

# Why Building Electrification?

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## Why Building Electrification?

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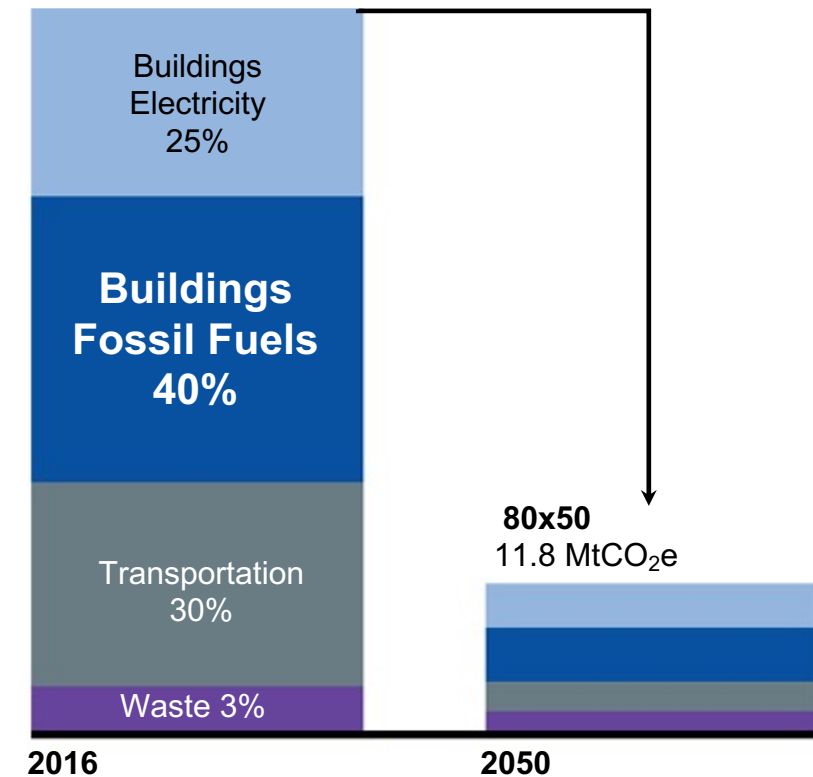


# Building Electrification | Climate Change

- On-site fossil fuel use in buildings accounts for 10% of U.S. greenhouse gas (GHG) emissions.
  - This equates to over 500 million tons of GHG emissions annually.
- Within cities, this proportion can be much greater.
  - On-site fossil fuels account for between 15%-40% of GHG emissions in a typical U.S. city.

## NYC Fossil Fuel Use in Buildings

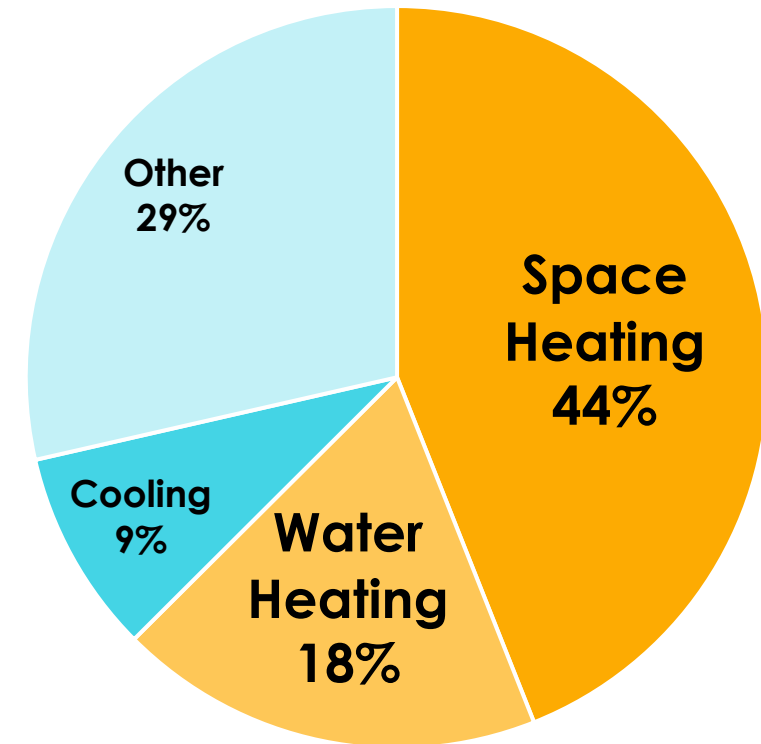
NYC GHG Emissions  
51.7 MtCO<sub>2</sub>e



# Building Electrification | Climate Change

- **Space and water heating account for the majority of on-site residential building energy use and GHG emissions.**
- **High-efficiency electric heat pumps provide clean space and water heating** by sourcing increasingly renewable electricity.
- **Heat pumps are a viable option for colder climates**, due to recent technology improvements.

