Energimyndigheten

Ref. no.

2014-004584

Programme description for the research and innovation programme

Marine energy conversion

01/01/2015–31/12/2018

Decision date

27/11/2014

Summary

The ocean is a virtually untapped renewable energy source, with the potential to contribute to the climate and environmental policy goals of both Sweden and Europe, and to a cost-effective Swedish energy supply. Technologies to generate energy from the oceans have now matured to a phase in which several concepts are being tested on a full scale. Sweden has a strong position when it comes to research and development within this field, and the programme is intended to further strengthen these aspects. Important objectives for the programme are to stimulate increased collaboration within and between the private and academic sectors, as well as contribute to the development of sustainable electricity production systems. These objectives have been set to provide conditions for an increased emphasis on marine energy within the energy system and for the development of future Swedish export products.

Requirement areas within the programme include increased knowledge on environmental impact, improved reliability and durability, development of systems and components for cost-effective energy transformation of ocean energy, technical solutions for cost-effective electrical systems as well as improved installation, operation and maintenance strategies.

The programme gathers all Swedish Energy Agency investments in wave and tidal energy, which allows for better opportunities for coordination and dissemination of information. In total, SEK 53 million will be allocated to the programme for the period 01/01/2015–31/12/2018.

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1 Programme direction

1.1 Introduction

The ocean is a virtually untapped source of renewable energy. On a Nordic, European and global level, ocean energy could play an important part in the transition to more sustainable energy provision. The Nordic electricity system is fully integrated at present, which means there are excellent conditions to provide ocean-based electricity to both private consumers and companies in Sweden in the future. Furthermore, the transfer capacity to the rest of Europe is constantly growing, which makes it possible to transfer electricity from renewable resources, such as ocean energy, to the place where it is currently being best put to use.

The vision of the Swedish Energy Agency is for Swedish research into ocean energy to contribute to the development of the domestic industry. Swedish exports result in economic growth in Sweden, and also contribute to the energy transition in other countries via ecologically, economically and socially sustainable solutions.

1.2 Aim

The Swedish Energy Agency's aim for the programme is to achieve a continued development of

- knowledge, skills and technology within the field of marine energy conversion, which can meet the needs of the industry and those of society at large, and
- create the right conditions for the implementation of marine energy conversion and contribute to increasing the importance of marine energy within the energy system, both in Sweden and abroad. An important part of achieving this aim is to increase the visibility of research and development efforts, and to increase information exchange both between academic research and the private sector and within these respective areas.

1.3 Scope

The Marine Energy Programme will run from 01/01/2015–31/12/2018, and is funded and administered by the Swedish Energy Agency. The programme funding is to be used for various projects. The budget is SEK 53 million over 4 years, in accordance with the table below, where the amounts are given in SEK millions.

Year	2015	2016	2017	2018	Total
Project funding (SEK million)	8	15	15	15	53

The programme funds are distributed through a number of advertisements, which may either entail the whole programme, or just specific parts of it. The Swedish Energy Agency is assisted by a programme board when developing such advertisements.

Results from projects within the programme will be shared and communicated through joint programme conferences, which will be organised in collaboration with the participating project implementers and with the support of the programme board.

An evaluation of the programme is planned for the last year of the programme period.

1.4 Goals

During the period 2015–2018, the programme's goal in the field of marine energy conversion is to:

- **help to improve Sweden's already solid position within research and development;**

  Sweden is home to internationally competitive – and in certain cases world-leading – R&D activities within several links of the value chain. The programme is intended to promote the research environments' contribution to the Swedish ocean energy sector in terms of skills provision, and provide a base for future innovation.

  Indicators:
    - At least 20% of the projects lead to a doctoral/licentiate degree.
    - At least 50% of the projects lead to other academic merits, such as publication in international journals, and presentations at international conferences.
    - New knowledge is developed within all the requirement areas in the programme.

- **contribute to the development of sustainable electricity production systems, with the potential for implementation in Sweden and abroad;**

  Research and development is to yield results that reduce the cost of the energy-generating system (the levelised cost of energy), such as improved efficiency, robustness or life span. The programme is intended to facilitate the emergence of a new Swedish industry. The programme is also intended to develop knowledge that facilitates the planning and installation of new electrical plants.

  Indicators:
    - At least 20% of the projects lead to new patents or patent applications, or alternatively to other types of agreements that protect the innovations.
    - At least 20% of the projects lead to the development of a prototype that contributes to a reduced levelised cost of energy.
    - At least 20% of the projects develop knowledge on, e.g., processes, environmental impact and power connections that can lead to facilitating the permit processes involved in marine energy conversion.

