ForskEL and ForskVE Call 2014

Contents

1. Purpose and application deadline

The PSO-financed programmes ForskEL and ForskVE are administered by Energinet.dk.

The purpose of the ForskEL programme is to support research, development and demonstration projects with the purpose of developing and introducing environmentally friendly electricity generation technologies, including the development of an environmentally friendly and safe electricity system. This year's round of applications is a financial framework of DKK 130 million for funding of projects.

The purpose of ForskVE is to support projects dealing with the dissemination of electricity generation facilities with a smaller electricity generation capacity, based on renewable energy. This year's round of applications is a financial framework of DKK 25 million for funding of projects.

The projects must support the energy-political objectives.

The application deadline is **Thursday 12 September 2013 at 12.00**. It is not possible to submit applications after this deadline.

Decision on approval or rejection is announced in the period December 2013 to January 2014.

Please note that EUDP and ELFORSK invite applications with the same deadline. See clause 13.

2. Energy political objectives

The programmes ForskEL and ForskVE contribute to supporting the energy political objectives about security of supply, climate, environment and cost-efficiency as well as contribute to realising the objective of making Denmark independent of fossil fuels in 2050.

With the Energy Agreement of 22 March 2012 on the Danish energy policy 2012-20, the Danish government and a majority in the Folketing have agreed upon a number of energy-political initiatives and objectives with regard to a more energy-efficient society, green and sustainable energy supply as well as a number of initiatives aimed at development of the electricity system to a smart electricity system.

Furthermore, the Danish government has in the energy strategy 'Our Energy' (Vores Energi) defined a number of more long-term objectives, including that use of fossil fuels for generation of electricity and heat must be completely phased out by 2035, and that the entire energy supply must be covered by renewable energy in 2050.

3. What can obtain funding?

ForskEL - Research, development and demonstration

The ForskEL programme can support projects concerning applied research, development as well as pilot and demonstration projects. When granting support, however, the main emphasis is on applied research and development. Projects with emphasis on demonstration are mainly supported by EUDP.

Applied research means projects of original character with regard to gaining knowledge and insight with an aim of specific practical objectives and uses.

Development means use of knowledge with regard to preparing new or improving existing materials, products, processes, methods, systems or services.

Pilot projects mean projects carrying out experimental test of a technology, system or a method in a larger scale than during laboratory conditions, but less than full-scale. A pilot plant will typically be 1:10 compared to full-scale.

Demonstration projects mean projects carrying out experimental test of a technology, a system or a method under realistic conditions with regard to subsequent

market introduction or, when the demonstration gives rise to it, further development before market introduction.

ForskVE - dissemination of electricity-generating facilities with less capacity, including communication
Projects promoting the dissemination of renewable energy, including communication activities regarding technologies can be supported under the ForskVE programme.

Energy development projects with support need over DKK 100 million.
EUDP, ForskVE and ForskEL programmes facilitate co-financing of development and demonstration projects with a total support need over DKK 100 million. It will thus be possible for applicants to receive funding from two or more of the programmes for the same project. Self-financing of at least the same size as the donation is expected.

A precondition is that the projects support the Danish climate and energy-political objectives as well as the project participants having a shared vision of both completing the project and establishing a business cooperation that can bring the energy technology closer to commercialisation. It is also a precondition that the purpose of the project falls within the co-financed programmes' focus areas.

Applicants with ideas of such large projects must apply to one of the programme suppliers EUDP, Energinet.dk or Danish Energy Association with a preliminary outline of the project no later than **14 June 2013**. A group of representatives from the affected programmes' secretariat will clarify practical aspects regarding the application no later than 28 June.

A complete application must be submitted before the application deadline 12 September 2013 at 12.00. An individual programme with time schedule up to the programmes' joint approval of the large project as part of the implementation of this year's call.

When considering an application, it must be investigated whether there is a possibility for co-financing from eg EU or others. The overall funding of a project must be covered within EU's state aid rules, if relevant.

4. Focus areas

In continuation of the energy agreement of March 2012, the Supervisory Boards for EUDP, ForskEL, ForskVE and ELFORSK have in cooperation identified the following focus areas:

- Energy renovation of existing buildings
- Smart Grid and
- Storage of energy

as being of special importance to the realisation of the long-term energy-political objective of transforming the Danish energy system to being 100% based on renewable energy. Two of these are relevant to the ForskEL programme.

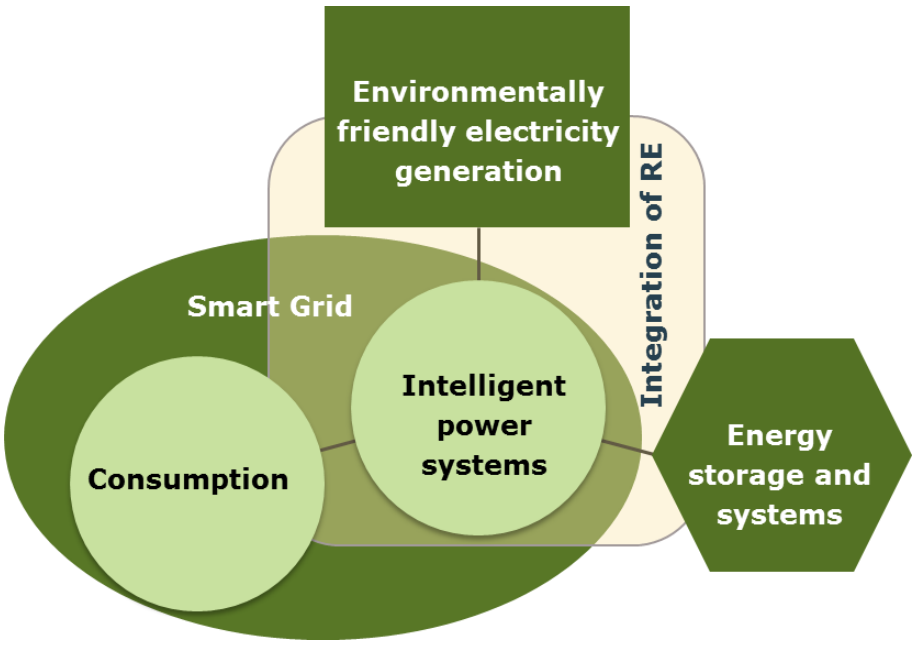
ForskEL programme

Three main focus areas.

