Factors contributing to the Europe 2020 target attainment

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Abstract

For my bachelor thesis I decided to investigate the Europe 2020 strategy and its targets referring to climate change and energy sustainability more closely. These targets are the reduction of greenhouse gas emissions by 20-30% compared to 1990 levels (depending on the conditions), an increase of the share in renewable energy sources by 20% in the final energy consumption, and a 20% growth in the overall energy efficiency. My research will concentrate on possible factors explaining the progress of the member states in attaining their nationally adopted targets referring to the reducing of greenhouse gas emissions, the implementation of renewable energy sources and growth in energy efficiency. Therefore, the exact research question will state as follows: "Which factors explain the progress of the European member states in achieving the Europe 2020 targets referring to climate change and energy sustainability?". In an attempt to answer this question I conducted a systematic literature analysis and retrieved three factors which will serve as independent variables in this study: affluence and population growth and the amount of RES support policies within the member states. I created and statistically tested six hypotheses via multivariate regression analyses in SPSS within this research. However, only one relationship shows statistical significance while also fulfilling the assumptions (linearity, independence, homoscedasticity, and normality). The hypothesis which is verified within this research is "A rise in population of the member state will result in a decrease in energy efficiency". The other hypotheses do not contain statistically significant relationships, do not fulfill the assumptions or indicate negative instead of positive correlations. Thus, for the last Europe 2020 strategy target the factors affluence and population growth explain 62 % of the progress towards achieving the energy efficiency target.

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1. INTRODUCTION

In order to bring the Union's economy back on track after the financial crisis in 2008 the European member states decided in 2007[1] to follow a 10-year strategy called "Europe 2020". This strategy promotes three basic priorities: Smart, sustainable, and inclusive growth. Among targets like higher employment rates or greater support for R&D the EU puts its emphasis on promoting a more resource efficient, greener and more competitive economy. Although the headline targets of smart, sustainable, and inclusive growth are very intertwined, this paper will solely focus on the goals concerning climate change and energy sustainability, which are the reduction of greenhouse gas (GHG) emissions by 20-30% compared to 1990 levels (depending on the conditions), an increased share of renewable energy sources (Macdonald et al.) by 20% in the final energy consumption, and a 20% growth in the overall energy efficiency.

Since 2020 is coming closer, it is time to infer how far these targets have been attained by the European member states until now. Therefore, I consulted various reports of the European Commission and other bodies working under the instructions of the Commission, like the European Semester, in order to find more information on the strategy, there are several country reports and recommendations published on the official website of the European Semester revealing the progress of the member states towards the Europe 2020 strategy[2]. In order to achieve these ambitious and agreed upon headline targets a reduction in greenhouse gas emissions has to take place significantly faster within this decade than within the last one. It also entails making the most use of new technologies such as carbon capture and sequestration possibilities[3]. A successful achievement of the targets by 2020 would result in € 60 billion less in oil and gas imports[4] due to efficient energy usage and renewable energies which not only ensures financial savings but is essential for future energy security when the supply of fossil fuels is exhausted. However, this potential amount of savings could be invested in further research and development within this field and employ a lot more people than the one million jobs which will already be generated in the European Union during the process of attaining the 20% renewable energy sources and the energy efficiency target[5].

It is substantial to draw a conclusion on how the European member states have transformed the EU 2020 strategy concerning climate change and energy sustainability into their own national targets through National Reform Programs[6] and how they proceeded on achieving these goals. Since the deadline for attaining the targets is for the time being not reached yet, every member state is still capable of successfully completing the strategy. However, by looking at the collected data it can already be detected which member states are performing properly in achieving the targets until now. Some member states have actually already met one or more of the sustainability targets, others in turn are far from reaching their goals or even

[1] (Cross et al., 2015)
[2] ("Europe 2020 in your country,")
[3] (BARROSO, 03.03.2010)
[4] (BARROSO, 03.03.2010)
[5] (BARROSO, 03.03.2010)
[6] ("Europe 2020 targets,")

have a permit from the European Union to further increase their emissions or energy consumption and, therefore, will only negatively contribute to the overall headline targets of the strategy.

However, most states are on good paths for the time being. Now, in order to judge their progress so far I will rely on the feedback given from the European Commission to the countries, check the headway they made so far from the starting point with the use of datasets from Eurostat, and compare the European member states' performances amongst each other.

Following in the *Tables 1* through *3*, the national targets which were set through the National Reform Programs of each member state can be viewed. Additionally and on the basis of the actual data from Eurostat[7], I calculated the level of goal achievements for the three sustainability targets. Therefore, I collected the data on the green-house gas emissions, the share of renewable energy sources, and the primary energy consumption of the member states for the year 2005, since this date was used as the reference year in most National Reform Programs and, therefore, is the base for calculating the progress on the level of goal achievement. I also gathered these data for the year with the latest existing data (2013). After calculating the progress on the targets of the strategy, I computed the percentage of goal achievement by looking at the advancement of the member states and their adopted national goals. These percentages of target attainments can also be viewed in the *Tables 1-3* below.

Table 1: Greenhouse Gas Emissions

Member states	National Target	Level of Target Attainment
Austria	-16%	87,13%
Belgium	-15%	117,67%
Bulgaria	+20%	-
Croatia	+20%	-
Cyprus	-5%	nd
Czech Republic	+9%	113,00%
Denmark	-20%	83,15%
Estonia	+11%	-
Finland	-16%	57,19%
France	-14%	83,29%
Germany	-14%	30,21%
Greece	-4%	572,50%
Hungary	+10%	-
Ireland	-20%	88,25%
Italy	-13%	187,54%
Latvia	+17%	-
Lithuania	+15%	-
Luxembourg	-20%	77,35%
Malta	+5%	-
The Netherlands	-16%	51,06%
Poland	+14%	-
Portugal	+1%	-
Romania	+19%	-
Slovakia	+13%	-
Slovenia	+4%	-
Spain	-10%	269,60%
Sweden	-17%	97,29%
UK	-16%	112,68%

[7] (*Greenhouse gas emissions*; *Primary energy consumption*; *Share of renewable energy in gross final energy consumption*)

Table 2:

Share of Renewable Energy Source in final energy consumption

Member states	National Target	Level of Target Attainment
Austria	34%	95,00%
Belgium	13%	57,69%
Bulgaria	16%	118,75%
Croatia	20%	140,50%
Cyprus	13%	62,31%
Czech Republic	13%	95,38%
Denmark	30%	91,00%
Estonia	25%	102,40%
Finland	38%	96,58%
France	23%	60,87%
Germany	18%	68,89%
Greece	18%	83,33%
Hungary	14,6%	65,07%
Ireland	16%	48,13%
Italy	17%	98,24%
Latvia	40%	92,75%
Lithuania	23%	100,00%
Luxembourg	11%	32,73%
Malta	10%	37,00%
The Netherlands	14%	34,29%
Poland	15%	75,33%
Portugal	31%	82,90%
Romania	24%	99,58%
Slovakia	14%	72,14%
Slovenia	25%	90,00%
Spain	20%	76,50%
Sweden	49%	106,12%
UK	15%	37,33%

Table 3:

Energy Efficiency in Primary Energy Consumption

Member states	National Target in TOE[8]	Level of Target Attainment
Austria	-1,0	60,00%
Belgium	-7,7	36,36%
Bulgaria	-2,0	130,00%
Croatia	+2,4	-
Cyprus	-0,3	100,00%
Czech Republic	-2,6	100,00%
Denmark	-1,5	93,33%
Estonia	+1,1	-
Finland	+2,5	-
France	-40,0	36,25%
Germany	-40,6	35,47%
Greece	-5,9	118,64%
Hungary	-1,3	353,85%
Ireland	-0,8	162,50%
Italy	-23,5	120,43%
Latvia	+0,9	-
Lithuania	-1,4	157,14%
Luxembourg	-0,3	166,67%
Malta	-0,3	33,33%
The Netherlands	-8,6	33,72%
Poland	+8,7	-
Portugal	-2,4	162,50%
Romania	+6,3	-
Slovakia	-1,4	135,71%
Slovenia	+0,3	-
Spain	-16,1	134,16%
Sweden	-5,3	30,19%
UK	-45,2	61,28%

[8] (*Primary energy consumption*)

From the tables it can be concluded that the European member states have set very different goals for themselves. Especially the targets of most Eastern European countries concerning the greenhouse gas emissions vary severely from the ambitious targets of the other member states, like Denmark or Sweden. . The variance in these goals can be partially attributed to the comparatively lower GDP in the European Union's eastern member states. Therefore, these member states are allowed to increase their greenhouse gas emissions compared to 2005, but should limit this greenhouse gas emissions growth to contribute to the independent reduction commitment of the Community[9]. Thus, economically more advanced developing countries commit themselves to still contributing adequately according to their responsibilities and capabilities. There are greater differences between the member states when it comes to actions being taken to increase the share of renewable energy sources: Denmark, Portugal and Sweden have set their goals in renewable energy share as high as a 30%, 31% and 49%. However, the United Kingdom has done the largest reform since privatization to enhance the share of RES and the Netherlands increased the subsidies in renewables[10] so further RES will be build. Referring to the energy efficiency target, some member states, like Finland, Poland or Romania, are again negatively contributing to the achievement of the European headline targets by planning to further expand their energy consumption (for the same reasons some member states are allowed increase their GHG emissions).

However, subject of the research within this paper will be to explain these Europe 2020 strategy state of art goal achievement of the European member states. Therefore, I will empirically test whether the factors which were discussed in several scientific articles I have read and on which I will elaborate in the theoretical part of this paper, actually contribute to the goal achievement of the member states towards the green Europe 2020 targets. Thereby, I will conduct a quantitative study using empirical data retrieved from Eurostat from the 28 European Member States and carry out a multivariate regression analysis via the statistical program SPSS and interpret the results, in order to answer the research question which I will present at the end of this section. Thus, I am aiming to fill the current knowledge gap concerning whether the theories I have read in several articles also apply to the latest data and are suited for this type of large scale and cross-national research including the 28 EU member states.

In any case, this gap must be filled since most scientific literature only focuses on the EU strategy itself or, like the European Commission does it, simply discusses the progress of the member states in meeting their targets. There have even been researchers or the European Commission itself predicting whether member states will reach the targets or not. Furthermore, one scientific article which will be analyzed in greater depth later[11] is paying only little to no attention at all to the energy

[9] (UNION, 05.06.2009)
[10] (Casals, Martinez-Laserna, Garcia, & Nieto, 2016)
[11] (Cross et al., 2015)

efficiency target. Hence, I will also provide information towards this third sustainability goal in order to fill this knowledge gap, as well. Additionally, that research which has been conducted on the Europe 2020 strategy does not examine possible factors which might influence the successful fulfillment of the strategy, like I am planning to do within this research.

