INTERNATIONAL BACCALAUREATE

EXTENDED ESSAY

ECONOMICS

SUSTAINABLE DEVELOPMENT IN CASTILLA-LA MANCHA, SPAIN

Research Question: To what extent has the European Green Deal impacted sustainable development in Castilla-La Mancha, Spain for the years 2020-2023 through the production of Wind energy?

Word count: 3995

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1. INTRODUCTION

An economy that relies on exponential growth is bound to collapse when reaching the boundaries of the finite system we live in. In economics, we learn that the free rider problem of exploiting common pool resources can have detrimental effects owing to their non-excludable and rivalrous nature. Non-renewable energy is one such resource at risk of depletion due to its scarcity and finite supply and often extremely harmful to the environment. 80% of the energy supply is obtained by burning fossil fuels,[1] which remains the leading cause of global warming. The consequences of our greed, introduce the 21st century to urgent real-world problems followed by a climate catastrophe such as rapid global warming, health-related issues as well as rising sea levels.

In economics we also discuss the role of government intervention in addressing market failures related to environmental problems; effective government intervention can simultaneously promote environmental and economic objectives and aid in sustainable development. While climate change poses significant threats to both Europe and the global community, addressing these challenges necessitates a comprehensive response, which is embodied in the European Green Deal (EDG) strategies.

[1]"Key Findings | United Nations." n.d. the United Nations. Accessed August 25, 2024. https://www.un.org/en/climatechange/science/key-findings#physical-science.

Renewable energy is not only environmentally friendly but also economically viable in the long term; however, the transition to clean energy requires significant investments and changes in government objectives. The inability of the free market to regulate the supply of nonrenewable energy invites discussions about policy instruments, incentives and economic strategies to correct market failure, achieve allocative and productive efficiency, promote economic growth, reduce unemployment, and maintain low and stable inflation. Governments should not trade the environmental harms for economic gains as the environmental impacts are irreversible. Therefore, the core focus of the research paper is to investigate the approaches and impacts of supranational organizations like the European Green Deal on wind energy and economic growth in Castilla-La Mancha, a region of Spain in sustainable development.

1.1 BACKGROUND INFORMATION

1.1.1 What is the European Green Deal (EGD)?

The EGD is the European Union's (EU) aim to achieve climate neutrality in Europe by 2050. Through renewable energy integration, they aim to ensure that economic growth is achieved without a corresponding increase in the use of resources. The initial action taken by the EGD was the establishment of a legal framework that solidified the objective of achieving climate neutrality.

Correspondingly, the European Climate Law was adopted on 4 March, 2020.[2] The emissions target in place today currently stands at 40%. However, the plan is to elevate this target to a range of 50-55%.[3] As for renewable energy, the target is presently set at 32%.[4]

The EGD seeks decarbonization not only in the electricity sector but also in transportation, heating and industries. To achieve this, a new strategy referred to as "sector integration" was developed,[5] with a strong emphasis on the 2030 National Energy and Climate Plans (NECP) to drive the energy transition and ensure that it is equitable. The EU's initiatives of the Next Generation EU (NGEU) project to address the recovery of the COVID-19 consequences are integrated to fit into the strategy of the EGD. It includes an augmentation of the Just Transition Fund which supports transitioning to clean energy in regions that are highly dependent on fossil fuels.[6]

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[2]"EU Green Deal." n.d. ECEEE. Accessed August 25, 2024. https://www.eceee.org/policy-areas/test/
[3]Mulholland, Eric. 2020. "THE EUROPEAN GREEN DEAL." European Sustainable Development Network. https://www.esdn.eu/fileadmin/ESDN_Reports/ESDN_Report_2_2020.pdf.
[4]"Renewable energy targets - European Commission." n.d. Energy - European Commission. Accessed August 25, 2024. https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en.
[5]"EU strategy on energy system integration." n.d. Energy - European Commission. Accessed August 25, 2024. https://energy.ec.europa.eu/topics/energy-systems-integration/eu-strategy-energy-system-integration_en.
[6]Timmermans, Frans. n.d. "The Just Transition Mechanism - European Commission." European Commission. Accessed August 25, 2024. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en.

1.1.2 Funding Climate Objectives of the EGD[7]

In total the European Commission has proposed to invest approximately a trillion Euros in sustainable investments under the EGD plans.

1.2 RESEARCH QUESTION

Following the trend in the background information, the research question below aims to investigate the correspondence of wind energy supplies to the EGD plans in the region of Spain.

To what extent has the European Green Deal impacted sustainable development in Castilla-La Mancha, Spain for the years 2020-2023 through the production of Wind energy?

[7]"Finance and the Green Deal - European Commission." n.d. European Commission. Accessed August 25, 2024. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal_en.

1.3 METHODOLOGY

To answer the research question, I primarily focused on secondary research.

1. Information for the research was compressed from browsing the internet and reliable sources. Reliable resources consisted of the European Commission, Spanish annual reports, Statista, IEA, Windenergy.org, and World Bank.
2. After each information was extracted, proper citations were given to the credible websites.
3. Emails to the European Commission and Wind energy companies were sent to inquire about resources that could enhance the research paper.
4. Compiled information that was confirmed through different source checks. Primary data was not recorded as individuals were unavailable.
5. Analyzed data through the author's economic background.

The data discussed and analyzed will be assessed mainly according to the inputs from the secondary sources.

2. BODY

2.1 DATA COLLECTION

The data aims to portray the influences of policy and aims to stimulate sustainable development in Castilla-La Mancha, Spain.

2.1.1 Spain concerning the EGD[8]

Spain maximized the utility of the newly available tools to advance their transition towards sustainable energy systems. National Recovery Plans (NECP) played a pivotal role in attracting EU financial support, emphasizing that these plans exhibited a high level of ambition, offering tangible proposals and projects that can be readily scaled up.

In April 2019, the Spanish government submitted its 2030 NECP, signaling a heightened commitment to reducing greenhouse gas emissions by 23% compared to the level of emission in 1990. The plan outlined targets for renewable energy to constitute 42% of their energy mix and generate 74% of their electricity through the production of clean energies like solar and wind energy supplies by 2030. To reach their objectives, it necessitates installations of 2.2 GW of new wind energy capacity each year.

[8]"How Spain can make the most of the EU Green Deal and Recovery Plan." 2020. WindEurope. https://windeurope.org/newsroom/news/how-spain-can-make-the-most-of-the-eu-green-deal-and-recovery-plan/.

