Regulation, Innovation, and Technology for 21st Century Energy Goals

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ABSTRACT

Energy is a key concern for every country, as it is inextricably linked with economic growth and sustainable development. As the world transitions to 21st century approaches to energy, numerous challenges arise to the forefront. These challenges include the crucial need for clean and renewable energy and transitioning away from fossil fuels, energy efficiency, energy security, and affordable energy for all. Achieving these goals involves innovation, investment, smart policies, and technological advancement. This article examines how two countries—The Republic of Ireland and Estonia—are faring towards achieving the above objectives. Both countries have implemented relevant measures and policies, such as the deployment of smart meters and grids, demand response, and promoting electric vehicles. However, both still need to take steps to accelerate progress. Many of their schemes could serve as models for other countries seeking to effectively decarbonize.

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INTRODUCTION

This article enumerates the energy strategy, policy framework, and regulatory architecture underpinning Estonia and the Republic of Ireland's ("Ireland") smart grid transitions. It will analyse the progress that both countries have made against their strategic objectives in light of the WiseGRID[215] project's principal aim: to contribute to the energy sector new technologies and solutions for the improvement of the smartness, stability and security of the European energy grid. This article also evaluates Estonia and Ireland's responses to the challenges that have arisen during their transition processes in the hope of stimulating further discussion on this important topic.

While Section I will deal with Ireland, Section II will analyse the case of Estonia. Section III concludes the article.

I. IRELAND (THE REPUBLIC OF)

A. Overview

Ireland has set a series of targets for renewable energy. By 2020, Ireland wishes to derive 16% of its energy consumption from renewable energy sources. It also has a 10% target for transport. To achieve these overall targets, Ireland has set itself sub-targets for electricity (40%) and heat (12%). It has also set itself an ambitious energy savings target, attempting to reduce its final energy consumption by 20% compared to 2005. Finally, Ireland has committed to reduce its greenhouse gas emissions by 20% by 2020.

Ireland has made good progress towards its targets. However, despite this progress Ireland is falling short of its national sub-targets, and efforts must accelerate to meet these by 2020. As of 2016, renewable energy sources contributed 27.2% to gross electricity consumption; the 2020 target is 40%[216]. Ireland is also falling short of

[215] WiseGRID is a research project (number 731205) funded by the EU's Horizon 2020 research and innovation program. Professor Dr Rafael Leal-Arcas is one of the Principal Investigators. www.wisegrid.eu

[216] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 4.

its GHG emissions reduction target: it is forecasted to have reduced non-ETS GHG emissions by only 1% below 2005 levels by 2020, well short of its 20% target[217].

Ireland has managed to cut significantly its dependence on its traditional energy industry, peat. However, its primary source of energy remains fossil fuels, which accounted for 91.9% of all energy used in 2016[218]. Nevertheless, Ireland has made significant steps towards the improvement of its renewable electricity generation capabilities in recent years: indigenous renewable energy production increased by 176% between 2005 and 2015[219]. Moreover, Ireland is the country with the highest level of new installed wind capacity relative to its total power consumption within the EU.

Ireland's governance system and regulatory framework are closely interlinked, with a number of programmes and regulatory measures in place to support the uptake of renewable energy sources. Ireland's primary innovation projects for the transmission network are the Your Grid, Your Tomorrow project and the DS3 programme, both delivered by the transmission system operator ("TSO"), EirGrid.

Meanwhile, the distribution system operator ("DSO"), ESB Networks, is heavily involved in distribution-level innovation. One such project is the Dingle project, based on the Dingle Peninsula. The DSO is also involved in a number of research and innovation projects: of particular note is the RealValue project, which seeks to demonstrate the value of storage technologies, and the partnership with the EPRI on its Smart Grid Demonstration Initiative. Harnessing grid flexibility by way of DSR and storage technologies features prominently in Ireland's energy strategy, with strong support from the TSO.

With non-synchronous electricity generation sources expected to comprise an ever greater share of the energy fuel mix in the coming years, the need to incorporate these variable energy sources into the balancing and capacity markets will become increasingly pressing for Ireland. Electric vehicles also have a crucial role in Ireland's energy strategy, and are served by a robust regulatory regime comprising incentive schemes and other regulatory measures.

Of particular concern from a regulatory perspective at present is Ireland's dependency on the United Kingdom ("UK") for energy supplies. Ireland participates

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[217] Environmental Protection Agency, "Ireland's Greenhouse Gas Emissions Projections 2017-2035," EPA, Dublin, 2018, 10.

[218] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 12.

[219] ibid, 43.

with Northern Ireland, part of the UK, in the whole-of-island Integrated Single Electricity Market ("I-SEM"). But it is still unclear what the impact of Brexit will be on cross-border energy supplies. Ireland will need to ensure that contingency measures are in place to ensure the continuity of supplies post-Brexit; therefore it is crucial that Ireland continue to progress current interconnections projects with the European mainland. A key policy goal for Ireland will be meeting its interconnections target with the EU, of which it is currently falling short[220].

With regard to the digitalisation of the grid, Ireland has now commenced the roll-out of its smart metering programme. The programme will involve a phased roll-out of smart meters[221]. The first phase will involve the installation of 250,000 meters by 2020. Phase 2, between 2021 and 2022, will support the installation of an additional 1 million meters. A final 1 million meters will be rolled-out between 2023 and 2024 in Phase 3. Customers who request a smart meter will be prioritised during the initial deployment stage, as will those who are due a replacement for old meters. The programme is being delivered by the DSO, ESB Networks. It is hoped that new digital technologies such as smart meters will assist in the delivery of a more democratic, decentralised grid. However, the success of smart metering hinges on there being major changes in societal behaviour; therefore it is important that solutions to customer concerns about data protection and cyber security be made a central component of the roll-out.

B. Energy Profile

1. Energy Mix

a. Ireland's Targets

Decarbonisation is at the forefront of Ireland's energy strategy. As a Member of the EU, Ireland has committed to two binding targets for energy use, to be achieved in each case by 2020: these targets stipulate that renewable energy must be used to source (i) 16% of final energy use for all sectors and (ii) 10% of energy use in the

[220] European Commission, "Commission Staff Working Document: Energy Union Factsheet Ireland," European Commission, Brussels, 2017, 5-6.

[221] Commission for Regulation of Utilities, "CRU Announces Delivery Plan for Smart Meters in Ireland," 28 July 2017. [Online]. Available: https://www.cru.ie/2017/07/28/post-2/.

transport sector. So as to achieve the overall 16% target, Ireland has set itself national sub-targets for heat (12%) and electricity (40%). The pathways to achieving these targets are set out in Ireland's National Renewable Energy Action plan, published every two years as required under Article 4 of Directive 2009/28/EC. The NREAP keeps the Commission updated on a country's progress against its national targets; the most recent was published in December 2017[222].

With regard to energy efficiency, Ireland has committed to making energy savings of 20% of the historical average energy use during the period 2000-2005 by 2020 (amounting to 31,925 GWh). It is also striving to achieve a 33% reduction in public sector energy use (amounting to 3,240 GWh). Ireland keeps track of its progress against its energy savings targets in its National Energy Efficiency Action Plans. The most recent NEEAP was published in 2014[223].

Finally, a challenging target for non-ETS greenhouse gas (GHG) emissions reductions also exists. This calls for a 20% reduction on 2005 non-ETS emissions levels by 2020[224].

Note that Ireland's 2020 targets differ from those of the EU both in ambition (the EU's targets are all at 20%) and timescale (all targets are compared to baseline 1990 levels).

b. Ireland's Energy Mix

Ireland's energy industry was traditionally based on peat. However, due to the ecological importance of peat lands in storing carbon, and their rarity, the EU passed legislation[225] to protect these landscapes; Ireland has since come under pressure from the EU to ban peat extraction[226].

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[222] Irish Government, "National Renewable Energy Action Plan (NREAP): Ireland, Fourth Progress Report submitted under Article 22 of Directive 2009/28/EC," Irish Government, Dublin, 2017.

[223] Department of Communications, Energy and Natural Resources, "National Energy Efficiency Action Plan 2014," DCCAE, Dublin, 2014.

[224] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 39.

[225] The Habitats Directive (92/43/EEC) and The Environmental Impact Assessment Directive (85/337/EEC).

[226] European Commission, "European Commission: Press Release Database," 16 June 2011. [Online]. Available: http://europa.eu/rapid/press-release_IP-11-730_en.htm?locale=en.

Ireland's primary source of energy is fossil fuels, which accounted for 91.9% of all energy used in 2016[227]. Of the conventional fossil fuels oil is the most dominant, accounting for 48% of the total primary energy requirement (TPER) in 2016[228]. Natural gas is also an important source of energy, accounting for 29% of TPER in 2016[229]. Meanwhile, renewable energy sources accounted for a mere 8% TPER[230]. In 2016, consumption of all fuels increased (following the general pattern of previous years) with the exception of coal, peat, and non-renewable wastes; oil and natural gas experienced the largest increases[231].

Ireland has four production sites for natural gas: Kinsale Head, Ballycotton and Seven Heads gas fields off County Cork, and the Corrib gas field off County Mayo. There are yet to be any commercial discoveries of oil[232].

As Ireland does not have significant fossil fuel resources, and only harnessed renewable sources in significant quantities very recently, it has tended to rely heavily on imported energy. In 2015, imports of oil and gas accounted for 77% of TPER (compared with 50% in the early 1990s)[233]; Ireland's overall import dependency was 88%, at a cost of approximately €4.6 billion (which reflects the falling oil and gas import prices in the period 2014-15)[234]. However, in 2016 this fell drastically to 69%, and €3.4 billion[235]. This change can be attributed in part to increased indigenous production at the Corrib gas field, from 106 ktoe in 2015 to 2,473 ktoe in 2016. However, production at Corrib is expected to tail off in the next few years[236]. The improvement in import dependency witnessed in 2016 should not therefore be taken for granted, and Ireland must take continued steps towards the integration of renewable energy sources if it wishes to improve its energy security for future generations.

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[227] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 12.

[228] Ibid.

[229] Ibid.

[230] Ibid.

[231] Ibid 12-13.

[232] Department of Communications, Climate Action and Environment, "Oil and Gas (Exploration and Production)," [Online]. Available: https://www.dccae.gov.ie/en-ie/natural-resources/topics/Oil-Gas-Exploration-Production/Pages/home.aspx.

[233] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2015 (2016 Report)," Sustainable Energy Authority of Ireland, 2016, 42.

[234] Ibid.

[235] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 43.

[236] Gas Networks Ireland, "Network Development Plan 2016: Assessing Future Demand and Supply Position," Gas Networks Ireland, 2016.

Ireland has made significant steps towards the improvement of its renewable electricity generation capabilities in recent years: indigenous renewable energy production rose by 176% during the period between 2005 and 2015 to 1,030 ktoe, but thereafter fell to 1,028 ktoe in 2016[237]. According to the SEAI this decline, which has been attributed to reduced wind and hydro levels, was balanced out by an increase in biomass and geothermal generation[238]. In 2015 the share of renewable energy sources in the electricity generation fuel mix increased to 16.7%; its share in 2014 was 14.5%[239]. While the use of renewables in the electricity generation fuel mix fell to 15.6% in 2016[240], this decrease is probably attributable to the increased production at Corrib, and the reduced wind and hydro resources that year. Electricity generated from renewable energy sources was also down, to 25.6% in 2016 compared with 27.3% in 2015; nevertheless, once normalised for wind and hydro in accordance with Directive 2009/28/EC, the share of gross electricity generated from renewables in 2016 was 27.2%[241]. Wind generation (once normalised) accounted for 22.3% of the electricity generated. In 2016 wind was the second-largest source of electricity generation after natural gas[242].

Within the EU, Ireland is the country with the highest level of new installed wind capacity relative to its total power consumption. It has a newly-installed wind capacity of 426 MW and an average power consumption of 3 GW (ratio of 14%). By way of comparison, Germany and the United Kingdom have a ratio of 12%. With regard to penetration rates, Ireland has a penetration rate of 24% (compared with Denmark's 44%)[243].

c. Ireland's Progress Against Its Targets

With regard to its renewable energy targets, Ireland has made considerable progress. Based on Ireland's fourth NREAP, it surpassed the interim target set by

[237] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 43.

[238] Ibid.

[239] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2015 (2016 Report)," Sustainable Energy Authority of Ireland, 2016, 20.

[240] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 20.

[241] Ibid 20-21.

[242] Ibid 21.

[243] Wind Europe, "Wind in Power 2017: Annual Combined Onshore and Offshore Wind Energy Statistics," Wind Europe, 2018, 19, 21.

Directive 2009/28/EC for final energy consumption, reporting an average of 9.5% against a target of 8.92%[244]. The share of electricity generated from renewable energy is also reported to have increased fivefold between 1990 and 2016. However, despite this progress Ireland is falling short of its national sub-targets, and efforts must accelerate to meet these by 2020. As of 2016, renewable energy sources contributed 27.2% to gross electricity generation; the 2020 target is 40%[245]. Meanwhile, the renewable share of thermal energy was 6.8% in 2016; the 2020 target is 12%[246].

Ireland reports substantial savings on its energy usage, with 39% of the national target achieved at the end of 2012[247]. However, Ireland itself has noted that a significant acceleration is required in order to meet its 2020 targets.

Ireland is also falling short of its GHG emissions reduction target: it is forecasted to have reduced non-ETS GHG emissions by only 1% by 2020, well short of its 20% target[248].

Thus, Ireland's decarbonisation efforts are ongoing. However, these must be accelerated if Ireland to meet its 2020 targets. The fact it is so lagging behind its own national sub-targets gives rise to questions about the robustness of the implementation of Ireland's energy strategy. It is also pertinent to scrutinise its regulatory framework for gaps or weaknesses. The following Sections 2 and 3 will do precisely this.

2. Market and Market Players

a. (Integrated) Single Electricity Market

From 2007, the island of Ireland has operated as a single wholesale electricity market ("SEM"). The legal basis for the single market is found in the Electricity Regulation (Amendment) (Single Electricity Market) Act 2007.

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[244] Irish Government, "National Renewable Energy Action Plan (NREAP): Ireland, Fourth Progress Report submitted under Article 22 of Directive 2009/28/EC," Irish Government, Dublin, 2017, 2.

[245] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 20-21.

[246] Ibid 31-32.

[247] Department of Communications, Energy and Natural Resources, "National Energy Efficiency Action Plan 2014," DCCAE, Dublin, 2014, Introduction p. 1.

[248] Environmental Protection Agency, "Ireland's Greenhouse Gas Emissions Projections 2017-2035," EPA, Dublin, 2018, 10.

The goal of the SEM is "to provide for the least cost source of electricity generation to meet customer demand at any one time across the island, while also maximising long-term sustainability and reliability"[249]. The networks in Northern Ireland and Ireland are now connected with three interlinks, forming the SEM; the SEM is also connected through Northern Ireland to the UK mainland.

The SEM is regulated jointly by the Irish regulator, the Commission of Regulation of Utilities ("CRU"), and the Northern Irish Regulator, the Utility Regulator. The decision-making body responsible for the governance of the SEM is the SEM Committee, which is comprised of the CRU, Utility Regulator and an independent member. Meanwhile, the SEM is operated by the SEM Operator, or SEMO.

A redesign of the SEM is underway in response to the EU's push for a common target model for cross-border electricity trading pursuant to EU Regulation 2015/1222. The new market is referred to as the Integrated Single Electricity Market, or I-SEM. The I-SEM builds on the SEM, but with an added emphasis on competition, transparency, and consumer engagement. The I-SEM introduces new arrangements for, among other matters, the capacity remuneration mechanism. The I-SEM went live in October 2018.

b. Market Players

The state-owned ESB owns Ireland's transmission system, which is operated and developed by EirGrid plc, another state-owned entity. EirGrid has now been certified as an independent TSO by the European Commission pursuant to Article 9(9) of Directive 2009/72/EC, subject to ongoing monitoring by CRU of the implementation of the arrangements[250].

ESB also owns the distribution system, which is operated by its wholly-owned subsidiary ESB Networks as the DSO.

For completeness, EirGrid, the TSO, also owns the Northern Ireland TSO, SONI. The Northern Ireland transmission and distribution systems are owned by

[249] Department of Communication, Climate Action and Environment, "Single Electricity Market (SEM)," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/topics/Electricity/commission-for-energy-regulation-(cer)/Pages/Single-Electricity-Market-(SEM).aspx.

[250] European Commission, "Single Market Progress Report: Ireland," European Union, Luxembourg, 2014, 117.

Northern Ireland Electricity Networks, now a subsidiary of ESB. NIE Networks is also Northern Ireland's DSO.

The incumbent energy supplier in Ireland is Electric Ireland, which is the supply arm of the state-owned ESB. ESB rebranded as Electric Ireland in 2010 to promote competition in the emerging open retail market. The retail market has only been wholly open since 2004/2005; other suppliers have since gained a foothold, but ESB, via Electric Ireland, continues to dominate. Other dominant players include Energia, which is part of the Viridian Group, Board Gais Energy, which is owned by Centrica, and SSE Airtricity, owned by SSE plc. While the retail market is being progressively liberalised, the challenge for Ireland over the coming years will be to incorporate the new generation of domestic prosumers. Smart meters will have a crucial role in facilitating the transformation to a more decentralised, localised market.

Table 1 below outlines the different market players in the I-SEM. Northern Ireland is therefore included for completeness.

Table 1: Market players in the Integrated Single Electricity Market

	Republic of Ireland	**Northern Ireland**
Regulatory Authority	CRU	UREGNI
Generators	Fossil fuels, Renewable, Demand-Side units, Aggregators	
Transmission Asset Owner	ESB	NIE Networks
Transmission System Operator	EirGrid	SONI
Distribution Asset Owner	ESB	NIE Networks
Distribution System Operator	ESB Networks	NIE Networks
Market Operator	SEMO	SEMO

Suppliers	BEenergy, Bord Gais Energy, Electric Ireland, Energia, Go Power, Just Energy, Naturgy, Panda power, Pinergy, Prepay Power, SSE Airtricity, Vayu	Electric Ireland, SSE Airtricity, Click Energy, Budget Energy, Energia, Go Power/LLC Power, Power NI, Vayu, 3T Power
Consumers	Large users (Industry, Commercial) SMEs, Residential	

c. Customer Profile

The Irish electricity market is comprised of four different market segments covering different Distribution Use of System groups: the domestic market, small-sized business market, medium-sized business market and large energy user market[251]. By end 2017, the total market size was approximately 2.3 million[252]. Of this, 88.1% consisted of the domestic market; 7.9% of small businesses, 3.9% of medium businesses, and 0.1% of large users[253] (figures rounded to 1 decimal place).

With regard to usage trends, in 2016 industry energy use increased by 3%, while residential energy use increased by 4.8% on a weather-corrected basis relative to 2015; final energy use in the commercial and public services sector increased by 8.5% on a weather-corrected basis; transport continues to be the dominant sector for energy consumption[254]. Industry's share of the primary energy requirement was 24%; residential was 24%; transport 35%; and commercial and public services 14%[255]. Agriculture and fisheries accounted for the remainder.

3. Transmission System

[251] Commission for Regulation of Utilities, "2017 Electricity and Gas Retail Markets Annual Report (CRU18126)," CRU, Dublin, 2018.
[252] Ibid, 101.
[253] Ibid.
[254] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 18.
[255] Ibid 13-14.

Ireland's transmission system comprises mainly overhead lines operating at 400kV, 220kV and 110k, with around 6,500 km lines in total[256]. The transmission system is owned by ESB and operated by the TSO, EirGrid.

