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ANALYSIS OF THE SUSTAINABLE DEVELOPMENT GOALS (SDG) IN A SELECTED GROUP OF EUROPEAN COUNTRIES[1]

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Abstract

For this year 2020, the European Union will have managed to reach its objectives within the climate and energy framework, bringing them closer to achieving the eradication of this environmental crisis. Since 1987, the words "sustainability" and "development" have been present in every plan to combat various world problems, one of them being climate change. In 2015, the Sustainable Development Goals (SDG) were established, 17 goals aimed at solving these global problems, 6 of those being related to the environment. Apart from the SDG's, the EU has established its own climate and energy targets to sustain the achievement of these 6 environmental related goals.

The analysis of the achieved progress of these targets in relations to the SDG's is the main purpose of this project. While doing a descriptive analysis, a multi factorial analysis has been made to see the similarities and characteristic between different EU countries. The results revealed great progress achieved since the implementation of the SDG's, however not all member states have progressed at the same pace or to the same degree as others, for example the states most affected by the 2008 financial crisis have had greater difficulty achieving the goals for this year 2020. Nevertheless, small progress is

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better than no progress at all.

Keywords: Sustainable Development Goals, environment, European Union, Multi factorial analysis.

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Resumen

Para este año 2020, la Unión Europea habrá conseguido alcanzar sus objetivos en el marco del clima y la energía, acercándolos a conseguir la erradicación de esta crisis medioambiental. Desde 1987, las palabras "sostenibilidad" y "desarrollo" han estado presentes en todos los planes para combatir diversos problemas mundiales, siendo uno de ellos el cambio climático. En 2015 se establecieron los Objetivos de Desarrollo Sostenible (ODS), 17 objetivos destinados a solucionar estos problemas globales, 6 de ellos relacionados con el medio ambiente. Además de los ODS, la UE ha establecido sus propios objetivos climáticos y energéticos para apoyar la consecución de estos 6 objetivos relacionados con el medio ambiente.

El análisis del progreso alcanzado en estos objetivos en relación con los ODS es el propósito principal de este proyecto. Al mismo tiempo que se realiza un análisis descriptivo, se ha hecho un análisis multifactorial para ver las similitudes y características entre los diferentes países de la UE. Los resultados revelaron los grandes avances logrados desde la implementación de los ODS. Sin embargo, no todos los estados miembros han progresado al mismo ritmo o en el mismo grado que otros; por ejemplo, los estados más afectados por la crisis financiera de 2008 han tenido mayor dificultad para alcanzar los objetivos para este año 2020. No obstante, un pequeño progreso es mejor que ningún progreso.

Palabras clave: Objetivos Desarrollo Sostenible, medio ambiente, Unión Europea, Análisis multifactorial.

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1. Introduction

"The climate crisis has already been solved. We already have the facts and solutions. All we have to do is to wake up and change." - Thunberg, G., TEDxStockholm, November 2018.

Greta Thunberg is a 17-year-old environmental activist who has gained momentum for protesting and making aware that humanity is facing an existential crisis arising from climate change. Our current predicament is due to decisions and actions taken from our predecessor to, in simple words, generate more money to produce a greater economic growth for our countries without taking the necessary preventive measure to minimize the impact on our ecosystem.

Throughout the past years, I myself have seen how this crisis has impacted my home, from having - 5 degree snow day on the 28th of February 2018 to having 26 degrees on the exact same day one year later. The planet is changing and not for the better of humanity. We need to change our customs and habits, our economies and policies, our laws and regulations, to ensure our survival from this existential crisis.

To do so, we have the Sustainable Development Goals (SDG), 17 global goals that reach from poverty and hunger, to climate action and animal well-fare. It is a guideline to achieving the change we seek. This dissertation is focused on shedding light into the SDG's and the progress made to overcome this crisis, giving answers to the most basic questions: what, why and how. It is separated in two parts: history and analysis.

Part one, is based on a chronological timeline starting from the first mentions of the term "sustainable development" to the creation of the current SDG's. Here, the answers to the first two questions: What are the Sustainable Development Goals? and, Why were they created? A literature review was carried out, using the bibliographic sources collected at the end of this dissertation, these being mainly sources of secondary information. Books, scholarly articles, official web sites, case studies and legal documents relevant to the area of sustainable development and the SDGs were used to create this first part.

Part two, is the analysis of certain SDG's in direct relation to taking environmental action concerning our existential crisis arising from climate change, answering the third question: How can this massive change be achieved? Two types of analysis will be carried out: a univariate analysis consisting of a descriptive study and a multivariable analysis using the statistical method of Multiple Factorial Analysis (MFA).

This specific path to center the dissertation on environmental issues has been chosen in view of the massive awareness it has been generating throughout the last few years starting with Greta Thunberg crossing the Atlantic Ocean in 14 days on a boat to attend climate change summits and creating "Fridays for Future" a student protest carried out all around the world to demand action from political leaders to take action to prevent climate change and for the fossil fuel industry to transition to renewable energy and ending with President Trump of the USA leaving the Paris Agreement. On a personal level, I have been recently made aware of all the consequences our actions have brought and still bring on to the environment. Not only are we destroying our atmosphere, also our wildlife and ourselves, that is the reason this theme was chosen, to see and make aware of the severity of our actions and how countries have progressed in making change.

2. Sustainable development in the political agenda

In 1987, the term "sustainable development" first appeared officially in the Brundtland Report, also known has Our Common Future. This report was about the future of our planet and the relationship between environment and sustainable development. According to said report, sustainable development is "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p.54).

At this point, the concept of "sustainable development" was starting to be considered as the main objective for the international community. A common goal. The 1980s, were the times of economic recessions and the start of the recognition of climate change.

James Hansen, an adjunct professor at Colombia University alongside other professor in 1981 wrote an article called *Climate impact of increasing atmospheric carbon dioxide* that was published in Science Magazine. Said article states "It is shown that the anthropogenic carbon dioxide warming should emerge from the noise level of natural climate variability by the end of the century, and there is a high probability of warming in the 1980s. Potential effects on climate in the 21st century include the creation of drought-prone regions in North America and central Asia as part of a shifting of climatic zones, erosion of the West Antarctic ice sheet with a consequent worldwide rise in sea level, and opening of the fabled Northwest Passage" (p.957). In other words, CO2 levels are going to go up causing global warming. This means environmental consequences for future generations.

Having this in mind, sustainable development was based on two basic goals: the sustainable and just use of our natural recourses and the combat of poverty around the world, looking at this last one from an economic and social point of view. It was considered to be a new political opportunity for those developing countries to grow their economies while the developed countries built up concerns towards protecting the environment. From this moment onwards, the importance of sustainable development will have grown to become a global political objective for the international community.

What do we mean by development? If we search in a dictionary, the Longman Dictionary of American English (1983) indicates "the act or action of developing or the state of being developed". An action, a process, to grow, increase or become more complete. It is an inevitable progress of transformation.

Our society is in constant change. The economy evolves as the society changes needs, attitude and way of thinking. However, this alteration is causing a negative effect on our planet. The more we want, the more damage we produce to our planet. CO2 levels, plastic waste in the oceans, deforestation, wars in the Middle East, poverty, gender violence, all these problems demand a transformation.

2.1. Earth Summit, Environment and Development, and Agenda 21

In 1992, from the 3rd to the 14th of June, for the first time, more than 178 Governments met at the United Nations Conference on Environment and Development, known also as the Earth Summit, held in Rio de Janeiro, Brazil. Where the first agenda for Environment and Development was drafted and adopted: Agenda 21. "A programme of action for sustainable development worldwide [...] Together they fulfill the mandate given to the Conference by the United Nations General Assembly when, in 1989 , it called for a global meeting to devise integrated strategies that would halt and reverse the negative impact of

human behavior on the physical environment and promote environmentally sustainable economic development in all countries." (United Nations (UN), 1992, p.3)

However, Agenda 21 is constructed by agreements. Agreements negotiated throughout a period of almost three years leading up to the Summit, where they were finalized. These agreements are not uphold by the international law. Nonetheless, there is a strong moral obligation to see to it that their fully implemented and carried out as planned. It stands "as a comprehensive blueprint for action to be taken globally" (UN, 1992, p.3).

Humanity has reached a turning point, deciding not to continue the present policies which amplify the economic division within and between countries. Policies that only increase poverty, hunger, sickness and ignorance, causing a constant deterioration of our ecosystem. Changing course towards improving the living standards of those who are in need. Nations working together to better manage and protect the ecosystem for a better future.

This Agenda was developed as a solution to the present problems in an economic, social and an environmental point of view, so that the present and future generations could have a better way of life. Agenda 21 is constructed by 40 Chapters, which have been divided into 4 sections, each a different area of expertise where changes have to be made for a sustainable future.

1. Section on Social and Economic Dimensions: objectives to improve human quality life and to make the economic system an environmentally conscious and sustainable process.
2. Section on Conservation and Management of Resources for Development: goals to protect, manage and preserve our ecosystem, and to cure the damages that we humanity have bestowed upon our own planet.
3. Section on Strengthening the Role of Mayor Groups: the governments can achieve it alone, they need the help of the people. Giving them access to information about environment and development so they themselves can start making changes to support sustainable progress giving them a voice inside the matter to the individuals, group and organizations. Base on goals for achieving real social partnership.
4. Section on Means of Implementation: the HOW of it all. How the nations are going to finance, manage and control that the goals are being met and the progress made. Starting with financials, then investigations to be sure of what is happening and why it is happening, to promote awareness, to insert arrangements and laws to legally bind, and keep development status for analysis to make sure that real progress is being made.

Inside of each chapter are the "Programme Areas" that consists of different goals that have to be integrated and met in each Nation. To better understand how to fulfill these goals, we first have "Basis for Action": it is the explanation of the problem at hand, and why this goal, in particular, is the way to a solution. With an analysis of the current situation, they see what is going right and what needs adjusting to improve said area.

Second are the "Objectives": this agreement is a process, and in every process there are several milestones which help to ensure that you are getting closer to your finish line, here the objectives are those mile stones. The number of objectives is different for each goal, some are more complex than other to achieve and may need as much as 12 objectives to make sure that the process is going forward. For example the goal 2 *Control of*

communicable diseases of the chapter 6 *Protecting and promoting human health* in section 1 *Social and Economic Dimensions,* has 12 objectives. Starting with "By the year 2000, to eliminate guinea worm disease" and ending with "To accelerate research on improved vaccines and implement to the fullest extent possible the use of vaccines in the prevention of disease".

Third "Activities": initiatives to take action. Programs, interventions, monitoring, all these systems will be put into action to control the progress and asses problems that may rose. Every national Government must introduce these action plans within their political policies, with the appropriate international assistance and support. Following the same example, the activities for goal 2 are: "National Public Health Systems, Public Information and Health Education, Intersectoral Cooperation and Coordination, Control of Environmental Factors that Influence the spread of Communicable Diseases, Primary Health Care Systems, Support for Research and Methodology Development, and Development and Dissemination of Technology". These are the action plans, inside of each plan are the real actions that need to be taken for initiation. In "National Public Health Systems" the following actions are stated:

— *Programmes to identify environmental hazards in the causation of communicable diseases.*

— *Monitoring systems of epidemiological data to ensure adequate forecasting of the introduction, spread or aggravation of communicable diseases.*

— *Intervention programmes, including measures consistent with the principles of the global AIDS strategy.*

— *Vaccines for the prevention of communicable diseases*. (UN, 1992, section 1, chapter 6, goal 2, activities)

Finally, fourth "Means of Implementation": strategies and programs for implementation of the activities, the tools necessary to put the action plans at work. The most important ones being *Financing and Cost evaluation* an estimated cost value is drafted and a financial plan made to overcome those costs, although the estimations are not yet review by each Government, it will depend on, the *inter alia,* so to speak, the strategy and program that Governments decided to implement.

Then there is *Capacity Building a* process by which institutions, health sector, organizations and individuals obtain, improve and spread the knowledge needed to set in motion the activities. It allows them to perform at a greater capacity. To end with our example, the *Capacity Building* in goal 2 *Control of Communicable Diseases* says: "The health sector should develop adequate data on the distribution of communicable diseases, as well as the institutional capacity to respond and collaborate with other sectors for prevention, mitigation and correction of communicable disease hazards through environmental protection. The advocacy at policy and decision making levels should be gained, professional and societal support mobilized, and communities organized in developing self-reliance".

In January 2012 a study was released on the implementation of Agenda 21 by Stakeholder Forum, which is an international organization working to advance sustainable development in all kinds of areas.

Researchers estimated that the progress on Agenda 21 had been limited. Out of all 40 chapters, only five had achieved great progress: chapter 18 (*Protection of the quality and supply of freshwater resources: Application of integrated approaches to the development,*

management and use of water resources), chapter 27 (*Strengthening the role of non-governmental organizations: Partners for sustainable development),* chapter 35 (*Science for sustainable development,* chapter 38 *International institutional arrangements),* and chapter 39 (*International legal instruments and mechanisms).* Everything to do with NGO's and local authorities having more involvement and finding out more about sustainable development and the tools needed for it.

They also state three chapters where no progress was made or that even a regression had been seen; chapter 4 on *Changing consumption patterns,* chapter 7 on *Promoting sustainable human settlement development* and chapter 9 on *Protection of the atmosphere.* Each of these chapters has a huge impact on society and on the environment, so why could there be a regression?

Globalization. Nowadays, we have easy access to every new product on the market. Changing consumption patterns in a society where we only think about having the latest iPhone, the newest model car, or even having that special dress for New Year's Eve that you know, you will only wear once. We are a society of mass consumption. We buy and buy but we do not stop and think about what kind of products we are really buying. Does it contain plastic? Is it "eco-friendly"? Can you recycle it? Where will this product end up when we finish with it?

If we mean to achieve chapter four, make society aware of the consequences of "wanting more, better quality, newest tech" products will do to our resources, ecosystems, and future. Put them in perspective. Tell them, what our future will be if we do not change our way of thinking. With this, you make people have a choice, to follow the same patterns and create a worst future for ourselves or change our ways to a sustainable and better future. Because if people do not have the full and complete information of what a product contains, of what it means to have whatever it has, of what it reflects on the environment, then you take that choice away and only keep promoting the same blind way of life.

Chapter 7 is about promoting sustainable human settlements. That means the right to an adequate housing for all. However, it is complicated to achieve when there is a lack of housing and the houses that are available are out priced for most of the population. One major reason for the lack of settlement initiatives is the insufficient funding of this area. The rate growth of the population is fast, we are getting bigger by the minute, so to speak. The modernization of the settlement plans have not caught up yet with the increased urbanization and population growth, which is the main problem of why this chapter has not been achieved. While there are some urban policy progressions made, the socio-economic inequalities and negative living conditions within many urban areas remain wide ranged in both developed and developing countries.

Lastly, studies have shown CO2 emissions increase year by year. Even the rate in which it grows increases and that the progress on limiting these emissions into our atmosphere have been "zero to nothing".

Although, consciousness of CO2 emissions has reach such a high level of importance that between the years of 1995 and 2015 treaties and agreements have been made to legally bind developed country parties to reduce their emissions levels to a certain target. Thus we have the Kyoto Protocol which is a treaty to legally bind parties to emission reduction targets. In 1995 negotiations were started about climate change and two years later The Kyoto Protocol was made, but was not implemented until 2008. Two commitment periods were established: first from 2008 until 2012, and second one from 2013 until next year 2020.

Then, there is the Paris agreement of 2015. It is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse gas emissions (CO2 emissions). "The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius" (UN, 2019, Climate change).

Overall, Agenda 21 made the concept of sustainable development into a common household phrase. It had such a strong impact that it went on to influence in the following international agreements and documents. The main positive aspect is that it put the concept of sustainable **human** development at the center of development, no "tech-based" solutions. Agenda 21 was the first to integrate environment and development through the Commission on Sustainable Development, where it achieved some success in issues like persistent organic pollutants, prior informed consent, oceans and forests.

It also put into scene non-governmental actors, with its nine chapters on "Mayor Groups" by identifying their roles and responsibilities. The Agenda 21 represented a progressive vision for action taking setting higher standards of ambition and success. Nevertheless, Agenda 21 also had its challenges as mentioned before on implementation and achieving real progress. All in all, Agenda 21 retains strong relevance and remains the largest undertaking by the UN to promote sustainable development.

