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Circular economy and applications in various sectors

Greece

Sectors in focus

December 2021

Alpha Bank Economic Research

Contents

Executive summary

Circular economy practices and policies adopted by government bodies, businesses and consumers can have significant contributions to reversing adverse environmental changes, by also addressing corporate responsibility and ESG criteria. Although circular economy practices and applications are gaining momentum over the linear economic model and are supported by institutional policy frameworks, there are still barriers and challenges that lie ahead. In order to reach a productive synthesis of the two models, the prevailing, linear economic model should be substantially infused with circular economy principles.

- **Rising temperatures provoked intense droughts and heatwaves and played a** determinant role in the intensiveness and disastrous effects of the Greek wildfires in summer 2021. Human-induced global warming, extended waste pollution, world population increase, and the abatement of resources signify the priority to substantially alter production and consumption patterns.
- **To achieve the climate targets and contain the environmental effects of pollution** and waste generation, we need a fundamental shift in economic values and procedures applied by businesses, consumers and governments. The shift pertains to the gradual synthesis of the linear and the circular economic model.
- **The European Commission (EC) defines the circular economy as a system in** which "the value of products, materials and resources is maintained in the economy for as long as possible and the generation of waste is minimised".
- **Waste generated by all economic activities and households in Greece has** increased since 2004, and more than doubled in 2016, while in 2018, it fell cumulatively by 34%, with the majority generated from mining and quarrying. The two most common packaging waste types in Greece and the EU-27 are paper and cardboard packaging and plastic packaging.
- **Waste management refers to the ways, actions and processes with which waste** is handled, collected, transported, treated and disposed after being generated. Disposal, such as landfilling, and recovery of waste, which includes recycling, are the two main processes of waste treatment.
- **Disposal of waste accounted for 85% of total waste treatment and recovery for** only 15% (2018). Regarding municipal solid waste, its largest part in Greece is treated in landfills and other forms of disposal (78%) and only 21% is recycled.
- **Greece lags European countries in recycling, with only 11% of total waste being** recycled, far behind the EU-27 average (38%). However, in certain categories, as with packaging waste (64% in 2018), recycling rates in Greece have converged to the EU-27 average. Paper and cardboard packaging records a high recycling rate (92%), but plastics a relatively low (40%).
- **Elimination of food waste is a priority of the circular economy as it is associated** with climate change and pressure on natural resources and the environment. It has been estimated that 8-10% of global GHG emissions are linked to food that is not consumed.
- **Electronic waste or e-waste includes electronic materials and components,** along with substances that can pose a threat to the environment and human health. Greece is close to the EU-27 average in its e-waste recycling rate (39% in 2018), the world leader of electronic recycling.
- **The need for waste limitation and more circular treatment solutions is evident in** various sectors and products, such as in construction and buildings, the agri-food sector, mining and metals, electronics, textiles, packaging and plastics and energy and transport. Various sector-specific policies and guidelines must be adopted in order to facilitate the transition to a more circular economic model.
- **The EU regulatory framework that guides the transition to a circular economy** contains the new Circular Economy Action Plan and other regulations, such as those for waste management. Greece recently introduced its New Action Plan for the Circular Economy 2021-2025, by also adopting other relevant regulations (e.g. Life – Circular Economy Implementation program) and policies for waste limitation (National Waste Management Plan).
- **ESG environmental criteria are also aligned with various circular economy** targets. Companies that integrate ESG factors within their business strategy and align with social and environmental criteria are also shown to be more attractive to the investors and have better financial performances.
- **The circular economy has been related to various environmental, economic and** social benefits that arise from its wider application. However, it has also various financial and practical limitations, while its applications are not feasible without significant transformations of the supply chain.

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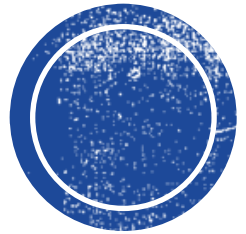
The context of a circular economy



Aggravated environmental conditions stress the importance of immediate action

Climate change and extreme weather phenomena pinpoint the need to accelerate efforts to reduce greenhouse gas emissions.

- Anthropogenic intervention in global warming (deforestation, fossil fuel burning, livestock growth, land use, nitrogen fertilizers, etc.), extended waste pollution, world population growth, and the depletion of resources affirm the priority of substantially altering production and consumption patterns during the 21st century.
- Immense overuse of the Earth's natural resources threaten the sustainability of the current, linear economic model. Resource depletion will render it no longer viable: we annually consume 1.75 times the earth's carrying capacity. The resources extracted from the Earth exceeded 93 billion tones in 2015 (National Geographic, 2020). Growth of the global population by 2030 (at 8.5 billion) and the middle class (at 5.3 bn) will result in analogous increases in food, water and energy demand and will pose unprecedented challenges (UN, 2015 and Accenture, 2020).
- Annual extraction of materials worldwide tripled from 2007 to 2017. Nearly half of global greenhouse gas emissions (GHG), more than 90% of the lost biodiversity and water stress are the result of resource extraction and processing of materials, fuels and food (European Green Deal, 2019). In the EU, only 12% of the used materials are recycled materials (around 9% worldwide). On a global scale, about 2/3 of raw materials, or more than 67 billion tonnes, is lost every year and cannot be retrieved (National Geographic, 2020).
- Human activities contribute directly to climate change and the acceleration of global warming by increasing the levels of carbon dioxide and other greenhouse gases in the Earth's atmosphere. It is estimated that human-induced climate change affects precipitation patterns and is responsible for the rise in extreme environmental and weather phenomena, such as concurrent heatwaves and droughts, hurricanes, storms and floods (ICPC, 2021). In the Mediterranean region, the effects of climate change (lower rainfall and prolonged droughts), in combination with land use changes, have also caused an increase in the frequency and extent of forest fires (WWF, 2019).
- To achieve the goal of the Paris Agreement of limiting global warming to 1.5°C compared to its preindustrial level, efforts must be accelerated towards the substantial reduction of GHG emissions. At the 26th UN Climate Change Conference (COP26) in November 2021, this goal remained, although it seems harder to achieve. Leaders from 200 countries pledged to adapt their national climate change plans and committed to revisit and tighten their 2030 emission reduction targets, if necessary. Many participating countries have engaged in limiting deforestation and phasing out coal, while around 90% of them agreed on net zero targets until 2050. However, the commitments related to emissions reduction so far cover less than 20% of the gap that needs to be closed by 2030 to keep the 1.5°C target feasible (IEA, 2021).
- To maintain the feasibility of sustainable economic growth prospects and limit the impact of climate change and environmental degradation, we must reconsider how much we produce, consume and throw away.

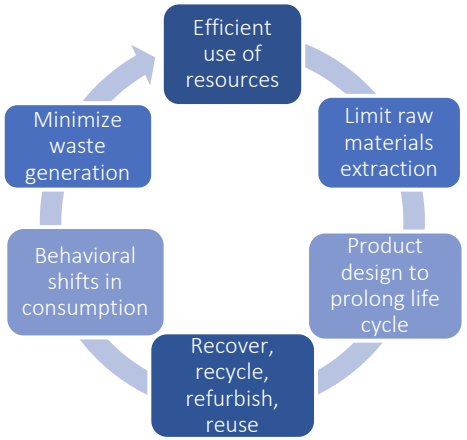
Climate change and the 2021 Greece wildfires

The Mediterranean Basin and therefore Greece are internationally recognized as "hot spot" areas, i.e. geographical regions sensitive to climate change (Dianeosis, 2021). Temperatures in the Mediterranean are increasing 20% faster relative to the global average, with nearly 0.6% of the Mediterranean's total forest area burnt every year (WWF, 2019). In the summer of 2021, the hottest for Greece in the last 30 years, the number of forest fires increased by 43% compared to the 2008-2020 average (National Observatory of Athens).

Until the end of August 2021, wildfires on the island of Evia and in southern Greece burned more than 1,000 square kilometers of forest, necessitating the creation of the Ministry of Climate Crisis and Civil Protection to prevent and combat the disastrous effects of climate change. Climate conditions played a determinant role in the intensiveness of these fires, due to rising temperatures which provoked severe droughts and heatwaves.

The role and concept of the circular economy

The transition from a linear to a circular economy requires shifts in consumption patterns, new business models and fundamental behavioral changes.



Key principles and operations of a circular economy

- To achieve the climate targets and contain the environmental effects of pollution and waste, we need a fundamental shift in economic values and procedures by businesses, consumers and governments. The shift pertains to the gradual synthesis of the linear and the circular economic model. A linear economy traditionally follows the "make-consume-dispose" principle, based on the extraction of raw materials, which are then transformed into products and are used until they are finally discarded as waste (World Economic Forum, 2014). On the other hand, the circular economy model aims to generate value from the materials that already exist in supply chains.
- The circular economy can transform production, consumption and waste management patterns. Its purpose is the deceleration of natural resources' reduction, the limitation of environmental damages from extracting and processing materials, and the containment of pollution from the processing, use and materials' end of life (Ekins et al, 2019 and EC, 2019).
- The circular economy is based on the circularity of systems that we also observe in the natural world (Ekins et al, 2019, EC, 2019), and thus relies on three principles: i) designing out waste and pollution, i.e. design for circularity, waste elimination and material substitution, ii) keeping products and materials in use, i.e., reuse products and components and recirculation of materials, and iii) regenerating natural systems, especially regarding agriculture regeneration (Ellen MacArthur Foundation, 2019).
- The European Commission defines the circular economy as a system in which "the value of products, materials and resources is maintained in the economy for as long as possible and the generation of waste is minimised" (EC, 2015). A circular economy "can be applied to all kinds of natural resources" and "provides opportunities to create well-being, growth and jobs, while reducing environmental pressures" (European Environmental Agency, EEA, 2016).
- The Ellen MacArthur Foundation (2019) identifies flows of technical and biological materials (nutrients) that circulate in a "value cycle" (the Butterfly diagram). The flows contain two cycles: the natural cycle and the manufacturing or technical cycle, in which materials are processed. In the natural cycle, the nutrients of biological origin can return to the biosphere as feedstock. In the technical cycle, materials and products reenter the circular loop of the system at the end of their life, by being redesigned, reused, refurbished, remanufactured or recycled.
- The circular economy is also based on behavioral changes and shifts in consumption patterns and new "sharing economy" business models facilitated by digital technologies that change the focus from "product sellers", to "service providers" and from "consumers" to "users".
- Focusing on shifting production in various key sectors as well as consumption patterns in ways that comply with sustainable development principles, the circular economy also aims to reduce carbon and material footprint. The use of renewable energy plays a crucial role in ensuring that the circular model is effectively regenerating and restoring. Renewable energy transition and energy efficiency can account for a reduction of 55% in GHG emissions, while the remaining 45% can be tackled via the production of everyday products we use, such as cars, food and clothes (Ellen MacArthur Foundation, 2019).

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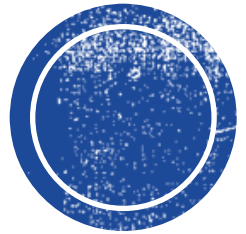
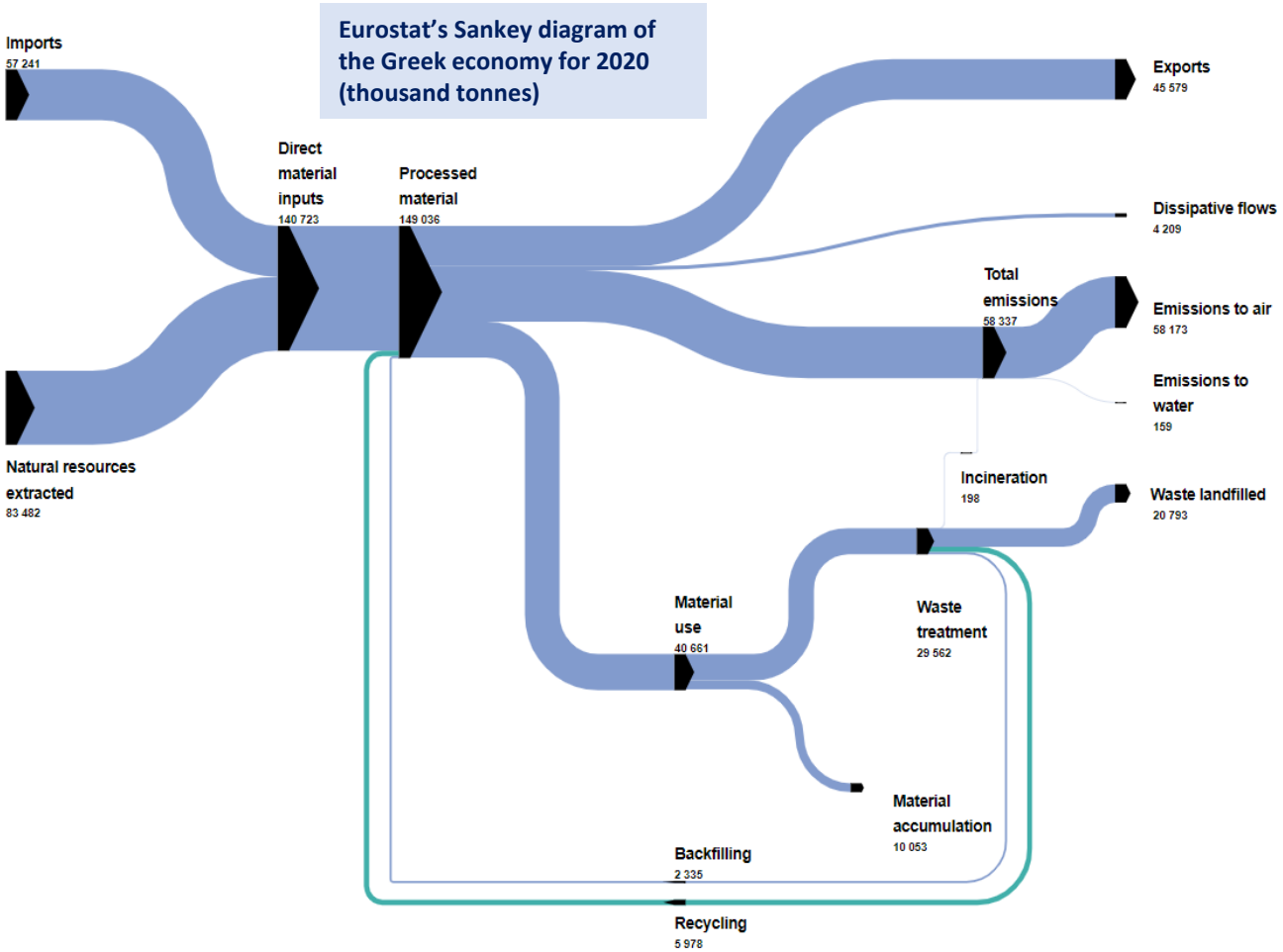
Material flows and the circular economy



The Sankey diagram of an economy's material flows

The Sankey diagram reflects the primary and secondary material flows of an economy: natural resources are extracted from the environment to produce goods, accumulate in societal stocks and leave residuals that are either discharged to the environment, reused in the economy or used for secondary materials production, thus reducing the need for future domestic extraction of materials.



Source: Eurostat, Circular economy diagrams, Greece

The Sankey diagram material flows

- The Sankey diagram is divided into flows of primary and secondary materials used for the domestic production of goods. The direct material inputs (DMI) include a) the natural resources that are extracted, which include the domestic extraction of materials, i.e. "the total amount of material extracted by resident units from the natural environment for further processing in the economy" (Eurostat) and b) imports of materials, i.e. the total amount of materials imported, including the imports of waste for recovery and recycling.

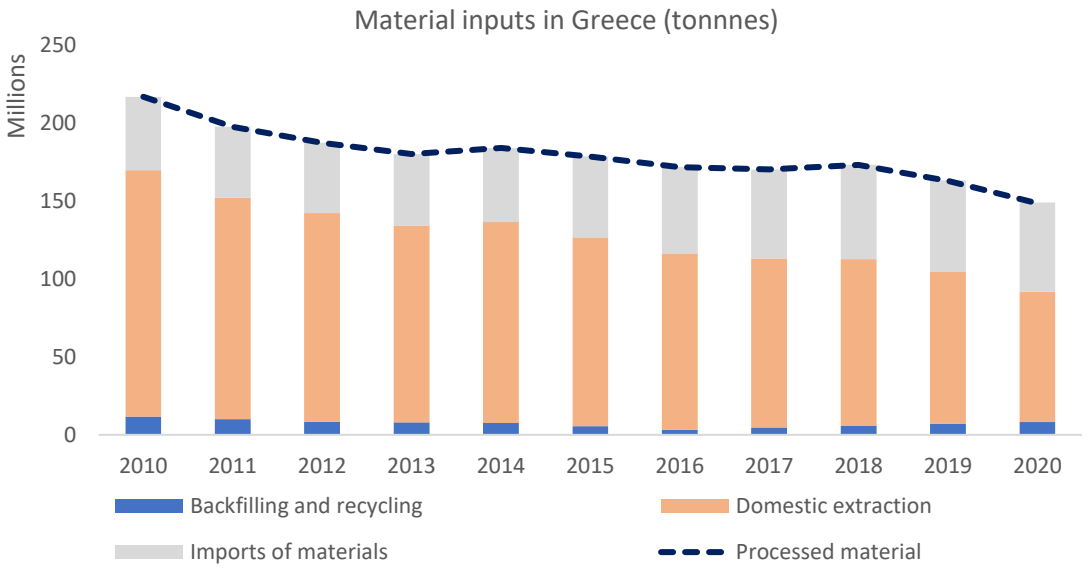
Processed material

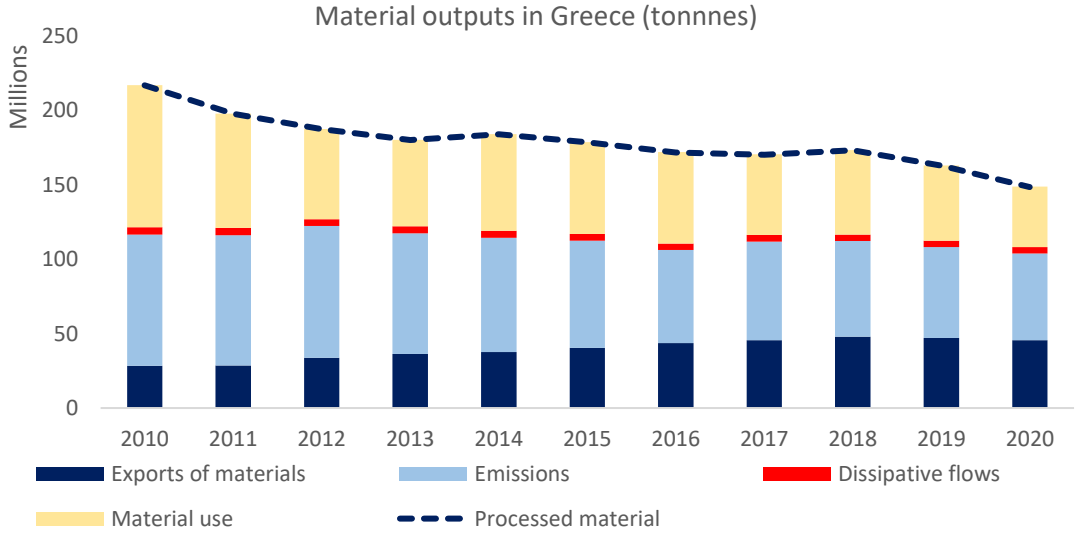
- The sum of DMI and secondary material inputs, i.e., materials from recycling and downcycling or backfilling, constitute the processed material of an economy. Processed material is then disintegrated into the following outputs: a) exports of materials, b) dissipative flows, i.e. materials dispersed into the environment as "a deliberate or unavoidable with current technology consequence of product use" (Eurostat), c) total emissions of liquid and gaseous materials (excluding water and respiratory carbon dioxide) generated by the economy and passed on to the natural environment, especially in the form of air emissions and d) material use.