Therefore, I will go one step further by focusing my research on combining on the one hand the studies that have already been conducted towards the Europe 2020 strategy and the member states' progress and on the other hand the multiple factors that are said to cause greenhouse gas emissions, influence the share of renewable energy sources, and contribute to the energy efficiency within a country. Thus, my general research question in this study will be: "Which factors explain the progress of the European member states in achieving the Europe 2020 targets referring to climate change and energy sustainability?"

By the end of this thesis I will be able to conclude whether or not the factors I chose from the scientific articles I have studied actually explain the progress of the European member states towards the three sustainability targets.

The structure of this thesis will be as follows: First of all, following this introduction, I will start this research with a theoretical part which entails several references to scientific literature, the elaboration of the research question, I already stated above, and most importantly discusses the three factors I withdrew from the articles. Within that section I will also present the six hypotheses which are statistically tested by three multivariate regression analyses in this paper. Furthermore, the theoretical framework will also include the conceptualization and operationalization of the three dependent variables, which are the three green headline targets of the Europe 2020 strategy, and the three factors selected from the literature, which will serve as independent variables within this study. Afterwards, there will be a methodology part, where I will describe my data collection methods for this study, as well as the data description and processing via SPSS. In connection to that I will report on the analyses of the research by presenting the statistical results of the conducted multivariate regression analyses. Additionally, the results section will also contain a part, where I will check the four assumptions for the regression analyses which are linearity, independence, homoscedasticity, and normality. Thereafter, I will complete the research with a section which discusses the SPSS results and concludes whether or not the independent variables explain the goal achievement of the member states towards the green Europe 2020 targets. In the end, I will close the thesis with an answer to the research question and provide a stimulus for further research approaches within this topic. The appendix with the evidence of my analyses can be found in the end of the paper, as well as the references used for supplying this thesis with the relevant information.

2. General Theoretical Framework

Since the main focus of this research is on the factors explaining the progress in goal achievement for the Europe 2020 targets concerning sustainability and climate change, I developed my theories from conducting a systematic literature analysis using databases like Google Scholar or Web of Science and selected the most relevant scientific articles for this topic. Thereby, I discovered the mayor drivers of greenhouse gas emissions, found out which forces contribute to a higher implementtation of renewable energy sources and which factors influence the level of energy efficiency within a country. In the following paragraphs I will elaborate on my findings, while referring to the three sustainably targets of the strategy one by one and present the three factors retrieved from the studied literature and their relationships with the targets. In connection to that, I will form the hypotheses of this research which will amount to a total of six. Thereafter, I will also include the conceptualization and operationalization of the three dependent variables and the three independent variables within this study.

Anyway, the commitment of the European Union to transform Europe into a highly energy-efficient and low greenhouse-gas-emitting economy led to the first European headline target which is the reduction of greenhouse gas emissions by 20-30% compared to the level in 1990. This target will thereafter take the position of the first dependent variable within this study. The purpose of this targeted reduction is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system and, therefore, in order to meet this objective, the Community agreed that the overall global annual mean surface temperature increase should not exceed 2 °C above pre-industrial levels. These plans also include a reduction of greenhouse gas emissions of at least 50% below 1990 levels by 2050[12]. Following are now the two factors which will serve as independent variables for this target.

The first two factors retrieved during the literature analyses are both from the scientific article called “The sustainability challenge of meeting carbon dioxide targets in Europe by 2020” by Saikku et al. who indicated that nations could only meet their sustainability targets if they countered rising population and affluence growth. This inference is also confirmed by the authors of the scientific article “Effects of population and affluence on CO2 emissions”. The authors of this article Dietz and Rosa had already inferred on these relationships ten years before Saikku et al. have and discovered that population and economic growth anticipated over the next decade will exacerbate greenhouse gas emissions. Another scientist Yao from China used an index decomposition analysis to reveal the main driving forces of CO_2 emissions in the G20 countries. Yao et al. discovered in their research for the article “Driving forces of CO_2 emissions in the G20 countries: An index decomposition analysis from 1971 to 2010” that in general, economic growth was the main factor for increasing greenhouse gas emissions and population growth seemed to have the second strongest effect on CO2 emission growth[13]. In the scientific article “Cities and greenhouse gas emissions: moving forward” the authors Hoornweg et al. present a detailed analysis of per capita greenhouse gas emissions for more than a 100 cities

[12] (UNION, 05.06.2009)

[13] (Yao, Feng, & Hubacek, 2015)

and it turned out that the average per capita GHG emissions for cities vary from more than 15 tons of carbon dioxide equivalent (tCO2e) (Sydney, Calgary, Stuttgart and several major US cities) to less than half a ton (various cities in Nepal, India and Bangladesh). Thereafter, the scientists found a strong correlation between high rates of GHG emissions and solid waste generation that infers from purchasing habits which are notably higher in affluent countries[14]. Yet another very recent study from May 2016 is an article called "Trends in Global Greenhouse Gas Emissions from 1990 to 2010" from Malik et al. who demonstrate that both affluence and population growth are outpacing any improvements in carbon efficiency in driving up emissions worldwide. They emphasize that policies to address unsustainable lifestyles and consumer behavior are essential to achieve emission reductions[15]. However, due to all of these findings, I withdraw my first two independent variables for this paper from these articles: affluence and population growth.

Thus, the first distinction between the European member states I want to address in this theoretical part of the study is their national wealth, in other words the affluence growth. According to Saikku et al. this factor places a huge role for member states in the ability to achieve their adopted sustainability targets. It is very challenging for countries with an economy, where energy plays a large part in the day-to-day life and in the manufacture, to limit and redesign their energy usage in order to reduce GHG emissions. Moreover, a wealthier population does not only consume more energy, it also produces more emissions than economically meager countries do, which also constitutes to a negative trend towards the attainment of the emission target. Like Saikku et al. stated in their article, it is essential for economies to counter affluence growth with the dematerialization of less energy per GDP and the decarbonization of less carbon per energy, since an increase in affluence leaves the country's population with more economical opportunities to spend their money on e.g. dish washers, cars, and larger homes, which all consume energy and generate emissions (at least during its production). Hence, for the first hypothesis in this study I expect a positive relationship between the first independent variable affluence growth and the amount of greenhouse gas emissions in the member states, meaning that if the independent variable rises or declines the dependent one will increase or decrease as well:

1. A rise in affluence of the member state will result in an increase in greenhouse gas emissions.

Saikku et al., Dietz and Rosa, Yao et al. and Malik et al. also investigated the effect of population growth on the achievement of the emission and efficiency goals within their research. Just like affluence growth, a growing population

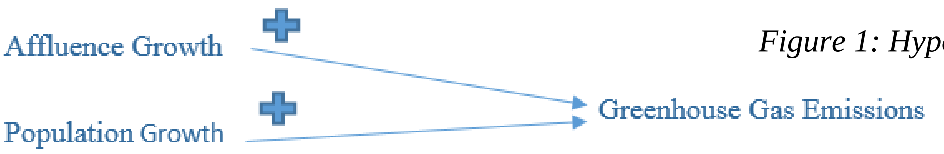


Figure 1: Hypotheses 1 and 2

[14] (Hoornweg, Sugar, & Gomez, 2011)

[15] (Malik, Lan, & Lenzen, 2016)

does lead to a higher consumption of energy and a rising level in GHG emissions within the population. A growing population entails a larger number of people that need to be provided with goods and services like housing and transportation, which again consume energy and generate emissions. Thereafter, I also expect a positive relationship between this factor population growth and the amount of greenhouse gas emissions within the member states. Thus, the second hypothesis will state as followed:

2. A rise in population of the member state will result in an increase in greenhouse gas emissions.

The position of the second dependent variable within this research will take the next green European target which is the increase in the share of renewable energy sources (Macdonald et al.) by 20% in the final energy consumption. Again the intended rise is in RES is a measure ascribed to the purpose of reducing greenhouse gas emissions into the atmosphere[16] and an opportunity for providing employment and regional development, especially in rural and isolated areas[17]. Furthermore, renewable energy sources also present a useful tool by which the European Union can reduce its dependence on imported oil or other fossil fuels. Due to these advantages, it is essential for the EU to promote the adoption of renewable energy sources as much as possible. Therefore, I will now present the two factors retrieved for the literature analysis which are determined to explain the share of renewable energy sources within a country. The first independent variable examined here is affluence growth which has already demonstrated its effect on greenhouse gas emissions in the previous paragraphs. The other independent variable is the third factor within this research trying to explain the member state's progress towards the successful fulfillment of the strategy: I will also examine the effect of policy intensity within the EU countries on the share in renewables.

However, the first factor, affluence growth, was retrieved from the five scientific articles by Saikku et al., Dietz and Rosa, Yao et al., Hoornweg et al., and Malik et al.. We have already learned that a wealthier population consumes more energy and, thereby, also produces more emissions than economically meager states do, a greater national wealth will also have an effect on the share of renewable energy sources within a country. Due to rising affluence within the member states, the governments will also have a higher budget available in order to invest in the implementation of an increased number of renewable energy sources which is clearly favoring the strategy's headline target concerning the share of RES. Thereafter, I expect a positive relationship between the affluence growth and the share of renewable energy sources. The third hypotheses within this study will therefore be:

3. A rise in affluence of the member state will result in an increase in the share of renewable energy sources.

[16] (Karakosta, Pappas, Marinakis, & Psarras, 2013)

[17] (UNION, 5.6.2009)

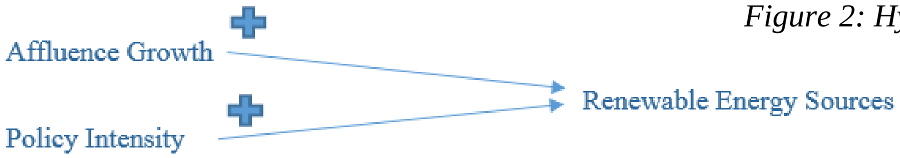


Figure 2: Hypotheses 3 and 4

The other factor which is assumed to have an influence on the share of RES is policy intensity which is referring to the amount of adopted support policies for renewable energy sources. The idea and the data on the 13 different policies are retrieved from the Renewable Energy Policy Network for the 21st Century (REN21-Steering-Committee) which is an international multi-stakeholder policy network for RES which offer global leadership to countries in order to guide them through the transition towards renewable energy technologies. However, this network analyzed the policy set up of 127 countries around the globe including all of the 28 European Union member states and presented in their Renewables Global Status Report of 2013[18] which policy approaches those states have adopted to further the implementation of RES within their nations. REN$_{21}$ has organized these 13 measures into three different policy fields including regulatory policies like feed-in tariffs or net metering, fiscal incentives like subsidies or tax reductions, and public financing where citizens e.g. receive public loans in order to be capable of investing in renewable energy technologies (the complete list of policies can the found in the conceptualization and operationalization part of this paper and in *Table 23* in the appendix). However, since these measures are meant to further the implementation of renewable energy sources, I expect a positive relationship between the number of adopted renewable energy support policies and the share of RES within the EU countries.

