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Energy, Electricity and Smart Grids in Latvia and Portugal – Developments and Concerns

Rafael Leal-Arcas, Filipa Santos and Danai Papadea

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By

Rafael Leal-Arcas,* Filipa Santos,* Danai Papadea*

Abstract

This article explores the electricity sector of Latvia and Portugal, the European Union's (EU) policy on clean energy, electricity, and smart technologies, the relationship developed between them, and the feasibility of smart grids' and other new tools and technologies' popularisation in the context of the Latvian and Portuguese electricity markets. As member states of the EU, Latvia and Portugal must follow the decentralization agenda while increasing their use of encouraging renewable energy sources and establish better interconnection of electricity between their respective neighbouring member states. In this context, this article explores the electricity market of Latvia and Portugal, taking into account promising policies introduced by the EU that aim to incorporate new technologies such as storage solutions and the creation of smart grids.

The article looks at how the priority of decentralized energy is being achieved in Latvia and Portugal. It explores the current domestic energy market in both countries, the current remarkable achievements in energy decentralization in terms of policy and legislation, as well as unique obstacles that have become apparent. It assesses new technologies and novel projects introduced to incentivize or further develop such technologies, namely smart metering systems, electric mobility, demand response, and electricity storage technologies. The article also looks at data protection concerns, the interconnection between the electricity markets of Portugal and Spain and the possibility of a place in the market for the new clean energy sources. The article concludes the domestic reality in both countries and outlines a set of recommendations to facilitate the introduction of new technologies in the energy sector and how to further implement the decentralization of the electricity market.

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1. Introduction

Pursuant to its commitments under the landmark Paris Agreement on Climate Change, the European Union (EU) has proved itself to be a leader in the fight against climate change.¹ This can be supported by the fact that the EU was the first major economy to establish a legally binding framework for its Member States in order to fulfil those climate change commitments, and is currently progressing towards the goal of achieving climate neutrality by 2050 through reducing its carbon emissions.² Preparing for that long-term goal, it needs to present a strategy to achieve it by 2020.³ Challenges for the future are the transition to the circular economy, how technology, innovation and sustainability will transform the way we live, the effective implementation of smart grids, the energy transition, smart cities, making use of electricity to reduce maternal mortality, and the transportation revolution, inter alia.

One of the ways to promote electricity derived from low-carbon, renewable energy that has been deemed worth examining is the development of smart electricity grids or “smart grids”, which have been described as a network “that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both”.⁴ They have been acknowledged to be able to safely integrate not only renewable energy in a country’s energy mix, but also electric vehicles and distributed generators in its network; they are deemed more reliable and capable to prevent or restore power outages thanks to their self-healing via automatic grid reconfiguration.⁵ Furthermore, the promotion of smart grids has the potential to provide, amongst others, energy security in the markets in which it is implemented, and it constitutes a unique opportunity for citizen empowerment⁶ through decentralization, conversely with the traditional centralised structure of energy networks.⁷

¹ Sebastian Oberthür, “Perspectives on EU Implementation of the Paris Outcome,” *Carbon & Climate Law Review*, Vol. 10, No. 1, (2016), pp. 34-45, 34.

² “Energy Union: Commission calls on Member States to step up ambition in plans to implement Paris agreement”, European Commission Press release, Brussels, 18 June 2019, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2993

³ European Commission, “The European Union continues to lead the global fight against climate change” - Brussels, 11 September 2019, available at https://europa.eu/rapid/press-release_IP-19-5534_en.htm

⁴ European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Smart Grids: from innovation to deployment, COM (2011) 202 final, 12 April 2011.

⁵ European Commission, Joint Research Centre – JRC Scientific and Policy Reports, Report EUR 25815 EN “Smart Grid projects in Europe: Lessons learned and current developments - 2012 update”, 2013, Vincenzo Giordano, Alexis Meletiou, Catalin Felix Covrig, Anna Mengolini, Mircea Ardelean, Gianluca Fulli, Manuel Sánchez Jiménez, Constantina Filiou, available at https://ses.jrc.ec.europa.eu/sites/ses.jrc.ec.europa.eu/files/documents/ld-na-25815-en-n_final_online_version_april_15_smart_grid_projects_in_europe_lessons_learned_and_current_developments_-2012_update.pdf, p. 3.

⁶ R. Leal-Arcas, M. Greger, and H. Knigge “Towards energy democratization,” *Colorado Natural Resources, Energy, and Environmental Law Review*, Vol. 31, Issue 1, pp. 101-185, 2020; R. Leal-Arcas, F. Leniewska, and F. Proedrou, “Smart grids in the European Union: Assessing energy security, regulation & social and ethical considerations,” *Columbia Journal of European Law*, Vol. 24.2, pp. 291-389, 2018; R. Leal-Arcas, “Empowering citizens for common concerns: Sustainable energy, trade and climate change,” *GSTF Journal of Law and Social Sciences*, Vol. 6, No. 1, Jan. 2018, pp. 1-37; R. Leal-Arcas, M. Peykova, V. Nalule, and P. Kara, “Decarbonizing the energy sector,” *Journal of Animal and Natural Resource Law*, Vol. XV, pp. 173-271, 2019.

⁷ European Commission, Joint Research Centre – JRC Scientific and Policy Reports, Report EUR 25815 EN “Smart Grid projects in Europe: Lessons learned and current developments - 2012 update”, 2013, Vincenzo Giordano, Alexis Meletiou, Catalin Felix Covrig, Anna Mengolini, Mircea Ardelean, Gianluca Fulli, Manuel Sánchez Jiménez, Constantina Filiou, available at https://ses.jrc.ec.europa.eu/sites/ses.jrc.ec.europa.eu/files/documents/ld-na-25815-en-n_final_online_version_april_15_smart_grid_projects_in_europe_lessons_learned_and_current_developments

This article explores the electricity sector of Latvia and Portugal, the European Union's policy on clean energy, electricity, and smart technologies, the relationship developed between them, and the feasibility of smart grids' and other new tools and technologies' popularisation in the context of the Latvian and Portuguese electricity markets.

The EU has been the most active region in the world in evolving energy policy and implementing climate change and environmental standards.⁸ This has led to the successful reduction of pollution, while growing the economy and fostering global technological leadership.⁹ However, EU member states still import a high level of fossil fuels such as oil and gas to produce electricity in their domestic energy systems, and Latvia and Portugal are no exception. The high imports and usage of fossil fuels pose a threat to the EU's decarbonization path and are contrary to a sustainable development.¹⁰

The decentralization and diversification of energy sources have been a priority in the EU's agenda,¹¹ not only for environmental reasons, but also due to the still oligopolistic nature of the production, consumption, and trade of oil and gas, and the unreliability of their supply due to geopolitical instability in oil-rich countries,¹² the volatility of oil prices and nationalism of resources, amongst other reasons.¹³ To continue with fossil fuel production and imports for the generation of electricity is not a sustainable option for the EU and the world, as it no longer meets energy demands and is irreversibly changing our natural environment. The role of clean energy sources in the energy mix of a country is more crucial than ever and fostering innovation

[-2012 update.pdf](#), p. 3; Rafael Leal-Arcas, Feja Lesniewska, Filippos Proedrou, (2018) 'Prosumers as New Energy Actors', in: Mpholo M., Steuerwald D., Kukeera T. (eds.) Africa-EU Renewable Energy Research and Innovation Symposium 2018 (RERIS 2018), available at https://link.springer.com/chapter/10.1007/978-3-319-93438-9_12

⁸ Alina Averchenkova, et al., "Climate policy in China, the European Union and the United States: main drivers and prospects for the future – in depth country analyses", Policy Paper, Centre for Climate Change Economics and Policy Grantham Research Institute on Climate Change and the Environment in collaboration with Bruegel and scholars at the Center on Global Energy Policy at Columbia University's School of International and Public Affairs 2016, pp.-1-96, at p.36.

⁹ Ger Klaassen et al., "EU climate policy explained", Routledge Publishing, 2015, Edited by Jos Delbeke and Peter Vis, 1st Edition, Chapter 1, at p.4. Available: https://ec.europa.eu/clima/sites/clima/files/eu_climate_policy_explained_en.pdf.

¹⁰ See generally R. Leal-Arcas, SOLUTIONS FOR SUSTAINABILITY: HOW THE INTERNATIONAL TRADE, ENERGY, AND CLIMATE CHANGE REGIMES CAN HELP, Springer International Publishing, 2019; R. Leal-Arcas, "Re-thinking global climate change: A local, bottom-up perspective," *Seton Hall Journal of Diplomacy and International Relations*, Vol. XX, No. 1, pp. 4-20, 2018; R. Leal-Arcas and A. Morelli, "The Resilience of the Paris Agreement: Negotiating and Implementing the Climate Regime," *Georgetown Environmental Law Review*, Vol. 31.1, pp. 1-63, 2018; R. Leal-Arcas, "New Frontiers of International Economic Law: The quest for sustainable development," *University of Pennsylvania Journal of International Law*, Vol. 40, Issue 1, pp. 83-132, 2018; R. Leal-Arcas, "Sustainability, common concern and public goods," *The George Washington International Law Review*, Vol. 49, Issue 4, pp. 801-877, 2017.

¹¹ See generally R. Leal-Arcas and J. Wouters (eds.), RESEARCH HANDBOOK ON EU ENERGY LAW AND POLICY, Cheltenham: Edward Elgar Publishing Ltd, 2017; R. Leal-Arcas et al., ENERGY SECURITY, TRADE AND THE EU: REGIONAL AND INTERNATIONAL PERSPECTIVES, Cheltenham: Edward Elgar Publishing Ltd, 2016; R. Leal-Arcas, THE EUROPEAN ENERGY UNION: THE QUEST FOR SECURE, AFFORDABLE AND SUSTAINABLE ENERGY, Claeys & Casteels Publishing, 2016; R. Leal-Arcas, A. Filis and E. Abu Gosh, INTERNATIONAL ENERGY GOVERNANCE: SELECTED LEGAL ISSUES, Cheltenham: Edward Elgar Publishing Ltd, 2014.

¹² R. Leal-Arcas et al., "Energy trade in the MENA Region: Looking beyond the Pan-Arab electricity market," *Journal of World Energy Law and Business*, Vol. 10, Issue 6, pp. 520-549, Oxford University Press, 2017.

¹³ Leal-Arcas, R. et al., "Energy decentralization in the EU", Queen Mary University of London, School of Law Legal Studies Research Paper No. 307/2019, pp.1-54, at p.2.

can aid meet energy security concerns, while, at the same time, help safeguard sustainable growth and the protection of the environment.¹⁴

The EU's "Third Energy Package" has promoted a greener energy policy by making member states focus on the decentralization of their domestic electricity markets.¹⁵ More recently, the introduction of the "clean energy for all Europeans" package has reinforced the EU's position on the crucial role that clean energy and energy efficiency have within its internal energy market, increasing the role that consumers have in the electricity market and integrating renewable energy sources into a more technological grid.¹⁶ Smart grids are expected to increase substantially across Europe and the decentralization shift from the large centralized power stations to smaller and more distributed local grids will better utilize electricity produced from renewable energy sources and create innovative new technologies to support the low-carbon transition.

As member states of the EU, Latvia and Portugal must follow the decentralization agenda while increasing their use of renewable energy sources and establish better interconnection of electricity between their respective neighbouring member states. In this context, this article explores the electricity market of Latvia and Portugal, taking into account policies introduced by the EU that aim to incorporate new technologies such as storage solutions and the creation of smart grids.

The article looks at how the priority of decentralized energy¹⁷ is being achieved in Latvia and Portugal. It begins by exploring the current domestic energy market in both countries, the current achievements in energy decentralization in terms of policy and legislation, as well as obstacles that have become apparent. It assesses new technologies and projects introduced to incentivize or further develop such technologies, namely smart metering systems, electric mobility, demand response, and electricity storage technologies. The article also looks at data protection concerns, the interconnection between the electricity markets of Portugal and Spain and the possibility of a place in the market for the new clean energy sources. Based on the analysis of the electricity market of Latvia and Portugal, the article concludes the domestic reality in both countries and outlines a set of recommendations to facilitate the introduction of new technologies in the energy sector and how to further implement the decentralization of the electricity market.

¹⁴ R. Leal-Arcas et al., "The contribution of free trade agreements and bilateral investment treaties to a sustainable future," *Zeitschrift für Europarechtliche Studien – ZeuS*, Issue 1/2020; R. Leal-Arcas et al., "Aiming at sustainable trade in the context of the Rule of Law: What role for citizens and how international trade can help reduce fossil-fuel consumption," *Trade, Law and Development*, Vol. 11, Issue 2, 2019.

¹⁵ See European Union Commission, "Third energy package", 21 May 2019. Available: <<https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation/third-energy-package>>.

¹⁶ European Commission, "Clean energy for all Europeans package completed: good for consumers, good for growth and jobs, and good for the planet", (News, 27/5/19), Brussels. Available: <https://ec.europa.eu/info/news/clean-energy-all-europeans-package-completed-good-consumers-good-growth-and-jobs-and-good-planet-2019-may-22_en>.

¹⁷ See generally R. Leal-Arcas et al., "Energy decentralization in the European Union," *Queen Mary University of London, School of Law Legal Studies Research Paper No. 307/2019*, pp. 1-55.

