

IRISH ENERGY RESEARCH COUNCIL
AN ENERGY RESEARCH STRATEGY FOR IRELAND





IRISH ENERGY RESEARCH COUNCIL

AN ENERGY RESEARCH STRATEGY FOR IRELAND

Published for the Energy Research Council by
The Department of Communications, Energy and Natural Resources,
29-31 Adelaide Road,
Dublin 2

ISBN 978-1-4064-2147-7

PRICE €1

CONTENTS

FOREWORD	5
EXECUTIVE SUMMARY	7
1. INTRODUCTION	9
2. THE CONTEXT FOR AN IRISH ENERGY RESEARCH STRATEGY	11
2.1. Irish and International Energy-related challenges	11
2.2. Ireland’s changing energy system	12
2.3. Energy Research: The Irish, European and international context	12
3. ENERGY RESEARCH IN IRELAND TODAY	17
3.1. Introduction	17
3.2. Current energy research activity in Ireland	17
3.3. Strengths, weaknesses, opportunities	19
4. A VISION FOR ENERGY RESEARCH IN IRELAND	23
5. ENERGY RESEARCH STRATEGY FOR IRELAND – A FRAMEWORK	25
5.1. Criteria for prioritisation	25
5.2. The strategic lines of activity	25
5.3. Allocation of funding	26
6. STRATEGIC LINE 1: ENERGY SYSTEMS MODELLING AND ANALYSIS	27
7. STRATEGIC LINE 2: FUNDAMENTAL FRONTIER AND MULTI-DISCIPLINARY ENERGY RESEARCH UNDERPINNING THE ENERGY SECTOR	29
8. STRATEGIC LINE 3: RD&D IN SECTOR-SPECIFIC FIELDS	31
9. STRATEGIC LINE 4 – WATCHING BRIEF	37
10. STRATEGIC LINE 5: IDENTIFYING AND MAPPING IRELAND’S ENERGY RESOURCES	39
11. ALIGNMENT WITH SUPPORT POLICIES FOR INNOVATION IN SUSTAINABLE ENERGY RELATED PRODUCTS AND SERVICES	41
12. IMPLEMENTATION AND COORDINATION	43
13. APPENDIX I – IRISH ENERGY RESEARCH COUNCIL REMIT	49

FOREWORD

As Chairman of the Irish Energy Research Council, I am pleased to present the Council's Energy Research Strategy for Ireland. In developing this strategy, the Council's aim has been to meet the requirement set out in the Government's Energy White Paper and the request made to the Council by the Minister for Communications, Energy and Natural Resources.

I believe that this strategy has the potential to create the conditions for the emergence over time of a well-rooted, productive and enduring Irish energy research sector to underpin the many changes we are sure to face over the coming years and help meet the challenges of moving to a more sustainable energy future. We now present it to the Minister as a basis for the consultation phase with energy and research stakeholders. We would urge all those interested in and affected by energy research to engage whole-heartedly with that process. We look forward to Government adoption of the resulting strategy for Irish Energy Research.

I would like to record my thanks to all of the Members of the Council for their work in bringing this Strategy to its present form. The wide range of essential expertise which they brought to the Council's deliberations, together with the commitment of their time made it possible to reach agreement on many different issues as the deliberations progressed.

In preparing the Strategy, the Council would like to acknowledge the assistance of Dr. Heather Greer of Network Resources Limited who assisted the Council in discussing, formulating and drafting the strategy and the Department's Secretariat for their unrelenting commitment and support to the Council's work.

Lorcan Lyons
Chairman,

Irish Energy Research Council
31st March 2008.

EXECUTIVE SUMMARY

INTRODUCTION

This Energy Research Strategy 2008-2013 has been prepared by the Irish Energy Research Council at the request of the Minister of Communications, Energy and Natural Resources. The Strategy focuses on the approach that should be taken towards basic and applied research to underpin new energy conversion, distribution and end use technologies.

The current status of energy research and energy research needs have been taken into account in formulating the strategy which sets out a vision for energy research in the mid-term. The overall framework for development includes a set of priority research areas for the short and medium term and a set of strategic actions for advancing these. The strategy also addresses implementation, institutional and coordination arrangements.

THE CONTEXT FOR IRISH ENERGY RESEARCH AND DEVELOPMENT

The need to respond to climate change and energy security challenges is the backdrop to the development of this strategy. The future development of the Irish energy system as set out in the Government's Energy Policy framework also create an imperative for energy research to support the ambitious targets set by Government, particularly in relation to renewable energy and energy efficiency.

The strategy is also informed by the European and international context. Ireland has a relatively low level of energy R&D spending by comparison to similar sized OECD countries. Structural changes at EU level have increased the relative importance of coordination and international linkages in energy R&D activities.

A review of the current status of energy research in Ireland reflects the historically low levels of investment (c. €6m in 2005) with fragmented research effort on a wide range of topics.

This context forms the backdrop for an examination of the existing strengths and weaknesses, as well as the opportunities and threats that now present themselves.

VISION AND FRAMEWORK

The Strategy sets out the Council's vision for energy research as:

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 strategy recognizes that while urgent action is needed, growing excellence in energy research and development is not an overnight exercise and sustained commitment over the long term is required. A strong research capability built up in this way will also provide a resource for innovation in energy-related products and services.

The strategy proposes a Framework with a set of selection criteria, a number of priority energy research areas for both the short and medium terms, a set of five major strategic lines of activity and a funding apportionment for the various lines.

The strategy describes the rationale and proposed strategic actions for each of the following major areas of research activity:

- Energy systems modelling and analysis
- Fundamental frontier and multi-disciplinary research
- Energy RD&D in a limited number of sector-specific fields
- Research support in identifying and mapping Ireland's energy resources
- Maintain a 'watching brief' for technologies of potential application in Ireland

The sector specific-fields identified as priority areas for targeted action are Ocean Energy, Grid / Infrastructure, Energy in Buildings, Energy in Transport and Sustainable Bioenergy. The strategy sets out the factors influencing the selection of these areas as well as suggesting some potential research topics which could be pursued. While there is concern not to spread any available funding too thinly, the strategy acknowledges that proposals in areas other than these which can present a justifiable case for funding should be considered for support.

The Council has held to the view that the primary purpose of the strategy is to create the basis for building the capacity to solve important energy technological and policy problems. It recognizes that the future market for sustainable energy technologies will be significant and that energy R&D capability has the potential for supporting innovation in energy related products and services and resultant commercial spin-offs. This should be supported by existing enterprise and innovation support schemes.

IMPLEMENTATION AND COORDINATION

The strategy recommends the use of existing bodies and mechanisms to promote and support energy research. The strategy recommends that Sustainable Energy Ireland be given responsibility for energy systems modelling, R&D programmes in sector specific fields and in the area of a watching brief on developments. Science Foundation Ireland will be responsible for energy related fundamental and frontier research and the strategy recommends that the Department of Communications, Energy and Natural Resources be responsible for mapping Ireland's energy resources.

The strategy stresses the need for input from and consultation with relevant stakeholders and the need for high-level coordination, monitoring and evaluation. It also recognizes that the cross-sectoral policy perspective requires structured coordination between the relevant government departments and their agencies.

While the strategy does not address the issue of project selection in detail, it emphasizes the need to ensure excellence in publicly supported energy R&D and addresses the need for Irish research to be fully informed and coordinated with EU and international efforts.

On a broader theme, the strategy points to the need for coordination between energy and related environmental research and suggests that demonstration projects should be evaluated against established baselines with published results. In terms of overall funding planning, the strategy suggests that energy research budgets be sufficiently clearly separated from non-research programmes to provide certainty for the long term and prevent flexibility in routine budgetary management from creating situations where energy research budgets are permanently reduced in the long term.

1. INTRODUCTION

1.1 This energy research strategy for Ireland has been prepared by the Irish Energy Research Council in response to a request by the Minister for Communications, Energy and Natural Resources¹.

1.2 Energy research involves a range of investigative and knowledge-seeking activities on a continuum which includes:

- Basic research on the fundamental scientific, engineering and social science questions that underpin new energy conversion, distribution and end use technologies
- Applied research to develop new or improved energy conversion, distribution and end use technologies, products and services and to assist in their uptake including policy relevant research
- Pilot and demonstration projects to test the application of energy technology in the field, and to demonstrate the cost-effectiveness of the technology.

While all of these elements are relevant to this strategy, the Council's areas of interest mainly involve the basic and applied research phases. The Council does not focus on research and development associated with the commercialisation of specific products or services².

1.3 This strategy is based on an assessment of the current status of energy research and of energy research needs specific to the developing energy system on the island. Implicit is the recognition that Ireland's relatively small scale of energy research affects its ability to develop new sustainable energy technologies.

1.4 A key element of this strategy is the development of energy research capabilities. This development can be stimulated and encouraged, but cannot be achieved overnight. However, existing energy research strengths can form the basis for a programme which can contribute to the development of a critical mass of research excellence at the heart of our education and business sectors, as well as helping to address energy and environmental challenges.