4. A rise in the amount of adopted RES support policies within the member state will result in an increase in the share of renewable energy sources.

Since the EU is facing unprecedented challenges resulting from the increased dependence on energy imports and scarce energy resources, and the need to limit the effects of climate change and to overcome the economic crisis, energy efficiency is a valuable tool for addressing these issues[19]. Therefore, the third dependent variable within this research will be the Europe 2020 target of a 20% growth in overall energy efficiency. This measure is necessary to improve the European Union's security of supply by reducing the amount of energy required to produce goods and services, by reducing the overall energy consumption and also energy imports. It contributes to decrease greenhouse gas emissions in a cost-effective way and thereby to mitigate climate change effects. Shifting to a more energy-efficient economy should also accelerate the spread of innovative technological solutions and enhance the competitiveness of the industry in the EU, boosting economic growth after the financial crisis and creating high quality jobs in several sectors

[18] (REN21-Steering-Committee, 2013)

[19] (UNION, 25.10.2012)

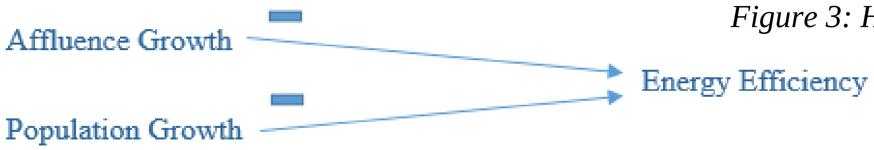


Figure 3: Hypotheses 5 and 6

connected to energy efficiency[20]. After the primary energy consumption peaked in 2006 (around 1706 Mtoe), it is substantial for the European Union to promote energy efficiency to ensure the achievement of the Europe 2020 target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. In order to attain the 20% increase in overall energy efficiency the Union's 2020 energy consumption has to be no more than 1474 Mtoe in primary energy consumption. However, the researchers Saikku et al., Dietz and Rosa, Yao et al., and Malik et al. seem to have found two factors which influence the level of energy efficiency[21]. After I have already discussed the effect of affluence and population growth on the level of GHG emissions and on the share of RES, I will now explain the relationships between these two independent variables and energy efficiency.

Again, according to Saikku et al. affluence growth places a huge role for member states to achieve their sustainability targets. This is also true for the energy efficiency goal: Like we have already seen in the context of the reduction of GHG emissions, it is very challenging for affluent countries to limit and redesign their energy consumption in order to meet the target. Cutting back energy consumption to the required extent entails an enormous social change in order to consume less energy. This is why the European Union determined the public bodies at the national, regional and local level to fulfil an exemplary role as regards to energy efficiency. Since 19% of the EU's GDP is consumed by public spending, the public sector will constitutes an important driver to stimulate market transformation towards more efficient products, buildings and services, as well as to trigger behavioral changes in energy consumption by citizens and enterprises[22]. However, the reduction of energy consumption by the EU industry and end consumers is essential to achieve the energy efficiency target but is certainly harder to obtain for affluent member states. Thereafter, for the eighth hypothesis I expect a negative relationship between the affluence growth of the EU member states and the level of achieved energy efficiency:

5. A rise in affluence of the member states will result in a decline in energy efficiency.

Just like affluence growth, a growing population does naturally lead to a higher consumption of energy[23] since an increasing amount of inhabitants within a country entails a larger number of people that need to be provided with goods and services like housing and transportation, which again consume energy during the production and usage. Thus, it is harder for the member states to cut back the energy consumption while their population is

20 (UNION, 25.10.2012)
21 (UNION, 25.10.2012)
22 (UNION, 25.10.2012)
23 (Saikku, Rautiainen, & Kauppi, 2008)

expanding. Thereafter, for the ninth hypothesis I expect a negative relationship between this factor population growth and the European headline target referring the growth of energy efficiency within a member state:

6. A rise in population of the member state will result in a decline in energy efficiency.

2.1 Conceptualization and Operationalization

For the purpose of clarification I will now define the concepts of the independent and dependent variables of this study and describe their operationalization in order to shed light on the dependability of the collected data.

The first European headline target and dependent variable greenhouse gas emissions is conceptualized and operationalized by the trends in total man-made emissions of the 'Kyoto basket' of greenhouse gases emitted into the atmosphere including carbon dioxide (which is clearly the major GHG[24]), methane, nitrous oxide, and the so-called F-gases (hydrofluorocarbons, perfluoro-carbons and sulphur hexafluoride). These gases are aggregated into a single unit using gas-specific global warming potential factors. These aggregated GHG emissions are expressed in terms of tons of carbon dioxide equivalent, as determined pursuant to Decision No 280/2004/EC, excluding greenhouse gases emissions covered under Directive 2003/87/EC[25]. However, the indicator does not include emissions and removals related to land use, land-use change and forestry; nor does it include emissions from international aviation and international maritime transport[26].

The second strategy target is the share of renewable energy sources which include any energy resource that is naturally regenerated over a short time scale and derived directly from the sun (such as thermal, photochemical, and photoelectric), indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass), or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). Renewable energy does not include energy resources derived from fossil fuels, waste products from fossil sources, or waste products from inorganic sources[27]. The share of RES is operationalized by the total share of renewable energy sources in gross inland energy consumption within the member states.

Energy efficiency which is the third sustainable European headline target stands for the ratio of output of performance, service, goods or energy, to input of energy[28]. Therefore, increasing energy efficiency is done by the reduction of the total amount of energy input required to produce the same amount of products and services. Thus, the energy efficiency target within this paper will be conceptualized by the energy intensity of the EU economies and operationalized by the ratio between the gross inland consumption of energy and the gross domestic product (GDP) for a given calendar year.[29] It measures the energy consumption of an economy and its overall energy

[24] (Saikku et al., 2008)
[25] (UNION, 05.06.2009)
[26] ("Europe 2020 in your country,")
[27] ("Definition of renewable energy,")
[28] (UNION, 25.10.2012)
[29] (*Energy intensity of the economy*, 2016)

efficiency. The data for this indicator is retrieved from the statistical website of the European Union Eurostat out of the dataset "Energy Intensity of the economy" where the gross inland consumption of energy is calculated as the sum of the gross inland consumption of five energy types: coal, electricity, oil, natural gas and renewable energy sources and where the GDP figures are taken at chain linked volumes with reference year 2010 in order to determine the energy intensity ratio: The gross inland consumption is divided by the GDP. Since gross inland consumption is measured in kgoe (kilogram of oil equivalent) and GDP in 1 000 EUR, this ratio is measured in kgoe per 1 000 EUR[30].

Now, concerning the independent variables of this research, I will start with the conceptualization and operationalization of affluence growth. The national wealth of a country refers to the total amount of wealth possessed by the population of that state at a certain point in time. This national wealth will be conceptualized by the affluence growth of the member states. Affluence growth is operationalized by the change in Gross Domestic Product (GDP) per capita of the European member states expressed in Purchasing Power Standards (PPS), like it was also done in the literature by Saikku et al.. GDP is a measure for the economic activity and is defined as the value of all goods and services produced within a country in a certain period of time (mostly one year) instead of the value of any goods or services used during their creation. The volume index of GDP per head in Purchasing Power Standards is expressed in relation to the European Union average set to equal 100. In case the index of a country is higher than 100, this country's level of GDP per capita is higher than the Union's average and vice versa.[31]

The second factor examined in this study is the population of a country which is the total amount of people living within that particular geographical region at a certain point in time. Therefore, the demographic growth of the nations will be measured by the population growth rate, which is operationalized by the change in total population.

The last factor which is conceptualized and operationalized in this research is policy intensity. This factor which is supposed to have a positive effect on reaching the renewable energy target is measured by the amount of renewable energy support policies within a member states. The policies taken into account in this research are the ones listed in the Renewable Global Status Report from 2013. There the Renewable Energy Policy Network for the 21st Century examined three policy fields which I already mentioned before: Regulatory policies and targets, fiscal incentives and public financing. The specific measures which are included in these fields are: Renewable energy targets, feed-in tariff/ premium payment, electric utility quota obligation/ RPS, net metering, biofuels obligation/ mandate, heat obligation/ mandate and tradable REC for the first policy field, capital subsidy, grant, or rebate, investment or production tax credits, reductions in sales, energy, CO_2, VAT, or other taxes and Energy production payment for the second policy field and public investments, loans, or grants and public

[30] (*Energy intensity of the economy*, 2016)

[31] ("Gdp per capita in pps," April 26 2016)

competitive bidding/ tendering for the last field. The precise listing of the EU countries who participate in which policies can be found in the appendix in *Table 18*. Out of these 13 policies the average amount of measures the European member states adopted is 7. Although this operationalization is not perfect since there could be more policies on RES in place or I could measure the policy intensity not by counting the adopted policies but differently by recording the policy change between 2005 and 2013 or by prioritizing some measures over the others. However, due to timely matters and limited data I cannot calculate the policy change or investigate all 13 policies closely in order to judge their significance. Thus and as you can see in *Table 20* and *23* in the appendix, I counted the adopted renewable support policies for each member state in order to compare their policy performance amongst themselves. Thereafter, the variable RES support policies ranges on a scale from four (for e.g. Bulgaria) to twelve (for Italy).

3. METHODOLOGY

The aim of the research within this bachelor thesis will be to empirically test whether the three factors I presented in the theoretical part of this paper actually contribute to the goal achievement of the member states towards the three Europe 2020 targets concerning climate change and energy sustainability. Therefore, I will make use of an explanatory empirical research question to account for the progress in the target attainment:

> "Which factors explain the progress of the European member states in achieving the Europe 2020 targets referring to climate change and energy sustainability?"

Hence, I am using the European member states as units of analyses in this study. Thereafter, I did not have to conduct any sampling for the units since I am examining all 28 member states. The dependent variable in the research question "the progress of the European member states in achieving the Europe 2020 targets referring to climate change and energy sustainability" is split into three elements since this study pays attention to all three sustainable strategy targets: The level of greenhouse gas emissions, the share of renewable energy sources, and the level of energy efficiency. The independent variables within this research are the three factors which I already presented in the paragraphs of the theoretical part. Therefore, I will examine if affluence and population growth and policy intensity actually have the presumed effects on the three targets and, therefore, explain the progress of the EU member states towards the strategy's green headline targets. I will examine the relationships between the independent and dependent variables by testing the six hypotheses of this research. A quick recap of the presented hypotheses:

1. A rise in affluence of the member state will result in an increase in greenhouse gas emissions.
2. A rise in population of the member state will result in an increase in greenhouse gas emissions.

