NaSTech Journal of Natural Sciences and Technologies
2022, 1(1), 100-112., DOI: 10.5281/zenodo.7313071

COMPARISON OF ENERGY EFFICIENCY STUDIES OF TURKEY AND GERMANY

Fatih Burak ÖZKANLI[1], Zafer DEMİR[2]

[1] Department of Advanced Technologies, Graduate School of Science, Eskişehir Technical University, Eskişehir, Turkey
2 Department of Electricity and Energy, Porsuk Vocational School, Eskişehir Technical University, Eskişehir, Turkey

ABSTRACT

Where energy is used is as important as obtaining it from a source. It has been demonstrated by the studies that significant savings will be achieved with the regulations to be made in the use of energy. With the concept of energy efficiency, countries attach importance to efficiency studies and adopt various policies to reduce energy waste. Turkey's energy efficiency studies, which started with Turkey's Regulation on Energy Efficiency in Industry, which started in 1995, became more frequent with the 2000s, and with the Energy Efficiency Law enacted in 2007, some obligations and sanctions were introduced to ensure energy efficiency. Especially in the European Union harmonization process, legal arrangements have been made for the directives published by the European Union (EU). With the Energy Conservation Law (EnEG) enacted in 1976, Germany took the first step in this sense by giving the government the authority to enact laws in the field of energy efficiency. Then with the EnEV regulation, standards in the field of energy efficiency were determined and legal regulations were made that would directly affect the citizens. Germany has published new updates over the years in order to comply with the directives and programs published by the European Union. In this study, an overview of the energy efficiency policies determined by Turkey and Germany from the past to the present will be made, and the progress made by the two countries on energy efficiency will be compared. The significant impact of EU Directives on energy efficiency laws will be examined. A comparison will be made about the differences in the laws enacted within the framework of the policies determined by Turkey and Germany. Different reference values in laws and regulations published for the same purpose will be compared. The effects of the renewable and emission-free energy target determined by Germany against the domestic energy target determined by Turkey on energy efficiency studies will be examined.

Keywords: Energy efficiency, Energy efficiency law, Building energy certificate, Energy efficiency policy

1. INTRODUCTION

Energy efficiency is now a concept that has an important place in the energy policies of most countries. The importance of energy efficiency as a policy objective is linked to benefits such as reducing CO_2 emissions and creating a clean environment, as well as creating economic, industrial competitiveness and energy security. Efficient use of energy is aimed with energy saving and energy efficiency. Obtaining energy from different energy sources has caused different legal regulations in the policies of the countries. Telli et al. (2021) compared Turkey's transition from fossil energy to renewable energy, energy policy, strengths and weaknesses, and targets with Germany, considering its own conditions. Thanks to the "Energiewende" policy, which entered the literature in the 1980s, Germany gained important experience in the energy transformation process. For this reason, the transformation model of Germany, which has technological superiority, has come to the view that it is a sample for Turkey, which has an important potential in renewable energy as well as other countries. It is shared that one of the differences between Germany and Turkey is that Germany aims to shut down nuclear energy in 2022, while Turkey will have nuclear power for the first time in 2023. [1] Turkey and Germany aim to achieve energy efficiency by adopting various energy policies. At the point where the adopted energy efficiency policies are not sufficient, new policies have been adopted or old legislation has been updated. In the study, it is aimed to determine the deficiencies and differences on the laws by comparing the energy policies of Turkey and Germany. Making this comparison contributes to the determination of more effective energy policies for countries.

2. COMPARISONS OF ENERGY EFFICIENCY STUDIES

2.1 Policies in Energy Resources

The main differences in the energy transition between Germany and Turkey can be said to be related to coal power plants and nuclear energy. Turkey has aimed to make energy domestic and renewable. Turkey has determined policies to achieve the goals. On the other hand, Germany has set the goal of gradually removing the use of coal and ending the use of nuclear energy and developing in renewable energy sources. Germany has placed the concept of "Energiewende" on its energy policy. In this concept, which emerged by combining the words "energy" and "conversion", the aim is to replace nuclear energy with renewable energy. Nuclear disasters in the world have an important role in taking this decision. Germany planned to fill the energy gap that will occur with the deactivation of nuclear power plants, with renewable energy sources, natural gas turbines, energy efficiency and savings, demand management, and existing conventional power plants.[2] Another target that Germany has set in line with its energy transformation strategy is to reduce coal power plants with 41 GW installed capacity to 17 GW by 2030. The German Coal Commission's forecast for 2030 is that renewable energy sources will increase to 65% and current coal production will decrease by two-thirds.[3]

Turkey does not consider to reduce the amount of coal use as a priority target. Domestic coal is preferred in power stations. Various studies are carried out to encourage the use of domestic coal to reduce foreign dependency in energy. Turkey’s target is to have electricity by using nuclear power and reduce foreign dependency. Nuclear energy is an important element in Turkey's policy to diversify its energy resources. Although Germany will close its last nuclear power plant in 2022, Turkey has a target of gradually producing electricity from nuclear energy in 2023.

