



ANALYSIS OF U.S. LOCAL GOVERNMENT SCIENCE-BASED TARGETS AND PATHWAYS TO ACHIEVE THEM IN THE RACE TO ZERO

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2021 Working Paper





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Executive Summary Highlights

- All U.S. local, regional, and state governments should adopt a science-based 2030 emission reduction target (SBT) to hold global temperature increase to 1.5 degrees Celsius by midcentury as outlined in the Paris Agreement.
- The median per-capita SBT for U.S. local governments is 63.3% reduction by 2030, based on a 50% global reduction and adjusted upwards based on each country's Human Development Index, per ICLEI USA's application of the WWF One Planet Cities Challenge methodology.
- This analysis reviewed GHG inventories of 138 U.S. local governments (referenced as "communities" throughout) representing the most recent year of emissions between 2016 - 2019), developed and recorded in ICLEI's [ClearPath](#) tool.
- Under a realistic, though ambitious, set of assumptions, ***it is possible for most U.S. local communities to reduce per-capita emissions by 63% or more by 2030.***

Abstract

This paper discusses the analysis, findings, and recommendations conducted by ICLEI Local Governments for Sustainability USA (ICLEI) to highlight the needed greenhouse gas (GHG) emissions reduction contributions from local governments, to illustrate the realistic pathways to achieve those reductions, to generate discussion and critical feedback, and to influence ongoing advancement of emerging policies and programs.



The 1.5C Emissions Trajectory and Science Based Targets

The [IPCC Special Report on Global Warming of 1.5C](#) found that emissions trajectories that reduce global greenhouse gas (GHG) emissions by about 45% from 2010 levels by 2030 and net emissions to zero by 2050 are consistent with keeping global temperature change within 1.5C.

The 1.5C threshold is important because of the significant risk of tipping points that lead to exponentially greater damage and risks if exceeded. Emissions reduction targets consistent with this trajectory are called *science-based targets* (SBT) and can be developed for countries, for institutions and corporate entities, and, as of November 2020, for local communities.¹

To develop SBTs for US cities and counties, ICLEI adapted a method developed by the WWF One Planet City Challenge, which adjusts responsibility based on the national Human Development Index (HDI) -- a "fair share" allocation of emissions reductions. The HDI includes a number of factors, including per-capita income, life expectancy, and education levels.

Using this methodology, cities and counties in the US should aim to reduce per-capita emissions by about 63% from 2018 levels by 2030, and to reach zero emissions by 2050 or sooner.

Variations between communities' specific SBTs are based on differences in assumed population growth and the inventory year from which the analysis is based.

The focus of the analysis discussed in this paper is how cities can reach their SBTs, or their 63% per-capita reductions by 2030. It should be noted that while the SBT focuses on per-capita emissions reductions, different local governments should expect different corresponding absolute reduction targets, based on projected rates of population growth between now and 2030. Reductions in absolute emissions range between 40% and 65%, with a median of 60% reduction for the 138 communities analyzed. This paper primarily references a 63% per-capita emission reductions target.

¹ ["Climate Targets for Cities."](#)



Changing Technology and Policy Landscape

Changes in availability and prices of key technologies over the past few years make a 63% reduction in emissions more achievable than was previously considered the case.

Most significant is the decrease in the cost and increased size of solar and wind generation, which have allowed for much wider and larger scale deployment and a significant reduction in US power sector GHG emissions. Another important advancement within the past five years is development of [heat pumps](#) for space heating and domestic hot water, even in colder climates. Lastly, electric vehicles (EVs) have also reached a new maturity, with a much wider range of models offered by many more manufacturers than a few years ago.² While there is still an up-front cost gap with gasoline powered vehicles, this is expected to narrow or close over the next few years, and tax credits and other utility incentives can often bridge the gap. Additionally, EVs are less expensive to operate and maintain such that the total cost of ownership is reduced relative to conventional gasoline and diesel power vehicles. EVs for heavy duty freight and delivery vehicles are also becoming increasingly [cost-competitive on a lifecycle basis](#).

Along with these technology and market developments, policy innovations are emerging to drive building efficiency and electrification, and the widespread adoption of EVs in equitable ways that can address energy affordability, health and transportation access challenges while reducing emissions.

Key Actions for 63% Per Capita Emissions Reductions by 2030

Clean Electric Grid

A clean electric grid is foundational to deep emissions reductions. Not only does clean electricity reduce current electricity emissions, it is essential to strategies to reduce transportation and building fuel emissions through electrification.

² ["Electric Vehicle Sales Surge in 2021."](#)



Since 2005, electricity generation emissions in the US have decreased by 40% (Figure 1).³

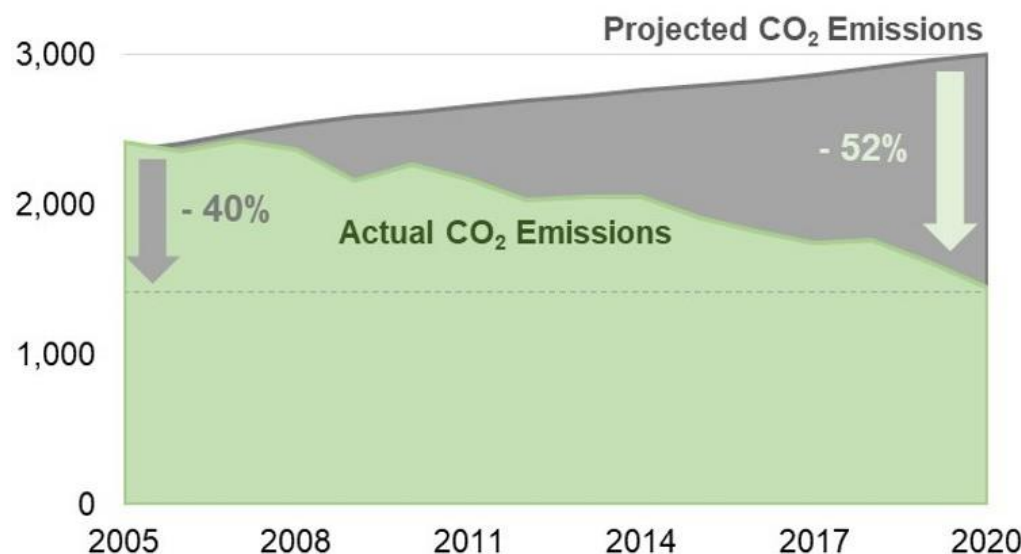


Figure 1. Electricity-related CO₂ emissions (MMT/yr).³

Development of wind and solar energy and battery storage (which together made up 81% of [expected new generation capacity in the US in 2021](#)) can continue to drive swift decreases in emissions (Figure 2).⁴ These energy sources are increasingly the lowest cost option for utilities and grid regions and can serve to both reduce emissions and lower utility costs.

