REPORT

MARCH 2026

The 5% Opportunity: Unlocking Europe's Innovative Renewables

An Analysis of 10 EU National Energy and Climate Plans

FCA Future Cleantech Architects

Executive Summary

The revised Renewable Energy Directive (RED III) introduces an important innovation lever: over the period from January 1, 2025 and December 31, 2030, member states are expected to ensure that at least 5%[1] of newly installed renewable electricity capacity contributes to the integration of innovative renewable energy technologies. While this provision establishes an indicative objective rather than a binding quantitative obligation, it represents a significant opportunity to accelerate the deployment of next-generation renewable technologies essential for the EU's long-term climate and energy goals.

Future Cleantech Architects (FCA) has analyzed the updated NECPs of ten member states - **Bulgaria, Denmark, France, Germany, Ireland, Italy, Lithuania, Slovenia, Spain, and the Netherlands** - with a specific focus on how this 5% target is interpreted and operationalized.

The analysis finds that seven countries explicitly reference the target in their National Energy and Climate Plans (NECPs) (if we count Italy and its capacity-based gigawatt [GW] objective), but only four provide any operational detail. Therefore, it is still necessary for the European Commission to offer comprehensive guidance to help member states achieve the target in an integrated, strategic way for the EU.

The main gaps we identified in our analysis include:

- **Limited engagement with the 5% target:** Only seven of the ten analyzed NECPs explicitly mention the 5% objective. Only four outline how it might be achieved, and even in these cases, structured deployment plans, capacity volumes, timelines, measures, and clear monitoring approaches are largely absent. In the European Commission's assessment of NECPs, only 10 out of 27 member states have included the target.
- **No shared operational definition of "innovative renewables":** Neither the NECPs nor existing EU guidance provide a harmonized interpretation of what qualifies as an innovative renewable energy technology. As a result, some member states classify relatively mature technologies (such as large heat pumps or conventional Power-to-X (PtX)) as "innovative," while higher-risk, early-stage technologies are rarely addressed.
- **Missing long-term road maps and integration strategies:** NECPs focus primarily on 2030, with minimal linkage between innovative renewables and long-term decarbonization pathways toward 2040 and 2050. This risks underinvesting in the cleantech needed for decarbonization beyond 2030.
- **Limited attention to high-potential innovative renewable technologies:** Technologies identified by FCA as innovative, such as concentrated solar power (CSP), perovskite and organic photovoltaic (PV), next-generation (enhanced, closed-loop, ultra-deep) geothermal, wave and tidal stream, ocean thermal energy conversion, salinity gradient, and airborne wind, are rarely mentioned in the NECPs and almost never linked to quantified deployment objectives.

The full implementation of the 5% requirement would imply more than 25 GW of innovative renewable capacity by 2030 across the ten countries analyzed alone. Today, this potential is not reflected in the NECPs, nor embedded in a coherent policy and governance framework.

With a proposal for a new EU renewable energy framework announced for Q3 2026, the European Commission has a unique opportunity to transform the 5% target from a symbolic provision into a central pillar for scaling next-generation renewable technologies.

FCA therefore proposes four concrete actions:

- Clarify what qualifies as "innovative renewable energy technologies" through EU-level guidance.
- Embed a dedicated and standardized section on the 5% target in NECP templates and related guidance, enabling transparent and comparable reporting.
- Strengthen the role of the 5% objective in the post-2030 renewable energy framework, including consideration of a more binding approach, accompanied by an evolving indicative technology list.
- Align EU and national funding instruments with the 5% objective, including explicit recognition in major EU programs and future National and Regional Partnership Plans (NRPPs).

[1] "Member States shall set an indicative target for innovative renewable energy technology of at least 5 % of newly installed renewable energy capacity by 2030." Article 3(3b) of Directive (EU) 2023/2413 ("RED III").

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Introduction

The starting point of this analysis is the 5% indicative target set out in the revised Renewable Energy Directive (RED III) for member states that *"shall ensure that, in the period from 1 January 2025 to 31 December 2030, at least 5% of the newly installed renewable electricity capacity contributes to the integration of innovative renewable energy technologies".*

This target is significant because it aims to accelerate the deployment of cutting-edge solutions that are essential for achieving the EU's long-term climate and energy goals. However, unlike the EU-wide renewable energy target, this provision does not establish a binding quantitative obligation but rather sets a policy direction intended to guide national planning, support schemes, and innovation frameworks. Within this legal context, Member States retain discretion over the choice of technologies, instruments, and implementation pathways, in line with the principles of subsidiarity and proportionality. At the same time, the Governance Regulation requires National Energy and Climate Plans (NECPs) to provide sufficient information to allow the European Commission to assess consistency, ambition, and credibility. This creates an expectation that the indicative objective should be reflected in a transparent and assessable manner in national planning documents.

Focusing on this provision allows for a clearer understanding of how innovation is being prioritized within national energy strategies. For Future Cleantech Architects (FCA), the intention is not only to incrementally increase deployment, but to:

- Shorten learning curves for emerging technologies, as promising solutions have the potential to become cheaper than fossil alternatives at scale.
- Diversify the renewable portfolio beyond solar photovoltaic (PV) and onshore wind.
- Prepare the ground for deep decarbonization beyond 2030.

National Energy and Climate Plans (NECPs) are the vehicle for embedding the 5% target in national strategies and for providing the European Commission with visibility on implementation. The first plans were submitted in 2019, with updated drafts due by June 2023. After receiving feedback from the European Commission on their first drafts, the member states submitted their final drafts in June 2024. On May 28, 2025, the Commission published its evaluation of the NECPs, assessing their ambitions and road maps for achieving the climate goals for 2030.

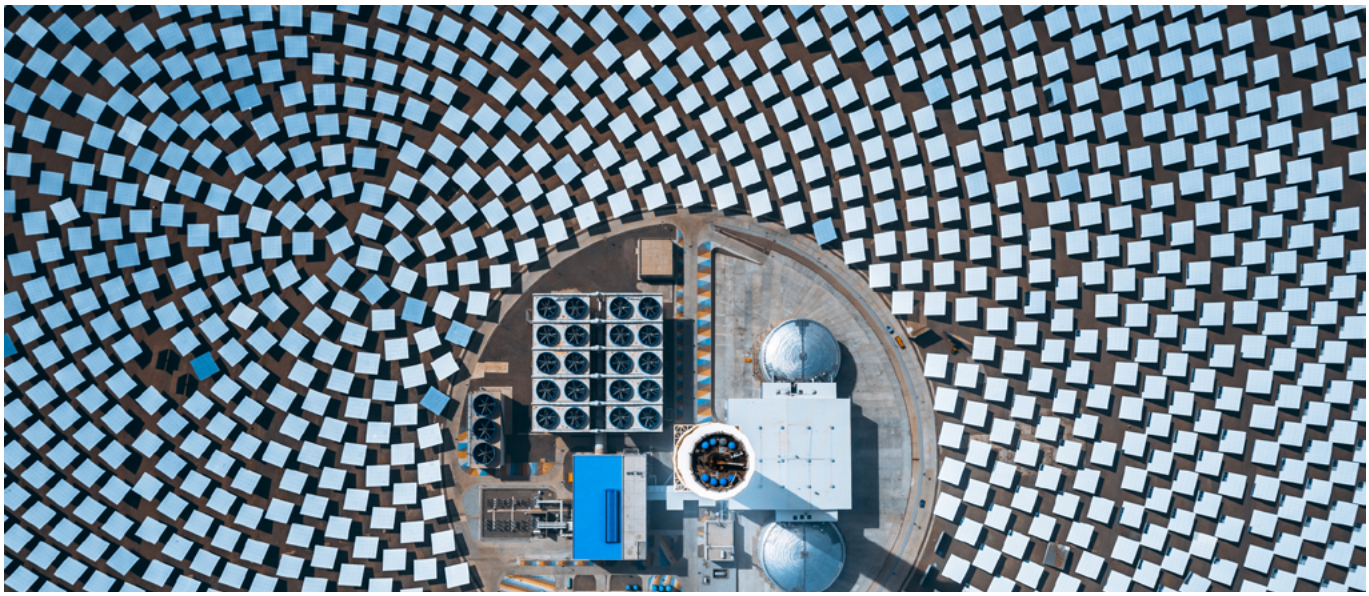
At the time this report was initiated in November 2024, 24 NECPs had been submitted. Of those, we selected ten member states based on their political relevance (i.e. holding of the EU presidency) and geographical balance across the EU: **Bulgaria, Denmark, France, Germany, Ireland, Italy, Lithuania, Slovenia, Spain, and the Netherlands**.

The analysis examines for each member state:

- whether and how the 5% target is referenced.
- how "innovative renewables" are described.
- what deployment volumes, timelines, and funding are identified.
- how these elements are linked to long-term decarbonization pathways.

The analysis in this report itself relies solely on the basis of the information provided by member states in their NECPs. This report also builds on FCA's earlier analysis of innovative renewables in four NECPs, incorporating final NECP submissions, the European Commission's 2025 assessment[2], and FCA's own capacity calculations.

According to the European Commission, ten member states have indicated an ambition to pursue the 5% target for innovative renewable energy. However, as the accompanying staff working document details, some of these countries have not established a road map outlining how they intend to achieve this objective. It means that 17 member states have not mentioned the target at all.



