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# A comparative analysis of the energy transitions of EU member states Germany and Spain

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# A COMPARATIVE ANALYSIS OF THE ENERGY TRANSITIONS OF EU MEMBER STATES GERMANY AND SPAIN

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Currently, the energy transition is gaining more and more importance in European energy policy. This article aims to introduce the achievements, contributions and challenges of Europe's current energy transition. The article outlines some of the main energy goals and initiatives proposed and developed by EU institutions. The EU attaches great importance to renewable energy, energy efficiency and reduction of greenhouse gas emissions (GHG), identifying them as the three ultimate supporters for achieving carbon neutrality. The EU aims to be climate neutral by 2050. However, since energy policy requires the joint efforts of EU institutions and the WTO, each WTO plays a key role in achieving the EU's goals. Differences in socio-economic and energy structures between EU WTOs lead to different speeds at which they can achieve EU targets. Taking Germany and Spain as examples, their political policies, measures and actions with regard to the energy transition are assessed. These two countries are just examples of differences in the implementation of EU energy and climate goals. The article also describes the ambitious "Green New Deal" initiative of the EU presidency. The initiative not only identifies key goals, but also safeguards Europe's commitment to the energy and climate transition. However, the plan faced major obstacles. The difference in energy level among member states in the process of energy transition may become an important factor hindering Europe from realizing the goal of energy transition. Another challenge is the opposition of some people, especially those who believe that the energy transition is designed to attract the coming economic and industrial transformation as well as harm their welfare and pose a potential threat to employment. Finally, the energy transition mentioned in this article is not only the responsibility of Spain and Germany, but also the responsibility of the entire European Union and other world economies. Only by working together to promote energy transition and build a community with a shared future for mankind can we make the world a better place. The United Kingdom (UK) also plays a major role in the European Union's (EU) energy transition ahead of its departure from the European Union in 2020. Here are some of the ways the UK is influencing the EU's energy transition: (i) The first is renewable energy: the UK is one of the EU leaders in the deployment of renewable energy, especially offshore wind. UK expertise and investment in renewable energy helps advance the EU's renewable energy targets and develop innovative technologies for clean energy generation. (2) The second is climate change: the UK has always been a staunch supporter of EU climate change policies, including the Paris Agreement. Its participation in the EU's efforts to reduce greenhouse gas emissions helps strengthen the EU's position as a global leader in the fight against climate change. (iii) The third is the energy market: as an energy consumer and producer, the UK is an important participant in the EU energy market. (iv) The fourth is energy research and innovation: the UK actively participates in EU-funded energy research and innovation projects. Its contributions to these programs help drive the development of new clean energy technologies and increase the overall effectiveness of the EU's energy transition efforts. Overall, the UK's participation in the EU's energy transition is significant, and its withdrawal poses some challenges for the EU. The impact of Brexit on the EU's energy transition is complex, and it remains to be seen how the EU will adapt to the loss of the UK's contribution to its energy policies and initiatives. Brexit will also have some impact on the EU's energy transition, especially in the field of renewable energy. First of all, the UK is an important energy market in Europe, and Brexit will have a certain impact on the EU energy market. Second, the UK's own energy policy and future development direction will also affect the EU's energy transition. The United Kingdom has a relatively high level of development in renewable energy, and its policies may change after Brexit, such as reducing subsidies for renewable energy. This may affect the EU's progress in renewable energy, and even delay the EU's energy transition process. In addition, after Brexit, energy trade with the EU may be subject to certain restrictions, and it will take time and resources to form a new trade relationship. This may have some impact on the EU energy market and supply chain. It can be seen that the impact of Brexit on the European Union will affect the various member states of the European Union. Brexit has brought certain uncertainties and challenges to the EU's energy transition, but at the same time there are also opportunities and potential areas of cooperation, which require the joint efforts of the EU and the UK.Finally, It can be explained how Europe's energy transition will also affect its external relations, for example with Russia, and propose how the two blocs can maintain energy relations in light of the energy transition, in particular through the conversion of natural gas into hydrogen and the storage/use of the resulting of carbon dioxide.

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Shuo Gao

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## 1. Introduction

Energy is an important resource that drives economic growth and development. Over the years, the energy sector has evolved with changes in production, consumption and technology. Global demand for energy is increasing, driven by population growth, urbanization and industrialization. Decarbonization and climate policy are gaining new momentum in public debates around the world, not least in the European Union (EU), which has declared a firm commitment to lead in this global energy transition. The G20 summit in 2023 will focus on how to accelerate the global energy transition in order to achieve sustainable energy production and consumption while reducing environmental impact.During the summit, leaders of various countries will discuss how to combine the experience and best practices of developing and developed countries to formulate a series of concrete measures to accelerate the energy transition. Among the main topics are:

（i）Promoting renewable energy: Countries will explore how to promote renewable energy domestically, including solar energy, wind energy, hydropower, etc., to reduce dependence on fossil fuels and improve energy sustainability.

（ii）Enhancing Energy Efficiency: Countries will share and promote best practices in energy efficiency to reduce energy consumption and waste, and reduce adverse impacts on the environment.

（iii）Develop clean energy technologies: Countries will share the latest clean energy technologies and innovations to advance sustainable development and address the challenges of climate change.

（iv）Strengthen transnational cooperation: Countries will strengthen transnational cooperation to jointly address the challenge of global climate change and promote global cooperation in clean energy and sustainable development.Improving energy supply chains

Countries will discuss how to improve energy supply chains, reduce environmental pollution, and maintain energy security. The above issues have also become the focus of discussion at the G20 summit in 2023, in order to promote cooperation among countries in the energy field and achieve sustainable development goals.

By the middle of the 21st century, the European Union and its member states face the pressing problem of achieving low carbon emissions and reducing greenhouse gas (GHG) emissions to zero in the future. Although in European integration, they may focus more on energy security and energy competition, but subsequently, climate change and sustainable development are closely linked with EU energy policy. Especially the need for global decarbonization in 1990, the Rio "Earth Summit" held in 1992 and the need for global energy transition after the promulgation of the "Kyoto Protocol" in 1997. The issue of energy transition has become a global issue. Climate change and energy issues are increasingly high on the global (and European) political, economic and ecological agenda. The Paris Agreement in 2015 and a special report by the Intergovernmental Panel on Climate Change (IPCC) in 2018.

The call to action is reiterated in two international documents highlighting the pressing issue of global warming. The 2015 Paris Agreement emphasized the urgent need to "hold the increase in global average temperature to well below 2° C above pre-industrial levels and to pursue efforts to limit the increase to 1.5° C above pre-industrial levels" . The agreement sets the goal of reducing greenhouse gas emissions

to zero. The EU is also actively involved in the negotiations and has become a signatory. The latest 2018 IPCC special report on global warming of 1.5° C further called for decarbonization action, claiming that to meet the 1.5° C goal, greenhouse gas emissions would drop by about 45% by 2030 and achieve net zero emissions by 2050 . Given the growing concern about climate change and global warming, the EU has expressed a serious political commitment to address the issue, setting numerous targets for energy efficiency, renewable energy and reducing greenhouse gas emissions. These goalss highlight the energy transition as a key priority for the EU. However, certain goals are more likely to be achieved than others. Indeed, there are challenges at both EU and member state level. Affected by various factors such as rising energy demand, limited domestic resources, and excessive reliance on imports, all member states are facing an energy crisis. This article compares and explores the energy crisis in Germany and Spain, two member states of the European Union, and the responses of energy companies. There are also the attitudes and efforts of the governments and people of the two countries towards energy transition. This article presents the literature review, methods, data analysis, and conclusions, highlighting the main findings. Finally, the it highlights the potential impact of the EU's energy transition on its external relations, namely with Russia, and how the two blocs can maintain their energy ties. The European Union has made significant progress in its energy transition to a more sustainable and renewable energy structure, and several other important economies in the world, such as China, the United States, and Russia, are also at different stages of energy transition.

**European Union:**

The EU has set goals to reduce greenhouse gas emissions by 55% by 2030 and to achieve climate neutrality by 2050. The European Union has made significant progress in the deployment of renewable energy, especially wind and solar. The EU has also implemented policies to reduce energy consumption, improve energy efficiency and promote sustainable transport. However, the EU's energy transition faces challenges such as insufficient investment in grid infrastructure, regulatory uncertainty, and energy security concerns.



China:

China has set the goal of peaking carbon emissions in 2030 and achieving carbon neutrality in 2060. China, the world's largest producer of renewable energy, has made significant progress in deploying wind and solar power. However, China also faces challenges such as lack of grid infrastructure and regulatory uncertainty. China has always followed and believed in a community with a shared future for mankind, and actively promoted energy transformation through international cooperation.

U.S:

The United States has set goals to achieve a 50-52% reduction in greenhouse gas emissions by 2030 and net zero emissions by 2050. The United States has made significant progress in the deployment of renewable energy, especially wind and solar power. However, the U.S. faces challenges such as regulatory uncertainty, energy security concerns, and a lack of investment in grid infrastructure.

Russia:

Russia has set a goal of reducing greenhouse gas emissions by 30% by 2030. Russia has made limited progress in the deployment of renewable energy, and a large part of its energy mix remains dependent on fossil fuels. Russia's energy transition faces challenges such as regulatory uncertainty, lack of investment in renewable energy, and dependence on the oil and gas industry. Due to the war, Russia's energy and all aspects have been affected, which has also affected the energy transition of other economies to a certain extent.

Overall, while all of these countries have ambitious goals for the energy transition, they also face various challenges that need to be addressed to ensure a successful transition to a more sustainable and renewable energy future.

Germany, Spain poised for recovery from COVID-19 crisis

The final national energy and climate plans of almost all member states were drawn up before the COVID-19 crisis, but economic activity in many European countries has been restricted due to the impact of the new crown epidemic. Residents and businesses in Italy, Spain, France and Germany have been forced to drastically reduce their daily activities and stay indoors as the coronavirus outbreak is brought under control. The sudden decline in economic activity has plunged Europe into a period of economic depression. Electricity consumption has been impacted, which has brought unpredictable consequences to people's long-term commitment to low-carbon emission reduction, especially for the green economy and renewable energy industries. Influence. However, as the goal of zero-carbon emission is deeply rooted in the hearts of the people around the world, and the long-term development of green energy in Europe continues to improve, according to the plan formulated by the European Commission, green energy will bring certain opportunities for its new environmental protection business in 2020. After the severe stage of the epidemic has passed, some investment has flowed into the clean energy market. Likewise, poor handling of the pandemic crisis and a typical global recession will cause clean energy transition plans to be delayed for some time compared to their original plans. The energy transition has almost regressed and needs to move forward slowly.



