PANTERA

Pan European Technology Energy Research Approach

Work Package WP4 "Key Topics and Content Management"

Deliverable D4.2.2

The 2nd report on Identification of Gaps and Missing Subjects

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:	**48 months**

Contractual delivery date:	**2020-09-30**
Actual delivery date:	**2020-09-30**
Lead beneficiary:	**UCC 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: 02

Revision / Status: Final

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Keywords: R&I Status, Technology, Gaps, Stakeholders, Decision

Document History

Revision	Content / Changes	Resp. Partner	Date
00	Creation of the document.	SINTEF	2020-07-06
01	Updated	UCC IERC; SINTEF	2020-09-13
02	Issued for comments in the task group	SINTEF	2020-09-17
03	Updated and issued for internal project review	SINTEF, IERC	2020-09-28
04	Comments implemented, document issued to the Coordinator	SINTEF	2020-09-30

Document Approval

Final Approval	Name	Resp. Partner	Date
Final Approval	Christina Papadimitriou	FOSS	5 October 2020
Final approval	Venizelos Efthymiou/Christina	FOSS	5 October 2020

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Abbreviations

Acronym	Meaning
AI	Artificial Intelligence
CEC	Citizens Energy Community
CSA	Coordination and Support Action
CSCC	Cross Sectoral Coordination Centre
CSP	Concentrated Solar Power
CYBAN	Cyprus Business Angels Network
DE	Distributed Energy
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
EPRI	Electric Power Research Institute
ES	Energy Storage
ETIP-SNET	European Technology and Innovation Platform Smart Networks for Energy Transition
EV	Electric Vehicle
FACTS	Flexible Alternating Current Transmission System
HEA	Higher Education Authority
HV	High Voltage
HVDC	High-voltage Direct Current
ICT	Information and Communication Technology
IDEK	The Research and Innovation Foundation of Cyprus
IES	Integrated Energy Systems
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)
LTS	Long-term Strategy
LV	Low Voltage
MNEs	Multi-National Enterprises
MoE	Ministry of Economics
MoF	Ministry of Finance
MV	Medium Voltage
NECP	National Energy and Climate Plan

NRA	National Regulating Authority
NRIC	The National Research and Innovation Council
PHEV	Plug-in Hybrid Electrical Vehicle
PV	Photovoltaics
R&D	Research and Development
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
TYND	Ten-year Network Development Plan
WP	Work Package
WT	Working Team

1 Introduction

The work in this report is carried out under activity "Key topics and content management" (WP4) 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 (R&I) 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 (for details see [1]).

1.1 Sub-activity "Identification of gaps and missing subjects" (T4.2)

According to the project's description of work, the main intention of this sub-activity 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 are 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 **third in the series of five project reports** in activity "Key topics and content management" (WP4), seeking to carry out the following analysis:

- Initial definition of the content for dissemination and networking activities (D4.1) [2]
- 1st Report on Identification of Gaps and Missing Subjects (D4.2) [3]
- 2nd Report on Identification of Gaps and Missing Subjects (D4.2.2) (the present document)
- Final Report on Identification of Gaps and Missing Subjects (D4.3)

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 final WP4 deliverable:

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

1.2 Summary of the previous findings in the activity

The first results of this activity were presented in report "D4.1 Content and Topics for Dissemination and Networking Activities" [1]. The key finding made during the starting phase of the WP4 activity was the definition of two separate dimensions for this WP: a technological dimension and a decision-making / regulatory dimension as a supporting part.

The first dimension contains a set of topics, based on the taxonomy that has been developed within the framework of the European Technology and Innovation Platform Smart Networks for the Energy Transition (ETIP-SNET) and validated by the key European stakeholders. In order to validate the initial set of topics, the project conducted a set of interviews with several stakeholders during the three PANTERA workshops in Sofia (BG), Dublin (IE) and Athens (GR), where the project received a valuable feedback, allowing to refine the proposal and outline further work in the following project activities. The target groups have been gradually extending towards new stakeholders.

The necessity of the second dimension was identified during the course of the project, when it was established that organisation of national regulatory and decision-making processes can be equally important as the technology-related part. In order to validate and further develop the first draft of a rather generic decision-making and regulatory structure for support and coordination of national R&I activities, it was done as a case-study. Norway was selected as main reference country for the case study mostly due to easy access to the necessary information. In the next D4.2 document [3] the case study was extended with several additional countries: Latvia, Cyprus and Ireland in order to justify the previous hypothesis and explore any potential shortcomings.

1.3 Purpose and limitations of the document

The document outlines the second version on identification of gaps and missing subjects for the PANTERA target countries. Completion of this task and deliverables depends on the outcome of multiple tasks within the PANTERA project. For example, identifying R&I status and gaps analysis in technology, assessing regulations, codes and standards (RCS) and energy policy barriers depend on activity "The state of R&I, standardisation and regulation" (WP3), also verification of some of the outcomes through the individual interview during the regional workshops, online survey etc. happens under activity "Workshop and dedicated stakeholders meeting organisation" (WP5).

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 the process of identification and its outcomes 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 two most PANTERA workshops in December 2019 in Dublin (IE) and in February 2020 in Athens (GR). 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 countries in this PANTERA project.

1.4 Structure of the Document

This document starts by a brief introduction of the sub-activity "Identification of gaps and missing subjects" and presenting summary of the preceding findings in it. The document further looks at the most recent changes in the Pan-European regulatory landscape, which are important for the targeted area of Smart Grids, storage and local energy systems. This is followed by a presentation of revised version of "R&I status and Continuous Gap Analysis" (RICAP) process, which was elaborated within another activity in PANTERA project. Then the document focuses on an updated summary of the interaction with the stakeholders, which was done essentially by interviews and workshops. The interviews have served as an important source for new ideas, some of which are further validated and refined in case studies of national decision-making and R&I supporting schemes, subsequently presented here. The preceding report "Content and Topics for Dissemination and Networking Activities" [4], based on interaction with the stakeholders suggested working topics, related to national decision-making process and corresponding funding mechanisms. The following section of the current report 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. Finally, the document arrives to the concluding parts, summarising the main findings.

2 Identification of the gaps

2.1 Changes in the Pan-European legislative and regulatory landscape

The intention of this section is to give a brief update on the recent changes in the Pan-European regulatory landscape, rather than providing a deep and exhaustive description. The focus is on the changes, which may directly influence the relevant R&I activities in the targeted countries.

Three following documents are often pointed out as the cornerstones for the European ambitions in the energy field:

- The European long-term decarbonisation strategy (LTS) "A clean Planet for all" aims at making Europe climate-neutral for all by 2050, with net-zero greenhouse gas emissions. The strategy shows how Europe can find the way to climate neutrality by investing into realistic technological solutions, empowering citizens, and aligning action in key areas such as industrial policy, finance or research.
- The Strategic Energy Technology (SET) plan, which defines the main priorities for the European energy ambitions of the energy transition according to the defined 10 Key actions. Several national case studies pointed out that national R&I strategies in the energy field are following the road paved by SET-plan.
- The New Circular Economy strategy is one of the main drivers, behind the most recent Green Deal Initiative, and is defined as Europe's new agenda for sustainable growth.

The Pan-European regulatory landscape has been constantly changing during the recent years, focusing on the long-term goals of decarbonising the power sector. The growing share of Renewable Energy Sources (RES), the appearance of new loads because of transport electrification and use of heat pumps for space heating, create several challenges in distribution and transmission networks. The Smart Grids technologies along with storage are key enablers allowing secure and reliable operation of the power grid.

The most pivotal event for the area of Smart Grids, storage and distributed energy resources domain was publication of "Clean Energy for All Europeans" package comprising several important documents and in particular EC Directive (EU) 2019/944 on common rules for the internal market for electricity (IEM) [5] and the corresponding IEM Regulation 2019/943 [6]. The package underlines several key issues and creates number of incentives in the following areas.

