

Research for Ireland's Future

Energy Strategy

Science Foundation Ireland



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Vision

Ireland will be a global knowledge leader that places scientific and engineering research at the core of its society to power economic development and social progress.

Mission

SFI will build and strengthen scientific and engineering research and its infrastructure in the areas of greatest strategic value to Ireland's long-term competitiveness and development.

1 Introduction

When it was established in 2000, Science Foundation Ireland (SFI) was charged with investing in the two areas of research that were at the time considered to be of the highest strategic importance for Ireland – Biotechnology and Information and Communications Technologies (ICT).

In May 2008, in recognition of the challenges and opportunities presented by the related issues of energy security and climate change, a third pillar was added to SFI's remit – sustainable energy and energy-efficient technologies (hereafter referred to as “energy”). This addition presents the organisation with the responsibility and the opportunity of making a significant contribution to the challenge of sustainable development. Ireland is particularly dependent on fuel imports, and is particularly well-endowed with sources of renewable energy. There are thus both supply and demand reasons why Ireland should seek to become a world centre of expertise and knowledge in the fields of sustainable energy generation and efficient energy usage.

The Department of Communications, Energy & Natural Resources (DCENR) has primary responsibility for energy policy. SFI, working within the Department of Enterprise Trade & Employment (DETE), plays a complementary and distinct role in funding and supporting world-class energy-related research.

The Irish Energy Research Council (IERC), which was established in 2006, delivered *An Energy Research Strategy for Ireland*¹ early in 2008. This provides the framework for SFI's strategy.

Among other Government agencies that have responsibilities in relation to energy Sustainable Energy Ireland (SEI), which operates under the aegis of DCENR, plays an important role in promoting and assisting the development of sustainable energy.

¹ *An Energy Research Strategy for Ireland*
<http://www.dcenr.gov.ie/Energy/Office+of+the+Chief+Technical+Advisor/Irish+Energy+Research+Council.htm>

SFI operates by investing in academic research and research teams that are most likely to generate new knowledge, leading edge technologies and competitive enterprises. Formally SFI is mandated to fund oriented, basic research in those areas of strategic importance to Ireland's economy. Energy-related research within these contexts, however, has some characteristics that differentiate it from research in the other two areas under SFI's remit:

- Energy research straddles many technological bases. As a result, energy applications and awards will be administered within the two existing SFI Directorates (Information, Communications and Emergent Technologies, and Life Sciences).
- Community building is seen as central, in addition to capacity building.
- There are immediate national interest issues that need to be addressed, such as energy stocks/supplies, regulatory policy, and international regulatory agreements and their implementation.
- Joint or related projects between Ireland and Northern Ireland are often necessary and logical. Currently this is not governed by the SFI legislation but steps are being taken to amend this.
- Social science and economics, as well as engineering and physical sciences, are key disciplines.

SFI intends to integrate energy-related research into its existing portfolio of programmes, occasionally with targeted calls for proposals, while recognising and responding to these unique characteristics. This document sets out SFI's strategic approach to developing the research base that underpins sustainable energy and energy-efficient technologies.

2 Ireland's Energy Research Strategy: Background

The vision for energy research set out by IERC in *An Energy Research Strategy for Ireland* sees 'Ireland meeting its energy system requirements in a manner that addresses the challenges of energy security and environmental sustainability, informed, underpinned and facilitated by highly motivated and strongly coordinated teams of energy researchers of world class standard operating in a stable, adequately resourced and continuous research environment.'

The IERC welcomed the Government's decision to extend SFI's remit to include energy, and expressed the belief that this would provide an excellent base for the development of energy research capacity for the long term.

IERC recommended that the relevant energy research organisations, including SFI, should cooperate in promoting and publicising fundamental and frontier activities and lines of enquiry. This should involve coordination activities with European and other research institutions. Irish research institutions should be encouraged to develop their networks in Europe with relevant centres of excellence, with a view to joining forces where warranted, and in particular with a view to developing research proposals for FP7.

