The Electricity Journal 30 (2017) 47–54

Contents lists available at ScienceDirect

The Electricity Journal

journal homepage: www.elsevier.com/locate/tej

Unintended consequences of Northern Ireland's renewable obligation policy

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ARTICLE INFO

Keywords:
Electricity network
Power grid
Wind
Renewable energy
Delivery
Learning

ABSTRACT

Northern Ireland's Renewable Obligation Policy radically increased the amount of small and micro-scale renewable energy generation in the country, putting strain on the small and somewhat isolated grid. We review the impacts of the policy on the generation mix, and the resulting impacts on the power grid. We discuss a range of mitigation methods, and conclude with a recommendation that countries consider flexible policies to provide incentives for stability along with renewable energy.

1. Introduction

By 2020 Northern Ireland hopes to source 40% of its final electricity consumption from renewable resources (RaISe and L & RS, 2013). To help support these goals, in 2005 the country instituted the Northern Ireland Renewables Obligation (NIRO) policy, similar to the 2002 Renewable Obligation (RO) policy in Great Britain. Both of these schemes are a part of a UK-wide market for renewable obligation certificates (ROCs), which are the primary policy mechanism for increasing the level of renewable generation capacity in the UK. In Great Britain the RO policy led primarily to increases in the level of large-scale generation, as intended (Bassi et al., 2012; Hain, 2005). Northern Ireland hoped for a similar response to their policy: the Department of Enterprise, Trade and Investment (DETI), stated that the purpose of increasing the ROC support for solar "is to get 100 MW–200 MW of large-scale solar PV into Northern Ireland. That will contribute to our targets, enhance our security of supply and ease costs to the consumer" (DETI, 2014b).

The result of the ROC, however, was different: small- and micro-generation (SMG), with capacities between 11.05 kW and 5 MW, and below 11.05 kW respectively, increased by 365% between 2012 and 2014. This put significant pressure on the reliability and cost-effectiveness of the small and poorly interconnected Northern Ireland grid. While other countries have provided incentives for, and seen increases in, SMG, Northern Ireland is of particular interest since it has a relatively small grid with a high renewable energy target. While the entire UK RO program closed to new generation on March 31, 2017, there are lessons to be learned by looking at this case study.

In this article, we complement previous work discussing the RO policy in Great Britain (Mitchell and Connor, 2004; Mitchell et al., 2006) by providing a retrospective look at a broadened RO policy in Northern Ireland. Other papers have addressed the impacts of SMG as part of other challenges, such as distributed generation (DG) more generally (Barker and De Mello, 2000; Ochoa et al., 2006; Silva et al., 2016), including concerns with specific integration methods, such as the "fit and forget" technique (Strbac, 2007). We examine the impacts of the rapid increase in the level of uncontrolled SMG in Northern Ireland, which was deployed using "fit and forget."

The remainder of the article is organized as follows. Section 2 describes the NIRO policy. Section 3 discusses the impact of the NIRO on deployment of SMG. Section 4 reviews the impacts on the power system resulting from the significant increase in SMG. Section 5 discusses potential mitigation methods, followed by conclusions and policy implications in Section 6.

2. The Northern Ireland renewable obligation policy

The power systems in Northern Ireland and the Republic of Ireland make up the island's wholesale electricity market, the Single Electricity Market (SEM). The SEM is regulated by the SEM-Committee, made up of representatives from the two electricity regulators on the island, playing a role similar to the Federal Energy Regulatory Commission in the U.S. (RaISe and L & RS, 2013). While the island is connected in one Energy Market, the two countries have retained separate grids connected by four tie-lines and interconnectors. As of 2015, there were 840,000 electricity customers in Northern Ireland, supplied by three conventional power plants using coal, oil, and natural gas, totalling 1645 MW, and 694 MW of non-SMG renewable technologies (including wind, solar, hydro, biomass, and anaerobic digestion, with wind providing the bulk of the capacity). In comparison, the peak demand for

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http://dx.doi.org/10.1016/j.tej.2017.07.002

Available online 03 October 2017
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2015 was 1759 MW (EirGrid, 2016), while the proportion of energy supplied by renewables has doubled from 10% in 2010 to 20% in 2013. In comparison, England, which consumes more than 35 times as much electricity, sourced 4.8% and 12% of its electricity generation from renewables in 2010 and 2013 (DECC, 2014). This comparison illustrates the small size and large proportion of renewables on Northern Ireland's power system compared to England. With such a small grid, Northern Ireland is a test bed for what would happen if large scale renewable penetration was implemented in larger power systems.

The UK RO policy came into effect in England, Scotland and Wales in 2002. This policy took the place of the Non-Fossil Fuel Obligation (NFFO), which was designed to primarily support nuclear generation while providing incentives for renewable generation (Mitchell, 1995). The NFFO policy supported large-scale generators through contracts for generation from specific projects. The ROC policy had a goal of more renewable development, but originally the policy mainly supported large established technologies. When the policy was first introduced, each generator received 1 ROC for 1 MWh of renewable energy generated, treating all technologies equally. A key difference between the RO and the NFFO is that the RO places a legal requirement on licensed electricity suppliers in the UK to source a portion of the electricity they supply from renewable sources (Mitchell and Connor, 2004). This requires developers to negotiate prices for electricity generation with suppliers, leading to a more competitive market for renewable technologies. ROCs are issued by Ofgem, the United Kingdom's regulator for electricity markets, and certify that a certain amount of energy has been generated by a qualifying renewable energy generator (Hain et al., 2005). Once they are obtained the generators can then trade ROCs with energy suppliers, who can use them to meet the RO and avoid paying a penalty. The monetary value of ROCs is determined by the market and influenced by the total amount of renewable generation on the grid and the size of the penalty (Hain et al., 2005). The NIRO was introduced in 2005 (Ofgem, 2015).

