



A Baseline Assessment of Ireland's Oil Dependence

Key Policy Considerations

April 2006

Foreword



The pace of change in the global economy continues to increase. Firms in Ireland are facing competitive challenges more comprehensive than at any point in recent economic history. One of the key functions of Forfás is to anticipate these challenges. Through policy foresight, we attempt to identify the long-term economic, regulatory, environmental and social trends and their potential implications for enterprise policy in Ireland.

Energy security and cost is one of the key concerns facing Irish business. Ireland's ability to continue attracting high levels of foreign direct investment and to provide a supportive environment for Irish industry generally will depend on its capacity to deliver a secure and uninterrupted energy supply at a competitive cost.

The high probability that a supply of cheap oil will peak over the next 10-15 years poses a serious challenge for the global economy. We in Ireland are more dependent on imported oil for our energy requirements than almost every other European country and it will take up to 10 years to significantly reduce this dependence. Therefore, it is essential that we now begin to prepare for such a challenge.

An overarching national strategy that encompasses areas of energy, transport, enterprise, spatial, environmental and research policy is a requirement for Ireland in preparation for the challenge of peak oil. Countries such as Sweden have taken the lead by adopting a proactive approach to this challenge. Ireland needs to follow suit.

The review of energy policy currently underway within the Department of Communications, Marine and Natural Resources provides a window of opportunity to prepare for the oil challenge. The decisions we make to address the threat of peak oil and other energy challenges will have consequences decades into the future. Breaking Ireland's dependence on oil brings many opportunities for strengthened competitiveness, technological development and progress.

Martin Cronin
Chief Executive

April 2006

Executive Summary

Introduction

A reliable, secure and competitively priced energy supply is a vital ingredient for the competitiveness of industry and long term economic development. Recent developments in the global oil market have resulted in many countries having to evaluate their overall dependence on oil as a key input to their economy. Threats to security of supply, increasing global demand, slowing rates of new oil discoveries and rising oil prices have become major concerns globally.

The enterprise sector in Ireland is expressing concerns regarding energy pricing and security of supply. A particular issue of concern is the capacity of the energy industry to meet not only the needs of existing energy sensitive industries but also the needs of multinational companies considering locating operations in Ireland. Ireland's ability to continue attracting high levels of foreign direct investment and to provide a supportive environment for Irish industry generally will depend on its capacity to deliver a secure and uninterrupted energy supply at a competitive cost.

The concept of *'Peak oil'* has become increasingly important in recent years. It refers to a situation whereby world oil production reaches a point where it can no longer be increased. There is considerable uncertainty about when this will occur. Some expert commentators believe that the supply of conventional oil (petroleum crude oil extracted using the traditional oil well method) will peak by 2012; others believe that it will not happen until at least 2030. While the timing of such an event is widely debated, the potential problems are not. As peaking is encountered, liquid fuel prices and price volatility could increase dramatically and governments, businesses and economies at large could face significant economic and social change. The rapid rise in world oil prices in recent times could well appear modest in comparison to the price escalations and oil shortages that would arise.

The key issue with peak oil is that it is not an energy crisis so much as a 'liquid fuels' crisis. In other words, the onset of peak oil will not have any immediate consequences for gas supplies (though gas prices will more than likely go up) nor electricity supplies (to the extent that electricity is or can be generated from fuels other than oil). But it will be a liquid fuels crisis, which will have immediate consequences for the main categories of oil usage, in particular transportation. As Ireland is particularly dependent on oil, especially for transportation, it is important to start preparing for such an event. Viable mitigation options exist both on the supply and demand sides to address this situation, but in order to have a substantial impact they must be initiated more than a decade in advance of peaking.

Against this backdrop, Forfás commissioned Amárach Consulting, in conjunction with US energy expert Dr. Robert L. Hirsch, to undertake a baseline assessment of Ireland's

dependence on oil as a key input into the Irish economy and to outline the key policy considerations for Ireland in minimising the impact of a peak oil scenario. This paper builds on the research of Amárach Consulting and Dr. Hirsch and provides a Forfás perspective on the issue¹.

Key Findings

- There is growing evidence to suggest that the era of a plentiful supply of conventional oil is approaching an end². Various experts and groups have developed projections for when peak oil will occur. While there is a wide variation of estimates about the likely timing, most expert commentators believe that 10-15 years from now, conventional oil supply will no longer be capable of satisfying world demand at current prices. While this subject is clouded by a low level of quality data, there is near global consensus that the potential consequences of peak oil for governments, economies, businesses and indeed individual consumers should be considered now as it will take at least ten years to prepare for its onset.
- Ireland consumed nine million tonnes of oil in 2004, an amount that has doubled since 1990³. In 2002, Ireland ranked 3rd highest among the EU-25 countries in terms of oil consumed per capita.
- Electricity generation and transportation are the two main factors for Ireland's high oil dependence. Ireland has relied considerably more on oil for electricity generation than most other EU countries and, as of 2002, had the 6th most oil dependent electricity generation system of the EU-25 countries. The amount of oil used for transportation in Ireland tripled between 1972 and 2002, leaving Ireland consuming at least 50 per cent more per capita than the average of the EU-25 by the end of the period⁴.
- Taking into account the Irish economy's relative dependence on imported oil and the relative share of oil in total Irish energy consumption, Ireland is among the most sensitive to rising oil prices and therefore among the most vulnerable to a peak oil scenario.

Key Policy Considerations for Ireland

The findings of this study suggest that Ireland needs to develop a national strategy to prepare for the challenge of peak oil. The Department of Communications, Marine and Natural Resources is currently preparing a *Green Paper* setting out Ireland's proposed medium to long term energy policy and this provides an opportunity to develop options for dealing with this challenge. Sweden has already taken a pro-active approach to the challenge of peak oil,

¹ The Amárach/Hirsch report can be accessed at <http://www.forfas.ie/publications/index.html>

² Non-conventional oil is oil extracted using techniques other than the traditional oil well method

³ BP Statistical Review 2005

⁴ Ireland 2003 Energy Review, International Energy Agency (IEA)

putting in place a strategy designed to greatly reduce its remaining dependence on oil by 2020⁵. Ireland also needs to consider pro-active measures.

An important consideration in the context of a peak oil scenario is the need for an EU energy policy that sets out a common co-operative approach to dealing with oil peaking. The European Commission recently launched a *Green Paper* that put forward proposals for a new comprehensive European energy policy, focusing on sustainability, competitiveness and security as the core principles⁶. In order to react to the challenges of high and volatile oil prices, increasing import dependency, strong growing global energy demand and global warming, the EU needs to have a clearly defined energy policy and Ireland should be fully supportive of this.

This report outlines a list of key policy options for Ireland that should be considered in developing a strategy on peak oil (see section 6). A summary of these options are outlined below.

- Ireland should undertake a number of initiatives to reduce the usage of oil in transportation, for example, by bringing about the replacement over time of the existing stock of vehicles with more fuel-efficient vehicles and the provision of alternative modes of transport, particularly public transport, that run on electricity rather than petroleum related fuels (e.g. electrified trams, trains and buses). The potential of using biofuels for transportation should also be investigated⁷.
- Ireland should assess options to address security of supply concerns that may arise in the context of peak oil. Options should include expanding domestic oil storage capabilities and contracting bilaterally with oil-producing countries that continue to have a surplus of production relative to their domestic requirements. Accelerating plans to develop more East-West electricity interconnection with the UK would also provide a significant degree of energy security, subject to the UK resolving its own security of energy supply problems.
- Ireland should consider increasing the use of renewable energy sources for electricity generation (such as wind, wave, tidal energy etc), maintaining the continued operation of Moneypoint (Ireland's only coal fired power station). Although not economically feasible in the short to medium term, Ireland should consider the possibility of developing nuclear energy as a more long-term solution.
- Ireland should adopt a proactive approach to energy efficiency, seeking to place Ireland at the leading edge of energy efficiency practices. The EU Energy Performance Building Directive (EPBD), which came into effect in January 2006 will provide a basis for assessing

⁵ <http://www.sweden.gov.se/sb/d/5992/a/51058/m/wai;jsessionid=aQoDZ6T7loWe>

⁶ http://europa.eu.int/comm/energy/green-paper-energy/doc/2006_03_08_gp_document_en.pdf

⁷ Biofuels are fuels derived from biomass crops or by-products that are suitable for use in vehicle engines or heating systems

and improving energy usage in commercial and residential buildings that is intended to result in a more efficient use of electrical energy.

