

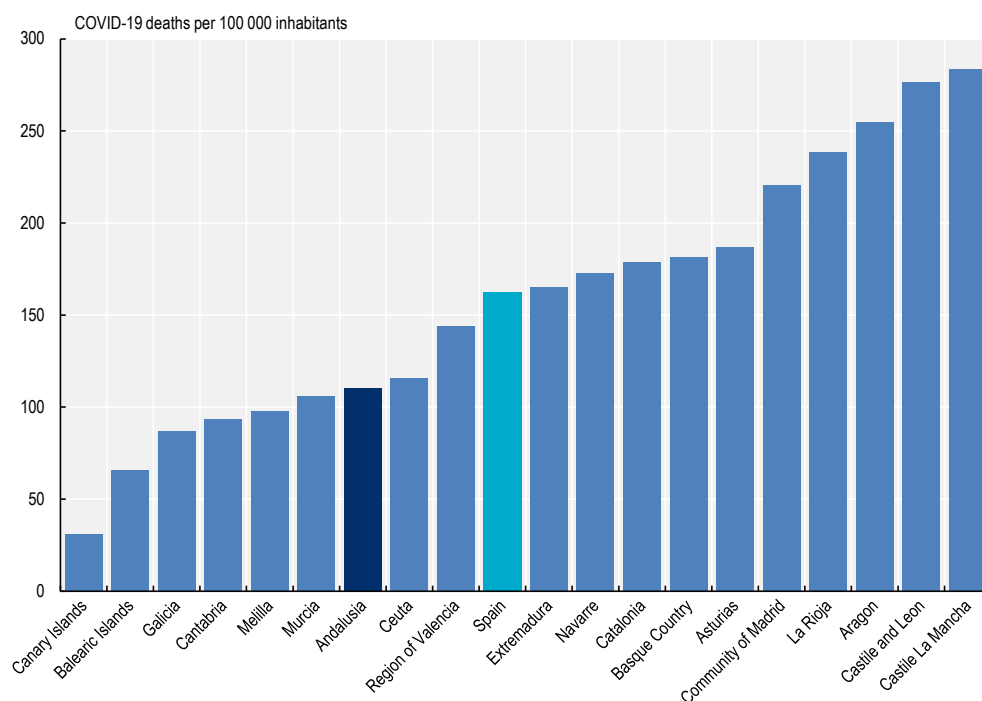
1 Socio-economic and environmental trends in Granada, Spain

This chapter provides an overview of the rationale for the circular economy transition in the city, by looking at the main socio-economic and environmental data, trends and drivers leading to a shift from a linear to a circular economy. The city of Granada is well known for its cultural heritage, which attracts thousands of tourists every year. It is also denominated City of Science and Innovation. As such, tourism and science, especially through digitalisation, can contribute to the economic growth of the city, in accordance with circular economy principles.

The circular economy in cities and the COVID-19 pandemic: Opportunities for a “new normal”

Spain has been hit particularly hard by the COVID-19 pandemic but the recovery provides opportunities to build back more sustainably. As many other cities around the world, Granada has also been affected by the pandemic. With almost 514 000 registered COVID-19 cases since the start of the pandemic and 9 315 total deaths as of 8 April 2021, the Autonomous Region of Andalusia (hereafter Andalusia) has the third-highest caseload and number of deaths in the country, after Madrid and Catalonia (Ministry of Health, Consumer Affairs and Social Welfare, 2021^[1]). Of these 9 315 deaths, the province of Granada accounted for 1 578 (around 17%). However, Andalusia is the seventh region with the lowest death rate per capita in Spain (Figure 1.1). While the crisis put many economic activities on hold, notably tourism – a pillar of Granada’s economy – the crisis has also been an opportunity to further reflect on sustainable production and consumption patterns. Environmental and social sustainability is one of the pillars of the Spanish Recovery, Transformation and Resilience Plan (*España Puede*): 37.1% of the funds will be allocated to the green agenda. In particular, funds will aim to accelerate sustainability in cities and rural areas (16%), resilient infrastructure and ecosystems (12.2%) and a just and inclusive energy transition (8.9%) (Government of Spain, 2020^[2]).

Figure 1.1. Andalusia COVID-19 death rate (January 2020 – April 2021), versus Spanish regions (TL2)



Note: Definition of COVID-19 deaths in Spain: A death due to COVID-19 is defined for surveillance purposes as a death resulting from a clinically compatible illness, in a probable or confirmed COVID-19 case, unless there is a clear alternative cause of death that cannot be related to COVID disease (e.g. trauma). There should be no period of complete recovery from COVID-19 between illness and death. Only in cases of violent deaths or where there is suspicion of criminality or in any other in which a judicial procedure has been initiated is an autopsy carried out (CGCOM, 2021^[3]).

Source: Ministry of Health (2021^[4]), Coronavirus Update.

In the post-COVID-19 scenario, the circular economy holds the potential to become the “new normal”. The circular economy is based on three principles: i) design out waste and pollution; ii) keep products and materials in use; and iii) regenerate natural systems (Ellen MacArthur Foundation, 2019^[5]). According to the OECD (2020^[6]), in cities and regions, the circular economy implies a systemic shift, whereby: services (e.g. from water to waste and energy) are provided, making efficient use of natural resources as a primary material and optimising their reuse; economic activities are planned and carried out in a way to close, slow and narrow loops across value chains, and infrastructure is designed and built to avoid linear lock-ins (e.g. district heating, smart grid, etc.) (see Chapter 2; Box 1.1).