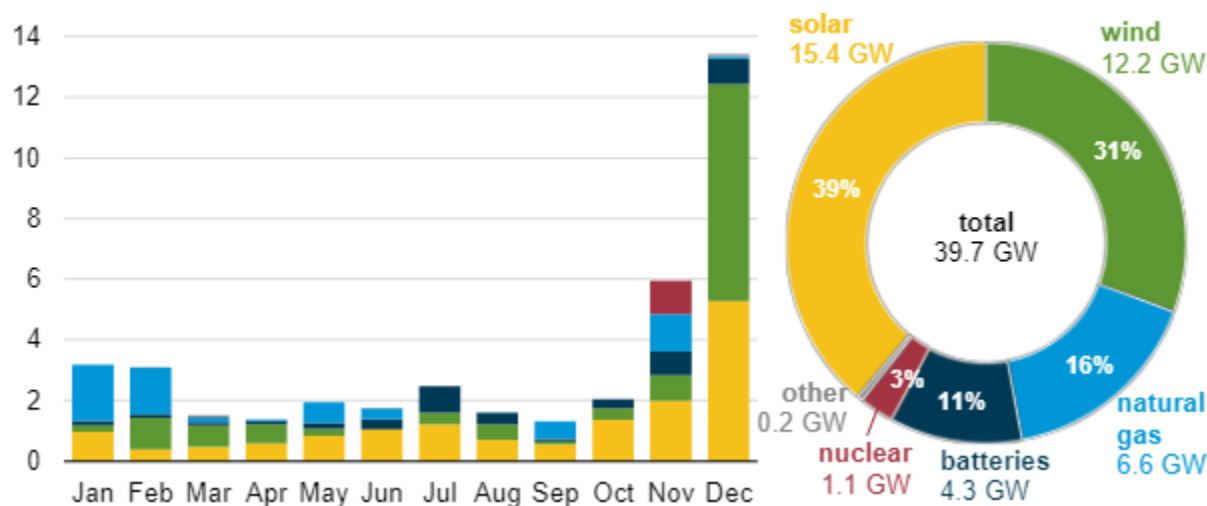


Figure 2. Planned U.S. utility-scale electricity generating capacity additions (2021) gigawatts (GW).⁴

³ Wiser et al., "[Halfway to Zero](#)."

⁴ "[Renewables Account for Most New U.S. Electricity Generating Capacity in 2021 - Today in Energy - U.S. Energy Information Administration \(EIA\)](#)."



Getting grid emissions to a necessary 2030 level (generally 60-80% reduction by 2030) will require not only renewable energy additions, but targeted fossil plant retirements, specifically of any remaining coal plants (*Figure 3*).⁵

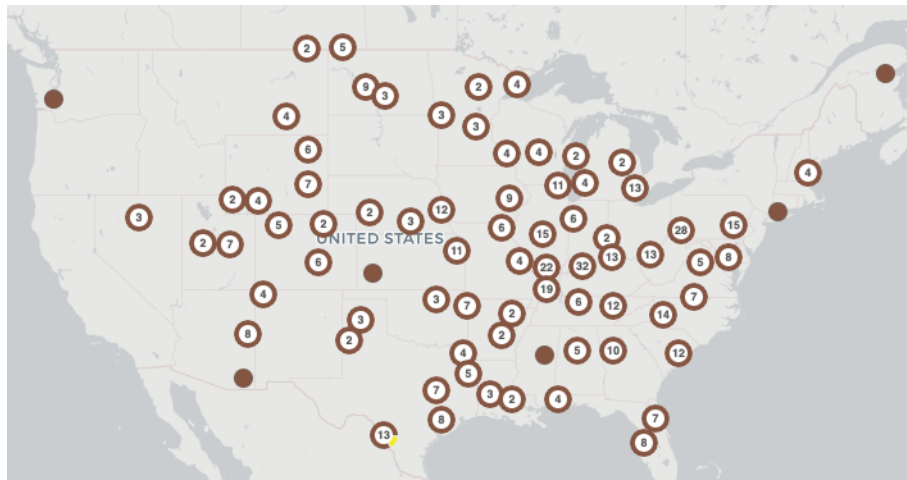


Figure 3. Map of operating coal plants in the U.S.⁵

Replacing this baseload capacity will then require extensive deployment of energy storage and demand management technologies. These reductions are already targeted in many states through their Renewable and Clean Energy Standards as illustrated in the figure below (*Figure 4*).⁶

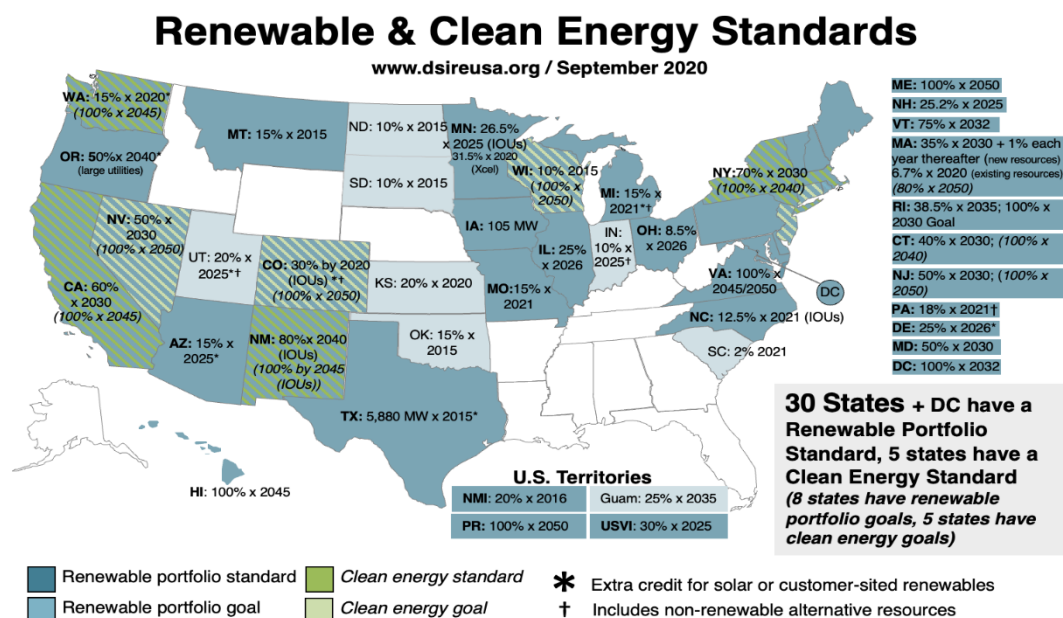


Figure 4. Renewable and Clean Energy Standards from Database of State Incentives for Renewables & Efficiency.⁶

⁵ "Global Coal Plant Tracker."