1.5 This is a broad high level energy research strategy and not a detailed programme. It sets out:

- A vision for Irish energy research in the mid to long term
- An overall framework for energy research and development
- A set of priority energy research areas for the short and medium terms and criteria for their selection
- A set of five Strategic Lines designed to achieve and implement its vision
- A brief outline of implementation, institutional and coordination arrangements.

¹ As set out formally in *Delivering a Sustainable Energy Future for Ireland – The Energy Policy Framework 2007-2020*, Government White Paper, 2007, 3.14.7, p45.

² The term R&D is used in this document to refer to applied research involving development as well as basic research; RD&D is used to refer to activities involving research, development and demonstration.

2. THE CONTEXT FOR AN IRISH ENERGY RESEARCH STRATEGY

2.1 IRISH AND INTERNATIONAL ENERGY-RELATED CHALLENGES

2.1.1 In common with the rest of the world, Ireland faces a formidable set of challenges. An overriding concern is the challenge of addressing the environmental impacts of energy use, reducing energy related greenhouse gas emissions in all sectors of the economy. The proportion of fossil fuels in Ireland's overall energy system is still among the highest in the world. Ireland's commitments within the EU mean we must achieve a 20% reduction in greenhouse gas emissions by 2020 compared to the baseline year, and much of that reduction must be achieved by changes in our provision and use of energy, with further required reductions likely³. This means we have to:

- **Reduce demand for energy**, particularly in the transport sector and in the built environment. Ultimately it is the decisions of individuals that determine how energy is used. New technologies, more effective use of social science research and appropriate incentives and regulation are needed to achieve a rapid change in consumers' behaviour both in the purchase of energy using equipment and appliances and in their use.
- **Achieve a major switch from fossil fuels** in the provision of electrical and thermal and transport energy. This means realising rapid penetration by renewable energy sources including wind energy, bioenergy, solar energy and, if the technology can be developed satisfactorily, ocean energy. The technical difficulties associated with achieving such changes should not be underestimated.
- **Consider the possibility of carbon capture and storage**, where fossil fuel electricity generation remains. This would apply particularly to any continued use of coal as a primary energy source for electricity.

2.1.2 A further serious concern is the challenge of maintaining security of energy supply. Ireland has limited indigenous fossil fuel resources, with no oil resources of its own, and finite reserves of natural gas. Ireland is especially vulnerable to the geo-politics of oil and gas supplies, given Europe's large and increasing dependence on fossil fuels supplied from the opposite side of the continent. The finite nature of fossil fuels represents a further spur to de-carbonise the Irish energy system to the extent that this is possible.

2.1.3 The global market for sustainable energy technology in the coming decades will be significant. Ireland currently has neither the R&D capability nor the industrial base to allow it to capture any sizeable market share for energy technology products, and it seems unlikely that we could develop the heavy engineering base needed to capitalise on most opportunities that will arise.

2.1.4 However, it is possible that Ireland could develop strong market positions in niche areas – for example, in renewable technologies with widespread potential application in Ireland where no other country yet has a dominant position, in software or in intellectual property.

³ The EU considers that greater GHG emissions reductions are required in order to avoid even greater climate change effects. The EU is leading action to achieve global action to address climate change, aiming for a 30% reduction by 2020 if other developed countries take on a similar target in the context of a wider international agreement.

There is a rapidly growing market worldwide for energy management services, and Ireland could build successful business ventures within such a market.

- 2.1.5** Ireland's energy costs have increased dramatically in recent years – at a rate greater than that of many of our competitor countries. Unit energy costs are now a matter of increasing concern to many businesses located in Ireland, along with the impact of future costs of carbon emissions. The move to increasing energy efficiency and to more sustainable energy sources has the potential to create positive competitiveness effects.

2.2 IRELAND'S CHANGING ENERGY SYSTEM

- 2.2.1** The Government White Paper *Delivering a Sustainable Energy Future for Ireland – The Energy Policy Framework 2007-2020* details policy on the future development of Ireland's energy system, addressing the three key policy issues of sustainability, energy security and competitiveness. The White Paper details actions, goals and targets, which will change the future structure of Ireland's energy system. These changes include:

- An ambitious firm target of 20% savings in energy demand by 2020 compared to the baseline year across all sectors with a further indicative target of 30% to surpass the EU ambition
- A greatly increased share in electricity generation for renewables (15% by 2010 and 33% by 2020), including an ambition for 2020 of 500 MW from ocean energy and 30% biomass co-firing in peat power plants by 2015
- Penetration by biofuels in the road transport market of 2% by 2008, 5.75% by 2010, and 10% by 2020, and full implementation of the *Bioenergy Action Plan for Ireland*, including capacity building for R&D activities
- Achievement of a 5% renewable share in the heating sector by 2010, and 12% by 2020.

- 2.2.2** This strategy is intended to support the targets and activities described in the White Paper. Although Ireland will be a technology taker in relation to much of the new and emerging energy technologies associated with the above, there is also the need and the opportunity for Ireland to expand its own energy research capabilities to deliver sustainable, secure, and competitive energy for the island of Ireland.

2.3 ENERGY RESEARCH: THE IRISH, EUROPEAN AND INTERNATIONAL CONTEXT

- 2.3.1** While the international attention paid to security of energy supply arising from the oil crises of the 1970s prompted increases in international public expenditure on energy R&D during the 1980s, there was no significant increase up to 2000. Private sector energy R&D expenditure declined in the same period reflecting a sharp decrease in expenditure by utilities needing to show short term profits in newly liberalised markets.

- 2.3.2** In the EU, energy R&D spend also declined in relative and absolute terms in each of the Framework Programmes in the same period. In 2000 the growing importance and urgency of European energy research, development and demonstration was recognised and the budgets for European energy research stabilised for the FP6 period. The 7th Framework and Euratom Programmes saw a modest increase in the share for energy research, although much of this is due to the sizeable allocation within Euratom towards the development of the ITER nuclear fusion project.
- 2.3.3** There have, however, been dramatic changes since 2000 in the prioritisation of publicly supported energy research activities worldwide through increased funding, the development of short to long term strategies and a new emphasis on energy R&D in the context of specific goals and plans for early deployment.
- 2.3.4** Public support for energy research is growing in almost every region of the developed world, and developing countries such as India and China are investing heavily in their own energy R&D. There is increasing concern globally to develop new sustainable energy technologies and a growing determination to accelerate the development and penetration of low-carbon energy technologies.
- 2.3.5** Ireland has made progress since 2002 in terms of energy R&D policies, but is still substantially behind a number of other IEA member countries. According to the European Commission, R&D on the exploitation of ocean systems for power generation is at present in the budget of five Member States – United Kingdom, Ireland, Denmark, Sweden and Portugal⁴.
- 2.3.6** Ireland's expenditure on energy R&D has been relatively low when compared to other IEA member countries. For 2005, Ireland spent 0.07% of GDP on energy R&D and this is in contrast to the spending patterns of countries similar in size to Ireland: Denmark (0.30% of GDP); Netherlands (0.27%); Norway (0.30%); Switzerland (0.43%)⁵.
- 2.3.7** In terms of overall public energy R&D expenditure, Ireland is in a similar position to the Czech Republic (0.07%)⁶; Greece (0.06%); Spain (0.05%); Hungary (0.04%)⁷.
- 2.3.8** In terms of national research and innovation policy, the publication of the Strategy for Science, Technology and Innovation [SSTI] in June 2006 was a significant development. The SSTI contained a section on energy research, which recommended the establishment of the Energy Research Council. Subsequently the National Development Plan 2007-2013 set out an energy research sub-programme, with €149 million to be invested over the period of the plan on sustainable energy actions and capacity building, and on further initiatives consequent on the research recommendations of the Council.
- 2.3.9** Ireland's share of funding from the EU Framework Programmes for energy and energy-related projects has been in steady decline. This may be due in part to the increased availability of public research funds within Ireland itself and in part also because the European Commission has moved progressively towards fewer and larger projects in which smaller Member States have greater difficulty in participating.

⁴ European Commission (2007) *Draft Capacity Map of Energy Research in EU Member States*. Brussels.

⁵ (*ibid*)

⁶ Figure for 2003

⁷ The above figures are directly from International Energy Agency (IEA) *Review of Energy Policies 2006* pp 370

2.3.10 It is also in part due to a relatively low level of success by Irish proposers to the ‘sustainable energy systems’ component of FP6. Irish participation in proposals was at a reasonable level proportionate to other EU Member States, but the rate of funding approvals was low⁸.

2.3.11 The relative lack of attention paid to coordinating energy research activities in Ireland with those at the European level is another barrier to participation in the Framework Programmes. The reality is that the approach to organising energy research in Europe is changing. Key features of relevance to the energy field of recent (and especially the current) Framework Programmes include:

- The establishment of Technology Platforms (TPs) for many of the important fields of energy technology research, increasing the level of coordination of energy research in Europe
- The development by some of the TPs of Strategic Research Agendas (SRAs) as roadmaps for coordinated R&D aimed at accelerating progress
- The creation of large-scale, highly coordinated research projects addressing not one but many research problems in a given field
- An objective to develop large-scale distributed centres of excellence in energy research in Europe, to enable European research to compete more effectively with large national laboratories in countries such as the USA and Japan.

