Up2Circ – Boosting the Uptake of Circular Business Model, Product and Process Innovation

Horizon Europe 2021-2027

GRANT AGREEMENT NUMBER — 101091367

SECTORIAL CATALOGUE
RENEWABLES ENERGIES

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Short introduction to the industrial ecosystem / content focus

The energy sector is one of the largest contributors to the generation of greenhouse gases, so the use of renewable resources in energy production is essential to make progress in the fight against climate change.

In 2022, the share of renewables in the global energy supply increased again (+1.5 points) to 30%, i.e. 10 points above the 2010 level. The share of renewables in energy supply is historically high in countries with large hydropower resources such as Brazil, Colombia, Canada, New Zealand, Sweden or Norway (more than 2/3 of electricity generated). In other countries, ambitious renewable energy policies and falling electricity production costs for solar and wind technologies have boosted renewable energy generation and contributed to a significant increase in the share of renewables in the energy supply. In Europe, it has grown by 18 points since 2010 to 43%, with strong increases in the UK (+36 points to 43%), the Netherlands (+30 points to 40%), Germany (+27 points to 44%) and Turkey (+15 points to 42%). The share of renewables in the energy supply also increased by 22 points to 31 % in Australia, 14 points in Chile to 55 %, 12 points in the USA (to 22 %), China (to 31 %), Japan (to 22 %) and Thailand (to 18 %) and 8 points in South Africa (to 10 %).

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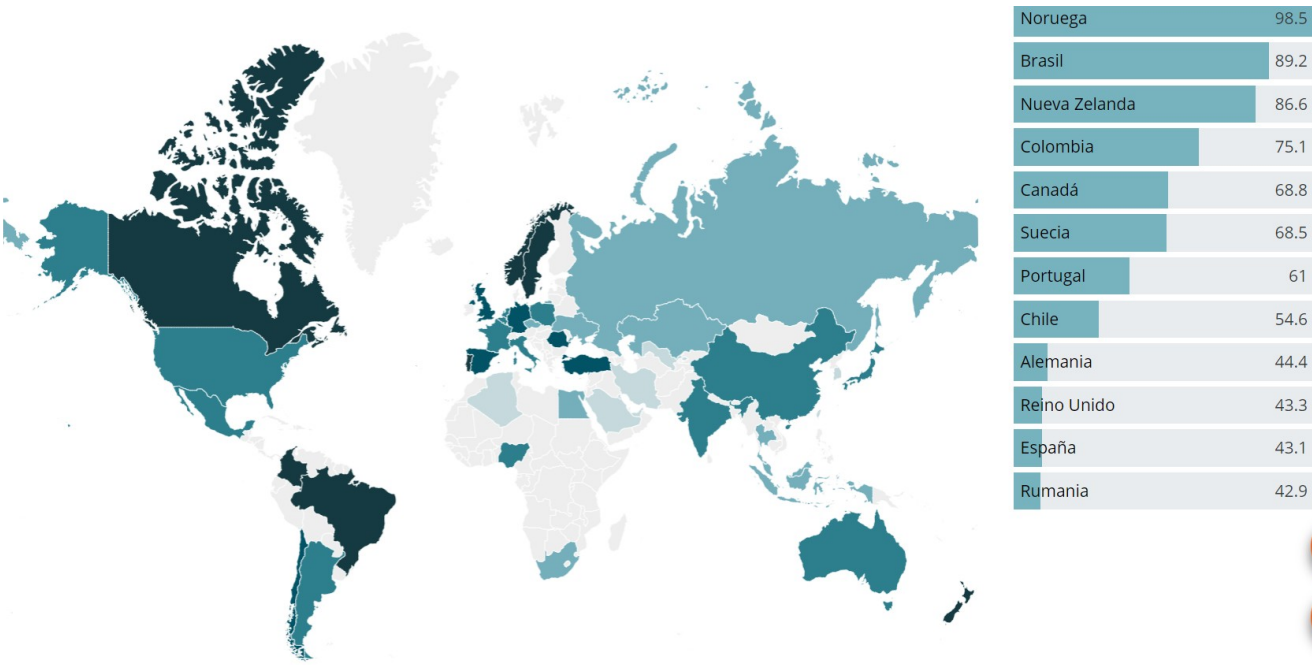

Image 1: Ratio between the electricity production from renewable energies (hydro, wind, geothermal and solar) and the total electricity production.

Renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed, are plentiful and all around us.

Traditionally, fossil fuels (coal, oil and gas) were the most widespread and used energy sources in the past. However, they are non-renewable resources that take hundreds of millions of years to form. Fossil fuels, when burned to produce energy, cause harmful greenhouse gas emissions, such as carbon dioxide.

Generating renewable energy creates far lower emissions than burning fossil fuels. Transitioning from fossil fuels, which currently account for the lion's share of emissions, to renewable energy is key to addressing the climate crisis[1].

In 2022, wind and solar power generated a fifth of the EU's electricity (22%). Renewables have for the first time overtaken fossil gas (20 %) in an energy sector dominated by nuclear and hydro (32.04 %), according to a report published by energy think tank Embere.

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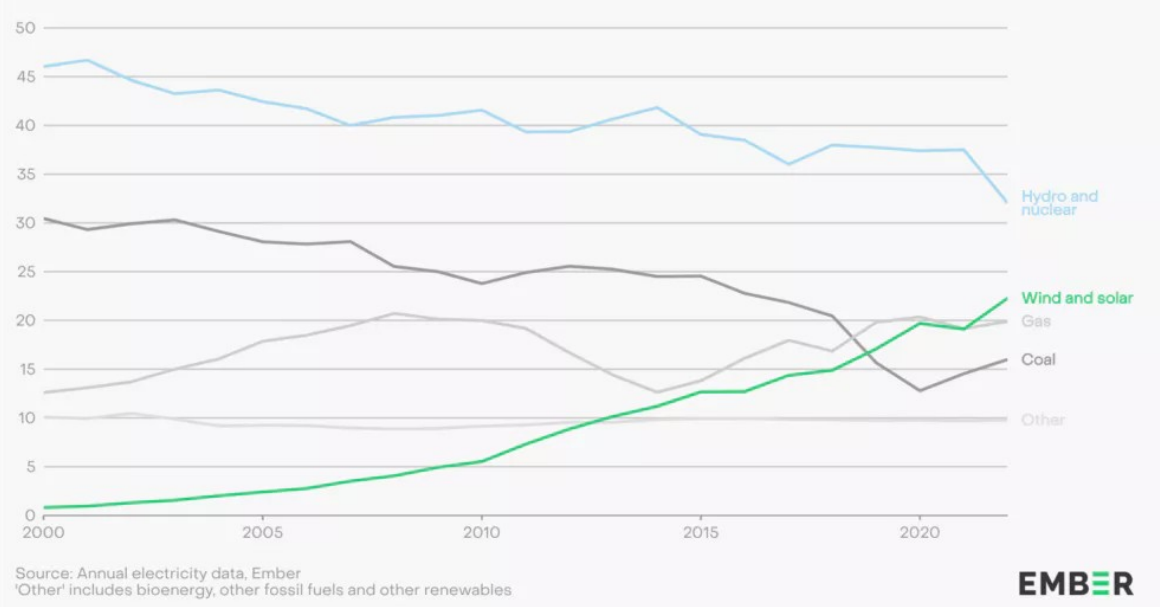

Image 2: Sources energy productions Europe

Renewables are now cheaper in most countries and generate three times more jobs than fossil fuels.

The common sources of renewable energy are:

- Solar energy
- Wind energy
- Geothermal energy
- Hydropower
- Ocean energy
- Bioenergy

