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Decarbonizing California's Buildings

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Carbon-Free Buildings, RMI

Better buildings improve people's lives

WHY

- Climate impact
- Health benefits
- Resilience
- Economic opportunity

90%

Of people's lives are spent inside buildings

3x

Income spent on energy costs for communities of color

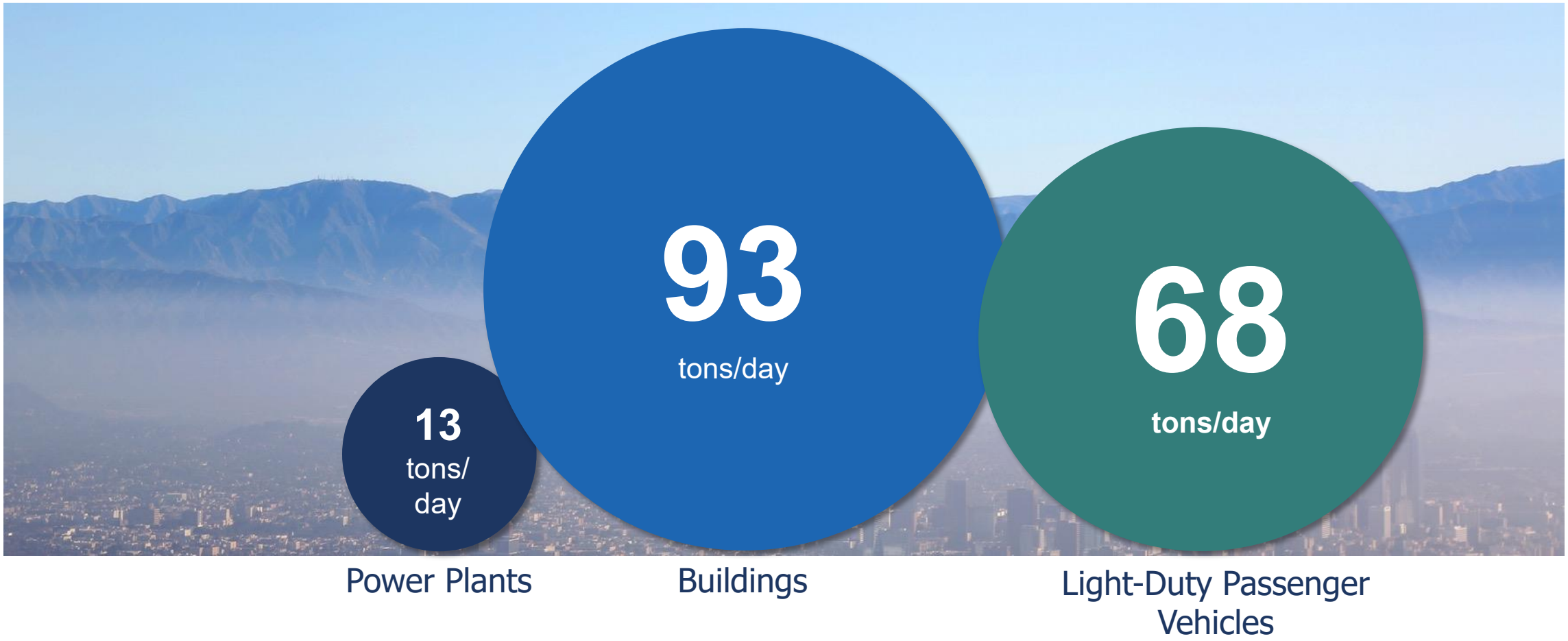
50-400%

Higher NO_2 emissions in homes with gas stoves vs. electric

Outdoor Air Quality:

Burning Fossil Fuels in Buildings Is a Big Source of Ozone & $PM_{2.5}$ Pollution

