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Urban Policies and Measures to Asdapt to Excessive Heat: Madrid and London

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1 ABSTRACT

The motivation for this paper is the recent, warrying increase in climate change denial, discouraging decisive action to accelerate both adaptation and mitigation measures, while dramatic climate change manifestations are on the increase. Surprisingly, countries that initially aligned themselves with the Paris Agreement are joining this trend, urging a reduction in the measures proposed to achieve net zero CO2 emissions, alleging a loss of competitiveness in the global market.Thesefacts are provoking reactions byglobal organisations, including COP30, as well as among politicians, academics and the media about how to stem this potential reversal.

Global warming is an all embracing phenomenon affecting all parts of the planet, and although its effects differ between countries and cities, they arose a wide range of responses, some tried and tested, others experimental and leading to innovation, at both governmental and city levels. This paper aims to identify these place-biased policies and practices whilelooking for possible commonalities of more general applicability, using as case study two cities situated in different climatic regions: Madrid, in a transition zone between the semi-arid temperate-cold climate and the mediterranean climate, and London, in a temperate maritime climate.

In both cases, climate change is generating new phenomena for which cities are not adapted. Madrid, with short springs and autumns, harsh winters and hot summers, attributes priority to measure against extreme heat which is increasing year on year. London with more even four seasons, undergoes increasing fluctuating temperatures, heavy rain falls, and high winds and storms from both the Atlantic and the Arctic, but its measures dealt with air pollution due to traffic, its key environmental problem. The focus of the paper is on concrete measuresto find possible common points of more general application, how they are being incorporated at national level in legislation and regulations, and how they are applied and tested in practice, at city level, city-wide, as well as in neighbourhoods and for buildings.

Keywords: climate change, cities, urbanism, urban heat, transformation

2 INTRODUCTION: CLIMATE CRISIS AND CITIES

The adoption of instruments and policies for the adaptation of cities to climate change began at the beginning of the 21st century[1], in response to the warnings issued by the scientific world since the 1970s. Implemented in different ways and with different degrees of effectiveness, their ability to cope with adverse weather conditions has been relative according to the specific circumstances of each country.

Despite these efforts, the increase in greenhouse gases is accelerating the climate crisis and with it the appearance of extreme weather events: droughts, forest fires, floods and, especially, extreme heat. As the World Meteorological Organisation (WMO[2]) records, the increase in the frequency, intensity and duration of heat waves over the past 11 years, 2015 to 2025, were individually the eleven warmest years in the 176-year observational record, with the past three years being the three warmest years on record.

Heat waves are particularly devastating as they affect public health and quality of life. According to a study by Imperial College London and the London School of Hygiene & Tropical Medicine (LSHTM),[3] between June and August 2025, heatwaves that affected Europe caused 16,500 deaths, according to the records of 854 cities (30% of the European population). The study estimates that the increase in average temperatures (2.2°C warmer on average in the areas studied) mostly affects people aged 65 years and older (85%).

[1] European Adaptation Strategy 2013. Covenant of Mayors, 2014-2016

[2] https://wmo.int/news/media-centre/2025-set-be-second-or-third-warmest-year-record-continuing-exceptionally-high-warming-trend

[3] https://wmo.int/news/media-centre/2025-set-be-second-or-third-warmest-year-record-continuing-exceptionally-high-warming-trend

In addition to older adults, heat stress especially affects outdoor workers, an issue highlighted by the World Health Organisation[4] and socioeconomically disadvantaged groups. In addition to personal vulnerability – associated with age, gender and health conditions – socioeconomic vulnerability – associated with energy poverty, resulting from the combination of low income, high energy prices and inefficient housing – prevents households from acquiring air conditioning appliances with the extra energy consumption that this implies. Overall, low levels of thermal comfort have direct consequences on people's well-being and quality of life.

