PANTERA

Pan European Technology Energy Research Approach

Work Package WP4 "Key Topics and Content Management"

Deliverable D4.2

1st Report on Identification of Gaps and Missing Subjects

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minor comments and last check	Christina Papadimitriou	FOSS	2020-03-13
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Abbreviations

Acronym	Meaning
CSA	Coordination and Support Action
CSCC	Cross Sectoral Coordination Centre
CYBAN	Cyprus Business Angels Network
DER	Distributed Energy Resources
DG RI	Directorate for Research and Innovation
DN	Distribution Network
DR	Demand Response
DSO	Distribution System Operator
EC	European Commission
EI	Enterprise Ireland
ENTSO-E	European Network of Transmission System Operators for Electricity
EPA	Environmental Protection Agency
ES	Energy Storage
ETIP-SNET	European Technology and Innovation Platform Smart Networks for Energy Transition
EV	Electric Vehicle
HEA	Higher Education Authority
HV	High Voltage
ICT	Information and Communication Technology
IDEK	The Research and Innovation Foundation of Cyprus
IoT	Internet of Things
IRC	Irish Research Council
IRP	Integrated Research Program
LEEA	Latvian Electrical Power Engineers and Builders Association
LEN	Local Energy Network
LES	Local Energy Systems
LIKTA	Latvian Information and Communications Technology Association (LIKTA)
LV	Low Voltage
MNEs	Multi-National Enterprises
MoE	Ministry of Economics
MoF	Ministry of Finance
MV	Medium Voltage
NRA	National Regulating Authority
NRIC	The National Research and Innovation Council
PV	Photovoltaics
R&I	Research and Innovation
RCS	Regulations, Codes and Standards
RD	Regional Desk
RE	Renewable Energy
RES	Renewable Energy Sources
RICAP	R&I status and Continuous gAP analysis
SEAI	Sustainable Energy Authority of Ireland

SEDA	The State Education Development Agency
SFI	Science Foundation Ireland
SME	Small and medium-sized enterprises
SRA	Administration of Studies and Research
TN	Transmission Network
TRL	Technology Readiness Level
TSO	Transmission System Operator
WT	Working Team
WP	Work Package

1 Introduction

The work in this report is carried out under activity "Key topics and content management" of the PAN European Technology Energy Research Approach (PANTERA) project.

PANTERA is an EU H2020 project aimed at setting up a European forum composed of Research & Innovation stakeholders active in the fields of smart grids, storage and local energy systems, including policy makers, standardisation bodies and experts in both research and academia, representing the EU energy system.

1.1 Activity "Identification of gaps and missing subjects"

The main intention of this task is to maintain throughout the project the significance and value of the operational topics of PANTERA by regular interaction with the stakeholders, following the legislative and political changes related to the EU energy transition (at national or EU level) and herewith to point out the gaps (in terms of technology, regulations, policy, national funding mechanism) and provide directions on missing subjects or aspects that hindering the energy transition. Interaction with stakeholders through surveys and individual interviews will be used as a further validation of the work.

This deliverable is the **second in the series of three project reports**, seeking to carry out the following analysis:

- Initial definition of the content for dissemination and networking activities (D4.1) [1]
- 1st Report on Identification of Gaps and Missing Subjects (D4.2)
- Final Report on Identification of Gaps and Missing Subjects (D4.3)

This report is the first version of the final report (and will run as a continuation process) on identifying the gaps and missing subjects. The main objective of this report is the verification and adjustment of the content, identification of the gaps and missing points in Smart grid Research and Innovation (R&I) activities at national level.

Additional evaluation of learnings from the R&I status identification and gaps analysis process as discussed in this deliverable as well as further elaboration of the topics of content will be discussed in the following related deliverables:

- Assessment of the defined topics, relevance, driving forces and trends (D4.4)

1.2 Purpose and limitations of the document

The document outlines the first version on identification of gaps and missing subjects for PANTERA CSA countries. Completion of this task and deliverables depend on the outcome of multiple tasks within the PANTERA CSA. For example, identifying R&I status and gaps analysis in technology, assessing regulations, codes and standards (RCS) and energy policy barriers depend on Work Package 3 (WP3), also verify some of the outcomes through the individual interview during the

regional workshops, online survey etc under the WP5.

Ireland has been chosen as the first case study to identify the R&I status and gaps (in technology).

As a part of the PANTERA project activities, there are ongoing discussions with several Pan-European industrial associations, related to the selected approach on identifying R&I activities and gaps. It means that this process and outcome can be modified in order to achieve the most efficient impacts of the project and the modification can be observed in the final deliverable.

In addition, this deliverable also includes results of ongoing surveys and the outcomes of the individual interviews carried out during the 2nd workshop of PANTERA, which was held on the 2nd of December 2019 in Dublin, Ireland. The whole process will continue for 30 months to identify the final gaps and missing contents to accelerate the R&I activities for the targeted/participating/low spending countries in this PANTERA project.

1.3 Structure of the Document

This document starts by briefly presenting some of the findings of smart grid R&I status in Ireland. The detailed analysis and R&I status and Continuous gap analysis (RICAP) process will be discussed within the WP3 "The State of R&I, standardisation and regulation" deliverables. The RICAP process considers the smart grid technological topics, which are based on the work done by the European Technology and Innovation Platform Smart Networks for Energy Transition (ETIP-SNET) and intended to feed in the preparation of ETIP-SNET roadmap in future [2].

To maintain the significance and value of the operational and smart grid technological topics by regular interaction with the stakeholders, PANTERA CSA introduces two conceptual frameworks, such as, working team (WT) and regional desk (RD). Interaction with stakeholders through surveys is used for further validation of the work. Hence, this deliverable further presents the outcomes of the 2nd round of individual interviews and pre-planned interaction with PANTERA stakeholders. This interview outcome also validates some of the findings of R&I status through the RICAP process.

The preceding report "Content and Topics for Dissemination and Networking Activities" [1], based on interaction with the stakeholders suggested working topics, based on national decision making process and corresponding funding mechanisms. The following section presents the next step in this activity, the national mechanisms of three targeted countries within the PANTERA CSA are discussed here. These are Ireland, Cyprus and Latvia. For rest of the countries, the mechanisms will be discussed in the final deliverable. At the end of this deliverable, discussion and conclusions are presented.

The overall structure of this deliverable has been developed in the following order:

- PANTERA stakeholder interaction process
- Identification of technological gaps, through
    - RICAP process
    - Workshop and individual interview
- Identification of missing subjects

- Workshop and individual interview
- Regional Desk

- Validation
  - Workshop and individual interview

2 PANTERA Stakeholder interaction

Figure 2.1 shows the simplified diagram of PANTERA RICAP process and its interaction with the stakeholders, working teams and regional desks activities.

One of the key pillars to successfully derive the PANTERA RICAP outcomes and make it more effective for the benefits of low spending/targeted countries is to collect the ongoing and completed projects information and to feed it as input of the RICAP process. One of the ways to do that is by interacting and integrating stakeholders with the PANTERA activities, as shown in Figure 2.1. PANTERA **integrates the stakeholders in two conceptual frameworks**: Working Team (WT) and Regional Desk (RD). Both are briefly presented here. Details of the RD activities can be found in PANTERA deliverable "D6.3 Consolidated summary report of desk activities in the target regions", which is due in October 2020.

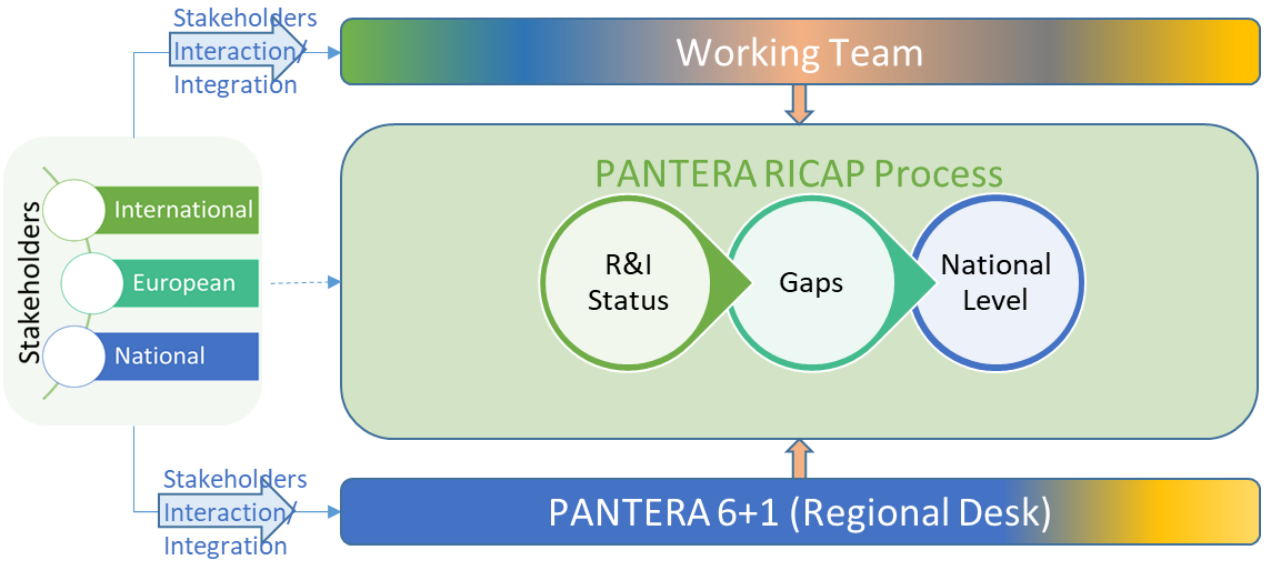

Figure 2.1 PANTERA RICAP process

In brief, the five WTs are the part of Working Group 5 (WG5) of ETIP SNET, as shown in Table 2.1. Details of the WT under the WG5 is in preparation for WG5 deliverable under the ETIP SNET. The responsibility of the WT members is primarily to support the Secretariat of ETIP SNET through the WG5 activities.

PANTERA WT members, being part of these WG5 and WTs, are working in a coordinated way by

i. passing on results/outcomes of the national R&I status and gaps to the PANTERA platform
ii. also analyse the projects outcomes through the ETIP SNET R&I implementation process to feed into the development of future roadmap.

In ETIP SNET, the R&I activities are organized with a two-level (clusters and functional objectives) structure, as it is briefly presented in Annex I, page 38 (see [2] for details). It is to be noted that ETIP

SNET roadmap covers a scope larger than the electricity system, encompassing interactions with the gas and heat networks and focusing on the integration of energy storage technologies into the power system [2].

There is a dedicated WT for gap analysis (WT3). PANTERA WT members of the WT3 provide the national R&I status and gap analysis. Other PANTERA WT members are also responsible to provide input in the relevant section of the RICAP process to get the best outcomes of PANTERA CSA.

Figure 2.2 shows the defined regional desks (RD) under the PANTERA CSA. The members in a RD are the active stakeholders of the respective region and they will be emphasizing their work on the issues of that region and how these can be passed on to the work of the relevant WTs and through them to the EU decision bodies. DR members also provide relevant input to the RICAP process. Such as, they assist to collect the national, regional and other project information to input in the RICAP process. Through the define activities, RD members also provide information to PANTERA WTs to identify the national R&I status and analyse the gaps. There is a dedicated best-practise Desk that also supports PANTERA WTs by sharing successful practical experience and knowledge which may be utilised for benchmarking and accumulating lessons learned.