Box 1.1. The importance of the circular economy in cities and regions

Being the places where people live and work, consume and dispose, cities and regions play a fundamental role in the transition to the circular economy. By 2050, the global population will reach 9 billion people, 55% of which will be living in cities, high-density places of at least 50 000 inhabitants. The pressure on natural resources will increase, while new infrastructure, services and housing will be needed. Already, cities represent almost two-thirds of global energy demand and release up to 70% of greenhouse gas (GHG) emissions. By 2050, urban dwellers will still be the most exposed to high concentrations of air pollutants. Cities produce 50% of global waste. It is estimated that globally, by 2050, the levels of municipal solid waste will double. A total of 80% of food is consumed in cities. At the same time, water stress and water consumption will increase by 55% by 2050. Moreover, in cities, income inequalities are higher than in other places and rich and poor dwellers live often spatially separated with consequences on equal access to goods and services. The circular economy in cities and regions is expected to reduce negative impacts on the environment in terms of pollution decrease, the share of renewable energy and recyclable resources, the growth and reduction of raw materials, water, land and energy consumption, while potentially increasing resilience and enhancing opportunities for economic growth and jobs.

Cities and regions hold core competencies for most policy areas underlying the circular economy. This includes water, solid waste, the built environment, land use or climate change. In the building sector, for example, cities can operate buildings and housing, and enforce regulation on commercial and residential buildings, in favour of heating, cooling and efficient energy performance. For solid waste, cities exercise powers in collection, treatment, cleaning, as well as in communication and information. Cities have powers over water management, operating infrastructures and incentivising water efficiency, amongst others. Cities and regions can approve land use planning and policies, including zoning, redevelopment and regeneration, encourage farmers' markets and commercial urban food production and develop climate adaptation plans.

According to the results of the OECD Survey on the Circular Economy in Cities and Regions across 51 cities and regions in OECD countries, major drivers for transitioning to a circular economy are environmental (climate change, 73%), institutional (global agendas, 52%) and socio-economic (changing economic conditions, 51%). Additionally, the circular transition is driven by job creation (47%), private sector initiatives (46%), new business models (43%), technical developments (43%) and research and development (R&D) (41%).

Source: OECD/EC (2020^[7]), *Cities in the World: A New Perspective on Urbanisation*, <https://dx.doi.org/10.1787/d0efcbda-en>; EEA (2016^[8]), *More from Less - Material Resource Efficiency in Europe*, European Environment Agency; FAO (2020^[9]), *Urban Food Agenda*, <http://www.fao.org/urban-food-agenda/en/>; UNEP (2013^[10]), *UNEP-DTIE Sustainable Consumption and Production Branch*, United Nations Environment Programme; OECD (2012^[11]), *OECD Environmental Outlook to 2050: The Consequences of Inaction*, <https://dx.doi.org/10.1787/9789264122246-en>; UNEP/IWSA (2015^[12]), *Global Waste Management Outlook*, United Nations Environment Programme; World Bank (2010^[13]), *World Development Report 2010*, <http://dx.doi.org/10.1596/978-0-8213-7987-5>.

By reconfiguring material loops, the circular economy can increase resilience in terms of food and energy security, reliable access to water, sustainable waste management and the future of transport. Cities could reclaim public space for people while regenerating green areas. Local food production could reduce transport costs, and organic waste could be used to close loops and strengthen links across urban and rural areas. Buildings, made of traceable and recyclable materials, could reduce emissions from material management and absorb carbon dioxide, increase water efficiency and be self-sufficient energy-wise. This will require conducive regulations, investments, new forms of collaboration and partnerships and a cultural shift towards a more resourceful and less wasteful society (Romano, 2020^[14]). The COVID-19 crisis highlighted that changes are possible, but that it is important to tackle inequalities (Box 1.2).

Box 1.2. Lessons learnt from the COVID-19 crisis to accelerate the transition towards a circular economy in cities and regions

There are three main lessons learnt from the crisis that can accelerate the transition towards a circular economy:

1. *Changes are possible*: Consumers have changed their consumption patterns. During the first wave of lockdowns in 2020, in all European countries, the proportion of households reporting a decrease in consumption compared to the pre-pandemic period ranged from 18% to 56.9%, and between 3.9% and 30.6% of households reported a total interruption in consumption. On the other hand, many companies showed great flexibility to adapt production to the need for new products or reinvent their business to cope with the decreasing demand and economic crisis. For example, automobile manufacturing companies such as Ford and Tesla transformed their production to manufacture respirators and ventilators, while other companies in the fashion industry (e.g. Gucci and Zara) shifted to supplying surgical masks. Local governments implemented policies that existed before the pandemic but not as politically and socially accepted: from the expansion of bike lanes (e.g. Medellin, Colombia; Rotterdam, the Netherlands; Seoul, Korea) to local food production (e.g. Paris, France) and the creation of city food hubs to avoid food waste (e.g. Milan, Italy).
2. *Act now, but look ahead*: The pandemic required immediate solutions to prevent the spread of the virus, such as the use of facemasks and gloves. While effective from a health point of view, this has led to an increase in the generation of unrecyclable waste. In the United Kingdom, illegal waste disposal has quadrupled. The Irish government announced EUR 1 million in funding to tackle the overwhelming level of illegal dumping attributed to the COVID-19 crisis. In Thailand, the generation of plastic waste increased from 1 500 to 6 300 tonnes per day due to the increase in food deliveries. The global plastic packaging market is forecasted to grow at a rate of 5.5% annually between 2019 and 2021, mainly due to the pandemic. This situation generates a reflection on how long-term impacts should be taken into account when implementing decisions that may have negative effects on human health and the environment, generating future societal costs. In this case, for example, eco-design and reusable products could have helped to reduce the amount of waste produced.
3. *There will be no circular transition without a just transition*: Projections show that transitioning from a linear to a circular economy is estimated to have a USD 4.5 trillion potential for economic growth by 2030. It is estimated that by 2030, the number of additional jobs would exceed 75 000 in Finland, 100 000 in Sweden, 200 000 in the Netherlands, 400 000 in Spain and half a million in France. Whether circular economy policies in cities will be effectively implemented or not largely depends on how green recovery packages will tackle social challenges and inequalities linked to affordability, access to jobs and services (water, waste, energy and transport). The OECD policy paper on cities responses to COVID-19 showed that the crisis exposed inequality across

people and places, especially in large cities, where vulnerable groups such as migrants, the poor, women and the elderly were hit hard. Failing to address these inequalities not only hinders the effectiveness of green policies; it also reduces buy-in and participation in the circular economy transition.