2.1 Effects of global warming on the population

2.1.1 Spain

Spain is increasingly affected by extreme heat. The final report of the Ministry of Health on the 2025 campaign of the National Plan for Preventive Actions against the Effects of Excessive Temperatures on Health,[5] recorded 870 episodes of extreme heat, 73% more than in 2024. Deaths attributable to heat were 3,832, of which 95.98% were people over 65 years of age and more than half (65.29%) were over 85 years of age. In the Community of Madrid, 591 deaths attributable to heat were registered, 84.1% more than in the same period of the previous year.[6]

During the heatwave episodes of 2025, daily electricity demand in the most affected countries, including Spain, soared by up to 14% due to the massive use of air conditioning and other systems to combat heat that increased the price of electricity by up to 15% on the most critical days. This increase caused one in three homes to not be able to reach an adequate temperature to withstand extreme heat, accentuating the phenomenon of energy poverty[7], a situation that affects almost 10% of the population, of which about 20% live in homes with structural problems. The data indicate that 27% of homes do not reach an adequate temperature in winter and 33.6% in summer. Given the magnitude of summer energy poverty, the National Energy Poverty Strategy 2019-2024[8] has been incorporated as a key indicator.

2.1.2 UK

The UK founding legislation to tackle the adverse effects of global warming is the Climate Change Act 2008. Climate change is also included in other statutory instruments.[9] The UK remains committed to the COP Paris Agreement to limit CO2 Emissions to 1.5º Celsius by 2050, albeit under growing opposition.

Putting the UK into the global context in Climate Change and Weather, the UK Met Officeacknowledges the contribution of human activity to warming the planet.[10] It predicts that in future the UK will experience warmer and wetter winters, hotter and drier summers and more frequent and intense weather extremes.[11] Climate change is already causing warming across the UK.[12] Climate models at national, regional and local level have been developed for projections.[13] Heavy rainfall is more likely. Since 1998 the UK had six of the

[4] https://www.who.int/es/news/item/22-08-2025-who-wmo-issue-new-report-and-guidance-to-protect-workers-from-increasing-heat-stress

[5] https://www.sanidad.gob.es/en/gabinete/notasPrensa.do?id=6760

[6] Daily Mortality Monitoring System, Carlos III Health Institute.

[7] Daily Mortality Monitoring System, Carlos III Health Institute: https://ember-energy.org/latest-insights/heat-and-power-impacts-of-the-2025-heatwave-in-europe/

[8] https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/estrategia-pobreza-energetica/actualizaciondelosindicadoresdelaestrategianacionalcontralapobrezaenergetica-2022_tcm30-549718.pdf

[9] Environmental Protection Act (1990), Flood and Water Management Act (2010), Local Government Act (2000)

[10] https://weather.metoffice.gov.uk/climate-change/effects-of-climate-change (undated)

[11] see table: changes to the UK climate and weather events, in Met Office "Effects of climate change"

[12] All of UK's ten warmest years on record have occurred since 2002. Heatwaves like in summer 2018 are now 30 times more likely to happened. Winter will be between 2 and 4.5 ºC warmer and up to 30% wetter and summer will be between 1 and 6º Celsius warmer and up to 60% drier, prolonged heat with extremes reaching 40 ºC.

[13] UK Climate Projections (UKCP).https://www.metoffice.gov.uk/research/approach/collaboration/ukcp

ten wettest years on record. Heavy rainfall will also increase and lead to flash floods. In 2015 winter storms were at least 40% more likely.[14]

Heatwaves are a risk to health. The summer heatwave of 2003 provoked over 2000 excess death, 680 in 2006and 300 in 2009, mainly of older people.[15] The UK Health Security Agency has set up Adverse Weather and Health Plans(UKHSA) to protect health from weather related harm.[16] It proposes Action areas to improve local planning.

2.1.3 But...

Faced with this backdrop and given changing geopolitical and economic conditions, including rising energy prices affecting the cost of living, there is political pressure in an increasing number of countries against investment in renewables and restrictions on fossil fuels, moving away from the commitment adopted by the COP to net zero CO2 emissions by 2050.