There are three similar goals about the energy transition of Germany and Turkey: reducing greenhouse gas emissions, expanding the use of renewable energy, and increasing energy efficiency. It is very important for every country that the energy has economic and continuous supply security. The cooperation between two countries in the energy field, especially the information and technology transfer from Germany to Turkey is constantly developing. Both countries arrange their national energy policies in line with the EU’s goal, which is to make zero GHG emissions by the year 2050. [1]

2.2 Energy Efficiency Studies in Transportation

The use of clean and environmentally friendly fuels in the transportation sector, the reduction of fuel consumption and the efficient and effective use of energy by using efficient transportation systems are energy efficiency. In this purpose, it is aimed to restrict private cars in traffic and to reduce single driving. At the same time, various support policies are established to encourage the use of public transport. Increasing the number of clean and energy efficient vehicles in traffic is possible by applying different strategies that support each other. There are legal regulations and incentives behind these strategies. [4] Intelligent transportation systems, developed by using information and communication technologies, will contribute to the improvement of environment and air quality as well as energy efficiency. In 2018, the transportation sector has a 26.2% share in final energy consumption in Turkey.

Therefore, ensuring energy efficiency in transportation will reduce energy consumption and reduce foreign dependence on energy. In this context, the "Regulation on Procedures and Principles for Increasing Energy Efficiency in Transport" was published by the Ministry of Transport and Infrastructure in 2019. With this regulation, the principles and procedures of reducing the fuel consumption of motor vehicles, increasing efficiency in vehicles, encouraging the use of environmentally friendly fuel, reducing air pollutants and greenhouse gas emissions, expanding public transportation, establishing smart transportation systems, improving transportation infrastructures and preparing city transportation plans have been determined.

NaSTech
Journal of Natural Sciences and Technologies
2022, 1(1), 100-112., DOI: 10.5281/zenodo.7313071

Table 2.1.1. Turkey and Germany energy efficiency targets

	Turkey	Germany
Energy Policies	• Reducing energy costs, ensuring energy supply security, transition to a low-carbon economy and protecting the environment • It is aimed to reduce the risks arising from foreign dependency by producing energy from domestic energy sources.	• Three targets have been set: energy security, efficient and economical energy, and environmentally compatible energy supply. • There is a target to phase out coal-fired power plants by 2030 and to switch to renewable energy by closing nuclear power plants by the end of 2022.
Energy Efficiency and Greenhouse Gas Emission	• In 2023, it is aimed to reduce Turkey's primary energy consumption by 14%. • Turkey has set a net-zero emission target until 2053. • Annual energy consumption in buildings and facilities of public institutions will be reduced by 10% until 2015 and 20% until 2023. • Within the scope of Turkey's 2023 energy strategy, it is aimed to increase the share of renewable energy in electricity generation to 30%.	• Germany aims to achieve Net Zero Emissions by 2045. It has set preliminary targets to reduce emissions by at least 65 percent by 2030 and 88 percent by 2040, compared to 1990 levels. • Projected photovoltaic solar power capacity will be increased from 1.9 GW to 6 GW in 2022. • The target of having a share of at least 32% for renewable energy has been adopted.

The above chart shows the amount of energy consumed in the transportation sector in Turkey between the years 2008-2018. In 2018, 28.0 MTOE was consumed, corresponding to 28% of the total final consumption. 28 MTOE is equivalent to approximately 300 TWh of electricity. Total transportation energy demand has grown rapidly, increasing by 88% since 2011. It can be said that the main reason for the remarkable increase in energy consumption in transportation is the growth in automobile use. Between 2006 and 2016, vehicle kilometers traveled per capita for cars and light trucks nearly doubled. [5] Road transport accounted for 92% of the total transport energy demand in 2018, the remaining 5% of local aviation and pipeline transport, rail transport shares.

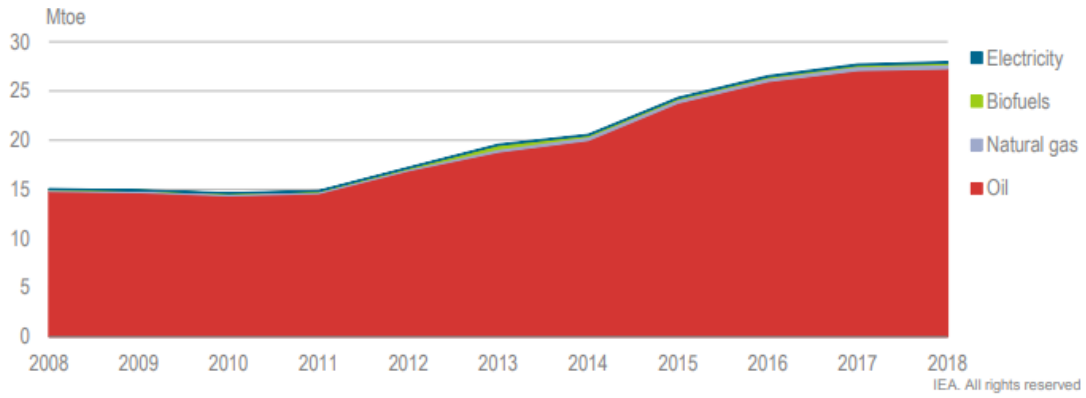


Figure 2.2.1. Final energy consumed in the transportation sector in Turkey between 2008-2018 [5]

