



PANTERA

***Pan European Technology Energy Research
Approach***

Work Package WP3 "The state of R&I, standardisation and regulation"

Deliverable D3.5

Roadmap to 2030

Grant Agreement No: **824389**
Funding Instrument: **Coordination and Support Action (CSA)**
Funded under: **H2020 LC-SC3-ES-7-2018: Pan-European Forum for R&I on Smart Grids, flexibility and Local Energy Networks**
Starting date of project: **01.01.2019**
Project Duration: **54 months**

Contractual delivery date: **31.05.2023**
Actual delivery date: **21.06.2023**
Lead beneficiary: **IERC**

Deliverable Type: **Report**
Dissemination level: **Public**
Revision / Status: **Final**

This project has received funding from the European Union's Horizon 2020 Coordination and Support Action Programme under Grant Agreement No. 824389

Document Information

Document Version: 04
 Revision / Status: Final

All Authors (Lead and Contributing Partners)

Authors Name	Organisation
Shafi Khadem	IERC (WP Lead)
Venizelos Efthymiou	FOSS (Task Lead)

Partner Contribution

Section	Name	Resp. Partner	First Draft Due Date
1	Mattia Cabiati	RSE	06.06.2023
2	Andrei Morch	SINTEF	06.06.2023
3	Anna Mutule	IPE	06.06.2023
4	Alexandros Tsitsanis	SUITE5	06.06.2023
5	Rad Stanev	TUS	06.06.2023

Document History

Revision	Content / Changes	Resp. Partner	Date
00	Creation of the document.	IERC	11/03/2023
01	Suggestions for consideration	IERC	10.04.2023
02	Suggestions for consideration	IERC	17.04.2023
03	Agreement on the structure and tasks distribution	IERC	20.04.2023
04	The first draft version of the deliverable	IERC	05.05.2023
05	The second draft version of the deliverable	IERC	20.05.2023
06	Suggestions for consideration	IERC	27.05.2023
07	The third draft version of the deliverable	IERC	15.06.2023

Document Approval

Final Approval	Name	Resp. Partner	Date
Review Executive Board	Venizelos Efthymiou	FOSS	21.06.2023

Disclaimer

This document contains material, which is copyrighted by certain PANTERA consortium parties and may not be reproduced or copied without permission. The information contained in this document is the proprietary confidential information of certain PANTERA consortium parties and may not be disclosed except in accordance with the consortium agreement.

The commercial use of any information in this document may require a licence from the proprietor of that information.

Neither the PANTERA consortium as a whole, nor any single party within the PANTERA consortium warrants that the information contained in this document is capable of use, nor that the use of such information is free from risk. Neither the PANTERA consortium as a whole nor any single party within the PANTERA consortium accepts any liability for loss or damage suffered by any person using the information.

This document does not represent the opinion of the European Community, and the European Community is not responsible for any use that might be made of its content.

Copyright Notice

© The PANTERA Consortium, 2019 – 2023

Table of Contents

Abbreviations	6
Executive Summary	8
1 Introduction	10
1.1 Structure of the document and links to other project tasks	10
2 Post-Project Activities and Sustainability of RICAP process	12
2.1 Overview of RICAP process.....	12
2.1.1 <i>Administrative</i>	12
2.1.2 <i>Technical</i>	13
2.2 Identification of smart grid technologies/systems R&I status, gaps and maturity index....	14
2.2.1 <i>R&I Status</i>	14
2.2.2 <i>R&I Priority</i>	14
2.2.3 <i>Maturity Index</i>	15
2.3 Recommendations for post-project activities	16
3 Working Teams Activities	16
3.1 Overview of PANTERA Working Teams activities.....	16
3.1.1 <i>WT1 Research Infrastructure</i>	17
3.1.2 <i>WT2 Regulation and Standartization</i>	17
3.1.3 <i>WT3 Gap analysis, R&I needs mapping and evaluation</i>	17
3.1.4 <i>WT4 Innovation support to the market uptake</i>	18
3.1.5 <i>WT5 Global & European Research and innovation community</i>	18
3.2 Linking WTs activities with ETIP SNET Working Group 5	19
3.3 Recommendations for post-project activities	20
4 Regional Desks Activities	20
4.1 Overview of PANTERA Regional Desks activities.....	20
4.2 ETIP SNET Regional Activities	22
4.3 Recommendations for post-project activities	23
5 EIRIE Platform	24
5.1 Overview of EIRIE Platfrom and activities	24
5.2 One-Stop Resource Living Platform	24
5.3 Linking EIRIE with BRIDGE and ETIP SNET	26
5.4 Recommendations for post-project activities and sustainability of EIRIE	26
6 Conclusions	28
7 References.....	30

Table of Figures

Figure 1 PANTERA proposed activities and framework solutions	11
Figure 2 PANTERA RICAP (Administrative) Process	13
Figure 3 PANTERA RICAP (Technical) Process.....	14
Figure 4: The methodology for smart grid system readiness in a nutshell.....	15
Figure 5 Dynamic process to identify the R&I status, priority and maturity of smart grid technologies	16
Figure 6 PANTERA / ETIP SNET WG5 Working teams.....	17
Figure 7 An example of the Tweets published within the WT5 activities.	19
Figure 8 An example of the Tweets published within the WT5 activities.	20
Figure 9 PANTERA 6+1 approach.....	21
Figure 10 PANTERA Desks activities and supporting measures.....	22
Figure 11 ETIP SNET Regional Workshop areas.....	23
Figure 12 EIRIE Platform Structure.....	24
Figure 13 Key principles identified for EIRIE Platform successful exploitation [Reference to D7.1]	25

Abbreviations

Acronym

CSA	Coordination and Support Action
DER	Distributed Energy Resources
DNO	Distribution Network Operator
DR	Demand Response
DSO	Distribution System Operator
DN	Distribution Network
EAC	Electricity Authority of Cyprus
EC	European Commission
EGD	European Green Deal
EIRIE	European Interconnection for Research Innovation and Entrepreneurship
EMS	Energy Management Systems
ENTSO-E	European Network of Transmission System Operators for Electricity
EPRI	Electric Power Research Institute
EPBD	Energy Performance of Buildings Directive
ESCo	Energy Service Company
ESS	Energy Storage System
ETD	Energy Taxation Directive
ETIP-SNET	European Technology and Innovation Platform Smart Networks for Energy Transition
EU	European Union
EV	Electric Vehicle
HLUC	High Level Use Case
ICT	Information and Communication Technology
IEA	International Energy Agency
IoT	Internet of Things
IRP	Integrated Research Program
LV	Low Voltage
LEM	Local Energy Market
MS	Member State
MV	Medium Voltage
NECP	National Energy and Climate Plan
PCC	Point of Common Coupling
NRA	National Regulating Authority
PV	Photovoltaics
R&D	Research and Development
RD	Regional Desk
R&I	Research and Innovation
REC	Renewable Energy Community
RES	Renewable Energy Sources
RESS	Renewable Electricity Support Scheme
RCS	Regulations, Codes and Standards

TSO Transmission System Operator
TN Transmission Network
WT Working Team

Executive Summary

This report (Deliverable 3.5) is the final deliverable “Roadmap to 2030” and describes the work carried out within task 3.5 of the PANTERA (PAN European Technology Energy Research Approach) covering the recommendations of the project consortium for post project activities in meeting the policies leading to 2030.

In the framework of this action, based on the developing approaches and proposed solutions to accelerating the R&I activities, PANTERA (during the project life time) and later (by and beyond 2030) is recommending the required actions to keep the exploitation of smart grid technologies for decarbonizing electricity in the energy roadmap 2050.

This deliverable suggests post-project sustainability actions for various activities while providing links to other tasks within PANTERA. It is crucial to have a well-structured and unified approach to assess the progress of these activities. PANTERA, has developed a universal methodology to analyze national and EU projects' R&I activities and status. To do this, the PANTERA team has developed administrative and technical processes/methodologies and tools to incorporate the categorization of "Smart Grid technologies/systems", their current R&I status, priorities and maturities to achieve the decarbonization of integrated energy system targets outlined by ETIP SNET Vision 2050. These are presented in this deliverable together with what is considered as plausible actions following the completion of the project PANTERA.