Table 2.1 Working Team

<table>
<tr><td rowspan="2">Domain</td><td colspan="5">Working Team (WT)</td></tr>
<tr><td>WT1</td><td>WT2</td><td>WT3</td><td>WT4</td><td>WT5</td></tr>
<tr><td>System</td><td rowspan="3">Research Infrastructure</td><td rowspan="2">Regulation & Standardization</td><td></td><td></td><td rowspan="4">Global & European Research & Innovation Community</td></tr>
<tr><td>Technology</td><td rowspan="2">Gap Analysis</td><td rowspan="2">Innovation support to the market uptake</td></tr>
<tr><td>Market</td><td></td></tr>
<tr><td>Society</td><td></td><td></td><td></td><td></td></tr>
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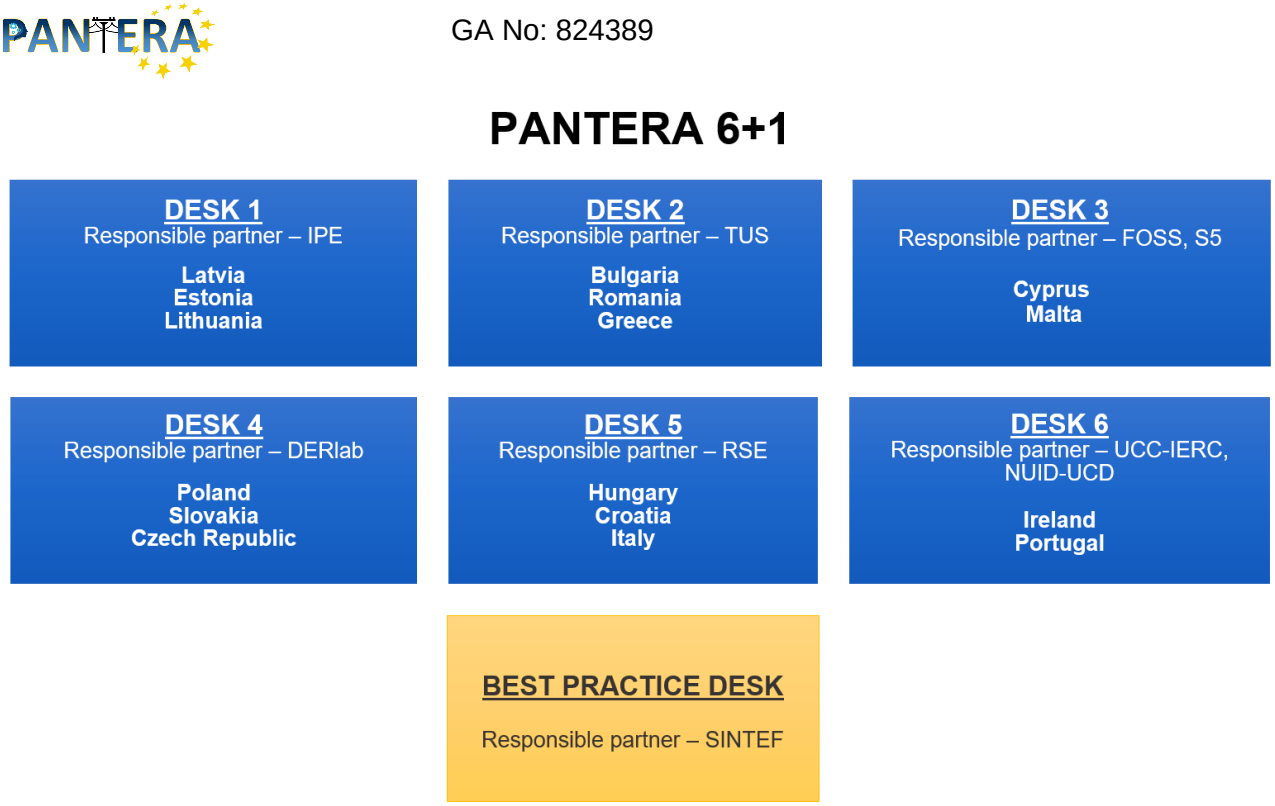

Figure 2.2 PANTERA Regional Desk structure

Besides these WT and RD members, PANTERA CSA organises regional workshops where the national and regional stakeholders, involved in clean energy transition process, are invited. This dedicated interaction along with the individual interview session is arranged to share their views, plan, possibilities, barriers and how to overcome to achieve the national target on decarbonised smart grid network.

3 Identification of gaps

It is already mentioned that the PANTERA team is working with ETIP SNET to effectively identify the R&I status, gaps at national and EU level and develop the R&I road map for 2030 to accelerate the consumer centric energy transition activities and thus to decarbonise the European power sector. This chapter describes two methods of identifying gaps: First, the RICAP process, including a case study on Ireland. Next, the identification of gaps through workshops and individual interviews.

3.1 Identification of technological gaps through (RICAP) process

With the support from WT and RD members, this process analyses the project info under the ETIP SNET roadmap 2017-2026 [2] framework where the clusters and functionalities are defined. The overview of these can also be found in the Annex I, page 38. The same process, as defined in ETIP SNET [3] is followed here and shown in Figure 3.1.

Under the WP3 "The state of R&I, standardisation and regulation" of PANTERA CSA, the PANTERA team is identifying the current status and progress of R&I activities at national level. Details of the R&I areas and status analysis at national level will be available in the deliverable of "D3.1 Report on current status and progress in R&I activities: Technology", which is due by June 2020. Final outcomes of this report will further be analysed in the context of identifying gaps and missing contents. This will be available in the final deliverable of the present task.

In the RICAP process, all the available projects data are analysed based on the ETIP SNET framework (to align with the road-map planning) to find out the initial gaps in R&I areas in the relevant domain.

It is to be noted that PANTERA team considers the smart grid projects with electricity aspects only. Other energy vectors and sector coupling issues are not included here. Hence, the functional objectives and tasks related to the other energy sector integration (sector coupling) are not considered in the analysis part. ETIP SNET roadmap 2030 and R&I implementation plan are being finalised with a new framework (research areas and functionalities) and integrated energy systems approach. Hence, in future, RICAP process can analyse the R&I status and gaps based on the new framework.

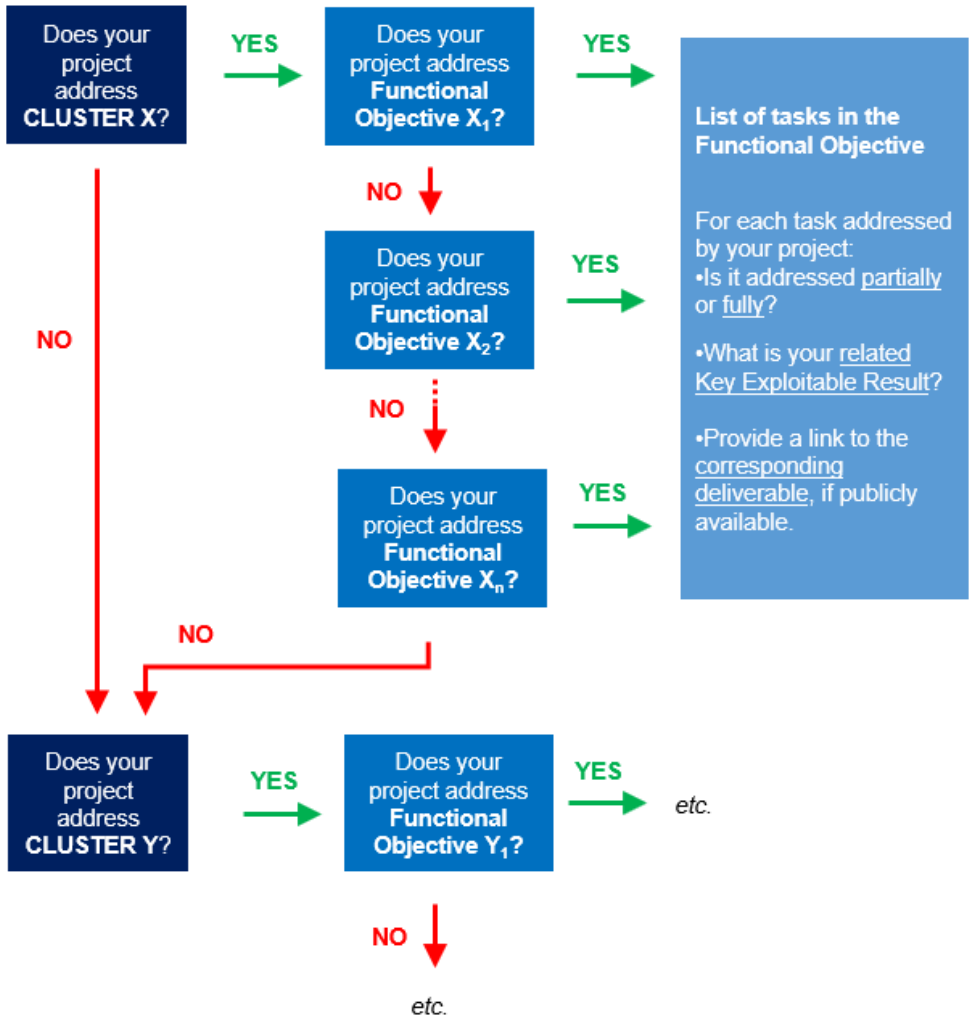

Figure 3.1 ETIP SNET process to identify R&I cluster and functionalities of a project

3.2 Case study on Technological gaps: Country - Ireland

As a part of the tasks under the WP3 (The state of R&I, standardisation and regulation) PANTERA is gathering smart grid project information to understand the R&I status and progress at national level. Project information are collected from the publicly available deliverables, reports, scientific

publications, different web platforms and the active stakeholders (national, EU and international) who are involved with the R&I activities. This section discusses the identified **technological gaps** at national level which is then partly verified with the stakeholders in individual interview and workshop process.

In case of Ireland, up to now, in total 57 projects' information have been collected. List of the analysed projects are also included in the Annex. The R&I status and the technological gaps in relation to the projects in transmission (TN) and distribution (DN) network domains are briefly discussed here.

3.2.1 Transmission Network (TN)

Out of 57 projects, it is found that till now 14 projects are in the transmission network domain. EU provides funds for 9 of these. Most of the projects are in demonstration level. Details are shown in Figure 3.2.

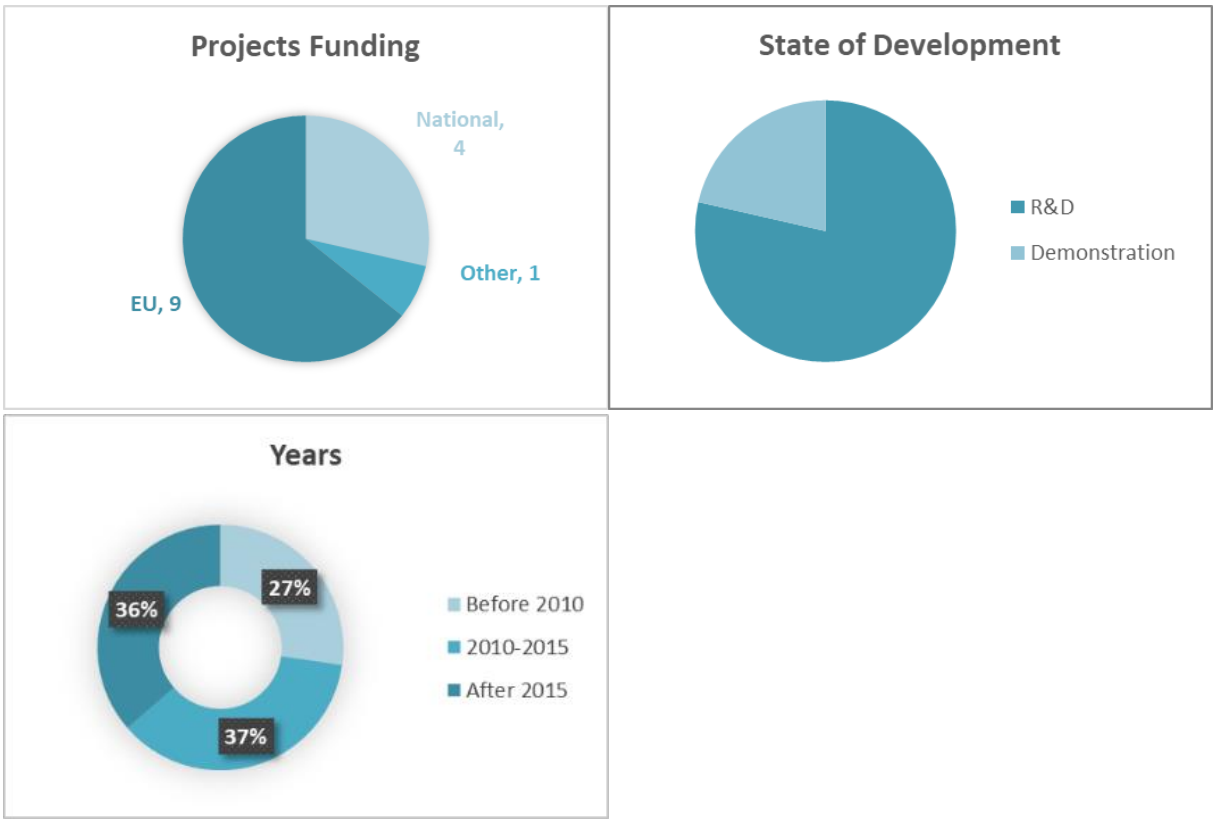

Figure 3.2 General information of R&I activities in Transmission network (Ireland)

