DIAMONDS4IF

DISCOVERY, IDENTIFICATION, APPLICATION, AND MONITORING OF DEVELOPED SOLUTIONS FOR INNOVATION FUND

Project title	Discovery, identification, application, and monitoring of developed solutions for innovation fund.		
Project acronym	DIAMONDS4IF		
Project number	101138004		
Project start date	01/01/2024	**Duration**	36 months

D1.3 – REPORT ON SELECTION APPROACH AND FRAMEWORK_PUBLIC VERSION

Due date	30/06/2024	**Delivery date**	28.06.2024
Work package	WP1		
Responsible Author(s)	Patrizia Bolognesi (PNO Consultants GmbH)		
Contributor(s)	Ariane Kroker (PNO Consultants GmbH)		
Reviewer(s)	Annemarie Reiche (PNO Consultants GmbH)		
Version	1.4		
Dissemination level	Public		

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

VERSION AND AMENDMENTS HISTORY

Version	Date	Created/Amended by	Changes
1.1	05.06.2024	Patrizia Bolognesi	First Draft
1.2	18.06.2024	Ariane Kroker	Review and additional contributions
1.3	21.06.2024	Patrizia Bolognesi	Final Version
1.4	24.06.2024	Annemarie Reiche	Final Review

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

TABLE OF CONTENTS

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

LIST OF FIGURES

LIST OF TABLES

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

LIST OF ABBREVIATIONS

Abbreviation	Description
AI	Artificial Intelligence
APAC	Asia-Pacific (APAC)
CINEA	European Climate, Infrastructure and Environment Executive Agency
CORDIS	Community Research and Development Information Service
CRL	Commercial readiness levels
CSA	Coordination and support action
EC	European Commission
ETIP	European Technology & Innovation Platforms
H2020	Horizon 2020
IF	ETS Innovation Fund
INNEN	INNOVATION ENGINEERING srl
IRENA	International Renewable Energy Agency
JRC	European Commission Joint Research Centre
LCOE	Levelized Cost of Electricity
MENA	Middle East and North Africa
MEYER BURGER	MEYER BURGER (Industries) GmbH
OEM	Original Equipment Manufacturers
OTEC	Ocean Thermal Energy Conversion
PNO	PNO Consultants GmbH
R&D	Research and Development
R&I	Research and Innovation
RAAMS	RAAMS AS
RWE	RWE offshore wind GmbH
SWAC	Sea Water Air Conditioning
TRL	Technology Readiness Level
WP	Work Package

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

0 INTRODUCTION

DIAMONDS4IF aims to support some Horizon 2020 (H2020) beneficiaries' companies in further developing their projects and applying to ETS Innovation Fund (IF), which helps them overcome barriers in turning R&D (Research and Development) into successful businesses.

The IF supports low carbon processes and technologies – and many H2020 project results offer promising solutions to be implemented. However, there are challenges in transforming H2020 findings into marketable products and securing funding. Our project tackles these obstacles, ensuring readiness and guiding applicants through the IF application process.

One of the main results of DIAMONDS4IF-Project will be to produce at least five IF proposals that include detailed plans for scalability, commercialisation, and financial models for submission to the IF. Our long-term goal is to create a sustainable innovation pipeline, effectively bridging the gap between H2020 discoveries and their practical deployment.

For this purpose, WP1 and WP2 in our project aim to create a pool of potential IF application candidates beyond the pilot cases that are already part of the project consortium. Potential IF application candidates, project owners, and exploitation responsible, will be selected, identified, and contacted. The selection will mainly be done by mining EC (European Commission) database and other relevant sources such as our innovative selection tool based on our intelligence platform ©Wheesbee.

In this way an initial list of relevant candidates will be established with the objective to find out at least three additional potential candidates to proceed then with the activities planned in WP3.

This report explains the development of a selection approach and framework for the identification of a candidates´ list related to the Task1.1.

The main purpose of the selection approach will be:

- Identification of potential IF candidates. An initial list will be created and is expected to be verified and further improved w.r.t. information on e.g. actual company data, company developments, etc.
- To demonstrate the methodology used by PNO for the selection of candidates for the next three cycles of Innovation Fund.

The report is structured across three main parts. In the first part, we will explain the innovation pipeline concept, which drives our principles and the methodology for the selection approach. Second, the value chains of the sectors involved will be described, and keywords related to the value chain steps and involved technologies are defined. Third, the specific use of our innovative searching tool Wheesbee is described, incl. using the keywords, creating queries and applying Wheesbee´s filter criteria to select potentially interesting projects and the partners involved. .

A preliminary list of potential IF applicant candidates has been drafted. In this list with sensitive content,we have identified 20 projects as potential applicants. This deliverable illustrates how PNO arrived at formulating this final list of potential candidates, in order to contact them in the next months. For reasons of privacy protection and sensitive data, the list will not be included in this public document.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

1 THE INNOVATION PIPELINE CONCEPT

1.1 Baseline: Horizon 2020 innovations

The call to which DIAMONDS4IF responded requested for: "*consortia [that] should include partners from at least 3 different Horizon 2020 projects having developed mature technological innovations with high potential of deployment under IF. […] Each proposal should also contribute to the development and operationalisation of a continuous innovation pipeline from Horizon 2020 innovations to deployment*." Among other activities (collaboration with key organisations and associations; joint activities across the funded consortia, open events, feedback on lessons learnt to EU IF), the call topic focused on "*supporting a project pipeline from Horizon 2020 to the Innovation Fund […] and other relevant funding means either at EU or national/regional levels*..." Thus, DIAMONDS4IF developed a concept to generate an innovation pipeline.

In general, the Innovation Fund is targeted to projects with higher TRLs and related commercial readiness levels (CRLs), as depicted in Figure 1. Thus, Horizon 2020 (which is the predecessor of Horizon Europe, situated left in the graphical illustration), is technologically at lower TRL and CRLs than Innovation Fund. Any "pipeline" that can be drawn from research to market, and a potential development of ideas, research, results, and exploitation, must therefore focus on exploitable results.

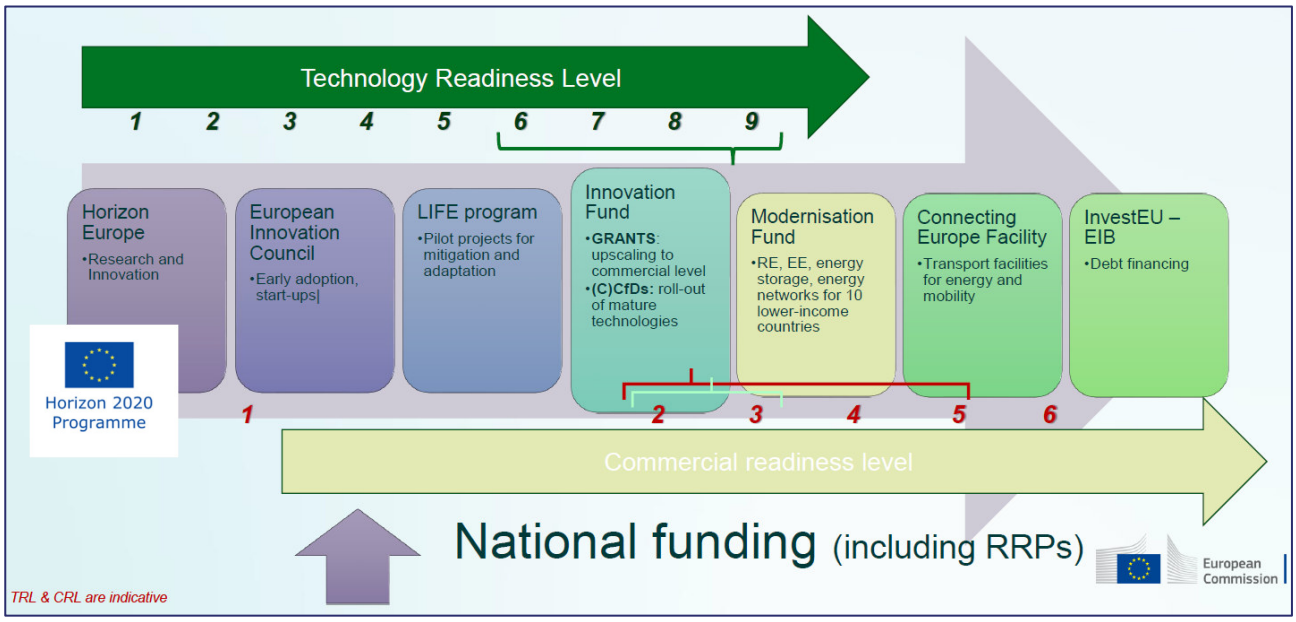


Figure 1: Innovation Fund: targeted project portfolio. Higher TRL are expected.
Source: Maria Alfayate, Deputy Head of Unit, CINEA (2024), H2020 image added by PNO

Apart from the Horizon Results Platform, which provides some insights but, overall, no comprehensive result-oriented database of Horizon projects, there is CORDIS (Community Research and Development Information Service), combining all funded project data. This data base is huge, as Horizon 2020 contributed to key scientific advancements and discoveries that are relevant to the sectors and technologies to be supported under Innovation Fund. For example, the projects can be assembled according to their call topics and the Horizon 2020-related Thematic Priorities like Climate action and resource efficiency, Future and Emerging Technologies, Industrial Technologies, or Secure, clean and efficient energy. The industry participation in the above-mentioned thematic priorities was around 13,500 unique participants, and 5,300 signed grants (see Figure 2).

