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Impact of COVID-19 and Ukraine-Russia Conflict on the National Energy and Climate Strategies of Portugal and Spain

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***Abstract*—This research examines the impact of the COVID-19 pandemic and the Ukraine-Russia conflict on Portugal and Spain's national energy and climate plans. Both countries have updated their plans in response to these events, emphasizing energy efficiency, renewable energy investment, and circular economy principles. Portugal focused on addressing energy poverty and digitalization, while Spain accelerated its energy transition to align with the European Green Deal. Additionally, the Ukraine-Russia conflict prompted measures to enhance energy security and NECPs in both countries. Through a semi-systematic literature review spanning 2020–2023, our study analyzes how these global events shaped national energy and climate plans. The case studies of Portugal and Spain highlight the importance of flexibility and resilience in crafting sustainable energy strategies during such a complex crisis.**

***Index Terms* - Energy Transition, Energy Policy, NECP, Geostrategy, Pandemic, Russia-Ukraine conflict**

INTRODUCTION

To provide more affordable, secure, and sustainable energy to the European Union (EU), the European Commission (EC) introduced a strategy, in 2015, known as the Energy Union [1]. This strategy encompasses five dimensions, namely: i) security, solidarity, and trust; ii) a fully integrated energy market; iii) energy efficiency; iv) climate action, decarbonizing the economy; and v) research, innovation, and competitiveness [2].

In December 2018, as part of the Clean Energy for All Europeans package, the regulation on the governance of the Energy Union and climate action was established. One of its main objectives was to address the EU's energy and climate targets for the year 2030 [2]. To achieve and regulate these goals, it was proposed the creation of the National Energy and Climate Plans (NECPs), to define an official ten-year strategy for each EU country. These plans cover key topics, including i) energy efficiency; ii) renewables; iii) greenhouse emission reductions; iv) interconnections; and v) research and innovation. EU countries submitted drafts of their initial NECPs, in early 2019, intending to start implementation in early 2020. Particularly, Portugal released its final NECP in December 2019, while Spain did it in January 2020 [3].

Analyzing the case studies of Portugal and Spain together is relevant because both countries, located on the Iberian Peninsula, are neighbors and electrically interconnected with significant capacity that allows an almost fully integrated Iberian electricity market (MIBEL), as the reduced episodes of market splitting among both countries prove. This partnership officially began in July 2007 when MIBEL was established. This initiative aimed to coordinate both electricity systems and electricity markets to benefit consumers in both countries [4].

Three years after the first versions of the NECPs, two international events occurred that impacted the European power system and its energy security. Namely, the COVID-19 pandemic, initiated in 2020, had a strong impact on the energy consumption patterns, and the escalation of the conflict between Russia and Ukraine, in early 2022, with notable implications on the gas supply and consequently on the electricity prices. Concurrently, EU countries were requested to draft updates of their NECPs by June 2023, following Article 14 of the Governance Regulation [3]. These circumstances led to changes in the initial goals outlined in the NECPs for the EU countries, including Portugal and Spain. Despite having independent plans, the fact that these countries are part of the MIBEL suggests that disruptions and alterations in electricity production and demand in one country will certainly affect the

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market in the other country, Therefore, it is relevant to analyze these changes in their energy and climate goals.

METHODOLOGY

This paper conducts a semi-systematic literature review combined with the snowball technique to investigate the impacts of the COVID-19 pandemic and the Russia-Ukraine conflict on the NECP of Portugal and Spain. The significance of these impacts is assessed, and their effects on the short-term and long-term energy plans of both countries are analyzed. The steps are described as follows:

- Data collection was searched from Scopus, Web of Science, and Google Scholar. The research began with a preliminary search using the following keywords: "COVID-19 pandemic," "Russia-Ukraine conflict," "National Energy and Climate Plans," "Portugal," and "Spain." Relevant articles and studies were identified. The search was performed mostly in November 2023. These databases ensure that besides access to indexed scholarly literature, other relevant documents, such as EU official reports and communications, are also focused and considered in the current research.
- Inclusion and exclusion criteria: articles published between 2020 and 2023 were selected. Only peer-reviewed articles, conference papers, and relevant reports were included. The language was restricted to English, Spanish, and Portuguese. Articles not directly related to the impact of the COVID-19 pandemic and the Russia-Ukraine conflict on the energy and climate plans of Portugal and Spain were excluded.
- Snowball technique: after initial relevant articles were identified, the snowball technique was used to expand the search. The references and citations of the initial articles were reviewed to find more relevant sources.
- Data extraction and analysis: data from the selected articles, including information on the impacts of global events (COVID-19 pandemic and Russia-Ukraine conflict) on the energy and climate plans of Portugal and Spain, were collected. Data analysis included both qualitative and quantitative assessments of the significance of these impacts.
- Revision of the NECPs of Portugal and Spain: the NECPs of Portugal and Spain for the years 2020 to 2023 were analyzed, as primary sources for understanding the energy and climate strategies of the two countries.
- Discussion: findings from the literature review and the NECPs analysis were synthesized to answer the research question (How does the COVID-19 pandemic and the Ukraine-Russia conflict impact the National Energy and Climate Strategies of Portugal and Spain?). Discussions were based on the significance of the impacts and the effects of the two events on the short-term and long-term energy and climate plans of Portugal and Spain.
- Conclusion: analysis and discussion of the research results and relevant conclusions.

