EU Energy Policy - Report

1. Introduction

The entire European continent is currently undergoing a major energy transition, moving away from fossil fuels to renewable energy sources. The primary impetus for this shift is global warming, which has been further accentuated by the Russian invasion of Ukraine.[1]

In this paper, we have analysed the plans for every EU country – except Cyprus and Malta – as well as Norway, Switzerland, and the United Kingdom, with the goal of creating a unified dataset containing targets for renewable power generation. In this report, we will explain the data we have gathered, the methodology we have used, the difficulties with interpreting the data, and we compare our findings to other research.

The novelty of this project lies in its focus on the political dimension. While most studies concentrate on the quantitative and mathematical aspects of energy transition models, this project aims to provide insights into the political realities that exist. It can be used as a reference or be used to calibrate models to give more weight to political realities.

2. Results

We find that European countries have an aggregated target of 1053 GW capacity for wind and solar energy; with 448 GW from wind and 605 GW from solar photovoltaic. The concrete targets, broken down by country, are found in Figure 1.

In Figure 1 we observe some general results about the plans. With one exception – the UK targeting more offshore wind production – Germany has by far the most ambitious targets for the build-out of renewable energy. There are various reasons for this, but the primary ones are the size of the German economy, the strength of the green party, and their historic reliance on Russian gas.[2] Comparing Germany to a similar country – France – their targets are much higher. This is probably related to the fact that French electricity has been, and will be for the foreseeable future, produced by nuclear sources.[3]

---

[1] 'REPowerEU', 18 May 2022, https://commission.europa.eu/topics/energy/repowereu_en.
[2] 'A (Very) Brief Timeline of Germany's Energiewende', Clean Energy Wire, 8 March 2017, https://www.cleanenergywire.org/factsheets/very-brief-timeline-germanys-energiewende.
[3] '"France 2030" Investment Plan – Policies', IEA, accessed 12 August 2025, https://www.iea.org/policies/14279-france-2030-investment-plan.