- Ireland should accelerate the implementation of the National Spatial Strategy in preparation for peak oil. Current spatial patterns in Ireland militate against the development of an efficient and effective public transport system. The development of regional gateways and hubs will play a key part in enabling urban communities to respond to the challenges of peak oil. Those communities that are adequately resourced in terms of public transport infrastructure will have greater choice in relation to how they respond.

1. Introduction

1.1 Background

The importance of oil to the world economy cannot be over emphasised. It provides the world with power, supplies fuel for factories and generates electricity. It is the major fuel source for the transport industry and is a vital raw material for a number of industries such as petrochemicals. Recent developments in the global oil industry have caused many countries to evaluate their overall dependence on oil as a key input to their economy. Potential threats to security of supply, increasing global demand, slowing rates of new oil discoveries and rising oil prices have become major concerns globally. Sweden has put in place a strategy designed to greatly reduce its dependence on oil by 2020, focusing on replacing fossil fuels with renewables before the anticipated future scarcity of oil leads to significant price rises.

The enterprise sector in Ireland is expressing concerns regarding energy pricing and security of supply. A particular issue of concern is the capacity of the energy industry to meet not only the needs of existing energy sensitive industries but also the needs of multinational companies considering locating operations in Ireland. Ireland's ability to continue attracting high levels of foreign direct investment and to provide a supportive environment for Irish industry generally will depend on its capacity to deliver a secure and uninterrupted energy supply at a competitive cost.

The concept of '*Peak oil*' has become increasingly important in recent years. Some expert commentators believe that the supply of conventional oil (petroleum crude oil extracted using the traditional oil well method) will peak by 2012; others believe that it will not happen until at least 2030. While the timing of peak oil is uncertain, the potential associated problems are clear, in that as peaking is approached, liquid fuel prices and price volatility will increase dramatically, and Governments, businesses and economies at large will face significant economic and social change. Indeed, the rapid rise in world oil prices in recent times could well appear modest in comparison to the price escalations and oil shortages that would arise.

Peak oil is not an energy crisis so much as a 'liquid fuels' crisis. The onset of peak oil will not have any immediate consequences for gas supplies (though gas prices will more than likely rise) or electricity supplies (to the extent that electricity is or can be generated from fuels other than oil). But it will be a liquid fuels crisis, which will have immediate consequences for the main categories of oil usage, in particular transportation. Viable mitigation options exist both on the supply and demand sides to address the peak oil, but to have substantial impact they must be initiated more than a decade in advance of peaking.

1.2 Objective and Methodology

Against this backdrop, Forfás commissioned Amárach Consulting, in conjunction with US energy expert Dr. Robert L. Hirsch, to undertake a baseline assessment of Ireland's

dependence on oil as a key input into the Irish economy and to outline some of the key policy considerations for Ireland in the event of an oil peaking scenario. The ultimate objective of the study was to understand exactly how vulnerable Ireland would be in a situation of continuing oil price rises and potential oil shortages in the medium to long term. The approach to addressing this objective included:

- an extensive review of the national and international literature on global oil developments and oil peaking scenarios;
- a consultation process with a diverse range of oil/energy experts in Ireland, Europe and the United States; and
- a series of workshops with a number of international oil experts, senior policymakers, business organisations and representatives from the petroleum industry.

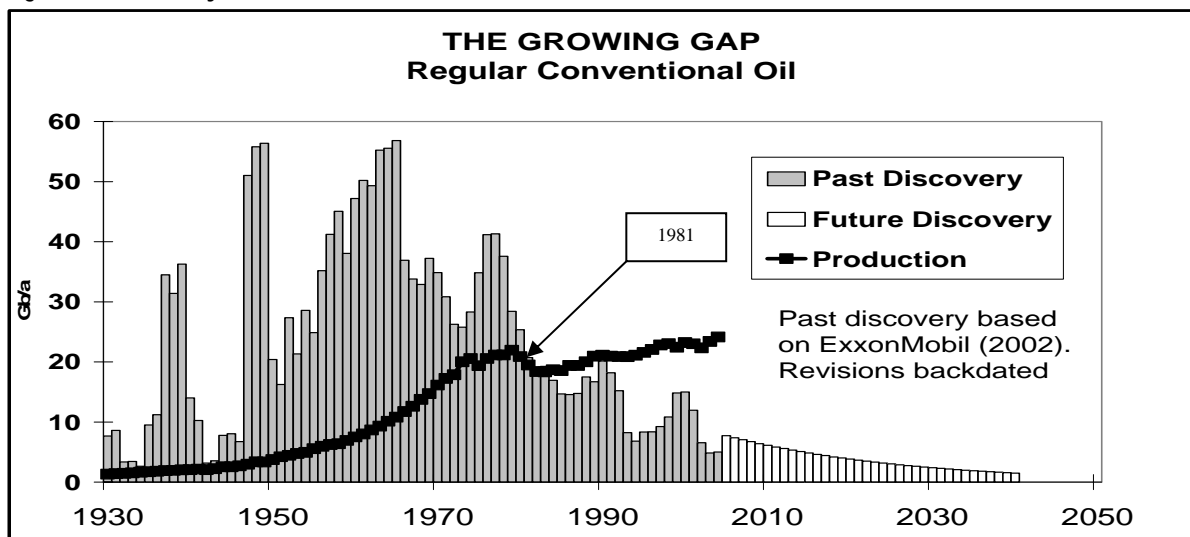
Forfás also established a Steering Group to oversee this study comprising representatives from the Department of Enterprise, Trade and Employment, the Department of Communications, Marine and Natural Resources, the Department of Transport, the Department of the Environment, Heritage and Local Government, IDA Ireland, Enterprise Ireland and Sustainable Energy Ireland.

This paper builds on the research of Amárach Consulting and Dr. Hirsch and provides a Forfás perspective on the issue.

2. Oil Peaking

Peak oil describes a situation in which world oil production reaches a point where it can no longer increase any further, giving way to a declining level of production for some time afterwards. The timing of the peak in oil output is difficult to forecast due to uncertainties about the likely output of existing and potential new oil fields in the future.

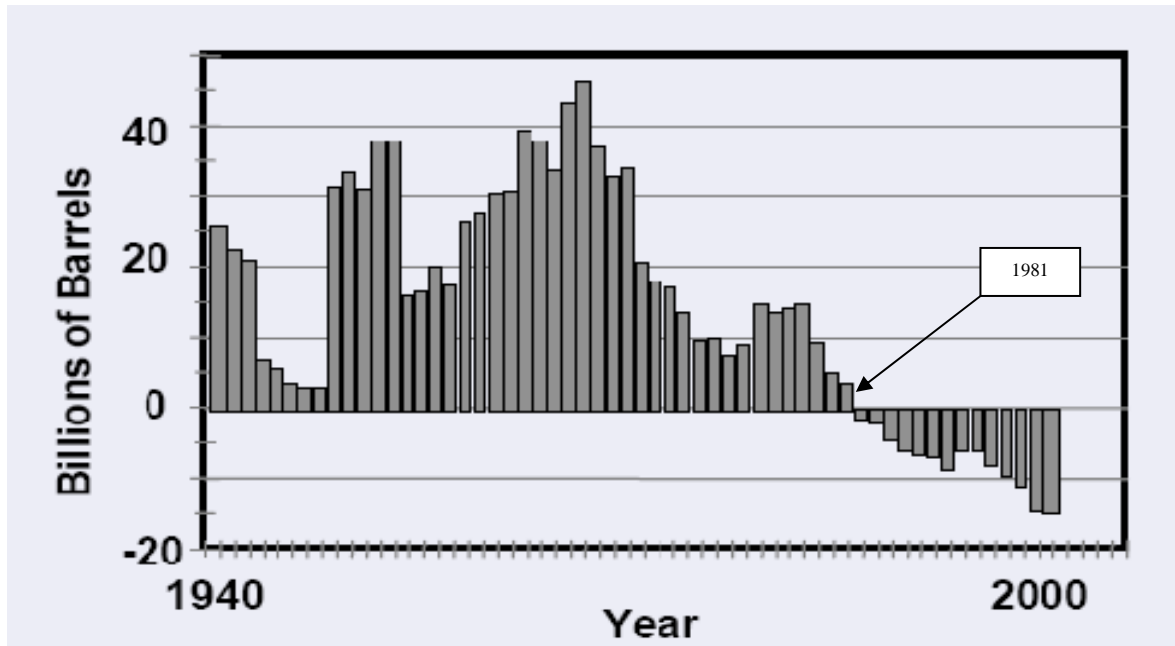
Figure 1: Discovery & Production of Conventional Oil



Source: Amárach Consulting, ExxonMobil

As Figure 1 illustrates, each year since 1981, the world has consumed more oil than is discovered. The relatively poor volume of discoveries in recent years, against a background of rising oil consumption, means that the gap is widening. Thirty three of the world's 48 largest oil-producing countries now have declining oil production levels. Figure 2 highlights the net difference between annual world oil reserve additions and annual oil consumption.

