Ref. Ares(2024)1190372 - 16/02/2024

FLEX INDUSTRIES

D8.11- Stakeholder Mapping_First Version

Funded by the European Union

1.1. D8.11: Stakeholder Mapping report_ first version WP 8, T 8.3

1.1.1. Authors: Erica Moresco (ICONS); Niccolò Belluati (ICONS), Claudia Crippa (ICONS)

2. Technical references

Project Acronym	FLEXIndustries
Project Title	Digitally-enabled FLEXible Industries for reliable energy grids under high penetration of Variable Renewable Energy Sources (VRES)
Project Coordinator	Alessandra Cuneo RINA - C alessandra.cuneo@rina.org Bruno Sodiro RINA - C Bruno.sodiro@rina.org
Project Duration	June 2022 – May 2026 (48 months)
Deliverable No.	D8.11
Dissemination level*	PU
Work Package	WP8 - Business plan, models, exploitation and dissemination
Task	T8.3. Stakeholders' dialogue, outreach, and engagement (M1-M48)
Lead beneficiary	10 (ICONS)
Contributing beneficiary/ies	ALL
Due date of deliverable	M20
Actual submission date	M20

* PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

v	Date	Beneficiary	Author
1.0	2/01/2024	ICONS	Moresco Erica
1.2	5/01/2024	ICONS	Niccolò Belluati
1.3	11/01/2024	ICONS	Claudia Crippa

3. Table of contents

3.1. List of Tables

3.2. List of Figures

4. Introduction

Following *the D8.3 Plan for Communication, Dissemination and Exploitation of results- first version* released at M6, this report presents the results of the work conducted in the context of *T8.3. Stakeholders' dialogue, outreach and engagement,* namely the identification, analysis, and mapping of FLEXIndustries's stakeholders.

FLEXIndustries employs a holistic approach across seven energy-intensive sectors to implement Energy Efficiency Measures and Process Flexibility Methods. The project revolves around seven key sectors: automotive, biofuels, polymers, steel, pulp & paper, pharmaceuticals, and cement. Each sector holds pivotal significance within the project's scope, delineating varied yet interconnected pathways for stakeholder engagement.
It introduces a Dynamic Energy and Process Management Platform to optimize industrial processes and integrate innovative energy assets. The projected impact includes substantial savings in Primary Energy, Life Cycle Costs, and CO2 emissions. Demonstrations in six countries aim to showcase enhanced efficiency, electrification, user satisfaction, and reduced environmental impact.

This report develops a comprehensive stakeholder mapping and analysis, assessing the role that each stakeholder can potentially play in the exploitation strategies preliminarily delineated for each of the project's Key Exploitable Results (KERs). The analysis considers the mapping and prioritization of stakeholders along two pivotal variables: the stakeholders' interest in the results and their potential impact on them. By assessing these factors, stakeholders will be prioritized to identify appropriate engagement strategies.

The report is organized as follows:
Chapter 5 - Methodology: the methodological chapter outlines the three steps followed to carry out the analysis.
Chapter 6 - Stakeholders' identification: EII Ecosystems and value chains: in this chapter the results of the first methodological step are presented, giving an overview of the identified stakeholders and their interconnected networks in the context of Energy Intensive Industries (EII).
Chapter 7- Stakeholders' Mapping and Prioritization: the session involves analyzing stakeholders' levels of interest and impact, creating visual maps to prioritize them accordingly.
Chapter 8 - Stakeholders' Profiles & Roles: the final chapter displays the results of the final methodological steps, namely the assignments of roles and the analysis of profiles of prioritized stakeholders.
Chapter 9 - Conclusions: the final chapter highlights the main takeaways of the analysis.

5. Methodology

5.1. Introduction

Stakeholder mapping utilizes a methodical procedure to identify and classify diverse stakeholder groups, evaluating their interest and influence on the dissemination and exploitation of project's outcomes. The analysis applies the following three methodological steps:

1. **Stakeholders' Identification, Profiling, and Definition of market context**: *who are the relevant stakeholders in the context of FLEXIndustries?*

2. **Stakeholders' Mapping and Prioritization**: *who are the stakeholders that should be prioritized? What are their interest and impact levels?*

3. **Stakeholders' Roles**: *what are the roles that prioritized stakeholders play?*

Figure 1- Stakeholder Mapping Methodological Framework

5.2. Stakeholders' Identification, Profiling, and Definition of market context

The initial methodological phase involves identifying stakeholders. To do so effectively, it is crucial to define who a stakeholder is. *Eurofound* defines stakeholders as "*an individual, group of persons or organization that can affect or is affected by the decisions of another organization*.[1]" In the context of this report, stakeholders are identified based on project's outcomes, specifically the Key Exploitable Results (KERs) developed by FLEXIndustries partners and the exploitation strategies for maximizing the impact of such results after the end of the project. As such, stakeholders encompass entities poised to be affected by or interested into FLEXIndustries' KERs.

[1] Eurofound. (Year). "Stakeholder." European Industrial Relations Dictionary. Retrieved from https://www.eurofound.europa.eu/en/european-industrial-relations-dictionary/stakeholder

Funded by the European Union

In the realm of FLEXIndustries, the identification of stakeholders also considers the diverse EIIs and their sectorial value chains, namely: automotive, biofuels, pulp & paper, cement, steel, polymer processing, and pharmaceutical industries.

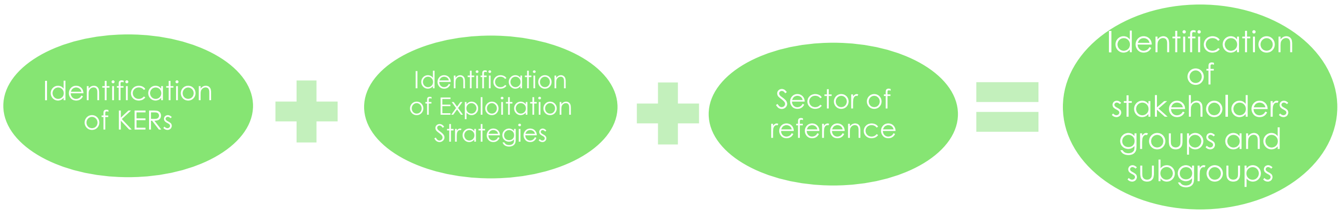

Figure 2- Stakeholders' Identification Methodology

All the identified stakeholders are profiled, taking into consideration different factors:

- The *market or operational context of the stakeholder group*, i.e., their specific sector and industry trends.
- The (primary) *geographical area of stakeholder operations*, i.e., whether they operate at the national or international level.
- The *main interests of each stakeholder group* at the project level.

5.3. Stakeholders' Mapping and Prioritization

The stakeholders identified may exhibit varying degrees of interest and impact concerning the project's outcomes. Stakeholders are, therefore, prioritized and mapped according to two variables, defined as follows:

- ***Interest**: degree of influence stakeholders wield over the implementation of exploitation strategies.*
- ***Impact**: the potential gains or advantages stakeholders anticipate from the utilization of the project's outcomes.*

The analysis aims to prioritize stakeholders, offering insights for dissemination and exploitation strategies, uncovering potential conflicts of interest, and generating stakeholder maps. The outcome is a matrix illustrating the relative degrees of interest and impact held by each stakeholder. This matrix guides dissemination strategies, customizing approaches based on the different positions of stakeholders within it.

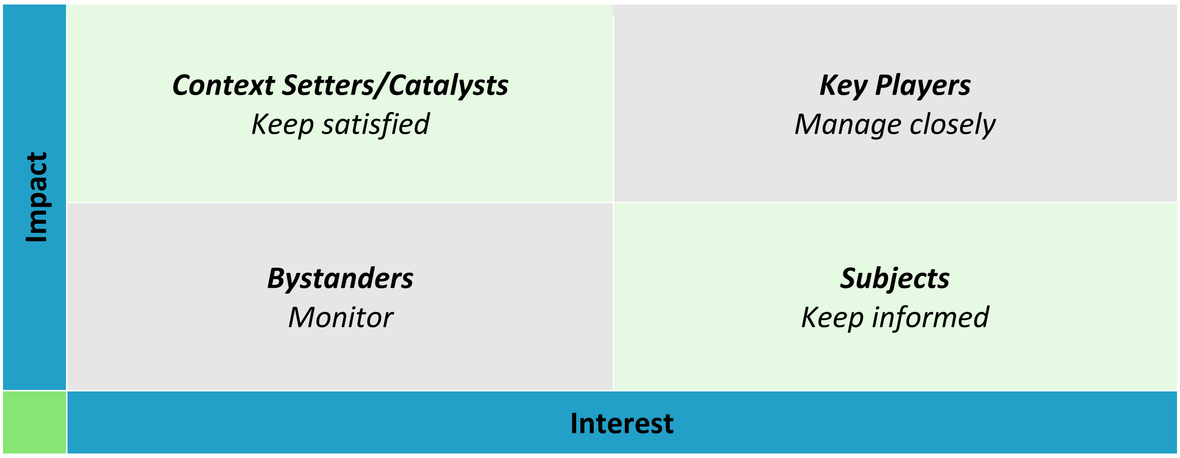

Figure 3- Stakeholders' Prioritization Matrix

Context Setters:

- These stakeholders in FLEXIndustries wield considerable influence but show limited interest or resources for engagement.

Key Players:

- Vital contributors to FLEXIndustries expected to provide significant input.

Subjects:

- High interest in FLEXIndustries but limited influence.

Bystanders:

- Low interest and impact in FLEXIndustries.

5.4. Stakeholders' Roles

The final methodological step concerns the assignment of roles to stakeholders. The goal is to understand which are the roles that each stakeholder can play in the context of the specific result and its exploitation strategy among the following:

Table 1- Stakeholders Roles

Roles	Definition
Customer/Consumer	Targets and early adopters of technologies/services
Partners	Partners in the development of novel technologies and services
Suppliers	Providers of raw materials and/or components for the assembly/manufacture of the technology products in the project
Enablers	They enable market uptake by providing standards or policies. They can also develop a favourable regulatory environment.
Supporters	They support the widespread adoption and the market uptake of the solutions through dissemination and communication activities targeted to the relevant sectors and personas.

The outcomes derived from this methodological phase are presented in Chapter 8 -Stakeholders' Roles.

5.5. Process

The process of stakeholder identification and prioritization within FLEXIndustries project involved the following procedural steps:

- **Stakeholders' identification - M1-M6**: stakeholders were identified through a combination of brainstorming sessions and thorough desk research.
- **Stakeholders' workshop - M8**: partners convened for an in-person workshop in Zaragoza (January 2023). During this session, the partners selected and scrutinized stakeholders based on their perceived impact and vested interest in the project's results and their subsequent exploitation. Each stakeholder was then assigned roles tailored to distinct exploitation strategies aligning with the project's objectives.
- **Analysis - M8-12**: Analysis of the results gathered through the workshop.
- **Methodology - M12-14**: Revision and set up of the methodological steps to follow for carrying out the analysis.
- **Final analysis - M14-M20**: the conclusive stage entailed mapping and prioritizing stakeholders based on their attributed roles and potential contributions to the project's outcomes. This final procedural stage culminates with the current deliverable D8.11-Stakeholder Mapping Report.

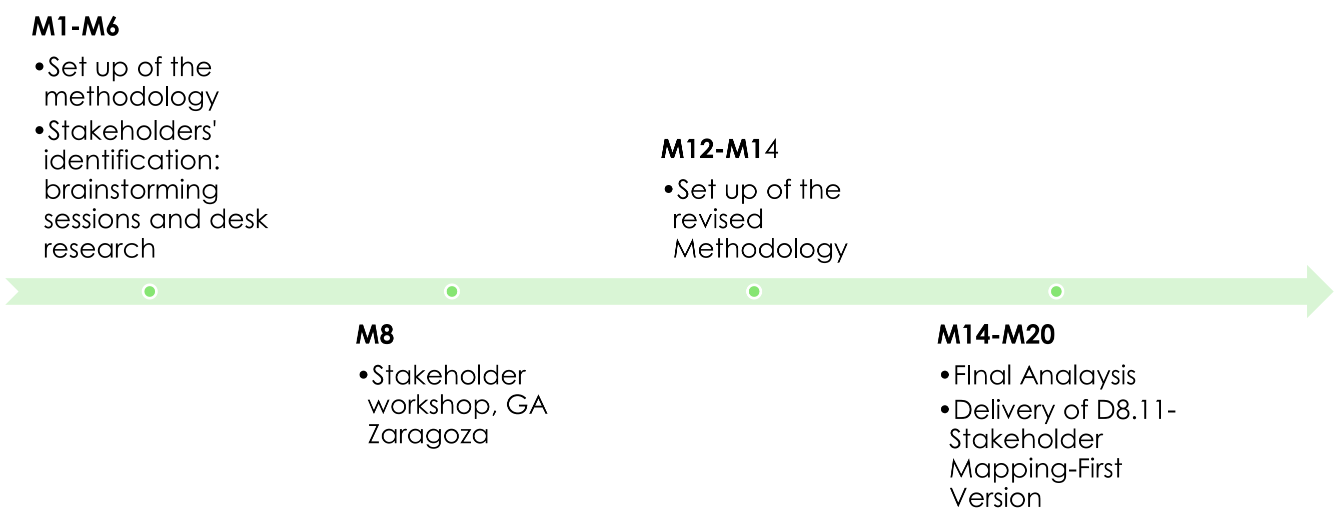

Figure 4- Stakeholder mapping Process

6. Stakeholders' Identification and Profiling, and definition of the market context

The following chapter provides:

- Firstly, an introduction indicating the KERs identified at the proposal stage and their corresponding projected exploitation roadmaps.
- Secondly, the identified stakeholders.
- Finally, it outlines the market contexts associated with these developments.

