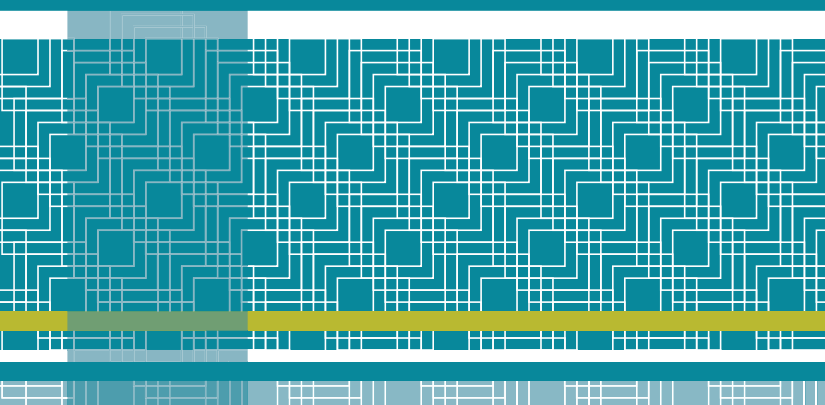


# Security of Supply in Ireland 2006





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Report prepared by  
Morgan Bazilian, Fergal O' Leary, Brian Ó Gallachóir and Martin Howley

December 2006

## Sustainable Energy Ireland

Sustainable Energy Ireland (SEI) is Ireland's national energy agency. Established on May 1st 2002 under the Sustainable Energy Act 2002, SEI has a mission to promote and assist the development of sustainable energy. This encompasses environmentally and economically sustainable production, supply and use of energy, in support of Government policy, across all sectors of the economy. Its remit relates mainly to improving energy efficiency, advancing the development and competitive deployment of renewable sources of energy and combined heat and power, and reducing the environmental impact of energy production and use, particularly in respect of greenhouse gas emissions.

SEI is charged with implementing significant aspects of the Green Paper on Sustainable Energy and the National Climate Change Strategy as provided for in the National Development Plan.

SEI manages programmes aimed at:

- assisting deployment of superior energy technologies in each sector as required;
- raising awareness and providing information, advice and publicity on best practice;
- stimulating research, development and demonstration;
- stimulating preparation of necessary standards and codes;
- publishing statistics and projections on sustainable energy and achievement of targets.

SEI is responsible for advising Government on policies and measures on sustainable energy; implementing programmes agreed by Government and stimulating sustainable energy policies and actions by public bodies, the business sector, local communities and individual consumers.

## Energy Policy Statistical Support Unit

Sustainable Energy Ireland has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is a vital input to meeting international reporting obligations, for advising policy makers and informing investment decisions. Based in Cork, the Energy Policy Statistical Support Unit is SEI's specialist statistics team. Its core functions are to:

- collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations;
- conduct statistical and economic analyses of energy services sectors and sustainable energy options;
- contribute to the development and promulgation of appropriate sustainability indicators.

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# 1 Introduction

There is an unprecedented focus and interest in the energy sector. Governments and businesses alike are coming to the conclusion that energy must be a focal point for strategic planning as it impacts all areas of society. Considerable analysis continues to point towards the complex interaction and tradeoffs between the three pillars of energy policy, and the need to better understand energy security. Only through rigorous analysis can evidence-based policy be formulated.

This report continues SEI's annual review of energy Security of Supply (SOS) in Ireland. The metrics, or indicators, presented in this report address a wide range of issues relevant to the topic of SOS. They span a range from national to international concerns and across primary fuels and their conversion into energy services. The report, set against the backdrop of a security focused world, is meant to inform debate and provide information to policy makers, energy market participants, investors, and the public. The metrics utilised have been refined to better focus on the issue of SOS since the initial report<sup>1</sup>. New analysis has been conducted in an attempt to better understand Ireland specific issues, as well as comparing them to other countries. The first report was well received nationally and internationally. It is intended that this document becomes a cutting-edge resource and model for the consideration of SOS.

Security of energy supply has emerged as a focus of the energy policy dialogue in 2006. Since SEI's initial SOS publication there has been considerable activity in the security of energy supply realm. This has been reflected in energy policy documents from the UK, USA, EU, G8, International Energy Agency (IEA), United Nations Industrial Development Organisation (UNIDO), etc. All of these countries and bodies have highlighted SOS as a priority for considering future energy policy.

The G8 leaders at the recent (July, 2006) St. Petersburg Summit created a position paper on the issue of global energy security<sup>2</sup>. It notes, *"Energy is essential to improving the quality of life and opportunities in developed and developing nations. Therefore, ensuring sufficient, reliable and environmentally responsible supplies of energy at prices reflecting market fundamentals is a challenge for our countries and for mankind as a whole."*

The challenges that are outlined in the G8 document are similar to those found in the myriad of policies and analyses that have been produced in Ireland and internationally in the last 12 months. Indeed there appears to be an emerging consensus on the diversity and difficult nature of the issues to be considered, and the requirement to look at them in a holistic manner. This consensus should be considered an opportunity for innovation and leadership. The energy challenges include:

- High and volatile oil and gas prices,
- Growing demand for energy,
- Political instability in producing countries,
- Increasing import dependence in many OECD countries,
- Enormous investment requirements along the entire energy chain,
- The vulnerability of the critical energy infrastructure,
- Fossil (and uranium) fuel reserves are in question,
- Considerable investment and technological "inertia" in the system,
- A liberalising and competitive market paradigm.

This security focus has also impacted upon energy policy in Ireland with the publication of the Energy Green Paper on the 1<sup>st</sup> October 2006<sup>3</sup>. Thus, this second annual publication of SEI's SOS Metrics is both timely and topical. The Green Paper summarises the policy targets for SOS for Ireland as follows:

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<sup>1</sup> The first SOS report is available from [www.sei.ie/getFile.asp?FC\\_ID=1122&docID=68](http://www.sei.ie/getFile.asp?FC_ID=1122&docID=68).

<sup>2</sup> The full text of the position paper is available at <http://en.g8russia.ru/docs/11.html>.

<sup>3</sup> The full text of the Green Paper is available at <http://www.dcmnr.gov.ie/Energy/Energy+Planning+Division/Energy+Green+Paper.htm>.

- Ensuring that energy supply can meet future demand,
- Ensuring security of gas supplies to the country,
- Addressing the diversity of fuels used within the electricity generation sector,
- Delivering electricity and gas to homes and business over networks that are adequate and secure,
- Encouraging investments in energy infrastructure by creating an attractive environment,
- Mitigating the impact of energy supply disruptions by ensuring that contingency measures are in place.

The complexity in this area of energy policy does not allow for simple solutions or measurement. By creating a context for informed action in the area of SOS, this second metrics report attempts to consider the issue holistically and allow stakeholders to respond in an informed manner. Hedging the various risks associated with SOS issues can take many forms, including; legal, regulatory, financial, policy, etc.

As part of the commitment to develop and improve SOS indicators, SEI in 2005 and 2006 supported research by the IEA on two policy scenarios for inclusion in the *World Energy Outlook 2006*<sup>4</sup>. The *Alternative Scenario* analyses how the global energy market could evolve if countries were to adopt all the policies related to energy security and energy related CO<sub>2</sub> emissions that they are currently considering. If this scenario were to be realised gas and oil import dependency of OECD countries would still increase by 33% by 2030, however this level would be reached by 2015 in the base or reference case. An even more ambitious scenario was considered in 2006. In the *Going Beyond the Alternative Scenario*, CO<sub>2</sub> emissions in 2030 are capped at 2005 levels. In this case world oil and natural gas consumption is 8% and 6% lower than consumption in the *Alternative Scenario*. This would, clearly, benefit all importing nations. For this case to be realised however, a step change in government policies and technological breakthroughs would be required.

## 1.1 Report Structure

The report aggregates and organises what is sometimes rather eclectic public data into one focused document. It also includes new analysis in three areas:

- The Supply/Demand Index, prepared by the Energy Research Centre of the Netherlands (ECN), a measure of SOS that is benchmarked with other EU member states,
- The use of Mean Variance Portfolio Theory for the Irish electricity sector,
- A high oil price energy forecast scenario to 2020 prepared by Economic and Social Research Institute (ESRI).

The other principal changes from the 2005 report are a reorganisation of the metrics into a new classification and the addition of data from the UK Joint Energy Security of Supply Working Group (JESS). The report has also benefited from feedback on the first version, in particular that provided by the Department of Communications, Marine and Natural Resources (DCMNR). The remainder of the report is structured as follows:

- Section 2 explores recent SOS developments internationally and in Ireland.
- Section 3 briefly discusses options for defining SOS.
- Section 4 presents a range of SOS metrics.
- Section 5 presents the results of new analysis for Ireland.
- Finally, section 6 contains acknowledgements and outlines options for further work.

The national energy balance data presented in this report are the most up-to-date at the time of writing (November 2006). Data is updated whenever more accurate information is known and the most up-to-date figures as well as time series back to 1990 can be found on the statistics publications section of the SEI website<sup>5</sup>. Feedback and comment on the report are welcome and should be addressed by post to the address on the rear cover or by email to "[epssu@sei.ie](mailto:epssu@sei.ie)".

<sup>4</sup> Details of both scenarios are available in the World Energy Outlook 2006. Available from <http://www.iea.org/textbase/weo/index.htm>.

<sup>5</sup> Available from <http://www.sei.ie/index.asp?locID=70&docID=-1>.

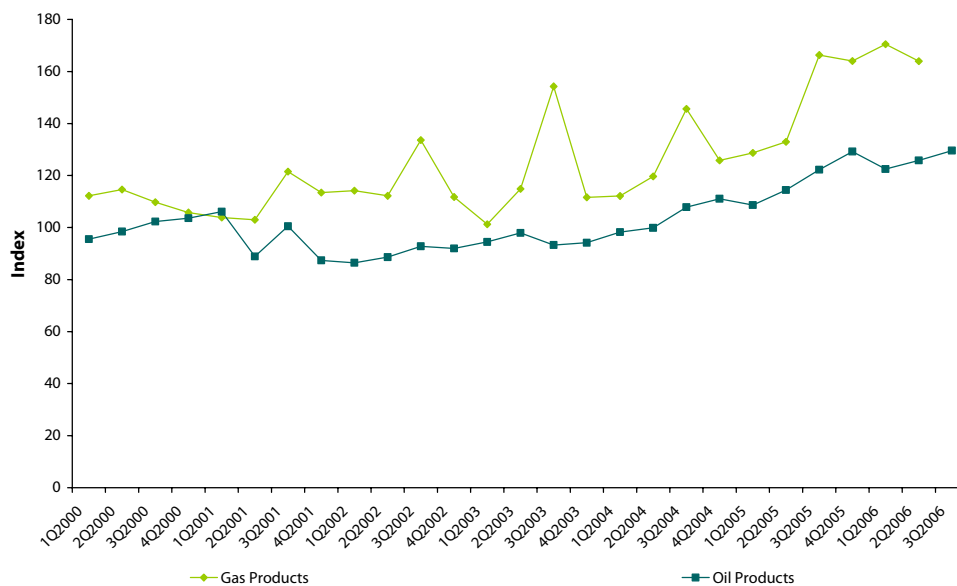
## 2 Recent Developments

### 2.1 International Development

The year 2006 began with an energy security crisis. On January 1<sup>st</sup>, Russian gas supplies were cut off to the Ukraine due to a dispute with Gazprom over a severe price hike<sup>6</sup>. There were immediate gas losses to Hungary, Poland, Germany, Italy, Slovakia, Austria, and France. Although supply was restored three days later, the incident had major reverberation in the EU and worldwide. More recently, on August 6<sup>th</sup> 2006, BP Oil Company announced the shutdown of about 400 thousand barrels per day (bbl/d) of crude oil production from the Alaskan Prudhoe Bay field because of corrosion discovered in the pipelines that gather crude oil from the producing wells for delivery to the Trans-Alaskan pipeline. A myriad of other energy security issues including: concerns about oil refinery capacity worldwide, political instability in Nigeria, nationalisation of resources in Bolivia, etc. occurred over the year, leading to the focus on this topic in energy policy statements and reports.

Sustained high oil and gas prices (and high volatility) are putting ever increasing pressure on global economies and their ability to deliver goods and services. Figure 1 shows a price data time series for these two commodities<sup>7</sup>. These price increases have an effect on all energy services: electricity, thermal energy (heating and cooling) and transport.

**Figure 1: Index of Real Oil and Gas Prices in Ireland Q1 2000 to Q3 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006s

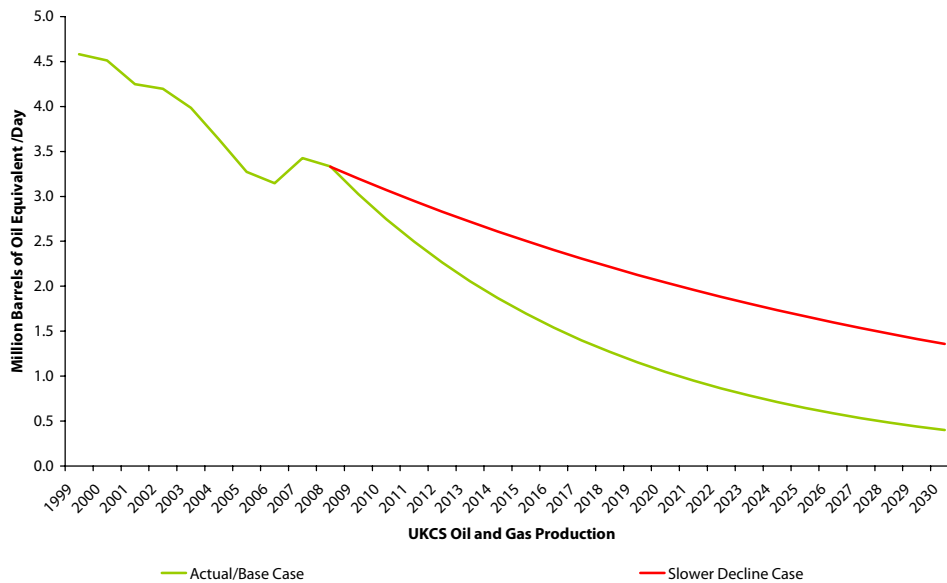
Price is only one vector of SOS however. Regulatory and policy decisions as well as the management of natural resources also impact on SOS. For example, as much of Irish gas is imported from the North Sea, it is useful to review predictions about its production levels over time as illustrated in figure 2<sup>8</sup>.

<sup>6</sup> Russia supplies about 8% of Ukraine's annual gas requirements. This gas has in recent times been supplied at heavily subsidized prices - about 50 USD per 1,000 cubic meters compared to the market rate of about 230 USD per 1,000 cubic meters. Note, however, Ukraine charges Russia transit fees for gas Russia passes through the Ukrainian gas pipeline network to Western European customers. Transit fees were taken in the form of gas, with Ukraine taking 15% of gas passing through their pipes (BBC Website, 2006).

<sup>7</sup>The data in figure 1 are an index of oil and gas prices charged to households and industry. They are corrected to eliminate the effects of inflation.

<sup>8</sup> Data are sourced from the *UK Energy Review 2006* which is available from <http://www.dti.gov.uk/energy/review/page31995.html>.

**Figure 2: Total UK Continental Shelf (UKC ) Oil and Gas Production to 2030**



Source: Department of Trade and Industry (UK)

The response to the focus on energy prices and stability led to a large number of policy outputs. A selection of those efforts and the associated dialogue is included in this section. The *EU Green Paper on Energy Policy*<sup>9</sup>, released in mid 2006, clearly indicates the interdependence of countries in the area of energy policy. It states that: *"This is the new energy landscape of the 21<sup>st</sup> century. It is one in which the world's economic regions are dependent on each other for ensuring energy security and stable economic conditions, and for ensuring effective action against climate change."*

UK Prime Minister Tony Blair in the UK's recent Energy Review (July, 2006)<sup>10</sup>, underlined the centrality of energy security, *"But we now face two immense challenges as a country – energy security and climate change. First, we will soon be net importers of oil, and dependent on imported gas at a time when global demand and prices are increasing. Energy consumption by China and India, for example, is projected to double by 2030. At the same time, many of our coal and nuclear power stations are coming to the end of their lives. Without action to ensure reliable supplies and replace power plants, there will be a dramatic shortfall in our energy capacity and risks to our energy security."*

On January 31<sup>st</sup> The European Policy Centre, together with the Clingendael International Energy Programme, held a Policy Dialogue on European energy security<sup>11</sup>. At that meeting the IEA noted that, *"...a simple extrapolation of current trends depicts the EU as massively dependent on energy imports and higher prices in a world of increased competition for resources. The only escape route from such dire misfortune is ...to make an abrupt switch to energy efficiency programmes."*

At the same meeting, Coby Van Der Linde noted, *"We're still heading for a confusion of 25 different Member State approaches [to energy policy] at a time when what is needed is more consensus...a re-examination of whether the EU is providing the right economic incentives for investment in the energy infrastructure and diversification that could help mitigate the risks of interruptions to its supply [is needed]... there is a need for a closer link between geopolitics and energy, and a clearer EU appreciation of underlying political and economic trends in the major energy producer and consumer regions...Russia and China are entering the world market on their own terms, with their own definitions. Glib assumptions of a universal and ineluctable transition towards the western market-driven approach will leave the EU with less than optimal policies on energy supply."*

<sup>9</sup> Green Paper, 2006, A European Strategy for Sustainable, Competitive and Secure Energy [http://ec.europa.eu/energy/green-paper-energy/doc/2006\\_03\\_08\\_gp\\_document\\_en.pdf](http://ec.europa.eu/energy/green-paper-energy/doc/2006_03_08_gp_document_en.pdf).

<sup>10</sup> See footnote 8.

<sup>11</sup> Full details of the event are available from [http://www.clingendael.nl/ciep/events/20060131/20060131\\_Event\\_Report\\_CIEP\\_EPC\\_Policy\\_Dialogue.pdf](http://www.clingendael.nl/ciep/events/20060131/20060131_Event_Report_CIEP_EPC_Policy_Dialogue.pdf).

Of course SOS issues are not limited to OECD countries. The impacts of sustained high prices for fossil fuels will be likely to have a large impact on the development process. To this end, UNIDO published a book on *Energy Security in Least Developed Countries*<sup>12</sup> (LDCs). It states that, *“the levels of production and consumption of energy in the majority of LDCs are inadequate and unstable. This clearly indicates a situation of energy security.”* The paper discusses interlinkages between energy security and other development topics, noting the complexity of the area. The analysis considers macro and micro economic issues. The first SEI SOS report was used in UNIDO’s analysis.

There is no reason to suspect that this focus on security will subside in the future. This annual publication hopes to contribute to the ongoing debate and decision making processes in Ireland and abroad.

## 2.2 National Developments

There were numerous SOS related activities in Ireland in 2006. This section attempts to review a number of them in order to provide a context for the metrics provided.

As mentioned in section 1, the Energy Green Paper *“Towards a Sustainable Energy Future for Ireland”*<sup>13</sup> was published on 1<sup>st</sup> October 2006. The Green Paper puts forward energy policy options for the next decade and beyond, designed to meet the needs of consumers and business to support and sustain our economic growth. These reflect the Government’s goals of ensuring safe and secure energy supplies, promoting a sustainable energy future, and delivering economically efficient prices to Irish consumers. The Government supports the delivery of these objectives through competitive market mechanisms, supplemented by regulatory oversight.

The Minister for Communications, Marine & Natural Resources, Noel Dempsey T.D. on the occasion of a successful appraisal well at Seven Heads gas field (by Island Oil and Gas Plc) noted that, *“Only 10 years ago over 85% of Ireland’s gas needs were met by production from the Kinsale field. Today that position is reversed with over 85% of our gas being supplied via two interconnectors. Security and access to indigenous sources of energy are vital for our national interests and any discoveries of domestic supplies which could reduce our dependency upon imports are to be welcomed”*<sup>14</sup>.

On 29<sup>th</sup> September the Minister for Communications, Marine and Natural Resources set a target of 15% of electricity to be generated by renewable sources by 2010.<sup>15</sup>

In August the Commission for Energy Regulation (CER) published a first report on Ireland’s SOS of electricity<sup>16</sup>. The report is produced by CER in accordance with the requirements of *Directive 2003/54/EC*<sup>17</sup> and *Statutory Instrument 60 of 2005*<sup>18</sup>. In the report the CER describes its monitoring activities, presents the conclusions drawn from that monitoring and the measures being taken, or planned to be taken, to protect Ireland’s SOS of electricity. The report examines the key areas (associated with electricity supply) of fuel, networks, generation and demand.

On the 19<sup>th</sup> May, 2006 Ireland, France, Spain and the United Kingdom lodged a joint submission with the UN’s Commission on the Limits of the Continental Shelf claiming an area of continental shelf about 80,000 km<sup>2</sup> in the area of the Celtic Sea and the Bay of Biscay that lies beyond 370 nautical km from shore. This will have impacts for the sovereign rights for the purpose of exploring and exploiting natural resources including oil and gas deposits as well as other minerals and biological resources in the seabed<sup>19</sup>.

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<sup>12</sup> See [www.unido.org](http://www.unido.org) for details.

<sup>13</sup> The full text of the Green Paper is available from <http://www.dcmnr.gov.ie/Energy/Energy+Planning+Division/Energy+Green+Paper.htm>

<sup>14</sup> Details are available from <http://www.dcmnr.gov.ie/Press+Releases/Dempsey+Welcomes+Promising+News+From+Island+Oil+and+Gas+plc's+Drilling+Operations+at+Seven+Heads.htm>.

<sup>15</sup> Details are available from <http://www.dcmnr.gov.ie/Press+Releases/Noel+Dempsey+Announces+Support+for+55+New+Renewable+Energy+Projects.htm>

<sup>16</sup> The document is available from <http://www.cer.ie/CERDocs/cer06187.pdf>.

<sup>17</sup> Available from [http://eur-lex.europa.eu/pri/en/oj/dat/2003/l\\_176/l\\_17620030715en00370055.pdf](http://eur-lex.europa.eu/pri/en/oj/dat/2003/l_176/l_17620030715en00370055.pdf).

<sup>18</sup> Available from <http://www.dcmnr.gov.ie/Energy/Energy+Legislation/>.

<sup>19</sup> Details are available from

The Corrib Gas issue continued throughout 2006. The Corrib field, containing gas with a very high methane content (over 90% by volume), is located approximately 65km off the coast of County Mayo in deep water (approximately 350m). An independent safety review was finalised in May of 2006. A report with recommendations from mediation on the Corrib pipeline prepared by Mr Peter Cassells was published on 28<sup>th</sup> July 2006. That report delivered recommendations addressing<sup>20</sup>:

- Safety concerns regarding the operation of the pipeline,
- The route of the pipeline and its proximity to local houses,
- The gas terminal, its location and environmental concerns,
- Improved benefits for local people and the region,
- Anomalies in financial compensation for landowners on the route,
- Monitoring of the project and consultations with the local community.

The impact of that gas on demand is included in this report in section 4. There is no further discussion or commentary on the issue outside of a supply/demand evaluation.

The Minister for Enterprise, Trade and Employment, Micheál Martin TD announced<sup>21</sup> on 22<sup>nd</sup> May, 2006 that Shannon Development, the regional development agency, has entered into an "option-to-purchase" agreement with Shannon LNG, in relation to 281 acres of the 600 acre Shannon Development owned land bank between Tarbert and Ballylongford, County Kerry. The site, which has been designated by Shannon Development for deep water projects, is about 25 km from the national gas pipeline grid. Under the agreement, Shannon LNG, an Irish subsidiary of Hess LNG Limited, is proposing to build a €400 million liquefied natural gas (LNG) receiving terminal on the Shannon Estuary. Announcing the initiative, the Minister said, *"I am delighted to formally announce this exciting proposed development... This major development has the potential to secure Ireland's long-term supply of natural gas and provide an important economic boost here in North Kerry."* Shannon Development stated, *"Subject to feasibility studies, technical assessments and in due course, planning and other approvals the Shannon LNG project has the potential to provide over 40% of Ireland gas requirements."*

Finavera Limited reported the results of technical evaluation work completed on its Lough Allen Natural Gas Field in the northwest of Ireland and Northern Ireland. This evaluation, completed in conjunction with Schlumberger has estimated a potential resource of 9.4 trillion cubic feet of gas, or 1.5 billion barrels of oil equivalent, with a predicted average recovery rate of 40%. Three "tight" gas sandstone reservoirs have been identified from seismic surveying and 14 vertical wells. The resource estimate of 9.4 trillion cubic feet of gas is based on two of the three reservoirs. Schlumberger has indicated that the potential exists for additional significant gas resources in a third higher porosity reservoir<sup>22</sup>.