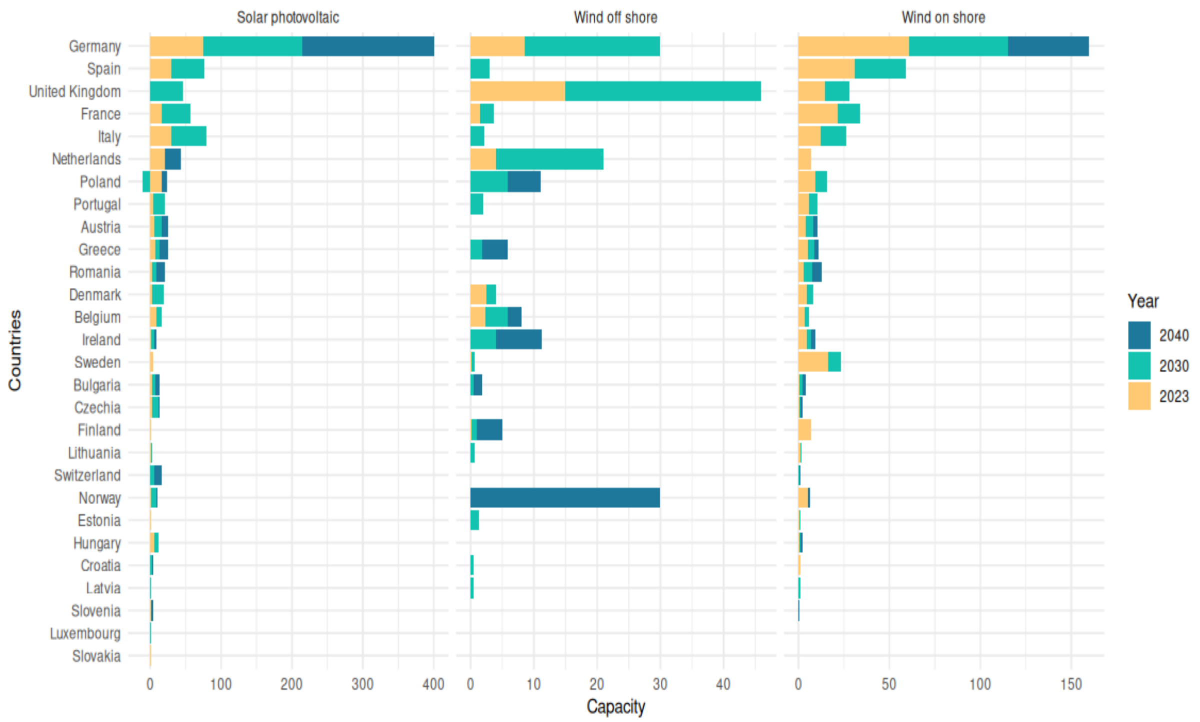

Figure 1: absolute target capacities (GW)

Another notable outlier in our analysis is Poland's target for 2030. The target – or more correctly the likely estimate – is set in the 2021 Energy Policy of Poland Until 2040.[4] However, by 2023, poland had already overshot this target. Thus when calculating the difference between 2023 and 2030, Poland would need to scale down capacity. Thus, Poland's targets should be seen as outdated, at least the one for 2030. The low target should be seen in light of the Polish government's focus on nuclear energy.[5]

Additionally, Norway stands out with its ambitious target for 2040, aiming for a substantial 30 GW capacity of offshore wind. This target aligns with a broader trend observed among countries bordering the North Sea, which tend to have higher targets for offshore wind energy. This is because of the international treaty called the North Sea Energy Plan, which is a combined effort to build offshore wind in the North Sea.[6]

To provide a different perspective on these targets we present the data in Figure 2. This alternative visualisation method offers the same information as Figure 1, but emphasises some of the regional differences and geographical distributions more effectively. The map highlights how certain regions, particularly those around the

[4] Energy Policy of Poland until 2040 (EPP2040) (2021), 68. https://www.gov.pl/web/climate/energy-policy-of-poland-until-2040-epp2040.
[5] Energy Policy of Poland until 2040 (EPP2040), 56.
[6] 'Offshore Wind', North Sea Energy, accessed 12 August 2025, https://northseaenergyroadmap.nl/offshore-wind.

North Sea, are leading the way in setting ambitious offshore wind targets, reflecting both their geographical advantages and strategic priorities.