- **contribute to increased collaboration between (and within) the private and academic sectors, both nationally and internationally.**

An increased collaboration between the private sector and the research and development conducted could contribute to building expertise and more co-funding being attracted to this area. International collaboration can raise the Swedish knowledge level even further, and increase future export opportunities.

Indicators:

- At least 50% of the projects lead to increased collaboration between industry and academia and within these respective areas.
- At least 25 % of the projects lead to international collaboration.
- At least two of the actors that receive support within the programme participate in a Horizon 2020 project.
- All projects present results at an annual programme conference.

1.5 Areas of research, development and technology

This programme encompasses energy conversion systems that use energy from the ocean as a resource, i.e. wave power, tidal power, as well as salinity and thermal gradient power. However, it has a great emphasis on the first two technologies mentioned, primarily due to the fact that these are priorities in the energy research strategy of the Swedish Energy Agency. The programme is intended to support research, experimental development and demonstration of technical solutions within five identified requirement areas, as specified below.

More knowledge on environmental impact during installation, operation and decommissioning

Knowledge about what effects various forms of established parks for marine energy conversion will have on their environment is currently limited. The oceans are already overstrained from all the activities associated with the sea, which places high requirements on responsible establishment of businesses and industries in them. It is important for the private sector and public authorities to take responsibility for ensuring sustainable installations. For example, the industry needs to build up more knowledge of sound emanating from marine energy systems and its effect on the marine environment. The systems also need to withstand the growth of algae, etc., and closer studies of how this may come to affect the marine environments are needed. More studies are also needed on electromagnetism, material properties, risk of leakage as well as possible environmental effects of these aspects. Environmental impact also includes the interaction between marine energy conversion technologies and fauna, such as fishes, seals, etc. Other aspects that need to be taken into consideration are upscaling and accumulative effects from marine energy systems, as well as methods to monitor, assess and evaluate environmental effects, for example through a Life Cycle Assessment. The studies that have been conducted within the programme can be used to continue building on the knowledge of the permit process, and provide documentation to support this process.

Improved reliability and durability

In order to ensure the future competitiveness of the marine energy industry within the global energy system, it is critical to prove a high degree of durability and reliability in the technologies, and to achieve a great cost reduction in the levelised cost of energy. Aspects that affect the reliability and durability of marine energy conversion systems are lifespan, robustness, maintenance requirements, storm strategies, anchorage, and foundations and fixtures. These challenges lead to an increased knowledge requirement when it comes to reliability modelling as well as the construction and testing of systems, subsystems and components.

Development of systems, subsystems and components for cost-effective conversion of marine energy

The marine energy industry is currently characterised by a number of various concepts in different stages of maturity. It is likely that the market will be consolidated later on. It is therefore important, already at this early stage, to study the energy conversion capability of various wave and tidal power technologies through modelling (for example, using generic models), design and testing. Systems, including subsystems and components, need to be developed. This may include systems for power transmission, or control and monitoring. Furthermore, there is a need to develop models to make predictions regarding the marine energy resource and electricity production. Increased knowledge is also needed when it comes to upscaling conceptual individual units to parks. The implementation of the aforementioned development requirements need to be closely linked to economic models and calculations.

Technical solutions for cost-effective electrical systems

The electric power system currently requires the connected electric power generation to be of the appropriate quality, and contributes to the stability of the system. Technical solutions for marine energy conversion systems must therefore be developed so as to contribute to a maintained or improved quality and stability at various levels within the electric power system. These solutions may concern transmission (e.g., underwater cables), power electronics or control systems.

Improved installation, operation and maintenance strategies

The cost of installation, operation and maintenance is high at present, which restricts the continued development. In order to reduce these costs, solutions pertaining to installation methods as well as operation and maintenance strategies need to be developed and improved. In connection to these activities, health and safety are important priorities, which means that risk analysis is another requirement area.

