

marinerg-i

Marine Renewable Energy Infrastructure

Date: [28/05/2018]

Report number: 6.2

Report on Funding streams

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Dissemination level: Public



This project has received funding from the European Union's H2020 Programme for research, technological development and demonstration under grant agreement No. 739550

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Document Information

Version	Date	Description			
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Abbreviations

CCS.....	<i>Carbon Capture and Storage</i>
CEF.....	<i>Connecting Europe Facility</i>
EFSI.....	<i>European Fund for Strategic Investments</i>
EIB.....	<i>European Investment Bank</i>
EIF.....	<i>European Investment Fund</i>
EIT.....	<i>European Institute of Innovation and Technology</i>
ERC.....	<i>European Research Council</i>
ERDF.....	<i>European Regional Development Fund</i>
EU ETS.....	<i>EU Emissions Trading System</i>
ITN.....	<i>Innovative Training Networks</i>
MSCA.....	<i>Marie Skłodowska-Curie actions</i>
NPBs.....	<i>National promotional banks</i>
NPIs.....	<i>National promotional institutions</i>
PBCE.....	<i>Project Bond Credit Enhancement</i>
RDI.....	<i>Research, Development and Innovation</i>
RES.....	<i>Renewable Energy Sources</i>
RISE.....	<i>Research and Innovation Staff Exchanges</i>
TP Ocean.....	<i>European Technology and Innovation Platform for Ocean Energy</i>

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Executive summary

With the main objective of demonstrating the sustainability of the distributed Research Infrastructures (RI), it is crucial to show that it is the right time to invest in this kind of distributed infrastructure.

While grants are a critical and fundamental source of financing for Research Infrastructures, new forms of financing are being adopted, such as zero-interest debt, venture capital and technology transfer funds [1].

The present deliverable reports on the funding streams available for research infrastructures, which are detailed both at European and National level, focusing on the countries that are part of the MARINERG-i project.

This study found that the research activities and infrastructures can be supported through a number of different schemes available at European and national level, although member states vary considerably in terms of the process and the availability of funding at any given time. This acknowledgement and wide understanding is needed in the scope of MARINERG-i.

At national level, typically there are funds allocated within national budgets targeted towards innovation, research and higher education. These funds can cover specific research programmes, such as PhD and project research, operation and implementation of R&D institutions and research infrastructures, and internationalization and research cooperation.

At European level, there are numerous funding streams available, through specific frameworks and programmes. These are established to be aligned with the European Commission's vision and to cover research and innovation gaps. However, funding for wave and tidal research is rarely technology exclusive, therefore these technology areas must compete with more established sectors such as fixed and floating offshore wind, and this raises particular challenges.

Insight into the landscape of funding streams available at each country node and at European level provides a more complete understanding of the financing options available for the MARINERG-i network and to the potential MARINERG-i end-users. This is important and will be factored into planning for the financial and operational framework of the distributed infrastructure, and also to inform financing agencies and end-users alike on more efficient utilization of funds. Sources of possible financial risk can also be identified, allowing for solutions to be implemented to remove or minimize them.

1. Introduction

Research Infrastructures (RI) have been long recognized as crucial to fostering research and innovation in Europe, and across various fields of study there has been an increasing number of new RIs. The long-term sustainability of these RIs has been a priority of the European Commission and the European Strategy Forum on Research Infrastructures (ESFRI), with consultations in 2016 [2] and a report with recommendations in 2018 [3]. The main recommendations established in the latter are:

1. Establish and maintain excellence through the entire lifecycle of RIs by all appropriate means, by securing adequate framework conditions, and by opening the RIs up to the world.
2. Ensure that RIs have the right people in the right place at the right time by strengthening and harmonising national research and educational systems to make sure that all essential skills are available.
3. Harmonise and integrate a vision for convergent operation of RIs and e-Infrastructures in Europe to ensure cost-effective service provision to the user communities.
4. Fully exploit the potential of RIs as innovation hubs by incorporating strategies for their development into national and European innovation policies.
5. Set up effective means of determining the economic and wider social value of RIs, and incorporate these benefits into science-policy-society dialogues.
6. Establish adequate framework conditions for effective governance and sustainable long-term funding for RIs at every stage in their lifecycle, together with effective management.
7. Foster broader coordination at National and European levels when designing processes for planning and supporting national and pan European RIs and so enhance their strategic value. [2]

MARINERG-i proposes to establish a modern, efficient, high-quality, state-of-the-art ecosystem of different members and stakeholders for cutting-edge research in ocean and offshore wind energy, in a distributed research infrastructure. It will exist in the ESFRI context and so, will need to prove its viability and long-term sustainability.

While not the only area that needs to be addressed, financial viability and sustainability will need to be demonstrated before the implementation of MARINERG-i distributed infrastructure. This report looks at how existing infrastructures can be financing in the current regulatory and political panorama.

The main activities of Research Infrastructures are generally considered non-profit. Depending on the nature of the infrastructure (public vs. private), consulting work may be frequent and represent a significant proportion of its financing. However, especially in public and private non-profit institutions, other methods of financing research are usually employed.

The particular revenue sources and more case specific financial details for MARINERG-i Research Infrastructures are detailed in deliverable 6.1. In general, the types of funding and revenue available for research institutions include:

- Grants;
- Funded Research;

- Public Funding;
- Private Investments;
- Payment for services rendered;
- Other Funding.

The funding sources can be the national funding agencies, ministries, scientific institutions and organisations, international organisations, foundations, associations, or private companies.

While grants are a critical and fundamental source of financing for Research Infrastructures, new forms of financing are being adopted, such as zero-interest debt, venture capital and technology transfer funds [1].

In the following sections, the funding streams available for research infrastructures and research activities are detailed at European level, and at National level, with focus on the countries that are part of the MARINERG-i project.

2. European funding streams

Within the European Union (EU), research and innovation are major pillars for policy development, as these are drivers for economic growth, employment and competitiveness.

To support activities in research and innovation, there are funds provided by the European Union available to participants from European countries. These funds may then be managed at European level or at national level, through national agencies.

The European funding streams for research and innovation come through three main sources [4]:

- (i) the EU Framework Programmes for research and innovation,
- (ii) the European Structural and Investment Funds (ESIF), specifically funding for research and innovation under the European Regional Development Fund (ERDF) and
- (iii) loans from the European Investment Group (EIG)

2.1. European Commission

The EU Framework Programmes are the European Commission's primary vehicle for supporting research and innovation. They provide funding support to promote the achievement of the following objectives:

- Strengthening Europe's position in global science, through support for high quality research;
- Reinforcing industrial leadership in innovation, including major investment in key technologies, greater access to capital and support for small and medium enterprises (SMEs);
- Helping to address major societal challenges such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.

The Framework Programmes are composed of a number of pillars and specific programmes with more specific purposes. Following there is an overview of the funding programmes.

2.1.1. Competitiveness of Small and Medium-sized Enterprises - COSME

Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) is running from 2014 to 2020 with a planned budget of EUR 2.3 billion, and aims to make it easier for small and medium-sized enterprises (SMEs) to access finance in all phases of their lifecycle – creation, expansion, or business transfer, in which EU 'financial instruments' are channelled through local financial institutions in EU countries.

The COSME programme provides Europe's small businesses with access to a wide range of business support measures, encompassing a number of business development functions, from access to finance, to support for internationalisation (exporting) and various aspects of entrepreneurship. The programme has a number of overlaps

(complementarities) with the innovation components of both Horizon 2020 and the European Structural and Investment Funds [4].

2.1.2. European Structural and Investment Funds - ESIF

The 5 European Structural and Investment Funds (ESIF) are: the European Regional Development Fund (ERDF), the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund.

These funds support economic development in regions across the EU with the aims of reducing inequalities and increasing cohesion. In addition, it is also possible to receive funding from ‘territorial collaboration’ projects under ERDF, such as Interreg, which include research and innovation activities.

European Regional Development Fund - Interreg V 2014-2020

It is one of the five European Structural and Investment Funds which complement each other and seek to promote a growth and job-based recovery in Europe.

The fifth period of Interreg is based on 11 investment priorities laid down in the ERDF Regulation contributing to the delivery of the Europe 2020 strategy for smart, sustainable and inclusive growth. At least, 80% of the budget for each cooperation programme has to concentrate on a maximum of 4 thematic objectives among the eleven EU priorities, shown in **Figure 1**.

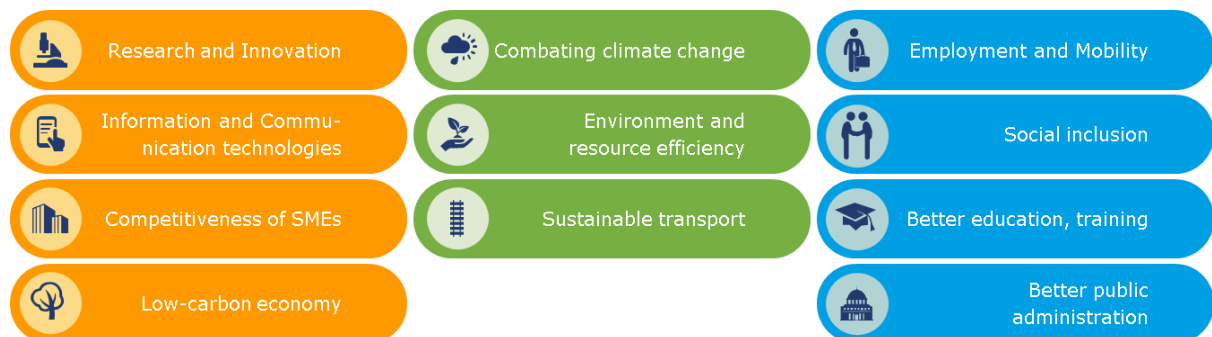


Figure 1 EU priorities in the ERDF Regulation

The fifth programming period of Interreg has a budget of EUR 10.1 billion invested in over 100 cooperation programmes between regions and territorial, social and economic partners.

One especially relevant project in the scope of MARINERG-i is the Funding Ocean Renewable Energy through Strategic European Action (FORESEA) project. It is an €11m Interreg North West Europe project, that helps bring offshore renewable energy technologies to the market by providing free access to North-West Europe’s world-leading network of test centres. It is one of Europe’s largest funds for MRE demonstration.

Since 2016, FORESEA has been supporting developers of offshore renewable energy technologies to test in real sea conditions around in North West Europe.

Support is awarded through a series of competitive calls run by the project consortium.

The programme is supported by the European industry body for ocean energy, Ocean Energy Europe, based in Brussels, and covers the following test centres:

- European Marine Energy Centre (EMEC): Orkney Islands, UK;
- SmartBay: Galway, Ireland;
- SEM-REV: Nantes, France;
- Dutch Marine Energy Centre: Alkmaar, Netherlands.

2.1.3. Connecting Europe Facility - CEF

The Connecting Europe Facility (CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. CEF investments aim to fill the missing links in Europe's energy, transport and digital backbone.

In addition to grants, the CEF offers financial support to projects through innovative financial instruments such as guarantees and project bonds. These instruments create significant leverage in their use of EU budget and act as a catalyst to attract further funding from the private sector and other public-sector actors [5].

Since January 2014, Innovation and Networks Executive Agency (INEA) is the gateway to funding under the CEF. INEA implements most of the CEF programme budget, in total €27.4 billion out of €30.4 billion (€22.4 billion for Transport, €4.7 billion for Energy, and €0.3 billion for Telecom).

A total budget of €5.35 billion is made available for energy projects for the 2014-2020 period, of which €4.7 in the form of grants managed by INEA.

2.1.4. LIFE Programme

The LIFE programme is the EU's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value.

LIFE began in 1992 and to date has co-financed some 3954 projects across the EU, contributing approximately €3.1 billion to the protection of the environment [6].

The LIFE multiannual work programme for 2014-2017 sets the framework for the next four years for the management of the new LIFE Programme 2014-2020. The total budget for funding projects during the period covered amounts to €1.1 billion under the sub-programme for Environment and €0.36 billion under the sub-programme for Climate Action.

2.1.5. Instrument for Greenland - IfG

The partnership between the Union on the one hand and Greenland and the Kingdom of Denmark on the other hand aims to preserve the close and lasting link between the partners while supporting the sustainable development of Greenland. Also, it acknowledges the geostrategic position of Greenland in the Arctic region.

The Instrument for Greenland (IfG) allows the EU to assist Greenland in addressing its major challenges (e.g. diversification of the economy, the need to increase the skills of its labour force...) and to contribute to the capacity of the administration of Greenland to formulate and implement national policies, in particular in areas that are of interest for both partners.

The main areas of cooperation include education and training, natural resources, energy, climate, environment and biodiversity, research and innovation, and sustainable use of living resources. There is strong cooperation between the Government of Greenland, the Government of Denmark and the European Commission, whereby the implementation of the Instrument is managed by the Government of Greenland and the European Commission according to their roles and responsibilities.

In terms of budget, a financial envelope for the IfG of €217.8 million is foreseen for the period 2014-2020.

2.1.6. The Partnership Instrument - PI

Through the Partnership Instrument (PI), the EU cooperates with partners around the world to advance the Union's strategic interests and tackle global challenges. The PI will fund activities that carry EU agendas with partner countries forward, translating political commitments into concrete measures.

The PI's budget for 2014-2020 amounts to EUR 954.8 million. It can fund activities in any non-EU country, with an emphasis on partner countries of strategic interest to the EU [7].

2.1.7. New Entrants' Reserve - NER 300, funded under the EU ETS

The EU Emissions Trading System (EU ETS) is a cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. It is the world's first major carbon market and remains the biggest one.

The EU ETS is now in its third phase – significantly different from phases 1 and 2. One of its new key features is a total of 300 million allowances set aside in the New Entrants Reserve to fund the deployment of innovative renewable energy technologies and carbon capture and storage.

NER 300 aims to establish a demonstration programme covering the best possible Carbon Capture and Storage (CCS) and Renewable Energy Sources (RES) technologies. It thus provides funding to a wide range of RES projects (bioenergy, concentrated solar power, photovoltaics, geothermal, wind, ocean and smart grids) as well as to one CCS project. By supporting commercial-scale demonstration projects, NER 300 bridges the gap between the end of the research and development phase and the full commercialisation of its

results, hence providing low-carbon technologies with financial support in a crucial stage of their development.

The cumulative NER 300 funding is €2.1 billion, which will leverage approximately €2.7 billion of private investments. In total, 38 projects in 19 EU countries have been selected for funding. Almost 80% of the NER 300 grants went to highly innovative or even potentially game changing projects. They will increase the EU's annual renewable energy production by some 18 TWh and reduce emissions equivalent to taking 3 million cars off European roads [8].

2.1.8. Horizon 2020

Horizon 2020 is the financial instrument implementing the Innovation Union, an Europe 2020 flagship initiative aimed at securing Europe's global competitiveness.

Seen as a means to drive economic growth and create jobs, Horizon 2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so put it at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs.

Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years, from 2014 to 2020, in addition to the private investment that this money will attract.

The Research Executive Agency is a funding body for research and innovation whose main responsibilities include helping manage parts of Horizon 2020 and to run research projects supported under Horizon 2020 and FP7, its predecessor [9].

European Research Council – ERC

The European Research Council (ERC) complements other funding activities in Europe such as those of the national research funding agencies, and is a flagship component of Horizon 2020 [10].

ERC grants are awarded through open competition to projects headed by starting and established researchers, irrespective of their origins, who are working or moving to work in Europe.

The European Research Council supports frontier research, cross disciplinary proposals and pioneering ideas in new and emerging fields which introduce unconventional and innovative approaches. A total budget of 13 095 million euro is available for the implementation of the ERC funding schemes under Horizon 2020 [11].

Different types of grants funded by the ERC:

- **ERC Starting Grant** for young, early-career top researchers (2-7 years after PhD) - up to 1.5 million euro for a period of 5 years.
- **ERC Consolidator Grant** for already independent excellent researchers 7-12 years after PhD) - up to 2 million euro for a period of 5 years.