PANTERA RICAP process finds that to meet the clean energy target by 2020, renewable energy (RE) integration is considered mostly in transmission network and hence the number of RE integration projects are very high for TN in Ireland. This aligns also with the national energy policy where decarbonising the smart grid network is targeted by 2050 [4]. As an island, it is also very important to focus more on renewable energy integration. Thus, the planning, operation, and management are also emphasized in most of the projects. Grid stability improvement and security issues are also getting importance.

According to the ETIP SNET roadmap and framework for cluster and functionality analysis, it is found that most of the projects fall under the cluster 3 where flexibility from generation/storage/demand

and network are the main point of research. This is followed by the cluster 2 which deals with security and system stability. Figure 3.3 shows the outcomes.

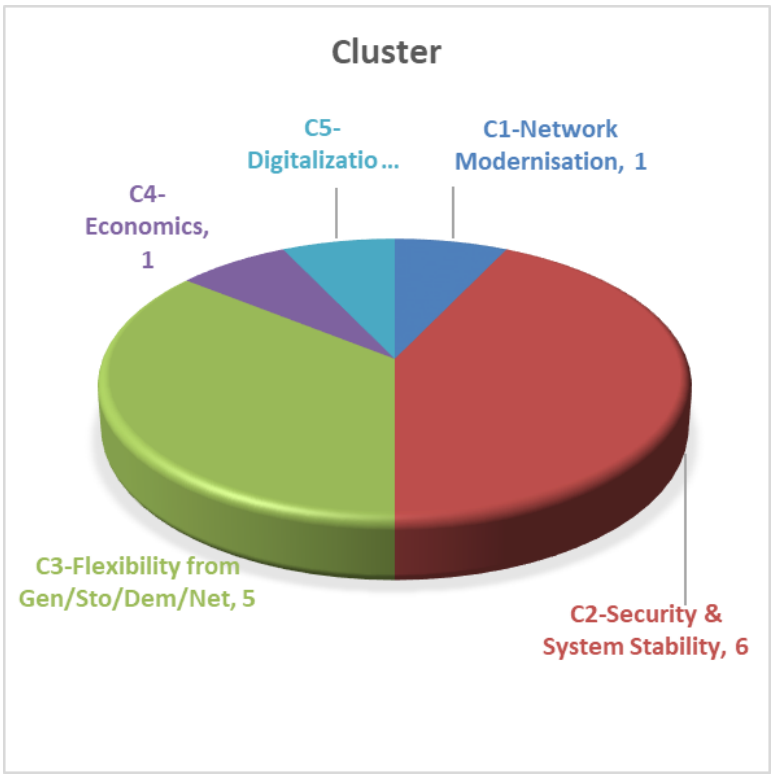

Figure 3.3 R&I status in TN under the ETIP SNET cluster (Ireland)

Analysis in the functional objectives area shows (see Figure 3.4) that multiple gaps occur in fulfilling the objectives. Most of the objectives have not been covered by these projects. Such as, under the cluster C1 for modernization of the network, none of the analysed projects deals with most of the functional objectives such as T2-Smart asset management, T3-New materials and technologies, T4-Environmental challenges and stakeholders.

Initial study also shows that in the smart grid network development and grid stability improvement, integration of energy storage (ES) is getting less importance yet, as shown in Figure 3.5 (T10). It is already well-known that ES plays a vital role in network stability improvement and balancing the energy supply and demand mechanism. When it comes to digitalisation (C5), cyber security, standardisation and big data exchange issues (T20) and IoT (T21) should also get equal importance as the data management (T19). All of these are more important when it approaches to the interoperability issue in smart grid network. Clear gap exists also in developing/identifying business models for the stakeholders and market integration (T16) who are directly involved in this domain. Consumer centric energy transition is the core of the EU energy transition which is reflected in [5]. Consumer should have access to the wholesale electricity market. In this case, TSO should also be involved with some R&I activities to convert the passive consumer into an energy active consumer. More details will be discussed in the final deliverables.

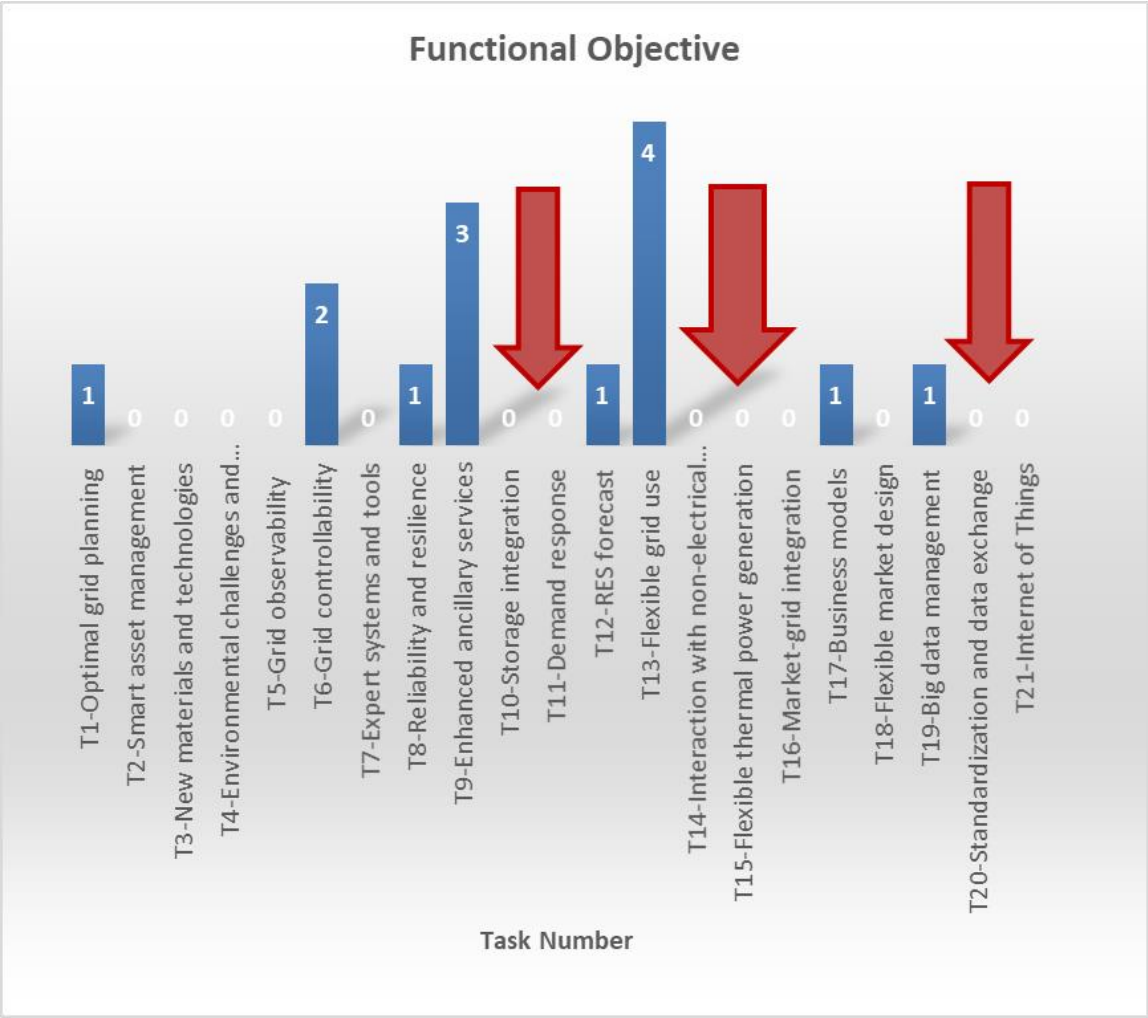

Figure 3.4 R&I status under the ETIP SNET functional objectives (TN) and gaps (Ireland)

3.2.2 Distribution Network (DN)

Similarly, information has been collected from 31 projects which have some R&I activities in the distribution network domain.

Out of 31 projects, 18 are funded by EU. Similar to Transmission network, demonstration has been given importance here. Outcomes of the general information are shown in Figure 3.5.

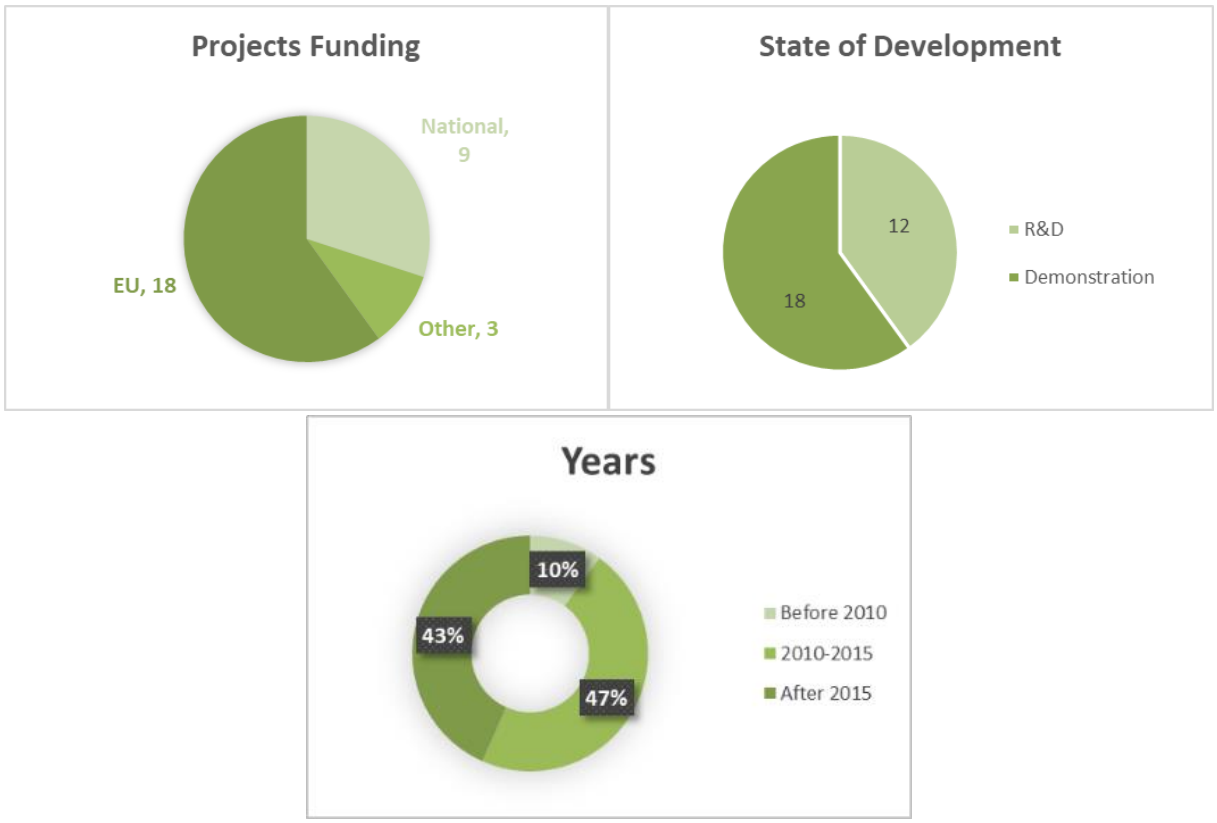

Figure 3.5 General information on R&I activities in Distribution Network (Ireland)

Analysis under the ETIP SNET roadmap, cluster and functional objective framework shows that most of the projects fall under the cluster 3 and 2 for RE integration and network operation in distribution network, as shown in Figure 3.6. Gap appears in planning and asset management area.

