

Cities and Climate Change: Understanding Cities' Greenhouse Gas Emissions Reduction Target

Kevin Chung¹, Jaesung Lee², Jongchan Lee³, and Royce Oh⁴

¹ Korea International School, Korea

² Youngsan International School, Korea

³ North London Collegiate School, Korea

⁴ Amador Valley High School, USA

INTRODUCTION

More cities around the world are turning their attention to the issue of climate change through methods of mitigation and adaptation (Bulkeley, 2010, Corban, 2009, Hoffstad et al., 2022). Reforestation, the development of renewable energy resources, and fuel substitution are just a few of cities' contributions towards greenhouse gas reductions. Cities also adapt to climate change, considering how best to handle climate disasters such as floods, droughts, hurricanes, or heatwaves (Keith et al., 2021). As climate impacts are rampant in most parts of the world, cities in both developed and developing countries are working to reduce further environmental impact.

In this report, we document to what extent cities have taken action to mitigate climate change and whether they have adopted carbon reduction targets in alignment with the Paris climate deal. The findings illuminate the vital role of cities in global carbon reductions as nations try to accomplish a net-zero carbon economy by 2050.

CLIMATE CHANGE AND CITIES

The Paris Climate Agreement proposed a goal to reduce greenhouse gas emissions to both mitigate and adapt to the inevitable temperature change. By recommending nations to pursue temperature rises only up to 1.5°C or 2°C, depending on the rigorousness that each country wants, the global community will strive to decrease temperature (IPCC, 2022).

To this end, counties' climate actions have diverged but showed similarity in that they focused on information sharing and infrastructure update. Some countries choose to educate and warn the public about the dangers of global warming while others may actively improve water infrastructure or management (Lee, 2022). Cities have been at the core of countries' climate actions since they are more severely affected by climate change due to pollution intensity and

high population (Hoffstad et al., 2022). With more factories and electronic devices running on a daily basis, cities are emitting more greenhouse gasses than nature can handle. Rising temperatures cause extreme weather events, from floods to storms and even diseases, driving serious health concerns (Kidd et al., 2021). Not only is nature at stake, but the health of people across the globe is also being damaged by climate change.

With energy efficiency strategies and emission reduction plans in mind, countries have set concrete climate goals for their cities. Electric vehicles, renewable electricity, and new policies on energy are just some of the major contributing factors to climate goals. In the U.S., cities have been particularly active in pledging climate goals, and some cities aggressively adopted an ambitious goal of "100% clean energy" in alignment with these climate action plans (ASF, 2020).

Cities' Greenhouse Gases (GHG) Emissions Reduction Target

It is known that 25% of the cities in the world account for half of the greenhouse gasses (Rumney & Binnie, 2021). On the other hand, ten of the top major emitting countries accounted for two-thirds of all the gasses emitted in 2016 (Kuramochi et al., 2020). It is evident that GHGs need to be reduced in developed countries and in particular urban areas.

To this end, city governments develop climate action plans including carbon reductions goals. Implementing or planning these goals in a specific way could help cities lower emissions more efficiently. First, more ambitious plans could incite cities to work at their goal faster and more rigorously (Wei et al., 2021). Prior scholars found location, temperature, and resource accessibility, affect how much and what type of greenhouse gasses a city emits (Kennedy et al., 2009). Understanding the causes of increasing GHG in city settings would help identify what GHGs are the most for them and what's the most beneficial and cost-effective way to reduce the emissions. Since every city is different in what type of gasses is the most prevalent, cities' climate plans should be carefully thought out, bringing different opinions from officials to figure out the most effective and cost-friendly way.

Even though plans might be planned to be as successful as they can be, there is still one problem, which is execution. There are some solutions to make sure that these plans are carried out and work effectively. Prior literature points out that local climate change plans should be associated with high government plans. Fuhr et al. (2018) explain that smaller cities do not have much power to make changes, making ambitious goals harder to achieve. Accordingly, there needs to be support from higher-level governments that could provide resources to cities (AFS, 2020). Also, it is known that having a climate action plan aligned with a

higher government could allow cities to make more impactful or substantial developments (Jaccard et al., 2019).

