

THE RELATIONSHIP BETWEEN SMART GROWTH AND SUSTAINABLE DEVELOPMENT FROM THE EU PERSPECTIVE

İrem Yalkı Berker

Asst. Prof., Istanbul Okan University, Istanbul Okan Universitesi
Tuzla Kampusu, 34959 Akfırat Tuzla, Istanbul, Turkey, Faculty of
Business and Administrative Sciences, Department of International
Trade, irem.yalki@okan.edu.tr

Abstract

The studies that focus on smart growth obviously show that countries interpret this concept in accordance with their own structures. The aim of smart growth in the US is more about planning the cities, in other words, smart cities. However, the concept is used equivalently to developing an economy based on knowledge and innovation in the EU, as it is mentioned in the Europe 2020 Report. For both of the different concepts of smart growth, the important part is that it has to include green policies to support sustainable development. Based on this fact, greenhouse gas (GHG) emissions is a crucial indicator to analyze the countries' sustainable development policies. This study aims to examine the relationship between smart growth and sustainable development in the EU. By following the EU's smart growth concept; this research mainly analyzes GHG emissions, as it is one of the main indicators of sustainable development. The study first specifies the sectors and countries with the highest share of GHG emissions in the EU, so that the sectors that need priority can be determined for policymakers. The results figure out that the energy sector has the most significant contributions to these emissions. In addition to this, the emissions of greenhouse gases and air pollutants from final use of CPA08 products are classified and their trends are examined. Direct emissions by private households has the largest share with a percentage of 19,04% in 2017. This ranking is followed by electricity, gas, steam and air conditioning with 8,57% and constructions and construction works with 7,22%. Considering all

these information and the data, it is concluded that the EU should implement urgent and primary policies to reduce GHG emissions in the energy sector in order to achieve its smart growth, and hence sustainable development.

Keywords: Smart growth, sustainable development, greenhouse gas emissions, the EU policies

1. Introduction

The definition of smart growth is stated by EPA as: “Smart growth, covers a range of development and conservation strategies that help protect our health and natural environment and make our communities more attractive, economically stronger, and more socially diverse.”(EPA, 2019). When the literature on the concept of smart growth is examined, it is seen that countries evaluate this concept according to their needs. The EU and US have different approaches to the concept of smart growth. The aim of smart growth in the US is about smart cities and also to prevent the migration from rural to urban areas.(Naldi, Nilsson, Westlund, & Wixe, 2015). Whereas in the EU, the concept means developing an economy based on knowledge and innovation as it is mentioned in the Europe 2020 Report.(European Commission, 2010). Although smart growth is handled differently among countries, the common point is that smart growth supports sustainable development. Sustainable development has been defined in many ways, but the most commonly used definition is the one that is mentioned in the Brundtland Report, Our Common Future: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”(Brundtland Report, 1987). As it is known, sustainable development has three dimensions: economic, social and environmental; however, as the environmental dimension has gained importance in recent years, countries need to reevaluate their policies to reach their sustainable development goals.

In terms of the EU, it has divided the targets needed to achieve its sustainable development goals into 3 main growth strategy areas included smart, sustainable and inclusive growth(European Commission, 2010). It is possible to achieve development goals in

many ways, but the main target is to do it without damaging the environment otherwise the development does not mean sustainable. The EU's sustainable growth targets focus on reducing GHG emissions, increasing the share of renewable energy, and energy efficiency. Considering the three targets of sustainable development, it is clearly seen that the main target is to reduce GHG emissions, and the energy factors are the subs-factors of this goal. On the other hand, smart growth targets are deal with increasing investments in R&D, innovation, and educational problems. The last aspect is inclusive growth, which is about the employment rate and poverty and social exclusion (Eurostat, 2018).

GHG emissions must be reduced in order to combat climate change, which is the biggest problem of the last decade and consequently, the importance of R&D and innovation comes to the forefront. As this ratio increases, new business areas will emerge and thus, the EU's last target, inclusive growth, will be occurred as well. For this purpose, the study is seeking to answer "Does smart growth support sustainable development in the EU?" hypothesis. If the hypothesis is accepted then another question needs to be answered which is "Is this support sufficient and sustainable?". If the hypothesis is rejected then "How should the EU pursue a policy to accomplish the issue?" comes into question.

Therefore, the study aims to determine the GHG emission levels and specify the sectors with the highest share in the EU, so that the sectors that need priority can be determined for policymakers. In accordance with this purpose, the study uses descriptive analysis as a methodology. The outline of the study is as follows: First, the paper presents recent literature then continues with the identify the concepts of smart, sustainable and inclusive growth from the EU perspective which takes place in the third section. Then the EU's GHG emissions' shares by sectors and GHG emissions from the final use of products are determined in the fourth and fifth sections, respectively; and in the conclusion section, by taking into consideration the EU's sustainable development targets, policy recommendations are made on smart growth strategies that should be implemented. For further information, the countries must be analyzed individually. But to examine all 28 countries could be another subject for another study and is beyond the limits of this study. Therefore, the issues are evaluated based on the

total data of the EU, and only the countries with the most shares of the issues are pointed out.