The outcome of functional objectives analysis is shown in Figure 3.7. Result shows that most of the objectives are covered by the DN research. Still, gaps appear in energy storage integration (D5), EV charging infrastructure (D6) areas and a hole appears under the functional objective, D13-Asset management.

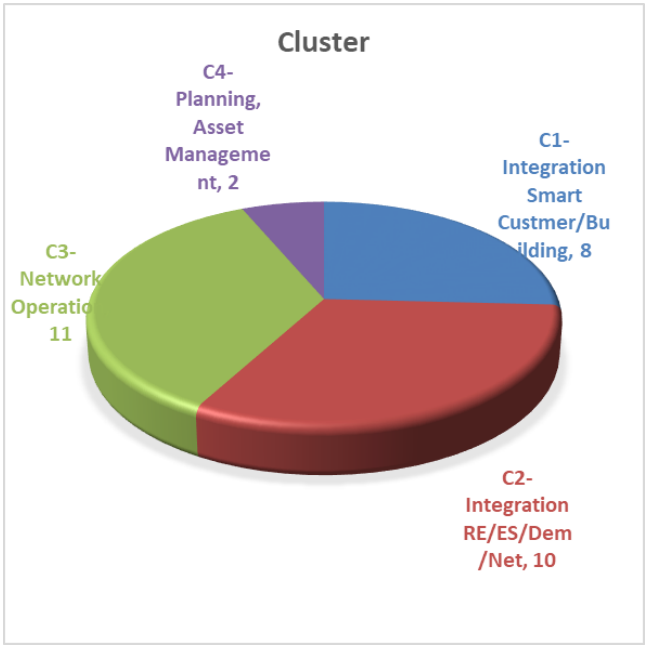

Figure 3.6 R&I status in DN under the ETIP SNET cluster (Ireland)

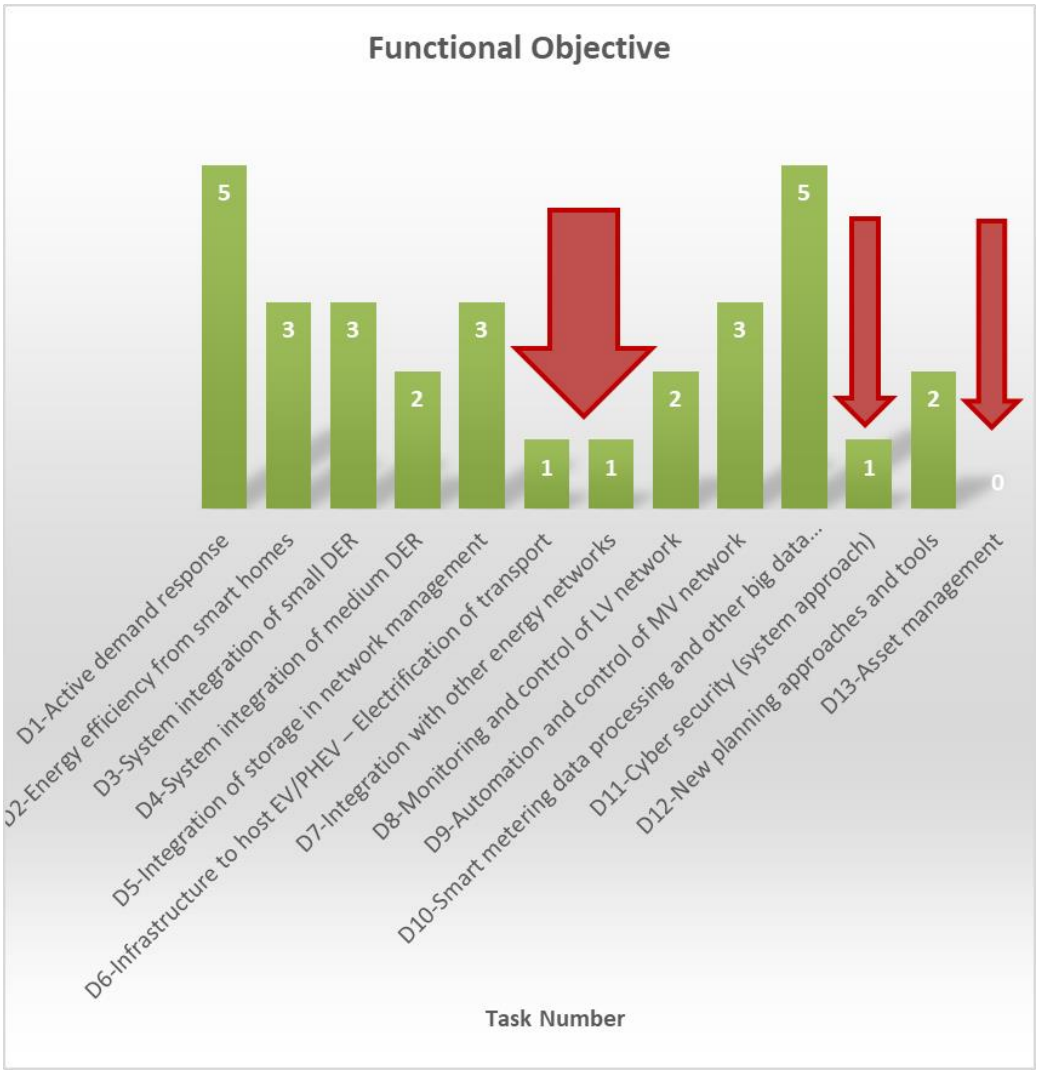

Figure 3.7 R&I status under the ETIP SNET functional objective (DN) and gaps (Ireland)

3.3 Identification of gaps through Workshop and individual interview process

PANTERA project was initially planned to function in a close and continuous dialogue with stakeholders, realised in different forms of cooperation e.g. workshops, surveys and interviews. In this particular activity the first interaction was done via a set of interviews with a representative selection of stakeholders, which was conducted during the first PANTERA workshop in Sofia (BG) in July 2019 and the second was at PANTERA workshop in Dublin (IE) in December 2019, where mostly stakeholders from Ireland were represented. The following section covers interviews in Dublin.

3.3.1 Purpose and method for the interviews

The overall approach is very similar to the one, which was previously applied in Sofia. Since this study can be defined as a rather qualitative research with a fairly limited number of respondents, the interviews were initially planned and conducted as so-called semi-structured interviews, allowing new ideas to be brought up during the interview as a result of what the interviewee says. The set of guiding questions was related to three main topics to be explored:

- Architecture of SmartGrid landscape: challenges, specifics of the national organisation, decision-making and national R&I support schemes
- Technical issues from the SmartGrid domain, including importance/prioritising and if possible, reasoning (see Annex I, page 38*)*
- Any other relevant information and inputs

Results of the interviews unlike online surveys are not statistically significant and thus have to be analysed in a qualitative way. The intention of the interviews was to receive opinions from representatives of different type of institutions, which are directly relevant to the activity. The group included:

- One representative from the Irish DSO (there is only one DSO in Ireland)
- One representative from R&I
- One representative from a DR aggregator

The interviewees represent positions of different stakeholders and have naturally different and somewhat contradicting opinions.

3.3.2 Technical gaps and Challenges within the SmartGrid Landscape

The respondents specifically mentioned several challenges, which will require implementation of SmartGrid technologies within the next 5-10 years:

- Distribution system is as huge challenge, and several respondents pointed out that monitoring and controllability of small-scale renewables will be the most critical challenge within the next 5-10 years. Missing this issue will create a serious threat to secure grid operation and problem for the grid with high share of renewable.

This issue is closely interrelated with (i) observability and controllability of the grid, (ii) system security and stability issues especially at lower voltage levels (DN). In addition, it also raises the necessity of improved utilisation of the potential for the existing distribution and transmission assets instead traditional expansion of the grid.

Electrification in general and especially the growing number of electrical vehicles is going to be a huge challenge.

- The market design: it is a big challenge that the market design often promotes itself as being neutral to different technologies, but they are only neutral if they are conventional power plants. The market designs need to admit the fact that there are different technologies and characteristics. It is important to have a proper qualification process (for both wholesale and ancillary market), which observes and assesses characteristics of each type of provider. These characteristics should be used to utilise the best they can deliver.

Among the other system challenges in the next years it was mentioned (i) SmartGrid interventions and transferring innovations to the industry, and (ii) growing need for training of DSOs personal according to the new challenges.

3.3.3 Feedback to the technical topics

The first draft of the technical topics is directly based on the taxonomy, which was previously suggested and verified by ETIP-SNET. Interviewees were asked about feedback to the list of the technical topics (functional objectives in ETIP-SNET's terminology), which have an immediate importance:

The following topics were mentioned (topics in bold were mentioned by several respondents)
For TSOs:

T2	Smart asset management
T3	New materials and technologies
T5	***Grid observability***
T6	***Grid controllability***
T9	Enhanced ancillary services
T10	Storage integration
T11	***Demand response***
T12	RES forecast
T13	***Flexible grid use***
T14	Interaction with non-electrical energy networks
T17	***Flexible market design***
T22	Flexible thermal power generation
T21	***Cybersecurity***

For DSOs:

D1	Active demand response
D2	Energy efficiency from integration with smart homes and buildings
D6	***Infrastructure to host EV/PHEV – Electrification of transport***
D7	***Integration with other energy networks***

D8	***Monitoring and control of LV network***
D10	Smart metering data processing and other big data applications
D11	Cyber security (system approach)
D12	New planning approaches and tools

It was commented that normally the TSO does not support broad R&I projects, but prefers bilateral projects exploring specific issues and challenges, this corresponds to the feedback previously received from Bulgarian workshop.

3.3.4 Potential benefits from implementation of SmartGrid solutions

Among potential benefits several respondents mentioned (i) better performance of the network, (ii) reduction of costs and (iii) general innovation as well as introduction of new business models.

3.3.5 Identification of other missing contents/subjects

R&I activities in Ireland are aligned with the recent Ireland's "Climate Action Plan" [6] defining a set of 183 clear priorities and setting directions of the SmartGrid research. There is an established decision-making and R&I funding system in Ireland.

According to the respondents, there are several well-established financial instruments in Ireland, supporting R&I activities including tax credits and Regulator's allowance. This especially encourages companies having substantial investments in R&I activities, both internal and external. There are several examples of collaborative financing of R&I activities, where several companies pool resources together. This can be mixed with financing from governmental dedicated research agencies e.g. Science Foundation Ireland. The financing priorities from these correspond to the above-mentioned Ireland Climate Action plan. Hence, more details of this decision-making and national R&I support schemes are discussed in a separate section below.