Data and Methods

In this study, we relied on data for cities from Carbon Disclosure Project (CDP). The CDP data was self-reported by governments through an annual questionnaire and includes information on emissions, climate actions, and climate risks. The 2021 Cities Emissions Reduction data included 1032 cities, and we used the dataset and relied on frequency distribution to learn about the characteristics of cities with emissions targets. The CDP questionnaire included if a city set emissions targets and if the target aligns with the global 1.5-2 °C pathway set out in the Paris Agreement.

Also, city governments were asked if the target is aligned to a requirement for a higher level of government. To determine if cities with carbon emissions target, we put the country's development status, being guided by the World Bank's Country Classifications by Income Level (World Bank, 2022). Lastly, we counted frequencies of cities by population size to determine if city resources create variances in cities' adoption rate of emissions target.

RESULTS

(1) How many cities adopted temperature-based GHG emissions targets?

The disclosure of cities' carbon emission targets showed unevenness. Out of 1032 cities, 401 cities provided information regarding their GHG emissions target. Other cities haven't disclosed it. Overall, 28 cities, 7% within the total number of cities, do not have any emission targets whereas other 373 cities have emission targets. 113 cities, which is 23% within the cities, had a mild target to decrease the temperature by 2 °C, and 258 cities, which is 64.7% within the cities had a rigorous target to reduce the temperature increase to 1.5 °C. Out of the 112 cities that aimed for a mild target, the majority of the countries come from Western countries such as the United States, Canada, and EU. Out of the countries that targeted a rigorous plan, again, most of the western cities took up the portion and some cities from East Asia and South America targeted a rigorous plan. Table I shows the frequency distribution of cities with carbon emissions target that are temperature-based under the Paris climate deal.

Table 1.

Cities with carbon emission target in alignment with the global 1.5~2 °C pathway set out in the Paris Agreement

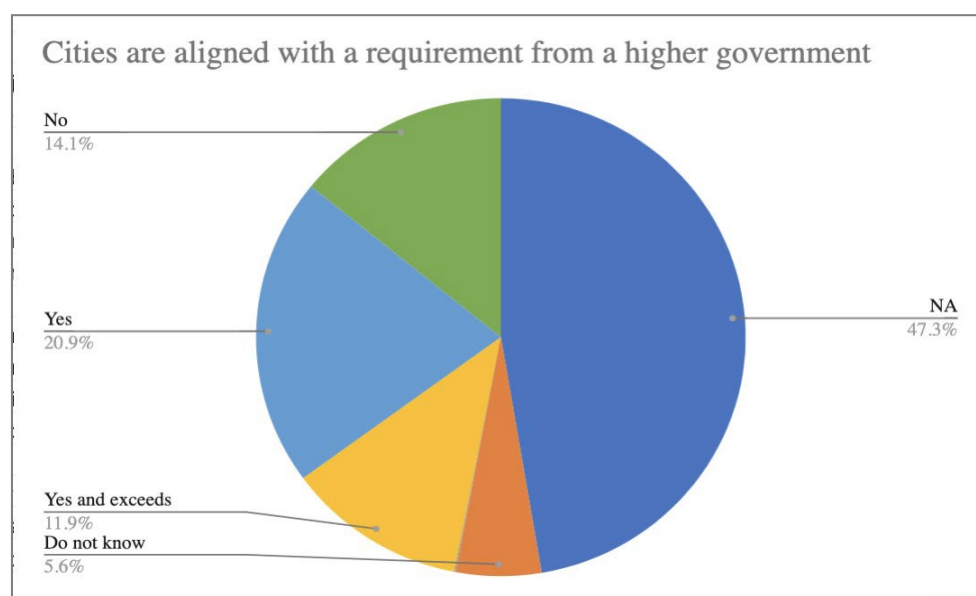
Emission target	Number of cities	Percentages in the Sample
No	23	7%
Yes - 2.0 °C	113	28.3%
Yes - 1.5 °C	258	64.7%

(2) Does this target align to a requirement from a higher level of government?

Out of 1032 cities, there were 147 cities that did not align to a climate goal requirement from a higher-level government. 216 cities answered their alignment. Interestingly, 123 (11.9%) cities had and exceeded the requirement. However, 223 cities without requirements from a higher government still reached the temperature goal, demonstrating cities proactivity in climate governance (ASF, 2020). There are also large numbers of cities (276) who neither aligned with a requirement nor met the goal.