2. Latvia

2.1. Electricity Market

2.1.1. Key figures and statistics on energy and electricity

According to data provided by the International Energy Agency, energy consumption in Latvia saw a general drop between 1990 and 2017.¹⁸ Examining each energy source separately, one can observe that all energy sources' consumption decreased independently, with the optimistic exception of biofuels and waste, whose consumption evolved significantly, from 616 kilotonnes of oil equivalent (ktoe) in 1990, up to 1,007 ktoe in 2017. Oil products have had almost at all times the highest consumption, evolving from 2,066 ktoe in 1990 to 1,428 ktoe in 2017, even when they reached their lowest consumption levels, with 1,095 ktoe in 1999. Their consumption was surpassed only briefly by heat, with 1,935 ktoe in 1991 versus oil products' 1,897; however, since then heat witnessed a sharp drop, with only 605 ktoe consumed in 2017. Electricity and natural gas consumption have remained relatively steady yet declining, with 715 and 698 ktoe respectively in 1990, evolving into 558 and 328 ktoe respectively in 2017. Last in consumption is coal, dropping from 312 ktoe in 1990 to only 37 ktoe in 2017.

Regarding renewables, there has been a remarkable progress in their inclusion in the Latvian energy mix, as per Sustainable Development Goal 7.¹⁹ While they were a mere 17.57% of the country's energy consumption in 1990, they progressed to become more than double in 2016, with the renewables' share being 38.48%.²⁰ This is a very impressive positive development, especially considering that this percentage surpasses country's current obligations on renewable energy consumption as a member of the EU. Specifically, Directive 2018/2001 set a target for the EU Member States to collectively achieve a minimum of 32% of renewable energy consumption by 2032 and tailor their national policies accordingly in order to achieve it.²¹

Examining electricity final consumption in Latvia from 1990 to 2018, one can observe that, similarly, it dropped from 9.05 terawatt hours (TWh) consumed in 1990 to 7.63 TWh consumed in 2018, demonstrating its lowest point in 1996 with 4.90 TWh consumed, but progressively rising after that.²² As for the electricity consumption per sector, from 1990 to 2017 commercial and public services' consumption has seen a notable increase, from 163 ktoe in 1990 to 238 ktoe in 2017, becoming the sector with the most electricity consumption, with a considerable difference from those that follow it. Those are industry and residential consumption, with 152 and 142 ktoe in 2017, respectively, while the least electricity-consuming sectors of the country are agriculture and forestry, consuming combined 16 ktoe in 2017, transport with 9 ktoe, and

¹⁸ Total final consumption (TFC) by source, Latvia 1990-2017 in IEA's World Energy Balances 2019 <https://www.iea.org/statistics/?country=LATVIA&year=2017&category=Energy%20consumption&indicator=TFCbySource&mode=chart&dataTable=BALANCES>

¹⁹ The United Nations' Sustainable Development Goals were introduced in 2015, aiming to crystallise the main targets within which sustainable development can be achieved globally. Sustainable Development Goal 7 is "Ensure access to affordable, reliable, sustainable and modern energy for all". UN General Assembly, 'Transforming our world: the 2030 Agenda for Sustainable Development', 21 October 2015, A/RES/70/1, available at http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

²⁰ Renewable share in final energy consumption (SDG 7.2) , Latvia 1990-2016 <https://www.iea.org/statistics/?country=LATVIA&year=2017&category=Energy%20consumption&indicator=TFCbySource&mode=chart&dataTable=BALANCES>

²¹ Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources [2018] L328/82, Article 3, available at <https://eur-lex.europa.eu/eli/dir/2018/2001/oj>

²² Electricity final consumption, Latvia 1990-2018 in IEA's World Energy Balances 2019 <https://www.iea.org/statistics/?country=LATVIA&year=2017&category=Energy%20consumption&indicator=TFCbySource&mode=chart&dataTable=BALANCES>

fishing, with 1 ktoe.²³ Interestingly, electricity consumption per capita has risen, from 3.40 MWh per capita in 1990 to 3.96 MWh per capita in 2018. It reached its lowest point, similarly to the data analysed above, in 1994, when it reached 1.97 MWh/capita, but has steadily increased from that point onwards.²⁴

As far as Latvia's energy production is concerned, it has demonstrated a relatively steady increase from 1.16 Million tonnes of oil equivalent (Mtoe) in 1990 to almost double that amount, 2.45 Mtoe in 2016.²⁵ On the other hand, the country's net energy imports have significantly declined, from 7.47 Mtoe in 1990 to 2.22 Mtoe in 2016, having reached their lowest point shortly before that, with 1.9 Mtoe in 2014.²⁶ This results in a national total primary energy supply (TPES) that has been reduced from 7.89 Mtoe in 1990 to 4.25 Mtoe in 2016 – the TPES has generally been fluctuating between 4.00 and 4.50 Mtoe (half of the 1990 amount) for the past decade.²⁷

An important element that can help understanding those figures is the fact that Latvia's population, according to the United Nations' statistics, has become the one with the highest decreasing speed worldwide, with a decrease percentage reaching 18.2% from 2000 (2.38 million) to 2018 (1.95 million). This "loss" of one fifth of the country's population is partly due to its rapidly ageing population, and partly to migration in search of better economic prospects within the European Union.²⁸

Latvia's electricity generation has been through several low points and subsequent recoveries in the past three decades, leading it to eventually have in 2018 a slightly higher amount of electricity generation than the one it had in 1990 (6,724 GWh and 6,648 GWh respectively).²⁹ It is interesting to observe how the generation by source has evolved: coal, which held a slim percentage in the 1990s, never exceeding 3.1%, has almost completely vanished from the mix today (0.1%), and oil, which used to be the country's third electricity generation source until 2004, providing up to 20.6% of Latvia's electricity generation in 1996, does not exist in the mix anymore. Wind and biofuels began to take their place in the mix in 1996 and 2001 respectively, starting to gain a noticeable percentage only after 2011, with 1.8% and 14% respectively. However, those amounts are far from comparable with the two largest sources of electricity for the country: hydropower and natural gas. From 1990 to 2018, hydropower has been dominating Latvia's electricity mix (67.6% and 36.2% respectively), with its peak percentage being an impressive 74.5% in 1998. As natural gas has become a strong contender for the first electricity generation source position, progressing from 26.1% in 1990 to 47.9% in 2018, hydropower's dominance has been toppled by it in 2011, 2014, 2015 and 2018.³⁰

²³ Electricity final consumption by sector, Latvia 1990-2017 in IEA's World Energy Balances 2019 <https://www.iea.org/statistics/?country=LATVIA&year=2017&category=Energy%20consumption&indicator=TFBySource&mode=chart&dataTable=BALANCES>

²⁴ Electricity consumption per capita, Latvia 1990-2018 in IEA's World Energy Balances 2019 <https://www.iea.org/statistics/?country=LATVIA&year=2017&category=Energy%20consumption&indicator=TFBySource&mode=chart&dataTable=BALANCES>

²⁵ Key stats for Latvia, 1990-2016 – Energy production <https://www.iea.org/countries/Latvia/>

²⁶ Key stats for Latvia, 1990-2016 – Net energy imports <https://www.iea.org/countries/Latvia/>

²⁷ Key stats for Latvia, 1990-2016 – Total primary energy supply <https://www.iea.org/countries/Latvia/>

²⁸ 'Latvia, a disappearing nation', Gordon F. Sander, 1/5/2018 <https://www.politico.eu/article/latvia-a-disappearing-nation-migration-population-decline/>

²⁹ Author's calculations based on Electricity generation by source, Latvia 1990-2018 in IEA's Electricity Information 2019 - Documentation <https://www.iea.org/statistics/?country=LVA&isISO=true>

³⁰ Electricity generation by source, Latvia 1990-2018 in IEA's Electricity Information 2019 - Documentation <https://www.iea.org/statistics/?country=LVA&isISO=true>

2.1.2. Characteristics and structure of Latvia's electricity market

Despite being a former member of the Soviet Union and therefore an ex-communist country, Latvia has made significant steps towards the opening of its market after the break-up of Soviet Union in 1991. Thanks to the reforms that followed the change of its regime, Latvia along with its Baltic neighbour Estonia are considered the “stars” of the transition from socialism to the market economy, as they succeeded in reaching fast the levels of development of Central European countries.³¹

In 2007, Latvia began its progress towards a free electricity market to all electricity users,³² pursuant to its obligations as an EU Member State, and more specifically to the Directive 2003/54/EC of the European Parliament and of Council of 26 June 2003. The opening of the market initially was limited to legal persons and eventually was completed in 2015, encompassing household consumers.³³

The legal framework within which the Latvian electricity market operates is provided by the Latvian Electricity Market Law, passed by Saeima (the Latvian Parliament) in 2005 and subsequently amended to meet new developments, such as the aforementioned opening of the market, in 2008, 2011, 2013, 2014, 2015 and 2016.³⁴ As the Latvian Electricity Market Law states in Section 2, its purposes are:

- 1) to establish prerequisites for the operation of an efficiently functioning electricity market;
- 2) to ensure that, taking into account the requirements of laws and regulations, all energy customers are provided with electricity in a safe and qualitative manner, in the most efficient possible way for justified prices;
- 3) to ensure all customers with the right to choose an electricity trader freely;
- 4) to promote the production of electricity by using renewable energy resources;
- 5) to promote energy independence ensuring different suppliers of energy resources necessary for production of electricity.³⁵

As for the scope of the Law's application, it regulates the production, transmission, distribution and trade of electricity as a free circulation commodity within Latvia and describes the duties of the electricity market participants and the electricity system participants within the national market. Furthermore, the Latvian Electricity Market Law defines the duties of the competent Latvian Ministry of Economics and the Public Utilities Commission (PUC or ‘the Regulator’, which the Ministry oversees) regarding the monitoring and regulation of the electricity market, and sets incentives for the increase of energy production from renewable sources.³⁶

³¹ Cato Institute, Policy Analysis No. 795, by Oleh Havrylyshyn, Xiaofan Meng, and Marian L. Tupy ‘25 Years of Reforms in Ex-Communist Countries: Fast and Extensive Reforms Led to Higher Growth and More Political Freedom’, 12 July 2016, available at <https://www.cato.org/publications/policy-analysis/25-years-reforms-ex-communist-countries-fast-extensive-reforms-led>

³² History, Augstsprieguma tīkls AS, <http://www.ast.lv/en/history>

³³ Diana Briede, Anda Zvaigzne, ‘Electricity Market Development in Latvia’ (2016) Latgale National Economy Research - *Journal of Social Sciences* No 1(8), 5, 6.

³⁴ Latvian Electricity Market Law (2005), Law of the Republic of Latvia, as amended in 2008, 2011, 2013, 2014, 2015 and 2016, available in English at <https://likumi.lv/ta/en/en/id/108834-electricity-market-law>, most recent amendment available in English at <https://likumi.lv/ta/id/287270>

³⁵ Latvian Electricity Market Law (2005), Law of the Republic of Latvia, Section 2, as amended in 2008 and 2016

³⁶ Latvian Electricity Market Law (2005), Law of the Republic of Latvia, Section 3, as amended in 2013.

Pursuant to the Latvian Law On Regulators of Public Utilities,³⁷ the Regulator is the authority responsible for licensing the provision of public utilities, and subsequently for supervising to which extent the public utilities comply with the conditions of their license, determined quality and environmental protection requirements, technical specifications, standards, as well as contract provisions.³⁸

Another important authority in the Latvian electricity market is Augstsprieguma Tīkls AS or AST, an independent electricity transmission system operator. AST originally was part of Latvenergo, the national state owned public utility company. After Latvenergo's legal unbundling in 2005 and eventually becoming an independent company in 2012,³⁹ AST's shares are wholly owned by the Latvian Ministry of Finance.⁴⁰ As per the Electricity Market Law, AST is obliged to "facilitate the operation of the internal electricity market and cross-border trade, including the support of electricity exchanges development".⁴¹ It is also obliged to annually submit a report to the Ministry of Economics and the Regulator, assessing whether the transmission system supply and consumption and the safety and provision of State electricity supply conform with the national production capacities.⁴²

While the aforementioned state owned Latvenergo used to be a historical monopoly, after the liberalisation of the electricity market new electricity producers have also claimed a place in it. In part because of the public distrust stemming from the fact that the electricity market's liberalisation happened later than it had been initially announced, Latvenergo still holds a strong position in the market despite the competition.⁴³ This can be visible by the fact that Latvenergo is the parent company and only shareholder of Sadales tīkls AS,⁴⁴ the country's main distribution system operator (DSO),⁴⁵ i.e. the national electricity network's maintainer and developer.⁴⁶

As can be observed from the above, the state holds a strong presence in the way the Latvian electricity market operates. This delay in progressing towards decentralisation can be explained by the fact that initially, in the process of bringing the European Union's third energy package in force in 2009,⁴⁷ EU granted a derogation specifically for Latvia.⁴⁸ The country was

³⁷ Latvian Law On Regulators of Public Utilities (2000),), Law of the Republic of Latvia, as amended in 2001, 2004, 2005, 2006, 2007, 2008, 2009, 2011, 2013, 2014, available in English at http://www.vvc.gov.lv/export/sites/default/docs/LRTA/Likumi/On_Regulators_of_Public_Utilities.pdf

³⁸ Sabiedrisko pakalpojumu regulēšanas komisija (Public Utilities Commission), 'Mission, Objective and Functions', <https://www.sprk.gov.lv/en/content/mission-objective-and-functions>

³⁹ European Commission, 2014 Country Reports – Latvia, p. 134, available at https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf

⁴⁰ History, Augstsprieguma tīkls AS, <http://www.ast.lv/en/history>

⁴¹ Organisation of the Electricity Market, Augstsprieguma tīkls AS, <http://www.ast.lv/en/content/organisation-electricity-market>, and Latvian Electricity Market Law (2005) Section 13.1 as amended in 2011.

⁴² Latvian Electricity Market Law (2005), Law of the Republic of Latvia, Section 15, as amended in 2008.

⁴³ Diana Bride, Anda Zvaigzne, 'Electricity Market Development in Latvia' (2016) Latgale National Economy Research - Journal of Social Sciences No 1(8), 9.