1.6 Energy relevance

Marine energy is a renewable energy resource that may contribute to the achievement of Sweden’s and Europe’s climate and environmental policy goals, as well as the Swedish Energy Agency's goals for an efficient and sustainable use of energy and a cost-effective Swedish energy supply. The increased integration of the energy system, on both Nordic and European level, means there are good conditions for electricity from renewable energy sources to be put to optimal use within the system. The energy and climate action of the EU may lead to a large expansion of wind and solar power plants in the Nordic countries and Europe over the next 10–15 years. This means changing the properties of the Nordic and European electricity system and balance maintenance. Marine energy, such as wave and tidal energy, provides a relatively stable and predictable electricity production, and could thereby have an important role in a future mix of electricity production forms, with a high proportion of renewable energy. Furthermore, electricity use is increasing around the world, and renewable energy resources constitute one of the most important resources contributing to meeting this need.

The global potential for marine energy is great, with significant geographic variation. Good conditions to utilise wave power can for example be found around the coasts of Australia, Southern Africa, Western USA and Canada, and along the Atlantic coast of Europe, which includes countries such as Scotland, England, Ireland, Norway and Portugal. In respect of tidal water power, there are favourable conditions in Canada, South America and European countries such as France, Scotland and England. Conditions to utilise ocean currents exist along the East coast of the USA and, for example, off the Philippines.

Sweden’s wave climate is less energy-rich than several other European countries. A few studies indicate varying potential (approx. 10–30 TWh). The tidal resource in Sweden is negligible, but there are ocean currents, for example around the Öresund Region. There is also potential to use river currents for electricity production.

1.7 Social and industrial relevance

There is already solid expertise when it comes to marine energy among the Swedish universities and development companies. This is something that needs to be maintained and strengthened through the programme, for example by supporting projects within identified requirement areas. The close collaboration between the academic and private sector that is promoted in the programme will ensure a solid academic foundation and applicability in society.

At present, there are many technologies that have not yet reached the commercial phase. There are thus several requirements that must be met; everything from technical challenges to policy and environment-based requirements to contribute to economically, ecologically and socially sustainable technologies. In addition, there is a wide selection of concepts in Sweden as well as globally, which means that subsystems differ from one manufacturer to the next. In the future, it is likely that only a few of these concepts will remain, meaning that collaboration may be preferable in order to more quickly reach optimal solutions. As the development progresses, an increased demand for components, subsystems, services and knowledge is created. This leads to new job opportunities along the entire value chain, in the manufacturing industry, consultant companies and shipping trade. There is also potential for a positive development of coastal communities. The great potential in wave and tidal power is found outside the Swedish borders, which entails great export opportunities in terms of goods and services. One of the difficulties for development companies is to find co-funding for their projects. Having a clear direction within the programme may encourage other funders to invest.

1.8 Environmental aspects

Marine energy is a renewable source of energy, and as such it does not contribute to any greenhouse gas emissions during operation. This makes the technology highly interesting for a future energy system. At the same time, other possible forms of environmental impact from various marine energy technologies remain largely unexamined, which may be cause for some concern in the general public and among decision-makers and various professional groups at sea. The low level of knowledge is largely to the early phase of development, with few actual full-scale installations in the ocean. There is a need to increase the understanding of the environmental impact of different technologies, not only when operational but throughout the value chain. In connection with installations, permits must be acquired. Part of the permit process is to conduct an environmental impact assessment, which must be approved by a Swedish Land and Environment Court. The environmental impact assessment gives an overall view of the environmental impact that the planned activity may have. This is information that can be used in the upcoming programme, as the knowledge is added and deepened within the identified areas of environmental impact. The programme can thus provide support in the permit process through added knowledge within the area, while the investigations conducted in connection with the environmental impact assessments can be put to use.

1.9 Project implementers

The project implementers of the Swedish Energy Agency's marine energy programme can be university departments, institutes and companies. Examples of implementing research staff include engineers, doctoral students at universities, industry-employed doctoral students, senior researchers and development staff.

Research projects with clear ties to the private sector facilitate dissemination and further development of the research results. Such ties can be made for basic research in the form of reference groups with representatives from the concerned industry or results recipients, or through direct collaboration and innovation development aimed at the future commercialisation of the research results. International participation within programme projects is encouraged. However, the regulations for government funding requires the programme funds to support project costs incurred within Swedish organisations.

1.10 Results and the dissemination of these

The project implementers are to develop proposals and jointly establish a communication plan, which is also to specify how results should be disseminated. This plan will be evaluated based on the size of the project.

Dissemination of results and information on the programme activities will take place at a programme conference. The programme conference is planned to be open to a somewhat wider circle than those active within the programme, and is intended to be used for knowledge dissemination, discussion and networking. The project is to be presented in the contexts requested by the Swedish Energy Agency. Furthermore, it must be clear at any verbal or written presentation that the project is financed by the Swedish Energy Agency.