⁶ "Renewable & Clean Energy Standards."



Operating Coal Plants in the U.S.

The specific levers local governments have to influence grid emissions vary depending on the local and state policy environment. For example, is a municipal utility in place, are Community Choice Aggregation (CCAs) organizations allowed by state law, does the state have a high Renewable Portfolio or Clean Energy Standard in place (targeting at least 60-80% reduction by 2030 or 2035), or whether the local utility has established similar goals.

Regardless, local governments are increasing their impact on local grids, even in those locations with limited policy environments, whether through direct action -- such as development of local renewable energy, distributed battery storage, and building demand response which can deliver local economic and enquiry benefits -- or through advocacy with utilities or at the state level.

As an example, State and local government leaders in Utah collaborated to initiate talks with Rocky Mountain Power, which resulted in the "community renewable energy act," authorizing the utility to create a renewable electricity bulk purchase program for cities. Residents in participating cities now receive renewable-generated electricity by default.

Similarly, city leaders in Des Moines, Iowa adopted [a 24/7 Carbon Free Electricity \(CFE\) resolution](#), the first city in the U.S. to commit to sourcing 100% carbon-free electricity every hour of every day by 2035 (*Figure 5*).⁷ They did so by initiating discussions and creating a partnership with their investor-owned utility, Mid-American Energy.



Figure 5. The 24/7 Carbon-free energy compact call to action.⁷

⁷ Nations, "[24/7 Carbon-Free Energy](#)."



Transportation - Vehicle Mile Reduction and Shift to Electric Vehicles

Transportation represents the largest source of emissions, both for the U.S. as a whole and for most of the communities we analyzed.

To substantially reduce transportation emissions, a rapid transition to EVs (including public, private, transit, rideshare, delivery trucks, and heavy duty trucks) will be required. A continued focus on vehicle miles travelled (VMT) reduction through increased mobility options including transit, rideshare, and micro-mobility solutions, will both support emissions reduction goals and improve overall quality of life, health and wellbeing, and community equity and should continue to be emphasized. However, VMT reductions are often limited to the 5-10% range within most U.S. communities which necessitates the need for EVs to account for the bulk of the GHG reductions. Fortunately, the adoption of EVs is already underway across the U.S., with EVs currently representing about 3% of new vehicle sales and anticipated to increase to 30% by 2030 (Figure 6).⁸

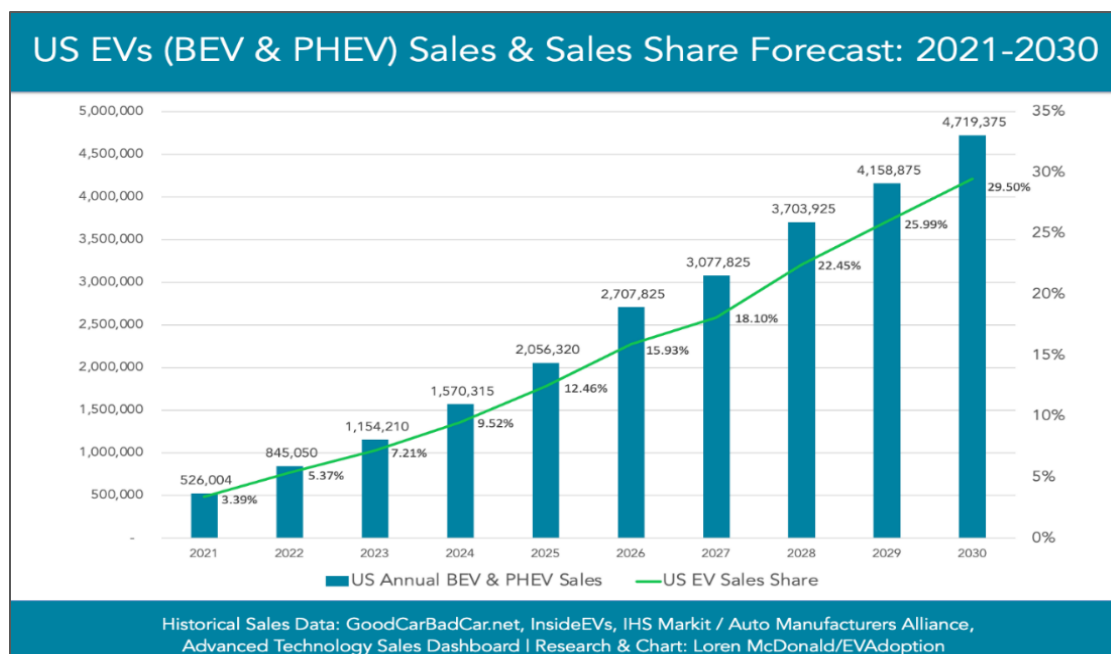


Figure 6. A long-term forecast for new electric vehicle (BEV & PHEV) in the U.S. through 2030.⁸

In those areas of the country where EV adoption is taking place at a more accelerated rate, such as California, current EV sales are around 8% of total vehicle sales, anticipated to climb to 56% by 2030 (Figure 7).⁸

⁸ ["EV Sales Forecasts – EVAdoption"](#)



From a local government perspective, placing an early focus for electrification on transit fleets and shared vehicles can help to address equity. The [EV Spot carshare service](#) being launched in St Paul and Minneapolis is a good example, with EV locations chosen specifically to provide access in lower-income neighborhoods with lower rates of vehicle ownership. Providing income-dependent EV incentives and including incentives for purchase of used EVs, [as is being done in San Mateo County](#), is another way to address equity.