⁴⁴ Sadales tīkls AS, 'About Company – Foundation', available at <https://www.sadalestikls.lv/en/about-us-2/who-we-are/sadales-tikls/>

⁴⁵ European Commission, 2014 Country Reports – Latvia, p. 134, available at https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf

⁴⁶ Sadales tīkls AS, 'About Company – Foundation', available at <https://www.sadalestikls.lv/en/about-us-2/who-we-are/sadales-tikls/>

⁴⁷ European Commission, 'Third energy package', available at <https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation/third-energy-package#content-heading-5>

⁴⁸ European Commission, 2014 Country Reports – Latvia, p. 134, available at https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf

considered an emergent gas market and was therefore excused to progress more gradually towards unbundling, the “heart” of the package.

However, the Latvian government does recognize the value of decentralised energy production, as it has been included in the National Energy and Climate Plan of Latvia (covering years 2021 to 2030, created under the country’s obligations as an EU member state⁴⁹) as one of the necessary steps to achieve energy security and independence.⁵⁰ As it is clarified in the document, Latvia embraces the decentralisation and micro generation and their inclusion in the network, as long as there is careful monitoring of their supply network, sufficient planning and analysis of their operation and development, and ensured efficient balancing of the network capacities.⁵¹

As far as the national electricity market’s cross-border interconnectivity is concerned, Latvia’s market at the wholesale level is integrated directly with the markets of Estonia and Lithuania (the Baltic States) as well as with those of Finland, Denmark, Norway and Sweden (the Scandinavian or Nordic countries) as of 2013.⁵²

The Latvian electricity market is also integrated in the EU internal electricity market, since the approval of the Baltic Energy Market Interconnection Plan (BEMIP) in 2009.⁵³ BEMIP is an initiative between the European Commission, Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland and Sweden (and Norway as an observer), aiming to synchronise the Baltics’ grid with the continental European network by 2025.⁵⁴ An initial Memorandum of Understanding was signed between the initiative’s members in 2009, and a new one followed in 2015, in order to further BEMIP’s scope to “security of supply, energy efficiency, renewable energy and the integration of the Baltic States’ electricity network into the continental European network, including their synchronous operation”.⁵⁵

This development is directly connected with EU’s interest in ending the “Baltic energy isolation” through projects of common interest (PCIs), as communicated in the European Commission’s European Energy Security Strategy from May 2014.⁵⁶ At the moment, the Baltic states have succeeded in having impressively high levels of interconnection, but there is still a

⁴⁹ Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, PE/55/2018/REV/1, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ.L:2018:328:FULL, Article 3.

⁵⁰ National Energy and Climate Plan of Latvia 2021-2030, Riga, 2018 (for submitting to the European Commission for evaluation, courtesy translation in English provided by the Translation Services of the European Commission), p. 138 (Annex 1).

⁵¹ Ibid, p. 144.

⁵² Organisation of the electricity market, Augstsprieguma tīkls AS, available at <http://www.ast.lv/en/content/organisation-electricity-market> and Flex4RES – Flexible Nordic Energy Systems, “Framework Conditions for Flexibility in the Electricity Sector in the Nordic and Baltic Countries”, December 2016, p. 53.

⁵³ Augstsprieguma tīkls AS, “Organisation of the electricity market”, available at <http://www.ast.lv/en/content/organisation-electricity-market>

⁵⁴ European Commission, ‘Baltic energy market interconnection plan’, available at <https://ec.europa.eu/energy/en/topics/infrastructure/high-level-groups/baltic-energy-market-interconnection-plan#content-heading-1> (Published 31 July 2014, last update 17 October 2019).

⁵⁵ Ibid.

⁵⁶ European Commission, ‘European Energy Security Strategy’, Brussels, 28.5.2014, available at <https://www.eesc.europa.eu/resources/docs/european-energy-security-strategy.pdf>

lot of potential untapped in terms of their integration and synchronisation with continental Europe.⁵⁷

2.1.3. Energy security

As was mentioned above, Latvia, along with the other Baltic states, Estonia and Lithuania, have been set to integrate into the European energy grid by the target date 2025. This development, apart from promoting interconnectivity within the European Union, also brings a significant shift in where Latvia's energy dependence relies, as it has been until now engaged in a quite different arrangement.

Historically, Latvia's electricity system, along with those of Belarus and Latvia's fellow Baltics Lithuania and Estonia, have been for decades, and still are, heavily interconnected with the Russian energy grid, a situation that was not altered after 1991 in spite of the Union's dissolution.⁵⁸ Although being a close neighbour to a country with such a prolific energy sector as Russia seemingly is advantageous, this is not necessarily the case if certain other elements are taken into account.

Geopolitically speaking, the instability in the Eurasia region has awoken concerns on Russia's ability to be a force of stabilisation, with the events of the 'Five Day War' in August 2008 as the most recent example.⁵⁹ Additionally, the management of Gazprom, the powerful Russian state owned energy group, has proven to be intrinsically linked with the Russian government, a fact that does little to inspire confidence in terms of maintaining a healthy market economy devoid of favouritism.⁶⁰ One can therefore see that Latvia's transition towards the European grid is clearly in its best interest in terms of connecting it with the market of a more politically stable and reliable force as the EU and promotes its energy security by reducing its dependence on Russia.⁶¹

It is worth noting that while this shift from one electricity grid to another has not been completed, there has been a number of cyberattack threats towards the Baltic grid, originating from hackers based in Russia, which if successful could endanger the entire region's energy supply. In order to counter them and minimize the countries' vulnerability against potential hacking attempts, cybersecurity has become a high priority for the Baltic States' authorities, resulting in them signing in October 2019 an agreement with the United States involving the Baltic energy grid's protection from cyberattacks through strategic and technical support.⁶²

2.2. How smart is Latvia's electricity system?

2.2.1. Examination of whether Latvian policy and legislation promote energy decentralization

⁵⁷ European Commission, 'Baltic energy market interconnection plan', available at <https://ec.europa.eu/energy/en/topics/infrastructure/high-level-groups/baltic-energy-market-interconnection-plan#content-heading-1> (Published 31 July 2014, last update 17 October 2019).

⁵⁸ European Commission, 2014 Country Reports – Latvia, p. 137, available at https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf

⁵⁹ Rafael Leal-Arcas et al., (2015) "The European Union and its energy security challenges", *Journal of World Energy Law and Business*, p. 29 - 31, available at: <http://ssrn.com/abstract=2616263>

⁶⁰ Ibid, p. 33 - 34.

⁶¹ Augstsprieguma tīkls AS, "Synchronisation with Europe – Main benefits", available at <http://www.ast.lv/en/projects/synchronisation-europe>

⁶² "US to help secure Baltic energy grid against cyber-attacks", Euractiv, 7 October 2019, available at <https://www.euractiv.com/section/energy/news/us-to-help-secure-baltic-energy-grid-against-cyber-attacks/>

i. Self-generation

An important factor that can indicate to what extent Latvia's electricity system is "smart" and conducive to decentralization, is the role of energy prosumers in it. Prosumers are defined as "self-generating energy providers, whether households or energy communities. Individuals contribute to the energy supply in their vicinity via their own installed renewable energy capacity, more often than not solar roofing, wind energy, or combined heat and power".⁶³ While there is no official definition of the term "prosumer" (a term derived from the words "produce" and "consume") from the European Union bodies, they are alternatively described in relevant documents as "active energy consumers", holding the potential to revolutionize the way electricity systems have been traditionally functioning until today.⁶⁴

Residential electricity generation in Latvia is not addressed, until today at least, by a particular piece of legislation, as so far, as in the other Nordics and Baltics, prosumers are a marginal phenomenon.⁶⁵ What has been preferred is to address prosumers within the national framework, specifically within the Latvian Energy Law and its Electricity Market Law.⁶⁶ In the Latvian Energy Law, prosumers are addressed under the term "autonomous producer", which is defined as "a merchant, an energy supply merchant or a natural person which produces electricity or thermal energy for the purpose of consuming it for personal needs or local heating supply needs".⁶⁷ According to the Latvian Electricity Tax Law, passed after the country's entrance in the EU, in compliance with the relevant Directives on energy products taxation, the autonomous producers that "generate and consume electricity for their own needs" fall out of the law's scope of application, provided that their electricity generation is smaller than two megawatts (MW).⁶⁸

As far as the prosumers' compensation is concerned, the current policy followed by Latvia mandates that when energy is transferred from a household to the power grid, this amount is subsequently deducted by the household's invoice for the next billable month. It is a policy based on the use of the net settlement system, which is in turn based on a metering system permitting net accounting of the electricity transferred and used.⁶⁹

ii. Investment and R&D

A popular practice to encourage the development of renewable energy projects has been the application of feed-in tariffs (FiT). A national economic policy on FiT involves usually appealing terms such as long-term agreements with renewable energy producers and

⁶³ Rafael Leal-Arcas, Feja Lesniewska, Filippas Proedrou, (2018) 'Prosumers as New Energy Actors', in: Mpholo M., Steuerwald D., Kukeera T. (eds.) *Africa-EU Renewable Energy Research and Innovation Symposium 2018* (RERIS 2018), available at https://link.springer.com/chapter/10.1007/978-3-319-93438-9_12

⁶⁴ European Parliament, Electricity 'Prosumers', Members Research Service Briefing, Nikolina Sajn for EP RS - European Parliamentary Research Service, October 2016, available at [http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593518/EPRS_BRI\(2016\)593518_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593518/EPRS_BRI(2016)593518_EN.pdf), p. 1.

⁶⁵ Flex4RES – Flexible Nordic Energy Systems, "Framework Conditions for Flexibility in the Electricity Sector in the Nordic and Baltic Countries", December 2016, p. 6.

⁶⁶ European Commission, Study on "Residential Prosumers in the European Energy Union", JUST/2015/CONS/FW/C006/0127, Framework Contract EAH/2013/CP/04, 2 May 2017, p. 34.

⁶⁷ Chapter I – Section 1 – Term 32 Latvian Energy Law (1998), Law of the Republic of Latvia, as amended in 2000, 2001, 2005, 2008, 2009, 2010, 2011, 2012, 2014, available in English at http://www.vvc.gov.lv/export/sites/default/docs/LRTA/Likumi/Energy_Law.doc.

⁶⁸ Latvian Electricity Market Law (2006), Law of the Republic of Latvia, Section 2, (3).1, available in English at https://vvc.gov.lv/image/catalog/dokumenti/Electricity_Tax_Law.doc

⁶⁹ European Commission, Study on "Residential Prosumers in the European Energy Union", JUST/2015/CONS/FW/C006/0127, Framework Contract EAH/2013/CP/04, 2 May 2017, p. 39.

guaranteed pricing, tied to the renewable energy production's cost, in order to attract investments in this form of energy and therefore the diversification of the energy mix.⁷⁰

Currently, FiT is a dominant practice in all Baltic countries except Latvia, as the FiT that had been in effect there since 2007 is on hold because of concerns on corruption and lack of transparency.⁷¹ The hold is due to last at least until January 2020, when there will be a judgement on the relevant State Aid case, meaning the government until then is hesitant to provide its support in new RES projects.⁷² In spite of that temporarily inconvenient setback, for the decade to come Latvia is certainly open to investments on a national and international level in order to promote low-carbon energy, placing much emphasis in the relevant technological research and development (R&D), which is definitely a positive sign for the future of smart tools and technologies in the country.

In a recent meeting in October 2019, the environment ministers of Latvia, Estonia and Lithuania signed a joint Baltic States Climate Declaration, where they affirmed their countries' common vision regarding to tackling climate change. Apart from committing once again to cross-border cooperation to achieve climate neutrality, they addressed the EU to request adequate funding from its budget in its following multi-year financial plan.⁷³

For the next decade, the European Union has already been set to provide Latvia with financial aid that will support the implementation of its energy and climate plan, through a variety of programmes and funds, such as the Multiannual Financial Framework for 2021-2027, InvestEU, Horizon Europe, the Connecting Europe Facility, the European Regional Development Fund (ERDF), the Cohesion Fund (CF) and the LIFE Programme for the Environment and Climate Action.⁷⁴ Some of them, such as Horizon, are particularly focused in promoting research and innovation, an essential part of the development of smart technologies.⁷⁵ Research and innovation in smart energy is also recognized as a priority area in the Research and Innovation Strategy of Latvia for Smart Specialisation (RIS3).⁷⁶ According to the first RIS monitoring report in 2017, while some relevant structural reforms have taken place in Latvia, such as the development of appropriate conditions to introduce contributions from the EU and national sources directed to science and innovation, eventually investments in the key area of research and development (R&D) had failed to increase, and the national contributions were not amassed as per the plan.⁷⁷

Apart from funding issues, R&D in Latvia is also impaired because of the lack of commercialization opportunities, as well as the lack of cooperation, in an international and a national level, between science, technological and educational institutions, state and industry.⁷⁸ In order to tackle the above, in the Latvian National Energy and Climate Plan for 2021-2030 there are provisions for augmenting the R&D investments and promoting innovation, such as

⁷⁰ Investopedia, "Feed-In Tariff (FIT)", reviewed by Will Kenton, available at <https://www.investopedia.com/terms/f/feed-in-tariff.asp> (last updated 17 September 2019).

⁷¹ Flex4RES – Flexible Nordic Energy Systems, "Framework Conditions for Flexibility in the Electricity Sector in the Nordic and Baltic Countries", December 2016, p. 53.

⁷² Ibid, p. 54

⁷³ Baltic News Network, "Baltic environment ministers sign joint climate declaration", 31 October 2019, available at <https://bnn-news.com/baltic-environment-ministers-sign-joint-climate-declaration-206882>

⁷⁴ National Energy and Climate Plan of Latvia 2021-2030, Riga, 2018, p. 67 – 74.

⁷⁵ Ibid, p. 69.

⁷⁶ Ibid, p. 40 – 41.

⁷⁷ Ibid, p. 118 – 119.