Material use

- Material use consists of metal ores, metals and non-metallic minerals and the parts of fossil and biomass materials not used for energy production. Material use is further divided into a) waste treatment, which includes waste landfilling, incineration, recycling and backfilling, and b) material accumulation, which measures the amount of materials annually added to the economy's stock, since old materials are removed from stock.

The balance of material flows of the Greek economy





Source: Eurostat

The balance of material flows of an economy implies that the processed inputs and outputs of primary and secondary materials must be equal.

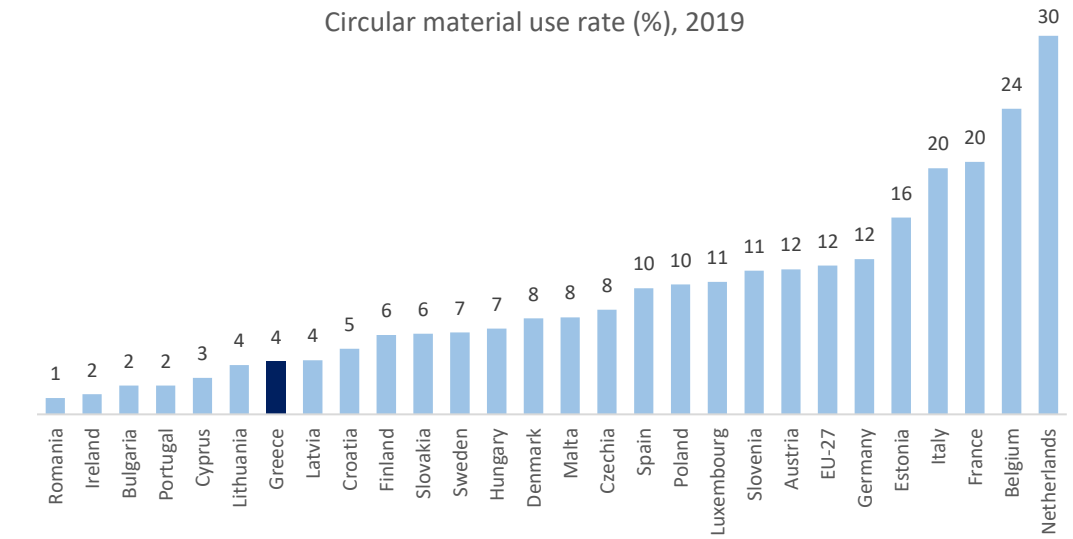
Material inputs

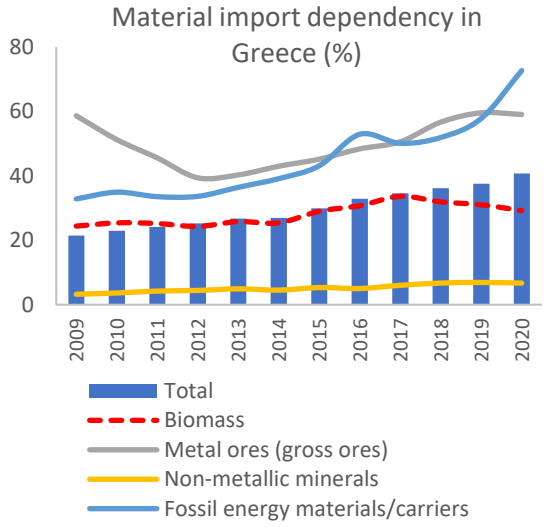
- The processed materials of the Greek economy reached 149 million tonnes in 2020, reduced cumulatively by 31% compared to 2010. Among the processed materials in 2020, 56% are primary materials produced by domestic extraction (from 73% in 2010). During the period 2010-2020, natural resources extraction was cumulatively reduced by 47%, standing at 83.5 million tonnes in 2020.
- Imported materials in Greece accounted for 39% of the processed materials of the economy in 2020, while in 2010, they represented 22% of the total materials. Imports of waste for recovery and recycling account for only 1.7% of the total imported materials. Imports of materials were cumulatively increased by 21% in the period 2010-2020, reaching 57 million tonnes in 2020. Direct material inputs (imports and extracted natural resources) reached 141 million tonnes in 2020.
- Backfilling and recycling operations of waste materials complete the list of material inputs, accounting for 6% of the processed materials of the Greek economy in 2020, when they amounted to nearly 8 million tonnes. Backfilling and recycling have been reduced by 29% since 2010, when they accounted for 5% of the processed materials.

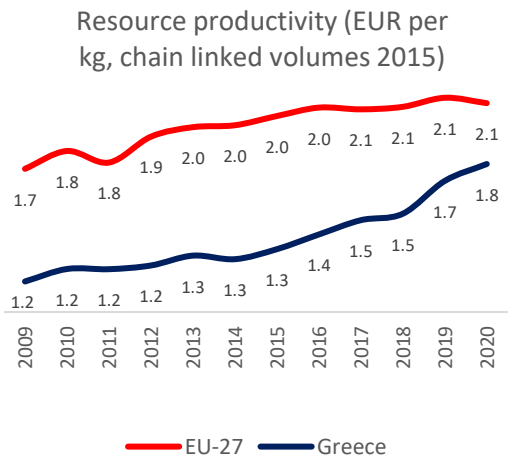
Material outputs

- Material use (waste treatment and material accumulation) reached 40.7 million tonnes in 2020 or 27% of processed material, reduced from 44% in 2010. Material use was cumulatively contained by 57% in 2020 relative to 2010. Dissipative flows account for only 3% of the processed material, reduced by 14% since 2010.
- Exports of materials, which is by and large exports excluding those for recovery/recycling, accounted for 31% of the material output in 2020, reaching 45.5 million tonnes, and cumulatively increasing by 61% in the period 2010-2020.
- Emissions of waste, which are primarily air emissions, accounted for 39% of the total material output in 2020. Emissions were downsized by 1/3 over the same period, reaching 58 million tonnes in 2020.

Circular material use rate, material import dependency and resource productivity







Source: Eurostat

The higher the circular material use rate – a circular economy indicator linked to the ratio of the materials recovered and backchanneled to the economy over the total material use – the lower the primary materials extraction and thus its negative environmental effects.

Circular material use rate

- The circular material use rate, as well as the material import dependency ratio, are closely related to the circulation of materials. The circular material use rate reflects the circular use of materials to the overall material use, which is defined as the sum of domestic material consumption and the circular use of materials. The circular use of materials "is approximated by the amount of waste recycled in domestic recovery plants, minus imported waste destined for recovery, plus exported waste destined for recovery abroad" (Eurostat).
- Greece stands well below the EU-27 average (12%) in terms of the circular material use rate, at 4% in 2019, implying lower circularity of secondary materials relative to the primary raw materials.

Material import dependency

- The material import dependency ratio is the percentage of imported materials over DMI, i.e. material imports plus natural extracted resources. Greece's material import dependency ratio was equal to 41% in 2020, increased from 22% in 2009, significantly higher than the EU-27 average (23%). The ratio reflects Greece's increased dependency on imported materials in order to meet domestic material needs. Material import dependency is higher for fossil energy materials/carriers (73% in 2020) and metal ores (59%) and lower for biomass (29%) and non-metallic minerals (7%).

Resource productivity

- Resource productivity is the ratio of GDP over domestic material consumption and it "reflects the GDP generated per unit of resources used by the economy" (Eurostat). In Greece, resource productivity increased from 1.2 EUR/kilogram (kg) in 2009 to 1.8 EUR/kg in 2020, close to the EU-27 average (2.1 EUR/kg), indicating a more productive use of resources in the economy.

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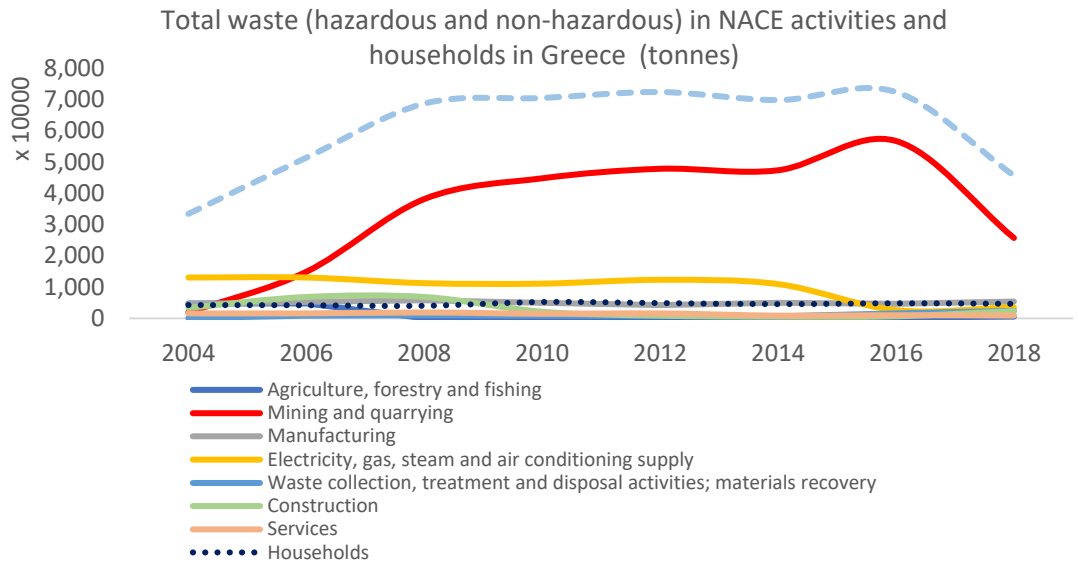
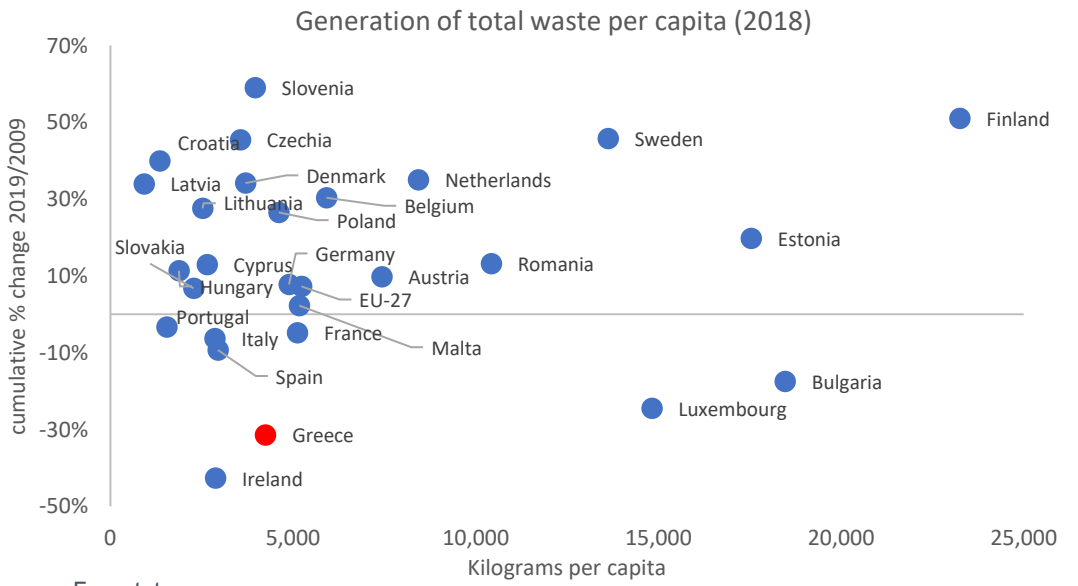
Waste generation per type and sector

Waste generation per economic sector and per capita



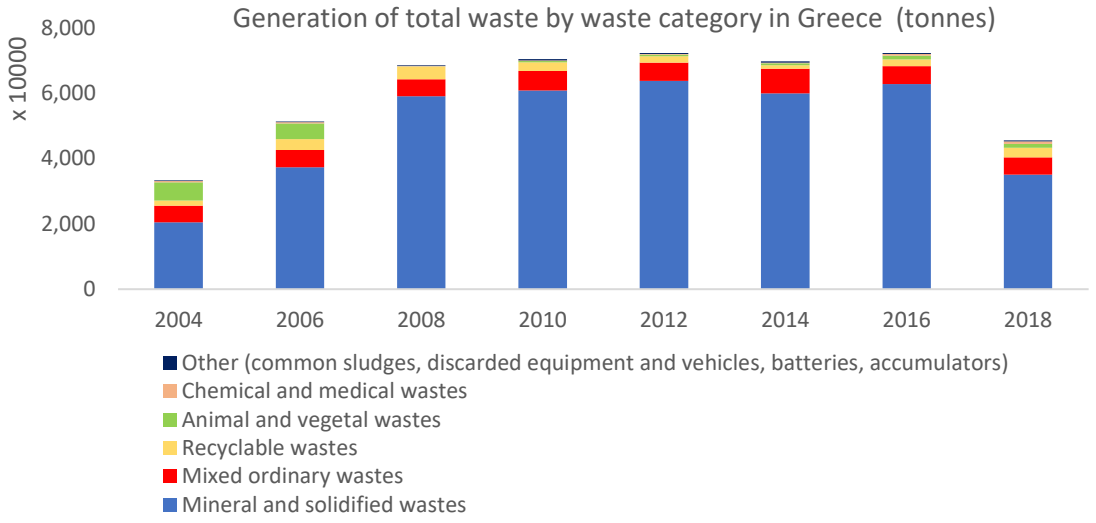


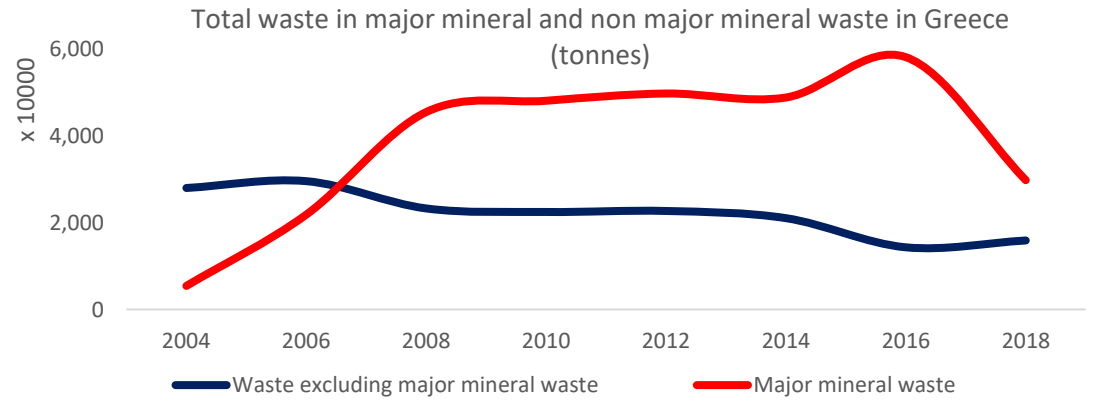
Source: Eurostat

The largest part of waste in Greece is generated from the sector of mining and quarrying, followed by manufacturing and households.

- Waste is defined as ''any substance or object which the holder discards or intends or is required to discard'' and can result in an extended reduction of resources (materials and energy) (EC, 2021). The prevention of waste generation is critical for the European waste management policies.
- Waste generated by all economic activities and households in Greece was increasing since 2004 and more than doubled in 2016, while in 2018 it fell cumulatively by 34% to nearly 46 million tonnes compared to 2008. Per sector, the largest part of waste in Greece is generated from mining and quarrying (56%) (27% is the EU-27 average), followed by manufacturing (12%), households (10%), electricity, gas, steam, air conditioning supply (8%), waste collection, treatment, disposal and materials recovery (6%), construction (5%), services (2%) and agriculture (1%).
- Waste per capita fell by 31% in 2018 compared to 2008, to 4,248 kg/capita, lower than the EU-27 average (5,234 kg/capita), which increased by 7%. Greece, due to the reduction of economic production during the economic crisis, was among the few EU-27 countries that recorded a drop. In the EU-27 countries, a higher waste per capita ratio is related to higher shares of waste from mining and quarrying.
- Waste excluding major mineral wastes per GDP unit, which indicates an economy's ability to produce more wealth while generating less waste, fell by 10% in Greece in 2018, to 85 kg/thousand EUR, higher than the EU-27 average (66 kg/thousand EUR), which decreased by 3%. In addition, waste excluding major mineral wastes per domestic material consumption, which reflects the efficiency of material consumption by comparing waste generation to domestic material consumption, rose to 13.3% in 2018, from 10% in 2008, higher than the EU-27 average (12.9%).
- Waste generation in Greece is predicted to increase in 2030 compared to 2018 for various sectors: 8.5% for industry, 10% for agriculture, 10% for mining, construction and demolition and 13% for batteries, accumulators, electrical and electronical equipment and end-of-life vehicles. Waste is expected to decrease for municipal waste (-3%) and for other hazardous waste (-6%) over the same period (National Program for the Prevention of Waste Generation 2021-2030).

Waste generation per material category





Source: Eurostat

- In Greece, municipal waste was cumulatively increased by 9% in 2019 compared to 2009, reaching its highest level since 2010. Per capita, it rose by 1/3 (to 524 kg/capita) during the same period, at a higher level than the EU-27 average (502 kg/capita). In 2018, municipal waste in Greece accounted for the 12% of total waste generated, larger than the respective EU-27 average (9%).