Household Energy Usage  
(U.S. Average)

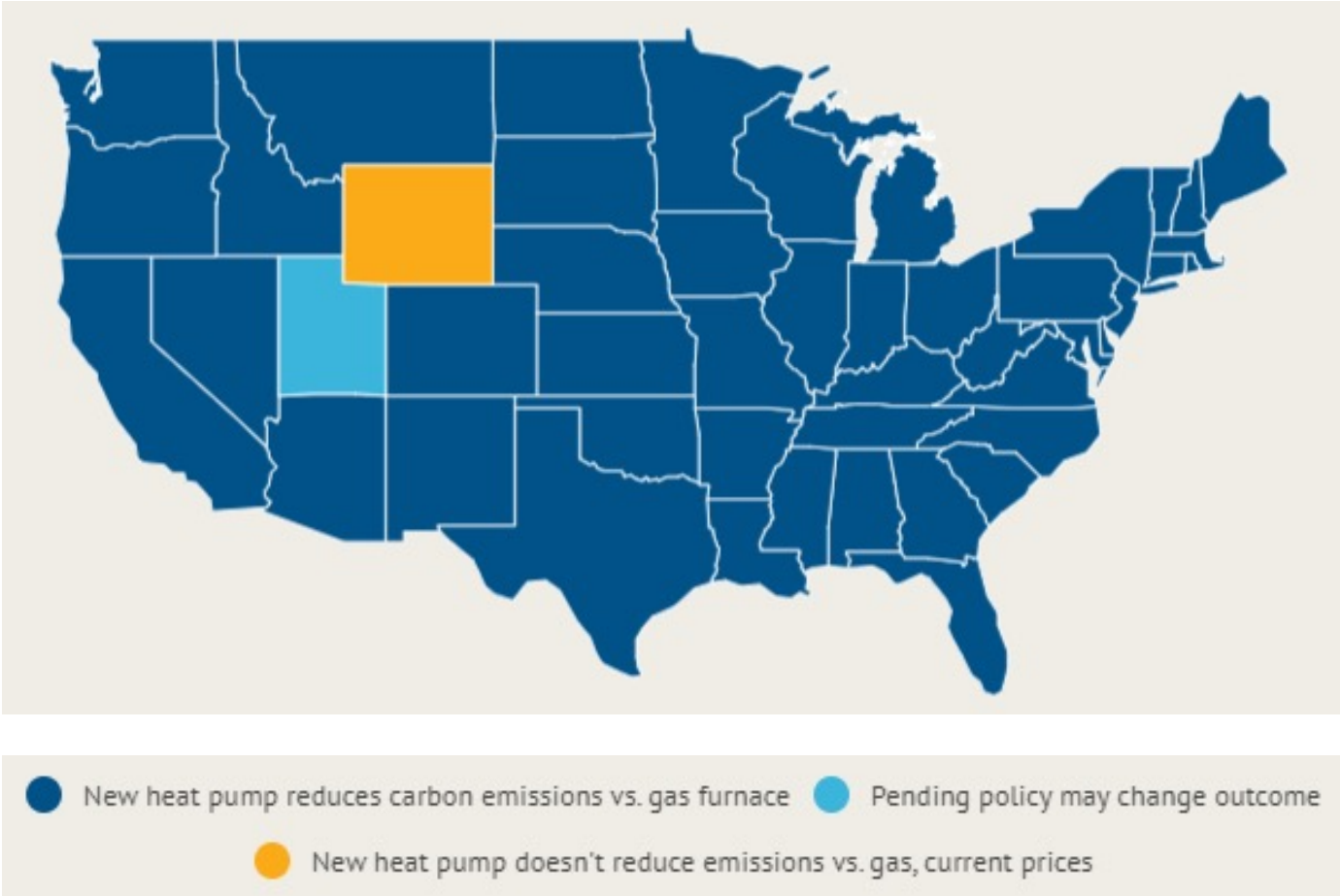




# Building Electrification | Climate Change

- **Building electrification can reduce GHG emissions in almost every state in the U.S. today** by using high efficiency electric heat pumps.
- GHG emissions will continue to decrease as the grid sources increasingly clean and renewable electricity.

States Where Heat Pumps Reduce Emissions Today

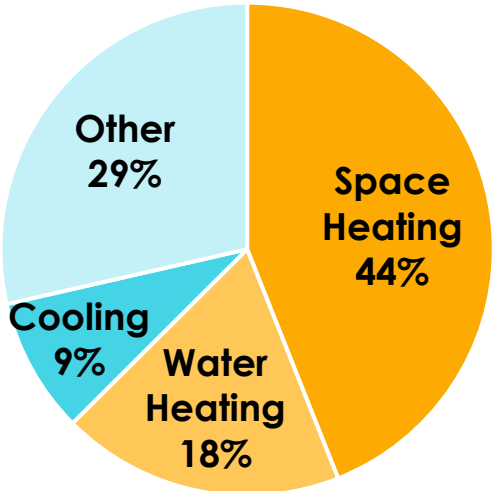


Source: (6) RMI, *Emissions Impact by State, Heat pumps vs. Gas Furnace*.