⁷⁸ Ibid, p. 122 – 123.

the introduction of R&D tax credit and the establishment of a cross-sector to connect business and research.⁷⁹

iii. *Smart meters*

Smart meters are an important technological tool that facilitates energy consumers to monitor in real time the amount of energy they are consuming. This function impacts positively their electricity bills and allows them a certain degree of flexibility, in contrast with traditional electricity metering.⁸⁰ They are sophisticated tools, that, apart from providing accurate information to their users, they also aid them to control their energy usage, and can empower to become active players in the energy market through the use of their smart grids.⁸¹ As requested by the European Directive 2009/72/EC, until 2020, where this tool has been made available and assessed positively, at least 80% of consumers should be equipped with smart meters.⁸²

As for Latvia's approach on the matter, the national transmission system operator has planned to install smart meters for all its customers by 2022.⁸³ There has been steady progress towards that direction, with approximately 110,000 meters being replaced yearly, resulting in half a million smart meters installed by September 2018.⁸⁴ According to the National Plan for 2021-2030, it is planned to promote their use even further, by raising consumer awareness on the benefits of their use.⁸⁵

iv. *Electric vehicles*

Electric vehicles (EVs) have been recognized by the European Union as a promising alternative to conventional, fossil fuel consuming vehicles that can support the progress towards sustainable, decarbonised transport in Europe.⁸⁶ This is visible from a series of official EU legal acts, such as the 2014 Directive on the deployment of alternative fuels infrastructure,⁸⁷ the 2016 Regulation on emissions from light passenger and commercial vehicles⁸⁸, the 2016 European Parliament Resolution on a European strategy for low-emission mobility⁸⁹ and the 2019 Regulation on CO2 emission performance standards for new vehicles,⁹⁰ that altogether

⁷⁹ Ibid, p. 139, 141 – 141.

⁸⁰ Flex4RES – Flexible Nordic Energy Systems, “Framework Conditions for Flexibility in the Electricity Sector in the Nordic and Baltic Countries”, December 2016, p. 13.

⁸¹ Rafael Leal-Arcas, Feja Lesniewska, Filippos Proedrou, (2018) ‘Prosumers as New Energy Actors’, in: Mpholo M., Steuerwald D., Kukeera T. (eds) *Africa-EU Renewable Energy Research and Innovation Symposium 2018* (RERIS 2018), available at https://link.springer.com/chapter/10.1007/978-3-319-93438-9_12

⁸² Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, Annex I (2), available at <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0072>

⁸³ National Energy and Climate Plan of Latvia 2021-2030, Riga, 2018, p. 32.

⁸⁴ Ibid, p. 59.

⁸⁵ Ibid, p. 142.

⁸⁶ European Environment Agency, “Electric vehicles in Europe”, EEA Report No 20/2016, Copenhagen, 2016/ Luxembourg: Publications Office of the European Union, 2016, doi: 10.2800/100230, p. 9.

⁸⁷ EU Directive 2014/94 of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure, available at <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094>

⁸⁸ EU Commission Regulation No. 2016/427 of 10 March 2016 amending Regulation (EC) No 692/2008 as regards emissions from light passenger and commercial vehicles (Euro 6), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R0427>

⁸⁹ European Parliament resolution No. 2016/2327 of 14 December 2017 on a European Strategy for Low-Emission Mobility, available at http://www.europarl.europa.eu/doceo/document/TA-8-2017-0503_EN.html

⁹⁰ Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0631>

create a roadmap towards a future where all transport will produce minimum or zero carbon emissions.

In view of the above, one of the objectives of the Latvian National Energy and Climate Plan for the next decade is to endorse alternative fuels and minimize the negative environmental impact caused by transport, through the promotion of this type of vehicles. This is a target covering two of the key five dimensions of the Energy Union⁹¹: energy efficiency and decarbonisation, along with the sub-dimension of renewable energy.⁹² The main policy steps considered necessary in order to accomplish that include the simplification of the administrative procedure needed in order to establish non-public electric vehicle charging points, the promotion of EV purchase and the improvement of the relevant regulatory framework on EVs and their charging infrastructure, and they are included in the country's Alternative Fuels Development Plan 2017-2020 ("AFDP 2020").⁹³

Those steps appear appropriate, considering the primary reason reported to be discouraging Latvians from purchasing EVs is their forbiddingly high price, which renders them a somewhat luxurious item for the average Latvian household, despite its benefits – one must remember that Latvia's GDP per capita is quite lower of its fellow Member States.⁹⁴ Although the benefits offered currently to electric vehicle owners are not negligible, including tax exemptions and use of public transport lanes, the price reduction to make them accessible to the wider public is critical.⁹⁵

v. *Demand response*

Demand response is defined as the intentional modification of normal consumption patterns by end-use customers in response to incentives from grid operators, designed to lower electricity use at times of high wholesale market prices or when system reliability is threatened.⁹⁶ It requires consumers to either actively respond the operator's signals or alternatively, to employ automated solutions to enter into contracts with service providers.⁹⁷ By their active involvement in demand response, those consumers can differentiate from their traditionally passive role and become prosumers.⁹⁸

⁹¹ The Energy Union is a European Union initiative, aiming to endorse EU's energy security, along with climate resilience and innovation, by creating "an integrated, continent-wide energy system". Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", at p. 1, COM(2015) 80 final (25 February 2015), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:80:FIN>

⁹² Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 and European Commission, "Building the energy union", 8 March 2017, available at <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/building-energy-union>

⁹³ National Energy and Climate Plan of Latvia 2021-2030, p. 154 – 155 and Latvian Alternative Fuels Development Plan 2017-2020, 25 April 2017, available in Latvian at <http://polsis.mk.gov.lv/documents/5893>

⁹⁴ National Energy and Climate Plan of Latvia 2021-2030, p. 88.

⁹⁵ Ibid, p. 88 – 89.

⁹⁶ European Commission, "Demand response - empowering the European consumer", SETIS Magazine, Smart Grids, March 2014, available at <https://setis.ec.europa.eu/publications/setis-magazine/smart-grids/demand-response-empowering-european-consumer>

⁹⁷ Ibid.

⁹⁸ Rafael Leal-Arcas, Feja Lesniewska, Filippos Proedrou, (2018) 'Prosumers as New Energy Actors', in: Mpholo M., Steuerwald D., Kukeera T. (eds) *Africa-EU Renewable Energy Research and Innovation Symposium 2018* (RERIS 2018), available at https://link.springer.com/chapter/10.1007/978-3-319-93438-9_12

In the EU legislative framework, the 2012 Energy Efficiency Directive (part of EU's Clean Energy Package⁹⁹) recognizes the importance of demand response in its preambles, as it promotes energy savings and optimal use of networks, and therefore stresses the need to improve the conditions necessary for it to take place and consumers' access to it.¹⁰⁰ For this to be achieved, certain EU member states' obligations have been mapped out. In the Energy Efficiency Directive, member states are called to remove incentives related to transmission and distribution tariffs that could hold behind either overall energy efficiency or "participation of demand response, in balancing markets and ancillary services procurement."¹⁰¹ Additionally, in the EU Regulation on the Governance of the Energy Union, regarding national climate and energy plans, those should include national objectives and measures to ensure, amongst others, the non-discriminatory participation of demand response, including via aggregation, in all energy markets.¹⁰²

No specific measures for the promotion of Demand Response are currently mentioned in the Latvian NEEAP (National Energy Efficiency Action Plan).¹⁰³ However, Latvia does recognize how important the development of such services is and has explicitly stated in its National Energy and Climate Plan that creating an appropriate legal framework for that is a priority.¹⁰⁴ This is an objective echoing the conclusions drawn from a 2017 working group between the Baltic and Finnish transmission system operators, Litgrid AB, Elering AS, and AS Augstsprieguma tīkls, aiming for a harmonised Baltic region approach towards demand response, realised through a common framework;¹⁰⁵ hopefully those plans will not exist solely in theoretical discussions anymore, and will soon become part of Latvia's practice.

vi. Electricity storage

In the European Union legal framework, there was no formal definition of electricity storage until recently, which, for long, had resulted in complications such as hesitation on behalf of transmission and distribution companies to invest in storage.¹⁰⁶ Eventually, in the latest

⁹⁹ The European Union's Clean Energy for all Europeans Package or Clean Energy Package is a set of eight legislative acts, functioning as EU's rulebook regarding to facilitating the energy transition and complying with the Paris Agreement. European Commission, "Clean energy for all Europeans package", (last updated 12 December 2019), available at <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans>

¹⁰⁰ EU Directive No. 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, available at <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF>, preambles (44), (45).

¹⁰¹ EU Directive No. 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, Article 15, paragraph 4.

¹⁰² Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, PE/55/2018/REV/1, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL, Annex I, 2.4.3.ii and 3.4.3.iii.

¹⁰³ European Commission, Joint Research Centre - JRC Science for Policy Report, "Demand Response status in EU Member States", 2016, Paolo Bertoldi, Paolo Zancanella, Benigna Boza-Kiss, DOI:10.2790/962868, p. 27.

¹⁰⁴ National Energy and Climate Plan of Latvia 2021-2030, p. 60.

¹⁰⁵ Augstsprieguma tīkls AS, Baltic Electricity Transmission System Operators' Public Consultation on "Demand Response through Aggregation – a Harmonized Approach in the Baltic Region", 10 November 2017, available at <http://www.ast.lv/en/events/baltic-electricity-transmission-system-operators-public-consultation-demand-response-through>

¹⁰⁶ European Parliament, Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy, "Energy Storage: which market designs and regulatory incentives are needed?", October 2015, available at [http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563469/IPOL_STU\(2015\)563469_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563469/IPOL_STU(2015)563469_EN.pdf) IP/A/ITRE/2014-05, p. 12, 46.

addition to EU's Clean Energy Package, the 2019 Directive on common rules for the internal market for electricity, energy storage in the electricity system was defined as “deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy or use as another energy carrier”.¹⁰⁷

As mentioned before, EU Member States are required to prepare national climate and energy plans, as per the EU Regulation on the Governance of the Energy Union.¹⁰⁸ Those plans have to include the country's national objectives and measures to ensure, amongst others, the non-discriminatory participation of energy storage, including via aggregation, in all energy markets.¹⁰⁹

Latvia currently does not have a developed framework concerning electricity storage and generally has not seen much development on that technological field.¹¹⁰ Similarly to the case of electric vehicles discussed above, this is understandable as decentralised energy storage's cost is still deemed prohibitively expensive,¹¹¹ especially considering the financial situation in Latvia in comparison to other EU member states. As per the national climate and energy plan, Latvia is optimistic that if all goes as planned, beginning from 2020, investments from EU funding sources such as the Innovation Fund and the Modernisation Fund will result in it developing appropriately its energy storage projects.¹¹² Concerning the EU-mandated elimination of discriminations, the plan states that no specific prohibitions for the introduction and use of renewable energy technologies are in force, but those technologies are always subject to restrictions on their location and possible environmental, biodiversity, societal, or territorial conditions.¹¹³

2.2.2. Data protection and cybersecurity concerns

Naturally, as technology and intelligent devices such as those described above gain more ground in citizens' everyday life, there can be a degree of concern about the alarming possibility of the government and other public or private entities being given too much power because of them. This power consists in their facilitated access to smart electricity consumers and their information, an exposure that renders consumers vulnerable against the state and anyone else in possession of their data, as they often contain pieces of information that consumers would prefer that remains strictly in the sphere of their private lives and knowledge.

¹⁰⁷ Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU, PE/10/2019/REV/1, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944>, Article 2(59).

¹⁰⁸ Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, PE/55/2018/REV/1, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL, Article 3.

¹⁰⁹ Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, PE/55/2018/REV/1, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG&toc=OJ:L:2018:328:FULL, Annex I, 2.4.3.ii and 3.4.3.iii.

¹¹⁰ Flex4RES – Flexible Nordic Energy Systems, “Framework Conditions for Flexibility in the Electricity Sector in the Nordic and Baltic Countries”, December 2016, p. 6.

¹¹¹ European Parliament, Electricity Prosumers, Members Research Service Briefing, Nikolina Sajn for EPRS - European Parliamentary Research Service, October 2016, available at [http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593518/EPRS_BRI\(2016\)593518_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593518/EPRS_BRI(2016)593518_EN.pdf), p.4

¹¹² National Energy and Climate Plan of Latvia 2021-2030, Riga, 2018, pp. 73 – 74.

¹¹³ Ibid, p. 36, 59.

Additionally, the automation and digitalisation of all services exposes providers and consumers alike to another danger: that of cyberattacks. The proliferation of the “internet of things” smart devices has opened many possible routes through which the function of a grid can be compromised: electric vehicles, smart meters, thermostats and home appliances, all could potentially be vulnerable parts in a targeted smart grid.¹¹⁴ As described before, especially Latvia has been no stranger to hacking attempts, which, despite the efforts to be kept at a minimum, still cannot be excluded as a possibility.

As far as fears on the protection of data are concerned, the recent EU legislation should be of help in tackling the matter adequately. In May 2018, the Regulation of the European Parliament and the Council known as General Data Protection Regulation or, in its abbreviated form, GDPR, entered into application, in a landmark moment for the Union, initiating “a new era” in the field of data protection of natural persons.¹¹⁵

In summation, the GDPR’s main provisions regulate the processing of personal data in compliance with six quality principles: first, they have to be the product of a fair and lawful process; second, they need to be gathered “for specified, explicit and legitimate purposes and not further processed in a manner incompatible with those purposes”, and third, the processing has to be of an appropriate extent. The other three principles are accuracy, the keeping of the data in an identifiable location only for the necessary amount of time, and security.¹¹⁶ Additionally, at least one of the following conditions concerning the data processing has to be met: the provision of the data subject’s consent, the necessity for either the performance of a contract with the data subject or compliance with a legal obligation, the need to protect the vital interests of the data subject through the processing, the processing’s possible significance for the public interest or the exercise of official authority, or, lastly, the processing’s importance for the controller’s or recipient’s legitimate interests (with the exception of the cases where those are surpassed by the data subject’s interests).¹¹⁷

Regulations, as per European Union law, are automatically binding from the very day they enter in force for all EU member states, who do not need to transpose them as they are already considered part of their legislation.¹¹⁸ It is then in each government’s discretion to decide whether it should promote the updating of national legislation to render it compliant to the Regulation’s content and avoid possible contradictions between its laws, which is what the Latvian government opted for. In fact, in July 2018, Latvia became the first Baltic country to adopt legislation on a national level regarding the GDPR, by entering into force its national

¹¹⁴ Yasin Yilmaz, Suleyman Uludag, “Mitigating IoT-based Cyberattacks on the Smart Grid”, 2017, 16th IEEE International Conference on Machine Learning and Applications, DOI 10.1109/ICMLA.2017.0-109, 517 – 522, 517.

