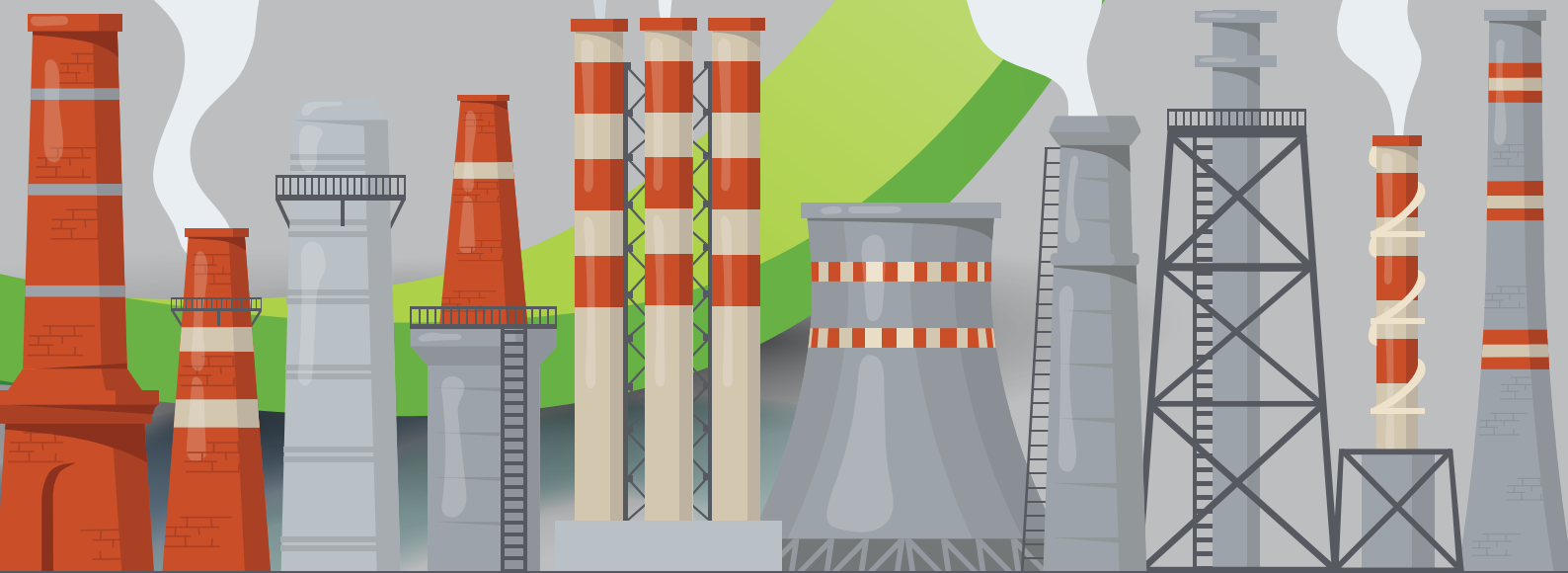


JULY 2021

# Trends in the Emissions Trading System in the EU and in Greece



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## Executive Summary

The EU Emissions Trading System (EU-ETS) is the flagship of the European Union (EU) climate policy. It was established in 2005 and is the first and largest carbon market in the world. It includes all EU countries, Iceland, Liechtenstein and Norway and currently covers around 40% of EU greenhouse gas (GHG) emissions from about 11,000 installations in the electricity and heat production, energy intensive industry and aviation sectors.

The main goal of the EU-ETS is to reduce GHG emissions in the sectors it covers in a cost-effective manner. Since being introduced in 2005, the EU-ETS has evolved to serve the EU's climate targets. In order to be aligned with the new EU-27 climate target to reduce GHG emissions by at least 55% by 2030 compared to 1990 levels, the EU-ETS directive is to be revised under the "fit for 55" legislative package. The European Commission's initial proposal is expected to be presented on July 14, 2021.

Understanding the course of developments to date serves as a good guide for the design of the right climate policy into the future; hence, this report analyzes the effect that the EU-ETS has had on GHG emissions reductions per sector for all EU countries (EU-27), as well as for Greece.

The study was based on the latest official data for EU-ETS GHG Emissions (2020) from the European Commission. It aims to examine the effectiveness of this economic instrument in meeting the EU's emissions reduction targets, but also to capture trends in the electricity and heat generation, energy intensive industry and aviation sectors in general.

Overall, from 2005 to 2020, EU-ETS emissions in the EU decreased by 42.3%, a considerable reduction to which the high CO<sub>2</sub> prices contributed, especially in the last two years, due to the EU-ETS. The reduction achieved in the ETS sectors by 2020, is practically equal to the target previously set for 2030 (43% compared to 2005 levels), highlighting, on the one hand, the low ambition shown by the EU a few years ago and, on the other, the potential that the EU-ETS offers in order to achieve the EU climate targets.

Analyzing the emissions by sector, it is clear that the overall decrease occurred mainly due to the decline in emissions in the electricity and heat generation sector (-42.7%, 2005-2020). On the contrary, the energy-intensive industry emissions remained at relatively stable levels with an exception of the year 2020, during which industry emissions shrank by 9.5%. Of course, this trend can be related to the pandemic and for this reason the emissions are expected to recover. Similarly to the industry, a significant decrease was observed in the aviation sector (65.6% between 2019-2020) due to the pandemic. However, aviation has a very small share of the total ETS emissions.

During the same period, Greece, reduced its total EU-ETS GHG emissions by 56.3% (from 73.7 million tons to 32.2. million tons in 2020), achieving the 3<sup>rd</sup> best performance in the EU. Similar to the rest of the EU, the reduction in total ETS emissions in Greece was achieved primarily due to the decline in the emissions of the electricity and heat generation sector and mainly during the 3<sup>rd</sup> phase of the EU-ETS (-60.3%, between 2013-2020). More specifically, emissions reduction in this sector is mainly due to the drastic reduction of lignite activity, especially since

2018, with the large increase in operating costs of the lignite plants due to the EU-ETS carbon price playing a significant role.

Part of the electricity production from lignite was replaced by fossil gas, thus causing a significant increase in emissions from fossil gas in Greece (+44% compared to 2013) and the appearance of fossil gas power plants in the list with the 10 biggest emitters in Greece during the 3<sup>rd</sup> EU ETS phase (2013-2020).

Similarly to the rest of the EU, industrial emissions in Greece remained relatively stable during the 3<sup>rd</sup> EU-ETS phase. On the contrary, during the first two phases of the EU-ETS (2005-2012), a significant decrease was observed in Greece as a result of the shrinkage of industrial activity in the country, mainly due to the financial crisis.

Taking into account both the existing Greek National Energy and Climate Plan (NECP) (-74% reduction in emissions in 2030 compared to 2005), the revised EU targets (-55% reduction in emissions in 2030 compared to 1990) and especially the long-term goal of climate neutrality by 2050, we can conclude that despite the significant progress made between 2005 and 2020 in reducing GHG emissions in the EU-ETS sectors in Greece, significant improvements are needed. The effort needs to be intensified and expanded to areas other than power generation such as the energy-intensive industry. In addition, new investments must utilize green/sustainable technologies and not different types of fossil fuels, such as fossil gas, which will increase emissions.

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## Introduction

The EU Emissions Trading System (EU-ETS) is the flagship of the European Union (EU) climate policy. It was established in 2005 to help the EU achieve the goals agreed in the Kyoto Protocol and is the first and largest carbon market in the world. It includes all EU countries, Iceland, Liechtenstein and Norway and currently covers around 40% of EU greenhouse gas (GHG) emissions from about 11,000 installations in the electricity and heat production, energy intensive industry and aviation sectors.<sup>1</sup>

The main goal of the EU-ETS is to reduce GHG emissions in the sectors it covers in a cost-effective way. For this reason, the EU-ETS was designed to be a “cap and trade” system. More specifically, there is a ceiling on GHG emissions that can be emitted by the participating facilities for a certain period of time. The units then purchase (or receive for free) a certain number of GHG emission allowances. At the end of the given period of time, every facility must hand over the emission allowances corresponding to its emissions. In case a facility has a surplus of allowances, it can sell them to other facilities/companies earning revenue or keep them to meet its future needs.

Therefore, the advantages of the EU-ETS can be summarized as follows<sup>2</sup>:

- By setting an ever-decreasing emission cap, the achievement of the environmental targets set is ensured.
- The carbon price is set through trading emission allowances, giving flexibility to the market and ensuring that the emission reductions are achieved in the least costly way.
- Emission allowance auctions provide governments with a new source of revenue, part of which must be channeled to tackle the climate crisis.
- The risk to the Member States budget is minimized.

The EU-ETS has evolved through four distinct phases since its launch in 2005. This evolution concerns both the sectors it covers and more detailed characteristics, such as the allowances allocation method, the emission cap reduction rate, the mechanisms for the regulation of market surpluses, the funds that utilize revenues from the auctions, etc. In particular, the phases of the EU-ETS are the following<sup>3</sup>:

1<sup>st</sup> phase (2005-2007): It was the first and the test phase of the EU-ETS, which included only the electricity and heat generation and the energy-intensive industry sectors. During this period most of the allowances were distributed for free.

2<sup>nd</sup> phase (2008-2012): The second phase of the EU-ETS included for the first time the aviation sector within the European Economic Area (EEA). However, also in this phase, about 90% of the allowances were distributed for free.