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

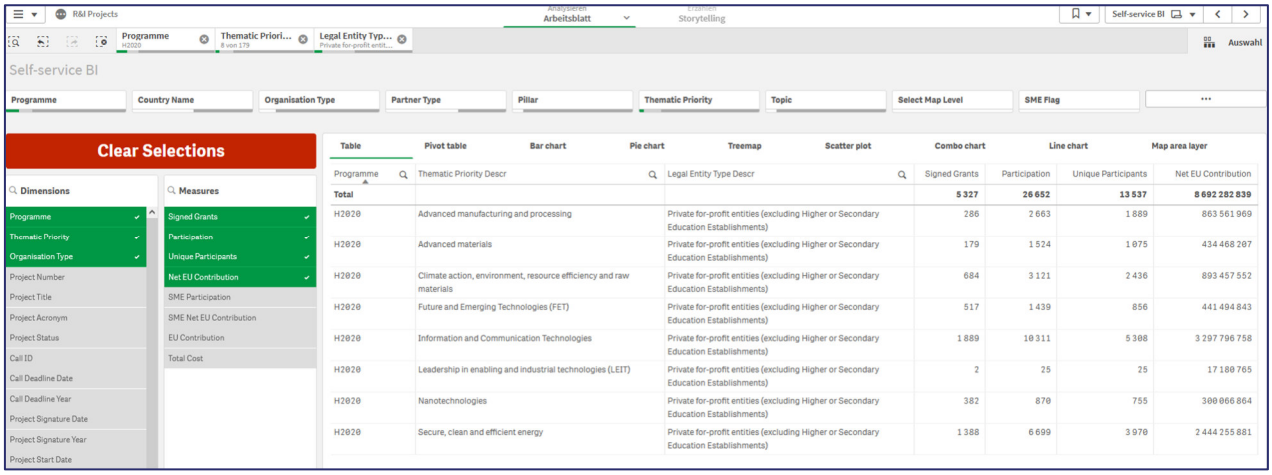


Figure 2: snapshot of H2020 dashboard applying filters for organization type, thematic priority and number of grants/beneficiaries

Apart from these thematic priorities there are other programmes that might be applicable for the innovation pipeline, for example the SME Instrument. Innovative technologies may evolve from all H2020 programmes. Therefore, we need a software-based approach to detect potentially interesting project results among all H2020 projects.

1.2 Developing an Innovation Pipeline concept

There are methods that assess classical outputs of projects like publications, but challenge-specific or impact information (for example on CO_2 emission data, further investment received etc.) is missing in the database. There is a major difficulty to identify and to track the project results. This is valid for all types of projects and results, and it is also applicable for the renewable energy sectors. The data cannot be directly matched with sector/industry/market relevant data. Research on CORDIS with focus on exploitable results would result in a laborious works of manual searches and data exports, manual downloads of probably thousands of documents, and reading of this information. To ease this process, DIAMONDS4IF has introduced a software-based approach for the pipeline creation, targeted to analysis of the documents that contain exploitation plans and reports, as these should provide better insight into the longer-term strategies and markets of the participants. The concept will be developed and refined further throughout the project, but the essential building blocks and underlying processes are:

1. Definition/characterization of which type of projects could qualify for Innovation Fund, related to the IF evaluation and success criteria.
2. Assessment of the baseline, i.e. the Horizon 2020 project database, specifically: the information of these projects represented on CORDIS.
3. Closing the gap between information accessible via CORDIS and information needed for project assessment, e.g. exploitable results. To this end, the ©Wheesbee tool has been further developed and qualified (see WP1/D1.1 Additional Analytic Framework for Wheesbee).
4. Use of the tool to identify relevant project results that would fit within the scope of the IF.
5. Selection of projects and analysis of project (result) owners to be informed.
6. Approach to candidates and provision of support to check viability of projects, candidates, deployment plans, and the potential of a future IF application.
7. Support of IF applications and/or recommendations on action, incl. other funding sources.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Comprehensively, the innovation pipeline is designed to canalize the vast Horizon 2020 database through an intelligent framework. It provides a selective approach to directly assess the relevant "core" of the funded projects, their results, and guides the selection further according to characteristics like TRL, market (value chain) relevance, and business readiness. This process is outlined in Figure 3.

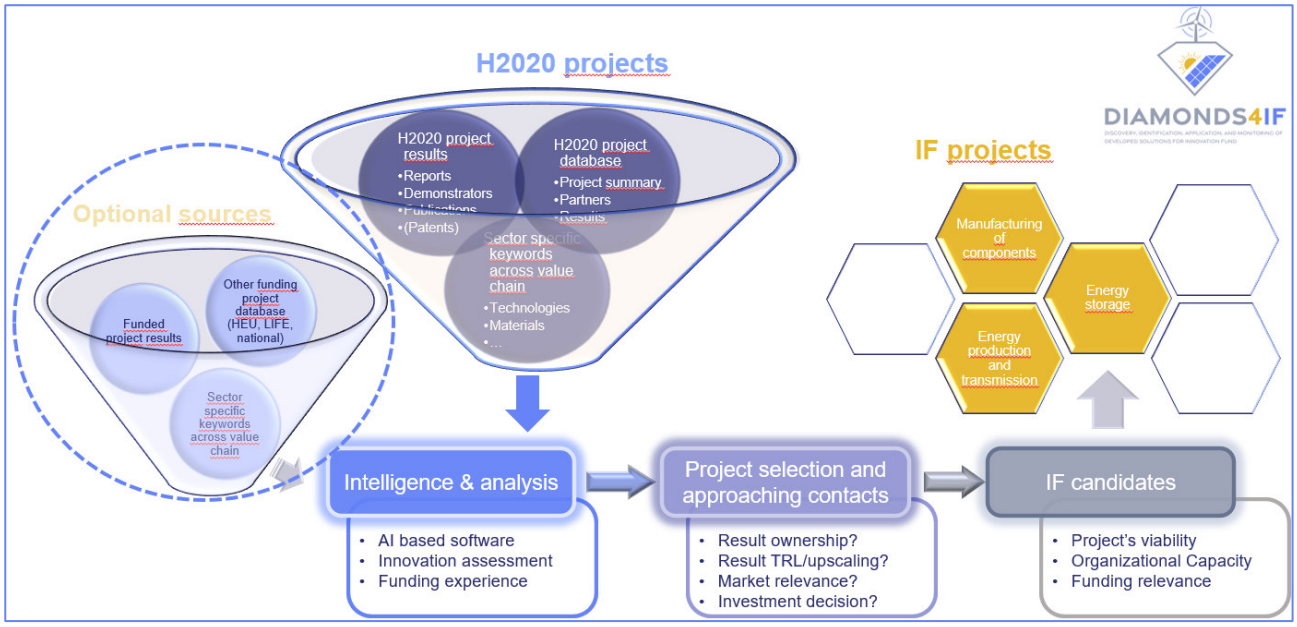


Figure 3: Graphical representation of the Innovation Pipeline. Source: PNO

According to the concept outlined above, there is relevant evidence on IF project scope and success factors available, and it will be further enhanced in other work packages of our project. However, the focus to derive suitable candidates, is to access CORDIS data. Therefore, relevant keywords and filter criteria are needed, and a technical approach to cope with the huge database and its "hidden" information, as in CORDIS, content of results and deliverables is only provided through short summary and manual "download" function of the sources itself.

The main purpose of the development of the Additional analytic Framework (D1.1) was to access the content of public project reports, demonstrators, and other deliverables like exploitation plans through AI enabled keyword analysis. Moreover, ©Wheesbee provides relevant filters and query combinations to allow the creation of relevant and manageable data sets for further analysis.

In line with the focus topic "renewable energies" of our project, the innovation pipeline will primarily address all sectors related, including wind, PV, geothermal and hydropower and their underlying technologies and materials. To derive keywords for each of the renewable sector and its whole value chain, the approach described in section 2 is used.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

2 THE RENEWABLE SECTOR'S VALUE CHAINS

2.1 Drawing value chains

An overview of the supply chains of the renewable energy market is important to focus attention on the entire production process and to see where innovation contributes to the next steps from development to pilot applications and market deployment. Defining technologies across the value chains allow us to identify the keywords associated with the different production phases.

In general, a value chain includes raw materials and basic technologies, equipment manufacturing, production processes, construction and installation, operation and maintenance, and related services, and in some cases fuel supply.

