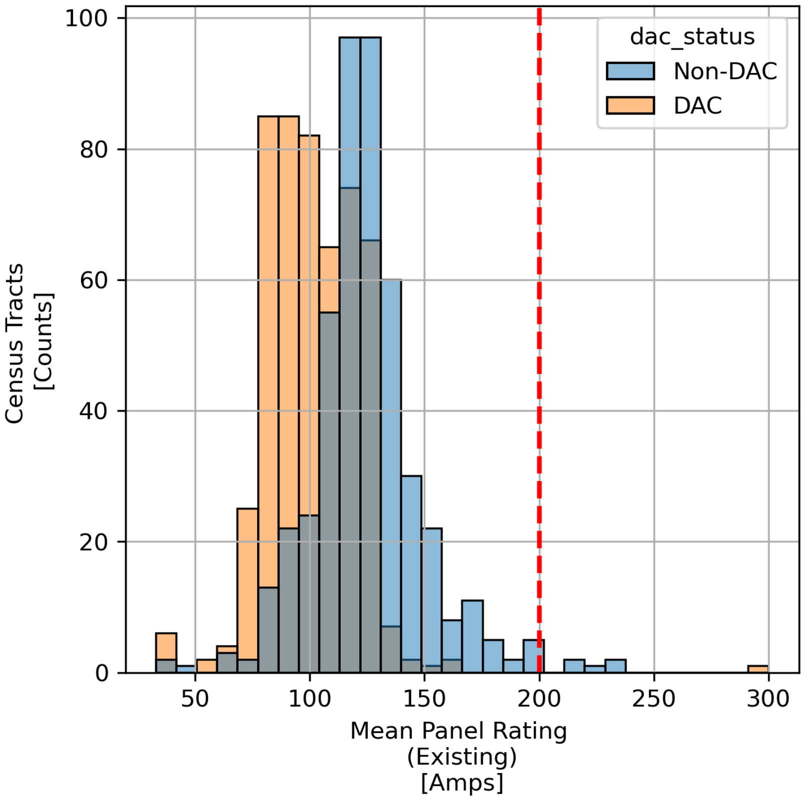
Panel Rating Classification	Upgrade Required for Future Full Electrification?	DAC Properties [Percentage]	Non-DAC Properties [Percentage]
<100 Amps	**Likely**	**51.09%**	**31.57%**
>=100 Amps & <200 Amps	Potentially	21.82%	36.00%
>= 200 Amps	Unlikely	27.08%	32.43%

Multi-Family Properties

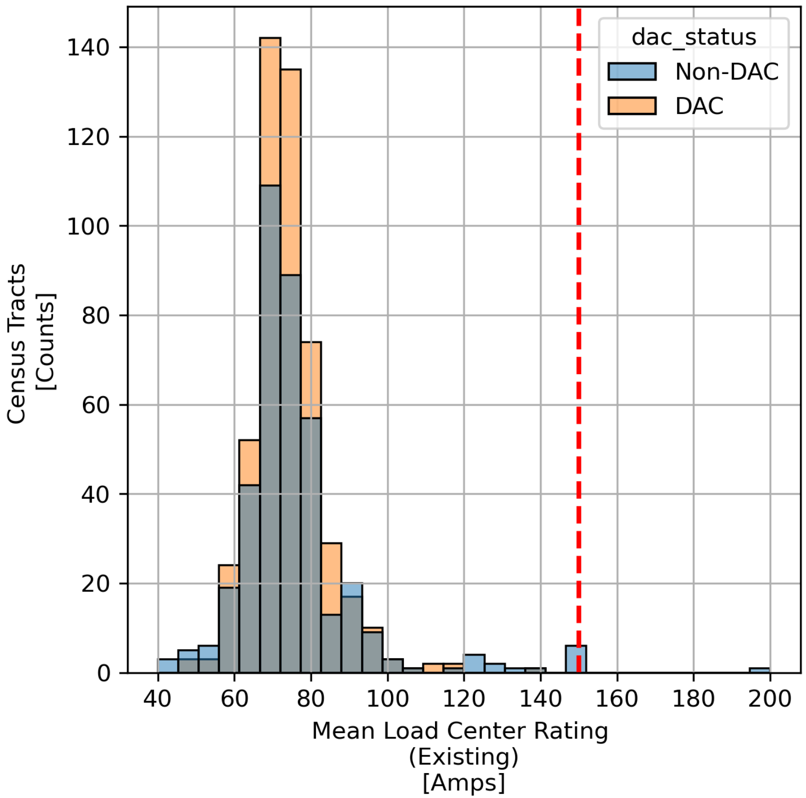
Panel Rating Classification	Upgrade Required for Future Full Electrification?	DAC Properties [Percentage]	Non-DAC Properties [Percentage]
<90 Amps	**Likely**	**72.06%**	**67.80%**
>= 90 Amps & <150 Amps	Potentially	16.37%	19.98%
>= 150 Amps	Unlikely	11.57%	12.22%

Estimated Existing Panel Ratings

Single-Family Properties



Multi-Family Properties



Results Overview

- The load center capacities that can guarantee support of full electrification are ≥200 Amps for single-family homes and ≥150 Amps for multi-family units.
- It is possible to partially electrify dwellings with smaller panel sizes, however, it will likely require more intelligent hardware, load splitting, and/or lower voltage appliances.
- ~50% of the single-family homes within DACs are likely to need panel upgrades in order to fully electrify. This ratio drops to ~30% in non-DACs.
- However, the larger number of single-family homes within non-DACs however means that, overall, the city's non-DACs contain a greater overall share of the total number of homes that will need to be upgraded.
- ~70% of multi-family properties in the city, across both DACs and non-DACs, are likely going to require load center upgrades to fully-electrify all end-use equipment.
- Upgrading the load centers of these multi-family buildings will be a more challenging and expensive than it will be for single-family properties.
- Increasing the rate at which these properties are upgraded should be considered and equity strategy priority.

Q & A

How to support customers whose buildings need panel upgrades?

How to avoid panel upgrades that aren't necessary?

How to take advantage of new smart panel hardware capabilities?

Going Forward

Tentative

Steering Committee Meetings

March 29, 2023 (Virtual)

- Grid Reliability and Resiliency preliminary results & strategies
- Air Quality and Health preliminary results & strategies
- Energy Atlas

April 19, 2023 (Virtual)

- Rates and affordability
- Access to home cooling
- Jobs

Subsequent Meetings

- Third Wednesday of each month, 10:00 a.m. – 12:00 p.m. PT
- Virtual for near-term

For another opportunity to provide input on the transportation strategies, watch for an email with a link.

Thank you!