3. A rise in affluence of the member state will result in an increase in the share of renewable energy sources.
4. A rise in the amount of adopted RES support policies within the member state will result in an increase in the share of renewable energy sources.
5. A rise in affluence of the member state will result in a decline in energy efficiency.
6. A rise in population of the member state will result in a decline in energy efficiency.

These relationships will be tested during the multivariate regression analyses which I will conduct via the statistical program SPSS. However, first I will include one section about the data collection method I used and another one about the data description and processing.

3.1 Data Collection

My data collection method is unobtrusive, since the data I used is secondary data and does not affect or influence the units of analyses, and verbal, since I am coding documents and data sets. I withdrew the information on the three adopted national targets from the 28 National Reform Programs published by the European member states themselves. However, in the case of Spain and Portugal the official Reform Programs are only published in their native languages. Due to this inconvenience I had to withdraw the information on the adopted national targets for these two countries from an official European Commission website called "Europe 2020 in your country". Unfortunately, I could not find perspicuous data towards the national energy efficiency targets in each of the National Reform Programs. Therefore, I had to retrieve these information from the data set provided by Eurostat[32]. There I found an overview of the primary energy consumption levels (the national targets on energy efficiency are there expressed by the level of PEC) from 1990 to 2014 for all European countries plus the target level for 2020 all expressed in million tons of oil equivalent. Anyway, these national targets can be seen in the tables 1-3 located in the introduction of this paper. The other data on the progress of the member states towards the three sustainability targets, is also retrieved from the data sets of Eurostat which reveals the amount of greenhouse gas emissions, the share of renewable energy sources and the level of energy intensity for the EU member states: "Greenhouse gas emissions", "Share of renewable energy in gross final energy consumption" and "Energy Intensity of the Economy". I used Eurostat for the collection of my data, since it is an official governmental website constructed to provide data like these about the European Union and its member states. Due to this official character, I can rely on the data to be valid.

The data for the three independent factors are partly also retrieved from Eurostat: The data sets "GDP per capita in PPS" and "Population change - Demographic balance and crude rates at national level" were used to calculate the levels of affluence and population growth. For information on the

[32] (*Primary energy consumption*)

intensity of policies, I retrieved data from another, however not less reliable, source published by the Renewable Energy Policy Network for the 21st Century. They published a global status report on renewables in 2013 and listed 13 RES support policies and analyzed which measures were taken by the 127 investigated countries worldwide[33]. These data provide my thesis with the required information on policy intensity.

In order to know how well the member states do in achieving the Europe 2020 targets concerning climate change and energy sustainability and to find out the change in the two independent variables affluence and population, I had to calculate the progress on the three targets and the percentage change in GDP per capita and in total population in order to figure out the growth of these variables. Therefore, I collected the data on greenhouse gas emissions, the share of renewable energy sources, energy intensity, the GDP per capita, and the total population of the member states for the year 2005, since this date is used as the reference year in the National Reform Programs and is, therefore, the base for calculating the progress respectively the change of the variables. I also gathered these data for the year with the latest existing data: The newest data for almost all of these variables were available for 2014. However, since the data for GHG emissions were only available for 2013, I decided to take that year for my calculations. For the variable policy intensity no further calculations were necessary since only the actual amounts of adopted renewable support policies in the member states count.

The data for the progress in the targets concerning greenhouse gas and energy intensity reduction and for the population and affluence growth can take positive as well as negative values implying an increase or decline in emissions, energy intensity, GDP per capita or total population. However, as an example: The data for affluence growth extends from -19,57% in Greece to 37,74% in Lithuania and for population growth from -11,42% in Lithuania to 18,12% in Cyprus.

In the appendix you can in find *Table 19* and *20* a screenshot of the aggregated data set I worked with organized in an Excel file.

3.2 DATA DESCRIPTION AND PROCESSING

The next paragraphs provide a general introduction to the data processing underlying this study and the descriptive statistics of the constructed variables. Now, concerning the coding, you can see in *Table 21* in the appendix that I created seven variables in SPSS in order to operationalize the six variables: Greenhouse gas emissions, share of renewable energy sources, energy efficiency, affluence and population growth, and policy intensity. All of these variables are numeric and measured metrically because they are all either expressed in percentages indicating the change of the variables or for the policy intensity variable expressed by the amount of RES support policies within the member states ranging

[33] (REN21-Steering-Committee, 2013) Table 3

on a scale from four to twelve. Since their measurement is metric rather that ordinal or nominal, the only code I used was *9999=no data*.

The seventh variable MS is called Name of Member State, because every case in the SPSS data set needs a name or a reference number. Since reference numbers or member state names are not metric values, this variable is a string variable and is measured nominal. It also does not need any codes for missing data, since it represents the units, and all units are known (member states).

In *Table 22* in the appendix the actual SPSS data set which I have constructed for the analysis of this research can be viewed.

Now, concerning the descriptive statistics for the variables in this research, the SPSS output reveals there are only two cases missing (due to a lack of data) when it comes to data concerning GHG emissions: Cyprus and Malta. This circumstance results in an *N* of *26* (instead of *N = 28*) for the first regression analyses. This also entails that the means of the independent variables for this first regression analysis substantially vary from the multivariate regressions for the other two targets, since there are data available for all EU member states and, thus, no cases are missing.

Anyway, as it can be seen in *Table 4* the value for the mean change of GHG emissions is *-14,15*, saying that on average the member states decreased their GHG emissions by 14,15% between 2005 and 2013. The two means for the independent variables population and affluence are, according to the SPSS output in *Table 4, 1,59* and *7,55*. These results indicate that the total populations of the member states on average grew by 1,59% between 2005 and 2013 and that the national wealth increased on average by 7,55% within those 8 years.

Table 4: Descriptive Statistics - GHG

	Mittelwert	Standardabweichung	N
Change in Greenhouse Gas Emissions	-14,1477	9,73380	26
Population Growth	1,5912	6,11968	26
Affluence Growth	7,5462	17,82860	26

However, please consider that these averages do not include the two missing cases of Cyprus and Malta. Since the next two analyses contain the data of all member states and, hence, have an *N* of *28*, the mean of the affluence growth rate varies from the first analysis from either 7,55% (*N=26*) to 6,64% (*N=28*) (see *Tables 4, 5 and 6*) and the mean for the population growth rate is either 1,59% (*N=26*) or 2,29% (*N=28*) for the third regression (see *Tables 4 and 6*). Thus, including all cases the total populations of the member states increased on average by 2,29% and that the national wealth grew on average by 6,64 % within the given timeframe.

Meanwhile, the average change in the share of renewable energies was 6,14% between 2005 and 2013 and all 28 EU countries had adopted on average 7 renewable energy support policies by 2013 (see *Table 5*).

Table 5: Descriptive Statistics - RES

	Mittelwert	Standardabweichung	N
Change in the Share of Renewable Energy Sources	6,136	2,4044	28
Affluence Growth	6,6425	17,68606	28
RES Support Policies	7,054	2,2209	28

Last but not least, the descriptive statistics of the third regression analysis (see *Table 6*) concerning energy efficiency reveals that the average change in energy intensity takes on the negative value of *–16,14* saying that the intensity of energy usage declined on average by 16,14% between 2005 and 2013 within the European member states.

Table 6: Descriptive Statistics - EI

	Mittelwert	Standardabweichung	N
Change in Energy Intensity	-16,1400	9,46077	28
Affluence Growth	6,6425	17,68606	28
Population Growth	2,2904	6,68074	28

4. RESULTS

The following part of this research paper deals with the statistical outcomes which are derived from multivariate regression analyses conducted via SPSS.

Now, applying the three multivariate regression analyses one by one, the outcomes will be analyzed and interpreted and the six hypotheses will be checked for statistical significance, correlation and determination. The first regression is examining the effects of two independent variables in this study on the first green Europe 2020 target referring to the reduction of greenhouse gas emissions. In the SPSS output below (*Table 7*) the correlations of the three variables can be seen. The Pearson Correlation indicates the inter-correlation of the variables. The correlation coefficient (*r*) can range between *–1 < r < 1*. Whereby, an r of *–1* indicates a strong negative correlation between the variables and *1* entails a strong positive correlation between them. Although, an *r* which is closer to *0* will indicate weak or even no correlation at all. Anyway, the correlation coefficients within this regression analyzes concerning the dependent variable GHG emissions show only a weak to medium correlations of *–0,251* and *0,333*. However, the most important information of the regression analysis is the p-value. It helps to determine the significance of the results and varies between *0* and *1*. A large p-value (above *0,05*) is an indicator for a

Table 7: Correlations - GHG

		Change in Greenhouse Gas Emissions	Affluence Growth	Population Growth
Korrelation nach Pearson	Change in Greenhouse Gas Emissions	1,000	,333	-,251
	Affluence Growth	,333	1,000	-,612
	Population Growth	-,251	-,612	1,000
Sig. (1-seitig)	Change in Greenhouse Gas Emissions	.	,048	,109
	Affluence Growth	,048	.	,000
	Population Growth	,109	,000	.
N	Change in Greenhouse Gas Emissions	26	26	26
	Affluence Growth	26	26	26
	Population Growth	26	26	26

Table 8: Coefficients - GHG

Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten	T	Sig.
		Regressionskoeffizient B	Standardfehler	Beta		
1	(Konstante)	-15,142	2,394		-6,325	,000
	Affluence Growth	,157	,135	,287	1,158	,259
	Population Growth	-,119	,394	-,075	-,302	,766

a. Abhängige Variable: Change in Greenhouse Gas Emissions

rather weak evidence against the null hypothesis. In contrast, a small p-value (below *0,05*) is an indicator for strong evidence against the null hypothesis. The null hypothesis is the assumption that the unstandardized coefficient is *0* and, thus, a result that represents no effect of the predictor on the dependent variable[34]. Furthermore, p-values below *0,05* indicate a significant relation whereas a value that is closer to *0,001* is more significant. This can also be summarized by the Rule of Thumb for the p-values:

$p < 0.01$: very strong presumption against null hypothesis

$0.01 < p < 0.05$: strong presumption against null hypothesis

$0.05 < p < 0.1$: low presumption against null hypothesis

$p > 0.1$: no presumption against the null hypothesis

However, *Table 8* reveals that there is no significant relationship between the independent and the dependent variables within this regression analysis. It seems that neither affluence nor population growth have a statistically significant effect on the progress of the member states towards the GHG emission target, since the SPSS output points out p-values of *0,259* for the affluence growth variable and *0,766* for the population growth variable. These high p-values lead to the conclusion that the hypotheses one and two do not have a statistically significant relationship and, thus, have no presumption against the null hypothesis which therefore will not be rejected. Thereafter, neither affluence nor population growth have had an effect on the change in greenhouse gas emissions within the European member states between 2005 and 2013. Therefore, the correlation coefficients from *Table 7* which are *0,333* and *–0,251* have no meaning. Anyway, while the direction of the first hypothesis between the change in national wealth and the change in greenhouse gas emissions would be positive as expected, the SPSS output would indicate a negative correlation between the population growth within a member state and the change in GHG and, thus, points in the opposite direction as expected. However, these data are not substantial since the hypotheses do not show statistically significant relationships any-ways. Concerning the constant in *Table 8* it can be concluded that in a member state with a constant national wealth and population the progress of the

[34] Null hypothesis: H0: b=0
Alternative hypothesis H1: b≠0

country towards the greenhouse gas emission target is a decrease of –15% in emissions.