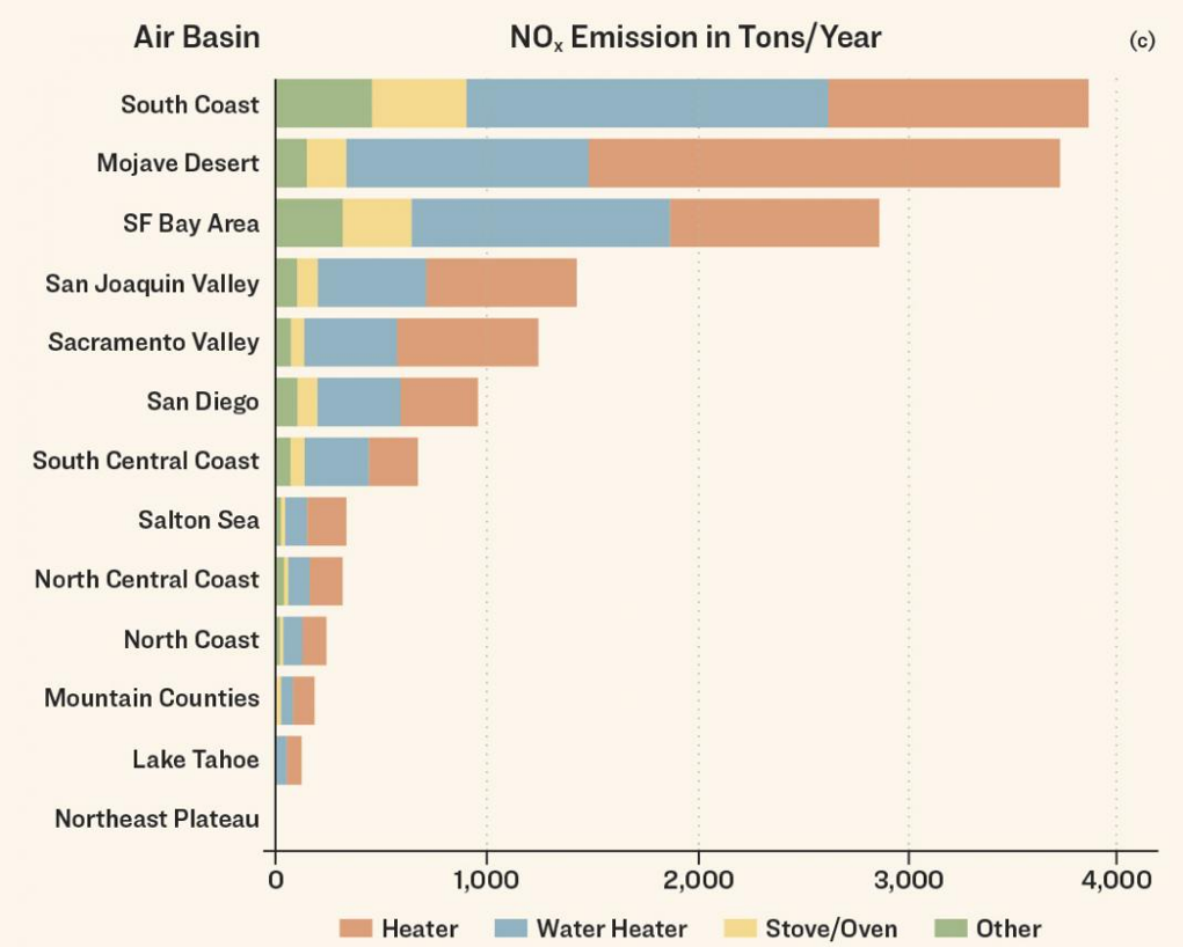
Nitrogen Oxides (NO_X) in California



Source: CARB Emissions Inventory, 2017 base year

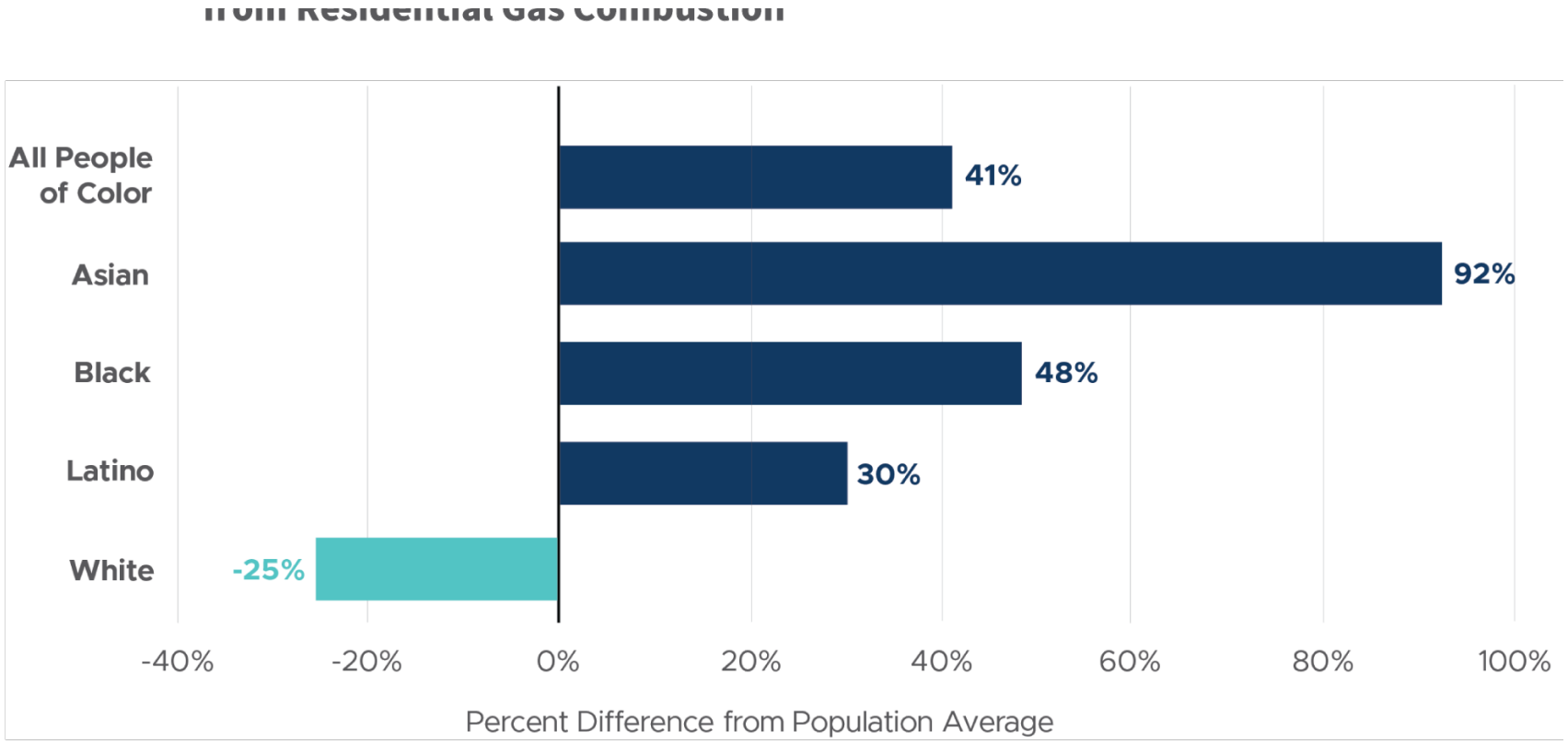
Replacing fossil fuel appliances with clean electric alternatives in California would save nearly $5 B/ year in health impacts

Gas appliances release nearly 16,000 tons/year of NOx outdoors – reducing these emissions would result in health benefits



*2018 scenario modeled from nitrogen oxides (NOX) and primary PM2.5 Source: Dr. Yifang Zhu et al., UCLA (2020). Only looks at residential.
$Billions and lives saved numbers based on RMI's additional analysis from 3 reduced complexity models used in: Jonathan J Buonocore (Harvard T.H. Chan School of Public Health) et al, "A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy", 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c