- Energy storage and coordination of energy systems
- Smart Grid and integration of renewable energy
- Environmentally friendly electricity generation

'Environmentally friendly electricity generation' primarily relates to development of different new technologies for electricity generation, whereas 'SmartGrid' as well as 'Energy storage and combination of energy systems' relates to technologies and concepts making it possible to integrate large volumes of renewable and fluctuating electricity generation.

This is illustrated in the figure below.



ForskVE programme

Previously, the focus areas for the ForskVE programme have been production technologies such as PV cells, wave power and biomass gasification. In future, it will also be possible for other production technologies to obtain funding. Similarly, it will also be possible to consider technologies promoting the dissemination of renewable RE electricity generation technologies through the ForskVE programme.

You can read a more detailed description of each focus area for the ForskEL and ForskVE programmes in appendix 1.

5. Who can apply?

Public or private enterprises or knowledge institutions, including universities and Approved Technological Service Providers (GTS institutes) registered in the Central Business Register in Denmark (CVR) can apply for funding from the ForskEL programme.

Also foreign project participants can apply for funding; however, it is emphasised that the results will promote the development of the Danish power system, and provided that main applicant is registered with a Danish Business Register Number.

6. How much can be applied for?

Every project participant must state in his budget how the activities in the project are expected to be financed by funding, self-financing and other financing, if relevant.

- **Funding rate**
  No upper or lower limit on the amount of funding to be applied for has been defined.

  For your information, funding has previously been granted in the interval DKK 0.25-25 million per project, but in general 20-30 projects are granted under the ForskEL and ForskVE programmes per year, each obtaining funding between DKK 0.5 and 30 million.

- **Funding rate**
  There is no fixed funding rate for all projects. The funding rate is fixed by ForskEL for each participant within the framework of EU's state aid rules based on among other things company size, project type, the commercial aspects as well as involved technical and economic risks.

  Projects covered by EU's state aid rules, *may* thus obtain funding up to the allowed level according to these rules.

  Public financing of research and development activities conducted by institutions of higher education or public research bodies not working with profit in view, and basic research carried out independently of these, are as a general rule not covered by EU's general conditions for state aid for research, development and innovation. Such activities can obtain funding of up to 90 per cent.

  It applies to development and demonstration projects that a degree of self-financing of minimum 50 per cent must be aimed at.

  Please note that all public support funds for projects must be included.

7. How do you apply?

The application is submitted electronically through the application portal www.forskel.dk

Here you will also find an application guideline (see section 12).

On the application portal, applicant must create a user profile, and a data sheet for applicants must be filled in as well as three documents to be uploaded:

1. Application (test template)
2. Budget form
3. Time schedule

Furthermore, as a minimum a one-page CV for the project manager must be attached.

Research-based content
Regarding projects with research-based content, an research-based description including a statement of research staff and a research plan, to be used for a research-based assessment. CVs of all key participants must be attached. The application guideline provides closer description of these rules.

Business potential
As regards demonstration projects and ForskVE projects an extended description of the business potential must be submitted. The application guideline provides closer description of these rules.

Language
Applications for DKK 3 million and above must be submitted in English, in order to facilitate the use of foreign specialists in connection with the evaluation.

Applications for less than DKK 3 million for the entire projects are allowed to submit their application in English or Danish.

Information about previous projects
Information about previous and ongoing publicly funded projects is available on energiforskning.dk.

8. Assessment criteria

When assessing the submitted applications, the following assessment criteria are emphasised:

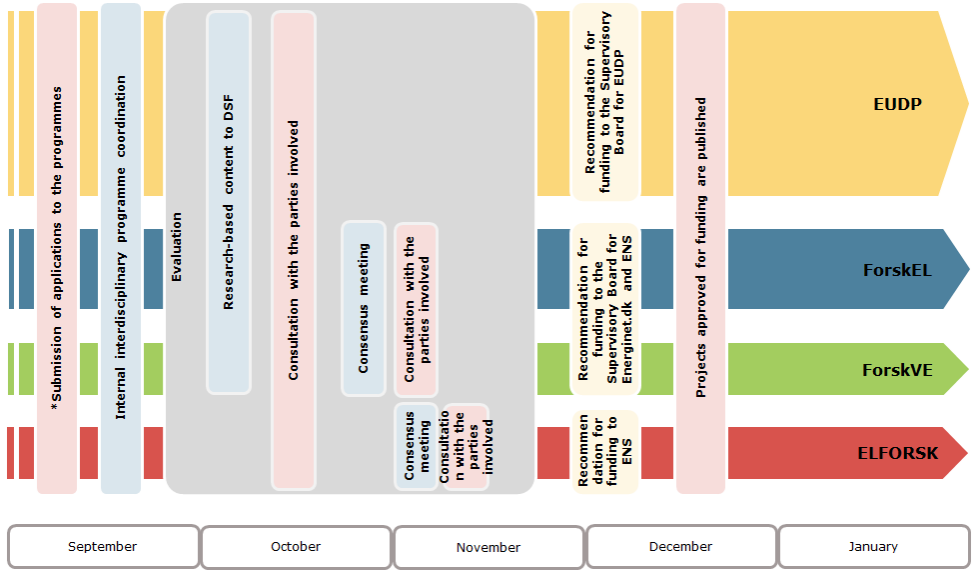
1. Description of purpose	A clear description of the purpose of the project and the state of the technologies, including the maturity and risk of the applying project.
2. Schedule and project structure	The project is arranged in work packages and specification of milestones.
3. Relevance	The project's meaning to energy-political objectives and the project's potential

4. Dissemination	How are the results of the project communicated?
5. Organisation	Description of participating persons and their competences including project management competences, brief description of participating companies, motivation for applied funding for foreign participants, if relevant.
6. Budget and financing	Is the project fair and are assumptions informed? Is a confirmation of participation from parties available?
7. Incentive effect and feasibility	Has it been made probable that the project will not be completed in the applied version, if funding it not obtained? Has it been made possible that the project is feasible?
8. Market potential	Description of competitive situation, expected market (where, when, how large), marketing plans.
9. Added value of the project	Description of the final target group and the added value of the project (economy, comfort, functionality etc.).
10. Research-based content	Projects with research content are assessed based on the quality of this.
11. Environmental impact	Has the project described potential important environmental challenges faced by the technology? In that case, have relevant milestones for reducing/avoiding the important environmental impacts been defined? Are there important environmental impacts connected to the technology or the production of the technology which the project has not stated? Does the project's contribution to a more environmentally friendly electricity supply outweigh the project's negative environmental impacts.