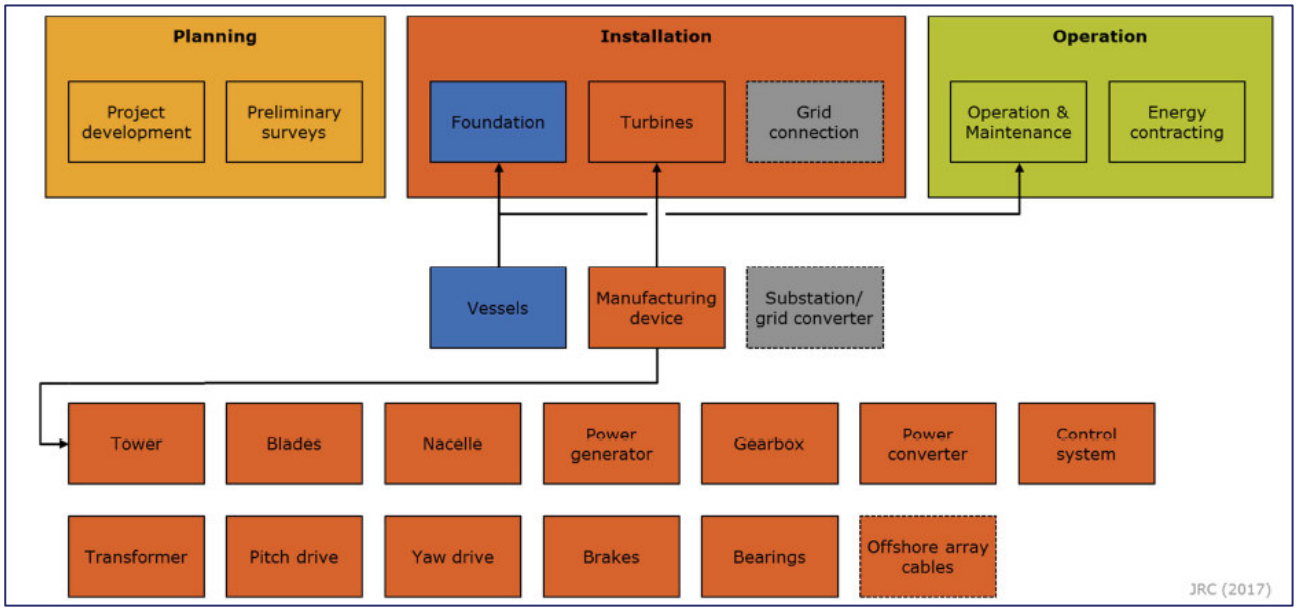
In the next paragraphs we give an overview of the sectors and their supply chains for wind energy, geothermal and hydropower incl. ocean energy, and solar photovoltaics.

2.1.1 Wind energy

The wind energy supply chain is illustrated in Figure 4. Across the value chains steps (planning, installation, operation), the wind sector differentiates **on- and offshore applications**, which vary in sizes of installed turbine capacities, some details of the technologies (e.g. geared vs. direct drives), investment need, investment dynamics, and geographic distribution. In Figure 4, dotted boxes refer to offshore wind.

As of the end of 2023, Europe had 238 GW of installed onshore wind power capacity. In 2023 a capacity increase of 14.5 GW of new onshore wind was installed. Germany led the onshore wind expansion with significant new capacity additions, followed by Sweden with 1.9 GW of new onshore installations in 2023. Europe is expected to continue strongly focusing on onshore wind, up to 2030.

Additionally, Europe reached a total offshore wind capacity of 34 GW by the end of 2023. The year 2023 saw a record 3.8 GW of new offshore wind capacity installations (21% of the total new wind capacity for the year). The Netherlands was the top contributor to new offshore capacity with 1.9 GW added in 2023. Other notable contributors included the UK, France, Denmark, Germany, and Norway. Offshore wind installations are expected to increase significantly towards the end of the decade. By 2030, new offshore installations are projected to nearly match new onshore installations annually, indicating a balanced growth in both segments.



Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Figure 4: Wind energy supply chain in details, with components and subcomponents. Source JRC (2017)

As the birthplace of the wind industry, Europe enjoys a mature supply chain spanning from turbine nacelles through to key components and raw materials. However, since establishing a local wind supply chain in 2008–2010, China has not only become the world's leading (Figure 5) wind turbine manufacturing base, but also the largest production hub for **key components and raw materials**.

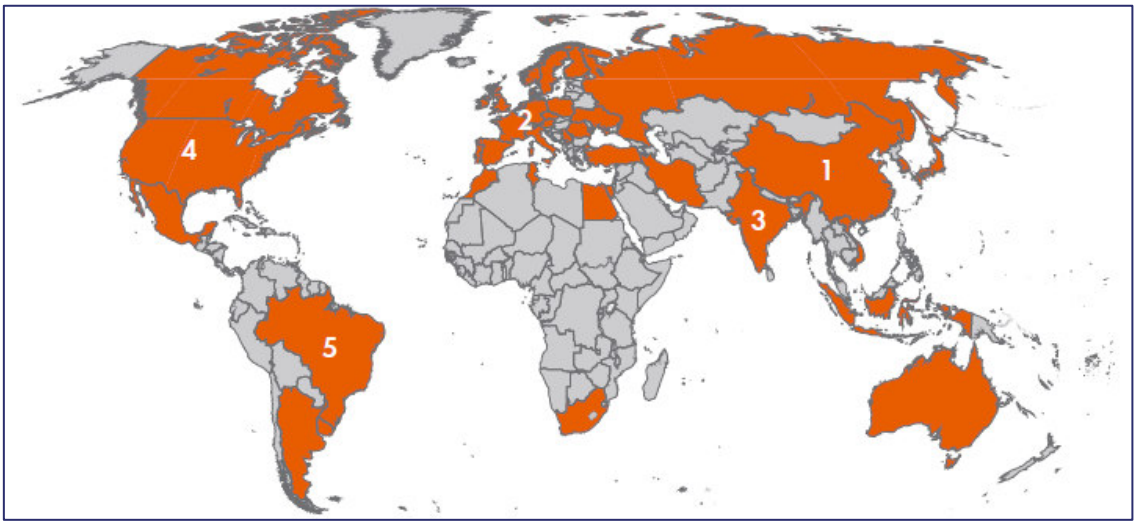
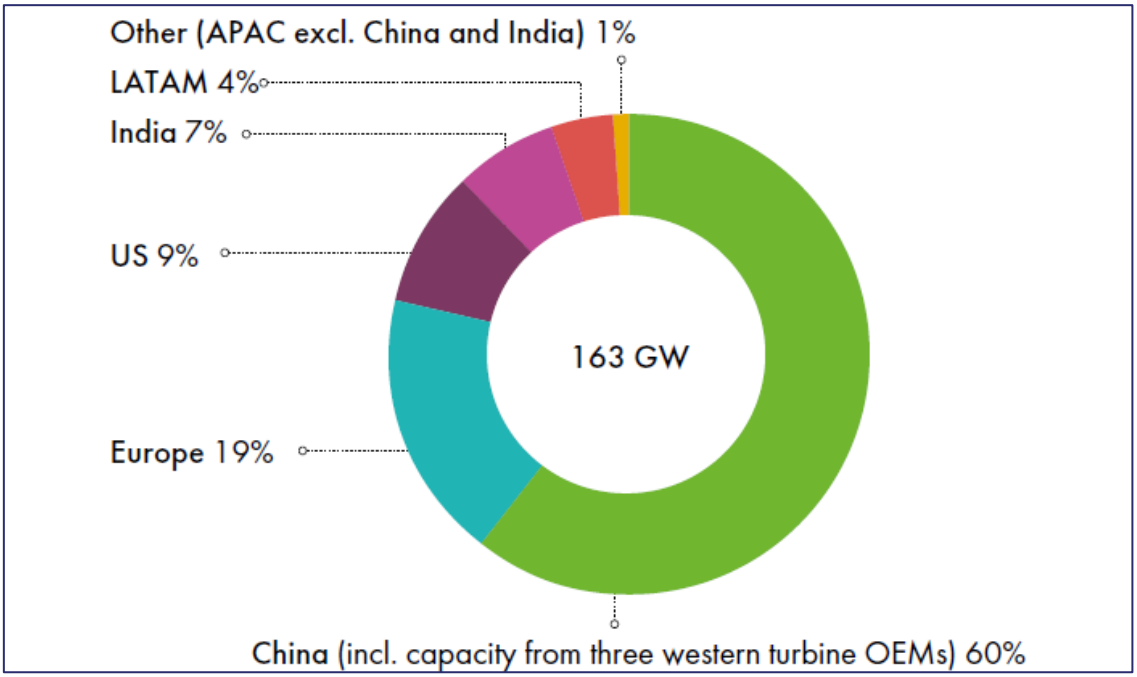


Figure 5: World's top five wind turbine and component production hubs by annual output (Source: GWEC Market Intelligence, February 2023)

Europe has the world's second largest turbine nacelle production capacity (Figure 6), with assembly facilities mainly located in Germany, Denmark, Spain, France, Portugal and Turkey.



Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Figure 6: Global wind turbine manufacturing capacity in 2023
(Source: GWEC Market Intelligence, February 2023)[1]

The supply chain for key components is thus highly dependent on China, and the major western turbine OEM manufacture a large part of their capacities in the country. This is valid for nearly all parts of the turbine, incl. gearboxes and generators, castings, forgings, slewing bearings, towers and flanges, where China has more than 70% of the global market share. Nevertheless, technologies for components and manufacturing have been also developed and are still being developed in Europe, which is represented also by numerous funded projects in the sector.

2.1.2 Geothermal

Geothermal energy is one of the oldest sources of renewable energy. It is generated from the thermal gradient inside the earth, i.e. from the heat that is trapped underground due to the difference in the temperature between the surface and the core of the earth. The earth is a huge reservoir of hot fluids that are in constant circulation.[2] The geothermal value chain includes several stages such as:

- Exploration: Identifying potential sites through geological surveys and surface exploration.
- Drilling: Involves high costs and risks associated with drilling wells to access geothermal reservoirs.
- Construction: Building the infrastructure necessary for geothermal power plants, including pipelines, turbines, and cooling systems.
- Operation and Maintenance: Running the geothermal plants and maintaining the infrastructure to ensure continuous and efficient energy production.

Figure 7 illustrates the supply chain for deep geothermal energy systems.

