SoER 2019

Climate change

Greenhouse Gas Emissions

Update of State of the Environment Report 2018

NCESD

NATIONAL CENTRE for the ENVIRONMENT
& Sustainable Development

Villa Kazouli, Kifissias av. 241, 145 61 Kifissia

tel. 210 8089271, 3, fax 210 8084707, e-mail: info-ekpaa@prv.ypeka.gr, http://ekpaa.ypeka.gr/

ISBN: 978-618-84787-9-4

Foreword

The National Center for Environment and Sustainable Development (NCESD) was established in 2000 with the aim to contribute in the integration of the environmental dimension into broader development policy, sub-sectors and strategic planning, providing appropriate know-how and objective information.

According to the Presidential Decree 325/2000 (A '266) concerning the establishment of NCESD, and in particular the point (e) of paragraph 2 of Article 3, it is provided that the NCESD shall draw up an annual report evaluating the environmental status of the country and undertaking assessments of the objectives, directions and measures of the actual environmental policy."

In November 2018, NCESD presented its 2018 State of the Environment Report (SoER 2018, https://ekpaa.ypeka.gr/wp-content/uploads/2019/10/181019_Book-YPEKA_LOW.pdf) for the first time after 2013 (concerning 2008-2011) and it was the fourth State of the Environment Report of Greece. The SoER 2018 is a comprehensive overview of the developments and challenges facing key environmental sectors and aims to provide citizens and the State with detailed information and links to the European Environment Agency's report. For the preparation of the Report, NCESD cooperated with academic institutions, research centers and technical companies. The SoER 2018 includes detailed information for the state of the environment in Greece in the fields of climate change, air quality, noise, nature, water, waste and horizontal environmental issues, thus providing to all interested stakeholders a useful database.

This update of SoER 2018 regarding Climate Change was based on the most recent available data and focuses only on greenhouse gas emissions for which there are newer official data compared to SoER 2018. The aim of the update is to provide an objective information database as well as contributing to the public dialogue on policy directions and measures to tackle climate change with a view to a sustainable future.

The Project Team for the Update of the SoER 2018 on Climate Change was drafted by P. Varelidis, E. Zikou, V. Kapsis and K. Korizi.

We would like to thank the Directorate of Atmospheric Quality and Climate Change for providing the required data.

Petros Varelidis
Executive Director of NCESD

Zoi Vrontisi
President of the Management Board of NCESD

Table of Contents

Annual variation of greenhouse gases emissions

Within the framework of the United Nations Framework Convention on Climate Change (UNFCCC), and having achieved its objectives under the Kyoto Protocol for the period 2008-2012, European Union (EU) adopted the objective of reducing by 20% NUCs till 2020, concerning the 2nd commitment period, under the Kyoto Protocol (Doha Amendment to the Kyoto Protocol) and 40% by 2030 under the Paris Agreement. The objectives are expressed as percentage changes in view of 1990 levels of GHG emissions.

The European Union and its Member States will implement the international commitments jointly. In order to achieve these targets, an upper limit has been set for the EU Emissions Trading Scheme (ETS), while individual national emission targets have been established in areas not covered by the ETS, within the framework of Effort Sharing Decision (ESD) 406/2009 / EC. The national target is 4% for 2020 and 16% for 2030 compared to 2005 levels.

As part of the monitoring and evaluation of GHG emissions, variation and main trends in Greece for the period 1990-2017 are recorded.

Greece and the European Union (EU-28) greenhouse gas emission data (EUC) come from the official reports of the country and EU submitted to the United Nations Framework Convention on Climate Change (UNFCCC, 2019) on an annual basis with the last reference year being 2017:

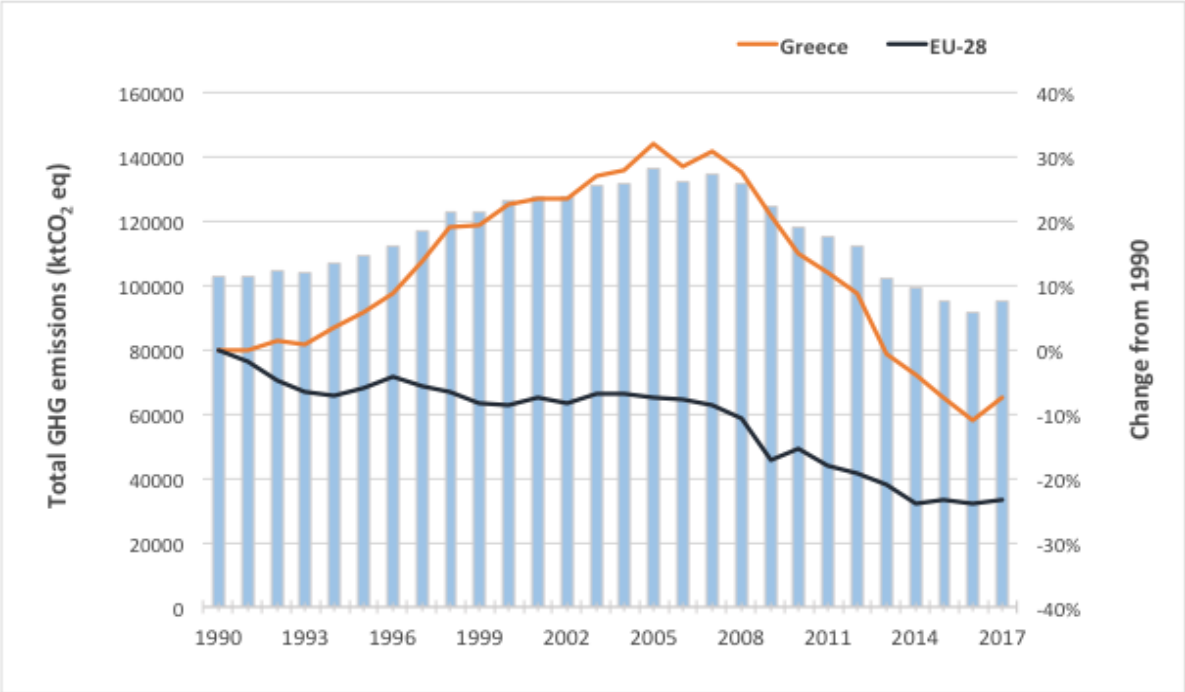
- UNFCCC, National Inventory Submissions, National Inventory Report (NIR), Greece, 2019
- UNFCCC, National Inventory Submissions, Common Reporting Format (CRF), Greece, 2019
- UNFCCC, National Inventory Submissions, Common Reporting Format (CRF), EU-28, 2019

For the greenhouse gases (GHG) emission data included in the provisions of Decision 406/2009 / EC, the data have been obtained from Eurostat (Greenhouse gas emissions in ESD sectors [T2020_35]).

Graph 1 shows the main GHG emission trends in Greece, excluding the contribution of land use, land use change and forestry (LULUCF). Specifically, in 2017 the total GHG emissions in the country without LULUCF was 95.4 Mt CO_2 equivalent, reduced by 7.4% since 1990.