Forfás<sup>23</sup> released a study on oil dependency issues for Ireland in 2006. The overall objective of the study was to assess Ireland's reliance on a single volatile resource as a key input into the Irish economy. The report states that in tackling what is possibly an unprecedented risk management problem, the challenge from the outset is three-fold; to ensure that a common level of understanding exists around the area of peak oil and to recognise that at some point, mitigation strategies must be considered. Secondly to assess what implications peak oil potentially holds for the Irish economy and finally to identify the correct approaches which could be adopted in a timely and effective manner.

The *Energy (Miscellaneous Provisions) Bill*<sup>24</sup> released in 2006 moves to facilitate full gas market opening, seeks to underpin the all-island energy market, grants power to the Minister to provide for the taking of emergency measures by ministerial order in the event of a sudden crisis in the energy market in addition to conferring on the Minister the power to issue policy directions to the CER and finally seeks to expand the functions of the CER allied to the removal of the legislative constraints so as to facilitate regulated electricity interconnection not owned by the ESB. The CER

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<http://www.dcmnr.gov.ie/Press+Releases/Joint+Submission+Deposited+by+Ireland+France+Spain+and+the+United+Kingdom+to+UN+Commission+Claiming.htm>

<sup>20</sup> Full details of both reports are available from <http://www.dcmnr.gov.ie/TAG/Technical+Advisory+Group.htm>.

<sup>21</sup> Full details are available from <http://www.shannondev.ie/NewsReleases/NewsReleases2006/Title,3708,en.html>.

<sup>22</sup> Details are available from <http://finavera.com/gas/default.asp>.

<sup>23</sup> The report is available from <http://www.forfas.ie/publications/show/pub223.html>.

<sup>24</sup> See <http://www.oireachtas.ie/viewdoc.asp?DocID=5209&&CatID=59> for full details.

appointed Bord Gáis Energy Supply as the Supplier of Last Resort (SoLR) for the gas retail market<sup>25</sup> and ESB Public Electricity Supply (PES) as SoLR for the retail electricity market<sup>26</sup>.

In June the Joint Oireachtas Committee on Communications, Marine and Natural Resources published<sup>27</sup> a *Review of Energy*. It is a comprehensive, open and transparent parliamentary review of Irish energy requirements and policy needs.<sup>28</sup> The first line in the introduction of the report refers to SOS: *"Ireland has a very high dependence on imported fossil based fuels. This places Ireland in a potentially invidious position. There is no cast iron guarantee on supply and the economy is open to price volatility."* Indeed the first section of the report after the introduction is a section on SOS. It states, *"...The Joint Committee has examined how to avoid supply shortage; these include the broadening of the existing fossil fuel portfolio and substituting imports with indigenous energy sources. The Joint Committee has concerns about the strategic issues of fuel reserves and the control of both the electricity and gas networks. Natural gas supply was identified as being potentially vulnerable which has major consequences for Ireland as gas constitutes a significant part of the overall energy supply."*

These "current events" are merely indicative of the diverse impacts on policy, investment, regulation, and behaviour of energy security. The impacts of this myriad of activities is not yet clear. It is clear that the international focus on energy security, previously outlined, is clearly being reflected in the Irish energy sector.

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<sup>25</sup> The report is available from [www.cer.ie/cerdocs/cer06005.pdf](http://www.cer.ie/cerdocs/cer06005.pdf).

<sup>26</sup> The report is available from [www.cer.ie/cerdocs/cer06006.pdf](http://www.cer.ie/cerdocs/cer06006.pdf).

<sup>27</sup> The full text of the report is available from [http://www.oireachtas.ie/documents/committees29thdail/commmarine-natresreports/energy\\_report/Energy\\_Report.pdf](http://www.oireachtas.ie/documents/committees29thdail/commmarine-natresreports/energy_report/Energy_Report.pdf).

<sup>28</sup> In 2006 a number of policy documents have also been released from organisations including IBEC, Fine Gael, and the Institute of Irish Academy of Engineers.

### 3 Defining Security of Supply

Based on international experience to date, a country's energy security policy generally comprises measures taken to reduce the risks of supply disruptions below a certain tolerable level. Such measures should be balanced to ensure that a supply of affordable energy is available to meet demand. Security of energy supply thus encompasses both issues of quantity and price. However, time is also a key parameter, as a sudden price hike will have very different effects on both society and the economy compared to those of a long-term price increase. Insecurity in energy supply originates in the risks related to the scarcity and uneven geographical distribution of primary fuels and to the operational reliability of energy systems that ensure services are delivered to end users<sup>29</sup>.

There remains no agreed definition of energy SOS, as discussed in the first SOS report. There are a number of perspectives from which the subject can be viewed. Because of the large number of related issues encompassed by the term, and the lack of a single analytical framework, SOS has tended to be an overused and misunderstood term. However, this has not limited its use or focus in energy policy, as outlined in the previous sections of this report.

Rather than use an all-encompassing and therefore a diffuse and inaccurate definition for SOS, this report will continue to provide information and analysis on areas that different stakeholders might classify in their own vocabulary as SOS (i.e. economists as price and quantity considerations, power systems operators as electricity reliability, end-users as availability and quality, etc.).

Of course in specific areas like electricity system security, definitions are possible. The Commission for Energy Regulation (CER) in a recent publication<sup>30</sup> states that it, "...refers to the ability of the electricity system to provide end-users with a sustained standard of electricity supply. This relates to the reliability of the electricity system (in terms of its tolerance for shocks/outages in maintaining electricity supplies and the management of the system in overcoming difficulties/issues) and in terms of the adequacy of infrastructure (generation capacity, transmission capacity). Yet even this definition requires a number of varied metrics ranging from issues of engineering to investment to emergency management.

Related to the difficulty in definition, Jacques de Jong noted<sup>31</sup> that in the EU, "...on the key issue of security of supply, little had been done to date and nothing comprehensive [in terms of policy, data analysis, etc.]. The resulting imbalance [compared to environmental and competitiveness] in policy [has] left the EU without any guarantees in its system, and exposed [it] to a long-term supply risk."

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<sup>29</sup> Blyth and Lefevre (IEA Information Paper), 2004, "Energy Security and Climate Change Interactions". Available from [http://www.iea.org/textbase/papers/2004/EnergySecurity\\_%20ClimateChange\\_COP10.pdf](http://www.iea.org/textbase/papers/2004/EnergySecurity_%20ClimateChange_COP10.pdf).

<sup>30</sup> The document is available from <http://www.cer.ie/CERDocs/cer06187.pdf>.

<sup>31</sup> Full details of the speech are available from [http://www.clingendael.nl/ciep/events/20060131/20060131\\_Event\\_Report\\_CIEP\\_EPC\\_Policy\\_Dialogue.pdf](http://www.clingendael.nl/ciep/events/20060131/20060131_Event_Report_CIEP_EPC_Policy_Dialogue.pdf).

## 4 Security of Supply Metrics

In SEI's first SOS report the metrics were classified by supply and demand, market signals and market response. The 2006 metrics have been revised and are classified into the following categories, which better reflect the available data:

- Overall Economy,
- Fuel,
- Exploration.

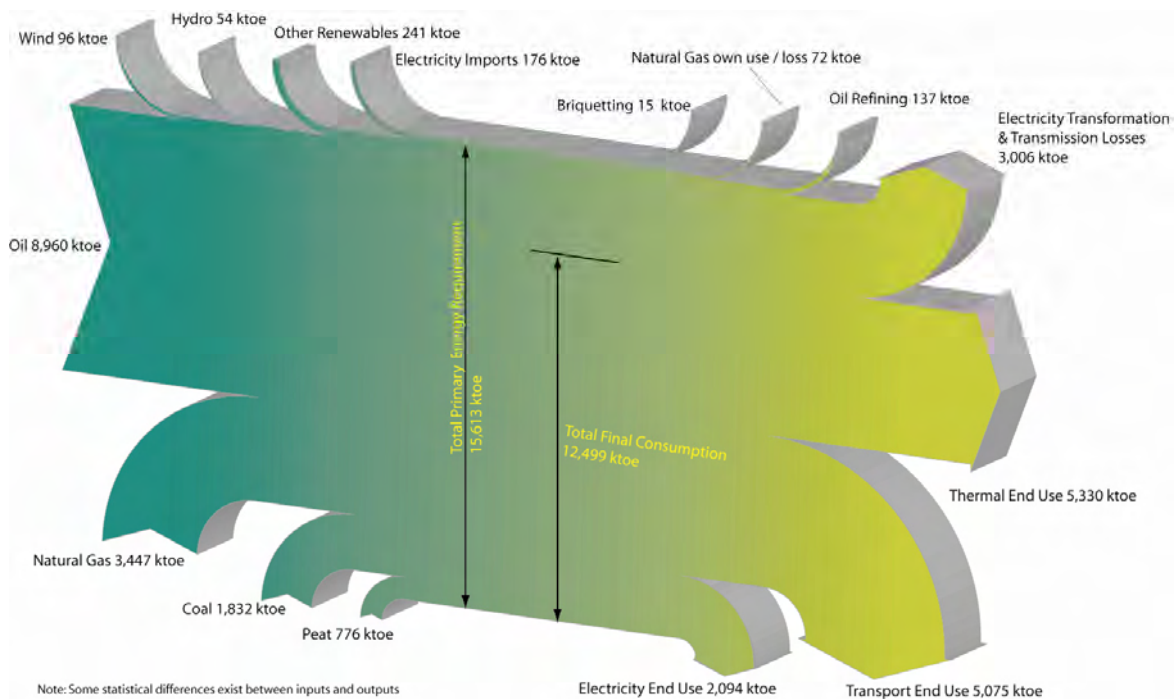
### 4.1 Security of Supply Metrics -Overall Economy

#### 4.1.1 Supply and Demand

Figure 3 shows the energy balance for Ireland in 2005 as a flow diagram. This provides a useful overview of the energy landscape. Figure 3 illustrates clearly the significance of each of the fuel inputs, energy lost in transformation and final energy demand to each of the end use markets, electricity, thermal and transport.

The main point to note is the dominant role that oil still occupies as a fuel of choice, which is largely being driven by growing demand in the transport sector. The size of the transport and thermal markets as compared to the electricity market is also significant. Other points of relevance include the relatively small overall contribution of renewables and the fact that electricity transformation losses still account for a significant proportion of primary energy supply (19%). Each of these fuels is examined in detail in section 4.2.

**Figure 3: Energy Flow in Ireland 2005**

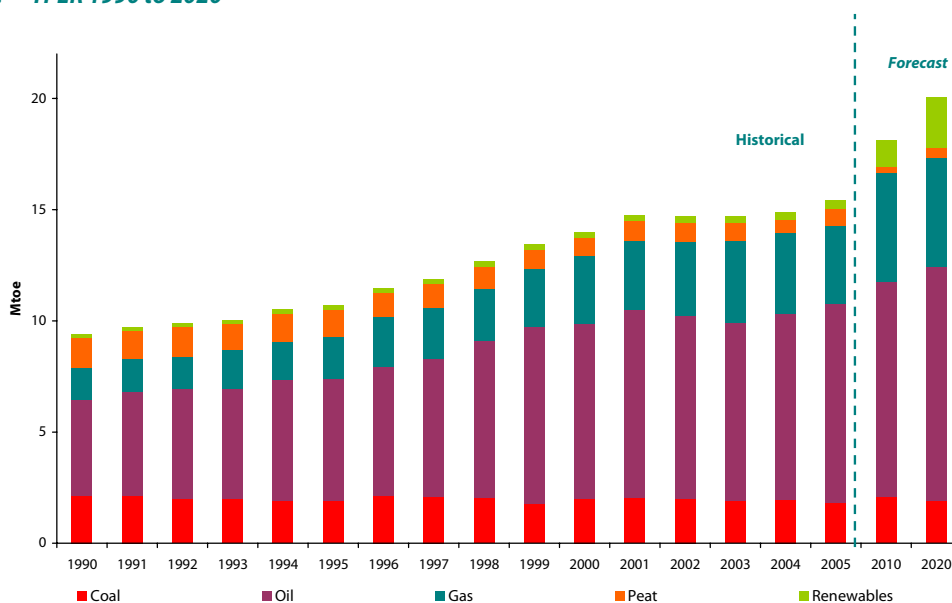


Source: SEI

Total Primary Energy Requirement (TPER) is the barometer used to gauge movements in energy demand. Figure 4 shows that between 1990 and 2005 Ireland's total annual energy requirement grew in absolute terms by 64% (3.4% per annum on average) and increased in 2005 by 3%. Oil remains the dominant fuel source accounting for 57% of TPER in 2005. Usage of natural gas has increased significantly to the point where its share of energy supply has now

reached 22%. It will be noted that natural gas use decreased in 2005 by 4.8% due almost entirely to fuel switching in electricity generation. The solid fuels, coal and peat, have both experienced a gradual decline over the period while renewable energy continues to grow from a very low base.

**Figure 4: TPER 1990 to 2020**



Source: SEI

Forecast data, prepared for SEI by the Economic and Social Research Institute (ERSI), is also included in figure 4. Ireland's primary energy supply is anticipated to grow at a rate of 3.2% per annum (on average) between 2005 and 2010 and then reduce to 1.0% annual growth for the next decade. This is driven by average annual economic (GDP) growth rates of 5.7% to 2010 and 2.4% between 2010 and 2020.

Oil usage is projected to continue to grow over the period, in particular in response to the increase in demand for transport energy and will remain the dominant fuel, accounting for 52% of energy supply in 2020. Natural gas usage is predicted to increase more significantly than oil up to 2010, but its contribution in 2020 is not anticipated to be higher than that in 2010, due to reduced gas usage in electricity generation. Renewable energy will show the fastest growth over the period but from a low base and contribute 11% of Ireland's primary energy supply by 2010. It is projected to provide 30% of Ireland's electricity supply, 8% of road transport energy and contribute 10% of Ireland's thermal energy demand by 2020. These targets are based on targets in Ireland's *Green Paper on Energy*<sup>32</sup> (30% Renewable Energy Sources [RES] –Electricity), the EU March Council meeting<sup>33</sup> (8% RES-Transport) and the Bioenergy Strategy Group medium scenario<sup>34</sup> (RES-Heat). Forecasts from a *High Oil Price* scenario were also developed for this report and are detailed in section 5.

<sup>32</sup> The full text of the Green Paper is available from

<http://www.dcmnr.gov.ie/Energy/Energy+Planning+Division/Energy+Green+Paper.htm>.

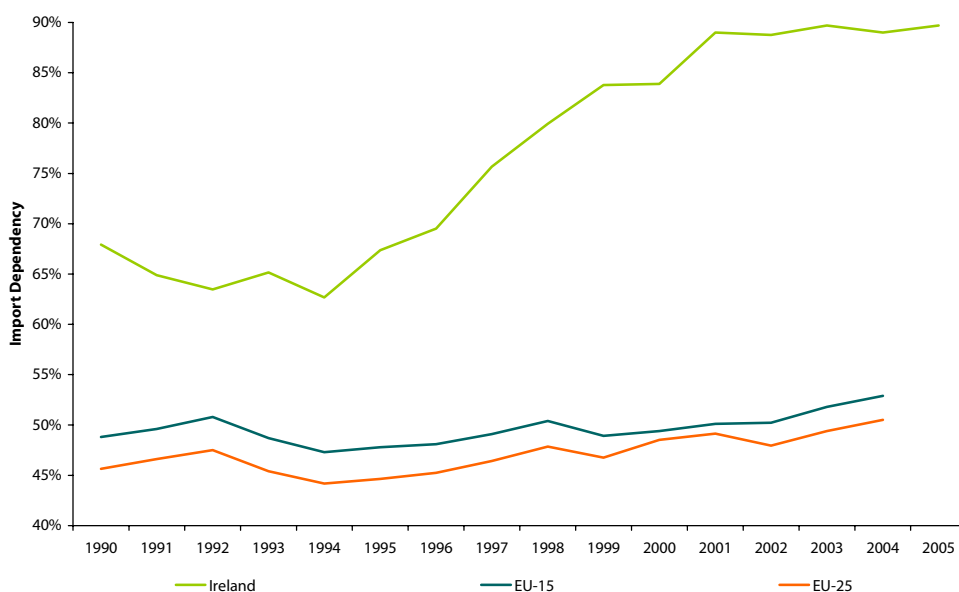
<sup>33</sup> Council of the European Union, 2006, *Brussels European Council 23/24 March 2006 – Presidency Conclusions*. Available from [http://www.eu2006.at/en/News/Council\\_Conclusions/2403EuropeanCouncil.pdf](http://www.eu2006.at/en/News/Council_Conclusions/2403EuropeanCouncil.pdf).

<sup>34</sup> DCMNR/ SEI, 2006, *Bioenergy in Ireland. A strategic report of the Bioenergy Strategy Group*. Available from [http://www.sei.ie/getFile.asp?FC\\_ID=1750&docID=913](http://www.sei.ie/getFile.asp?FC_ID=1750&docID=913).

### 4.1.2 Import Dependency

Figure 5 illustrates the trend in import dependency since 1990, comparing it with the EU as a whole (distinguishing between the EU-15 and the enlarged EU-25).

**Figure 5: Import Dependency of Ireland and EU 1990 to 2005**



Source: SEI and Eurostat

Domestic production accounted for 32% of Ireland’s energy requirements in 1990. However, since the mid-1990s import dependency has grown significantly, due to the increase in energy use together with the decline in indigenous natural gas production at Kinsale since 1995 and decreasing peat production. Ireland’s import dependency reached 90% in 2005, increasing from 69% in 1990. Table 1 presents the results of a forecast to 2025.

**Table 1: Import Dependency Forecasts to 2025**

%	2010	2015	2020	2025
<b>EU 25</b>	55	61	64	64
<b>Ireland</b>	88	87	87	86

Source: PRIMES (2006)

This trend in figure 5 and table 1 reflects the fact that Ireland is not endowed with significant indigenous fossil fuel resources and has to date not harnessed significant quantities of renewable resources, although there has been strong growth in renewables in recent years from a small base. Figure 6 shows the indigenous energy fuel mix for Ireland over the period. The reduction in indigenous supply of natural gas is clearly evident from the graph as is the switch away from peat. Production of indigenous gas decreased by 75% over the period since 1990, peat by 43% and renewable energy in contrast increased by 140%. Indigenous production peaked in 1995 at 4.1 Mtoe and there has been a 59% reduction since then.

**Figure 6: Indigenous Energy by Fuel 1990 to 2005**



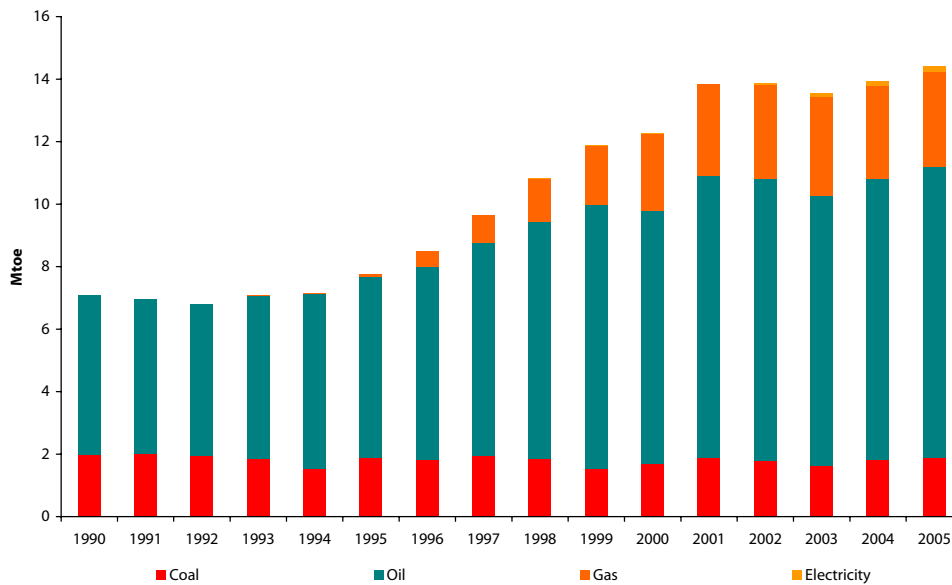
Source: SEI

The share of native gas within the indigenous fuels contribution was 28% in 2005, compared with 54% in 1990. The share of peat increased from 41% in 1990 to 48% in 2005, in absolute terms its consumption reduced by 43%. Renewable energy increased its share from 9% to 24% and in absolute terms by 140%.

Some proposed developments are likely to impact on this trend including the plans to extract and utilise gas at the Corrib Gas Field and the targets for increasing the deployment of renewable energy to be achieved by 2010.

Figure 7 shows the trend for net fuel imports (imports minus exports) over the period 1990 to 2005. The growing dependence on oil due largely to increase in energy use in transport is the most striking feature. There was a doubling (103%) of total net imports over the period with an 83% increase in net imports of oil. The decline of indigenous natural gas reserves at Kinsale is also indicated by the growth in imported natural gas in the latter part of the decade. Coal imports have remained stable over the period reflecting the base load operation of Moneypoint electricity generating plant. In 2005, oil, gas and coal accounted for 65%, 21% and 13% of net imports respectively. Electricity accounted for 1.2% of net imports in 2005.

**Figure 7: Imported Energy by Fuel 1990 to 2005**



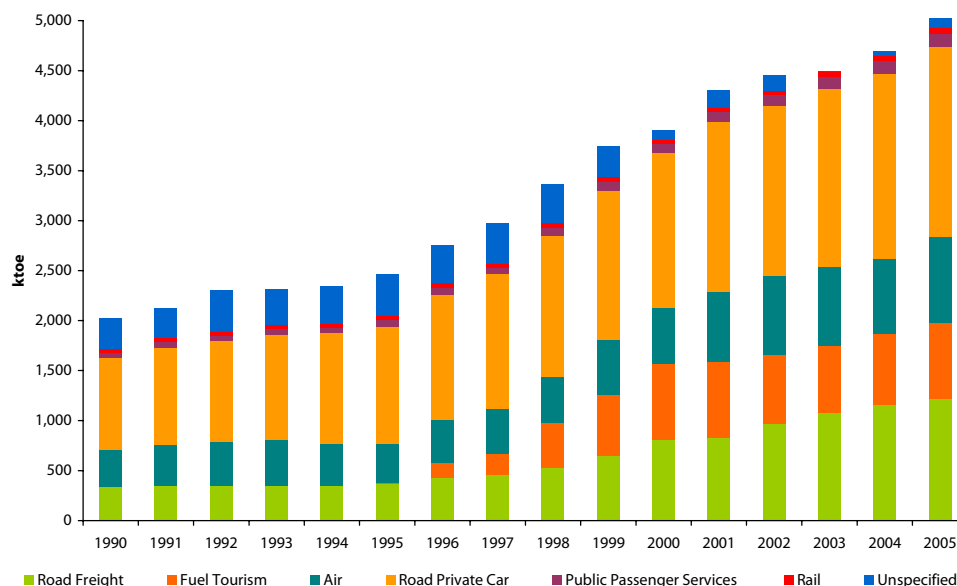
Source: SEI

#### 4.1.3 Growth in Transport Energy by Mode

Transport is a key area in terms of Ireland's SOS as it is almost exclusively oil based, all of which is imported, as seen in figure 7. Fuel consumption in transport is closely aligned to the mode of transport used: kerosene is almost all used for air transport, fuel oil for shipping and electricity is consumed by the Dublin Area Rapid Transport (DART) system and Luas light rail from 2004. Liquefied petroleum gas (LPG) is almost exclusively used for road transport, as is petrol. The bulk of petrol consumption for road transport can be assumed to be for private car use although there is a significant number of petrol driven taxis in operation. Diesel consumption is used for navigation, rail and road purposes but the bulk is used for road transport. This diesel consumption is used for freight transportation, public transport in buses and taxis, private car transport and other applications such as agricultural, construction and other machines. The contribution from each mode of transport to energy demand is shown in figure 8. Data in this section is taken from a report entitled *Energy in Transport*<sup>35</sup> published in September 2006.