- **ERC Advanced Grant** for senior research leaders with significant research achievements in the last 10 years -up to 2.5 million euro for a period of 5 years.
- **ERC Proof of Concept Grants** for ERC grant holders who want to check the market and/or innovation potential of research results from ERC-projects -up to 150,000 euro for a period of 12 months.
- **Synergy Grants** for a group of two to four Principal Investigators working together and bringing different skills and resources to tackle ambitious research problems. Grants can be up to a maximum of € 10 million for a period of 6 years and an addition € 4 million can be requested in the proposal in total to cover the purchase of major equipment and/or access to large facilities.

Future and Emerging Technologies Programme

The mission of the Future and Emerging Technologies (FET) Programme is very concrete: to turn Europe's excellent science base into a competitive advantage.

Future and Emerging Technologies actions are expected to initiate new lines of technology through unexplored collaborations between advanced multidisciplinary science and cutting-edge engineering. Under Horizon 2020, FET actions have been allocated a provisional budget of 2 696 million euro.

The FET programme has three complementary lines of action to address different methodologies and scales, from new ideas to long-term challenges:

- FET Open funds projects on new ideas, at an early stage when there are few researchers working on a project topic. This can involve a wide range of new technological possibilities, inspired by cutting-edge science, unconventional collaborations or new research and innovation practices;
- FET Proactive nurtures emerging themes, seeking to establish a critical mass of European researchers in a number of promising exploratory research topics. This supports areas that are not yet ready for inclusion in industry research roadmaps, with the aim of building up and structuring new interdisciplinary research communities;
- FET Flagships are 1-billion, 10-years initiatives where hundreds of excellent European researchers unite forces to focus on solving an ambitious scientific and technological challenge.

Marie Skłodowska-Curie actions - MSCA

The Marie Skłodowska-Curie actions (MSCA) provide grants for all stages of researchers' careers - be they doctoral candidates or highly experienced researchers - and encourage transnational, intersectoral and interdisciplinary mobility. The MSCA enable research-focused organisations (universities, research centres, and companies) to host talented foreign researchers and to create strategic partnerships with leading institutions worldwide.

Research networks: support for Innovative Training Networks (ITN)

ITNs support competitively selected joint research training and/or doctoral programmes, implemented by European partnerships of universities, research institutions, and non-academic organisations.

The research training programmes provide experience outside academia, hence developing innovation and employability skills. ITNs include industrial doctorates, in which non-academic organisations have an equal role to universities in respect of the researcher's time and supervision, and joint doctoral degrees delivered by several universities. Furthermore, non-European organisations can participate as additional partners in ITNs, enabling doctoral-level candidates to gain experience outside Europe during their training;

Individual fellowships (IF): support for experienced researchers undertaking mobility between countries, optionally to the non-academic sector

Individual Fellowships support the mobility of researchers within and beyond Europe - as well as helping to attract the best foreign researchers to work in the EU. The grant usually covers two years' salary, a mobility allowance, research costs and overheads for the host institution. Individual researchers submit proposals for funding in liaison with their planned host organisation. Proposals are judged on their research quality, the researcher's future career prospects, and the support offered by the host organisation. Fellows can also spend part of the fellowship elsewhere in Europe if this would boost impact, and those restarting their career in Europe benefit from special eligibility conditions;

International and inter-sectoral cooperation through the Research and Innovation Staff Exchanges (RISE)

RISE supports short-term mobility of research and innovation staff at all career levels, from the most junior (post-graduate) to the most senior (management), including also administrative and technical staff. It is open to partnerships of universities, research institutions, and non-academic organisations both within and beyond Europe. In worldwide partnerships, academia-to-academia exchanges are permitted;

Co-funding of regional, national and international programmes that finance fellowships involving mobility to or from another country

The MSCA offer additional funding to regional, national and international programmes for research training and career development. COFUND programmes encourage the movement of researchers across borders and provide good working conditions. The scheme can support doctoral and fellowship programmes.

Research Infrastructures, including e-Infrastructures

State-of-the-art research infrastructures becomes increasingly complex and costly, often requiring integration of different equipment, services and data sources, as well as extensive transnational collaboration.

The actions under this objective aim at developing the European research infrastructures for 2020 and beyond, fostering their innovation potential and human capital and reinforcing European research infrastructure policy [12].

Three groups of activities will be supported to enable excellent science in Europe:

- Implementation and operation of the research infrastructures listed on the ESFRI Roadmap, covering the preparatory phase of new ESFRI projects, and the implementation and the operation phases of prioritised ESFRI projects;
- Optimising the use of the national facilities by integrating them into networks and opening their doors to all European researchers;
- Further deployment and development of ICT based e-infrastructure which are essential to enable access to distant resources, remote collaboration, and massive data processing in all scientific fields.

Leadership in Enabling and Industrial Technologies - LEIT

Aiming at new and breakthrough technologies, this part of the programme will contribute to boosting competitiveness, creating jobs and supporting growth.

Key Enabling Technologies (KETs), ICT and Space are areas of key industrial competences determining Europe's global competitiveness.

The emphasis is on areas of research and innovation with a strong industrial dimension and where mastering new technological opportunities will enable and drive innovation. The objective is to achieve the EU Industrial policy goals, which represents an important component of the EU Strategy for Key Enabling Technologies [13].

Innovation in SMEs

Horizon 2020 actively supports SMEs by providing both direct financial support, and indirect support to increase their innovation capacity. 'Innovation in SMEs' aims at creating a bridge between the core of the framework programme - support to research, development and innovation projects - and the creation of a favourable ecosystem for SME innovation and growth.

The SME instrument addresses the financing needs of internationally oriented SMEs, in implementing high-risk and high-potential innovation ideas. It aims at supporting projects with a European dimension that lead to radical changes in how business (product, processes, services, marketing etc.) is done. It launches companies into new markets, promotes growth, and creates high returns of investment. The SME instrument addresses all types of innovative SMEs to be able to promote growth champions in all sectors.

Provided with about € 3 billion in funding over the period 2014-2020, the SME Instrument helps high-potential SMEs to develop ground breaking innovative ideas for products, services or processes that are ready to face global market competition. Available to SMEs only, which can however organise a project in the way that best fits their business needs – meaning that subcontracting is not excluded – the new scheme has opened a new highway to innovation through phased, progressive and complimentary support.

Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy

A transition is needed towards an optimal and renewable use of biological resources and towards sustainable primary production and processing systems. These systems will need to produce more food, fibre and other bio-based products with minimised inputs, environmental impact and greenhouse gas emissions, and with enhanced ecosystem services, zero waste and adequate societal value.

Agriculture, forestry, fisheries and aquaculture, together with the bio-based industries, are integral parts of the European economy and society. Relying on the use of limited natural resources, these sectors produce and process biological resources to satisfy the demand of consumers and a wide range of industries for food, feed, bio-energy and bio-based products. While they enhance Europe's self-reliance and provide jobs and business opportunities essential for rural, coastal and marine areas, these sectors are also facing significant challenges which require solutions based on research and innovation.

Aquatic living resources and marine research

Oceans and seas represent over 70% of the earth's surface, and living aquatic resources can provide a significant contribution to food, energy and bio-based products. The objective is to sustainably manage and exploit aquatic living resources to maximise benefits from Europe's oceans, seas and inland waters. This includes optimising the sustainable contribution of fisheries and aquaculture to food security, boosting innovation through blue biotechnologies and fostering cross-cutting marine and maritime research to harness the potential of Europe's oceans, seas and coasts for jobs and growth.

Secure, Clean and Efficient Energy

The Energy Challenge is designed to support the transition to a reliable, sustainable and competitive energy system. It is structured around seven specific objectives and research areas:

- Reducing energy consumption and carbon footprint
- Low-cost, low-carbon electricity supply
- Alternative fuels and mobile energy sources
- A single, smart European electricity grid
- New knowledge and technologies
- Robust decision making and public engagement
- Market uptake of energy and ICT innovation.

A budget of €5 931 million has been allocated to non-nuclear energy research for the period 2014-2020. Out of this figure, more than €200 million is earmarked to support European Institute of Innovation and Technology activities, subject to a mid-term review [14].

Low Carbon Technologies

It is important to develop and bring to market affordable, cost-effective and resource-efficient technology solutions to decarbonise the energy system, secure energy supply and complete the energy internal market. Research activities within this area will cover:

Photovoltaics, Concentrated Solar Power, Wind energy, Ocean Energy, Hydro Power, and others [14].

European Institute of Innovation and Technology (EIT)

The EIT contributes to the competitiveness of Europe, its sustainable economic growth and job creation by promoting and strengthening synergies and cooperation among businesses, education institutions and research organisations.

Together with its Knowledge and Innovation Communities (KICs), the EIT creates favourable environments for creative thoughts to enable world-class innovation and entrepreneurship to thrive in Europe.

The EIT funding model seeks to align, pool and eventually leverage the KICs' innovation investments. In order to meet these objectives, the EIT applies a funding model where the EIT's financial contribution does not exceed 25% (on average) of a KIC's overall resources over its lifetime.

A KIC should attract further funding beyond their partners' own revenues and resources, such as private and/or public funding at national, regional and EU level, particularly the European Structural and Investment Funds and the Horizon 2020 programme.

The EIT's financial contribution to the KIC is provided in the form of a grant for action, where the EIT funding rate for the specific grant may be up to 100% of the total eligible costs of KIC added-value activities [15].

Fast Track to Innovation Pilot

The Fast Track to Innovation (FTI) pilot (2015-2016) was a fully-bottom-up measure in Horizon 2020 to promote close-to-the-market innovation activities, and open to all types of participants.

The Fast Track to Innovation (FTI) pilot provides funding for bottom-up proposals for close-to-market innovation activities in any area of technology or application. This thematic openness – combined with the possibility for all kinds of innovation actors to work together and deliver innovation onto the market and/or into society – should nurture trans-disciplinary and cross-sectoral cooperation.

The aim is to:

- reduce time from idea to market;
- stimulate the participation of first-time applicants to EU research and innovation funding;
- increase private sector investment in research and innovation.

The Commission has proposed to continue the FTI under the remit of a European Innovation Council Pilot, which was launched upon the adoption of the Horizon 2020 Work Programme 2018-2020 at the end of October 2017 [16].

ERA-NET Cofund

ERA-NET Cofund under Horizon 2020 is designed to support public-public partnerships, including joint programming initiatives between Member States, in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as Union topping-up of a trans-national call for proposals. It allows for programme collaboration in any part of the entire research-innovation cycle.

The main and compulsory activity of the ERA-NET Cofund under Horizon 2020 is the implementation of the co-funded joint call for proposals that leads to the funding of trans-national research and/or innovation projects (one co-funded call per Grant Agreement). In addition to the co-funded call the consortia may implement other joint activities including other joint calls without Union co-funding. The reimbursement rate for ERA-NET Cofund is 33% [17].

The Ocean Energy ERA-NET Cofund (OCEANERA-NET COFUND) is an initiative of eight national and regional government agencies from six European countries, which has received funding from the European Union under the Horizon 2020 Programme for Research and Innovation. The new five-year action, operating from 2017 to 2021, will build on the work of the Ocean Energy European Research Area Network (OCEANERA-NET) which started in 2013 and will end in November 2017.

The aim is to coordinate support for research and development in the ocean energy sector, to encourage collaborative projects that tackle some of the key challenges identified for the sector as it progresses towards commercialisation.

OCEANERA-NET COFUND will support the implementation of the Ocean Energy Forum Strategic Roadmap and the European Technology and Innovation Platform for Ocean Energy (TP Ocean) Strategic Research Agenda.

The specific objectives of the project are to:

- Facilitate cooperation within the ocean energy sector and alignment of national and regional research programmes to support collaborative projects which capitalise on Europe's research and industrial strengths; and
- Support the demonstration and associated research required to address a number of current challenges, providing solutions which can be applicable to a range of needs across the ocean energy technologies.

The five-year programme will include:

- A Co-Funded Joint Call to support transnational, collaborative projects to demonstrate and validate innovative technologies for ocean energy;
- A Second Joint Call to support R&D in ocean energy, scope to be defined; and
- Other joint activities to support knowledge transfer and exploitation of results.

2.2. European Investment Bank

The EIB Group consists of the European Investment Bank (EIB) and the European Investment Fund (EIF). The EIF focuses on innovative financing for SMEs in Europe. Its

majority shareholder is the EIB, while the remaining equity is held by the EU (represented by the European Commission), as well as other European public and private entities.

The EIB is the European Union's bank, the only bank owned by and representing the interests of the European Union Member States, working closely with other EU institutions to implement EU policy. It has a long-standing history of providing financing to support research, development and innovation (RDI) through a set of financial instruments under different programmes and mechanisms. The classic EIB loan types are illustrated in

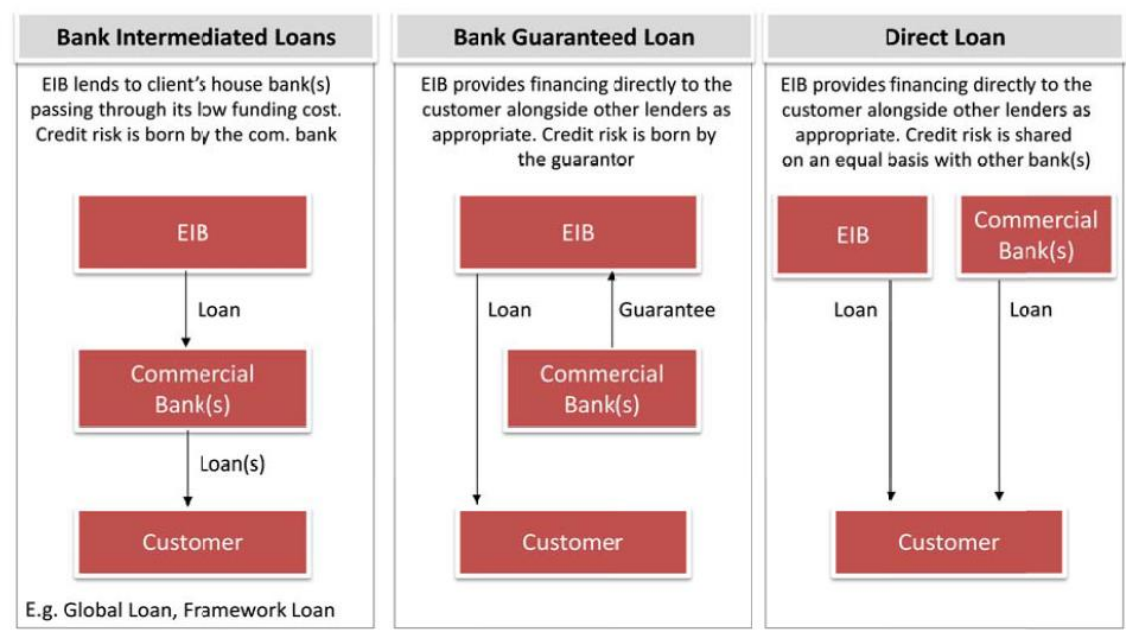


Figure 2.