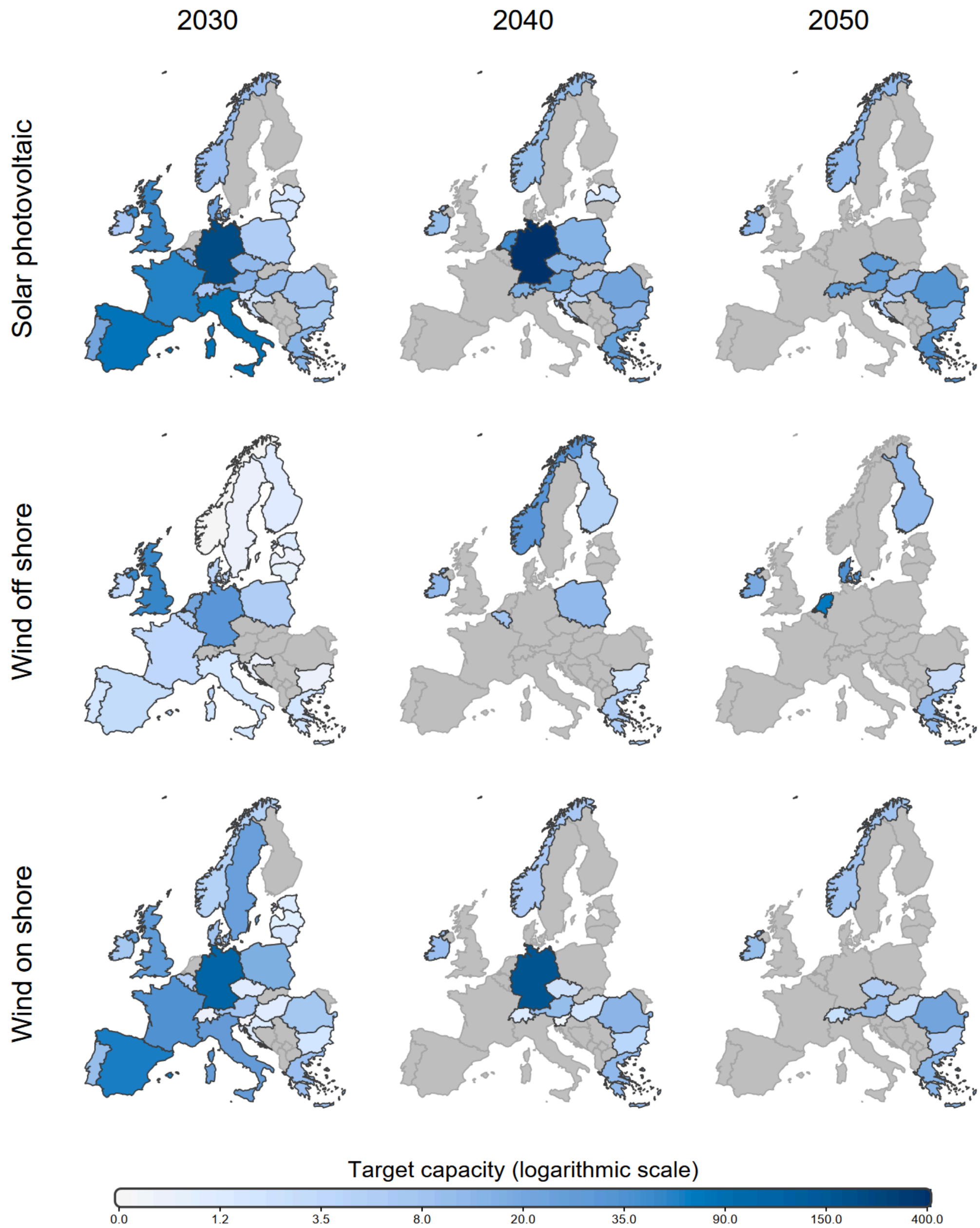

Figure 2: renewable energy capacity targets for 2030, 2040, and 2050 (GW)

3. Methodology

The data gathering process has been more or less challenging depending on the country. The EU countries are required to make a National Energy and Climate Plan

(NECP) for the years 2021-2030.[7] However, they usually include outlooks even up to 2050. These are quite similar to each other, but there are some discrepancies between the countries in how concrete the targets are. Here we should highlight Germany as a good example, with both large and concrete targets. We supplement the NECP with other sources where required, mostly relying on official government documents.

3.2 The non-European countries

Of the three non-EU members, Switzerland had by far the best policy document, which is called Energy Perspectives 2050+.[8] The document gives a detailed account of how Switzerland is to achieve its energy transition including almost all relevant policy information.

Norway, on the other hand, has no integrated policy document and the targets are found in several different places. E.g., the Norwegian wind energy capacity target can be found on the government's own web page,[9] while the solar target is found buried in a policy proposal on the web page of the Norwegian parliament.[10] Excluding these targets, for information on Norway we have mainly relied on the Norwegian Water Resources and Energy Directorate's (NVE) report on 'The Development in the Power Market to 2050'.[11]

The UK falls somewhere between Norway and Switzerland. There are official documents containing targets and estimates for the build out of renewables. While this information is well structured it lacks the targets for 2050 like Switzerland.[12]