Forfás (having consulted with Enterprise Ireland (EI), IDA Ireland and SFI) responded to the IERC Energy Research Strategy by pointing out that the research strategy should develop the national energy research capability and capacity so that they can address and support national social, economic and enterprise development objectives. This is in keeping with all other SFI activities. Energy research should be directed at the specific issues that need to be addressed:

- Restoring energy cost-competitiveness;
- Improving electricity generation adequacy;
- Ensuring diverse sources of electricity supply;
- Providing adequate regional energy (gas and electricity) capacity;
- Improving energy efficiency;
- Planning energy policy for the longer term; and
- Minimising impact on and impact by climate change.

Forfás also emphasised the need for research results to be commercialised – that is for new products, processes and services to be entered into the marketplace for exploitation. Roles for EI and SEI are anticipated for these activities.

3 Background Considerations for SFI's Energy Research Strategy

When SFI's remit was expanded to include energy, all existing SFI award programmes were opened to applications in the broad area of energy and SFI's support for energy-related research was widely disseminated, with the aim of attracting more researchers into this area.

SFI is strongly committed to supporting research and underpinning technologies in the sector-specific fields listed in the IERC *Energy Research Strategy*:

- Ocean Energy
- Grid/Infrastructure
- Energy in Buildings
- Energy in Transport
- Sustainable Bioengineering

as part and parcel of the major strategic lines of energy research activity that include:

- Energy systems modelling and analysis
- Fundamental frontier and multi-disciplinary research which has the potential to benefit the energy sector, and
- Capacity building, in particular in the quality and quantity of science and engineering expertise.

SFI consulted with a wide range of stakeholders including industry and other interested parties, and organised a major symposium in October 2008, involving world-leading researchers and relevant industries. This process endorsed SFI's general approaches and in addition identified a number of critical issues:

- There is a severe shortage of engineers with relevant skills (in particular electrical, mechanical, civil, chemical, aeronautical, and bio), both in Ireland and worldwide;
 - All areas of energy require materials science and research in this area should be redirected to address problems relevant to energy;
 - Multidisciplinarity, based on collaborative teams, is often necessary for progress;
 - Infrastructure, and in particular the power grid, is an essential concomitant of energy.
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It was noted that dealing with energy issues is particularly complex, due to the extent to which energy issues are intertwined with other policy areas. The closely coupled areas of energy, environment and climate present urgent social challenges, and – the reverse side of the same coin – significant opportunities for science and technology, for engineering and for business innovation.

The task facing us is daunting. For example, according to the International Energy Agency (IEA), €30 trillion must be invested worldwide by 2050 in order to reduce CO₂ emissions by half. This investment is needed to create the necessary changes to our transport systems and our urban physical infrastructures, and to prevent and/or recover from the effects of extreme and exceptional weather events.²

SFI's view is that, wherever possible, existing areas of investment should be leveraged so that they yield returns in the energy area. Problems of climate change should be addressed in close conjunction with the various issues to be addressed in relation to energy as they are intertwined. This leads to taking into consideration at one and the same time the power and energy inputs, together with the waste and emissions outputs. The science and especially engineering of energy and waste infrastructures need to be co-developed, or developed in tandem.

In areas such as smart grids, smart houses, autonomic networks, and modelling generally, ICT has a major role to play. Therefore the science and engineering of ICT infrastructure also needs to be co-developed, or developed in tandem, with energy and waste infrastructures. In general terms, many of the issues relating to information collection, reprocessing, distribution and delivery are similar to those relating to energy distribution.

Tandem development of infrastructure means, for example, that telecommunications infrastructure and the power grid, are based on parallel systems with shared properties that include: capital and maintenance; management; security; value-chain; and underpinning support technologies such as sensor networks, and modelling based on mathematics and high performance computation.

The close relationships between these apparently separate areas, the trade-offs between them, and the likely benefits to each from developments in others, suggest that an integrated approach is likely to result in financial and other resource economies, as well as disproportionate benefits in terms of discoveries and commercialisable outputs. SFI therefore intends to foster the convergent trajectories of the sciences of information and of energy to the greatest extent possible.