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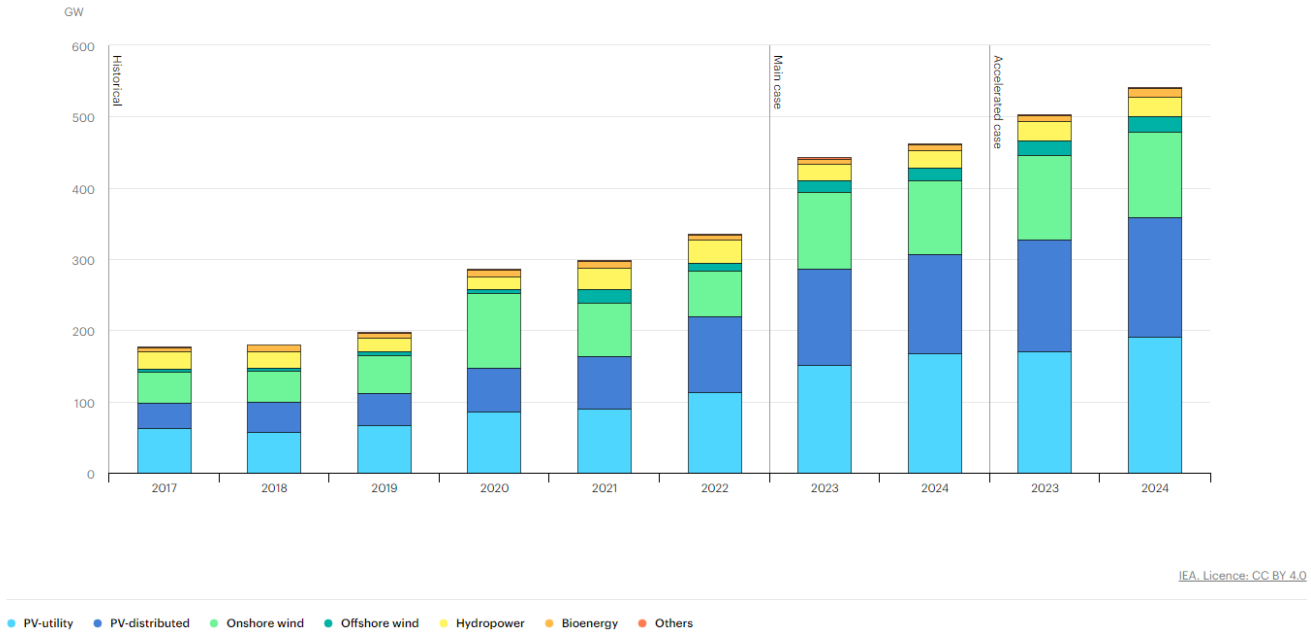

Image 3: Net renewable electricity capacity additions by technology, 2017-2024. Source: IEA[2]

Challenges for the sector with regard to sustainability demands, including a brief overview of relevant regulations

Electricity accounts for only a fifth of global energy consumption and finding a greater role for renewable energy sources in transportation and heating remains critical to the energy transition.

The energy transition is a major challenge for the 21st century. It involves a structural transformation of energy production and consumption patterns.

Greenhouse gas emissions are mainly due to the energy sector, so it is necessary to transform from an energy system based on fossil fuels to an energy system based on renewable energies.

The main challenges facing society are as follows:

- Decarbonisation

2

The greenhouse gas emissions of recent decades are a direct cause of global warming, a real threat to the planet. Over the years, both organisations and society in general have become aware of the situation and the need to reverse it. And we are faced with the challenge of decarbonisation.

In the coming decades, society must face the challenge of carrying out a rapid decarbonisation process that will affect all sectors of activity. Industry, which is a relevant sector in terms of energy consumption and CO2 emissions, cannot remain oblivious to this objective. Despite having made significant efforts to improve energy efficiency and reduce the consumption of fossil fuels, industry faces the enormous challenge of adapting its production processes in terms of technology and energy. And it must do so not only without losing competitiveness, but also by taking advantage of the new opportunities that arise in the European and international context to increase its capacity for industrial and business development.

-Energy Storage and Distribution

Certain storage technologies have associated environmental impacts that need to be understood and mitigated. For example, batteries may require access to limited natural resources during the production stage, the extraction of which will need to take into account potential environmental effects in order to work to mitigate and minimise these.

On the other hand, lithium-ion batteries are the most widespread, but have several drawbacks. In addition to the fact that lithium is a finite and expensive substance, the cost of storing energy in these devices skyrockets. The future lies in what are known as solid-state batteries. They work by eliminating the current liquid or gel electrolyte and replacing it with ceramic or polymer substances, which have the same function, but with a much higher energy density, thus increasing storage capacity.