2. Literature

Since sustainable development is one of the main objectives for the countries, it has been widely studied from many different aspects, so there are numerous researches on sustainable development in the literature. However, especially in the last decade, the speed of change is increasing expeditiously, so countries have to find new sustainable development models in order to achieve the acceleration and also the models have to involve smart and green policies as key factors. Otherwise, models focusing exclusively on growth will cause irreversible damage to both the economy and the environment. (International Institute for Sustainable Development (IISD), 2019). As a consequence of that, there is an ongoing debate on "the growth is really necessary?" Recent literature reviews by (Sandberg, Klockars, & Wilén, 2019) analyze the argument for green growth or degrowth using the critical social theory. The concepts have different approaches to preserve the environment. While green growth states that countries maintain economic growth in an environmental framework, degrowth does not prioritize growth and specifies that it is a more social concept. Also, the study criticizes that green growth has been dominating the literature, and besides, degrowth has not adequately studied.

This paper influences from International Institute for Sustainable Development -IISD (2019), United Nations Conference on Trade and Development – UNCTAD (2019), Naldi, Nilsson, Westlund, & Wixe (2015) and Aghion, Hemous, & Veugelers (2009) as these studies based on the necessity of new economic development models for the new decade. Accordingly, these studies focus on the measurable variables and indicators needed on the matter. Modelling for Sustainable Development: New Decisions for a New Age Report states all the models about sustainable development, also in every decision that has been evaluated, have to include environmental, social and economic parameters. In addition to the necessity of modelling, it also emphasizes the importance of understanding the connections and interactions between the countries' development

goals and these parameters.(International Institute for Sustainable Development (IISD), 2019).Recently published Trade and Development Report: Financing a Global Green New Deal specifies growth rate has slowed in most developing countries, and to be able to cope with the situation, the report evaluates issues related to sustainable development in many aspects such as global trends, challenges, and finance. Furthermore, the study determines a road map for global growth and sustainable development. (United Nations Conference on Trade and Development (UNCTAD), 2019). Particularly in researches, to have variables that can be measured is a weighty matter as (Naldi et al., 2015) underline the pivotal point in their study. In order to make a literature contribution to a lack of smart growth indicators, the study states an overview of the determinants of smart growth (Naldi et al., 2015). The study addressed by (Aghion et al., 2009) emphasizes that it is impossible to maintain green growth without innovation and it also refers to the importance of governments' essential role on the subject. Even though not all these studies directly express the term "smart growth" as EU Report (European Commission, 2010) mentioned, they are all strictly related to the concept of smart growth. Hence, their coverage could be evaluated with the same meaning.

In literature "smart growth" mainly takes place from the US perspective, which refers to smart cities, and in this context, there are several recently published papers; such as (Artmann, Inostroza, & Fan, 2019; Artmann, Kohler, Meinel, Gan, & Ioja, 2019; Wang et al., 2019). In these papers, generally, two main ideas come to the fore: one of them is inhibiting migration from rural to urban areas and the other one is creating smart cities in order to optimize resource allocation.

The growing literature on smart growth, for both of the perspectives, emphasizes the negative impacts of increasing GHG emissions on sustainable development. So, reducing greenhouse gas emissions has become one of the main goals for the countries, but due to differences in the structure of the countries, the policies they determine are different from each other. In this study, the concept has been evaluated as specified by the EU Report (European Commission, 2010).

3. Smart, Sustainable and Inclusive Growth in the EU

According to the latest Eurostat report on Europe 2020 strategies (Eurostat, 2018), Europe 2020 strategy thematic areas are as follows:

- R&D and innovation
- Education
- Poverty and social exclusion
- Climate change and energy
- Employment

All these thematic areas include at least two measurable targets which take place in different growth strategies given in Table 1:

Table 1:The Europe 2020 Growth Strategies and Its' Targets

	Targets
Smart growth	- Increasing combined public and private investment in R&D to 3 % of GDP - Reducing school drop-out rates to less than 10 % - Increasing the share of the population aged 30–34 having completed tertiary education to at least 40 %
Sustainable growth	- Reducing greenhouse gas emissions by at least 20 % compared to 1990 levels - Increasing the share of renewable energy in final energy consumption to 20 % - Moving towards a 20% increase in energy efficiency
Inclusive growth	- Increasing the employment rate of the population aged 20–64 to at least 75 % - Lifting at least 20 million people out of the risk of poverty and social exclusion

Source: Eurostat, 2018.