Table 9: Model resume - GHG

Modell	R	R-Quadrat	Korrigiertes R-Quadrat	Standardfehler des Schätzers
1	,338[a]	,114	,037	9,55003

a. Einflußvariablen : (Konstante), Population Growth, Affluence Growth

b. Abhängige Variable: Change in Greenhouse Gas Emissions

The value R^2 which is also called the coefficient of determination can be found in the SPSS output above, *Table 9*. It describes to what extent data fits a statistical model. In other words, the coefficient points out how well the regression line converges the real data points. R^2 is used to explain the variance in the dependent variable (progress of the member states towards the strategy targets) by the independent variables. An R^2 of *0* indicates that the regression line does not fit the data at all, saying that no variance is explained by the model, whereas an R^2 of *1* states that the regression line fits the data perfectly, meaning the independent variables explain and predict the progress of the country towards the GHG emission target entirely. The R^2 of this multivariate regression is *0,114* which indicates, referring to the explanation above, that the regression line of this analysis only fits the data to a low extent: 11,4% of the variance in GHG emission would be explained by the variance in affluence and population growth of the member states, if the hypotheses showed statistically significant relationships. However, since the hypotheses did not show any statistical significance I have to reject hypotheses one and two.

Furthermore, you can also see in *Table 7* that there is another significant relationship amongst the independent variables of the study: Apparently, there is a relationship between the affluence and population growth rates with a p-value so low (*0,00*) that it leaves no doubt about its significance. The SPSS output reveals that there is a clear negative relationship between these variables with a correlation coefficient of *–0,612*.

Table 10: Correlations - RES

		Change in the Share of Renewable Energy Sources	Affluence Growth	RES Support Policies
Korrelation nach Pearson	Change in the Share of Renewable Energy Sources	1,000	-,045	,242
	Affluence Growth	-,045	1,000	-,300
	RES Support Policies	,242	-,300	1,000
Sig. (1-seitig)	Change in the Share of Renewable Energy Sources	.	,411	,107
	Affluence Growth	,411	.	,061
	RES Support Policies	,107	,061	.
N	Change in the Share of Renewable Energy Sources	28	28	28
	Affluence Growth	28	28	28
	RES Support Policies	28	28	28

The second multivariate regression is examining the effects of two independent variables on the second strategy target referring to the change in the share in renewable energy sources. Again, the SPSS output above (*Table 10*) reveals the correlation coefficients of the three variables which are *r = –0,045* for the relation between affluence growth and the change in the share of RES and *r = 0,242* for the relationship between population growth and the change in the share of renewable energies. As it can be seen in *Table 11* there is apparently no p-value low enough to indicate a significant relationship between affluence growth and the number of renewable energy support policies within a member state with the change in the share of RES. The SPSS output shows that there is no statistically significant relationship between these variables with p-values of *0,881* for the affluence growth and *0,228* for the number of support policies. Thus, the hypothesis three, saying that a rise in the affluence of the member state will result in an increase in the share of renewable energy sources, and four, saying that the a higher amount of support policies for RES within the member state will result in an increase in the share in renewable energy sources, have to be rejected.

However, in case the hypotheses did show statistically significant relationships merely 5,9% of the variance in the change in the share of RES would be explained by the variance in affluence growth and the number of support policies within the EU member states.

Table 12: Model resume - RES

Modell	R	R-Quadrat	Korrigiertes R-Quadrat	Standardfehler des Schätzers
1	,244[a]	,059	-,016	2,4233

a. Einflußvariablen : (Konstante), RES Support Policies, Affluence Growth

b. Abhängige Variable: Change in the Share of Renewable Energy Sources

Anyway, the third multivariate regression analysis is investigating the effect of the change in wealth and population within the member states on the progress towards the third sustainable strategy target concerning energy efficiency. *Table 13* presents the correlations of the three variables: Starting off with the first relationship between affluence growth and the change in energy intensity, the SPSS output reveals an *r* of *–0,529* which signifies a rather solid negative connection. However, although I expected a negative relationship between the change in national wealth and energy efficiency, the output does not confirm the hypothesis since this strategy target which is about energy efficiency is operationalized by the change in energy intensity and, thus, the hypothesis shifted the direction within the analysis, meaning although the actual hypothesis reads “A rise in affluence of

Table 11: Coefficients – RES

Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten	T	Sig.
		Regressionskoeffizient B	Standardfehler	Beta		
1	(Konstante)	4,189	1,681		2,492	,020
	Affluence Growth	,004	,028	,031	,151	,881
	RES Support Policies	,272	,220	,251	1,236	,228

a. Abhängige Variable: Change in the Share of Renewable Energy Sources

Table 13: Correlations - EI

		Change in Energy Intensity	Affluence Growth	Population Growth
Korrelation nach Pearson	Change in Energy Intensity	1,000	-,529	,166
	Affluence Growth	-,529	1,000	-,637
	Population Growth	,166	-,637	1,000
Sig. (1-seitig)	Change in Energy Intensity	.	,002	,199
	Affluence Growth	,002	.	,000
	Population Growth	,199	,000	.
N	Change in Energy Intensity	28	28	28
	Affluence Growth	28	28	28
	Population Growth	28	28	28

the member state will result in a decline in energy efficiency", the direction of the relationship within the calculation switched due to the measurement of the target, therefore: "A rise in affluence of the member state will result in an increase in energy intensity".

Anyway, the sign of the Pearson Correlation coefficient for hypothesis six suggests that the relationship between population growth and the change in energy intensity is positive (*r = 0,166*) as expected but rather weak. However, as you can see in *Table 14* this coefficients does not even matter because of the p-value of this relation which is *0,189* and, thus, exceeds the threshold of *0,1* from the Rule of Thumb. Therefore, I fail to reject the null hypothesis which is indicating that there is no relationship between the change in total population and the progress towards the Europe 2020 target referring to energy efficiency.

Hypothesis five on the other hand turns out to entail a statistically significant relationship with a low p-value of *0,003*. This outcome is an indication of covariance between the affluence growth of an EU member state and its change in energy intensity. However, since the SPSS output shows the opposite direction of what was expected in hypothesis five (*p = –0,529* instead of a positive value), I have to reject the hypothesis anyway.

However, these results mean that in a member state with a constant national wealth and population the progress of the country towards the energy efficiency target is an increase of 12,68% as shown

Table 14: Coefficients – EI

Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten	T	Sig.
		Regressions koeffizientB	Standardfehler	Beta		
1	(Konstante)	-12,680	2,008		-6,316	,000
	Affluence Growth	-,381	,114	-,712	-3,345	,003
	Population Growth	-,407	,301	-,287	-1,350	,189

a. Abhängige Variable: Change in Energy Intensity by the value for the constant in *Table 14.* In a state with a one percent increase in wealth the energy efficiency will increase by 0,381% (or in other words: the energy intensity will decline by 0,381%) as indicated by the unstandardized coefficient of *–0,381*. Unstandardized coefficients imply that for a growth for one unit on the predictor variable (percentage change in affluence growth), the outcome variable increases by the number indicated by the unstandardized coefficient *(–0,381*).

The R^2 of this multivariate regression is displayed below in *Table 15* and indicates that the regression line of this analysis fits the data to a medium extent: 32,8% of the variance in energy intensity is explained by the variance in affluence and population growth.

Table 15: Model resume - EI

Modell	R	R-Quadrat	Korrigiertes R-Quadrat	Standardfehler des Schätzers
1	,573[a]	,328	,275	8,05774

a. Einflußvariablen : (Konstante), Population Growth, Affluence Growth

b. Abhängige Variable: Change in Energy Intensity

Again, the inter-correlation between the two independent variables affluence and population growth arises in this regression analysis again, as it did in the first one, and also shows statistical significance. However, there are slightly different results due to the inclusion of the previously missing cases (Cyprus and Malta) the correlation coefficient here is *–0,637* instead of *–0,612*, indicating that the connection between these two variables is even stronger.

The assumptions for the regression anylses are checked in the appendix and it turns out that the assumptions for the first regression concerning GHG emissions are fulfilled: The data is neither linear nor independent nor is the homoscedasticity assumption met. However, the data within that regression is normally distributed. For the second regression analysis all assumptions are met. While I was testing the assumptions for the third regression analyses I noticed an outlier in the scatterplot (see appendix) for the energy intensity regression analysis. After I investigated this residual closely, I can certainly exclude the member state which is causing this inconvenience from this regression analysis. It appears that Estonia is the only member state with an increase in energy intensity (7,04%) compared to all other 27 EU countries which contributed to the energy efficiency target by reducing their energy intensity between 5,41 and 33,15%. After the exclusion of the outlier, I can conclude that all assumption are checked for this forth regression analysis. Apart from the fulfilled assumptions, the correlation, coefficient and model summary output changed as well for the hypotheses five and six. Now, as you can see in *Table 16* below the correlations between the affluence and population growth of a member state and its energy intensity became more significant.

The value of the Pearson correlation for the fifth hypothesis changed from *-0,529* from the previous regression analysis with N = 28 to *-0,746*. The same is the case for the sixth variable: The correlation between the population growth and energy intensity is now *0,275* instead of *0,166*. The

Table 16: Correlations – EI excluding an Outlier

		Change in Energy Intensity	Affluence Growth	Population Growth
Korrelation nach Pearson	Change in Energy Intensity	1,000	-,746	,275
	Affluence Growth	-,746	1,000	-,627
	Population Growth	,275	-,627	1,000
Sig. (1-seitig)	Change in Energy Intensity	.	,000	,082
	Affluence Growth	,000	.	,000
	Population Growth	,082	,000	.
N	Change in Energy Intensity	27	27	27
	Affluence Growth	27	27	27
	Population Growth	27	27	27

overall statistical significance also improved for these relationships: The p-value for hypothesis five is now *0,000* (previously *0,003*) and for number six it is *0,063* (it was previously exceeding the threshold). Thus, while the relationship between affluence growth and energy intensity stays statistically significant, the p-value for the sixth hypothesis now reveals some presumption against the null hypothesis. Thereafter, I can conclude that I found a statistically significant relationship between the population growth and the energy intensity within a European member state and, thus, I can verify the six hypothesis. Thus, in a state with a one percent increase in population the energy efficiency will decline by 0,397% (or in other words: the energy intensity will increase by 0,397%) as indicated by the unstandardized coefficient of *–0,381*. Furthermore, the independent variables now explain 61,8% of the variance in energy intensity due to an increase from an R^2 of *0,328* to an R^2 of *0,618* within the last regression analysis.