6.1. Introduction: KERs and exploitation strategies

FLEXIndustries aims to generate various tangible outcomes associated with its innovative proposals. An overview of the KERs identified so far is provided in the table below. The list of KERs provided is defined at the proposal stage, it will be subject to regular review and updates throughout the project's implementation.

Table 2- FLEXIndustries KERs

KERs	Type
KER1. Dynamic Energy & Process Management platform	Integrated Software
KER2. Individual algorithms for industrial demand-side management, process planning, and optimization	Models; Software
KER3. Integrated stationary BESS for industries + EMS	Technology; Software
KER4. Low-GWP HP-solution for combined heating & cooling	Technology
KER5. Novel ORC unit based on close-to-isothermal expansion process	Technology
KER6. Novel ORC unit based on Elektra turbine design	Technology
KER7. WHR thermoelectric generator (TEG)	Technology
KER8. Integrated industrial solar thermal system + EMS	Technology; Software
KER9. Energy System models including flexible industries	Models; Software
KER 10. Novel business models for Industrial Flexibility	Models

Funded by the European Union

Drawing from the KERs outlined during the proposal phase, a list of stakeholders has been developed at M6 in *D8.3 Plan for Communication, Dissemination, and Exploitation of Results - First version*. The outcomes primarily encompass models, software, technologies, and knowledge tailored for energy management and distribution within various energy-intensive industries (EIIs). Central to the project concept is the development of a *Dynamic Energy & Process Management Platform*, serving as a pivotal decision-making tool. Additionally, other KERs focus on designing or creating innovative components aimed at enhancing facility efficiency. These components integrate into the Dynamic Energy & Process Management Platform using IoT networks comprising sensors and actuators. The project generates significant expertise in energy management tools, process planning & management tools, Digital twin technology, communication tools, simulation tools, DER & ORC technologies.

The exploitation strategy of FLEXIndustries will be anchored on four primary exploitation pillars, each associated with the diverse partner profiles within the consortium. The following table summarizes the main exploitation pillars associated with the different KERs and partners involved.

Table 3- FLEXIndustries Exploitation Strategies

Exploitation Pillar	Type of KERs involved
Commercial Exploitation	Products, Services, Technologies, Software, and models.
TRL upscaling	Products, Services, Technologies, Software, and models.
Replication	Products, Services, Technologies, Software, and models.
Academic, scientific, and research exploitation	Models

6.2. Identified Stakeholders and Profiles

The list of stakeholders identified at M6 associated with the KERs developed during the project and their exploitation roadmaps is presented in the table below:

Table 4- FLEXIndustries Stakeholders groups and stakeholders

Stakeholder groups	Stakeholders
Policy Makers	Local and National Governments
	Supranational institutions
	Standardization bodies
European partnerships	Private / public partnerships
Associations, clusters, membership organisations, and sister projects	Associations and clusters of experts and other players, international technology platforms and business and industrial initiatives

	Sister Projects
Energy Intensive Industries (EIIs) and industrial facilities	Automotive
	Biofuels
	Polymer Processing
	Steel-making industry
	Pulp & Paper
	Pharmaceutical
	Cement Industry
	Food, beverage product manufacturing
	Other EIIS
Technology and service providers	Material producers and suppliers
	Engineering companies dealing with Digital Twin, Energy Management System and Digital Energy
	Manufacturers of energy solutions: BESS, Low GWP refrigerators, ORC units; WHR thermoelectric generators, Solar Thermal Systems
	Network operators, including DSOs and TSOs
	Energy service companies (ESCOs)
	Aggregators
Research&Academia	Research bodies, Universities, Research Institutions/Centres, R&D departments of industrial players
Media	Journalists and local/international media

The profiling of the identified stakeholders is presented in *D8.3- Plan for Communication, Dissemination, and Exploitation -first version*, in which the following aspects have been considered:

- Reference market or operational setting;
- Overview of their interconnections, particularly the construction of value chains;
- Examples of organizations/players within these groups.

The following paragraphs aim to provide a summary of identified stakeholder groups and their subgroups within each Energy Intensive Industry (EII) targeted by FLEXIndustries. Paragraph 6.3 gives an overview of the market contexts in which the stakeholders operate, the focus is on highlighting evolving needs and opportunities within the value chains of these diverse EIIs.
The analysis primarily relies on desk research involving available information, all of which is referenced in the footnotes.

6.2.1. Policymakers and standardization bodies

Policy makers operate across various levels, supported by internal bodies, aiming to achieve specific goals. Their pivotal role involves driving advanced industrial and digital technologies towards eco-friendly, efficient industries. They shape FLEXIndustries by creating favorable regulations, offering incentives for research projects and innovative energy systems, and funding technology R&D. These

Funded by the European Union

policymakers fall **into local, national, and supranational** categories, including EU bodies like the *European Commission, European Parliament, and various directorates and agencies focusing on FLEXIndustries*.

Standardization bodies are entities, such as *ETSI, CEN, and CENELEC* that serve as governance authorities established to create, coordinate, advocate, and explain technical standards. Across 34 European countries, there are 43 National Standardization Bodies in Europe, working collectively to create European Standards in response to industry needs identified by businesses and standard users. These bodies bring together specialized experts in various sectors or subjects to collaborate on developing these standards. The countries hosting FLEXIndustries demonstration sites and replicators have their National Standardization Bodies, including *UNI (Italy), UNE (Spain), TSE (Turkey), NQIS/ELOT (Greece), DIN (Germany), and BDS (Bulgaria).* These bodies play a crucial role in setting and maintaining standards relevant to the FLEXIndustries domain.

6.2.2. European Partnerships

European partnerships unite public and private sectors, driving joint research and innovation to tackle pressing challenges. Operating at an EU regional level, they serve as ongoing platforms for developing advanced technologies, policy learning, and collaboration. These partnerships cover diverse aspects within the FLEXIndustries project, spanning renewable energy, digital innovation, and energy-intensive industries. Notably, the *Energy Efficiency Financial Institutions Group (EEFIG)* coordinates over 200 organizations dedicated to advancing energy efficiency investments across the EU. Other examples include:

1. *Renewable Energy Partnership*: Collaborations like the European Partnership for Clean Energy Transition focus on advancing clean energy solutions, while initiatives like EIT InnoEnergy drive innovation in energy-related sectors.
2. *Digital Innovation Partnership*: Entities like the European Partnership for High-Performance Computing and EIT Digital concentrate on driving advancements in digital technologies.
3. *Energy-Intensive Industries Alliance*: Groups such as the Alliance of Energy Intensive Industries work on promoting sustainable practices within energy-intensive sectors like steelmaking.
4. *Energy Efficiency Financial Institutions Group (EEFIG):* This group coordinates efforts among financial institutions, investors, and experts to boost energy efficiency investments across the EU.

6.2.3. Associations, clusters, membership organisations, and sister projects

Associations and clusters aligned with FLEXIndustries' objectives operate across national, regional, and international levels as collaborative platforms advancing innovative solutions. These groups, including **associations, clusters, forums, and membership organizations**, share common interests with European Partnerships, aiming to reduce industrial energy consumption, promote sustainable practices, drive innovative energy management systems, and enhance digitalization. They aim to convene global industry leaders. Examples include:

- Energy Sustainability: *CEM, MI, IRENA*, and others focus on sustainable energy practices.

- Energy Management: Initiatives such as the *Flexible Power Alliance Network and BRIDGE* prioritize innovative energy management systems.
- Energy-Intensive Industries (EIIs): groups like *IFIEC Europe and Processes4Planet (P4Planet) Partnership* target energy efficiency within industries.
- System and Network Operators: entities like *ENTSO-E, EU DSO* Entity, and others concentrate on system operations and management.
- Digital Twin: Organizations such as *IDTA and Digital Twin Consortium* are involved in digital twin technology advancements.

This stakeholder group also includes US and Canadian entities like the *National Renewable Energy Laboratory (NREL),* the US *Energy Assoc., American Clean Power Assoc., Canadian Renewable Energy Assoc., and the Energy Council of Canada*, indicating transatlantic engagement in these efforts.
Alongside associations and forums, **sister projects** like *BAMBOO, ECOFACT, ENERMAN, PLANET, MONSOON, RECLAIM, FLEXnCONFU, and CO2LHEAT* bolster FLEXIndustries' goals. They focus on diverse aspects such as sustainable materials, energy management, environmental impact, and technological innovation, amplifying efforts to reduce industrial energy consumption and promote global sustainability. They can serve as collaborative platforms, enabling the sharing of expertise, innovative practices, and insights across diverse realms.

6.2.4. Energy Intensive Industries (EIIs) and industrial facilities

Industrial production drives slightly over 50% of global energy consumption, and the journey towards climate neutrality demands significant transformation within this sector, responsible for 15% of the EU's emissions. Energy Intensive Industries (EIIs), pivotal to the European economy, are deeply integrated into vital value chains and account for more than half of the EU industry's energy usage. Achieving the 2050 targets necessitates prompt action due to the extended investment cycles in these industries.
EIIs encompass various sectors like Cement, Chemicals, and Steel, among others. Their energy costs, notably higher, currently jeopardize their competitiveness compared to global counterparts, urging strategies to optimize energy consumption and prices for sustained economic growth.
A number of these EIIs are actively engaged in the FLEXIndustries project through demo sites and early adoption, signifying their crucial role as primary stakeholders. Their involvement is pivotal in shaping the project's success and their commitment is integral to its outcomes. A clear overview and market trends concerning FLEXIndustries Sectors are provided in the next subchapter (6.3).

6.2.5. Engineering companies

Engineering companies dealing with Digital Twin, Energy Management System and Digital Energy harness these technologies to optimize processes, support the smart energy transition in Energy Intensive Industries (EIIs), and improve reliability, availability, and efficiency. These firms focus on:

1. *Digital Twin Technology*: Using IoT, cloud, XR, and AI to create digital models of industrial processes for real-time monitoring and optimization.
2. *Energy Management Systems*: Addressing challenges in integrating energy resources and flexibility provision to optimize networks and financial decisions in line with EU energy efficiency standards.

Funded by the European Union

3. *Digital Energy*: Embracing digitalization to create opportunities for traditional energy companies and foster collaborations between energy and tech firms.

Their goal is to leverage the expertise gained from projects like FLEXIndustries to tackle connectivity, interoperability, and communication challenges among smart devices, fostering innovation for a flexible transition.

6.2.6. Material producers and suppliers

Material producers and providers within the European context encompass a diverse range of entities specializing in supplying raw materials and manufacturing various components, and equipment used in industrial processes and technology development. These can include manufacturers of heat exchangers, compressors, and refrigerants, providing essential components for heat pumps and thermal systems. Companies producing specialized alloys, high-grade metals, and ceramics tailored for specific industrial applications also fall within this category. Additionally, chemical companies form another segment, supplying low-GWP refrigerants or eco-friendly materials utilized in innovative solutions. European material producers like *Alfa Laval*, *Danfoss, Linde, and BASF* are notable examples involved in providing critical components and materials for energy-efficient systems, contributing significantly to sustainable industrial advancements.

6.2.7. Value chain manufacturers

Manufacturers of energy solutions comprises companies and industries producing innovative solutions applicable across various industrial processes. They leverage their expertise to replicate these solutions in different sectors, utilizing the knowledge gained from FLEXIndustries for broader impact. The following highlights manufacturers linked to solutions developed within FLEXIndustries and potential integrations into the Dynamic Energy & Process Management Platform:

1. *Battery Energy Storage (BESS):* the European market's growth is spurred by supportive policies for green energy, prompting various industry players to offer advanced BESS units.
2. *Low GWP Refrigerators*: the global market is competitive, driven by several regional and domestic companies.
3. *ORC Waste Heat to Power Units*: market opportunities are fueled by supportive policies and investments, especially in industries like cement, pulp & paper, and petrochemicals. Turkey is becoming a hub for ORC waste heat to power system manufacturers due to increasing geothermal opportunities.
4. *WHR Thermoelectric Generators*: the increasing demand for these generators stems from their low-maintenance, renewable nature, supported by government regulations and industrial automation.
5. *Solar Thermal Systems*: he adoption of solar heating systems in industrial processes presents significant market opportunities. Many companies have experimented successfully with solar heating systems in commercial and industrial sectors, leading to a fragmented market with regional and global players.

This group doesn't just encompass current manufacturers but also potential future collaborators who could be involved in replicating solutions within the FLEXIndustries platform, catering to specific industrial processes and industries.

Funded by the European Union

6.2.8. Network operators

This stakeholder group combines Transmission System Operators (TSOs) and Distribution System Operators (DSOs) as key players in shaping novel business models and Energy System models for Industrial Flexibility decision-making. TSOs manage electricity and gas transmission systems, while DSOs oversee distribution networks, adapting to changing demands and increased generation connections. Both TSOs and DSOs play critical roles in the evolving energy market models proposed by FLEXIndustries, offering new services to energy-intensive industries, and utilizing project knowledge for growth. *ENTSO-E* brings together 43 TSOs covering the European Power System, while the EU DSO Entity represents 906 DSOs, including those in demo site countries, utilizing project insights to address emerging network challenges.