The IEM Directive opens with the statement that DSOs should be incentivised for using distributed resources as an active part of the power system as, for example, for avoiding network expansions. The Directive has a specific section dedicated to incentives for use of flexibility in distribution networks, which states that the distribution network development plan shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the distribution system operator is to use as an alternative to system expansion. Furthermore, the same document defines that when elaborating the ten-year network development plan (TYNDP), the transmission system operators (TSOs) shall fully take into account the potential for the use of demand response, energy storage facilities or other resources as alternatives to system expansion. The IEM Regulation states that in order to integrate the growing share of renewable energy, the future electricity system should make use of all available sources of flexibility, particularly demand side solutions and energy storage, and should make use of digitalisation through the integration of innovative technologies with the electricity system. The document puts on equal terms redispatching rules for generation and

demand response. It shall be open to all generation technologies, all energy storage and demand response, including those located in other Member States unless technically not feasible.

More importantly, the European Commission has started the formalisation process of several new business actors, including so-called Citizens Energy Communities (CEC) by indicating a broad scope of their potential roles and responsibilities in the IEM Directive [5]. Eurelectric, the association representing key stakeholders in the European electricity industry, looks at microgrids and in particular Citizens Energy Communities (CEC) as an important future resource, which can be endorsed with new duties (especially balancing responsibility) when acting either as a supplier, as an active customer, as a DSO, or as any other system user

The most recent TYNDP2020 established by ENTSO-E [7] includes among others Distributed Energy (DE) scenario taking a de-centralised approach to the energy transition. A key feature of the scenario is the role of the energy consumer (prosumer), who actively participates in the energy market and helps to drive the system's decarbonisation by investing in small-scale solutions and circular approaches.

The above-mentioned changes in the Pan-European regulatory landscape reaffirm the previously committed decarbonisation targets and indicate that we are stepping into decisive phase of energy transition in Europe.

2.2 Rethinking the process of "R&I status and Continuous Gap Analysis" (RICAP)

In the initial review process under activity "The state of R&I, standardisation and regulation" (WP3), PANTERA identifies that ETIP SNET is one of the most important initiatives in EU, which has developed the detailed roadmap 2017-2026 for smart grid R&I activities at EU level [8].

Hence, in the first year (2019) of PANTERA CSA, the RICAP process proposed in WP3 and accordingly the present activity (WP4), directly adopted the ETIP SNET R&I roadmap (2017-2026) which is based on clusters and functional objectives for transmission and distribution network.

2.2.1 Refinement of the RICAP process

In early 2020, ETIP SNET delivers an updated version of the "R&I Roadmap 2020-2030" [9] to align this document with its another farsighted publication "Vision 2050" [10]. The new roadmap considers the decarbonisation of whole integrated energy systems (IES), thus classifies the R&I activities in different ways i.e. research area and functionality. It is identified that the project evaluation method will then also be different for these two roadmaps. Hence, it is important to find out a common path to evaluate the R&I projects that will also allow an easy way to move forward from roadmap 2017-2026 to 2020-2030.

In the meantime, PANTERA team reviewed intensely the other international and EU initiatives on R&I activities, also the project evaluation methods. To dig into much deeper level, the R&I priorities as identified in the National Energy and Climate Plan (NECP) for each of the targeted countries are reviewed. At this stage, it is also interesting to learn how the progress is happening along with the ETIP SNET roadmap but analysing it at national level. It is also important to find out the way how to map NECP R&I priorities to align these with ETIP SNET roadmap.

All these studies and analysis finally help PANTERA to refine the RICAP process, where an attempt has been made to develop a universal methodology by linking the past to the present and future plans to achieve the targets based on the ETIP SNET vision 2050. The details of this review and development process are discussed in the deliverable D3.1 [11]. The RICAP process is also shown in Figure 2.1.

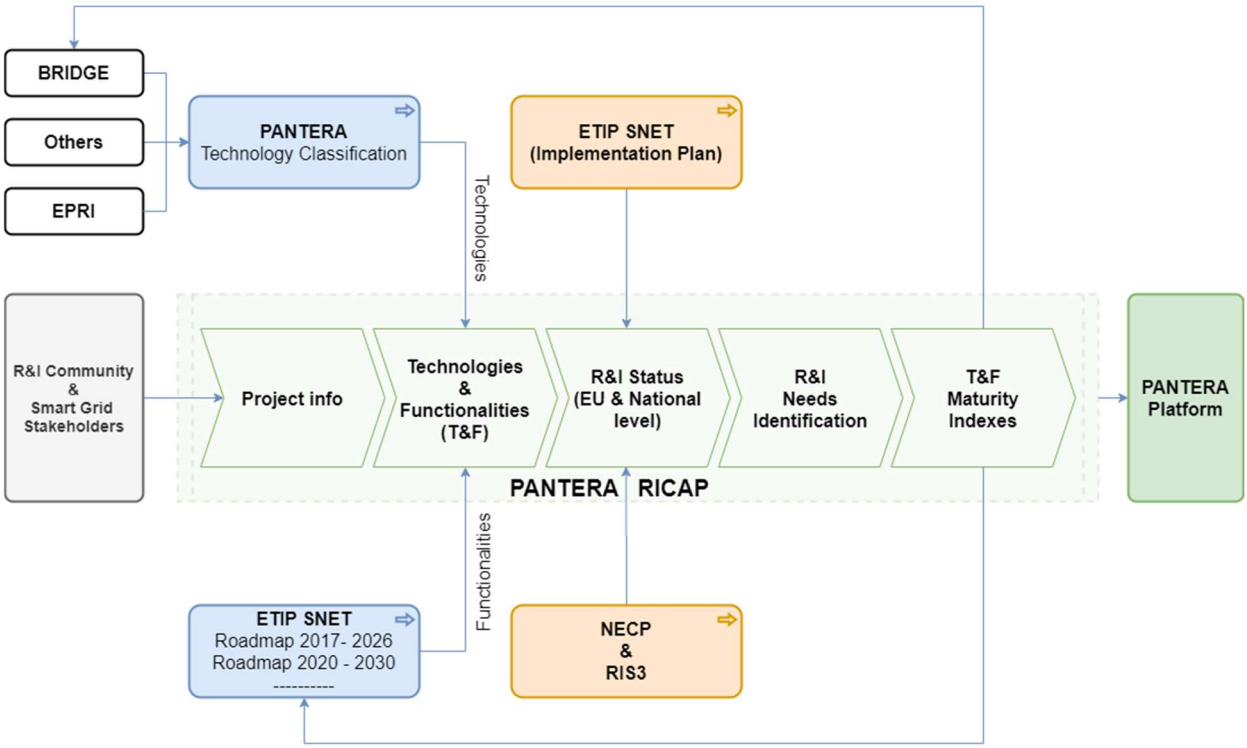

Figure 2.1 PANTERA RICAP (Technical)

In general, PANTERA RICAP process considers the ETIP SNET roadmaps (2017-2026 and 2020-2030), R&I priorities in NECPs and smart grid project evaluation methods practicing by ETIP SNET, BRIDGE and EPRI and proposed a generalised method.

2.2.2 PANTERA proposed Technology Classification and links to ETIP SNET FUNCTIONALITY

PANTERA is proposing the RICAP process supporting the ETIP SNET approach for the integrated energy system. Under this prism, PANTERA is proposing a list of technologies/systems for the integrated energy system that the R&I projects should be classified under. This, as already mentioned, is aimed to have a universal approach so that solid quantified feedback from all projects are given through the platform.

Towards the above direction, PANTERA consortium is working closely with ETIP SNET and BRIDGE initiative [12]. PANTERA recommends a new “Technology Classification”, as shown in Annex II (see page 29), and shows how the proposed technology classification can be linked to the FUNCTIONALITIES of the ETIP SNET 2020-2030 roadmap. Table 2.1 lists the key divisions of technology/systems that have been considered under the PANTERA “Technology Classification”.