Table 18: Model resume – EI excluding an Outlier

Modell	R	R-Quadrat	Korrigiertes R-Quadrat	Standardfehler des Schätzers
1	,786[a]	,618	,586	5,44258

a. Einflußvariablen : (Konstante), Population Growth, Affluence Growth

b. Abhängige Variable: Change in Energy Intensity

Table 17: Coefficients – EI excluding an Outlier

Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten	T	Sig.
		Regressions koeffizientB	Standardfehler	Beta		
1	(Konstante)	-13,335	1,361		-9,796	,000
	Affluence Growth	-,455	,078	-,944	-5,832	,000
	Population Growth	-,397	,203	-,316	-1,953	,063

a. Abhängige Variable: Change in Energy Intensity

5. DISCUSSION AND CONCLUSION

After conducting the multivariate regression analyses via SPSS and checking the four assumptions for these. The results of the research are rather disappointing. Only two out of six hypotheses seem to contain a statistically significant relationship. These are hypothesis five which is “A rise in affluence of the member state will result in a decline in energy efficiency” and hypothesis six which is “A rise in population of the member state will result in a decline in energy efficiency”. However, since the Pearson Correlation coefficient is negative for hypothesis five, although a positive relationship was expected, I also have to reject this hypothesis. It turns out that a rise in the affluence of member states will result in an increase in energy efficiency. Apparently, when economic growth is strong, energy usage does not increase at the same pace, whereas energy levels do not drop according to a negative development in national wealth.

Thus, the only true relationship found during this research with a p-value of *0,063* and a correlation of *0,275* is between the population growth and energy intensity within a member state. Thereafter, Dietz and Rosa, Saikku et al., Malik et al., and Yao et al. were correct when they concluded that population growth places an essential role for member states in the ability to achieve their adopted energy efficiency target. The result of my research also confirms this finding and verifies the fact that it is indeed challenging for member states with an increasing population, to limit and redesign their energy usage in order to reduce energy consumption. This consumption of energy, goods and services is increasing for a growing population and leads to the observed positive effect of population growth on energy intensity.

Besides this effect on energy intensity, I did not find any factors that reliably explain the progress of the member states in achieving the Europe 2020 targets concerning greenhouse gas emissions and the share in renewable energy sources, since the p-values of these regression analyses were all between *0,251* and *0,934* which clearly lead to the conclusion to fail to reject the null hypotheses: The relationships in hypotheses one, two, three, and four are not statistically significant.

However, the most disconcerted result of this study is that against the findings of Dietz and Rosa, Saikku et al., Malik et al., Yao et al. and Hoornweg et al. affluence growth does not have be assumed effect on the Europe 2020 targets, again the correlation coefficients between the population growth and energy intensity is especially very off-throwing. This finding contrast the results of the researchers and hypothesis five in this study which assumes a positive effect of affluence growth on energy intensity. Thus, this field of study needs further and up-to-date and also cross-national research in order to find new results on whether or not the affluence growth nowadays or only in Europe contributes or counteracts to the progress in achieving the strategy goals.

Anyway, in the end of this research, I have to admit that, against my expectations, most of the hypotheses I formulated during my literature analysis do not explain any progress of the member states towards the Europe 2020 strategy targets. Thus, the attempt to explain this progress towards the sustainability targets with the use of the three factors affluence and population growth, and policy intensity has failed. The only relationship that was found was between population growth and the progress towards the Europe 2020 target concerning energy efficiency.

In the perspective of the findings within this paper I shall now reflect on the research design used to investigate the effects of affluence and population growths and RES support policies on the Europe 2020 targets referring to sustainability. It should be said that although the last regression analysis showed a statistically significant relationship between population growth and energy efficiency, it did not prove causality between the two. Correlational research designs can only measure relationships between independent and dependent variables but cannot prove causation. When I consider the findings for the other hypotheses of this paper, I have to reflect on the data used for this research: The quality of data for the variables affluence and population growth, greenhouse gas emissions, share in renewable energy sources, and energy intensity is indisputably high since these data are retrieved from Eurostat which is a very reliable source for data in the European Union. However, the quality of the data on policy intensity, here measured by the amount of adopted RES support policies is questionable and certainly could have been done differently. However, under the given circumstances, we can only infer on the present result of this study and answer the research question “Which factors explain the progress of the European member states in achieving the Europe 2020 targets referring to climate change and energy sustainability?” with “Affluence and population growth explain 62% of the variance in the progress towards the Europe 2020 target concerning energy efficiency”.

6. Appendix

Table 19: Data on the progress on the strategy targets organized in an Excel file

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
2				%	%	%				%	%	%				%
3					base 2005				Absolut	Relative	total share				Absolut	Relative
4		GHG 2005	GHG 2013	Change in GHG	GHG goal	% goal achievement	RES 2005	RES 2013	Change in RES	Change in RES	RES goal	% goal achievement	Energy intensity 2005	Energy intensity 2013	Change in Energy Intensity	Change in Energy Intensity
5	**Austria**	117,01	100,7	-13,94	-16	87,13	23,80	32,3	8,5	35,7	34	95	123,8	110,2	-13,6	-10,99
6	**Belgium**	99,51	81,95	-17,65	-15	117,67	2,3	7,5	5,2	226,1	13	57,69	173,4	151,8	-21,6	-12,46
7	**Bulgaria**	48,38	42,13	-12,92	20	64,6	9,4	19	9,6	102,13	16	118,75	609,4	430,7	-178,7	-29,32
8	**Croatia**	98,11	78,2	-20,29	11	184,45	23,8	28,1	4,3	18,1	20	140,5	222,5	197,7	-24,8	-11,15
9	**Cyprus**	nd	nd	nd	-5	nd	3,1	8,1	5	161,29	13	62,31	149,9	124,1	-25,8	-17,21
10	**Czech Rep.**	74,35	65,45	-11,97	9	113	6	12,4	6,4	106,67	13	95,38	325,4	267,9	-57,5	-17,67
11	**Denmark**	94,45	78,74	-16,63	-20	83,15	16	27,3	11,3	70,63	30	91	81,1	74,8	-6,3	-7,77
12	**Estonia**	43,15	51,01	18,22	11	-165,64	17,5	25,6	8,1	46,29	25	102,4	373,9	400,2	26,3	7,04
13	**Finland**	97,64	88,71	-9,15	-16	57,19	28,8	36,7	7,9	27,43	38	96,58	192,2	181,8	-10,4	-5,41
14	**France**	98,39	86,92	-11,66	-14	83,29	9,6	14	4,4	45,83	23	60,87	143,8	126	-17,8	-12,38
15	**Germany**	80,55	77,14	-4,23	-14	30,21	6,7	12,4	5,7	85,07	18	68,89	140,9	120,1	-20,8	-14,76
16	**Greece**	127,43	98,25	-22,9	-4	572,5	7	15	8	114,29	18	83,33	136,7	131,8	-4,9	-3,58
17	**Hungary**	65,82	49,77	-24,38	10	243,8	4,5	9,5	5	111,11	14,6	65,07	278,3	226,6	-51,7	-18,58
18	**Ireland**	128,31	105,66	-17,65	-20	88,25	2,9	7,7	4,8	165,52	16	48,13	93,5	82	-11,5	-12,3
19	**Italy**	111,88	84,6	-24,38	-13	187,54	7,5	16,7	9,2	122,67	17	98,24	116,6	103,5	-13,1	-11,23
20	**Latvia**	42,61	42,12	-1,15	17	6,76	32,3	37,1	4,8	14,86	40	92,75	252,6	220,8	-31,8	-12,59
21	**Lithuania**	46,88	40,36	-13,91	15	92,73	17	23	6	35,29	23	100	329,5	209,3	-120,2	-36,48
22	**Luxembourg**	100,11	84,62	-15,47	-20	77,35	1,4	3,6	2,2	157,14	11	32,73	137,2	103,4	-33,8	-24,64
23	**Malta**	nd	nd	nd	5	nd	0,2	3,7	3,5	1750	10	37	162,8	120,9	-41,9	-25,74
24	**Netherlands**	100,09	91,91	-8,17	-16	51,06	2,5	4,8	2,3	92	14	34,29	142,4	126,9	-15,5	-10,88
25	**Poland**	70,68	70,09	-0,83	14	5,93	6,9	11,3	4,4	63,77	15	75,33	321,8	250,8	-71	-22,06
26	**Portugal**	146,14	108,19	-25,97	1	2597	19,5	25,7	6,2	31,79	31	82,9	157,4	133,6	-23,8	-15,12
27	**Romania**	52,97	39,87	-24,73	19	-130,16	17,6	23,9	6,3	35,8	24	99,58	357,2	243	-114,2	-31,97
28	**Slovakia**	71,62	60,62	-15,36	13	118,15	6,4	10,1	3,7	57,81	14	72,14	356,3	238,2	118,1	-33,15
29	**Slovenia**	100,5	89,25	-11,19	4	279,75	16	22,5	6,5	40,63	25	90	220,2	195,7	-24,5	-11,13
30	**Spain**	152,13	111,12	-26,96	-10	269,6	8,4	15,3	6,9	82,14	20	76,5	140,7	116,5	-24,2	-17,2
31	**Sweden**	92,62	77,3	-16,54	-17	97,29	40,6	52	11,4	28,08	49	106,12	149,5	128,4	-21,1	-14,11
32	**UK**	89,9	73,69	-18,03	-16	112,68	1,4	5,6	4,2	300	15	37,33	130	105,2	-24,8	-19,08

