Los Angeles Affordable Housing Decarbonization Study Phase 2

September 2021

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00 Report at a Glance

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Report at a Glance

01 Introduction

Mitigating GHG emissions and actively protecting existing affordable housing are two urgent needs for the City of Los Angeles with a complex relationship with one another. New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.

- Los Angeles has set ambitious decarbonization goals. Building electrification is an essential piece of that strategy.
- There are significant short- and long-term benefits of building decarbonization for occupants, owners, and communities, such as improved indoor and outdoor air quality, enhanced safety and resilience, and lower utility bills.
- Yet, decarbonization can have unintended consequences for residents of affordable housing. Affordable housing is a complex sector with many unique challenges and preservation of existing affordable housing is essential for the future of Los Angeles.
- Centering affordable housing in decarbonization policy development can yield better results in terms of societal benefits and market transformation.

New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.

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02 What is the state of affordable housing in Los Angeles?

Even before COVID-19 struck low-income communities, costing many their lives, health, and jobs, LA was suffering from an affordable housing crisis. In simple terms:

- Not enough of the existing housing stock is affordable.
- The existing multifamily housing stock is aging, with backlogs of deferred maintenance. Not only are rising rents and expiring covenants reducing the availability of affordable housing, but when future climate impacts and other hazards like earthquakes are factored in, available units are becoming less fit for purpose (i.e., less safe, healthy, and comfortable to live in).
- Energy burden across Los Angeles was felt intensely before COVID-19 and is disproportionately concentrated in low-income communities and communities of color. More families were brought into utility debt or further into utility debt during COVID-19.
- Programs to improve the quality or energy performance of residential buildings are largely targeted to market rate or single-family housing. Benefits therefore often do not reach households that are low-income, renters, or in multifamily buildings.
- There is a significant need to not only build new affordable housing, but also to protect and retrofit existing units in ways that improve habitability, reduce household expenses, and support a healthier environment.
- Any policies that affect the residential market must therefore be carefully considered and designed to directly support affordable housing and low-income households.

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Report at a Glance

03 What are the implications of electrification on affordable housing?

We conducted a targeted analysis of two unit types across two building vintages, for a total of four building typologies, to evaluate implications of decarbonization retrofits (specifically electrification measures) for both tenants and building owners.

- We found that energy consumption was reduced across all scenarios through the electrification retrofit, resulting in operational cost savings. The greatest savings were seen for the older (1980 era) higher density (62-unit) building.
- To accommodate all-electric appliances and equipment, base building electrical systems are likely to require upgrades.
- The upfront cost of electrification in this study was found to exceed routine end-of-life equipment replacement.
- If passed onto tenants, these upfront costs will exceed operational savings from efficiency, resulting in a net cost increase for tenants.
- There are benefits to implementing retrofits in a phased approach (readying the base building, upgrading the common areas, and then doing unit-by-unit retrofits).

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Report at a Glance

04 Policy and Program

- The affordable housing sector faces a unique and complex set of barriers to implementing decarbonization. To be effective, decarbonization must be deeply entwined with the biggest challenge of the sector: affordable housing preservation.
- Programs should be designed with the combined goals of decarbonization, affordability protection, and retrofits to keep housing safe, healthy, and fit-for-purpose in a changing climate.
- Stakeholders (both those with deep technical knowledge and those with lived experience) must be at the table to ensure program design repairs—rather than perpetuates—cycles of racism and disenfranchisement.
- Mandates are needed to force implementation but should be leveraged to protect housing affordability and prevent burdening tenants.
- A wide range of technical, financial, regulatory, and administrative tools must be customized to address the specific challenges and vulnerabilities of the sector and increase
- Funding and financing for retrofit programs currently comes from a wide range of sources targeting narrow interventions that don't meet the needs of affordable housing. Aggregating both financing and service delivery is needed to make implementation accessible.
- Streamlined, targeted deployment should occur at the neighborhood scale in collaboration with community-based organizations (CBOs) to specifically address community needs.

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05 Conclusion

- Affordable housing is an essential component of resilient communities and must be protected and expanded to address the multiple crises this sector is facing in LA. Preservation of existing affordable housing should be a dimension of policies and programs.
- Efficiencies associated with electrification upgrades in affordable housing are likely to result in small energy cost savings, particularly in older buildings. However, these savings will likely not be sufficient to offset first costs and there is a risk they will be passed on to tenants.
- Both climate change and the housing crisis pose existential threats to LA, and both must be addressed with utmost urgency. Affordable housing should be included in future decarbonization mandates but will need targeted and comprehensive programs and support to prevent displacement and other unintended consequences. If not addressed in tandem, the goals of affordable housing preservation and decarbonization will be in conflict. Addressing these challenges together poses greater opportunity than addressing either one alone.
- Lack of funding, limited access to capital, the complexity of financing structures, backlogs of deferred maintenance, and other challenges make affordable housing least likely to transition by market forces alone. Sector stakeholders must be included in the policy design process to avoid perpetuating the cycle of disenfranchisement.
- Decarbonization can be leveraged to drive investment into existing affordable housing to improve performance and keep units fit for purpose in a changing climate. Policy approaches are needed to support social equity, such as:
  - → displacement and rent increase protections,
  - → tools to expand the pool of regulated affordable housing and support alternative ownership, and
  - → wealth-building opportunities for tenants.
- The LA Retrofit Accelerator provides a strong vehicle to aggregate funds and accelerate deployment. Work is needed to more comprehensively integrate the range of challenges and opportunities associated with affordable housing.

Appendix

- Energy Modeling Details

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01 Introduction

Study Context

Framing

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Purpose

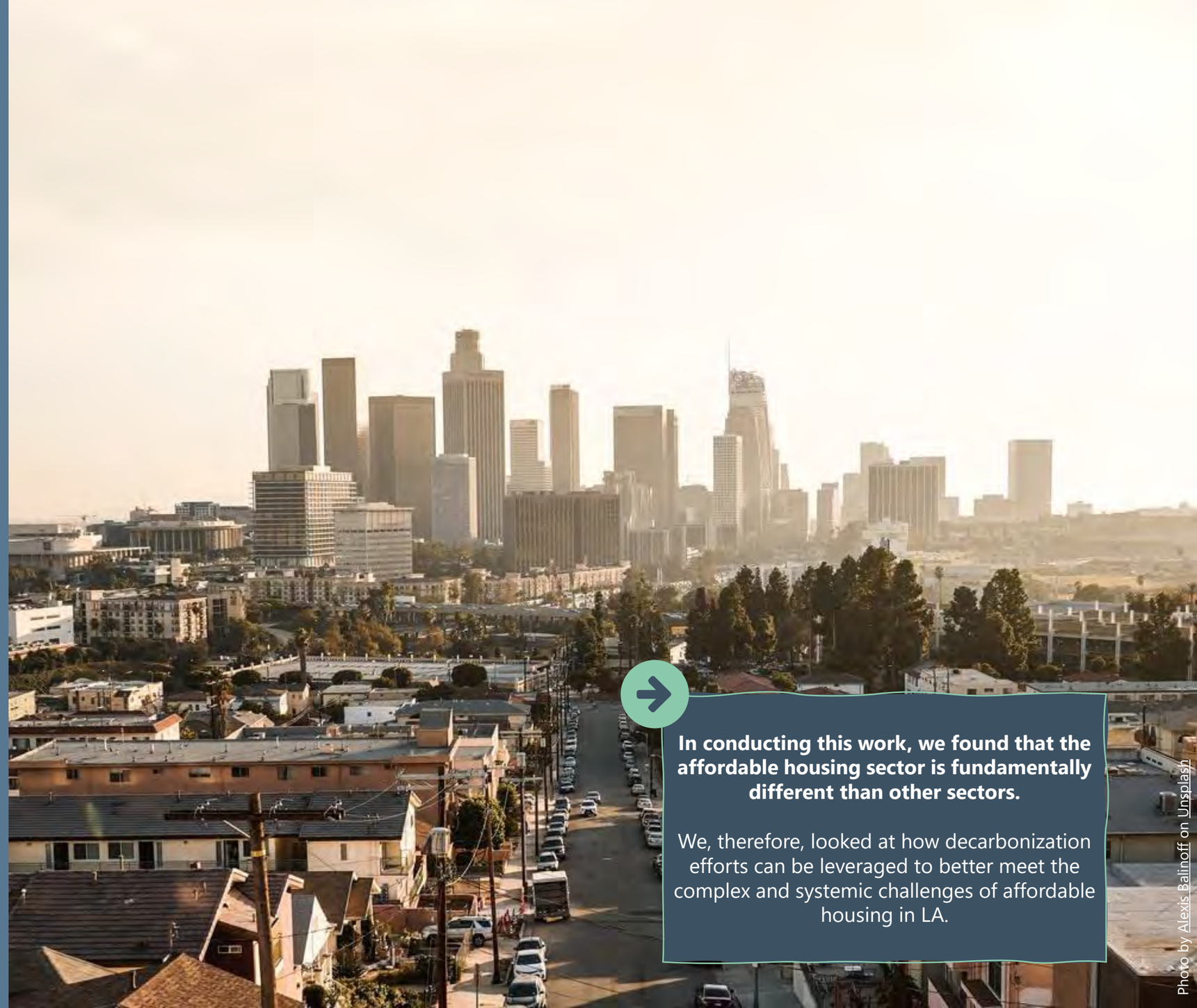
The City of Los Angeles has committed to aggressive energy and carbon goals. Meeting these goals will require some level of building electrification and grid decarbonization.

New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.

The purpose of this report is to explore potential costs and benefits for affordable housing owners and tenants, and to identify potential approaches that can be tapped to maximize value and prevent unintended consequences.

This project focuses on the existing affordable housing market segment within the City of Los Angeles. It draws on significant self-funded research conducted by Arup on pathways to decarbonization that looked at multiple building types and vintages and reviewed a variety of electrification and energy efficiency measures (*Zero-Carbon Collaboration: The Case for Los Angeles*).[1]

1. Arup, *Zero-Carbon Collaboration: The Case for Los Angeles* (2021)



In conducting this work, we found that the affordable housing sector is fundamentally different than other sectors.

We, therefore, looked at how decarbonization efforts can be leveraged to better meet the complex and systemic challenges of affordable housing in LA.

Photo by Alexis Balinoff on Unsplash

Los Angeles Climate Goals

A previous analysis[3] shows efficiency alone won't meet these targets **– electrification is needed at some level.**

Grid

Los Angeles Department of Water and Power is committed to providing[1]:

80% renewable and

97% carbon-free energy by 2030

Buildings

Goals for building energy use intensity (EUI) reduction for all types of buildings from L.A.'s pLAn[2]:

- **22% by 2025**
- **34% by 2035**
- **44% by 2050**

1. Mayor Eric Garcetti, "State of the City" (2021)
2. Office of Mayor Eric Garcetti, "L.A.'s Green New Deal" (2019)
3. Arup, "Zero-Carbon Collaboration: The Case for Los Angeles" (2021)

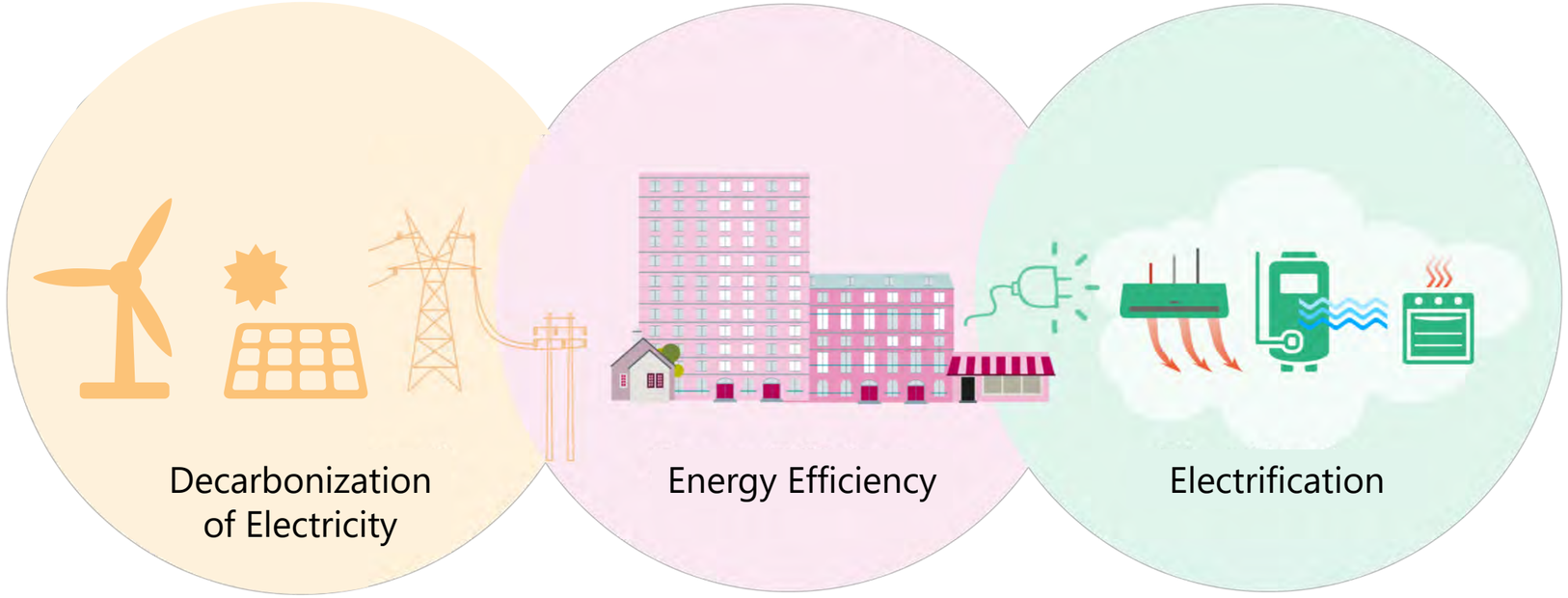
Building Electrification

What is building electrification?

Building electrification is the removal and replacement of equipment that combusts fossil fuels (e.g., natural gas, oil, propane) with all-electric equivalents. In multifamily apartments, this commonly includes equipment and appliances like furnaces, gas-fired hot water heaters, and gas stoves.

Why is it needed?

As the electricity grid gets greener, removing fossil fuels from energy generation, electricity will have a lower carbon intensity than natural gas and will eventually be carbon-free. Meeting local and statewide decarbonization goals will require buildings to not only reduce energy use but stop using natural gas in order to reach greenhouse gas (GHG) emission reduction targets.



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The Benefits of Building Electrification

Improves air quality & health

Natural gas combustion in the home results in air pollutants that negatively impact occupant health. Electric building systems combined with a decarbonized grid result in less air pollution both indoors and out.

Increases efficiency, reducing utility bills

Newly installed or replaced equipment must meet the current energy code, which typically calls for greater efficiency than the older / outgoing equipment has. Further, some all-electric equipment like heat pumps are especially efficient because the technology takes advantage of ambient conditions.

Safety

Natural gas is a highly flammable substance. Gas lines can be disturbed by earthquakes, subterranean digging, and failures in aging infrastructure, leading to potential fires and explosions. Moving away from a distributed natural gas system can present significant safety improvements.

Can add air conditioning to apartments without it

Heat pumps can provide both heating and cooling. This means that for an apartment that doesn't already have air conditioning, changing the space heating from a gas furnace to a heat pump can introduce this capability. LA already experiences extreme heat waves and will continue to face them with increasing frequency and intensity given climate change. The upgrade of having cooling available could be very impactful in terms of occupant comfort and health – particularly for households with medically vulnerable family members, elderly occupants, or children.

Reduces the risk of stranded assets

As buildings in a neighborhood move towards electrification, buildings that remain on natural gas may bear the costs to upkeep the aging gas infrastructure through higher monthly bills.

Resilience Implications of Electrification

Energy resilience for affordable housing and low-income communities will require a variety of strategies, including **access to on-site generation, storage and islanding technologies, prioritization of medically vulnerable populations for backup systems,** and **deployment of community resilience hubs** to provide safe havens during disruptions.

Photo by Johnny McNeil

Increasing Grid Disruptions

Building electrification requires shifting more energy uses to the electrical grid network. It is likely that California will see an increase in grid disruptions due to extreme weather events and proactive shutdowns during high fire conditions, known as Public Safety Power Shutdown (PSPS) events. Such disruptions can be especially impactful during extreme conditions such as heatwaves or for sensitive populations such as those who depend on energy for life support, mobility, or other medical needs.

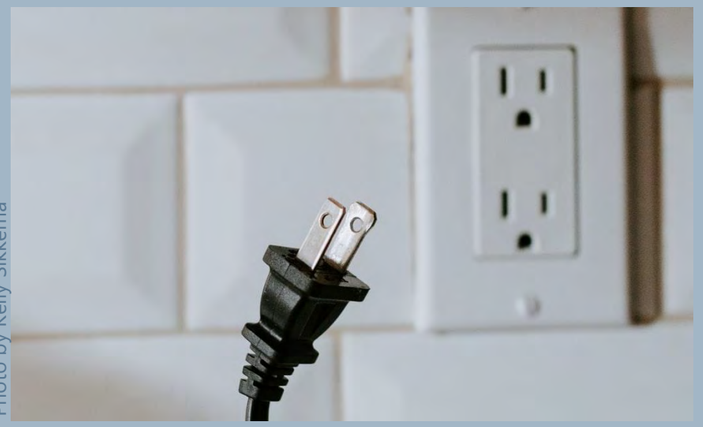


Photo by Kelly Sikkema

Functionality During Power Outages

Many people assume that having natural gas end uses in homes provides resilience benefits. This is potentially true, particularly in older homes with older natural gas appliances. Appliances that do not require electricity to operate may still be functional even when the power goes out, like a stove that can be manually lit.

However, this benefit of such systems is becoming increasingly less common. Most modern gas appliances have electric components that must be operational for equipment to work.

Photo by Mortiz Kindler

Distributed Energy Systems

In the short term, movement away from natural gas in buildings may have a negative impact on resilience by reducing the diversity of sources and shifting a greater load onto a vulnerable grid. However, there is potential for grid decarbonization to increase energy resilience by shifting toward a more distributed and decentralized grid network that can limit the extent of power outages. Smart systems both in front of and behind the meter can enable better demand management to prevent disruptions during peak events. On-site generation, storage, microgrids, and islanding capacity can provide significant energy resilience benefits.

Affordable Housing Key for Resilient Communities

Keeping Angelenos housed and keeping housing fit for purpose (safe, healthy, and comfortable) should be viewed as a baseline requirement for any climate-related mandates, as failing to do so will exacerbate the existing crises and leave communities even less prepared to manage climate impacts.

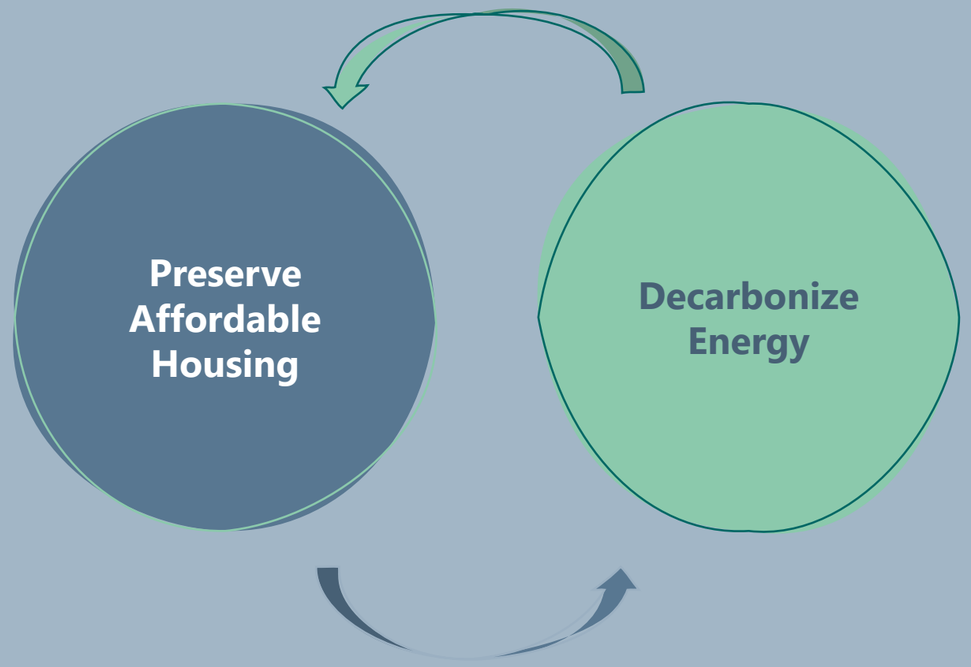
According to 2019 Census data, nearly half a million LA City households are rent-burdened (i.e., spending 30% or more of their household income on rent)[1]. COVID-19 has left many low-income households with drastically reduced income due to either illness, job loss, or death of a household's wage earner. The threats associated with displacement and further marginalization are real and must be addressed as hazards through a resilience lens.

Safe, affordable housing is a fundamental component of resilient communities. When people are unhoused, they face an increasing spiral of obstacles to participating in basic life activities such as school, work, and family obligations and instead must rely on already overburdened social support systems.

In communities such as Los Angeles that are experiencing housing shortages, this challenge is already at a crisis level. Homeless populations are growing, new construction is not meeting the demand for affordable housing, and existing affordable housing stock is aging with long backlogs of deferred maintenance. With rising home values, building owners are under pressure to reposition their units to capture higher rents.

New affordable housing is not being built fast enough to meet current demand. Preservation of existing affordable housing is key to keeping Angelenos safe, healthy, and protected from the elements. Policies around energy, decarbonization, and electrification should support, rather than detract from, the preservation of affordable housing.

New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.



1. U.S. Census Bureau, *American Community Survey 1-Year Estimate* (2019)

Preservation of Affordable Housing is Essential to Climate Resilience

Preserving existing affordable housing is an essential climate resilience strategy. Displacement can be viewed as a worst-case scenario with high individual and social costs. California is already losing housing to fire faster than new housing is being built, and extreme heat will make housing less habitable without remediation.

At the same time, housing is becoming increasingly out of reach for more people. Shortages combined with the commoditization of housing are increasing prices and driving more people out of their homes.

The costs of homelessness can be used as a baseline to calculate the true benefits of public investment in affordable housing preservation.

Climate and energy strategies can be and leveraged as part of a comprehensive approach to affordable housing preservation to protect affordability and keep units fit for purpose in a changing world.

Homelessness

Photo of unhoused in LA by Nathan Dumlao

Post-disaster displacement

Photo of post-Katrina displacement

Refugees

Photo of Syrian refugee camp by Julie Ricard

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Key Considerations for Affordable Housing Tenants

Decarbonization is both a needed transition at a societal level and a huge disruption at the household level.

There are potential negative consequences related to requiring decarbonization for affordable housing.

Increasing rent burden

There is a risk of the first costs of retrofits getting passed on to renters.

Increasing utility costs

There is a potential for energy costs to increase due to the higher cost of electricity compared to natural gas*.

Displacement

Displacement can be triggered by increased rent or by building owners repositioning units to market rate or converting them to condos.

There are also potential negative consequences if affordable housing is left out of electrification.

Missing benefits of decarbonization

Low-income populations would miss out on benefits such as improved air quality indoors and out.

Stranded assets/ stranded communities

Properties and communities that don't transition may bear the cost of maintaining natural gas infrastructure or become stranded by the gas system.

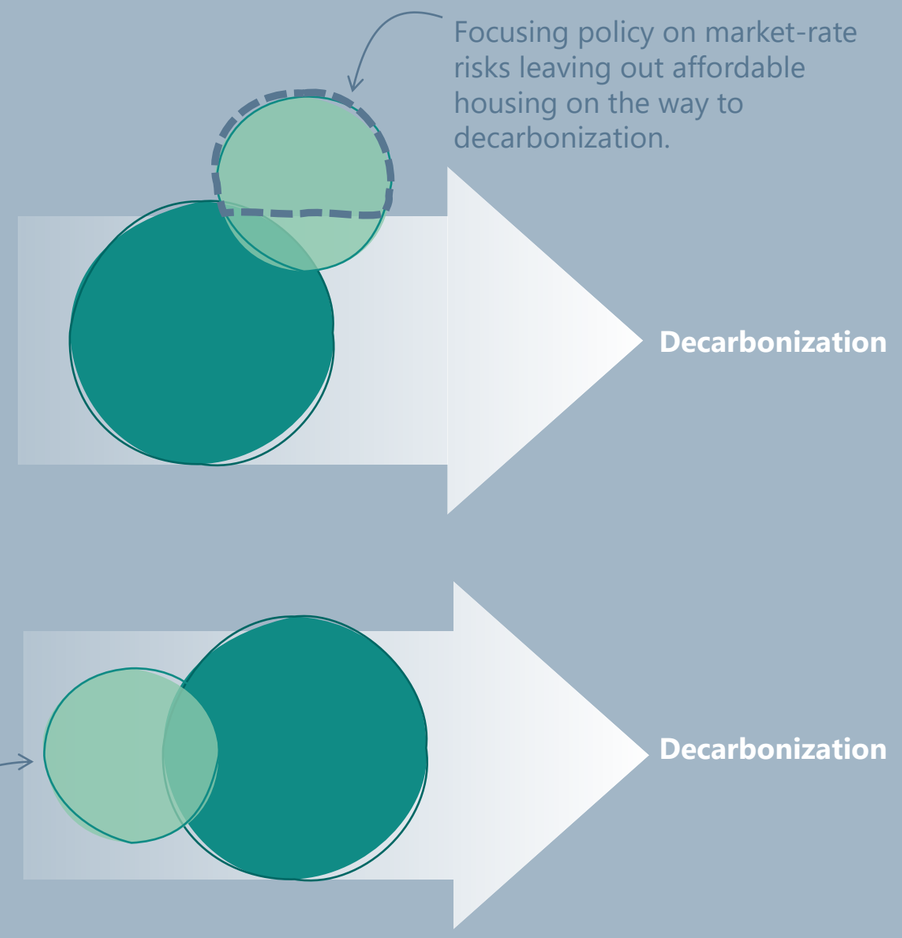
*Note—while this has not been the case in our analysis, it is theoretically possible in newer buildings with more efficient natural gas systems. It can also be triggered by increased energy use as heat pumps provide air conditioning capacity where it may not have been available prior to retrofit.

Centering Around Affordable Housing

The traditional approach to developing policies for new and existing buildings is to focus on the technical issues and costs associated with market-rate building stock, and then to consider how (or even whether) to include affordable housing. Again and again, this approach perpetuates a cycle that deprives affordable housing and low-income communities of resources and leaves them disenfranchised. The reason is that the affordable housing sector is fundamentally different from other building types.

An equity-centered approach that targets affordable housing and low-income communities has the potential to yield programs, policies, and implementation pathways that:

1. **Are designed through meaningful consultation with stakeholders to better address underlying issues and create new opportunities**
2. **Better serve the needs of affordable housing tenants and building owners, generating higher rates of implementation**
3. **Avoid unintended consequences such as increased rent or displacement while maximizing benefits and co-benefits of decarbonization**
4. **Expand the market for electrification, thereby spurring faster market transformation across all sectors**
5. **Serve as one part of reparations to begin addressing generations of racist practices.**



Due to the complexity of the affordable housing sector, starting with and centering affordable housing will more easily include everyone.

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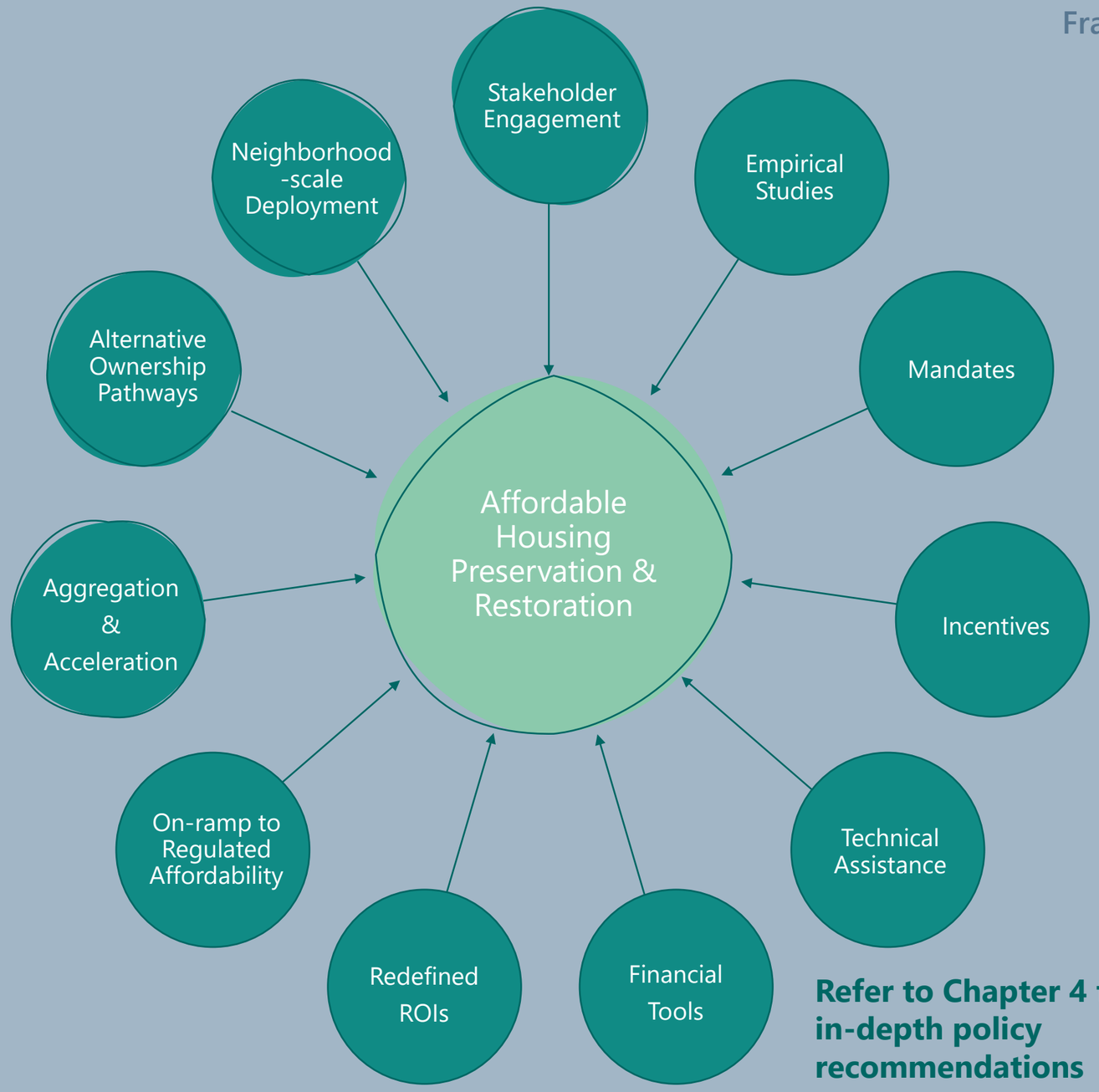
Framing

A systemic approach to housing preservation and decarbonization would include:

- An extensive and ongoing stakeholder engagement that drives program and policy development
- A full range of incentive and technical assistance programs that respond to the needs of affordable housing stakeholders
- The ability to pool or aggregate capital from different sources to allow flexibility for owners to make a full range of energy- and resilience-related retrofits
- Support for transitioning labor, with a focus on small contractors that serve low-income communities
- Incorporate anti-displacement measures and requirements
- Provide multiple pathways for expanding the pool of regulated affordable housing
- Facilitate movement toward alternative ownership structures and other measures that bring value to tenants as well as to building owners



Refer to Chapter 4 for more in-depth policy recommendations

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This Report

This report is:

- A high-level quantification based on illustrative examples to frame the issues
- Based on building prototypes that align with a segment of existing affordable housing in LA
- An order-of-magnitude summary of first costs and operating costs for building owners and tenants at the building and unit level
- A set of recommendations for an equity-centered approach to leveraging decarbonization to support the preservation of affordable housing

This report is NOT:

- A response to any specific policy proposal from the City of Los Angeles
- A complete review based on a full range of affordable housing building typologies and vintages
- A detailed calculation of expected costs and benefits
- A market study evaluating the total cost of implementation, or the sale of capital required for implementation

01 Summary

Introduction

Mitigating GHG emissions and actively protecting existing affordable housing are two urgent needs for the City of Los Angeles with a complex relationship with one another. New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.