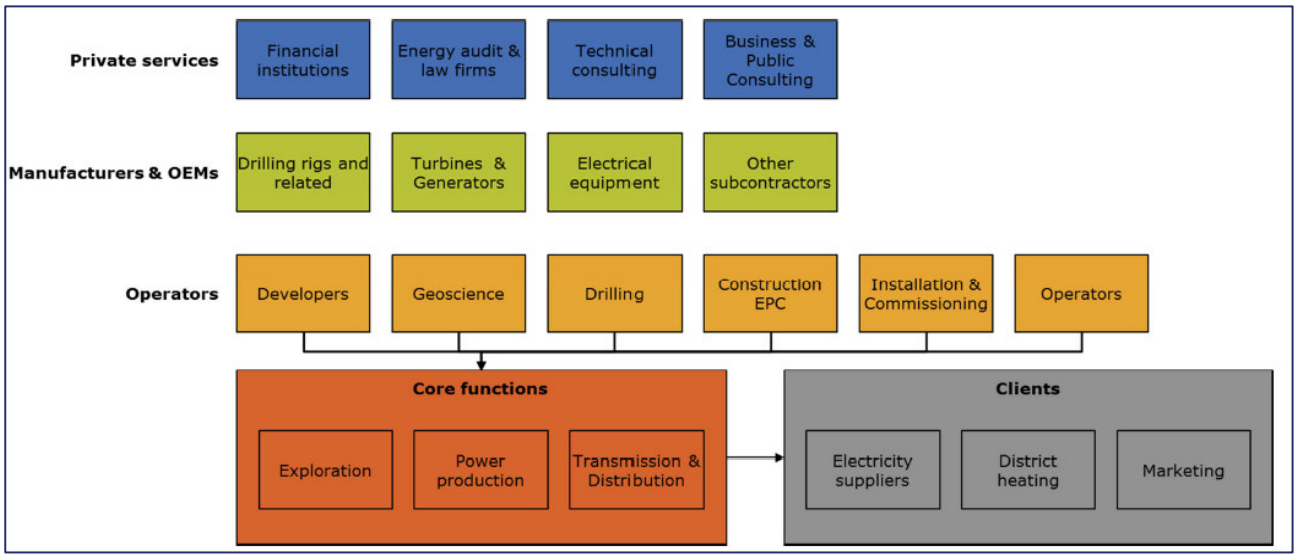


Figure 7: Supply chain for geothermal energy systems: example for deep applications
(Source: Geoelec, 2014, simplified and adapted)[3]

[1] GWEC - Global Wind Energy Council (12.2023) | Mission Critical: Building the Global Wind Energy Supply Chain For A 1.5°C World, https://gwec.net/wp-content/uploads/2023/12/MISSION-CRITICAL-BUILDING-THE-GLOBAL-WIND-ENERGY-SUPPLY-CHAIN-FOR-A-1.5%C2%B0C-WORLD.pdf, page 25

[2] What Is Geothermal Energy?, Geothermal Energy-Uses, Sources, And Advantages (eduinput.com)

[3] JRC Science Hub (2017) | *Supply chain of renewable energy technologies in Europe - An analysis for wind, geothermal and ocean energy*, page 24

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Geothermal systems can be installed in both residential and commercial settings. Every geothermal system involves:

- **deep wells** to access suitable subsurface temperatures,
- **fluid** that serves to transfer temperature differentials, and
- **furnaces** that convert the temperature differential to heat or cool a building.

The manufacturing supply chain for the drilling of wells is very similar to that of natural gas and oil well drilling and most suppliers of geothermal equipment for the underground part of the installations are coming from oil & gas industry (e.g. exploration, drilling, pipes, and pumps). Manufacturers from the conventional energy sector are the main suppliers for aboveground installations (e.g. turbines).

The technologies are divided into **Hydrothermal and Petrothermal Solutions**, where Hydrothermal Systems are the most common type of geothermal energy resources and involve the extraction of hot water or steam from underground reservoirs. The steam or hot water is then used to generate electricity or provide direct heating. Petrothermal Solutions (also called Enhanced Geothermal Systems) involve creating artificial reservoirs by injecting water into hot dry rocks to produce steam, which can then be used for electricity generation and heating.

The total installed geothermal power generation capacity in Europe stood at 16,335 MW by the end of 2023. Turkey is the leading country in Europe for geothermal power generation, with a capacity of 1,691 MW, making it one of the top 10 geothermal countries globally. Other European countries with significant geothermal capacities include Italy with 916 MW and Iceland with 754 MW (source: IRENA). The emphasis in Europe remains more on geothermal development for heating purposes rather than power generation. The geothermal district heating and cooling sector in Europe saw a growth rate of 6% in installed capacity, reaching 2.2 GWth by 2021. Figure 8 provides a map showing the geothermal heating potential in Europe through the Pan-European Thermal Atlas[4]

[4] https://www.thinkgeoenergy.com/interactive-map-showing-the-areas-with-geothermal-heating-potential-in-europe/

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

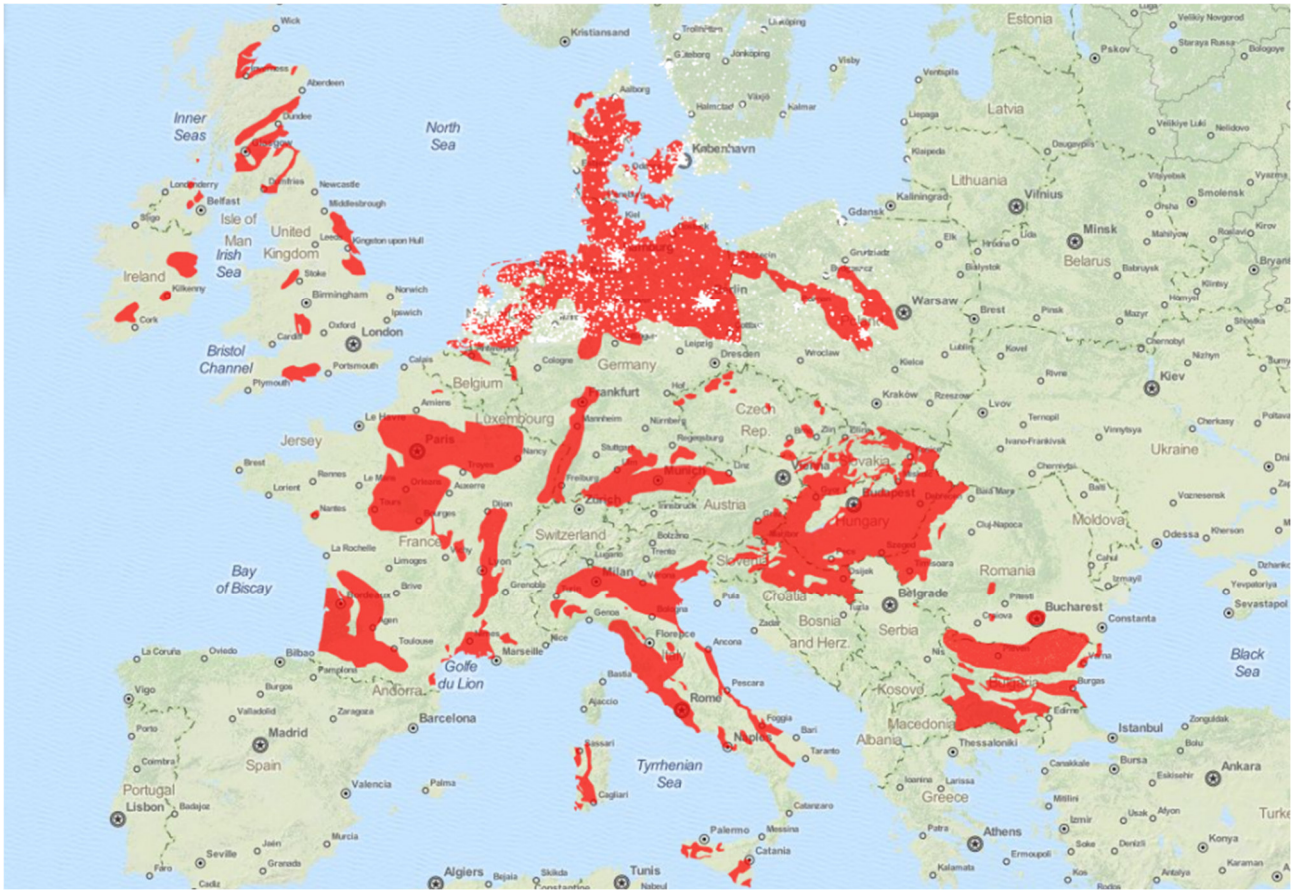


Figure 8: Thermal demand and geothermal district heating potential in Europe. source. www.heatroadmap.eu

2.1.3 Hydropower, incl. ocean/marine energy

In 2018, the total global renewable electricity generation amounted to 6.7 PWh, almost two thirds from hydropower plants (IEA 2019). Also, Europe has a robust hydropower capacity that plays a crucial role in the renewable energy mix. The region's total installed hydropower capacity is approximately 230 GW (2023). Notably, the EU hosts more than a quarter of the global pumped-hydropower-storage capacity.

The existing hydropower capacity can be differentiated across **conventional and Pumped Storage Hydropower**. Pumped storage is important for balancing supply and demand and plays also a pivotal role for integrating intermittent renewable sources like wind and solar and providing grid stability. Recent projects in Switzerland (Nant-de-Drance) and Portugal (Tâmega) added substantial capacities, but in general, the focus is on modernizing existing hydropower plants to enhance their efficiency and flexibility, incl. incorporating digital technologies and updating infrastructure to tap hidden hydropower potential in existing facilities and hydraulic infrastructures.

While conventional and pumped storage hydropower is a mature and reliable technology, increasingly, alternative solutions like **marine/ocean energy technologies** are being developed.