A single 275 kV double circuit interconnector cable connects Ireland with Northern Ireland between Louth (Ireland) and Tandragee (Northern Ireland) substations. Meanwhile, two lower-capacity 110 kV cables connect at Letterkenny in Co. Donegal and Corraclassy in Co. Cavan[257]. These interconnections facilitate the functioning of the SEM.

The Irish grid is also connected to the mainland UK through two interconnectors: through the Moyle Interconnector to Scotland, and through the East-West Interconnector to Wales[258]. However, and notwithstanding the current interconnection arrangements, Ireland has not yet reached its 10% interconnection target with the EU. In 2017, its level of interconnection was 7.4% of installed generation capacity[259]. Plans are in place to improve Ireland's interconnection arrangements in the coming years[260]. A second major interconnector is currently being planned between Ireland (Co. Cavan) and Northern Ireland (Co. Tyrone): this so-called North-South Interconnector would add another 400 kV of interconnection to existing arrangements, but remains in the planning stage. EirGrid is also exploring an interconnector between Ireland and France ("Celtic Interconnector"), and between Ireland and Wales ("Greenlink").

The development of Ireland's interconnectivity with mainland Europe will be particularly pressing following the UK's departure from the EU. The Institute of International and European Affairs ("IIEA") has identified that Ireland's poor interconnections with EU Member States may leave it vulnerable to energy crises in a post-Brexit environment[261]. After the UK leaves the EU in March 2019, any energy derived from the UK will be deemed to be derived from a 'third country'. But as a third country, the UK will no longer be obliged to comply with the EU's solidarity

[256] Commission for Energy Regulation, "Factsheet: Electricity Network and Charges," July 2010. [Online]. Available: https://www.cru.ie/wp-content/uploads/2010/07/cer10106.pdf.

[257] EirGrid Group, "Transmission System Map," September 2016. [Online]. Available: http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-Transmission-System-Geographic-Map-Sept-2016.pdf.

[258] Ibid.

[259] European Commission, "Commission Staff Working Document: Energy Union Factsheet Ireland," European Commission, Brussels, 2017, 5-6.

[260] EirGrid, "Projects," [Online]. Available: http://www.eirgridgroup.com/the-grid/projects/.

[261] Institute of International and European Affairs, "IIEA Policy Brief: What Does Brexit Mean for the Energy Sector in Ireland?," Institute of International and European Affairs, Dublin, 2016.

principle, and to compensate Ireland for supply disruptions. Moreover, the uncertainty surrounding the UK's departure may pose a hurdle to investment in ongoing interconnectivity projects. In short, Ireland's relatively isolated position on the fringes of the European energy market and the forthcoming British exit from the EU means that the need to consider new interconnectivity projects other than the current UK-Ireland projects is particularly urgent. Subsection 2 of Section D will consider the energy security dimension in further detail.

4. Distribution System

The distribution system allows for the flow of electricity from the transmission system to 2.3 million customers in Ireland. The wires on this low voltage network are typically operated at 38kV, 20kV and 10kV, although are operated at 110kV in and around Dublin[262]. There is about 165,000km of these low voltage lines across Ireland[263]. The distribution system is operated by the distribution system operator, ESB Networks.

In Ireland, a significant proportion of the population lives outside of cities and towns and the spread of this rural population in Ireland is reflected in the extent and the characteristics of the distribution system. Ireland has four times the European average of length of network per capita, with the ratio of overhead lines to underground cables over 6:1[264]. With so much overhead line exposed to weather and other events, maintaining a reliable supply of electricity to these rural areas poses a considerable challenge to the DSO. The integration of non-synchronous generation sources will put the distribution system under additional, and increasing, pressure: the onus is therefore on the DSO to maintain and upgrade the system in order to facilitate the smart grid transition.

[262] ESB Networks, "ESB Networks - Our Infrastructure," [Online]. Available: https://esbnetworks.ie/who-we-are/our-networks.

[263] Commission for Energy Regulation, "Factsheet: Electricity Network and Charges," July 2010. [Online]. Available: https://www.cru.ie/wp-content/uploads/2010/07/cer10106.pdf.

[264] ESB Networks, "ESB Networks 2027: Lighting the Way to a Better Energy Future," ESB Networks, Dublin, 2014, Introduction p. 1.

C. Governance System

1. Energy Strategy

Ireland's energy strategy is derived from the targets laid down by the relevant EU Directives and other international commitments.

Under Directive 2009/28/EC, Ireland set the following 2020 targets:

- 16% of final energy use (all sectors) must be sourced from renewable sources (sub-targets of 12% for heat; 40% for electricity); and
- 10% of energy use in the transport sector must be renewable.

Ireland also has a target to reduce its non-ETS greenhouse gas emissions by 20% compared to 2005 levels by 2020[265]. It has also committed to make energy savings of 20% of the historical average energy use during the period 2000-2005 by 2020, alongside a 33% reduction in public sector usage[266]. Targets also exist with respect to the 2030 climate and energy framework, and 2050 low-carbon economy.

As noted above, Ireland has consistently struggled to identify a pathway that will ensure its achievement of its targets. Its forecasted greenhouse gas emissions for 2035 have been described as 'disturbing' by its Climate Advisory Council; with emissions increasing at a rate of 2 million tonnes per annum, there is 'great concern' that the country will fail to achieve its 2020 and 2030 targets[267]. At the time of writing, Ireland is expected to have reduced its emissions by less than 1% come 2020[268]. Meanwhile, renewable energy sources contributed only 27.2% to gross electricity generation in 2016, compared to a 2020 target of 40%[269]. Accordingly, the question that dogs Ireland is whether its energy strategy is a workable one.

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[265] Environmental Protection Agency, "Ireland's Greenhouse Gas Emissions Projections 2017-2035," EPA, Dublin, 2018, 10.

[266] Department of Communications, Energy and Natural Resources, "National Energy Efficiency Action Plan 2014," DCCAE, Dublin, 2014.

[267] Climate Change Advisory Council, "Annual Review 2018," Climate Change Advisory Council, Dublin, 2018, Executive Summary (iii)-(iv).

[268] Environmental Protection Agency, "Ireland's Greenhouse Gas Emissions Projections 2017-2035," EPA, Dublin, 2018, 10.

[269] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 20-21.

In May 2012, the DCCAE (then the DCENR) published its Strategy for Renewable Energy: 2012-2020[270]. This paper served as an expression of Ireland's intention to develop renewable energies, and laid down the strategic goals seen as necessary to achieve this. The paper acknowledged *inter alia* the importance of smart grids to the future green economy: among the paper's strategic goals was the need to develop robust and efficient networks. To this end, the paper called for a multi-departmental and cross-collaborative approach towards the development of smarter electricity grids.

Ireland's National Policy Position on climate change was published in 2014[271]. The National Policy Position provides a high-level framework for the transition to a low-carbon economy by 2050. To this end, it anticipates that energy policy will be based on an aggregate reduction in CO2 emissions of at least 80% compared to 1990 levels. The paper also envisioned a sustainable approach to carbon neutrality in the agricultural and land-use sector which will not compromise the country's food security.

The Offshore Renewable Development Plan was also published in 2014[272]. The plan provides a pathway for the development of Ireland's offshore renewable energy resources.

The White Paper on Energy Policy, Ireland's Transition to a Low Carbon Energy Future 2015-2030 was then published in 2015. The White Paper sets out a framework to guide energy policy in the period to 2030[273]. It advanced an approach to the transition objective which focuses on the democratisation of Ireland's energy grid: an evolution from the current, centralised energy system model to a new model which engages individuals and communities, set within and facilitated by a stronger regulatory framework, more effective, competitive markets, robust infrastructure and improved cooperation between Ireland and its energy partners in the United Kingdom and EU. The "three energy pillars" of Ireland's energy policy are given as sustainability, security of supply, and competitiveness.

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[270] Department for Communications, Energy and Natural Resources, "Strategy for Renewable Energy: 2012-2020," DCENR, 2012.

[271] Department for Communications, Climate Action and Environment, "National Policy Position on Climate Action and Low Carbon Development," 1 January 2013. [Online]. Available: https://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/National-Policy-Position.aspx.

[272] Department of Communications, Energy and Natural Resources, "Offshore Renewable Energy Development Plan: A Framework for the Sustainable Development of Ireland's Offshore Renewable Energy Resource," DCCAE, Dublin, 2014.

[273] Department of Communications, Energy and Natural Resources, "Ireland's Transition to a Low Carbon Energy Future: 2015-2030," DCENR, 2016.

The Climate Action and Low Carbon Development Act 2015[274], which is the first piece of climate change legislation enacted by Ireland, provides the statutory basis for the abovementioned National Policy Position. It formally recognises the importance of Ireland's national transition objective. During the transition period, the Act envisages the submission by the Minister of a series of National Mitigation Plans and National Adjustment Frameworks. The first National Mitigation Plan (NMP) was submitted in July 2017[275]. The 2017 NMP afforded particular attention to the following sub-areas:

- the decarbonisation of electricity generation (with a focus on improvements to European interconnection, and existing infrastructure);
- the improvement of energy efficiency in the built environment (e.g. through smart metering, improved building regulations);
- the decarbonisation of transportation (low emission vehicles, investment in public transport); and
- the facilitation of carbon neutrality across the agricultural and forestry sectors ('smart farming' – improving farms' environmental performance, reducing carbon footprint, organic farming).

The pursuit of the national transition objective, as expressed within the National Policy Position, the White Paper, the 2015 Act and the various publications which have stemmed from these, is overseen by the Cabinet Committee on Infrastructure, which is chaired by the Taoiseach. Independent advice is provided by the Climate Change Advisory Council (CCAC), established under the Climate Action and Low Carbon Development Act 2015.

2. Integration of Governance and Energy Strategy

a. EirGrid (TSO)

Grid 25/Your Grid, Your Tomorrow/DS3 Programme

In response to Ireland's national transition objective and related targets, EirGrid is working to modernise the existing electricity infrastructure so as to

[274] "Climate Action and Low Carbon Development Act 2015 (No 46 of 2015)".

[275] Department of Communications, Climate Action and Environment, "National Mitigation Plan: July 2017," DCCAE, 2017.

contribute towards the delivery of a smarter, more cost-effective, and responsive electric grid.

EirGrid's plan to upgrade the transmission network by 2025 was coined 'Grid25'[276]. The project continues to be implemented, but has been built on by the publication of Ireland's 'Grid Development Strategy: Your Grid, Your Tomorrow', in 2017[277].

Among the major projects proposed by EirGrid to facilitate the integration of renewable energies and ensure the security of supply is the building of a North-South Interconnector between Northern Ireland and Ireland. A Celtic Interconnector between Ireland and France is also mooted. Other potential interconnection projects which would link into the strategy include The Irish-Scottish Links on Energy Study (ISLES) project, which envisages an offshore transmission network and subsea electricity grid in the Irish Sea-North Channel area and off the west coast of Scotland[278]. This project is administered by the DCCAE, alongside the Scottish Government and the Department of the Economy in Northern Ireland. Meanwhile, the North Seas Countries' Offshore Grid Initiative (now integrated into the Political Declaration on Energy Cooperation between the North Seas Countries) involves nine EU countries and Norway[279].

The DS3 (Delivering a Secure, Sustainable Electricity System) programme is addressing the operational challenges entailed by the integration of very high levels of renewable energy to the grid[280]. Non-synchronous (variable) generation is less reliable than the traditional, synchronous generation produced by fossil fuels. Thus, DS3 is focused on how to meet Ireland's 2020 targets in a secure and sustainable manner, while minimising curtailment in accordance with Directive 2009/28/EC.

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[276] EirGrid, "Grid25: A Strategy for the Development of Ireland's Electricity Grid for a Sustainable and Competitive Future," EirGrid, Dublin, 2011.

[277] EirGrid, "Ireland's Grid Development Strategy: Your Grid, Your Tomorrow," EirGrid, Dublin, 2017.

[278] Irish Scottish Links on Energy Study (ISLES), "ISLES," [Online]. Available: http://www.islesproject.eu/.

[279] European MSP Platform, "Political Declaration on Energy Cooperation Between the North Seas Countries," [Online]. Available: https://www.msp-platform.eu/practices/political-declaration-energy-cooperation-between-north-seas-countries.

[280] EirGrid Group, "DS3 Programme," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/.

Smart Wires Collaboration

EirGrid is collaborating with Smart Wires, a US-based technology company[281]. EirGrid has trialled Smart Wire's Powerline Guardian device, which could assist with the control of power flows in real-time. EirGrid is now conducting a pilot project with the company's SmartValve device from Smart Wires that builds on the Powerline Guardian technology.

Storage Projects

EirGrid is also participating in two innovative storage projects in County Offaly and County Kerry[282]. These are covered in further detail in Subsection 2 of Section H.

Power Off and Save

Power Off and Save is a pilot programme that rewards customers who agree to reduce their energy usage when electricity demand is high[283]. EirGrid has developed the Power Off and Save programme in partnership with Electric Ireland. The Power Off and Save programme will be discussed in further detail in Section F.

b. ESB Networks (DSO)

Innovation Strategy

In 2017, ESB Networks launched its Innovation Strategy. The strategy sets out how ESB Networks intends to meet the challenges of the changing energy landscape[284].

FINESCE/FIWARE FP7 Research Project

ESB Networks participated in the FINESCE smart energy case use project[285] (part of the EU's FP7 research and innovation funding programme for 2007-2013), which centred on the development of an open IT-infrastructure for the development of

[281] EirGrid, "Key Innovation Projects," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/innovation/enhanced-user-facilitatio/.

[282] Ibid.

[283] Ibid.

[284] ESB Networks, "ESB Networks Launch their Innovation Strategy," 28 September 2017. [Online]. Available: https://www.esb.ie/tns/press-centre/2017/2017/09/28/esb-networks-launch-their-innovation-strategy.

[285] ESB Networks, "ESB Networks' Projects," [Online]. Available: https://www.esbnetworks.ie/who-we-are/innovation/projects.

app-based solutions in the smart utility services field. From this project emerged the FIWARE open source cloud platform.

EvolvDSO

EvolvDSO[286] was an EU-funded project which aimed to define the future DSO function based on scenarios driven by different distributed renewable energy sources, penetration levels, degrees of technological progress and customer acceptance patterns. The project concluded in December 2016.

Plan Grid EV

PlanGridEV[287] was another EU-funded project which completed in February 2016. This project aimed at developing the tools and methods required for Distribution DSOs to increase their hosting capacity for the deployment and integration of electric vehicles to the grid.

RealValue

RealValue[288] is an ongoing EU-funded energy storage project. As part of the project, ESB Networks is installing advanced Smart Electric Thermal Storage Systems (SETS) into homes across Ireland. This technology will aid the promotion of the demand-side management agenda, by demonstrating how local, small-scale storage could bring benefits to the market as a whole, in particular with regard to energy balancing, grid security and supply, and the decarbonisation and integration of renewable energy systems. The project will conclude in 2018.

Winter Peak

As load profiles in the low voltage network could undergo significant change as new technologies become available, ESB Networks is focusing on the development of new policy frameworks to ensure the successful integration of these technologies into the network. The Winter Peak project[289] is undertaken in partnership with Intel, Siemens and Trinity College Dublin.

EPRI International Smart Grid Demonstration Initiative

ESB Networks is also collaborating with the US-based Electricity Power Research Institute (EPRI) to develop solutions to facilitate and manage the increased renewable penetration on the Irish electricity grid[290].

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[286] Ibid.
[287] Ibid.
[288] Ibid.
[289] Ibid.
[290] Ibid.

Dingle Project

ESB Networks has launched a major project in Dingle, which will see a range of technologies deployed to help build a secure, reliable electricity network for those on the peninsula[291]. The peninsula will therefore serve as a pilot to assess how new and evolving technologies will help to future-proof the future electricity network.

Smart Energy Services

Through its energy management subsidiary, Smart Energy Services, ESB Networks provides consultancy, capital funding and energy management services to help commercial consumers reduce energy use, costs and carbon emissions[292]. Since 2016, Smart Energy Services has helped 200 Irish and UK companies to deliver €55 million in energy savings[293].

c. DCCAE

Pilot Microgeneration Scheme

DCCAE has announced that it will make available to domestic customers grant supports for those who install PV systems as part of its pilot microgeneration scheme[294]. Additional grants will be available for customers who install battery storage systems alongside solar PV panels.

The scheme will be administered by the SEAI.

Funding for Energy Research Projects

In September 2018, DCCAE announced the allocation of €8 million in Government funding for 45 innovative and varied Energy Research Projects across Ireland[295]. The funds shall be administered by SEAI.

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[291] ESB Networks, "ESB Networks' Dingle Project," [Online]. Available: https://www.esbnetworks.ie/who-we-are/innovation/ireland's-energy-future.

[292] ESB, "Smart Energy Services," [Online]. Available: https://www.esb.ie/our-businesses/smart-energy-services/smart-energy-services-overview.

[293] The Irish Examiner, "ESB to Deliver €150 Million in Savings to Large Businesses," 5 February 2018. [Online]. Available: https://www.irishexaminer.com/breakingnews/business/esb-to-deliver-150-million-in-savings-to-large-businesses-826436.html.

[294] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Launches Pilot Micro Generation Scheme Targeting Domestic Customers and Self-Consumption and Announces Increase to Grant Supports for Home Insulation," 31 July 2018. [Online]. Available: https://www.dccae.gov.ie/en-ie/news-and-media/press-releases/Pages/Minister-Denis-Naughten-launches-pilot-Micro-Generation-scheme-targeting-domestic-customers-and-self-consumption--and-annou.aspx.

[295] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Announces €8 Million for Innovative Energy Research Projects," 10 September 2018. [Online].

d. SEAI

Administration of Government Funding Schemes

SEAI is responsible for administering government funding for energy research projects to companies and research institutions throughout Ireland, including the energy research projects and microgeneration pilot programme referred to in Subsection c in Section 2 above.

SEAI and IEA

SEAI is the contracting party for a number of International Energy Agency (IEA) Technology Collaboration Programmes (TCPs)[296]. Among these TCPs is the International Smart Grid Action Network, or ISGAN. ISGAN creates a strategic platform to support high-level government action on the development and deployment of smart grids.

Tools and Calculators

SEAI has published a number of tools and calculators which may be used by the general public to calculate energy efficiency and potential cost savings[297].

Electric Vehicle Information Hub

SEAI has created a publicly-available information hub regarding electric vehicles[298].

Smart Grid Road Map

SEAI has produced a road map which explores the contributions a smart grid could make with respect to achieving Ireland's national transition objective, and also the operational measures to be taken to ensure its effective deployment[299].

Available: https://www.dccae.gov.ie/en-ie/news-and-media/press-releases/Pages/Minister-Denis-Naughten-announces-%E2%82%AC8-million-for-innovative-Energy-Research-Projects.aspx.

[296] Sustainable Energy Authority of Ireland, "International Energy Agency," [Online]. Available: https://www.seai.ie/sustainable-solutions/research-development-demonstration-and-innovation/international-energy-agency/.

[297] Sustainable Energy Authority of Ireland, "Tools," [Online]. Available: https://www.seai.ie/resources/tools/.

[298] Sustainable Energy Authority of Ireland, "Electric Vehicles," [Online]. Available: https://www.seai.ie/sustainable-solutions/electric-vehicles/.

[299] Sustainable Energy Authority of Ireland, "Smartgrid Roadmap," [Online]. Available: https://www.seai.ie/resources/publications/Smartgrid-Roadmap.pdf.

3. Reflections on the Governance System

Ireland's governance system is distinctly centralised. This attribute has possibly aided Ireland with the formulation of a clear energy strategy for the years ahead. The energy strategy has then been implemented consistently across the governance chain, as has been made evident in this Section 3.