Figure 1.

Percentages of cities that align to a requirement from a higher government



(3) Are cities located in developed countries or developing countries?

Of 1032 cities, 43% of them were located in developing countries, and 57% of cities were in developed countries. About 86% of cities who met the 1.5°C target originated from developed countries, and 79% of cities who met the 2°C target were from developed countries. The cities in developing countries who met the 1.5°C target goal were from Mexico, Colombia, Indonesia, Portugal, Philippines, and Brazil. The cities located in developing countries that met the 2°C goal were Costa Rica, United Republic of Tanzania, Chile, Indonesia, Portugal, and Taiwan.

Figure 2.

Countries that had cities with 1.5°C temperature target under the Paris Climate Deal

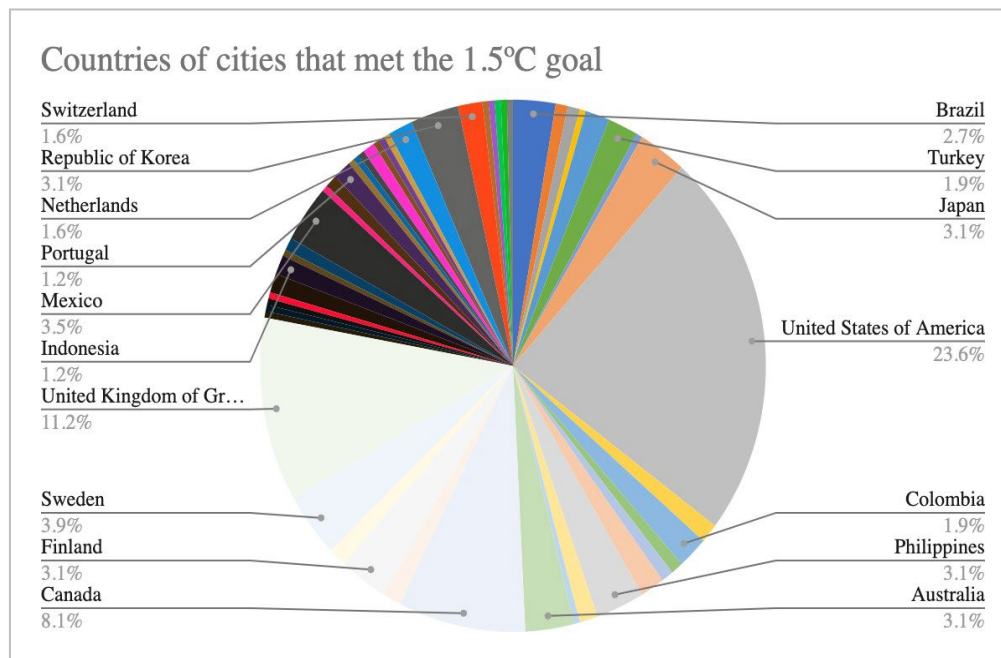
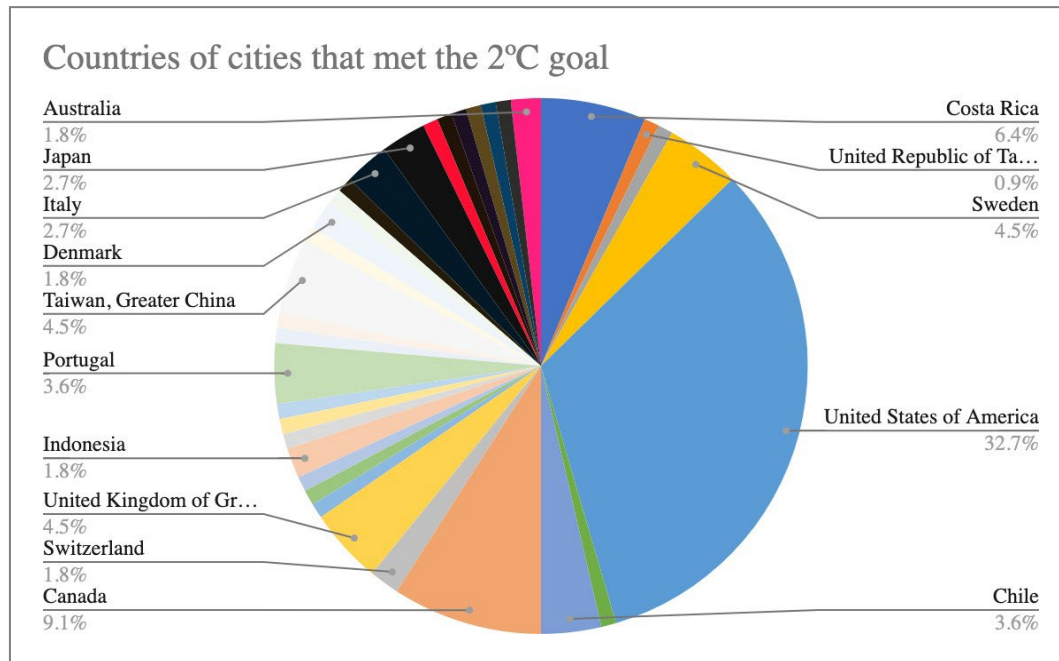


