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Energy Security Analysis: The case of constrained oil supply for Ireland

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HIGHLIGHTS

- We investigate energy security within a techno-economic model of Ireland to 2050.
- We impose scenarios constraints of volume and price derived from IMF forecasting.
- Continued high oil prices lead to natural gas supplanting oil at 54% TFC by 2020.
- Declining oil production induces additional energy system costs of 7.9% GDP by 2020.
- High oil and gas prices are likely to strain existing Irish gas import infrastructure.

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ABSTRACT

Ireland imports 88% of its energy requirements. Oil makes up 59% of total final energy consumption (TFC). Import dependency, low fuel diversity and volatile prices leave Ireland vulnerable in terms of energy security. This work models energy security scenarios for Ireland using long term macroeconomic forecasts to 2050, with oil production and price scenarios from the International Monetary Fund, within the Irish TIMES energy systems model. The analysis focuses on developing a least cost optimum energy system for Ireland under scenarios of constrained oil supply (0.8% annual import growth, and −2% annual import decline) and subsequent sustained long term price shocks to oil and gas imports. The results point to gas becoming the dominant fuel source for Ireland, at 54% total final energy consumption in 2020, supplanting oil from reference projections of 57% to 10.8% TFC. In 2012, the cost of net oil imports stood at €3.6 billion (2.26% GDP). The modelled high oil and gas price scenarios show an additional annual cost in comparison to a reference of between €2.9bn and €7.5bn by 2020 (1.9–4.9% of GDP) to choose to develop a least cost energy system. Investment and ramifications for energy security are discussed.

1. Introduction

This paper investigates the optimum, least-cost, energy system for the Republic of Ireland under a range of security of supply scenarios using the Irish TIMES energy system model. Peer reviewed research using this model has to-date focused on the technically feasible, least-cost Irish energy system required to achieve renewable energy targets and green-house-gas mitigation targets from European Directive 2009/28/EC, Directive 2009/29/EC and Decision 2009/406/EC (Chiodi et al., 2013a; Deane et al., 2012; O'Gallachoir et al., 2010a, 2010b, 2012). In contrast, the focus of this work is upon maintaining energy services demand at least cost in the context of energy security scenarios. Irish TIMES is extracted from the Pan European TIMES Model (PET[36]). The TIMES model has also been used previously in European scale energy security scenario modelling for both the SECURE and REACCESS projects (Doukas et al., 2008; Lavagno, 2011). The scenarios considered here investigate the effects of constrained supply, long term price shocks to supply of crude oil, refined crude oil products, and indexed gas prices on the Irish energy system.

1.1. Irish context

Ireland currently imports 88% of total primary energy requirement (TPER) while the EU-27 average in 2011 stands at 54%. Oil accounts for 49% of TPER and 59% of Total Final Consumption (TFC) (see Fig. 1 (1)) (Howley et al., 2012). This high import dependency and lack of fuel diversity particularly in residential heating and transport leaves