## 2. Literature review

Spain: passive consent in civil society

Since its inception, Spain's energy transition has been driven by a strong anti-nuclear movement and the need to find alternatives to nuclear power. Nuclear Opposition was one of the world's first producers of wind turbines. _ Spanish support for these early nuclear alternatives The roots and founders of the Catalan Eco-Cooperative were involved in the nuclear opposition and were among the first producers of wind turbines in the world. Nuclear Opposition was one of the world's first producers of wind turbines. _ Since Spain relies heavily on energy imports, it has vigorously developed energy companies. Some Spaniards supported these early nuclear alternative energy plans because of the country's heavy dependence on energy imports. Energy was seen as a way to reduce dependence on external sources of energy (Puig and Boix, 2009), but as Spanish society became more depoliticized following the nuclear moratorium, participation in social movements declined. Renewable energy was seen as a way to reduce dependence on external energy sources (Puig and Boix, 2009), but as Spanish society became increasingly depoliticized after the moratorium on nuclear energy in 1984 and the country’ s transition to democracy, social movements Participation

declined (Huke, energy was seen as a way to reduce dependence on external energy sources (Puig and Boix, 2009), but as Spanish society became increasingly depoliticized following the 1984 nuclear moratorium and the country’s transition to democracy, Participation in social movements has declined (Huke, 2017: 145)-147). In the process of energy transition, Spanish society is becoming more and more inert. Spanish society is becoming increasingly inert when it comes to the energy transition. The energy transition is driven by the country's enterprises and regions (Personal Communication, FR) The energy transition is driven by the country's enterprises and regions (Personal Communication, FR). Poised for rapid expansion of renewable energy due to rapid technological advances, favorable geography, and growing electricity demand during economic booms (Beckberg, Due to the pace of technological advancement, favorable geography, and growing People are ready for the rapid development of renewable energy (Beckberg, China is well prepared for the rapid development of renewable energy due to the pace of technological progress, favorable geographical environment, and growing electricity demand during the economic boom prepared (Beckberg, 2009). Wind energy develops rapidly._ However, on the basis of passive consent, the intensity of the conflict is low due to less social participation (Gramsci, 1992: 224, 370). Even building new wind and gas power The enterprise can also continue to operate its old business, which promotes the rapid development of wind energy._ Due to the reduction of social participation and passive consent, the intensity of conflict is lower (Gramsci, 1992: 224, 370). Can continue to operate its traditional business while new wind and natural gas generation facilities supply the world's growing energy supply However, conflict intensity is lower due to reduced social participation and passive consent (Gramsci, 1992: 224, 370) Social participation and passive consent Agreed reduction, conflict intensity is lower (Gramsci, 1992: 224, 370). Firms can continue to operate their traditional businesses while new wind and natural gas New wind and natural gas plants are built, and even as large energy companies build new wind and natural gas plants to meet growing energy demand, businesses can continue and can continue to operate their traditional businesses. Except for natural gas. They were also part of the growth, in addition to substantial spending on wind and wind energy facilities._ Subsequently, Iberdrola became the world's largest operator of wind farms (Galan, 2013). They were also part of the growth due to large investments in wind and gas energy facilities. In addition to substantial investments in wind and gas energy facilities, they were also part of the growth. At the same time, Iberdrola jumped to become the largest wind farm operator in the world (Galan, 2013). At that time, Iberdrola had become the largest wind farm operator in the world wind farm operator (Galan, 2013). At the time, Iberdrola jumped to become the largest wind farm operator in the world (Galan, 2013). Along the renewable energy value chain, some SMEs have created their own business plans and expressed their interest through for-profit institutions like the Personal Communication Environmental Fund (Spanish Optoelectronic Union), the Personal Communication APPA (Social Environmental Transformation), the Personal Communication AEE (Social Environmental Retrofit), and the Personal Communication AEE (Social Environmental Transformation). The short-lived PV boom of 2007 and 2008, which was fueled by overpayments under Royal Decree 661/2007 (RD 661/2007), was not dominated by significant energy corporations, in contrast to wind energy (del Rio and Mir-Artigues, 2014d). Along the renewable energy value chain, some SMEs have created their own business plans and

expressed their interest through for-profit institutions like the Personal Communication Environmental Fund (Spanish Optoelectronic Union), the Personal Communication APPA (Social Environmental Transformation), the Personal Communication AEE (Social Environmental Retrofit), and the Personal Communication AEE (Social Environmental Transformation). The short-lived PV boom of 2007 and 2008, which was fueled by overpayments under Royal Decree 661/2007 (RD 661/2007), was not dominated by significant energy corporations, in contrast to wind energy (del Rio and Mir-Artigues, 2014d). Spanish energy industry power players and opposition Renewable Energy's Power Environmental NGOs and small businesses were the main proponents of the renewable energy system after the Spanish energy crisis began. Related organizations like APPA and the United Nations Environment Fund were also involved, but they were both too weak to defend renewable energy (Personal Communications, Environmental Fund). Although there have been some moves against fossil fuels, they have not been strong enough to assure Spain's departure of the old energy system (Foro Nuclear Energy, 2013: 39). This is despite the country's general aversion to nuclear energy. Passive opposition to current regimes is correlated with passive support for renewable energy. As a result, federal legislation has undergone considerable revisions at the expense of renewable energy sources, lowering funding for current installations retroactively and suspending feed-in tariffs for new installations (Paz Espinosa, 2013a). Environmental Innovation and Social Transformation 31, 200‑210 (2019), T. Has Also worth mentioning is the politicization of Spain's opposition to austerity measures. The Movement of May 15, 2011 (M15), when protesters from all around Spain occupied the square, became a symbol of political turmoil. The privatization of the health care system (Blanca) and education cuts, as well as the forced eviction of homeowners who are unable to make their mortgage payments (PAH), have all been the targets of protests at the same time (Huke, 2017). These activities are linked to the increasing politicization of energy issues. It can be seen that the passive consent of Spanish citizens has affected or even hindered Spain's energy transition, compared to Germany or other EU member states.



Germany: Active consent within civil society

The active participation of society's members is what is driving Germany's energy transition. From 77 in 2005 to 754 in 2012, there were private energy cooperatives (Trends: Research and Luhana University Lüneburg, 2013: 60). Much more. Both municipal utilities and many farmers are making investments in various types of renewable energy technologies, including solar and biomass systems. The energy shift presents opportunities for local governments to create value, particularly in rural areas. The energy transition (Becker et al., 2012) and the decentralization of energy systems originally based on sizable fossil fuel and nuclear power plants have both benefited from the strong and active engagement of civil society (Guering and Rollin, 2016). In Germany, citizen energy facilities produced over 40% of the country's renewable energy in 2012, compared to just over 20% from traditional energy providers, the Big Four, and municipal businesses (Trends: Research and Indian University of Lemburg, 2013: 46). This demonstrates how society in Germany is actively engaged in the energy transition. The birth of significant ecological movements in the 1970s is what can be attributed to the robust engagement and active identification of civil society in Germany (Gramsci, 1992: 224, 370) (Sander, 2016). These campaigns paved the way for the

advancement of renewable energy while also promoting the phase-out of nuclear power (Toke, 2011: 71–72). Green capital organisations like BEE (German Energy Association), BWE (German Energy Association), or BSW (German Solar Energy Association) were established in the 1980s and 1990s as the renewable energy sector expanded and matured. The old fossil nuclear energy system and its main function are clearly opposed by them (Haas and Sander, 2013: 13‑17). A large trend from NGOs to social movements has gathered speed over the past few years, especially since the Fukushima nuclear tragedy in Japan (Haas and Sander, 2016). Germany's vigorous resistance to nuclear and fossil fuel technology is related to its support for renewable energy sources. The Renewable Energy Act (Energy Energy, EEG), which was adopted by the German Parliament in 2000, is the primary vehicle for supporting the energy transition. The law ensures that renewable energy sources be used first and establishes a predetermined payment for each kilowatt-hour generated. Several lawmakers took the initiative to pass this law and advocated for its enforcement in the face of opposition from important economic ministries (Hirschl, 2008:59‑196). This implies that these forces are responsible for societal change and environmental innovation. Renewable energy-based energy systems effectively incorporate their advantages into changes in national policy (Sander, 2016: 123‑133). However, it should not be forgotten that social forces in Fukushima opposed to a quick and disjointed energy transformation have attacked the EEG, claiming that renewable energy is too expensive and jeopardizes German industry's competitiveness (Gawel et al., 2013). It can be seen from this that the active consent of the German society has promoted the development of energy transition, and it can also be seen that Germany's attitude towards the development of nuclear energy.

RIE polling on climate attitudes in Spain

The Royal Institute of Elcano (RIE) provided the data used to analyze Spanish citizens' perceptions toward climate change and the switch to renewable energy sources. Between April 8 and April 26, 2019, they performed a telephone survey. A representative sample of 1,000 locals was used. Based on local data, the survey uses stratified sampling. To choose respondents proportionate to the demographic distribution of each class, age and gender quotas are utilized. 3.2% is the sample error with a 95.5% confidence level. Ideological and economical questions were included in the questionnaire's final section. Respondents were asked to rate their level of ideology on a scale of 0 to 10, with 0 being the far left and 10 representing the far right. Researchers from the Royal Institute of Elcano and academics from the University College of Cardenal Cisneros distributed the pilot questionnaire while Random Strategy, a market research firm, conducted the field research. Elcano's survey, which was based on rational action theory (Fishbein and Ajzen 975), asked people about their knowledge of climate change, their worries about the threat it would pose to the world, the nature of their ecological worldview (Dunlap et al. 2000), and their opinions on whether sufficient steps are being taken to address it at the national and international levels. A dichotomous question is also used to gauge support for policies addressing climate change and the energy transition. Additionally, using Likert scales, respondents were questioned about their support for various components, techniques, and procedures that ought to be taken into account while creating a framework climate law

(Averchenkova 2019). The support for totally renewable electricity systems, emission reduction targets, and greenhouse gases are all strongly related to the research subject.