When Table 1 is examined, it is clear that all the growth strategies and their targets are strongly related to each other, hence it is impossible to analyze them separately. Another point is, in fact, one of the

objectives of the study, the target that includes GHG emissions has particular importance among the others. The reason for this importance is that policies on GHG emissions are also at the center of the other policies which are classified into different growth strategies. So, if priority is given to policies aimed at reducing GHG

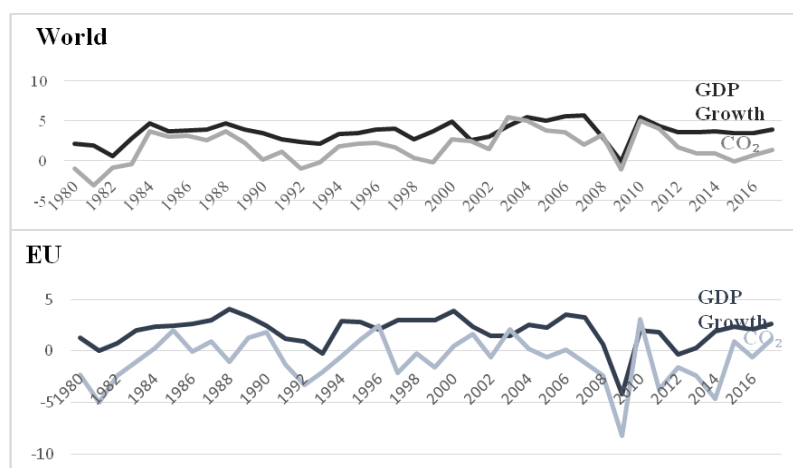


Figure 1: The Relationship Between Real GDP Growth and CO₂, Annual Percent Change

Source: IMF, 2019. & Global Carbon Atlas, 2019.

emissions, it makes a major contribution to the achievement of other targets such as creating new jobs which is about inclusive growth and creating new R&D areas to support smart growth. Despite the situation, green growth strategies substantially ignore innovation and knowledge factors (Aghion et al., 2009).

“Gross domestic product (GDP) is the market value of all final goods and services produced within an economy in a given period of time.” Although it does not take into account some important factors, it is still considered as one of the best measurements of the economy (Mankiw, 2009). In figure 1, the relationship between the real GDP growth rate and CO₂¹ is given. The graph shows how much CO₂ is released to the world when countries are producing goods and

¹Due to data availability, CO₂ data is used instead of GHG emissions. But it does not make a difference because CO₂ is the most weighted component of GHG emissions so in the graph it can represent GHG emissions.

services, in other words, how much the countries are damaging the environment. As it is clearly seen, the real GDP growth rate and CO₂ show the same trend and they are strictly related to each other. It seems in many years, the contribution to GDP growth rate and CO₂ emissions are decreasing but they are not. They are still increasing but with a less percentage than the previous year but they are still positive so, this means the increase is continuing. In 38 years from 1980 to 2017, CO₂ values have been negative in only 9 years in the world but in the EU this number is 23. On the other hand, the EU has a slower growth rate and for 2 years it has been negative. Also, the negative CO₂ rates have been on a much lower level compared to the increasing rates. Another remarkable point is that the negative growth rates have always been in the crisis and the following years. Thus, this graph is a proof that when countries increase their growth rates, as they produce more goods and services, they also harm the environment accordingly. Therefore, every policy about CO₂, are extremely associated with the growth rate.

When the world's and the EU's CO₂ values over the years is analyzed, as shown in figure 2, the world's value is increasing rapidly, while in the EU it appears to be a decline, albeit slowly. Therefore, the EU's CO₂ share in the world is gradually decreasing. In 1980 this share was close to 24%, but in the following years, there has been a continuous decline. After 1990, the share was less than 20%, and in 2005 it was less than 15%, and the latest data for 2017, it was 9.8%, which is a very low share.

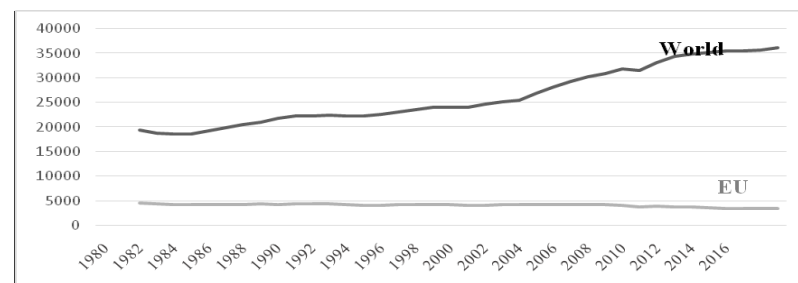


Figure 2: Territorial Emissions in MtCO₂

Source: Global Carbon Atlas, 2019.

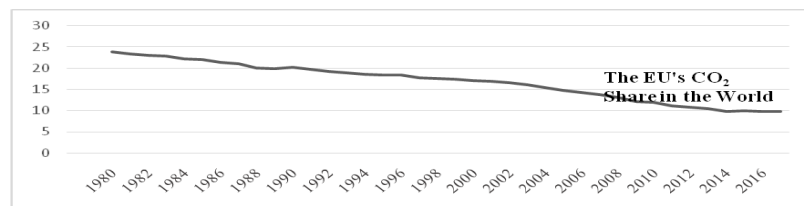


Figure 3: The EU's CO₂ Share in the World (%)

Source: Global Carbon Atlas, 2019.