As of 2014, the environmental assessment is converted to being a fully integrated part of both application and selection process. It must be stressed that it is not disqualifying for an applicant to state negative environmental impacts. On the contrary, it is an advantage to a project if attention is paid to the negative environmental impacts, especially if a number of milestones have been defined for the purpose of working on the impacts.

9. Assessment of applications

The submitted applications for ForskEL and ForskVE are assessed according to following time schedule, where also the time schedule for ELFORSK and EUDP is stated.



* 2013: Partial harmonisation of application formats, procedures etc. 2014: Maximum harmonisation of application formats, procedures etc. in connection with new portal solution.

Applications will be rejected, if

- the project does not contribute to fulfilling the purpose of the programme to a sufficient extent.
- the application or budget form has not been filled in in accordance with the requirements set out in the guidelines.
- other applications within same focus area are better qualified and more worthy of funding.
- the application has not been submitted within the deadline with the required appendices.

Publication of funded projects

The contents of the applications are treated confidentially within the framework of Danish Act on Public Access to Documents in Administrative Files.

- Publication of funded projects
  An overview of all projects receiving funding is published at www.energinet.dk. In this overview, a brief description of the purpose of the project is included, based on the information provided in the application.

The descriptions of the funded projects with information about participants and budget is also shown atwww.energiforskning.dk

10.If funding is obtained

If a commitment of funding for a project has been received, there are a number of requirements which must be met in connection with the completion of the project. A set of general rules for payment of support have been made. Among other things, the following applies:

- **Coordination, reporting and accountability**
  Commitment holder (the company/institution responsible for the project) is responsible the progress of the project and economic, and has the contact to Energinet.dk. It among other things includes gathering information from other project partners as well as forwarding paid out funding for these.

- **Communication and use of results achieved as well as rights**
  Project results must be made available to the public, however, in connection with applying for patents this will be taken into consideration. In special cases, the Danish Energy Agency can give permission to not publishing results. When completing the project, a report suitable for publication is prepared.

  In the course of the project, the project manager will be asked to deliver pictures of the project's activities and products for the use of the web portals.

  Information on all projects receiving funding is published on the web portal: www.energiforskning.dk.

- **Disbursement of funding**
  Funding will be disbursed based on calculation of all paid expenses eligible for funding and the funding percentages, determined for every funding recipient.

  In connection with disbursement of funding, the status of the project's scientific progress must be reported on. In principle, the disbursement takes place twice a year, but it is possible to agree on more than two disbursements per year.

  It is a condition for funding that *the activity is not commenced*, before commitment of funding is given[1], and that distribution of agreement on rights is available.

The full description of commitments is available in the set of rules for the programmes. See clause 12.

11.Legislation

ForskEL is a PSO-financed R&D programme aiming to support the development and integration of environmentally friendly electricity generation technologies for grid connection in the power system. Each year, applications are invited for funding within the budgetary framework and focus areas for the programme are approved by the Danish Minister for Climate, Energy and Building.

Legal framework and purpose of the ForskEL programme appears from the Danish Electricity Supply Act (LBK 279 article 29) and Executive Order on transmission system operation and the use of the electricity transmission grid, etc. (BEK 891 chapter 7). The ForskEL programme complies with the EU's rules on state subsidies, which also set out the framework for the funding which can be expected for the individual project.

The ForskVE programme is also financed through PSO funds and aims to promote the deployment of the smaller RE technologies.

Legal framework and purpose of the ForskVE programme appear from Danish Renewable Energy Promotion Act (LBK 1074 section 49) as well as the Executive Order on grants to promote the electric power generated from renewable energy sources (BEK 692).

12.Other documents

Guidelines and rules

- Application guideline.
- Set of rules for ForskEL and ForskVE.

Other inspiration

www.energiforskning.dk - Shared web site for all Danish energy research programmes with collection of project reports, national technology strategies, focus areas as well as figures and statistics for Danish energy research.

Applicants are encouraged to familiarise themselves with the below background documents published on www.energinet.dk as inspiration and guidance:

- Strategy 2014+
- A successful RD&D project
- Risk Appetite of the ForskEL programme
- Inspiration for user involvement in ForskEL projects

Technological and professional documents published on www.energinet.dk:

- Technology catalogue for individual heat and energy transport
- Technology catalogue for electricity, district heating, storage and energy conversion

- Smart Grid Ready communication
- Assessment of flexibility potential

13.Other subsidy schemes

There are a number of subsidy schemes within energy technology supporting research, development, demonstration and/or market maturation, see below figure. Applicants should consider which support scheme is most relevant. An overview of existing energy technological support schemes is available on www.vækstguiden.dk and on www.ens.dk/da-DK/NyTeknologi/om-eudp. The ForskEL secretariat can provide further information.

The energy research programmes' possibilities for funding withn each technology area 2013

Energy research programme		EUDP	ELFORSK	ForskEL	ForskVE
Wind power					
Wave power					
Hydrogen and fuel cells					
Solar power	- to electricity				
	- to heat				
Bioenergy and waste	- CHP				
	- biofuel				
Smart Grid and systems					
Energy efficiency					
Energy storage					
Other technologies					
Course of development Height indicates the priority of the programme		A U P D M	A U P D M	A U P D M	A U P D M

The technology's course of development
A: Applied research
U: Development
P: Pilot
D: Demonstration
M: Market maturation

The overall focus areas for ForskEL, ForskVE and ELFORSK are annually approved by the Danish Ministry of Climate, Energy and Building. Hereby, the continuous limitation between the programmes of the ministry (including EUDP) is ensured, which weighs the consideration to on the one side reducing overlap between the programmes, and on the other side considers the need for more interdisciplinary projects are funded in their entirety under one programme.

Specifically it can be mentioned that

- Applications focusing on energy systems using Smart Grid or on environmental improvements and efficiency improvement of existing electricity and CHP plants must be addressed to the ForskEL programme. Large development and demonstration projects within these areas may consider applying for funding from both ForskEL and EUDP.

- Research and development projects within environmentally friendly electricity generation technologies must be addressed to ForskEL, while demonstration projects and more commercial projects must be addressed to EUDP.

- Research and development projects within efficient energy use must be addressed to ELFORSK, which focuses on use of electricity, while demonstration projects must be addressed to EUDP.

- Actual research projects are generally referred to other support schemes in the area, first and foremost the Danish Council for Strategic Research

as well as ForskEL, ELFORSK and The Danish National Advanced Technology Foundation.