2.3.12 These organisational developments make it more difficult for smaller Member States to participate in EU-level energy research. They also increase the importance of coordination of energy research at Member State level, to improve coordination at the European level. The European Commission’s ERANET Scheme – a Member State networking scheme aimed at achieving greater coordination between European and Member State energy research programmes and activities – is therefore of vital importance to smaller Member States such as Ireland. Effective participation in the ERANET scheme in turn requires strong coordination at national level.

2.3.13 In March 2008, the Spring European Council adopted the Strategic Energy Technology Plan (SET Plan) for energy research to cover the period up to 2050⁹. The vision it seeks to achieve is of:

“...a Europe with a thriving and sustainable economy, with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies as a motor for prosperity and a key contributor to growth and jobs. A Europe that has grasped the opportunities lying behind climate change and globalisation and that is contributing to addressing the global energy challenge, including increasing access to modern energy services in the developing world.”

2.3.14 The SET Plan will guide and shape both Member States’ and European level energy research priorities, objectives, targets and programmes up to 2050, including Ireland. The aspects

⁸ *Energy Research, Development and Demonstration in Ireland, 2005*, Bazilian M, MacNamee B and McLoughlin E. Sustainable Energy Ireland, 2006, p 4. In relation to the general issue of Irish participation in FP7, it should be noted that there is now a revised structure in place – the National Support Network based in Enterprise Ireland – to encourage researchers and enterprises, where appropriate, to avail of opportunities within the programmes.

⁹ The *European Strategic Energy Technology Plan (SET- Plan)*, November 2007

most relevant to Ireland include the emphasis on accelerating development of renewable, grid integration, storage and energy efficiency technologies, on pooling resources through collaboration, specific joint actions and greater levels of knowledge sharing and finally on tackling the human capital shortages in energy research.

- 2.3.15** Ireland is a Party to a number of international conventions whose aims if achieved will impact on future energy systems being developed in Ireland, the EU and globally. The most notable of these is the UN Framework Convention on Climate Change (UNFCCC), which provided the international forum to address climate change. A number of activities, systems and mechanisms established under the UNFCCC have enabled the development and piloting of innovative sustainable energy solutions, and also global diffusion and transfer of sustainable technologies. Awareness and engagement with these systems and processes can provide avenues for development and utilisation of innovative research from Ireland as well as enabling access to global markets.
- 2.3.16** While the primary focus of this strategy is aimed at addressing energy needs and issues particular to Ireland, it is vital to ensure that Irish energy research be outward-looking in order to maintain relevance and to avoid unnecessary overlaps and duplication of effort. It is also vital to ensure adequate European and international linkages between an Irish energy research programme and those elsewhere.

3. ENERGY RESEARCH IN IRELAND TODAY

3.1 INTRODUCTION

3.1.1 Energy technology has not been a high priority for Ireland in the past. Economic development came relatively late, compared with most other western countries.

3.1.2 While Irish industry responded to the rural electrification scheme in the 1950s by developing and manufacturing electrical products, the small domestic market could not sustain such an industry in the longer term, and energy-related engineering industry more or less died out. There was, therefore, little impetus or support for a tradition of long-term energy technology research and development in Irish institutions.

3.2 CURRENT ENERGY RESEARCH ACTIVITY IN IRELAND

3.2.1 2005 is the latest year for which data are available on Irish energy research, development and demonstration activities¹⁰. *Energy Research, Development and Demonstration in Ireland, 2006*, published by Sustainable Energy Ireland (SEI), reveals that approximately €12.8 million was spent on energy RDD activity in Ireland¹¹, the sources of funding being as follows:

Table 3.1: Funding sources and amounts for Irish energy RDD – 2005

FUNDING SOURCE	2005 FUNDING
Irish Government sources	€8.7 million ¹
EU sources (FP5/6; IEE ²)	€1.8 million
Own funding	€1.4 million
Other private funding sources	€0.9 million
Total energy RDD funding – 2005	€12.8 million

¹ Of which €6.3 million was provided by SEI, and a further €0.76 million by Enterprise Ireland

² Intelligent Energy - Europe programme

3.2.2 The distribution of funding in Ireland in 2005 by technology area is summarised in Table 3.2 below:

¹⁰ The primary source for this section is *Energy Research, Development and Demonstration in Ireland, 2005*, Bazilian M, MacNamee B and McLoughlin E, Sustainable Energy Ireland, 2006. The 2005 inventory is the latest available investigation into Irish energy research at time of writing. This inventory was based on a questionnaire survey, and it may omit some energy research activity not accessed by the survey.

¹¹ This compares with a total of €7.1 million spent on energy R&D in Ireland in 2003 (*Energy Research, Development and Demonstration Activity in Ireland – a Strategic Review*, Hanna B, Department of Communications, Marine and Natural Resources, 2005). This section, including the factors listed in paragraph 3.3.6, draws on the material in that paper.

Table 3.2: RDD spend by technology area (2005)

TECHNOLOGY AREA	PERCENTAGE OF FUNDING	SUB-TOTAL	TOTAL
Energy conservation	33% ¹		€4.3 million
Renewable energy	29%		€3.6 million
Wind energy		€1.45 million	
Biomass		€1.03 million	
Ocean energy		€0.61 million	
Small hydro, solar, geothermal		€0.56 million	
Cross-cutting technologies and research	23%		€2.98 million
Nuclear fission and fusion (ITER)	7%		€0.91 million
Power and storage technologies	5%		€0.60 million
Fossil fuels – oil, gas, coal	3%		€0.36 million
Total	100%		€12.8 million

¹ Almost all of this (96%) was spent on projects in the residential and commercial sectors.

3.2.3 The inventory for 2005 included 191 separate RD&D projects. The average funding per project was €66,889. €6.9 million was spent on R&D projects, and the balance of €5.9million was spent on demonstration projects. The project with the largest external funding (approximately €0.78 million) was Ireland's participation in international nuclear fusion research (ITER). Seven projects received funding of €0.28 million or more, while at the lower end 109 projects received funding of up to €40,000. Almost half (49%) of the projects were carried out in educational establishments. Industry projects accounted for 17%, public sector, housing construction, community and other organisations for 32%, and public research institutes for 2%.

3.2.4 The EU Framework Programmes (FP5 and 6) provided between them a total of €0.45 million¹² in 2005, a small amount in relation to the size of the Framework Programme budgets for energy RD&D.

3.2.5 The analysis in this inventory shows that in absolute terms the scale of energy research in Ireland is small, with only c. €6 million spent on energy R&D in 2005. The average size of most projects is very small and the research effort is fragmented and carried out by a wide range of organisations on a wide range of energy related topics.

3.2.6 €1.5m was invested by the Marine Institute on Ocean Energy in 2004 and 2006 and significant funding has been allocated in 2006 – 2007 through the DCENR Charles Parsons Awards (€20m over the period to 2013) and through SFI ICT and Biotech research projects that have application in the energy area (c. €16m).

¹² €0.78 million was also provided from Euratom for fusion research (ITER), and a further €0.6 million came from other EU sources.

3.3 STRENGTHS, WEAKNESSES, OPPORTUNITIES

Below, some of the main strengths and weaknesses in the current Irish energy research system are listed, together with some of the threats and opportunities that now present themselves.

3.3.1 Key strengths in the Irish energy RD&D system include the following:

- Some well-established centres for research into specific fields of energy research
- Though small in number, some highly qualified and experienced energy research leaders, some with extensive experience and strong international reputations and networks
- Because of large funding and a strategic focus on building research strengths in areas such as ICT, biopharmaceutical research, nanotechnology, some highly qualified teams of researchers potentially capable of undertaking important fundamental research into energy related areas
- Good and growing cross-border cooperation
- An active network of organisations and public sector agencies already engaged in and/or supporting cross-sectoral energy and/or environmental research
- Established state agencies with programmes that can support energy and environmental research, innovation and commercialisation in Irish industry
- Membership of the EU and the IEA, and in a small number of cases strong existing links between Irish research groups and important European energy research networks
- A strong and clear level of Government support for energy research, development, demonstration and innovation, with some well-run, easy-to-access funding and support schemes in place, albeit established relatively recently

3.3.2 Weaknesses in Irish energy research, though relatively small in number, are nevertheless very significant:

- No real tradition of energy research or energy engineering in Ireland
- Little of the medium and heavy engineering industry required for many of the important fields of energy research and development
- Until recently, no real Government support for energy research, and very low levels of irregular national funding tranches for research in this field
- No State agency with a RD&D programme for energy similar to those that exist for environmental research (EPA's STRIVE) or marine research (Marine Institute's Marine Research Sub-Measure)
- Much of the funding to date allocated to demonstration projects (mostly involving technology transfer) rather than to fundamental or applied research
- State funding programmes of relevance to energy exist in all key sectors, but there has been little coordination of these programmes