Table 20: Data on the five independent targets organized in an Excel file

	A	B	C	D	E	F	G	H
1								
2		GDP per capita	GDP per capita	%	Total	Total	%	
3								
4		**Affluence 2005**	**Affluence 2013**	**Af Gr**	**Population 2005**	**Population 2013**	**Pop Gr**	**RES Support policies**
5	**Austria**	125	131	4,8	8 201 359	8 451 860	3,05	7
6	**Belgium**	119	120	0,84	10 445 852	11 161 642	6,85	7
7	**Bulgaria**	36	46	27,78	7 688 573	7 284 552	-5,25	6
8	**Croatia**	99	84	-15,15	733 067	865 878	18,12	4
9	**Cyprus**	58	59	1,72	4 310 861	4 262 140	-1,13	4
10	**Czech Rep.**	80	83	3,75	10 198 855	10 516 125	3,11	8
11	**Denmark**	123	127	3,25	5 411 405	5 602 628	3,53	9
12	**Estonia**	59	75	27,12	1 358 850	1 320 174	-2,85	5
13	**Finland**	116	113	-2,59	5 236 611	5 426 674	3,63	7
14	**France**	110	109	-0,91	62 772 870	65 600 350	4,5	9
15	**Germany**	116	122	5,17	82 500 849	80 523 746	-2,4	9
16	**Greece**	92	74	-19,57	10 969 912	11 003 615	0,31	7
17	**Hungary**	62	67	8,06	10 097 549	9 908 798	-1,87	6
18	**Ireland**	146	132	-9,59	4 111 672	4 591 087	11,66	5,5
19	**Italy**	106	98	-7,55	57 874 753	59 685 227	3,13	12
20	**Latvia**	51	62	21,57	2 249 724	2 023 825	-10,04	6
21	**Lithuania**	53	73	37,74	3 355 220	2 971 905	-11,42	6
22	**Luxembourg**	241	265	9,96	461 230	537 039	16,44	5
23	**Malta**	81	85	4,94	402 668	421 364	4,64	5
24	**Netherlands**	134	133	-0,75	16 305 526	16 779 575	2,91	10
25	**Poland**	50	67	34	38 173 835	38 062 535	-0,29	8
26	**Portugal**	80	77	-3,75	10 494 672	10 487 289	-0,07	11
27	**Romania**	35	54	54,29	21 382 354	20 020 074	-6,37	6
28	**Slovakia**	59	76	28,82	5 372 685	5 410 836	0,71	4
29	**Slovenia**	86	81	-5,81	1 997 590	2 058 821	3,07	4
30	**Spain**	100	91	-9	43 296 338	46 727 890	7,93	9
31	**Sweden**	124	125	0,81	9 011 392	9 555 893	6,04	8
32	**UK**	125	108	-13,6	60 182 050	63 905 297	6,19	10

Table 21: Data Variable Coding in SPSS

	Name	Typ	Spaltenf...	Dezimal...	Beschriftung	Werte	Fehlend	Spalten	Ausrichtung	Messniveau	Rolle
1	MS	Zeichenfolge	8	0	Name of Member State	Keine	Keine	8	Links	Nominal	Eingabe
2	GHG	Numerisch	8	2	Change in Greenhouse Gas Emissions	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe
3	RES	Numerisch	8	2	Change in the Share of Renewable Energy Sources	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe
4	EI	Numerisch	8	2	Change in Energy Intensity	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe
5	Aff_Growth	Numerisch	8	2	Affluence Growth	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe
6	Pop_Growth	Numerisch	8	2	Population Growth	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe
7	Policies	Numerisch	8	2	RES Support Policies	{9999,00, n...	9999,00	8	Rechts	Metrisch	Eingabe

Table 22: SPSS Data Set

	MS	GHG	RES	EI	Aff_Growth	Pop_Growth	Policies
1	Austria	-13,94	8,5	-10,99	4,80	3,05	7,0
2	Belgium	-17,65	5,2	-12,46	,48	6,85	7,0
3	Bulgaria	-12,92	9,6	-29,32	27,78	-5,25	6,0
4	Croatia	-20,29	4,3	-11,15	1,72	-1,13	4,0
5	Cyprus	9999,00	5,0	-17,21	-15,15	18,12	4,0
6	Czech Re	-11,97	6,4	-17,67	3,75	3,11	8,0
7	Denmark	-16,63	11,3	-7,77	3,25	3,53	9,0
8	Estonia	9999,00	8,1	9999,00	27,12	-2,85	5,0
9	Finland	-9,15	7,9	-5,41	-2,59	3,63	7,0
10	France	-11,66	4,4	-12,38	-,91	4,50	9,0
11	Germany	-4,23	5,7	-14,76	5,17	-2,40	9,0
12	Greece	-22,90	8,0	-3,58	-19,57	,31	7,0
13	Hungary	-24,38	5,0	-18,58	8,06	-1,87	6,0
14	Ireland	-17,65	4,8	-12,30	-9,59	11,66	5,5
15	Italy	-24,38	9,2	-11,23	-7,55	3,13	12,0
16	Latvia	-1,15	4,8	-12,59	21,57	-10,04	6,0
17	Lithuani	-13,91	6,0	-36,48	37,74	-11,42	6,0
18	Luxembou	-15,47	2,2	-24,64	9,96	16,44	5,0
19	Malta	9999,00	3,5	-25,74	4,94	4,64	5,0
20	Netherla	-8,17	2,3	-10,88	-,75	2,91	10,0
21	Poland	-,83	4,4	-22,06	34,00	-,29	8,0
22	Portugal	-25,97	6,2	-15,12	-3,75	-,07	11,0
23	Romania	-24,73	6,3	-31,97	54,29	-6,37	6,0
24	Slovakia	-15,36	3,7	-33,15	28,82	,71	4,0
25	Slovenia	-11,19	6,5	-11,13	-5,81	3,07	4,0
26	Spain	-26,96	6,9	-17,20	-9,00	7,93	9,0
27	Sweden	-16,54	11,4	-14,11	,81	6,04	8,0
28	UK	-18,03	4,2	-19,08	-13,60	6,19	10,0

Table 23: Renewable Energy Support Policies in the EU[35]

	REGULATORY POLICIES AND TARGETS							FISCAL INCENTIVES				PUBLIC FINANCING	
• Indicates national level policy ○ Indicates state/provincial level policy	Renewable energy targets	Feed-in tariff/ premium payment	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding/ tendering
Austria	•	•			•		•	•	•			•	
Belgium	•		○	○	•		•		•			•	•
Bulgaria	•	•			•			•		•		•	
Croatia	•	•						•				•	
Cyprus	•	•			•			•					
Czech Rep.	•	•			•		•	•	•	•		•	
Denmark	•	•		•	•		•	•		•		•	•
Estonia	•	•			•						•	•	
Finland	•	•			•		•	•		•	•		
France	•	•			•		•	•	•	•		•	•
Germany	•	•			•	•		•	•	•	•	•	
Greece	•	•			•			•	•	•		•	
Hungary	•	•			•			•		•		•	
Ireland	•	•			•	○	•						•
Italy	•	•	•	•	•	•	•	•	•	•		•	•
Latvia	•	•			•					•		•	•
Lithuania	•	•	•		•	•						•	
Luxembourg	•	•			•			•		•			
Malta	•	•		•				•		•			
Netherlands	•	•		•	•		•	•	•	•	•	•	
Poland	•		•		•		•	•		•		•	•
Portugal	•	•	•	•	•	•		•	•	•		•	•
Romania	•		•		•		•			•		•	
Slovakia	•	•						•		•			
Slovenia	•	•						•					•
Spain	•	•		•	•	•		•	•	•		•	
Sweden	•		•		•		•	•	•	•		•	
UK	•	•	•		•	•	•	•		•	•	•	

[35] (REN21-Steering-Committee, 2013)

6.1 CHECKING THE ASSUMPTIONS

After having analyzed the relationships between the variables of the six hypotheses, I am now checking if the data fulfils the four assumptions which are:

Linearity: A linear relationship bet-ween the explanatory and dependent variables of the nine hypotheses.

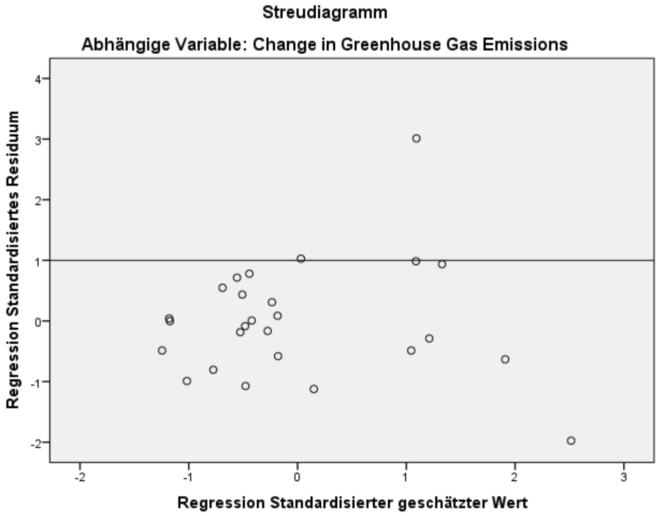
Independence: The residuals are assumed to be independent from each other.

Homoscedasticity: I anticipate that the distances of the residuals to the line of best fit does not change across the values of the independent variable.

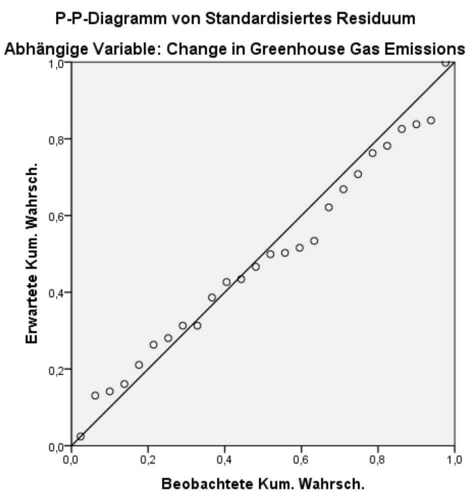
Normality: A normal distribution of the residuals is assumed.

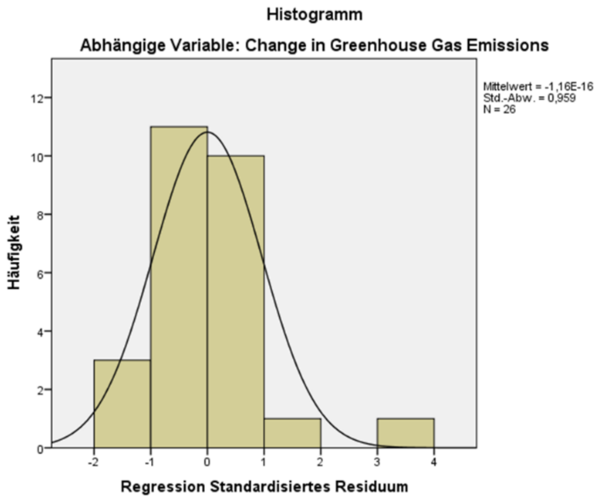
If these assumptions cannot be applied on the data, I would have to suppose that the estimations of the statistical significance and the coefficients (e.g. *r* and *b*) are biased and therefore had to reject the hypotheses affected by that. In the following, the assumptions are separately checked for each multivariate regression analysis. During the following paragraphs I am referring to the SPSS output that was solely created to check the assumptions of the three regression analyses. These graphs are available in the appendix (*SPSS output 1 - 4*).

Anyway, I will start with the first regression referring to the strategy's greenhouse gas emission target. Looking at the scatterplot of the residuals below it can be said that the relationship between the variables is neither linear, since except for one outlier all residuals are plotted on or below the line, nor independent, because the dots group in on the left side of the scatterplot and, thus, take on a special pattern. The same is the case for checking the homoscedasticity assumption: The dots of the scatterplots still group together and form a specific pattern and, therefore, I will assume heteroscedasticity for these data.