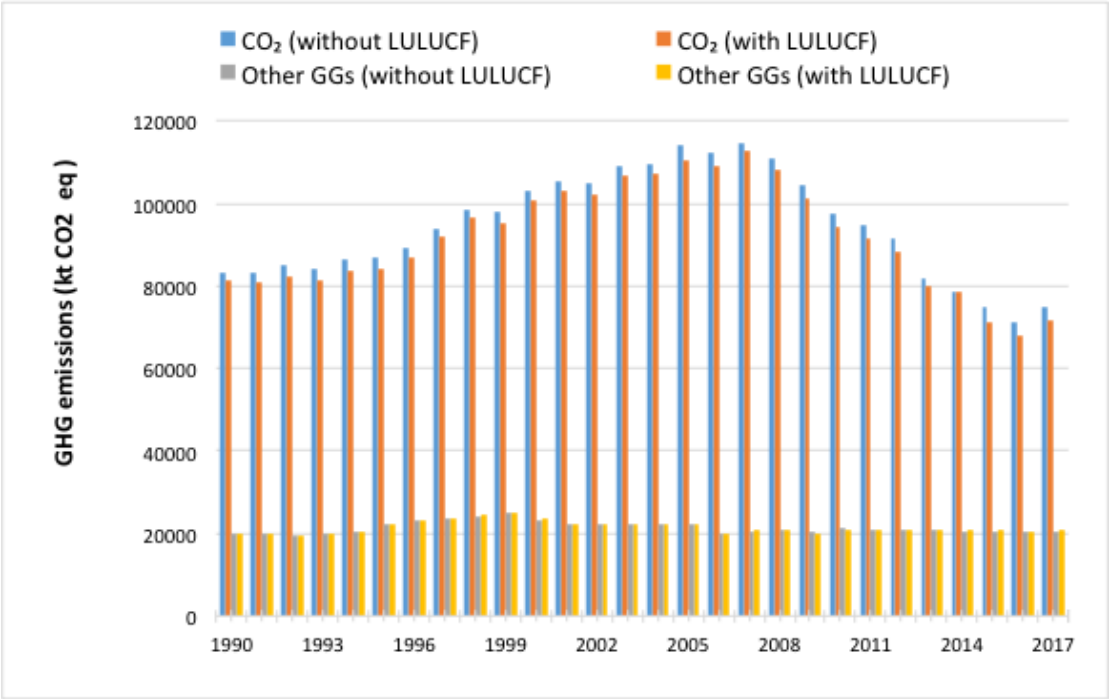
In comparison with the steady decreasing trend of total GHGs recorded in the EU compared to 1990, Greece recorded an increasing trend until 2007, after which there was a steady downward trend after 2007, with a total decrease of 29.3% over the last decade (2007-2017 period).

Graph 1
Annual variation of GHG emissions in Greece (without LULUCF), in terms of equivalent CO_2 and % variation (lines) from the base year 1990



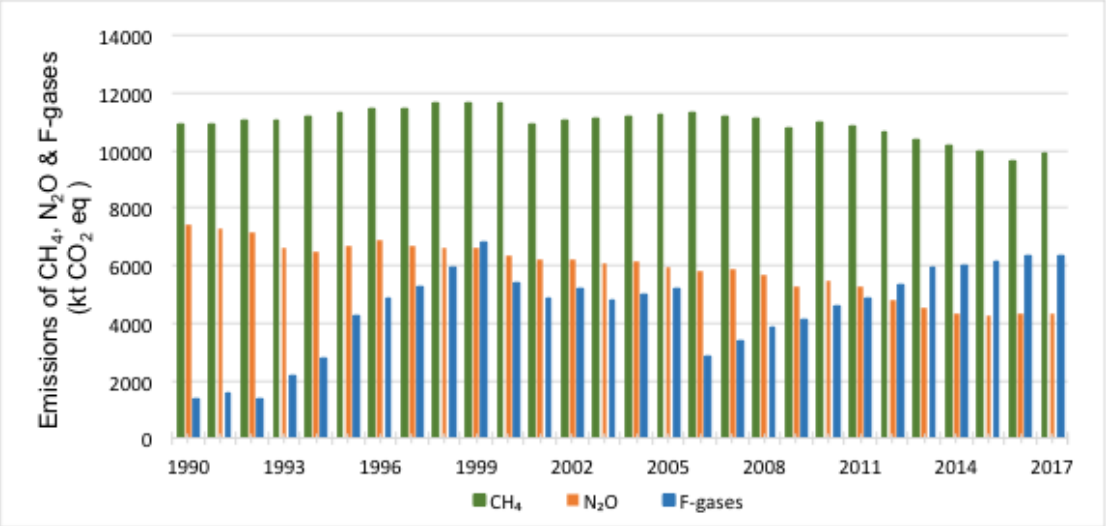
Carbon dioxide is the largest contributor to greenhouse gas emissions as shown in Graph 2. Total CO_2 emissions (without LUCUF) for 2017 have decreased by 10.2% compared to 1990, while there is also a 34.7% decrease over the last decade. The annual variation of CO_2 emissions greatly shapes the corresponding of total GHGs, especially since the emissions of the remaining greenhouse gases are less time-varying.

Graph 2
Annual variation of CO_2 emissions and the other greenhouse gases, with or without LULUCF



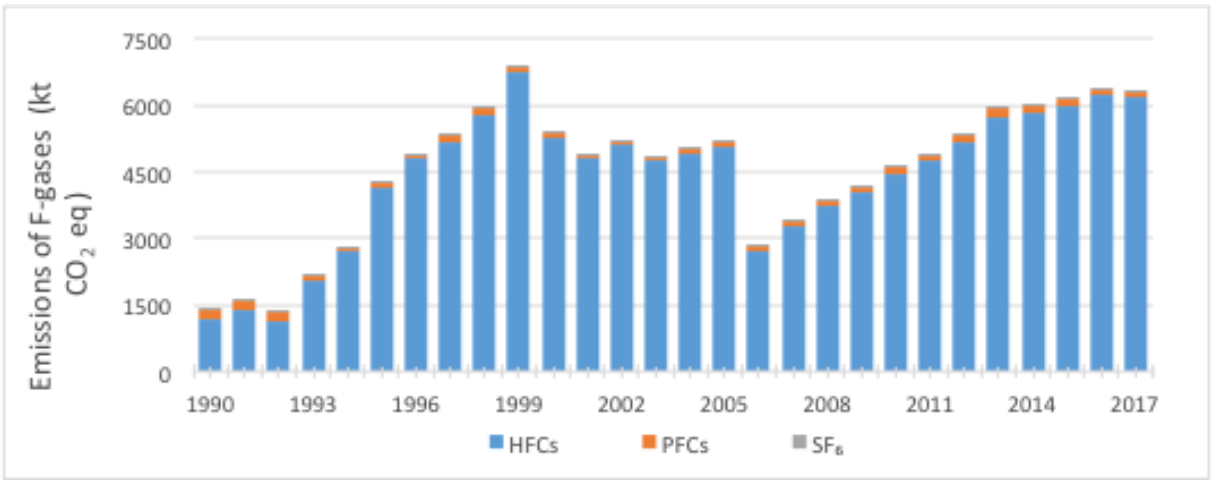
Emissions of other greenhouse gases except CO_2 are shown in Graph 3. Regarding methane (CH_4) emissions, a slight decrease has been recorded compared to 1990 (-9.1%), while the corresponding reduction of N_2O emissions is much higher (-41.5%). However, emissions from the production and use of fluorinated greenhouse gases are significantly higher (33.1%) than in 1995 (base year for F-gases).

Graph 3
Annual variation of emissions of methane (CH_4), nitric oxide (N_2O) and fluoride compounds (F-gases)



As shown in Figure 4, hydrofluorocarbons (HFCs) are by far the largest contributors among fluorine compounds.