3<sup>rd</sup> phase (2013-2020): The big difference in this phase, which also includes the electricity and heat generation, energy-intensive industry and domestic aviation sectors, was that the majority

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<sup>1</sup> European Commission. EU Emissions Trading System (EU ETS). <https://bit.ly/3qmgF2M>

<sup>2</sup> European Union. 2015. EU ETS Handbook. <https://bit.ly/3gOVZgr>

<sup>3</sup> E3G. 2021. The EU ETS: From cornerstone to catalyst. <https://bit.ly/3vTf4SW>

of GHG emission allowances was distributed through auctions (57%). Especially for the electricity and heat generation sector, almost all of the allowances were distributed in this way, with the exception of some power plants in 10 Member States. However, also in this phase many allowances were distributed to the energy-intensive industry for free.

4<sup>th</sup> phase (2021-2030): Based on the latest revision of the EU-ETS directive<sup>4</sup>, the percentage of allowances offered through auctions has been maintained at 57%. However, the reduction rate of the emission cap was increased from 1.74% in the 3<sup>rd</sup> phase to 2.2%, a market stability reserve to keep the market stable, and a new special fund for the modernization of energy infrastructure in eligible Member States (Modernization Fund) were established. The practice of free allowances distribution under specific conditions for various installations was extended to 2030.

The existing directive that governs the EU-ETS during its 4<sup>th</sup> phase is compatible with EU's previous 2030 target of a 40% GHG emission reduction compared to 1990. In order to be aligned with the new EU-27 2030 climate target to reduce GHG emissions by at least 55% compared to 1990 levels, the EU-ETS directive is to be revised under the "fit for 55" legislative package. The European Commission's initial proposal will be presented on July 14, 2021.

Understanding the course of developments to date serves as a good guide for the design of the right climate policy into the future; hence, this report analyzes the data of the GHG emissions from the installations covered by the EU-ETS since its launch, in 2005, until the end of its 3<sup>rd</sup> phase, in 2020, at both EU-27 and national levels, focusing on Greece. The analysis uses the latest available data (2020) for the EU-ETS GHG emissions published by the European Commission<sup>5</sup> and the European Environment Agency<sup>6</sup>

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<sup>4</sup> Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814. <https://bit.ly/3d3WCjY>

<sup>5</sup> European Commission. 2020. Verified Emissions for 2020. <https://bit.ly/3zSnk8Y>

<sup>6</sup> EEA. 2021. EU Emissions Trading System (ETS) data viewer. <https://bit.ly/3hMoLxL>



## EU-ETS Emissions in Europe

While analyzing the EU-ETS emissions in the EU-27, it can be observed that all Member States reduced their emissions between 2005 and 2020 at rates ranging between 15% and 58%. Overall, the emissions fell from 2.065 billion tones in 2005 to 1.191 billion tones in 2020<sup>7</sup>. The percentage decrease of 42.3% between 2005 and 2020 was practically equal to the target set by the EU-28 in 2014 to be achieved in 2030 (-43%)<sup>8</sup>, highlighting, on the one hand, the low ambition shown by the EU a few years ago and, on the other, the potential that the EU-ETS offers in order to achieve the EU climate targets.

The reduction of GHG emissions between 2019 and 2020 were significant. Notably, 2020 was the year of the pandemic, during which renewables exceeded fossil fuels in electricity generation, while emissions in the sectors of the EU-ETS decreased by 248.8 million tones (-17.3%).

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<sup>7</sup> Data on a few installations in some Member States for 2020 are missing, with most notable the lack of some data regarding installations in Bulgaria

<sup>8</sup> European Council. 2014. European Council (23 and 24 October 2014) – Conclusions. <https://bit.ly/3zLwSCV>

## Comparison among Member States

In addition to total emissions at EU-27 level, changes in emissions per Member State are also examined. Percentage changes of GHG emissions in 2020 compared to 2019 and 2005 per EU-27 Member State are presented in

Figure 1.

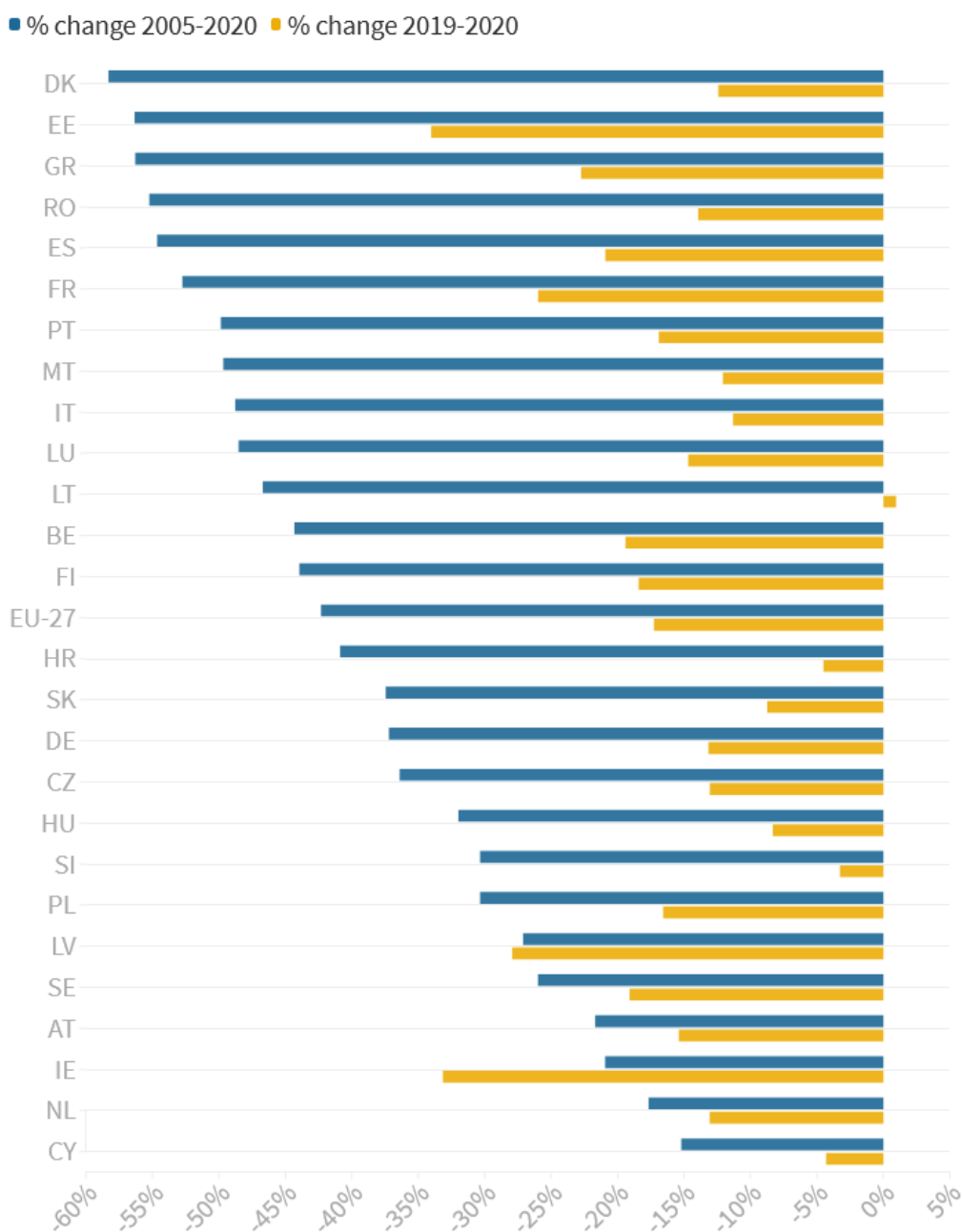


Figure 1: Percentage change in GHG emissions per Member State in 2020 compared to 2005 and 2019.

Greece had the 3<sup>rd</sup> largest decrease in emissions included in the EU-ETS since its launch, in 2005, until the end of its 3<sup>rd</sup> phase, in 2020, emitting 56.3% less GHGs (from 73.7 million tonnes in 2005 to 32.2 million tonnes in 2020), while it was the 5<sup>th</sup> among EU-27 Member States in the percentage reduction between 2019 and 2020 (-22.8%).

The largest percent decrease was achieved by Denmark (-58.3%), while between 2019 and 2020 Estonia was the champion reducing its emissions by 34%. Laggards in emission reductions between 2005 and 2020 were Cyprus (-15.2%), the Netherlands (-17.7%) and Ireland (-20.9%), while the worst performances last year were from Lithuania (+1%), Slovenia (-3.3%) and Cyprus (-4.3%).

Between 2019 and 2020, with the exception of Lithuania which increased its emissions by 1%, all other Member States decreased their emissions between 3.3% and 34%.

## Sector comparison

In addition to examining total emissions per Member State, the analysis of emissions per sector for the EU-27 is also of interest. It is observed (Figure 2) that fossil fuel burning for electricity and heat generation (hereafter combustion in the relevant figures) had, by far, the largest share in the EU-ETS GHG emissions, ranging between 59.2% in 2020 and 71.6% in 2009, followed by industry with shares between 27.5% in 2012 and 39.1% in 2020, while aviation within the EEA had a smaller share between 2.9% in 2020 and 6.4% in 2019.