6.2.9. Energy service companies (ESCOs)

These companies stand out for their ability to finance or arrange financing for operations, directly tying their compensation to achieved energy savings. This characteristic enables them to utilize FLEXIndustries' business models and technologies. By leveraging the project's knowledge and tools, they can enhance their services, consultancy, and optimize financing activities through collected data, maximizing their compensation.
The European Commission's DG JRC conducts analysis and research on ESCOs, with 2724 ESCOs included in the *ESCO Library of the European Energy Efficiency Platform (E3P)* managed by JRC.

6.2.10. Aggregators

The recent European framework emphasizes the pivotal role of aggregators in liberalizing energy markets and integrating Distributed Energy Resources (DER) for carbon-neutral energy systems. FLEXIndustries' solutions and expertise are poised to address the challenges emerging from these new market scenarios. They can be harnessed to provide advanced consultancy services, leveraging the project's digital tools for exchanging real-time industry monitoring data and market information. This exchange enhances bargaining power on energy tariffs.

6.2.11. Research, Academia, and R&D

The FLEXIndustries project aims to advance research beyond current standards, enabling stakeholders to select and implement suitable Energy Efficiency Measures (EEMs) and Process Flexibility Methods, positively impacting the Energy System. Its research spans three main areas: *digital Innovation, energy technology innovation, and business innovation.*
The stakeholders involved are diverse:

- **European Research Bodies and Networks:** Entities like *ETIP SNET and EERA* guide RD&I for Europe's energy transition.

- **Universities:** Integral in providing cutting-edge research; the FLEXIndustries consortium includes leading universities (*UoP and TUL*) promoting collaboration with others.
- **Research Centers and Institutions:** Funded to pioneer technologies and advance science, driving new industries.
- **Research Groups:** Collaborative platforms comprising public and private research entities, universities, and companies.
- **R&D Departments of Industrial Players:** Complement scientific efforts with privately-funded research, often operating at regional and international levels.

These stakeholders collectively contribute to research, innovation, and technology development, aiming for international visibility and attracting diverse talents and skills.

6.2.12. Media

The enduring discussion revolves around whether media functions as a recipient or amplifier of information. Our perspective aligns with the latter, viewing media as a channel to engage with the specific stakeholders outlined in this report, rather than an endpoint in itself.

6.3. Market Contexts

The following paragraphs outline the main market trends of the EIIs covered by FLEXIndustries.

6.3.1. Automotive Sector

The automotive industry stands as the leading R&D investor in Europe, surpassing even the pharmaceutical sector, accounting for the 28 percent share of the total research expenditure. In 2018, the European Union witnessed a remarkable 6.7 percent increase in automotive R&D investment, reaching an annual sum of €57.4 billion. Along with the growth in R&D investments, the demand for more efficient coatings processes in paint shops is increasing, aiming to drive down costs, minimize waste, decrease energy consumption, and reduce CO2 emissions and volatile organic compounds (VOCs).[2] This trend follows the expanding global automotive paints market, which is encouraged by the growing worldwide demand for vehicles and the increasing necessity for paint protection, aesthetics, and customization. Moreover, the rise of automotive manufacturing in emerging economies contributes significantly to this market expansion. Technological advancements in paint formulations, offering enhanced durability, weather resistance, and eco-friendliness, further fuel the market's growth. Notably, eco-friendly water-based paints and sustainable coatings are gaining importance due to their alignment with stringent environmental regulations. This competitive market witness established players continually innovating products and strategically expanding to fortify their market presence.[3]

[2] Coatings World. (2020, January 1). Europe's OEM Automotive Coatings Market Expands. Coatings World. https://www.coatingsworld.com/issues/2020-01-01/view_europe-reports/europes-oem-automotive-coatings-market-expands/

[3] MarketsandMarkets. (n.d.). Automotive Paints Market by Type, Resin, Technology, Paint Equipment, Texture, Content, ICE & EVs, Refinish, and Region - Global Forecast to 2025. MarketsandMarkets. https://www.marketsandmarkets.com/Market-Reports/automotive-paints-market-1246.html

In FLEXIndustries, the automotive sector is of paramount importance and the results of the action are focused on the upgrade of monitoring infrastructure and deployment of the FLEXIndustries platform focusing on creating a paint shop digital twin and advanced energy management algorithms. Additionally, there's a plan for a 1.5 MW PV plant integration to bolster local green energy supply, the installation of a solar wall to curb natural gas energy consumption, EV charging optimization, a stationary BESS incorporation, and a study on grid communication for novel market operations.

6.3.2. Biofuels Sector

The European Commission highlighted that bio-based products and biofuels contribute significantly to the economy, generating around 300,000 jobs and accounting for approximately EUR 57 billion in annual revenue[4]. However, the production of liquid biofuels is notably energy-intensive, leading to higher production costs compared to alternative resources[5]. The substantial energy consumption in the biofuels sector largely stems from the utilization of varying temperature levels, necessitating robust infrastructure capable of harnessing thermal energy generated by Combined Heat and Power (CHP) units[6]. The biofuels sector's value chain encompasses feedstock production involving the cultivation or harvesting of raw materials, followed by processing and conversion methods like fermentation or chemical treatment to produce biofuels. These fuels are then distributed via logistics networks to end-users for applications in transportation, heating systems, and industrial uses. Byproducts and residues from production are managed, either through further utilization or environmentally conscious disposal[7].
Aside from *MIL OIL HELLAS SA*, a partner in the FLEXIndustries project, key players in the European biofuel industry are part of the *Envien Group*, comprising eleven member companies. These entities collectively shape the landscape of the biofuels industry within Europe.

6.3.3. Pulp and Paper Sector

The forecasts for the Global Pulp and Paper Market Size indicate significant expansion between 2023 and 2030. This growth surge stems from the industry's adoption of circular economy principles, emphasizing the reuse, recycling, and repurposing of paper goods to curtail waste and prolong material life cycles. Key players are strategically concentrating on Advanced Packaging Solutions, Carbon Neutrality and Carbon Capture, Digital Transformation, and Industry 4.0 initiatives to bolster their market positions within the industry[8].
The pulp and paper production process demands substantial energy input. In 2005, the pulp and paper industry accounted for about 5% of the world's total industrial energy usage and contributes to around 2% of the direct carbon dioxide (CO_2) emissions from industry. Global demand and production of pulp and paper are expected to see a substantial rise by 2050. This growth is anticipated to result in an overall increase in energy consumption and greenhouse gas (GHG)

[4] ETIP Bioenergy. (n.d.). Combined Heat and Electricity Production. Retrieved from https://www.etipbioenergy.eu/value-chains/products-end-use/end-use/combined-heat-and-electricity-production
[5] Ibidem
[6] ENVIEN Group. (n.d.). [About Biofuels]. Retrieved from https://www.enviengroup.eu/en/
[7] Gnansounou, E., & Dong, J. (Eds.). (2021). Value Chain of Biofuels. Elsevier.
[8] McKinsey & Company. (2023). Pulp, Paper, and Packaging in the Next Decade: Transformational Change. *McKinsey & Company*. [The packaging, pulp and paper industry in the next decade | McKinsey]

Funded by the European Union

emissions within the industry[9]. A key factor fueling market growth is the transition towards sustainable and eco-friendly production methods. The pulp industry has faced an increased scrutiny for its role in deforestation and greenhouse gas emissions. Consequently, businesses are making investments in innovative technologies and embracing more sustainable sourcing practice[10]. The definition of more sustainable production processes spans across the whole value chain, encompassing raw material sourcing, manufacturing, distribution, product use, and end-of-life management. Engaging stakeholders across this comprehensive value chain, including governments, industry associations, associations and technology clusters, technology and service providers, and research and academia entities, is fundamental.

6.3.4. Cement Sector

In 2023 the European cement industry reached a market value of nearly EUR 30.8 billion[11]. Cement production stands as a notably energy-intensive sector, demanding approximately 110kWH of electricity to manufacture one tonne of cement. The process involves the utilization of rotary clinker kilns operating at extremely high temperatures (around 1450ºC), contributing significantly to heat loss. Furthermore, large-scale machinery in this industry requires water for cooling purposes, further dissipating substantial heat resources[12].
TITAN Cement's involvement in the FLEXIndustries project underscores efforts to innovate within this sector. Additionally, prominent players dominating the European cement industry include Buzzi Unicem, Cimpor, Heidelberg Cement, Holcim, Italcementi, and Lafarge.
The high energy demand for the value chain in this sector requires the application of innovative and sustainable solutions.

6.3.5. Steel Sector

The steel industry holds a pivotal position within the European Union, contributing significantly to economic growth, employment, and technological advancements. Given its close ties to various industrial sectors like automotive, construction, electronics, and renewable industries, steel plays a foundational role in these domains. The European steel industry has a turnover of around EUR 130 million, with an average production of 152 million tonnes per year[13]. Like other energy-intensive industries, the steel sector faces substantial challenges regarding energy prices and operational costs. On average, energy expenses make up around 40% of the total operational costs in steelmaking. The recent upsurge in energy prices poses a unique set of challenges for the European steel industry, potentially impacting its competitiveness compared to counterparts facing different cost dynamics[14].

---

[9] Available at: Pulp and Paper Industry — Global Efficiency Intelligence
[10] Available at: Pulp Industry 2024 (reportlinker.com)
[11] Available at: Europe Cement Industry Market Report 2023: Output is (globenewswire.com)
[12] EU-MERCI EU coordinated MEthods and procedures based on Real Cases for the effective implementation of policies and measures supporting energy efficiency in the Industry _HORIZON 2020 Project Nr. 693845 : Technical analysis – Cement sector (NACE C23.5-23.7)
[13] Available at: FINAL_EUROFER_Steel-in-Figures_2023.pdf
[14] European Commission - Single Market Economy. (n.d.). Metal Industries: Steel. Retrieved from https://single-market-economy.ec.europa.eu/sectors/raw-materials/related-industries/metal-industries/steel_en

STOMANA's role as a FLEXIndustries demosite highlights the industry's commitment to innovation and flexibility in addressing energy efficiency and sustainability. Notably, ArcelorMittal, a major player in the European steel sector, holds the position as the second-largest global leader in steel production, trailing behind the Chinese Baowu Group. This status highlights Europe's significant presence in the global steel market, despite the challenges posed by energy costs and international competition.

6.3.6. Pharmaceutical Sector

The pharmaceutical sector holds a central position within the European Union, with a market evaluation reaching EUR 270 billion in 2021. Projections indicate a continued growth trajectory, expected to surge at a compound annual growth rate (CAGR) of 5.4% from 2021 to 2028[15]. Among the key players in the pharmaceutical sector, companies like Novartis, AstraZeneca, Hoffmann-La Roche, Novo Nordisk, and Sanofi are prominent, showcasing leadership in innovation, R&D, and sustainable practices. Moreover, Suanfarma stands out as a part of the FLEXIndustries demonstrator, emphasizing its commitment to flexible, innovative, and energy-efficient manufacturing practices within the pharmaceutical industry.
The pharmaceutical industry's energy-intensive processes span a spectrum of crucial activities, highlighting various areas demanding significant energy consumption and innovation for sustainability and efficiency. For instance, the fermentation processes can consume up to 30% of the energy allocated for pharmaceutical production due to its complex and resource-intensive nature. Air compression systems are vital but energy-demanding: they ensure precise control of air quality and pressure for critical processes, contributing significantly to the industry's overall energy consumption, also refrigeration and cooling systems, necessary for storing raw materials, intermediates, and finished products, demand substantial energy input. Sterilization of equipment and products is imperative to maintain stringent quality standards and ensure product safety. Heating processes, often used for sterilization, consume notable amounts of energy within pharmaceutical manufacturing facilities[16].
Innovations and initiatives focusing on energy efficiency, such as optimizing processes, adopting green technologies, implementing novel energy recovery systems, and exploring alternative energy sources like renewables, are crucial for the industry's sustainable growth. Collaboration among industry leaders, research institutions, and regulatory bodies is pivotal in driving these advancements, ensuring a balance between meeting global healthcare demands and minimizing the environmental footprint of pharmaceutical production processes.

6.3.7. Polymer Sector

The polymer processing sector, an integral part of the European plastic industry, encompasses various segments such as plastic raw material producers, plastic converters, recyclers, and manufacturers. This industry significantly contributes to the European economy, providing

[15] Available at: Europe Pharmaceutical Market Size, Share & Trends Analysis Report By Product (Branded, Generic), By Type (Prescription, OTC), By Therapeutic Category, By Region, and Segment Forecasts, 2021-2028 (researchandmarkets.com)
[16] Ibidem

Funded by the European Union

employment to 1.56 million individuals[17] and with a market evaluated around EUR 649 billion as of 2021[18].
However, the polymer processing industry has to cope with substantial energy demands, particularly for thermal energy, resulting in increased production costs that disadvantage European producers. To address this challenge, the industry is exploring the valorization of waste heat to optimize and enhance production efficiency[19].
Among these initiatives, the involvement of K-FLEX as a demosite exemplifies the industry's commitment to exploring innovative solutions for efficient processes. Noteworthy leaders in the European polymer processing industry include companies like *Nolato and Taylor Engineering & Plastics*, showcasing their prominence and contributions to the sector's advancements and developments.