3 MEASURES FOR THE ADAPTATION OF CITIES TO CLIMATIC EVENTS

3.1 European Union

The EU's contribution to the issue began with the approval of the European Adaptation Strategy in 2013, aimed at promoting the establishment of specific measures in member countries, improving decision-making in this area and promoting adaptation in the most vulnerable sectors. The New European Strategy for Adaptation to Climate Change, approved in 2012, advocated the construction of a society resilient to climate change through the promotion of knowledge of climate impacts and adaptation solutions, adaptation planning and climate risk assessments. For its part, the European Green Deal, established in 2019, promotes the ecological transition in order to achieve climate neutrality by 2050, contributing to the goals of the Paris Agreement (COP 2015) to contain global warming to a maximum of +1.5 °C compared to pre-industrial levels. The action of the Covenant of Mayors, 2014-2016, was crucial for the promotion of specific plans and actions at the local level.

In addition, special campaigns have been launched to promote local initiatives, such as "Cities Refresh", adopted in 2019 as part of the European Green Deal to combat heat through nature-based solutions and resilient designs, and the EU Mission: Climate-Neutral and Smart Cities for 2030, launched in 2021 and promoted in 2025 by the European Union's Covenant of Mayors for Climate and Energy, with the aim of acting as innovation laboratories and accelerating the transition to climate neutrality. Among the 100 cities initially selected, there are seven Spanish cities – Barcelona, Madrid, Seville, Valencia, Valladolid, Vitoria-Gasteiz and Zaragoza – and two from the United Kingdom – Bristol and Glasgow.[17]

3.2 Spain

3.2.1 National and regional level.

The increase in heat is the most relevant issue for all levels of government. The winter temperatures – even higher than usual and episodes of extreme heat affects the entire population. Thus the government activatedthe Cold Campaigns to attend to certain social groups.

The national government's action on climate change and extreme temperature issues focuses mainly on inter-administrative coordination, public health and energy regulations in buildings. The Ministry for the Ecological Transition and the Demographic Challenge prepared the National Plan for Adaptation to Climate Change (PNACC) 2021-2030[18] to respond to the effects being experienced in the country – expansion of the semi-arid climate, lengthening of summers, heat waves, increase in the surface temperature of the

[14] https://weather.metoffice.gov.uk/climate-change/climate-change-in-the-uk
[15] UK Health Security Agency, Adverse Weather and Health Plan 2025-2026
[16] ibid.
[17] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en
[18] https://www.miteco.gob.es/content/dam/miteco/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc-2021-2030_tcm30-512163.pdf

Mediterranean and its impact on large cities and the Mediterranean coast – and to set the guiding principles for policies associated with these future climate scenarios.

The aforementioned National Plan of Preventive Actions against the Effects of Excessive Temperatures on Health, 2025, launched by the Ministry of Health, is activated between 16 May and 30 September to prevent its impact on vulnerable groups (the elderly, children, people with chronic illnesses, and outdoor workers). The plan is based on the Meteosalud early warning system, which coordinates health and emergency services in the 182 areas with similar climatic characteristics into which the country is divided. Alerts are activated according to weather forecasts and health risk maps produced daily by the State Meteorological Agency. The Health and Climate Change Observatory, under the same ministry, prepared the Practical Communication Guide. Health and heat, 2025[19], so that institutions, the media and health personnel transmit effective messages to the population for the promotion of self-protection behaviours.

The National Information Coordination Centre on Forest Fires (CCINIF), under the Ministry for the Ecological Transition and the Demographic Challenge, monitors weather risks and coordinates the available state resources to respond to different levels of emergency. The National Emergency Monitoring and Coordination Centre (CENEM), under the Ministry of the Interior, is responsible for monitoring fires and managing the National Alert Network.