The EU's one of the targets is; 20% reduction of GHG emissions compared to the level of 1990, it is seen the EU has already achieved its target, in 2016 the EU's GHG emissions were cut down by 22.4%(Eurostat, 2018). Although all these progress might seem inspired, it has to be considered that the growth rate in the EU is also slowed, especially after the global impact of the financial crisis(European Commission, 2010). As the real GDP growth rate and GHG emissions are strictly related to each other, countries have to make choices between growth or harm the environment in the short-run (Marques, Fuinhas, & Tomás, 2019). The EU has met some of its' targets with a slower growth rate, but when a higher growth rate is mentioned, is this progress will be enough in the long run?This situation reveals that a comprehensive and deeper research is needed on GHG emissions that shows its' effects on the related areas such as production process and sectors.For this purpose, in the next section, the EU's GHG emissions by source sector is analyzed.

4. The EU's GHG Emissions by Sectors

The EU's sustainable development target is primarily reducing GHG emissions. Therefore, it is necessary to first determine the areas cause the highest GHG emissions.So, policymakers can start to take action from these areas and figure4shows the EU's GHG emissions by source sector, as it is classified at the European Environment Agency, EEA.(EEA, 2019). The energy sector is the cause of most of the GHG emissions in the EU. Looking at the magnitude of this ratio,which is 73% in 2017,it seems inevitable to say,the energy sector is one of the main problems for the EU; since the energy sector is the key factor for sustainable development.This situation is forcing the economies as a form of a paradox. The countries need the energy to achieve their growth rates but, on the other hand, the energy sector is the cause of GHG emissions(Ye, Fang, Li, Li, & Chang, 2019).The EU, despite

being one of the group of countries using renewable energy the most, it remains the dominant sector, which causes the most GHG emissions.

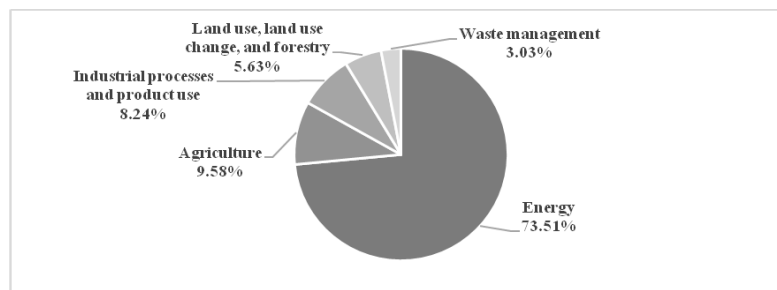


Figure 4: The EU's GHG Emissions by Source Sector
Source: Eurostat, 2019a.

The share of renewable energy in total energy has been continuously increasing over the years in the EU. In 2017, the renewable energy ratio constitutes 17.5% of the total energy consumed. The share of renewable energy in 13 of the 28 EU member states is higher than the EU's average. Sweden is the country that uses the highest level of renewable energy with a share of 54.5%. Finland, Latvia, Denmark, and Austria are following Sweden with a share of 41%, 39%, 35.8% and 32.6% respectively. On the other hand, Iceland and Norway have a share of 71% for this ratio (Eurostat, 2019b). These countries' energy policies must be investigated thoroughly as a model and implement these necessary policies for the EU's countries expeditiously to increase renewable energy rates. Thus, it is a priority for policymakers to change the structure of the energy sector and make it sustainable (Mangla et al., 2020).

When the other sectors' share is examined; agriculture, industrial processes and product use, land use, land use change and forestry, and waste management are following the energy sector, with a share of 9.58%, 8.24%, 5.63% and 3.03% respectively. Although these rates are for the year 2017, there is no significant change in this distribution over the years. In order to aiming a reduction in these rates, the resources have to be used more efficiently; and to be succeeded in this evolution, innovation and R&D investments, in other terms smart development, is one of the key factors.

Besides, not only the GHG emissions caused by the sectors but also the GHG emissions from the final use of products is a crucial matter in order to demonstrate the structure of the economies. Therefore, this issue is examined in detail in the next section.

5. The GHG Emissions from the Final Use of Products

All kinds of products and services produced in economies require the use of energy, which inevitably leads to an increase in GHG emissions (Aznar-Márquez & Ruiz-Tamarit, 2016), and specifying the highest shares that cause the most GHG emissions in this process, will lead the policymakers. Therefore, emissions of greenhouse gases and air pollutants from final use of CPA08 products, input-output analysis, is given in figure 5. As it is seen, there are two kinds of data, the data above includes direct emissions by private households for the year 2017. The other data does not take this factor into account. The difference between the two data is striking and devastating as well. The cause of the 19.04% GHG emissions is human beings, directly. This ratio represents the demand side of the GHG emissions. The mode of production must be restructured and in addition to this, consumers must be raised awareness to change their consumer behaviors. For this to occur, policymakers have to impose strict restrictions and regulations on non-renewable energy sources to be used in the production process otherwise, most of the firms will not leave their traditional production process since such a change will result in higher costs. At this point, the urgency of policies based on innovation and knowledge is also seen.

