

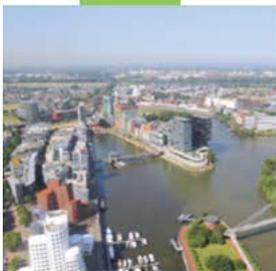
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EERASE3



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Existing and new funding instruments promoting alignment of energy research

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Executive summary

Around 7-8 % of the total funding for European Research is distributed through the framework programmes; the rest is spent in the Member States (MS) and Associated Countries (AC). There are strong arguments supporting that Europe could gain a much larger competitive edge related to competing economies if we could work closer together and coordinate these national and European resources more efficiently. The urgency of realizing the SET Plan Implementations Plans emphasise the importance of achieving this.

Through the EERASE3 (H2020) project, the European Energy Research Alliance (EERA) has conducted an exercise on European energy research alignment consisting of three main pillars:

1. Screening and comparative analysis of existing and new funding instruments promoting alignment of European energy research
2. Mapping of cross-national funding schemes for Strategic Energy Technology Plan (SET Plan) countries
3. Recommendations to strengthen coordination/alignment on European energy research

This first part of the report covers the first pillar through a study of the most recent projects and reports addressing research co-funding. It provides a brief overview of the reports/projects and their main findings.

The main input has been from EERA LEARN 2020, a recent Technopolis report commissioned from the Estonian presidency period, the ERKC project and a broad experience by EERA members on practical Joint Programming.

The main findings are that there is a lack of proof that Joint Programming provides more added value than the regular framework projects, that the EU side is too complex due to the large number of available instruments for cross-national collaborations, and that on the MS/AC side the governments interest varies largely and the available funding for coordinated European initiatives lacks flexibility.

The findings from this review provide input to a second pillar that collects 1-pager descriptions of SET Plan Countries funding schemes with focus on funding flows and volumes, identification of key decision-makers in the funding distribution process and the share of funding made available for co-funded research at the European level.

Based on the findings from these two pillars, a third section will address possible means to develop existing or shape new co-funding models and processes to reinforce European energy research alignment focusing primarily on the SET Plan Implementation Plans. The second and third pillars will be covered in the second half of the report.

It is worth noting that the findings and proposals in this report are EERA's and do not represent the opinions or recommendations of the European Commission (EC), the SET Plan Steering Group (SET Plan SG) or any of the involved stakeholders but is intended to be a starting point for a discussion for further action by the actors in their decision fora.

List of abbreviations

| | |
|---------------|--|
| AC | Associated Countries |
| CCS | Carbon Capture and Storage |
| CSA | Coordination and Support Actions |
| CSP | Concentrated Solar Power |
| CSP-IP | Concentrated Solar Power Implementation Plan |
| EC | European Commission |
| ECRIA | European Common Research and Innovation Agenda |
| EERA JP CSP | EERA JP on Concentrated Solar Power |
| EERA | European Energy Research Alliance |
| EJP | European Joint Programme |
| ERA | European Research Area |
| ERIC | European Research Infrastructure Consortium. |
| ERKC | The Energy Research Knowledge Centre |
| ESFRI | European Strategy Forum on Research Infrastructures |
| ESIR | Expert Group on the economic and societal impact of research and innovation |
| ETIPs | European Technology and Innovation Platforms |
| EU | European Union |
| IPR | Intellectual Property Rights |
| IRP STAGE-STE | Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy |
| IRP | Integrated Research Programmes |
| IWG | Implementation Working Group |
| JPIs | Joint Programme Initiatives |
| JPs | Joint Programmes |
| KPIs | Key Performance Indicators |
| MOP | Mission Oriented Policy |
| MoU | Memorandum of Understanding |
| MS | Member States |
| NFOs | National Financing Organizations |
| NSON | North Sea Offshore Network |
| P2Ps | Public to Public Partnerships |
| PPPs | Public Private Partnerships |
| R&D | Research & Development |
| R&I | Research & Innovation |
| RIA | Research and Innovation Action |
| SDGs | Sustainable development goals |

| | |
|-------------|---|
| SET Plan SG | SET Plan Steering Group |
| SET Plan | Strategic Energy and Technology Plan |
| SETIS | SET Plan Information System |
| SMEs | Small medium-sized enterprises |
| SRA | Strategic Research Agenda |
| SWOT | Strengths, Weaknesses, Opportunities, Threats |
| TRL | Technology Readiness Level |
| TWG | Temporary Working Group |

Introduction

This is the first pillar of three on European energy research alignment under the H2020 EERASE3 project. It covers the most recent projects and reports addressing research co-funding. It provides a brief overview of the reports/projects and their main findings.

The findings from this review provide input to a second pillar that collects 1-pager descriptions of SET Plan Countries funding schemes with focus on funding flows and volumes, identification of key decision-makers in the funding distribution process and the share of funding made available for co-funded research at the European level.

Based on the findings from these two reports, a third pillar will address possible means to develop existing or shape new co-funding models and processes to reinforce European energy research alignment focusing primarily on the SET Plan Implementation Plans.

It is worth noting that the findings and proposals in this report are EERA's and do not represent the opinions or recommendations of the European Commission (EC), the SET Plan Steering Group (SET Plan SG) or any of the involved stakeholders but is intended to be a starting point for a discussion for further action by the actors in their decision fora.

Background

The projects/reports that have been analysed and summarised are as follows:

1. ERA LEARN 2020 – PPP, P2P, JU, JPI, ERANETs – SWOT Analysis

The Council of the European Union adopted the concept of "joint Programming" as late as 2008 to promote the pooling of national research efforts to make better use of Europe's public R&D resources. Researching in parallel at national level should be replaced by strategically coordinated research at the European level with large increase in efficiency and added value.

The European Research Area and Innovation Committee's High-Level Group for Joint Programming defines alignment as: "the strategic approach taken by Member States to modify their national programs, priorities or activities as a consequence of the adoption of joint research priorities in the context of Joint Programming, with a view to implement changes to improve the efficiency of investments in research at the level of Member States and the European Research Area".

ERA LEARN 2020 is a three-year project dedicated to collect a comprehensive amount of data about European partnership instruments, analyse them and recommend how to develop them further. The data and the reports are available at the website www.era-learn.eu that also includes a list of current networks and links to their calls. From a large amount of data three reports are selected to share key discussions and recommendations.

Summing up, ERA LEARN 2020 sets out to:

- Establish a typology to create a common understanding of what alignment is
- Identify good practices through case studies
- Undertake a SWOT analysis of alignment actions and instruments

1.1 Definition and Typology of Alignment (Report November 2015)

First a definition of the research programming cycle is offered, followed by a detailed run through of how different instruments are applied along this cycle, listing approach and cooperation mode, as shown in Figure 1.

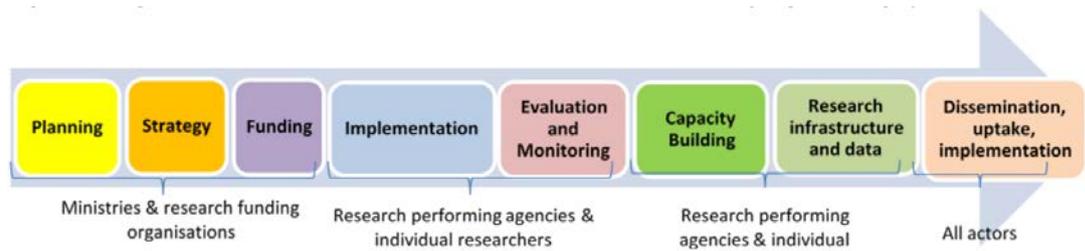


Figure 1. Alignment actions across the entire research programming cycle

The document provides a good platform for establishing a "common world view" and a language to discuss and develop alignment, but the detailing is primarily useful for the alignment experts shaping future instruments and processes. At policy level the findings below are offered.

Key barriers to alignment at national level:

- Lack of common understanding and terminology
- Insufficient inter-operability between various national rules and procedures for funding and executing research
- Weak in-country coordination and consultations on strategic research priorities
- Lack of sufficient national funding to support transnational coordination
- Difficulty to show concrete results from alignment in the short-term

Key factors for successful alignment include:

- The combination of **bottom-up** (researchers, researcher performing organisations) alignment actions such as knowledge hubs and other researchers' networks, and **top-down** alignment actions (Ministry, research funding organisations) such as joint, long-term integrated research programmes and the set-up of common research centres and infrastructures.
- Strong political commitment (e.g., Nordforsk "common pot without fair return")
- Mutual trust and consensus-building at all levels (researchers, research performing and funding organisations, Ministries, etc.) via regular consultations and dialogue

1.2 Toolbox of current and novel alignment modalities and instruments (Report September 2017)

The Toolbox is primarily targeted at research program owners and managers and focuses on P2P's (public to public partnerships) and provide a list of 29 actions that can be used during different stages, as shown in figure 1, and depending on what you want to achieve.

At the top level the terminology is suited for policy makers agreeing on principle choices and actions to be taken. The details are for those diving into P2P implementation. The actions are:

Strategic alignment

- Joint Foresight
- Joint mapping of existing research
- Adoption of common strategic research and innovation priorities
- Adoption of common strategic implementation/action plan
- Joint stakeholder consultations
- Cooperation between P2Ps
- Cooperation between P2Ps and PPPs

- Cooperation with countries outside EU
- Set up a network of national (and EU) research funding organisations

Financial alignment

- Synchronisation of national calls for research proposals
- Joint transnational calls for research proposals

Operational alignment

- Establish an integrated joint research programme
- Establish a strategic, long-term integrated joint research programme using Article 185
- Establish a network/alliance of research performing (and funding) organisations
- Establish a joint research centre
- Set up a network of individual researchers
- Common framework for monitoring, evaluation and impact assessment of P2P network
- Joint project monitoring
- Develop KPIs across JPIs and P2Ps
- Joint training for researchers, policymakers and practitioners
- Cross border mobility for researchers, policymakers and practitioners
- Transnational access to research infrastructure
- Coordination of existing infrastructures (ESFRI)
- Establish a joint research infrastructure facility
- Open access to national scientific research output
- Harmonize/standardize scientific techniques, data and methods
- Joint exchange, learning and dissemination of research output to policy makers
- Joint dissemination of research output to stakeholders and end-users
- Joint facilities and instruments to upscale and replicate research findings

1.3 SWOT analysis of alignment modalities (Report November 2017)

This ERA Learn 2020 report focuses on P2P (public to public partnerships).

Three levels of alignment suggested: Strategic, operational and financial. Strategic aligning can be described as creating a common world-view or basis for operational and financial cooperation. Moving to operations you start working together using varieties of in-kind funding based on institutional or national interest. In the end you put money on the table to back it, rewarding the process in advance with increased resources to further develop the cooperation.

Targeted actions to address the challenges within the different levels are detailed and refer to the 29 actions in the toolbox report. The most important issues to address within each level are given.

Strategic alignment

- Identify areas of common interest and develop Strategic Research and Innovation agendas - SRIA
- Need to improve coordination at national level (inside nations)

Operational alignment

- Identify call topics
- One call secretariat for call management
- Funding procedures and reporting

- Sharing data, research and infrastructure
- Capacity building and knowledge transfer/interaction with users

Financial alignment

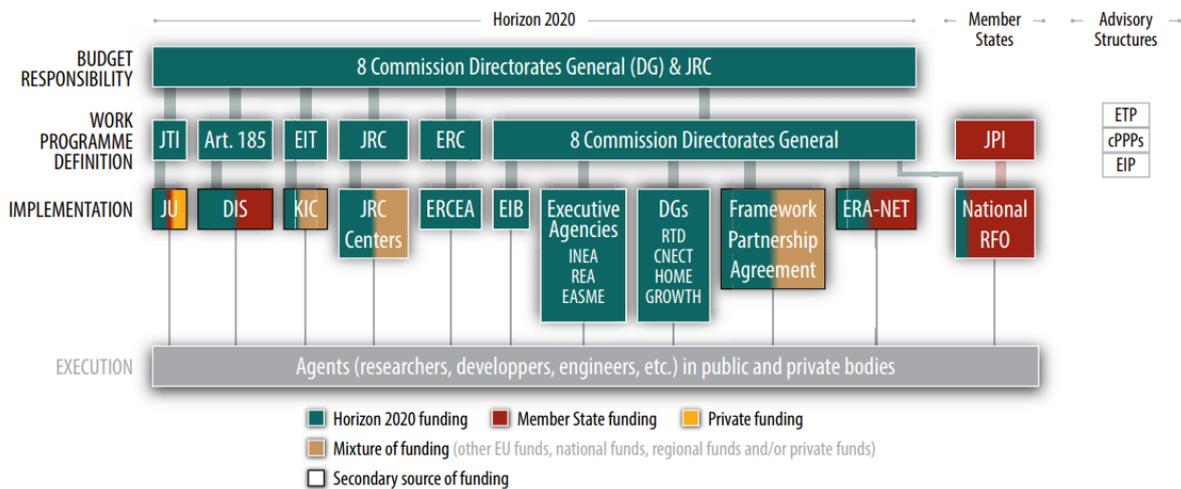
- Funding models; virtual common pot, real common pot, and mixed mode
- Cash and in-kind contribution
- Ensuring "fair" national contribution sharing
- Maximising EU contribution

Opportunities and threats

- Political commitment
- National R&I funding structured around societal challenges
- A dedicated coordinated national structure for P2P participation
- A budget dedicated to participation in Joint programming
- Flexible budgeting for Joint programming participation
- EU dedication to develop the Joint Programming landscape (simple, flexible, trusted, inclusive, efficient)
- Future dictates need for EU to succeed (in global competition)

2. Estonian Technopolis Report: Increased coherence and openness of European Union research and innovation partnerships (December 2017)

This report undertakes the challenge of evaluating ECs rather chaotic set of partnering instruments in H2020, as shown in the figure copied from the report.



Source: EPRS, based on European Commission data.

Figure 2. Overview of the H2020 bodies involved in its implementation and instruments in operation

In terms of funding, the entire partnership instruments are estimated to capture roughly 25% of the total Horizon 2020 budget for 2018. However, only 16% of the budget is earmarked for specific partnerships, while the rest 9 % is estimated for projects initiated by partnerships including ERA-NET, Joint Programme Initiatives (JPI) and European Joint Programmes (EJP) co-funding (<1%).

Evaluating all EU partnering instruments aimed at creating European added value since 2000 with focus on challenges, the report ends up with a set of recommendations for improvement. Main findings:

- Partnerships can be an efficient way to avoid duplication, address fragmentation, respond to societal challenges, but it is not documented or visible and the evidence is largely missing. In other words, the idea is good and backed by strong qualitative reasoning, but the data to prove it is missing.
- The evidence of European added value from the partnership instruments and partnerships is scarce. Systematic evaluation has not been performed and except for P2Ps the monitoring of partnerships is not systematic or transparent. Hence, there is no clear and convincing evidence of European added value achieved through the partnership instruments.
- The EU partnership landscape is complex and should be simplified. The complexity and lack of openness/transparency favour the big professional actors in industry and the R&D community on expense of the smaller and less experienced.
- There is a lack of real common effort by the three main actors that need to step up to make innovation happen; industry, governments and the research community. Instead of revising and developing partnerships the tendency is to form new ones by political initiatives to fix the weakness of the first without terminating the first, leading sometimes to these actors approaching the same challenge in different programs (following diverging scientific disciplines) without interacting.
- The partnerships use primarily the same type of instruments as the regular H2020 calls (R&D&I project funding), probably the main reason for why there is no evidence that one creates higher European added value than the other. The main difference is the creation of a European strategic agenda, an important first step, but without profiting on it to align the work to be done.
- There is a stepwise offer of types of partnerships, from the open project calls in the framework programs to large legally constructed programs that last a decade and have committed funding from both governments and industry. New types of higher ambition partnerships are needed – as a further evolution of the most promising existing ones already active – primarily by inclusion of demand side instruments.

Main recommendations for further developing European partnerships:

- Openness and transparency in preparation and partner selection and develop/require partnership models that allow for new entrants over its lifetime.
- EC and MS should establish relevant Key Performance Indicators (KPIs) and a commonly agreed process to measure the partnerships added value
- Reduce the number of partnership models – simplify, reduce and develop
- Take a dual approach, establish a long-term strategic agenda with dynamic short-term project level commitment (flexibility), and a stable commitment to high innovation ambitions utilizing a wider range of demand side instruments. A mission-oriented approach strengthens such a development.

3. EERA community experiences

3.1 EERA lessons learned – JPs, IRP, ECRIA

This document outlines the key findings on lessons learnt from EERA, based on the initial input gathered from the coordinators of EERA Joint Programmes (JPs) and Integrated Research Programmes (IRPs). The findings focus on added value and main achievements, key challenges and suggestions on how to move forward.

EERA's vision is to provide leading energy research for a competitive and sustainable Europe. Its mission is to deliver on the SET Plan by connecting and aligning European research to accelerate the development and market uptake of low carbon solutions. EERA pursues its vision by exchanging knowledge, creating common research and innovation agendas, sharing resources, implementing joint projects and programmes and delivering results to policy makers and industry.

The expectations of the European Commission towards EERA as a key stakeholder in the SET Plan are:

- Playing an advisory role
- Implementing SET Plan actions
- Acting as a SET Plan ambassador
- Coordinating the scientific community in the energy sector to produce excellent research

- Supporting mobility of researchers and student training programs
- Facilitating knowledge transfer to industry

When EERA was founded in 2008 by ten research organizations, the interaction on strategy and alignment between European research institutions within the SET Plan focus areas was weak and based mainly on opportunities for working together at Framework Programme's project level. In 2015, EERA had 17 JPs focusing on SET Plan challenges and more than 175 members (24 EU MS in addition to Turkey, Norway and Switzerland). During these years, the JPs have done an unprecedented alignment effort by:

- Developing common research and innovation agendas
- Actively pursuing possibilities for common projects
- Contributing to strategy development with SET Plan stakeholders (EC, MS and industry)
- Setting up schemes for sharing research infrastructures and increasing researcher mobility
- Interact with industry through ETIPs and other partnerships in the field of energy
- Advising policy makers through expert workshops and other channels

Statistics on participation in FP7 show EERA's ability to attract a very large number of European research institutions active in energy, and EERA members accounted for close to 90% of the FP activities.

The document provides a detailed list of internal (EERA) and external challenges related to coordinating energy research together with recommendations for how to move forward.

Focusing on the external factors, the lack of a direct communication arena with MS/AC R&D funding decision makers and flexibility in MS/AC project funding, little direct interaction with industry, and a too complicated alignment funding instruments scene was highlighted.

The recommendations addressed these shortcomings with several concrete suggestions to improve both the EU instruments (EC) and the MS/AC side of co-funding instruments and how to ensure that innovations are picked up by industry. On both the EC and the MS/AC sides there is a need for dialogue to ensure smooth coordination and cooperation at both policy and funding organizations level to overcome the many small practical hurdles that make alignment difficult to implement.

3.1.1. JPs experience – CSP, Wind and ESFRI

Two types of RIA Call, IRP and ECRIA, have caused positive response in terms of proposals from the EERA JPs. The first one (IRP) is a combination of a RIA and a CSA, the latter (ECRIA) a RIA that required documented in-kind contributions from the participants funded by their respective MS/AC.

The IRPs have been evaluated as part of the EERA JP Characterization report, discussed in 3.2. It has proved to make a difference for those JPs able to take schemes for researcher mobility, shared use of labs and infrastructure, alignment of national activities and industry integration from the planning face to actual implementation. Even though the will to do this exists at the MS/AC level, the funds to do it are not available. The results are believed to be dependent on both types of funding components, i.e. RIA and CSA.

EERA Joint Programme CSP

EERA JP on Concentrated Solar Power (EERA JP CSP) succeeded as one of few to win both an IRP and an ECRIA project to work on aligning scientific and innovation projects across SET Plan countries. These projects ran in parallel to developing the Research and Innovation Action Plan, contributing to the related Temporary Working Group (TWG) and participation in the Implementation Working Group (IWG) with other key stakeholders. This Action is viewed as one of the most advanced when it comes to implementing the SET Plan IPs. The following is a summary of the process and experience by JP CSP with pointers for how to move ahead:

EERA JP CSP experience on European alignment activities were associated to the IRP STAGE-STE. In the context of this Horizon 2020 project a specific task was defined to find a suitable mechanism to finance large research initiatives, using different potential sources (national funding, EC, ...) to provide significant advance to CSP technologies. Such relevant initiatives can be envisaged, discussed and proposed, as the whole research sector actively participated either in the JP CSP or the IRP STAGE-STE. Thanks to the engagement of a significant number of stakeholders a quick TWG organization and progress was possible when the CSP targets were approved. From the initial TWG discussions (spring 2016), the following statements were agreed among the participants:

- As the approved targets implied specific objectives in 4 to 6 years timeframe (maximum), initial TRL of R&IA to be identified (to achieve previous targets) should be high. It was defined initial TRL in the range of 6 to 7.
- Activities to be defined should be ambitious and were considered they should be addressed in a sole integrated project. Otherwise, if broken down in subprojects or partially addresses at national level, objectives would be only partially achieved.
- Once defined the activities, a procedure should be defined and agreed (among all stakeholders) to also provide a ranking of technological relevance in order to give to the National Financing Organizations (NFOs) significant additional information to help in the process of final decision (which activities to be financed and how).