<sup>35</sup> SEI, 2006, *Energy in Transport – Trends and Influencing Factors 2006*. Available from <http://www.sei.ie/index.asp?locID=1048&docID=934>.

**Figure 8: Transport Energy Demand by Mode 1990 to 2005**



Source: SEI

During the period 1990 to 2005 overall transport sector energy usage increased by 151% (6.3% per annum on average). The road freight category recorded the largest growth over the period of 264% (9% per annum). This is significant because the focus of attention in the sector is often the private car mode.

The mode with the second largest increase was public passenger services which grew by 190% (7.4% per annum), air grew by 129% 5.7% (per annum), road private car increased by 107% (5% per annum) and rail consumption increased by 13.6% (0.9% per annum).

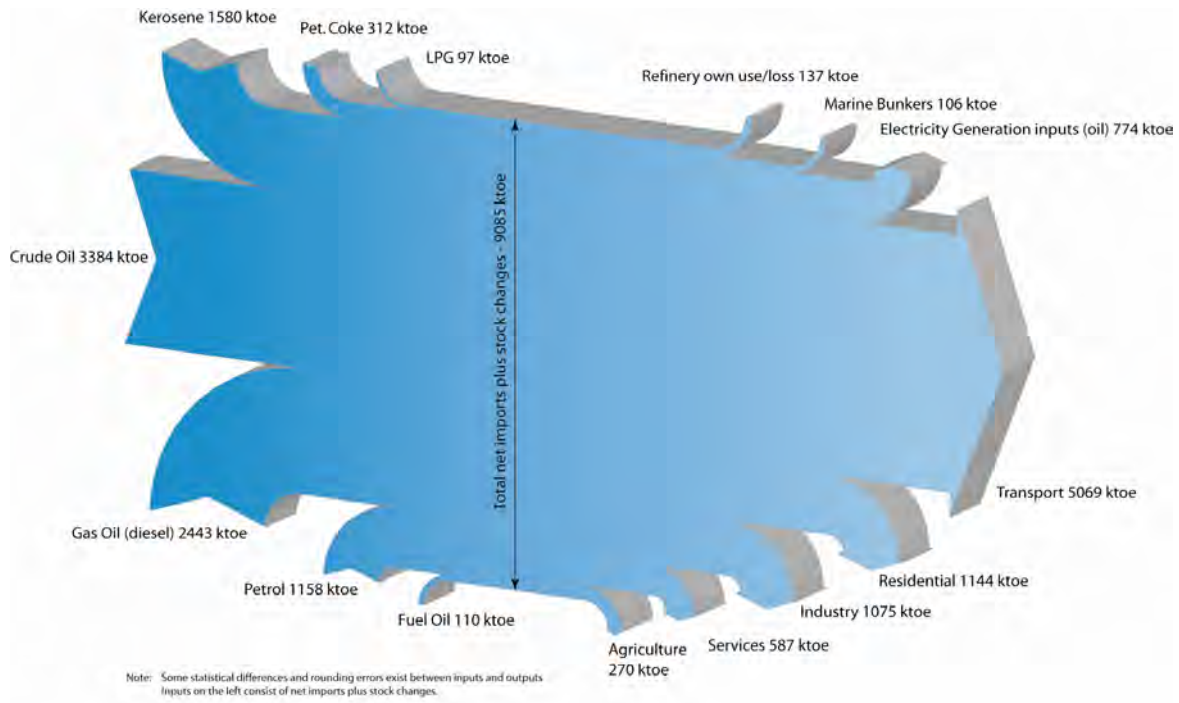
Combined petrol and diesel fuel tourism is also included in figure 8. Only fuel tourism out of the Republic of Ireland (ROI) is included in this report i.e. fuel which is purchased in ROI but consumed elsewhere. Before 1995 the trend was negative i.e. fuel was purchased outside and consumed within the State.

## 4.2 Security of Supply Metrics – Fuel

### 4.2.1 Oil Usage

As stated in section 4, oil is by far the dominant energy source in Ireland. In terms of TPER, that dominance increased from 47% of the total in 1990 to a peak of 59% in 1999. The share of oil in 2005 was 57% and consumption increased by 3% over 2004. It is worth reiterating that the total amount of oil used in Ireland is imported. Figure 9 presents an energy flow diagram for oil usage in 2005. Inputs on the left are split into oil's various components while outputs on the right are categorised by sector.

**Figure 9: Energy Flow 2005 –Oil**



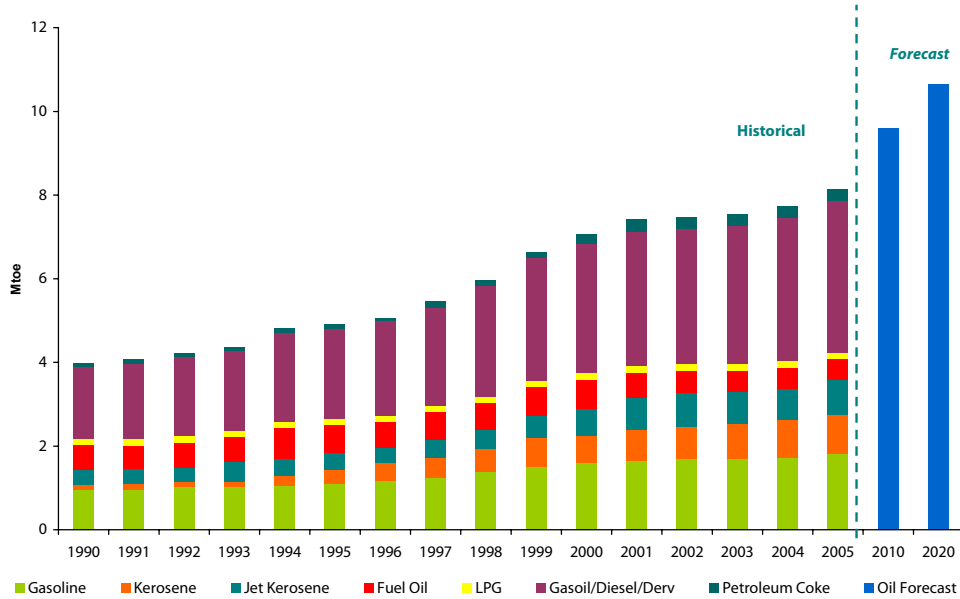
Source: SEI

It can be seen from figure 9 that transport accounts for the largest share of oil usage, approximately 56% in 2005 follows by residential at 13% and industry at 12%. Electricity generation inputs were responsible for 8% of oil consumption.

Figure 10 presents the growth in oil from 1990 to 2020. Forecast data (at the aggregate oil level) from 2010 and 2020 were prepared for SEI by ERSI in November 2006. Forecast data is only available at the aggregate oil level. Looking firstly at the period 1990 to 2005, kerosene recorded the largest growth, 656% over the period followed by petroleum coke which grew by 288%. Over the same period, usage of diesel increased by 112% while gasoline rose by 93%.

Forecast data, shown on the right of figure 10 predicts that the use of oil will increase by 31% over the period to 2020.

**Figure 10: Final Consumption of Oil 1990 to 2020**



Source: SEI

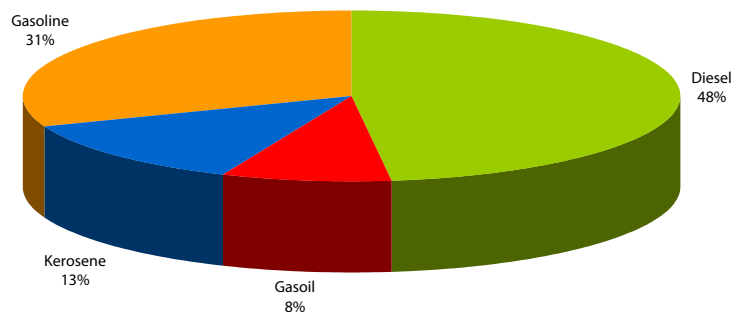
#### 4.2.2 Oil Market

The oil market in Ireland is served by a number of companies, both multi-national and domestic independents.

Ireland has one oil refinery located at Whitegate, Co. Cork which was operated by the Irish National Petroleum Corporation (INPC), a State-owned company, until July 2001 when it was sold to Tosco Corporation. Tosco Corporation was subsequently taken over by Phillips Petroleum, which was acquired by Conoco and is now known as ConocoPhillips. The refinery is now operated by the Irish Petroleum Company Limited (IPCL), a ConocoPhillips subsidiary which also operates the storage terminal at Whiddy Island, within Bantry Bay, on the southwest coast of Ireland.

The latest available production figures indicate that over 15 million barrels were refined in 2005. Figure 11 provides a breakdown of production by fuel type.

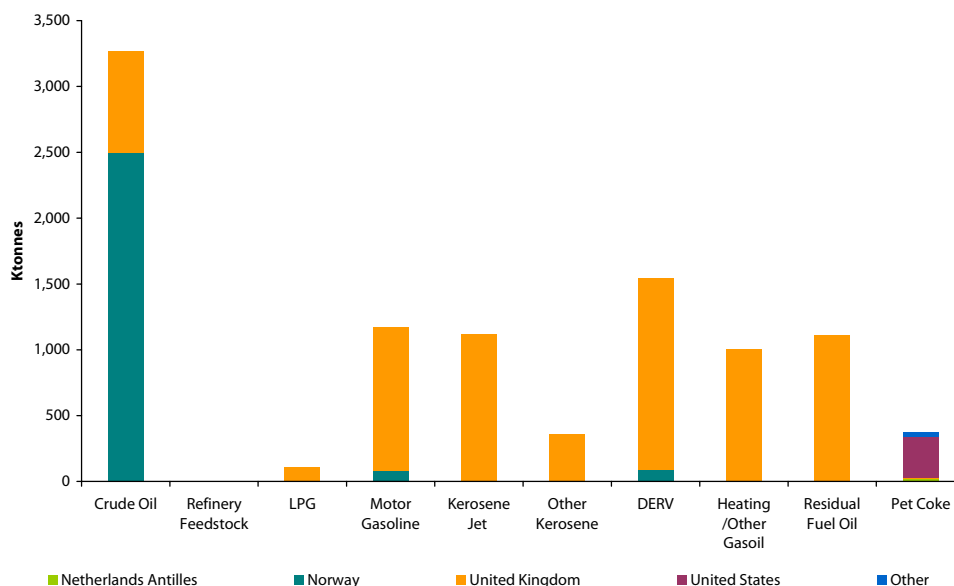
**Figure 11: Whitegate Refinery Production 2005**



Source: ConocoPhillips

Figure 12 and table 2 illustrate where the oil used in Ireland comes from and it can be seen that the majority (70%) is sourced from the UK followed by Norway which was responsible for 27% of oil imports in 2005.

**Figure 12: Oil Imports by Type and Country of Origin 2005**



Source: SEI

**Table 2: Oil Imports by Type and Country of Origin 2005**

ktonnes	Crude Oil	Refinery Feedstock	LPG	Motor Gasoline	Kerosene Jet	Kerosene Other	DERV	Heating /Other Gasoil	Fuel Oil	Pet Coke	Total	% of Total
<b>Netherlands Antilles</b>										19	19	0.2
<b>Norway</b>	2500			85		1	88	3			2677	26.6
<b>United Kingdom</b>	772	5	109	1090	1118	357	1457	1001	1115	4.25	7028	69.8
<b>United States</b>										317	317	3.1
<b>Other</b>										34	34	0.3
<b>Total</b>	3272	5	109	1175	1118	358	1545	1004	1115	374	10075	100

Source: SEI

Inland distribution of oil products within Ireland is by road from a number of marine terminals and the road loading facility located at the Whitegate oil refinery.

#### 4.2.3 National Oil Reserves

Ireland's national oil stockholding policy has evolved in response to its international commitments arising from membership of the EU and the International Energy Agency (IEA). Currently, the EU requires the holding of 90 days stocks based on the previous year's consumption, while the IEA requires 90 days stocks based on previous year's net imports of oil.

Following the European Communities (Minimum Stocks of Petroleum Oils) Regulations, 1995 responsibility for the management of Ireland's oil stocks was vested in the National Oil Reserves Agency (NORA)<sup>36</sup>. This body acts as an agent on behalf of the Minister for Communications, Marine and Natural Resources. Stock holdings<sup>37</sup> are held either

<sup>36</sup> NORA receives no funding from the Exchequer. It is funded by way of a levy of 0.476 cent per litre imposed on oil sales/usage by oil companies and oil consumer companies. This levy has remained unchanged since NORA's establishment in 1995.

<sup>37</sup> To date Ireland has concluded six oil stockholding agreements with the UK, Sweden, Denmark, The Netherlands, Belgium and France.

directly by the Agency itself or on its behalf by third parties, either within Ireland or within countries with whom Ireland has concluded a Government-to-Government Oil Stockholding Agreement.

Oil stocks may be either wholly owned by NORA or held on NORA's behalf under what, in the industry, is termed "stock tickets" - the latter is a mechanism whereby NORA has the option to purchase, under commercial contracts and at market prices, volumes of oil in the event of an oil emergency being declared.

Table 3 shows the situation as of 1<sup>st</sup> August 2006. A total of 107 days (based on IEA methodology) worth of stocks were held, of which 72 days were held within Ireland. Ireland's IEA stockholding requirement for 2006 amounts to 2,278 Mtoe.

**Table 3: Number of Days of Oil Stocks Held by Ireland at 1<sup>st</sup> August 2006**

	In Ireland (days)	Abroad (days) *	Total (days)
<b>NORA stocks Wholly owned</b>	33	7	40
<b>Ticketed (Stock Tickets) **</b>	0	28	28
<b>Industry/Consumer Stocks ***</b>	39	0	39
<b>Total</b>	72	35	107

Source: NORA

\*Stocks held in other EU countries under cover of Bilateral Agreements whereby the host country guarantees that it would not oppose the transfer of the oil in question to Ireland in the event of an emergency.

\*\* Surplus (i.e. over and above operational stocks) private sector stocks over which NORA has an option to purchase (during the period of the contract) in the event of an emergency.

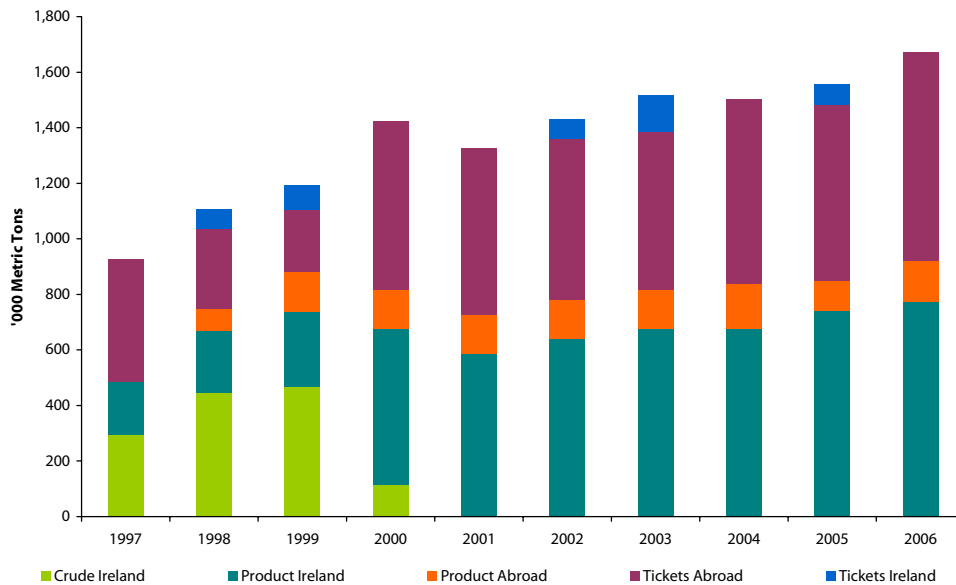
\*\*\* These are operational stocks held at major ports, the Whitegate refinery and by large consumer companies such as the ESB which would be legally and physically amenable to the Government control in the event of an emergency being declared under the Fuels Acts 1971 and 1982. Industry stocks that have already been delivered to filling stations etc. are not included.

The 2006 Energy Green Paper<sup>38</sup> recommends the holding of a greater proportion of NORA owned stocks within Ireland while having regard to storage availability on the island and value for money.

Figure 13 illustrates Ireland's oil stock levels during the period 1997 to 2006. Product refers to holdings of oil products (petrol, diesel, etc) that are held either in Ireland or in other jurisdictions covered by a relevant Oil Stockholding Agreement.

<sup>38</sup> The Green Paper is available at <http://www.dcmnr.gov.ie/Energy/Energy+Planning+Division/Energy+Green+Paper.htm>

**Figure 13: NORA Oil Stocks 1997 to 2006**

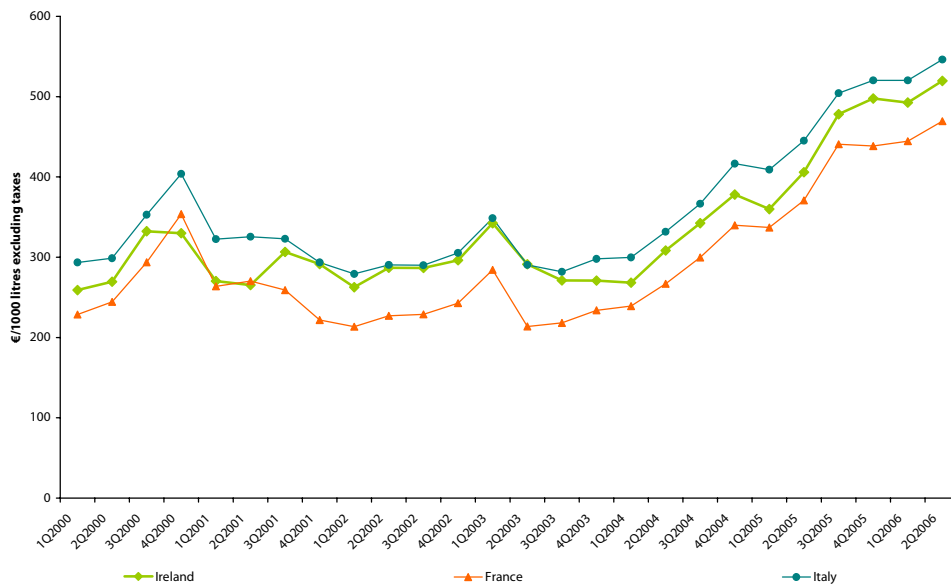


Source: NORA

#### 4.2.4 Oil Prices

Oil prices to industry in Ireland were almost 50% higher in real terms in mid 2006 than in the year 2000. This was the highest increase of any of the countries shown. When the effects of inflation are taken into account (real prices) the increase was in the middle of the range of countries.

**Figure 14: Fuel Oil Prices to Industry (Nominal Prices) Q1 2000 to Q2 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

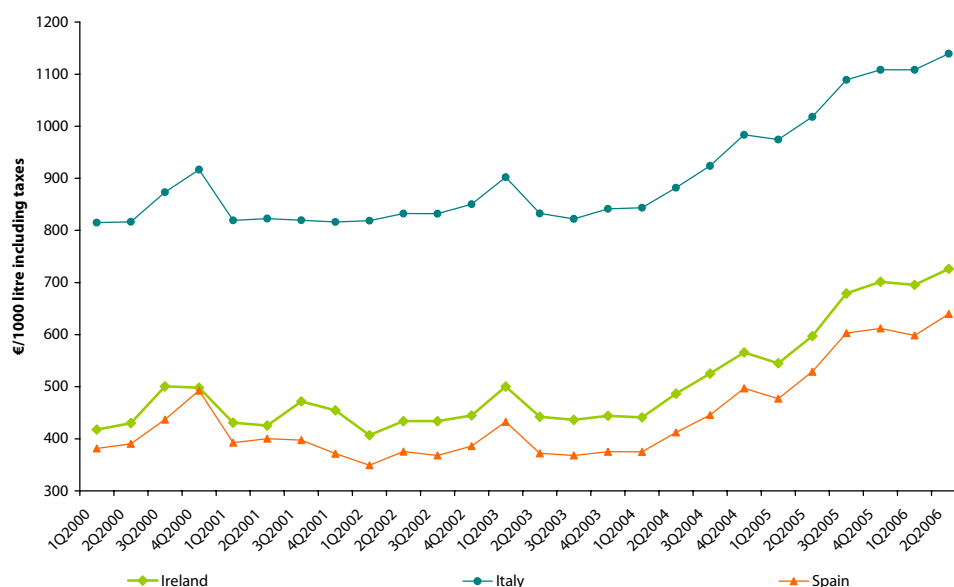
**Table 4: Oil Price to Industry Increase Since 2000**

Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Oil Prices 2 <sup>nd</sup> qtr 2006 (nominal)	155.6	116.3	141.7	122.2	127.8	132.8	142.8	143.7	135.7	135.1	138.6	130.3	159.4	140.7	140.6	125.4
Oil Prices 2 <sup>nd</sup> qtr 2006 (real)	122.2	102.5	127.8	109.7	126.1	124.8	130.2	115.3	149.7	115.5	111.0	110.9	137.7	118.3	129.7	114.6

Source: Energy Prices & Taxes © OECD/IEA, 2006

Nominal heating oil prices to Irish householders (figure 15 and table 5) increased by 28% since 2000 but increased by 4% when the effects of inflation are removed.

**Figure 15: Household Heating Oil Prices (Nominal Prices) Q1 2000 to Q2 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

**Table 5: Oil Price to Households Increase Since 2000**

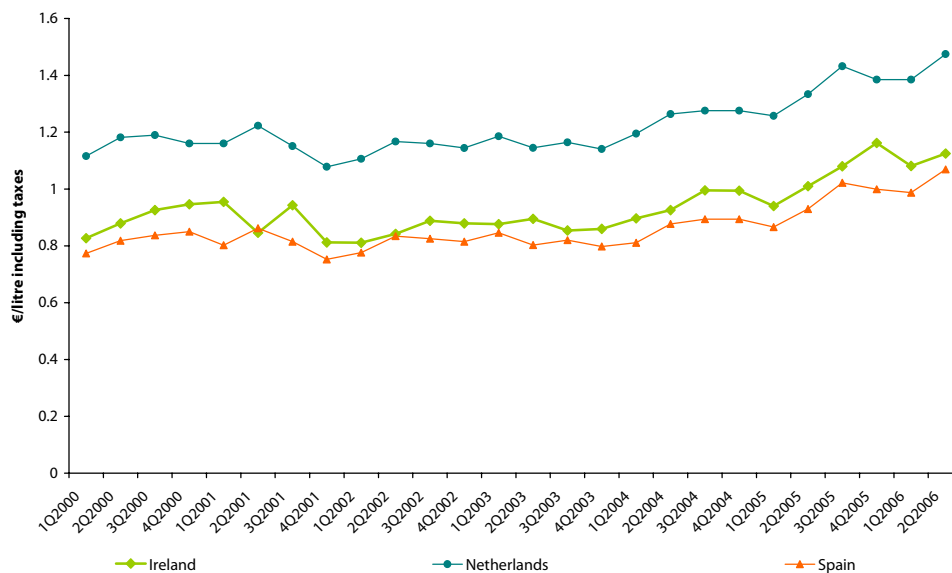
Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Oil Prices 2 <sup>nd</sup> qtr 2006 (nominal)	134.7	129.1	148.3	123.7	123.2	125.0	136.0	130.4	127.9	124.6	141.8	127.2	152.7	133.3	130.4	119.2
Oil Prices 2 <sup>nd</sup> qtr 2006 (real)	114.1	114.9	131.1	109.8	114.4	111.6	123.6	106.4	103.9	108.4	123.0	111.1	127.4	109.3	119.5	102.7

Source: Energy Prices & Taxes © OECD/IEA, 2006

Petrol and diesel prices shown here are inclusive of both excise duty and vat.