Appliance pollution disproportionately harms People of Color



People of Color are exposed to nearly **twice as much** $PM_{2.5}$ formed by residential gas appliances as Whites

Source: Christopher Tessum et al., *$PM_{2.5}$ Polluters Disproportionately and Systemically Affect People of Color in the United States*, 2021, https://www.science.org/doi/10.1126/sciadv.abf4491

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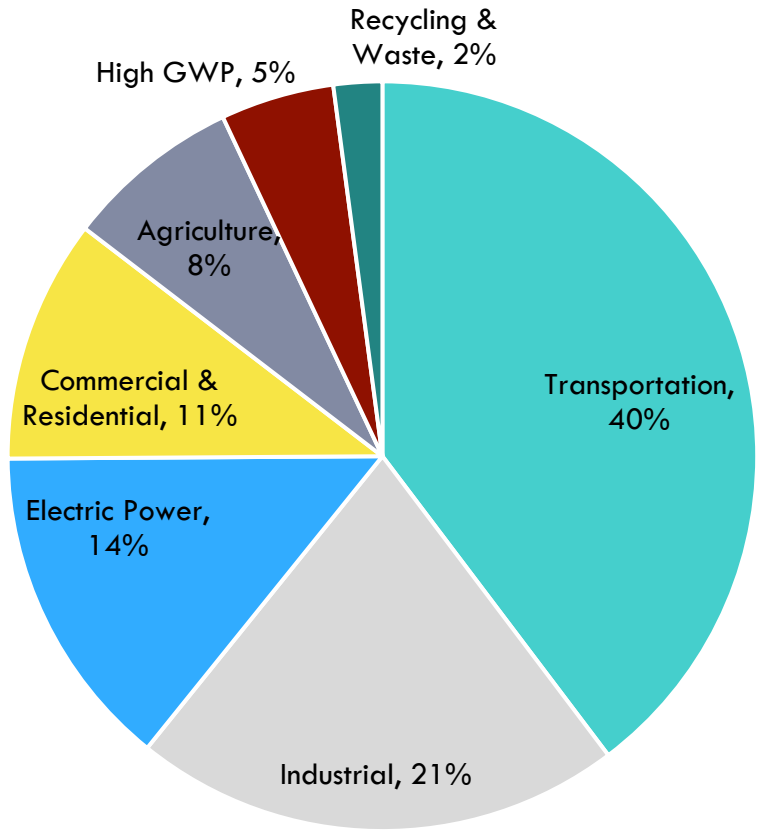
Source: Christopher W. Tessum et al., *$PM_{2.5}$ Polluters Disproportionately and Systematically Affect People of Color in the United States*, 7 Sci. Adv. eabf4491 (2021).