As the discussion process within the TWG (lasting from May till November 2016) was defined as fully inclusive (any stakeholder willing to collaborate in the discussion process was immediately included), the achievement of a final agreement on the results from all involved stakeholders required a long process with many hours of discussion and the previous definition of decision protocols.

The results were submitted to the SET Plan SG and used to prepare the CSP Implementation Plan (CSP-IP). Even after the final approval of the CSP-IP the difficulties of NFOs to define how the IP could be financed demanded an additional process to be addressed by the TWG:

- Consultations at national level to the reference industrial stakeholders and NFOs to define the activities of national priority interests, providing a ranking of relevance at each participant country.
- Once identified the level of interest and the countries willing to share resources, a tentative mapping of needed financial resources by country to the execution of different activities was provided.
- Following step would be the decision, by the different involved NFOs, of activities to be financed according to the existing national resources and considered available instruments (financial commitment at national level).

Final but most challenging step would be the definition of procedure to the implementation/execution of selected activities, based on public competitive calls and always assuming that each country would only finance the participation of national industries, research centers or universities. This process would imply the unanimous agreement of all involved NFOs.

After all these discussions and consultations (April 2016 – December 2017) it became clear that a suitable tool to implement this type of collaborations currently does not exist in Europe. Current ERANETs or the use of BERLIN model was considered to be valid to much less ambitious initiatives due to important shortcomings and implementation difficulties (financial, administrative, etc.). Therefore, it is suggested the development of a new European tool to make it feasible for this kind of project to be defined, financed and executed.

EERA Joint Programme Wind and European coordination

EERA JP Wind also won an IRP for which they credit much of the achievements they have related to R&I coordination and alignment. They have several successful activities directed at responding to calls and other funding opportunities, but have a challenge related to industry participation mainly due to IPR issues. Precompetitive issues are coordinated but as the activity comes closer to markets, industry loses interest.

The European partners in JP wind have had several joint initiatives, both on multi- and bilateral national levels. Two such examples are the NSON initiative and the MoU signed by SINTEF and DTU on strategic research cooperation.

NSON

The NSON project has its core ambition to advance the realisation of an efficient and secure energy transmission system in the Northern Sea Region, called the Northern Seas Offshore Network (NSON). This is done by developing an analysis framework for a stepwise transmission system deployment approach using hybrid technologies, and a cost/benefit sharing market design attractive for all participants and investors. These outputs will help the region move towards a single electricity market, support increased utilisation of its wind resources, make national markets more efficient by increasing connection capacity, and provide balancing from Nordic hydro power. Solving the challenge for this region is sufficiently complex for the results to potentially be used as a blueprint for shaping a single EU electricity market.

One of the main objectives of the NSON initiative has been to continue advancing the alignment of national research activities aimed at charting the way towards a Northern Seas Offshore Network (NSON). NSON has been a joint initiative by SINTEF (Norway), Fraunhofer (Germany), Strathclyde University (UK), DTU (Denmark), ECN (Netherlands) and UCD (Ireland). NSON intends to provide research-based means for the harvesting, sharing and trading of offshore wind resources in the North Sea Basin; support utilisation of its wind resources; make national markets more efficient by increasing connection capacity; and provide balancing from Nordic hydropower in the Northern Seas. The collaboration among the NSON partners has already partially succeeded at aligning national research activities in the area and will continue to do so.

The research partners initially defined a common project with an agreed sharing of work and succeeded in gathering the relevant national funding institutions in a meeting in London in 2011 to discuss how to fund the project. Due to large variances in funding schemes it proved impossible to get a go or no-go for the coordinated project. It had to be split up in national subsets and funded as such. In the end the group succeeded in getting most of it funded, but it took a long time and it was difficult to coordinate because the process of funding of the sub projects gave a delay of up to two years for some as compared to the original plan. Due to this delay the project is still running in some of the countries. The conclusion was that even though the institutions and the nations all agreed the project should be run, administrative hurdles made the realisation really difficult.

Shared research infrastructure - ESFRI

The European Strategy Forum on Research Infrastructures (ESFRI) area is another complex cooperative Arena for European Research partners. Establishing a joint research infrastructure – either in a physical single location, as a distributed infrastructure (facilities in many countries) or as an E-infrastructure – is a process that requires combined and synchronized efforts from several interested EU and associated countries. The first bottleneck is to secure at least a funding sponsor and 2 more national support letters from government level to enter the process of getting into the ESFRI roadmap. Thereafter the interested countries must clearly document and drive the process and support in their own countries with the goal of defining and establishing the European Infrastructure, eg as an ERIC – European Research Infrastructure Consortium.

All EERA JPs have a clear understanding of the benefits of a shared research infrastructure, and some are well advanced in the ESFRI scheme for funding and organizing this type of coordination.

A multitude of cultural aspects, national processes and funding agencies need to be considered. This is always very challenging in combination with a mix of competitive schemes, unclear government /ministry responsibilities regarding the field of science/research. In some countries there are barriers such that only infrastructure of > 15 MEuro can be considered for Engineering Sciences, basically ruling out most commonly proposed distributed and E-infrastructures. In some countries R&D groups rely heavily on political support with lobbying schemes, while others have a route through the Research Council in a nationally competitive scheme. In the latter case, only if successful, the infrastructure will be listed on the national roadmap enabling political support for national membership in the said ESFRI.

As a result of the asynchronous aspect of the national funding and signing/support processes it is much more challenging for the research groups in these countries to achieve the goals of collaborative European infrastructures and push forward with a sufficient momentum. The European ESFRI projects are attractive as they strengthen research mobility, improve collaboration and European competitiveness, make the top facilities well known, and give researchers from other countries access to top European facilities where they otherwise would not.

3.2 Report on JP Characterization

EERA set up a scheme for an assessment of the performance of the EERA JPs related to its strategy along the dimensions "implementing programmes", "delivering results" and "sharing resources" (knowledge, facilities). Each dimension is composed of elements that are more easily qualitatively or quantitatively measured. The EERA JPs did a self-assessment based on this framework, grading themselves along the different scales.

An overall observation is that the JPs that have succeeded in attracting coordination funding have significantly higher achievements than those who have not. The difference is most visible in the advanced parts of the alignment chain, sharing resources and implementing common projects/programmes. As forming strategic agendas was part of establishing the JPs there is a good score for this item for all, as shown in Figure 3 and Figure 4.

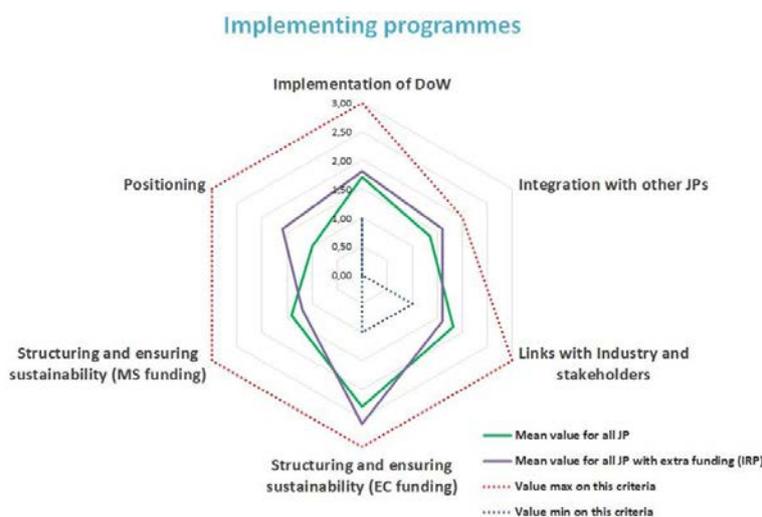


Figure 3. Implementing Programmes: mean values. Source: EERA - JP Characterization 2017

The main findings as stated in the report: The results of the JP Characterization exercise offer many elements to reflect on JPs' inner potentialities, which could be leveraged to reach a better and deeper level of integration of energy research programmes in Europe. In general, EERA and the "JP model" confirms itself as a powerful means for alignment and coordination of research programmes, at the organisation level and often in coordination - if not cooperation - with industry. To this extent, all JPs are fulfilling the basic mission of the Alliance and have reached a good level of integration resulting in the definition of European Research and Innovation Agendas, which inform and conform research activities As the process of integration and implementation requires additional or dedicated funding, differences emerge: communities that can rely on EU funding, namely IRP projects, have significantly progressed in activities related to the "sharing" dimensions (mobility, mapping of research resources, creation of databases etc.).

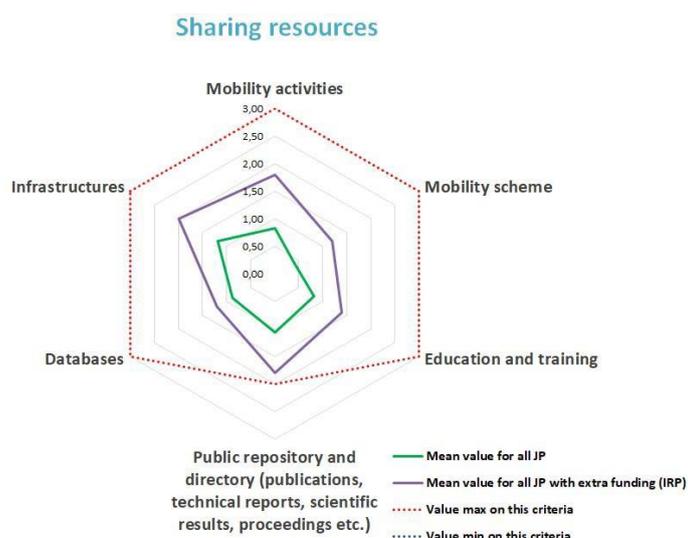


Figure 4. Sharing Resources: mean values. Source: EERA - JP Characterization 2017

3.3 Berlin model (NSON, Gateway, BIGH2)

The Berlin model was presented at the international conference “Energy Research in Europe: Germany’s Contribution to the SET Plan” on 19 March 2012 and was introduced for the first time in H2020 in the 2014/2015 Work Programme (Coordination and Support Actions). It was also planned in the draft 2016/2017 Work Programme but then it was deleted from the finalised version.

The 'Berlin model' is a bottom-up model of transnational cooperation. It consists of a three-stage process to identify, coordinate and implement joint research projects between several SET Plan countries in an informal and target-oriented way:

- Potential project partners from different countries identify a joint research project and present a draft proposal to their respective national/regional funding agencies.
- Upon positive evaluation of the draft proposal by all funding agencies, project partners submit a full proposal to their national/regional funding agencies, considering the need to satisfy the different evaluation procedures in different countries.
- After a positive evaluation of the full proposals by the national/regional funding agencies, and a synchronised allocation of national/regional funds, the project partners may ask the European Commission for additional support that can serve to incentivise the collaboration and coordination of the consortium partners.

The third point is not a necessity of the model, it can be put to work also without EC top-up funding. The definition of the model has not been developed and detailed, so several versions of how the model works both when it comes to governance and funding are used.

The Berlin model has several advantages. It is a less ‘bureaucratic’ approach and quicker procedure compared to ERANET Cofund, hence facilitating alignment of national and European funding. Besides, it establishes an explicit link between the national and the EU fundings based on national strategies and priorities, and the bottom-up approach is in line with the objectives of the SET Plan as this is a requirement for EC top-up funding.

This model has been used in two projects involving EERA members, none of them with EC funding:

- The NSON project (a collection of coordinated projects involving IWES Fraunhofer, SINTEF, University of Strathclyde/UKERC, ECN, DTU, and University College Dublin)
- The BIGH2 project (consortium: SINTEF, DLR and Alstom)

The ECs arguments for discontinuing the Berlin model were that this model is not considered in line with the simplification of H2020, Member States' budgets cannot be audited by the EU, low success rates because there are no common rules in place (not a well-defined "instrument"), and difficult to evaluate due to expected variations in implementation.

A third project, the Gateway project, addressed these shortcomings to explore possible developments of the model to fund EU level CCS R&I projects and came up with 3 scenarios:

- *Scenario 1: Direct revision of the Berlin Model* - This requires setting a formal way of establishing, evaluating and funding Berlin type models among a set of MS/AC, with top-up funding provided by EU for given criteria being fulfilled.
- *Scenario 2: ECRIA* – This is a normal RIA (Research and Innovation Action) that allows in-kind funding from the consortia partners that is documented by means of deliveries that can be shared within the project.
- *Scenario 3 (RBM3): European Centres of Excellence to fill research gaps* – This is based on creating an aligned network of national Centres of Excellence to form a European effort big enough to challenge US, Korean, Chinese or other large national research centres. The contribution from each MS/AC will be at overall project level. Top-up funding from EU could serve as a carrot for building this type of networks based on call. The clustering in networks would then by definition be according to MS/AC priorities.

Even though the Berlin model is discontinued, the idea of a top-down focus call with some reward triggering a bottom-up response from the research community involving in-kind or flexible MS/AC funding lives on and seems a very well fit for the Mission Oriented Policy (MOP) approach being discussed for FP9.

4. ESIR Memorandum (December 2017) and Mission-Oriented Research & Innovation in the European Union MISSIONS - A problem-solving approach to fuel innovation-led growth (Mariana MAZZUCATO February 2018)

The report is fresh from the press and the last in a series of discussion papers related to the use of Mission Oriented Policies (MOP) as a means to increase Europe's competitiveness, often mentioned in relation to FP9.

The outset is that European research is fragmented and uncoordinated due to its history of being each nation states sole concern. This needs to change; Europe must coordinate and align it's resources in order to achieve a concentration and scale that can stand up to other major players in the global economy like the US and China, who have centralised and focused research clusters. Europe has some of the best research institutions in the world, but are surpassed by other regions that are better at innovation (putting knowledge to work). We are not tapping into the potential that is there.

According to the ESIR report *Missions offer a solution: top down mission formulation, made possible by very similar strategies between nations, meet bottom up resource allocation from MS/AC (pre-filtered by strategy-based MS/AC priorities) and researcher based project (or program) proposals depending on "type of Mission"*.

The result is more focus on fewer topics and more alignment within each topic, or in other words – more resources and better efficiency in addressing a mission.

Mazzucato argues extensively for the MOP approach, using the illustration on the next page.

At the top we have the Sustainable development goals (SDG) set by the United Nations at the global level. Europe has defined a limited set of *Societal Challenges* and often reflected in MS/AC policies as well. But these challenges are too wide and ill-defined to serve to concentrate efforts at the project level directly. In between we need *Missions* with clear and ambitious objectives that can be achieved by a portfolio of R&I projects with supportive measures as policy interventions, deployment actions and end-user participation.

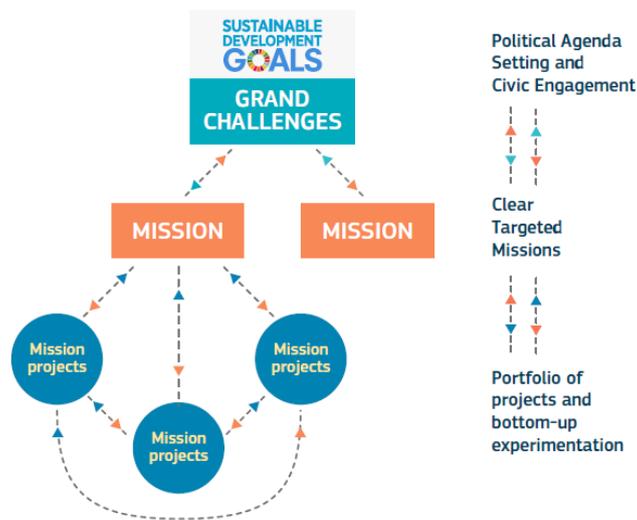


Figure 5. From Challenges to Missions Image: RTD - A.1 based on Mazzucato (2017)

To ensure the involvement of the citizen the *Missions* should be formulated through a process involving all stakeholders to ensure engagement and participation. Public engagement is essential for a *Mission* to survive over time and achieve its goal. The mission states what to achieve, not how to achieve it, that is left to a bottom-up cross disciplinary and cross stakeholder response based on a multitude of ideas and approaches. In this context the researchers, industry, governments and the citizen all must take part and contribute for a project to succeed.

For a *Mission* to trigger the right type of response, Mazzucato lists these criteria:

- Bold, inspirational with wide societal relevance
- A clear direction: targeted, measurable and time-bound
- Ambitious but realistic R&I actions
- Cross – disciplinary, sectorial and innovation actor
- Multiple, bottom-up solutions

Mazzucato also offers a set of criteria to ensure the success of the mission approach, applicable to the *Mission* and the *Missions* project portfolio:

- Engagement of diverse national and regional stakeholders
- Measurement and impact by goals and milestones
- A portfolio of instruments to foster bottom up solutions
- Flexibility, pro-active management and building in-house capabilities

Finally, Mazzucato's report offers a small set of *Societal Challenges* to be met by *Missions* and reached by a portfolio of projects, examples that can serve as a blueprint for structuring alternative missions. The mission examples used are:

- 100 Carbon neutral cities by 2030
- A plastic free ocean
- Decreasing the burden of dementia

5. The Energy Research Knowledge Centre (ERKC)

The Energy Research Knowledge Centre (ERKC) is a European energy research web portal under the umbrella of the SET Plan Information System SETIS. The ERKC collected validated, referenced information on energy research programmes and projects as well as their results and analyses from across the EU and beyond. Thanks to its vast searchable database, one can access high-quality information about actors, activities and funding in energy research. The ERKC project is now finished. Updates to the database are only performed on a voluntary basis by sectoral stakeholders who are solely responsible for the quality of the data submitted. The homepage <https://setis.ec.europa.eu/energy-research/> has detailed information on MS/AC funding schemes, but with no direct description of which instruments and funding shares are available to support co-funding.

Even though the web portal does not discuss nor evaluate co-funding it is of great value as a starting point for the mapping work to be developed and discussed in a second report.

6. Bi- and multilateral coordination without EC support

The common pot for European research dispersed through the EC is estimated to around 7-8%, of which according to the Technopolis Report around 25% is used in relation to coordination actions. The common pot is ECs possibility to set an agenda at European level to point a direction also for use of national R&I funds and an interpretation of the numbers could be that currently one quarter is used to directly cause coordination/alignment.

In addition to the EC initiated coordination several bi- and multilateral initiatives between two or more countries exist. A fresh example is the French – German Joint Call on Sustainable Energy addressing TRL 1-5 and focusing on the topics: i) conversion and storage of energy from renewable sources, and ii) smart grids at transmission and distribution levels and reported to have a funding frame of around 200 million Euros.

Norway and Denmark have also established bilateral cooperation on offshore wind through research cooperation between SINTEF, DTU and NTNU. Based on the long-term cooperation within EERA JP Wind, SINTEF Energy, NTNU and DTU Wind Energy decided to enter into a committed cooperation to better face the research and innovation challenges within the offshore wind sector. The three R&D partners have expressed their desire to initiate a strategic partnership through an MoU signed at the EERA DeepWind R&D Conference in Trondheim in January 2018. The focus is on offshore wind energy R&D with the aim to implement an ambitious research effort of maintaining and developing the European technology leadership in Offshore Wind Turbine Technology and minimizing risks and costs for society in the field of expertise of the Parties stated above. All parties are leading national centres of excellence and aim to be a leading European actor.

Germany, Austria, Finland and Switzerland have or have had similar calls. The SET Plan and its governance has been one meeting place to make this happen, the key being to form a team-of-the-willing that has strong common national interests in pushing the area forward. Lessons can be learned from these experiences regarding the IWG processes now running.

Mainly related to SMEs, EUREKA has a long-standing experience in coordinating national R&I efforts mainly based on coordinated national funds. This is also a model that should be considered for implementing the SET Plan IPs.

Science Europe has recently stated in a Policy brief "On Public-to-Public Partnerships and the Next Framework Programme for Research and Innovation" that they propose a broad dialogue between all stakeholders to agree on an efficient framework to boost P2P projects.

7. Innovation Instruments – higher TRL levels

This report has a focus on the challenges and instruments targeted on the research part of the innovation chain, mainly TRL levels 2-5 but also up to 7 and occasionally 8. For levels 6 and up a similar set of instruments is available for supporting innovation and market introduction. Alignment and coordination at this level is even harder due to Intellectual Property Rights (IPR) and competitive reasons. As research and innovation was merged into one program in Horizon 2020 the goal and challenge were a real merger, not just paralleling the instruments. The success of the merger can be debated, but it is obvious by observation that a lot remains to be done. Europe has great science but is underperforming in transforming discoveries into businesses as pointed out by Commissioner Moedas and inspired initiatives like the European Innovation Council and Missions. At national level, several countries are pursuing ARPA like instruments where low TRL ideas with high market potential are granted a "fast track" status up the TRL chain support schemes to shorten time to market times.

When investigating instruments and tools for how to best realise the Implementation Plans it is important to have the whole suit of Tool and Instrument menu on the table. When doing this the main actors of the innovation triangle should be part of the discussion as to what can be done to ensure that IPs have a best possible change of succeeding, as illustrated in Figure 6.