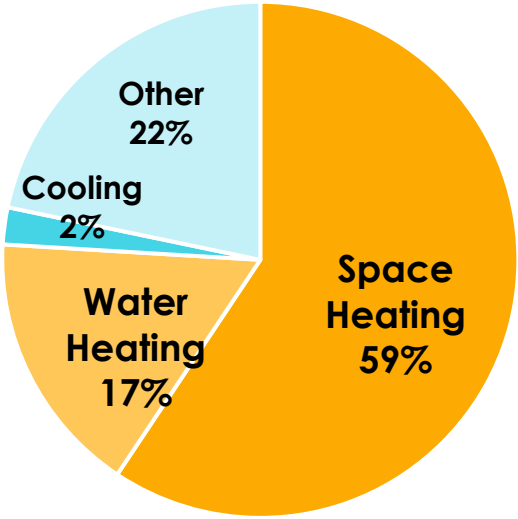
# Building Electrification | Clean Heating

- Space and water heating varies across region, but still accounts for the majority of energy use and GHG emissions in every region in the U.S.

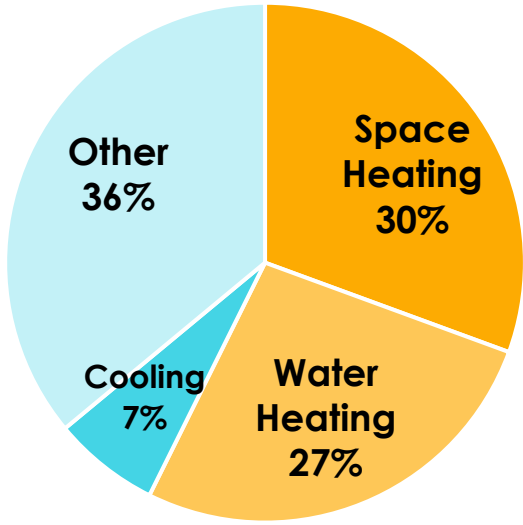
Household Energy Usage  
(U.S. Average)



Household Energy Use in  
New England



Household Energy Usage on  
the Pacific West Coast



Household Energy Use in  
the Mountain North

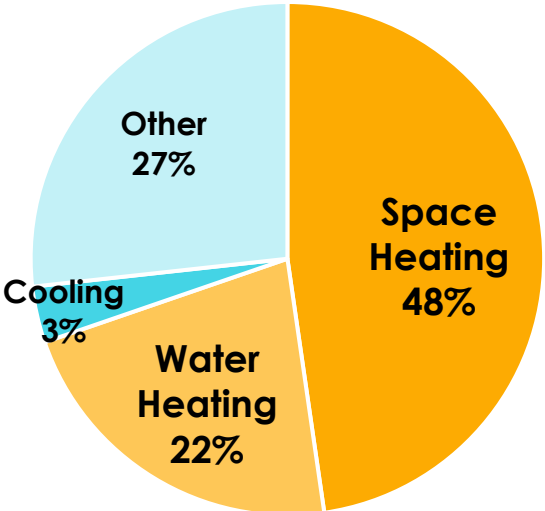


Chart Source: (5) EIA Residential Energy Consumption Survey, 2015.

# Building Electrification | Cooling

- **Climate change is causing heat waves and hotter seasons.**
  - In cities, this is exacerbated by the urban heat island effect.
  - Low-income communities and communities of color disproportionately lack central cooling.
- **Air source heat pumps provide high efficiency cooling.**

