Security of Energy Supply in Ireland - A Key Driver for Renewable Energy

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Abstract

Recent oil and gas price rises coupled with Russia – Ukraine gas supply interruptions have again focussed attention on security of energy supply. Security of energy supply is not always a well-defined or understood term. It is a multi-faceted phenomenon and may be classified in terms of physical (quantity) risks and price (economic) risks. It may also be treated in different timeframes, with short-term risks typically having different characteristics and impacts than long-term risks. This paper investigates the issues associated with security of energy supply using Ireland a case study for the analysis. The focus is on the electricity rather than thermal or transport energy markets. This provides a direct linkage to renewable energy policy, which in Ireland has been concentrated principally on in creasing renewable energy penetration in the electricity market. This in turn results in the focus of this paper being on security of gas supply, as gas is account for 72% of Ireland's electricity generation fuel mix in 2020. The paper examines a number of concerns regarding the existing gas supply system and explores options to address these. These include the short term risks associated with the single point of failure on the Scottish Interconnector and low pressure gas supply in the Cork area. The long term issues are linked to the increasing geographical concentration from which imports are drawn coupled with delays in harnessing the gas from the Corrib Gas Field. While options do exist for improving the gas supply infrastructure, a key component of improving Ireland's security of energy supply is the increased penetration of renewable energy, in particular wind energy in the short term. The key advantages of renewable energy in this regard are related to the indigenous nature of renewable resources and that absence of fuel price volatility.

Introduction

Energy plays a vital role in our society and the economic impact of supply disruption can be severe and wide ranging [1]. Projections for the adequacy of energy resources to meet future global demand are not optimistic. The International Energy Agency (IEA) reports in its World Energy Outlook 2004 that while the world's energy resources are adequate to meet the demand to 2030, it expresses concerns regarding the period thereafter [2]. Others are less optimistic and project that based on 'peak oil' analysis, if the Earth's fossil fuel resources are not utilised more economically and efficiently, they will run out within a relatively short time [3].

The primary energy resources inside the OECD are no longer sufficient to meet its own needs, and are declining significantly as the demand within the OECD increases rapidly. So dependence on imports is growing rapidly [2]. That is why it is important for Government to develop future strategy in energy imports, to encourage development and research of alternative sources of energy and provision of new technologies.

This paper focuses on the issues facing one such OECD Government in order to shed light on some of the myriad of issues that security of energy supply encapsulates. The country chosen for this case study analysis is Ireland, which is interesting in a number of ways. Within the EU Ireland is second only to Luxemburg in terms of the level of energy import dependency, which was 87% in 2004 [4].

Security of energy supply is not always a well-defined or understood term and the difficulties of grappling with the issue are touched on in this paper. The focus in this paper is on security of supply associated with the electricity market. The paper does not deal with the electricity network infrastructure, which clearly has a significant role in ensuring supply security.

It rather explores the fuel mix for electricity generation and uses this as the launching point for analysis.
The rationale for this is to clearly link the topic to the theme for this conference, renewable energy. The focus of renewables policy in Ireland has been on the electricity market in order to achieve the EU Directive (2001/77/EC) for Ireland – 13.2% of gross electricity consumption from renewable sources by 2010. This is despite the potentials and opportunities that exist for renewable penetration into Ireland's other energy markets, namely thermal and transport. In 2004, the electricity and thermal energy markets each accounted for 34% of Ireland's primary supply while the transport market accounted for 32% [4].

There is recent evidence that this situation may be changing with the announcement within the 2006 Budget Speech [5] that new incentives are planned for both the transport market (excise relief to facilitate biofuels achieve 2% of transport energy market by 2008) and for the thermal market (grants for biomass heating systems in industrial, commercial and domestic buildings).

Focusing on the electricity generation fuel mix market leads to an analysis of gas dependency. While gas accounted for 27% of the generation fuel mix in 1990, this increased to 45% in 2004 and is projected to further increase to 71% in 2020, under a base case scenario [4].

The paper examines a number of issues associated with this level of dependency that include the risks associated with future sources of gas and with the gas supply infrastructure examining both short and long term risks and physical supply and economic risks.

The paper examines possible solutions to addressing these issues and finally discusses a number of key conclusions.