Social sustainability index of IASS Germany
About the German population The dataset was obtained as part of the Social Sustainability Table (www.iass-potsdam.de/en/barometer), an annual survey research of the Institute for Advanced Sustainability (IASS), which analyzes and monitors subjective experiences and attitudes of the energy transition in Germany (Setton 2019; Wolf 2020), was used to collect the data. The poll includes a wide range of inquiries to ascertain public opinions on both broad topics and particular facets of technology and government. Between October 16 and November 6, 2019, the Forsa Institute ran an online or teletext survey in Germany to gather data at the household level. Potential interviewers were chosen at random from the 75,000 respondents in the nationally representative family panel of forsa.omninet. 6,117 individuals in all completed the survey. According to the German Census of 2018, the sample's mean age was 57, which was older than the German average of 44. Additionally, 42% of the sample's population was female, compared to 50.7% in Germany, and the sample's average family size was 2.1, up from 1.9 in Germany. 25% of households have a university degree (17% in Germany), and the average household income is 3,200 to 3,700 EUR per month. 8% of voters back the Left Party, 18% the Green Party, 17% the Social Democrats, 5% the Liberal Democrats, 23% the Christian Democrats, 7% the Alternative for Germany (AfD), and 17% do not support any party. Dichotomous questions are used in the Social Sustainability Table to gauge respondents' overall support for the promotion of renewable energy. On a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly support), participants also expressed their degree of support for the policy objectives as well as for certain renewable energy technologies and power line extensions. It is demonstrated here how German citizens feel about the growth of interregional grids, biomass power plants, and geothermal energy using data from three flexibility choices. In order to determine participants' political ideologies, we asked them to name the German party they most closely identified with, from left to right: Left Party (Die Linke), Green Party (Bündnis 90/Die Grünen), Social Democrats (SPD), Free Democrats (FDP), Conservatives The Christian Democrats (CDU/CSU), and right-wing populist Alternative for Germany (AfD). Overall, Germany had more respondents than Spain did, and both countries employed the dichotomous technique to gather and analyze first-hand data.

## 3. Methodology

This article employs a qualitative research design that involves the review of secondary sources such as company annual reports, academic journals, and government reports. Data analysis is based on thematic analysis, which involves identifying themes and patterns in data. The data analysis focuses on the strategies adopted by Spanish and German energy companies to solve the energy crisis. Government reports focus on the policies, attitudes, and contributions of the two governments. The company's annual report focuses on analyzing the proportion of traditional energy and clean energy in the two countries, as well as the importance and prospects of energy transformation.
I referred to the website of the European Commission, the website of the European Parliament. I also referred to the website of the International Energy Agency, and the

website of the World Nuclear Association. IN academic research, primary data refers to data that is collected directly from original sources, while secondary data refers to data that is collected by someone else and used by the researcher.

Primary data can be obtained through various methods such as surveys, interviews, experiments, observation, or direct measurement. Researchers may also collect primary data through the use of sensors, questionnaires, or focus groups, among other methods. For example, if a researcher is conducting a study on the impact of social media on mental health, they may collect primary data through surveys or interviews with individuals who use social media.

Secondary data, on the other hand, can be obtained through a variety of sources, including government reports, academic journals, online databases, or previously published studies. Secondary data can also be obtained through sources such as online archives, public records, or commercial data providers. For example, a researcher may use secondary data from a previous study on the impact of social media on mental health to inform their own research.

When using secondary data, it is important for the researcher to evaluate the quality and reliability of the data source. This may involve assessing factors such as the data collection methods, the sample size, the accuracy of the data, and the relevance of the data to the research question.

In summary, primary data is collected directly by the researcher, while secondary data is collected by someone else and used by the researcher. Primary data can be obtained through surveys, interviews, experiments, or direct measurement, while secondary data can be obtained through sources such as government reports, academic journals, or online databases.

Due to objective reasons, it is impossible to go to Spain and Germany to directly collect first-hand data on the spot. The local population in Spain and Germany cannot be obtained first-hand through various methods such as surveys, interviews, experiments, observations or direct measurements. If there is this opportunity, first-hand information will be added to make the information obtained more sufficient and comprehensive.



**4. Data analysis**

Germany's energy transition is an important part of the EU's internal energy policy, and its main goal is to realize the transition of energy supply, from the use of fossil fuels to renewable energy sources. Within the European Union, Germany's energy transition policy has become the focus of other member states, and many countries have begun to adopt similar policies.

According to the EU's energy policy, member states need to gradually reduce carbon dioxide emissions and increase the use of renewable energy to achieve the goal of net zero emissions by 2050. Germany's energy transition policy is an important part of the plan, as Germany has one of the largest economies in Europe.

Germany has achieved certain results in energy transition, but still faces some challenges. These challenges include high costs, dependence on rail transmission, and more. At the same time, Germany's electricity market faces high prices and complex regulations. However, despite these problems, other EU member states are still learning from Germany's energy transition experience and using it as a reference to advance their own energy transition.

In general, within the EU, the implementation of Germany's energy transition policy

can be seen as a positive initiative. Through the implementation of this policy, Germany not only reduces its dependence on fossil fuels, but also provides other EU member states with A reference for feasibility and reliability.

Spain's energy transition is an example of a European energy transition that plays an important role among EU member states. Currently, the European Union is working towards the goal of carbon neutrality, which means reducing emissions and achieving net zero emissions by 2050. Under this goal, EU member states need to reduce their dependence on fossil fuels and accelerate the development of renewable energy.

Spain has been promoting the development of renewable energy in the past decade. According to the National Energy and Climate Plan, Spain plans to increase the share of renewable energy in total energy use to 42% by 2030. Spain has used a variety of policy measures, such as subsidizing the development of renewable energy, building wind power and solar power plants, and supporting research and development of energy storage technologies, to accelerate its energy transformation process.

Spain's achievements in the field of renewable energy have been recognized by the European Union. The European Union promotes the process of energy transformation in Europe through various policies, such as the implementation of the "European Green Agreement" and the establishment of the European Green Investment Plan. As one of the EU member states, Spain is also actively participating in the EU's energy transition.

In conclusion, Spain has shown good energy transformation performance and positive attitude among EU member states, and its experience and policy measures in promoting renewable energy also provide inspiration for other countries

### 4.1 What challenges do Spanish energy transformation encountered ?

High -dependence: Spain's current energy output is still mainly fossil fuel, especially natural gas and oil. Therefore, the state needs to increase the output of renewable energy to reduce its dependence on imported fossil fuel.

Technical problems: Spain has made significant progress in renewable energy, but it still needs to solve some technical problems, such as energy reserves technology and complementarity with traditional energy.

Economic cost: Due to the high cost of maintaining and constructing renewable energy, Spain needs high investment to promote this transformation. The government and enterprises must evaluate the balance between the economic costs they invested and the income obtained.

Policy framework: The reasonable or not of the policy framework is critical to the success of energy transformation. Spain needs to optimize the policy framework to attract more private capital and foreign investment, in order to continue to develop renewable energy, while maintaining the stability of the domestic competitive environment.

Dividend distribution problem: Energy transformation may create employment opportunities, but it may affect certain economic interest groups. Therefore, the government needs to balance interests to ensure that transformation can include all groups.

Energy storage problem: As the proportion of renewable energy in the German energy structure continues to increase, the instability and volatility of the power system require a large amount of energy storage technology to balance energy supply and demand.

Funding: Energy transformation requires a lot of capital investment, but the current burden on public finance in the German government is already very heavy, and social

affordability still needs to be improved.
Social recognition: Some people have a low degree of acceptance and acceptance of new energy. They need to strengthen publicity and education, improve social identity, and promote the smooth progress of energy transformation.
Local governments participation: Energy transformation requires the participation and support of local governments, so it is necessary to strengthen the coordination and communication between policies and local governments.
International competition: In global energy transformation competition, Germany needs to accelerate technological innovation and practical applications to enhance energy technology competitiveness and international discourse.

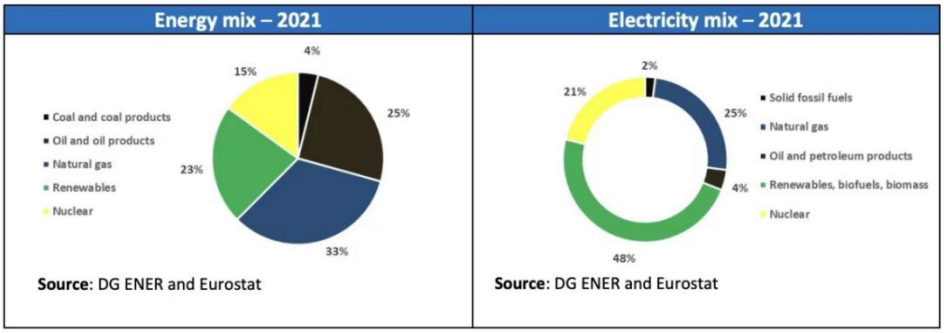
### 4.2WHAT CHALLENGES DO GERMANY ENERGY TRANSFORMATION ENCOUNTERED ?

Energy storage problem: As the proportion of renewable energy in the German energy structure continues to increase, the instability and volatility of the power system require a large amount of energy storage technology to balance energy supply and demand.
Funding: Energy transformation requires a lot of capital investment, but the current burden on public finance in the German government is already very heavy, and social affordability still needs to be improved.
Social recognition: Some people have a low degree of acceptance and acceptance of new energy. They need to strengthen publicity and education, improve social identity, and promote the smooth progress of energy transformation.

### 4.3THE PROPORTION OF TRADITIONAL ENERGY AND CLEAN ENERGY IN SPAIN

It can be seen that in 2021 Spain's energy accounted for 15% of nuclear energy, 23% of renewables,33% of natural gas,25% of oil and oil products,and44%of coal and coal products.Spain’electricty accounted for 22% of nuclear,48% of renewables,biofuels,biomass,4% of oil and petroleum products,25%natural gas and 2% of solid fossil fuels.

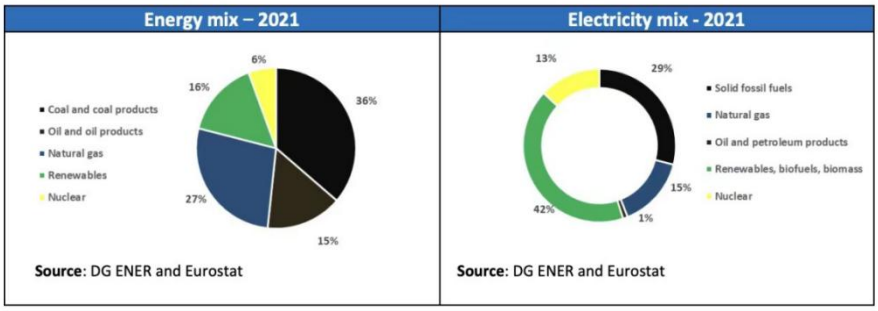
Table 1




### 4.4THE PROPORTION OF TRADITIONAL ENERGY AND CLEAN ENERGY IN GERMAN

It can be seen that in 2021 Germany's energy accounted for 6% of nuclear energy, 16% of renewables,27% of natural gas,15% of oil and oil products,and36%of coal and coal products.Germany’electricty accounted for 13% of nuclear,42% of renewables,biofuels,biomass,1% of oil and petroleum products,15%natural gas and 29% of solid fossil fuels.