History of global surface temperature since 1880

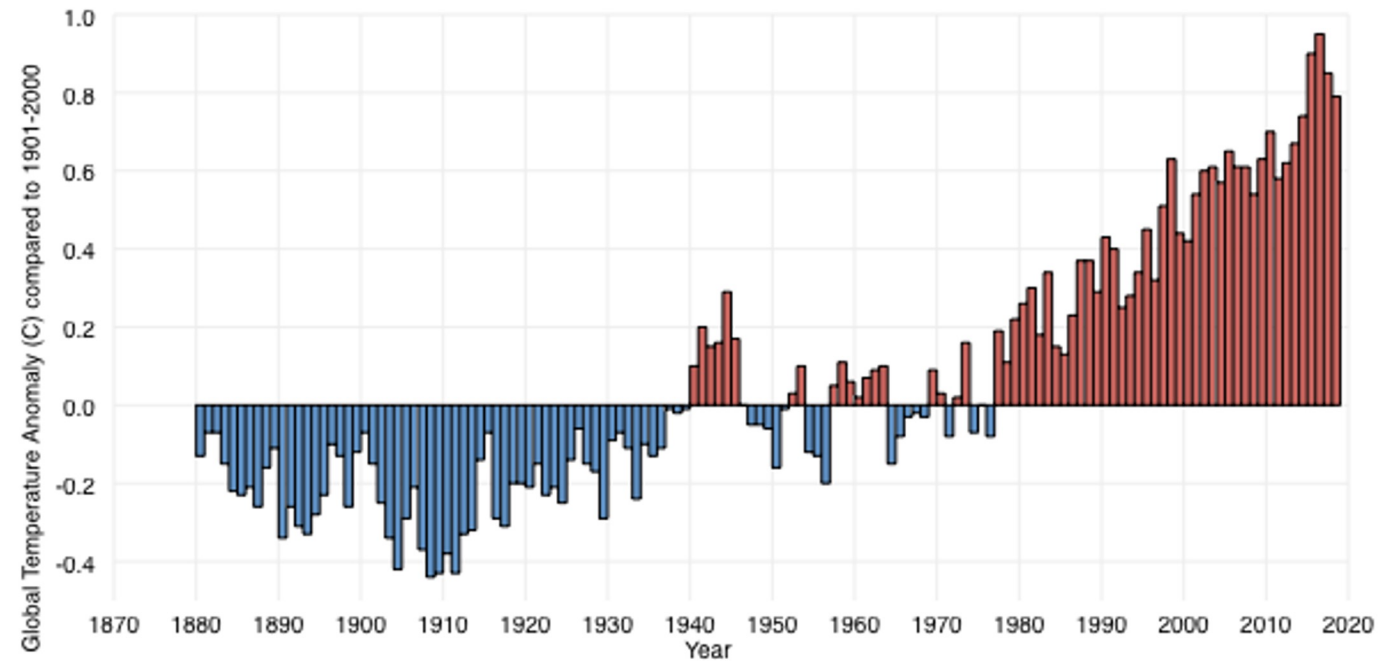
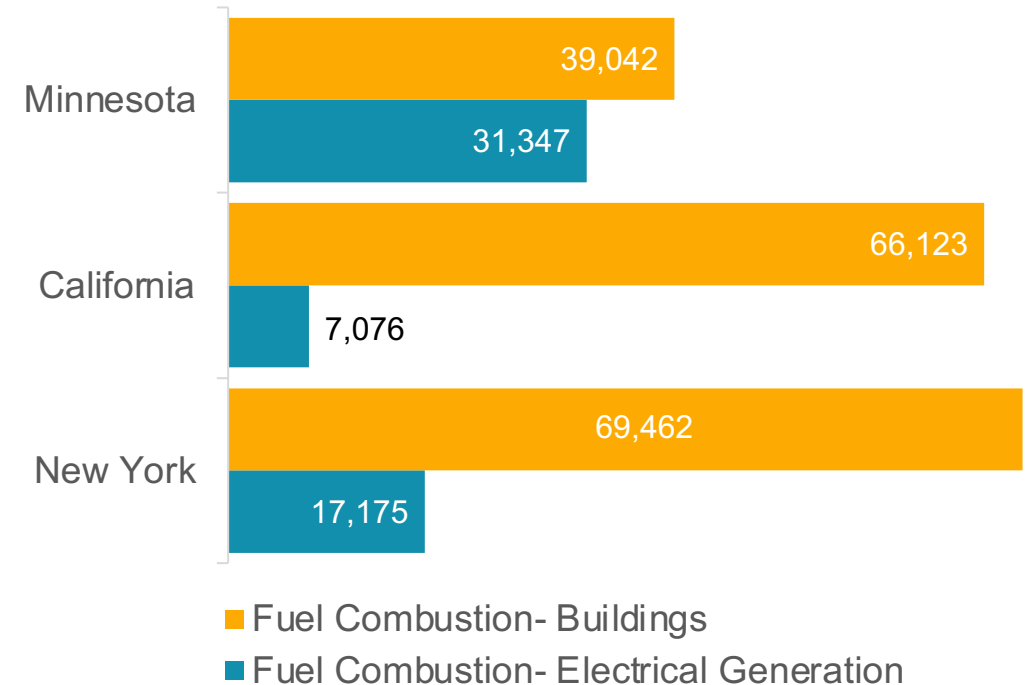


Image Source: (7) National Oceanic and Atmospheric Administration, *Climate Change: Global Temperature*

# Building Electrification | Health

- In many states, **fossil fuel combustion in buildings results in more NOx emissions than power plants.**
- Gas appliances are linked to poor indoor air quality. In homes with gas stoves, **children have a 42% increased risk of developing asthma.**
- Carbon monoxide, which results from burning gas, results in roughly 15,000 emergency room visits and 500 deaths in the U.S. annually.

**2014 NOx Emissions by Source (tons)**



**Notes:**

- “Electric Generation” includes biomass, coal, natural gas, oil, and other fuels combusted to generate electricity.
- “Buildings” includes biomass, coal, natural gas, oil, and other fuels combusted for commercial, institutional, residential, and industrial boilers.