Based on the findings reported in this deliverable the conclusions reached for recommendations for post-project activities are the following:

- *Develop the complete framework and working tool for the whole RICAP process and include it in the EIRIE platform. R&I status, priority and maturity index analysis require active involvement of the stakeholders/experts from each member state. More information from national projects is required to get the more accurate R&I outcomes for each country.*
- *The existence of PANTERA and ETIP SNET working teams are very important for further improvement of the RICAP process. Hence, their composition and planned work should continue and be aligned with the needs of EIRIE and the build up valuation process of projects. Thus, once the PANTERA project is finished, the teams involved will move on to working within the ETIP SNET WG5 framework, which is constantly adapting to meet the evolving needs of research and innovation. To facilitate these activities, the EIRIE platform will serve as a central hub for collaboration and information sharing. By collecting data and insights from real-life project results, research topics, and best practices from the R&I community and stakeholders, EIRIE supports the ETIP SNET teams in their role of guiding and facilitating the energy transition-related R&I.*
- *The existence of PANTERA regional desk activities are also important to continue the stakeholder engagement at national level, thus more information on the projects at national level can be identified and made available to feed in the valuation process.*
- *During the post-project period, it will be crucial to streamline the processes, methodologies, and tools developed for assessing the R&I status, priority, technology maturity, innovation, and market potential of project results. These should be transposed into the EIRIE platform and linked to specific artifacts published in the EIRIE Innovation Marketplace. This will enable matchmaking between investors/procurers and innovators, supporting continued progress in the field.*
- *Keeping up with international developments is essential to avoid missing key opportunities*

in the dynamic R&I field. The EIRIE platform should serve as a relevant interface for disseminating information and keeping up with ongoing activities.

- *The PANTERA Desk approach was created to cater to project requirements for countries with lower involvement in collaborative research and investment in Smart Grids, known as target countries. Desks refer to the organizational structure within the consortium rather than a geographical division. To plan post-project activities, Desks should be viewed from the broader perspective of widening countries. The analysis of project activities shows that stakeholders from these countries lack access to established networks. Hence, this will be a central point to dwell on and enrich.*
- *Targeted collaboration work strengthens the position of widening countries and provides a foundation for attracting more investment and support both nationally and at the European level. Through the collaboration opportunities offered through EIRIE that will be constantly enhanced, widening countries can pool their resources, expertise, and experiences to address common challenges and take advantage of opportunities. Additionally, it fosters a sense of unity, strengthens the collective voice of widening countries, and promotes a more inclusive and balanced approach in shaping research and innovation policies to better cater to their specific needs and circumstances.*
- *The approach and activities of PANTERA Regional Desks can be integrated with those of the ETIP SNET regional workshop to identify, take initiatives, and develop collaborations necessary to accelerate R&I activities in not only low-active but all EU countries.*
- *The EIRIE platform and Confluence Desk pages are designed to host such targeted collaborative activities. The Desks structure is incorporated there and can be modified further to meet the needs of widening countries. With the acknowledgment of DG ENER and JRC, EIRIE, the relevant Confluence pages become a powerful tool to participate in setting a common research and innovation agenda and access knowledge endeavors.*
- *To ensure the project's long-term success, securing adequate funding for development is crucial. With solid financial resources, the project can continue to operate smoothly, expand its network of stakeholders, and offer new services. Collaborating with other platforms can also help in promoting the integration of R&I value chain and advancing efforts towards energy transition. The funding will cover hosting and maintenance costs, while also enabling the platform to enrich its content by integrating with new platforms and information sources. Additionally, engaging stakeholders through workshops, webinars, and special sessions targeted towards low-spending EU Member States will ensure the growth and maintenance of the platform's user base.*
- *Engaging further with the JRC scope of serving the R&I community builds a strong diverse source of applications that seamlessly communicate and serving each other. This scope is promising and much more desirable and feasible. The first signs of this scope is seen through the support offered to the current version of the EIRIE platform.*
- *The consortium actively engaged in communication with the European Commission and platform owners to promote the concept of the EIRIE platform and gain their support for hosting and operating it under JRC and the europa.eu domain. After extensive discussions and meetings, an agreement was eventually reached to secure the financial sustainability of the platform through a tailored service contract under the governance of DG ENER. This opted approach gives life to a platform that is serving in all respects the R&I community and it is the home of projects. This service will grow and the benefits multiplied. Through targeted service contracts, EIRIE can operate flawless, extending services to all connected users.*

1 Introduction

This report (Deliverable 3.5) is the final deliverable “Roadmap to 2030” and describes the work carried out within task 3.5 of the PANTERA (PAN European Technology Energy Research Approach) as a part of the ongoing effort in Work Package 3 (WP3) of the project. WP3 has been aimed at determining the state of research and innovation, standardisation and regulation with special attention to the key activities on identifying the R&I status and gap in accelerating smart grid research in low active countries. The work presented in this deliverable covers the recommendations of the project consortium for post project activities in meeting the policies leading to 2030

In the framework of this action, based on the developing approaches and proposed solutions to accelerating the R&I activities, PANTERA (during the project life time) and later (by and beyond 2030) is recommending the required actions to keep the exploitation of smart grid technologies for decarbonizing electricity in the energy roadmap 2050.

The other deliverables under this WP3:

D3.1 Report on current status and progress in R&I activities: Technology [1]

D3.2 D3.2 Report on Regulations, Codes and Standards in EU-28 [2]

D3.3 Report on community energy policy and barriers [3]

D3.4 Initial report on key challenges and bottlenecks [4]

1.1 Structure of the document and links to other project tasks

This deliverable suggests post-project sustainability actions for various activities while providing links to other tasks within PANTERA. It is crucial to have a well-structured and unified approach to assess the progress of these activities. PANTERA, which stands for PAN European Technology Energy Research Approach, has developed a universal methodology to analyze national and EU projects' R&I activities and status. To do this, the PANTERA team has developed administrative and technical processes/methodologies and tools to incorporate the categorization of "Smart Grid technologies/systems", their current R&I status, priorities and maturities to achieve the decarbonization of integrated energy system targets outlined by ETIP SNET Vision 2050.

PANTERA consortium believes that with the active actions and sustainability of these activities will accelerate the exploitation of smart grid technologies for decarbonising electricity in the energy roadmap 2050. The key processes and solutions are;

1. RICAP Process
2. Working Teams
3. Regional Desks
4. EIRIE Platform

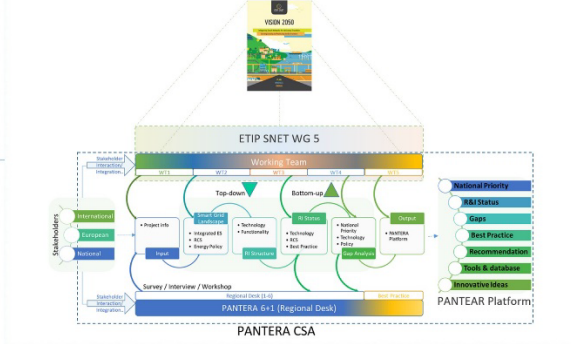
The following sections discuss the key points in relation to these PANTERA proposed process and framework solutions, as shown in Figure 1.

PAN ERA RICAP

R&I status and Continuous gAP analysis process

(How PAN ERA is contributing to shape the EU and National Smart Grid Research & Innovation (R&I) activities towards the decarbonisation of Integrated Energy System)

• **PAN ERA RICAP (Administrative)** – Linking all the relevant stakeholders



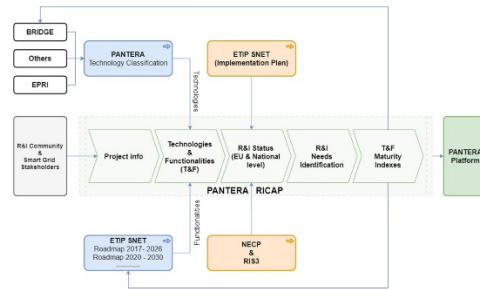
• **PAN ERA Working Teams -**

Working Domain			
System	Technology	Market	Society
WT1: Research Infrastructure			
WT2: Regulation & Standardisation			
WT3: Gap Analysis			
WT4: Innovation Support to the Market Uptake			
WT5: Global & European Research & Innovation Community			

• **PAN ERA Regional Desks -**



• **PAN ERA RICAP (Technical)** - A universal methodology: Linking the past to the present and to the future