IMPACT OF THE EXTERNAL EVENTS ON PORTUGUESE AND SPANISH NECPS

A. Covid-19 Pandemic

The SARS-CoV-2 pandemic, known as COVID-19, spread rapidly across Europe. The first case was detected in France in January 2020, and from that point, the situation escalated to other European countries. The rest of the world was facing a similar situation, and on March 11th of the same year, the World Health Organization declared it a global pandemic [5]. From the energy sector perspective, the impact on energy consumption was significant, unexpectedly making the entire EU close to achieving its energy efficiency targets for 2020, due to a drop in the energy demand, with energy consumption falling 4.8% in comparison to 1990 levels [6]. In this regard, the EC recognized that this situation was not the result of any structural changes and anticipated a subsequent increase in energy consumption once the global situation stabilized [7]. Regarding Portugal and Spain, evidence of electricity consumption shifts during the lockdown period showed that Portugal endured an extended negative impact, affecting both years of 2020 and 2021 in comparison to Spain which felt negative impacts only during 2020 [8]. Among the measures that contributed to reducing electricity consumption in both countries was the closing of schools [8].

At the end of 2020, still during COVID-19, the EC issued an official communication, in which it acknowledged that the Energy Union had recognized the importance of energy efficiency, establishing it as a fundamental principle for the future. However, it was noted that, in practice, most of the final NECPs only made limited references to this principle. The conclusion drawn was that there was a critical need to enhance the concept of 'Energy Efficiency First' in the decision-making process for future energy infrastructure investments [7]. This perspective had the potential to lead to substantial improvements in the EU's energy infrastructure beyond the COVID-19 situation. Indeed, the EC recognized that this situation could be an opportunity to advance green investments in energy, resource efficiency, and renewable energies. To achieve this, the full implementation of the NECPs was crucial for mobilizing new public and private investments in the upcoming years [7]. Moreover, the NECPs are also related to environmental issues. Indeed, air quality represents a critical environmental factor that may either increase or reduce the prevalence of certain respiratory and cardiovascular diseases. During the COVID-19 pandemic, the EU communication mentioned before, delivered at the end of 2020, highlighted that EU governance regulations required Member States to report on the impacts of transport, agriculture, industry, and energy policies and measures on air pollution, in line with the environmental legislation. However, although some attempts were undertaken, the response to these issues remained inadequate. There continued to be insufficient reporting details of the projected impacts of the planned policies and measures on air pollutant emissions by Member States in their final plans, including, among others, the bioenergy expansion plans [7]. As a result, it was proposed that the updated NECPs should strengthen their ties with the National Air Pollution Control Programmes (NAPCPs). This integration would help promote the inclusion of synergies [7].

It is important to mention that the European Green Deal (EGD) was a strategy created before the COVID-19 pandemic to achieve climate neutrality within the EU by 2050 [9]. However, following the COVID-19 pandemic, it emerged as one of the most significant policy initiatives concerning the energy sector. Through some of its programs, funds were directed towards targets, including a set of proposals to align the EU's climate, energy, transport, and taxation policies to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels [10]. The EGD is closely related to the development of goals outlined in the NECPs.

Before the pandemic, Portugal had made advances in phasing out energy subsidies, especially for fossil fuels, as assessed by the European Commission [11], and partially addressed the recommendation to analyze interactions with air quality, providing some broad quantitative estimates in the final plan [12]. However, the pandemic catalyzed significant changes in Portugal's energy and climate strategies for the updated draft 2023, aligning with the 2030 energy goals outlined in its NECPs [13].