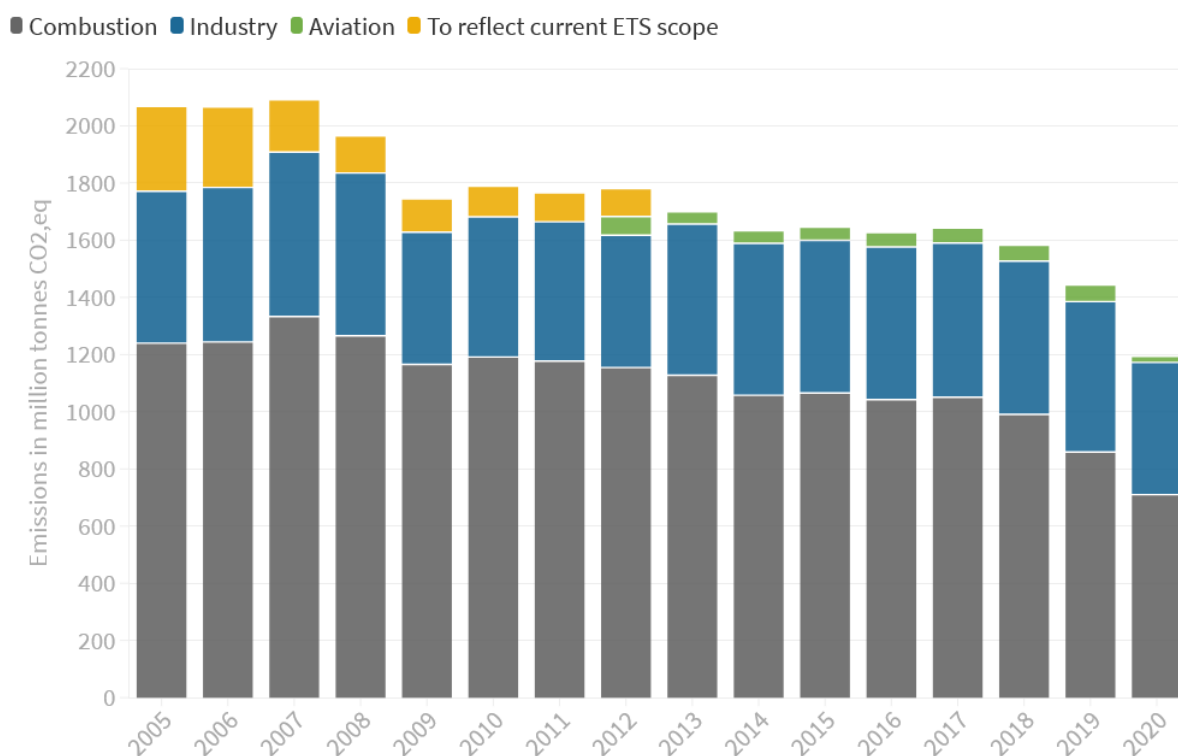


Figure 2: EU-ETS GHG emissions distribution per sector in the EU-27 for the period 2005-2020. The emissions of installations not included in the EU-ETS until 2012, are shown in yellow.

Emissions from electricity and heat generation fell from 1.24 billion tonnes in 2005 to 710 million tonnes in 2020 (-42.7%), while the reduction of emissions from industry was much smaller from 531.6 million tonnes in 2005 to 463.3 million tonnes in 2020 (-13%). Figure 3 shows the percentage change per sector for the period 2005-2020.

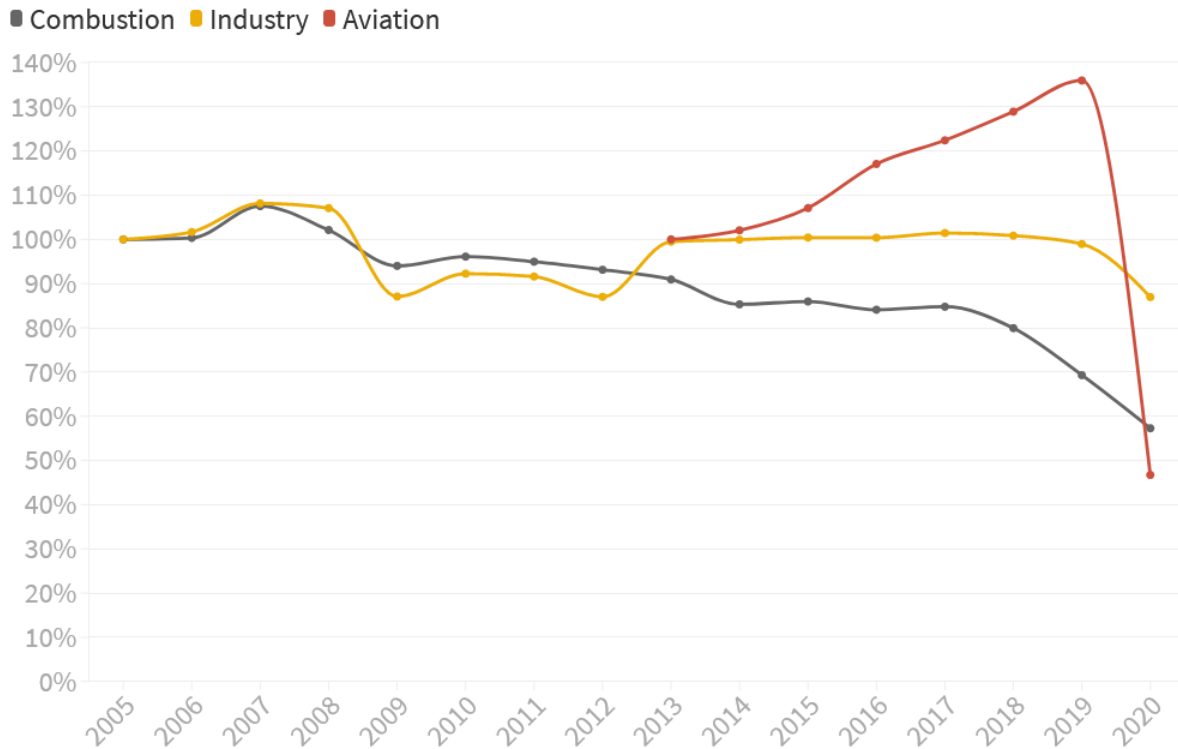


Figure 3: Emissions percentage change by sector, with 2005 as a base year for combustion power plants and energy-intensive industry and 2013 for aviation.

From both figures (Figure 2, Figure 3), it appears that the greatest reduction in industry emissions occurred between 2019 and 2020 and coincided with the reduction of economic activity due to the pandemic crisis. On the contrary, the emissions reduction in the electricity and heat generation sector was more systemic and took place gradually, increasing its rate after 2013, when most power plants were forced to buy emission allowances from the EU-ETS. This has not been the case for industry, to which a large number of free allowances was distributed, especially during the period 2008-2012 to avoid the risk of “carbon leakage”<sup>9</sup>. As a result of these choices, the percentage emissions reduction from energy-intensive industries between 2005 and 2019 was only 1%.

GHG emissions from aviation have been steadily increasing since the start of the 3<sup>rd</sup> EU-ETS phase, in 2013, and peaked in 2019 reaching 55 million tonnes, 36% more than 2013. However, the drastic reduction of air travel after the first two months of 2020 led to the sinking of the respective emissions, which decreased by 53.3% compared to 2013 and by 65.6% compared to their peak in 2019.

<sup>9</sup> Carbon leakage is the increase in GHG emissions in one country due to emission mitigation measures in another. In this case, it refers to the risk of relocating activities, mainly industrial, to countries outside the EU and EEA, where conditions are not as strict as in the EU-ETS.

## The role of lignite and coal

The above-mentioned reduction in emissions in the electricity and heat generation sector is largely due to the reduction of coal combustion, including both lignite and hard coal. As can be observed analyzing data from the “Europe Beyond Coal” campaign database, as shown in Figure 4, these fuels had the lion’s share of the sector emissions with rates ranging between 52% (2020) and 66% (2015). The decrease of emissions was observed following the 2015 Paris Agreement, which was followed by major reforms in the EU-ETS directive.

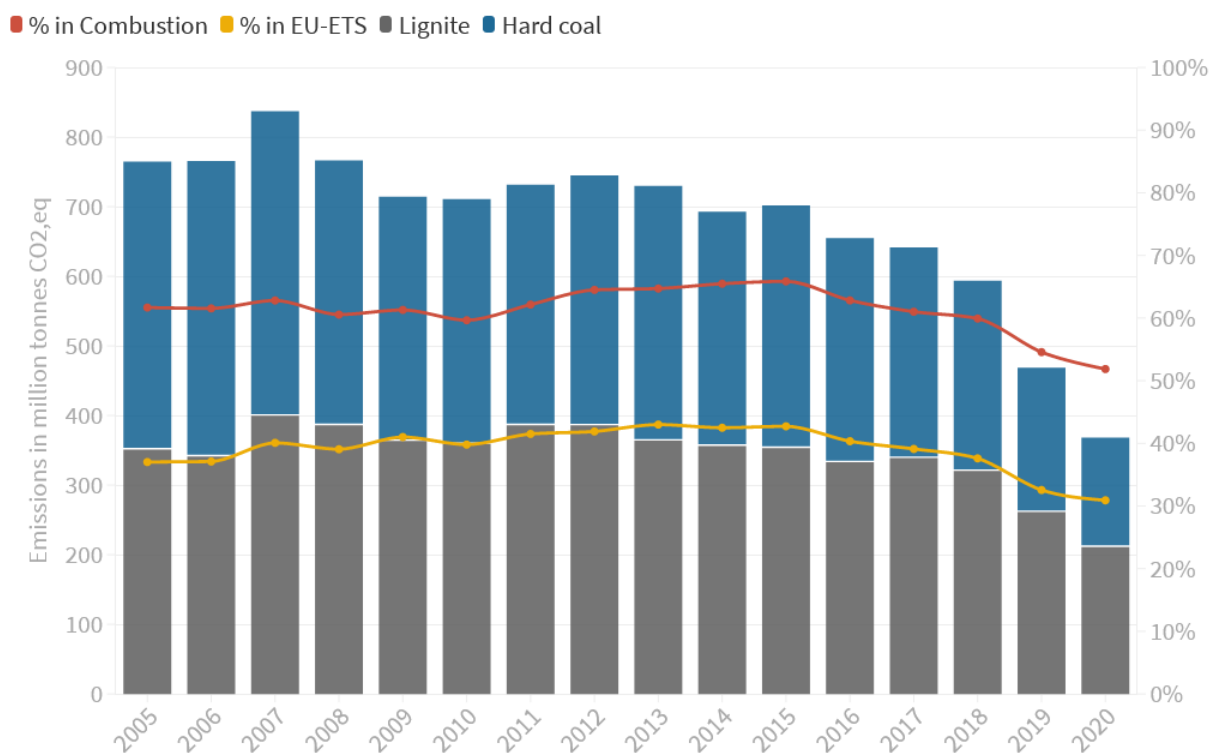


Figure 4: Emissions from all EU-27 lignite and hard coal power plants<sup>10</sup> as well as their share in the electricity and heat generation sector (red) and in total in the EU-ETS (yellow).

