3 Analysing local greenhouse gas emissions, climate impacts and vulnerabilities across OECD countries: Key findings

This chapter provides an initial assessment of local climate greenhouse gas (GHG) emissions, climate impacts and risks, applying the territorial indicator framework presented in Chapter 2 to OECD countries at different subnational levels. The chapter analyses 21 out of the proposed 45 indicators. It provides an overview of where OECD regions and cities stand in their journey toward climate neutrality by 2050, along with a discussion of the associated impacts and risks of climate change. The results reveal large territorial disparities within countries in terms of GHG emissions, mitigation potential as well as vulnerability to climate change. Such results reiterate the need for a territorial approach to climate and resilience policies.

Introduction: Applying the OECD territorial climate indicator framework to cities and regions

This chapter analyses the current trends and challenges of climate change in OECD cities and regions by applying the OECD territorial climate indicator framework presented in Chapter 2. It aims to provide an overview of where OECD regions and cities stand in their journey toward climate neutrality by 2050, along with an examination of the associated risks they encounter. Out of the proposed 45 indicators in the framework, this chapter analyses 21 indicators (14 climate mitigation indicators, 7 climate adaptation and resilience indicators). "Actions and opportunities" indicators will be discussed in Chapter 4. Sixteen out of these 21 indicators were calculated for Territorial Level 2 regions (TL2) and Level 3 regions (TL3)[1], and 5 for functional urban areas (FUAs)[2] (Table 3.1). The selection was made according to the principle of data availability. For each indicator, where relevant, the distance of cities and regions to achieving the global targets is measured and assessed.

Table 3.1. The list of indicators analysed in this report

Indicator	Unit of analysis	Reference point
Climate mitigation		
1. Total greenhouse gas (GHG) emissions, level and percentage change	TL2 and TL3 regions, FUAs of more than 500 000 inhabitants	The 2030 emissions per capita target (4.7 tCO_2-eq) defined based on computations derived from the IEA NZE Scenario for advanced economies (IEA, 2021[1]) multiplied by 2030 population projection
2. GHG emissions per capita, level and percentage change	TL2 and TL3 regions, FUAs of more than 500 000 inhabitants	The 2030 emissions per capita target (4.7 tCO_2-eq) defined based on computations derived from the IEA NZE Scenario for advanced economies (IEA, 2021[1])
4. GHG emissions by sector: share of total emissions, level, per capita and percentage change	TL2 and TL3 regions, FUAs of more than 500 000 inhabitants	The 2030 emissions per capita target by sector, defined based on computations derived from the IEA NZE Scenario for advanced economies (IEA, 2021[1]): agriculture 0.1 tCO_2-eq/capita; buildings 0.4 tCO_2-eq/capita; industry 1.7 tCO_2-eq/capita; power 1.3 tCO_2-eq/capita; transport 1.3 tCO_2-eq/capita
6. Electricity generation by source	TL2 and TL3 regions	100% of electricity generated from low-carbon sources.
7. Carbon intensity of electricity generation	TL2 and TL3 regions	Carbon intensity of electricity generated by the lowest emission-intensive source, i.e. 11 grams of CO_2-eq per kilowatt-hour (kWh) (wind).
10. Emission intensity of the manufacturing industry	TL2 and TL3 regions	To be defined.
11. Access to public transport	Metropolitan areas (only largest metropolitan area in each OECD country)	100% of the population with access to public transport.
12. Private vehicle ownership	TL2 and TL3 regions	Best performers, e.g.. 385 vehicles for 1 000 inhabitants for TL2 regions.
13. Electric and hybrid vehicle adoption	TL2 and TL3 regions	100% of electric or hybrid vehicle adoption.
15. Built-up area growth	TL2, TL3 regions, FUAs	To be defined.
16. Built-up area per capita	TL2, TL3 regions, FUAs	Best performers, e.g.. 65 square metres per capita for metropolitan areas.
17. Difference between built-up area growth and population growth	TL2, TL3 regions, FUAs	To be defined.
18. Waste generation	TL2 and TL3 regions	Best performers, e.g. 350 kg per capita per year for TL2 regions
19. Waste recovery	TL2 and TL3 regions	100% of recycled municipal waste.

Indicator	Unit of analysis	Reference point
Climate adaptation and resilience		
24. Heat stress exposure	TL2 and TL3 regions, FUAs	Mean number of days of different heat stress levels over 1981-2010.
25. Urban heat island intensity (daytime and night-time)	FUAs, SAUs	To be defined.
27. Burnt area by land cover type	TL2 and TL3 regions	Reference point defined as 0%.
28. Forest exposure to wildfire danger	TL2 and TL3 regions	Reference point defined as 0%.
29. Population exposure to river flooding	TL2 and TL3 regions	To be defined.
30. Population exposure to coastal flooding	TL2 and TL3 regions	To be defined.
31. Agricultural drought	TL2 and TL3 regions	Mean cropland soil moisture over 1981-2010.

Climate mitigation

Most OECD regions are far from reaching climate neutrality

Recent GHG emission trends differ largely across and within OECD countries. From 1990 to 2018, production-based emissions in Chile, Israel, Korea and Türkiye more than doubled, while those in the Baltic states and the United Kingdom decreased by more than 40%. In 40% of OECD large regions, emissions dropped, while in 25% of the regions, emissions increased by more than 50%. For example, in Korea, emissions in the Chungcheong region have increased 3 times since 1990, while those in Jeju increased by 38% (Figure 3.1 and Figure 3.2).

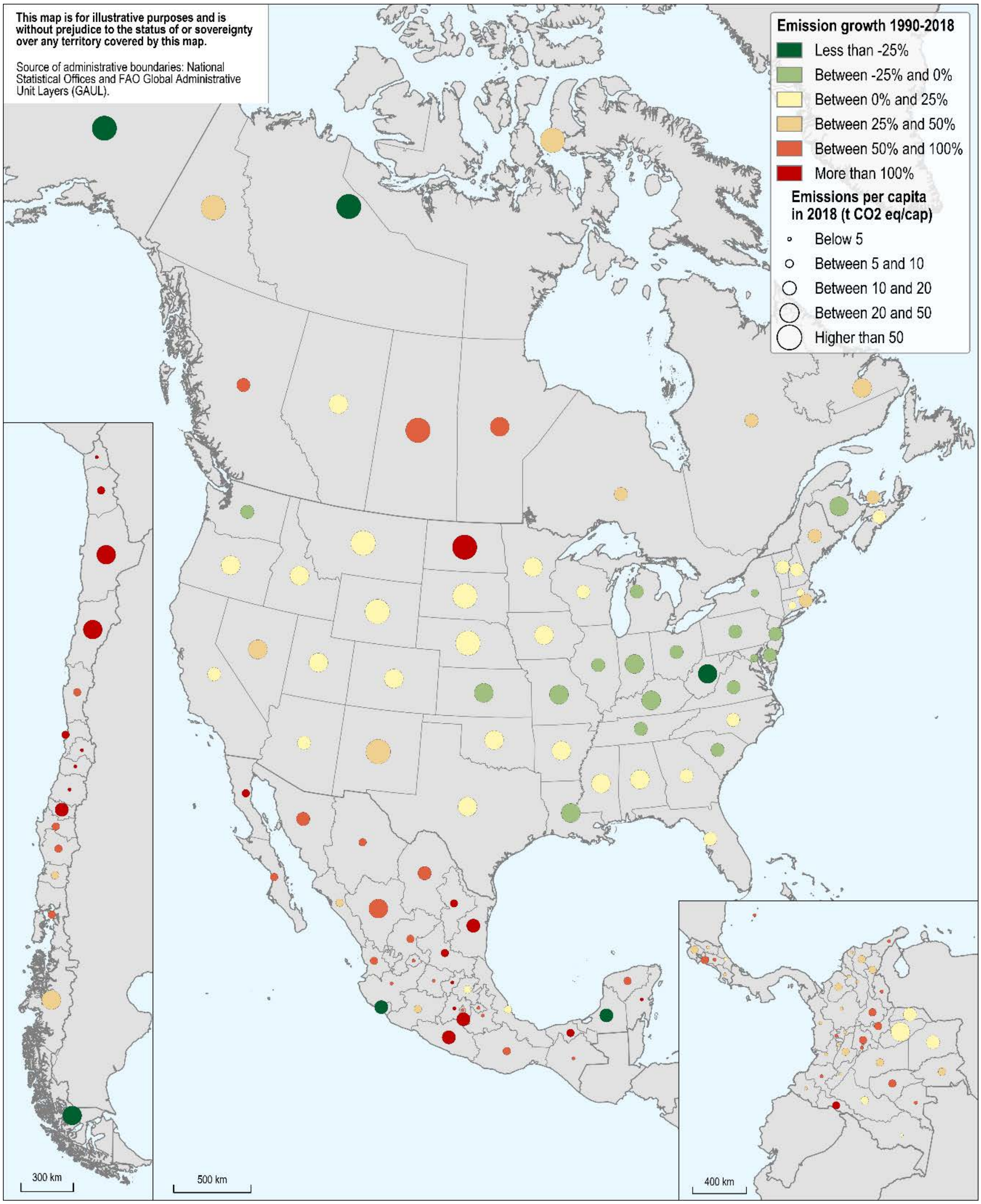
When comparing emission trends in OECD regions with the nationally determined contributions (NDCs) set at the national level, OECD large regions will have, on average, to cut their emissions by 35% by 2030 compared to 2018. This assumes the same regional distribution of emissions in 2030 as in 2018. When now looking at the more ambitious target of 4.7 tCO_2-eq per person derived from the IEA NZE Scenario, OECD regions will have, on average, reduced their emissions by a factor of 2.8 by 2030. In 2018, only 61 out of the 432 OECD large regions registered lower production-based emissions per capita than the required 4.7 tCO_2-eq per capita. In 40% of the regions, emissions per capita were higher than 10 tCO_2-eq.

Regional disparities are particularly important in the United States, where emissions per capita ranged from 3.6 tCO_2-eq in the District of Columbia to 180.7 tCO_2-eq in North Dakota (the latter probably due to its shale oil industry). Large regional disparities in emissions per capita also exist in other OECD countries, such as Canada, the Netherlands and New Zealand (Figure 3.1 and Figure 3.2).

The diverse levels of GHG emissions across regions are mainly attributed to the type of regions (urban or rural) and the existence of the power and industry sectors. In almost all OECD countries, emissions per capita are lower in metropolitan regions than in other types of regions (Figure 3.3.). On average, emissions per capita are twice as low in metropolitan regions as in regions far from a metropolitan region. In European OECD countries, metropolitan regions witnessed the largest decline across types of small regions. Emissions per capita per year reached 7 tCO_2-eq in 2018, i.e. 27% lower than in 1990. Metropolitan regions in South American OECD countries registered the lowest emissions per capita in 2018, with 2.9 tCO_2-eq. However, these regions experienced the largest relative increase in emissions across the OECD (+80%) since 1990 (Figure 3.4.).

Figure 3.1. Most OECD regions are far from reaching climate neutrality, Americas

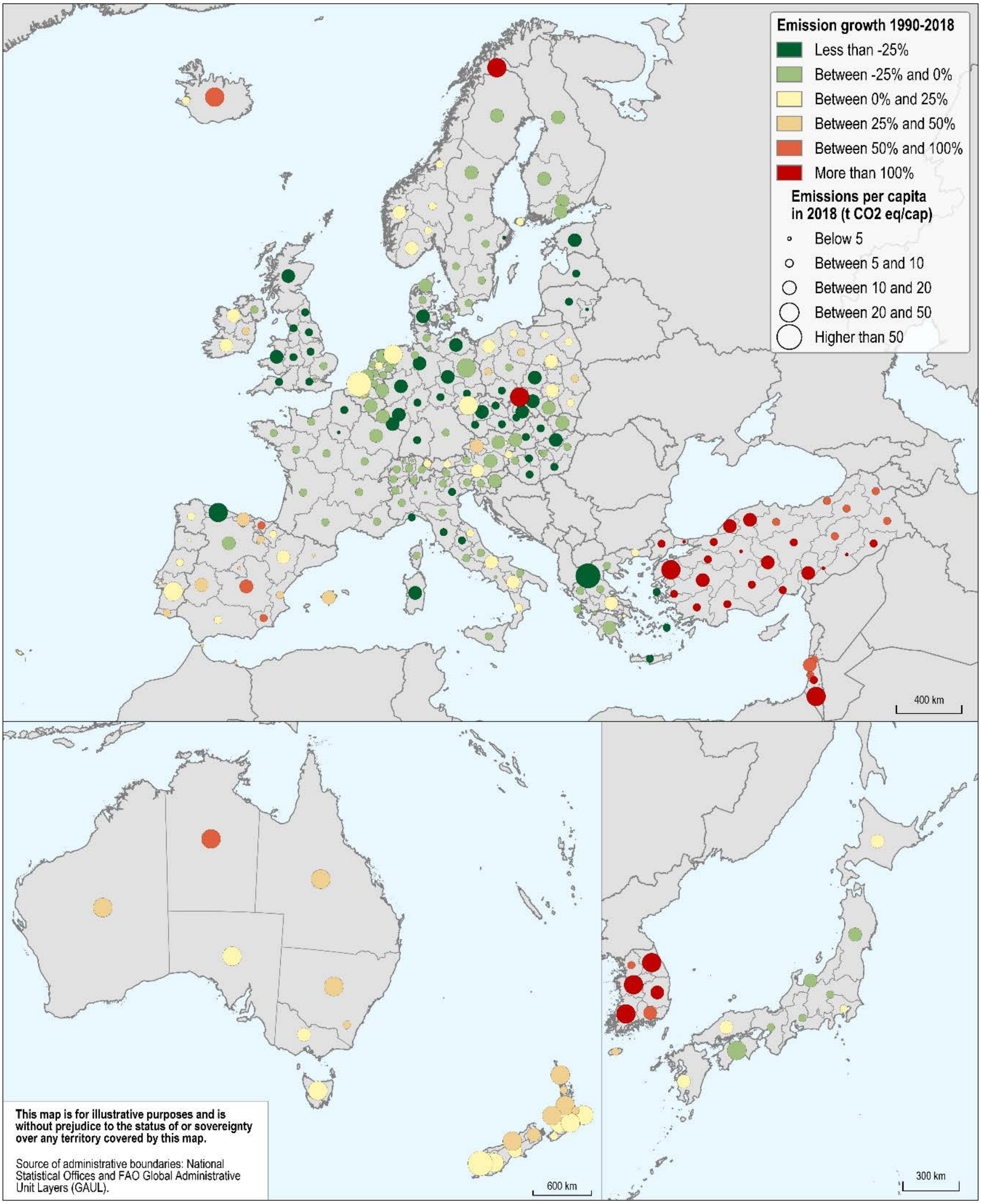
Total production-based GHG emissions (tCO_2-eq) per capita, 2018; emission growth (%) 1990-2018, OECD large regions (TL2)



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

Figure 3.2. Most OECD regions are far from reaching climate neutrality, Europe, Asia, Pacific

Total production-based GHG emissions (tCO_2-eq) per capita, 2018; emission growth (%) 1990-2018, OECD large regions (TL2)

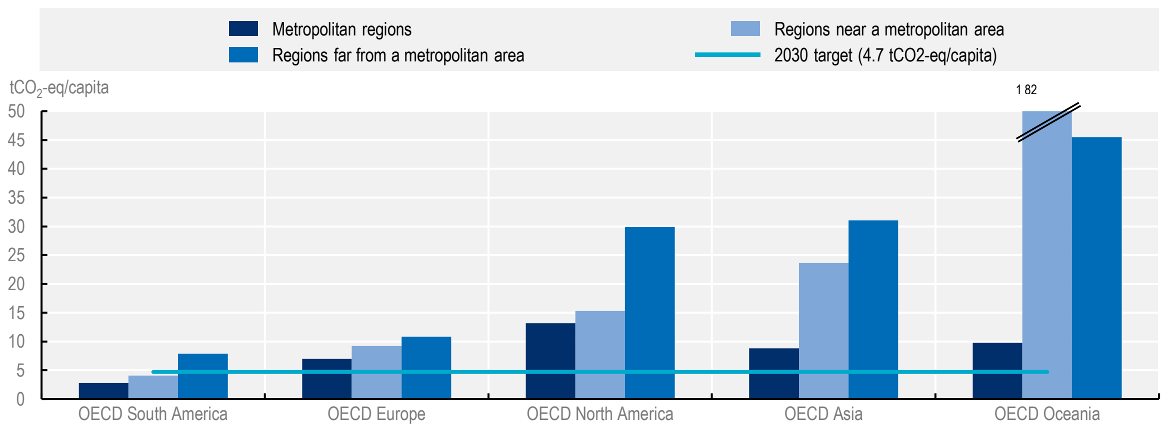


Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

The distribution of emissions by sector also varies across types of regions. In large metropolitan regions, buildings account for a larger share of total emissions than in other types of regions. Similarly, in regions near a metropolitan area, emissions in the power industry are relatively higher. The same trend applies to agriculture in remote regions (Figure 3.5).

