Chapter 29
Contribution of Global Cities to Climate Change Mitigation Overrated

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29.1 Limited Reach of Urban Policies

Work on ecological economics in Barcelona as founded by Joan Martinez-Alier tends to pay much attention to local conditions and conflicts associated with global environment challenges. This encompasses studies of cities, including policies and strategies by urban authorities. Generally, this work is characterized by considerable optimism, reflecting the fact that local policies can achieve a lot by restricting and guiding urban development or by encouraging local initiatives and bottom-up processes (e.g., Ecología Política, 2014). Incidentally, Joan himself has shown to be more skeptical, emphasizing the concern that "cities displace environmental loads to larger geographical scales" (Martinez-Alier, 2003). This links to the systemic effects discussed in Sect. 29.3 of this chapter.

Here, I consider the previous "optimistic thesis" for the case of climate change and associated mitigation (i.e., emission-reduction) policies by cities. Indeed, the message that cities can do a lot to help solving climate change is popular. It was reinforced by repeated failures of international climate negotiations, suggesting that ambitious climate mitigation policies by cities can compensate for weak national policies (Watts, 2017). This has given rise to various networks of cities combating climate change, such as the UN's Compact of Mayors or the C40 Cities Climate Leadership Group. However, despite so many cities seemingly setting ambitious targets and implementing many policies, we do not see the effect of this in terms of

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reduced global greenhouse gas (GHG) emissions (Siskova & van den Bergh, 2021). Hence, there is a need for critical and quantitative studies that depict a realistic role of cities to reduction.

The motivation in several publications for the supposed important role of cities in global GHG emissions reduction is that the largest part of the world population and emission sources are located within urban areas. This is illustrated by the following citations: "Cities are crucial to global mitigation efforts. […] urban areas are responsible for 71% of global energy-related carbon emissions" (Rosenzweig et al., 2010); "Cities must address climate change. More than half of the world's population is urban, and cities emit 75% of all carbon dioxide from energy use" (Bai et al., 2018); and "Cities are at the heart of the decarbonisation effort. The energy landscape is shaped by cities. […] cities account for about two-thirds of primary energy demand and 70% of total energy-related carbon dioxide (CO_2) emissions. […] Hence, efforts aimed at fostering sustainable urban energy paths are crucial to meet national and global low-carbon ambitions." (IEA, 2016). While superficially these statements sound like reasonable points, careful scrutiny shows they raise too high expectations of what cities can contribute to global emissions reduction.

A fundamental problem is that studies tend to attribute GHG emissions associated with consumers and firms to cities, without checking if cities are really responsible, that is, can in any way control such emissions (Satterthwaite, 2008). One study reviewing 200 European cities attributes emissions reduction in urban areas to the respective cities without identifying a concrete link with feasible urban policies (Reckien et al., 2014). This evidently creates a false picture, exaggerating the contribution of cities. Even so, the study claims that if up-scaled to all cities, only 20% of required emissions reduction by the EU – i.e., to meet the 2 °C target – will be achieved. A rare study of the actual impact of urban climate policies confirms this picture. It statistically analyzes data from 478 cities in California for eight policy outputs (green building projects and standards, residential solar photovoltaic systems, street lighting, waste programs, pedestrian/bicycle infrastructure, gasoline sales, and commute vehicle share), finding little evidence for emissions reduction being causally related to urban climate plans and policies. Its conclusion is that the latter are largely formalizing outcomes that would have been realized anyway, in view of prevailing environmental preferences and national policies (Millard-Ball, 2012). Another study examines which factors explain differences in emissions among ten cities with populations varying from 432,000 to 9,519,000 (Kennedy et al., 2009). Most factors identified, including geophysical and technical ones, turn out to be not or hardly controllable by city authorities.

Studies that are optimistic about the contribution of cities tend to ignore the fact that the largest part of GHG emissions – from industry, electricity generation, tourists, consumers, and transport – cannot be controlled by urban policies. Even though arising within city borders, such emissions strongly depend on specific national policies. Indeed, actions and strategies such as levying carbon taxes on fossil fuels, creating carbon markets, providing subsidies for renewable energy or electric vehicles, regulation of industries, or setting emission standards for cars all belong to the domain of national governments. Regarding tourism, an important part of its GHG emissions is due to international and interurban travel, which is beyond the control of city governments. Moreover, while many studies suggest cities can do a lot about building-related emissions, building codes and energy efficiency standards/labels are generally set by national governments. Urban authorities merely monitor and control construction permissions on their basis.

