

Cities at the forefront: current modelling practices and opportunities for integrated assessment models

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- Over half of the global population are living in urban areas
- Increased prominence of cities in UNFCCC and the forthcoming IPCC Special Report on Cities
- **>10,000 cities have pledged climate actions** that can potentially bridge the gap between national policies and Paris Agreement targets (Hsu et al., 2020).
- **Several methodologies to set targets** and design climate actions in cities, for instance:
 - C40's Deadline 2020
 - Tyndall Centre
 - WWF's One Planet City Challenge
 - Science-based Climate Targets

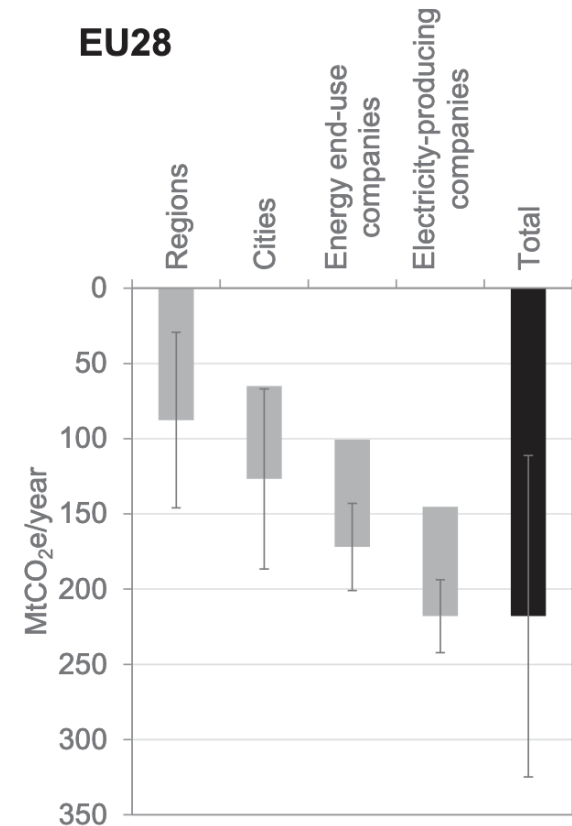


A GUIDE TO THE **CARBON & CO-BENEFITS** DECISION SUPPORT TOOL



WWF'S ONE PLANET CITY CHALLENGE 2025-2026 **THE OPCC IN A NUTSHELL** EMPOWERING CITIES ON THEIR CLIMATE JOURNEY

- Integrated assessment models (IAMs) have shaped global climate action and can also support urban-scale action (Hsu et al., 2019).
- IAMs and cities till now:
 - **Downscaling** global/national results (Van Vuuren et al., 2010), e.g., for setting city targets
 - **Aggregation** of city climate actions in IAMs (Kuramochi et al., 2020)
- IAMs are constantly improving (e.g., better granularity, links with detailed models, inclusion of climate impacts)
- **Another potential use:** What lessons can we draw from the evolution of IAMs to support city-scale climate action?



GHG impacts of implemented city-level pledges (Kuramochi et al., 2020)

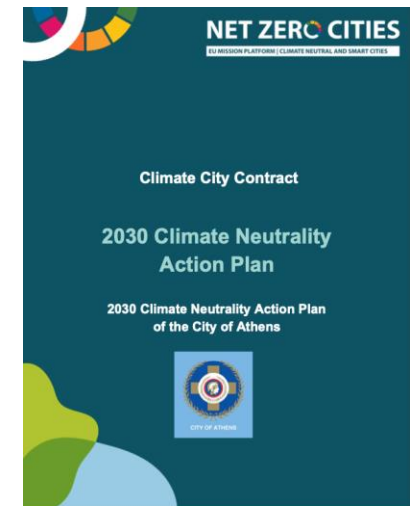
Research questions

- What is the **role of models** (for energy or climate action in general) in the way that **cities set and update their targets**?
- How can we **support this process** based on lessons from using (and improving) IAMs?




Overall approach

- We first examine pertinent methods for setting city-level targets and whether and how they include modelling.
- We then dive into the modelling process for Athens Climate Action Plan to understand specific problems and how modelling developments could potentially help.



Methodology

- Collect emission targets self-reported to CDP in 2024 (*Q6.1: Does your jurisdiction have an active greenhouse gas emissions reduction target(s) in place?*)
- Assess the methodology used to set the target and whether it includes modelling (*Q6.1.1: Specify if target is considered a science-based target (SBT) and the SBT methodology it aligns to*)

 (Carbon Disclosure Project)

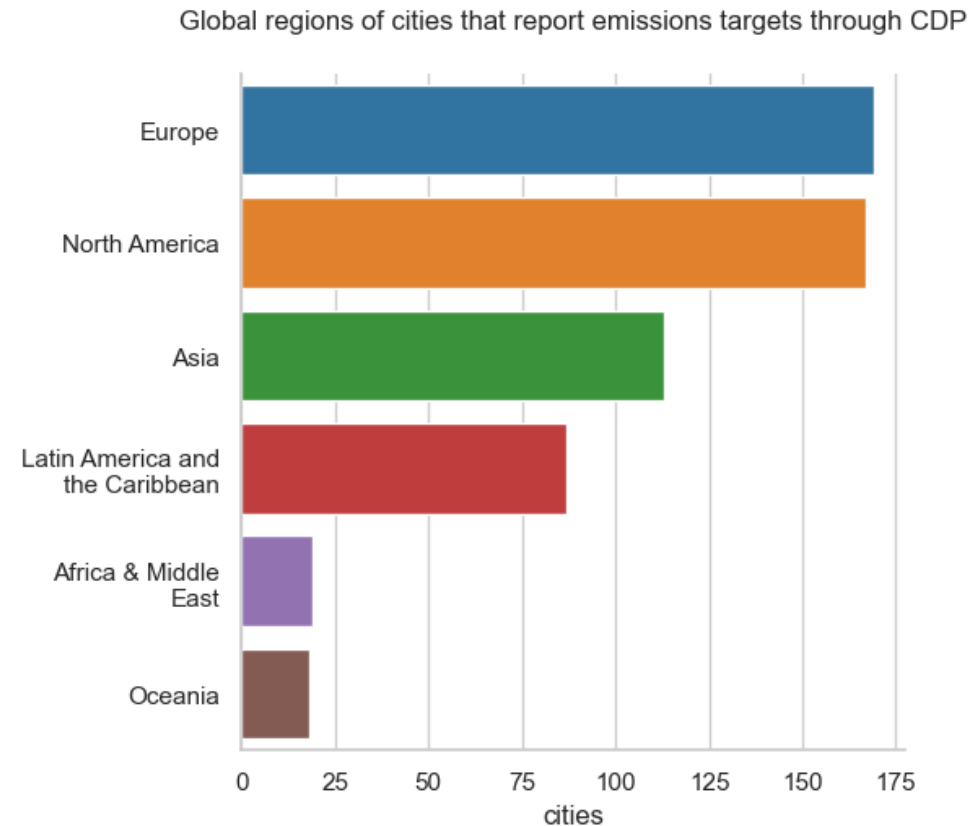
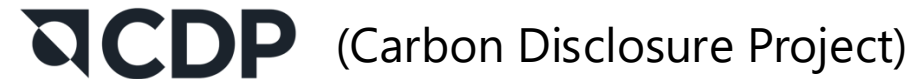