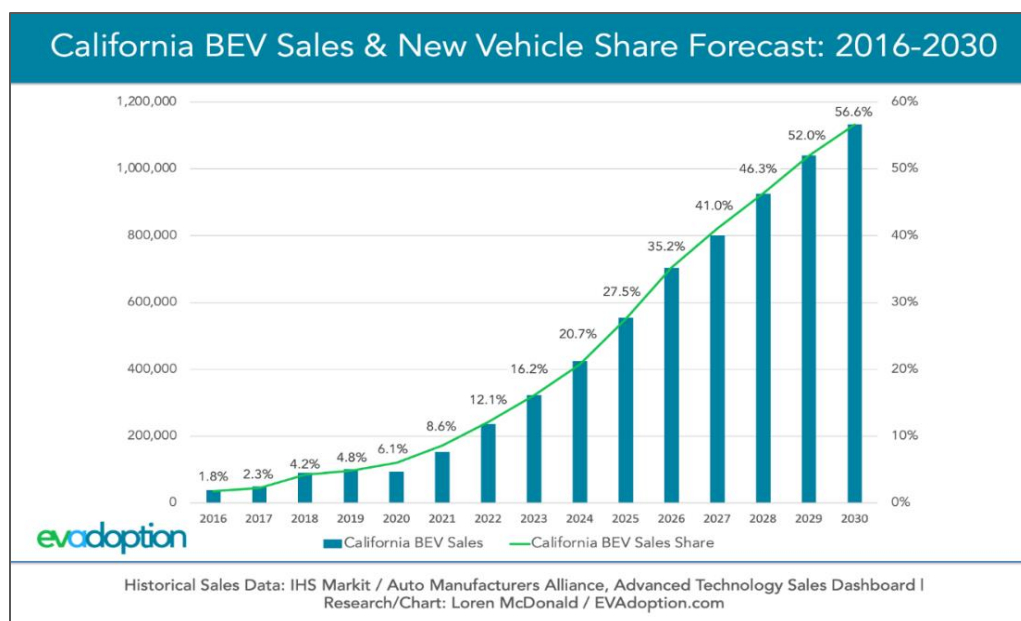


Figure 7. A 2030 forecast for the BEV sales in the State of California.⁸

Buildings - Efficiency and Electrification

As with transportation, both efficiency and electrification are elements of building decarbonization. And like transportation, electrification of buildings via heat pumps also supports human health and wellbeing, removing combustion sources from inside of buildings. Electrification is also a key efficiency strategy because in most U.S. climate zones, a heat pump uses about one third to one half of the energy as a combustion furnace or boiler to deliver the same amount of heating to a home (Figure 8).⁹ In addition, low

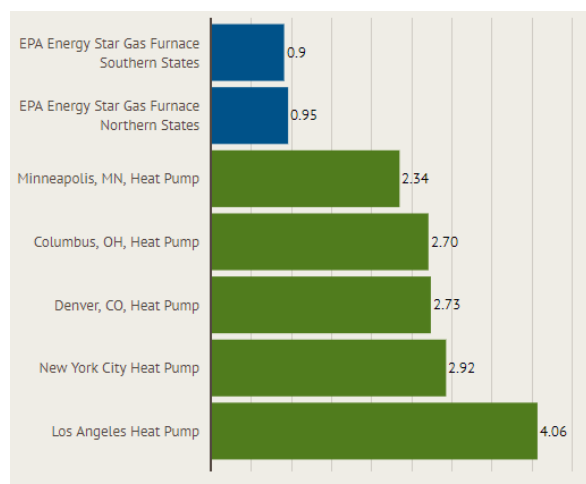


Figure 8. A bar graph depicting space heating efficiencies and Coefficient of Performance in various climates.⁹

⁹ ["It's Time to Incentivize Residential Heat Pumps."](#)



temperature heat pumps are now available such that technical barriers in cold climates no longer exist. Because of these efficiency gains, heat pumps reduce GHG emissions in all U.S. electric grid regions, and will represent an increasing form of reductions as the grid gets increasingly cleaner.

Heat pumps can also support the increasing penetration of renewable energy on the grid. Like EVs, they represent controllable electric loads, which the utility can include as part of larger demand response programs to increase grid resilience.

In order for local governments to accelerate the adoption of heat pumps and the corresponding phasing out of natural gas in buildings, a number of policy levers will be needed. Updating new building codes to require heat pumps in most applications is an important first step. Implementing utility or local government incentive programs to address any cost premiums or upgrades in electrical service is another. Lastly, contractor and public training and education on the benefits of heat pumps will be another high priority. Coupling these with building benchmarking ordinances, emerging [building performance standards](#), and [equitable](#) implementation programs will be important elements of a robust local building decarbonization program.

Science-Based Target Analysis

The Data

The analysis described herein is based on community GHG inventory data entered by cities and counties in ICLEI's ClearPath tool. Over 650 cities and counties are using the ClearPath as of 2020. Of these, we used community inventories for 2016, 2017, 2018 or 2019 that had been marked both complete and official by the local government completing them. The communities analyzed cover twenty-eight states (Figure 9).

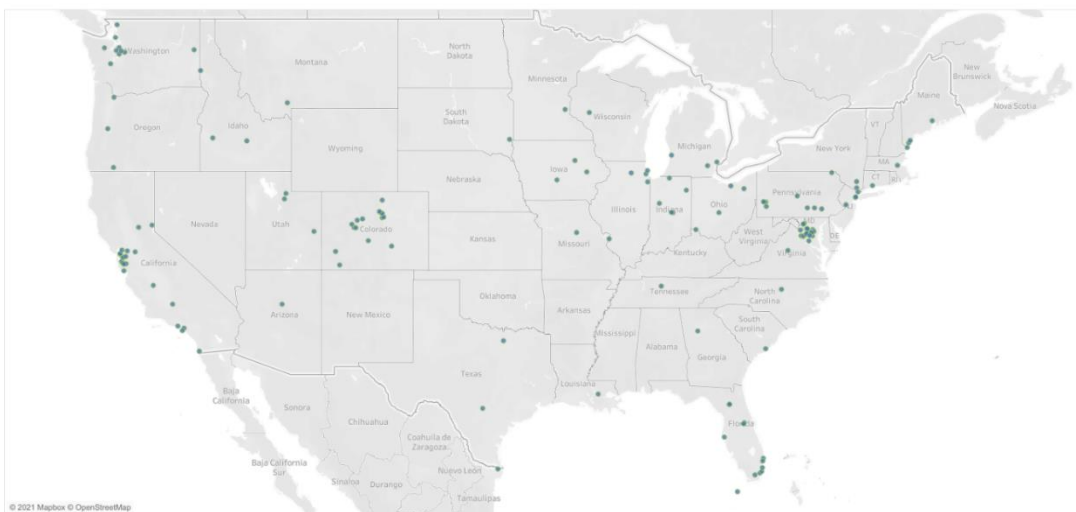


Figure 9. A map highlighting the communities analyzed in the paper.