Figure 3.3. Metropolitan regions register lower emissions per capita than other types of regions

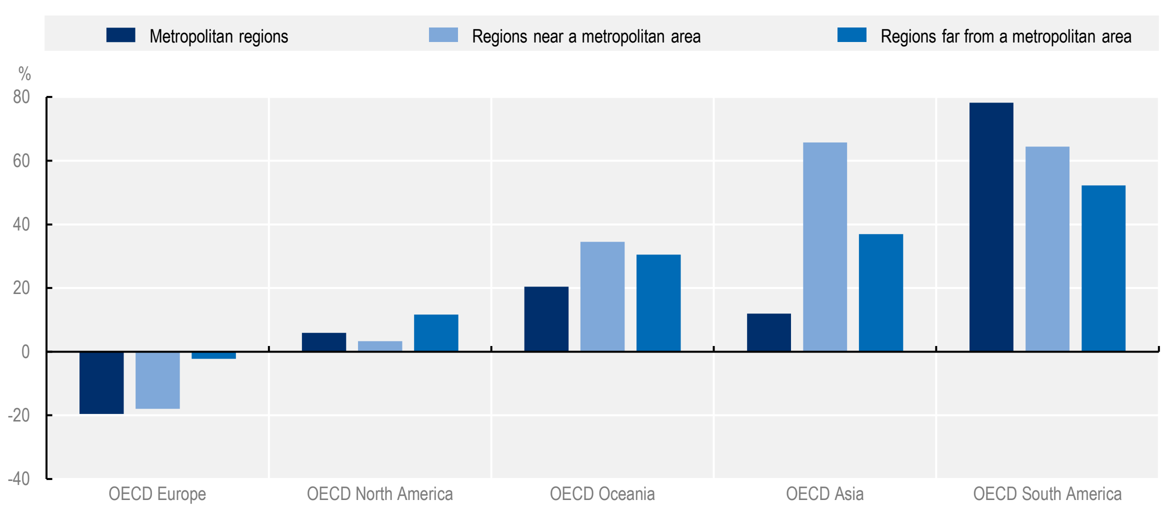
Emissions (t CO_2-eq) per capita, 2018, by type of small regions (TL3)



Note: Estimates based on OECD computations.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

Figure 3.4. Emissions declined the most in metropolitan regions in OECD Europe

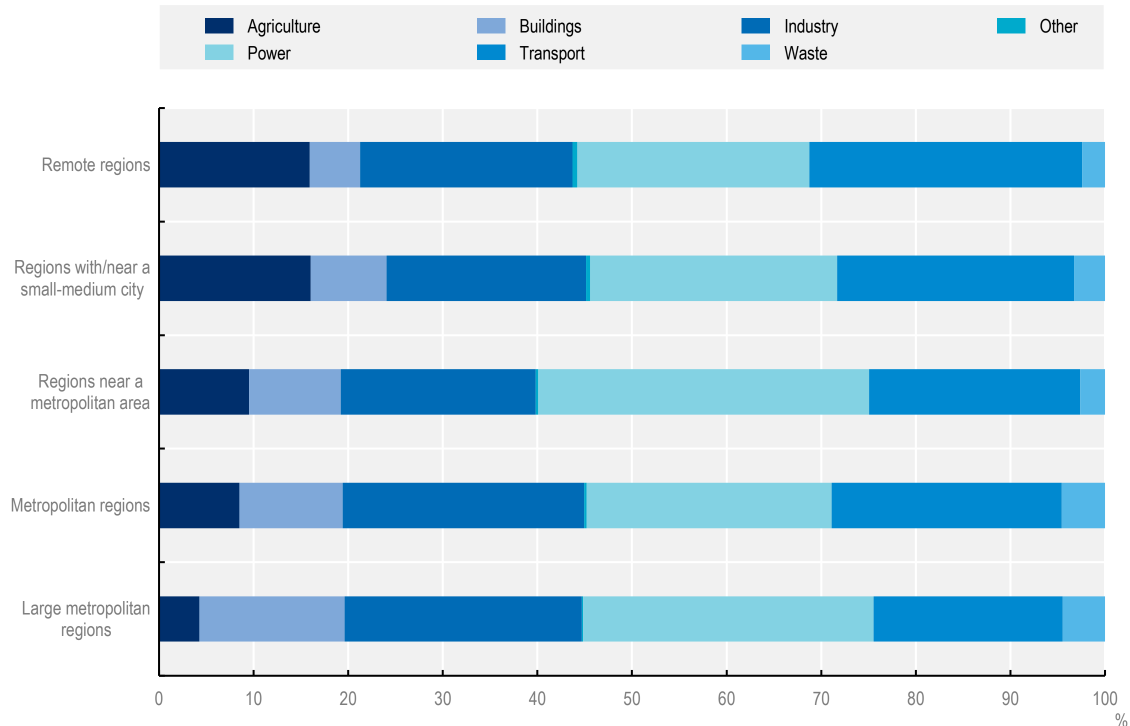
Emissions growth, 1990-2018 (%), by type of small regions (TL3)



Note: Estimates based on OECD computations.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b.

Figure 3.5. The sectoral distribution of emissions varies across types of small regions

Distribution of GHG emissions by sector in OECD small regions (TL3), 2018



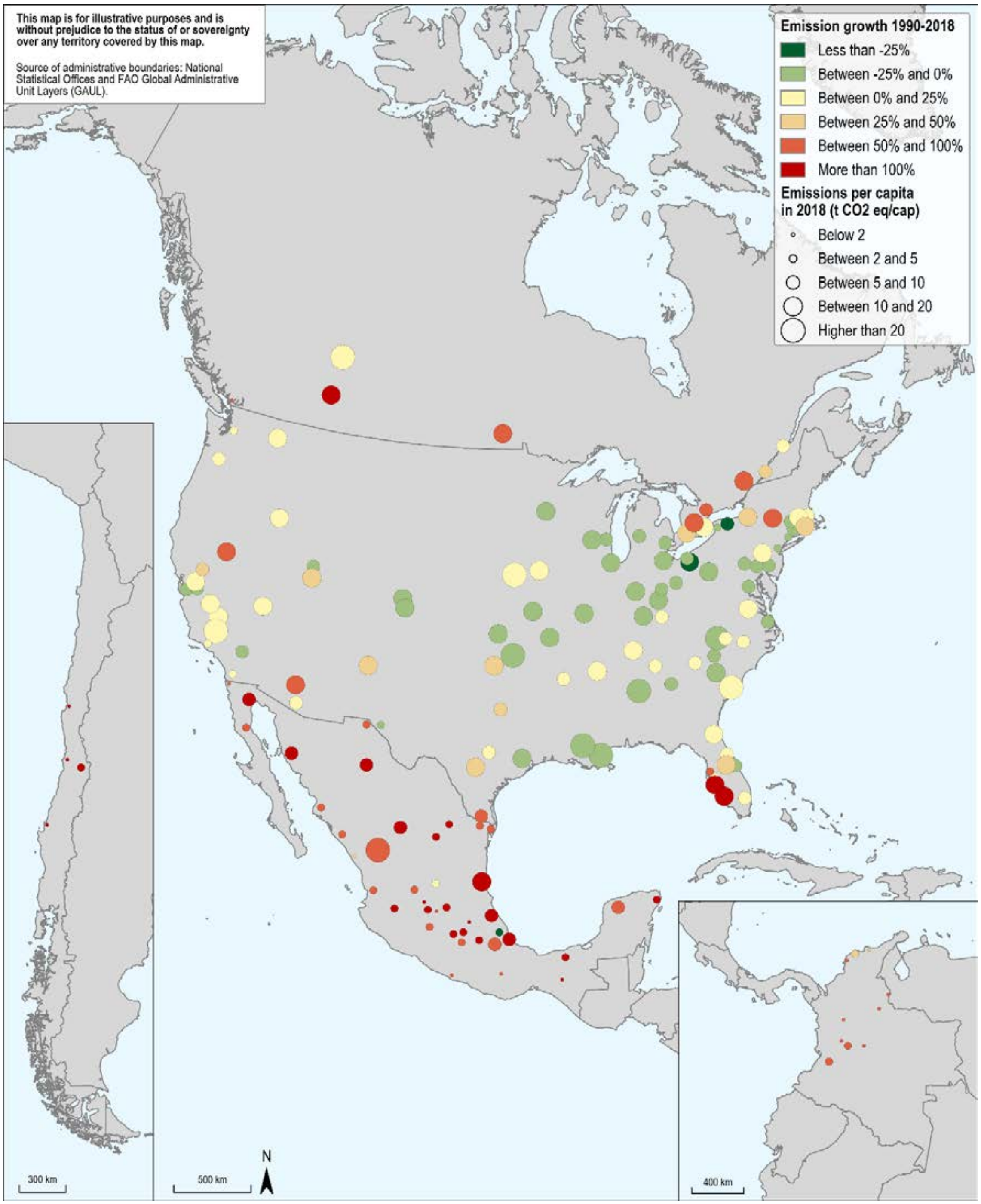
Note: Estimates based on OECD computations.
Source: Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b.

OECD cities also record high levels of GHG emissions, challenging climate neutrality

OECD metropolitan areas record high levels of GHG emissions per capita, with wide disparities across countries. On average, metropolitan areas of more than 500 000 inhabitants had per capita emissions of 6.9 tCO_2-eq in 2018 and experienced an emission growth of 24% from 1990 to 2018 (Figure 3.6). Disparities across metropolitan areas are particularly important. The Ruhr metropolitan area in Germany recorded close to 19.2 tCO_2-eq/capita in 2018, whereas Istanbul in Türkiye recorded a significantly lower level of 0.2 tCO_2-eq/capita (Figure 3.8). In 2018, almost half of OECD metropolitan areas with more than 500 000 inhabitants recorded production-based emissions per capita lower than the target of 4.7 tCO_2-eq per person. To reach this target, the remaining metropolitan areas will have to cut their emissions by an average of 44% by 2030.

Figure 3.6. GHG emissions per capita in OECD metropolitan areas illustrate wide disparities across countries, Americas

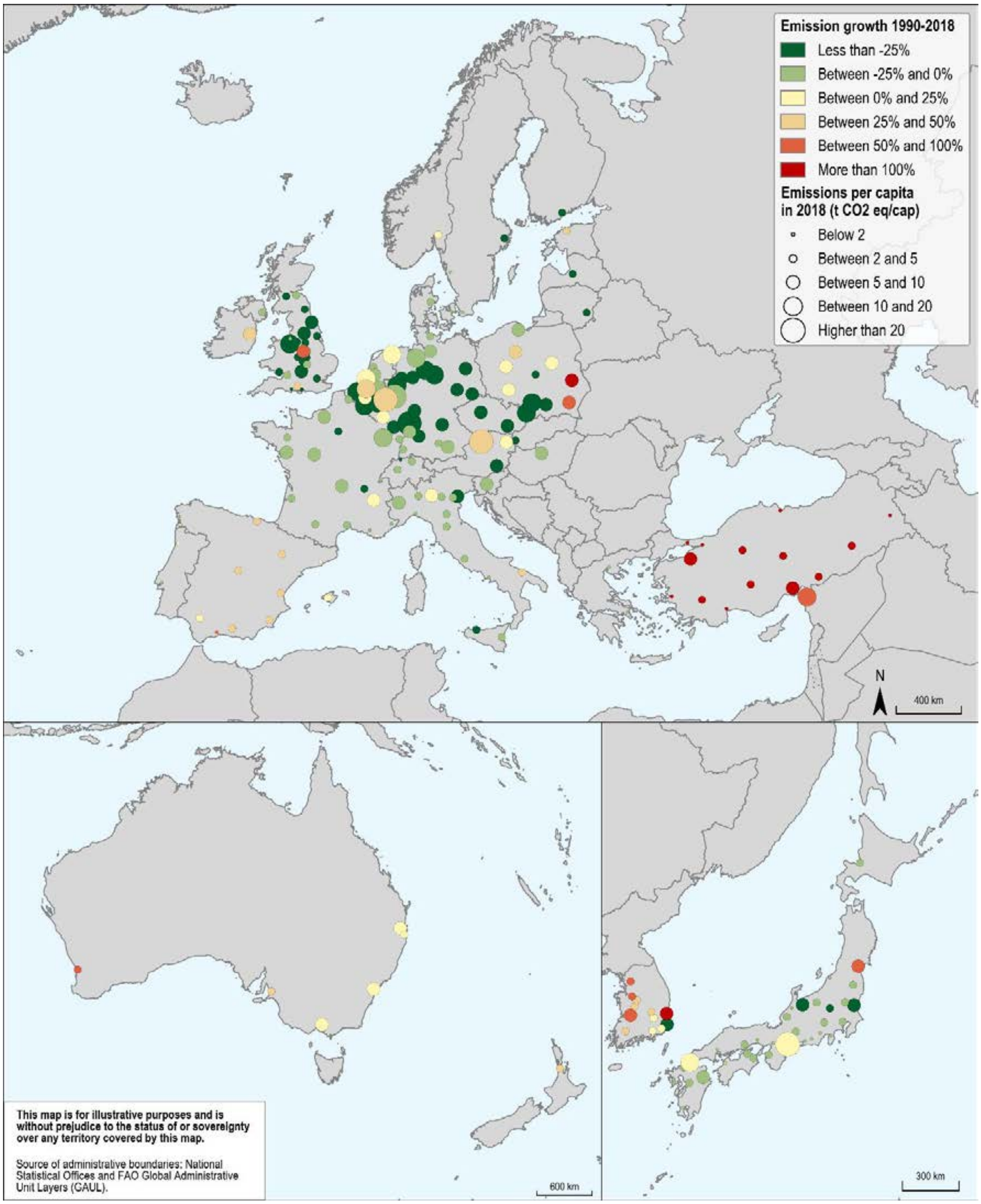
Total production-based GHG emissions (tCO_2-eq) per capita, 2018; emission growth (%) 1990-2018, OECD metropolitan areas of more than 500 000 inhabitants (FUA)



Source: Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

Figure 3.7. GHG emissions per capita in OECD metropolitan areas illustrate wide disparities across countries, Europe, Asia, Pacific

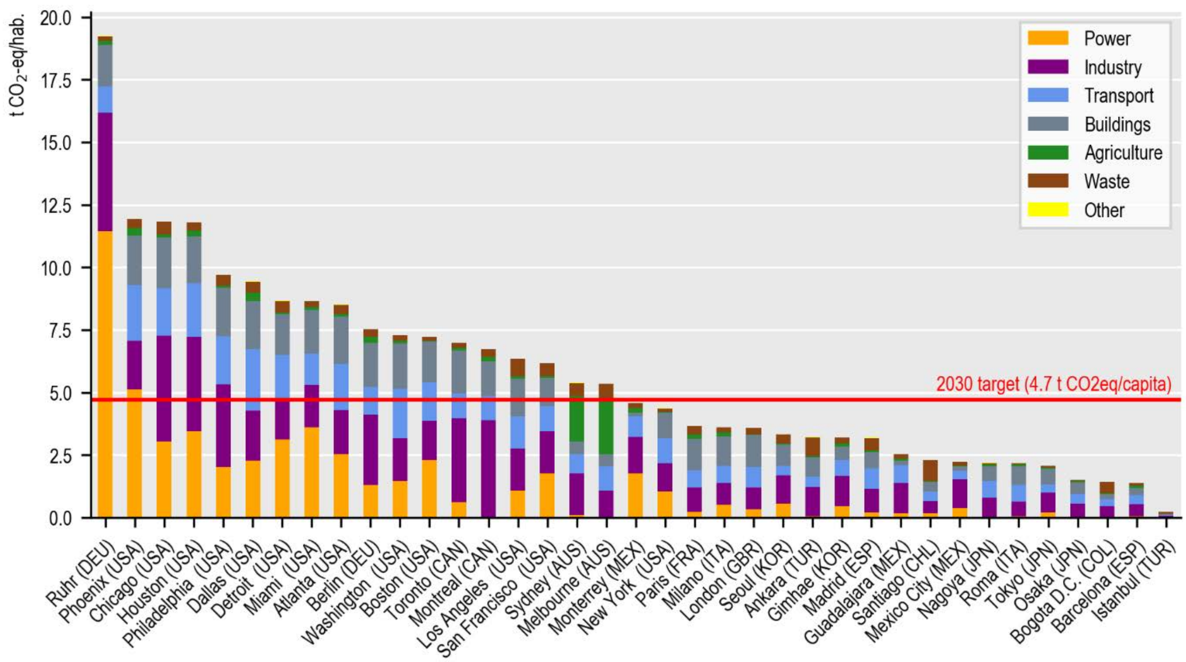
Total production-based GHG emissions (tCO_2-eq) per capita, 2018; emission growth (%) 1990-2018, OECD metropolitan areas of more than 500 000 inhabitants (FUA)



Source: Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

Figure 3.8. Among the most populated OECD metropolitan areas, Ruhr (Germany) records the largest emissions per capita

Emissions per capita by sector in OECD metropolitan areas of more than 4 million inhabitants, 2018



Note: Estimates based on OECD computations.

Source: Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

OECD regions show strong disparities in low-carbon power supply and manufacturing industry

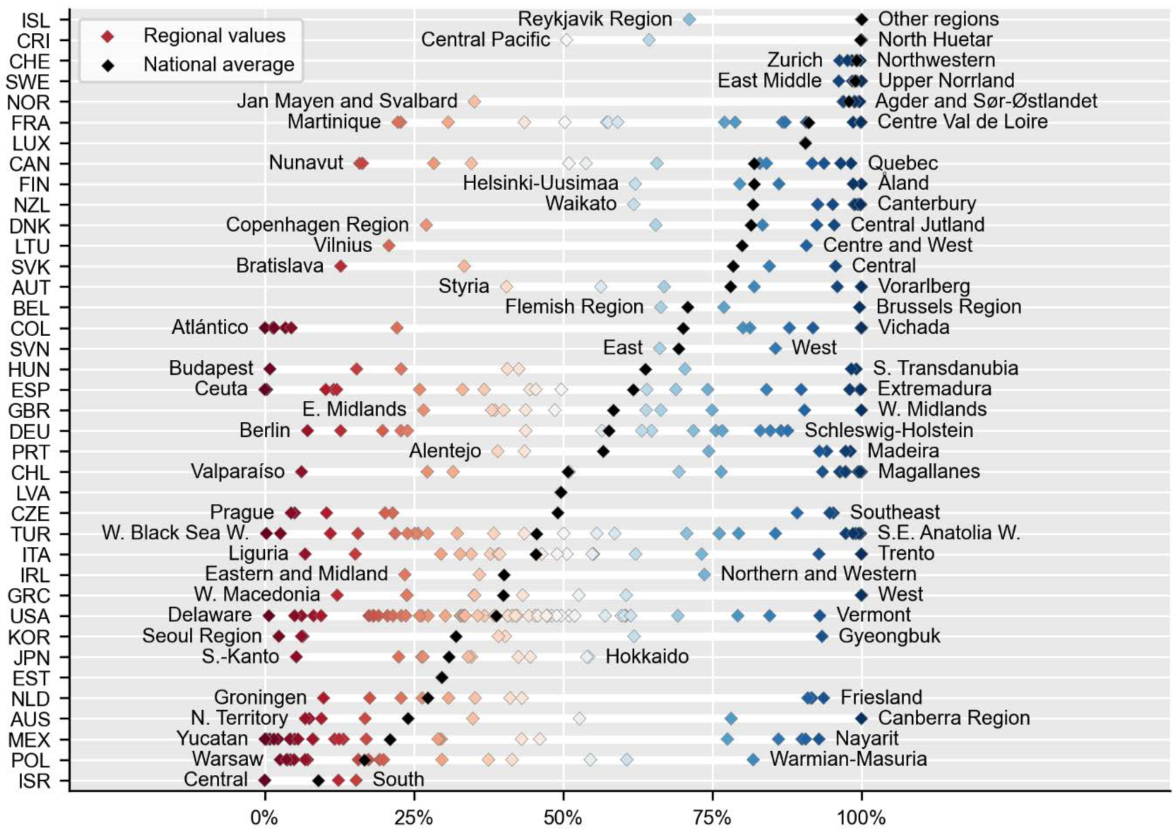
Many OECD regions are still far from reaching low-carbon electricity generation. More than 50 regions spread across 19 OECD countries still rely heavily on coal for power generation. However, over one-third of regions generate most of their power from low-carbon sources (nuclear or renewables) (Figure 3.9). Quebec (Canada), Auvergne-Rhône-Alpes (France) and Scotland (United Kingdom) are the largest producing regions in their respective countries and rely for more than 90% of their electricity on low-carbon sources. Power generation in these regions emits less than 100 gCO_2-eq. per kWh, which is more than 3 times below the OECD average (350 gCO_2-eq/kWh) (Figure 3.10).

Remote regions tend to generate cleaner energy. Renewables account for more than half of the electricity generation in remote regions and less than 20% in large metropolitan regions. Metropolitan regions tend to produce more carbon-intensive electricity. Almost half of the power in large metropolitan regions is generated from natural gas (Figure 3.12).

Emissions in the manufacturing industry mostly declined in metropolitan regions (-31%) and increased in remote regions (+7%). Emissions in this sector are concentrated in a few subsectors, such as the manufacturing of cement or steel, which can drive important disparities in emissions within countries. For example, in the Netherlands, the manufacturing emissions per unit of gross value added (GVA) in the region of Zeeland are more than six times higher than in Limburg. The manufacturing industry is an important sector in both regions as it accounts for more than 20% of total GVA but emissions in Zeeland are particularly concentrated in the manufacture of chemicals and chemical products. Large disparities are also observed in Australia, Mexico and the United States (Figure 3.13).