29.2 Lack of Effective Urban Instruments

On the websites of the various city-for-climate networks, one can find attractive terminologies such as "city intelligence," "reinventing cities," "transforming urban lifestyles," "new urban agenda," and "buying local". One must not expect, though, to find much information on effective regulatory policies. It seems that – like commercial companies – cities are prone to green marketing. One review finds that "… existing initiatives are fragmented and … do not address many of the key drivers and determinants involved," concluding that "… local authorities tend to move towards rhetoric rather than meaningful responses." (Romero-Lankao, 2012). A SWOT analysis in a mid-term evaluation of the Covenant of Mayors for the European Commission is also rather critical, noting that legal constraints limit the capacity of municipalities to implement own plans, that the covenant triggers mitigation actions only to a limited extent, that country participation is very uneven (e.g., dominance of southern Europe), and that many cities do not achieve even modest targets. In addition, the report signals a focus of cities on funding local actions rather than regulating polluters (Technopolis Group, 2013). A review of 55 US cities finds that voluntary outreach programs with low participation prevail, while more effective regulatory policies are little used (Ramaswami et al., 2012). This study offers details on the city of Denver, concluding that a combination of urban voluntary and regulatory actions yields at best ∼1% GHG mitigation annually in buildings and transportation.

There seems to be even confusion about what counts as urban climate mitigation policy, let alone an effective one. To illustrate this, consider a recent study that identifies 13 main urban mitigation strategies (Ürge-Vorsatz et al., 2018):

1. Urban design and form.
2. Modal shift, mobility services, traffic optimization.
3. High-efficiency, low-emissions, smaller vehicles.
4. Low-energy demanding, heat-resistant architecture.
5. High-efficiency appliances and equipment.
6. Energy efficient and low-carbon urban industries.
7. High-performance operation of buildings.
8. Reducing urban heat island.
9. Infrastructure-integrated renewable energy systems generation.
10. Fuel switch to low(er) carbon generation.
11. Affordable low-carbon, durable construction materials; timber infrastructure.

12. Carbon capture and utilization in construction materials.
13. Lifestyle, behavior, choices, sustainable consumption and production, sharing economy, circular economy.

However, this list suffers from various shortcomings. A main one is that none of these are really policies or strategies but rather desired effects. Moreover, most items lack a clear connection with effective policies set by urban authorities. To illustrate: point 2 requires partly national policies such as carbon or gasoline taxes, and vehicle taxes; point 3 is mainly driven by technology constraints (at national and EU levels) and gasoline prices; points 4 and 5 depend on building and technological standards, which are usually defined at a national level; point 6 depends largely on energy prices and national efficiency standards and labels; cities have little influence over point 7; points 9–12 depend predominantly on national innovation and industrial policies; point 13 is a very broad category of issues driven mainly by nonurban factors, notably national regulatory policies, including carbon pricing.

This is not to say that cities cannot do anything. The most concrete and effective strategies are investing in more energy-efficient public buildings and cleaner (especially non-diesel) buses or garbage trucks. Here, one should realize, though, that public buildings and transport only contribute a very small portion of all GHGs within city limits, often around 1% (UITP, 2011). A unique role of cities is altering urban form to lower emissions (strategy 1 above). This might involve restricting cars in certain zones, creating green intra-urban spaces, reducing sprawl, improving access to public transport, and creating bicycle lanes. However, emission reduction effects of these are very limited, unless bold changes in infrastructure and access regulation to cities are implemented in a majority of cities around the world – which must be judged as unlikely. And, if possible, it would require a major transition taking a very long time (Siskova & van den Bergh, 2019). In addition, major changes in urban form are a sluggish process, limited by past choices and geographical conditions.

29.3 Free Riding and Systemic Effects

A solution to climate change is difficult as solutions to climate change are hampered by free riding by countries as well as subnational actors, due to the public goods nature of the climate. An effective solution is a binding global climate agreement, committing countries to install mutually coherent, stringent policies. It has turned out to be very difficult to achieve this type of solution, and unfortunately the Paris Agreement does not count as such. It failed to solve the free rider problem by allowing for voluntary pledges. While the role of cities became a big issue in the slipstream of failures to strike an effective agreement (Hale, 2016), a focus on subnational agents does not bring a solution to the global free rider problem closer, rather the opposite. Not only is the urban level further removed from effective, systemic policies – such as nationwide carbon pricing – but also it includes many more decision-makers: compare the tens of thousands of cities worldwide with a much smaller number of countries (<200).