Source: Author's elaboration based on data from: CEPR (2020^[15]), *COVID Economics*, <https://cepr.org/content/covid-economics-vetted-and-real-time-papers-0>; OECD (2020^[16]), "Cities policy responses", <https://www.oecd.org/coronavirus/policy-responses/cities-policy-responses-fd1053ff/>; IFC (2020^[17]), *COVID-19's Impact on the Waste Sector*, https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/infrastructure/resources/covid-19-and-waste-sector; UNEP (2020^[18]), *Working with the Environment to Protect People: Covid-19 Response*, <https://www.unep.org/resources/working-environment-protect-people-covid-19-response>.

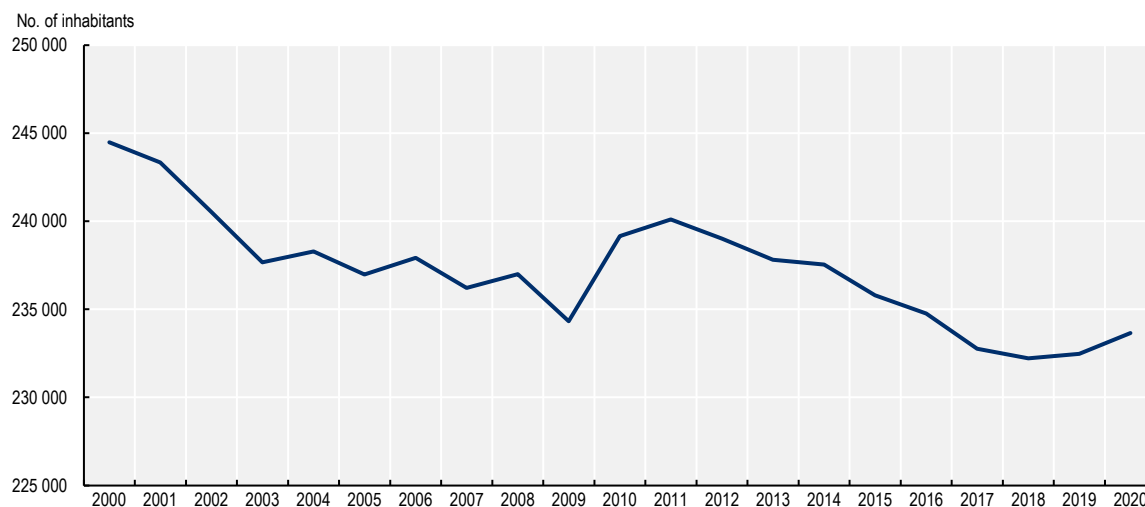
The drivers for the circular transition in Granada, Spain

Socio-economic drivers

Granada is the capital city of the homonymous province and the fourth most populous city in Andalusia. The region is composed of 8 provinces (Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga and Seville) and is Spain's most populous (8 464 411 inhabitants in 2020) (INE, 2021^[19]). In 2020, Granada hosted 233 648 inhabitants, making it the 20th most populous city in Spain (INE, 2021^[20]). Its metropolitan area covers 34 municipalities and represented, in 2019, over half of the population of the province of Granada (914 678 inhabitants), which is mainly composed of small municipalities with less than 2 000 inhabitants (Institute of Statistics and Cartography of Andalusia, 2021^[21]).

The population of Granada is ageing and shrinking. In 2019, the senior population (over 65 years of age) represented 21.5% of the total population of the city, a figure that is higher than the national (19.4%) and regional (17.1%) level (INE, 2020^[22]). Additionally, the population decreased by 4.4% between 2000 and 2020 (Figure 1.2) (INE, 2021^[23]). For the 2013-22 period, the National Statistics Institute forecasts a negative population growth of -0.66% for the province of Granada, entailing the loss of 6 085 inhabitants in the census and an average annual loss of 609 Grenadians (Granada City Council, 2015^[24]). The ageing trend of the local population can bring changes in energy and consumption emissions. Emissions per capita tend to be lower in households with senior citizens than in households with other age ranges (EEA, 2019^[25]).

Figure 1.2. Population trend in Granada, Spain, 2000-20



Source: INE (2021^[20]), *Población por capitales de provincia y sexo* (Population by Capitals of Province and Gender in Spain), <https://www.ine.es/jaxiT3/Tabla.htm?t=2911&L=0> (accessed on 12 January 2021).

Granada attracts thousands of students from all over Europe every year, however the graduate retention rate is low. The University of Granada, one of the oldest universities in Spain and a descendant of the Arab Madrasahs, is the fourth-largest higher education institution in the country. It ranked among the top ten Spanish universities in 2020 (University of Granada, 2020^[26]). During the 2019-20 academic year, approximately 55 000 students enrolled in the university, reaching the highest Erasmus exchange rate in Europe (University of Granada, 2020^[27]). The number of international students was constantly increasing before the COVID-19 pandemic. The main research areas of the university are artificial intelligence, information and communication technology (ICT), food and health sciences. However, graduate retention rate in Granada is low, as graduates tend to leave the city in search of more attractive work destinations.

Granada is well known for its cultural heritage and one of the most important touristic destination in Spain. Granada hosts the Alhambra Palace, named United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in 1984, which is one of the most visited monuments in Europe and the most visited in Spain, with 2.7 million visitors in 2019 (Government of Andalusia, 2020^[28]). There are many touristic attractions in Granada and its surrounding areas, including the Sierra Nevada ski resort, the natural areas of La Vega, the Llano de la Perdiz, the Sierra de Huétor. In 2017, with the arrival of 1 786 852 tourists, half of which were international, Granada recorded an average stay of 1.82 days (Government of Andalusia/Granada City Council, 2020^[29]). Granada belongs to the UNESCO Creative Cities Network, which promotes cities that prioritise creativity as a driver for sustainable urban development. The city also aims to present its candidacy for the European Capital of Culture in 2031, to be officialised

between 2024 and 2025. Granada is seeking to achieve this award by improving and optimising the city's historical heritage, with an investment of over EUR 23 million (UNESCO, 2021^[30]; Granada City Council, 2021^[31]).