Direct building CO_2 emissions are over 10% of CA's statewide total, comparable to electric power and agriculture

2019 CO_2 emissions in California by sector

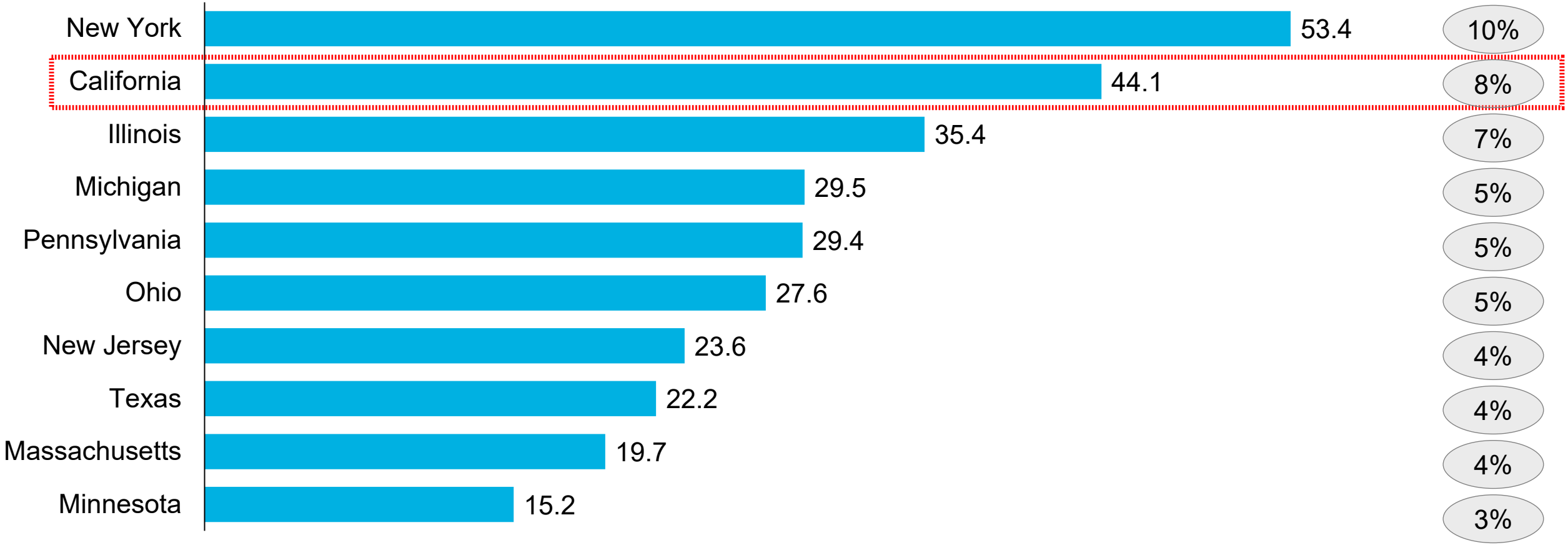


Source: CARB Greenhouse Gas Emissions Inventory

A third of US gas use is in buildings. Ten states are responsible for 56% of direct building emissions nationally, California is #2