Notwithstanding the foregoing, Section 2 highlighted Ireland's struggle to meet its ambitious targets. In light therefore of Ireland's ostensibly effective governance system, it should be asked whether the current targets are simply too ambitious for Ireland to achieve. Over-ambition is itself detrimental to the climate change agenda, insofar as it threatens to foster more widespread disillusion with the transition as a whole. Meanwhile, a more temperate, modest agenda - one which poses sensible, attainable targets - would tend to bolster public confidence in the national transition authorities, and minimise mounting scepticism towards the wider EU climate change agenda.

D. Regulatory Framework and the Energy Security Dimension

1. Regulatory Framework

The electricity market in Ireland is highly regulated. Ireland's regulatory framework for the electricity market is comprised of a series of legislative instruments, ranging from Statutory Instruments, to Acts, to communications from the CRU. Together, these regulations and laws transpose EU Directives and international treaty obligations (such as those derived from the Paris Agreement) into Irish Law.

a. Legislation Pertaining to the Electricity Market

The Electricity Regulation Act 1999: the principal legislative instrument governing the electricity industry, it established the regulatory framework for the competitive generation and supply of electricity throughout Ireland, together with the regulatory authority, the CRU. The 1999 Act has been amended multiple times.

The Electricity Regulation (Amendment) (Single Electricity Market) Act 2007: the 2007 Act amended the Electricity Regulation Act 1999. The 2007 Act provided for the establishment and operation of a single competitive wholesale

electricity market (the Single Electricity Market, or SEM) on the island of Ireland and its islands, and to provide for related matters.

Each jurisdiction's utility regulator retained exclusive competence to regulate in its particular jurisdiction. The regulators are required to discharge their SEM-related functions through the SEM Committee.

Note that the SEM has undergone a significant change in 2018: EU legislation has driven the coming together of energy markets across Europe with the aim of creating a fully liberalised internal electricity market. In response, the SEM has been redesigned. From October 2018, the reformed 'Integrated Single Electricity Market', or I-SEM has been in force. The I-SEM builds on the SEM, but with greater emphasis on maximising competition, delivering security of supply and improving transparency.

The Energy Act 2016 (No. 12 of 2016): provides for various amendments to the Electricity Regulation Act 1999, the Gas Act 1976, the National Oil Reserves Agency Act 2007, the Sustainable Energy Act 2002 and the Registration of Title Act 1964 in order to, among other matters, facilitate the I-SEM project and re-name the utility regulator (formerly the Commission for Energy Regulation, henceforth the Commission for Regulation of Utilities, or CRU).

Climate Change and Low Carbon Development Act 2015: the 2015 Act provides for new arrangements aimed at the transition to a low carbon economy. It builds on the National Climate Change Adaption Framework and includes provision for the establishment of a Climate Change Advisory Council, as well as the publication of National Mitigation and Adaption Plans.

b. Regulatory Framework and the Smart Grid

Integration of Renewable Energy Sources

In Ireland, the generation and supply of electricity to a final customer are licensable activities: licences are granted at the CRU's discretion under Section 14(1) of the 1999 Act. The cost of generation licences varies considerably, from €35 for a

station with installed capacity of 1MW to <5MW, to €3,980 for 500 MW or greater[300]. The application fee for a supply licence is €254[301].

One of the primary drivers of the smart grid transition is the integration of non-synchronous energy sources into the electricity grid. The connection of renewables to the grid is regulated in Ireland by the 1999 Act, alongside statutory instruments S.I. No. 445/2000 (EC Internal Market in Electricity Regulations) and S.I. No. 147/2011 (EC Renewable Energy Regulations), as well as by directions of the CRU and SEM Committee.

A 'gate' system, operated by EirGrid, for the connection of larger renewable and conventional generators was in place until 2009. A non-gate process was established in 2009 to enable smaller renewable and low carbon generators as well as experimental technologies to connect to the system outside of the 'gate' process. The CRU subsequently published its Decision on Enduring Connection Policy Stage 1 (ECP-1) on 27 March 2018[302]. ECP-1 is the new process for grid connection, open to all generating and/or storage technologies. The ECP-1 applications window opened on 27 April 2018 and closed on 28 May 2018. EirGrid is no longer accepting applications for the 2018 batch of ECP-1. There will presumably be further batches in following years.

Of all the renewable energy sources, wind energy plays the most prominent role in the Irish energy supply mix. The Planning and Development Act 2000 (as amended by the Strategic Infrastructure Act 2006 and the Planning and Development (Amendment) Act 2010) allows for an enhanced approval procedure for planning applications for wind turbine developments consisting of more than 25 turbines or with an output of greater than 50MW, subject to conditions. The enhanced approval procedure applies where the project is determined by the Planning Appeals Board to be of strategic, economic or social importance; provides a substantial contribution to the fulfilment of the National Spatial Strategy or regional planning guidelines; or would have a significant effect on multiple planning authority areas. In 2006 the Wind Energy Development Guidelines were published: these laid down the national policy context to be applied by planning authorities when considering planning applications

[300] Commission for Regulation of Utilities, "Authorisation to Construct and Licence to Generate," [Online]. Available: https://www.cru.ie/professional/licensing/atc-gl-licensing-2/.

[301] Commission for Regulation of Utilities, "Electricity Supply Licence," [Online]. Available: https://www.cru.ie/professional/licensing/electricity-supply-license-2/.

[302] Commission for Regulation of Utilities, "Enduring Connection Policy Stage 1 (ECP-1): Decision (CRU/18/058)," CRU, Dublin, 2018.

for wind farms. On 13 June 2017, a preferred draft approach to address the key aspects of the review of the 2006 Wind Energy Development Guidelines was announced[303].

Feed-In Tariff Schemes

In Ireland, electricity from renewable sources was mainly promoted through a renewable energy feed-in-tariff scheme (RE-FIT) that operated as a floor price; however, the closing date for applications for these support schemes has now passed[304].

The proposed new Renewable Energy Support Scheme[305] should help to plug some of the gap left by the demise of the old tariff regime. RESS auctions will be held on a regular basis; projects seeking support will need to satisfy pre-qualification criteria, with community investment underpinning the new system. Crucially, the RESS will be underpinned by the principle of "technological neutrality" which should aid the creation of a level playing field for less established technologies, such as solar PV.

Alongside the RESS, the Government has announced the microgeneration solar PV pilot scheme, which is available to homeowners of dwellings built and occupied before 2011, provided eligibility criteria are met[306]. The one-off grant payment should encourage the instalment of solar PVs on eligible dwellings. However, it is not available for commercial enterprises or community buildings. It will also not be available to farmers with large warehouses or shed rooftop space. These will instead have to participate in the RESS auctions. That an appropriate pilot scheme for such installations has not been created is perhaps a missed opportunity. Nevertheless, the RESS and microgeneration grants are a step in the right direction.

Public Bodies

Ireland's regulatory framework is also comprised of measures directed towards public bodies. More specifically, Ireland runs certification programmes that require public bodies to procure equipment and vehicles that satisfy certain energy efficiency criteria, or which are listed on the Triple E Products Register maintained by the SEAI.

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[303] Department of Housing, Planning and Local Government, "Minister Coveney and Minister Naughten Announce Key Development in the Review of the Wind Energy Development Guidelines," 13 June 2017. [Online]. Available: https://www.housing.gov.ie/planning/guidelines/wind-energy/coveney-and-naughten-announce-key-development-review-wind-energy-development-guidelines.

[304] ResLegal, "Feed-in tariff (Renewable Energy Feed-in Tariff - REFIT)," [Online]. Available: http://www.res-legal.eu/search-by-country/ireland/single/s/res-e/t/promotion/aid/feed-in-tariff-renewable-energy-feed-in-tariff-refit/lastp/147/.

[305] Department of Communications, Climate Action and Environment, "Renewable Electricity Support Scheme (RESS)," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/ress/Pages/default.aspx.

[306] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Launches Pilot Micro Generation Scheme Targeting Domestic Customers and Self-Consumption and Announces Increase to Grant Supports for Home Insulation," 31 July 2018.

These measures find legal expression in S.I. No. 542/2009 (as amended by S.I. 151/2011), and S.I. No. 426/2014.

Heating and Cooling Schemes

There are a number of regulatory measures relevant to buildings in Ireland. New buildings are required to comply with the renewable energy requirements of Part L of the Building Regulations (specifically S.I. No. 259/2008 and S.I. No. 259/2011). Meanwhile, a range of energy efficiency grants are made available to homeowners via the SEAI; this scheme has been coined the Better Energy Homes Scheme, and aims at those homeowners seeking to upgrade their home through, among other things, improved insulation and/or the installation of heating pump systems and heating controls[307].

In July 2018 the DCCAE introduced a pilot micro-generation scheme, with the offer of grant supports for domestic customers who install solar photovoltaic systems in their homes[308]. The scheme, while funded by the DCCAE, will be administered by SEAI. The grant is available for homes built and occupied prior to 2011.

Companies may also take advantage of the Accelerated Capital Allowance scheme, whereby companies, on the purchase of qualifying energy efficient equipment, may depreciate 100% of the purchase value of qualifying equipment against their profits in the year of purchase[309]. This latter scheme is subject to the provisions of the relevant statutory instruments, including the TCA 1997 (Taxes Consolidation Act 1997 (TCA) and its amending acts) and S.I. No. 446/2016 (Taxes Consolidation Act 1997 (Allowances for Energy Efficient Equipment)(Amendment) (NO. 2) Order 2016).

Transportation Schemes

Transport is a major source of greenhouse gas emissions. With a view to reducing emissions, Ireland has introduced the Biofuels Obligation Scheme: this scheme obliges fuel suppliers to include a certain percentage (currently 8% by volume) of biofuels in their annual fuel sales[310]. The scheme is administrated by NORA and is

[307] Sustainable Energy Authority of Ireland, "Home Energy Grants," [Online]. Available: https://www.seai.ie/grants/home-energy-grants/.

[308] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Launches Pilot Micro Generation Scheme Targeting Domestic Customers and Self-Consumption and Announces Increase to Grant Supports for Home Insulation," 31 July 2018.

[309] Sustainable Energy Authority of Ireland, "Accelerated Capital Allowance," [Online]. Available: https://www.seai.ie/energy-in-business/accelerated-capital-allowance/.

[310] Department of Communications, Climate Action and Environment, "Increase to Biofuel Obligation Rate Consultation," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Biofuel-Obligation-Scheme-Consultation.aspx.

subject to the provisions of both the Energy (Biofuel Obligation and Miscellaneous Provisions) Act 2010 and the NORA Act 2007 (Biofuel Obligation Rate) Order 2016. S.I. No. 483/2014, regarding the EU (Renewable Energy) Regulations 2014, is also pertinent.

Since 2011, SEAI has been administering grants to incentivise the purchase of electric vehicles. Grants of up to €5,000 are available[311]. Up to €600 is also available for electric car owners to help cover the purchase and installation of home charger systems[312]. A grant of up to €7,000 or €3,500 was made available towards the purchase of a BEV or PHEV respectively for vehicles in the taxi sector through the Electric Small Public Service Vehicle grant scheme. However, the scheme closed end 2018.

In addition to the current grant scheme, a number of generous taxation incentives are available. Users of electric vehicles may claim motor tax and vehicle registration tax reliefs; these are discussed further in Subsection 1 of Section H. The ACA tax incentive scheme, referred to above, also supports the purchase of electric and hybrid vehicles, and the associated charging equipment by companies. A carbon tax, whereby a tax is levied on the carbon content of fuels, was introduced in the 2010 Budget. The current rate is €20 per tonne of CO2 emitted by the fuel concerned and applies to both petrol and diesel[313]. Finally, the adoption of natural gas as a transport fuel is being encouraged with the excise rate applied set at a reduced rate to incentivise the uptake of natural gas as a transport fuel, and to provide a pathway for the use of biogas in transport[314].

Lastly, since July 2018 there is has been a reduced tolling scheme for electric vehicles, with refunds capped at €500 for private vehicles (€1,000 for goods/commercial vehicles)[315].

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[311] Sustainable Energy Authority of Ireland, "Electric Vehicle Grant Values," [Online]. Available: https://www.seai.ie/grants/electric-vehicle-grants/grant-amounts/.

[312] Sustainable Energy Authority of Ireland, "Electric Vehicle Home Charger Grant," [Online]. Available: https://www.seai.ie/grants/electric-vehicle-grants/electric-vehicle-home-charger-grant/.

[313] Citizens Information, "Carbon Tax," 21 March 2017. [Online]. Available: http://www.citizensinformation.ie/en/money_and_tax/tax/motor_carbon_other_taxes/carbon_tax.html.

[314] Revenue: Irish Tax and Customs, "Excise Duty Rates," [Online]. Available: https://www.revenue.ie/en/companies-and-charities/excise-and-licences/excise-duty-rates/electricity-and-other-energy-products.aspx.

[315] eToll, "What is the Electric Vehicle Toll Incentive (EVTI)?," [Online]. Available: http://www.etoll.ie/electric-vehicle-toll-inc/.

c. Reflections on the Regulatory Framework

A robust regulatory framework of requirements, codes of practice and regulatory guidance, supported by legislation and other statutory instruments, will be necessary to ensure the enforcement of Ireland's smart grid policy. Subsection 1.b of Section D makes clear that a comprehensive framework is already in place, in particular for the integration of renewable energy sources and energy efficiency measures. Yet a number of gaps can be readily ascertained.

As matters currently stand, Ireland relies heavily on imported energy, in particular on supplies of gas (although 2016 provided a brief respite). Subsection 2 of Section D will consider the implications of this in further detail. But in terms of the regulatory framework specifically, while Ireland has adopted a wealth of legislation pertaining to energy efficiency, renewables, electricity, gas and oil, it is yet to enact legislation which relates specifically to the security of supply[316]. This is a not-inconsiderable oversight from a regulatory perspective, as it means that security of supply is dealt with only as a secondary concern through pre-existing legislation, and through non-binding policy frameworks. Given Ireland's dependency on energy imports, and on the UK in particular, this issue will likely become increasingly relevant in the near future.

As will go on to be detailed in Section E, Ireland is undertaking an ambitious smart meter roll-out, headed by the DSO. Ireland's retail market has only been liberalised relatively recently, and continues to be dominated by powerful incumbents. Accordingly, smart meters will have a crucial role in the decentralisation and democratisation of Ireland's energy grid. However, the existing regulatory framework provides little direction on how the smart meter technology fits in to Ireland's broader smart grid strategy. This lack of direction, coupled with the absence of competitive market incentives, means that it remains to be seen whether the DSO in particular will be sufficiently incentivised to utilise smart meters so as to facilitate the broader transition to a smarter grid. While ESB Networks' 2027 strategy report recognised the importance of smart technologies, it provides only a policy framework: the regulatory

[316] Department of Communications, Climate Action and Environment, "Security of Supply: Related Legislation," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/topics/Security-of-Supply/Pages/related-legislation.aspx.

framework may therefore lack the enforceable targets often necessary to produce widespread change in the absence of a competitive DSO market.

Another potential gap in the regulatory framework concerns data protection in the smart meter context. At present, data falls to be protected under the GDPR and relevant domestic data protection legislation; however there is no legislation that deals specifically with data originating from smart meters. Given that concerns about data protection are one of the material hurdles to a wider smart meter roll-out, it seems prudent to consider making specific legislative provision for the protection of such data.

The integration of non-synchronous energy generation sources will necessitate the development of demand-side response technologies capable of balancing supply and demand. However, persistent regulatory gaps hamper the participation of demand response in the available markets. In particular, but not exclusively, the balancing market must be opened to small consumers. Efforts should also be focused on maximising revenue streams and facilitating the access of demand response to the capacity market.

Finally, energy storage, which will play an important role in the management of non-synchronous energy sources, is not recognised by the current framework as a licensable activity in its own right. Absent such recognition, the business of an entity engaged in the storage of electricity has historically been regulated on the basis of the separate licensable activities that the storage business entails: in particular, the supply and generation of electricity. While specific treatment of batteries and pumped storage units should be introduced as part of the I-SEM project, for the time being storage activities remain woefully overlooked in the regulatory framework. This, coupled with the high capital costs associated with storage technologies, has had negative implications for the storage market; Subsection 2 of Section H considers further.

2. Energy Security Dimension

Ireland continues to lag behind on its interconnection target of 10% of installed electricity production capacity by 2020[317].

[317] European Commission, "Commission Staff Working Document: Energy Union Factsheet Ireland," European Commission, Brussels, 2017, 5-6.

Ireland is reliant on oil and natural gas to meet its primary energy demand, with shares of 48% and 29% respectively[318]. Meanwhile, the share of natural gas in the electricity generation fuel mix was 48% (2,334 ktoe) in 2016; this was a 23% increase compared with 2015[319]. However RE sources are gradually becoming more important to the energy fuel mix. With regard to primary energy demand, renewables' share was 8% in 2016[320]. The share of renewables in the electricity generation fuel mix was 15.6%[321].

Notwithstanding Ireland's dependence on fossil fuels, it has limited indigenous natural resources: accordingly, it has historically relied heavily on imports to meet its energy demand. In 2014, Ireland had an import dependency of 85%: its oil dependency was fourth highest in Europe at 49% of energy usage, and 96% of natural gas used in Ireland was imported, compared to the EU average of 65%[322]. Generally speaking, Ireland's energy security has declined since 2000. In 2016 however Ireland's import dependency fell to 69% from 88% in 2015[323]. This ostensibly dramatic fall reflected increased production in the previous 12 months at the Corrib gas field, rather than improvements in indigenous renewable energy production.

As with all countries, Ireland's economy depends on secure, reliable and safe supplies of electricity, gas and oil. But Ireland's reliance on fossil fuels makes it particularly vulnerable to disruptions in supply, given its limited indigenous supply of the resource. Weaning Ireland off its dependence on oil and natural gas is therefore an important consideration in terms of building a more sustainable and secure energy supply. The onus, in short, is on Ireland to improve its indigenous renewable energy production such that it can maintain its independence from imports in the future.

Diversifying the fuel mix will require improvements to Ireland's existing energy infrastructure, in particular to the transmission and distribution networks. One way in which the relevant market players are helping to facilitate the transition is through the DS3 programme, headed by the TSO, EirGrid alongside its Northern Irish

[318] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 12.

[319] Ibid 20.

[320] Ibid 12.

[321] Ibid 20.

[322] Sustainable Energy Authority of Ireland, "Energy Security in Ireland: A Statistical Overview (2016 Report)," SEAI, 2016, 3.

[323] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 4.

counterpart, SONI[324]. The aim of the DS3 programme is to find solutions to the challenges posed by the integration of variable renewable generation sources, with a particular focus on improvements to infrastructure. So far, the DS3 programme has enabled EirGrid to increase levels of renewable generation possible on the system at any given time from 50% to 65%, with the aim of increasing this incrementally to 75% over the coming years. EirGrid is also implementing a comprehensive grid development programme, under the auspices of the Grid25 programme and the more recent 2017 Grid Development Strategy: Your Grid, Your Tomorrow.

However, support schemes will continue to be necessary to incentivise the widespread deployment of renewable energy technologies. While the RE-FIT scheme has been withdrawn, the proposed Renewable Energy Support Scheme will continue to provide much-needed support, while also encouraging community-ownership of projects[325]. The new microgeneration pilot scheme for domestic dwellings[326] is another promising development.