¹¹⁵ European Commission, “A new era for data protection in the EU - What changes after May 2018”, available at https://ec.europa.eu/commission/sites/beta-political/files/data-protection-factsheet-changes_en.pdf

¹¹⁶ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), Document 32016R0679, Article 5.

¹¹⁷ Ibid, Article 6.

¹¹⁸ European Commission, “Applying EU law - EU law and its application”, available at https://ec.europa.eu/info/law/law-making-process/applying-eu-law_en#eu-law and “Types of EU law – Types of EU legal acts”, available at https://ec.europa.eu/info/law/law-making-process/types-eu-law_en

Law on Personal Data Processing¹¹⁹ in lieu its Law on the Protection of Personal Data of Natural Persons (the “DPA”) of 2000.¹²⁰

The authority responsible to supervise the new law’s enforcement is the Data State Inspectorate of Latvia (DSI), which represents the country as its national supervisory authority in the European Data Protection Board, EU working groups and other international forums.¹²¹

It is interesting to note that while the aforementioned DPA Law was in force, there had been approximately 600 inspections related to the Law’s violation in the course of 16 years. It was found that there had indeed been a violation in less than a quarter of the cases inspected, and eventually a fine was imposed in a tenth of the cases inspected, usually ranging in amounts disproportionately low to the fining capacity of the DSI (up to €14,000 for a single case).¹²² Today, after the GDPR and the Latvian Law on Personal Data Processing have entered into force, while the amount of complaints reached a “record number”, the DSI has not imposed many penalties or fined heavily, generally imposing fines up to €2,000¹²³ with the recent exception of a €7,000 fine in August 2019.¹²⁴ The authority has justified its approach by the particularly large number of the complaints which should be examined appropriately, combined with its decision to mainly consult in order to guarantee the GDPR is properly implemented in the first year after its application.¹²⁵

In view of the above, Latvia does have the appropriate legislative tools to address possible cases of data protection violations because of the use of smart electricity technologies. However, the enforcement part does not seem to be as developed yet, and considering the technological advancements taking place every day, and subsequently the potential risks they could pose, it is something Latvian authorities should definitely progress on.

Concerning the possibility of the smart grids being exploited by hackers, cybersecurity in energy infrastructure has been recognized as an important subject by the European Union, mirrored in the creation of a Smart Grids Task Force in 2017, which in June 2019 submitted an energy-specific report on cybersecurity.¹²⁶ The report proposed a Network Code on Cybersecurity to complement the 2019 EU Cybersecurity Act,¹²⁷ and concluded in suggesting

¹¹⁹ Eurocloud, ‘Latvia has adopted the Law on personal data processing’, 31 July 2018, available at <https://eurocloud.org/news/article/latvia-has-adopted-the-law-on-personal-data-processing/>

¹²⁰ Linklaters, “Data Protected – Latvia”, contributed by Ellex Klavins law firm, available at <https://www.linklaters.com/en/insights/data-protected/data-protected---latvia#security> (last updated August 2018).

¹²¹ Ibid and Data Inspectorate of the Republic of Latvia, “International Cooperation”, available at <https://www.dvi.gov.lv/en/personal-data-protection-2/international-cooperation/> (last update 26 June 2017).

¹²² Linklaters, “Data Protected – Latvia”, contributed by Ellex Klavins law firm, available at <https://www.linklaters.com/en/insights/data-protected/data-protected---latvia#security> (last updated August 2018).

¹²³ Law Business Research, “Latvia - The GDPR one year on”, by Anna Vladimirova Krjukova, 25 June 2019, available at <https://www.lexology.com/library/detail.aspx?g=b22dc949-5d51-4e66-a03f-b6b88edc239f>

¹²⁴ European Data Protection Board, “Data State Inspectorate of Latvia imposes a financial penalty of 7000 euros against online retailer”, 3 September 2019, available at https://edpb.europa.eu/news/national-news/2019/data-state-inspectorate-latvia-imposes-financial-penalty-7000-euros-against_en

¹²⁵ Law Business Research, “Latvia - The GDPR one year on”, by Anna Vladimirova Krjukova, 25 June 2019, available at <https://www.lexology.com/library/detail.aspx?g=b22dc949-5d51-4e66-a03f-b6b88edc239f>

¹²⁶ Smart Grid Task Force Expert Group 2, “Recommendations to the European Commission for the Implementation of Sector-Specific Rules for Cybersecurity Aspects of Cross-Border Electricity Flows, on Common Minimum Requirements, Planning, Monitoring, Reporting and Crisis Management”, Final Report, June 2019, available at https://ec.europa.eu/energy/sites/ener/files/sgtf_eg2_report_final_report_2019.pdf, p. 5.

¹²⁷ (at the moment of the Report’s publishing still proposed, today in force) Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for

a holistic approach in mitigating threats of that nature, demanding the collaboration of public and private actors, and the building of trust between EU member states, with each other and their international allies.¹²⁸ Furthermore, in October 2019 a briefing of the European Parliamentary Research Service on cybersecurity of critical energy infrastructure was presented before the European Parliament, also stressing the urgency of developing and applying “strong socio-cyber-physical security measures and policies, notably in the electricity sector”.¹²⁹

As for Latvia’s approach on the matter, the Latvian national climate and energy plan does acknowledge the danger of cyber-attacks and states that in the context of energy security, at today’s digital age one has to be vigilant of cybersecurity issues when developing energy projects.¹³⁰ However, apart from those rather brief statements, no concrete strategy to prevent or at least minimize the risk of cyber-attacks is announced in the plan.

3. Portugal

3.1. Energy Profile

3.1.1. Overview of Portugal’s energy market

Compared to the EU-28 countries, Portugal had the seventh highest energy dependence in 2015.¹³¹ The country relies on energy imports of oil and gas from various other countries in order to meet its energy needs, with the biggest share of imports from Angola.¹³² Portugal has decreased its energy dependence from 83% to 79% of fossil fuel imports due to the increase of renewable energy production, but the dependency on imports for energy supply remains excessively high. In 2017, the country imported 3,072 Gigawatt-hour (GWh) in a total of €168 million, which was more than in 2016, where electricity imports were totalled €88 million.¹³³

Energy production

The energy produced in Portugal is enough to meet the needs of the population, but the country imports electricity from Spain, for commercial reasons. On the other hand, Portugal also exports its electricity production surplus to Spain. According to Redes Energéticas Nacionais (REN)¹³⁴, in the beginning of 2018, renewable energy provided for 61% of energy consumption needs, (31% from wind power, 24% from hydroelectric power, 5% from biomass and 1.1%

Cybersecurity) and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013 (Cybersecurity Act), available at <https://eur-lex.europa.eu/eli/reg/2019/881/oj>

¹²⁸ Smart Grid Task Force Expert Group 2, Final Report, June 2019, p. 100.

¹²⁹ EPRS - European Parliamentary Research Service, European Parliament Briefing authored by Gregor Erbach and Jack O’Shea, “Cybersecurity of critical energy infrastructure”, October 2019, available at [http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/642274/EPRS_BRI\(2019\)642274_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/642274/EPRS_BRI(2019)642274_EN.pdf), p. 7.

¹³⁰ National Energy and Climate Plan of Latvia 2021-2030, p. 56.

¹³¹ Carlos V. Miguel, Adélio Mendes and Luís M. Madeira, “An Overview of the Portuguese Energy Sector and Perspectives for Power-to-Gas Implementation”, MDPI energies review, (2018), 11, 3259, pp. 1-20.

¹³² Carlos V. Miguel, Adélio Mendes and Luís M. Madeira, “An Overview of the Portuguese Energy Sector and Perspectives for Power-to-Gas Implementation”, MDPI energies review, (2018), 11, 3259, pp. 1-20.

¹³³ Mónica Carneiro Pacheco and João Marques Mendes, “Electricity regulation in Portugal: overview.”, Thomson Reuters: Practical Law, Resource ID 6-564-1565, pp.1-23.

¹³⁴ REN operates two major businesses: 1) the transmission of very high voltage electricity in the National Electricity System; and 2) the transport of high-pressure natural gas and overall technical management of the National Natural Gas System, guaranteeing the reception, storage and regasification of LNG and underground storage of natural gas.

from photovoltaic energy), while the remaining 39% of energy needs were met by non-renewable energy production (22% from natural gas and 17% coal).¹³⁵

Portugal is one of the leading countries in Europe promoting the production of energy from renewable sources due to its strategic efforts to replace fossil fuels. In the period between 2005-2015 the amount of renewable energy produced increased 50.64% from 3392 to 5110 kilotons of oil equivalent (ktoe), as seen in Figure 1.¹³⁶ Portugal produced 5.6 million tonnes of oil equivalent (Mtoe) energy in 2014 from a multitude of resources such as from biofuels and waste (52.2%), hydropower (23.9%), wind power (18.5%), geothermal (3.1%) and solar power (2.3%), as per information stated by the International Energy Agency in its 2016 report.¹³⁷

Figure 1: Evolution of renewable energy production between 2005 and 2015

Renewable Energy Type	2005	2007	2009	2011	2013	2015	Δ (2015/2005)
Biofuels	0	162	226	330	274	321	-
Electricity ¹	599	1265	1456	1872	2369	1927	3.2
Biomass ²	2773	2891	3019	2571	2812	2781	1.0
Other renewables ³	20	23	36	61	74	82	4.1
Total	3392	4342	4737	4835	5530	5110	1.5

¹ Includes the contribution of hydro, wind, photovoltaic, and geothermal power; ² includes the contribution of biogas; ³ includes solar (for thermal purposes) and (low enthalpy) geothermal sources.

Source: International Energy Agency¹³⁸

Since Portugal has no indigenous oil reserves and no fossil fuel production (including coal, natural gas and oil), it has a high dependency rate on imports to produce energy. From 2004 to 2014, energy production in Portugal rose 44.4%.¹³⁹ Energy production by renewables is steadily increasing, however its production is volatile due to the intermittent nature of the sources, leaving Portugal with the conundrum on how to the investment and development the urgently needed storage solutions.

Energy consumption

The country's total final consumption (TFC) was 16.2 Mtoe in 2013 as per the most recent available data.¹⁴⁰ The largest consuming sectors are industry (36.7%) and transport (33.3%).¹⁴¹ The residential sector's TFC represented 16.3%, while the commercial and other service

¹³⁵

See

<[https://www.ren.pt/en-GB/media/comunicados/detalhe/renewable production supplied over 60 of electricity consumption in portugal during the first quarter of 2018](https://www.ren.pt/en-GB/media/comunicados/detalhe/renewable%20production%20supplied%20over%2060%20of%20electricity%20consumption%20in%20portugal%20during%20the%20first%20quarter%20of%202018)>.

¹³⁶ Taken from Direção Geral de Energia e Geologia (DGEG): "Renováveis-Estatísticas Rápidas". Available at: <<http://www.dgeg.gov.pt>>.

¹³⁷ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.16.

¹³⁸ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.16.

¹³⁹ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.16.

¹⁴⁰ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.18.

¹⁴¹ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.18.

sectors represented 13.7% TFC.¹⁴² From 2003 to 2013, the industry sector has cut its consumption by 26.7%, while transport demand declined by 16.2%, and the residential and commercial sectors decreased 15.3% and 3.5 %, respectively.¹⁴³

The TFC increased only slightly to 16.11 Mtoe in 2016.¹⁴⁴ In 2015, the transport sector was the most energy intensive sector representing a 41.2% share of the country's final consumption.¹⁴⁵ The industry sector's final energy consumption was at 27.8%, the residential sector was at 15.8% and on the service sector the consumption shared 12.2%.¹⁴⁶ The share of final energy consumption by Portugal in the transport sector was above the EU average which stands at 33.1% while the residential sector was below the EU average of 25.4%.¹⁴⁷ Between 2005 and 2015, the energy consumption by the transport sector saw a decrease of 0.8%.¹⁴⁸ It is likely that the demand will keep decreasing due to energy efficiency initiatives and the increase of renewable energy capacity and generation.

Energy supply

Portugal's total primary energy supply (TPES) was 21.1 Mtoe in 2014, which is 18.3% lower than in 2003.¹⁴⁹ Government projections anticipate an increase in demand in the coming years and predicts that in 2020 the TPES will be 13.5% higher than in 2014.¹⁵⁰ The main supply comes from fossil fuels, accounting for 74.3% of TPES in 2014 (oil (45.1%), natural gas (16.4%) and coal (12.7%)).¹⁵¹ Renewables accounted for 25.4% in 2014, however in recent years renewable supply has been increasing. For example, due to the increase in wind generation, the share of renewables in TPES from 2004 to 2014 has increased from 0.1% to 4.9%.¹⁵²

The most recent statistics by PORTADA show that renewable energy amounted to 4,794 tonnes of oil (toe) in the TPES, an increase from the 4,141 toe in 2003, however a decline from 2016 where the TPES amounted to 5,568 toe.¹⁵³ The decrease of renewable energy in the TPES was

¹⁴² International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.18.

¹⁴³ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.18.