# Building Electrification | Safety

- **Natural gas is a major cause of fire-related injuries and death.**
  - 3 out of 5 fires on U.S. properties are caused by gas, propane, or other flammable liquid (over 212,000 per year).
  - 20-50% of total post-earthquake fires are related to gas leaks.
  - Nearly 650 gas distribution pipeline accidents and over 200 fatalities in the 20 years.

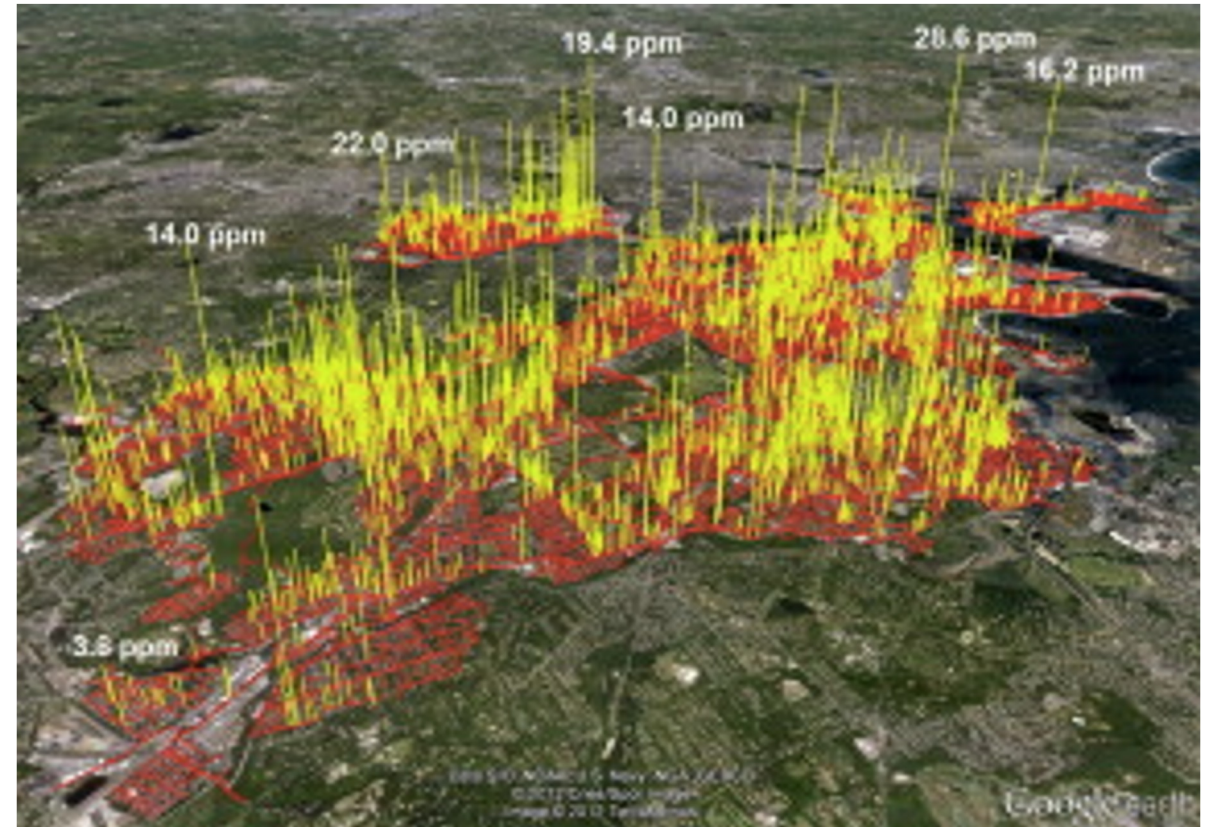


Image Source: KRON/Associated Press

# Building Electrification | Methane Leakage

- Gas infrastructure leaks methane at a rate of between 1%-12%—meaning that **gas likely has a global warming impact that is worse than coal.**
  - Methane has 80 times the warming impact of carbon dioxide over a 20-year timeframe.
  - A 2.3% methane leak rate makes the warming impact from gas equivalent to that of coal.
  - Methane leakage is also a cause of gas pipeline explosions and serious health concerns.