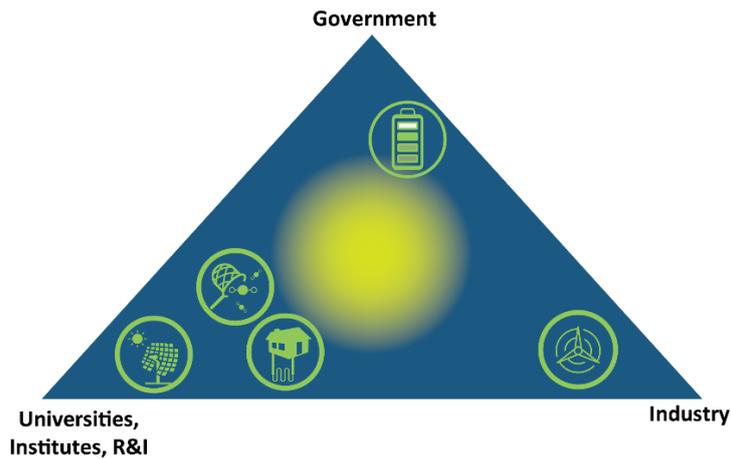


Figure 6. Innovation triangle including public authorities, industrial stakeholders and the research community

8. Discussion and recommendations – alignment in the SET Plan Context

8.1 Why aligning?

Figure 6, using production of wind turbines as an example, shows why it is close to always better for smaller actors (one MS) to align than not when aiming for a larger share of the global marketplace. The same principle also applies to global companies when merging parallel activities in several locations.

On the left side, three countries M1-3 all research, develop and produce a complete windmill locally, researching, developing and producing all the windmills three basic components. Assuming there is a strong correlation between the resources available and the quality of the finished product, let's assume all use the same resources and produce windmills of quality level 1. By optimal alignment that means a common product of quality level 3. It is plausible that a product of 3x the quality (tech-economic) will take much more than 3x the market share than the original windmills (quality 1). Thus, there is a big business incentive to align and harvest the gain. As shown by the alignment options in the middle of the figure there are many ways of aligning in practice, the choice depending on the degree of trust between the partners, ability to take out efficiency potential, ease of communication between teams, etc.

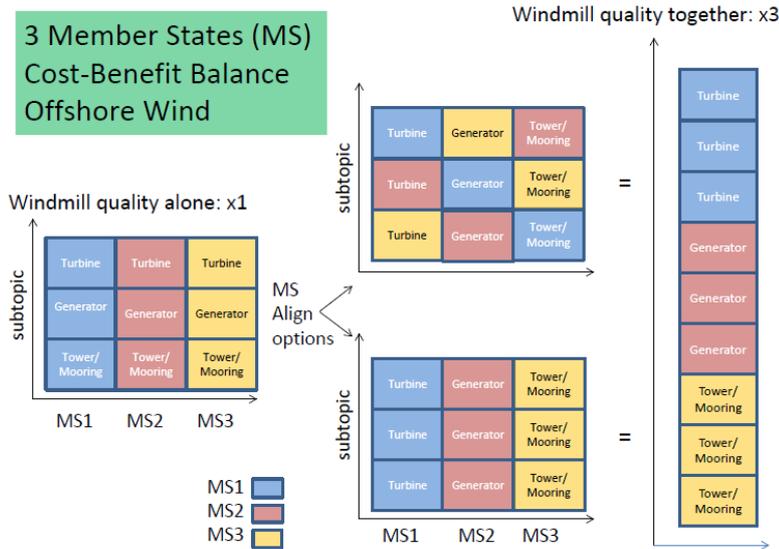


Figure 6. Alignment possibilities in the field of wind turbines

The illustration is primarily to show the common sense and the potential huge gains in aligning. The urgent need to tap into this potential for Europe is that we need to unite MS/AC efforts to be able to compete with the global competitors like US and China, who have the advantage of running R&I as centralised common efforts within their economies. Europe's MS/AC are too small alone, but aligned we can compete.

8.2 How does this translate to the SET Plan context?

According to the ERA LEARN 2020 project and Technopolis reports, there are plenty of well-defined partnership instruments available from the EC side. The downside is that they are too many, too complex, too much closed clubs and that there is no hard evidence that they deliver added value compared to normal framework program projects. SET Plan stakeholders have initiated, participated in and have experience from several of them. Due to lack of competence, network mismatch between EC and MS/AC decision-makers, and inflexible national funding schemes, the MS/AC involvement and the interaction with industry is low. By experience top-up funding for alignment (CSA and/or RIA) it works but is rarely available from MS/AC and limited from EU.

There is an obvious need for fixing it, both at EU and MS/AC sides. The EU needs, as illustrated in Figure 7, to reduce and simplify their instruments, maybe down to one option for each category of cooperation depending on size and degree of alignment, from the classic WP project to a Flagship. The MS/AC need to allocate dedicated funds to aligned projects, alternatively provide the flexibility needed to support EU alignment processes and form a strategy for what to research nationally and what to best research as part of a European team (Figure 7).

This means there is a job to do on the government side both at EU and MS/AC level. EU shall simplify and make alignment favourable by co-funding; MS/AC shall shape an EU alignment strategy and ensure the funding flexibility needed to participate. On both sides, the people involved must be key decision-makers, with the power to change the rules, usually ministries, research funding agencies or research funds on the MS/AC side.

This is where MOP as proposed in the Mazzucato report can contribute. As illustrated in Figure 5 (page 11), EU should restrict itself to define common European missions and spend a fair amount of FP9 to co-fund a portfolio of projects that aim to achieve the publicly agreed missions derived from the overarching SDGs and Societal Challenges. The projects should be created by a bottom-up process by 'teams-of-the-willing' and selected for funding by means of its probability to fulfil the Missions goal.

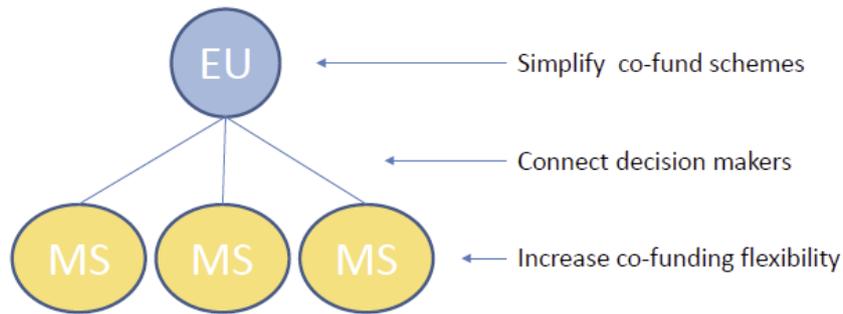


Figure 7. Measures to improve European alignment

Related to an already existing activity, the JAWG initiative within the SET Plan SG is a good starting point for such an action. It focuses on expanding the use of ERANETs within SET Plan and has the challenging task of juggling MS/AC and EC interests around common topics in a setting where all parties are more reserved than pushing. With larger and more flexible funding on all sides to ease the task and lift motivations, one could start the JAWG discussions by defining a set of missions given by intersection of the selected global challenges and SET Plan, and then forming teams-of-the-willing around each mission that implement the Mission in a bottom-up process using a further developed ERANET scheme. Moving forward this way has the advantage of using existing instruments and activities that can achieve higher levels of alignment by increasing flexibility, funding and applying the efficient, flexible and low overhead MOP approach.

In the SET Plan context, the climate challenge has already set the scene for selecting a set of publicly endorsed Missions. The challenge is widely accepted by all MS/AC and there is a broad agreement on the what could easily be defined as high-level Missions to battle it, while the priority areas vary according to a nations competitive advantage with that topic based on competence in research, industry or governance. So, the initial important phase of alignment highlighted in the ERA LEARN on common SRAs, is already in place. Even the R&I funding priority process is done, with EC and MS/AC selection of focus areas based on national research competence, industrial and political interest. In the ERA LEARN terminology we are now deep into the operational part of the alignment, with the participants funding potential already on the table.

This is not a trivial task, as illustrated by the reasons given to discontinue the development of the Berlin model as an instrument. There is still a joint job to be done by the EU and the MS/AC, to make sure that more loosely co-funded projects can be properly audited as a portfolio coordinated sub-projects with each funder trusting the others to do their part of the auditing according to agreed and common principles. The co-funded projects/programmes formed by Mission response need to allow MS/AC committed funding, MS/AC fresh funding, common pot, in-kind from institutions, top-up from EC and more to exist alongside each other in a transparent and auditable environment where promise of deliverables can be tested and trusted.

The overall picture that emerges is that the release of an alignment potential is more depending on the right people (decisionmakers) from all stakeholders meeting around the same table to work out the remaining organisational and funding obstacles. The SET Plan is far advanced in aligning SRAs, it has established meeting places between EC, MS/AC and the stakeholders have experience in using most of the existing co-funding schemes/instruments, and the MOP approach pushed in relation to FP9 is well suited opportunity to take the step up to the next level of alignment. If we can get the decisionmakers around the same table and start forming 'teams-of-the-willing' around Missions.

An additional advantage of this approach is that it can easily be expanded to interact with the global Mission Innovation (MI) initiative, launched in relation to COP21 in Paris. The European SET Plan Missions could easily be defined as our contribution to the MI Challenges and as such give Europe excellent platforms to interact with the global effort.

Mapping of national energy funding schemes

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Executive summary

This second half of the report is a pilot exercise conducted by the European Energy Research Alliance (EERA) on European energy research alignment under the H2020 EERA Secretariat 3 (EERASE3) project. The first report addressing existing and new funding instruments promoting alignment of energy research, is now complemented by a tailored-made mapping of national energy funding schemes including two main elements:

- 1-to-2 pager descriptions of Strategic Energy Technology (SET) Plan countries funding schemes with focus on funding cash-flows and volumes, identification of key decision-makers in the funding distribution process and the share of funding made available for co-funded research at the European level (available in Annex)
- Way forward to develop existing or shape new co-funding models and processes to reinforce European energy research alignment focusing primarily on the SET Plan Implementation Plans (SET Plan IPs).

Based on the comprehensive description of the national schemes, focused on identifying opportunities for increased coordination of Member States (MS) / Associated Countries (AC) research efforts, three types of funding that might deliver on the needed flexibility are identified:

- In-kind funding
- Institutional funding
- Competitive funding

Based on a qualitative discussion a list of further working actions towards increased EU collaboration is given:

- Identify national ongoing projects/activities contributing to the specific SET Plan IP's actions
- Identify specific national funding calls contributing to the specific SET Plan IP's actions
- Identify and if possible quantify the specific contributions of EERA members (175 organisations) to the execution of the SET Plan IP's.
- Identify the gaps of activities not covered nationally and the most suitable national and/or European instruments to meet these gaps in a tailored-made approach. Focus on Technology Readiness Level (TRL) 3-7 but include instruments along the whole TRL chain.
- Define together with the European Commission (EC) and the SET Plan Steering Group (SG) members the role of EERA as a facilitator of the dialogue between SG members/ national funding bodies/ national research organisations to support the SET Plan implementation
- Ensure participation of European Union (EU)-13 countries

List of abbreviations

| | |
|--------------|---|
| AC | Associated Countries |
| DG RTD | Directorate-General for Research and Innovation |
| EC | European Commission |
| EERA | European Energy Research Alliance |
| EERASE3 | EERA Secretariat 3 |
| Energi21 | Norwegian national strategy for research, development, demonstration and commercialization of new energy technology |
| Energiewende | German national strategy for transforming Germany's energy system |
| ERA-NET | European Research Area Net |
| ERKC | The Energy Research Knowledge Centre |
| EU | European Union |
| GDP | Gross Domestic Product |
| IPR | Intellectual Property Right |
| MS | Member States |
| RTO | Research and Technology Organizations |
| SET Plan | Strategic Energy and Technology Plan |
| SET Plan IP | SET Plan Implementation Plan |
| SET Plan SG | SET Plan Steering Group |
| SNRE | Stratégie Nationale de la Recherche Energétique |
| TRL | Technology Readiness Level |

Introduction

This second half of the report is a pilot exercise conducted by EERA on European energy research alignment under the H2020 EERASE3 project. The first report addressing existing and new funding instruments promoting alignment of energy research is now complemented by a tailored-made mapping of national energy funding schemes including two main elements:

- 1-to-2 pager descriptions of SET Plan countries funding schemes with focus on funding cash-flows and volumes, identification of key decision-makers in the funding distribution process and the share of funding made available for co-funded research at the European level (available in Annex)
- Way forward to develop existing or shape new co-funding models and processes to reinforce European energy research alignment focusing primarily on the SET Plan Implementation Plans (SET Plan IPs).

A reference group consisting of nine active members with extensive experience in cross-national activities and complementary roles representing eight SET Plan countries covering the whole Europe was established to receive direct input and quality assurance from MS/AC. Some members are SET Plan SG representatives, others are key decision-makers in national funding agencies and some others are EERA members. The EC through DG RTD participated to the reference group as observers.



Figure 1. Members of the reference group representing SET Plan countries

It is worth noting that despite the establishment of this reference group, the findings and proposals in this report are EERA's and do not represent the opinions or recommendations of the EC, the SET Plan SG or any of the involved stakeholders but is intended to be a starting point for a discussion for further action by the actors in their decision fora.

SET Plan countries funding schemes

A significant number of SET Plan countries (21) have provided, through SET Plan SG members and/or national funding agencies' experts, highly valuable information to the mapping of national energy research funding schemes, enabling systematic comparison and identification of gaps and overlaps among countries. The SET Plan countries covered in this report are listed below:

- | | | |
|------------------|-----------|-------------------|
| - Austria | - Germany | - Portugal |
| - Belgium | - Greece | - Spain |
| - Cyprus | - Hungary | - Sweden |
| - Czech Republic | - Iceland | - Switzerland |
| - Denmark | - Italy | - The Netherlands |
| - Finland | - Norway | - Turkey |
| - France | - Poland | - United Kingdom |

The mapping conducted by EERA has been inspired by and complementary to the Energy Research Knowledge Centre (ERKC) project. The ERKC collected high-quality information about energy research programmes and projects as well as their results and analyses from across the EU and beyond, enabling identification of actors, activities and funding in energy research.

EERA's mapping has been structured into three main categories, namely:

- Funding cash-flows and volumes
- Key decision-makers
- National strategies and national funding programs on energy research

and compiles both qualitative as well as quantitative contributions. It is worth noting the substantial heterogeneity of the inputs provided by the SET Pan countries covered in this work.

1. Funding cash-flows and volumes

1.1. National budgets for energy research

Figure 2 illustrates the national budgets (2016) for energy research for 10 SET Plan countries and the distribution of these resources among energy sectors for 5 of the 10 countries. For some countries, not represented, though there is R&D funding, it has not yet been possible to quantify national budgets dedicated to energy research. The figure clearly shows enormous variations among countries. One could quickly identify that France and Germany allocate substantially more efforts on energy research than the other MS/AC.

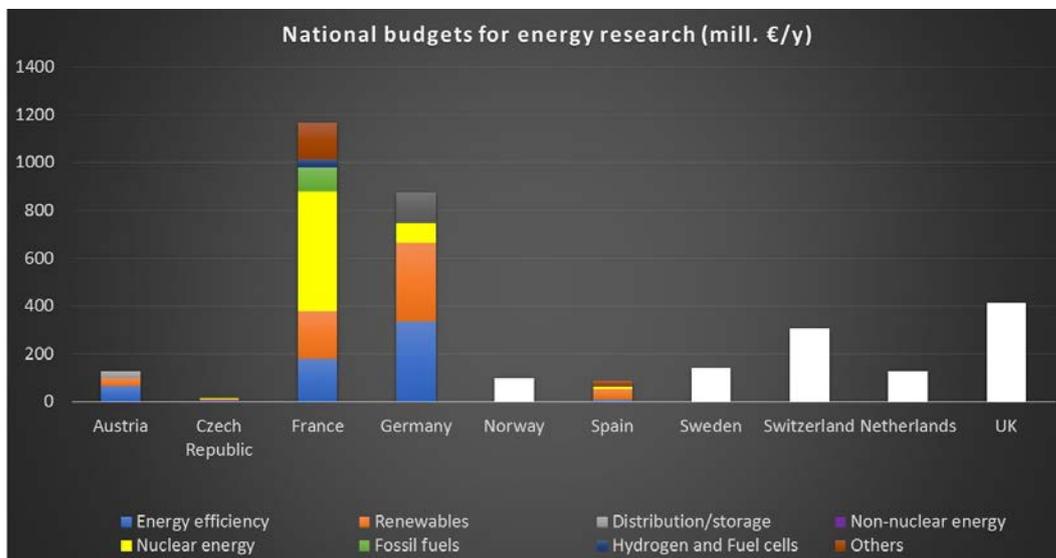


Figure 2. National budgets (2016) for energy research for 10 SET Plan countries (in mill. €/year)

However, when accounting for Gross Domestic Products (GDPs), the placing of major efforts on energy research mutate significantly and the variations among countries decrease considerably, as shown in Figure 3.

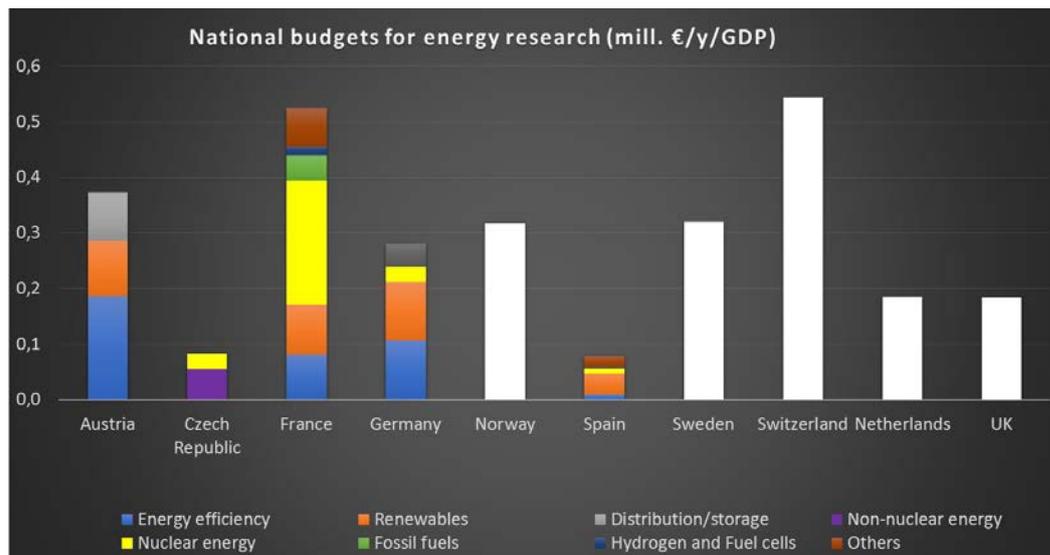


Figure 3. National budgets (2016) for energy research for 10 SET Plan countries (in mill. €/year/GDP)

In that case, smaller countries such as Austria, Norway, Sweden and Switzerland are by all means at similar or higher levels than the largest economies in the EU like France and Germany, making them all act as drivers for the development of an European research energy agenda.

Additional factors that could partly explain the significant differences in national budgets among countries are TRL, institutional funding or the regional dimension. This exercise aimed at illustrating and comparing budgets for energy research, i.e. TRL 2-5, accounting for all funding mechanisms. However, there is no certainty that the figures provided by SET-Plan countries exclude demonstration and deployment activities (TRL > 5) and/or exclude institutional funding (state owned enterprises). Besides, and particularly for countries with a high degree of federalism, there is no complete verification of whether regional R&D budgets were included. It is therefore crucial to verify and further systematize these figures in future works.

In terms of budget distribution across energy sectors and when making a comparison between 3 SET Plan countries, i.e., Austria, France and Germany, one can recognise two outstanding energy sectors common for all three countries, namely energy efficiency and renewable energy sources. Even though the proportions diverge this should be considered as a great opportunity for European alignment within these two energy sectors across the three countries.

Ideally, all MS/AC should facilitate their national budgets for energy research, including sectorial distributions, to identify SET Plan countries priorities and boost their cross-national convergence towards the SET Plan objectives.

Complementary to the top-down governmental alignment, there is the need for structuring a “bottom-up” institutional alignment resulting in the strong and unique convergence of efforts towards sharing research agendas across organizations within and across EU and associated countries.

1.2. Degree of flexibility

When asking for national inputs on funding cash-flows and volumes EERA also asked for the degree of flexibility of such funding volumes, i.e. how flexible funding is once allocated and approved by decision-makers. One could define three levels of flexibility:

- In-kind flexibility
- Institutional funding flexibility
- Competitive funding flexibility

With in-kind flexibility we mean the ability to use all or parts of *already funded national projects or programs* as part of a coordinated European effort. The requirement is that the deliverables from these projects can be shared with their European counterparts to fulfil a common effort. Alternatively, that the projects funding is not fully specified at the start, so that part of it can be tailored to fit in a coordinated project. Also in this case, the requirement for a formal decision to share project deliverables is still valid. European alignment may be easier when coordinating already national committed funding by means of in-kind as compared to requiring additional national (cash) funding. Legal issues related to Intellectual Property Rights (IPR), who owns the project (the one to decide if it is ok or not) and auditing needs to be solved. These issues are particularly important when the private sector is involved.

