ICSTI
IRELAND

Irish Council for Science,
Technology and Innovation

# Technology Foresight Ireland

## Report of the Energy Panel

Forfás

*Established by the Government and Forfás to advise on Science, Technology and Innovation*

# Executive Summary

### Objectives

- Identify the energy technologies and skills relevant to Ireland in the medium to long term
- Identify the policies necessary to support the uptake of these technologies and skills.

### Strategic Questions

The Panel agreed the following strategic energy questions:

- How would we maximise the benefits to Ireland of innovation in the energy sector?

  *- this means identifying new technologies, research, development and demonstration needs and business opportunities which result from innovation in the energy sector.*

- How should we manage and meet Ireland's energy demand up to 2015?

  *- this entails examining the energy technology response to Ireland's commitments under the Kyoto Climate Change Protocol, maintaining international competitiveness and addressing security of supply.*

### Recommendations

Our recommendations envisage collaboration between Government, enterprise, state agencies, education, training & research institutions, energy companies and international energy players to deliver a well resourced, clearly defined, time bound, performance based energy research, development and demonstration programme. This programme should focus on the identified key technologies.

Technologies I and II, as described overleaf and in the body of this report, are new technologies. Ireland has existing strengths in these technologies and for strategic energy and commercial reasons they must be developed and exploited. Technologies III and IV are existing technologies whose enhanced uptake will address some of Ireland's commitment under the Kyoto Protocol.

## Technology I

*New and renewable energy technologies for the electricity, thermal and transport markets, especially wave energy, hybrid energy systems, energy storage systems and alternative environmentally friendly transport systems.*

**Cost**

IR£20 million (e25.4 million) in government funding for an initial three year research, development and demonstration programme.

**Enabling Policies**

- Prepare, resource and implement a multi-annual national research, development and demonstration programme for new and renewable energy technologies
- Encourage the construction of new and renewable energy systems through an expanded renewable energy development programme
- Provide fiscal incentives to encourage investment in new and renewable energy technologies, skills and R&D
- Establish Ireland as a centre of excellence and expertise in the provision and export of emissions' trading services and products. This can be helped by licensing and supporting an energy emissions' exchange in the International Financial Services Centre.

## Technology II

*Intelligent consumer energy products*[1].

**Cost**

IR£5 million (e6.3 million) for an initial three year programme aimed at developing a number of new energy products.

**Enabling Policies**

- Provide support and incentives for integration of information technology and energy services, and for new product development
- Support the development of indigenous enterprise to exploit progress on crossover technologies
- Incorporate modules on energy enterprise and technical skills into the education and vocational training systems.

1 Examples include photosensitive lighting, motion and heat detectors and the intelligent home of tomorrow.

## Technology III

*Energy efficient and renewable energy technologies in buildings*[2].

**Cost**

IR£24 million (e30.5 million) for an initial three year programme comprising the Energy Action[3] model, personal tax relief for energy conservation measures in private housing and research into energy conservation potential in the Irish environment.

**Enabling policies**

- Revise building regulations on energy efficiency to international standard- setting levels
- Initiate a retro-fit programme for the socially disadvantaged
- Introduce personal tax relief for energy conservation activities
- Research energy use and conservation potential in buildings in the Irish environment
- Encourage the education and training sectors to act as enablers of an energy culture, through the incorporation of energy in their curricula and services' portfolios
- Ensure maximum uptake of the tax relief opportunities available for investment in solar energy technologies under the Finance Act, 1998.

## Technology IV

*Optimise the sourcing, distribution and utilisation of energy at all levels of energy consumption.*

**Cost**

IR£20 million (e25.4 million) for an initial three year programme of tax relief for CHP (Combined Heat and Power) investment modelled on Section 62 of the Finance Act, 1998.

**Enabling policies**

- National coverage for the natural gas network including extension to the western seaboard to support offshore gas finds
- Upgrade the electricity infrastructure
- Liberalisation of the Irish electricity and natural gas markets must be expedited and must occur in tandem
- Industrial planning at all levels must include integrated energy planning
- Secure the early adoption and use of advanced energy technologies[4] by enterprise through the provision of appropriate support systems
- Evaluate CHP (Combined Heat and Power) viability in all new buildings.

2 Examples include passive solar heating, daylighting, natural cooling and 'active' solar systems

3 Energy action is a charity which provides fuel poverty services

4 Examples include co generation, condensing boilers, variable speed drives, energy efficient lighting, building energy management systems and heat pumps.

## Conclusion

In the long term, Ireland must position itself in those energy technologies which offer the best commercial opportunities to the country. In the Panel's view, these technologies and skills are wave energy systems, hybrid energy systems, energy storage systems, alternative environmentally friendly transport systems and intelligent consumer energy products. To do this, Ireland must nurture and build on the expertise which exists here in leading edge energy technologies. New markets for energy products and services which are opening up will provide huge export potential for these technologies. Ireland should aim to employ 10,000 people in these areas by 2015. The export target should be IR£300 million (e381 million)[5].