[2] "In terms of innovative renewable energy technologies, 10 Member States [BG, DK, DE, FR, IT, LV, NL, PT, SI, FI] set ambitious targets for newly installed capacity by 2030, aiming to meet the indicative 5% target set in the revised RED"

Defining Innovative Renewables

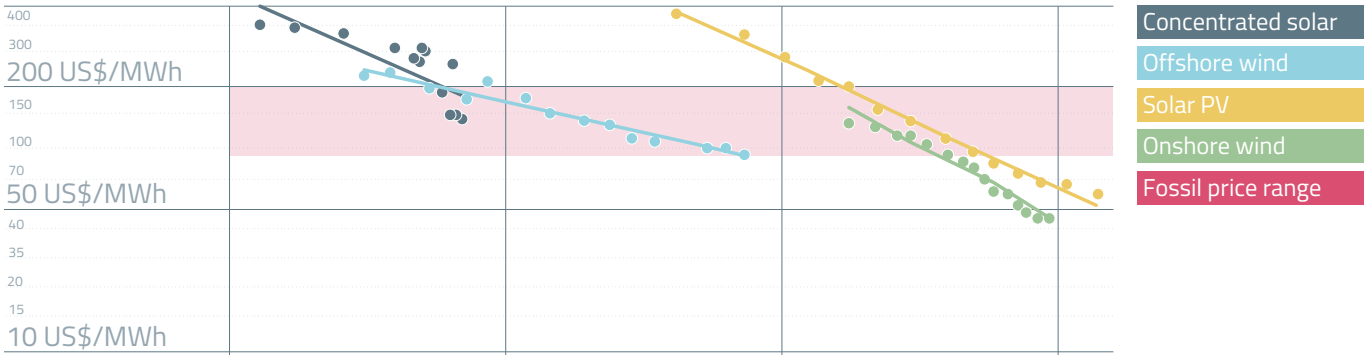


Figure 1: Levelized cost of electricity by technology (Global, 2010–2023). Source: IRENA 2024

The REDIII Article 2 defines innovative renewables as follows:

"*Innovative renewable energy technology' means renewable energy generation technology that improves, in at least one way, comparable state-of-the-art renewable energy technology or that renders renewable energy technology that is not fully commercialized or that involves a clear degree of risk exploitable.*"

FCA's approach agrees with the REDIII definition of "innovative renewable energy technology" as encompassing technologies that are entirely new or substantially improve the state of the art – but it is also more precise. In FCA's view, innovative renewable energy technologies introduce fundamentally different approaches to electricity generation that offer significant potential benefits, such as higher capacity factors, improved system value, or long-term cost reduction, but are less mature and therefore dependent on public support to scale up and become competitive.

As shown in Fig. 1, historical experience with solar PV and wind shows that innovation requires sustained support well beyond the laboratory and first commercial development, until deployment reaches gigawatt-scale and leverages learning curves. This supports REDIII's broader interpretation – capturing not-yet-commercialized and higher-risk technologies. Conversely, the Net-Zero Industry Act (NZIA)'s focus on market availability risks excluding technologies still in the critical scaling phase, thereby disincentivizing the initial commercialization needed to achieve competitiveness.

Applying this definition, FCA focuses on the following technologies (see Fig. 2): concentrated solar power (CSP), perovskite PV, organic PV, space-based solar PV, enhanced geothermal, closed-loop geothermal, ultra-deep geothermal, wave, tidal stream, ocean thermal energy conversion, salinity gradient,[3] and airborne wind.

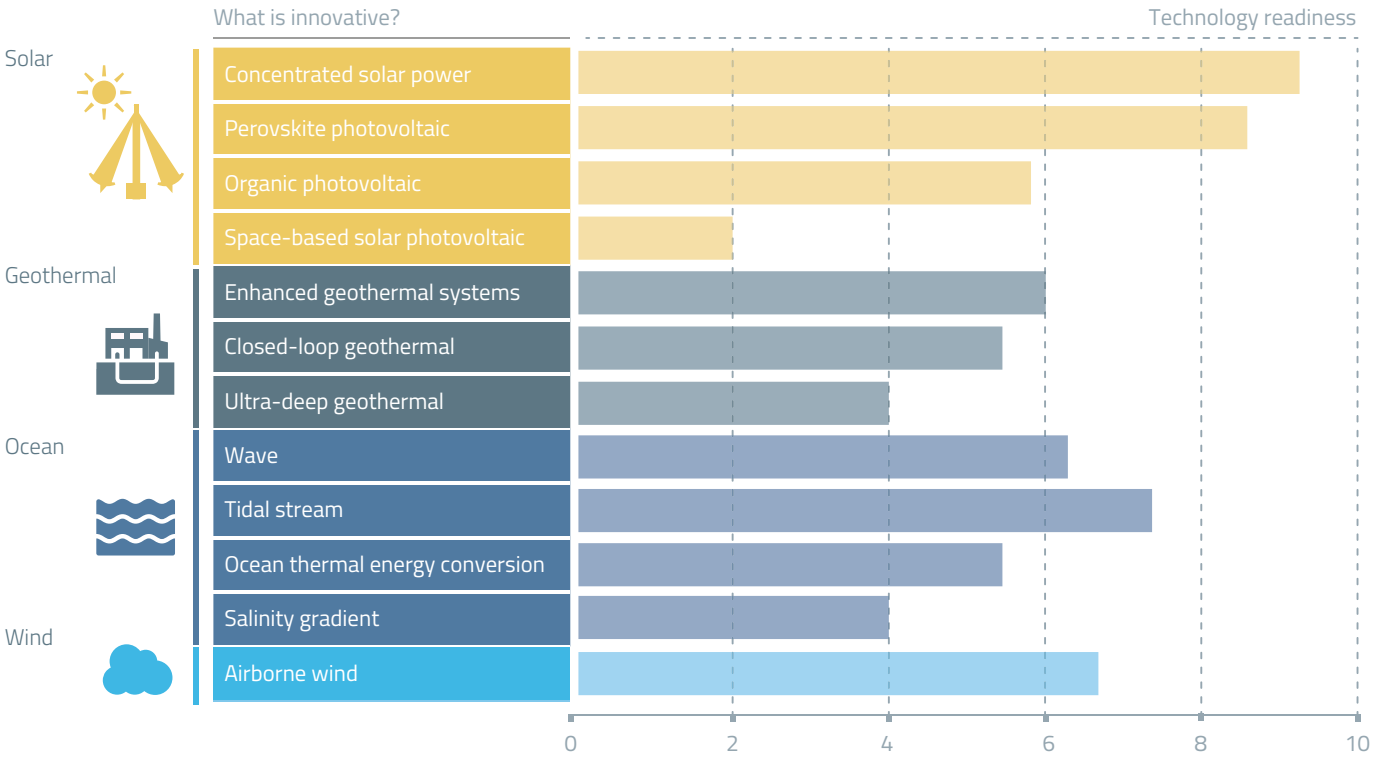


Figure 2: Technological Readiness Levels. Source: FCA analysis

[3] There is probably less potential for ocean thermal energy conversion, salinity gradient, and space-based solar PV.

Main Findings from NECP Analysis

The following section provides FCA's analysis of the NECPs of the ten selected member states, focusing on how innovative renewable energy technologies are defined, prioritized, and integrated into national planning.

Our main findings are:

1. Limited acknowledgment and weak operationalization of the 5% objective.
2. No harmonized operational definition of "innovative renewables".
3. Limited attention to potential breakthrough technologies.
4. Lack of long-term roadmaps and integration pathways beyond 2030.

As a general remark, the NECPs are comprehensive documents that are rich in information. However, the lack of consistency in data presentation, such as varying calculation methods, units, and formatting as well as the reliance on automated translation, create challenges for cross-country comparison and analysis. These limitations reduce the effectiveness of NECPs as tools for enabling investment, monitoring progress, and assessing compliance with EU objectives.

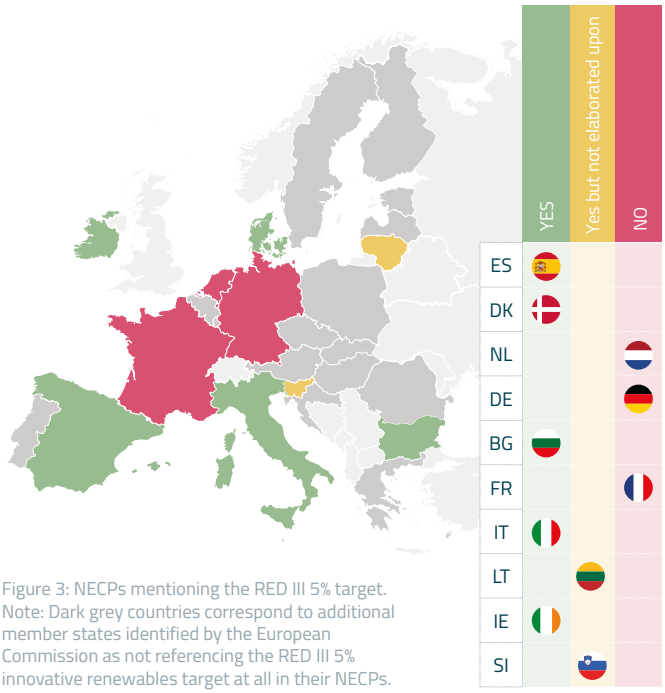


Figure 3: NECPs mentioning the RED III 5% target. Note: Dark grey countries correspond to additional member states identified by the European Commission as not referencing the RED III 5% innovative renewables target at all in their NECPs.

Operationalization Overview of the Target by Member States

Box 1

Some Member States nonetheless demonstrate that a more operational approach is possible within the existing framework. Spain, Denmark, Italy, and Ireland illustrate different, but complementary, ways of moving beyond generic references to innovation. Spain represents the most comprehensive approach, explicitly embedding the 5% objective into its NECP through a dedicated measure on innovative renewable capacity, supported by identified technologies, funding envelopes, pilot projects, and regulatory sandboxes. Denmark also provides a structured response, integrating the objective quantitatively through a calculation methodology and indicative contribution of innovative solutions, demonstrating the value of transparency and assessment, even where interpretations focus primarily on system integration and more mature technologies. Italy, while not explicitly referencing the 5% target, sets a clear absolute objective of 5 GW of innovative renewable capacity by 2030, backed by EU-approved state aid and dedicated de-risking instruments, notably for advanced geothermal energy. Finally, Ireland explicitly acknowledges the 5% objective and links it to innovation and demonstration measures, but without quantified capacity targets. A second group of Member States - Lithuania, Slovenia, and Bulgaria - explicitly reference the 5% requirement or innovative renewables in their NECPs, but provide limited detail on eligible technologies, deployment pathways, or funding mechanisms. In these cases, innovation remains largely framed at a strategic or research level, with no clear translation into deployment planning.
Finally, France, Germany, and the Netherlands address innovation through broader decarbonization, industrial, or system integration strategies but do not mention the target, only selected innovative elements (such as floating offshore wind or geothermal heat).

1. Limited Acknowledgment and Weak Operationalization

Of the ten countries analyzed, seven explicitly address the objective of deploying innovative renewable energy capacity, either through direct reference to the RED III 5% requirement or through the establishment of an explicit national target for innovative renewables (notably in the case of Italy).

Although all the NECPs acknowledge the importance of innovation in general terms for the energy transition, the indicative nature of the 5% objective has translated into uneven and limited operationalization: only four include a dedicated section or measure outlining how the 5% target is expected to be achieved, accompanied by indicative technology list or support instruments.

Even in these cases, the treatment of the 5% target is qualitative and partial: None of the analyzed NECPs include a standardized calculation showing total additional renewable electricity capacity required by 2030, an indication of the corresponding 5% volume, and the breakdown by innovative technologies. Monitoring, indicators, and responsible authorities are rarely specified.