2.2. Millennium Summit (2000), World Summit (2002), Millennium Declaration, Millennium Development Goals and the Post-2015 Agenda

In September 2000, around 189 countries gathered together at the United Nations headquarters in New York to discuss the role of the UN in this new millennium, hence the name Millennium Summit, also known as the 55th General Assembly. From the 6th to the 8th of September, the world leaders discussed about the main issues that dominated, by adopting the Millennium Declaration, which is based on 8 time-bound and measurable goals called the Millennium Development Goals (MDG), aimed at sustainable development and eradicating poverty.

The Millennium Declaration represents a pact between the world leaders. Developing countries promise to improve their government policies and management, and to increase accountability to their own citizens; while developed countries promise to provide them with resources.

The commitments to the goals were strongly reaffirmed by all UN members at the Johannesburg World Summit on Sustainable Development in September 2002. The progress made on the outcomes of the 1992 Earth Summit in Rio were examined. Knowing how little progress it had made, the Johannesburg Plan of Implementation was set out to make sure of the success of the MDGs. With specific timetables to address some issues including reducing the rate of loss of biodiversity by 2010 and halve the number of people without access to drinking water by 2015.

The Millennium Development Goals serve to bring forward political commitment and to provide baselines for measuring progress in promoting human development and poverty reduction. As a universally agreed agenda, MDGs bring for the first time, clarity to the shared responsibilities and objectives of all development parties: governments, donors, civil society organizations and the private sector. According to an article published by the University of Leon called *Millennium Development Goals*: "MDGs become, for the first

time, specific objectives of the whole set of international policies. They give us the opportunity to place the issue of development at the center of the structural policies" (Robles Llamazares, 2006, p.94).

As mentioned before, MDGs are 8 time-bound and measurable goals, 21 targets and 58 indicators. The MDGs give high importance to health, as it is a valuable contributor to several other goals. "The significance of the MDGs lies in the linkages between them, they are a mutually reinforcing framework to improve overall human development" (World Health Organization, 2006)

- **Goal 1**: Eradicate extreme poverty and hunger.
  - Target 1.1: To halve the proportion of people living in extreme poverty, people living on less than $1 per day, by 2015.
    - Poverty gap ratio o [incidence x depth of poverty]
    - Share of poorest quintile in national consumption
  - Target 1.2: Achieve decent employment for women, men and young people.
    - GDP Growth per Employed Person
    - Employment Rate
    - Proportion of employed population below $1.25 per day (PPP values)
    - Proportion of family-based workers in employed population
  - Target 1.3: To halve the proportion of people who suffer from hunger by 2015.
    - Prevalence of underweight children under five years of age
    - Proportion of population below minimum level of dietary energy consumption
- **Goal 2**: Achieve universal primary education.
  - Target 2.1: All children can complete a full course of Primary education/primary schooling, girls and boys, by 2015.
    - Enrollment in primary education
    - Completion of primary education
- **Goal 3**: Promote gender equality and empower women.
  - Target 3.1: Eliminating gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015.
    - Ratios of girls to boys in primary, secondary and tertiary education
    - Share of women in wage employment in the non-agricultural sector
    - Proportion of seats held by women in national parliament

- **Goal 4**: Reduce child mortality.
  - Target 4.1: Reduce by two-thirds the under-five mortality rate by 2015.
    - Under-five mortality rate
    - Infant (under 1) mortality rate
    - Proportion of 1-year-old children immunized against measles
- **Goal 5**: Improve maternal health.
  - Target 5.1: Reduce by three quarters the maternal mortality ratio by 2015.
    - Maternal mortality ratio
    - Proportion of births attended by skilled health personnel
  - Target 5.2: Achieve, by 2015, universal access to reproductive health.
    - Contraceptive prevalence rate
    - Adolescent birth rate
    - Antenatal care coverage
    - Unmet need for family planning
- **Goal 6**: Combat HIV/AIDS, malaria, and other diseases.
  - Target 6.1: Halt by 2015, and begin to reverse the spread of HIV/AIDS.
    - HIV prevalence among population aged 15–24 years
    - Condom use at last high-risk sex
    - Proportion of population aged 15–24 years with comprehensive correct knowledge of HIV/AIDS
  - Target 6.2: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it.
    - Proportion of population with advanced HIV infection with access to anti-retroviral drugs
  - Target 6.3: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.
    - Prevalence and death rates associated with malaria
    - Proportion of children under 5 sleeping under insecticide-treated bed nets

- Proportion of children under 5 with fever who are treated with appropriate anti-malarial drugs
- Incidence, prevalence and death rates associated with tuberculosis
- Proportion of tuberculosis cases detected and cured under DOTS (Directly Observed Treatment Short Course)

- **Goal 7**: Ensure environmental development.
  - Target 7.1: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources.
  - Target 7.2: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss.
    - Proportion of land area covered by forest
    - CO2 emissions, total, per capita and per $1 GDP (PPP)
    - Consumption of ozone-depleting substances
    - Proportion of fish stocks within safe biological limits
    - Proportion of total water resources used
    - Proportion of terrestrial and marine areas protected
    - Proportion of species threatened with extinction
  - Target 7.3: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation.
    - Proportion of population with sustainable access to an improved water source, urban and rural
    - Proportion of urban population with access to improved sanitation
  - Target 7.4: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum-dwellers.
    - Proportion of urban population living in slums
- **Goal 8**: Develop global partnership for development.
  - Target 8.1: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system.
    - Includes a commitment to good governance, development, and poverty reduction – both nationally and internationally
  - Target 8.2: Address the Special Needs of the Least Developed Countries (LDCs).

- Includes: tariff and quota-free access for LDC exports; enhanced programme of debt relief for HIPC and cancellation of official bilateral debt; and more generous ODA (Official Development Assistance) for countries committed to poverty reduction

- Target 8.3: Address the special needs of landlocked developing countries and small island developing States.
  - Through the Programme of Action for the sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly
- Target 8.4: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term.
  - Some of the indicators listed below are monitored separately for the least developed countries (LDCs), Africa, landlocked developing countries and small island developing States.
  - Official development assistance (ODA)
  - Market access
  - Debt sustainability:
    - Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative)
    - Debt relief committed under HIPC initiative, US$
    - Debt service as a percentage of exports of goods and services
- Target 8.5: In co-operation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries.
  - Proportion of population with access to affordable essential drugs on a sustainable basis
- Target 8.6: In co-operation with the private sector, make available the benefits of new technologies, especially information and communications.
  - Telephone lines and cellular subscribers per 100 population
  - Personal computers in use per 100 population
  - Internet users per 100 Population

The MDGs have provided a framework allowing countries to plan their social and economic developments, as well as donors to provide effective support at a national and international level. Six out of the 8 Development Goals, 9 of the 21 targets and 23 of the 58 indicators are relate directly to health, where most of the progress, worldwide, has been focused; to improve maternal and child health, and to reduce transmission of

communicable diseases. While less attention has been paid to environmental sustainability and the development of a global partnership.

Up to now, several targets have been at least partially achieved: hunger reduction is on track, poverty has been reduced by half, living conditions of approximately 200 million deprived people improved, maternal and child mortality as well as communicable diseases reduced and education improved. Nevertheless, some goals have not be met yet, due to the different challenges the poorest regions have to deal with such as the lack of synergies among the goals or the economic crisis.

Certain studies have underlined regional differences in the importance that is attributed to specific MDGs. For example, goals 4 and 5 have been considered of the outmost importance in the African region, while goals 7 and 8 in the Western Pacific Region. Low-income countries have assigned goal 1 as the most relevant when compared to high-income countries. Due to ethnic, religious, political and social limitations, Arab countries have not considered the Millennium Development Goals as one of their top priorities for the policy makers, academia and social actors.

It's true, that at a global scale, poverty and child mortality have been reduced, the access to drinking water enhanced and efforts have been coordinated to advance the fight on eradication of HIV / AIDS, malaria and other communicable diseases. However, despite the progress made, following the reflection given by the temporal perspective and analysis made of the goals, targets and indicators, studies confirm that none of the eight goals in the MDGs have been achieved in their totality, nor in all the cases, neither in all countries, nor in all population groups. Even if a major part of the MDGs has been at least partially accomplished, many see the MDGs as "unfinished business".

Thus, a new chapter opens, where new thinking and advances have to be made, considering the MDGs as a baseline to improve. A better version of it with a universal drive on what needs to be achieved at an economic, political, social and life conditions of humanity level, based on a more open, participatory, and transparent process, taking into account the new global context that is marked fundamentally by two global issues: new technologies and social changes. Among them, on the one hand, the pressure of emerging countries with increasing economic and political power and on the other, a Europe weakened by the crisis that, immersed in its economic recovery.

The post-2015 agenda has to be based on the previously said, to have a universal will, not to separate the north and the south, all issues are the same all around the world, doesn't matter if you're a poor country or rich. The issues we face do not discriminate. That is why the post-2015 goals must be universally relevant, that are equal to all. However, targets and indicators must be adaptable to a country's health priorities and needs and regional differences. Accountability remains of primary importance. On the one hand, better data will be required to allow transparency, proper evaluation and improvements. On the other hand, government's engagement and partnership dynamics between all actors should be improved and adapted to the new socio-political context.

It is an agenda of universal viability, not limited to the poorest countries, although it recognizes its specific needs, and at the same time with the capacity to adapt to the different regional, national and local realities. It can be interpreted, therefore, as a "multilevel" development governance framework, which is global in nature but at the same time identifies the principle of subsidiarity, without which it would be difficult to mobilize collective action. On one side, low and lower-middle income countries should be able to assemble local resources and improve in-country productivity as well as bring innovations and solutions that are more suitable for emerging countries. On the other side,

rich countries should contribute more to the UN system. MDGs were agreed on a voluntary base by governments; the new goals should be norms for global governance, as mentioned before. These goals should be global social contracts between governances and societies, and the concept of social responsibility, lacking for the MDGs, should be included.

2.3. Sustainable Development Summit (2015) and Agenda 2030, the Sustainable Development Goals

The United Nations Sustainable Development Summit from the 25th to the 27th of September 2015 in UN headquarters, in New York City happened. The United Nations summit for the adoption of the post-2015 development agenda was held, and convened as a high-level priority meeting of the General Assembly. The Sustainable Development Goals set to achieve by 2030, are part of the Resolution 70/1 of the UN General Assembly, the Agenda 2030.

The United Nations Summit on Sustainable Development Rio+20, in June 2012, where the document *The Future We Want* was adopted, establishing the principles and procedure for the development of these SDGs.

"On behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and people-centered set of universal and transformative Goals and targets. We commit ourselves to working tirelessly for the full implementation of this Agenda by 2030. We recognize that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development. We are committed to achieving sustainable development in its three dimensions - economic, social and environmental - in a balanced and integrated manner. We will also build upon the achievements of the Millennium Development Goals and seek to address their unfinished business" (A/RES/70/1, 2015, p.3)

The SDGs are a better and more extensive version of the MDGs. By this time, society is becoming more aware of the problems that are overcoming our way of life and planet. Of how a great change must be made to provide a better tomorrow for ourselves and future generations. The Agenda 2030 is more integrated, where sustainable development is at the center, it gives a global responds to the issues that are closely linked to the current planetary emergency situation. The SDGs are action oriented, brief and easy to communicate, limited in number and ambitious, have a global character and are universally applicable to all countries.

For a sustainable development agenda to be effective, partnerships between governments, the private sector, and civil society are needed. These inclusive alliances are built on the basis of principles and values, a shared vision and common goals that give priority to the people and the planet, and are necessary at a global, regional, national, and local level. The involvement of technology for economic and social development is increasingly important, since technology is playing a high leveled role in this new era in which society is emerged in techno-based developments to make life easier.

Furthermore, the SDGs are at the end of a long series of global goals that the United Nations has been adopting since the "first decade of development" with the purpose of mobilizing international collective action and guiding the action of governments, within each country, towards fundamental development issues. The 17 Sustainable Development Goals, 169 targets and 230 verifiable indicators demonstrate the scale and ambition of

this universal Agenda 2030. “They seek to build on the MDGs and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental” (A/RES/70/1, 2015, p.1)

- **Goal 1**. End poverty in all its forms everywhere.
- **Goal 2**. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- **Goal 3**. Ensure healthy lives and promote well-being for all at all ages.
- **Goal 4**. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- **Goal 5**. Achieve gender equality and empower all women and girls.
- **Goal 6**. Ensure availability and sustainable management of water and sanitation for all.
- **Goal 7**. Ensure access to affordable, reliable, sustainable and modern energy for all.
- **Goal 8**. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- **Goal 9**. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
- **Goal 10**. Reduce inequality within and among countries.
- **Goal 11**. Make cities and human settlements inclusive, safe, resilient and sustainable.
- **Goal 12**. Ensure sustainable consumption and production patterns.
- **Goal 13**. Take urgent action to combat climate change and its impacts[2].
- **Goal 14**. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- **Goal 15**. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
- **Goal 16**. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels**.**
- **Goal 17**. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

The Agenda 2030 for Sustainable Development is universal, it commits all countries and all actors (governments, civil society, private sector, and academia), which will

[2] Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change - United Nations, A/RES/70/1.

necessarily imply a transformation of world society in terms of values, habits of life and consumption, forms of production and distribution.

Thus, in this new Agenda, it is fined by concrete goals that break down, in a more specific way, problems that in the previous one (MDGs) were collected by a smaller number of goals and more generic. Where MDG 7 used to ensure the sustainability of the environment in general, now it is defined in three specific SDGs aimed at climate change (SDG 7), terrestrial ecosystems (SDG 14) and marine (SDG 15). And to this are added the intertwined targets in different SDGs that have to do with energy, the use of resources, the influence of the environment on poverty or consumption patterns that affect natural exploitations, for example.

One thing that was lacking in the MDGs, was the collaboration of the companies with the governments, for a successful implementation and achievement of the goals. Before the elaboration of the SDGs, the United Nations through the Global Compact queries taking place all around the world where to define the contribution of the private sector to the global development. The result of all the inquiries, was that the United Nation incorporated the companies has fundamental collaborators for the achievement the Sustainable Development Goals. Encouraging the governments to associate with the companies for the successful implementation of the SDGs.

Another strong point of the SDGs, which cannot fail to be taken into account for their understanding, is the cross-cutting nature of the goals and their targets. Despite being 17 differentiated points, none can be understood separately or addressed without taking into account other challenges. The entire agenda is a set of interrelated goals and was designed like this from the beginning, “they are literally universal, integrated and indivisible goals” (Rodríguez Vindel, V., 2017).

The new goals and targets were establish on January 1st, 2016, and during the next 15 years the countries will try to implement the Agenda 2030 taking into account the different realities, capacities and levels of development of each country and respecting their policies and national priorities. While the goals express worldwide aspirations, each Government will set its own national goals, guided by the ambitious general aspiration but taking into account the country's circumstances along the way. With that said, the Agenda 2030 takes into account the different realities, capabilities and development levels of each country and states that national policies and priorities will be respected.

Something very reasonable since that in the international society there are more than 190 countries and each of them face specific challenges in their search for sustainable development. “They deserve special attention”, as indicated in the Resolution 70/1 of the United Nations (2012), “the most vulnerable countries and, in particular, African countries, least developed countries, landlocked developing countries and small island developing States, as well as, the concrete difficulties that middle-income countries are going through. Countries in conflict situations also deserve special attention” (p.7).

Therefore, the Agenda 2030 for the Sustainable Development, is a plan of action which puts the people and planet in first place, and that seeks to involve the international community to address the enormous challenges that humanity faces, including those related to the world of work.

However, one thing is what it represents and another is how it will react once it’s in motion. 3 years have passed since the Sustainable Development Goals and the Agenda 2030 were established. The progress has been slow, but the awareness between our societies has reached a new level, people are noticing that a change must be made, people

around the world are protesting for that change, for progress, for sustainable development, for our future.

Although, this is true, some goals come to a "stand still", where a matter of logics and common sense enter into scene to overcome it, but eventually it all comes down to the person in charge and if they rather change for a better future or keep things at it is to keep having a better salary. For instance, SDG 16 says "Promote peaceful and inclusive societies" when the western countries that signed the agreements are the main arms sellers in the world. Or SDG 13 which obligates to "take urgent action to combat climate change", while there are countries that deny even this phenomenon exists.