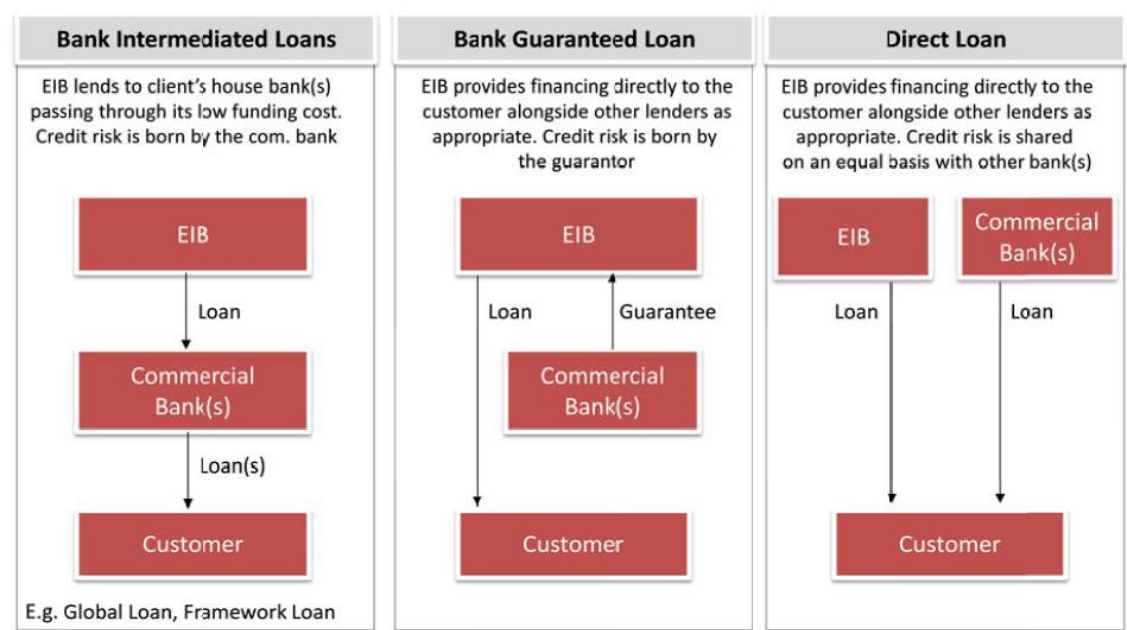


Figure 2 EIB loan types

The EIB Group has a track record of (co-)financing of research infrastructures such as CERN, the European Space Observatory and the European Synchrotron Radiation Facility, and to a lesser extent the direct financing of infrastructures for innovation and commercialisation projects.

2.2.1. Project loans

The EIB lends to individual projects for which total investment cost exceeds EUR 25 million. In certain cases, it can also provide direct loans to Midcap companies with up to 3 000 employees where the loan volume requested is between EUR 7.5 million and EUR 25 million.

The EIB also provides loans to finance research and innovation programmes. EIB support is often the key to attracting other investors. These loans can cover up to 50% of the total cost for both public and private sector promoters, but on average this share is about one-third.

2.2.2. Intermediated loans

It makes loans to local banks and other intermediaries which subsequently "on-lend" to the final beneficiaries, such as:

- Small-and-medium-sized businesses;
- Midcap businesses;
- Large businesses;
- Local authorities;
- National administrations;
- Public sector bodies.

All intermediated loans must further at least one of their public policy goals:

- Increase in growth and employment potential – including SME and Midcap support;
- Economic and social cohesion by addressing economic and social imbalances, promoting the knowledge economy/skills and innovation and linking regional and national transport infrastructure;
- Environmental sustainability - including supporting competitive and secure energy supply;
- Action for climate-resilient growth.

2.2.3. European Fund for Strategic Investments (EFSI)

The European Fund for Strategic Investments (EFSI) is an initiative to help overcome the current investment gap in the EU. Jointly launched by the EIB Group and the European Commission, it aims to mobilise private investment in projects which are strategically important for the EU [18].

EFSI is one of the three pillars of the Investment Plan for Europe that aims to revive investment in strategic projects around the continent to ensure that money reaches the real economy [19].

EFSI is a EUR 16 billion guarantee from the EU budget, complemented by a EUR 5 billion allocation of the EIB's own capital. The total amount of EUR 21 billion aims to unlock additional investment of at least EUR 315bn by 2018, as Figure 3 shows.

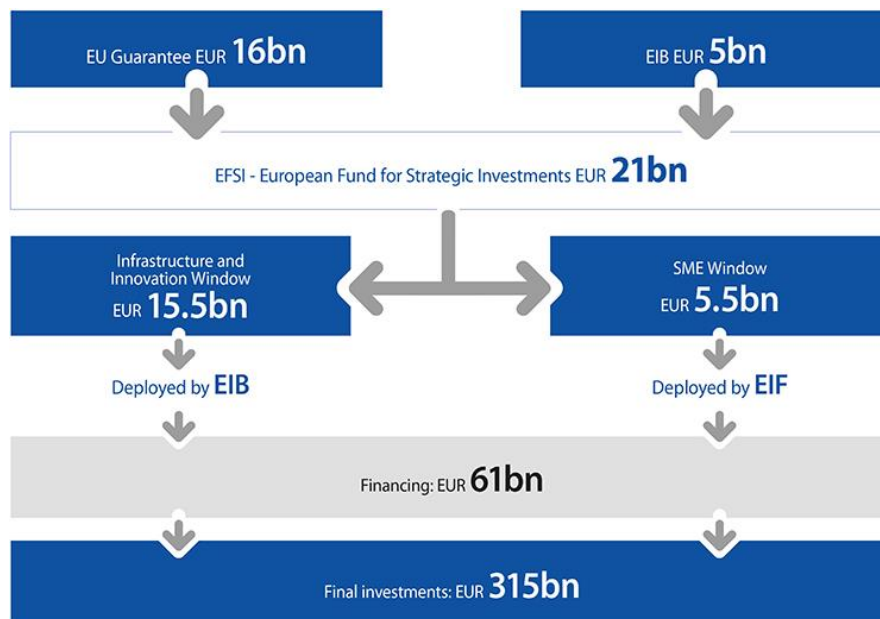


Figure 3 EFSI's funding scheme [19]

With EFSI support, the EIB Group is providing funding for economically viable projects, especially for projects with a higher risk profile than usually taken on by the Bank. It will focus on sectors of key importance for the European economy, including:

- Strategic infrastructure including digital, transport and energy;
- Education, research, development and innovation;
- Renewable energy and resource efficiency;
- Support for small and mid-sized businesses.

EFSI provides EIB increased capacity to risk financing for large infrastructure projects via the “Infrastructure and Innovation Window”. With this, project promoters have a better chance in securing finance for projects with a higher risk profile that, until now, could not receive financial support, or not to the same extent.

2.2.4. The Europe 2020 Project Bond Initiative - PBI

The Project Bond Initiative (PBI) is a joint initiative by the European Commission and the EIB with the objective of stimulating capital market financing for large-scale infrastructure projects in the sectors of transport (TEN-T), energy (TEN-E) and information and

communication technology (ICT). According to the Commission, the European Union's infrastructure investment needs to meet the Europe 2020 objectives in these sectors could reach as much as EUR 2 trillion.

The Project Bond initiative is designed to enable eligible infrastructure projects promoters, usually public private partnerships (PPP), to attract additional private finance from institutional investors such as insurance companies and pension funds.

The mechanism of improving the credit standing of projects relies on the capacity to separate the debt of the project company into tranches: a senior and a subordinated tranche. The provision of the subordinated tranche increases the credit quality of the senior tranche to a level where most institutional investors are comfortable holding the bond for a long period.

The subordinated tranche – namely the Project Bond Credit Enhancement (PBCE), provided by the EIB with EC support – can take the form of a loan, which is given to the project company from the outset, or a contingent credit line which can be drawn upon if the revenues generated by the project are not sufficient to ensure senior debt service.

The proposed mechanism of the initiative will have a maximum size of individual transactions of up to the lower of EUR 200 million or 20% of credit enhanced senior debt [20].

The scope of the pilot phase was to test the project bond concept during the remaining period of the previous multi-annual financial framework 2007-2013. Additional funding for the Project Bond Initiative (PBI) under the “Connecting Europe Facility (CEF) in the 2014-20 period would allow a further development of the initiative depending on budgetary allocations.

2.2.5. European Local Energy Assistance - ELENA

ELENA is a joint initiative by the EIB and the European Commission under the Horizon 2020 programme. ELENA provides grants for technical assistance focused on the implementation of energy efficiency, distributed renewable energy and urban transport projects and programmes.

The annual grant budget is currently around EUR 20 million. Projects are evaluated and grants allocated on a first-come-first-served basis. ELENA may co-finance investment programmes in the following fields, among others:

- Energy efficiency and distributed renewable energy;
- Local infrastructure including smart grids, information and communication technology.

Typically, ELENA supports programmes above EUR 30 million over a period of around 2-4 years and can cover up to 90% of technical assistance/project development costs. Smaller projects can be supported when they are integrated into larger investment programmes [21].

2.2.6. InnovFin – EU Finance for innovators

InnovFin – EU Finance for Innovators is a joint initiative launched by the European Investment Bank Group (EIB and EIF) in cooperation with the European Commission under Horizon 2020.

InnovFin consists of a series of integrated and complementary financing tools and advisory services offered by the EIB Group, covering the entire value chain of research and innovation (R&I) in order to support investments from the smallest to the largest enterprise. Its financing tools cover a wide range of loans and guarantees which can be tailored to innovators' needs. Financing is either provided directly or via a financial intermediary, most usually a bank.

By 2020, InnovFin is expected to make over EUR 24bn of debt and equity financing available to innovative companies to support EUR 48bn of final R&I investments.

Of special importance:

InnovFin Technology Transfer (InnovFin TT) tool supports technology transfer projects or technology rights, through commercial demonstration and commercialisation, by targeting investments into technology transfer funds operating in the pre-seed (including proof of concept) and seed stages.

Its objective is to accelerate technological innovations, especially in the areas of key enabling technologies and other Horizon 2020 objectives, such as IP promotion / exploitation (licensing, sale of patents) and spin-outs, spin-offs or joint venture activities [22].

2.3. European Investment Fund

The European Investment Fund (EIF) central mission is to support Europe's small and medium-sized businesses (SMEs) by helping them to access finance, by designing innovative financial products addressed to their partners (banks, guarantee, leasing and microfinance institutions, private equity and venture capital funds, among others), acting as their financial intermediaries [23].

2.3.1. Equity Products

The EIF invests in venture capital and growth funds, mezzanine funds that support SMEs. Investment activities also cover technology transfer and business incubators.

Through their venture capital and private equity interventions, they play their role in the creation and development of high-growth and innovative SMEs by facilitating access to equity for these companies across the entire life cycle of corporate innovation.

EIF cooperates with a wide range of financial intermediaries (banks, guarantee institutions, private equity and venture capital funds, etc.) that offer financial products targeting SMEs and Small Mid-Caps across Europe.

EIF-NPI Equity Platform Investment Programmes

The EIF-NPI Equity Platform is a new collaborative initiative launched by the EIF in 2016 that promotes knowledge sharing and best practices between EIF and national promotional institutions (NPIs) or banks (NPBs) across EU Member States. Its ultimate goal is to enhance access to funding for SMEs and Midcaps, support defragmentation of equity markets, and match national, EU and private sources of funding.

This initiative is established on the occasion of the Investment Plan for Europe, and as a response to priorities set by EU stakeholders and NPIs. It will guide EIF and NPIs in implementing equity investments, including EFSI-related activities. EIF shares the objective of NPIs, active across the EU, of supporting a well-functioning European Venture Capital and Private Equity market for the ultimate benefit of European SMEs and Midcaps [24].

EIF fund investments for technology transfer organizations and venture capital

Technology Transfer - the process of transforming the results of research and development into marketable products and services - is a strategic area for the EIF.

This transformation can take place through various means, in particular through the collaboration between research organisations and industry, the licensing of intellectual property rights, the creation of start-up businesses or university spin-out companies.

2.3.2. Debt products

The EIF cooperates with a wide range of financial intermediaries such as banks, leasing companies, guarantee funds, mutual guarantee institutions, promotional banks or any other financial institution providing financing to SMEs, or guarantees for SME financing. The guarantee instruments consist of two main products supporting access to finance for SMEs:

- Credit Enhancement/Securitisation (Guarantees for securitised SME financing instruments);
- Guarantees/counter-guarantees for portfolios of micro-credits, SME loans or leases (Management of European Commission initiatives).

3. National funding streams

Each member state has its own funding and financing structure. This section identifies the main actors and funding streams.

3.1. France

The French research and innovation system is structured around a number of agencies. Most of the public funding of research comes from the MIREs (Mission interministérielle recherche et enseignement supérieur)¹ budget, which has a strong input from the Ministry for Education, Higher Education and Research.

There are many agencies through which this funding is managed, at national and local level. The main agencies are the National Research Agency (ANR) and the Agency for Environment and Energy Management (ADEME). In addition to these research agencies, the public investment bank Bpifrance provides support for R&D and innovation projects to businesses, especially SMEs [25].

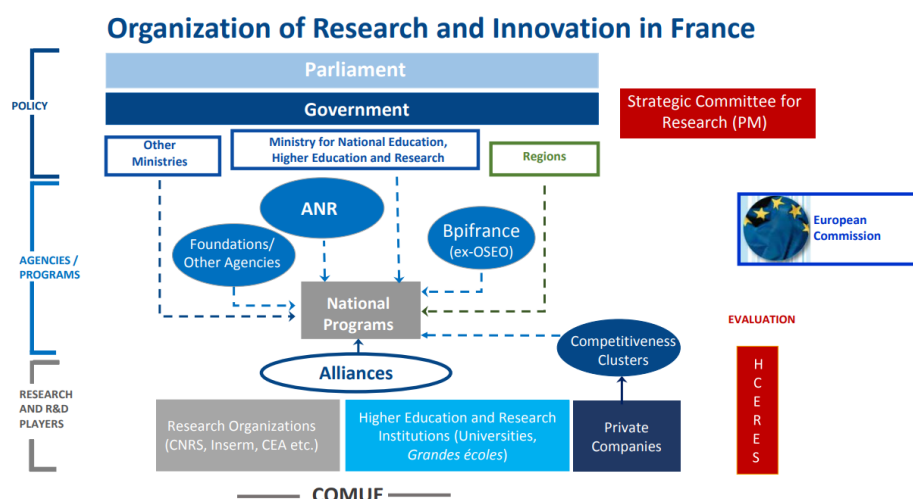


Figure 4: Organization of Research and Innovation in France [26]

In 2016, the Ministry of Higher Education and Research has updated the 'National Strategy on Research Infrastructures', which defines the roadmap for French National Research Infrastructures and their contribution to the European roadmap [25].

3.1.1. Agence Nationale de la Recherche

The Agence Nationale de la Recherche (ANR)² is a public body under the authority of the Ministry of research, which provides funding for project-based research. It is responsible for managing the research and higher education programmes [27].

¹ Inter-ministerial Mission for research and higher education

² National Research Agency

From 2005 to 2015, ANR has funded about 14,300 projects, in an amount of 6B€ [ANR brochure].

Investments for the Future

Launched in 2009 by the French Government, the Investments for the Future programmes are strategic initiatives which aim to boost French competitiveness by investing in research, higher education and vocational training, in industry and SMEs, in sustainable development.

The programme has three main types of action, with competitive calls in each of them:

- Centres of excellence
- Health and biotechnology
- Technology transfer and valorisation



Figure 5: Action types [27]

3.1.2. Agence de l'environnement et la maîtrise de l'énergie

The Agence de l'environnement et la maîtrise de l'énergie (ADEME)³ was created within the framework of the governmental policy to better take into account environmental concerns. It helps finance projects, from research to implementation, in the areas of waste management, soil conservation, energy efficiency and renewable energy, raw materials savings, air quality, noise abatement, circular energy transition and food wastage abatement.

ADEME is also responsible for managing Investments for the Future programmes, in the topics of:

- Vehicle of the future
- Low-carbon energies
- Circular economy
- Smart electricity grids

³ Environment and Energy Agency

The projects in these programmes can be supported by state funds, via state aid with systematic profit-sharing or grants; or supported by long term investment [28].

3.1.3. Banque publique d'investissement

The Banque Publique d'Investissement (BPI France)⁴ provides support for R&D to businesses, especially SMEs, through pre-financing of R&D Tax Credits, Seed and Innovation funding and direct investment. BPI France also has a 600 M€ development fund directed toward large projects in specific areas, such as health, digital, and environment [27].