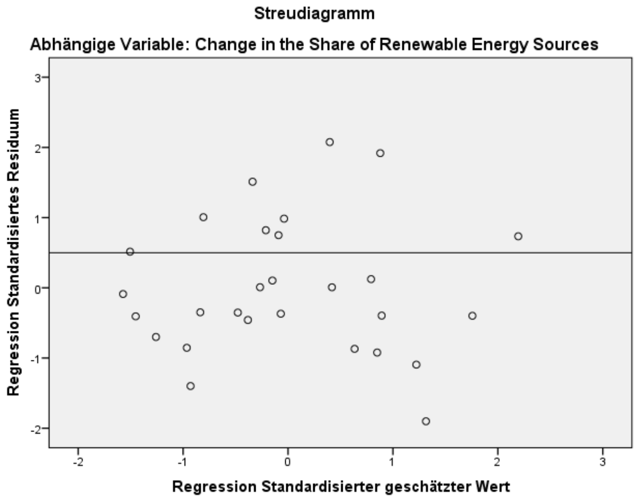
Last but not least I am checking the normality of the distribution by looking at the P-P-Diagram and the histogram of this regression analysis. Here you can see that the dots roughly stick to the line and the distribution in the histogram looks pretty normal, except for one outlier. This still leads to the conclusion that the graph is normally distributed.



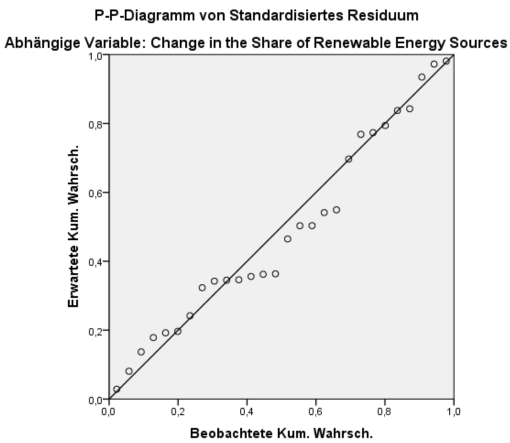


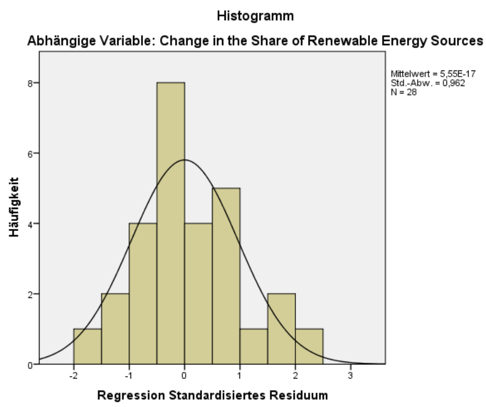
Thereafter, I have to conclude that for the hypotheses one and two not all of the four assumptions are successfully checked. However, this inference does not impair the research anyway since the relationships between the affluence and population growth of the member states and the level of GHG emissions do not show statistical significance.

Now, I will continue by checking the assumptions of the second regression analysis concerning the share of renewable energy sources, although again none of the hypothesis in this regression showed statistical significant p-values and therefore these information are not essential for the results of this research as well. The second multivariate regression analysis meets the linearity assumption perfectly, since the residuals in the scatterplot below are spread above and underneath the line equally. Furthermore, the residuals in the scatterplot do not form any kind of pattern which leads to the conclusion that the independent assumption is also verified for this regression analysis. The same is true for checking the homoscedasticity assumption: The dots in the scatterplot still do not form a specific pattern and, therefore, I will conclude that the homoscedasticity assumption applies to these data as well.

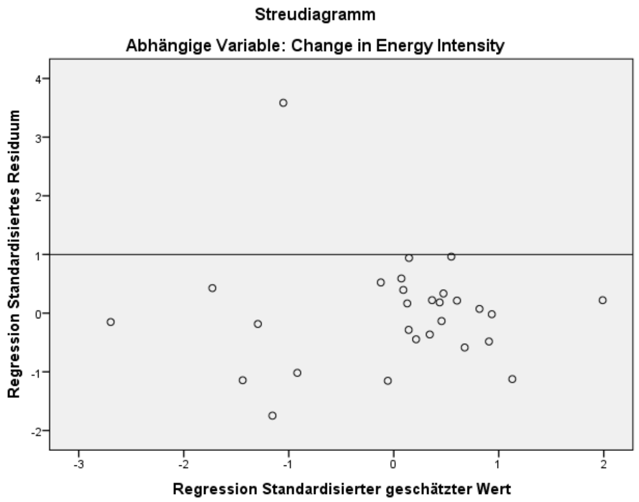


Now, I am checking the normality of the distribution by looking at the P-P-Diagram and histogram. In the P-P-Plot the dots roughly stick to the line and do not detach too far from it. Also by looking at the histogram I can conclude that the normality assumption can be verified for this regression analysis, since the distribution looks normal.

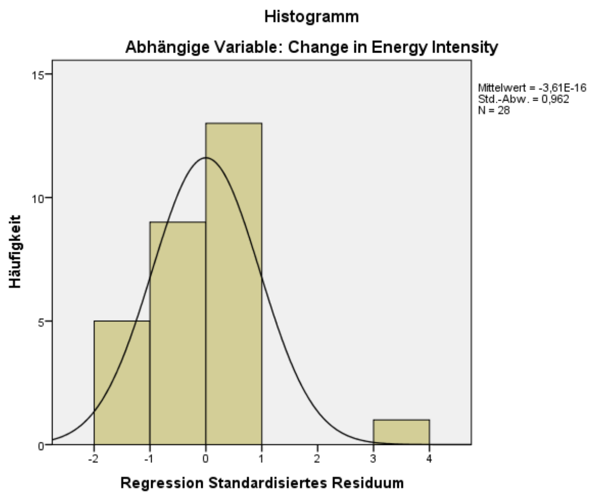


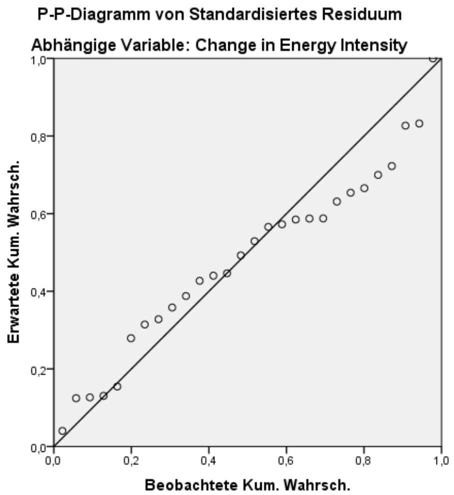


Last but not least, I am checking the assumptions for the third multivariate regression analysis concerning the energy efficiency target measured by the energy intensity of the member states. This regression has the issue of only meeting the normality assumption. The scatterplot below does not show nicely distributed residuals: Almost all dots group are below the line; there is only one outlier which peaks far above the other residuals. This also leads to the rejection of the independence assumption as well as the homoscedasticity assumption.

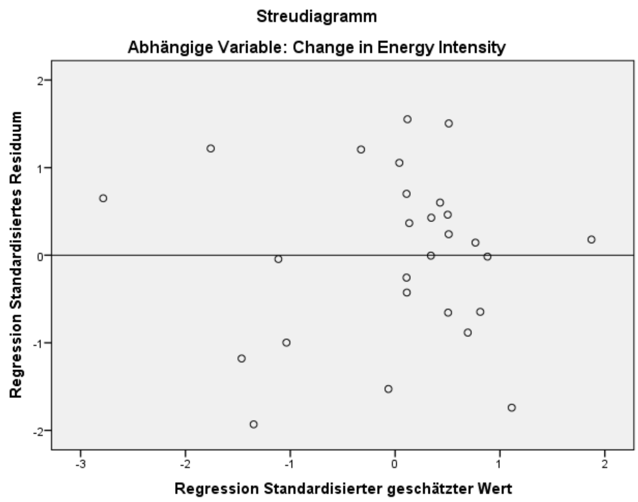


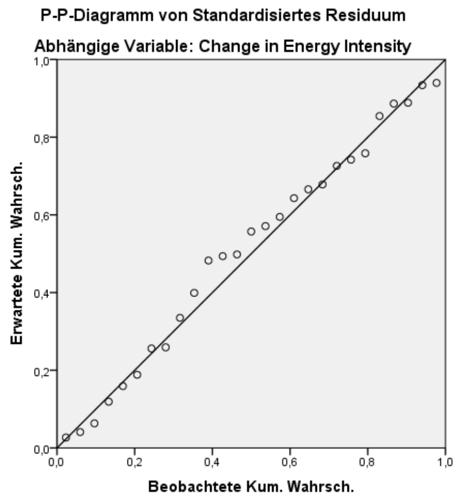
Again, the last assumption is checked by looking at the P-P-Diagram and histogram. The model in the histogram is kind of normally distributed and the dots in the P-P-Plot roughly stick to the line.

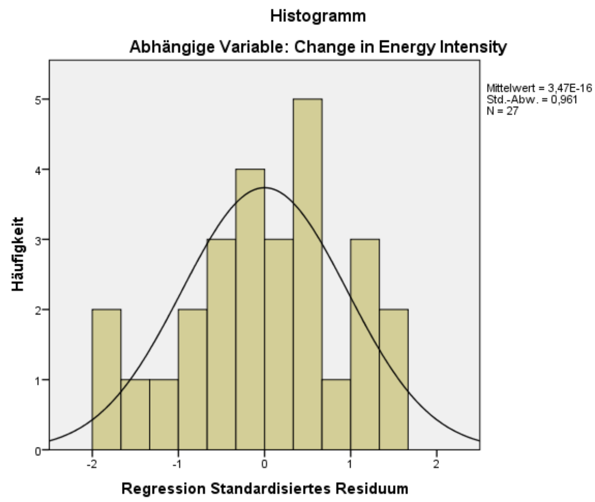




However, after investigating the outlier from the scatterplot I already mentioned closely, I can certainly exclude the member state which is causing this inconvenience from this regression analysis. It appears that Estonia is the only member state with an increase in energy intensity (7,04% as you can see in *Table 14*) compared to all other 27 EU countries which contributed to the energy efficiency target by reducing their energy intensity between 5,41 and 33,15%. After the exclusion of the outlier, I can conclude that all assumption are checked for this forth regression analysis. As you can see below the residuals within scatterplot are spread everywhere and therefore the linearity, independence and homoscedasticity assumptions are fulfilled for this regression.







And due to the almost perfect distribution in the P-P-Diagram and the histogram, I will conclude that the data within this regression analysis is normally distributed.

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