4. Limitations and challenges

[7] European Commission, 'National Energy and Climate Plans', accessed 21 July 2025, https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en.
[8] Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation, 'Energieperspektiven 2050+ Kurzbericht', 4 December 2022, https://www.bfe.admin.ch/bfe/de/home/politik/energieperspektiven-2050-plus.html.
[9] Olje- og energidepartementet, 'Vindkraft til havs - tidslinje', Tidslinje, Regjeringen.no, regjeringen.no, 13 October 2021, https://www.regjeringen.no/no/tema/energi/vindkraft-til-havs/id2873850/.
[10] Stortinget, 'Representantforslag fra stortingsrepresentantene Lars Haltbrekken og Kari Elisabeth Kaski om fritak for skatt på egenprodusert strøm til eget forbruk', dok8, Stortinget, Stortingets administrasjon, 5 January 2024, httpss://www.stortinget.no/no/Saker-og-publikasjoner/Publikasjoner/Representantforslag/2023-2024/dok8-202324-068s/.
[11] Norges vassdrags- og energidirektorat, *Utviklingen i Kraftmarkedet Mot 2050* (2024), https://www.nve.no/media/17623/utviklingen-i-kraftmarkedet-mot-2050.pdf.
[12] 'Clean Power 2030 Action Plan: A New Era of Clean Electricity – Main Report', GOV.UK, accessed 30 June 2025, https://www.gov.uk/government/publications/clean-power-2030-action-plan/clean-power-2030-action-plan-a-new-era-of-clean-electricity-main-report.

During the project, we have encountered various problems related to the plans, particularly in how they were structured and what information was available. In this section, we discuss the general challenges we faced during the data gathering process. For concrete problems specific to each country, see the annexes.

4.1 Uniformity of Data

A central issue of gathering and comparing data between countries, is that there is no standard for what information to include and how to present it. This makes creating a uniform dataset a challenge. Even though the EU has a common framework for the NECPs, the countries differ quite a lot in what information to include.

While the EU member states work off the NECP-framework, countries like the UK and Norway do not even have an integrated plan, with the information being spread out and hard to find. On the other hand – Switzerland – which is also not a EU member, does have an integrated plan. As a matter of fact, Switzerland's plan is in many ways superior to many of the NECPs. Thus, while the NECPs are useful tools, they do have their limitations.

4.2 Targets

There are quite large discrepancies when it comes to how the renewable targets are defined. Sometimes the language is just imprecise when it comes to defining targets. The difference between a target and an estimate is muddled; often by the fact that they use both words when describing some number.

At other times, the difference is one of approach. Some countries, notably Germany and many of the central and eastern European member states, are very specific with their targets. Others again are very vague, preferring to state emission and overall targets without defining specific aims for technologies. We see this as a major divide in how countries approach the energy transition, with some countries using a top-down approach where the governments set specific targets, while others use a bottom-up approach where the governments set overarching targets, and then let the market decide how the transition is to be achieved. Both are reasonable approaches and we consider this an interesting avenue for future research.

4.3 Language and Translation

The different countries write their NECPs in their respective languages and there is no requirement of offering an official English translation. Despite this, there is a machine translation available for every NECP. While the translations are very helpful, these machine translations can be confusing or even misleading. Specifically, we deal with terminology that can often overlap or easily be mistranslated. The translations might confuse words like ‘power,’ ‘energy,’ and ‘electricity’ depending on context, or the translations confuse ‘GWh’ and ‘GW.’ The often complicated language of the policy documents makes the translations worse than it otherwise could have been, and even small mistakes may have large consequences for how we label our data. Thus, the machine translation should be thought of as a possible source of errors.

A concrete, and absurd, example of this is found in the Greek NECP where the machine writes ‘RES in grossFrench consumption Enr Earth**’, and is what we assume to be the ‘RES in gross final consumption’ or ‘renewable energy in gross consumption of energy’[13]. This highlights the errors that can occur with machine translations. Which in some cases, like here, are easily apparent, but it can cause problems when the error is not as easily seen.

Another issue is the difference between comma and period in numbers. These two symbols represent two different things in the British Isles vs the rest of Europe. This could be another source of problems for the data set.