⁴ Public Bank of Investments

3.2. Ireland

The Irish R&I system is fairly centralised with the bulk of R&I budgets being controlled by Government Departments. The government is involved in R&I policy development and implementation through two key ministries: the Department of Business, Enterprise and Innovation (DBEI) and the Department of Education and Skills (DES). They accounted for 77% of the government budget in 2013. The main actors in the higher education sector (HES) are the seven universities, accounting for approximately 80% of research funding in the HES.

The higher education agency (HEA) is an agency of the DES charged with the responsibility for the effective governance and regulation of the HES. It is also the funding body for the universities and Institutes of Technology. Knowledge Transfer Ireland is the national structure to promote technology transfer in the HES. The HES is the second largest research performing sector after the business sector, with 22% of the total research performed in 2014.

The Public Research Organisation (PRO) sector is small by EU standards, 4.5%, while the business sector accounted for 73.5% of expenditure on research performed in 2014. BERD is dominated by a very small number of mainly foreign owned MNCs (100 companies accounted for 70% of BERD in 2013), which are concentrated in a number of high tech sectors such as life sciences and Information and communications technology. The research activity of the indigenous business sector is small but growing [29].

IBEC, American Chamber of Commerce Ireland and the Industry Research & Development Group (IRDG) are the main representative bodies for the business sector in Ireland. The private non-profit sector in Ireland does not undertake research activity of any significance.

Innovation 2020 is the new national RDI strategy, launched in December 2015 (the previous RDI strategy ended in 2013). It sets out action terms of Ireland's current R&I policy specifying an ambitious target for GERD (2.5% of GNP by 2020) and for doubling the level of private support for R&D performed in the public research system. It focuses on enterprise innovation, education for innovation, innovation for social progress, the role of IP in innovation, and innovating with the EU and the wider world.

The Department of Business, Enterprise and Innovation develops, promotes and co-ordinates innovation, research and development policy. It influences the European and International research agenda to allow research and enterprise in Ireland avail of opportunities arising through research programmes. It also funds Enterprise Ireland (EI), Science Foundation Ireland (SFI) and the Programme for Research in Third Level Institutions.

3.2.1. Science Foundation Ireland (SFI)

Science Foundation Ireland (SFI) is Ireland's national foundation for investment in scientific and engineering research. It provides grants for researchers from around the world who wish to relocate to Ireland and those already based in Ireland, for outstanding investigators, for conferences and symposia, and for collaboration with industry [30].

SFI invests in academic researchers and research teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises in the fields of science, technology, engineering and maths (STEM).

SFI strongly encourages research collaboration between SFI funded scientists & engineers and industry. The Foundation has developed a suite of funding programmes which have been designed to facilitate industry to work on collaborative research projects with academia. These include mobility programmes such as the Industry Fellowship which supports the transfer of academic staff to industry and vice versa and larger scale project programmes such as the Spokes programme which allows companies to enter partnerships with SFI Research Centres.

SFI Industry Fellowships

The purpose of the Industry Fellowship Programme 2017 is to enhance industry-academia collaborations through the funding of collaborative industry-academia research projects, and to stimulate excellence through knowledge exchange and training of engineers and scientists. Both aims will be pursued by the Industry Fellowship Programme, through the temporary placement of academic researchers in industry, and of industry researchers in academia.

SFI Research Centres

A key objective of Science Foundation Ireland's Agenda 2020 is to develop a set of world-leading, large-scale research centres that will provide major economic impact for Ireland. SFI Research Centres link scientists and engineers in partnerships across academia and industry to address crucial research questions; foster the development of new and existing Irish-based technology companies; attract industry that could make an important contribution to Ireland and its economy; and expand educational and career opportunities in Ireland in science and engineering.

Twelve SFI Research Centres have been established through an investment of €355 million from Government through Science Foundation Ireland and a further €190 million from industry collaborators. Over 200 companies are involved in collaborations with the centres. After an extensive review for scientific excellence and impact the first seven centres were established in 2013. Five additional centres were approved in 2014 and commenced operations in early 2015.

These are world leading, large scale Research Centres with a major economic impact for Ireland. SFI Research Centres may be funded at a level of between €1-5 million per year in direct costs. SFI funds up to 70% of the overall Research Centre budget. A minimum of 30% of the budget must be secured from industry partners, at least one-third of which must be in cash.

MaREI is the marine and renewable energy research, development and innovation Centre supported by Science Foundation Ireland. It combines the expertise of a wide range of research groups and industry partners, with the shared mission of solving the main scientific, technical and socio-economic challenges across the marine and renewable energy sectors. MaREI is coordinated by the Environmental Research Institute (ERI) at University College Cork and has over 200 researchers working across 6 academic institutions collaborating with over 45 industry partners and a combined budget of over 35m Euro.

The MaREI Centre conducts fundamental scientific research relating to marine and renewable energy applications and enables the development and testing of technology through to the construction of demonstration systems. MaREI offers unique world class MRE testing infrastructure, state-of-the-art structural laboratories, novel prototypes and

measurement equipment that allow the systematic identification and reduction of development risks through a structured TRL development cycle. MaREI headquarters are housed in the new UCC ERI Beaufort Building in Ringaskiddy, Co. Cork along with the Lir National Ocean Test Facility (Lir-NOTF). Lir NOTF is a custom designed facility for small to medium scale laboratory testing of ocean and maritime systems. It consists of state of the art test tanks for wave and current emulation, and electrical test rigs.

SFI Spokes Programme 2015 – Fixed and Rolling Call

This programme is a vehicle to enable the addition of new industrial and academic partners and projects to a SFI Research Centre, so allowing the Centre to expand and develop in line with new priorities and opportunities. This will ensure that the Research Centre retains its ability to do cutting edge research and its industrial relevance, and so enhance its sustainability. The Spokes programme also provides a vehicle to link together, in a meaningful and relevant way, different Research Centres.

The Programme has been designed to deliver excellent basic, oriented research results and discoveries in targeted projects associated with SFI Research Centres and hence will deliver significant economic and societal impact during the lifetime of the programme.

Like the SFI Research Centres, the SFI Spokes programme will help link scientists and engineers in partnerships across academia and industry to address crucial research questions, foster the development of new and existing Ireland-based technology companies, attract industry that could make an important contribution to Ireland and its economy, and expand educational and career opportunities in Ireland in science and engineering.

SFI Partnership Programme

A key goal within SFI's Agenda 2020 strategy is to build strategic partnerships that fund excellent science and drive it out into the market and society. Partnership approaches will enhance the delivery of SFI's strategy through leveraging its investment and capability to the maximum extent possible.

The SFI Partnership Schemes aim to provide a flexible mechanism by which SFI can build strategic collaborations with key partners such as industry, funding agencies, charities, philanthropic organizations or higher education institutes (HEIs) with the goal of co-funding outstanding opportunities. The schemes will co-fund projects or people (for a limited time) to aid development and retention of talented researchers, foster industrial collaborations and develop capacity in areas of current and emerging economic importance. Significant co-funding opportunities within all areas covered by SFI's legal remit will be considered, including the 14 areas of national priority as defined in the Report of the Research Prioritization Steering Group.

3.2.2. Industrial Development Agency (IDA)

IDA Ireland (Industrial Development Agency) is an Irish Government agency with responsibility for securing new investment from overseas in manufacturing and internationally traded services sectors. It also encourages existing investors to expand and develop their businesses.

IDA Ireland works closely with the Higher Education Authority (HEA) and Science Foundation Ireland (SFI) in helping Universities and Colleges to find collaborative industry partners. Together the agencies have developed new incentives and initiatives to encourage collaborative research projects, which will help Ireland to develop a strong community of world-class researchers in academia and industry.

3.2.3. Irish Research Council (IRC)

The mission of the Irish Research Council is to enable and sustain a vibrant research community in Ireland by supporting excellent researchers in all disciplines from arts to zoology.

It operates within the policy framework of the Department of Education and Skills and the Higher Education Authority, but is independent in its funding decisions. To best deliver for citizens, it partners nationally and internationally with the research community, government departments and agencies, enterprise and civic society. IRC engages with the Irish research community regularly to inform its work and the future development of its activities. It ensures high standards in its practices and policies through periodic review and evaluation.

The Council is an associated agency of the Department of Education and Skills and operates under the aegis of the Higher Education Authority [31].

3.2.4. Enterprise Ireland (EI)

Enterprise Ireland is the government organisation responsible for the development and growth of Irish enterprises in world markets. EI provides funding and supports for companies - from entrepreneurs with business propositions for a high potential start-up through to large companies expanding their activities, improving efficiency and growing international sales. EI also provides funding and supports for college based researchers to assist in the development, protection and transfer of technologies into industry via licensing or spin-out companies. EI innovation vouchers (5k) and Innovation Partnerships (IP's) up to 200k. The IP programme encourages Irish-based companies to work with Irish research institutes resulting in mutually beneficial co-operation and interaction. Companies can access expertise and resources to develop new and improved products, processes, services, and generate new knowledge and know-how. The participating company benefits in terms of its growth, the evolution of its strategic research and development and the creation of new knowledge that it can use to generate commercial advantage. The research institute benefits in terms of developing skill sets, intellectual property and publications.

3.2.5. Sustainable Energy Authority of Ireland (SEAI)

The sustainable energy authority of Ireland is an agency of the Department of Communications, Climate Action and Environment (DCCAE). SEAI aims to ensure that Ireland's energy future is sustainable, secure, affordable and clean. It leads the transition to smarter more sustainable, low carbon energy activities, including supporting the development of Offshore and Onshore renewables. SEAI have been key supporters of the

MARINERG-I concept since inception and remain the key stakeholder representing government interests going forward. SEAI administers various grants and funding programmes, and operates Service Level Agreements with key institutes including UCC-MaREI under which the LIR national ocean test facility operates. SEAI also operates a research development and demonstration programme RD&D. The 2018 funding call for this opened in January 2018. A total of 2.5m Euro is available under the call for projects that deliver energy efficiency and cleaner energy. The four key objectives of the programme are:

- Accelerate the development and deployment in the Irish marketplace of competitive energy-related products, processes and systems
- Support solutions that enable technical and other barriers to market uptake to be overcome
- Grow Ireland's national capacity to access, develop and apply international class RD&D
- Provide guidance and support to policy makers and public bodies through results, outcomes and learning from supported energy project

3.3. Portugal

In Portugal, the allocation of funds for R&D is mostly a centralised effort, with only some structural funds being managed regionally. The organisations within government in charge of policy are the Ministry for Science, Technology and Higher Education (MCTES) and the Ministry for the Economy (ME).

The main funding agency for academic research is the Fundação para a Ciência e a Tecnologia (FCT). In parallel, the Agência Nacional de Inovação (ANI) funds applied research activities, aimed at supporting firm-oriented R&D, including cooperative projects between firms and R&D organisations.

In terms of private non-for-profit (PNPs), there are two main foundations for research funding: the Gulbenkian Foundation and the Champalimaud Foundation, focused on biomedical research [32].

3.3.1. FCT

In Portugal, the Fundação para a Ciência e Tecnologia (FCT)⁵ is the main funding body for R&D activities. The budget of the institution is assured in large part by the State Budget, and by structural funding from the European Union. In 2008, of its 436 M€ expense, 427 M€ were spent in funding science activities in Portugal. The volume spent in funding activities has decreased in more recent years, with 367 M€ spent in 2016 in direct funding in science activities [33], [34]. In 2014 about 19% of funding was toward R&D institutions and Science and Technology infrastructures, while 2008 this value was 25% (a change resulting from more funding toward specific R&D projects) [34], [35].

Funding schemes are available to individual scientists, research teams or R&D centres, in order to support higher education, research and development, establishment and access to research infrastructures, networking and international collaborations, conferences and meetings, science communication and interactions with industry.

The available funding schemes are:

- Studentships and fellowships
- PhD programmes
- Career development
- Project grants
- R&D institutions
- Research infrastructures
- International opportunities
- Scientific community support fund
- Protocols
- Prizes

Of these, R&D institutions and Research infrastructures funding are of interest within the context of MARINERG-i.

⁵ Foundation for Science and Technology

Funding for R&D institutions

From 2015 to 2020, R&D institutions that were reviewed in the 2013 Evaluation of R&D Units will be funded via the Portuguese state budget and, whenever eligible, co-financed by EU funds. The EU funds are contemplated in the Partnership Agreement between Portugal and the European Commission, named Portugal 2020.

Previously and until 2011, this funding stream used the Pluriannual Funding model (Financiamento Plurianual), consisting of periodic review of reports and activity plans as well as direct contact with researchers and institutions, through visits to all units by panels of international experts. Institutions were awarded a qualitative grade by the panel to determine the amount of funding to be awarded for the upcoming period.

From 2011 until 2014, and motivated by the evolution of the system for scientific research, the national funding model was changed. National R&D institutions, Associate Laboratories and R&D Units that had been evaluated as “Good” or higher in the previous evaluation exercise (2007/2008) submitted strategic projects, that were both of public interest and matched to their activity plans [33].

Funding for Research infrastructures

FCT supports research infrastructures of strategic interest, to underpin scientific and technological advances and bolster the capacity of the R&D community in Portugal to be an active member of European and international projects. As such, FCT has established a National Roadmap of Research Infrastructures of Strategic Relevance, which was launched in 2013 in alignment with the ESFRI roadmap.

The first phase of the Roadmap identified forty research infrastructures, which will be funded during the second phase of the Roadmap (2014-2020). There are periodic reviews of the National Roadmap of Research Infrastructures [33].

3.3.2. Agência de Inovação/Agência Nacional de Inovação

The Agência de Inovação (AdI)⁶, recently rebranded Agência Nacional de Inovação (ANI)⁷ manages a set of funding streams directed toward research and innovation, with a business-oriented perspective.

ANI also manages Portugal 2020 funds, as well as Tax benefits for R&D conducted in the private sector. Programa Interface is a Knowledge Transfer Program, that provides support to entities that stimulate the linking between higher education institutions and private companies. Furthermore, some of the programmes are co-funded in order to stimulate private investment in R&D.

The Portugal 2020 programme provides support in the following areas [36]:

- Mobilizing Programmes - Strategic cross-thematic R&D projects that envisage the development of new products, processes or services highly intensive in technology and innovation;

⁶ Agency for Innovation

⁷ National Agency for Innovation

- R&D Teams in Companies - Projects in Co-Promotion, ensuring creation, valuing and reinforcement of internal competences in business R&D;
- Demonstrators - Projects demonstrators of advanced technologies and pilot lines
- R&D in Co-Promotion - Business projects in co-promotion with other companies or other entities of the R&I system;
- Internationalization of R&D - Encouraging the participation of companies and other entities of the R&I System in European research and innovation programmes
- Industrial Property - Industrial Property Rights Protection.

3.4. Spain

In Spain, the Committee for Science and Technology (CICYT) is an inter-ministerial body responsible for the planning, evaluation and coordination of the main Spanish instruments for R&D and innovation.

The State Secretary for Research, Development and Innovation (SEIDI) implements the Ministry of Economics and Competitiveness's (MINECO) R&I related decisions. Its tasks include the execution of central government policies on R&I, the supervision of OPIs, coordination with regional R&I bodies and the international representation of the Spanish government on R&I issues. The main funding agencies involved in the implementation of R&I policies are the Spanish Research Agency (AEI²) and the Centre for Industrial Technological Development (CDTI).

The Information System of Science, Technology and Innovation (SICTI) will be responsible for the data collection, ex post analysis and impact assessment of all policy programmes and instruments of the R&I policy.

The two main advisory bodies of MINECO are the Council of Science, Technology and Innovation (CPCTI) and the Centre for Research Scientific and Technological Support (CACTI).

Main focus is given here to the Centre for Industrial Technological Development, due to its funding programs on National and International Cooperation R&D projects.