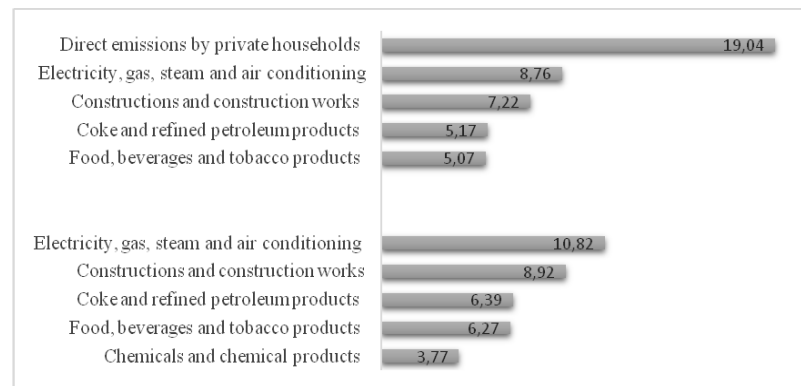


Figure 5: Emissions of greenhouse gases and air pollutants from final use of CPA08 products, input-output analysis in 2017.

Source: Eurostat, 2019c.

When direct emissions by private households does not take into account, the GHG emissions are falling down, but other factors' share does not change that means the structure of the producing is still the same. In appendix I and II, the percentages of GHG emissions from final use of CPA08 products are given. Although the rates are very low, the values they represent correspond to really high GHG emissions; and their share does not change over the years. These assessments indicate that if the EU does not change the structure of production, it is impossible to achieve its low carbon economy target in the long-run.

6. Conclusion

Especially, in the last decade, the concept of economic growth has changed. The meaning is not the traditional economic growth no longer, it has to be green growth. But on the other hand, industrialization, technology, energy, and other major issues related to economic growth is still a priority for all countries. GDP growth rate and CO₂ rate follow the same trend, it is a proof that they are robustly relevant, and it is not sustainable in the long run. In order to achieve their sustainable development goals, countries have to review and change their policies, so this new era leads countries to seek new development models in accordance with their economic structure. There is a solid progress on the subject, but it is still too slow. The EU has announced, some states have reached their 2020 GHG emission targets already, it seems like a big process, but it has to be considered that the EU's growth rate is not a high value. When the EU's GHG emissions are examined by source sectors and from the final use of products, it is clearly seen that energy and direct emissions by private households are the dominant factors; and the countries, which have the highest growth rates in the EU such as Germany, UK, France, Italy, and Poland are responsible for the most GHG emissions. The main source of the problem is the structure of the model that the growth rate and GHG emissions are strongly related to each other and thus is forcing the economies to a paradox. Actually, the solution is simple, innovation and knowledge are the crucial factors on the subject. So, it reveals the EU needs an urgent new

development model depends on clean technologies aiming to reduce GHG emissions, particularly in the energy sector, and it is impossible to change the structure without innovation and knowledge-based policies, in other words, smart growth. The EU's one of the smart growth targets is to increase combined public and private investment in R&D to 3 % of GDP, which is a very low percentage to change the structure of the models (Eurostat, 2018) and in 2017, the rate was realized as 2.7% (Eurostat, 2019d). The governments have to implement rigid smart growth policies urgently, in defiance of the time needed for the adaptation of the new clean technologies. The absence of the regulations focus on smart growth occurs that; based on the fact that no company wants to bear this transition cost willingly, the development model will remain the same. On the other hand, if the EU could implement these regulations, then it could take a leading role on the international stage as the policymakers are attached particular importance to sustainable development regarding all the aspects.

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Appendix I: Percentages of Emissions of Greenhouse Gases and Air Pollutants from Final Use of CPA08 Product– Input-Output Analysis (Including Direct Emissions by