It is important for the Ministry to prepare calculation, modeling and reporting practices for reducing fuel consumption and emission values by improving transportation infrastructures. At this point, urban

transportation planning should be done properly. In transportation plans, priority is given to surrounding highways and rail system studies. To encourage public transportation, the share of the rail system is increased in corridors where passenger demand is sufficient. In this way, applications are developed to reduce vehicle use, especially in city centers. With the reduction of vehicle use, areas where bicycles can be left safely are created in public parking lots to support bicycle transportation. Apart from these measures and practices, training and awareness raising activities are also an important factor in ensuring energy efficiency in transportation. Along with the educations, the awareness of the citizens is ensured by including economic driving technique and environmental pollution.

In addition to these, it is an important factor to remove the vehicles with high energy consumption from the traffic to ensure efficiency. Turkey enacted a scrap vehicle law and encouraged users not to use old vehicles. Thus, it provided a reduction in CO_2 emissions with the old cars removed from the traffic. For example, without the scrap law in 2010 and 2011, approximately 16.11 and 16.75 million tons/year of CO_2 emissions will occur, respectively, from automobiles. It has been calculated that if an effective scrap law for 20-year-old vehicles is enacted in 2010, these CO_2 emissions could decrease by 0.3% in 2010 and 1.9% in 2011. [6]

Another way to reduce CO_2 emissions is to reduce the number of internal combustion engine vehicles in traffic and to expand the use of electric vehicles. The electric vehicle trend in the world has also been effective in Turkey. There has been an increase of electric vehicles in Turkey in recent years. When compared to the increase in the world, it is seen that the increase is not enough. The main reason for this is the lack of incentives for electric vehicles. It is important to attract investors to this area with incentives and to reduce fossil fuel dependence, since the number of vehicles is still low and the cost of investment takes many years. In addition, Turkey is preparing to start mass production of its own domestic electric car in 2023.

When we look at the transportation sector of Germany, it constitutes approximately 28% of the total final energy consumption in Germany as of 2015. One of the aims of German energy efficiency is to reduce carbon emissions by 80 to 95% by 2050, with contributions from the electricity and heating sectors as well as transport. In the field of transport, Germany has set a target of reducing final energy consumption by 10% by 2020 and 40% by 2050, with reductions compared to 2005 levels. [7]

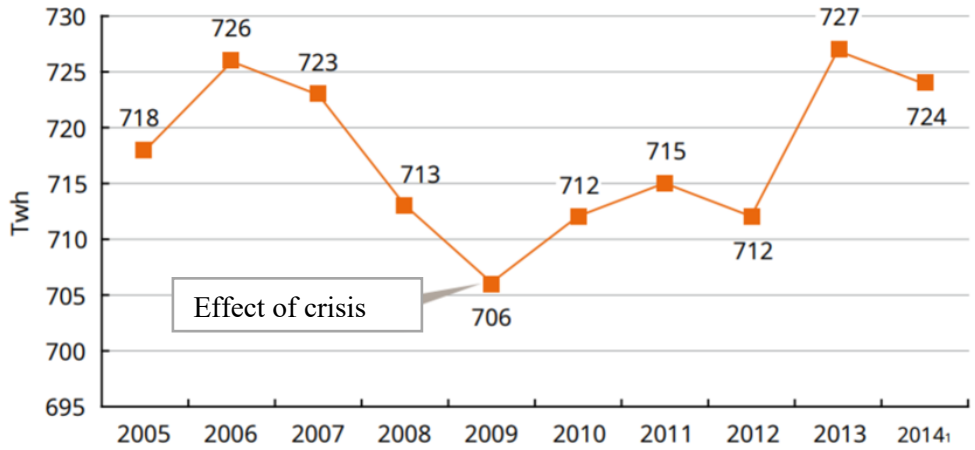


Figure 2.2.2. Final energy consumed in the transportation sector in Germany between 2005-2014 [7]

The chart above shows the final energy consumption in transportation in Germany between 2005 and 2014. While it decreased to its lowest level in 2009 with the effect of the economic crisis, it increased to 727 TWh in 2013 again.