States are also considered to have received very few indications of how to move forward in their implementation or in the coordination of agendas. This is true to the point that large disparities begin to appear in the implementation of the SDGs between countries. This is aggravated by the voluntariness and the fact that governments are responsible for setting the pace of their establishment, as stated in target 17.15: "respect each country's policy space and leadership" noticing that this allows each country to do whatever they want without any limitation (Carlos Gómez Gil, 2017).

Since the United Nations approved the Agenda 2030, different countries, scientific organizations and international institutions have launched several studies of different nature with the purpose of monitoring progress towards achieving the SDGs, mapping available resources and reviewing the strategies applied. On the contrary, other countries and institutions have made interesting studies where they have explored the capabilities and challenges of each country, analyzing the institutional strategies needed along with mapping analysis and results. Among all the studies carried out, three stand out for their findings and criticism:

1. The *UK implementation of the Sustainable Development Goals* elaborated between the years 2016 and 2017 by the British Parliament. Analysis of the SDGs through different areas, to see what changes must be made for a successful implementation and achievement of the SDGs by 2030. "To be most effective and stand the best chance of success, governments 'implementation of the SDGs must be aligned to existing national priorities. National implementation must be a country-led process with opportunities for democratic engagement by citizens and civil society. We welcome DFID's emphasis on encouraging national ownership of the SDGs in its priority countries. It can do this by supporting governments as they map the targets and indicators against national plans to identify where they align with existing priorities and where there are gaps. DFID will then be in a position, in partnership with other stakeholders, to offer support to the government to fill these gaps" (International Development Committee, 2016, p.44).
2. Members of the Stockholm Environment Institute (SEI) developed the study *Sustainable Development Goals for Sweden: Insights on Setting a National Agenda*. The study carries out a thorough review of each of the SDGs to select the most important goals for Sweden, being able to plan the best policies to achieve them. First there must be an inclusive, government-led process to interpret the SDG goals and targets, for the specific national context. Then they find the targets more suitable at a national level. "We suggest that national indicators be given greater priority than global indicators. A review and follow-up system at national level for the nationally agreed targets and indicators can run alongside the UN's global tracking framework, and ensure transparency and accountability towards citizens. To define such a national framework, countries need to take stock of

existing indicators and create new ones to fill the gaps. National indicator frameworks should aim to harmonize with other countries, where appropriate through cooperation via OECD, UNSTAT and the EU, but must always prioritize adequate monitoring of issues on the nationally agreed agenda. This is important to make sure the SDGs go beyond an indicator-based reporting exercise to become a real policy and action agenda for sustainable development" (Nina Weitz, Åsa Persson, Måns Nilsson & Sandra Tenggren, 2015, p.20-21).

3. The study by International Council of Science (ICSU) and International Social Science Council (ISSC) called *Review of targets for Sustainable Development Goals. The science perspective* which states that of the 169 targets beneath the 17 draft goals, just 29% are well defined and based on the latest scientific evidence, while 54% need more work and 17% are weak or non-essential. "SDG 17 contains key enablers for action across the entire SDG framework. Data availability represents a critical tool for sustainable development at the local, national, and global levels. This goal could also further stress the importance of stakeholder engagement in implementing the SDGs through partnerships. Strengthening institutional, financial, scientific, technological capacities will be key to the success of the SDGs. The targets would greatly benefit from further specification and quantification" (ICSU and ISSC, 2015, p.82).

In order to achieve a successful implementation and achievement of the Sustainable Development Goals for 2030, five key elements have to be taking into account, which all three studies have in common:

1. Improvement of knowledge and technical information for officials, civil society and specialized organizations.
2. The deciding work to obtain precise commitments from the Governments.
3. Generate scientific knowledge regarding the SDG and its application.
4. Solve the problems of lack of data and clarification of the targets and indicators for its correct implementation.
5. A precise specification of economic, political and technical responsibilities and commitments.

In conclusion, considering all these elements, the SDGs and the Agenda 2030 are a starting point of a process in which there are still many tasks to be accomplished. Since the approval of the SDGs, global development governance continues to face many unfulfilled tasks related to the effective monitoring of progress at a national level, without renouncing to the strong ambition it has, integral character and universality that will lead over the new set of global goals. The Agenda, in short, should be able to establish a convincing narrative and a mobilizing horizon in the coming years, and to reflect, as clear as possible, both the collective aspirations of human progress, as well as the responsibilities that will have to be assumed to make them a reality.

3. Methodology and Data Source

For the theoretical framework, a literature review has been carried out, using the bibliographic sources collected at the end of this dissertation, these being mainly sources of secondary information. Analyzing books, scholarly articles, official web sites, case studies and legal documents relevant to the area of sustainable development and the

SDGs. By doing so, I provide a summary description and critical evaluation of the main topic in question, from the first agenda created to the current SDGs and their impacts.

For the empirical analysis, two different analysis will be conducted. On the one hand, a univariate descriptive study and on the other, a multivariable analysis. In both analysis (univariate and multivariate), I study the evolution of countries over the years 2010 being the first year before the SDG agenda agreement with data available, 2015 being the year of implementation and 2017 being the last year with full access to information on each indicators for each country.

The univariate analysis consists of a descriptive study of specific SDGs. This study will be limited between four European countries: Sweden, Germany, France and Spain, which have been chosen through a survey made on climate change by Kantar on behalf of Kantar Belgium at the request of the European Commission. This survey mentions a European perception on climate change, were the countries are listed from the country where most of the population consider climate change is the most serious problem the world has to face, to the one where just a few believe it is a primary problem. Apart from the survey, Germany, France and Spain have been chosen for their demographic size, these being the largest countries in the EU. Sweden, however, has been chosen not for its size but for its behavior and action on environment.

This analysis will be centered on the goals that have a direct connection to the environment, having been there a raise in awareness on the impacts of climate change. The goals are SDG 7: affordable and clean energy; SDG 11: sustainable cities and communities, and SDG 13: climate action.

There are several other SDGs that are also related to the environment such as: SDG 12 on responsible consumption and production; SDG 14 on life below water; and SDG 15 on life on land. However, they do not possess all the data necessary for the year 2017, which is why these goals will not enter in this study. For each goal (SDG 7, SDG 11 and SDG 13) a set of specific indicators are going to be examined: primary energy consumption, final energy consumption and share of renewable energy from the SDG 7; recycling rate of municipal waste and share of public transportation use from the SDG 11; and finally, greenhouse gas emissions from the SDG 13.

On the 3rd of March 2010 the European Commission proposed a 10-year strategy plan to help the EU emerge from the crisis it was in. “It emphasizes smart, sustainable and inclusive growth in order to improve Europe's competitiveness and productivity and underpin a sustainable social market economy” (European Commission, 2010). The strategy is separated into five areas, one of them being Climate change and Energy. The selection of the indicators for the SDG 7 and 13 are based on the targets that are defined to accomplish the objectives for this area. For the SDG 11 the indicators were chosen for their relativeness with the SDG 13 (will be explained in more detail further on).

The multivariate analysis, on this part, will be carried out by using the statistical method of Multiple Factorial Analysis (MFA). The MFA is a factorial method devoted to the study of tables in which a set of individuals (countries in this Project) is represented by a set of variables (quantitative and/or qualitative) arranged in groups. The objective is to define the underlying structure of a dataset by analyzing the structure of correlations between the variables by defining a series of dimensions, called factors. A factor is defined as any linear combination of variables in the data matrix. The MFA is done in two phases. First, a Principal Component Analysis (PCA) is performed for each of the groups of variables separately and the first value of each of these partial analyzes is reserved. Second, the same technique is used but this time for the whole set of variables,

this processes is the global analysis. The purpose is to balance the influence between the tables. This statistical method also allows to be carried out two types of complementary analysis (Altuzarra et al, 2018).

On one hand, an analysis of the variables selected to observe the relationships between the groups of variables and to measure the degree of global similarity, and on the other hand, a study of the individuals which is based on the results of the analysis of the variables. This enables to project the individuals on to the factorial planes from different perspectives. A Cluster Analysis will be conducted to complete the study, which allows individuals to be organized into classes. The individuals who belong to the same class share similar characteristics among themselves and different from the individuals of another class. Creating different profiles for each group.

The MFA includes 22 EU countries. Croatia, Cyprus, Estonia, Latvia, Lithuania and Malta are excluded for their small size in demographics and/or their outlier behavior. Based on the data availability the different indicators for each year under study were selected. These indicators measure the countries performance regarding SDGs 7, 11, 12 and 13[3].

4. Univariate analysis for selected European countries: France, Germany, Spain and Sweden

As mentioned before, the analysis will be based on three specific Sustainable Development Goals: SDG 7 on Affordable and Clean Energy; SDG 11 on Sustainable Cities and Communities and SDG 13 on Climate Action. Within each goal, several indicators will be examined based on the availability of data. Primary energy consumption, Final energy consumption and Share of renewable energy from the SDG 7; Recycling rate of municipal waste and Share of public transportation use in total passenger transport from the SDG 11; and finally, Greenhouse Gas emissions from the SDG 13.

The indicators for the SDG 7 and 13 have been chosen in connection to the Europe 2020 strategy, which is "the EU's agenda for growth and jobs for the current decade" (European Commission, 2010). The strategy is divided into five areas:

- Employment
- Research and Development
- Climate change and energy
- Education
- Poverty and social exclusion

Climate change and energy, being this the third area, is where the cited indicators have been chosen from, taking into account that the main targets to be reached by 2020 are:

- Energy efficiency to be improved by 20%.
- Share of renewable energy sources in final energy consumption to be increased to 20%;

[3] SDG-14 and 15 are not included because of lack of data.

- Greenhouse gas emissions to be reduced by 20% compared to 1990;

Regarding the indicators for the SDG 7, energy efficiency can be explained by relating primary energy consumption with final energy consumption. Energy efficiency means to use less energy to provide the same task. Therefore, comparing how much energy is consumed (final energy consumption) as to how much energy is needed (primary energy consumption), can explain if the country in questioned is consuming more than it needs or if it is energy efficient. Primary energy consumption measures the total energy needs of a country excluding all non-energy use of energy carriers for example natural gas used not for combustion but for producing chemicals. This indicator includes the energy consumption by end users such as industry, transport, households, services and agriculture, also energy consumption of the energy sector itself.

Final energy consumption analysis the energy end-use in a country excluding all non-energy use of energy carriers as the previous indicator. The difference, it does not include energy consumption of the energy sector, only the energy consumed by end users.

The share of renewable energy measures the proportion of renewable energy consumption in final energy consumption. The net final energy consumption is the energy used by end-users (final energy consumption, explained before), thus represent the electricity mix that actually is consumed in the households or with which even electric vehicles are charged.

Concerning the SDG 13, GHG emissions is the main indicator for the analysis. GHG emissions measure the total national emissions and international aviation of "Kyoto basket" of greenhouse gases, which includes: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the so-called F-gases (hydrofluorocarbons, per-fluorocarbons, nitrogen trifluoride (NF3) and sulphur hexafluoride (SF6)) that can be released into the atmosphere in many ways (livestock, waste, transportation, industry...).

Apart from how much energy is consumed and the number of gases emitted, the SDG 11 helps to understand the sustainability of each country in the matter of contamination. Analyzing, the use of public transportation, being this in direct correlation with CO2 emissions (SDG 13), measuring the share of collective transport modes in total inland passenger transport performance, expressed in passenger-kilometers (pkm). Regarding transport modes are buses and trains, may also include coaches and trolley buses.

Recycling helps to reduce the pollution caused by waste. Waste has a big negative impact on the natural environment, due to the hazardous chemicals and GHG that are released from these residues collected in landfill sites. Habitat destruction and global warming are some of the effects caused by these landfills. The indicator of Recycling rate of municipal waste measures the tonnage recycled from municipal waste divided by the total municipal waste arising.

4.1. Energy efficiency to be improved by 20% (SDG-7)

To understand correctly what is going to be analyzed in this point, the difference between being effective and being efficient must be explained. Effective is to produce the desired results, does not matter how they reach the goal, their only concern is to achieve it. To be efficient is to work well, quick and without waste; it is about the process to achieving the goal with the least amount of resources possible.

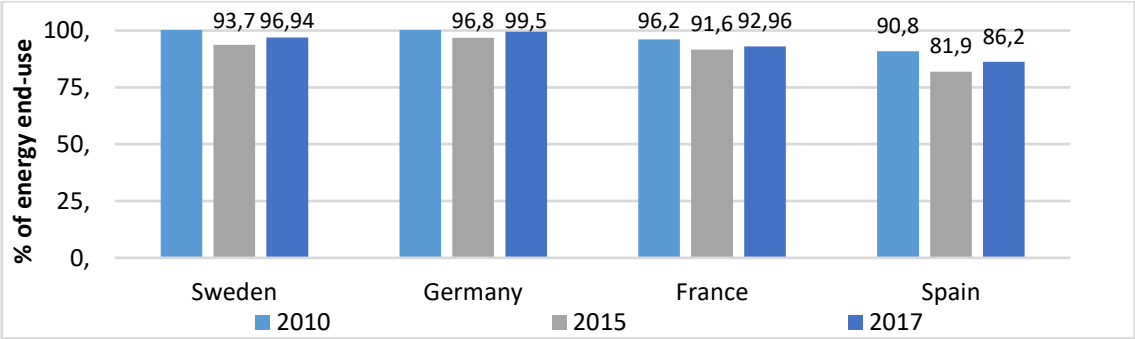
Knowing that efficiency is related to saving or reducing sources to achieve the same outcome, to improve energy efficiency simply means using less energy to perform the same task. Which in environmental terms means to reduce greenhouse gas emissions, in

economic terms to reduce demand for energy imports and reduce costs on a household and economy-wide level.

In 2012, under the Energy Efficiency Directive 2012/27/EU, the EU set a 20% energy efficiency target by 2020. In concrete terms, this means lowering the EU's final energy consumption to no more than 1,086 million tons of oil equivalent (down to 90.73 percent) and/or primary energy consumption to no more than 1,483 Mtoe (down to 85.5 percent). In order to achieve this, every EU country was required to set their own indicative national energy efficiency targets whether it was to reduce final energy consumption and/or primary energy, also they were to publish 3-year national energy efficiency action plans, and annual progress reports.

As shown in Figure 1, the final energy consumption of Sweden and Germany was more than 100 percent in 2010. By this time both countries were consuming much more energy than what they needed. After 2012, each Member State took measures to implement the Energy Efficiency Directive at a full scale. Developing energy savings schemes for all sectors, such as industry, transport, services and residential. Such ideas being the use of more renewable sources or the alternative to a motor vehicle being the electric vehicle.

Figure 1. Final energy consumption



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

In 2015, Sweden manage to reduce by 7.39 percentage points (p.p.) their end-use of energy. By 2013 the energy use decreased for the industrial and transport sectors and by 2014 the energy use in households and services. The use of fossil fuels for heating and electricity like oil, natural gas and coal also decreased which is accurate with the increase of renewables in 2015 shown (see Figure 6 in section 4.3).

Even though Sweden had made some significant progress to reducing final energy consumption, by 2016 its energy uses increase to 96.94 percent, being just 6.21 p.p. above its national target for 2020. The increase of energy use in 2016 and 2017 was due to weather conditions, having had a comparatively cold few years in which the demand for electricity and heating rose. In 2018, according to the Eurostat, final energy consumption decreased to 95.5 percent, 1.44 p.p. less than the previous year and 4.77 p.p. above its 2020 target. This reduction is also due to weather conditions, the year 2018 was astonishingly warm reducing the use of electricity and heating, the exact opposite of the previous year 2017.

Germany, as mentioned before, has an energy end-use of a 101.5 percent in 2010, 10.77 p.p. over the energy efficiency 2020 target. Nevertheless, same as Sweden, it manage to decrease its end-use by 4.7 p.p. from 2010 to 2015. This reduction is caused by the

increase of renewable energy and by the decrease in nuclear power use. After the 2011 disaster of the nuclear power plant Fukushima in Japan, Germany decided to phase out the use of nuclear energy. In fact, installations generating electricity from renewable energies have a calculated efficiency of 100 percent, and will therefore push plants with a lower level of efficiency out of the market such as nuclear power plants that have a calculated efficiency of 33 percent.