Regarding buildings, the Ministry of Housing and Urban Agenda updated the Technical Building Code (CTE) in 2025 to align it with Directive (EU) 2024/1275.[20] In addition to regulating the basic requirements of quality, safety and habitability of buildings, the code introduces the obligation to calculate the Global Warming Potential (GWP) to assess the climate impact of a building throughout its life cycle. Other measures are the reinforcement of energy savings (solar panels, light efficiency), the promotion of sustainable mobility (charging for electric vehicles, bicycle parking) and the updating of indoor environmental quality (thermal insulation, cross ventilation, use of thermal inertia materials). Royal Decree-Law 14/2022, on energy saving measures[21], limits the temperature in public buildings, commercial buildings, department stores, transport stations and airports by establishing a maximum of 19 °C for heating and a minimum of 27 °C for cooling.

At the regional level, the Autonomous Communities have their own protocols to deal with episodes of high temperatures, being able to activate specific mechanisms in certain areas, such as education (modification of schedules), work (prohibition of outdoor activities at times of maximum radiation) or resource management (restrictions on the use of water or reinforcement of devices for extinguishing forest fires)

3.2.2 Local level

The initiatives adopted by Spanish cities for adaptation to climate change are numerous, implemented in different ways and with different degrees of effectiveness. The proposals are varied, including green and blue infrastructure, nature-based solutions, biodiversity corridors, specific rules and regulations for building and special architectural and urban designs. With respect to extreme heat and despite the adverse climatic effects, the adoption of specific municipal plans is markedly unequal, with the cities in the north and east of the country having more instruments compared to those in the south and northwest.

Barcelona is the most advanced example given the implementation of the Superblocks programme in 2016, seeking to transform the city model to give priority to pedestrians, reduce road traffic and increase green areas to mitigate the urban heat island. In addition, the approval of the Climate Plan 2018-2030[22] proposes, among other measures, to incorporate the climate variable into urban planning, improve the thermal comfort of buildings and public spaces, increase green spaces and create a network of climate shelters that has 401 shelters (1 for every 4200 inhabitants), the largest in Spain.

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https://www.sanidad.gob.es/areas/sanidadAmbiental/riesgosAmbientales/calorExtremo/publicaciones/docs/Guia_Salud_y_Calor_v2.pdf

[20] https://www.codigotecnico.org/

[21] b https://www.boe.es/buscar/act.php?id=BOE-A-2022-12925

[22] https://www.barcelona.cat/barcelona-pel-clima/sites/default/files/plan_clima_juny_ok.pdf

Bilbao is another outstanding example. Its Climate Change Adaptation Plan[23] focuses on high temperatures and heat waves and promotes the creation of a network of 131 climate shelters – 1 shelter for every 2,600 inhabitants, one of the best in Spain. The BIK project was approved in 2025 to adapt the metropolitan area of Bilbao to the impacts of climate change, mainly floods, heat waves and rising sea levels. One of the fundamental pillars of this project is the predictive modelling of climate risks and the implementation of early warning systems.

The creation of networks of climate shelters in open spaces and public facilities is the most widespread urban strategy, although with uneven development. According to the Greenpeace report Red Hot Cities: Climate Shelters and Lack of Protection Against Extreme Heat[24], in July 2025 only 16 of the 52 capital cities had climate shelters with different per capita ratios ranging from very good to acceptable, being insufficient or very insufficient in heat-affected cities, such as Madrid, Valencia, Seville, Cordoba and Alicante.

3.2.3 Madrid

The increase in heat is the most relevant issue for local and regional governments since even winter conditions register higher average temperatures than usual. According to the State Meteorological Agency, the 2023-2024 winter was one of the warmest since 1961, the starting date of the historical series of records. Even when the low winter temperatures activate the Cold Campaigns to provide emergency accommodation, day centres and social care for people in street situations, the episodes of extreme heat are the most alarming as they affect the entire population.

The Air Quality and Climate Change Plan. Plan A[25], was approved in 2017 with the dual objective of guaranteeing the health of the population against the challenge of pollution, and of strengthening the city against the impacts of climate change, reducing its vulnerability to the risks associated with global warming.