Figure 3.9. Over one-third of OECD regions generate their electricity from low-carbon sources

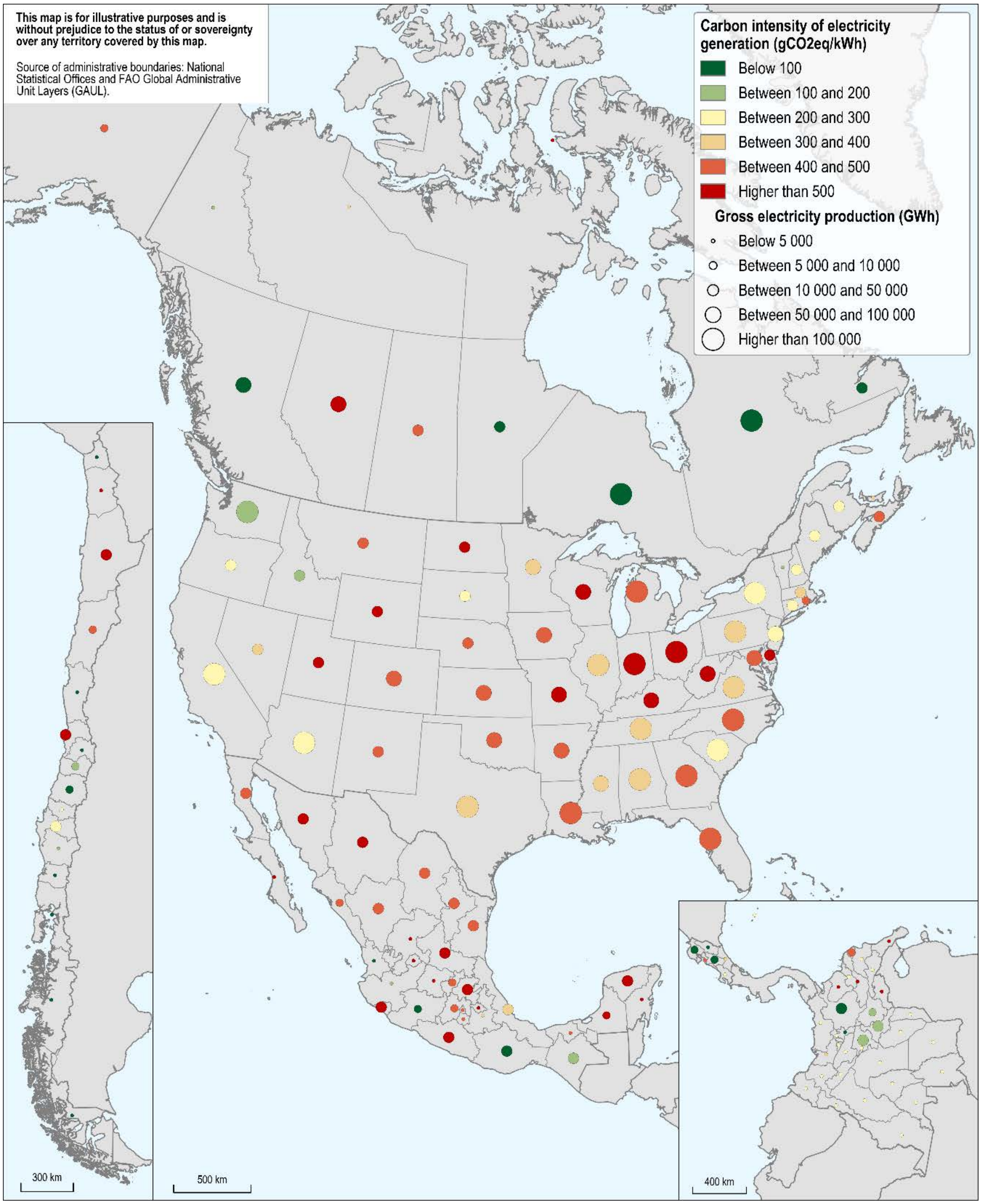
Share of electricity generated from low-carbon sources (renewables or nuclear), OECD large regions (TL2), 2019



Source: Estimates based on Byers, L. et al. (2021[5]), *A Global Database of Powerplants*, https://www.wri.org/research/global-database-power-plants; IEA electricity and heat database (2023[6]); Dunnett, S., A. Sorichetta and G. Taylor (2020[7]), "Harmonised global datasets of wind and solar farm locations and power", *Scientific Data*, Vol. 7/1, p. 130.

Figure 3.10. Many OECD regions still lag behind in clean power generation, Americas

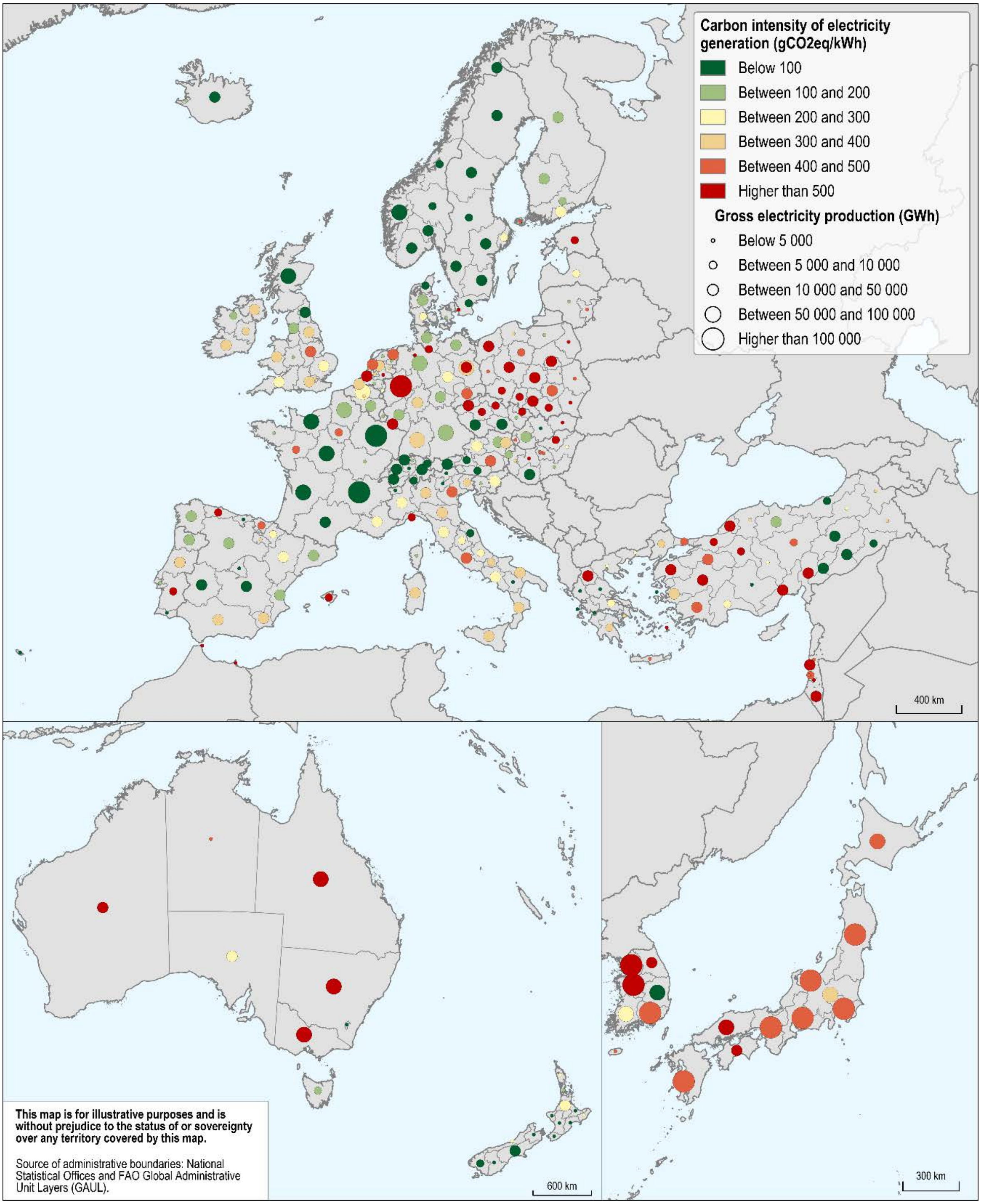
Gross electricity production (GWh) and carbon intensity of electricity generation (gCO$_2$-eq/kWh), OECD large regions (TL2), 2019



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Byers, L. et al. (2021[5]), *A Global Database of Powerplants*, https://www.wri.org/research/global-database-power-plants; IEA electricity and heat database (2023[6]); Dunnett, S., A. Sorichetta and G. Taylor (2020[7]), "Harmonised global datasets of wind and solar farm locations and power", *Scientific Data*, Vol. 7/1, p. 130.

Figure 3.11. Many OECD regions still lag behind in clean power generation, Europe, Asia, Pacific

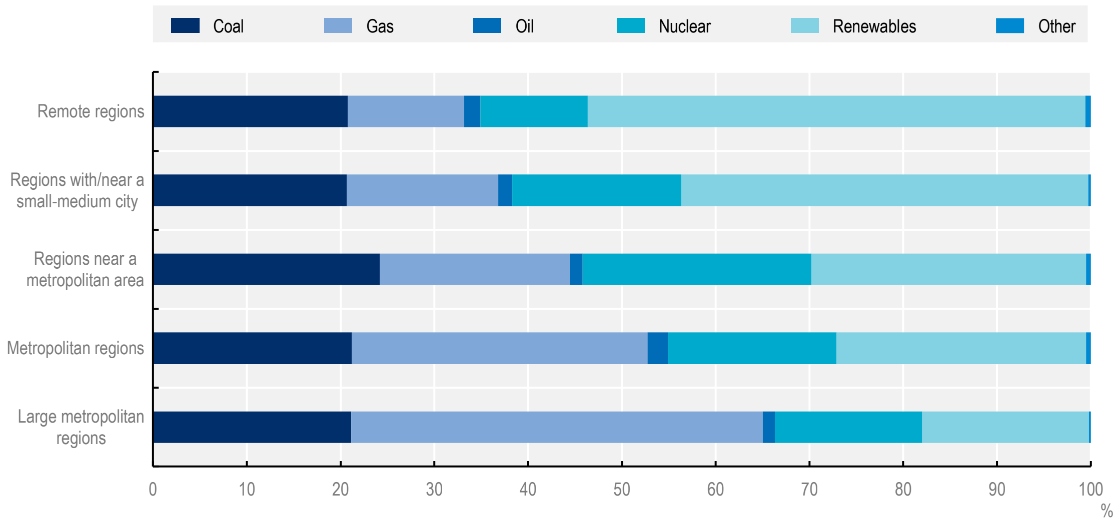
Gross electricity production (GWh) and carbon intensity of electricity generation (gCO_2-eq/kWh), OECD large regions (TL2), 2019



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Byers, L. et al. (2021[5]), *A Global Database of Powerplants*, https://www.wri.org/research/global-database-power-plants; IEA electricity and heat database (2023[6]); Dunnett, S., A. Sorichetta and G. Taylor (2020[7]), "Harmonised global datasets of wind and solar farm locations and power", *Scientific Data*, Vol. 7/1, p. 130.

Figure 3.12. Remote regions generate cleaner electricity

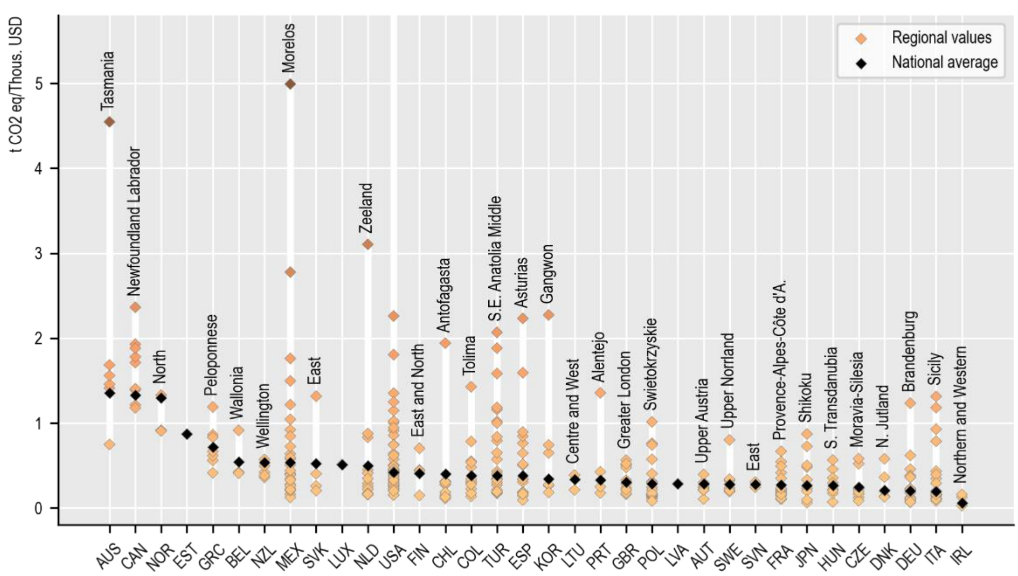
Power generation by source (2019), by type of small regions (TL3)



Note: Estimates based on OECD computations.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Byers, L. et al. (2021[5]), *A Global Database of Powerplants*, https://www.wri.org/research/global-database-power-plants; IEA electricity and heat database (2023[6]); Dunnett, S., A. Sorichetta and G. Taylor (2020[7]), "Harmonised global datasets of wind and solar farm locations and power", *Scientific Data*, Vol. 7/1, p. 130.

Figure 3.13. Regional disparities in manufacturing emissions per unit of GVA

Emissions per unit of GVA in manufacturing (tCO_2-eq/USD thousands), 2017, OECD large regions (TL2)



Note: Manufacturing industry emissions include the combustion for manufacturing, oil refineries and transformation industry, chemical processes, non-metallic minerals production, iron and steel production, non-ferrous metals production, non-energy use of fuels and solvents and products use. Only regions where the GVA in manufacturing is higher than USD 1 billion (constant prices, constant purchasing power parity, base year 2015) are represented in the chart. Alaska (United States), not shown in this graph, records 6.8 tCO_2-eq/USD thousands.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; GVA in manufacturing obtained from the OECD regional database (2023[8]).

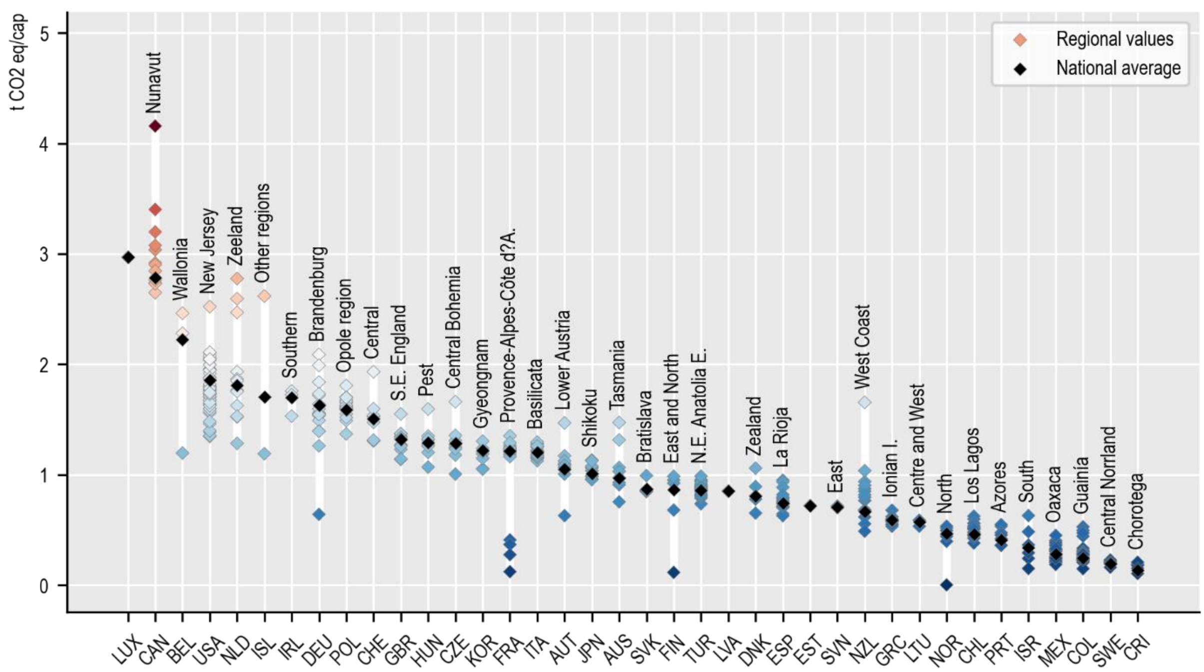
Emissions from the building and transport sectors show large territorial disparities

Building sector

Direct building emissions (excluding the carbon intensity of purchased electricity and of the materials used in building construction) accounted for 11% of total GHG emissions in 2018 (Crippa et al., 2021[3]). Large disparities in building emissions across and within countries can only be partly explained by climate differences, as they may also originate from differences in energy sources used in the residential sector. In Germany, building emissions per capita in Brandenburg are three times higher than those in Bremen (Figure 3.14). Since 2000, building emissions per capita have decreased in three-quarters of OECD large regions, with Swedish regions experiencing a decrease of more than 75%. However, emissions increased in many regions located in the Baltic states, Colombia and Türkiye.

Figure 3.14. Large disparities in building emissions are only partly explained by local climate

Direct building emissions (tCO_2-eq) per capita, OECD large regions (TL2), 2018



Note: Estimates based on OECD computations.

Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

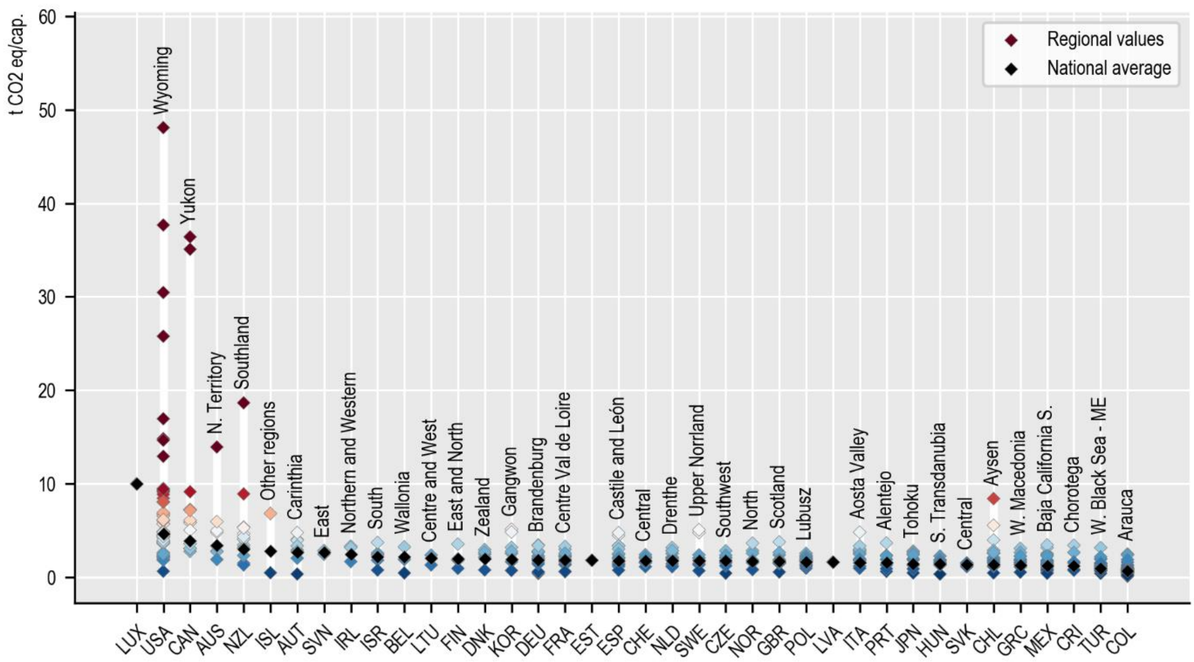
Transport emissions

Road transport accounts for the largest share of transport-related emissions in OECD countries. If we exclude international aviation and international shipping, road transport accounts for 88% of transport emissions, followed by domestic aviation (7%), rail and others (3%) and domestic shipping (2%) (Crippa et al., 2021[3]).