## Methane Leaks in Boston

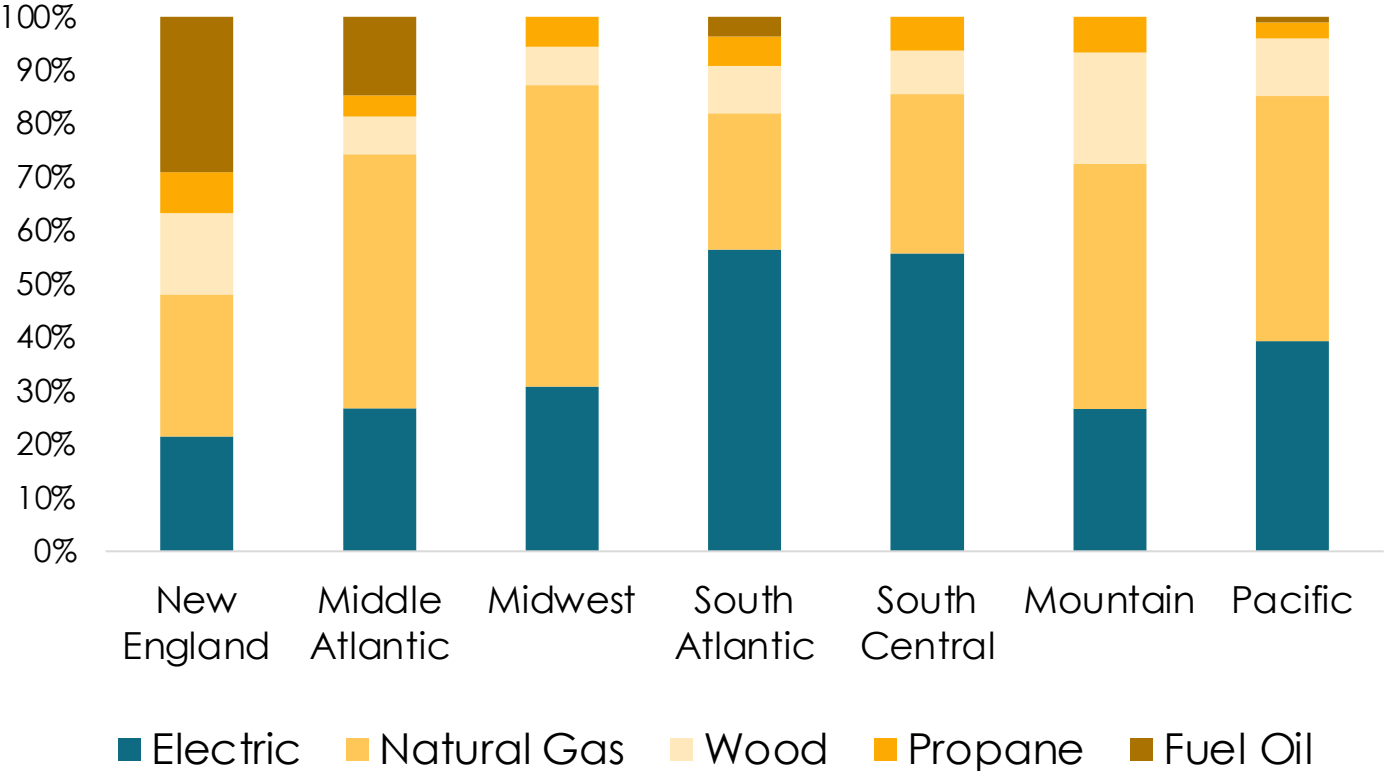


**Total leaks in Boston in 2013: 3,356**

# Building Electrification | Delivered Fuels

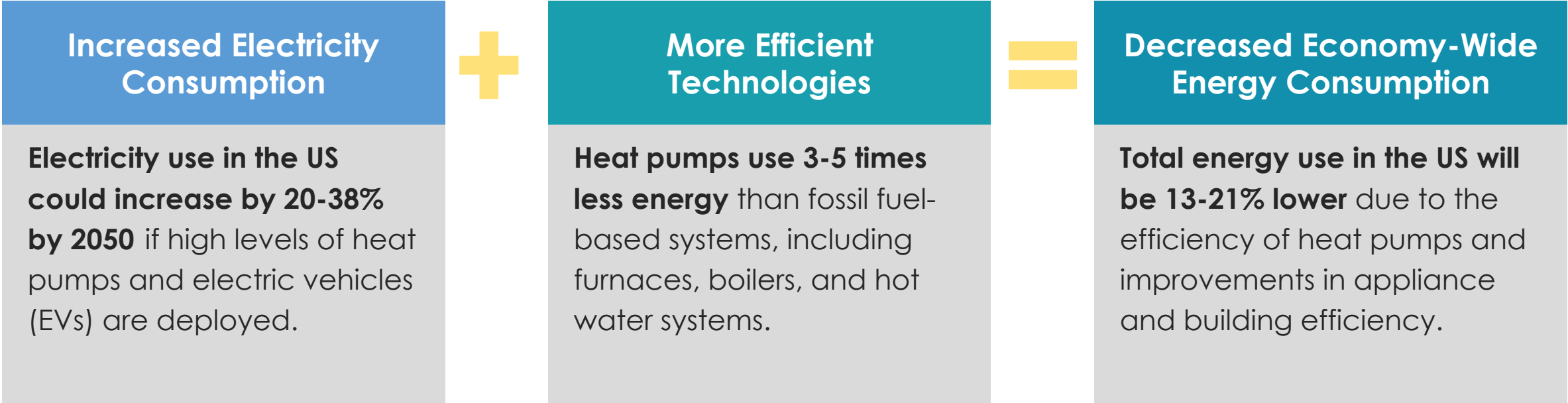
- **Many homes in the U.S. still burn oil or propane for heat**, particularly in the Northeast.
- Electrifying these systems significantly cuts GHG emissions and is often cost-effective.