3.4.1. Centre for Industrial Technological Development (CDTI)

The Centre for the Development of Industrial Technology (CDTI) is a Public Business Entity, answering to the Ministry of Economy and Competitiveness, which fosters the technological development and innovation of Spanish companies. It is the entity that channels the funding and support applications for national and international R&D&I projects of Spanish companies. CDTI thus seeks to contribute to improving the technological level of the Spanish companies by means of implementing the following activities:

- Financial and economic-technical assessment of R&D projects implemented by companies.
- Managing and fostering Spanish participation in international technological cooperation programmes.
- Fostering international business technology transfer and support services for technological innovation.
- Supporting the setting up and consolidating technological companies.

Research and Development Projects

Research and Development projects are business projects of an applied nature, comprising both industrial research activities as well as experimental development [37]. The funding modality for the project will be Partially Reimbursable Aid, with financial cover of up to 75% of the total approved budget which, by way of exception, may amount to up

to 85%. Such aid may comprise a non-reimbursable tranche (NRT) which shall depend on the characteristics of the project and the beneficiary.

Individual R&D projects

The funding is directed to projects where the beneficiaries are individual private companies and the minimum fundable budget is €175 000.

National Cooperation R&D projects

This funding is directed to projects where the beneficiaries are either an Economic Interest Grouping (EIG) or a consortium governed by a private collaboration agreement comprised of, at least, two independent companies.

The minimum fundable budget will be around €500 000, with a maximum budget of around €1 750 000.

International Technological Cooperation Projects:

International Technological Cooperation Projects are promoted by international consortia related to Spanish participation in programs of international technological cooperation managed by the CDTI. These projects enable Spanish companies to reinforce their technological capacities, by likewise expanding the impact of their products, processes and services on the global markets.

The Spanish participation may be financed through a single project or a project in national cooperation based on the number and type of participants.

The beneficiaries are individual companies or an EIG or a consortium made up of at least two independent companies. The length of the project and other conditions are the same as for National Cooperation R&D projects.

Technology Fund

The Technology Fund is a special item in European Union FEDER funds allocated to promoting business R&D&I in Spain. The CDTI has been appointed to manage part of them for which different instruments with FEDER/CDTI joint financing have been designed in accordance with community requirements.

The Technology Fund is also executed through a specific programme of subsidies via a call for applications (FEDER-Interconecta) which support integrated experimental development projects, of a large-scale, strategic nature, and whose objective is the development of new technologies in forward-looking technological areas with economic and commercial prospects at the international level.

In the round of 2014-2020, the calls will be funded through the Smart Growth Pluriannual Regional Operational Program.

EEA Grants

For EEA Grants 2009-2014, Spain received a total budget of over EUR 42 million, of which EUR 18 215 000 have been allocated to the Programme "Environmental and Climate Change-related Research and Technology". The budget of this programme was completed with a contribution from CDTI in the form of soft loans.

The call for proposals of EEA-Grants will be made in a competitive basis, and aims to fund Industrial Research and Experimental Development projects, presented by Spanish companies, under the role of Project Promoters, in order to obtain new products, processes or services, or significantly improved ones. Projects should be oriented to the development of an innovative product, process or service with market prospects.

Funding from the EIB

The European Investment Bank (EIB) has given Spain a loan to support investment projects undertaken by small and medium enterprises (SMEs) and small and mid-cap companies (companies with less than 3 000 employees). CDTI will allocate the amount of this loan to co-finance part of the R&D projects that it manages.

CDTI financial aids: INNPRONTA

The INNPRONTA is a programme for the financing of large integrated industrial research projects, of a large-scale and strategic nature, which serve to develop new technologies in forward-looking technological areas with economic and commercial prospects at the international level.

Industrial research definition is defined in the Regulation (EC) No. 800/2008 of August 6, 2008, ("General exemption by categories regulation"): planned research or critical studies whose purpose is the acquisition of new knowledge and techniques that may be useful for creating new products, processes or services, or contribute to considerably improving existing products, processes or services. It includes the creation of components for complex systems that are necessary for industrial research, especially the validation of general technology, except for prototypes.

Regardless of the possible approval of special interest proposals in other fields, the following subject areas have priority:

- Energy, environment and climate change;
- Biotechnology, health and food;
- Other sectors, provided that the projects contribute high added value to the participants, a high technology level and boost the creation of skilled employment.

The minimum budget per project is 15M€, with 40% of funding for small companies, and 35% for large companies and the remaining as a loan.

CDTI financial aids: INNTERNACIONALIZA

Funding for projects to internationalize R&D results (INNTERNACIONALIZA) seeks to foster the international exploitation of the results of the R&D activities implemented by Spanish companies. The aim is to help Spanish SMEs to overcome the barriers inherent to an own-technology internationalization process in foreign markets.

The INNTERNACIONALIZA projects must be based on a structured internationalization plan with well-defined business objectives and a coherent work plan, which can include technology transfer, adapting the developed technology to the international market requirements and promotion activities.

The beneficiaries are any Spanish SME that wish to internationalize its technology. This technology may have been developed by the company in a previous CDTI project, in a project funded by other Administration or in a project implemented with the own resources of the company.

It is a partially reimbursable funding of up to 75% of the budget approved with a non-reimbursable part of 5%.

CDTI financial aids: INNVOLUCRA

The aim of the INNVOLUCRA program is to drive the participation of Spanish entities in international technology cooperation programs, especially the EU VII R&D Framework Program, as well as the submission of bids to large science-technology facilities.

Funds for bid preparation (APO):

The aim of this financing is to foment participation in bids for the design, development and operating of national and international Large Science-Technology Facilities, in which Spain contributes, such as CERN, ITER, ESO, ESA, EUMETSAT, Sincrotrón ALBA and GRANTECAN.

The final aim sought is to maximize Spanish industrial returns in these centres. The bid budget must exceed 200 000 euros and the financing is limited to one application per company and facility.

The financing instrument consists of credits of between 3 000 and 30 000 euros which are only refundable if the contract is obtained, if the bid is disqualified on technical grounds or if the bid exceeds the price of the contract awarded by more than 25%.

Managers Specialization Program

This measure has the objective of supporting the specialization of the human resources of the Spanish organizations (research groups, universities, companies, administration, etc.) who participate in the Horizon 2020 proposals and parallel initiatives.

e+: International Technological Cooperation Projects

The 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.

The projects funding method will be a Partially Reimbursable Grant, up to a maximum of 75% of the approved total budget, with a reimbursable part and a non-reimbursable part.

Other support mechanisms

There are other CDTI instruments dedicated to support innovative companies in different phase of the technological development.

- The INNVIERTE programme seeks to promote business innovation through investment in technological or innovative companies.
- Neotec Venture capital, with the support of national banks and industrial companies.

3.4.2. National Innovation Company (ENISA)

The **National Innovation Company** (ENISA- Empresa Nacional de Innovación, S.A.) is a state-owned enterprise -dependent of the MINECO, through the General Directorate of Industry and Small and Medium-Sized Enterprises-. Since 1982, its mission is to promote the financing of viable business projects and innovators of Spanish SMEs, promoting the diversification of their sources of financing. Financial lines:

- "Young Entrepreneurs" Line: offers financing to recently established SMEs, created by entrepreneurs up to 40 years old.
- "Entrepreneurs" Line: offers financial support to recently established SMEs, promoted by entrepreneurs with no age limit.
- "Growth" Line: financial support to business projects focused on the expansion and competitive improvement.

3.4.3. Biodiversity Foundation

The **Biodiversity Foundation (Fundación Biodiversidad)** is a non-profit organization set up in 1998 to protect the Spanish natural capital and biodiversity and today is part of the Spanish Ministry of Agriculture, Food and Environment. The mission of *Fundación Biodiversidad* is to help protect and conserve our natural heritage and biodiversity, taking a two-pronged approach: carrying out large conservation projects, and channelling aid and funding - much of which is European funding to develop the projects of other organisations such as NGOs, research bodies, universities, and so on. Each year the foundation collaborates in more than 300 projects to conserve terrestrial and marine biodiversity, fight climate change and promote green economy.

3.4.4. ICEX Invest in Spain

ICEX is an instrument of the MINECO to attract foreign investments and export national products and services.

The *Investment Program for Foreign Companies in R&D Activities* seeks to encourage development of new research and development activities by companies with foreign capital which are or plan to be established in Spain.

The amount of the aid may come to an overall maximum of 200 000 euros per beneficiary in any period of three consecutive fiscal years (De minimis aid regulation) and will be a percentage of the investment made (Community Framework for State Aid for R&D&I (2014/C 198/01). The activities for which the aid is awarded must be carried in one or more of the following Autonomous Communities: Extremadura, Canary Islands, Castilla la Mancha, Murcia and Galicia.

3.4.5. Specific for ocean energy

There are several R&D public funding programs in Spain not specific for ocean energy but applicable in competition with other sectors. In addition, there are a couple of programs more specific for ocean energy:

- The European network OCEANERA-NET, participated by the Spanish Government through CDTI and agencies from Asturias, Cantabria, Basque Country and the Canary Islands, launched a second call in 2016 with the aim of funding projects to support research and innovation in the ocean energy sector. CDTI and EVE (Basque Country) have been also working on a continuation of this network to secure a new call in 2017 under a co-funding mechanism with the European Commission;
- In the Basque Country, a new call to support open sea testing was launched by EVE in 2016. The purpose of this program is the demonstration and validation of emerging marine renewable energy technologies.

3.5. United Kingdom

In the UK, the Department for Business, Energy and Industrial Strategy (BEIS) is the major provider of research funds for the public sector and is also responsible for the allocation of the UK Science Budget for the Research Councils, the Royal Society and Royal Academy of Engineering. Funding for large facilities and infrastructure is available from the Research Councils, government departments, the private sector and other sources.

The Research Councils invest, each year, about 3.35 M€ to support R&D and research training. Investing for growth: Capital Infrastructure for the 21st Century is a strategic framework launched in 2012, to be used by the Research Councils to plan future investments in the UK's capital infrastructure for research [38], [39]. The Research and Innovation organization and Flow of R&D funding in the UK, as of 2012, can be seen in the Figure 6 and Figure 7.

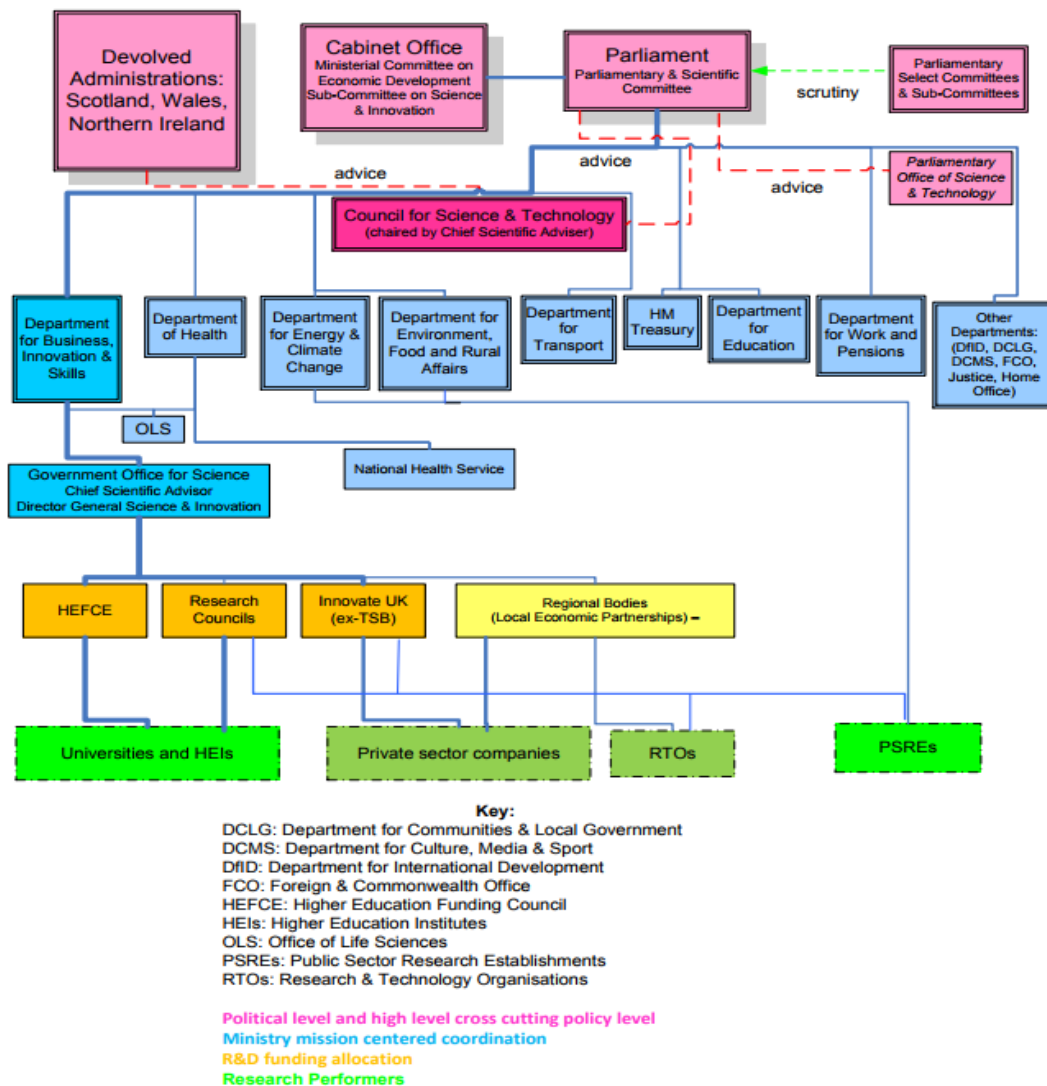


Figure 6 UK Research and Innovation organization [39]



There is also allocation of funds to universities from the Higher Education Funding Councils and equivalents, which are made on the basis of the Research Excellence Framework.

Research funding for the public sector is also available from the private-non-profit sector, through a range of charities and foundations, the majority connected to medical research.

The private sector also benefits from R&D support from the UK Government, through range of innovation support measures, including tax credits administered via the Treasury and Innovate UK. The combined R&D Tax Credit schemes account for 75% of the public support for private R&D. Another funding support scheme for the private sector is the Smart programme which targets SMEs and is funded through Innovate UK and Scottish Enterprise.

There are also many schemes aimed at linking the public and private sectors, including Knowledge Transfer Networks, Collaborative R&D and Knowledge Transfer Partnerships, funded through the Technology Strategy Board, and the Research Councils' CASE awards. Many of these schemes involve variable elements of co-funding from industry and are not always eligible for the definition of 'direct funding'. Several schemes also aim at the stimulation of additional financing support, particularly for SMEs.

3.5.1. Research Councils UK

Research Councils UK (RCUK), Higher Education Funding Bodies, Innovate UK and the UK Space Agency (referred to collectively below as 'UK funding bodies') support collaboration in research and related activities [41]. Collaborations may include public or private sector research organisations, as well as business and other partner organisations where these bring distinctive contributions to the collaborative research activity.

All Research Councils support international collaboration through their grant funding, for example in matters of support for travel, of promoting Pathways to Impact, and for basing equipment overseas.

Grants can also include international researchers visiting from overseas who are of acknowledged standing, and international collaboration from project partners (international collaborators bring their own funding) or consultants (subcontractors are allowed where there is a lack of appropriate expertise)

The Research Councils run a number of schemes to support activities that foster international collaboration through initiating or further developing long term relationships between researchers in the UK and another country. These include establishing partnership links between research institutions, building on existing links between research groups and extending networks, and encouraging researchers from overseas to undertake research in the UK as well as UK researchers to spend time abroad.