6.3.8. Food and Bevarage

Within the European Union, the food and drink industry stands out as a fundamental sector in terms of employment and value creation and also in terms of energy consumption. This sector employs 4.6 million individuals, generating a turnover of €1.1 trillion, and contributing €230 billion in value added[20]. This establishes it as one of the foremost manufacturing industries within the EU. This sector, contributing approximately 10.4% to the EU's industrial energy consumption, holds significant influence within the overall energy landscape. Recognizing its pivotal role in the European economy, the FLEXIndustries project targets also this sector. Energy constitutes a substantial portion of the operational costs for food and drink manufacturers, accounting for about 15% of their expenses[21]. Escalating energy prices pose a threat to their economic sustainability, directly impacting their manufacturing outputs. Nestlé currently leads the industry in Europe, trailed by Anheuser-Busch InBev and Heineken.

6.3.9. Other EIIs

Beyond the project's scope, different industries qualify as energy-intensive, making them pivotal targets for FLEXIndustries' transformative solutions. These sectors not only benefit significantly from the impact of FLEXIndustries solutions on individual processes and industry-wide operations but also serve as prime candidates for the replication of these innovative methodologies across

[17] Plastics-The Facts 2020; An analysis of European plastics production, demand and waste data by Plastics Europe-Association of Plastic Manufacturers; 12-2020
[18] Available at: Polymer Market Size, Share & Trends Analysis, By Type (Elastomers, Thermoplastics, Thermosets), By Application (Agriculture, Electrical & Electronics, Textile,), By Region and Forecast Period 2022 – 2030 (marketresearchcommunity.com)
[19] Khripko, Diana & Schlüter, Alexander & Rommel, Benjamin & John, Michele & Hesselbach, Jens. (2016). Energy demand and efficiency measures in polymer processing: comparison between temperate and Mediterranean operating plants. International Journal of Energy and Environmental Engineering. 7. 10.1007/s40095-015-0200-2.
[20] Available at: Data & Trends of the European Food and Drink Industry 2022 - FoodDrinkEurope : FoodDrinkEurope
[21] Available at: https://www.centricabusinesssolutions.com/blogpost/energy-accounts-15-food-and-drink-manufacturers-costs-scope-ease-pressure-margins-clear

Funded by the European Union

diverse settings. Additionally, these industries display a substantial interest in adopting FLEXIndustries' expertise and solutions.
According to the International Energy Outlook (IEO), the chemicals, refining, nonferrous metals, and non-metallic minerals industries fall under the classification of energy-intensive sectors.

7. Stakeholders' Mapping and Prioritization

7.1. Introduction

In this section, the analysis encompasses the prioritization and mapping of stakeholders for the different KERs that the FLEXIndustries project will develop.
The objective is to analyze the stakeholders involved in the potential exploitation roadmaps forcasted for each category of KERs. This strategic approach is essential for understanding which stakeholders should be prioritized considering the interests and impacts of each stakeholder group, contributing to the enhancement of dissemination and exploitation strategies.
The analysis focuses on individual KERs for technologies and groups KERs for models, designs, and algorithms to comprehensively understand stakeholder priorities and tailor effective communication and exploitation strategies.
The following table synthesizes the structure of the chapter.

Table 5- Structure of the Analysis

Sub-chapter	KERs Analyzed
7.2.1.	KER1- Dynamic Energy & Process Management Platform
7.2.2.	KER3- Integrated stationary BESS for industries + EMS
7.2.3.	KER4- Low-GWP HP-solution for combined heating & cooling
7.2.4.	KER5- Novel ORC unit based on close-to-isothermal expansion process
7.2.5.	KER7- WHR thermoelectric generator (TEG)
7.2.6	KER8- Integrated industrial solar thermal system + EMS
7.2.7	Models, designs and, algorithms: - KER2. Individual algorithms for industrial demand-side management, process planning, and optimization - KER6. Novel ORC unit based on Elektra turbine design - KER9. Energy System models including flexible industries - KER 10. Novel business models for Industrial Flexibility

7.2. Stakeholders' Mapping and Prioritization

7.2.1. KER1- Dynamic Energy & Process Management Platform

KER1 is a Dynamic Energy & Process Management Platform designed to optimize production processes and energy demand response (DR) in energy-intensive industries. This platform integrates digital tools aimed at enhancing process flexibility and DR capabilities across industries. It operates at multiple levels—device, process, and value chain—considering technical, economic, and environmental criteria for decision-making. By connecting with various energy grids and incorporating data from industrial processes, local energy production assets, grid requests, and electric markets, the platform enables comprehensive data handling to optimize the integrated energy and industrial system.

The strategy to exploit the platform, once the project ends, involves a phased approach. It starts with upscaling the TRL from 7 to 8, progressing from the prototyping stage to the integration, possibly through customer projects. The second phase concerns the commercialization of the developed technology for widespread adoption and utilization. Therefore, the final focus involves offering this platform as a service, implementing it within various industrial settings, and providing comprehensive support for its application. Developers would market the platform as a service to end-users, emphasizing its capabilities to enhance energy and process management within energy-intensive industries. This could involve tailoring the platform to specific industry needs and demonstrating its efficacy. To do so different networks of stakeholders are necessary, the following matrix represents the prioritized stakeholder groups.

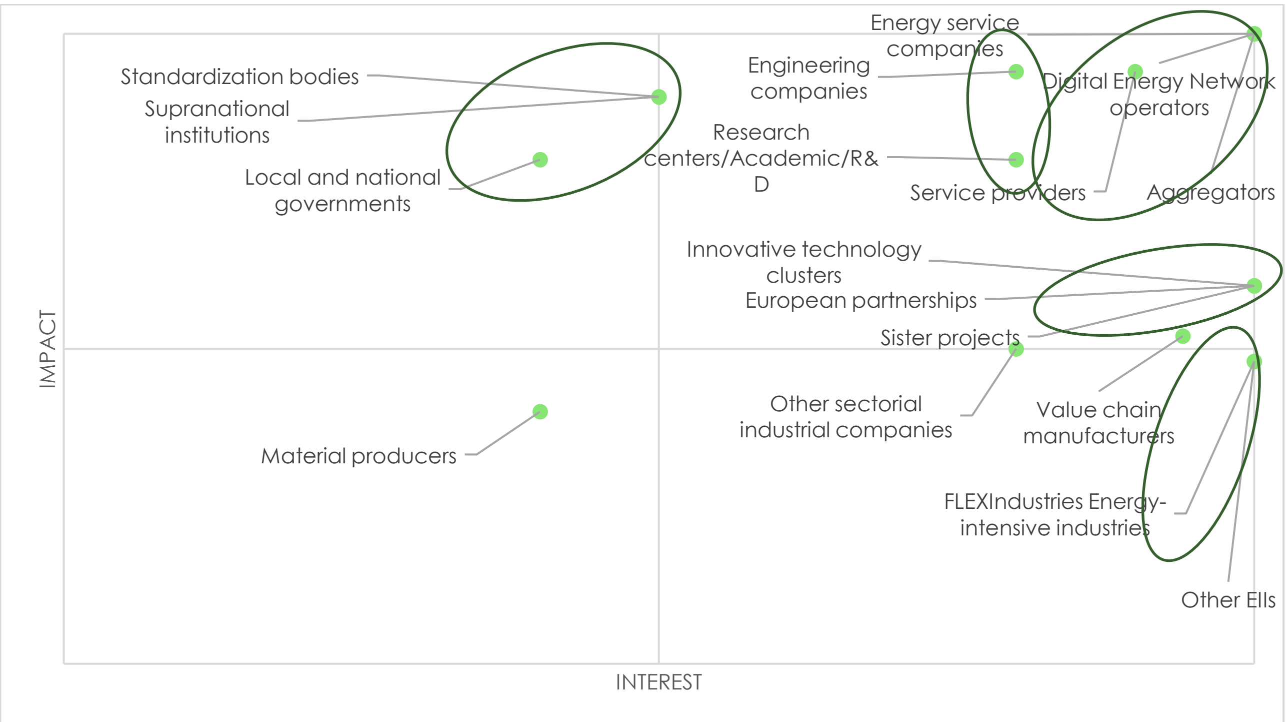

Figure 5 - Stakeholder mapping for KER1

- **Digital Energy Network operators, Energy service companies, and Aggregators**, as **key players**, hold high interest and impact levels due to their pivotal roles in the energy ecosystem:
  - **Digital Energy Network operators** manage and regulate energy distribution networks. Their high interest in the KER1 platform stems from its potential to enhance energy grid management and optimization. Implementing this platform would enable them to streamline data handling, monitor local energy production, and efficiently balance grid requests, contributing to better grid stability and performance. Their high impact level is due to their capacity to implement and integrate such platforms into existing grid infrastructures, impacting a wide range of consumers and industries.
  - **Energy service companies** providing energy-related services are highly interested in technologies like KER1 as they offer tools to optimize energy consumption and production within industries. They can leverage this platform to offer comprehensive energy management services, optimizing processes, reducing costs, and enhancing sustainability for their clients. Their impact level is high as their adoption of such technologies could influence multiple industries, fostering a broader adoption of energy-efficient practices.
  - **Aggregators** specialize in collecting and optimizing energy data, often serving as intermediaries between producers and consumers. Their interest in KER1 lies in its capability to aggregate data from various sources and optimize energy usage. Implementing this platform allows them to offer more efficient energy solutions to their clients, thereby positively impacting their portfolios. Their impact level is notable as they can influence energy optimization strategies across multiple sectors by integrating KER1 into their service offerings.
- **Associations and clusters of experts, European partnerships, sister projects, business and industrial initiatives**: Such stakeholders are to be considered as **key players**. Their active participation significantly contributes to the dissemination and widespread adoption of KER1, impacting the provision of the service-by-service providers in the field. These entities serve as conduits for sharing and promoting innovative concepts. By hosting discussions, events, and forums, they facilitate the exchange of knowledge and encourage the adoption of novel technologies. Their role extends to fostering collaborations, building awareness, and driving acceptance within the industry.
- **FLEXIndustries Industrial Sectors and other EIIs**: All industrial sectors have a potential interest in KER1 due to its adaptability and versatility, they are to be considered as fundamental **subjects/key players** in the context of exploitation of KER1 from service providers. The capability of the result to optimize energy processes and enhance overall efficiency makes it relevant across diverse sectors, including automotive, manufacturing, pharmaceuticals, and more. Each sector can benefit uniquely from the platform's capabilities, contributing to its widespread adoption and utilization.
- **Research bodies, Universities, Research Institutions/Centres, and R&D departments** of industrial players showcase high interest but relatively modest levels of impact in the exploitation of KER1. They exhibit a significant eagerness and enthusiasm for the platform's implementation and utilization for their respective research endeavors and industrial advancements.

7.2.2. KER3- Integrated stationary BESS for industries + EMS

KER3 revolves around the implementation of Integrated Stationary Battery Energy Storage Systems (BESS) and Energy Management Systems (EMS) for industries. These systems consist of two stationary BESS units and a thermal storage tank, designed to be modular and efficiently managed through the FLEXIndustries platform. The challenges associated with BESS include managing large storage capacities, numerous cells, and high-power rates leading to unbalanced cell conditions, affecting performance and State of Charge (SOC). FLEXIndustries aims to address these challenges by developing specific integration solutions, tackling battery aging concerns, and conducting economic and environmental analyses for suitable business models and regulatory compliance. FLEXIndustries will implement this innovation by integrating 100 kWh 2nd-life batteries from EVs at FORD's demo site and a 400 kWh system at SUAN's site. These installations will include enhanced routines to maintain battery balance and SOC alignment, improving overall system performance. Moreover, the project will integrate a latent heat-based thermal storage tank at the PRO facility, storing steam from an adjacent RDF-fired CHP plant. This innovative approach will transfer crucial knowledge to relevant industrial applications and enable the formulation of robust business cases, validated at TRL7. The **exploitation strategy** for KER3 encompasses several pivotal elements. It entails the integration with Renewable Energy Sources (RES) to optimize performance and sustainability, alongside a focus on optimizing the Balance of Plant (BoP) to reduce costs. Additionally, rigorous testing targeting grid flexibility services will showcase adaptability, while plans for full certification and standardization ensure compliance with industry regulations. With a comprehensive aim for market entry by 2028, this strategy reflects a holistic approach, transitioning from development to commercialization, encompassing regulatory compliance and market readiness.