- Los Angeles has set ambitious decarbonization goals. Building electrification is an essential piece of that strategy.
- There are significant short- and long-term benefits of building decarbonization for occupants, owners, and communities, such as improved indoor and outdoor air quality, enhanced safety and resilience, and lower utility bills.
- Yet, decarbonization can have unintended consequences for residents of affordable housing. Affordable housing is a complex sector with many unique challenges and preservation of existing affordable housing is essential for the future of Los Angeles.
- **Centering affordable housing in decarbonization policy development can yield better results in terms of societal benefits and market transformation.**
- **New approaches are needed to not only include affordable housing in decarbonization efforts but also to leverage decarbonization investments in ways that support and preserve affordable housing.**

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02. What is the state of affordable housing in Los Angeles?

- Targeted Outreach
- Building Inventory & Trends
- Utility Burden
- Challenges

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Defining Affordable Housing

There are many ways to define and classify affordable housing. Overall, there are two main types of affordable housing: subsidized and unsubsidized.

There are significant differences between subsidized and unsubsidized affordable housing, from how utility bills are distributed between owners and tenants to their risk of losing affordability. This report does not dig into those differences but rather speaks to affordable housing more generally.

We recommend working with stakeholders to link specific definitions of affordable housing to different levels of program support and incentives, and right-size those programs based on a more detailed market characterization.

Regulated affordable housing is housing that is deed-restricted or covenanted by the housing authority. This could be partially subsidized housing (e.g., through low-income housing tax credits or Section 8 vouchers) or fully subsidized public housing.

Naturally occurring affordable housing (NOAH) refers to unsubsidized housing that is privately owned and operated. It is "affordable" by virtue of being below market-rate in the area.

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Targeted Outreach

Better World Group conducted surveys and interviews to get a better picture of current issues and challenges for tenants and affordable housing building owners.

The following is a summary of market findings from the interviews conducted by Better World Group.

Stakeholder feedback

- **COVID-19 has exacerbated the housing crisis into a rent emergency.**
- There is strong support for decarbonization and recognition that low-income communities bear the brunt of climate burdens.
- Increased costs and related impacts are a major concern.
- There is strong support for strategies to reduce energy bills and household expenses.
- There is deep concern about displacement.

Two types of potential displacement associated with electrification

1. There is a potential for first costs to be passed onto tenants, making units unaffordable.
2. There is a potential that construction will trigger evictions.

There is a critical need for a policy structure that brings the benefits of building decarbonization while protecting rent-burdened households from cost increases.

Much is Still Unknown

The complexity and diversity of affordable housing will require additional information in order to develop a comprehensive approach. Many variables will influence the first costs, potential for savings, and requirements for related mitigations.

Stakeholder engagement is required to more fully evaluate the state of the affordable housing sector to develop effective programs and policies.

There is a need for a comprehensive market characterization of affordable housing to inform better policy design.

- LA affordable housing sector not well characterized.
- Data gaps limit validation and scaling of the results; there is a lack of data for regulated affordable housing and especially for naturally occurring affordable housing.

Affordable housing cannot be fully represented by a single prototype.

There is diversity in affordable housing sector in terms of:

Building attributes

- Size and configuration
- Number of units
- Year constructed
- Maintenance regimes and retrofits

Level of affordability

- Regulated and naturally occurring
- Definition of “affordable”

Rent structure

- Who pays utilities?
- What is the lease term or payment term?

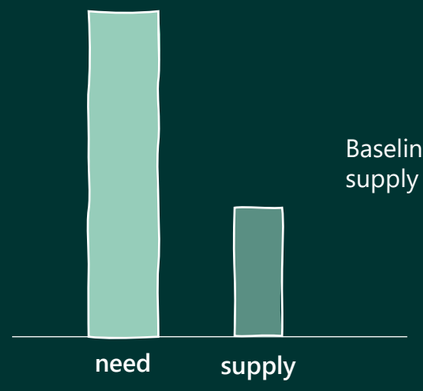
Building owner type

- Mission-driven non-profit
- Corporate/large for-profit
- Small mom-and-pop

Limited Supply Pre-pandemic

Even before COVID-19 exasperated existing economic disparities, the affordable housing stock across LA County was falling critically short of meeting demand.

Los Angeles was deemed the third most rent-burdened metro area by the 2019 Freddie Mac report - ranking even ahead of New York.[1]

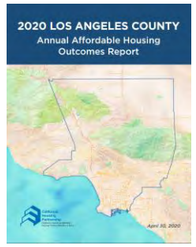


Baseline: limited supply

1. Freddie Mac Multifamily, *Rental Burden by Metro* (2019)
2. California Housing Partnership, *Los Angeles County Annual Affordable Housing Outcomes Report 2020* (2020)

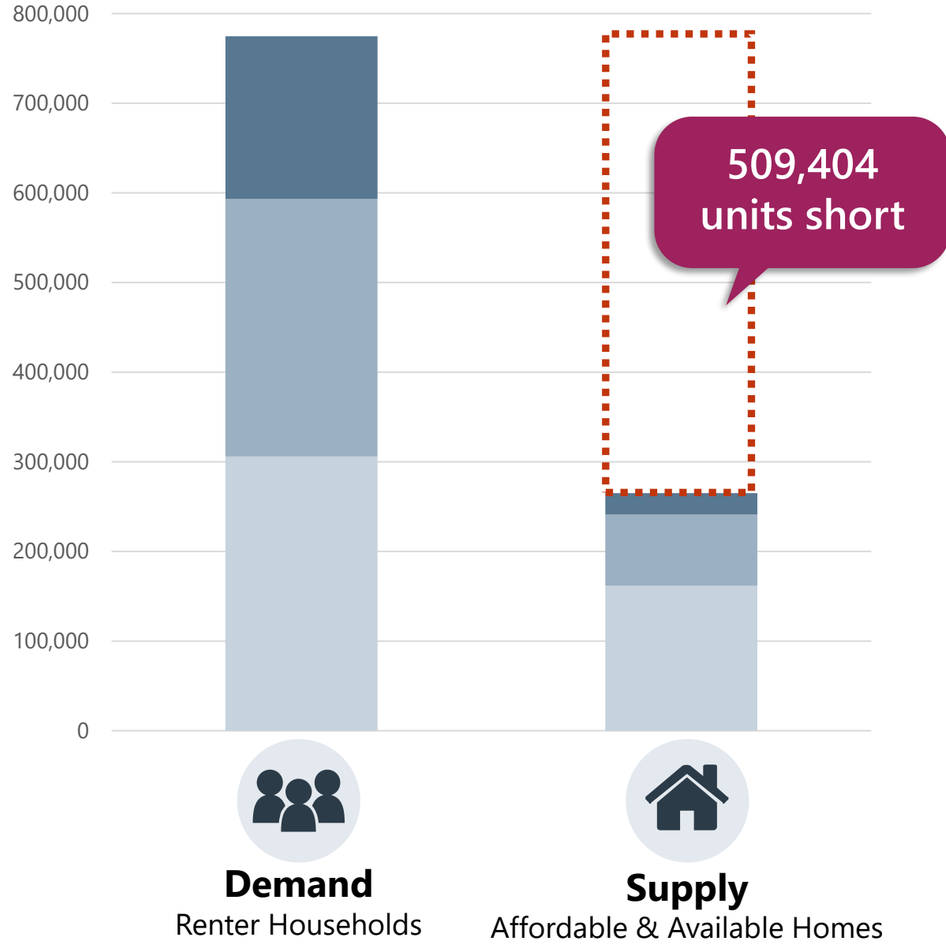
Starting with a severe shortfall

Gap analysis from California Housing Partnership highlights that the county's affordable housing market (as of 2018) fell short of the need by about half a million homes.[2] In this analysis, "affordable and available" rental homes refer to units that would require renters to pay no more than 30% of their income on rent and utilities.



Source: Adapted from California Housing Partnership *Los Angeles County Annual Affordable Housing Outcomes Report 2020*

Los Angeles County Affordable Rental Housing Shortfall (2018) – Adapted from California Housing Partnership



- Very low-income (30-50% AMI)
- Extremely low-income (15-30% AMI)
- Deeply low-income (0-15%)

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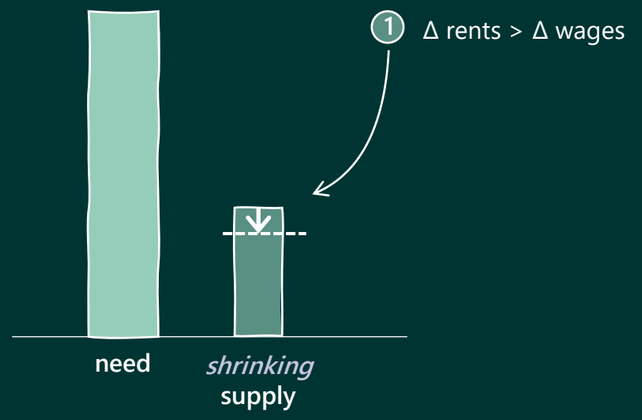
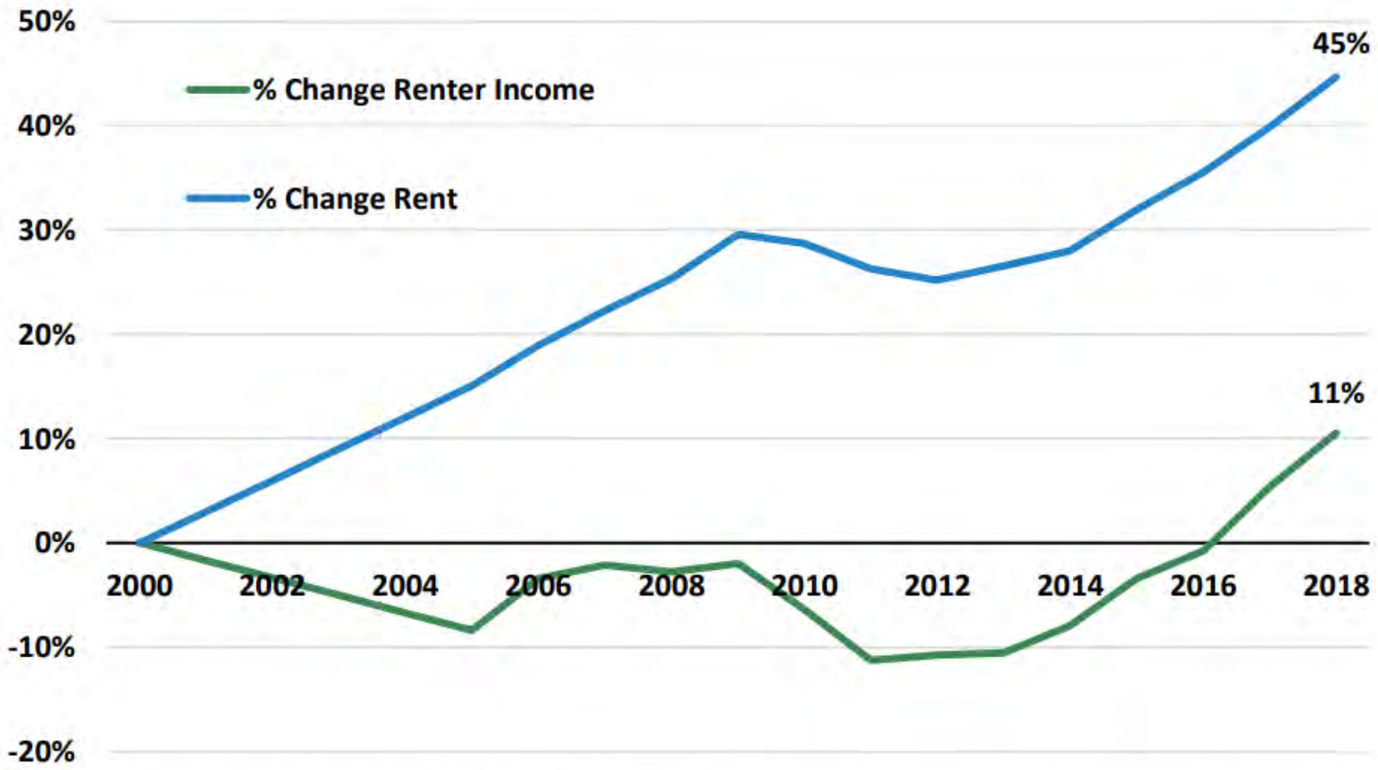
Rents Outpacing Renter Incomes

Rents have been rising faster than wages, reducing the availability of affordable housing.

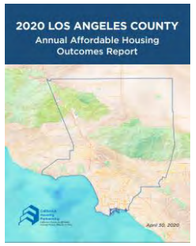
Before COVID-19, the discrepancy between growth in rent prices and income levels has been compounding, positioning an increasing share of renters to be rent-burdened.



Median Renter Household Income Versus Median Rents in Los Angeles County (2000-2018) - CHPC



Source: California Housing Partnership analysis of U.S. Census Bureau American Community Survey, 1-year estimates, table ID: S2503, 2000-2018.
**Median renter income and rent from 2001-2004 are estimated trends. Median renter income and rent are inflation adjusted to 2018 dollars.*



Source: California Housing Partnership *Los Angeles County Annual Affordable Housing Outcomes Report 2020*

1. California Housing Partnership, *Los Angeles County Annual Affordable Housing Outcomes Report 2020* (2020)

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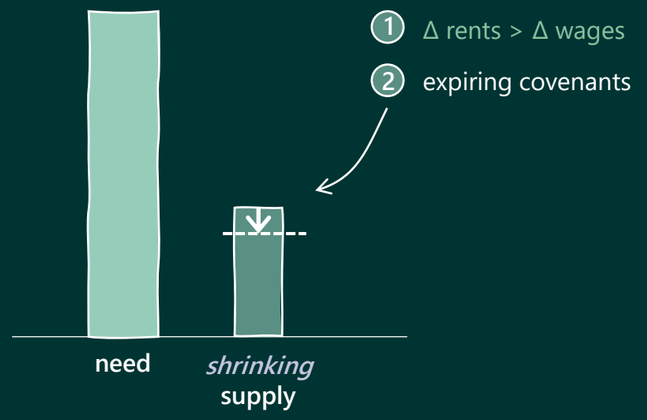
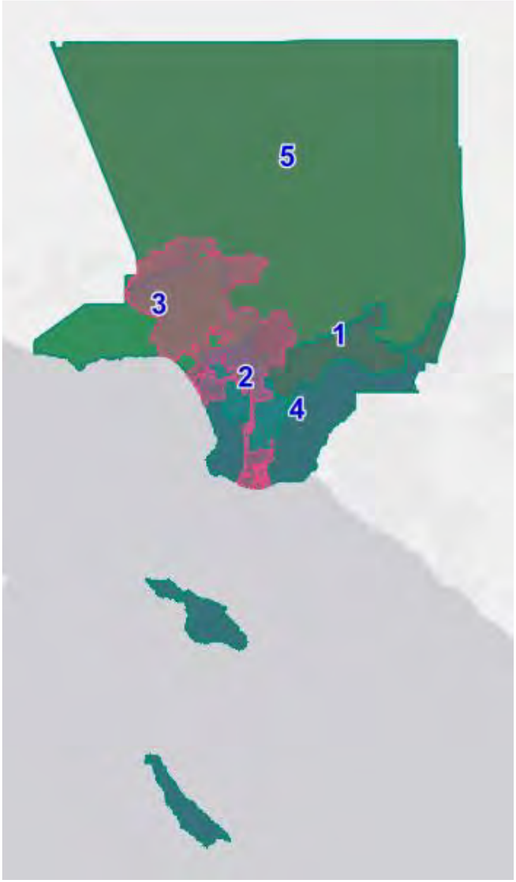
Expiring Covenants

For the deed-restricted market, there is a risk that affordable housing providers will convert units to market-rate when covenants expire or when there are changes to existing rent restrictions.

This risk is already present, but the expenses incurred by electrification may provide further incentive to recoup costs - especially if the affordable housing is not owned by a large, stable, mission-driven non-profit.[1]



1. California Housing Partnership, *Los Angeles County Annual Affordable Housing Outcomes Report 2020* (2020)

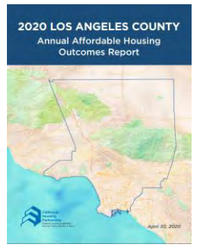


Summary of Federal, State, and County-Administered Affordable Housing and At-Risk Housing in Los Angeles County

The following maps of LA County Supervisorial Districts (SD), with the City of LA's boundaries, highlighted in pink, contextualize the analysis conducted by the California Housing Partnership. The City spans multiple SDs, but with the largest share in SD 3 where the percent of subsidized homes at risk of conversion to market rate is 10%, based on values published by CHPC.

- Supervisorial District 1
- Supervisorial District 2
- Supervisorial District 3
- Supervisorial District 4
- Supervisorial District 5
- City of Los Angeles Boundary

Supervisorial District (SD)	Federal, State, and County-Administered Affordable Homes	At Risk of Conversion to Market Rate	% At Risk
SD 1	34,043	2,165	6%
SD 2	33,548	2,461	7%
SD 3	22,652	2,348	10%
SD 4	14,899	565	4%
SD 5	14,612	1,334	9%
County Total	119,754	8,873	7%



Source: Adapted from California Housing Partnership *Los Angeles County Annual Affordable Housing Outcomes Report 2020*

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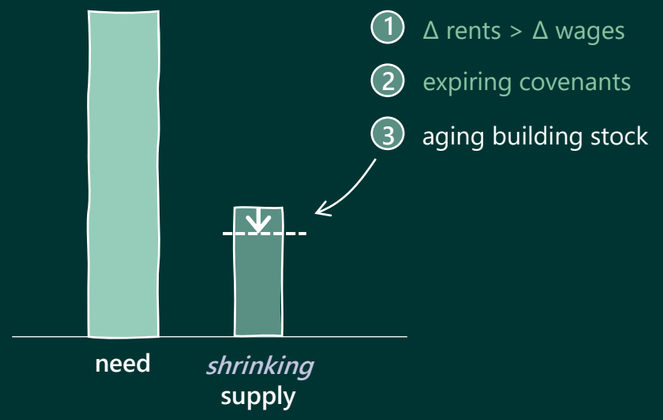
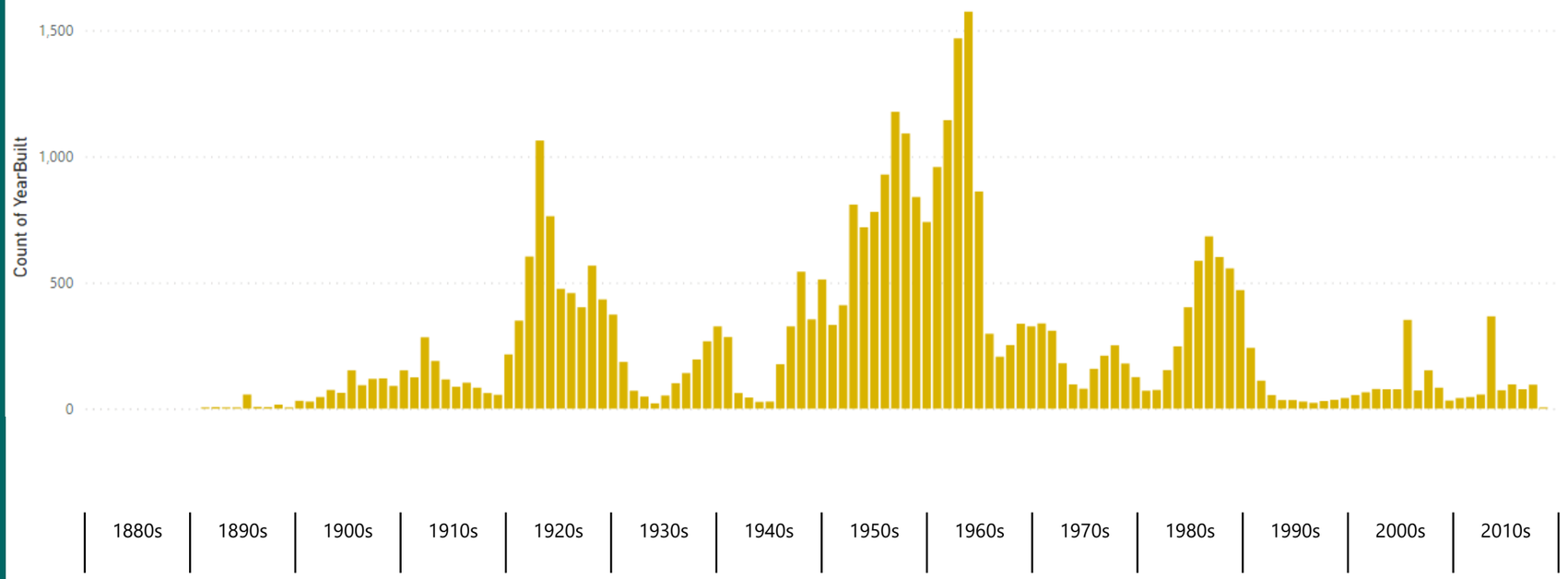
Deferred Maintenance

With an aging multifamily building stock, there are backlogs of deferred maintenance that can put units at risk of becoming less fit for purpose.

This risk can either be due to vulnerabilities to future climate impacts and hazards like earthquakes, or the conditions becoming less safe and healthy to live in.



City of Los Angeles Residential Building Stock with 5 or More Units (2019)



On top of compounding wear and tear, older buildings predate significant health and safety codes & standards

Needed maintenance can include remediation issues (e.g., mold, lead, asbestos) as well as fire and life safety, ADA compliance, and obstacles to aging in place.

1. County of Los Angeles Assessor Data (2019)

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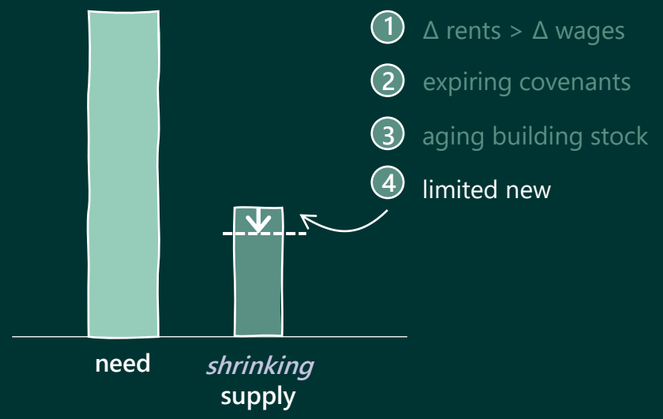
Limited New Housing…

In Los Angeles, residential construction is currently concentrated at the upper tier of the market.

Average rents across the county fell in 2020 but are currently rising again. Mid-2020 saw a rise in vacancies as renters migrated east to the Inland Empire, where rents on average are $400/month cheaper, or to more affordable metro areas like Phoenix and Las Vegas.[1]



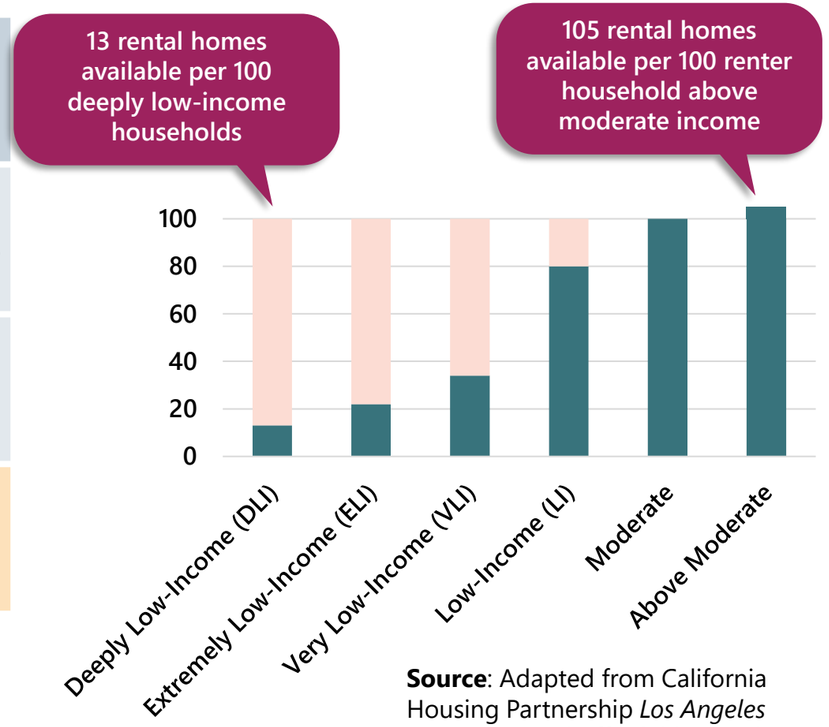
1. Based on multifamily market data for LA County from CoStar Group (www.costar.com) dated 5/15/2021
2. California Housing Partnership, *Los Angeles County Annual Affordable Housing Outcomes Report 2020* (2020)

Los Angeles County Multifamily Market in Current Quarter (Q2 2021)[1]

Residential Unit Types	Existing Units	Vacancy Rate	Avg Asking Rent	Units Under Construction
4 & 5 Star (luxury end of the market)	118,915	12.4%	$2,943	22,964
3 Star	215,755	5.50%	$2,098	2,367
1 & 2 Star	640,297	4.90%	$1,552	17

Source: CoStar

Affordable and Available Rental Homes per 100 Renter Households (2018)[2]



Source: Adapted from California Housing Partnership *Los Angeles County Annual Affordable Housing Outcomes Report 2020*

Mismatch between demand and new construction

The lower end (e.g., typically the more affordable end) of the market has the lowest availability (vacancy rate) and slowest growth (only 17 units under construction currently compared to 22,964 at the high end of the market). The imbalance between supply and demand is more extreme at the lowest income levels, as illustrated by the graph at top right adapted from the CHPC.

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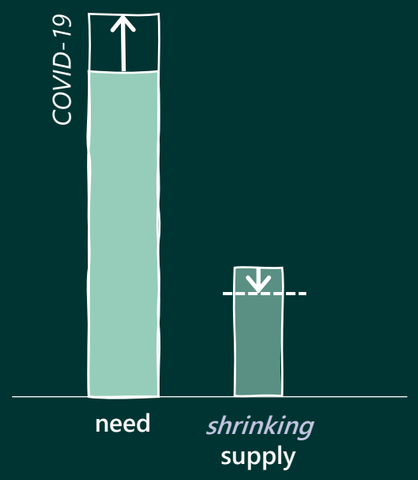
...Then Exacerbated

COVID-19 triggered interrelated health and economic risks due to widespread job and income loss, resulting in increasing housing vulnerability, food insecurity, and greater unaffordability of basic household needs.[1]



1. UCLA Luskin Center for Innovation, *Keeping the Lights and Water On: COVID-19 and Utility Debt in Los Angeles' Communities of Color* (2021)

COVID-19 Furthered Inequalities

These consequences have been disproportionately felt by communities of color. Under this intense economic pressure, families are faced with difficult trade-offs between paying bills, making rent payments, buying food, and receiving medical care.

Photo by Nick Sparkman on Unsplash

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Market Trends

LA has one of the highest percentages of renters (roughly half of households) compared to other U.S. metro hubs.[1]

Costar attributes this indicator as a result of high homes prices - comfortably affording a median-priced LA County home requires an income of above $110,000, but the median household income in L.A. is $73,000. Rents in the high-end properties are down as a result of competition from new development and economic uncertainty inspiring hesitation to sign pricy leases. However, while the top of the market becomes less expensive, rents are climbing in the lower-priced units.[1]

Photo by Austin Prock on Unsplash

1. Based on multifamily market data for LA County from CoStar Group (www.costar.com) dated 5/15/2021

Utility Bills

The Utility Shutoff Moratorium in California is set to expire at the end of September 2021, forcing customers to face past-due bills that have accumulated during the pandemic.[1] Across the country, about 1/3 of households fall into this delinquent category.[2] Biden's $1.9 trillion rescue aid package includes $5 billion for people who need help paying power and water bills, which will be distributed through the low-income Home Energy Assistance Program. However, this $5 billion in support falls short of the $27 billion in past-due balances of U.S. households, as estimated by the National Energy Assistance Directors Association.[2]

Los Angeles Times

Damage from coronavirus: Utility bills overwhelm nearly a third of U.S. households

Mikel Haye was forced into performing a financial triage after he lost all three of his part-time jobs shortly after the pandemic struck in Brooklyn. (John Minchillo / Associated Press)

By MICHAEL LIEDTKE AND CATHY BUSSEWITZ | ASSOCIATED PRESS

MARCH 23, 2021 5:27 PM PT

SAN RAMON, Calif. — Millions of U.S. households are facing heavy past-due utility bills, which have escalated in the year since the COVID-19 pandemic forced Americans hunkered down at home to consume more power.