In 2009 it was noted that the one-to-one ratio of the ROC policy had primarily encouraged investment in well-established technologies. Thus, Ofgem introduced a range of support levels, from 1 to 4 ROC per MWh, for the various technologies, as seen in Table 1.

3. Impact of NIRO on SMG development

After the differentiated support levels were introduced, Northern Ireland saw a 365% increase in SMG between 2012 and 2014. This increase came as a surprise. DETI's "high" growth projection identified 267 MW of SMG by the year 2020 (Mccullough, 2015). By the end of 2015, however, there was already 187 MW of SMG connected to the power system: this rate of growth would lead to the 2020 "high" growth projection being achieved by 2017.

Table 1
Number of ROCs per MWh for SMG Technologies.

Technology	Year				
	2002–2009	2010	2014/15	2015/16	2016/17
Onshore Wind < 250 kW	1	4	4	4	4
Onshore Wind 250kW–5 MW	1	1	1	1	1
Solar < 50 kW	1	4	4	3	2
Solar 50 kw–250 kW	1	2	2	2	2
Anaerobic Digestion < 500 kW	1	4	4	4	4
Anaerobic Digestion 500 kw–5 MW	1	3	3	3	3
Hydro < 20 kW	1	4	4	4	4
Hydro 20 kW–250 kW	1	3	3	3	3
Hydro 250 kW–1 MW	1	3	2	2	2
Hydro 1 MW–5 MW	1	3	1	1	1

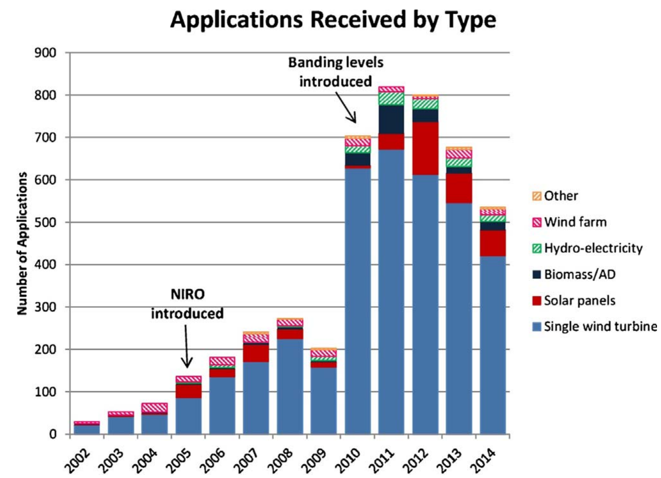

Fig. 1. Number of planning applications received by type of technology. Solid sections represent SMGs, while stripes represent non-SMG technologies. Data sourced from (NI Direct Website, 2015).

In order to get ROCs, most operators must have planning permission. Fig. 1 shows the number of applications for planning permission. It should be noted that some solar installations do not require planning permission, so the numbers shown underestimate the solar projects attempting to connect to the grid. The majority of solar panels and single wind turbines are SMG, while wind farms are large-scale generation.

The original NIRO policy, with a 1-to-1 ratio led to a small increase in applications. The introduction of the support levels described in Table 1 led to the significant jump in applications in 2010. Even with a high cost to connect to the grid, and a waiting period of nearly three years, the incentive to apply for a connection was large, because once approved, operators receive ROC payments for 20 years, in addition to the revenue generated from their energy production. The increase in applications was most significant for wind, followed by solar, then biomass.

The large jump in applications led to a rethinking of the policy. In 2012, the UK government announced it would reduce support for large-scale onshore wind under the RO to 0.9 ROCs between 2013 and 2017 (DECC, 2015). In June 2014 DETI proposed reducing the amount of ROCs for solar PV to 1.6 ROCs/MWh, citing a decrease in solar costs and the large increase in solar PV installations (DETI, 2014a). This proposal, intended to take effect in April 2015, was met with severe opposition from Northern Ireland's solar PV industry and over 330 responses in the consultation period. Thus DETI rescinded its proposed reduction in the solar ROCS, and stated that there would be no changes to ROC levels prior to October 2015 (Symington, 2015). Finally, in 2015, the Northern Ireland Enterprise Minister stated that the government would be ending the ROC policy a year earlier than originally planned.

Fig. 2 shows the increases in SMG cumulative installed capacity in the power grid over the 2012–2015 period, resulting from the increased applications. After planning applications are received there is typically a 2.6-year waiting period for generators to be connected to the power system (Mccullough, 2015). Between 2012 and 2015, microgeneration grew by 6400%, from 1 MW to 65 MW, and small scale generation grew by 388%, from 25 to 122 MW. Large-scale generation, on the other hand, increased by only 46% in the same time period.

In terms of specific renewable technologies, the number of accredited solar PV stations increased from 227, with an installed capacity of 1 MW in 2011, to 1138 stations with 5 MW in 2013, to 3750 stations with a combined installed capacity of over 20 MW in 2014. In 2010 there were approximately 395 onshore wind turbines with installed capacity of 40 MW, which jumped in 2014 to 523 turbines with a

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