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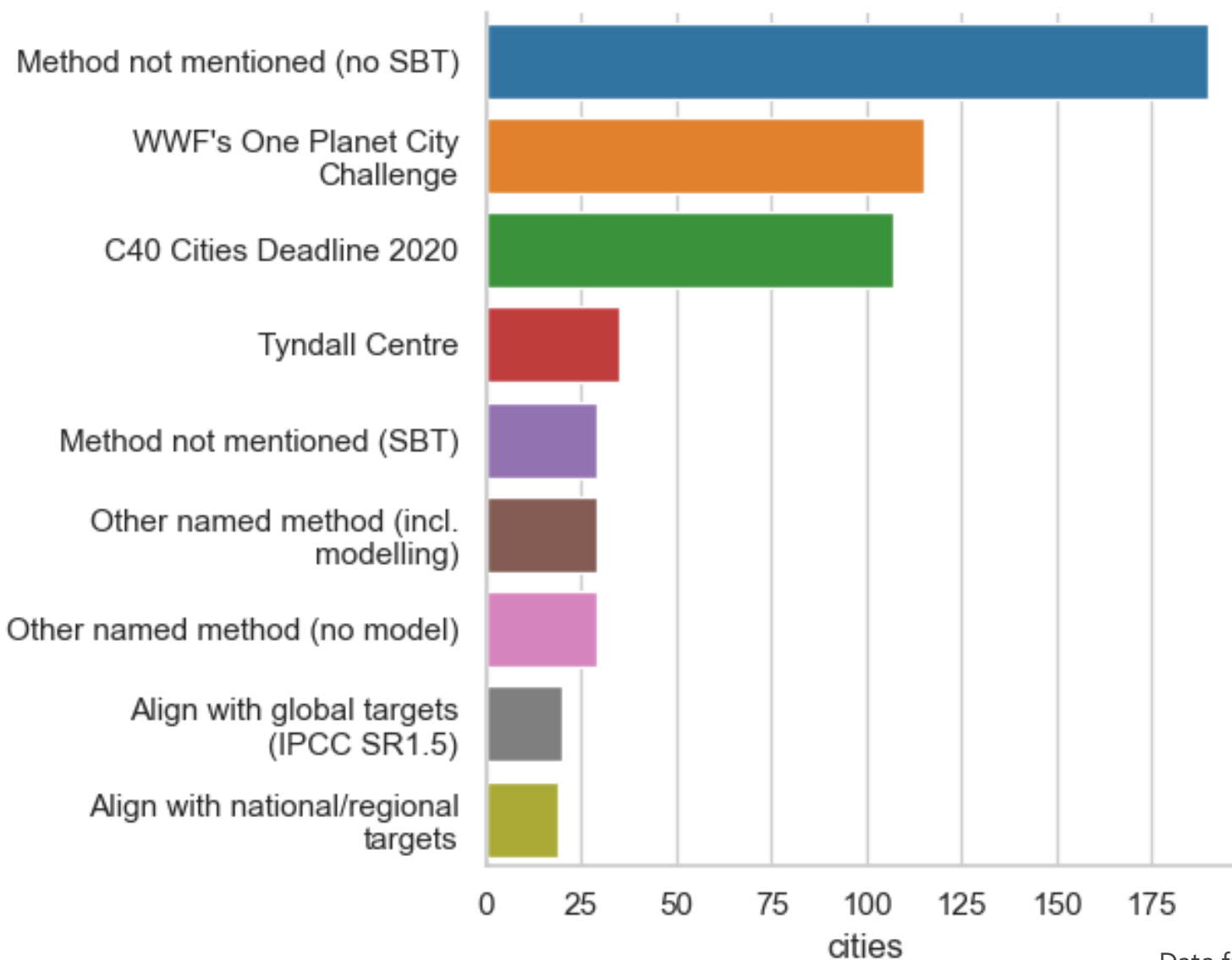
Data sample

- 1390 targets reported by 573 cities in 2024
- Most cities were from Europe and North America



Data from CDP ([2024 Full Cities Public Data](#)); Own analysis.

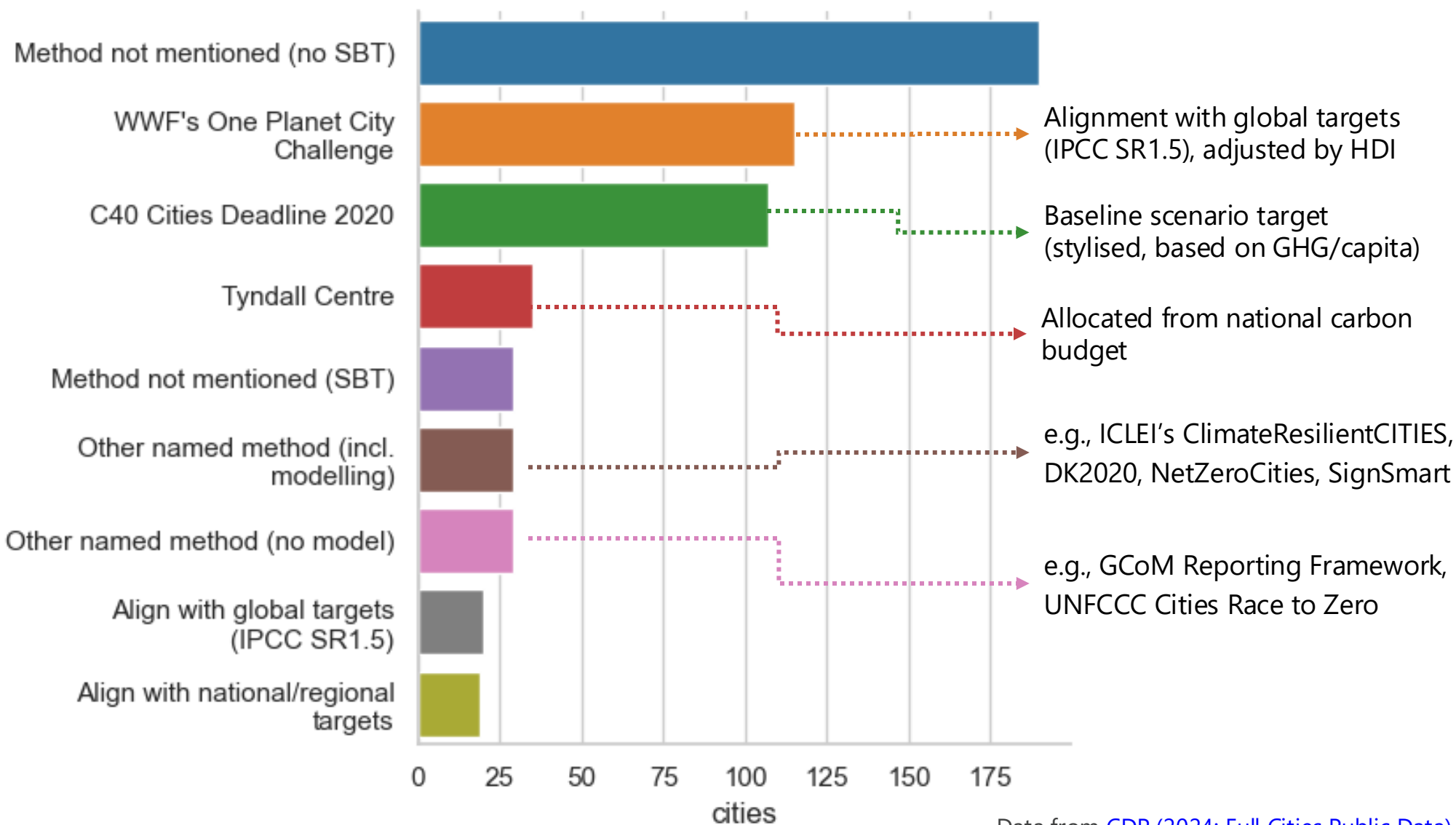




Data from [CDP \(2024: Full Cities Public Data\)](#)