It is to be noted that, PANTERA proposed technologies for IES are covering all the smart grid technologies that are already being considered by Electric Power Research Institute (EPRI) and BRIDGE initiative in their project evaluation methodologies. This way, a seamless transition of classification is secured without jeopardizing of losing critical information of the past and present projects from PANTERA database.

Table 2.1 Key Divisions of Technology/Systems

Integrated Grid
Customers and Market
Storage
Generation
Digitalization, Communication and Data

2.2.3 R&I Status Analysis based on refined RICAP process: A case study

A case study for Ireland is given as an example in the deliverable D3.1 to demonstrate the R&I status based on the PANTERA technology classification and its mapping with FUNCTIONALITY under the RICAP process. Graphical representation of the analysis is also shown in "Annex III" (see page 34).

Key findings of R&I status are as follow;

Integrated Grid
High Focused Technologies/Systems: Technologies for the network equipment, sensing monitoring for network management, control, system security and stability, feeder auto-restoration
Less Focused Technologies/Systems: HVDC, FACTS for the Transmission/cross-border network

Customers and Market
High Focused Technologies/Systems: Electricity market
Less Focused Technologies/Systems: Energy communities

Storage
High Focused Technologies/Systems: Electrical Storage and Flexibility
Less Focused Technologies/Systems: Thermal, power to gas, pumped hydro

Generation
High Focused Technologies/Systems: Flexible Generation, Wind
Less Focused Technologies/Systems: Solar, Hydro, other generations

Digitalisation, Communication and Data
High Focused Technologies/Systems: Communication network, data connectivity, security etc
Less Focused Technologies/Systems: Advancement in digitalisation such as AI

Final recommendation is made to implement the proposed RICAP process in future R&I status analysis towards the achievement of decarbonised EU smart grid network.

This example also shows how the PANTERA proposed technology classifications can be linked to the R&I areas that have been identified as priorities through the NECP. Table 2.2 shows the findings.

The green rows indicate that the smart grid projects in Ireland are already giving a moderate to good effort in these technologies as identified by the PANTERA RICAP process. Based on the R&I priorities in NECP, the other outlined technologies should also get preferences in the years ahead to achieve the 2030 target.

Table 2.2 Status of R&I activities in Ireland through the PANTERA RICAP process

R&I Priority in NECP	Projects evaluation under PANTERA RICAP	
	PANTERA Technologies	ETIP SNET FUNCTIONALITY
Decarbonisation		
High penetration of RES, especially from Wind, floating solar and wind	Wind, Flexible Generation	F1, F7, F10
	Solar PV	
Utilization of wave / tidal energy	Other Generation	F1, F7, F10
Development of power-to-gas storage systems	Power to Gas	F2, F7, F8, F10
Energy Efficiency		
Network stability improvement	network equipment, sensing monitoring, control, system security and stability, feeder auto-restoration	F1, F7, F9
	FACTS, Asset Management, Simulation, Modelling tools, Artificial Intelligence	
Energy Storage integration, flexibility and demand response	Storage Electric, Distribute Flexibility, Demand response	F3, F6, F7, F8, F10
Smart metering	Smart Metering Infrastructure, ICT solutions	F6, F7, F10
EV integration	Electric Vehicles	F10, F12
Heat pump	Thermal Storage	F10, F11
Energy Security		
Increase security of supply including gas network	Power to Gas, Thermal Storage	F1, F2, F11
	Forecasting, Flexible Generation	
Improvement in network operation and management	Outage management, fault finding, Smart Appliances, Artificial Intelligence	F1, F3, F6, F7, F8, F9
Interconnection	HVDC, Models, Tools, Systems for operation	F1, F2, F10
Internal Energy Market		
Single Electricity Market	Electricity Market	F4, F5, F10
Promoting sustainable energy communities	Energy Communities, Smart Appliances	F3, F5, F8, F10

2.3 Identification of gaps through Workshops 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 (see D4.1 [2]), the second in Dublin (IE) in December 2019 and the third in Athens (GR) in February 2020. The following section presents results from the two most recent workshop interviews.

2.3.1 Purpose and method for the interviews

The overall approach of the first three interviews was very similar. 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 Smart Grid landscape: challenges, specifics of the national organisation, decision-making and national R&I support schemes
- Technical issues from the Smart Grid domain, including importance/prioritising and if possible, reasoning (see Annex I, page 27*)*
- 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:

In Dublin:

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

In Athens:

- One representative from R&D company, working on multiple aspects of energy products.
- One representative from an energy cooperative, working as a facilitator and enabler of energy communities in Greece

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

2.3.2 Technical gaps and Challenges within the Smart Grid Landscape

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

> Distribution system is *a 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 of 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 these 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) Smart Grid interventions and transferring innovations to the industry, and (ii) growing need for the training of DSO's personnel according to the new challenges.

- One of the most important outstanding challenges was the necessity to improve the economics within the power sector, making it more targeted, and facilitate reliability and security of energy supply. Apart from this there are several regulatory issues, which should be improved in order to play a more supporting in role in the transition of the power sector and specifically in its distribution part.
- Decentralisation of the energy system and local distributed generation on local levels was mentioned as another important challenge, requiring implementation of Smart Grid technologies.

2.3.3 Feedback to the technical topics

Since re-definition and refining of the technical topics was a parallel ongoing activity, the part related to evaluation of the technical topics in the workshops was based on the initial taxonomy defined by ETIP SNET [8]. Interviewees were asked about feedback to the list of the technical topics (functional objectives in ETIP-SNET's terminology), which have an immediate importance.

Following the initial approach, based on the first ETIP SNET taxonomy, the following topics (see Table 2.3) were mentioned during the workshop in Ireland (topics in bold were mentioned by several respondents).

Table 2.3 Technical topics defined during the Dublin workshop.

Modernization of the network	Smart asset management
	New materials and technologies
Security and system stability	***Grid observability***
	Grid controllability
	Enhanced ancillary services
Power system flexibility from generation, storage, demand and network	Storage integration
	Demand response
	RES forecast
	Flexible grid use
	Interaction with non-electrical energy networks
	Flexible market design
	Flexible thermal power generation
	Cybersecurity

Integration of smart customers and buildings	Active demand response
	Energy efficiency from integration with smart homes and buildings
Integration of decentralised generation, demand, storage and networks	***Infrastructure to host EV/PHEV – Electrification of transport***
	Integration with other energy networks
Network operations	***Monitoring and control of LV network***
	Smart metering data processing and other big data applications
	Cyber security (system approach)
Planning and asset management	New planning approaches and tools

At the workshop of Greece, the respondents suggested that the first priority area should be the implementation of Smart Metering (several non-technical challenges prevent introduction of Smart Metering) and digitalisation of network operation, planning and licensing procedures (connection of PV to an LV network takes several months at the moment). There is also an open question about processing of metered data and approaching flexibility markets.

The technical topics specifically mentioned during the workshop in Greece are presented in Table 2.4.

Table 2.4 Technical topics defined during the Athens workshop.

Modernisation of Network	Environmental challenges and stakeholders
Security and System stability	Expert systems and tools
	Reliability and resilience
	Grid observability
	Enhanced ancillary services
Power system flexibility from generation, storage, demand and network	Demand response
Economic	Business models
	Flexible market design
Integration of decentralised generation, demand, storage and networks	Integration of storage in network management
	Infrastructure to host EV/PHEV – Electrification of transport
Network operators	Monitoring and control of LV network
	Automation and control of MV network

The importance of observability in distribution networks was specifically emphasised, in combination with improved planning of grid operation as is the case with the inclusion of flexibility into planning. Electrification of transport is a key activity, necessary for reduction of emissions and automation and control.