Granada relies on tourism as a pillar of its economy. In 2013, 84.6% of the 22 363 existing firms in the city operated in the service sector, mainly related to tourism, and employed 83% of the total labour force (Granada City Council, 2015^[24]). However, certain neighbourhood associations in Granada (especially of the Albaicín neighbourhood) claim that gentrification and unsustainable tourism have resulted in higher rents, despite 85% of stays in 2016 occurring in hotels, with flat rentals (5%) or Airbnb (1%) reported as being less common (Government of Andalusia/Granada City Council, 2020^[29]). The city could generate positive environmental, social and economic impacts through greater circularity in sectors related to culture, tourism and hospitality. This would include circular approaches in value chains and policies related to food, housing and mobility, among others.

Granada is a digital hub thanks to its strong specialisation in R&D in technology and artificial intelligence. In 2017, the Spanish Ministry of Economy, Industry and Competitiveness designated Granada as City of Science and Innovation, acknowledging the city as leader for investment in scientific and technological infrastructure. Following this designation, the Municipality of Granada set up the Bureau for Science (*Mesa por la Ciencia*) to promote dialogue and research. In addition to the council, the bureau is composed of the University of Granada, the Science Park, the Granada Health Technology Park (*Parque Tecnológico de la Salud, PTS*), five centres of the Higher Council for Scientific Research, as well as the Granada Confederation of Businesses and the Government of Andalusia (Granada Ciudad de la Ciencia y la Innovación, 2021^[32]). Granada hosts the PTS, one of the few technology sites specialised in health in Europe and contributing to the regional strategy for the digital industry, Industry 4.0.; as well as the largest technology and biotechnology cluster in the region, OnGranada (onGranada, 2018^[33]). The qualification of the city of Granada as City of Science and Innovation and initiatives for implementing smart solutions in (Box 1.3) could be a way through which to develop concrete links between digitalisation and the circular economy. For example, applications would consist of using data and technology for circular economy models preventing waste, increasing energy efficiency in buildings, monitoring and reducing air pollution through traffic data, transforming waste into resources and regenerating natural systems.

Box 1.3. Digital and smart initiatives in Granada, Spain

There are a number of initiatives in Granada towards a digital transformation and a smart vision for the city, including:

- Granada's Smart City Strategic Plan (*Plan Estratégico Granada Smart City*): Launched in 2018 and in force until 2020, the Plan established the modernisation of the local administration with greater citizen participation, the improvement of private sector competitiveness and the incorporation of ICT in prioritised services related to mobility, the environment and accessibility.
- LabIN Granada: A citizenship innovation laboratory for the brainstorming of ideas, prototyping of solutions and development of projects for the city.
- FIWARE Zone office: To help companies become more competitive by providing advice, training and technical support in the development of "Smart City" solutions.
- Digital Cities Challenge: Together with 15 other European cities, in 2018, Granada was part of the first round of an initiative of the European Commission (EC) that fostered complementarities between existing policies including digital priorities and newly planned actions supporting digital transformation. Policies were the following: Granada Human Smart City, Integrated Sustainable Urban Development Strategy Granada and Granada Smart City Strategic Plan 2020.
- Intelligent Cities Challenge (ICC): Building on the Digital Cities Challenge, Granada joined the EC initiative in 2020. Along with 130 other cities, the initiative aims at developing an innovative ecosystem to drive industrial transformation and intelligent and sustainable growth, while promoting leadership and collaboration among all relevant stakeholders in Granada.

The EC identified three key pillars of Granada's digital community for the design and implementation of a digital ecosystem in the city: i) the University of Granada (especially the School of Computer and Telecommunications Engineering); ii) the Granada Health Technology Park; and iii) the cluster OnGranada, which gathers the main technology-based companies (see Chapter 2). However, some obstacles make the city's digitalisation process challenging. These include the lack of open data, the lack of access to private finance, especially for digital start-ups, and the lack of co-ordination among stakeholders. Nevertheless, digitalisation can enable the circular economy. According to the OECD synthesis report on the circular economy in cities and regions (OECD, 2020^[6]) 51% of cities and regions use digital tools to enable the circular economy, while 33% are planning to link digitalisation and their circular economy initiatives in the short term (OECD, 2020^[6])