Table 2




## 4.5How the German government is promoting the energy transition

Energy transition policy: The German government has formulated energy policies, such as the "Energy Transition 2020" plan and the "Energy Transition 2025" strategy, to guide domestic companies and individuals to transition to renewable energy and reduce their dependence on fossil fuels.

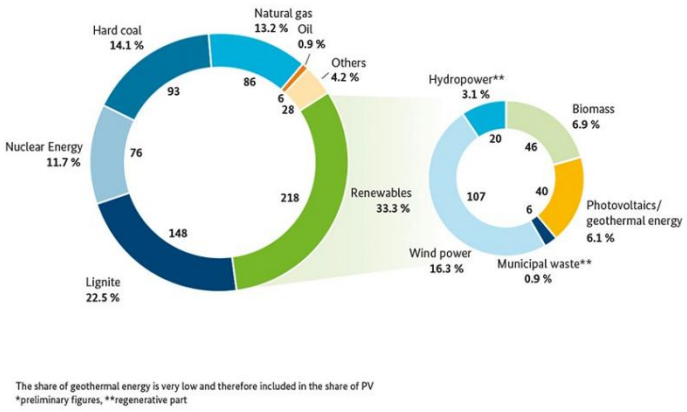
Government subsidies: The German government encourages companies and individuals to use renewable energy power generation equipment through various subsidy measures, such as Feed-in Tariff (FIT) and investment subsidies, to reduce usage costs, improve market competitiveness, and promote the renewable energy market development of.

Development of infrastructure: The German government has laid a solid foundation for energy transformation by developing infrastructure, such as building wind power and solar power generation equipment, and building electric vehicle charging stations.

Tax policy: The German government has adopted tax policies, such as tax cuts for energy-saving products and renewable energy power generation equipment, to increase the enthusiasm of enterprises and individuals and encourage more people to participate in energy transition.

Awareness education: The German government encourages people to actively participate in the energy transition by strengthening public awareness education, and promotes society's awareness and understanding of sustainable development.

Table 3

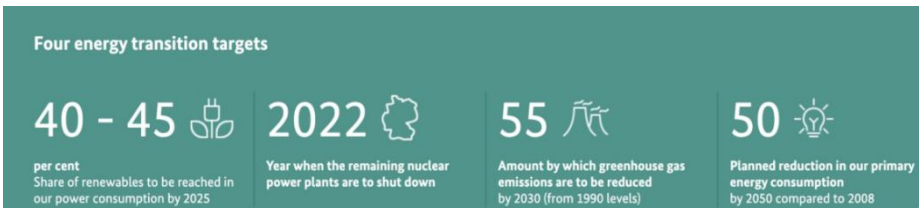



Gross electricity generation in Germany in 2017 in ; TW preliminary figures incl. some estimates; **regenerative part; last updated: February 2018

©Working Group on Energy

Balances

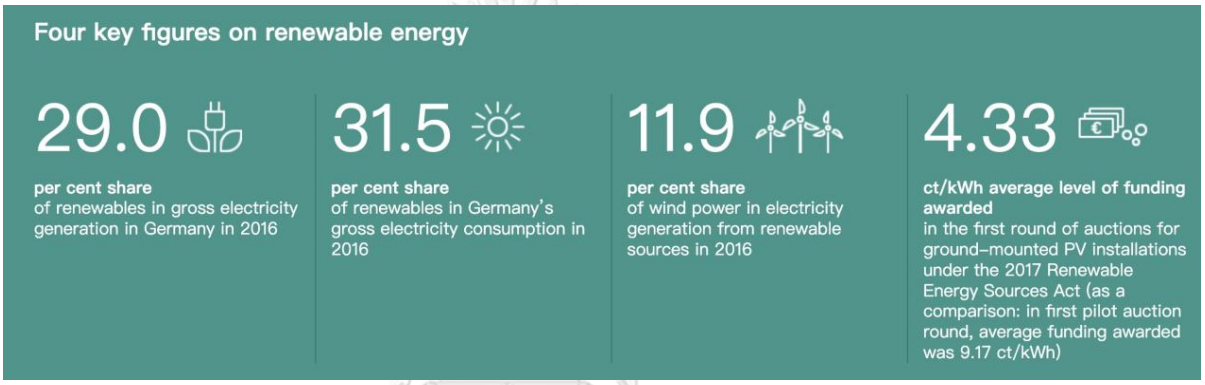
Table 4






It can be see that Germany's energy transition has four goals. The first is to achieve a 40-45% share of renewable energy in electricity consumption by 2025. The second is to shut down all remaining nuclear power plants by 2022. The third is ( Reduce greenhouse gas emissions by 55% by 2030 from 1990 levels). The fourth is to plan to reduce our primary energy consumption by 50% compared with 2008 by 2050.

Table 5






The four key figures for renewable energy in Germany are 29% share of renewables in gross electricity generation in 2016, 31.5% share of renewables gross electricity consumption in 2016,11.9% share of wind power in electricity from renewable sources in 2016 and 4.33ct/kwh average level of funding awarded in the first round of auctions for ground-mounted PV installations under the 2017 Renewable Energy Sources Act (as a comparison: in first pilot auction round, average funding awarded was 9.17ct/kwh)

## 4.6How the Spanish government is promoting the energy transition

The Spanish government promotes the energy transition through a series of policies and measures, some examples are as follows:

Legal framework: The country has a legal framework in place, including the Renewable Energy Law of 2007 and the Energy Reform Law of 2013, which provide a clear policy and legal basis for the development and support of renewable energy.

Energy market reforms: Spain reformed its energy market in 2014, which led to better commercialization, competition and participation by companies.

Technology investment: The government has been investing in technology research and development for the energy transition, especially in solar and wind energy, to improve the efficiency and reduce the cost of renewable energy.

Tax incentives and subsidies: The government offers a range of tax incentives and subsidies for renewable energy, including reduced taxes, subsidies and loans.

Promoting sustainable energy use: The Spanish government is promoting public awareness and use of renewable energy through education and campaigns promoting sustainable energy use.

Overall, the Spanish government's initiatives to promote renewable energy and advance

the energy transition demonstrate its commitment to a more sustainable and environmentally friendly energy future.

Table 6


Oil covered half of total final consumption in 2019. The transport and industry sectors are dominated by fossil fuels, but electricity is significant in the residential and services sectors.

* *Industry* includes non-energy consumption.

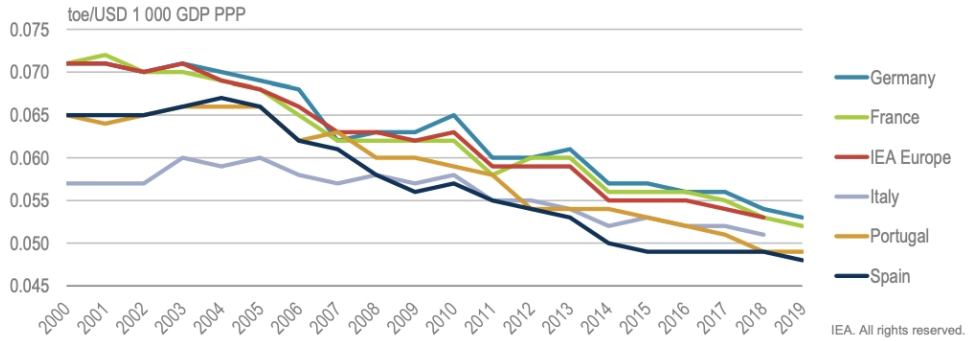
** *Services/others* includes commercial and public services, and agriculture and forestry.

*** *Other renewables* includes geothermal and solar thermal.

Source: IEA (2021), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

This is Spain's total final consumption and it is by source and sector,2019

Table 7




Spain's energy intensity per GDP has decreased in recent years, similar to other European countries.

Notes: toe = tonne of oil equivalent. GDP data are in billion USD 2015 prices and PPP (purchasing power parity).
Data for Italy and IEA Europe are not available for 2019.

Source: IEA (2021), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

The Energy intensity is in select IEA member coutries,2000-19

It can be seen that the energy intensity of some IEA member countries is higher in Germany and lower in Spain.

4.7WHAT ARE SPANISH ENERGY COMPANIES DOING FOR THE ENERGY TRANSITION?

Spanish energy companies have done a lot on the energy transition, including:

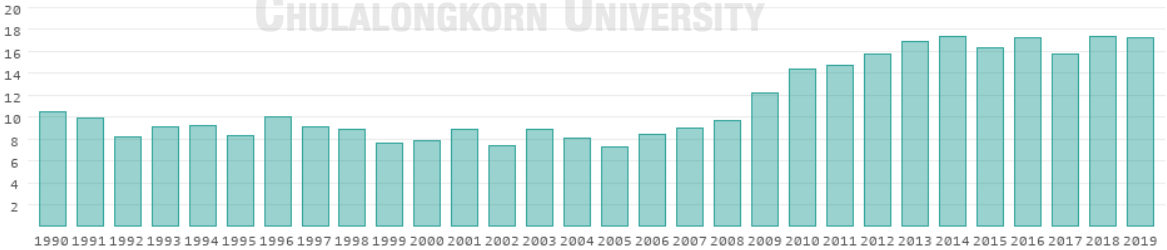
Increased use of renewable energy: Spanish energy companies have significantly

increased their use of renewable energy, especially solar and wind, over the past few years. This helps reduce dependence on fossil fuels.
Reduce carbon emissions: Spanish energy companies have also taken various measures to reduce carbon emissions. These measures include improving fuel efficiency, using clean technologies and implementing carbon capture and storage technologies, among others.
Investing in energy storage technologies: Spanish energy companies are actively investing in the R&D and deployment of various energy storage technologies, including batteries, hydrogen storage and heat storage systems. This helps to address the instability of renewable energy.
Implementation of smart grid: Spanish energy companies are also actively promoting the construction of smart grid, making energy transition easier to achieve.
In conclusion, Spanish energy companies have done a lot in energy transition, and their efforts will contribute to the sustainable development of energy.