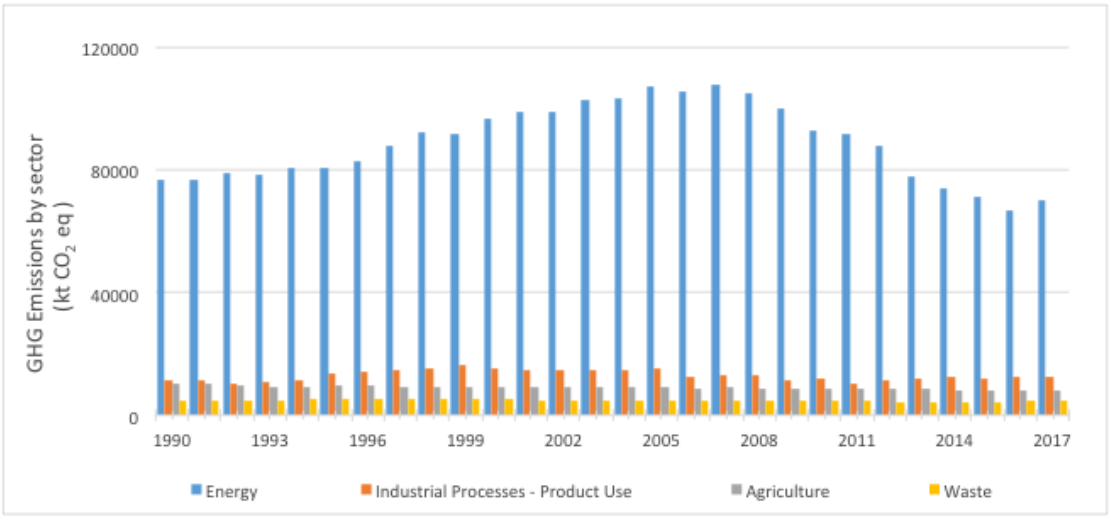
Graph 4
Annual variation of fluorinated greenhouse gases (F-gases) emissions (HFCs: hydrofluorocarbons, PFCs: perfluorocarbons, SF_6)



Graph 5 shows the annual variation of total GHG emissions, by main activity sectors. The energy sector is the one with the largest volume of greenhouse gas emissions.

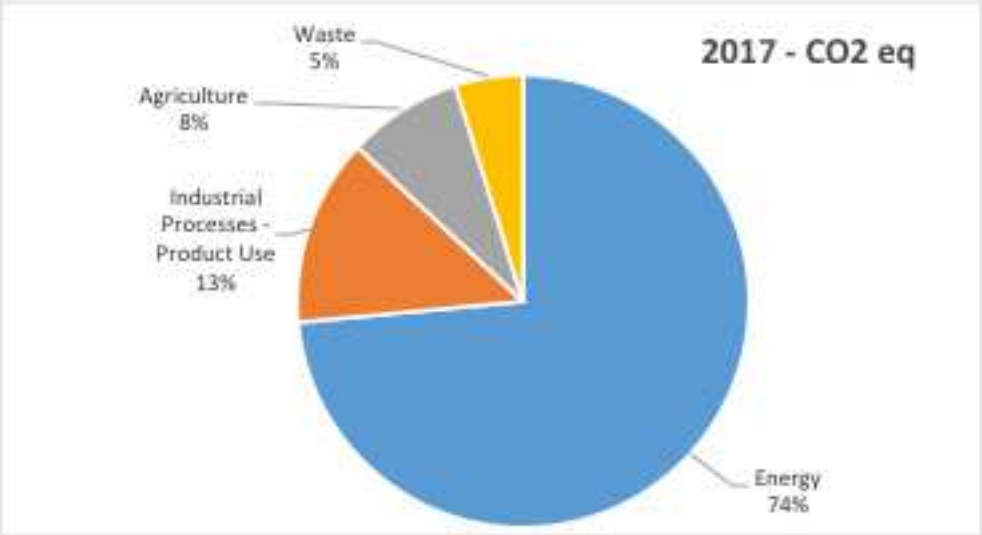
Emissions of the energy sector are reduced by 8.7%, compared to 1990. Specifically, during the last decade (period 2007-2017) it is recorded a significant decrease of 35.1%, while 2016 emissions are at their lowest levels over time.

Graph 5
Annual variation of GHG emissions by sector, expressed in CO_2 equivalent



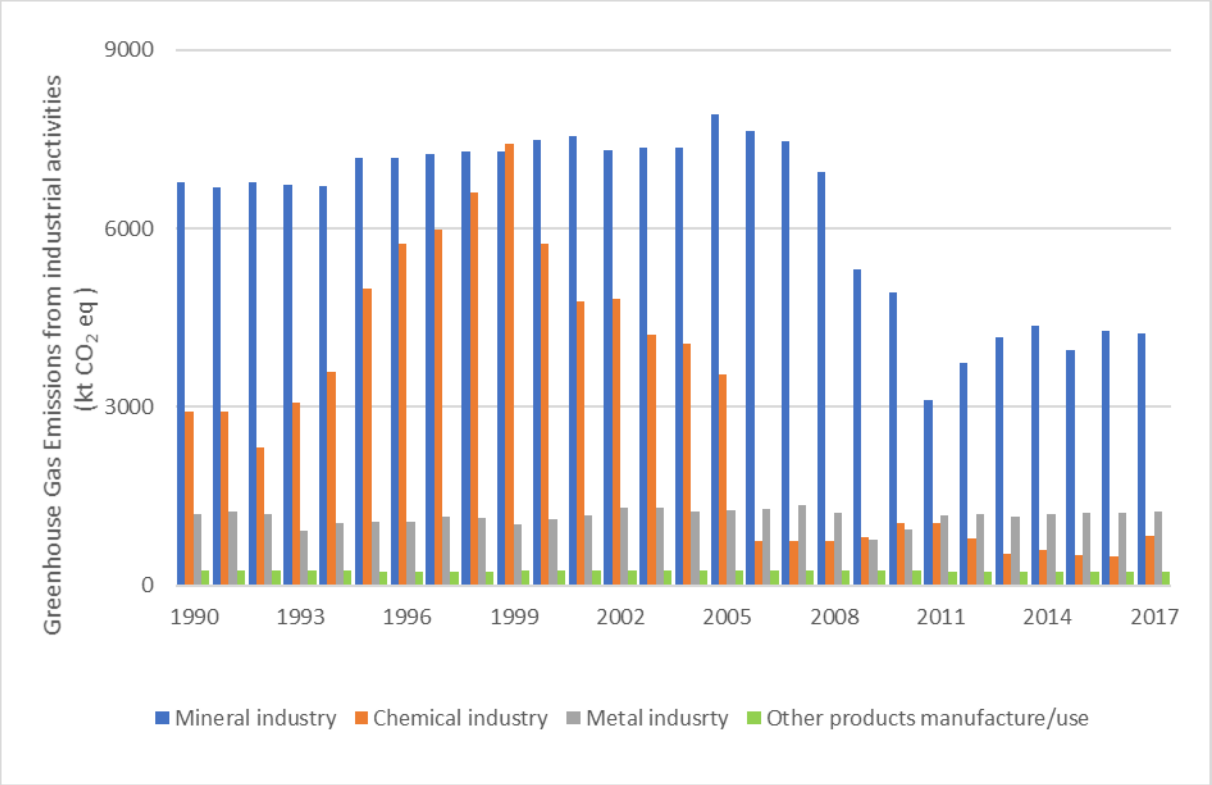
Especially for 2017 reference year, the distribution of the main sectors' contribution to GHG emissions (without LULUCF) is shown in Graph 6. The energy sector generates almost 3/4 of the total emissions followed by industrial processes - products with 13%.