Inventories entered in ClearPath generally follow either the U.S. Community Protocol or Global Protocol for Community Scale Inventories. Data on residential, commercial and industrial electricity and natural gas use is generally obtained from the utility providing those fuels, and is thus high quality aggregation of metered usage data. Data for on-road transportation is typically provided by regional planning organizations based on travel demand models; this vehicle mile travelled (VMT) data is then multiplied by standard vehicle fuel efficiencies and emissions factors. Some of the inventories include other sectors such as scope 3 air travel, but for this analysis we focus on residential, commercial and industrial energy use and on-road transportation to provide consistency across communities analyzed. On average, these sectors represent 90.36% of the total community GHG emissions represented. An average emissions profile across all of the communities is shown in *Figure 10*.

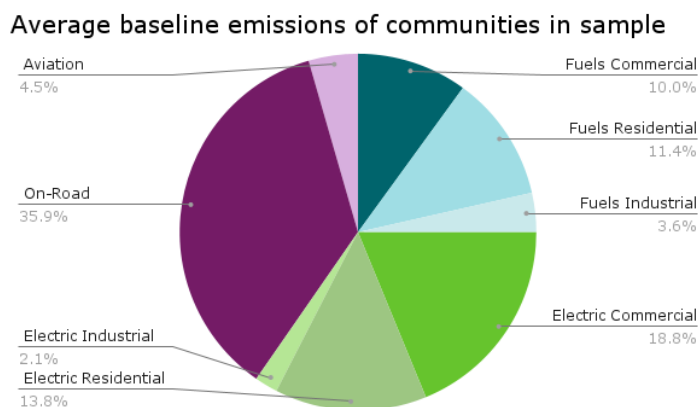


Figure 10. An average emissions profile across all of the communities.

Growth Modeling

Population growth was modeled for each community. Base Year Population as extracted from ClearPath (if entered) or collected from the United States Census. 2030 population projections were sourced from publicly available local government websites. If data wasn't available at this scale, county or regional growth projections were applied. If county/regional projections were not available, state growth projections were applied. This projected growth was used to determine the absolute SBT, emissions to meet the science-based target, and to project business as usual emissions. For business as usual emissions, it was assumed that all building energy use and VMT would grow proportionally to population.

Scenarios

To see the potential for communities to reach a science-based target, we looked at three scenarios with varying degrees of implementation emphasis on different sectors. Each scenario includes differing levels of implementation across five categories of High Impact Actions (HIAs): grid decarbonization, VMT reduction, EV adoption, building efficiency, and building electrification. For all three scenarios we assume grid reductions that would be equivalent to the Biden Administration's proposed Clean Energy Standard, or an 80% reduction in electricity emissions intensity by 2030. The scenarios differ in the assumptions about VMT reduction, the



rate of EV adoption, and the rate efficiency and electrification that are applied to existing buildings. The scenarios are described below and summarized in *Table 1*.

Transportation-Focused Scenario

The transportation-focused scenario combines aggressive transportation actions with modest actions on building energy. For a transportation-focused approach, we assume an aggressive goal to achieve total VMT reduction of 10%, and an increase in electric vehicle market share by 6% each year (based on California's EV sales projections). For the transportation focused scenario, we assume no efficiency or electrification of new buildings. However, we assume that 5% of the existing building stock each year will receive both a 20% efficiency upgrade and convert from heating fuels to electric heat pumps.

Building-Focused Scenario

The building-focused scenario applies more aggressive building-focused actions with more modest transportation actions. We assume that total VMT will be constant, and that EVs will increase their market share by only 3% each year (the current business-as-usual projection for the United States). For new buildings we assume all will meet the 2018 model code and be all electric. However, we assume that 10% of the existing building stock each year will receive both a 20% efficiency upgrade and convert from heating fuels to electric heat pumps.

	Scenario		
	Transportation	Building	Balanced
Grid Electricity	80% reduction in CO2e/kWh		
VMT	10% reduction	No change	5% reduction
EVs	6% per year	3% per year	4.5% per year
New Buildings	None	2018 code and all electric	2018 code and all electric
Existing Building 20% Efficiency	5% per year	10% per year	5% per year
Existing Buildings to Electric	5% per year	11% per year	6% per year

Table 1. Summary of High Impact Action scenarios analyzed.

Balanced Scenario

The balanced scenario combines actions on both transportation and buildings between those of the other two scenarios. We assume a 5% total decrease in VMT and that EVs will increase their market share by 4.5% per year (as currently projected for California). For buildings, we assume all new construction will meet the 2018 model code and be all electric and 5% of existing buildings receive efficiency retrofits and electrification each year.



Results

We apply the three scenarios across different types of communities, using three different classification systems. First, we compare communities with high and low starting per-capita emissions. Next, we compare communities across different climate zones. Finally, we compare communities with high and low population densities.

Comparison based on baseline per-capita emissions

Figure 11 shows baseline per-capita emissions for communities with the highest and lowest 25% percent of per-capita emissions (quartiles), as well as the average for all communities in our sample.