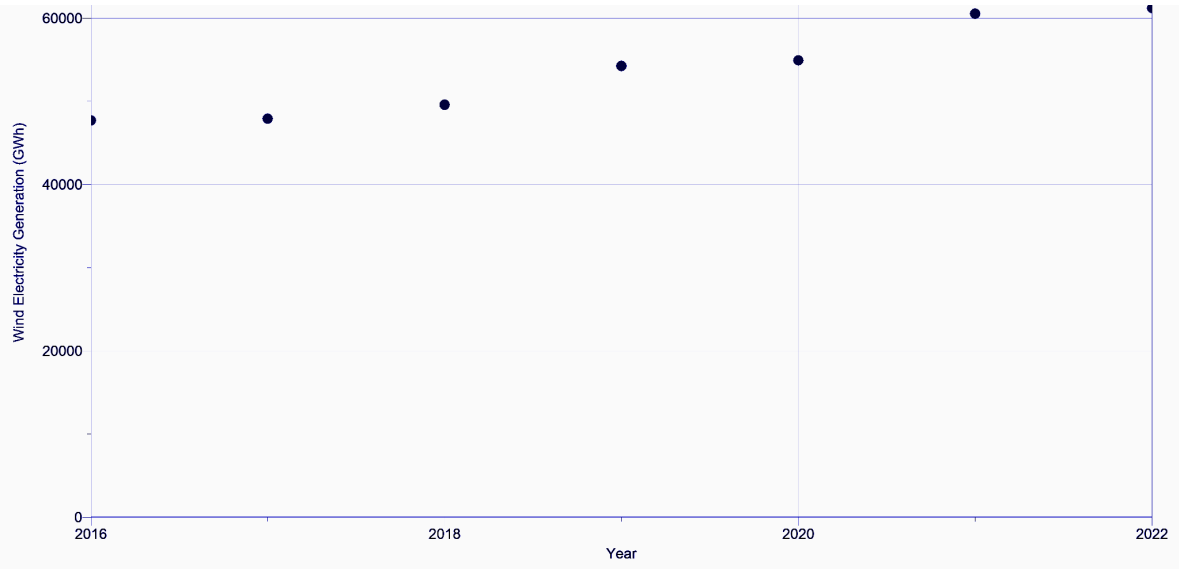

Figure 1. Wind energy supply in Spain[9]

Figure 1 shows an increase in the supply of wind electricity after the year 2020 linking a correlation with the requirements of the EGD in Spain.

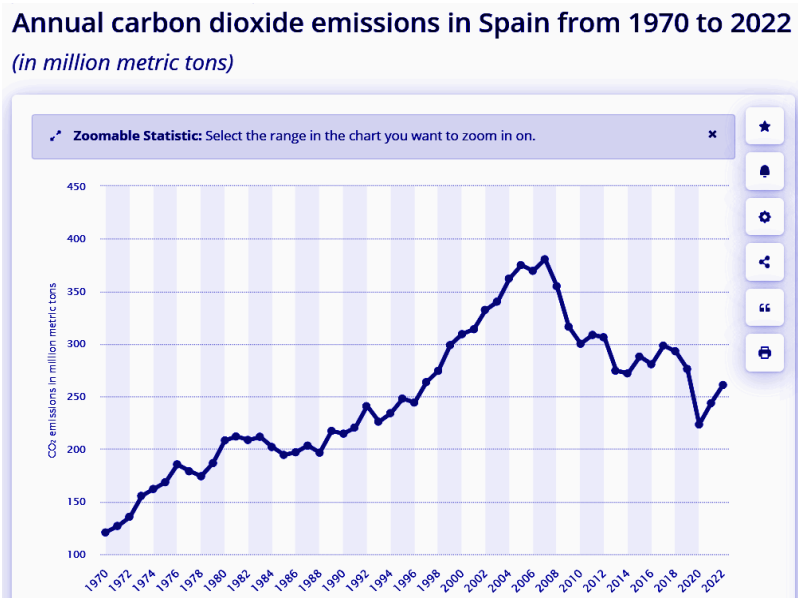

Figure 2. CO2 emissions Spain[10]

[9]"The Spanish electricity system | System reports." n.d. Informes del sistema. Accessed August 25, 2024. https://www.sistemaelectrico-ree.es/en/spanish-electricity-system.
[10]Salas, Erick B. 2023. "Spain: carbon dioxide emissions 1970-2022." Statista. https://www.statista.com/statistics/449821/co2-emissions-spain/.

Figure 2 shows a downward trend of CO2 emission rate from 2020 compared to the levels of 1990 which proves the success of the European Green Deal in reaching their targets. The drop of CO2 levels in the year 2019-2020 is possibly due to the pandemic.

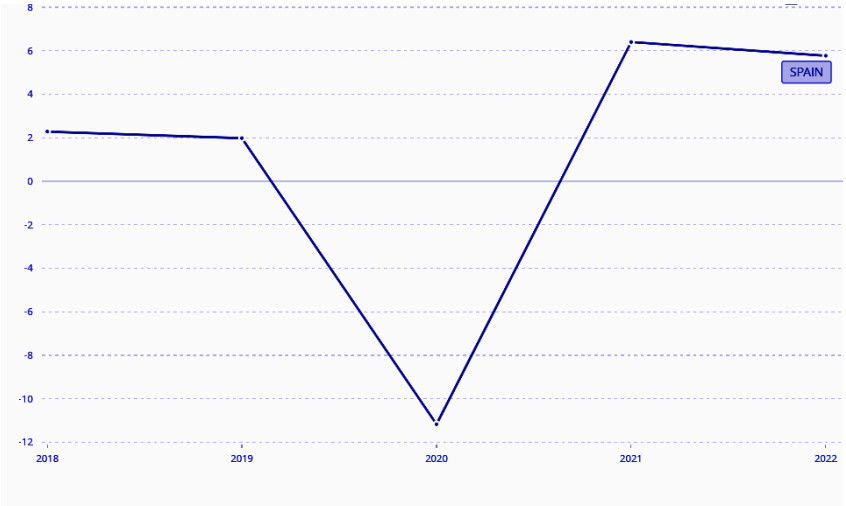

Figure 3. GDP growth rate Spain[11]

The GDP in the year 2019-2020 drastically decreased due to the pandemic however, following the PNIECP objectives, Spain has been able to grow their GDP according to the clean energy targets and investments in the following year.

2.1.2 Wind energy in Castile-La Mancha, Spain[12]

Out of all the energy generated in Castilla-La Mancha today, a substantial 79% is sourced from renewable means and wind power accounts for 38.1% of this total currently accounting for 4,706 megawatts.

[11]The World Bank. 2017. ‘‘GDP growth (annual %) - Spain’’. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2022&locations=ES&start=2018&view=chart.