### 4.8 What are Germany energy companies doing for the energy transition?

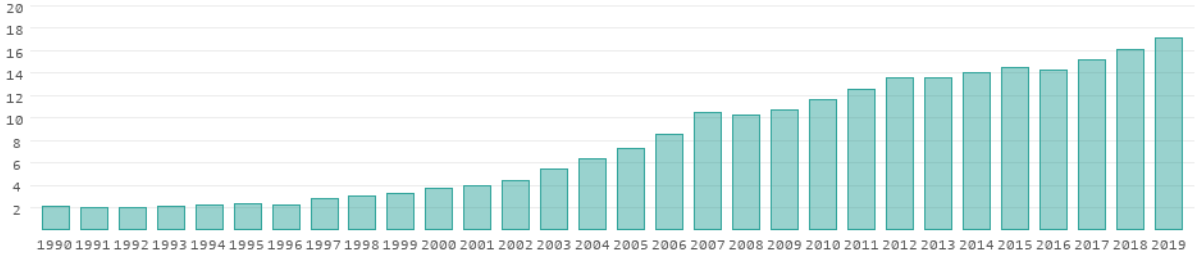
German energy companies have made the following efforts in the energy transition:
(i)Increase the share of renewable energy: Germany has set a target to increase renewable energy, while German energy companies are also working to increase the share of renewable energy in order to reduce the use of fossil fuels.
Promote energy storage technology: Energy storage technology can help balance the supply and demand of renewable energy. German energy companies are promoting various energy storage technologies, such as battery energy storage and water pump energy storage.
(ii)Improved energy efficiency: German energy companies are developing more efficient energy equipment to reduce energy waste.
(iii)Transition to new energy companies: More and more energy companies in Germany are beginning to transition from fossil fuels to renewable energy.
(iv)Promote energy trading: German energy companies are promoting energy trading platforms to facilitate the trading and trading of renewable energy generation, helping more renewable energy projects to get financial support.

Table 8




https://www.worlddata.info/europe/spain/energy-consumption.php

Table 9




https://www.worlddata.info/europe/germany/energy-consumption.php

As can be seen from Figures 8 and 9, the share of renewable energy in Spain and Germany is very close in 2019, almost reaching 18%. But looking at the previous changes, the difference is very obvious. Spain's renewable energy is not bad, fluctuating in a small range. However, Germany's renewable energy has gradually increased from a small amount at the beginning. It can be seen that Germany is focusing on the development of possible renewable energy, and thus it can be seen that Germany's energy transition has improved.

German Renewable Energy

In terms of renewable energy, Germany mainly proposed detailed and quantified policies and measures to achieve the country's contribution goals, and formulated paths and specific measures to achieve transportation goals. According to the EU Directive, Germany has proposed a route for the development of renewable energy, which provides more details on renewable energy. Unfortunately, however, the plan still sometimes lacks descriptions of the impact and details of the different expected measures, especially in the area of heating and cooling. The German power industry has set an ambitious target for renewable energy to account for 65% of electricity consumption by 2030, which would require around 200 GW of installed renewable energy capacity. This will be achieved mainly through large-scale photovoltaics, onshore and offshore wind, and downsizing auctions. However, Germany faces some difficulties in achieving these goals, such as onshore wind project permitting and re-powering issues. In addition, in terms of heating and cooling, Germany has set a renewable energy project of 27%. Nevertheless, the contribution of waste heat has not been determined. Key policy measures in this area include some such as financial incentives, while the use of heat pumps, geothermal and solar thermal is also gaining importance. However, the policy measures proposed in the current plan appear to be on target, and detailed effects of each measure are lacking. In transport, Germany has set a target of 14% for renewable energy, but the national level target is higher at 27%, which includes a reformulated renewable energy directive. However, so far, Germany has room for improvement in meeting its renewable energy targets.

Germany plans to raise first-generation and advanced biofuels to 5.3% and 3.5% respectively by 2030. The primary goals of this strategy in Germany are to reduce greenhouse gas emissions by boosting fuel content, raising the price of carbon dioxide, and introducing infrastructure for fuelling and charging vehicles.To encourage the market adoption of electric, gas, plug-in hybrid, and battery fuel cell vehicles, Germany is also providing financial incentives. The federal government intends to encourage the production of renewable fuels made from non-biological sources and advanced biofuels. Germany's renewable energy targets for the transportation industry are

believed to be achievable with the help of these policies and actions, electrification regulations, and an anticipated 10% decrease in energy demand. With a considerable decrease in power generation and only modest gains in transportation and heating, it is anticipated that biomass energy output will somewhat diminish. Germany claims that future bioenergy use will rely increasingly on waste and residues and does not anticipate having more land available for bioenergy production in Germany. This encourages the growth of alternative energy sources while efficiently controlling the development of bioenergy.

Renewable energy in Spain

For greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (ETS), Spain's final comprehensive National Energy and Climate Plan (NECP) sets a 2030 objective, a decrease of 26% from 2005 levels. This is consistent with the Shared Regulations' objectives. Spain intends to surpass its ESR target by 13 percentage points and enhance land use, land-use change, and forestry as part of the national focus on greenhouse gas emissions (23% reduction relative to 1990). The strategy depends on The distribution of mechanisms and duties for all non-ETS systems is handled by a complete set of measures. The plan places special emphasis on actions to cut by a third in the transportation sector. Spain commits to meeting 42% of the EU's 2030 objective for total final energy consumption from renewable sources and 32% of the required percentage. Spain wants to contribute 24%, 30%, and 34% of its energy needs to renewable sources by 2022, 2025, and 2027, respectively.

As can be seen, Spain likewise attained 34% and put a lot of effort into achieving the EU's objectives. According to the plan, while the target contribution to the 2030 EU renewable energy target is 32%, the national contribution is 42% of the total final energy consumption. However, a goal level of 35% is set in Spain's draft law on climate change and energy transition. To achieve a target of 42% by 2030 for indicator statistics, the plan includes reference points for 2022 (24%), 2025 (30%), and 2027 (34%) as well. Some of the industry shares for 2030 that were listed in the plan cleanup have been revised. The proposal adjusts the 2030 contributions of the other two sectors but maintains the share of renewables in the power sector at 74%. At 31% instead of 34% in the draft plan, renewable energy now makes up slightly less of the heating and cooling system. The plan anticipates that renewable energy will make up 28% of transportation energy, up from the 22% mentioned in the draft plan. In addition, the plan raises the percentage of advanced biofuels and biogas to 3.7% in 2030, in line with the REDII's minimum 3.7% requirement. 5%. However, while the final plan includes absolute values for renewable energy in transport (apart from renewable electricity), it does not include absolute values for each applicable renewable energy or provide information on how to calculate relative values for transport targets. Responses calculate the contribution of high indirect resource use change risk biofuels made from food and feed crops, liquid biofuels, and biomass fuels by taking into account the absolute value of renewable energy in transport. The plan for renewable energy is ambitious and in-depth.

Between 2021 and 2030, 59 GW of capacity is anticipated to be added to the power industry, mostly through the conduct of auctions (3,000 MW annually) and initiatives to increase the grid's use of renewable energy. The strategy also outlines a framework for encouraging self-consumption and suggests actions to encourage the growth of communities using renewable energy sources. The finalized plan includes initiatives to

encourage the use of renewable heating and cooling systems, such as updates to building technical requirements, usage of origin warranties, and use support programs. The final plan calls for promoting the use of electricity and biofuels in the transportation sector, which implies that fuel suppliers will be subject to both general responsibilities and particular obligations for the provision of advanced biofuels. The phase-out of biofuels, biofluids, and biomass fuels made from food and feed crops, which carry a high indirect risk of causing a change in the way land is used, is not taken into account in the plan. Spain has not notified the European Commission of its national long-term strategy as of 1 September 2020, in accordance with Article 15 of the Governance Regulation. It is clear that Spain will eventually need to submit a report to the European Commission outlining its long-term energy plan.

Fiscal and political steps to ease Spain's transition

The promotion of the energy transition through fiscal measures, such as tax allocations and government expenditure, as well as the employment of market-based mechanisms, is a frequent strategy in European policy. This might be a little different from other economies. Taxation as a means of compensating for environmental externalities is a common justification in public finance. It prioritize some topics that stakeholders identified as potential investment areas rather than viewing these problems as a magic bullet for the energy transition. These policy agendas may place an emphasis on energy efficiency investments or supportive policies for marginalized people, which are frequently disregarded in more comprehensive transformational talks.

Stakeholders evaluated green taxes, primarily a carbon tax on sectors not yet included in the EU Emissions Trading System (EU ETS), followed by a carbon tax on sectors within the ETS, and taxes on nitrogen oxides, when it came to fiscal measures for the energy transition (Q12). electricity, SOx, diesel, and pre-tax fuel. Given that energy prices in Spain are among the highest in Europe and that the average rate increased by 76% between 2007 and 2013, taxing the electrical grid itself seems to be the least popular choice. Policies shouldn't be created in isolation because it must be acknowledged that various instruments, including ETSs and the deployment of renewable energy sources, may interact positively or negatively with one another. As a result, creating policies for Spain's energy transition is extremely challenging and cannot be done in a vacuum. Instead, policies will determine the course of the transformation.In addition to defending the environment as a public good and holding polluters accountable, green tax measures may also present the chance to reap a double benefit by raising revenue and so reducing current tax inequalities. The first dividend is the improvement of the environment; the second dividend is the reduction of the total excess burden on the tax system. Stakeholders indicated a preference for either compensating households at risk of energy poverty or using the proceeds from environmental taxes to finance energy efficiency and renewable energy. The economic implications of the energy transition are more the focus of this change.

The transformation of entire socio-economic systems, including the building, transportation, and industrial sectors, is essentially what the energy transition entails. The medium-term policy measures are also captured during our listening phase. Stakeholders typically believe that technological advancement (such as the development of smart grids and the electrification of vehicles) and policy implementation (such as banning conventional vehicles and enforcing regulations) are more likely and more powerful. Although the majority of policies have a high

influence, policy changes and technical alternatives are more likely to be successful. However, these factors do not always imply significant changes in how socioeconomic systems operate. This topic may also be related to the mechanisms' inability to meet these objectives, given the recent worsening of the emissions target gap.

The influence of political parties in Spain on the energy transition is important, as the country's government decisions and concrete actions in terms of energy policy are crucial. Here's how different political parties might have an impact:

Socialist Party: The Socialist Party pays close attention to environmental issues such as climate change and sustainable development in terms of energy transition, supports the use of clean energy, and promotes the development of renewable energy. Over the past few years, socialist-led governments have moved to create infrastructure and markets to increase the production and consumption of renewable energy. The Socialist Party also promised to make the proportion of renewable energy reach 100% by 2030. It can be seen that the Socialist Party attaches great importance to renewable energy, which is of great significance for the realization of energy transition.

