

Renewable Energy Production

1. Short Description

Innovative solutions to generate and manage renewable energy, both heat and electricity, in order to increase the sustainability and sovereignty of Europe's energy supply. Focus topics include geothermal heat & power, energy-efficient hydrogen production (including from waste), biomass-based energy, hydro and tidal power and solutions to decrease dependency on non-European supply of materials and technologies for solar and wind energy. Also in focus are relevant smart & AI-based solutions for energy & grid management, sector coupling and demand-response systems.

If your solution involves AI, smart grids, or digital tools for managing urban utilities, consider the "AI-Powered Utility Management" opportunity. This focuses on optimizing city resources using AI, complementing renewable energy efforts but emphasizing digital management.

2. The Problem

The energy transition in Europe is progressing but is facing several challenges to reach the targets set by the European Commission and Member States. The following issues are in focus here.

- **Intermittent renewable energy production.**
The most prominent renewable energy sources, solar and wind, are both highly intermittent. Their production strongly varies between day and night, as well as between seasons. There is a strong need for more stable renewable energy production, providing a baseload capacity to the grid, which is currently still provided by fossil fuel and nuclear sources. Examples of solutions are e.g. (deep) geothermal, hydro and wave energy.
- **Focus has been on electricity, while heat is the mostly needed energy.**
Most renewable energy efforts have been focused on generating electricity. While this is crucial for our energy transition, the generation of heat is as least as important. There is a need for more innovations in this field, e.g. through deployment of (deep) geothermal, industrial waste energy, or biomass.
- **Dependency on materials and technology from outside Europe.**
Many renewable energy systems are dependent on (raw) materials and technologies imported from outside of Europe. The most obvious examples are critical materials like Neodym for magnets, but also copper and specific electronics are crucial for these systems. At the same time, huge production capacities, e.g. for solar panels, have been developed outside of Europe. The strong dependency on such imports creates a serious risk for the sovereignty of Europe and for the success of our energy transition. Therefore, there is a strong need for alternative technologies that are less dependent on critical materials or manufacturing

capacities, e.g. by using alternative materials that can be sourced in Europe or by recycling critical materials.

- **Sustainability impact of building renewable energy systems.**
Renewable energy solutions such as solar and wind power are producing green energy but are generally having a substantial CO2 impact during production. Standard solar panels, for example, take several years of producing green energy to balance out the CO2 generated during their production. The massive concrete pillars for big wind turbines also produce serious CO2 amounts during construction. There is a need for alternative designs and production methods to reduce the “day 0” CO2 footprint of renewable energy production technologies.
- **Suboptimal management of demand and supply.**
Without efficient planning and management of energy supply and demand, the energy transition will be hard to realise without strong price fluctuations, over- and under-capacity issues and interruptions (blackouts), esp. If we depend mainly on solar and wind energy. More integral management, supported by AI, is needed to realise the potential of efficient grids, demand-response solutions and sector-coupling.

3. Sustainability and Sovereignty Impact Potential for Europe

Developing and deploying innovative solutions addressing the challenges mentioned above is essential for Europe to:

- Realise the ambitions of REPowerEU and the Renewable Energy Directive, and the Commission principles for energy storage as reflected in the Clean Energy for all European package adopted in 2019 and the Commission Recommendation Energy Storage – Underpinning a decarbonized and secure EU Energy System, adopted in March 2023.
- Assure baseload energy production at all times, additionally to the strongly fluctuating power generation from solar and wind
- Strengthen European sovereignty by strongly reducing the dependency on critical materials and imports from outside Europe for the building of renewable energy capacity in Europe
- Secure a strong EU leadership position in innovative renewable energy production technologies and manufacturing processes
- Create a flourishing industry and a substantial number of jobs.

4. Deeptech and Digital Innovation Potential

A broad range of Deeptech and Digital innovations will be considered to address the challenges mentioned above. These include, but are not restricted to:

- Innovative renewable energy production technologies, such as tidal- or wave-based, wind kites, vertical wind turbines, energy harvesting,

- Baseload providing renewable energy sources, such as (deep) geothermal
- Renewable heat sources, such as (deep) geothermal, industrial heat waste
- Alternative materials and manufacturing technologies for renewable energy systems, which reduced the sovereignty risk for Europe, e.g. using locally sourced materials
- Recycling technologies for key or critical materials used in renewable energy solutions
- Innovative energy solutions and manufacturing technologies to reduce the “day 0” CO2 footprint of renewable energy systems
- Innovative, AI-supported, energy management solutions, to enable e.g. grid optimisation, demand-response solutions and sector-coupling. This includes hardware, sensors, and IT innovations.

The deployment of energy storage to address the intermittent character of solar and wind energy has been addressed by another D2XCEL call on Large-Scale Stationary Energy Storage and therefore is not in scope here.

5. European Market Potential

Renewable energy sources such as wind, solar and hydroelectric power, ocean and geothermal energy, biomass and biofuels offer cleaner alternatives to fossil fuels. They reduce pollution, broaden our energy options and decrease our dependence on volatile fossil fuel prices. In 2022, renewable energy accounted for 23% of the European Union’s energy consumption. In 2023, lawmakers increased the Union’s target for the share of renewable sources of energy in gross energy consumption from 32% to 42.5% by 2030, aiming for 45%. Therefore, EU countries need to intensify their efforts to collectively comply with the new EU target for 2030, which requires increasing the share of renewable energy sources in the EU’s gross final energy consumption by almost 20 pp. Becoming the world’s first climate-neutral continent by 2050 is the greatest challenge and opportunity of our times.

References:

- [EU Directive 2023/2413](#)
- https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics#Share_of_renewable_energy_more_than_doubled_between_2004_and_2022
- <https://www.iea.org/reports/renewable-energy-market-update-june-2023/executive-summary>
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