CORONAVIRUS, VACCINES AND PANDEMIC

Hope here, despair there: For Indian Americans, heartbreak over the homeland

Hundreds of bodies found buried along riverbanks in northern India

The unwitting are the target of COVID-19 falsehoods online

Tracking reopenings

Latest on vaccines and pandemic

Grappling with past due utility bills

The Los Angeles Times (article pictured here) refers to a study conducted by Arcadia, which found the average past-due amount was about $850 as of January 2021.[2]

Equity barriers to accessing utility bill assistance

As pointed out in the UCLA report, applying for and accessing aid is more challenging for households with English language barriers or limited broadband. The applications themselves are lengthy and heavy on document requirements, further deterring eligible applicants.[4]

1. California Public Utilities Commission, "Coronavirus (COVID-19) Information" (2021)
2. Los Angeles Times, "Damage from coronavirus: Utility bills overwhelm nearly a third of U.S. households" (2021)
3. Office of Governor Gavin Newsom, "Economic Recovery Package Factsheet" (2021)
4. UCLA Luskin Center for Innovation, *Keeping the Lights and Water On: COVID-19 and Utility Debt in Los Angeles' Communities of Color* (2021)

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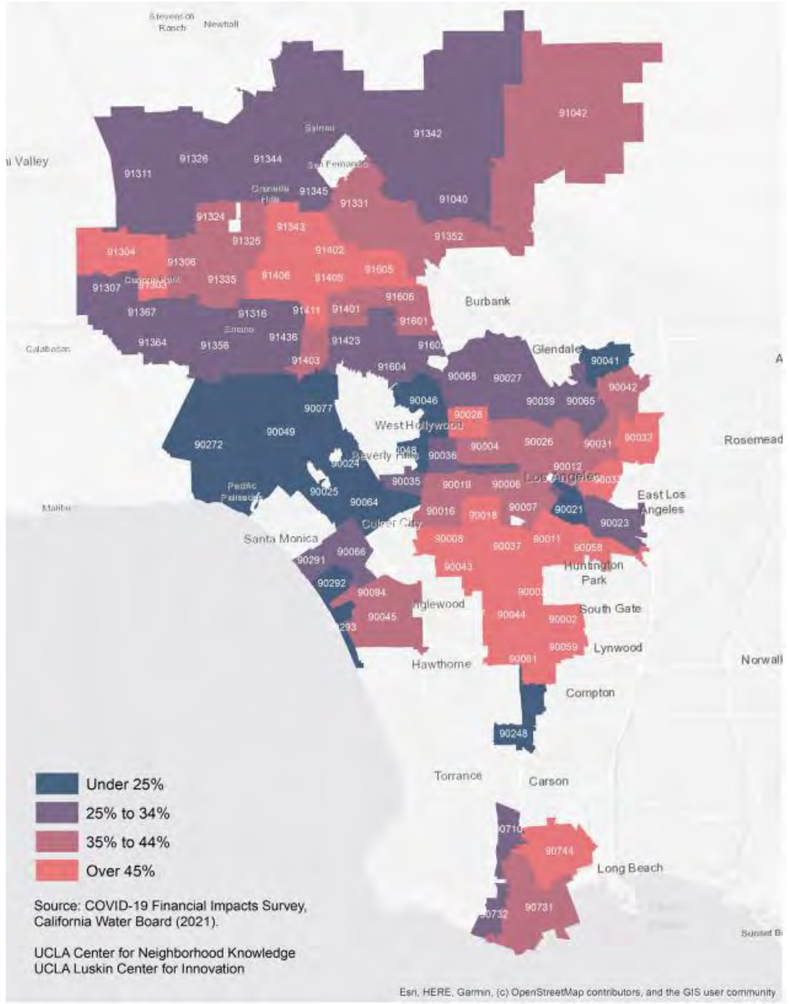
Utility Debt Concentrated in DACs

A recent UCLA study found that 1/4 to 1/3 of LADWP customers had utility debt as of November 2020 - and these debts were disproportionally experienced by low-income communities and communities of color.[1]

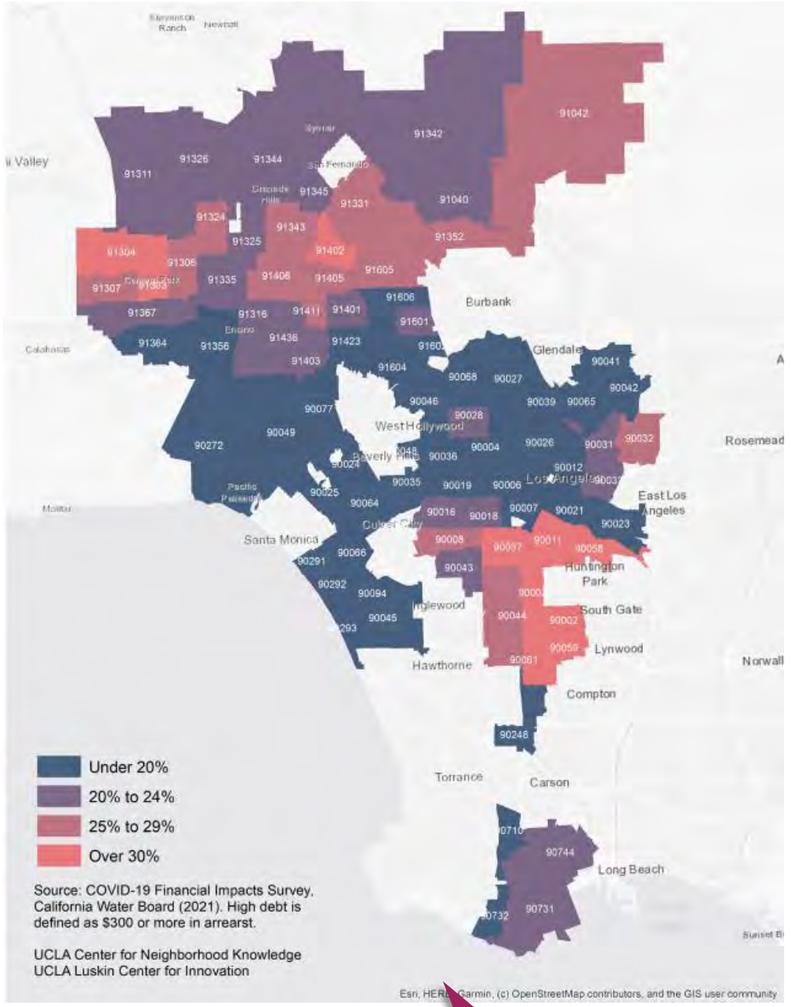
As the study points out, there is an acute need for targeted relief programs for low-income ratepayers moving forward. The City allocated funds from the CARES Act to provide utility payment assistance, but the amount falls short of meeting the need.[1]

The study found racial disparities in utility debt burden even after controlling for housing characteristics and income. In Watts, for example, a historically predominately Black neighborhood, 85% of households were behind on utility bills.[1]

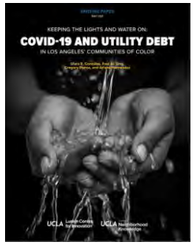
Share of Households in COVID-19 Utility Debt (Nov 2020)



Households Where Debt > $300 (Nov 2020)



$300 is half a week of wages at minimum wage ($15/hr in LA)



Source: UCLA Luskin Center for Innovation, UCLA Center for Neighborhood Knowledge. *Keeping the Lights and Water On: COVID-19 and Utility Debt in Los Angeles' Communities of Color.* (Published May 2021)

1. UCLA Luskin Center for Innovation, *Keeping the Lights and Water On: COVID-19 and Utility Debt in Los Angeles' Communities of Color* (2021)

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Obstacles to Decarbonizing Affordable Housing

With limited publicly funded housing in LA, the affordable housing that does exist faces challenges that may not be experienced by other building sectors.

The challenges around how affordable housing is developed, financed, owned, and maintained in Los Angeles make it extremely difficult to bring investment to existing properties.

This combination of factors means that it is hard to get capital into affordable housing, even when incentive programs do exist. These barriers have resulted in decades of underinvestment and backlogs of deferred maintenance.

Challenges in Financing Affordable Housing Retrofits

The **complex capital stacks** required for affordable housing mean that developers and operators are often negotiating with multiple lenders who must sign off on capital expenditures.

Limited rents (e.g. restricted or reduced compared to market rate) mean limited operating capital.

Smaller owners, such as mom-and-pop building owners, may have **limited access to capital.**

Maintenance and retrofit projects may have limited returns and therefore present **challenges attracting traditional investment.**

Many communities have been historically left out due to **discriminatory practices** in land use, lending, and public investment. This has resulted in housing quality issues, more pressing retrofit needs, and incidentally more expensive upgrades.

Financing happens at the individual property level, and deals are often **considered high risk.**

Multifamily housing, particularly mid-sized housing, **is not well served** by many incentive and financial programs.

The **split incentive** between owners and tenants make the investment in energy savings hard for building owners to justify financially.

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Challenges

Decarbonization in the Affordable Housing Context

Traditional policy approaches that target all building sectors and then attempt to include affordable housing are unlikely to be successful without triggering a range of unintended consequences.

A better approach will be to look at the full ecosystem of issues, challenges, and needs associated with the way that affordable housing is financed, developed, owned, and operated to create a comprehensive strategy that maintains affordability, keeps housing fit-for-purpose, and supports a just transition.

Related Challenges

- Housing shortage
- Affordability
- Vulnerability of tenants
- Displacement concerns
- Climate impacts
- Complex capital stacks
- Limited access to capital
- Regulatory requirements
- Affordability covenants
- Deferred maintenance
- Habitability
- Utility bills and utility burden
- Aging infrastructure
- Chronic disinvestment
- Racial injustice
- COVID-19 impact

Related Opportunities

- GHG emissions reduction
- Improved indoor air quality
- Improved outdoor air quality
- Weatherization
- Fire safety
- Mold remediation
- Health and safety retrofits
- Seismic retrofits
- Water conservation
- Water quality
- Regulation of affordability
- Ownership structures
- Accessibility
- Aging in place

Affordable housing stakeholders face a policy landscape that is disjointed, confusing, and not well aligned for the specific challenges and opportunities of the sector. **There is a strong need to aggregate funding sources, consolidate technical resources and streamline administrative processes in order to make programs successful.**

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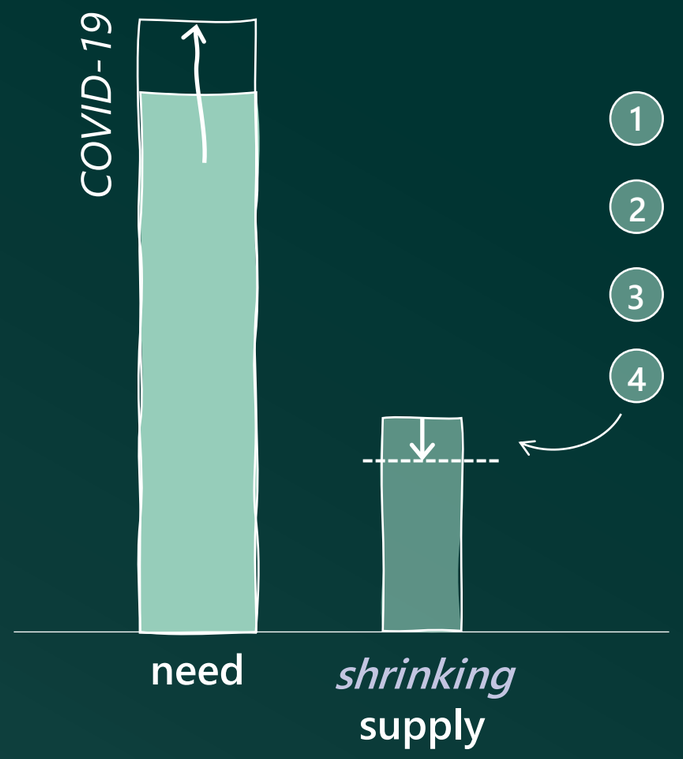
02 Summary

What is the state of affordable housing in Los Angeles?



1. Δ rents > Δ wages
2. expiring covenants
3. aging building stock
4. limited new

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02 Summary

What is the state of affordable housing in Los Angeles?

Even before COVID-19 struck low-income communities, costing many their lives, health, and jobs, **LA was suffering from an affordable housing crisis**. In simple terms:

- Not enough of the existing housing stock is affordable.
- The existing multifamily housing stock is aging, with backlogs of deferred maintenance. Not only are rising rents and expiring covenants reducing the availability of affordable housing, but when future climate impacts and other hazards like earthquakes are factored in, available units are becoming less fit for purpose (i.e., less safe, healthy, and comfortable to live in).
- Energy burden across Los Angeles was felt intensely before COVID-19 and is disproportionately concentrated in low-income communities and communities of color. More families were brought into utility debt or further into utility debt during COVID-19.
- Programs to improve the quality or performance of residential buildings are largely targeted to market rate or single-family housing. Benefits therefore often do not reach households that are low-income, renters, or in multifamily buildings.

There is a significant need to not only build new affordable housing, but to protect and retrofit existing units in ways that improve habitability, reduce household expenses, and support a healthier environment.

Any policies that affect the residential market must therefore be carefully considered and designed to directly support affordable housing and low-income households.

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03. What are the implications of electrification on affordable housing?

Energy Modeling Approach

Energy Modeling Results

Cost Estimating

Discussion

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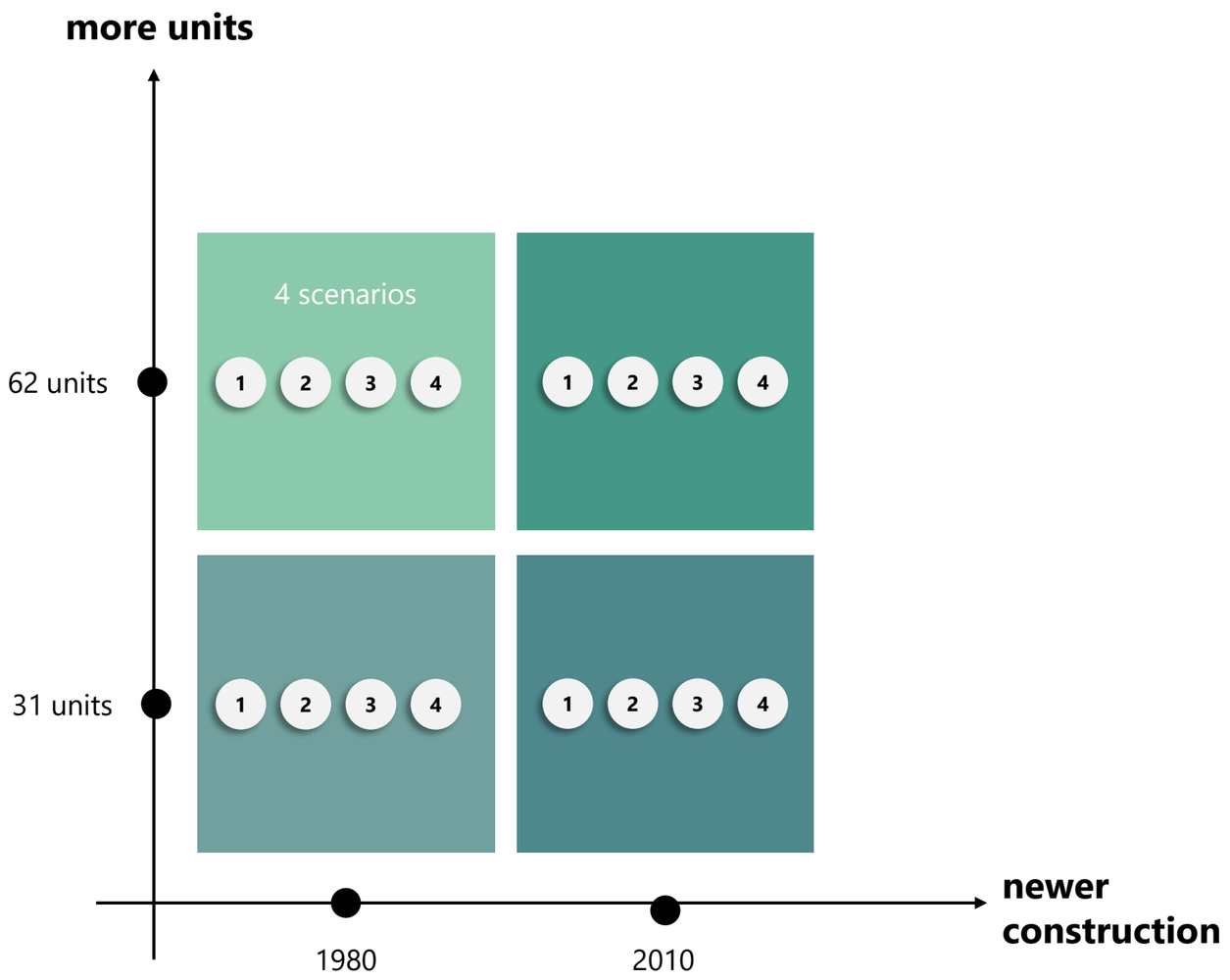
Overview

Arup conducted a series of energy simulations to parameterize the impacts of electrification on multifamily residential buildings. The purpose of this exercise was to provide insight into first costs and operating costs for both owners and tenants.

16 energy simulations were conducted to estimate the impact of electrification on the energy consumption of a mid-rise multifamily building in Los Angeles.



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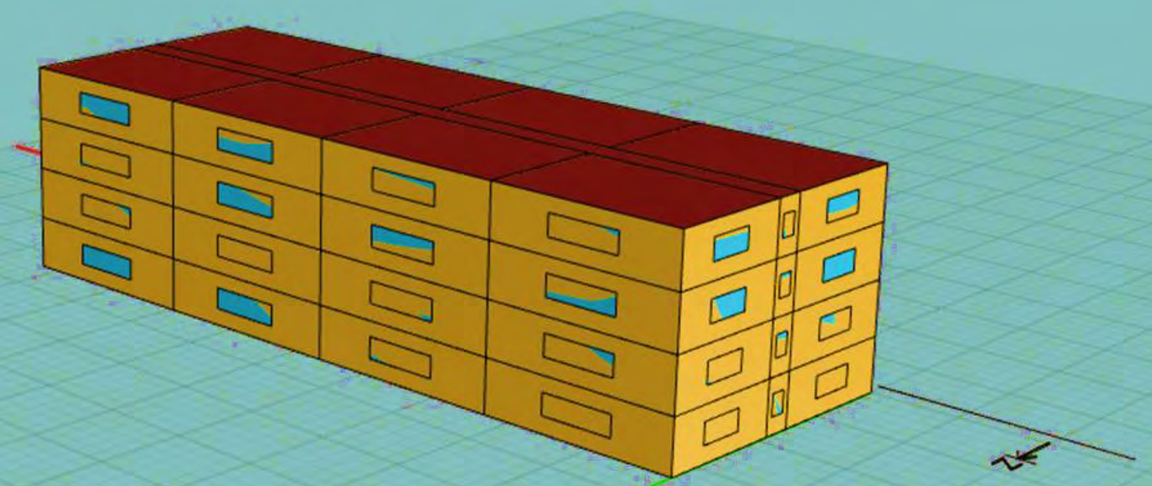
Approach

The Pacific Northwest National Laboratory (PNNL) mid-rise residential prototype energy model was adapted to better represent characteristics of LA's affordable housing market (e.g., shared rather than in-unit laundry).

This is an illustrative model because parameters like existing conditions, occupant behavior, and building orientation would have significant impacts on end energy use and costs. For more details on modeling assumptions, please refer to the Appendix.

More Details on Modeling

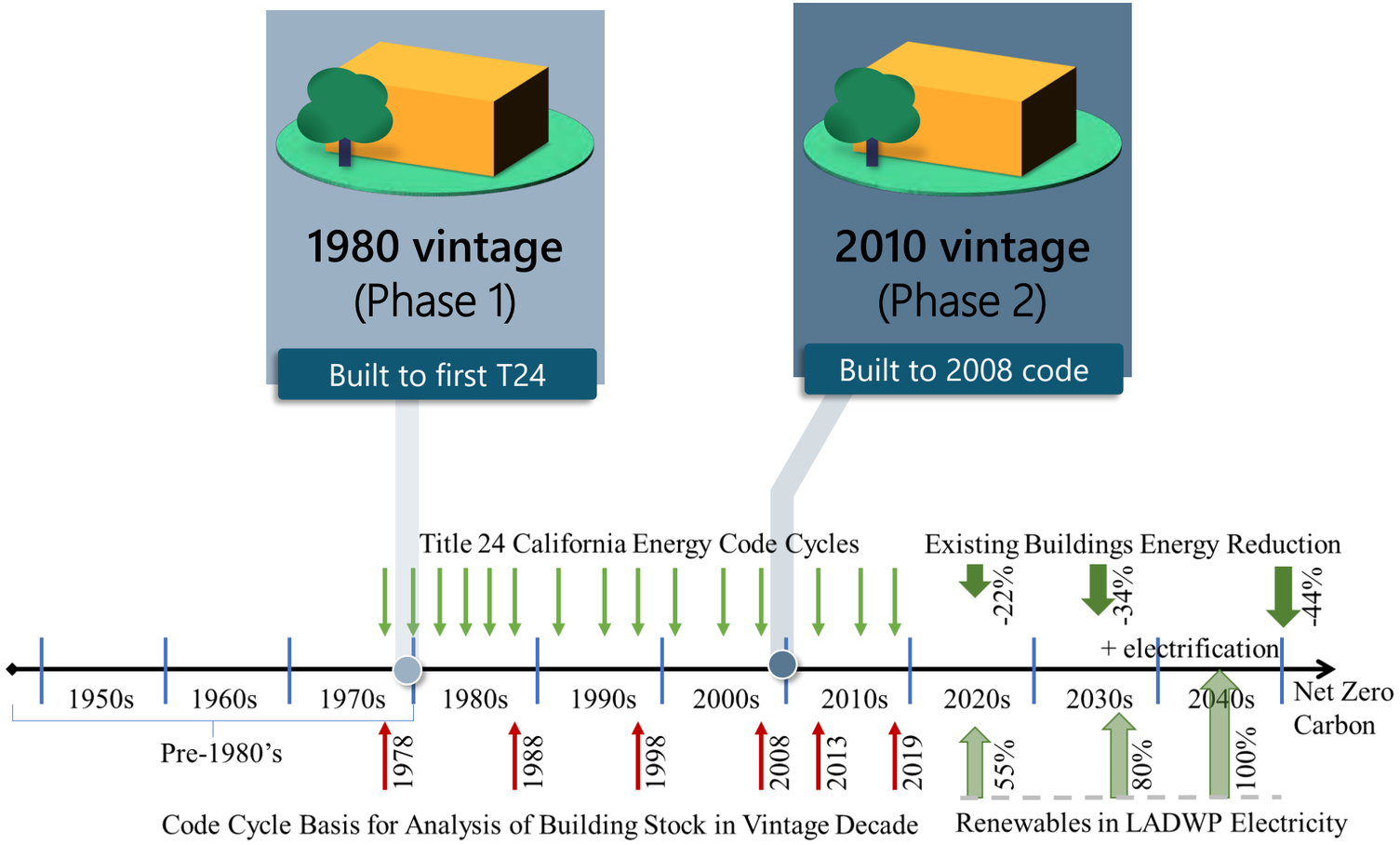
The geometry and occupancy profiles were based on the PNNL model and performance assumptions for the equipment, lighting, envelope, and HVAC equipment were based on the version of California's Building Energy Code, Title 24 (T24), that corresponds to the vintage and – for end uses not listed in T24 - residential project design experience. EIA's Residential Energy Consumption Survey (RECS) was leveraged to prorate the equipment energy consumption for the 1980's era building prototypes. A diversity factor was applied to better reflect expected use.



Modeling Approach

The two building vintages selected for modeling were 1980 and 2010.

Where these vintages fall in terms of code cycles is illustrated on the timeline at the right.



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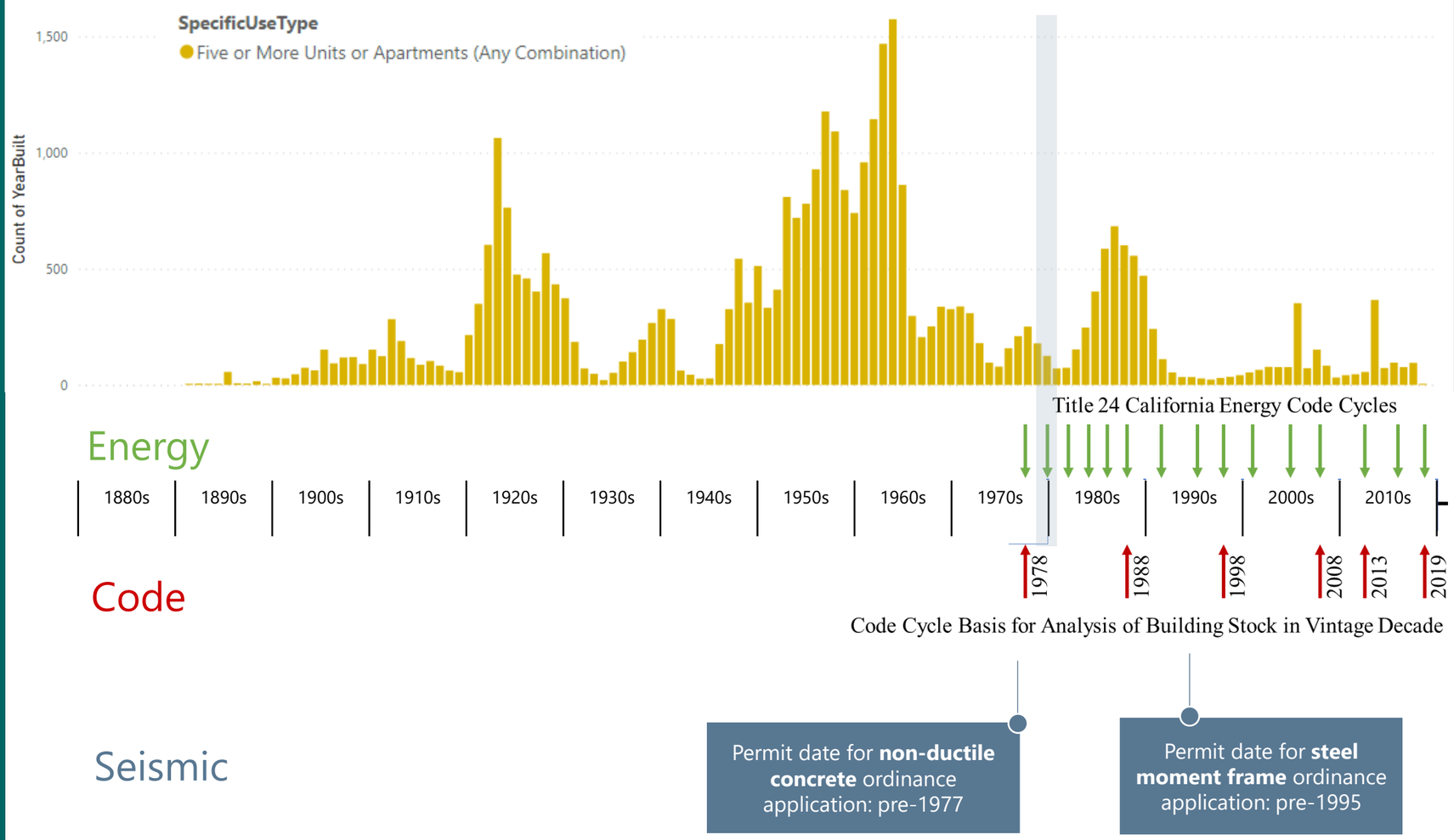
Vintage Selection

Why a 1980-era building prototype?

- **The majority of market-rate and affordable multifamily housing in Los Angeles is not recently constructed.** Multifamily residential development began in LA in the mid-1880s, boomed in the 1920s, and again in the 1950s and 1960s[1] - as can be seen in the graph of assessor data to the right. LA's Rent Stabilization Ordinance applies to buildings constructed before 1978.
- **1980 is the earliest year it makes sense to evaluate, given the onset of energy standards.** 1978 marks the introduction of California's Energy Code, Title 24, before which there were a lot of inefficiencies in building design and performance varied. Because code adoption typically takes a couple of years, 1980 serves as a functional threshold. We have no fixed point of reference to minimum building construction material performance before the 1978 code, but it would be reasonable to assume that the performance is worse than that code unless a significant upgrade has been performed.