Bharatiya Janata Party: The Bharatiya Janata Party supports fossil fuel producers and advocates for the dominance of cartels and other forces in energy markets. But in recent years, the Bharatiya Janata Party has also undergone changes in terms of energy transition, and has begun to support the development of clean and renewable energy, while also advocating reducing excessive dependence on imported energy. It can be seen that the BJP is also concerned about its dependence on imported energy.

## 5. Finding

According to data research, Spain's leading energy firms have taken a variety of steps to address the energy problem. To diversify its energy mix, Iberdrola, for instance, has boosted its investments in renewable energy. Edessa is dedicated to cutting CO2 emissions and increasing energy efficiency. To lessen its environmental impact, Repsol has also made investments in renewable energy and created innovative technologies.

The analysis also demonstrates that structural inefficiencies in the energy sector are a major contributor to Spain's current energy crisis. Energy industry overcapacity drives up costs and reduces earnings for businesses. Furthermore, Spain is susceptible to changes in the price of energy on a worldwide scale due to its reliance on fossil fuels. When the economy declines, it also leads to a reduction in energy demand, which further aggravates the crisis and leads to a vicious circle.

5.1 Impact on Spain's energy transition process

The idea of the energy transition is deeply political and value-based. The goals of those in authority and the systems of politics are the foundation for transition tactics and objectives, which in turn influence and include a variety of individuals. The politics in which energy transitions and policies operate at the national or regional level cannot and should not be separated from one another. It is crucial to understand how political stages are temporal and how they affect energy and climate policy in different ways. The solar tax experiment is only one illustration of how a lack of vision and ambitious policies may impede change. Comparatively to other transition programs like the German energy transition up until recently, the Spanish transition discussion and its focus should benefit from a more collaborative and active deliberation-based discourse arena. It is clear that the energy transition also necessitates adjustments or modifications involving social citizens.

Plans for 2030 and 2050 have been heavily influenced by Spain's new Ministry of Energy and Ecological Transition. This is demonstrated by Spain's participation in the EU27 environment as well as the increased ambition in the stakeholder engagement process..Spain's national plan received the top rating out of 27 member states in a recent assessment by the European Climate Foundation for its suitability of national objectives, thoroughness and quality of policy explanations, and inclusivity and engagement. The European Commission, however, also urged "more effort, greater ambition, more detail in the policy, more specific investment needs, or more social equity work." To achieve 1.5° C, the NDC targets would need to be increased by more than five times and tripled globally. These results can reinforce policy objectives, support ambitious aims, and keep participants at the forefront of change. But Spain needs to act to achieve its objectives.

It is frequently helpful to explore criteria of fairness and representativeness from a variety of viewpoints, and it is essential to create the framework for future energy and climate policy design by developing socially resilient methodologies and integrated support. Even when interests diverge, learning and action can still be guided by the inclusiveness and reflective change principles. Different viewpoints and arguments are also clarified in this manner as opposed to being ignored. or to ignore sometimes-overlooked voices by marginalizing them. Understanding the varied effects and difficulties that a low-carbon energy transition may bring requires more than one point of view or one area of competence. Any economy, not only those in the EU, can use this.

Different viewpoints on the stability of stakeholder positions might be seen. There are instances when people are apprehensive of ambition because there is a lesson to be learnt from the past due to regulatory changes or procedural injustices. These are the disruptive forces preventing the widespread adoption of renewable energy. Large energy suppliers and investors, for example, have deliberately tightened their control over new laws and regulations, preferring Spain to follow other nations' lead rather than take the initiative alone. Sometimes, these incentives enable underlying vested interests to play out and maintain the status quo in order to prevent society as a whole from impeding the pursuit of goals.

Achieving bottom-up qualitative and structural change (from grassroots initiatives and social movements) is further igniting ambition among participants who have historically been driven by NGOs and small-scale energy providers. The social agenda has changed as a result of the growth of renewable energy cooperatives, allowing important issues of justice to interact directly with both micropolitics and macropolitics. The expansion of cooperatives for renewable energy provide a chance for joint education on social justice and sustainable development. These programs not only improve the efficiency of teamwork but also boost visibility and communication for effective group action. Citizens will alter their perspectives and thereby propel the energy transition when their interests are closely aligned with their own, and if active support and consent heighten those interests.

### 5.2 Implications for the German Energy Transition Process

Germany's energy transformation direction and efforts are focused on four primary areas: phase-out of nuclear power, expansion of renewable energy, improved energy efficiency, and reduction of greenhouse gas emissions..Prior policy frameworks that drew some modest investments from diverse actors at the local and regional levels have

been a major influence on the implementation of renewable energy. The involvement of local authorities in the installation of renewable energy in their regions has grown to be one of the most notable aspects of the German energy transition process in the wake of the emergence of these new actors in the energy sector, citizen energy cooperative investments. According to ownership type analysis, local and regional initiatives accounted for more than one-third (36.4%) of installed renewable energy capacity, where citizens have the majority of the power to make decisions, as opposed to energy utilities, which only make up 12% of installed energy capacity (Trend: Research GmbH and Euphane Universitat Luèneburg, 2013). Numerous local governments, including counties and cities, are ardent supporters of the energy transition and the expansion of renewable energy sources. For instance, the idea of 100% RES villages is quickly gaining ground, demonstrating how well-liked decentralized renewable energy production is with local authorities (Beermann, 2009). It is obvious that it is fairly well-liked. The 100% RES community has been working hard to put numerous strategies into place with the aim of supplying the grid with the same amount of locally produced renewable energy that the area uses each year. While this is happening, the market dissemination of renewable energy generation technologies has advanced to a point where it is necessary for jurisdictions at all levels to coordinate their policies (see Ohlhorst, Tews, and Schreurs, 2013). The political importance of EU policies for Germany's energy transition has only recently attracted more political attention. Clear indications of action at the EU level from leaders support this. Diverse voices have been pointing out the drawbacks of viewing coordination requirements from a national perspective in the German discussion for a while. The argument revealed two opposing schools of thinking. One camp contends that the EU's efforts to accomplish an economically efficient transition of energy supply inside the bloc's energy market are threatened by Germany's tenacious commitment to transform its energy system. According to Bo'ckers, Haucap, and Heimeshoff (2013), Germany must modify its programs and accompanying tools to the EU energy market. Another group is concerned that Germany is being pressured by EU politics to gradually scale back its plans to modernize its energy system. This stance is supported by the belief that given the data provided, Germany's energy transition strategy may serve as an example for other nations to imitate. As a result, according to Geden and Fischer (2014), "Europeanization of German energy transition politics" is required.

### 5.3 GERMANY ENERGY POLICY

Prevent global climate change

Reducing national GHG emissions can help prevent climate change. For example, IPCC AR4 suggests that in order to meet the global 2 ° C target by 2050, industrialized nations must reduce their GHG emissions by between 80 and 95 percent.

Become a pioneer in the fight against global warming by reducing greenhouse gas emissions quickly and setting an example for other nations.

RES cost reduction via learning effects: Supporting RES development in Germany results in a learning effect that lowers the cost of technology globally. This frequently coexists with climate-leading runs.

Beyond climate change, safeguard the regional and global environment.

Atomic phase-out: phasing out nuclear power facilities early and abandoning the usage of nuclear electricity to reduce associated risks.

Preventing harmful emissions from fossil fuel power plants and environmental impact from fossil fuel mining activities is one way to protect the local and national environment (such as clean air).
Protection of finite resources: protecting all limited natural resources.
Added "energy triangle" objectives
Maintain the present level of supply security: Maintain supply security at the existing, by outages-driven levels.
Low electricity prices for end users in the short- to medium-term: To prevent short- to medium-term increases in power prices or to keep electricity prices at levels that are still affordable is how the term "competitiveness" is often understood.
Economic dimension of fossil fuel import independence: reduces reliance on fossil fuels, whose supply volumes and prices are unstable (particularly oil and natural gas), increasing supply security.
Goals pertaining to other policy areas
In the RES Sector, Job Creation and Regional Value Addition: The deployment of RES generates regional income and jobs, making it strongly tied to structural economic policy.
Building domestic businesses that can become global market leaders in the field of renewable energy is a strategy for industrial leadership.
other objectives pertaining to political ideals
Political aspect of fossil fuel import independence: Political disputes (extortion, violent confrontations, etc.) associated to their extraction, trade, and usage can be avoided or at least lessened by reducing reliance on imported fossil fuels.
Weakening the market oligopoly typically associated with the four major German utilities (RWE, E.On, EnBW, and Vattenfall). Weakening the economic and political influence of the market oligopoly.
Decentralized energy systems (such as private rooftop solar PV and wind cooperatives): Entire societies should take part in the production of essential commodities and services (even locally autonomously), rather than relying on a small number of strong multinational enterprises.
Unifying the German people behind a project that has received international acclaim is creating an identity. An energy transition that fosters social cohesiveness and a sense of shared purpose should be one that people can identify with.
Spain has made the biggest strides in the domain of energy.
Spain dominated the expansion of the European photovoltaic industry in 2019, with installed capacity of onshore wind power exceeding that of other EU nations. As of right now, Spain is the first nation in the world to have both wind and solar power installed. Over 100,000 GWh of renewable energy have been produced, which is more than enough to satisfy all domestic energy needs in the nation. The large decline in emissions from the energy sector in 2019 is also explained by the historical fall in coal consumption that has coincided with the rapid expansion of renewable energy. Early in 2019, the number of coal-fired power plants was dropping; this rate of deconstruction has only been observed in a small number of nations worldwide, and it happened in an orderly manner with little social impact.
For Spain, the energy transformation must provide a significant challenge. To transform fleets, decrease overall energy use, alter our consumption patterns, create technological solutions, and reduce territorial and environmental repercussions, among other things,

it is important to raise the money needed.The effects of solar and wind power facilities as well as the creation of conversion plans to lessen the effects of decarbonization in certain Spanish locations. All of this is taking place against a backdrop of decreased hydropower water use and an increase in extreme event frequency, which will have an impact on the energy system and therefore the energy transition. However, the prospects brought about by the energy transition are vast: Spain has a great deal of potential for solar and wind energy, as well as top firms in the renewable energy industry, multiple ambitious policies, and medium- and long-term decarbonization roadmaps. This shift will result in considerable increases in employment and economic activity, as well as significant reductions in Spain's annual cost of importing fossil fuels. It will also modernize the manufacturing system. According to estimations by the Spanish Ministry of Ecological Transition and Demographic Challenges, with the implementation of the National Energy and Climate Integrated Plan (PNIEC) 2021-2030 and the Long-Term Decarbonization Strategy (ELP) up to 2050, compared to the 2050 trend. According to the scenario, the GDP level will rise by around 2%, and the average annual net employment will rise by roughly 250,000. Another significant benefit anticipated by the government is a decrease in reliance on external energy sources. Over the next three decades, Spain could reduce imports by more than 340 billion euros by substituting fossil fuels, which is the equivalent of seven years' worth of public education spending. In fact, compared to the total imports in 2019, the full electrification of Spain's current fleet could result in a savings of about €18 billion by 2050.