Ocean energy generation exploits the power of tides and waves, as well as differences in sea temperatures and salinity, to produce electricity. Although not yet commercially available, promising ocean technologies include:

- **Wave energy**: Wave energy technologies capture the movement of ocean and sea waves and use it to create energy – usually electricity. The amount of energy created depends on the speed, height and frequency of the wave, as well as the water density. Wave energy can

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

provide utility-scale power production and works very well in tandem with other renewables such as wind. In comparison with tidal energy, the wave energy industry has yet to reach precommercial deployments. Technology is currently being demonstrated at TRL7.

- **Tidal energy**: Tidal currents are caused by the gravitational forces of the sun and the moon, and are particularly concentrated in narrow bodies of water, such as around islands or inlets. Tidal turbines can be fixed to the seabed, or float nearer the surface with moorings attached to the seafloor.
- **Salinity gradient energy**: arise from differing salt concentrations, as occurs where a river empties into an ocean. Demonstration projects use "pressure retarded osmosis", with freshwater flowing through a membrane to increase the pressure in a tank of saltwater; and "reverse electro dialysis" with ions of salt passing through alternating tanks of salt- and freshwater. [5] The energy released from 1 m^3 fresh water is comparable to the energy released by the same m^3 falling over a height of 260 m.
- **Ocean Thermal Energy Conversion** (OTEC) plants use deep cold seawater and warmer surface seawater to produce a steady power supply. Technologies target a temperature differential of around 20°C or more between cold and warm water. OTEC prototypes are often land based, but floating prototypes are also under development, which can move from place to place.
- **Sea Water Air Conditioning** (SWAC) is the perfect technology to decarbonise heating and cooling systems around the world's coasts. SWAC installations are located close to shore and pump water from the nearby sea or ocean. Depending on the water depth and the season, the pumped seawater is used to cool or heat a closed freshwater loop via a series of heat exchangers. A single system can provide heating or cooling to an urban area several kilometres wide.[6]

[5] IRENA (International Renewable Energy Agency) https://www.irena.org/Energy-Transition/Technology/Ocean-energy
[6] OTEC, https://www.oceanenergy-europe.eu/ocean-energy/otec/

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

The Figure 9 provides an overview of the expected ocean energy supply chain, highlighting the production of ocean energy converters and essential components. Due to the localized nature of wave and tidal energy resources, it is expected that supplementary activities such as project development, operations, and maintenance will be managed by local firms.

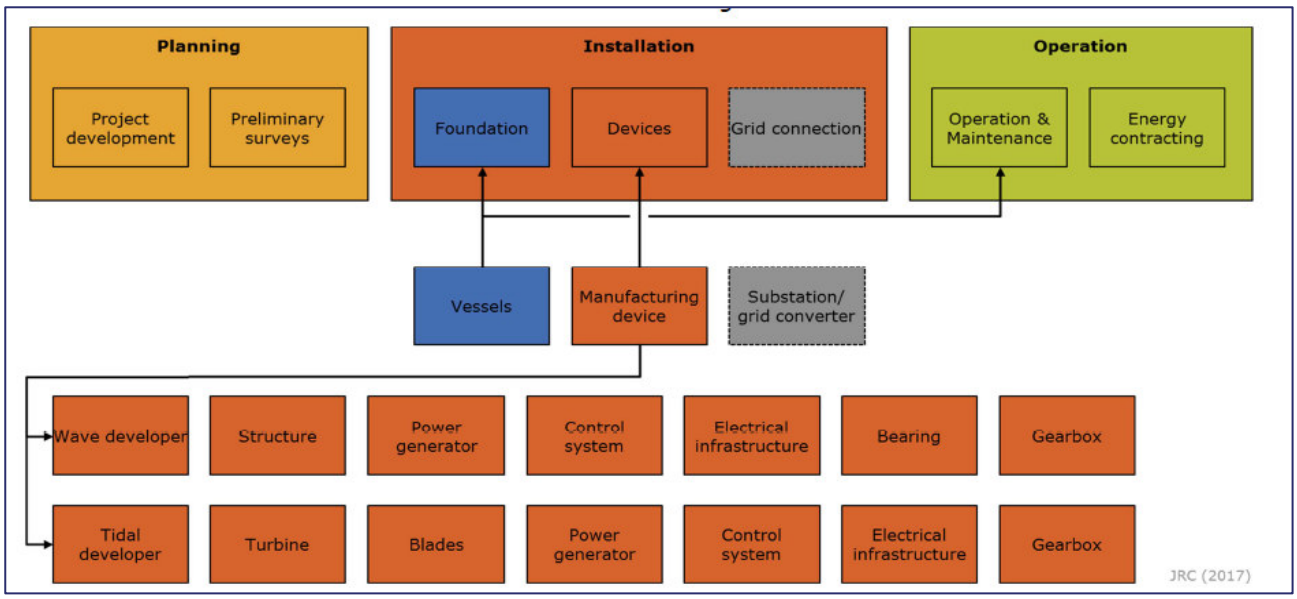
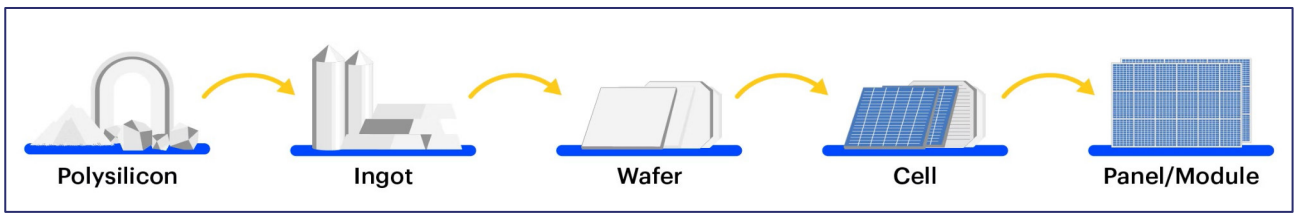


Figure 9: Ocean energy supply chain accounting for component and subcomponents (Source: JRC 2017)

Currently, Europe holds a leading position in the development of ocean energy technology, accounting for 52% of tidal and 60% of wave energy development. This leadership is further reinforced by Europe housing 70% of the global ocean energy infrastructure. Additionally, European technology maintains a leadership position in terms of installed capacity worldwide. Out of the 16 operational tidal energy projects globally, 15 utilize European technologies.[7]

2.1.4 Solar Photovoltaics (PV)

Solar PV is one of the sources with lowest LCOE[8] for generation of electricity. Its supply chain can be drawn on the process that involves materials, manufacturing processes of wafers, cells, and modules, as well as shipping, installation, and usage. Figure 10 illustrates the way from raw materials to the finished product, spanning the five main segments of the manufacturing process: polysilicon, ingots, wafers, cells and modules.



[7] JRC (2017), page 33

[8] LCOE stands for "Levelized Cost of Electricity" (or "Levelized Cost of Energy"). It is a measure used to compare the cost of generating electricity from different sources. The LCOE represents the per-unit cost (typically expressed in cents per kilowatt-hour or dollars per megawatt-hour) of building and operating a generating plant over an assumed financial life and duty cycle. It includes all the costs over the lifetime of the project. LCOE provides a convenient summary measure of the overall competitiveness of different generating technologies.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Figure 10: Key stages in the main manufacturing process for solar PV. Source IEA (2022)[9]

In 2021, the global production capacity for *solar PV modules* was 460 GW. This included 98% from crystalline silicon technology and the rest from thin-film module production. PV supply chain is geographically concentrated in China, which is a result of massive local investment programmes, and which has led to dominating > 80 percent of the market share in all stages of the PV supply chain, including solar panel manufacturing as well as the upstream consisting of polysilicon, ingots, wafers, and cell production.[10]

The EU is a prominent global producer of machine tools across diverse industries and has long been at the forefront of PV innovation. Recently, new concepts, incl. floating PV, Agri-PV, and building-integrated PV play a significant role among the technologies developed and exploited in Europe. However, while the European PV machine tools industry is strong for "downstream" components like cell manufacturing and module assembly equipment, there are significant gaps in production capacity and expertise for "upstream" equipment such as wafering and materials. Recently, at least the massive deployment of solar modules is encouraged and nurtured by rooftop solar regulations etc. However, Europe is depending on imports of final products.

The public announcements of capacity development and expansion until 2025 are outlined in Figure 11. However, these have been recently distracted by several shutdowns and relocation plans of the major players. The reason is the current market situation, where European manufacturers are facing strong competition from highly subsidised Chinese products, and a high incentive is provided through the US Inflation Reduction Act. There is an increasing market risk of postponed investments in renewable sector due to e.g. bottlenecks in finance, and market forecasts have currently low predictability.