During the assessment of the first Spanish NECP [14] in late 2020, the EC pointed out that Spain largely addressed most of the Commission recommendations. The final plan included a catalog of energy subsidies, encompassing tax breaks for renewable energy, combined heat and power, and waste, with a phased-out target set for 2024. However, specific timelines, quantified targets, and funding mechanisms were not clarified for most objectives [15].

As a response to the pandemic, in 2021, the European Union launched the NextGenerationEU, an investment of EUR 750 billion, with 90% articulated through the Recovery and Resilience Facility, a temporary EC program, which consists of the effort of the Commission to make funds available on the capital markets for the EU Member States to implement investments related to digital and green transition [16]. This investment aims to accelerate the decarbonization agenda and support economic recovery in various EU countries [17, 18].

B. Ukraine-Russia Conflict

The geopolitical situation between Ukraine and Russia has deep historical roots, but tensions escalated notably in 2014 with the annexation of Crimea by Russia, extending tensions beyond their borders [19]. The conflict intensified in early 2022, after the most critical period of the COVID-19 pandemic, with military incursions into other areas of Ukraine, triggering an international, humanitarian, and political crisis with important consequences [20]. From a European energy perspective, the conflict resulted in a significant reduction in gas flow to Europe, leading to increased supply risks [13]. This reduction in gas flow contributed to record-high gas and electricity prices, peaking in August 2022 [21]. The European Commission's communication COM (2022)230 in May 2022 highlighted the impact of the conflict on the world energy system, emphasizing Europe's overdependence on Russian fossil fuels and the need to accelerate the transition to clean energy [22]. The communication introduced initiatives like the European Global Hydrogen Facility and the REPowerEU plan to enhance energy security and diversify energy sources [22].

The NECP draft for Portugal in 2023 [13], acknowledges the significant effect of the Ukraine-Russia conflict (U-Rc) on energy systems, mentioning challenges in energy prices and international security concerns. The draft mentions the implementation of the REPowerEU plan and the Green Deal Industrial Plan as responses to the conflict. To address energy security concerns, Portugal presented several legislative measures, including simplifying procedures for renewable energy production and expanding energy storage capacity. Despite Russian gas imports being below 10%, Portugal focused on diversifying its energy supply and increasing gas storage capacity in response to the conflict. The draft also projected inflation and energy price volatility in Portugal due to the conflict, emphasizing the need for long-term projections for strategic planning [13].

Similarly, the Spanish NECP draft for 2023 highlights the impact of the U-Rc on energy systems and the need for increased renewable energy targets and energy savings [17]. Spain aims to achieve emission reduction targets and enhance energy security through measures like the More Energy Security Plan. The draft emphasizes initiatives like the Iberian mechanism to lower electricity prices and regulatory measures to ensure stability in the gas market. Spain also focuses on integrating its gas market into the broader European market and enhancing energy efficiency through organizational strategies and energy-saving initiatives [17].

In general terms, the Ukraine-Russia conflict has influenced energy policies and strategies in Portugal and Spain, prompting measures to enhance energy security, diversify energy sources, and accelerate the transition to clean energy, in alignment with broader European initiatives. The impact is evident in various sectors, with Portugal enacting legislative measures, such as Decree-Law No 30-A/2022, to simplify procedures for renewable energy production and expand energy storage capacity [13]. Spain, on the other hand, has implemented initiatives like the Iberian mechanism to lower electricity prices and enhance energy security [17]. These measures reflect a concerted effort, between Portugal and Spain, to mitigate the effects of the conflict on energy systems and advance towards sustainable energy solutions.

COMPARATIVE ANALYSIS 2020 VS MID-2023 FOR EACH COUNTRY

Given that the named global events have different origins and possess distinct characteristics, quantifying their effects on the NECPs is challenging due to the various dimensions that can be analyzed. Nevertheless, it is possible to compare the initial goals set by Portugal and Spain at the beginning of 2020 with the drafts presented in mid-2023, which already incorporated the impacts of the COVID-19 pandemic and the Ukraine-Russia conflict. The following comparative analysis joins the tables found on the NECPs from 2020 and 2023 from Portugal and Spain that were able to be compared. For details see the Appendix.