With the diversification of Ireland's fuel mix, the tendency will be for imports to acquire an increasing share of the mix in order to respond to the challenges of non-synchronous generation. Thus it is important that Ireland reinforce its links with the EU. A particular challenge for Ireland with respect to its energy security is its dependency on the United Kingdom for its energy supply. Post-Brexit, it is likely that planned connection projects with the UK will face funding problems[327]. Moreover, the UK's exit from the EU could result in tariff barriers to the cross-border supply of UK-transited energy[328]. Most crucially of all, the UK would, as a third party country, no longer be obliged to observe the solidarity principle in the event of supply disruptions or shortages. Thus it is critical that Ireland takes action to ensure the security of its future supply. In addition to the modernisation of its network infrastructure and the development of indigenous (renewable) electricity generation, Ireland must therefore bolster its pipeline connections with Europe. The Celtic Interconnector is one example

[324] EirGrid Group, "DS3 Programme," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/.

[325] Department of Communications, Climate Action and Environment, "Renewable Electricity Support Scheme (RESS)," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/ress/Pages/default.aspx.

[326] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Launches Pilot Micro Generation Scheme Targeting Domestic Customers and Self-Consumption and Announces Increase to Grant Supports for Home Insulation," 31 July 2018.

[327] Institute of International and European Affairs, "IIEA Policy Brief: What Does Brexit Mean for the Energy Sector in Ireland?," Institute of International and European Affairs, Dublin, 2016, 6-7.

[328] Ibid 8-9.

of how Ireland is seeking to address its dependency problems, through measures to bolster the connections between Ireland and the EU. Meanwhile, the North Seas Countries' Offshore Grid Initiative involves nine EU countries (including Ireland) and Norway. However, Ireland continues to see the UK as a critical trading partner, with both parties seeking to strengthen existing interconnections via a second Northern Ireland (the 'North-South') 400kV pipeline. A 500MW interconnector between Wales and Ireland (the "Greenlink" interconnector) is also being developed. The importance of further interconnection, specifically with the UK and France, is highlighted in Ireland's 'Project Ireland 2040' infrastructure investment plan, published in 2018[329].

As noted in Subsection 1 of Section D, Ireland has not implemented legislation specifically pertaining to the security of the energy supply. This is a considerable oversight from a regulatory perspective, as it means that the security of supply may not adequately be considered in the context of the smart grid transition strategy. This is an area to which Ireland may wish to attend in the coming months and years, particularly in light of the pressure that the UK exit from the EU will put on import supplies.

E. Smart Metering Scheme

1. The Irish National Smart Metering Programme

The Irish National Smart Metering Programme was established in 2007 by the CRU to meet the EU's target of 80% of residential consumers having smart electricity meters by 2020. Its main stakeholders are the CRU, the DSO (ESB Networks) as deliverer, Gas Networks Ireland and the energy suppliers.

The CRU has conducted a cost-benefit analysis on smart metering[330]. It is satisfied that the planned roll-out represents value for money. However, persuading customers of the value of the technology is proving to be an uphill battle. When surveyed on smart metering, a significant minority of residential customers (48% of electricity and 45% of gas customers) indicated an interest in the programme[331]. However, 57% of residential customers indicated that they had no interest in switching to a smart meter[332]. Notwithstanding the foregoing, 7 out of 10 residential customers

[329] Government of Ireland, "Project Ireland 2040: National Development Plan 2018-2027," Government of Ireland, 2018.

[330] Commission for Regulation of Utilities, "Smart Metering Cost Benefit Analysis (CRU17324)," CRU, Dublin, 2017.

[331] Commission for Regulation of Utilities, "CRU Annual Survey of Residential and SME Customers in the Gas and Electricity Markets in Ireland: December 2017 (S17-115)," CRU, 2017, 47.

[332] Ibid.

believe in the importance of renewable energy generation[333], which implies that if it is made apparent that smart meters would contribute towards the facilitation of domestic micro-generation then the roll-out may be more widely accepted among residential customers. The majority of small-medium enterprises saw value in the technology[334].

Ireland has run several trials which have shown that there is potential for peak shifting and load reduction through "Time of Use" (ToU) tariffs (which incentivise users to use more electricity at traditional off-peak times, in order to balance demand). A pilot study conducted by the CRU has indicated that there may be significant savings associated with a roll-out[335]. The study reported that, when put in place alongside demand-side management arrangements, ToU tariffs reduced domestic usage by 2.5% and peak usage by 8.8%.

The smart metering programme will involve a phased roll-out of smart meters[336]. The first phase will involve the installation of 250,000 meters by 2020. Phase 2, between 2021 and 2022, will support the installation of an additional 1 million meters. A final 1 million meters will be rolled-out between 2023 and 2024 in Phase 3. Customers who request a smart meter will be prioritised during the initial deployment stage, as will those who are due a replacement for old meters.

2. Smart Metering Regulatory Framework

The CER (now CRU) published a Decision, CER/15/270, on extending ToU tariffs to consumers[337]. The CRU intends for time-of-use tariffs to become the norm for consumers, but has decided that this must be by way of a customer-driven transition. The starting point for the CRU's tariff strategy is a Standard Smart Tariff comprising three different time-of-use rates: a peak rate at 5pm-7pm, 5pm-9pm or 7pm-9pm; a day rate at 8am-11pm (but excluding the peak period); and night rate at 11pm-8am.

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[333] Ibid 48.

[334] Ibid 47.

[335] Commission for Energy Regulation, "Smart Metering Information Paper 4: Results of Electricity Cost-Benefit Analysis, Customer Behaviour Trials and Technology Trials (CER11080)," CER, Dublin, 2011.

[336] Commission for Regulation of Utilities, "CRU Announces Delivery Plan for Smart Meters in Ireland," 28 July 2017.

[337] Commission for Energy Regulation, "CER National Smart Metering Programme Rolling Out New Services: Time of Use Tariffs (CER/15/270)," CER, Dublin, 2015.

Further to the publication of Decision CRU/18/18164, suppliers will be given primary responsibility for engaging with electricity customers as they transition to ToU tariffs[338]. By moving away from a 'one-size-fits-all' approach to the transition, the CRU's method will reflect the concepts of empowerment and democratisation which underpin the wider EU approach to the smart grid transition. Other innovative ideas include Smart Pay-as-you-Go, through which prepayment is made available to all without the need for an additional meter (CER/15/271); the proposed empowerment of consumers via smart billing, and the availability of a downloadable harmonised data file directly from the supplier or the DSO (CER/15/272); and the proposed implementation of a regulatory framework incorporating transitional licence obligations, and a revenue recovery and incentive approach (CER/15/273).

In short, Ireland is well on its way to producing a regulatory framework that reflects the needs of consumers, and meets the commercial needs of electricity suppliers. It is important however that customer tariffs accurately reflect the costs incurred in dispatching generation and managing flows across transmission and distribution networks, as passed on to the supplier then finally customer. Using actual data, and half-hourly metered data would help to avoid inaccuracies creeping in; Ireland's smart billing and PAYG strategies appear to put it on the right path.

Ireland should also be wary of the opportunities for market distortion, particularly in light of the monopoly position of the DSO. The DSO has no competitive incentive to ensure a speedy, cost-effective transition. The Irish market can therefore be compared, somewhat unfavourably, to the US market. The advances of the US market could be viewed as stemming directly from the competitive market situation present there, and absent from Ireland: without the drive of competitive markets, Ireland arguably requires a more robust regulatory framework so as to ensure that the necessary incentives are in place.

Thus Ireland has constructed a relatively robust regulatory framework around the smart metering programme. However, the current framework provides little direction on how the smart meter technology fits in to Ireland's broader smart grid strategy. It also lacks the competitive incentives that tend to facilitate a smooth transition. Whether the regulatory framework will provide sufficient direction and incentives to encourage the DSO to utilise the technology so as to facilitate the smart grid transition therefore remains to be seen.

[338] Commission for Regulation of Utilities, "Smart Meter Upgrade: Standard Smart Tariff (CRU/18/18164)," CRU, Dublin, 2018.

Ireland first major smart metering programme was with regard to Irish Water. However, this smart metering programme was brought to a halt by the CRU after it became apparent that the costs of completion were prohibitive[339]. The detailed cost-benefit analysis that has been conducted in advance of the electricity smart meter roll-out will hopefully ensure that such mistakes are not repeated in the course of the current roll-out. Indeed, the fact that the roll-out will be led by the DSO, not the suppliers (as it was in the UK) should lead to a lower cost for the Irish consumer, as meters will be part of the regulated asset base. Moreover, it should make it easier for consumers to change suppliers once they have the installed meter: the DSO is driven by the aim of optimising the network; suppliers by selling electricity.

Notwithstanding the hurdles identified in this section, perhaps the most significant obstacle to a successful roll-out is public opinion. The central aim of the smart meter scheme is to aid the transformation of the grid model. Spurred on by the dramatic changes in the electricity fuel mix, the grid model will be decentralised and digitalised, with communities and consumers active participants in a new distributed energy grid. However, the desire to decentralise does not appear to be shared by retail customers. With this in mind, Ireland's opt-out approach could help to minimise resistance in the shorter-run, by giving customers the opportunity to be persuaded of the technology's value. But while the value of smart meters to the grid is clear - digitalisation means efficiency gains; democratisation and the empowerment of the consumer enhances competition - the value to customers of smart meter information will probably only be realised when those customers become themselves micro-generators. Thus, a compulsory programme may be the most efficient way forward. But in order to appeal to customers – who ought to be the focus of the smart grid transition - such a programme must focus on the issues that matter most to the customer: cyber security issues, privacy and data protection concerns, and potentially even a multi-metered, multi-utility approach to the roll-out, which reflects the modern, multi-technology home.

F. Demand Response

[339] S. Bardon, "Regulator says Irish Water should not proceed with metering," The Irish Times, 11 January 2017. [Online]. Available: https://www.irishtimes.com/news/politics/regulator-says-irish-water-should-not-proceed-with-metering-1.2933685?mode=sample&auth-failed=1&pw-origin=https%3A%2F%2Fwww.irishtimes.com%2Fnews%2Fpolitics%2Fregulator-says-irish-water-should-not-proceed-with-mete.

Ireland has a competitive wholesale energy market and a relatively open balancing market[340]. The country also has standardised arrangements in place between balance response parties and independent aggregators[341]. These factors have contributed to the development of a commercially active market with a high demand for flexibility.

1. Role of the TSO

a. Demand Response/Demand Side Management Schemes

Electricity consumers can currently participate in demand side management through tariff-based schemes where they are encouraged to move their usage to cheaper off-peak times: examples include the NightSaver tariff. EirGrid also operates two demand response schemes focused on large electricity users: Short Term Active Response (STAR) and Powersave[342].

STAR: electricity consumers are contracted to make their load available for short-term disruptions. Previously known as the 'Interruptible Load' scheme, STAR has been running for 20 years.

Powersave: participating consumers are encouraged to reduce their energy demand on days when the demand is close to available supply, through payment based on the kWh reductions achieved.

b. DSUs

Medium to large users can also participate, as Individual Demand Sites, in a Demand Side Unity (DSU) or Aggregated Generating Unit (AGU)[343]. EirGrid provides incentives (capacity payments) to encouragement enrolment. The first DSU became operational in July 2012; the second in December 2012.

[340] Smart Energy Demand Coalition, "Explicit Demand Response in Europe: Mapping the Markets 2017," Smart Demand Energy Coalition, Brussels, 2017, 117-124.

[341] Ibid.

[342] EirGrid Group, "Demand Side Management," [Online]. Available: http://www.eirgridgroup.com/customer-and-industry/becoming-a-customer/demand-side-management/.

[343] Ibid.

A DSU Aggregator may contract with Individual Demand Sites and aggregate them together to operate as a single DSU: the DSU Aggregator then coordinates and manages the reduction from Individual Demand Sites, and offers this management service to the system. The DSU Aggregator is therefore a third party company specialising in demand side participation.

DSUs must satisfy a number of preconditions: for one, a Supply Licence is required from the CRU; DSUs must also register as a party to and unit of the I-SEM, as well as obtain from EirGrid an Operational Certificate. DSUs must have a minimum demand reduction capability of 4 MW. There is no lower limit to the demand reduction capability of Individual Demand Sites comprising a DSU, but Individual Demand Sites with a demand reduction capability of 10 MW or greater must be a DSU in their own right.

Presently, the DSU arrangements are focused on medium and large energy consumers. However, even greater flexibility could be realised if demand response market participation was extended to small consumers, including domestic dwellings. The need for further research on small scale demand side participation is identified in the SEAI's smart grid roadmap[344].

c. Balancing Services

STAR and Powersave are on offer as balancing services for large electricity users.

The DS3 programme has introduced Interim Arrangements for balancing market ancillary services. The Interim Arrangements opened up the ancillary services market to demand response. The following ancillary services are available in the balancing market as part of the Interim Arrangements: Fast Frequency Response, Primary Operating Reserve, Secondary Operating Reserve, Tertiary Operating Reserve 1 and 2, Replacement Reserve – Synchronised, and Ramping Margin 1, 2 and 8[345].

Aggregators which fulfil the DSU requirements can participate in the balancing market.

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[344] Sustainable Energy Authority of Ireland, "Smartgrid Roadmap," [Online]. Available: https://www.seai.ie/resources/publications/Smartgrid-Roadmap.pdf.

[345] Smart Energy Demand Coalition, "Explicit Demand Response in Europe: Mapping the Markets 2017," Smart Demand Energy Coalition, Brussels, 2017, 120.

d. Capacity Auction Market

The redesign of the SEM necessary to create the European-wide I-SEM has entailed the overhauling of Ireland's wholesale energy market arrangements, including the reconfiguration of Ireland's capacity market.

In the SEM, generators received a payment, known as the Capacity Payment Mechanism, for being available to generate electricity on demand. In the I-SEM a similar mechanism now exists, called the Capacity Remuneration Mechanism ("CRM")[346]. The crucial difference between the two mechanisms is that in the I-SEM payments are made available through a competitive auction process. Ireland's first capacity auction market for the I-SEM took place in December 2017.

The first contract pursuant to the new auction model was awarded to EnerNOC, an Enel subsidiary. EnerNOC has been tasked with the delivery of 217MW of demand response capacity; Enel will hold 40% of the demand response market in Ireland as a result of the contract[347].

The capacity auction market is now fully-functional, although teething issues have been identified. Demand Side Units (DSUs) are able to participate in the capacity auction market as generators. However, while they receive availability payments, they do not currently receive utilisation payments[348].

It has also been revealed that DSUs with a limited duration for demand reduction (of less than or equal to six hours) will now be hit with the same de-rating factors used for energy storage, despite the fact that demand response and storage are different technologies[349]. This change will apply from capacity year 2019/20. Critics argue that this will discourage demand side response providers from participating within the I-SEM and the capacity market by reducing the available revenues.

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[346] Sustainable Energy Market Committee, "Capacity Remuneration Mechanism," [Online]. Available: https://www.semcommittee.com/capacity-remuneration-mechanism.

[347] Renews.biz, "Enel Answers Irish Demand," [Online]. Available: https://renews.biz/33490/enel-answers-irish-demand.

[348] Smart Energy Demand Coalition, "Explicit Demand Response in Europe: Mapping the Markets 2017," Smart Demand Energy Coalition, Brussels, 2017, 122.

[349] D. Pratt, "Demand response facing de-rating in Irish capacity market," Current, 8 June 2018. [Online]. Available: https://www.current-news.co.uk/news/demand-response-facing-de-rating-in-irish-capacity-market.

The CRM has received State Aid clearance from the European Commission. However, the changes relating to DSUs may leave the CRM open to the accusation that demand-side response technologies are being hampered from participating effectively alongside generation. This issue is particularly relevant given the recent ruling of the General Court of the European Union, which has resulted in the temporary suspension of the UK capacity market[350].

2. Role of the DSO

ESB Networks is developing its network to facilitate the participation of all customers in future demand response services. It has forecasted that by 2030 there will be 2,500MW of demand side response capability in its customers' premises, and plans to invest to ensure this capability is realised[351].

ESB Smart Energy Services is a business line within ESB Networks which offers clients managed energy services using, among other technologies, demand response management platforms[352].

3. Smart Meters, Demand Response and the Smart Grid

Existing demand response schemes focus on the provision of services to medium and large electricity customers. However, the proposed roll-out of smart meters at a residential level over the next five years should open up a larger market for demand response schemes, particularly in light of Ireland's proposed Time-of-Use tariff structure.

Power Off and Save is a pilot programme involving up to 1,500 residential customers over an 18 month period. Participants are being asked to switch off their appliances for about 30 minutes each time on 10 occasions when demand is

[350] Case T-793/14 Tempus Energy Ltd and Tempus Energy Technology Ltd v European Commission supported by United Kingdom of Great Britain and Northern Ireland, 15 November 2018.

[351] ESB Networks, "Flexibility on Our Networks," [Online]. Available: https://www.esbnetworks.ie/who-we-are/innovation/our-innovation-strategy/flexibility-on-our-networks.

[352] ESB, "Smart Energy Services," [Online]. Available: https://www.esb.ie/our-businesses/smart-energy-services/smart-energy-services-overview.

particularly high[353]. The programme is being run by EirGrid in partnership with Electric Ireland. Power Off and Save could help the TSO to assess the viability of extending demand response services to the domestic market. Further pilot projects on demand response services in the domestic context, and incorporating smart meter technology, would be welcomed.

G. Data Protection

The Data Protection Acts 1988, 2003 and 2018, together with the General Data Protection Regulation ("GDPR") comprise the basic legal framework for data access and privacy within Ireland. The observance and implementation of these and related regulations is monitored by the Comisiun Cosanta Sonrai, or Data Protection Commission (English translation).

Data controllers and data processors must register with the Office of the Data Protection Commissioner, subject to the exemptions articulated under the 1988 Act, as amended, and S.I. No. 657/2007. Data controllers have certain key responsibilities in relation to the information that is kept on individuals; data processors are subject to lesser responsibilities, and their compliance with these is overseen by the data controller.

The deployment of smart meters and the creation of a data management model are matters to be addressed at the Member State level. Yet in Ireland there is limited guidance about how smart meters will fit into the wider data protection framework. Among other matters, it will be necessary to clarify in the future which of the data collected by smart meters is 'personal' data: consumption data which is used for the purposes of billing and setting tariff rates could certainly be treated as 'personal' data, but may arguably be better viewed as less sensitive 'technical' data. It will also be important to delineate clearly the roles of data 'controller' and 'processor'. The actors involved in the smart grid chain will be numerous and their roles varied: assigning these actors the appropriate legal definition will prove vital with regard to the application of the data protection framework. Finally, all personal data must be kept safe and secure; to date, however, there is very little guidance as to what measures should be taken to ensure that personal data accrued pursuant to smart meters is kept private. The EU has adopted a light regulatory approach such that the matter is left in the hands of the Member States, but given the systemic vulnerabilities apparent in the smart grid context, guidance on the security issues is sorely needed. The CCS/DPC could provide valuable guidance to this end.

Notably, the GDPR adds a new obligation on data controllers, who must now conduct a privacy impact assessment where 'high risk' processing is carried out. The DPC is entitled to draw up a list of those processing operations which are or are not subject to this requirement: a draft list of the operations requiring an impact assessment

[353] EirGrid Group, "Power Off and Save," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/power-off-save/.

was published in June 2018[354]. The European Data Protection Board released its opinion in September 2018, including a set of recommendations[355]. In response, Ireland issued a revised list incorporating the EDPB's recommendations in November 2018[356]. The rather broad-brush approach to the categorisation of processing operations evident from the publication underlines the continued lack of clarity about the role of Ireland's smart grid operators within the data protection framework.