• **ETIP SNET Technologies**

Group of Technologies	Technology/System	N	
Integrated grid	Flexible AC transmission systems (FACTS)	1	
	Models, Tools, Services for the operation analysis, control and the development of the integrated grid including cost elements	2	
	WPPC	3	
	Forecasting (DESI)	4	
	Asset management	5	
	Outage management, Cash finding and associated equipment (including protection)	6	
	Equipment and operation of the integrated grid	7	
	Equipment, sensing, monitoring, monitoring for topology and stability and control	8	
	Advanced distributed control	9	
	Flexible and autonomous self-healing smart metering infrastructure	10	
Customer and market	SmartGrid Facility: Smart communities, management & control and demand response including and device, communication infrastructure and system	11	
	Smart applications	12	
	Building control, automation and energy management system	13	
	Electric vehicles	14	
	Energy communities	15	
	Lighting	16	
	Electricity market	17	
	Electric storage	18	
	Thermal Storage	19	
	Power to X	20	
Storage	Power to X	21	
	Thermal storage	22	
	Other storage	23	
	Flexible generation	24	
	Solar including PV & Concentrated Solar Power	25	
	Generation	Hydrogen	26
		Hydrogen	27
		Hydrogen & sustainable gas	28
		Other generation	29
		Communication networks including devices and systems for signals and data connectivity and switching	30
Digital Tools		31	
Artificial intelligence		32	
Data and other security including capabilities		33	

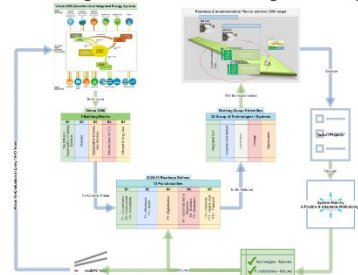
• **ETIP SNET High-Level Use Cases (HLUC)**

HLUC	High-Level Use Cases (HLUC)
HLUC1	Optimal cross sector integration
HLUC2	Market-driven TSO-DSO-Prosumer interactions
HLUC3	Pan-European Wholesale Markets, Regional and Local Markets
HLUC4	RES Massive Penetration into the transmission and distribution grid
HLUC5	One stop shop and Digital Technologies for market participation of consumers (citizens) at the centre
HLUC6	Secure operation of widespread use of power electronics at all systems levels
HLUC7	Enhance System Supervision and Control
HLUC8	Transportation Integration & Storage
HLUC9	Flexibility and Building/Infrastructure Integration

• **Linking Tech - HLUC**

HLUC	Technologies in support of the high-level use cases
HLUC1	2, 4, 9, 12, 15, 16, 19, 20, 21, 23, 29
HLUC2	12, 13, 15, 16, 18
HLUC3	12, 16, 18
HLUC4	2, 4, 23, 15, 16, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28
HLUC5	12, 13, 14, 15, 16, 18, 30, 33
HLUC6	1, 2, 3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 30, 33
HLUC7	1, 5, 6, 7, 8, 9, 10, 11, 12, 16, 31, 32
HLUC8	2, 3, 11, 12, 15, 16, 19, 28, 30, 33
HLUC9	2, 9, 11, 12, 13, 14, 15, 16, 17, 18, 28, 30, 33

• **Vision 2050 – Achieving decarbonisation of Integrated Energy System**



• **Conceptual Structure for Flexible and Self-Adaptable Classification of ETIP SNET Technologies and Functionalities**

Figure 1 PAN ERA proposed activities and framework solutions

2 Post-Project Activities and Sustainability of RICAP process

2.1 Overview of RICAP process

The PANTERA team has developed a method called RICAP (R&I status and Continuous gAP analysis) to evaluate the current state of smart grid technologies and systems. It analyzed national climate and energy plans and strategies for 2020-2030 to identify research and innovation priorities and their connection to smart grid technologies/systems within integrated energy systems. This analysis was extended to the EU level to provide a comprehensive overview.

To evaluate the latest developments in smart grid R&I projects, different organizations like ETIP SNET, EPRI, BRIDGE, and JRC have used various approaches. PANTERA's RICAP method combines and synthesizes these approaches, creating a technology and systems mapping under five dimensions: Integrated Grid, Customers and Markets, Storage, Generation, and Digitalization, Communication, and Data. If you want to learn more about the RICAP process, please refer to [1].

The overall RICAP process is divided into two parts: (i) Administrative and (ii) Technical. One of the key pillars to successfully derive the PANTERA RICAP (Administrative) outcomes and make it more effective for the benefits of low activity/targeted countries is to collect the ongoing and completed projects information and to feed it as input of the RICAP process (Technical). Details of the process are explained in PANTERA deliverables D3.1 [1]. Following sub-sections briefly explain the key points of this process.

2.1.1 Administrative

The RICAP administrative process thoroughly explains the main administrative methodologies and activities to involve and unite stakeholders with PANTERA activities, as depicted in Figure 2. PANTERA incorporates stakeholders into two conceptual frameworks: Working Team (WT) and Regional Desk (RD). WTs work closely with ETIP SNET Working Group 5, and some of their activities are briefly outlined in section 3. The key activities of RDs are also briefly explained in section 4. Further details on the RD activities can be found in PANTERA deliverable D6.3 [5]. The RICAP administrative process provides extensive and highly effective support for the PANTERA team to gather all the necessary information to identify the R&I status and advance smart grid R&I activities at the national and EU levels.

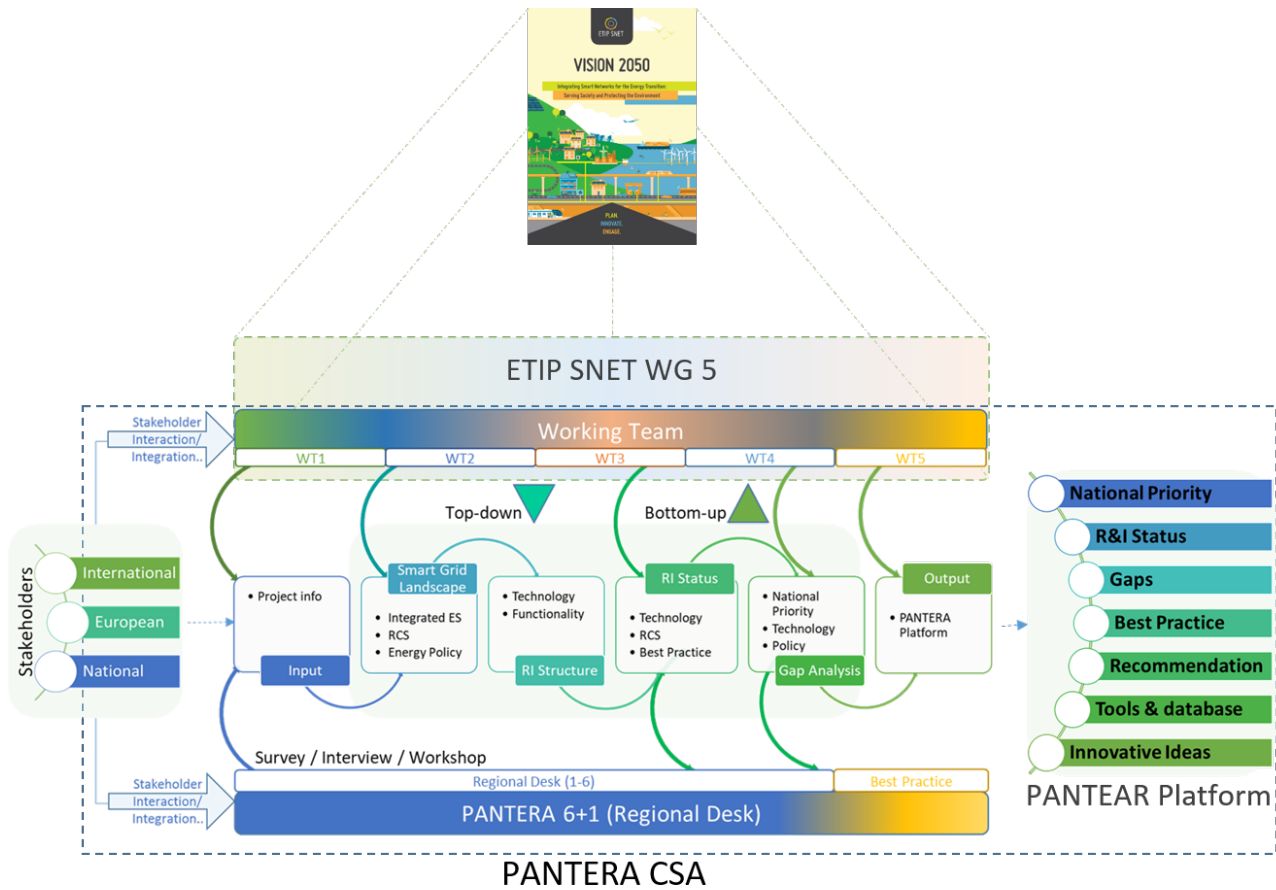


Figure 2 PANTERA RICAP (Administrative) Process

2.1.2 Technical

The Technical RICAP process begins by gathering input from various projects. To collect project information, we reach out to different stakeholders at the international, European, and national levels. Basic information can be found on project websites, publicly available deliverables, and scientific papers. Additionally, project-related data is accessible through established platforms like Smart Grids projects map of JRC, NER300 projects, CORDIS, ETIP SNET, Expera Smart Grids+, etc. Our team members and country-specific RD members are also available to provide support during this phase. To conduct an initial analysis of country-specific R&I status and identify technological gaps, we process relevant project information through the “Technologies-FUNCTIONALITY” cell. This process has been further improved with a dynamic identification process, which will be explained in the following sub-section. It is to be understood that the process is dynamic and it captures advancements in policies such as the adaption of High Level Use Cases (HLC) by ETIP SNET in their Ten-Year-Plan replacing the Functionalities. The RICAP process is still valid since what changes is only the matching exercise of technologies to HLUC instead of Functionalities. Not the process.