Figure 2: Trend in Volume of Oil Discoveries minus Consumption



Source: Amárach Consulting, ASPO⁸

Various expert individuals and groups have developed projections for when world oil production might peak. As table 1 shows, there is no clear consensus as yet about the likely timing of peak oil, with some commentators expecting an imminent peak (in the next few years), while others push the date out to beyond 2030. However, there is an emerging consensus that non-OPEC⁹ oil output will peak around 2010, but considerably less consensus about the timing of the peak in OPEC's output. Most of the differences in relation to the timing of peak oil therefore relate to differences in assumptions about the future production capabilities of OPEC.

⁸ Association for the Study of Peak Oil and Gas

⁹ The Organization of the Petroleum Exporting Countries (OPEC)

Table 1: Projections of the Peaking of World Production

Source of Projection	Projected date of peak oil	Source of Projection	Projected date of peak oil
Individual Experts		Governments	
A. Bakhtiari	2006-2007	Dutch Government (IEA HI copy)	After 2030
M. Simmons	2007-2009	French Government	2020-2030
C. Skrebowski	2007-2010		
K. Deffeyes	2005-2009	Analyst Firms	
J. Laherrère	2010-2020	IHS Energy	2011-2020
P. Odell	2060	Douglas Westwood	2010-2020
B. Pickens	2005-2007	Energy Files	2010-2020
M. Lynch	After 2030	PFC Energy	2014-2025
C. Campbell	2010		
S. Al-Husseini	2015	Energy advisory organisations	
J. Gilbert	2010	World Energy Council	After 2020
T. Petrie	Before 2010	Energy Research Center Netherlands	2010-2035
		CERA	After 2020
Oil Companies		ASPO	2010
CNOOC	2005-2010	IEA deferred investment scenario	Around 2020
Total	2020-2025	IEA high resource case	After 2030
Shell	After 2025		
BP	We cannot know	Other Organisations	
Exxon-Mobil	After 2030	Volvo	2010-2015
		Ford	2005-2010

Source: Amárach Consulting

A number of factors could conceivably impact the timing of oil peaking including:

- the extent of Middle East oil reserves (which is not fully known);
- future world economic and population growth;
- discovery of new oil fields or new natural gas reserves (which can be converted to liquid fuel);
- a scientific breakthrough that comes into commercial use, mitigating oil demand well before oil production peaks;
- political instability in oil producing countries; and
- the level of energy efficiency.

These range of factors influencing the timing of any global peak in oil production illustrate the difficulties in forecasting future oil demand and supply. However, there is clear consensus that sustaining continued growth in the world's economy, particularly in China and India, will require a growing supply of oil due mainly to rising demand for transport. In an unconstrained

scenario, world demand for oil is expected to grow from an average daily requirement of under 85 million barrels per day in 2005 to over 115 million barrels per day in 2030¹⁰.

Not all commentators agree that oil peaking is a problem, or that it will be soon. Lord Browne, CEO of British Petroleum, stated in February 2006 that *“the idea that oil is running out is simply untrue. There is no physical shortage of oil or gas. The reality is that the physical resource base is strong, and the amount that we can recover from that base is being expanded by technology all the time”*. Critics point to additions to reserves and the potential of new areas for exploration, suggesting that oil reserves will be adequate to meet future needs for many years. The potential of oil in other forms, such as oil shale and tar sands, from which oil can be extracted, is also often emphasised. Another argument is that alternative forms of liquid fuels such as agriculture derived ethanol can be used or that energy efficiency measures could significantly reduce the rate at which oil reserves are depleted, allowing time for alternative forms of energy to be developed.

However, there are a number of uncertainties behind these arguments:

- Some oil reserves estimates are regarded as optimistic, especially where some state-owned reserves figures are concerned.
- There are mixed views on the quality of the extraction technologies being developed. Also, too rapid an increase in oil production in a field can make the remaining reserves more difficult to recover.
- The rate at which additional oil can be recovered from non-conventional oil sources (such as shale) is uncertain.
- The production of alternative liquid fuels (such as agriculture-derived ethanol) itself requires liquid fuel inputs, directly and indirectly, and the full potential of biomass in general would take time to be realised.
- The conversion of transport equipment to adapt to alternatives to oil (electricity, biofuels etc) needs time that may not be available if oil peaking were to occur in the short term.

3. Ireland’s Oil Resources and Requirements

Ireland has no indigenous sources of oil; all our oil requirements are imported. As a result, Ireland’s balance of trade is vulnerable to rising oil prices feeding through into a rising cost of oil imports. Ireland relies mainly on the importation of refined petroleum and related products, with some refining of imported crude oil at the Whitegate refinery in Cork. Though there were high expectations for the development of an offshore oil industry in Ireland in the 1970s and 1980s, subsequent findings were discouraging. Operators spent some €2 billion between 1971 and 2003 drilling more than 140 exploration and appraisal wells. Ireland’s exploration success rate has been among the lowest in the world. Though there has been success in developing commercially viable gas fields (Kinsale and Corrib), there have been no

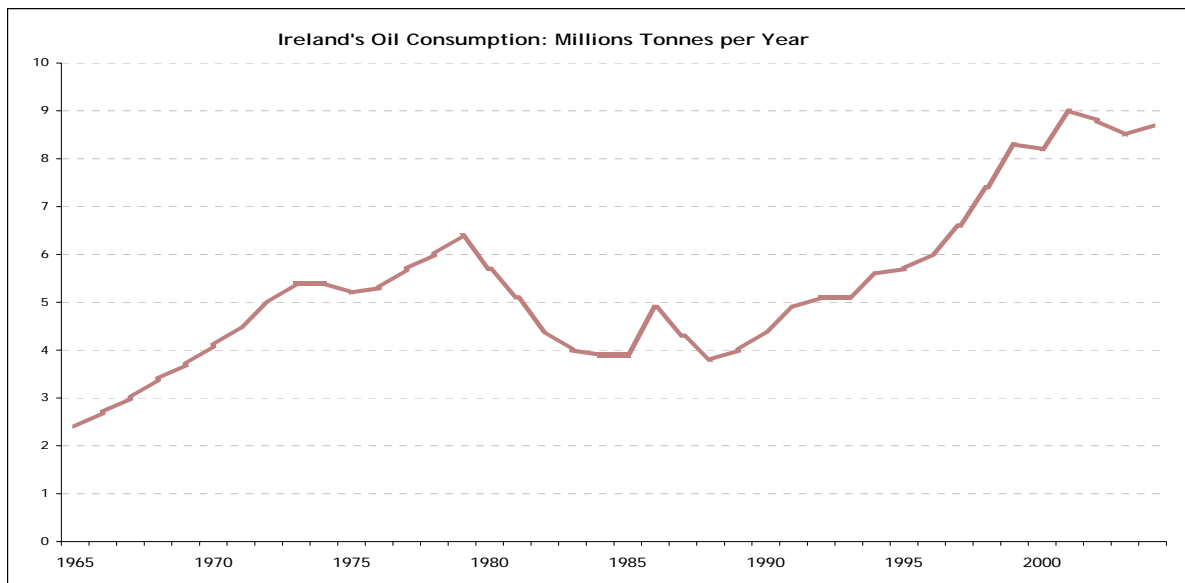
¹⁰ International Energy Agency World Energy Outlook (2005) – based on assumption that price of oil is inflation-adjusted to 2030

viable oil finds nor is there any prospect of one at present. In all likelihood, Ireland will continue to rely on imports to meet all the country's oil requirements for the foreseeable future.

The importation and distribution of all of Ireland's oil requirements is handled by commercial oil companies. Through the National Oil Reserves Agency (NORA), the State is responsible for the management of the country's strategic oil reserve stocks (in compliance with EU, IEA and national criteria) in case of a physical interruption in commercial oil supplies. NORA has oil stocks stored in various locations around Ireland as well as in a number of overseas facilities. In addition, NORA has contracts in place to secure additional oil reserves in a time of emergency.