Per capita emissions by sector for 1st and 4th quartile baseline per-capita emissions in sample

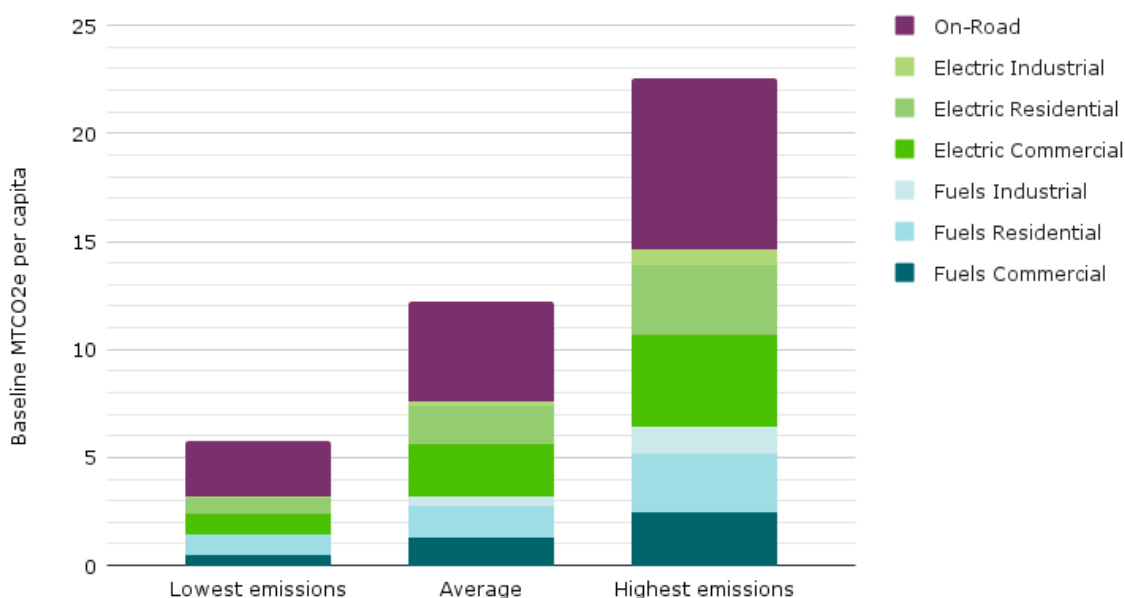


Figure 11. Emissions profile of communities broken down by highest and lowest 25% per-capita emitting communities with the sample wide average serving as a baseline.

There is a considerable range of per-capita emissions between the lowest and highest emitters. Higher emissions communities had higher emissions across all sectors, particularly in commercial and industrial fuel use, and on-road transportation.



Per capita emissions reduction in 2030, by baseline per capita emissions

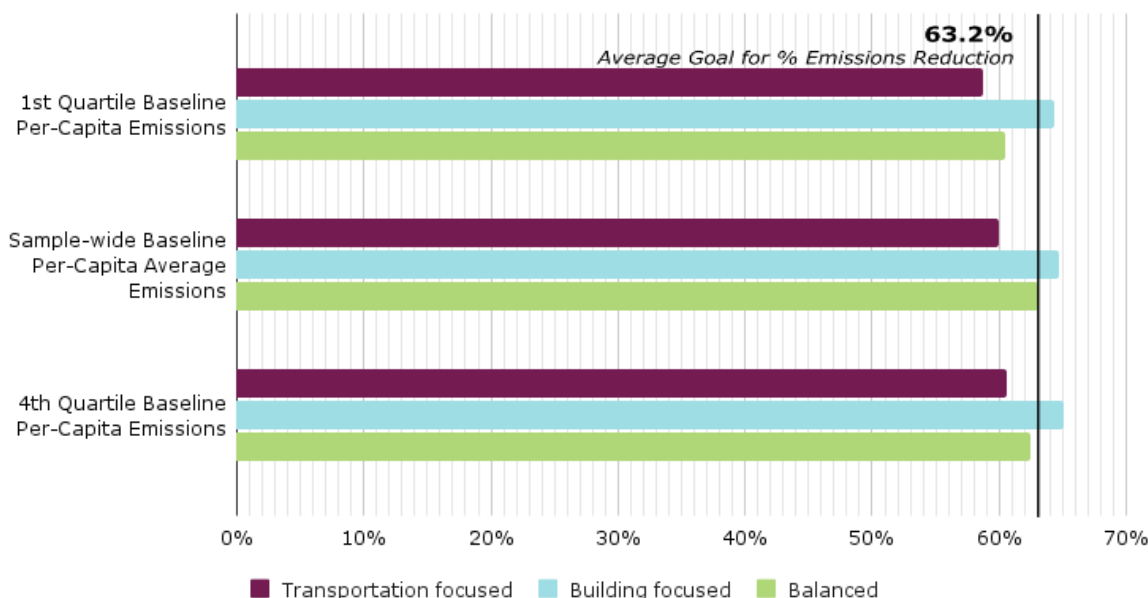


Figure 12. Per-capita SBT analysis for the three scenarios described previously.

Figure 12 shows the emissions reductions that can be expected for each of these community types under each of the three HIA scenarios described in the previous section.

Despite the very different starting per-capita emissions, both very low and very high emissions communities are able to reduce per-capita emissions by over 60% under the building focused scenario, and by 60-63% under the balanced scenario.

On an absolute basis, those communities that are starting with lower per-capita emissions have far fewer reductions needed to meet their SBT. Whether this is because these communities have already enacted and implemented climate policies or whether they benefit from an already relatively clean grid mix, these communities can achieve similar per-capita reduction targets on a percentage basis as the higher emissions communities, but need to reduce absolute emissions by a far smaller amount to do so.



Comparison by Climate Zone

Next, we look at communities across different climate zones; *Figure 13* shows baseline per-capita emissions for communities in warm (ASHRAE climate zones 1-3), medium (zones 4-5), and cold (zones 6-7) climate zones.