Aspects of Supply Security

Security of energy supply is a multi-faceted phenomenon It can be defined as the availability of energy at all times in various forms, in sufficient quantities, and at reasonable and/or affordable prices [6]. It can also be referred as to the likelihood that the energy will be supplied without disruption and that there is enough capacity to cover demand at all times. It can further be considered as encompassing fuel diversity and hedging against volatile fossil fuel costs on international markets. Disturbances of energy supply may occur in various ways, in specific contexts, in a certain time frame, in different places and with a great variety in consequences [7].

There are not always clear measures for the security of supply, though some research and analysis have already been done. In particular, there has been ongoing activity in the UK [8] to develop a set of security of supply metrics and a recent initial exercise in defining security of energy supply metrics for Ireland [9].

There are a number of distinct aspects to security of supply. Quantity (physical) risks may be discussed separately to price (economical) risks, for example. The discussion may also be split into two timeframes, i.e. short-term and long-term security of supply [10].

This paper focuses largely on short-term quantity risks but also explores in less depth price risk and longer term security of supply issues for Ireland.

Physical Risk

Physical risk is associated with system vulnerability to physical supply disruption, which can be temporary or permanent. Temporary disruption (short term) can result from a number of different conditions [11], including:

- inability of a producing country to export because of either internal (civil war or unrest) or external (transport accident, natural disaster) conditions;

- export restrictions by producing countries for political or strategic ends;

- embargo disruption;

- disruptions associated with faults or damage to the internal supply infrastructure within a country.

The Government's focus in the security of supply work in the short term covers working collectively to minimize the risks of a physical unplanned interruption in energy supplies [8].

Permanent disruption (long-term) can occur when an energy source is exhausted or production ceases, or in case of geopolitical problems. In this case in long-term new sources of fuel are required.

Price Risk

Price risk, or economic risk is linked to physical supply and arises from a general perception that supplies are or will be physically disrupted. If a physical disruption takes place, the price can increase significantly, and even the risk of such event makes the price more volatile. In case of supply disruption price increases and the energy supply becomes very shaky [12].

Thus price risk and physical risk are connected to each other as evidenced recently by the oil price increase to $71.85 per barrel due to a number of geopolitical and environmental issues affecting physical supply (including hurricane Katrina in Mexican gulf which forced oil production to be stopped).

In percentage terms, the effect of recent oil price changes on Gross Domestic Production (GDP) is relatively small, producing losses in the order of 0.5% of GDP for a 10% oil price increase, however oil prices have increased more than 100% over the past 2 years.

This oil-GDP effect influences the security of supply by means of price risk, in addition oil price increase creates wealth transfers from oil importing to exporting countries; reduces production output and wages and induces inflationary tendencies [13]. Thus, for the government it is important to track oil price, to predict changes, to prevent supply interruption and to provide adequate regulation at the oil market.

Within the EU, as indigenous fossil fuel energy resources become exhausted, the evolving policy is aimed at minimizing the risks and articulated in the EU Green Paper – *Towards a European Strategy for Security of Energy Supply* [14]. The policy includes energy mix diversity and geographical diversification of fuel origin, use of indigenous fuel, increased penetration of renewable and alternative sources of energy, strengthening contacts and relationships with producing countries, energy efficiency, technological innovation and development, public understanding and trust.

Security of Supply in Ireland

Ireland's energy supply is characterized by high fossil fuel dependency (98%) and high import dependency (87%) [4]. While each of the energy end use markets (electricity, thermal, transport) accounts for roughly an equal share in energy supply the fuel mix in each market is different. Oil dominates the transport energy market (99.7%), gas holds the largest share in the electricity fuel mix (45%) and the thermal energy market is split 60% oil and 26% gas, with solid fuels and renewables accounting for the remainder.

The focus of this paper is on the electricity market and hence gas supply, which is projected to increase its share in the fuel mix to 71% by 2020 in a base case scenario [4].

Physical Gas Supply Risk

Because of Ireland's projected dependence on gas for electricity generation in particular, short-term physical supply interruptions can have a significant impact on the economy, due to potential knock interruptions in electricity supply.

More than 80% of gas in Ireland is imported [15], there is physical risk of supply disruption, especially in the future with gas resources depleting in the UK and the need for new suppliers.

The integrity of the physical supply infrastructure (including Interconnector capacity and operation) holds the key to ensuring short term supply security. In the longer term, physical supply security is linked to the depleting European gas resources, consequent increase in distance from Ireland to gas sources and the end of pipe characteristics of Ireland's geographic location on the international gas pipeline.