Appendix 1 ForskEL and ForskVE focus area Call 2014

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1. Focus areas

1.1 Strategic focus areas

The common aspect of the projects eligible for funding under the ForskEL and ForskVE programmes is that they must have relevance in relation to the power system and they must benefit Danish electricity supply and Danish society in the form of more jobs, a cleaner environment, maintained security of supply and, preferably, increased exports.

With the Energy Agreement of 22 March 2012 on the Danish climate and energy policy 2012-20, the Danish government and a majority in the Folketing have agreed upon a number of energy-political initiatives and objectives with regard to a more energy-efficient society, green and sustainable energy supply as well as a number of initiatives aimed at development of the electricity system to a smart electricity system.

Bearing these items in mind, the programmes have prepared 'Strategy 2014+'. The strategy describes among other things focus areas and technological focus areas for ForskEL and ForskVE respectively and is available on www.energinet.dk.

This year's call is of course closely related to the new 'Strategy 2014+', and the programmes' focus appears from *Table 1*.

Table 1. The ForskEL and ForskVE focus areas during call for tenders 2014

FORSK EL Energinet.dk	FORSK VE Energinet.dk
• Energy storage and coordination of energy systems • Smart Grid and integration of RE • Environmentally friendly electricity generation	• The main initiative within wave power, solar cells and biomass gasification • Related areas on integration and dissemination of RE

ForskEL - Energy storage and coordination of energy systems

Integration of large quantities of fluctuating electricity generation in the electricity system from among other things wind turbines and solar cells requires establishment of new large-scale energy consumption in periods where generation is high. On the other side, there is a need for electricity from dispatchable electricity generation units in periods, where generation from the fluctuating sources cannot meet the demand.

One of the solutions to this lie in interaction between the different energy systems: electricity, gas, heat and transport (*Figure 1*). For example electricity can be converted to gas, which can be stored and converted again to electricity or used in the transport sector. Heat from the conversion process can be used for heating, eg through the district heating systems. Similarly, flexible plants can be designed to generate electricity, gas, heat or transport fuels according to need and market value, and synergies between different plants can be used.

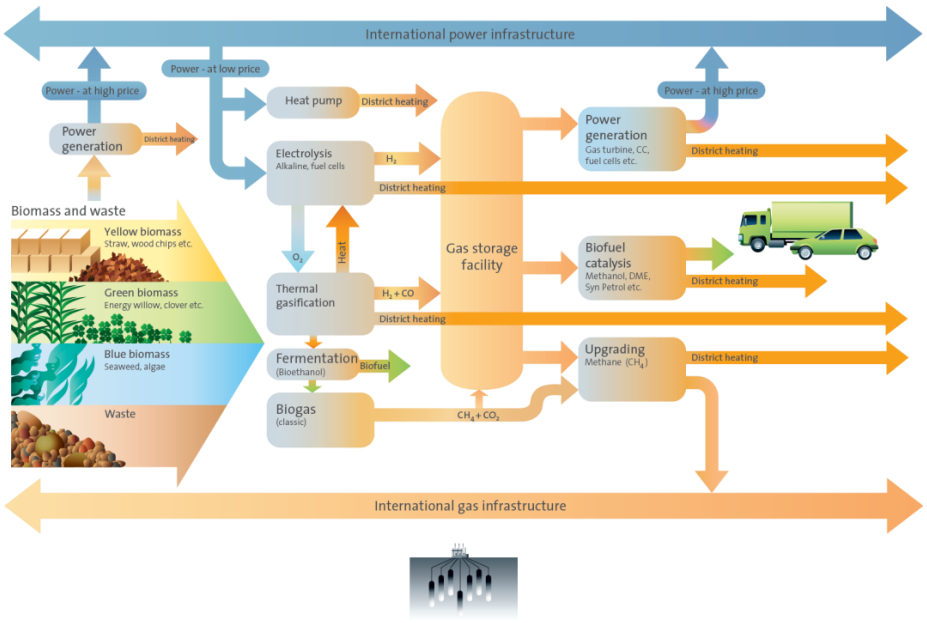


Figure 1. Interaction between the energy systems of the future

ForskEL - Smart Grid and integration of RE

The area Smart Grid includes control and regulation of the electricity system, market design of electricity markets, information and communication technology (IKT) and not least activation of electricity consumers. Particularly the future consumer is a considerable factor for the success of the future Smart Grid. This year's

call for tenders will therefore focus on how eg private households, industries and service industry can be motivated to contribute.
The integration of RE takes place in all areas in the energy system, but has been included under Smart Grid, as the technological solutions and instruments are closely related to the Smart Grid idea.

ForskEL - Environmentally friendly power generation
The focus areas in this field partially concern development of new electricity-generating technologies, partially cost reduction of existing technologies. Decisive is that the generation method is based on renewable energy (RE) and is not yet completely commercialised.

ForskVE
The programme will as of this call for tenders have wider focus and not only be limited to supporting electricity-generating technologies such as PV cells, wave power and biomass gasification. Also small-scale generation technologies based on renewable energy sources can obtain funding. Similarly, technologies supporting dissemination of RE-based generation technologies can obtain funding.
The ForskVE programme facilitates that projects that previously have received funding through the other energy-research programmes also can obtain funding, when they have come closer to market introduction.

Overall the ForskEL and ForskVE programmes will have special focus on projects with impact on the electricity system concurrently with using the interaction between two or more of the energy systems as illustrated in Figure 2.

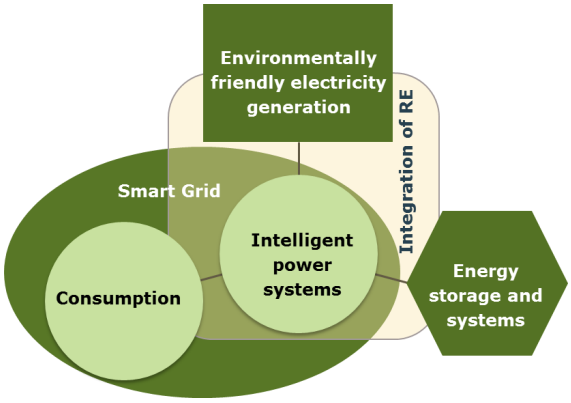


Figure 2. The connection between the three main focus areas for ForskEL and partically ForskVE

1.2 Technology strategies and programme cooperation

The ForskEL and ForskVE programmes cooperate with:

- The Danish Council for Strategic Research (DSF)
- The Danish National Advanced Technology Foundation
- Danish Energy Association (ELFORSK) and
- Danish Energy Agency (EUDP)

and the total Danish energy research effort. Including coordination of technology areas and division of roles. Applicants should therefore seek information on which programme is the most suitable for their application.