**Main Heating Fuel by Region**  
Proportion of Households, 2015



# Building Electrification | Economy-Wide Energy Efficiency

- **Widescale deployment of heat pumps may increase total electricity use but decrease economy-wide energy use.** This is because heat pump technologies are so energy efficient.



# Building Electrification | Potential to Reduce Costs

**There are opportunities for installation and operational cost savings in many scenarios.**

- Retrofitting oil, propane, or electric resistance systems to heat pumps are likely to result in operational savings.
- Retrofits of gas systems can also reduce operational costs in some scenarios, especially when including weatherization.
- Most new all-electric buildings have lower construction costs than new mixed fuel buildings.

## Comparison of Costs of Heating, Cooling, and Hot Water

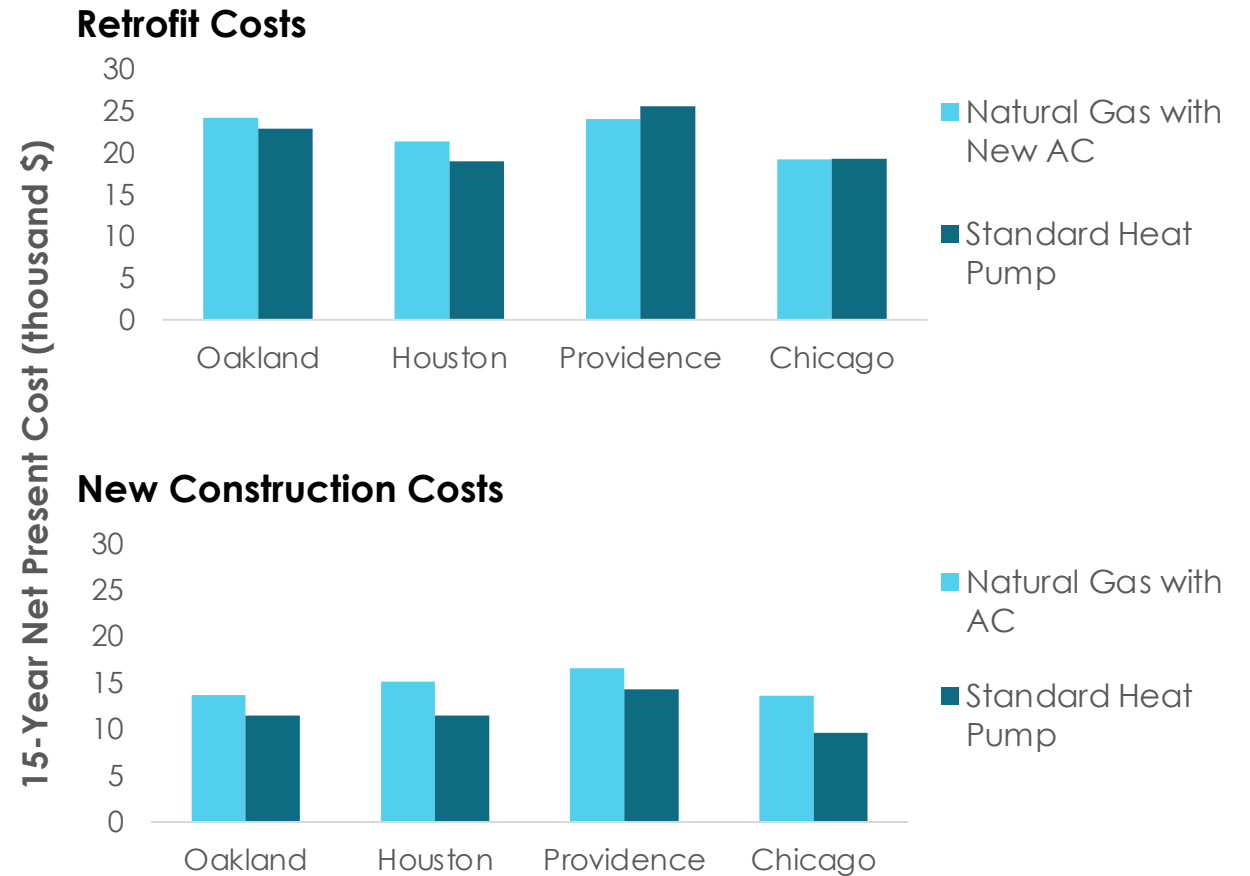


Chart Source: (1) RMI, *Economics of Electrifying Buildings*, 2018



# Building Electrification | Potential Barriers



## Economic Barriers

- High installed costs for retrofits
- Inadequate financing and funding options
- Capital constraints for many building types



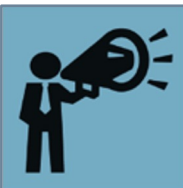
## Technical Barriers

- Low equipment renovation rates
- Lack of performance and market data for certain building types
- Electric grid integration and planning needs