2.3.4 Potential benefits from implementation of Smart Grid solutions

A common opinion was shared across different interviews and stakeholders regarding the potential benefits: several respondents mentioned expectations of improving economics by better performance of the networks and reduction of costs. General innovation as well as introduction of

new business models are expected to contribute energy security and reliability.

In addition, it was also mentioned that a more active engagement of customers with more active involvement of them in the energy markets, decarbonisation of the economy, improved TSO-DSO coordination are some of the other benefits.

The most important aspect of Smart Grid technologies for the Citizen Energy Communities (CECs) is to have a holistic approach. Energy communities do not normally have one single service as energy production only. Normally there are several services combined together as for example EV fleet and smart equipment services in households. The expected benefit from Smart Grids is interlinking all these services together under the same system in a transparent manner for the community members. The transparency is also important to keep the community members together.

Several issues, related to organisation, roles and responsibilities of CECs as ownership of batteries, involvement in electricity trade and provision of ancillary services are specifically interesting for the project because, as it was mentioned in Section 2.1, CECs is an entirely new actor in Europe, which has been recently introduced.

2.3.5 Specifics of the national organisation, decision-making and national R&I support schemes

R&I activities in Ireland are aligned with the recent Ireland's "Climate Action Plan" [13] defining a set of 183 clear priorities and setting directions of the Smart Grid 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 own 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 Section 3. 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.

When it comes to Greece, it was indicated that at present the Smart Grid-related activities are approximately 20% financed by governmental agencies and EU projects.

There are no specific schemes incentivising funding of Smart Grid-related activities in Greece. This is also further complicated by very few actors present in the power sector i.e. single TSO and DSO.

The energy communities in Greece is a very new model, which started in 2018. According to the legal requirements 20 % of the capital had to be contributed by the members of a given energy community. This provides the necessary incentives to the members of the community. The rest of the capital is normally provided by bank loans, so the financial model can be replicable for several communities. In some cases, the communities are looking for additional support as for example state grants, but this is not typical.

Some additional incentives are established specifically for the energy communities as for example discount on obtaining of permits. No tax discounts for the energy communities exist. The international experience also shows that providing too many incentives may attract speculative investors misusing the incentives.

2.3.6 Barriers for more activities in Smart Grid domain

In case of Ireland, the following issues, which 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.

Several issues were pointed out as barriers in Greece: very low level of digitalisation combined with bureaucracy leads to very long waiting periods as for example, when it comes to connection of flexible assets such as for example batteries to the grid. Normally System Operators are not very interested to connect flexible assets, and combined with the overall bureaucracy, it may take very long time.

Among specific barriers for more activities in energy communities' field in Greece it was mentioned that the communities are normally organised as limited liability companies, and this complicates obtaining of financial loans.

2.3.7 Any other relevant information and inputs

The PANTERA approach received positive feedback, specifically mentioning that it is very important to involve stakeholders to participate and assist more actively in policy-making at the national level, facilitating the dialogue between regulators and stakeholders, using EC as a support.

As a take away for PANTERA it was the strong message to avoid looking at single topics only, but follow a holistic approach combining several aspects e.g. technical, social, regulatory, economic and financing in a balanced way to achieve a big advancement forward

2.3.8 Conclusions and next steps in PANTERA interviews

The overall experience from the interviews conducted in PANTERA so far has been twofold. In one way it proves that it is extremely difficult to find relevant and qualified stakeholders, wanting to participate in the interviews. The number of participants therefore has been varying from meeting to meeting. At the very same the feedback, received during the interviews was very valuable. Several respondents were experienced professionals in different fields related to the Smart Grid domain and provided not merely replies to the questions, but very valuable insights and opinions. As in case of Citizens Energy Communities, the respondents pointed out that creation and formalisation of CECs is an important issue, which was not initially foreseen by the project.

Considering that the overall experience with the interviews was very positive, the project consortium

agreed to extend the scope of the interviews to several other activities within the project. This means that in case other activities have any specific issues, which require clarification or any other relevant feedback, this may be included as additional questions into WP4 interviews.

3 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 [2]) related to national decision-making and funding mechanism.

3.1 Introduction to the topic: steps in the decision making and support process

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 [2] based on an initial case study of research and decision-making landscape in Norway. The workshops in Dublin and Athens 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&D projects deserves a specific explanation. A comprehensive comparative evaluation of regulatory regimes for DSOs across whole Europe, with specific focus on funding of R&D activities in the Smart Grids domain has been done by Eurelectric [14], 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 3.1 describes a generic decision-making process, which includes several national and regional institutions. The figure has been refined from the version presented in a preceding report [2], and depicts a set of roles, which can be populated with instances appropriate for any given country.

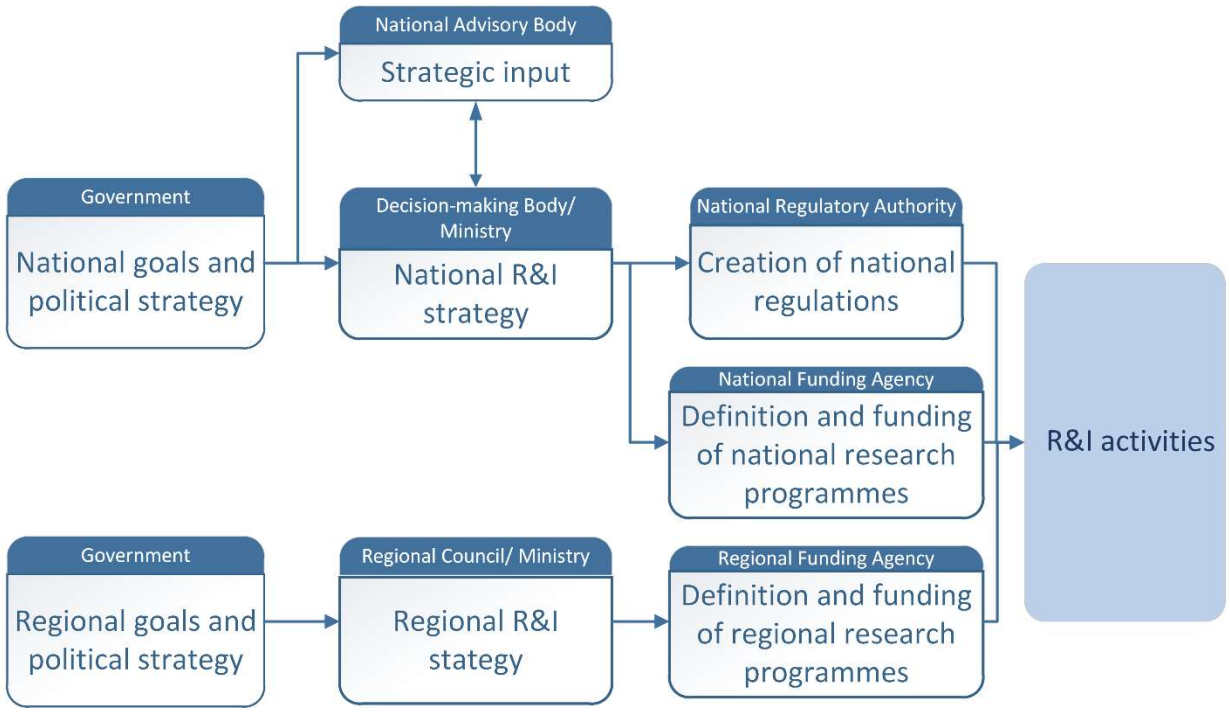

Figure 3.1: Steps in the decision-making process of funding for R&I activities.

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 initiate and encourage specific 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 provide input back to the strategic input. In addition, there may also be regional goals and political strategy, which inspire 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.

3.2 Discussion of results from the case studies

Table 3.1 shows a summary of the R&I actors in the case studies, as shown in Figure 3.1.