Direct building greenhouse gas emissions by state

Million metric tons CO_2e, 2017



Source: EIA

*Does not include methane leakage

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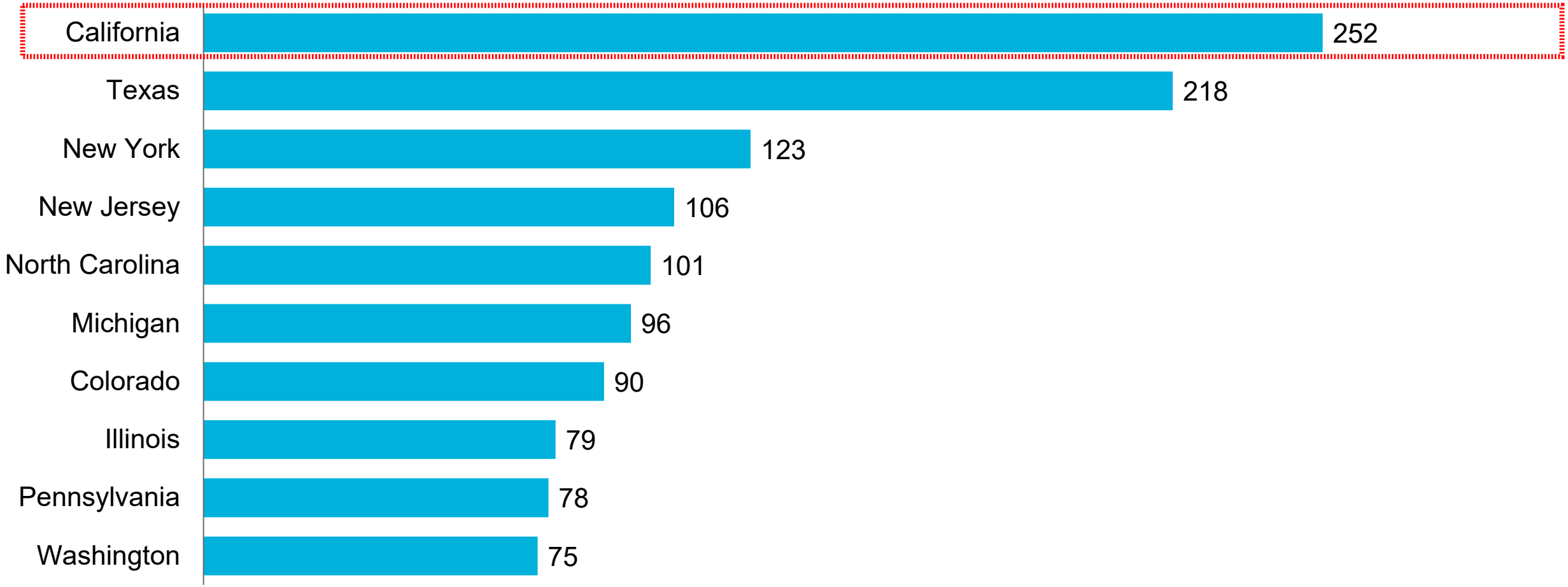
California is adding more new gas customers faster than any other state

New gas customers, 2013–2017

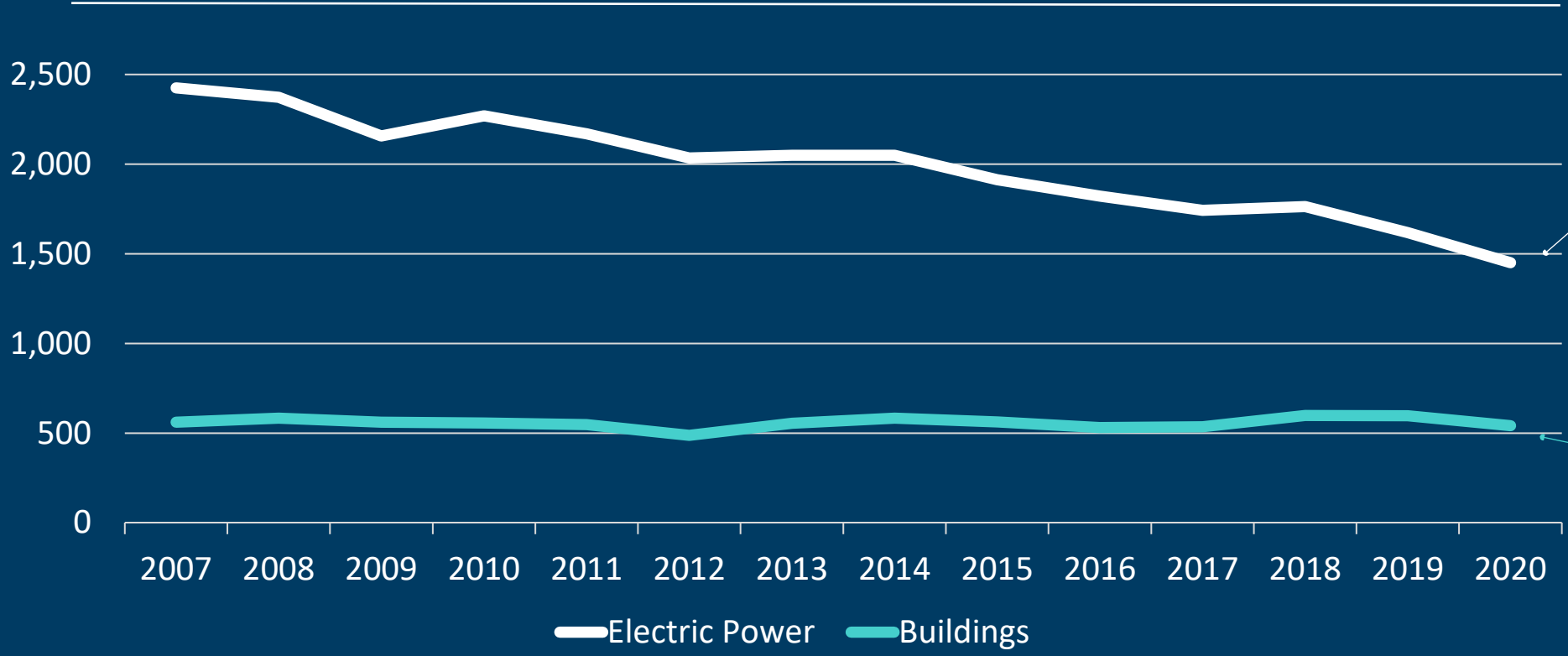
Thousands of customers, residential and commercial sectors