[12]“WIND FARMS IN CASTILLA-LA MANCHA: TRADITION, INNOVATION AND DEVELOPMENT.” n.d. Industrial de Castilla-La Mancha. Accessed August 26, 2024. https://www.industrialclm.com/en/news/tradition-innovation-and-development/.

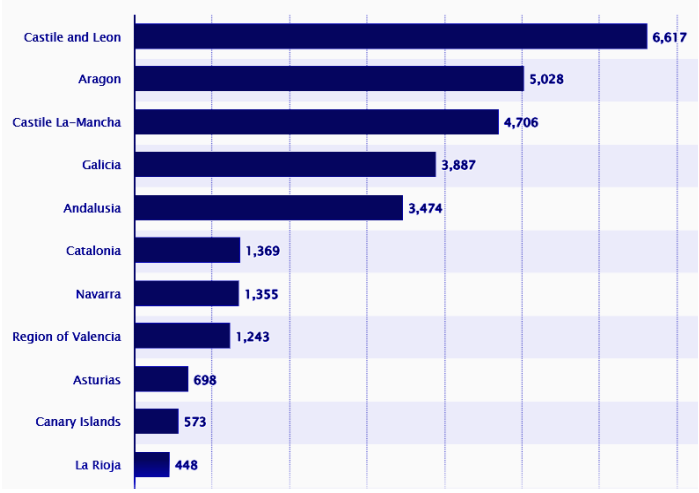

Figure 4. Wind energy capacity supply in Autonomous communities[13]

The figure above represents the wind power capacity of autonomous communities in megawatts. There are presently 1,300 wind farms in Spain and Castilla-La Mancha is home to 139 of them. The country also hosts over 250 companies engaged in the manufacturing, installation, and maintenance of wind energy systems with some of the largest entities situated in the La Mancha region. This integrated approach serves to reduce production costs each time a new wind farm is established and the region is witnessing a steady influx of such enterprises.

[13]Fernández, Lucía. 2024. "Installed power capacity by technology Spain." Statista. https://www.statista.com/statistics/1002759/installed-power-capacity-in-spain/.

2.1.3 Trend of Wind Energy Production and Policies in Castilla-La Mancha, Spain

The following data tracks the development of wind energy in Castilla-La Mancha after the 2019 intervention of the European Green Deal.

- **Wind energy production and policies in 2020**

The Minister of Sustainable Development, José Luis Escudero, pointed out that in the year 2020, there was a notable growth in the installed capacity of "clean" energy sources, amounting to an increase of 600 MW reaching 6,964 MW. This expansion brought about investments of nearly 700 million euros and contributed to the creation of approximately 3,000 job opportunities in Castilla-La Mancha.[14]

The plan for Castilla-La Mancha, ‘‘A Strategic Plan for Energy Development in Castilla-La Mancha, Horizon 2030,’’ employs possibilities to harness the potentials of wind energy which included the following measures:[15]

1. Establishing the groundwork for decarbonization in Castilla-La Mancha by adopting a sustainable energy model that emphasizes energy efficiency, leading to a 32% reduction in energy consumption and emissions.

[14] “Castilla-La Mancha, the third autonomous region in Spain with the highest installed renewable power capacity.” 2022. Red Eléctrica. https://www.ree.es/en/press-office/news/press-release/2022/02/castilla-la-mancha-third-autonomous-region-in-spain-with-highest-installed-renewable-power-capacity.

[15]“Castilla-La Mancha ends 2020 with 75 percent of its electrical energy from solar and wind power | REVE News of the wind sector in Spain and in the world.” 2021. evwind.es. https://www.evwind.es/2021/02/15/castilla-la-mancha-ends-2020-with-75-percent-of-its-electrical-energy-from-solar-and-wind-power/79349.

2. Enhancing and modernizing existing energy installations. This included upgrading transmission and distribution networks for installation materials.
3. Streamlining bureaucratic procedures, reducing up to 70% of the requirements for submitting renewable energy projects.
4. Combinating the processing and approval of preliminary and construction permits for power plant construction. Cases with existing favorable environmental impact assessments were expedited.
5. Implementation of prioritized criteria, based on energy type and the location's sensitivity zone. Castilla-La Mancha stands out favorably in this context as one of the regions benefiting the most.

- **Wind energy production and policies in 2021**[16]

In 2021, the La Mancha region wrapped up the year with a 14.22% share of the total installed energy capacity and a 13.05% contribution to the overall energy production, accumulating an impressive nearly 4,000 megawatts (MW). Additionally, the Spanish government approved the first Offshore Wind Roadmap in 2021, aiming to have up to 3 GW of offshore wind capacity operating by 2030.

[16] IBID., 13.

- **Wind energy production and policies in 2022**[17]

Castilla-La Mancha has solidified its position as one of Spain's top regions for wind power with 15.70% of its installed capacity and 12.12% of its generation capacity attributed to wind energy. Wind energy emerged as the primary source of electricity generation, boasting a capacity of 4,705 MW.

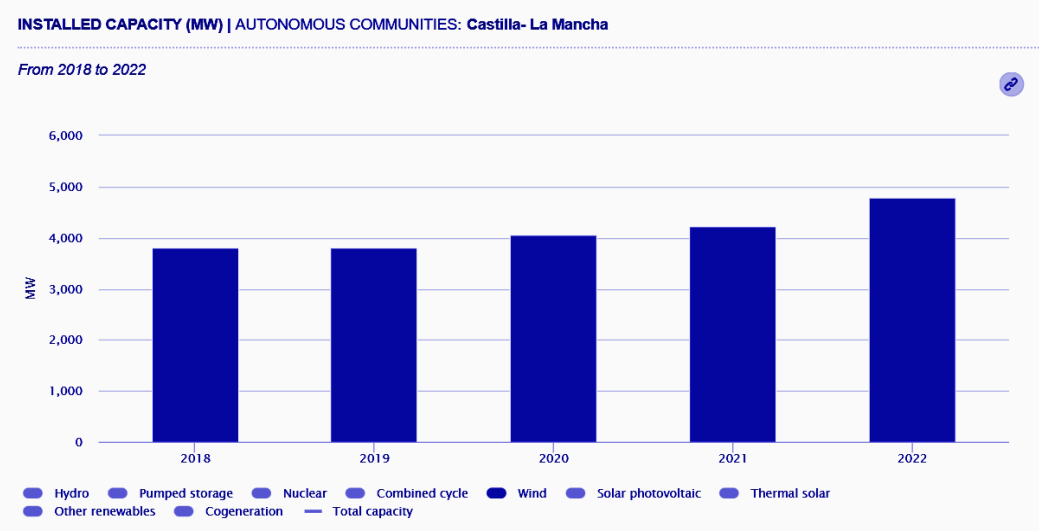

Figure 5. Installed Capacity for Wind Energy, Castilla- La Mancha[18]

The figure above represents the increase in the installed capacity for wind energy in Casrilla-La Mancha after the implementation of the EDG.