1. Historic Resources Group, *SurveyLA: Los Angeles Historic Resources Survey* (2018)

City of Los Angeles Residential Building Stock with 5 or More Units (2019)



Source: 2019 LA County Assessor Data
Data filters applied:
- City = spellings of Los Angeles
- GeneralUseType = Residential
- YearBuilt > 1890
- SpecificUseType = 5 or more units or apartments

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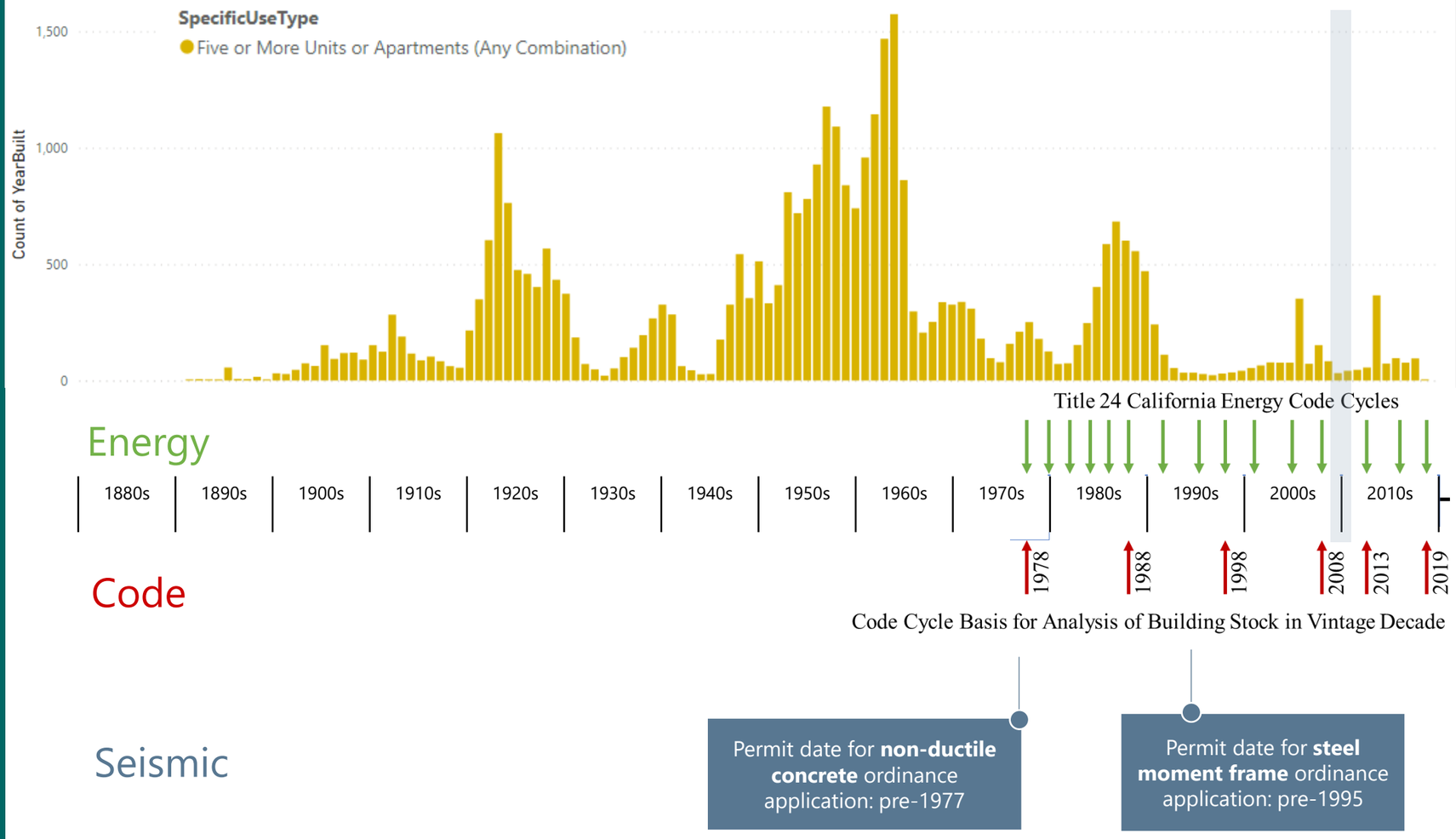
Vintage Selection

Why a 2010-era building prototype?

- **The value proposition of electrification was likely to be different for buildings that have been constructed to be more energy efficient codes.** The cycles of Title 24 in the four decades between 1978 and 2008 have markedly improved the performance standards.
- A building built in 2010 under the 2008 code has been in use approximately a decade and therefore is within 5-10 years of needing replacement on typical residential HVAC systems, giving **enough time to plan a path for upgrade and secure funding.**

City of Los Angeles Residential Building Stock with 5 or More Units (2019)



Source: 2019 LA County Assessor Data
Data filters applied:
- City = spellings of Los Angeles
- GeneralUseType = Residential
- YearBuilt > 1890
- SpecificUseType = 5 or more units or apartments

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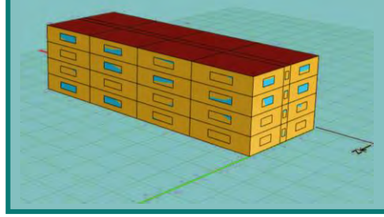
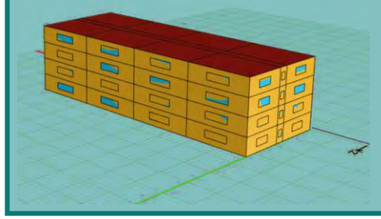
Analysis Overview

Building Models



31 units
950 sqft / unit
33,740 sqft



62 units
425 sqft / unit
33,740 sqft

2 baseline buildings with the same building envelope, but different numbers of units

x

Vintages

1980 vintage

2010 vintage

2 vintages modeled, with applicable codes dictating equipment and envelope performance

x

Equipment Scenarios

1 Base Case
Natural gas is used for space heating, cooking, service hot water heating, and dryers.

2 Base Case: No AC
The same use of natural gas as the base case, but no air conditioning is included. There is an additional electric load considered for fans.

3 Electrification: Minus Stoves
All appliances and equipment are electrified *except* for each apartment unit's natural gas stove and oven.

4 Electrification: Whole Building
Centralized infrastructure, in-unit infrastructure, and natural gas appliances retrofitted and replaced with typical all-electric from today's market.

4 scenarios modeled to compare energy use and costs

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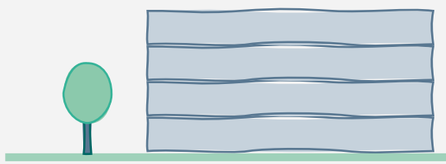
Key Assumptions

This page highlights some key assumptions used in this study.



4 story building

33,740 sf total

Located in the City of LA

As a mid-rise multifamily building, this study

1. looks at a sizable building area, which is already subject to energy use benchmarking and tune-up ordinances, unlike smaller or single-family residences.
2. complements other published CA-based studies, like E3's *Residential Building Electrification in California* that evaluated single-family and low-rise multifamily.

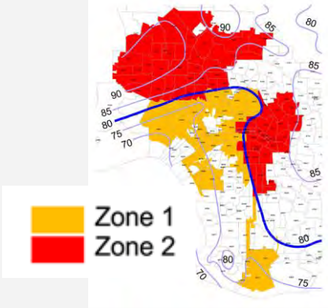
Shared laundry

No pool

A shared on-site laundry room, rather than in-unit washers and dryers, were modeled in order to be more consistent with LA's affordable housing. For the same reason, no pool was modeled.

2.5 occupants per apartment

2.5 occupants were modeled per apartment based on the PNNL model. Note: occupancy (number of people and use characteristics) strongly impacts energy use. Multi-generational households, for example, are likely to use more energy on average.



LADWP R1A-Zone 2 rate structure applied for common areas, R-3 for sub-metered apartments

Zone 2 was selected due to a higher concentration of low-income Census tracts.

In-place equipment assumed to be era of year constructed

Note: At least some of these systems of the 1980 vintage would likely to have been upgraded / replaced (e.g., HVAC and lighting). Appliances in affordable housing however are often used until end-of-life due to budget constraints.

Image: LADWP Residential Rate Zone Map (lawdp.com)

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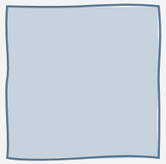
Key Differences

The following are key differences between the standard and the denser models.

Standard

The standard unit size and number of units are based on the PNNL model.

31 units

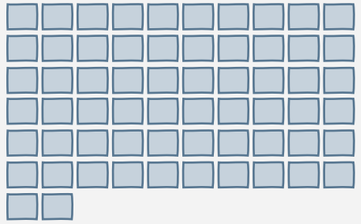


950 sqft / unit

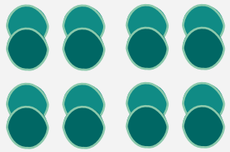
Denser Case

As a point of comparison, a denser case with half the unit size and double the units was modeled within the same overall building geometry.

62 units



425 sqft / unit



2x washers & dryers

to serve twice the number of residents

Larger domestic hot water heater

There's a centralized hot water heater – in the denser case, it's larger to serve twice the number of apartments

ARUP

Utility Cost Breakdown

There are a variety of structures, but this analysis evaluates the following breakdown:

Utility Cost Model: Submetered

Owner

- **Common areas** (e.g., hallway electrical and space heating, elevators, leasing office)
- **Shared laundry** (washers and dryers)
- **Service hot water** serving laundry room and apartments

Tenant

- **Apartment electricity use** (e.g., plug loads, cooling)
- **Apartment natural gas use** (e.g., space heating and cooking. This does not include service hot water.)

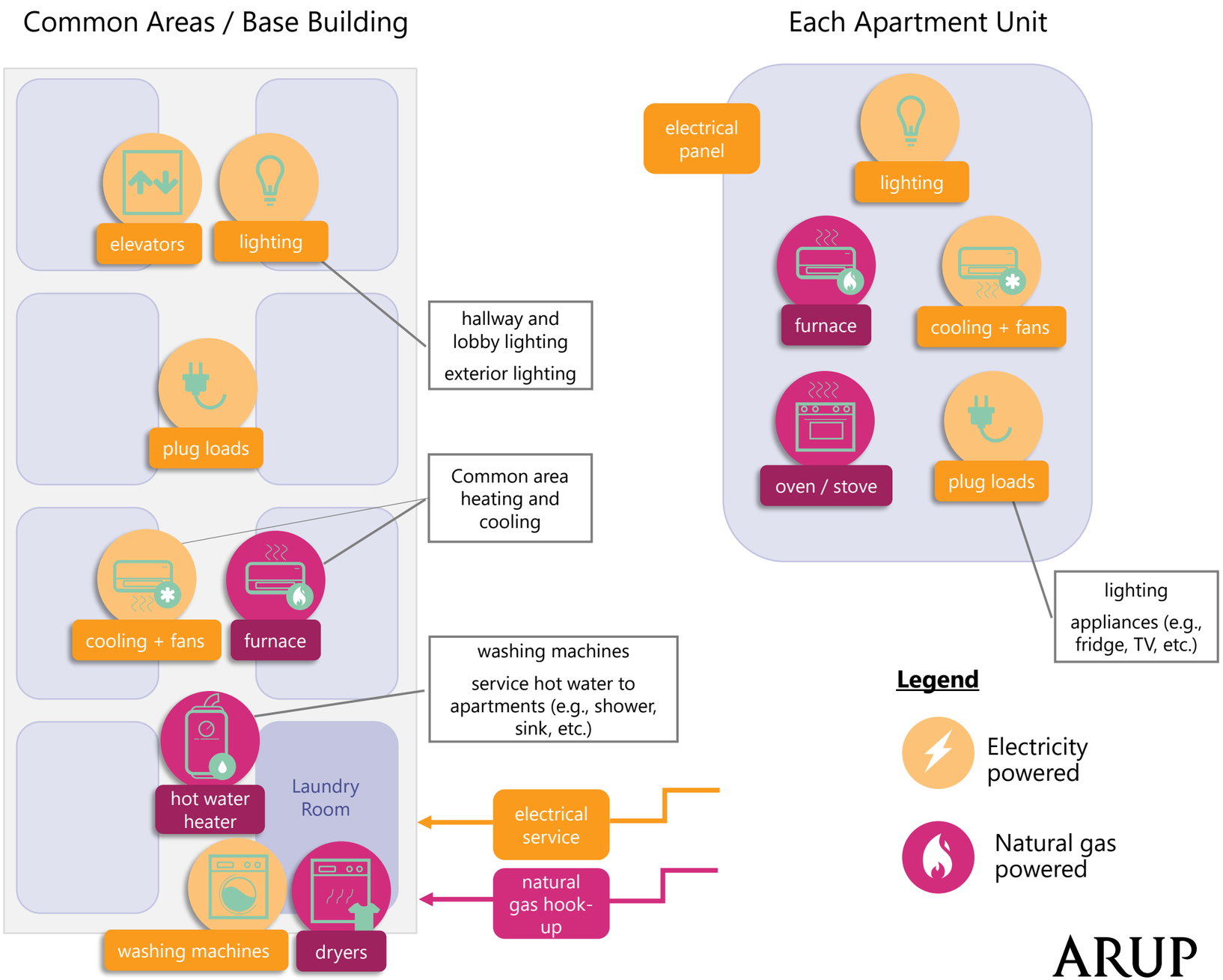
Base Case

In the base case, natural gas is used for space heating, cooking, service hot water, and clothing dryers.

Assumptions:

- Shared laundry facility with natural gas clothes dryers
- Natural gas stove and ovens in apartments
- Gas-fired water heater for service hot water (SHW)
- Cooling fan unit (direct-expansion/split system) for space cooling and natural gas furnaces for space heating in the apartments and in the common areas

1



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Base Case: No AC

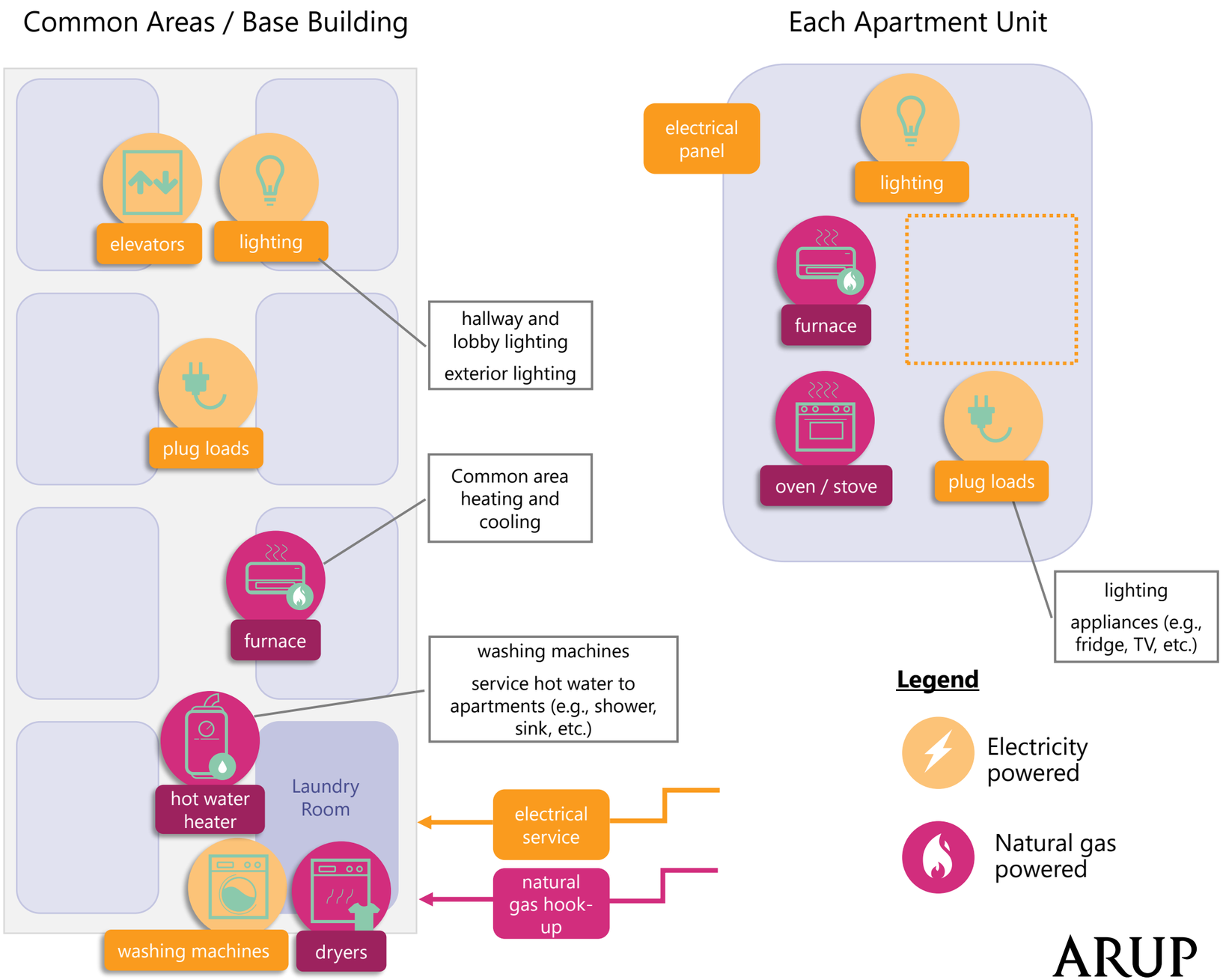
But what if the apartments – like many in Los Angeles – are not outfitted with air conditioning?

The following version of the base case removes the air condition load modeled within the apartments and within the common areas.

Assumptions:

- In the no AC scenario, an uptick in fan energy is anticipated and factored into the calculations (e.g., for ceiling fans)

2



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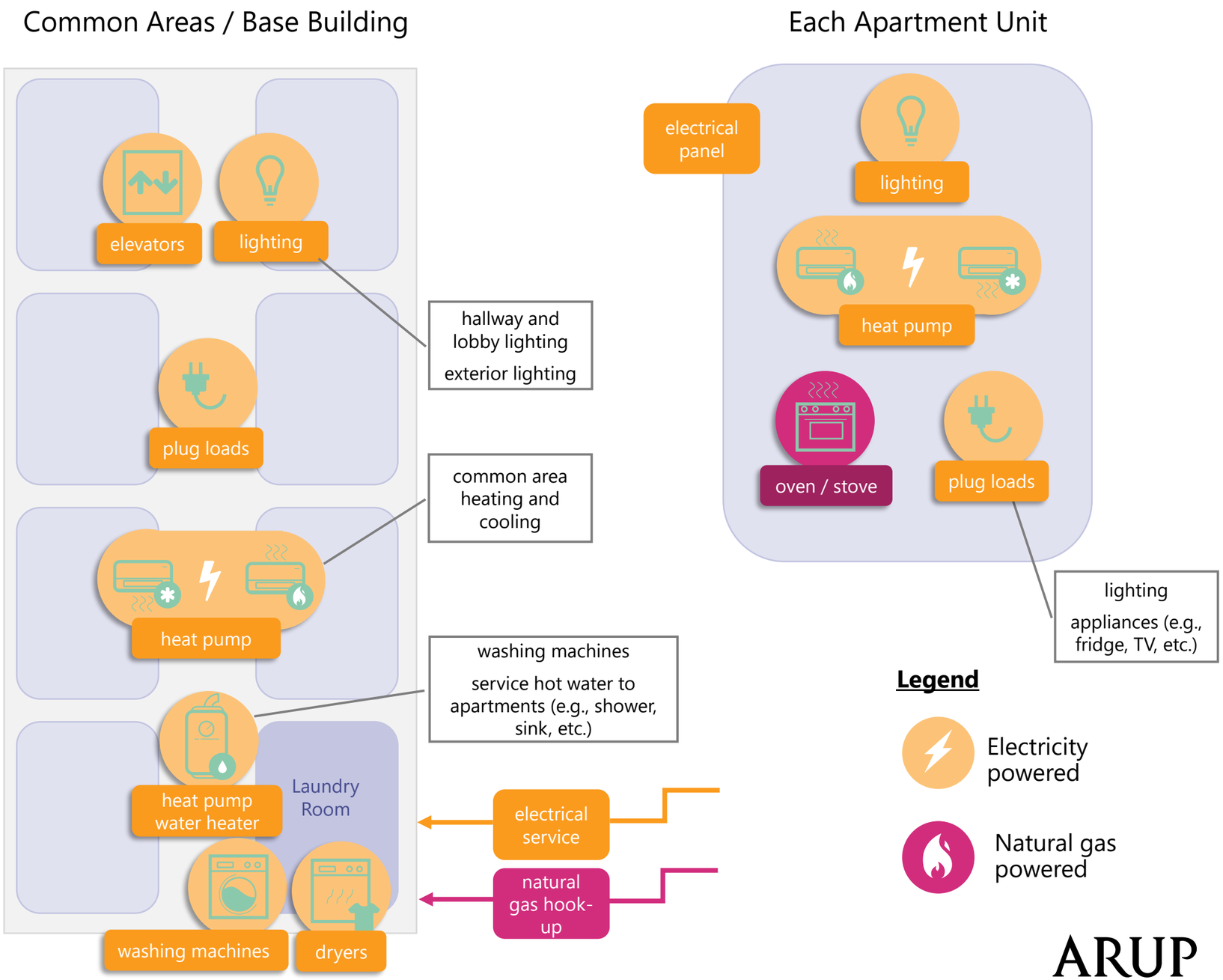
Electrification: Minus Stoves

In this scenario, all appliances and equipment are electrified *except* for each apartment unit's natural gas stove and oven.

Assumptions:

- Stoves and ovens in the apartments are not updated from their natural gas original installs
- Shared laundry facility has all-electric clothes dryers
- Heat pump water heater for service hot water (SHW)
- Code-compliant heat pump for space cooling and heating in the apartments and the common areas

3



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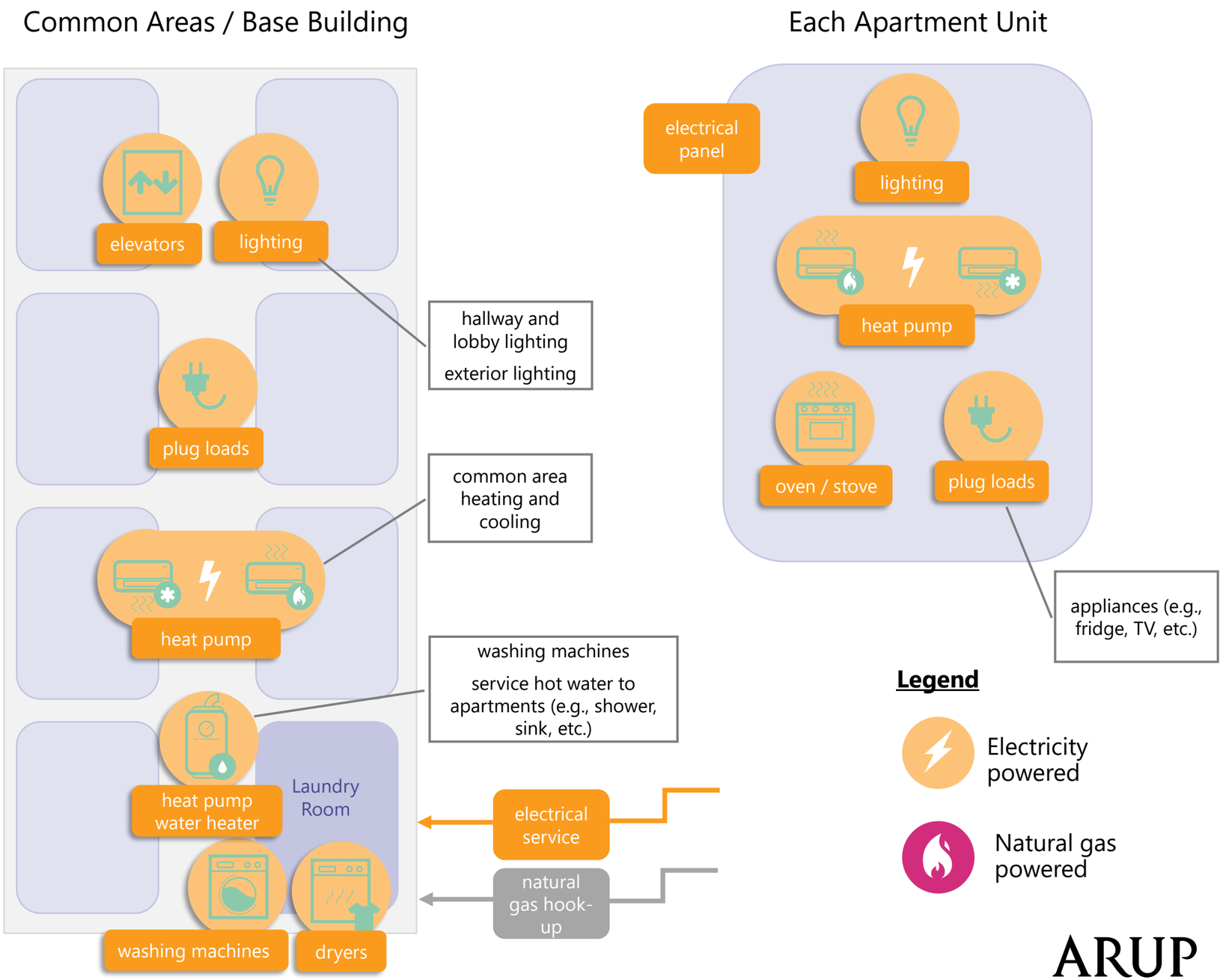
Electrification: Whole Building

The centralized electrical infrastructure, in-unit infrastructure, and natural gas appliances are retrofitted and replaced with typical all-electric from today's market in the whole building electrification scenario.

Assumptions:

- Shared laundry facility has all-electric clothes dryers
- All-electric stoves and ovens in the apartments
- Heat pump water heater for service hot water (SHW)
- Code-compliant heat pump for space cooling and heating in the apartments and the common areas

4

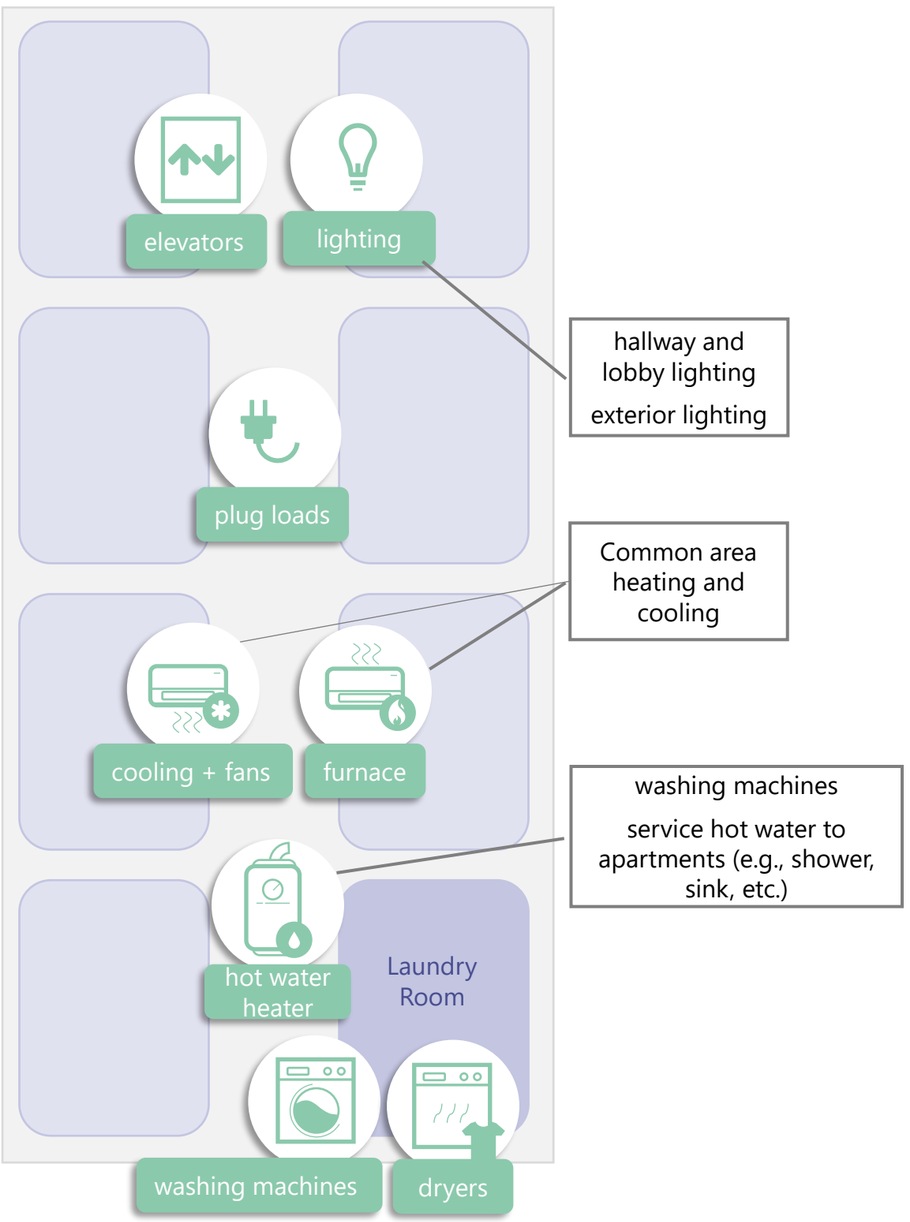


ARUP

Cost Split

In the following estimate, the building owner pays for the following:

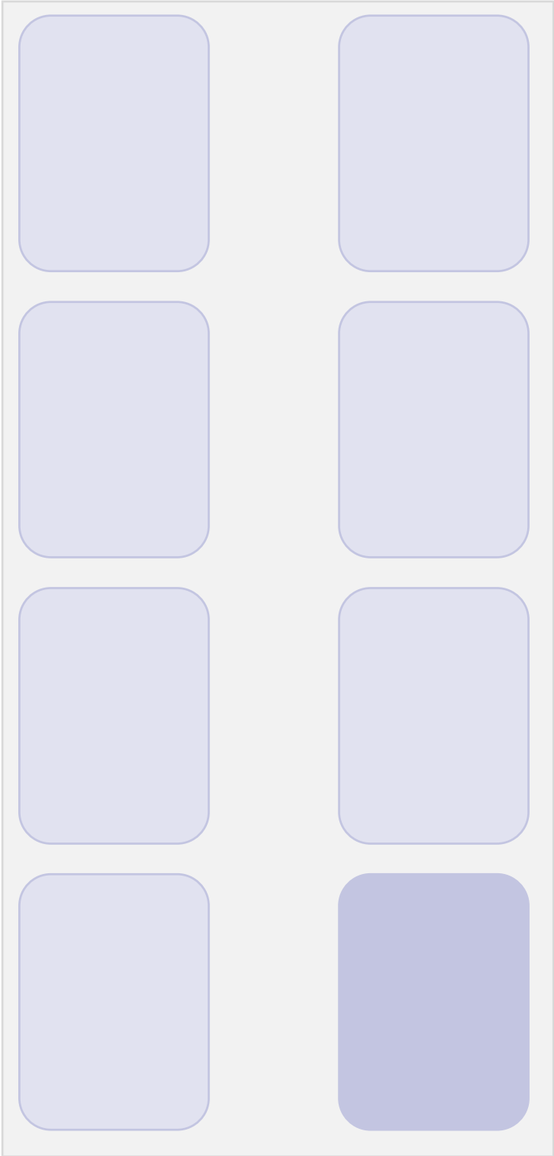
Common Areas / Base Building



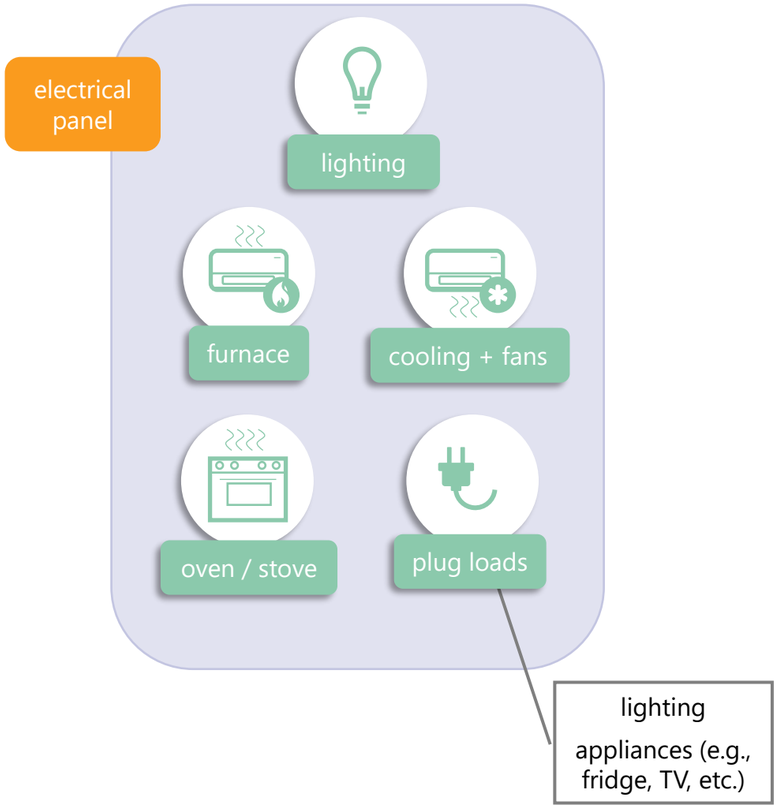
ARUP

Cost Split

In the following estimate, the tenant pays for the following:

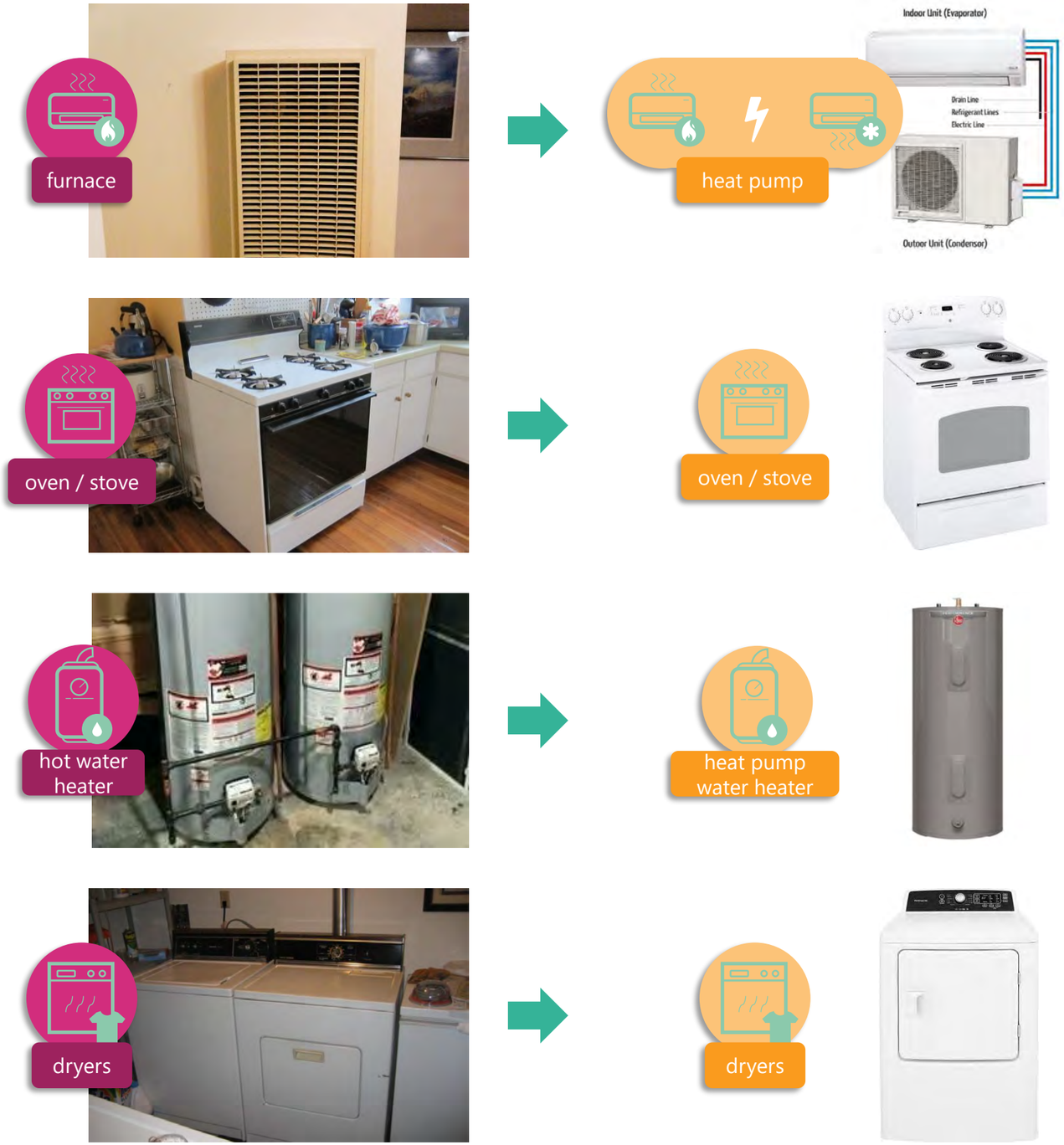


Each Apartment Unit



Electrification

The following is an illustration of the equipment changes occurring in the electrification scenario.



Images:

Wall furnace: https://diy.stackexchange.com/questions/23330/how-can-i-retrofit-this-existing-wall-heater-with-an-external-thermostat

Gas stove: https://www.flickr.com/photos/70684282@N00/6014911331

Hot water heater: https://www.billfrusco.com/water-heaters.html

Gas dryer: https://www.automaticwasher.org/cgi-bin/TD/TD-VIEWTHREAD.cgi?15957

Mini split heat pump: http://addairinc.com/mini-split/split-system-diagram/

Electric stove / oven: https://www.amazon.com/GE-JBP23DRWW-White-Electric-Range/dp/B004SU7AC4

Electric water heater: https://www.peerlessappliance.com/gas-vs-electric-water-heater/

Electric dryer: https://www.amazon.com/Frigidaire-FFRE4120SW-Electric-Capacity-Temperature/dp/B06XDDY452

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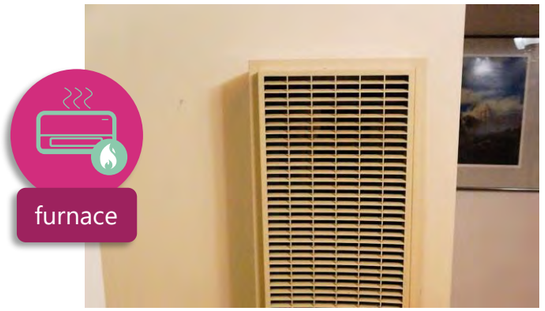
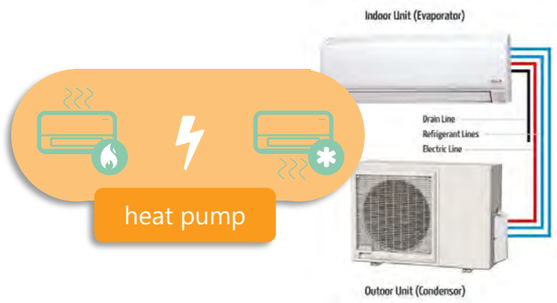
Electrification: Heat Pumps

The following spotlights two significant system changes: the space heating equipment and the water heating equipment.

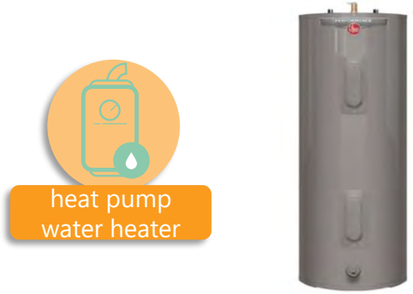
A key benefit of replacing a furnace with a heat pump is that it can provide both heating and cooling. So, if an apartment does not already have AC, replacing the furnace with a heat pump can offer that functionality to help weather increasingly severe heatwaves.





Air source heat pump

How does it work?
A heat pump transfers heat either indoors (to provide heating) or outdoors (to provide cooling) using electricity and refrigerant. Because a heat pump leverages the temperature difference (rather than purely generating heat), it is very efficient.



Heat pump water heater

How does it work?
Similar to the air source heat pump used for space heating and cooling, a heat pump water heater uses electricity to transfer heat from ambient air to the water tank. This is markedly more efficient than generating the heat (e.g., electric resistance heaters or natural gas water heaters).

Images:

Wall furnace: https://diy.stackexchange.com/questions/23330/how-can-i-retrofit-this-existing-wall-heater-with-an-external-thermostat

Hot water heater: https://www.billfrusco.com/water-heaters.html

Mini split heat pump: http://addairinc.com/mini-split/split-system-diagram/

JBP23DRWW-White-Electric-Range/dp/B004SU7AC4

Electric water heater: https://www.peerlessappliance.com/

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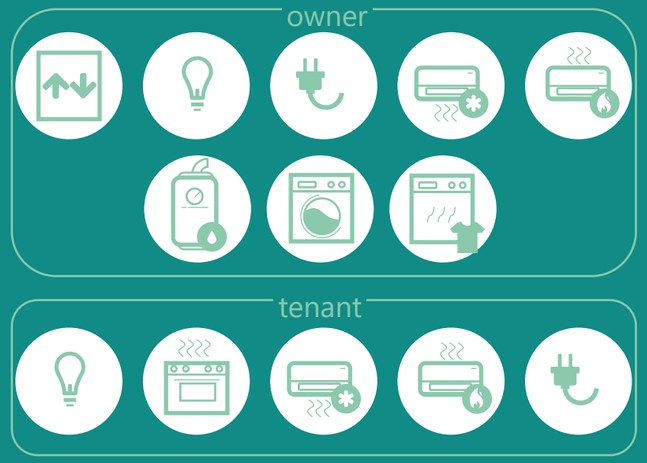
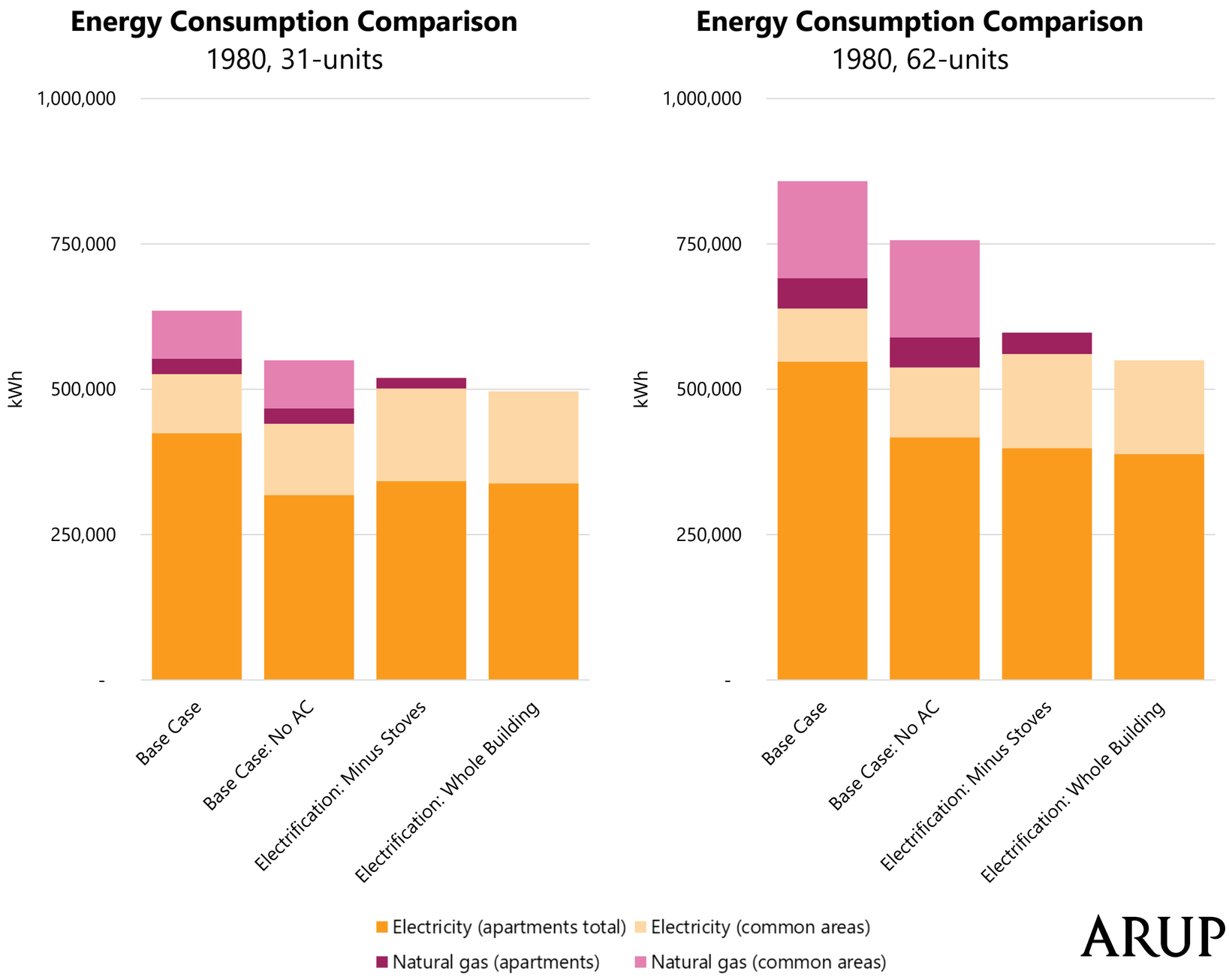
Energy Consumption

1980 vintage

The following graphs illustrate the energy consumption across scenarios for the 31-unit complex (left) and the 62-unit complex (right).

Electricity consumption is indicated in yellow and natural gas consumption in pink, with the shade referring to whether it is tied to what the tenant or owner would pay for in this assumed structure.





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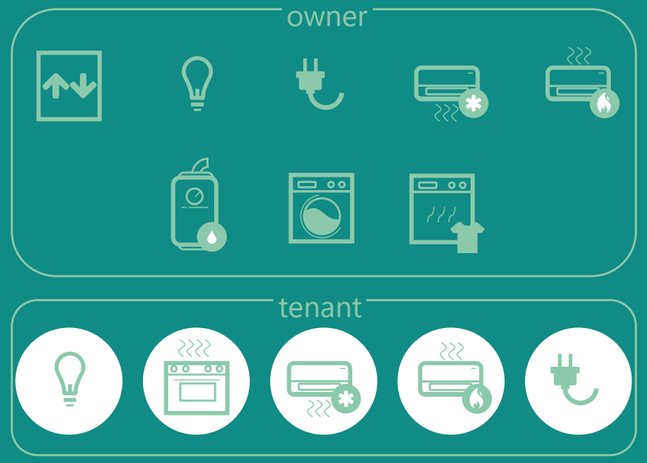
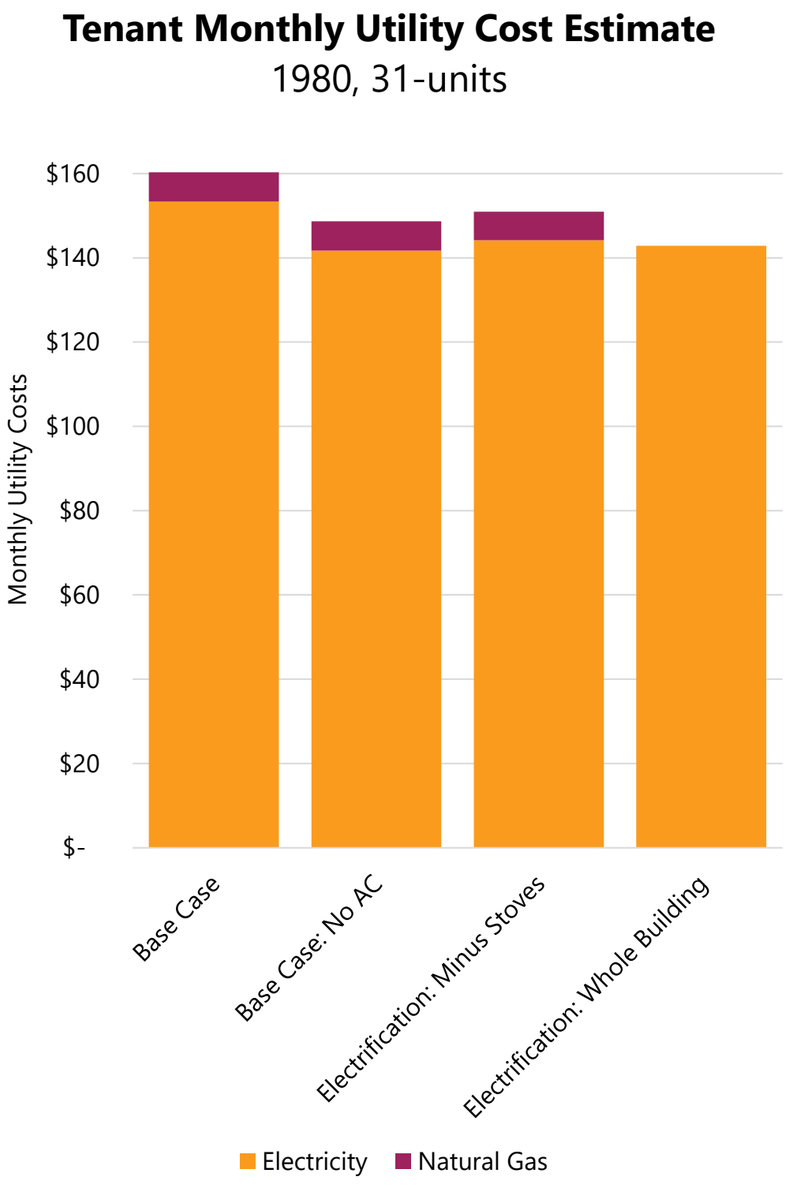
Utility Cost Estimates

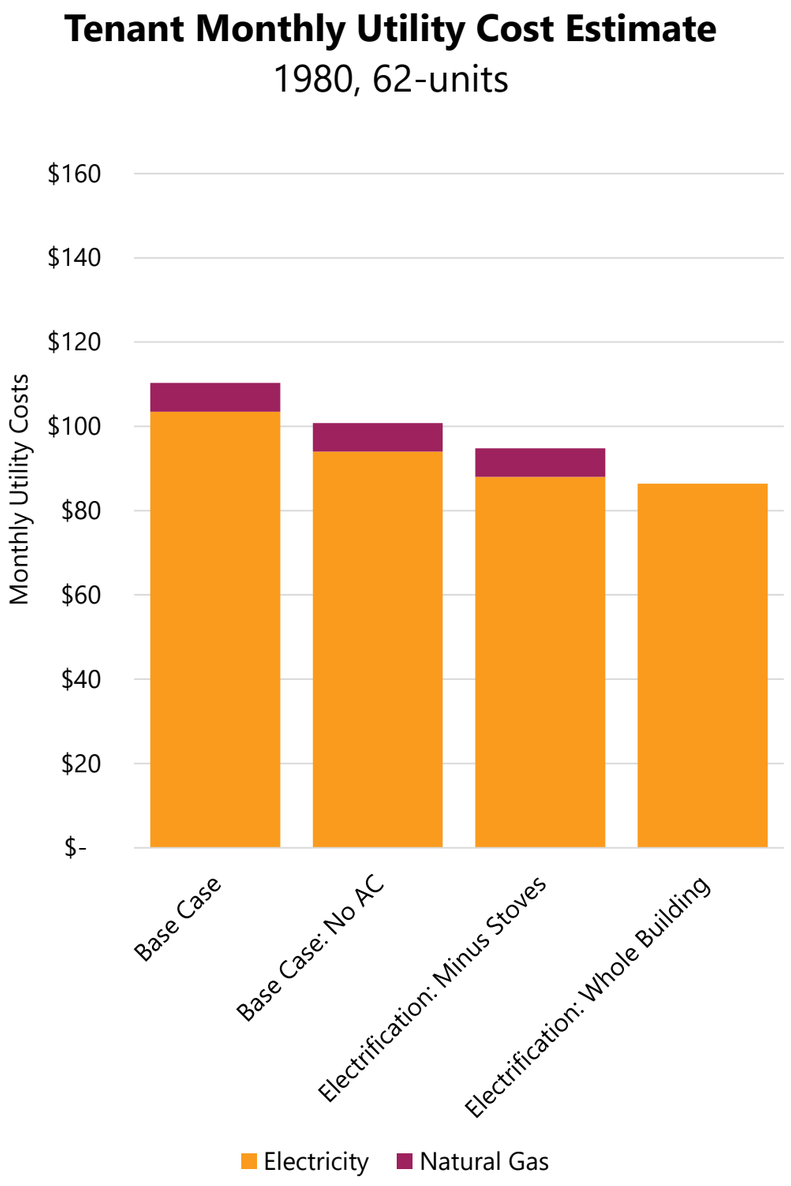
1980 vintage: Tenants

For the 31-unit case, tenants would see an average savings of about 11% on their monthly utility bills going from the base case to whole building electrification. For the 62-unit case, these savings grow to roughly 22%.

Overall, the energy use in the denser (62-unit) model is lower per apartment because each apartment is smaller, so there is less area to heat, cool, and provide lighting for. The monthly utility estimate is the average across the year – e.g.., it would be higher in the summer and lower in the fall.







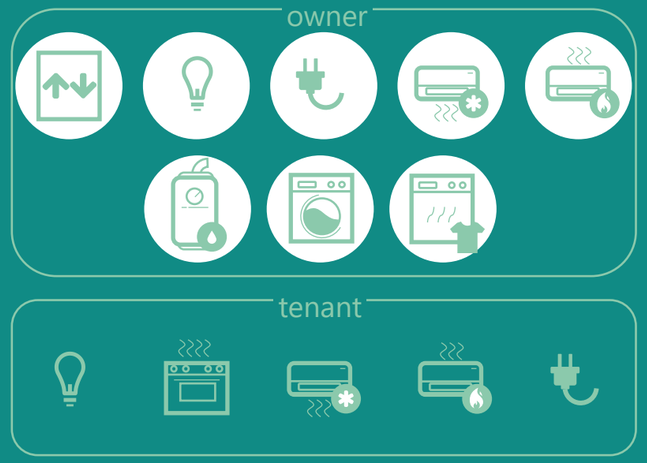
ARUP

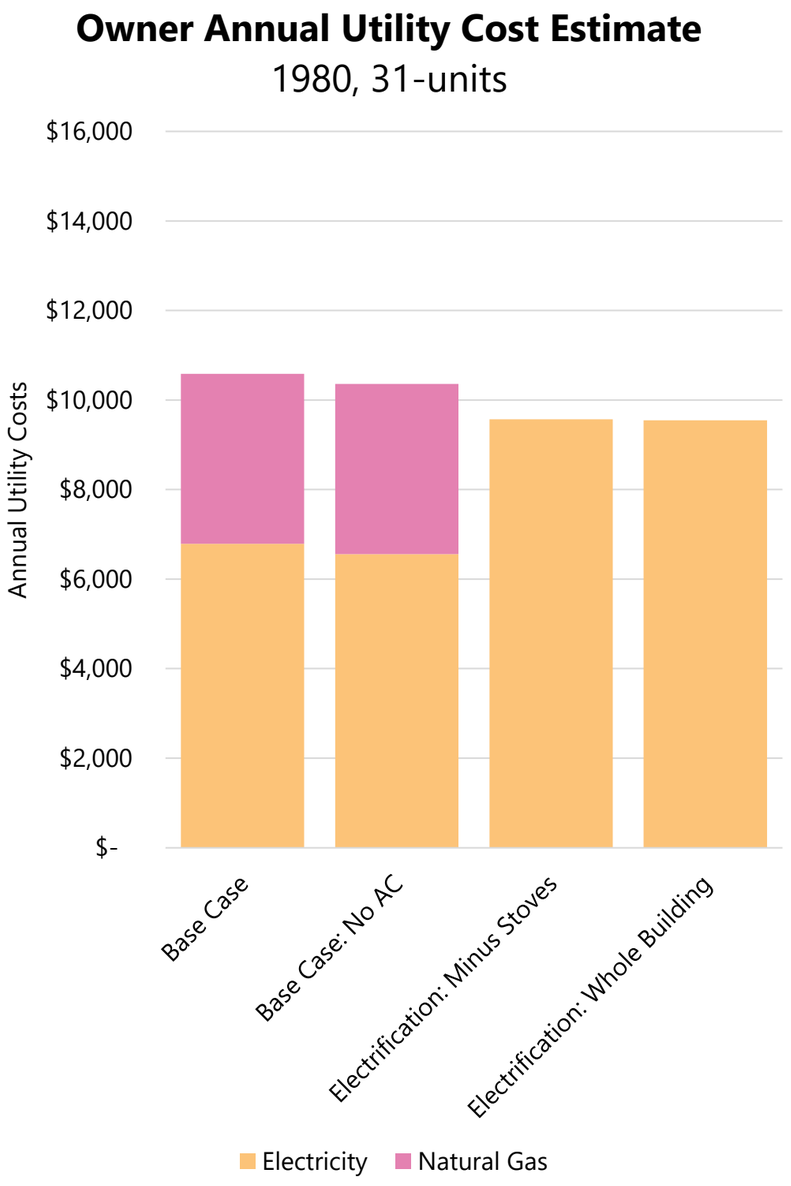
Utility Cost Estimates

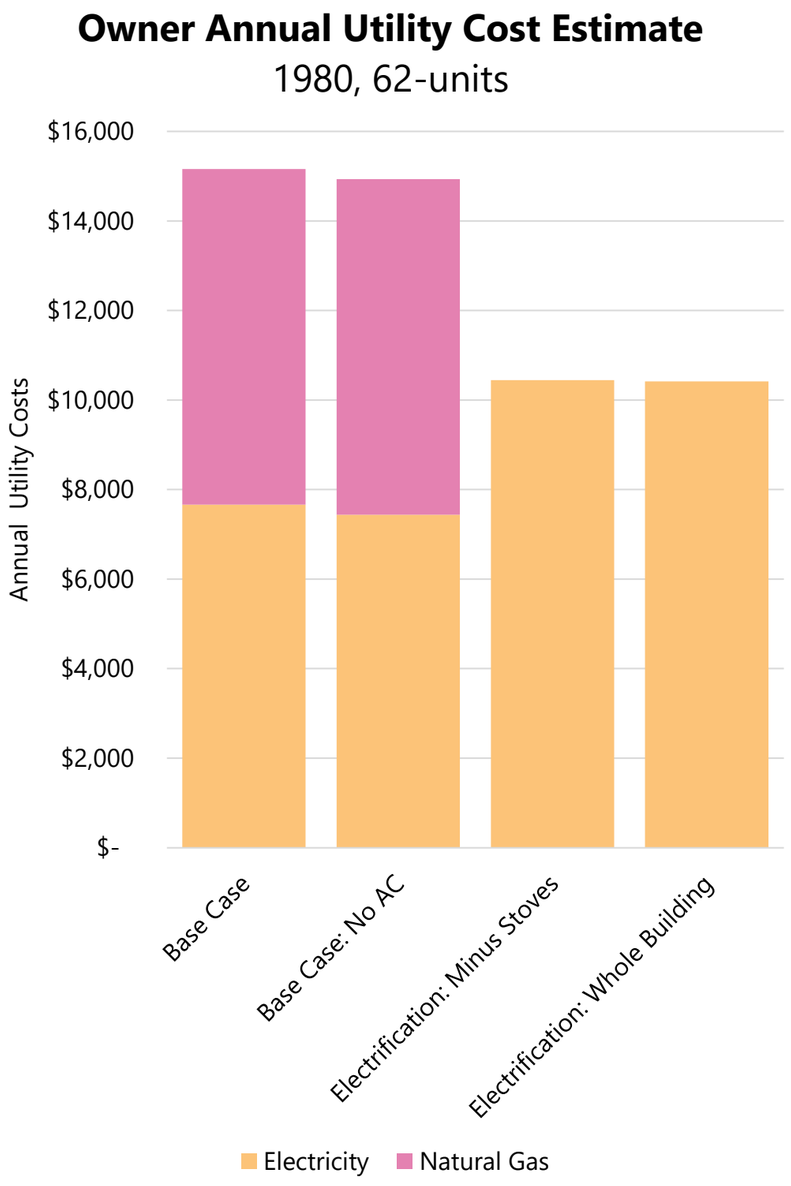
1980 vintage: Owners

For the 31-unit model, there were about 10% cost savings for the owner to transition from base case to whole building electrification. For the 62-unit, these savings grow to 31%.

The owner costs are overall higher for the denser case due to higher demand for hot water and twice as many washers and dryers in the shared laundry room. Consequently, replacing the 1980's era natural gas appliances with today's all-electric code-compliant equivalents provides a greater savings potential for the denser case.