The Research Councils offer a number of opportunities depending on the type of collaboration being undertaken:

- Stage 1 - First Links: funds to cover the travel and subsistence for short term visits usually from the UK to another country;
- Stage 2 - A Broader Relationship: where there is already a more established relationship, researchers may wish to apply for funds to extend this relationship in the country of choice;

- Stage 3 - Pilot Studies: where relationships are more mature it may be the case that researchers need financial support to carry out pilot research;
- Stage 4 - Sustainable Interactions: dedicated schemes to support transnational collaboration or where the funding for international collaboration is embedded in the activities of programmes, often within the UK contribution to specific multilateral organisations.

3.5.2. Engineering and Physical Science Research Council

There are a number of facilities supported by the Science and Technology Facilities Council (STFC). Major facilities include Diamond, ISIS, Central Laser Facility (CLF), Institut Laue-Langevin (ILL) and the European Synchrotron Radiation Facility (ESRF).

EPSRC provides support for groups to carry out projects which use the facilities through research grants. Typically, EPSRC funds the research staff and consumables needed for a project, with the research group accessing beam time at the facilities free at the point of access. STFC is responsible for allocating access to the facilities.

Total theme funding, £492.83 million (10.63% of whole portfolio) across research areas. There are 476 grants in the Energy theme [42].

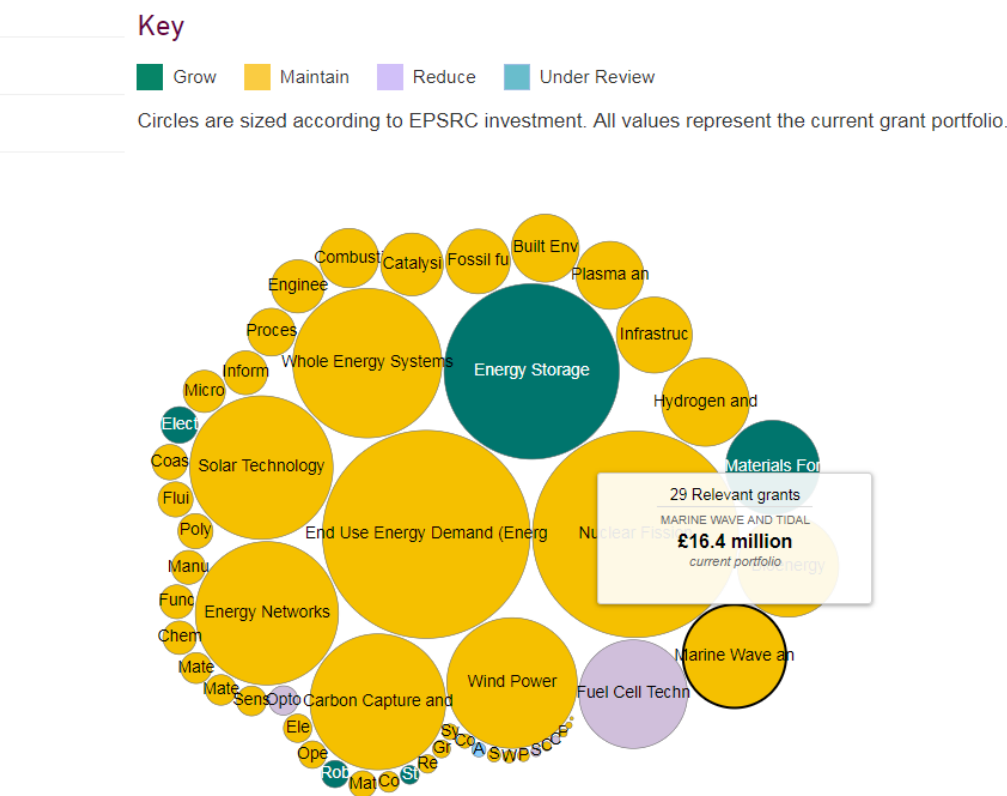


Figure 9 Current EPSRC support by research areas for the Energy theme [42]

International collaborative research groups

In exceptional circumstances, where a clear scientific need that is of particular importance to the UK research program and which can only be addressed by developing a beamline /

instrument not available anywhere else, there is the possibility to consider a request for collaborative research group support.

Other facilities

It's also possible applying for funding to access both EPSRC facilities and facilities that are not supported by EPSRC on grant applications. Below is a list of interesting facilities in the MARINERG-I context that are available to EPSRC researchers.

Hydromechanics Facilities

The QinetiQ hydromechanics test facilities include the UK's largest Ocean Basin (122m x 61m x 5.5m) and a Ship (Towing) Tank (270m x 12m x 5.5m). Both facilities can create waves and are used by customers to predict ship and submarine performance as well as research and develop marine renewable devices. These facilities are available to UK academics (at minimum cost to EPSRC grant proposals) who wish to carry out experiments.

Wave Test Service

Coastal, Ocean and Sediment Transport (COaST) is a physical modelling facility providing model experimentation with combined waves, currents and wind. The facility comprises an Ocean Basin (wind, waves and currents, 35 x 15.5 x 3m), a Coastal Basin (waves, currents + sediments, 15 x 10 x 0.5m) and a Wave Flume (with or without sediments, 35 x 0.6 x 0.8m).

National Wind Tunnel Facility (NWTF)

NWTF presently comprises seventeen wind tunnels around the UK. The wind tunnels and accompanying equipment are expected to be open access for up to 25% of the time to other UK based researchers (as well as those from overseas) in both industry and academia.

3.5.1. The UK Energy Research Centre UKERC

The UK Energy Research Centre (UKERC) manages a flexible research fund allocated through a series of open research calls, overseen by an independent Research Committee. Around EUR 3.58 million were available for the flexible research fund and proposals from universities or other institutions are still being accepted for the third call of proposals [43].

3.5.2. Innovate UK

Innovate UK is the UK's innovation agency working with UK companies to de-risk, enable and support innovation [44]. To do this, its main objectives are to:

- determine which science and technology developments will drive future economic growth;
- meet UK innovators with great ideas in the fields we're focused on;
- fund the strongest opportunities;
- connect innovators with the right partners they need to succeed;
- help innovators launch, build and grow successful businesses.

UK-based business or research organisations can apply for innovation funding, and compete for government-backed funding to:

- research and develop a process, product or service;
- test innovation ideas;
- collaborate with other organisations.

3.5.3. Wave Energy Scotland

Wave Energy Scotland (WES) – fully funded by the Scottish Government – is taking an innovative and unique approach to the development of wave technology in a new research programme. WES will support wave energy technology development until the technical and commercial risks are low enough for private investment to re-enter the sector [45].

Recently, ten wave energy development projects have been awarded a total of £3 million by Wave Energy Scotland (WES). The projects, devised by individual companies and partnerships, will explore the potential of different materials and processes in the production of wave energy converters (WECs); devices that convert ocean waves into electricity.

This latest announcement from WES brings the total investment by the organization in wave energy development to EUR 15.41million across 51 projects in less than two years.

WES was established as part of Highlands and Islands Enterprise (HIE), at the request of the Scottish government, during December 2014. HIE is the Scottish government's economic and community development agency for the north and west of Scotland [46].

3.6. Belgium

3.6.1. Research Foundation - Flanders

The Research Foundation - Flanders (FWO) is a Public Utility Foundation, supported by the Flemish Government, the Federal Government, the National Lottery and private companies, institutes and individuals.

It provides funding in the following areas:

- PhD fellowships
- Postdoctoral fellowships
- Research Grants
- Research projects
- Infrastructure
- International mobility
- International collaboration
- International contacts
- Scientific prizes
- European programmes

The infrastructure support is separated into medium and large scale, defined as:

- Medium-scale research infrastructure is defined as research infrastructure with a total financing cost of at least EUR 150,000 and at most EUR 1,000,000.
- Large-scale research infrastructure is defined as research infrastructure with a total financing cost of at least EUR 1,000,000

The current call has 19.6M€ budget available for medium scale RIs, and 9.5M€ for large scale RIs [47], [48].

The construction of a new maritime laboratory in Ostend, set to be operational in 2020, has received a funding of 28 million euro by FWO. Ghent University, the Catholic University of Leuven and Flanders Hydraulics Research will use this infrastructure to study the impact of waves, tides and wind on ships and constructions at sea [49].

3.6.2. Fund for Scientific Research

The Fund for Scientific Research (FNRS) is a public utility foundation which is supported in more than 90% by public funds. The goal of the foundation is to encourage scientific research in the Wallonia-Brussels Federation by subsidizing researchers and their research activities, and institutions in order to enable them to equip or run research units.

The FNRS has a wide range of funding instruments, with a "bottom up" approach, in all scientific domains. The "Grants and Mandates" and "Credits and Projects" calls are open once a year. In addition, throughout the year the FNRS supports the activities of networks, mobility and dissemination [50]. Figure 10 shows a scheme of FNRS support.

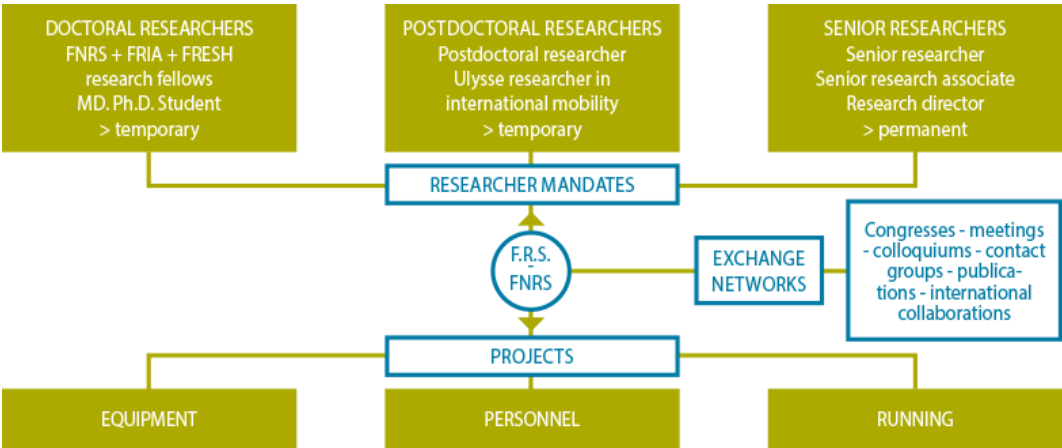


Figure 10 Support from the FNRS [50]

3.7. Denmark

The eight universities are the main performers of public R&D. Since 2014, the nine university colleges of higher education have been obligated to perform research activities, nevertheless these are still in their early phases.

The Danish government is also co-financing eight private, certified Advanced Technology Group's - ATG's (research and technology organizations). Their primary objective is to stimulate primarily SMEs to become more competitive and innovative.

Significant investments in research and innovation are made by private foundations in Denmark. The 12 largest foundations have spent around €1.3bn on research, development, and higher education in 2012-2014. The main share of these funds goes to the Danish universities.

The private sector performs about two thirds of all R&D in Denmark, and many firms are highly R&I intensive. Networks and linkages for innovation are important gateways to access and transfer knowledge.

To stimulate more collaboration between R&I actors, the Danish government has since 2007 supported more than 20 nation-wide innovation networks. These networks are designed to facilitate interaction between universities, RTO's and firms and are topically defined e.g. focusing on transport, production, energy including offshore technologies, food or service innovation.

A new application round was completed in the spring of 2014 for a new four-year period (2014-2018) with a total funding of €39m supporting 22 networks [51].

3.7.1. National Committee for Research Infrastructure

The Danish Agency for Science, Technology and Innovation appointed a permanent National Committee for Research Infrastructure in 2013.

The Committee is mandated to act as a forum for preparing decision support documents and agreements on prioritisation, establishment, continuation and financing of national and international research infrastructures, and research support activities to facilitate optimal national utilisation of the research infrastructures.

The Committee is composed of representatives from the Danish universities and the Danish Council for Independent Research, with the Danish National Research Foundation as an observer [52].

3.7.2. Innovation Fund Denmark (IFD)

Innovation Fund Denmark (IFD) participates in several international programmes aimed at promoting market-driven research and innovation, in which Danish companies and universities can apply for funding.

The international programmes are linked to IFD's national programmes and very much reflects IFD's strategic impetus. The purpose is to develop knowledge and solutions that strengthen research and innovative solutions to benefit growth and employment in

Denmark, and focus specifically on increasing research and innovation initiatives in small and medium-sized companies.

IFD distributes funds under the Danish Finance Act, which in 2017 is approximately DKK 120m for International collaborations, through calls throughout the year [53].

Innovation Fund Denmark prioritises its international involvement within four frameworks:

- Innovation Fund Denmark's national programmes (Grand Solutions and Innobooster)
- Bilateral country collaborations (Brazil, India, China and Korea)
- Targeted investments in small and medium-sized companies (Eurostars)
- Societal challenges with considerable international perspective which cannot be solved nationally (e.g. Horizon 2020 programmes)

So far in 2107, IFD participates in four thematic calls: 'Neurodegenerative Diseases', 'Electromobility', 'Quantum Information and Communication Sciences & Technologies' and Strategic Collaboration in Food Science with Brazil.

For calls in 'Non-thematic programmes' IFD is involved in EUREKA Turbo, a new research and innovation programme for large public-private partnerships. This is a collaboration with France, Austria, Spain and Finland with a 2017 budget of DKK 30m.

IFD also continues its activities with the Eurostars programme, which is dedicated to research intensive SMEs in all thematic areas. The programme is open for market-oriented development projects in all disciplines and themes, with the possibility of creating a collaboration amongst 34 European countries and a few countries outside Europe.

3.7.3. Energy Technology Development and Demonstration Program (EUDP)

EUDP (Energy Technology Development and Demonstration Program) supports private companies and universities to develop and demonstrate new energy technologies. Support is given in accordance with EU state aid rules.

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.

The EUDP Act states that the objective of the EUDP is to provide support for energy-policy targets for security of supply, Danish fossil fuel independence, global climate considerations and considerations for a cleaner environment and cost-effectiveness. Furthermore, the Act contains an objective to promote exploitation and development of business potentials in order to benefit growth and employment.

In terms of energy-policy targets, a long-term objective is for Denmark to become independent of fossil energy. The energy system must be transformed to renewables, i.e. to being based on wind, solar, wave, biomass and geothermal energy. Furthermore, energy use must be made more efficient in all sectors, so as to ensure the highest possible value for the energy resources consumed and so as to reduce total energy consumption.

Since 2007, the EUDP has supported more than 600 RDD projects through funding of almost DKK 3 billion out of a total budget of almost DKK 6 billion. Of these projects, around 400 are ongoing and have been granted a total commitment of around DKK 2 billion.

3.7.4. The Obel Family Foundation

The Obel Family Foundation is a philanthropic foundation. It funds projects within the areas of our three strategic focuses:

- Research;
- Social objectives;
- Art.

Apart from these three areas, which are mainly applied to a Danish context, the foundation also supports international projects within the social area. International applications are processed annually every December.

By tradition, the Obel Family Foundation enjoys a special attachment to Aalborg and Northern Jutland and disperses its grants more broadly in that region of Denmark. In addition, the Foundation also supports projects outside Denmark, although on a more limited scale.

In 2017 The Obel Family Foundation granted 113,6 million DKK for the benefit of the public good.

Research is primarily supported at Aalborg University and Aalborg University Hospital where researchers may obtain support for their research projects, purchase of instruments and travel expenses related to their research.

3.7.5. The Velux Foundations

THE VELUX FOUNDATIONS are comprised of the two philanthropic foundations VILLUM FONDEN and VELUX FONDEN. Among their grant areas are science, environmental, social and cultural purposes in Denmark and internationally. In 2017, the two foundations gave joint grants of approx. EUR 168 million.

Both foundations were established by graduate engineer Villum Kann Rasmussen - the founder of VELUX and other companies in the VKR Group, whose mission it is to bring daylight, fresh air and a better environment into people's everyday lives.