Methods used to set climate targets in cities



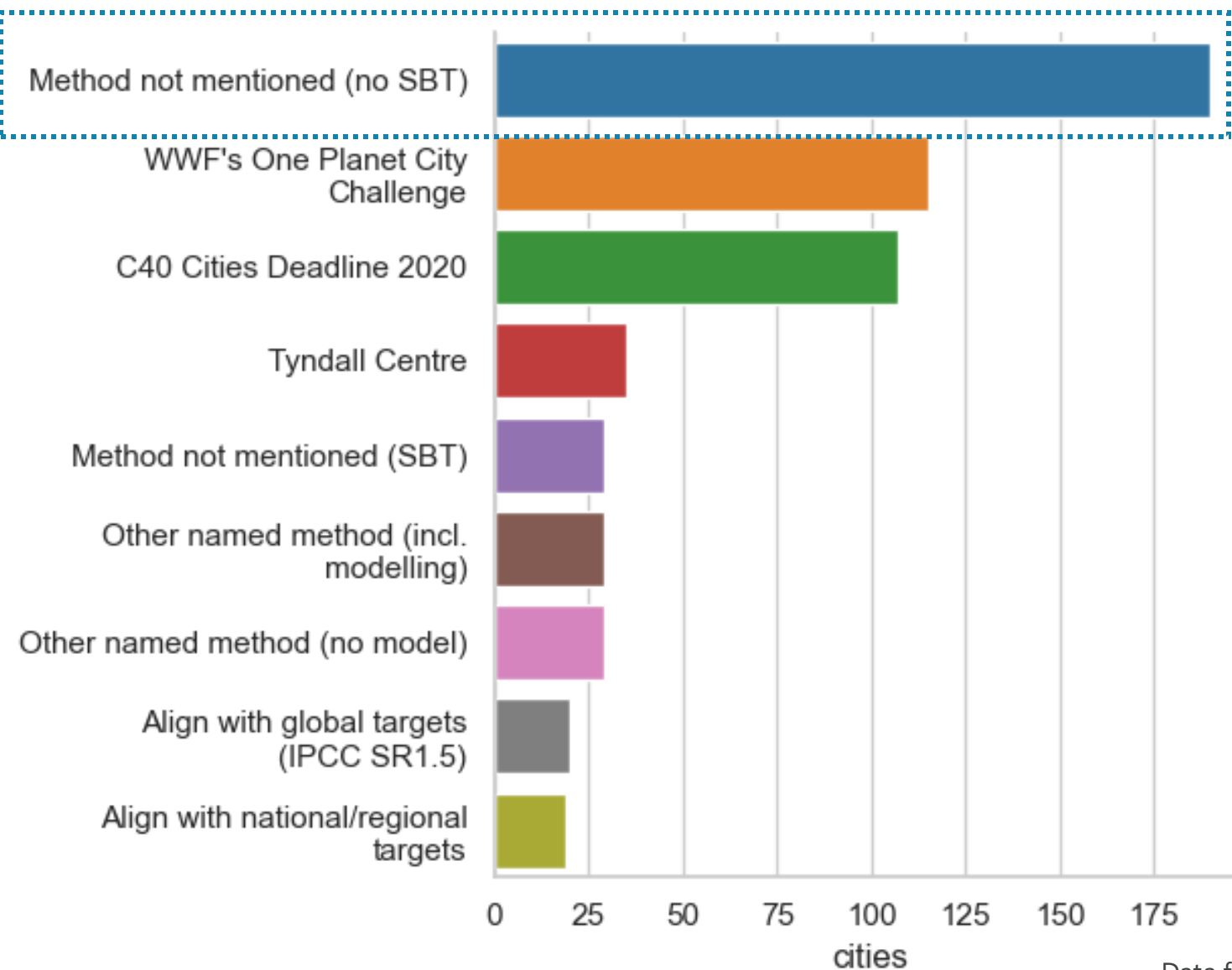
Data from [CDP \(2024: Full Cities Public Data\)](#)



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Methods used to set climate targets in cities



Finding #1: Many cities report that they do not use an SBT method at all.

Example of responses

"Not aligned with an SBT methodology"

"We are not committed to setting a science-based in the next 2 years"

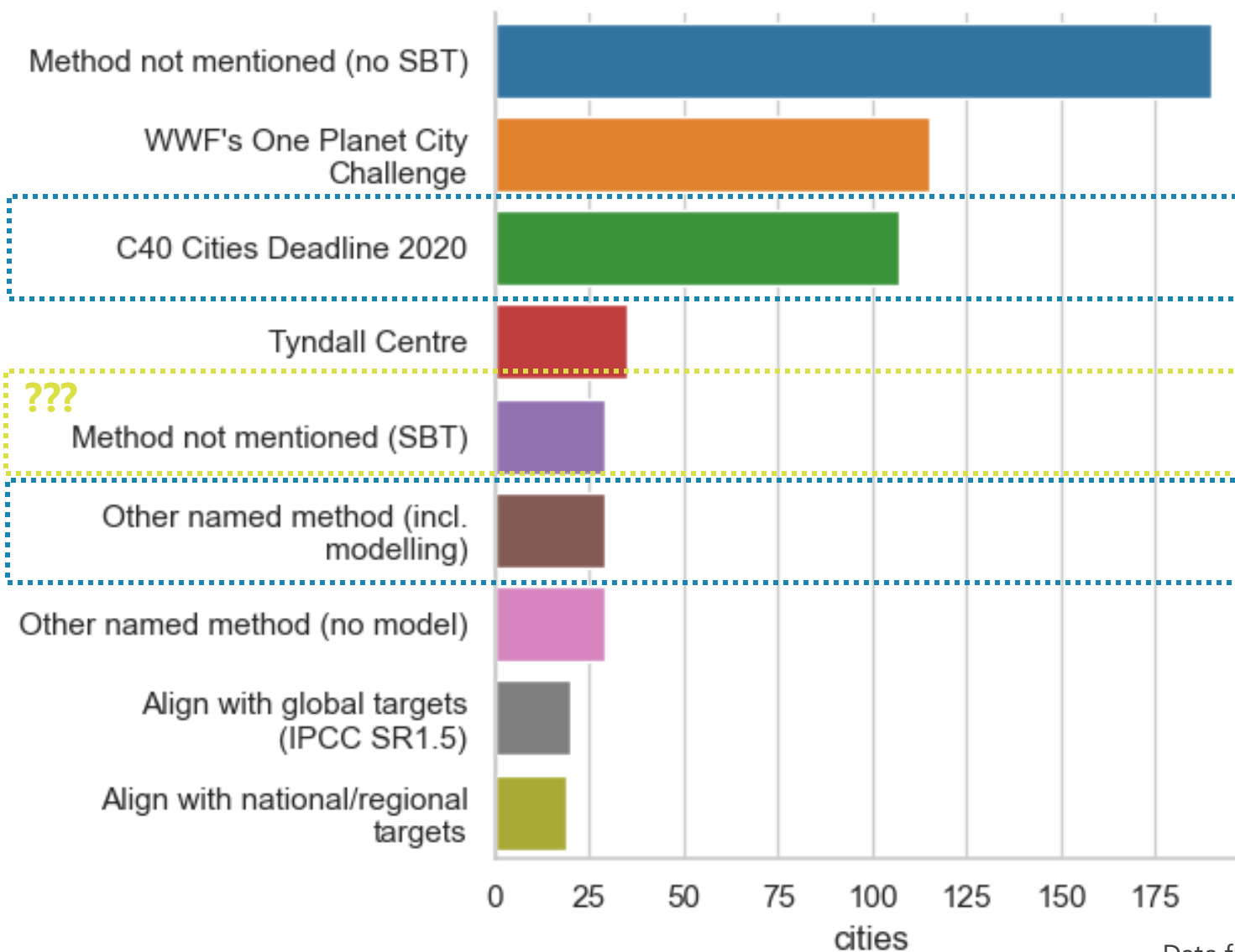
"Other: Intervention based target"