Municipal waste in Greece accounts for 12% of total waste generation, while major mineral wastes constitute 2/3 of total waste.

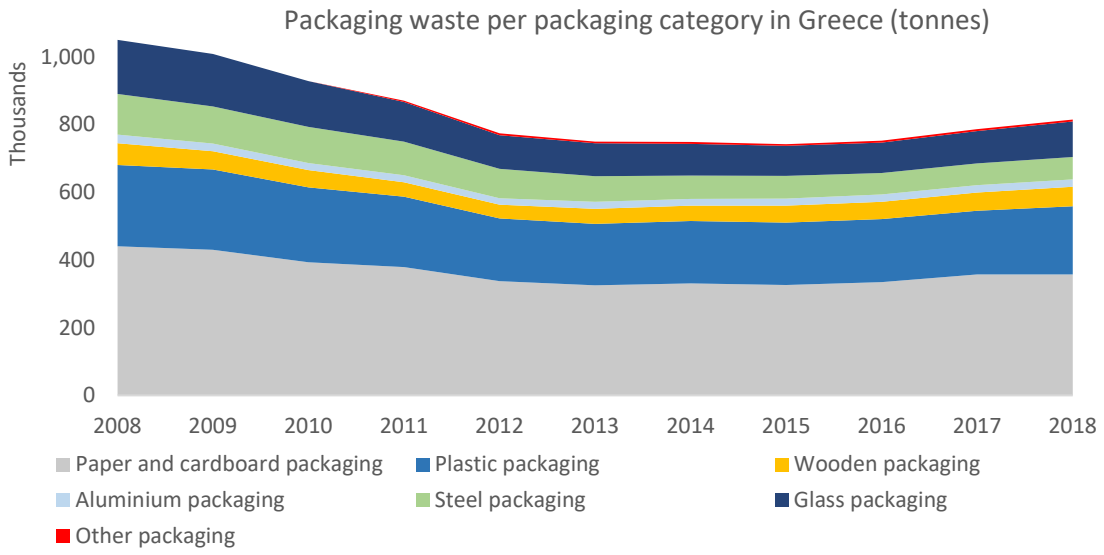
Waste generation categories

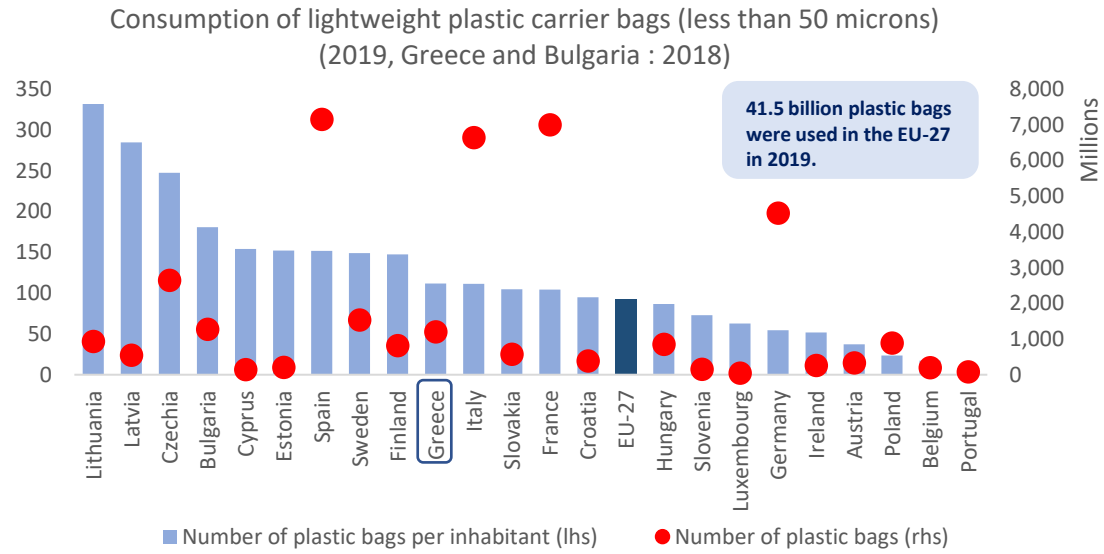
- The waste generated in Greece is mainly primary waste (97% in 2018) and the rest is secondary waste (3%), generated during waste treatment operations such as recovery and disposal, and includes residual materials, in the form of sorting residues, mineral wastes from waste treatment, sludges and liquid wastes, and combustion waste (EC).
- The greater part of waste in Greece and the EU-27 is non-hazardous (99% and 96%, respectively). Hazardous waste is found in chemical, medical or biological waste, batteries and accumulators and discarded vehicles and has chemical and physical properties that render it potentially harmful to human health and the environment.
- Per material category, the generated waste in Greece consists mainly of mineral and solidified wastes (77% in 2018), with the shares of the other categories being considerably smaller: 12% is ordinary waste, 6% recyclable waste, 3% animal and vegetal waste, 2% chemical and medical waste and 1% other waste.
- Almost 2/3 of total waste generated in Greece, a lower share than that of the respective EU-27 average (74%), is major mineral wastes (65% in 2018), which include wastes from mining and quarrying, construction and demolition. Major mineral wastes were markedly decreased by 35% in 2018 compared to 2008.

Municipal waste generation

- Municipal waste (ordinary garbage) is mainly non-hazardous waste generated from households and similar waste from commerce, administration, education, health services, accommodation, food services and other services and activities.
- Municipal waste is of a highly mixed nature due to its composition, distribution among many sources, direct proximity to citizens, very high public visibility, and link to consumption patterns and economic wealth. It consists of everyday items used and then thrown away (product packaging, grass clippings, furniture, clothing, food scraps, newspapers, appliances, paint, batteries). Kitchen waste represented ¼ of municipal waste in the EU-27 in 2012, and paper and board waste 18% (Valavanidis and Vlachogianni, 2015).

Packaging waste generation per category





* There are no data for the Netherlands, Denmark, Malta and Romania

Source: Eurostat

Greece consumes over 110 plastic carrier bags per inhabitant or a total of 1.2 billion bags per year, which accounts for nearly 3% of total usage in the EU-27.

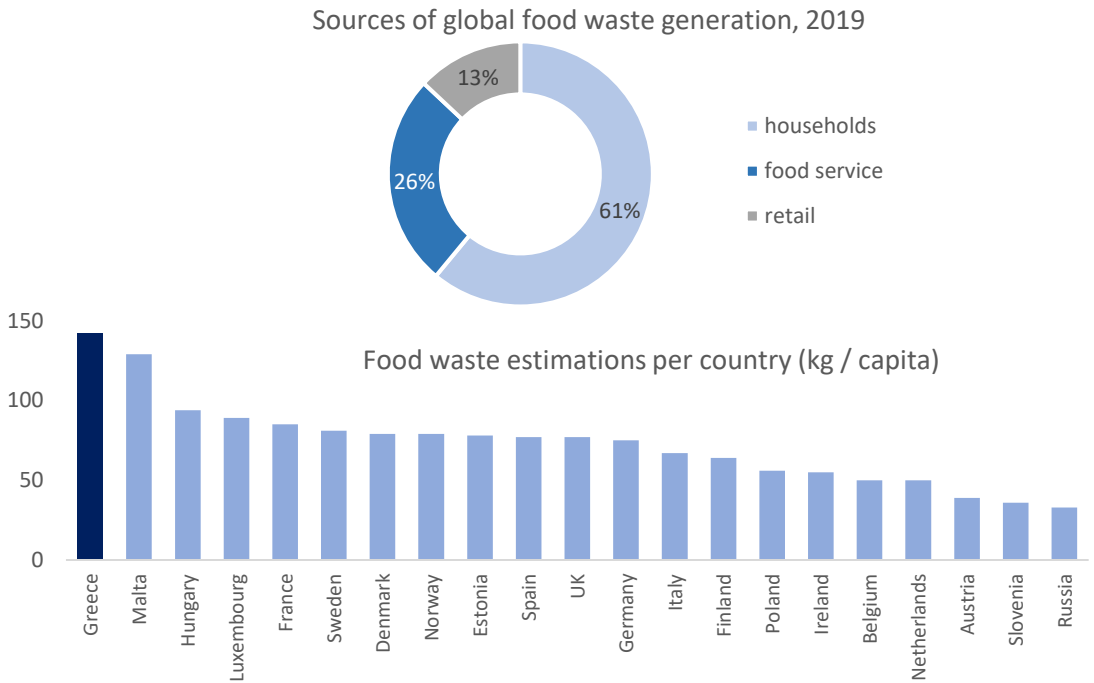
Packaging waste generation

- Packaging waste includes all materials used for the "containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer, excluding production residues" (Eurostat). There are five main categories of packaging waste: paper and cardboard, plastic, wooden, metallic and glass packaging.
- Packaging waste declined in 2009 in Greece and the EU-27 due to the outburst of the financial crisis. By 2018, packaging waste in Greece was cumulatively decreased by 22% compared to 2008, while on the contrary in the EU-27, it increased by nearly 10%. All generated packaging waste per category in Greece was diminished, while the largest decrease was recorded in steel (-45%) and glass packaging (-35%) during the period 2008-2018.
- The most common type of packaging waste, both in Greece and the EU-27, is paper and cardboard packaging, representing 44% and 41%, respectively, of the total packaging waste generated in 2018. The second largest category in Greece is plastic packaging (25% in 2018), followed by glass packaging (13%), steel packaging (8%), wood packaging (7%) and aluminum packaging (3%).

Usage of plastic carrier bags

- Among the ten most consumed items of plastic packaging types in Europe are plastic carrier bags with a wall thickness below 50 microns, which are usually used only once and then are thrown away. In 2019, over 41 billion plastic carrier bags were consumed in the EU-27, indicating an inadequate turn away from plastic usage.
- In per capita terms, Greece consumed 111.5 plastic bags per inhabitant (2018), standing above the EU-27 average (92.8 bags per inhabitant). Lithuania and Latvia present the highest per capita use (332 and 284 bags per inhabitant respectively). In absolute numbers, Greece consumed 1.2 billion bags, accounting for 3% of the total usage in the EU-27. Spain, France, Italy and Germany, although they are not among the largest per capita users. consume 61% of the total plastic bags in the EU-27.

Food waste and e-waste generation



Source: United Nations Environment Programme, Food Waste Index Report 2021

Waste electrical and electronic equipment (WEEE)

- E-waste or WEEE includes electronic materials and components, and it can contain substances that pose a threat to the environment and human health. E-waste collected in 2018 in Greece mainly consisted of large household appliances (68%), followed by consumer equipment (13%), IT and telecommunications equipment (9%), small household appliances (4%) and lighting equipment (3%).
- The WEEE collected in Greece originates from the following sources: municipalities (1.5%), retailers (22%), scrap dealers (69%), and other companies (7%) from public and private sectors (Balde et al, 2020).

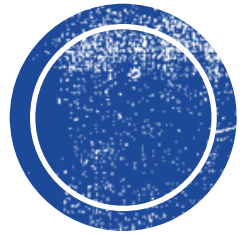
Food waste generation has become a major problem in western societies, calling for a quick solution via food donation encouragement and facilitation.

Food waste generation

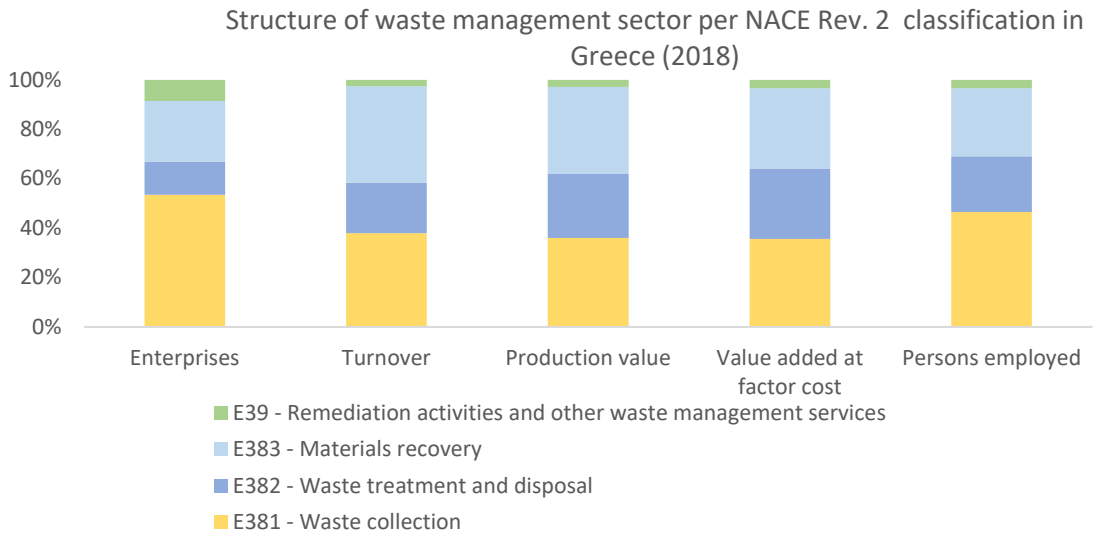
- Food waste is defined as ''the waste generated in the production, distribution and consumption of food'' (Eurostat), while its elimination has become a priority of circular economy as it is associated with pressure on natural resources, the environment and climate change.
- The United Nations Environment Programme (UNEP) has developed the Food Waste Index, which gives insights into food waste and provides a methodology for countries to track progress in meeting the United Nations Sustainable Development Goal target by calculating country-level food waste estimates. The Sustainable Development Goal aims to reduce food loss along production and supply chains, as well as per capita food waste generation at the retail and consumer level by 50% by 2030.
- According to the UNEP Food Waste Index Report 2021, 17% of total global food production from households, food service activities and food retail is potentially wasted. Global food waste in 2019 was estimated at 931 million tonnes, generated mainly from households (61%), followed by food service activities (26%) and food retailers, such as supermarkets (13%).
- Among the 21 participating European countries in this index, Greece records the largest food waste index (142 kg/capita), followed by Malta (125 kg/capita). This implies that on average, a Greek household or food service activity throws away the largest per capita quantities relative to the other European countries. According to Abeliotis et al (2015), 30 out of 100 kg of food waste per capita that is generated annually in Greece is avoidable.
- Regarding the impact of food waste on the environment and climate change, it has been estimated that 8-10% of global GHG emissions are associated with food that is not consumed. It has been indicated that if food waste was a country, this would be the third biggest source of GHG emissions in the world (UNEP, 2021). In Greece, food waste is associated with 5.3% of GHG emissions, while regarding its treatment, 98% of it is landfilled, i.e. thrown away as common garbage (Abeliotis et al, 2015).

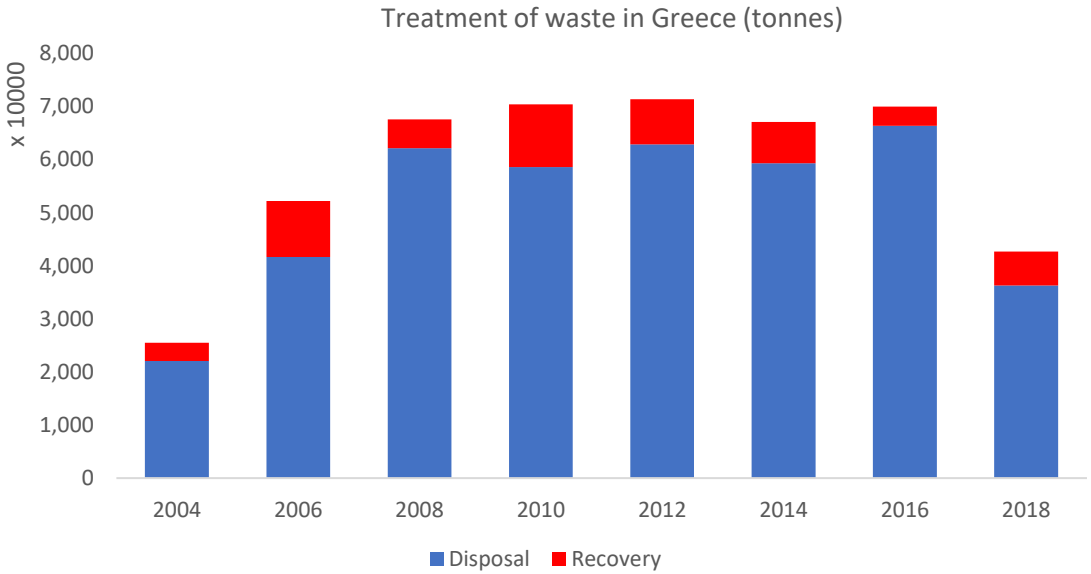
ALPHA BANK

Waste management operations and recycling



The waste management sector



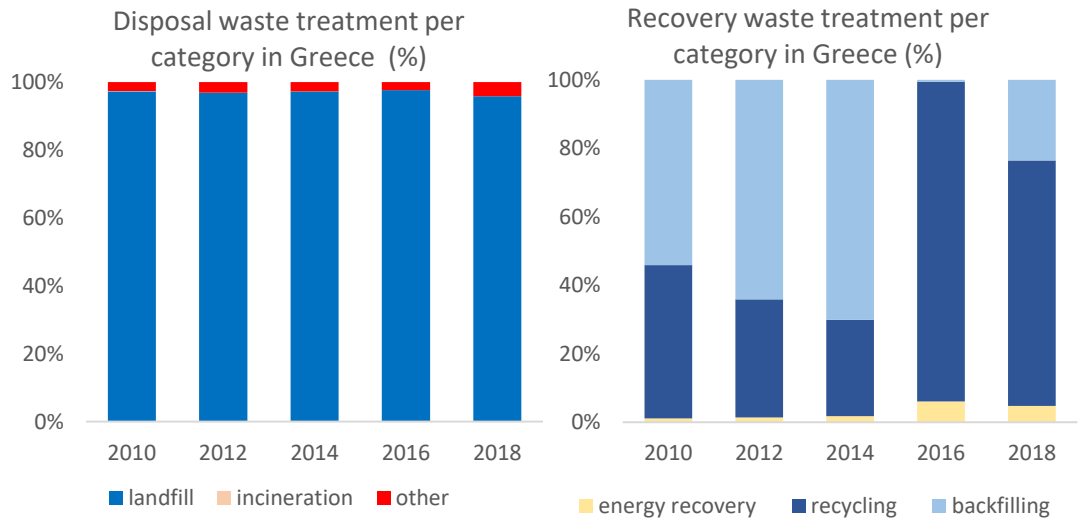


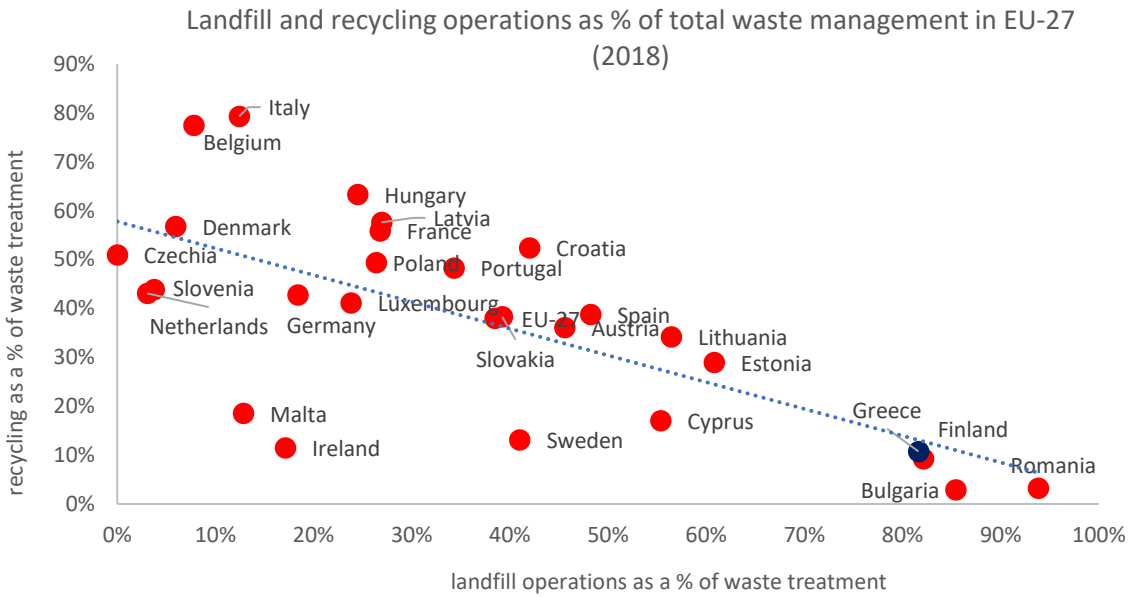
Source: Eurostat

Waste management or waste treatment refers to the ways, actions and processes with which waste is handled, collected, transported, treated and disposed of after being generated.