Graph 6
Contribution of different sectors in national emissions of greenhouse gases for 2017



The GHGs activities per sector from the the Industrial Processes and Product Use (IPPU) are shown in Graph 7. The fossil fuel industry has been steady until 2007, following a pattern of decrease over the last decade (43.3%, between 2007-2017) and being relatively stable over the last five years. However, the chemical industry has been growing until 1999, and then has been on a downward trend after 2005 (-79.2% between 2005 and 2006), with steady trends over the last decade. The mining industry is relatively stable over time.

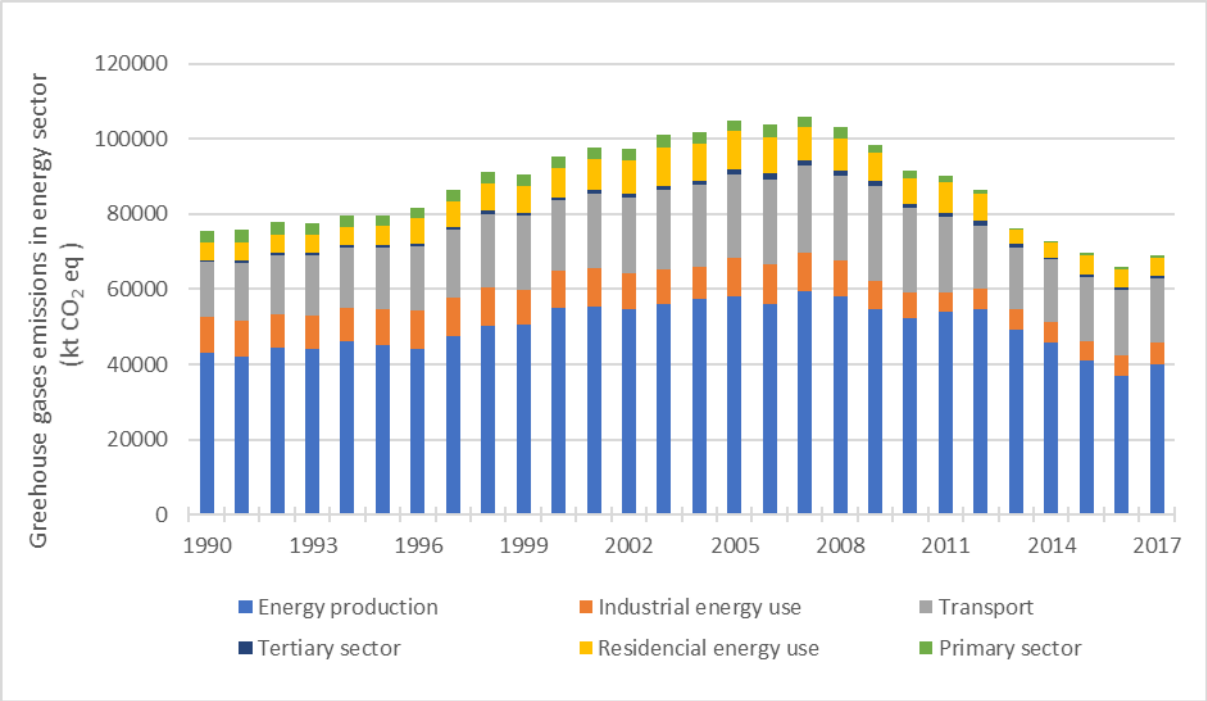
Graph 7
Annual variation of GHGs from the sector of industrial activities and product use



The reduction recorded in total GHG emissions in energy sector during 2007-2017 was observed for most of the individual activity categories of the sector (Graph 8). During the same period, emissions from power generation, which constitute 57.9% of total GHG emissions for 2017 (Graph 9), are reduced by 33%. Accordingly, energy for industrial use, which constitutes 8.4% of total GHGs, is reduced by 42.5% and for transport accounting for 25.0% of total GHGs, is reduced by 25.7%.

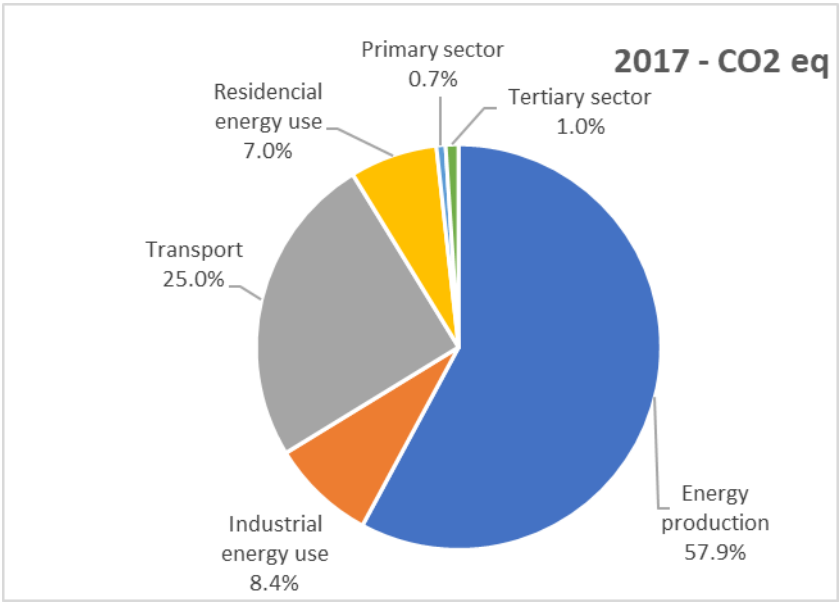
It should be noted, however, that compared to the base year (1990), emissions from the transport sector have increased by 18.8%, while those from the energy production sector have decreased by only 7.7%.

Graph 8
Timeseries of GHG's changes from combustions in the energy sector



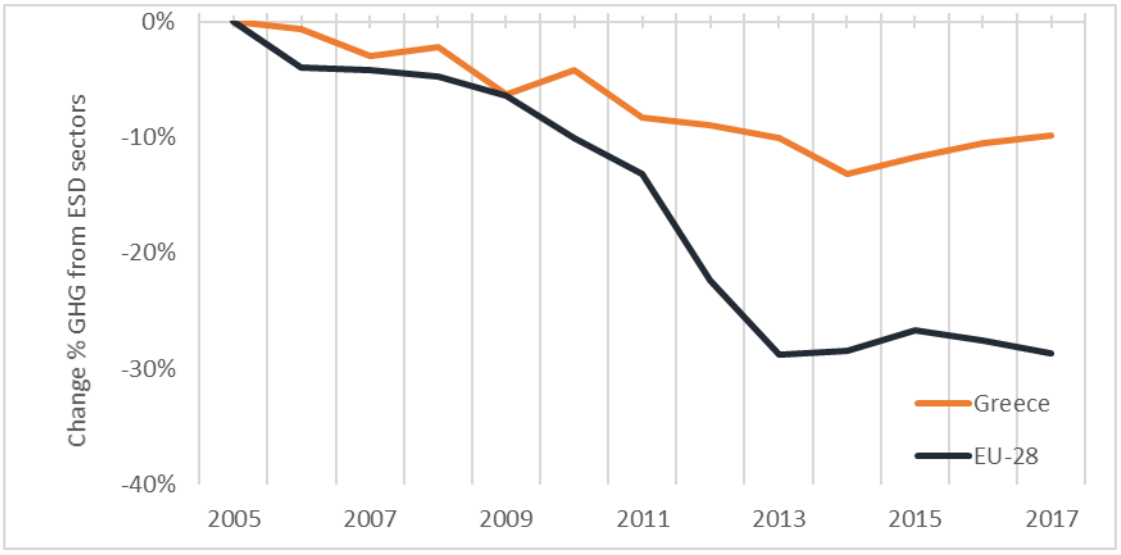
The residence energy sector accounts for 7.0% of the total GHG for 2017 (Graph 9), with emissions increasing by 1.2% compared to the base year 1990. In the contrary, in the primary sector, which accounts for 0.7% of the total GHG, there is a significant reduction in emissions by 84.3% compared to the base year 1990. Correspondingly, the tertiary sector accounts for 1.0% of total GHG for 2017, showing a significant increase compared to the base year 1990 of 36,9%.