Table 3.1: 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	Department of An Taoiseach	Ministry of Economics, Ministry of Education and

	including Ministry of Energy		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 the practical difference is between having one, main funding agency, as opposed to having several funding agencies and how the division of tasks should be done.
- Furthermore, how can we make best use of the potential from regional funding schemes, and when this is necessary or if it is sufficient having national funding schemes only.

As a comment to the second bullet point 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 [14], 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 well-functioning 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.

4 Conclusions

The present document is an update of the first version, which was completed in the first part of 2020. Based on results of the activity the following can be concluded:

4.1 Technical topics

4.1.1 Rethinking of the RICAP process

Towards the achievement of vision 2050, decarbonising the integrated energy system, PANTERA team has refined the RICAP process where the new classification of Technologies/Systems have been proposed. A link between the Technologies/Systems and the FUNCTIONALITIES along with the NECP R&I priorities have been created to identify the R&I status and gaps at national level. Hence, it is important to update the stakeholders' interview questions to match with the proposed Technologies/Systems and Functionalities. The interviewed stakeholders in general agree that the adopted ETIP SNET's taxonomy and approach are highly relevant and sufficient for setting the technical priorities.

4.1.2 Emerging topics

Citizens Energy Community as an entirely new actor has been recently introduced in Clean Energy for all Europeans package. Feedback from the stakeholder indicates a growing interest towards this issue from different points of view, including roles, responsibilities, organisation and interaction with the rest of actors in the energy sector.

4.2 Non-technical topics

4.2.1 Regional Cooperation

The results of interviews and the case studies indicate that there are normally several layers of research programmes and underlying funding agencies e.g. national, regional and pan-European. An example of regional cooperation between several neighbouring countries was presented in a case study, developed for the Nordic countries, which have historically cooperated in many decades. The experience shows that regional cooperation may be a powerful tool for the acceleration of R&I activities by replicating best practices and fast technology deployment in similar countries. Initiation and development of regional cooperation however, requires certain political will and coordinating efforts.

4.2.2 Financial instruments and schemes encouraging R&I projects

It has been indicated that schemes for initiation and financing of targeted R&I processes on national level are of great interest for the stakeholders. Studying best experiences from other countries and replication of these through adoption to the local conditions, may increase both the scope of activities and make them more applied i.e. increase TRL levels due to close cooperation with industry.

4.2.3 Replication of best practices rather than pointing out specific mistakes

During an extensive dialogue with stakeholders, it has been understood that the PANTERA project should not try to point out specific errors and shortcomings in specific countries. The project does not have sufficiently deep knowledge about background or possible forthcoming developments. It is

also quite likely that through such a practice, there is the possibility to provoke an unwanted negative reaction from the stakeholders, which can demoralise their interest to be involved in the PANTERA process.

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6 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 [8]. 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 6.1 and Table 6.2 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 6.1 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 6.2 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

7 ANNEX II: PANTERA proposed Technology Classification

Table 7.1 PANTERA proposed Technologies and Systems for Integrated Energy System

Technologies and Systems in support of the Functionalities			
No.	**Group of technologies**	**Technologies**	**Description**
1	**Integrated Grid**	Flexible ac transmission systems (FACTS)	Controllable power electronic equipment that will support the Transmission smart grid operations
2		Models, Tools, Systems for the operation analysis, control and the development of the integrated grid including cost elements	Advanced models, tools, systems for the operation analysis, control, state estimation and the development of the integrated grid (TYNDP etc) including cost elements
3		HVDC	High Voltage Direct Current overhead and underground grid.
4		Forecasting (RES)	Advanced forecasting tools (RES) that will allow a low estimation error and provide an accurate feedback for the actors that need this type of services. E.g. aggregators, operators, RES owners, ESP, the market operator etc.
5		Asset management	The methodology, procedures, the devices and software that allow the efficient management of assets of the integrated grid.
6		Outage management, fault finding and associated equipment (including protection)	The methodology, procedures, the devices and software that allow the efficient management of outages including fault finding of the integrated grid.
7		Equipment and apparatus of the integrated grid	All the primary equipment (rated at the rated voltage of the system) and apparatus constituting the integrated grid including Power guards and limiters.
8		Equipment, sensing, monitoring, measuring for analysis, solutions and control	Equipment, sensing, monitoring, measuring for analysis, solutions and control including procedures and software that make observable the integrated grid. These include the devices and the procedures that allow PMUs, PDCs and GPS to be efficient tools of the smart grid paradigm
9		Advance distributed load control	Software or hardware devices or procedures that allow advanced distributed control of distributed assets of the grids including different type of DERs and load
10		Feeder auto-restoration / self-healing	Advanced procedures and systems that facilitate the feeder auto-restoration thus implementing the self- healing of the interconnected system
11		Smart metering infrastructure	All the procedures and systems that are related to smart meters as devices and complete bi-directional communication link between metering data management systems

			and end users.
12	Customers and market	Distributed flexibility, load management & control and demand response including end devices, communication infrastructure and systems	All procedures, controls and devices that facilitate distributed flexibility, load management including explicit demand response and system
13		Smart appliances	Smart appliances that allow customer market participation and smart load control.
14		Building control, automation and energy management systems	All procedures, controls and devices that secure smart building automation including home energy management, active control, monitoring and market participation
15		Electric vehicles	Electric vehicles are vehicles based on battery or fuel cell resource for transport needs.
16		Energy communities	Its primary purpose is to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates. May engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders;
17		Lighting	Any apparatus emitting light and related systems.
18		Electricity market	All elements of the electricity market including platforms that enable wholesale, retail, real time pricing / spot, flexibility, aggregated and peer to peer trading including ancillary services, etc.
19	Storage	Storage Electric	In the electricity system, apparatus capable of deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy.;
20		Thermal Storage	The main parts and all auxiliary components that form a ready to integrate device capable of storing thermal energy for use at a later stage.
21		Power to gas	The main parts and all auxiliary components that form a ready to integrate device from technologies that uses electrical power to produce a gaseous fuel for storing or use otherwise.
22		Pumped storage	The main parts and all auxiliary components that form a ready to integrate system to operate as a Pumped storage system which is the process of storing energy by using two

			vertically separated water reservoirs. Water is pumped from the lower reservoir up into a holding reservoir. Pumped storage facilities store excess energy as gravitational potential energy of water.
23		Other Storage	The main parts and all auxiliary components that form a ready to integrate device capable of storing energy other than the above systems.
24	**Generation**	Flexible generation	The main parts and all auxiliary components that form a ready to integrate device
25		Solar including PV & CSP	The main parts and all auxiliary components that form a ready to integrate systems capable of generating electricity from PV or CSP technologies.
26		Wind	The main parts and all auxiliary components that form a ready to integrate systems capable of generating electricity from wind technologies.
27		Hydropower	The main parts and all auxiliary components that form a ready to integrate system capable of generating electricity from flowing hydro.
28		Hydrogen & sustainable gases	The main parts and all auxiliary components that form a ready to integrate systems capable of generating electricity from hydrogen and other sustainable gases.
29		Other generation	The main parts and all auxiliary components that form a ready to integrate systems capable of generating electrical energy other than the above.
30	**Digitalization, Communication and Data**	Communication networks including devices and systems for signals and data connectivity and solutions	Any combination of equipment and systems forming a communications network as a group of *nodes* interconnected by *links* that are used to exchange messages between the nodes. The links may use a variety of technologies based on the methodologies of *circuit switching*, *message switching*, or *packet switching*, to pass messages and signals including Local Area Networks, Home Area Networks and web-based solutions and cloud services for smart gird operations
31		Digital Twins	Any combination of equipment and systems forming Digital twins that are virtual replicas of physical devices that can used to run simulations before actual devices are built and deployed.
32		Artificial intelligence	Any combination of equipment and systems forming Artificial intelligence that simulates human intelligence in machines that are programmed to think like humans and mimic their actions.
33		Data and cyber security	Any combination of equipment and systems

		including repositories	offering Cyber security for defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks, including generated data from the interconnected system with related repositories other than that related to the MDMS (Meter and Data Management System).