- **Recovery, recycling and reuse of materials** and obtaining critical metals for the energy transition. "Faced with challenges such as the scarcity of resources as a result of the high demand for raw materials and the need for increasingly complex consumer products, it is necessary to make great efforts to design processes that enable the recovery of certain materials at the end of the life cycle of the consumer products that contain them.

- Wind blade recycling: The recycling of these blades is a top priority for a wind industry committed to the principles of the circular economy. The wind industry uses an estimated 2.5 million tonnes of composite materials worldwide and this figure could rise to 43 million tonnes by 2050 if the wind market continues to grow at its current rate.

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-Recycling of photovoltaic panels: The International Renewable Energy Agency (Irena) estimates that, by 2050, waste from these panels could reach 8 million tonnes by 2030 and 78 million tonnes by 2050.

-Technologies for recycling components: EIT InnoEnergy for the Naturgy Foundation claims that the recycling of photovoltaic panels in Europe would provide an opportunity for the recovery of critical raw materials. According to the report, germanium, tellurium, indium, selenium and silicon will also face supply problems in the future. In addition, solar panels contain toxic materials that decompose and contaminate soil and groundwater, causing a serious impact on the environment.

Brief overview of relevant regulations on green energy transition:

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

Fit for 55: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

Circular Economy Action Plan: https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

Paris Agreement on climate change: https://www.consilium.europa.eu/en/policies/climate-change/paris-agreement/

Circular Economy opportunities for the sector, including best practices

Renewable power growth is surging, driven by the global energy crisis and policy momentum.

Global additions of renewable power capacity are expected to jump by a third this year as growing policy momentum, higher fossil fuel prices and energy security concerns drive strong deployment of solar PV and wind power. Solar PV capacity, including both large utility-scale and small distributed systems, accounts for two-thirds of this year's projected increase in global renewable capacity.

The crisis triggered by Russia's invasion of Ukraine has accelerated renewable energy deployment in the European Union, driving the bloc to urgently reduce its dependence on Russian natural gas

imports. Policy actions in many European countries has led us to revise our forecast for renewable capacity additions in the EU in 2023 and 2024 upwards by 40% compared with before the war. Rapid growth in distributed solar PV is the main reason for the more positive outlook, accounting for almost three-quarters of the EU forecast revisions. This is driven by high electricity prices that make solar PV more financially attractive and by increasing policy support in key EU markets, especially in Germany, Italy and the Netherlands.
The growth is set to continue next year with the world's total renewable electricity capacity rising to 4500 gigawatts (GW), equal to the total power output of China and the United States combined.

Solar panels on rooftops, electric cars and wind turbines on the horizon are becoming quite common and ordinary sights across Europe. Yet, fossil fuels remain the largest source of energy.

The future projection shown a strong growth for renewables. The rest of variables experience a more moderate growth, increasing over time both the electricity demand, as well as the storage capacity and connection with other regions. Here below you will find a graph showing all variables and the forecast:

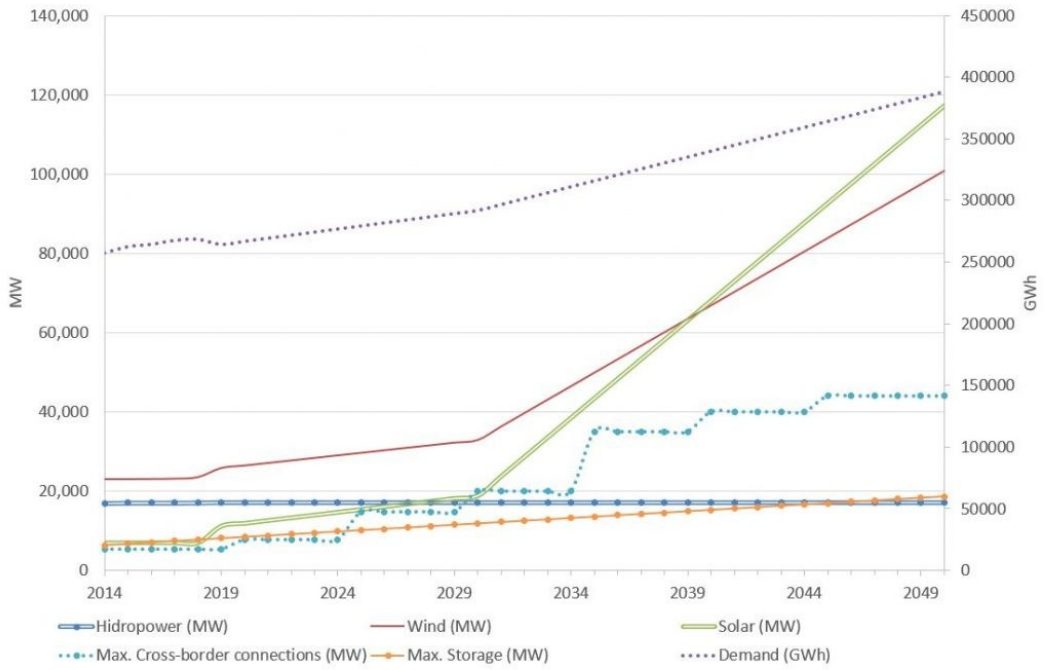

Image 4: historical data and future projection of installed capacities and demand in the electrical system until 2050.

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Digital transformation and technologies

Improved energy efficiency makes renewable energy companies gain increasing weight in the sector, and become more competitive.

In this sense, digitalisation comes into play through management software that optimises their processes and thus their energy services and faces the challenges of these companies such as development and productivity.

The European Union's environmental objectives require the support of digitalisation in both electricity generation and the management of interconnected electrical systems.

The variability that characterises renewable generation technologies, such as wind and photovoltaics, make the acquisition, processing and transmission of information essential in high volumes and at high speeds. This is precisely where Big Data comes into place.

Artificial intelligence (AI) and machine learning (ML) algorithms can optimize renewable energy generation and consumption by analyzing vast amounts of data. AI and ML can enable accurate weather forecasting for renewable energy generation, optimize energy distribution and storage, and improve load forecasting, enhancing grid management and efficiency.

Recycling can conserve critical materials

Between 2022–2050, the energy transition could require the production of 6.5 billion tonnes of end-use materials, 95% of which would be steel, copper and aluminium which the energy transition will require, with much smaller quantities of critical minerals/materials such as lithium, cobalt, graphite or rare earths. This cumulative material extraction compares with the over 8 billion tonnes of coal currently extracted annually

BATTERIES: As electric vehicles become more and more common, the battery industry is booming, but a shortage of the necessary metals is expected to arise in the near future. Recycling used batteries is a solution that reduces the need for new raw material as well as the generation of waste.

Practically all metals used in batteries can be recovered and recycled. These include nickel, manganese, cobalt, and lithium. However, the recycling of other components such as graphite, the liquid electrolyte and the separator plastic between the cathode and anode surface still require further development, which is ongoing.

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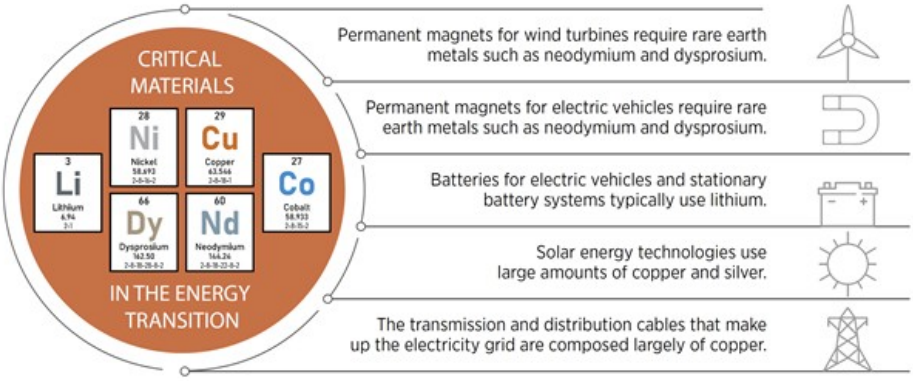
WIND ENERGY: The European wind industry and the European steel industry play a key role in enabling Europe's clean tech economy. The upcoming EU Critical Raw Materials Act must account for the strategic role of this key value chain. It must ensure access to all critical materials for wind and steel, including rare earths, nickel, manganese, copper, aluminium, ferrous scrap, and glass-fibre fabrics

Designing wind energy technologies to use fewer resources, last longer, and break down more easily. Many components of wind turbines can already be recycled. In addition, it will be necessary develop ways to make large turbine blades easier to recycle at end-of-life.