Ireland's oil consumption has increased significantly as a result of rapid economic growth. Ireland consumed nine million tonnes of oil in 2004 - approximately 180,000 barrels of oil per day - compared to four and a half million tonnes in 1990 (see Figure 3).

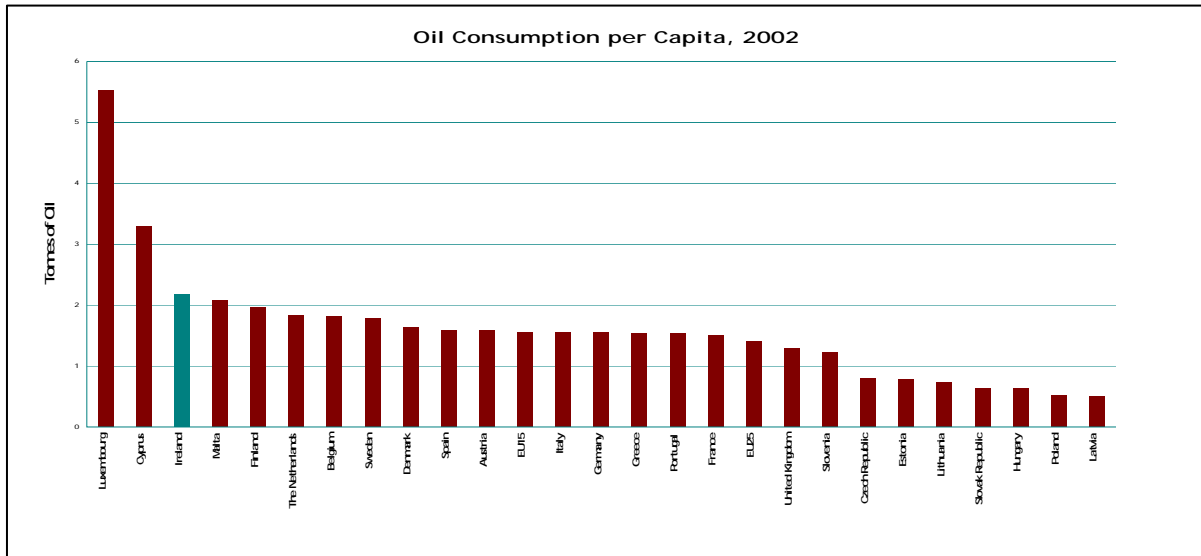
Figure 3: Ireland's Oil Consumption



Source: Amárach Consulting, BP Statistical review 2005

Such has been the speed and scale of the increase in Ireland's oil consumption since 1990 that as of 2002 Ireland ranked 3rd among the EU-25 countries in terms of oil consumed per capita (see figure 4).

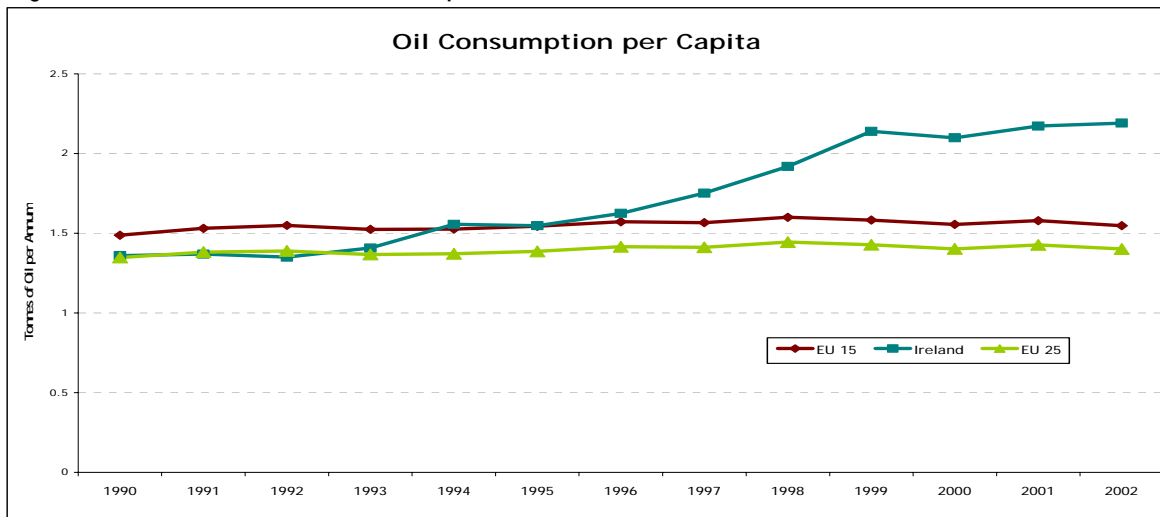
Figure 4: Ireland's Relative Oil Consumption per capita



Source: Amárach Consulting, EU Energy & Transport Figures 2004

Ireland's exceptional growth in oil consumption is illustrated in figure 5, which shows oil consumption per capita for Ireland, the EU-15 and the EU-25 countries. While oil consumption per capita has remained constant in the EU as a whole, Ireland's consumption per capita has increased by over 50 per cent between 1990 and 2002. Some of this high dependence on oil is inevitable given the island nature of our economy. However, some is a matter of choice as Ireland has adopted patterns of transportation, spatial development and energy production that are oil intensive.

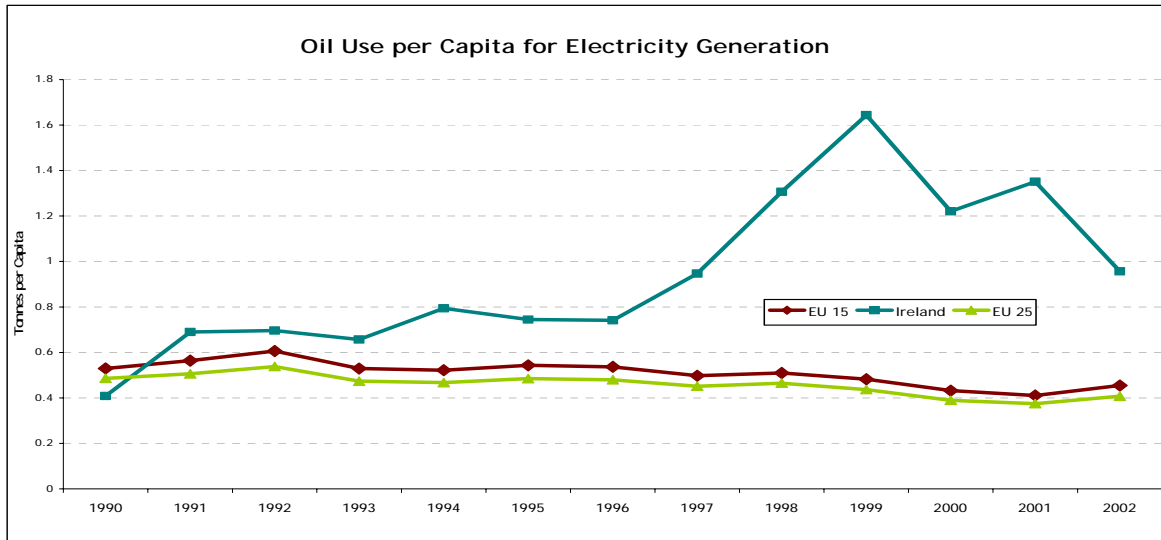
Figure 5: Ireland's Relative Oil Consumption



Source: Amárach Consulting, EU Energy & Transport Figures 2004

Electricity generation and transportation are the two main factors contributing to this pattern of rising oil dependence.