More specifically, emissions from solid fossil fuels were reduced by 51.8% between 2005 and 2020. Most of this reduction took place during the 3<sup>rd</sup> EU-ETS phase (2013-2020), when lignite and hard coal plants were required to pay for CO<sub>2</sub> emissions, leading to a 49.5% reduction of their emissions

In addition, it is interesting to note that while in the first years of EU-ETS hard coal was leading in emissions among solid fossil fuels, subsequently lignite, a more polluting fuel (per unit of energy produced) took the lead. In 2020, 57.6% of the emissions from solid fossil fuels came from lignite combustion.

The contribution of each country to the reduction of emissions from coal, which has played an important role in the improvement of EU-27 climate performance, is worth further analysis. Figure 5, shows that the largest percentage decrease in lignite and hard coal emissions

<sup>10</sup> Europe Beyond Coal.2021. Database. <https://bit.ly/3qwuYSt>

(presented jointly as coal emissions) between 2005 and 2020 was achieved by Belgium, Sweden and Austria, which phased-out coal completely by 2016, 2020 and 2020 respectively. Spain (-91.4%), France (-85.7%) and Ireland (-84.8%) follow.

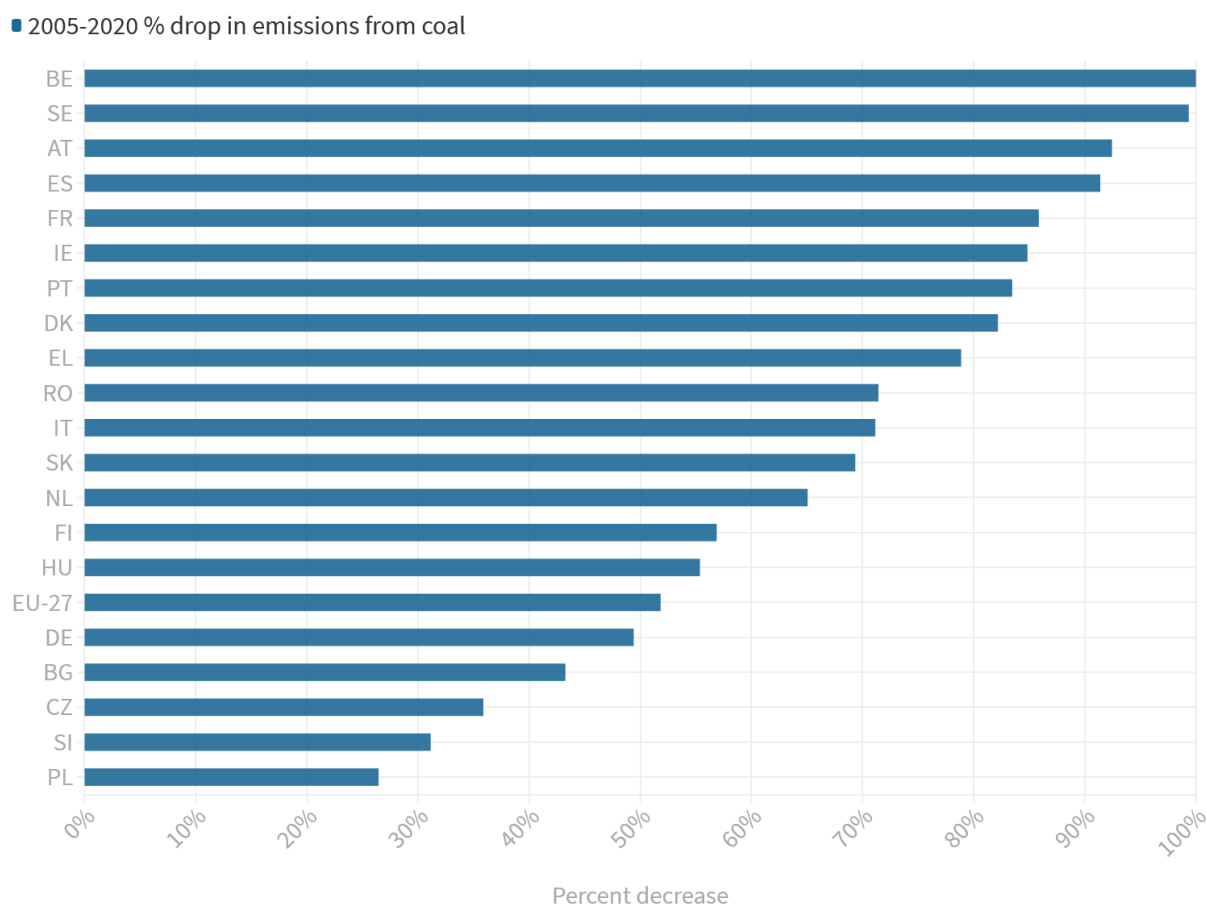


Figure 5: Percentage decrease in GHG emissions per EU-27 Member State.

First among the coal-producing countries was Greece, reducing its emissions from 43 million tonnes GHG in 2005 to less than 9.3 million tonnes in 2020, a decrease of 78.9%. Percentage emissions reductions in the other major coal producing countries of the EU-27, Germany Bulgaria, Czechia and Poland were below the EU-27 average, -49.4%, -43.3%, -35.9% and -26.5% respectively<sup>11</sup>.

The future course of the use of lignite and hard coal in the EU-27 Member States depends on various factors, such as the forthcoming changes in EU legislation under the “fir for 55” package, the evolution of cost of other power generation technologies and national policies. However, by utilizing data from the EU-ETS and applying the linear regression method, it is possible to estimate the year of complete coal phase-out for each Member State and the EU-27 as whole. Figure 6 shows these forecasts on the basis of calculations using emissions data from the 3<sup>rd</sup> EU-ETS phase (2013-2020) as a whole, and using only more recent data, after the Paris Agreement (2016-2020). Given that the changes in the EU legislation, which led to the drastic reduction in the use of solid fossil fuels, took place following the Paris Agreement, the first set of forecasts,

<sup>11</sup> To fill in the 2020 missing data from lignite and hard coal power plants in Bulgaria, the average emissions of the previous two years for the same plants were used.

based on data from the entire 3<sup>rd</sup> phase of the EU-ETS can be considered as conservative, while the second as the most compatible with current trends, which are characterized by large reductions in solid fossil fuel power production.

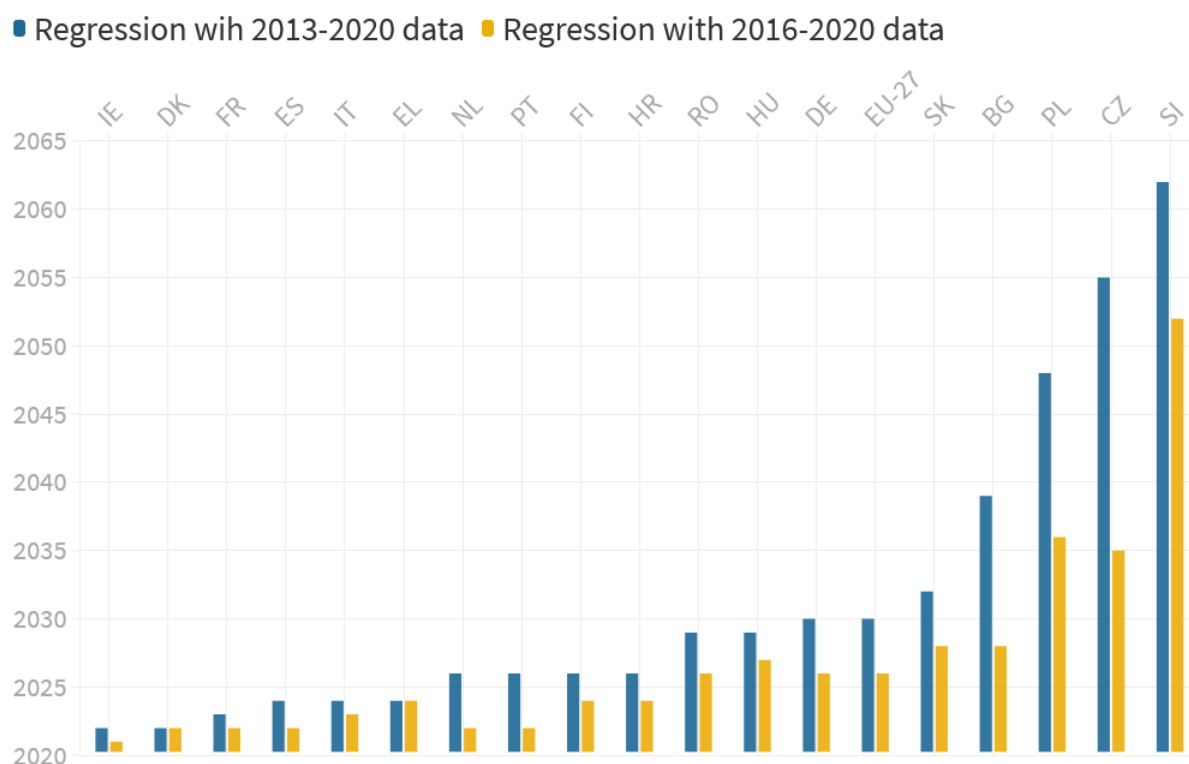


Figure 6: Estimation of complete coal phase-out year for each Member State and the EU 27 applying the linear regression method.

