Chapter 19
Project Funding for Innovative Research and Development Projects: A Practical Example in the Field of Renewable Energy

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Abstract In order to guarantee sustainable economic growth and future-oriented jobs, governments are in charge of providing the right framework conditions. An important lever is to support inventions as well as innovations all along the value chain. That applies to all fields of technology, and to the field of renewable energy in particular. Besides various national and regional specific funding programmes the Federal State of Lower Saxony (Niedersachsen), Germany, established a subsidisation guideline mainly targeted at small and medium-sized companies (SME) to enable the implementation of research and development projects. Provided that the content-related and formal criteria of a project proposal meet the requirements of the guidelines, the applicant may receive up to 50 % sponsorship of the total project costs. This paper focusses on the process of project funding with respect to a practical example in the field of renewable energy, beginning with the relevant network activities and ending with the evaluation scheme applied to decide whether the proposal qualifies or not. The practical example chosen deals with the application of a PEM fuel-cell system to be installed in a wind energy plant in order to maintain emergency functions during power failure or while the assembly phase is still ongoing.

Keywords Innovation framework · Evaluation scheme · Technology transfer · Renewable energy

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Short Introduction

The Federal State of Lower Saxony (Germany) established a subsidisation guideline mainly targeted at small and medium-sized companies, to enable the implementation of research and development projects. This paper focusses on the process of project funding with respect to a practical example in the field of renewable energy, beginning with the relevant network activities and ending with the evaluation scheme applied to decide whether the proposal qualifies or not. The specific example of this paper focusses on the application of a PEM fuel-cell system to be installed in a wind energy plant in order to maintain emergency functions during power failure.

Introduction

Drivers of innovation processes can mainly be divided into four groups: science, economy, consumer and policy. The interaction of these groups can be illustrated by considering the innovation supply potential over the innovation demand potential (Fig. 19.1). Evidently, the supply potential of science and economy is high as well as economy and consumers providing a high demand potential. This way two driving trends can be observed: one is the technology trend with its origin in science and moving towards economy (e.g. micro and nanotechnology, bio and gene technology, automation), and the second one is the consumer trend (e.g. mobility, health, communication). Consequently, new, innovative products are being introduced to the market for the benefit of the consumer.

Unfortunately, the introduction of clean energy technologies to the market is the best example that the economic system does not always work this way. Even if there is a certain interest in a product on the demand side, there might still be too many obstacles that prevent development on the supply side. The exceptions to the rule can often be subsumed by market failures. If desirable products within the

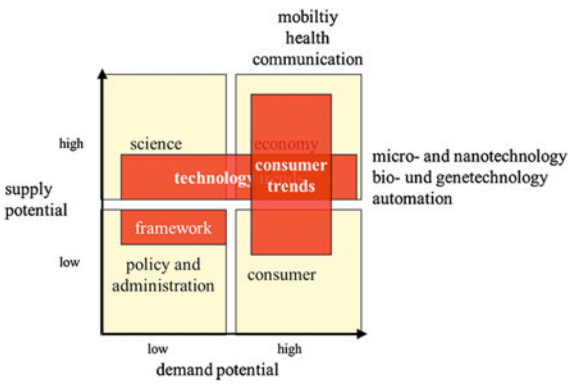

Fig. 19.1 Drivers of innovation

range of clean technology on the one hand, show outstanding figures on the carbon footprint but on the other hand, cannot guarantee functionality to a reasonable price that is already state of the art in comparable products, they will not find many customers. High technological and economic risks very often keep the industry from making further progress despite promising market situations, so that only innovations would change this attitude. In order to enable the development of these products, the fourth driver of innovation—policy—should therefore set up appropriate framework conditions.

Framework for Innovation and Technology Transfer

There is no patent solution regarding a framework for innovation. The policy of any country or region is responsible for setting up a system that fits to its individual requirements.

Niedersachsen as a Site for Technology

This paper reflects on the individual requirements of Niedersachsen (Lower Saxony), a federal state of Germany. Its technology site status remains a key priority for adjusting a framework for innovation and technology transfer, by taking into account that strengthening the virtues of a site eventually leads to its future prospects. Regarding companies and research institutes that belong to leading entities with respect to a certain field of technology, an overview of Niedersachsen as a site for technology is derived (Fig. 19.2). Three classifications can be made to distinguish the level of a branch of technology from its national and international competitors. Focussing on wind energy and vehicle manufacturing, the economy in Niedersachsen belongs to the top few worldwide. Therefore, a practical example of supporting the innovation process within the framework was chosen from the interaction between renewable energy (wind energy) and drive technology (fuel cell).