- Research groupings of very small scale, well below critical mass in most cases
- Energy research effort fragmented and small in scale, with little or no national coordination
- Low and still falling numbers of students opting for careers in engineering and science – falling numbers of enrolments in third level courses in engineering and science
- Poor and declining participation in EU energy research programmes

3.3.3 To list threats is to imply that there is something to be threatened. In reality, the Irish energy research system is at the present time so small and insignificant (relative to the scale and organisation of energy research elsewhere) that the threats listed are more to do with strategic national issues than with Irish energy research per se:

- Ireland needs energy related research capability to inform future decisions and implementation in all sectors and involving all energy end uses
- Lack of contact between Irish research and technology developments elsewhere make it increasingly difficult to assess the applications of new and emerging technologies in this island. Ireland's participation in international energy research programmes has been low to date
- A sizeable increase in national funding – especially when accompanied by relative ease of accessing those funds – could lead to a further turning-away from European and other sources of funding for energy research
- There are energy-related problems of significant proportions facing Ireland, some of which are specific to a small, relatively isolated island with a climate and social and cultural characteristics not necessarily the same as those in many other countries and regions and which has enjoyed the benefits of rapid economic growth
- The small scale, and lack of funding for, energy research to date means that it is difficult – and will become *more* difficult – to attract world-class researchers to Ireland.

3.3.4 There are, however, opportunities, though these must be tempered with a sense of realism:

- A strong Government policy stance on energy research and innovation means that a shortage of funding is now not a major problem. This is set in the context of structured frameworks such as the National Development Plan 2007-2013 and the Strategy for Science, Technology and Innovation 2006-2013
- Challenging European and Irish targets for penetration of certain fuels and technologies and in relation to climate change mean that there are many opportunities for the application of research results on the island of Ireland
- Continuing economic growth provides many opportunities for deployment of new energy technologies in Ireland
- Ireland enjoys access to large renewable resources of increasing importance in developing low-carbon technologies. In some cases, the technologies are at such an

early stage in their development and commercialisation that Ireland could capitalise on opportunities to be among the world leaders. The requirements emanating from international targets on energy and climate change underscore this potential

- There is an excellent foundation of national agencies capable of administering support programmes
- There is strong and growing interest among all sections of the population – and especially among the young – in issues such as climate change, the environment and sustainable energy. Sustainability could become a focal point for revitalising higher education in engineering, technology and the sciences
- As members of the EU, English-speaking and members of the Euro-zone, Ireland could participate more fully in major European and international energy research programmes and projects, and could carve out niche strengths that would enable it to contribute meaningfully to such programmes and projects
- Since there are many opportunities for discoveries relevant to energy and the environment in areas of science outside of engineering, and since Ireland has developed strengths in some of these areas, important fundamental research in Ireland could lead to significant advances in knowledge

3.3.5 Strategically, crucial factors are those where a weakness can be associated with a threat, or a strength with an opportunity. These include the following:

- The need to build scale in key areas of Irish energy research, and the need to target efforts
- The need to commit to an ongoing, structured programme of energy research capacity building with consistent adequate funding
- The need to harness research strengths in fields not traditionally associated with energy and environment
- The need for strong coordination, within Ireland, between north and south, and between Ireland and Europe (and the need to identify and remove barriers to coordination)
- The overriding need for well-informed policy decisions in relation to energy and environmental issues across sectors
- Urgency in developing research strengths in new and emerging technologies, particularly where Ireland itself has sizeable energy resources to draw upon

3.3.6 Both at European level and globally, an ever increasing focus on developing and implementing climate change policies and related implementation mechanisms will promote and emphasise sustainable energy and environment-related research programmes. These initiatives may create significant funding and collaboration opportunities from which Irish researchers can benefit and ultimately assist sustainable and low carbon energy use in developing countries.

4. A VISION FOR ENERGY RESEARCH IN IRELAND

4.1 The Irish Energy Research Council's vision for energy research in Ireland is of the following:

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.

4.2 There is clearly a time dimension to this vision. To some extent there is urgency attached to all elements of the vision, yet growing a centre of excellence in energy research and development will take time and prolonged effort, requiring a continuing adequate and predictable commitment over the long term, not least because growing research capacity is itself inherently a long term activity. Hence, while the main focus of this strategy is on the period of the current National Development Plan up to 2013, the Council emphasises the need for a certain, predictable and long-term commitment to energy research over the coming decades.

4.3 The key deliverables from this vision for energy research in Ireland are as follows:

- Increased critical mass in energy research in Ireland
- Increased number of PhDs and Post Doctoral research in energy
- Improved research support infrastructure for energy research in Ireland
- Comprehensive support for the development of energy and environmental policies for Ireland
- A more coordinated and focused approach to energy research on the island of Ireland

4.4 While the actions proposed in this strategy are designed to achieve this vision, they should also generate other desirable side effects and outcomes, particularly from the enterprise and science policy perspectives, such as:

- An enhanced reputation for Ireland as a knowledge economy, including peer reviewed journal papers
- A more vibrant and appealing higher education sector in engineering, technology and relevant sciences
- Energy research base and infrastructure capable of supporting the development of industries which can produce and sell sustainable energy solutions, contributing to continued economic growth and job creation in a sector relatively new to Ireland

4.5 A strong Irish energy research capability, necessarily to be built up over the long term, will also provide a resource for Irish innovators in energy-related products and services. Furthermore, strong links between energy research bodies and industry will serve to increase the relevance of research outputs to the commercialisation agenda.

- 4.6** Though not stated in the vision itself, implicit is the imperative to maximise the potential for research to contribute to the more effective delivery of energy policies and related technologies. More energy research should provide a better evidence base for sound energy policy decisions. It can also assist with testing, demonstrating and piloting new sustainable energy technologies on a sufficient scale. In turn, such projects, properly scoped and designed can provide a very rich data set upon which further research, including policy relevant work, can be carried out. This issue of the proper use of test, demonstration and pilot projects for energy research purposes is returned to later in the strategy.

5. ENERGY RESEARCH STRATEGY FOR IRELAND – A FRAMEWORK

The overall framework for energy research and development set out in this section comprises:

- A set of priority energy research areas, for both the short and medium terms, and criteria explaining their selection
- A set of five Strategic Lines designed to achieve and implement the energy research vision set out in section 4.1
- Proposed funding apportionment of any available public funding resources

5.1 CRITERIA FOR PRIORITISATION

5.1.1 The Council has used the following criteria as a basis for developing a strategic framework for energy research in Ireland, and for identifying the areas for energy RD&D of the greatest relevance to Ireland and to guide priorities in allocating resources:

- The extent to which research in a given field/topic addresses problems relevant to meeting our own energy demand needs
- The extent to which it addresses challenges in some way particular to Ireland and countries like Ireland
- The extent to which there are existing proven research strengths in Ireland, adequate for building a meaningful programme of further research in a given field
- The extent to which research activity in the given field/topic would be likely to represent value for money, especially recognising that significant public funds will be invested in priority areas, and recognising the scale of the R&D effort outside of Ireland. Energy R&D takes place within a competitive market of global dimensions, and Irish energy R&D must be able to compete within that market.

5.1.2 It is important to emphasise that while the Council has developed a set of priorities based on these criteria, it leaves open the potential to develop capabilities in other areas of fundamental and/or applied research outside of the priority areas where support can be justified.

5.2 THE STRATEGIC LINES OF ACTIVITY

5.2.1 The Council proposes five major lines of energy research activity:

1. Development of research capacity for energy systems modelling and analysis
2. Fundamental frontier and multi-disciplinary research which has the potential to benefit the energy sector
3. Energy RD&D in a limited number of sector-specific fields as follows:

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

4. Research support in identifying and mapping Ireland’s energy resources
5. Maintain a ‘watching brief’ for technologies of potential application in Ireland

5.2.2 In line with the vision set out in Section 4.1 of the Strategy, capacity building should be regarded as an intrinsic element in each of the Strategic Lines proposed here.

5.3 ALLOCATION OF FUNDING

5.3.1 A detailed costing of proposals is not appropriate in the context of this high level strategy. The Council does, however, propose an indicative spread of public funding across the elements of the strategy in Table 5.1 below. The proportions are not necessarily indicative of relative priorities. Some elements may be of high priority, but the research proposed may be inexpensive compared to other elements.

Table 5.1: Indicative spread of public funding across elements of the framework

STRATEGY ELEMENT	INDICATIVE PROPORTION OF TOTAL PUBLIC FUNDING
RD&D in Sector-specific fields	50%
Fundamental frontier and multi-disciplinary energy research	20%
Energy systems modelling and analysis	10%
Identifying and mapping Ireland’s energy reserves	5%
Watching Brief	10%
Administration and related activities including monitoring and evaluation	5%
Total	100%

5.3.2 The Council regards capacity building across all of the strategic lines as being a key foundation for future energy research, providing the base for all of the research activities identified in this Strategy.