Source: EIA 2017

The United States has reduced carbon emissions from electricity, while the buildings sector is flat

Annual CO_2 emissions from electric power and buildings sectors
Million metric tons CO_2, US total, 2007–2020



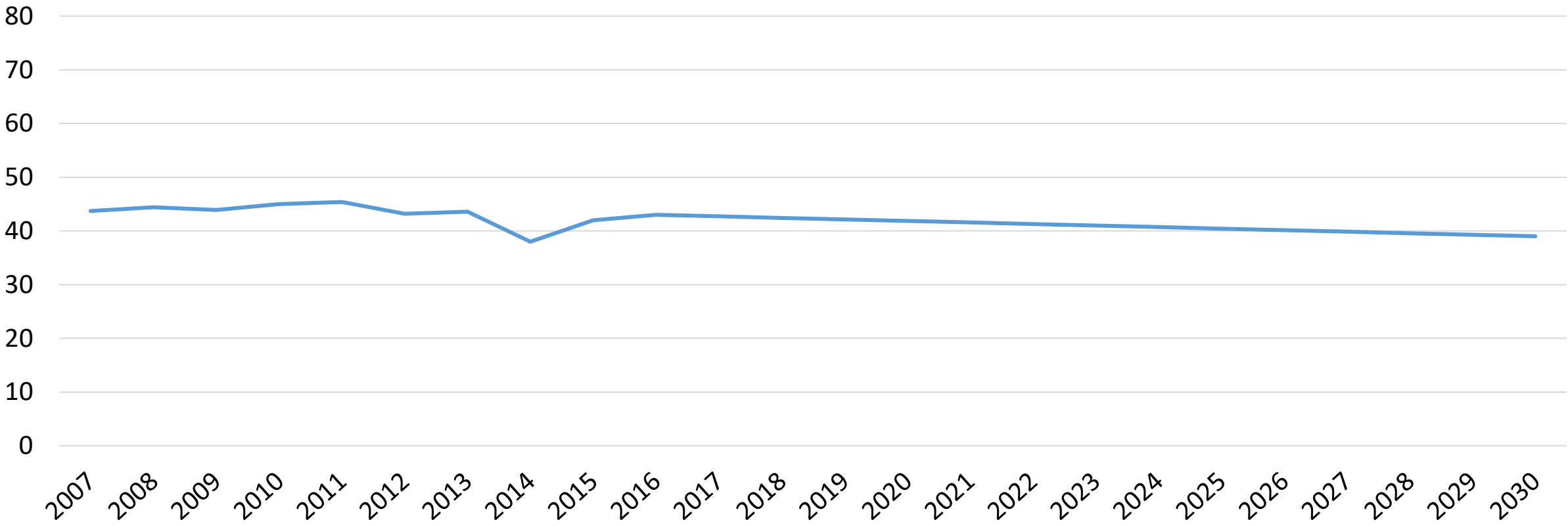
Electric Power: Down 40% since 2007

Buildings: Down 3% since 2007

No plan to reduce building emissions in 2017 Scoping Plan

Building GHG emissions in California, historical and forecasted

MMT CO_2e, Electric Power and Buildings Sectors, California



Source: CARB's 2017 Scoping Plan

Electric appliances are an efficient, widely available, zero-emitting control technology