NaSTech
Journal of Natural Sciences and Technologies
2022, 1(1), 100-112., DOI: 10.5281/zenodo.7313071

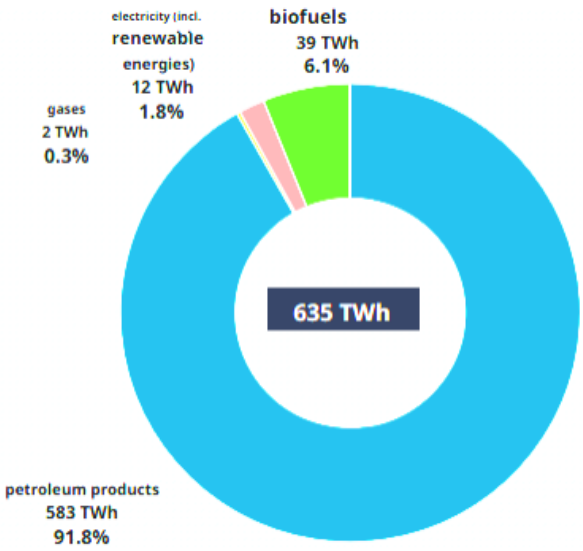


Figure 2.2.3 Final energy consumed in the transport sector in Germany in 2020 (https://www.umweltbundesamt.de)

The chart above shows the final energy consumption values in transportation for 2020. Looking at the 2020 data, the final energy consumption in transportation has been measured as 635 TWh. Fossil fuels (petroleum products) accounted for 91.8% of this consumption. It can be said that the lower energy consumption level compared to previous years is due to the pandemic. The closure decisions taken within the scope of Covid measures caused a significant decrease in energy consumption in the transportation sector. Experiencing the pandemic process has resulted in lower levels of final energy consumption than the crisis in 2009.

Measures such as the Energy Concept, the German Government's roadmap for the transition to renewable energy, and the 2014 Energy Efficiency National Action Plan (NAPE) outlined the promotion of a wide range of renewable energy technologies and policy tools, including the promotion of electric vehicles. At this point, electric vehicles have an important place in the climate-friendly transformation of transportation. All-electric cars produce no exhaust emissions while driving. It also produces no CO_2 emissions when charged with electricity from renewable sources. Also, batteries in electric cars can take on a storage function for the power system if they are charged when large amounts of electricity are available from wind and solar power plants. In this way, the batteries also support the system integration of renewable energy. As part of its goals to reduce CO_2 emissions, Germany put into use the world's first hydrogen-powered trains as of 2018. However, the use of hydrogen-powered buses in German cities is becoming more common day by day. Considering all these, the widespread use of electric and hydrogen-powered vehicles increases efficiency in transportation and has an important role in reducing carbon emissions. To achieve this, the German government provides a maximum subsidy of 9000 Euros for users who want to buy electric cars. As a matter of fact, with the determination of these incentives, the share of electric vehicles, which was 13.5% in 2020, increased to 26% in 2021.

There are big differences between the energy used in transportation in Turkey and the energy used in transportation in Germany. Looking at the final consumption, consumption in Germany is almost twice that of Turkey. When these policies are compared, it can be said that there is not enough incentive for electric vehicles in Turkey compared to Germany. Since the initial investment cost is higher than the current internal combustion engine vehicles, these vehicles were not preferred in Turkey. On the other hand, there are not enough vehicle charging stations and infrastructures for electric vehicles in Turkey. As of 2021, while there are 3457 electric vehicle charging stations in Turkey, it has been announced as

50,901 in Germany. It can be said that the big difference is due to the low number of electric vehicles in Turkey and the lack of adequate charging infrastructure when compared to Germany.

There are no significant differences at this point, as automobile manufacturers use European similar vehicle models in terms of low fuel consumption and reduction of vehicles. However, due to high oil prices, high volume engine options of some vehicles are not offered in Turkey. As engine volumes increase, the increase in tax brackets has directed users to vehicles with smaller engine volumes.

2.3 Energy Efficiency in Buildings

The concept of energy efficiency has gained importance for Turkey and Germany over the years, and both countries have increased their studies in this field and supported these studies with laws and regulations. Along with these determined policies, energy efficiency has also been achieved. Turkey and Germany, together with their efforts to ensure energy efficiency, have made laws mandatory for the implementation of the requirements. Sanctions were imposed in case of non-implementation of these laws. Considering the concepts of energy efficiency, the concept of energy efficiency in Germany emerged earlier than in Turkey.

It has been concluded that technically possible and economically necessary savings in the field of energy efficiency in Germany cannot be implemented without legal regulations. For this reason, with the EnEG law in 1976, it was aimed to ensure economical and rational energy use. Not only energy efficiency, but also reducing dependence on imported energy sources is one of the energy policies that Germany has determined in the first place. The first legal energy efficiency study in Turkey emerged with the Industrial Energy Efficiency Regulation in 1995. With the first laws enacted, it is possible to say that Germany has issued a more general regulation in the first place, while Turkey has only issued a regulation to reduce energy expenditures in the industrial sector and to save energy. With this law, some obligations have been brought to the enterprises operating in the industrial sector to ensure energy efficiency. However, in the EnEG Law enacted by Germany, the law has no direct effect on the citizens and the government has been given the authority to regulate. With this authority, the government can issue regulations based on EnEG. Requirements for energy efficient thermal insulation and operation of heating and ventilation systems for buildings to be built are mentioned. In fact, EnEG provided a legal basis for other laws enacted by Germany in the field of energy efficiency.