PrivateHouseholds)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Direct emissions by private households	17,00	19,34	18,83	17,68	18,18	18,76	18,20	18,32	19,03	19,04
Electricity, gas, steam and air conditioning	9,82	10,66	10,24	9,93	10,59	10,18	9,73	9,25	8,92	8,76
Constructions and construction works	8,46	7,79	7,57	7,70	7,24	6,96	7,17	7,11	7,17	7,22
Coke and refined petroleum products	4,32	3,99	4,09	4,59	4,70	4,52	4,41	5,28	5,16	5,17
Food, beverages and tobacco products	4,75	5,04	4,88	4,91	5,12	5,10	5,21	5,14	5,12	5,07
Chemicals and chemical products	2,79	2,46	2,74	2,81	3,00	3,00	3,03	3,09	3,02	3,05
Air transport services	2,41	2,42	2,46	2,58	2,73	2,70	2,79	2,87	2,91	2,96
Motor vehicles, trailers and semi-trailers	2,87	2,41	2,79	2,93	2,88	2,85	2,90	2,90	2,89	2,90
Land transport services and transport services via pipelines	2,20	2,35	2,24	2,33	2,34	2,37	2,49	2,51	2,53	2,55
Machinery and equipment n.e.c.	2,74	2,15	2,42	2,65	2,53	2,53	2,55	2,53	2,49	2,53
Wholesale trade services, except of motor vehicles and motorcycles	2,55	2,57	2,50	2,93	2,64	2,84	2,55	2,52	2,51	2,51
Water transport services	2,38	2,12	2,18	2,29	2,26	2,22	2,23	2,33	2,38	2,38
Accommodation and food services	2,45	2,66	2,53	2,46	2,38	2,35	2,36	2,33	2,36	2,33
Public administration and defence services; compulsory social security services	2,52	2,78	2,64	2,46	2,45	2,42	2,36	2,30	2,29	2,25
Retail trade services, except of motor vehicles and motorcycles	2,49	2,70	2,61	2,53	2,21	2,17	2,28	2,25	2,24	2,22
Real estate services	2,09	2,23	2,15	2,15	2,01	2,08	2,05	2,00	1,99	1,96
Human health services	1,86	2,05	1,99	1,94	1,96	1,95	1,99	1,96	1,94	1,92
Basic metals	2,12	1,49	1,80	2,10	1,74	1,86	1,83	1,78	1,73	1,77
Products of agriculture, hunting and related services	1,30	1,30	1,31	1,34	1,40	1,39	1,47	1,44	1,44	1,44
Scientific research and development services	1,10	1,08	1,10	1,12	1,12	1,17	1,23	1,22	1,23	1,23
Textiles, wearing apparel, leather and related products	1,42	1,25	1,30	1,34	1,29	1,29	1,27	1,24	1,21	1,21
Other non-metallic mineral products	1,16	1,01	1,02	1,05	1,10	1,10	1,21	1,17	1,17	1,19
Education services	1,20	1,32	1,27	1,18	1,16	1,15	1,16	1,13	1,13	1,11
Furniture and other manufactured goods	1,23	1,09	1,13	1,11	1,05	1,05	1,08	1,08	1,07	1,07
Computer, electronic and optical products	1,45	1,11	1,26	1,18	1,11	1,09	1,04	1,03	1,01	1,03
Fabricated metal products, except machinery and equipment	1,09	0,89	0,97	0,97	0,97	0,99	1,02	1,00	0,98	1,00
Other transport equipment	1,13	0,91	1,01	0,93	0,89	0,87	0,95	0,96	0,95	0,96
Electrical equipment	1,08	0,88	0,98	1,00	0,98	0,93	0,99	0,96	0,95	0,95
Wholesale and retail trade and repair services of motor vehicles and motorcycles	0,88	0,91	0,89	0,90	0,88	0,89	0,89	0,89	0,89	0,89
Basic pharmaceutical products and pharmaceutical preparations	0,80	0,74	0,77	0,75	0,79	0,88	0,89	0,88	0,86	0,86
Residential care services; social work services without accommodation	0,75	0,83	0,81	0,79	0,78	0,80	0,83	0,81	0,81	0,80
Computer programming, consultancy and related services; Information services	0,55	0,49	0,51	0,53	0,54	0,56	0,62	0,64	0,65	0,65
Mining and quarrying	0,68	0,55	0,61	0,55	0,70	0,71	0,68	0,65	0,62	0,64
Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services	0,55	0,60	0,60	0,60	0,57	0,56	0,63	0,62	0,62	0,62
Paper and paper products	0,57	0,54	0,57	0,57	0,63	0,62	0,62	0,61	0,59	0,59