The institutional and competitive flexibility is related to the funding process, which varies a lot between MS/AC. Flexibility in allocation of institutional funds needs to be an issue when funding institutions and Research and Technology Organizations (RTO)s RTOs discuss details in short- and long-term budgets. It is impossible for RTOs to allocate resources to European coordination within thematic areas they are given responsibility if it is not agreed with the funding ministry or agency.

Flexibility in competitive funding could be built into the call texts for project proposals to realise international coordinated projects when the opportunity arises, of course within the scope of the project. Larger, long-term projects such as research centres and flagships could have a similar scheme, designed to motivate the projects to pursue European collaboration. Another option is for the funding agency to decide on a policy goal to participate in European Research Area Net (ERA-NET) co-funds as a percentage of their project portfolio, focusing on thematic areas where European cooperation is desired.

Both, institutional as well as competitive funding face the same formal challenges as the in-kind one. None of the schemes are in principle dependent on EC funding even though a carrot in the form of top-up, co-funding or the availability of simple contract framework from the EC most certainly would push the coordination process forward.

As already stated in our previous report *EERA's draft report on European alignment – existing and new funding instruments promoting alignment of energy research* (2018), the more dynamic and flexible funding instruments are, the higher degree of coordination/alignment can be accomplished.

Unfortunately, the inputs received so far (only qualitatively) indicate that the degree of flexibility of national funding for energy research is nearly inexistent, making difficult the coordination of European activities. Therefore, there is the need for MS/AC to provide the flexibility needed to support EU alignment processes and for that it is crucial the involvement of key decision-makers with the power to change the rules, usually ministries, research funding agencies or research funds on the MS/AC side. As an example, some funding agencies could require that a certain % of national projects budgets are not allocated right from the start to well-defined activities but instead kept free for research topics to be aligned cross-nationally during the project lifetime. As a second example, other funding agencies would require that project coordinators formally apply for an extension or modification of the implementation of the project within budget.

1.3. National budgets for cross-national activities

Alignment of European research activities is not only challenged by the low degree of flexibility in national funding instruments; it is also burdened by the extremely low cash volumes dedicated to cross-national activities. The feedbacks received indicate volumes of $\leq 1\%$ of the national budgets for energy research. Needless to say, this figure is obviously insufficient to ensure a successful coordination of activities across Europe. An increased share of national budgets towards international collaboration would contribute to reverse this situation. Alternatively, national programs could comprise funding for international collaboration, including cross-national activities.

2. Key-decision makers

The involvement of national (and regional) key decision-makers in EU alignment processes is essential. However, the complexity of national funding systems, with several decision-making players and hierarchical levels makes it difficult to ensure that MS/AC involve actors with similar roles and decision power in such processes.

For instance, in the SET Plan SG, aiming at ensuring better alignment between the different research and innovation programmes at EU and national level, as well as the SET Plan priorities, the high-level country representatives usually have a ministerial role. Even when having a good overview and understanding of the national/regional funding schemes and/or the national energy research priorities they represent, they are usually having limited "real" power to change the rules of the funding mechanisms that can facilitate alignment or to influence the program portfolio. It is thus imperative the establishment of a solid and continuous dialogue between SET Plan SG representatives and key decision-makers such as policy makers (e.g. influencing budgets) and national program managers within funding agencies.

When mapping key decision-makers we have mainly defined three categories:

- Government
- National funding agencies
- Regional funding agencies

As for governments, a noticeable large majority (~ 75%) of the SET Plan countries providing input specified at least 2 ministries with a key role in funding energy research, as shown in Figure 4.

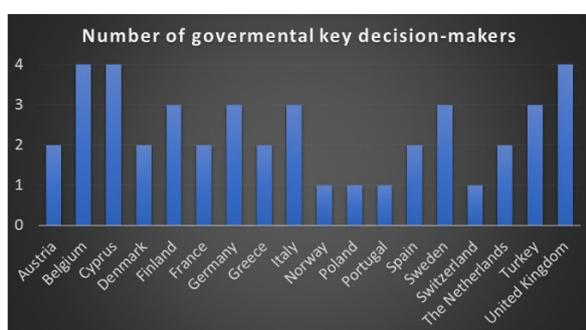


Figure 4. Number of governmental key decision-makers and national funding agencies

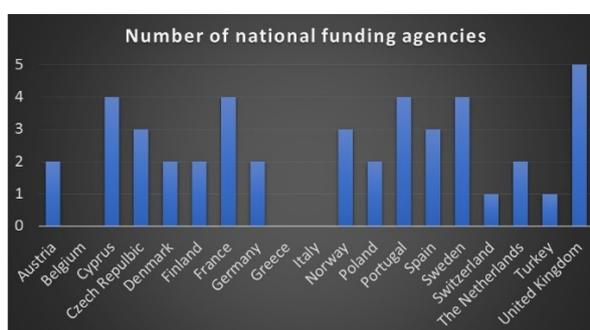


Figure 5. Number of national funding agencies

This number is even higher when considering national funding agencies, as depicted in Figure 5. This rather large number of actors with distinctive decision-making roles requires an arena where they can meet and discuss how to best align energy research across Europe and in particular which funding mechanisms can facilitate this.

The dominant trend in Europe towards increased regionalism leading to a greater share of power between national and regional entities requires the involvement of regional key decision-makers in alignment processes. In other words, Europe seems to evolve as an emerging federal system, in line with the federal system government of some of its countries such as Germany and Switzerland where there is a division of responsibilities between two levels of government.

In the context of the SET Plan, on the other hand, subnational levels of governance such as regions and cities is of key importance, e.g. when addressing smart cities. As part of this mapping work, EERA asked SET Plan countries to identify regional funding agencies supporting energy research. Nevertheless, the input received has been very limited, indicating the difficulties MS/AC have in pinpointing key decision-makers at subnational level.

In order to succeed in European alignment, it is also crucial the involvement of the private sector, complementing public funding. The Estonian Technopolis Report *Increased coherence and openness of European*

Union research and innovation partnerships (December 2017) identified low industry involvement as one of the main barriers for alignment. It will be thus indispensable to ensure dialog and coordination between industrial stakeholders and national/regional funding agencies.

3. National strategies and national funding programs on energy research

The third and final category included in the mapping covered national strategies and funding programs on energy research as well as funding mechanisms for cross-national cutting activities. Surprisingly, only 4 SET Plan countries, i.e. Finland, France, Germany and Norway reported dedicated national strategies on energy research whereas 5 others, i.e. Belgium, Czech Republic, Greece, Spain and Turkey referred to other type of relevant strategies with a wider scope (usually referring to strategies on research and innovation), as listed below:

| SET Plan country | National strategies of energy research |
|------------------|---|
| Finland | <ol style="list-style-type: none"> 1. Bioeconomy and Clean Solutions 2. Carbon-neutral industry 3. Strong today - stronger tomorrow |
| France | <ol style="list-style-type: none"> 1. SNRE (Stratégie Nationale de la Recherche Energétique) |
| Germany | <ol style="list-style-type: none"> 1. Energiewende |
| Norway | <ol style="list-style-type: none"> 1. Energi21 |
| Sweden | <ol style="list-style-type: none"> 1. Government bill (2016/17:66) Energy Research and Innovation for Sustainability, Competitiveness and Security of Supply |

| SET Plan country | Other relevant strategies |
|------------------|---|
| Belgium | <ol style="list-style-type: none"> 1. SET Plan Flanders |
| Czech Republic | <ol style="list-style-type: none"> 1. National Research, Development and Innovation Policy 2016-2020 |
| Greece | <ol style="list-style-type: none"> 1. National Research and Innovation Strategy for Smart Specialization |
| Spain | <ol style="list-style-type: none"> 1. Spanish Strategy on Science, Technology and Innovation 2013-2021 2. National Action Plan on Renewable Energies 3. Spanish National Action Framework for Alternative Energy in Transport 4. Autonomous region strategies on energy |
| Turkey | <ol style="list-style-type: none"> 1. National Science, Technology and Innovation Strategy 2. Turkish Research Area |

As for dedicated I funding programs the figure is slightly better, with approximately 50% of the SET Plan countries having dedicated national funding programs for energy research. At any rate, the challenge is evident; how to strengthen EU alignment across the European R&I energy sector when the majority of the SET Plan countries do not have any national strategy with clear energy priorities and at least half of the countries do not have any dedicated funding schemes for energy research? The elaboration of national strategies and establishment of funding programs specific for energy research could facilitate identification of common research agendas across SET Plan countries, hence contributing to EU alignment.

Despite the low degree of ongoing cross-national activities in Europe, as described in section 1.3, the inputs provided by MS/AC show that a large majority acknowledge the same type of funding instruments for collaboration across countries, namely ERA-NET cofunds, H2020 and bi/multilateral mechanisms.

Discussion

Since its establishment, EERA has primarily focused on "bottom-up" institutional alignment, i.e. coordination of priorities and resources of its member organisations. This has helped also achieving a critical mass – and a substantial voice – to bring priorities and messages across to decision makers, at national and European level. Keeping in mind the need to keep and nurture the bottom-up dimension and recognizing the complexity of the challenge, EERA launched this unique initiative gathering stakeholders from a reference group of SET Plan countries, in an effort to identify best strategies to move one step further and catalyse bottom-up and top-down convergence accelerating the execution of the SET Plan IPs.

This mapping exercise providing a reasonably good overview of the current national funding schemes on energy research constitutes, despite being a pilot exercise with the need to be extended to all SET Plan countries, a fundamental building block for a successful EU alignment.

The 1-to-2 pager descriptions of SET Plan countries funding schemes clearly showed that the national energy funding systems are country tailored-made, making their comparison challenging. Furthermore, the quantity and quality of the content of the inputs received varied significantly, leading evident gaps during the systematization process and making difficult the harmonization of the inputs.

The difficulty in comparing and streamlining was emphasized by the lack of a common framework for comparative analysis, particularly for specific terminology. In this respect, a taxonomy with clear definitions on keywords typically used in alignment such as degree of flexibility, cross cutting activities, cross-national activities, types of in-kind contributions, large scale/ long term focused national efforts like centres of Excellence/flagships, etc., could facilitate discussions and harmonization.

One of the main outcomes of this pilot initiative shows that substantial national funding cash volumes on energy research are commonly allocated to the renewables and energy efficiency sectors. If this funding allocation priorities could to a large extent be replicated across all SET Plan countries, the EU alignment of energy research activities should be a priory easier than today's situation. The existence of dedicated national strategies and funding programmes for energy research would possibly further facilitate alignment. The outcomes from this exercise indicate that approximately only half of the SET-

Plan countries have energy strategies and only 20% have dedicated funding mechanisms. The mapping of the cash-volumes also indicates the low degree of flexibility at all levels, and the extremely low share ($\leq 1\%$) of the budgets dedicated to cross-national activities, both factors challenging energy research coordination across Europe. As an example of recommendation to increase funding flexibility, national funding agencies could facilitate larger flexibility through their research funding programmes by asking researchers to keep a % of the funding available in projects for cross-national collaborations. That is particularly relevant in large national projects such as Centres of Excellence/flagship initiatives.

In terms of key decision-makers the situation has been shown to be complex, with several hierarchical levels of decision power and a significant number of ministries and national funding agencies with a key role in decision-making processes for funding allocation. In order to ensure that all these actors have the possibility to meet regularly to discuss and decide on EU alignment it would be necessary to establish a limited set of common meeting places. Given the dominant trend in Europe towards increased regionalism leading to a greater share of power between national and regional entities and the important role of local governments in some of the SET Plan IPs, it would certainly be an added-value the involvement of regional key decision-makers in these alignment processes. The input received in terms of regional key decision-makers has been nearly inexistent and hence more efforts are needed in identifying local decision-makers in further work.

Further work

A list of further actions building on the work described in this report is proposed below:

- Identify national ongoing projects/activities contributing to the specific SET Plan IP's actions
- Identify specific national funding calls contributing to the specific SET Plan IP's actions
- Identify and if possible quantify the specific contributions of EERA members (175 organisations) to the execution of the SET Plan IP's.
- Identify the gaps of activities not covered nationally and the most suitable national and/or European instruments to meet these gaps in a tailored-made approach. Focus on TRL 3-7 but include instruments along the whole TRL chain.
- Define together with the European Commission (EC) and the SET Plan Steering Group (SG) members the role of EERA as a facilitator of the dialogue between SG members/ national funding bodies/ national research organisations to support the SET Plan implementation
- Ensure participation of European Union (EU)-13 countries

ANNEX

This section compiles 1-to-2 pager descriptions of Strategic Energy Technology (SET) Plan countries funding schemes with focus on funding cash-flows and volumes, identification of key decision-makers in the funding distribution process and the share of funding made available for co-funded research at the European level. It is worth reminding that this is a pilot exercise where some countries have provided partial information and some others are not represented. The SET-Plan countries (21) that have provided the 1-to-2 pager descriptions are listed below:

- Austria
- Belgium
- Cyprus
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Italy
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Switzerland
- The Netherlands
- Turkey
- United Kingdom

Energy R&D funding in Austria

Austria offers universities, non-university research institutions and industrial research & development an effective funding system with clearly designated contact points for both basic and applied research. Companies in Austria driving innovation through research, development and technology can benefit from direct funding and tax incentives which serve to significantly reduce investment risk. Several contact points have been established to facilitate access to research funding for RTI initiatives and projects. The key contact points are:

- **Austrian Research Promotion Agency (FFG):** The FFG is the central contact point for application-focused RTI projects. More than half of project funding managed by the FFG goes to industrial research. Shareholders are the Federal Ministry of Science, Research and Economy (bmwfw) and the Federal Ministry for Transport, Innovation and Technology (bmvit)
- **Austrian Science Fund (FWF):** The FWF is Austria's central body for the promotion of basic research.
- **Austrian Wirtschaftsservice GmbH (aws):** The aws is the development bank for the Republic of Austria. It supports the RTI agendas of start-ups, SMEs and large established enterprises in the form of subsidies, low-interest loans, liabilities and guarantees.
- **Austrian Business Agency ABA:** The ABA is the first point of call for foreign companies wishing to establish research units in Austria. The ABA itself does not provide funding.

In the area of energy and climate, the **Climate and Energy Fund** was brought to life in 2007 by the federal government in order to support putting its climate strategy into action – short, middle and long term. The owner is the Republic of Austria, represented by Federal Ministry for Agriculture, Forestry, Environment and Water management (Lebensministerium) as well as the Federal Ministry for Transport, Innovation and Technology (bmvit). The strategies of the Austrian federal government in the areas of research and technology, environmental protection and energy provide the basic essentials that are reflected in the programmes of the Climate and Energy Fund. Important cornerstones for all of the measures are the sustainability and efficiency. The overriding importance of all actions remains the requirement to implement the reduction of national greenhouse gas emissions as quickly and sustainably as possible.

Public spending energy research 2016

In 2016 the total public spending on energy research amounted to 140.9 Mio Euros, which represents an increase of about 12.5 Mio Euros compared to 2015. Around 970 energy related projects and activities have been carried out in 2016.

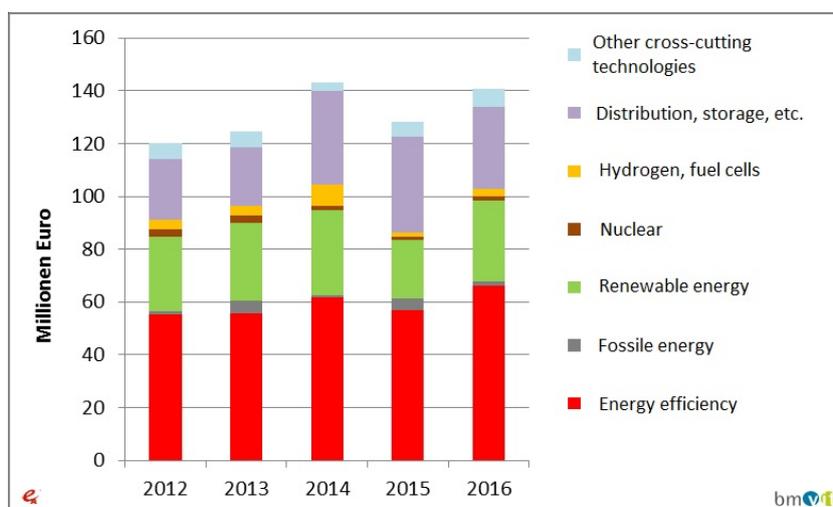


Figure 1. Source: *Energie – Forschung und Entwicklung. Ausgaben der öffentlichen Hand in Österreich 2016*, bmvit and Austrian Energy Agency, June 2017 (data according to IEA-standards, Energy technology RD&D budgets, released in October 2017).

National FFG support for environmental and energy research

Environment and energy-related research and innovation projects are not only good for the environment but also for Austria's economy. This is why they play a central role in research funding: about 16% of all FFG funding is made available to the field of environment, energy and sustainability (average 2008 – 2010). A large number of projects from this thematic field are funded under the General Programmes and other programmes that are open to all fields, e.g. the Structural Programmes. This includes COMET competence centres and K projects, COIN projects and the FFG's human resource programmes.

Apart from these generic programmes, the following thematic funding schemes are particularly suited for research in the areas of environment and energy:

- The **New Energies 2020** programme supports innovations that make a significant contribution to reducing the burden on the climate and increasing efficiency. The key goals in this context are to develop a sustainable energy system and to increase competitiveness by gaining a technological edge with national economic benefits. The focus of funding is on energy efficiency, renewable sources of energy, smart energy systems and electromobility.
- The program "**City of Tomorrow**" is focused on the research and development of new technologies, technological systems as well as urban services for future cities. In particular City of Tomorrow puts emphasis on the built infrastructure in connection with urban energy systems, both on a district-level and within the wider agglomeration (suburban areas).
- The **Building of Tomorrow Plus** programme focuses on energy-producing buildings of the future and energy efficient housing and was initiated by the Federal Ministry for Transport, Innovation and Technology (BMVIT). The programme is managed by the FFG in cooperation with Austria Business Service (AWS) and the Austrian Society for Environment and Technology (ÖGUT). Transnational energy research projects and activities carried out in cooperation with the International Energy Agency (IEA) are also funded via the BMVIT.
- The vision pursued by the "**Smart Energy Demo – FIT for SET**" programme is the first-ever implementation of a "smart city" or a "smart urban region" in Austria. Smart green technologies are being applied to turn cities and urban districts into "zero emission cities" and "sustainable urban regions".
- The research and demonstration programme "**Electromobility's Technical Beacons**" concentrates on sustainable mobility and energy supply and is geared to the strategic concerns and priorities of the Climate and Energy Fund.
- Austria also participates in IEA research cooperation projects (tasks, annexes) under the cooperation scheme with the **International Energy Agency (IEA)**. Research activities under this scheme relate to internationally agreed priorities, national network and dissemination tasks and delegation activities.

Transnational cooperation

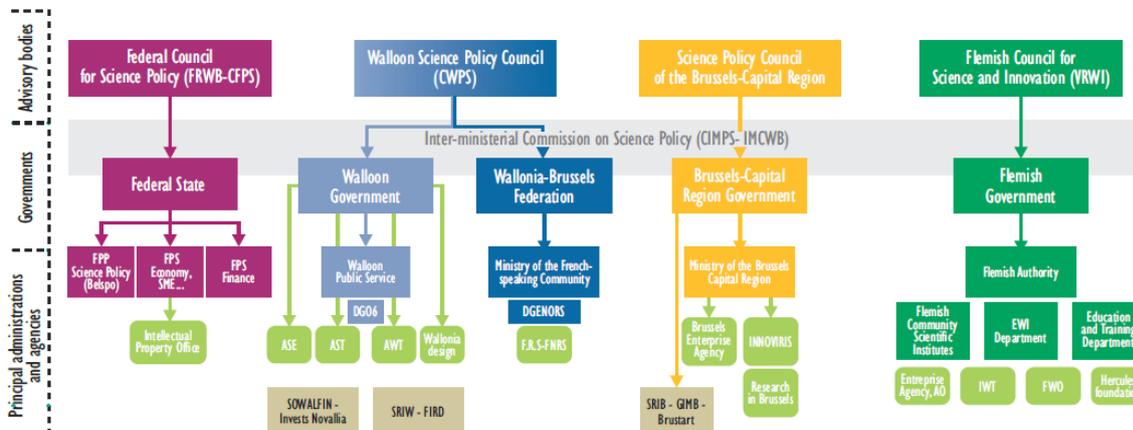
The 8th Framework Programme Horizon 2020, EUREKA and Eurostars as well as the Competitiveness and Innovation Framework Programme CIP (with its Intelligent Energy Europe Programme, IEE) are relevant for research and innovation projects in the European and international context. Furthermore, funding for international cooperations was provided by the Austrian government in the following ERA-Net initiatives:

- ERA-NET for materials research and innovation (BMVIT, FFG)
- ERA-Net Smart Grids Plus: support deep knowledge sharing between regional and European Smart Grids initiatives (BMVIT, FFG)
- ERA-NET Smart Cities and Communities (BMVIT, FFG)
- Bioenergy Sustaining the Future (BESTF) 3 (BMVIT)
- SOLAR-ERA.NET Cofund (BMVIT, FFG, Klima- und Energiefonds)

- ERA-NET Cofund Smart Urban Futures (BMVIT)
- Consolidating the European Research Area on biodiversity and ecosystem services (FWF)
- The European network for observing our changing planet (IIASA)
- Era-Net Electromobility +
- JPI Urban Europe

Energy R&D funding in Belgium

Scheme



Source: BELSPO annual report on science and technology indicators for Belgium.