The NECPs of Portugal and Spain show a notable transition towards more ambitious renewable energy targets and a departure from fossil fuels. In Portugal, the capacity generation projections, as detailed in Appendix Table 1, reveal a growth in hydro, wind, and solar PV capacities between NECP 2019 and

the updated version of 2023. The revised energy mix goals, depicted in Appendix Table 2, underscore a commitment to enhancing energy efficiency and transitioning to cleaner technologies across various sectors. Similarly, national goals outlined in Appendix Table 3 highlight Portugal's dedication to aggressive climate action and sustainable energy transition. Meanwhile, Spain's NECP revisions, outlined in Appendix Table 4, signify a shift towards a more diverse and renewable-centric energy landscape, with a particular emphasis on wind and solar PV. The detailed analysis of generation balance in Appendix Table 5 further illustrates Spain's increased reliance on wind, and solar PV, reflecting the country's commitment to sustainable energy practices. Overall, the comparative analysis demonstrates a shared commitment between Portugal and Spain to sustainability, energy efficiency, and climate mitigation strategies amidst evolving global challenges.

DISCUSSION

The comparative analysis between PNECs for each country shows that both Portugal and Spain demonstrated a commitment to more ambitious renewable energy goals in their updated NECPs. This includes significant increases in wind and solar capacities, indicating a shared commitment to cleaner and sustainable energy sources. Both countries showed a relevant commitment to emissions reduction, with Spain narrowing down its target from -45% to -55%. On the other hand, consistency in energy efficiency goals in Portugal at 35% reflects a shared dedication to reducing primary energy consumption.

The changes in capacity generation projections for 2030 reflect a clear shift towards renewable energy sources. Both countries prioritize wind and solar PV, indicating a shared vision for a more sustainable and diversified energy mix.

a) COVID-19; Portugal and Spain

Portugal experienced, during 2020, a significant impact on energy consumption, leading to a reduction in final energy consumption and a decrease in energy dependency. This was attributed to changes in habits, reduced coal imports, and increased domestic production from renewable sources. According to Bento et al. [23], it is estimated that under the state of emergency, between April and May, average consumption decreased up to 12% and 17% for the 'Portuguese and Spanish peninsular loads, respectively' pp.13; along with a significant contribution from RES, has actively contributed to decreased electricity prices in 2020.

Furthermore, Reforms and investments were highlighted, emphasizing digitalization, green industrialization, and the development of the renewable hydrogen value chain. The "vale eficiência" program, addressing energy poverty, was influenced by the pandemic. It aims to mitigate energy poverty in the homes of economically vulnerable families. These families can apply for a voucher to acquire services, materials, or equipment that allows them to improve the energy performance of their homes [13].

Spain's NECP reported a notable impact on the economy and energy consumption. The energy transition was accelerated, and the NECP adapted to the new energy landscape, with increased climate ambition. Specific impacts included decarbonization in the electricity sector and a significant reduction in CO_2eq emissions.

b) Impact of the Ukraine-Russia Conflict on Portugal and Spain

Portugal's NECP draft highlighted the cumulative effect of the U-Rc and the challenges it brought to energy systems, affecting energy prices and international security concerns. Legislative measures [22, 24] were enacted to address energy security concerns, promote the transition to renewables, and enhance energy storage capacity.

The Spanish NECP draft continually mentioned the U-Rc and its consequences. The conflict influenced the context of the NECP update, aligning objectives with European emission reduction targets. The More Energy Security Plan, approved after the start of the U-Rc conflict, aimed to accelerate the energy transition and safeguard consumers.

c) Short-Term and Long-Term Implications:

Portugal and Spain adapted their NECPs in response to the dual challenges of the COVID-19 pandemic and the Ukraine-Russia conflict. Reforms and investments were prioritized, and legislative measures were enacted to enhance energy security, reduce dependency, and promote renewable energy.

The NECPs highlighted the importance of strategic autonomy in the industrial value chain for the energy transition. Measures to optimize interconnection utilization, strengthen emergency response capacities, and integrate gas markets into the broader European context were emphasized.

Financial measures, such as the NextGenerationEU investment, were called to accelerate the decarbonization agenda. Regulatory measures, including amendments to address economic and social consequences, were implemented to protect consumers and to promote energy transition.

However, there is still time to see if the goals are going to be reflected in the real application and to evaluate whether the possible scenarios will become true to fulfill the energetic goals for 2030.

d) Other factors influencing changes in the NECPS

It is important to mention that in Portugal and Spain, alongside the impacts of the COVID-19 pandemic and the Ukraine-Russia conflict, significant shifts in energy and climate policies have been influenced by international agreements and commitments. The adoption of the Glasgow Climate Pact during COP26 in November 2021 signifies a global recognition of the urgency to limit the rise in global temperatures. This pact, along with initiatives like the European Green Deal and the European Climate Law, has promoted these countries to enhance their climate targets and align their strategies with broader EU objectives [13, 17].