The aim of the project reporting and dissemination of results is to ensure that the project results reach various social actors and the private sector, where they can be utilised to achieve continued development of knowledge, expertise and technology. It is also important that the results are shared between different academic groups.

1.11 Recipients

Researchers at universities and research institutes will be able to use the results from the programme projects as a basis for continued development within the field and to further academic excellence. Contacts in the private sector will increase opportunities for research results to be implemented in innovations.

For the private sector, the programme will entail greater opportunities to turn technical innovations into commercial products, both through individual research and through the development of new products and increased exchange with academic research. The private sector will also receive expertise in the form of the individuals educated within this field.

The Swedish government, authorities, municipalities and consultants will be the recipients and users of knowledge and expertise, in order to promote a sustainable society in the future.

2 Background

2.1 General

Marine energy is a development area for renewable energy conversion, in which energy is derived from the oceans. The energy from the sun is stored in the oceans, partly as heat and partly in the waves and currents, which makes them a large renewable source of energy that historically has been impossible to utilise. The high density of the water yields a high energy density, which is beneficial when the kinetic energy of the ocean is to be converted into electric energy.

‘Marine energy’ in this programme refers mainly to wave and tidal power, but also to salinity and thermal gradient power.

The term wave power is an umbrella used to describe various technologies to derive sustainable energy from waves. Waves can travel long distances without losing significant amounts of energy. This means that there can be waves even when there is no wind, which allows for a high degree of utilisation of the wave energy. Different ways of deriving energy from ways have been studied for a long time, and today, the technology has developed into a phase where concepts are being tested full-scale. A number of different concepts have now reached a demonstration phase, for example point absorbers, attenuators, overtopping systems and oscillating water columns. A point absorbing system consists of a point absorber, for example a buoy, which is smaller than the wavelength of the current wave climate. The absorber will move vertically and/or horizontally against the wave, thus absorbing the wave’s energy, which propels a generator with the help of a mechanical or hydraulic system. One benefit of the point absorbing system is that they work regardless of the wave direction. Attenuators are long, floating and often segmented systems lying on the surface of the water, parallel to the direction of the waves, following their movements. The difference in height between waves causes movements in the attenuator, which can propel a hydraulic pump or other form of converter. Overtopping systems collect water by letting the waves crash over a fixed structure. Much like a traditional hydro-electric power station, it then uses the height difference as the collected water is drained out through a turbine. An oscillating water column consists of a chamber with an internal water column that is raised and sinks every time a waive rises and sinks. Air is compressed within the chamber and propels a turbine at the exhaust point.

There is great theoretical potential when it comes to wave power, and the continued development of existing technologies may come to yield 2,000 TWh per year (World Energy Council, Survey of Energy Resources 2007), which amounts to 10% of the world’s current energy needs. If technologies for less energy-dense wave conditions can be developed, the theoretical potential is even higher. In Sweden, where the height of waves is limited, the estimated potential is 10 TWh per year[1], but if technologies for smaller waves are developed, this potential may amount to 24 TWh

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[1] Alain Clement , Pat McCullen , Antonio Falcao, Wave energy in Europe: current status and perspectives, Renewable and Sustainable Energy Reviews 6 (2002) 405–431, 2002

per year[2]. In Sweden there is currently a wave power plant installed in Lysekil, which is a project led and developed by Uppsala University. More wave power plants are presently under development: in Sotenäs, a wave farm is being developed by Seabased, which is planned to be one of the largest in the world. The facilities in both Lysekil and Sotenäs are point absorbing systems.

'Marine tidal power' is a broad term that refers to renewable electric energy conversion of streaming water. From a global perspective, this field has attracted more and more interest over the last 10 years, particularly in countries with tidal currents, and more recently, the potential applications for rivers and streams have also been considered to an increasing degree. At present, there are several different projects underway, intended to find financially viable concepts for marine tidal power, and a number of full-scale facilities have been tested in an ocean environment. In technical terms, the concepts for marine hydrokinetic power stations are often similar to wind turbines, with the difference that the blades are smaller and move more slowly, due to the high density of the water. The most common form is vertical or horizontal turbines, and an overview of the field conducted by IRENA (International Renewable Energy Agency) in 2014 shows that 88% of the ongoing projects are of these types.