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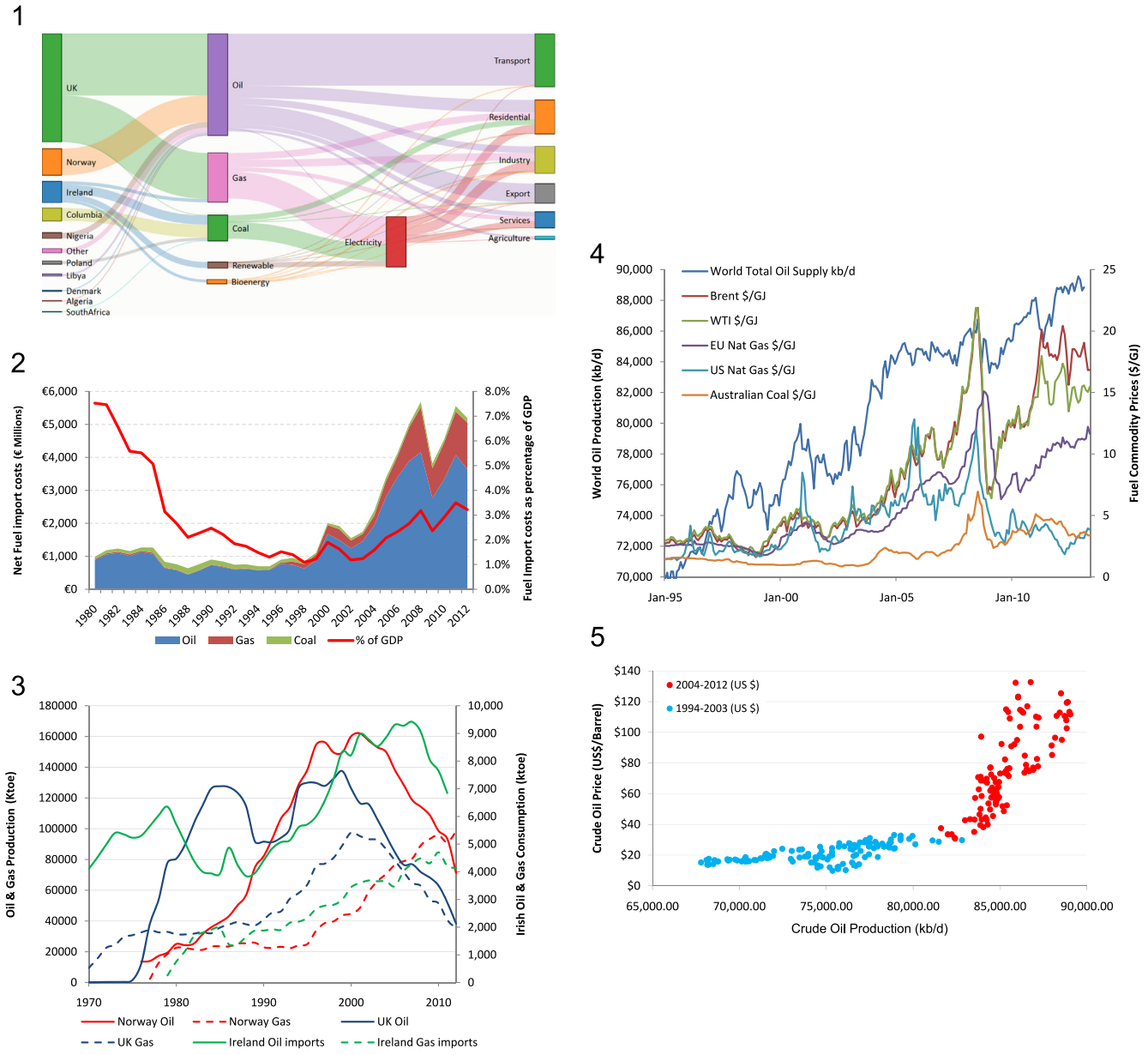

Fig. 1. (1) Ireland's present energy system energy flow 2011 (Data Source: SEAI). Primary energy flows from energy sources on the left to sectorial final consumption on the right. (2) Net cost of Irish energy imports. (Central Statistics Office – TSA06; Value of Merchandise Trade by Commodity Group, Year and Statistic http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?Maintable=TSA06&Planguage=0). (3) Irish oil & gas imports. (Data Source: US Energy Information Administration (EIA) – International Energy Statistics http://www.eia.gov.) from Norwegian and UK, total oil and gas production. (4) European and US commodity prices and world crude oil production. (Data Source: US Energy Information Administration – International Energy Statistics http://www.eia.gov). (Data Source: EUROSTAT http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/). (Data Source: International Energy Agency – Natural Gas Information Series). (Data Source: World Bank – Commodity Pink Sheets). (5) Monthly world oil production and price. (Data Source: EIA).

Ireland with increased vulnerability to oil price and supply volatility (Bazillian et al., 2006; Dennehy et al., 2011; Forfas, 2006; Gupta, 2008; Hirsch, 2006; IEA, 2007; O'Leary et al., 2007; Scheepers et al., 2007; Stewart et al., 2008). Ireland's total oil imports are declining on average by 6.6% per year since its peak in 2006 at 202 thousand barrels a day (kb/d). Irish TFC of oil products has declined since 2007 at a rate of −6.28% per year since its peak at 8592 thousand tonnes of oil equivalent (ktoe) (~168 kb/d). Even given declining imports, the nominal costs of net imports of oil rose to €4.07bn in 2011, representing 2.56% of GDP. The stabilisation of the European debt crisis and thus exchange rates in 2012 have seen Irish oil imports drop to €3.6bn, equivalent to 2.26% of GDP. Total fossil fuel imports have declined from €5.55bn (3.49% GDP) in 2011 to €5.19bn (3.22% GDP) in 2012 (see Fig. 1(2)). The United Kingdom is Ireland's primary supplier of refined oil product historically accounting for over 90% market share, with near 100% market share in 2012. Their crude oil production is declining at 7.6% per year since 1999. Primary UK crude oil suppliers for 2012 are Norway (47%), Nigeria (12.8%), Russia (12.6%) and North and West Africa (16%). Norway, Ireland's primary supplier of crude oil with 100% market share in 2000, supplied 22.6% of Irish crude oil imports in 2012 with the remaining 77% from non-OECD Algeria, Libya and Nigeria. Norwegian oil production is declining on average at 5.6% since its peak in 2001, and combined with operation and maintenance outages, 2012 oil production is down 23.7% on 2011 (see Fig. 1(3)). Declining oil production within European OECD countries, is increasingly forcing Ireland to source crude oil supplies and by proxy, refined product, from geopolitically less stable countries. This increases the probability of detrimental consequences for