Nevertheless, in 2017, it increased its energy end-use by 2.7 p.p. almost reaching the energy end-use as in 2010. By sector, households recorded the largest increase in final energy consumption by 4 p.p., ahead of the commercial and service sectors with 3.7 p.p. and then transport with 2.9 p.p. and industry with a 1.3 p.p. increase. Both the economic growth of 1.9 percent and an increase in the population of around 662,000 people, contributed to the increase. In 2018, the final energy consumption decreased to 98 percent, just 7.27 p.p. over the 2020 target, as for the decrease in Sweden the reason is the same, weather conditions for this particular year were warmer, hence the less use of heating in winter.

In Figure 1, France shows a noticeable beginning, having just consumed 96.15 percent of the energy produced in 2010. After the 2012 Energy Efficiency Directive, France took law regulations and other alternative measure to ensure the achievement of this 2020 target. Implementations of the white certificates these being, an environmental policy, and documents certifying that a certain reduction of energy consumption has been reached. Other alternatives are the taxes implemented on carbon base energy products, tax credits for energy transitions, and environmental bonuses and penalties, which entails a reward for those who chose to buy a new car with less CO2 emissions and penalizes those who opt for the most highly polluting models (Ministère de la Transition écologique et solidaire, 2015).

Having put all this measures into motion, by 2015 the energy end-use had decreased by 4.54 p.p., reaching a final energy consumption of 91.61 percent. The sectors where the energy end-use decreased were the industry, transport and service sectors compare to energy levels in 2010. Moreover, the energy end-use in the agriculture and residential sectors have increased by 3.6 p.p. and 0.4 p.p. respectively. The residential sector rose due to the increase in the number of households in the previous years by 0.9 p.p., and the agricultural sector rose because of the increase in oil consumption. Nevertheless, the decrease in energy consumption of the other sectors was significant enough to reduce the final energy consumption in 2015.

By 2017, it had rose 1.35 p.p. due to weather conditions, just as Sweden and Germany, but still it had decreased by 3.29 p.p. in regards to 2010 energy end-use levels. Having corrected the variation due to weather conditions, final energy consumption dropped 0.8 p.p. between 2015 and 2016. In fact, all final energy consumption by sector had dropped, the largest decrease being in the service sector by 2 p.p., ahead of the residential sector was a decline of 1 p.p. and industry 0.9 p.p. In the transport sector, which remains the main energy consumer in France, consumption is stable after two years of increase, as does the agricultural sector. In 2018, final energy consumption dropped to 91.5 percent, only 0.77 p.p. above its 2020 target, showing a very possible reach having a downwards trend in most energy consuming sectors (Eurostat, 2018).

Spain is one of the countries with the most progress made in reducing final energy consumption (Figure 1) as well as reducing primary energy consumption (Figure 2). In regards to final energy, Spain has achieved the 2020 target by 2010 reaching a 90.83 percent energy end-use, 0.1 p.p. below the 2020 target of 90.73 percent. Between 2010

and 2015, it manages to decline its energy consumption to 81.92 percent, by promoting energy efficiency and energy savings throughout Spain. How exactly, energy companies like Iberdrola have been providing information, training, solutions and technologies to ensure a better understanding of what means to be energy efficient and how can society take part in this action.

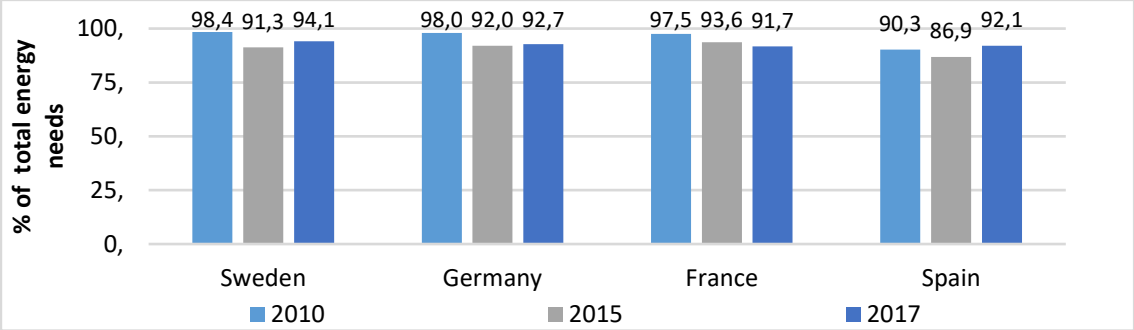
In 2017, it rose by 4.28 p.p., which is accurate with weather conditions for this year. All four Member States rose in 2017 their final energy consumption due to weather, having been a colder winter, and 2016 being a leap year, which means having one more day of energy consumption. Despite the raise in 2017 to 86.2 percent, still it is below the 2020 target, being the most energy efficient country out of the four countries under study. As mentioned previously, Iberdrola is one of the biggest energy suppliers in Spain, which provides many services to improve energy efficiency and energy savings.

> *"As an electricity supplier, it aims to contribute to a more efficient use of energy amongst consumers, informing and training users and providing solutions to help them become more energy efficient and reduce the environmental impact of their energy habits and consumption. It also promotes and develops energy efficient buildings. As an energy-consuming company, focuses on the ongoing improvement of energy efficiency across its operations (offices and buildings, vehicles, water, mobility, employee awareness, etc.)" (Iberdrola, 2020).*

Spain is mostly center in the transport and building sectors in the increase of energy efficiency, in regards to the transport section, actions are directed towards sustainable and alternative mobility, i.e. the more use of electric cars. In regards to buildings, beyond the legislative measures developed, there are a number of programs and measures intended to renovate buildings for improving energy efficiency, where Iberdrola and many other energy companies are providing help, focusing especially on buildings belonging to the public administration. In 2018, final energy consumption rose to 88.5 percent; however, progress is being made in a overall view, still being below the 2020 target by 2.23 p.p.

Concerning primary energy consumption (Figure 2) and its target to reduce to an 85.5 percent total energy needs by 2020 is in progress. The primary energy consumption for all four countries is less than 100 percent in 2010. Sweden has the highest decrease in total energy needs between 2010 and 2015, dropping from 98.38 percent in 2010 to 91.32 percent in 2015, having a reduction of 7.06 p.p. in all energy needs. This is due to the extended measures that the Swedish government has taken to increase energy efficiency in its cities. For example, by means of giving tax reliefs to mayor power industries in exchange for developing new energy plans to take steps in reducing energy use and offering energy advisers in each city to whom people can turn to for help and guidance on how to be more energy efficient (Sweden Institute, 2018).

Figure 2. Primary energy consumption



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

In 2017, total energy needs increased to 94.1 percent, having rose by 2.78 p.p. since 2015. However, still decreasing in regards to 2010 by 4.28 p.p. Between the years 2015 and 2017, the increase in primary energy consumption is heavily dependent on the increased electricity generation from nuclear power plants in addition to the increase energy use in housing and service sectors due to weather conditions as in the raise of the final energy consumption mentioned above. By 2018, primary energy consumption in Sweden has rose to 95 percent, according to the data provided by Eurostat, making Sweden just 9.5 p.p. over the 2020 target.

Germany has 98 percent of total energy needs in 2010. By 2015, primary energy consumption had decreased to 92 percent, having a decline rate of 1.2 p.p. per year. Not like Sweden, this decrease in primary energy between the years 2010 and 2015 is due to reducing nuclear power as a source of energy generation. It is easy to see that in the next years a high raise in primary energy has occurred as well as in final energy consumption.

In 2017, primary energy increase to 92.7 percent, the cool weather in 2016 had a consumption-increasing effect compared to the previous year, as a considerable part of the primary energy is used for room heating in Germany. As mentioned above, 2016 was a leap year, thus having an additional day in which energy was consumed and which contributed about 0.3 p.p. to the increase in primary energy consumption. In 2018, a downward trend could be seen, having decrease to 90.7 percent, 2 p.p. less in regards to 2017, and only 5.2 p.p. over the 2020 target, 4.3 p.p. ahead of Sweden.

Just like Sweden and Germany, Spain also improved its energy uses, but increased again in the last year. Figure 2 shows that Spain is the country with the least primary energy consumption, as in final energy (Figure 1). Nevertheless, it has a tendency to increase in the last year as in Sweden and Germany, having a rollercoaster effect. Primary energy consumption was at 90.31 percent in 2010, 4.81 p.p. above the national 2020 target. Five years later with the help of regulations, carbon taxes, and sharing awareness to society about energy saving, Spain managed to decrease by 3.41 p.p. its total energy needs to 86.9 percent, just 1.4 p.p. over the 2020 target having almost achieved by 2015 the 2020 target. Despite the decline, by 2017 energy needs increased again to 92.1 percent, the reason for this is the same for the increase in final energy consumption, cooler weather means higher use of heating (weather forecast in 2017).

In 2018, Spain took another turn to the better by decreasing energy needs to 91.3 percent due to higher knowledge on energy saving technologies, the increase use of electric

scooters, hybrid cars, less heating, the increase use of low energy consuming lights, and many other measures to improve energy efficiency.

France, as shown in Figure 2, is the only country with a very positive progress in decreasing primary energy consumption throughout the three years in questioned. In 2010, primary energy is 97.52 percent, ahead of Sweden and Germany by almost 1 p.p. but behind Spain by 7.21 p.p. By 2015, France had a decline in total energy needs by almost 4 p.p. due to the implementations of the white certificate and other alternatives to ensure energy efficiency in companies and consumers in general. Having this in mind, in 2017, France declined again by almost 2 p.p., reaching 91.7 percent in total energy needs. The environmental policies applied, have done their jobs to guarantee reductions in primary energy consumption, it is a positive progress into an energy efficient country. In 2018, it reduces to 91.6 percent, a small progress, but making it closer to achieving the 2020 target.

Sweden and Germany have a rollercoaster tendency progress, in final energy consumption as well as in primary energy consumption. Still they have a small way to go to achieve the 2020 target of energy efficiency, with their measure in place to ensure the advancement and adaptability for this planet needs. Spain has the exact same tendency; regardless it had achieved the 2020-energy efficiency target in reducing the final energy consumption by 2010, and is still ahead by 2018 reducing even more and exceed the target at hand.

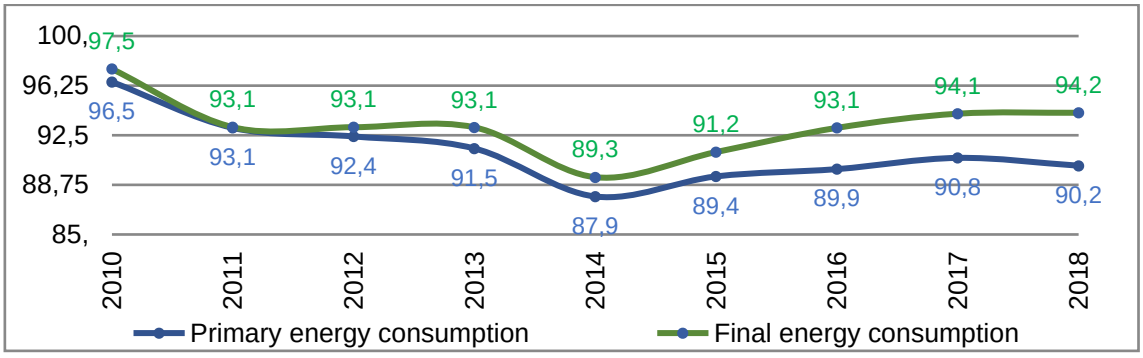
Nonetheless, Spain still has some progress to be made in the primary energy section. France has two faces, one being the rollercoaster tendency as well as the others, in the final energy consumption, still it has progressed in a better way than Germany and Sweden. Second, it is the very positive progress in primary energy consumption, having a downward trend and making it closer to achieving the intended goal.

In this particular analysis, it is visible, easy to see, that no matter how many measures a country may take if the weather of a certain year is not favorable, you will consume more than expected.

There are many ways in which a country can become energy efficient: from optimizing building designs to incorporate renewable energy technologies creating zero-energy building, to changing human behavior by giving them the information and tools to do so. The EU has provided all the measures possible for the success of achieving all three climate and energy targets for this year 2020, having achieved already 1 out of 3 by 2014 (GHG emissions, see Figure 9) and making significant progress in the other two, being just 1.1 p.p. points away from a 20% share in renewable energy in 2018 (Figure 5) and being just 8.17 p.p. away from achieving a 20% energy efficiency by 2020.

Figure 3 shows the average of primary and final energy consumptions in the EU between the years 2010 and 2018. As demonstrated, from 2010 to 2014 both primary and final energy have had a decreasing tendency, reaching a minimum of 87.87 and 89.33 percent, respectively. From this point, energy consumption increased until 2017, said increase could partly be attributed to good economic performance since 2014, with low oil prices and colder winters (weather conditions, as mentioned many times before). According to data from provided by Eurostat, primary energy consumption was 4.7 percent above the 2020 targets in 2018, whereas the final energy consumption was 3.47 percent above those targets.

Figure 3. Evolution of the primary and final energy consumption for the EU



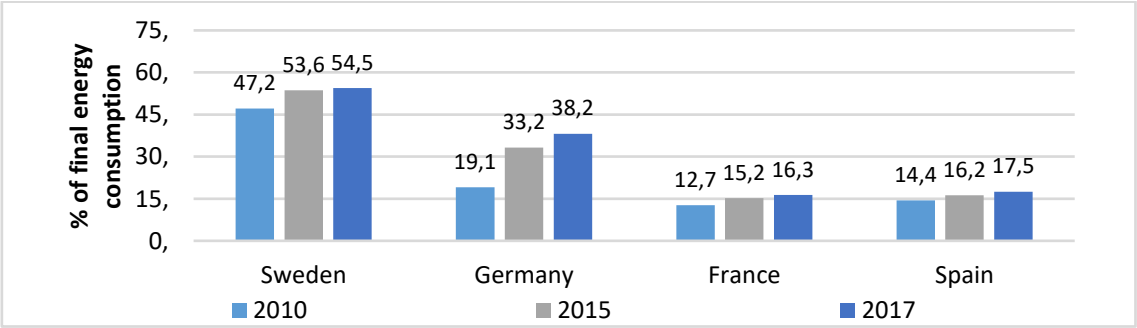
Source: own elaboration with data provided by the EUROSTAT and UNSTAT.

4.2. Share of renewable energy sources in final energy consumption to be increased to 20% (SDG-7)

Renewable energy refers to energy collected from renewable resources, which means they are naturally replenished, such as sunlight, wind, rain, and waves. As the word says, they are made new again. To use more renewable energy equals the reduction in use of fossil fuels, which in environmental terms reduces the exposure of greenhouse gases. Increasing the use of these renewable sources does not only prevent to exposure of these gases but also prevents soil, water and air pollutions. It is one of the most important parts in achieving a sustainable and environmental friendly future.

All through the study, Sweden has shown its dedication on creating a better future, being the leader in sustainability and development for a healthier planet. Not only has it reduced its emissions by 25 p.p. in 2018 but it also has the highest use of renewable energy. In 2010, 47 percent of its power came from renewable sources (Figure 4). In five-year time, it reached more than 50 percent, and in 2017, it increased to almost 55 percent.

Figure 4. Share of renewable energy



Source: own elaboration with data provided by Fraunhofer Institute, EUROSTAT and UNSTAT.

By 2015, Sweden had surpassed its 2020 target of a 49 percent share of renewable energy by almost 5 p.p. Sweden's renewable sources come from water, wind, solar and any other source that is replenished through a natural process. Between them all, water and biomass are the highest sources within their renewable energy system. Hydropower made up 65 percent of all electricity generated in 2017, and 18 percent was made from wind power.

Solar and wind power have been increasing since 2016, with the rise of wind turbine and solar panel installations. By 2018, the solar panels grid systems increased to a 67 percent, according to the Swedish Energy Agency (2019) reaching a 54.645 percent of share of renewable energy.

One curious source which Sweden has decided to use is humans own body heat. The Swedish Institute states: "So-called passive houses are built without conventional heating systems and are kept warm by the heat given off by their occupants and electrical appliances. Sweden's first passive house was completed in 2001. Since then, more buildings have followed. In Stockholm, the body heat from commuters passing through the central station is used to heat a nearby building, and in the southern town of Växjö, there are passive high-rises" (Swedish Institute (official web page), energy use in Sweden, 2019).