- Disposal and recovery of waste are the two main processes of waste treatment. According to the EC Waste Framework Directive 2008, waste recovery includes operations involving waste that is reprocessed into products, materials or substances to be reused either for their original purpose or for other purposes. As such, recovery of waste refers to more environmentally friendly forms of waste treatment and includes recycling, backfilling and energy recovery.
- Any operation which is not recovery is disposal of waste. The latter includes landfill, incineration and other forms of treatment (e.g. land treatment, deep injection, surface impoundment, release into a water body including seas and oceans).
- Waste management as an economic sector is defined by the following NACE Rev. 2 subsectors: a) sector E381 of Waste collection, b) sector E382 of Waste treatment and disposal, c) sector E383 of Materials recovery and d) sector E39 of Remediation activities and other waste management services. In some cases, sector 46.77 of Wholesale of waste and scrap is also included.
- Waste management is a relatively small sector: the above four subsectors constitute 0.5% of the value added of the Greek industry, 0.8% of its employed persons, 0.4% of its turnover and 0.7% of its enterprises (2018). Waste collection operated 476 enterprises in 2018, with nearly 3.5 thousand persons employed, being also the largest subsector in terms of valued added and turnover. Materials recovery is the second largest subsector of waste management: in 2018, it accounted for nearly 2 thousand jobs and 219 enterprises.
- Waste treatment affects resource efficiency, i.e. the containment of the environmental impact from producing and consuming goods, from the stage of raw material extraction to the stage of waste treatment. While the most effective way to reduce the environmental impacts of waste generation is waste prevention, improving resource efficiency by reusing waste and extracting resources from it under circular economy principles helps to contain or even eliminate it.

Treatment of waste by management operation



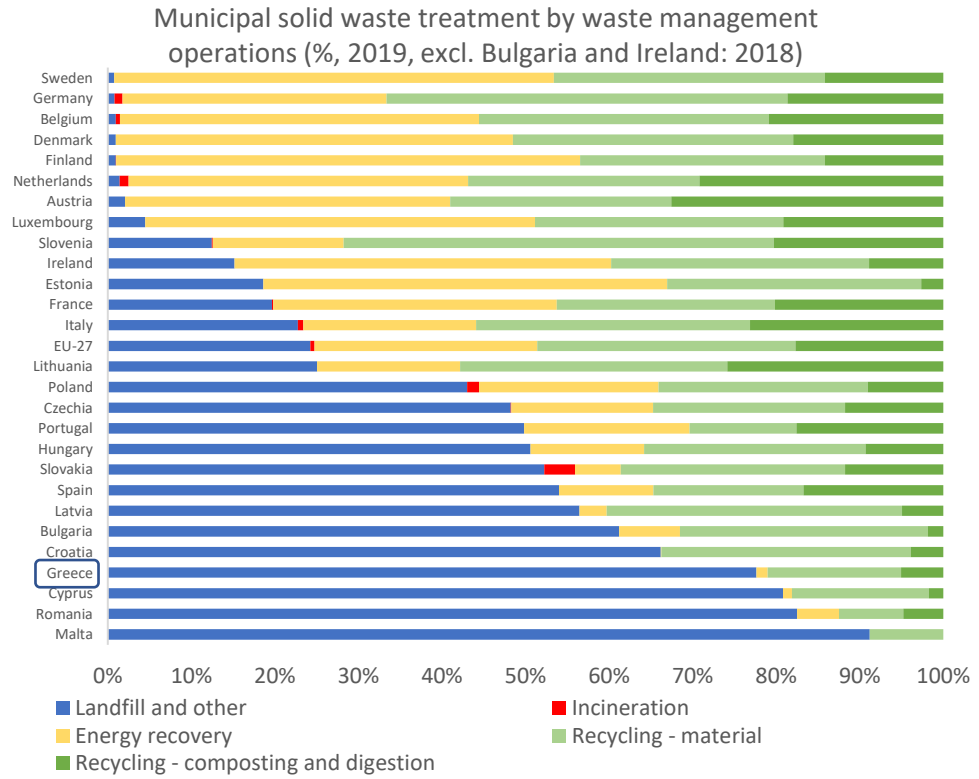


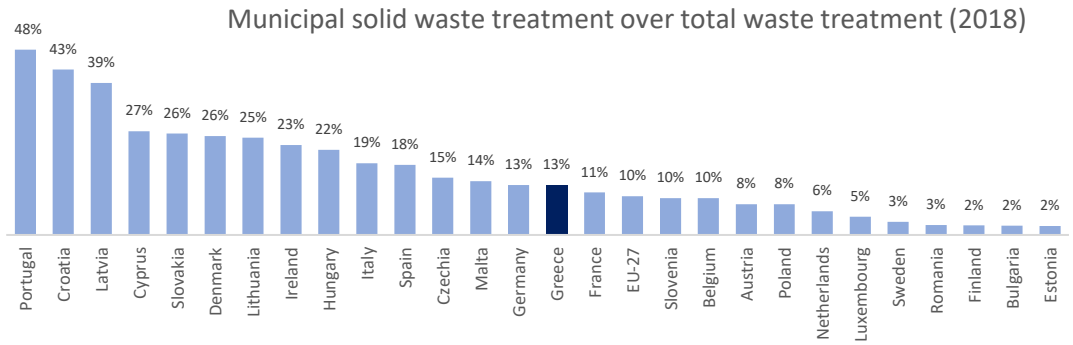
Source: Eurostat

Greece is a straggler among European countries in waste treatment processes related to circular economy, such as recycling.

- The waste treated in Greece amounted to 42.7 million tonnes in 2018 or 94% of the waste generated over the same year, cumulatively reduced by 39% between 2010 and 2018. Disposal of waste accounted for 85% of total waste treatment and waste recovery for only 15% (2018). Contrary to the EU-27 averages (45% and 55%, respectively), the small recovery rates in Greece imply a far narrower use of circular economy principles in waste treatment.
- Waste disposal in Greece consists mainly of landfilling operations (96% in 2018). Landfills are engineered pits for waste burial with various layers, lined and sealed at the bottom in order to prevent groundwater pollution. A properly functionable landfill requires well-designed operations and a large area for its construction, since it can fill up quickly and be a source of high pollution when functioning as an open dump.
- Greece is among the EU countries that rely heavily on landfilling operations for waste treatment: 82% of waste ends up in landfills, the highest share after those of Romania (94%) and Bulgaria (85%), and the same as that of Finland. On the contrary, countries like Czechia, Slovenia or the Netherlands, use close to zero waste burial procedures.
- There are still over 50 non-legal disposal sites (dumps) operating in Greece that must be shut down, of which 22 are on the islands and 21 in Peloponnese (WtERT, Material and Energy Recovery). Other forms of waste disposal constitute 3% of total waste treatment in Greece, while incineration, an environmentally harmful source of air pollution, has a rather limited share (0.02%).
- Recovery waste treatment, on the other hand, consists of a) recycling, i.e. the process of converting waste into materials that can be reused, b) backfilling, which is ''the use of waste in excavated areas for the purpose of slope reclamation or safety, or for engineering purposes in landscaping'' (Eurostat), and c) energy recovery, in which waste is used as a fuel to generate energy.
- Recycling in Greece, although increased since 2016, accounts for only 11% of waste treatment (2018), far behind the EU-27 average (38%), rendering the country a laggard in waste treatment consistent with the circular economy principles.

Municipal solid waste management



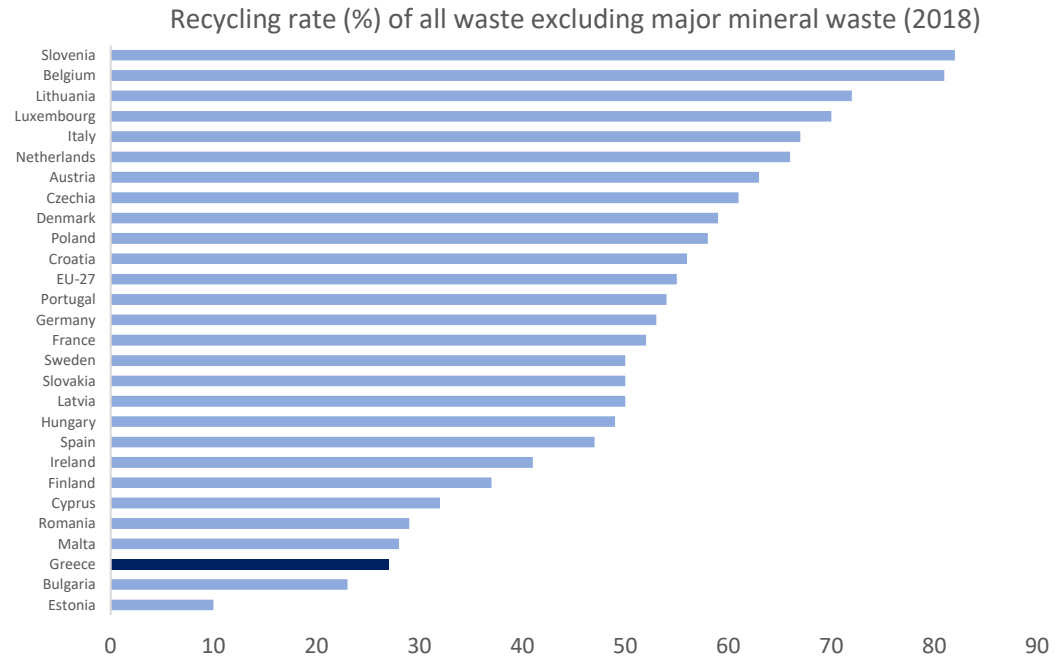


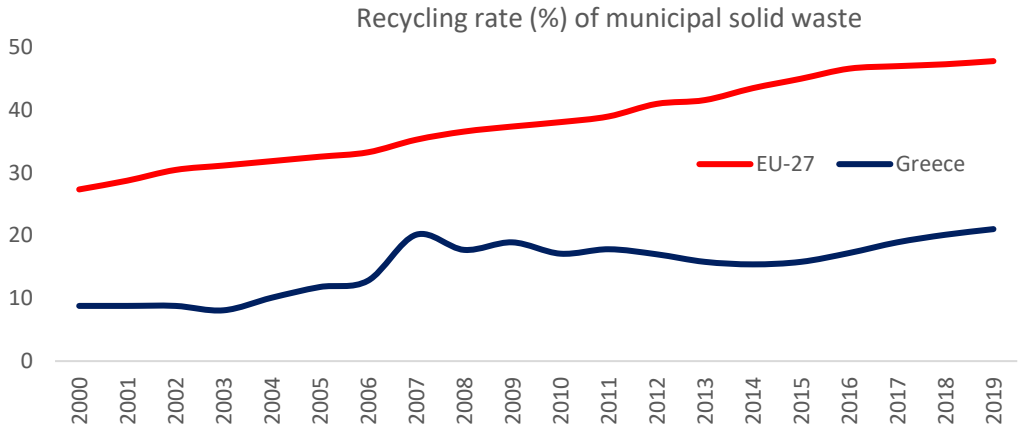
Source: Eurostat

Although its share in municipal solid waste treatment is slightly reduced, since that of recycling is increased, disposal in landfills remains the prevalent form of municipal waste treatment in Greece.

- Municipal solid waste treatment in Greece includes landfilling and other disposal operations, as well as energy recovery and recycling, in the form of material recycling, composting and digestion. A large share of the country's municipal waste is still treated in landfills, underscoring the fact that waste management is recognized as one of the major concerns in Greece's environmental performance and compliance with the circular economy principles.
- During the period 2009-2019, municipal solid waste treatment increased cumulatively by 9%, whereas in 2019 it amounted to 5,613 thousand tonnes. In Greece, all municipal waste that is generated is also treated. Municipal solid waste management operations represent 12% of total waste management operations (2018), contrary to countries such as Portugal (48%), Croatia (43%) or Latvia (39%), in which the ratio of municipal to total waste is significantly higher.
- Germany exhibits the largest amount of municipal solid waste treatment (over 50 thousand tonnes), followed by France and Italy, while Greece, despite its much lower population, ranks 7th among EU countries. In per capita terms, Greece ranked 10th in 2018 among the EU-27 countries, with 515 kg/capita of municipal waste treated. Denmark (812 kg/capita), Luxembourg (803 kg/capita) and Malta (617 kg/capita) had the highest per capita ratios, while Latvia (351 kg/capita), Poland (329 kg/capita) and Romania (264 kg/capita) had the lowest.
- Although there has been an increase in municipal waste generation over the years, the ratio of municipal waste treated in landfills has been reduced, implying less disposal and more recycling. However, as with total waste treatment in Greece, the largest part of municipal solid waste is treated in landfills and other forms of disposal (78% in 2019 from 88% in 2005), and only 21% is recycled (from 12% in 2005).
- On the contrary, Slovenia (72%) and Germany (67%) exhibit the highest recycling rates, while countries such as Finland (56%) and Sweden (53%) are using energy recovery as a main option for municipal waste treatment.

Recycling of municipal waste and all waste excluding major mineral waste





Source: Eurostat

Recycling reduces the consumption of raw materials and the use of energy, and thus contributes to the reduction of greenhouse gas emissions.

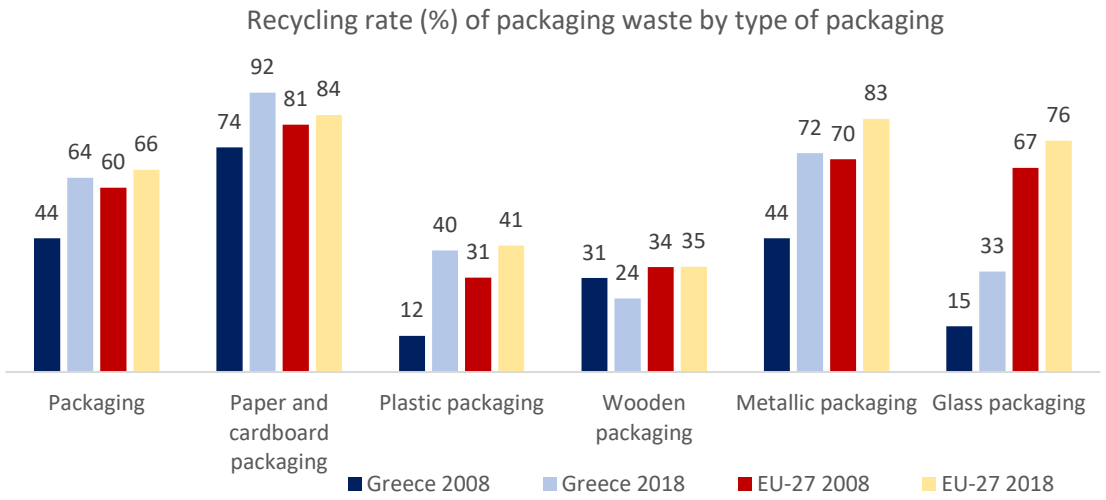
Recycling of all waste excluding major mineral waste

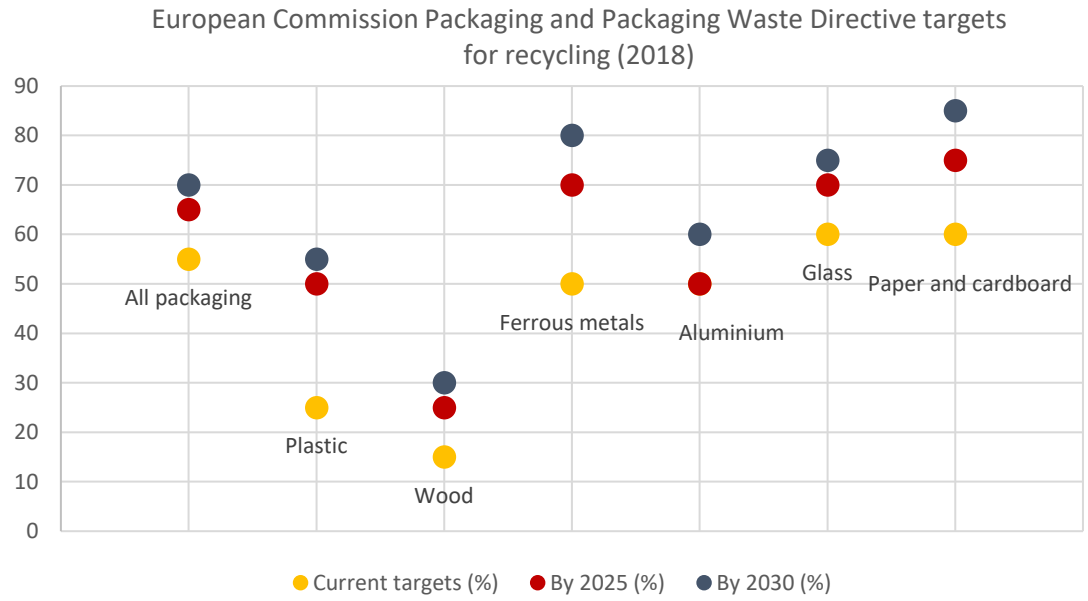
- Recycling rates are a measure of the circular economy that shows the degree to which waste is used as a resource and fed back into the economy. The recycling rate for all waste excluding mineral waste is a significant circular economy indicator, more easily comparable across countries, since it includes all hazardous and non-hazardous waste, but excludes mineral waste. In countries such as Greece, in which mining and construction are main economic activity drivers, mineral waste is usually a source of significant waste production.
- The recycling rate of all waste excluding major mineral waste in Greece is substantially lower than the EU-27 average: in 2018, it stood at 27%, placing the country in 25th position, after Estonia and Bulgaria. Slovenia ranks first in recycling, with 82% of total treated waste excluding major mineral waste being recycled. The EU-27 average stood at 55% in 2018.