[17]"Renewable Energy Sector." n.d. Invest In CLM. Accessed August 26, 2024. https://www.investinclm.com/en/renewable-energy-sector/.
[18]"| Red Eléctrica." n.d. | Red Eléctrica. Accessed August 26, 2024. https://www.ree.es/en/datos/generation/installed-capacity.

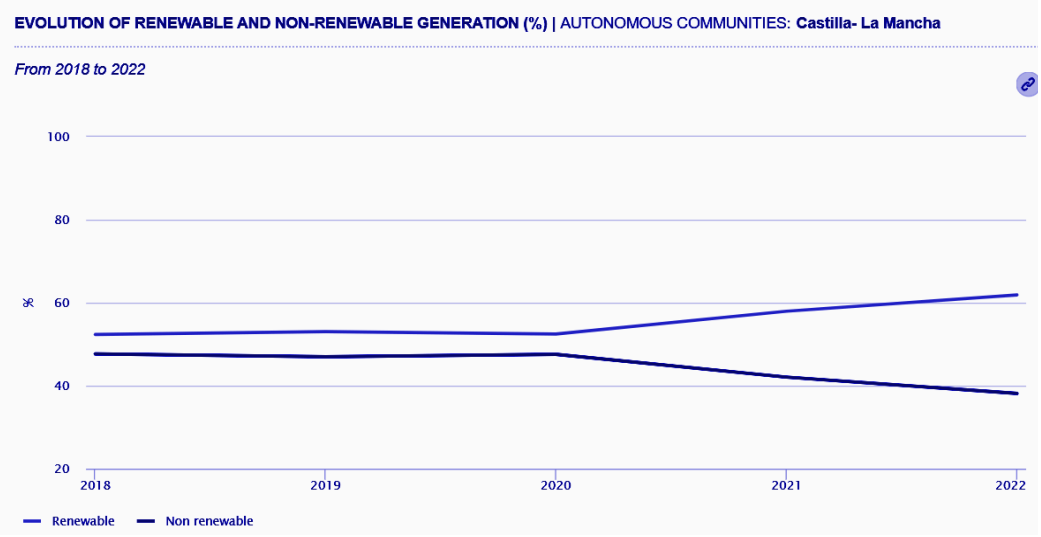

Figure 6. The trend of renewable and non-renewable energy[19]

Figure 6 is the representation of the evolution of renewable and non-renewable energy sources in Castilla-La Mancha, showcasing a decrease in the generation of non-renewable energy and an increase in the generation of renewable energy.

[19]"Installed capacity (Wind) | System reports." n.d. Informes del sistema. Accessed January 26, 2024. https://www.sistemaelectrico-ree.es/en/renewable-energies-report/wind/installed-capacity-wind.

2.2 DATA ANALYSIS AND EVALUATION

2.2.1 Correcting Negative Production and Consumption Externalities of Non-Renewable Energy Using Taxes (Microeconomics)

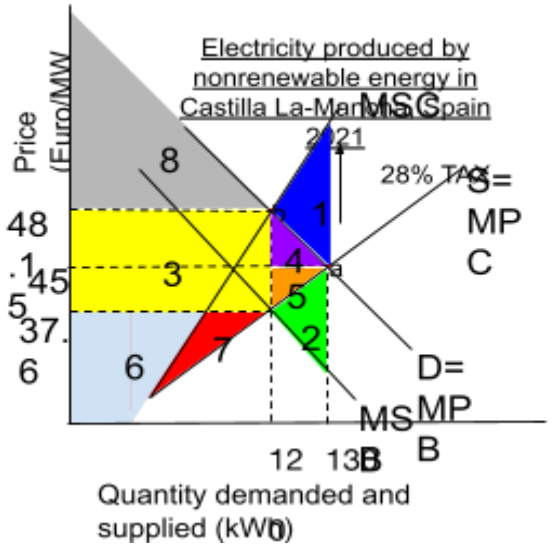

Figure 7. Addressing negative externalities through taxation

This is the market for non-renewable electricity in Castilla-La Mancha, Spain. The demand curve is equal to the Marginal Private Benefit (MPB) and not equal to the Marginal Social Benefit (MSB) for nonrenewable energy. The MPB curve represents the consumer's price of consuming one more unit of non-renewable energy and the MSB represents the cost to society of consuming one more unit of non-renewable energy.[20] The vertical difference between MSB and MPB represents the external costs to third parties caused by unsustainable consumption of non-renewable resources known as negative consumption externality potentially caused by unattended use of electricity.

[20]Tragakes, Ellie. 2020. *Economics for the IB Diploma Coursebook with Digital Access (2 Years)*. N.p.: Cambridge University Press.

Similarly, the supply curve is equal to the Marginal Private Cost (MPC) and not equal to the Marginal Social Cost (MSC) for nonrenewable energy. The Marginal Private Cost (MPC) curve represents the firm's private costs of producing one more unit of non-renewable energy and the Marginal Social Cost (MSC) represents the cost to society of producing one more unit of non-renewable energy.[21] The vertical difference between MSC and MPC represents the external costs to third parties caused by unsustainable production of non-renewable resources known as negative production externality such as the production of fuel through the burning of fossil fuels and emitting high levels of CO2.

The market initially operates at the intersection of MPC and MPB where the prices correspond to 45 Euro/GWh and quantity demanded and supplied at 130KWh[22] accounting for Spain's population[23] in Castilla La Mancha[24] and overall quantity of non-renewable energy accounting for 60.5%[25] of energy use. At equilibrium point a, there is overproduction and overconsumption of non-renewable energy. Triangle 1 and 2 represents welfare loss due to the misallocation of resources.

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[21]Tragakes, Ellie. 2020. *Economics for the IB Diploma Coursebook with Digital Access (2 Years)*. N.p.: Cambridge University Press.
[22]2017. YouTube: Home. https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Europe/Spain_Europe_RE_SP.pdf.
[23]"Spain - Place Explorer." n.d. Data Commons. Accessed January 26 https://datacommons.org/place/country/ESP?utm_medium=explore&mprop=count&popt=Person&hl=en.
[24]2017. YouTube: Home. https://datacommons.org/place/nuts/ES42?utm_medium=explore&mprop=count&popt=Person&hl=en.
[25]Fernández, Lucía. 2024. "Spain: share of renewable and non-renewable power." Statista. https://www.statista.com/statistics/1007913/share-of-renewable-and-non-renewable-energy-generation-in-spain/.