H. Electric Vehicles and Electricity Storage

1. Electric Vehicles

Electric vehicles feature prominently in Ireland's strategy to mitigate climate change, as expressed in its 2017 National Mitigation Plan[357]. According to the NMP, the transport sector was the fastest growing source of greenhouse gas emissions between 1990 and 2015: the sector represented 27.5% of Ireland's non-ETS (Emissions Trading System) emissions in 2015. Moreover, emissions from the sector are forecasted to increase during the period up to 2050. Accordingly, the decarbonisation of the sector is one of the key aims of Ireland's climate action strategy. The important role of electric vehicles in Ireland's energy strategy is also observable in the Government's National Development Plan, which included an ambitious target to increase the number of EVs on Irish roads to 500,000 by 2030[358]. Meanwhile, the National Policy Framework on Alternative Fuels Infrastructure for Transport in Ireland 2017 – 2030 includes the policy aim that from 2030 all new cars and vans sold will be zero emission (or zero-emission capable)[359]. In addition to these self-imposed targets, Directive 2009/28/EC specifies a legally binding 10% renewable energy in transport target to be achieved by all Member States by 2020.

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[354] An Coimisiun um Chosaint Sonrai (Data Protection Commission), "Public Consultation: Draft List of Types of Data Processing Operations which Require a Data Protection Impact Assessment," An Coimisiun um Chosaint Sonrai (Data Protection Commission), 2018.

[355] European Data Protection Board, "Opinion 11/2018: On the Draft List of the Competent Supervisory Authority of Ireland Regarding the Processing Operations Subject to the Requirement of a Data Protection Impact Assessment (Article 35.4 GDPR)," EDPB, Adopted 25 September 2018.

[356] An Coimisiun um Chosaint Sonrai (Data Protection Commission), "List of Types of Data Processing Operations which require a Data Protection Impact Assessment," An Coimisiun um Chosaint Sonrai (Data Protection Commission), Dublin, 2018.

[357] Department of Communications, Climate Action and Environment, "National Mitigation Plan: July 2017," DCCAE, 2017.

[358] Government of Ireland, "Project Ireland 2040: National Development Plan 2018-2027," Government of Ireland, 2018, 75.

[359] Department of Transport, Tourism and Sport, "National Policy Framework: Alternative Fuels Infrastructure for Transport in Ireland 2017 to 2030," Department of Transport, Tourism and Sport, 2017, 44.

Achieving these targets will require a sea-change in consumer behaviour. There were 2.68 million vehicles on the road in 2017[360]; however, some 914 new electric vehicles were registered. This was the highest number yet recorded[361]. According to the SEAI, there are now approximately 5,500 electric vehicles on the road[362]. Nevertheless, the use of electricity as a fuel source remains negligible in comparison to the use of fossil fuels.

Ireland has taken a lead in recognising the importance of a consumer-driven transition to the decarbonisation of the transport sector. To this end, the SEAI has created an online information hub on its website, through which it makes readily available to the general public its research and other publications on the transport sector[363]. The online hub also includes sections on, among other matters, finding a dealer of EVs; a costs and emission savings calculator; and general information on the grants available for those wishing to purchase an EV.

The Biofuels Obligation Scheme is the primary mechanism being deployed to achieve Ireland's 10% renewable energy target for the transport sector by 2020[364]. This scheme places an obligation on suppliers to ensure that a proportion of the transport fuel placed on the market in Ireland consists of environmentally sustainable biofuels. The Biofuels Obligation rate is currently 8% (by volume). A draft order on the proposal to increase the biofuel obligation rate to 10% (by volume) from 2019 was published in April 2018. Consultations on this have now closed.

The Biofuels Obligation Scheme notwithstanding, Ireland is encouraging the EV transition by way principally of support schemes, including through grants and generous tax reductions. Current grant schemes include those offered by the SEAI, of up to €5,000 for the purchase of a battery ("BEV") or plug-in hybrid electric vehicle ("PHEV")[365]. Meanwhile, the Accelerated Capital Allowance scheme encourages the purchase of energy efficiency assets by corporations by allowing companies to write

[360] Department of Transport, Tourism and Sport, "Transport Trends: An Overview of Ireland's Transport Sector 2018," Department of Transport, Tourism and Sport, 2018, 3.

[361] Ibid 28.

[362] Sustainable Energy Authority of Ireland, "Electric Vehicles," [Online]. Available: https://www.seai.ie/sustainable-solutions/electric-vehicles/

[363] Ibid.

[364] Department of Communications, Climate Action and Environment, "Increase to Biofuel Obligation Rate Consultation," [Online]. Available: https://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Biofuel-Obligation-Scheme-Consultation.aspx.

[365] Sustainable Energy Authority of Ireland, "Electric Vehicle Grant Values," [Online]. Available: https://www.seai.ie/grants/electric-vehicle-grants/grant-amounts/.

off up to 100% of the purchase value of qualifying equipment against profits[366]. Finally, Gas Networks Ireland has set up a Natural Gas Vehicle Fund to support the deployment of dedicated compressed natural gas ("CNG") vehicles in what has been coined the "Causeway Project"[367]. The fund, which is worth €700,000, has been set up to fund the difference in cost between a conventional vehicle and a CNG vehicle.

With respect to taxation, a zero-emissions band for electric vehicles applies for motor tax purposes[368]; Vehicle Registration Tax ("VRT") relief of up to a maximum of €5,000 is also available[369]. In the 2018 Budget, it was announced that the VRT relief on BEVs will continue up to 2021, and until end 2019 for PHEVs and hybrids. Furthermore, a carbon tax, whereby a tax is levied on the carbon content of fuels, was introduced in the 2010 budget[370]. However, despite much public support for an increase in the 2018 budget, the current rate of €20 per tonne of CO2 emitted continues to apply. The adoption of natural gas as a transport fuel is also being encouraged with the excise rate applied set at a reduced rate[371]. Finally, since July 2018 drivers of electric vehicles have been able to avail themselves of a toll tax reduction scheme[372].

A full electrification of the car fleet of the kind envisaged by the Government's decarbonisation strategy could represent a feasible option for Ireland, but the supporting grid infrastructure must also be developed. A pilot project looking at the delivery of the distribution system necessary to support electric vehicle uptake was cancelled in 2018, following a decision by the CRU to cancel the funding for the assets

[366] Sustainable Energy Authority of Ireland, "Accelerated Capital Allowance," [Online]. Available: https://www.seai.ie/energy-in-business/accelerated-capital-allowance/.

[367] Gas Networks Ireland, "The Causeway Project," [Online]. Available: https://www.gasnetworks.ie/business/natural-gas-in-transport/the-causeway-project/.

[368] Department of Planning, Housing and Local Government, "Rates of Duty on Motor Vehicles (effective 1 January 2016) Environment, Community and Local Government," December 2015. [Online]. Available: https://www.housing.gov.ie/sites/default/files/publications/files/20170626_amended_motor_tax_rates_01_january_2016_0.pdf.

[369] Revenue Irish Tax and Customs, "Calculating Vehicle Registration Tax: Electric and hybrid vehicles," [Online]. Available: https://www.revenue.ie/en/importing-vehicles-duty-free-allowances/guide-to-vrt/calculating-vrt/electric-and-hybrid-vehicles.aspx.

[370] Citizens Information, "Carbon Tax," 21 March 2017. [Online]. Available: http://www.citizensinformation.ie/en/money_and_tax/tax/motor_carbon_other_taxes/carbon_tax.html.

[371] Revenue: Irish Tax and Customs, "Excise Duty Rates," [Online]. Available: https://www.revenue.ie/en/companies-and-charities/excise-and-licences/excise-duty-rates/electricity-and-other-energy-products.aspx.

[372] eToll, "What is the Electric Vehicle Toll Incentive (EVTI)?," [Online]. Available: http://www.etoll.ie/electric-vehicle-toll-inc/.

developed during the course of the project[373]. While the cancellation of this project is unfortunate, other projects are ongoing. The Causeway Project is considering the impact of the deployment of CNG refuelling infrastructure in Ireland: the construction and deployment of refuelling stations and gas injection point will continue until 2019, with a projected completion date sometime in 2020. Meanwhile, a pilot project is to take place on the island of Cape Clear, which could see the first fully electric fleet of public buses; the tender process for the contract is ongoing[374]. A similar, albeit smaller-scale pilot, may also be in the pipeline for Dublin[375]. Further infrastructure projects will be necessary if Ireland is to continue to make solid progress on its EV and transport targets.

2. Electricity Storage

In Ireland there is currently only one bulk energy storage facility: the Turlough Hill PHES facility. Commissioned in 1974, it has an installed capacity of 292 MW[376]. There is no bulk energy storage facility In NI.

Storage technologies have a prominent role in Ireland's wider energy strategy. To support higher levels of renewable energy generation and reinforce the robustness of the network as part of its DS3 programme, EirGrid (alongside its Northern Irish counterpart) has opened up a procurement process for new System Services[377]. The System Services on offer include fast frequency response products, as well as primary, secondary and tertiary reserve products. Consultations on the arrangements are ongoing.

Storage projects are now being accepted by EirGrid under its new Enduring Connection Policy (ECP), the new connections processing framework which has

[373] Commission for Regulation of Utilities, "ESBN Electric Vehicle Pilot and Associated Assets (CRU17283)," CRU, Dublin, 2017.

[374] M. Hilliard, "Tiny Irish island to become first area with fully electric buses," The Irish Times, 26 October 2018. [Online]. Available: https://www.irishtimes.com/news/environment/tiny-irish-island-to-become-first-area-with-fully-electric-buses-1.3676033.

[375] H. McGee, "Electric Dublin Buses may start running this year," The Irish Times, 26 January 2018. [Online]. Available: https://www.irishtimes.com/news/politics/electric-dublin-buses-may-start-running-this-year-1.3369945.

[376] ESB, "40 Years of Turlough Hill," ESB, 2008.

[377] EirGrid Group, "DS3 Programme," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/.

replaced the old 'gate' system[378]. Over 370MW of energy storage projects, along with 1.25GW of solar, have been accepted in the first batch of projects assessed under ECP[379].

Meanwhile, EirGrid is pushing ahead with two DS3 storage projects: Kelwin and Schwundgrad Energie[380]. The goal of the former is to develop a 37MW wind farm in Co Kerry: each turbine will have an integrated battery and the project will test how these batteries can be used to capture, storage and feedback excess energy. The latter is a flywheel-battery pilot project.

A recently-introduced pilot micro-generation scheme for solar also promotes storage technologies[381]. The scheme offers homeowners access to grants of €700 per kW of solar installed up to 2kW; any installation up to 4kW will also be supported in the event that a battery storage system is installed. In such cases, a grant of €1,000 is available towards the battery storage system. The pilot scheme will run until 31 December 2020.

In terms of barriers to storage technologies, high capital costs are one of the most significant barriers to the widespread deployment of the technology in Ireland, as elsewhere. Given the high start-up costs, storage often struggles compete alongside existing flexible generation and interconnectors. For storage to properly participate in the market there needs to be a clear cost-benefit analysis that shows the operational benefits delivered by storage. Accordingly, emerging energy storage technologies would benefit from a friendlier market environment in the EU overall. Additional support may be necessary to justify the business case for their deployment, alongside network reinforcement and/or flexible generation. Ireland's pilot micro-generation scheme is therefore a step in the right regulatory direction, and the results of the scheme will undoubtedly inform future support schemes.

A crucial oversight in the Irish electricity regulatory framework is the failure of to recognise electricity storage as a licensable activity in its own right. Absent such recognition, the business of an entity engaged in the storage of electricity falls to be

[378] EirGrid, ESB Networks, "Enduring Connection Policy (ECP-1): 2018 Batch," EirGrid, ESB Networks, 2018.

[379] D. Pratt, "Ireland to process 373MW of energy storage under new connections procedure," Energy Storage News, 5 September 2018. [Online]. Available: https://www.energy-storage.news/news/ireland-to-process-373mw-of-energy-storage-under-new-connections-procedure.

[380] EirGrid, "Key Innovation Projects," [Online]. Available: http://www.eirgridgroup.com/how-the-grid-works/innovation/enhanced-user-facilitatio/.

[381] Department of Communications, Climate Action and Environment, "Minister Denis Naughten Launches Pilot Micro Generation Scheme Targeting Domestic Customers and Self-Consumption and Announces Increase to Grant Supports for Home Insulation," 31 July 2018.

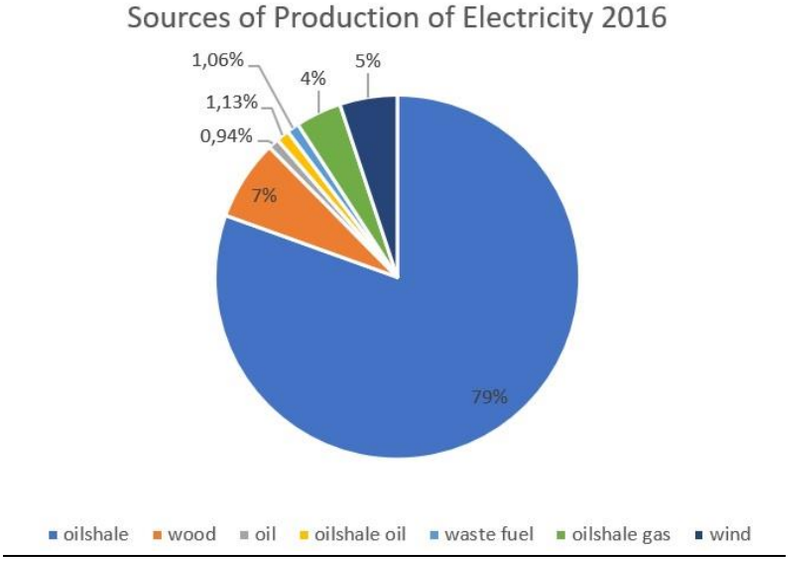
regulated as a generation asset. However, this classification does not recognise the potential contribution of storage as a demand response asset. Moreover, those owning and operating storage units are liable to be double-charged for generating as well as using electricity; storage units are also charged for the electricity distributed[382]. A new definition of storage, reflected in appropriate amendments to the system charges structure, could therefore facilitate the removal of many of the current barriers to its deployment. That being said, the new I-SEM market rules for the balancing market now include reference to storage technologies[383].

II. Estonia

A. Energy Profile

Figure 1 below shows the energy mix for the production of electricity as follows:

Figure 1: Sources of production of electricity[384]



[382] EirGrid Group, "Storage Technology Workshop," 15 May 2018. [Online]. Available: http://www.eirgridgroup.com/site-files/library/EirGrid/Storage-Technology-Workshop-Slide-Deck.pdf.

[383] SEMO, "Balancing Market Rules," [Online]. Available: http://www.sem-o.com/rules-and-modifications/balancing-market-modifications/market-rules/.

[384] Estonian Statistics. Available online: http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=KE032&ti=ELEKTRIJAAMADE+V%D5IMSUS+JA+TOODANG&path=../Database/Majandus/02Energeetika/02Energia_tarbimine_ja_tootmine/01Aastastatistika/&lang=2

As for the consumption of energy in general in Estonia, the situation is as described in Table 2:

Table 2: Consumption of energy in Estonia

Consumption, tera-joule								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Energy total	113 024	118 782	114 800	119 682	117 421	116 153	115 289	121 688
Solid fuel	21 303	20 904	19 931	20 583	21 187	20 263	18 960	19 457
Liquid fuel	35 559	37 710	38 625	39 126	37 661	39 140	39 783	39 882
Gas fuel	5 324	5 626	4 606	5 495	6 582	5 272	5 926	7 289
Electric energy	23 278	24 821	23 818	25 127	24 486	24 863	24 663	26 284
Heat	27 560	29 721	27 820	29 351	27 505	26 615	25 957	28 776

Percentage of whole consumption, %								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Energy total	100	100	100	100	100	100	100	100
Solid fuel	19	17	17	17	18	17	16	16
Liquid fuel	31	32	34	33	32	34	35	33
Gas fuel	5	5	4	5	6	5	5	6
Electric energy	21	21	21	21	21	21	21	22
Heat	24	25	24	24	23	23	23	23

Renewable energy made up 16.9% of the total amount of electric energy consumed in Estonia in 2017, while altogether 1,612 gigawatt-hours (GWh) of renewable energy were produced in the 12 months.[385]

[385] Estonian Wind Power Association. Available online: http://www.tuuleenergia.ee/en/2018/01/renewable-energy-accounted-for-16-8-pct-of-estonias-electricity-consumption-in-2017/

1. Energy Dependency

Due to the use of oil shale and, increasingly, renewable fuels, Estonia can largely meet the energy requirements of the country, as depicted in Tables 3 and 4.[386]

Table 3: Electrical energy balance as of 1 September 2017 (gigawatt-hour)[387]

	2009	2010	2011	2012	2013	2014	2015	2016
Gross production	8 779	12 964	12 893	11 966	13 275	12 444	10 417	12 176
Net production	7 884	11 732	11 356	10 526	11 823	11 013	9 062	10 424
Import	3 025	1 100	1 690	2 710	2 712	3 730	5 452	3 577
Import from Russia	0	0	0	0	0	0	0	0
Import from Latvia	562	664	815	554	335	108	175	328
Import from Lithuania	2 328	172	374	545	0	0	0	0
Import from Finland	135	264	501	1 611	2 377	3 622	5 277	3. 24 9

Table 4: Liquid- and gas fuel balance as of 21 September 2018[388]

Natural gas, million m³					
	2013	**2014**	**2015**	**2016**	**2017**
Primary energy production	0	0	0	0	0
Converted energy production	0	0	0	0	0
Import	678	530	471	518	492

[386] Ministry of Economic Affairs and Communications. Available online: https://www.mkm.ee/en/objectives-activities/energy-sector

[387] Estonian Statistics. https://www.stat.ee/34170

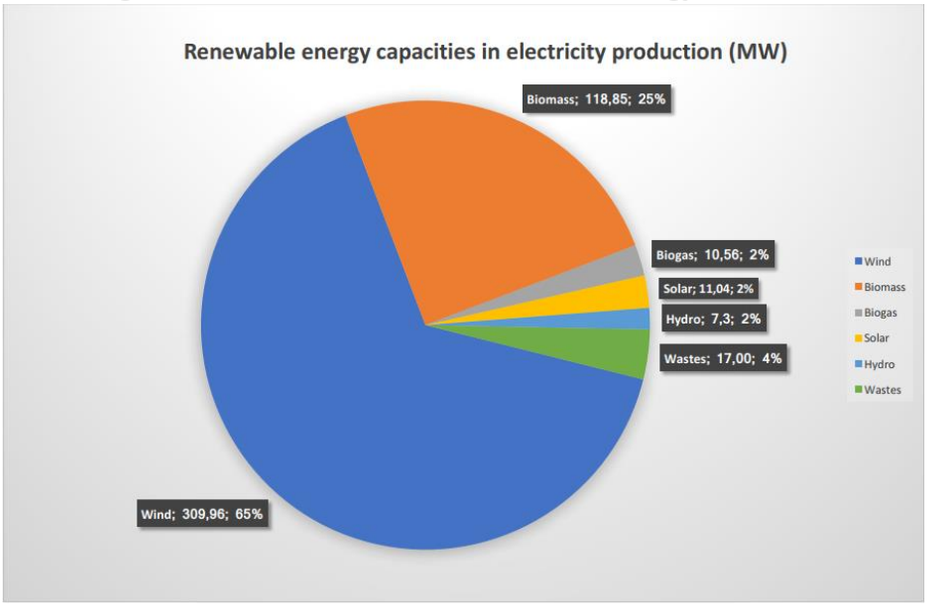
[388] Estonian Statistics. Available online: https://www.stat.ee/34176

Liquid gas, thousand tons					
	2013	**2014**	**2015**	**2016**	**2017**
Primary energy production	0	0	0	0	0
Converted energy production	0	0	0	0	0
Import	12,6	16,2	26,4	35,8	40,0
Diesel fuel, thousand tons					
	2013	**2014**	**2015**	**2016**	**2017**
Import	655	636	660	687	665
Gasoline for cars, thousand tons					
	2013	**2014**	**2015**	**2016**	**2017**
Import	358	434	403	483	453

2. Renewable energy production

In Estonia, renewable energy is mainly based on wind; other sources include biomass, waste, bio-gas, solar and hydro power (see Figure 2).