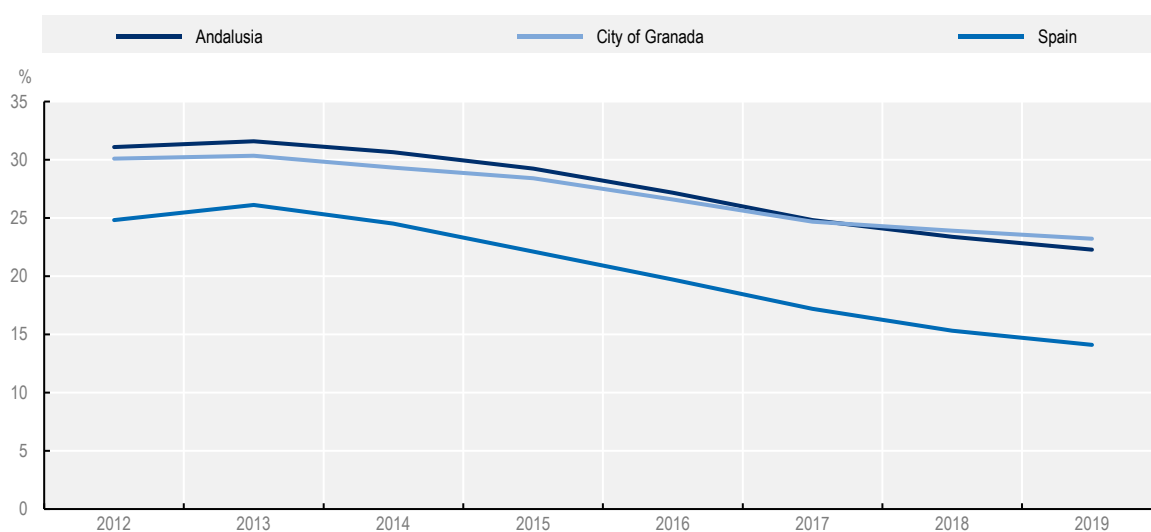
Source: EC (EC, 2019^[34]), Assessment Report for the City of Granada: Creativity and Wellness, Core of the Digital Transformation in Granada Digital Cities Challenge, European Commission; OECD (2020^[6]) The Circular Economy in Cities and Regions: Synthesis Report, <https://dx.doi.org/10.1787/10ac6ae4en>; Intelligent Cities Challenge (2020^[35]) Granada, Spain, <https://www.intelligentcitieschallenge.eu/cities/granada> (accessed on 8 January 2021).

Granada's economy is characterised by the service sector. In 2019, the service sector represented 77.6% of the province of Granada's gross domestic product (GDP), slightly higher than the regional (73.9%) and national (74.7%) levels (Ministry of Employment and Social Security, 2020^[34]). In contrast, the industrial sector in the province of Granada represented 8.1% of GDP in 2019, below the regional (12.1%) and national (16.2%) averages (Ministry of Employment and Social Security, 2020^[34]). In the same year, the agricultural sector represented 7.7% of GDP, more than double the national level (3.1%), while the relative contribution of agricultural employment in the province (8.6% in 2018) was slightly higher than in Andalusia (8.3%) and twice as high as in Spain (4.2%) (Unicaja, 2019^[35]). According to the latest available data, in

2015, Andalusia accounted for approximately two-thirds of the integrated agricultural production areas in Spain in 2015, while their distribution varies considerably across provinces and crops (Government of Spain, 2021^[36]). In 2019, Granada was the third province of Andalusia in terms of integrated production (70 183 hectares). These areas were dedicated mainly to olive groves (98.4%), as well as almond trees (1.3%) and protected agriculture (0.2%) (Government of Andalusia, 2019^[37]).

Unemployment in Granada recorded a downward trend over the last five years but remains high compared to national and OECD standards. Since 2012, the unemployment rate in the city of Granada has dropped from 30.1% in 2012 to 23.2% in 2019, almost aligning with the Andalusian rate (22.3%) but above the national average (14.2%) (OECD, 2021^[38])(Figure 1.3). As a consequence of the sanitary crisis, between February and December 2020, the number of job seekers in the city increased by 26.7%, from 22 935 to 29 069, bringing the city of Granada's unemployment rate to 28.4% (Spanish Public Employment Service, 2021^[39]).

Figure 1.3. Unemployment rates in the city of Granada, Andalusia and Spain



Note: The municipal and regional unemployment rate is calculated as the coefficient between the volume of unoccupied claimants at a given time in a territory and the aggregation of these claimants with the affiliations of residents in this same territory. The national unemployment rate for Spain is measured in numbers of unemployed people as a percentage of the labour force and is seasonally adjusted (OECD, 2021^[38]). The unemployed are people of working age who are without work, are available for work and have taken specific steps to find work. The uniform application of this definition results in estimates of unemployment rates that are more internationally comparable than estimates based on national definitions of unemployment.

Source: Own elaboration based on Institute of Statistics and Cartography of Andalusia (2021^[40]), *Tasa municipal de desempleo*, <http://www.juntadeandalucia.es/institutodeestadisticaycartografia/sima/info.htm?f=i11> (accessed on 19 January 2021) and OECD (2021^[38]), *Unemployment Rate - OECD Data*, <https://data.oecd.org/unemp/unemployment-rate.htm> (accessed on 9 April 2021).

The labour market in the province of Granada is concentrated geographically in its capital. This is evidenced by the fact that 38.2% of all job seekers at the provincial level in 2019 were affiliated with the social security system of the municipality of Granada (National Public Employment Service, 2020^[41]). The average net income in the city of Granada amounted to EUR 21 710 in 2018, close to Andalusian levels (EUR 21 799) for the same year but below the Spanish average (EUR 25 950 (Institute of Statistics and Cartography of Andalusia, 2018^[42])).

Potentially, the circular economy can create job opportunities in Granada. In the province of Granada, 9 720 jobs associated with the circular economy were reported in 2018 (Spanish Public Employment Service, 2020^[43]). According to the *Prospective Study of Economic Activities Related to the Circular Economy in Spain* report published by the Spanish Public Employment Service in 2020, in 2018, there

were 601 894 employees in activities related to the circular economy in Spain, which represented a 0.5% increase compared to 2009 (Spanish Public Employment Service, 2020^[44]). Job families associated with the circular economy included the following areas:

- Collection, treatment and disposal of waste; recovery.
- Decontamination activities and other waste management services.
- Rental activities (e.g. cars, leisure and sports equipment, machinery, office equipment).
- Repair and installation of machinery and equipment.
- Repair of computers, personal effects and household goods.
- Retail sale of second-hand goods in shops.
- Sale and repair of motor vehicles and motorbikes.
- Wastewater collection and treatment.
- Water collection, treatment and distribution.
- Wholesale trade of scrap metal and waste products.

Box 1.4 presents international examples of employment opportunities linked to the circular economy.

Box 1.4. Employment opportunities in the circular economy

Between 2012 and 2018, the number of jobs related to the circular economy in the European Union (EU) increased by 5% to reach around 4 million. The International Labour Organization (ILO) projects the net creation of 18 million green jobs by 2030, including 4 million in manufacturing and 9 million in renewables and construction.