The foundations are philanthropic even though VILLUM FONDEN is the principal shareholder of VKR Holding, the parent company of the VKR Group, which has more than 14,000 employees and comprises a number of companies, among which VELUX, VELFAC and Rationel Vinduer are the most well-known. However, the foundation does not have any controlling influence within the VKR Group even though it is the majority shareholder; and that is why it is a philanthropic foundation.

Each foundation has its own trust deed detailing the types of projects it supports.

VILLUM FONDEN

VILLUM FONDEN (a part of THE VELUX FOUNDATIONS) is a philanthropic foundation that supports technical and scientific research as well as environmental, social and cultural projects in Denmark and internationally. It was established in 1971 by graduate engineer Villum Kann Rasmussen – the founder of VELUX and other companies in the VKR Group. In 2017, VILLUM FONDEN granted approx. EUR 140 million.

In 2011, VILLUM FONDEN took the initiative for strengthening the physical framework conditions for science and technology research in Denmark. The Danish universities and research institutions were invited to submit proposals for prospective large-scale research infrastructures.

Following evaluation of proposals, dialogue with applicants and the assistance of international peer reviewers, at the end of 2012 and start of 2013, the VILLUM FONDEN Board reached the decision to make three grants of DKK 60-75 million each.

There are no specific plans for a new application round for large-scale research infrastructures, and applications may be submitted by invitation only.

VELUX FONDEN

VELUX FONDEN (a part of THE VELUX FOUNDATIONS) is a philanthropic foundation that supports scientific, cultural, social and environmental purposes. It was established in 1981 by graduate engineer Villum Kann Rasmussen – the founder of VELUX and other companies in the VKR Group. Further grant areas are active senior citizens, gerontology and ophthalmology. In 2017, VELUX FONDEN granted approx. EUR 28 million.

The purpose is to use the trust deed as a tool for promoting the democratic society of Denmark on an informed, inclusive and sustainable basis.

3.8. Germany

R&I is a shared responsibility of the Federal Government and the 16 Länder. At the national level, the Federal Ministry of Education and Research (BMBF) covers most of the responsibilities for research policy. The Federal Ministry of Economics and Energy (BMWi) is involved in some areas of innovation and technology policy. The Länder fund the universities in their state [54].

Much of publicly funded research is conducted in the university system and in the non-university public research organisations which are co-funded by the Federal government and the Länder. The four major non-university research organisations are Max Planck Society (MPG), Fraunhofer Society (FhG), Helmholtz Association (HGF), and Leibniz Association (WGL).

The German Research Foundation (DFG) complements institutional funding with project funding for basic research, selecting the most promising research projects by scientists and academics at universities and non-university research institutions based on a competitive basis.

In 2015, the German Higher Education landscape counted about 400 institutions, including 110 universities and more than 230 universities of applied sciences. R&D performed by German HEIs represents about 0.50% of GDP and is funded through a combination of institutional funding and project funding (e.g. Initiative of Excellence, R&D thematic programmes by BMBF) and contract research conducted for industry. R&D performed by academia and funded by the German private sector amounts to 0.07% of GDP. These shares are quite stable and have not changed much over the past years. The institutional funds received by universities are for both teaching and research and are largely provided by the Länder.

In 2015, eight of the 50 largest R&D investors worldwide were headquartered in Germany.

Germany has several policy initiatives to leverage geographical clusters such as the Leading-Edge Cluster Competition ('Spitzencluster-Wettbewerb') and the initiatives Entrepreneurial Regions ('Unternehmen Region') and 'Zwanzig20 – Partnerschaft für Innovation' of the Federal Ministry for Education and Research. Apart from these cluster initiatives, the German Federation of Industrial Research Associations (AiF) plays a crucial role in connecting research and innovation.

3.8.1. Federal Ministry of Education and Research - BMBF

Leading-Edge Cluster Competition

The Leading-Edge Cluster Competition was launched by the Federal Ministry of Education and Research (BMBF) in 2007 as part of the High-Tech Strategy for Germany.

Three rounds of the competition have been held. The emphasis is on innovative approaches to a long-term cluster strategy. Clusters are arranged with respect to regional representation. The competition, which is open to all disciplines, aims to support the strongest regional associations (leading-edge clusters) with participation from research, business and society in developing internationally competitive solutions and strategies for their project proposal.

In each round of the competition, up to 200 million euros has been made available to form up to five leading-edge clusters (40 million euros each) over a period of five years. Realisation requires a matching level of funding from industry and private investors.

Entrepreneurial Regions and 'Zwanzig20 – Partnerschaft für Innovation'

Entrepreneurial Regions is an innovation initiative of the Federal Ministry of Education and Research (BMBF) that aims to develop regional alliances in eastern Germany into regional clusters. The initiative funds outstanding innovation potentials in a targeted way. The focus is firmly on the feasibility and marketability of the ideas involved.

The initiative currently uses five different funding programmes to support regional alliances that develop their core competencies into clusters of a high standard and with a strict market orientation. All programmes observe the principles: think laterally, collaborate, plan strategically and act entrepreneurially.

Since 2016, Entrepreneurial Regions has been broadened into a nationwide innovation development strategy to support regions facing special challenges as a result of structure change.

Twenty20 – Partnership for Innovation, the latest funding line, is making available up to 500 million euros until 2019 for supraregional and interdisciplinary partnerships in eastern Germany.

3.8.2. German Federation of Industrial Research Associations - AiF

The German Federation of Industrial Research Associations (AiF) was founded in 1954. As a registered non-profit association, the AiF promotes R&D in all industrial sectors on behalf of small and medium-sized enterprises (SMEs). The association is active at the national and European level.

The AiF is organised by industry and is particularly involved in increasing the competitive strength of SMEs by supporting the efficient application and advancement of R&D programmes. This includes a variety of fields of applied research, such as process control, building industry, medical technology, food science and agricultural science.

3.8.3. German Research Foundation (DFG)

The German Research Foundation (DFG) is the self-governing organisation for science and research in Germany. The DFG receives the large majority of its funds from the federal government and the states, which are represented in all grants committees [55].

Scientific Instrumentation and Information Technology

Scientific instrumentation and equipment can be applied for in several of the DFG's funding programmes. In addition, major instrumentation for research at universities can be co-financed by the DFG (50%) and state-funded instrumentation for training, teaching and medical care may be reviewed by the DFG. Proposals for major research instrumentation are reviewed according to technical and scientific criteria. Additional information on particular equipment categories and infrastructure measures are also available.

Major Research Instrumentation Programme

In accordance with the Major Research Instrumentation Programme, the DFG funds large scientific equipment through its Major Research Instrumentation Programme. Financing is provided in equal parts by the DFG and the university's home state. To be eligible for funding, proposed research instrumentation projects must be of high quality and national importance. The instrumentation must primarily serve research purposes. This criterion is fulfilled if the necessity of the purchase and its usage are based solely on its intended use in research. In addition, the instrumentation may also be used in teaching and/or medical care. These areas will not be considered when assessing the necessity of the equipment.

Major instrumentation is the sum of the components, including accessories, that form an operational unit for the intended application. The instrumentation must cost over €100,000 for universities of applied science and over €200,000 for other universities. The maximum limit is €5 million.

Major Instrumentation in Research Buildings

The major equipment proposed here differs from that in the Major Research Instrumentation Programme in that this equipment is financed within the framework of constructing a research building

Proposals by the states for the financing of research buildings are submitted to the federal government and the German Council of Science and Humanities. The Council makes recommendations to the BLK (Federal-State Commission for Educational Planning and Research) as to which of the measures applied for by the state should be realised. The BLK decides at least once annually about the acceptance of the project into the joint funding.

Proposals for major instrumentation exceeding €5 million undergo the same application procedure as proposals for research buildings. The DFG provides the German Council of Science and Humanities with a recommendation about the equipment and for instrumentation contained in research buildings.

The financial processing of research buildings is negotiated between the federal government and the respective state.

State Funded Major Instrumentation

Under this programme, major instrumentation is procured for German universities and university clinics and financed by the states/universities. The DFG is commissioned by the states to review proposals for major instruments that are to be used for research, teaching and training, or for medical care. The funds can serve this purpose either directly or indirectly.

Instrumentation must exceed €200,000 for universities and €100,000 for all other higher education institutions. The thresholds applicable in Bavaria, Schleswig-Holstein and Saarland are €125,000 for universities and €75,000 for all other higher education institutions.

Core Facilities

With appropriate use and management concepts, the establishment of core facilities can contribute to an overall improvement in research infrastructure. The German Research Foundation therefore supports the establishment of core facilities and the joint – as well

as external – use of technologies offered/available therein. This occurs in the form of calls for funding proposals.

Scientific Library Services and Information Systems

To establish effective information services and innovative information infrastructures suited to meet the needs of the research community at German universities and research institutions.

Scientific service institutions (such as libraries, archives, media and computer centres), research institutes and scientists or academics (Ph.D. required) from any discipline working at German research institutions. As a rule, only publicly funded institutions are eligible to apply.

Funding includes staff, instrumentation, travel expenses, miscellaneous costs (e.g. work contracts).

Collaborative Research Centres

Collaborative Research Centres are long-term university-based research institutions, established for up to 12 years, in which researchers work together within a multidisciplinary research programme.

They allow researchers to tackle innovative, challenging, complex and long-term research undertakings through the coordination and concentration of individuals and resources within the applicant universities. They therefore enable institutional priority area development and structural development. Cooperations with non-university research institutions are expressly encouraged.

Collaborative Research Centres consist of a large number of projects. The number and scope of these projects depend on the research programme. Individual projects are led by one researcher or jointly by several researchers.

International Programmes

The DFG supports international research cooperation in all of its funding programmes and with a multitude of instruments. Regardless of the specific type of project funding involved, researchers may apply for necessary funds in addition to the project funding itself. Special lines of funding are listed below.

Initiation of International Collaboration

Applicants interested in establishing collaborative scientific relationships with partners abroad may apply for funding for trips and research stays abroad or for preliminary workshops. Three different modules are available: “Exploratory Workshops”, “Trips Abroad” and “Guest Visits”.

International Scientific Events

The DFG provides funding for the organisation of scientific events in Germany. Such events include international congresses, symposia, colloquia and workshops, international scientific conferences, annual meetings, and bilateral events.

3.9. Italy

In Italy's R&D and innovation system a key role is played by the central government, namely the Ministry of education, university and research (MIUR) and the Ministry of economic development (MISE). Existing funding programs from these two bodies are described here in details.

Potentially relevant for the political support of the Italian government into the MARINERG-I initiative is also the Ministry for Environment, Land and Seas (MATTM).

3.9.1. Ministry of Education, Universities and Research – MIUR

The current vision and strategy for research in Italy is set by the National Research Program (*Programma Nazionale della Ricerca* – PNR) for period 2015-2020, issued by the MIUR Ministry.

The strategy to prioritize, strengthen and support research is based on six pillars: internationalization, human capital, public/private cooperation, regional cohesion, funding efficiency, and notably here, research infrastructures.

A number of areas of specializations are identified as key sector to strengthen knowledge and industrial competitiveness in the global scenario. These areas are also selected for prioritization of available resources. The overall program provides a budget of 2.5 billion Euros for period 2015-2017 as an additional contribution to an average budget of 8 billion Euros that are yearly granted by MIUR for Universities and research centers. It is estimated that about 15% of resources is directly addressed to the research infrastructures pillar.

Two among primary objectives of the strategy for research are particularly relevant in the MARINERG-i context:

- the internationalization, coordination and integration of national initiatives with European and global actions
- selective support to Research Infrastructures (RIs) that are prioritised for their excellence and the impact towards societal challenges

The alignment of the selection process for national RIs with guidelines from ESFRI is a key point in this strategy.

The PNR 2015-2020 introduces twelve National Technology Clusters as the areas of specialization of applied research with prioritized support mainly from public/private resources. Among these twelve areas, the “Blue Italian Growth” (BIG) cluster covers actions on Offshore Renewable Energy (ORE) that are relevant for the MARINERG-i initiative. CNR, the Italian partner in H2020 MARINERG-i is leading the BIG Cluster.

Financial support to research bodies and University is provided by MIUR for the actuation of the PNR 2015-2020 according to two main streams: structural funds and additional funds. Main funding programs are described here below.

Ordinary fund for the financing of research bodies and institutes FOE

FOE (*Fondo Ordinario per gli Enti di Ricerca*) is the primary contribution of the Italian Ministry of Education, Universities and Research (MIUR) to fund the research activities conducted by public research bodies and institutes acting under the supervision of the Ministry.

Funding is awarded on the basis of the preventive programmes submitted by the research bodies. Since 2011, with the objective to support the activities of public research bodies and to promote an effective and efficient use of the resources, part of the fund (not less than 7% and progressively increasing in the next years) is reserved for specific programmes and projects submitted by research bodies and it is distributed on the basis of the merits and qualities of the projects proposed. Another part of the fund (not more than 8% of the total) is earmarked for “flagship projects”, i.e. projects of particular interest via which the research system in sectors of key strategic importance for the development of the country is managed [56].

It is worth noting that FOE is the main funding program dedicated to support RIs for their participation to running ESFRI projects. Funding is also directed to RIs that are prioritized as a result of the selection process under the PNIR 2014-2020 strategy (see below).

Ordinary Financing Fund – FFO

The FFO (*Fondo di Finanziamento Ordinario*) funding scheme is dedicated to Universities and is primarily addressed to create job opportunities for young researchers with specific measures to stimulate the return of Italian researchers working abroad. Within this context, a limited budget is directed to projects including valorization of existing Research Infrastructures.

National Operational Program - PON

The National Operational Program "Research and Innovation" 2014-2020 is the instrument with which Italy contributes to the realization of the European Union's Cohesion Policy in favour of its most disadvantaged territorial areas.

The Program, managed by the Ministry of Education, University and Research (MIUR), is concerned with the Transition Regions (TR): Abruzzo, Molise and Sardinia and the Regions in Development Delay (LD), Basilicata, Campania, Calabria, Apulia, Sicily, with a total budget of € 1,286 million [57].

PON Research and Innovation develops in consistency with the strategic objectives of the Horizon 2020 and Cosme European programs, in synergy with the National Strategic Intelligence Strategy (SNSI) and regional operational programs and strategies for smart specialization.

Priority of PON Research and Innovation is the competitive repositioning of the most disadvantaged regions in order to produce structural change changes in order to increase the ability to produce and use quality research and innovation to trigger intelligent, sustainable and inclusive development.

The program's scope of application follows the 12 areas of specialization identified in the PNR 2015-2020: Aerospace, Agrifood, Blue Growth, Green Chemistry, Design, Creativity and Made in Italy (Non-R & D), Energy, Smart Factory, Sustainable Mobility, Healthy, Smart, Secure and Inclusive Communities, Life Technologies, Cultural Heritage Technologies.

In these areas the intention is to create opportunities for territorial development, stimulate the formation of truly "innovation laboratories", in which to cultivate new knowledge, talents, innovative entrepreneurship, opportunities to attract skills.

Part of the budget made available under PON is dedicated to financially support the Technology Clusters launched with the PNR 2015-2020. Funding from PON is also directed

to support priority RIs including those present in the ESFRI roadmap or in the application process.

The most relevant axis for MARINERG-i is “Axis II - Thematic Projects”, worth 952 million euro. Axis II aims to remove structural, business and contextual constraints, in line with the guidelines set out in the National Strategy for Intelligent Specialization (SNSI), through funding for Research infrastructures (€ 286 million), technology clusters (€ 327 million) and research projects on qualifying technologies (KET's) (€ 339 million).

Fund for Scientific and Technological Research - FIRST

The Ministry of Education, Universities and Research (MIUR) is appointed to regulate the use and management of the Investment Fund for Scientific and Technological Research (FIRST).

This is to support industrial research activities, extending to non-major experimental development processes and related human capital training activities as well as fundamental research, embedded in European and international agreements and programs.

FIRB fosters knowledge growth and strengthens its competitive ability by supporting core research activities of high scientific and technological content, including international value. FIRB supports eligible projects in the form of a 70% contribution of the related cost.