Warehousing and support services for transportation	0,50	0,51	0,51	0,53	0,53	0,54	0,54	0,53	0,53	0,54
Rubber and plastic products	0,51	0,46	0,49	0,54	0,52	0,54	0,55	0,54	0,53	0,53
Repair and installation services of machinery and equipment	0,46	0,41	0,43	0,43	0,41	0,42	0,43	0,43	0,43	0,43
Other personal services	0,39	0,42	0,40	0,40	0,42	0,43	0,44	0,43	0,43	0,42
Insurance, reinsurance and pension funding services, except compulsory social security	0,44	0,46	0,44	0,44	0,43	0,42	0,43	0,41	0,41	0,41
Telecommunications services	0,48	0,50	0,48	0,47	0,47	0,45	0,43	0,41	0,41	0,41
Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	0,37	0,41	0,40	0,38	0,38	0,38	0,39	0,39	0,38	0,38
Architectural and engineering services; technical testing and analysis services	0,36	0,33	0,33	0,36	0,34	0,33	0,35	0,35	0,35	0,36
Rental and leasing services	0,27	0,26	0,26	0,26	0,31	0,33	0,34	0,34	0,34	0,34
Sporting services and amusement and recreation services	0,35	0,38	0,36	0,34	0,35	0,35	0,35	0,35	0,35	0,34
Financial services, except insurance and pension funding	0,33	0,35	0,34	0,35	0,33	0,31	0,34	0,33	0,33	0,33
Natural water, water treatment and supply services	0,32	0,34	0,33	0,31	0,32	0,32	0,33	0,32	0,31	0,31
Publishing services	0,33	0,34	0,33	0,28	0,27	0,28	0,30	0,30	0,30	0,30
Travel agency, tour operator and other reservation services and related services	0,29	0,31	0,30	0,29	0,28	0,29	0,29	0,29	0,30	0,30
Services furnished by membership organisations	0,28	0,31	0,30	0,28	0,28	0,28	0,26	0,25	0,25	0,25
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	0,23	0,22	0,22	0,23	0,23	0,23	0,24	0,24	0,23	0,24
Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	0,29	0,29	0,29	0,26	0,24	0,24	0,24	0,24	0,24	0,23
Legal and accounting services; services of head offices; management consultancy services	0,22	0,20	0,20	0,22	0,22	0,22	0,23	0,23	0,23	0,23
Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	0,22	0,20	0,21	0,17	0,16	0,18	0,19	0,19	0,19	0,19
Fish and other fishing products; aquaculture products; support services to fishing	0,14	0,16	0,15	0,15	0,15	0,15	0,17	0,15	0,15	0,14
Other professional, scientific and technical services and veterinary services	0,10	0,10	0,10	0,11	0,11	0,11	0,12	0,12	0,11	0,11
Services auxiliary to financial services and insurance services	0,07	0,07	0,07	0,06	0,06	0,07	0,08	0,08	0,07	0,08
Repair services of computers and personal and household goods	0,07	0,07	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06
Products of forestry, logging and related services	0,05	0,05	0,05	0,05	0,05	0,05	0,06	0,06	0,06	0,06
Postal and courier services	0,05	0,05	0,05	0,05	0,05	0,05	0,06	0,06	0,06	0,06
Advertising and market research services	0,04	0,03	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04
Printing and recording services	0,06	0,06	0,05	0,05	0,05	0,05	0,04	0,04	0,04	0,04
Employment services	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Services of households as employers; undifferentiated goods and services produced by households for own use	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Services provided by extraterritorial organisations and bodies	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Appendix II: Percentages of Emissions of Greenhouse Gases and Air Pollutants from Final Use of CPA08 Products– Input-Output Analysis (Except Direct Emissions by Private