Figure 2: Division between renewable energy sources[389]



[389] Estonian Renewable Energy Association. Available online: http://www.taastuvenergeetika.ee/en/renewable-energy-estonia/

Subsidy rate (€/kWh)	**Conditions for payment**
0,0537	from renewable energy sources, except biomass
0,0537	from biomass in CHP mode
0,032	in efficient CHP mode from waste, peat or oil shale retort gas
0,032	in efficient CHP mode using generating equipment with a capacity of not more than 10 MW

The production of renewable energy has been incentivised by renewable energy subsidies paid for electricity generated from renewable sources, from biomass in co-generation of heat and power (CHP) mode, or in efficient CHP mode. The renewable subsidies are regulated in Electricity Market Act (EMA), in particular in its § 59 *et seq*.

According to the EMA, it is the transmission system operator (TSO), that is Elering, which pays out the subsidies. The cost of financing the subsidies is passed on to consumers in proportion to their consumption of network services and the amount of electricity consumed through direct lines. According to § 59^1 of the EMA, producers of electricity from wind energy may receive subsidies until a total of 600 GWh of electricity has been produced from wind sources in Estonia in a calendar year. Calculations are kept separately for each calendar year.

According to § 59(1) and (2^2) of the EMA, renewable energy producers who had started works on their investment project by 31 December 2016 (so-called existing producers) are entitled to fixed subsidy amount based on following rates for 12 years from starting production:

Renewable subsidies for new producers (i.e. producers who have started works on their investment project after 31 December 2016) will be based on competitive bidding processes. At date of today's date, no bids have taken place thus far, but the rules for bidding process are being prepared.

Based on § 59(2^4) of the EMA, for renewable producers with electrical capacity of less than 1 MW, the fixed rate renewable subsidies are available if their installation generates electricity at the latest by 31 December 2018. The current renewable support scheme and the new bid based scheme have been approved in the light of EU state aid rules by the European Commission decision of 17 December 2017, State Aid SA.47354 (2017/NN) – Estonia, Amendments to Estonian RES and CHP support scheme.

3. Predictions For the Demand in Renewable Energy

Pursuant to the "National Development Plan of the Energy Sector Until for 2020",[390] the Estonian Government is required to provide measures that will increase the proportion of renewable energy in total the Estonian energy mix. The Renewable Energy Action Plan is intended to provide the steps required in order for Estonian to achieve its renewable energy goal of a twenty-five per cent proportion of renewable energy proportionate to total energy consumption.

4. Gas production

Estonia does not produce natural gas or liquefied gas and hence relies on imports regarding gas. However, there is a relatively small production of bio-gas.[391] Since 2017, the total power production from bio-gas has remained at a level of 10.56 MW (see Figure 3).

Figure 3: Bio-gas production power[392]



[390] National Development Plan of the Energy Sector Until 2020, available online: https://www.mkm.ee/sites/default/files/taastuvenergia_tegevuskava.pdf (in Estonian)

[391] Estonian Bio Gas Association, page 30. Available online: http://eestibiogaas.ee/tootmine-ja-kasutamine/

[392] Renewable Energy – Yearbook 2017. Available online: http://www.taastuvenergeetika.ee/taastuvenergia-aastaraamat-2017-2/

5. Interconnection Lines with Estonia's Neighbors

Grid interconnectors are essential to any power pooling initiatives within regions. In this regard, Estonia has established interconnection lines, as well, as a further interconnection line under construction (the Balticconnector Project, see below). This points to the fact that arguably Estonia may be seen as a potential energy hub in a regional power pool initiative.

EstLink Projects

EstLink 1 is the first high voltage direct current (HVDC) interconnection between Estonia and Finland, with nominal transmission power of 350 MW (Table 5). With the development of the electricity market a need for additional interconnections arose. EstLink 2 is the second HVDC interconnection between Estonia and Finland that triples the transmission capacity between the Baltic and Nordic regions. As a result of EstLink 2, Estonia and Finland have essentially become one market area.[393] The construction of the EstLink 2 cable was jointly financed by Elering and Fingrid Oyj. Further, pursuant to a decision by the European Commission on 8 July 2010, the European Union contributed 100 million euros into the capital investment project.[394]

Table 5: EstLink 1 and 2

EstLink 1		EstLink 2
350 MW	Nominal transmission power	**650 MW**
+- 150 kV	Nominal voltage	**450 kV**

Estonia – Latvia and Estonia Russia Electricity Landlines

Estonia is connected, via three 330 kV lines, to the power systems of Russia and with two lines of the same capacity to Latvia[395] (in addition to submarine connection lines EstLink 1 and EstLink 2 with Finland described above).[396]

Estonia–Russia and Estonia–Latvia Gas Pipelines

[393] Estlink's web site: http://estlink2.elering.ee/en/

[394] Elering's web site: https://elering.ee/en/european-commission-agrees-put-100-million-euros-estlink-2-capital-project

[395] Ministry of Economic Affairs and Communications. Available online: https://www.mkm.ee/en/objectives-activities/energy-sector/electricity-market

[396] The electricity import and export can be observed in real time over Elering's web site: https://dashboard.elering.ee/en/transmission/cross-border.

The need for regional connectivity is evidenced by the support that Estonia receives from both the Latvian and Russian markets. Given that the Estonian gas system does not have its own compressor station, the pressure required for transmission within the Estonian system is provided by compressor stations that form part of the Russian transmission system, or the compressor station in Latvia. The Estonian electricity markets is connected to Russia through Narva and Värska-Izborska, and to Latvia via Karksi[397]: The type of common support system and pooling of electricity infrastructure is key to regional integration of electricity market.

Balticconnector Project

The merging of the Finish and Estonian energy markets will be further solidified by the Balticconnector project (see Table 6), a gas pipeline under construction between Finland and Estonia. This pipeline will connect Estonian and Finnish gas grids and assist in enabling security of gas supply in the region.[398]

Pursuant to a decision of the European Commission, the EU will fund surveys amounting to 5.4 million euros for constructing Balticconnector. Balticconnector has been included in trans-European energy networks (TEN-E). Further, Balticconnector has been included in the Projects of Common Interest (PCI) list of the EU Connecting Europe Facility (CEF) program. The support of the European Commission has been instrumental in funding this project: on 15 July 2016, the European Commission decided to co-fund the establishment of Balticconnector up to 75% and the enhancement of Estonia-Latvia gas connection up to 50%, with total funding amounting to 206 million euros.[399]

Table 6: Balticconnector project

General information	
Type	natural gas
Partners	Elering Baltic Connector OY
Expected	2020
Technical information	

[397] Ministry of Economic Affairs and Communications. Available online: https://www.mkm.ee/en/objectives-activities/energy-sector/gas-market

[398] BEMIP Gas Regional Investment Plan 2012–2021 *(Report). Available online:* https://www.cire.pl/pliki/1/GRIP_BEMIP_MAIN3.pdf

[399] Elering's web page. Available online: https://elering.ee/en/balticconnector

Length	151 km (94 mi)
Maximum discharge	2 billion cubic metres per annum (71×10^9 cu ft/a)
Diameter	20 in (508 mm)

B. Governance System

1. Relevant Institutions in the Energy Sector

Legislative power. The Parliament (Riigikogu) is the single-chamber parliament of Estonia, with the main task of fulfilling the function of establishing legal acts (laws). Therefore, the main laws in the field of energy are also adopted by the Riigikogu. The most important legal acts passed by Riigikogu in the field of energy are the Electricity Market Act (EMA) and Natural Gas Act (NGA).

Government. Regulations implementing the aforementioned laws are passed either by the Government of the Republic or by the relevant minister. The Ministry of Economic Affairs and Communications is responsible inter alia for the activities in the energy sector in relation to the electricity market, energy efficiency, renewable energy, heating sector, gas market, liquid fuels.

Regulators and agencies. The Estonian Competition Authority is the main energy market regulator in Estonia as regards issuing relevant operational licenses and approving prices that are subject to price subject to price regulation as well as terms and conditions of services that are subject to approval requirement by law. The Estonian Competition Authority also performs supervision over the compliance with competition law rules. The Estonian Technical Surveillance Authority is responsible for securing safety and efficient use of resources, inter alia in the field of energy. The Estonian Consumer Protection Board is responsible for protecting consumers' rights, inter alia in the field of energy. The two latter authorities have merged as of 1 January 2019. All the aforementioned authorities are administrative bodies with the power to conduct surveillance over the compliance of laws by the market participants in their areas of responsibility; they can also issue fines for violations.

Market participants with administrative functions. A wholly state owned public limited company Elering is the Estonian electricity and gas transmission system operator (TSO) with the task of connecting the producers, various network operators and consumers who make up the system into a unified whole. Elering has also some administrative functions, such as operating renewable energy support scheme (including establishing renewable energy charges payable by energy consumers and paying out subsidies to renewable energy producers). Elering is in the administrative area of competence of the Ministry of Economic Affairs and Communications and the shareholders' rights over Elering are executed by the minister of Minister of Economic Affairs and Infrastructure.

The effective central government supported by a robust regulator plays a crucial role in Estonian energy policy and has the competence and ability to determine national energy development. This strong central government supported by an effective regulatory framework lays the ground for further implementation of EU energy policies.

2. Tariff structures

Tariff structures and setting prices for energy products. The price of electricity and gas is not regulated in Estonia and market participants are free to set their prices. The only exception relates to dominant sellers of gas. Section 9^1(3) and (4) of the NGA provides that the sales price of gas of a dominant gas seller must ensure the reimbursement of operating costs and that a commercial profit is made Further, the Estonian Competition Authority may request evidence to ensure compliance with the foregoing conditions. In addition, §10 of the NGA regulates the selling price of gas to household customers by dominant gas sellers. Therefore, it can be noted that other than as set out above, the Estonian electricity and gas market is a liberalised market.

The price of heat in respect of district heating is regulated by District Heating Act (DHA). According to §9(1) of DHA, the approval of the Estonian Competition Authority is required in relation to the price ceiling for heat. Section 8(3) of the DHA sets out the criteria for establishing the price ceiling for the price of heat. Therefore, provided that the price ceiling is not exceeded, the price for heat is not regulated.

While the prices or electricity and gas are generally not regulated, the prices and standard terms and conditions of network services (both for transmission network services and for distribution network services, as well as for district heating network) are regulated by the law (§71-74 of the EMA, §23-23[2] of the NGA and §10-12 of the DHA) and must be approved with the Estonian Competition Authority. Also, the price of balancing services for electricity and gas and standard terms and conditions of balance agreement are regulated respectively by § 53 of EMA and §12 of NGA.

Levies and tolls. In order to finance the renewable energy subsidies, renewable energy charges are payable by all energy consumers. According to § 59[2] of the EMA, Elering as the TSO determines the charge payable each year.[400]

In addition, excise duties apply to fuel[401], gas and electricity. The basis for such excise duties is established in Alcohol, Tobacco, Fuel and Electricity Excise Duty Act (Excise Duty Act) and the collection excises is generally managed by the Estonian Tax and Customs Board. In the case of natural gas, the § 22(1) 7[4] of the Excise Duty Act provides when this excise must be paid by network operators. The excise for gas transmitted to consumers is charged by the network operators from consumers. In the case of electricity, § 22(1) 7[5] of the Excise Duty Act provides that excise must be paid by network operators who consume electricity or transmit electricity to consumers, consumers of self-produced electricity and consumers of electricity transmitted through a direct line. As in the case of gas, the excise for electricity transmitted to consumers is charged by the network operators from consumers.[402]

3. Proposals to Save Energy

The Ministry of Economic Affairs and Communications is primarily responsible for developing measures to save energy and increase energy efficiency and ensure the compliance of the goals set out in Energy Efficiency Directive 2012/27/EU. As for the promotion of renewable energy, the renewable energy support scheme is set out in the EMA and implemented mainly the by TSO, Elering.

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[400] The details of determining and collecting the charge is set out in § 59[2] of the EMA.

[401] Fuel is defined in section 19 of the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act.

[402] https://www.emta.ee/eng/business-client/excise-duties-assets-gambling/fuel-and-electricity.

4. General Planning In the Energy Sector

The general planning of energy sector is in the administrative area of competence of the Ministry of Economic Affairs and Communications. However, the general development plans have been approved by the Government of the Republic in the National Development Plan of the Energy Sector until 2030, which describes the objectives of Estonia's energy policy until 2030, the vision for the energy sector until 2050, as well as the overall and specific targets and actions to meet them.

Security of supply. In the field of electricity, the EMA sets out the requirements for securing the supply, imposing respective obligations mainly on Elering. In the field of natural gas, the NGA sets out the requirements for securing the supply, imposing respective obligations also mainly on Elering. The supervision over the implementation of security of supply measures lies with the Estonian Competition Authority.[403]

5. Transmission and Distribution Network Services

The transmission and distribution network services providers charge network service charges. The prices and standard terms and conditions of network services (both for transmission network services and for distribution network services, as well as for district heating network) are regulated by the law (§ 71-74 of the EMA, § 23-23^2 of the NGA and § 10-12 of the DHA) and must be approved with the Estonian Competition Authority. The Estonian Competition Authority prepares annually Estonian electricity and gas market reports, in which is provides detailed market overview.[404]

6. Planned Structural Reforms In the Electricity Sector

[403] Elering has recently published the Security of Supply Report 2018, available at: https://elering.ee/sites/default/files/public/Infokeskus/elering_vka_2018_web_trc_ENG_v4.pdf.

[404] The reports in English are available at the Estonian Competition Authority's web site: https://www.konkurentsiamet.ee/index.php?id=14463. The 2017 report describes in detail the principles regarding determining electricity network charges.

On 20 October 2017, the Government of the Republic approved the National Development Plan of the Energy Sector until 2030, which highlights all of the most important near future plans and reforms in the energy sector. In the area of renewable energy, the most important upcoming change is the introduction of competitive bidding process for renewable support. The conditions for the bidding process are currently being prepared.

C. Energy Regulatory Framework

The key legal acts in the field of energy are Electricity Market Act (EMA), which implements various EU electricity directives[405], and Natural Gas Act (NGA), which implements various EU gas directives[406]. The EU legislative package deals with an array of questions such as ownership unbundling; regulatory oversight and cooperation; network cooperation; transparency; record keeping. Whilst the government has the ability to influence prices for political reasons such as to limit inflation, for instance. Estonia has implemented and followed EU legislation. Both in electricity and in gas, the ownership unbundling between the production and transmission system operation has been implemented. In the field of electricity, the basis for unbundling is §16 of the EMA, in the field of gas, the basis for unbundling is §8[1] of the NGA.

The Estonian Competition Authority's latest Estonian Electricity and Gas Market Report comments the fulfilment of the ownership unbundling obligation in the field of electricity as follows:

> "In the second half of 2013 the Competition Authority conducted the assessment of compliance of Elering AS the transmission network undertaking upon its application or, the so-called certification process. In the assessment the Competition Authority followed in addition to the provisions of the Electricity Market Act also the requirements provided for in Regulation (EC) No 714/2009 of the European Parliament and of the Council (that treats of the network access conditions in the cross-border electricity trade). The Authority confirmed the compliance of the undertaking to the requirement by its decision made in December 2013.
>
> A distribution network undertaking shall form a separate business entity if the number of customers exceeds 100 000 and shall not operate in other area of activity than the provision

[405] By way of example, Directive 2009/72/EC of the European Parliament and of the Council and Directive 2001/77/EC of the European Parliament and of the Council.

[406] By way of example, Directive 2009/73/EC of the European Parliament and of the Council and Directive 2009/28/EC of the European Parliament and of the Council.

of network service. Respective requirement applies only to the distribution network Elektrilevi OÜ that belongs to the Eesti Energia AS group, while other distribution network undertakings have less than 100 000 customers.
If a distribution network undertaking has less than 100 000 customers it shall separate its accounts by areas of activity as follows:

- provision of network service;
- sale of electrical energy;
- ancillary activity.

Also, all distribution network operators, regardless of their size, shall keep their accounts on the same principles, as separate undertakings operating in the same area of activity should have been required to keep. Therefore, a distribution network operator that is not required to form a separate business entity is obliged to keep its accounts similarly to a business entity and shall submit in its accounts separately the balance sheet, profit and loss account, management report and other reports provided for in the Accounting Act both for network services, electricity sales and ancillary activities. Respective information shall be submitted in their annual report and made public. The auditor shall give its evaluation on the separation of the fields of activity."[407]

The Estonian Competition Authority's latest Estonian Electricity and Gas Market Report notes the fulfilment of the ownership unbundling obligation in the field of electricity as follows:

"From 1 March 2016 the complete ownership unbundling of the Estonian system operator is finalised and the Estonian gas system operator is Elering AS (100% in the ownership of the Estonian state).
From the beginning of 2016 Elering AS consolidated the electricity and gas transmission networks into one company and continuous its activity as the operator of the joint system. In the second half of 2016, upon the application submitted by Elering AS, the Competition Authority conducted the evaluation of the latter as the natural gas system operator's compliance to the requirements or, the so-called process of certification. Besides the bases of the Natural Gas Act in the evaluation the Competition Authority adhered also to the provisions of Regulation no. 715/2009 of the European Parliament and of the Council (treats of the network access conditions). In December 2016 the European Commission informed that it agrees with the draft resolution prepared by the Competition Authority

[407] Estonian Electricity and Gas Market Report, 2017. Available online: https://www.konkurentsiamet.ee/index.php?id=14463, page 12, see also following pages regarding equal treatment obligation.

upon the application of Elering AS and the Authority confirmed the undertaking's compliance to the requirements by its decision made in December 2016." [408]

1. Interconnection

The European Union recommended in 2002 that all Member States should reach by 2020 a minimum of a 10% interconnection ratio (import capacity vs installed generation capacity). Estonia is well over the threshold in respect of the advocated interconnection capacity of 10%. Estonia has, as of 2014, exceeded the advocated thresholds for 2020 and 2030. Relying on studies by ENTSO-E the future perspective of Estonia regarding interconnection capacity is ranked high among Member States in respect of interconnection capacity.[409] In 2017, the electricity interconnection level of Estonia was 23.7%.[410] New cross-border links do not *per se* have to be established and financed in order to meet the EU electricity interconnection standards as these standards have already been met. However, the transfer capacity on the Latvian – Estonian border will be improved in the following years and the existing bottlenecks will be removed in several stages by 2020, 2024 and 2025 through the construction of the Estonia-Latvia 3rd interconnection and the enhancement of transfer capacity of internal lines within the Baltic States. [411] In 2015, the European Commission decided to finance the construction of the Estonia-Latvia electric power transmission line with 112 million euros. The sum covers 65% of the project's planned 172 million total cost.[412]

Whilst formerly an "energy island", the Baltic States region is connected with European partners through recently established electricity lines with Poland (LitPol Link), Sweden (NordBalt) and Finland (EstLink). These projects were made possible and built with EU support. For historical reasons, however, the Baltic States' electricity grid is still operated in a synchronous mode with the Russian and Belarusian systems.

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[408] Ibid, page 13.