¹⁴⁴ PORTADA (Portuguese database), "Final energy consumption: total and by type of consumer sector", (visited 26/09/2019), available at: <https://www.pordata.pt/en/Europe/Final+energy+consumption+total+and+by+type+of+consumer+sector-1397> .

¹⁴⁵ European Commission, "Energy Union Factsheet Portugal", Commission Staff Working Document SWD (2017) 408 final, Brussels, 23.11.2017, p.10. Available at: https://ec.europa.eu/commission/sites/beta-political/files/energy-union-factsheet-portugal_en.pdf .

¹⁴⁶ European Commission, "Energy Union Factsheet Portugal", Commission Staff Working Document SWD (2017) 408 final, Brussels, 23.11.2017, p.10

¹⁴⁷ European Commission, "Energy Union Factsheet Portugal", Commission Staff Working Document SWD (2017) 408 final, Brussels, 23.11.2017, p.10

¹⁴⁸ European Commission, "Energy Union Factsheet Portugal", Commission Staff Working Document SWD (2017) 408 final, Brussels, 23.11.2017, p.11.

¹⁴⁹ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.17.

¹⁵⁰ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.17.

¹⁵¹ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.17.

¹⁵² International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.17.

¹⁵³ See: <https://www.pordata.pt/en/Portugal/Primary+energy+consumption+total+and+by+type+of+energy+source-1130-9142> .

mainly due to the volatility of hydropower production and its reliability. In 2017, the Iberian Peninsula suffered from a drought¹⁵⁴ which significantly affected the production of electricity by hydropower energy sources. The drop is explained, as hydropower sources between the years 2014 and 2016 provided for 29% of the country's power demand.¹⁵⁵

Since there is a lot of potential for greater renewable energy development in Portugal, there should be more incentives for projects to take place, and there should be more subsidies in place to help the consumer install solar PV's in their homes, however there should also be more development of storage projects, such as research and development into the best batteries to store electricity from renewable sources.

Electricity generation

Within this, electricity generation in 2014 was 52 Terawatt-hour (TWh), 3% higher than in 2013 and 16.1% higher than in 2004.¹⁵⁶ These figures are volatile due to the variable generation by hydropower.¹⁵⁷ In relation to electricity consumption, in 2013 it amounted to 46.3 TWh, which was 5.6% higher than in 2003.¹⁵⁸ The energy produced in Portugal is enough to meet consumption needs, but energy is traded between Portugal and Spain. In 2014, the new import of electricity from Spain was 0.9 TWh, 2% of domestic demand.¹⁵⁹ These imports are volatile due to the nature of hydropower generation, as it can be seen in 2008 these were as high as 9.4 TWh, however in 2014 they were as low as 0.9 TWh.¹⁶⁰

The indicator of energy intensity¹⁶¹ of the country has decreased from 152.2 toe per million of GDP in 1995 to 86.4 toe per million of GDP in 2016, however Portugal is still below EU-28 average standards.¹⁶² In 2010, energy consumption in Portugal peaked at 50.5 TWh before declining in the following years, and 2013 it amounted to 46.3 TWh.¹⁶³ The largest consuming sectors are the commercial and public services sector, which includes fisheries and agriculture, with 35.8% of electricity consumption.¹⁶⁴ The demand for commercial services has increased by 6.5% since 2003. The second largest consuming sector is industry accounting for 34.6% of electricity consumption, followed by the residential sector with 26.6%.¹⁶⁵ The demand for

¹⁵⁴ See: <https://www.hydropower.org/sites/default/files/publications-docs/2019_hydropower_status_report.pdf

¹⁵⁵ <https://www.icis.com/explore/resources/news/2018/02/23/10196550/icis-power-perspective-the-iberian-peninsula-droughts-%20xe2-0x80-hydro-at-risk-gas-fired-power-on/>>.

¹⁵⁶ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.82.

¹⁵⁷ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.81.

¹⁵⁸ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.83.

¹⁵⁹ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.83

¹⁶⁰ Figures 6.3 in International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p. 84.

¹⁶¹ Expressed ratio between gross inland energy consumption and GDP.

¹⁶² EU-28 average was 147.2 toe per million GDP in 1995, and is currently 74.2 toe per million GDP as per: <[https://www.pordata.pt/en/Europe/Energy+intensity+of+the+economy+\(toe+per+million+of+GDP\)-3271](https://www.pordata.pt/en/Europe/Energy+intensity+of+the+economy+(toe+per+million+of+GDP)-3271)>.

¹⁶³ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

¹⁶⁴ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

¹⁶⁵ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

industrial services has decreased by 0.8% in 2013, compared to 2003.¹⁶⁶ On the other hand, the consumption from the residential sector has increased 4.1% since 2003, but the demand has decreased 15.2% from 2010 to 2013.¹⁶⁷ Electricity consumption in the transport sector amounts to only 0.8%, as it uses mostly fossil fuels, and therefore the demand was less unstable than the other sectors.¹⁶⁸

3.1.2. Electricity market

Key characteristics

The Portuguese electricity market is on the way to be fully liberalised and privatised. This process was aided by the introduction of EU directives such as Directive 2009/72/EC¹⁶⁹ and by measures under the financial assistance plan and conditions imposed by the Troika¹⁷⁰ from 2011 to 2014. As an EU member state, Portugal has undergone many policy changes and updates in order to liberalise and centralise its electricity market.

In 1995, the EU's released a White Paper introducing new energy policy goals, including the overall competitiveness of the electricity market, security of supply and environmental protection.¹⁷¹ The policy changes meant that the liberalisation of the internal market for electricity and natural gas became a priority for all EU member states. Subsequently, to meet the liberalisation objectives, the EU adopted the first electricity directive 96/92/EC¹⁷² and gas directive 98/30/CE¹⁷³, introducing competition rules and giving consumers a free choice of energy suppliers.

Directives 2003/54/EC¹⁷⁴ and 2003/55/EC¹⁷⁵ respectively replaced the previous two directives, adopting common rules for the internal electricity and natural gas markets. These directives, especially directive 96/92/EC gave benefits in terms of efficiency gains, higher standards of service, price reductions and improved competitiveness. However, this was not adequate in avoiding risks of market dominance and predatory behaviour.¹⁷⁶

¹⁶⁶ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

¹⁶⁷ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

¹⁶⁸ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.84.

¹⁶⁹ Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

¹⁷⁰ The Troika is the representative of the EU in its foreign relations concerning its common foreign and security policy, specifically in relation to the International Monetary Fund (IMF), the European Central Bank (ECB), and the European Commission; Eurofound, "Troika", (31 August 2017, Eurwork), European Observatory of Working Life, available: <<https://www.eurofound.europa.eu/observatories/eurwork/industrial-relations-dictionary/troika>>

¹⁷¹ See: <https://europa.eu/rapid/press-release_IP-95-1418_en.htm>.

¹⁷² Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity.

¹⁷³ Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas.

¹⁷⁴ Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.

¹⁷⁵ Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC.

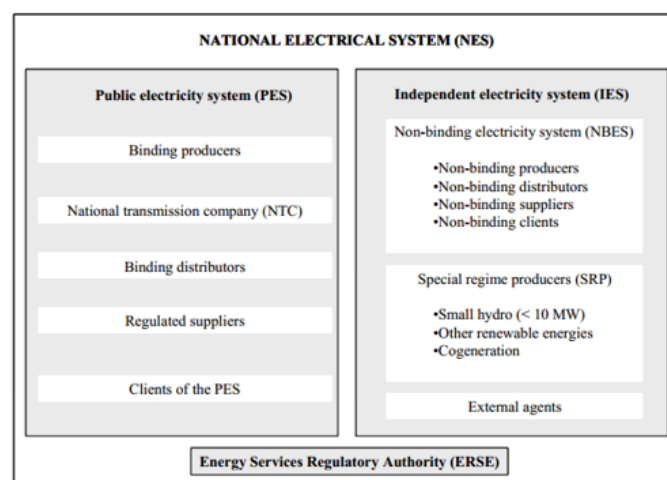
¹⁷⁶ Directive 2003/54/EC; Commission of the European Communities, "Annual Report on the Implementation of the Gas and Electricity Internal Market", (2005), Brussels, COM(2004) 863 final, 5.1.2005.

In Portugal, the opening of the electricity generation market transpired in 1981, however the liberalisation of large industrial consumers only happened in the mid-1990's.¹⁷⁷ Eligibility for small consumers was extended after the market fully opened in 2004. However, this was only done for household consumers in 2006.¹⁷⁸ The EU Commission in 2004 considered that Portugal was at its early stages of its competitiveness development in the electricity market.¹⁷⁹ However, Portuguese legislation was ahead of time, due to the extension of eligibility to small electricity consumers established by Decree-Law 192/2004 of 17 August 2004.

Decree-Laws 182/95 to 187/95 amended by Decree-Laws 56/97 and 198/2000, established the basis of the Portuguese electricity sector. Additionally, Decree-laws 184/2003 and 185/2003 revised the National Electricity System (NES), adapting the Portuguese system to the Iberic Market (MIBEL).

The country's electricity model is based on two sub-systems: the public electricity system (PES) and the independent electricity system (IES),¹⁸⁰ as illustrated in Figure 2.

Figure 2: Portuguese National Electricity System in 2004



Source: ERSE¹⁸¹

The PES must supply electricity to all mainland territory as a public service system. This system comprises of the production activities, the national transportation grids and the distribution activities.

Producers within this system are bonded to the National Transmission Company (NTC) with an exclusivity long-term contract, and must exclusively provide the PES. A concession to operate the transmission network is awarded exclusively to the NTC as a public service system. In Portugal, the NTC is REN who is responsible for the electricity transmission. The Medium

¹⁷⁷ Paula Ferreira and Madalena Araújo, "An overview of the Portuguese electricity market", (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19.

¹⁷⁸ Paula Ferreira and Madalena Araújo, "An overview of the Portuguese electricity market", (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19.

¹⁷⁹ European Commission, "Towards a competitive and regulated European electricity and gas market", (2004), MEMO.

¹⁸⁰ Paula Ferreira and Madalena Araújo, "An overview of the Portuguese electricity market", (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19; See also: http://www.erse.pt/pt/electricidade/actividadesdosector/distribuicao/Documents/Report_DistributedGeneration.pdf.

¹⁸¹ Table found in Paula Ferreira and Madalena Araújo, "An overview of the Portuguese electricity market", (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19., p.5.

Voltage (MV) and High Voltage (HV)¹⁸² distributors may only acquire electricity out of the PES with an 8% limit of their energy and power requirements and are bound to the NTC. Regulated suppliers must supply to all the PES clients, and as per Decree-Law 185/2003, the appointed regulated supplier (and last resource supplier) is Energias De Portugal (EDP) Distribuição.

The IES is formed by the non-binding electricity system (NBES) and the special regime producers (SRP). The NBES is set up as a non-regulated market system with free access to the production and distribution activities apart from Low-Voltage distribution. The non-binding producers, distributors, suppliers and clients all form part of this system. For the non-binding producers and the clients to access the PES transmission and distribution grids a regulated tariff is charged for the services. There can be involvement by external agents such as companies which were legally established in other EU countries that are entitled to trade electricity. Agents and suppliers can perform cross-border commercial transactions using the existing EU transmission grid interconnections.

As per EU Directive 2003/54/EC all member states must assure that all consumers can freely purchase electricity from the supplier of their choice. since 2007.¹⁸³ According to Portuguese law, all consumers located in continental Portugal have access to the NBES and can choose their suppliers and negotiate the terms of their relationship.¹⁸⁴

As per the Regulatory Entity for Energy Services (ERSE), the ability to switch suppliers was possible for small consumers from September 2006, after the implementation of the necessary technology for managing the switching procedure in an effective manner.¹⁸⁵ The small hydropower generation, the cogeneration and the production from other less developed renewable energy sources all form part of the SRP regime. The public electric grid has an obligation to buy the electricity produced by the SRP during the license period at prices based on the avoided costs to the PES and on the environmental benefits of each of the energy sources used in production.¹⁸⁶ ERSE's must regulate the PES and the correlation between PES and NBES. Other competences of ERSE include the setting of regulated tariffs such as the price for electricity for final Low Voltage (LV) consumers, adjusting the rates for the services of the NTG and binding distribution companies and creating codes for commercial dealings and grid access, amongst other competences.

The generation, distribution, and supply activities are unbundled in Portugal, and transmission experienced procedures of unbundling of ownership.¹⁸⁷ There are four categories within the electricity system such as: the generation of electricity; the transmission of electricity through very high and high voltage grids; the distribution of electricity through high, medium and low voltage grids; and the supply of electricity to consumers.¹⁸⁸ These different activities are mostly unbundled as will be outlined below. However, some are subjected to regulation, such as the

¹⁸² Entidade Reguladora dos Serviços Energéticos (ERSE) (Energy Regulator), "Annual report to the European Commission", (2005), Lisboa, Portugal, September 2005.

¹⁸³ Amongst other obligations, Member States must ensure the implementation of a system of third-party access to the transmission and distribution systems for all eligible customers.

¹⁸⁴ Decree-Law 192/2004 of August 17, 2004 on consumers' eligibility of low voltage energy.

¹⁸⁵ ERSE, "Comunicado- Consumidores domésticos podem mudar de fornecedor de electricidade a partir de Setembro de 2006", Lisboa, December 2005 (In Portuguese).

¹⁸⁶ ERSE, "Comunicado- Consumidores domésticos podem mudar de fornecedor de electricidade a partir de Setembro de 2006", Lisboa, December 2005 (In Portuguese).

¹⁸⁷ Unbundling refers to legal and accountability separation.