Niedersachsen has installed 6.8 GW of wind energy (June 2011) which is approximately one quarter of current installed capacity in Germany. Germany's energy strategy aims to source at least 80 % of gross electricity consumption from renewable energy sources by 2050, while simultaneously taking offline nuclear power plants by 2022 (Bundesministerium für Wirtschaft und Technologie, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 2010). Despite the high number of wind turbines in Niedersachsen, the expansion and implementation of wind energy is still ongoing. The importance of the energy issue has lead to the decision to create a specific energy strategy for Niedersachsen (Niedersächsisches Ministerium für Umwelt und Klimaschutz 2011).

Fig. 19.2 Technology site of Niedersachsen

Aligning to milestones, Niedersachsen plans to source 80 % of gross power consumption from renewable energy—including offshore wind energy—roughly 140 % of consumption is theoretically possible. Wind energy is, therefore, a key factor in meeting the targets. Niedersachsen's energy strategy proposes the following regulatory framework concerning onshore and offshore activities (Table 19.1).

Table 19.1 Regulatory framework for wind energy in Niedersachsen

Onshore wind energy	Offshore wind energy
Reducing the regulatory limitation of height of the wind turbine	Enabling port infrastructure
Instead of setting up strict distance limits, individual decisions on appropriate areas are allowed	Defining areas for required power lines for connecting offshore wind farm
Simplifying the admission of wind turbines	Initiating part-time degree courses for employees
Repowering	Defining test areas to study wind energy within the 12 mile zone
Establishing a repowering platform for owners of old wind turbines and investors	
Regional policy supports the activities on a national level	

Nevertheless, apart from a regulatory framework, there are still several technological challenges that need to be solved by interaction between science and companies, such as increasing power output per asset, fluctuating electricity input, setting up load-bearing structures, improving weather forecasts, grid expansion and European integration of energy markets.

Volkswagen, as one of the world's largest vehicle manufacturers, is making great efforts in the research and development of low-carbon drive technologies on the basis of biomass and synthetic fuels, as well as electric mobility. The development of next generation batteries and fuel cells is still subject to national and international research. Just considering the broad field of fuel cells, there is an enormous need for development concerning all components, in terms of reducing costs, extending lifetime and simplifying the system, meaning an intensive level of innovative activity is required (Table 19.2).

Innovation Framework of Niedersachsen

A sustainable climate and energy policy and the competitiveness of the companies at the site are both decisive factors for an innovation framework in Niedersachsen. The next section provides the means of knowledge and technology transfer in order to introduce innovations despite the technological challenges named above, and refers to the actors that contribute to the value added chain of innovation (Fig. 19.3).

Institutional funding of universities and scientific research institutions provides a basis guaranteeing the interaction of several faculties, which is necessary for investigating the complex subjects of climate change and energy topics. Therefore, the government of Niedersachsen established research institutes that work together

Table 19.2 Technological challenges for developing fuel cells

Material technology of stack components	MEA technology (MEA = diaphragm electrode unit)	Fuel/air-supply
Bipolar plate	New coatings	Integration of motor, motor driver electronic and compressor
Resistivity against corrosive media, high temperature and mechanical load	Zero-carbon electrode substrates	Process stability for vehicle-specific features during operating conditions
Sufficiently high electric potential and conductivity	Platinum free catalytic converter	Design and production of pressure regulation
Cost-effective materials and automated manufacturing	Proton-conducting membrane electrolytes	Investigation of life cycle and corrosion
Power electronics and control systems		
Test engineering		