Electricity was chosen to represent the externality good as it is a common manufactured good and it is easier to quantify. The demand and supply for electricity are inelastic as both production and consumption are not responsive to the change in price. The demand for electricity is a basic necessity for homes to function and the supply of electricity takes time to adjust to prices as it requires changes in infrastructure and technology. Hence, the shift in the supply or demand curve will not have a huge impact on the change in quantity.

Spain increased the value-added tax on the consumption of electricity by 21%[26] according to the Royal Decree-Law in 2021 and tax on electricity production (IVPEE) by 7%[27] compete on par with the EU countries. This causes the MPC curve to shift upwards to MSC reaching socially desirable output. The shape of the supply shift is not parallel as the ad valorem tax impacts the prices at different levels. The taxes also correspondingly disincentive the demand for the consumption of nonrenewable energy at the quantity aligning with MSB.

At that point, nonrenewable energy sells for 48.15 Euro/GWh and quantity can be calculated through the price elasticity of demand.

[26]"How much is VAT on electricity in Spain?" 2022. Endesa. https://www.endesa.com/en/blogs/endesa-s-blog/light/VAT-electricity-spain.
[27]IBID., 21,

$$PED = \left(\frac{Final\ QD - initial\ QD}{initial\ QD} * 100\right) / \left(\frac{Final\ P - initial\ P}{initial\ P} * 100\right) \quad (1)$$

Assuming that the general price elasticity of demand for electricity is -0.5 [28], we can conclude that the final quantity corresponds to:

$$Final\ QD = \frac{845}{7} = 120$$

At equilibrium point b, externality is closed and the society gains the external benefit that was previously lost due to overproduction and overconsumption that caused environmental and health threats by reducing CO2 emissions more than 46000 tons per year.

Stakeholders losing from the policy are consumers and producers who get less quantity of non-renewable energy for a higher price. This can be graphically represented in the loss of surplus in areas 3, 4, 5 and 7. Stakeholders gaining from this policy are the third parties who get better air quality represented with the negative externalities areas 1, 2 and 7 and the government earns revenue from area 3.

An advantage to this policy is that producers are discouraged from producing because of the higher cost of producing this demerit good. However, a disadvantage would be that due to the high profit of selling non-renewable energy, the amount of tax is not enough to change their level of production.

[28] "," 2023. , - YouTube. https://www.sciencedirect.com/science/article/abs/pii/S0301421519306664.

It appears that for Castilla-La Mancha, the policy instrument is effective as there is a downward trend of non-renewable energy after the years of the implementation of the EGDl Plans as shown in figure 6[29] by 10%.

The graph is based on the assumption that it could potentially redistribute income through taxation. However, a limitation to this assumption is that it could disproportionately impact low-income individuals who use electricity. Spain investing in renewable energy could account for the electricity costs which will be discussed in the next section.

[29]"Installed capacity (Wind) | System reports." n.d. Informes del sistema. Accessed August 26, 2024. https://www.sistemaelectrico-ree.es/en/renewable-energies-report/wind/installed-capacity-wind.

2.2.2 Internalising Positive Externalities for Renewable Energy by Provision of Subsidies to Wind Energy (Microeconomics)

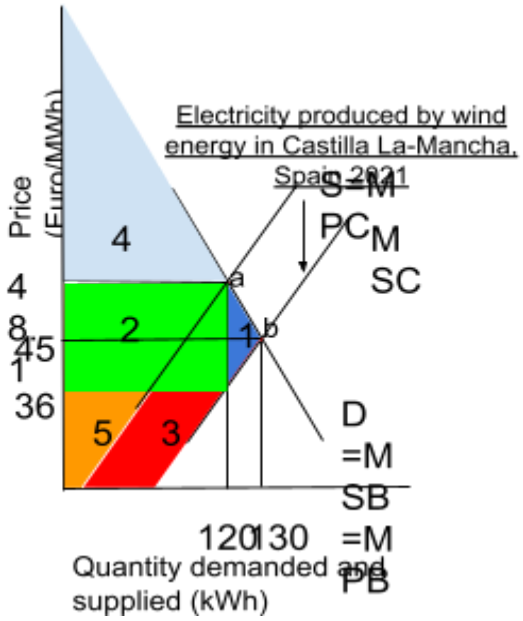

Figure 8. Achieving positive production externalities through subsidies

This is the market for electricity produced by wind energy in Castilla-La Mancha, Spain. Initially, the welfare loss represented in Triangle 1 is not utilized for social benefit because not enough wind energy is produced as a sustainable and nondepletable source of energy that provides multiple benefits to households and companies. For instance, it provides light for students to study or heat to survive in winter. The market equilibrium operates at the intersection of MSB and MPC which corresponds to quantity 120kWh and price 48.1 Euro/MWh because wind energy is high in cost and lacks means of good infrastructure. At that point, there is an underproduction of wind energy.

The EGD identifies the amount of funding necessary to produce more wind energy and harness Spain's potential for the production of cleaner energy due to its geographic location. Hence, this funding enabled Castilla La Mancha to provide subsidies for local producers. The MPC then shifts to MSC closing the externality by providing the goods at lower cost and higher supply. At the new intersection of MSC and MSB, corresponding to a price of 45 Euro/MWh and Quantity 130 kWh, wind energy production is increased and the third parties gain the external benefits.

The externality closes under the assumption that funds are appropriately utilized or that the government is working for economic and social benefit. However, the limitations to this assumption are that there may be corruption or the government is working under political pressure discarding economic outcomes. In the case of Castilla-La Macha, it is safe to say that the funds were allocated appropriately as the installed capacity for wind energy increased as shown in figure 5[30] which would not have been possible without significant funding. Similarly, the people affected disproportionately by the high cost of electricity, will now be able to afford it again.

[30]"| Red Eléctrica." n.d. | Red Eléctrica. Accessed August 26, 2024. https://www.ree.es/en/datos/generation/installed-capacity.

In theory, wind energy substitutes non-renewable energy. In reality, however, the extra energy produced may just be supplemental on top of the fossil fuel productions instead of replacing it. However, the downward trend in non-renewable energy from Figure 6[31] again proves that renewable energy did serve as a substitute.

Society benefits most from this policy as we become less dependent on fossil fuels and pollution is reduced. The social surplus increases to 1, 2, 3, 4 and 5. The government is worse off because it involves taking away from national revenue represented by Area 2 and causes deficits in the government budget which can later lead to government debt and associated problems. We can also see the connection to nonrenewable energy here which means that the taxations from nonrenewable energy can subsidize the wind energy sector as electricity costs the same regardless and essentially we are aiming to reduce dependency on fossil fuel while meeting the demand for electricity by increasing generation of wind energy. However, in this case, funding is provided by the European Green Deal. This proves that supranational organizations like the European Union are powerful in collectively improving the environment through aims and funding, especially for Castilla La Mancha.