Heat Pump Water Heater

Heat Pumps for Heating and Cooling

Induction Stove

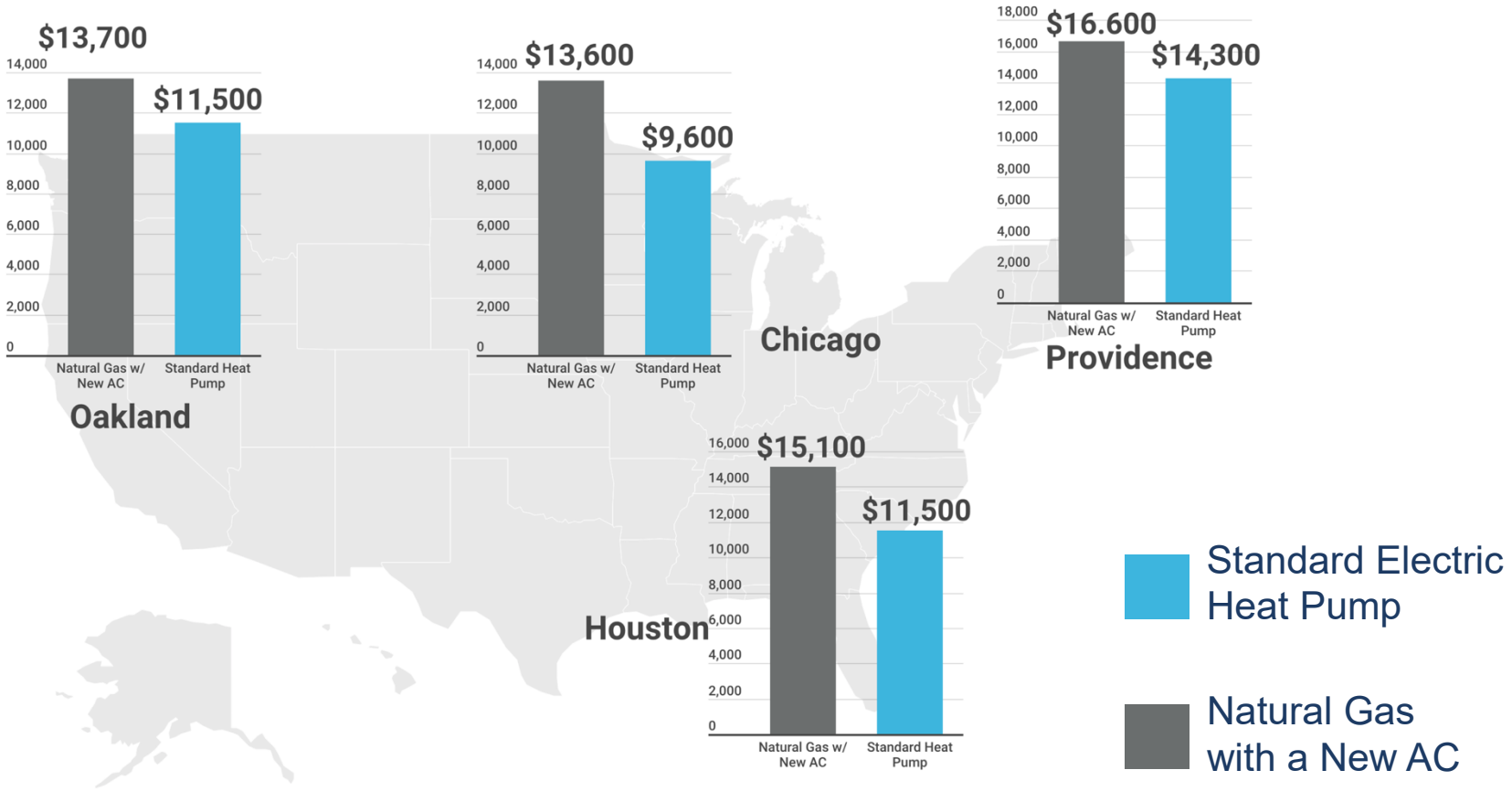
Heat pumps emit less than gas appliances, even when powered by gas plants