At the city scale, the city of **Amsterdam**, the Netherlands, estimated that the adoption of its circular economy plan would create 2 000 new jobs, including 700 in the building sector and 1 200 in agriculture and food processing (Circular Amsterdam, 2016). The city of **London**, United Kingdom, projected that the uptake of its circular economy route map would create 12 000 new jobs. Part of the jobs that will be created relate to the shared economy, as platforms to share resources such as homes, cars, clothing, books and other belongings create new economic opportunities. For example, the mayor of **Chicago**, United States, supported a resource management and exchange platform that worked with Northwestern University and its affiliated hospital system to launch the COVID-19 Emergency Resource Exchange (ERx) aiming to connect frontline workers with surplus masks from tattoo artists, veterinarians and other organisations.

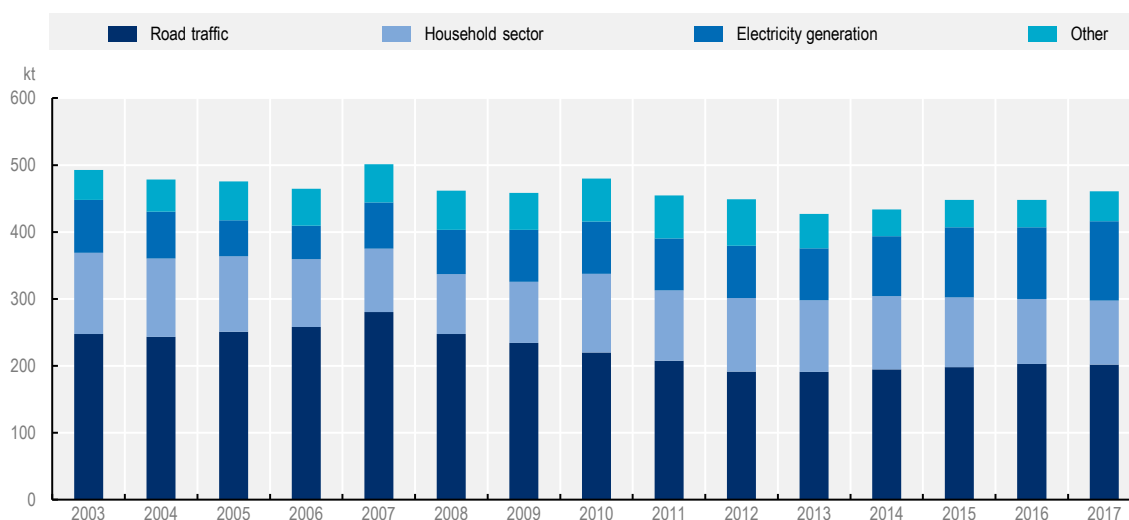
The EC estimates that the implementation of all existing waste legislation will lead to the creation of more than 400 000 jobs in the EU, including 52 000 in Spain. In the country, the transition to a circular economy has the potential to boost job creation in areas directly connected to the environment and nature conservation, including waste management, water and air quality, eco-industries and other sectors. However, these activities have not fully achieved their growth potential; neither have other sectors such as wastewater treatment, environmental R&D, organic farming, forest resource management and biodiversity.

Source: WRAP/Green Alliance (2015^[45]), *Employment and the Circular Economy: Job Creation in a More Resource Efficient Britain*, https://circulareconomy.europa.eu/platform/sites/default/files/britain_employment_and_ce.pdf; ILO (2019^[46]), *World Employment and Social Outlook – Trends 2019*, International Labour Organization; IISD (2018^[47]), “Estimating employment effects of the circular economy”, <https://www.iisd.org/system/files/publications/employment-effects-circular-economy.pdf?q=sites/default/files/publications/employment-effects-circular-economy.pdf>; Circle Economy/Fabric/TNO: Gemeente Amsterdam (2016^[48]) *Circular Amsterdam - A Vision and Action Agenda for the City and Metropolitan Area*, <https://amsterdamsmartcity.com/projects/circle-scan-amsterdam>.

Environmental data and trends

Granada faces important environmental issues but CO₂ emissions and air pollution are the main concerns to which the circular economy could provide solutions. CO₂ emissions in the city of Granada have remained relatively stable since 2003 but the main drivers of emissions have changed over time. Annual CO₂ emissions in Granada have varied between 427 and 502 kilotonnes of CO₂, with a spike in 2007 before the global financial crisis and a low point in 2013, but total emissions have decreased by 6.4% overall (Figure 1.4). The importance of road traffic as a driver of CO₂ emissions has declined since 2007 but CO₂ emissions from electricity generation have been increasing since 2012, both in absolute terms and as a share of total CO₂ emitted. The contribution of the domestic sector has remained relatively stable over time, accounting for 19% to 25% of CO₂ emissions in Granada.

Figure 1.4. CO₂ emissions in the city of Granada, Spain, 2003-17



Note: Other includes the following categories: extractive activities and mineral treatment; agriculture; oil and gas distribution; wildfires; waste incineration; food industry; chemical industry; dry cleaning; agriculture machinery; other means of transport and mobile machinery; use of solvents; rail transport; and commercial and institutional sector.

Source: Government of Andalusia (2021^[49]), *Inventory of Atmospheric Emissions in Andalusia*.