Per capita emissions by sector and climate zone

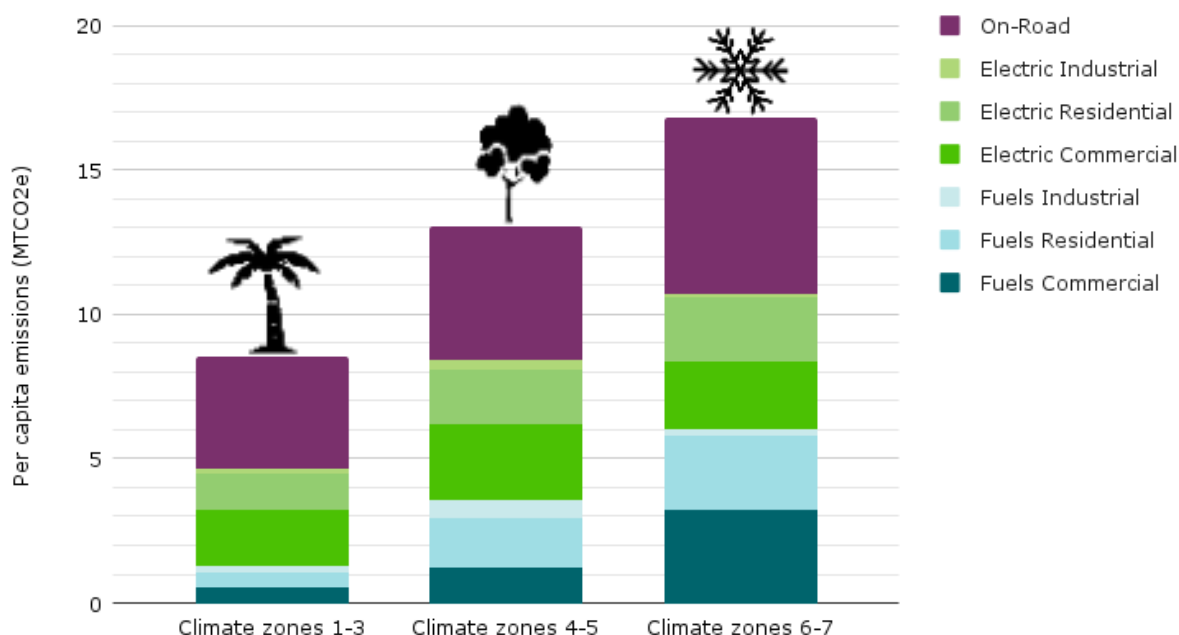


Figure 13. Emissions profile of communities broken down by climate zones.

As would be expected, residential and commercial fuel use make up a significantly larger proportion of emissions in colder climates due to the fuel used for heating. Electricity use also increases somewhat in colder climates, which may be attributable to the fact that even in the coldest parts of the US, a portion of buildings use electric heat, generally older, inefficient electric resistance heating.

For each climate group, we compared the results of the HIA scenarios, the results of which are shown in *Figure 14*. Because of the predominance of heating fuels in colder climates, the building focused scenario is relatively more effective than the transportation focused scenario for those communities. For warmer climates, the building focused scenario is also more effective than the transportation focused scenario, but to a lesser degree. In all climates, at least one of the HIA scenarios produces per capita emissions reductions of 60%.



Per capita emissions reduction in 2030 by climate zone and scenario

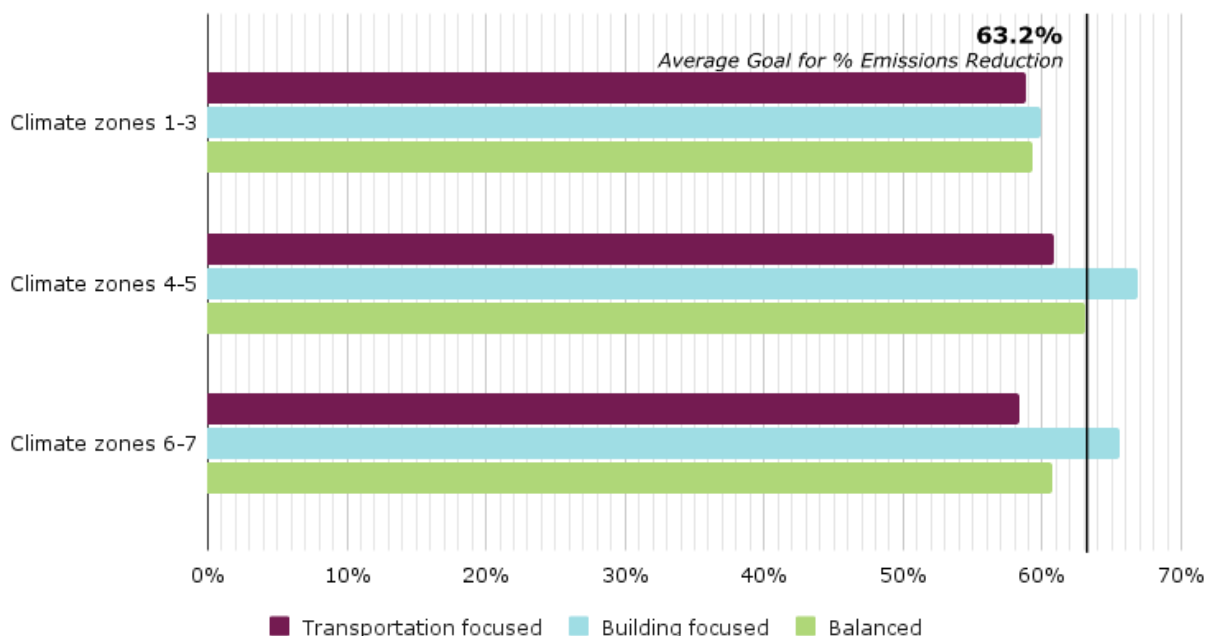


Figure 14. Climate zone SBT analysis for the three scenarios described previously.

What these scenarios do not explicitly illustrate is the relative importance of electrification in certain areas and efficiency in others. For warmer climates, where there is a smaller amount of fuel used for space heating and domestic hot water, electrification has a smaller impact, while efficiency can achieve significant reductions. Conversely, in northern climates, electrification will have a much greater impact, since efficiency might be limited to reductions in fuel use of only 10-30%, while electrification + efficiency + a clean grid can effectively zero out emissions from the building sector over time.

Comparison by population density

Finally, we look at communities by population density; *Figure 15* shows per-capita emissions for communities with high population densities (above the median density for our sample), and low population densities (below the median value).

As would be expected, lower density communities have higher transportation emissions. Lower density communities also have significantly more emissions from industrial energy use, indicating that energy-intensive industries tend to be located outside of densely populated areas, as one would expect (*Figure 16*). Even though lower density communities have higher transportation emissions than higher



density communities, the transportation-focused scenario is only marginally more effective in the lower density communities. Conversely, the buildings focused scenario is relatively more effective in the higher density communities.