Recycling of municipal solid waste

- Recycling of municipal solid waste, another important circular economy indicator, includes material recycling, composting, i.e. the biological process of decomposing solid waste, and anaerobic digestion, i.e. the biological process that breaks down organic matter. The EU-27 average recycling rate of municipal solid waste in 2019 stood at 48%, while the EU target by 2035 is set at 65% (EEA, 2020).
- Greece has the 4th lowest municipal solid waste recycling rate in the EU-27. Although it more than doubled from 9% in 2000, to 19% in 2009, it has since remained at low levels. In 2014, it was reduced to 15%, only to slightly climb up to 21% in 2019.
- The “blue bin” scheme of municipal solid waste recycling in Greece has been operating systematically since 2001, while in 2018, it engaged 35 Recycling Sorting Centers (Sikalidis and Emmanouil, 2019). Recycling of municipal waste in Greece started to increase after the Mechanical Biological Plants (MBT) were put in operation in the period 2004-2007. MBTs are waste processing facilities which separate recyclable from non-recyclable waste and use biological treatment (EEA, 2016).

Recycling of packaging waste





Source: Eurostat

Recycling of packaging waste includes various types, such as plastic packaging, which in certain forms can take up to half a millennium to degrade naturally if it is not recycled.

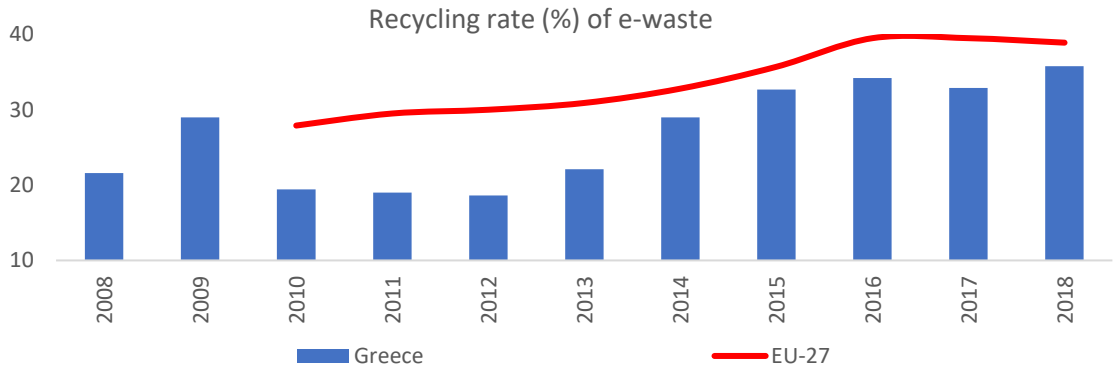
Packaging recycling

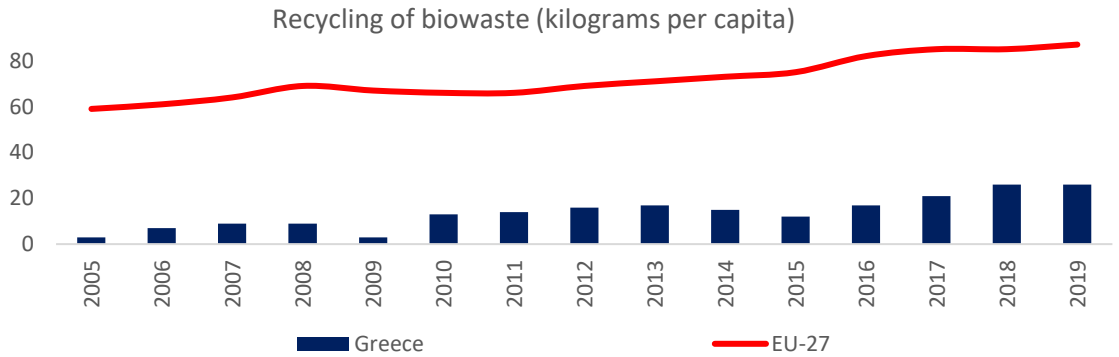
- The recycling rate of packaging waste is a circular economy indicator, defined as the share or recycled packaging over all packaging waste. High-quality recycling presupposes the separate collection of packaging waste (EC, 2020). This indicator monitors the progress of the packaging recycling rate targets set by the EC Packaging and Packaging Waste Directive (PPWD 94/62/EC), which covers all packaging design and waste management. The targets are revised frequently, currently set at 70% by 2030 for all packaging.
- The recycling rate of packaging waste in Greece has increased significantly over the years and reached the levels of the EU-27 average: in 2008, only 44% of all packaging waste was recycled, while by 2018, this indicator increased to 64%. In the EU-27, the packaging waste recycling rate stood at 60% in 2008 and rose to 66% in 2018.
- Of the main packaging waste categories, paper and carboard, the largest category, records the highest recycling rate in Greece as well as in the EU-27, standing at 92% and 84%, respectively, in 2018.

Plastic packaging recycling

- Plastic packaging, although the second largest packaging waste category, exhibits relatively lower recycling rates compared to other categories. However, it has increased over the years (to 40% in 2018 – close to the EU average – from 12% in 2008. This indicator reflects the necessity for reduction in the usage of plastic bags and the increase of plastic packaging recyclability.
- Plastics can be recycled into various items, such as bags, recycled plastic packaging, car components, furniture, building materials and so on. The 2018 update of the 1994 EC PPWD includes target revisions for the plastic packaging recycling rate to 50% by 2025 and 55% by 2030, in order to align with circular economy objectives to reduce plastic waste that can take up to half a millennium to degrade naturally.

Recycling of e-waste, biowaste, end-of-life vehicles and batteries





Source: Eurostat

Recycling of end-of-life vehicles and batteries

- Recycling of end-of-life vehicles reflects how much of "old scrap" vehicles is recycled. In all European countries, this ratio is relatively high: the EU-27 average stood at nearly 75% in 2018, while that of Greece was slightly higher, at 82%.
- Greece recycled 21 thousand tonnes of lead batteries in 2018. Out of the sold portable batteries and accumulators in 2018 (1.6 thousand tonnes), only 34% was collected for recycling, representing the 4th lowest recycling rate among the EU-27 countries.

Recycling of e-waste, biowaste and end-of-life vehicles are three significant indicators of circular economy that reflect how much of these waste streams are recycled and reused.

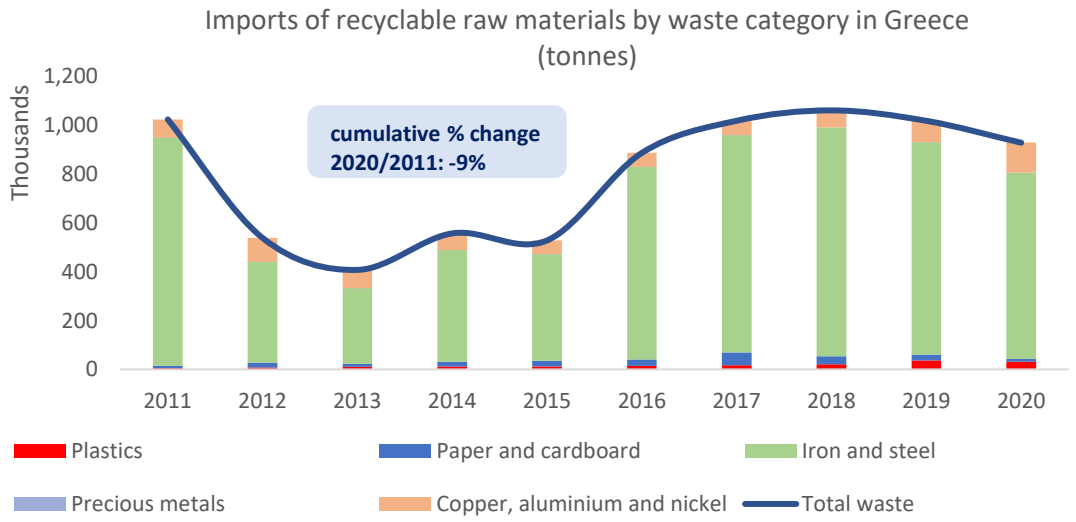
Recycling of e-waste

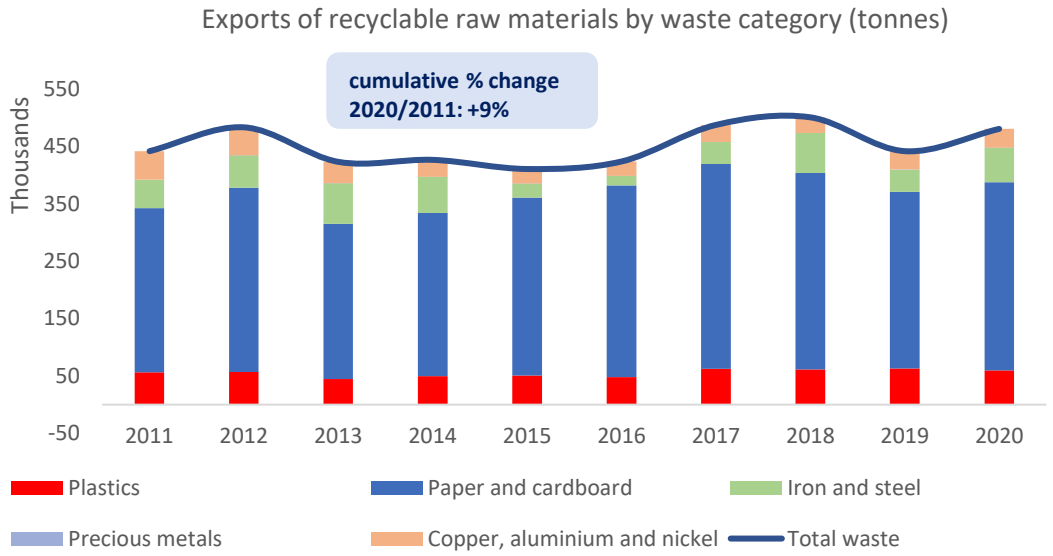
- The recycling rate of e-waste or WEEE (waste of electrical and electronic equipment, such as computers, televisions, fridges and mobile phones) is another circular economy indicator. It shows how much of e-waste, one the fastest increasing waste streams, which also includes precious materials, is reused and recycled.
- The EU-27 is the world leader in e-waste recycling, with a rate of 39% in 2018. Greece, although relatively close to the EU average (36% in 2018), ranks 21st among the other European countries. The country has made some progress over the last decade in increasing its WEEE recycling, since in 2010 the respective rate stood at only 19%. Recycling and preparing for reuse is the major treatment method of e-waste, making up 81% of e-waste management in Greece (2018), close to the 82% European average.

Recycling of biowaste

- Recycling of biowaste is a circular economy indicator, measured as the kg per capita ratio of composted/methanised municipal waste over the total population. Biowaste materials that can be recycled include sludges, manures, food scraps and so on.
- Biowaste recycling comprises an important recycling procedure of municipal waste, since biowaste is the largest component of municipal waste (34% is the EU-27 average). Greece stands far below the EU-27 average (87 kg/capita) in terms of biowaste recycling: in 2019, the ratio stood at 26 kg/capita, although it has increased significantly since 2005 (3 kg/capita).
- The recycled output of biowaste materials are compost and digestates, soil improving materials and fertilisers, as well as biogas, which is a renewable energy source. The basic treatments of biodegradable materials, including organic waste, such as food and garden waste, are aerobic composting and anaerobic digestion.

Trade in recyclable raw materials





Source: Eurostat

Trade in recyclable raw materials is an indicator that measures the quantities of imported and exported selected waste categories and by-products per country that are recycled and refed into the economy as secondary raw materials, i.e. raw materials originating from waste.

Imports of recyclable raw materials

- Imports and exports of recyclable raw materials include five classes of materials: a) plastic, b) paper and cardboard, c) precious metals, d) iron and steel, e) copper, aluminum and nickel.
- From these classes of recyclable raw materials, Greece imports mainly iron and steel: these two materials make up 82% of its total recyclable materials imports. The second largest import category is copper, aluminum and nickel (13%) and a small percentage is recyclable plastics (3%).
- Total imported recyclable waste in Greece reached 929 thousand tonnes (or EUR 508 mn) in 2020, cumulatively reduced by 9% compared to 2011. Greece's recyclable material imports account for only 1.5% of the total EU-27 imports. Moreover, 70% of the selected recyclable materials in Greece originate from non-EU countries, with 30% being intra EU-27 imports.

Exports of recyclable raw materials

- The exports of Greece in terms of the recyclable raw materials include mainly paper and cardboard (68% in 2020), but also plastics (12%), iron and steel (12%) and a small amount of copper, aluminum and nickel (7%).
- Total exports of these materials waste and by-products reached nearly 480 thousand tonnes in 2020 (or EUR 145 mn), implying that the country' s exports of recyclable materials amount to nearly half its respective imports.
- All selected raw material exports have been cumulatively increased by 9% since 2011, representing 0.5% of the total EU-27 exports of these materials. Greece exports 54% of its raw materials waste and by-products to the EU-27 countries, with the rest being exported to countries outside the EU.

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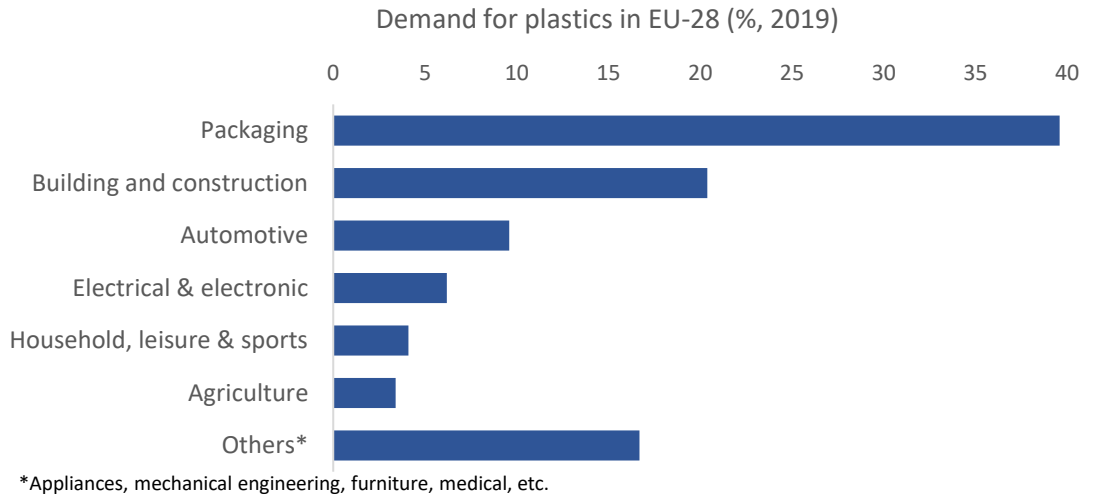
Applications of the circular economy in various economic sectors

Packaging and plastics: waste and environment

Although plastic products are widely used thanks to their adaptability, they also create considerable environmental problems due to the vast amounts of waste they generate, a large proportion of which ends up in oceans as plastic litter.

- Global plastics production has increased 20 times in the last 50 years and is expected to double in the next 20 years. Plastic is a significant and widespread material of low cost for everyday life with many functions and, largely made of oil: 90% of plastic feedstock is oil. This represents 6% of global oil consumption, which is expected to skyrocket to 20% by 2050 (Smart Prosperity Institute, 2021). The production of plastics has increased due to economic growth, rising population and growing urbanization.
- Globally, only 14% of total plastic waste is recycled, a share significantly lower than that of the EU, where 1/3 of total plastic waste is recycled, 25% is landfilled and 43% goes to energy recovery, i.e. fuel combustion in waste-to-energy facilities (Smart Prosperity Institute, 2021).
- In the EU, 40% of plastics demand is for packaging (2019), which also accounts for 61% of plastic waste (Plastics Europe, 2020). Building and construction consume 1/5 of total plastic demand, and nearly 10% is used by the automotive sector. Electrical and electronic devices, as well as household leisure and sports commodities account for another 10% of total plastic demand.
- In terms of plastics pollution, over 150 million tonnes of plastics, most of which is plastic packaging, have ended up in the oceans. Over the last years, 8 million tonnes of plastic are annually thrown in the maritime environment, a number which is expected to double by 2030 and quadruple by 2050 (Smart Prosperity Institute, 2020). Although EU countries are responsible for a small fraction of the annual plastic litter found in the oceans (around 4%), the majority of this ends up in "particularly vulnerable" areas, such as the Mediterranean Sea and the Arctic Ocean (EC, 2018). According to the Ellen MacArthur Foundation (2021), ''there could be more plastic in the ocean than fish by 2050 (by weight).''
- One out of two of pieces of plastic waste in the ocean is a single-use plastic product, which is ''typically intended to be used just once or for a short period of time before being disposed of'' (EC, 2019). The 10 most frequently found single-use plastic items on European seacoasts are cotton bud sticks, cutlery, plates, straws, stirrers, balloons, sticks for balloons, food and beverage containers, beverages cups, cigarette butts, plastic bags, packets and wrappers, wet wipes and sanitary items. These items account for 70% of EU marine litter. Plastic bags for example usually need centuries to fully decompose and, in the meantime, can be swallowed by animals or are break down into microplastics (below 5mm in size) accumulated in the sea and pass into the human and animal food chain.
- More recycling and less plastics use is the only answer to this problem: the Ellen MacArthur Foundation (2020) reports that global demand for recycled plastics increased by 17% between 2012 and 2016. In addition, interest in recycling from plastic producers has also intensified. At the same time, there has been a customer turn to reusable plastics from single-use plastics, as well as customer pressure regarding plastic pollution. In the USA for example, reusable plastic packaging for new products is forecasted to be among the fastest growing packaging types (Ellen MacArthur Foundation, 2020).