Spain needs to undergo an energy transition in the future to achieve carbon neutrality and resource conservation. having intentional and accountable patterns of production and consumption. As a crucial step toward the energy transition, Spain must incorporate the ideas of planetary constraints and integrated welfare indicators into the design, execution, and assessment of all public programs. Adapting to new risks and altering its relationship with nature will help Spain become more resilient to climate change and protect biodiversity. This will also help it minimize the harm done by environmental degradation and fully utilize the opportunities presented by ecological transition. Spain must adhere to the international agreements and rules demanded by the European Union in order to execute these changes. Spain already has a vast network of public and commercial organizations, initiatives, and strategies that show the way forward and give the necessary resources to do this. Additionally, in order to strengthen the objectives already established, individuals will need to come to agreements through social discussion in the upcoming years and update draft lists of precise objectives so that progress can be tracked and future reforms may be directed.

### 5.4An overview of Spain's revise of renewable energy policies

Spain has some of the highest installed wind and solar power capacities in the world. Spain is a pioneer in the promotion of renewable energy on a global scale. Spain's electrical sector law (Act No. 54 of 1997) included a specific regime for the promotion of renewable energy in 1997, which enabled the use of renewable energy. The number of photovoltaic installations has remained low since the mid-1990s, despite the growth of wind energy installations (del Ro and Mir-Artigues, 2014). In Spain, the quickening of the deployment of renewable energy plants was started by Royal Decree No. 661 of 2007. First, it prioritizes grid connection; second, it offers more favourable conditions for installed capacity surpassing 100 kW; and third, it reviews the feed-in tariff subsidy

rate every four years. Domestic solar PV installations increased as a result of this legislation, going from 103 MW in 2006 to 544 MW in 2007 and 2,708 MW in 2008. Although solar PV only accounted for around 10% of renewable energy generation, the cost of solar feed-in tariffs grew to over 50% of the total cost of support for renewable energy after rapid development (see del Ro and Mir-Artigues, 2014).

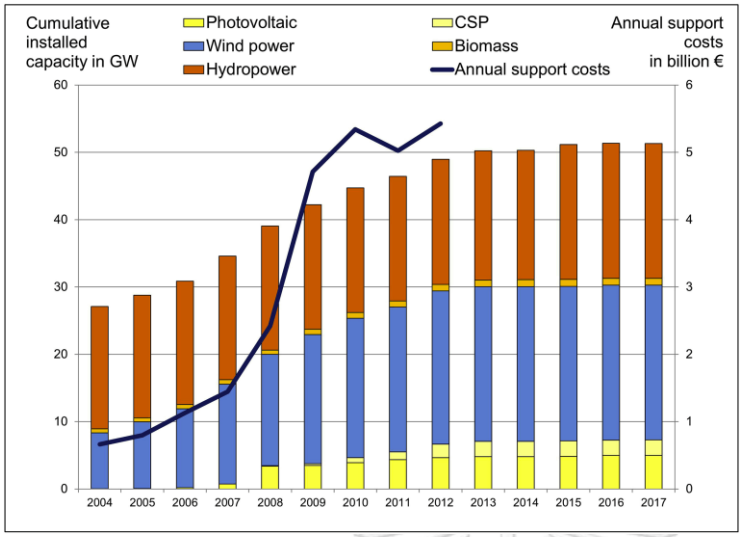
The Spanish government halted significant changes to its program to assist renewable energy, particularly for the solar photovoltaic industry, at the end of September 2008. The most significant of these modifications (Royal Decree 1578, 2008) include a 400 MW annual cap on support for new PV installations, a drop in the amount of electricity rates for future PV installations, and a maximum length of PV subsidies. The advancement of solar energy has been substantially impacted by these shifts. A cap on the yearly power generation hours of facilities was imposed, and the feed-in tariff for solar photovoltaic power generation was further cut in 2010 (Royal Decree No. 14 of 2010).

Financial incentives for all RES-E energy sources were terminated in January 2012 under the new conservative People's Party-led administration (del Ro and Mir-Artigas, 2014; see also European Photovoltaic Industry Association (EPIA), 2013; Royal Decree Act No. 1 of 2012). (Law 15 of 2012) In December 2012, a 7% special power tax was imposed on all generators, both conventional and renewable. The Spanish pay structure underwent a major overhaul in the middle of 2013 (Royal Decree No. 9 of 2013). Renewable energy projects receive unique compensation based on installed capacity, which ensures a supposedly fair return on installation, rather than being paid a feed-in tariff for the energy produced (Bird and Bird, 2014). The resulting uncertainty and reduced profitability have led to stagnant renewable energy expansion (Red Electrics de Espinas, 2015). After four years of stagnation, Spain relaunched its renewable electricity auction in 2017 (Clean Technical, 2017), still looking to continue the energy transition.

The role of policy design

Spain's decision to halt fiscal incentives for renewable energy has two key justifications: first, there are design defects; second, there is a lack of flexibility. The feed-in tariff's structure has caused renewable energy to spread quickly and mostly unchecked. Feed-in tariffs in Spain lack controls to limit the number of new installations and the expenses that emerge from them. Poor monitoring as a result of "significant time lags in reporting investments by local governments" is a further issue (del Ro & Mir-Artigas, 2014). The Spanish solar PV market has experienced brief but severe boom-and-bust cycles as a result of its poorly constructed technology-specific termination mechanisms. The government can announce the end of the associated feed-in tariff subsidy when the specific technical target reaches 85%, but only after setting a transition period of at least 12 months. This objective was met for solar photovoltaics in September 2007. However, the news of the FiT's phase-out resulted in an abrupt and exponential rise in investment from developers eager to take advantage of the opportunities still available. Spain has the greatest annual installed capacity of solar PV as a result in 2008. This shows that demand, particularly for solar PV, is much higher than feed-in tariff rates (ES08; also see del Ro and Mir-Artigas, 2014). The plan also lacks a mechanism for lowering feed-in rates in accordance with technology prices. The solar boom in 2008 therefore placed a very heavy cost burden on the Spanish electricity system. Because the initial reforms hit solar PV much harder than the wind industry,

solar PV was the main driver of accelerated cost growth (Haas, 2017).
Table 10




Total installed renewable energy capacity in Spain and its related support costs who will ultimately be responsible for paying for the subsidies is also not totally apparent. Like many other nations with FiT systems, Spain's FiTs are typically refinanced through surcharges on consumer power bills (Haas, 2017, p. 53). The fact that the ultimate electricity price is regulated as a safeguard for customers makes the Spanish instance unique. As a result, taxpayers have not seen their prices increase as a result of the FIT for solar PV and other renewable energy technology. As a result, they produce what are known as "tariff deficits" (TD)6 (del Rio and Mir-Artigas, 2014: 8f.). The discrepancy between consumers' fixed power pricing and the increased real costs disclosed by energy firms is what leads to TD. Five vertically integrated utilities in Spain initially carried the burden of this tariff gap (European Commission, 2014). TD grew since 2000 (European Commission, 2014; based on CNE data) and reached €28.5 billion by the end of 2013 (European Commission, 2015), or little under 3% of Spain's GDP. The contribution of renewable energy subsidies to TD has been a hot topic of political discussion among opponents of renewable energy expansion, especially affected utilities (ES02, ES06).

## 5.5Spain and Germany have different performances and attitudes towards nuclear energy.

Nuclear energy production in Spain and Germany

Spain is one of the few countries in Europe that uses nuclear energy. The combined generation of nuclear power plants exceeds that of natural gas, the second largest source of energy. Spain has seven nuclear power plants, which provide 20% of the country's total electricity supply. Based on energy security and reducing dependence on natural gas, the Spanish government has announced that it will maintain the existing nuclear power plants and continue to study the construction of new nuclear power plants.

Germany does not have abundant nuclear energy resources, and the construction of critical reactors has attracted public attention and opposition. Since the 1970s, Germany has built 17 nuclear power plants, which account for 14% of total electricity production. However, after the Fukushima nuclear disaster in 2011, Germany realized the risks and costs of nuclear energy, and planned to gradually withdraw the original nuclear power

plants from operation. Germany has decided to completely abandon the nuclear energy industry by 2022.

Based on the consideration of national economy and environmental protection

Spain is often affected by unstable energy supply and high dependence on external energy inputs. Therefore, the country's government feels compelled to continue using the most reliable and stable sources of energy to keep the domestic market stable. Nuclear power is one of the most reliable sources of energy in Spain, providing stability to the energy supply.

For Germany, environmental protection and the prevention of nuclear catastrophe are the primary considerations. The German government laid out a plan in 2000 to reduce the use of fossil fuels to a minimum level and increase the share of renewable energy by 2020. Since the Fukushima nuclear disaster in 2011, Germany has strengthened its environmental protection and nuclear disaster prevention measures, and plans to completely abandon the use of any nuclear energy industry before 2038.

Future trends

Although Spain promises to continue to develop the nuclear energy industry on the original basis, with the increasing awareness of global environmental protection and the continuous innovation of renewable energy technologies, Spain may be more cautious in decommissioning the nuclear energy industry in the next few years.

For Germany, the future will see an accelerated shift to the development of renewable energy, smart grids, energy storage and other technologies. The German government has promised to invest more and support innovation and implementation in the field of renewable energy at the domestic and international levels.

Spanish and German attitudes towards nuclear energy have evolved in different ways over the years.

In Germany, there has been a growing opposition to nuclear energy since the Chernobyl disaster in 1986. In response to public concerns, the German government announced plans to phase out nuclear power plants by 2022. This decision was made in part due to safety concerns and the risk of accidents, as well as the public's preference for renewable energy sources.



In contrast, Spain has continued to support nuclear energy as part of its energy mix. As of 2021, Spain has seven nuclear power plants in operation, generating around 20% of the country's electricity. The Spanish government has also expressed support for the use of nuclear energy as a means of reducing greenhouse gas emissions and meeting energy demand.

However, there have also been concerns about the safety of nuclear power plants in Spain. In 2011, there was a public outcry over the safety of the Garoña nuclear power plant, which had been operating for over 40 years. The plant was ultimately shut down in 2013 due to safety concerns and public pressure.