[31]"Installed capacity (Wind) | System reports." n.d. Informes del sistema. Accessed January 26, 2024. https://www.sistemaelectrico-ree.es/en/renewable-energies-report/wind/installed-capacity-wind.

2.2.3 Changes in The Production Possibility Curve (Macroeconomics)

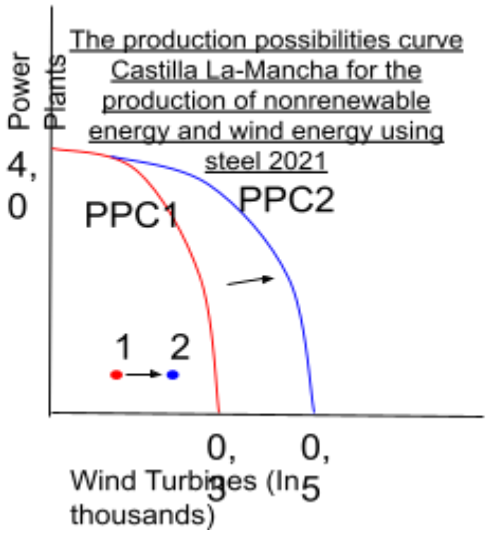

Figure 9. Growth of Production Possibilities

The curve above represents the combination of the maximum amount of nonrenewable energy and wind energy that can be produced when resources are efficiently used and fully employed and is called the production possibility curve. The assumptions of perfectly efficient and fully employed in the graphing of PPC are flawed as in reality there is always some inefficiency and unemployment. However, it serves as a good base for comparisons. The resource is narrowed to steel as it constructs 70%[32] wind turbines and is also used for making a power plant[33] for manufacturing nonrenewable energy[34] which makes it a reasonable materi Mo al to compare and quantify.

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[32]Wilburn, David R. n.d. "What materials are used to make wind turbines? | U.S. Geological Survey." USGS.gov. Accessed January 26, 2024. https://www.usgs.gov/faqs/what-materials-are-used-make-wind-turbines.

[33]"Nonrenewable Resources." 2023. National Geographic Society. https://education.nationalgeographic.org/resource/nonrenewable-resources/.

[34]n.d. Power Plant Materials. Accessed January 26, 2024. https://www.desware.net/sample-chapters/D12/E3-10-01-07.pdf.

The shape of the curve is not linear as the wind turbines require more steel and the opportunity cost of producing one more unit of turbine is higher than the opportunity cost of producing one more unit of power plant. Currently, the market of Castilla La Mancha generates wind energy from approximately 2277 wind turbines accounting for 139[35] wind farms in Castilla-La Mancha and 22042[36] wind turbines in Spain. For nonrenewable energy, nuclear energy is another huge part of energy generation in Castilla la Mancha. They have two[37] nuclear power plants. Assuming that all of the steel is not employed or efficiently used to make the wind turbines or the nuclear power plants we are initially producing at point 1.

Due to the government spending and investment in wind energy, there is more employment of resources[38]. Hence this causes real growth whereby the point shifts horizontally to point 2. In the long run, investments in technology increase productive efficiency and shift the curve from PPC 1 to PCC 2 leading to economic growth. In regards to sustainable development, it is important to factor in renewable energy as they do not deplete or cause irreversible environmental damage.

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[35]"WIND FARMS IN CASTILLA-LA MANCHA: TRADITION, INNOVATION AND DEVELOPMENT." n.d. Industrial de Castilla-La Mancha. Accessed January 26, 2024. https://www.industrialclm.com/en/news/tradition-innovation-and-development/.

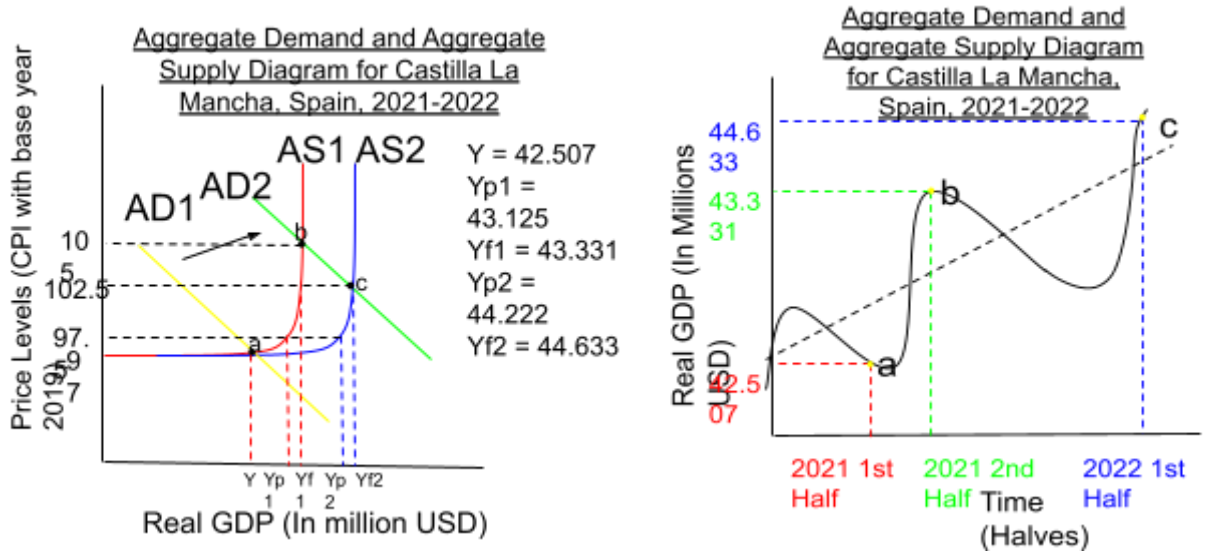
[36]"Spanish wind power capacity nears 30 GW of installed capacity." n.d. Ormazabal. Accessed January 26, 2024. https://www.ormazabal.com/en-gb/spanish-wind-power-capacity-nears-30-gw-of-installed-capacity-2/.

[37]"José Cabrera Nuclear Power Station." n.d. Wikipedia. Accessed January 26, 2024. https://en.wikipedia.org/wiki/Jos%C3%A9_Cabrera_Nuclear_Power_Station. "Trillo Nuclear Power Plant." n.d. Wikipedia. Accessed January 26, 2024. https://en.wikipedia.org/wiki/Trillo_Nuclear_Power_Plant.