By a rough estimate, it is technically possible to install marine power plants reaching a total effect of 1 TW in the world, based on areas off the coasts[3]. The Swedish potential, which is still difficult to assess, has been estimated by the CFE group (Centre for Renewable Electric Energy Conversion) at between 2 and 5 TWh/year. The majority of this potential relates to streaming water in rivers and streams, the tidal resource is a negligible one in Sweden. There is currently a marine hydrokinetic power station producing 7.5 kW installed on Swedish land in Söderfors, Dalälven. This plant is of the vertical-axle turbine type.

In addition to wave power and tidal power, there are concepts to derive marine energy from salinity and thermal gradients. Concepts to derive energy from differences in salinity are often placed at the mouth of a river/stream, where sea water is mixed with freshwater. The energy is then harvested as the osmotic pressure is evened out through an ion-selective membrane. The temperature differences of the ocean can be converted into electric energy by placing a thermal engine between the warm surface water and the colder water below.

Several countries with long coastlines see great potential in marine energy, for example the UK, the USA, Canada and South Korea. The UK is one of the countries investing most in marine energy, and began taking serious initiatives in 2003, when the EMEC (European Marine Energy Centre) was opened, which has greatly contributed to the development within the field. Despite Sweden having a relatively small potential in this context, there is research of a high quality by international

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[2] Bernhoff, H., Sjöstedt, E. & M. Leijon, Wave energy resources in sheltered sea area: A case study of the Baltic Sea, Fifth European Wave Energy Conference, 2003

[3] Irena Ocean Energy Brief 3, 2014: http://www.irena.org/DocumentDownloads/Publications/Tidal_Energy_V4_WEB.pdf

comparison, as well as a number of smaller companies developing promising technology for marine energy conversion. This gives Sweden excellent conditions to develop a future export industry based on marine energy.

2.2 Driving forces

Directives and regulations

The current energy and climate action of the EU has set the goal of reducing energy consumption within the EU by 20%, and for the greenhouse gas emissions to be reduced by 20% by the year 2020, compared to the 1990 levels. Carbon neutral electricity production will be rewarded. The EU directive on the promotion of the use of energy from renewable sources (2009/28/EC) has set the goal of 20% of the EU energy supply being provided by renewable energy sources by 2020. In January 2014, the European Commission presented a proposal for a new climate and energy policy framework for up until 2030. The proposal is for the EU to reduce its greenhouse gas emissions by 40%, and that the proportion of renewable energy is to amount to at least 27% by 2030. The Electricity Certificate System has been put in place in order to promote electricity from renewable energy sources in Sweden. Marine energy is a renewable energy source with low levels of emissions and a small environmental impact, which could contribute to reaching the European climate objectives and to reducing the production based on sources with high CO_2-emissions.

Potential and development status

Globally speaking, there is great potential for marine energy conversion, see section 2.1. The technological development for converting marine energy is at a stage where many technological concepts are being developed simultaneously, and where research and development, as well as testing of the various concepts, are in different phases.

Profitability of marine energy

As the technology is still in a developmental stage in the case of many concepts, it is in some respects difficult to gain a perspective on the costs and profitability of different marine energy concepts. Even if the total investments in marine energy have increased over the last 10 years, the willingness to invest has varied in later years. In Sweden, the Electricity Certificate System is the only support system providing guidance for these investments in marine energy.

Future role in the power supply system

Several analyses indicate that the EU energy and climate action (and especially the current Renewable Energy Directive) could entail a large expansion of wind energy in the Nordic Countries over the next 10–15 years. Electricity production from solar cells is also growing in Europe, and there is an increased public interest in individual production of electricity. A large-scale expansion of wind and solar power will mean a change in the properties of the Nordic and European electric system and balance maintenance. Marine energy systems are expected to provide a relatively stable and predictable electricity production, and may come to play an important role in an energy system with a high proportion of renewable sources. In addition, the electricity consumption in the world is increasing, and renewable energy sources provide an opportunity to meet these new needs in a sustainable way.

By developing increasingly intelligent electrical grids, it will be possible to integrate more of this new, renewable electricity production. At present, this mainly relates to electricity from solar power and wind, but marine energy could also be included.

More knowledge and experience regarding the effects of an increased share of marine energy in the energy system is needed.