This creates a risk that the implementation of the 5% target remains ad-hoc, fragmented, and difficult to track within the NECP governance cycle.

2. No Harmonized Definition of "Innovative Renewables"

None of the NECPs provide a clear, operational definition of "innovative renewable energy technologies". And neither RED III nor the NZIA currently offers a non-binding, indicative technology list to guide member states' interpretation. As a result, there is a wide divergence in how countries operationalize this concept: Some include incremental innovations, system-related, and near-market solutions (e.g. large heat pumps, Power-to-X (PtX), battery storage) as "innovative." Others focus predominantly on the deployment of mature technologies and largely omit early-stage or breakthrough generation technologies.

This makes it difficult to:

- ensure comparability across member states.
- evaluate compliance with the 5% target.
- develop a coherent EU-wide narrative on renewable energy innovation progress.

The European Commission's Recommendation of July 2025 on system integration and innovative forms of renewable energy deployment provides useful clarification, but its scope is limited primarily to floating offshore wind, ocean energy, and certain innovative solar deployment models. Much high-potential breakthrough cleantech remain outside the core policy spotlight, and the Recommendation does not provide guidance on how the 5% share should be calculated in practice.

3. Limited Attention to Potential Breakthrough Technologies

Based on the 2030 renewable energy targets outlined by member states in their NECPs, FCA calculated the additional renewable energy capacity (in gigawatts, GW) required in each member state and the implied 5% innovative share (Fig. 4).

The 2023 figures for each country are drawn from Eurostat's "Electricity production capacities for renewables and wastes" dataset, while 2030 targets are sourced from the respective NECPs.

Both numbers account for national solar and wind capacities[4]. FCA calculated the 5% target for each member states based on the difference between each country's 2030 capacity goal and its 2023 capacity (Table 1).

Applying FCA's working list of innovative technologies[6], we find that these technologies are rarely or not at all mentioned in the NECPs analyzed (see Fig. 5). When they are mentioned (e.g. some geothermal options, ocean energy), they are not linked to concrete capacity targets or funding roadmaps. The bulk of innovative activity in member states seems to focus on:

- **advanced uses of mature technologies** (e.g. floating PV, hybrid systems).
- **system integration solutions** (storage, PtX, demand-side flexibility).
- **low-risk technologies** with only clear relevance for the 2030 timeframe.

This suggests that the 5% target is currently not being leveraged enough as a strategic tool to prepare the next wave of breakthrough renewable technologies needed for 2040–2050.

Country	RES capacity 2023 (GW)	RES target 2030 (GW)	Additional capacity (GW)	Implied 5% innovative RES (GW)
Bulgaria	6.2	11.9	5.7	0.3
Denmark	11.3	44.5	33.2	1.7
France	66.5	124.9	58.4	2.92
Germany	144.4	360.0	215.6	10.8
Ireland	5.5	22.0	16.5	0.83
Italy	49.4	131.0	81.6	4.08
Lithuania	2.6	10.3	7.7	0.39
Netherlands	32.0	48.9	16.9	0.84
Slovenia			3.7	0.19
Spain	77.1	158.5	81.4	4.1

Table 1: Implied 5% Innovative Capacity[5]. Source: Eurostat; NECPs.

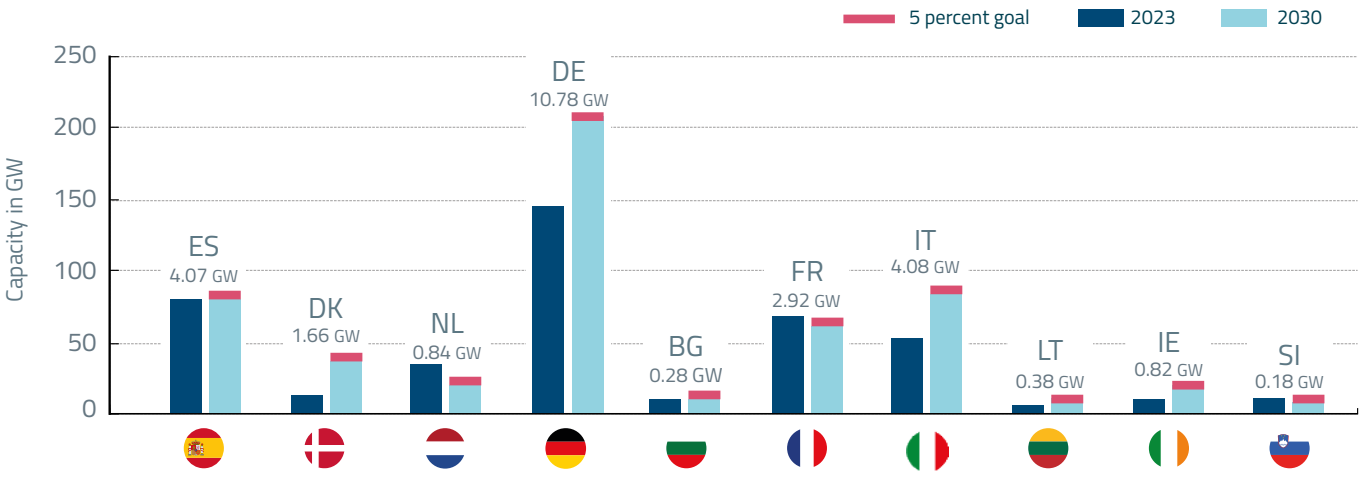


Figure 4: Estimation of the 5% target per country in GW

[4] For Denmark, the values also include hydro, waste, biogas, and geothermal capacities in order to reflect the fact that these categories are represented in Denmark's NECP. The same applies to Spain's values, which additionally encompass ocean capacity.

[5] All renewable electricity capacity figures are based on Eurostat installed capacity in 2023 and 2030 targets as reported in the updated NECPs. The implied 5% innovative renewable capacity is calculated as 5% of the additional capacity required between 2023 and 2030. Slovenia stands alone in not specifying the total RES target 2030 but only the additional capacity directly, which is used to derive the implied 5% innovative RES.

[6] Including CSP, perovskite PV, organic PV, enhanced/closed-loop/ultra-deep geothermal, wave and tidal stream, ocean thermal energy conversion, salinity gradient, and airborne wind.

On a positive note, all countries mention that they actively participate in EU-level funding programs, such as Horizon Europe, the SET Plan, and NextGenerationEU, and collaborate through industrial partnerships in areas like offshore wind and storage. These efforts reflect a shared European commitment to accelerating innovation in renewable technologies.

However, participation in EU initiatives alone does not substitute for national ambition, and does not necessarily mean there is a coherent EU-wide strategy for the development of these technologies that also recognizes the potential within different regions of the EU. Concrete investments and structured implementation plans are essential to translate innovation into impact.

4. Lack of Long-Term Road Maps and Integration Pathways

Most NECPs focus mainly on achieving the 2030 targets for renewable energy, energy efficiency, and emissions. They treat innovative renewables mainly as research topics, pilot projects, or niche elements, and they do not factor into their long-term planning the potential benefits that such technologies can bring in 2040 or in 2050 when the EU is due to achieve climate neutrality. However, some NECPs include funded pilot projects and innovation sandboxes, signaling growing recognition of their value.

Spain, Ireland, and Denmark's NECPs give strong importance to innovation and deployment planning, while Germany and the Netherlands emphasize as innovation, infrastructure, hydrogen, and electrification but provide limited direction on innovative renewable technologies.

This lack of focus on innovation undermines the potential of the 5% target to act as a bridge between today's deployment agenda and tomorrow's decarbonization needs. Member states risk missing critical opportunities to invest early in next generation renewable energy technologies.

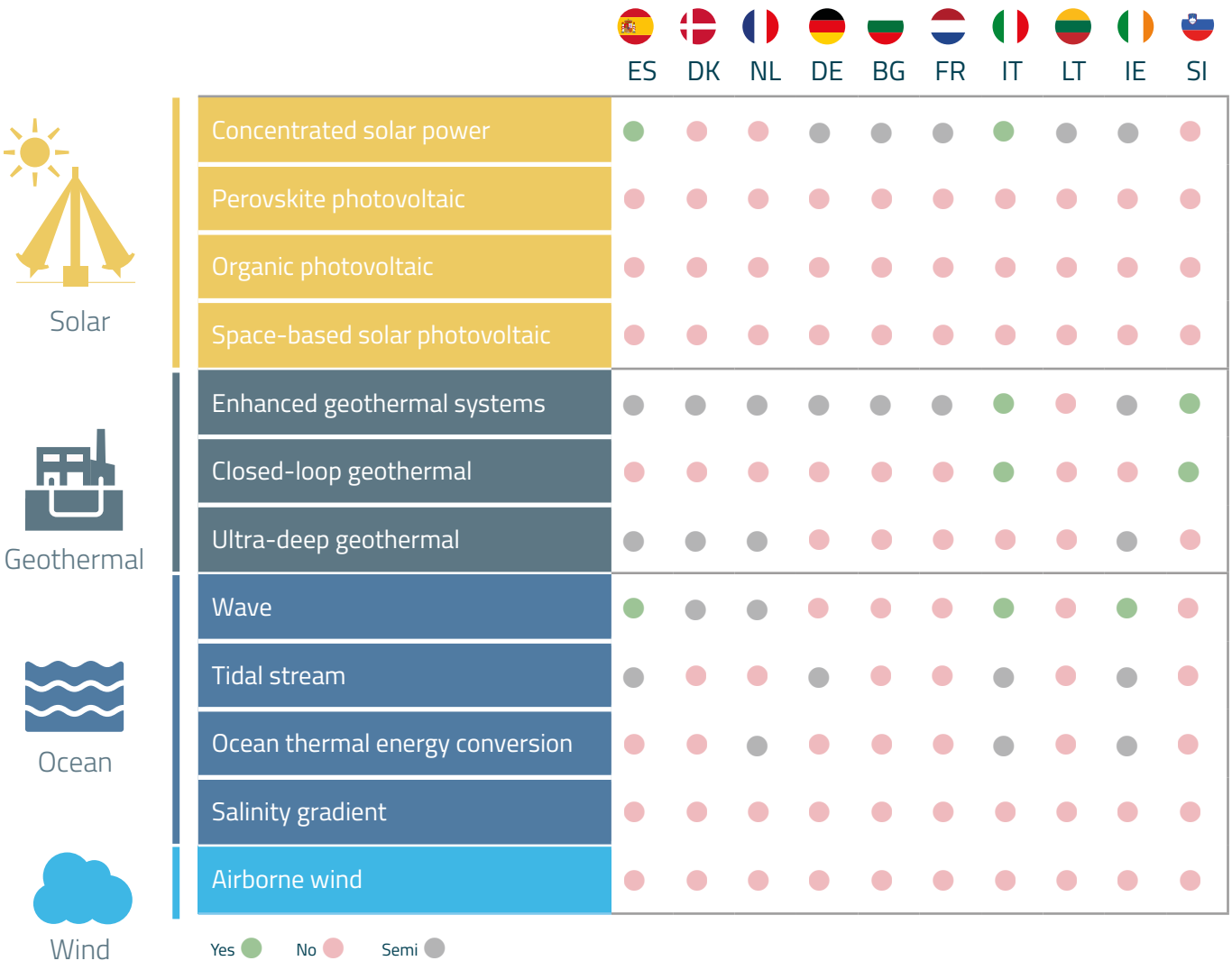


Figure 5: Innovative technologies mentioned in NECPs

Recommendations

FCA proposes four concrete steps:

Establish clear guidance on innovative renewables and build on the European Commission's Recommendation from July 2025. We propose to define "innovative renewables" using a combination of Technology Readiness Level (e.g. TRL 6–8), performance criteria (e.g. capacity factor, system value), and scalability potential, accompanied by an indicative, non-exhaustive and dynamic list of eligible technologies to be updated periodically. It is also necessary to clarify under which conditions near-market technologies may be counted, while encouraging member states to include a diversified portfolio of higher-risk/reward cleantech.