When more recent data (2016-2020) are used, the EU-27 is predicted to be completely coal free in 2026, while in the more conservative scenario, where data from 2013 to 2020 are used (when the lignite use was still high), the year of complete coal phase-out for the EU-27 does not go beyond 2030.

Similar to the EU-27, the same predictions apply also for Germany, which currently holds the first place among the EU-27 in terms of total coal GHG emissions. Even the more conservative prediction for a coal phase-out by 2030, which based on the EU-ETS entire 3<sup>rd</sup> phase data, is in contrast to 2038, the set year of complete coal phase-out in Germany<sup>12</sup>.

Moreover, based on the latest trends following the Paris Agreement (2016-2030), it is predicted that all EU-27 Member States will be coal-free by 2028 with the exception of the following three Member States: Czechia (2035), Poland (2036), and Slovenia (2052). In the more conservative estimate, based on the entire 3<sup>rd</sup> EU-ETS phase data (2013-2020), the following five Member States are projected to extend the use of coal beyond 2030: Slovakia (2032), Bulgaria (2039), Poland (2048), Czechia (2055) and Slovenia (2062). However, it is noted that Slovakia is already committed to a complete coal phase-out by 2030<sup>13</sup>, while recently the government of Czechia

<sup>12</sup> The Library of Congress. 2020. Germany: Law on Phasing-Out Coal-Powered Energy by 2038 Enters into Force. <https://bit.ly/3qkq5eR>

<sup>13</sup> PPCA. 2020. Slovakia coal phase-out. <https://bit.ly/3Ahcny5>

rejected the proposal of the committee in charge for complete phase-out by 2038, calling for a more forward-bearing delignitization<sup>14</sup>.

In both cases, Greece is expected to be completely lignite-free by 2024, an estimate that roughly coincides with the official planning of the Greek Power Production Corporation (PPC)<sup>15</sup>.

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<sup>14</sup> Reuters. 2021. UPDATE 1-Czech government parties fail to agree on 2038 coal phase-out target. <https://reut.rs/3qCxtT7>

<sup>15</sup> The Green Tank. 2021, April 23. Greece brings coal exit forward three years to 2025. <https://bit.ly/2UYczCb>



## **EU-ETS Emissions in Greece**

Greece's performance in the sectors covered by the EU-ETS has been significantly better than the EU average as an emissions reduction of 56.3% (EU-27 average: 42.3%) has been achieved since the launch of the EU-ETS, while between 2019 and 2020 an emissions reduction of 22.8% was achieved (EU-27 average: 17.3%). However, the progress made so far in the EU-ETS is still far from the 74% emissions reduction target set by the existing Greek National Energy and Climate Plan (NECP). This target is expected to become even more ambitious in the upcoming NECP revision, so as to be in line with the new EU-27 2030 climate target to reduce net emissions by at least 55% compared to 1990 levels.

## Sector Comparison

As in the case of the EU-27, it is clear that the GHG emissions from the electricity and heat generation sector are responsible for most of Greece's emissions in the EU-ETS (Figure 7), with a share ranging between 81.3% (2011) and 62.9% (2020).

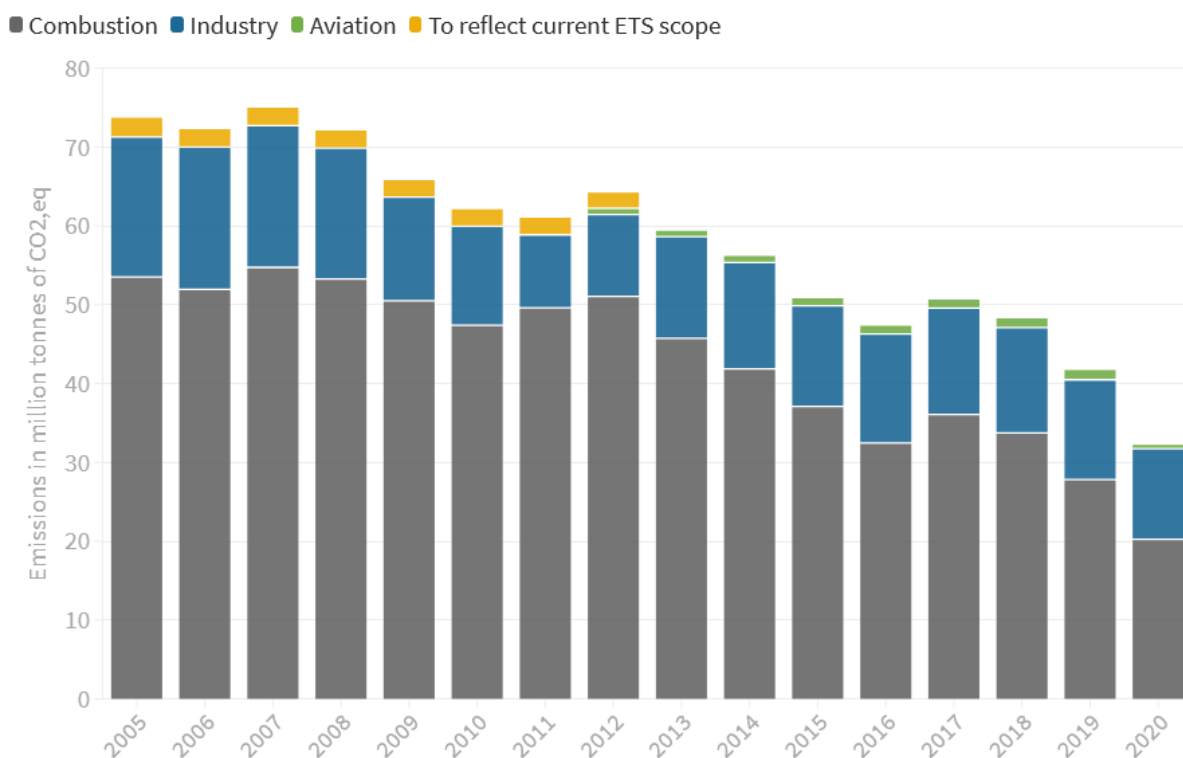


Figure 7: EU-ETS GHG emissions distribution per sector in Greece for the period 2005-2020. The emissions of installations not included in the EU-ETS until 2012, are shown in yellow.

During the first two phases of the EU-ETS (2005-2012), the share of the electricity and heat production sector in the total GHG emissions of the Greek EU-ETS, increased from 72.6% to 79.5%, while the share of the industry sector decreased from 24% to 16.2%. On the contrary, during the period 2013-2020, when total EU-ETS GHG emissions decreased more, a reduction in the share of the electricity and heat production sector from 77% to 63% and respectively an increase of the industry sector share from 22% to 35.6% were noted.

Analyzing further the emissions per sector, it can be observed that the period 2005-2020 could be divided into two sub-periods based on the observed trends (Figure 8). During the first sub-period 2005-2012 (1<sup>st</sup> and 2<sup>nd</sup> phase of the EU-ETS), the emissions of the electricity and heat generation sector remained almost stable, recording a decrease of only 4.7%. Industry emissions in Greece demonstrated a sharp decrease especially after 2008, i.e. during the financial crisis, in contrast to the stability of emissions from the energy-intensive industry in the EU (see Figure 3). Between 2005 and 2012 a reduction of industry emissions of 41.3% was noted.

In contrast, during the 3<sup>rd</sup> phase of the EU-ETS (2013-2020), the reduction of emissions in the electricity and heat generation sector was much greater (-55.7%), mainly due to the CO<sub>2</sub>

emissions allowances costs incurred. The reduction rate was gradual and accelerated after 2018. On the other hand, GHG emissions from the energy-intensive industry remained relatively stable between 2013-2019 and decreased only in 2020, when the pandemic began, leading to an overall decrease of 11.2% between 2013 and 2020.

Finally, aviation in Greece displayed an explosive increase of 66% between 2013 and 2019, much higher than the corresponding level at the EU-27, but sank in 2020 due to the pandemic, resulting in a reduction of 60% in 2020 compared to 2019 and of 43.8% compared to 2013, significantly lower than the respective EU-27 reduction for the same period (-53.3%).