Home Heat Demand		Gas Consumed	Power Generation	Energy Input to Distribution System	T&D Losses	Energy Input to Appliance	Appliance Efficiency	GHG Emissions lbs CO_2
10.0 MMBtu 2,921 kWh	Gas Furnace	**10.5** MMBTU	n/a	**10.5** MMBTU	**0.4%** Leakage	**10.5** MMBTU	**0.95** AFUE	1,229
	Heat Pump	**9.6** MMBTU	CCGT Heat Rate 7,812 Btu / kWh	**4.2** MMBTU **1,235** kWh	5% Line losses	**4.0** MMBTU **1,173** kWh	**2.49** COP	1,123
		0	No fuels	**1,235** kWh	5% Line losses	**4.0** MMBTU **1,173** kWh	**2.49** COP	0

Sources: EIA (average US line loss, gas plant heat rate, and gas combustion CO_2 rate); EnergyStar (appliance efficiencies benchmarked at EnergyStar qualification level)

All-Electric Houses Already Have Lower Lifetime Energy Costs than Those with Gas

Lifetime Heating, Cooling, and Water Heating Costs for New Houses with Electric Heat Pumps vs. Gas Options



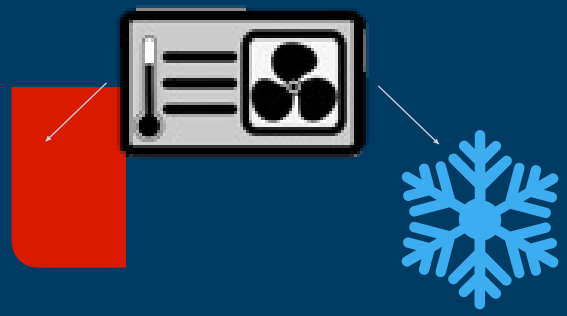
Source: https://rmi.org/insight/the-economics-of-electrifying-buildings/

- Electric heat pumps are cost-effective and efficient
- The National Renewable Energy Lab projects continued cost decreases and a doubling in efficiency still to come
- Taking gas out of buildings eliminates the major source of indoor air pollution

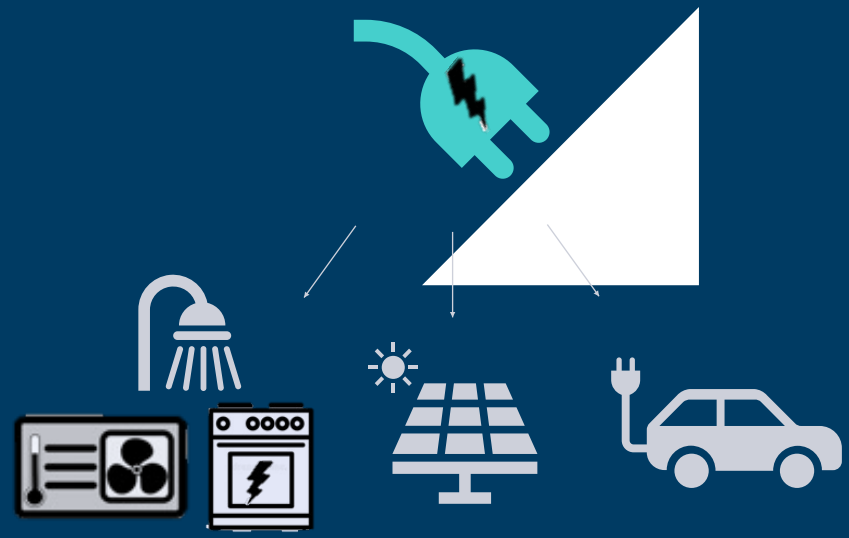
Building electrification's benefits extend far beyond emissions reductions

Health and climate benefits

Heat pumps heat and cool homes



When needed, panel upgrades expand access to EV charging, solar & storage



Less exposure to volatile gas prices

Grid management benefits

Leaders in reducing building pollution

- **California**
  - 52 cities have policies limiting gas connections for new buildings
  - Electrification policy support from Cal. Air Resources Bd., Cal. Energy Comm'n, Cal. Public Utilities Comm'n
  - Bay Area & South Coast Air Quality Management Districts considering zero-NOx standards
- **New York**
  - New York City in process of phasing out gas in new construction city-wide
  - NYC Local Law 97 limits GHG emissions for buildings greater than 25,000 square feet
  - Ithaca has committed to decarbonize all building in city by 2030
  - New York State climate council focusing on building electrification in scoping plan
- **Progress in other states, including CO, ME, MA, MI, MO, NJ, WA**
  - Significant policies in Denver, Eugene, Seattle, and more

Thank you!

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