The Panel agrees that Ireland will not meet its obligations under the Kyoto Climate Change Protocol without taking drastic action. If, however, the Panel's recommendations are implemented significant progress will be made towards meeting those obligations. The Panel estimates that Ireland could reduce its energy related emissions by between 3.6 million and 6 million tonnes of carbon dioxide per annum[6]. In the context of Kyoto convergence, our recommendations must be allied with significant corrective and supportive changes in Irish energy policy, management and practices at all levels.

## Action Plan

The momentum created by this initiative must not be lost. Accordingly, we recommend that:

- The Minister for Public Enterprise convene an Action Panel to secure implementation of our recommendations through:
    - - drawing up a fully costed, clearly defined, time bound implementation programme
    - - engaging the relevant implementing agencies and organisations
    - - overseeing the implementation of the programme.
- The Minister for Public Enterprise report regularly to government on programme implementation
- The recommendations of the report be integrated into the policy and strategy statements of the relevant government departments and state agencies
- From time to time an expert panel reviews this report in light of technological progress, macroeconomic changes, regulatory issues, progress on implementation, cross-cutting opportunities, environmental issues, security of supply and competitiveness issues.

5 The objective is to report the success of the Danish wind energy industry in these new technologies

6 The Panel calculated that Ireland will breach its Kyoto target by up to 6 million tonnes of $CO_2$

# Overview of the Energy Sector

The energy sector in Ireland currently employs 45,000. Our annual energy bill approaches IR£3 billion (e3.8 billion). Ireland had remarkable levels of growth in energy consumption in the last 20 years. This has derived from economic growth which has surpassed all expectations, especially in recent years.

The main trends[7] indicate that total primary energy requirement has grown from 8 MTOE (million tonnes of oil equivalent) in 1980 to 11.8 MTOE in 1997, an increase of 46 per cent. Significant changes in the Irish energy market include the discovery of natural gas fields in the 1970s, a reduction in dependence on oil as a primary energy source and the increasing consumption of coal following the construction of the Moneypoint electricity plant in 1986.

In the same period, final energy consumption[8] increased by 40 per cent from 6:23 MTOE to 8.7 MTOE in 1997.

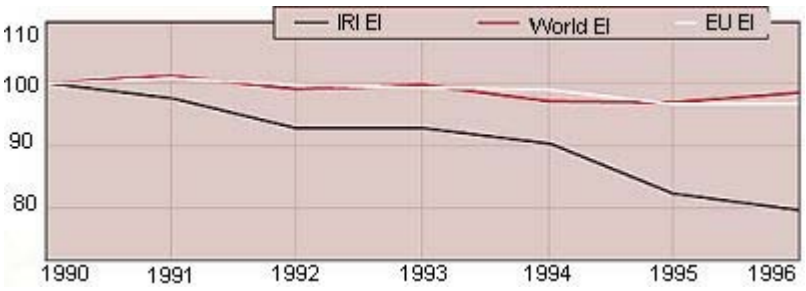
To compare more recent energy trends in Ireland with those in the European Union, and the world as a whole, it is interesting to look at the energy intensity of the economy. Figure 1 shows the energy intensity developments in Ireland, Europe and the World from 1990 to 1996. Energy Intensity is equal to TPER (Total Primary Energy Requirement) divided by GDP.

Ireland's declining energy intensity since 1990 can be attributed largely to changes in the structure of the economy. New companies coming on stream since then have been less energy intensive. The decline is also due, in some measure, to increases in energy efficiency in the period.

## Energy Technology

Energy technology has undergone many changes in recent years as summarised in Appendix II[9]. The changes have increased the efficiency of energy conversion systems and processes. The changes have also reduced environmental impacts..

**Figure 1. Energy Intensity in Ireland, EU and the World. 1990 = 100[10]**




*Energy Intensity = TPER / GDP*

7 Estimates and Assessment of Trends in Energy Consumption in Ireland 1980-1996. Irish Energy Centre, 1998.

8 Primary energy requirement less energy used in transformation (electricity production, oil refining, etc.)

9 Atlas project – Strategy for energy technologies with market potential. European Commission DG XVII, 1997.

10 CO2 Emissions from fuel Combustion 1971-1996. IEA Statistics, 1998.

# Forces of Change

Energy demand will continue to grow for the foreseeable future. There is, however, some uncertainty regarding how much it will grow by, what the supply mix will be and how energy services (lighting, heating, mobility, etc.) will be delivered to and used by the consumer. The forces of energy change raise a number of key issues regarding the future of the sector. These were identified by the Panel and used to develop strategies and recommendations.

Among these influencing forces are the size and structure of the population, changing societal values and lifestyles - including attitudes to the environment, the level and nature of economic activity, the political structures within which these activities take place, and very importantly, technological development.

The Panel categorised the forces of change into two groups, strategic and responsive forces. Strategic forces are the drivers of energy policy internationally. Responsive forces influence the pattern of energy consumption resulting from behavioural change.

## 2.1 Strategic Forces

The strategic forces are environmental responsibility, cost competitiveness, and supply security. These are the three pillars on which our energy policy rests. In the developed world, security of supply was a primary driver of energy policy following the oil crises. This has been supplanted in importance by environmental responsibility as a result of the increased awareness of the environmental damage caused by the energy sector and its related implications, such as global warming. In the developing world, on the other hand, the main driver remains security of supply. Two billion people in the world (of a total population of 6 billion) currently do not have access to modern energy supplies.