Energy efficiency has become increasingly important globally in the 2000s. With the depletion of fossil fuel resources and the increase in energy demand, the number of studies and legal regulations on this concept has increased. With the Energy Efficiency Law enacted in 2007 in Turkey, it can be said that a policy that includes efficiency in every sector has been adopted to use energy effectively and to prevent waste. Within the framework of similar policies, in the other version of EnEG issued by Germany in 2005, it was decided to determine an efficiency certificate for existing buildings and new buildings, just like electrical appliances. This decision was determined under the same title in the Energy Efficiency Law in 2007.

It can be said that the "Energy Performance in Buildings Directive (2002/91/EC)" of the European Parliament and the Council, which entered into force on January 4, 2003, was effective in determining the energy efficiency certification policy for both countries. In line with this directive, when constructing, selling or renting a building, a certificate is required to be submitted with details of its energy performance. The validity period of this certificate is determined as 10 years. To comply with the European Union Laws for Germany and to follow the policies in accordance with the European Union harmonization process for Turkey, energy certificate requirements have been introduced in buildings. When the energy certificates of the two countries are compared, the “energy consumption” values are taken as a basis while obtaining the building energy certificate in Turkey. However, Germany

offers two different building energy certificate options according to consumption and demand. The usage areas of these two certificates were determined according to the construction date of the building in Germany and the scope of the 1977 WSWO Thermal Insulation Regulation. In some cases (for example, if it meets the 1977 Thermal Insulation Regulation), the right to choose between the energy requirement certificate and the energy consumption certificate is granted. The table below contains general comparison information about the contents of the building energy certificates of Turkey and Germany.

Table 2.3.1. Comparison of Energy Performance Certificates of Turkey and Germany

	Turkey	**Germany**
Energy Performance Certificate	• Energy Performance Certificate is valid for 10 years from the date of issue. • Classified from A to G. • The reference value is placed in the C class.	• Energy Performance Certificate is valid for 10 years from the date of issue. • Classified from A+ to H. (GEG 2020) • The reference value is placed in the C class.
Places Where Energy Performance Certificate is Required	• New buildings require energy certification. Newly constructed or under construction buildings with a level lower than Class C cannot obtain occupancy permits by law. • Energy Performance Certificate (EKB) will be used in all buildings except for the buildings mentioned below. - Buildings where production activities are carried out in industrial areas, buildings with a planned usage period of less than two years, - Buildings with a total usage area of less than 50 m^2, -Greenhouses, Workshops, Buildings such as warehouses, warehouses, barns, barns that are built individually and do not need to be heated or cooled. • When the building or detached section is sold or rented, the building's Energy Performance Certificate is also given to the buyer or tenant by the owner. • A copy of the energy identity document must be given to the other party in the purchase, sale and rental transactions.	• Energy certification is required for new buildings. If a new building is built, the client must ensure that the owner of the building is provided with a proof of need for the completed building. • Structures exempt from Energy Certificate are as follows. -Residential buildings intended for less than 4 months of use per year, -Places of Worship - Buildings with a total usage area of less than 50 m^2, -Holiday apartments • An energy certificate should be issued and exhibited in officially used buildings with heavy public traffic and more than 250 m^2 of usage area. Private owners of buildings with high public traffic must show identification for 500 m^2 or more of usable space. • Landlords are obliged to present the energy certificate to the buyer or tenant if they rent or sell their house. After the purchase or rental agreement is signed, the landlord must deliver the energy performance certificate to the buyer.
Places authorized to issue Energy Performance Certificate	• Consultancy companies authorized by the Ministry to issue EKB	• Energy Efficiency Consulting companies

NaSTech Journal of Natural Sciences and Technologies
2022, 1(1), 100-112., DOI: 10.5281/zenodo.7313071

In the table above, there are energy efficiency classes in the energy identity certificates of Turkey and Germany, as in electrical appliances. While Germany determined 9 different efficiency classes, Turkey determined 7 different energy classes. This difference is because the Energy Performance/Reference Indicator (EP/RI) ratio is specified in the German energy certificate for A+ and for H level.

Table 2.3.2. Classification table showing the building energy performance class of Germany

Building Energy Efficiency Class	Energy Class Index (EP) by Primary Energy Consumption
A+	$0 \leq EP \leq 30$
A	$30 \leq EP \leq 50$
B	$50 \leq EP \leq 75$
C	$75 \leq EP \leq 100$
D	$100 \leq EP \leq 130$
E	$130 \leq EP \leq 160$
F	$160 \leq EP \leq 200$
G	$200 \leq EP \leq 250$
H	$250 \leq EP$

The table above shows the values of the building energy efficiency class determined in Germany. In the table below, building energy efficiency class values for Turkey are determined according to the EP Index.