In 2025 the City Council launched the Action Plan for Extraordinary Episodes of High Temperatures – CALORMAD[26], derived from the Municipal Emergency Territorial Plan approved in 2023. It is a reactive strategy that is activated based on public health reports and its aim is to reduce morbidity and mortality during extreme heat waves through self-protection recommendations for citizens. In addition to intensifying social reinforcements to respond to the needs of vulnerable people (minors, the elderly, the chronically ill), it offers advice on how to combat the heat at home and abroad, and includes recommendations for activities during hot hours and prevention measures at work, especially work taking place outdoors.

The measures proposed by the Action Plan consist of the opening of at least one centre for the elderly per district between July and August, the adaptation of climate shelters in existing air-conditioned places (cultural spaces, museums and public and private facilities), and the use of municipal swimming pools and certain outdoor spaces. These urban spaces correspond to the existing public fountains and to specially adapted areas in certain parts of the city – water jets (“urban beach” Madrid Río), removable awnings (Plaza del Sol) and nebulizers (children's play area in Plaza de España and pergola in La Gavia park). Other measures are two pilot projects: three low consumption nebulisers in public places (Plaza de Milmarcos, Murcia Street and Porto Avenue) and two refrigerated bus stops (intermodal areas of Pavones and Villaverde Cruce).

4 COMMENTS

Although CALORMAD represents an effective management model to deal with climate crises from the health point of view, the greatest criticism focuses on the lack of a comprehensive long-term urban proposal with more far-reaching initiatives. The interventions adopted are punctual, of limited importance, high cost and low effectiveness. It is worth noting the scarce provision of green areas in peripheral and socially disadvantaged neighbourhoods, the scarcity of public swimming pools and summer sports facilities (30

[23] https://biobilbao.bilbao.eus/wp-content/uploads/2021/05/PLAN-DE-ADAPTACION.pdf

[24] https://es.greenpeace.org/es/sala-de-prensa/informes/informe-ciudades-al-rojo-vivo-refugios-climaticos-y-desproteccion-frente-al-calor-extremo/

[25] https://www.madrid.es/UnidadesDescentralizadas/Sostenibilidad/CalidadAire/Ficheros/PlanAire&CC_Eng.pdf

[26] https://www.madrid.es/UnidadWeb/Contenidos/ContenidoGenerico/PlanesEmergencia/olacalor8.pdf

facilities for 3.5 million inhabitants) and the insufficient number of public climate shelters with free access. According to the Greenpeace report mentioned above, Madrid has 31 shelters (1 per 110,000 inhabitants), a clearly insufficient ratio to meet the demand of its population (3,527,924 inhabitants).

4.1 UK

The Third National Adaptation Programme NAP3 and the Fourth Strategy for Climate Adaptation Reporting,[27] 2023 identifies 5 mechanisms to address risks related to health, communities and the built environment.[28] Its Health and Wellbeing chapter lists intervention to mitigate climate related health risks. New building regulations address overheating in residential buildings.

The Department of Energy Security and Net Zero has incorporated climate adaptation into its net zero retrofit programmes to upgrade existing buildings. NHS Trusts incorporate adaptation strategies into their green plans and are updating resilience standards by 2025.[29]

4.2 London

The global warming situation differs in London from Madrid. Being a more temperate climate with a more puritanical population there was late practice of space heating in the winter and no perceived need for air conditioning in the summer. However, with rising living standards and an increasingly cosmopolitan population central heating became widespread. Relatively cheap energy due in part to indigenous oil and gas discoveries and exploitation in the North Seapeople paid their energy bills and did not feel the need to invest in insulation.

Changes to the UK climate and weather events

	Changes in intensity or frequency so far	Is this linked to climate change?	What is expected in the future?
UK warm spells	Increase	Yes	Increase
UK cold spells	Decrease	Yes	Decrease
UK heavy rain	Increase	Inconclusive	Increase
UK dry spells	No trend detected	Inconclusive	Increase (summer)
UK wind storms	No trend detected	Inconclusive	Increase*

* Some, but not all, evidence supports an increase.

Figure 1: Changes to the UK climate and weather events.