### Environmental Responsibility

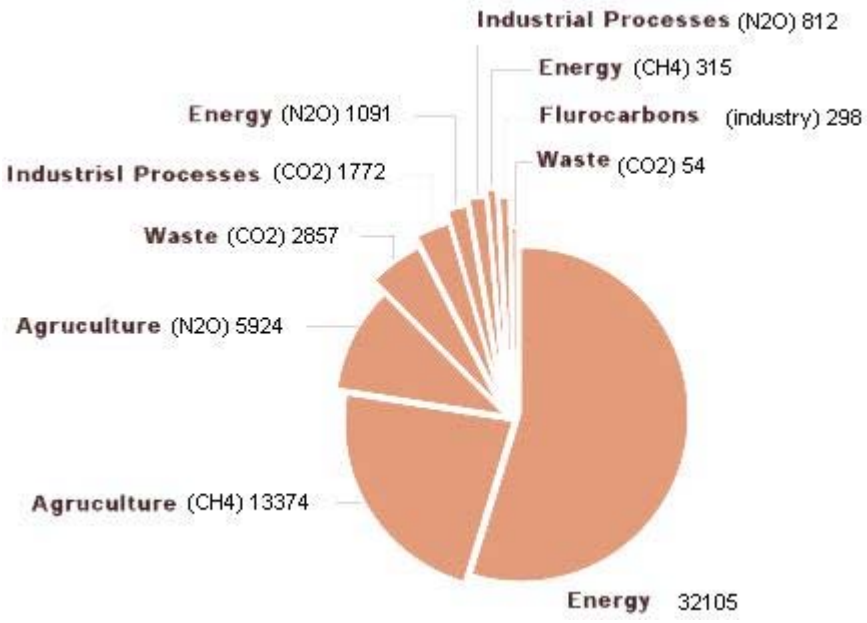
While the overriding strategic policy goal of many countries remains security of energy supplies, attention is focusing increasingly on environmental objectives. Pollution has risen dramatically with the explosive growth in economic and energy activity and human population. Energy use and production is by far the most important source of greenhouse gas emissions, representing 80 per cent of 1990 EU emissions[11]. The evidence of climate change has not only heightened concern regarding the energy future but also raised complex new questions relating to energy technology policy and associated research and development.

The Third Conference of the Parties to the UN Framework Convention on Climate Change held in Kyoto, Japan, in December 1997, agreed legally binding targets to limit and reduce greenhouse gas emissions. As a result of this Convention, the EU has made a legally binding commitment to reduce its collective emissions of a 'basket' of six greenhouse gases by eight per cent below 1990 levels in the period 2008 to 2012. In order to meet its obligation to the EU commitment, Ireland must stabilise its greenhouse gas emissions at 13 per cent[12] above 1990 levels within the period 2008 to 2012. Figure 2 shows the composition of Ireland's greenhouse gas emissions.

11 Climate Change – Towards a Post-Dyoto Strategy. Commission of European Communities, 1998.

12 **European Environment Council meeting 16-17 June, 1998 – Luxembourg.**

**Figure 2. Ireland's aggregate greenhouse gas emissions, 1995, by sector[13]**




As a result of the scenario analysis undertaken by the Panel, it is anticipated that without introducing drastic change, Ireland will fail to meet its Kyoto obligation. The amount by which the target could be breached by 2010 varies from scenario to scenario and could reach six million tonnes of carbon dioxide. This represents up to 19 per cent of our 1997 primary energy requirement.

**Cost Competitiveness**

The competitiveness of Ireland's economy in terms of energy costs is not particularly good. The high costs of heavy fuel oil for smaller industrial users need particular attention. The opening of the natural gas and electricity markets to competition over the next few years will result in more competitive pricing of energy to industry and to other users in Ireland[14].

As energy is an important feedstock of economic growth, the main emphasis in the developed world has been on lowering energy costs. In the developing world, where new markets are opening up, the emphasis is on making energy available.

As one of the most open economies in a world which is liberalising rapidly, Ireland's energy policy must take account of the competitive situation. It is quite clear that energy is an important component in our competitive mix.

For the EU also, a key policy driver is economic competitiveness. As illustrated in Figure 3, energy costs to industry in the US are lower than in the EU. Liberalisation of the energy market must close this competitiveness gap.

13 Based on ktonnes CO2 equivalent in terms of 100-year global warming potential. Source: EPA/DELG data.

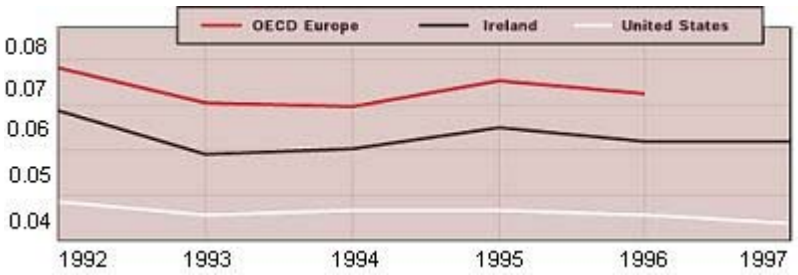
14 1998 Annual Competitiveness Report. National Competitiveness Council.