Apart from using body heat as a renewable energy source, Sweden has been dedicating a 100% on making sure renewable energy is the primary source for not only end users but also companies and industries, by promoting the use of renewable energy in the government's energy policies, for example, creating a "Green electricity certification". The certificate is "to qualify, electricity must come from wind, solar, geothermal or wave power; biofuels or small-scale hydroelectric plants. Electricity retailers are required to buy a proportion of 'green electricity' as part of their normal supply, while power producers receive certification for the renewable electricity they generate" (Swedish Institute, 2019).

As Sweden progresses in a very positive manner, it has already established new goals for the up coming years, such as reaching a 100 percent of electricity production from renewable sources by 2040.

Germany, although having very positive aspects in the previous point, is below 50 percent in the share of renewable energy by final energy consumption between the years 2010 and 2017. Nevertheless, it does shown an upwards trend developing. In 2010, only 19 percent of Germany's total final energy consumption came from renewable sources, where 7.1 percent came from wind power and only 2.2 percent from solar power.

By 2015, when the new SDG were created and implemented and Germany had increased its share of renewable energy by 14.1 p.p, which is an impressive reach in only 5 years. By this time solar power had rose 4.8 percent in regards to 2010, and wind power rose 7.2 percent, putting solar and wind power generators ahead of hard coal and nuclear. The power generated by biomass and hydropower also increased by almost 24 percent in regards to 2014.

In 2017, solar power increased just 1 percent from 2015. However, in the month of June solar power generation was much higher than that from hard coal. Wind energy increased by 4.8 percent more since 2015, making wind power the second largest power source after lignite (brown coal). Together, solar and wind were the primary energy source ahead of all other non-renewable energies. Hydropower and biomass did not alter as much as the other almost maintaining their levels. Thus, renewables made up 38.2 percent of public net power supply in 2017, 5 p.p. more than in 2015 (Prof. Dr. Burger, B., 2016).

According to the Fraunhofer Institute in Freiburg (2020), the share estimate of renewable energy in net electricity generation for public power supply for this 2020 year is 55.5 percent, having reached an increase of 17.5 percent in regards to 2017 in just 3 years, 3.2 p.p. above the increase made between the years 2010 and 2015. In 2019, wind power rose to a 24.7 percent generation of electricity, 5.6 percent above the 2017 generation. Solar

rose almost 2 percent more than 2017, reaching a 9 percent generation of power for this previous year. Germany, as Sweden, is headed to an upwards trend.

France and Spain have similar numbers. Neither France nor Spain have reached a 20 percent average throughout the 3 years (see Figure 5). Yet, there is some positive progress with massive changes to be made. France's primary energy source is nuclear, 45 percent of total energy generated was nuclear in 2015, and in 2017 it rose up to 72 percent. According to an online article about nuclear power written by Benjamin K. Sovacool for the Energy Policy magazine:

> "*Nuclear power generation itself doesn't produce greenhouse gases, but what is often overlooked are the emissions over the entire lifecycle of a reactor and all its inputs. Nuclear facilities emit greenhouse gases during the initial construction, when uranium ore is mined and processed, and waste treated and stored. Finally, a reactor must be decommissioned at the end of its life and mines reclaimed. All of these activities can result in the emission of greenhouse gases, and thus contribute to global warming*" (Sovacool, 2008).

Nonetheless, nuclear power has proven to be very unstable and extremely dangerous, when the correct safety measure are not followed or when even design flaws are not taking seriously and not changed at the correct moment, i.e. Chernobyl. Having this in mind, France still powers most of its country via nuclear. In 2017, as mentioned before, 72 percent came from nuclear and only a 16.3 percent was from renewable sources, where 10.1 percent was from hydropower, 4.5 percent wind and 1.7 percent solar.

By 2018, renewable energy sources accounted for 22.6 percent of the total power consumption in France, 6.3 p.p. above 2017. According to the RTE (la Réseau de Transport d'Electricité), 5.8 percent came from wind power, 2.1 percent from solar, 13.1 percent (the highest ever) from hydropower, and 1.6 percent from bioenergy. Showing significant progress, France is only 9.4 percent away from achieving its renewable energy target of having 32 percent of total power consumption come from renewable sources by 2030. Keeping this progress by investing more dedication will surely make this goal happen.

Spain has a similar progress as France. Start with only a 14.4 percent of share renewable energy in 2010, five years later this increases by 1.82 p.p. reaching 16.2 percent. As France has dependency for nuclear power, Spain has dependency for fossil fuels. In 2008, 81 percent of Spain's energy source came from fossil fuels alone. By 2012 it managed to decrease to 70.2 percent but because of the drought in 2017 the number increased to 73.9 percent. This is one of the main reasons Spain still has high levels of GHG emissions by 2017, having 73.9% of its energy come from fossil fuels, which are the main sources for CO2 emissions. By 2018, the energy dependency on fossil fuels descended to 73.4 percent, still too high for combating GHG emissions (APPA, 2018).

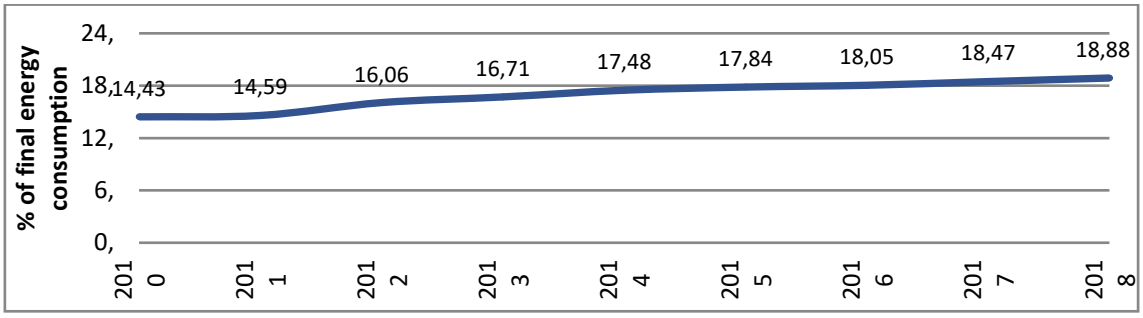
By this same year, Spain actually reduces in share of renewable energy from 17.51 in 2017 to 17.45 percent in 2018. Spain is one of the countries that is a far from achieving the goal of increasing renewable sources to a 20% by 2020. To achieve this, both the Energy Savings and Efficiency Action Plan 2011-2020 and the Renewable Energy Plan 2011-2020 are in motion. If these plans are followed to the last point, the reduction of energy dependence to fossil fuels will be possible, which also means reductions in GHG emissions.

However, the Spanish Government, through its Energy Planning published in 2015, establishes that the installation of 8,500 new renewable MW will be necessary to achieve the European objectives, which is a difficult view considering the share of renewable energy has not changed from 17 percent in the last years (APPA, 2018).

Although France and Spain have not yet reached their intended targets, still they keep their heads high and make sure that progress is being made in any means necessary. Sweden and Germany have exceeded their expectations and keep growing. Many other countries like Finland, Denmark, Romania, Italy, Greece and Czech Republic have also exceeded their targets by 2018.

In total, the European Union, in 2018, had reached 18.9 percent of total final energy consumption from renewable sources (Figure 5), just 1.1 p.p. below its 2020 target, which is well on its way to be achieved. As it has achieved its goal of the reduction by 20% of greenhouse gas emissions in regards to 1990. The EU is well on its way to achieving its targets for 2020, which means it's also on its way to achieving the SDGs for a better future.

Figure 5. Average share of renewable energy for the EU



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

4.3. Reduction of greenhouse gas emissions by 20% compared to 1990 (SDG-11 and SDG-13)

Since 1990, greenhouse gas emissions have been analyzed year by year to guaranteed the success of the climate and energy policies that were and have been placed to secure a future. Greenhouse gases have long-ranging environmental and health effects. They cause climate change by trapping heat inside the atmosphere, and contribute to respiratory diseases from fog and air pollution.

According to Christina Nunez a writer for National Geographic, greenhouse gas levels are so high mainly because humans have released them into the air by burning fossil fuels. "The gases absorb solar energy and keep heat close to Earth's surface, rather than letting it escape into space. That trapping of heat is known as the greenhouse effect"(Nunez, 2019). Extreme weather, food supply disruptions, and increased wildfires (cases of wildfire increasing in Australia and California) are other effects of climate change caused by greenhouse gases. Some of the mayor greenhouse gasses are:

- Carbon dioxide (CO2): the primary greenhouse gas responsible for about three-quarters of emissions. It can dawdle in the atmosphere for thousands of years. Carbon dioxide emissions mainly come from burning organic materials like coal, oil, gas, wood, and solid waste.

- Methane (CH4): is the main component of natural gas. Methane is released from landfills, natural gas, petroleum industries, and agriculture (especially from the digestive systems of herding animals). It does not stay in the atmosphere as long as carbon dioxide, it can remain up to 12 years. However, it is at least 84 times more potent over two decades. According to National Geographic, Methane accounts for about 16 percent of all greenhouse gas emissions.
- Nitrous Oxide (N2O): it takes a relatively small share of global greenhouse gas emissions, but it is 264 times more powerful than carbon dioxide over 20 years, and its lifetime in the atmosphere exceeds a century, according to the IPCC. Agriculture and livestock, including fertilizer, manure, and burning of agricultural residues, along with burning fuel, are the biggest sources of nitrous oxide emissions.
- Industrial gases: Fluorinated gases such as hydrofluorocarbons, per-fluorocarbons, chlorofluorocarbons, sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) have heat-trapping potential thousands of times greater than CO2 and stay in the atmosphere for hundreds to thousands of years. Accounting for about 2 percent of all emissions, they're used as refrigerants, solvents, and in manufacturing, sometimes coming to pass as byproducts.

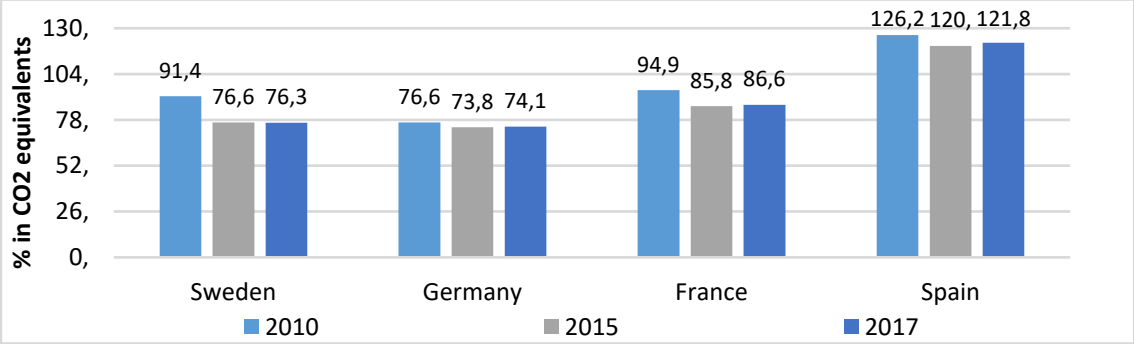
There are many sources from where greenhouse gases can emerge. Methane and nitrous oxide are mainly exposed to the atmosphere in livestock, animal agriculture, mostly by enteric fermentation and manure storage. To reduce the emission of these gases, mitigation strategies are necessary to meet the increasing demand for livestock products driven by population growth:

> *"One of the principal ways to achieve this environmental standard is to adopt effective mitigation strategies. To increase the effectiveness of these strategies, complex interactions among the components of livestock production systems must be taken into account to avoid environmental trade-offs" (Grossi, Goglio, Vitali & Williams, 2019).*

The excessive use of fossil fuels such as oil, petroleum and natural gas, is the primary cause to the massive emissions of carbon dioxide released each year to the earth's atmosphere made by human activities. Fossil fuels are used in many ways, for instance in industrial sectors to produced products for society, in generation of electricity and heating, and in transportation. Carbon dioxide is released in even higher quantities than what the environment can reabsorb, thanks to mankind's thirst for more. In addition to fossil fuel use and agriculture, greenhouse gases can also be released by land use, forestry, and waste.

In 2010, GHG emissions decreased in an average of 14.1 p.p. in the EU (see Figure 9), being in the lead Germany with a reduction of 23.4 p.p. (Figure 6) in regards to emission levels in 1990. According to an online article released in Renewable Energy World publications in 2010, 17 percent of Germany's energy source is provided by wind turbines, hydroelectric plants, solar cells, and biogas digesters, that is renewable energy. Although they have manage to increase their use of renewable energies, still 22 percent of their energy source is nuclear.

Figure 6. Greenhouse gas emissions



Source: Own elaboration with data provided by EUROSTAT and UNSTAT

Germany's Energiewende (energiewende is a planned transition, which was supported legally in 2010), focuses on renewable energy and sustainable development. Energiewende goals include eliminating nonrenewable energy sources from Germany's energy portfolio, phasing out nuclear power generation by 2022, reducing dependence on energy imports, and lowering carbon emissions 40 percent by 2020 and between 80 and 95 percent by 2050 relative to 1990 levels.

By 2015, renewable energy generated 32.5 percent of the country's electricity, decreasing GHG emissions by almost 3 p.p., 26.2 percent in relative to 1990. This rapid increase of renewable energy is associated with the 2011 meltdown at Japan's Fukushima nuclear power plant, which led Chancellor Angela Merkel to declare that Germany would shut all 17 of its own reactors by 2022. Nine have been shut down by 2015. So far, Germany has increased in renewables and is getting closer to its goal of reducing its GHG emissions by 40 percent for 2020.

By the year 2017, Germany rose by 0.3 p.p. However, this small increase does not change the fact that Germany is the leader in replacing nukes and fossil fuels with wind and solar technology. According to an annual assessment on power generation in Germany made by the Fraunhofer Institute, in 2017 power generated by renewables like solar, wind, hydropower and biomass rose up to 15 p.p. in regards to the previous year's. Thus making up around 35 percent of public net power supply provided only by renewables.

Germany achieved a reduction of 30.8 percent on 1990 CO2 emission levels by 2018. According to the Federal Environment Agency (UBA), which published these estimates in April 2019, the decline was primarily due to reduced emissions in the energy industries sector where higher CO2 prices increased costs for coal, and power plants being shut down. In addition, warmer weather (climate change) and higher oil prices cut heating oil use. By last year 2019, Energiewende estimate emissions declined by 35 percent, 4.2 p.p. higher than the previous year, due to a drop in coal use and higher use of renewable energy.

Sweden comes in second, with a reduction of 23.4 p.p. by 2015. Sweden's goal to reduce GHG emissions compared with 1990 by 40 p.p. by 2020, and to get rid of fossil fuels by 2030 are some of the milestones for the achievement of the goal of a society with no net GHG emissions by the year 2050.

Sweden reduces a 0.3 p.p. more by 2017. The decline on 1990 CO2 emission levels is contributed to the high share of renewable energy (see Figure 4) that Sweden possesses, having a rich supply of moving water and biomass. Hydropower and bioenergy are the

top renewable sources in Sweden, from which hydropower is mostly used for electricity production and bioenergy for heating. According to an article written in the Independent, 57 percent of Sweden's power comes from renewables with the remainder coming from nuclear power. By this time, Sweden has already surpassed its target of 50 percent of renewable source by 2020, making its next target 100 percent by 2040 (Sims, A., 2016).

By 2018, Sweden reduces its GHG emissions to 74.47 percent (Statista, 2020), a 25.5 percent. decline in regards to 1990 emission levels. Having this in mind, is it clear that a downward trend of emission levels is taking place, not only for the increase in renewable energy but also the high carbon taxes and the use of more low carbon and electric vehicles.

Even though, Sweden and Germany have a high share of renewable energy and seem to be increasing year by year, there are countries where still a grand part of their power source is nuclear, such as France. Since 1990, France has only achieved a reduction of 5.1 p.p. by the year 2010 in GHG emissions. Five years later, it manages to reduce in 9.1 p.p and has a slight increase of 0.8 p.p. in 2017 but decreases in 13.4 p.p in relation to emission levels in 1990, making it the country with the smallest positive progress between the four.