Table 7.2 The PANTERA recommendation on technologies' connection with FUNCTIONALITY

	Technologies in support of the FUNCTIONALITY		
No.	**Group of technologies**	**Technologies/Systems**	**FUNCTIONALITY**
1	**Integrated Grid**	Flexible ac transmission systems (FACTS)	F7
2		Models, Tools, Systems for the operation analysis, control and the development of the integrated grid including cost elements	F9
3		HVDC	F7
4		Forecasting (RES)	F4,F5,F9
5		Asset management	F1,F7, F9
6		Outage management, fault finding and associated equipment (including protection)	F1,F7
7		Equipment and apparatus of the integrated grid	F7, F1
8		Equipment, sensing, monitoring, measuring for analysis, solutions and control	F7, F6, F1
9		Advance distributed load control	F7, F1
10		Feeder auto-restoration / self-healing	F1,F7
11		Smart metering infrastructure	F6,F7,F8, F1
12	**Customers and market**	Load management & control and demand response including end devices, communication infrastructure and systems	F3,F5,F7,F8,F10,F11
13		Smart appliances	F6,F5, F8
14		Building control, automation and energy management systems	F3,F10,F11,F8
15		Electric vehicles	F5,F8, F2
16		Energy communities	F5,F8,F10, F11, F12
17		Lighting	F10
18		Electricity market	F2, F5,F10, F3,F4, F8, F11, F12
19	**Storage**	Storage Electric	F4, F5,F10, F12,F8
20		Thermal Storage	F2,F10,F11,F8
21		Power to gas	F2,F10,F8
22		Pumped storage	F2,F10,F11,F8
23		Other Storage	F2,F10,F8
24	**Genera tion**	Flexible generation	F2,F10,F4,F5,F8
25		Solar including PV & CSP	F2, F4, F8
26		Wind	F4,F8

27		Hydropower	F8, F10
28		Hydrogen & sustainable gases	F2,F8,F10,F12
29		Other generation	F8,F10,F12
30	**Digitalization, Communication and Data**	Communication networks including devices and systems for signals and data connectivity and solutions	F6
31		Digital Twins	F6, F9
32		Artificial intelligence	F6,F9
33		Data and cyber security including repositories	F6