### Globalisation

A number of factors have accelerated the globalisation process in energy markets in recent years :

- The successful conclusion of the Uruguay Round of trade negotiations, which included trade in services and trade related investment measures
- Multilateral Investment Agreements
- The expansion of the European Union and NAFTA, and the development of APEC
- Corporatisation, privatisation and changed regulatory frameworks
- Political and economic developments, such as the move from centrally planned to market economies in Eastern Europe, and the expansion and increasing integration of the European Union.

**Figure 3. Electricity prices for industry in US dollars / kWh[15]**




Economic growth in a number of developing countries also means that they will be much more important players on both the supply and demand sides of the energy market than previously, creating new opportunities and challenges for established players.

### Security of Supply

Figure 4 illustrates the decrease in the indigenous contribution to total primary energy requirements in the period 1990 – 1997. The quantity of energy supplied[16] by indigenous sources is roughly equal to that supplied in 1990, derived mainly from natural gas and peat, with a small contribution from renewable energy. Since the total primary energy requirement has increased by 25 per cent in the period, the indigenous contribution has decreased relatively.

15 Electricity Information 1997. IEA Statistics 1998.

16 The indigenous contribution in 1998 was lower, however, resulting from the depletion of the natural gas reserves at Kinsale and the significant increase in imported oil for the transport sector.

**Figure 4. Relative share of indigenous to imported energy sources for 1990 and 1997**[17]


**1990: TPER = 9.42 MTOE** **1997: TPER = 11.78 MTOE**

Ireland currently depends on imports for over 75 per cent of its energy supplies. This dependence is set to increase in the future. The bulk of this external supply may come either from regions which are further and further away from its territory, which makes it more costly, or will be concentrated more and more in the same geographical area, which makes it more risky.

## 2.2 Responsive Forces

Energy consumption varies in response to structural changes in the economy, behavioural changes in society, technological developments and energy efficiency.

### Structural effects

The pattern of energy consumption at national or sectoral level is influenced by structural changes in the economy. A shift in industry towards less energy intensive production will result in an overall reduction in energy intensity.

### Behavioural effects

As individuals become better off, they seek improved quality of life and diversity of services. This greater emphasis on quality will be reflected in the demand for energy services and indeed in the quality of the environment in which we live and work.

### Technology effects

The impacts of new technology upon lifestyles may mean drastic changes in energy use. These effects can no longer be consigned to the far future. They are with us today. Our lack of experience of their effects upon the energy industry of tomorrow is one of the major uncertainties of this outlook. Developments in information and communications technology, such as increases in teleworking, virtual tourism and teleshopping, to name a few, could impact significantly on energy consumption patterns.

### Energy efficiency

Changes in energy technologies at the supply, distribution and end use stages all have an impact on energy consumption patterns.

17 Energy Balances for 1990 and 1997 (provisional). DPE 1998.

### 2.3 Key issues for Ireland to 2015

**1. Ireland's new internationally legally binding commitments under the Kyoto Climate Change Protocol and the EU Ambient Air Quality Directives**

These call for environmentally more benign energy sources and reduced fossil fuel use with lower acceptability thresholds for polluting emission levels.

**2. Liberalisation of energy markets**

Competitive energy is an important ingredient in macro-economic competitiveness and export performance. In this context, competition in energy markets is an imperative, as is the independent regulation of access to energy infrastructure, particularly electricity and natural gas networks. The liberalisation of both sectors must happen in tandem.

**3. A public/private approach to the development of energy infrastructure**

The energy infrastructure must be extended, particularly to the western seaboard, to accommodate exploitation of indigenous energy resources. The construction and access to the energy infrastructure must be open to public and private interests. Access pricing must encourage the development of indigenous energy resources.

**4. Energy research, development and demonstration in Ireland**

Ireland has a human, financial and physical capital deficit in research, development and demonstration of energy technologies. The development of key energy technologies and skills of strategic importance identified in this report must be resourced and brought to the market.

**5. The right conditions, including necessary support systems, are required for energy technologies to move forward**

Ireland must aim to be a technology maker and leader in certain strategic areas, for example in new and renewable energy technologies, such as wave energy, energy storage systems and offshore wind energy systems. The right conditions for early adoption of leading edge energy technologies must be created.

**6. Fuel security (gas availability and price) and reliability of supply (renewables) will increase in importance**

Ireland's external energy dependence could rise to 96 per cent by 2010, if there were no significant policy shifts. In Ireland, energy security means diversification of energy sources, physical interconnection, energy stocks and back-up, increasing supplies from indigenous sources, including natural gas and renewable energy, and enhancing energy efficiency.

**7. Rational use of Energy (RUE) across all sectors**

A leading energy question in Ireland is how to get onto a sustainable growth path that reconciles the social and economic aspirations of people for higher well being with securing

a cleaner environment. The construction market is one case in point with demand growing at the rate of 30,000 units per annum.