The Danish energy-research programmes have jointly identified a need for a shared setting of priority of three special focus areas:

- Storage of energy
- Smart Grid technologies
- Energy efficiency measures of the existing building stock

With the joint setting of priorities, the programmes wish to promote applications within these three focus areas. The setting of priorities still takes place with regard to each programme. Further information is available on www.energiforskning.dk.

2. ForskEL programme

2.1 Energy storage and coordination of energy systems

Electricity and energy storage is one of the means for balancing the fluctuating wind power and other VE generation. Energy storage must together with combination of energy systems ensure that the energy always is converted to the energy form, which is in demand here and not - represented at the highest price, possibly stored for later use.

Electricity to gas

Conversion of electricity to gas (P2G - Power to Gas) by using electrolysis can contribute to take large amounts of electricity in periods with high RE electricity generation. Gas can be stored in large amounts (TWh) and over long time (months), and can thus add a high level of flexibility to the energy system.

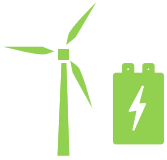
Alkaline electrolysis is a known and an industrial commercial technology, but there is a need to increase efficiency and reduce the cost of the investment, if it is to be used for energy purposes.

The newer technologies, SOEC and PEM electrolysis developed based of fuel cell technologies, are not large-scale commercial, and require development regarding useful life, price and efficiency. SOEC has potential to be used for CO_2/H_2O electrolysis.

Alkaline electrolysis for energy purposes is assessed to be most advanced, while PEM and SOEC are at the development stage and are expected to be commercial after 2020.

ForskEL will focus the development effort at cell/stack level on PEM and SOEC cells. At system level, the effort will be on both alkaline, SOEC and PEM electrolysis.

Electricity to electricity



There are several technologies - large batteries, CAES (Compressed Air Energy Storage) and pumped storage power - for storing electricity with later conversion to electric form. These are however still relatively expensive in Danish context.

As example can be mentioned that pumped storage power in Denmark must be able to compete with corresponding service from eg Norway. This may most likely be the case if the pump storage plant also can deliver ancillary services and not just energy balancing.

The efficiency for the process electricity to electricity must be increased and the price for storage per kWh must be reduced. Furthermore, there is a need for research and development in relation to reasonable lifetime, when the technologies must be adapted in a Danish market-related context, where the need for eg start/stop can be big.

Electricity to other

Electricity to other provides the opportunity to use RE-based electricity in the heat and transport sector.

Electricity to heat through both heat pumps (individual and large) as well as electric boilers are basically mature technologies. There may be a development and demonstration need regarding flexible integration into the market.

Electricity to transport as electric vehicles (EV) and hybrids from this are on the consumption side (G2V) commercial, while electric vehicles as source to generation of power (V2G) lacks important research and development.

Long-term storage, in particular, will be in demand during days and weeks without wind. Technologies which can help to ensure power balance, energy balance and ancillary services will be preferred. The ForskEL programme is limited to funding storage technologies that are relevant to the Danish electricity system, and which with development, innovation and pilot projects can be brought to demonstration.

In *Table 2* a list of relevant technologies is shown. It should be noted, however, that the list is not exhaustive and that other storage technologies may also be eligible for funding. ForskEL funding for electrolysis must be relevant to the power system and must thus contribute to the integration of renewable energy. If, on the other hand, the main activity in an electrolysis project is relevant to the gas system, the project would be more suited under EUDP.

Table 2. Categories eligible for funding within energy storage

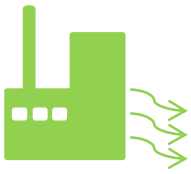
Category	Examples
Electrolysis	Use of technologies as SOEC and PEMC, while classic alkaline electrolysis only is of interest as part of integrated systems.
Energy carriers	Generation and short-term storage of RE gases and synthetic fuels with regard to conversion to electricity again on the same plant. Other projects regarding generation of RE gases are referred to EUDP.
Batteries, including electricity to transport	Systems with AC/DC - DC/AC inversion with low loss and integration in the high-voltage system with possibility of fast balancing of the wind power.
Air storage (CAES)	Assembled systems with time balancing of wind power and delivery of ancillary services for the power system. Projects must focus on the total efficiency electricity-storage-electricity
Electricity to electricity	Projects with storage of electricity in the form of eg pumped storage power can only be funded, if feasibility studies have been carried out beforehand, which prove relevance for the

	Danish power system in competition with corresponding resources abroad. The ForskEL Programme can fund the feasibility studies.
Heat pumps	Can function as flexible consumption and be combined with heat storage facilities for energy optimum solutions, however, without possibility for reproduction of electricity.
International	Participation in European projects is a given, as many countries need to develop possibilities for electricity storage. Furthermore, there is access to EU co-funding.

In addition, please note that it is not a possibility for the ForskEL programme to fund very expensive hardware projects such as eg procurement of batteries for testing in the Danish power system. It is expected that hardware suppliers will be interested in testing their equipment and therefore contribute to the project with a substantial extent of self-financing.

Energy storage has been selected as one of the shared highly prioritised focus areas for the Danish energy research programmes. Storage of energy can be many things. Eg, projects on storage of energy in form of electricity, which can be transformed to electricity again are very relevant to the ForskEL programme. Storage of thermal energy in buildings can be relevant to ELFORSK and DSF. Storage of energy as heat or conversion to gas can be relevant to EUDP.

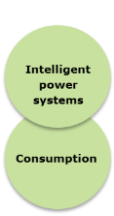
Polygeneration and integrated plants



Polygeneration means plants that besides electricity can generate other products, eg gaseous or liquid fuels or some totally different products. Hereby the plants can be made more flexible, and generation is thus optimised. It will typically concern delivery of at least a third product besides electricity and heat. The purpose is high degree of resource and energy efficiency as well as improved business economics in connection with generation of electricity and heat.

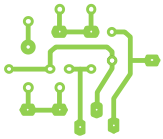
Integrated plants comprise plants in which several different technologies are combined in a kind of symbiosis to mutually utilise each other's residual products. This may be eg heat, oxygen, CO_2, etc. It is a precondition, however, that there is a clear link to the power system, either in the form of power generation or in the form of electricity storage through conversion to other energy carriers.

ForskEL only funds projects with a connection to the power system, either in the form of electricity generation or storage in connection with conversion of electricity to other energy carriers.