[409] Towards a sustainable and integrated Europe Report of the Commission Expert Group on electricity interconnection targets November 2017. Available online: https://ec.europa.eu/energy/sites/ener/files/documents/report_of_the_commission_expert_group_on_electricity_interconnection_targets.pdf

[410] Brussels, 23.11.2017, SWD(2017) 391 final, COMMISSION STAFF WORKING DOCUMENT, Energy Union Factsheet Estonia, page 5. Available online: https://ec.europa.eu/commission/sites/beta-political/files/energy-union-factsheet-estonia_en.pdf

[411] *Ibid.*

[412] Elering's web site. Available online: https://elering.ee/en/third-estonia-latvia-interconnection

On 28 June 2018, heads of state of Poland and the Baltic states and the European Commission agreed on the Political Roadmap for synchronising the Baltic States' electricity grid with continental Europe. The synchronisation project is included on the third European Union list of Projects of Common Interest and will also qualify for EU support.[413]

The pan-national developments noted above appear to constitute a favourable picture for the market penetration of the set of solutions and technologies brought by the WiseGRID project in the Estonian electricity market. The resilience of the Estonian electricity market can be evidenced by the electricity interconnection level of Estonia was 23.7% (as of 2017). Moreverover, the strong electiricty exchange capacities are conducive to the itegration of increased reenewables on to the Esotnian national grid. Indeed, smart grid applications are being sought after as a means for Estonian consumers to make energy efficient choices.

2. Organisation of the Estonian Energy Market

In Estonia, the selling prices of electricity and gas are not fixed by the government and both electricity and gas markets are fully liberalised. Further, contractual conditions of for sale of electricity are not regulated. The EMA only sets out certain minimal requirements for the invoices submitted to consumers for the sale of electricity in § 75^1. The EMA (§§ 76^1-76^3) also regulates sale of energy by way of universal service – this is available for small consumers, who are able to buy electricity from the network operator at an equitable price.

The selling price of gas is subject to certain legal requirements only in the case dominant gas sellers. As regards terms and conditions and other obligations of gas sellers, §§ 9-10 of the NGA provide the requirement concerning the sale of gas, which includes *inter alia* the obligation to service all household customers and the obligation to publish the terms and conditions for the contracts relating to the sale of gas publicly available.

In relation to the wholesale market for electricity and gas, the prices or contractual conditions are not regulated. In relation to wholesale of electricity in an open market, market participants have the ability to trade through bilateral agreements as well as on the electricity exchange. According to § 11^1 of the EMA, a power

[413] http://europa.eu/rapid/press-release_MEMO-18-4285_en.htm.

exchange operator is the nominated electricity market operator designated by the Estonian Competition Authority in accordance with the requirements set out the Commission Regulation (EU) 2015/1222 (OJ L197, 25.07.2015, pp. 24−72). Currently, Nord Pool is the power exchange operator. Nord Pool offers day-ahead and intraday markets. The day-ahead market is the main arena for trading power, and the intraday market supplements the day-ahead market and helps secure balance between supply and demand.[414]

The wholesale of gas is based on bilateral agreements but can also be operated through Baltic Gas Exchange operated by GetBaltic. Baltic Gas Exchange organises trade for physically settled spot and forward gas products in the market areas located in Estonia, Latvia, and Lithuania. All the participants of the natural gas market, who have the participant's status, may execute trade on the exchange.[415]

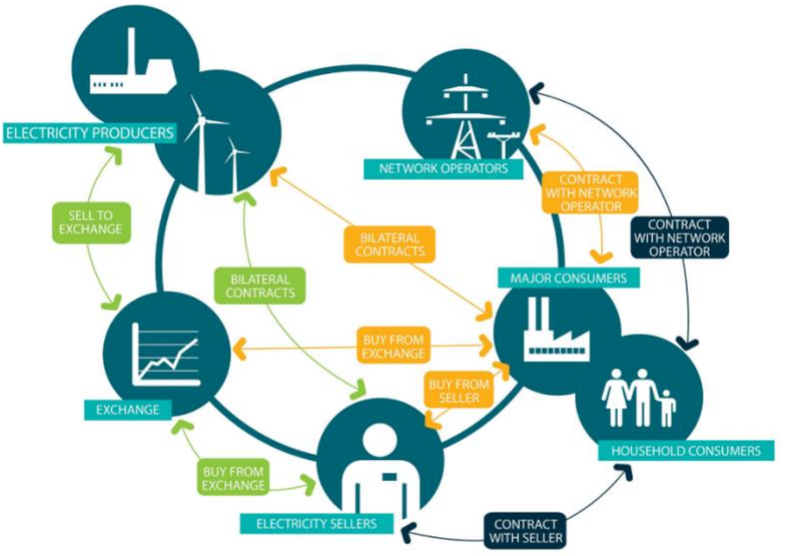
Operation Market

In order to ensure the operation both electricity and gas markets in Estonia, the TSO, Elering acts as the central point. Elering Live brings together data about the Estonian electricity and gas system including electricity production and consumption, cross-border energy flows and energy balance.[416] As the energy markets are liberalised, the role of market regulator is relevant only as concerns network services, but not the market operation *per se*. The system operator both for electricity and gas is Elering, market operators are Nord Pool for electricity and GetBaltic.

[414] Web site of Nord Pool: https://www.nordpoolgroup.com/
[415] Web site of GetBaltic: https://www.getbaltic.com/en/exchange/trade_on_the_exchange
[416] See Elering LIVE web site: https://dashboard.elering.ee/en.

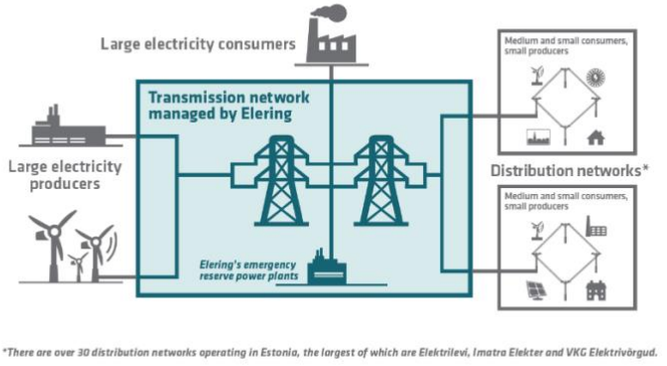
Indeed, given the rather limited role of the market regulator, Figure 4 on the functioning of the electricity market does not contain the market regulator.

Figure 4: Functioning of the electricity market[417]



As noted above, the Estonian electricity system is divided between generation, transmission, distribution, and sale (see Figure 5 below). The market is generally liberalised; except that, as described above, the prices and standard terms and conditions are regulated and must be approved by the Estonian Competition Authority.

Figure 5: Scheme of the electricity system[418]



[417] Elering's web site: https://www.elering.ee/en/electricity-market#tab1.
[418] Elering's web site: https://www.elering.ee/en/electricity-system.

D. Smart Homes/Smart Meters[419]

In relation to electricity consumption, as of 2017, all the electricity meters have been updated to remotely read meters. This is due to the fact that the Estonian Grid Code § 39 (1) states that all standard electricity meters in Estonia had to be replaced by the network operator, by remotely read meters by the end of 2016.[420] Remotely read meters are meters that record data in relation to the amounts of electricity by the hour and allow for automatic transmission of such data, without a need to physically access the metering device.

In relation to gas consumption: there is no data on the amount of remotely read meters in the market. NGA § 24 (6) set-outs the obligation for the procedure and timeframes for the transition to remote metering systems. However, as of early 2019, no transition to remotely read meters have been adopted in the respective network code. Therefore, in contrast to the electricity market, on the gas market, there are currently no general obligations to ensure the transition to remotely read meters. It should be noted that § 2 (4) of network code governing the operation of the gas market, provides a definition for the remotely read meters defined as: remotely read meters are meters which record data regarding amounts of gas by the hour and enable instantaneous transmission of data without a requirement to physically access the metering device.

Nevertheless, pursuant to NGA § 24 (1^3), a network operator will be obliged to ensure that all measuring points where gas is consumed in the amount of at least 750 m^3 per year, are equipped with a measuring system that measures the temperature of gas in the system and enables the collection of measurement data remotely by 1 January 2020. Similarly, NGA § 24 (1^4) provides that a network operator must ensure that by 1 January 2020 all measuring points where gas is consumed at pressure of more than 20 millibars are equipped with a measuring system that measures the pressure and

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[419] "Smart Home" in this context is defined as a home that includes appliances and smart devices that can be accessed or can be controlled using smart devices or systems. At the EU level, smart metering systems or intelligent metering systems are understood as an electronic system that can measure energy consumption, providing more information than a conventional meter, and can transmit and receive data using a form of electronic communication.

[420] The Estonian Grid Code. Available online: https://www.riigiteataja.ee/akt/12831412?leiaKehtiv. An English translation of the Grid Code as of 2012 is available online: https://www.riigiteataja.ee/en/eli/ee/VV/reg/511052016001/consolide

temperature of gas in the system and enables the collection of measurement data remotely.

1. Estonia's Legislative Portfolio Related to Smart Metering Systems

The main legislative acts related to smart metering systems are the EMA and the NGA, which primarily state that the obligation to ensure installation of remotely read meters is on the network operator and in addition establishes the minimum requirements of such remotely read meters. From the perspective of data protection that is related to processing of data via smart metering systems the respective regulation is provided in Personal Data Protection Act and General Data Protection Regulation (EU) 2016/679 ("GDPR"), which is directly applicable in Estonia. Due to the fact that as of 2017 all electricity meters in Estonia have been replaced with remotely read meters that transmit consumption information by the hour, it is possible for the consumers to make decisions regarding billing based on real consumption. For example, Eesti Energia (state owned energy company) has developed a mobile app that allows consumers to view consumption volumes with hourly precision and enables comparison over longer periods (week, month and year) for a more thorough analysis. The application also shows consumers the exchange prices of electricity for the next day. By planning consumption on the basis of actual prices, a consumer can directly influence its electricity bill. The application delivers the greatest benefit in relation to the Exchange Package[421] if a consumer selects the hourly price calculation.[422]

2. Energy Security Considerations: Interplay Between Estonian Policies and Policies Issued by the European Commission[423]

[421] In the Exchange Package, the price of electricity depends entirely on the exchange price and changes every hour as a combined result of many factors.

[422] Eesti Energia's web site: https://www.energia.ee/en/tark-tarbimine/mobiiliapp.

[423] In general, the anticipated roll-out of roughly 200 million smart meters by 2020 in the Member States' electricity industries falls under the objective to promote energy efficiency in the EU. The EU has set itself the challenge to hit a 20% and 27% energy savings target by 2020 and 2030, respectively. The premise is that more efficient energy use can generate multiple positive outcomes. Energy efficiency can cut energy bills for European citizens, reduce CO2 emissions, and foster energy security by alleviating energy dependency on external suppliers.

The Estonian energy security considerations run in parallel with EU policies and the Ministry of Economic Affairs and Communications has confirmed that Estonia's policies regarding energy efficiency and savings are in line with EU policies. Estonia is planning its activities in the area of development of energy efficiency in line with the European Union energy efficiency directive 2012/27/EU adopted in 2012. To ensure the implementation of the large number of measures specified in the directive to all the economic sectors, a new, horizontal Energy Management Act[424] has been adopted in Estonia that transposes the measures of the directive to national law.[425]

In order to guide Member States in this smart-metering transition, the Commission Recommendation 2012/148/EU outlines a series of functionalities to ensure technical and commercial interoperability, or at least ensure the possibility to add such functionalities at a later stage. [426]

In general, Estonia has managed to comply with the minimum requirements for functionalities of the "smart" meters regarding electricity meters, however, some functionalities, by way of example, the data exchange frequency of every 15 minutes is yet to be achieved also regarding electricity meters. The gas meters currently installed in Estonia do not meet the majority of requirements for functionalities.

The gas and electricity meters installed in Estonia provide readings directly to the customer and any third party designated by the consumer. User interfaces and applications have been developed by service providers to allow easy access to consumption data.

All the electricity consumption meters in Estonia allow remote reading of meters by the operator and provide two-way communication between the smart metering system and external networks for maintenance and control of the metering system. As described above, by definition, current remotely read meters both for gas and electricity must enable data recording by the hour. This means, that even though the current meters in use may have the capacity to record consumption data more frequently than by the hour, there is no obligation on the network operators to (and they do not) process data at such frequency. Therefore, as of today's date, the update rate of every 15 minutes for remotely read meters is not achieved in Estonia. As far as support of advanced tariff systems goes, due to the fact that as of 2017 all electricity meters in Estonia have been replaced with remotely read meters that transmit

[424] Adopted on 09.07.2018 and currently available only in Estonian.

[425] Ministry of Economic Affairs and Communications web site. Available online https://www.mkm.ee/en/objectives-activities/energy-sector/energy-efficiency

[426] Ministry of Economic Affairs and Communications web site. Available online https://www.mkm.ee/en/objectives-activities/energy-sector/energy-efficiency

consumption information by the hour, it is possible for the consumers to make decisions regarding billing based on real consumption, as described in paragraph 0.

In relation to privacy, the current electricity meters only measure the total amount of electricity consumed each hour and once a day the number of kilowatt-hours the consumer has consumed is transmitted. The data sent by the meter does not show which devices the consumer has been using and they cannot even be used to determine whether anyone is at home or devices are being switched on automatically. Access to the data on the amount of electricity each customer consumes is restricted by law and the network operators have rules in place to ensure that only authorised personnel can access the data and that they can monitor who is viewing the information. When network operators handle data, they use the same modern security measures to ensure the security of their customers' information as banks, online stores or medical institutions.[427]

E. Data Protection

As smart grids rely on retention of data, it is critical to understand data protection regulation and policies in light of Estonian and European data protections and how Estonia has implemented the European directives on data protection. The safeguard of consumer privacy is a question of the utmost importance, especially in the context of the European internal energy market. The effective deployment of smart metering systems must be subject to the adequate management of consumption data streams. Data protection and consumer privacy are imperative as they constitute basic requirements for the success of the large-scale deployment of smart meters. In turn, smart meters represent one of the most promising tactics to encourage energy efficiency as a means to tackle energy security challenges. The pace of innovation has enabled smart grids to integrate information and communication technologies capable of monitoring energy consumption almost in real time.

Estonia’s data protection regime is in general regulated by the EU General Data Protection Regulation (GDPR) which became directly applicable to all the EU member states on 25 May 2018. Although, the GDPR is directly applicable, the GDPR allows the member states to derogate from some of the provisions and add certain specifications. For that purpose, the members states, including Estonia have adopted national laws on data protection which would regulate the derogations from the GDPR.

[427] Elektrilevi’s home page. Available online: https://www.elektrilevi.ee/en/abi/arvesti#meter_q4

The Estonian Parliament passed the national law on data protection – Personal Data Protection Act (PDPA) – on 12 December 2018. In order for the PDPA to enter into force, the President of Estonia must proclaim the law. There are no relevant derogations or specifications in the PDPA which would have material impact on the data protection with regards to the use of smart grids. Therefore, the general principles and conditions of the GDPR must be taken into consideration.

As described above, the privacy of data subjects is a question of the utmost importance and is an important factor to take into account in the topic of energy market. Firstly, it is important to detect to what extent the personal data is processed in the use of smart grids. Inevitably the registration data provided by the data subject when entering into a contract for using the smart meter (name, address and information on consumer's billing data and payment methods) are considered personal data. But the metering and consumption data, which at first sight might be considered as technical data, is linked with the natural person who is responsible for the metering account via a unique identifier, such as a meter identification number. The aforementioned data are therefore also regarded as personal data because they are associated with an identified or identifiable user and disclose information on his/her energy usage, thereby providing insights on the daily life of the data subject. The Article 29 Working Party[428] has also reached a conclusion in one of its opinions that the use of smart meters falls within the processing of personal data.[429]

The European Commission has issued a recommendation of 9 March 2012 on preparations for the roll-out of smart metering systems (2012/148/EU)[430] in which it emphasises the importance of data protection in the use of smart grids and brings out five main tools that should be used and taken into account:

- data protection impact assessment (DPIA),
- data protection by default,
- data protection by design,

[428] A former advisory body made up of a representative from the data protection authority of each EU Member State, the European Data Protection Supervisor and the European Commission.

[429] Art 29 Working Party, Opinion 12/2011 on smart metering, WP 183 (2011). https://ec.europa.eu/justice/article-29/documentation/opinion-recommendation/files/2011/wp183_en.pdf

[430] Commission's Recommendation of 9 March 2012 on preparations for the roll-out of smart metering systems (2012/148/EU) https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012H0148&from=EN

- privacy enhancing technologies (PETs),
- best available techniques (BATs).

Although this recommendation was issued before the GDPR entered into force, all the five tools are also relevant in the context of the GDPR.

According to Art 35 (1) of the GDPR, where a type of processing, in particular using new technologies, and taking into account the nature, scope, context and purposes of the processing, is likely to result in a high risk to the rights and freedoms of natural persons, the controller shall, prior to the processing, carry out an assessment of the impact of the envisaged processing operations on the protection of personal data. The use of smart grids entails without a doubt such type of processing. In order to guarantee protection of personal data throughout the EU, the Commission's Recommendation stipulated that a data protection impact assessment template should be developed on EU level[431] and which has been developed accordingly.[432]

The Commission's Recommendation also encouraged the incorporation of data protection by design and data protection by default settings in deployment of smart grids and smart metering. These principles have also been included in the Art 25 of the GDPR and the last two tools – privacy enhancing technologies and best available techniques – could also be categorised under the aforementioned principles.

Furthermore, in the use of smart grids, it is essential to detect the relevant parties participating in the data processing, who would be regarded as data controller, processor or simply an authorised third party in accordance with the GDPR. The allocation of roles and responsibilities is important, because when several parties are involved, their responsibilities must be clearly determined. According to Art 28, the data processor and the data controller must conclude an agreement concerning the data processing. Furthermore, data subject must know whom to they can turn when they want to exercise their rights under the GDPR.

Data subjects' rights are another important factor to take into account. The right to be informed when personal data are being collected and processed, the right of access as well as the right to object to certain processing activities (including profiling) and to automated individual decision-making are relevant in the smart metering systems' context. Amongst the new rights, the right to data portability is also likely to be of relevance when smart meters are fully operational.

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[431] https://ec.europa.eu/energy/sites/ener/files/documents/dpia_for_publication_2018.pdf

[432] https://ec.europa.eu/energy/en/data-protection-impact-assessment-smart-grid-and-smart-metering-environment

Concerning the right of access, a mechanism of access to personal data should be established and information on its particular details would best be provided by means of the relevant services contract, once entered with subscribers.[433]

Article 17 of the GDPR stipulates the right to be forgotten and Art 20 the right to data portability, which, in the meaning of smart grids, means that the customers have the right to switch between service providers and the same time decide what amount of data to be transferred to the new service providers and what amount of data to be forgotten. Another important issue to consider is that the processing of personal data in the use of smart grids would be based on valid legal basis. Art 6 of the GDPR lists different legal basis which can be used for data processing, consent being one of them. If processing is based on consent, according to Article 7 and section 32 of the preamble of the GDPR, such consent needs to be freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data.

In the smart grid context, consent might prove unsuitable, mostly due to the fact that the data subjects can freely withdraw it. This is why the legal basis of performance of a contract might be of more relevance to the smart grid purposes: once an individual applies for or has entered a contract for the provision of smart grid services, this will perhaps constitute a more relevant legal basis governing the same individual's personal data processing.[434]

Considering the volume and sensitivity of the data they process; smart meters need to feature secure storage systems as well as backup and contingency policies. Analysing the smart metering data of end user enables to derive surprisingly precise observations about their private lives: time spent at home, working schedule, holidays, use of particular appliances, their habits, and so forth. Such information is valuable for third parties for a number of reasons. The practice of consumer profiling puts the privacy of consumers at stake. It should be noted that the Estonian Data Protection Act does not contain any specific regulations with regard to the profiling of data subjects, the requirements of GDPR apply.