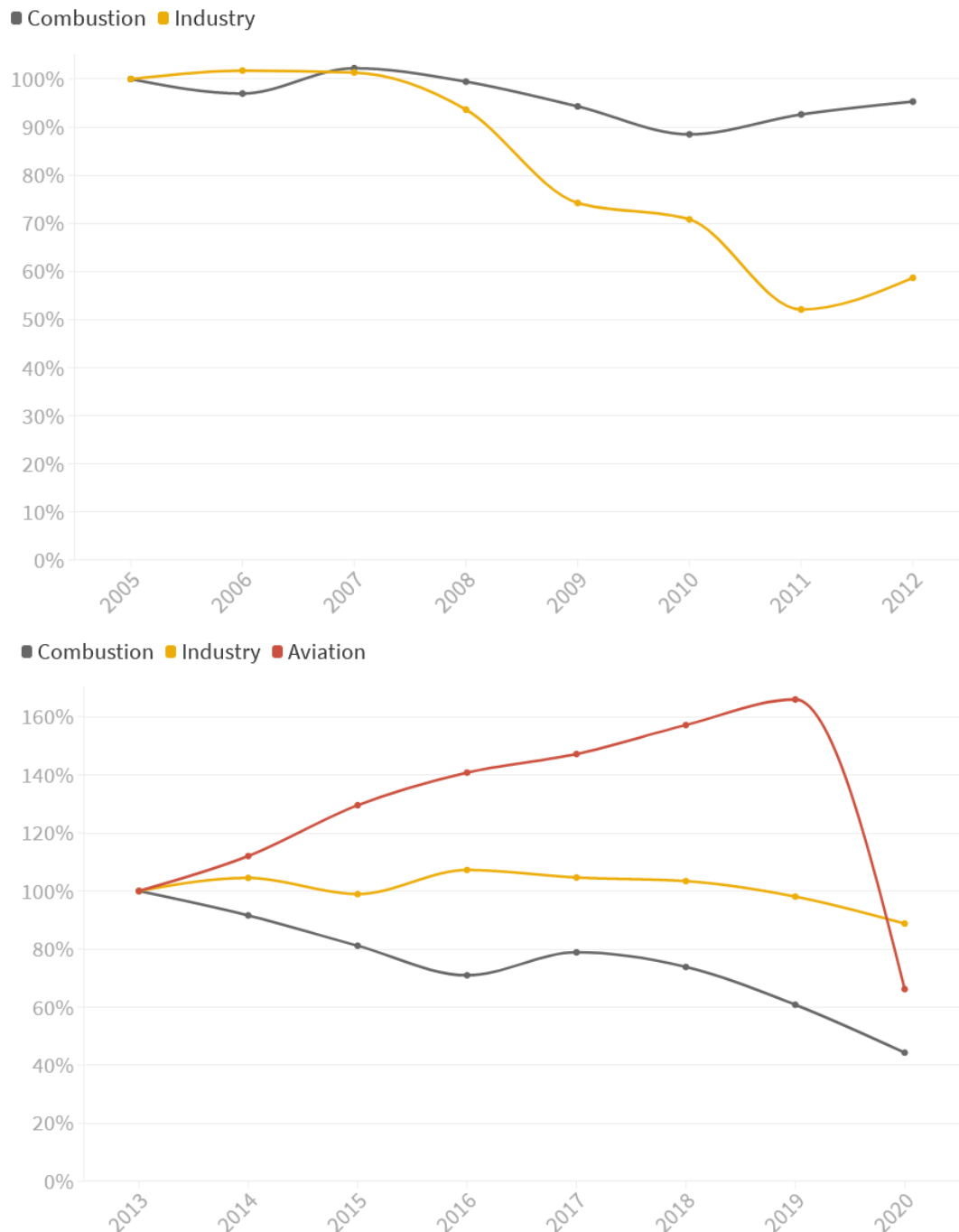


Figure 8: Emission percentage change by sector in Greece, with base year 2005 (top graph) and 2013 (bottom graph).

## Electricity and heat generation sector

The reason for the large reduction in emissions in the electricity and heat generation sector in Greece can be better understood by further analyzing the sector into sub-categories based on fuel. Figure 9 shows the evolution of emissions from lignite, fossil gas and oil plants in the period 2005-2020 in parallel with the evolution of the carbon price in the EU-ETS<sup>16</sup>.

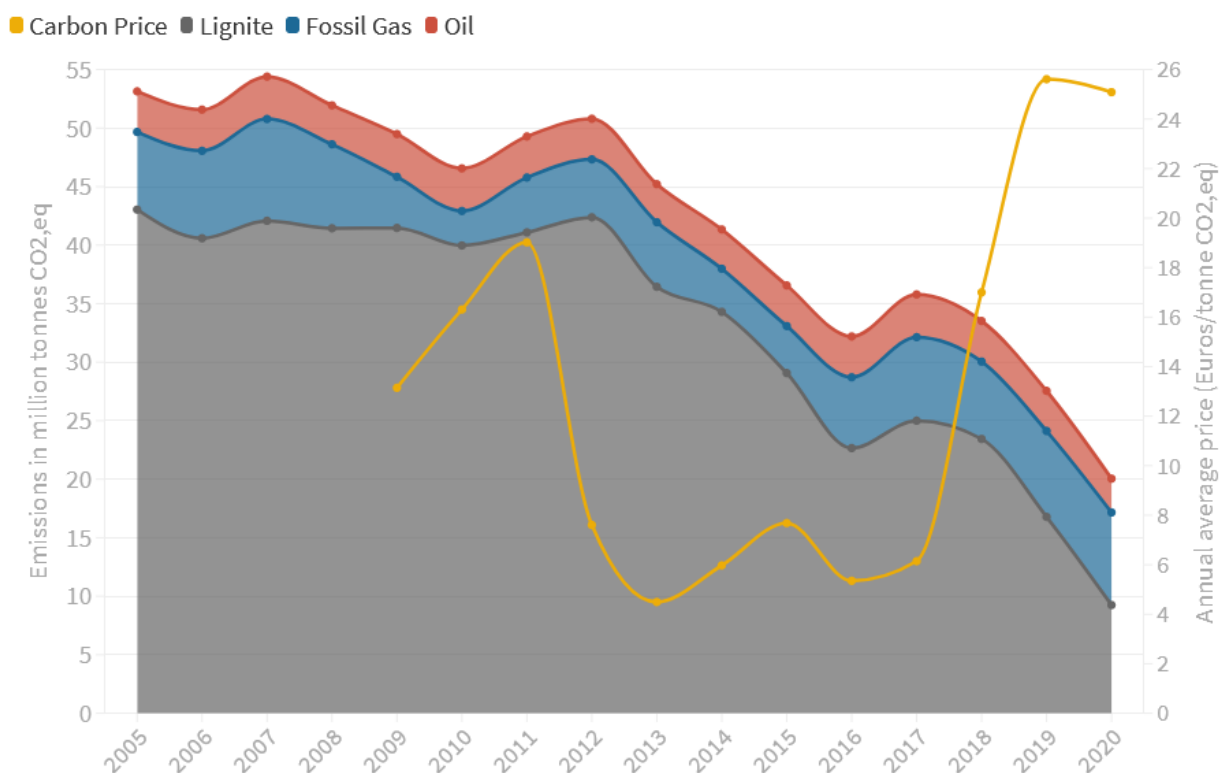


Figure 9: GHG emissions from the electricity and heat generation sector by fuel in Greece (2005-2020) and the carbon price of the EU-ETS (2008-2020)

Overall, the sector emissions decreased from 53.5 million tonnes in 2005 to 20.3 million tonnes in 2020 (-62%).

From Figure 9 it becomes clear, that from the launch of EU-ETS and until 2020, lignite had the largest contribution to CO<sub>2</sub> emissions in the sector. The PPC lignite plants emitted a total of 529 million tonnes of CO<sub>2</sub>, or 77% of the total emissions of the electricity and heat generation sector in the period 2005-2020.

Lignite production remained almost stable during the first two EU-ETS phases (2005-2012), when the vast majority of emission allowances were free; however, it began to decrease in 2013 when PPC lignite plants started to pay for their CO<sub>2</sub> emissions. Between 2013 and 2018 lignite emissions decreased by 35.7%. However, the reduction was intensified from 2018 onwards, when the prices of carbon emission allowances on the EU-ETS began to skyrocket. As a result, in

<sup>16</sup> Investing.com. Carbon Emissions Futures Historical Data. <https://bit.ly/3h8wPK3> (Assessed 1/7/2021)

the two years (2019-2020), emissions from lignite plants decreased by 61% compared to 2018 (-14.2 million tonnes), while they decreased by 45% (-7.5 million tonnes) between 2019 and 2020.

Overall, lignite emissions decreased from 43 million tonnes in 2005 to 9.3 million tonnes in 2020 (-78.9%), with the greatest share of the reduction noted during the 3<sup>rd</sup> EU-ETS phase (2013-2020) (-74.6%) and the largest annual reduction (-44.9%) between 2019 and 2020. Despite the overwhelming decline, in 2020 lignite maintained its leading position in emissions in the electricity and heat generation sector with 9.3 million tonnes CO<sub>2</sub> compared to 7.9 million tonnes from fossil gas plants. However, 2020 was the first year that emissions from the energy-intensive industry (11.5 million tonnes), surpassed the emissions from lignite plants reaching the first place in the Greek EU-ETS.

Thus, it becomes clear that the most important factor for the reduction of emissions in the electricity and heat generation sector and consequently the Greek EU-ETS as whole, during the 2005-2020, was the drastic reduction of lignite production that started in 2013 and was escalated in the period 2018-2020.

Fossil gas power plants hold the second place emitting a total of 95.2 million tonnes of CO<sub>2</sub> or 13.8% of the total emissions in the electricity and heat generation sector. These emissions fluctuate over the years reflecting the corresponding changes in both fuel costs and the regulatory framework of the electricity market. However, after 2018 and the reduction of lignite production, emissions from fossil gas plants show a steady increase, resulting in 7.9 million tonnes emissions in 2020, just 0.8 million tonnes less than in 2007, a peak year for emissions from fossil gas (8.7 million tonnes) and 19.2% more than in 2005.