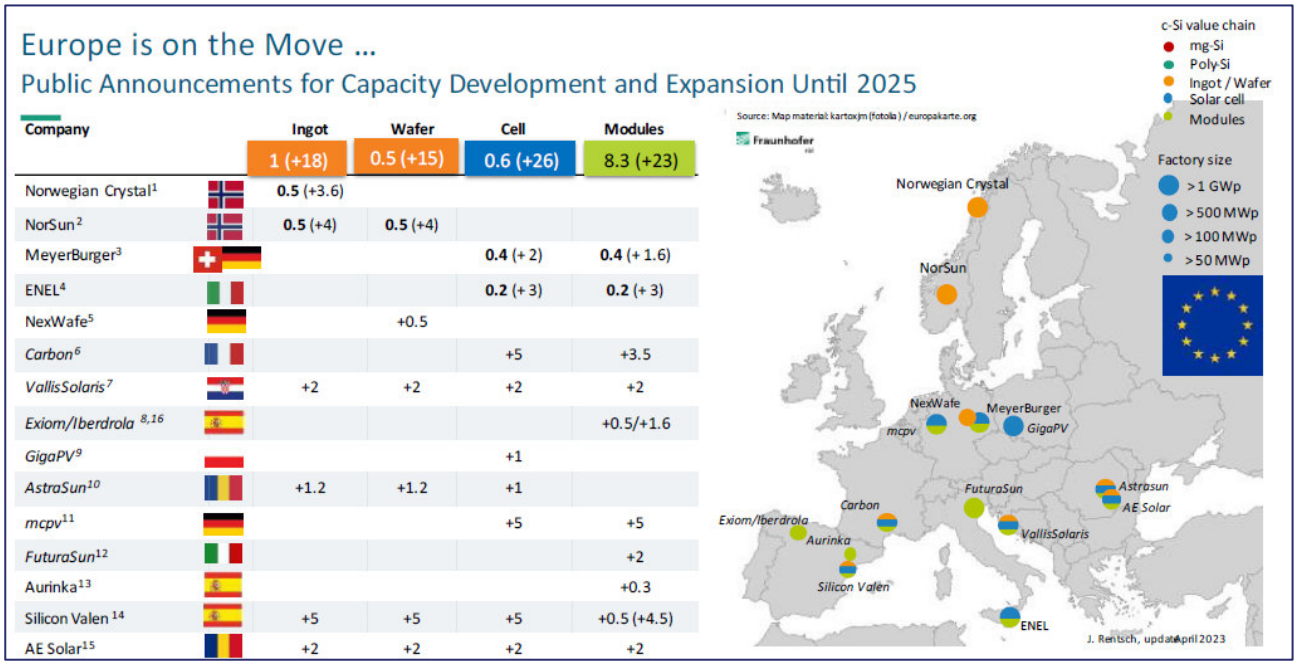


Figure 11: Planned investments in PV manufacturing capacity across the value chain (Source: Fraunhofer ISE)[11]

[9] IEA (2022) | Special Report on Solar PV Global Supply Chains, Solar PV Global Supply Chains – Analysis - IEA
[10] ETIP Photovoltaics (May 2023) | PV Manufacturing in Europe: understanding the value chain for a successful industrial policy
[11] ETIP Photovoltaics (2023), page 14

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

2.2 Interviewing project partners to define keywords

After having investigated the key stages in the supply chains of the above-mentioned renewable subsectors, the selection process in 2024 focuses on the technologies represented by our consortium, i.e. wind energy and solar photovoltaics. With their deep expertise, our project partners - RWE, Meyer Burger and RAAMS – supported the process to identify and collect the keywords related to the different steps of their sector's value chains.

Figure 12 illustrates simplified but more focused versions of the supply chains as used for the next steps. Subsequently, the other renewable sectors will follow throughout the next months and the iterations of the search.

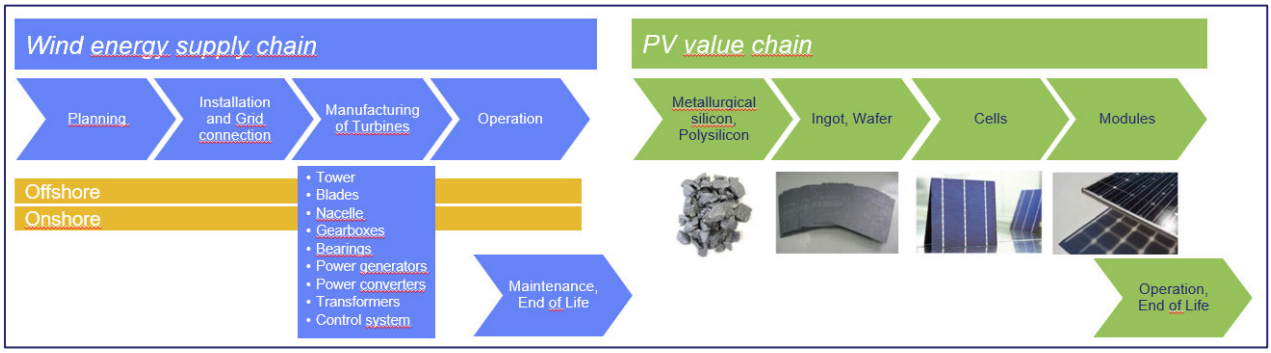


Figure 12: Renewable energy sector value chains, summary graphic presentation. Source PNO

Figure 13 shows a simplified representation of the types of keywords requested to our partners. In a separate sensitive document, we collected the keywords provided by our project partners, enhanced and refined in an iterative review.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

	Wind Turbine Manufacturing					Balance of plant			Installation & Operation		
	Rotors & Blades	Bearings and gearbox	Nacelle & Controls	Generator & Power Electronics	Tower Components	Foundation	Electrical components	Other	Transport	Installation	Maintenance
Equipment											
Materials											

Figure 13: Keywords in the value chain – Simplified table as an example. Source PNO

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

3 PERFORMING THE ANALYSIS

3.1 Wheesbee

The main tool, ©Wheesbee, is accessible via wheesbee.eu. Wheesbee is a web platform to support research and innovation related processes by providing access to a huge knowledge base, built by integrating millions of contents from different sources. It includes patents, scientific papers, funded projects at European and national level, funding and collaboration opportunities. INNEN; our project partner and developer of Wheesbee, provided us (PNO) with the premium user rights to perform the analyses. The Additional Analysis Framework for project results has been developed in 2024 and was a precondition to perform the analyses as described. The main feature is that results and the content of the CORDIS-attached documents are accessible for keyword searches and can be displayed directly in Wheesbee. More information is available in D1.1.

3.1.1 Wheesbee operators

The first step is to assess the platform's structure, its operators, and to gain ability to use various filters to select the information gathered within the platform. Second, the keywords received from our partners are combined with these operators and filters. Third, the sensitivity and knowledge on IF success factors need to be integrated through additional filters and more complex queries leveraging multiple operators. The operators used are listed in Table 1.

Table 1: Wheesbee operators and descriptions

Operator	Description
OR	Used to match documents containing at least one of the terms separated by the operator. Results containing more than one of the terms will likely have a higher score.
AND	Default query operator for multiple terms separated by spaces. Matches documents where both terms exist in the text of a single document.
NOT	Excludes documents that contain the term after NOT.
+	Requires that the term after the operator exist, in order for the query to return a match.
""	Requires that the whole phrase enclosed between them exist in order for the query to return a match.
*	Acts as a wildcard which can be used before and/or after a keyword to match whatever term starts with, ends with, or includes the keyword.
Grouping Operators	Use parentheses to build more complex queries, by grouping terms and building clauses with the operators earlier described.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

3.1.2 Filter criteria

Different filter criteria and queries have been used based on the experience acquired step by step. Among the filters, there are e.g. Funding programmes (here: Horizon 2020), status of the projects, and the type of organisations sought, which are also available in CORDIS. Going beyond this, the additional functionality "results" has been implemented to Wheesbee recently. This allows to extract more specific information about the actual results carried out within a project, which is not in general description of the project, and to identify which of the organisations in the consortium played a specific role or was involved in a specific activity. Figure 14 shows an overview of some filter criteria.

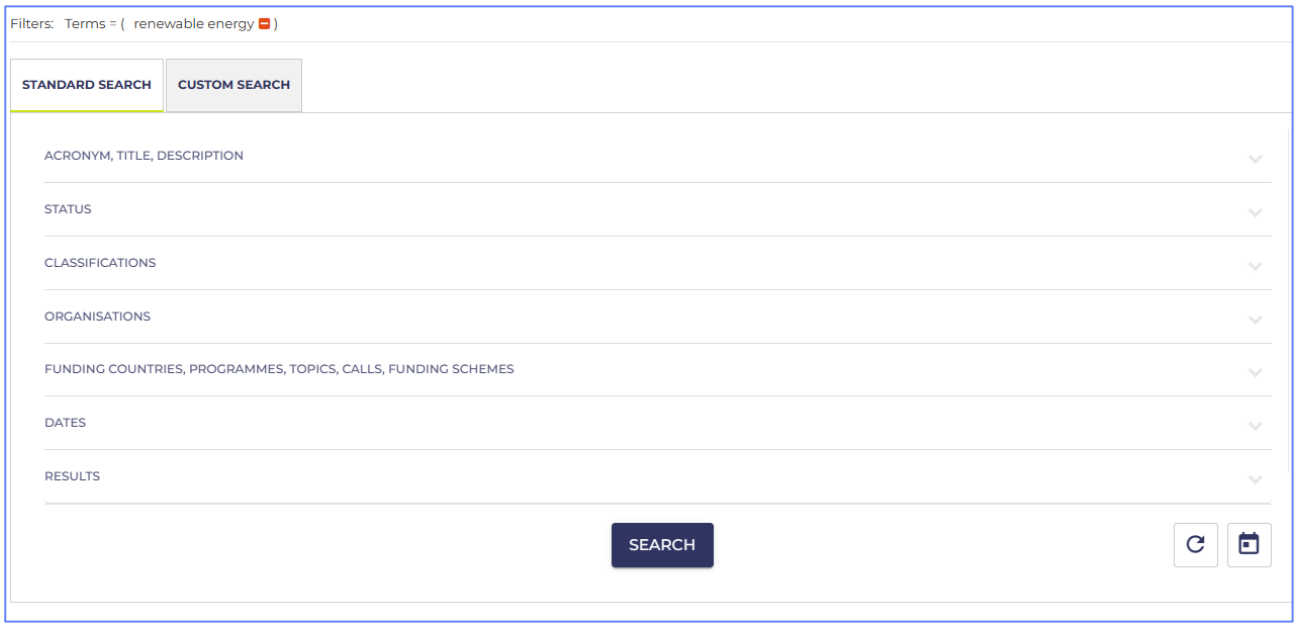


Figure 14: Wheesbee filter possibilities

Each criteria represented in Figure 14 also has subcategories, allowing the search to be restricted down by defining for example the fields of science, the countries of the organizations involved, specifying the start and the end dates of a project, the funding programmes as well as the funding scheme, the financial authorities, the status of the project (closed or still active) and the type of output desired (deliverable, publication, others…). Table 2 provides examples of filters that we have used in different combinations.