According to a report by Globaldata (2019), renewable energy increased to almost a 20 percent in 2018. However, this is not enough to achieve a similar decline rate in GHG emissions as Germany and Sweden considering that France is known for being leader in the nuclear power source in the entire EU (72%). Considering this, the French government has set out targets and certain environmental policies to achieve a 40 percent reduction on GHG emissions by 2030 and increase renewable energies by 32 percent by 2030; also manage a reduction on nuclear dependency from 71 percent to 50 percent by 2025.

Spain shows an increase of GHG emissions of 26.2 p.p. by 2010. Out of the four countries, Spain has the most negative progress in CO2 emission levels throughout the 3 years in questioned. Nonetheless, it has manage to decrease emissions by 6.2 p.p in the next 5 years and have a slight increase of 1.8 p.p in 2017 but still declining by 4.4 p.p. in regards to 2010.

By 2018, the transport sector was the largest contributor to the GHG emission inventory (27% of emissions). By itself, road traffic counts for 25 percent of all GHG emissions and one-third of that is concentrated in urban areas. Moreover, there has been a decline in emissions in this year which primarily originates from the strong increase in hydro-power production, which grew by 84.9 percent in 2017 thanks to a hydrologically wet year, as well as a 3.5 percent increase in wind power. These two factors led to a 15.7 percent reduction in the emissions tied to electricity generation given that the increase in renewable sources allowed for less production from combined-cycle power plants, coal power plants and liquid fuel power plants (La Moncloa, 2019).

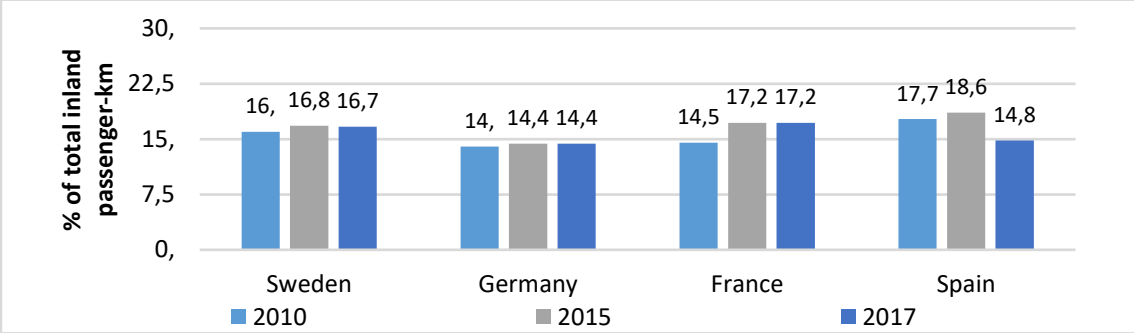
Nevertheless, other sectors have shown an increase in their emissions when compared with data from 2017. Rises were recorded in the emissions tied to transport up by 2.7 p.p., to fuel consumption in residential, commercial and institutional sectors by 1.9 p.p., to fuel consumption in agricultural, forestry and fishing machinery by 4.1 p.p., and emissions from the industries sector rose by 2 p.p. (La Moncloa, 2019).

Overall, these numbers put the level of emissions in Spain 15.4 p.p. above the emission levels in 1990 (La Moncloa, 2019). The fact is that Spain drafted an Integrated National Energy and Climate Plan 2021-2030 (PNIEC), which will lead them to a future were its electricity system will entirely depend on renewable sources and completely decarbonize

its economy by 2050. The draft provides for a series of actions aimed at reducing this emission levels by 21 p.p. when compared with 1990 levels by 2030. However, Spain still has a long way to go to achieve its goals considering how advances his fellow countries are.

As mentioned before, 27 percent of GHG emissions comes from transport. Despite this information, Figure 7 shows that between 2010 and 2015, Spain is the country with the highest shares in national public transportation use. However, it shows a decrease in public transport use by 4.1 p.p. in 2017. This decline is associated to the massive increase in use of the private car. According to a study done by Ecologists in Action (2017), the urban and transport policies have been aimed at favoring and encouraging the use of the private car. This adaptation of the city map to the massive use of the car has made the distances covered every day by citizens double in the last thirty years.

Figure 7. Share of Public transportation use



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

Since the implementation of the SDGs in 2015, the Spanish government has promoted "sustainable mobility". Applying this term to the field of transport, sustainable mobility is related to the implementation of a series of measures that guarantee the reduction of the use of private cars, the reduction of their environmental and urban impact, and the promotion of public transport.

To ensure the rise of sustainable mobility the Spanish Network of Cities for Climate, belonging to the Spanish Federation of Municipalities and Provinces has provided 5 measures to promote sustainable mobility:

1. Promote public transport alternatives
2. Pedestrianize and encourage the use of the bicycle
3. Restrict car use
4. Reduce the speed of cars in the city or in its accesses
5. Promote the collective use of means of transport

Therefore, the more use people give to public transport and/or other means of transport like bicycle, less CO2 emissions by petroleum consumption.

Germany, however, is one of the countries with less use of the public transport system according to the data recovered from Eurostat in Figure 7, having just 14 percent of total inland passenger by km. Nonetheless, this does not affect Germany as much for it has an

elevated share of renewable sources depending less on fossil fuels, coal, gas and nuclear power. Yet the German government has an anti-air-pollution law that obligates drivers in Germany (resident and foreigner) to have a special environmental sticker or badge on their car in order to enter the "green zone" of most German cities. To enhance public transport use, lower CO2 emissions in city center and lower air pollution by particles matters (The Germany way and more, 2020).

In Sweden only 16.7 percent of total inland passengers travel by bus or train, which is a small number for a country where more than 50 percent of its energy comes from renewable sources. In 2017, the Swedish Transport Administration submitted a proposal on a national plan for the transportation system in 2018-2029, with the premise to contribute to a modern, effective and sustainable transportation system. With the help of new technologies, Swedes want to emphasize the relationship between using public transportation and being environmentally friendly, for example converting to fossil free fuels. "We are working to create an accessible Sweden, where everyone arrives at their destination smoothly, the green and safe way. Our focus is a transportation system that works for everyone. It should be easy to travel and to get to work and school or to transport freight and goods" (Swedish Transport Administration, 2017).

France starts with a 14 percent of total inland passenger - km by 2010, which then increases by 3.2 p.p. in 2015 and stays steady all through the years 2016 and 2017. The reasons for this increase can be the cheap prices of using public transport, in addition to having a great public transport system in and around France in terms of geographical spread, speed and upkeep.

In 2017, the metro was the most popular public transport type in Paris. That year more than 1.53 billion journeys were taken on the metro in the French capital. Public transport in Paris is composed by a large network of metro stations, bus lines, suburban trains and tram services. These different modes of transport makes it possible to travel in the French capital but also within the large suburbs surrounding Paris. Therefore, more than 492 million people used the suburban trains called RER which connects Paris to the suburbs. Almost 70 percent of people living in the French capital use metro, buses or suburban trains to go to work, compared to 40.7 percent of employees in Lyon, the third most populated city in France (Statista, 2017).

As previously stated in the beginnings of the analysis, greenhouse gas emissions are liberated into the atmosphere by many sources (fossil fuel use, transportation, agriculture...). Waste, everything to do with materials that humans no longer want or can no longer find a use for, is one the many ways that these emissions can be released. Waste can be organic which is biodegradable or inorganic which is non-biodegradable, such as plastic materials. The recycling of these non-biodegradable wastes is essential to converse the environment.

Waste has a big negative impact on the natural environment, due to the hazardous chemicals and GHG that are released from these residues collected in landfill sites. The organic waste collected is used as compost or biogas. Inorganic waste like paper, glass and plastic (only plastic that can be recycled) are drifted off to the recycling industry to give it a second life. Not only recycling, but reducing the amount of waste that is generated, has an important part in climate protection by keeping trash out of incinerators and landfills, where it can produce high levels of GHG emissions.

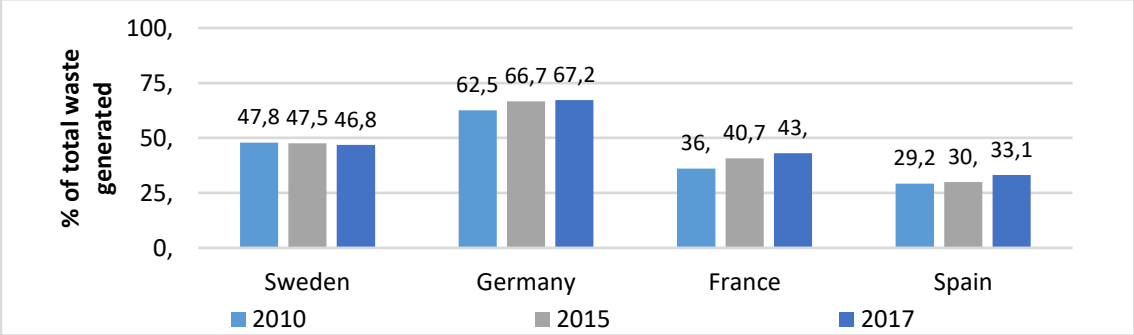
In Figure 8, the recycling rate of municipal waste is shown for the four countries in study. Neither Sweden, France nor Spain reached a 50 percent recycling rate between the years

2010 and 2017, which means they likely generate waste at a faster pace than the amount recycled.

Sweden, is one of the Nordic countries with the most progress made in achieving the Sustainable Development Goals. Having notice that their recycling rate in 2017 was only a 46.8 percent, and showing a downward trend since 2010, made an ambitious objective for a zero waste society.

To incentive recycling, in 2017 the tax system was reformed so that people could get cheaper repairs on used items, and Swedish clothing company H&M started a recycling scheme where customers get a discount upon handing in their old clothes. However, there are other problems that the Swedish people face, the difficulty to dispose of certain vital products. The Swedish government approached this inquiry with a circular economy system, which involves using products that can be reused completely. In 2018 the Swedish government established a special advisory group to help it make circular economy a key part of its policy (Sweden Institute, 2019).

Figure 8. Recycling rate of municipal waste



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

France ends the decade in 2010 with a 10 p.p. increase in recycling since 2001 (Gentil, 2013), thanks to a new waste management policy and a waste management strategy developed in 2007 by the French government with a detailed stakeholder engagement process, known as the "Grenelle Environnement" process. Involving government, unions, employers, NGOs and local authorities' representatives discussing a wide range of environmental issues including waste management where specific targets were enabled at a national level (Gentil, 2013).

In 2009, the first "Grenelle Environnement" law was set in motion with specific points to be achieved. Within these specific points, the achievement of a recycling rate (material and organic recycling) of 35 percent in 2012 was one of them.

France achieved its target of a 35 percent recycling rate by 2010 with an additional 1 p.p increase. From this year onwards it was increased its recycling rate by 4.7 p.p in 2015, and an additional 2.3 p.p. increase by 2017, achieving a 43 percent recycling rate, and demonstrating an upward trend for the coming years.

Spain has the least progress. Still it has made an increase in almost 4 pp. by 2017, reaching a 33.1 percent recycling rate. Taking into account the 10 p.p. increase Sweden made from 2001 to 2010, 4 p.p increase in Spain from 2010 to 2017 it not so significant. Although, it is important to know that Swedish mentality is not the same as the Spanish. Even a

small progress is better than no progress. Thanks to the social awareness on many environmental issues, Spain is taking charge on altering the outcome. Regardless, Spain is still far from being on the European level of a 45 percent recycling rate.

Germany is the country with the highest recycling rate in all the EU. Starting with a 62.5 percent in 2010, after 5 years it increased by 4.2 p.p and after 2 more years by 0.5 p.p., reaching a 67.2 percent recycling rate in 2017. Germany is an advised country when it come to recycling. As Sweden, the circular economy is a very important part for the environmental policy, having a special recycling system with plastic bottles and aluminum cans where people can get money back when returning these items. They also have specific containers for different color glass, separating the recycling process not only between paper, plastics and organic, but also in the different types of glass.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), states that the German public is generally aware of the importance of waste separation and recycling, and that with modern sorting, treatment and recycling technologies well-established, the recycling capacity has expanded. “The environmental benefits of the circular economy are well-documented: it benefits the soil, water, air and climate. What is more, it also pays off financially. Waste management in Germany has evolved into a large and powerful economic sector” (BMU, 2018).

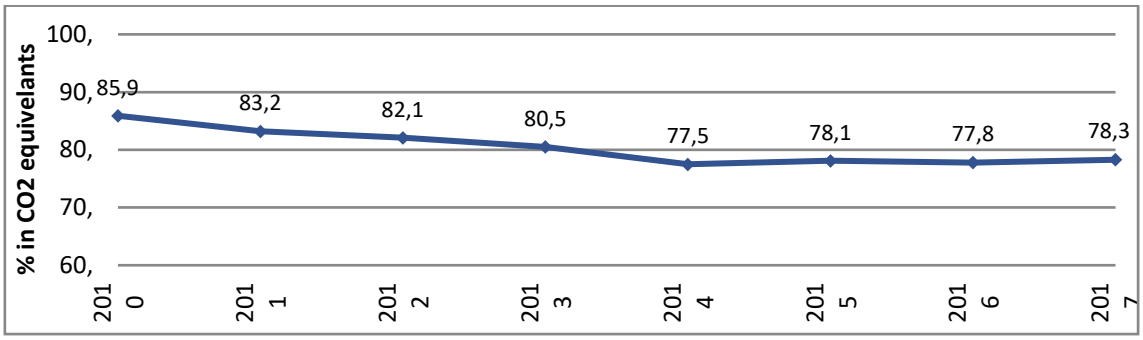
One of the key aims of waste management policy in Germany is to prevent negative environmental impacts, maintaining their high standards to protect water, soil and the air from the emissions associated with waste treatment and storage. Since 2005, the prohibition on dumping untreated waste has helped to continuously reduce emissions of greenhouse gases, like methane from landfills. “Recycling and the harvesting of energy from waste also helps to minimize greenhouse gases. In this way, since 1990, annual emissions from the waste management sector have been reduced by some 56 million tons of carbon dioxide equivalents”(BMU, 2018).

Overall, greenhouse gas emissions from waste in the EU have fallen by 42 percent (Eurostat, 2020). The amount of emissions from waste depends on how the waste is treated. For example, when waste is landfilled, the organic material in the waste decomposes and produces gas, most commonly Methane gas. To overcome waste each country has established different measures.

Germany and Sweden have an advanced circular economy with additions, such as implementing a “costs of emissions” in the production line for companies in Sweden, or creating a powerful economic sector by harvesting energy from waste in Germany. Thanks to the Ecoembes a non-profit environmental organization that promotes sustainability and environmental care through recycling, Spain has made more accessible recycling containers to all population, and is creating more social awareness of the issues humanity faces. Last, France is approaching the matter by updating regulations and laws, in 2016 a French law was passed that obligated businesses, offices and administration to recycle waste (ADEME, 2016 & Jacobsen, 2018).

The European Union 2020 Climate and Energy strategy introduced a clear approach to achieving a 20 percent reduction in total greenhouse gas emissions compared with 1990 emission levels (Figure 9). “The EU Emissions Trading System (ETS) is the EU's key tool for cutting greenhouse gas emissions from large-scale facilities in the power and industry sectors, as well as the aviation sector. The ETS covers around 45% of the EU's greenhouse gas emissions. In 2020, the target is for the emissions from these sectors to be 21% lower than in 2005” (European Commission, 2010).

Figure 9. Average greenhouse gas emissions for the EU



Source: own elaboration with data provided by EUROSTAT and UNSTAT.

Having analyzed the effect of greenhouse gas emissions from general electricity generation, transportation and waste, by 2017 the EU had already achieved and surpassed its target to reduce by 20 percent greenhouse gas emissions compared to 1990 with a reduction of 21.7 p.p (see Figure 4). The European Environment Agency (EEA) in its annual reports on "Trends and projections" stated a 2 p.p decrease in emissions from 2017 to 2018, bringing the collective reductions down to 23.2 p.p below 1990, well over the 2020 target.

Nevertheless, the development for a sustainable future does not stop here. The EU legislation has adopted new GHG emissions targets for 2030, at least a 40 percent reduction in greenhouse gas emissions compared with 1990. However, this ambitions goal for 2030 is not yet possible for some Member States which project that with the current policies and measures they can deliver a 30 percent reduction by 2030. Conclusion, it is necessary the adaptability of environmental policies and measure in all the sectors that contribute to the emissions of these gases throughout the EU countries to facilitate the achievement of these targets in order to have a better future.