Benefit from international efforts and experiences

Sweden has participated in the IEA Ocean Energy Systems (IEA OES) since 2008, along with 21 other member states and regions, to accelerate the establishment of marine energy technologies with great consideration of environmental aspects. Participation and focus in the IEA OES has varied, based on the questions dealt with in this international collaboration and how they have varied in relation to the issues prioritised from a Swedish perspective. The Swedish Energy Agency is also part of the Ocean Energy European Research Area Network (OCEAN ERA-NET), a European collaboration programme under the 7th Framework Programme of the EU, in which 15 member states and regions have come together to finance projects that support the national programmes for research, development and innovation.

3 Implementation

3.1 Programme board and application criteria

The programme is to be associated with a programme board, whose task it is to provide advice and recommendations in the assessment of project applications, and assist the authority in the planning and implementation of advertisements, programme conferences and programme evaluations.

The board is to consist of representatives from the industry, public authorities, the academic sector and other intended recipients of the project results. The Swedish Energy Agency strives towards gender equality and ethnic diversity. This will especially be taken into account when appointing the programme board.

The programme board assesses applications and gives its recommendation to the Swedish Energy Agency, which makes the formal decision of approval or rejection using this recommendation as a basis. Where required, the Swedish Energy Agency may also ask for opinions from international experts in the assessment of a project application. All decision within the programme are made on the basis of the Ordinance (SFS 2008:761) on state aid to research and development in the energy sector and/or the Energy Agency’s current appropriation directions from the government.

The assessment of applications is based on the project application’s compliance with the programme vision, aim and goals, which are stated in the programme description, and the assessment criteria specified in each advertisement.

4 Delimitations

4.1 Delimitations in regard to research, development and technology areas

This programme is limited to energy conversion systems that use energy from the ocean as a resource, i.e. wave power, tidal power, as well as salinity and thermal gradient power, focusing particularly on the first two technologies mentioned. When it comes to tidal power, this programme is limited to technologies for marine tidal power. However, technologies for flowing water in water courses may be included if they are also applicable in marine environments.

Applicants working with marine-based wind power and bioenergy are asked to submit a separate application, outside of the programme. In terms of wind power, marine-based forms may have certain areas in common with wave and/or tidal power, for example in respect of anchorage, power connection, environmental impact and improved infrastructure for installation, decommissioning and service, and may then be included in the programme.

Demonstration projects close to the commercialisation phase may not be included in the programme, but are instead referred to Conditional Loans, which can be applied for from the Swedish Energy Agency's Department of Business Development and Commercialisation.

4.2 Associated measures within the Swedish Energy Agency

Research, development and demonstration

The Swedish Energy Agency supports research into wave power and marine tidal power at the Centre for Renewable Electric Energy Conversion at Uppsala University. In association with this research, the Swedish Energy Agency also supports the testing of wave power plants at the research facility in Lysekil, and the demo version of a hydrokinetic power station in Söderfors. Furthermore, the Agency supports research into anchorage systems conducted at Chalmers University of Technology. The Agency also supports the development and demonstration of a number of different concepts within the marine energy industry.

Agenda for the strategic innovation area Marine Electricity Production (SIO agenda)

Together with VINNOVA, the Swedish Energy Agency is supporting a project intended, in the long term, to create conditions for a new, extensive Swedish export industry. A strategy for the establishment of two test beds will be developed to lower the development costs within the areas of wave power and floating wind power.

International

The Swedish Energy Agency participates in the IEA Ocean Energy Systems (OES), which is part of the International Energy Agency. Sweden is one of 21 countries participating in the collaboration regarding research and development matters relating to marine energy. The Swedish Energy Agency also participates in OCEANERA-NET, which is a research programme within the EU Framework Programme. Along with other European countries and regions, Sweden is financing translational projects to strengthen developments in the field of marine energy. Furthermore, the Swedish Energy Agency takes part in the Ocean Energy Forum, which was started on the initiative of the European Commission, and in which different actors are to collaborate in order to develop a new strategic plan to bring the marine energy sector closer to industrialisation.

4.3 Other associated activities and actors

Relevant public sector actors are public authorities and ministries, regions and municipalities. These are either involved in research and development or in permit assessments for testing and demonstration facilities in a marine environment. In addition to the Swedish Energy Agency, VINNOVA is another important funder supporting technology development. Other contributions come from the Swedish Agency for Economic and Regional Growth and the Swedish Research Council in the form of financing aid. The Swedish Agency for Marine and Water Management is currently (2014) preparing a national Marine Plan, which will affect permit assessment.

5 Further information

Information about the programme can be found at the Swedish Energy Agency website http://www.energimyndigheten.se/Forskning

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