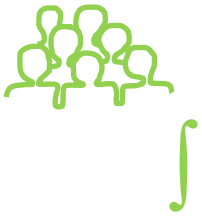


2.2 Smart Grid and integration of RE

Overall, the focus area covers the same sub areas as previous calls, however, they have been restructured to be divided as follows and the area 'Integration of RE' is now placed under Smart Grid.



- Intelligent power systems, including
    - Control and regulation
    - Market design
    - Information and communications technology (ICT)
- Consumption
- Integration of VE, including
    - Inverter-based generation
    - Models



In Denmark, focus is on integrating renewable energy into the power system, most of which comes from fluctuating wind power.
This requires intelligent solutions, both in order to utilise the large generation of electricity, when the wind blows and not least to have alternatives ready for when the wind is not blowing.

Focus on consumer and generation flexibility, market, and control and regulation
The establishment of a Smart Grid requires focused and coordinated development and demonstration activities which encourage the advancement of those technologies and solutions that will form the building blocks for the intelligent power system of the future.

Table 3. Categories eligible for funding within Smart Grid

Categories	Examples
Control and regulation	Plug and play solutions Power balancing Ancillary services Control and regulation of distributed energy resources (DER) and 'demand response' (DR)
Market	Optimisation of the power system through improved and market-related control and regulation of all generation units. New market tools for utilisation of DER and DR
ICT	Smart Grid is to a large extent development of IT systems for communication, control and regulation of distributed energy systems. This may also be VPP solutions for aggregation of many smaller units and market integration of electricity-generating RE facilities.
Standardisation work	Support for participation in actual standardisation work is not funded. However, projects with cooperation on pre-standard development and test can obtain funding.
Consumer flexibility and acceptance	Price and control signals to customers. Communication equipment Assessment of the flexibility potential in existing electricity consumption. New intelligent and flexible electricity consumption for electric vehicles, heating sector etc. New products for electricity consumers for optimisation of the consumption profile in relation to the needs of the electricity market. Anthropological and sociological studies
Generation flexibility	Flexible generation complementing wind power generation. DC/AC inverted electricity generation System and market participation

Categories	Examples
Models	Eg solar and wave forecast Commercial models and forecasts are not funded.
International	International cooperation for strengthened development in Denmark. Special focus on EU-funded projects, ENTSO-E cooperations and EEGI projects. The ForskEL Programme participates in ERA-NET Smart Grids that has a joint European call for tenders in 2013.

The ForskEL programme will concentrate its funding on the categories as described in *Table 3*.

A common feature of the categories is that it is emphasised that the communication follows agreed IEC standards (see www.energinet.dk, 'Smart Grid ready') and supports the double Virtual Power Plant (VPP) mind set:

- Market VPP: Aggregation of many small consumption and generation units on market terms through the balance responsible
- Technical VPP: Aggregation of the mode in the local grid as control and regulation tool for the grid company.
-

Demonstration of technologies and not least total solutions is given high priority just like achieving consumer acceptance through eg sociological, legal or anthropological studies.

Besides, reference is made to below publications which all are available on www.energinet.dk:

- DanGrid - the grid companies' concept, information model and roadmap for Smart Grid (2012)
- Smart Grid Strategy from The Danish Ministry of Climate, Energy and Building (2013)
- The research network's Smart Grid Roadmap (2013)

Furthermore, the applicant should stay informed of the cooperation between the Danish energy research programmes, where Smart Grid is one of three prioritised focus areas (see also section 1.2). This means eg that ELFORSK will be able to fund projects dealing with Smart Grid in relation to control of buildings' energy consumption and EUDP will be able to support large demonstration projects.

2.3 Environmentally friendly power generation

Environmentally friendly electricity generation

2.3.1 Bioenergy

Bioenergy is the energy or energy carriers derived by converting material of biological origin.

In connection with implementation of the energy-political objectives, biomass has been selected to supplement the fluctuating RE generation sources such as wind and sun.

In order to obtain funding from the ForskEL programme, it is a condition that projects must concern electricitygeneration technologies connected to the power grid or must in some other way play a role in relation to the power grid. Bioenergy is a very broad concept which also covers the production of liquid and gaseous energy carriers. These technologies are only included in the extent that the product can be used for electricity generation immediately after generation. For example biogas or gasification plants, where the gas is used for subsequent electricity generation in step the production of gas, or where the gas only is stored to a limited extent on the plant.

Focus on energy conversion
Focus is on the actual conversion of biomass. Biomass pre-treatment is eligible for funding to the extent that this impacts power generation.

Projects concerning biomass production and logistics are referred to the GUDP programme under the Danish Ministry of Food, Agriculture and Fisheries.
Projects focusing primarily on the production of biofuels for the transport sector or heat generation for the district heating sector are referred to the EUDP programme.

Production of combined heat and power at conventional combustion of biomass is today regarded as being commercial, which is why it is no longer an important focus area for ForskEL. In connection with transformation of the central power stations to biomass, there may, however, be a need for funding to RDD in new and not near-commercial technologies for suspension firing of biomass.

Table 4. Categories eligible for funding within bioenergy.

Category	Examples
Biogas facility	Production of combined heat and power and with focus on operational flexibility and integrated production. Traditional upgrade of biogas is not relevant in ForskEL.
Thermal gasification	Production of combined heat and power with focus on demonstration and process optimisation, including hot-gas cleaning.
Combustion	New and not near-commercial technologies in connection with suspension firing of biomass. Particularly with focus on operation and fuel flexibility in connection with power generation.
Other uses of biomass	New innovation methods where biomass is used for power generation.
Pre-treatment of combustion	Only projects where there is a considerable use of biomass for electricity generation.

Bioenergy for peak-load generation requires dispatchability and flexibility
Bioenergy has been chosen to be one of the possibilities for backup for wind power when there is no wind. This means that there is a need for highly flexible (dispatchable) plants in order for such plants to be able to support a power system with fluctuating generation capacity. In order to ensure independence on the fuel side, it may also be important that the plants are fuel flexible, making it possible to switch between different types of biomass. In addition, emphasis will be on the

plants being incorporated into integrated solutions which, at times when power generation is not needed, can produce other products such as gas, liquid fuels, heat, etc.

Reference is also made to the current biogas and gasification strategies for research and development.

Examples of projects of interest appear from *Table 4*.

2.3.2 Waste

Within the field of waste, the objective is to achieve optimum energy utilisation of all waste fractions which – on the basis of a socio-economic and environmental assessment – can be utilised most efficiently for energy production.

Focus on new flexible and dispatchable technologies with high electricity efficiency.
It is desirable with new technologies, in order to utilise the energy with as high electricity efficiency as possible, simultaneously with taking into account as much recycling of other resources from waste as possible.