Households)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity, gas, steam and air conditioning	11,83	13,22	12,62	12,06	12,94	12,53	11,90	11,33	11,02	10,82
Constructions and construction works	10,19	9,66	9,32	9,35	8,85	8,57	8,76	8,70	8,86	8,92
Coke and refined petroleum products	5,21	4,95	5,04	5,58	5,75	5,56	5,39	6,46	6,38	6,39
Food, beverages and tobacco products	5,72	6,25	6,01	5,96	6,26	6,27	6,37	6,29	6,32	6,27
Chemicals and chemical products	3,37	3,05	3,37	3,41	3,66	3,69	3,71	3,79	3,73	3,77
Air transport services	2,90	3,00	3,03	3,14	3,34	3,32	3,41	3,51	3,60	3,66
Motor vehicles, trailers and semi-trailers	3,45	2,99	3,43	3,56	3,53	3,51	3,55	3,55	3,56	3,59
Land transport services and transport services via pipelines	2,65	2,91	2,76	2,83	2,86	2,92	3,04	3,07	3,12	3,15
Machinery and equipment n.e.c.	3,30	2,66	2,98	3,22	3,09	3,11	3,11	3,09	3,08	3,12
Wholesale trade services, except of motor vehicles and motorcycles	3,08	3,19	3,08	3,56	3,22	3,49	3,12	3,08	3,10	3,11
Water transport services	2,86	2,62	2,68	2,79	2,76	2,74	2,73	2,86	2,93	2,94
Accommodation and food services	2,95	3,30	3,12	2,98	2,90	2,89	2,89	2,86	2,91	2,88
Public administration and defence services; compulsory social security services	3,03	3,44	3,25	2,99	2,99	2,97	2,88	2,81	2,83	2,78
Retail trade services, except of motor vehicles and motorcycles	3,00	3,35	3,22	3,08	2,71	2,67	2,79	2,76	2,76	2,75
Real estate services	2,51	2,77	2,65	2,61	2,46	2,56	2,51	2,45	2,45	2,42
Human health services	2,25	2,54	2,45	2,35	2,39	2,40	2,43	2,39	2,40	2,37
Basic metals	2,55	1,85	2,22	2,55	2,13	2,28	2,24	2,18	2,14	2,19
Products of agriculture, hunting and related services	1,56	1,61	1,61	1,63	1,71	1,71	1,80	1,76	1,78	1,78
Scientific research and development services	1,32	1,34	1,36	1,36	1,37	1,44	1,50	1,49	1,52	1,53
Textiles, wearing apparel, leather and related products	1,71	1,55	1,60	1,62	1,58	1,59	1,55	1,52	1,49	1,50
Other non-metallic mineral products	1,40	1,25	1,26	1,28	1,34	1,35	1,48	1,44	1,44	1,47
Education services	1,44	1,63	1,56	1,44	1,42	1,41	1,42	1,39	1,39	1,38
Furniture and other manufactured goods	1,49	1,35	1,40	1,35	1,29	1,29	1,32	1,33	1,32	1,32
Computer, electronic and optical products	1,75	1,37	1,55	1,43	1,36	1,34	1,27	1,26	1,25	1,27
Fabricated metal products, except machinery and equipment	1,32	1,11	1,19	1,18	1,18	1,21	1,25	1,22	1,22	1,23
Other transport equipment	1,37	1,13	1,24	1,13	1,09	1,07	1,17	1,18	1,17	1,18
Electrical equipment	1,30	1,09	1,21	1,21	1,20	1,15	1,21	1,17	1,17	1,17
Wholesale and retail trade and repair services of motor vehicles and motorcycles	1,06	1,13	1,10	1,09	1,07	1,10	1,09	1,09	1,10	1,10
Basic pharmaceutical products and pharmaceutical preparations	0,96	0,91	0,95	0,91	0,97	1,09	1,08	1,08	1,06	1,06
Residential care services; social work services without accommodation	0,90	1,03	0,99	0,95	0,95	0,98	1,01	0,99	1,00	0,99
Computer programming, consultancy and related services; Information services	0,66	0,61	0,63	0,65	0,65	0,69	0,76	0,78	0,80	0,80
Mining and quarrying	0,82	0,68	0,75	0,67	0,86	0,88	0,84	0,80	0,77	0,79
Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services	0,67	0,74	0,74	0,73	0,70	0,69	0,77	0,75	0,76	0,76
Paper and paper products	0,69	0,67	0,70	0,69	0,77	0,77	0,76	0,74	0,72	0,73
Warehousing and support services for transportation	0,60	0,63	0,63	0,65	0,65	0,66	0,66	0,65	0,66	0,66
Rubber and plastic products	0,61	0,56	0,60	0,66	0,64	0,67	0,67	0,66	0,65	0,66
Repair and installation services of machinery and equipment	0,55	0,51	0,53	0,52	0,51	0,52	0,52	0,53	0,53	0,54
Other personal services	0,47	0,52	0,49	0,49	0,52	0,53	0,54	0,53	0,53	0,52
Insurance, reinsurance and pension funding services, except compulsory social security	0,53	0,57	0,54	0,53	0,52	0,52	0,52	0,50	0,50	0,51
Telecommunications services	0,58	0,63	0,59	0,58	0,57	0,55	0,52	0,51	0,50	0,50
Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	0,45	0,51	0,49	0,47	0,46	0,47	0,47	0,47	0,47	0,46
Architectural and engineering services; technical testing and analysis services	0,43	0,41	0,41	0,44	0,42	0,40	0,43	0,43	0,44	0,44
Rental and leasing services	0,33	0,32	0,32	0,32	0,38	0,41	0,41	0,42	0,42	0,43
Sporting services and amusement and recreation services	0,42	0,47	0,45	0,41	0,42	0,43	0,43	0,42	0,43	0,42
Financial services, except insurance and pension funding	0,40	0,43	0,42	0,42	0,40	0,38	0,41	0,41	0,41	0,41
Natural water; water treatment and supply services	0,38	0,42	0,40	0,38	0,39	0,39	0,40	0,39	0,39	0,38
Publishing services	0,40	0,42	0,41	0,34	0,33	0,34	0,36	0,37	0,37	0,37
Travel agency, tour operator and other reservation services and related services	0,35	0,38	0,37	0,35	0,34	0,36	0,36	0,36	0,37	0,37
Services furnished by membership organisations	0,34	0,39	0,37	0,34	0,34	0,34	0,31	0,31	0,31	0,30
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	0,27	0,27	0,27	0,28	0,28	0,29	0,29	0,29	0,29	0,29
Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	0,34	0,36	0,36	0,31	0,29	0,30	0,29	0,29	0,29	0,29
Legal and accounting services; services of head offices; management consultancy services	0,26	0,25	0,25	0,27	0,27	0,27	0,28	0,28	0,28	0,29
Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	0,27	0,25	0,26	0,20	0,20	0,22	0,23	0,23	0,23	0,24
Fish and other fishing products; aquaculture products; support services to fishing	0,17	0,19	0,19	0,18	0,18	0,18	0,21	0,19	0,19	0,18
Other professional, scientific and technical services and veterinary services	0,13	0,13	0,13	0,13	0,13	0,13	0,14	0,14	0,14	0,14
Services auxiliary to financial services and insurance services	0,09	0,08	0,08	0,08	0,08	0,08	0,09	0,09	0,09	0,09
Repair services of computers and personal and household goods	0,08	0,08	0,08	0,07	0,07	0,07	0,08	0,07	0,07	0,07
Products of forestry, logging and related services	0,06	0,06	0,06	0,07	0,06	0,07	0,07	0,07	0,07	0,07
Postal and courier services	0,06	0,07	0,07	0,06	0,07	0,07	0,07	0,07	0,07	0,07
Advertising and market research services	0,05	0,04	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Printing and recording services	0,07	0,07	0,07	0,06	0,06	0,06	0,05	0,05	0,05	0,05
Employment services	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,01
Services of households as employers; undifferentiated goods and services produced by households for own use	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Services provided by extraterritorial organisations and bodies	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00