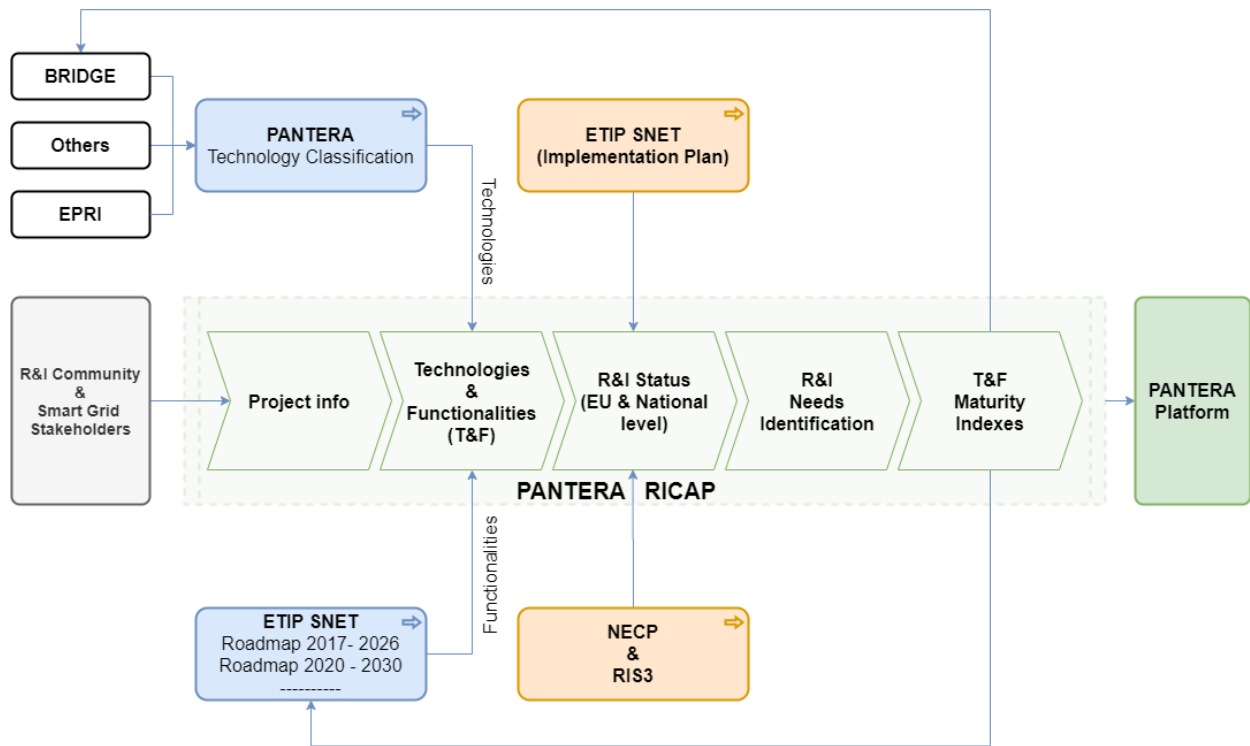


Figure 3 PANTERA RICAP (Technical) Process

2.2 Identification of smart grid technologies/systems R&I status, gaps and maturity index

Figure 5 shows the dynamic process for determining the R&I status and priority under the RICAP process is detailed. The input for this process is the "smart grid project info," which extracts specific project information from publications and deliverables. This information is then sent to the "smart grid technologies/systems" block, where the R&I status is analyzed at a national level. The Smart grid technologies/systems information is then transferred to the NECP block, where the R&I priorities are extracted from the national plan document. The final block of this dynamic process is the "Identification of R&I needs," where the final status, priority, technological maturity, and gaps are analyzed. The EIRIE platform is then fed with the final outcomes. The important part of this process is briefly discussed below.

2.2.1 R&I Status

As part of the PANTERA RICAP, Smart Grid projects are identified through the JRC database, ETIP SNET platform, BRIDGE, and national funding agencies. The focus is on EU MSs with low activity in smart grid R&I activities. The outcomes of these projects are analyzed to determine the present R&I status, highlighting the smart grid technologies/systems that have already received significant attention. For EU/International collaborative projects, it's difficult to identify and judge individual contributions from each participating country. Therefore, the overall contribution for all participating countries is considered equal. However, for accurate findings, direct involvement and input from national stakeholders are crucial.

2.2.2 R&I Priority

PANTERA team has taken the initiative to understand the R&I activities as outlined in the NECPs and to link the R&I priorities to the smart grid technologies/systems. Further details are available in

[1] which summarise the smart grid R&I priorities in other EU countries as set out in their NECP plans. The details of the R&I status and R&I priorities for each low active countries are analysed and explained in the PANTERA deliverables D3.1 [1], D4.2 [5], D4.3 [6].

2.2.3 Maturity Index

The PANTERA project has developed a comprehensive methodology for determining the maturity level of smart grid functionalities / HLUC, as outlined in the ETIP SNET roadmap. This methodology involves evaluating the progress of technologies, assessing the maturity level of the functionalities / HLUC that will support the future integrated grid, and determining the overall readiness of the smart grid system. To facilitate analysis of complex subsystems, a nesting process has been adapted to provide a detailed assessment.

To facilitate the analysis, the three metric process has been employed for assessing the Technologies Advancement, High-level use cases maturity and Integrated Systems Readiness. Starting for TRL which is a universal approach for characterizing the projects' main advancements and thus can be easily collected through the EIRIE platform. As such, three different SRLs have been developed. Three nests have been formed as shown in Figure.4 Each nest interacts with each other through the IRL matrixes that capture the interaction and together evaluate the system readiness level.

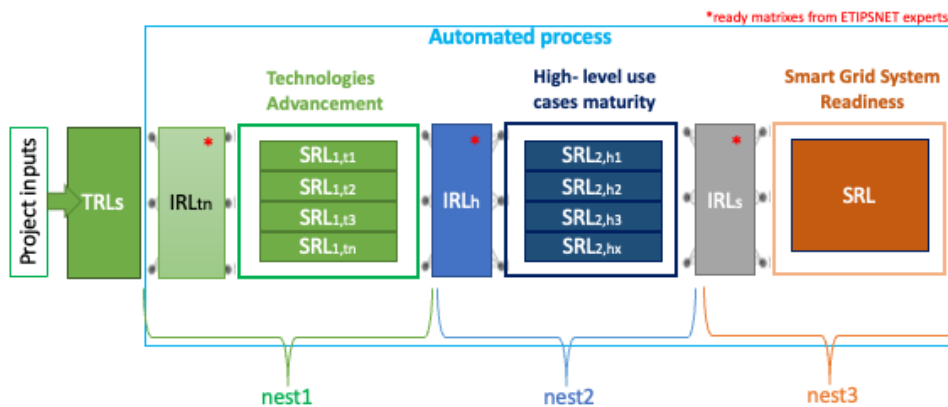


Figure 4: The methodology for smart grid system readiness in a nutshell

The methodology has been implemented in the EU multi-functional platform EIRIE, offering a quantitative evaluation methodology for smart grid projects at both EU and national levels. The "Identification of R&I needs" block focuses on improving technologies in terms of maturity achievement, resulting in the calculation of a "maturity index".