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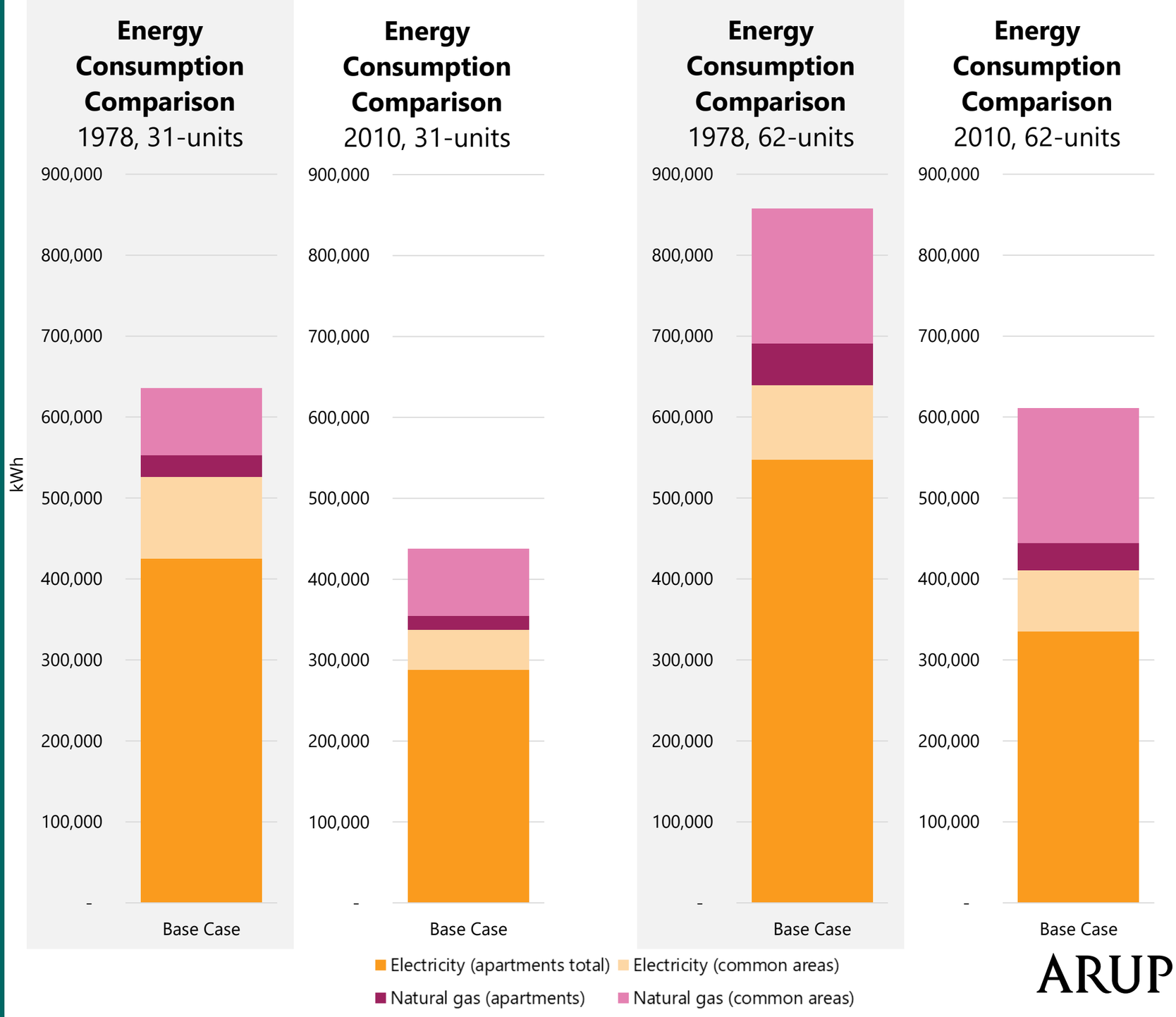
Energy Consumption

The following graphs compare the energy consumption between the base cases. **There are three drivers for why the 2010 base model is more energy-efficient than the 1980 version:**

1. **Baseline equipment efficiency** – the equipment installed in a 2010 building to be code-compliant is more efficient than decades prior**. This is the variable that changes across the scenarios in this study.** The electrified scenarios of the 1980 and 2010 models, which models the replacement with *today's* code-compliant all-electric equivalents, have the same equipment efficiencies. In other words, the models have different starting points but the same endpoint.
2. **Lighting** – the 1980 model consumes nearly 3x the energy for lighting than the LED fixtures modeled in the 2010 building. Lighting upgrades are a powerful tool for energy savings, but not one of the modeled retrofits given the focus of this study on electrification, so the lighting load does not vary across scenarios.
3. **Envelope Performance** – the 2010 model has a better performing envelope in terms of the air infiltration rate, thermal performance, and solar performance. More information on this is detailed in the Appendix.



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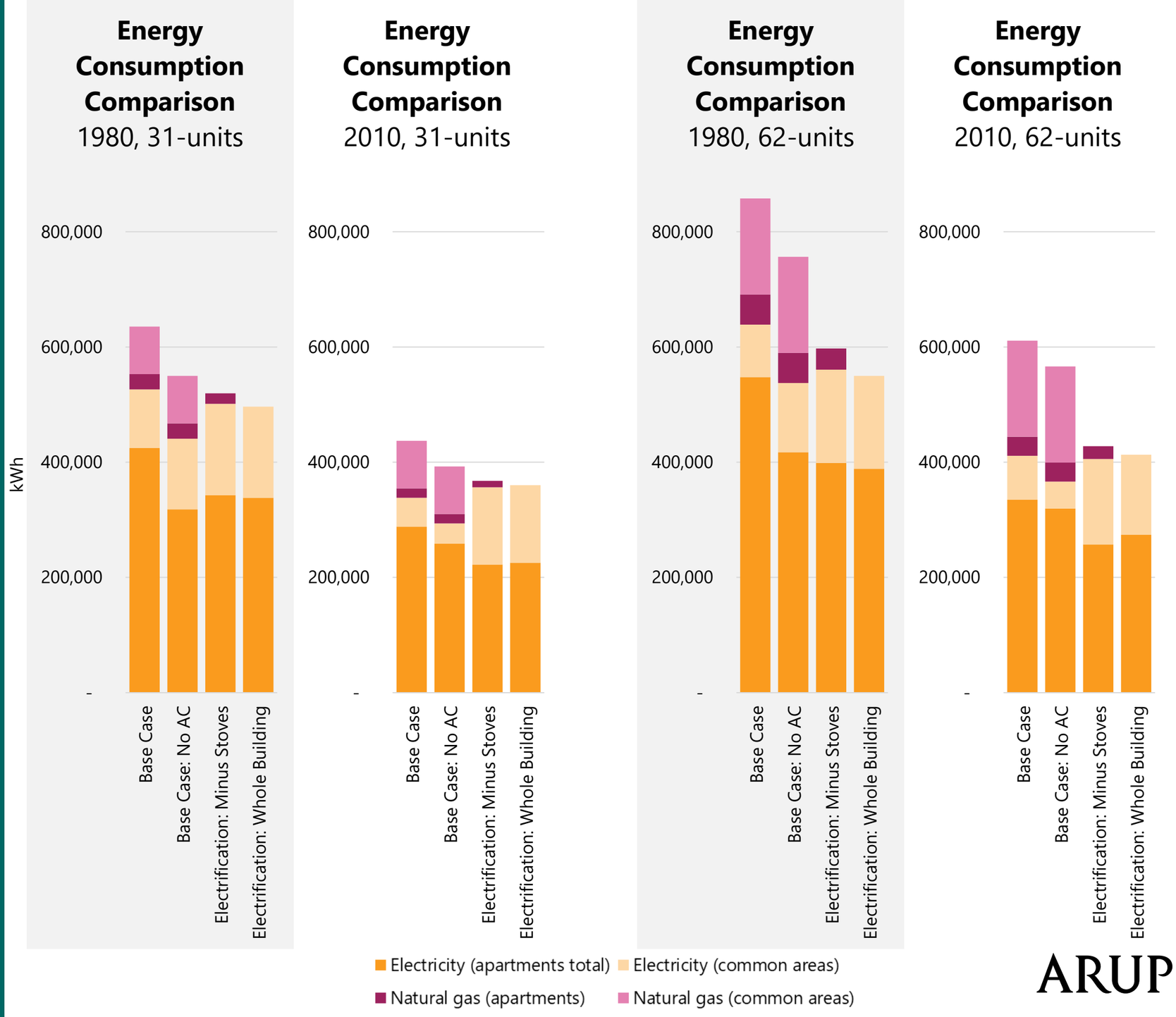
Energy Consumption

The following graphs compare the energy consumption between the two vintages across **electrification scenarios**.



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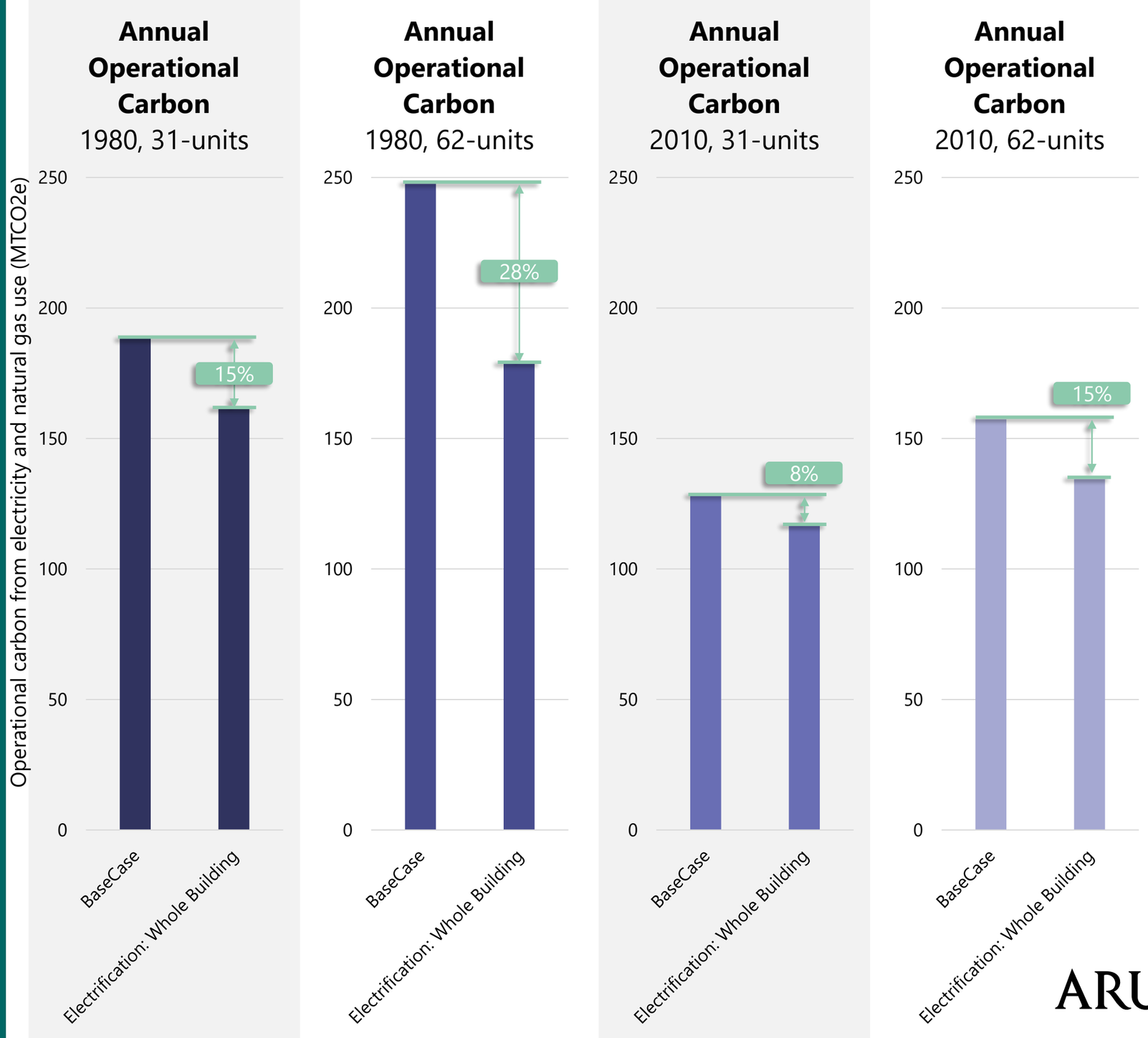
Reduction in Carbon Emissions

The following graphs illustrate the annual **operational carbon emissions saved** by transitioning from the base case to whole building electrification.

Please note, the carbon emissions estimated here assume the current (2021) local energy generation mix. As fossil fuels are removed from energy generation, the carbon intensity of electricity will become lower and eventually carbon-free. In other words, **as the grid gets cleaner, the emissions reduction through electrification will be much more significant.**

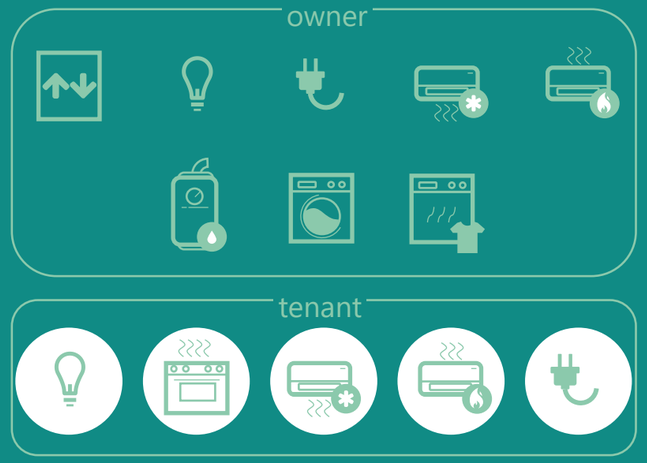


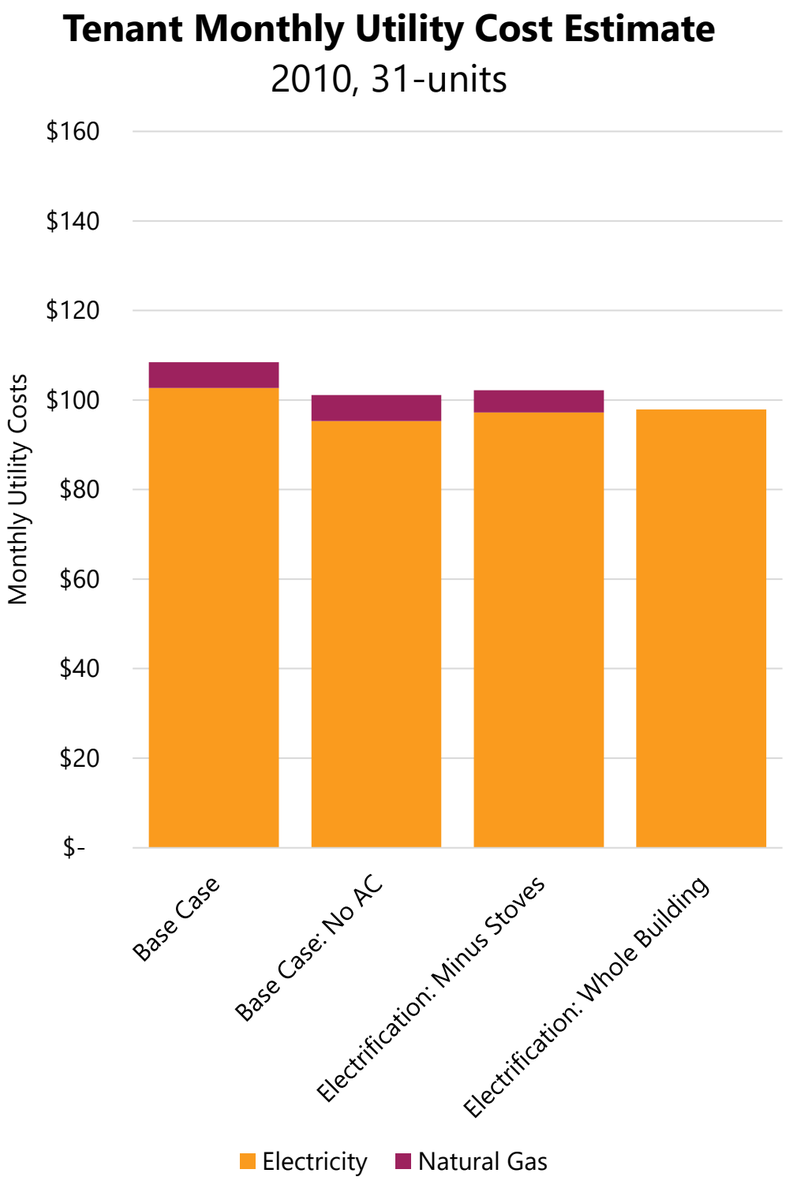
ARUP

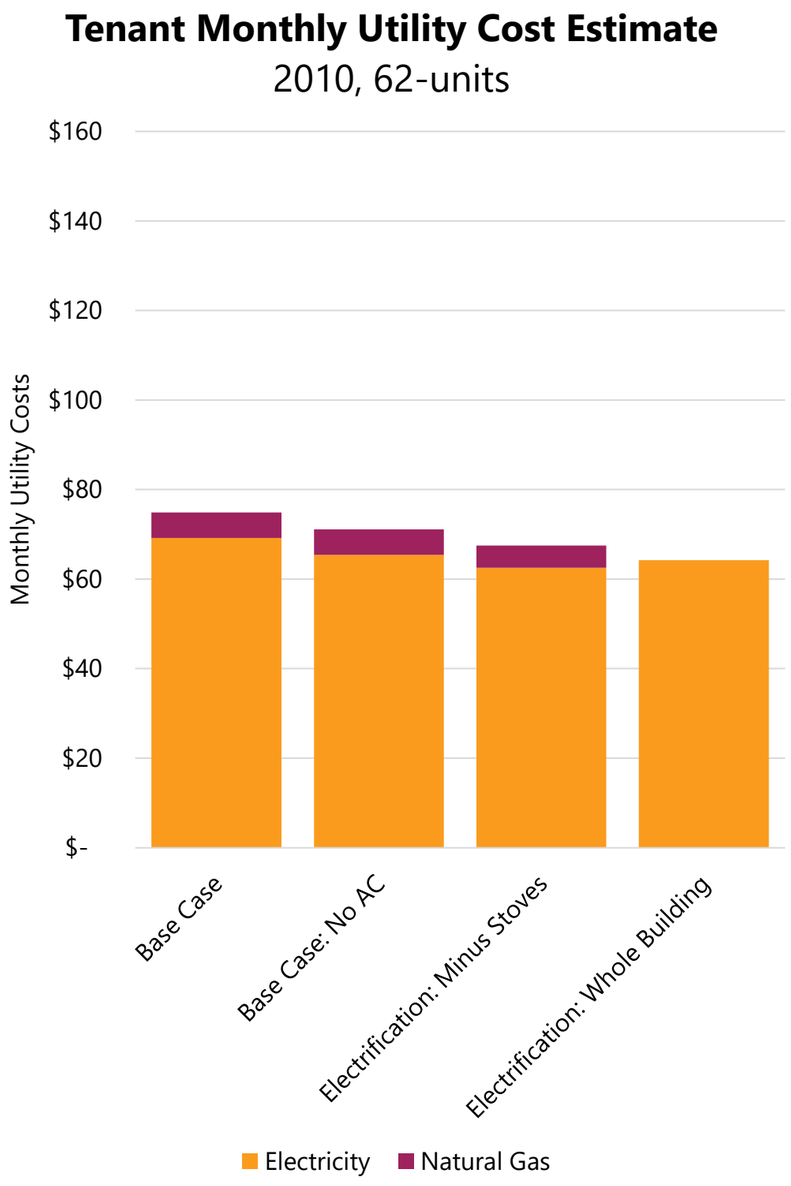
Utility Cost Estimates

2010 vintage: Tenants

For the 31-unit case, tenants in this model would see average savings of about 10% on their monthly utility bills going from the base case to whole building electrification. For the 62-unit case, these savings grow to roughly 14%.





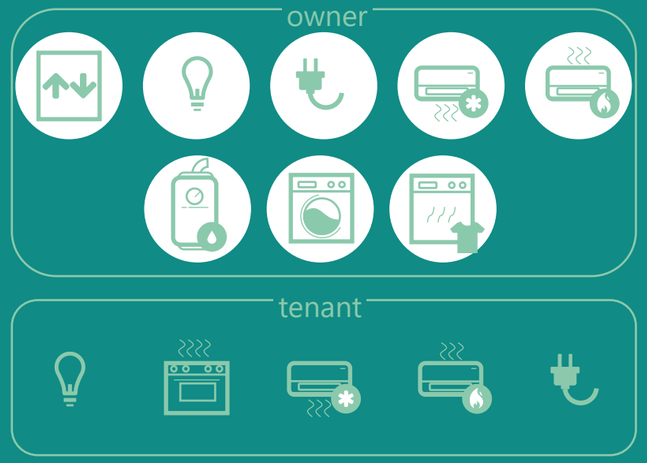


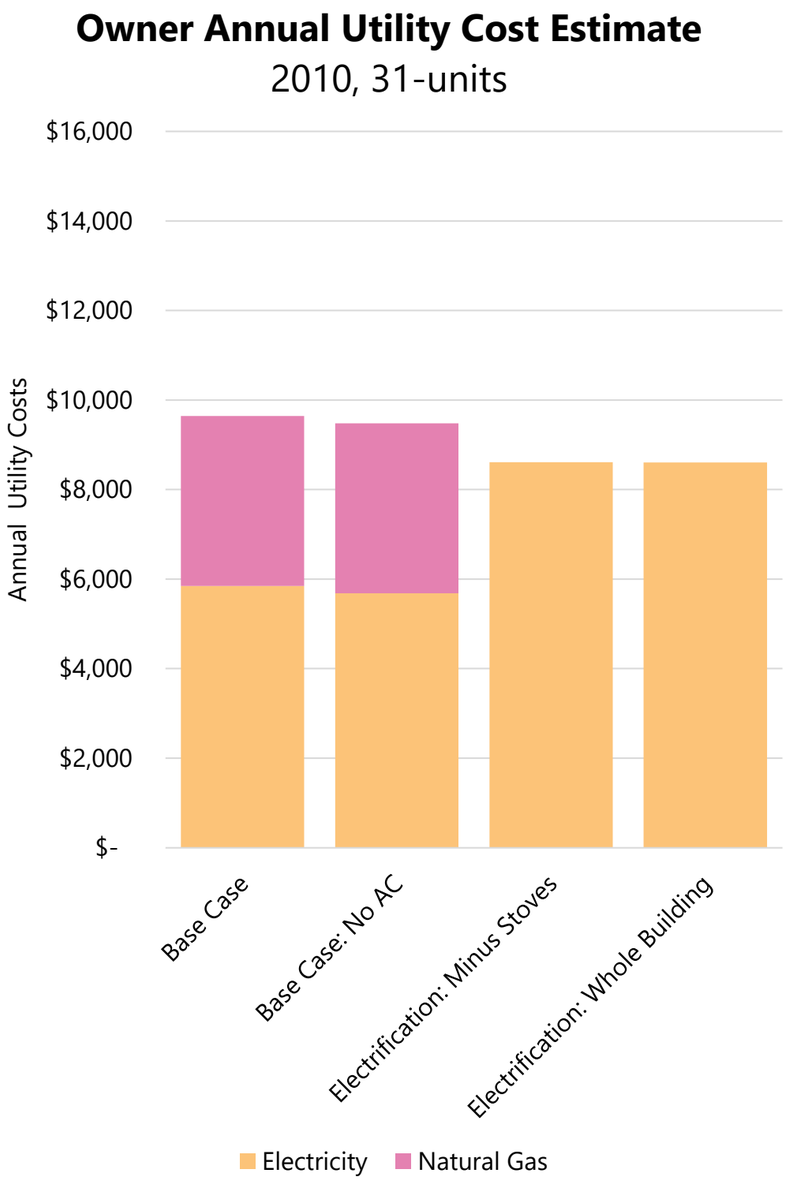
ARUP

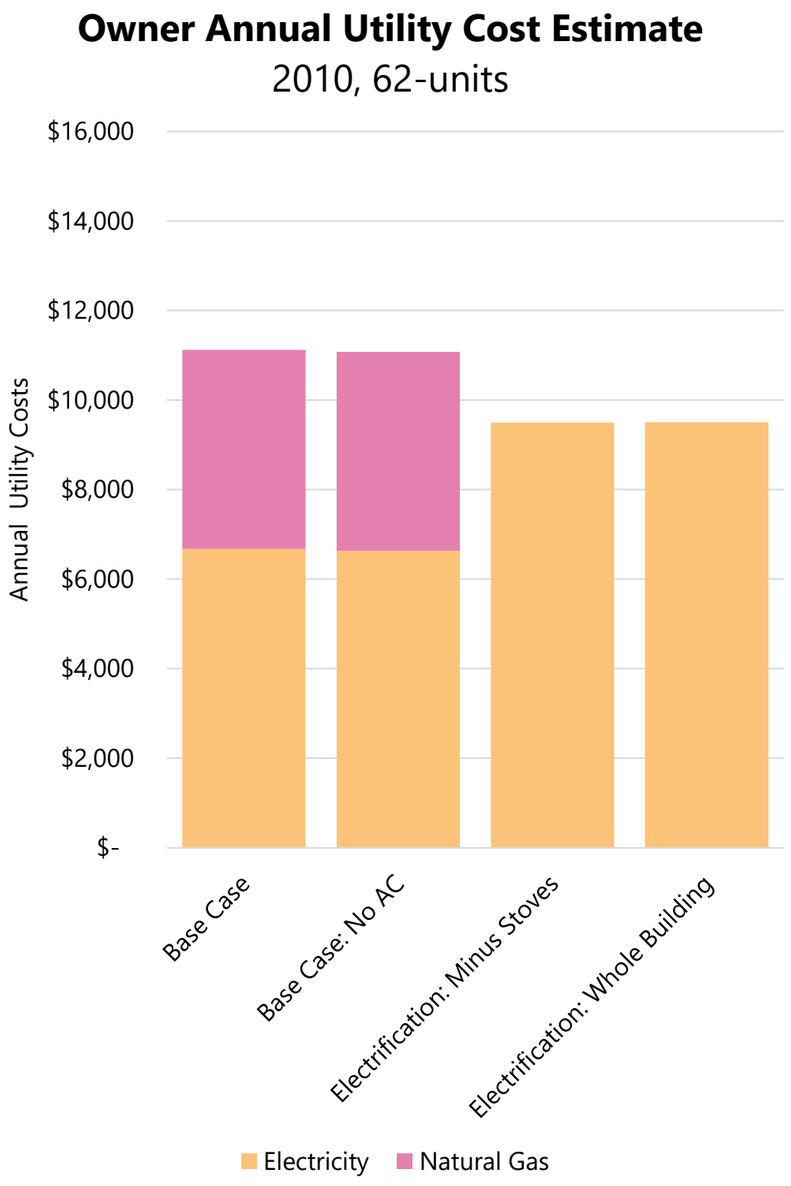
Utility Cost Estimates

2010 vintage: Owners

For the 31-unit case, building owners would see average savings of about 11% on their monthly utility bills going from the base case to whole building electrification. For the 62-unit case, these savings grow to roughly 15%.







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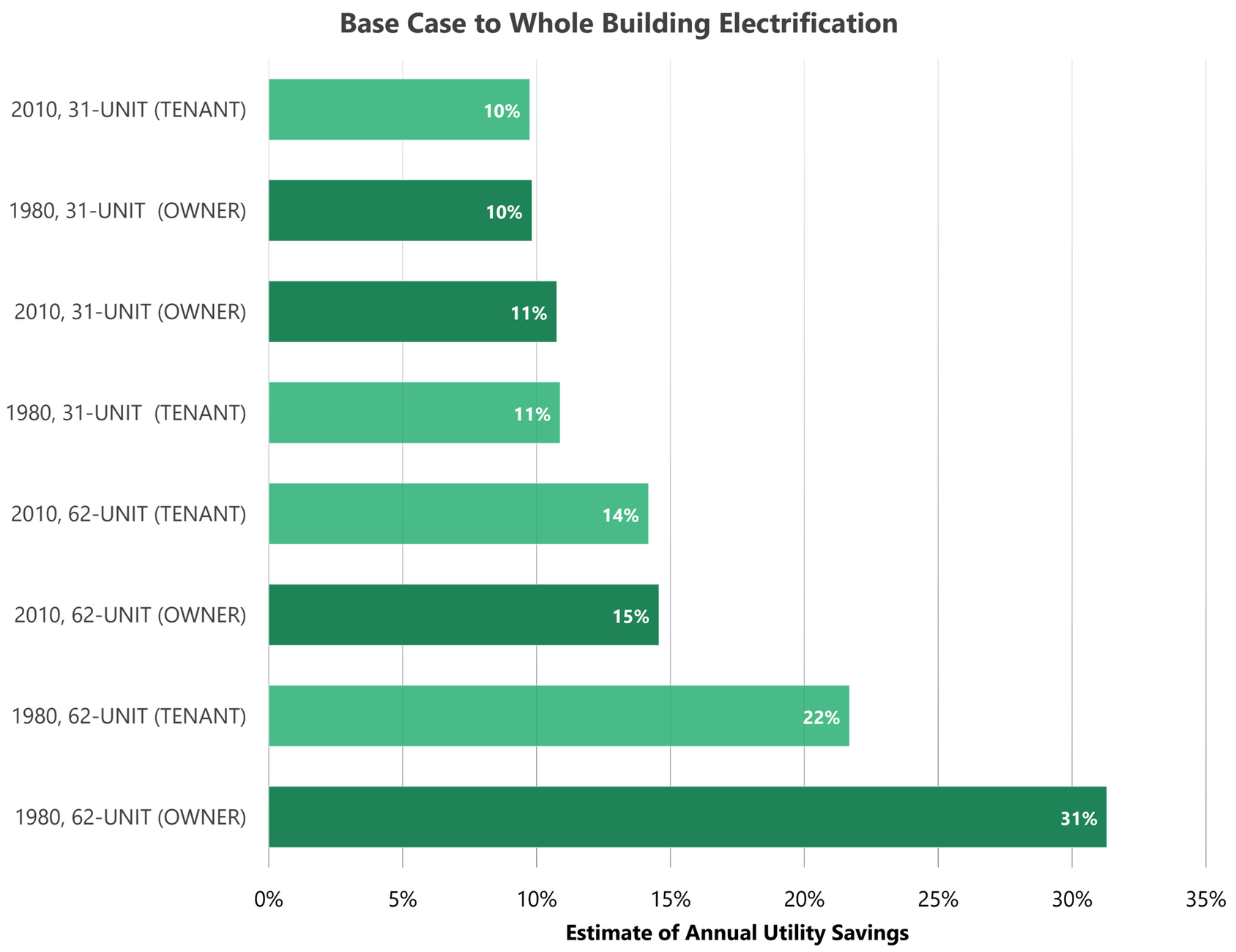
Estimated Savings Summary

1. **All modeled scenarios for each vintage showed an annual utility savings potential (rather than bill increases) when transitioning from the base case to whole building electrification.**
2. The greatest savings are seen for the owner of the 1980 62-unit model. These savings are due to the equipment efficiency gains from updating 1980's era appliances with today's all-electric equivalents.