Funded by the European Union

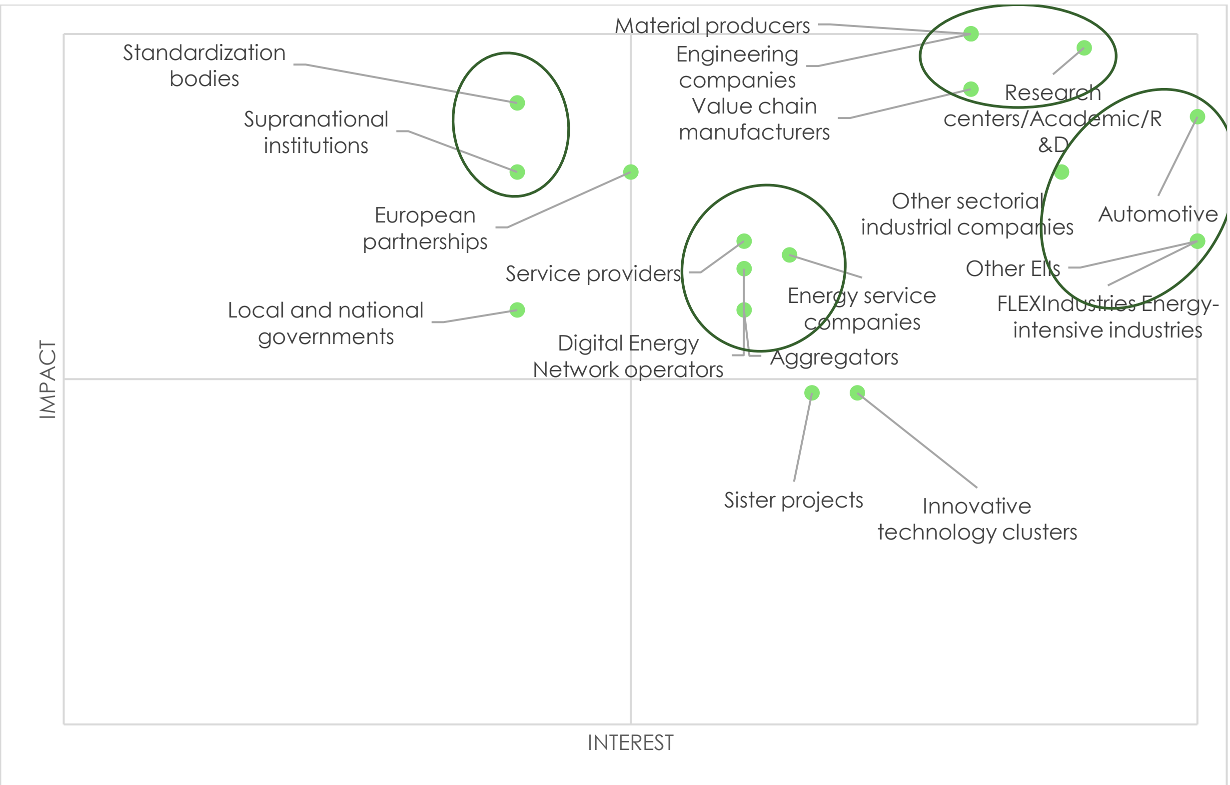

Figure 6- Stakeholder Mapping KER3

The BESS value chain is structured across three primary segments: *Battery system manufacturing (50-55%)*, *System Integration (25-30%)*, and *Customer Acquisition (10-20%)*. Challenges within this framework arise from **complex supply chains** and **potential material shortages**, emphasizing the need for efficient management and sourcing strategies. Crucially, **Engineering Procurement and Construction (EPC)** capabilities and capacities emerge as fundamental factors in navigating these challenges and ensuring the smooth progression of BESS projects from conception to deployment[22].

- In the realm of the BESS and EM value chain, battery system manufacturing stands out as the crucial segment. Among the stakeholders, the ones showing the most significant interest and impact are the technology providers, including **Engineering companies, Value chain manufacturers, and Research centers** involved in academia and R&D. Their pivotal role lies in their capacities, capabilities, and resources to advance and upscale the technology. Equally significant are Material producers, as the development and functionality of BESS and EMS rely on complex supply chains. Potential challenges concerning raw material shortages accentuate their critical role in ensuring the seamless progression of these systems. These entities stand as **key players**, driving the innovation and evolution of sustainable energy solutions.
- Systems integration holds significant weight within the value chain, and several **key stakeholders** play pivotal roles in this sphere. **Digital Energy Network Operators, Energy**

[22] Jarbratt, G., Jautelat, S., Linder, M., Sparre, E., van de Rijt, A., & Wong, Q. H. (2023). "[redacted]Enabling renewable energy with battery energy storage systems." *McKinsey & Company.* [Enabling renewable energy with battery energy storage systems | McKinsey]

Service companies, Aggregators, and service providers are instrumental in the context of KER3 and its exploitation strategy for various reasons. These stakeholders collectively contribute to the effective integration, optimization, and practical application of BESS and EMS within industries, aligning the technology with grid requirements, enhancing efficiency, and enabling reliable energy services.

- Stakeholders involved in customer acquisition are the **EIIs**, as **key players** in the adoption of BESS and EMS solutions. Their collective interest stems from the potential benefits these systems offer in optimizing energy usage, reducing costs, and enhancing overall operational efficiency. Among these stakeholders, the **automotive industry** stands out as a primary key player due to its substantial energy requirements and the inherent need for reliable, sustainable energy solutions. The automotive industry's endorsement and integration of these systems could set a precedent for broader adoption across other energy-intensive sectors, further validating the solutions' effectiveness and driving their market penetration.
- **Policymakers at the European level and standardization bodies** play a pivotal role as **context setters** due to their influence on regulations, guidelines, and industry standards. Their actions significantly shape the regulatory landscape that governs the implementation and operation of innovative technologies like BESS and EMS within the European market. Policymakers create frameworks and policies that encourage or mandate the adoption of energy-efficient solutions. Additionally, standardization bodies establish norms and technical standards that ensure interoperability, safety, and compliance across different systems and stakeholders. Their contributions facilitate the smooth integration and widespread acceptance of BESS and EMS solutions, fostering a more conducive environment for their adoption and implementation across various industries.

7.2.3. KER4- Low-GWP HP-solution for combined heating & cooling

Development of a Low-GWP (Global Warming Potential) Heat Pump (HP) Solution for combined heating and cooling purposes. This solution is crafted to provide both cold water at 10°C for cooling processes and hot water at 90°C simultaneously. Its components are optimized to produce high-temperature water using new-generation, low-GWP refrigerants, thus reducing fuel consumption, curbing energy dependency, cutting down unwanted emissions, and enhancing overall production efficiency within industrial sites. This innovation involves optimized components, such as a double-stage screw compressor with intermediate cooling, utilizing new-generation, low-GWP refrigerants like R515B or R516A, ensuring high efficiency in producing high-temperature water. Simultaneously, THD is developing a cutting-edge heat-to-power engine to harness the waste heat from internal combustion engines in biogas plants operating at temperatures below 90ºC. The engine incorporates an advanced expander that works close to isothermal conditions, yielding efficiency gains of 1.0-1.5% compared to standard systems. Despite these advancements, the overall costs remain comparable to conventional systems, mainly due to modifications concentrated in the expander, while employing environmentally friendly refrigerants with low GWP (Global Warming Potential) and zero ODP (Ozone Depletion Potential). The exploitation strategy revolves around key developmental steps aimed at advancing the TRL and ensuring market viability. These steps primarily involve integrating the technology with Thermal Energy Storage (TES) systems and aligning it with local Waste Heat/ Renewable Energy Sources (WH/RES) for optimization. Additionally, optimizing the Balance of Plant (BoP) components aims to reduce costs while enhancing system efficiency. To enhance marketability, the strategy emphasizes achieving full certification and standardization of the solution within a comprehensive technology package, with a targeted market entry set for 2028. This approach underscores a phased progression, aligning technology development with market readiness and regulatory compliance to facilitate successful commercialization. To do so different networks of stakeholders are to be considered.

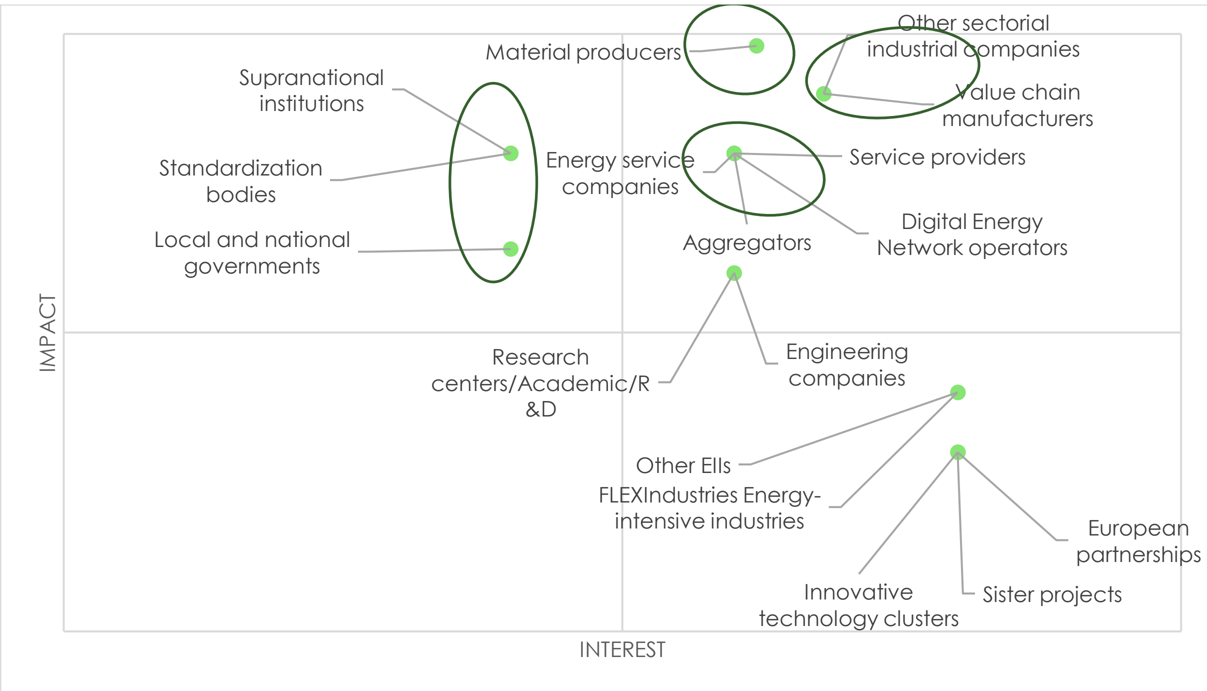

Figure 7- Stakeholder Mapping for KER4

- **Material producers and suppliers** are **key players** in the development and commercialization of KER4, they supply specialized components optimized for high-temperature water production, such as compressors designed for this purpose and new-generation, low-GWP refrigerants like R515B or R516A. Their stake remains significant as suppliers of these critical components, ensuring the efficiency and functionality of the solution. Their interest lies in providing components that enhance the performance and sustainability of the technology, impacting its overall efficiency, cost, and environmental footprint. The impact of these material providers is substantial, as their components directly influence the innovation's functionality, efficiency gains, and compliance with environmental standards, thereby affecting its market readiness and adoption. However, they face challenges related to supply chain bottlenecks and dependencies on non-European manufacturers for key elements like compressors, impacting the cost and scalability of heat pump production. Addressing these challenges requires their involvement in fostering supply chain resilience, potentially by diversifying sourcing options within Europe or investing in local production capabilities[23].

[23] Ibidem

- **Digital Energy Network Operators, Energy Service companies, Aggregators**, and service providers are **key stakeholders** in facilitating the integration of heat pumps. Their roles encompass upgrading energy infrastructure, including the electricity grid, to accommodate the demand for heat pumps in industrial processes. These entities are instrumental in deploying distributed resources, optimizing flexibility through storage solutions, and ensuring connectivity with renewable energy sources like solar PV and storage. However, challenges persist due to limited knowledge about large-scale heat pump applications, deployment strategies, and concerns about operational costs. Their involvement is crucial in overcoming these hurdles and realizing the untapped potential of large-scale heat pumps in utilizing excess heat within industries, thereby closing the energy cycle and enhancing overall energy efficiency.
- **Other sectorial companies and value chain manufacturers** play **key roles** in the integration of the Low-GWP Heat Pump Solution within industrial settings. They might offer vital expertise and support necessary for successful integration. They can be the ones who will implement, adapt, and utilize this technology within their specific industrial processes. Their expertise in various industrial sectors is pivotal in ensuring seamless integration, optimizing the system's performance, and tailoring it to suit diverse manufacturing contexts. Hence, they are significant customers or end-users of this technology, leveraging their industry-specific knowledge to ensure the effective implementation and utilization of the Low-GWP Heat Pump Solution. These stakeholders offer valuable insights and industry-specific knowledge, aiding in the development of efficient and tailored heat pump solutions for various industrial sectors.
- **Policymakers** especially supranational institutions, especially at the European level, play a pivotal role as **context setters**. One of the primary hurdles obstructing the widespread adoption of heat pumps in the market is the significant upfront implementation costs[24]. Government support and strategic policies are crucial in incentivizing industries to adopt heat pumps by alleviating the financial burden. In this context, policymakers play a vital role in crafting supportive frameworks, offering financial incentives, and fostering collaboration between the public and private sectors to facilitate the industrial-scale deployment of heat pump technology. Addressing these challenges is essential for unlocking the full potential of heat pumps in revolutionizing energy usage across various industrial domains.

7.2.4. KER5- Novel ORC unit based on close-to-isothermal expansion process

KER5 focuses on the design of a novel ORC unit utilizing the Elektra turbine design. The design applies the unconventional Elektra turbine design to ORC systems for the first time. This design improves efficiency and optimizes heat transfer in heat recovery units, especially at lower temperatures, resulting in higher overall system efficiencies.
Innovation in Organic Rankine Cycle (ORC) technology through a close-to-isothermal expansion process. THD's heat-to-power engine, designed for biogas plants, incorporates an expander

[24] European Climate Foundation, & European Heat Pump Association. (2023, June). "EU Heat Pump Accelerator" Retrieved from https://www.ehpa.org/wp-content/uploads/2023/06/EU-Heat-Pump-Accelerator_FINAL_June-2023.pdf

operating close to isothermal conditions, resulting in increased efficiency of 1.0-1.5% beyond the State of the Art (SoA).

KER5's **exploitation strategy** is a phased process, encompassing diverse pathways to enhance the commercialization and market entry of the result.