Figure 1. Organisation of Belgium's public energy research development and deployment (RD&D)

Description

In Belgium, the ETRDD (energy technology research, development and demonstration) is a shared competence between the federal level, responsible for nuclear ETRDD and offshore energy, and the three regions (Flanders, Wallonia and Brussels-Capital) in charge of non-nuclear energy.

In the Flemish region, the SET-Flanders strategy has been developed by the innovation platform Generaties to align the innovation strategy with the SET Plan objectives. The ETRDD policy is mainly implemented by the Research Foundation Flanders (FWO, basic research) and the Institute for Innovation by Science and Technology (IWT). Both use a wide range of funding instruments.

In the Walloon region, the Directorates for Research and for Energy of the Public Service of Wallonia are in charge of running the calls for proposals. The calls issued by the Dir.Energy are aligned with the SET-Plan objectives.

The Brussels-Capital region focuses its activities on eco-construction and energy efficiency, especially with the construction cluster Ecobuild.

The communities (French Community, Flemish Community and German-speaking Community) are responsible for education and fundamental research (including strategic basic research) at universities and higher education establishments, including the Community scientific institutes.

Cross-national funding schemes

Belgium is involved in several ERANETS, article 185 initiatives and in most joint programming activities.

In the Flemish region, both funding agencies FWO and IWT co-operate in EU programmes and support the participation of their RTDI actors in these programmes (ERA-NETS, EUREKA, Horizon 2020) by advising and/or co-funding ETRDD projects. FWO promotes international collaboration via several instruments (international mobility, international collaboration and international contacts). IWT promotes international collaboration through an additional premium support of 10%.

The Walloon region participates also through several funding instruments dedicated to the SET-Plan, i.e. through the organisation of European calls like ERA-NET Plus. The Walloon region also co-operates in EU programmes and supports the participation of RTDI actors in the programmes Horizon 2020 and EUREKA.

In the Brussels-Capital region, universities, companies and other organisations participate in ETRDD-related calls for European programmes such as Horizon 2020. An opportunity analysis is prepared each time to determine the relevance of joining an ERA NET and the validation goes through Innoviris (the Brussels Institute for Research and Innovation).

Energy R&D funding in Cyprus

Scheme



Figure 1. Energy R&D funding scheme overview for Cyprus (modified; <https://setis.ec.europa.eu/energy-research/country/cyprus>)

Description

The energy mix of Cyprus is heavily oil-based. The R&D funding in Cyprus relies largely on public expenditure; business funding of R&D is amongst the lowest in the EU (0.1 % of GDP in 2010, 0.46 % in 2015; with national R&I intensity target 0.5 % of GDP by 2020). Energy research in Cyprus focuses on wind, solar, geothermal, marine and biomass, as well as on the development of new renewable energy technologies including energy generation, transfer and storage. Other priorities include the improvement of energy technologies and energy efficiency in industry, transport and buildings. Energy saving is an important pillar of the country's energy policy, as well as security of the energy supply.

The latest funding initiative in Cyprus came through RPF's RESTART 2016-2020 programme, which has a total budget of €100m to assign in various research categories within this time. It does not allocate a specific amount to energy, but through its various headings it funds energy-related projects that span from infrastructures to desk-based research, with a special focus on Interdisciplinarity. The main 'pillars' of research for Cyprus are chosen by local stakeholders and the government are documented in the 'Smart Specialisation Strategy' for Cyprus, available [here](#) (in Greek). In this, energy is a 'dominant priority sector', which means that it will attract a large percentage of the aforementioned funds. The RESTART document in English can be found [here](#). The Action Plan funding over period 2016-2020 is 142 million €.

Organisational structure

At the political level, the System for Research, Technological Development and Innovation (SRTDI), which is ruled by the Ministerial Council, is responsible for drafting and approving R&D policy. The Ministerial Council represents all the ministries of the Republic of Cyprus. The National Council for Research and Innovation drafts policy with advice from the Cyprus Scientific Council. The Directorate General for European Programmes, Coordination and Development (DG EPCD) is an independent organisation, which designs the research agenda in Cyprus. It is responsible for the co-financing of projects and programmes under the Structural Funds and Cohesion Funds. The objectives of the DG EPCD also include the creation of new mechanisms of research, technological growth and innovation. Research is implemented through the Research Promotion Foundation (RPF), the main government body that promotes the development of scientific and technological research. RPF manages the individual R&D budgets of each ministry. The government is the main source of institutional funding.

Governmental departments on energy

Ministry of Energy, Commerce, Industry and Tourism – The Energy Service of the Ministry has overall responsibility for energy issues including the preparation of energy conservation programmes and the promotion of RES. The Ministry is responsible for drafting and deploying the governmental policy with regard the electricity market in Cyprus.

Ministry of Agriculture, Natural Resources and Environment – The Department of the Environment of this ministry is responsible for several energy-related areas such as environmental impact assessment, eco-labelling, climate change and pollution.

Research funding bodies on energy

Research Promotion Foundation (RPF) – The RPF was established in 1996 to promote the development of scientific and technological research. The RPF develops and operates national research funding programmes and manages EU programmes and other international initiatives.

Cross-national funding schemes

The main external funding umbrella of H2020 and its previous incarnations (FP6, FP7 etc.) from the EU play a large role in energy research in Cyprus. It is estimated that around €20-30m of funding for energy has been secured through competitive calls all over the island nation in the last 3-4 years. This is supplemented by smaller amounts coming for other regional calls (such as INTERREG and ENPI-CBC Med). Two NER300 projects have been secured for the construction of two 50MW CSP plants in Cyprus, but these are still pending construction.

References / Info pages

<https://setis.ec.europa.eu/>

[DGEPCD - http://www.dgepcd.gov.cy/dgepcd/dgepcd.nsf/index_en/index_en?OpenDocument](http://www.dgepcd.gov.cy/dgepcd/dgepcd.nsf/index_en/index_en?OpenDocument)

[MECIT - http://www.mcit.gov.cy/](http://www.mcit.gov.cy/)

[CERA - https://www.cera.org.cy/en-gb/home](https://www.cera.org.cy/en-gb/home)

[http://www.dgepcd.gov.cy/dgepcd/dgepcd.nsf/6966F1D9F8511C00C2257C7D0048701E/\\$file/S3CY_FINAL_corrections_31032015.pdf](http://www.dgepcd.gov.cy/dgepcd/dgepcd.nsf/6966F1D9F8511C00C2257C7D0048701E/$file/S3CY_FINAL_corrections_31032015.pdf)

<https://rio.jrc.ec.europa.eu/en/library/rio-country-report-cyprus-2016>

Energy R&D funding in Czech Republic

Scheme

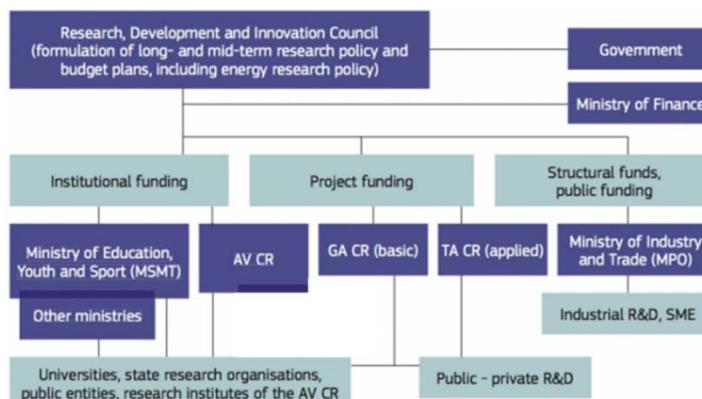


Figure 1. Energy R&D funding scheme overview for Czech (<https://setis.ec.europa.eu/energy-research/country/czech-republic>; modified)

Description

The institutional framework for R&D in the Czech Republic is organised centrally: its main policy is implemented by the Czech Parliament, while conceptual and strategic management is the ultimate responsibility of the Prime Minister. Operational management is led by the Research, Development and Innovation Council, and all public funding, as an integral part of the state budget, is administered by the Ministry of Finance. Until 2008 all public R&D funding was provided through the budgets of 22 public bodies: ministries, central offices of state and public administration.

Main funding providers

MSMT: Ministry of Education, Youth and Sport

AV CR: Czech Academy of Science

GA AV: Grant Agency of the Academy of Science of the Czech Republic - does not exist any more

GA CR: Czech Science Foundation

TA CR: Technology Agency of the Czech Republic

The main public funding bodies remain, though with new responsibilities. The Research, Development and Innovation Council provides funds for university research; the Czech Science Foundation (GA CR) supports basic research; the Ministry of Education, Youth and Sport and the Academy of Sciences are responsible for institutional funding; and the Ministry of Regional Development provides structural funds. Significant private funding of R&D is also now developing, and its share is nearly as high as the public one, with foreign companies dominant.

Budget overview

1 EUR = 25,3 CZK actual course

| millions CZK/EUR | 2014 | 2015 | 2016 |
|---------------------------|--------------------|--------------------|-------------------|
| non-nuclear energy | 297 CZK (11,7 EUR) | 291 CZK.(11,5 EUR) | 245 CZK.(9,7 EUR) |
| nuclear energy | 239 CZK (9,4 EUR) | 170 CZK (6,7 EUR) | 122 CZK (4,8 EUR) |

Table 1. Information from Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad (2014-2016)

Policy

The energy research is part of National innovation platform of National Research, Development and Innovation Policy 2016-2020. The emphasis is on nuclear fission; thermonuclear fusion; renewable and alternative energy sources (biomass, wind, geothermal and solar energy); energy systems and networks; fossil fuels (combustion and multi-fuel operation); production and distribution of heat/cold; energy in transport; energy consumption and energy savings.

Energy R&D funding in Denmark

Scheme

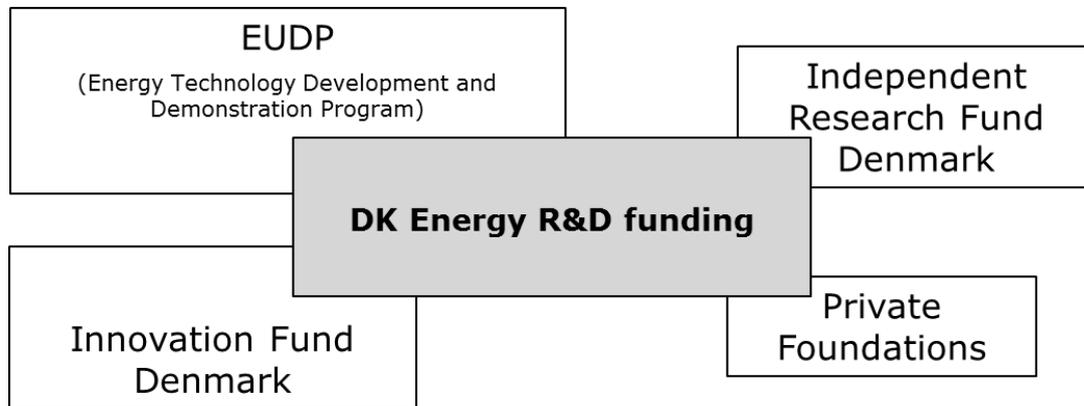


Figure 1. Energy R&D funding scheme overview for Denmark

Danish Energy R&D Programmes

Energy Technology Development and Demonstration Program (EUDP)

The largest public Danish programme dedicated to the field of Energy. It supports private companies and universities to develop and demonstrate new energy technologies. Current budget is 55M EUR with the aim to increase to 75M EUR by 2020. Foreign project participants can receive EUDP aid according to the same rules as Danish participants. However, the main applicant must be a Danish registered company or university. EUDP can support energy technologies widely such as renewable energy technologies, energy efficiency technologies, conversion technologies such as fuel cells and hydrogen, integration of energy systems including storage, more efficient methods for recovery of oil and gas and storage of CO₂. EUDP supports development of new efficient and climate-friendly energy technologies that can help Denmark to become free of fossil fuels by 2050. At the same time, projects should develop Danish business potential for growth and employment.

Innovation Fund Denmark (IFD)

In 2018, IFD has a budget of 28M EUR - in the areas of energy, bio-resources, climate, environment, water resources, buildings and transport - and further 18M EUR in the area of "New Technological Opportunities". Energy research competes for funding within this rather wide area, with a clear focus on growth and business potential. Priority areas of IFD are annually determined by the Government/Parliament through the Danish Finance Act.

Additional funding instruments

Independent Research Fund Denmark has an annual budget of around 140M EUR. Energy research applies in competition with any other research area – the primary selection criterion is research quality.

Danish private Foundations – Denmark has a rather big sector of private foundations supporting research. They play an increasing role in the research funding landscape and offer opportunity also for energy research. Energy competes with other research areas and major criteria are fit to scope of call/foundation and quality.

Energy R&D funding in Finland

Scheme

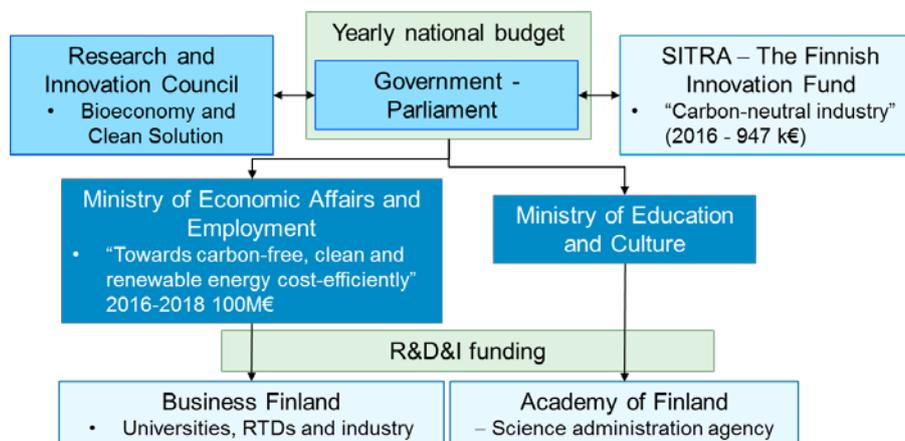


Figure 1. Energy R&D funding scheme overview for Finland

Description

The Finnish Government draws up the yearly budget, which the Parliament approves in December. Main Ministries to administer energy research funding are ‘Ministry of Economic Affairs and Employment’ and ‘Ministry of Education and Culture’. Finland is a member of the international Mission Innovation, and hence committed to seek to double their governments’ clean energy research and development investments by 2020. The Smart Energy programme launched by Tekes (from 1.1.2018 Business Finland) in May 2017 is one of Finland’s measures to reach this goal.

Research and Innovation Council

The Research and Innovation Council is an advisory body chaired by the Prime Minister. The Council discusses key issues relating to the development of research and innovation policy that supports the wellbeing, growth and competitiveness. The Strategic Programme of the Government describes the Government-term objectives, one being within Bioeconomy and Clean Solutions: “Finland has achieved the 2020 climate objectives already during the government term. Imported fossil fuel-based energy has been replaced by clean and renewable domestic energy.”

Energy policy by the Ministry of Economic Affairs and Employment

In energy policy, the principal tasks are to develop the energy markets and the security of supply, promote renewable energy and energy efficiency, and regulate nuclear energy. The Ministry’s responsibilities also include implementing emissions trading and coordinating the national preparation and implementation of climate policy. The Government’s five strategic priorities include 26 spearhead projects. One of the strategic priorities is “Bioeconomy and clean solutions”, which includes “Towards carbon-free, clean and renewable energy cost-efficiently” project. The funding for 2016-2018 is 100 M€. <http://tem.fi/en/energy>.

Business Finland (formerly TEKES – the Finnish Funding Agency for Innovation)

Business Finland is an accelerator of global growth, by supporting companies to go global, as well as funding innovations. Business Finland offers Finnish companies a unified customer journey for innovation activities, internationalization, investments and tourism promotion. Business Finland finances business R&D projects and

public research projects at universities, research institutes and universities of applied sciences. In 2017, Business Finland (formerly Tekes) granted a total of €450 million funding for innovation activities.

Sitra – the Finnish Innovation Fund

In 2014, Sitra launched its “Carbon-neutral industry” focus area. A group of major leading companies committed themselves to acting as an example in making decisions that contribute to Finland’s efforts to become carbon neutral. Sitra has finalised the Energy and Climate Road map 2050 (in Finnish only) for companies and provided information for the planning of the National Energy and Climate Strategy 2030. <https://www.sitra.fi/en/topics/carbon-neutral-industry/#what-is-it-about> According to Sitra, companies play a key role in the implementation of climate targets. The decisions made by pioneering companies make a transition towards a carbon-neutral society possible; a transformation that will affect all of society. Funding for this topic was 947 k€ in 2016.

Academy of Finland

The Academy of Finland provides funding and expertise with a view to advancing the quality and impact of scientific research, renewing science and developing research environments in Finland. The Academy of Finland is a science administration agency under the Ministry of Education, Science and Culture. Funding the Academy was 419 M€ (of which 238 M€ unbound funding) in 2016 for all scientific areas, main beneficiaries being the universities in Finland (81.3 %).

Cross-national funding schemes

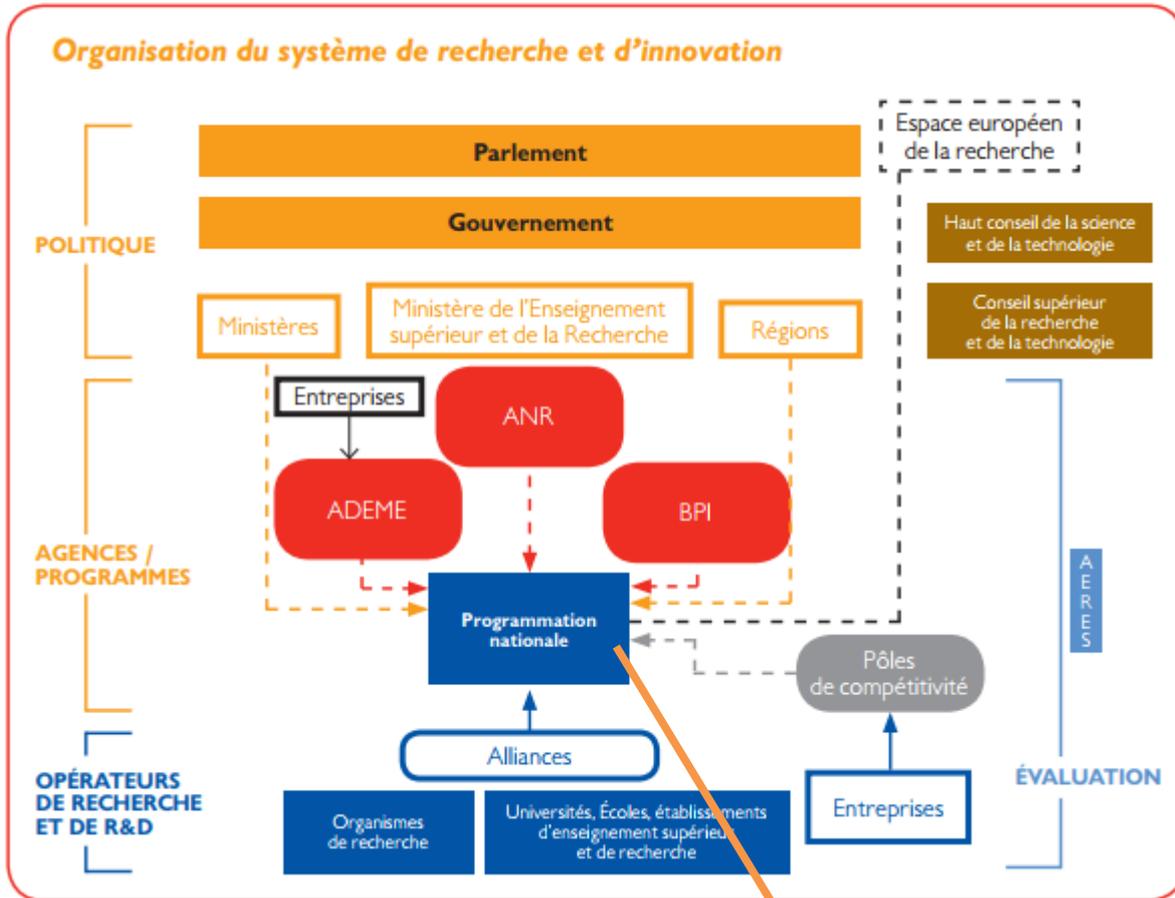
ERA-net projects are applied for certain topics, and Business Finland is the funding agency. In 2016, the share of EU funding for eight ERA-NET projects was less than 1 M€.