27 https://assets.publishing.service.gov.uk/media/64ba74102059dc00125d27a7/The_Third_National_Adaptation_Programme.pdf

28 The National Planning Policy Framework | MHCLG, Building regulations | MHCLG, Flood and Coastal Erosion Risk Management Strategy, Policy Statement and Roadmap, Environment Agency, Adverse Weather and Health Plan | UKHSA, Publicly Available Specification 2030-2035 | TrustMark

29 https://assets.publishing.service.gov.uk/media/67fe2667694d57c6b1cf8d3c/AWHP_2025_to_2026.pdf

More recently, with rising summer temperatures cooling became more used, initially in work places but also in homes. Rising affluence increased also car ownership often dual in families and larger vehicles. Moreover, more family holidays abroad and foreign business trips all added to CO2 emissions.

At the same time concerns about global warming and the impact on future generations became more widespread and people started to care about attenuating adverse impacts. Promises of taking measures to curb pollution and improve the urban environment by politicians and similar pledges in their manifesto formed part of electioneering.

London was without a London-wide government since the abolition of the Greater London Council in 1986 under Thatcher's premiership. Mounting pressure for a strategic devolved London government led to the creation of the Greater London Authority and for the first time an elected mayor albeit with rather limited powers. From inception of a new London government in 2000 environmental protection was high on the mayors' objectives. Initially labour mayor Ken Livingstone had been known for his 'green' tendencies and had initiated various measures during his two terms of office, including congestion charging andbikes for hire. Later the tory mayor Boris Johnson implemented these policies.The current labour mayor Sadiq Khan continued to take "greening" measures for London in his two terms and his current third one.

These environmental policies form part of the Mayor's London Plan. The last London Plan was approved in 2025 and a new one is under preparation. Sadiq Khan, an ex-transportation minister focused on curbing pollution from cars. He strengthened the measure of the central London congestion charge zone, added another Ultra Low Emission Zone (ULEZ) first in central London, thenin steps for the whole of the Greater London area. This was not implemented without strong objections but the mayor remained firm. He additionally promoted building retrofits, measures to increase solar capacity and enhance green spaces by making 50% of the city green by 2050. He alsowas more stringent than government regulations about better insulation and fossil free heating in the London Building Regulations which are implemented for his current ambitious house building programme.

Accordingly, the latest London Plan includesthe following environmental policies:[30]

- air quality and transportation: London-wide ULEZ; 100% congestion charging in central London; electrifying the London bus fleet; investing in cycle lanes and other infrastructures.
- climate change mitigation: more ambitious net-zero carbon emissions target by 2030 than the central government 2050; "green new deal" to support low carbon jobs; promoting the accelerated green pathway (reducing heat demand in buildings and installing 2.2 million heat pumps by 2030.
- energy efficiency: "warmer homes" – grants for insulation and heating improvements for low income households; 57% more energy efficient new buildings than national standards in the London building regulations.
- green infrastructure and biodiversity: more green roofs, and walls, making 50% of London green by 2050; promoting "National Park City" status, expanding urban forests, improving biodiversity-waste management: recycling 65% of municipal waste by 2030; send no biodegradable wate to landfill by 2026; make London a zero waste city in the longer run.
- solar energy: The Solar Action Plan includes a reverse solar auction programme to encourage the installation of solar panels on homes, aiming to increase capacity to 100MW by 2030.

The mayor is backing up these policies with money with a GBP 9 million "Greener City Fund" and the GBP 34 million "Energy for Londoner" programme.

London's overall emissions have fallen by 21% since 2016 due to implementing these policies. It has to be noted though that no measures are taken of de-sealing London's streets or any measures to turn London into a "Sponge City": and at the same time The Mayor is introducing "grey belt" status in the green belt to be able to build new housing there, thus reducing "green lungs". Also regarding development permits the London Boroughs have the ultimate powers to impose and enforce planning conditions on developers which are the way to extract contributions towards combating global warming.

