INVESTING IN INNOVATION: A KEY STRATEGY TO ENSURE A SUSTAINABLE FUTURE FOR EDF ENERGY NETWORKS

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ABSTRACT
EDF Energy Networks has recently recognised that investing in innovation and Research & Development (R&D) is crucial in ensuring the successful future of the company. The Innovation Funding Incentive (IFI) was introduced in 2004 by OFGEM (The UK regulator for gas and electricity companies) to reverse the declining trend in R&D investment. This scheme is one of the initiatives supported by EDF Energy Networks as part of its innovation strategy, which is presented in this paper.

INTRODUCTION
Since the privatisation of the United Kingdom (UK) electricity industry in 1990 and the consequent pressures to improve efficiency, the level of R&D investments by (DNOs) had, by 2003, steadily declined to reach a level of less than £1m. OFGEM recognised that this low level of investment would not be sustainable for the long term, and would have a detrimental effect on the electricity infrastructures. It would also affect the ability of companies to find innovative ways to manage their distribution networks.

The recently introduced IFI is currently the main scheme to fund innovation in EDF Energy Networks. This could change in the future as EDF Energy recently decided to further reinforce its commitment to innovation (e.g. membership to the Energy Technologies Institute (ETI)) and stronger links are developed with EDF R&D (France).

SOURCES OF FUNDING FOR INNOVATION

Innovation Funding Incentive
The IFI allows a DNO to spend 0.5% of its combined distribution network revenues on eligible R&D projects, (approximately £4.3m/year for EDF Energy Networks). Companies are allowed to recover 80% of these costs via ‘pass-through’ charges in their tariffs.

Since its introduction, the IFI has been widely supported by EDF Energy Networks (Figure 1) and other British DNOs. Following this encouraging start, the scheme has recently been extended to the British Electricity Transmission and Gas network operators.

The rules of the IFI regulatory framework have encouraged:
- A “decentralised” and “transparent” approach to R&D: The research is carried out by external providers (manufacturers, universities, etc) and a core team is managing the EDF Energy Networks research programme. A publicly available activity report is submitted to the Regulator each year.
- Cooperation between the British network operators: A number of projects are jointly funded by several companies, and regular meetings take place to discuss and ensure a coherent approach between the different companies.
- A strong emphasis on delivery of benefits, in order to ensure that the end customers (who are funding this scheme) receive value for money.

The definition of an eligible IFI project, as defined in the good practice guide, is: “A project will qualify as an eligible IFI project provided that it is designed to enhance the technical development of the electricity distribution networks. IFI projects will embrace aspects of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning” [1].

Together with the above definition, IFI projects also need to meet the following three key criteria:
- Technical Development - The project must be of a technical nature and related to enhancing the technical performance of a Network Operator’s network.
- Degree of Innovation - the project will demonstrate at least Incremental Innovation.
- Customer value - whether sufficient value (financial or non-financial) is delivered to end consumers if the project is successful.

Ofgem will not usually approve IFI projects, but reserves the right to audit IFI activities if this is judged to be necessary.

Energy Technologies Institute

The ETI is an organisation established as a private-public partnership, funded equally by member companies and the Government.
- The private members are: EDF Energy, BP, EON, Rolls Royce, Shell and Caterpillar.
- Public sector members are: The Engineering and Physical Sciences Research Council (EPSRC), The Department of Energy and Climate Change (DECC), Department of Transport, Department for Innovation, Universities & Skills.

The main objective of the ETI is to accelerate the development, demonstration and eventual commercial deployment of a focused portfolio of energy technologies, which will increase energy efficiency, reduce greenhouse gas emissions and help achieve energy and climate change goals.

The ETI was created in 2006. The programmes of work relating to networks, are currently being defined.

EDF R&D (France)

EDF R&D currently employs 2000 people, including 500 PhD’s and 150 lecturers. Research relating to Networks and environment represents approximately 11% of all activities. Coordination of the UK and French research programmes has been established in order to increase synergies within the EDF Group, and maximise the outputs of the two portfolios.

EDF ENERGY NETWORKS INNOVATION STRATEGY

Investing in R&D and Innovation

EDF Energy Networks has recognised that it is important not to lose sight of the future, and that the shape of that future will be informed by having a good research and development function

Following the introduction of the IFI, EDF Energy Networks has defined the following guidelines for its research portfolio:
- Align the innovation portfolio and individual projects with internal drivers and external activities from national and international working groups.
- Develop a diversified portfolio of projects and ensure that both short and long term business relevant issues are addressed.
- Make sure projects deliver tangible benefits.

Work programmes

Over the past four years, EDF Energy Networks has built a portfolio of R&D projects based on four work programmes (presented below). Key themes and major milestones have also been defined under each one of them but are not presented in this paper.

Sustainability and environment:

In order to meet its environmental obligations surrounding energy efficiency, carbon reduction and renewable generation, the UK Government is developing a renewable energy strategy. This, as well as the development of new enabling technologies will lead to an increase in Distributed Generation (DG). It is crucial that the behaviour and the effect of these embedded generators on the distribution network are fully understood and managed.

Network operations

Day to day working practices have a significant impact on EDF Energy Networks’ performance and the customer perception. It is essential that novel working techniques relating to all aspects of the distribution network (cables & overhead lines, laying techniques, fault location, etc) are developed. These will lead to improved safety for our staff and customers, as well as improved efficiency.