As can be anticipated, this process is universal, it captures progress achieved throughout the EU and enhances the TRL index tackling all the weaknesses that this index carries. Specifically, a solid process is provided on how the SRL can be quantified as well as providing feedback on the implementation plan and Roadmap of ETIP SNET to define the priorities, tasks and topics for the EU calls. It is also made possible to perform sensitivity analysis on the TRLs and IRLs within the system of interest to analyse the SRL projection of the system.

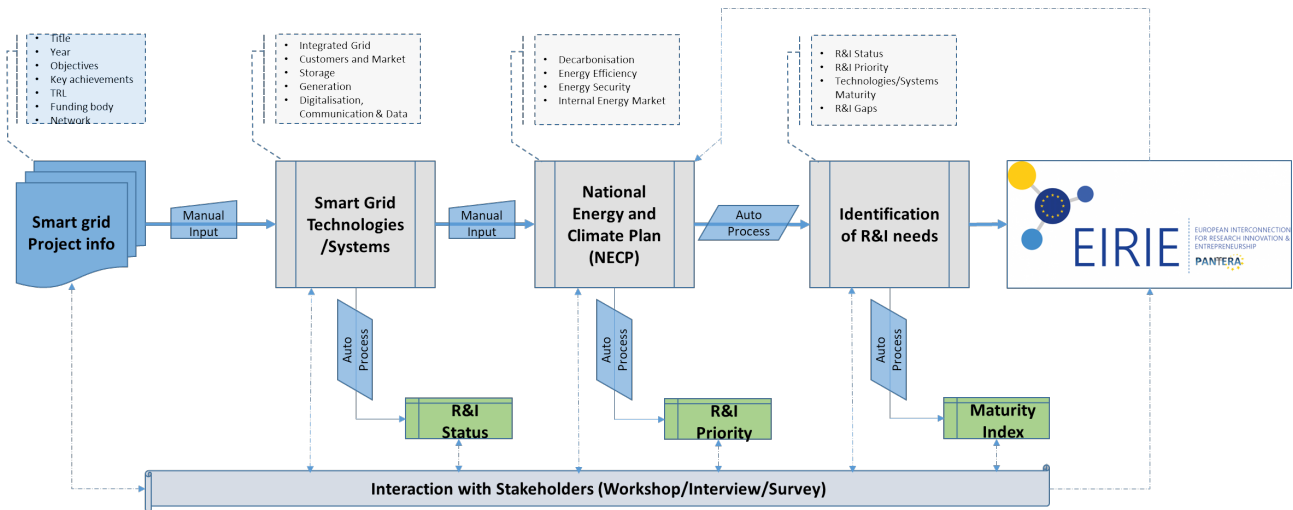


Figure 5 Dynamic process to identify the R&I status, priority and maturity of smart grid technologies

2.3 Recommendations for post-project activities

- *Develop the complete framework and working tool for the whole RICAP process and include it in the EIRIE platform. R&I status, priority and maturity index analysis require active involvement of the stakeholders/experts from each member state. More national projects information are required to get the more accurate R&I outcomes for each country.*
- *The existence of PANTERA and ETIP SNET working teams are very important for further improvement of the RICAP process.*
- *The existence of PANTERA regional desk activities are also important to continue the stakeholder engagement at national level, thus more information on the projects at national level can be identified.*

3 Working Teams Activities

3.1 Overview of PANTERA Working Teams activities

Closely collaborating and contributing to ETIP SNET the PANTERA consortium established 5 Working Teams (WTs) jointly formed by PANTERA partners and other ETIP SNET WG5 experts, as shown in Figure 6,:

WT1 Research Infrastructure

WT2 Regulation and Standardization

WT3 Gap analysis, R&I needs mapping and evaluation

WT4 Innovation support to the market uptake

WT5 Global and European Research and Innovation Community

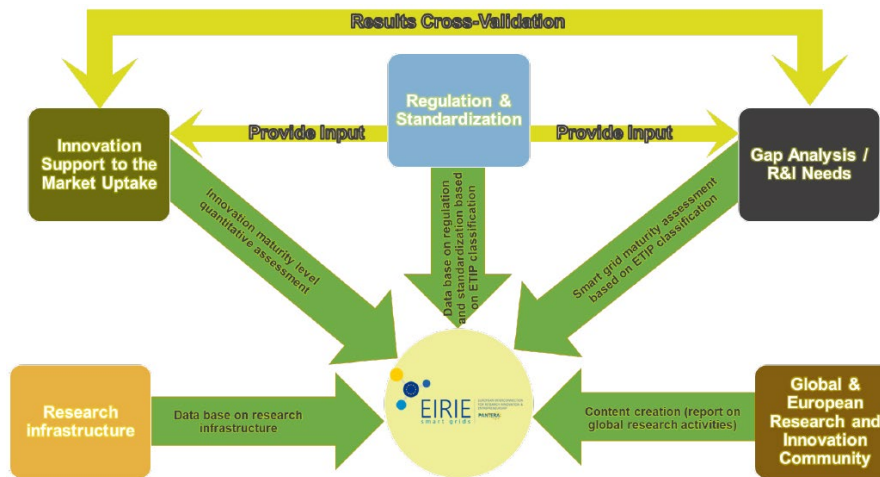


Figure 6 PANTERA / ETIP SNET WG5 Working teams

All of the working teams provided valuable input for creating, maturing and feeding the EIRIE platform in order to respond the topics tackled adequately to the needs of the R&I community. Some of the major WT activities will be shortly mentioned below.

3.1.1 WT1 Research Infrastructure

According to the analysis conducted, the limited availability of Research Infrastructure and lack of knowledge on its proper use are major hindrances for R&I in less active countries. It was discovered that low activity countries need not compete with more advanced nations that have already established strong national funding for cutting-edge RI. Replicating rarely used RIs in multiple countries and institutes is not cost-effective. Instead, it is more efficient to construct critical infrastructure and perform experimental research using the ERIGRID 2.0 project's transnational access, which facilitates collaborative access to Europe's leading laboratories. As a result, WT1 focuses on enabling the collaborative interlinking of RI in individual countries and entities using the EIRIE platform to meet Europe's flexible, interoperable, and efficient RI needs. Working together with DERlab, ERIGrid, and JRC, PANTERA WT1 developed a shared RI repository in the EIRIE platform that effectively supports the R&I community's collaborative and efficient RI needs.

The partners have successfully coordinated a standard taxonomy to interlink various RI databases. The DERlab Database of DER and Smart Grid Research Infrastructure, as well as the resources of other partners, have been linked with EIRIE. This common repository provides support and services to the R&I community across all EU countries. The EIRIE RI architecture enables stakeholders to generate and edit RI data and information easily and flexibly, and keep it efficiently updated.

3.1.2 WT2 Regulation and Standardization

Throughout the PANTERA project, it was discovered that connecting Standards and Grid codes Working with current ETIP SNET technologies is necessary and offers numerous benefits to research and innovation stakeholders. However, this has not yet been accomplished. To address this issue, experts from WT2 conducted extensive work to link standards and codes with technologies on the EIRIE platform. This resulted in valuable filtering and search options, which have already been successfully completed and are now available to serve the R&I community through the EIRIE platform.

3.1.3 WT3 Gap analysis, R&I needs mapping and evaluation

WT3's experts are committed to identifying the research and innovation needs related to smart grids at a European Union level. Their aim is to find solutions that can provide quantitative evaluations

and information on the maturity of technology and systems, while identifying existing gaps. To achieve this, a methodology has been generated that allows for quantitative identification based on minimal input from EU projects, which can be enriched by qualitative feedback from experts.

This work process has been undertaken in close collaboration with BRIDGE and EPRI to identify and agree on a unified taxonomy and classification of technologies and systems. As a result, a new tool design has been developed.

Currently, an extensive effort is being made to implement the tool on the EIRIE platform, which will be followed by a thorough validation process using data from selected projects. The tool is expected to be fully operational by the end of PANTERA to support ETIP SNET experts in preparing and implementing their 10-year plans.

3.1.4 **WT4 Innovation support to the market uptake**

WT4's aim is to facilitate collaboration between innovation providers and investors/incubators to bring innovative products to the market. Working closely with the commission's services, WT4 supports innovation project consortia in promoting their R&I products in the real economy. An innovative radar process is employed to help project consortia identify their key innovations, business strengths and weaknesses. This process is expected to be incorporated into the EIRIE platform and supplemented with real-life examples. By providing valuable support, WT4 helps project consortia to develop strategies that lead to successful exploitation and business innovation.

3.1.5 **WT5 Global & European Research and innovation community**

WG 5 aims to support the linking of the R&I activity done in Europe with the ones done in the rest of the world. In this view it is very important to keep track of the different ongoing initiative at global level within the energy system R&I field.