3.3.6 Barriers for more activities in SmartGrid domain

Several issues were pointed out as barriers:

- The power system in Ireland has limited resources and expertise available, thus it faces many complex challenges ahead.
- Until recently the DSO was not fully on-board with DR, but recently the DSOs started to realise the importance of DR.
- The scope of R&I challenges is very broad, allowing further increase of the national funding limits.

4 Decision-making and national R&I support schemes

This deliverable is meant to elaborate on proposals and conclusions from the preceding activity "Key topics and content management" (for details see [1]) related to national decision-making and funding mechanism.

As a part of this deliverable, this is one of the suggested topics for PANTERA to learn more about improving possibilities for the decision-making and national R&I funding mechanisms, with special focus on Smart Grid domain. This topic was initially identified in a preceding report [1] based on a case study of research and decision-making landscape in Norway. The workshop in Dublin provided an opportunity to verify the importance of this topic and to know more details of this mechanism. Hence, the case-study is now being extended for three more countries.

The topic of regulatory-driven incentivisation of DSOs to participate in R&I projects deserves a specific explanation. A comprehensive comparative evaluation of regulatory regimes for DSOs across whole Europe, with specific focus on funding of R&I activities in the Smart Grids domain has been done by Eurelectric [7], where some specific examples of best practice were mentioned. The project team has therefore recognised the importance of this topic for PANTERA networking activities and intended to verify this through interviews and case studies. It is necessary to mention that PANTERA sees the complexity of this issue, but considering its importance, finds it highly relevant.

Figure 8 describes a generic decision-making process, which includes several national and regional institutions. The figure has been slightly modified from the version presented in a preceding report [1], and depicts a set of roles, which can be populated with instances appropriate for any given country.

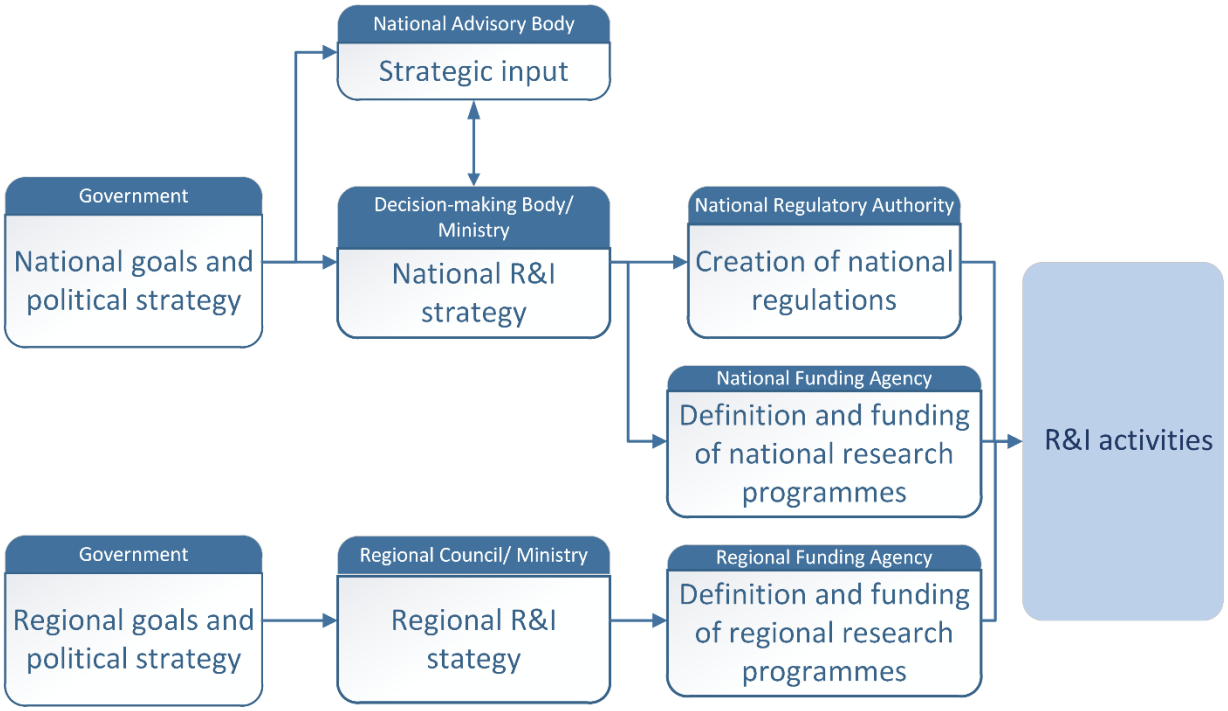

Figure 8: Steps in the decision-making process of funding for R&I activities.

As given in the figure, national goals and political strategy lead to a national R&I strategy, which

again leads to the creation of national regulations, and definition and funding of national research programmes. The two latter may both lead to R&I activities. The R&I activities could be industry support schemes or research programmes. The national goals and political strategy may also lead to a strategic input to the national R&I strategy, which may again give input back to the strategic input. In addition, there may also be regional goals and political strategy, which lead to a regional R&I strategy, leading to the definition and funding of regional research programmes which brings R&I activities. This section only discusses the national decision-making process and funding mechanism in brief for Cyprus, Ireland and Latvia.

4.1 Case Study: Cyprus

4.1.1 R&I system structure/funding landscape

National Research and Innovation (R&I) Governance System is considered as one of the key pillars for successful implementation of the National R&I Strategy. The System, adopted by the Council of Ministers of 2018, is a follow-up to the study of how successful National Research and Innovation Systems abroad are, the specificities and specialized needs of the Cypriot Research and Innovation ecosystem, as well as the potential for innovation, staffing of new structures inside and outside the government structure.

The new R&I Governance System (shown in Figure 4.9) was developed to meet the following basic requirements:

- Making the most of synergy between the public and private sectors and connecting all stakeholders in the knowledge chain
- Strong political guidance, supervision and ownership
- Making use of existing extensive experience and know-how
- Ensuring the resources and capabilities required to operate the governance system
- Adoption of monitoring and evaluation mechanisms

The new System includes new institutions and bodies, such as the new National Council for Research and Innovation, the Chief Scientist, the "R&II Coordinators" in all Ministries. It also envisions a unified and integrated approach to Research and Innovation at all levels, including the integration of Research and Innovation issues into the Minister of Finance's portfolio, as well as the functioning of the Research and Innovation Foundation (IDEK) as an executive arm.

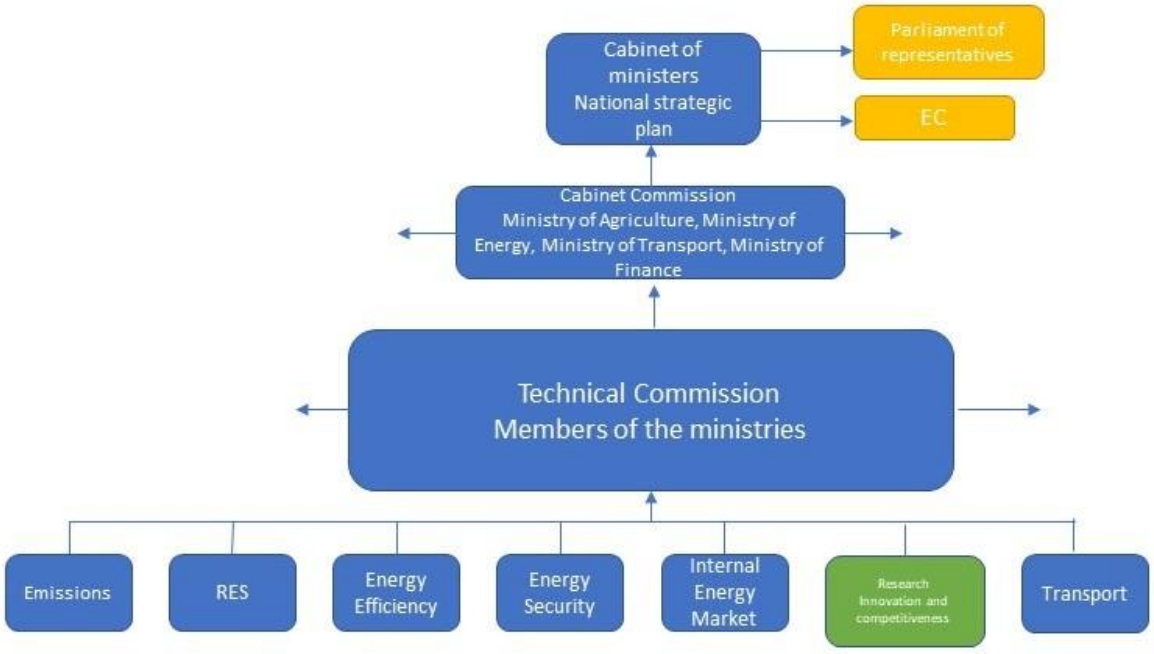

Figure 4.9 National Research and Innovation Governance System (R&I) Governance of the Research and Innovation System.

4.1.2 Decision-making bodies (ministries) and national advisory bodies

Issues that are related to Finance Research and Innovation are integrated into the portfolio of the Minister of Finance. In this context, the Minister of Finance is the responsible Political Head for Research and Innovation at both national and European level.

The National Research and Innovation Council (NRIC) is the **primary advisory body** for strategy development. The Council will undertake the promotion and implementation of the Research and Innovation Strategy on the basis of the recommendations of the report "INNOVATE CYPRUS: Proposal for the Creation of a New Single National Framework for Research, Innovation and Entrepreneurship in Cyprus", will present proposals and recommendations on strategy issues and will monitor the implementation of issues adopted at the policy level. In addition, it will have a supervisory and guidance role in the implementation of the new proposed National Research & Innovation Framework and will be able to plan corrective and evolutionary actions regarding the operation of the system and the implementation of the national strategy and individual policy measures. The Council will meet on a regular basis and its work will be supported by the Chief Scientist (ex-officio member) and the Directorate for Research and Innovation (DG RI), which will perform the duties of the NRIC Secretariat.

The creation and operation of the **Chief Scientist** position (physical person) is based on the practices of other countries (such as Israel, the UK, etc.) and its mission is to coordinate and guide the national framework at the policy level. The Lead Scientist assumes a coordinating and supervisory role in the formulation and implementation of Policy Research and Innovation and the functioning of the national Research and Innovation Governance System, including the Departments and Agencies involved at both the policy and technocratic level. In addition, the Chief Scientist supports the work of the NRIC to formulate recommendations for Strategic Research and Innovation, as well as suggestions on the structure and functioning of the Governance System. The adoption of

the institution is expected to contribute to the performance of the Governance System and to the smooth adaptation to new data. At the same time it will enhance their coordination, proper functioning and their effective contribution to the development and implementation of R&I strategy and policy. Finally, the Chief Scientist institution is expected to act as a catalyst in raising awareness, activating and developing the elements of the National Research and Innovation System and promoting culture.

The Chief Scientist is appointed by the President of the Republic and the appointment is valid until the expiry of the term of the President of the Republic or until terminated by the President and is administratively supported by the IDEK and Directorate of DG RI. The Chief Scientist is appointed ex-officio as Chairman of the Board of the IDEK.

4.1.3 Funding agencies and programmes

National Funding system for research in Cyprus is straight forward and rather compact as it is applied from a single organisation. The **Research and Innovation Foundation (IDEK)** is the national agency responsible for supporting and promoting research, technological development and Innovation in Cyprus. So, IDEK is the government's executive arm for Research and Innovation issues. Its mission is achieved through the Foundation's core activities, which include the design and management of research grant programs and innovative activities, support for the integration of Cypriot researchers into European and international research services and the provision of support services to businesses for innovation development, technology transfer and international networking.