Table 2.3.3. Classification table showing the building energy performance class of Turkey

Building Energy Efficiency Class	Energy Class Index (EP) by Primary Energy Consumption
A	$0 \leq EP < 40$
B	$40 \leq EP < 80$
C	$80 \leq EP < 100$
D	$100 \leq EP < 120$
E	$120 \leq EP < 140$
F	$140 \leq EP < 175$
G	$175 \leq EP$

While the EP/RI ratio is between 0-40 in Turkey, it is classified as A+ class for 0-30 and A-class for 30-50 in Germany. While the lowest efficiency class is G in Turkey, this class is determined as H in Germany.

NaSTech
Journal of Natural Sciences and Technologies
2022, 1(1), 100-112., DOI: 10.5281/zenodo.7313071

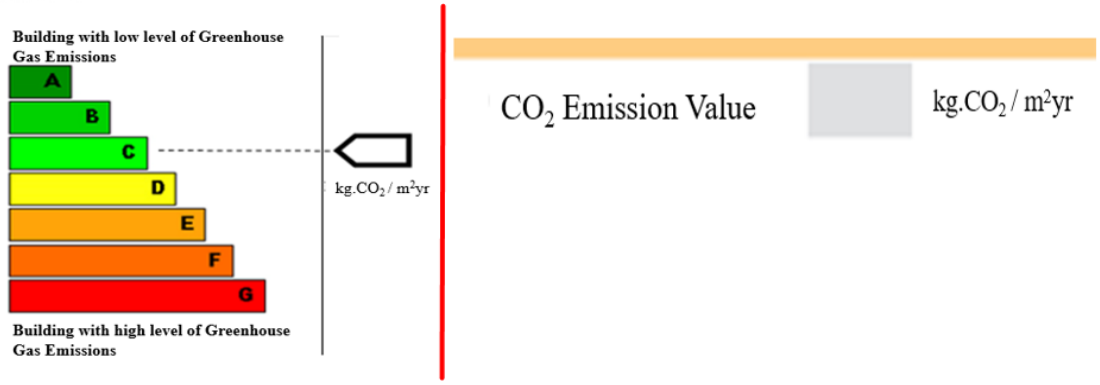


Figure 2.3.1. Greenhouse Gas Emission Value fields in the Energy efficiency certificate of Turkey and Germany (Left side: Turkey, right side: Germany)

As seen in the image above, it is mandatory for each country to specify the Greenhouse Gas Emission values in addition to the energy efficiency class. In the certificates in Turkey, classes have been determined for the greenhouse gas emission value, just like the energy need. In the energy certificate of Germany, only the Greenhouse gas emission value must be entered in the relevant part, there is no other classification system. These information and parameters constitute the energy identity class of the building. The lowest class of the energy certificate for newly constructed buildings has been determined as class C for Turkey and Germany. It is obligatory for buildings not to be lower than this energy class. Building permits are not issued for buildings with a level lower than C class. These certificates are issued by energy efficiency consultancy companies authorized by the state in both countries. Companies analyze the buildings and create the building energy certificate in line with the data they obtain.

When the energy efficiency policies of the two countries are examined, the laws and regulations created include decisions to ensure the energy efficiency of the buildings. It can be said that a significant part of the energy produced is due to its use in buildings and housing sector. The share of the building sector in final energy consumption worldwide has exceeded 30%, and its share in global electricity consumption has exceeded 50%, and the building sector is responsible for one third of global carbon emissions. [8] Therefore, saving on energy consumption in buildings is of great importance in terms of ensuring energy efficiency and reducing consumption.

To ensure energy efficiency, Germany and Turkey have determined reference limit values to be used in technical designs for existing and newly constructed buildings. When these design values and parameters are examined, one of the important differences is the situations determined by the countries depending on the climatic conditions. For example, the heat transfer coefficients vary according to 4 different degree-day regions for Turkey. It expresses the severity of weather conditions (cold and hot) in a specific period, considering the degree day zones, outdoor temperature and room temperature. Different reference values have been determined for regions with colder/warmer climates. Heating/Cooling Degree Days measures the amount of heating or cooling required in your property. Degree days are measured on a base of 18 degrees. Above 18 degrees it is assumed that property will need cooling, and below 18 degrees it is assumed that property will need heating. For each degree greater or less than the reference value, the degree-day concept is used. However, reference limit values for the heat transfer coefficient in Germany are same and constant for each region. Although 4 seasons are seen prominently in Turkey, Germany has a temperate climate. Due to the geographical and climatic characteristics, there are large temperature differences in most regions of Turkey in summer and winter. Therefore, countries have determined different reference values in line with their climates. There are differences when the heat transfer coefficient values are compared.