4.4 Readability of data

Another central issue is the readability of data tables. There are two different problems in relation to this. One is, again, the machine translation transforming the headers for the tables making it difficult to read. The other being the actual lack of concrete numbers on the graph.

[13] NECP, ‘Greece - Final Updated NECP 2021-2030 (Submitted in 2025) - European Commission’, accessed 13 July 2025, https://commission.europa.eu/publications/greece-final-updated-necp-2021-2030-submitted-2025_en.

Table 3 Annual targets for the penetration of new
the Greek market by 2030 (Scenario A – Base Scen

Screenplay	Year	Purchase of new passenger	Total passenger market change
I	2018 *	103.431	—
B	2019 *	114.109	10.678
— I- 3	2020 *	80.977	— 33.132
C	2021 *	100.911	19.934
O *. h >	2022 *	105.283	4.372
N	2023	*130.000*	*24.717*
N	2024	*136.500*	*6.500*
'i.77	2025	*143.325*	*6.825*
Ligueur t'ivory	2026	*150.491*	*7.166*
> H UN F	2027	*158.016*	*7.525*
Ivory £	2028	*165.917*	*7.901*
2 – h	2029	*174.212*	*8.296*
§ >	2030	*182.923*	*8.711*

Figure 3 [14]

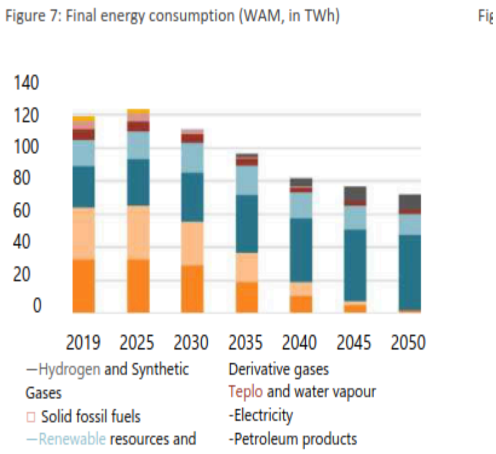

Figure 4 [15]

An example of the former is here found in figure 3, where in the greek NECP the column on the left became “screenplay” and its content became scrambled. An example of the latter is found in the slovakian NECP where the numbers are not present. This might be because of the author(s) wanting to convey other information than the concrete numbers, however, this is a problem in a project such as this.

5. Data structure

The structure of the data we have collected is in a country-year format and includes a *region* variable based on the regions in van Greevenbroek et al.,[16] which we extend to cover all the countries. We have also included the type of energy generation (*siec* and *type*), the unit of the energy generation (*unit*), the source of the information (*source*), and the scenario from which the estimation or target is derived (*scenario*).

Some of the targets or estimates use an interval, with low and high values indicating the range. In these cases the main variable (cap) uses the mid value of the interval, and the low and high values can be found in the cap_min and cap_max variables respectively.

[14] NECP, ‘Greece - Final Updated NECP 2021-2030 (Submitted in 2025) - European Commission’, 109.
[15] NECP, ‘Slovakia - Draft Updated NECP 2021-2030 - European Commission’, 51, accessed 2 July 2025, https://commission.europa.eu/publications/slovakia-draft-updated-necp-2021-2030_en.
[16] Koen van Greevenbroek et al., ‘Trading off Regional and Overall Energy System Design Flexibility in the Net-Zero Transition’, *Nature Sustainability* 8, no. 6 (2025): 629–41, https://doi.org/10.1038/s41893-025-01556-2.

For easier sorting we include four additional binary variables. The first two are named *target* and *target_exp*. The variable *target_exp* only includes values that are explicitly stated as being targets. However, not all countries have explicit targets, so we include a *target* variable with what the countries consider the main development path.[17] The third is named *demand*, and indicates if the value is a demand (1) or supply (0) estimate. Demand entails estimates about energy or electricity consumption, in addition to the number of vehicles and heat pumps. Supply entails all targets and estimates about the energy or electricity producing capacity. The last binary variable is named *problem* and is a quick way to sort out rows that are problematic in some respects. To help the sorting, we also include a variable named *problem_desc* which includes a brief comment describing the problem. For more detailed information, see the codebook.