Granada is one of Spain's most polluted cities, mainly as a result of emissions due to traffic, heating and construction but also due to its orography and climate conditions (Government of Spain, 2019^[50]). The city and its metropolitan area are located in a valley surrounded by mountains, a situation that favours the formation of thermal inversions and weak winds, hindering the dispersion of pollution during the winter season. In 2019, the metropolitan area of Granada registered the highest mean population exposure to PM_{2.5} air pollution¹ in Spain (15.1 µg/m³), above the OECD average (13.9 µg/m³) and the World Health Organization (WHO) standard (10 µg/m³) (OECD, 2021^[51]). However, progress has been made over the last decade, as exposure to PM_{2.5} air pollution has decreased by 22% between 2005 and 2019 (OECD, 2021^[51]). Granada has set up initiatives to improve air quality and the transition to the circular economy is believed to contribute to this goal (Box 1.5). Figure 1.5 shows the words that the city of Granada most associates with the circular economy concept according to the OECD Survey (2020^[52]). The bigger the word in the figure, the higher the importance. These words are, in the order of priority, "climate change", "environment", "sustainable development", "reusing" and "recover".

Southwest Metropolitan Urban Area. This initiative for the improvement of air quality complements other measures already in place such as the installation of information panels on municipal buildings and video cameras to raise awareness on air quality.

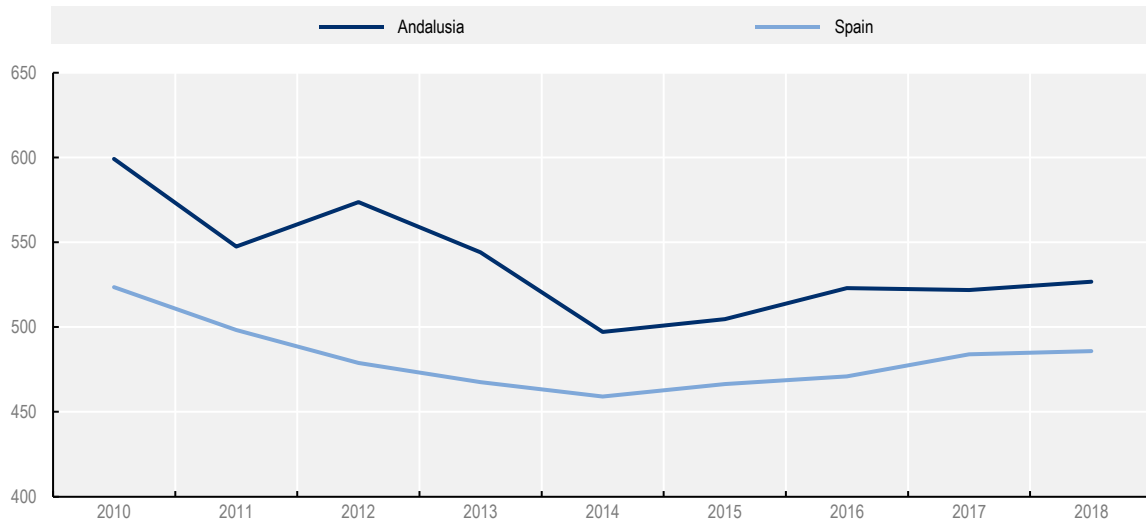
Source: Granada City Council (2017^[53]), *Plan de mejora de la calidad del aire del término municipal de Granada 2017-2020 (Air Quality Improvement Plan for 2017-2020)*, <https://www.granada.org/inet/wordenanz.nsf/wwalias/3DA6AC842BD8A240C1258221004B7F52>; Provincial Council of Granada (2021^[54]), "Diputación comienza en Gójar las mediciones para el diagnóstico de calidad del aire en el área metropolitana de Granada (The Provincial Council begins in Gójar the measurements for the diagnosis of air quality in the metropolitan area of Granada)", <https://www.dipgra.es/amplia-actualidad/noticias-inicio/diputacion-comienza-gojar-mediciones-diagnostico-calidad-del-aire-areas-metropolitana-granada>; Granada City Council (2020^[55]), "Nace el 'skyline' verde de la ciudad de Granada, el Anillo Verde (The green 'skyline' of the city of Granada)", <https://www.granada.org/inet/wprensa.nsf/0284aa18655e179cc1257be5003cc7f9>; Granada City Council (2019^[56]), "El Ayuntamiento extiende a toda la ciudad la limitación de la velocidad a 30 kilómetros hora (Granada City Council extends 30 km/h speed limit to the whole city)", <https://www.granada.org/inet/wprensa.nsf/0284aa18655e179cc1257be5003cc7f9>; Forum Ambiental Foundation (2019^[57]), *Premios Ciudad Sostenible (Sustainable City Awards)*.

Regarding the waste sector, one of the pillars of the circular economy, available data at the regional rather than at the local scale, shows that levels of separate waste collection in Andalusia are still relatively low in the region compared to other Spanish autonomous regions and there is no yet ambitious vision for conceiving a paradigm change from waste as a resource. Urban waste per capita collected in Andalusia decreased by 13.4% between 2012 and 2014 but has been growing since then, following the overall trend for Spain (Figure 1.6). In 2018, urban waste collected per capita in Andalusia reached 526.7 kg per capita, over 40 kg above the Spanish average of 485.9 kg per capita, making Andalusia the fourth-highest autonomous region in terms of urban waste collected per capita. On average, 12% of all urban waste collected in Andalusia had been separated between 2010 and 2018, below the Spanish average of 18.6%. The share of separate waste as a share of total urban waste collected in Andalusia remained relatively stable between 2010 and 2018, oscillating between 11.1% and 13.7%, below the overall Spanish level (Figure 1.7). In Spain, separated waste as a share of the total waste collected surpassed the 20% bar in 2018 (20.4%). Responsibility for the different phases of municipal waste separation, collection and treatment is fragmented, and the Municipal Waste Management Programme for the province of Granada 2014-24 does not integrate circularity principles. Data is available at the city level but it is both unclear in terms of the indicators measured and inconsistent with national sources. Integrating circular economy principles into waste management and other economic sectors could help to significantly reduce the amount of waste generated, as well as increase the share of waste separated and recycled (INE, 2019^[58]).