Table 2.3.4. Comparison of thermal conductivity coefficients of Turkey and Germany

Component	Unit	Turkey				Germany	
		1st Zone	*2nd Zone*	*3rd Zone*	*4th Zone*	*Residential Building*	*Non-residential Building (a building with a temperature of more than 19°C)*
Outer Wall (U_D)	W/m^{2}K	0.70	0.60	0.50	0.40	0.28	0.35
Window U_P)	W/m^{2}K	2.4	2.4	2.4	2.4	1.3	1.3
Ceiling (U_t)	W/m^{2}K	0.70	0.60	0.50	0.40	0.35	0.35

The table above shows the heat transfer coefficients determined by Turkey and Germany. In Turkey, these values are determined as common for all building types, but in Germany, reference limit values are determined differently for residential buildings and non-residential buildings. For non-residential buildings, Germany has determined different values for buildings that are heated between 12-19 degrees and have temperatures higher than 19 degrees. For example, in the TS 825 standard, the heat permeability coefficient of the exterior wall in residential buildings in Turkey is 0.70 W/m^{2}K for the 1st zone, 0.60 W/m^{2}K for the 2nd zone, 0.50 W/m^{2}K for the 3rd zone and 0.40 W/m^{2}K for the 4th zone [9]. In Germany, this value was determined as 0.28 W/m2K in GEG 2020. For non-residential buildings, it is determined as 0.28 W/m^{2}K for buildings with heating temperatures higher than 19 degrees, and 0.40 W/m^{2}K heated between 12-19 degrees. [10]

While the heat transfer coefficients for windows were determined as 2.4 W/m^{2}K in all heat zones in Turkey, this value was determined as 1.3 W/m^{2}K in Germany. Therefore, it can be said that reference values in building design are determined at more stringent levels in Germany. According to statistical information: The heating energy need of an existing house in Turkey, which has the same climate conditions and the same usage area as countries where energy is used efficiently, such as France, Germany, England, Sweden, is 2-5 times more than a house in these countries. [11]

2.4 Comparison of Standards

The standards set by the countries are the set of instructions used when answering the question of how to do a job better. Standards consist of technical information and have prescriptive features by being used with laws.

To ensure energy efficiency, Turkey and Germany have set various standards. Among these standards, there are TS 825 Thermal Insulation Rules determined in Turkey and similar DIN4108 standards determined in Germany. The purpose of these standards is to limit the amount of energy used for heating buildings, to increase energy efficiency and to determine the calculation methods and references to be used for calculating energy needs. Looking at the TS 825 Standard, it was created after the DIN 4108 determined by Germany. While creating the TS 825 standard, the German DIN 4108 standard was taken as reference. Therefore, these standards show many similarities. So much so that when TS 825 was first

published, idiomatic errors were made and the heat transfer concept could not be studied well because the German DIN 4108 standard was translated without a good understanding. [13] In general, the aim of adapting these standards to EU standards has been adopted.

In part of the TS 825 standard, the data of the DIN 4108 German standard has been accepted. For example, DIN 4108 and TS 825 accept a limit of 1440 hours for condensation times on walls and roofs, and 2160 hours for evaporation time. However, considering factors such as the difference in climatic conditions and material quality, it is seen that the usability of these values is a matter of discussion for Turkey. The use of a single value in the standards for these two countries, which are located in different geographical regions from each other, is not a correct standard setting method. It can be said that the outside temperatures vary greatly depending on the climate of the countries, especially in terms of providing insulation in buildings. [13]

Table 2.4.1. Comparison of the building's annual energy need calculation of DIN 4108 and TS 825 Standards [13]

	Germany's DIN 4108 (Q_{Annual})	**Turkey's TS 825 (Q_{Annual})**
$A/V_{gross} \leq 0.2$	54.0 kWh/m^2	27 - 104 kWh/m^2
0.5	70.2 kWh/m^2	41 - 129 kWh/m^2
1.0	97.3 kWh/m^2	64 - 171 kWh/m^2
$A/V_{gross} \geq 1.05$	100.0 kWh/m^2	66 - 175 kWh/m^2
Q_{annual} : The total annual heating energy requirement of a building.		

In the table above, it is seen that the German DIN 4108 Standard and the Turkish TS 825 standard are compared based on the annual total heating energy needs of a building. Comparative values in this table are selected values for the same A/V_{gross} ratios. [14] A/V_{gross} ratio is the value obtained by the ratio of the total heat-losing surface area (A) to the heated gross volume (V_{gross})of the building. While calculating the annual heating energy of the building, the calculation is made using this ratio. While different A/V_{gross} constants are used for 4 different degree day regions in Turkey, this ratio is constant for each region in Germany. Looking at the average of the values in the table, it can be said that the annual heating energy need of the building in Germany is less than that of a building in Turkey. The reason for this may be that the reference values determined by Germany are lower than those of Turkey.

3. CONCLUSIONS AND SUGGESTIONS

Energy is an important issue on which all countries work intensively. How the energy will be used is an important factor as well as from which source it is produced. At this point, both countries have determined various energy targets and policies. It has put these policies into practice with both laws and regulations and strategic action plans.