To achieve this objective PANTERA has established good collaboration links with different European and global initiatives, in particular:

- The **International Smart Grids Action Network (ISGAN)**, a technology Collaboration Program of the International Energy Agency (IEA) and a workstream of the Clean Energy Ministerial devoted to accelerate the development and deployment around the world of smarter, cleaner electricity grids
- **Mission Innovation** and in particular with the Green Powered Future Mission (GPFM). Within this initiative several countries from all around the world, companies from the private sector and international organisation are collaborating towards the goal of power system fed by 100% renewable energies.
- The **European Energy Research Alliance (EERA)** and in particular its Joint Program (JP) on Smart Grids (SG) devoted to share information about R&I activities and avoid duplication of efforts at European level.

Within the WT5 of the PANTERA project a series of post through the Twitter account of the project related to international activities have been issued. By this activity the PANTERA project would like to reach a broad public to transfer information collected at international level and raise awareness in the citizens about the ongoing efforts and collaborations towards the decarbonisation targets. Figure 7 reports a sample of the tweets published.



Figure 7 An example of the Tweets published within the WT5 activities.

3.2 Linking WT5 activities with ETIP SNET Working Group 5

The ETIP SNET role is to guide R&I brought together stakeholders and experts from the energy sector to support the EU energy transition using six Working Groups focusing on key R&I areas and topics:

- WG1 Reliable, economic and efficient energy system
- WG2 Storage technologies and system flexibilities
- WG3 Flexible generation
- WG4 Digitalisation of the electricity system and customer participation
- WG5 Innovation implementation in the business environment
- National Stakeholders Coordination Group

The EIRIE platform was established by the PANTERA process as a collaborative environment specifically designed to facilitate knowledge generation and output from all ETIP SNET working groups and address collectively horizontal issues. Joint working teams (WT1-WT5) were formed by PANTERA and WG5 of ETIP SNET to build collaborative links through regional workshops and perform specific tasks requested by the ETIP SNET Governing Board. They also promoted horizontal issues, such as the policy paper on Regulatory Sandboxes, supported some activities of the commission regarding LVDC expert groups, and carried out other activities related to the WG5 working teams.

WT1 supports the identification of research infrastructures within the EU research institutes that can be used to develop and demonstrate novel R&I solutions as outlined by the R&I needs in ETIP SNET road map.

WT2 assists in identifying updated regulations and standard documentations and information, and updates their links through the EIRIE platform.

WT3 continually supports ETIP SNET in identifying R&I status and gaps and technological maturity by analyzing projects.

WT4 actively contributes to the development of the innovation assessment methodology, while providing guidance on the reusability and transposition of the methodology to the EIRIE platform, so that it can effectively be integrated into the Innovation Marketplace area of EIRIE.

WT5 participated in the ETIP SNET working group 5 activities, with PANTERA members reporting updated news about different ongoing international initiatives that the project is closely monitoring. The ETIP SNET WG5 members showed interest in the reporting and, in some cases, asked for deeper information, which was provided.



Figure 8 An example of the Tweets published within the WT5 activities.

3.3 Recommendations for post-project activities

- Once the PANTERA project is finished, the teams involved will move on to work within the ETIP SNET WG5 framework, which is constantly adapting to meet the evolving needs of research and innovation. To facilitate these activities, the EIRIE platform will serve as a central hub for collaboration and information sharing. By collecting data and insights from real-life project results, research topics, and best practices from the R&I community and stakeholders, EIRIE supports the ETIP SNET teams in their role of guiding and facilitating the energy transition-related R&I.
- During the post-project period, it will be crucial to streamline the processes, methodologies, and tools developed for assessing the R&I status, priority, technology maturity, innovation, and market potential of project results. These should be transposed into the EIRIE platform and linked to specific artifacts published in the EIRIE Innovation Marketplace. This will enable matchmaking between investors/procurers and innovators, supporting continued progress in the field.
- Keeping up with international developments is essential to avoid missing key opportunities in the dynamic R&I field. The EIRIE platform should serve as a relevant interface for disseminating information and keeping up with ongoing activities.

4 Regional Desks Activities

4.1 Overview of PANTERA Regional Desks activities

The PANTERA project has developed a unique approach to support countries with low involvement in collaborative R&I activities and investment in the Smart Grid domain. This approach involves six dedicated PANTERA Regional Desks, which are not limited to specific geographical regions but rather represent an organizational structure within the consortium. The goal is to closely engage with local stakeholders and identify ways to support wider involvement in the field. The countries selected

for the Regional Desks were based on a report by JRC 2017 [5]. In addition, there is one best-practice Desk that focuses on gathering and systematizing successful experiences in projects and R&I governance from countries that have excelled in these areas.

PANTERA 6+1



Figure 9 PANTERA 6+1 approach

Desk activities include various dimensions (see Figure 9): stakeholder consultations (Desk survey), stakeholder interactions during regional and nano-workshops, bilateral meetings, promotion of PANTERA through local publications and exploring different R&I related practices through the dedicated case studies. For more details and results of these actions see WP6 deliverables:

- Stakeholder consultation plans (one for each region/country) (D6.2) [6];
- Review of EU strategic priorities and relevant policy developments (D6.1) [7];
- First version of Consolidated Summary Report of Desk Activities in the Target Regions (D6.3) [8];
- Second version of Consolidated Summary Report of Desk Activities in the Target Regions (D6.5) [9];
- Catalogue of potential solutions to overcome acceptance barriers for each country (D6.4, *in process*).



Figure 10 PANTERA Desks activities and supporting measures

Based on the analysis conducted, it was found that many target countries have lower levels of involvement in the EU policy-making process. These countries are less likely to participate in public consultations and have fewer opportunities to participate in EU initiatives such as the SET-plan. Additionally, they face challenges related to underfunding and brain drain, which negatively impact their research systems and ability to retain talented researchers.

Surveys have revealed that participation in EU framework programs can be challenging due to perceived high levels of competition and the belief that more advanced countries have a competitive advantage. Proposal preparation and consortium building were identified as particularly demanding steps in the process.

To address these issues, the PANTERA project has taken steps to foster a more effective dialogue between national and international stakeholders. Workshops have been conducted to encourage collaboration, share lessons learned, and explore potential synergies. Additionally, the Best Practice Desk has explored examples of well-functioning mechanisms from more advanced countries, including funding schemes, financial incentives, regional cooperation, and regulatory sandboxes. More details in [8] and [9].

The EIRIE regional corner serves as a specialized platform that publishes country-specific analyses, offering valuable insights and information pertinent to each target country. Moreover, the Confluence Desk pages were designed to enhance efficient communication and collaboration among stakeholders at both national and regional levels. These pages act as a central hub, where stakeholders can access critical resources, share information, exchange ideas, and participate in discussions.

4.2 ETIP SNET Regional Activities

ETIP SNET organises Regional Workshops as part of its mission of guiding Research, Development and Innovation activities to support Europe’s energy transition. It plans four workshops per year over the course of the next 4 years, covering the whole European Union.

The Regional Workshops aim at [10]:

- Presenting national and regional RD&I projects of significant added value addressing energy system integration issues, in line with the thematic priorities of the ETIP SNET Working Groups;
- Identifying unsolved RD&I topics and monitoring the implementation of RD&I activities at national and regional levels in Europe;
- Ensuring consistency between national and European views;
- Stimulating knowledge-sharing between stakeholders and among Member States and associated countries, to foster the efficient implementation of RD&I projects all over Europe.



Figure 11 ETIP SNET Regional Workshop areas

4.3 Recommendations for post-project activities

- *The PANTERA Desk approach was created to cater project requirements for countries with lower involvement in collaborative research and investment in Smart Grids, known as target countries. Desks refer to the organizational structure within the consortium rather than a geographical division. To plan post-project activities, Desks should be viewed from the broader perspective of widening countries. The analysis of project activities shows that stakeholders from these countries lack access to established networks.*
- *Targeted collaboration work strengthens the position of widening countries and provides a foundation for attracting more investment and support both nationally and at the European level. Through collaboration, widening countries can pool their resources, expertise, and experiences to address common challenges and take advantage of opportunities. Additionally, it fosters a sense of unity, strengthens the collective voice of widening countries, and promotes a more inclusive and balanced approach in shaping research and innovation*

policies to better cater to their specific needs and circumstances.