Embed the 5% innovative renewable energy target in future NECP structure and content: The Commission should further operationalize the 5% innovative renewable energy target by updating the NECP template and accompanying guidance to require a specific section dedicated to innovative renewable energy technologies, in line with the structure and reporting logic of the Governance Regulation[7].
Within this section, member states should set out, in a transparent and comparable manner, indicative calculations of additional renewable electricity capacity and the associated innovative share, identify categories of innovative renewable technologies relevant at the national level, describe the main measures and investment intended to support their deployment, and outline basic monitoring arrangements and responsible authorities. To support consistency and facilitate assessment, the Commission should provide a standardized table or annex for this information, enabling comparability across member states and supporting the monitoring of collective progress toward the objectives of the Renewable Energy Directive.

Integrate the 5% objective into the upcoming 2040 renewable energy framework: Looking beyond 2030, and as the EU energy system becomes increasingly reliant on variable renewables, ensuring the timely development of innovative and system-supporting technologies may require a stronger and more predictable regulatory signal. The 5% target should be binding in the post-2030 energy framework, and be accompanied by an indicative list of cleantech which would evolve in a dynamic way over time. This would position it as the innovation pillar of the future renewable energy framework to integrate plans deeper into a future-oriented road map that goes beyond 2030. The 5% innovative renewables target has the potential to become a cornerstone of Europe's next wave of clean energy innovation.

Align EU and national funding with the 5% target to reach the GW potential for each country: Projects contributing to the 5% target in major EU instruments with specific dedicated windows (Innovation Fund, Horizon Europe successor, Connecting Europe Facility, etc.) should also be explicitly recognized, and national earmarking of EU funds should be encouraged (pilot and demonstration projects, regulatory sandboxes and innovation-friendly procurement, derisking tools for early deployment). These innovative renewables should be clearly included in the newly proposed National and Regional Partnership Plans (NRPPs).

Innovation Policy Toolbox

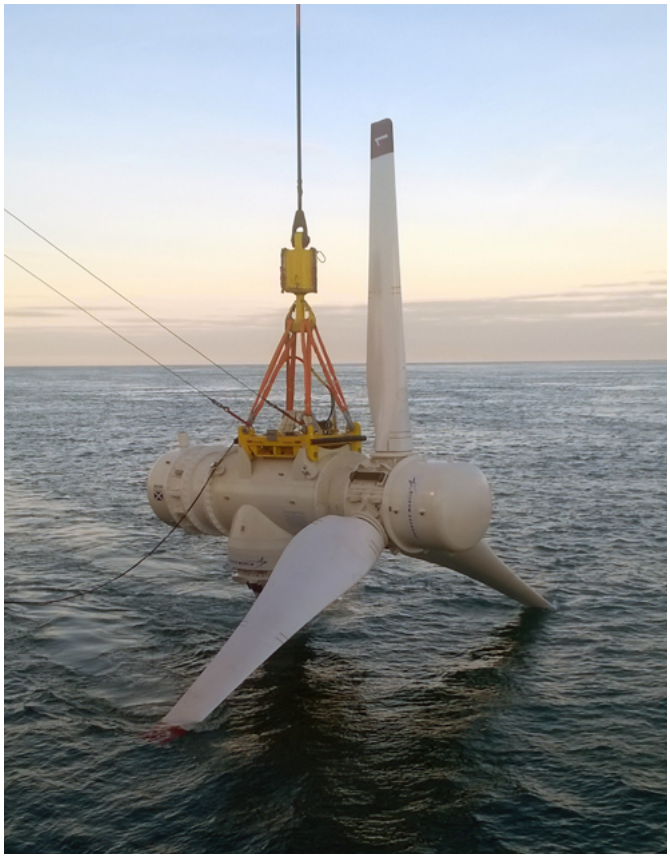
Box 2

Member States have access to a wide range of policy instruments that can support innovative renewable energy technologies in compliance with EU law, including state aid rules.

These instruments can be combined and adapted to national circumstances and technological strengths, and may include for instance:

- Dedicated auctions or innovation windows within renewable energy sources support schemes
- Contracts for Difference or feed-in premiums adapted to first-of-a-kind or higher-risk projects
- Investment grants and operating support for pilot and demonstration projects
- Risk-sharing instruments such as public guarantee mechanisms
- Regulatory sandboxes and experimentation frameworks to test new technologies or business models under lighter regulatory conditions
- Innovation-oriented public procurement and pre-commercial procurement, meaning before anything is ready to be bought at scale
- Targeted grid access and connection prioritization for innovative projects

Each Member State can selectively deploy these tools where it sees the greatest system, industrial, or strategic value, allowing innovative renewables to be developed in line with national energy mixes and long-term decarbonization pathways.



[7] Regulation - 2018/1999 - EN - EUR-Lex

Conclusion

If the 5% target is not further clarified and operationalized, there is a risk that it will primarily support incremental deployment of mature technologies, rather than accelerating learning and cost reductions for next-generation renewables across the EU.

Strengthening its implementation would help avoid a future gap between 2030 deployment pathways and the technologies needed for climate neutrality in 2040 and 2050, while reinforcing Europe's long-term innovation capacity and industrial competitiveness.

Annex: Country Profiles – Assessment of NECPs with Respect to Innovative Renewable Energy Technologies

*All information is drawn from the respective NECPs.

Bulgaria

Bulgaria's electricity system remains carbon-intensive, with coal accounting for a significant share (26%) of electricity generation, and a planned phase-out by 2038. The NECP prioritizes energy efficiency, grid modernization, and the gradual expansion of solar and onshore wind.

Renewable Energy (in GW) Installed by 2030

Based on Eurostat data, Bulgaria had an installed renewable electricity capacity of 6.2 GW in 2023 and aims to reach 11.9 GW by 2030, implying an additional 5.7 GW of new capacity over that period. In line with the RED III requirement, according to our calculations, this would correspond to around 0.3 GW of innovative renewable electricity capacity between 2025 and 2030.

Coverage of Innovative Renewable Technologies

The plan includes limited references to CSP, notably in the context of converting a coal-fired power plant, and to geothermal technologies, primarily for heat applications. Other innovative renewable technologies identified by FCA, including perovskite PV, organic PV, ocean energy, salinity gradient, and airborne wind, are not addressed.[8]

Assessment of How the 5% Target Is Addressed

Bulgaria explicitly refers to the RED III requirement and sets an indicative target of 6.2% innovative renewables by 2030, thereby exceeding the EU minimum, providing a useful starting point for innovation-driven deployment. However, the NECP does not provide intermediate milestones, quantify the corresponding capacity volume, nor provide a breakdown of innovative technologies. Furthermore, no detail is provided on how this target will be met, and no supporting measures are outlined.

The strategic value of the 5% target could be enhanced by clarifying eligible technologies, defining deployment pathways, and linking the target to concrete timelines and funding instruments. The planned CSP-coal conversion project illustrates how the 5% target could be used more systematically to support industrial transition and regional transformation.

[8] Figure 2 showcases the share of newly installed capacity for 2022, 2025, and 2030.

Denmark

Denmark's NECP is strongly oriented toward large-scale deployment of renewable electricity, particularly offshore wind, combined with strong system integration through Power-to-X, storage, and district heating. The country positions itself as a regional hub for offshore energy and hydrogen.

Renewable Energy (in GW) Installed by 2030

Denmark's installed renewable electricity capacity amounted to 11.3 GW in 2023 and is projected to increase to 44.5 GW by 2030, implying an additional 33.2 GW of new capacity. Applying the REDIII requirement, this would correspond to approximately 1.7 GW of innovative renewable electricity capacity over the period to 2030.

Coverage of Innovative Renewable Technologies

Denmark classifies a broad range of near-market technologies as "innovative," including large heat pumps, PtX installations, storage, and exploratory wind turbines. While geothermal energy is included, most high-risk, breakthrough generation technologies identified by FCA, such as CSP, perovskite PV, advanced geothermal systems, ocean energy, and airborne wind, are largely absent.

Table 2: Denmark's renewable energy targets for 2030. Source: Danish NECP p. 45

	Creation of new renewable energy capacity				Creation of new innovative renewable energy capacity (MW)						
					Electricity			District heating			
Year	Electricity	Remove-heat	Biogas	Heat pumps	Experimen-talmills	Energy islands	PTX	Stock	Heat pumps	Geothermia	Share %
2025	2820	580	120	140	0	0	360	100	130	0	16
2026	3150	2410	270	230	150	0	360	1030	360	0	31
2027	4360	2690	480	350	150	0	660	1030	690	0	32
2028	4340	2840	560	460	150	0	660	1030	930	0	34
2029	4980	3240	660	560	150	0	660	1030	1330	0	34
2030	9290	3530	790	670	150	0	660	1030	1540	100	24

Assessment of How the 5% Target Is Addressed

Denmark explicitly integrates the RED III requirement and estimates that innovative renewables could account for up to 24% of newly installed capacity by 2030. Denmark's NECP demonstrates a strong and proactive approach to meeting the RED III requirement, supported by clear calculations and a high projected share of innovative capacity.

This number meets the letter of the RED III requirement, but only partially its intention to accelerate breakthrough renewable generation technologies, as it has a broad definition of "innovative".