Asset Management

A large proportion of distribution network assets were installed more than 40 years ago. In many respects, an ageing distribution network increases the risks to the DNOs. These risks need to be managed effectively in order to ensure quality and security of supply for the customers.

Future networks

The distribution network is constantly evolving and over the past decade, the electricity industry has seen a significant increase in network automation. The next step in network development is the development of autonomous networks (i.e. minimal human intervention, automatic reconfiguration, support from energy storage technologies,
etc), able to cope with different types of generation and fault conditions.

**Budget allocation**

Approximately 85% of the IFI programme is committed to delivering the work programmes and the associated key themes, whilst 15% is used to finance smaller but more strategic projects.

EDF Energy Networks is also supporting some of the initiatives aiming to reduce the shortage of engineering skills and stimulate research in the United Kingdom. One of these initiatives was the setting up of the Power Networks Research Academy (PNRA). Its aims are to:
- Encourage graduates to undertake research in power networks related subjects.
- Establish an effective mechanism to enable power network companies to work with universities in helping to fund and support needed areas of research.

**EDF ENERGY NETWORKS INNOVATION PROGRAMME**

**Current portfolio**

The EDF Energy Networks innovation portfolio is made up of 35 live projects (primarily financed through the IFI), and is currently worth around £15m. It is expected to deliver several tens of millions of pounds worth of benefits over the next few years, as an increasing number of projects reach the implementation stage.

Figure 2 shows how some of the projects map with the work programmes.

**Example of current R&D projects**

**Waste heat recovery**

Project description: Substation transformers produce waste heat which is usually lost to the environment. A new substation will use grid transformers with water cooled heat exchangers to assist the Tate Modern art gallery (London) with its building heating process.

Main benefits:
- Re-usable energy efficient solution.
- Fewer maintenance interventions for cooling.
- Reduced auxiliary electricity consumption.
- Lower noise level from coolers.

Project status:
System expected to be operational by April 2009

**FENIX (Flexible Electricity Networks to Integrate the eXpected ‘energy evolution’)**

Project description: The objective of the FENIX European project is to boost the integration of Distributed Energy Resources (DER) by maximising their contribution to the electric power system, through aggregation into a Large Scale Virtual Power Plants (LSVPP).

Main benefits:
- Maximise the contribution of DER to the electricity network.
- Reduction of carbon emissions.
- Optimising network utilisation through real time balancing of DG, Demand Side Management and network capacity.

Project status:
Several demonstrations are being carried out in the UK and Spain.

**On-line condition monitoring**

Project description: The use of partial discharge measurement is a well known method of checking the condition of electrical insulation. Over the past nine years, EDF Energy Networks has been actively involved in the development of online partial discharge monitoring and mapping techniques.

Main benefits:
- Preventive online faults detection, location and repairs.
- Development of a cable replacement strategy.
- Quality of supply improvement.

Project status:
- Several switchgear failures have been prevented.
- An increasing number of cable sections have
successfully been preventively replaced following the detection and location of incipient faults.

Innovative leak location of fluid filled cables

Project description: Development of an innovative method for locating leaks in fluid filled cables, involving the addition of Perfluorocarbon Tracers (PFTs). When the PFT reaches the leak in the cable it disperses into the atmosphere and can be detected using a bespoke test instrument (mass spectrometer or gas chromatograph).

Main benefits:
- Faster and more accurate fluid leak locations.
- Operational cost savings with fewer and smaller excavations.
- Reduced impact on environment.
- Reduction in network risks as the process can be applied with the circuit live.

Project status:
13 leaks have so far been located in 14 excavations. The savings per leak is estimated to be in the region of €35k.

Vulnerable customers Uninterruptible Power Supply (UPS)

Project description: This project aims to develop a solution (Fuel cell powered UPS) that provides continuity of electrical power to vulnerable customers (e.g. requiring medical equipment).

Main benefits:
- Minimise the impact of power cuts on vulnerable customers.
- Improved utilisation of fault restoration resources.

Project status:
An engineering demonstrator has been developed.

Challenges and Delivery of benefits

EDF Energy Networks’ innovation portfolio is relatively “young” and the transition towards a more R&D oriented organisation has not been easy. Communications has played a vital role in ensuring the right level of engagement from the rest of the business, and the acceptance that change is necessary.

Delivery of benefits and business deployment is also vital to the success of the overall innovation portfolio. EDF Energy Networks has therefore defined and implemented the following:
- A project selection and scoring methodology.
- A rigorous project management and review process.
- A project lifecycle (Figure 3).

Following the closure of the Research, Development and Demonstration phase, and following satisfactory migration towards business deployment, the involvement of the R&D team is progressively reduced.

An estimation of the financial benefits (NPV) is carried out and reviewed at key stages throughout the project. This is done to ensure that the projects can be stopped if necessary, and to verify that following deployment, the expected benefits have been fully achieved.

CONCLUSION

Since its introduction, the IFI scheme has been very successful. Almost 200 research projects have been started by the UK DNOs, and an increasing amount of financial benefit is being reported. OFGEM has recently announced that the scheme will continue during the next price control review period (2010 - 2015).

As more R&D projects come to a conclusion, the portfolio matures and processes are refined, the delivery of benefits will increase. As a result, innovation is expected to become a major business support function within EDF Energy Networks.

Over the next few years, EDF Energy Networks will continue to embed R&D and innovation into its business processes. The delivery of the IFI and ETI research programmes are expected to be one of the main driving forces ensuring a sustainable future for EDF Energy Networks.

REFERENCES