- The approach and activities of PANTERA Regional Desks can be integrated with those of the ETIP SNET regional workshops to identify, take initiatives, and develop collaborations necessary to accelerate R&I activities in not only low-active but all EU countries.
- The EIRIE platform and Confluence Desk pages are designed to host such targeted collaborative activities. The Desks structure is incorporated there, and can be modified further to meet the needs of widening countries. With the acknowledgment of DG ENER and JRC, EIRIE, and relevant Confluence pages become a powerful tool to participate in setting a common research and innovation agenda and access knowledge endeavors.

5 EIRIE Platform

5.1 Overview of EIRIE Platform and activities

The EIRIE platform aims to enhance collaboration and connectivity within the EU R&I community, with the goal of fostering interest and utilization of project results, avoiding redundancy and funding wastage, and strengthening the participation of all Member States in support of the Energy Union's fifth pillar and the energy transition. The platform, detailed in D7.1 (Exploitation strategy and plan), offers a diverse range of services in four key areas: project evaluation and reporting, stakeholder community building, sustainability and collaboration, and data search. Additional services such as matchmaking, training, and news and events updates are also available. The platform's functionality enables knowledge co-creation, access to research facilities, collaborative discussions, data search, and various support services to promote collaboration, awareness, and education within the R&I community. Figure 12 shows the overall EIRIE Platform structure.

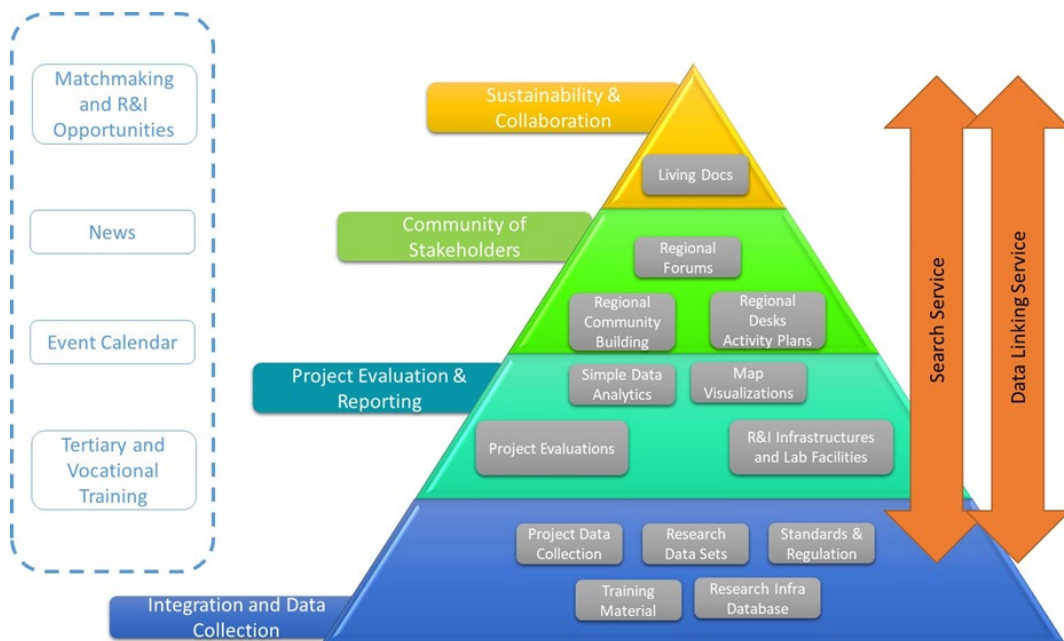


Figure 12 EIRIE Platform Structure

5.2 One-Stop Resource Living Platform

Introducing a new platform called EIRIE, which serves as a centralized hub for Smart Energy Systems information, data, and knowledge. EIRIE seamlessly integrates data from various platforms

using standardized semantics and taxonomies specific to the domain. The platform offers versatile search engines, access to a wide range of information, and unique analytics tools to evaluate research and innovation (R&I) performance across EU member states. EIRIE facilitates collaboration through thematic spaces, enabling the formulation of R&I priorities and strategies at different levels. As a central networking node, EIRIE connects R&I organizations throughout the EU, fostering future fruitful collaborations. With the backing of DG ENER and JRC, EIRIE consolidates information from established databases, associations, and organizations, ensuring high availability, reliability, and visibility at multiple levels. To fully utilize the PANTERA project's primary outcome embodied in the EIRIE platform and other outcomes contributing valuable knowledge to the community, the PANTERA Consortium has identified three key principles: ensuring platform sustainability, engaging stakeholders, and ensuring platform viability.

EIRIE achieves seamless operation, trust, and reliability by using scalable and cost-effective infrastructures and hosting the platform on a trusted web domain, thereby encouraging stakeholder engagement and enhancing confidence in the platform's content and services.

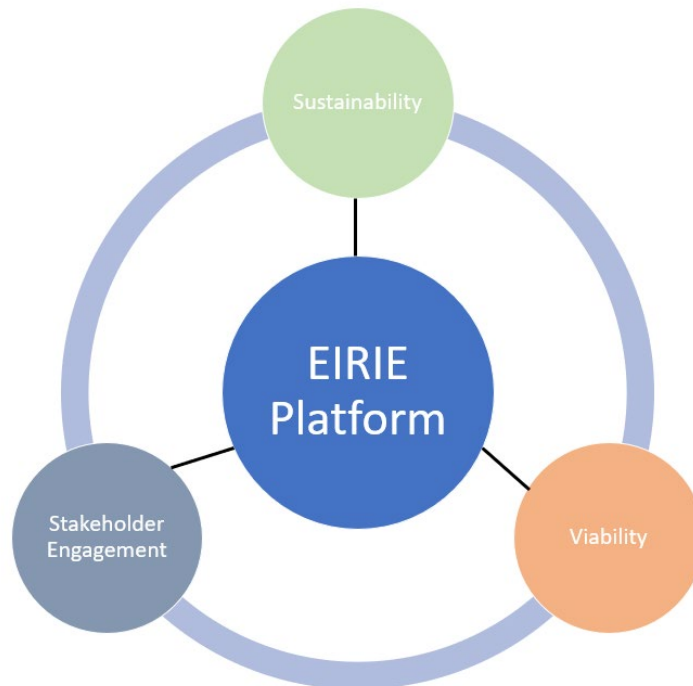


Figure 13 Key principles identified for EIRIE Platform successful exploitation [Reference to D7.1]

The PANTERA consortium went to great lengths to make sure that the EIRIE platform would continue to operate after the project was completed. They meticulously planned and executed activities that involved collaborating with stakeholders, updating content regularly, and adhering to high-quality standards. To ensure the platform's sustainability, the consortium explored alternative options and engaged with potential hosts, operators, and maintainers. The ultimate goal was to ensure that the platform would be effective, reliable, and operate on scalable infrastructures for the long-term. In summary, the options considered included:

- Hosting the EIRIE Platform in DERlab's infrastructures.
- Transferring the responsibility for hosting the EIRIE Platform to the Governance Board of ETIP-SNET.
- Hosting the EIRIE Platform in the SES Infrastructure under the auspices of the Joint

Research Centre of the European Commission and DG ENER.

The PANTERA consortium had a key goal of integrating content with major platforms in the Smart Energy Systems industry. This integration aimed to enable smooth data exchange and ensure that the EIRIE platform is continuously enriched. To achieve this, it was important to engage with experts, R&I practitioners, policy makers, and market stakeholders across the EU, to collaboratively create knowledge and actively participate in R&I activities. These efforts also aimed to showcase the advantages and innovative capabilities of low-spending EU Member States, thereby enhancing their positioning in the EU R&I landscape.

5.3 Linking EIRIE with BRIDGE and ETIP SNET

The EIRIE platform has successfully established a dedicated collaborative space for the Working Groups of ETIP-SNET and BRIDGE, using the Confluence tool as outlined in D7.1. The platform has designed a structured framework that allows experts from both communities to easily engage and collaborate in knowledge generation, working together towards achieving their desired outcomes within their respective activities.

Currently, the collaboration environment is undergoing comprehensive testing and customization to align with the specific thematic areas and sub-structures of each working group. The objective is to ensure a seamless transition to the new mode of operation, beginning with ETIP-SNET Working Group 5. This customized approach is intended to promote collaboration and streamline the exchange of ideas and information within the working groups.