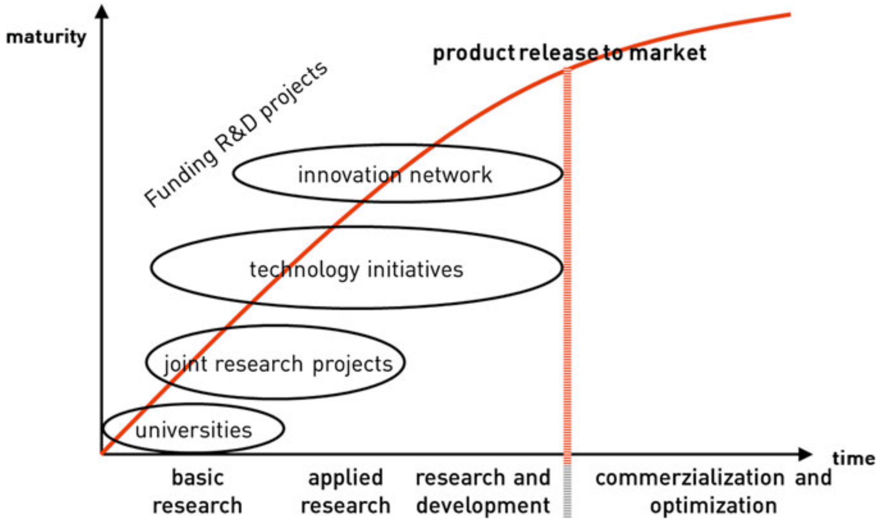

Fig. 19.3 Partners in the value added chain of innovation

across locations. The energy research centre of Niedersachsen (EFZN) was founded to ensure interdisciplinary analysis of the complete energy chain. Furthermore, the centre for wind energy research (ForWind) includes wind energy research activities from the universities Oldenburg, Hannover and Bremen in a broad spectrum within the areas of physics and engineering. The German wind energy institute (DEWI) is one of the leading international consultants in the field of wind energy, offers all kinds of wind energy-related analysis for industry, wind farm developers, banks, governments and public administration.

Funding joint research projects on energy topics enables knowledge transfer mainly between different areas of research. The second task is to provide a competent contact point for companies that are already interested in the basic research. At this stage, the cooperation between areas of research, namely researchers and companies, not only increases the quality of research and teaching, but may also result in far advanced products or services. There are presently three joint research projects in Niedersachsen dealing with decentralised energy systems: sustainable use of biomass energy between conflicting priorities of climate protection, landscape and society, and the consequences of climate change for costal protection, animal and crop production, forestry and land-use planning.

The further research and development advances on the time scale, the higher the product maturity achieved. Technology initiatives aim at intensifying the knowledge and technology exchange between companies, respectively companies and research institutes. Technology initiatives set up networks providing a trans-technological and interdisciplinary communication platform. This network supports research institutes and companies (preferably SME) in order to develop innovative products, processes and services, resulting in increasing innovation capabilities within the companies, and contributing to increasing the number of or

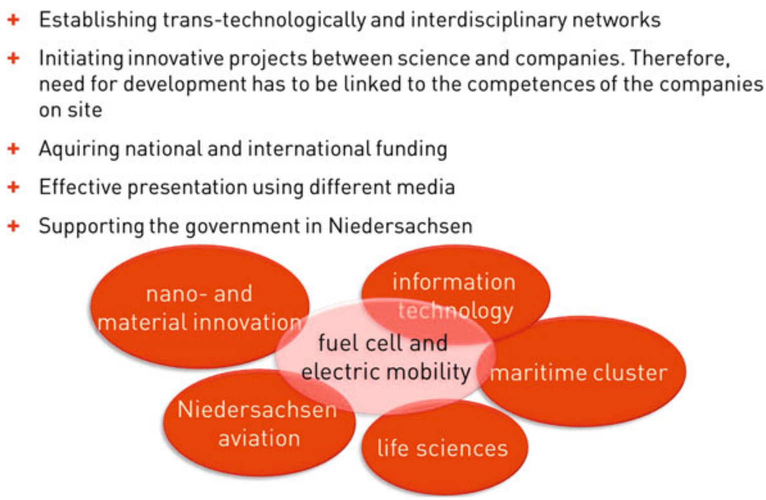

Fig. 19.4 Main tasks of technology initiatives in Niedersachsen

securing existing jobs. Currently, the technology initiatives nano and material innovations, life science, aviation, maritime cluster, information technology and fuel cell/electric mobility, convey innovations. The main tasks of a technology initiative are described in Fig. 19.4

Funding Research and Development

Along the value added chain of innovation, different guidelines support the funding of research and development. The guidelines set up rules that have to be followed by the project partners in order to receive non-repayable subsidies. The following section shows the subsidisation guidelines developed especially for Niedersachsen, along with the evaluation scheme for independent experts, and ends with a practical application of the guidelines to a research and development project in the intersection fuel cells and wind energy.

Niedersachsen's Innovation Guidelines

After all relevant players were brought together on the technical side, suitable national and international funding programs have to be considered. Niedersachsen offers guidelines open to all types of technology, with the specific aim of supporting research and development by small to medium enterprises dealing with high technological targets and risks (Investitions- und Förderbank Niedersachsen—Nbank 2011).