5.3.3 Given that Ireland has only recently ramped up energy research activity, that energy research capacity building is a long term process and that many other actions and programmes in this strategy are dependent on such capacity being in place, the Council believes that capacity building should attract immediate and sustained attention. In the event that constraints arise in terms of rolling out the Strategy, including funding provisions, the Council recommends that this be accorded a high degree of importance in the immediate term.

6. STRATEGIC LINE 1: ENERGY SYSTEMS MODELLING AND ANALYSIS

6.1 KEY STRATEGIC OBJECTIVES

- Deliver an energy systems modelling, analysis and research capability to guide and inform all energy-related policy analyses and decisions needed at a national level.
- Develop and implement a programme of energy systems modelling research capable of identifying and informing future policy and energy systems options including future energy research priorities.

6.2 RATIONALE

- 6.2.1** Both energy supply and energy use cut across all sectors: residential, commercial, industrial, transport and agriculture. Furthermore, energy is delivered through three individual energy modes that represent distinct energy markets (electricity, thermal energy and transport energy). The imperative to achieve major cuts in energy-related GHG emissions means diversifying into a wide range of renewable energy sources and achieving significant reductions in energy demand and increased energy efficiency through increased uptake of energy efficient and low carbon technologies and behavioural change. All of these characteristics and requirements have increased the complexity and cross-sectoral effects in relation to energy systems and also intensify the importance of sound analysis to underpin policy formulation and decision-making. Energy modelling also needs close interfaces with modelling in connected cross-sectoral areas such as the environment and transport sectors.
- 6.2.2** In addition, consideration of Ireland's energy future is itself a complex matter. Options for policies and for energy technologies depend on many factors, not many of which can easily be specified in advance. There is a need for adequate models of Ireland's energy system and also for adequate data gathering and analysis as inputs to the modelling process.
- 6.2.3** Experience with energy systems modelling in Ireland is limited (with the exception of macro-economic modelling), but certain research capacities do exist, and the historical energy databank has improved dramatically in recent years. Ireland has access to a number of major modelling systems, but more in-depth capacity is needed to develop and use models which are specific to Ireland.
- 6.2.4** At present there are energy systems modelling resources in a number of universities and institutions both north and south of the border. However, the Council considers that what we have at present is insufficient, and that there is an urgent need to build our capabilities in this key area.
- 6.2.5** Human aspects of sustainable energy need consideration and analysis, as well as economic, technical and environmental matters. A separate research strand should focus on how to ensure increased effectiveness and maximum value for money is gained from awareness and behaviour change programmes.

6.3. PROPOSED STRATEGIC ACTIONS

- 6.3.1** The State needs access to its own energy systems modelling and related research and analysis expertise. SEI should be charged with developing its own expertise in this area for that purpose and should work closely with energy modelling experts in the other relevant institutions.
- 6.3.2** As part of this role, SEI should allocate ring-fenced funding on an ongoing basis to increase energy systems modelling research capacity and expertise in a concentrated number of the institutions with existing systems modelling and analysis capacity.
- 6.3.3** In addition, SEI should be charged with the coordination of Irish energy systems modelling and related research and analysis activities, building on existing work in this area being developed by SEI in cooperation with the Environmental Protection Agency (EPA). As part of this function, SEI should also establish mechanisms to ensure a high level of coordination on an all-island basis.
- 6.3.4** An early step should be the development of a programme of research in energy systems modelling and analysis by SEI, in conjunction with the Department. Key elements in this should be building research capacity in the use of energy models, the identification of needs for new and modified models, planning for the development of models tailored specifically to Irish needs and the design of research measures to analyse effectiveness, value for money and the human aspects of sustainable energy.

7. STRATEGIC LINE 2: FUNDAMENTAL FRONTIER AND MULTI-DISCIPLINARY ENERGY RESEARCH UNDERPINNING THE ENERGY SECTOR

7.1 KEY STRATEGIC OBJECTIVES:

- Develop research units in third level and other research institutions that attract the best researchers in the world, and that can undertake fundamental research in energy-related topics, building on existing strengths
- Assist in revitalising third level education in engineering and relevant sciences focusing on the needs of sustainable energy systems
- Create meaningful linkages and collaborations with world-leading research establishments internationally, with a particular focus on building linkages with EU-level energy research.

7.2 RATIONALE

- 7.2.1** In Ireland, our R&D strengths now lie in areas such as ICT, biopharmaceuticals and nanotechnology, while we also have strengths in areas such as materials science¹³ due to a focused approach to research funding. On the other hand, most energy research strategies and programmes adopt a fairly broad portfolio approach, and in particular they encourage fundamental and frontier research in a diversity of areas, along with cross-cutting and multi-disciplinary research. The Council believes that this approach could result in important new discoveries either as a basis for innovation in Ireland or as a contribution to Ireland's knowledge-based economy.
- 7.2.2** The key energy technologies of the future may as yet be undiscovered, and the solutions may be found in areas not traditionally associated with the energy sector. For instance, technologies based on the use of enzymes or algae may in the future dominate hydrogen production, mass production of competitive photovoltaic film may derive from further research in quantum physics, bioenergy technologies may depend on discoveries in a range of areas including plant genetics and crop management.
- 7.2.3** Furthermore, there are research problems in many of the current areas of energy research which involve materials science more than they do traditional energy research. There are also energy research challenges in the area of the social sciences.
- 7.2.4** Such fundamental and frontier energy research tends to be long term in nature, and is high risk in that much of the work is speculative. It is only rarely that business interests will invest in such research, unless they are already active within the given area and enjoy market strengths in it (ocean energy is one of the few examples of this in Ireland). Pursuing this strategic line will help develop Ireland's knowledge economy and enhance third level education.

¹³ And it is worth noting that some Irish energy-related innovation leading to the development of important energy products for global markets derive from areas such as materials science – for example, the production of low net carbon thermoplastic rotor blades for wind turbines.

7.2.5 In this context, the Council welcomes the Government's decision to extend the remit of Science Foundation Ireland (SFI) to include the areas of sustainable energy and energy efficient technologies. The key focus of SFI is the development of human capital in oriented basic research in strategic areas of scientific endeavour. SFI's funding programmes are aimed at delivering on this element of the Government's *Strategy for Science Technology and Innovation 2006-2013*. The Council believes that the extension of SFI's remit to the sustainable energy area will provide an excellent base for the development of energy research capacity for the long term.

7.3 PROPOSED STRATEGIC ACTIONS

7.3.1 The Council proposes that SFI's adoption of the areas of sustainable energy and energy efficient technologies is implemented and given practical effect as soon as possible. This could be done by, inter alia, the application of existing programmes and mechanisms, or the development of new initiatives, specifically to cover proposals in this area, preferably to include promotion. This can be developed by SFI in accordance with its remit, building on its proven experience, expertise and outcomes in fundamental and frontier research in its more established areas of ICT and biotechnology.

7.3.2 All energy research agencies, taking account of their different remits, should encourage research groups in all institutions on the island of Ireland to consider the potential of energy-related fundamental and frontier research, building on their existing research strengths.

7.3.3 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, including for the Ideas component.

7.3.4 The Council proposes that the potential be investigated for other relevant research funding bodies, such as the Irish Research Council for Science, Engineering and Technology (IRCSET) and the Irish Research Council for the Humanities and Social Sciences (IRCHSS), to recognise energy-related research, having regard to the remits of such bodies in each case.

8. STRATEGIC LINE 3: RD&D IN SECTOR-SPECIFIC FIELDS

8.1 KEY STRATEGIC OBJECTIVES

- Over time, develop research units in third level and other research institutions that attract the best researchers in the world, and that can undertake fundamental research in energy-related topics, building on existing strengths
- Assist in revitalising third level education in engineering and relevant sciences focusing on the needs of sustainable energy systems
- Provide the solutions needed for successful deployment of sustainable energy technologies within the island of Ireland, building linkages with international RD&D efforts
- Demonstrate the technical and economic feasibility of sustainable technologies in Ireland
- Build applied energy research base and associated research capacity.

8.2 RATIONALE

8.2.1 There are areas of energy research which are particularly relevant to Ireland, either because they draw on sizeable resources accessible to this island or because they are in areas of energy end use which are particularly significant in Ireland. Where these conditions exist and where there are existing R&D strengths on the island of Ireland (see criteria in Section 5.1), then a targeted effort may be justified. The Council considers that these conditions are satisfied in the cases of:

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

A summary of the factors influencing this selection is provided in Exhibit 8.1. A selection of research topics of potential relevance are summarised in Exhibit 8.2.