Data from [CDP \(2024; Full Cities Public Data\)](#)



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Finding #2: Even among the methods that are based on SBTi, only some of them include modelling

Example of responses

"AIM/ExSS, IPCC Waste Model"

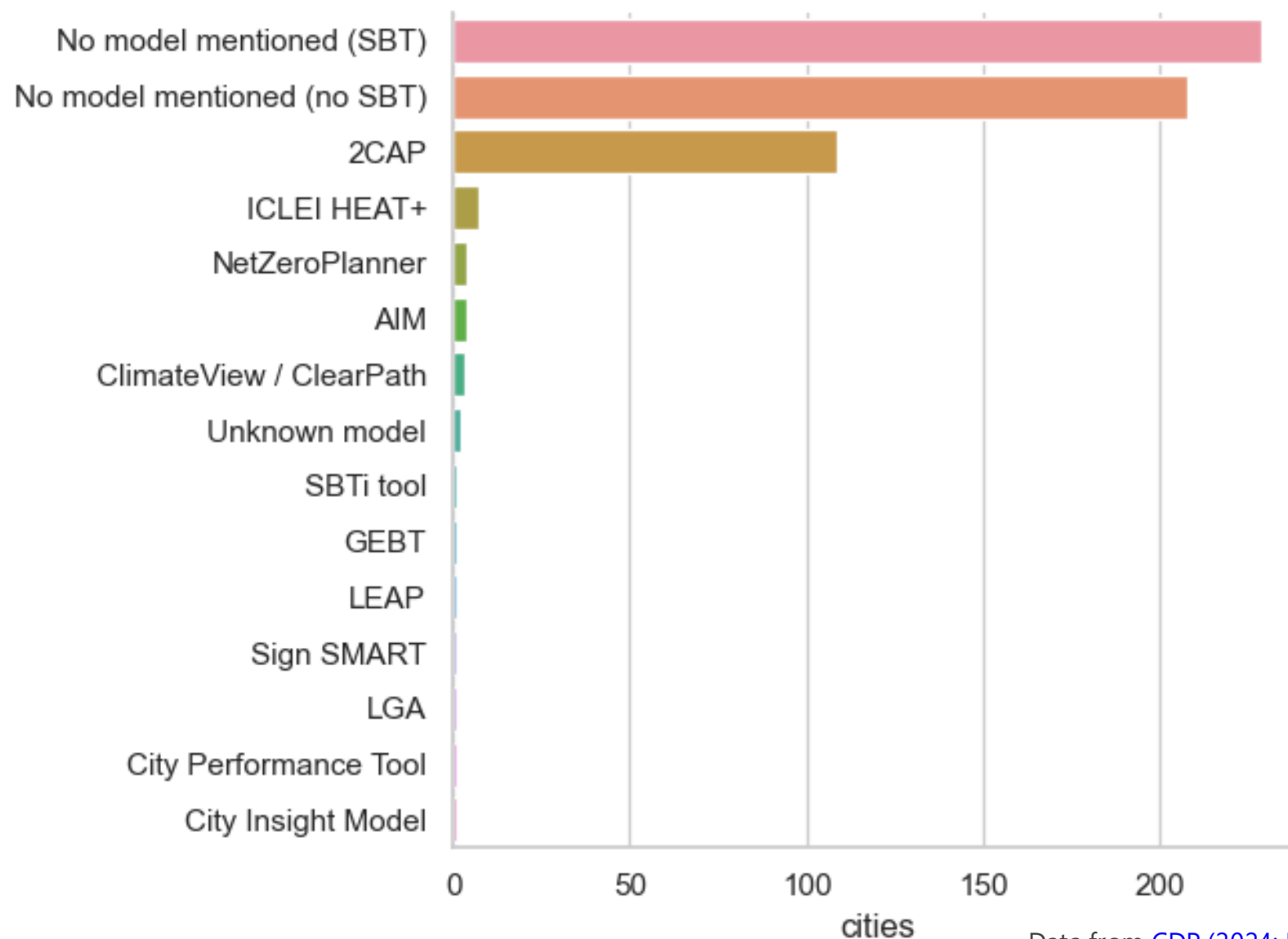
"Used SBTi tool to calculate target"

"Climate Emergency Action Plan target is science-based."

"Small world consulting"

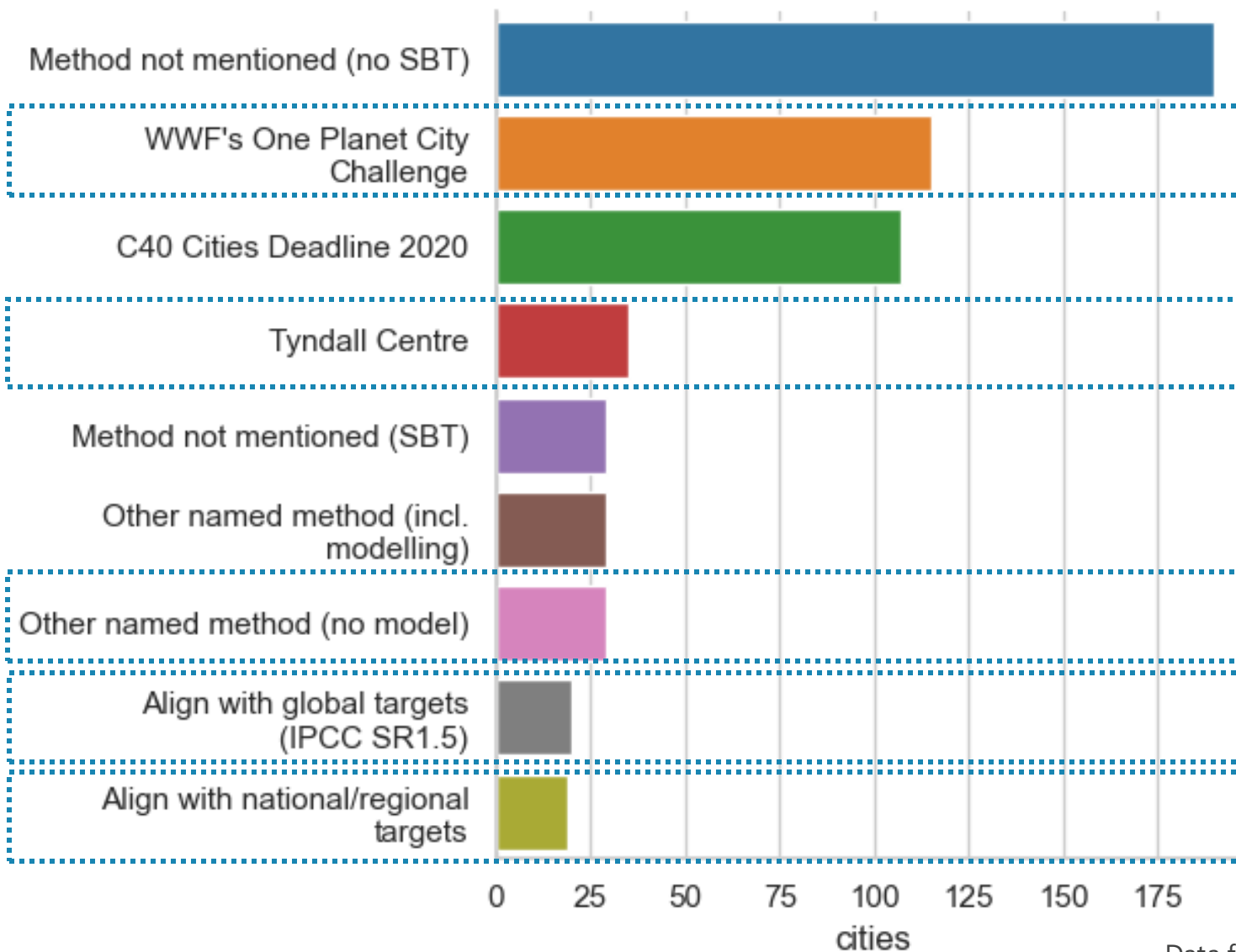
Data from [CDP \(2024; Full Cities Public Data\)](#)

Models used for target setting in cities



Data from [CDP \(2024; Full Cities Public Data\)](#).