Figure 16 shows that the increase in petrol prices in Ireland over the period 2000 to 2006 were the lowest of the countries shown. Petrol prices in Ireland increased by just 2% in real terms since 2000 which is below the 10% average increase for OECD Europe countries.

**Figure 16: Retail Unleaded Petrol Prices (95 RON<sup>39</sup>) (Nominal Prices) Q1 2000 to Q2 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

**Table 6: Petrol Price Increase Since 2000**

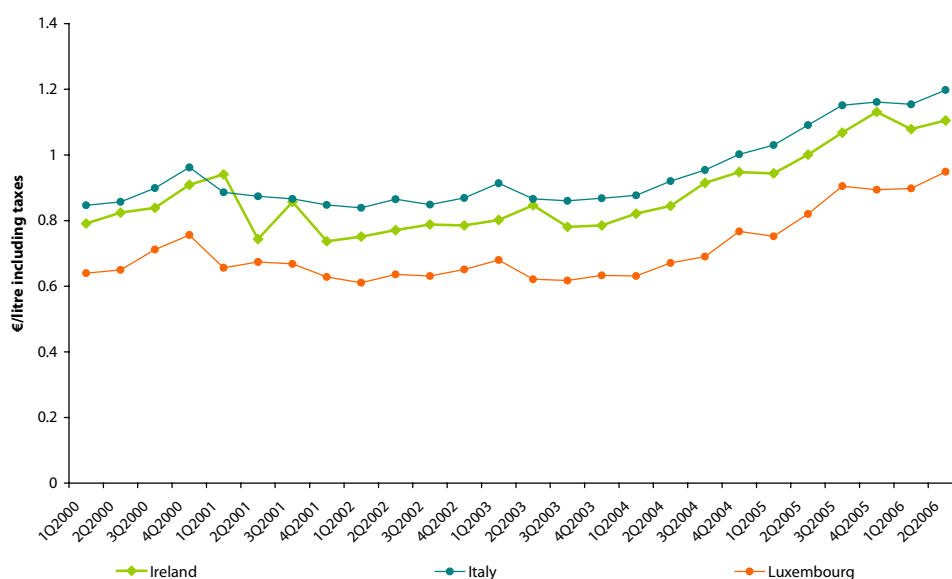
Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Petrol Prices 2 <sup>nd</sup> qtr 2006 (nominal)	132.9	120.6	135.2	120.7	118.1	118.6	133.0	130.3	125.8	123.1	137.6	127.2	152.7	130.5	126.7	119.1
Petrol Prices 2 <sup>nd</sup> qtr 2006 (real)	110.4	107.3	119.5	107.2	109.6	105.9	120.8	106.4	102.2	107.1	119.3	111.1	127.4	107.1	116.2	102.7

Source: Energy Prices & Taxes © OECD/IEA, 2006

Figure 17 shows that the increase in diesel prices in Ireland was in the upper range for the countries shown. Diesel prices in Ireland increased by 7% in real terms since 2000 which is below the 18% average increase for OECD Europe countries.

<sup>39</sup> RON is the research octane number used in Europe to rate the characteristics of petrol.

**Figure 17: Retail Road Diesel Prices (Nominal Prices) Q1 2000 to Q2 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

**Table 7: Auto diesel Price Increase Since 2000**

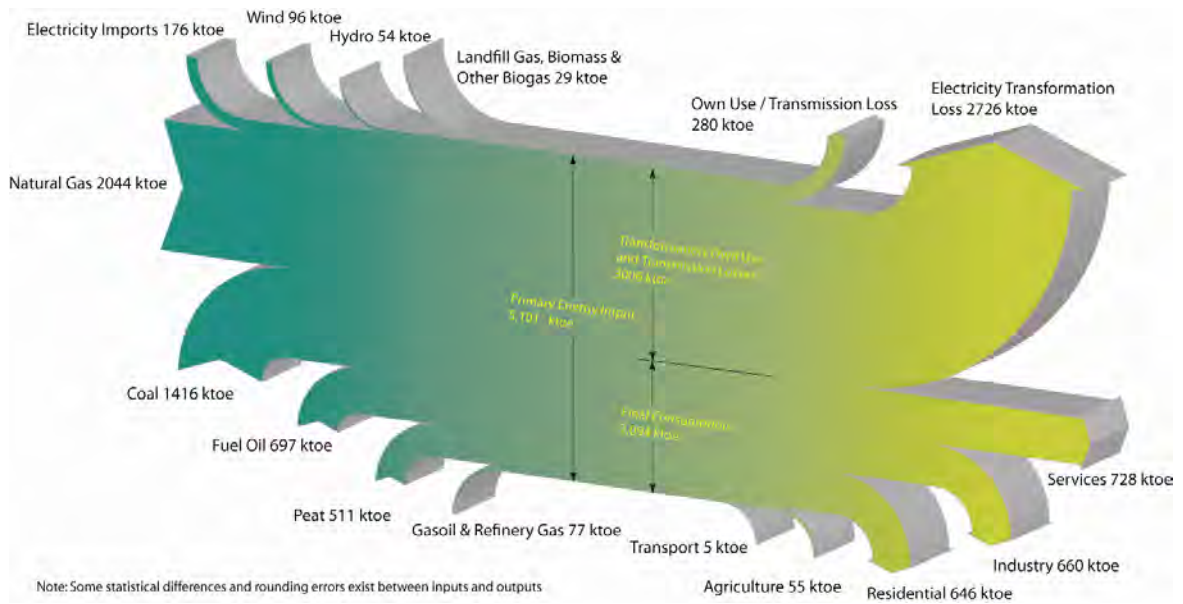
Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Diesel Prices 2 <sup>nd</sup> qtr 2006 (nominal)	148.8	133.8	136.9	118.7	121.9	131.4	141.9	152.6	131.2	134.3	137.7	131.3	163.0	140.4	135.6	120.4
Diesel Prices 2 <sup>nd</sup> qtr 2006 (real)	118.0	119.0	121.1	105.4	113.2	117.3	128.9	124.6	106.6	116.8	119.5	114.7	135.9	115.2	124.3	103.8

Source: Energy Prices & Taxes © OECD/IEA, 2006

#### 4.2.5 Electricity Usage

Figure 18 shows graphically the flow of energy in electricity generation and supply. The relative size of the useful final electricity consumption and the energy lost in transformation and transmission is striking. These losses represent 59% of the energy inputs. The small, but growing, contribution from renewables is also notable as is the dominance of gas in the generation fuel mix. In 2005, renewables accounted for 3.5% of the energy inputs to generate electricity with wind contributing 1.9% of total inputs. Wind accounted for 54% of the renewable energy used for electricity generation.

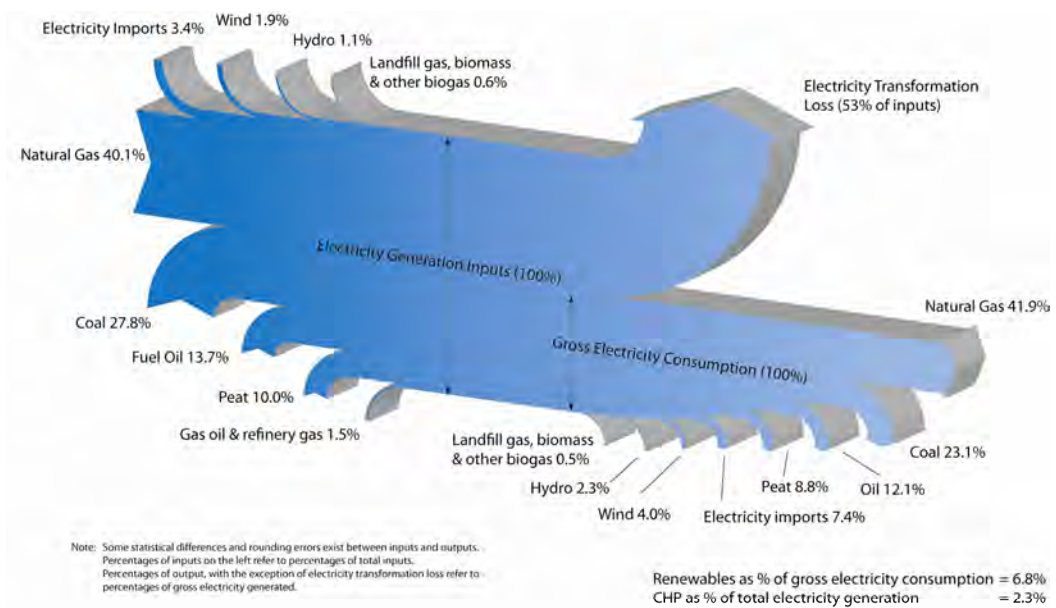
**Figure 18: Energy Flow in Electricity Generation and Supply 2005**



Source: SEI

Figure 19 shows a similar picture to figure 18 except that the electricity outputs are shown by fuel use to generate the electricity and as percentages for the purposes of comparison with the various targets. Renewable generation makes use of wind, hydro, landfill gas, biomass and other biogas and in 2005 accounted for 6.8% of gross electricity consumption compared with 5.2% in 2004. As mentioned in section 2.2 the Minister for Communications, Marine and Natural Resources set a target of 15% of electricity to be generated by renewable sources by 2010.

**Figure 19: Flow of Energy in Electricity Generation- Fuel Inputs /Electricity Outputs 2005**

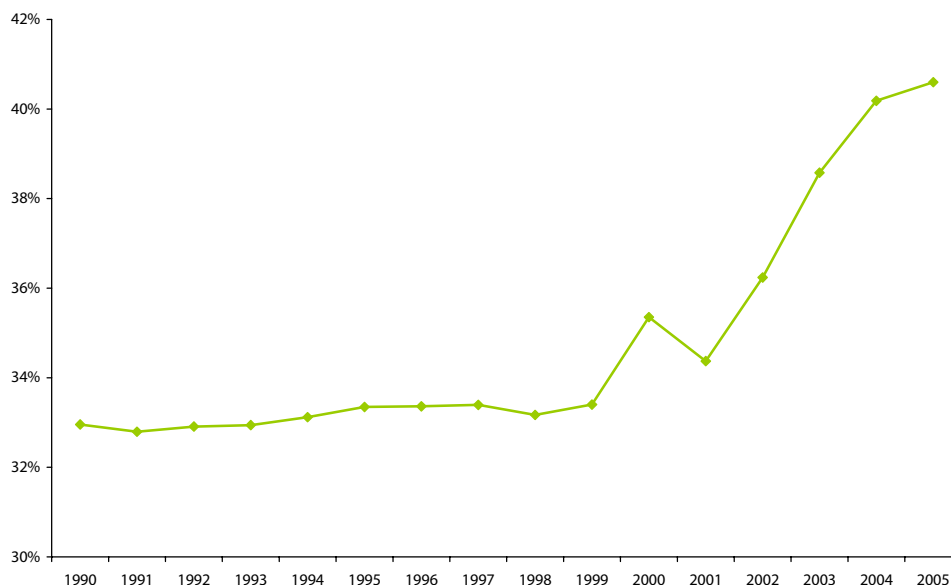


Source: SEI and Eirgrid

The efficiency of electricity supply shown in figure 20 is defined as final consumption of electricity divided by the fuel inputs required to generate this electricity and expressed as a percentage. The inputs include renewable sources

and imports and the final consumption excludes the generation plants' "own use" of electricity and transmission and distribution losses. Hence this is supply efficiency rather than generating efficiency.

**Figure 20: Efficiency of Electricity Supply 1990 to 2005**



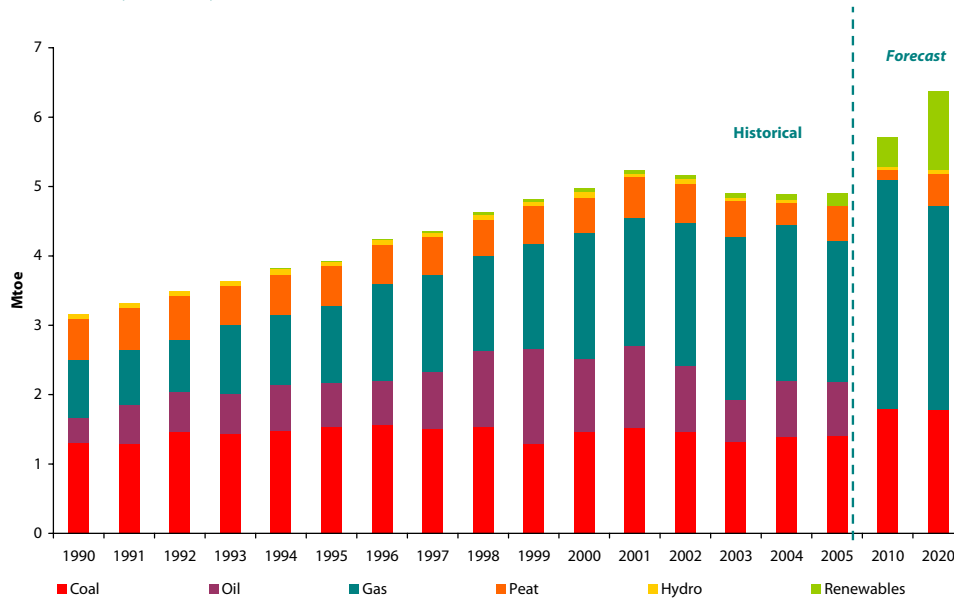
Source: SEI

From the mid 1990s onwards the influence of the use of higher efficiency natural gas plants and the increase in production from renewable sources is evident. The sharp rise between 2002 and 2004 (from 35% to 40%) is accounted for, principally, by the coming on stream of new CCGT plant (392 MW in August 2002 and 343 MW in November 2002), an increase in imports of electricity and the closure of old peat fired stations.

The most recent data indicates that a small increase in efficiency occurred improving from 40.2% in 2004 to 40.6% in 2005.

Figure 21 shows the primary fuel requirement for electricity generation for the period 1990 to 2020. It grew by 65% from 3.1 Mtoe in 1990 to a high of 5.2 Mtoe in 2001. Between 2001 and 2004 the requirement reduced by 5%, while at the same time the final consumption of electricity increased by 10%. In 2005, 5.1 Mtoe of energy was used to generate electricity. As a share of total primary energy requirement the inputs to electricity generation were 33% in 2005. Electricity consumption as a share of total final consumption increased from 14% to 17% between 1990 and 2005.

**Figure 21: Electricity Primary Fuel Mix 1990 to 2020**

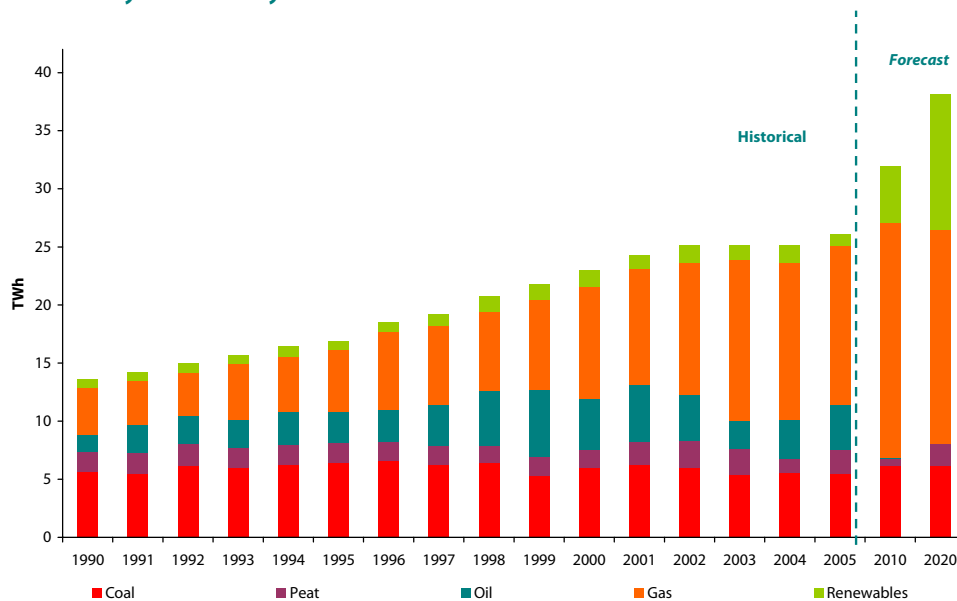


Source: SEI

Also shown on the right of figure 21 are forecasts to 2020. The principal areas of growth are in natural gas and renewables, both associated with significant increases in installed capacity, but the contribution from coal increases also. Oil reduces significantly over the period and no longer contributes in 2020.

The contribution from renewables is more evident in figure 22, which presents the electricity generated by fuel. In 2020, renewable energy accounts for 30% and the dependency on natural gas reduces (relative to projections generated in 2005) to 48%.

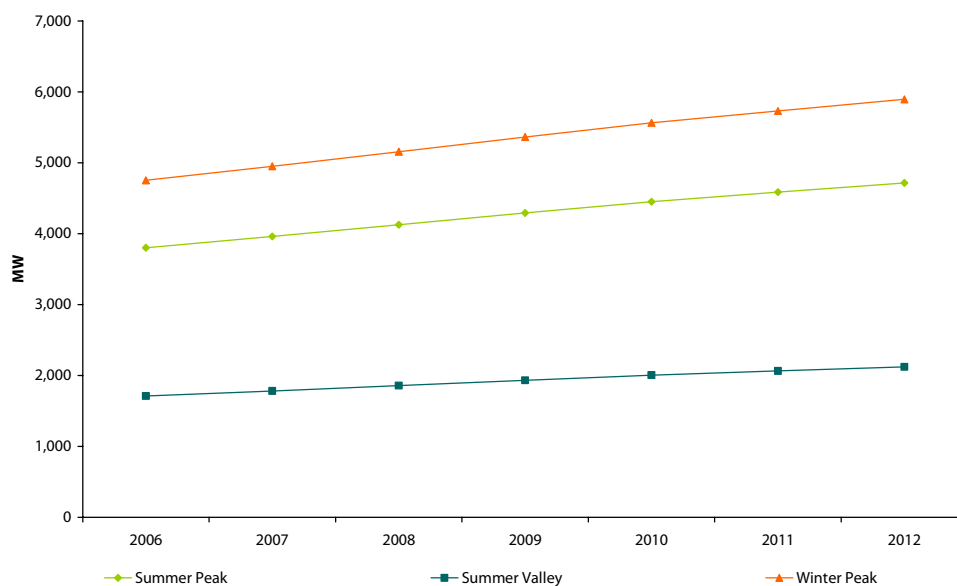
**Figure 22: Electricity Generated by Fuel 1990 to 2020**



Source: SEI

Figure 23 presents the forecasts of transmission demand for the seven years 2006 to 2012 for Eirgrid's (the Transmission System Operator) *Transmission Forecast Statement (TFS)*<sup>40</sup>. While it is difficult to accurately predict a peak demand figure for a particular year, the forecasts in figure 23 may be taken as indicative of a general trend in demand growth. Three demand values are presented for each year: the winter peak, the summer peak and the summer valley. It can be seen that winter peak and summer peak demand are both projected to increase by 24% over the course of the period.

**Figure 23: Transmission Demand Forecast 2006 to 2012**



Source: Eirgrid

The winter peak figures represent the expected annual peak demands that are forecast to occur in the October to February winter period of each year, for example the 2006 forecast of 4,754 MW is the maximum demand projected to occur in winter 2006/07. These peak forecasts take account of the influence of demand-side management (DSM) schemes, such as Eirgrid's winter peak demand reduction scheme (WPDRS). In winter 2004/05, DSM accounted for approximately 120 MW of a reduction to the peak demand. This amount of DSM is assumed by Eirgrid to continue over the next seven years.

The summer peak refers to the average peak value between March and September. This is typically 20% lower than the winter peak. While the overall grid power flow may be lower in summer than in winter, this may not be the case for flows on all circuits. In addition, the capacity of overhead lines is lower because of higher ambient temperatures, while network maintenance, normally carried out in the March to September period, can weaken the network, further reducing its capability to transport power.

The annual minimum is referred to as the summer valley in the TFS. Summer valley cases examine the impact of less demand and less generation dispatched. This minimum condition is of particular interest when assessing the capability to connect new generation. With local demand at a minimum, the connecting generator must export more of its power across the grid than at peak times. In preparing the forecasts Eirgrid reviewed historical summer valley demand data and the analysis showed a trend over recent years of increasing summer valley demand. Based on this evidence the forecasts of summer valley demands in figure 23 assume a higher figure of 36% of the annual maximum demand.

<sup>40</sup> Available from <http://www.eirgrid.ie/EirgridPortal/DesktopDefault.aspx?tabid=Forecast%20Statement%202006-2012>.

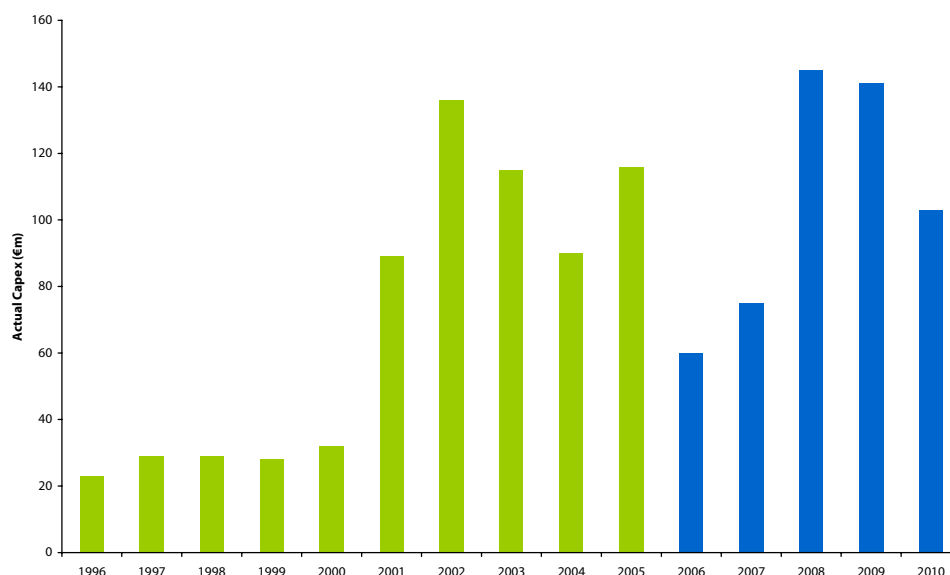
#### 4.2.6 Electricity Infrastructure /Investment

Investment in electricity network assets is a critical ongoing part of maintaining a secure system. In terms of electricity infrastructure, Ireland relies on an extensive high-voltage transmission network and a medium- and low-voltage distribution network to transport electricity domestically.

Ireland's electricity transmission and distribution network has experienced a long period of significant under-investment. To address this challenge, a network investment programme worth €4.4 billion, in both transmission and distribution networks, was undertaken between 1996 and 2005. An additional €3.2 billion investment in both transmission and distribution networks is planned for 2006 to 2010.

Figure 24 shows the investment in Ireland's electricity network over the last decade. Total transmission investment over the period 1990 to 2005 was €687m. The CER in its 2006 to 2010 *Transmission Price Control Review Decision Paper*<sup>41</sup>, published on the 9<sup>th</sup> September 2005, has set a cap on capital expenditure on transmission of €520 million. The planned spend by ESB Networks during the period is presented (in blue) on the right of figure 24<sup>42</sup>. The impact of this capital constraint will be continually reviewed as project designs and costs evolve.