EXHIBIT 8.1: FACTORS INFLUENCING SELECTION OF PRIORITY SECTOR-SPECIFIC FIELDS

Ocean Energy:

- **Very large wave and marine current resources, accessible to Ireland**
- If the technology can be developed to the point at which wave energy devices can be deployed successfully in commercial, grid-connected arrays, it could provide a vast source of low-carbon energy
- Irish third level expertise in ocean energy and sea current turbine design, wave tank model testing and wave energy modelling
- Suitable device test facilities are currently in development off Ireland
- Irish wave and sea current developers currently have prototype devices at various stages of development – Ireland is among the leaders in ocean energy R&D in the world
- A comprehensive strategy for ocean energy development in Ireland has been produced (*Ocean Energy in Ireland*, Marine Institute/SEI/DCMNR, 2005)
- Potential returns very high, but risk is also high, hence public funding support is needed if progress is to be made

Grid / Infrastructure:

- Ireland's high targets and high potential for renewables penetration (together with the relative isolation of Ireland's electricity system) requires a grid and distribution network capable of absorbing multiple small-scale electricity generating power plants with variable outputs
- Ireland's high targets and potential, together with its isolation, create unique problems for its electricity networks
- Irish research programme already underway, with strong support from the electricity sector and the participation of SMEs
- Existing links with relevant research in Europe and elsewhere (including participation in the EU Smartgrids Technology Platform)

Buildings (Residential and Commercial):

- Low energy efficiency of existing buildings stock, requires retro-fit solutions
- Research is needed to tackle problems in Irish buildings at all stages – planning, design, construction, materials, occupancy and use
- High potential for energy-emissions reductions if we can accelerate progress towards zero- or near-zero carbon dwellings and buildings for commercial use, with designs acceptable to Irish occupants

- Existing Irish strengths (north and south) in energy-related buildings research, with good track record and high-level links over many years with major European research programmes and networks
- There is a strong public good element to buildings research

Transport:

- The fastest growing end use sector in Ireland, with almost 100% dependence on imported fossil fuels for private transport, and in much public transport
- Although Ireland will be a technology taker in respect of alternative propulsion systems for vehicles, there is a need for clear understanding of needs, issues and policies for penetration of low-carbon transport technologies
- Specifically Irish research is needed in all aspects of traffic management and other energy demand reduction topics
- Does not call for research expertise in cutting-edge technology development; a need to build capabilities in applications of technologies in Ireland

Sustainable Bioenergy:

- Potentially high levels of indigenous bioenergy feedstocks: bioenergy crops (including grass), woody feedstocks for second generation liquid biofuels, biogas from agriculture
- Need to replace fossil fuel based liquid fuels, particularly given the growth in emissions in the transport sector
- Potential for use of biomass (direct firing, cofiring, gasification) for thermal and electrical energy production
- National Bioenergy Action Plan has been adopted by Government, with a high priority given to research, development and deployment
- Various bodies in Ireland currently engaged in aspects of bioenergy R&D

EXHIBIT 8.2: SOME POTENTIAL RESEARCH TOPICS FOR SELECTED SECTOR-SPECIFIC FIELDS

Ocean Energy:

- Ongoing modelling and wave tank testing
- Pilot-scale device testing in real-life conditions
- Full-scale development and grid-connected testing of individual devices

Grid / Infrastructure:

- Real time monitoring, control optimisation and systems development
- Distributed generation (DG) – active networks, smart metering, demand side technologies
- Complementary generation technologies

Buildings (Residential and Commercial):

- Low-energy housing and the built environment in public and private sectors, where there are specific climatic and cultural (occupancy) issues to be addressed
- Control and management systems
- Advanced building components relevant to Irish construction methods
- Incorporation of renewable energy technologies into buildings in Ireland
- Use of buildings
- Retro-fit of energy-saving technologies to existing Irish buildings

Transport:

- Applications of new, low-carbon and demand reduction transport technologies in Irish conditions
- Traffic management systems
- Research problems arising from energy modelling and analysis activities
- Specific transport interventions and developments aimed at energy demand reduction and/or modal shift

Sustainable Bioenergy (Excluding First Generation Liquid Biofuels):

- Plant genetics for Irish growing conditions
- Crops and crop management under Irish conditions
- Second generation liquid and gaseous biofuel production utilising ligno-cellulosic feedstocks suitable for Irish conditions
- Use of biomass and biogas for thermal, electrical and motive energy production in an Irish context

8.2.2 In general, the Council is concerned that if available public funding were to be spread too thinly across the whole energy sector, this would take much-needed funds from the areas it has identified as priorities above. However, where proposals can be made which demonstrate that:

- The proposed R&D is of specific relevance to Ireland
- Research excellence exists in Ireland and
- The proposed research is well coordinated with European and international programmes and projects

then such proposals should also be considered for funding.

8.2.3 The Council notes particularly that investment in ocean energy research entails significant risk. The Council considers that this underlines the importance of adopting a balanced portfolio approach when considering the utilisation and development of funding.

8.2.4 The commercialisation of new energy technologies is not the direct aim of these priority energy research areas. However, this strategic line should also result in a desirable outcome from the enterprise policy perspective, namely the creation of an applied energy research base as a potential and complementary energy research resource for other programmes aiming to assist Irish businesses to develop sustainable energy related products and services.

8.3 PROPOSED STRATEGIC ACTIONS

- 8.3.1** A programme of applied RD&D focusing primarily on the above energy research priorities should be developed and administered by SEI, responsible to the Department of Communications, Energy and Natural Resources. Work programmes should draw on other relevant stated Government policies where these are relevant. As part of this action, SEI should promote and encourage networking and collaboration with bodies funding energy research in Northern Ireland and with European and other international energy research programmes and projects. Such collaboration and networking should be explicitly encouraged in the design and administration of an Irish energy RD&D programme.
- 8.3.2** The Council considers it vital that such programmes be firmly focussed on the applied research. Funding for applied research linked directly to innovation and commercialisation should be drawn from other sources as there are existing funding programmes for such activity.
- 8.3.3** Demonstration projects will be needed in order to show the practical application of technologies in these energy research priority areas in various conditions in Ireland. Such projects are costly, and it is important to learn from them. The Council strongly recommends that concrete baselines for the measurement of outputs and outcomes be established in advance, that consistent reporting formats be developed, with appropriate monitoring and evaluation built into the process, and that the validated results of demonstration projects be disseminated and published.
- 8.3.4** The Council proposes that the potential be investigated for other relevant research funding bodies, such as IRCSET and IRCHSS, to recognise the targeted energy research fields discussed above as priorities for supporting capacity building in research establishments. This action should have due regard to the remits of such bodies.
- 8.3.5** The programme of applied RD&D focusing primarily on the above energy research priorities should include the maintenance of a watching brief on international developments in the sectors concerned as intrinsic in research in these fields.
- 8.3.6** Close links should be established between this strategic line and the Council's recommendations on energy systems modelling and analysis. Again this should be recognised in the programme of applied RD&D.

9. STRATEGIC LINE 4 – WATCHING BRIEF

9.1 KEY STRATEGIC OBJECTIVES

- Develop the capacity to understand and interpret the outcomes of international energy technology development of potential relevance to the island of Ireland, across the whole energy field.
- Inform Government policy and any revisions to this strategy, in respect of energy research developments which may be relevant to Ireland’s energy system.

9.2 RATIONALE

- 9.2.1** There are many fields of energy research that are not included in the Council’s recommended areas for support, but that may be of relevance in developing a sustainable energy system on the island of Ireland¹⁴. There is a need to be able to understand and interpret the outcomes of such developments in the context of an energy system on the island of Ireland, since they may play an important role here in the future. Where R&D expertise does not exist in Ireland, it is important that there be the capacity to monitor and interpret developments and applications of new technologies.
- 9.2.2** ‘Watching brief’ activities may themselves lead to additional topics for research, perhaps via research studies, or limited participation in such as Technology Platforms, ERANETs, IEA Implementing Agreements and the like.

9.3 PROPOSED STRATEGIC ACTIONS

- 9.3.1** SEI should be tasked with developing the capacity to maintain a watching brief over research developments across the entire energy sector, including conversion technologies, energy for transport, and other end-use technologies.
- 9.3.2** As part of this task, linkages should be developed as appropriate with research bodies on the island of Ireland, and with research programmes and institutions elsewhere, especially within the EU.
- 9.3.3** Mechanisms should be put in place to disseminate results, to facilitate learning from all ‘watching brief’ activities and to ensure that developments relevant to Ireland are highlighted.

¹⁴Examples include renewable energy technologies such as offshore wind and solar heating and cooling, electricity production from photovoltaics, advanced coal technologies, carbon capture and storage, mid-scale energy storage technologies, transport technology options and efficient end-use technologies. Even within the targeted areas, the R&D effort is broader than any that will be pursued in Ireland, and it is essential to maintain a watching brief over all developments of potential relevance.

10. STRATEGIC LINE 5: IDENTIFYING AND MAPPING IRELAND'S ENERGY RESOURCES

10.1 STRATEGIC OBJECTIVES

- Develop and maintain an adequate inventory of Ireland's oil and gas resources in order to provide a sound basis for future energy policy and decision making
- Stimulate the private sector to explore for and extract indigenous oil and gas resources by reducing the level of uncertainty relating to key resource information issues which affect prospectivity
- Understand and have characterised Ireland's marine hydrate and marine algae resources.