8 Annex III: R&I Status study through the refined RICAP process

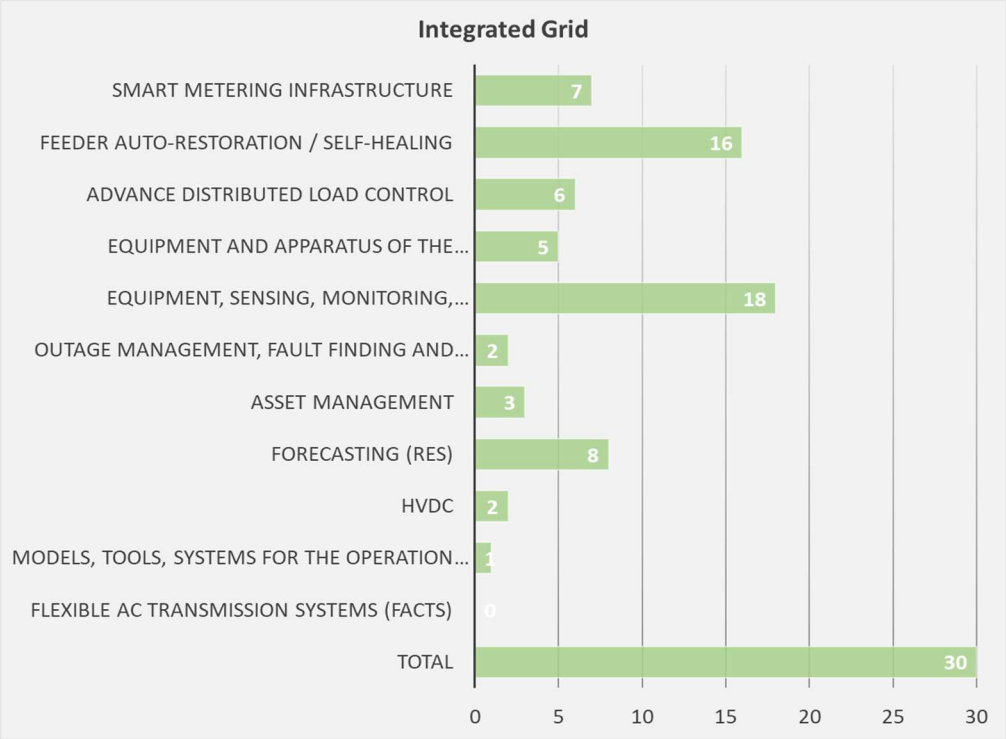

Figure 8.1 Integrated Grid

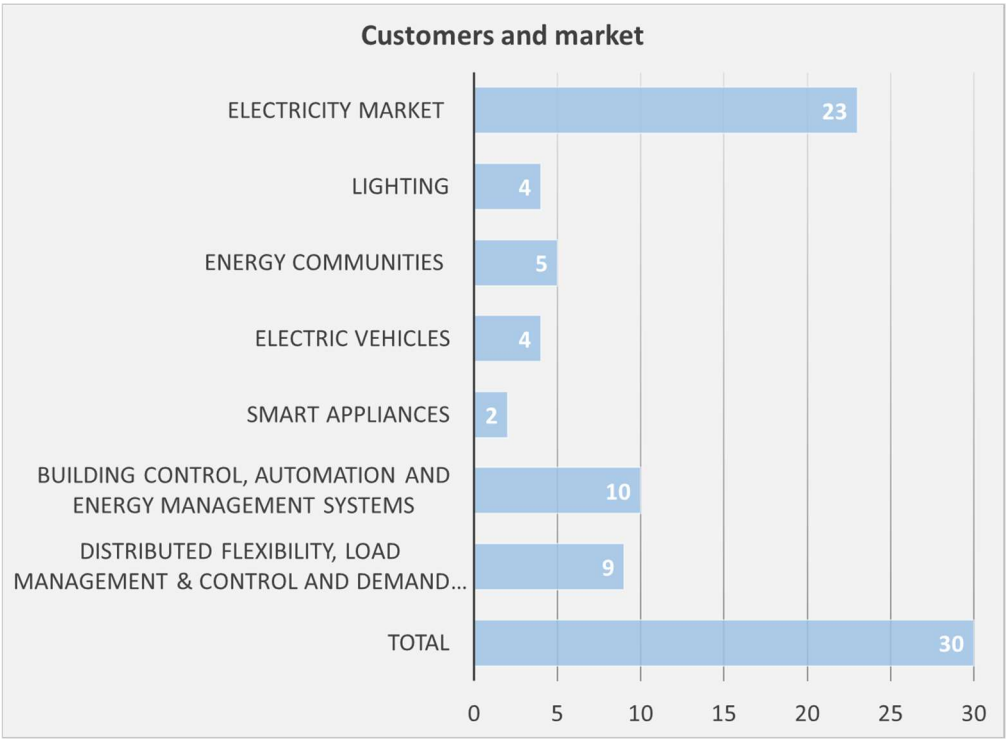

Figure 8.2 Customers and market

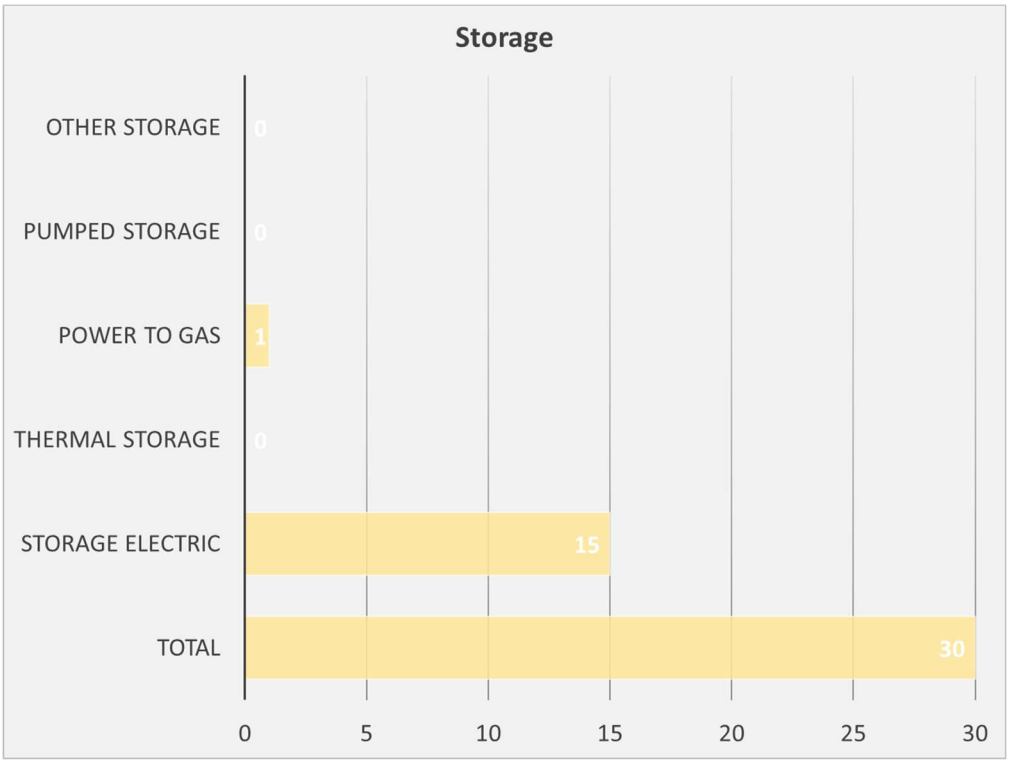

Figure 8.3 Storage

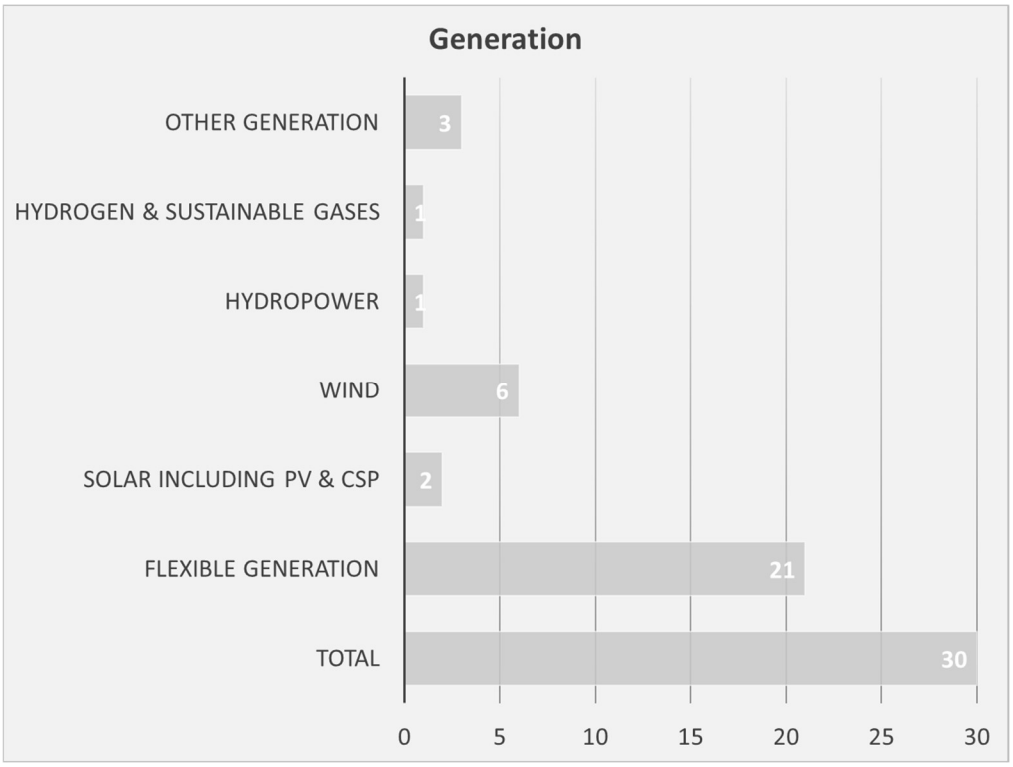

Figure 8.4 Generation

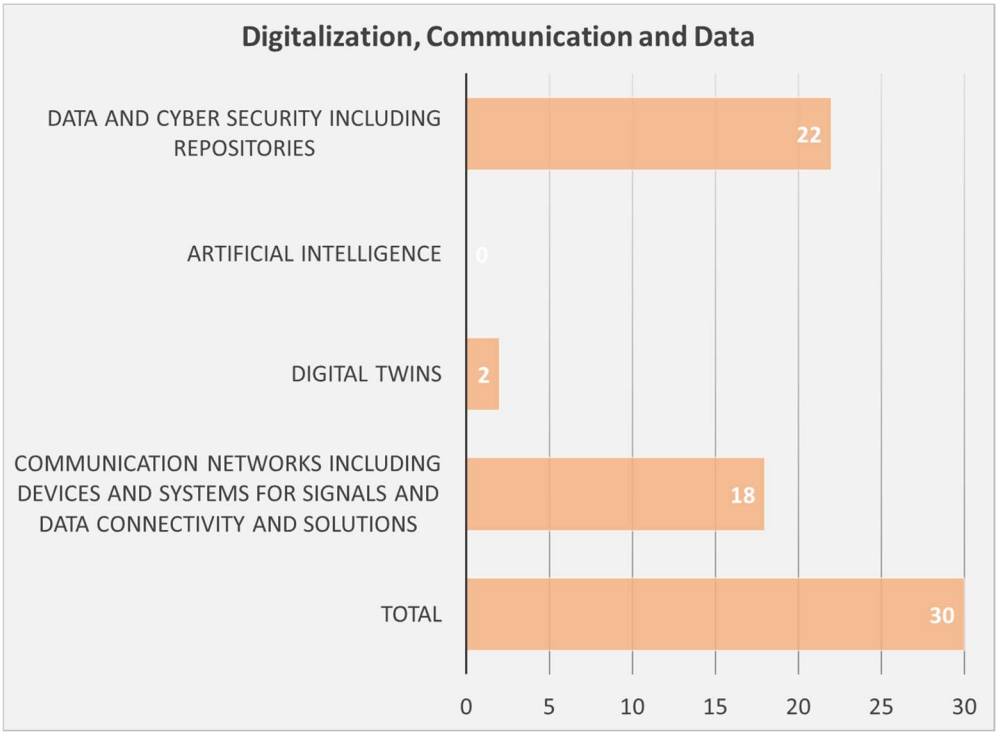

Figure 8.5 Digitalisation, Communication and Data

9 Annex IV: Case Studies

9.1 Case Study: Cyprus

9.1.1 R&D system structure/funding landscape

National Research and Innovation Governance System (R&D) is considered as one of the key pillars of success and implementation of the Strategic Goals of the National Strategic Research and Innovation. 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&D Governance System (shown in Figure 9.1) 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&D 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.