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First Costs

The first costs for this multifamily model can be broken into three steps that can be done at once or phased.

Costs may vary significantly due to as-built conditions and the labor market at the time of retrofit – this is intended to provide a rough order of magnitude (ROM) estimate. Costs estimates were based on standard union labor in Los Angeles, 2021 Q1, and material is estimated for the local market. No discount was applied for economies of scale but could be roughly estimated at 12% (for bulk purchasing of equipment and avoiding remobilization costs).

1

Preparing the base building

I.e., buying new electrical capacity at the incoming service

2

Upgrading the common areas

I.e., swapping out the natural gas equipment for all-electric and upgrading the supporting electrical infrastructure

- **dryers** (if shared vs in-unit)
- **space heating** of common areas
- **water heating** (if centralized vs in-unit)

3

Upgrading each apartment

I.e., replacing natural gas appliances with all-electric equivalents, changing the voltage to the new devices (if upgrade needed from standard 120V to 240V plugs), may require adding receptacles and running conduit

- **stove/oven**
- **space heating**

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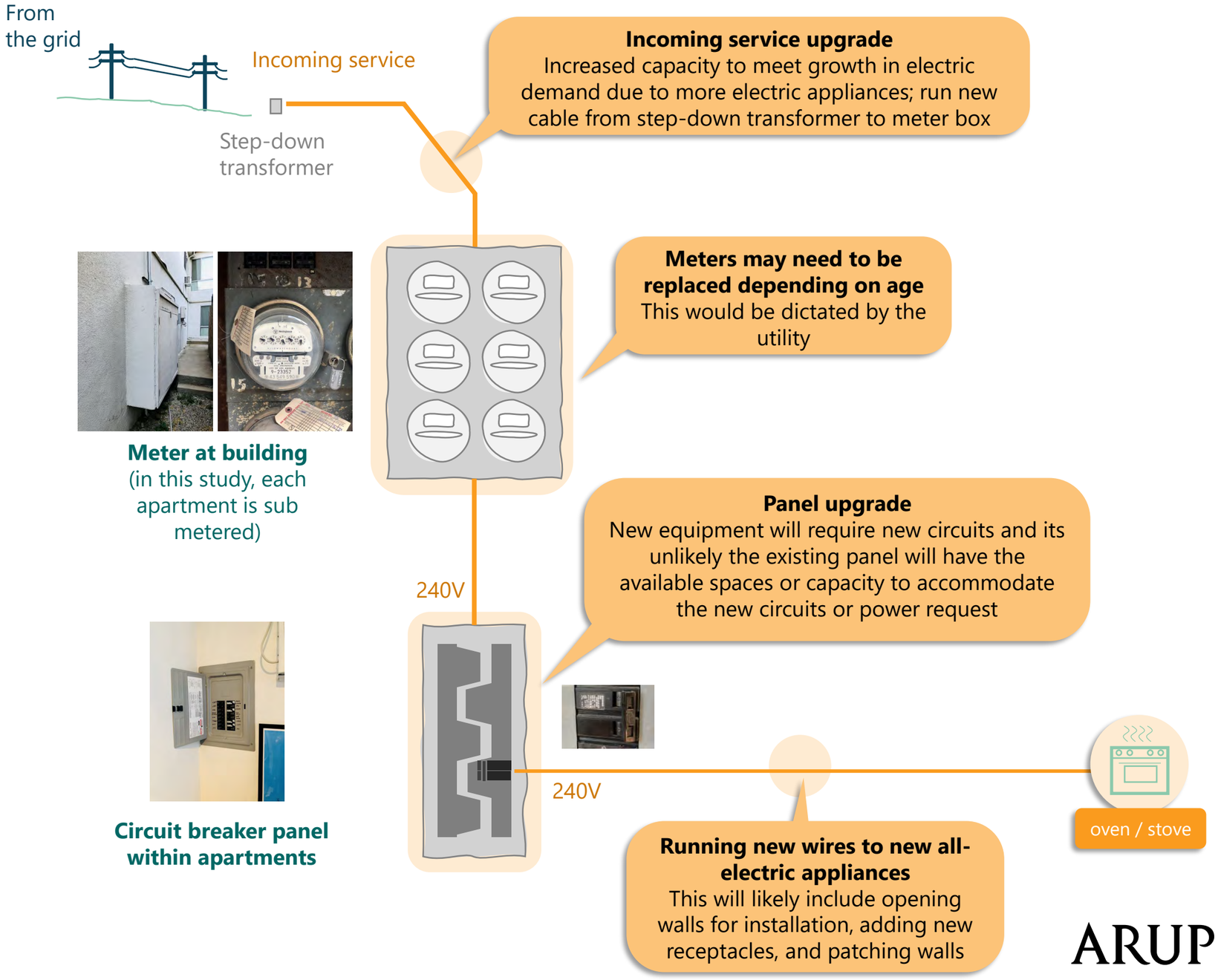
Electrical Infrastructure

The following simplified diagram provides more detail and contextualizes the previous slide by illustrating the electricity flow from powerlines to the new electrical appliances. Updates anticipated for electrification are highlighted in the yellow bubbles.



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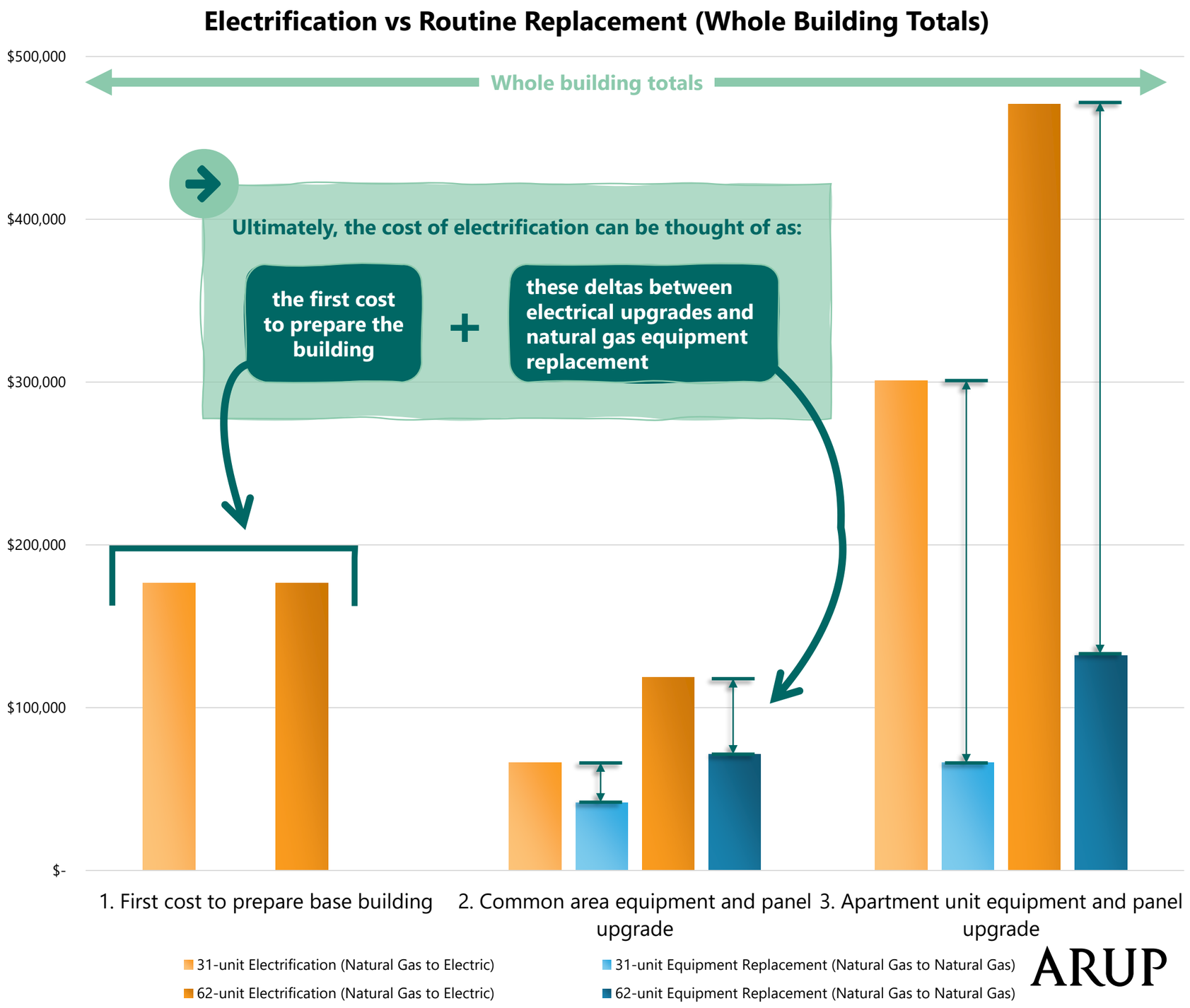
First Costs

The following graph is an estimate of electrification first costs and routine replacement costs associated with this hypothetical model.

The net cost of electrifying can be understood as the difference, or delta, between the costs of:

- upgrading electrical infrastructure and replacing natural gas equipment with all-electric equivalents at end-of-life (in yellow) and
- replacing the natural gas equipment with new natural gas equipment when it reaches end-of-life, likely an anticipated maintenance cost for the building owner.

Note that choosing not to electrify would not mean zero cost, as appliances still need to be replaced at end-of-life. So electrification costs should only include the delta between natural gas and electrical versions of the same appliance type. While the delta is significant now, it is likely to decrease as electrical appliances become more common and readily available in the market.



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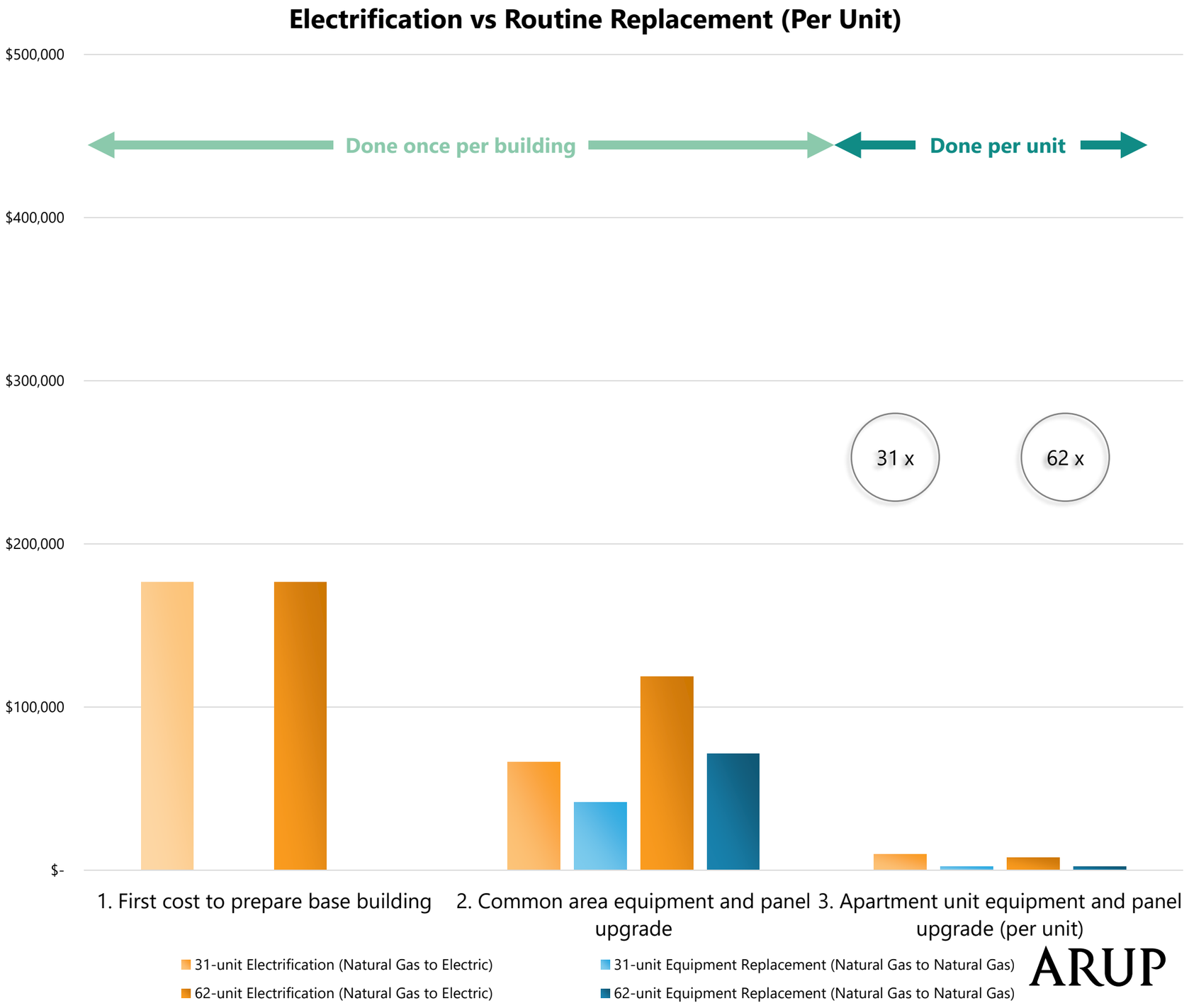
First Costs

The difference between this graph and the preceding one is this version teases out what the per apartment cost would be for this model.

Preparing the base building could position the building owner to carry out apartment retrofits between tenants or as needed when equipment reaches end-of-life. The drawback would be missing opportunities to save through purchasing/installing in bulk.



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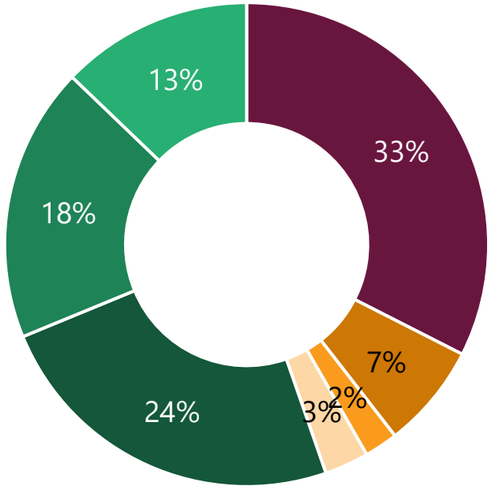
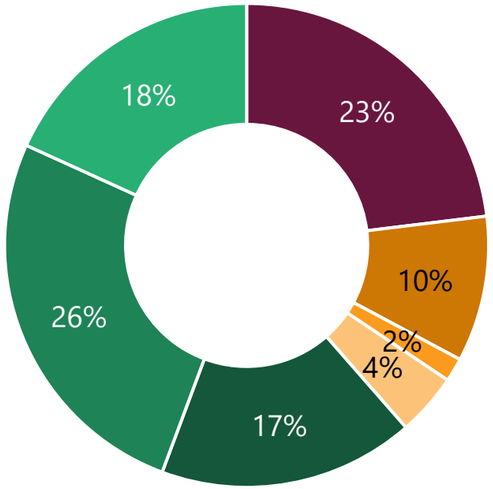
Cost Estimate Breakdown

Illustrative case using the 1980 vintage

Total Cost for 31-unit Electrification



Total Cost for 62-unit Electrification



	Notes
1. First cost to prepare base building	
1A. Upgrade central electrical service	This first cost includes upgrades to existing building electrical infrastructure to accommodate additional plug loads. The estimate is based on a square foot cost. This is estimated to be roughly the same for both the 31-unit and 62-unit buildings.
2. Common area equipment and panel upgrade	
2A. Replace NG hot water heater servicing common areas and apartments SHW with electric (centralized system)	This includes the labor of removing the existing equipment, which is a centralized system (i.e., a large natural gas water heater serving the laundry room and every apartment). A heat pump water heater is then purchased and installed. Miscellaneous wiring is anticipated.
2B. Replace split system in common areas for each floor (4 floors)	The common areas, like the entrance and the hallways on each floor, are assumed to be conditioned by a split system. The existing cooling system (coil and condensing unit) and heating system (furnace and fans) would be removed. A heat pump per floor would be purchased and installed, and miscellaneous electrical work would be needed (upgrade wring, change upstream switchboards, etc.)
2C. Replace dryers (4 in 31-unit, 8 in 62-unit)	This assumes the contractors installing the newly purchased electric dryers would include haul away of the existing equipment for a fee. A laundry room electrical panel upgrade is anticipated and factored in.
3. Apartment unit equipment and panel upgrade	
3A. In-unit electrical infrastructure upgrade	Each apartment is anticipated to need an upgrade to the electrical infrastructure (including a panel upgrade) to accommodate additional plug loads.
3B. Replace split system per apartment with heat pump	Like the common areas, each apartment's existing cooling system (coil and condensing unit) and heating system (furnace and fans) would be removed and replaced by a heat pump in this scenario.
3C. Replace gas stoves/ovens with electric	A new electric stove/oven would be purchased, and it is likely that the contractor installing the new equipment would remove the existing equipment for an added fee.

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Discussion of Results

In this study, we have used a federally-endorsed model and then professional judgment on two average occupancies to represent a reasonable range for the affordable housing development market in aggregate. There are different configurations of buildings, equipment types, and status of replacement that should be considered in extrapolating from our generalized findings. This page highlights some key drivers that would impact the energy consumption (and therefore operational costs) and first costs. This is illustrative and not an exhaustive list of variables. In all cases of investment-grade interventions, a building-specific analysis should be completed.

These variables underscore the need and value of case studies to further parameterize first costs and operational savings in a range of vintages and building configurations.

AC / baseline panel size

Before the 1980s, residential air conditioning in Los Angeles was less common. Apartments constructed without air conditioning with are **more likely to need panel upgrades** when electrifying. If apartments do have air conditioning, 100A panels, and 120/240V service in the base case, it is possible their panels already have sufficient capacity and space for electrification and do not need to be upgraded, thus **reducing first costs.**

Status of equipment replacement

Since we did not know what upgrades would have been applied in widespread use, we benchmarked against the original equipment without upgrades. This does not change the retrofit's final performance but would **reduce the energy savings**.

Upgrades to lighting during electrification

Because this energy analysis was solely focused on, the modeling did not include lighting replacement. Based on other studies[1], lighting upgrades would **increase savings.**

Whether apartments are already all-electric

If a building already has all-electric apartments and only the centralized systems (e.g., the service hot water) are powered by natural gas, the **cost of electrification is reduced.**

Existing conditions

Space available for equipment replacement, new service distribution pathways, the state of ductwork, etc. all **impact first costs** and, for some variables, operational costs.

Occupancy behavior & density

The amount of and behavior of occupants **could increase or decrease energy use** (e.g., fewer/more people in a household or less/more time spent in the apartment).

Building orientation & context

The building's massing, orientation, and surroundings **could increase or decrease energy use** (e.g., garden-style, east/west exposure, self-shading by neighboring buildings, amount of glazing).

These features are always unique to a property, and it is hard to predict a cost range without more case studies.

1. Arup, *Zero-Carbon Collaboration: The Case for Los Angeles* (2021)

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03 Summary

What are the implications of electrification on affordable housing?

We conducted a targeted analysis of two unit types across two building vintages, for a total of four building typologies, to evaluate implications of decarbonization retrofits (specifically electrification measures) for both tenants and building owners.

- We found that energy consumption was reduced across all scenarios through the electrification retrofit, resulting in operational cost savings. The greatest savings were seen for the older (1980 era) higher density (62-unit) building.
- To accommodate all-electric appliances and equipment, base building electrical systems are likely to require upgrades.
- The upfront cost of electrification in this study was found to exceed routine end-of-life equipment replacement.
- If passed onto tenants, these upfront costs will exceed operational savings from efficiency, resulting in a net cost increase for tenants.
- There are benefits to implementing retrofits in a phased approach (readying the base building, upgrading the common areas, and then doing unit-by-unit retrofits).

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04. Policy and Program Recommendations

- Stakeholder Engagement
- Empirical Studies
- Mandates
- Incentives
- Technical Assistance
- Financial Tools
- Redefined ROIs
- On-ramp to Regulated Affordability
- Aggregation & Acceleration
- Alternative Ownership Pathways
- Neighborhood-scale Deployment

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Pathway to Decarbonizing Affordable Housing

The key findings of this report are that:

- **Affordable housing is a uniquely complex, constrained and essential sector, unlike other building sectors.**
- **A traditional approach to a decarbonization ordinance for existing buildings could place real burdens on affordable housing.**
- **At the same time, leaving affordable housing out of such an ordinance would also have unintended consequences.**

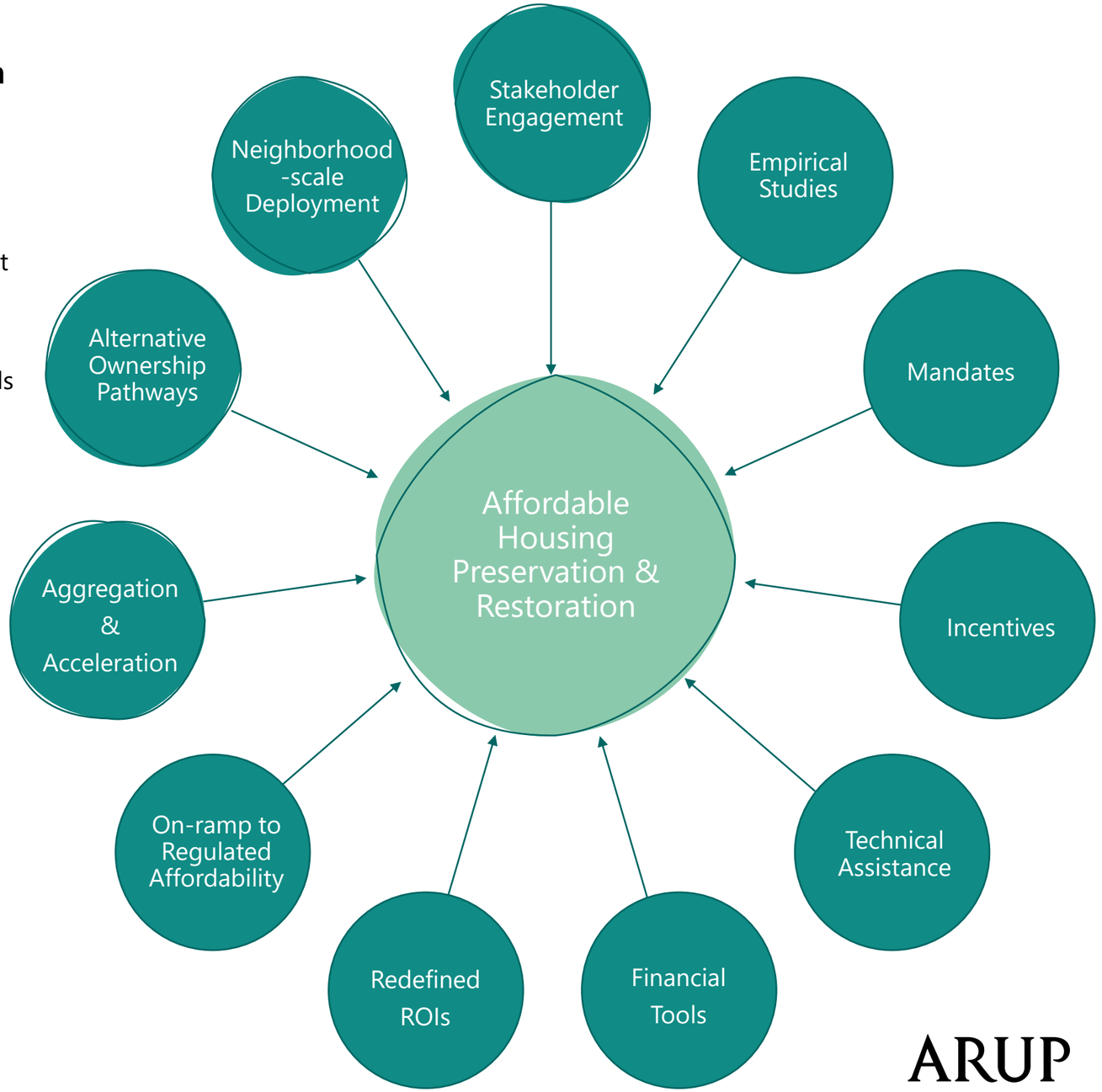
Therefore, a new approach is needed to bring the benefits of decarbonization and electrification to affordable housing without triggering unintended consequences.

A comprehensive program must be designed specifically to address the financial, regulatory, physical, and social realities of the affordable housing sector.

The pathway to equitable building decarbonization must be interwoven with affordable housing preservation.

A comprehensive set of initiatives designed to meet the needs of multifamily affordable housing tenants and owners has the potential to yield high levels of co-benefits and drive bottom-up market transformation while supporting populations most vulnerable to the impacts of climate change.

In this section, we will highlight key tools needed to develop this comprehensive approach.



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Stakeholder Engagement

What's Needed: A deep stakeholder engagement process is required to design intentional and equity-focused programs that meet the needs of impacted stakeholder groups. Advancing programs without this process runs the risks of perpetuating cycles of disenfranchisement and of ultimately being unsuccessful in achieving its intended result of transforming buildings into healthy, efficient, sustainable assets.

To design programs that effectively move the affordable housing market, two parallel tracks of stakeholder engagement are needed:

1. Deep consultation with *subject matter experts:* individuals who can advise on legal, regulatory, financial, and technical issues.
2. Active engagement with the broader affordable housing community around policies that will impact them directly.

Both types of engagement may include the following types of stakeholders:

- Tenants and tenants' rights groups
- Mission-driven and mom-and-pop building owners
- Community-based organizations (CBOs)
- Contractors, tradespeople, and union members
- Environmental justice organizations
- Neighborhood-based community development corps
- Housing and public health agencies
- Utilities and energy service providers
- Banks and investors
- Philanthropies

Best Practices for Stakeholder Engagement

- **Recognize** the history of discriminatory practices that have left communities disenfranchised and under-resourced. Commit to addressing these structural inequities in all phases of collaboration.
- **Identify** trusted community partners and collaborate with them to design a stakeholder engagement process that provides space and support for voices that are traditionally left out of the conversation.
- **Meet** stakeholders where they are—don't just expect them to come to your meetings.
- **Value** participants' time by making engagement meaningful. Provide capacity-building, networking opportunities, compensation, or other types of support that are relevant to participants.
- **Provide** ample opportunity for participants to share their experience and opinions around what works, what doesn't, and why.
- **Ensure** equitable access to the process through language, logistics, locations, etc.
- **Co-create** solutions with and for key stakeholders.
- **Honor** commitments with clear processes for holding each other accountable.
- **Engage** with humility and reciprocity, recognizing and building from local knowledge and expertise.

A useful reference:

Greenlining Institute & Energy Efficiency for All, *Equitable Building Electrification: A Framework for Powering Resilient Communities* (2019)

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Empirical Studies

What's Needed: The cost implications of decarbonization in affordable housing need to be further explored with **real-world case studies** in order to understand differences related to vintage, size, deferred maintenance, ownership and rent structure, utility rate, location, etc. Findings from case studies should be incorporated into program design.

- Work with groups that regularly implement energy programs in affordable housing to collect project data and lessons learned.
- Work with affordable housing asset manager groups such as the LA CDC Neighborhood Exchange to understand current portfolio needs.
- Work through the emerging Los Angeles Retrofit Accelerator to develop, fund, implement and evaluate new case study projects.
- Conduct tenant and operator interviews.
- Create data collection infrastructure so that future projects can be tracked and evaluated in ways that allow for ongoing improvement in related programs.

Potential Case Study Collaborators:

There are organizations already working toward implementing case studies and who are well-positioned to capture data and lessons learned. Examples include:

- LA Better Buildings Challenge (LABBC) is working with LADWP to launch the LA Retrofit Accelerator (LARA) program and is well-positioned to develop, implement and evaluate new case studies on the impacts of decarbonization. The LARA program is designed to aggregate funding and technical support, provide contractor training and spur implementation of new case study projects.
- Association for Energy Affordability is a non-profit group involved with energy project implementation in affordable housing in CA and NY with a significant portfolio of completed work. Work with groups like AEA to collect and analyze project data.
- USGBC-LA Green Affordable Housing Program (GAHP) is piloting tenant education and efficiency/electrification retrofits in a select set of affordable multifamily buildings in LA's Eastern San Fernando Valley, which may yield useful project case studies and insights.

Example Case Studies:

- LIWP Electrification Case Study: Low-income Weatherization Program (LIWP) compared energy and cost impacts of electrification on six different properties multifamily properties.
- Efficiency Vermont Case Study is a portfolio-based program geared toward low-income families. The program resulted in the creation of the nation's first public energy efficiency utility, offered free replacement of old equipment, and addressed the split incentive barrier.

Mandates

What's needed? Experience has proven that voluntary actions are insufficient to support the scale of action needed to meet the City's climate goals. Legislative and regulatory tools are necessary to fully drive citywide market transformation – especially at the scale and speed required to meet GHG reduction targets. **In order to mitigate unintended consequences and bring benefits of decarbonization to affordable housing, this sector must be included, and policies and programs need to be designed specifically to protect and improve the affordable housing sector.**

Protections — link mandates to anti-displacement measures.

Resources and Infrastructure — work aggressively to put technical and financial resources in place to support implementation.

Phasing — balance urgency of decarbonization with the ability to preserve affordable housing.

Targets — design policies around both climate and equity goals and metrics.