10.2 RATIONALE

10.2.1 With the global demand for hydrocarbons and the need to meet Ireland's domestic energy requirements, one of the strategic goals identified in the 2007 Government White Paper *Delivering a Sustainable Energy Future for Ireland – The Energy Policy Framework 2007-2020* is to create a stable attractive environment for hydrocarbon exploration and production. It is a Government policy objective to encourage investment in oil and gas exploration off the Irish coast and to optimise the value of any oil and gas finds for Ireland, maximising exploitation of the State's natural hydrocarbon resources and increase the level of production activity.

Delivering a Sustainable Energy Future for Ireland also states:

"Ireland's ability to plan for the future in relation to the production of indigenous gas or oil is very much constrained by the limited evidence currently available. Latest indications are that there are significant hydrocarbon resources offshore Ireland. However we need to increase our understanding of our 'proven' hydrocarbon resources. Developing this knowledge will accordingly continue to be a key policy objective as it is essential to facilitate effective public policy development in this area." (p 31)

10.2.2 International research has shown the potential for marine hydrates to be a significant source of energy. The Marine Institute's recent Foresight exercise identified the presence of a substantial marine hydrates resource in Irish waters. Similarly, collaborative research by several Irish universities has indicated that the forms of marine algae found in Irish waters have the potential to be used as fuel.

10.2.3 Mapping Ireland's energy resources is a different public good task to applied, fundamental/ frontier or modelling research and as such is presented here as a separate Strategic Line.

10.3 STRATEGIC ACTIONS

- Funding should be made available for projects designed to increase further our knowledge of Ireland's marine energy resources.
- Projects involving strategic geological and geophysical petroleum research data acquisition should be given priority.
- The Department of Communications, Energy and Natural Resources should invite proposals for projects that will result in better understanding of Irish marine energy resources. It is essential that the results of such publicly funded projects be made available to the public.

11. ALIGNMENT WITH SUPPORT POLICIES FOR INNOVATION IN SUSTAINABLE ENERGY RELATED PRODUCTS AND SERVICES

- 11.1** The foregoing strategic lines are not primarily or directly intended to address R&D for commercialisation purposes. Indeed the Council is firmly of the view that the development of energy R&D must take place primarily to build our capacity to identify and solve important energy technological and policy problems. Nonetheless, there are many opportunities for innovation in sustainable energy products and services, and there is a growing number of Irish SMEs successfully competing in international markets, producing and selling such products and services which have been developed in this country.
- 11.2** The global market for sustainable energy technology in the coming decades will be significant. In a limited number of areas – for example, wave and marine current energy devices – Ireland could aim for leadership, although gaining and retaining dominant market share would almost certainly require strong international partnerships. Ireland could also compete effectively in global markets for components of energy technologies, building on specific research and manufacturing strengths.
- 11.3** The Council is of the view that the energy recommendations made in this strategy can help in establishing an energy R&D capacity capable of supporting innovation in energy related products and services and eventually the development of commercial spin-offs in these areas. There are a number of existing support schemes for innovation-driven and/or commercial R&D, operated by Enterprise Ireland and others. There is already work underway to ensure that these schemes are utilised for innovation in energy related products and services. The Council welcomes such initiatives and is hopeful that existing initiatives will result in easy-to-access enterprise support for energy-related innovation.
- 11.4** There is a need for close contact between the energy research community and the energy related business sector. The Council would like to see a continuous and effective dialogue between industry, the energy research community and the agencies involved in promoting and supporting innovation to maximise the opportunity for capturing economic benefits from energy research and ensure that energy research policies and programmes contribute to enterprise, innovation and commercialisation in the economy.

12. IMPLEMENTATION AND COORDINATION

12.1 RESPONSIBLE BODIES AND TIMELINES

12.1.1 In considering the implementation and coordination arrangements for this strategy, the principle adopted by the Council has been wherever possible to recommend the use of existing bodies and mechanisms for promoting and supporting energy-related research. There are some administrative, programme and coordination activities that would most appropriately be carried out by SEI as Ireland's national energy agency.

12.1.2 The Table below sets out the Council's major recommendations regarding the implementation of actions under each of the strategic lines in the strategy.

MAIN STRATEGIC LINES

Strategic Line 2: Fundamental Frontier and Multidisciplinary Research		
PROPOSED STRATEGIC ACTIONS	MAIN IMPLEMENTING BODY	TIMING
Develop State expertise and coordinate energy modelling and analysis activities	SEI	Initiate as soon as possible. Increase modelling capacity in 2008. First research programme to be developed before end-2008.
Allocate funding to increase permanent modelling capacity and expertise	SEI	
Ensure high level of coordination nationally and North/South	SEI	
Develop a programme of research in energy systems modelling and analysis	SEI and DCENR	
Strategic Line 2: Fundamental Frontier and Multidisciplinary Research		
Implement and give practical effect to SFI's adoption of the areas of sustainable energy and energy efficient technologies	SFI	Work to start immediately with commitment needed over the long term. Early results should not be anticipated.
Encourage all research groups to consider the potential for energy-related fundamental and frontier research	All energy research agencies	
Promote and publicise fundamental and frontier research activities	Relevant energy research organisations	

Strategic Line 3: RD&D in Sector-Specific Fields		
Establish a programme of applied RD&D focusing on priorities	SEI	Draft work programme soon as possible
Establish concrete baselines for measuring outputs and outcomes for demonstration projects with appropriate monitoring, evaluation and publication of validated results	SEI	Make significant progress on programme within the current National Development Plan period.
Strategic Line 4: Watching Brief		
Develop the capacity to maintain a watching brief	SEI	Information reports on an annual basis.
Develop linkages nationally and all-island	SEI	
Dissemination of information	SEI	
Strategic Line 5: Identifying and Mapping Ireland's Energy Resources		
Funding should be made available for projects designed to increase further our knowledge of Ireland's marine energy resources	DCENR	Work to start in 2008 with commitment needed over the long term.
Invite proposals for projects that will result in better understanding of Irish marine energy resources.		

12.1.3 The Council notes that the areas of responsibility recommended above for SEI represent a significant increase in scale on existing activities in some areas and, in others, the adoption of responsibility for new functional areas. It recognises that this will represent a significant challenge for the organisation in terms of expertise, scale and resources. Design and implementation of these programmes are necessarily long term and will take time to develop.

12.2 OVERARCHING ORGANISATIONAL AND COORDINATION ARRANGEMENTS

12.2.1 At the highest level of organisation, there is a need for the following functions in relation to energy R&D programmes and implementation. These include:

- Coordination of actors and activities to ensure that gaps are addressed, duplication avoided and policy objectives met
- Delivery and management
- Regular monitoring and reporting on progress and deliverables in relation to vision and strategic objectives

- Evaluation of outputs, results and outcomes along with process issues
- Policy formulation and adjustment in light of experience gained and changing circumstances

12.2.2 There is also a need to ensure adequate input from and consultation with the energy sector itself, energy-related industry and energy research stakeholders, including academic and research institutions.

12.2.3 There is a strong cross-sectoral element to energy-related RD&D, affecting various Government departments and their agencies, as well as the need to align energy research with the objectives of other related Government policies, specifically those on enterprise, environment and science/innovation. This will require structured coordination between the following departments and their agencies:

- Department of Communications, Energy and Natural Resources
- Department of Environment, Heritage and Local Government
- Department of Transport and the Marine
- Department of Agriculture and Food
- Department of Enterprise, Trade and Employment
- Department of Education and Science

12.2.4 The Council suggests that a high level cross-departmental/agency forum, chaired by the Department of Communications, Energy and Natural Resources, be established to coordinate and monitor all energy research activities and programmes which have a cross-sectoral aspect.

12.2.5 The Council recognises the overarching need for coordination, taking account of the many bodies and agencies involved. The Council is conscious that its own remit provides for such a coordination role.

12.3 PROJECT SELECTION/ENSURING EXCELLENCE

12.3.1 The Council did not address in detail the approach to be taken to the process of energy research project evaluation and selection under the Strategic Lines. The Council considers that these are matters to be considered by the implementing bodies. However, two major issues emerged in the context of the Council's strategic analysis, namely the need to ensure excellence and to ensure appropriate coordination with EU programmes.

12.3.2 It is vital to ensure that publicly supported energy R&D is planned and carried out to the highest possible standards, such that (a) real research results are obtained of value in advancing knowledge and making a genuine contribution to a sustainable energy system for Ireland and (b) Irish energy R&D compares to the best energy research elsewhere.