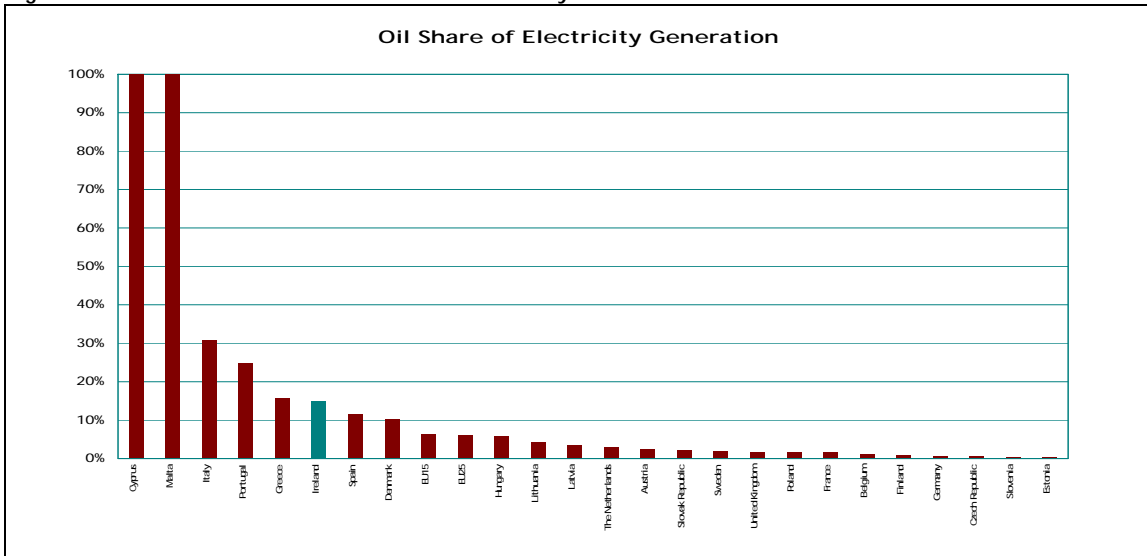
Figure 6: Ireland's Relative Oil Use for Electricity Generation



Source: Amáarach Consulting, EU Energy & Transport Figures 2004

- In terms of **electricity generation**, four of ESB's 15 Irish stations use oil (accounting for between 25-50 per cent of generation capacity). Figure 6 shows that Ireland's reliance on oil for electricity generation has fallen in recent years. This is due partly to the increased use of gas (up from 37 per cent of total fuel input in 2000 to 51 per cent in 2004) and also to the growing contribution of wind-generated electricity.
- Nevertheless, through most of the past fifteen years, Ireland has relied more on oil for electricity generation than the EU as a whole and, as of 2002, had the 6th most oil dependent electricity generation system of the EU-25 countries (see Figure 7). This is primarily because countries such as France, Germany, the UK and Finland use nuclear energy for electricity generation. Most of these countries also have higher hydroelectric generation capacity.

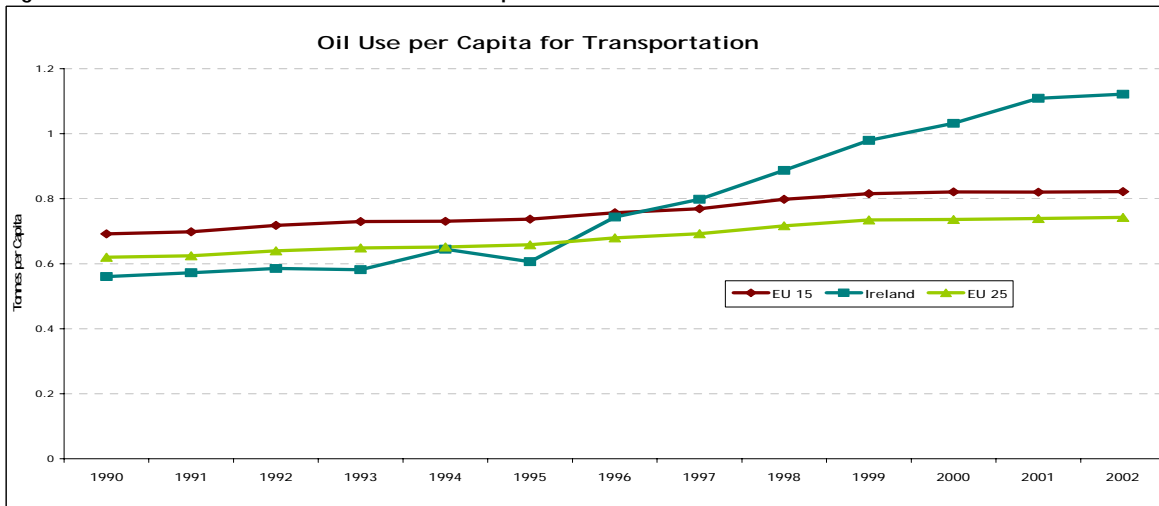
Figure 7: Ireland's Relative Oil Share of Electricity Generation



Source: Amárach Consulting, EU Energy & Transport Figures 2004

Transportation is the other main source of Ireland's growing demand for oil. The amount of oil required for transportation in Ireland has more than tripled since 1973. As in most developed economies, significant economic prosperity has led to a surge of growth in car ownership in Ireland, with cars per 1,000 of the population doubling between 1980 and 2004 as GDP per capita more than doubled. In the early 1990s, Ireland used less oil per capita for transportation than the average of the EU-25 countries. However, by 2002, Ireland had consumed at least 50 per cent more oil per capita for transportation purposes (see figure 8).

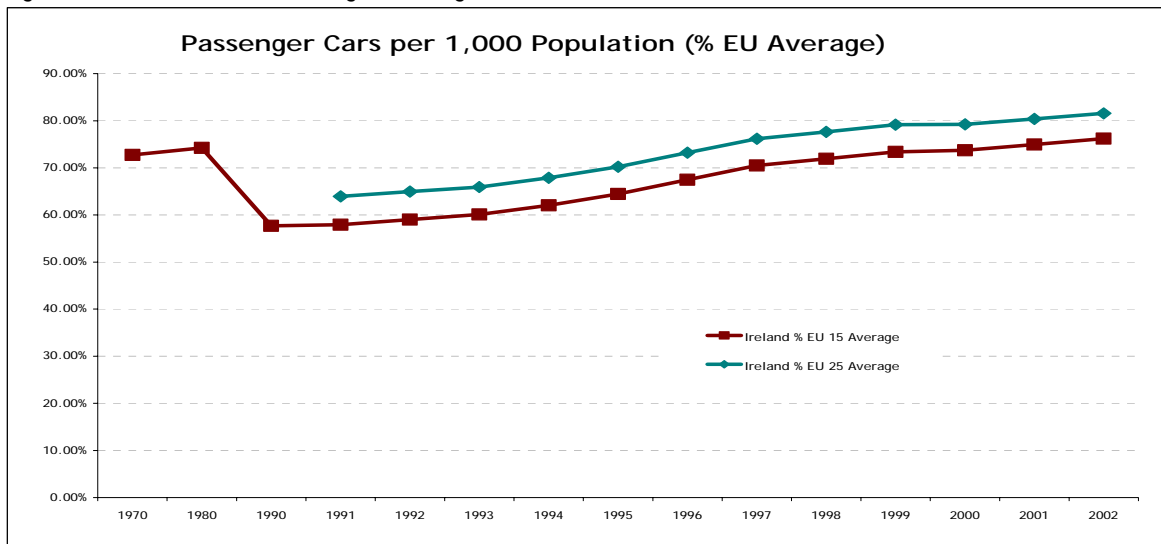
Figure 8: Ireland's Relative Oil Use for Transportation



Source: Amárach Consulting, EU Energy & Transport Figures 2004

- Surprisingly, as Figure 9 illustrates, Ireland still has some way to go in terms of car ownership relative to the EU average. This suggests considerable room for further growth in car ownership and usage in the decades ahead. The anomaly of lower rates of car ownership but higher oil usage for transportation can be attributed to a number of factors.

Figure 9: Ireland and EU Average Passengers Car Numbers



Source: Amárach Consulting, EU Energy & Transport Figures 2004

- Firstly, it may be that Irish residents use the existing stock of cars more intensively than in other EU countries, due to more distributed settlement patterns, longer commuting distances and weaknesses in the public transportation infrastructure.
- Secondly, increased freight transport by road has contributed to the increasing consumption of oil in transportation in Ireland. Between 1995 and 2002, national road haulage volumes more than doubled, compared with an EU-15 growth of just 19 per cent. Over the same period, rail haulage volumes fell by 28 per cent in Ireland, while they increased by six per cent in the EU-15 countries.
- Thirdly, the emergence of low cost air travel and the revolution in air travel availability from Ireland has also contributed to the increasing consumption of oil in transportation. Between 1990 and 2002, the number of passenger kilometers generated by Irish air travellers to other EU-15 countries more than doubled, while the volume of total EU traffic rose by 78 per cent over the same period.