Table 2: Wheesbee filters: some examples

Wheesbee filters	Filters used by PNO in different combinations
Funding Country	European Union
Authority	European Commission
Funding Programmes[12]	(H2020) Horizon 2020
Status[13]	Both closed & active projects
Organisations [14]	Not used

[12] Filter projects by the Programmes under which they have been submitted. This field is available only if the values "Australia", "Canada", "Europe", "Finland", "The Netherlands" or "United States" are selected in the "Funding countries" field.
[13] Filter projects by their status (Active, Closed, Unknown or Any)
[14] You can search all projects in which an organisation is involved specifying the name of the organization.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Wheesbee filters	Filters used by PNO in different combinations
Coordinators	Not used
Participants	Not used
Start Date	• Start date from: 01/01/2020 to 31.12.2022 • Start date from: 01/05/2018
Classification, Fields of science[15]	Renewable Energy
Funding Scheme[16]	Innovation Action
Results	Description of the projects, relevant deliverables, exploitation plans, but sometimes also the periodic reports or "other"

3.1.3 Design of the Queries

Utilizing the various operators outlined in paragraph 3.1.1 and combining them with the diverse Wheesbee filters as detailed earlier, along with the pertinent keywords obtained from the partners' projects regarding their product value chains, we have created a set of queries (Table 3).

Table 3: Some of the Queries used to derive projects relevant for the wind sector

Examples for Queries
(recycl* blades) AND wind) OR (renewable energ*)
((recycl* blades) AND wind) OR (renewable energ*)
(recycl* blades) AND (wind OR (renewable energ*))
("3d printing" OR "additive manufacturing") AND ("wind turbine" OR rotor OR blade)
((rotor blade) OR (flatback airfoils)) AND (integrated sensors) AND (wind OR (renewable energ*))
(Turbine Manufacturing) OR (Installation Vessel) AND (wind OR (renewable energ*))
(Wind OR (Turbine Manufacturing)) AND ("rotor" OR "rotor blades" OR gearbox) AND renewable
(Wind Turbine Manufacturing) AND renewable

Figure 15 and Figure 16 illustrate the list of projects derived from the combined use of the "(Wind OR (Turbine Manufacturing)) AND ("rotor" OR "rotor blades" OR gearbox) AND renewable" query and the pre-selected filters. In addition to the 32 results listed, Wheesbee also offers (on the right side) a graphical representation of the aggregated data.

[15] The fields of science classification is based on EuroSciVoc, a taxonomy that represents all the main fields of science (more than 1000) that were discovered from the CORDIS projects through a semi-automatic process based on AI techniques. (Source: Wheesbee 2024)

[16] Filter projects by specific Funding scheme. This field is available only for projects funded by the European Commission and related to programmes Horizon, H2020, FP7, FP6

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

Figure 15: List of projects selected by Wheesbee

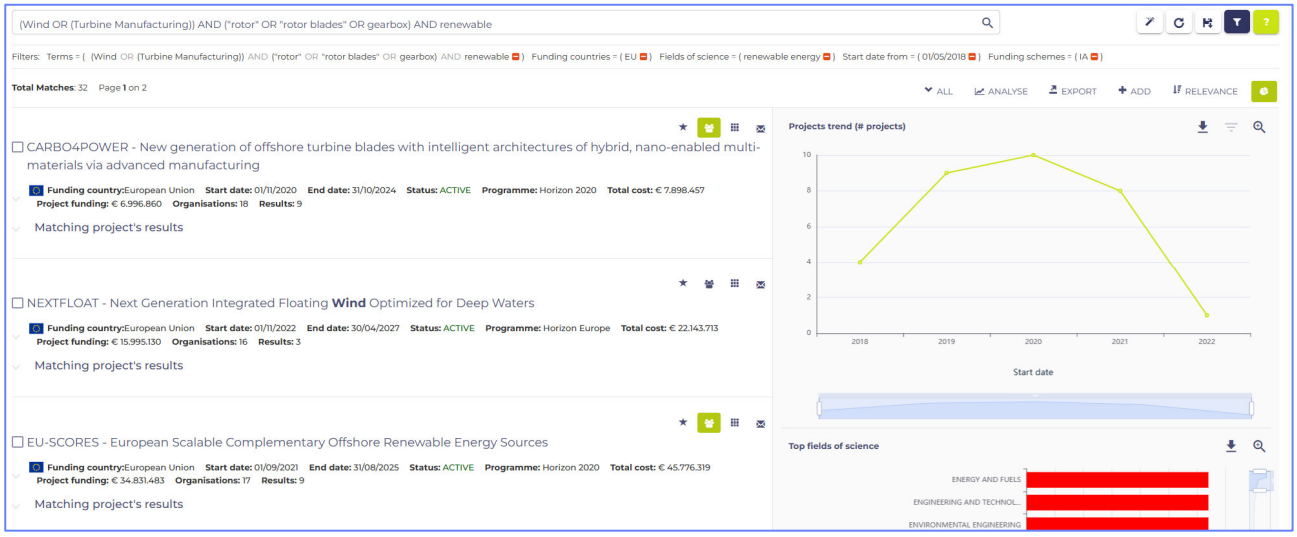


Figure 16: List of projects selected by Wheesbee. Details

3.2 Processing the search results

3.2.1 Data exports

Using the complex queries, a manageable number of projects with relevant results has been derived from the original database, that now does not only contain project meta-data and summaries but the content of the project results.

To analyse the lists of projects extracted, the data set can be automatically exported into an Excel format. The exported results include all the information previously selected in Wheesbee, along with additional details, as illustrated in Figure 17.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

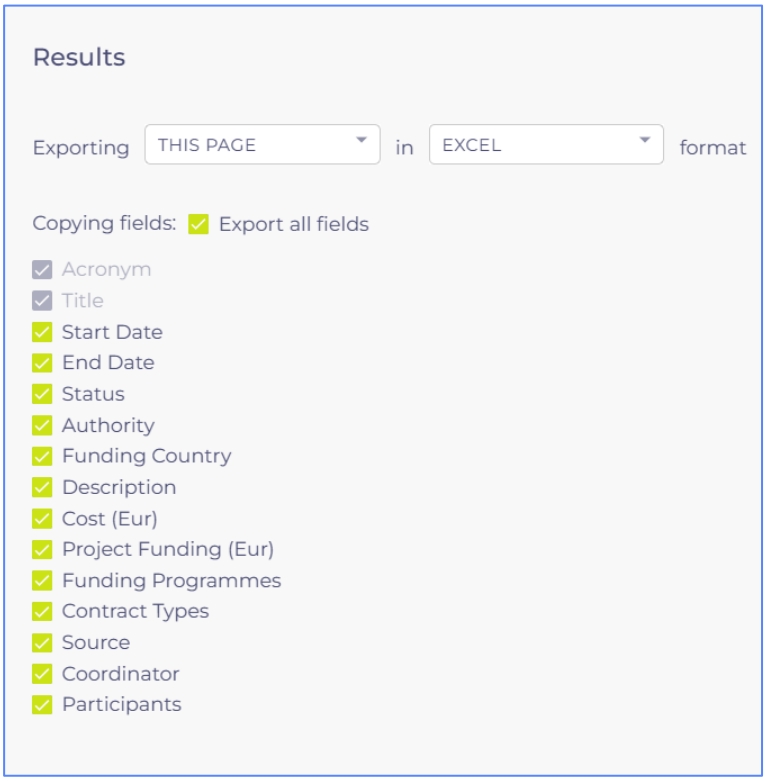


Figure 17: Illustrative overview of Wheesbee results categories

In the exported excel tables it is possible to find, in our case the projects listed previously in Wheesbee, as well as a list of the project participants, containing details such as company type, address, city, role and more.