**Figure 24: Electricity Transmission Investment 1996 to 2010**



Source: ESB Networks

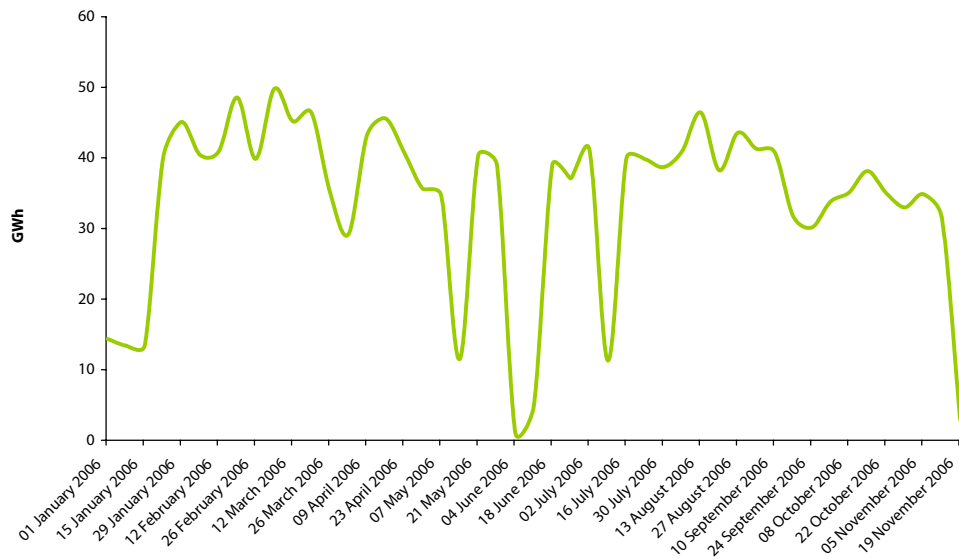
Currently the electricity network in the Republic of Ireland is interconnected with Northern Ireland. The main interconnector is at Louth 220 kV station. In addition there are 110 kV connections at Letterkenny in Co. Donegal and Corraclassy in Co. Cavan. The two Transmission System Operators (TSOs) in the Republic of Ireland and Northern Ireland are jointly progressing plans to develop an additional North-South interconnector. The Government has also endorsed the planned build of a new interconnector with Britain (the "East-West interconnector"). It is anticipated that these new interconnectors will become operational by 2012 and will enhance Ireland's SOS and competitiveness.

Figures 25 and 26 show that from January to the middle of November 2006, over 1,600 GWh of energy was imported over the interconnector from Northern Ireland, with only 10 GWh exported in return. The average daily volume of energy imported over the interconnector was in excess of 4.97 GWh.

<sup>41</sup> Available from <http://www.cer.ie/cerdocs/cer05144.pdf>.

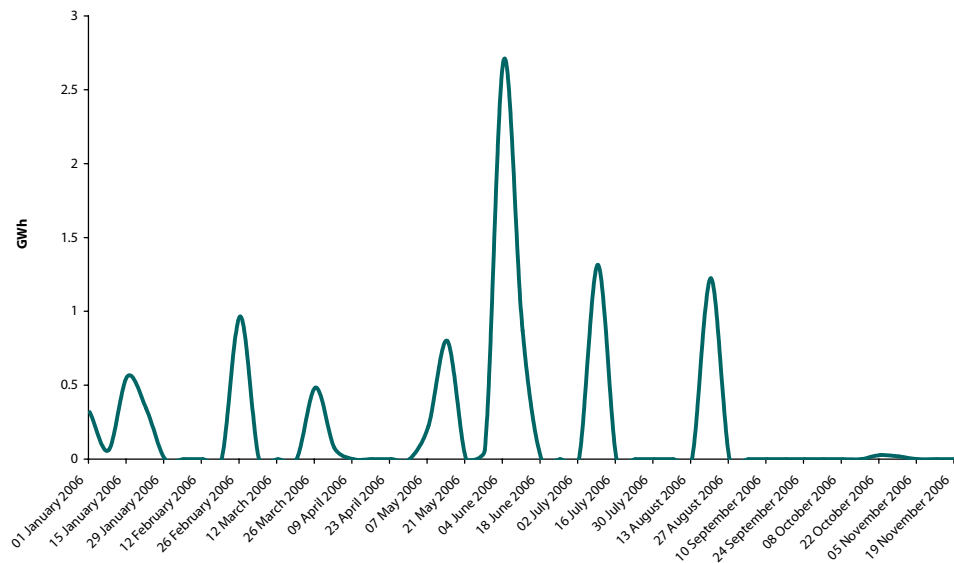
<sup>42</sup> Note that estimates are provisional and are subject to change, especially as projects may be delayed by the planning processes or by difficulties with way leaves etc. The costs shown are the costs which are expected to be incurred by ESB Networks, and do not include any investment which is paid for directly by third parties (e.g. for line diversions or grid connections). The forecasts are shown in 2006 currency values.

**Figure 25: Interconnector Trading-Imports January to November 2006**



Source: Eirgrid

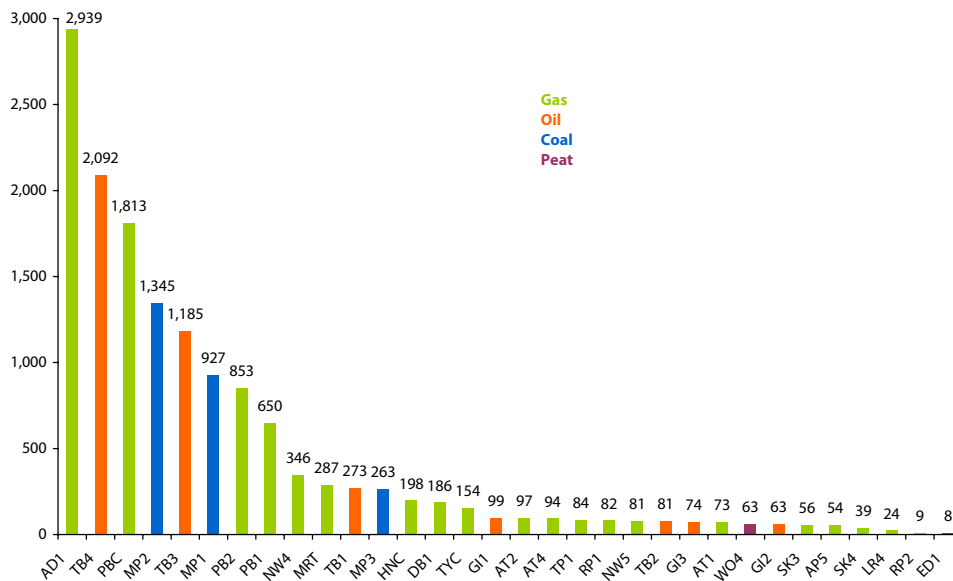
**Figure 26: Interconnector Trading-Exports January to November 2006**



Source: Eirgrid

Figure 27 shows the generating units setting the spill price from July 2004 to October 2005 (i.e. the last generator in each half hour from which electricity is drawn to meet demand). Aghada's gas-fired unit AD1 set the spill price more often than any other unit. Gas is the dominant fuel setting the spill price, followed by oil, coal and peat.

**Figure 27: Generator Units Setting the Spill Price July to October 2006**



Source: Eirgrid

#### 4.2.7 Public Service Obligation

The *Electricity Regulation Act 1999 (Public Service Obligations) Order 2002 (PSO Order) (S.I. No. 217 of 2002<sup>43</sup>)* provides for the imposition on ESB of public service obligations. These obligations require ESB to produce or buy electricity generated from peat and renewable sources. The requirement is in place to ensure that a percentage of the country's available electricity is produced from indigenous fuel for SOS reasons and to help protect the environment.

The *Electricity Regulation Act 1999*, is amended by the *Electricity Regulation Act 1999 (Public Service Obligations) (Amendment) (No. 2) Order 2005, (S.I. No. 511 of 2005<sup>44</sup>)*, of 5<sup>th</sup> August 2005 so as to allow for the imposition of a further public service obligation on ESB, in the interest of SOS. This Order places a requirement on ESB to procure temporary peaking capacity to meet short-term peak demand. It also provides for the compensation of ESB for the additional costs incurred in complying with this obligation.

The PSO Order provides for the introduction of a PSO levy to compensate ESB for the additional costs incurred in complying with these public service obligations. The levy, which is approved by the Commission for Energy Regulation (CER), is recoverable from all final customers of electricity, based on the proportion of maximum demand attributed to each category of accounts (Domestic, Small/Medium, and Large).

Figure 28 shows the cost breakdown for the PSO from 2003 to 2007. It can be seen that negative values occur in the other and renewable categories. The reasons are explained as follows:

Many of the historic renewable energy contracts have current prices for electricity which are below the proxy benchmark market price for electricity (the "Best New Entrant" price, BNE) which is used in setting the value of the PSO. In such a case rather than ESB Customer Supply being paid for the excess in renewable electricity price the Government receives a credit which is offset against other PSO costs. In 2007 renewable electricity generation supported under the PSO mechanism, primarily wind energy, rather than requiring compensation payment to the relevant supplier, will bring about a surplus of €29.8 million returned to the PSO fund.

The "other" category includes administration costs incurred by the Transmission System Operator (TSO), Public Electricity Supply (PES) and Distribution System Operator (DSO) and other market participants. It also includes the

<sup>43</sup> A copy of the legislation is available from <http://www.irishstatutebook.ie/ZZSI217Y2002.html>.

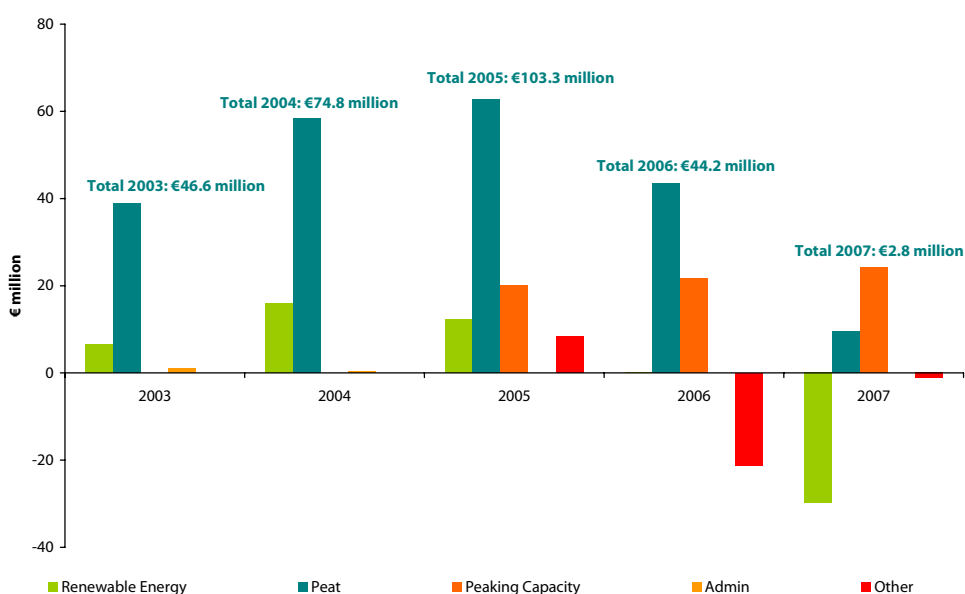
<sup>44</sup> Available from

<http://www.dcmnr.gov.ie/NR/rdonlyres/DFAAB159-3681-4F0E-A3E9-6217D1203F34/0/SINo511of2005PSOOrder2005.doc>

2005 corrections for over/under recoveries for PES and ESB Power Generation and it can be seen that the total in this category is a negative amount for the second year.

For 2007 the total amount to be recovered through the levy is approximately €2.8 million<sup>45</sup>. In consideration of the level of costs to be recovered via the PSO levy in 2007 and the resultant very low levy, the Commission has decided that the 2007 levy will be set to zero. This is on the basis that the administrative work involved in collecting the levy from all customers would be unduly onerous relative to the costs to be recovered. The PSO costs will be rolled-over to the following year's (2008) allowed PSO costs. The low levy requirement for 2007 is due primarily to the difference between the BNE price of €86.4/MWh and the lower production prices of the renewable generators under the AER and the Edenderry peat plant.

**Figure 28: PSO Cost Breakdown 2003 to 2007**



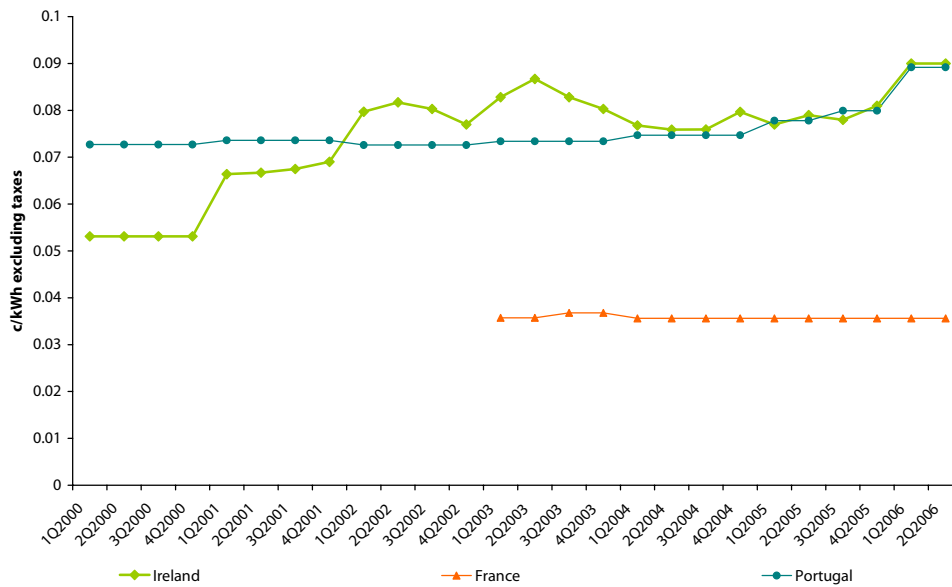
Source: CER

#### 4.2.8 Electricity Prices

Electricity prices to Irish industry have risen by 87% in real terms between 2000 and 2006, the largest increase of the countries shown in table 8. The bulk of this increase occurred between the end of 2000 and the second quarter of 2002.

<sup>45</sup> The breakdown of the impact of these costs on various consumer levels can be found in the PSO decision papers (CER/02/152, CER/03/186, CER/04/269, CER/05/125 and CER 06/147) on the CER's website. ([www.cer.ie](http://www.cer.ie)).

**Figure 29: Electricity Prices to Industry (Nominal Prices) Q1 2000 to Q3 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

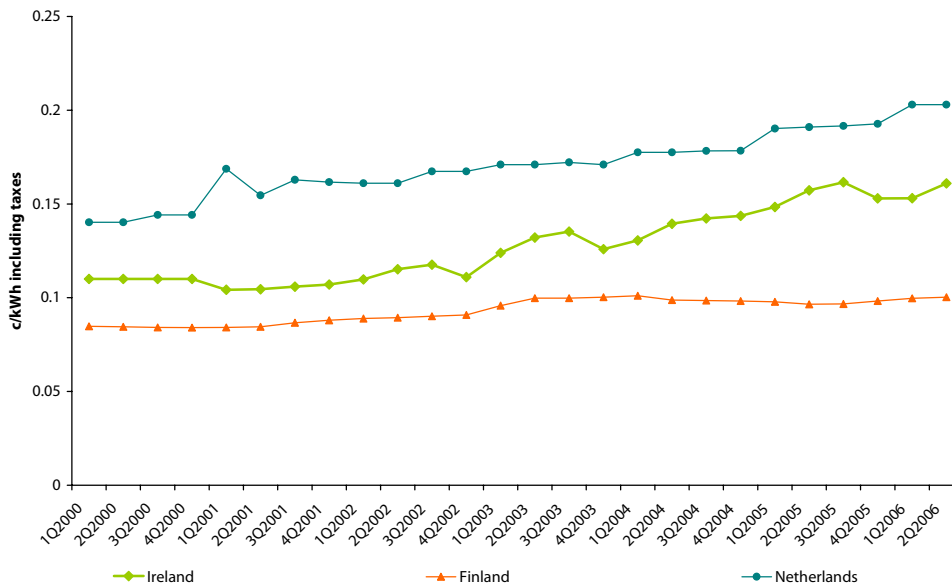
**Table 8: Electricity Price to Industry Increase Since 2000**

Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Electricity Prices 2 <sup>nd</sup> qtr 2006 (nominal)	151.2	211.5	130.3	112.5	140.3	103.4	166.8	127.4	169.5	134.7	99.0	133.0	122.7	145.2	143.9	157.0
Electricity Prices 2 <sup>nd</sup> qtr 2006 (real)	126.4	186.5	117.5	101.0	138.4	97.1	152.1	102.2	187.1	115.2	79.3	113.2	106.0	122.1	132.7	143.4

Source: Energy Prices & Taxes © OECD/IEA, 2006

Electricity prices to Irish householders increased by 19% in real terms since 2000. Of the countries shown in table 9 only the UK, Netherlands, Germany and Sweden experienced higher real growth in household electricity prices.

Figure 30: Household Electricity Prices (Nominal Prices) Q1 2000 to Q3 2006



Source: Energy Prices & Taxes © OECD/IEA, 2006

Table 9: Electricity Price to Households Increase Since 2000

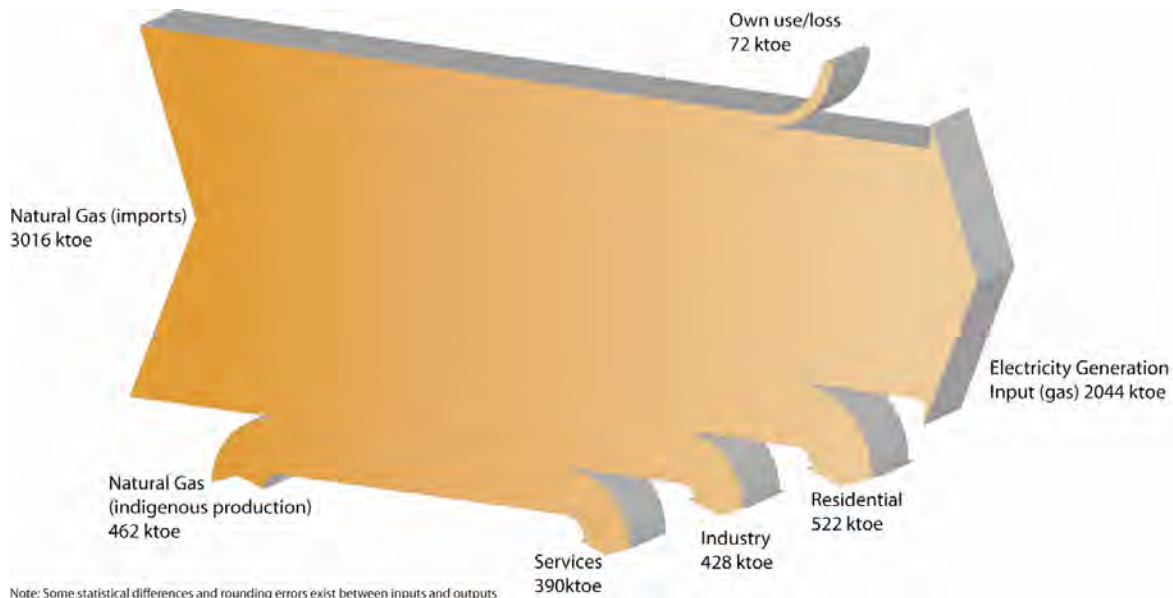
Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Electricity Prices 2 <sup>nd</sup> qtr 2006 (nominal)	134.7	105.1	102.1	120.3	118.8	102.8	150.6	119.3	146.4	104.8	109.7	142.7	113.0	97.3	143.8	141.3
Electricity Prices 2 <sup>nd</sup> qtr 2006 (real)	112.3	93.5	90.3	106.8	110.3	91.8	136.8	97.4	118.9	91.1	95.1	124.7	94.3	79.8	131.8	121.8

Source: Energy Prices & Taxes © OECD/IEA, 2006

#### 4.2.9 Natural Gas

Figure 31 presents an energy flow diagram for gas usage in 2005. The total input, categorised by imported and indigenous is shown on the left while outputs on the right are categorised by sector. It can be seen that the majority of gas is imported (87%) and electricity is responsible for largest share of output (59%).

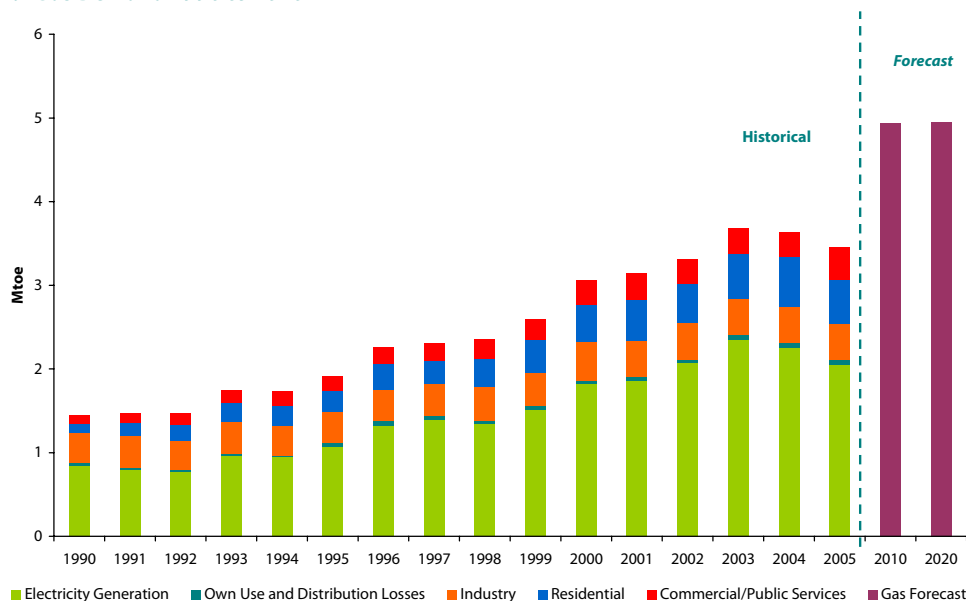
**Figure 31: Energy Flow 2005 –Natural Gas**



Source: SEI

Gas demand at a sectoral level is shown in figure 32. It can be seen that total gas demand has increased over the period 1999 to 2005 by an average of 6% per annum (for a total increase of 140%). Use of gas in the power generation sector in particular has been strong and was 142% or 6.1% per annum over the period. Gas demand has also continued to grow in the residential and industrial and commercial sectors. By the end of 2005, 59% of total gas was used for power generation, 11% by the commercial and industrial sector and 15% by the residential sector. Natural gas use decreased in 2005 by 4.8% due almost entirely to fuel switching in electricity generation.

**Figure 32: Gas Demand 1990 to 2020**

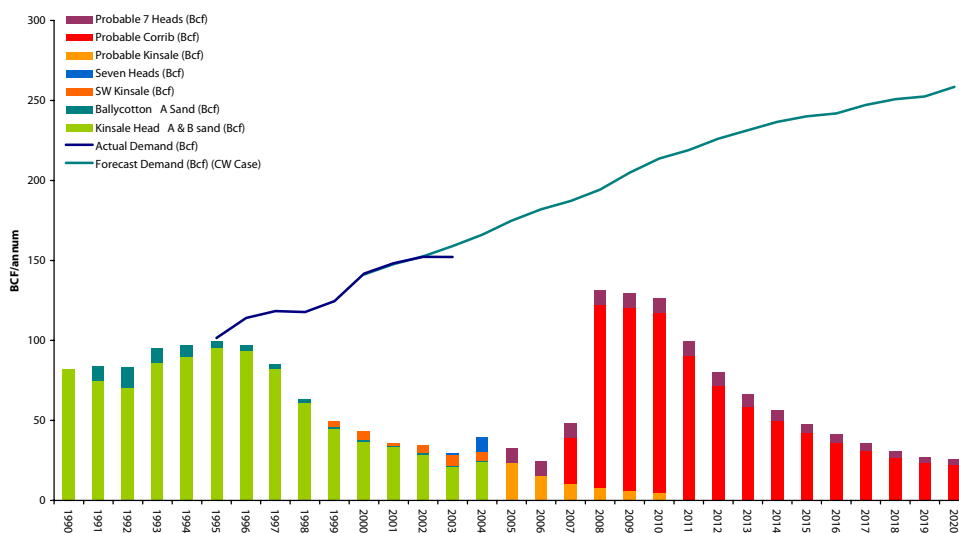


Source: SEI

Forecasts of gas demand are shown on the right of figure 32. Forecast data is only available at the aggregate gas level. Gas demand is expected to increase by 42% over the period to 2010 and remain at this level to 2020.

Forecast data for indigenous production of natural gas are also available from the Petroleum Affairs Division<sup>46</sup> (PAD), a section within the Department of Communications, Marine and Natural Resources. Data are presented in figure 33 for the period to 2020. It can be clearly seen that the forecasted demand is far in excess of what will be available from indigenous sources.