[38]Fernández, Lucía. n.d. "Wind energy in Spain - statistics & facts." Statista. Accessed August 25, 2024. https://www.statista.com/topics/9046/wind-energy-in-spain/.

Hence, the PPC provided above not only indicates economic growth but also sustainable growth. While emphasizing the environment, it is also important that we have economic growth as it is crucial for living standards, low unemployment, and equal distribution of income. Through the Production Possibility Curve, we can allocate resources to appropriate sectors that are sustainable which can also lead to economic growth.

2.2.4 Expansionary Fiscal Policy in Aggregate Demand and Aggregate Supply with Business Cycle (Macroeconomics)



Figures 8 and 9. Government Spending and Real GDP Growth

The two diagrams above the market for wind energy in Castilla La-Mancha. In Figure 8, the free market corresponds to real GDP Y and price levels 97 at the intersection of the AD1 curve and AS1 curve. Aggregate demand measures the total amount of demand for all finished goods and services produced in an economy.

Figure 9 demonstrates the economic activity and change in Real GDP over time. Initially, at point a, the market in the first half of 2021 operates at a Real GDP of 42.507 million dollars and is in a phase of contraction, a phase where economic output declines.

There is advancement in technologies of the wind energy sector in Spain as shown in Figure 1[39], funded through the EGD. Improvements in technology stimulate investment spending, further causing increases in aggregate demand and a rightward shift in the AD curve from AD1 TO AD2. A rightward shift from AD1 to AD2 presented in the graph indicates that for a high increase in aggregate demand high increases in price levels. This leads to an increase in Real GDP to Yf1 and inflation of price levels at 105 at point b. Yf1 represents the full potential of the economy at the available resources prevailing at that time. It indicates that unemployment is lower than the natural rate of unemployment and those who are frictionally, seasonally, or structurally unemployed are employed at Yf1. We know from the research that about 2000[40] workers in Castilla La-Mancha were correspondingly employed.

[39]"The Spanish electricity system | System reports." n.d. Informes del sistema. Accessed August 25, 2024. https://www.sistemaelectrico-ree.es/en/spanish-electricity-system.
[40]n.d. Wikipedia. Accessed January 26, 2024. https://www.investinclm.com/en/castilla-la-mancha-one-of-the-spanish-regions-with-the-highest-investments-in-renewable-energies/.

Yp1 represents the point where unemployment is equal to the natural rate of unemployment. In Figure 9, the economy grows to point b which represents a peak where it is the highest point of economic expansion at that period corresponding to the second half of 2021 and a Real GDP of 43.332 million dollars.

Over time the development of infrastructure and improvements in research and development shift the AS curve from AS1 to AS2. Aggregate supply is the total quantity of goods and services produced in an economy over a particular period at different price levels. Government spending and investments increase efficiency in the production of wind energy as there are now better machines to produce the same energy at faster rates or require fewer resources for the same amount of output than before. At point c, price levels decreased to 102.5 as there was a 5.5[41] percent inflation in 2022 compared to 2021. Due to the extremely low number of unemployed people in Castilla La Mancha, we can assume that the Real GDP corresponds to Yf2 at that point indicating that unemployment is lower than the natural rate of unemployment. As a low and stable rate of inflation is preferred, the government should lower the price levels through monetary policies such as increasing interest rates to discourage borrowing, encourage savings, and shift the AD curve.

[41]"Castilla- La Mancha." 2023. CaixaBank Research. https://www.caixabankresearch.com/sites/default/files/content/file/2023/07/04/34411/F-CCAA-Castilla%20la%20Mancha-en.pdf.

In theory, we can conclude that infrastructure improvement raised the GDP as shown in Figure 5 for Spain. In reality, however, government investment spending as a factor cannot single-handedly increase the GDP and other factors should be considered, such as the COVID-19 pandemic or the export and import of electricity.

Comprehensively, Spain should continue funding the wind energy sector through the EGD Funds, as it has shown to have great outcomes and potential not only for growth but also for sustainable development. These benefits are not only crucial for the country's economy and environment but also for Europe and the World as a whole.

3. CONCLUSION

In conclusion, this research paper has explored the impact of the EGD on wind energy production in Castilla-La Mancha, Spain. It provides a comprehensive analysis of economic theories related to scarcity, government intervention, economic well-being, sustainability, and choice. The research question has guided the investigation into the intricate relationship between environmental policies and economic outcomes. The findings reaffirm that a well-planned execution to green transition can yield sustainable development.

The success of the EGD in boosting wind energy production and aligning environmental and economic objectives serves as a model for other regions and countries facing similar challenges aiming to develop sustainably post-pandemic.

The Spanish experience highlights the potential of the EGD and similar initiatives to drive the transition to renewable energy sources and combat climate change. By adopting similar policies, countries worldwide can collectively work on common goals to achieve environmentally friendly economic growth.

Based on the research and analysis, I propose the following recommendations for policymakers seeking a balanced approach:

1. Countries should consider streamlining bureaucratic procedures for renewable energy projects and offer incentives to attract investments.
2. Policymakers should set ambitious renewable energy targets fostering the growth of the green energy sector and reducing reliance on fossil fuels.
3. Continued investment in renewable energy research and development is essential for long-term sustainability and innovation in the sector.
4. Collaboration among nations is crucial to address climate change comprehensively. To do so, sharing best practices and technologies can accelerate the transition to green energy sources on a global scale.

Further research could explore the socio-economic impacts of wind energy on local communities in greater depth, assess the scalability of Spain's approach to other regions and investigate the long-term environmental benefits of reduced fossil fuel usage. Comparative studies across different countries and regions could provide valuable insights into the effectiveness of various policy measures in achieving sustainable development.

BIBLIOGRAPHY

2017. YouTube: Home. https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Europe/Spain_Europe_RE_SP.pdf.

2017. YouTube: Home. https://datacommons.org/place/nuts/ES42?utm_medium=explore&mprop=count&popt=Person&hl=en.

2023. Spain, a benchmark in renewable energies, is in the throes of far-reaching reforms to lead the green transition in the EU. https://spanish-presidency.consilium.europa.eu/en/news/spain-renewable-energies-green-transition-eu/.

n.d. Power Plant Materials. Accessed January 26, 2024. https://www.desware.net/sample-chapters/D12/E3-10-01-07.pdf.

n.d. Wikipedia. Accessed January 26, 2024. https://www.investinclm.com/en/castilla-la-mancha-one-of-the-spanish-regions-with-the-highest-investments-in-renewable-energies/.

“,.” 2023. , - YouTube. https://www.sciencedirect.com/science/article/abs/pii/S0301421519306664.