Graph 9
Contribution of individual categories in GHG from combustion in the energy sector for 2017



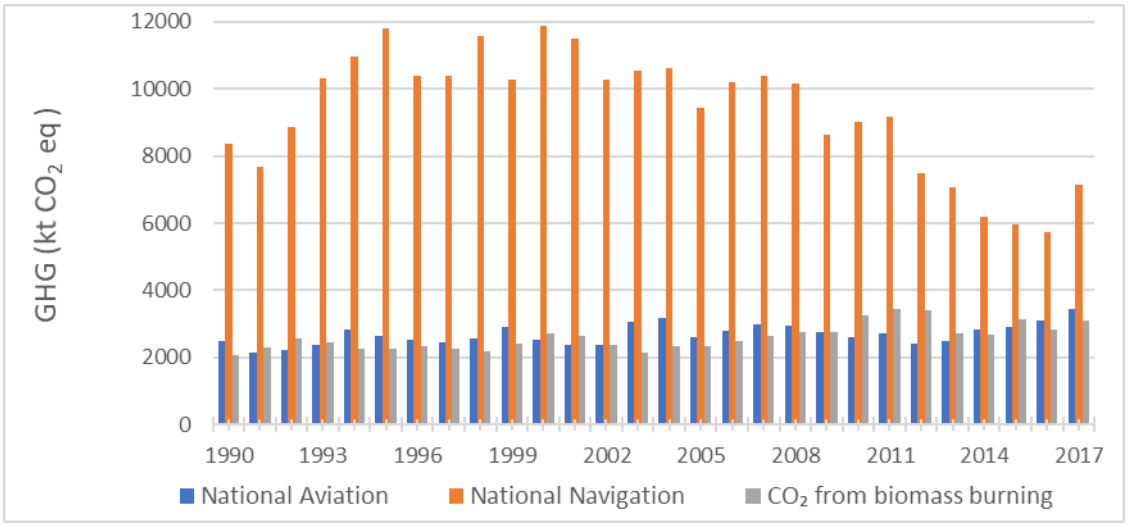
The trend over time of emissions falling under the provisions of Decision 406/2009/EU and are not covered by the Emissions Trading Scheme (ETS), compared to the base year 2005, is shown in Graph 10, which shows that the reductions in Greece during the period 2005-2017 are close to 10%. However, during the period 2014-2017 there is an increasing trend in emissions that may reflect the tendencies to stabilize the economy after the economic crisis.

Graph 10
Changes over time from the year 2005, of GHG that are in line with the provisions of Decision 406/2009/EU (ESD - Effort Sharing Decision)



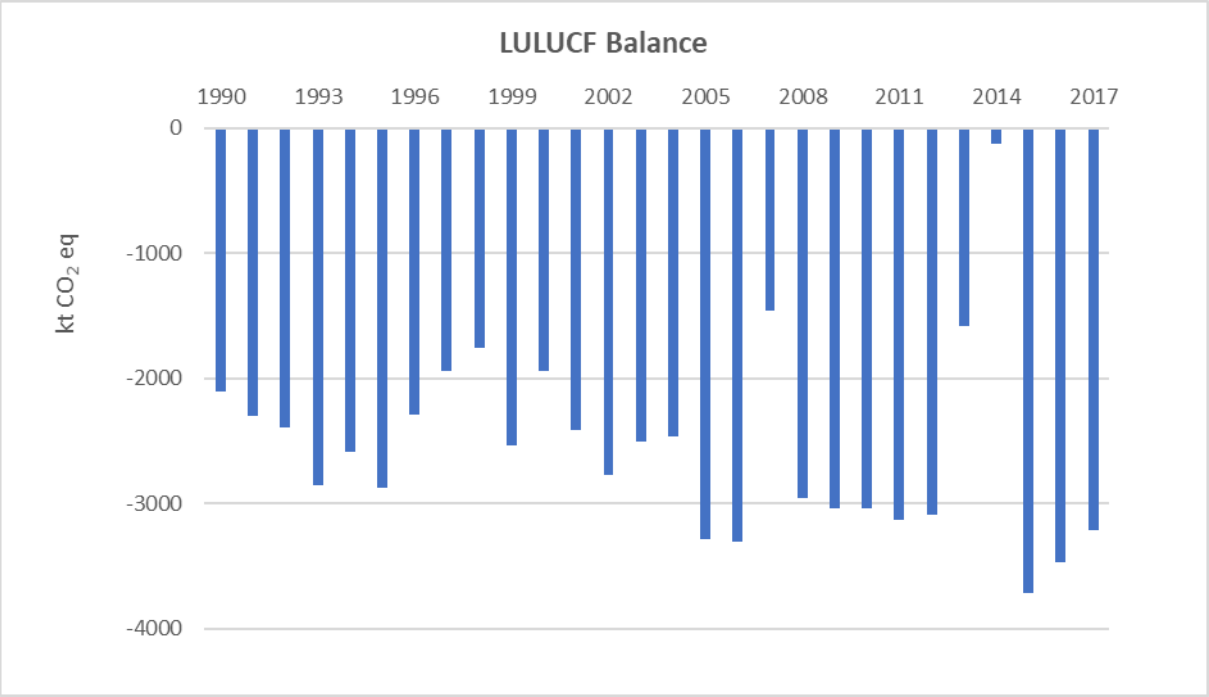
Emissions from sectors not included in national totals (memo items), for the inventory process of GHG according to UNFCCC, and international maritime emissions, emissions from international aviation and CO_2 emissions from biomass burning are presented in Graph 11.

Graph 11
Annual variation of GHG from sectors not included in the national total.



Graph 12 shows the significant time-varying contribution of the sector to the balance emissions/absorption of greenhouse gases. Compared to 1990, net absorption has increased by 52.2%.

Graph 12
Annual variation of the balance emissions/absorption of greenhouses gases from the sector of land use, land use change and forestry (LULUCF)



Annual variation of greenhouse gases emissions intensity

The annual variation of GHG intensity is shown in key demographic and economic terms.

The data of greenhouse gases emissions (GHG) for Greece and the European Union (EU-28) are derived from the official national and European reports to the UNFCCC (UNFCCC, 2019), for the year of reference 2017.