Intermittency

Renewable energy sources, such as solar and wind, are intermittent, meaning that they do not produce electricity all the time. This can make it difficult to integrate renewable energy into the grid and can lead to blackouts or brownouts.

Intermittent renewables are challenging because they disrupt the conventional methods for planning the daily operation of the electric grid. Their power fluctuates over multiple time horizons, forcing the grid operator to adjust its day-ahead, hour-ahead, and real-time operating procedures.

Take the example of solar panels. Solar energy is inherently only available during daylight hours, so the grid operator must adjust the day-ahead plan to include generators that can quickly adjust their power output to compensate for the rise and fall in solar generation. Furthermore, power plants that typically produce electricity all day every day might instead be asked to turn off during the middle of the day so that the energy produced from solar can be used in lieu of fossil electricity.

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However, the effects of climate change on the reliability and predictability of renewables are not limited to solar. While research on the impact of climate change on wind patterns is still emerging, one recent study suggests GHG (Greenhouse Gas) emissions could reduce onshore wind power density by 15% by 2100 –with some regions reduced by as much as 40%

While no perfect solution exists, one thing is clear: the intermittency issues with solar and wind energy are here to stay and may, in fact, get worse as climate change impacts predictability and variability of these sources. Our clean energy transition will, realistically, need to include a more stable backup and supplemental energy source like natural gas for the foreseeable future.

Photovoltaic solar energy technology

Here you can find the technologies and topics related to photovoltaic energy production, together with the possible opportunities offered by the sub-sector: https://www.cheetah-exchange.eu/pv_technologies.asp

BEST PRACTICES

WIBLE: the circular alternative to mobility: Carsharing service of plug-in hybrid cars launched jointly by Repsol and its partner Kia Motors Iberia. The initiative promotes collaborative consumption and decreases the carbon footprint of cities:

SACYR: Circular management of a construction machinery fleet: Aurora Project: the machinery fleet does not have a connection to the electrical grid. Conventional diesel generators were replaced by a solar panel and a wind turbine. Subsequently all the luminaires were replaced by LEDs.

EXELON: Executive compensation: The energy producer has introduced an innovative long-term performance share scheme that rewards executives for meeting non-financial performance goals, including safety targets, GHG (Greenhouse Gas) emissions reduction targets and goals engaging stakeholders to help shape the company's public policy positions.

GAMESA SIEMENS: fully recyclable turbine, ensuring that all materials in the turbine can be recycled. Siemens Gamesa developed the world’s first recyclable wind turbine blade.

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Overview of tech-savvy SMEs that develop/offer solutions to increase circularity in the sector

Eficae Soluciones: is Spanish engineering company specialising in renewable energy and energy efficiency projects. Its aim is to maximise energy savings, improving or maintaining your comfort conditions, always proposing sustainable solutions that reduce their impact on the environment.

Senergyps: is a spin-off company of the University of Extremadura (Spain) and its main objective is the development of products and services for the intelligent management of electrical energy, both in its consumption and in its generation or storage, covering the fields of renewable energies, electric vehicles, smart grids, energy storage and energy management systems.

Metanogenia: is a Spanish technology-based company with extensive experience in the energy recovery of agri-food by-products through biomethanisation to obtain biogas. It has two specialised areas of work, on the one hand the improvement of the biological process of anaerobic digestion and the associated R&D&I, and on the other hand the technical office for the development of industrial projects.

Blok-Z is a Greentech blockchain startup from Turkey that aims to transform energy from a commodity to a Web3 service via verifying the origin of renewable energy and offering a fully managed validator and staking service for energy companies.

Solum is a Spanish startup that develops solar pavements for charging micro-mobility vehicles. The startup's solar pavements feature high-energy photovoltaic (PV) cells that generate energy for charging vehicles. In addition, the modular plug & play installation allows the charging stations to be customized according to the area available. The startup's solutions are installable in offices, education buildings, public spaces, and shopping malls. The miSolum online platform allows remote configuration, monitoring and management of charging stations.