- Initial focus revolves around elevating the TRL through targeted customer projects, emphasizing capacity scale-up. Further refinement involves optimizing the design and Balance of Plant (BoP) through demonstrations using diverse waste heat sources to enhance technology.
- Ongoing progress includes licensing and IP transfer procedures.
- The goal involves full certification and standardization of the solution, facilitating market entry in 2030. Deployment of the innovative ORC unit in practical applications is a key step.
- This deployment strategy extends to diverse sectors, aiming to replicate successes across various markets.
- Finally, dissemination efforts through publications will contribute to wider awareness and knowledge transfer.

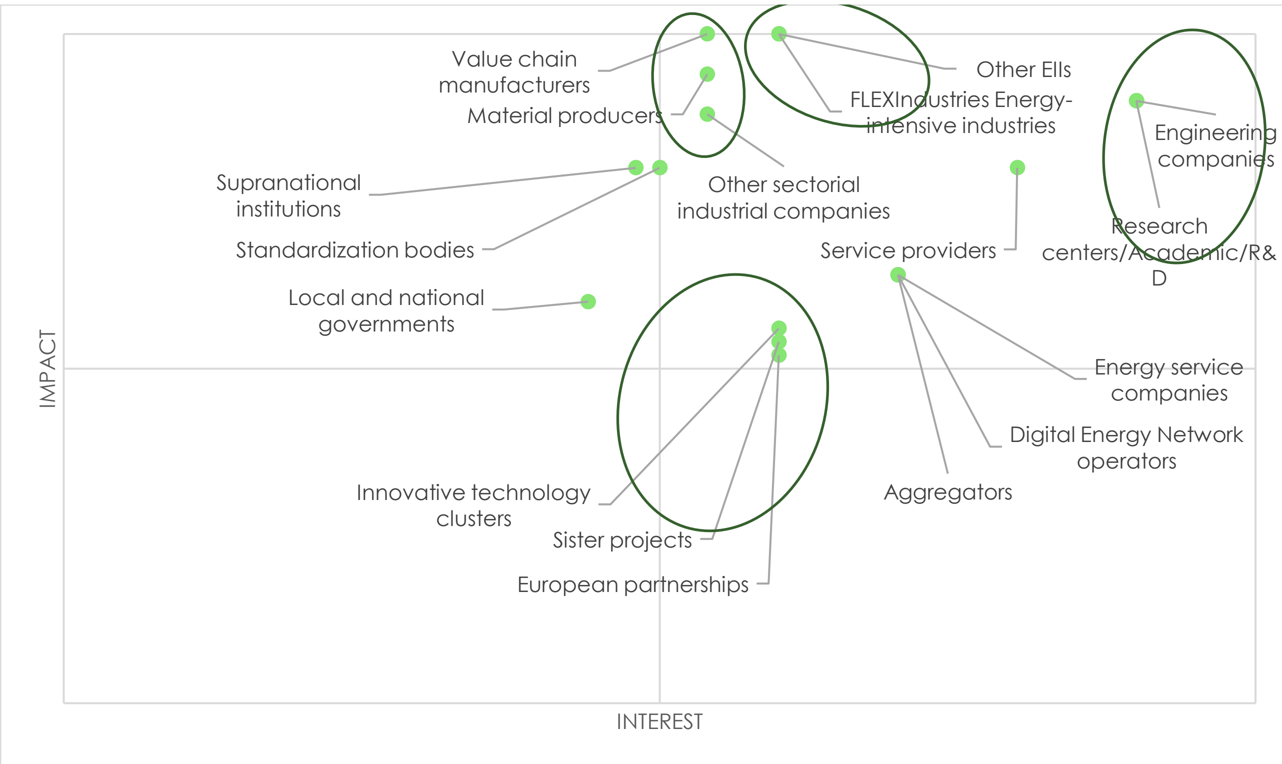

Figure 8- Stakeholder Mapping for KER5

- **Engineering companies, Research Centers, Universities and R&D departments**, are **key players**, displaying high levels of interest and impact, to advancing the TRL of the ORC technology in KER5.
    - **Engineering companies** contribute by refining design aspects and feasibility studies. Those firms are specialized in energy solutions or in innovative turbine design or heat-to-power systems. These companies contribute by applying their expertise in

mechanical and electrical engineering, focusing on the practical implementation and integration of the ORC unit into real-world settings.

- **Research Centers**, particularly those focusing on thermodynamics or sustainable energy, can contribute by conducting in-depth studies on heat transfer, fluid dynamics, and efficiency improvements.
- **R&D departments** play a pivotal role in conducting in-depth analyses, enhancing components, and optimizing the system's functionality focusing on industry-specific applications and innovations in thermal engineering or renewable energy systems.
- **Universities** focusing on applied research, can add value through fundamental research, exploring innovative materials, and theoretical advancements, and can work on practical aspects like design optimization and system efficiency. Together, they cover a spectrum from practical application to theoretical innovation, pushing the ORC unit closer to widespread adoption.

- **Material producers and suppliers, value chain manufacturers, and other sectorial companies** are **key players** and can also be considered in this sense as **context setters** as they can drive the commercialization of the solution.
  - **Material suppliers** hold a pivotal position in the ORC value chain. Their provision of essential elements like iron, carbon, chromium, nickel, titanium, aluminum, and plastics significantly influences the manufacturing and functionality of the ORC unit. These suppliers play a crucial role in determining not just the availability but also the quality and pricing of these raw materials. Any fluctuations in material supply or cost can directly impact the production cost of the ORC unit, thereby influencing its overall commercialization strategy.
  - **Value chain manufacturers** play a pivotal role in translating innovation into reality, particularly in scaling up the ORC unit. Companies specializing in precision engineering or metalworking craft essential components from materials such as iron, carbon, chromium, nickel, titanium, and aluminum, forming the core structure of the ORC unit. Their role extends beyond mere fabrication; they are instrumental in refining, assembling, and integrating these components to create a fully functional and scalable system. Furthermore, their capability to ensure consistent quality, meet production schedules, and optimize manufacturing processes significantly influences the commercialization timeline. The efficiency and cost-effectiveness of these manufacturers directly impact the ORC unit's market competitiveness and its ability to enter the market in a timely and competitive manner.
  - **Other sectorial companies**, which might include firms specializing in metallurgy, plastics manufacturing, and mechanical systems, contribute expertise, components, or tailored services necessary for the successful introduction and market penetration of the ORC technology. Their involvement spans from providing essential components to offering specialized services needed for full-scale production and successful market entry.
- **FLEXIndustries and other energy-intensive industries (EIIs)** play critical roles in shaping industry contexts, they are simultaneously **key players and context setters** in the realm of the commercialization of KER5. ORC technology stands out for its adaptable nature, making it a versatile solution for harnessing external thermal energy sources, and facilitating combined power generation, heating, and cooling. The potential for utilizing the solution in

industrial processes is immense, making the EIIs fundamental actors for the uptake and replication of the solution[25]. Studies, focusing on sectors like steel, cement, and glass manufacturing, underline the economic feasibility of ORC systems for waste heat recovery, showcasing potential cumulative installed capacities[26]. While there's a pressing need to reduce emissions and enhance energy efficiency, industries' investment priorities may not align with energy infrastructure needs, it is therefore fundamental to reach out to such actors also through publications and other targeted dissemination activities.

- **Sister projects, European partnerships, and innovative technological clusters** play a central role not only in spreading information but also in facilitating profound knowledge exchanges. Their significance lies in their ability to offer substantial insights, methodologies, and successful strategies from their projects and experiences. Their contributions in sharing best practices and expertise elevate the TRL, allowing for more rapid advancements and adoption of the innovative solution across diverse sectors and industries.

7.2.5. KER7- WHR thermoelectric generator (TEG)

KER7 focuses on leveraging Waste Heat Recovery (WHR) through a Thermoelectric Generator (TEG) to enhance conversion efficiencies and facilitate technology scaling. This innovation centers on an optimized thermoelectric heat capture module tailored for high-temperature applications, effectively covering a rotary clinker kiln's surface. TRAF, with the aim of technology upscaling, plans to optimize and expand the heat capture module's capacity to 0.5MW. The redesigned module, previously tested at a smaller scale, aims to transition from an air-to-water to a liquid-to-liquid system, fostering improved heat recovery at the TITAN demo site. The exploitation strategy focuses on reaching TRL9 through scalability measures, encompassing design optimization and demonstrations across varied waste heat sources and temperatures. The overarching goal involves achieving full certification and standardization of this solution within a comprehensive technology package, positioning it for market entry by 2029.

---

[25] Wieland C., Schifflechner C., Dawo F., Astolfi M., "*The organic Rankine cycle power systems market: Recent developments and future perspectives*", Applied Thermal Engineering, Volume 224,2023,119980,ISSN 1359-4311, https://doi.org/10.1016/j.applthermaleng.2023.119980.

[26] Ibidem

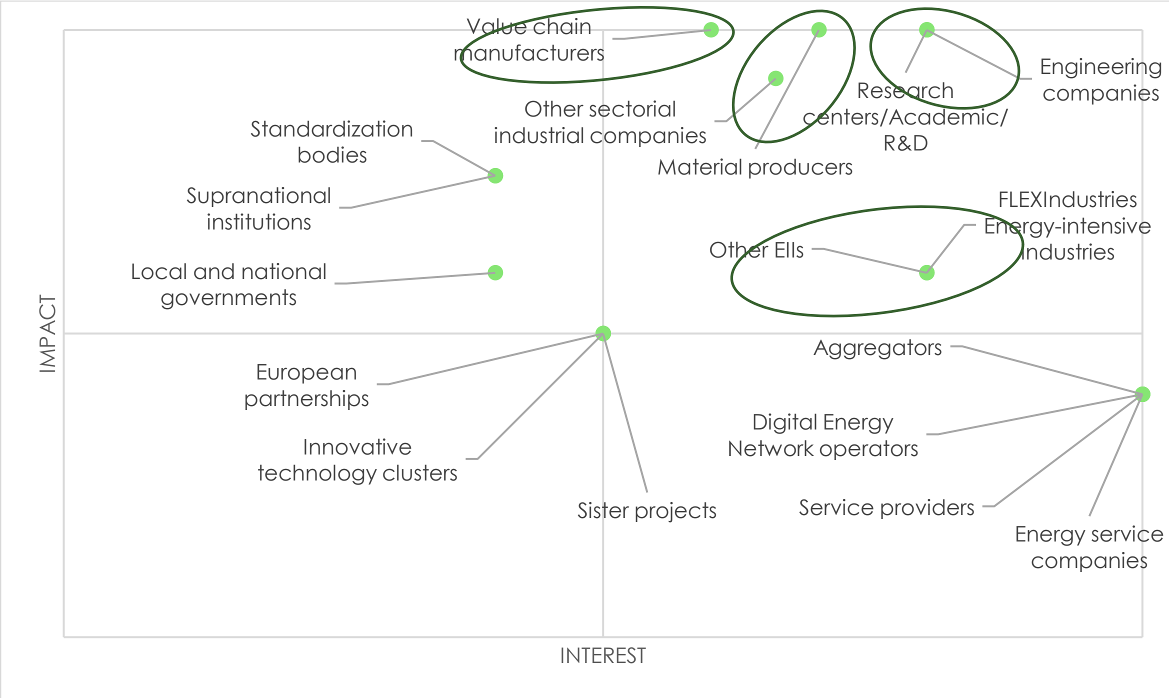

Figure 9- Stakeholder Mapping for KER7

The WHR TEGs development follows a structured value chain, comprising critical segments that drive the development, upscaling, and commercialization of such technology. These fundamental segments include **material definition and supply**, **system design and components**, **manufacturing**, and **standardization**. Each stage is pivotal in ensuring the successful creation and deployment of Waste Heat Recovery Thermoelectric Generators (WHR TEGs) in practical applications.

- In the context of system design and components for thermoelectric generators (TEGs), research-related stakeholders, including **engineering companies, research centers, universities, and R&D departments**, are pivotal **key players**. Their involvement in the TEG development process is pivotal for advancing the understanding of thermoelectric materials, optimizing system designs, and innovating new technologies to enhance TEG efficiency. These entities contribute through extensive research, experimentation, and technological advancements that directly impact the material selection, module design, and overall system performance of TEGs. Their contributions significantly influence the evolution and effectiveness of TEG systems.
- **Material producers** play pivotal roles, as **key players**, displaying the highest levels of impact, and having a high effect on both the upscale and the commercialization of the technology. Thermoelectric materials are key components in thermoelectric generators (TEGs) and are categorized into various types like chalcogenide, clathrate, skutterudite, half-Heusler, silicide, and oxide. These materials, notably bismuth telluride and lead telluride, are crucial for TEGs due to their thermoelectric properties[27]. Despite advancements in materials,

[27] LeBlanc S., "*Thermoelectric generators: Linking material properties and systems engineering for waste heat recovery applications*", Sustainable Materials and Technologies, Volumes 1–2, 2014, Pages 26-35, ISSN 2214-9937, https://doi.org/10.1016/j.susmat.2014.11.002.

challenges arise when applying these materials to real-world devices. Matching material properties with fluctuating temperatures in applications, device stability, and mechanical properties remain significant concerns[28]. Moreover, material producers play a fundamental role in TEG commercialization by influencing supply stability, material costs, and overall market feasibility. Their ability to ensure stable supply chains and competitive prices significantly impacts the widespread adoption of TEG technology.