**Figure 33: Forecast - Corrib, Kinsale and Seven Heads to 2020**



Source: DCMNR (PAD)

#### 4.2.10 Infrastructure /Investment

The natural gas network in Ireland is operated by Bord Gáis Éireann (BGÉ) a commercial state body. The high pressure transmission network consists of approximately 82km of pipe and conveys gas from two entry points (at Inch and Moffat) to directly connected customers and distribution networks throughout Ireland, as well as to connected systems at exit points in Scotland (the Scotland-Northern Ireland Pipeline), and the Isle of Man.

The Moffat entry point, located onshore in Scotland, connects the Irish natural gas system to that of Transco in the UK, and allows for the importation of UK gas to Ireland via two sub-sea interconnectors. The Inch entry point, located in Cork, connects the Kinsale and Seven Heads gas fields and the Kinsale storage facility to the onshore network. The Irish system has three compressor stations, Beattock and Brighthouse Bay in southwest Scotland, and Middleton near Cork.

The two Ireland-Scotland interconnectors in 2005 provided 87% of the gas supply. The maximum daily import capacity for the interconnectors is imposed by the capability of the compressor stations to deliver high pressure flows into the pipelines. This current limit is 23 million cubic metres per day (mscmd) imposed by Brighthouse Bay compression. Further compression power and/or onshore pipeline reinforcement in Scotland could enable the interconnectors to increase to the order of 50 mscmd. In the long term there will be an increasing reliance on the interconnectors to access the European gas sources. The traditional sources of the Dutch and UK sectors of the North Sea are in decline and future gas supplies are projected as being delivered from more distant fields such as the northern Norwegian sector or LNG from outside the EU.

Considerable investment has occurred in the natural gas network in recent years. A total of €1.53 billion was invested in the period 2001 to 2005 and a further €1.25 billion is scheduled for investment between 2006 and 2010. The network is currently being expanded with the development of the Galway to Mayo pipeline. This will be the principal extension of the gas network over the period to 2013 and when complete will link the Corrib gas field to the Irish market.

<sup>46</sup> See <http://www.dcmnr.gov.ie/Natural/Petroleum+Affairs+Division/> for full details of PAD’s work and responsibilities.

BGE is also in the process of completing the South-North Pipeline, linking the Irish and Northern Irish markets, which will enhance SOS to Northern Ireland.

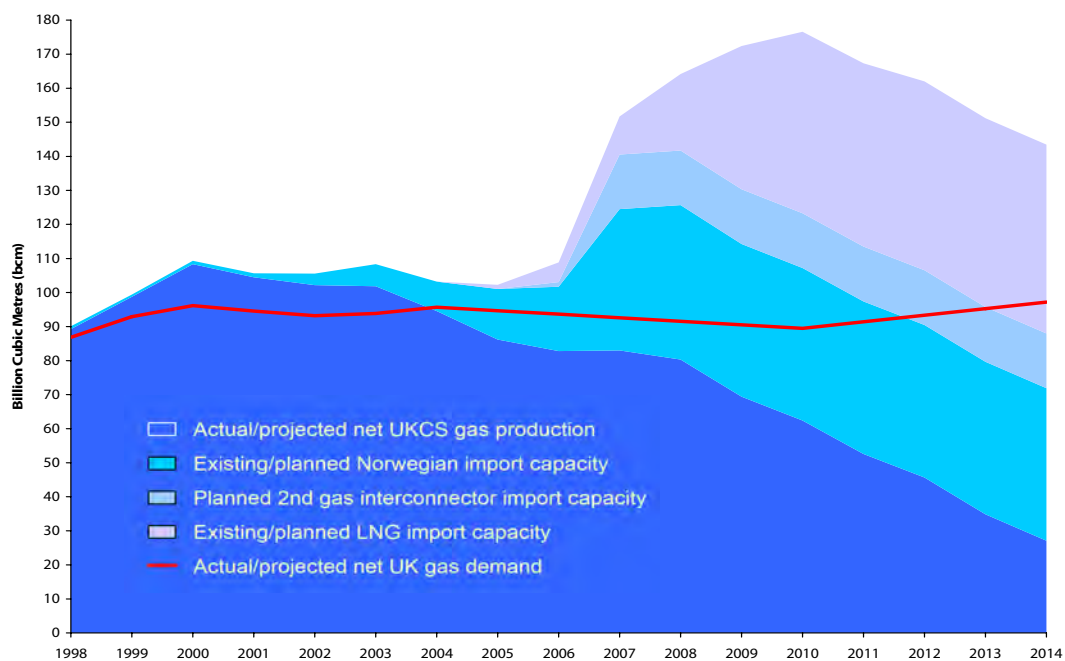
Figure 34 gives an indication of the possible availability of gas to meet annual UK demand over the period to 2014. Data is sourced from the Department of Trade and Industry's (DTI) Joint Energy Security of Supply (JESS) working group report<sup>47</sup>.

Imports to the UK are currently possible from Continental Europe through the Bacton–Zeebrugge interconnector. However, because seasonal exports are expected to continue at times of low UK demand (i.e. in the summer months), figure 34 assumes no net contribution from the interconnector to annual UK supply (or demand), notwithstanding the expected progressive increase in its import capacity through the installation of additional compression at the Belgian end. There is existing infrastructure in place permitting imports of gas from Norway, principally the Vesterled pipeline to St Fergus. The Norwegian entry on figure 34 also includes the import capacity of projects to bring additional Norwegian gas to the UK, in particular from the large Ormen Lange Field but also from Statfjord and Sleipner.

Also shown in figure 34 is the capacity of the second gas interconnector and of the various liquefied natural gas (LNG) import projects being planned. In both cases the chart shows the progressive build up of supplies to the UK that these projects would make if they were to go ahead to the fullest extent currently expected. In practice the build up of import capacity and, particularly, of actual gas imports would be more closely matched to the growth of demand.

The demand projection also includes an estimate of non-energy demand for gas (e.g. use for petrochemicals). Demand from Northern Ireland is included but demand from the Irish Republic (around 4 bcm of which is currently met by imports from the UK) is not. As with the production projection, there is great uncertainty attached to the gas demand projection (with industry estimates ranging up to 125 bcm by 2014); both should be treated as only indicative.

**Figure 34: Annual UK Gas Demand and Potential Supply 1998 to 2014**



Source: JESS

<sup>47</sup> Full details of the group's activities are available at <http://www.dti.gov.uk/energy/energy-reliability/security-supply/jess/index.html>.

Gas production from the UK Continental Shelf (UKCS) peaked in 2000. It is now expected to stabilise for a year or two and then resume progressive decline. Over the next decade or so, UK demand for gas is expected to fall gently and then rise slowly. The implied growing need for imports has implications for import infrastructure and for the underpinning commercial and intergovernmental agreements.

Between 1997 and 2003, the UK was a net exporter of gas on an annual basis, mainly via the Bacton–Zeebrugge interconnector. As a result of declining UKCS production, in 2004 the UK was again a net importer of gas and a large and growing import requirement is expected by the end of this decade and beyond. Although reliance on gas imports is not a new feature of the UK energy supply mix, the extent of previous dependence (imports met as much as a quarter of annual UK gas demand in the 1980s) was not on the scale now anticipated (with net imports meeting perhaps a third of UK annual gas demand in 2010 and four fifths or more in 2020). Were they all to go ahead, the capacity of existing import projects and those currently being considered could meet the annual shortfall in supplies from the UKCS well into the next decade. Imports are likely to come from a range of sources and by a variety of routes, thus contributing to gas supply diversity. There is also some upside potential from UKCS production which, like UK demand, may respond to price signals.

#### 4.2.11 Gas Storage

Ireland's first storage facility commenced operations in 2001 at the Southwest Kinsale Field. The facility enables gas to be injected during the summer and delivered to the Irish market in the winter, when demand is higher.

The gas storage facility was opened to third party access in June 2006<sup>48</sup>. It is treated as a source of supply on the peak day, but is a demand on the minimum day with injection into storage requiring gas to be moved from the onshore transmission network to the offshore facility.

The facility is operated by Marathon Oil Ireland Limited and provides approximately 70 million standard cubic metres (mscm) of space with a summer time injection rate of 0.4 mscm per day and a peak day withdrawal capacity of 2.5 mscm per day. It may be possible to increase output from the storage facility into the transmission system on a short term basis (days) in the event of a supply shortfall from another entry point. Marathon is currently evaluating the feasibility of expanding the storage facility by between 30% and 40% and examining if it is feasible to operate such a facility on a stand alone basis in the long term. The viability of such an expansion, however, is likely to be linked to access to the UK gas market.

Also as mentioned in section 2.2 in May 2006 Shannon LNG, an Irish subsidiary of Hess LNG Limited, is proposing to build a €400 million liquefied natural gas (LNG) receiving terminal on the Shannon Estuary.

Finally, a study has been commissioned to assess medium to long-term SOS on an all-island basis, including the scope for a common approach to gas and LNG storage. The report will be completed by the end of 2006.

#### 4.2.12 Gas Prices

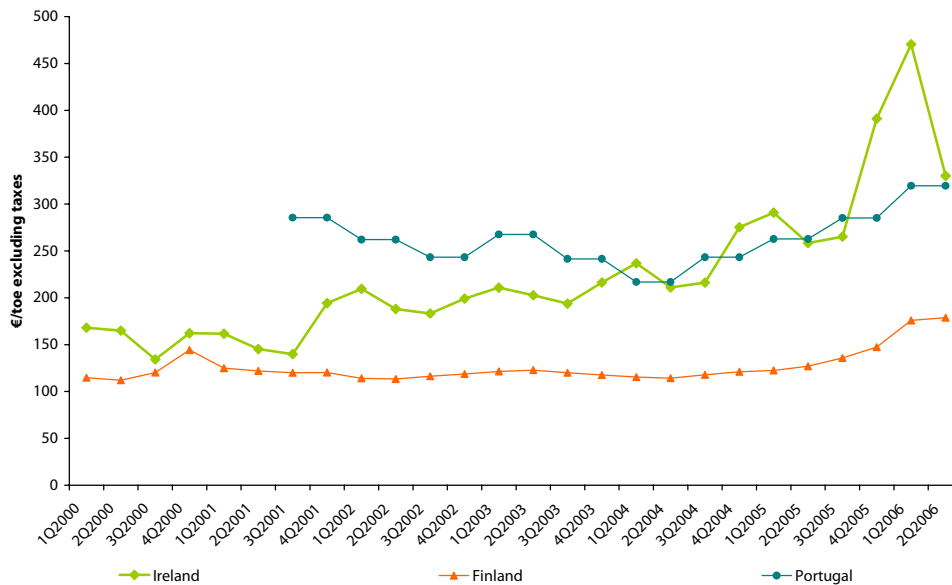
Natural gas prices to Irish industry, in real terms (shown in figure 35 and table 10) are almost three times higher than in 2000. Of the countries shown only the UK experienced a higher increase.

Figure 35 shows that there were two distinct periods where gas prices rose dramatically. These were between the third quarter of 2001 and the first quarter of 2002 and then again between the third quarter of 2003 and the first quarter of 2005.

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<sup>48</sup>The licence for the storage facility can be viewed at <http://www.cer.ie/CERDocs/cer06101.pdf>.

**Figure 35: Natural Gas Prices to Industry (Nominal Prices) Q1 2000 to Q3 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

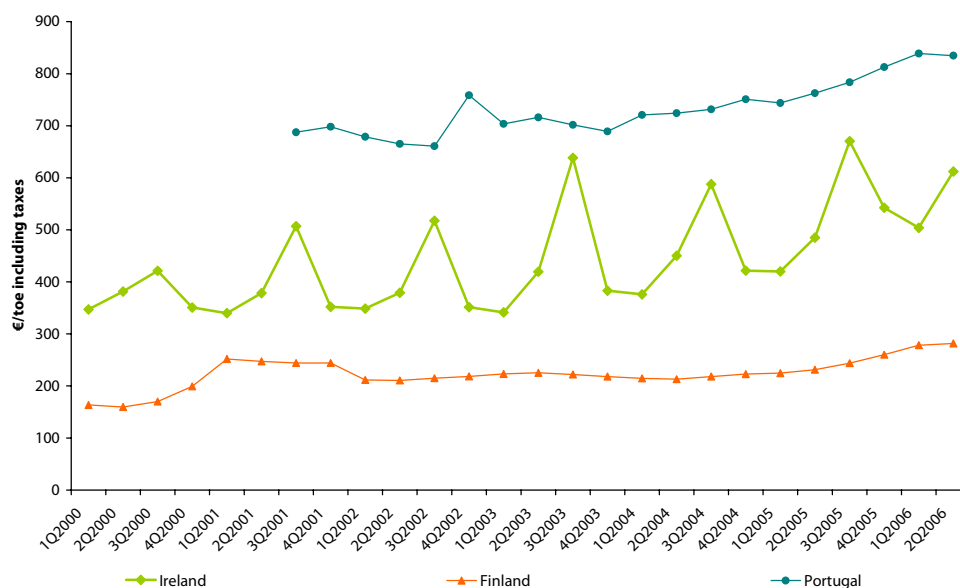
**Table 10: Natural Gas Price to Industry Increase Since 2000**

Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Gas Prices 2 <sup>nd</sup> qtr 2006 (nominal)	172.0	165.2	139.6	..	140.0	164.6	139.7	149.3	266.4	123.4	99.0	131.5	..	150.5	..	304.7
Gas Prices 2 <sup>nd</sup> qtr 2006 (real)	147.3	145.7	125.9	..	138.1	154.7	127.4	119.7	294.1	105.6	79.3	111.9	..	126.6	..	278.2

Source: Energy Prices & Taxes © OECD/IEA, 2006

Up to mid 2005 natural gas prices to Irish households (figure 36 and table 11) had increased, in real terms, by 33% since 2000. This was slightly above the average increase of 32% in the OECD Europe countries. Note that the peaks shown in the Irish gas price in figure 36 reflect fixed standing charges and low consumption during summer months resulting in higher unit prices.

**Figure 36: Household Natural Gas Prices(Nominal Prices) Q1 2000 to Q3 2006**



Source: Energy Prices & Taxes © OECD/IEA, 2006

**Table 11: Natural Gas Price to Households Increase Since 2000**

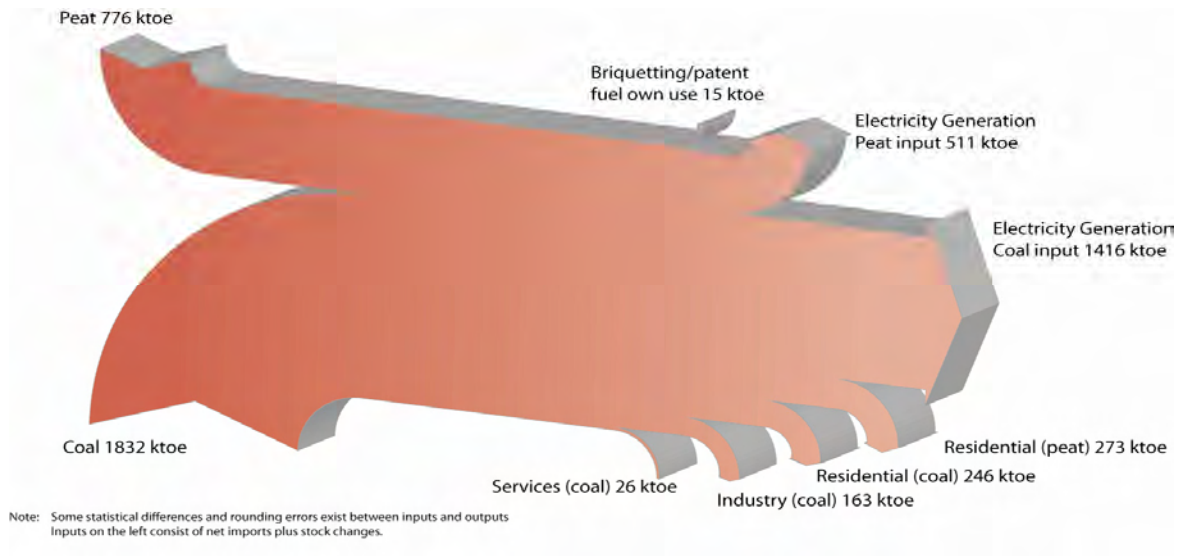
Index 2000 = 100	OECD Europe	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Gas Prices 2 <sup>nd</sup> qtr 2006 (nominal)	158.8	165.2	143.2	132.6	162.9	149.4	139.8	144.7	163.1	123.4	99.0	182.9	..	113.3	..	175.6
Gas Prices 2 <sup>nd</sup> qtr 2006 (real)	132.3	147.0	126.6	117.7	151.2	133.4	127.0	118.1	132.5	107.3	85.9	159.7	..	92.9	..	151.4

Source: Energy Prices & Taxes © OECD/IEA, 2006

#### 4.2.13 Solid Fuels

Figure 37 presents an energy flow diagram for solid fuels in 2005. Coal and peat inputs are shown on the left while outputs on the right are categorised by sector.

**Figure 37: Energy Flow 2005 -Solid Fuels**

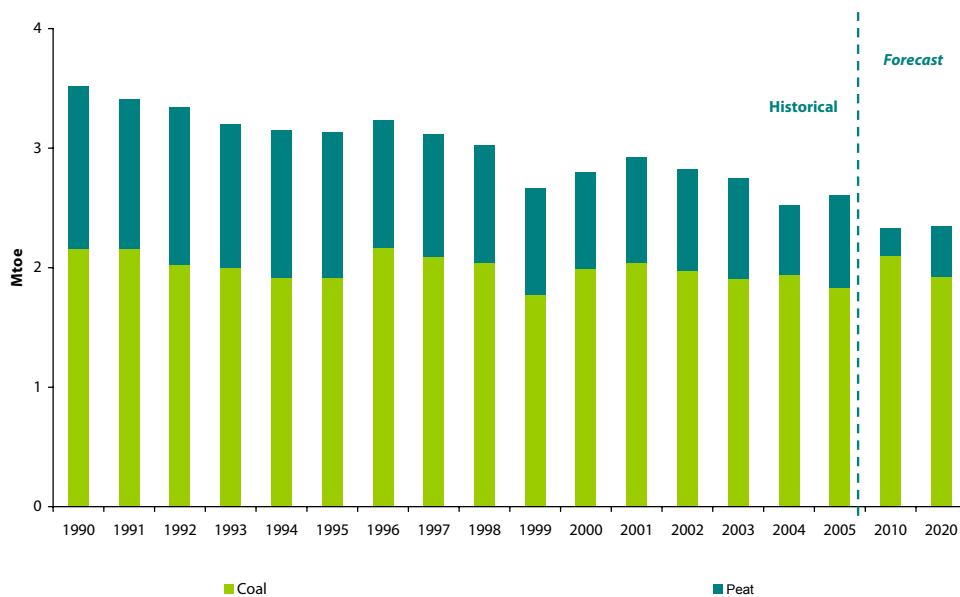


Source: SEI

It can be seen that coal is the dominant fuel accounting for 70% of total solid fuels in 2005. Electricity generation accounts for the largest share of solid fuel usage in 2005 (74%).

Figure 38 illustrates the primary demand for coal and peat over the period 1990 to 2020. Looking firstly at the historical data, consumption of coal and peat declined by 12% and 44% respectively for the period 1990 to 2005. The forecast on the right of figure 38 indicates that consumption of coal is expected to increase by 15% by 2010 and then decline by 8% during the period to 2020. Consumption of peat is forecast to fall by 71% by 2010 but will increase by 85% over the period 2010 to 2020.

**Figure 38: Coal and Peat Consumption 1990 to 2020**

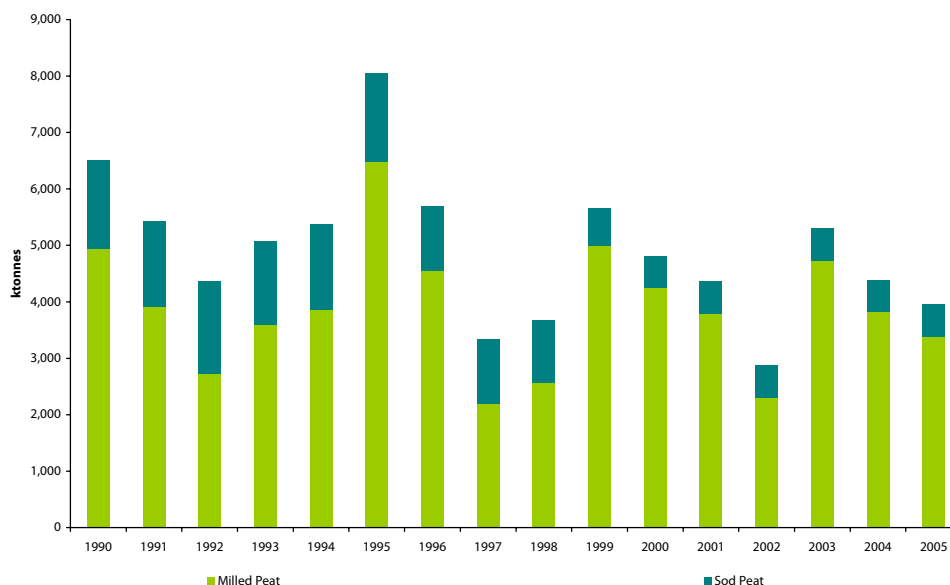


Source: SEI

#### 4.2.14 Peat Production

Figure 39 shows the production of peat during the period 1990 to 2004. Milled peat is produced by Bord na Mona while sod peat is produced by the private sector. Total peat production peaked in 1995 at 8 million tonnes. Total production in 2005 was 3.9 million tonnes of which 85% were milled peat.

**Figure 39: Peat Production 1990 to 2005**



Source: Bord na Mona

Regarding future consumption, Bord na Mona's current resources are approximately 70 million tonnes; this can supply 3.5 million tonnes per annum, which is approximate to current usage, for 20 years. In addition there are approximately 15 million tonnes of peat not owned by Bord na Mona, which are being worked by companies and private individuals.

#### 4.2.15. Coal Imports

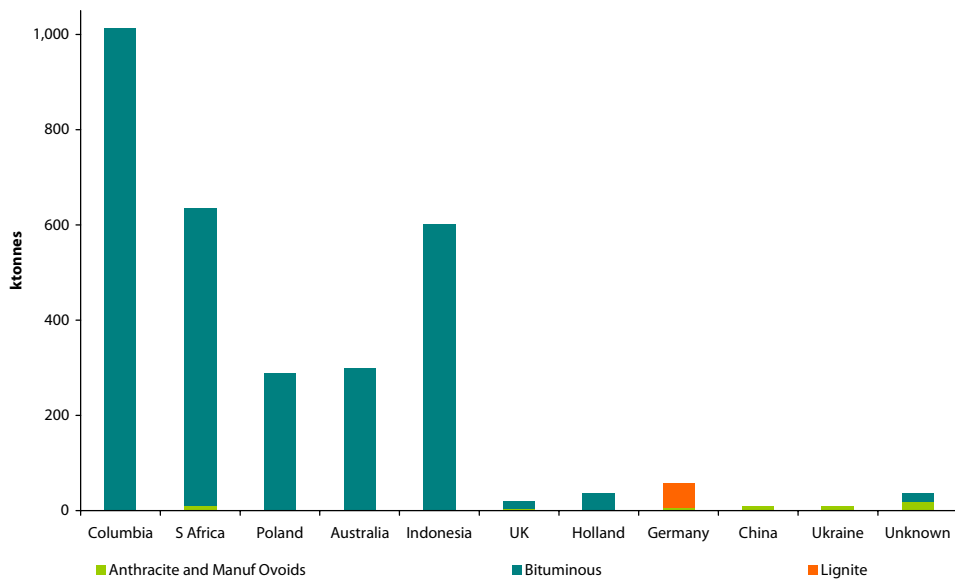
In 2005 coal (which in this case includes lignite, bituminous coal, manufactured ovoids and anthracite) imports into Ireland totalled 3 million tonnes. Table 12 and figure 40 illustrate the type and origin of the coal used in 2005. It can be seen that 96% of coal consumption was bituminous. The largest share of Ireland's imports of coal came from Columbia (34%).