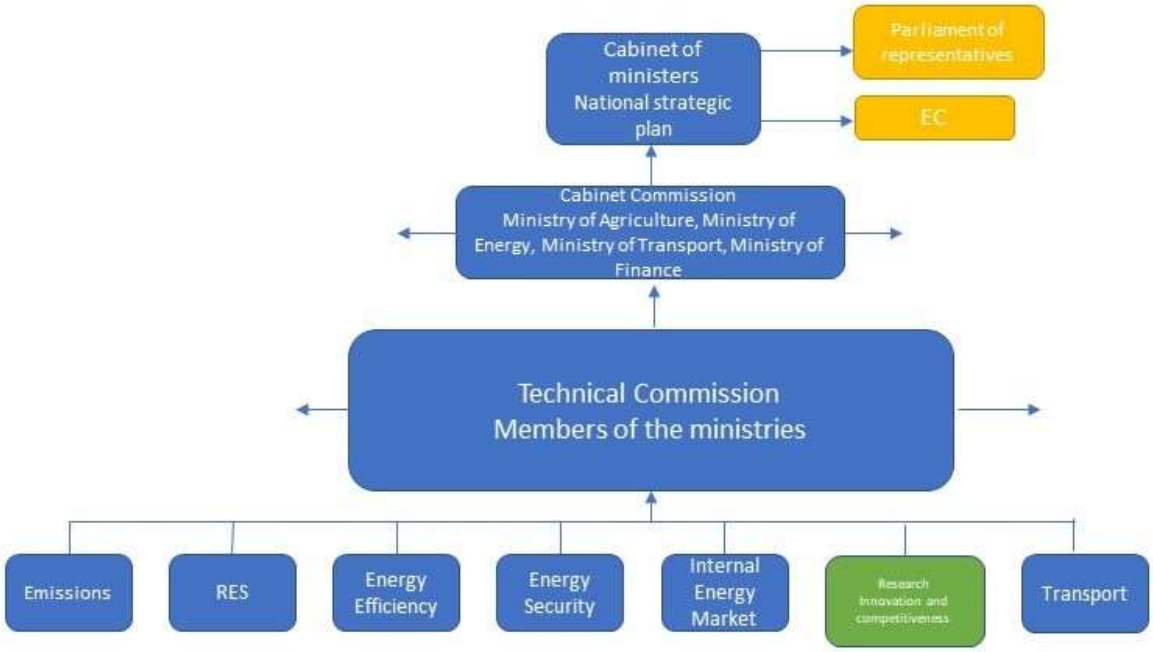

Figure 9.1 National Research and Innovation Governance System (R&D)

9.1.2 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, their coordination and proper functioning and their effective contribution to the development and implementation of strategic and policy R&D. 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.

9.1.3 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.

9.1.4 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&D Strategy
- Designing and coordinating R&D 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.

9.1.5 Incentives and support schemes for participation in R&D

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&D 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.

9.1.6 Regional funding schemes

There are not any regional funding schemes, covering Cyprus.

9.2 Case Study: Ireland

9.2.1 R&D system structure/funding Landscape

The Government of Ireland has set out a National Development Plan for 2018 to 2027 [15] 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 contributed to a Climate Action Fund to support initiatives that contribute to the achievement of Ireland's climate and energy targets, and to a Disruptive Technologies Innovation Fund. Specific targets for climate action are set out in the National Climate Action Plan [13].

9.2.2 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 is also a Research Prioritisation Steering Group, a Climate Change Advisory Council, and a Climate Action Delivery Board is to be established.

Levels of Government R&D expenditure as a percentage of all Government expenditure are approximately 1% [16]. 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&D are administered through State agencies including IDA Ireland, Enterprise Ireland and others.

9.2.3 Funding agencies and programmes

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

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.

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

9.2.4 National regulating authority

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

9.2.5 Incentives and support schemes for participation in R&D

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&D activities may also qualify for tax incentives under schemes such as the R&D 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.

9.2.6 Regional funding schemes

There are no regional funding schemes covering Ireland.

9.3 Case Study: Latvia

9.3.1 R&D system structure/funding landscape

Latvian research and innovation funding system is complicated, and functions are fragmented between various institutions (see Figure 9.2). 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).

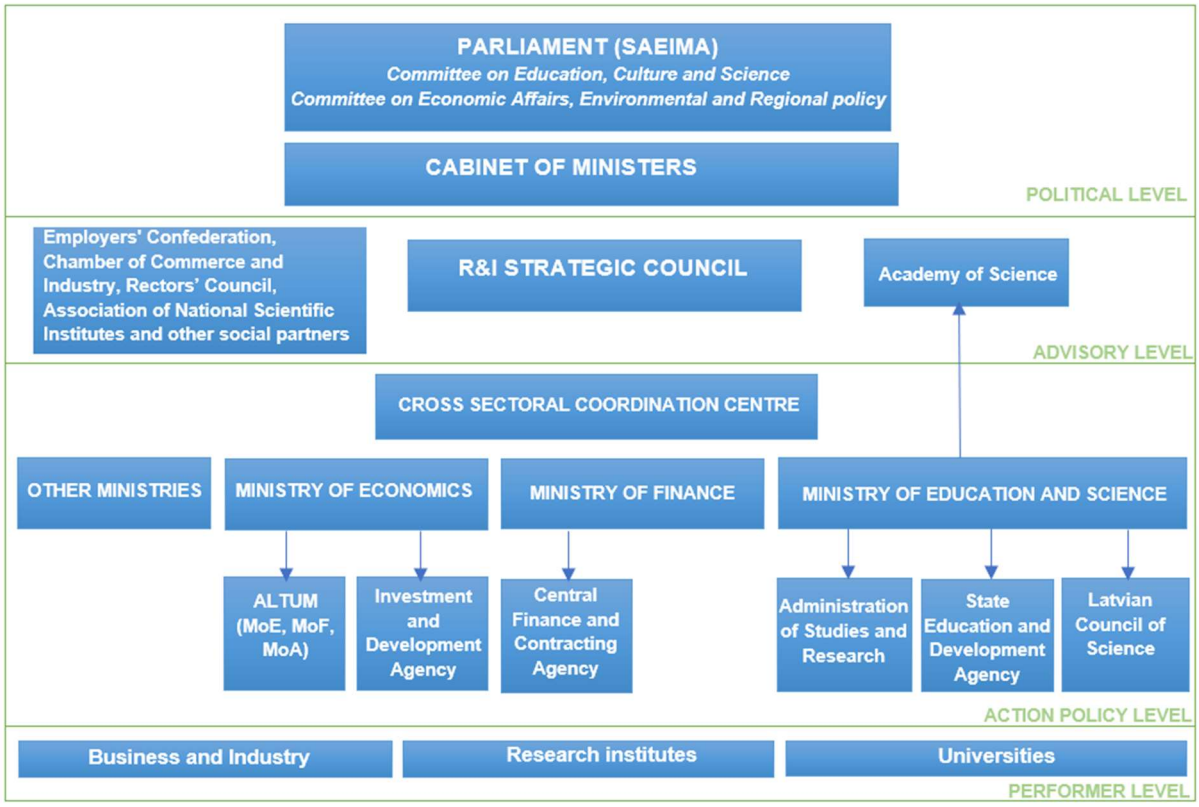

Figure 9.2 Latvian R&I funding system.

9.3.2 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**. Its function 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 of its own and only experiences a political drive to be active at times then there are large amounts of budget to be allocated [17].

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 [18].

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 [19].

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 [17].

9.3.3 Funding agencies and programmes

R&D 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 [20]. 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 [21].

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 [22].

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 [23].

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 [24]. 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 [25]. Research Funding Programme Department of SEDA performs functions relates to the R&D 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 [26].

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.

9.3.4 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.

9.3.5 Incentives and support schemes for participation in R&D

There are a number of instruments supporting and funding industrial innovation in Latvia, most important are [17] [27]:

- 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&D 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 are not specific arrangements in the regulation regime for national DSO and TSO, which will create specific incentives for involvement into R&D activities.

When it comes to industrial associations, having a coordinating roles in R&D, 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.

9.3.6 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.

9.3.7 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 [28].

EU Policy Support Facility instrument's experts recommended to streamline the structure and governance of state organisations [17]:

- 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 [28].