Disparities in road emissions per capita within countries are particularly large in Oceania and North America (Figure 3.15). Sparsely populated regions in North America record the highest road emissions per capita, including North Dakota, Wyoming and Yukon, which all record more than 30 tCO_2-eq per capita. From 2000 to 2018, road emissions per capita increased, particularly in Eastern Europe, Colombia, Korea and Türkiye.

Figure 3.15. Regions in Oceania and North America are experiencing the largest disparities in road transport emissions per capita

Road transport emissions (tCO_2-eq) per capita in OECD large regions (TL2), 2018



Note: Estimates based on OECD computations.

Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

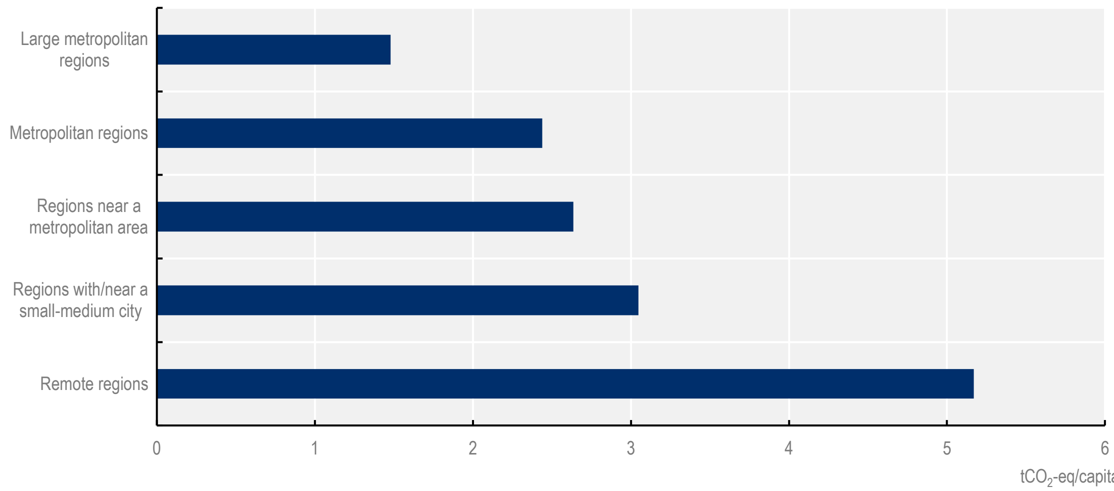
Road emissions per capita in remote regions are, on average, more than three times higher than in large metropolitan regions (Figure 3.16). These differences can be explained by population density, socio-cultural factors, such as the average number of vehicles per household, and the availability of public transport.

Private vehicle ownership

Across OECD countries, private vehicle ownership is concentrated in certain types of regions. In Australia, Mexico, Türkiye and East European countries, metropolitan regions record higher numbers of vehicles per capita than other regions. In contrast, in Asia and most European countries, non-metropolitan regions record more vehicles per capita than metropolitan regions. In Italy and the United States, regional disparities are particularly large. For example, the region of Aosta Valley in Italy records almost 1 800 vehicles per 1 000 inhabitants, the highest number of private vehicles per capita across OECD regions and more than 3 times the number of vehicles per capita observed in Liguria (Figure 3.17).

Figure 3.16. Road transport emissions per capita are three times higher in remote regions than in large metropolitan regions

Road transport emissions per capita by type of small regions (TL3), 2018

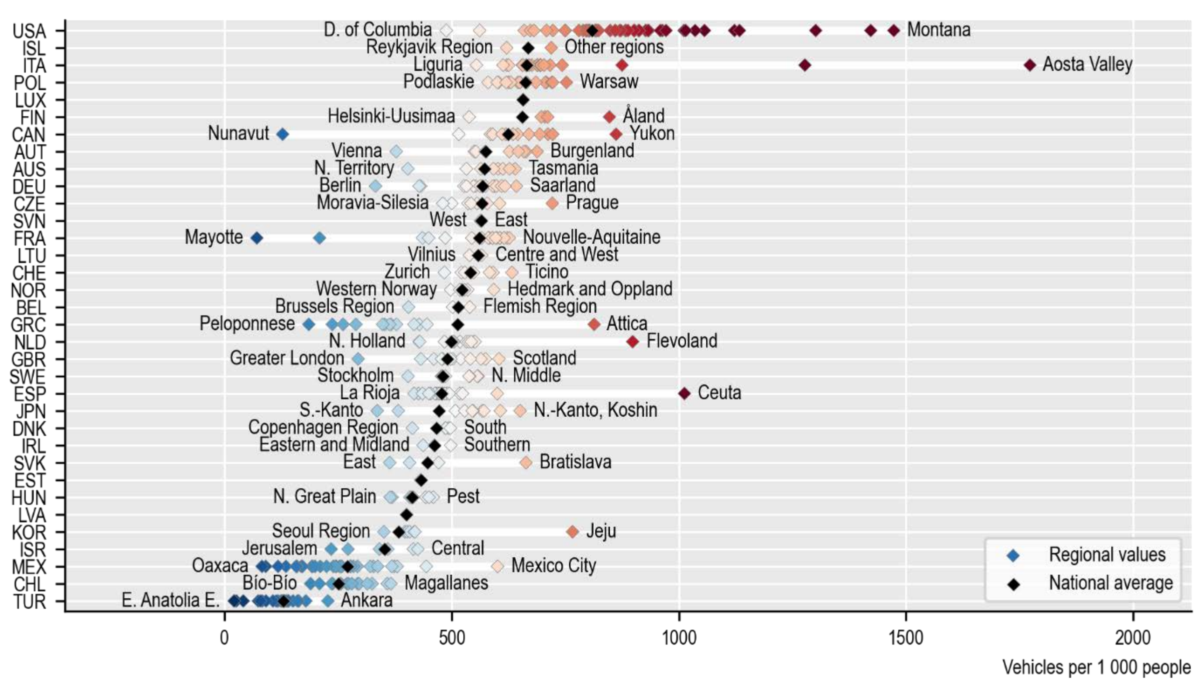


Note: Estimates based on OECD computations.

Source: Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b; Schiavina, M., S. Freire and K. MacManus (2019[4]), *GHS Population Grid Multitemporal (1975, 1990, 2000, 2015) (dataset)*, Joint Research Centre (JRC), European Commission.

Figure 3.17. Large regional disparities in private vehicle ownership

Private motor vehicles per 1 000 inhabitants in large regions (TL2), 2021



Note: 2009 for CAN; 2010 for ESP; 2011 for EST; 2012 for LUX; 2013 for JPN; 2014 for ISL and TUR; 2019 for ISR and DEU; 2020 for AUS, CHE, CHL, CZE, FIN, GBR, GRC, IRL, ITA, KOR, LTU, MEX, NLD, NOR, POL, SVK, SVN and USA.

Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en.

In recent decades, the number of private vehicles per capita decreased in most European capital regions. For example, Greater London recorded a decline of 12% in vehicles per capita since 2000. However, in many American regions, especially in Chile, Mexico and the United States, the concentration of private vehicles has increased significantly. In the regions of Morelos and Tlaxcala (Mexico), for example, private vehicles per capita were four times higher in 2020 than in 2001.

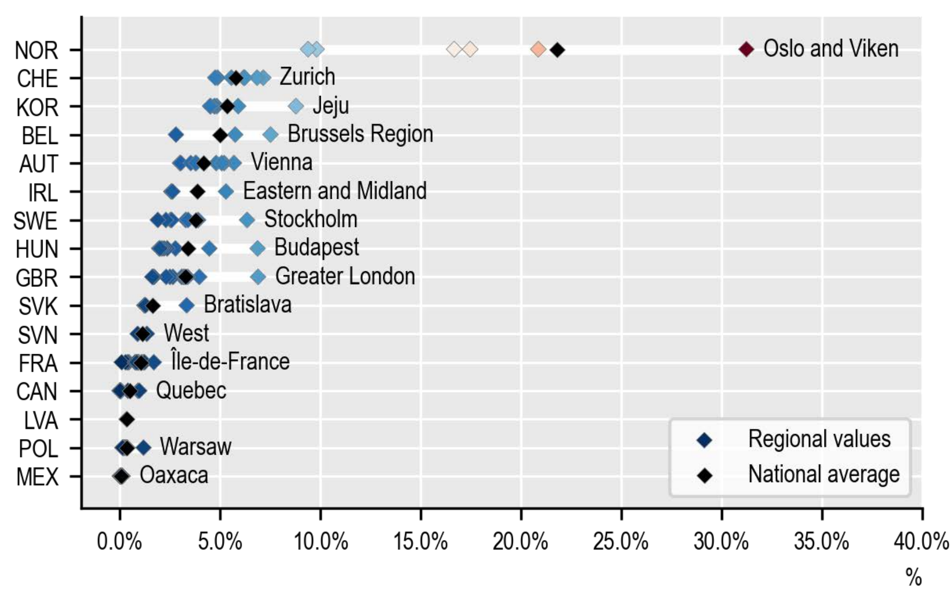
As discussed in Chapter 2, the target corresponds to the "best performers", i.e. 385 vehicles for 1 000 inhabitants, which corresponds to Eastern Anatolia in Türkiye. However, it is worth noting that this target is not perfect as there is no evidence available regarding the number of vehicles that rely on fossil fuels, which can be a more accurate indication of the progress towards achieving low-emissions transport.

Electric or hybrid vehicle adoption

Norway registers the highest electric mobility adoption rate, as 22% of private vehicles are either electric or hybrid. The carbon intensity of electricity in Norway is also one of the lowest in the OECD, as it is mostly generated from hydropower. Across the OECD, capital regions are leading the adoption of electric or hybrid vehicles. In the Brussels Capital Region (Belgium), Budapest (Hungary), Stockholm (Sweden) and Greater London (United Kingdom), around 7% of private vehicles were either electric or hybrid in 2020. The region of Oslo and Viken (Norway) had a share of 31% of electric or hybrid vehicles in 2020, more than 20 percentage points higher than in 2016 (Figure 3.18).

Figure 3.18. Capital regions are leading the adoption of electric and hybrid vehicles

Share of private electric or hybrid vehicles in large regions (TL2), 2020-21



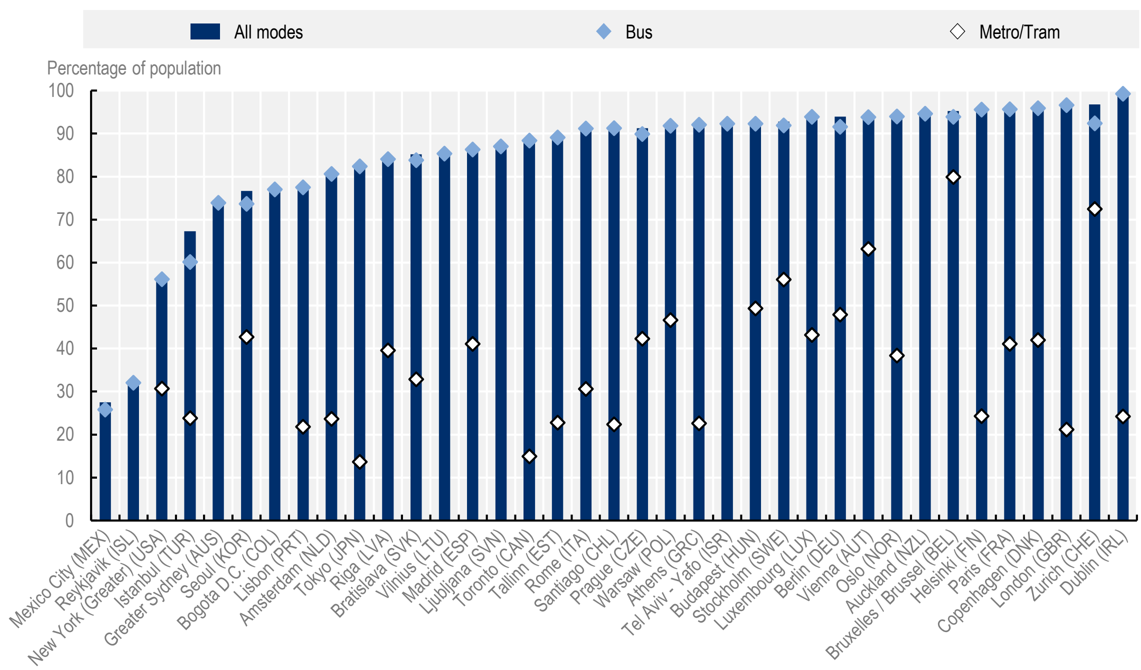
Note: 2020 for CHE, GBR, IRL, KOR, MEX, NOR, POL, SVN, SWE; 2021 for AUT, BEL, FRA, HUN, LVA, SVK.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en.

Public transport accessibility in cities

In terms of public transport accessibility, across the largest metropolitan areas per OECD country, on average, 83% of the population has access to a bus stop within a 10-minute walk and 31% to a metro or tram stop. In 31 out of the 35 largest cities in the OECD, more than 70% of the population has access to a public transport stop within a 10-minute walk. Only Reykjavik (Iceland), Mexico City (Mexico), Istanbul (Türkiye) and New York (United States) register low accessibility rates. Many European cities, as well as Auckland (New Zealand) tend to offer the best accessibility to public transport. However, Southern European cities show relatively low accessibility to metro or tram stops (e.g. Lisbon 21%, Athens 22% and Rome 30%), while Northern and Central European cities record much higher accessibility rates (e.g. Zurich 72%, Vienna 63% and Stockholm 56%) (Figure 3.19).

Figure 3.19. Public transport accessibility is high in Central and Northern European capital cities

Share of population with access to public transport (within 10 min walk from a public transport stop), largest FUA per OECD country



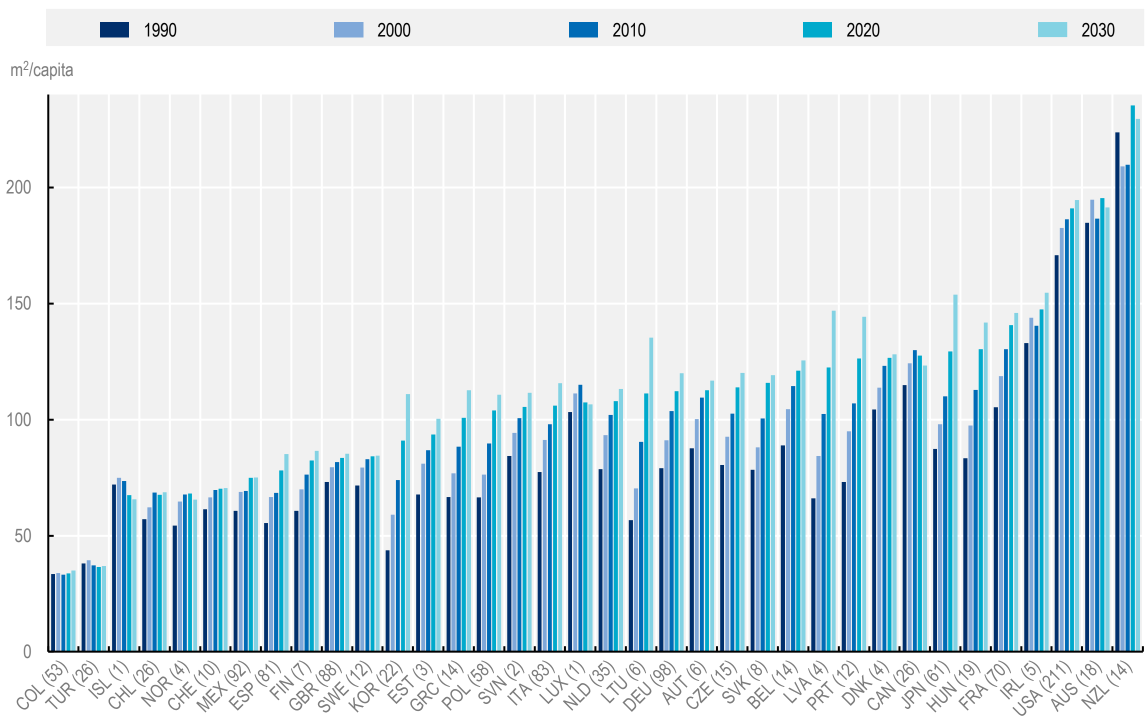
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; based on Open Street Map (2023[9]), Mapbox Isochrone API (2023[10]).

Continued built-up expansion affects emissions from agriculture, forestry and other land use (AFOLU)

Extensive built-up areas are associated with changes in land use through deforestation and soil artificialisation and can thus contribute to shrinking carbon sinks and increasing AFOLU emissions. In addition, low-density housing and urban sprawl can be associated with higher energy demand and transport-related CO_2 emissions (OECD, 2018[11]). In OECD countries, metropolitan areas recorded an average of 120 square metres (m^2) of built-up surface per capita in 2020. However, across OECD countries, built-up area per capita in FUAs varies by a factor of 7, ranging from 34 m^2 per capita in Colombia to 235 m^2 in New Zealand (Figure 3.20).

In 80% of OECD FUAs, built-up areas grew faster than population between 2000 and 2020. The difference between built-up area growth and population growth is particularly high in cities located in Japan, Korea and Eastern Europe. In almost 80% of the FUAs with high levels of built-up area per capita in 2000 (above 100 m^2 per person), land consumption has increased at a higher rate than the population. For example, built-up surface in Polish FUAs increased by 36% in the last 20 years while the population remained constant. Built-up area per capita has been increasing at different speeds depending on city size, with faster increases in smaller cities. Built-up area per capita in FUAs with less than 100 000 inhabitants has increased by 26%, from 87 m^2 to 109 m^2 per person from 2000 to 2020, while it increased by 4% during the same period in large metropolitan areas, i.e. in FUAs with more than 1.5 million inhabitants (Figure 3.21).