4. Economic Impact of Peak Oil

Determining the economic consequences of peak oil is quite difficult because past experience is of limited value. This is because previous OPEC instigated oil shocks eventually gave way to a restoration of supply. Indeed, rising oil prices instigated an expansion of non-OPEC oil exploration and development, which in turn led to an expansion of non-OPEC supply through the 1980s and 1990s. With the onset of a global peak in oil production, there will be no immediate equivalent to 'non-OPEC' conventional oil supplies to meet the shortfall created by a decline in OPEC's production. The economic impact will be structural rather than cyclical, with all the major actors in the economy required to adjust to a permanent reduction in oil availability.

Faltering conventional oil production following oil peaking will be reflected in rising oil prices. These price rises will themselves reduce the demand for oil and encourage new exploration, delaying the onset of a production peak. Some economists suggest that we will not experience a single 'peak' in global oil production, but rather an undulating 'plateau' involving cycles of rising prices, demand destruction, oversupply, falling prices and a re-stimulation of demand. Such a cycle could continue for some time as the interplay of supply and demand works itself out, but all the time leading to a structural escalation in the price of oil. A summary of the literature illustrates the widespread economic impact of higher oil prices¹¹.

- Economic output: Increases in oil prices will reduce economic growth in many economies leading to higher unemployment. Impacts on individual economies will vary depending on their domestic macroeconomic and sectoral policies. Higher prices result in large income transfers from oil importing economies to net oil exporting economies. The negative impacts are therefore largest in oil importing economies with high oil intensity. While oil exporting economies will benefit from higher export earnings from higher oil prices, it is possible that economic growth may slow for some oil exporters as a result of flow-on effects from other economies, such as reduced demand for other exports.
- Inflation/wages: Higher oil prices lead to increased wage and inflationary pressures in many economies, although the magnitude will in part depend on the fiscal and monetary policy responses. There could be upward pressure on interest rates as central banks attempt to limit inflation. Overly contractionary policies could exacerbate the decline in economic growth and increase unemployment in some economies.
- Trade balance: For net oil importing economies, the increase in the price of oil imports will cause trade balances to worsen, that is, the value of imports will increase more than the value of exports. Conversely, oil exporting economies will experience an improvement in their trade balance.

¹¹ Impact of oil prices on trade in the APEC region, ABARE Research Report 05.3 for the APEC Energy Working Group, October 2005

A 2004 study by the European Central Bank (ECB) evaluated the impact of rising oil prices on the EU¹². It calculated that, for the eurozone, a 50 per cent increase in the level of oil prices will add 0.3 to 0.6 percentage points to inflation and reduce real GDP growth by 0.1 to 0.8 percentage points in the first year. This study distinguished between direct and indirect effects with rising oil prices working their way through the economy but the full effect is not immediate. Higher oil prices result in increased costs for the production of goods and services, as well as consumer price inflation, unemployment, reduced demand for products other than oil and lower capital investment. Tax revenues decline and budget deficits increase, driving up interest rates. These effects will be greater the more severe the oil price increase and will be exacerbated by the impact on consumer and business confidence.

The above analysis assumes a continued orderly functioning of the global oil market, where oil is rationed by the price mechanism. However, there is a danger that oil peaking will lead to geo-political instability, resulting in a breakdown in the smooth functioning of the oil market and physical interruptions in supply. The economic consequences of such a scenario are impossible to predict, but the overall impact would clearly be grave.

5. The Impact of Peak Oil on Ireland

As part of this research, Amárach Consulting (sourcing World Bank figures), developed an oil vulnerability index which illustrates the sensitivity of various economies to developments in the global oil industry¹³. This vulnerability is based on three measures, namely

- the sensitivity of the economy to a rise in oil prices;
- the dependence of the economy on imported oil rather than indigenously produced oil; and
- the share of oil in the total energy consumed by the economy.

These three measures combine to create the oil vulnerability index displayed below, with a higher index equating to greater vulnerability. Table 2 suggests that Ireland is one of the most vulnerable of the benchmarked countries.

¹² Oil prices and the Euro area economy, ECB Monthly Bulletin, November 2004

¹³ 'The impact of higher oil prices on low income countries and on the poor' - World Bank March 2005

Table 2: Oil Vulnerability Index

	Oil Price Sensitivity (1)	Oil Import Dependence (2)	Oil Energy Dependence (3)	Oil Vulnerability Index (4)
Singapore	-1.3	0.98	0.97	3.25
Israel	-0.8	0.99	0.72	2.51
Hong Kong	-0.7	1	0.68	2.38
Greece	-0.7	0.98	0.62	2.3
Ireland	-0.6	1	0.6	2.2
Spain	-0.6	0.98	0.54	2.12
Germany	-0.6	0.95	0.4	1.95
Italy	-0.5	0.94	0.5	1.94
Sweden	-0.6	1	0.32	1.92
Switzerland	-0.5	0.99	0.42	1.91
Japan	-0.4	0.98	0.5	1.88
Iceland	-0.6	1	0.27	1.87
Finland	-0.5	0.96	0.36	1.82
Austria	-0.5	0.91	0.4	1.81
France	-0.4	0.96	0.37	1.73
New Zealand	-0.6	0.67	0.32	1.59
Netherlands	-0.1	0.91	0.48	1.49
USA	-0.4	0.54	0.39	1.33
China	-0.4	0.3	0.25	0.95

1. Impact on GDP of a 10% increase in real oil prices - % change
2. (Oil Consumption - Indigenous Oil Production)/Oil Consumption
3. Ratio of Petroleum Consumption to Total Primary Energy Consumption
4. Sum of 1-3 (using absolute value of price elasticity)
Sources: Indicators 1,2&3 World Bank 2005
Indicator 4 Amárach Consulting estimates

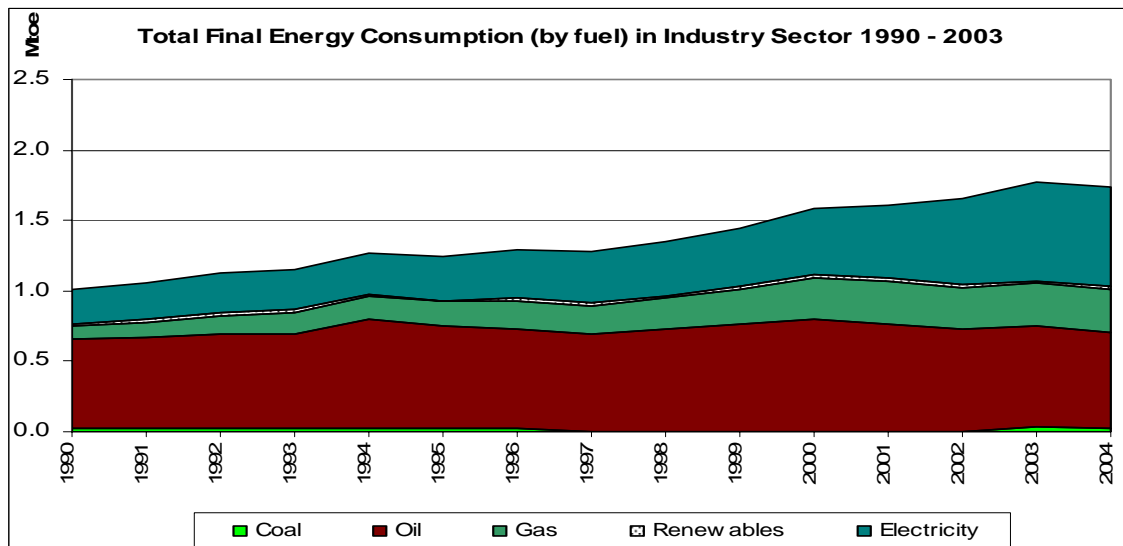
Ireland will not be unique in relation to how we are affected by high oil prices and potential oil shortages. However, unlike many other countries, Ireland is completely dependent on oil-fuelled air and sea transport for its international connectivity.

While the potential macroeconomic impact of oil price rises has been well documented, it is less clear how a potential oil shock of the magnitude and duration of peak oil would affect individual sectors of the economy.

The **agriculture** sector uses oil for operating tractors and self-propelled machinery. However, oil costs represent a relatively small part of total operating costs. Agriculture may be more vulnerable to the indirect impacts such as the knock-on impact of rising oil prices on gas prices and therefore on artificial fertiliser prices (as gas is a key input into fertiliser manufacture). On the positive side, demand for agricultural products tends to be less sensitive to economic downturns than demand for other goods and services.