Emissions from oil power plants on the non-interconnected islands remained relatively stable between 2005 and 2019, showing a small decrease of 15.7% between 2019 and 2020, which is mainly attributed to the reduction in tourism related activity due to the pandemic. The stability of oil emissions (between 3.25 and 3.65 million tonnes of CO<sub>2</sub> per year in the period 2005-2019) is a result of the very slow penetration of RES in the islands and the delays in the interconnections of the islands with the mainland electricity network, that retained the share of electricity from oil at around 80% in the power mix of non-interconnected islands<sup>17</sup>.

The result from the large reduction of lignite emissions together with the increase of fossil gas emissions is presented in Figure 10, which shows the share of each fossil fuel in the total emissions of the electricity and heat generation sector of Greece in the period 2005-2020. The lignite share decreased from 81% in 2005 to 46% in 2020, while for the same years the share of fossil gas increased from 12% to 39% respectively.

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<sup>17</sup> DEDDIE. 2020. Production report for the non-interconnected islands for December 2020. (80,2% in 2020 based on the DEDDIE report). <https://bit.ly/2SjsBpa>

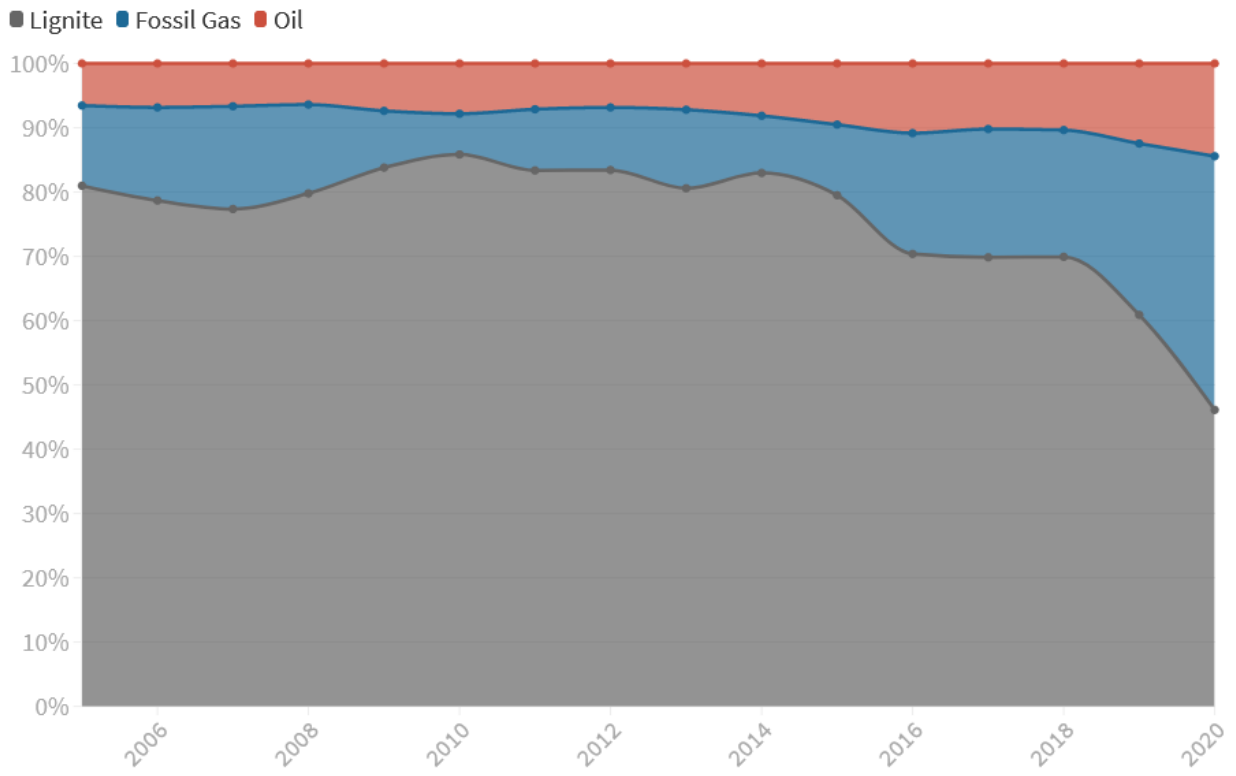


Figure 10: GHG emission share by fuel in the electricity and heat generation sector in Greece (2005-2020)

## The 10 biggest emitters

When examining the installations, that is, the participating facilities, as these are recorded in the EU-ETS, Greece's lignite power plants have emitted the largest quantities of GHGs over time. However, the ranking of the biggest emitters in Greece has changed over the years, especially during the 3<sup>rd</sup> EU-ETS phase. Figure 11 shows the ten installations that emitted most GHGs at the beginning and at the end of the 3<sup>rd</sup> EU-ETS phase (2013 and 2020), respectively.

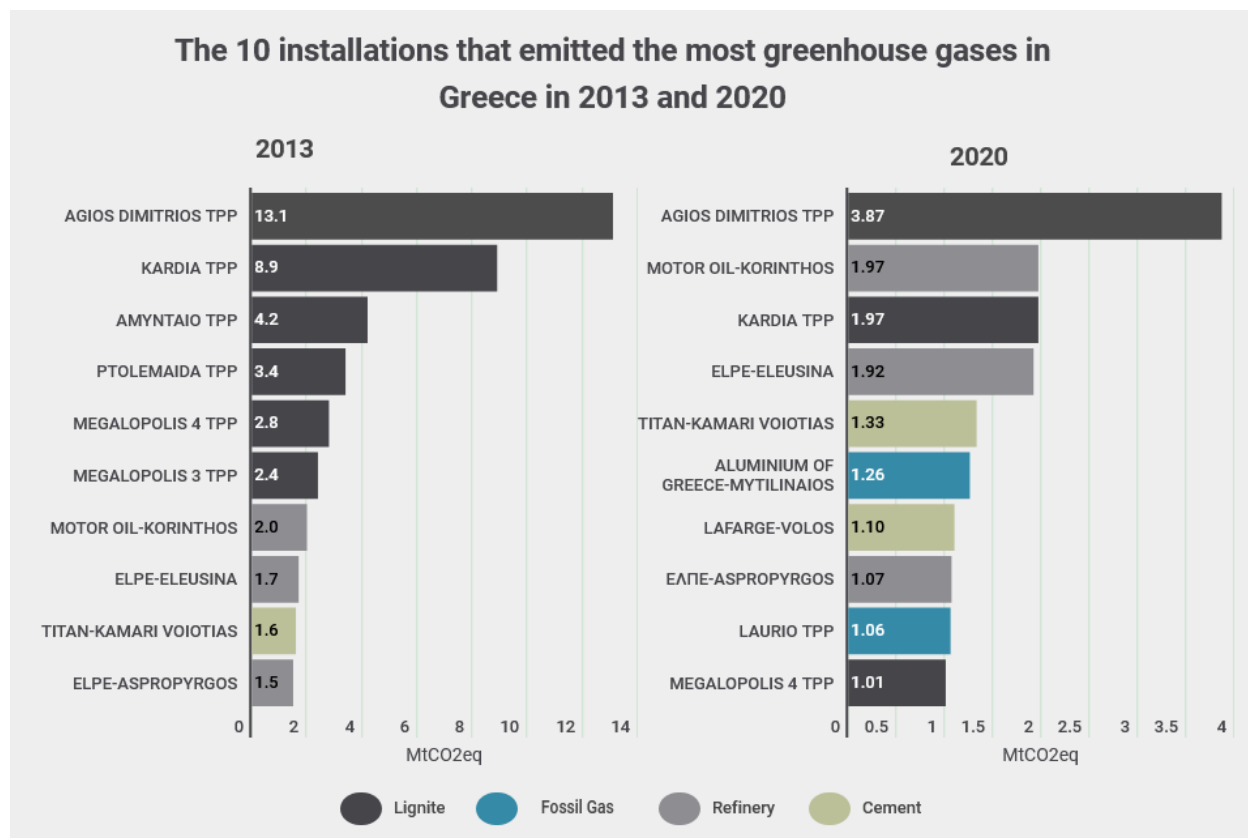


Figure 11: The 10 installations of the EU-ETS that emitted the most GHG emissions in Greece in 2013 and 2020

The lignite power plant “Agios Dimitrios” was the biggest emitter in Greece in both years. However, while in 2013 it was one of the most polluting installations in Europe, emitting 13.1 million tonnes of CO<sub>2</sub>, in 2020 it emitted 70% fewer tonnes of CO<sub>2</sub> (3.87 million tonnes). The constant presence of the energy-intensive industry on the list is also remarkable. In fact, 2020 was the first year that energy-intensive industry installations were more numerous in the top 10 emitters list than lignite power plants (2 refineries and 2 cement installations versus 3 lignite power plants). Also, 2020 was the first time during the 2013-2020 period, when two fossil gas power plants were listed among the 10 biggest emitters in Greece.

The geographical distribution of the facilities emitting the most GHG in 2020 is presented in Figure 12. As can be seen, the highest concentration of emitting facilities today is observed in Central and Southern Greece and especially in the regional units of Attica, Viotia (Boeotia) and Corinth. These three regional units collectively take the first place from the Region of Western Macedonia, where the four biggest, by far, emitters – all lignite power plants – of Greece were

located in 2013. They second place was held by the Regional Unit of Arcadia, in the Peloponnese, where the fifth and sixth biggest emitters, the lignite power plants of Megalopolis, were located.