Through the resources of FIRB, MIUR intervenes in support of:

- Basic research projects of high scientific or technological value, even internationally;
- Strategic development projects of pervasive and multisector technologies;
- Projects to upgrade large-scale public or public-private research infrastructures;
- Proposals for the establishment, upgrading and networking of centres of high scientific qualification, whether public or private, even on an international scale.

Research Facilitation Fund - FAR

The Research Facilitation Fund (FAR) is a ministerial fund for industrial research, possibly integrated with pre-competitive development and / or training activities designed to implement and produce research results to the production of a prototype. The fund is fuelled by government policies and is divided into two sections: "national area" and "depressed areas" [58].

Fundable activities can be grouped into the following macro-categories:

- Industrial research: aimed at acquiring new knowledge, useful for the development of new products, production processes and services, or to achieve a significant improvement in existing products, production processes and services.
- Pre-competitive development: the actualization of research results in a plan, design or design for new, modified or improved production, product or service processes, for sale or use, including the creation of a first prototype unsuitable for commercial purposes.
- Professional training of researchers and research technicians.

Projects of National Interest – PRIN

The programme Projects of National Interest (PRIN) is a mechanism for the allocation of funds based on co-funding, group research work and peer evaluation. The main objective for the next years is the reinforcement of the national scientific foundations in view to securing a more effective participation in the European initiatives related to the Framework Programmes. Yearly and with an ad-hoc decree, the MIUR announces a call for proposals for funding, on a three-year basis, research projects of national interest (PRIN) [59].

Unified Fund for Research Infrastructures – FUIR

The PNR 2015-2020 provides the strategy for research in general, while the strategy and governance of Research Infrastructures is further developed in the National Research Program for Research Infrastructures (*Programma Nazionale Infrastrutture di Ricerca - PNIR*). As a part of the PNR, the PNIR is issued by the MIUR Ministry.

The PNIR document has the primary objective to provide selection criteria to identify priority RIs in accordance with European Commission guidelines. This is a precondition to have access to resources under the European Structural Investment Fund (ESIF).

In this context, the rationalization of national funding schemes for RIs is also addressed. With the PNIR 2014-2020, a new funding scheme is introduced: the Unified Fund for Research Infrastructures (*Fondo Unico per le Infrastrutture di Ricerca - FUIR*). The FUIR aims to rationalise the framework of financial support to RIs by integrating resources from above cited FOE, FFO, PON and from other funding bodies like FSC (*Fondo Sviluppo e Coesione*), and regional funding schemes (POR).

As a result of this integration of budgets from different schemes into the FUIR, an average yearly budget of 280 Million Euros for the period 2015-2020 is estimated to be the endowment for the valorisation of priority RIs.

3.9.2. Ministry of Industry and Economic Development – MISE

The Ministry for Economic Development (MISE) is in charge of supporting the national energy strategy with a research program (*Ricerca di Sistema*) and related funding focused on technology developments and industrial research. In this respect its contribution is complementary to the one provided by MIUR that is more specific for actions aimed at strengthening knowledge and research capabilities.

The Research Experts for the Electricity Sector Committee (*Comitato di Esperti di Ricerca per il Settore Elettrico - CERSE*) plays a strategic role in orienteering R&D activities for the electrical system and energy resources. CERSE is in charge of issuing and periodically updating the Triennial Research Plan for the Electrical System (*Piano Triennale della Ricerca di Sistema elettrico*) with costs covered from the so-called System Research Fund (*Fondo per la Ricerca di Sistema*) that is fed with incomes from electricity tariffs.

Although the present Research Plan does not allocate specific funding for research infrastructures, an indirect support is provided through the financing of industrial research projects. At present, this type of support is given to national projects on ORE applications.

3.10. Netherlands

In the Netherlands, public funding for R&D&I comes predominantly from the Ministry of Education, Culture and Science and the Ministry of Economic Affairs. Whereas the first one mainly focuses on fundamental research, the innovation policies of EA are more oriented towards the commercialization of new knowledge. As for the balance in funding: the total budget for fundamental research is significantly larger than the budget available for applied research and support for innovation activities by businesses [60].

Since the 1990s, the Ministry of Economic Affairs has initiated a number of grants via generic R&D instruments; these are also available for ocean energy research.

Many projects have been supported in National funding programmes; Archimedes Wave Swing (for wave (swell) energy), Tocardo Tidal turbines, REDstack (salinity with reverse electro dialyses), BlueWater (tidal), BlueRise (OTEC), Teamwork Technology (tidal, wave) and many R&D Institutions, like ECN, NIOZ, Wetsus, Imares, Deltares, Marin, TNO and the Universities.

At the moment, two projects have been granted within the DEI (Demonstration of Energy innovations) subsidy scheme; BlueTec and Tocardo-Huisman.

3.10.1. Ministry of Education, Culture and Science

The Dutch government provides more than €4.5 billion for scientific research every year. Most of the €4.5 billion provided consists of block grants and project grants for:

- research by universities and research centres;
- international organisations such as CERN and ESA;
- research in specific fields;
- programmes to encourage or reward individual scientists, such as the Spinoza Prize and the Innovational Research Incentives Scheme;
- large-scale research facilities and ICT infrastructure.

Some of the funding is allocated by the Netherlands Organisation for Scientific Research (NWO).

3.10.2. Netherlands Organisation for Scientific Research - NWO

The Netherlands Organisation for Scientific Research supports the system of sciences in the Netherlands. As a national research organisation with an active contribution to various parts of the national science and innovation policies, NWO plays different roles: financing, programming, bringing together, supporting and influencing.

NWO funds scientific research at Dutch universities and research institutes, through a range of funding instruments linked to its ambitions. There are several categories of funding instruments for researchers:

- large-scale, long-term research programmes focussed on a specific target or theme, or collaboration between researchers, partly set up in close consultation with other;
- for individual researchers focussed on encouraging talent;

- for the realisation and use of large-scale infrastructure;
- for curiosity-driven, non-programmed research;
- for research programmes focussed on international collaboration and exchange;
- for knowledge dissemination and open access publication of research results.

The funding instruments cover the entire spectrum of fundamental and applied research. Knowledge utilisation (societal and scientific applicability of the results) is increasingly a criterion in the assessment of funding instruments.

3.10.1. Netherlands Enterprise Agency - RVO.nl

Through its agency RVO.nl (the Netherlands Enterprise Agency), the Energy Innovation Demonstration (DEI) grants have been made available to entrepreneurs or groups of entrepreneurs who want to invest in a concrete demonstration of an energy innovation. This grant, available since 2014 with a total budget of around 16m EUR per year, is eligible for investments in the fields of Smart Grids & Infrastructure (including energy storage) and a number of other energy-related areas.

The DEI grants are allocated through yearly competitive funding rounds, which assess potential projects against technical and economic criteria. Interested companies are expected to share a substantial part of the risk themselves. The projects are explicitly aimed at the demonstration phase just before general market introduction, prior research and development costs can only make up 30% of the total budget. The grants are between 125k EUR and 4m EUR per project [61].

3.11. Norway

The Norwegian research and innovation system is relatively dispersed at the political level as well as on the performing level, while at the strategic/intermediary level R&D and innovation funding is concentrated in a few central funding organisations.

The Ministry of Education and Research (MER) provides by far the largest share of public R&D funding. This Ministry is also assigned a formal responsibility for coordinating R&D policies. Apart from the Ministry of Education and Research a number of sector ministries provide substantial funding to R&D, in particular the Ministry of Trade, Industry and Fisheries and the Ministry for Health and Care Services

A Regional Research Fund was established from 2010, which is organised according to 7 geographical regions, all of which with independent boards appointed by the council municipalities in the region. Funds are allocated from the Ministry of Education and Research and administered by the Norwegian Research Council. Total annual funding amounts to around €29 million as of 2015.

Furthermore, a set of three different cluster schemes have been introduced in order to foster the development of emerging (The ARENA scheme), mature (Centers of Expertise) and internationally oriented clusters (Global Centres of Expertise). These cluster policies are in most cases regionally oriented and include cooperation between local industry, higher education institutions, research institutes, public sector and other relevant stakeholders.

The major player here is the Research Council of Norway (RCN). Unlike most other research funding agencies, RCN covers all research disciplines and sectors including support to research based innovation. In 2014, more than 25% of all public R&D funding was channelled through RCN via a number of instruments, ranging from support to centres of excellence, infrastructure and large thematic programmes to business oriented and user driven projects. In addition to research funding, the RCN has the mandate to advise the government on research policy and to facilitate networking and communication between different actors in the Norwegian R&D and innovation system.

The Ministry of Research and Education and the Ministry of Trade, Industry and Fisheries are the most important contributors to RCN's budget, but following the sector principle, RCN administers funding from 15 ministries.

Innovation Norway and the Industrial Development Corporation of Norway (SIVA) are the primary public institutions providing support for innovation. Innovation Norway provides programmes and services with the objective of promoting innovation at the regional and national level, with a particular focus on small and medium sized companies. SIVA is involved in the provision of science parks, incubators and services mainly to start-up firms. Both the RCN and Innovation Norway are assigned with tasks that in many other countries would be spread between a number of different institutions [62].

The path for funding for ESFRI participation in Norway is pretty clear and is possible mainly through one channel, the RCN, however requiring that MARINERG-i is registered as a full member of the ESFRI infrastructure roadmap. Following this it's possible to apply for status and potential funding for a limited period (up to 5 years). After that it has to be self sustained and documented to be realistic in this sense.

In most cases funding will from day one have to be generated through project work and associated rental costs of the national labs involved. This can of course include open access.

The following funding organizations may be relevant in the scope of MARINERG-i.

3.11.1. Enova

The Norwegian Energy Agency, Enova, offers capital grants for full scale demonstration projects of ocean renewable production. While up to 50% of eligible costs can be covered, Enova's funding measured in absolute figures is limited. In addition, Enova has a programme that supports demonstration of new energy technology, on the basis that the technology is applied in Norway.

3.11.2. Innovation Norway

Innovation Norway runs a programme supporting prototypes within "environmental friendly technology". Ocean energy is included in this definition and projects are supported with up to 45% of eligible costs.

3.11.3. Research Council of Norway

ENERGIX

The Research Council of Norway runs an energy research programme called ENERGIX. This programme supports R&D within all renewable energy technologies.

The programme is designed to generate new knowledge and solutions that promote the long-term development of the energy system. This will require steadily increasing consumption of renewable energy, more energy-efficient solutions, closer energy integration with Europe, and improved flexibility. Important secondary objectives for the programme are:

- To achieve sustainable utilisation and consumption of renewable energy resources;
- To reduce Norwegian and global emissions of greenhouse gases;
- To ensure Norway's security of supply;
- To strengthen innovation in Norwegian trade and industry and the public sector;
- To further develop Norwegian research and educational institutions.

The ENERGIX programme encompasses the stationary energy system and environment-friendly energy for transport [63].

Knowledge-building Project for Industry

Most innovation projects need assistance from a research group. Applicants are encouraged to contact a relevant research group and to work together with them on preparing the grant application.

The relevant research group can also apply for Research Council funding for a *Knowledge-building Project for Industry* in cooperation with the company. This gives the research

group greater expertise in the company's area of activity, while the company receives valuable input towards future production processes, products or services [64].

3.12. Sweden

The bulk of the Swedish public research budget is allocated to the universities and university colleges. They are the main public research performing actors in the R&I system. There has been consistent policy focus since the 1990s on measures that would promote university collaboration with other sectors, primarily business and public sector actors. In addition, a handful of initiatives were launched to promote university collaboration with civil society [65].

The main public funding mechanism for research, business and technology development and technology demonstration are Swedish governmental agencies tasked to support academic and private sector R&D in the various stages of innovation. There are a number of governmental agencies from which researchers and developers can apply for funding.

3.12.1. Swedish Energy Agency

The Swedish Energy Agency is the Swedish agency responsible for facilitating a sustainable energy system in Sweden. As such, the agency funds research, business and technology development and technology demonstration which is relevant for the sustainability of the energy system and the sustainability of the energy industry sectors [66].

In the beginning of 2015, the Swedish Energy Agency started a national ocean energy programme that will run for four years with a total budget of around €5,7 million (53 MSEK). The aim is to strengthen the research and development being done in the area and increase the cooperation between and within academia and industry. A total of 16 projects have been approved for funding within the programme. The programme will now be evaluated before any new calls. In parallel, there is ongoing work with a strategy for research and support to marine energy that will be used by the Swedish Energy Agency.

The Swedish Energy Agency is also involved in OCEANERA-Net, which is a collaboration between national/regional funding organisations and EU to support the ocean energy sector and fund transnational projects.

3.12.2. Swedish Research Council

The Swedish Research Council, which, among other things, is tasked to fund fundamental research and expensive equipment for research purposes within a large number of topic areas.

Research environment & Research collaboration funding

The aim of research environment and research collaboration funding is to support a research objective or research field in the long term. This involves support to operations within excellent research environments, networks and research schools or support towards building up such operations.

Research infrastructure funding

The aim of infrastructure funding is to support the coordination, development, construction and operation of research infrastructure of national interest, including Swedish participation in international research infrastructure of national interest.

Operational grant funding

Operational grant funding is a complement to infrastructure funding and its aim is to contribute to the other supportive structures and mechanisms necessary for research at national or international level.

3.12.3. Swedish Governmental Agency for Innovation Systems

The Swedish Governmental Agency for Innovation Systems (VINNOVA), supports business and technology development. In addition, regional authorities are able to grant funding to varying extents.

3.12.4. Funds

The government announced in January 2016 the creation of two new funds for demonstration facilities and companies in early stages. A couple of additional initiatives have also been discussed such as the establishment of Saminvest AB.

The amount of funding remains unclear, although a first proposal mentions circa €160m for demonstration facilities and about €40m for the seed fund. In addition, the European Investment Fund (EIF), Almi Företagspartner (Almi) and Svensk Exportkredit (SEK) have signed guarantee agreements to increase lending to innovative Swedish SMEs. The agreements will allow Almi and Svensk Exportkredit to issue around €210m- worth loans to innovative companies in Sweden over the following 2 years [65].

4. Conclusions

Research activities and infrastructures can be supported through a range of funding mechanisms available at European and national level.

At European level, there are numerous funding streams available, through specific frameworks and programmes. These are established to be aligned with the European Commission's vision and to cover research and innovation gaps.

However, wave, tidal and offshore wind funding is rarely technology exclusive, therefore they need to compete with more established energy sectors which is particularly challenging with a proposal success rate often below 10% for ocean energy.

Forms of financing other than grants are also offered at European level, through the European Investment Bank and European Investment Fund. These forms include debt financing, equity products and project bonds.

At national level, typically there are funds set on the national budget destined towards innovation, research and higher education. These funds can cover specific research programmes, such as PhD and project research, operation and implementation of R&D institutions and research infrastructures, and internationalization and research cooperation.

While the budget for research and innovation is set by the government, the management of these funds is typically distributed among innovation agencies. Innovation agencies may also be responsible for the management of European Structural and Investment funds. Other funds may be available through private foundations that invest on innovation and science research.

Each member state is very different regarding the process and the funding opportunities. Furthermore, there are also political and geopolitical aspects to consider, meaning that a wide understanding is needed in the scope of MARINERG-I, as the distributed infrastructure will need to co-exist within the different national nodes and within a European scope.

Knowing the funding streams available at each country node and at European level allows to understand the financing options available for the MARINERG-i network and to the potential MARINERG-i end-users, and to better plan the financial framework under which the distributed infrastructure will operate, in order to ensure its long-term sustainability.

Furthermore, by using the knowledge and expertise gathered within the MARINERG-i network, additional infrastructure services could also include guidance for funding agencies in order to establish more objective and directed screening processes. Advice and guidance could also be provided to end-users on where to access the funding schemes available at each development stage, and how best to utilise it to move their technology towards commercialization.

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