As smart meters require the retention of data in order to be effective and the GDPR requires the protection of data, there is a careful balancing act required between the European data protection legislation and the implementation of smart meters. Whilst there is no specific legislation in Estonia which would cover the data protection issues in the use of smart meters, EMA prescribes several obligations for the TSO. Of note, EMA § 64 (7) and (8) stipulate that the TSO must publish information on its

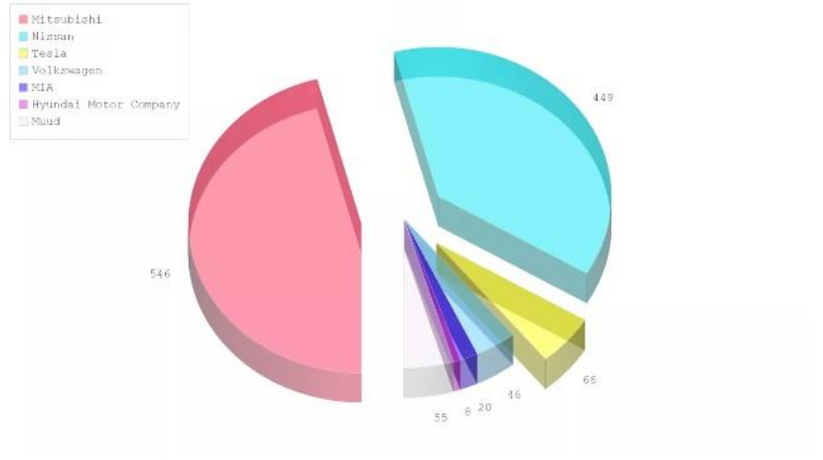
[433] S. Goel et al., Smart Grid Security, SpringerBriefs in Cybersecurity, p 81.
[434] Ibid, p 84.

website how the consumer can access its consumption data and that the consumption data shall be disclosed to the consumer in accordance with the application form regulated in the Estonian Grid Code. Furthermore, EMA § 421 (2) stipulates that if the personally identifiable consumption data is to be transferred to any other party (with whom the consumer does not have a valid contract) though the use of data exchange platform, the consumer must give its consent for such transfer. Such consent must meet the requirements stipulated in the GDPR. In light of the above, arguably the Estonian legislation (via the implementation of GDPR) manages the aforementioned balancing act effectively.

F. Electric Vehicles: Market Penetration

As of 31 December 2017, the Estonian Road Administration register includes 1190 electrical vehicles. There is a total of 725,944 cars registered; therefore, the percentage of electrical vehicles is just 0.16% (Figure 6).

Figure 6: Distribution of manufacturers of electrical vehicles registered in Estonia[435]



There are 167 quick charger stations in Estonia. Of those, 102 quick chargers are in towns and 65 by roads. Out of larger towns, 38 quick chargers are in Tallinn, 11 in Tartu, 5 in Pärnu, 3 in Viljandi and 2 in Narva. The charging stations are distributed as follows:

[435] Accelerista's web site (source Estonian Road Administration). Available online: https://www.accelerista.com/arvamus/mitu-elektriautot-eestis/

- All roads with dense traffic are covered;
- The distance between quick charging points is 40-60 km, suitable and frequently visited places are considered as locations for quick charging stations, e.g. petrol stations, cafes, shops, etc;
- Ports servicing international private transport and local travel ports;
- All settlements with over 5000 inhabitants;
- In towns, charging points are built in locations where people move anyway – for example, next to shopping centres, petrol stations, post offices, bank buildings, parking lots and so forth.[436]

Distribution of the purchase grant and the administration of the quick charging network was organised by Foundation KredEx. It was possible to apply for the grant to purchase electric cars from 18 July 2011 until 7 August 2014. The quick charging network of electric cars was constructed in Estonia by ABB.[437]There have been rumours that the Government of the Republic of Estonia is planning to reinstate the support system for the purchase of electrical vehicles. However, as of today's date, no such systems have been launched. Given the small size of Estonia, the internal transport is mostly conducted by road transportation – air or marine transport, in most cases is not feasible (see Table 7).

Table 7: Transportation of goods by transport types[438]

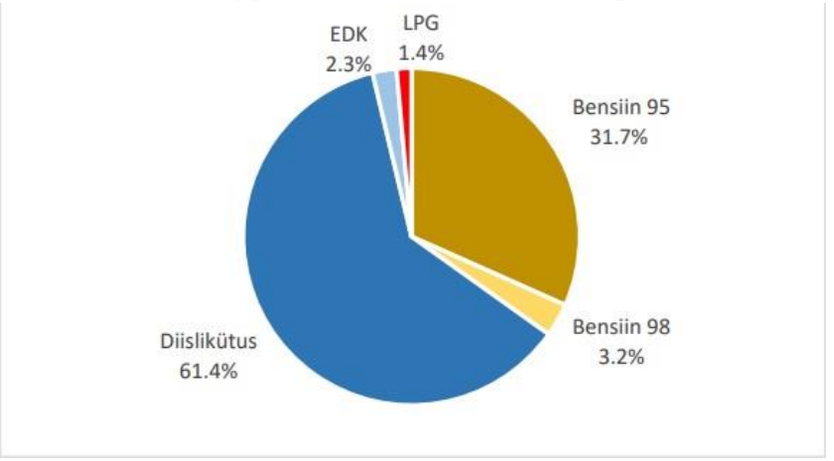
Transportation of goods, thousand tons									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total	67 681	79 127	81 057	78 142	78 726	75 141	66 219	65 354	56 434
Road	27 928	30 276	31 007	31 733	33 131	37 269	36 778	38 810	28 966
Railway	38 392	46 705	48 378	44 731	43 682	36 289	28 026	25 364	27 256
Marine	1 361	2 146	1 672	1 678	1 911	1 580	1 411	..	..
Air	..	..	..	1	2	3	4	..	..

The Estonian transport sector largely relies on liquid fuels to sustain its energy needs. Taken into account that the percentage of electrical vehicles in Estonia is just

[436] ELMO web site. Available online: http://elmo.ee/charging-network/
[437] ELMO web site. Available online: http://elmo.ee/elmo/
[438] Estonian Statistics. Available online: https://www.stat.ee/389969

0.16% and that there are altogether ca 8000 gas vehicles, i.e., ca 1.1% of all the vehicles, the transport sector heavily relies on liquid fuels (see Figure 7). For example, car gas represented only 0.5% of all types of fuel (petrol, diesel, gas) in 2017.[439] During the last 6 months of 2017, 468.8 million liters of fuel were sold in Estonia. Diesel formed two thirds of the total Estonian transportation fuels.

Figure 7: Distribution of type of fossil fuel in the transport sector in Estonia[440]



Approximately 25% of the energy consumed in Estonia is spent by the transport sector. Liquid fuels are imported from abroad for that purpose. 94% of the transport sector energy consumption is attributable to transport by road and vehicles. As Estonia has no oil resources, Estonia does not produce, or process oil and liquid fuels are mostly imported from works in Finland, and Lithuania; smaller quantities also come from Belarus and Sweden. Over the last 10-15 years, the volume of energy and fuels consumed by transport sector has increased by more than 33%. Only in the recession years, 2008-2009, fuel consumption somewhat decreased.[441]

The Estonian government has issued regulations and policies geared towards advancing a "smarter" and more sustainable transport industry.[442] Indeed, the Estonian

[439] Alexela Oil home page. Available online: https://www.alexelaoil.ee/est/uudised.n/autogaasi-muuk-kasvas-moodunud-aastal-ligi-viiendiku-vorra

[440] OSPA home page. Available online: http://www.ospa.ee/eesti-vedelkutuste-turu-kokkuvote/

[441] Ministry of Economic Affairs and Communications web site. Available online: https://www.mkm.ee/en/objectives-activities/energy-sector/liquid-fuels

[442] The electrical vehicle (EV) will play a crucial role in the electricity architecture of the future, particularly in terms of distributed energy storage systems as EVs can integrate storage capacity in smart grids. Indeed, vehicle-to-grid (V2G) systems allows EVs to power and to be powered by the grid. Further, V2G permits the storage of electricity so that it can be used in hours of low production. The promotion of EVs can bring about several benefits. Smart charging during valley hours contributes to flatten the demand curve; EVs will help optimise electricity grid surpluses and will enable a greater share of RES to be integrated in the domestic grid. In addition, the deployment of

Government has had major role in developing the electric charging stations and promoting purchases of electric vehicles in Estonia as described above. Estonia is under the obligation of achieving a situation by 2020 whereby 10% of the transport sector's energy consumption is provided by renewable sources of energy. The main measures applied to ensure the availability of the required quantities of energy from renewable sources are the obligation to supply liquid fuels with a bio component and facilitation of the use of alternative types of fuel. The latter measure includes continued implementation of the ELMO programme and facilitation of the use of bio methane in the transport sector. The new Transport Sector Development Plant 2014-2020 also establishes long-term goals for that purpose.

The National Transport Development Plan 2014-2020 describes the plans for both international passenger and carriage of goods for the next six years. Economic efficiency and environmental soundness have become the most important aspects for planning the development of the transport sector Estonia's main goals in the development of the transport sector over the next years are related to the following areas:[443]

Although the main goals do not *per se* refer to "smart" solutions, the National Transport Development Plan 2014-2020 does note that Estonia has the potential to be a good location for companies to develop and test new solutions thanks to the nation-wide electric charging stations for electrical vehicles.[444]

Therefore, ddespite the nation-wide electric charging stations network and government grants to purchase electric cars from 18 July 2011 until 7 August 2014 the number of electric vehicles in Estonia is still marginal. As noted above, as of 31 December 2017, the Estonian Road Administration register includes 1190 electrical vehicles and the percentage of electrical vehicles is just 0.16%. Therefore, arguably the implementation of the electric vehicle in Estonia to-date has not been effective and further developments are required.

EVs will assist in reducing CO2 emissions, mitigating dependency from foreign energy supplies as well as improving air quality and curtailing noise pollution in cities.

[443] Ministry of Economic Affairs and Communications website. Available online: https://www.mkm.ee/en/objectives-activities/transport

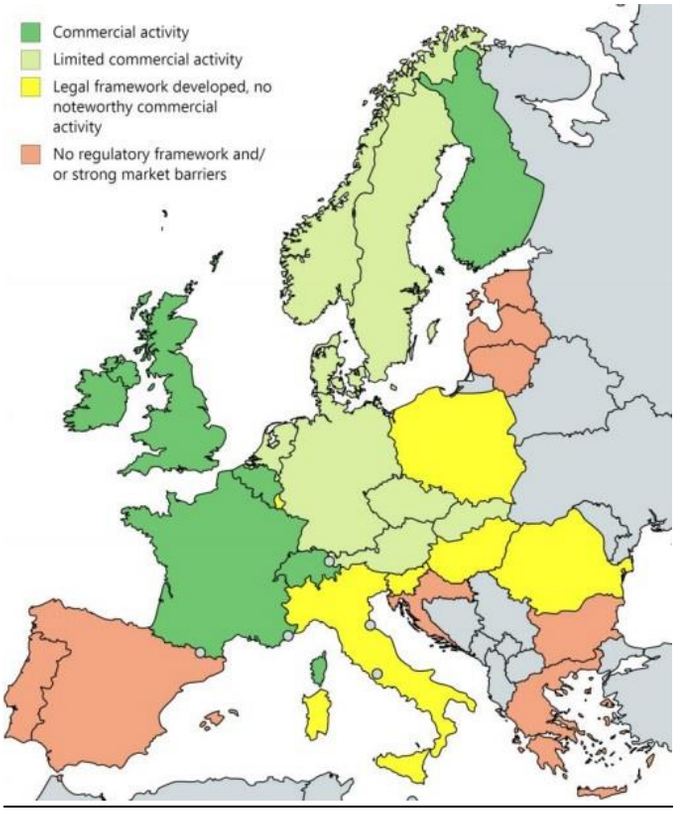
[444] Ministry of Economic Affairs and Communications website. Available online: https://www.mkm.ee/en/objectives-activities/energy-sector/liquid-fuels

G. Demand Response

The concept of aggregator for demand response does not currently exist in Estonia. Indeed, there is no specific legislation within Estonia to support demand response, albeit it is not directly prohibited. It should be noted that at the end of 2017 the Baltic transmission system operators (TSOs) conducted a study to on demand response (DR). The study was the first report prepared by the Baltic TSOs with a goal to develop a proposal for harmonized market framework for explicit DR and aggregation service integration in the Baltic countries.

The goal of this section, as depicted in Figure 8, was to present the concept of a harmonized Baltic DR market model for aggregators participating in the balancing market (mFRR standard product).

Figure 8: Overview of explicit DR integration in EU [445]



[445] Demand response Through Aggregation – A Harmonized Approach in Baltic Region, Concept proposal 2017. Available online: https://elering.ee/en/closed-consultations#tab1

There is no specific legal framework for demand response. The ambigous legal framework currently presents a barrier to the development of demand response and a specific legal framework would be required in order for the efffeictve implementation of demand response.

III. CONCLUSIONS

Decarbonisation is a cornerstone of Ireland's energy strategy. Its commitment to binding targets under Directive 2009/28/EC has pushed renewables and energy efficiency to the forefront of the energy agenda. But while Ireland has made good progress towards these targets, stronger efforts are now required. The 2020 target for gross electricity generation from renewables is 40%, but as of 2016 renewable energy sources contributed to only 27.2%[446]. It should also be recalled that the renewable share of thermal energy was 6.8% in 2016, still significantly below the 2020 target of 12%[447]. On energy efficiency, Ireland also lags behind. While 39% of the national energy savings target was achieved at the end of 2012, efforts need to be accelerated in order to meet the 2020 target, which commits to savings equivalent to 20% of the historical average energy use during the period 2000-2005[448]. Ireland's progress on reducing GHG emissions is dispiriting: current forecasts suggest that non-ETS GHG emissions will be reduced by only 1% by 2020. The target is 20%[449].

Ireland must also consult on how to advance its progress towards its EU interconnection target. The Commission Expert Group behind the 2017 report on electricity interconnection targets identified Ireland as one of the regions most in need of improved interconnectivity, with interconnection levels well below 30%[450]. Improved interconnectivity levels would be essential following the UK's exit from the EU. The so-called "Brexit" would impact on trade through the existing Ireland-UK interconnectors. Moreover, the UK would, as a third party country, no longer be obliged to observe the EU's solidarity principle in the event of supply disruptions or

[446] Sustainable Energy Authority of Ireland, "Energy in Ireland: 1990-2016 (2017 Report)," Sustainable Energy Authority of Ireland, 2017, 20-21.

[447] Ibid 31-32.

[448] Department of Communications, Energy and Natural Resources, "National Energy Efficiency Action Plan 2014," DCCAE, Dublin, 2014, Introduction p. 1.

[449] Environmental Protection Agency, "Ireland's Greenhouse Gas Emissions Projections 2017-2035," EPA, Dublin, 2018, 10.

[450] Commission Expert Group on Electricity Interconnection Targets, "Towards a Sustainable and Integrated Europe: Report of the Commission Expert Group on Electricity Interconnection Targets," European Commission, 2017.

shortages. Accordingly, Ireland should consider making plans now to ensure the security of its supply after the UK exits the EU. At the same time, Ireland should consult closely with the UK about the contingency measures to be put in place to enable the functioning the I-SEM in a post-Brexit environment.

In terms of decentralisation, Ireland's energy market remains distinctly centralised compared to the market of its closest neighbour, the UK. The TSO is a state-owned entity and the DSO a subsidiary of the state-owned utility company, ESB. Meanwhile, Ireland's retail energy market was opened relatively recently, in 2017. Therefore it has significantly fewer players than that of the UK, with the market dominated by the incumbent utility, the state-owned ESB.

Disrupting the domination by the incumbent market players will require the adoption of a new distributed, digital market model. Locally-based networks will need to become the new norm. To help achieve this end, Ireland is now commencing the roll-out of its smart metering programme. But rather than put delivery in the hands of the utility suppliers, as happened in the UK, Ireland has put this under the wing of the DSO. This has helped to put the consumer at the heart of the roll-out. However, Ireland faces public resistance to the programme, which if it remains unchecked may hamper Ireland's efforts to democratise the grid. Accordingly, the roll-out may benefit from being redesigned or adapted in a way that both engages and reflects the demands of the consumer. To this end, Ireland must consider how best to communicate the benefits of digitalisation and democratisation to the residential consumer. Media campaigns to advance smart meters' visibility will help up to a point, but further research and consultation into how to incentivise behavioural change is the most pressing issue.

Ireland has established a robust governance system and comprehensive regulatory framework focused on the implementation of its energy strategy, with the smart grid at its heart. But while Ireland is at the forefront of the transition towards a smart grid in many respects, gaps do remain. In particular, but not exclusively, Ireland will need to ensure that a suitably robust infrastructure is in place to enable the streamlined integration of indigenous renewable technologies; this will undoubtedly be aided by the ongoing DS3 programme. With domestic consumer generation and non-synchronous technologies forming an ever larger part of Ireland's energy mix in its medium to long-term future, innovative market mechanisms to facilitate the deployment of demand response and storage technologies should be prioritised. Meanwhile, Ireland should not lose sight of its early successes in the uptake of electric vehicles: further progress in this regard will hinge however on the appropriate modifications being made to Ireland's nationwide transport infrastructure.

In the case of Estonia, the implementation of policies and regulations of electricity and gas market in Estonia have resulted in a fully liberalised markets where the selling prices of electricity and gas are not fixed by the government. Furthermore, both in electricity and gas markets, the ownership unbundling between the production and transmission system operation has been fully implemented. Therefore, the market is open to competition and consumers are open to choose their suppliers which would

support the set of solutions and technologies brought by the WiseGRID project in the Estonian electricity market.

In relation to smart meters in the electricity market, it has been noted that all standard electricity meters in Estonia have been replaced by remotely read meters as of the beginning of 2017, whereas by law, the remotely read meters have to be meters which record data regarding amounts of electricity by the hour and allow automatic transmission of such data without the need to physically access the metering device. Therefore, the regulation regarding smart meters in electricity market has arguably been effective in supporting the transition to smart grids. However, as opposed to the electricity market, there is currently no general obligation to make the transition to remotely read meters on the gas market. Nevertheless, by 1 January 2020 gas network operators are obliged to ensure that measuring points with larger consumption amounts must also make the transition to remotely read meters. Therefore, the Estonian regulation regarding smart meters in gas market supports the eventual transition to smart grids.

Furthermore, there is a mobile application that allows consumers to view consumption volumes with hourly precision and enables comparison over longer periods (week, month and year) for a more thorough analysis. The application also shows consumers the exchange prices of electricity for the next day. The existence of such technology confirms that Estonia would be receptive to the transition to smart grids.

It should also be noted that both the National Development Plan of the Energy Sector until 2030 and National Transport Development Plan 2014-2020 have placed an emphasis on the utilisation of smart meters and smart grids, which arguably will contribute to Estonia adopting further regulations in support of smart grids to give effect to the above-mentioned plans.

In terms of whether the regulatory models provide the right incentives for investment in smart grid technologies, Estonia is a country governed by rule of law, where the policies and regulations have created a general supportive atmosphere for the transition to smart grids along with liberalised and unbundled electricity and gas markets. Hence, from a legal perspective the regulatory models provide adequate incentives for investment in smart grid technologies.

Based on the above, it can be concluded that the policies and regulations in Estonia have been and are currently robust in supporting the transition to smart grids.