5.1 Demand Projections

An added dimension of the data set is various demand projections and targets for the different countries. The data is given in various dimensions and units of energy such as total energy demand often given in ktoe, total number of EV-cars on the road in 2030, and so on. These data points are added in the same way that the capacity is added i.e. it contains the same information that exists for the capacity data points.

5.2 WAM, WEM, and Targets

A challenge to the dataset is the interpretation of *targets.* In the NECPs they often include two scenarios – WEM and WAM. The former stands for ‘With Existing Measures,’ and the latter for ‘With Additional Measures’. The two scenarios are present in the large majority of the NECPs. These are the two main scenarios being used in the NECPs for making estimates on emissions and energy demand. The former is based on measures already in place by 2021, and the latter is based on the measures and policies planned to come into effect after 2021.[18] Our interpretation has been that of assuming that, unless stated otherwise, the WAM scenario is the target scenario.

6. Discussion and comparisons

Here we show how our data compares to previous modelling on the subject. We focus on three previous works, and analyse how the political targets compare to the modelling outputs.

6.1 WIMBY

[17] In the NECPs, this is most often, but not always, the ‘With Additional Measures,’ WAM, scenario.
[18] Environmental Protection Agency of Ireland, ‘Greenhouse Gas FAQ’s’, accessed 21 July 2025, https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/frequently-asked-questions/.

WIMBY (Wind In My BackYard) is a GIS-model which models renewable energy capacity build-out in 2050. It takes into account environmental and social factors i.e. how much land is available for wind and solar capacity. These factors are then given different weights from low to high, where the high scenario creates more restrictions and vice versa for the low. This creates 9 different combinations of high, medium and low restrictions. Figure 5 shows the nine scenarios for the potential for onshore wind.[19]

Comparing the WIMBY results, we observe similarities and differences with the onshore wind targets of Figure 2.[20] One example is that Germany is modelled to build out less onshore wind than it actually targets. There are a myriad of reasons which could explain this difference but one possible explanation is that the threat of climate change outweighs the threat of local nature degradation in Germany.