Nordic energy cooperation over the next 5-10 years

In January 2016, the Nordic Council of Ministers commissioned Jorma Ollila to conduct a strategic review of Nordic energy cooperation. The analysis is also part of the reform work that aims to improve the effectiveness of the Council of Ministers. In June 2017 in Oslo, he presented the report “Strong today – stronger tomorrow” containing 14 proposals for developing Nordic energy cooperation over the next 5–10 years. <http://norden.diva-portal.org/smash/get/diva2:1106010/FULLTEXT01.pdf>.

Energy R&D funding in France

Scheme



Source: ADEME, Stratégie Recherche Développement Innovation 2014-2020

| | |
|---|--|
| Programme 172 | Programme 190 |
| Multidisciplinary scientific and technological research | Research in energy, sustainable development and mobility |
| Challenge "Clean, reliable and efficient energy" | Action "Research in Energy" |

Description

The national research strategy (S.N.R) is defined by the Ministry of Research and aims, among other objectives, at reinforcing the consistency with H2020 priorities. This strategy includes a multiannual programming of resources. Commitments and payment appropriations for research are then detailed each year in the public finance law (LOLF).

The programme 172 aims at implementing the national research strategy in line with H2020 with ten societal challenges. This relates to rather low TRLs. The role of national alliances is recognised in terms of providing inputs to define the national programming. The French National Research Agency (ANR) has a key role in implementing R&I priorities.

The programme 190 contains a specific action related to energy (action 10) which covers for instance technological research linked to climate change. The funding is earmarked for research activities conducted by CEA (Alternative Energies and Atomic Energy Commissariat) and IFPEN (IFP Energies nouvelles). In this programme, ANCRE (National alliance for coordination of research on energy) has a specific role to propose research programmes and contributes to the definition of national research strategy in energy.

Furthermore, the environment and energy management agency (ADEME) supports research close to the market (high TRLs) and guides the French competitiveness clusters that bring together public and private operators. Several of these clusters are specialised in energy.

Cross-national funding schemes

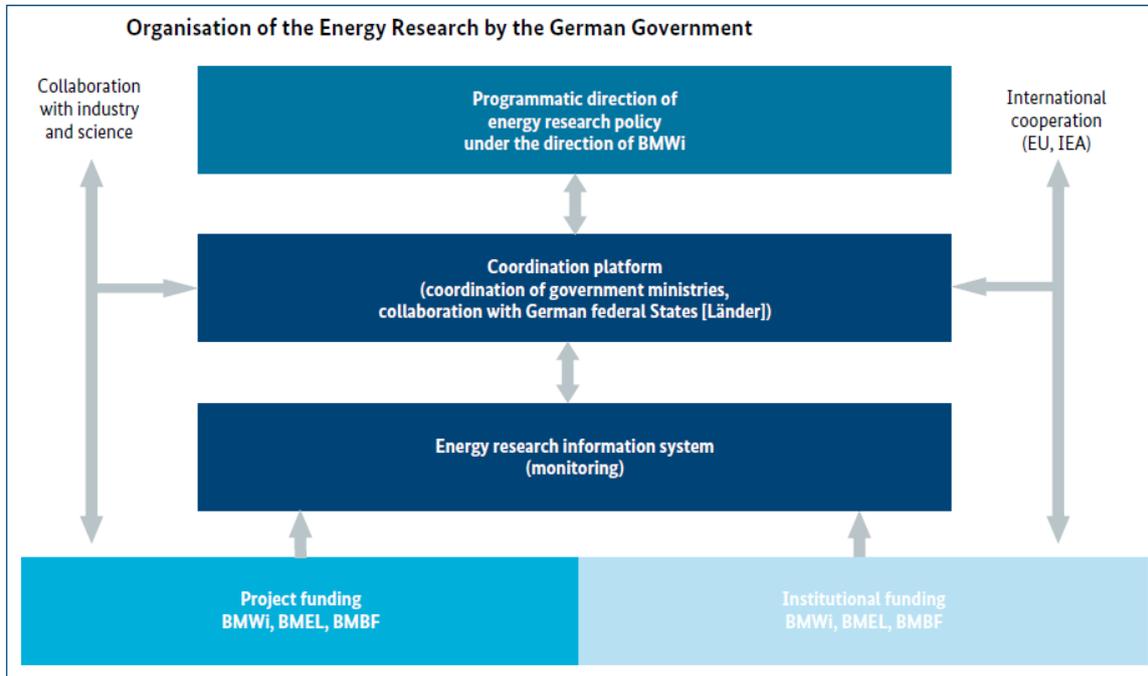
The ANR is mandated to develop transnational collaborations with EU and non-EU partners via two cooperation schemes in order to heighten the influence of the French scientific research community. The first scheme consists of European or other bi- or multi-lateral collaboration joint calls, and includes the establishment of an international evaluation committee. The second consists of regular national programmes with a transnational collaboration component through which common methods of funding and assessment are agreed upon.

France leverages the openness of Horizon 2020 to work with key international partners, in particular Mexico, Russia, China, India and Brazil. It is also heavily involved in public-private partnerships with third countries via the ERA-NET and ERA-NET Co-fund initiatives.¹

¹ http://ec.europa.eu/research/era/pdf/era_progress_report2016/country_fiches/era-fr.pdf

Energy R&D funding in Germany

Scheme



In Germany education and research is under the authority of the local governments. Only for major activities like the Energiewende the federal government is allowed to contribute to the research activities. Mainly 3 German Federal Ministries support the 6th German Energy Research Programme. The responsibility for application-oriented research in the areas of energy efficiency and renewable energy now rests with the Federal Ministry for Economic Affairs and Energy (BMWi). However, the Federal Ministry of Education and Research (BMBF) still coordinates the funding of basic research in the field of energy technology and the Federal Ministry of Food and Agriculture (BMEL) of applied research in bioenergy.

Description

The control over the government’s programmatic orientation rests with the BMWi, although the inter-ministerial and international cooperation is done within the frame-work of the Coordination Platform Energy Research. The information system Energy Research depicts project funding and institutional support in a transparent manner. A regular exchange of information between industry and academia – both nationally and internationally – ensures the practical relevance and takes the current technical and scientific developments into account.

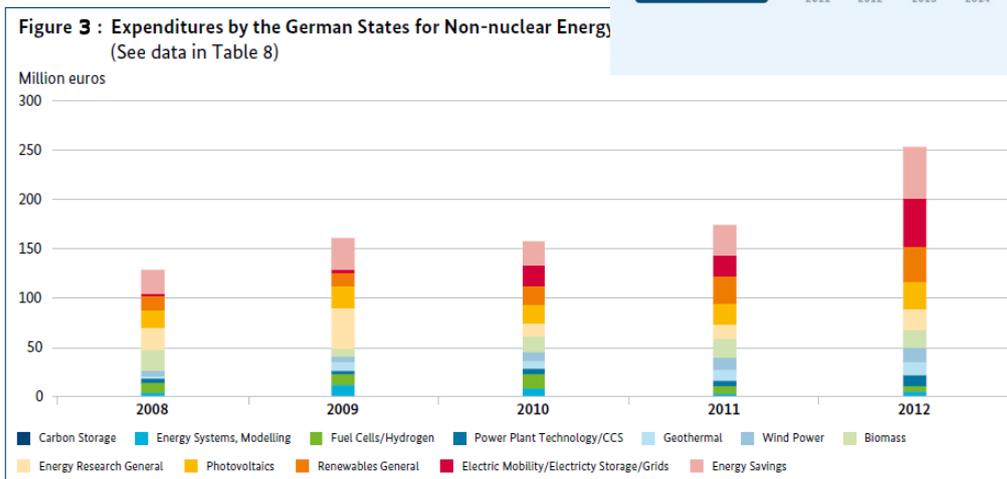
Thematically, the BMWi is entrusted with application-oriented project funding in the areas of energy efficiency, renewable energy sources and nuclear safety and waste disposal research, as well as for institutional funding in the field of energy at the German Aerospace Center (DLR).

The BMBF is also responsible for the institutional funding for the HGF centres (with the exception of the DLR), the Fraunhofer Society, the Max Planck Society and the Leibniz Association.

The application-oriented research of the BMWi and the BMEL funds research, development and demonstration of possible future applications and thus creates the conditions for the implementation of innovations.

Within the *National Hydrogen and Fuel Cell Technology Innovation Programme (NIP)*, the Federal Ministry of Transport and Digital Infrastructure (BMVI) funds – in addition to the funding presented here for technological development by the BMWi in the Sixth Energy Research Programme – market preparation activities such as demonstration and infrastructure projects and field tests in the context of applied research and development.

Energy R&D funding of the federal government (see figure right). About 60% of the funding was institutional funding. The contribution from the Länder or the German States is presented in Figure 3.



Cross-national funding schemes

For the implementation of the SET-Plan, Germany has proposed the “Berlin Model.” The core element of this funding model is an as unbureaucratic and efficient multi-national funding for research projects as possible in close cooperation with the respective national funding pro-grams or organisations. The first bilateral collaborative projects using this model were successfully started as part of a joint call for proposals with Finland on the topic of energy efficiency in 2013. Other co-operations exist with Austria and Switzerland in research areas which focus on energy efficient cities and hydrogen and fuel cell technology. There are plans for an expansion of funding based on the Berlin Model.

The BMWi, as the leading department, has set up the Coordination Platform for Energy Research for this information exchange with the participation of the federal ministries BMBF, BMWi and BMEL, which were in charge of the Sixth Energy Research Programme. In this platform – taking into account the growing importance of the European aspects – the cornerstones for governmental funding for research in the field of energy are established and interdepartmental cooperation is arranged.

Energy R&D funding in Greece

Description

The General Secretariat for Research and Technology (GSRT) under the Ministry of Education, Research and Religion, remains the administrative unit responsible for designing national R&I policies, implementing measures of public R&I funding, providing the funding for and overseeing the main public research organisations and representing the country in international research policy organisations, fora and bilateral agreements.

The Ministries of Education, Research and Religion (through the GSRT and the Secretariat of Education and Life-Long Learning) and of the Economy, Development and Tourism (through the Secretariats for Public Investments and of Industry) are the main funders of R&I. The latter manages the Structural Funds and has overall responsibility for supporting regional development in general, including entrepreneurship and, quite recently, innovation. The Regional Councils assume responsibility for funds coming from the Regional Operational Programmes.

In general, the R&I strategies have been formulated taking into account the broader targets and approaches of the European FPs. The national strategies for development and competitiveness and those for R&I follow the programming cycle of the Structural Funds that have so far provided the corresponding funding almost exclusively.

The National Smart Specialisation Strategy (RIS3) prepared by the GSRT for the current programming period 2014-2020, opt for supporting also cross-national funding schemes, like ERANETs, Bi- and/or Multi-lateral collaboration joint calls, has been developed following an entrepreneurial discovery process, from which the following priority areas have emerged:

- Agrofood,
- Life Sciences & Health – Medicine,
- Information and Communication Technologies,
- Energy,
- Environment and sustainability,
- Transport and logistics,
- Materials – Construction, and
- Culture – Tourism - Cultural & Creative Industries.

These priority areas have been further divided into individual priorities, taking into account regional dimensions and using innovation platforms set up by GSRT involving policy makers from relevant public and private bodies.

The smart specialisation approach was an opportunity for Greece to build a strategy aligning the research priorities to national and regional needs where comparative advantages can be developed/exploited.

The process has contributed to raising awareness of business and industry to the benefits of a stronger focus on Research and Innovation, which may increase private sector involvement in actions aiming to commercialise products and services of higher added value, with support from national/structural funds and/or FPs. A positive outcome of this process is creating more prospects of employment for the highly educated workforce of the country, especially in fields related to science and technology.

Energy R&D funding in Hungary

Description

The National Research, Development and Innovation Office (NRDIO) of Hungary is a national strategic and funding agency for scientific research, development and innovation. The NRDIO established by fusion of National Scientific Research Office (OTKA Office) and National Innovation Office (NIO). The new office started operation from 1.1.2015. <http://nkfih.gov.hu/the-office/mission>

The only national fund for research is **the National RDI fund**.

<http://nkfih.gov.hu/funding/portfolio-of-calls-to>

The Structural Funds are the main financial instruments of EU regional policy, and those are the other sources for RDI support in Hungary. Hungary has gained the right to directly take part of the various Structural Funds. Details on https://www.palyazat.gov.hu/implementation_system

Public funding

Figure 1 represents the EU funding available for Hungarian SME companies and how it is distributed in 2014-2020. Figure 2 represents what types of projects were funded in 2015-2016 by EU and domestic funds.

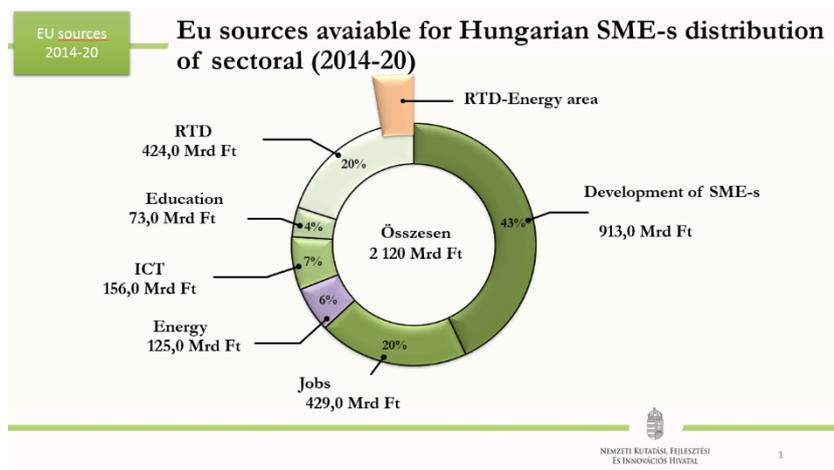


Figure 1. EU funding for Hungarian SME's.

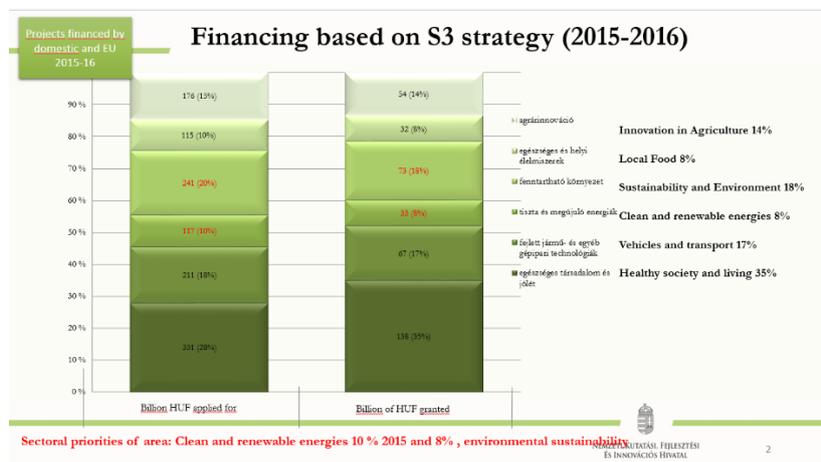


Figure 2. Project funding in Hungary 2015-2016.

The main areas supported in energy topics:

- Energy producing
 - Nuclear
 - Renewable and alternate methods
 - Fossil energy
- Distribution, transport and storage of energy
- Energy Efficiency
 - Smart systems
 - Energy Efficiency in Industry and decreasing emission
 - Energy Efficiency in Buildings
- Mobility: alternatives in fuel

The energy related projects and their funding is shown in Figure 3. Hungary has also introduced good practices for energy innovations (2015-2017) divided to large companies, research organizations, start-up's and SME's as shown in Figure 4.

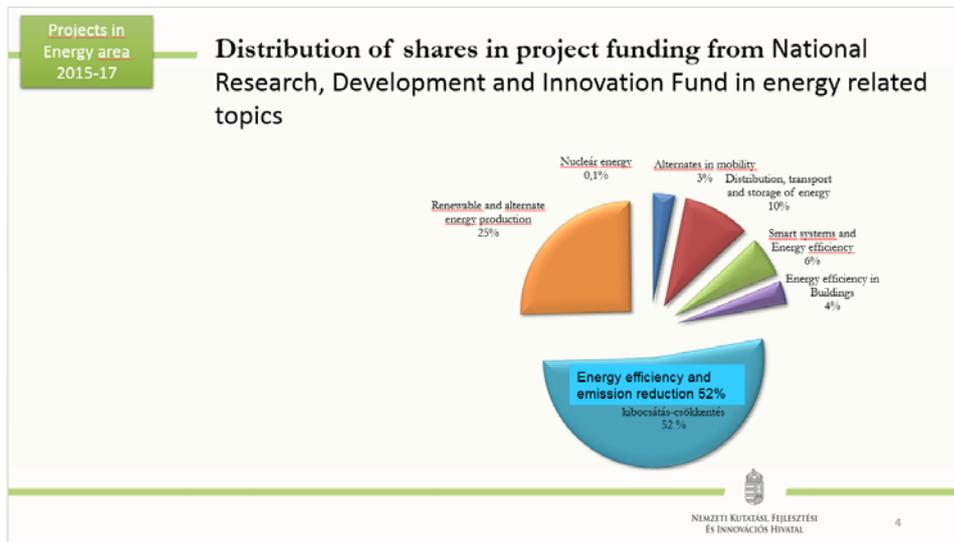


Figure 3. Energy funding in Hungary.

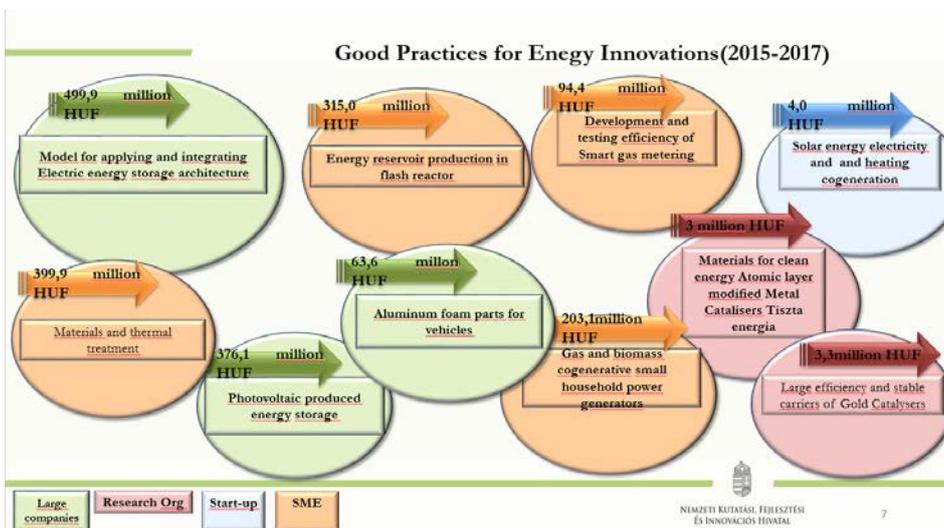


Figure 4. Hungarian good practices for energy innovations 2015-2017

Energy R&D funding in Iceland

Historical overview

During the course of the 20th century, Iceland went from one of Europe's poorest countries, dependent on peat and imported coal for its energy, to a country with a high standard of living where practically all stationary energy is derived from renewable resources. The present value of the estimated savings of space heating with geothermal instead of oil between 1914 and 2012 is estimated at 200.000€ per family (4 persons).

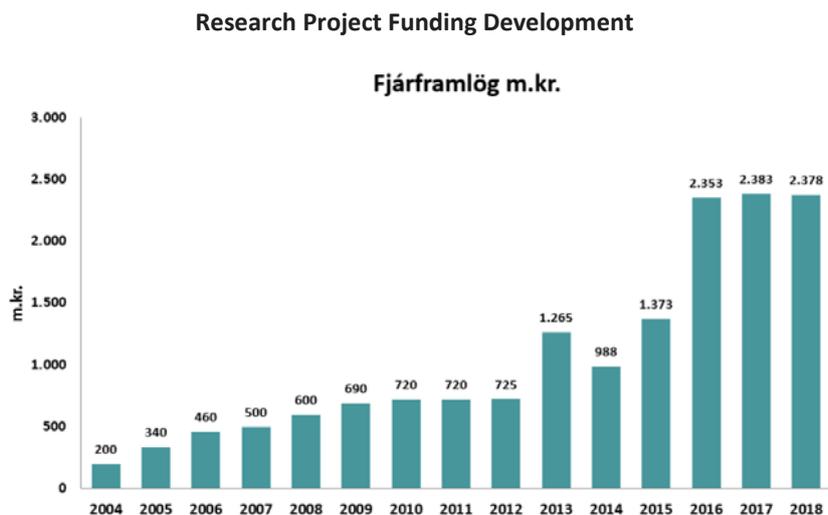


Figure 1. R&D funding of the “Technological Development Fund” in Icelandic Krona (1 €= 125 kr today, was higher up to 150 kr in the past)

Description

Overall Iceland will spend about ~500 M€ on research, development and innovation in 2018. The “Technological Development Fund” has a budget of ~19M€ available for competitive calls. There is no special pot for energy research calls. In the years 2010-11-12-13, there were 4-1-0-3 energy related projects funded. Additionally there are also a few materials for energy projects supported, but even less than directly energy related once. In 2013 65 projects were funded with a budget of 7.4 M€. Therefore the average project since was very small. More information is available on <https://en.rannis.is/funding/research/technology-development-fund/>

Cross-national funding schemes

There are no current activities. Iceland coordinated a FP7 geothermal ERA-net until October 2016 (<http://www.geothermaleranet.is/>).