“Castilla- La Mancha.” 2023. CaixaBank Research. https://www.caixabankresearch.com/sites/default/files/content/file/2023/07/04/34411/F-CCAA-Castilla%20la%20Mancha-en.pdf.

“Castilla-La Mancha, the third autonomous region in Spain with the highest installed renewable power capacity.” 2022. Red Eléctrica.

https://www.ree.es/en/press-office/news/press-release/2022/02/castilla-la-mancha-third-autonomous-region-in-spain-with-highest-installed-renewable-power-capacity.

"Castilla-La Mancha ends 2020 with 75 percent of its electrical energy from solar and wind power | REVE News of the wind sector in Spain and in the world." 2021. evwind.es. https://www.evwind.es/2021/02/15/castilla-la-mancha-ends-2020-with-75-percent-of-its-electrical-energy-from-solar-and-wind-power/79349.

"Commission Work Programme 2021." 2020. European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1940.

"EU Green Deal." n.d. ECEEE. Accessed August 25, 2024. https://www.eceee.org/policy-areas/test/.

"EU strategy on energy system integration." n.d. Energy - European Commission. Accessed January 25, 2024. https://energy.ec.europa.eu/topics/energy-systems-integration/eu-strategy-energy-system-integration_en.

Fernández, Lucía. 2024. "Installed power capacity by technology Spain." Statista. https://www.statista.com/statistics/1002759/installed-power-capacity-in-spain/.

Fernández, Lucía. 2024. "Spain: share of renewable and non-renewable power." Statista. https://www.statista.com/statistics/1007913/share-of-renewable-and-non-renewable-energy-generation-in-spain/.

Fernández, Lucía. n.d. "Wind energy in Spain - statistics & facts." Statista. Accessed January 25, 2024. https://www.statista.com/topics/9046/wind-energy-in-spain/.

"Finance and the Green Deal - European Commission." n.d. European Commission. Accessed January 25, 2024.

https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal_en.

“How much is VAT on electricity in Spain?” 2022. Endesa. https://www.endesa.com/en/blogs/endesa-s-blog/light/VAT-electricity-spain.

“How Spain can make the most of the EU Green Deal and Recovery Plan.” 2020. WindEurope. https://windeurope.org/newsroom/news/how-spain-can-make-the-most-of-the-eu-green-deal-and-recovery-plan/.

“Installed capacity (Wind) | System reports.” n.d. Informes del sistema. Accessed January 26, 2024. https://www.sistemaelectrico-ree.es/en/renewable-energies-report/wind/installed-capacity-wind.

“José Cabrera Nuclear Power Station.” n.d. Wikipedia. Accessed January 26, 2024. https://en.wikipedia.org/wiki/Jos%C3%A9_Cabrera_Nuclear_Power_Station.

“Key Findings | United Nations.” n.d. the United Nations. Accessed August 25, 2024. https://www.un.org/en/climatechange/science/key-findings#physical-science.

Mulholland, Eric. 2020. “THE EUROPEAN GREEN DEAL.” European Sustainable Development Network. https://www.esdn.eu/fileadmin/ESDN_Reports/ESDN_Report_2_2020.pdf.

“Nonrenewable Resources.” 2023. National Geographic Society. https://education.nationalgeographic.org/resource/nonrenewable-resources/.

Platts, S&P G. 2020. “Spain passes renewables law to tackle grid permit backlog.” S&P Global.

https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/spain-passes-renewables-law-to-tackle-grid-permit-backlog-59193532.

"| Red Eléctrica." n.d. | Red Eléctrica. Accessed January 26, 2024. https://www.ree.es/en/datos/generation/installed-capacity.

"Renewable Energy Sector." n.d. Invest In CLM. Accessed January 26, 2024. https://www.investinclm.com/en/renewable-energy-sector/.

"Renewable energy targets - European Commission." n.d. Energy - European Commission. Accessed January 25, 2024. https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en.

Salas, Erick B. 2023. "Spain: carbon dioxide emissions 1970-2022." Statista. https://www.statista.com/statistics/449821/co2-emissions-spain/.

"Spain." n.d. IEA Wind TCP. Accessed January 25, 2024. https://iea-wind.org/about-iea-wind-tcp/members/spain/.

"Spain - Place Explorer." n.d. Data Commons. Accessed January 26, 2024. https://datacommons.org/place/country/ESP?utm_medium=explore&mprop=count&popt=Person&hl=en.

"Spain presents the new National Integrated Energy and Climate Plan (PNIEC) 2023-2030." 2023. Global Factor. https://www.globalfactor.com/en/spain-presents-the-new-national-integrated-energy-and-climate-plan-pniec-2023-2030/.

"Spain's integrated National Energy and Climate Plan for 2021-2030." n.d. Climate Change Laws of the World. Accessed January 25, 2024.

https://climate-laws.org/document/spain-s-integrated-national-energy-and-climate-plan-for-2021-2030_d10c.

“The Spanish electricity system | System reports.” n.d. Informes del sistema. Accessed January 25, 2024. https://www.sistemaelectrico-ree.es/en/spanish-electricity-system.

“Spanish offshore wind reaches key milestone.” 2021. WindEurope. https://windeurope.org/newsroom/news/spanish-offshore-wind-reaches-key-milestone/.

“Spanish wind power capacity nears 30 GW of installed capacity.” n.d. Ormazabal. Accessed January 26, 2024. https://www.ormazabal.com/en-gb/spanish-wind-power-capacity-nears-30-gw-of-installed-capacity-2/.

The World Bank. 2017. ‘‘GDP growth (annual %) - Spain’’. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2022&locations=ES&start=2018&view=chart.

Timmermans, Frans. n.d. “The Just Transition Mechanism - European Commission.” European Commission. Accessed January 25, 2024. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en.

Tragakes, Ellie. 2020. *Economics for the IB Diploma Coursebook with Digital Access (2 Years)*. N.p.: Cambridge University Press.

“Trillo Nuclear Power Plant.” n.d. Wikipedia. Accessed January 26, 2024. https://en.wikipedia.org/wiki/Trillo_Nuclear_Power_Plant.

Wilburn, David R. n.d. “What materials are used to make wind turbines? | U.S. Geological Survey.” USGS.gov. Accessed January 26, 2024. https://www.usgs.gov/faqs/what-materials-are-used-make-wind-turbines.

“WIND FARMS IN CASTILLA-LA MANCHA: TRADITION, INNOVATION AND DEVELOPMENT.” n.d. Industrial de Castilla-La Mancha. Accessed January 26, 2024. https://www.industrialclm.com/en/news/tradition-innovation-and-development/.