If stringent, a single city's climate policies will carry a significant economic and political cost while not making much of a difference in global emissions and warming. Only if a fair share of all cities worldwide reduce emissions in concert will the effects be visible. This should include the vast majority of the approximately 1700 cities worldwide with over 300,000 inhabitants, as well as the 430 cities with over a million inhabitants (UN, 2016). Current city-for-climate networks remain very far from these numbers, and anyway do not represent binding agreements. At best, city governments are then motivated to implement soft, nonbinding policies.

If cities were, hypothetically, able to implement restrictive regulations for consumers, producers, and tourists, they would quickly be punished economically due to households and firms moving out of their borders, less national and international interest in their more expensive products, and tourists opting for cheaper destinations. All these responses would furthermore contribute to carbon leakage. Other systemic effects may reduce the net climate and environmental effects of urban policies. For instance, densification aimed at reducing transport-related emissions can strengthen urban heat island effects, unless done with sound green design.

Local politicians proposing effective regulation – e.g., banning cars from the city – should, in addition, expect political repercussions during elections. This is another reason why few cities implement effective regulatory policies. It implies that in a highly urbanized country such as the United Kingdom, only two cities have implemented congestion schemes, namely London and Durham, while in a much larger country such as the United States, no such city is found.

29.4 A Tentative Quantification of Global Emissions Reduction by Urban Policies

Using the previous insights, I undertake a back-of-the-envelope calculation in Table 29.1 and the text below to derive two indicators: (1) an upper bound to maximally controllable emissions by cities (expressed as a share of global emissions), assuming that any effective urban policy is implemented in all cities around the world; and (2) emissions reduction through realistic – i.e., unilateral, voluntary, and politically feasible – urban policies, accounting for divergent ambitions and opportunities of cities worldwide. To this end, the emissions share of distinct sources is determined (column 2 in Table 29.1), followed by the maximum share of cities in these (column 3) and the realistic share (column 4).

To derive column 4, diversity of climate policy effectiveness among cities has to be considered. Few systematic studies address effectiveness of urban policies. An evaluation for Denver finds that only 2–4% of households respond to door-to-door campaigns with actions that reduce emissions and < 1% for voluntary adoption of loans for efficiency measures in homes (Kennedy et al., 2009). The authors refer to

Table 29.1 Impact of urban policies on GHG emissions: tentative upper bound estimates[a]

Sector	Share in global GHG emissions[b]	Maximally controllable emissions (share) due to limited reach of urban policies	Realistic share emissions control due to limited effectiveness urban policies
Agriculture, forestry, and other land use	24%	0.1%	0.1%
		The percentage reflects that most agriculture is outside city borders, which depends on national climate/agricultural policies, while there is a small role for urban agriculture and green space in cities. This is, however, limited by suitable plot/rooftop area and existing regulations (fire risks, fertilizer use, proximity of contaminating roads, etc.)	Cities can only stimulate urban agriculture through soft policies. It is not clear that shifting from traditional to urban agriculture will reduce emissions anyway, also in view of loss of economies of scale. Because of uncertainties, the number in column 3 is not discounted in this column
Buildings	6%	1.5%	0.105%
		Building codes and energy efficiency standards/labels are generally set by national governments. Urban authorities merely monitor and control construction permissions on their basis. Some cities, though, require roofs of residential and commercial buildings to be "solar-ready" or with actual investments in solar energy. Since new buildings make up a very small portion of total buildings, this has a limited effect, though. An optimistic estimate, accounting for a large share of buildings outside city borders and limited control by cities, is 25% on average for all cities globally	Studies indicate a very low effectiveness of voluntary programs, loans, etc. A 7% global average effectiveness for cities is applied – see the derivation in the text

(continued)

Table 29.1 (continued)