Furthermore, new technologies should have as much flexibility and dispatchability in the electricity generation as possible. The flexibility may consist of that besides electricity, many different products can be produced depending on need.

Technology for conventional waste incineration plants can be funded to a limited extent, but only if it immediately will mean considerable improvements in electricity efficiency or dispatchability.

2.3.3 Fuel cells

In the Danish strategies, fuel cells are limited to PEMFC and SOFC fuel cells.

Focus on R&D and applications supporting a power system based on renewable energy (RE)
In recent years, fuel cells have received massive funding from the ForskEL programme. With the establishment of the EUDP, which primarily grants funding for demonstration, Energinet.dk chose to limit the ForskEL funding to fuel cells to comprise research and development only. As of call 2012, the ForskEL programme has been further limited to only support fuel cell applications which directly support a RE-based power system, as described in *Table 5*. Great importance is attached to the fact that the fuel cells can be integrated in system solutions, in which besides power generation, there is also optimisation of the total energy efficiency, eg through utilisation of heat.
In general, only the tracks SOFC, HT-PEM and LT-PEM are eligible for funding. It should be noted that funding may be granted for developing methods for utilising emergency power units in a flexible, intelligent power grid, but not for developing the actual emergency power unit. The ForskEL programme follows national strategies for fuel cells, which are available on the website of Partnership for Hydrogen and Fuel Cells: www.hydrogennet.dk.

Table 5. Categories eligible for funding within fuel cells.

Category	Examples
CHP	Technology development Considerable price reduction Production processes. High efficiency. Long service life System solutions with overall energy optimisation
Integration in the power system	Flexible generation complementing wind power generation. Efficient and cost-efficient DC/AC inverters. Integration Control and regulation System and market participation VPPs
Pre-treatment of RE fuels	Reformation of RE gases. Cleaning of RE gases and other RE fuels.
Reserve power supply integrated in the power system	System and market participation VPP
International	Participation in international projects can contribute with valuable knowledge for Danish players. Denmark is member of FCH JU and IEA AFC.

2.3.4 Wave power

Wave power relates to power generation by converting the energy captured from ocean waves.

Operational reliability, useful life and reduced kWh price

Developing efficient, reliable devices as well as achieving adequate useful lives are the major challenges in respect of wave power. The Danish Commission on Climate Change Policy deems the production price per kWh to be a barrier to more widespread use of wave power in Denmark. Consequently, the development should be based on the factors which have the greatest impact on the price per kWh generated, and the development should therefore be based on a general analysis of wave power devices relative to efficiency, production costs and maintenance. Documentation of this must be based on Energinet.dk's standard spreadsheet for calculation of the energy price (COE calculation sheet), which is available on Energinet.dk's website.

Cooperation

Energinet.dk wishes to promote the cooperation and in particular grant funding for joint projects specialising in areas playing a special role in reducing the price per kWh. In the recently published strategy for wave power, prepared by the partnership for wave power, several topics relevant for shared development projects have been pointed out. The projects must as far as possible be based on experience and competencies from other sectors in order to make it possible to customise the efforts to the unique, technical challenges posed by wave power.

New concepts

Funding may still be granted for the development of new concepts, provided that the focus is on the unique properties of the plant vis-à-vis comparable plants and that these properties have a favourable effect on the price per kWh. To the extent feasible, the development must be based on already developed components and existing experience, both in respect of the development of the device and the calculation of the price per kWh.

Grid-connected plants will primarily be eligible for funding through ForskVE, and, in this context, it is expected that the grant payments will be made dependent on the performance of the device relative to the wave climate.
Examples of projects of interest appear from of *Table 6*.

Table 6. Categories eligible for funding within wave power.

Category	Examples
Partnership projects with focus on components	Technology development of components that are applicable within the business and have special significance to the achieved production price per kWh. Cooperation with specialised companies and/or other players in the business.
New concepts	New principles for harvesting the wave energy focusing on efficiency and cost efficiency. Utilising existing components where possible
International	Collaboration with other European countries on development of wave power, eg through EU funded projects.

2.3.5 Offshore wind power

Wind power involves large commercial interests, both in terms of developing model tools and in respect of the actual turbine technology. In addition, extensive international research is going into all aspects of wind power. In this context, it is therefore particularly important to justify the need for funding from the ForskEL programme – the so-called incentive effect – as well as to relate the projects to existing knowledge, also internationally.

Focus on new wind power-related issues

Energinet.dk wants to focus on projects presenting new angles on wind power-related issues with an impact on Danish power generation, including new components such as near-shore turbines as well as the development of 'wind power stations', where wind power units have the same regulating properties as conventional power stations, which can contribute to regulating and stabilising the power system.

Table 7. Categories eligible for funding within wind power.

Category	Examples
Interdisciplinary projects	Where the business is involved in, eg pre-standardising and operational analyses, or where construction of shared test facilities is a derived part of the project. (Mega wind projects)
Offshore	Wake effects, corrosion conditions, components, floating wind turbines for Danish waters.
Meteorology	Wind forecasts, topography and wind farm sitings
System integration	Electro-technical conditions in relation to the power system, including delivery of ancillary services from single wind turbines and/or wind farms.

Forecast models, offshore technology, wake effect, etc.

Focus will still be on improving existing forecast models, offshore technology, wake effect models, etc., but product development of commercial products is not, as a point of departure, eligible for funding. Reference is also made to the existing

wind power strategy, which can be found at www.energinet.dk, as well as to reports and strategies from the Megavind partnership (see www. windpower.org).

Examples of projects of interest appear from *Table 7*.

2.3.6 Photovoltaic cells

PV cells concerns PV - photovoltaics - electricity generated by solar energy. Priority will not be given to projects on solar heating under the ForskEL programme.

Focus on polymer photovoltaic cells and building integration
The ForskEL programme still grants funding for the development of third-generation photovoltaic cells. In line with last year's call, the focus within the technology development is continued in order to increase efficiency, service life as well as reducing the price. In future, the ForskEL programme will give priority to polymer PV cells as well as nano-based photovoltaic cells. Funding for other types of photovoltaic cells will be granted indirectly only via funding provided for building-integrated photovoltaic cells or integration into the power system.

The Danish Commission on Climate Change Policy deemed the high production price per kWh to be a barrier to more widespread use. From 2013, the Folketing has passed new settlement rules for small and large photovoltaic cell units, among other things as consequence of falling prices for the photovoltaic cells. However, the kWh price is still higher than for several other RE technologies, therefore, the reduction of the electricity generation price from photovoltaic cells will also be in focus.