Figure 3.20. Built-up area per capita in FUAs have been increasing in most OECD countries



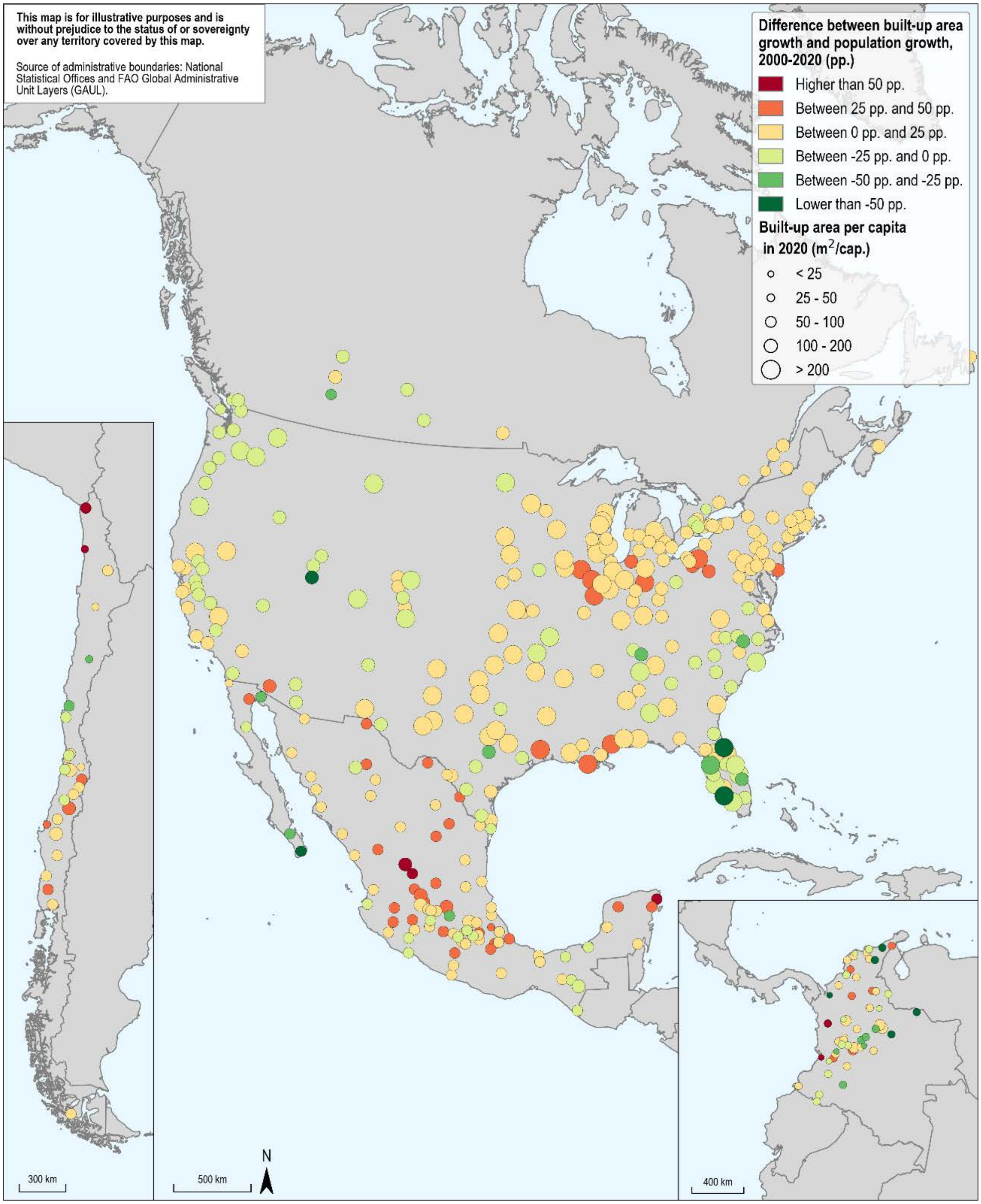
Source: Schiavina, M. et al. (2023[12]), *GHS-POP R2023A - GHS Population Grid Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/2FF68A52-5B5B-4A22-8F40-C41DA8332CFE; Pesaresi, M. and P. Politis (2023[13]), *GHS-BUILT-S R2023A - GHS Built-up Surface Grid, Derived from Sentinel2 Composite and Landsat, Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/9F06F36F-4B11-47EC-ABB0-4F8B7B1D72EA.

Deforestation and tree cover loss are some of the main drivers of AFOLU emissions. Tree cover area has declined in half of OECD large regions between 2000 and 2020. Particularly large declines in tree cover can be observed in Korea, Northern Chile and the Northeast of the United States. For example, the District of Columbia recorded a decline of almost 40% in tree cover during this period (Figure 3.23).

Agriculture is also a key driver of GHG emissions. These emissions are concentrated in a few regions in OECD countries. According to estimates based on European Commission's Emissions Database for Global Atmospheric Research (EDGAR) data, one-quarter of OECD regions concentrate 70% of agricultural emissions. New South Wales (Australia) and Iowa and Texas (United States) recorded the largest emissions in the sector in 2018. The most emission-intensive regions in terms of emissions per unit of GVA in agriculture are Southern Ireland (Ireland), Canterbury (New Zealand), Wales (United Kingdom) and Montana (United States) (Figure 3.25).

Figure 3.21. In most OECD cities, built-up areas grew faster than populations, Americas

Difference in percentage points between built-up area growth and population growth, 2000-2020

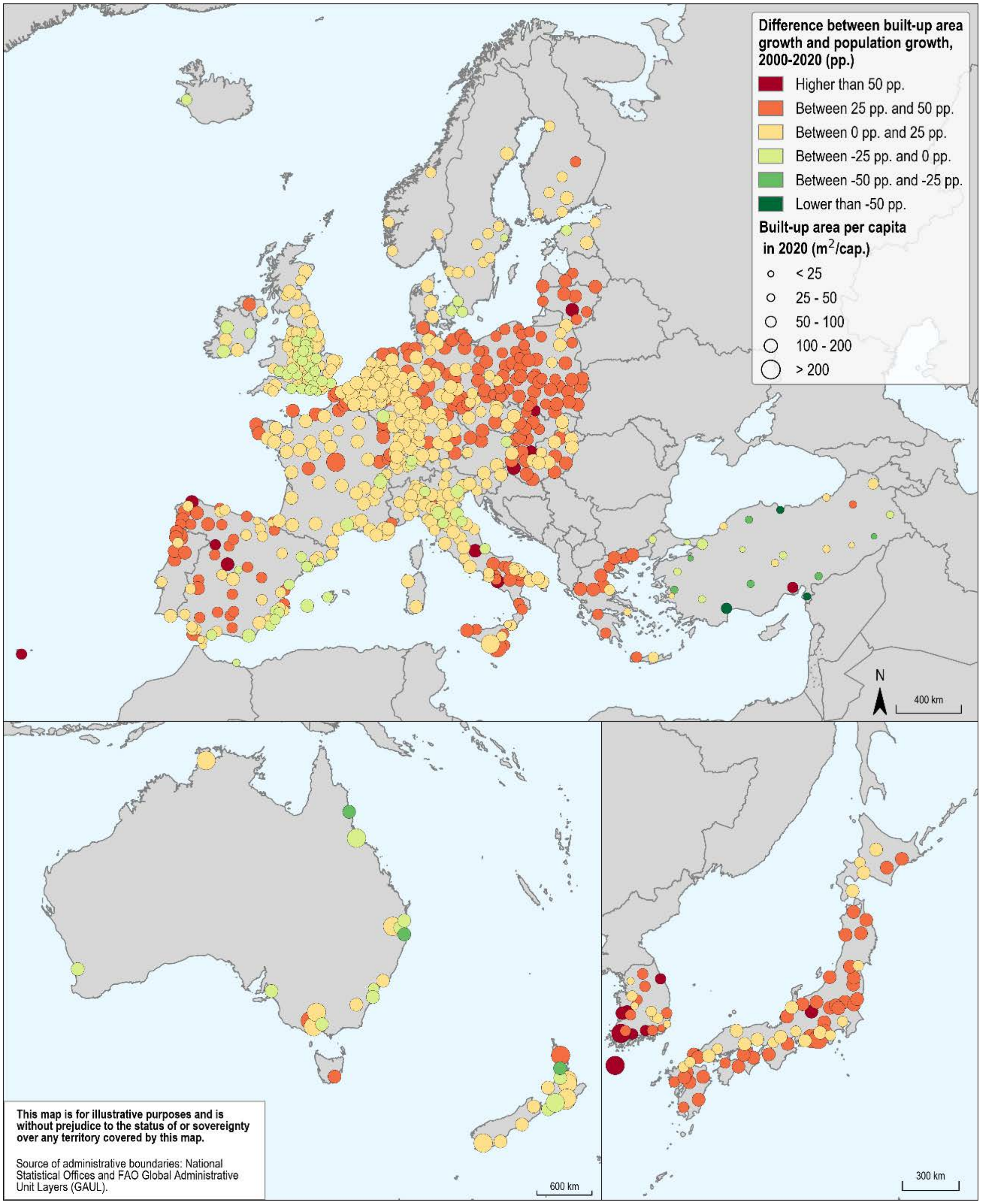


Note: Red dots are associated with a much faster built-up area growth than population growth. On the other hand, green dots correspond to faster population growth than built-up area growth.

Source: Schiavina, M. et al. (2023[12]), *GHS-POP R2023A - GHS Population Grid Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/2FF68A52-5B5B-4A22-8F40-C41DA8332CFE; Pesaresi, M. and P. Politis (2023[13]), *GHS-BUILT-S R2023A - GHS Built-up Surface Grid, Derived from Sentinel2 Composite and Landsat, Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/9F06F36F-4B11-47EC-ABB0-4F8B7B1D72EA.

Figure 3.22. In most OECD cities, built-up areas grew faster than populations, Europe, Asia, Pacific

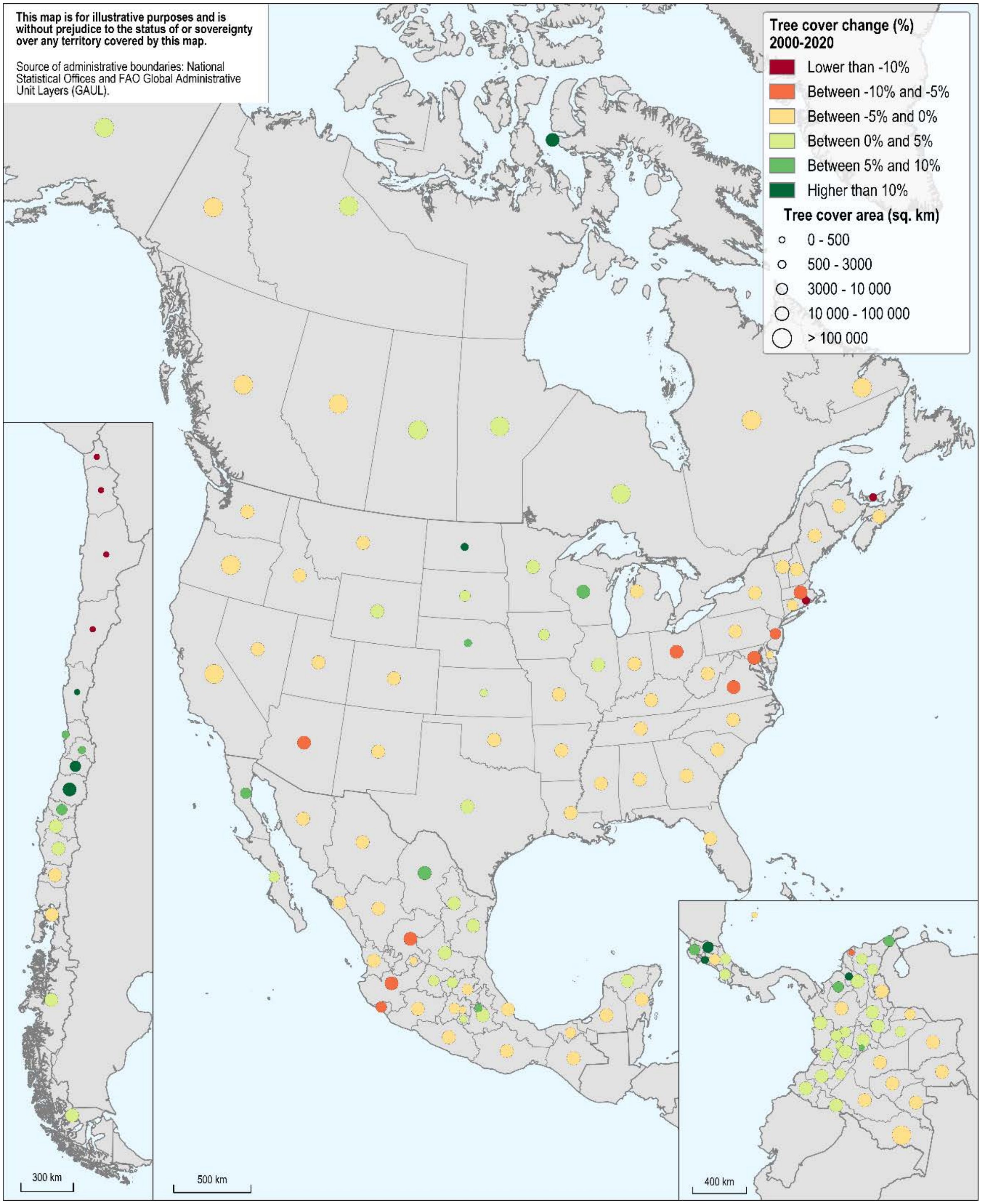
Difference in percentage points between built-up area growth and population growth, 2000-20



Note: Red dots are associated with a much faster built-up area growth than population growth. On the other hand, green dots correspond to faster population growth than built-up area growth.

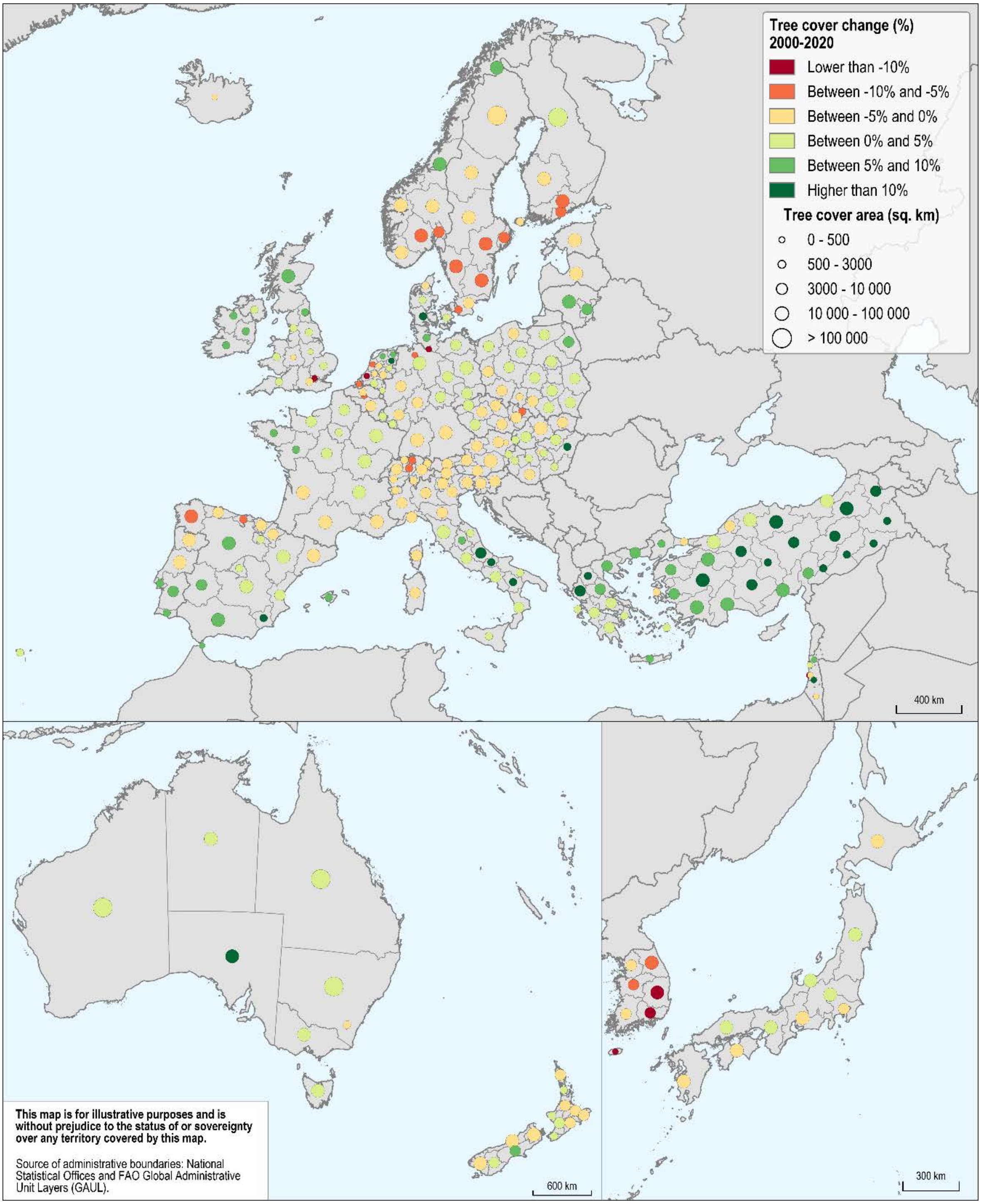
Source: Schiavina, M. et al. (2023[12]), *GHS-POP R2023A - GHS Population Grid Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/2FF68A52-5B5B-4A22-8F40-C41DA8332CFE; Pesaresi, M. and P. Politis (2023[13]), *GHS-BUILT-S R2023A - GHS Built-up Surface Grid, Derived from Sentinel2 Composite and Landsat, Multitemporal (1975-2030) (dataset)*, https://doi.org/10.2905/9F06F36F-4B11-47EC-ABB0-4F8B7B1D72EA.

Figure 3.23. Tree cover area has declined in half of OECD large regions between 2000 and 2020, Americas



Source: EC (2019[14]), *Land Cover Classification Gridded Maps from 1992 to Present Derived from Satellite Observations*, European Space Agency Climate Change Initiative.