Sector	Share in global GHG emissions[b]	Maximally controllable emissions (share) due to limited reach of urban policies	Realistic share emissions control due to limited effectiveness urban policies
Electricity and heat production	25%	7.5%	0.525%
		Electricity is used by roughly 30% of services and 30% of residential.[c] With regard to heat, cities can encourage district heating or biogas/electricity production from waste. Assume optimistically that cities can maximally affect at most half of services and residential electricity use, or $0.5 \times (30\% + 30\%) \times 25\% = 7.5\%$ of emissions	Cities mostly can use persuasive, not regulatory, instruments to reduce electricity use by consumers. Studies indicate a very low effectiveness of voluntary programs and soft policies. As indicated above, an effectiveness of 7% is applied
Industry	21%	1%	0.3%
		Mainly the domain of national policies, except waste management in some cities. The percentage is reflecting global share of waste management in total activity (1.5%),[d] the share of industry in total activity (30%), ratio of household to industrial waste (1:2), and share of households worldwide living in cities (0.6). The result is $(0.015/0.3) \times 1/3 \times 0.6 = 0.83\%$, which is rounded off to 1%	Cities can reduce waste in a very limited way through voluntary programs. Pricing waste bags has proven to be very complicated and ineffective. However, cities can aim for more recycling and energy recovery from unrecyclable waste. Cities do not, however, always control what happens in the waste phase. To capture these features, we optimistically assume a 30% effectiveness as a global average

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Sector	Share in global GHG emissions[b]	Maximally controllable emissions (share) due to limited reach of urban policies	Realistic share emissions control due to limited effectiveness urban policies
Transportation	14%	5.2%	0.794%
		60% of transportation emissions is from personal cars, rest is freight transport, aircraft, rail, and water (all uncontrolled by cities). [e, f] Most use of personal cars (in terms of distance) is outside urban borders.[g] Hence, cities control roughly less than half of 60% = 30%, which applied to 14%, gives 4.2% of global emissions. Fleet of city busses and garbage trucks represents roughly 1% of all traffic, which theoretically could be converted to 100% clean energy	Few cities ban cars or limit their use with congestion charges. Cities do not control fuel prices or car emission standards. They can discourage car use through zoning or parking tariffs. Promoting public transport has been found to have a limited effect on car use. For the 4.2% of private cars we use, as above, the 7% global average policy effectiveness and for the 1% city fleet, a 50% effectiveness (highly optimistic[h]), giving 0.294 + 0.5
Other (fuel extraction, refining, processing, and transportation)	10%	1.5%	0.183%
		This is a multiplier effect of the energy industry in total fuel use. If cities can reduce fuel consumption by roughly 15.3% (sum of the above estimates), then this could additionally reduce emissions 10% of that, i.e., 1.5%	Same multiplier effect as in left cell, i.e., 10% of sum of above estimates (1.824%)
Total	100%	16.8%	2%

Notes:

[*]The second and third columns makes many optimistic assumptions which are likely contribute to an upper bound of the overall estimates in the final row. The final column of the table reflects various facts: cities lack effective regulatory instruments such as technical emission standards or serious carbon pricing; a minority of cities will implement effective measures (e.g., banning cars in cities or severely limiting their use); and cities in majority rely on soft, weak policies (information provision, voluntary programs, loans, and small subsidies), which have been shown to have a low effectiveness in terms of emissions reduction (see text). To get from column 3–4 for cells that address consumer behavior (consumption, electricity use, heating, car use), a 7% average policy effectiveness for all global cities is applied, which is motivated by calculations in the main text

[b]IPCC (2014)

[c]EEA (2013)

[d]http://siteresources.worldbank.org.vu-nl.idm.oclc.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/AnnexE.pdf

[e]IEA (2016)

[f]https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

[g]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/676205/Transport_section_Jan_2018_Final.pdf

[h]Ramaswami et al. (2012)

various other studies to show that these participation rates are in line with those reported in national-level reviews of outreach and loan programs. In addition, it is found that local government transport fleets contribute only 1.2% to total vehicle kilometers travelled in the city, causing even aggressive programs to retrofit engines to contribute to <1% of emissions reduction. Such low effectiveness numbers are confirmed by other studies (Millard-Ball, 2012). In view of this, an effectiveness of urban climate policies of 1% may be seen as realistic, while 5–10% is very optimistic and 20% extremely high, applying at best to the most ambitious cities.

To upscale to a global level, one must distinguish between ambitious and less ambitious cities. Indeed, one has to expect a great disparity in terms of mitigation ambitions, if only because climate concerns are a luxury for many cities in developing countries that are often entombed by urgent local challenges, such as poverty, crime, slums, lack of clean water, and inadequate road or electricity systems. Surveying 55 US cities that pledged GHG mitigation, it was found that less than 30% used some regulations, while the large majority relied on weak voluntary programs (Ramaswami et al., 2012). If we upscale this to the whole world and combine it with the afore-suggested effectiveness range 1–20%, then the average emissions reduction effectiveness of urban policies can be estimated as equal to $0.7 \times 0.01 + 0.3 \times 0.20 = 6.7\%$. We apply this percentage rounded off to above, 7%, to derive results related to private consumption, heating, electricity use, and car use as we move from the third to the fourth column in Table 29.1. This results in a realistic global contribution of city policies as 2%, which must be regarded as an upper bound because of consistently adopting optimistic assumptions, as indicated above and in the table. Another reason for interpreting this value as an upper bound is that the calculation in the table excludes considerations of systemic feedbacks, such as rebound and carbon leakage, which would reduce the global effectiveness of many urban policies.