*Appliances, mechanical engineering, furniture, medical, etc.

Source: Association of plastics manufacturers, Plastics Europe 2020

Packaging and plastics: best circular practices

The European Strategy for Plastics in a Circular Economy (2018) stipulates that by 2030 all produced plastics must be reused, recycled or composted in a cost-effective manner and focuses on promoting various innovations for recyclable plastics.

Packaging

- The EU has adopted special policies for all types of packaging waste since 1994, such as Directive 94/62/EC, a new revision of which is planned to be released in 2021. According to the new Circular Economy Action Plan (2020), the adoption of circular economy principles for packaging waste is feasible by ensuring that all waste is reusable or recyclable in an economically viable way by 2030.
- EU policies aim to ensure a high level of environmental protection and focus on the reduction and more circular treatment of packaging waste, the design of reusable and recyclable packaging and the decrease of the complexity of packaging materials. Furthermore, they set specific targets for the preparation for reuse and recycling of total packaging waste and of various packaging waste types, such as plastics, wood, ferrous metal, aluminum, glass, paper and cardboard for 2025 and 2030.

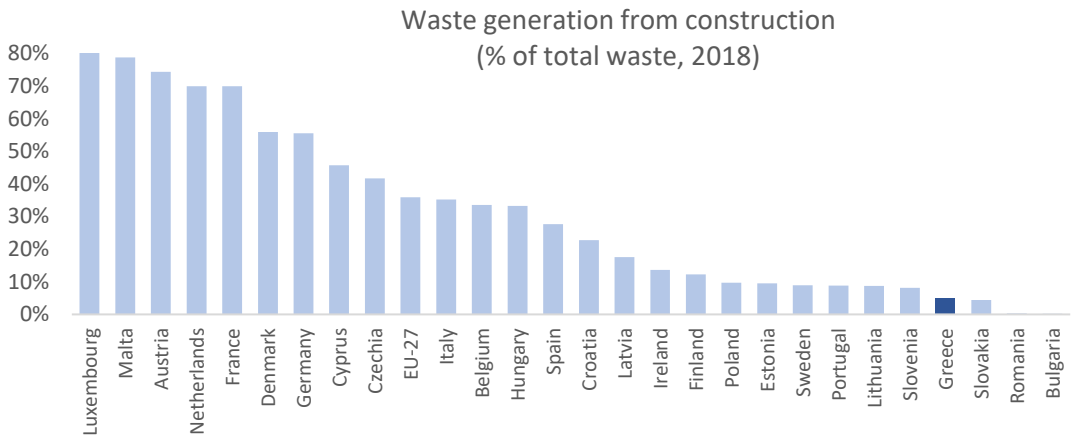
Plastics

- Innovation in plastics can contribute to the improvement of plastics' recyclability and the creation of new types of plastics. Globally, many plastic manufacturers invest in innovation and circular economy to address the higher demand for plastic and the increasing concerns about plastic waste and ocean pollution. In order to prevent plastics waste and apply circular economy principles in their production and use, plastics should be treated as valuable material resources.
- Optimization of resources use by channeling plastic products through reusable packaging platforms and the maintenance and repair of plastic products is among the practices that serve this purpose. In addition, eco-design is a strategy for lower resource consumption in plastics via a) research in plastics made from carbon resources using carbon capture technology, b) combining recycled resins with virgin resins in plastic production and c) use of polymers that can be infinitely repurposed (Smart Prosperity Institute, 2021).
- In 2018, the New Plastics Economy Global Commitment was launched by the Ellen MacArthur Foundation in collaboration with the UN Environment Programme. Its signatories represent over 20% of the global plastics production and include businesses, governments and other organisations, united ''behind a common vision for a circular economy for plastics in which plastics never become waste''. The Association of the Greek Manufacturers of Packaging & Materials is among these signatories.
- The EU adopted the European Strategy for Plastics in a Circular Economy in 2018, which will contribute to achieving the 2030 Sustainable Development Goals, the objectives of the Paris Climate Agreement and the EU industrial policy. This strategy is based on the forecasted increase in plastic consumption and the urgency to tackle plastic pollution, especially of the marine environment. Moreover, the EU Action Plan for Circular Economy (2020) prioritizes the necessity for circularity in the way plastics are produced, used and discarded.

Single-use plastics

- The EU has set a target of 77% by 2025 and 90% by 2029 for the separate recycling collection of single-use plastic product waste (Directive 2019/904). In addition, single-use plastic products for which there are sustainable, easily available and affordable alternatives (such as cotton bud sticks, cutlery, plates, straws, stirrers, sticks for balloons), but also food and beverage containers from expanded polystyrene and all single-use plastic products made of oxo-degradable plastic, will be exempted from member countries' markets by 2021.
- Regarding plastic bags, the EU has adopted Directive 2015/720 to deal with unsustainable consumption and use of lightweight plastic carrier bags with a thickness below 50 microns. The Directive requires member countries to take special measures, such as national reduction targets of plastic bags, marketing restrictions (bans) and/or economic instruments (e.g. fees, taxes).

Construction and buildings



Source: Eurostat, Circular economy

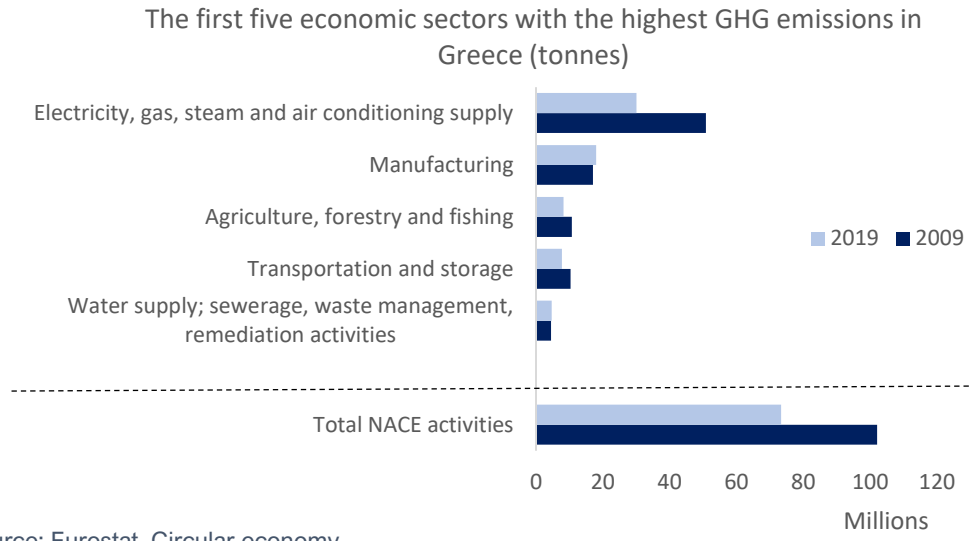
- On a European level, the building and construction sector consumes 50% of the materials consumed by all economic sectors (Norouzi et al, 2021). It is forecasted that by 2060, 1/3 of the global material demand increase will come from this sector (UNEP, 2021).
- Globally, construction and buildings accounted for 36% of energy consumption in 2020 (UNEP, 2021). Energy related CO_2 emissions of the sector represented 37% of total emissions in 2020, down by 17% since 2015, due to energy decarbonization efforts. For 2021, GHG emissions of the sector are expected to rise due to higher construction demand (UNEP, 2021). The Ellen MacArthur Foundation (2019) sees opportunities in circular economy practices to reduce the sector's CO_2 emissions by 38% in 2050.
- In Greece, the share of the construction sector in total GVA is equal to 2% (2019), whereas the waste generated by the sector represents 5% of the total waste (2018), the 4th lowest in the EU-27 (36%), after Bulgaria, Romania and Slovakia. GHG emissions from the sector constituted 0.5% of total emissions in 2019 (EU-27: 2%), down by 52% compared to 2009 (EU-27: -11%).

Energy efficiency of buildings is a key step in efforts to reduce GHG emissions and the use of resources.

Best practices and circular economy objectives

- A leading circular economy practice in the construction sector is to lower resource consumption. A key strategy to achieve this is eco-design applied through a) the design of buildings for disassembly, allowing their components to be reused after dismantling, b) sustainable sourcing of materials, such as the use of wood over steel or concrete, or the use of concrete with lower CO_2 emissions.
- Process optimization is another key strategy that includes practices such as a) just-in-time construction with materials ordered on an as-needed basis and b) modular and prefabricated buildings that optimize material efficiency and minimize waste (Smart Prosperity Institute, 2021).
- Resource use optimization through intensification and maximization of product utilization, via the sharing economy, including sharing tools, materials, information and other assets, and short-term renting is also critical. It is noteworthy that in Europe, 60% of office space is unused during working hours (Smart Prosperity Institute, 2021).
- Circular practices also include the extension of buildings' lifetime and their redesign based on circular principles and guidelines by means of their maintenance, reparation and renovation (Smart Prosperity Institute, 2021).
- Circular economy policies in the construction sector should also focus on the design of cities through city plans which require the construction of new buildings to incorporate circular economy principles. Designing compact cities with buildings that have mixed operations and uses can reduce urban extension and GHG emissions (Ellen MacArthur Foundation, 2019).
- The EC adopted the Renovation Wave Strategy (2020) which includes the principle of "life cycle thinking and circularity" so that buildings are "less carbon-intensive over their full life circle". Government support measures and Directives (2010/31 and 2012/27) on the buildings' energy efficiency and performance supported the increase in energy efficiency investments by 11% in 2020 and 40% since 2015 (UNEP, 2021).

Food and agriculture



Source: Eurostat, Circular economy

- Food production is expected to surge by 70% in 2050 compared to 2005, as a result of markedly higher food demand due to the population growth (Smart Prosperity Institute, 2020).
- The agri-food sector plays a pivotal role in the Greek economy. Agriculture, forestry and fishing contributes 4% to total GVA and 3% to the manufacture of food products, beverages and tobacco products (2019).
- Waste generated from the agri-food sector in Greece accounted for 3% of total waste generation in 2018 (1% from agriculture and 2% from food, beverages and tobacco manufacture), same as that of the EU-27.
- GHG emissions from agriculture, forestry and fishing represented 11% of total emissions in 2019 in Greece, the third largest percentage after those of electricity, gas, steam and air conditioning supply (41%) and of manufacturing (25%). On the other hand, gas emissions from food manufacturing accounted for only 1% of all NACE activities emissions. On a global scale, the agri-food industry produces approximately ¼ of GHG emissions, being the second largest source of emissions after the energy sector.

Large-scale farming and especially livestock farming, is responsible for a significant amount of GHG emissions of carbon dioxide, methane and nitrous oxide, released through animal waste and the widespread use of fertilizers.

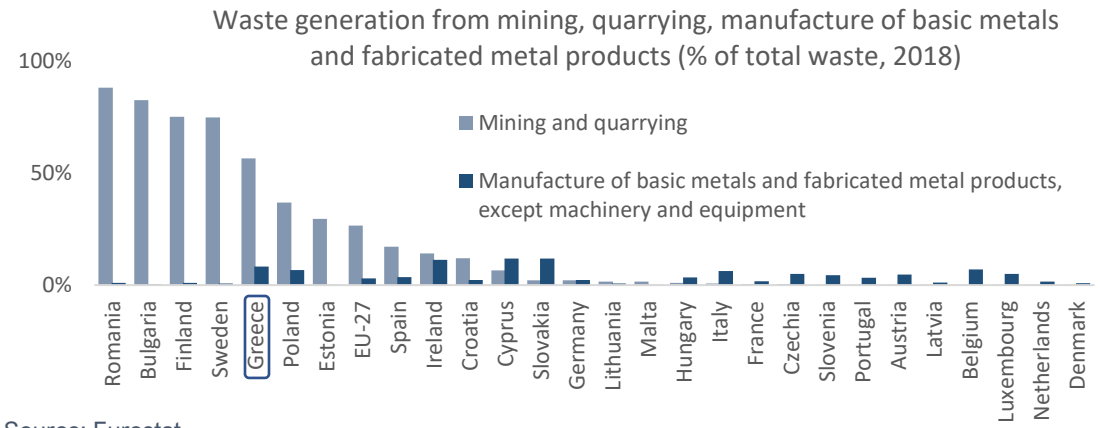
Best practices and circular economy objectives

- Lowering consumption of resources, a circular economy practice for the agri-food sector, can be achieved by a) eco-design, which includes the design of farms that cut down CO_2 emissions and have higher energy efficiency and b) process optimization, which includes the shortening of supply chains to match consumer demand with supply, by avoiding food waste and increasing consumer awareness of sustainable food choices.
- Moreover, product use intensification via a) sharing, donation and reselling of food in surplus and b) long-existing practices of providing “new life” to resources through recycling, composting or energy recovery (e.g., fertilization with manure) can lead to resource optimization (Smart Prosperity Institute, 2020). Food design, which refers to product concept, ingredient sourcing, selection and packaging is also of major importance. Food design is based on using ingredients that are recycled and/or have a lower environmental impact (Ellen MacArthur Foundation, 2021).
- Furthermore, the circular economy for food also focuses on cities, since 68% of the global population is expected to live in cities and 80% of food to be consumed by urban residents by 2050 (Ellen MacArthur Foundation, 2021). Circular economy practices for food in cities can be achieved via municipal programs aimed at the education of city residents on food waste and the creation of relationships with local food producers. Cities developed under circular economy principles and designed to enhance the resilience of urban food systems, can promote local food production, urban hydroponic farms and the use of food waste (Smart Prosperity Institute, 2020).
- The EU member countries can achieve food waste reduction of 30% by 2025 and 50% by 2030 through a) cutting down food waste generation in primary production, processing and manufacturing, retail and other distribution of food, restaurants, food services and households, b) promoting food donation and c) developing food waste prevention programs (EC, 2018/851).

Mining and metal industry

Best practices and circular economy objectives

- The metal industry can play a critical role in the production of green technologies and can contribute the most to the circular economy through best practices and programs, aimed at industrial symbiosis of various mining operations (ICCM, 2016). The use of recovered and recycled metals, residues and waste from mining operations (e.g. mine tailings to produce renewable energy), decreased resource consumption, eco-design strategies and product life extension are among the main circular objectives of the industry (Smart Prosperity Institute, 2020).
- Technology and innovative methods for metal and mineral extraction are crucial for aligning with the circularity principles. The environmental impacts of extraction should be focused upon low-carbon techniques, water conservation, minimization of the produced waste and the use of harmful chemicals (Smart Prosperity Institute, 2020). Best practices also include the short-term rental of extraction equipment that can be designed for reuse, repair or refurbishment, the recovery of mine sites after the completion of all operations, as well as "environmental offsets" in order to counterbalance damages in the surrounding ecosystem.



Source: Eurostat

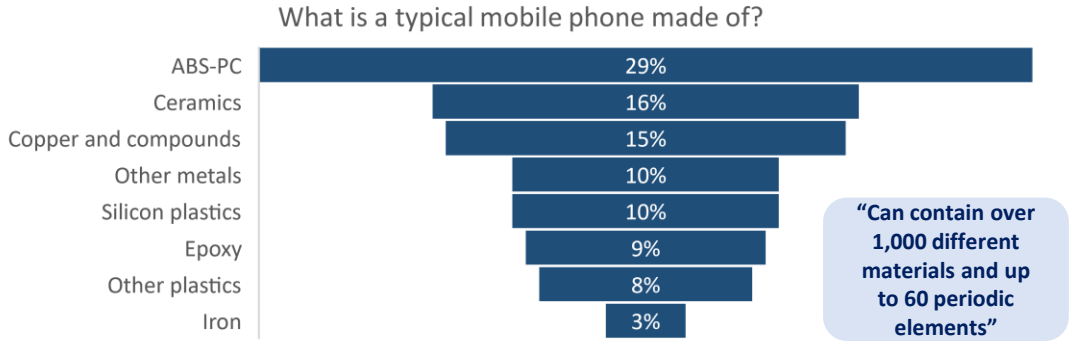
New technologies will enable a) the recovery of valuable waste from the extraction and processing of metals and minerals and b) the use of metals and minerals in various circular applications.

- The mining and quarrying industry and the manufacture of basic metals and fabricated metal products, contributes 1.5% to the Greek GVA (2019) and nearly 10% to exports. At the same time, the sector is responsible for a considerable amount of waste, such as waste rock, emissions, water treatment sludge and leftover waste material (ICCM, 2016). In many European countries, waste generation from mining represents a large percentage of total generated waste, with the EU-27 average standing at 27%. Greece (56%), together with Romania (88%), Bulgaria (82%), Finland (75%) and Sweden (75%) record the largest shares of waste generated from mining. On a global scale, mineral and metal products produce over 100 billion tonnes of solid waste per year and consume large amounts of resources (Smart Prosperity Institute, 2020).
- Some metals and minerals, such as aluminum and steel, exhibit durability, anticorrosion, conductivity and formability properties and thus can be indefinitely recyclable so that their inherent properties are not altered. In Greece, the steel industry uses only scrap as a primary resource for its production (EY, 2016). The demand for metals, minerals and rare earth elements is expected to increase substantially in the future, largely due to their role in the circular economy and their use in green building construction, transportation, electric vehicles and electronics. Mineral and metal production is expected to surge by 250% by 2030 to keep up with demand, and as such it will also increase raw material extraction and waste generation (Accenture, 2020).
- The need of new infrastructure for renewable energy constructions will require large quantities of metals and minerals: special types of steel for the construction of pipes and pipelines, copper, aluminum and graphite for electrical cables, generators and electric motors, various non-ferrous metallic minerals for solar photovoltaic panels and so on. Indicative of the demand for metals for renewable energy constructions are the requirements for a 3-megawatt wind turbine: 335 tonnes of steel, 4.7 tonnes of copper, 1,200 tonnes of cement, 3 tonnes of aluminum, 2 tonnes of rare earths and zinc (Greek Association of Mining Companies).