The overall contribution from the 7th European framework programmes on energy research projects was 3.9 M€ + a few hundred thousand € in the NMP area. The overall European funding support was reduced to 1/3 in H2020.

Energy R&D funding in Italy

Description

In Italy the energy-related research activities are co-ordinated by public institutions, at both national and regional level, as follows:

The Council of Ministers and the Inter-Ministry Committee for Economic Planning (CIPE) are the high level political bodies in charge also to set the energy research funding. As well, each year the Italian Parliament sets the funding framework for R&D by approving the Legge di Bilancio (Budget bill) proposed by the Government.

The funds are distributed to the ministries responsible. The principal ministries involved in funding energy R&D are the following:

- Ministry of Education, Universities and Research;
- Ministry of Economic Development;
- Ministry for the Environment, land and Water.

At technical level, the public research institutions which carry out research activities in the energy field are ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development), CNR (National Research Council), and RSE (Research on Energy Systems).

Moreover, central State and Regions share regulatory competences on several matters, among which also energy.

Public funding for Energy R&D flows to research organisations either directly or through different channels such as the National Programme for Research (Piano Nazionale della Ricerca, PNR), the National Operational Programme (Piano Operativo Nazionale, PON) for research and competitiveness (co-financed by the European Structural Funds), and the Interregional Operational Programmes. Fundraising for energy R&D is also achieved through a special component of the end-user electricity tariff. A policy incentive in form of tax relief for stakeholders has been introduced to promote private R&D in the energy sector within the framework of the "Industry 4.0" National Plan. In addition, the Cassa Depositi e Prestiti, a public financial institution, supports mid- and long-term investment in the energy sector, with a favourable interest rate

Of course, Italy is fully aligned with the SET-Plan and fully involved in the Mission Innovation process to double the funding for energy, as well as in the different European energy funding.

Energy R&D funding in Norway

Scheme

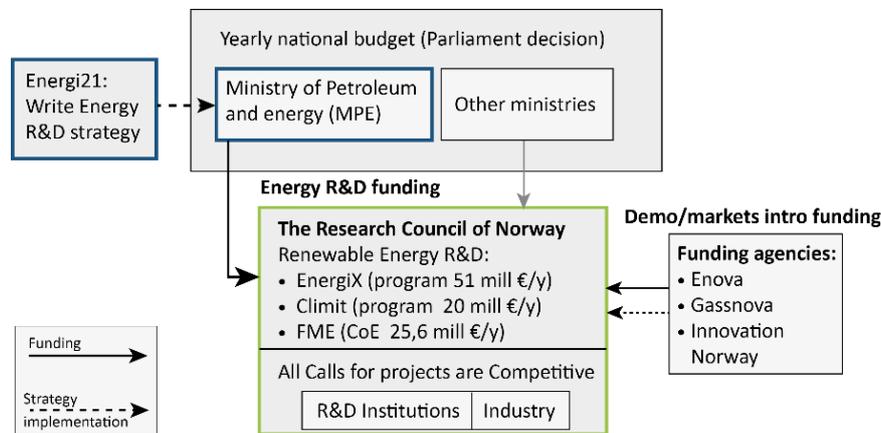


Figure 1. Energy R&D funding scheme overview for Norway

Description

The Norwegian parliament sets the funding framework for R&D as part of the money spent through the ministries. The total energy R&D funding is the sum of the energy R&D funding from all the ministries. The major bulk of R&I investment for energy comes from the Ministry of Petroleum and energy (MPE), but energy receives funding from about half the ministries. It is made easier for the users by sending all the R&D funding straight to the Research Council to implement intentions/conditions of the money coming from the different ministries within one single program administration, as efficient as possible. The Research Council collaborates closely with three funding agencies, i.e. Enova, Gassnova and Innovation Norway, supporting research implementation through demo-scale projects.

OED has appointed a strategic body called [Energi21](#) consisting of experts from industry, leading R&D institutions and key government agencies to come up with a broadly supported R&I strategy for renewable energy, revised every 2-3 years. The strategy is evaluated and endorsed by OED before being passed to the Research Council for implementation through R&D projects via competitive calls. All these projects are funded by means of three instruments, two general programmes (EnergiX and CLIMIT) and a dedicated program for national flagships, known as "FME" in Norway. All three instruments are competitive. All R&D projects must have some industry funding. Typically, long-term, competence building projects, led by R&D institutions require 20% funding from industry whereas the requested industrial funding for short-term, nearer-market projects, led by industry, is over 50%. On the other hand, the FMEs are funded for 8 years with 2-3 MEUR/y from the Research Council (up to 50%). This sum must be matched by industrial (25%) and institutional funding (25%).

Cross-national funding schemes

ERANET is the main instrument for cross-national funding in Norway. Decisions on joining and funding ERANET or other cross-national funding schemes are taken by EnergiX and CLIMIT at the expenses of national projects within their overall budget. The current strategy is to support ERANET if the topic is better researched on the European arena together with other European researchers than in Norway. Currently only 2-3% of the EnergiX budget is spent this way. Instead the CLIMIT programme devotes 15-20% of the funding to cross-national initiatives. Besides these two programmes, there are schemes to support Norwegian researchers' active participation in agenda-setting processes that are approximately at the same level of funding.

The main decision-makers to engage with regarding the development of more attractive cross-national funding schemes are the EnergiX and CLIMIT managements, the EnergiX and CLIMIT boards, their counterparts in Energi21 and the key R&D personnel in OED.

Energy R&D funding in Poland

Scheme

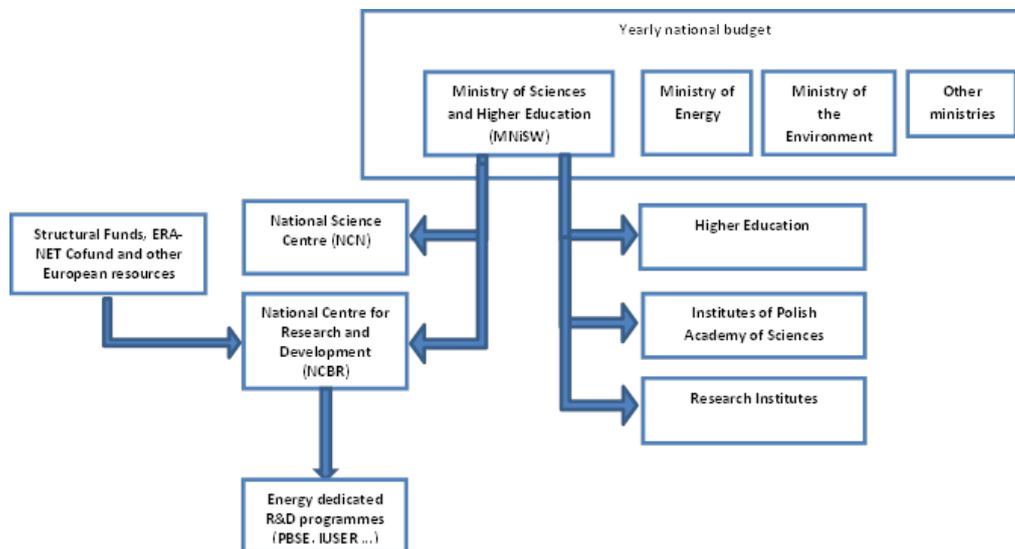


Figure 1. Energy R&D funding scheme overview for Poland

Description

The Polish parliament sets the funding framework for all ministries. There is not any special national budget dedicated for energy R&D. The national budget for science and research is directed to Ministry of Sciences and Higher Education (MNiSW). The Ministry of Energy (as well as the Ministry of Environment) have not got any budget appointed for energy R&D. The resources of MNiSW are distributed for research in many ways. The most important are: 1. statutory subsidy for maintaining the research potential of scientific institutions (higher education, institutes of Polish Academy of Sciences and more than 100 other research institutes). The subsidy for the majority of the above research institutes is below 10% of their yearly budget); 2. resources transferred by the ministry to its agencies: National Science Centre (NCN) and National Centre for Research and Development (NCBR); 3. dedicated programs launched by the ministry (for example for young researchers, large infrastructure, research dissemination etc.)

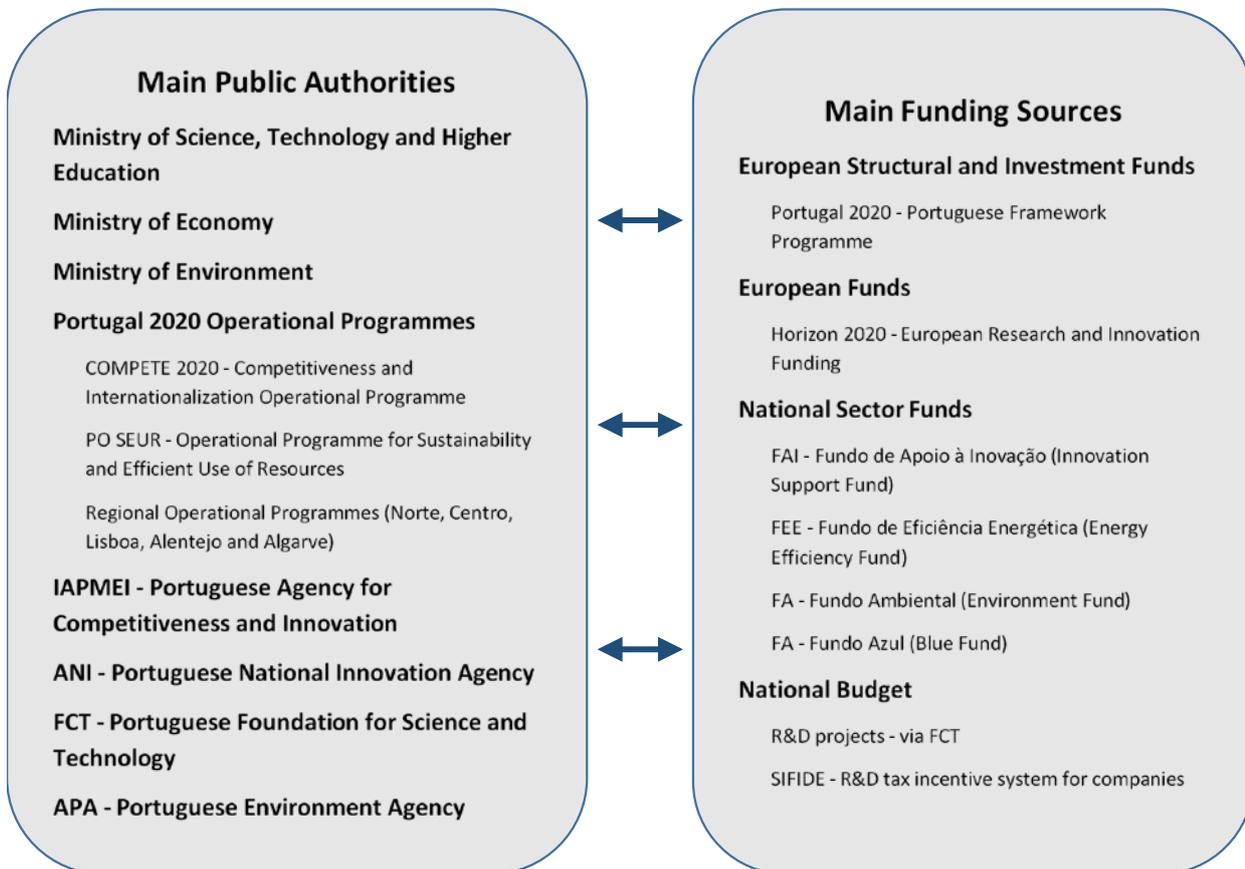
The National Science Centre (NCN) is an executive MNiSW agency appointed to support scientific activities in the field of basic research, that is experimental or theoretical work undertaken primarily to acquire new knowledge about the fundamentals of phenomena and observable facts, without any direct commercial use. The NCN resources are not distributed for special research fields but rather to the best researchers having the most promising ideas (also in energy areas). The National Center for Research and Development (NCBR) is an MNiSW executive agency implementing national policy tasks in the field of applied research, technology and innovation. NCBR launches programs and as a part of them competitive calls for R&D projects. The programs use national funds and European structural funds. Some of these programs are dedicated to the research and implementation of energy technologies, for example PBSE and IUSER programs financed from the funds of the Innovative Development Operational Program. PBSE concerns the production of new products (conventional and renewable energy, electricity networks, etc.), and IUSER - their management systems (energy storage, generation and energy control in end user distributed systems, energy efficiency improvement systems, Internet of Things, critical infrastructure safety systems) . There are other programs not thematically focused, but the highest ranked projects from various thematic areas are selected as part of the competition.

Cross-national funding schemes

The main instruments for cross-national funding in Poland are ERANET, Structural Funds and other European resources (for example Polish-Norwegian Research Cooperation Program and other bilateral programs).

Energy R&D funding in Portugal

Energy R&D funding in Portugal



Source: ANI - Portuguese National Innovation Agency

Figure 1. Energy R&D funding scheme overview for Portugal

Within the Portugal - European Union partnership agreement — the so-called Portugal 2020 framework programme — there are several support and incentive schemes to fund R&D activities. Energy specific R&D funding is subject to competitive calls for projects amongst all other areas.

The European Commission’s Framework Programme for funding collaborative research and innovation all over the EU and its international cooperation partner countries — the Horizon 2020 — is one other funding source for Energy R&D, with specific funding schemes for Energy and also competitive calls.

There are four National Sector Funds that also support R&D projects and, specifically, Energy R&D projects: the FAI - Innovation Support Fund, the FEE - Energy Efficiency Fund, the FA - Environment Fund and the FA - Blue Fund.

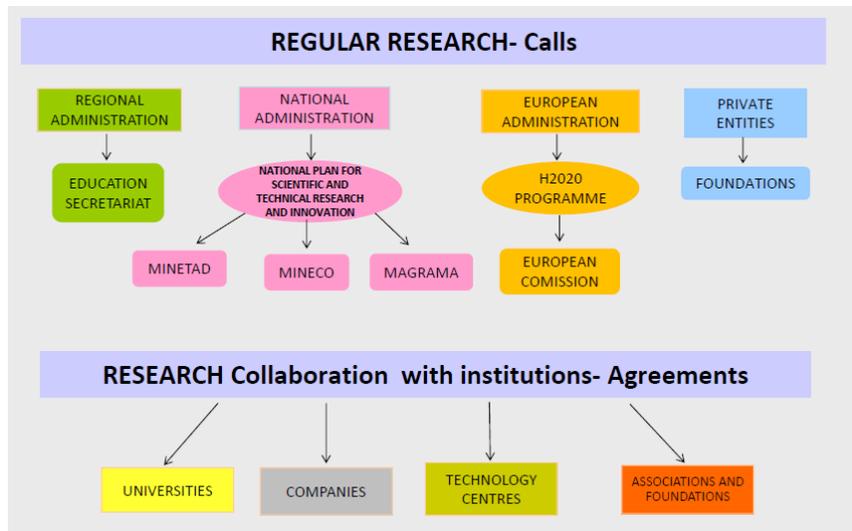
On a National Budget basis, the SIFIDE is the R&D tax incentive system for companies, which aims to boost the competitiveness of companies by supporting their R&D efforts through a corporate tax deduction applied to expenditures of such nature. Energy R&D performed by companies is eligible for such system.

Also through the National Budget FCT (the Portuguese Foundation for Science and Technology) supports the scientific community in Portugal through a range of funding schemes, tailored for individual scientists, research teams or R&D centers. Through its funding schemes, FCT can support Energy R&D in competition with any other research area.

For the Energy sector actors, the main public national authorities relevant for the promotion of the Portuguese national innovation system and also managing such funding sources are the one listed in Figure 1.

Energy R&D funding in Spain

Scheme



Description

The SPANISH NATIONAL PLAN FOR SCIENTIFIC AND TECHNICAL RESEARCH AND INNOVATION 2017-2020 enables a simultaneous, continuous approach to the design of actions to foster and coordinate the RDI process, which encompasses everything from generating new ideas to their incorporation in the market in the form of new products and/or processes, improving quality of life, the well-being of citizens and contributing to economic development. It is aimed at all stakeholders in the Spanish Science, Technology and Innovation System responsible for: (a) execution of RDI activities; (b) management of RDI RDI activities; and (c) provision of RDI services for progress in science, technology and innovation in Spanish society and the economy as a whole.

Therefore, public funds are assigned mainly through public tenders and proposals to be funded are selected taking scientific and technical criteria into account, as well as criteria of technological viability, entrepreneurial and commercial criteria backed by internationally validated principles, in accordance with standardised, transparent evaluation processes based on peer evaluation committees.

At the same time, due to their horizontal nature, the public RDI activities must be supported and strengthened by sectorial policies. Therefore, the Spanish Ministry of Economy Industry and Competitiveness through the State Research Agency coordinates the actions of those ministerial departments whose policies contribute to the achievement of the scientific, technical and innovation objectives established.

The drafting of the NATIONAL PLAN coincided with the debate and drafting of the future Framework Programme for Research and Innovation RDI in the European Union, “Horizon 2020”, and therefore with the reflection on the big challenges and opportunities of EU RDI policies and those of the Member States.

Table 1. National Programmes of the SPANISH NATIONAL PLAN FOR SCIENTIFIC AND TECHNICAL RESEARCH AND INNOVATION

| |
|--|
| NATIONAL PROGRAMME FOR PROMOTION AND INCORPORATION OF TALENT AND ITS EMPLOYMENT |
| NATIONAL PROGRAMME TO ENCOURAGE SCIENTIFIC RESEARCH AND TECHNICAL EXCELLENCE |
| NATIONAL PROGRAMME ON BUSINESS LEADERSHIP IN R&D&I |
| NATIONAL PROGRAMME FOR RESEARCH AIMED AT THE CHALLENGES OF SOCIETY |

The NATIONAL PLAN develops the NATIONAL RDI PROGRAMME FOCUSED ON SOCIETY’S CHALLENGES, in which each of the challenges also represents an essential part of the scientific and technological and social priorities of

the Spanish System for Science, Technology and Innovation's stakeholders for the coming years. In the area of energy: CHALLENGE ON SAFE, EFFICIENT AND CLEAN ENERGY. This CHALLENGE'S specific objective is to promote the transition towards an energy system which allows for reducing dependence on fossil fuels in a scenario in which we simultaneously contemplate a lack of these fuels, a global increase in their demand and their environmental impact. Taking into account the international commitments acquired, it is mandatory to coordinate the actions derived from the NATIONAL PLAN with the different European initiatives and especially with the STRATEGIC ENERGY TECHNOLOGIES PLAN (SET Plan), proposed by the European Commission in 2007 and endorsed by the Member States and the European Parliament.

Cross-national funding schemes

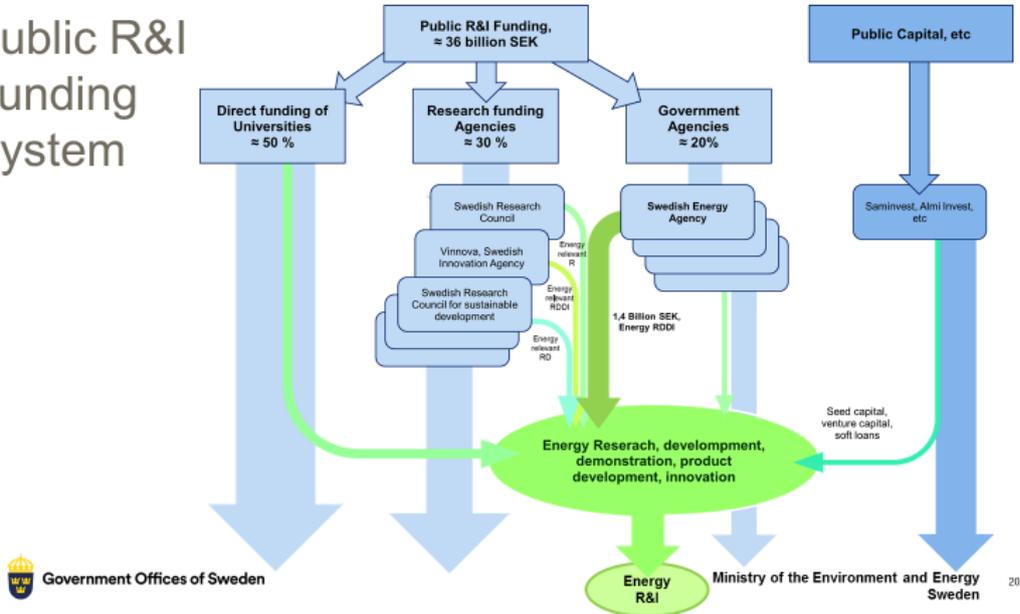
ERANET is the one of the instrument for cross-national funding in Spain. Decisions on joining and funding ERANET or other cross-national funding schemes are taken by the State Research Agency and by the State Innovation Agency (CDTI-Centre for Industrial Technological Development) through the **International joint programming actions calls**. The objective is to promote scientific and technical research and innovation carried out in our country in transnational collaboration to address major scientific and societal challenges together, particularly within the framework of the European Union. These are grants which make it possible to complete co-funding percentages of European initiatives provided for the purpose of incorporating doctors, R&D projects, and acquisition of infrastructures, innovation and transfer of results, among others. Likewise, Joint Regional Programming Activities are included, following a similar scheme to that proposed at international level makes it possible to undertake activities co-funded by the NATIONAL PLAN and the Autonomous Regions through their respective Plans and "Smart Specialisation Strategies in Research and Innovation" in order to ensure proper coordination between the state and the regions emphasising the need to rationalise resources by avoiding duplication.