Finding #3: Many methodologies are based on aligning with global, regional or national goals (e.g., net zero by 2050) or carbon budgets (e.g., Tyndall Centre)

Example of responses

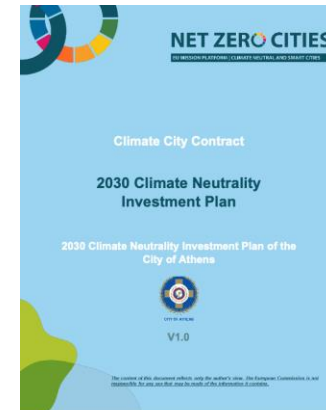
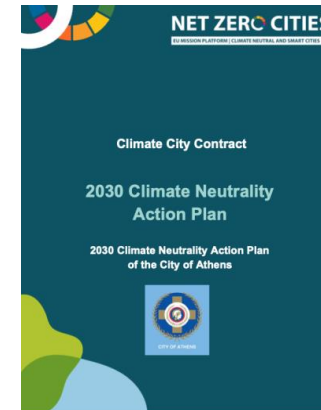
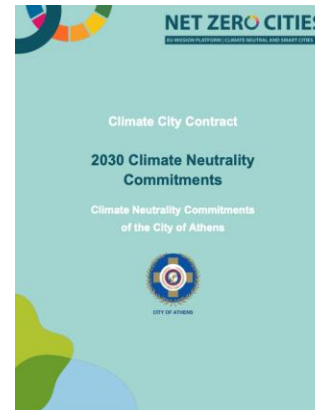
"We consider net-zero by 2050 ... based on CDP guidance."

"Aligns with IPCC"

"Adopted National Target"

"United States contribution to the Paris Agreement"

Data from [CDP \(2024; Full Cities Public Data\)](#)



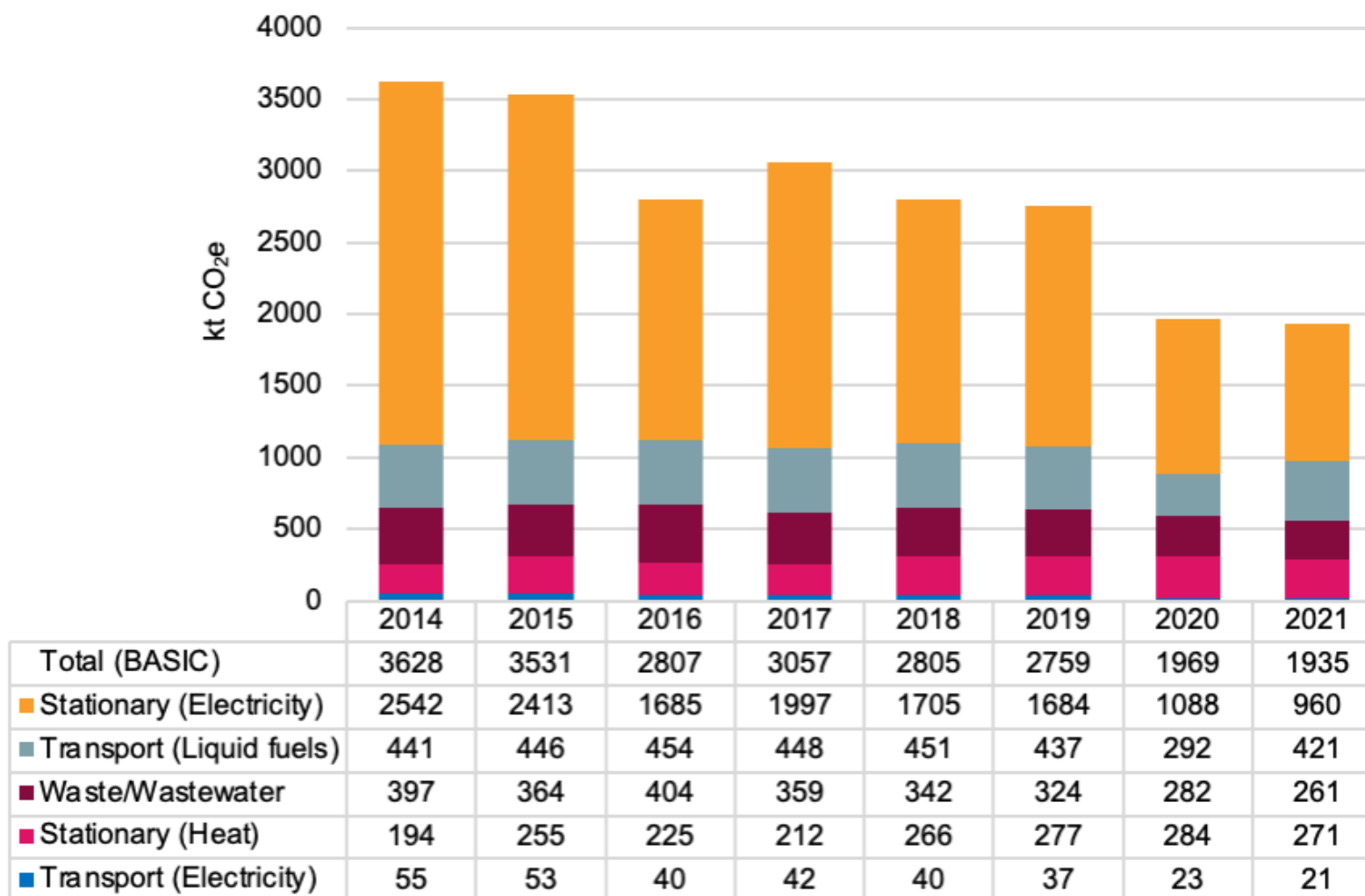
Objectives of the EU Cities Mission

1. Deliver more than 100 climate-neutral and smart cities by 2030
2. Ensure that these cities act as experimentation and innovation hubs to enable all European cities to follow suit by 2050

Athens developed a Climate City Contract (CCC) with the following goals:

1. **Reduction of GHG emissions by 80% by 2030** (compared to a BAU scenario)
2. Offsetting the remaining 20% of the emissions (e.g., with reforestation actions, nature-based solutions)

GHG emissions (BASIC level)