Short Term Physical Gas Supply Risk

The risks associated with short term gas supply to Ireland are linked to two characteristics of the supply infrastructure, namely the single point of failure on the gas Interconnector onshore in Scotland and low pressure gas in the Cork area.

In order to increase short-term gas security, a second Interconnector (IC2) between Ireland and Scotland was built in 2002. This pipeline feeds natural gas from the UK's Transco pipeline at Beattock (Moffat) in Scotland to Gormanstown via Brighouse Bay. It complements the original Interconnector (IC1), which has been in operation since 1993 and connects Beattock with Loughshinny. If there is an interruption in supply in IC1, gas can still follow through IC2 and vice versa.

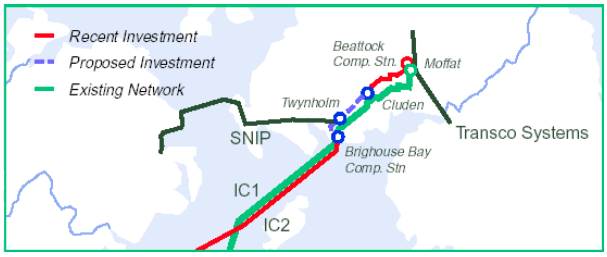

Figure 1 Possible solutions for Pipeline Cluden-Brighouse Bay [15].

Referring to figure 1, the onshore pipeline in Scotland was reinforced with the construction of IC2, through a twinning of the pipeline from Beattock to Cluden (30 km). The remaining 50 km pipeline between Cluden and Brighouse Bay remains as a single pipeline and hence a single point of failure on the system.

In addition, there is a further pipeline to Northern Ireland on this single pipe section, at Twinholm, the Scottish Northern Ireland Pipeline (SNIP). While plans are in place to build an Interconnector between Belfast and Gormanstown, this single pipeline between Cluden and Brighouse Bay remains a key concern [16].

In case of an incident or accident disrupting supply between Cluden and Twynholm, all gas from Moffat is lost completely for Ireland. If such an event occurs between Twynholm and Brighouse Bay, it will still be possible to transport a certain amount of gas to Northern Ireland by SNIP (approx. 8 mscmd), and subsequently to the Republic of Ireland[1].

In addition to risk issues associated with the single pipeline, a further concern relates to the pipeline capacity. Based on the Mass Balance, provided by CER [15] the capacity, available from Britain is projected to be sufficient to cover growing gas demand in Ireland. In the case of high demand and low indigenous supply however (Corrib delays), which could coincidence with a sudden supply interruption on a peak day[2] demand via Interconnectors are anticipated to increase over the capacities provided.

The other issue relating to short term supply security relates to the Cork area. The region is provided with gas mainly from the Kinsale gas field via the compression station in Midleton. Originally the Cork gas pipeline was designed for 70 bar pressure, but with the Kinsale gas reserve depletion, gas is supplied at the lower pressure of 30 bar. When gas from Kinsale field is insufficient for Cork area, gas is supplied from the Dublin region at a pressure of 70-80 bar. This would force the gas from Kinsale back to Inch terminal and as a result the gas from Dublin has its pressure stepped down at the Middleton compressor station.

In case of a pipeline leak or failure in Cork area, this low pressure will shorten the time frame for the problem to be addressed, which aspects.

Long Term Physical Gas Supply Risk

Long term physical gas supply risk in Ireland is linked to depletion of domestic gas resources, high level of gas import dependency and increase in distance from Ireland to gas sources.

The dependence on gas from Russia and Caspian Sea Countries in particular is set to increase. The main gas transmission routes from Russia to Europe are via Ukraine and Belarus. There has been recent evidence of tension between Russia and these countries concerning gas transit, which creates increased uncertainty and hence insecurity for the future. There is certain threat to the security of supply, in case if Ukraine or Belarus refuses to transit gas again. The option of raising the price of transit is also possible leading to a price risk.

[1] North-South pipeline due for completion in Q4 2006.

[2] The coldest day in a winter in 50 years with extreme conditions which leads to the increase of gas consumption. Such day is likely to happen once in 50 years.

The most pressing issue in this regard is the delay in harnessing the available domestic resource of gas from the Corrib gas field, which can provide a 15-year supply of indigenous gas supply and to significantly reduce import dependency.