**8. Continuing high priority to energy supply quality and service**

To underscore competitiveness, Ireland's energy supply systems and services must continue to be benchmarked against those countries which compete with Ireland for both inward investment and exports.

**9. Adapting the energy infrastructure to accommodate efficient decentralised energy production with increased reliance on distributed generation**

This derives from broader concerns including industrial development, subsidiarity, demography and socio-economics as well as specific energy issues.

**10. Transport gridlock and the energy cost**

Energy use in the transport sector accounted for 34 per cent of energy consumption in 1997 and for most of the increase in energy consumption since 1980. Future transport planning must include integrated energy planning. Transport planning is a cross-cutting issue with implications for national competitiveness, national productivity, environmental quality and lifestyle.

**11. Ireland's energy trade deficit**

The development and exploitation of indigenous natural gas and oil supplies has very fundamental implications for national competitiveness, energy intensity, environmental emissions and security of supply. The exploitation of indigenous natural gas and oil supplies must be supported by energy policy, flexible regulation and infrastructure.

# Strategies Recommended

The Panel agreed the following key strategic questions

**How should we maximise the benefits to Ireland of innovation in the energy sector?**

**How should we manage and meet Ireland's energy demand up to 2015?**

**First Strategic Question.**

**How should we maximise the benefits to Ireland of innovation in the energy sector?**

This question relates to maximising the gains to Ireland from exploiting new and emerging energy technologies, skills and expertise. Emphasis on this type of innovation will position Ireland to

- respond to growing domestic energy needs
- seek out international energy markets
- participate actively in new and emerging energy markets
- close the balance of energy trade deficit.

**Strategies needed to address this strategic question.**

- *Encourage investment in the research, development and demonstration of new and renewable energy conversion processes such as ocean wave, integrated renewable energy systems, fuel cell technology, active solar heating and biomass technologies*
- *Develop hybrid energy technologies, particularly in the context of electricity and heat generation*
- *Develop and employ advanced energy demand management techniques to increase the efficiency of the electricity system*
- *Develop high efficiency co-generation technologies (Combined Heat and Power) through research, development and demonstration at all energy consumption levels*
- *Exploit and support the uptake of innovative next generation and cross-cutting technologies in energy distribution and storage (such as new battery storage and super conductivity) and technologies of strategic importance to Ireland.*

### Second strategic question

How should we manage and meet Ireland's energy demand up to 2015 ?

This question examines the technology options, research and development needs and the suggested mechanisms for managing and meeting Ireland's energy demand to 2015. The question examines energy supply, management and demand. It takes into account the impact of two key developments in the period - our legally binding limitations on greenhouse gas emissions under the Kyoto Climate Change Protocol and the liberalisation of the gas and electricity markets.

**Strategies needed to address this strategic question - Supply Side**

- *Design and develop natural gas infrastructure to encourage further exploitation of Ireland's identified offshore oil and natural gas resources and prioritise interconnection to Northern Ireland and to trans-European energy networks*
- *Encourage and promote the environmental upgrading of existing primary energy conversion processes*
- *Foster energy source diversification, including efficient fuel conversion and environmentally driven fuel switching including renewable fuels*
- *Promote the continued exploitation of proven renewable energy technologies, i.e. wind power, small scale hydro power, passive and active solar energy and biomass - landfill gas, waste (including wood waste), wood as a fuel (thermal) and wood fired CHP*
- *Nuclear energy is not seen as part of the energy supply mix in the period under discussion. Nuclear energy technology was not considered a relevant energy technology option*

**Strategies needed to address this strategic question - Demand Side**

- *De-centralise energy conversion processes, particularly in the electricity sector*
- *Exploit intelligent consumer energy products*
- *Promote the rational use of energy techniques in the domestic, commercial and industrial sectors through deployment of energy efficient technologies, management know-how and behavioural change techniques*
- *Incorporate energy modules in training courses for the building professions*
- *Promote transport planning and fuel diversification*
- *Position expertise for Ireland as a centre for carbon commerce: c- commerce*
- *Introduce regulatory and fiscal reform to promote the implementation of cost effective measures to improve the energy efficiency of buildings*
- *Re-engineer the taxation system to promote the uptake of environmentally friendly fuels.*

The scope for new energy technology business opportunities and energy savings is arguably very large. Yet it is uncertain whether energy savings could arise primarily from policy, behaviour or technology or a combination of these. The Panel used a scenario approach to address the uncertainties.

This approach drew on the projections carried out by the Economic and Social Research Institute (ESRI)[18] (essentially a business as usual scenario). The Panel then applied assumptions drawn from an EU study[19] to ESRI's projections focusing on two specific scenarios. The futures dealt with each of the two main driving forces of energy up to 2015, namely, the increased level of environmental responsibility required from the energy sector (which was explored in the Forum scenario) and the liberalisation of energy markets (which was explored in the Hypermarket scenario) .

The Panel tested the agreed strategies against both scenarios in order to prioritise the recommendations.