The plan primarily emphasizes near-market and system integration technologies. Looking ahead, the 5% framework could be leveraged to explore a broader portfolio of breakthrough renewable generation technologies, complementing Denmark's leadership in offshore wind and PtX.

France

France's NECP is anchored in the National Low-Carbon Strategy and the Multiannual Energy Program, with a strong emphasis on nuclear energy, transport electrification, and industrial decarbonization, alongside expanding renewable energy deployment. France's nuclear fleet consists of 56 reactors across 18 power stations, with a total installed capacity of 61.4 GW. Nuclear energy plays a central role in the NECP, with strategies outlined for both existing and future plants.

Renewable Energy (in GW) Installed by 2030

France's installed renewable electricity capacity stood at 66.5 GW in 2023 and is projected to increase to between 116.9 GW and 124.9 GW by 2030, implying an additional 58.4 GW of new capacity. In line with the RED III requirement, this would correspond to around 2.92 GW of innovative renewable electricity capacity over the period from 2023 to 2030.

France's NECP reflects substantial ambition for renewable energy development, especially in offshore wind. In 2023, the Law on the Acceleration of Renewable Energy Production was adopted to speed up deployment, notably in response to Article 15b of RED III, which requires member states to designate areas suitable for renewable energy development in line with their 2030 targets.

By 2035, at least an additional 177 TWh of renewable electricity is expected to be produced through the combined deployment of PV, wind, and hydropower technologies, reaching around 125 GW in 2030 and between 160 and 190 GW in 2035.

Table 3: France's renewable energy targets in 2030 and 2035. Source: The French NECP

Renewable Energy Source	2030	2035
PV	54–60 GW	75–100 GW
Onshore wind	33–35 GW	40–45 GW
Offshore wind	3.6 GW	18 GW
Hydropower	26.3 GW*	28.5 GW*

*including pumped-storage hydropower

If we zoom in on offshore wind, projects launched since 2010 are expected to bring installed capacity to 3.6 GW by 2030, including 1.5 GW already operational by mid-2024. Floating offshore wind is prioritized as a key innovation pathway, with a 250 megawatt (MW) floating wind project awarded a Contract for Difference (the first of its kind), which, once completed, is expected to be the largest floating offshore wind project globally.

Coverage of Innovative Renewable Technologies

Technologies identified by FCA as innovative renewables, such as perovskite PV, airborne wind, and ocean energy, are largely absent from the French NECP. Geothermal and solar thermal energy are mentioned, mainly for heat applications. Offshore wind innovation focuses primarily on floating wind. Regarding solar thermal installations, the government plans to launch a dedicated call under the Heat Fund and develop a national solar thermal plan.

Assessment of How the 5% Target Is Addressed

The French NECP does not explicitly reference or quantify the RED III indicative target requiring at least 5% of newly installed renewable electricity capacity to come from innovative technologies. No calculation methodology or indicative capacity volume is provided.

While the 5% innovative renewables target is not explicitly addressed, existing initiatives in floating offshore wind, geothermal, and solar thermal provide a foundation on which a more structured innovation pathway could be built. Integrating these elements into a dedicated 5% framework would improve visibility and help align innovation efforts with France's long-term decarbonization objectives.

While the national acceleration strategies (*stratégies d'accélération*) outline thematic priorities, their operationalization in the NECP remains limited. In particular, clearer budget allocations, implementation timelines, and expected contributions to renewable energy supply are not specified.

Germany

Germany's NECP focuses on the rapid expansion of renewable electricity production, grid modernization, and the decarbonization of industry, specifically industrial production and green hydrogen, with strong regional and cross-border cooperation. Due to Germany's federal system, the engagement of stakeholders across the country is acknowledged and facilitated in the Climate-Neutral Electricity System Platform, ensuring integrated and efficient electricity market design. Regional cooperation is viewed as a core component of Germany's energy and climate transition, as demonstrated by its joint renewable electricity projects with Denmark and the United Kingdom, and hydrogen projects with the Netherlands and Norway. Germany is a highly interconnected country with collaborative relations in the climate field, in the form of the Pentalateral Energy Forum, the North Seas Energy Cooperation, and Baltic Energy Market Interconnection Plan.

Renewable Energy (in GW) Installed by 2030

Germany's installed renewable electricity capacity amounted to 144.4 GW in 2023 and is projected to increase to 360 GW by 2030, implying an additional 215.6 GW of new capacity over the period. In line with the RED III requirement, this expansion would correspond to around 10.8 GW of innovative renewable electricity capacity by 2030.

Coverage of Innovative Renewable Technologies

Geothermal energy and solar thermal technologies are mentioned, primarily in the context of heat supply and permitting acceleration. Concentrated Solar Power is referenced indirectly through participation in EU-level working groups (SET Plan). However, advanced geothermal systems, perovskite or organic PV, ocean energy, airborne wind, and other breakthrough technologies identified by FCA are not addressed.

Geothermal is recognized in the German NECP, as included in the estimated installed capacity of renewable energy, set to contribute 8 MW from 2024–2030. This number, however modest, does show that geothermal is on the radar, in line with it being included under other renewable energy categories. The measure under examination includes a draft to speed up approval procedures for geothermal, heat pumps, and thermal storage facilities. However, advanced geothermal, closed-loop geothermal, and ultra-deep geothermal are not mentioned explicitly.

Assessment of How the 5% Target Is Addressed

The German NECP does not explicitly reference or quantify the RED III 5% target for innovative renewable energy technologies. No indicative capacity volume, calculation methodology, or monitoring approach is provided. The plan does not explicitly acknowledge or quantify the 5% innovative renewable energy target.

The data from 2023 shows that innovation in the field of renewables has expanded, with the number of patent applications for solar technology, wind power, and other regenerative energy technologies increasing by 18.6% year-over-year in Germany. And the German NECP presents a strategy for scaling renewable electricity, modernizing grids, and accelerating industrial decarbonization. As highlighted above, there is some focus on FCA-defined innovative technologies, mainly advanced geothermal and CSP. The inclusion of geothermal in permitting and regulatory frameworks, as well as the acknowledgment that other renewable energy technologies will increase in significance over the 2020s, can be perceived as crucial to the further integration of this technology.

However, other innovative technologies, such as perovskite PV, airborne wind, and ocean energy, are not discussed in the NECP. Moreover, the NECP is limited in its details on the budget earmarked for research and innovation in general.

Ireland

Ireland's NECP focuses on the rapid decarbonization of electricity, driven primarily by large-scale offshore wind deployment, electrification, and grid reinforcement, reflecting high energy import dependency and the need to strengthen energy security.

Ireland's greenhouse gas (GHG) emissions were reduced by 6.8% in 2023, with reductions recorded across almost all sectors. This represents the lowest level of GHG emissions in three decades, falling below the 1990 baseline. Since 2010, Ireland has had a national carbon tax, with revenues earmarked to support vulnerable groups through the decarbonization transition. Ireland has also committed to ending coal-fired electricity generation by 2025, replacing it with low-carbon and renewable technologies.

Renewable Energy (in GW) Installed by 2030

Ireland's installed renewable electricity capacity stood at 5.5 GW in 2023 and is projected to reach 22 GW by 2030, implying an additional 16.5 GW of new capacity. Applying the RED III requirement, this would correspond to around 0.82 GW of innovative renewable electricity capacity over the period to 2030.

The Irish NECP sets the ambition of achieving 80% of electricity demand from renewable energy sources by 2030. To support this goal, it created the Renewable Electricity Support Scheme (RESS) as the primary support scheme for utility-scale renewable electricity generation, covering onshore wind, solar, hybrid systems, and offshore wind. The RESS operates through competitive auctions, offering a two-way floating feed-in premium to successful projects.

Ireland had outlined an ambition to deploy 6 GW of onshore wind and up to 5 GW of solar PV by 2025, increasing to 9 GW of onshore wind, 8 GW of solar PV, and at least 5 GW of offshore wind by 2030.

Coverage of Innovative Renewable Technologies

Ireland's NECP addresses innovation mainly through offshore wind and ocean energy research and development (R&D), system integration, and grid flexibility. Other innovative renewable technologies identified by FCA, including advanced geothermal systems, perovskite or organic PV, and airborne wind, are not included in the deployment planning.

The Irish NECP identifies the development of a Low-Carbon Technology Demonstration Pilot Call as a key measure to support innovative renewable energy technologies. The pilot is intended to fund the development and demonstration of a broad range of technologies, including offshore renewables, storage, and grid solutions, thereby helping to build a domestic innovation pipeline contributing to compliance with RED III, including the 5% innovative renewables target.

Offshore renewable energy is highlighted as a central pillar of Ireland's decarbonization strategy. To underpin development in this area, funding is directed toward offshore and ocean test site facilities, including:

- **Lir National Ocean Test Facility in Cork**, a small-scale site, with state-of-the-art wave tanks comprising a deepwater basin and wave test tanks that allow for scaled testing in a controlled environment, addressing Technology Readiness Level (TRL) 1–4.
- **SmartBay Marine and Renewable Energy[9] Test Site in Galway Bay**, an intermediate-scale site for marine energy and monitoring technology, supporting projects at TRL 4–6.
- **Atlantic Marine Energy Test Site off the Mayo coast**, intended to host full-scale marine energy devices that could be tested at their final stages of pre-commercial development, at TRL 7–9 (currently under development, and expected to be operational by 2027).

In relation to geothermal, Ireland commits to research and geological data collection to promote the sustainable development of its geothermal resources for heating and cooling of buildings, and for industrial uses and power generation. Geothermal technologies are included in national plans to deliver low-carbon solutions under the Climate Action Plans and sectoral road maps. The Geological Survey Ireland is developing geological maps and datasets to support both deep and shallow geothermal deployment across different markets. To manage peak seasonal electricity demand linked to heating electrification, the strategy will assess the optimal balance between ground-source and air-source heat pumps and promote geothermal storage and heat reuse.

Ireland also places strong emphasis on ocean energy, with continued support for research, development, and demonstration (RD&D) projects. Ireland's NECP highlights its significant marine energy potential and includes measures to support the ocean energy RD&D pathway. Under the Climate Action Plan 2024, one research and innovation action foresees the publication of a 2030+ road map to define pathways for offshore and ocean energy deployment. Long-term targets for marine energy capacity are set at 225 MW by 2040 and 475 MW by 2050.

Assessment of How the 5% Target Is Addressed

Ireland explicitly highlights the RED III requirement to ensure that at least 5% of newly installed renewable electricity capacity contributes to the integration of innovative renewable energy technologies.