Manufacturing relies on oil both for transportation and lubrication of machinery. A number of manufacturing sectors play a key part in Ireland's economic and trade performance, including the ICT, pharmaceuticals and biotechnology sectors. These sectors have a below average level of vulnerability in relation to the direct consumption of oil. Some other sectors, such as mining and equipment manufacturing, are more reliant on oil (as a share of total fuel requirements). Figure 10 shows that oil consumption by industry in general has remained relatively unchanged in volume terms over the past 15 years, falling substantially as a share of both total fuel usage and output. Electricity generation is a category within industry, and not surprisingly accounts for the dominant share of industry's oil requirements. Overall, however, industry has only limited direct exposure to oil and it is the indirect effects (the impact of falling consumer demand as a result of a global economic downturn) that will be more important.

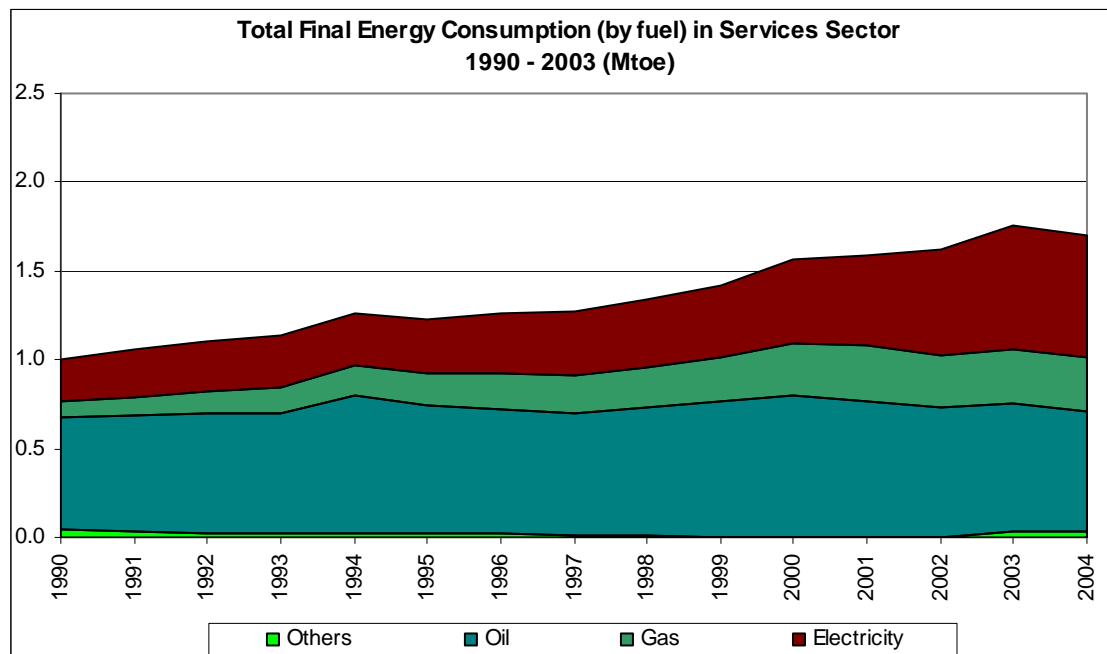
Figure 10: Industry Sector Energy Consumption



Source: Amárach Consulting, Sustainable Energy Ireland

As with manufacturing, oil consumption by the services sector has remained relatively unchanged in volume terms over the past fifteen years, and has fallen substantially as a share of total fuel usage, giving way to gas and electricity (see Figure 11).

Figure 11: Services Sector Energy Consumption



Source: Amárach Consulting, Sustainable Energy Ireland

The direct impact of peak oil on the services sector will be quite limited. Though oil is used for space and water heating in services companies located in regions without access to gas, most requirements can be met by electricity. Most vulnerable will be significant service sub-sectors such as transport and tourism. Tourism, in particular, is highly exposed, reflecting its dependence on various forms of transportation. It is, however, the indirect impacts of oil peaking that will be more significant. Demand for services (particularly leisure related services) tends to be more sensitive to economic downturns than demand for goods or food).

6. Peak Oil: Key Policy Considerations for Ireland

National Strategy

Ireland needs to develop a national strategy in preparation for the challenge of peak oil. The Department of Communications, Marine and Natural Resources is currently preparing a *Green Paper* on Ireland's medium to long term energy policy and this provides an opportunity to incorporate such a strategy. Countries such as Sweden have already taken a proactive approach to the challenge posed by peak oil, putting in place a strategy that will greatly reduce its remaining dependence on oil by 2020. Ireland also needs to consider proactive measures for reducing our dependence on oil.

Common European Approach

An important consideration in the context of a peak oil scenario is the need for an EU energy policy that sets out a common co-operative approach to dealing with oil peaking. The

European Commission recently launched a *Green Paper* that put forward proposals for a new comprehensive European energy policy, focusing on sustainability, competitiveness and security as the core principles. In order to react to the challenges of high and volatile oil prices, increasing import dependency, strong growing global energy demand and global warming, the EU needs to have a clearly defined energy policy and Ireland should be fully supportive of this.

Below is a list of **policy options** for Ireland that should be considered in preparation for the challenge of peak oil.

Transport

There are a number of short term initiatives that can be undertaken to reduce the usage of oil in transportation, mainly relating to changes in commuting and working patterns, such as increases in teleworking, incentives for car pooling and greater use of existing public transport services. In the longer term, however, there are only two options in relation to reducing oil consumption for transportation purposes, namely:

- Bringing about the replacement over time of the existing stock of vehicles with more fuel-efficient vehicles, including hybrids and others that do not run on petroleum related fuels (e.g. biofuels, hydrogen fuel cells). Ireland already provides some tax relief in relation to hybrid cars. The budget of 2006 extended the hybrid tax relief to fuel-flexible cars. A more radical adoption of this approach could lead to a faster increase in hybrid usage (and therefore fuel efficiency benefits) than will otherwise be the case.
- The provision of alternative modes of transport, particularly public transport, that run on electricity rather than petroleum related fuels (e.g. electrified trams, trains and buses). The recent *Transport 21* programme of capital spending on transport over the next 10 years can play a key part in preparing Ireland for the transition to a world of falling oil supplies - its strong emphasis on public transportation infrastructure (accounting for €16 billion of the total spend of €34 billion) will be central to this preparation. An opportunity exists to 'fast track' those elements of *Transport 21* relating to public transportation that are currently envisaged as part of medium-term and long-term priorities rather than for immediate implementation.

Neither option is likely to yield significant benefits in the form of reduced oil demand for transportation in less than five years, with the main benefits arising after 5-10 years as older cars are replaced and new public transport infrastructure comes on stream.

In time, the electrification of transport will likely be the main route to mitigating the social, spatial and economic impact of peak oil on businesses and consumers. But this in turn highlights the importance of the time horizon Ireland adopts in analysing peak oil and potential mitigating strategies. Given the structural changes in the pattern of economic

activity that peak oil will induce, it is essential to assess the strategies for mitigating its more adverse consequences over an appropriate timescale - up to 20 years and more.