18 The costs to Ireland of greenhouse gas abatement. ESRI, 1997.

19 European Energy to 2020 – a scenario approach. European Commission, 1996.

# Key Technologies and Enabling Policies

The Panel recommends the following key technologies and enabling policies to ensure that Ireland maximises the benefits from innovation in the energy sector and strategically manages energy demand up to 2015. All the recommendations will, if implemented, result in considerable balance of trade savings.

### Key Technology I

**New and renewable energy technologies, especially ocean wave energy, hybrid energy systems, energy storage systems and alternative environmentally friendly transport systems.**

Ireland enjoys a singularly favourable wave climate. The principal technologies for the development of this resource (civil, electrical and ocean engineering) are already well developed in this country. Wave energy is as yet at a developmental stage, analagous to the position of wind energy some 20 years ago. Thus the conditions exist which would enable us to take a lead in the further development and commercialisation of this technology. The benefits include national energy supply and a major export opportunity for products and technologies.

Reliability of supply of wind and wave energy is a major obstacle to penetration of existing and future energy markets. Ireland should take the lead in developing technologies and systems to address this issue, using energy storage and hybrid energy technologies.

Transport gridlock affects business, quality of life and the environment. Energy use in the transport sector accounted for 34 per cent of energy consumption in 1997. Transport is responsible for 11 per cent of Ireland's greenhouse gas emissions[20]. Given the huge anticipated growth in energy consumption in the transport sector, it is of paramount importance that alternative environmentally friendly systems be developed.

**Enabling Policies**

- Prepare, resource and implement a multi-annual energy research, development and demonstration programme, concentrating on the following new and renewable energy technologies : ocean wave energy (IR£7 million, e8.9 million); hybrid energy systems (IR£5 million, e6.3 million); energy storage systems (IR£5 million, e6.3 million) and alternative environmentally friendly transport systems (IR£3 million, e3.8 million).

  *An Energy Research, and Technology Development & Demonstration programme will give Ireland a leading edge advantage in technologies which have both a national application and export potential.*

- Encourage the construction of new and renewable energy systems through an expanded renewable energy development programme.

  *According to the scenario analysis carried out by the Panel, Ireland will not meet its limitations targets under the Kyoto Climate Change Protocol without major policy shifts. Although there are uncertainties surrounding the penalties which may arise, it is prudent to seek to avoid breaching this limit at the earliest possible date. We may face more stringent targets in the future.*

20 Limitation and reduction of CO2 and other greenhouse gas emissions in Ireland. ERM, 1998.

- Provide fiscal incentives to encourage investment in new and renewable energy technologies, skills and R & D.

- Establish and support an energy emissions trading exchange in the International Financial Services Centre. Develop validation, certification, trading and settlement systems.

  *Arising from the Kyoto protocol $CO_2$ permit trading will grow in importance in the next 10 years. Ireland should take advantage of this opportunity by establishing expertise in the provision and export of emissions trading services and products.*

### Key Technology II

**Intelligent consumer energy products**[21]

Integrating information and communications technologies and energy control at home and at work will result in lower energy consumption, lower energy bills and lower greenhouse gas emissions.

**Enabling Policies**

- Provide support and incentives for integration of information technology and energy services, and for new product development (IR£5 million, e6.3 million)

  *Ireland should choose and mentor winning concepts, products, skills, etc. in this area. The incentive proposed is a competition for proposals to develop and bring to the market new products integrating information technology and energy services.*

- Support the development of indigenous enterprise to exploit progress on crossover technologies

  *Provide incentives for indigenous enterprise to capitalise on energy environment market opportunities at home and abroad.*

- Incorporate modules on energy enterprise and technical and professional skills into the education and vocational training systems

  *Skills will be the key determinant of future competitiveness in the context of accelerating technological change*[22]*. The potential energy skills supply deficit should be identified now and addressed through a comprehensive national energy skilling programme. In this regard the Panel endorses the First Report of the Expert Group on Future Skills Needs.*

21 Examples include photosensitive lighting, motion and heat detectors and the intelligent home of tomorrow.

22 National Competitiveness Council Statement on Skills, 1998.

## Key Technology III

**Energy efficiency and renewable energy technologies in buildings.**

Energy consumption in buildings accounts for approx. 30 per cent of our greenhouse gas emissions. The total Irish housing stock is about 1.1 million units, a significant proportion of which has no existing insulation. New building completions are estimated at 20,000 – 30,000 a year, making Ireland unique in the EU in relative growth terms.

There is vast potential to reduce energy consumption and improve comfort levels in both new and existing buildings. This can be achieved through an integrated range of measures designed to support energy conservation and improved efficiency, and increased use of renewable energies in buildings - especially passive solar heating, daylighting, natural cooling and active solar systems, where appropriate.

Even after taking account of the expected increase in building stock by 2015, it should still be possible to reduce the total energy consumption and carbon dioxide emissions of the buildings sector significantly.