In sections below, IDEK interrelations with the R&I mechanisms of Cyprus are highlighted.

Strategic Planning Unit: The Strategic Planning Unit is responsible for designing and monitoring the Foundation's strategy. The responsibilities of the Unit include the design and evaluation of programs and invitations announced by the IDEK, the participation of the IDEK in programs, its representation in committees and international activities, monitoring the performance of the Foundation, contributing to the development of the Research System and Innovation in Cyprus, the management of EU Investment and Structural Funds issues, State aid issues and the development of a Central Technology Transfer Office.

Research and Innovation Projects Unit: The Research and Innovation Projects Unit is responsible for managing and monitoring research projects for all IDEK Programs from the submission of proposals to the completion of research projects. More specifically, the Unit's responsibilities include the collection, management and evaluation of project proposals, the monitoring of the scientific field, the financial audit as well as the legal issues related to the research projects. The Unit is also responsible for the activities of the Public to Public Programs in which the IDEK participates

Promotion and Consulting Unit: The Promotion and Counselling Unit is responsible for providing information and consulting services to the public on all Foundation activities. The Unit is responsible for promoting Cyprus's participation in the Horizon 2020 Program and for the operation of Enterprise Europe Network Cyprus. Its responsibilities include promoting the culture of research, technological development and innovation, organizing and participating in events and competitions, managing the sponsorships offered by the IDEK, and promoting and promoting the Foundation.

Administrative and Financial Services Unit: The Administrative and Financial Services Unit is

responsible for matters related to the operation of the Foundation's administrative and financial services. More specifically the activities of the Unit include the preparation of the budget and financial statements, the management of the accounting, IT and technological infrastructure, the archive, the bids and public procurement, the security and health, the recording of the operating procedures of the Foundation as well as human resources management issues.

4.1.4 National regulating authority (NRA)

The Directorate for Research and Innovation (DG RI) has the following responsibilities:

- Coordinate, support and monitor the implementation of the National R&I Strategy
- Designing and coordinating R&I policy issues
- NRIC Secretariat Duties
- Administrative Support Chief Scientist, in addition to IDEK support

The coordination of the National Strategy for Research and Innovation and the management of policy issues is led by the Chief Scientist and the responsible Minister. Hence, the Chief Scientist is also a regulatory authority in addition to an advisory body.

4.1.5 Incentives and support schemes for participation in R&I

Cyprus provides significant tax incentives to research and innovation organizations, subject to a tax deduction of up to 50% of taxable income for investing in such organizations. Concerning intellectual property revenue, there is a special provision in the law, according to which 80% of income is exempt from taxation, providing an additional incentive for organizations to use Cyprus to register such rights. In addition, specific tax incentives are provided should senior executives and / or researchers decide to settle in Cyprus. That is to say, 50% tax exemption is provided when their total annual income exceeds 100,000 euros.

However, there are no additional incentives for DSO embedded into the national regulation regime.

Several industrial associations act as coordinators for R&I activities, as for example Cyprus Business Angels Network (CYBAN) is an Angel Investment Network in Cyprus. They connect innovative fast-growing companies to equity finance through their membership of experienced angel investors.

4.1.6 Regional funding schemes

There are not any regional funding schemes, covering Cyprus.

4.2 Case Study: Ireland

4.2.1 R&I system structure/funding Landscape

The Government of Ireland has set out a National Development Plan for 2018 to 2027 [8] prioritising its strategic objectives which include: Sustainable Mobility, A Strong Economy, supported by Enterprise, Innovation and Skills and Transition to a Low-Carbon and Climate-Resilient Society. It support initiatives that contributes to the achievement of Ireland’s climate and energy targets, through the Disruptive Technologies Innovation Fund and Climate Action Fund. Specific targets for climate action are set out in the National Climate Action Plan [6].

4.2.2 National decision-making bodies and advisory body

There are multiple **national advisory boards**. The overall advisory function for the National Development Plan lies within the Department of An Taoiseach. It acts via interdepartmental groups including the Department of Business, Enterprise and Innovation who set out plans such as Innovation2020.[1] There are also a Research Prioritisation Steering Group, a Climate Change Advisory Council, and a Climate Action Delivery Board established.

Levels of Government R&I expenditure as a percentage of all Government expenditure are approximately 1% [9]. Government funding for Research, Development and Innovation programmes in Ireland in the higher education sector are administered by the Department of Education and Skills, the Higher Education Authority (HEA), Science Foundation Ireland (SFI) and others. Government funding for business sector R&I are administered through State agencies including IDA Ireland, Enterprise Ireland and others.

4.2.3 Funding agencies and programmes

Government funds are distributed through several state research funding agencies, with different disciplinary or industry sector focus. There is some overlap between the agencies' responsibilities so that Smart Grid RD&I projects could possibly be funded by any of the agencies depending on the project's focus. The most relevant of these agencies to Smart Grid RD&I are SFI and the IRC.

Science Foundation Ireland (SFI) funds fundamental research across science, technology, engineering and mathematics (STEM) disciplines and all career stages. It provides grants for researchers from around the world who wish to relocate to Ireland and those already based in Ireland, for individual investigators, for large research centres, for conferences and symposia, and for collaboration with industry. SFI supports international research through agreements with international research bodies such as EPSRC in the UK, the National Natural Science Foundation of China, and the US National Science Foundation.

The **Irish Research Council (IRC)** funds fundamental research across all disciplines and career stages and is open to all disciplines including the arts, social sciences and humanities. Smart Grid RD&I which focuses on consumers and/or societal issues may be funded. The IRC funds researchers based in Ireland to participate In European Research Agency associations.

The **Environmental Protection Agency (EPA**) funds research and innovation in the intersection of environment, climate and energy. Funded projects are mainly environmentally focused but may link to Smart Grids/Smart Cities where decarbonisation is the key focus.

The **Industrial Development Authority** supports Foreign Direct Investment into Ireland from Multi-National Enterprises (MNEs). Many MNE have located their headquarters and association RD&I activities in Ireland, some MNEs are active in the ICT/analytics and therefore Smart Grid domains. Research in other areas which may intersect the Energy System are funded by additional agencies. For example, research and innovation projects in biofuels is funded by **Teagasc**, Ireland.

[1] https://dbei.gov.ie/en/What-We-Do/Innovation-Research-Development/Innovation-2020/

Sustainable Energy Authority of Ireland (SEAI) funds research, development and innovation in Ireland's transition to a clean and secure energy future.

4.2.4 National regulating authority

The **Commission for Regulation of Utilities** is responsible for regulation in the energy sector, but does not fund R&I.

4.2.5 Incentives and support schemes for participation in R&I

Enterprise Ireland is the government organisation responsible for the development and growth of Irish manufacturing and internationally traded services companies and also one of the state agencies with responsibilities for R&I. They support partnerships between Irish enterprises and research performing organisations and act as the national Horizon 2020 contact point. They also support businesses from start-ups to SMEs based in Ireland to connect with Research Performing Organisations in the higher education sector, and to set up “Technology Centres”. Companies investing in R&I activities may also qualify for tax incentives under schemes such as the R&I Tax Credit Scheme, and the Knowledge Development Box which are managed by the Office of the Revenue Commissioners.

The **Industrial Development Authority** is the state agency responsible for attracting inward foreign direct investment into Ireland. Such multinationals based in Ireland may perform research and innovation and apply for R&I funding where eligibility criteria allow.

4.2.6 Regional funding schemes

There are no regional funding schemes covering Ireland.

4.3 Case Study: Latvia

4.3.1 R&I system structure/funding landscape

Latvian research and innovation funding system is complicated, and functions are fragmented between various institutions (see Figure 4.10). However, institutions may have mixed functions, in order to keep the description as clear as possible every institution is allocated to the most relevant functional level (political level, advisory level, action policy level and performer's level).

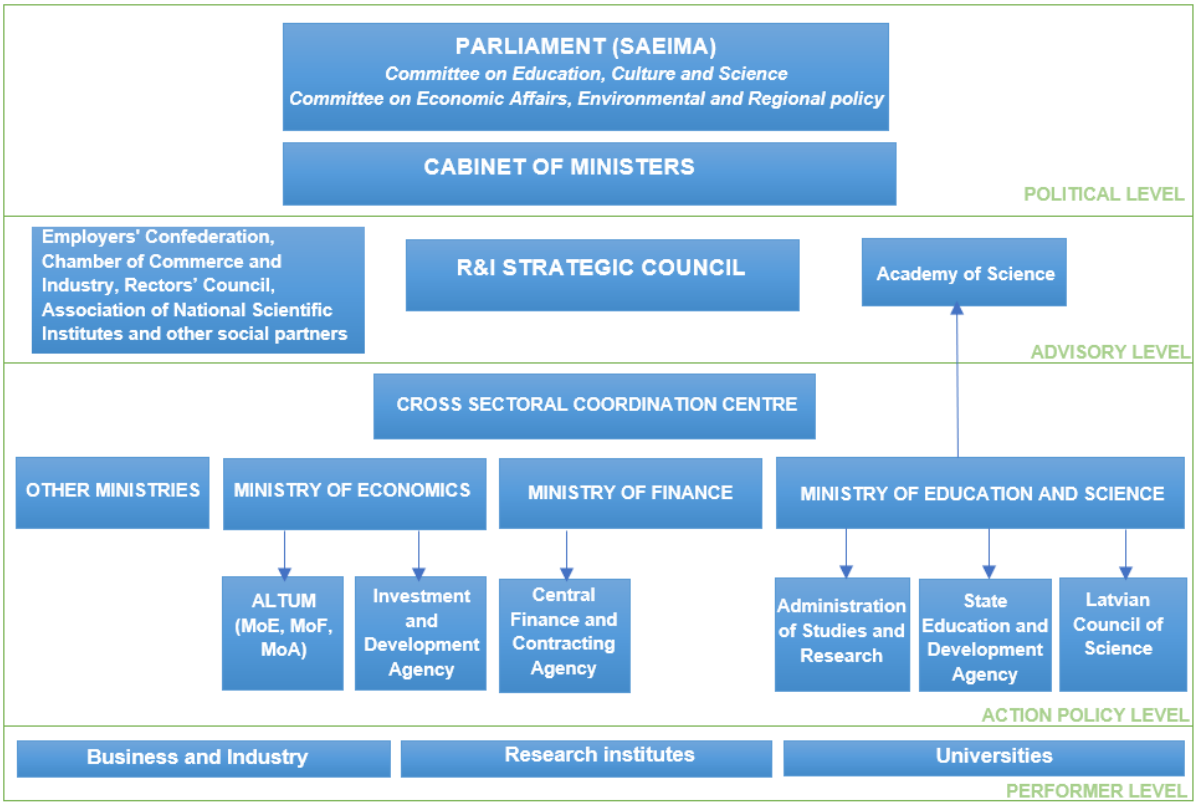

Figure 4.10 Latvian R&I funding system.

4.3.2 National advisory body and decision-making bodies

The **Parliament (Saeima)** and the **Cabinet of Ministers** are responsible for defining the broad directions of national R&I policy and allocating the budget for R&I policy, setting the evaluation criteria for assessing the efficiency of research institutions, and approving the prioritised research directions and State Research Programmes for financing fundamental and applied research every four years.

The **R&I Strategic Council** is chaired by the prime minister and contains a number of other ministers as well as representatives of a wide range of research and innovation stakeholders and is the **national advisory body**. The task of this council is to advise the government on priorities. While it was very effective at the start of the current Structural Funds planning period, it has since not been so active. It has little analytic capacity on its own and only experiences a political drive to be active at times then there are large amounts of budget to be allocated [10].

Academy of Sciences is a subordinate institution to the Ministry of Education and Science, which is mainly a discussion and lobbying platform for the research community. However, at the moment it does not retain its earlier significant role as policy advisor to the government.