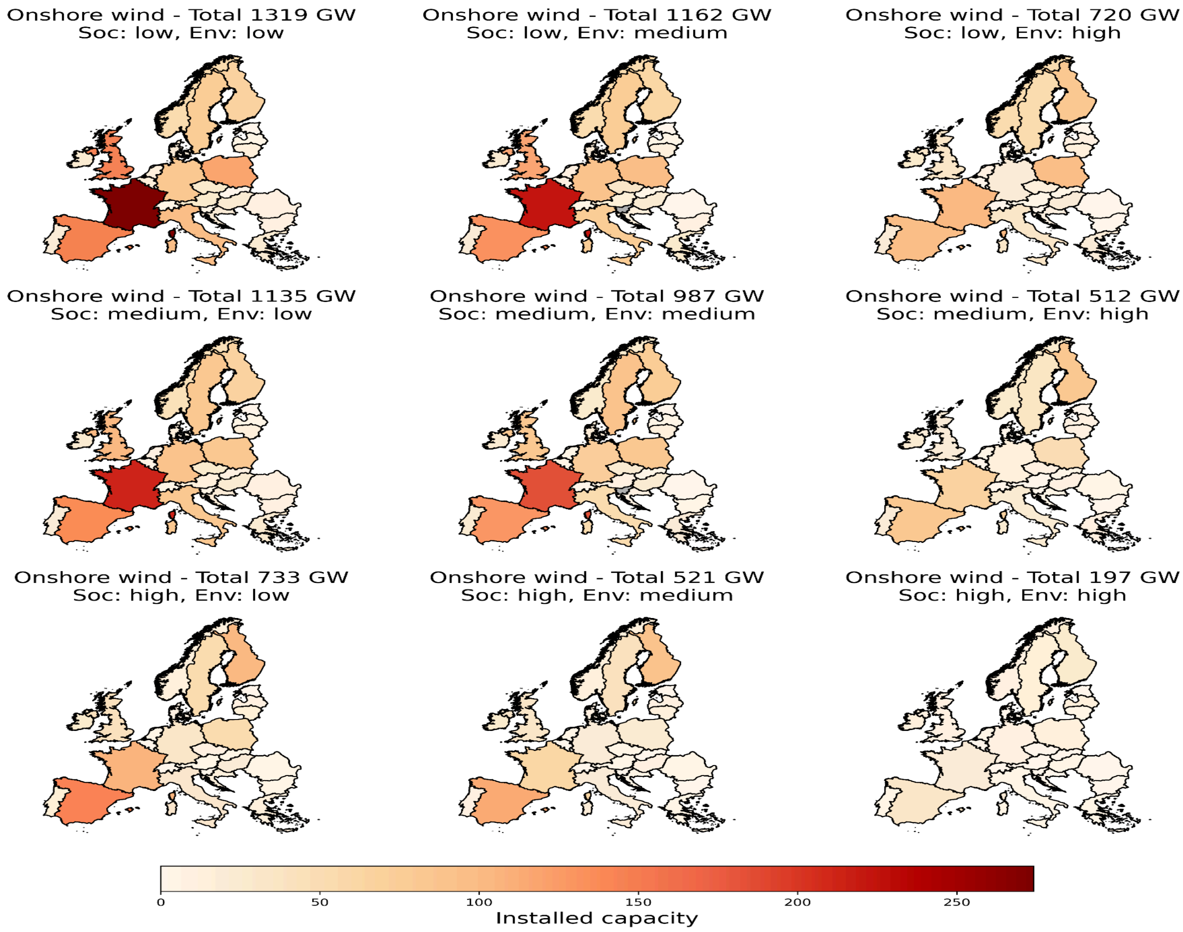

Figure 5: WIMBY results

6.2 Speed of technological transformations

[19] 'Wimby - Wind in My Backyard - European Funded Project', The WIMBY Project, accessed 12 August 2025, https://wimby.eu/.
[20] Note that Figure 2 uses a logarithmic scale and that the WIMBY results are only for 2050.

The paper by Victoria et al. (2022) investigates alternative transition paths for the European energy system under various carbon budgets corresponding to temperature increases between 1.5 and 2 degrees Celsius. Using the *PyPSA-Eur-Sec* model, the study highlights the necessity for rapid and unprecedented build-out of technologies like solar PV, wind power, and electrolysis capacity to meet more ambitious climate targets. The model shows that while the technological transformation varies significantly. The study also emphasises the economic implications, noting that more ambitious paths could be cost-optimal when considering the social cost of carbon, and underscores the need for high CO_2 prices and substantial deployment of negative emissions technologies to achieve net-zero emissions.

This variability in political targets can impact the overall pace and scale of technological transformations and the economic implications of achieving net-zero emissions. In the article by Victoria et al. (2022), they state that to reach the target of keeping global warming to below 1.5 degrees Celsius, the European countries would need to build 400 GW of capacity per year between 2025 and 2035.[21] Given the European target of 1053 GW for 2030, it would imply that Europe as a whole would miss the models' prediction for keeping the 1.5-degree-target by at least twice the amount needed. Together, these approaches can inform a more comprehensive and resilient energy transition strategy for Europe, combining technological, economic, and political perspectives. Figure 6 comes from the Victoria et al. article and shows the necessary capacity development for keeping warming below certain thresholds ranging between 1.5 and 2.0 degrees Celsius.