**Enabling Policies**

- Immediate, substantial and continuing tightening of energy efficient requirements of the building regulations and mandatory energy ratings on all buildings being sold or rented, i.e. eco-branding

  *Buildings being constructed today can be expected to be used for 50 years or more. This has huge implications for energy consumption. Building regulations can be a very effective means of improving energy efficiency in buildings.*

- Initiate a targeted, centrally funded retro-fit programme for the socially disadvantaged (IR£3 million, e3.8 million)

  *Develop Energy Action model in 10 urban centres.*

- Introduce a scheme of personal tax relief for investment in energy conservation measures (IR£18 million, e22.9 million)
- Resource a research programme to examine energy use in buildings and the conservation potential in the Irish environment (IR£3 million, e3.8 million)
- Encourage the education and training sectors to act as enablers of an energy culture, through the incorporation of energy in their curricula and services' portfolios
- Ensure maximum uptake of the tax relief opportunities available for investment in solar energy technologies under the Finance Act, 1998.

### Key Technology IV

**Optimise the sourcing and distribution of energy at all levels of energy consumption.**

**Enabling Policies**

- National coverage for the natural gas network including extension to the western seaboard to support offshore gas finds
- Upgrade the electricity infrastructure (including international connectivity) to facilitate decentralisation of electricity generation, exploitation of indigenous energy resources and competition
- The liberalisation of the Irish electricity and natural gas markets must be expedited and must happen in tandem (as commercial aspects of the different energy sources interlock)
- Industrial planning at all levels must include integrated energy planning
- Support CHP development through a tax relief measure modelled on Section 62 of the 1998 Finance Act (IR£20 million, e25.4 million)
- Secure the early adoption and use of advanced energy technologies by enterprise through the provision of appropriate support systems

  *These technologies include cogeneration, condensing boilers, variable speed drives, energy efficient lighting, building energy management systems and heat pumps. It increases the energy efficiency and results in financial savings and reduced environmental emissions*

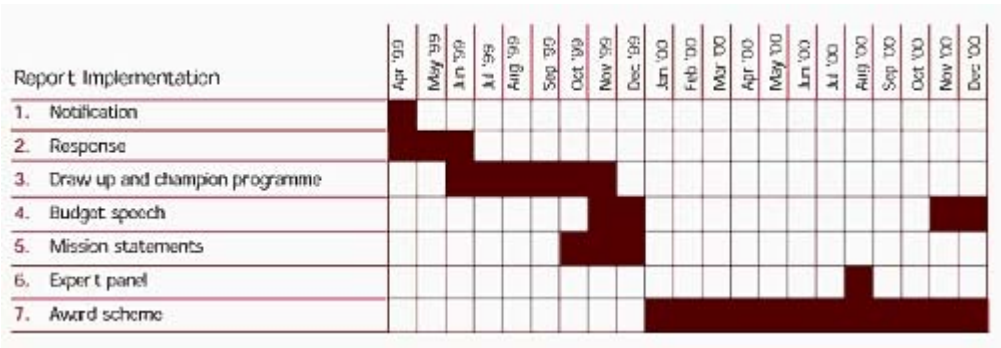
- Evaluate combined heat and power viability in all new commercial, residential and industrial developments.

# Action Plan

We recognise that the rapid evolution of the energy market means that new approaches to energy technology, training and management are constantly required. The implementation of this report must be characterised by meaningful collaboration involving government, the education sector and industry. Targeted investment in research, development and demonstration of the technology recommendations of this report is crucial.

**The Energy Panel recommends that:**

- The Minister for Public Enterprise convene an action panel to secure the implementation of the report by:
  - *identifying and notifying each of the implementing bodies of the recommendations in this report which relate to their respective areas of competence*
  - *eliciting a formal response from each implementing body by mid-1999 on their proposals on implementation, the time scales and the resources and mechanisms they propose to deploy*
  - *drawing up a fully costed programme with specific objectives, deliverables and time-scales to implement the recommendations of this report.*
- The Minister for Public Enterprise is given responsibility for championing the implementation of the report at government level
- The Minister for Finance include in the annual budget speech a statement on research, development and demonstration investment in frontier areas within the energy field. Each of the implementing State agencies should make provision for implementing the recommendations of this report in their annual Estimates
- The implementing State agencies incorporate the recommendations of this report in their Mission Statements and in their Statements of Strategy. They should also publish an annual statement on progress in implementing the recommendations of this report
- The Minister for Public Enterprise convene an Expert Panel from time to time to review this report in light of technological progress, macroeconomic change, regulatory change, progress on implementation, cross-cutting opportunities, environmental issues, security of supply and competitiveness issues
- The Minister for Public Enterprise, in consultation with the energy sector, should initiate a system of national research awards in energy
- The timetable below for implementation be adhered to.



# Appendix I Panel Members

| Panel Members | |
|---|---|
| **Colum MacDonnell,** Chairman | Chief Executive, Irish Exporters Association |
| **Dr. Eamon McKeogh,** Deputy Chairman | NUI - Cork & Renewable Energy Information Office |
| **Michael Forde** | Managing Director, Irish Shell |
| **Rosemary Steen** | Assistant Director, IBEC |
| **Pat Mercer** | Managing Director, Flogas |
| **Jim O'Brien** | Group Technical Advisor, CRH plc |
| **John Fingleton** | Managing Director, Fingleton, White & Co |
| **Sean Noone** | Managing Director, SELC Ireland |
| **Owen Wilson** | Manager of Corporate Safety & Environment, ESB |
| **Sadhbh O'Neill** | Acting Co-ordinator, Earthwatch |
| **Charles Shier** | Commercial Manager, Peat Energy Division, Bord na Móna |
| **Rory O'Grady** | Gas Utilisation Manager, Bord Gais |
| **Denis Blanch** | Branch Secretary, Irish Congress of Trade Unions |
| **David Taylor** | Director, Irish Energy Centre |
| **Professor J. Owen Lewis** | Energy Research Group, NUI - Dublin |
| **Fergus Cahill** | Ireland Representative, Philips Petroleum |
| **Niall Ó Donnchú,** Secretary | Department of Public Enterprise |