Table 19.3 Quality criteria for innovation funding based on Niedersachsen's guidelines

Features	Guideline for innovation funding
Quality criteria	Derived product, process or service is either new or a significant improvement to the German market
	Project approach is clarified in detail
	Project approach promises success
	Derived product, process or service is marketable
	Project contributes to the performance of industry situated in Niedersachsen
	Jobs are ensured or created
	Project contains high technical risk
	Project contains high economic risk
	Use of resources is as efficient as possible
	Environment and sustainability are taken into account
	Gender aspects are guaranteed
General notice	All quality criteria have to be fulfilled
	Evaluation of quality criteria is carried out by independent experts
Deadline	None
Rejection	In case of rejection the applicant receives the negative evaluation

Before the project is notified of their grant, so that the project can start, certain steps have to be carried out carefully.

First of all, the project consortium has to prove that formal aspects such as liquidity and solvency are sufficient for the proposed project. Then, an evaluation of the quality, according to the innovative topics, is matched with the criteria of the guidelines. The guidelines are certified by the European Union. Table 19.3 shows the criteria that have to be evaluated by the expert committee.

Evaluation Scheme

In order to evaluate the quality criteria, a scheme has to be applied to enable a comprehensible and reproducible assessment for the expert. Table 19.4 shows a scheme that is used to evaluate research and development projects based on Niedersachsen's guidelines.

Initiating a Research Project Crossing Over Between Fuel Cells and Wind Energy

The application of the Niedersachsen guidelines can be illustrated using a research and development project at the intersection of fuel cells and wind energy. As the first step, the technology initiative for fuel cell and electric mobility created these issues and passed them to the suppliers.

Table 19.4 Evaluating scheme

Features	Evaluating scheme
Innovation	Product, process or service has a definable task. Compared to other products this task is achieved with a higher ideality:
	A higher ideality results from dissolving the connection between added functionality and added disadvantages (major restraint of growth)
	The connection between added functionality and added disadvantages is dissolved by the application of at least one of one of the following: miniaturisation, automation, integration, and/or self-organisation
	Product, process or service:
	Improves functionality
	Introduces new technologies from other disciplines
	Increases possible applications by integrating new functions
	Increases possible applications by integrating formerly unknown functions
	Consists of a new technical system
	Product, process or service:
	Is new to the German market
	Is an adaptive development
Market	Target market
	Commercial customers [B2B, customer (B2C), public sector]
	State of development
	Mature market, growing market, future market
	Consumer trend
	Mobility, communication, health, sustainability
	Number of target industries
	Benefit for the customer
	Usability, time to market, anticipated price
Resources	Knowledge resources
	Within project consortium, external service supply, network, applied research, basic research
	Personnel resources
	No change, safe jobs on a long-term scale, creates new jobs
	Added value in Niedersachsen
Competence	Degree of competency within the consortium
Overall impression	Technical risk
	Economic risk

The suppliers confirmed that all relevant components of forced-air ventilated, low temperature PEM fuel cells are already on the market. The suitable configuration is still to be determined and optimised for industrial application. Then, the technology initiative for fuel cell/electric mobility put the producer of fuel cells in touch with with several potential users on the industrial side. Finally, a producer of wind turbines agreed to participate in a combined project. The application of PEM fuel cells within a wind turbine could be a new and innovative solution to maintain important emergency functions during power failure, or while the assembly phase is still ongoing.

An application was submitted on the basis of the Niedersachsen guidelines. The common factor shared by all research and development projects is that the project must be ready to start as soon as possible after the application. Therefore, the evaluation of the formal and innovation criteria has to compromise between accuracy and a short processing time. With respect to the practical example, independent experts stated that all quality criteria were fulfilled, and in case there is a liquidity problem,a grant could be delivered to the consortium.

Conclusion

Innovation guidelines should take into account the individual structure and potential of the local companies and research institutes in an area. This paper illustrated the means for a regulatory and innovative framework according to a practical example at the intersection of two areas of clean-energy technology. Focussing on the process of initiating and funding a research and development project, the Niedersachsen subsidisation guidelines and their evaluation scheme were taken as a basis. Funding innovative projects that would not otherwise be considered by industry is one measure against market failure, and one step towards sustainable economic growth with future-oriented jobs in the field of renewable energy.

References

Bundesministerium für Wirtschaft und Technologie, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2010) Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. Berlin, Germany

Investitions- und Förderbank Niedersachsen—NBank (2011) Richtlinie über die Gewährung von Zuwendungen im Rahmen des Niedersächsischen Innovations-förderprogramms. Hannover, Germany

Niedersächsisches Ministerium für Umwelt und Klimaschutz (2011) Verlässlich, umweltfreundlich, klimaverträglich und bezahlbar—Energiepolitik für morgen. Hannover, Germany