- **Value chain Manufacturers** and **other sectorial companies** also have very high levels of impact and interest, being **key players**. Their involvement is multifaceted and is fundamental for the production and commercialization of the solution.
  - **Value chain manufacturers** play pivotal roles in the development and commercialization of technologies like KER7 (WHR TEG). They're instrumental in translating innovations into tangible devices. Their expertise in component fabrication, system integration, and material sourcing is crucial for scaling up these technologies. For KER7 specifically, their involvement in sourcing materials like thermoelectric elements and substrates, while considering manufacturing intricacies, is crucial.
  - Additionally, **other sectorial companies**, especially those specializing in heat exchangers or materials used in thermal interface solutions, hold importance. Their contributions enhance the efficiency of the TEG by optimizing heat transfer, which directly impacts power output. Ultimately, these stakeholders ensure the successful translation of theoretical concepts into practical, scalable devices, making them vital in the journey from ideation to real-world application.
- **EIIs** hold high interest in the upscale and commercialization of KER7: they are **subjects and key players** as they can apply and enhance the uptake and replication of the solution in different sectors. These industries, spanning manufacturing segments like **steel, cement, glass, automotive, heavy machinery, and chemicals**, produce substantial waste heat as a byproduct of their processes. WHR TEGs offer a promising solution to harness this thermal energy, enhancing overall energy efficiency and reducing reliance on external power sources. Furthermore, applications extend to power generation and utilities, where power plants utilizing combustion-based methods release waste heat in exhaust gases. Similarly, sectors like **food processing, textiles, and paper manufacturing**, known for their high-temperature processes, stand to benefit from WHR TEGs by capturing and utilizing waste heat, contributing to energy conservation. Additionally, these generators hold potential in **automotive and transportation sectors** by capturing waste heat from vehicle exhaust systems, potentially enhancing vehicle efficiency and reducing emissions. As EIIs continue to seek sustainable practices and energy efficiency improvements, WHR TEGs present a versatile and valuable solution across various industries.

7.2.6. KER8- Integrated industrial solar thermal system + EMS

KER8 revolves around the integration of an Industrial Solar Thermal System with an Energy Management System (EMS). The development of the result involves pioneering an innovative EMS capable of accurately predicting and regulating internal energy flows while managing connections

[28] Ibidem

Funded by the European Union

to external energy networks. This integration with solar thermal systems significantly augments intra-day flexibility within industrial environments. TVP aims to replicate and scale up this integrated ST&TES system for widespread implementation.

The commercial offering encompasses various facets:

- Feasibility assessments tailored to each case.
- Complete design and engineering of the solution.
- Manufacturing of High-Voltage Field Panels (HVFPs).
- Procurement and shipment of system components, including the Thermal Energy Storage (TES) tank, relevant Balance of System (BoS), and the Monitoring and Control (M&C) system.
- On-site activities such as transportation, civil works, mechanical and electrical installation, commissioning, and ongoing operation & maintenance (O&M) support.
- It's important to note that apart from manufacturing (point 3), other activities may be partially outsourced to local partners or subcontractors.

Regarding funding sources, innovative applications of multi-MW systems could be financed through the Innovation Fund. Additionally, national funding schemes or subsidies may also contribute to funding such initiatives.

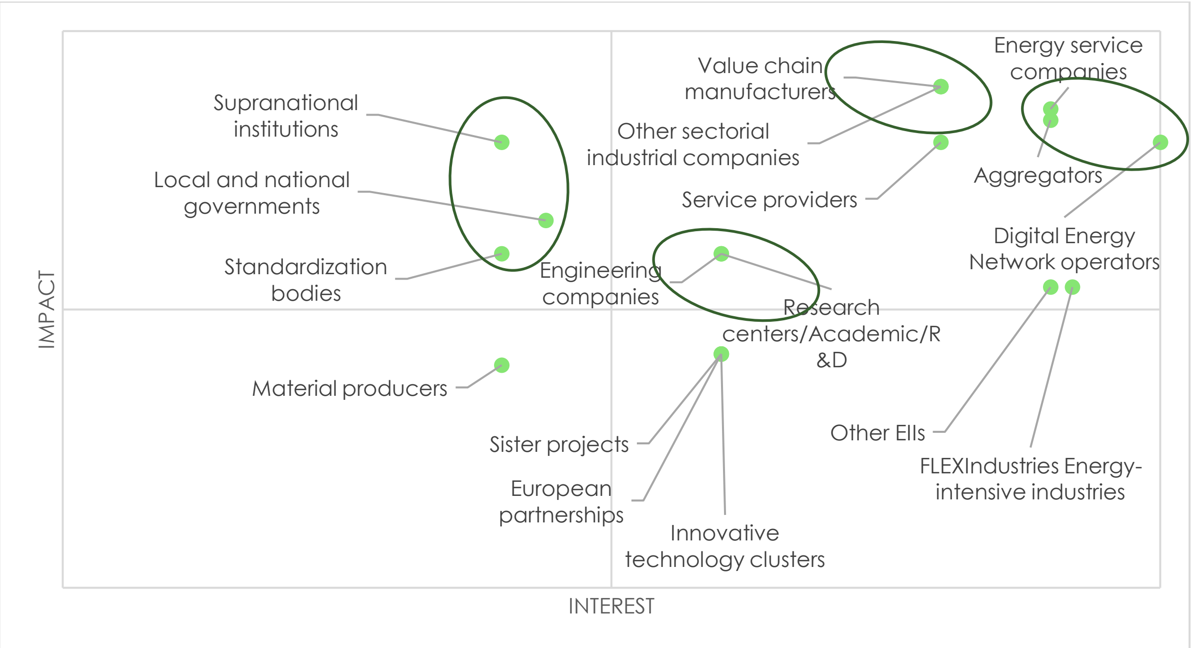

Figure 10- Stakeholder Mapping for KER8

- **Value chain manufacturers** along with **other sectorial companies** involved in the production of Solar Thermal Collectors, play a **key role** in the implementation and commercialization of KER8. They serve as essential contributors in developing and manufacturing the technology's components required for the integrated system. Their expertise in the fabrication of Collectors, ensures the functionality and efficiency of these systems. Additionally, these manufacturers provide essential support in the scaling-up process, contributing to the successful deployment of the integrated Industrial Solar Thermal System and EMS for widespread implementation.

- Energy service providers, which encompass **network operators (DSOs and TSOs), energy service companies, and aggregators**, exhibit significant interest and wield substantial impact regarding KER8 implementation, making them relevant **key players** for the further exploitation of the solution.
  - Firstly, **Network Operators (DSOs and TSOs)** are essential stakeholders involved in managing the distribution and transmission of electricity across regional and national grids. Their high interest in KER8 arises from its potential to augment grid flexibility, improve load management, and integrate renewable energy sources efficiently.
  - Secondly, **Energy Service Companies** are entities focusing on delivering energy-related services and solutions to consumers and businesses. They are keenly interested in adopting innovative technologies like KER8 to diversify their service portfolios, enhance energy efficiency, and offer sustainable solutions to their clientele.
  - Lastly, **Aggregators** play a crucial role in the energy market by consolidating and managing the energy output from multiple sources. Their interest in KER8 lies in its potential to optimize energy sourcing, enabling them to offer more competitive energy supply solutions to consumers while enhancing grid stability through better energy management strategies.
- **Policymakers** and supranational institutions hold significant influence in the adoption and scaling of KER8, even if their interest might not be at the highest level, they are fundamental **context setters**. Their role involves shaping regulatory frameworks, providing financial incentives, and establishing standards that facilitate the integration of innovative technologies like the Industrial Solar Thermal System with Energy Management Systems. The upscaling and production phases require substantial funds, funding sources could include the Innovation Fund for innovative multi-MW applications, alongside possible contributions from national funding schemes or subsidies aimed at supporting such projects.
- **Engineering companies and research-related entities** play **key roles** in the development and advancement of KER8. Their involvement revolves around the innovation, design, and engineering of the integrated systems, contributing technical expertise, and conducting research to enhance the efficiency and functionality of the Industrial Solar Thermal System and Energy Management System. These entities pioneer technological advancements, optimize system designs, and conduct experiments aimed at improving energy flows, thereby advancing the overall capabilities and performance of the integrated solution. Their contributions directly impact the feasibility, design, and successful implementation of KER8.

7.2.7. Models, Designs, and Algorithms

This section offers an aggregated view of stakeholder mapping for knowledge-related results involving models, algorithms, and designs. These KERs encompass advancements in AI-driven algorithms for industrial optimization (KER2), energy system modeling (KER9), novel business models for industrial flexibility (KER10), and the design of an Elektra Turbine (KER6). The following stakeholder mapping provides an overarching understanding of key players involved in the exploitation of such results.
KER2 involves the development of tailored algorithms for industrial demand-side management, optimizing manufacturing processes and energy usage. These AI-driven algorithms extract and

forecast crucial data like energy and material costs, consumption patterns, and renewable energy availability, supporting informed decisions for process optimization.
KER6 involves the pioneering implementation of the Elektra turbine design in an innovative Organic Rankine Cycle (ORC). This marks the debut of the non-conventional Elektra turbine within ORC systems, offering heightened efficiency and optimized heat transfer capabilities in heat recovery units.
KER9 focuses on Energy System models designed for flexible industries, introducing a data model and simulation framework. This system evaluates the flexibility of various industrial processes, enhancing grid flexibility and establishing secure, efficient local energy systems.
KER10 revolves around novel business models for Industrial Flexibility, transforming industries into active participants in providing flexibility services to the grid. These models leverage digital twins, forecasting, and planning algorithms to make informed decisions about flexibility services, generating additional revenue streams for industries.
The **exploitation strategies** for such results revolve around the provision of specialized services aligned with each KER's objectives. The strategies encompass the application of these results to various technologies and industrial processes, aiming to optimize energy usage, improve operational efficiency, and enable industries to actively participate in flexibility services, thereby fostering revenue generation and sustainable energy practices. They aim to offer industries solutions for demand-side management, energy system modeling, innovative business models for flexibility, and novel ORC unit applications. These strategies focus on catering to industry needs, leveraging advanced technologies such as AI-driven algorithms, simulation frameworks, and non-conventional turbine designs to optimize manufacturing processes, enhance grid flexibility, and boost overall system efficiencies. Additionally, the strategies involve replication and dissemination, aiming to proliferate these advancements across industries, enhancing their adoption and enabling broader access to efficient energy practices and innovative business models.