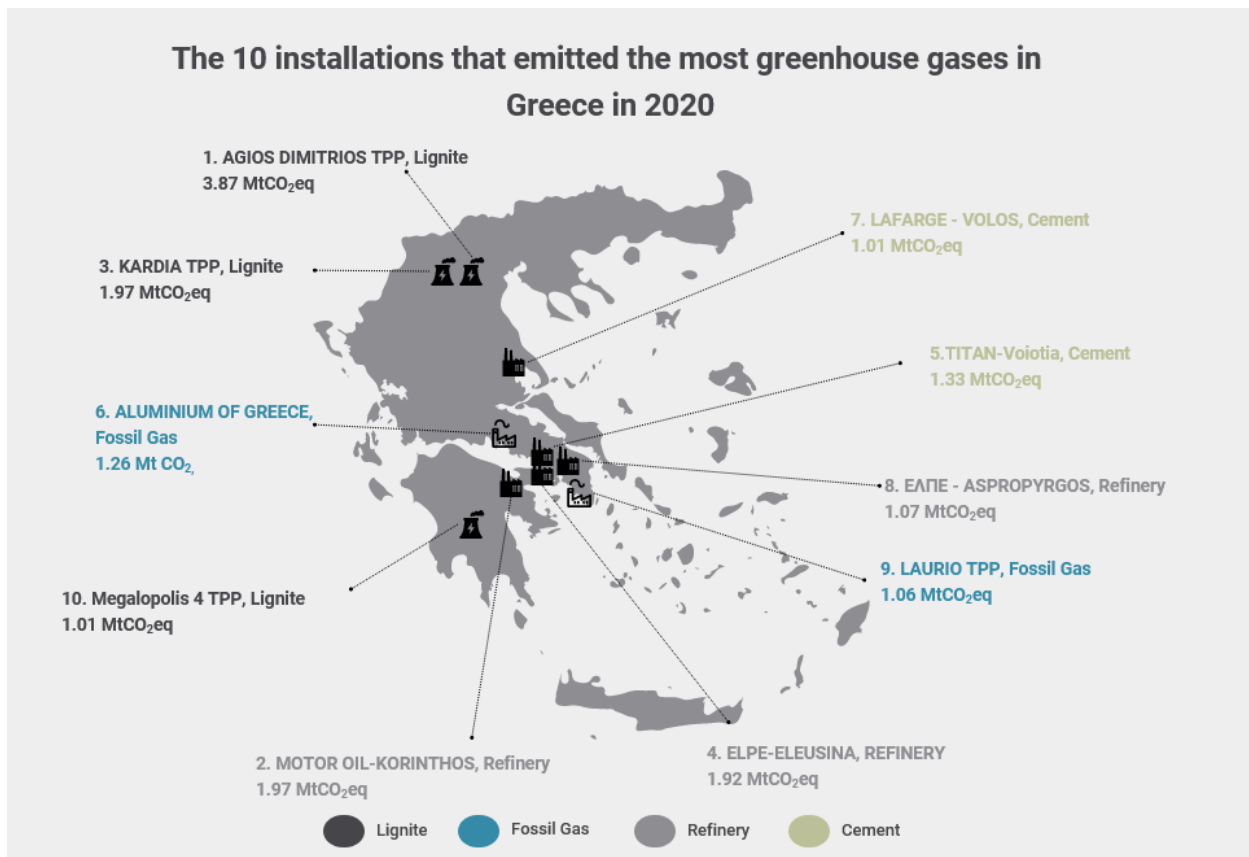


Figure 12: Geographical distribution of the 10 installations of the EU-ETS that emitted the most GHG emissions in Greece in 2020



## Conclusions – Recommendations

The official data from the European Commission and the European Environment Agency used in this analysis, showed that the EU-27 GHG emissions of the EU-ETS sectors decreased by 42.3% between 2005 and 2020. The reduction of emissions in the EU-ETS sectors until 2020 is practically equal to the target set for the EU-ETS for 2030 (43% compared to 2005), highlighting, on the one hand, the reduced ambition shown by the EU a few years ago and, on the other, the potential provided by the EU-ETS in order for the EU to achieve its climate targets.

Given the urgency of scientists' warnings to tackle climate change, it is important that the 2030 targets set under the new “fit for 55” legislative package will be much more ambitious.

The electricity and heat generation sector, which accounts for the largest share in the total EU-ETS emissions (between 59.2% and 71.5%), had the greatest contribution in the EU-27 EU-ETS emissions reduction of 42.7% between 2005 and 2020. During the same period, the emissions from the energy-intensive industry, the second most important EU-ETS sector, remained relatively stable due to the abundance of free allowances that were distributed to industries since the launch of the EU-ETS to date. An exception occurred in 2020, when the emissions from the energy-intensive industry decreased by 9.5% compared to 2019 levels due to the pandemic. Also, in 2020, the emissions from aviation decreased dramatically by 65.6% compared to 2019, while in the period 2013-2019 they were continuously rising, reaching, cumulatively, an increase of 36%.

The decline in the coal-based electricity production, which escalated especially following the Paris Agreement, had a key role in the EU-ETS emissions reduction, leading to a 51.8% reduction between 2005 and 2020. Based on emissions data from the EU-ETS and analysis using the linear regression method for these power plants for the period 2016-2020, it is estimated that the EU-27 will be coal-free by 2026, while in the most conservative scenario (based on data from the entire 3<sup>rd</sup> EU-ETS phase, 2013-2020), the phase-out from the most polluting fuels on the planet for the EU-27 is estimated to take place by 2030.

In Greece, a large reduction in EU-ETS emissions, from 73.7 million tonnes in 2005 to 32.2 million tonnes in 2020 (-56.3%), is noted. This is the 3<sup>rd</sup> best performance in the EU-27, after Denmark and Estonia. In the first two phases of the EU-ETS, facilities in Greece reduced their emissions by 9.5 million tonnes compared to 2005, a reduction attributed mainly to the decrease in the industrial activity by more than 41% due to the financial crisis and only marginally to the electricity and heat generation sector (-4.7% on the same period). However, most of the total reduction in 2005-2020 occurred during the 3<sup>rd</sup> EU-ETS phase (-32 million tonnes or -49.9%) and is attributed to the drastic reduction of emissions from the electricity and heat generation sector (-30.8 million tonnes or -60.3%) during this period. Contrary to the first two phases, emissions from the energy-intensive industry during the 3<sup>rd</sup> EU-ETS period remained relatively stable with the exception of 2020, when a decrease of 11.2% is noted, as a result of the overall decline in economic activity due to the pandemic.

The observed reduction of emissions from the electricity and heat generation sector in Greece during the 3<sup>rd</sup> EU-ETS phase is mainly a result of the obligation of power plants to pay for

emission allowances at the carbon market since 2013, in combination with the CO<sub>2</sub> price spike since 2018. PPC lignite power plants which emit about 1.6 tonnes of CO<sub>2</sub> per MWh produced, were highly affected by these conditions, resulting in a reduction of their emissions from 42.4 million tonnes in 2012 to 25 million tonnes in 2017, before starting to decline even faster, reaching 9.3 million tonnes in 2020.

Part of the rapidly declining electricity production from lignite has been replaced by fossil gas, due to the relatively low fuel cost in recent years and mainly due to the fact that fossil gas plants emit about a quarter of the amount of CO<sub>2</sub> emitted from the Greek lignite power plants per unit of power produced; making them, therefore, less vulnerable to high emissions allowance prices at the carbon market. As a result, especially from 2018 onwards, emissions from fossil gas increased reaching in 2020 the highest emissions levels since 2007.

Yet, the significant progress that has been achieved so far in the Greek EU-ETS sectors is still far from the target of a 74% reduction compared to 2005 set in the current Greek NECP for 2030. This target is also expected to become even more ambitious in the upcoming revision of Greece's NECP, aimed to align Greece with the new EU-27 2030 climate target to reduce net emissions by at least 55% reduction compared to 1990 levels.

According to the current NECP, the sectors of the Greek EU-ETS in total are projected to contribute 18.9 million tonnes in 2030, that is, 13.3 million tonnes less than the 32.2 million tonnes emitted in 2020. In particular, the electricity and heat generation sector is expected to emit only 6.6 million tonnes of CO<sub>2</sub> in 2030, while in 2020 it emitted 20.3 million tonnes, 7.9 million tonnes of which (39%) came from fossil gas power plants.

Moreover, carbon market analysts forecast further escalation of emissions allowances prices that could exceed 100 Euros/tonne over the decade<sup>18</sup>. Such price levels question the economic viability of fossil gas plants.

Therefore, in order for Greece to contribute to the new European climate target of a net emissions reduction of 55% by 2030 and do so in the best possible way for its national economy, there is a need for great care in the selection of new power generation investments. The option of fossil gas as transition fuel, is not compatible with the 2030 intermediate climate targets. It is also not in line with the long-term goal of climate neutrality by 2050, nor with the corresponding national targets of the NECP.

At the same time, investments are required to reduce the carbon footprint of the energy-intensive industry, which, with 11.5 million tonnes emissions in 2020, replaced the lignite industry as top emitters among the EU-ETS sectors. Finally, an undeniable challenge for the future is the emissions reductions in the aviation sector, for which a recovery is expected in the post-pandemic period.

The findings of the analysis above should be taken into account in the upcoming revision of the EU-ETS directive as an integral part of the "fit for 55" legislative package. The results of the

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<sup>18</sup> Carbon Pulse. 2021. POLL: Big boost for EU carbon price forecasts as several analysts see EUAs topping €100 this decade. <https://bit.ly/3h1c5Td>

analysis for the first three phases (2005-2020) prove that the EU-ETS is a highly effective tool for the implementation of EU climate policy. In addition to the significant reduction in emissions in all of its sectors, the EU-ETS was the driving force for the acceleration of the energy transition in Greece and other European countries through coal phase-outs. Thus, in the upcoming period, Greece should support the formation of an EU-ETS that will further support the transition away from fossil fuels, both in the electricity production and the other EU-ETS sectors.