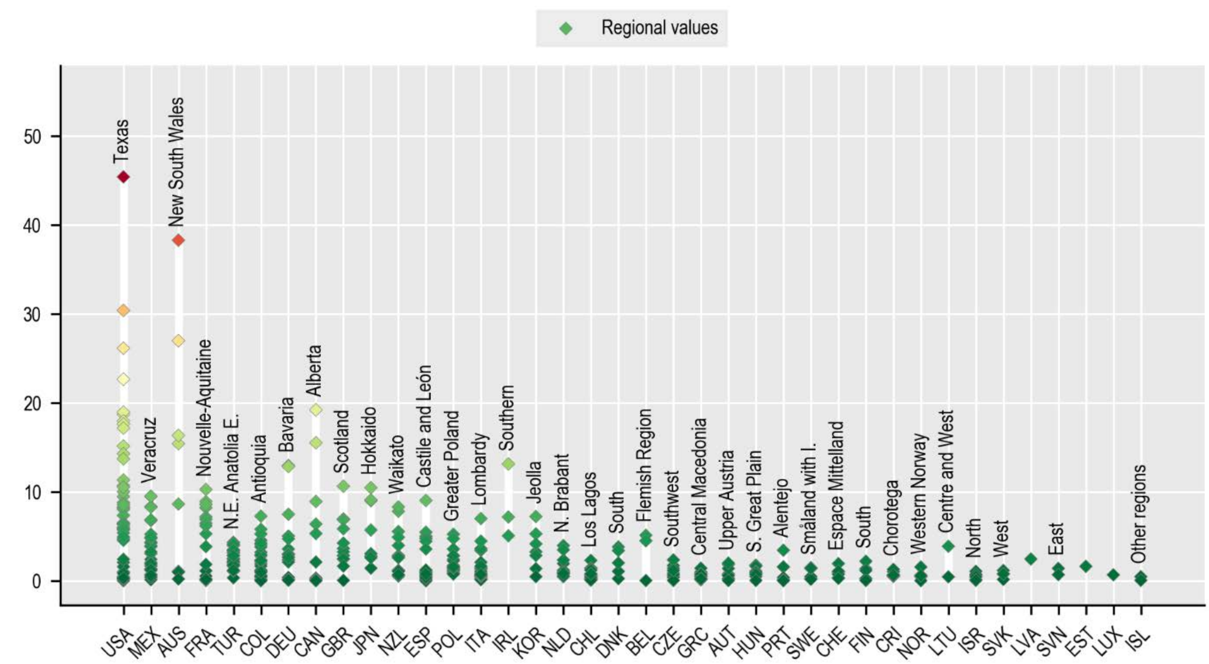
Figure 3.24. Tree cover area has declined in half of OECD large regions between 2000 and 2020, Europe, Asia, Pacific



Source: EC (2019[14]), *Land Cover Classification Gridded Maps from 1992 to Present Derived from Satellite Observations*, European Space Agency Climate Change Initiative.

Figure 3.25. Emissions in agriculture are concentrated in a few regions

Emissions from agriculture in $MtCO_2$-eq in OECD large regions (TL2), 2018



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Crippa, M. et al. (2021[3]), "EDGAR v6.0 Greenhouse Gas Emissions", http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b.

Municipal waste per capita increased in many OECD regions

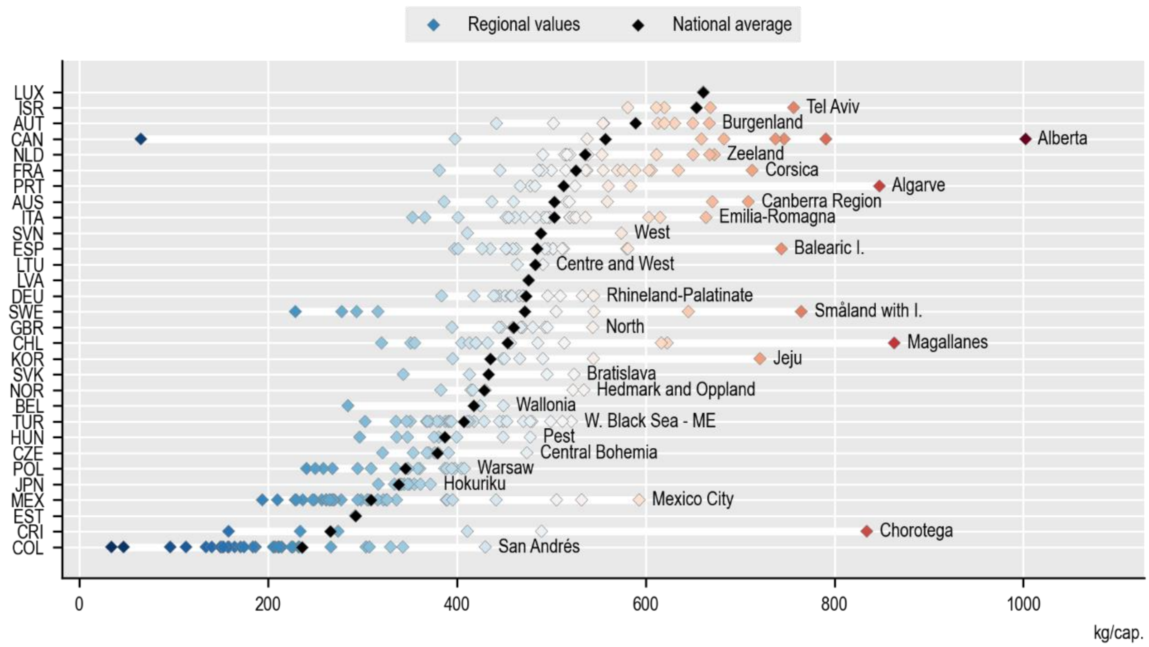
Waste reduction, better waste management and a shift in demand towards sustainable consumption are important mitigation options to reach climate neutrality by 2050 (Shukla et al., 2022[15]).

Israel and Luxembourg record, on average, almost three times more municipal waste per inhabitant than Canada, Colombia and Sweden, and Latin American countries record large regional disparities. Mexico City, for example, records three times more waste per inhabitant than the state of Oaxaca in Mexico. Over the past decade, municipal waste per capita increased in Colombia, Korea, Mexico and most East European countries. However, many European capital regions register the largest decline in per capita waste in their respective countries (Figure 3.26).

Waste recovery remains limited in Türkiye and Latin America, whereas it is developed in many European countries, particularly in Austria, Belgium, the Netherlands, Norway and Sweden. In the latter countries, recovery rates are close to 100% in most large regions. Capital regions tend to register the highest recovery rates in many OECD countries, such as in Australia, Belgium, France and the Slovak Republic (Figure 3.27).

Figure 3.26. Regional disparities in municipal waste per capita

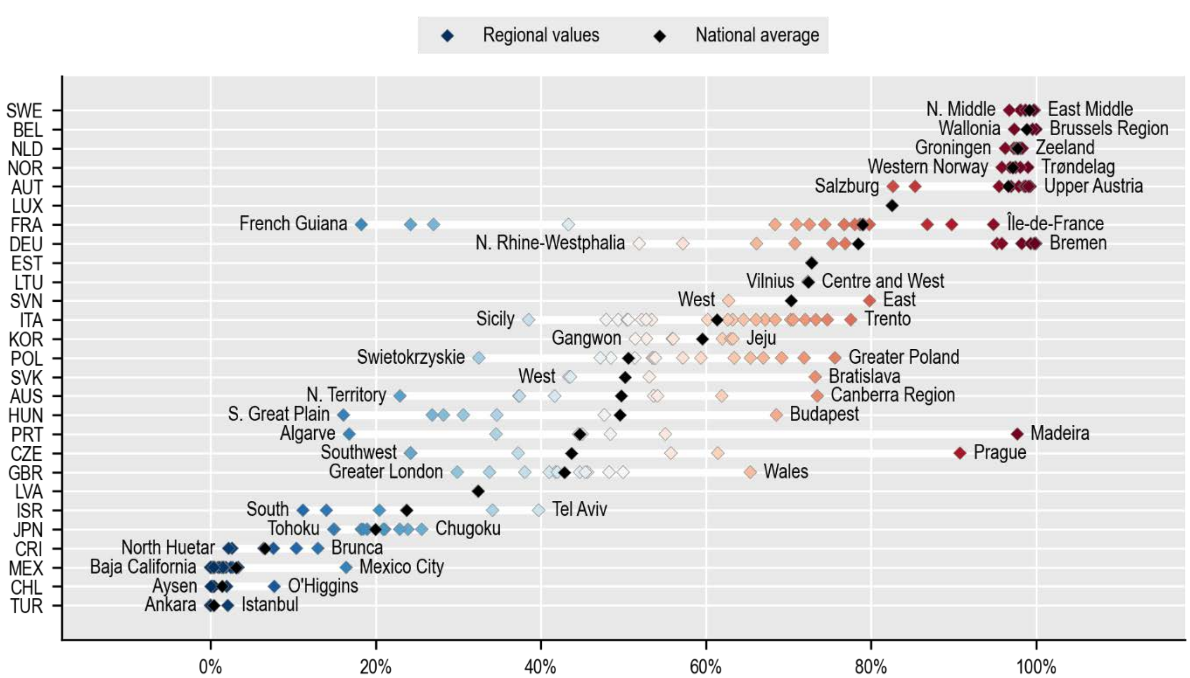
Municipal waste (kg) per capita, OECD large regions (TL2), 2020



Note: 2013 for EST, LUX; 2014 for TUR; 2016 for CAN; 2017 for CHL; 2018 for JPN; 2019 for AUT, COL, ESP, FRA, HUN, ISR and ITA.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en.

Figure 3.27. Waste recovery is very developed in many European regions

Municipal waste recovery rates (%), OECD large regions (TL2), 2020



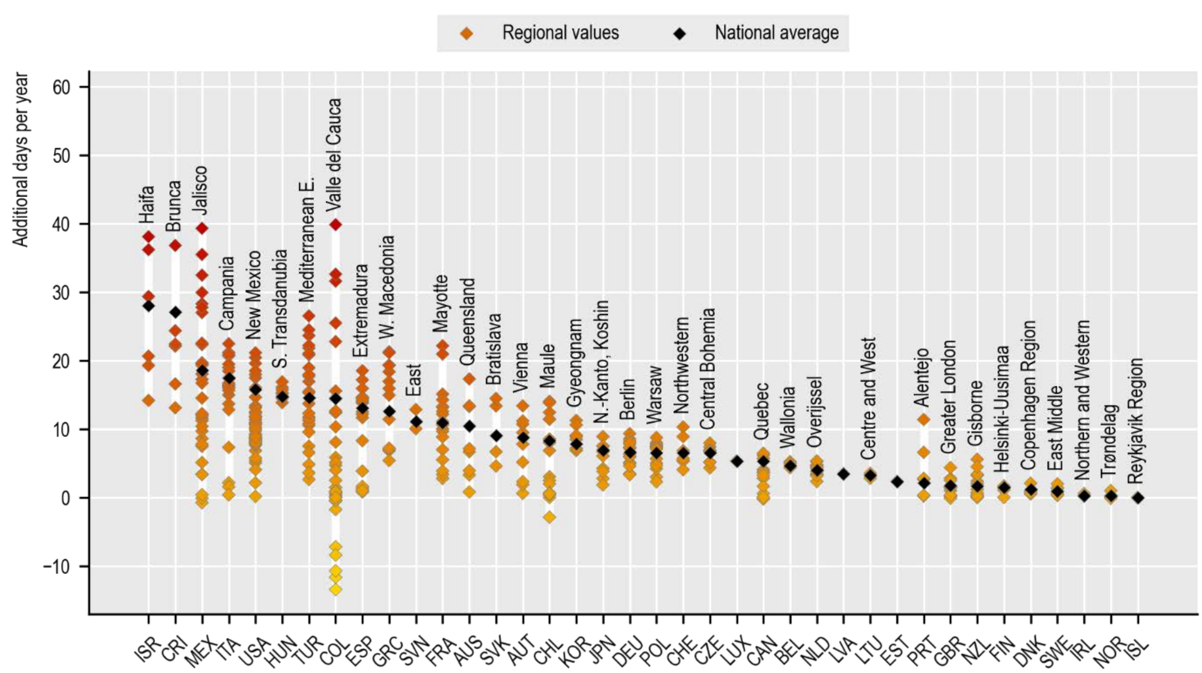
Note: 2013 for CZE, EST, LUX; 2014 for TUR; 2015 for DEU; 2017 for AUS, CHL; 2018 for FRA, JPN; 2019 for AUT, HUN, ISR and ITA.
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en.

Climate adaptation

Cities are particularly affected by heat stress

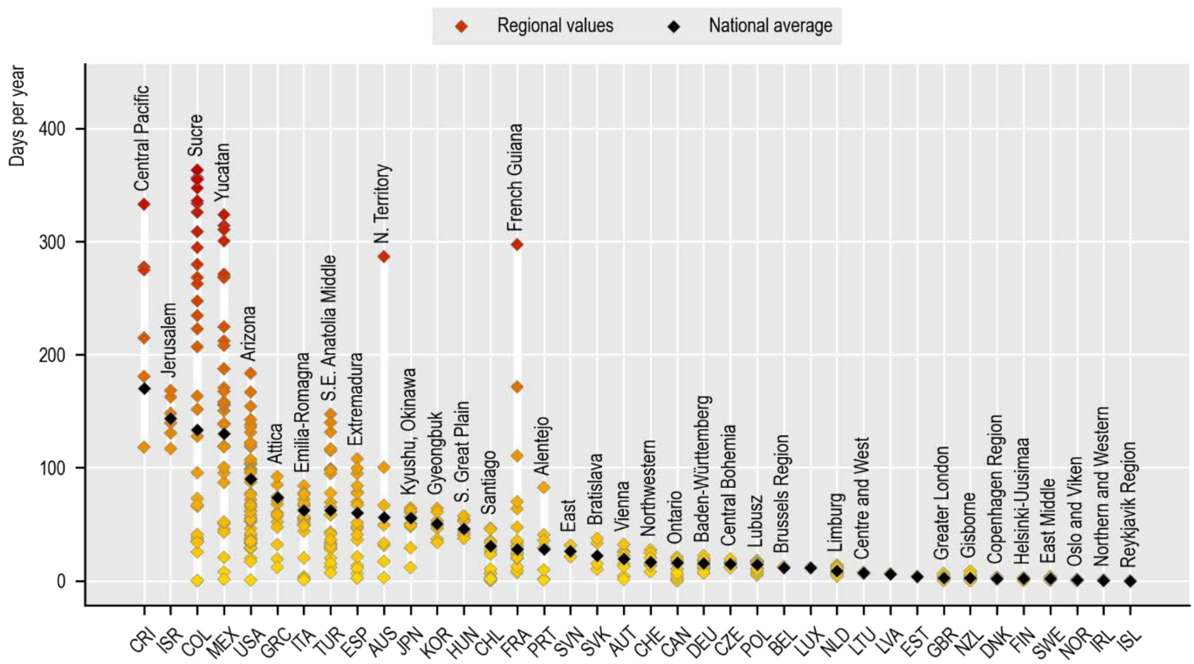
Over the past five years, population exposure to heat stress has been particularly high and has increased faster in Central America and in the Mediterranean Basin. In Costa Rica and Israel, the population experienced, on average, more than 140 days per year of strong heat stress, i.e. over 25 days longer than during the 1981-2010 period (reference period). Nearly all (95%) regions in OECD countries had increased exposure to heat stress over the past five years compared to the reference period (Figures 3.28 and 3.29). For example, over the past 5 years, the region of Córdoba (Colombia) experienced an average of 267 days per year of very strong heat stress as indicated by the Universal Thermal Climate Index (UTCI) surpassing 38°C, i.e. 70 days more than during the 1981-2010 period. Exposure to strong heat stress (UTCI > 32°C) in the districts of Haifa and Tel Aviv in Israel increased by more than a month per year over the past 5 years. The states of Baja California Norte in Mexico and Arizona in the United States were the most impacted by extreme heat stress (UTCI > 46°C) in their respective countries during the past 5 years.

Figure 3.28. Additional days of strong heat stress per year in OECD large regions (TL2), 2017-21 compared to 1981-2010



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Maes, M. et al. (2022[16]), "Monitoring exposure to climate-related hazards: Indicator methodology and key results", https://doi.org/10.1787/da074cb6-en; Copernicus thermal comfort indices derived from ERA5 reanalysis, UTCI (2020[17]).

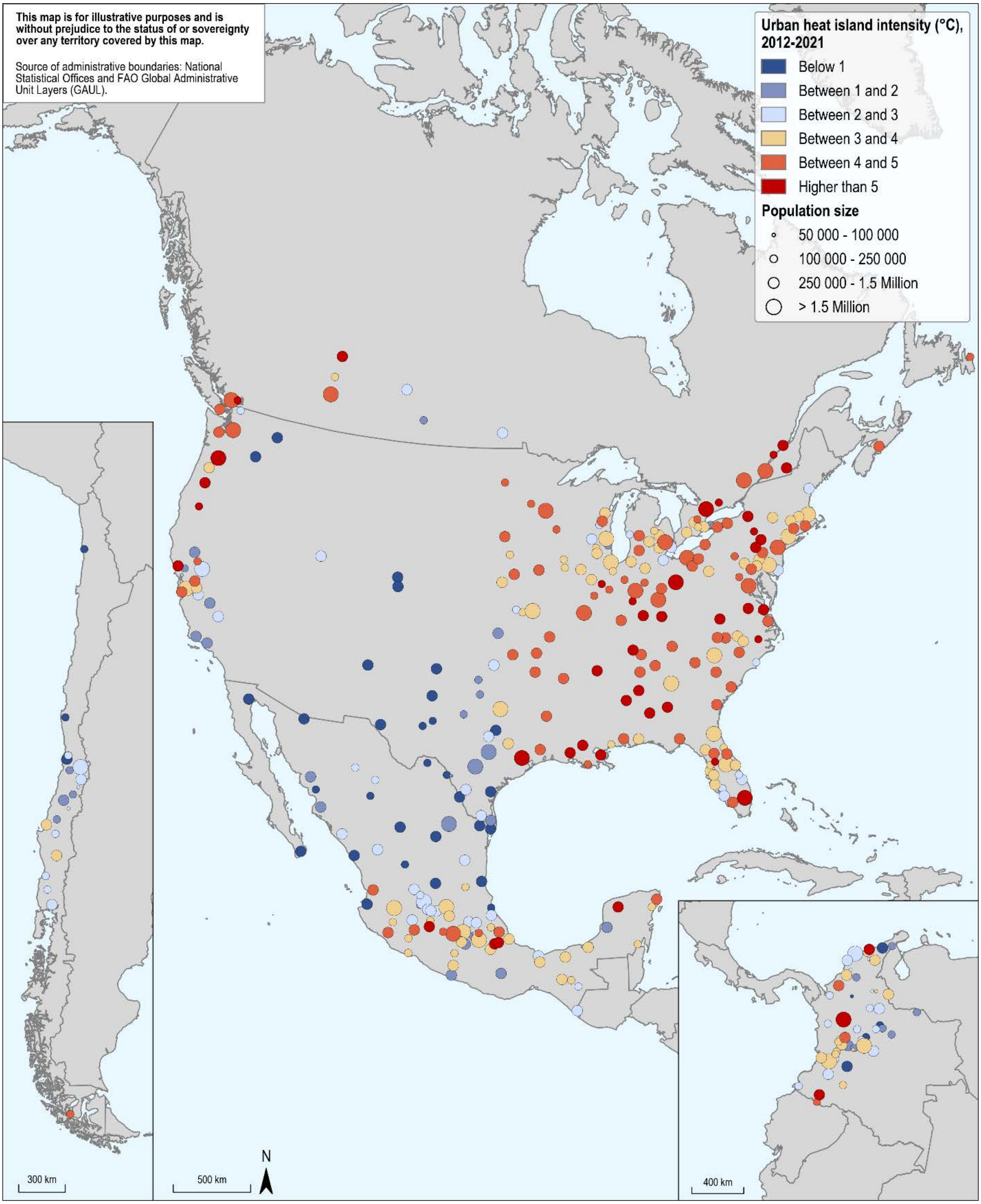
Figure 3.29. Days of strong heat stress per year in OECD large regions (TL2), 2017-21



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Maes, M. et al. (2022[16]), "Monitoring exposure to climate-related hazards: Indicator methodology and key results", https://doi.org/10.1787/da074cb6-en; Copernicus thermal comfort indices derived from ERA5 reanalysis, UTCI (2020[17]).