In both countries, there has been increasing support for renewable energy sources as a means of reducing greenhouse gas emissions and addressing climate change. While attitudes towards nuclear energy differ between Spain and Germany, both countries are investing in renewable energy sources such as wind and solar power as part of their transition to a more sustainable energy mix.

5.6 The impact of Russia and the Russia-Ukrainian War on Spain’s energy transition is more complicated, mainly in the following aspects:

Russia oil and gas exports have a major impact on Spain's energy supply. Spain still

needs to import large quantities of oil and gas from Russia, which limits Spain's ability to diversify its energy sources and reduce its dependence on fossil fuels.
The Russia-Ukraine war led to unstable natural gas supply, and Spain was affected to a certain extent. In 2014 and 2015, a gas dispute between Ukraine and Russia led to gas supply disruptions, so Spain was also affected to some extent. Spain had to import natural gas through other means, which increased the cost of its energy.
The Russia-Ukrainian War has accelerated Spain's energy transition. Spain's energy transition goals are to reduce dependence on fossil fuels, increase the proportion of renewable energy, and increase energy self-sufficiency. The Russia-Ukraine War strengthened Spain's will and motivation to achieve these goals, and promoted Spain to accelerate its energy transition.
Generally speaking, the Russia-Ukraine war has a certain impact on Spain's energy transition, but it is not decisive. Spain still needs to work on multiple fronts to achieve energy sustainability and self-sufficiency.
Germany's energy transition plan aims to gradually reduce dependence on fossil fuels and increase the utilization of renewable resources in order to achieve a more environmentally friendly and sustainable energy supply. However, the Russia-Ukraine war had a great impact on Germany's energy transition, especially on Germany's energy supply and cost.
Russia is one of Germany's major natural gas suppliers, and the Russia-Ukrainian War has led to instability in natural gas supply, forcing Germany to seek other sources of energy. Germany has aggressively developed its electricity market, shifting its focus to renewable energy sources such as offshore wind and solar to reduce its dependence on Russia and other countries. But at the same time, this transition also leads to higher energy costs, which may affect the economic efficiency of Germany.
In addition, the war between Russia and Ukraine also poses a threat to Germany's energy security. Germany's energy supply is no longer secure, as any emergency may affect the energy supply. Therefore, Germany must consider how to improve the security of its local energy supply, such as developing more underground natural gas storage facilities and building more liquefied natural gas plants.
All in all, the Russia-Ukraine war had a profound impact on Germany's energy transition, especially on Germany's energy supply and costs. It also reminded Germany to attach importance to local energy security in order to respond to changes in the international situation.

## 6. Conclusion

The European Union has decided to lead the energy transition, aiming to be the first in China and the mainland to achieve climate change goals by 2050, which will significantly change European societies and economies. The EU has set important climate and energy targets to tackle greenhouse gas emissions. The latest major initiative is the European Green New Deal, launched by the Commission President to decarbonize Europe's energy, economy and society. As well as supporting these goals financially, the EU is actively promoting "climate hubs", working with other regions to make efforts to tackle climate change more widespread and successful. Otherwise, without action by other countries, Europe's climate efforts will have significantly less global impact and could even lead to rising energy costs and wreaking havoc on the European economy.

Europe's energy transition will also affect its relations with external countries, especially with those currently major energy suppliers, such as Russia. Russia is Europe's largest supplier of coal, oil and natural gas. European climate policies and targets will affect the demand for these resources and reduce dependence on fossil fuels, especially coal. While natural gas is often seen as a “transition fuel”, current discussions also address the long-term future of natural gas and the need to decarbonise natural gas to meet Europe’s goal of reducing greenhouse gas emissions by 2050. Given the current economic structure, a potential reduction in imports of European fossil fuels could be economically damaging, especially to Europe's dependent gas market and almost the entire pipeline system with the entire European gas industry. Mainly, opportunities for structural economic transformation, from a resource economy to a manufacturing economy, can also be mentioned. In addition, Russia could also advocate for Europe to support its decarbonization efforts by becoming an exporter of fossil fuels, such as conducting research on the possibility of exporting carbon dioxide through its pipelines. A hydrogen economy in Europe could help decarbonize, and the cheapest way to produce hydrogen is not through renewable energy as is usually envisioned in Europe. Russia should find suitable long-term solutions in order to continue to be an important and decarbonized energy supplier to Europe. However, several factors could prevent Russian gas exports to Europe in the short to medium term.

The energy transition relationship between the EU and other economies is also important. The European Union is one of the world's largest economies, and its energy policy and transition are central to global energy markets and environmental impacts. At the same time, the EU also needs to cooperate with other economies to jointly promote sustainable energy transformation and address challenges such as climate change and energy security.

The impact of the EU on the energy transition of other economies is mainly manifested in the following aspects:

The first is to promote the development of renewable energy: the EU has been committed to promoting the use of renewable energy, such as wind energy, solar energy, water energy and so on. The EU has made important advances in renewable energy technologies, becoming an innovation center in the field of renewable energy and energy efficiency. At the same time, the EU also shares renewable energy technology and experience with other economies through multilateral mechanisms and partnerships, helping them promote the development of renewable energy and reduce the use of fossil energy.

The second is to improve energy efficiency: the EU has also introduced a series of policies related to energy efficiency, such as requiring buildings to be more energy-efficient, promoting more efficient transportation methods, and building smarter power grids. These policies not only help the EU achieve energy self-sufficiency, but also provide lessons for other economies. Improving energy efficiency can help facilitate the transition.

The third is to promote clean energy investment: the EU's clean energy investment policy has become a global model, which drives clean energy investment and innovation through investment and stimulates economic activities. This model has been widely followed and imitated by other countries and regions. Not only EU

member states, but also cooperation with other economies such as investment can be carried out.

Cooperation between the EU and other economies can also promote the balance and stability of the international energy market, improve the security of global energy supply, and reduce the risks of all parties. At the same time, this kind of cooperation can also provide useful experiences and mechanisms for economic development and solutions to global issues such as climate change mitigation.

In this article, the strategies and measures taken by Spain and Germany in energy transition are worth learning and drawing lessons from. Of course, when implementing a strategy, be prepared for some challenges. In any case, we should continue to promote the sustainable energy transition to achieve global emission reduction and sustainable economic development.

Summary of Spain's energy transition:

Policy support: The Spanish government actively promotes the development of the renewable energy industry, formulates a series of industry policies and regulations, and provides policy support and encouragement for renewable energy.

Increase renewable energy capacity: Spain is actively expanding renewable energy capacity, and has become one of the largest wind and solar power markets in Europe through the vigorous development of renewable energy such as wind and solar.

Improve energy efficiency: Spain has strengthened the management of energy efficiency, promoted the reduction of energy consumption, adopted more energy-saving technologies and measures, and improved the efficiency of the entire energy system.

Reducing carbon emissions: Spain has greatly reduced carbon emissions by reducing the use of fossil fuels and vigorously developing renewable energy. Spain has become a model for reducing carbon emissions.

Promote the development of new energy technologies: Spain actively promotes the R&D and application of new energy technologies, continuously innovates and uses new technologies, and accelerates the process of energy transformation.

Accelerate the deployment of renewable energy, with a focus on decentralized installations and self-consumption, including further simplification of permitting procedures and improved grid access. Support complementary investments in storage, network infrastructure, electrification of buildings and transport, and renewable hydrogen. Expand energy interconnection capabilities. Increase the availability of energy efficient social and affordable housing, including through renovation.

In general, Spain has successfully promoted the development of energy transition through various measures such as vigorously developing renewable energy and improving energy efficiency. This provides experience and reference for other countries around the world.

Summary of Germany's energy transition:

Germany's energy transition began in 2011 and aims to achieve a transition from fossil fuels to renewable energy in order to reduce greenhouse gas emissions, protect the environment and combat climate change.

Notable results: Germany has achieved notable results in the energy transition. In 2019, renewable energy accounted for 42.1% of the country's electricity consumption, exceeding the proportion from fossil fuels.

There are many challenges: There are many challenges to realize the energy transition, such as the lack of appropriate energy storage technology, the expansion of the power grid, etc. In addition, transformation also requires huge investment and policy support. Germany can reduce its overall reliance on fossil fuels and diversify its imports by improving energy efficiency, encouraging energy conservation, diversifying energy supply and routes, reducing investment bottlenecks, further simplifying the permitting process, increasing investment and accelerating the deployment of electricity networks and reliability. Renewable energy, and further promote participation in energy-related cross-border cooperation.

Policy-driven: Policy is critical to the realization of the energy transition. The German government has formulated a series of policies to promote energy transition, such as setting targets for the proportion of renewable energy and providing financial support.

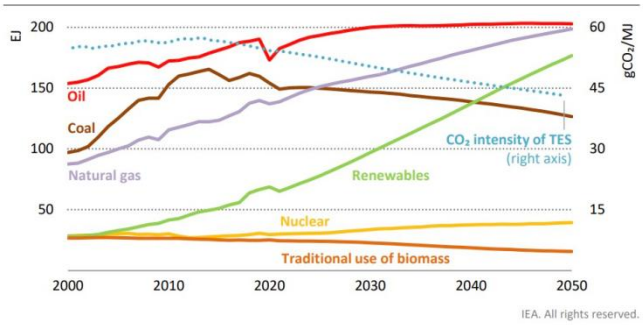
Social participation: Energy transition requires broad social participation and support. Governments, businesses and the public need to work together to promote the development of sustainable energy.

The energy transition is not only important for individual countries like Spain and Germany, but also for the EU and the world as a whole. The EU's commitment to achieving carbon neutrality and reducing greenhouse gas emissions can serve as an example for other countries and regions to follow. If the world as a whole is able to transition to renewable energy sources and achieve carbon neutrality, it will be possible to mitigate the impacts of climate change and ensure a sustainable future for generations to come.

global cooperation

Table 11

Total energy supply and CO2 emissions intensity in the STEPS




*Coal use declines, oil plateaus and renewables and natural gas grow substantially to 2050*

Note: EJ = exajoule; MJ = megajoule; TES = total energy supply.

Between now and 2050, coal remains the dominant source of electricity generation in emerging market and developing economies, despite strong growth in renewables; in advanced economies, coal power declines sharply.

The path to net zero emissions by 2050 will require unprecedented international cooperation among governments. This means not only all countries working together to achieve net zero, but all countries cooperating in an effective and mutually beneficial manner. Achieving net zero emissions will be extremely challenging for all countries, but low-income countries will face the greatest challenges.

The most serious, and the most intractable, in many of these countries, technical and financial support will be critical to ensure the early deployment of key emissions-reducing technologies and infrastructure. The goal of reducing emissions to net zero by 2050 will not be achieved without international cooperation.

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