Electronics

Best practices and circular economy objectives

- The Ellen MacArhtur Institute (2020) refers to various business opportunities in the circularity of electronics and e-waste, which include: a) electronics resale platforms and marketplaces for refurbished electronic devices, b) device repair, maintenance and upgrade, c) recycling and disassembly technologies, d) access-over-ownership business models and e) reverse logistics of electronics and infrastructure for collection and sorting.
- Device-as-a-service (DaaS) supply chain models are also gaining ground in recent years and especially after the outbreak of the COVID-19 pandemic. DaaS models are lease-like models in which consumers and businesses can acquire hardware without the obligation of buying, configuring or managing it. Cloud computing and the Internet-of-Things (IoT) have also supported the dematerialization of the electronics industry. By 2019, DaaS solutions were offered to customers by PC producers with an over 65% market share (from 0% in 2015) (Accenture, 2019).
- The International Telecommunication Union has set the target of the global e-waste recycling rate at 30% by 2023 (from 17.4% in 2019), while large electronics companies, such as Apple, Dell, HP, Samsung, Cisco and various other brands, are elaborating how to increase recycling and reuse of their products, by placing emphasis on eco-design and material efficiency.

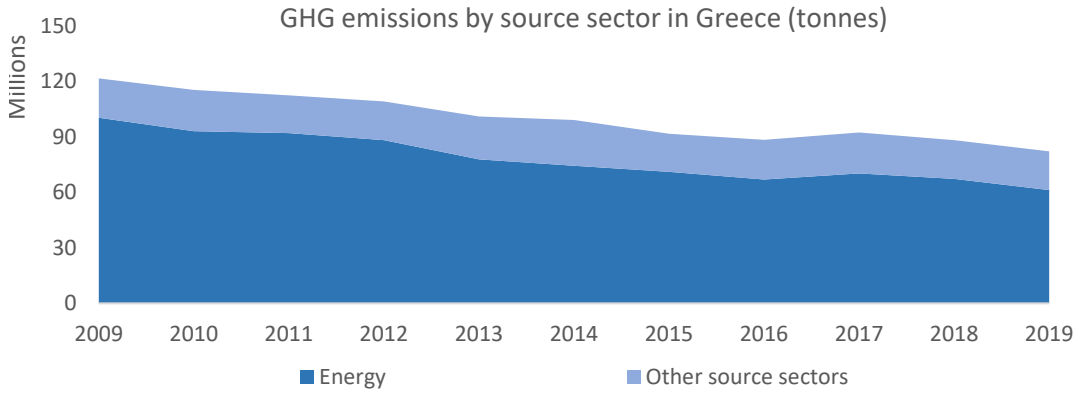


Source: World Economic Forum 2019 and Smart Prosperity Institute 2020

Although e-waste is the fastest growing waste stream with an annual growth rate of 2% and potentially harmful effects for human health and the environment, less than 40% is recycled in the EU.

- Electrical and electronic equipment has a significant environmental impact due to the extraction of raw materials, such as precious and rare earth metals, used for their energy-intensive production. After products reach their end-of-life, vast amounts of e-waste are created, many of which can contain various toxic and hazardous additives and substances (such as mercury, BFR plastics, CFCs and HCFCs). When handled improperly, e-waste can pose a threat to human health and the environment.
- E-waste raw materials' global value in 2019 was over EUR 49 bn (The Global e-waste Statistics Partnership). Over 50 Mt of e-waste are created each year: in 2019, global e-waste generation reached 53.6 Mt or 7.3 kg per capita, of which only 17.4% or 9.3 Mt was collected and properly recycled (Global E-waste Monitor 2020).
- Of the more than 80% of e-waste that is left unrecycled, 4% is thrown away as household garbage and the rest is disposed in landfills, traded or recycled in unsafe ways for human health and the environment (Balde et al, 2020). Moreover, half of global e-waste originates from personal devices, such as cell phones (435 tonnes in 2016) (Smart Prosperity Institute, 2020). However, 2/3 of European citizens would like to continue using their digital devices for longer periods, given that their performance is not largely affected (EC, 2020).
- If no action is taken to further increase the circularity of the sector, e-waste could reach 120 million tonnes by 2050 (World Economic Forum, 2019). Less waste, reuse, refurbishment and proper treatment of e-waste by setting greener targets will support circular economy objectives.
- The EC's "Circular Electronics Initiative" aims to extend product lifetimes and address e-waste challenges by a) providing regulatory measures for electronic devices under low-carbon and eco-design Directives, b) setting electronics as a priority sector for the "right to repair", c) providing options for an EU-based "take back" scheme for old cell phones, tablets and chargers and d) reviewing hazardous substance restrictions on e-waste.

Energy: renewables and net zero goals



Source: Eurostat

Energy related greenhouse gas emissions and net-zero 2050

- Around ¾ of GHG emissions originate from the energy sector worldwide. In the EU-27, this percentage stands at 82% and in Greece at 75% in 2019, although it has decreased cumulatively by 14% and 39%, respectively, relative to 2009. Fuel combustion in energy industries (public electricity and heat production, petroleum refining) account for 39% of total emissions in Greece, in manufacturing industries and construction for 6%, in transport for 22% and in other fuel combustion sectors for 7%.
- Renewable energy sources (RES) play a catalytic role in green transition and circular economy, supporting the decarbonization of the energy sector and reducing GHG emissions from fuel combustion. Therefore, reducing emissions to net-zero up to 2050 and limiting the long-term increase of global temperature to 1.5°C is not feasible without expanding renewable energy.
- Policy measures to achieve that goal include the expansion of RES and the enhancement of energy use efficiency (Oxford Institute for Energy Studies, 2021). Energy storage technologies, such as pumped hydro, batteries, thermal energy or mechanical energy storage, are key to smoothing out energy demand and reducing fossil fuels dependency.

The extensive use of renewables in the energy sector is a circular economy requirement and a prerequisite for achieving climate neutrality by 2050.

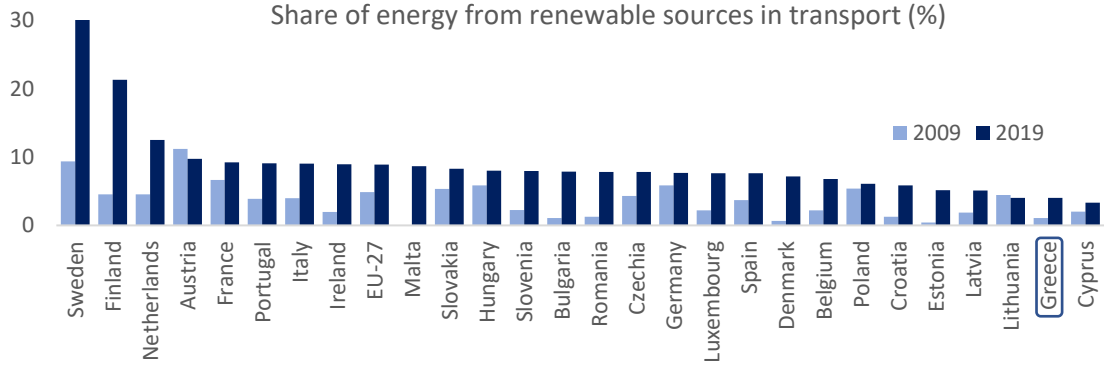
The pandemic effect on energy prices

- The novel pandemic brought about only a short-term reduction in global GHG emissions. Fossil CO_2 emissions (from coal, oil, gas and cement) decreased sharply in 2020 due to COVID-19, but are rapidly rebounding as economies recover, reaching new record highs (Global Carbon Project 2021 and United in Science, 2021).
- As the economy rebounds, another outcome of the pandemic is evident in the surge of energy prices, mainly those of oil, gas and electricity in the second half of 2021. Inflationary pressures from energy prices affect consumers in Europe and thus Greece, posing a potential threat to economic recovery after the pandemic. Rising fossil fuel prices and electricity energy costs are caused by backstops in supply chains and increasing demand, due to low temperatures in the northern hemisphere and forecasts for a particularly cold winter.
- Carbon prices, which incorporate the effects of CO_2 emissions and reflect carbon taxation, the emissions trading systems (ETS) and fuel excise taxes, have also scaled up in 2021. Carbon pricing is a tool for supporting the green transition, as well as cleaner and low carbon investments. The average explicit carbon price in G20 countries (which produce nearly 80% of global GHG emissions) has increased by 128% in 2021, to 4 EUR /t CO_2 (OECD, 2021).

	HICP		Electricity		Natural gas		Liquid fuel		Solid fuel	
	EU-27	Greece	EU-27	Greece	EU-27	Greece	EU-27	Greece	EU-27	Greece
Jan-21	1.2	-2.4	4.0	-0.9	-1.8	-6.0	-17.4	-18.4	0.6	-2.4
Feb-21	1.3	-1.9	2.1	-0.9	-0.9	6.0	-8.1	-10.2	1.0	-2.1
Mar-21	1.7	-2.0	4.0	-0.9	0.4	8.0	5.0	4.7	1.0	-2.3
Apr-21	2.0	-1.1	7.4	-0.9	3.5	9.2	12.5	19.4	0.9	-0.4
May-21	2.3	-1.2	8.0	-0.9	4.1	19.7	22.6	28.9	1.0	0.1
Jun-21	2.2	0.6	8.1	0.7	5.2	37.9	22.3	28.9	1.2	-0.8
Jul-21	2.5	0.7	8.5	0.7	12.6	44.3	25.8	28.9	1.6	-0.6
Aug-21	3.2	1.2	9.3	0.8	14.1	55.8	26.9	28.9	2.0	-0.7
Sep-21	3.6	1.9	10.9	0.8	15.8	66.5	35.6	28.9	3.3	-0.3
Oct-21	4.4	2.8	14.3	18.9	22.4	82.1	52.7	45.9	10.0	0.1

Source: Eurostat, Inflation rates in various energy products

Energy: transport and batteries



Source: Eurostat

Transport

- Transport is a key sector for a sustainable, decarbonized economy and among the sectors that will play a key role in the transition to a circular economy. To achieve that, transport will have to rely increasingly on the use of renewable fuels and electric mobility, but also on a different urban planning, on sharing vehicles, on new vehicle designs for reuse and remanufacturing and on new rules for the end-of-life vehicles.
- RES used in transport (road, water, air, rail) include biofuels blended with conventional fuels, upgraded biomethane and electrification, either through battery electric and plug-in hybrid vehicles or the development of hydrogen fuel cell electric vehicles.
- So far transport is the sector with the lowest penetration of renewable energy. The share of energy from RES gross final consumption in transport stood at 9% in 2019 in the EU-27, increased only by 4 p.p. since 2009. In Greece, although the RES average share was increased significantly to 20% (from 9% in 2009), being equal to the EU-27 average, the share of RES in transport stood at the particularly low level of 4% in 2019.

Electrification of mobility relies heavily on the extensive use of new battery technologies that are also used in consumer electronics and renewable energy storage systems.

Batteries

- Batteries contain various minerals, metals, chemicals and critical raw materials, obtained under mining procedures with harmful effects for the environment. In Europe, over 1.9 million tonnes of battery waste are produced annually, with collection and recycling rates that vary according to the battery category.
- According to global demand projections, demand for batteries is expected to increase substantially until 2030, to over 2,000 GWh (Statista) (from 185 GWh in 2020), due to the rising demand for consumer electronics, but primarily because of the expected surge in transport electrification. Demand for lithium-ion batteries (LIBs), a rapidly growing technology that can be used in portable electronics, electromobility and stationary energy storage systems, is predicted to soar over the next decade, increasing more than 30% per year. Up to mid-century, the needs for electric vehicles and energy storage in the EU will require 60 times more lithium and 15 times more cobalt (European Parliamentary Research Service).
- The new Circular Economy Action Plan (2020) identifies batteries and electromobility to be major sources of the EU's circular economy and climate neutral future. The new regulatory framework for batteries, which is still in progress, will emphasise their importance and role in electric vehicles, portable electronics and the digital economy, as well as the storage of intermittent renewable energy. The objectives of the new legislation are to strengthen the functioning of the internal market, promote circularity and put into place the prerequisites for usage, sustainability, safety, labelling and end-of-life management of batteries.
- The legislative proposal will include various new regulations for batteries such as: rules and measures on the collection and recycling rates, recovery methods for valuable materials produced with the lowest possible environmental impact, gradual withdrawal of non-rechargeable batteries and requirements for the sustainability, transparency and high-performance of batteries along their entire life cycle (EC, 2020).

ALPHA BANK

Regulations of the circular economy and public funding

The European circular economy action plans

The new Circular Economy Action Plan adopted in 2020, following the first Circular Economy Action Plan in 2015, guides the European Union's transition to a circular economy.

Circular Economy Action Plan (2015)

- The EC's policies and strategy related to circular economy were initiated in 2015, based on the "Europe 2020 Strategy for smart, sustainable and inclusive growth", which was adopted in 2010. The Strategy established an agenda for resource efficiency which, together with resource retainment, was a cornerstone for the promotion of circular economy.
- In 2015, the EC developed the Circular Economy Package and published the first Circular Economy Action Plan, which included measures that aimed to a) stimulate the transition of the EU towards circular economy, b) promote sustainable economic growth, c) create new jobs and d) enhance global competitiveness. The plan included 54 actions covering the entire product life cycle, from production and consumption to waste management and the market for secondary raw materials and presented measures in various areas, including plastics, food waste, critical raw materials, construction and demolition, biomass and bio-based products.
- The implementation of the first Circular Economy Action Plan was further supported in 2018 by a set of measures which included a monitoring framework for tracking progress towards a circular economy. When the plan was fully completed in 2019, its actions had already contributed to the acceleration of Europe's transition to a circular economy through more pronounced recycling and reuse of products policies, with various benefits for the environment and the economy.

New Circular Economy Action Plan (2020)

- In March 2020, the EC introduced the new Circular Economy Action Plan, also part of the EU Industrial Strategy, which included 35 actions referring to the entire life cycle of products. The legislative and non-legislative measures introduced by the new Plan aimed at:
  - promoting efforts on circular economy,
  - making sure that resources are used for as long as possible,
  - ensuring the prevention of waste,
  - stimulating sustainable consumption,
  - boosting sustainable products as a norm in the EU,
  - emphasizing the design of new products, and
  - focusing on economic sectors and products that offer high potential for circularity and use large amounts of resources. Among these sectors are electronics and ICT, batteries and vehicles, packaging, plastics, textiles, energy, construction and buildings, and food, water and nutrients.
- Moreover, in the new Circular Economy Action Plan, the EC also proposed a broader alliance to advance a global circular economy by bringing together governments and organizations. In February 2021, the EU, the United Nations Environment Programme and the United Nations Industrial Development Organization initiated the Global Alliance on Circular Economy and Resource Efficiency (GACERE).

Circular Economy and the European Green Deal

- Circular economy is expected to create sustainable growth, halt the loss of biodiversity and reduce pressure on the over-exploitation of natural resources. The transition to a circular economy was considered a prerequisite for achieving the EU 2050 climate neutrality target of net-zero greenhouse gas emissions and the maintenance of global temperature increase well below 2°C.
- The new Circular Economy Action Plan is therefore one of the main building blocks of the European Green Deal, which was adopted in 2019 and constituted Europe's new agenda for sustainable growth.
- Part of the European Green Deal Climate Agenda is also the EC "Fit for 55 package", which was introduced in 2021. The package includes revisions related to the EU Green Deal actions and proposals for the alignment of regulations for climate and energy, with the target of a 55% reduction of GHG emissions by 2030 relative to the 1990 levels.

Circular economy regulations and connection with the ESG

Waste treatment policies in Europe are in line with the circular economy principles regarding the reduction of resource depletion, the minimization of disposal operations, such as landfilling, and the promotion of efficient methods for product reuse and recycling.

Legislative framework on waste

- The EU has implemented laws on waste since the 1970s for specific waste categories such as packaging, plastics, electrical and electronic equipment, batteries and accumulators, construction and demolition, mining waste, bio-waste and end-of-life vehicles. The relevant legislative framework aimed at reducing waste and waste landfilling and preventing waste generation.
- After adopting the first Circular Economy Action Plan, the EU revised its waste legislative framework twice (in 2015 and in 2018), in order to protect the environment and human health and support the transition to a circular economy. These revisions set targets for preventing waste, improving waste management, stimulating innovation in recycling and limiting landfills.
- The EU 2018/851 waste framework directive is the latest legislation for treating and managing waste in the member countries. The directive sets principles so that waste is managed without:
  - risking human health and harming to the environment,
  - endangering water, air, soil, plants and animals,
  - creating nuisance, such as noise and odors
  - negatively impacting the countryside and other places of special interest.
- Specifically, the Directive's targets regarding waste preparation for reuse and recycling include among others a) minimum targets of 55%, 60% and 65% by 2025, 2030 and 2035, respectively, for reuse and recycling of municipal waste, b) a maximum target of 10% by 2030 for the landfilling of municipal waste, c) a target of 65% and 75% by 2025 and 2030, respectively, for reuse and recycling of packaging waste, d) a target of 55% for plastic packaging waste by 2030, e) a target of 65% by 2025 and of 70% by 2030 for the collection of portable batteries and f) a reduction of 30% by 2025 and of 50% by 2030 for food waste.
- Waste management under the Directive is supported by measures to promote reuse and stimulate industrial symbiosis, which involves turning one industry's by-product into another industry's raw material. The measures also include economic incentives for producers to put greener products on the market and support recovery and recycling of products.

Sustainability in financial services and ESG disclosure

- In the context of the European Green Deal and aligned with the Paris Agreement benchmarks, the EU integrated sustainability considerations and related disclosures in its financial policies, which are applied to certain financial services sectors since March 2021.
- These are included in the Sustainable Finance Disclosure Regulation (SFDR), according to which, financial market participants (institutional investors, asset managers, financial advisers and others) must consider sustainability and Environmental, Social and Governance (ESG) factors in their investment decision-making and assess a company's socially responsible investment impact. Companies must be also aligned with disclosure obligations on how ESG related risks are integrated in their business strategy.
- ESG risks and criteria regarding the environmental dimension are also aligned with various circular economy targets and principles and include among others a) actions on climate change and net zero targets, b) GHG or other toxic emissions reductions, c) usage of water and natural resource conservation, d) waste reduction and pollution, e) renewable energy use, f) treatment of animals and g) compliance with environmental regulations.
- There are various financial benefits for companies that align with ESG criteria and for those that seek more responsible investments. There is evidence that companies with higher ESG scores are more attractive to investors and have better performance in terms of their stock market valuations, cost of capital and market risk (The Banker, November 2021 and MSCI, 2021).

National strategies for a circular economy in Greece

The National Strategy for Circular Economy 2018-2019 was the first regulatory initiative for the promotion of circular economy principles in Greece and the predecessor of the recent and more detailed roadmap of the New Action Plan 2021-2025.