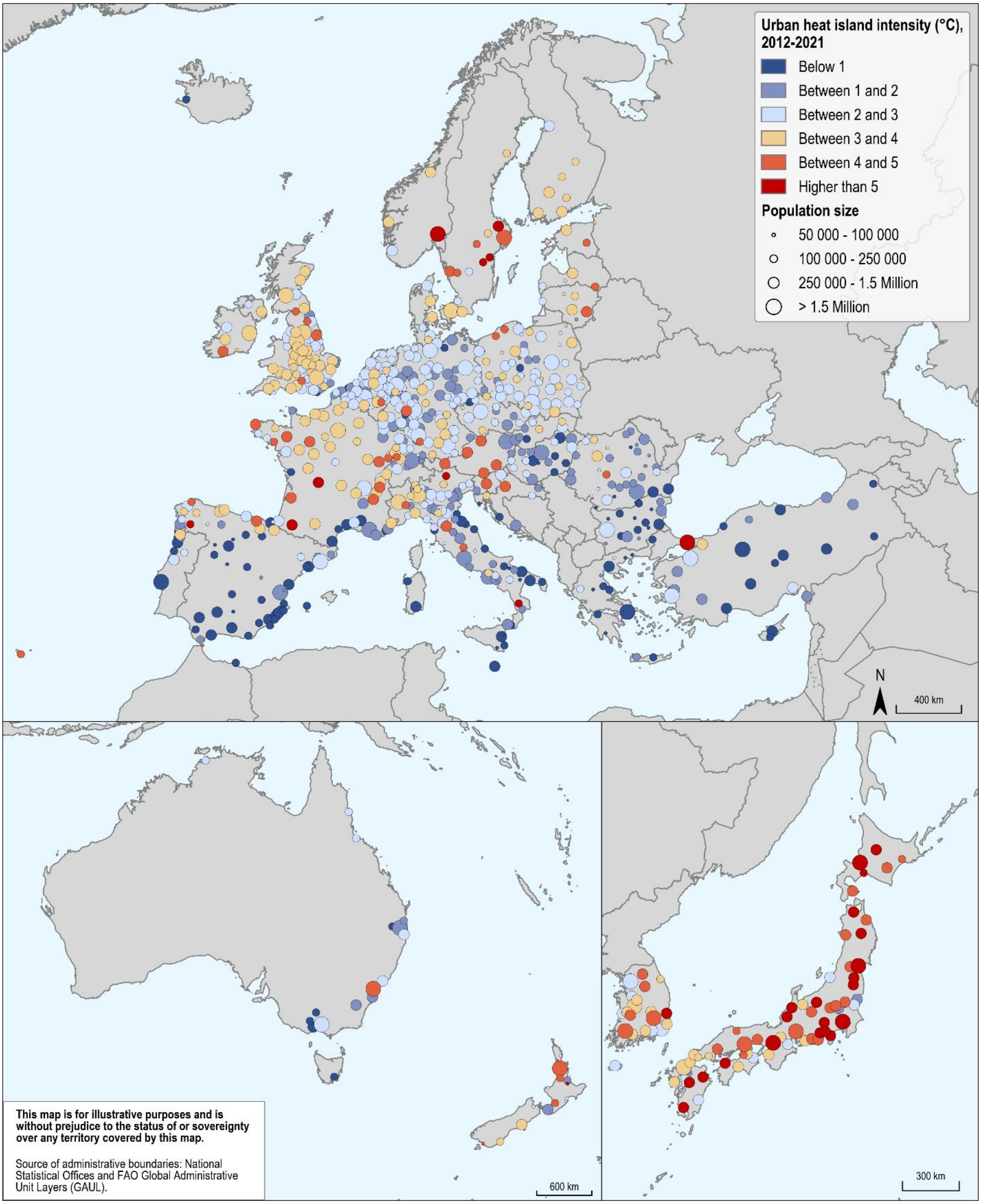
Cities are particularly affected by heat stress due to the urban heat island effect. In 2021, nearly 80% of cities in OECD countries registered a yearly urban heat island intensity higher than 1°C and almost half of OECD cities witnessed a summer daytime heat island effect higher than 3°C. The urban heat island intensity varies across OECD cities, depending on the population size and the climate zone. For example, built-up areas in metropolitan areas, i.e. in cities with more than 250 000 inhabitants, are on average 3°C warmer than their surrounding area, which is almost twice as high as in cities with less than 100 000 inhabitants. Cities located in France, Japan, Korea, the United Kingdom, Scandinavian countries and the East Coast of the United States are more impacted by the urban heat island phenomenon than other OECD cities (Figure 3.30).

Figure 3.30. Urban heat island intensity varies across OECD cities, summer, daytime, 2012-21, Americas



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Wan, Z., S. Hook and G. Hulley (2021[18]), *MODIS/MYD11A1 Aqua & MOD11A1 Terra Land Surface Temperature/Emissivity Daily L3 Global 1km SIN Grid V061*; Friedl, M. and D. Sulla-Menashe (2019[19]), *MCD12Q1 MODIS/Terra+Aqua Land Cover Type Yearly L3 Global 500m SIN Grid V006*, NASA EOSDIS Land Processes DAAC.

Figure 3.31. Urban heat island intensity varies across OECD cities, summer, daytime, 2012-21, Europe, Asia, Pacific



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Wan, Z., S. Hook and G. Hulley (2021[18]), *MODIS/MYD11A1 Aqua & MOD11A1 Terra Land Surface Temperature/Emissivity Daily L3 Global 1km SIN Grid V061*; Friedl, M. and D. Sulla-Menashe (2019[19]), *MCD12Q1 MODIS/Terra+Aqua Land Cover Type Yearly L3 Global 500m SIN Grid V006*, NASA EOSDIS Land Processes DAAC.

Regions in Australia, Latin America and the Mediterranean Basin are particularly exposed to wildfires

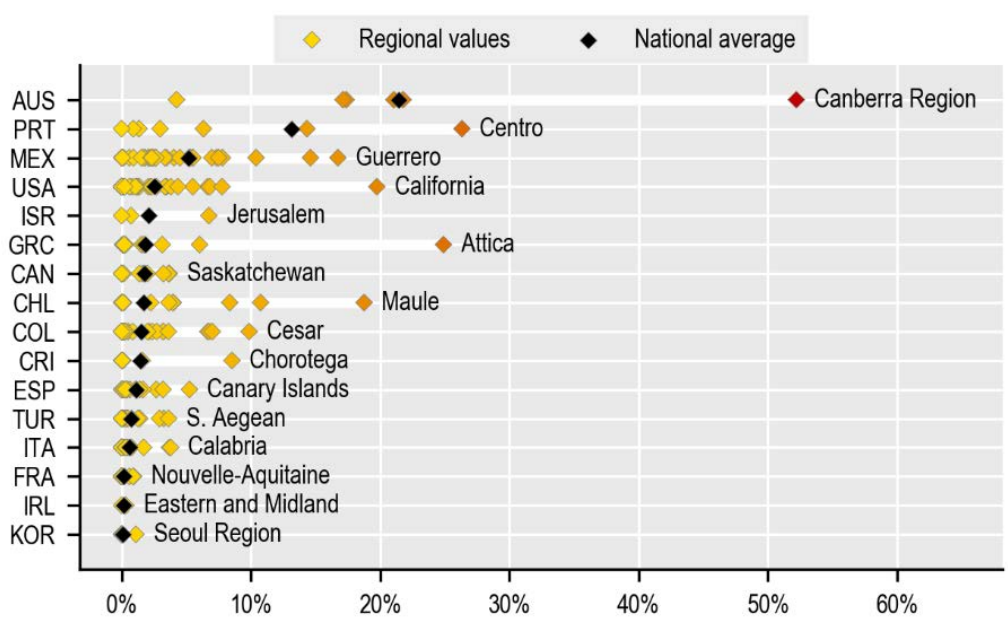
Burned area

Over the past 5 years, in 29 regions located in Australia, Latin America and around the Mediterranean Basin, more than 50% of the population has been exposed to wildfires. Wildfire hazard is usually highest in regions characterised by ignition, fuel and weather conditions conducive to fire (OECD, 2023[20]). For example, more than 70% of the population in the Australian Northern Territory has been exposed to wildfire compared to only 3% in Tasmania over the last 5 years.

Wildfires have also been affecting forests and agricultural lands. All four OECD regions with the largest burnt forest area during the last five years are located in Australia: Queensland, followed by Western Australia, New South Wales and Northern Territory. Together, these 4 regions registered almost 165 000 km^2 of total forest area burnt over the past 5 years, equivalent to half the area of Germany. Relative to the total forest area, the most impacted regions are the Canberra region in Australia where 52% of the forest area burnt in the past 5 years, followed by Central Portugal (26%) and Attica in Greece (25%) (Figure 3.32). In terms of cropland exposure, more than 3% of the croplands were burnt in the past 5 years in Australia, Costa Rica, Mexico and Türkiye. In the region of South-eastern Anatolia – Middle, around 20% of the cropland area burnt over the past 5 years, corresponding to a total of 5 500 km^2.

Figure 3.32. Regions in Australia, Mexico and Portugal were particularly exposed to wildfires

Forest area burned as a percentage of total forest area, OECD large regions (TL2), 2017-21



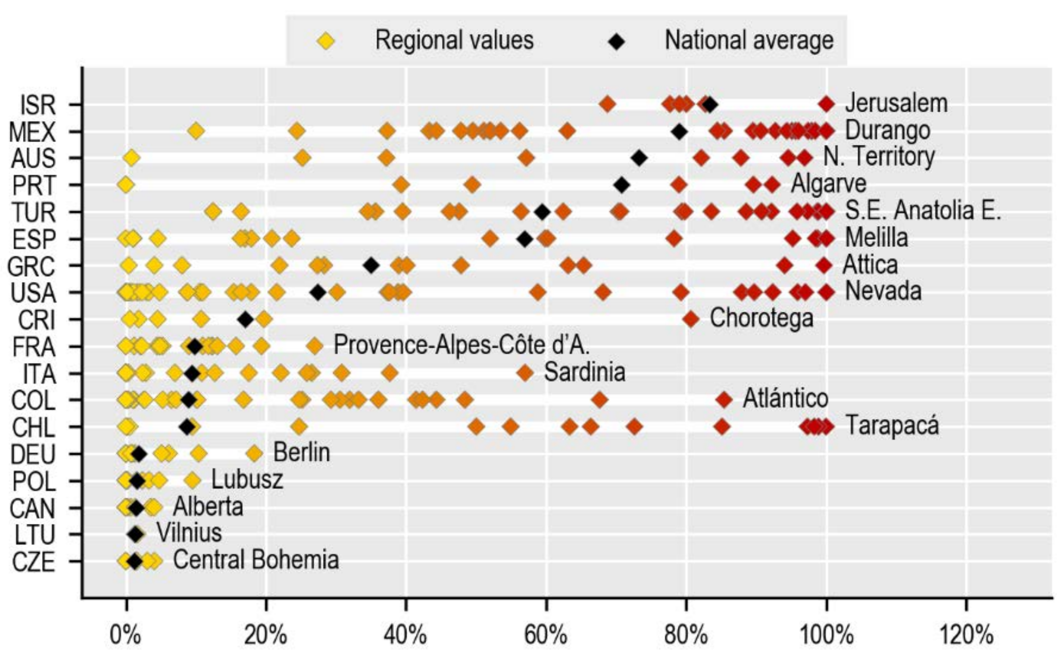
Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Global wildfire dataset (2019[21]); *Land Cover Classification Gridded Maps from 1992 to Present Derived from Satellite Observations*, European Space Agency Climate Change Initiative (2019[14]).

Wildfire danger

OECD regions located around the Mediterranean Basin, in Australia, Northern Chile and the Western United States have been particularly exposed to fire danger in recent years. For example, all forest areas in South-eastern Anatolia East, Middle and West (Türkiye) have been exposed to very high or extreme fire danger for at least three consecutive days every year over the past five years (Figure 3.33). Compared to 2001-05, the share of forest exposed to very high or extreme fire danger has increased in 179 OECD regions. Valparaíso in Chile has experienced the largest increase in fire danger exposure, as 66% of its tree cover was exposed to very high or extreme fire danger in the past 5 years, compared to 13% in 2001-05.

Figure 3.33. Regions in Australia, Northern Chile, Mexico, Western United States and around the Mediterranean Basin are at most exposed to fire danger

Share of forest exposed to very high or extreme fire danger over three consecutive days, OECD large regions (TL2), annual average, 2016-20



Source: Maes, M. et al. (2022[16]), "Monitoring exposure to climate-related hazards: Indicator methodology and key results", https://doi.org/10.1787/da074cb6-en; EC (2019[22]), *Fire Danger Indices Historical Data from the Copernicus Emergency Management Service*, https://doi.org/10.24381/cds.0e89c522.

Regions in Belgium, Northern Germany and the Netherlands are particularly vulnerable to coastal and river floods

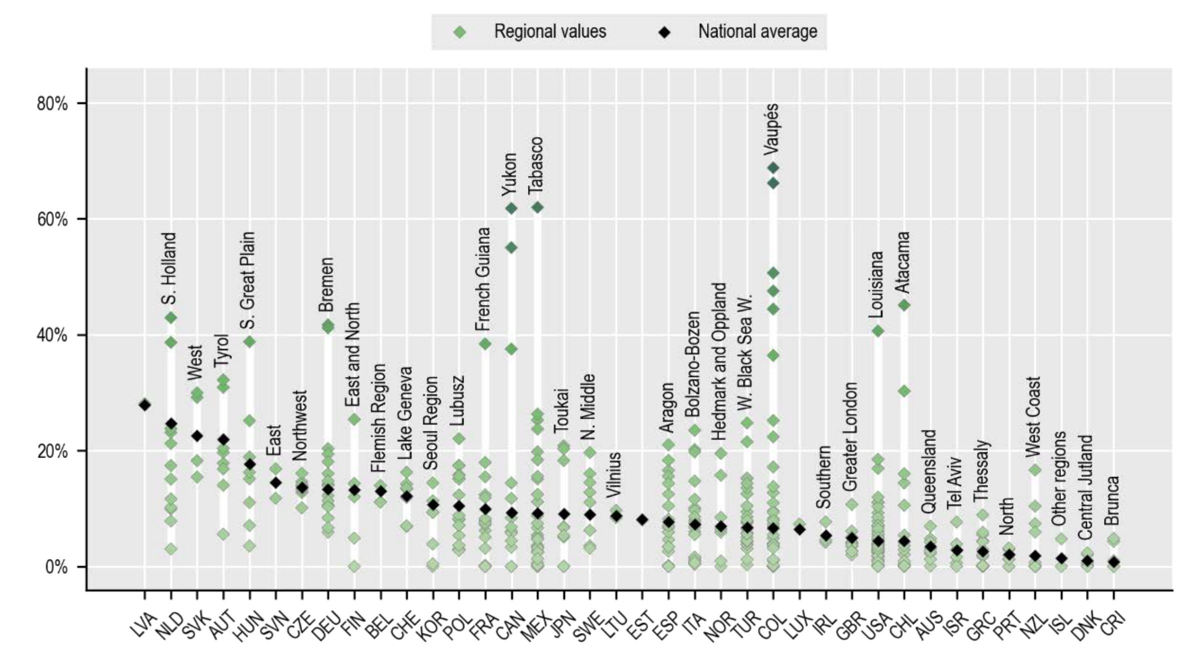
Using a 100-year return period flood extent and population distribution allows for identifying regions where a large share of the population lives within an area at risk of flood. With more than 20% of their population at risk, Austria, Latvia, the Netherlands and the Slovak Republic are, on average, the most exposed OECD countries. In total, 45 OECD regions located in 18 different countries have more than 20% of their population at risk. In some regions, such as Yukon (Canada), Guaviare (Colombia) and Tabasco (Mexico), the share of people living in areas at risk reaches more than 60% (Figure 3.34).

Cities, which often concentrate areas of high population density around rivers, are particularly vulnerable to floods of large magnitude. Rotterdam in the Netherlands is the most exposed OECD metropolitan area of more than 1.5 million inhabitants in terms of river flooding, as more than 60% of its population is at risk, followed by Nagoya in Japan and Hamburg in Germany. Given the long-life cycles of many urban and infrastructure systems, sea level rise will continue to have increasing implications even if warming is stabilised (IPCC, 2022[23]).

In terms of coastal flood hazard, the most exposed OECD countries are in Northern and Western Europe. The Netherlands is the country most at risk, as 55% of its population is exposed to 100-year coastal floods. Population exposure is higher than 90% in 4 Dutch regions. The other OECD regions particularly exposed are Bremen in Germany, where 55% of the population is exposed, followed by Nunavut in Canada (43%) and Hamburg in Germany (33%) (Figure 3.35).

Figure 3.34. Large subnational disparities in exposure to river flooding

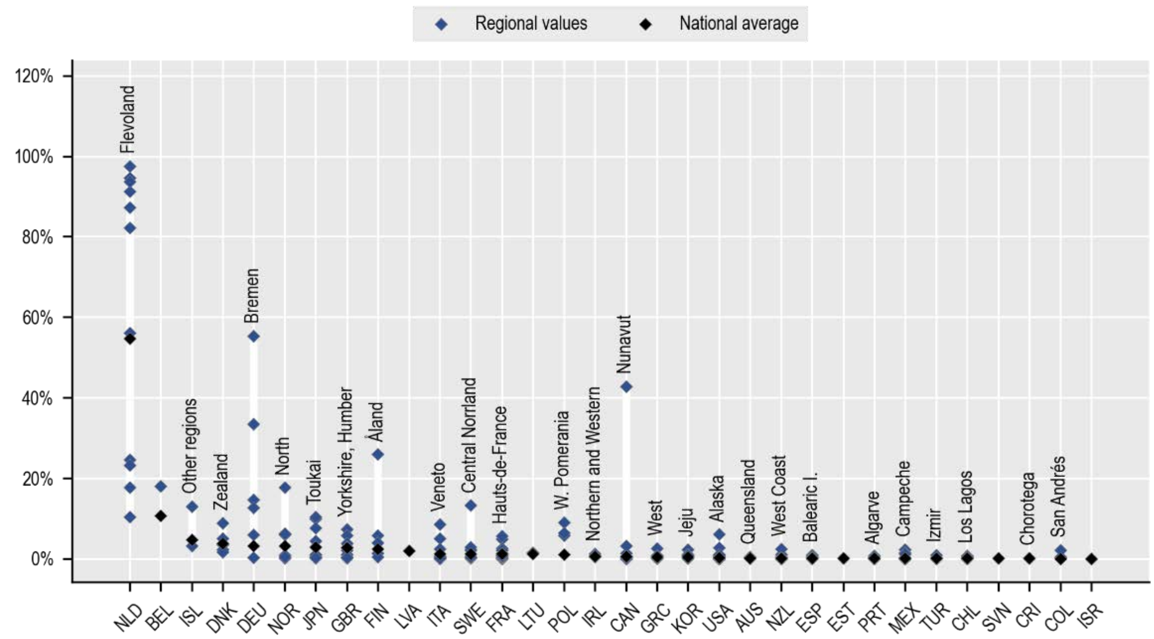
Population exposure to 100-year river flooding in OECD large regions (TL2), 2015



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Maes, M. et al. (2022[16]), "Monitoring exposure to climate-related hazards: Indicator methodology and key results", https://doi.org/10.1787/da074cb6-en; Dottori, F. et al. (2021[24]), *River Flood Hazard Maps for Europe and the Mediterranean Basin Region (dataset)*, https://doi.org/10.2905/1D128B6C-A4EE-4858-9E34-6210707F3C81; Florczyk et al. (2019[25]), *GHS Urban Centre Database 2015, Multitemporal and Multidimensional Attributes, R2019A (dataset)*, https://data.jrc.ec.europa.eu/dataset/53473144-b88c-44bc-b4a3-4583ed1f547e.