² http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=263

4 Implementation

SFI is fully committed to integrating the energy remit into its functions and portfolio of programmes, as outlined below.

4.1 The Key Aspect of Partnership

SFI's activities are guided and directed by the Government's *Strategy for Science, Technology and Innovation (SSTI)*, which is a core component of the current National Development Plan (NDP).³ In relation to its energy brief, SFI is addressing the priorities identified in the IERC's *Energy Research Strategy* – cost competitiveness, security of supply, environmental sustainability and climate change – focusing in particular on energy-related fundamental and frontier research of strategic relevance and on the development of human capital.

Energy policies, and the associated research priorities, are sensitive and have widespread implications for and interdependencies with many other areas of public policy. In all its work, SFI coordinates its activities and consults with EI, IDA Ireland, Forfás, DCENR, the Higher Education Authority (HEA) and the Higher Education Institutes (HEIs), in order to deliver maximum benefit to the Irish economy and society. In relation to its energy brief, SFI will also work closely with SEI, and with a wide range of other relevant agencies that will play a central role with us in advancing research and development in sustainable energy and energy efficient technologies. These include:

- The Irish Research Council for Science Engineering & Technology
- The Irish Research Council for the Humanities & Social Sciences
- The Economic & Social Research Institute
- The Marine Institute
- Coillte
- Teagasc
- The Environmental Protection Agency
- The National Roads Authority
- The Commission for Energy Regulation
- The Central Statistics Office
- SFADCo
- The Health Research Board
- Údarás na Gaeltachta
- The National Council for Forest Research & Development
- Comhar
- The Geological Survey of Ireland
- The Office of Public Works
- Met Éireann

³ <http://www.entemp.ie/science/technology/sciencestrategy.htm>

Where appropriate, SFI will also involve other semi-state bodies, industry associations and consortia, professional and trade associations and bodies, and individual industries and businesses.

For example, SFI is currently represented on SEI's Ocean Energy Development Unit, on the EPA's Climate Change Research Coordination Committee and on a wide range of other Government and industry fora.

4.2 Existing SFI Award Programmes: Their Link with New Energy Research Themes

In view of the range of technical skills available in this Directorate, SFI has broadened the role of the Director of Information, Communications and Emergent Technologies (IC&ET) to include the development of energy research activities. The Director has the targeted support of a Scientific Programme Manager with the relevant scientific and engineering skills to manage the energy brief, with special consideration for the boundary areas that characterise energy research. This is in addition to other Scientific Programme Managers in both technical Directorates, IC&ET and Life Sciences, who contribute to monitoring and overseeing SFI's evaluation processes. Organisationally, for SFI the new energy research themes span, and are underpinned by, both technical Directorates. In this way, energy is a horizontal theme and benefits from full integration with both Directorates.

The portfolio of SFI award programmes is broad and nuanced, and includes support for research activities at each stage of a research career, with the objective of generating sustainability, intellectual property and commercial opportunities. These programmes include:

- Starting Investigator Research Grant (SIRG)
- Research Frontiers Programme (RFP)
- Principal Investigator (PI)
- President of Ireland Young Researcher Award (PIYRA)
- Stokes Professorship and Lectureship
- Research Professorship

Each of these programmes is open to applicants coming from research areas relating to sustainable energy and energy efficiency technologies, and SFI has been active in stimulating the take-up of these programmes by researchers working in relevant fields.

A Technology and Innovation Development Award (TIDA) which is designed to increase collaboration between the researcher and industry, is being expanded, and opportunities will be sought to enhance these interactions particularly in areas relating to energy.

It is expected that approximately 10% of applications in future will come from areas of research of relevance to energy that would not have been funded by SFI in the past.