National Strategy for Circular Economy 2018-2019

- Greece has put the circular economy at the core of its development strategy, as the transition to the circular model is a precondition for entering a path of sustainable development and prosperity. The 2018-2019 plan determined a more coherent strategy and a series of actions for the acceleration of the country towards the circular economy and set its long-term goals.
- The pillars of the plan included sustainable resource management, support of the circular economy and circular consumption. The actions and interventions of the action plan contained a) regulatory and legislative reforms to support the circular economy and address bureaucracy, b) financing and financial incentives, c) improvement of knowledge, management, exchange procedures and connection with production, economy and society and d) support of the circular economy and networking governance.
- However, the implementation of the circular economic model in Greece did not advance as quickly as planned according to the 2018-2019 National Strategy remaining at a premature stage. This is demonstrated by the relatively worse circular economy indicators of Greece compared to those of other EU countries.

New Action Plan for the Circular Economy 2021-2025

- The New Action Plan is the new roadmap of 66 actions for the period 2021-2025 that aims to accelerate the transition to the circular economy. Out of these actions, 45 pertain to basic economic axes, such as production, consumption, waste and horizontal measures (e.g. governance). The other 21 actions regard circular policies for certain commodities and products.
- In addition to the horizontal actions, the new action plan also includes a series of actions for businesses, citizens and cities via existing as well as new, innovative and digital models and the promotion of circular economy principles and applications in various municipalities.
- In the New Action Plan, all actions are divided into five axes, which include:
  - sustainable development and industrial policy actions, aimed at the promotion of industrial symbiosis and a climate neutral and efficient circular economy,
  - sustainable consumption actions in order to strengthen consumers' participation in the circular economy and the demand of sustainable products,
  - less waste with greater value aimed at the reduction of waste generation and landfilling, as well as the increase of waste recycling,
  - horizontal actions related to governance, legislation, organization and implementation and
  - special actions for certain commodities, which need to be addressed as a matter of priority, due to their environmental footprint, such as electronic and ICT equipment, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food and water.

Source: New Action Plan for the Circular Economy 2021-2025

Circular economy regulations in Greece

The National Waste Management Plan for 2020-2030 aspires to end uncontrolled waste disposal and rehabilitate illegal landfills by 2022.

Regulatory initiatives in 2019-2021

- Apart from the New Action Plan for the Circular Economy 2021-2025, during 2019-2021 a series of various other regulatory initiatives have been undertaken to promote the circular economy in Greece. These included:
  - The new proposed legal framework for waste, landfill and alternative waste management, the revision of the National Waste Management Plan and the National Strategic Waste Prevention Plan.
  - The new legal framework for disposable plastics, the signing of the European Plastic Pact Agreement, the business plan for the implementation of relevant actions, as well as the approval of the action plan for green public procurement.
  - The enactment of a series of flagship national measures such as a) the prevention of food waste, b) reuse initiatives, such as the obligation to serve consumers with a reusable cup at a reduced price, c) separate waste collection actions, such as the refund guarantee system for bottles (DRS), d) redesign of products, such as the minimum recycled content in new bottles, e) citizen awareness, such as mandatory separate waste collection in schools, f) free water supply to public taps and g) provision of incentives and disincentives, such as the landfill fee, the classification of producer contributions within “the polluter pays” principle and the implementation of "pay as I throw" systems by local authorities.
  - The establishment of the “Alliance for food waste reduction” in Greece and the operation of the “National Council of Circular Economy” with the participation of various stakeholders.
  - New funding programs for actions regarding a) the environmental protection due to climate change, b) the need for sustainable energy, c) the promotion of circular economy principles, d) the intensification of auctions for new projects regarding waste treatment activities and e) the design of focused awareness actions.

National Waste Management Plan for the period 2021-2030

- The extreme situation of illegal landfilling in Greece was reflected in series of convictions by the European Court of Justice, the first of which took place in 2005 for the operation of 1,125 illegal landfills. From 2014 until 2019, Greece had paid EUR 58.9 mn in fines for illegal dumps. The new National Waste Management Plan for 2021-2030 is in line with the EU standards for sustainable development and circular economy principles, aimed at the construction of 17 waste treatment plans in Greece. The previous plan for 2015-2020 failed to comply with the objectives that were then set. Despite the efforts, Greece continues to perform poorly regarding waste management compared to other EU countries and stills pays fines for the remaining 50 illegal landfills.
- The reduction of landfilling to 10% in 2030 and the increase of recycling to 55% in 2025 and 60% in 2030 (including biowaste) are among the plan’s main objectives. The Plan aims to achieve full coverage of the country with 43 Waste Treatment Plants, 43 to 46 Bio Waste Treatment Plants and 4 power plants with energy recovery from waste and separate collection of organic waste.

LIFE – the Circular Economy Implementation program in Greece

- LIFE-IP CEI-Greece aspires to contribute to the implementation of the National Waste Management Plan and the National Strategy for the Circular Economy. The project aims to develop actions in nine municipalities and one region to promote a) an integrated waste management plan, b) preparation for reuse and separate waste collection, c) hazardous household waste management, and d) financial tools implementation.
- The objectives of the program also include a) the promotion of actions for food waste prevention via regional alliances for agri-food waste management, b) secondary material standards to support circular economy, c) greater awareness of the circular economy and waste management implications among authorities and the public and d) the mobilization of complementary financing resources to support the National Waste Management Plan.

Financing of the circular economy

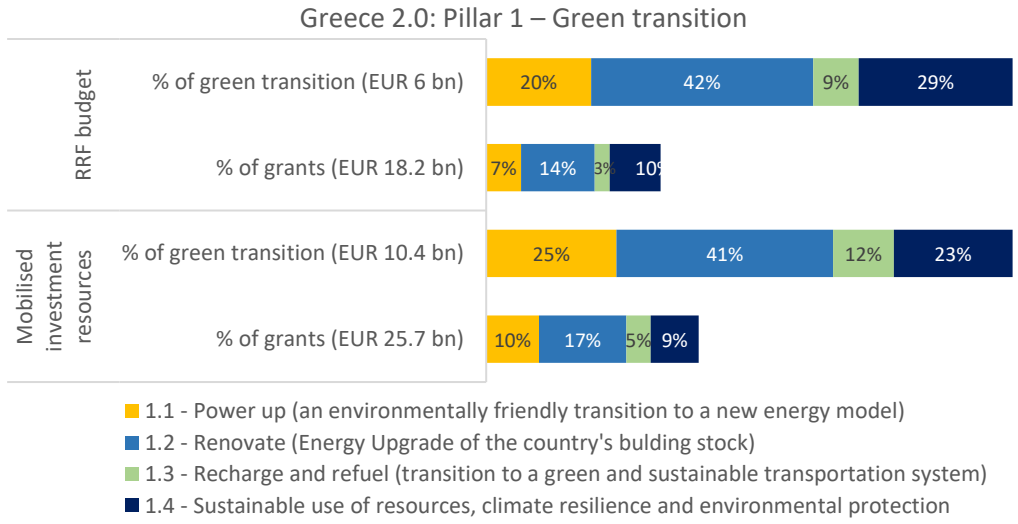
Achieving the transition to a circular economy requires the mobilization of public as well as private funding sources, such as the National Recovery and Sustainability Plan (Greece 2.0).

EU and Greek public funding for a circular economy transition

- The EC has initiated funds for the transition to a circular economy, which necessitates investments in innovation and support from various industries. The EC 2016-2020 funding amounted to more than EUR 10 bn and included a) EUR 1.4 bn until 2018 from Horizon 2020, EUR 350 mn of which is earmarked for the circularity of plastics, b) EUR 7.1 bn from the Cohesion Policy, EUR 1.8 bn of which will go to eco-innovative technologies and EUR 5.3 bn to waste legislation, c) EUR 2.1 bn from the European Fund for Strategic Investments and Innovfin and d) EUR 100 mn for 80 projects from the LIFE program.
- According to the Circular Economy Action Plan, the financing of the circular economy transition in Greece will come from a) EU-based public funding, such as the Partnership Agreement (ESPA/NSRF) 2021-2027 and the National Recovery and Sustainability Plan, b) national funding from levies, taxes and contributions such as levies on landfills, plastic carrier bags and disposable plastics, c) other funding from programs in Greece and international financial institutions and d) the EU Taxonomy which facilitates the flow of private funds with a positive impact on the environment, the economy and climate, and accelerates the transition to a circular economy.

National Recovery and Sustainability Plan – Greece 2.0

- The National Recovery and Sustainability Plan or Greece 2.0 contributes to the country's green transition by devoting 1/3 of the estimated RRF budget (EUR 6 bn), and 40% of mobilized investment resources (EUR 10.4 bn), to achieving the climate targets. The green axes, reforms and investments of the first Pillar of Greece 2.0 are in line with the priorities set by the Pissaridis Commission Report for economic growth. The Report recognized the importance of protecting and restoring the natural environment and strengthening of the circular economy, sustainable waste management and resilience to climate change and its effects (Growth Plan for the Greek Economy, 2020).
- Greece 2.0 green pillar axes include a) an environmentally friendly transition to a new energy model, estimated to absorb 7% of the total RRF budget or 20% of the first pillar's budget, b) an energy upgrade of the building stock (14% of total grants or EUR 2.5 bn), c) the transition to a green and sustainable transportation system, funded with 9% of the pillar's budget and d) the sustainable use of resources, climate resilience and environmental protection (10% of total grants or 29% or the first pillar budget).
- The green pillar of Greece 2.0, in combination with other national environmental plans, such as the Just Transition Development of Lignite Areas and the Reforestation program, forms strategies that support green transition. Greece 2.0 also reflects the strategic priorities and climate objectives of the National Energy and Climate Plan and incorporates the EC's recommendations on the use of the Recovery and Sustainability Fund to achieve the 2030 energy and climate targets.



Source: Greece 2.0 – National Recovery and Resilience Plan

ALPHA BANK

Accelerating the synthesis of the linear with the circular economy

Benefits of and barriers to the circular economy

"A strong move towards recycling and circularity is likely, but fundamental changes are required to support this transition, including appropriate infrastructure, regulation and legislation, and competitive cost economics" (World Economic Forum, 2015).

Why circular economy

Circular economy practices and policies adopted by government bodies, businesses and consumers are perceived to make significant contributions to reversing adverse environmental changes, by also addressing corporate responsibility and ESG criteria. The circular economy is necessitated by a) changing environmental conditions brought about by human interventions, such as climate change, pollution, waste accumulation, limitation of natural resources, energy inefficiencies, biodiversity losses and b) the current technological trends and innovations that interlink businesses from various economic sectors and consumers, such as digitalization, automation and artificial intelligence.

The circular economy has also emerged as a vital resort for economic recovery after the COVID-19 pandemic, which highlighted the risks associated with a linear economy, such as the reliance on expanded international, instead of local supply chains and the heavy dependency of production on natural resources instead of exploring circular opportunities. Although circular economy practices and applications are gaining momentum over the linear economic model and are supported by institutional policy frameworks, there are still barriers and challenges ahead. In order to reach a productive synthesis of the two models, the prevailing, linear economic model should be substantially infused with circular economy principles.

Benefits and drivers

- The circular economy has been related to various environmental, economic and social benefits that arise from its wider application. Macroeconomic benefits are connected to increased output and employment, while industrial opportunities for firms can render them more competitive and innovative. Economies will benefit from significant net material savings, improved land productivity, and long-term resilience of the economy (WEF, 2017).
- It has been estimated that around 700,000 new jobs, especially in the waste management, recycling, resale and remanufacturing activities, can be created in the EU, equal to an additional 0.3% employment increase by 2030 (Ekins et al, 2019). Regional unemployment in areas with high unemployment can be reduced and losses of mid-level skill jobs due to industrial changes can be offset (Rizos et al, 2017). Research indicates that production in a circular economy is more labor-intensive than in a linear economy (Wijkman & Skånberg, 2016). The EC has predicted an additional 0.5% rise in GDP by 2030 due to circular economy adoption policies (EC, 2020).
- Higher recycling, resource productivity and efficiency can reduce GHG emissions through the circulation of products and materials instead of the production of new ones (Platform for Accelerating the Circular Economy 2021). Global GHG emissions are estimated to fall by 39% by 2032 compared to 2018. Reducing resource extraction and regenerating farmlands will also address 90% of the biodiversity loss (Ellen MacArthur Foundation, 2020).

Barriers and challenges

- However, circularity has financial and practical limitations that should be taken into account. For example, recycling has physical limitations, while the recycling of long lifespan products can be difficult, costly and more energy consuming. Large investments might be required in advanced technologies and in modernizing existing facilities and equipment. Financial barriers could hinder these investments, which require intensive funding and economic incentives.
- Thus, circular economy applications are not feasible without a marked transformation of both production and consumption, which involves the entire supply chain and various sectors. Practical and cultural issues regarding the efficient interdependence of different stakeholders and their complex collaboration, communication and coordination require special attention. Cultural barriers, lack of consumer interest and awareness and hesitance or reluctance due to company culture are the main barriers for businesses and policy-makers.

References

Articles and reports

- Abeliotis, K., Lasaridi, K., Costarelli, V., and C. Chroni, The implications of food waste generation on climate change: The case of Greece, Sustainable production & consumption, 2015
- Accenture
  - Device-as-a-Service: Your next supply chain model, 2020
  - The Case for Circularity in Metals and Mining, 2020
  - Winning in a circular economy: Practical steps for the European chemical industry, 2020
- Association of plastics manufacturers, PlasticsEurope, Plastics–the facts 2020 an analysis of European plastics production, demand and waste data, 2020
- Balde C., Fortis V., Kuehr, R., and G. Bel, The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential, United Nations University, 2020
- The Banker magazine, November 2021
- Dianeosis, Incorporating climate change in the reform of the development model of Greece, 2021
- Ekins, P., Domenech, T., Drummond, P., Bleischwitz, R., Hughes, N., and L. Lott, The Circular Economy: What, Why, How and Where, University College London, Institute for sustainable resources, 2019
- Environmental Energy Agency, 2016, Circular economy in Europe: Developing the knowledge base
- Ellen MacArthur Foundation
  - Circular Consumer Electronics: An initial exploration, 2018
  - Circular economy systems diagram, 2019
  - Financing the circular economy, 2020
  - The new plastics economy: Rethinking the future of plastics & catalysing action, 2016
  - Towards the Circular Economy, 2013
- European Commission/European Union
  - A European strategy for plastics in a circular economy,2018
  - A new Circular Economy Action Plan for a cleaner and more competitive Europe, 2020
  - Attitudes towards the Impact of Digitalisation on Daily Lives Special Eurobarometer 503, 2020
  - Closing the loop-EU action plan for Circular Economy, 2015
  - Directive 2018/851 on waste, 2018
  - Directive 2019/904 on single-use plastics, 2019
  - ''Fit for 55'': delivering the EU's 2030 Climate Target on the way to climate neutrality, 2021
  - What is the European Green Deal?, 2019
- European Environment Agency
  - Circular Economy in Europe- Developing the Knowledge Base, 2016
  - The European Environment—State and Outlook 2020: Knowledge for Transition to a Sustainable Europe. 2020
- European Parliamentary Research Service, New EU regulatory framework for batteries, 2021
- EY, Study on the Circular Economy in Greece, 2016
- Global Carbon Project, United in Science, 2021
- Hellenic Republic, Pissarides Committee, A development plan for the Greek economy-Interim Report, 2020
- International Council on Mining and Metals, Role of Mining in National Economies: Mining Contribution Index, 2016
- International Energy Agency, World Energy Outlook, 2021
- IPCC, Climate Change 2021-The Physical Science Basis, Geneva: World Meteorological Organization, 2021
- Kumar, V., Sezersan, I., Garza-Reyes, J., Gonzalez E. and M. Al-Shboul, Circular economy in the manufacturing sector: benefits, opportunities and barriers, 2021
- Ministry of Environment & Energy
  - National Circular Economy Strategy, 2018
  - New Action Plan for the Circular Economy 2021-2025, 2021
  - National Program for the Prevention of Waste Generation 2021-2030
- Ministry of Finance, Greece 2.0-National Recovery and Sustainability Plan, 2021
- MSCI, Net-Zero Alignment Objectives and Strategic Approaches for Investors, 2021
- OECD, Carbon pricing in times of Covid-19, What has changed in G20 economies?, 2021
- Oxford Institute for Energy Studies, The Energy Transition: Key challenges for incumbent and new players in the global energy system, 2021
- Platform for accelerating the circular economy (PACE), Circular indicators for governments, 2021
- Rizos, V., Tuokko, K. and A. Behrens, The circular economy, A review of definitions, processes and impacts, 2017
- Sikalidis, A. and C. Emmanouil, Description and economic evaluation of a "Zero-waste mortar-producing process" for municipal solid waste management in Greece, Journal of Open Innovation: Technology, Market, and Complexity, 2019
- Smart Prosperity Institute, Background materials for circular economy sectoral Roadmaps (Plastics, Agri-food, Construction, Mining and metal industry, Electronics), 2020, 2021
- United Nations
  - Department of Economic and Social Affairs, Population Division, Population 2030: Demographic Challenges and Opportunities for Sustainable Development Planning, 2015
  - UN Environment Program, Food Waste Index Report, 2021
- Valavanidis, A. and Vlachogianni, T., Municipal Solid Waste and Environmental Pollution. Trends of Municipal Waste Management in European Countries and in Greece, 2015.
- World Economic Forum
  - Towards the circular economy: Accelerating the scale-up across global supply chains. Geneva: World Economic Forum, 2014
  - Mining and Metals in a Sustainable World 2050, 2015
- WWF, The Mediterranean burns: WWF's Mediterranean proposal for the prevention of rural fires, 2019

Databases and websites

- OECD
- Eurostat
- https://eleftherostypos.gr/ellada/749240-kleinoun-oi-teleytaies-50-xomateres/
- https://globalewaste.org/
- https://www.investopedia.com/terms/e/environmental-social-and-governance-esg-criteria.asp
- https://www.kathimerini.gr/society/561323068/dyo-chomateres-ligoteres-to-2020-apomenoyn-50/
- https://www.meteo.gr/article_view.cfm?entryID=1892&fbclid=IwAR3yszl15NkD4yTGcJcs_LrPRMr3UrxeJmAmee1L8AePaRqfYQ_WHU9cEdg
- https://www.nationalgeographic.com/magazine/article/how-a-circular-economy-could-save-the-world-feature
- https://www.sme.gr/xoris-tin-exoriktiki-metallourgiki-viomichania-den-iparxei-kikliki-oikonomia/
- www.statista.com
- https://www.weforum.org/agenda/2019/01/how-a-circular-approach-can-turn-e-waste-into-a-golden-opportunity/
- https://www.wtert.net/paper/3827/Current-State-of-Waste-Management-in-Greece.html

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