| Contributors | |
|---|---|
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| **Mr. Denis Blanch** | Irish Congress of Trade Unions |
| **Mr. John Brady** | Enterprise Ireland |
| **Mr. John Goulding** | Energy Research Group, UCD |
| **Mr. Ciaran King** | UCD |
| **Mr. Michael McDonnell** | CIE |
| **Mr. Pat Naghten** | Irish Energy Centre |
| **Mr. Sean Noone** | SELC Ireland |
| **Mr. Peter O Neill** | Department of Public Enterprise |
| **Ms. Sadhbh O'Neill** | Earthwatch |
| **Mr. Sean Quinn** | Sean Quinn Group |

| Technical Support | |
|---|---|
| **M. Brian Ó Gallachóir** | Energy & Environment Research Unit, UCC |

| Administrative Support | |
|---|---|
| **Ms. Mary Dooley** | Department of Public Enterprise |
| **Ms. Michele St. John** | Department of Public Enterprise |

# Appendix II Recent Trends in Energy Technology

| Sector | State of Technology |
|---|---|
| **Gas fired plants** | **Combined cycle** technologies produce efficiencies of 45 per cent - 58 per cent depending on size, gas turbine, fuel type and heat recovery steam generator type.<br><br>**Natural gas combined cycle** is a well established technology with sales growing rapidly with capacity ranges 5 – 400 MW. |
| **Coal fired plants** | Lowest cost coal plants are **pulverised combustion** supercritical plants with moderate steam parameters (up to 43 per cent efficient.)<br>- with double reheating efficiencies can reach 47 per cent<br>- further increase in efficiency (52 per cent) possible if steam temp 700°C<br>**Fluidised bed combustion** technology introduced commercially, atmospheric or circulation (depending on fluidisation velocity). Both need specific development and demonstration for low grade fuels.<br>**Integrated Gasification Combined Cycle** plants make it possible to run combined cycle on solid fuel. They are fuel flexible (low-grade coal, oil refinery residues) with high efficiencies.<br>**Pressurised Pulverised Combustion** planned to be introduced to the market after 2010. Critical component of this indirect coal-fired combined cycle is ceramic high temp recuperator. |
| **Fuel Cells** | Electrochemical systems which convert the energy of the fuel directly into electric power at up to 65 per cent efficiency with very low emissions. Fuel cells are at an early stage of development – only **phosphoric acid fuel cells** are commercially available. |
| **Renewable Energy** | **Wind energy** matured rapidly in last decade. Technology now commercially available, particularly at medium range (300kW – 1MW). Larger scale machines (up to 3MW) at demonstration stage.<br>Large scale **Biomass power** generation (or CHP) can be achieved with a number of different fuels and technological approaches. The spectrum of maturity for conversion technologies is very wide with further R, D & D required for gasification technologies and pyrolysis. |
| **Renewable Energy** | **Solar Photo-voltaic (PV)** costs are continuing to come down significantly but are still competitive only in certain niche applications. Thin film PV modules are being researched and lower cost solar grade silicon production.<br>**Solar thermal** technology for domestic water heating and swimming pools is well established and commercially available. |

| | |
|---|---|
| | **Wave Energy** is still at the development stage and not yet ready for commercial deployment. The most advanced devices are those mounted on or near the shoreline.<br><br>**Hydro Power** technological developments have been mainly focussed on new low head turbines, new construction materials and load control equipment.<br><br>Technologies to produce electricity and heat from **Landfill gas** are now well established. |
| **Transport** | **Vehicle technologies** being currently developed include advances in petrol and diesel engines, technologies to reduce pollutant emissions, improved transmission systems, composite and light materials, vehicle design optimisation and new engine concepts, such as fuel cells.<br><br>Of the **Alternative fuels**, natural gas and LPG engine vehicles are penetrating the market, with a more modest input from electric vehicles. Technologies to convert conventional engines to run on CNG, LPG and biofuels are fully mature.<br><br>**System technologies** being developed include technologies for public transport management and urban traffic control and management systems.<br><br>On **Freight and rail transport**, technologies recently developed include system management technologies (freight), high speed aerodynamics and new suspension systems (rail). |
| **Buildings** | Developments in **Design** have focused on passive hybrid & low energy cooling techniques, daylighting, ventilation (natural) and (envelope and) passive solar components.<br><br>The **Energy saving technologies** currently being researched and demonstrated are in ventilation, artificial lighting, BEMS & controls and thermal energy storage.<br><br>**Energy supply technologies** include domestic hot water, heat and cool generation, combined heat and power and fuel. |