Energy efficiency studies have gained importance in both countries in the 2000s. With the concept of energy efficiency, which emerged earlier in Germany than in Turkey, the aim is to save in areas where

energy is used intensively. Laws enacted to ensure savings in these areas have imposed obligations on the sectors and, if not implemented, sanctions have been imposed along with strict controls. On the other hand, together with the objectives and processes determined by the European Union, the legal regulations of the countries have also been shaped over time. At this point, due to the harmonization process initiated by Germany to meet the requirements the European Union has been effective in updating the legal regulations and taking it as a reference. European Union Directives are effective in updating legal regulations and taking references for Turkey to become a member of the European Union.

The energy efficiency study appeared earlier in Germany compared to Turkey. It is obvious that the adoption of these policies and the provision of energy efficiency will benefit countries both economically and environmentally. To achieve these efficiencies, these policies have been made mandatory in various sectors and sanctions have been applied if they are not implemented. In this way, compliance with the standards was ensured. The directives published by the European Union have an impact when determining these standards. These directives have been put into practice by both countries. Germany, which is a member of the European Union, has the aim of fulfilling the requirements and Turkey has the aim of fulfilling the requirements in the harmonization process. Therefore, laws and regulations issued by countries have been subject to various updates in line with these directives. Releasing these updates is a requirement for both countries. Changes in technologies, energy usage habits and climates of countries over the years require changes in legal regulations.

Countries are working in the field of energy efficiency with the thought that the use of energy is as important as its production. By comparing these studies between countries, information about the accuracy of the determined targets and policies can be obtained. Although it seems like a common goal for the two countries to give importance to energy efficiency, the need for energy efficiency is to reduce foreign dependence on energy in Turkey. In Germany, the aim is to increase the use of renewable resources, reduce carbon emissions and increase energy efficiency.

When we look at the studies carried out by Turkey in the field of energy efficiency, it is obvious that there are standards and studies that take Germany as a reference. Providing a comparative assessment of the energy efficiency of the two countries may be beneficial in identifying weak and open points in current energy policies. The establishment of joint energy efficiency commissions by the two countries may be effective at this point. In addition, the applied examination of the studies of the two countries together with the energy efficiency joint programs at undergraduate, graduate and doctoral levels will pave the way for the creation of a more beneficial and development-based system for young engineers and politicians.

REFERENCES

[1] Telli, A., Erat, S., & Demir, B. Comparison of energy transition of Turkey and Germany: energy policy, strengths/weaknesses and targets. Clean Technologies and Environmental Policy, 2021; 2(23), 1-15.

[2] Morris, C., & Pehnt, M. Energy Transtion: The German Energiewinde. Berlin: Heinrich Böll Fundation, 2015.

[3] A Roadmap for a Just Transition from Coal to Renewables. Agora energiewende, 2019. Retrieved March 15, 2022, from www.agora-energiewende.de: https://www.agora-energiewende.de/en/publications/the-german-coal-commission

[4] Kessler, J., & Schroeer, W. Meeting mobility and air quality goals: Strategies that woek. Transportation, 1995; (22), 241-272.

[5] Turkey - Energy policy review report. International Energy Agency (IEA). 2021 Retrieved January 2022 from https://iea.blob.core.windows.net/assets/cc499a7b-b72a-466c-88de d792a9daff44/Turkey_2021_Energy_Policy_Review.pdf

[6] Şahin, Ü., Onat, B., Sivri, N., & Yalçın, E. Hurda yasasının otomobil kaynaklı sera gazı emisyonunda oluşturacağı muhtemel etki. Journal of the Faculty of Engineering and Architecture of Gazi University, 2013; 3(26).

[7] Energiewende outlook: transportation sector - executive summary. PWC. 2015 Retrieved April 2022, from https://www.pwc.de/de/energiewende/assets/energiewende-outlook-transportation-2015.pdf

[8] Kabakçı, O. K. Binalarda Enerji Verimliliği.Wordl Energy Council, 2019. Retrieved April 2022, from https://www.dunyaenerji.org.tr/wp-content/uploads/2019/11/21112019Sunum.pdf

[9] TS 825 - Binalarda Isı Yalıtım Kuralları. Turkish Standards Instution, Turkey, 2013.

[10] Gebäudeenergiegesetz. German federal ministry for economic affairs and climate action, Germany, 2020.

[11] Açıklamalı ve Örneklerle TS 825 Standardı Binalarda Isı Yalıtım Kuralları. İzocam. 2013.

[12] Dağsöz, A. K., Bayraktar, K. G., & Ünveren, H. H.. Isı yalıtımı ve kalorifer tesisatı standartları üzerine görüşler. Tesisat Mühendisliği 2001; 50-54.

[13] Pehlevan, A. Binalarda ısı yalıtım kuralları standardının yoğuşma ve buharlaşma süreleri açısından değerlendirilmesi. V. Ulusal Tesisat Mühendisliği Kongresi, 3-6 October 2001; İzmir, Turkey, 441-458.

[14] Özenç, A. Edirne'deki Isı Yalıtım Uygulamaları, Trakya Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Edirne, Turkey, 2007.