Ireland's NECP explicitly recognizes the RED III 5% target and links it to concrete RD&D instruments, notably through the planned Low-Carbon Technology Demonstration Pilot Call. This creates a credible pipeline for innovative technologies, particularly in offshore and ocean energy. Further strengthening the framework by quantifying deployment volumes and clarifying the contribution of these measures to the 5% target would enhance the NECP and implementation certainty.

There also seems to be a political commitment to exploring the potential of geothermal, both deep and shallow, including for industrial power generation for industry. Similarly, the NECP demonstrates consistent support for marine energy, with long-term capacity targets that signal sustained ambition and strong alignment with Ireland's offshore wind strategy.

[9] www.internationalwaters.info/smartbay

Italy

Italy's NECP highlights the country's climate vulnerability, with among the highest potential economic losses related to climate change in Europe. This context underlies its focus on climate adaptation, industrial competitiveness, and energy security, with particular emphasis on geothermal energy. Italy has a historical expertise in geothermal technologies, which is clearly reflected in its NECP. Nuclear power also appears as a recurring theme, notably through the establishment of a national platform for sustainable nuclear energy. In parallel, the NECP places a strong focus on the battery value chain, critical raw materials, and large-scale hydrogen investment.

Renewable Energy (in GW) Installed by 2030

Based on the renewable energy projections set out in the NECP, Italy aims to reach a total renewable electricity capacity of 131 GW by 2030. Applying the RED III requirement, this would correspond to approximately 4.08 GW of innovative renewable electricity capacity, as illustrated in Table 1.

The Italian NECP foresees 131 GW of renewable installations by 2030, with around 80 GW from PV and 28 GW from wind, corresponding to a total capacity increase of around 74 GW compared to 2021. Of this increase, approximately 57 GW is expected from PV and 17 GW from wind.

In connection with the EU "Offshore Renewable Energy Strategy," Italy adopted two non-binding agreements in January 2023, committing to connect up to 4 GW to the national grid by 2030 in the "South and West Offshore Grids" priority corridor and 4.5 GW in the "South and East Offshore Grids" corridor.

In Italy, the primary support mechanism for renewable electricity remains tariff-based incentives. In 2022, nearly 1.8 million agreements with private and public entities were in place, supporting the operation of around 1.2 million renewable installations with a combined capacity of approximately 40 GW.

Coverage of Innovative Renewable Technologies

Innovative technologies such as offshore wind and floating wind, floating PV, agrivoltaics, thermodynamic solar, marine energy, and advanced geothermal energy are expected to contribute an additional 5 GW of capacity by 2030.

Thermodynamic solar is listed as one of the innovative technologies expected to contribute to this 5 GW objective, while certain types of PV applications, such as floating PV and agrivoltaics, are identified as having "significant innovation potential".

While Italy does not explicitly frame this objective in RED III 5% terms as such, the scale of its innovative renewables ambition, particularly in geothermal, would be sufficient to meet or exceed the implied requirement if fully delivered. The plan recognizes the high investment risks associated with geothermal projects and highlights the need for dedicated risk-mitigation instruments, notably a specialized guarantee fund, explicitly referring to France as a benchmark. This approach is reinforced by a state aid scheme approved by the European Commission in June 2024, aimed at de-risking investment and enabling geothermal deployment beyond its traditional concentration in Tuscany.

Italy set out detailed technological development objectives for geothermal energy, including:

- expanding energy conversion from underutilized or hard-to-access geothermal resources (low-enthalpy and superhot/supercritical deep fluids).
- developing closed-loop systems and well exchangers, including heat recovery from oil wells and spent gases, as well as underground heat storage.
- improving the performance of geothermal power and heat plants, including low-enthalpy installations with heat pumps and hybrid RES applications.
- testing the extraction of critical raw materials from geothermal fluids.
- innovating drilling technologies, plant components, and geothermal prospecting methods to better identify, assess, and use geothermal resources.

A target of 1,000 MW of geothermal power capacity by 2030 is explicitly stated. In parallel, research linked to carbon dioxide (CO_2) and hydrogen storage is also advancing, covering both high- and low-enthalpy geothermal resources.

Marine energy is likewise recognized as innovative and strategically relevant and is included among the technologies contributing to the 5 GW innovative capacity objective. The NECP highlights the significant wave energy potential of the west coast of Sardinia and the Strait of Sicily, which Italy intends to further explore. The plan underlines the strong engagement of national research institutions in developing wave energy conversion devices, supported by funding for basic research as well as pilot and demonstration projects.

These efforts are aligned with the objectives of the SET Plan Ocean Energy Working Group, which Italy chairs, showcasing its leadership role in this field.

Under the section on research and innovation instruments up to 2024, the Pendulum Wave Energy Converter (PeWEC) is cited as a flagship prototype project, aiming for a full-scale offshore installation. Opportunities for regional cooperation and shared offshore development projects in tidal and wave energy are also identified as feasible.

Technologies such as airborne wind, ocean thermal energy conversion, and salinity gradient are not addressed in Italy's NECP.

Assessment of How the 5% Target Is Addressed

Although not framed explicitly as a percentage, Italy's absolute target of 5 GW of innovative renewable capacity is broadly consistent with the RED III requirement and is supported by concrete policy instruments, particularly for advanced geothermal and marine energy. The NECP demonstrates substantial engagement with innovative renewable technologies, with geothermal and marine energy emerging as clear strategic priorities.

The recognition of investment risk and the deployment of dedicated de-risking mechanisms, combined with EU-approved state aid, provides a credible enabling framework for scaling advanced geothermal technologies. In addition, Italy's emphasis on long-term price signals, including Contracts for Difference, reflects a clear understanding of the financing conditions required to accelerate investment in innovative renewable and storage solutions.

Overall, Italy's NECP offers a solid foundation for innovation-led renewable deployment, which could be further strengthened by explicitly linking the 5 GW objective to the RED III 5% framework and by clarifying timelines and monitoring arrangements.

Lithuania

Lithuania has one of the highest levels of public investment in climate mitigation in the EU, amounting to 1.5% of national gross domestic product (GDP). However, its carbon intensity remains more than 60% above the EU average. Lithuania aimed to have the Baltic states' electricity system synchronized and fully operating with EU grids by 2025.

Renewable Energy (in GW) Installed by 2030

Lithuania's installed renewable electricity capacity amounted to 2.6 GW in 2023 and is projected to increase to 10.3 GW by 2030, implying an additional 7.7 GW of new capacity thanks to offshore and PV, as well as biomass, biogas, and waste incineration. In line with the RED III requirement, this would correspond to around 0.38 GW of innovative renewable electricity capacity by 2030.

It is estimated that the deployment of electricity storage facilities will need to add 300-600 MW of capacity to provide balancing services. In addition, the NECP refers to a measure planned for the end of 2024 to promote investment in electricity storage connected to the transmission grid, with an indicative target of around 800 MWh of electricity storage capacity, funded through the Modernization Fund.

Coverage of Innovative Renewable Technologies

Innovation is discussed mainly in relation to solar R&D and industrial competitiveness. Specific innovative renewable generation technologies are not addressed in deployment planning.

CSP is mentioned once, in a list of renewable energy technologies whose costs have declined since 2022, but this reference is not linked to any existing or planned projects in Lithuania. In the context of skills and training, it is noted that engineering education should feature renewable energy equipment installations, including solar thermal collector systems.

Under the R&I dimension, Lithuania states its ambition to become the largest solar technology exporter in the Baltic and Nordic region. Ongoing research focuses on developing more energy-efficient solar modules and exploring new applications of solar energy. Within the smart specialization framework, renewable energy is identified as a dedicated theme, with a focus on technological development and improved production of solar and other renewable energy technologies.

Perovskite PV and organic PV are not mentioned.

Geothermal energy is referenced in a broader context alongside other renewable energy sources, including training programs, buildings, alternative and renewable energy use in industry, and in Annex 2 under "capacity electricity generation by source." However, enhanced geothermal systems, closed-loop geothermal, and ultra-deep geothermal are not mentioned specifically.

References to ocean energy are limited to offshore wind development. Two offshore wind farms are proposed, with a combined capacity of 1.4 GW. Wave energy, tidal stream, ocean thermal energy conversion, salinity gradient power, and airborne wind are not mentioned.

Assessment of How the 5% Target Is Addressed

Lithuania's NECP acknowledges the RED III requirement and highlights innovation as a strategic priority, particularly in solar technologies. While the 5% target is not yet operationalized, the country's strong focus on R&I and industrial competitiveness provides a basis on which a more structured deployment pathway could be developed. Clarifying eligible technologies and linking innovation efforts to capacity targets would strengthen implementation.

The NECP does present its overall budget, but the prioritization of funding and the mechanisms through which the planned increase in R&I expenditure to 4% of GDP will be implemented are not clearly specified.

The clearly defined emissions reduction targets for 2030, 2040, and 2050 are nevertheless welcome, as they demonstrate a sustained commitment to achieving climate neutrality by 2050.

The Netherlands

The Dutch NECP emphasizes offshore wind expansion (North Sea), electrification, energy storage, and hydrogen, reflecting the country's role as an industrial and energy hub in northwestern Europe. Innovation policy is strongly embedded across sectors.

In addition, the country is investing in battery innovations, with a focus on electricity storage and incentives for integrating batteries into large-scale solar panel systems. With Europe's largest port (Rotterdam) and a strong industrial sector (refineries, steel, chemical hubs), the country also aims to become a hydrogen hub for northwestern Europe, facilitating hydrogen imports and exports. Emissions reduction targets are clearly outlined for five main sectors: electricity, industry, built environment, mobility, and agriculture.

Renewable Energy (in GW) Installed by 2030

The Netherlands' installed renewable electricity capacity stood at 32 GW in 2023 and is projected to reach 48.9 GW by 2030, implying an additional 16.9 GW of new capacity. In line with the RED III requirement, this would correspond to around 0.84 GW of innovative renewable electricity capacity over the period from 2023 to 2030 (Table 1).

The Netherlands aims to generate 32-42% of energy from renewable sources by 2030, in line with the EU renewable energy target of 42.5%. The current level of onshore wind and solar is 25.5 TWh and is projected to reach 35 TWh in 2030. In 2023, the country met its 4.5 GW target for offshore wind capacity, while its target for 2030 is 21 GW. The plans to develop additional renewable energy capacity include "deployment of, inter alia, offshore wind, solar rooftop and scaling up innovative technologies such as hydrogen and green gas".