Admittedly, the estimated range of 2–16.8% in the table is tentative and merits further study, ideally by employing a disaggregate and multiregional approach. However, the order of magnitude of the estimates is sobering, given that previous studies (mentioned in "Limited Reach of Urban Policies" section) suggest that cities are responsible for 69–75% of global energy-related emissions and that this percentage will even increase as urbanization continues. Note that the range is consistent with a rough estimate by another study, which suggested that cities could contribute up to 15% of global GHG reductions required to stay within 2 °C warming (Erickson & Tempest, 2014).

29.5 Concluding Remarks

This study was motivated by a lack of evidence on the overall contribution of cities worldwide to climate change mitigation. The arguments offered here and the tentative quantification provide a consistent picture, which moreover is in line with pessimistic conclusions of the few quantitative studies and reviews in the literature (Millard-Ball, 2012; Ramaswami et al., 2012; Stone et al., 2012; Boehnke et al., 2019; van den Bergh, 2020). According to Chapter 12 in IPCC's AR5, "Thousands of cities are undertaking climate action plans, but their aggregate impact on urban emissions is uncertain" (Seto et al., 2014). Two specific assessment reports contain more hopeful statements, but without providing any serious test of the effectiveness of urban climate policies (Rosenzweig et al., 2011, 2018).

Altogether, the evidence and arguments in these and the current study suggest that we should expect cities to fulfil a modest, and in the worst case a very small, role in reducing global GHG emissions. The main reasons are summarized in Fig. 29.1. This underpins that city strategies are no excuse for serious national regulation of emissions. In other words, national politicians remain most responsible for climate solutions. This is not to deny that cities should try, through adequate urban policies, to contribute maximally to GHG emissions reduction, as well as achieve adaptation to climate change to ameliorate negative consequences for their citizens. Some argue that cities possibly can serve as experimental labs for not-yet-tried-out climate policies (Bulkeley & Castán Broto, 2013), but also here evidence of a serious impact is lacking. Surely, city mayors are well positioned to diffuse a sense of

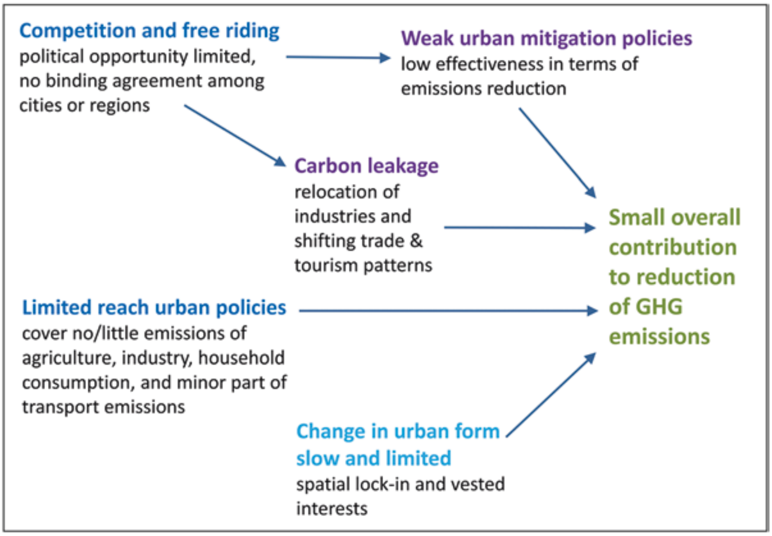

Fig. 29.1 Main reasons for a modest contribution of cities to global GHG emissions reduction

urgency about climate action. The most effective role that city councils and mayors can play, arguably, is lobby and cooperate with their national parties to achieve national climate policies that are consistently applied in all cities, thus avoiding policy competition and carbon leakage. In addition, they should encourage a binding global agreement on climate policies, not just targets (as the Paris Agreement). Only this would guarantee consistent and stringent, and hence effective, climate policies in all countries, cities, and other municipalities around the world.

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