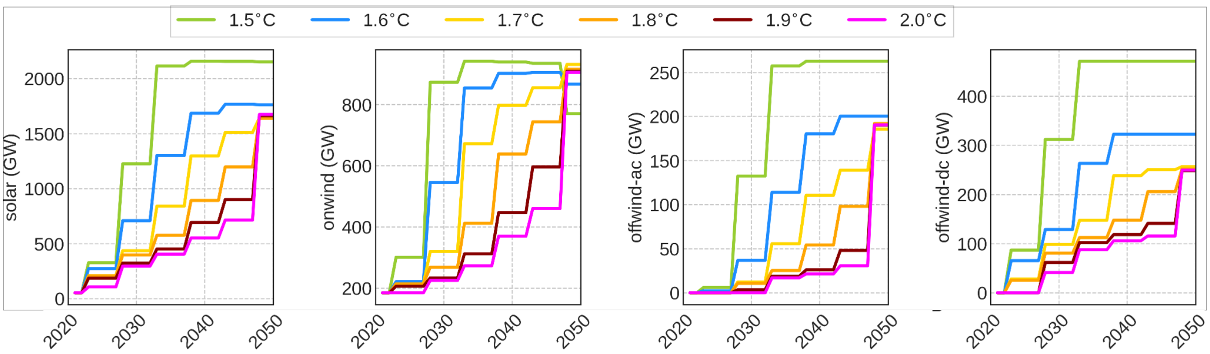

Figure 6: capacity needed to stem global warming [22]

6.3 Designing a sector-coupled European energy system

The paper by Gøtske et al. (2024) explores the impact of interannual weather variability on the design and operation of a highly renewable European energy

[21] Marta Victoria et al., 'Speed of Technological Transformations Required in Europe to Achieve Different Climate Goals', *Joule* 6, no. 5 (2022): 1066–86, https://doi.org/10.1016/j.joule.2022.04.016.
[22] Victoria et al., 'Speed of Technological Transformations Required in Europe to Achieve Different Climate Goals'. https://github.com/martavp/budgets/blob/main/figures/capacities.png

system. Using 62 years of historical weather data (1960-2021), the study optimises capacity layouts for a European energy system under net-zero CO_2 emissions constraints and assesses their robustness to interannual weather variations. The authors find that capacity layouts designed for years with compound weather events are more robust, achieving higher resource adequacy and net-negative CO_2 emissions. The study also identifies strategies to increase robustness, such as additional backup generation, energy storage, and a more distributed H_2-network.[23]

While Gøtske et al. (2024) provide valuable insights into the technical and operational aspects of designing a robust European energy system, our analysis reveals varying levels of detail and ambition in national targets. Some countries have specific targets for renewable energy capacity and demand projections, while others are more vague. This variability in political targets can impact the overall robustness and resource adequacy of the European energy system. Together, these approaches can inform a more comprehensive and resilient energy transition strategy for Europe, combining technical, operational, and political perspectives.[24]

7. Further work

Here we propose some ways to use our data for future works. The main objective is to use this data in modelling, however, there are some interesting avenues of research we want to point out.

As mentioned previously, we see two main strategies of formulating targets: bottom-up and top-down. An interesting way forward would be to analyse the two different groups of countries and see how they differ in achieving their results.

Another interesting study would be to look at how the NECPs are updated. The different countries have developed and expanded on their NECPs since 2019, and analysing changes in targets for the different countries would have been an interesting study. It might be interesting to look if there was a major shift in the targets for each country before and after the breakout of the war in Ukraine. Are there any geographical differences? How has this affected targets in countries closer to Russia? These, among many others, might be interesting questions to try to answer.

Github repository: https://github.com/highRES-model/EU-Energy-Policy-Review

[23] Ebbe Kyhl Gøtske et al., ‘Designing a Sector-Coupled European Energy System Robust to 60 Years of Historical Weather Data’, *Nature Communications* 15, no. 1 (2024): 10680, https://doi.org/10.1038/s41467-024-54853-3.
[24] Gøtske et al., ‘Designing a Sector-Coupled European Energy System Robust to 60 Years of Historical Weather Data’.