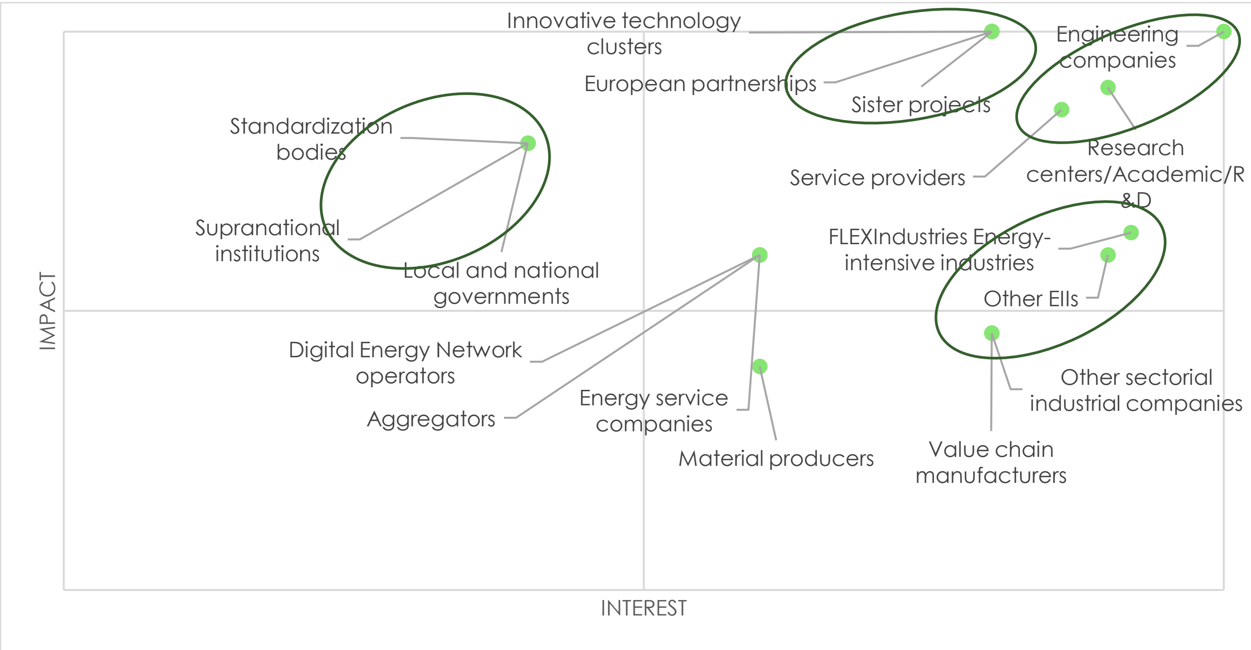

Figure 11- Stakeholder Mapping for Models, Designs, and Algorithms

Funded by the European Union

- **Engineering companies, Research centers academic bodies, R&D Departments** as **key player** hold the highest levels of interest and impact in these KERs. Their involvement is critical in advancing these innovations to a stage where they can be applied across diverse industries and technologies. Their expertise, testing facilities, and research insights are instrumental in adapting and optimizing these innovations for practical application. Their influence is particularly pertinent when it comes to the application and adaptation of KER2 (Industrial Demand-side Management), KER6 (Novel ORC unit based on Elektra turbine design), and KER9 (Energy System Models). Their expertise and involvement are crucial in implementing these innovations across various industries, optimizing their functionality, and tailoring them to suit diverse technological landscapes.
- **Associations and innovative technology clusters, European partnerships, Sister projects, and Business and Industrial Initiatives** are **key players** in disseminating these innovations. They play a pivotal role in fostering knowledge exchange and dissemination, Associations, partnerships, and sister projects facilitate this dissemination by sharing best practices, promoting collaboration, and ensuring that these innovative business models reach a wider audience, encouraging their adoption and implementation across industrial sectors. They areparticularly essential for KER10 (Industrial Flexibility Business Models). KER10 focuses on developing innovative business models that leverage digital twins, forecasting, and planning algorithms. These models enable industries to actively participate in providing flexibility services to the grid, generating additional revenue streams.
- **FLEXIndustries, Energy-Intensive Industries (EIIs), other EIIs, value chain manufacturers, and other sectorial companies** are important **subjects and key players** and exhibit very high interest due to the implications of these innovations in their operational contexts. They can integrate these innovative results into their production processes for manufacturing technologies. They act as customers interested in adopting and applying these innovative solutions within their operational frameworks. Their interest lies in leveraging these technologies to enhance their manufacturing processes, ensuring compliance with regulations, improving energy efficiency, and achieving sustainability targets within their industries. This integration aids in advancing their product lines, optimizing energy usage, and enhancing overall operational efficiency. They are keen on understanding how these solutions align with industry regulations, financial viability, and sustainability objectives. Their focus is on ensuring that these innovations meet regulatory standards and are financially feasible for implementation within their specific industrial settings.
- **Policymakers including supranational institutions, national and local governments as well as standardization bodies**, are important context setters also in the framework of these KERs. They hold high-impact potential but may need further engagement. Their involvement is crucial in creating an enabling environment through policies, regulations, and funding mechanisms to facilitate the widespread adoption and scaling of these innovations. Raising their interest is essential to garner the necessary support for successful implementation through policy initiatives and financial backing.

8. Stakeholders' Roles

8.1. Introduction

The assignment of roles is the final step in developing the stakeholder mapping for the FLEXIndustries project. The following paragraphs analyze the roles and the needs that, the stakeholders previously prioritized have according to:

- KER typology
- Partners' profiles
- Exploitation strategies.

8.2. Stakeholders' Profiles & Roles

The following tables outline the roles that each prioritized stakeholder play in the context of the different KERs or groups of KERs analyzed.

8.2.1. KER1- Dynamic Energy & Process Management Platform

Table 6- Prioritized stakeholders' roles for KER1

Prioritized Stakeholders	Roles
Digital Energy Network operators, Energy service companies, and Aggregators	**Partners**: due to their industry expertise, market reach, and infrastructure, can serve as valuable partners for the KER1 platform developers across its development, deployment, testing, and market penetration stages.
Associations and clusters of experts, European partnerships, sister projects and, business and industrial initiatives	**Enablers**: such stakeholders can lead to the dissemination of the platform to different players and entities in the different industrial sectors.
FLEXIndustries Industrial Sectors and other EIIs	**Customers**: EIIs are the main targets for the implementation and application of the platform.
Research bodies, Universities, Research Institutions/Centres, and R&D departments of industrial players	**Partners**: research-oriented entities can be future partners for service providers in up-scaling the TRL of the platform as a service.

8.2.2. KER3- Integrated stationary BESS for industries + EMS

Table 7- Prioritized stakeholders' roles for KER3

Prioritized Stakeholders	Roles

Engineering companies, Value chain manufacturers, and Research centers	**Suppliers**: they provide essential components, materials, expertise, and innovations crucial for the development and implementation of KER3.
Digital Energy Network Operators, Energy Service companies, Aggregators, and service providers	**Partners**: they can collaborate as partners in implementing, supporting, and optimizing the utilization of KER3 technologies.
EIIs and the Automotive Sector	**Customers**: they act as primary customers benefiting from the deployment and utilization of KER3 technologies.
Policymakers at the European level and standardization bodies	**Enablers**: they set the regulations and the political frameworks for the uptake of the result.

8.2.3. KER4- Low-GWP HP-solution for combined heating & cooling

Table 8- Prioritized stakeholders' roles for KER4

Prioritized Stakeholders	Roles
Material producers and suppliers	**Suppliers**: they supply and provide the fundamental materials and components for the production of the solution.
Digital Energy Network Operators, Energy Service companies, Aggregators	**Partners**: they can collaborate in upgrading the infrastructure, deploying resources, and optimizing flexibility for large-scale heat pump integration.
Other sectorial companies and value chain manufacturers	**Partners**: they are fundamental partners for the integration of the solution in different settings and sectors.
Policymakers especially supranational institutions	**Enablers**: they enable the production and application of the technology by setting the suitable regulatory, financial and standard-related frameworks.

8.2.4. KER5- Novel ORC unit based on close-to-isothermal expansion process

Table 9- Prioritized Stakeholders' roles for KER5

Prioritized Stakeholders	Roles
Engineering companies, Research Centers, Universities and R&D departments	**Partners**: they can collaborate in the upscale of the technology and be pivotal in replicating and adapting the solution in different sectors and environments.
Material producers and suppliers, value chain manufacturers, and other sectorial companies	**Suppliers**: they provide the materials, expertise and workforce fundamental for the production and commercialization of the technology.

FLEXIndustries and other energy-intensive industries (EIIs)	**Customers**: they are the primary customers benefitting from the utilization and deployment of KER5 solutions within their operational frameworks.
Sister projects, European partnerships, and innovative technological clusters	**Supporters**: They aid in promoting awareness, sharing best practices, and extending the reach and adoption of these technologies within their respective ecosystems and beyond, contributing to their widespread acceptance and utilization.

8.2.5. KER7- WHR thermoelectric generator (TEG)

Table 10- Prioritized Stakeholders' roles for KER7

Prioritized Stakeholders	Roles
Engineering companies, research centers, universities, and R&D departments	**Partners**: these entities are pivotal partners, contributing extensive research and innovation to advance thermoelectric materials and system designs for TEGs.
Material producers	**Suppliers**: they provide crucial thermoelectric materials, influencing TEG functionality, stability, and cost-effectiveness.
Value chain Manufacturers and other sectorial companies	**Partners**: facilitate the translation of theoretical concepts into practical devices, leveraging their expertise in fabrication, system integration, and optimizing heat transfer.
Energy Intensive Industries	**Customers**: EIIs can seek to enhance energy efficiency by implementing WHR TEGs, aiming to reduce waste heat and align with sustainability objectives.

8.2.6. KER8- Integrated industrial solar thermal system + EMS

Table 11- Prioritized Stakeholders' roles for KER8

Prioritized Stakeholders	Roles
Value chain manufacturers along with other sectorial companies	**Providers**: they are fundamental suppliers of crucial components and expertise essential for the system's functionality and scaling.
Energy service providers: network operators (DSOs and TSOs), energy service companies, and aggregators	**Partners**: through formal agreements, such entities can facilitate grid flexibility, diverse energy services, and optimized energy management strategies.
Policymakers and supranational institutions	**Enablers**: such stakeholders are pivotal for shaping regulatory frameworks, providing incentives, and establishing standards for technology integration.

Engineering companies and research-related entities	**Partners**: such stakeholders can be partners by contributing technical expertise, innovation, and advancements to optimize system design and functionality.

8.2.7. Models, Designs and, Algorithms

Table 12- Prioritized Stakeholders' roles for Models, Designs, and Algorithms

Prioritized Stakeholders	Roles
Engineering companies, Research centers academic bodies, R&D Departments	**Partners**: they can be collaborative entities facilitating the adaptation and application of innovative results.
Associations and innovative technology clusters, European partnerships, Sister projects, and Business and Industrial Initiatives	**Supporters**: they are fundamental entities instrumental in promoting knowledge exchange and dissemination related to these results.
FLEXIndustries Energy Intensive Industries, other EIIs, value chain manufacturers, and other sectorial companies	**Customers**: they can be the entities using and integrating these results into their development processes and manufacturing technologies.
Policymakers	**Enablers**: they set the financial and regulatory environment conducive to the adoption and implementation of these innovative outcomes.

9. Conclusions

The objective of this report is to map and prioritize stakeholders instrumental for the dissemination and exploitation of FLEXIndustries' outcomes. This is aimed at identifying stakeholders that can sustain the further utilization of FLEXIndustries' results, maximising the impacts of project's outcomes. The identification, mapping and prioritization of the stakeholders helps guiding dissemination activities to meet the specific needs of stakeholders. The analysis considered different aspects, including the project's results, the exploitation strategies, and the operational context or market where these results can find practical application.

This report presents the outcome of a three-step methodological approach encompassing:
- stakeholder identification,
- stakeholder mapping and prioritization
- assignment of roles to prioritized stakeholders.

The key findings are as follows:
- **Engineering Companies and Research/Academic Entities:** These stakeholders can be integral partners in furthering the advancement of FLEXIndustries' innovations. Their involvement not only aids in upscaling but also offers a bridge to new knowledge realms and cutting-edge expertise.
- **Material Producers and Suppliers:** Their role extends beyond mere suppliers, exerting influence on the pricing and construction aspects by providing essential material resources necessary for technology development.
- **Value Chain Manufacturers:** Positioned as key players, their collaboration is envisioned both as collaborative partners in the development process and as crucial customers who can integrate and implement these technologies into their operations.
- **Digital Energy Network Operators, Energy Service Companies, and Aggregators:** These entities hold pivotal roles in embracing and benefiting from the innovations brought forth by the project. Their involvement is vital in optimizing energy infrastructure, grid flexibility, and renewable energy integration.
- **Policymakers:** Recognized as significant enablers, they wield the power to shape the regulatory and financial landscape, profoundly impacting the successful implementation of these technologies.
- **Clusters, Associations, and Sister Projects:** Their importance lies in serving as conduits for disseminating knowledge, fostering collaboration, and creating a collective synergy for advancing innovative solutions in the industry.

By understanding and acknowledging the roles and importance of these stakeholder groups, FLEXIndustries aims to create tailored strategies, ensuring the seamless integration and widespread adoption of its groundbreaking outcomes, ultimately paving the way for a more sustainable and efficient industrial future.

10. References

- Jarbratt, G., Jautelat, S., Linder, M., Sparre, E., van de Rijt, A., & Wong, Q. H. (2023). "Enabling renewable energy with battery energy storage systems." *McKinsey & Company.* [Enabling renewable energy with battery energy storage systems | McKinsey]
- Wieland C., Schifflechner C., Dawo F., Astolfi M., "*The organic Rankine cycle power systems market: Recent developments and future perspectives*", Applied Thermal Engineering,Volume224,2023,119980,ISSN1359-4311, https://doi.org/10.1016/j.applthermaleng.2023.119980
- LeBlanc S., "*Thermoelectric generators: Linking material properties and systems engineering for waste heat recovery applications*", Sustainable Materials and Technologies, Volumes 1–2, 2014, Pages 26-35, ISSN 2214-9937, https://doi.org/10.1016/j.susmat.2014.11.002.
- Eurofound. (Year). "Stakeholder." European Industrial Relations Dictionary. Retrieved from https://www.eurofound.europa.eu/en/european-industrial-relations-dictionary/stakeholder
- Coatings World. (2020, January 1). Europe's OEM Automotive Coatings Market Expands. Coatings World. https://www.coatingsworld.com/issues/2020-01-01/view_europe-reports/europes-oem-automotive-coatings-market-expands/
- MarketsandMarkets. (n.d.). Automotive Paints Market by Type, Resin, Technology, Paint Equipment, Texture, Content, ICE & EVs, Refinish, and Region - Global Forecast to 2025. MarketsandMarkets. https://www.marketsandmarkets.com/Market-Reports/automotive-paints-market-1246.html
- ETIP Bioenergy. (n.d.). Combined Heat and Electricity Production. Retrieved from https://www.etipbioenergy.eu/value-chains/products-end-use/end-use/combined-heat-and-electricity-production
- ENVIEN Group. (n.d.). [About Biofuels]. Retrieved from https://www.enviengroup.eu/en/
- Gnansounou, E., & Dong, J. (Eds.). (2021). Value Chain of Biofuels. Elsevier.
- McKinsey & Company. (2023). Pulp, Paper, and Packaging in the Next Decade: Transformational Change. *McKinsey & Company*. [The packaging, pulp and paper industry in the next decade | McKinsey]
- European Climate Foundation, & European Heat Pump Association. (2023, June). "EU Heat Pump Accelerator" Retrieved from https://www.ehpa.org/wp-content/uploads/2023/06/EU-Heat-Pump-Accelerator_FINAL_June-2023.pdf
- Wieland C., Schifflechner C., Dawo F., Astolfi M., "*The organic Rankine cycle power systems market: Recent developments and future perspectives*", Applied Thermal Engineering, Volume 224,2023,119980,ISSN 1359-4311, https://doi.org/10.1016/j.applthermaleng.2023.119980
- LeBlanc S., "*Thermoelectric generators: Linking material properties and systems engineering for waste heat recovery applications*", Sustainable Materials and Technologies, Volumes 1–2, 2014, Pages 26-35, ISSN 2214-9937, https://doi.org/10.1016/j.susmat.2014.11.002.