Social partners, such as Latvian Employers' Confederation (largest association of employers' organisations that represents employers in Latvia), Latvian Chamber of Commerce and Industry (biggest association of entrepreneurs in Latvia), Latvian Rectors' Council, Association of National Scientific Institutes etc., are independent institutions representing their interests in the sectors concerned and developing operational strategies and industry statutes.

Cross Sectoral Coordination Centre (CSCC) is the leading institution in national development planning and coordination in Latvia. CSCC is under direct authority of the Prime Minister. CSCC is responsible for developing and monitoring the highest national development planning documents: National Development Plan of Latvia for 2014-2020 and the Sustainable Development Strategy of Latvia until 2030, and implementation of national development planning documents in relation to the EU. It oversees the entire central government planning process, making changes when needed and providing guidance to ministries through consultation, elaborating a Handbook on Development Planning and giving open lectures for government officials on policy planning issues at the School of Public Administration. CSCC performs analytical tasks assigned by the Prime Minister and the Prime Minister's Office, including assisting with the Government Declaration and Action Plan. CSCC contribution lies in initiating cooperation at all levels of the decision-making process, as well as planning and assessment [11].

Ministry of Economics (MoE). The main working areas of the MoE cover the development of business activities (industrial development, innovation), export promotion, development of energy and tourism sectors, etc. The Ministry is responsible for the development of long-term policy agendas concerning key economic issues, such as competitiveness and production. The Ministry represents the economic interests of Latvia in the EU and participates in all stages of decision making. Moreover, the Ministry introduces and supervises the programmes and projects financed by EU structural funds and other foreign financial means. The Ministry finances selected state aid schemes to promote technology transfer, cooperation between researchers and business companies, development of new products and technologies, etc [12].

Ministry of Finance (MoF) is responsible for the development and coordination of financial policy and budget allocation, as well as the administration of EU Structural Funds and the Cohesion Fund.

Ministry of Education and Science (MoES) articulates policy for higher education and research, interacts and negotiates with the research performing institutions in the course of providing institutional and performance-based funding and planning the development of research infrastructure. The ministry also developed and oversees the national smart specialisation strategy (RIS3) and a number of structural funds programmes. It coordinates research needs among the spending ministries and manages the state research programmes intended to meet these.

Other Ministries largely do not fund research. Instead, the Ministry of Education and Science consults the other ministries about their research needs and then designs the state research programmes on their behalf. An exception is the Ministry of Agriculture which maintains two research institutes and a university. It also manages two programmes of the European Agricultural Fund for Rural development that support science industry links and knowledge exchange in agriculture and

forestry [10].

4.3.3 Funding agencies and programmes

R&I investment in Latvia is low and dependent on European Structural and Investment Funds.

The main funding lines for the research system include:

- Institutional research funding (baseline funding): funds to enable universities to have and maintain internal research facilities and resources, which the universities are able to spend as they themselves decide, in line with the principle of university autonomy
- Nationally financed grants: academically orientated competitive research funding (state-research programme) and competitive funding for more applied research in the national Priority Directions in Science
- International funding: EU Structural Funds, EU Framework Programme, other international funding (European Economic Area and Norway grants).

In the 2018 the MoE launched the state-research programme in energy sector covering four dimensions: analytical framework of state long-term energy policy planning, energy efficiency, sustainable energy infrastructure and market, renewable and indigenous energy resources [13]. The programme is implemented in the form of separate research projects. In the open procedures of projects application in total 18 research projects submitted by various organisations were evaluated from administrative, science and sector specific criteria. In the result, 11 projects were selected for funding and all of these are coordinated by Riga Technical University [14].

Latvian Investment and Development Agency is an innovation funding agency which is a subordinate institution to the MoE. Agency's main task is to promote business development by facilitating more foreign investment, in parallel increasing the competitiveness of Latvian entrepreneurs in both domestic and foreign markets and effective utilisation of resources from EU funds. Agency supports companies in Latvia trading internationally, as well as overseas businesses seeking partners or locations in Latvia, and administrates state support programmes for entrepreneurs, co-financed from EU funds [15].

The JSC Development Finance Institution ALTUM (ALTUM) is not a funding agency, but a state-owned development finance institution. Three ministries are its shareholders (the Ministry of Finance (MoF), Ministry of Economics and Ministry (MoE) of Agriculture (MoA)). It offers state aid for various target groups with the help of financial tools (such as loans, credit guarantees, investing in venture capital funds, etc.). ALTUM develops and implements state aid programmes to compensate for the market's shortcomings that can't be solved by private financial institutions. State aid programmes administered by ALTUM, are implemented with public resources – EU and other international institutions, national and ALTUM's attracted financing [16].

Central Finance and Contracting Agency is a funding agency which is a subordinate institution to the MoF. Agency's mission is to supervise implementation of EU funding and other financial instrument projects that are important for development of Latvia [17]. It effectively takes the implementation of structural funds programmes out of the hands of the ministries and agencies operating in the respective policy area, leaving them only with implementation responsibility for nationally-funded programmes.

The State Education Development Agency (SEDA) is a funding agency which is a subordinate institution to the MoES. The aim of the activities of SEDA is to implement the national policy in the field of development of higher education and science, lifelong learning system, vocational education system and general education system and to implement and monitor projects financed by European Union (EU) Structural Funds, education innovation projects, EU programmes and other financial instrument programmes, projects and initiatives [18]. Research Funding Programme Department of SEDA performs functions relates to the R&I programs and consists of four units: International Research Programme Unit, PostDoc Programme Unit, European Economic Area/Norway Grants Unit, and Horizon 2020 National Contact Point [19].

Administration of Studies and Research (SRA) is a funding agency which is a subordinate institution to the MoES. It is responsible for student loan administration but has also a Science Department to administer and monitor research funding using national funds (state-research programme and fundamental and applied research grants).

The **Latvian Council of Science** is a funding agency which is a collegial institution and direct administration institution subordinated to the MoES. It is in effect a research council. It is responsible for peer review and selection of research proposals in the bottom-up fundamental and applied research programme and in the thematic state research programme. The Council does proposal assessment and project selection work for the Ministry of Education and Science and plays a role in homologating new PhD courses.

4.3.4 National regulating authority

The National Regulating Authority - **Public Utilities Commission** - is not evolved in the R&I support mechanisms. It monitors network tariffs and may influence the TSO's 10-year investment plan.

4.3.5 Incentives and support schemes for participation in R&I

There are a number of instruments supporting and funding industrial innovation in Latvia, most important are [10] [20]:

- Tax relief to earlier stage start-ups (low flat social tax and no individual tax for start-up employees)
- Support to technology-orientated start-ups – attraction of highly skilled workers (45% co-financing offered by the government)
- Support to development of new products and technologies within competence centres
- Technology transfer system and innovation vouchers
- Support to implementation of new products into production
- Innovation motivation programme
- Support for employee training to increase business competitiveness and innovation
- Support for training to improve ICT skills, capacities for non- technological innovation and attracting foreign investment
- Clusters.

Corporation income tax R&I allowance was cancelled in 2018. Latvia’s rate of corporation tax before tax reform in 2018 was 15%. At that level, the incentive was not very attractive, given the administrative complexity of obtaining it. It was only of value to companies making fairly substantial

profits.

There is no specific arrangement in the regulation regime for national DSO and TSO, which will create specific incentives for involvement into R&I activities.

When it comes to industrial associations, having a coordinating roles in R&II, the Latvian Electrical Power Engineers and Builders Association (LEEA) and Latvian Information and Communications Technology Association (LIKTA) can minimally influence R&I projects. For example, by issuing letters of support. As for coordination and pooling funding, there is no such association.

4.3.6 Regional funding schemes

Baltic Research Program involves the Baltic States and the donor countries – Norway, Iceland and Lichtenstein. Baltic states are also involved into the Nordic Research Council programmes, which are dedicated to the energy field.

4.3.7 Recent developments in the funding system

In October 2019 the Cabinet of Ministers has approved the MoES developed conceptual statement "About institutional consolidation of Latvian science policy implementation system" and assigned the MoES responsible for the implementation of relevant changes before the 1st of July 2020 [21].

EU Policy Support Facility instrument's experts recommended to streamline the structure and governance of state organisations [10]:

- reduce the number of organisations involved in research and innovation funding and to allow a smaller number to develop capacities that at present are lacking or in small supply
- stop separating nationally resourced and structural funds-based policies and instruments
- limit tasks fragmentation between maximum two agencies
- centralise peer review into a single competent organisation that can provide a peer review service to others as necessary

Experts proposed two governance scenarios for discussion: a unitary implementation agency (one agency for research and innovation) and a 'two-pillar' structure (separate research and innovation governance). According to the conceptual statement, the first option would require changes in the State Administration Structure Law and shall be evaluated in the medium term.

The conceptual statement introduces a solution to consolidate science and technology development policy implementation functions realized by affiliated institutions. It proposes to reorganise small affiliate institutions subordinated to the MoES - the Latvian Council of Science and SRA – thus creating a united and strong direct administration institution – the Latvian Council of Science. The renewed Latvian Council of Science would take over also the functions of the Research Funding Programme Department of SEDA and the Science Department of SRA, thereby the science policy implementation functions would be concentrated in one institution subordinated the MoES. At the same time, SEDA would take over student loan administration functions from SRA [21].

4.4 Discussion on case studies

Table 2 shows a summary of the R&I actors in the case studies, as shown in Figure 8.

Table 2: Summary of R&I actors in case studies.

	Country		
Actor	**Cyprus**	**Ireland**	**Latvia**
Government - national	Parliament of Representatives, Council of ministers, National board of R&I	Department of An Taoiseach (the Prime Minister's office)	Parliament (Saiema), Cabinet of Ministers, Cross Sectoral Coordination Centre (CSCC)
Government - regional	N/A	N/A	N/A
National Advisory body	NRIC, Chief scientist	N/A	R&I Strategic Council, Academy of Sciences to some extent
Decision-making body / Ministry	Ministry of Finance, Council of Ministries including Ministry of Energy	Department of An Taoiseach	Ministry of Economics, Ministry of Education and Science, Ministry of Finance
Regional Council / Ministry	N/A	N/A	Ministry of Environmental Protection and Regional Development
National Regulatory Authority	Chief scientist, R&I Directorate	Commission for Regulation of Utilities, Sustainable Energy Authority of Ireland	Public Utilities Commission
National funding agency	IDEK	SFI, IRC, Enterprise Ireland, and others	Latvian Council of Science, SEDA, SRA, CFLA, LIDA, Ministry of Economy
Regional funding agency	N/A	N/A	State Regional Development Agency, Nordic Energy Research

The aim of the case studies on decision-making and national R&I support schemes was to define topics which are important to address and discuss further in the PANTERA project. Information from the different case studies can help define topics which should be discussed with stakeholders, to move closer to an understanding on how the R&I system structures and funding landscapes affect the possibilities of R&I.

During the first round of individual interviews, the need for coordination across the whole decision-making and funding process was mentioned repeatedly. The case studies have shown that there are many different ways of coordinating and segmenting the decision-making and funding in different European countries.

- One discussion point is how the decision-making should be divided between several

decision-making bodies/ministries.

- Another point is that, what is the practical difference between having one, main funding agency, as opposed to having several funding agencies and how the division of tasks should be done.
- It should also be discussed what value of regional funding schemes could bring to a country, and in which cases it is necessary or if it is sufficient to have national funding schemes only.

As a comment to the second bullet point mentioned above, R&I activities are here defined as both research programmes and incentives and support schemes for industry. To ensure that all parts of R&I are covered from fundamental research to pilots and field activities, it might be a good idea to split these R&I activities depending on Technology Readiness Levels (TRL).