The most strongly industry- and deployment-oriented layer of the SFI portfolio rests in the Centres for Science, Engineering & Technology (CSETs) and Strategic Research Clusters (SRCs). These programmes have had a significant impact both on research and on connections with industry, both international and national. Experience has shown that the CSET model works best when the scientific community involved in it has had the opportunity to cooperate on a joint programme over a number of years. This principle has been adopted by SFI in the SRC programme, and a diverse range of projects is now supported in this programme. As energy was not specifically included in the earlier calls, SFI intends to issue a special SRC call for proposals in the area of energy.

Although the energy theme is new in formal terms to SFI, there are many existing examples where work on ICT or Biotechnology overlaps with, or has benefits for, energy research, such as:

- Sensor networks (SFI CSETs CLARITY and DERI)
- Information and Communication Technology for Sustainable and Optimised Building Operation (SRC)
- Advanced Biomimetics for Solar Energy Conversion (SRC)
- Advanced Geotechnologies (SRC)
- Materials science (CRANN CSET and the Tyndall National Institute)
- Many Research Frontiers Programme (RFP) Awards, including those from the disciplines of chemistry, geosciences, and mechanical engineering
- A SFI Engineering Professorship in the area of solar energy
- A SFI Engineering Lectureship in power systems engineering
- A SFI Engineering Lectureship in wind energy

In addition, the seven Charles Parsons Energy Research Awards originally funded by the DCENR, which cover ocean energy, biofuels, power grids and other areas, are now the responsibility of SFI, and their monitoring is being integrated into the SFI portfolio.

4.3 Engineering

There are serious shortages of engineering skills in the energy area. From the perspective of the national economy and future development, there is an urgent need to grow the number of engineers graduating with the relevant skills.

The core problem is that engineering is not high on the list of degree courses chosen by those sitting their Leaving Certificate. SFI, in conjunction with other agencies that share the concern, and with Engineers Ireland as the professional body, will work to address this deficit, by promoting engineering as a career and attempting to make the choice for school-leavers more financially attractive and interesting. For example, there are registration fees in the higher education sector, and targeted support for high quality engineering students could lower this barrier to entry. The existing SFI/Dell Young Women in Engineering Scholarship Programme, which is open to all female students studying engineering, may provide a useful precedent.

Bologna-compliant Masters degrees are currently being introduced in Irish universities and Institutes of Technology. It is important that the final two years of these programmes should be used to produce as many as possible top quality engineers of relevance to energy.

In order to drive an increase and an improvement in engineering education, Ireland needs more internationally-competitive, research-active lecturers and professors to supplement those already in the system. Some success has already been achieved in this regard but much more has to be done by all, including the HEIs themselves. For this reason, SFI will emphasise energy when future calls for the SFI Stokes Professorship and Lectureship Programme are possible, and target posts for energy-related disciplines.

The need for engineers with PhDs and further degrees is also evident. SFI will consider additional support measures, including additional support for those pursuing a PhD in an engineering topic as a component of a SFI-funded project.

4.4 Interdisciplinarity and Engagement with Economics and the Social Sciences

Recognising the necessity of interdisciplinarity in relation to energy research, SFI will foster interdisciplinarity in energy-related proposals and research capability. The required level of interdisciplinarity goes beyond the obvious targets of the sciences, engineering and mathematics, to embrace the social sciences, economics, management science, art and design, the behavioural sciences, anthropology, and relevant areas of cultural studies.

SFI will ensure that none of its programmes impede such desirable interdisciplinary work. To date, the PI Programme has generally tended to be focused on a single applicant, or (occasionally) two closely linked researchers working in the same discipline. In future, SFI will encourage interdisciplinary applications in all areas, but particularly in proposals within the energy remit.

The need for interdisciplinarity within a group which has a primary discipline as its focus will also be encouraged. This could be provided by the inclusion of a postdoctoral fellow with skills that are based on training that is clearly different from that of the PI applicant. SFI is considering a programme whereby a researcher with a different scientific background (including economics or social science) can be added to an existing SFI-funded group, with supplemental funding.

5 Conclusion

The strategy outlined above positions SFI in the overall palette of activities related to energy research in Ireland.