Large-scale central photovoltaic plants
The objective is focus on the qualities of photovoltaic cell units as well as control of these to support the power system.

As concerns establishment of large-scale plants and for promoting more widespread use of phototvoltaic cells in general, reference is made to the ForskVE programme.

Examples of projects of interest appear from *Table 8*.

Table 8. Categories eligible for funding within photovoltaic cells.

Category	Examples
Third generation photovoltaic cells	Technology development, production processes, service life as well as considerable price reduction. Price reduction for polymer PV cells and PV cells based on nano technology.
Integration in the power system	Efficient and cost-efficient DC/AC inverters. Integration Ancillary services Control and regulation Including handling of larger concentrations of photovoltaic cells eg at large-scale farm units.
Photovoltaic cells in construction (BIPV)	Integrated use of PV cells in multi-functional construction components. Design and product adaptation
Larger plants	Incorporation of larger units (over 1 MW) in the power system, to obtain system stabilising electricity generation.
International	Participation in European projects which can contribute with useful knowledge to Denmark from countries with higher

share of solar energy.

2.4 Other

There are technologies which today are at the fundamental research stage and are far from being commercial. If some of these technologies become relevant in connection with environmentally friendly electricity generation and incorporation, they can obtain funding, to the extent that it is used research, feasibility studies or pilot projects.

However, applicants must render probable that there under Danish conditions is an economic relevant potential in the long term.

Examples of projects of interest are stated in *Table 9*.

Table 9. Examples of projects eligible for funding within the area 'Other'.

Category	Examples
New RE technologies	Brand new technologies for generation of renewable electricity
Analysis projects	Projects for development of models or analysis for assessment of connections between a power system with a large RE share and other energy systems.
Security of supply	Projects on increased security of supply for the power system
International	'Top up'-financing of eg EU-funded projects, where Danish participation can be valuable on the road towards a power system independent of fossil fuels.

3. ForskVE programme

In continuation of the government initiative 'Our Energy', the Folketing has with the energy agreement of March 2012 enacted that the ForskVE programme for promotion of the dissemination of the RE technologies is continued in a period from 2012-2015 with a pool of DKK 25 million per year.

3.1 Focus areas

Previously the focus areas have been production technologies such as photovoltaic cells, wave power and biomass gasification. In future, other production technologies based on renewable energy sources will also be funded. Similarly, it will also be possible to consider technologies promoting the dissemination of renewable RE-based electricity generation technologies through the ForskVE programme.

3.2 General conditions for funding

- Funding can be given to increased utilisation of the above-mentioned RE technologies
- In order to obtain funding, electricity-generating installations must be connected to the grid.
- Funding can be granted for establishment and operation of plants as well as communication of experiences gained and results achieved.
- No funding can be provided for the sale of components
- No funding can be provided for support of existing plants, unless it is technologies for dissemination of the production technology in question.

3.3 Special aspects of the individual technologies

Wave power

- Based on documented demo-plants, account must be given for the economic aspects for calculation of the energy price, including expected electricity generation in specific wave climate, production costs, installation and maintenance.
- When calculating the energy price, Energinet.dk's standard Cost of Energy calculation spreadsheet (COE) must be used. All preconditions must be described in the enclosed memorandum with reference to possible existing test data or comparable constructions.

Photovoltaic cells

- Priority is given to large-scale projects such as photovoltaic farms and industrial plants which are not included in the net meter scheme as well as small-scale plants delivering important additional services such as eg energy savings.
- Photovoltaic solutions incorporated in a Danish context
- Priority will be given to distinctive projects with lighthouse effect.

Biomass gasification

- Plants must supply electricity and heat (eg district heating), and the operating economy must include heat supply.
- Priority will be given to plants based on residual products from biomass (eg wood chips and straw) or waste. Possible income from the receipt of waste must be included in the operating economy
- RE gasification plants not engaged directly in electricity generation, but producing gases to be used for electricity generation in combination with other fuels can also be prioritised for operating aid. However, in these cases reliable documentation for the share of electricity which the gasification plant contributes to besides the value of the plant's heat production must be included. An example could be a gasification plant connected before a power station boiler.

Other generation technologies based on renewable energy sources

- Plants must supply electricity and heat, if possible (eg district heating), and the operating economy must include possible heat supply.
- Plants must be able to document that the energy source is based on renewable energy sources.

Technologies for promotion of small-scale RE-based production technologies

- Intelligent control (Smart Grid) of small RE technologies, in order to optimally integrate them in the power system.

3.4 Explanatory remarks

Connection with other programmes

The purpose of the programme is increased utilisation of small-scale RE technologies. The objective of the programme in the development chain is dissemination and market introduction and the programme is therefore a natural extension of both the ForskEL programme and other programmes funding demonstration projects.

A ForskVE project can therefore be set up in continuation of a ForskEL project and it is thus possible to submit applications for funding under both programmes at

the same time. However, it is a requirement that two applications are submitted, where the application for the ForskVE programme is a continuation of the ForskEL application. Eg, funding for construction of plants is applied for under the ForskVE programme or similar programme, while funding for operation is applied for under the ForskVE programme.

Energinet.dk coordinates applications submitted under the ForskEL and ForskVE programmes, including applications regarding the same plant submitted for both programmes.

No funding can be provided for market introduction of plants However, provided that the plant is developed to such a degree that regular electricity generation is possible, but that there are obstacles for generation on market terms. This may be eg insufficient funding or potential buyers' lack of knowledge of the new technology.

Business plan or strategy for dissemination
Plants eligible for funding under the ForskVE programme are expected to be near-commercial. It is a requirement that the application contains either a well-founded business plan for the specific company selling the plant in question, or a more general business strategy for a commercial utilisation of the technology as a whole.

Performance-based funding
The ForskVE funding may be made fully or partially dependent on the delivered electricity generation, eg indirectly through measurement of the kWh supplied, or indirectly through eg generated effect, availability or similar.

Payment of funding thus indicates that the project has been successfully completed.

An application for fully or partially performance-based funding will - all other things being equal - have greater chance of being granted funding. On the other hand, in connection with contract negotiations, Energinet.dk may make parts of funding dependent on performance.

Communication activities
In addition to construction and operation aid, it is also possible to obtain funding for communication activities and sales and information campaigns for the purpose of promoting the use of the plant in question. This also includes communication concerning the plant's environmental properties. It is only possible to obtain communication financing for a specific project.