Per capita emissions by sector and population density

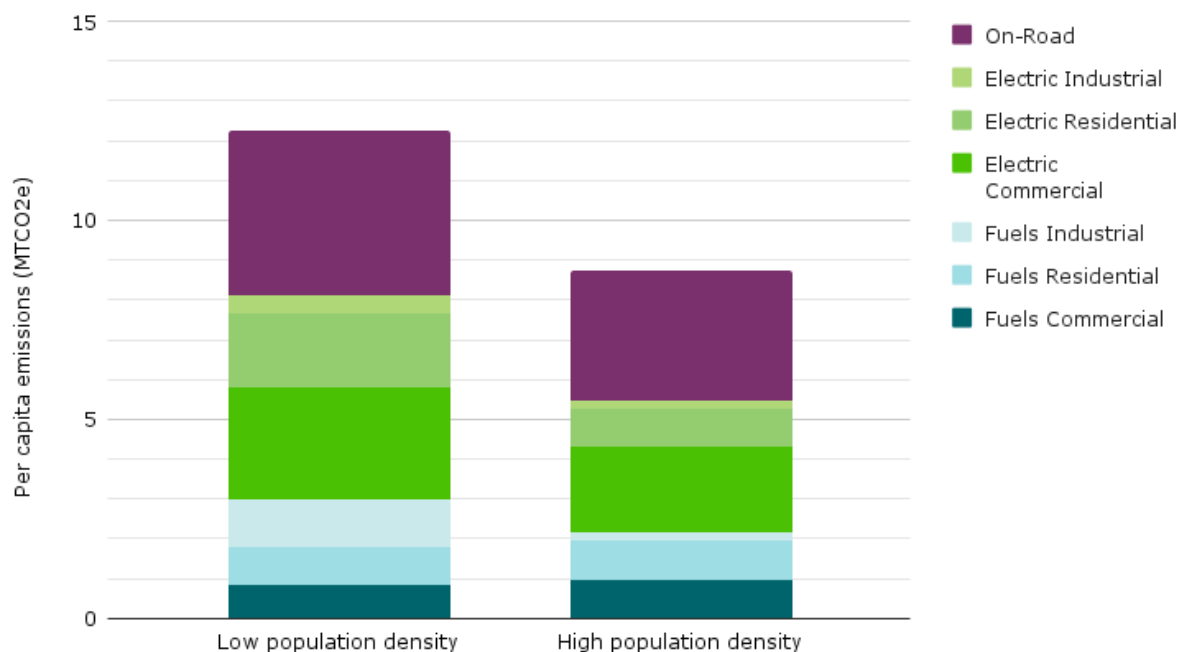


Figure 15. Emissions profile for cities broken down by high population density and low population density separated by the sample wide median of 4,000 people per square mile.

Per capita emissions reduction by population density and scenario

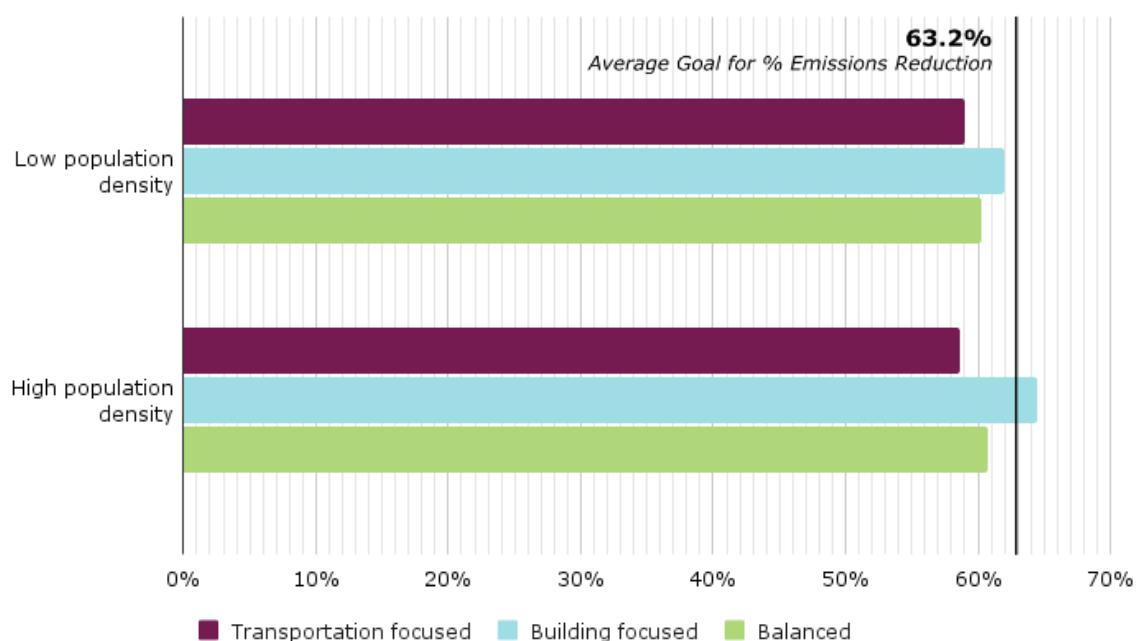


Figure 16. Population density SBT analysis for the three scenarios previously described. 18



Conclusion

While reaching a 63% SBT emissions reduction goal by 2030 will require significant action among local governments along with support from states, utilities, and the federal government, our analysis shows that achieving these goals is possible, and builds off of trends that are taking place already. We need cleaner electrical grids, which is the foundation for any successful program, and there is strong evidence that most grids in the U.S. will continue to add renewables and retire fossil fuels. We need a rapid increase in EV adoption, and there is both a shift in consumer preference in this direction as well as strong policy support (Federal and often State as well) for this transition. Lastly, there is increased awareness of the link between heat pumps, air quality, human health, and equity, as well a rapid increase in available technologies to drive building electrification to support existing building efficiency and code initiatives. The challenge is not figuring out what to do, but rather accelerating the change taking place to bring benefits to local communities and align the pace of this change with that needed to maintain temperatures at or below 1.5 C.

We believe that adopting and making a serious attempt to meet a SBT is the best approach for local governments to maximize the impact of their climate actions and meet the urgency of the current moment.

This initial working paper will be followed by additional analysis on this topic in 2022. ICLEI welcomes reader comment and input to help shape future analysis. Contact us at iclei-usa@iclei.org

Acknowledgements. The authors would like to thank ICLEI intern Blayne Libby and the 138 communities whose GHG inventories provide the basis for this analysis.

Suggested citation

Radoff, J. Yewdall, E. Katz, M. 2021 "ANALYSIS OF U.S. LOCAL GOVERNMENT SCIENCE-BASED TARGETS AND PATHWAYS TO ACHIEVE THEM IN THE RACE TO ZERO" Working Paper. Denver, Colorado ICLEI Local Governments for Sustainability USA available online at <https://icleiusa.org/resources/analysis-of-us-local-government-science-based-targets-and-pathways/>.



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