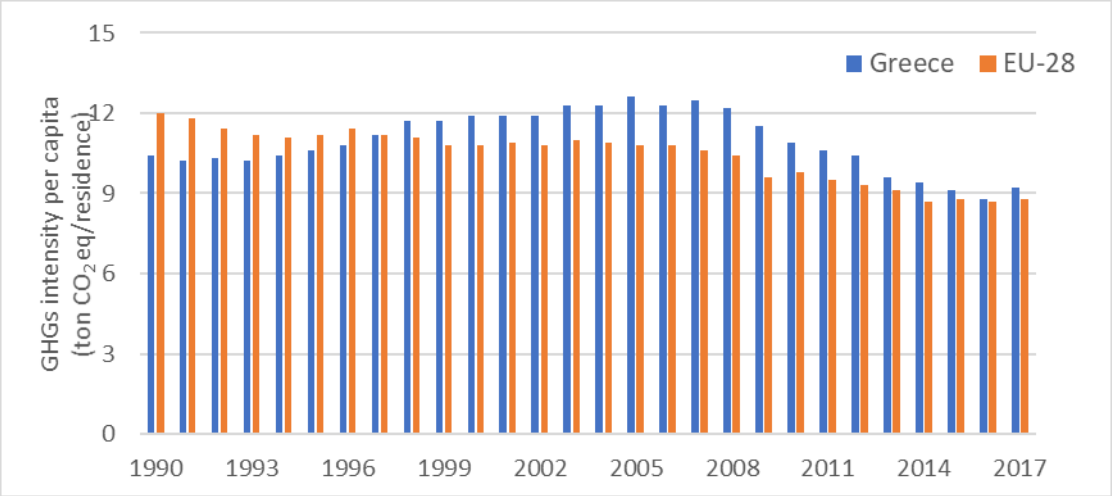
- UNFCCC, National Inventory Submissions, National Inventory Report (NIR), Greece, 2019
- UNFCCC, National Inventory Submissions, Common Reporting Format (CRF), Greece, 2019
- UNFCCC, National Inventory Submissions, Common Reporting Format (CRF), EU-28, 2019

Statistics for the Gross Domestic Product (GDP), the GDP per capita in Purchasing Power Standards (GDP-PPS), the industrial activity in terms of Gross Value Added (GVA), the number of households and the production of electricity (net generated - GWh), come from the database of the European Statistical Office (Eurostat), as submitted by the Greek Statistical Authority.

- Eurostat, Greenhouse gas emissions (source: EEA) [SDG_13_10]
- Eurostat, GDP and main components (output, expenditure and income) [nama_10_gdp]
- Eurostat, Gross value added and income by A*10 industry breakdowns [nama_10_a10]
- Eurostat, Number of private households by household composition, number of children and working status within households (1 000) [lfst_hhnhwhtc]
- Eurostat, Gross and net production of electricity and derived heat by type of plant and operator [nrg_ind_peh]

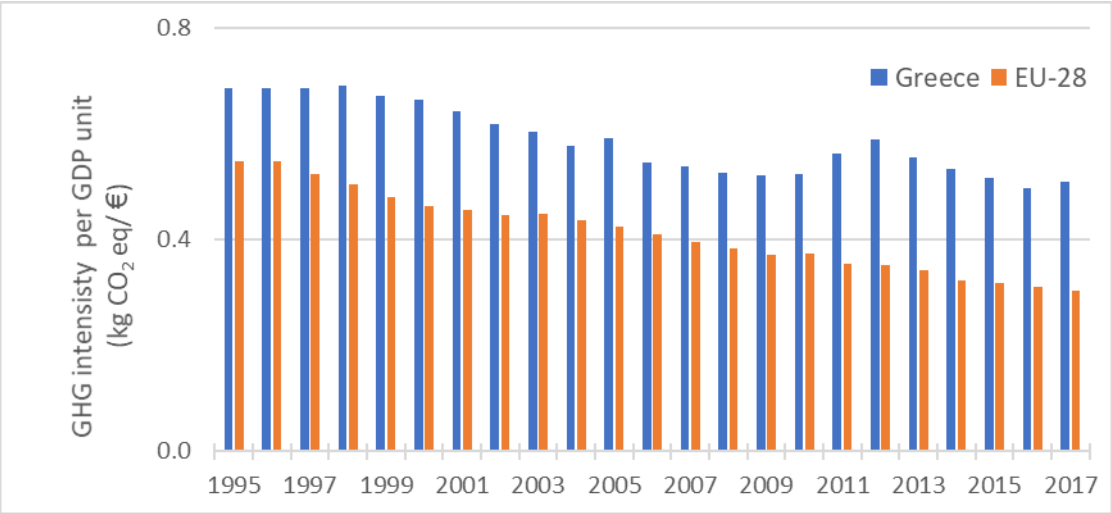
From 2013 onwards every resident of the country (Graph 13) emits less than 10 tons of equivalent CO_2 per year, without considering the LULUCF sector. In 2017 the volume per capita is estimated at 9.2 tons of GHG per capita, a decrease of 11.5% compared to 1990 being comparable to the EU average of 8.8 tons per capita for the same year.

Graph 13
Annual variation of GHG intensity (excluding LULUCF) per capita



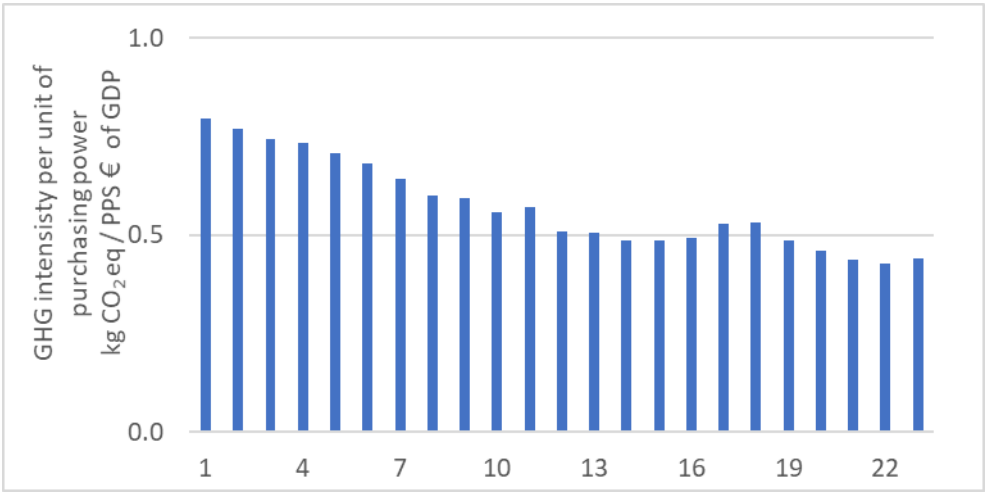
The change in national emissions of greenhouse gases (excluding LULUCF) to gross domestic product (GPD at constant 2010 values) is shown in Graph 14. During the period 1995-2007, GDP growth of 57.9% was accompanied by an increase of GHG by 23.7% resulting in a decrease of the GHG intensity per unit of GDP by 21.7%. During 2007-2017, the intensity has remained almost unchanged (0,50-0,59), as the significant decline of GHG by 29.3%, is accompanied – and largely depends on – the economic downturn, which is reflected in the 25.3% decline in GDP over this period.