5.4 Recommendations for post-project activities and sustainability of EIRIE

- *To ensure the project's long-term success, securing adequate funding was crucial. With solid financial resources, the project can continue to operate smoothly, expand its network of stakeholders, and offer new services. Collaborating with other platforms can also help in promoting the integration of R&I value chain and advancing efforts towards energy transition. The funding will cover hosting and maintenance costs, while also enabling the platform to enrich its content by integrating with new platforms and information sources. Additionally, engaging stakeholders through workshops, webinars, and special sessions targeted towards low-spending EU Member States will ensure the growth and maintenance of the platform's user base.*
- *Deliverable D7.4 (Sustainability and Business Development Plan) provides a detailed description of the Sustainability and Business Development Plan for the PANTERA project, with a focus on ensuring the long-term viability of project activities and the sustainability of the EIRIE Platform. The plan addresses the challenge of convincing JRC and DG ENER to host and operate the platform on their servers and integrate it into the europa.eu domain, which required meeting specific requirements set by JRC.*
- *The consortium actively engaged in communication with the European Commission and platform owners to promote the concept of the EIRIE platform and gain their support for hosting and operating it under JRC and the europa.eu domain. After extensive discussions and meetings, an agreement was eventually reached to secure the financial sustainability of the platform through a tailored service contract under the governance of DG ENER.*
- *To ensure the long-term maintenance, expansion, and content population of the EIRIE platform, it was decided to transfer these responsibilities to the SPRING project, which supports the operation of platforms like ETIP-SNET and BRIDGE. The post-project costs that will be covered by SPRING, DG ENER, and JRC, as well as the involvement of the PANTERA consortium in certain activities are presented in the following table.*

Cost Category	JRC	DG ENER	SPRING	PANTERA Consortium
Pan-European Workshops Hosting/ Participation		√	√	
Regional Workshops Hosting/ Participation			√	√
Platform Hosting	√			
Content Population			√	√
News/ Newsletter Update			√	
Moderation			√	
Domain Name	√			
SSL Certificate	√			
Tech Support	√		√	
Website Design			√	
Bug fixing and Fine-tuning			√	
SEO			√	
Social Media Handling			√	
Event Participation/ Platform Promotion	√		√	√
Integration with other Platforms			√	
Collaboration with EU Initiatives		√	√	√
Service Enrichment		√	√	

Table 1 Post-project categories involvement

- *The post-project expenses and estimated costs are expected to be funded through EU-wide funding programs that align with the project's objectives. The consortium has conducted a prioritization of relevant topics and calls in order to identify suitable funding opportunities, as discussed previously, in the context of D7.3. Subsequent to this, the consortium plans to submit applications to secure the necessary funds and resources to sustain PANTERA's operations and these activities will be further detailed in Deliverable D7.5.*

6 Conclusions

This report (Deliverable 3.5) is the final deliverable “Roadmap to 2030” and describes the work carried out within task 3.5 of the PANTERA (PAN European Technology Energy Research Approach) covering the recommendations of the project consortium for post project activities in meeting the policies leading to 2030.

In the framework of this action, based on the developing approaches and proposed solutions to accelerating the R&I activities, PANTERA (during the project life time) and later (by and beyond 2030) is recommending the required actions to keep the exploitation of smart grid technologies for decarbonizing electricity in the energy roadmap 2050.

This deliverable suggests post-project sustainability actions for various activities while providing links to other tasks within PANTERA. It is crucial to have a well-structured and unified approach to assess the progress of these activities. PANTERA, has developed a universal methodology to analyze national and EU projects' R&I activities and status. To do this, the PANTERA team has developed administrative and technical processes/methodologies and tools to incorporate the categorization of "Smart Grid technologies/systems", their current R&I status, priorities and maturities to achieve the decarbonization of integrated energy system targets outlined by ETIP SNET Vision 2050. These are presented in this deliverable together with what is considered as plausible actions following the completion of the project PANTERA.

Based on the findings reported in this deliverable the conclusions reached for recommendations for post-project activities are summarised below:

- *Develop the complete framework and working tool for the whole RICAP process and include it in the EIRIE platform.*
- *The 5 teams formed to support EIRIE will continue working within the ETIP SNET WG5 framework, constantly adapting to meet the evolving needs of research and innovation.*
- *The existence of PANTERA regional desk activities are to continue the stakeholder engagement at national level,*
- *To streamline and transpose into EIRIE the processes, methodologies, and tools developed for assessing the R&I status, priority, technology maturity, innovation, and market potential of project results.*
- *Preserve the international developments update through the EIRIE columns / pages.*
- *The Regional Desks should be viewed from the broader perspective of widening countries, enriched serving the collaborative work of local stakeholders.*

- *Through the collaboration opportunities offered through EIRIE that will be constantly enhanced, widening countries can pool their resources, expertise, and experiences to address common challenges and take advantage of opportunities.*
- *The approach and activities of PANTERA Regional Desks can be integrated with those of the ETIP SNET regional workshop.*
- *The EIRIE platform and Confluence Desk pages will continue hosting the targeted collaborative activities of regions and stakeholders.*
- *Engaging further with the JRC scope of serving the R&I community builds a strong diverse source of applications that seamlessly communicate and serving each other. This scope is promising and much more desirable and feasible. The first signs of this scope is seen through the support offered to the current version of the EIRIE platform.*
- *Through targeted service contracts, EIRIE can operate flawlessly, extending services to all connected users.*

7 References

- [1] S. Khadem, L. Sanchez, C. Papadimitriou, V. Efthymiou, R. Stanev, A. Tsitsanis and P. Carroll, "D3.1 Report on current status and progress in R&I activities: Technology," 30 June 2020. [Online]. Available: <https://pantera-platform.eu/wp-content/uploads/2020/07/D3.1-Report-on-current-status-and-progress-in-RI-activities-Technology.pdf>.
- [2] e. Anna Motule, "D3.2 Report on Regulations, Codes and Standards in EU-28, https://pantera-platform.eu/wp-content/uploads/2021/01/D3.2_Report-on-Regulations-Codes-and-Standards-in-EU-28.pdf," 2021.
- [3] e. a. Shafi Khadem, "D3.3 Report on community energy policy and barriers, https://pantera-platform.eu/wp-content/uploads/2021/02/Deliverable-D3.3_Report-on-community-energy-policy-and-barriers.pdf," 2021.
- [4] A. et.al, "D3.4 Initial report on key challenges and bottlenecks, <https://pantera-platform.eu/wp-content/uploads/2023/01/D3.4-Initial-report-on-key-challenges-and-bottlenecks.pdf>," 2021.
- [5] e. Shafi Khadem, "D4.2, https://pantera-platform.eu/wp-content/uploads/2020/07/D4.2_1st-Report-on-Identification-of-Gaps-and-Missing-Subjects.pdf".
- [6] e. Shafi Khadem, "D4.3, https://pantera-platform.eu/wp-content/uploads/2023/01/D4.3_Identification-of-gaps-and-missing-subjects_V7.pdf".
- [7] G. Flavia, V. Julija, C. Catalin-Felix, M. A. Maria and F. Gianluca, "Smart Grid Projects Outlook 2017," Publications Office of the European Union, 2017.
- [8] A. Mutule, I. Antoskova and R. Lazdins, "Stakeholder consultation plans (one for each contry/region)," PANTERA H2020 project, 2019.
- [9] A. Mutule, I. Antoskova and R. Lazdins, "Review of EU strategic priorities and relevant policy," PANTERA H2020 project, 2019.
- [10] A. Mutule, I. Antoskova, R. Lazdins, V. Efthymiou, C. Papadimitriou, A. Morch, M. Shalaby, P. Carroll, A. Nouri, R. Stanev, C. Mattia and S. Khadem, "Consolidated Summary Report of Desk Activities in the Target Regions," PANTERA H2020 project, 2020.
- [11] A. Mutule, I. Antoskova, V. Efthymiou, A. Morch, K. K. Fjær, P. Carroll, A. Nouri, S. Khadem, R. Stanev, Y. Kumar and M. Cabiati, "Consolidated Summary Report of Desk Activities in the," PANTERA H2020 project, 2022.
- [12] "ETIP SNET Regional Workshop, <https://smart-networks-energy-transition.ec.europa.eu/events/regional-workshops>".
- [13] e. Shafi Khadem, "D3.1 Report on current status and progress in R&I activities, <https://pantera-platform.eu/wp-content/uploads/2020/07/D3.1-Report-on-current-status-and-progress-in-RI-activities-Technology.pdf>, 2020.
- [14] National Energy and Climate Plan, https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en, European Commission, 2020.

- [15] I. A. V. E. C. P. a. A. M. A. Mutule, "Research and Innovation Supporting Energy Transition: Challenges for Wider Participation of Lagging Countries," in *IEEE Madrid PowerTech*, 2021.