A subsidiary of Shell, Enterprise Energy, plans to bring the gas ashore on the north Mayo coast and treat it in a €150 m terminal nine miles inland at Bellanaboy. There is a strong objection by local residents and environmental, farming and inshore fishing groups, who have mounted a Shell to Sea Campaign [17], who wish to see the terminal relocated from its planned on-shore location to 70 km miles at the site of the gas field itself.

Improving Supply Security

Based on an analysis of the key issues and within the limitations of the current discussion (electricity market and gas supply), the following recommendations are made with respect to improving security of energy supply in Ireland

Short Term Recommendations

1. Ensure all new electricity generators are complying with their licensing requirements to maintain a 5 day minimum supply of secondary fuel
2. Provide a twinning of the onshore Scotland pipeline Cluden – Brighouse Bay to remove this single point of failure. The construction of this pipeline would cost approximately €75-85 million [15].
3. Actively develop and implement a workable solution to the current impasse with respect to the development of the Corrib Gas Field
4. Consider the following improvement in capacity for the supply infrastructure at Beattock Compressor Station. Upgrade the Brighouse Bay Compressors Station and install of a compressor station in Twynholm on the SNIP to provide diversification in supply [16].
5. Raise the pressure in the Cork area up to 70bar. This requires an additional bypass pipe from the north side of Midleton compressor station going into Cork (apr. 2 km long). This pipeline would provide gas delivery to Cork from Dublin at high pressure, avoiding Midleton [16].
6. Develop a long-term strategy for secure energy supply and optimal energy mix, providing an appropriate balance between fossil fuel availability and (both physical and price) risks and renewables.
7. Encourage the development of a limited commercial storage facility as a part of gas trade via the interconnectors, which would provide additional gas capacity in case of emergency or unexpected short-term demand growth due to the weather conditions etc.

Long Term Recommendations

1. In the longer term it is important to fully explore and maximise geographical diversification in gas supply. One potentially promising option is through LNG (liquid natural gas) trade. This would provide give possibility to transfer gas from remote countries (Algeria, Nigeria, Malaysia, Trinidad and Tobago, United Arab Emirates and Qatar), without using pipelines, which are not economically viable. An LNG terminal in Ireland could be constructed near Kinsale Gas Field, connected to the gas platform, thus the existing gas pipeline from the gas field to Inch can be used. In this way, LNG could be used provide at least a quarter of national gas demand or be sufficient entirely for the Cork area [16]. LNG can also be used as seasonable gas storage at the LNG plant (liquefaction and storage during warm season and vaporisation and injection into local pipelines during cold period). This service can increase the volume of storage in Ireland, which is currently limited to what is contained within the pipelines and remaining reserves at the Kinsale Gas Field.
2. Consider future possible routes of gas importation to Ireland after the UK reserves deplete and provide secure gas transmission. Explore the possibility of secure routes for gas transmission from Eastern Europe. For example, Germany has already started the construction of a gas pipeline from St-Petersburg to

Germany under the Baltic Sea, avoiding borders. This is expected to provide more reliable supply form Russia to the West by 2010 [16].

3. Explore possible imports from Iran (another major gas supplier), whose gas can be transmitted via Turkey and Mediterranean pipeline. In the current climate however, it cannot be considered secure, due to current geopolitical activity in the Persian Gulf.

Link to Renewables

In the long term, with fossil fuel reserves depleting, the key component of improving Ireland's security of energy supply is to gradually diversify completely from gas. Given that oil is in shorter supply than gas and the environmental concerns associated with coal and nuclear energy (including safety in the case of the latter), this points clearly to the increased penetration of renewable energy, in particular wind energy in the short term.

By February 2006, Ireland's installed capacity from renewable energy reached 801 MW. In order to meet the 13.2% EU Directive target, Ireland requires approx. 1,433 MW by the end of 2009. Although a significant challenge, based on current build rates (178 MW in 2004, 163 MW in 2005), this is realistically achievable.

Looking out to 2020 and beyond, moving beyond this level of penetration (10% wind, the remaining 3.2% from hydro and biomass) will require the grid integration issues associated with wind energy in Ireland [18] to be properly tackled. This will require a concerted effort by the wind energy industry, the transmission system operators and the wind energy research community, facilitated by the Commission for Energy Regulation and Sustainable Energy Ireland.

Wind is the lowest-cost electricity source for the foreseeable future for Ireland. There is also significant potential biomass energy, in the first instance as co-firing within the existing peat fired power plants. Wave and tidal current energy also offer significant resource potential and require significant development and deployment effort, with potential export spin off benefits.

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