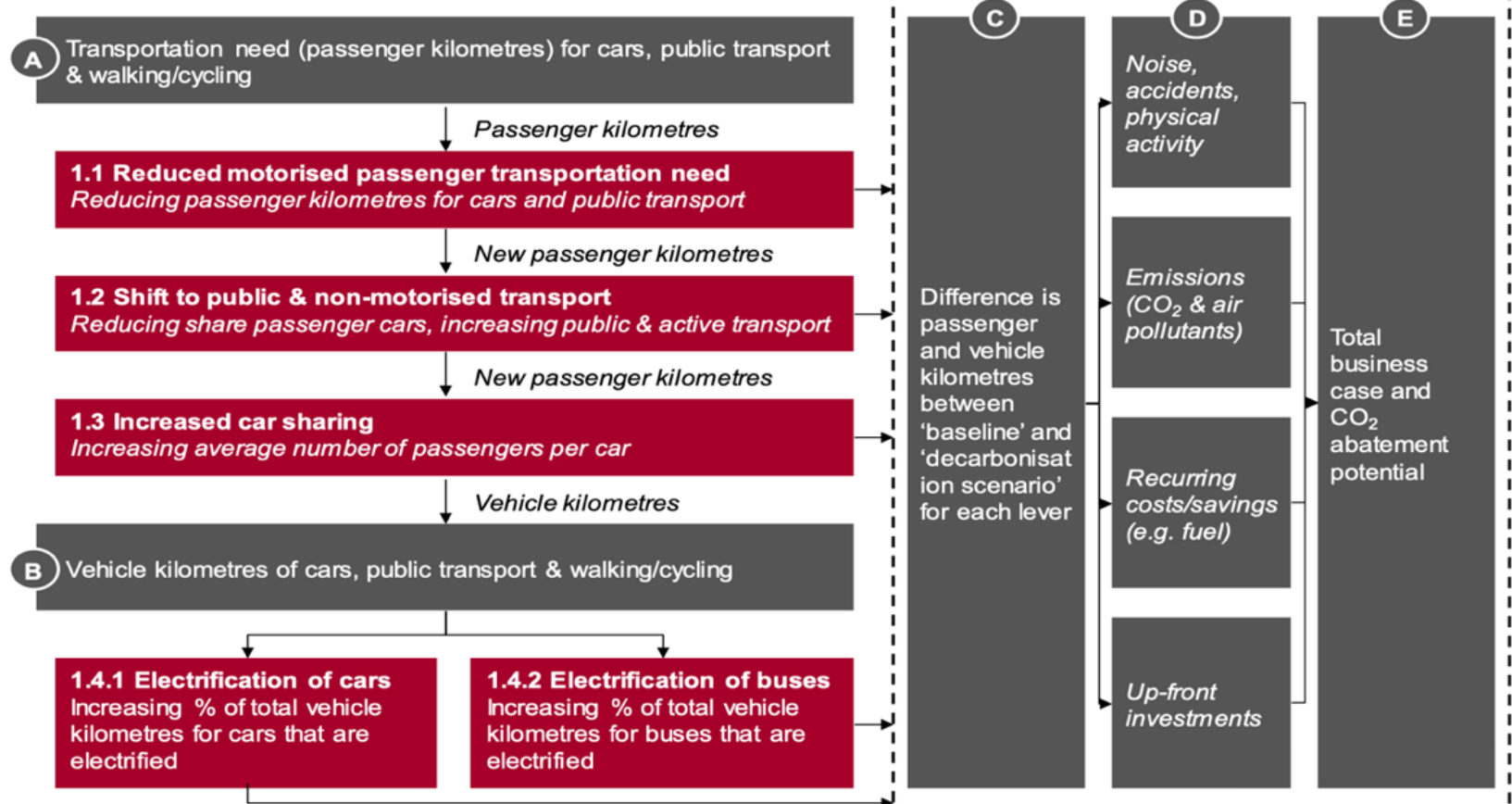


Source: Emission data from the Municipality of Athens' report to CDP; own figure.

PASSENGER TRANSPORT

Overview of modelling methodology

The levers' impact on kilometres travelled modelled in step A-B



Source: Documentation of NZC Economic Model, reproduced from Material Economics (2020)

Sector	Systemic Levers	GHG reduced (ktCO ₂ e)	Resulting targets for 2030
Electricity	Decarbonizing electricity generation	1,420	88% of the electricity demand from RES (at least 16% local)
Buildings	Building renovations (envelope)	23	Energy upgrades of buildings within the Municipality so that at least 34% have an energy class B or higher.
	New energy-efficient buildings	1	
	Efficient lighting & appliances	98	
	Decarbonizing heating generation	107	
Transport	Reduced motorized passenger transportation need	51	Reduce car and motorcycle traffic by 50% compared to 2019
	Shift to public & non-motorized	90	
	Increased car-pooling	31	
	Electrification of cars + motorcycles	45	
	Electrification of buses	5	
	Optimized logistics	9	
Waste	Increased waste recycling	33	Increase recycling and composting to 85%

Gaps in the modelling process

- Lack of detailed interactions between the city and the national and European policies
- Lack of detailed co-benefits quantification
- Simplified calculation of economic costs per different type of stakeholders (what about the equity of the plan?)
- No consideration of climate impacts despite their prevalence in Athens
- No synergies modelled between mitigation and adaptation actions
- No consideration of significant barriers such as grid congestion



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Potential opportunities for IAMs

- Downscaling global & national modelling results e.g., Kikstra et al. (2024)
- Quantify co-benefits e.g., using SDG indicators (van Vuuren et al., 2022)
- Calculate distributional impacts across a wide range of demographics, household types, e.g., Fragkos et al. (2021)
- Assess interactions between mitigation actions and impacts, e.g., Weyant (2017)
- Assess emissions and adaptation potential e.g., Estrada et al. (2019)
- Use feasibility indicators (Jewell & Cherp, 2023) and detailed models.

- Model use for city-level target setting appears to be rather limited
- Many cities align directly with global or national targets or base on carbon budgets (potentially without considering local or national context)
- There are many opportunities for IAMs and other relevant models to inform and improve target-setting and action design in cities



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Limitations and next steps

- CDP data are self reported, find more ways to understand model use in cities and its impacts
- More analysis is needed on how IAMs and other models can help
- Move beyond one-time consulting and create a consistent process for cities to update their targets and plans based on science-based methods and tools

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Thank You

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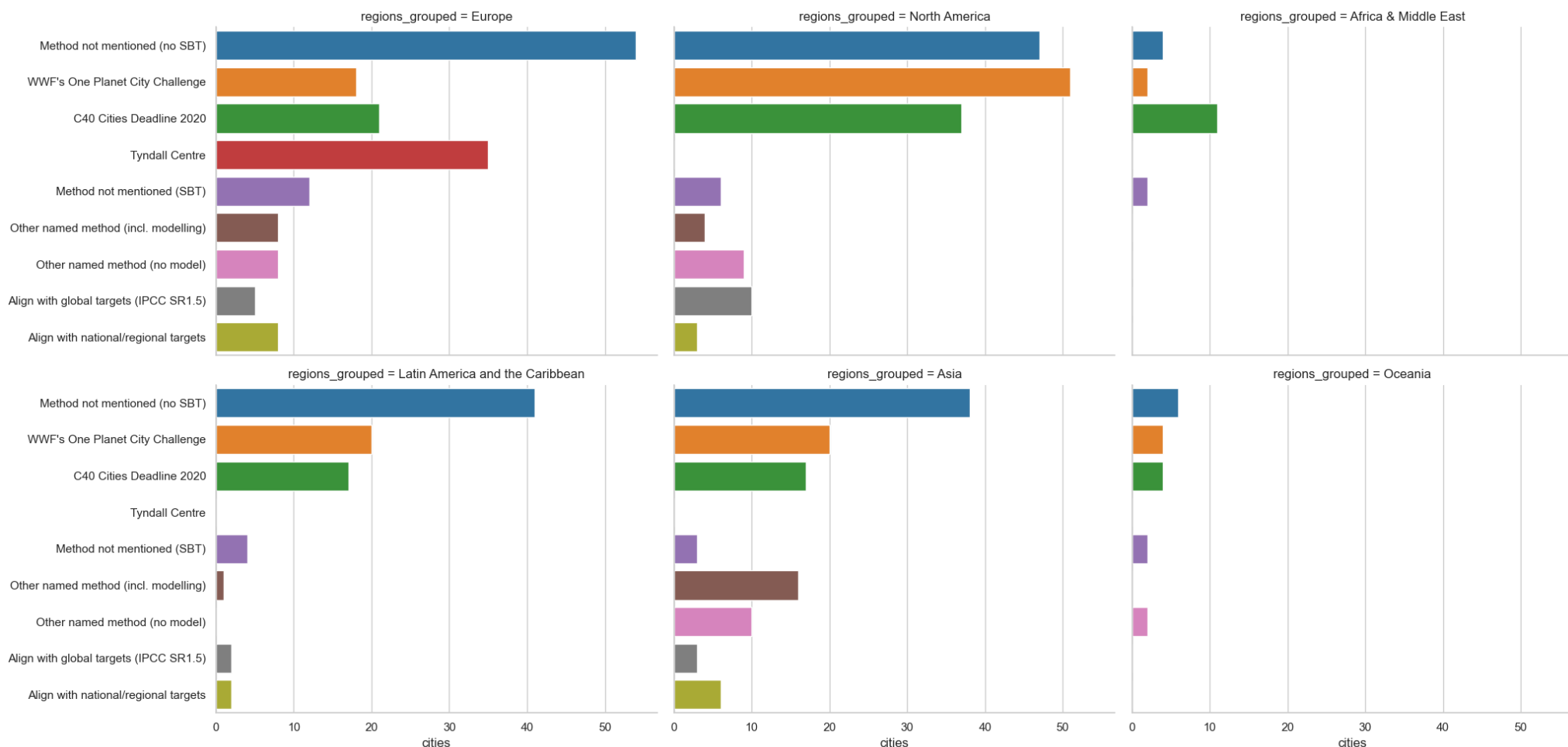