¹⁸⁸ ERSE, "Annual report on the electricity and natural gas markets in 2017: Portugal", July 2018, pp. 3-134.

transmission, distribution, the supplier of last resort and the logistic operations for switching supplier, and the administration of organised markets.¹⁸⁹

Generation and supply activities are liberalised and therefore not regulated. These activities can be established by any company that the proper procedures such as licensing, registration or prior communication to the start of the activities.¹⁹⁰ There are two categories which define the generation of electricity: the ordinary and the special regimes.¹⁹¹ The ordinary regime can include for example, thermoelectric power plants, while the special regime covers electricity generation from renewable sources, cogeneration, small production and production by any other ‘special’ regimes, such as self-consumption.

The transmission activities are done through exclusive public concession awarded by REN, as these were denationalised in 2011.¹⁹² REN has an exclusive concession contract for all mainland Portugal territory. The transmissions provider by law has an obligation to connect all entities into its network on a non-discriminatory basis if it is economically and technically feasible to do so, and if the applicant meets the connection conditions.¹⁹³ The right of access to the transmission network is given by written agreement vis-à-vis the use of the network. The operator can receive compensation for the use of its facilities as set out in the Tariff Regulation that was passed and is monitored by ERSE.

Under the public concession regime, the operators obtain the exclusive right to perform distribution activities in different parts of the country. There must be an agreement drafted for the use of the distribution grids and the payment of the regulated tariffs as established by ERSE in the Tariffs Regulation must be executed prior to access to the distribution grid is assumed. The terms and conditions of the agreement must be approved by the regulator (ERSE). Within this, there are two regimes for the supply of electricity, namely: the free market supply to eligible consumers and the supply of last resort.

The free market supply to eligible consumers represents to the consumers who have been entitled to such supply since 4 September 2006. Such supply is provided by the free vendors using negotiated conditions between the parties, excluding certain conditions that are compulsory and regulations set by ERSE. The supplier of last resort represents the supply licenses that must guarantee the universal supply to specific consumers under regulated tariffs established annually by ERSE. This supplier must purchase all special regime production at regulated fixed prices for each generation technology, whether under feed-in-tariffs or other subsidiary schemes. This does not mean that the special regime producers cannot sell their electricity to other suppliers.

The generation activities in a free market regime are connected to a wholesale market, where producers can sell the generated electricity and consumers seek to buy it. The trading of electricity is a retail market in Portugal, where trading agents will compete to supply electricity to end customers. A recent trend in Portugal has been the exponential increase in renewable energy generation. This is such that in March 2018, the generation of electricity by renewable

¹⁸⁹ ERSE, “Annual report on the electricity and natural gas markets in 2017: Portugal”, July 2018, pp. 3-134.

¹⁹⁰ Paula Ferreira and Madalena Araújo, “An overview of the Portuguese electricity market”, (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19.

¹⁹¹ Mónica Carneiro Pacheco and João Marques Mendes, “Electricity regulation in Portugal: overview”, Thomson Reuters: Practical Law, Resource ID 6-564-1565, pp. 1-23, at pp. 2 and 6.

¹⁹² The privatisation process was established in Decree-Law 228/2006 of 22 November 2006.

¹⁹³ Such as unbundling requirements under the Third Energy Package; See: <https://www.ceer.eu/documents/104400/3731907/C15-LTF-43-04_TSO-Unbundling_Status_Review-28-Apr-2016.pdf/a6a22f89-3202-4f8b-f9ed-adf705185c33>.

energy sources was superior to the effective consumption in the mainland.¹⁹⁴ Another trend is that there has been an increase in applications for production licenses.¹⁹⁵

Portugal has also been promoting the use of electric vehicles and charging points for such vehicles which will be explored in more detail. All these activities will be discussed in the paragraphs below to determine to which extent it is aiding the country fulfilling the intended liberalisation and decentralisation of the electricity market.

Transmission and distribution

The national transmission grid provides electricity transmission activities under a concession agreement, awarded exclusively to REN by virtue of article 69 of Decree-Law No. 29/2006 of 15 February. REN is responsible for all transmission activities such as the planning, implementation and operation of the national transmission grids, related infrastructure, any relevant interconnections and facilities which are necessary to operate the grid. To ensure the efficient and homogenous operation of the system and ensure a continuous and secure supply of electricity, REN must coordinate the national electricity system's infrastructure.

For the operation of the national distribution grid an exclusive concession also needs to be granted. EDP's subsidiary, EDP Distribuição exclusively holds the concession as per article 70 of Decree-Law 29/2006 of 5 February, as a result of a conversion of the licence held by EDP Distribuição under the previous electricity framework.. The terms of the concession are laid out in Decree-Law 172/2006 of 23 August. However, in the Autonomous Region of Madeira (RAM), the concession for electricity distribution is held by Electricidade da Madeira (EDM), and in the Autonomous Region of Azores by Electricidade dos Açores (EDA).

The electricity distribution network is approximately 99% owned by EDP Distribuição in Portugal's mainland. The network consists of high-voltage (60 Kilovolts (kV)), medium-voltage (30kV, 15kV and 10kV) and low-voltage overhead and underground power lines. Additionally, it has sub-stations, transformation posts and other equipment needed for exploitation. Public lighting amenities can also form part of the distribution system.

There is a Quality of Service Regulation¹⁹⁶, with competences including responsibility and obligation of quality of service for the different agents and entities operating the electricity sector. ERSE has the responsibility to assure the fulfilment of this regulation as per Decree-Law No. 215-B/2015 of 8 October 2015.

3.1.3. Place in the Market for different energy sources

Historically, Portugal has a high dependency in imported energy as it does not produce oil, natural gas or coal. Recently however, an increase in renewable energy generation, has led to the decline in dependency. In 2017, wind and hydro power generation were the main drivers in growing energy production in Portugal, with 21.6% wind energy production and 13.3% hydropower energy production.¹⁹⁷

¹⁹⁴ Report by the Portuguese Renewable Energy Association and the Sustainable Earth System Association said citing data from power grid operator REN: <<https://www.weforum.org/agenda/2018/04/last-month-portugal-produced-almost-104-of-its-electricity-from-renewables>>.

¹⁹⁵ Mónica Carneiro Pacheco and João Marques Mendes, "Electricity regulation in Portugal: overview", Thomson Reuters: Practical Law, Resource ID 6-564-1565, pp.1-23.

¹⁹⁶ ERSE Regulation No. 455/2013, published 29 November 2013.

¹⁹⁷ Monica Carneiro Pacheco and João Mendes, "Energy 2020: Chapter: Portugal", Global Legal Insights, 7th edition, (2019), in Phillip Thomson and Julia Derrick (eds.), pp.173-181. Available at: <https://www.acc.com/sites/default/files/resources/20190314/1492599_1.pdf>.

Portugal's solar power production is expected to increase in the future, especially with new incentives and projects emerging in the national and regional levels. Due to a lack of precipitation in 2017, the national production decreased, and due to the low representation of renewable sources there was an increase in the annual price of electricity in the wholesale market from €39.4/MWh in 2016 to €50.40/MWh in 2017.¹⁹⁸

Nevertheless, the country was still able to run for 122 non-consecutive hours on 100% renewable generated electricity sources¹⁹⁹, proving that running on renewable energy is achievable. The increase in renewable capacity was done especially between 2004 and 2011, with the installation of several wind farms. New power plants have been commissioned in 2017, including the Foz Tua hydroelectric plant (263MW), the Pico Alto geothermal power plant (4.5MW) and large-scale photovoltaic solar power plants (14MW), many other small-scale PV plants that count for self-consumption, and other small projects.²⁰⁰ Other renewables technologies have not seen this increase in capacity, and technologies such as biomass and wind power stagnated in 2017.²⁰¹

There has been a proliferation in new renewable energy projects, with many power plants being licensed, and some already are in the construction stage. The Portuguese Government predicts that by 2021, the current installed capacity of renewable energy sources will increase from a total of 572MW to 1,600 MW, counting with the 30 power plants currently being built.²⁰² Power purchase agreements are being negotiated with energy traders and suppliers, pursuant to which generator is responsible for enabling the disposal of the electricity for a buyer, which in turn will resell it on organised markets or by bilateral agreements. This method gives generators a price per MWh agreed with the buyers. This represents a change in policy from the previous remuneration method for renewable projects through feed-in-tariffs set by law and regulation.²⁰³ It may provide for an effective solution, as the feed-in-tariffs have not increased capacity as predicted.

In order for the promotion of renewable energy to be fruitful, there is a need to solve the intermittency and storage conundrum, which is one of the reasons Portugal is witnessing a 'lithium rush', with growing utilisation of the mineral for the production of batteries used in electric vehicles and electricity storage.²⁰⁴

The country has also been encouraging the development and investment in electro-mobility, as discussed in section 1.6. of this article. Portugal has regions which form part of the EU outermost regions (ORs)²⁰⁵, with a high potential for renewable energy sources to be used instead of fossil fuels, due to the regions having ideal weather conditions such as all-year round sunlight. Included in these small islands is the island of Porto Santo in RAM. This island is a perfect candidate to become a self-sufficient community based on renewable energy sources,

¹⁹⁸ According to Associação Portuguesa de Energias Renováveis (APREN), available at

<<https://www.apren.pt/contents/publicationsreportcarditems/09-boletim-energias-renovaveis--setembro.pdf>>.

¹⁹⁹ See: <<https://www.sciencealert.com/portugal-just-ran-for-4-straight-days-entirely-on-renewable-energy>>.

²⁰⁰ Monica Carneiro Pacheco and João Mendes, "Energy 2020: Chapter: Portugal", Global Legal Insights, 7th edition, (2019), in Phillip Thomson and Julia Derrick (eds), pp.173-181.

²⁰¹ Monica Carneiro Pacheco and João Mendes, "Energy 2020: Chapter: Portugal", Global Legal Insights, 7th edition, (2019), in Phillip Thomson and Julia Derrick (eds), pp.173-181.

²⁰² See: <<http://ieefa.org/portugal-to-triple-solar-capacity-by-2021/>>

²⁰³ Monica Carneiro Pacheco and João Mendes, "Energy 2020: Chapter: Portugal", Global Legal Insights, 7th edition, (2019), in Phillip Thomson and Julia Derrick (eds), pp.173-181.

²⁰⁴ See:<<https://phys.org/news/2018-09-booming-electric-car-sales-lithium.html>>

²⁰⁵ Small Islands (with the exception of French Guiana) which have a vast supply of renewable energy sources that are better than in continental Europe but are still heavily dependent on oil imports; as per Eduardo Maldonado, "Final Report: Energy in the EU Outermost Regions (Renewable Energy, Energy Efficiency)", pp.1-21, at p.2.

and it could be a leader in the low-carbon transition.²⁰⁶ The problem is the isolation of the island can make it difficult to obtain energy sources if renewables fail to operate for in case of a shortage. This makes it crucial to have guarantees of system stability and penetration of storage solutions.

The Portuguese government saw the potential of Porto Santo Island and has started a pilot project to develop storage capacity in order to use more effective stability providers, such as better batteries²⁰⁷, and has plans to increase the renewable capacity of the island.²⁰⁸ Porto Santo plans to be 100% renewable by 2030 and its favourable weather conditions are an advantage in achieving this objective.²⁰⁹ However, the island lacks the necessary infrastructure needed to fully capitalise on intermittent energy sources, and more investment and initiative is needed to achieve the objectives. For example, instead of investing in the current infrastructure used to produce energy in the island from gas and oil, the investment should be going to replacing the wind turbines that were removed.

3.2. The liberalization of the Portuguese electricity market

The liberalisation of the electricity market in Portugal followed a process like most EU member states. The process started with the entrance of independent power producers with long-term contracts. Following this, a more active wholesale market was established and the retail market opened to competition at the last stage.²¹⁰

Different legislation has been introduced in Portugal to aid the process. As an illustration, in 1981 Decree-Law 20/81 mentioned for the first time the possibility of electricity auto-production, for entities producing from renewable energy or using technology that promoted reduction in primary energy consumption. Decree-Law 149/86 of 1986 built on the principle onto power plants that exclusively produced electricity. There were delays however, which lead to the introduction of Decree-Law 189/88 to establish a more rapid liberalisation procedure and created conditions allowing for the economic viability for small power plants.²¹¹ Decree-Law 189/88 replaced the previous laws and instituted the guidelines for independent power production, which allowed and incentivised the production of electricity from renewable energy sources and cogeneration.

The PES was introduced by Decree-Law 99/91 along with the license system which opened competition fully in the electricity generation sector. Following this, Decree-Laws 182/95 to 187/95 reviewed Decree-Law 99/91 setting the bases of the PES and the IES in 1995.²¹² The process was followed by the progressive opening of the retail market between 1995²¹³ and 2004.²¹⁴

The Portuguese wholesale market is jointly established with the Spanish one. The Portuguese and Spanish governments signed an agreement to develop the Iberian power market (MIBEL)

²⁰⁶ Eduardo Maldonado, “Final Report: Energy in the EU Outermost Regions (Renewable Energy, Energy Efficiency)”, pp.1-21, at p.2.

²⁰⁷ Eduardo Maldonado, “Final Report: Energy in the EU Outermost Regions (Renewable Energy, Energy Efficiency)”, pp.1-21, at p.2.

²⁰⁸ Pact of Islands, “Sustainable Energy Action Plan: Porto Santo Island”, March 2012. Available at <http://aream.pt/files/2016/05/ISEAP_Porto_Santo_EN.pdf>.

²⁰⁹ See: <<https://phys.org/news/2018-09-booming-electric-car-sales-lithium.html>>

²¹⁰ A. Al-Sunaidy and Richard J. Green, “Electricity deregulation in OECD countries”, *Energy*, (2006) volume 31 (6-7), pp. 769-787.

²¹¹ Since its publication, Decree-Law 189/88 suffered some changes published in subsequent text laws.