- Incentives embedded into national regulations of System Operators, especially DSOs [7], is another important point which should be further discussed. This topic has been raised by other organisations as Eurelectric but remains highly important issue for creation of incentives to System Operators.

A good connection and communication between industry/academia and decision-makers is key to ensuring that R&I funding supports topics which are relevant and important for the industry. This can for instance be achieved by having interdisciplinary interest and coordinating groups which help advise and give input to decision-makers for their members. It is also important to ensure a good connection and communication between industry and academia/research institutes. Coordinating groups may also help in this, by matchmaking of partners from academia and industry to collaborate in common projects.

5 Conclusions

This deliverable under the task 4.2 of PANTERA CSA, is to identify the technological gaps and missing subjects or aspects through the R&I status and gap analysis process, direct interaction with the stakeholders through workshop and individual interviews. Hence, a gap identification process is being developed with the support from another activity in PANTERA project (The state of R&I, standardisation and regulation) which is planned to:

- identify the current status of R&I activities at national level (specifically for the low spending/targeted countries)
- assess the national regulations, codes and standards
- national policy to accelerate the R&I activities towards the consumer centric energy transition as defined by the EU.

The process outcomes are shown for the R&I activities involved in Ireland transmission and distribution network. From the first gap analysis, it is found that both the TN and DN could give some more emphasis on energy storage integration, grid services for network stability improvement, asset management, cyber security and IoT for communication and digitalisation, consumer engagement and ancillary market.

It needs to be highlighted here that the clustering of TN and DN among projects are based on the past categorization. As we are moving to the integrated grid and the integrated functionalities approach throughout the whole network we need to provide a fresh view of classification. This will be mirrored in the gap analysis methodology that will be shaped by PANTERA and ETIPSNET WG5-WT3 cooperation and reported within D3.1 by M18.

As a further validation, the individual interview process is also ongoing. The outcome of the interviews during the 2nd workshop in Dublin, Ireland has been outlined here. **Both the technological gap analysis process and individual interview outcomes reflects some common points**, such as;
TN needs to emphasise more on grid observability and controllability issues, demand response, flexible market design, cybersecurity issues. Similarly, DN should focus more on integration of renewables and energy storage in LV network, infrastructure to host EV, monitoring and control of LV network, asset management etc.

From the other missing contents point of view, gaps include the shortage of expertise, TSO/DSO involvement in advanced grid operation (such as introducing demand response) R&I activities and also limited national funding.

It was also interesting to know the decision-making for research funding mechanisms at national level. The main outcome of the case studies were proposals for discussion points with stakeholders in the PANTERA project: Coordination and segmentation of the decision-making and R&I funding, TRL-based differentiation of research activities, incentives embedded into regulation, interaction between decision-making and industry/academia, regional funding schemes and common project and coordination of these.

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7 ANNEX I: Proposal for TSO- and DSO-specific technical topics (based on ETIP-SNET "Integrated Roadmap 2017-2026")

Several partners participating in PANTERA have been previously involved in European Technology and Innovation Platform Smart Networks for Energy Transition (ETIP-SNET) and more specifically in the development of ETIP-SNET's Integrated Roadmap 2017-2026 [2]. It is also necessary to mention that several PANTERA partners are also participating in the development of 2020 to 2030 roadmap.
The integrated roadmap is a thorough and well-detailed framework, but due to its complexity and since it is intended to serve a different purpose, it is not feasible to transfer the whole roadmap structure to PANTERA's communication with stakeholders. On the other hand, the suggested taxonomy of the functional objectives for the Smart Grid domain has been validated by key European actors as ENTSO-E and DSOs and thus can be deployed as a starting point for PANTERA, as it was initially stipulated in PANTERA Description of Work.

Table III and Table IV present an overview of functional objectives as it has been elaborated in the Integrated Roadmap. Since ETIP-SNET uses very specific terminology and for the sake of simplicity, the present document will use term "topics" instead of "functional objectives" from now on.

Table III Functional objectives (topics) for the Distribution System Operators

Cluster (main activity)	FO ID	Functional Objectives
C1 – Integration of smart customers and buildings	D1	Active demand response
	D2	Energy efficiency from integration with smart homes and buildings
C2 – Integration of decentralised generation, demand, storage and networks	D3	System integration of small DER
	D4	System integration of medium DER
	D5	Integration of storage in network management
	D6	Infrastructure to host EV/PHEV – Electrification of transport
	D7	Integration with other energy networks
	D14, 37, 38	Integration of flexible decentralised thermal power generation
C3 – Network operations	D8	Monitoring and control of LV network
	D9	Automation and control of MV network
	D10	Smart metering data processing and other big data applications
	D11	Cyber security (system approach)
C4 – Planning and asset management	D12	New planning approaches and tools
	D13	Asset management

Table IV Functional objectives (topics) for the Transmission System Operators

Cluster (main activity)	FO ID	Functional Objectives
C1 – Modernization of the network	T1	Optimal grid planning
	T2	Smart asset management
	T3	New materials and technologies

	T4	Environmental challenges and stakeholders
C2 – Security and system stability	T5	Grid observability
	T6	Grid controllability
	T7	Expert systems and tools
	T8	Reliability and resilience
	T9	Enhanced ancillary services
C3 - Power system flexibility from generation, storage, demand and network	T10	Storage integration
	T11	Demand response
	T12	RES forecast
	T13	Flexible grid use
	T14	Interaction with non-electrical energy networks
	T22	Flexible thermal power generation
C4 - Economic	T15	Market-grid integration
	T16	Business models
	T17	Flexible market design
C5 – Digitalization of power system	T18	Big data management
	T19	Standardization and data exchange
	T20	Internet of Things
	T21	Cybersecurity

8 ANNEX II: List of National and EU projects where Ireland is taking part as coordinator or project partner.

TN	DN	LEN
Project	Project	Project
AFTER	CITIES	Dundalk's IT Wind Turbine
EWIS	COOPERaTE	Templederry Community Wind Farm
GridTech	CRISTAL	Tipperary County Council Solar PV
REserviceS	Distributed Connected Wind-Farms	Cloughjordan Ecovillage
SafeWind	ELSA (ETIP-SNET project)	Ballynagran Energy Plus Community
SGIH	Encourage	Sustainable Clonakilty-Clonenergy 2020
TWENTIES	EvolvDSO	Gurteen Agricultural College
Electrical Network Efficiency Improvement Phase 2: Support Scheme for PV Solar	FINESCE	Erris Sustainable Energy Community
Enhancement of Inertial Stabilisation of the Electricity Grid using Local Electrochemical Processes for Load Levelling	FINSENY	Aran Islands Energy Cooperative
Low Cost Monitoring and Control of Small Scale Renewables (IoTas)	GREAT	O'Shea Farms Solar PV Systems
Using blockchains to facilitate renewable power generation: forecasting, hedging and tokenisation applications	GREENCOM	Integrating the Tallaght Smart Energy Living Lab for Smart Grid and enerXchange Research
PROMOTioN	GrowSmarter	Extension of the "Smart Micro Energy Cluster Test Bed" Commonly known as the "Tallaght Smart Energy Test Bed"
EU-SysFlex	Mas2tering	NECS - Northwest Energy Communities Start-up
FLEXITRANSTORE (ETIP-SNET project	ModeSto	Microgrids in Rural and Isolated Communities in Ireland Model Development using the island of Inis Oirr as a case study
	PlanGridEV (ETIP-SNET project)	Energy Masterplan for Clonburris Strategic Development Zone (SDZ)
	RealValue (ETIP-SNET project)	Business Models for Community Wind Farms
	Smart Green Circuits	Legislative Mechanisms for Local Community Ownership and Investment in RE Infrastructure'
	SmartGridEnable	Community Engagement in Wind Energy: Innovative approaches to achieving a social license (Co-Wind)
	SmartRuralGrid	Support tools for community renewable energy
	SPARKS	EnergyPOLITIES: Politico-institutional framing of collective engagements with the energy system
	VIMSEN	AgroRES
	Trinity Smart Grid	Firespol
	Dundalk Virtual Energy Microgrid (DVEM)	Intensify
	Electrical Network Efficiency Improvement - Phase 1: Loss reduction potential assessment	
	Smart Grid demonstration site utilising PV and battery storage	
	Flexigrid - Solo Energy Ltd	
	eStore	
	Smartblocks	
	GOFLEX (ETIP-SNET project)	
	RE-SERVE	
	REACT	

9 ANNEX III: A screen shot of the TN project analysis for RICAP process.

Project	Funding	State of Developme	Start Yea	End Yea	Network	ICT&Digitalizatio	Socio-Economic&Mark	Coordination	Cluster	Functional Objective	Tasks	Regulations, Codes & Standards	Energy Policy & Barriers
AFTER	FP7 (EU)	R&D	2011	2014	System Security & Stability/ Planning, Operation & Management	Ciber Security/ Data Management	Ancillary Services (engineering & consultancy)	_	Security & System Stability (C2)	Reliability and resilience: defence and restoration plans, probabilistic approach, risk assessment, self-healing (T8)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 17, 18, 19	Integration of project results in national and international standards.	No information available
EWIS	FP6 (EU)	R&D	2007	2009	System Security & Stability/ Renewable Energies Integration/Planning, Operation & Management	_	Energy Market	Cross Boarder-TSO	Power system flexibility from generation, storage,demand & network (C3)	Flexible grid use: dynamic rating equipment, power electronic devices, use of interconnectors (T13)	1, 2, 3, 4, 6	Urgently progress ENTSO-E pilot work on harmonising wind grid code (using material identified by EWIS and its stakeholders).	Policy makers and planning authorities should ensure necessary network infrastructure is given equivalent priority as that given to renewable generation developments so that necessary network upgrades are progressed in a timely fashion. They also should consider the information from the pan European market model to inform future development of wind support mechanisms and network access rules.
GridTech	IEE (EU)	R&D	2012	2015	Renewable Energies Integration/ Energy Storage Integration/System Security & Stability	_	Energy Market	_	Power system flexibility from generation, storage,demand & network (C3)	Flexible grid use: dynamic rating equipment, power electronic devices, use of interconnectors (T13)	1, 2, 3, 4, 5, 6	Addressing necessary changes of the legal, regulatory, and market framework.	Assessment of several nontechnical barriers for transmission expansion and distortions for market-compatible RES-E grid and market integration in Europe with reference to the challenges addressed in the relevant European policy documents (EC, ENTSO-E). Recommendations for policy making in remaining EU countries through consultation processes, communication, dissemination activities, policy debates and cooperation with ENTSO-E.
REserviceS	IEE (EU)	R&D	2012	2014	Renewable Energies Integration/ Energy Storage Integration/System Security &Stability/Planning, Operation & Management	Ciber Security	Energy Market/ Ancillary services (frequency & voltage control)	Cross Boarder-TSO/ TSO-DSO	Security & System Stability (C2)	Enhanced ancillary services for network operation (T9)	1, 2, 3, 4, 5,7, 8, 9, 10, 11, 12, 13, 14	Network Codes and Grid Codes should provide detailed specifications for minimum technical capabilities for generators to participate in GSS. Requirements should be function-oriented in addressing design capabilities and delivery performance. They should not prescribe technical solutions to reach a certain performance.	Policy makers should properly evaluate the cost/ benefit ratio of the proposed solutions in this project for market based frameworks and assign appropriate price ranges for the provision of grid support services (GSS). To incentivise investments, prices — be they related to bid-based markets, auctions or capability payments to generators— should capture both the benefits provided to the system in terms of system
SafeWind	FP7 (EU)	R&D	2008	2012	Renewable Energies Integration/ Planning, Operation & Management	Data Management	Energy Market/ Ancillary services (wind prediction)	_	Power system flexibility from generation, storage,demand & network (C3)	Improved RES forecasting and optimal capacity operation (T12)	1, 2, 4	No information available	No information available