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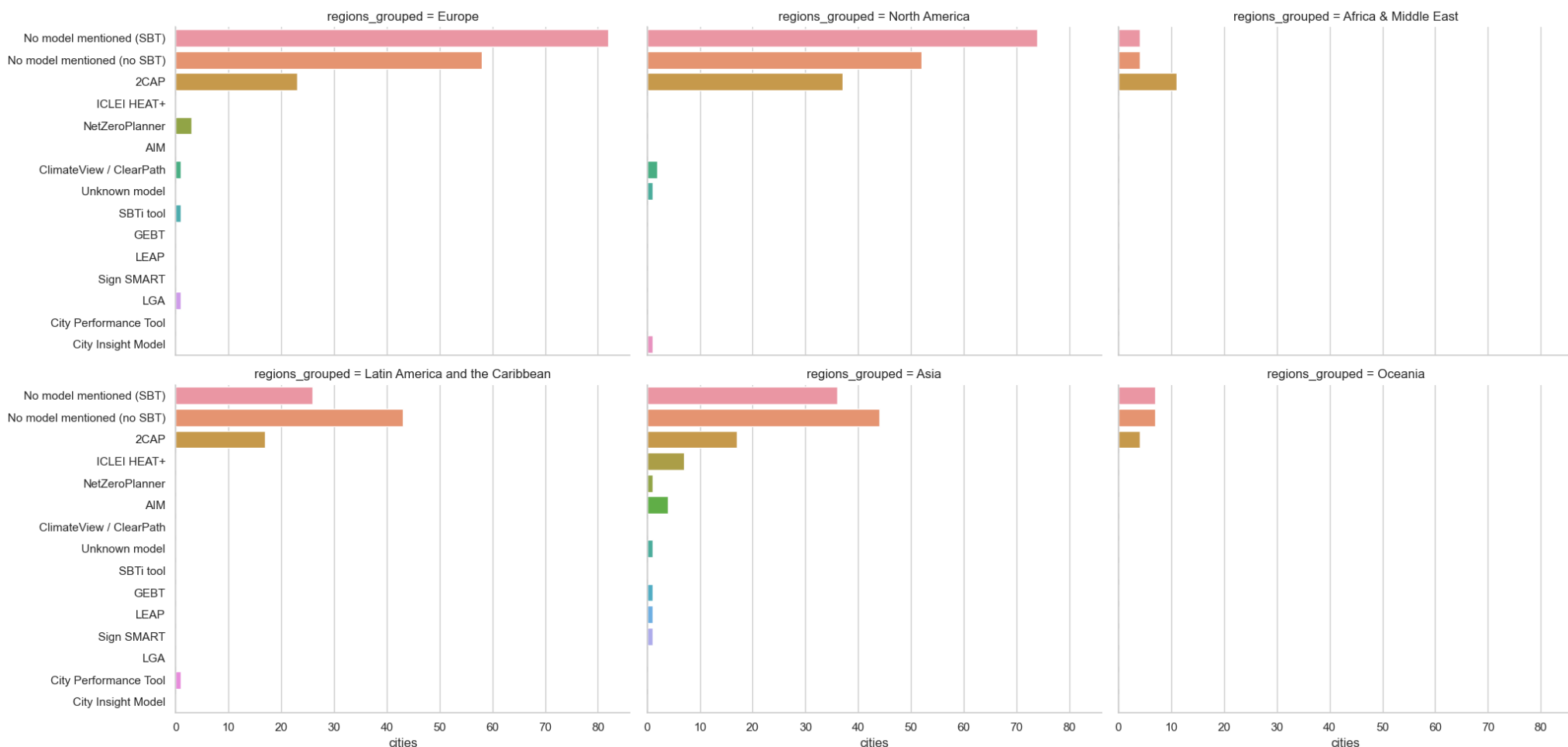
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#ClimateDiamond