[30] London Climate Action Plan: Environment Strategy and Pathway to net zero by 2030. Mayor of London, January 2022. To be updated in 2026

Water is also an issue in the changing weather patterns. With more draughts in the summer the reservoirs are low, floods are more frequent with intense rain fall which the drainage is unable to absorb, while rising sea level requires the replacement of the Thames Barrier to prevent flooding upstream. Thames Water the private company which supplies London with drinking water and is responsible for sewage and storm water drainage has increasingly discharged sewage into the rivers and the sea and hasneglected to maintain and repair the water network which loses a fifth of drinking water in leaks. Water demand is estimated to have outstripped supply by 10% by 2025 and will increase to 21& by 2040. The Mayor 2050 plan in the manifesto puts sustainable urban drainage and natural flood management in the forefront of the battle to maximise London's water resources. In reality the mayor has no powers over the private Thames Water company and the regulator has been extremely lenient with the company which passes the fines to the water consumers. It is only when the central government stepped in under pressure of rising complaints that Thames Water has started a programme of replacement of old pipes and equipment, but with the permission to pass a large cost onto the water bills.

Like most London's infrastructure energy supply network is antiquated, deficient and becoming redundant and the electricity substations are reaching full capacity. However, London will never be able to be fully self-sufficient in energy provision, even when using more renewables and it depends on the state and the private companies for its energy security, andonly to some extend for its energy greening objectives.

4.3 Comments

London, like most UK cities and local authorities have long ago had to relinquish municipal control over its basic services, water, energy, transportation (although it gained back quite a lot of the latter), as well as telecommunications and other ICTs which are counted as essential services at present. Recycling can attenuate the service provision problem and campaigns to change people's user habits can also help, but the actual deficit in all these services seems very difficult to overcome and likely impossible without central government support. All this has a direct effect on measures against increasing heat and heavy rain due to climate change.

Measures to curb the warming effects of climate change are multi-fold and interdependent. Ideally they should create positive synergy but in reality they may also contradict each other. This is especially challenging when assessing the impacts on people, their cost of living and the need for them to adjust their behaviour which they may consider against their interests.

5 CONCLUDING REMARKS: CHALLENGES FOR CITIES TO ADAPT TO CLIMATE CONDITIONS

Interventions are an essential tool for urban adaptation to climate change to combat excessive heat, but they require strong legal frameworks, adequate financing, and equitable approaches to avoid social inequalities. The examples of Madrid and London show that cities are able to adopt measures to alleviate extreme weather conditions. Nevertheless, these actions are severely constrained.

Awareness of climate change and the need to take remedial action is widespread and supported, but there remain strong "climate denial" lobbies. Remedial measures require finance and during times of "cost of living crisis" burdening households with extra costs, especially for long term infrastructure measures is creating obstruction, while city budgets are toostrained to carry such investments.

Impacts of global warming on cities are multi-fold, complex and often interdependent and would require comprehensive measures well beyond the means of cities. Both Madrid and London have taken partial measures against global warming, Madrid focusing on combating excess heat and London curbing traffic CO2 emissions. These measures should be fully integrated in local plans.

Each positive measure to curb excess heat or other contributors to global warming can have adverse side effects, and they do not tend to give full attention, such as climate gentrification caused by the displacement of vulnerable populations to less suitable places. Thus provision of climate proposals have to equitable and applied especially in the most disadvantaged neighbourhoods.

Many of these partial measures to curb excess heat and other climate adverse effects in cities are experimental and it is important to set up a robust monitoring system to discover unforeseen side-effects to

be able to take corrective measures. The same evaluation system should also be capable of assessing the effectiveness of the adopted measures.

At present in both Spain and the UK climate change measures are in the hand of central governments, but actions are needed at all levels and more devolution of power has to be instated to the cities as well to local communities. Vertical coordination of measures to alleviate the heat and other effects of climate change is essential to put into place at all levels at the same time. Similarly horizontal coordination between partial action into a more joined-up system has to be set up with channels of user-friendly two-way communications.

The biggest challenge remains financing these enormous efforts still required to realise the COP objective to which both Spain and the UK remain committed and to maintain these levels in the longer term.

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