**Table 12: Coal Imports by Type and Country of Origin 2005**

ktonnes	Anthracite and Manuf. Ovoids	Bituminous	Lignite	Total	% of Total
<b>Columbia</b>		1013		1013	33.7
<b>S Africa</b>	10	624		634	21.1
<b>Poland</b>		288		288	9.6
<b>Australia</b>		299		299	10.0
<b>Indonesia</b>		602		602	20.0
<b>UK</b>	4	15		19	0.6
<b>Holland</b>		36		36	1.2
<b>Germany</b>	5		52	57	1.9
<b>China</b>	9			9	0.3
<b>Ukraine</b>	9			9	0.3
<b>Unknown</b>	19	19	0	38	1.3
<b>Total</b>	56	2896	52	3004	100.0

Source: SEI

**Figure 40: Coal Imports by Type and Country of Origin 2005**

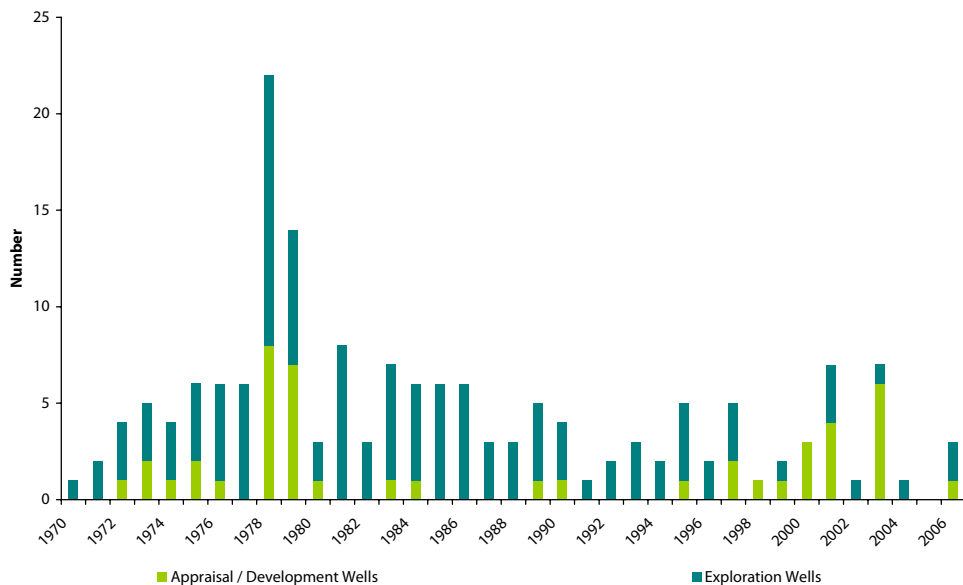


Source: SEI

### 4.3 Security of Supply Metrics -Exploration

In Ireland, the primary gas field over the last decade, Kinsale, is in decline. Also, off of the Cork (South) coast is the Seven Head's field. Ramco, the developer, has stated that the field has proven reserves of 337 billion cubic feet, or 59 million barrels of oil equivalent. Figure 41 shows the amount of exploration for oil and gas taking place in Irish waters. The number of wells drilled is currently very low, reflecting the perceived unattractiveness of Irish waters for mineral exploration. It should be noted that of the 129 wells that have been drilled since 1970, only 9 discoveries have been commercially worthwhile. They are, Kinsale Head, Ballycotton, Seven Heads, Helvick, Connemara, Spanish Point, 35/8-1, Corrib and Doish.

**Figure 41: Wells Drilled in Ireland for Exploration 1970 to 2006**



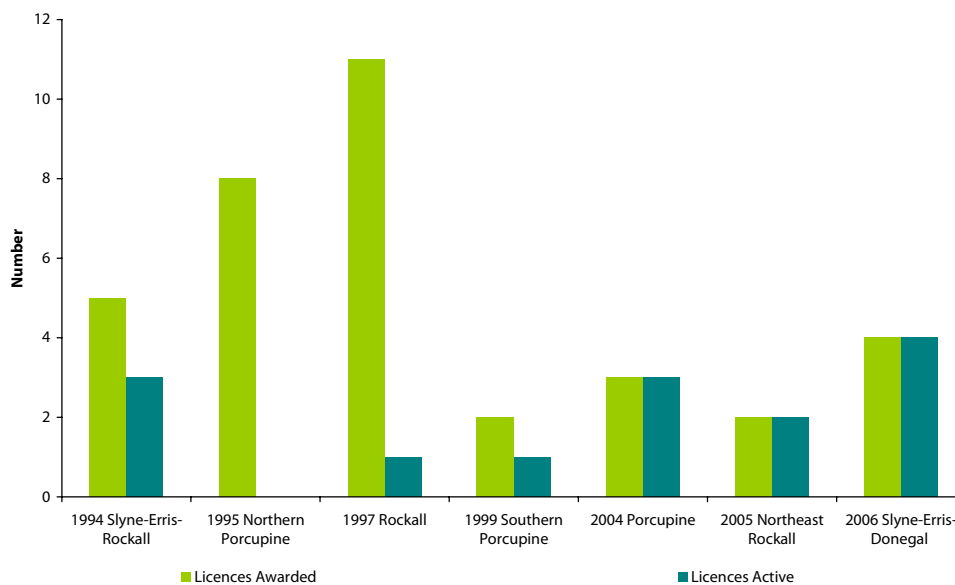
Source: DCMNR (PAD)

An explanation of the graph legend is as follows:

- Exploration wells are drilled on valid prospects outside the interpreted limits of commercial or potentially commercial discovered hydrocarbons.
- Appraisal wells are drilled subsequent to establishing the location of hydrocarbon accumulations, within the interpreted limits of commercial or potentially commercial discovered hydrocarbons, for the purpose of delineating the size and productive capacity of the reservoir(s), and
- Development wells are drilled for the purpose of production, injection, observation or disposal of fluid to or from known fields.

The number of licences to explore that have been granted since 1992 and the amount that are currently active are shown in figure 42. The acreage on offer in the most recent licensing round (Slyne-Erris-Donegal) covered approximately 25,000 square kilometres.<sup>49</sup> The next licensing round will be in the Porcupine Basin in 2007.

**Figure 42: Number of Licences 1994 to 2006**



Source: DCMNR (PAD)

While the above refers to natural gas and oil there may also be reserves of coal. For example the Kish Bank Basin, offshore of Dublin, is thought to contain significant quantities of bituminous coal. However, an extensive programme of exploration is required to quantify resources. A Geological Survey of Ireland report<sup>50</sup> in 1986 considered the potential for exploiting this coal. Currently, however, there are no exploration licences covering the area.

<sup>49</sup> Details are available at <http://www.dcmnr.gov.ie/Natural/Petroleum+Affairs+Division/Petroleum+Affairs+Division.htm>.

<sup>50</sup> Geological Survey of Ireland, 1986, *Offshore Coal in the Kish Bank Basin: its potential for Commercial Exploitation*. <http://www.gsi.ie/>.

## 5 New Analysis

This section presents the key findings of new research which are intended to give an insight into Irish energy SOS.

### 5.1 Security of Supply/Demand Index

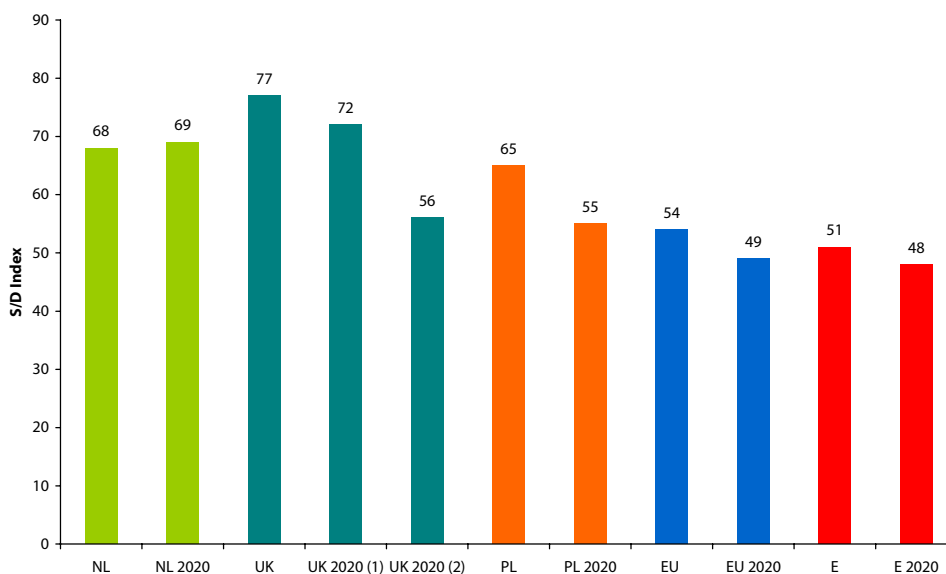
#### 5.1.1 Introduction

SEI commissioned the Energy Research Centre of the Netherlands (ECN) and the Clingendael International Energy Programme (CIEP) to calculate a recently derived indicator of SOS using Ireland as a case study. The full analysis is presented in Annex 1, a brief introduction and the results are detailed here.

The Supply/Demand (S/D) Index for review and assessment of energy SOS includes all three parts of the energy system: final energy demand, energy conversion and transport and the supply of primary energy sources. The S/D index results in a score between 0 and 100. The higher the score, the better the SOS position.

The use of the S/D Index is illustrated in figure 43 with examples for the EU-25, the Netherlands (NL), Poland (PL), Spain (E), and the United Kingdom (UK). Using the latest available data the index values for these examples vary from 51 to 78. Indicative 2020 values for these five cases range from 48 to 72. The second index for the UK 2020 assumes that there will be 75% import dependency for oil and gas and 50% of imported gas from outside the EU/Norway.

**Figure 43: S/D Index**



Source: ECN

#### 5.1.2 Results for Ireland

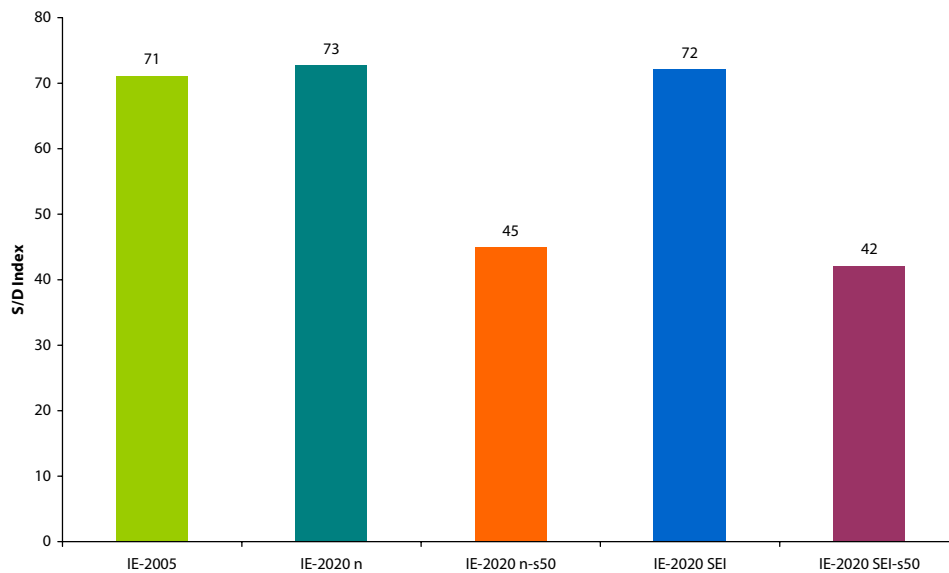
Five cases have been quantified for Ireland:

- IE-2005  
Quantification of the S/D index for 2005 based on the energy balance for that year, supplemented with other data from other sources (Eurostat, Odyssee, EC).
- IE-2020 n  
Quantification for 2020 based on a new and updated PRIMES baseline (EC, 2006).
- IE-2020 n-s50  
Sensitivity on IE-2020n with assumption the 50% of imports of oil and gas come from outside EU and Norway.
- IE-2020 SEI  
Quantification for 2020 based on SEI forecasts, supplemented with data used for the IE-2020n case.

- IE-2020 SEI-s50  
Sensitivity on IE-2020sei with assumption the 50% of imports of oil and gas come from outside EU and Norway.

The results are summarised in figure 44.

**Figure 44: S/D Index - Ireland**



Source: ECN

The results indicate a score of 71 for 2005, which compares well to the other cases shown in figure 42. Ireland's S/D index lies between the Netherlands (68) and the UK (77). Based on the most recent PRIMES scenario for Ireland, the 2020 value (73) represents an improvement on the 2005 score. However, this may be largely biased by the assumption made on the origins of the oil and gas imports, which have been assumed equal to the current situation i.e. based on Eurostat information for the year 2004. It is likely that this will change in the future.

As an illustration a case with a 50% share of import from outside EU/Norway has been quantified for the 2020 cases. The S/D Index then decreases substantially, from 73 to 45, due to a large decrease of the primary energy sources sub-index (from 95 to 39). This decrease is due to the decrease of the scores on oil and gas (to 29) and the relative high share of oil and gas (83%) in the primary energy sources mix.

Data for an alternative scenario that results in changes of the final energy demand shares, of the primary energy sources mix, and of the CHP share, compared to the PRIMES baseline is also shown. The total impact is small, and an S/D index of 72 results. For the SEI forecast, a similar sensitivity on the import origin of oil and gas was performed. In that case the S/D index drops to 42, for the same reasons as in the PRIMES baseline scenario.

From the cases it can be concluded that Ireland's S/D Index is largely determined by the origin of the imported oil and gas, given the large share of oil and gas in the primary energy mix (more than 80%). If the shares imported from outside the EU and Norway increase substantially, a significant drop in the S/D Index can be expected. This would indicate a considerable increase in exposure to potential SOS disruptions.

## 5.2 Mean Variance Portfolio

### 5.2.1 Introduction

In order to better understand issues relating to SOS and fuel diversity in the electricity sector, SEI has conducted an analysis to consider the power generation plant mix in 2020. The study utilises financial mean-variance portfolio analysis<sup>51</sup>, which evaluates the Irish generating mix in terms of both cost and risk thereby enhancing the insights into the SOS and competitiveness dimension of energy policy. Portfolio optimization may be useful in informing future energy policy and associated regulation.

The study uses a portfolio optimization tool developed as part of a project funded by REEEP, UNEP and the UK Global Opportunities Fund<sup>52</sup>. It is primarily based on the framework developed by Awerbuch and Berger<sup>53</sup>. Full details of the methodology and results of the analysis are available from the SEI website<sup>54</sup>.

### 5.2.2 Portfolio Analysis Model Results

The results of the portfolio analysis are based on the 2020 forecasts prepared for SEI by ESRI in 2005. The optimization model locates portfolio mixes with the lowest possible cost at every given level of risk. The results are generally evaluated using the “target mix” as a benchmark.

The ‘**target mix**’ represents the business-as-usual scenario. For the Ireland case study, it represents the SEI/ESRI forecast energy mix for the 2020 Irish electricity system. At that point in time Ireland is projected to be over 70% dependent on gas-fired plant for its electricity requirements. Not surprisingly, such a high dependency on any single fuel source is relatively risky. The cost of the target mix is also relatively given the high gas prices forecasts. The target mix has a generating cost of €74/MWh and a portfolio risk of 0.17%.

Portfolio optimization produces an efficient frontier, the location of all efficient (optimal) generating portfolios. Efficient generating mixes are optimal in the sense that further cost reductions can only be attained by accepting higher risk. Efficient generating portfolios and their technology components are evaluated using the projected business-as-usual (BAU) generating mix as a benchmark.

Figure 45 shows the efficient frontier for Ireland under the high energy forecast scenario<sup>55</sup>. The x-axis plots the cost of electricity for a particular portfolio and the y-axis shows portfolio risk as measured by the standard deviation of technology generating costs. The frontier clearly shows how the Ireland 2020 BAU mix is sub-optimal, with an infinite range of better solutions available along the efficient frontier. These all exhibit lower risk or cost and hence are more attractive than the BAU target mix.

Although an infinite number of optimal portfolio solutions are possible, policy makers may want to focus on several ‘typical mixes’ as follows<sup>56</sup>:

- **Mix P** represents the portfolio with the lowest possible risk, taking into account the technology data and the bounds set to the generating assets. Such a portfolio would generally consist of a diversity of fuel sources in order to mitigate against over dependency on any one type of generation. In this case the mix

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<sup>51</sup> Awerbuch, S, 2006, *Portfolio-Based Electricity Generation Planning: Policy Implications for Renewables and Energy Security, Mitigation and Adaptation Strategies for Global Change*, (Springer) May 2006.

<sup>52</sup> Renewable Energy and Energy Efficiency Partnership (REEEP), 2003, *Enhancing Energy Security & Diversity, Demonstrating & Building Capacity for Portfolio-based Energy Planning in Developing Countries*, <http://www.reeep.org/index.cfm?articleid=886>.

<sup>53</sup> Awerbuch, S. and M. Berger, 2003, *EU Energy Diversity and Security: Applying Portfolio Theory to Electricity Planning and Policy-Making*, Paris: International Energy Agency, February 2003, <http://www.iea.org/textbase/papers/2003/port.pdf>.

<sup>54</sup> [www.sei.ie/getFile.asp?FC\\_ID=1631&docID=59](http://www.sei.ie/getFile.asp?FC_ID=1631&docID=59).

<sup>55</sup> The report examined two energy forecast scenarios presented for the Irish economy by the ESRI and SEI. They were a high energy forecast (HEF) and Low Energy Forecast (LEF). The growth pathways are closely aligned, inter alia, to the future development of the US economy. The forecasts have recently been updated for inclusion in this report (sections 4 and 5.3).

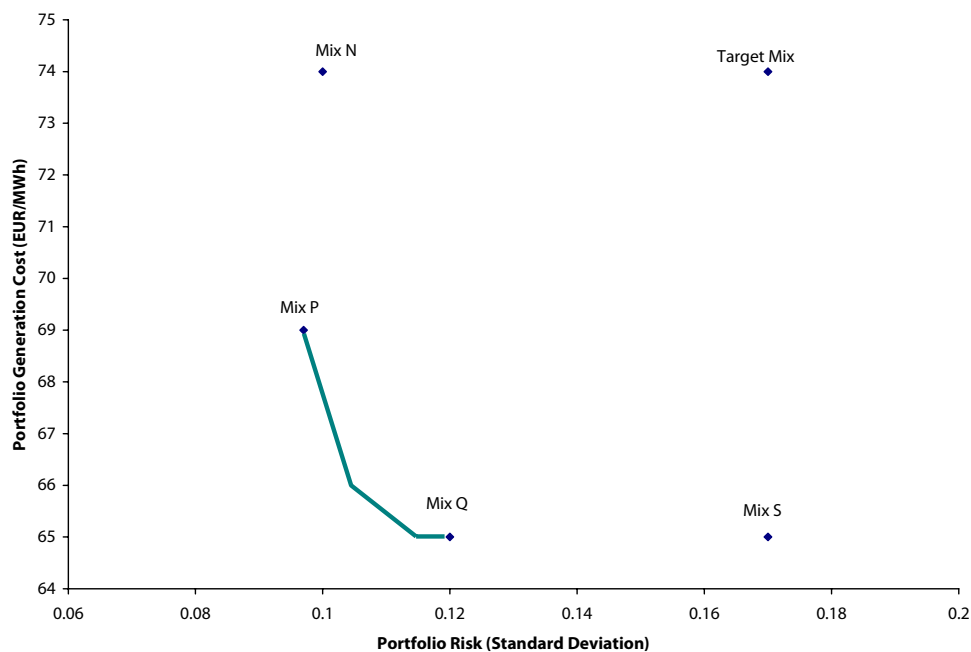
<sup>56</sup> See: S. Awerbuch, 2007, *Efficient Electricity Generating Portfolios for Europe: Maximizing Energy Security and Climate Change Mitigation*, EIB Papers in Economics and Finance, Luxembourg: European Investment Bank, January 2007.

consists of more coal powered generation (26.1%) as well as a greater use of renewable energy sources such as wind (19.5%) and biomass (4.9%). Mix P not only reduces Ireland’s risk exposure, it does so at a lower cost relative to the target mix.

- **Mix N** represents the mix whose cost equals that of the target mix. It is used to demonstrate how it is possible to achieve a lower level of risk exposure at the same cost as the target mix. In the case of Ireland the risk factor decreases by 41%. Again, more coal and renewables are used to meet the electricity requirement and in so doing displace gas from the system. Indeed, the deployment of renewables such as wind in such portfolios indicates its current cost attractiveness *vis-à-vis* other technologies, even after an intermittency penalty of €6/MWh is applied.
- **Mix S** is the point on the efficient frontier whose risk equals that of the target mix. It demonstrates how the same risk profile can be achieved at lower cost, by deploying technologies that offer the same risk exposure but are more cost effective. In our application, Mix S reduces generating cost to €65/mwh, €9/MWh lower than the target mix. This is achieved mainly through deployment of coal and biomass plants.
- **Mix Q** is the lowest cost point on the efficient frontier, although in this case it has virtually the same cost as Mix S, but with considerably less risk. Mix Q is therefore superior to ‘Mix S’ and represents a more diversified portfolio.

From a policy perspective portfolio mixes between P and Q are considered efficient or “optimal” with risk rising as costs fall. All mixes in this range are more attractive than the target since they have lower risk and cost. However, it is important to bear in mind that this optimization model does not reflect system requirements for flexible or mid-merit plant. In certain cases then the model can be considered an illustrative abstraction and may at times return portfolio options that are not feasible in practice given the need to meet diurnal load patterns and maintain system security.

**Figure 45: Efficient Frontier for HEF**



Source: SEI

### 5.3 High Oil Price Forecast

The projections of overall energy supply and of Ireland's fuel usage presented in section 4 are based on oil price projections that are broadly consistent with those of international analysts. Specifically, it is anticipated that the price of oil is assumed to come down from the high-growth path it has been following up to 2006, reaching a price of \$50 (in 2005 prices) per barrel in 2010 and \$55 (in 2005 prices) per barrel in 2020.

The IEA's *World Energy Outlook 2006*<sup>57</sup> reports that the average IEA crude oil import price in 2005 was \$51 per barrel in 2005 and is assumed to average \$60 (in 2005 prices) in 2006 to 2007, before declining to \$47 per barrel in 2012. It is assumed to rise again slowly to \$50 per barrel in 2020 and \$55 in 2030<sup>58</sup>.

These projected reductions in oil prices reflect the view that the high prices in 2005 /2006 were driven by short term supply constraints caused by specific factors, including the heavy 2005 hurricane season in the Gulf of Mexico and the high level of unrest in the Middle East. This is borne out by more recent price reductions.

While the factors underpinning the price increases in 2005 /2006 are becoming clearer in retrospect, the price increases were not anticipated in advance to reach the levels witnessed. Arising from this uncertainty, coupled with growing concerns regarding the timing of global peak oil production, SEI in conjunction with ESRI have developed an alternative scenario for Ireland's future energy supply based on higher oil prices than those assumed for the base case. In this scenario the real (2005) price of oil increases to \$70 per barrel in 2010 and to \$100 in 2020. This is equivalent to an increase of the real price of oil and gas (expressed in Euro) of more than 5 per cent per year. This causes the time weighted average price of electricity generation to rise, and the expected price under these assumptions goes up to €71.33 per MWh in 2010 and €73.63 in 2020. These and the other key assumptions related to this scenario are presented in table 13.