CONCLUSION

This work has made a summary of the impacts of COVID-19 and the Ukraine-Russia conflict on the energy policies of Portugal and Spain, highlighting the flexibility to adapt these policies in response to global events. Combining the semi-

systematic literature review and snowball technique with the analysis of the NECPs, a comprehensive understanding of the impact of global events on national energy and climate plans, specifically in the context of Portugal and Spain, has been provided.

The NECPs of Portugal and Spain are aligned with European goals, responding to external challenges while emphasizing energy efficiency, renewable energy, and strategic autonomy. Legislative changes, investment plans, and regulatory measures reflect a commitment to long-term sustainability.

Recommendations include continued adaptation to evolving global circumstances, collaboration in cross-border projects, and a focus on energy savings and efficiency. Strengthening ties between NECPs and air pollution control programs is crucial for holistic environmental planning.

The study underscores the first insights related to the need for NECPs to integrate responses to global events seamlessly. The European Green Deal and REPowerEU plan serve as frameworks for aligning national energy and climate plans with broader EU objectives, emphasizing the interconnectedness of global events and regional policies. The policy lessons derived from both the COVID-19 crisis and the Ukraine-Russia conflict might vary depending on the context of each nation. However, we can emphasize the importance of resilience, adaptability, and collaboration, in shaping national strategies [25, 26]. In essence, these principles can be integrated into the policymaking frameworks not only in Spain and Portugal, but also into other countries, which can enhance their energy security, contribute to regional stability, and progress towards their long-term sustainability goals.

Future research should extend beyond official communications and NECP documents, encompassing a diversified literature review that includes newspaper articles and alternative sources. Investigating public perceptions and stakeholder engagement strategies in Portugal and Spain, as well as conducting a comparative analysis across various EU countries, will offer a better understanding of the socio-economic and political dynamics influencing energy transitions.

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APPENDIX

1) Portugal

Appendix Table 1 compares the NECP goals for the years 2020, 2025, and 2030 between NECP 2019 and the updated version of 2023, including changes in installed capacity (in GW) across various energy sources.

Appendix Table 1. Evolution perspectives for installed capacity projections towards 2030 in Portugal (adapted from NECPs Portugal 2019–2023)

	NECP 2019				Draft NECP 2023	
(GW)	2020	2025	2030 min	2030 max	2025	2030
Hydro	7	8.2	8.2	8.7	8.1	8.1
of which in pumping	2.7	3.6	3.6	4.1	3.6	3.9
Wind	5.4	6.8	9.3		6.3	12.4
Onshore wind energy	5.4	6.7	9		6.3	10.4
Offshore wind energy	0.03	0.1	0.3		0	2
Solar Photovoltaic	2	6.6	9		8.4	20.4
of which is centralized	1.5	5.8	7		6.1	14.9
of which is decentralized	0.5	0.8	2		2.3	5.5
Concentrated Solar Thermal (CSP)	0	0.1	0.3		0	0.6
Biomass (biogas and waste) (2023)	0.4	0.4	0.5		1.2	1.4
Other renewables	0.03	0.06	0.1		N/A**	N/A**
Geothermal	0.03	0.03	0.06		0	0.1
Waves	0.001	0.03	0.07		0	0.2
Coal	1.8	0	0		N/A**	N/A**
Natural gas	3.8	3.8	2.8	3.8	4.9	3.8
Petroleum Products. fuel/diesel	0.4	0.3	0.3		0.6	0.4
Grand Total	**20.8**	**26.3**	**30.5**	**32**	**30**	**47**

The overall hydro capacity sees an increase from 20.8 GW in 2020 to a range of 30.5-32 GW in 2030 in NECP 2019. NECP 2023 proposes a higher capacity, ranging from 30 GW in 2025 to 47 GW in 2030, indicating an increment of 9.7-11.2 GW. Onshore and offshore wind energy capacities experience significant growth from 2020 to 2030 in both plans. NECP 2023 presents more ambitious goals, with increments ranging from 4.2 GW (16%) to 26.2 GW (125.96%) compared to NECP 2019. Solar PV capacities show a remarkable increase, particularly in NECP 2023, with an increment of 22% (9.2 GW) to 54% (26.2 GW) compared to NECP 2019. The reduction in fossil fuel capacities aligns with broader environmental goals, emphasizing a transition towards sustainable and low-emission energy systems.