5. Multivariate analysis for the European Union countries

As I have pointed out in the methodological section, the MFA allows us first, to analyze the relationships that exist between the variables; second, to study if there are patterns of commitment to similar SDGs among the countries; and third, to examine the trajectory followed by the countries during the years 2010, 2015 and 2017 in relation to the SDGs. The statistical packaged used is SPAD 7.5.

Based on the data available, I have selected a set of variables related to SDGs 7, 11, 12 and 13 for each year, grouped into three groups. Each group of variables characterizes then countries in that year. All the variables are continuous and, as I already mentioned, 22 EU countries are included.

Table 1 represents the three groups of variables and provides a basic statistical descriptive.

Table 1. Variables by year

	Label	Mean	Standard deviation	Min	Max
2010	SDG7_primary_energy consumption (%, 2005=100)	97,3	5,4	89,8	109,8
	SDG7_final_energy consumption (%, 2005=100	97,6	5,6	87,2	113,3
	SDG 7_Share of renewable energy (%)	15,3	10,5	2,9	47,2
	SDG 11_Exposure to air pollution by particulate matter (µg/m3)	17,7	6,2	7,4	31,1
	SDG 11_Recycling rate of municipal waste (%)	33,3	15,3	9,1	62,5
	SDG11_Share of busses and trains in total passenger land transport (%)	18,4	4,8	10,9	31,4
	SDG 12_Circular material use rate (%)	9,5	6,5	1,7	25,4
	SDG13_Greenhouse gas emissions (%, 1999=100)	91,5	19,5	50,0	126,2
2015	SDG7_primary_energy consumption (%, 2005=100	89,5	5,3	75,9	102,4
	SDG7_final_energy consumption(%, 2005=100	91,3	6,0	78,7	106,5
	SDG 7_Share of renewable energy (%)	19,1	11,5	5,1	53,6
	SDG 11_Exposure to air pollution by particulate matter (µg/m3)	14,9	5,3	5,8	25,0
	SDG 11_Recycling rate of municipal waste (%)	39,2	13,5	13,2	66,7
	SDG11_Share of busses and trains in total passenger land transport (%)	18,4	4,4	11,1	31,8
	SDG 12_Circular material use rate (%)	9,4	6,2	1,4	25,9
	SDG13_Greenhouse gas emissions(%, 1999=100)	82,3	18,0	47,1	120,0
2017	SDG7_primary_energy consumption (%, 2005=100	92,4	6,8	76,8	112,7
	SDG7_final_energy consumption(%, 2005=100	95,1	7,9	79,9	121,3
	SDG 7_Share of renewable energy (%)	19,8	11,7	6,3	54,5
	SDG 11_Exposure to air pollution by particulate matter (µg/m3)	14,3	5,3	4,9	23,8
	SDG 11_Recycling rate of municipal waste (%)	41,7	12,5	14,0	67,2
	SDG11_Share of busses and trains in total passenger land transport (%)	18,5	5,5	11,5	35,6
	SDG 12_Circular material use rate (%)	9,5	6,7	1,3	29,0
	SDG13_Greenhouse gas emissions(%, 1999=100)	83,1	19,4	46,1	122,8

5.1 Results of the MFA

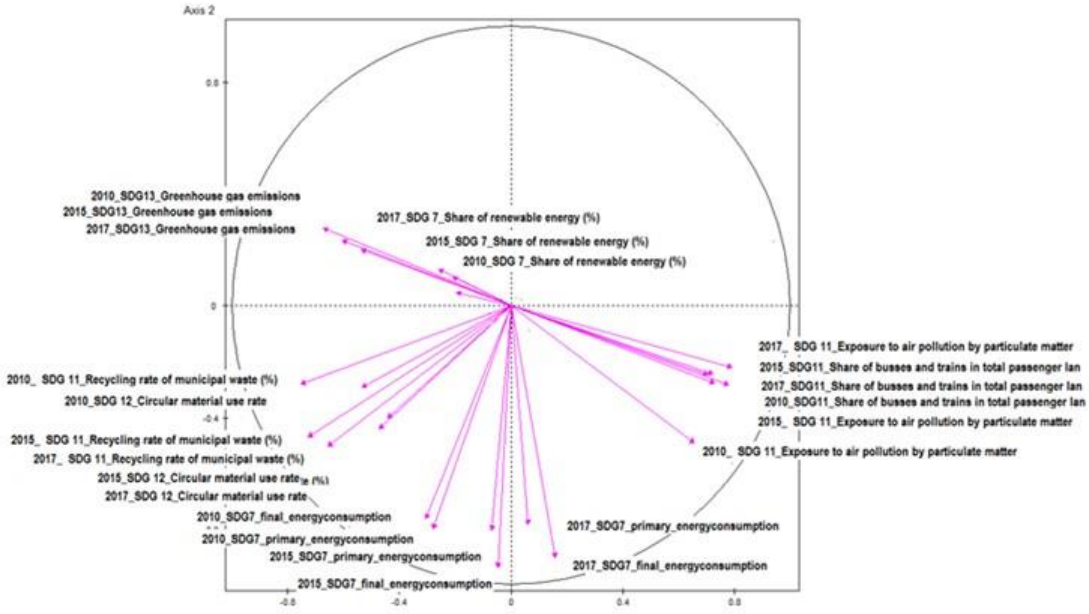
Table 2 represents the first two eigenvalues of the global analysis, i.e., taking into account the three groups of variables. The first factor explains 47.6 % of the variance and the second factor 22.9%. Therefore, the first two factors together explain the 70.5% of the total variance.

Table 2. Two first eigenvalues

Number	Eigenvalue	Percent	Cumul. percent
1	2,3826	47,6524	47,6524
2	1,1447	22,8943	70,5467

Figure 10 shows the projections of the variables on the first factorial plane. This projection allows us to visualize the contribution of the variables to the formation of the factors and their sign.

Figure 10. Projection of active variables in the first factorial plane(1-2)



The first factor suggests from right to left, a first distribution of countries. The left semi-plane includes countries characterized by indicators related to the SDG 11 (recycling rate of municipal waste), SDG 12 (circular material use rate) and SDG 13 (GHG emissions) and, to a lesser extent, to the SGD 7 (Share of renewable energy). On the right semi-plane are countries characterized mainly by two indicators relate to the SDG 11 (Exposure to air pollution by particular matter, share of busses and trains in total passenger land transport).

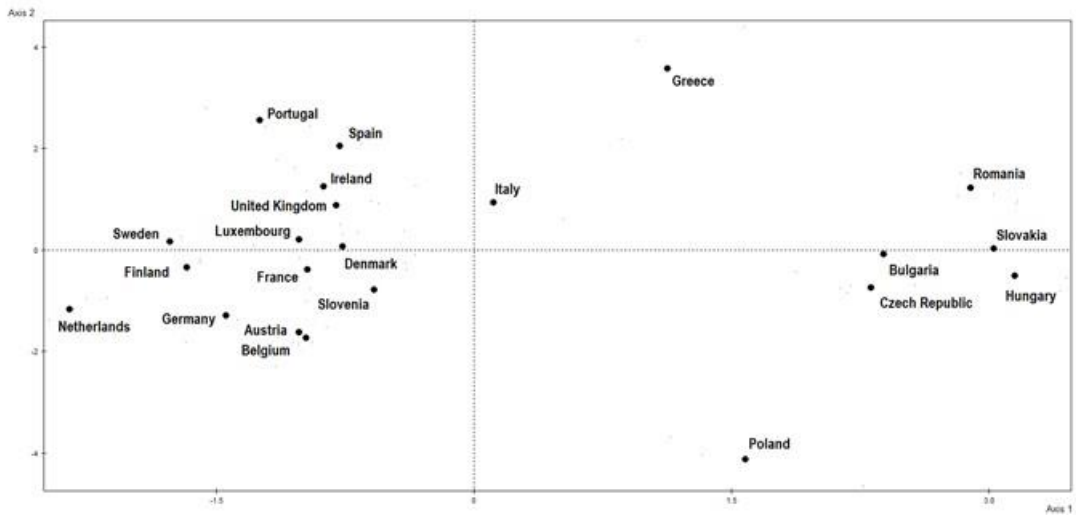
The second factor compares the countries characterized by some indicators of the SDG 7 (share of renewable energy) with the countries characterized by the rest of the indicators of this goal (primary energy consumption and final energy consumption) (see details in Table A1 “A.1. Results from the MFA in detail” in the Appendix).

Based on this distribution of variables, in the first factorial plane (Figure 11) the average individuals have been projected, that is, the average relative position that countries occupy, taking into account all the groups of variables considered.

In accordance with the previous interpretation, the first factor reflects, in the left-hand semi-plane, the countries characterized by the indicators related to SDG 11 (recycling rate of municipal waste), 12 (circular material use rate), 13 (GHG emissions) and SGD 7 (Share of renewable energy): Netherlands, Sweden, Finland, Germany, Austria, Belgium, France, Luxembourg, Portugal, UK, Spain, Ireland, Denmark and Slovenia. On the right-hand semi-plane are the countries associated with the indicators of SDG 11 (Exposure to air pollution by particular matter, share of busses and trains in total passenger land transport): Hungary, Slovakia, Romania, Bulgaria, Czech Republic, Poland, and Greece and, to a lesser extent, Italy

The second factor, as noted, characterizes the countries with regard to SDG 7. For example, it confronts Poland with high values in both primary and final energy consumption indicators, while Greece with low values in these indicators.

Figure 11. Projection of countries on the first factorial plane



5.2. Cluster analysis

The cluster analysis has been conducted using the information obtained in the previous MFA on the first two factors extracted. The cluster analysis groups the countries into three different classes. Countries belonging to the same class have homogeneous characteristics while countries belonging to different classes have different features. It should be noted that countries within the same class do not necessarily share all the variables that characterize the class, although they do share most of them.

Figure 12 shows the dendrogram resulting from the implementation of the Ward's hierarchical agglomerative method. It can be seen that from the set of countries, two large groups of countries are obtained, which in turn can be divided into subgroups. We have chosen three classes of countries, since it is the most suitable option for the objectives of this Project.

Figure 12. Dendrogram

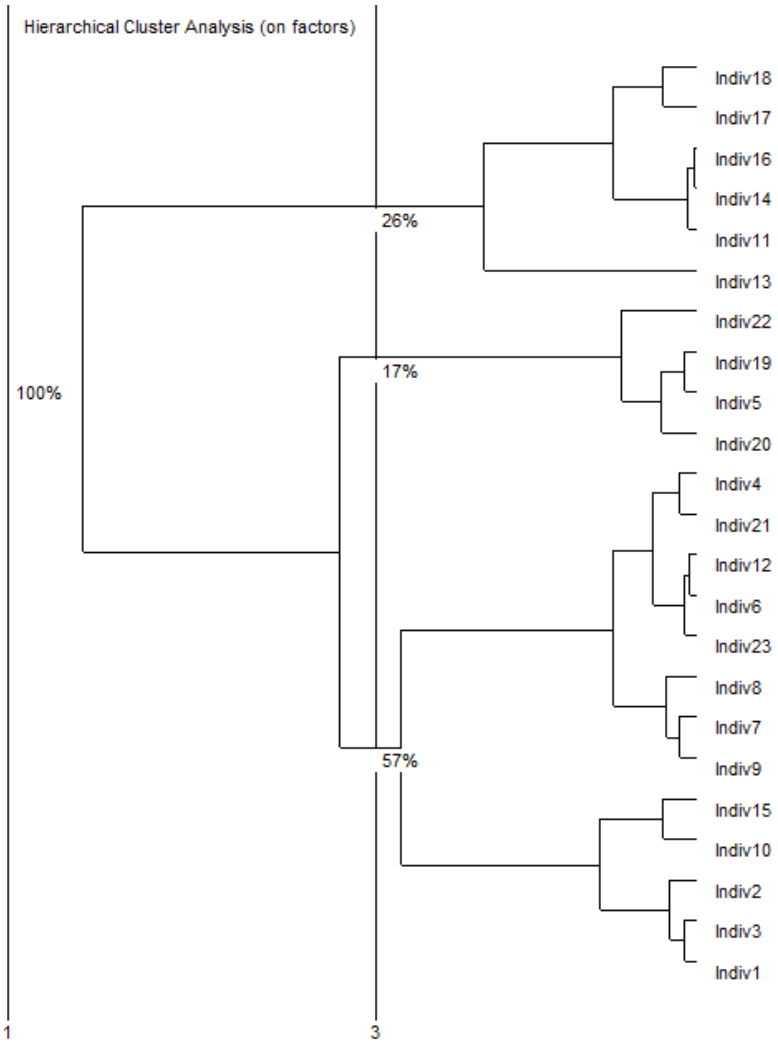


Figure 13 shows the countries (average individuals) grouped according to the result of the Cluster Analysis (see the Appendix "A.2. Results from the Cluster Analysis" for the complete results of the cluster analysis).

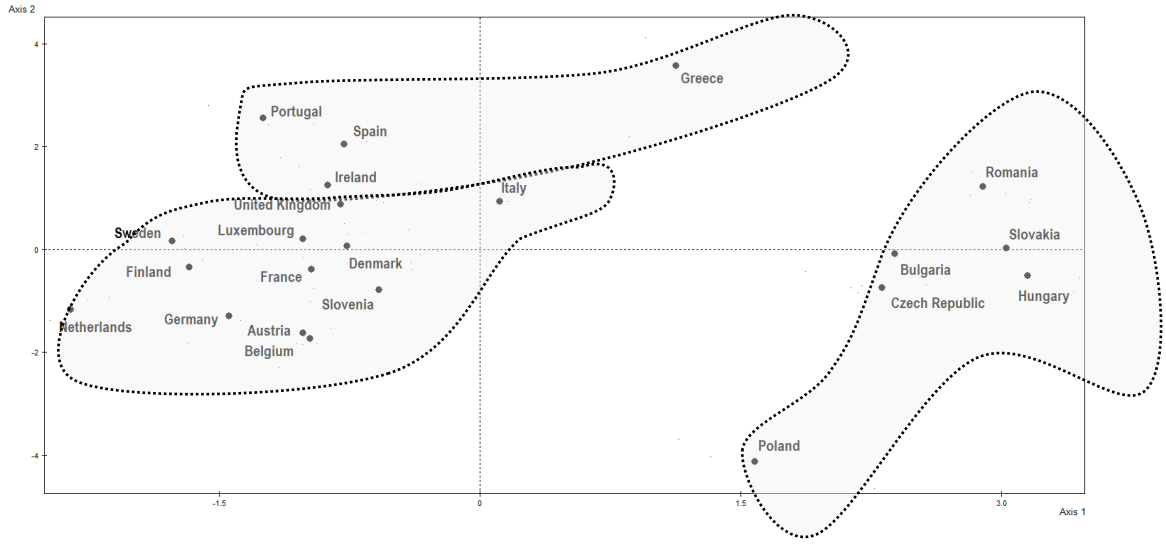
Cluster 1 consists of 11 countries: Netherlands, Sweden, Finland, Germany, Austria, Belgium, France, Luxembourg, UK, Denmark, Slovenia and Italy. These countries are characterized by having higher both recycling rate of municipal waste and circular material use rate than the whole set of countries in all the three years considered. In 2017, this subset of countries had a recycling rate of 50.5% while the average for all countries was 41.7%.The circular material use rate in the same year was 13.1% for this group of countries while the average for the EU was 9.5%. This subset of countries is also characterized by a lower share of busses and trains in total passenger land transport (16.7% in 2015 compared to 18.5% for the whole sample) and a lower exposure to air pollution (12% in 2017 compared to 14.3% in the EU average). Countries belonging to this class are the most advanced countries in the EU.

Cluster 2 is made up of 4 countries: Spain, Portugal, Ireland and Greece. This group of countries is characterized by a high level of greenhouse gas emissions (112.8 in 2017

while the average for the whole sample was 83.1). This group of countries has lower recycling rate of municipal waste (30.2% in 2017 as compared to the average of 41.7% for the whole sample), circular material use rate (3.3% in 2017 as compared to 9.5% in the whole set of countries) and final energy consumption (86.5% in this group of countries versus 95.1 in the whole group of countries) than the average of the whole group of countries. It is worth mentioning that these countries were referred to as "convergence countries" during the 1980s and 1990s because their per capita income was less than 90% of the EU-15 average. Moreover, this group of countries was very severely affected by the 2008 financial crisis and required financial support from the European institutions.