SEaB Energy is a British startup that offers solutions to generate on-site energy from waste. The startup's containerized anaerobic digester, Muckbuster, turns slurry and farm waste into electricity and heat, generating fertilizer as a by-product. The digester converts slurry into biogas which then fuels a combined heat & power (CHP) engine. Similarly, another digester, Flexibuster, turns organic waste like food waste into energy by utilizing the same mechanism.

Carbominer is a Ukrainian startup that provides direct air capture technology. On installation, the startup's capturing module traps CO2 from the ambient air without any need for liquefaction or transportation of the gas. The captured CO2 finds use in greenhouses where it improves plant growth and provides greenhouse operators with a cost-effective zero-carbon energy source.

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Fuergy is a Slovak startup that develops virtual energy networks of existing energy grids to achieve simultaneous energy balance using AI-powered energy sharing systems. They have developed its own proprietary, highly scalable hardware device and AI-powered software called “brAIn”. This unique solution helps to optimize energy consumption and maximize efficiency of renewable energy sources. Through this software’s automated energy management, one can significantly reduce energy costs and achieve an exceptional 3-year payback period of the investment in renewables

Volta Energy is a Netherlands innovative mobile energy supply that uses renewable energies, on location, to power the energy demand of the customer on sight, without noise, smell and emission. Is solar based, IoT integrated (to secure power), portable and easy to use.

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Links to sector specific online contents, including sector specific funding opportunities

Online content of interest:

There is a report from the International Energy Agency (IEA) of the **Outlook for 2023 and 2024 of the Renewable Energy Market Update** that you can download in this link.

The **Climate and energy in the EU** website from the European Environment Agency is available in the following link.

We need to talk about renewables: https://ellenmacarthurfoundation.org/articles/we-need-to-talk-about-renewables-part-1

A circular economy for batteries to underpin renewable energy growth: https://ellenmacarthurfoundation.org/articles/a-circular-economy-for-batteries-to-underpin-renewable-energy-growth

Renewable energy: Council adopts new rules: https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/renewable-energy-council-adopts-new-rules/

Evolution of renewable energy: How energy use has changed over time: https://ratedpower.com/blog/evolution-renewable-energy/

FUNDING OPPORTUNITIES

Green technology innovation requires access to finance, which can be a major challenge for inventors. International organizations, regional and national banks, governments and private organizations have increased their levels of financing available[3].

Some of the European funding opportunities can be found below.

[3] WIPO - World Intellectual Property Organization

Cohesion Fund

The EU's Cohesion Fund aims to reduce economic and social disparity between EU countries and promote sustainable development.

The fund supports energy-related projects that benefit the environment for example by reducing greenhouse gas emissions, increasing the use of renewable energy or improving energy efficiency.

Part of the Cohesion Fund is used to implement the energy union strategy with the help of the Energy and Managing Authorities Network (EMA).

Connecting Europe Facility

The Connecting Europe Facility (CEF) is the EU's funding instrument for boosting energy, transport, and digital infrastructure.

Every 2 years the European Commission draws up a list of EU projects of common interest (PCIs) which may apply for CEF funding.

European Investment Bank and the European Fund for Strategic Investments

The European Investment Bank (EIB) helps finance energy projects by providing companies with loans and other financial instruments. The EIB, together with the European Commission, launched the European Investment Advisory Hub as part of the Investment Plan for Europe. The hub acts as a single access point that provides advice and expertise on administration and project development across the EU.

In November 2019, the EIB adopted a new and more ambitious energy lending policy that aims to phase out traditional fossil fuel energy projects by 2021.

The European Fund for Strategic Investments (EFSI) is a joint initiative between the EIB Group (the EIB and the European Investment Fund) and the Commission. It aims to mobilise private investment in projects which are strategically important for the EU, including the areas of energy efficiency, renewable energy, power grids and interconnectors – all essential to speed up the decarbonisation of the EU economy.

European Regional Development Fund

The European Regional Development Fund (ERDF) aims to reduce economic and social disparity between the EU's regions.