Electricity

- Transport electrification and industrial conversion will require much greater electricity generating capacity. In planning to reduce our dependence on oil, the most obvious alternative fuel for additional electricity generation is gas. However, gas is subject to an increasing level of uncertainty about its future supply. It seems, sensible, therefore, to look to other fuels as alternatives to oil (and gas) in meeting future generation requirements.
- The use of coal and peat for electricity generation, while not ideal from an environmental perspective, provides additional diversity of supply which could be considered as part of a wider assessment of responses to peak oil. Global supplies of coal are considered adequate for the foreseeable future. Therefore, the continued operation of Moneypoint (Ireland's only coal fired power station) and the development of new coal fueled power stations could be options for the future. However, as coal is a carbon intensive fuel, any new stations will have to be equipped with advanced CO₂ sequestration technologies.
- Ireland has some potential to increase the use of renewable energy sources (such as wind) for electricity generation, though the capacity of the national grid to import and distribute the variable output of wind generation will require significant development. The potential of developing other forms of renewable sources such as wave, biomass and tidal energy must also be given consideration.
- An All-Ireland electricity market will have only marginal impact on the security of supply given the broadly similar exposure of Northern Ireland's generators to fossil fuels to that of those in the Republic of Ireland. However, accelerating plans to develop more East-West electricity interconnection with the UK would also provide a significant degree of security of electricity supply, subject to the UK resolving its own security of energy supply problems.
- Ireland should give more consideration to 'distributed generation' (e.g. combined heat and power (CHP) usage in homes). This has the potential to take significant pressure off the electricity generation capacity, through encouraging homes and communities to provide more of their own electricity requirements and even to resell back to the grid when not required. Such distributed generation would likely work with renewables such as wind and biomass, and to a lesser extent gas and peat.
- Another option for Ireland to secure its long run energy security, especially in relation to electricity generation, will be to consider developing the use of nuclear energy. Although this is explicitly not part of Ireland's policy preferences at present, the revived interest in redeveloping a nuclear electricity sector in the UK will provide an important context for

Ireland's electricity options in the next 5-15 years. The Economic and Social Research Institute (ESRI) suggest that, due to the large size of nuclear plant and the small size of the Irish electricity system, a nuclear facility would require so much back-up conventional plant as to substantially raise its overall costs, reducing any potential attraction for investors¹⁴. The economically feasible scale of a nuclear power station would exceed the capacity of the Irish market to absorb its output. Therefore, Ireland is currently not an attractive location for building a nuclear power station. However, if smaller scale power stations were to come on stream and Ireland's level of interconnection with the UK market was significantly increased, nuclear energy could become a more realistic energy option for Ireland.

- Another potential source of electricity generation is through energy recovery from waste (i.e. thermal treatment). This can form an important part of a diversification strategy in relation to electricity generation. Waste to energy capacity has been developed successfully in many countries including Sweden, Denmark and Singapore.

Security of Supply

A "peak oil" scenario threatens not just an escalation in oil prices, but also geo-political instability that could threaten the smooth functioning of the global oil market leading to physical interruptions in supply. It is, therefore, prudent that Ireland consider ways to provide enhanced security of access to oil.

- Ireland has limited oil storage facilities and relies on overseas storage for a large share of its strategic reserves. It may be prudent to consider expanding the domestic storage capabilities managed by NORA to extend the strategic reserve and to provide enhanced security of access to oil in the event of short term disruptions. Though increasing this reserve would only be of temporary value, the role strategic reserves can play in mitigating against an emergency supply shock is still a worthwhile consideration. China have taken precautionary steps and pursued a policy of building up their strategic oil reserve, aimed at bolstering their energy security as consumption soars and domestic oil output stagnates. The actions of China and other countries highlights their willingness to take pro-active measures to address security of supply concerns and their recognition of the urgency surrounding this action. Ireland needs to consider similar measures.
- Ireland's oil requirements are comparatively small in an international context. In the event of a global shortage, the Irish Government could consider contracting with National Oil Companies (NOCs) in oil producing countries that continue to have a surplus of production relative to their domestic requirements. A number of bilateral agreements of this nature could be put in place as options to be managed by NORA, and established as binding treaties between Ireland and the supplying countries.

¹⁴ "Aspects of Irish Energy Policy" ESRI, September 2005

- Additional support for the production of biofuels by Irish farmers could also provide a modest volume of alternative fuel supplies, for use even in supporting agricultural output itself in the event of actual oil shortages. Germany has set a target to increase the share of bio-fuels to 5.75 per cent of fuel consumption by 2010, mitigating to some extent the likely impact of peak oil.

Enterprise Policy

- Ireland's ability to continue attracting high levels of foreign direct investment and to provide a supportive environment for Irish industry generally will depend on its capacity to deliver a secure and uninterrupted energy supply at a competitive cost. By preparing well in advance for oil peaking, Ireland can gain a competitive edge. Ireland needs to set clear, public domain goals for delivering security of electricity supply into the future through diversification of fuels and increased generation capacity. In adopting such goals in relation to energy security, Ireland should position itself as an emerging 'post oil' economy and an ideal location for inward investment and international trade.
- Environmental issues have come to the fore in enterprise policy over the past decade. In comparison to most EU member states, Ireland allocates a relatively minimal amount of state aid for the purposes of assisting companies to achieve environmental objectives. Policy makers and enterprises are becoming aware of the benefits that enhanced environmental practices can have in strengthening competitiveness in tandem with improving environmental protection. Such practices can result in improved energy efficiency and more efficient use of raw materials. Preparing for the peak oil challenge in advance could place Ireland in a favourable position in terms of accessing more EU environmental aid and fiscal incentives for promoting enterprise development. As well as reducing our dependence on increasingly expensive fossil fuels, this will also facilitate Ireland in meeting its Kyoto obligations and maintaining the strategically important asset of a clean environment which is vital to the development of many new high technology sectors such as Bio-Pharmaceuticals.

Energy Efficiency

- Though some initiatives have been adopted to improve energy efficiency standards in Ireland, the most important initiative in relation to total energy usage will be that of the Energy Performance Building Directive (EPBD) which came into effect in January 2006. This will provide a basis for assessing and improving energy usage in commercial and residential buildings that is intended to result in a more efficient use of electrical energy in particular.
- Going forward, Ireland could adopt a proactive approach to the Directive, seeking to place Ireland at the leading edge of energy efficiency practices, and supporting the

development of businesses that can provide the delivery of the same practices in other markets.

Environmental Obligations

- In the long-term, policies to mitigate against peak oil are likely to be consistent with efforts to lower CO₂ emissions by Ireland consistent with our obligations under the Kyoto Treaty. However, a sudden and more imminent onset of peak oil may well require the suspension of the current Kyoto targets as advanced economies become more reliant, temporarily at least, on other carbon intensive fuels such as coal, gas and peat.

Technology Development

- The development and deployment of new energy technologies will be essential to delivering security of supply, sustainability and industrial competitiveness in the future. Energy-related research has already contributed to improved energy efficiency and to energy diversity through renewable energy sources. However the magnitude of the peak oil challenge requires increased efforts. The 7th EU Framework Programme recognises that there is no single solution to our energy problems, but deals with a wide portfolio of technologies: renewable energy technologies, making clean coal and carbon capture an industrial reality, developing economically viable biofuels for transport, new energy sources such as hydrogen, energy efficiency and advanced nuclear fission.
- The recent European Commission *Green Paper* called for an appropriately resourced strategic energy technology plan which would accelerate the development of promising energy technologies and help to create the conditions to bring such technologies efficiently and effectively to the EU and world markets. Ireland should be fully supportive of this proposal.
- For Ireland, an accelerated national R&D programme for energy would not only address the strategic concerns posed by oil peaking but would also develop new possibilities for enterprise growth. The strategic direction for energy research should focus on increasing the efficiency of energy use in order to reduce demand, on bringing forward promising renewable energy technologies and on making the national energy infrastructure more efficient.

Energy Policy Management

- The scale and complexity of the energy agenda might be considered to be such that it would be inappropriate to house all the responsibility for the agenda under one Irish ministerial department. However, the experience of transport policy has shown how a focused approach, bringing together previously diverse departments and functions, can provide the kind of holistic analysis and policy making that is more likely to succeed.

- The cabinet sub-committee on infrastructure should be used to provide the cross-departmental collaboration needed to oversee the early stages of adjustment to the challenge of peak oil.

Spatial Development

- Ireland's current spatial patterns, which encourages extensive car usage and long commutes, militates against the development of an efficient and effective public transport system. The proposed development of regional gateways and hubs (as part of the National Spatial Strategy) should play a key part in enabling urban communities to respond to the challenges of peak oil. Those communities that are adequately resourced in terms of public transport infrastructure will have greater choice in relation to how they respond.

Telecommunications

- One likely response to peak oil and its impact on business costs will be to encourage more people to work from home, placing considerable demand on both the fixed line and mobile telephone networks (for data as well as voice traffic). Ireland currently has a comparatively low level of broadband availability and take-up, and mobile data networks are still only being rolled out. Therefore, a key issue will be the access of workers to the higher bandwidth communications networks they will require in order to work from home or other non-office locations.

Conclusion

An assessment of the policy considerations outlined above highlights the importance of initialising the changes that will be required as soon as possible. The decisions made in the coming years, in response to the threat of peak oil and to other energy challenges, will have consequences decades into the future. While it is often difficult for policymakers and businesses to take a long-term view of the issues that they face, that is the requirement in regard to the peak oil challenge. Breaking Ireland's dependence on oil brings many opportunities for strengthened competitiveness, technological development and progress.