3.2.2 Finetuning of criteria

The most important criteria to be operationalized would be the target to look for projects with a TRL 7 (Technology Readiness Level) or higher. However, there may be several methods to do so, apart from a mere filter, as TRL can also have been emerged throughout the time since a project has been reporting its results to the funding authority.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

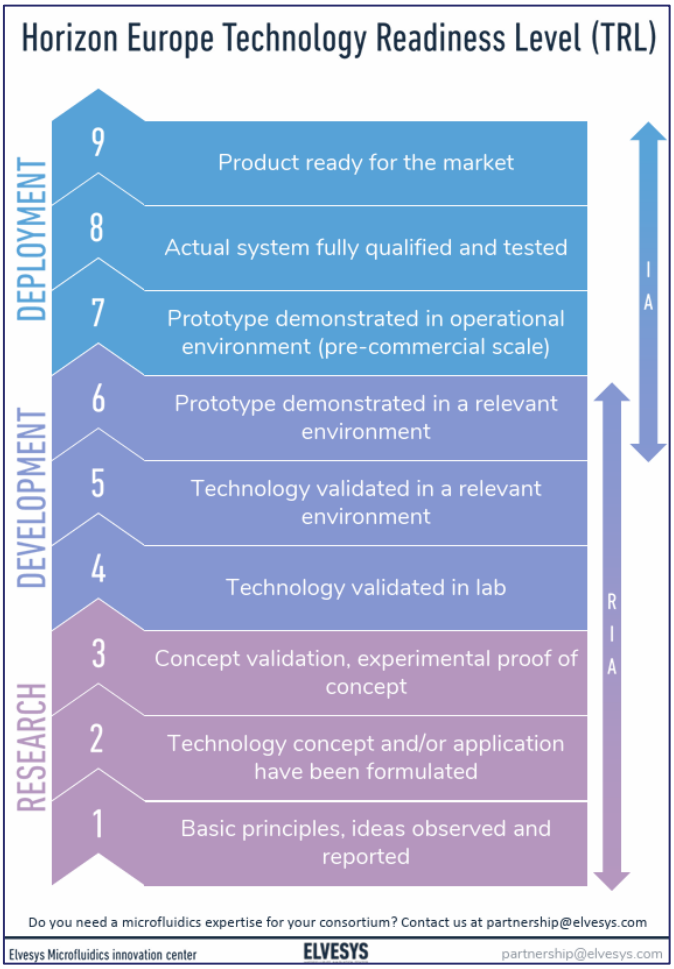


Figure 18: Graphical Representation of the TRL Scale

After establishing an initial list of ideas and projects, the following aspects have been further analysed and assessed manually based on our IF experience:

- Description of the project
- Market relevance
- Previous/other/connected H2020 projects
- Private companies or “other”
- Internal knowledge based on sector experiences and personal contacts across countries

To focus on project owners with exploitation goals, we selected, for instance, projects with partners defined as “other” or “private company.” We also focused our attention on smaller consortia, even without universities or research institutes. Large enterprises are particularly interesting among the organizations.

Additionally, a final selection may prefer Innovation Actions due to their close-to-market characteristics, but this again depends on the timeframe chosen for the project end date.

Moreover, also current and future Innovation Fund topics need to be considered, as well as the potential match with available information on companies and projects from other sources (websites, sector news, company data, reading some of the result reports).

This continuous refinement resulted in the initial list of relevant projects. In this list, a colour code according to traffic lights is used to indicate projects to be considered (green), those which still need

Funded by the European Union

This project has received funding from the European Union’s Horizon Europe research and innovation programme under Grant Agreement No 101138004.

revision (yellow), and those which will not be considered (red). Based on the projects with a good final rating (defined by PNO based on our experiences in the IF field), PNO will contact potential candidate partners for IF applications.

A final scoring model is still under development, as the data in the list allow for “best guess” of projects of interest, there is still work to be done to define an intuitive and comprehensive scoring system.

3.2.3 Exclusion of projects

The drafting of the initial list also considers our synergies with our CSA sister project REALIZE, carried out from Euro Funding and active in the renewable sector as well. After establishing contacts with our project partners, we excluded the Horizon projects that had already been examined and contacted by them.

3.3 Moreover, we exclude projects that apparently do not fit within the criteria and filters, even if the software-based research has extracted them. This may have various reasons, incl. ambiguity of keywords, overambitious TRL classifications etc. All the refinement work on the list was done manually without the use of automated processes or tools. Milestone 1: Definition of Candidates

According to the purpose of WP1 and WP2, which is to create a pool of potential IF application candidates beyond the pilot cases, and with the goal of the first milestone listed in the Grant Agreement, which aims at identifying at least three candidates from the database by project month 6, we have provided our initial list of relevant projects. What can be observed from this list is that approximately 20 of these projects have been highlighted in “green” as potential IF applicants. All these projects are connected to the renewable energy sector, however from various positions in the value chain. In this sense we can consider the Milestone goal achieved.

Funded by the European Union

This project has received funding from the European Union’s Horizon Europe research and innovation programme under Grant Agreement No 101138004.

4 NEXT STEPS

4.1 Lessons learned

Throughout the process of researching potential candidates and subsequently drafting a list of possible applicants, it provided added value to assess and investigate the CORDIS database based on the extracted project data in a kind of back-loop. Some of the results have been screened by our consultants. Moreover, additional web search was needed to verify data that was not sufficiently detailed in CORDIS. In these first months of our DIAMONDS4IF project, PNO has been able to develop and implement a systematic approach to selecting funded project results, thanks to our innovative tool ©Wheesbee. Through advanced AI techniques, Wheesbee analyses millions of documents, extracting pertinent information and insights. This dramatically enhances effectiveness in technology discovery and innovation assessment. We have therefore successfully extracted a list of relevant projects , incl. the most relevant data that were the source for their selections. This will enable us to select projects and partners, rate the results, and subsequently approach and contact them.

As shown in Figure 3 in section 1, one of the lessons learned during this process is that the database scope used by Wheesbee, and its filters could be expanded by considering other funded project results and EU programs.

These results lay the foundation for further project steps and will also contribute to defining and providing feedback to CINEA. Our aim is to improve and streamline the entire process of candidate search, selection, and application for the Innovation Fund.

4.2 Approach to contact persons

In a second step, all potential candidates will be contacted by PNO.

The Innovation Fund scheme projects will be introduced, including answering candidates' questions and explaining the benefits. Furthermore, potential ideas for IF projects will be evaluated and an initial "Viability Check" will be provided, encompassing the award and eligibility criteria of the Innovation Fund. This will provide an overview of the status of the project idea, including the areas where potential questions may arise (financial maturity and eligibility).

The ideal outcome would be a match between the company’s ambitions, their planning status, and the Innovation Fund. However, a low response and/or matching rate is expected due to various decision pathways and changes in company strategies, especially during the past five years of pandemics, energy crises, and global disruptions. These changes can only be addressed with a flexible and open approach to include many different results.

Funded by the European Union

This project has received funding from the European Union’s Horizon Europe research and innovation programme under Grant Agreement No 101138004.

5 CONCLUSIONS

PNO has developed a comprehensive approach to establish a sustainable innovation pipeline to select H2020 projects and support them for IF applications for the upcoming three cycles of Innovation Fund. PNO is continuously refining this approach and framework using tools like Wheesbee to analyse projects and extract valuable insights. A new iteration of the search will be performed according to the integration of all renewable energy sectors and sources.

Our main goal is to keep improving our methods to better identify potential candidates from previous EU funded projects and creating a baseline of potential candidates beyond the pilot cases that are already represented in the DIAMONDS4IF project.

Specifically with reference to DIAMONDS4IF, we are aiming to support at least five IF proposals, including detailed plans for scalability, commercialization, and financial models for submission to the IF.

In this report, we have outlined the development of a selection approach for the identification of candidates and created a first preliminary list of potential IF applicant candidates as requested in Task 1.1. These results will be continuously updated based on actual company data, changes in names, locations, etc. Additionally, in accordance with the objectives of Milestone 1, we have identified approximately 20 candidates from the database. For one candidate we already submitted an IF application, for another one we currently perform a viability check.

The approach of PNO encompasses various facets, including the utilization of cutting-edge tools and technologies, such as our innovative AI-based software, Wheesbee. We will continue to harness the power of Wheesbee, refining its algorithms and expanding its capabilities to uncover hidden opportunities and insights within the vast H2020 ecosystem.

In these early months of 2024, PNO has made significant progress in refining and implementing this approach. Through rigorous testing and optimisation, we have refined our selection and evaluation criteria to ensure maximum effectiveness in identifying suitable candidates.

In essence, PNO's efforts reflect our commitment to fostering a high level of innovation and meaningful collaborations in the European research and industrial development landscape.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004.

6 LIST OF REFERENCES

- IRENA - International Renewable Energy Agency (2018) | Global Energy Transformation: A roadmap to 2050, International Renewable Energy Agency, Abu Dhabi. This report is available for download from www.irena.org/publications . For further information or to provide feedback, please contact IRENA at info@irena.org, page 52. https://www.irena.org/Energy-Transition/Technology/Ocean-energy
- What Is Geothermal Energy? Geothermal Energy-Uses, Sources, And Advantages (eduinput.com)
- JRC Science Hub (2017) | Supply chain of renewable energy technologies in Europe - An analysis for wind, geothermal and ocean energy, page 24
- Geothermal Supply Chain - Catalyst Connection
- Ocean Energy Europe, https://www.oceanenergy-europe.eu/
- OTEC, https://www.oceanenergy-europe.eu/ocean-energy/otec/
- IEA - International Energy Agency (2022) | Special Report on Solar PV Global Supply Chains, Solar PV Global Supply Chains – Analysis - IEA & Executive summary – Solar PV Global Supply Chains – Analysis - IEA
- EARTH ORG, Is the Solar Supply Chain System Broken? | Earth.Org
-
- ETIP Photovoltaics (May 2023) | PV Manufacturing in Europe: understanding the value chain for a successful industrial policy, info@etip-pv.eu
- GWEC - Global Wind Energy Council (12.2023) | Mission Critical: Building the Global Wind Energy Supply Chain For A 1.5°C World, page 25. MISSION-CRITICAL-BUILDING-THE-GLOBAL-WIND-ENERGY-SUPPLY-CHAIN-FOR-A-1.5°C-WORLD.pdf (gwec.net)

7 ACKNOWLEDGEMENT

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101138004

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.