12.3.3 The general recommendations of the Council in respect of project selection/ensuring excellence are as follows:

- There should be international peer review for all significant funding proposals, to the highest practicable standards. The fact that strict application of peer review, in the same way as in the academic case, can pose difficulty in the cases of energy research projects in demonstration and policy relevant areas should be taken into account in this regard, with a more nuanced approach to be defined for such projects.
- All major research programmes and projects should incorporate strict 'Go/No-Go' milestones, such that if goals are not being met, funding should cease.
- There should be a strong emphasis – with dedicated funding and resources – on ex ante and ex post evaluation of projects. It is particularly important that demonstration projects, which can be costly and highly visible, have a strong research dimension, that this dimension be clearly spelt out at the proposal stage, and that outcomes be made explicit and published.
- The body developing and administering publicly funded R&D programmes should be charged with developing objective measures of excellence in funded projects. This could include monitoring the level of peer-reviewed publications, major events, IPR applications and the like.
- A strong international dimension as proposed above will contribute to the pursuit of excellence, provided that the cooperating international bodies are themselves working to the highest standards in R&D and have a strong track record.
- A criterion for selection of proposals for public funding of projects should be the existence of strong EU and other international linkages and networks.

12.4 IEA AND EU COORDINATION

12.4.1 The need for EU collaboration has been emphasised throughout previous sections of this strategy. In all fields of energy R&D, there is a high and increasing level of activity in the developed and indeed in much of the developing world. It is vital that Irish research be fully informed about activities at the EU and international level to avoid duplication and to ensure relevance. This is particularly the case where detailed strategic research agendas have been produced to guide European researchers.

12.4.2 The Council recommends that:

- Each body with responsibility for developing and implementing programmes of specific research activities under this strategy should be responsible for coordination of those activities in Ireland with relevant activities in Europe and elsewhere.
- Ireland should wherever possible participate in European Member State networking activities (ERANET and the like) in fields where there is active Irish R&D.
- There should be stronger national promotion of, and support for, Irish participation in EU Framework Programme projects of relevance to Ireland, building on the work of the National Support Network structure in place to encourage FP7 participation. Increased public funding from the Irish Exchequer should not be allowed to diminish participation in the Framework Programmes.

- Ireland already participates in a number of IEA Implementing Agreements (IAs), which provide a framework for international cooperation and collaboration. There are advantages to participation, and the IA framework provides a legal mechanism for cooperation. Stronger national coordination would enable Ireland to maximise the return to Ireland from such agreements. The Council recommends that a study be undertaken of Ireland's participation to date, making recommendations on how Ireland could increase the returns from participation.

12.5 COMMON IMPLEMENTATION THEMES AND ISSUES

POLICY COORDINATION AND ALIGNMENT

12.5.1 Implementation of this Strategy has the potential to enhance coordination between energy and environmental research, particularly in relation to climate change research. The aim is to improve capacity to address current issues and challenges as well as emerging issues. Explicit provision should be made for this improved coordination to be achieved, through the development of enhanced systems for information exchange and coordination of analyses between linked operational activities.

12.5.2 SEI should be requested to work closely with the EPA in relation to the environmental aspects of all energy-related research activities.

12.5.3 Learning from Energy Demonstration projects

Some programmes in various strategic lines will involve sizeable demonstration projects in many sectors and fields, whether or not they are explicitly intended to show the application of technologies in various conditions in Ireland. Such demonstration projects are costly and it is important to learn from them. Too often, pilot and demonstration projects suffer from a lack of meaningful research carried out at the time, leading to few real lessons for the future. The Council therefore strongly recommends in relation to demonstration projects that:

- baselines to measure attributable impact are identified in advance, together with associated data sources or collection processes
- consistent reporting formats are developed with appropriate monitoring and evaluation systems built into projects from the start,
- the results are published
- the data set generated is available for further research

12.5.4 Energy Research Ring Fenced

The Council recognises that there is potential for funding for energy research to be reallocated to other areas, as indeed there is potential in the reverse direction. While the efficient and effective management of multi annual budgets requires flexibility, it is also important that energy research budgets be clearly separated from non-research programmes in order to provide the certainty required and demonstrate commitment for the long term.

12.5.5 In addition to the imperative to distinguish energy research funding from that for other programmes, it is also important in the case of bodies with wider functions than energy research, to distinguish also between the goals, outputs and expected results from the energy research programme and those from other programmes.¹⁵

12.5.6 Integration of Policy Relevant Energy Research

Ensuring that policy relevant energy research, and particularly the energy modelling research strand, is supplied is only one part of the equation. The Council recognises that ensuring that the policy system can interpret and absorb higher quality and more energy policy-relevant research requires a twin track approach, on both the demand and supply sides. This approach should comprise capacity building in the public sector, particularly at policy and advisory level, as well as capacity building in academic institutions, various public sector implementing agencies and research bodies.

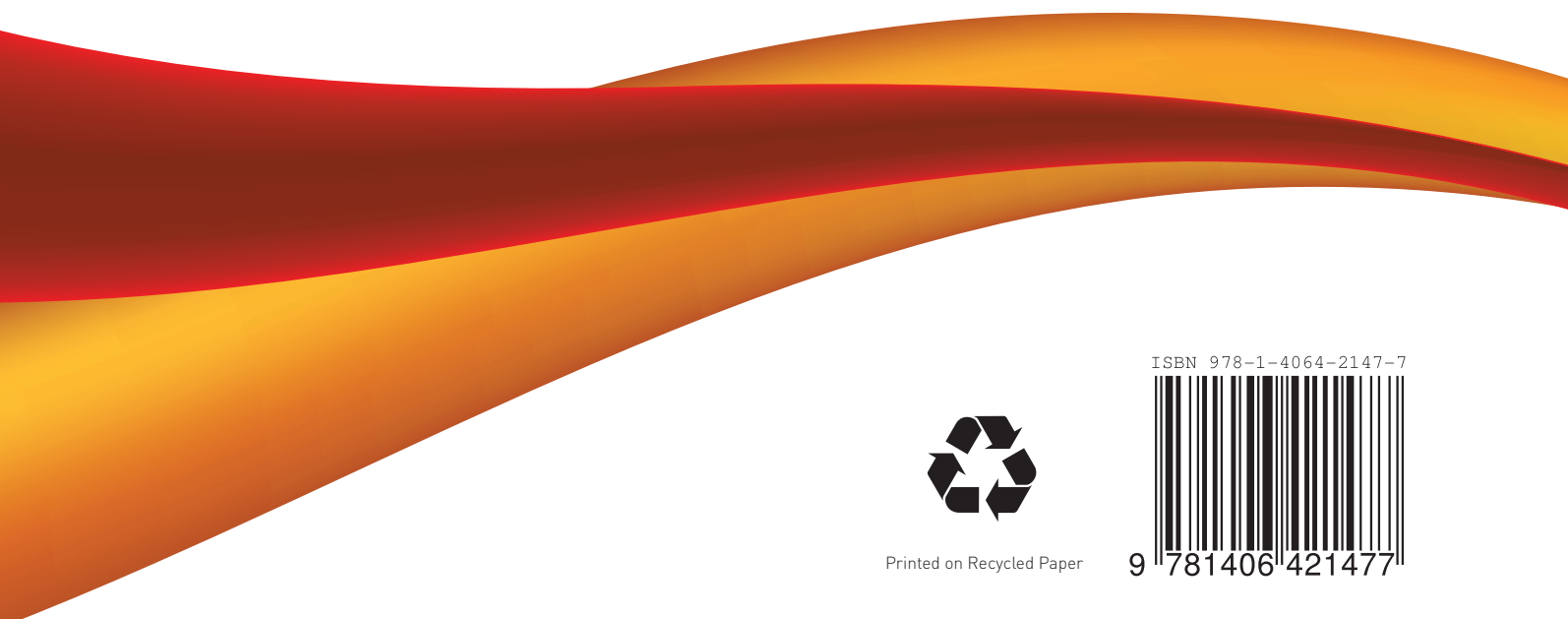
¹⁵An example is in the area of ocean energy. Within the Ocean Energy Strategy, there are research elements, prototype development elements and commercialisation elements that collectively represent a comprehensive programme to accelerate ocean energy development. In order to raise the profile of energy research, it is important to distinguish clearly between the goals, programme and funding for the research element and the other elements of the Ocean Energy Strategy.

13. APPENDIX I – IRISH ENERGY RESEARCH COUNCIL REMIT

IRISH ENERGY RESEARCH COUNCIL – REMIT

- Advise on the development of policy for energy research and on the priorities for Irish Energy Research up to 2013 and for the longer term
- Provide analysis and advice on the research capacity (human and infrastructure) required to address these priorities
- Coordinate existing energy RTDI activities in Ireland
- Facilitate positioning of energy research policy with overall energy policy as well as with policies for transport, environment, agriculture, enterprise, science and education
- Play a key role in linkages with EU and appropriate international bodies (including the International Energy Agency), and advise on coordinating the Irish engagement with the energy elements of programmes including the EU Framework Programmes
- Undertake (or commission) such underpinning analysis as required to inform policy development and strategic direction for relevant national energy RTDI programmes
- Support where appropriate major strategic research initiatives not encompassed by existing mechanisms
- Have regard to the all-island dimensions in delivery of these remits.

Details of the Membership of the Council can be found on the Department's Website:
<http://www.dcmnr.gov.ie/Energy/Office+of+the+Chief+Technical+Advisor/Irish+Energy+Research+Council.htm>



Printed on Recycled Paper

ISBN 978-1-4064-2147-7



9 781406 421477