Appendix Table 2 outlines the NECP goals for Portugal for the year 2030, comparing the original targets in PNEC 2030 with the revised goals in NECP 2023 for the years 2020, 2025, and 2030 across different sectors: Electricity, Heating and Catering, and Transport. The revised goals are higher, indicating a commitment to enhancing energy efficiency and transitioning to cleaner technologies in these sectors.

Appendix Table 2. Estimated sectoral share of renewable energy in the final energy consumption towards the 2030 goals for Portugal, comparison between NECP 2019 and 2023 (retrieved from Draft NECP Portugal 2023)

	NECP 2019			Draft NECP 2023	
Estimated Pathways for sectorial share on renewable energy	**2020**	**2025**	**2030**	**2025**	**2030**
Electricity	60%	69%	80%	77%	85%*
Heating and catering	34%	36%	38%	43%	47%
Transport	10%	13%	13%	10%	23%

Appendix Table 3 compares the NECP goals for 2019 and 2023 across various categories: Emissions reduction, Energy Efficiency, Renewables, Renewables in Transport, and Electricity Interconnections. The changes underscore a commitment to more aggressive climate action, renewable energy integration, and a sustainable energy transition in the revised plan of 2023 compared to the earlier version in 2019.

Appendix Table 3. Portugal NECP goals for 2019 and 2023 across various categories (adapted from NECPs Portugal 2019–2023)

NECP 2019 vs Draft NECP 2023					
National goals	Emissions (without lulucef; in relation to 2005)	Energy efficiency (reduced to primary energy)	Renewables	Renewables in transport	Electricity interconnections
PNEC 2030	-45% to -55%	35%	47%	20%	15%
Revision	-55%	35%	49%	23%	15%

2) Spain

Appendix Table 4 outlines the H2030 Target Scenario in the Energy and Climate Change Plan for Spain, focusing on installed capacity for the years 2030 under the PNEC 2020 and PNEC 2023. The changes in installed capacity signify a shift

towards a more diverse and renewable-centric energy landscape, with a significant emphasis on wind and solar PV.

Appendix Table 4. H2030 Target Scenario Energy and Climate Change Plan comparison in mainland Spain (adapted from NECPs 2020 and Draft 2023)

	NECP 2020 installed capacity goals for 2030		**Draft NECP 2023 installed capacity goals for 2030**	
	Installed capacity in Spain (MW)	%	Installed capacity in Spain (MW)	%
Nuclear	3.05	2%	3.041	1%
Coal	0	0%	0	0%
Cycles (combined cycle power plants)	24.56	16%	24.499	12%
Hydroelectric (+ pumping)	24.14	16%	14.562	7%
Wind	48.55	31%	60.322	30%
Solar PV	38.404	25%	72.751	36%
Solar thermal	2.3	1%	4.804	2%
Solar thermal storage 9h	5	3%	N/A	N/A
Other RES	1.73	1%	1.964	1%
Cogeneration and other	3.98	3%	4.071	2%
Batteries	2.5	2%	N/A	N/A
Storage	N/A	N/A	17.637	9%
Total electricity system	154.214	100 %	203.649	100 %
Electrolyzers	N/A	N/A	10.881	N/A

Appendix Table 5 provides a detailed analysis of the generation balance for Mainland Spain, comparing the first plan for 2020 and the updated version in 2023, both for the year 2030. The differences between 2020 and 2023 values highlight shifts toward increased reliance on nuclear, wind, and solar PV, with reductions in cycles and changes in solar thermal and storage.

Appendix Table 5. Generation balance (GWh) comparison in mainland Spain (adapted from NECPs 2020 and Draft 2023)

	NECP 2020 for 2030			**Draft NECP 2023 for 2030**		
	GWh	%	Hour's utilization	GWh	%	Hour's utilization
Nuclear	22.034	7%	7.224	34.573	9%	6.778
Coal	0	0%	0	0	0%	0
Cycles (combined cycle power plants)	27.617	9%	1.124	16.516	4%	0.674
Hydroelectric power	32.376	11 %	1.341	28.914	8%	1.987
Wind	109.464	36 %	2.255	126.739	34%	2.033
Solar PV	65.18	21 %	1.697	127.212	34%	3.489
Solar thermal	4.629	2%	2.013	9.47	3%	1.749
Solar thermal storage 9h	15.156	5%	3.031	N/A	N/A	1.971
Other RES	12.088	4%	6.987	13.743	4%	6.997
Cogeneration and other	18.399	6%	4.623	19.356	5%	4.755
Generation	306.942	100%	blank	376.551	100 %	blank