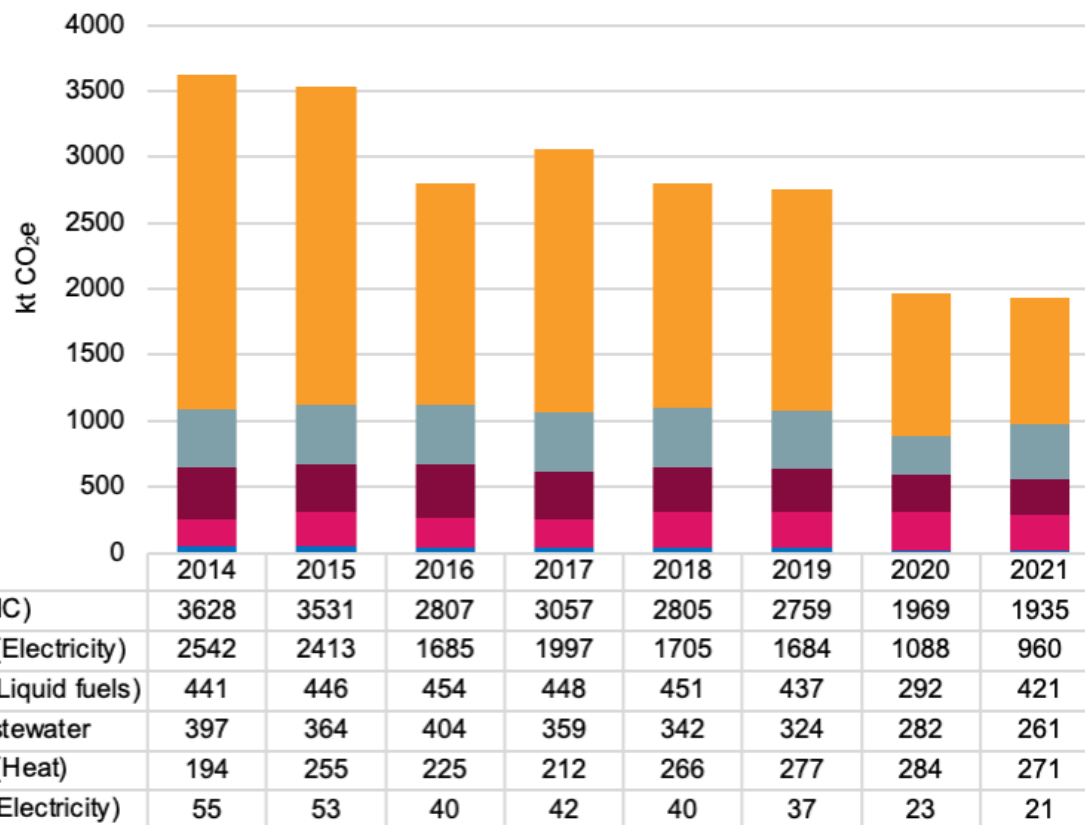
Example of downscaling IAM results



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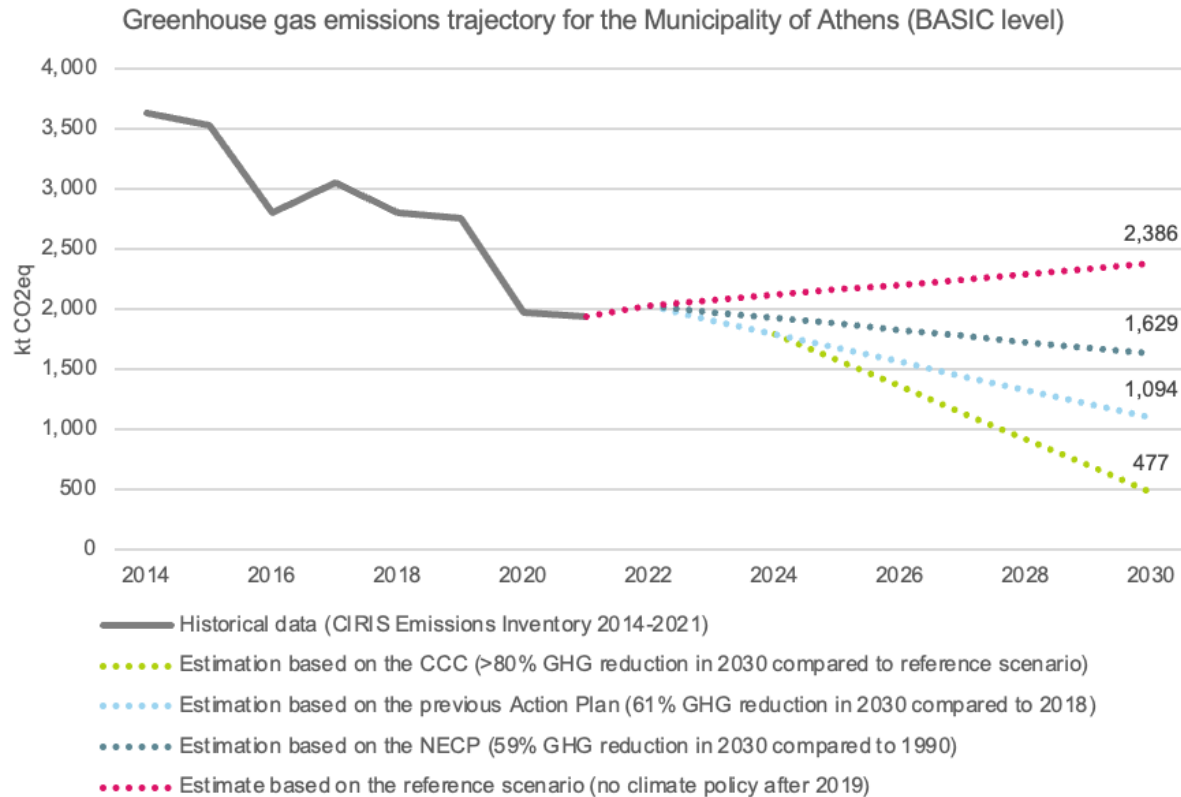
GHG emissions (BASIC level)



Source: Emission data from the Municipality of Athens' report to CDP; own figure.

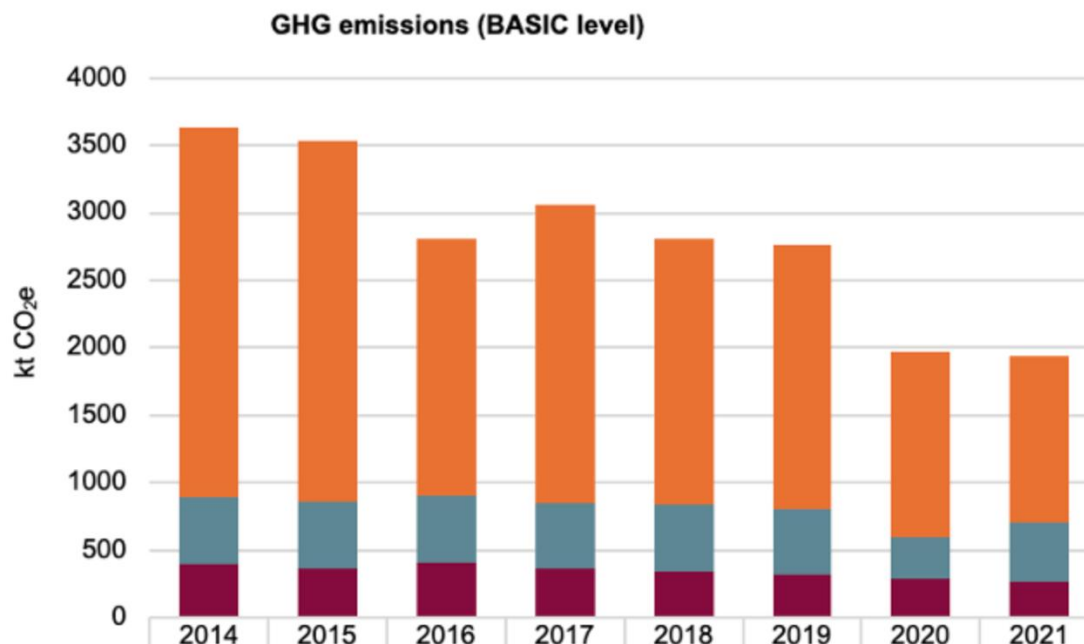
Targets for achieving climate neutrality

- Increase electricity from **renewable energy sources** through municipality & citizen-led initiatives
- Increase **building retrofits**
- Increase **pedestrian movement, bicycles** and zero-emission public transport
- **Electrification of road vehicles** (especially cars and machines)
- **Almost zero solid waste** in landfills, increase composting and recycling
- Use **Nature-Based Solutions** to reduce emissions, cool the city, shade buildings, and strengthen its resilience



Further needs: Lack of detailed interactions between decarbonisation measures for the city and the national and European policies. What would happen if national policies are not successful?

Contributions of IAMs: Downscaling global and national climate action e.g., Kikstra et al. (2024) and evaluating interactions with local policy plans



Total (BASIC)	3628	3531	2807	3057	2805	2759	1969	1935
Buildings/Streetlighting	2736	2668	1909	2209	1971	1961	1372	1231
Transport/Mobility	496	499	494	490	492	475	315	443
Waste/Wastewater	397	364	404	359	342	324	282	261

Buildings/Streetlighting	75%	76%	68%	72%	70%	71%	70%	64%
Transport/Mobility	14%	14%	18%	16%	18%	17%	16%	23%
Waste/Wastewater	11%	10%	14%	12%	12%	12%	14%	14%

Evolution of emissions

- Decline in all sectors before COVID and during the pandemic
- Biggest reduction in the buildings sector (55% between 2014 and 2021)
- BASIC reporting level: Scope 1 and 2 included for buildings and transportation, all scopes for waste.

Source: Emission data from the Municipality of Athens' report to CDP; own figure.