Other cross-national funding programmes/schemes (EUREKA, IBEROEKA, Bilateral programmes, EUROSTARS,...) are managed by the State Innovation Agency (CDTI-Centre for Industrial Technological Development). The objective is to promote international R&D&i projects headed by companies, at both multilateral (Eureka and Iberoeka) and bilateral levels, refer to the value added of innovation performed internationally and enable Spanish companies to reinforce their technological capacities, simultaneously expanding the impact of their products, processes and services on global markets.

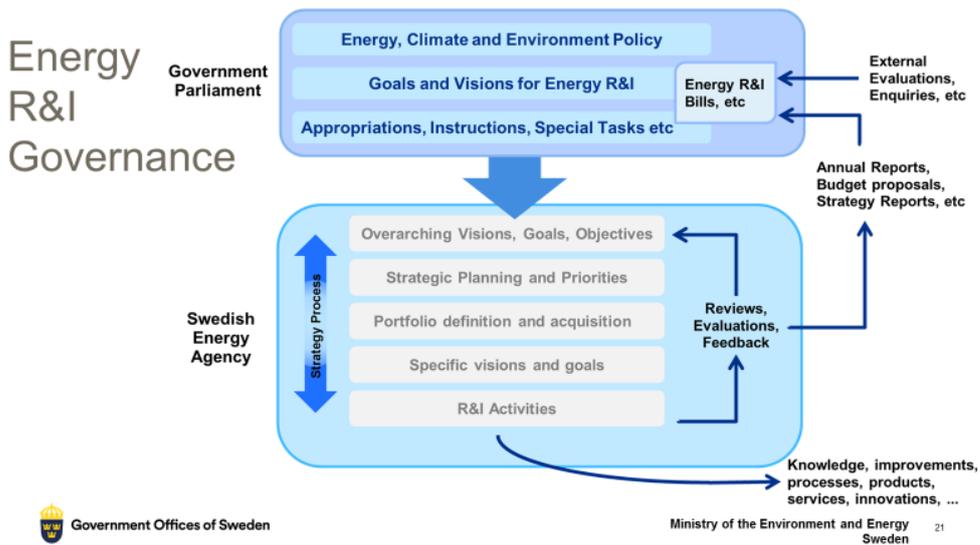
Energy R&D funding in Sweden

Scheme

Public R&I Funding System



Energy R&I Governance



Description

The Ministry of the Environment and Energy is responsible for the Government's environmental, energy and climate policy. The Swedish Energy Agency has the overall responsibility for implementation of energy RDI&D policy and the National Energy Research and Innovation Programme. Some energy related activities are also carried out by other agencies, often in cooperation with the Swedish Energy Agency. Basic research on nuclear fission and fusion is financed by the Swedish Research Council². More general basic research in the energy field is carried out jointly between the Swedish Research Council and the Swedish Energy Agency.

The Swedish Energy Agency may fund academia as well as institutes and the private sector. Funding can be applied for at all TRL-levels and most programmes are open for international collaboration. In the beginning of 2017 about 50 programmes and many individual projects were active under the National Energy Research and Innovation Programme. Besides research programmes run by the Swedish Energy Agency there are also collaboration programmes run together with the private sector and programmes that are run jointly together with other research funding governmental agencies (The Swedish Research Council (VR), Sweden's innovation agency (VINNOVA)³ and The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS)⁴.

Moreover, Swedish funding agencies participates in several European cooperation networks, partnership programmes etc, such as Joint Programming Initiatives (JPIs), EUREKA and ERA NETs. The latter include bioenergy, ocean energy, solar energy, smart cities and communities, sustainable urban development, smart grids, wind power, transport and adaptation to climate change.

For further information, please find below an overview of the national Energy R&I Governance (1) as well as the Public R&I Funding System (2).

Energy R&D funding in Switzerland

Scheme

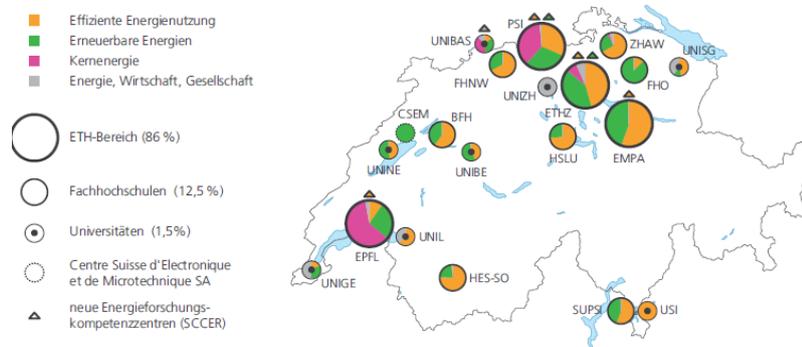


Figure 1. Energy R&D funding distribution

The Swiss Federal Office of Energy (SFOE) 's current energy research concept applies for the period 2017-2020 and is closely based on the concept of federal energy research 2017-20203, which is drawn up by the Swiss Federal Energy Research Commission CORE.

Description

With its energy research programmes, the SFOE (www.bfe.admin.ch) covers almost the entire spectrum of energy research. In 2014, the public sector spent CHF 305.9 million on energy research. At 51.6 %, the ETH Domain made the largest contribution. With a share of 11.2%, the SFOE was the third-largest research funder, ahead of the European Commission (FP7, 7.2%). The SFOE is not only one of the most important funding institutions, but is also the central body for coordinating the various funding instruments. With the establishment of eight Swiss Competence Centers in Energy Research (SCCER) from 2014, the need for coordinating public sector activities has increased further.

Cross-national funding schemes

One of the SFOE's central tasks is to involve Swiss researchers in international research activities. In addition to various multilateral agreements, these include in particular the research programmes of the International Energy Agency (IEA) and the European Commission.

Multilateral cooperations: In addition to the EU and the IEA, multilateral cooperation is also of central importance for Swiss researchers. Through various agreements, the SFOE ensures that Switzerland can participate in other international programmes, such as the International Partnership for Geothermal Technology or agreements with Germany and Austria (DACH co-operations) in the fields of smart grids and smart cities.

EU Research Framework Programmes: As from 1 January 2017 Switzerland is associated to the entire Horizon 2020. It is expected that this is also the case for FP9.

In the area of the so-called ERA-Net Cofund Action (ERA-Net CFA), in which the European Commission increases the national funding pooled for joint calls for projects by up to 15 million euros, the SFOE finances the Swiss projects. For each ERA-Net CFA and year, the SFOE estimates around one million Swiss francs.

Energy R&D funding in The Netherlands

Scheme

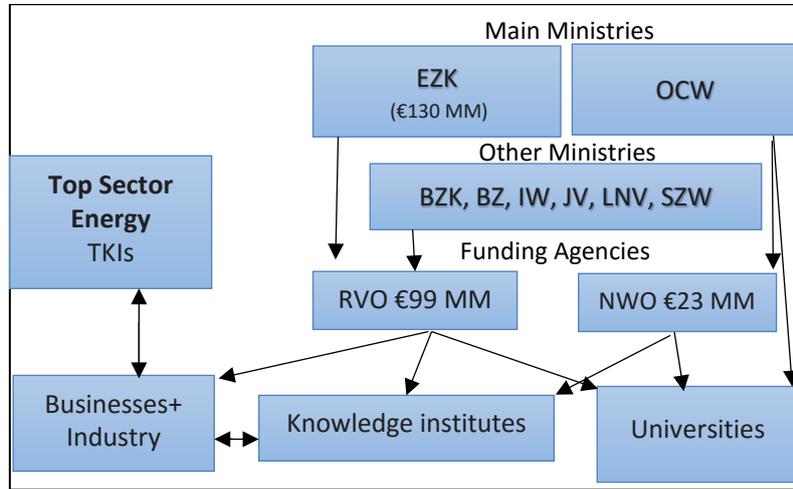


Figure 1. Direct and indirect funding of publicly financed energy research in the Netherlands.

Description

The Netherlands has three governmental funding mechanisms for public-funded research: direct public funding from the Ministries, indirect public funding via intermediaries and other sources including private organisations. The Ministry of Economic Affairs and Climate Policy (EZK €130 MM/year) is the largest contributor and funds the Netherlands Enterprise Agency (RVO €99MM/year) an intermediary organization which is responsible for the implementation of a large part of the Dutch energy innovation agenda through R&D projects via competitive calls. EZK also funds directly knowledge institutes like Energy Research Centre of the Netherlands (ECN) and the Organization for Applied Scientific research (TNO). Besides EKZ, RVO also receives projects from other ministries, such as: Home Affairs and Kingdom Relations (BZK), Foreign Affairs (BZ), Infrastructure and Water Management (IW), Justice and Security (JV), Agriculture, Nature and Food Quality (LNV), Ministry of Education, Culture and Science (OCW) and the Ministry of Social Affairs and Employment (SZW). OCW mostly funds energy research through the Netherlands Organisation for Scientific Research (NWO, €23 MM/year) which funds fundamental knowledge institutes such as AMOLF in Amsterdam and DIFFER in Eindhoven and research projects carried out by universities through competitive calls. NWO also plays an important role in the funding of top sectors and the funding of the TKIs.

Dutch R&D energy funding is mainly coordinated by the Top Sector Energy (TSE) which involves financial support through a combination of generic (i.e. financial) instruments and a focused emphasis on achieving optimum cooperation in the „golden triangle“ formed by companies, research institutions and government. The TSE is an umbrella for four so-called Top Consortia for Knowledge and Innovation (TKIs), which are public-private partnerships between research institutes and industries. The TKIs fulfill an important role in stimulating the required innovations by focusing on organizational capacity: programming through a Knowledge and Innovation Agenda (KIA), network building and knowledge dissemination. The TSE's portfolio will increasingly be more focused on innovation expenditures for the energy transition and mission-driven programs.

Cross-national and international funding schemes

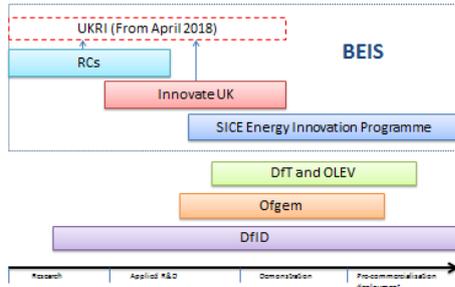
The Dutch government also contributes to the EU R&I budget which funds R&I programmes and projects in all EU and associated countries such as Horizon 2020 (ERC, SCs, PPPs in JTI's, Eurostars) and the EU's regional structural funds. Through successful calls for proposals in these programmes Dutch energy R&D stakeholders received around €20 MM/year in grants and (co-)funds. Cross-national funding also exists through bilateral agreements e.g. the Living Lab Biobased Brazil (a consortium of universities, companies and governments). International collaboration in research will also be integrated into regular NWO programming according to the 'Money follows researcher' principle.

Energy R&D funding in the United Kingdom

Scheme

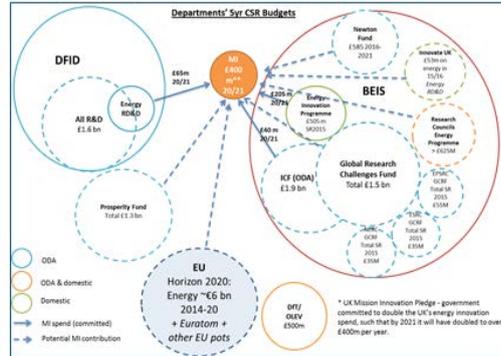
UK's Energy Innovation Landscape

Government bodies that spend on energy innovation, and where their interests lie on the innovation scale



A complicated UK picture x-Government

Indicative example of UK funding landscape and budgets for energy R&I (including potential for international collaborations)



Description

The UK's Treasury determines the budget available for R&D through a semi-regular cycle of spending reviews. These reviews are informed by evidence generated across government, and set top level strategic outcomes that are then overseen by the UK's Energy Innovation Board (EIB).

The EIB plays a strategic role, aligning domestic and international clean tech investments across Government, led by the Department for Business, Energy and Industrial Strategy (BEIS); and including Innovate UK and the Research Councils (soon to become UK Research and Innovation - UKRI); other Government Departments; and additional organisations such as the Office for Gas and Electricity Markets (Ofgem).

The introduction of the UK's Industrial Strategy; Clean Growth Strategy; and UK Aid Strategy, taken together under the umbrella of the EIB, provides a strong focus for UK R&D policy. This focus will be further reinforced in the near future by an overarching International Research and Innovation Strategy and a specific International Energy Strategy.

The UK's Energy R&D spending is predominately administrated through BEIS and UKRI, although some is handled through Ofgem, the UK energy market regulator and through the UK's Devolved Administrations in Scotland, Wales and Northern Ireland.

Academic funding is allocated through competitive calls to Research Units hosted in UK Universities. These calls are shaped through extensive consultation with the research community and delivery is primarily scrutinised by the Energy Strategic Advisory Committee (SAC) comprising providers and users of research. One of the key metrics assessed is the impact of the R&D on society and the economy.

Cross-national funding schemes

There are a number of UK international programmes, bilateral agreements and multilateral initiatives, which connect UK R&D to a global audience. The largest of these are delivered through BEIS reflecting the UK's strategic goals in both R&D and international development.

Across HMG, we expect to launch R&D collaborations with developed countries including the US, Canada and South Korea. UKRI (both Research Councils and Innovate UK) have run several competitions with these countries in the current Spending Review period. As part of future collaborations, BEIS and UKRI will discuss the possibility of co-funding additional Calls.

The draft International Research and Innovation Strategy has recognised the issue of a relative lack of funding for collaboration with developed countries within the broader international research context – and is proposing a new non- Overseas Development Aid (ODA) fund to support such collaboration.

As part of the UK's existing ODA funding, the UK Government has a substantial portfolio of RD&D collaboration in developing countries, part of a wider set of ODA activities which span the full spectrum from R&D to technical assistance, and supporting innovation in market design and regulatory frameworks.

UK ODA funding for international energy innovation is delivered through many programmes and organisations, namely: BEIS (Newton Fund, Global Challenge Research Fund, and the International Climate Fund); UKRI (Newton Fund, Global Challenge Research Fund); and the UK's Department for International Development (DfID).

At EU level, the UK is a very active contributor to the ongoing work of the Strategic Energy Technology (SET) Plan, providing the Chair for two of its governance bodies (the SET Plan's Bureau and Joint Actions Working Group). The UK participates in ten (out of fifteen) temporary working groups for the implementation of the integrated SET Plan, co-leading the one on nuclear safety. In addition, the UK is participating in 6 ERA-Net Co-Funds launched under H2020 (CCS, Bioenergy, Offshore Wind, Smart grids, Ocean energy and Solar Energy). Regarding Horizon 2020, the UK is involved in almost half of all successful H2020 Energy project proposals.

Energy R&D funding in Turkey

Scheme

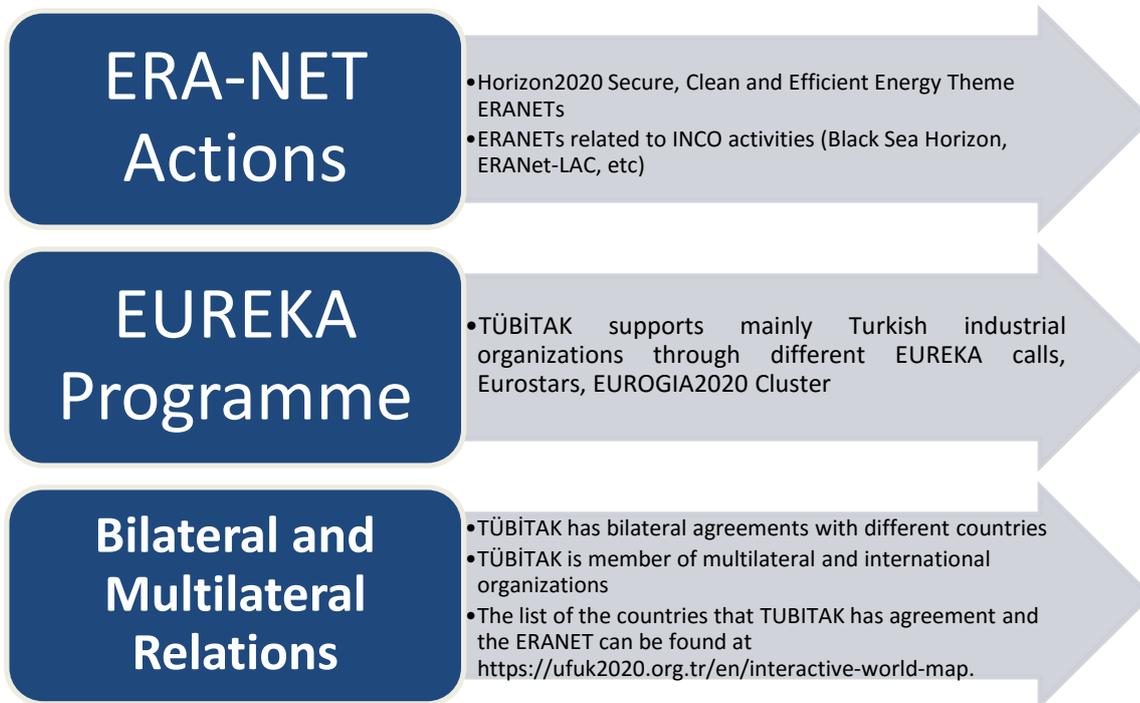
The Turkish R&I system is centralized and led by the Supreme Council of Science and Technology (BTYK), the legally formalized body chaired by the prime minister. There are also 26 Regional Development Agencies (RDAs) which are affiliated to the Ministry of Development (MoD) to encourage R&D and innovation on a regional scale.

The main public bodies responsible for the allocation of research funds are Ministry of Science, Innovation and Technology (MoSIT) and TÜBİTAK which is the leading actor at the operational level.

Institutional funding is a more dominant type of funding as compared to project funding. The institutional funding by the MoD is generally directed towards the research infrastructures (public R&D labs, thematic research labs, and central research labs).²

Description

TÜBİTAK is the main body for RDI funding in Turkey. International RDI cooperation activities are conducted in TÜBİTAK through the dimensions given below.

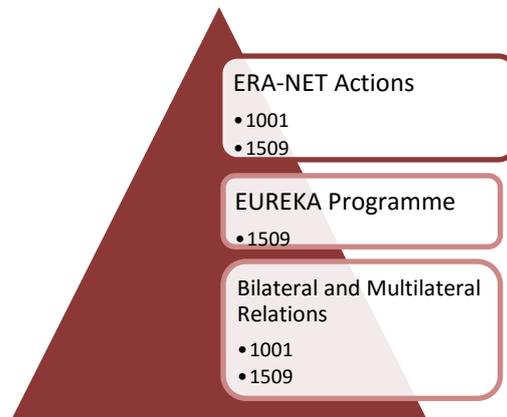


TÜBİTAK has two different programmes used for international project funding. These programmes are:

- **1509 - TÜBİTAK International Industrial R&D Projects Grant Programme**
The objective of the program is to create market focused R&D Projects between European countries and to increase cooperation between Europe wide firms, universities and research institutions, by using cooperation webs such as EUREKA.
- **1001 - Scientific and Technological Research Projects Funding Programme**
The purpose of this Programme is to support research in Turkey for generating new information, interpreting scientific findings, or solving technological problems on a scientific basis.

² <file:///C:/Users/mm253635/Downloads/RIO%20Country%20Report%20Turkey%202015.pdf>

These Programmes are used to fund the instruments above, as shown in the graph below.



Cross-national funding schemes

According to country reports, Turkey is one of the most active countries in terms of ERA-NET participation and other transnational activities, such as European Cooperation in Science and Technology (COST), Black Sea Economic Cooperation (KEI) and European Molecular Biology Conference (EMBC).³

Turkey has been involved in ERA-NET Smart Cities, ERANET SmartGridPlus, SOLAR-ERA.NET Cofund, GEOTHERMICA, ACT and EN SGplusRegSys H2020 ERA-NET projects.

Decisions of involvement in ERA-NET Projects are taken into consideration according to following criteria:

- The topic should be in line with National Science, Technology and Innovation Strategy
- It should be in accordance with activities undertaken in Turkish Research Area (TARAL)

³ http://ec.europa.eu/research/era/pdf/era_progress_report2016/country_fiches/era-tk.pdf