Additional considerations to be informed through stakeholder engagement and focus groups:

- **Multiple pieces of supporting infrastructure are needed to facilitate decarbonization:**
  - Stakeholder engagement and community oversight
  - Active participation from experts and advocates from across the sector
  - Technical resources for owners and contractors
  - Financial tools that work for affordable housing
  - Incentives tied to affordability commitments
  - Time of sale incentives for equipment and appliances
  - Structures that allow owners to exit the market by selling to community-supporting entities
- **Phasing mandates is critical to:**
  - Allow the affordable housing sector to stabilize following the disruption of COVID-19
  - Provide a clear signal for the direction of market transformation based on future mandates
  - Allow operators time to phase implementation across units and portfolios
  - Provide additional incentives, bonuses, and support for early adopters
  - Coordinate with LADWP to build grid capacity and resilience
- **Connect to broader affordable housing preservation measures**
  - Include strong anti-displacement measures in any mandates
  - Link to broader energy efficiency improvements that can yield greater savings
  - Focus programs on stabilizing communities and keeping people in their homes

Incentives

What's needed? A broad range of incentives are needed to:

- Eliminate or reduce first costs for owners and prevent first costs from being passed onto tenants
- Help contractors, especially small businesses serving the affordable housing market, become cost-competitive
- Allow for flexibility of implementation to address a full range of issues faced
- Target housing at greatest risk of displacement/loss of affordability

→ These incentives need to be simple and accessible.

Prioritize incentives that minimize upfront expenditures and support contractors:

Direct-install programs, can be linked to other programs like LIWP

Mid-stream incentives for equipment and/or labor, so the process is easier for end-user

Grants and low interest loans prioritized based on provision of and commitment to long-term affordability

Targeting Affordable Housing:

Operators of affordable housing experience multiple challenges related to accessing LADWP incentives, including a high level of complexity; lack of programs targeted for multifamily; and untimely, inflexible, and insufficient funds.[1] A successful transition to decarbonization will require targeted programs for the sector delivered through accessible, flexible, timely, and streamlined processes.

Incentives may include direct grants, access to financing, technical support, and other measures that remove barriers and drive implementation. Incentives should be tied to affordability commitments. Incentive programs should be designed to drive bottom-up market transformation, helping to transition properties that might not otherwise move and that support the highest levels of affordability. These programs must be designed in consultation with sector stakeholders to ensure market penetration.

A one-stop-shop service model that can offer access to multiple types of incentives, including funding and financing, technical assistance, equipment discounts, direct installation, etc. is needed to make programs accessible and manageable for low-income properties.

Example Program:

The California Low-Income Weatherization Program for Multifamily Properties[2] can serve as a model. The program is funded by cap-and-trade dollars and targets projects that reduce GHGs, improve health and reduce energy costs for low-income tenants. The program supports energy efficiency and solar generation and has been used to support electrification. The program offers financial incentives, free property assessments, work scope development, contractor procurement, construction management assistance, and quality control.

1. Energy Efficiency for All, *Affordable Homes First: Advancing a Green New Deal for Los Angeles Renters* (2019)
2. Association for Energy Affordability LIWP website: https://aea.us.org/programs/california-efficiency-program/

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Technical Assistance

What's needed? The benefits of electrification are still not widely understood. Education, training, and technical assistance are needed to enable owners to effectively plan and contractors to be cost-competitive.

Technical assistance to owners:

Owners and asset managers require information, tools, and resources in order to justify upfront costs, plan strategically for phased implementation, hire qualified professionals, purchase appropriate systems, and access funding sources. Work with groups like the Neighborhood Exchange and the Southern California Association of Nonprofit Housing to effectively design programs.

Technical assistance to contractors:

Contractors should be viewed as key partners in the energy transition. The amount of work required to retrofit LA's affordable housing is significant, with high potential for job creation and business growth. Small, local, disadvantaged businesses that serve the affordable housing sector should be prioritized for technical training and access to mid-stream incentives.

Example Program

Silicon Valley Clean Energy (SVCE) Technical Assistance Program[1]

Silicon Valley Clean Energy (SVCE), a non-profit Community Choice Aggregator that serves 270,000 residential and business customers in the Silicon Valley, offers a free Building Electrification Technical Assistance program. SVCE has published case studies describing the support provided and the result. This program includes the following:

- **Basic or in-depth project assistance**: Queries answer either by email, phone, or addressed via extended support from an assigned team.
- **Designer and developer roundtables**: SCVE conducted online and in-person discussions of building electrification strategies, technology, and successful implementation practices.
- **Technical training for contractors**: SCVE provided in-person trainings as well as webinars covering technology, installation, maintenance, and sales. This type of educational events also serve as opportunities to connect owners with equipment suppliers, professional organizations, and trades.

There is additional support available to affordable housing projects:

- Design charrette facilitation
- Owner Project Requirements (OPR) or Request for Proposal (RFP) language adjustments
- Cost-benefit analysis
- Measurement and verification plan scoping

1. Silicon Valley Clean Energy (SVCE) Building Electrification Technical Assistance website: https://www.svcleanenergy.org/building-tech-assist/

Financial Tools

What's needed? Affordable housing owners are not well served by many of the existing financial tools that could support decarbonization retrofits. New tools are needed that are designed to penetrate this market.

Non-profit, mission-driven owners of multifamily homes often have limited access to capital and limited choices in terms of loan programs. Affordable housing retrofits are often difficult to implement because properties have multilayered financial structures and limited cash flow. In addition, approval may be needed from multiple lenders before grants or funds can be accepted.

These complicated financial structures mean that existing investors must be repaid first before any new loans can be taken out and may not allow for additional loans. In some cases, the process may even prohibit or encumber acceptance of grant funding.

While most electrification retrofits are likely to yield at least some operational savings, the rate of return will often be too long for traditional investment vehicles. Related retrofits to support code compliance or other health or resilience-related remediation measures that emerge in conjunction with the energy project (e.g., mold, lead, or asbestos remediation or seismic retrofits) may have no ROI at all.

To support the financing of affordable housing retrofits for decarbonization and resilience, programs will need to supplement private capital with public and philanthropic dollars.

New financial tools that recognize affordable housing as critical social infrastructure with significant public benefit will be needed to support the business case for affordable housing preservation. Financial tools should:

- Be designed to address constraints of mission-driven, non-profit, and mom-and-pop building owners
- Provide flexibility in the range of measures they can support
- Minimize or prevent first costs from being passed onto tenants and include anti-displacement measures
- Pool public, private and philanthropic funds
- Have competitive rates and terms
- Be leveraged to increase affordability commitments at a level appropriate for the amount of support received

Example Program

Enterprise Equitable Path Forward[1]: The Enterprise Community Partners' Equitable Path Forward is an example of a targeted initiative to drive investment into affordable housing by working with Black, Indigenous, and People of Color ("BIPOC") and other historically marginalized housing providers. The program seeks to "dismantle the deeply-rooted legacy of racism in housing" by offering entity-level lending and grants as well as project-level equity and debt. This investment is supported by developer advisory services and leadership development for BIPOC people in real estate.

In Los Angeles, Enterprise has made a $6 million financing commitment to the Coalition for Responsible Community Development to support housing in East and South LA. This includes a $1.5 million line of credit for general organizational expenses as well as a $4.5 million loan to finance the development of new housing.

1. Enterprise Community Partners Equitable Path Forward website: https://www.enterprisecommunity.org/impact-areas/racial-equity/equitable-path-forward

Redefining Return on Investment

What's needed? New ways of measuring the full benefits of affordable housing are needed in order to make the business case for investment.

Traditional methods of evaluating investment value fail to capture the full benefit of measures like building decarbonization and preservation of existing affordable housing might have to society. Meanwhile, investments that increase property value for owners, incentivizing them to reposition their properties and displace tenants, are easier to justify financially.

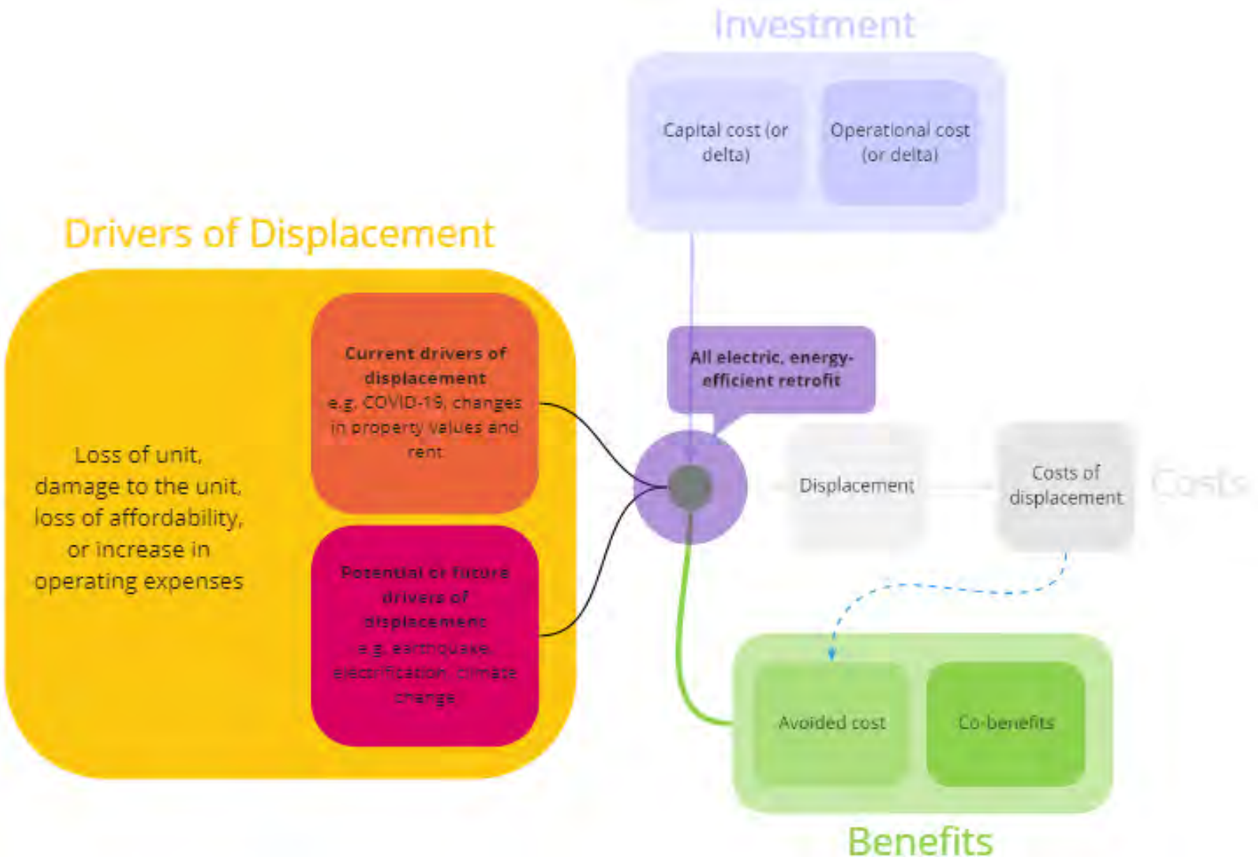
Health, environmental, resilience, and other social benefits are real and measurable and should be factored into public investment decisions. These benefits are not abstract; housing that is either not affordable or not fit for purpose creates a significant public burden that will only increase as the climate changes.

New formulas are needed to monetize indirect benefits related to affordable housing preservation, health, and resilience. Recognizing the societal benefit of affordable housing from a health, climate, and resilience perspective will enable greater justification for investment and support better prioritization and design decisions—both at the programmatic and project level.

Developing New Business Models

Affordable housing provides significant public benefit, particularly compared to the cost of displacement or the costs of building new homes. Systemic accounting can illustrate the value of affordable housing preservation and retrofit and justify public spending.

Multiple models and tools exist for calculating social ROI. C40 has developed a framework for evaluating the co-benefit of climate action. Below is a model that Arup developed to evaluate investment in affordable housing by comparing retrofits to the costs of displacement.



1. Enterprise Community Partners Equitable Path Forward website: https://www.enterprisecommunity.org/impact-areas/racial-equity/equitable-path-forward

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Provide On-Ramp for Affordability Commitments

What's needed? Incentives targeted at affordable housing should be tied to commitments for long-term affordability.

Incentives can be designed specifically to maintain and expand regulated affordability in the following ways:

- Design eligibility requirements around existing rent affordability for regulated properties
- Tie incentives to the expansion of commitments for affordability (e.g., via extending covenant terms or adding additional units to affordability requirements)
- Creating new covenants to convert naturally occurring affordable housing into regulated housing.

Eligible measures should include a wide range of energy, resilience, seismic, health, safety, and building integrity issues and should allow a portfolio-wide approach. In order to leverage incentives as an on-ramp or expansion of regulated affordable housing, the housing authority must be a key player to ensure that affordability commitments are properly covenanted.

The regulatory structure for such commitments must be interdisciplinary. While energy-related incentives are generally distributed through the utility, affordability commitments are overseen and enforced by the housing department. Administration, oversight, and enforcement mechanisms must be structured to facilitate ongoing implementation.

Leveraging Incentives to Maintain Affordability

Tax abatement incentives for retrofits that are linked to affordability measures are possible, but their complexity and the cost of administering them can be prohibitive. Tax abatement programs could do much to support affordability preservation, particularly for NOAH, if they were streamlined and simplified.[1]

Linking incentives to affordability commitments must be done in consultation with targeted owners (such as mission-driven, non-profit, and mom-and-pop building owners), as well as tenants' rights groups, lenders and funders, and other key stakeholders, and appropriate city agencies.

Key considerations:

- Define levels of affordability requirements and tie them to appropriate levels of incentives. Commitments that are too restrictive will limit participation, while commitments that are too loose will undermine the purpose of the program
- Defining eligibility requirements for owners, to avoid the potential problem of free-loading by corporate owners or other building owners with extractive management practices
- Defining financial terms that are better than market-rate loans. Other programs that have been developed to drive investment into decarbonization (such as PACE) have not been able to provide competitive terms and therefore have had limited uptake
- Streamlining and simplifying program processes to make them more accessible and affordable to implement for a broader range of participants.

Example Program

New York's Green Housing Preservation Program provides low and no-interest loans to conduct energy and water retrofits and lead and other rehabilitation. The program can provide up to $80,000 for retrofits per unit and can assist in securing additional funds and in contract management. In exchange, participants enter into an affordability agreement with the Housing Preservation Program.[2]

1. McKinsey, "Preserving the largest and most at-risk supply of affordable housing" (2021)
2. https://www1.nyc.gov/site/hpd/services-and-information/green-housing-preservation-program-ghpp.page

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Aggregate and Accelerate

What's Needed: To inject investment that supports affordable housing preservation and decarbonization, a one-stop-shop targeted toward mission-driven affordable housing providers is needed.

Operators of affordable housing experience multiple challenges related to accessing LADWP incentives, including a high level of complexity; lack of programs targeted for multifamily; and untimely, inflexible, and insufficient funds.[1] A successful transition to decarbonization and electrification will require targeted programs for the sector delivered through accessible, flexible, timely, and streamlined processes.

Fund Aggregation Programs:

Affordable housing finance requires the compilation of complex capital stacks. Streamlined funding sources are needed that allow pooling of resources from public, private and philanthropic sources to address a wide range of decarbonization and resilience measures and protect housing quality and affordability. Such funding can be deployed in conjunction with project accelerator programs.

Accelerator Programs:

Accelerator programs that serve as one-stop-shops can offer access to aggregated funding, technical assistance, guidance on requirements around tenants' rights protections, and referrals for contractors and equipment that can facilitate and expedite implementation.

Links to Incentives and Requirements:

In order to realize the potential of incentive programs tied to affordability commitments, accelerator programs should link directly with the appropriate regulatory bodies that can support administer and enforce covenants directly must work in tandem with accelerators to simplify and streamline the process.

Large-scale aggregator/retrofit accelerator programs, such as the programs in New York and Washington DC, have proven effective in targeting projects that might not otherwise transition. They can be particularly helpful to smaller owners who do not have the resources to calculate strategies at a portfolio scale.

Example Program

New York Retrofit Accelerator[2], established in 2006, provides a one-stop-shop for energy and water retrofits. The program coordinates across city departments to prioritize retrofit projects and provide direct technical guidance to affordable housing decision-makers on energy projects and compliance.

Energy Savers Retrofits in Chicago[3] is a collaboration between the nonprofit Elevate Energy and Community Investment Corporation (CIC), a community development financial institution. The program provides a one-stop-shop for technical support, financial information, and underwriting for retrofit projects. The program combines public, private, and philanthropic dollars with the goal of preserving affordable housing.

Example Business

Bloc Power[4] is a Brooklyn-based energy technology company focused on bringing high-efficiency electrical upgrades to multi-family buildings in low-income communities in New York and other cities. To date, they have delivered more than 1000 retrofits and are expanding to deliver Wi-Fi. By bundling incentive and subsidy programs, project finance, and operational savings, they can deliver retrofits with no up-front costs, low and predictable operating costs, and without requiring new liens on the building.

1. Energy Efficiency for All, "Affordable Homes First: Advancing a Green New Deal for Los Angeles Renters" (2019)
2. NYC Accelerator: https://www1.nyc.gov/site/nycaccelerator/index.page
3. Retrofit Chicago Multi-Family Residential Partnership: https://www.chicago.gov/city/en/progs/env/retrofit_chicagoresidentialpartnership.html
4. Bloc Power: https://www.blocpower.io/

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Support Alternative Ownership Structures

What's needed? Alternative ownership structures are emerging as models that can protect affordability and build wealth for residents. Accelerators can provide resources to help transition properties from overburdened building owners to alternative ownership structures.

The establishment of energy retrofit mandates may push smaller owners to exit the affordable housing market. This is particularly true for naturally occurring affordable housing, where ownership changes are more likely to result in tenant displacement. Land trusts, co-ops, public ownership, and other emerging models can provide alternatives that prevent owners from selling to corporations or repositioning to market-rate housing.

Tenant-based ownership structures can help tenants build wealth and break the cycle of poverty. Land trusts and non-profit or public ownership models can keep housing affordable and manage that housing for the public interest on energy and resilience. These pathways can help stabilize and support existing communities without extractive capital forces.

New structures are needed to make these options more accessible and viable. The opportunity to transition properties can be linked to decarbonization efforts and supporting resources can be provided through accelerator programs.

Alternative Ownership Structures:

- Land trusts, co-ops, public ownership, and other emerging models can provide alternatives that prevent owners from selling to corporations or repositioning to market-rate housing. They own and operate properties with a commitment to protect affordability in perpetuity. These pathways can help stabilize and support existing communities without extractive capital forces.
- Land trusts and non-profit or public ownership can keep housing affordable and manage that housing for the public interest in terms of energy and resilience.
- Land trusts can help tenants build wealth and break the cycle of poverty.

Example Program

T.R.U.S.T South LA is a community-led effort to stabilize neighborhoods south of Downtown LA and to "build community control over land, to preserve and promote opportunities for working-class people to remain in their community." Permanent assets within its control are preserved and governed by members, who are restricted to low-income people who live or work in the land trust area.

Deploy Solutions at Scale by Neighborhood

What's Needed: Decarbonization measures can be deployed at scale by targeting neighborhoods holistically and engaging with trusted community partners.

While accelerator programs give stakeholders a place to go to initiate decarbonization and preservation projects, more will be needed to have the level of impact needed to address the real challenges of climate change and housing.

By prioritizing communities that are at the greatest risk of displacement and bringing resources directly out to stakeholders, the transition process can be supercharged.

The key to success will lie in establishing equitable partnerships with community-based organizations that can design locally tailored engagement processes and serve as trusted ambassadors and providers.

The full package of technical, financial, administrative tools and clear information about affordability protections and pathways to alternative ownership models can be delivered directly to community members through pop-up accelerators. At the same time, small local and disadvantaged contractors can be supported and matched with local projects. This could generate efficiencies in technology deployment, infrastructure readying, and community empowerment.

Targeted Resilience Zones: In order to shift responsibility for projects at the individual property level, entire neighborhoods could be targeted at once. This would provide potential economies of scale for contractors and equipment purchases, enable more rapid and efficient deployment of public investment and subsidies, and create investable portfolios of projects that spread the risk beyond individual owners.

Neighborhoods could be prioritized based on a combination of factors including:

- Disadvantaged community status or communities with high concentrations of affordable housing that have experienced chronic disinvestment and are at risk of displacement
- Communities with a high risk of displacement from public investments (i.e., linear public investments, such as transit or river projects)
- Locations with sufficient grid capacity to support broad electrification, or align with grid side retrofits by the utility
- Locations at high risk for climate impacts that could be addressed through infrastructure improvements

04 Summary

Policy and Program Recommendations

- The affordable housing sector faces a unique and complex set of barriers to implementing decarbonization. To be effective, decarbonization must be deeply entwined with the biggest challenge of the sector: affordable housing preservation.
- Programs should be designed with the combined goals of decarbonization, affordability protection, and retrofits to keep housing safe, healthy, and fit-for-purpose in a changing climate.
- Stakeholders (both those with deep technical knowledge and those with lived experience) must be at the table to ensure program design repairs—rather than perpetuates—cycles of racism and disenfranchisement.
- Mandates are needed to force implementation but should be leveraged to protect housing affordability and prevent burdening tenants.
- A wide range of technical, financial, regulatory, and administrative tools must be customized to address the specific challenges and vulnerabilities of the sector.
- Funding and financing for retrofit programs currently comes from a wide range of sources targeting narrow interventions that don't meet the needs of affordable housing. Aggregating both financing and service delivery is needed to make implementation accessible.
- Streamlined, targeted deployment should occur at the neighborhood scale in collaboration with community-based organizations (CBOs) to specifically address community needs.

05 Conclusion

Takeaways

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Takeaways from this study

- Affordable housing is an essential component of resilient communities and must be protected and expanded to address the multiple crises this sector is facing in LA. Preservation of existing affordable housing should be a dimension of policies and programs.

- Efficiencies associated with electrification upgrades in affordable housing are likely to result in small energy cost savings, particularly in older buildings. However, these savings will likely not be sufficient to offset first costs and there is a risk they will be passed on to tenants.

- Both climate change and the housing crisis pose existential threats to LA, and both must be addressed with utmost urgency. Affordable housing should be included in future decarbonization mandates but will need targeted and comprehensive programs and support to prevent displacement and other unintended consequences. If not addressed in tandem, the goals of affordable housing preservation and decarbonization will be in conflict. Addressing these challenges together poses greater opportunity than addressing either one alone.

- Lack of funding, limited access to capital, the complexity of financing structures, backlogs of deferred maintenance, and other challenges make affordable housing least likely to transition by market forces alone. Sector stakeholders must be included in the policy design process to avoid perpetuating the cycle of disenfranchisement.

- Financial subsidies to promote decarbonization should be targeted at affordable housing that is owned and operated by non-profits, mission driven organizations or small mom and pop owners that have the hardest time accessing capital. These are the projects least likely to transition on their own and create the greatest opportunity to provide social benefit and broad market transformation.

- Decarbonization can be leveraged to drive investment into existing affordable housing to improve performance and keep units fit for purpose in a changing climate. Policy approaches are needed to support social equity, such as:
  - → displacement and rent increase protections,
  - → tools to expand the pool of regulated affordable housing and support alternative ownership, and
  - → wealth-building opportunities for tenants.

- The LA Retrofit Accelerator provides a strong vehicle to aggregate funds and accelerate deployment. Work is needed to more comprehensively integrate the range of challenges and opportunities associated with affordable housing.

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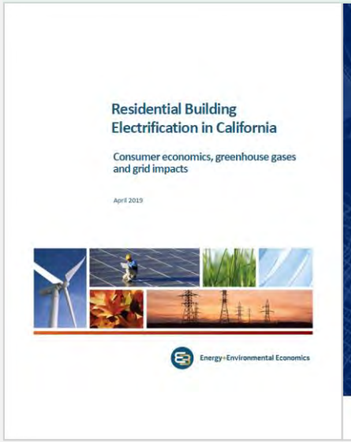
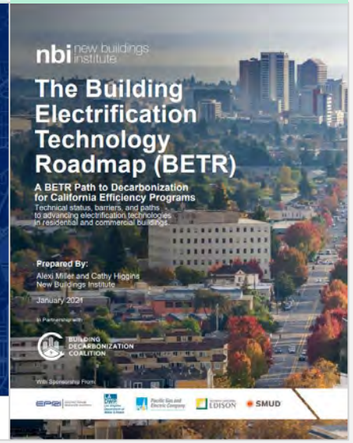
Resource Spotlight

Other recent, informative electrification studies that speak to different dimensions of the market:

E3 Report Apr 2019	EEFA May 2019	NBI Jan 2021
		

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Appendix

Energy
Modeling
Details

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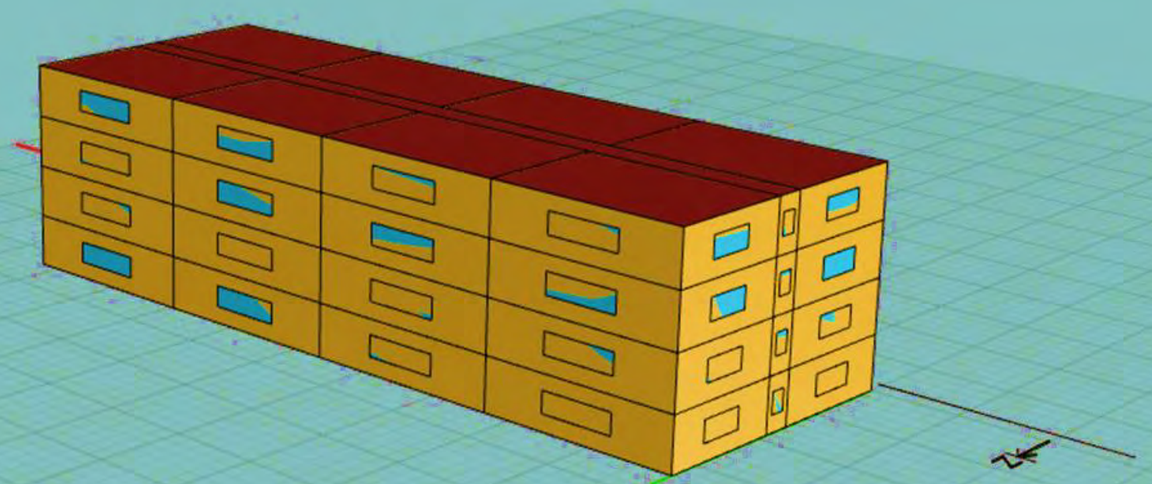
What’s driving change?

The following two slides get into detail on how end uses are changing between scenarios – and thus what is driving reductions in costs.

The first page spotlights the 1980 31-unit and the primary end uses that change.

The second page shows the bigger picture (e.g., including lighting, elevators, and other end-uses that were not altered by electrification) across all models.



1980 31-unit

End Use Spotlight – Detailed Breakdown

Annual Energy Use in kBtu

Space Heating: In LA's climate, there's a much higher cooling than heating demand. The shift from the in-situ natural gas furnace to the heat pump saves energy (by about 20%), but it is relatively a very minor end-use for the building.

Space Cooling: In the no AC base case, an uptick in fan energy was factored in (not seen in this graph). Removing combustion sources reduces the cooling load within the apartments, which is why a slight reduction in cooling energy can be seen between the two electrification scenarios – natural gas stoves add more heat to the ambient indoor air than all-electric equivalents. Additionally, the heat pumps in the electrified scenarios are more efficient than the base case split system.

Service Hot Water Heating: Overall energy use benefits from replacing the in-situ gas hot water heater serving each apartment and the laundry room with a more efficient, all-electric hot water heater. For this 31-unit configuration, this saves about 40% in energy use (shown here). For the 62-unit configuration, there is a more dramatic 70% energy savings between gas and electric.

Laundry: The laundry energy demand includes the washer and dryers. Updating to all-electric improves the equipment efficiency significantly, cutting the overall energy use nearly in half.

Cooking: The all-electric stove / oven is much more efficient than the 1980's era gas appliance – consuming almost 90% less energy annually.

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Energy (kBtu) per End Use

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Envelope

The 2010 vintage has a significantly higher-performing envelope than the 1978 vintage – based on T24 code cycles.

Some key differences between the 1980 and 2010 models are with the efficiency of the envelope (airtightness, thermal performance, and solar performance). With cycles of the T24 code, requirements for the building construction have become more stringent / higher-performing, which impacts the baseline energy use.

This slide shows the modeled assumptions compared per vintage.

	1980	2010	*Based On*
Air Infiltration Rate	0.169 cfm / sf-façade	0.045 cfm / sf-façade	*T24 applicable code cycles*

What is it? The air infiltration rate is the rate air flows in and out of a building through the building envelope (i.e., through glazing or opaque wall assemblies). In other words, it's a measure of how airtight a building is.

What is the impact? Unmitigated airflow through small gaps between building materials also means unmitigated heat flow. So, for example, if an apartment unit's space heater is on in the winter but the air infiltration rate is high (leakier), some of that conditioned air will escape outside and thus more heating will be needed to keep the space comfortable. The same concept is true for air conditioning a space during the summer.

	1980	2010	*Based On*
Exterior Wall U-value	0.122 Btu/hr*sqft*°F *wood framed wall with R9 cavity insulation*	0.059 Btu/hr*sqft*°F *wood framed wall with R19 cavity insulation*	*T24 applicable code cycles*
Roof U-value	0.062 Btu/hr*sqft*°F *wood framed roof with R15 cavity insulation*	0.028 Btu/hr*sqft*°F *wood framed roof with R28 cavity insulation*	
Glazing U-value & SHGC	1.03 Btu/hr*sqft*°F 0.80 SHGC *single pane window*	0.47 Btu/hr*sqft*°F 0.40 SHGC *double pane window*	

What is it? U-value is a measure of the thermal performance of a material or assembly. The lower the value, the higher performing (i.e., more insulating) the component is. The solar heat gain coefficient (SHGC) refers to how much solar energy is transferred through the glazing – the lower the value, the higher performing the window is.

What is the impact? Thermal and solar performance is key to passively keeping interior spaces comfortable when outside conditions are not, thus reducing the amount of heating or air conditioning needed. In the warm, dry climate of Los Angeles, the most relevant is reducing the cooling demand with more insulation in the walls or double-paned (rather than single) window.