Funded by the European Union

One of the ERDF's four priority areas for 2014-2020 is 'the low carbon economy'. A minimum percentage of ERDF funding must be channelled towards low carbon projects in regions: 20% for more developed regions,15% for transition regions and 12% for less developed regions.

Horizon 2020 and Horizon Europe

Around €5.8 billion will be invested in energy research and innovation projects in the EU's Horizon Europe programme 2021-2022. These projects aim at the creation and improvement of clean energy technologies, such as smart energy networks, tidal power and energy storage.

The European Climate, Infrastructure and Environment Executive Agency (CINEA) is running parts of Horizon 2020 and Horizon Europe in the areas of transport and energy, as well as innovation of energy efficient technologies and solutions for buildings, heating and cooling and more.

Apply for Horizon Europe funding

InvestEU

The InvestEU Programme supports sustainable investment, innovation and job creation in Europe. It will bring together, under one roof, the European Fund for Strategic Investments and 13 other EU financial instruments and aims to trigger more than €372 billion in additional investment over the period 2021-2027.

Just Transition Mechanism

The Just Transition Mechanism is a financial tool that provide tailored support to the most vulnerable and coal-intensive regions in the transition to a greener economy. Over the period 2021-2027, it will mobilise at least €150 billion of investments to alleviate the socio-economic impact. The mechanism consists of three pillars

- a Just Transition Fund of €40 billion to primarily provide grants
- a dedicated scheme under InvestEU to crowd in private investments
- a public sector loan facility with the EIB Group to mobilise additional investments and leverage public financing

LIFE: Clean Energy Transition

The sub-programme of the LIFE Programme is dedicated to clean energy transition. It aims to offer support to deliver on sustainable energy-related polices that contribute to reach the European Green Deal objectives.

Funded by the European Union

With a budget close to € 1 billion for the period 2021-2027, the sub-programme aims to facilitate the transition towards an energy efficient, renewable energy based and resilient economy by funding coordination and support actions across Europe. It is managed by CINEA.

Modernisation fund

This fund will contribute to the investment needs of the 10 lower-income EU countries: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia. It supports investments in generation and use of energy from renewable energy sources, energy efficiency, energy storage, modernisation of energy networks and the just transition in carbon-dependent regions.

The European Investment Bank (EIB) auctions the EU allowances of the Modernisation Fund, assesses investments proposed by the beneficiary EU countries, manages revenues and transfers resources.

Recovery and Resilience Facility

The Recovery and Resilience Facility (RRF) is the key instrument at the heart of NextGenerationEU, the EU's plan for emerging stronger from the COVID-19 pandemic. It is structured around 6 pillars: green transition; digital transformation; economic cohesion, productivity and competitiveness; social and territorial cohesion; health, economic, social and institutional resilience; policies for the next generation. The RRF will help the EU achieve its target of climate neutrality by 2050.

The Innovation Fund

The Innovation Fund is managed by the European Climate, Infrastructure and Environment Executive Agency (CINEA).

It is the successor of the NER 300 programme, with a focus on highly innovative technologies and big flagship projects that can bring significant greenhouse gas reductions. It funds low-carbon technologies and processes in energy-intensive industries, carbon capture storage and utilisation, renewable energy generation and energy storage.

European Energy Programme for Recovery

Launched in 2009 in order to support key investments in the context of the economic crisis and in order to promote energy transition, the €3.98 billion European Energy Programme for Recovery (EEPR) finance aimed to fund 44 gas and electricity infrastructure projects, 9 offshore wind projects and 6 carbon capture and storage projects.

Funded by the European Union

After 7 years of implementation, EEPR achieved good results in 2018. 35 projects out of 44 in gas and electricity infrastructure projects were completed; 4 out of 9 in the offshore wind projects are operational, but only 1 in the carbon capture and storage projects. The EEPR website was archived in 2019.

The Commission continues to monitor closely the on-going remaining projects. Lessons learned from EEPR were used in the preparation and the implementation of the projects of common interest (PCI).

Under the EEPR, the Commission also launched the European Energy Efficiency Fund (EEE-F) which aims at promoting a sustainable energy market and climate protection.

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