Graph 14
Annual variation of GHG intensity (excluding LULUCF) per GDP unit (expressed in constant market values)



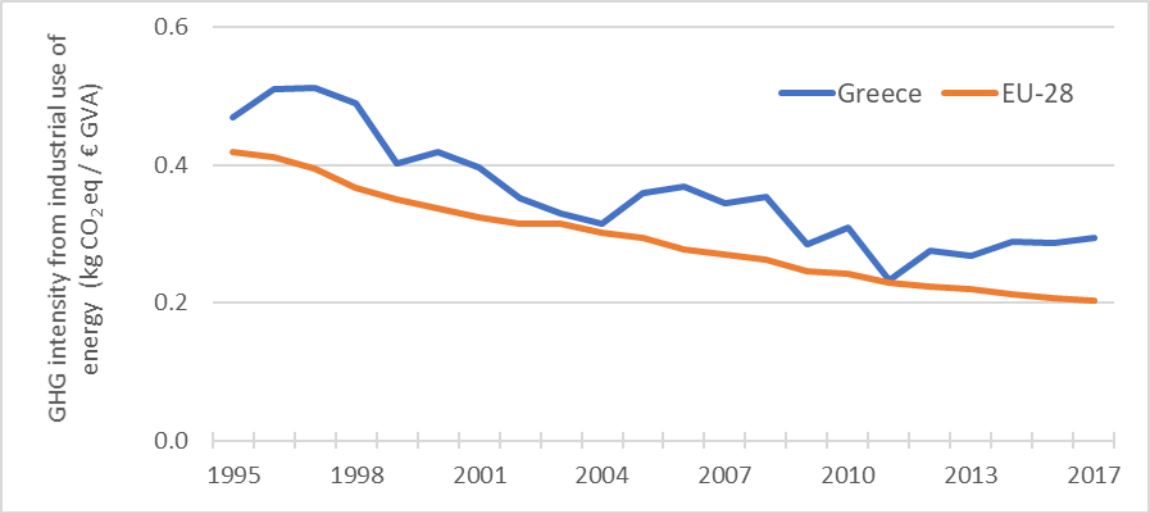
The annual variation of the GHG intensity per GDP in terms of purchasing power, is summarized in Graph 15.

Graph 15
Annual variation of GHG intensity in Greece (excluding LULUCF) per GDP unit (GDP expressed in terms of purchasing power - PPS, relative to EU-28)



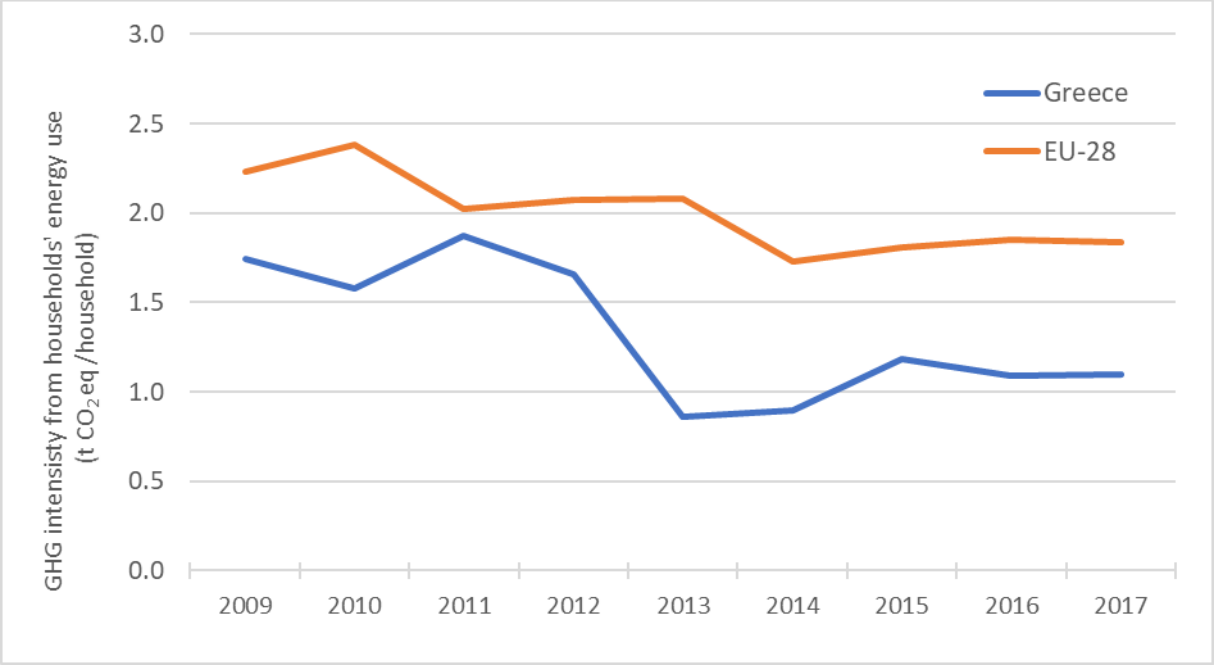
Graph 16 shows the intensity of emissions from energy use in industry. Gross Value Added (GVA, expressed at constant 2010 values) is used as an indicator of industrial activity for emissions weighting, for activities falling under NACE B-E codes, excluding construction. It is shown that emissions intensity, although declining over the last decade, remains higher and more volatile than at EU level, which has been steadily declining as a result of energy efficiency and emission reduction policies, while the sector is still growing.

Graph 16
Annual variation of GHG intensity from industrial use of energy.



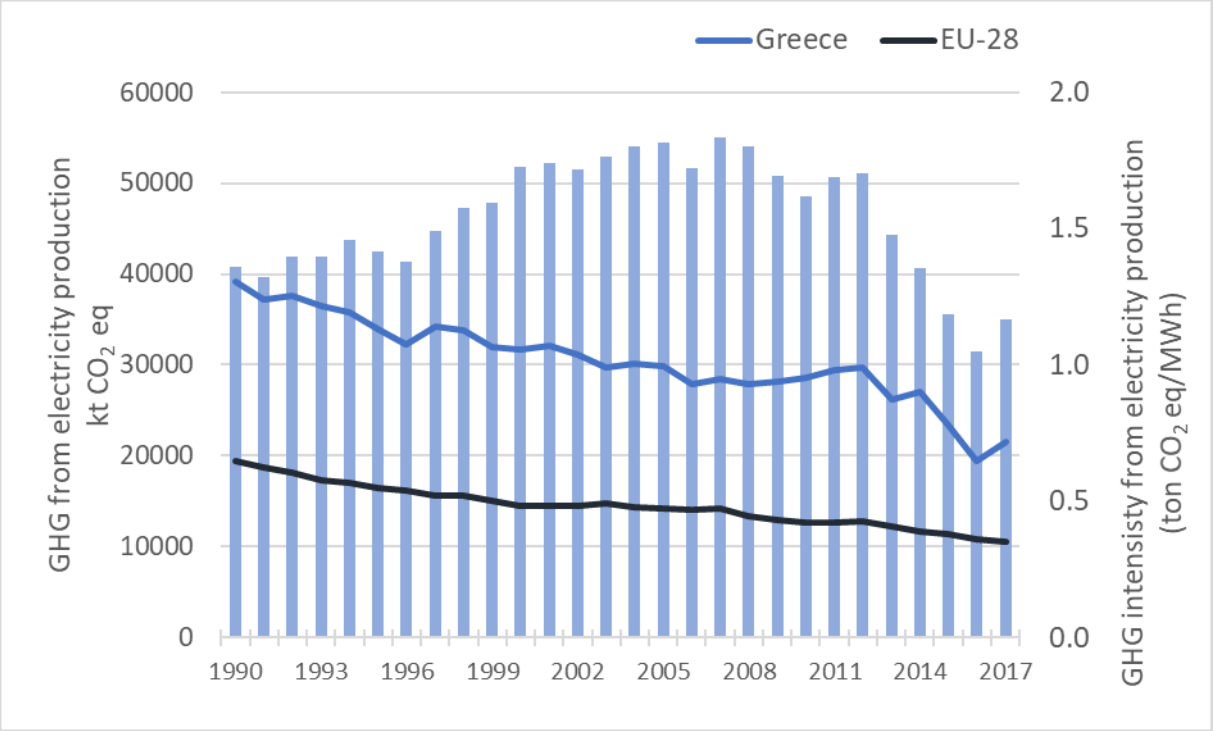
The intensity of emissions from households' energy use (Graph 17) is lower in Greece than at EU level during 2009-2017. The impact of the change in the domestic sector of residential energy use, during the recession is reflected in the rapid decline in the period 2011-2013, that indicates a reduction in household oil burning and its replacement by alternative ways of heating, including domestic biomass burning.