In the coming years, the partial revision of the North Sea Programme will identify new wind energy areas for the possible realization of offshore wind energy after 2031. A comprehensive table is provided in the NECP showing renewable energy projects and their realization progression.[10] Furthermore, the Netherlands, as part of the North Seas Energy Cooperation (NSEC), has developed non-binding targets for offshore renewable energy generation by 2050, amounting to 218 GW, including intermediary targets for 2030 and 2040.

Coverage of Innovative Renewable Technologies

Geothermal energy receives explicit attention, with quantified targets for heat production by 2030 and 2040. Floating solar and offshore innovation projects are mentioned, mainly in an R&D context. However, innovative technologies such as perovskite PV, organic PV, advanced geothermal systems, ocean energy, and airborne wind are largely absent in the NECP.

Apart from conventional renewable energy sources, additional efforts are being made to stimulate the supply of renewable energy sources by focusing on offshore wind, solar-on-rooftop, geothermal, green gas, and aquathermal, as well as the production and import of hydrogen.

For geothermal, there are targets to increase capacity to 15 petajoules (PJ) in 2030 and 28.3 PJ in 2040, with the current level at 6.8 PJ. Additionally, the NECP highlights that seven applications to the Sustainable Energy Production and Climate Transition Incentive Scheme (SDE++) have been submitted for deep geothermal. Furthermore, ocean energy is mentioned under the Technology Collaboration Programmes (TCPs) of the International Energy Agency (IEA)[11], of which the Netherlands participates in more than half, notably, on ocean energy systems, smart grid, PV power systems, solar heating, and cooling. Ocean energy is noted in this context. Moreover, an innovation program focused on offshore floating solar R&D has been allocated €44.5 million in funding in 2019, with the intention of understanding whether scaling up after 2030 is an attractive option.

Funds have been set aside to achieve clean dispatchable power, for example by incentivizing the use of hydrogen focusing on electricity storage, investing in battery innovations, and incentivizing batteries in large-scale solar panels.

Assessment of How the 5% Target Is Addressed

The NECP does not explicitly acknowledge or operationalize the 5% target under RED III. No indicative capacity volume or dedicated planning section for innovative renewable technologies is included.

However, the Dutch NECP demonstrates a commitment to innovation across the energy system, particularly in offshore wind, hydrogen, and energy storage. Existing (deep) geothermal targets and offshore innovation programs provide relevant building blocks. Embedding these elements within a dedicated 5% framework would enhance coherence and visibility within the NECP.

The program focusing on offshore floating solar is also a positive step, as exploring innovative technologies in the field of solar will be crucial for the development of renewable energies and for providing a more diverse energy portfolio. However, it appears disconnected from core NECP delivery strategies, making further development of this program potentially limited, as it is not rooted in a larger roadmap. Finally, the eight support schemes of the member states that are adapted to the different stages of innovation can help bridge the gap from concept development and research to market.

[10] The Supplementary Road Map Windenergie 2030, p. 31, The Netherlands' NECP.

[11] Technology Collaboration Programme – Programmes - IEA

Slovenia

Most of Slovenia's GHG emissions stem from the transport sector, highlighting the need for substantial investment in infrastructure. Historically, Slovenia has benefited from extensive forest cover providing important ecosystem services. However, forest health has deteriorated in recent years due to wildfires, droughts, and pests. Nuclear energy plays a significant role in domestic electricity generation, with the Krško nuclear power plant accounting for 25.8% of electricity production in 2020. Renewable energy deployment, particularly wind, is constrained by permitting challenges and geographical limitations.

Renewable Energy (in GW) Installed by 2030

Slovenia's installed renewable electricity capacity amounted to 2.4 GW in 2023 and is projected to increase to 3.7 GW by 2030, implying an additional 1.3 GW of new capacity. In line with the RED III requirement, this would correspond to around 0.19 GW of innovative renewable electricity capacity by 2030.

Slovenia's overall target is to reach a minimum 33% share of renewable energy in final energy consumption by 2030, which remains below the EU target of 42.5%. Solar electricity production is expected to increase by 2-3.8 TWh (1.8-3.5 GW) by 2030, requiring the installation of approximately 350 MW of solar capacity per year by 2030.

Wind energy development remains modest due to environmental and spatial constraints, with an additional 147 MW projected by 2030 and a potential of 430-530 MW by 2040.

Coverage of Innovative Renewable Technologies

Solar energy receives significant attention in the NECP as the primary renewable energy source for electricity generation, as well as heating and cooling. The plan foresees the construction of electricity storage facilities and prioritizes solar deployment in areas with sufficient existing grid capacity, in order to limit the need for additional grid investment.

Concentrated solar power, perovskite PV, and organic PV are not mentioned.

The NECP places strong emphasis on both deep and shallow geothermal energy, including measures aligned with advanced system development and research. Geothermal plants are considered important for electricity system adequacy, with a target of 88 gigawatt-hour (GWh) of geothermal electricity generation by 2030. Dedicated measures (notably Measure M12.4) support the development of multipurpose deep geothermal energy, focusing on research, regulatory monitoring, and learning from countries with more mature geothermal markets.

Slovenia plans to intensify research and establish expert baselines to assess environmentally acceptable levels of geothermal exploitation, alongside annual monitoring of deep geothermal efficiency trends. Measures include the monitoring of geothermal aquifers and inactive wells by 2026 to incentivize the development of wells and thermal water exploitation systems. The NECP explicitly refers to deep geothermal cascading systems and pilot projects for geothermal electricity generation, with completion foreseen by 2030.

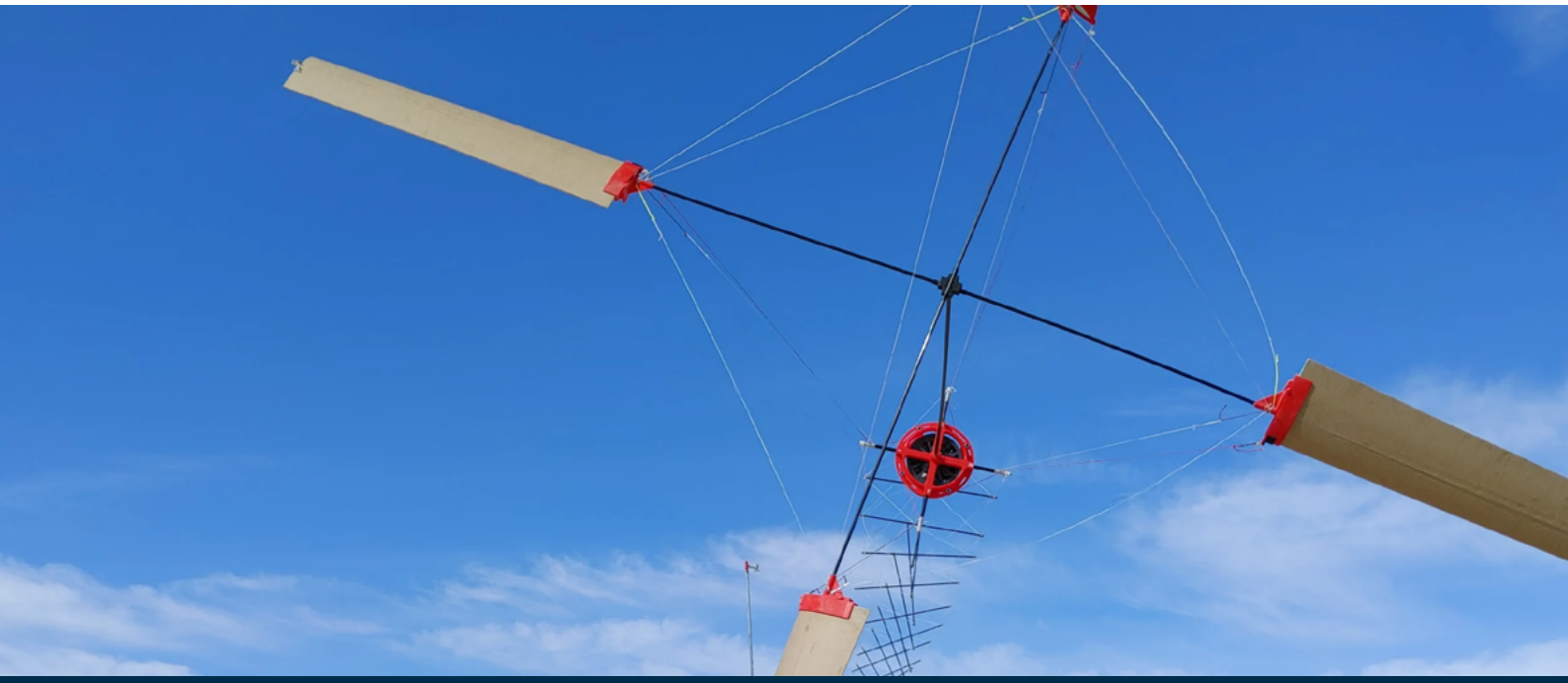
The NECP acknowledges that geothermal production potential might not yet be fully quantified due to data limitations, underscoring the need for further research. Shallow geothermal development is also addressed, with a focus on removing barriers and supporting market uptake. Enhanced geothermal systems, closed-loop geothermal, and ultra-deep geothermal are not mentioned specifically.

Ocean energy technologies, including wave, tidal stream, ocean thermal energy conversion, salinity gradient power, and airborne wind, are not addressed. Wind energy development, both onshore and offshore, remains limited due to geographical and environmental constraints.

Assessment of How the 5% Target Is Addressed

Slovenia explicitly references the RED III requirement that at least 5% of newly installed renewable energy capacity should come from innovative renewable technologies.

The Slovenian parliament adopted the long-term climate strategy in 2021, which spans to 2050, illustrating a long-term perspective and commitment, which is reflected in the NECP. The NECP's focus on both deep and shallow geothermal is welcome, as is the commitment to a target for energy generation from geothermal in 2030, including research, pilot projects, and regulatory preparation. This focus creates a promising foundation for innovative renewable deployment. Greater clarity on how geothermal development contributes to the 5% target, alongside dedicated funding and monitoring arrangements, would further strengthen implementation.



Spain

Spain's NECP places strong emphasis on renewable electricity deployment, energy independence, and a just transition, positioning wind and solar as the central pillars of the energy system. The NECP serves as a core instrument of Spain's climate and energy policy framework, reflecting a strong commitment to EU climate objectives and legislation. Spain has established itself as a leading European market for wind and solar deployment.

Renewable Energy (in GW) Installed by 2030

Spain plans to increase renewable electricity capacity from approximately 77 GW to 158.5 GW by 2030, an increase of 77.4 GW. The 5% target would therefore correspond to around 4.1 GW of innovative renewables by 2030.