Cluster 3 consist of 6 countries: Poland, Rumania, Hungary, Czech Rep. Bulgaria and Slovakia. This group of countries is characterized by higher exposure to air pollution (20.8 µg/m3 in 2017 as compared to 14.3 µg/m3 average in the whole sample), higher share of busses and trains in total passenger land transport (24.7% in 2017 while the average for the whole sample was 18.5%) and higher final energy consumption (100.8 in 2017 as compared to 95.1 average in the whole sample). Moreover, this group of countries has lower both recycling rate of municipal waste (30.2% in 2017 as compared to the average of 41.7% for the whole sample) and greenhouse gas emissions (64.5% in 2017 as compared to 83.1% in the whole set of countries). The countries within this group joined the EU in the 2004 and 2006 enlargements. All of them have per capita levels of income below 90% of the EU average.

Figure 13. Clusters



5.3. Dynamics of the EU countries: 2010, 2015 and 2017

In this section, I will analyze the trends in the group of indicators that have been examined throughout the years 2010, 2015 and 2017. To do so, I have selected countries from each cluster. More specifically, from cluster 1, I examine Germany, Sweden and Denmark, from cluster 2, Spain and from cluster 3, Bulgaria, Poland and Hungary. The notation G1, G2 and G3 refer to the year 2010, 2015 and 2017, respectively.

Figure 14 shows the projection of the trajectories of the selected countries in the first factorial plane over the years 2010, 2015 and 2017.

Germany exhibits a displacement from the origin downwards, from 2010 to 2015 due to a significant relative increase in the circular material use rate and a relative reduction of air pollution. However, from this year it begins to approach towards the origin and upwards. This displacement is due to an increase, in relative terms, in the level of exposure to air pollution and in the GHG.

Denmark shows an upward trend towards the origin from 2010 to 2015 caused by the relative decrease in the percentage of buses and trains in the total land transport and in energy consumption. From 2015 to 2017 it presents a displacement rightwards as a result of a relative improvement in the share of public transport, less exposure to air pollution and a relative reduction of GHG.

Sweden hardly changes its relative position. There is a trend towards the origin owing to the fact that the European Union, which had more room for improvement, has made greater progress than Sweden, which had and still has an advantageous position in the environmental field.

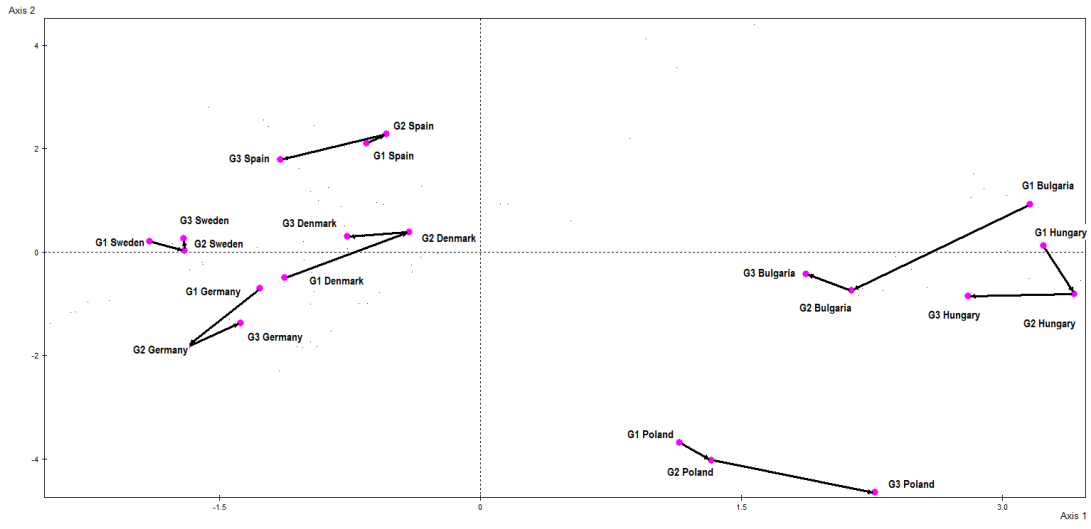
Spain shows an improvement in its relative position from 2010 to 2017. This relative improvement is mainly attributed to advances in the recycling rate of municipal waste, the exposure to air pollution and the share of renewable energy.

With respect to Eastern European countries, Poland shows a trend towards the right and downwards. This trend is due to a relative increase in primary and final energy consumption and a relative reduction in the use of renewable energy.

Hungary, in turn, has a trend towards the origin mostly due to a relative improvement in the recycling rate of municipal waste. It also shows a relative increase in energy consumption.

Bulgaria has a similar trajectory to Hungary, with a trend towards the left. This displacement is due to a significant improvement in the recycling rate of municipal waste and the exposure to air pollution. However, this country also shows a relative increase in the consumption of energy.

Figure 14. Projection of the trajectories of countries over the years 2010, 2015 and 2017. Selected countries



6. Conclusions: For a better future

The Sustainable Development Goals are a blueprint to achieving a better and sustainable future for all, made out of 17 global goals reaching from eradicating hunger and poverty to insuring animal welfare and climate action. This specific project is made to display the progress made on SDG 7, 11, 12 and 13 by our fellow EU countries, explaining how that progress is carried out, while at the same time finding similar characteristic between these countries (i.e. showing how two very different countries can have the same trajectory towards one or more SDG's).

Only 1 out of 3 2020 targets for Europe has been reach, to decrease greenhouse gas emissions by 20% since 1990. By 2014 the EU had achieved a reduction of 22.5%, 2.5 p.p. ahead of the intended target, while increasing by 20% the share of renewable energy and energy efficiency have not yet been achieved. The EU is close and will make the necessary changes to reach its purpose every year. Between the countries in study, Sweden is the one with the highest advancements on the SDG's and on this 2020 targets having reached 2 of the 3 targets and also achieving SDG 7 in its whole by 2018 with a 25.5% reduction in GHG emissions, 5.5 p.p. ahead of the 2020 target, and with a 54.645% of its final energy consumption coming from renewable energy, more than half of Sweden's energy comes from wind, solar and water.

Germany, being a very sustainable country, has carried out the successful reduction of GHG emissions by 2007 with a decrease of 20.9%, 0.9 p.p. ahead of the 2020 target more than one decade ago. By 2018 a 30.8% reduction of emissions was reached, 10.8 p.p. ahead of the 2020 target and 5.3 p.p. ahead of Sweden. The increase in share of renewable energy by 20% has also been achieved, by 2017 it increased its share from 19.1% in 2010 to 38.2% in 2017, exactly a 19.1 p.p. increased in a period of 7 years. By 2018 40.3% of Germany's energy came from renewable sources (Fraunhofer Institute, 2019), increasing 2.1 p.p. and achieving the second 2020 target of increasing by 20% share of renewable energy. According to the Fraunhofer Institute by this year 2020, Germany will have achieved a 55.5% share of renewable energy, catching up the Sweden.

Sweden and Germany have progressed in a highly significant way, as shown in the cluster analysis a northern country and a western country have the same trajectory towards a more "sustainability idea" giving that they have already achieved the systematic reduction of GHG emissions and the systematic increase of renewable energy use. France and Spain, however, have not been so lucky. Neither of the two have been able to achieve any of the three 2020 targets, nevertheless, this does not mean they have not made advances.

France, being one of the countries with the most nuclear power plants in all of Europe, has made it its purpose to drastically reduce the use of nuclear power as one of its primary energy sources and thereby make renewables its main source, having a similar trajectory of sustainability like Sweden and Germany. By 2018, France had achieved an increase in share of renewables by 22.6%, not enough to reach the 2020 target. Nonetheless, progress is progress, and by making changes and adapting to new circumstances, Frances has move forward in this climate battle.

Spain, on the other hand, has been more focused on achieving energy efficiency than increasing its share of renewables or reducing GHG emissions, which is related to its position in the cluster analysis by having a high level of greenhouse gas emissions (121.8% in 2017 while the average is 83.1%), a lower recycling rate (33.1% in 2017) and circular material use rate (3.3% in 2017), and final energy consumption (86.2%). Although having a high level of GHG emissions, Spain has center itself more in improving energy efficiency.

Spain's progress, in all fields, is mainly due to the massive advertisements companies make to provide society with the awareness of the changes our planet is undertaking. Energy companies like Iberdrola are offering new energy planes to its costumers to achieve energy saving, they are also investing in renewable energy to ensure the sustainability and development of energy use.

The government, has also progressed in a slower way by implemented certain regulations, for example to increase the recycling rate, not at a German level rate, but still helping to reduce the impact of Methane gas which is realized by waste landfills and also farming animals. In certain Autonomous Communities, like the Basque Country, are facilitating access to public transport and improving cities infrastructure to promote the use of bicycles in order to reduce CO2 emissions, the Spanish Government has been promoting "sustainable mobility" since 2015 to guarantee the reduction of the use of private cars, the reduction of their environmental and urban impact, and the promotion of public transport.

As the 2020 targets were made, the 2030 climate and energy framework with new targets and policy objectives has already been created for the next decade to come. Key targets for 2030 are:

- At least 40% cuts in greenhouse gas emissions (from 1990 levels)
- At least 32% share for renewable energy
- At least 32.5% improvement in energy efficiency

Even thought some Member State have not yet reach the 2020 targets and may be doubting the achievement of these future objectives, we must remember that we are not the same, there for our progress will not be as one, each country will achieve its respective targets in due time, as long as we have the desire to have a sustainable and better developed system.

Development no matter how small or big, is considered as progress. As we move forward, we are getting closer to our goals, to our goal of saving a planet that we ourselves have been weakening little by little. However, progress does not end when achievement is made, it is an infinite progress that will make us evolve as human beings and emerge from our past failures into a better future.

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Appendix

A.1. Results from the MFA in detail

Lg relation coefficients between groups

RV relation coefficients between groups

	Group 1	Group 2	Group 3	Group 4	All groups
Group 1	1,9244				
Group 2	1,7967	2,3903			
Group 3	1,7581	2,2592	2,3950		
All groups	1,9541	2,2990	2,2869	3,4918	2,3325

Coordinates and helps to the interpretation of the groups. Active groups

	Group 1	Group 2	Group 3	Group 4	All groups
Group 1	1,0000				
Group 2	0,8377	1,0000			
Group 3	0,8189	0,9442	1,0000		
All groups	0,9224	0,9737	0,9676	0,4875	1,0000

	Coordinates					Contributions					Squared cosines				
Group	axis 1	axis 2	axis 3	axis 4	axis 5	axis 1	axis 2	axis 3	axis 4	axis 5	axis 1	axis 2	axis 3	axis 4	axis 5
1	0,94	0,66	0,47	0,21	0,16	33,68	27,13	27,53	21,07	28,19	0,46	0,23	0,12	0,02	0,01
2	0,94	0,91	0,60	0,34	0,20	33,59	37,33	35,19	34,86	34,78	0,37	0,34	0,15	0,05	0,02
3	0,92	0,86	0,64	0,43	0,21	32,74	35,54	37,28	44,07	37,03	0,35	0,31	0,17	0,08	0,02
All groups						1,00	1,00	1,00	1,00	1,00	0,39	0,30	0,15	0,05	0,02

Canonical variables

Correlations between the canonical variables and the factors of the global analysis

Group	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	0,9820	0,9466	0,9555	0,8860	0,7088
2	0,9931	0,9796	0,9919	0,9844	0,8708
3	0,9860	0,9859	0,9842	0,9710	0,9139

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
0,9741	0,9329	0,9460	0,8593	0,6917

Ratio : inertia inter/total inertia

A.2. Results from the Cluster Analysis

Characterization by continuous variables of clusters

Cluster 1 / 3 (Weight = 13.00 Count = 13)

Characteristic variables	Cluster mean	Overall mean	Cluster Std. deviation	Overall Std. deviation	Test-value	Probability
2015_ SDG 11_Recycling rate of municipal waste (%)	49	39,2	7,1	13,5	3,9	0,000
2017_ SDG 11_Recycling rate of municipal waste (%)	50,5	41,7	7,2	12,5	3,8	0,000
2010_ SDG 11_Recycling rate of municipal waste (%)	43,6	33,3	11,1	15,3	3,6	0,000
2015_SDG 12_Circular material use rate	12,9	9,4	5,5	6,2	3,1	0,001
2010_SDG 12_Circular material use rate	13,1	9,5	6	6,5	3	0,001
2017_SDG 12_Circular material use rate	13,2	9,5	6,5	6,7	2,9	0,002
2015_SDG11_Share of busses and trains in total passenger lan	16,8	18,4	2,4	4,4	-2,0	0,024
2017_SDG 11_Exposure to air pollution by particulate matter	12,0	14,3	4,2	5,3	-2,3	0,01
2010_SDG11_Share of busses and trains in total passenger lan	16,3	18,4	2,9	4,8	-2,3	0,01

Cluster 2 / 3 (Weight = 4.00 Count = 4)

Characteristic variables	Cluster mean	Overall mean	Cluster Std. deviation	Overall Std. deviation	Test-value	Probability
2017_SDG13_Greenhouse gas emissions	112,8	83,1	11,7	19,4	3,3	0,000
2015_SDG13_Greenhouse gas emissions	109,8	82,3	10,5	18	3,3	0,001
2010_SDG13_Greenhouse gas emissions	117,8	91,4	5,3	19,5	2,9	0,002
2017_SDG 11_Recycling rate of municipal waste (%)	30,2	41,7	7,8	12,5	-2,0	0,024
2017_SDG 12_Circular material use rate	3,3	9,5	2,8	6,7	-2,2	0,024
2015_SDG 12_Circular material use rate	3,3	9,4	2,5	6,2	-2,1	0,017
2017_SDG7_final_energyconsumption	86,5	95,1	4,6	7,9	-2,4	0,009
2015_SDG7_final_energyconsumption	83,4	91,3	3,6	6	-2,8	0,002

Cluster 3 / 3 (Weight = 6.00 Count = 6)

Characteristic variables	Cluster mean	Overall mean	Cluster Std. deviation	Overall Std. deviation	Test-value	Probability
2010_SDG11_Share of busses and trains in total passenger lan	24,40 €	18,40 €	3,80 €	4,80 €	3,50 €	0,00 €
2017_SDG 11_Exposure to air pollution by particulate matter	20,80 €	14,30 €	2,40 €	5,30 €	3,40 €	0,00 €
2017_SDG11_Share of busses and trains in total passenger lan	24,80 €	18,50 €	6,80 €	5,50 €	3,20 €	0,00 €
2010_SDG 11_Exposure to air pollution by particulate matter	24,80 €	17,70 €	4,50 €	6,20 €	3,20 €	0,00 €
2015_SDG11_Share of busses and trains in total passenger lan	23,40 €	18,40 €	4,70 €	4,40 €	3,10 €	0,00 €
2015_SDG 11_Exposure to air pollution by particulate matter	20,80 €	14,90 €	3,10 €	5,30 €	3,10 €	0,00 €
2017_SDG7_final_energyconsumption	100,80 €	95,10 €	9,20 €	7,90 €	2,00 €	0,02 €
2017_SDG 11_Recycling rate of municipal waste (%)	30,20 €	41,70 €	7,50 €	12,50 €	-2,60 €	0,01 €
2017_SDG13_Greenhouse gas emissions	64,60 €	83,10 €	12,50 €	19,40 €	-2,70 €	0,00 €
2015_SDG 11_Recycling rate of municipal waste (%)	25,40 €	39,20 €	8,10 €	13,50 €	-2,90 €	0,00 €
2015_SDG13_Greenhouse gas emissions	62,90 €	82,30 €	10,70 €	18,00 €	-3,00 €	0,00 €
2010_SDG 11_Recycling rate of municipal waste (%)	16,40 €	33,30 €	4,90 €	15,30 €	-3,10 €	0,00 €
2010_SDG13_Greenhouse gas emissions	66,70 €	91,40 €	11,40 €	19,50 €	-3,50 €	0,00 €