**Table 13: Key Assumptions (Constant 2005 Prices) Underpinning Baseline and High Oil Price Scenario**

	Price Assumptions			Average annual growth rates	
	2005	2010	2020	2005-2010	2010-2020
GDP				5.7%	2.4%
Growth in Household Numbers				2.9%	2.2%
No. persons per household	2.9	2.7	2.5		
Oil price \$ a barrel (Baseline)	50	50	55		
Oil price € a barrel (Baseline)	40.3	37.3	34.4		
<b>Oil price \$ a barrel (High Price)</b>	<b>50</b>	<b>70</b>	<b>100</b>		
<b>Oil price € a barrel (High Price)</b>	<b>40.3</b>	<b>52.2</b>	<b>62.5</b>		
Exchange rate \$/€	1.24	1.34	1.6		
Electricity price (Baseline) € / MWh		54.72	45.17		
<b>Electricity price (High Price) € / MWh</b>		<b>71.33</b>	<b>73.63</b>		
Carbon Dioxide € / tonne		20	20		
Real oil and gas price growth (Baseline)				-1.5%	-0.8%
Coal price real growth (Baseline)				-2.0%	1.0%
Peat price real growth (Baseline)				0.0%	0.0%
<b>Real oil and gas price growth (High Price)</b>				<b>5.3%</b>	<b>5.3%</b>
<b>Coal price real growth (High Price)</b>				<b>0.0%</b>	<b>2.0%</b>
<b>Peat price real growth (High Price)</b>				<b>0.0%</b>	<b>0.0%</b>

Source: SEI

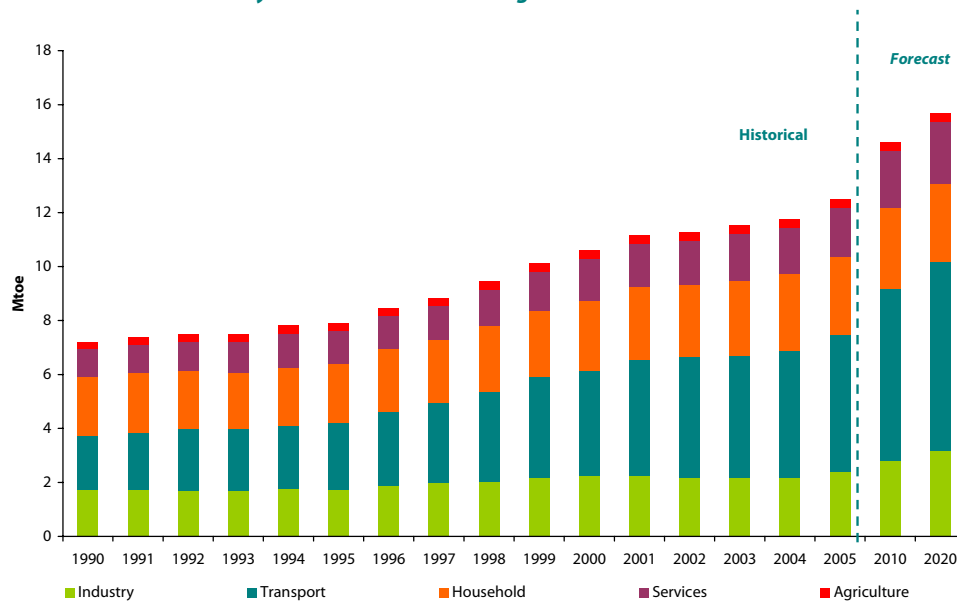
In this scenario it is further assumed that biofuels account for 10% of road transport energy demand (compared with 8% in the baseline) and that the high biomass scenario from the Bioenergy Strategy Group is used to determine the renewable energy contribution to thermal energy (331 ktoe in 2010 and 645 ktoe in 2020).

<sup>57</sup> Available from <http://www.iea.org/textbase/weo/index.htm>.

<sup>58</sup> Prices of major benchmark crude oils (for example Brent) are anticipated to be higher than this average. In 2005, the average IEA crude oil import price was \$3.90 per barrel lower than date Brent.

The high oil prices impact on both the projected amount of energy required and the fuel mix employed to deliver energy supply. Figure 46 shows the sectoral shares of final energy demand comparing the historical trend with high oil price projections for 2010 and 2020. The demand is dampened by 3% for 2010 relative to baseline projections and 7% by 2020. The reduced demand relative to the baseline is most marked in the services sector (12% in 2020) followed by the residential sector (8%) and transport (6%).

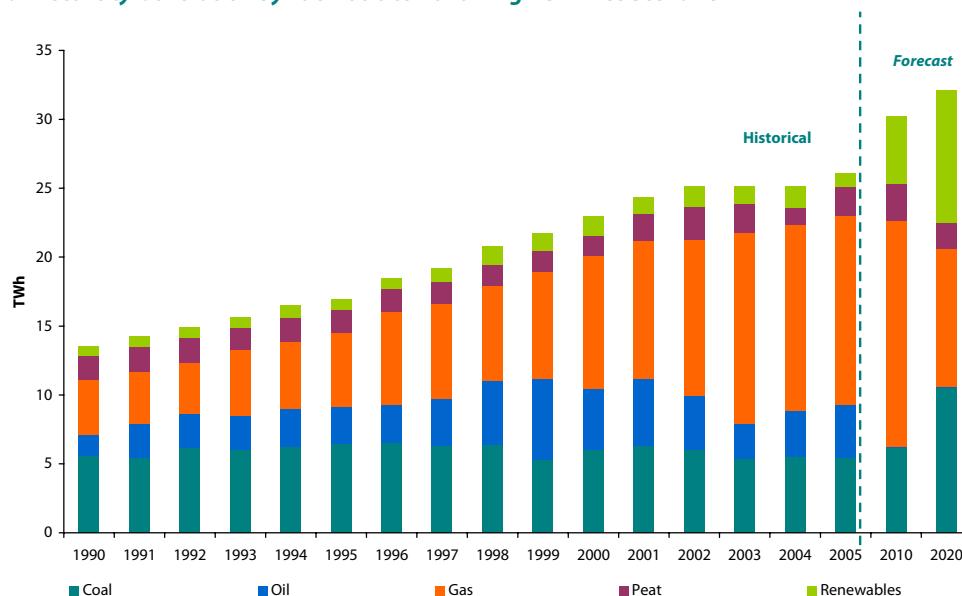
**Figure 46: Total Final Demand by Sector 1990 to 2020 - High Oil Price Scenario**



Source: SEI

This is related to the significant reduction (24%) in electricity demand in 2020 relative to the baseline due to the pass through of higher oil prices. As shown in table 13, the price of electricity is expected to increase from €45.17 / MWh to €73.63 / MWh in the high oil price scenario. This prompts the introduction of a new coal plant that would be profitable at this higher price, and is therefore included in the generation capacity mix. The coal plant introduced here uses a Circulating Fluidized Bed (CFB) combustion technology, and has a capacity of 600 MW and an efficiency of 38%. Figure 47 shows the projections for electricity generation by fuel to 2020 in the high oil price scenario.

**Figure 47: Electricity Generation by Fuel 1990 to 2020 - High Oil Price Scenario**

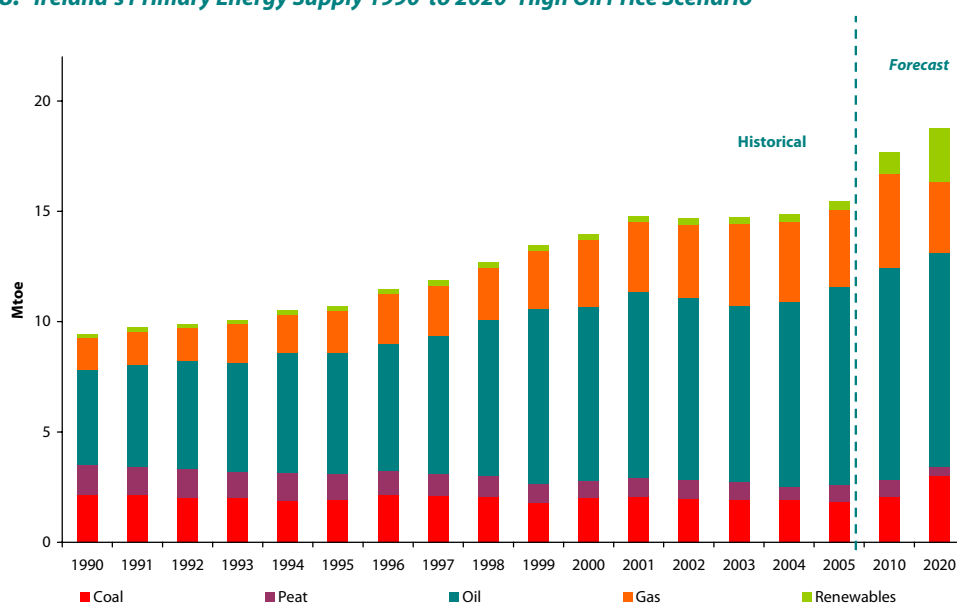


Source: SEI

Comparing figure 47 with figure 22 (baseline projections) illustrates the reduction in electricity generation and the changes to the fuel mix. In this high oil price scenario, natural gas accounts for 31% of electricity generation, compared with 48% in the baseline forecasts. Coal accounts for 33% compared with 16% in the baseline. The Government 30% target for renewable energy is maintained in both scenarios.

The impacts of reduced energy demand and changing fuel mix are presented in figure 48. Oil continues to dominate with a share of 52% in 2020 (the same share as in the baseline). This dominance does not reveal the 8% reduction in oil demand associated with primary energy reduction of 8%. Natural gas suffers most in this scenario with consumption reduced by 52% in 2020 relative to the baseline. This relates to the changes in the electricity generation fuel mix and the dominance of oil in transport.

**Figure 48: Ireland's Primary Energy Supply 1990 to 2020 -High Oil Price Scenario**



Source: SEI

Renewable energy in the high oil price scenario contributes 13% to Ireland's primary energy supply in 2020 compared with 11% in the baseline scenario. The contributions to each energy mode are 30% of electricity to be sourced by renewables (maintaining the *Green Paper* target for electricity), 10% of transport fuels to be renewable (compared with 8% biofuels in baseline) and 14% of thermal energy to be renewable (compared with 10% in the baseline scenario).

## 6 Next Steps and Acknowledgements

### 6.1 Future Work

This document will continue to be developed and refined on an annual basis. SEI is currently working with Energy Research Centre of the Netherlands (ECN), The Clingendael Centre for Strategic Studies and the Dutch Government on a new indicator, the Crisis Capability Index. The index combines an assessment of a Member State's risk to be confronted with sudden supply interruptions and its potential impacts (Risk Assessment: RA) and the capability of that country to mitigate these impacts (Mitigation Assessment: MA). If the risk is high, more weight should be put on effective crisis capabilities than when this risk is low. It is anticipated that the results will be presented in next years report.

It is also hoped to move towards ways in which these metrics can be used to generate scenarios for SOS planning in support of the DCMNR's policy goals in this area.

Comments are welcome on how best to improve the document, and suggestions for concerted collaboration in this area nationally and abroad are welcomed.

### 6.2 Acknowledgements

Special thanks are due to the following who provided material for the report or who commented on specific aspects of this or the first report:

Raphael Kelly, Mary Austin, Bob Hanna, Sean Griffin, Aoife MacEvilly, Miriam Finnegan, Michael Hanrahan, Kevin Broderick (Department of Communications, Marine and Natural Resources); Nicola Kirkup and Steve Davies (Joint Energy Security of Supply Working Group); Noelle Ameijenda, Nezar Kamaluddin, Mark Lane and Michael Kelly (Eirgrid); Donal Phelan (ESB Networks); Ad Seebregts and Martin Scheepers (ECN); Suzanne Broderick (ConocoPhillips); Adele Bergin and John Fitzgerald (ESRI) and Shimon Awerbuch (Tyndall Centre).

## Data Sources

Bord Gáis Éireann

Bord Na Mona

Commission for Energy Regulation

Department of Communications, Marine and Natural Resources

Department of Trade and Industry (UK)

Economic and Social Research Institute

Eirgrid

Eurostat

ESB Networks

International Energy Agency

Joint Energy Security of Supply Working Group

National Oil Reserves Agency

Odyssee

Petroleum Affairs Division

## Annex 1 Supply /Demand Index

SEI commissioned the Energy Research Centre of the Netherlands (ECN) and The Clingendael International Energy Programme (CIEP) to calculate a recently derived indicator of SOS using Ireland as a case study. This indicator is one of the three elements proposed as part of an 'EU standard' for the security of energy supply<sup>59</sup>. This section describes the results of the quantification of the SOS Supply/Demand Index (S/D Index) for Ireland for 2005 and for 2020. A short description of the essence of the S/D index is presented in section A.1.1.

The 2005 quantification is based on a combination of data sources:

- The 2005 national energy balance,
- Eurostat (2004, 2006), Odyssee<sup>60</sup> (2006) or PRIMES model results for the year 2005 (EC, 2006) supplemented with information from other sources.

In addition, ECN has quantified the S/D index for the year 2020 based on two scenarios:

- The 'Trends to 2030' scenario that has been recently updated (EC, 2006),
- SEI forecast for 2020.

### A.1.1 Description of the S/D Index

Quantitative indicators describing energy SOS often focus on the energy supply of one or several primary energy sources. An assessment of SOS should however also include energy demand. Energy security may be affected by a strong increase of energy demand due to economic growth, whereas energy-saving policies may improve the energy security situation. Furthermore, the end-use of energy is to a large extent based on secondary energy carriers such as electricity, transport fuels and heat. The supply security of end users also depends on the capacity and reliability of energy conversion installations (e.g. power stations, refineries, etc.) and energy transmission and distribution networks.

The S/D Index for review and assessment of energy SOS includes all three parts of the energy system: final energy demand, energy conversion and transport (C+T) and the supply of primary energy sources. It uses four types of inputs, two objective types and two types of a subjective nature. The objective inputs concern the shares of different supply and demand types (i.e. for demand: industrial use, residential use, tertiary use and transport use; for supply: oil, gas, coal, nuclear, renewable energy sources, and other) and the values characterising capacity and reliability in conversion and transport (infrastructure and networks). The subjective inputs concern weights that determine the relative contribution of the different components in the index (such as the relationship between supply and demand outputs in the Index or the different appreciation of EU imports and non-EU imports) and the scoring rules for determining various Index values reflecting different degrees of perceived vulnerabilities.

The S/D index results in a score between 0 and 100. The higher the score, the better the SOS position.

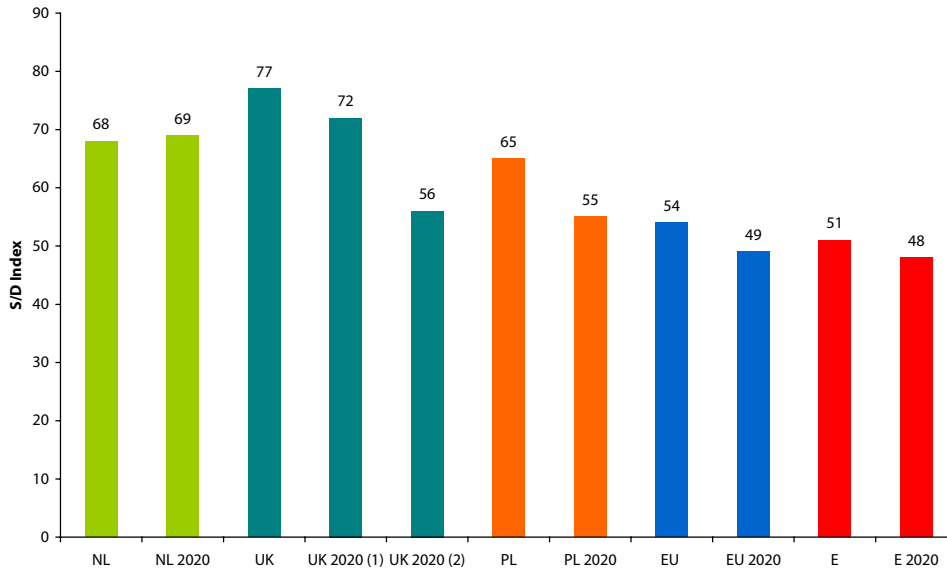
The use of the S/D Index is illustrated in figure 49 with examples for the EU-25 and for the Netherlands (NL), Poland (PL), Spain (E), and the United Kingdom (UK). Using the latest available data the index values for these examples vary from 51 to 78. Indicative 2020 values for these five cases range from 48 to 72, based on EC baseline scenarios published in 2003 that have been updated recently. The examples are based largely on objective information contained in energy balances combined with weighing factors and scoring rules, using existing indicators where possible. The second index for the UK 2020 assumes that there will be 75% import dependency for oil and gas and 50% of imported gas from outside the EU/Norway.

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<sup>59</sup> Scheepers, M.J.J., A.J. Seebregts, J.J. de Jong, J.M. Maters (2006): *EU Standards for Energy Security of Supply*, ECN-C-06-039, ECN/CIEP, Petten/The Hague, the Netherlands, June 2006. Available at <http://www.ecn.nl/docs/library/report/2006/c06039.pdf>

<sup>60</sup> Odyssee is a cross European project which develops and maintains a database of energy efficiency indicators. More information can be found at <http://www.odyssee-indicators.org/>.

Figure 49: S/D Index



Source: ECN

## A.1.2 Results for Ireland

ECN has quantified five cases for Ireland:

- IE-2005  
Quantification of the S/D index for 2005 based on the energy balance for that year, supplemented with other data from other sources (Eurostat, Odyssee).
- IE-2020 n  
Quantification for 2020 based on a new and updated PRIMES baseline (EC, 2006).
- IE-2020 n-s50  
Sensitivity on IE-2020n with assumption the 50% of imports of oil and gas come from outside EU and Norway.
- IE-2020 SEI  
Quantification for 2020 based on SEI forecasts, supplemented with data used for the IE-2020n case.
- IE-2020 SEI-s50  
Sensitivity on IE-2020sei with assumption the 50% of imports of oil and gas come from outside EU and Norway.

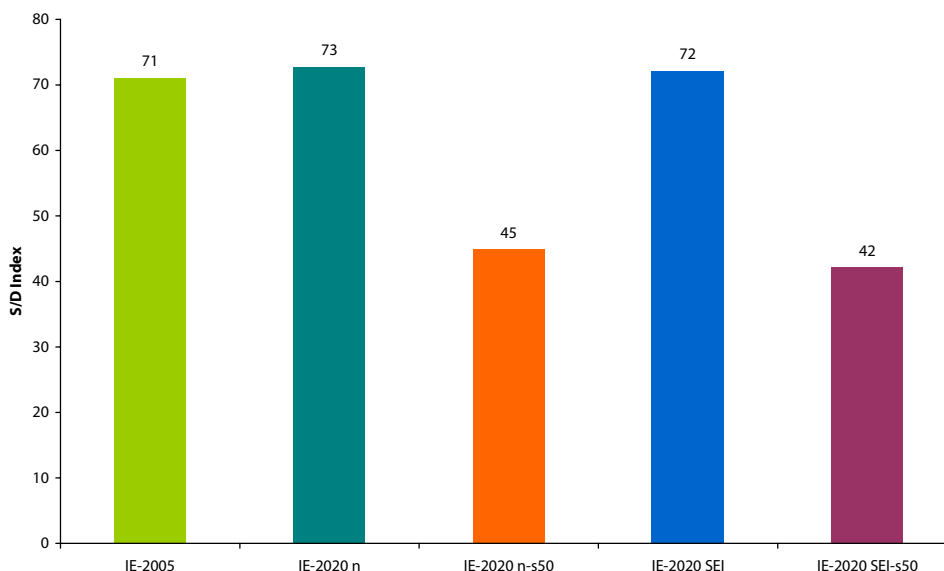
The results are summarised in table 14 and figure 50. In addition to the overall S/D index, the table provides the sub-scores and the weighting factors with which the sub-scores are combined into the overall S/D index.

Table 14: S/D Index - Ireland

	IE-2005		IE-2020 n		IE-2020 n-s50		IE-2020 SEI		IE-2020 SEI-s50	
	Weight/share	Index score	Weight/share	Index score	Weight/share	Index score	Weight/share	Index score	Weight/share	Index score
<b>S/D Index</b>		<b>71.1</b>		<b>72.7</b>		<b>44.9</b>		<b>72.1</b>		<b>42.1</b>
<b>Demand</b>	0.3	<b>58.9</b>	0.3	<b>56.6</b>	0.3	<b>56.6</b>	0.3	<b>56.9</b>	0.3	<b>56.9</b>
<b>Industry</b>	0.19	100	0.17	100	0.17	100	0.17	100	0.17	100
<b>Residential</b>	0.23	52	0.23	46	0.23	46	0.22	46	0.22	46
<b>Tertiary</b>	0.17	43	0.19	45	0.19	45	0.18	45	0.18	45
<b>Transport</b>	0.41	50	0.41	50	0.41	50	0.42	50	0.42	50
<b>Supply</b>	0.7	<b>76.4</b>	0.7	<b>79.6</b>	0.7	<b>39.9</b>	0.7	<b>78.6</b>	0.7	<b>35.8</b>
<b>C+T</b>	0.3	<b>35.0</b>	0.3	<b>42.9</b>	0.3	<b>42.9</b>	0.3	<b>37.7</b>	0.3	<b>37.7</b>
<b>Electricity</b>	0.3	70	0.3	78	0.3	78	0.3	78	0.3	78
<b>Heat</b>	0.5	10	0.5	21	0.5	21	0.5	10	0.5	10
<b>Tr. Fuels</b>	0.2	45	0.2	45	0.2	45	0.2	45	0.2	45
<b>PES</b>	0.7	<b>94.1</b>	0.7	<b>95.2</b>	0.7	<b>38.6</b>	0.7	<b>96.1</b>	0.7	<b>35.0</b>
<b>Oil</b>	0.59	96	0.54	96	0.54	29	0.53	96	0.53	29
<b>Gas</b>	0.22	100	0.29	100	0.29	29	0.35	100	0.35	29
<b>Coal<sup>61</sup></b>	0.17	78	0.10	74	0.10	74	0.07	74	0.07	74
<b>Nuclear</b>	0.00	100	0.00	100	0.00	100	0.00	100	0.00	100
<b>RES</b>	0.03	100	0.07	100	0.07	100	0.03	100	0.03	100
<b>Other</b>	0.00	100	0.00	100	0.00	100	0.01	100	0.01	100

Source: ECN

Figure 50: S/D Index - Ireland



Source: ECN

The results indicate a score of 71 for 2005, which compares well to the other cases shown in figure 45. Ireland’s S/D index lies between the Netherlands (68) and the UK (77). The primary energy sources sub-score is quite high (94) as oil and gas are imported mainly from within EU and Norway. The oil and gas scores are therefore 96 and 100,

<sup>61</sup> Includes Peat.

respectively. The C+T score is low (35), mainly due to the low CHP share, which results in a score of only 10 in the C+T heat part.

Based on the most recent PRIMES scenario for Ireland (EC, 2006), the 2020 value (73) represents an improvement on the 2005 score. However this may be largely biased by the assumption made on the origins of the oil and gas imports, which have been assumed equal to the current situation i.e. based on Eurostat information for the year 2004. It is likely that this will change in the future.

As an illustration a case with a 50% share of import from outside EU/Norway has been quantified for the 2020 cases. The S/D Index then decreases substantially, from 73 to 45, due to a large decrease of the primary energy sources sub-index (from 95 to 39). This decrease is due to the decrease of the scores on oil and gas (to 29) and the relative high share of oil and gas (83%) in the primary energy sources mix.

Data for an alternative scenario that results in changes of the final energy demand shares, of the primary energy sources mix, and of the CHP share, compared to the PRIMES baseline is also shown. The total impact is small, and an S/D index of 72 results. For the SEI forecast, a similar sensitivity on the import origin of oil and gas was performed. In that case the S/D index drops to 42, for the same reasons as in the PRIMES baseline scenario.

From the cases it can be concluded that Ireland's S/D Index is largely determined by the origin of the imported oil and gas, given the large share of oil and gas in the primary energy mix (more than 80%). If the shares imported from outside EU and Norway increase substantially, a significant drop in the S/D Index can be expected. This would indicate a considerable increase in exposure to potential SOS disruptions.



**Sustainable Energy Ireland  
Energy Policy Statistical Support Unit**

Building 2200  
Cork Airport Business Park  
Co. Cork  
Ireland

**t** +353 21 454 7050

**f** +353 21 454 7059

**e** [epsu@sei.ie](mailto:epsu@sei.ie)

**w** [www.sei.ie](http://www.sei.ie)

**Sustainable Energy Ireland**

Glasnevin  
Dublin 9  
Ireland

**t** +353 1 8369080

**f** +353 1 8372848

**e** [info@sei.ie](mailto:info@sei.ie)

**w** [www.sei.ie](http://www.sei.ie)