By 2030, renewables are expected to account for 81% of electricity generation and 48% of final energy consumption. Wind power capacity is projected to reach 62 GW, including 3 GW of offshore capacity, while solar capacity is expected to reach 76 GW, complemented by 4.8 GW of solar thermoelectric capacity. Nuclear energy is projected to contribute 3 GW.

Spain's energy storage strategy foresees the deployment of 22.5 GW of storage capacity by 2030, including 12.5 GW of daily and weekly storage and 10 GW of seasonal storage, supporting system flexibility and large-scale renewable integration. Taken together, these measures would bring total renewable electricity capacity to approximately 160 GW by 2030.

Coverage of Innovative Renewable Technologies

The NECP identifies a broad range of technologies as innovative, including offshore wind, floating PV systems, hybrid renewable installations, marine energy, geothermal energy, and solar thermoelectric generation with storage. These technologies are supported through targeted funding schemes and regulatory sandboxes designed to facilitate experimentation and early deployment.

The plan lists innovative applications across multiple sectors, including electricity self-consumption, energy storage, renewable electricity, and thermal energy in agriculture, concentrated solar power for industrial processes, renewable air-conditioning solutions, bioenergy, geothermal energy, marine energy, and advanced PV applications such as agrivoltaics and floating PV. Large-scale solar thermoelectric generation with storage is also highlighted as a flexible and dispatchable option.

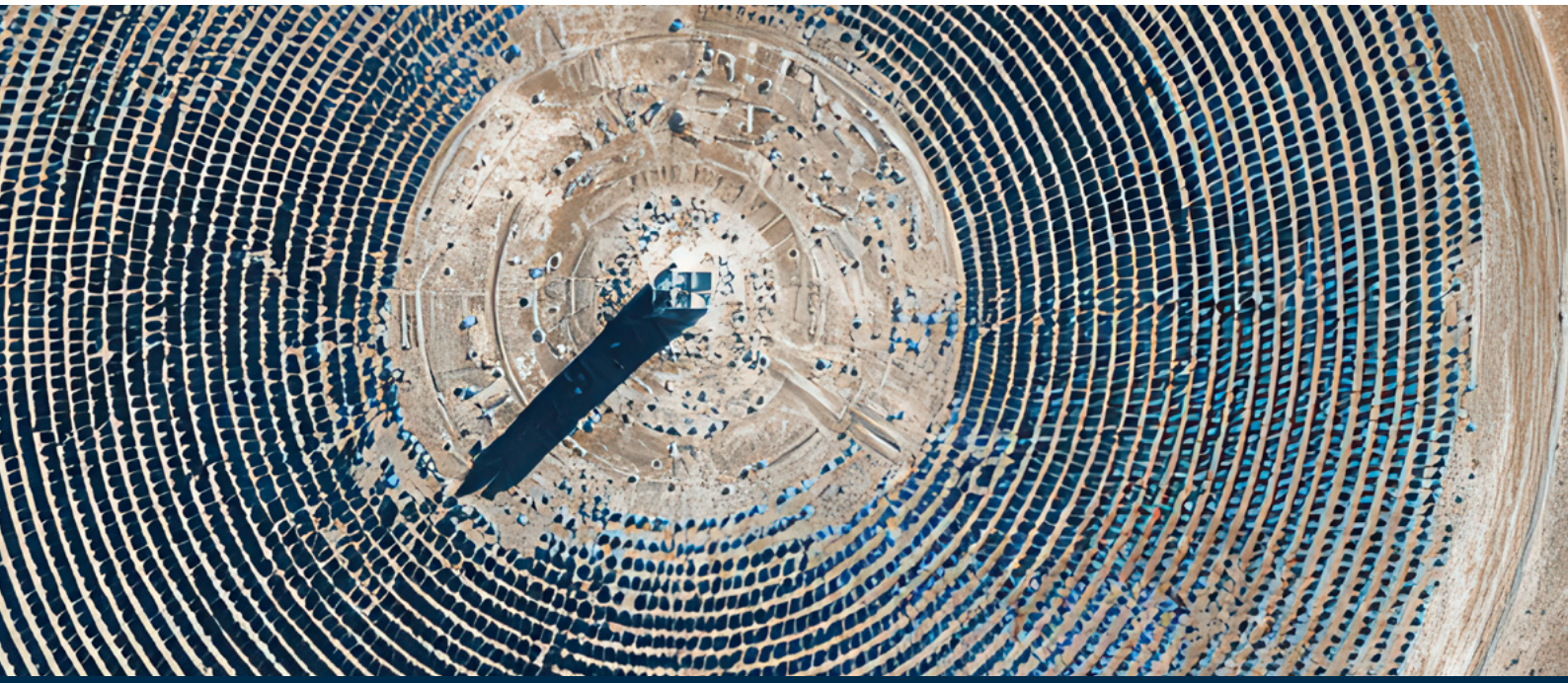
The NECP further identifies several technologies with high potential that are not yet competitive, including deep geothermal energy and large-scale solar thermoelectric generation with storage, and foresees the creation of dedicated financial support instruments to enable their development. A regulation has been adopted to provide aid to the country's autonomous communities for renewable thermal energy systems across the economy, aiming to accelerate the deployment of ambient and geothermal heat pumps, solar thermal technologies, direct-use geothermal, and biomass.

Spain also deploys regulatory sandboxes and provides detailed information on funded pilot projects, including initiatives in marine wind and energy, medium- and high-temperature geothermal energy, biogas, energy storage R&D, hybrid renewable-storage installations, standalone storage, and heat pumps. Project budgets range from €54.6 million to €250 million, with expected outputs between 55.7 MW and 904 MW, depending on the project.

Assessment of How the 5% Target Is Addressed

Spain explicitly addresses the RED III 5% requirement through a dedicated policy measure on innovative renewable installations. The NECP includes a specific section, Measure 1.4 "Development of innovative renewables installations," which sets out priority sectors, funding instruments, and pilot programs aligned with this objective. It sends a strong signal of Spain's commitment to renewable energy innovation.

The plan adopts a broad and forward-looking approach, covering offshore wind, floating PV, hybrid systems, marine energy, high-temperature geothermal, solar thermoelectric generation with storage, and agrivoltaics, supported by regulatory sandboxes and targeted financial instruments. The inclusion of support mechanisms for less mature technologies, such as deep geothermal, further strengthens Spain's innovation ecosystem and positions the country well to scale innovative renewable technologies beyond 2030. However, this seem to be only with MW-scale pilots and no GW-scale trajectory so far



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We are a climate innovation think tank. We exist to close the remaining innovation gaps to reach net-zero emissions by 2050. To reach this objective, we accelerate innovation in critical industries where sustainable solutions are still in very early stages.

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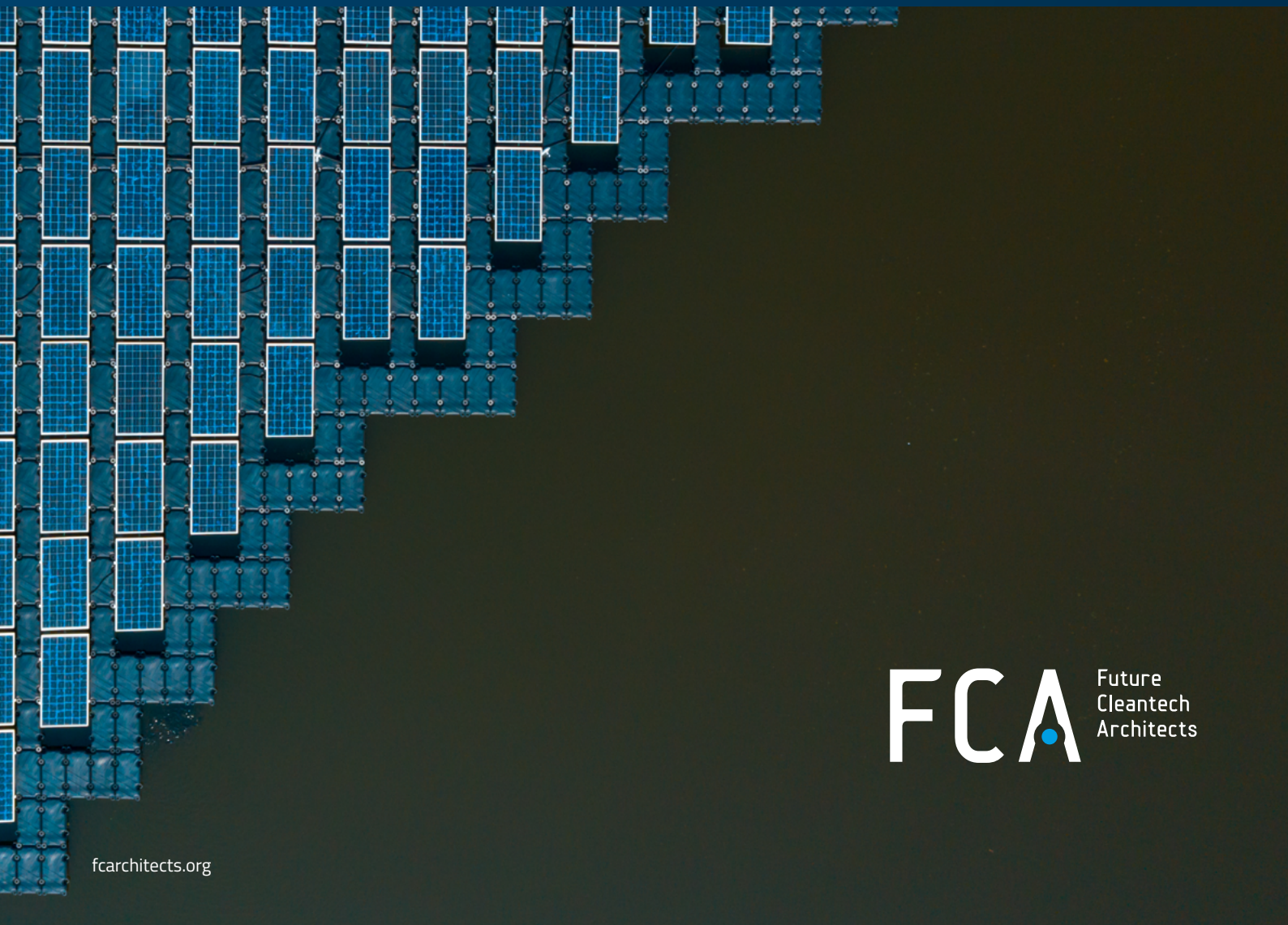

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