## Supply Chain Barriers

- Insufficient number of high-skilled contractors
- Staff training needs for operations and maintenance
- Supply chain inefficiencies in some markets



## Awareness & Decision-making Barriers

- Lack of consumer and contractor awareness
- Split incentives/ high rate of renting
- Lack of confidence in technology



## Regulatory & Policy Barriers

- Utility incentive programs that discourage electrification
- Utility regulations that continue to encourage gas use
- Lack of long-term funding and planning

# Building Electrification | Takeaways

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- Building electrification is a critical opportunity to reduce GHG emissions from buildings in order to solve the climate crisis.
- Building electrification can also help improve the health, safety, and resiliency of communities.
- Building electrification has the potential to reduce building construction and operational costs in many climates and scenarios.
- To realize the benefits of building electrification, it will be critical to overcome the potential barriers, including economic, technical, supply chain, awareness, and regulatory barriers, which can vary widely across local contexts.

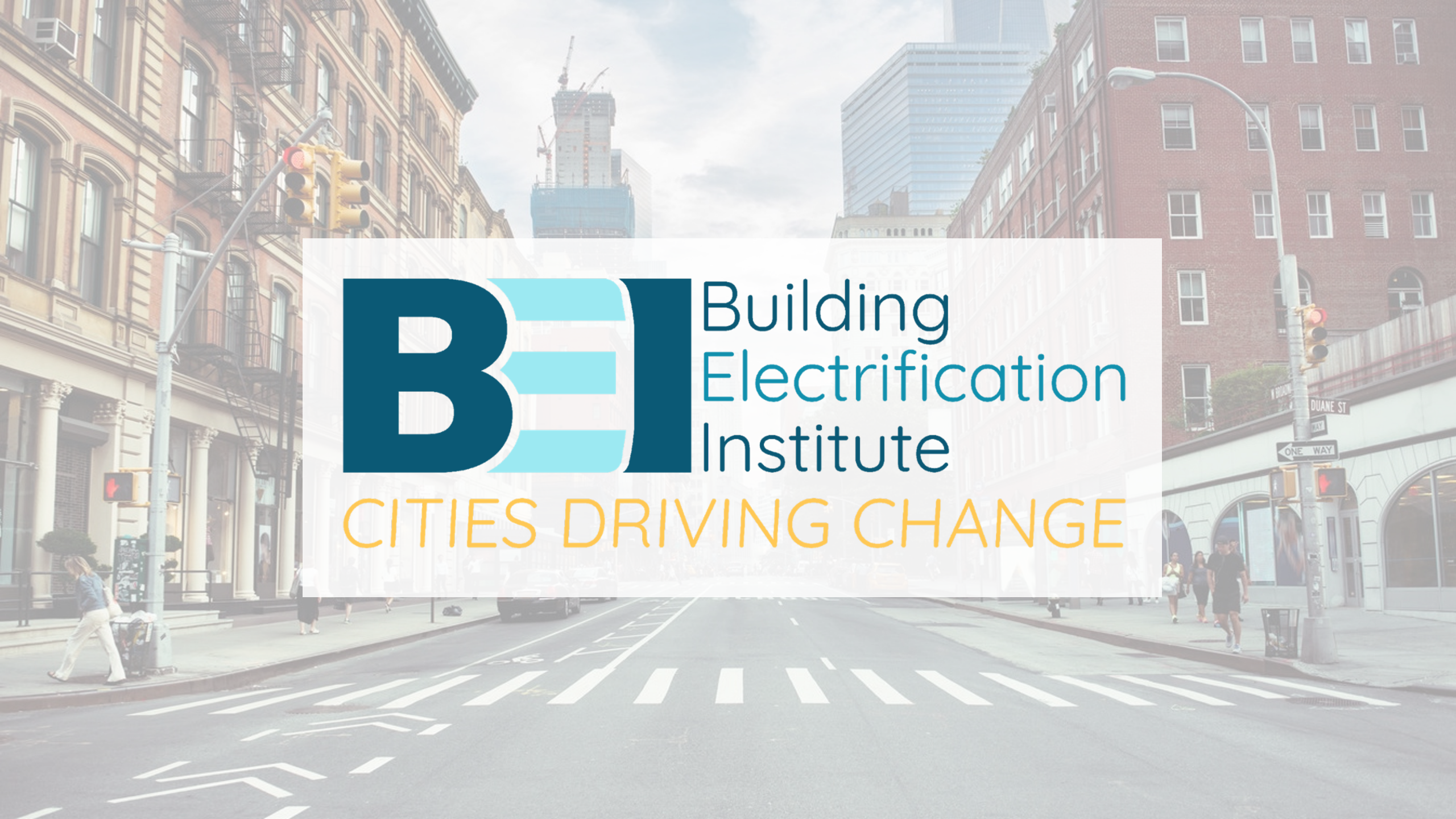
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