Water consumption in Granada is decreasing but wastewater treatment and reuse in Andalusia remain relatively limited. Water consumption in the city of Granada and its 14 adjacent municipalities² decreased by 22.6% between 2013 and 2020, from 50 980 350 m³ to 39 439 912 m³, according to Emasagra (2020^[59]). In 2018, the average household water consumption in Andalusia was 128 litres per inhabitant per day, just below the national average of 133 litres (EP Data, 2021^[60]). Granada has high-quality drinking water, well above the norms established by the WHO, the EU and Spanish sanitary authorities (Emasagra, 2020^[61]). However, just 75.3% of the population of the province of Granada benefitted from water treatment (considering plants in operation and still under construction), the lowest rate of all Andalusian provinces and well below the Andalusian average of 89.7% (Government of Andalusia, 2020^[62]). Furthermore, just 4.8% of treated wastewater is reused in Andalusia, below the national average of 11.2% (Official Association of Biologists of Andalusia, 2021^[63]). Moving from a linear to a circular approach reducing and reusing water can have positive environmental, economic and social impacts, particularly in water-scarce areas such as Andalusia.

Figure 1.6. Collected municipal waste in Andalusia and Spain, 2010-18

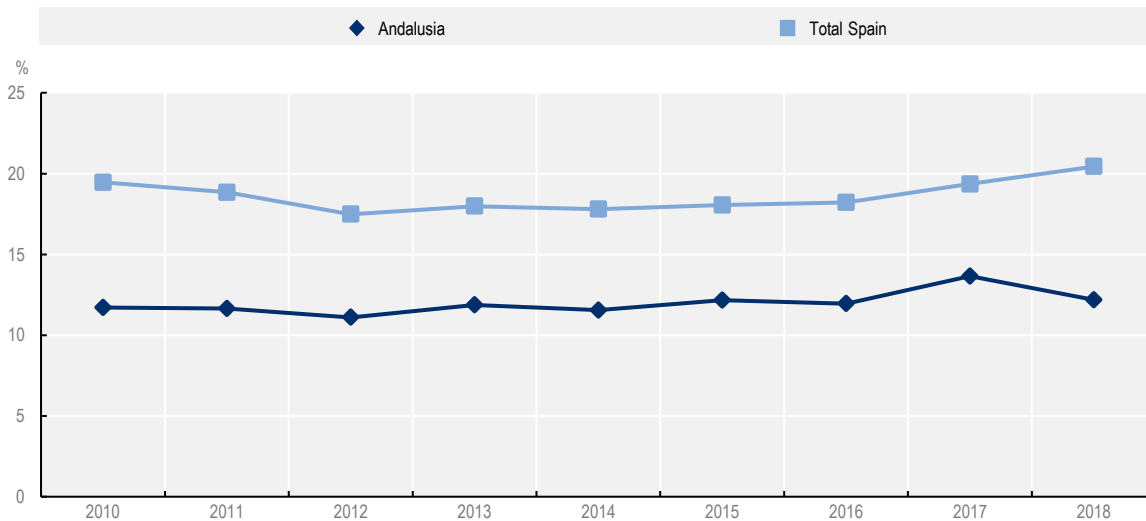
Per capita per year (kg)



Source: INE (2019[58]), Estadísticas sobre recogida y tratamiento de residuos. Residuos urbanos: Serie 2010-2018, <https://www.ine.es/jaxi/T/abla.htm?path=/t26/e068/p01/serie/I0/&file=02003.px&L=0>.

Figure 1.7. Separated municipal waste in Andalusia and Spain, 2010-18

Share of total waste collected



Source: INE (2019[58]), Estadísticas sobre recogida y tratamiento de residuos. Residuos urbanos: Serie 2010-2018, <https://www.ine.es/jaxi/T/abla.htm?path=/t26/e068/p01/serie/I0/&file=02003.px&L=0>.

No clear trend towards reduced final energy³ consumption can be observed for the province of Granada between 2008 and 2018. However, the municipality aims to enhance energy efficiency. (Government of Andalusia, 2019[64]). Final energy consumption has varied between 1 164.3 and 1 396.3 kilotonnes of oil equivalent annually over this period. However, the province of Granada accounted for just 9.9% of Andalusia's total energy use in 2018, with Cádiz, Málaga and Seville being the highest energy consumers. In 2018, 67.5% of the province of Granada's final energy consumption came from fossil sources (petroleum

and natural gas), while 22.1% of the final energy consumed was electric. Transport – which still overwhelmingly depends on fossil fuels – and the residential sector were the main drivers of final energy consumption, accounting for 41.6% and 20.9% respectively in 2018. The municipality aims to reduce consumption through savings and efficiency campaigns in the residential sector, the implementation of the Sustainable Urban Mobility Plan 2025⁴ and the use of alternative energies (Granada City Council, 2013^[65]). The transition to a circular economy can contribute by promoting shared transport solutions, thus increasing efficiency and by improving energy efficiency in buildings. Further details on how the circular economy can contribute to a more sustainable Granada will be discussed in Chapter 2.

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 economicas-relacionadas-con-la-economia-circular-en-espana](https://www.sepe.es/HomeSepe/que-es-el-sepe/comunicacion-institucional/noticias/detalle-noticia.html?folder=/2020/Noviembre/&detail=estudio-prospectivo-de-las-actividades-economicas-relacionadas-con-la-economia-circular-en-espana) (accessed on 9 April 2021).
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Notes

¹ Calculated as the mean annual outdoor PM2.5 concentration weighted by population living in the relevant area, that is, the concentration level, expressed in $\mu\text{g}/\text{m}^3$, to which a typical resident is exposed throughout a year.

² Alhendín, Armilla, Cájar, Cenes de la Vega, Cúllar Vega, Churriana de la Vega, Gójar, Huétor Vega, La Zubia, Las Gabias, Ogíjares, Otura, Pinos Genil and Pulianas.

³ Final energy measures all energy supplied to the final end users (households, agriculture, industry, services, etc.) for all energy uses (Government of Andalusia, 2019^[64]).

⁴ See http://www.movilidadgranada.com/pm25_index.php.



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