Figure 3.

Countries that had cities with a 2°C temperature target under the Paris Climate Deal



(4) Are cities with carbon emission target small or large?

The population of each city is categorized into four groups by population size; cities with a population of 0 ~ 25,000, 25,000 ~ 100,000, 100,000 ~ 1,000,000, and above 1,000,000, respectively. Amongst 1,032 cities, there were 190 cities without population data and those cities were categorized to the “No data” category (Table 2).

41.4 % of cities having carbon emission target are categorized in “100,000 ~ 1 million” portion which was the greatest amongst the cities. 17.4% of cities had a population that is between 25,000 and 100,000, while 14.2% of cities had a population that exceeds 1 million. Cities below the population size of 25,000 took account of 8.5%, marking the smallest segment. The outcomes suggest the limitation of smaller cities to making climate goals and the need for financial and technical support from higher-level governments (Fuhr et al., 2018, AFS, 2020).

Table 2.*Cities with carbon emission target by population size*

Population size	Number of cities	Percentage in the Sample (%)
0 ~ 25,000	88	8.5%
25,000 ~ 100,000	180	17.4%
100,000 ~ 1,000,000	427	41.4%
Above 1,000,000	147	14.2%
No data	190	18.4%

DISCUSSION AND CONCLUSION

Cities hold enormous potential for climate mitigation since more than half of the world's population lives in urban areas, and the urban population continues to grow. This phenomenon elicits the need to develop city emission reduction targets. In this study, we aimed to document to what extent cities adopted carbon emission reduction target and what features cities hold. Knowledge of cities' carbon goals and factors that may affect cities' climate goal setting would help understand if cities can be trusted as a critical actor for climate mitigation. There are two primary research contributions to the literature of climate governance.

First, our study underpins that cities need to pay more attention to carbon emission reduction goals that are aligned with the global 1.5-2 °C pathway set out under the Paris Agreement. Only one-third of cities aligned with the Paris agreement pathway, and many of them answered the ignorance of their alignment. This means more cities need to put their carbon reductions in a large context, and enhancing the rigor of climate targets can lead to cities' much larger contributions to overall global climate mitigation.

Second, for cities to adopt climate emissions reduction target, higher government guidance and support are essential. As indicated by our results, smaller cities minimally declared their carbon emissions targets, warranting higher governments' support and guidance as their resources and technical understanding of climate goal targets and carbon-reducing technologies or options would be limited (Jaccard et al., 2019). By contrast, cities with more than 1 million residents showed a relatively low climate goal set-up rate. Much-needed support from international policymakers for those megacities is critical, as most populous cities these days are located in developing countries.

Lastly, cities in developing countries could leverage city-based climate governance networks. Cities without climate goals would be most likely inactive or less concerned about carbon reductions, and residents would be affected by regional climate change. As mayors in developed countries create learning and knowledge-sharing networks to cost-efficiently reduce carbon emissions and innovate climate technologies (ASF, 2022), it is essential for mayors of cities in developing countries to pursue support from such climate governance networks. In doing so, cities across the world would advance equally in climate mitigation and urban sustainability. Future research could research the setbacks of cities in developing countries without climate targets.

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