Figure 3.35. Large subnational disparities in exposure to coastal flooding

Population exposure to 100-year coastal flooding in OECD coastal regions (TL2), 2015



Source: Muis, S. et al. (2016[26]) , "A global reanalysis of storm surges and extreme sea levels", https://doi.org/10.1038/ncomms11969; Florczyk et al. (2019[25]), *GHS Urban Centre Database 2015, Multitemporal and Multidimensional Attributes, R2019A (dataset)*, https://data.jrc.ec.europa.eu/dataset/53473144-b88c-44bc-b4a3-4583ed1f547e.

Soil moisture has decreased in 70% of OECD regions

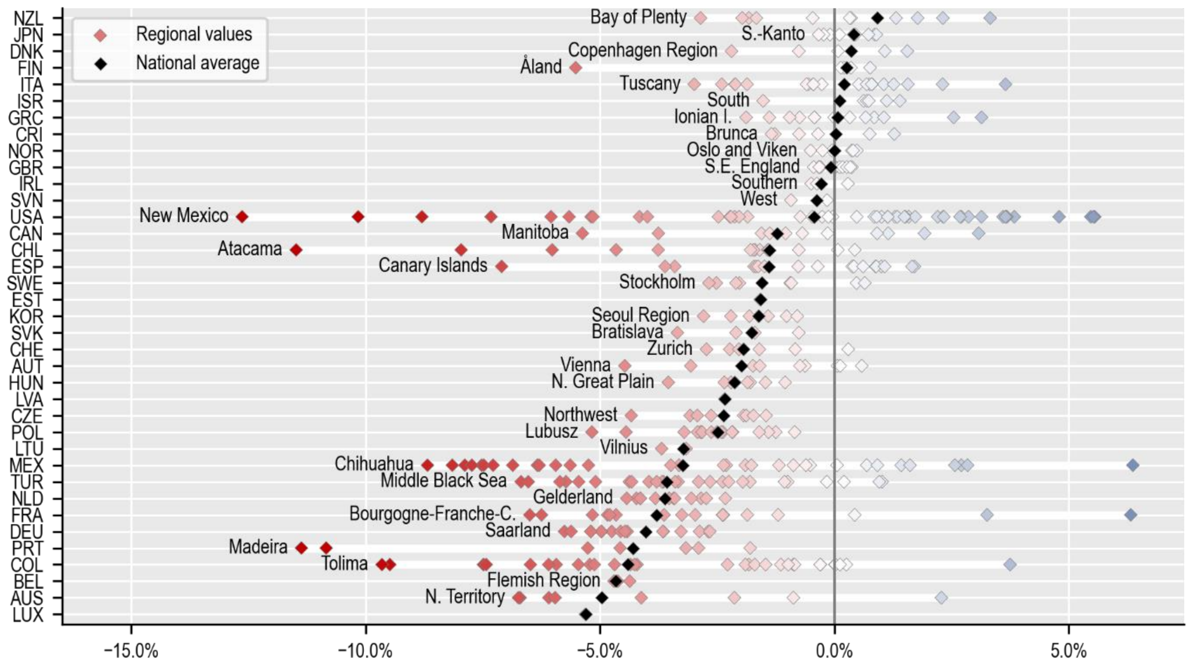
To identify regions where water stress conditions are worsening, the proposed indicator framework uses soil moisture percentage change. Over the past 5 years, the average croplands' soil moisture was lower than during 1981-2010 for 70% of OECD large regions (Figure 3.36). Long-term averages allow for capturing overall trends in soil moisture changes over time but do not reflect shorter drought events.

Soil moisture anomalies at the national level range between -5% and 1% for most countries, when comparing the average soil moisture over the past 5 years to the reference period 1981-2010. However, national averages can hide more severe and localised drops in soil moisture. Seven OECD countries (Australia, Canada, Chile, Colombia, Mexico, Spain and the United-States) recorded soil moisture local drops of more than 30% in the past 5 years compared to 1981-2010 (Figures 3.37 and 3.38).

Combining changes in soil moisture data with an indicator reflecting the importance of the agricultural sector in the regional economy helps identify regions that are particularly vulnerable to changes in drought conditions. For example, cropland soil moisture has decreased by 10% and 9% in Tolima in Colombia and in Chihuahua in Mexico respectively over the past 5 years compared to the reference period. In these 2 regions, GVA in agriculture, forestry and fishing accounts for an important share of total GVA (17% and 7% respectively).

Figure 3.36. Agricultural drought

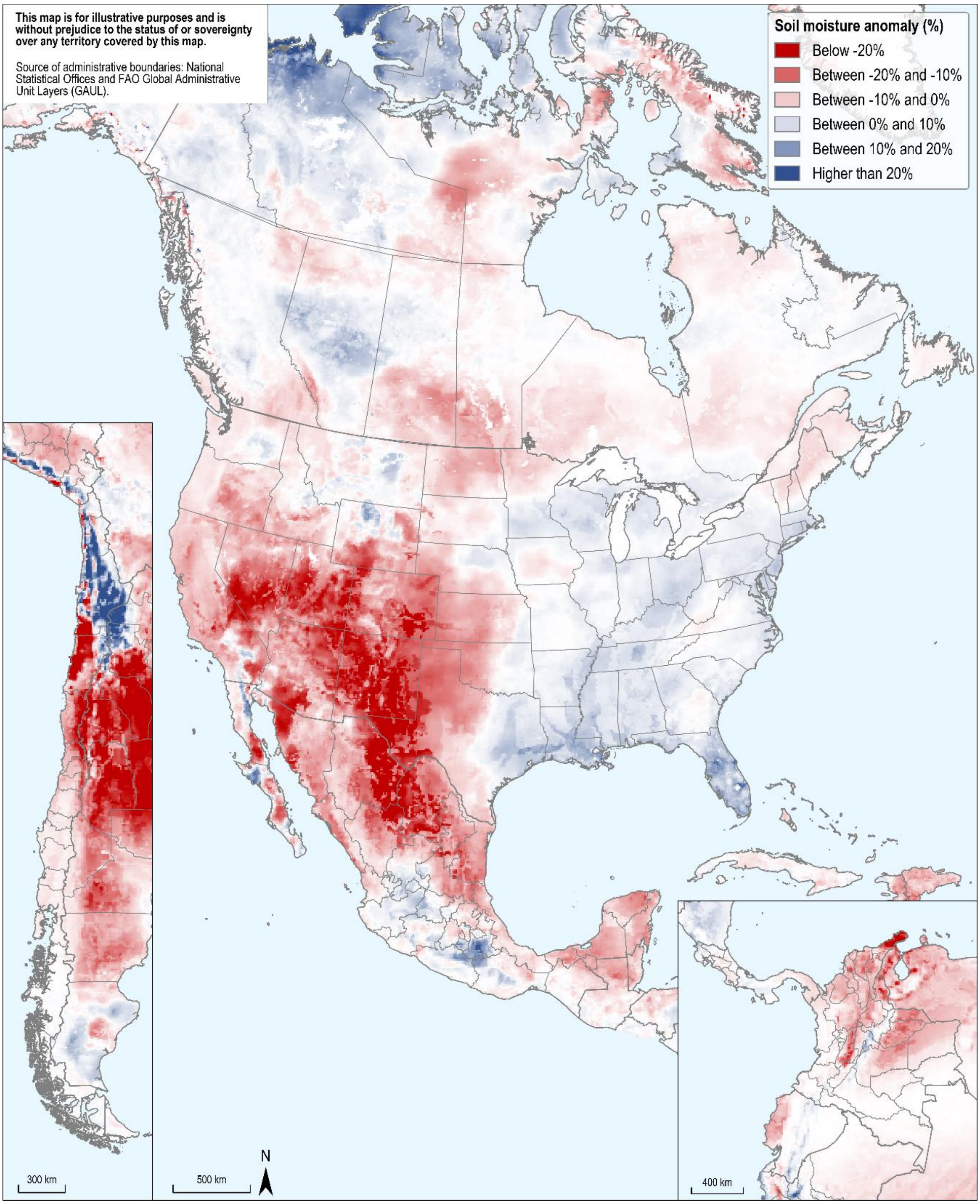
Cropland soil moisture anomaly (%) in 2017-21, compared to 1981-2010 (reference period)



Source: OECD (2022[2]), *OECD Regions and Cities at a Glance 2022*, https://doi.org/10.1787/14108660-en; Maes, M. et al. (2022[16]), "Monitoring exposure to climate-related hazards: Indicator methodology and key results", https://doi.org/10.1787/da074cb6-en; EC (2019[14]), *Land Cover Classification Gridded Maps from 1992 to Present Derived from Satellite Observations*, European Space Agency Climate Change Initiative.

Figure 3.37. The Mediterranean Basin, South America and the United States are particularly impacted by agricultural droughts, Americas

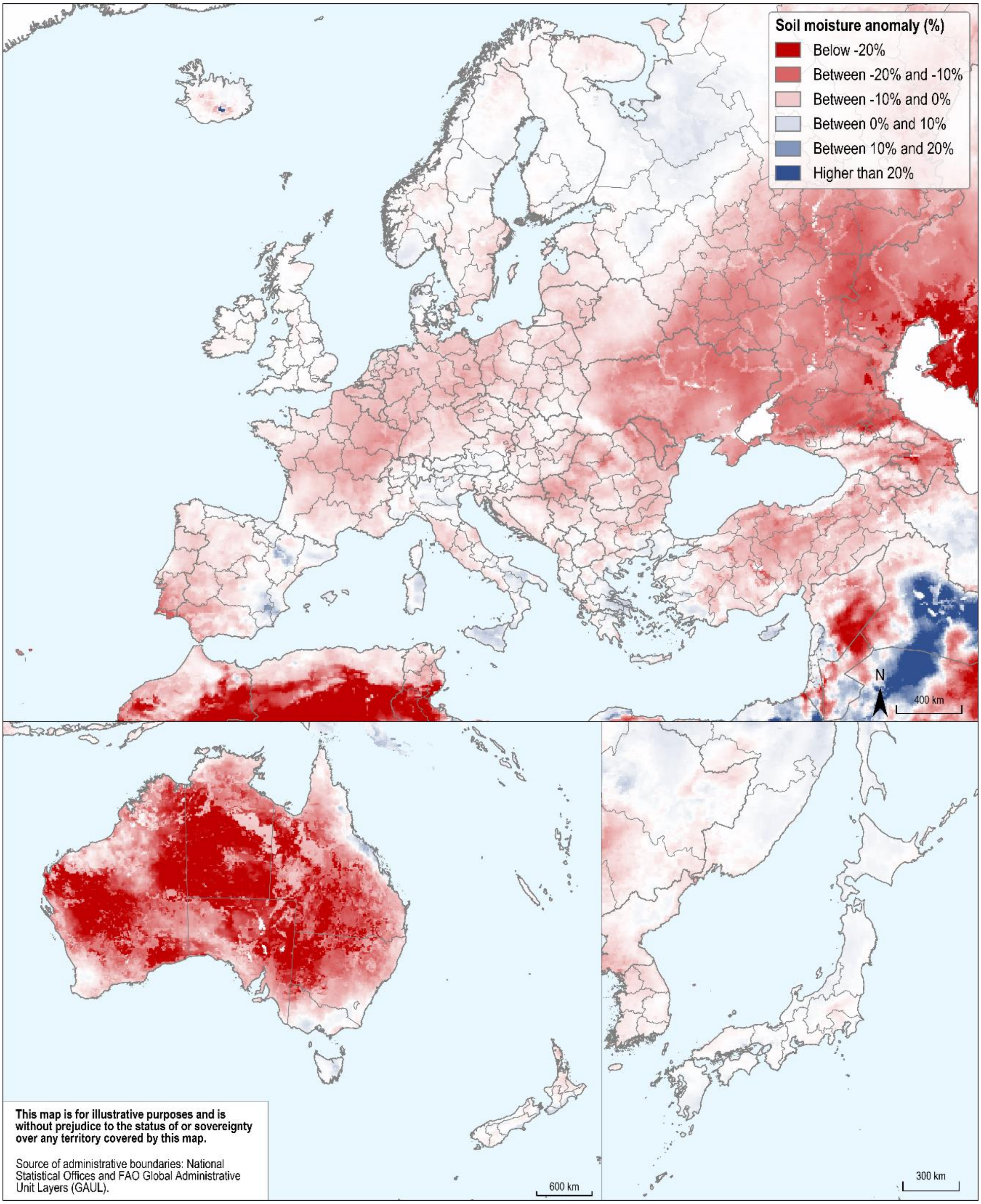
Soil moisture anomaly (%) in 2017-21, compared to 1981-2010



Source: EC (2022[27]), *ERA5-Land Monthly Averaged Data from 1950 to Present*, https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview.

Figure 3.38. Australia is particularly impacted by agricultural droughts, Europe, Asia, Pacific

Soil moisture anomaly (%) in 2017-21, compared to 1981-2010



Source: EC (2022[27]), *ERA5-Land Monthly Averaged Data from 1950 to Present*, https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land-monthly-means?tab=overview.

Conclusions

The analysis in this chapter revealed that most OECD cities and regions are far from reaching climate neutrality. It also found that the volume and source of GHG emission vary significantly across geographical scales within countries, highlighting that the pathways to achieving a net zero transition and enhancing resilience will also differ. Key findings which are worth highlighting include the following:

- In relation to climate mitigation, OECD cities and regions would need to increase their efforts to achieve climate neutrality.
    - Most OECD regions are far from reaching climate neutrality. In 2018, only 61 out of the 432 OECD large regions registered lower production-based emissions per capita than the required global target of 4.7 tCO_2-eq per capita derived from the IEA NZE Scenario. In 40% of the regions, emissions per capita were higher than 10 tCO_2-eq per capita. On average, OECD regions will have to reduce their emissions by a factor of 2.8 by 2030 in order to meet the global target.
    - OECD cities also record high levels of GHG emissions, challenging climate neutrality. In 2018, almost half of OECD metropolitan areas with more than 500 000 inhabitants recorded production-based emissions per capita lower than the target of 4.7 tCO_2-eq per person. To reach this target, the remaining metropolitan areas will have to cut their emissions by an average of 44% by 2030.
    - There are significant territorial disparities in terms of GHG emissions within cities and regions in OECD countries. Regional disparities are particularly important in the United States, where emissions per capita ranged from 3.6 tCO_2-eq in the District of Columbia to 180.7 tCO_2-eq in North Dakota (the latter probably due to its shale oil industry). Large regional disparities in emissions per capita also exist in other OECD countries, such as Canada, the Netherlands and New Zealand. Similarly, road emissions per capita in remote regions are on average more than three times higher than in large metropolitan regions.
    - Many OECD regions are still far from reaching low-carbon electricity generation. More than 50 regions spread across 19 OECD countries still rely heavily on coal for power generation. However, over one-third of regions generate most of their power from low-carbon sources (nuclear or renewables). Quebec (Canada), Auvergne-Rhône-Alpes (France) and Scotland (United Kingdom) are the largest producing regions in their respective countries and rely for more than 90% of their electricity on low-carbon sources. Power generation in these regions emits less than 100 gCO_2-eq/kWh, which is more than 3 times below the OECD average (350 gCO_2-eq/kWh).
- Continued built-up expansion affects emissions from agriculture, forestry and other land use (AFOLU). In 80% of OECD FUAs, built-up areas grew faster than population between 2000 and 2020. The difference between built-up area growth and population growth is particularly high in cities located in Japan, Korea and in Eastern Europe. In almost 80% of the FUAs with high levels of built-up area per capita in 2000 (above 100 m^2 per person), land consumption has increased at a higher rate than the population. For example, the built-up surface in Polish FUAs increased by 36% in the last 20 years while population remained constant.
- OECD cities and regions also need to accelerate adaptation action if they want to couple with the far-reaching consequences of climate change:
    - Cities are particularly affected by heat stress. In 2021, nearly 80% of cities in OECD countries registered a yearly urban heat island intensity higher than 1°C and almost half of OECD cities witnessed a summer daytime heat island effect higher than 3°C. The urban heat island intensity varies across OECD cities, depending on the population size and the climate zone. For example, built-up areas in metropolitan areas, i.e. in cities with more than 250 000 inhabitants,

are on average 3°C warmer than their surrounding area, which is almost twice as high as in cities with less than 100 000 inhabitants. Cities located in France, Japan, Korea, the United Kingdom, Scandinavian countries and the East Coast of the United States are more impacted by the urban heat island phenomenon than other OECD cities.

- Cities and regions are particularly vulnerable to river and coastal floods. In terms of river flooding, 45 OECD regions located in 18 different countries have more than 20% of their population at risk of river flooding. In some regions such as Yukon (Canada), Guaviare (Colombia) and Tabasco (Mexico), the share of people living in areas at risk reaches more than 60%. Furthermore, cities, which often concentrate areas of high population density around rivers, are particularly vulnerable to floods of large magnitude. Rotterdam (the Netherlands) is the most exposed OECD metropolitan area with more than 1.5 million inhabitants, as more than 60% of its population is at risk, followed by Nagoya (Japan) and Hamburg (Germany). In terms of coastal flood hazard, the most exposed OECD countries are in Northern and Western Europe. The Netherlands is the country most at risk, as 55% of its population is exposed to 100-year coastal floods. Population exposure is higher than 90% in 4 Dutch regions. The other OECD regions particularly exposed are Bremen in Germany, where 55% of the population is exposed, followed by Nunavut (Canada) (43%) and Hamburg (Germany) (33%).

The findings outlined above underscore the critical importance of advancing a territorial approach to tackle climate challenges. The diverse GHG emission profiles and climate risks and impacts of OECD cities and regions suggest that a one-size-fits-all approach would be insufficient. Instead, policies need to be tailored to the specific context and unique needs of each place. To do so, countries, cities and regions need to have a better understanding of GHG emissions trends and climate-related risks at the local and regional scales.

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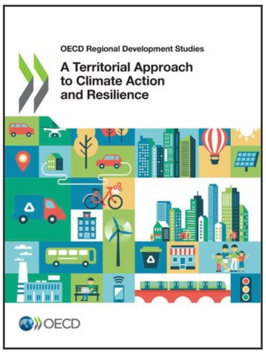
Notes

[1] OECD subnational regions are classified into two scales: large regions, referred to as Territorial Level 2 (TL2), and small regions, referred to as Territorial Level 3 (TL3). Large regions generally refer to the first government level after the national or federal one. Small regions are contained within large regions and, in the case of European countries, correspond to the NUTS3 nomenclature.

[2] Developed in collaboration with the European Union and endorsed at the 2020 Statistical Commission of the United Nations, Functional Urban Areas (FUAs) consist of densely populated cities together with their surrounding commuting zones. This definition looks at the full extent of cities' labour markets to capture the economic boundaries of cities. FUAs are generally the aggregation of local units.



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