Graph 17
Annual variation of GHG intensity from households' energy use.



The emissions intensity from electricity production (GHG from the public electricity and thermal power production, available for consumption) has been gradually decreasing since 1990 (Graph 18). The reduction in the intensity of electricity production highlights the gradual transition of the electricity sector to fuels and technologies of lower emissions due to the operation of natural gas generating units and the increased participation of RES. However, the dependence of electricity production on the burning of lignite of low calorific power is reflected in the divergence observed compared to the intensity in EU countries.

Graph 18
Annual variation of GHG in Greece from electricity production and emissions intensity (lines).



Conclusions and assessments of environmental policy objectives, guidelines and measures

Regarding **climate change mitigation action in Greece**, greenhouse gas emissions increase in 2017 equals the corresponding decrease observed the previous year, which is mainly due to energy production which generates ¾ of the total emissions. The total GHG emissions in the country (excluding LULUCF) amounted to 95.4 Mt equivalent CO_2, reduced by 7.4% compared to the base year 1990. In contrast to the steady declining trend of total GHG emissions recorded in the EU compared to the base year 1990, Greece recorded an increasing trend until 2007, while after 2007 a steady decreasing trend was observed, with a total decline of 29.3% (period 2007-2017) with the exception of the last year.

Emissions from non-ETS sectors (transport, agriculture, buildings, waste, smaller industries) decreased by 10% compared to the base year 2005, during the period 2005 -2017. However, during the period 2014-2017, there is an increasing trend in emissions that may reflect the tendencies to stabilize the economy after the economic crisis.

In 2017 the greenhouse gases emissions (GHG) intensity per capita is estimated at 9.2 t/res. (ton of equivalent CO_2), decreased by 11.5% compared to 1990 and being comparable to the EU average of στους 8.8 t/res.. It is noted that several countries have a significant rate of nuclear power production (with zero emissions) which, while reducing the overall GHG emissions, cannot be considered a sustainable solution due to significant environmental and human health hazards implied, however, there are still some that achieve a lower greenhouse gas (GHG) emission intensity per capita without the use of nuclear power.

Correspondingly, during the period 1995-2007, GDP growth of 57.9% was accompanied by an increase of GHGs by 23.7% resulting in a decrease of GHGs intensity per GDP unit by 21.7%. In the period 2007-2017, the trend has remained almost unchanged (0.50-0.59), as the significant decrease in GHGs by 29.3% is accompanied - and largely depends on - the economic downturn, which is reflected in the 25.3% decrease in GDP over this period. Consequently, during the last decade (2007-2017) no further release of economic growth from the production of GHG emissions is observed.

Concerning **climate change adaptation**, there are no substantial developments in relation to the situation reflected in the SoER 2018. The National Commission (involving the relevant Ministries, NGOs, economic actors and the academic community) aiming at safeguarding the horizontal integration of climate change adaptation policies into sectoral development policies has not yet worked. Correspondingly, all regional plans have been delayed and are expected to be completed by 2020.

Of primary importance for the steady decrease of GHGs over the next decade is the implementation the measures envisaged in the National Plan for Energy and Climate (Decision of the Governing Council of Economic Policy no. 4/2019 "Ratification of the National Plan for Energy and Climate (Crucial to the National Plan for Energy and Climate", B' 4893) in order to lead the economy to gradual decarbonization and in particular the electricity production to be detached from the lignite. Accordingly, the measures envisaged in the National Strategic Transport Plan should be implemented once their compatibility with the National Energy and Climate Plan is ensured. Particularly in the transport sector, it is crucial to promote electrification through financial incentives initially for

business vehicles, tax incentives, green public procurements, etc. (focusing on multi-kilometer sectors such as taxis and rental vehicles) and the necessary development of charging station network.

Further, it could be examined the feasibility of measures such as:

- the adoption of a climate change law that will provide a comprehensive coherent framework for both adaptation and emissions reduction. This law could highlight through their explicit and unambiguous institutionalization the elements of the National Plan for Energy and Climate, the long-term goal of reducing the country's emissions for 2050, as well as intermediate milestones (development of long-term national strategy and road map with regular review every five years), targets for selected sectors (e.g. electricity, transport etc.), national inventory system etc. in accordance with respective laws of other EU MS,
- the continuation of reducing the use of fossil fuels in electricity production by promoting the interconnection of the electricity transmission network of non-interconnected islands with the one of the mainland and, in islands where interconnection is not advantageous, developing RES with battery storage systems to store the electricity produced,
- the preparation for the timely claiming activation and utilization of the Special Fund for Greece created by par. 9 of the Article 10a of the Directive 2003/87 as amended by the Directive 2018/410[1] which gives up to "25 million emissions[2] allowances to co-finance up to 60% of the detachment of the islands electricity supply from carbon emissions" for the period 2021-2030,
- the continuation and further strengthening of savings policies with emphasis on the renovation of the building stock, both public and private,
- in the above direction of promoting energy savings, it is proposed to introduce incentives (e.g. income tax deduction etc.) for the installation and use of solar water heaters in dwellings where feasible (for morphological reasons). The measure will also bring economic benefits since a large part of the market is covered by Greek water heaters,
- the revision/improvement of the general building regulation for the construction of buildings targeting at achieving zero emissions,
- the support of lignite areas with development actions to help alleviate any problems in the local economy by closing lignite plants – development of a fair transition plan in cooperation with local communities by utilizing national and EU resources,
- the promotion of biogas plants (solving simultaneously the problem of waste management of farm facilities by simplifying their licensing procedures, the full activation of Ministerial Decision 166640/2013 and examining the possibility of compulsory shipment of waste from the above facilities to biogas plants, according to the Cypriot model.
- the review of the Forest Reference Level (FRL) as soon as the new forest inventory is completed to properly reflect the existing situation and a parallel retrospective correction of national reports in the EU and UNFCCC,
- the further enhancement of the climate change dimension (mitigation and adaptation where appropriate) in Environmental Impact Studies, possibly by gradually introducing a zero-carbon obligation for new large projects (subcategory A1) by taking compensatory measures wherever possible,
- the completion of regional climate change adaptation plans,

[1] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32018L0410&from=EN

[2] worth of about €625 mil. at current prices

- the hierarchy of the proposed measures based on cost-benefit analysis,
- η ιεράρχηση των προτεινόμενων μέτρων με βάση ανάλυση κόστους – οφέλους
- in addition to regional adaptation plans, the definition of sectoral policies (e.g. agriculture, tourism, etc.) that require acting at national level,
- the full use of "LIFE IP AdaptInGR - Boosting the implementation of adaptation policy across Greece"[3] to enhance the implementation of the National Strategy and the 13 Regional Plans for Adaptation to Climate Change during the current 1st cycle of adaptation to climate change (2016- 2025) and prepare for the transition to the 2nd round of adaptation policy (2026+), with appropriate actions at national, regional and local level.

[3] https://www.adaptivegreece.gr/el-gr/