- The focus of SFI on **excellence**, allied to strategic relevance to Ireland, is a core value, and one which will also be maintained rigorously in this area.
- The addition of energy-related and **targeted actions** through, e.g. the SRC programme, should bring a new vigour to the sector and provide opportunities for companies active in or migrating to energy to benefit from the research investment.
- The emphasis on **human capital**, and in particular the awareness of the need for special efforts to increase the number of engineers, is an extension of current SFI activities, but takes into account the special needs of the energy-related sector.
- Steps to increase **interdisciplinary research** and the joining of efforts of different research groups in Ireland is also one which has a special resonance in the area of energy, but is not unique to it.

In all of its activities SFI will highlight the challenges and opportunities for scientists and engineers who are not currently active in energy, and encourage them to consider transferring their skills to this crucial sector.

Throughout, SFI will pay particular attention to international developments, with the aim of increasing the involvement of Irish scientists and engineers, particularly in European activities, both those of the Framework Programme and those of international collaborations.

CRANN	Centre for Research on Adaptive Nanostructures & Devices
CSET	Centre for Science, Engineering & Technology
CO ₂	Carbon dioxide
DCENR	Department of Communications, Energy & Natural Resources
DERI	Digital Enterprise Research Institute
DETE	Department of Enterprise, Trade & Employment
EI	Enterprise Ireland
EPA	Environmental Protection Agency
FP7	Framework Programme 7
HEA	Higher Education Authority
HEI	Higher Education Institute
IC&ET	Information, Communications and Emergent Technologies
ICT	Information and Communications Technology
IDA	Industrial Development Authority
IEA	International Energy Agency
IERC	Irish Energy Research Council
NAP	National Access Programme
PhD	Doctor of Philosophy
PI	Principal Investigator
PIYRA	President of Ireland Young Researcher Award
R&D	Research and Development
RFP	Research Frontiers Programme
SEI	Sustainable Energy Ireland
SFADCo	Shannon Free Airport Development Company
SFI	Science Foundation Ireland
SIRG	Starting Investigator Research Grant
SRC	Strategic Research Cluster
SSTI	Strategy for Science, Technology & Innovation
TNI	Tyndall National Institute

Annex

Consultations on SFI's Energy Strategy

An Energy Symposium took place on 1 October 2008. It saw debate and presentations on a wide range of themes by national and international speakers, coming from universities and research institutes, and from companies and businesses both large and small. These included the University of Notre Dame; MIT; The Joule Centre for Energy Research and Development, Manchester; ESB International; Aquamarine Power; Bord na Móna; Purdue University; National Taiwan University; Directorate Energy Research, European Commission; Volvo Technology Corporation; M+W Zander; Big Green Innovations, IBM; and Microsoft.

An industry consultation meeting in March 2009 had participants including Intel, EirGrid, SLR Consulting Ireland, Oriel Windfarm, IBM, Microsoft, Sure Engineering, Veolia/Dalkia, Bord Gáis Éireann, PWC, Ocean Energy, Marine Renewables Industry Association, ESB Networks, Wavebob, IBEC, and ESBI.

The skills and expertise needs were noted, in areas that include: engineering, mathematics, and application areas such as ocean and deep geothermal. Challenges to be addressed include greenhouse gas abatement, European Union 2020 renewable energy objectives, and energy use in buildings, in particular the current stock in Ireland of 900,000 houses. Medium and longer term goals were referred to, relating for example to electric vehicles and the smart grid. The potential for Ireland to be a testbed for some of these technologies is a point which was raised, and one to which SFI is strongly committed. Individual discussions took place with Engineers Ireland and with many industrial and business organizations, large and small. All of these discussions helped to shape the SFI Energy Strategy.

SFI is a member of the Ocean Energy Development Unit, chaired by SEI. SFI is also represented on the EPA's Climate Change Research Coordination Committee. Plans are underway for a Smartbay coordination group, with the Marine Institute. SFI is a member also of the Energy Coordination Group, chaired by DCENR.

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