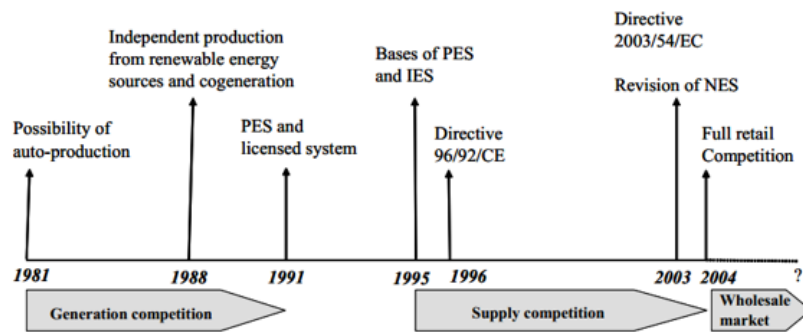
²¹² Since its publication, Decree-Law 182/95 suffered some changes published in subsequent Decrees-Law.

²¹³ Decree-Law 182/95 of 27 July 1995.

²¹⁴ Decree-Law 192/2004 of 17 August 2004.

in 2004, approved by the Resolution of the Assembly of Republic 33-A/2004. Decree-Laws 184/2003 and 185/2003 established the dispositions for the supply, importation and exportation activities in the free Iberian market, where electricity is traded by bilateral contracts or on organised markets and the Power Purchase Agreement will be terminated. Any termination of these agreements imply economical compensations to the involved parties. In Decree-Law 240/2004, values for maximum compensation for the PES power plants were established.²¹⁵

Figure 3: The Process of Liberalization of the Portuguese Electricity Market



Source: Paula Ferreira and Madalena Araújo, “An overview of the Portuguese electricity market”, (2006) Paper from the Department of Production and Systems, University of Minho, pp.1-19, p.5.

The electricity-market liberalization process in Portugal, as depicted in Figure 3, was meant to make the electricity market competitive and result in more favorable tariffs for consumers. In 2012, the Portuguese government announced the elimination of regulated tariffs,²¹⁶ which was meant to resolve the electricity tariff deficit and the elimination of regulated for domestic consumers finalising the liberalisation process of the electricity market in the country. Under the terms of Government Ordinance No. 39/2017 of 26 January 2017, consumers who still have regulated tariffs have a transitional period until 31 December 2020 to choose an electricity market supplier.

Government Ordinance No. 144/2017 of 24 April 2017 states that consumers who still have these regulated tariffs have a transitional period until 31 December 2020 to choose a natural gas market supplier. It is free to switch supplier in Portugal, a process which is propelled by the supplier which the consumer has chosen for the supply of electricity and it requires no changes of meter. ERSE provides lists of companies that operate in the electricity market and offers a price comparison simulator to help consumers be better informed before switching supplier.²¹⁷

3.3. Regulatory Framework

Regulators

As already mentioned, the generation and supply of electricity and natural gas in Portugal are free activities, which are not regulated. On the other hand, the operation, transmission and distribution, LNG terminals and storage facilities, as well as maintenance and exploration activities are regulated, with access tariffs which are set administratively by the national

²¹⁵ The European Commission has examined the state aid given to EDP in relation to the compensation. See <https://ec.europa.eu/competition/state_aid/cases/249957/249957_1520737_47_2.pdf>.

²¹⁶ European Commission, “Country Reports: Portugal”, (2014). Available at <https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_portugal.pdf>.

²¹⁷ Price simulations by ERSE, available at: <<https://simulador.precos.erse.pt/>>

regulatory authority, ERSE.²¹⁸ ERSE is responsible for the regulation, supervision and sanctioning of the energy sector. Law No. 9/2013 of 28 January 2013, created the Energy Sector Sanctioning Regime and reinforced ERSE's sanctioning competencies and functions. Decree-Law No. 84/2013 of 25 June revised ERSE's by-laws and completed the implementation of Directives 2009/72/EC and 2009/73/EC.

Another regulator worth mentioning is the General Directorate of Energy and Geology (DGEG), which develops and implements state policies and guidelines concerning the energy sector and the exploitation of natural resources. The DGEG competencies include granting the licensing and other clerical permissions which are energy related such as exploration and production licenses for oil and gas developments, or power—generating licenses. In this respect, ERSE is the independent national regulatory authority and the DGEG represents the state on energy matters, with licensing competencies.

The main legal framework for the electricity sector can be found in Decree-Laws No. 29/2006 and No. 172/2006, both created on the 15 February 2006. The governing laws for the natural gas sector can be found in Decree-Laws No. 30/2006 of 15 February 2006, and No. 140/2006 of 26 July. The regulations put forward by ERSE, such as the Commercial Relations Regulations, the Tariff Regulations, the Quality of Service Regulation and the Infrastructure Operation Regulation²¹⁹, are also sources of law within the scope of the energy sector. The DGEG also has put forward regulations, namely the Transmission Network Regulation and the Distribution Network Regulation.²²⁰

Government policies have been set up in the National Plan of Action for Energy Efficiency 2013-2016 (PNAEE 2016)²²¹ and in the National Plan of Action for Renewable Energies 2013-2020 (PNAER 2020).²²² These two policies purposes were to aid the improvement of strategic energy creation and use by finding ways to achieve international goals and obligations Portugal has committed to²²³ in relation to energy efficiency and the increase in use of renewable energy sources, without harming economic development and ensuring fair and reasonable energy prices for the consumer. Considering that the country's scarcity and dependence on imports of fossil fuel resources and the economic situation in the previous decade, these Plans of Action aim to reduce the energy dependence of the country by increasing the generation of energy by renewable sources and by promoting energy efficiency and assuring an increased sustainable future.

Regulated activities

The transmission and distribution of electricity are subject to administrative authorisations, in most cases given by DGEG.²²⁴ The operation and exploration of the national transmission and distribution networks are given under concession agreements entered with the government,

²¹⁸ ERSE's by-laws were enacted by Decree-Law No.97/2002 of April 12, 2002, amended by Decree-Law No.212/2012 of September 2012.

²¹⁹ Available at <www.erse.pt/pt>.

²²⁰ See <<http://www.dgeg.gov.pt/?cn=7165726772697295AAAAAAA>> .

²²¹ Information available in English at: <<https://www.ica.org/policiesandmeasures/pams/portugal/name-43751-en.php?s=dHlwZT1lZSZzdGF0dXM9T2s.&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwwYT4gInJhcXVvOyA8YSBocmVmPSlvcG9saWNpZXNhbmRtZWZzdXJlcy8iPlBvbGliaWVzIGFuZCBNZWFzdXJlczwvYT4gInJhcXVvOyA8YSBocmVmPSlvcG9saWNpZXNhbmRtZWZzdXJlcy9lbmVyZ3llZmZpY2llbmN5LyI-RW5lcmd5IEVmZmljaWVuY3k8L2E-PC9uYXY->>> .

²²² Information in English available at: <<https://rea.apambiente.pt/content/renewable-energy?language=en>> .

²²³ EU 20/20/20 measures which commits Portugal to achieve an overall reduction of primary energy consumption of 25% and to have 31% of its gross energy consumption fuelled by renewable energy sources.

²²⁴ Morais Leitão, Galvão Teles, Soares da Silva & Associates, "Electricity Regulation in Portugal", 26 March 2019. Available at <<https://www.lexology.com/library/detail.aspx?g=cfec2d65-0615-46cc-a86e-76334f4f01ce>> .

which grant the exclusive right to explore the networks within an agreed region with the concessionaires for 50 years for transmission and 35 years for distribution activities. As well as the national distribution network (generally high and medium voltage), there are municipal distribution networks, mainly low-voltage grids. The right of exploration of the municipal grids is granted by concession agreements given by the corresponding municipalities for a period of 20 years.

The exploration and production, transmission, distribution and operation of liquid natural gas (LNG) terminals and LNG storage facilities are regulated subject to administrative authorisation. The operation of LNG transmission and distribution networks and of LNG storage facilities are granted by means of concession which last 40 years within a certain area. Additionally, there are local natural gas distribution networks, without physical connection to the national distribution network. A license for 20 years is obtained for the operation from the Minister of the Economy and Employment (MEE) and delivered to the DGEG's office.

Regarding the right for oil exploration, development and production is granted by the MEE also through a concession agreement. No discovery of oil which would be economically viable to explore, and produce has ever been found in Portugal to date. However, the law was established in a way that makes it an attractive and simple endeavour for upstream activities.²²⁵ For example, there is no legal obligation for production sharing and the concessionaire is exempt from paying royalties and free to sell the oil, except in the event of a war or national emergency. The concessionaire is free to dispose of any natural gas found and does not have to pay any production tax. These concession agreements are granted by means of a public procurement process.

The generation of electricity is a free activity, subjected to the granting of a generation license. The licensing entity can vary, depending on the technology used or the location of the generation plant. Prior the industrial exploration, the generation entity must obtain an exploration license, which is granted after technical inspections take place to ensure the safety conditions of the operating plant.

3.4. Smart metering systems

Smart metering systems are crucial in the energy sector as they will allow collection of detailed data on the energy use of small consumers. Portugal has undertaken various studies comprehensive field trial of the smart metering technology. The information obtained from the studies should be utilised to support the roll-out of advanced metering technologies to smart meter systems and commercial enterprises with a view to supporting their efforts to manage energy demand. Infrastructure and regulatory incentives are not heavily present in the country for this type of technology, but there is evidence that it is emerging.

There are a few examples where some pilot projects are taking place in the country to test and roll-out smart metering systems. For example, a project called SmartGalp (2010-12)²²⁶ was a technical study in the smart metering sector aiming to demonstrate and quantify the bundling that the real-time consumption monitoring and new interactions with residential consumers could have on: energy efficiency, consumption reduction, greenhouse gas (GHG) emissions,

²²⁵ For more information see: Mónica Carneiro Pacheco and Bernardo Cunha Ferreira, "Oil and gas regulation in Portugal: overview", Thomson Reuters: Practical Law, Resource ID W-017-8901. Available at <<https://uk.practicallaw.thomsonreuters.com/w-017-8901?transitionType=Default&contextData=%28sc.Default%29>>.

²²⁶ Information available at <<https://www.galp.com/corp/Portals/0/Recursos/Investidores/SharedResources/Relatorios/EN/2010RA/RelatorioSustentabilidade2010EN.pdf>>.

and in cost reductions for the end-consumer. Other projects have been implemented such as Your Home, Your Energy (PPEC) (2014-15)²²⁷, which was a nationwide initiative focusing on the promotion of energy efficiency in the residential sector, with the aim to contribute towards an effective reduction on energy consumption. This project provided access of information regarding energy efficiency measures, tailored to individual consumers depending on their energy spending. The information for the tailored plans was provided through measures such as smart metering data.²²⁸

According to the International Energy Agency's 2016 report, EDP Distribuição is developing second-generation of smart meters to 100,000 customers throughout Portugal, aiming to develop a supply chain and improving the integration of existing processes.²²⁹ However, Portugal still has no legal framework for wide-scale smart meter development²³⁰, which can provide a challenge to the development of the technology, as regulatory uncertainty generally stagnates progress.

3.5. Electric mobility

Portugal is committed to improving mobility by introducing more electric vehicles and improving charging infrastructure. There has been an expansion of the national public grid of charging stations and installations of charging infrastructures at home and in the workplace, with some regions such as in the RAM where a project called Sustainable Porto Santo/Smart Fossil Free Island is experimenting on electric mobility and vehicle-to-grid (V2G) technology, which will be detailed in section 1.8. of this article.

There are free charging points for volunteers of a Renault electric vehicle project to use for 18 months in the island.²³¹ The project is a cooperation between the car company Renault and Empresa de Electricidade da Madeira (EEM)²³², costing €9 million in the first phase to install 40 charging points for 14 Renault Zoe cars and six Kangoo electric vans. This pilot scheme is serving as a “testing ground” for the future of electric mobility and electric storage, as it can be seen by the expected use of this technology in other countries in Europe after being experimented in Porto Santo.²³³ The pilot scheme will help advance electric vehicle solutions technologically and economically, and show how decentralised grids can be an effective and achievable solution to reduce infrastructure costs and encourage the consumption of renewable energy.

Portugal wants to increase competition in electric vehicles and reduce the price difference of electric and plug-in hybrid vehicles compared to conventional vehicles. It is achieving this

²²⁷ International Energy Agency (IEA), “Energy Policies of IEA Countries: Portugal”, 2016 Review, pp. 7-155, p.138.

²²⁸ International Energy Agency (IEA), “Energy Policies of IEA Countries: Portugal”, 2016 Review, pp. 7-155, p.138.

²²⁹ International Energy Agency (IEA), “Energy Policies of IEA Countries: Portugal”, 2016 Review, pp. 7-155, p.58.

²³⁰ Council of European Energy Regulators (CEER), “Retail markets monitoring report”, 21 November 2017, Ref: C17-MMR-83-02, pp.1-54. Available at <<https://www.ceer.eu/documents/104400/6122966/Retail+Market+Monitoring+Report/56216063-66c8-0469-7aa0-9f321b196f9f>>

²³¹ See: <<https://www.madeira-web.com/en/news/porto-santo-smart-fossil-free-island.html>>.

²³² The only Distribution System Operator/Transmission System Operator in Madeira, responsible for the activities related to production, transport, distribution and commercialisation of electricity.

²³³ See: <<https://www.greencarcongress.com/2019/03/groupe-renault-launching-large-scale-v2g-trials-with-fleet-of-15-zoe-evs.html>>.

through to the introduction of the Green Taxation Reform²³⁴, by introducing government incentives by subsidising schemes to help the public to acquire an electric vehicle and sponsoring the acquisition of electric vehicles in the public administration.

The Portuguese government as an attempt to drive independence on conventional resources for the production of energy and due to the environmental impacts of the use of fossil fuels, has invested in various newly founded energy models for mobility to reduce air pollution and increase quality of life. This has led to the creation of the Electric Mobility Network, an integrated networking which links 1,300 charging stations in Portugal, managed by MOBI.E, enabling electric vehicles to recharge their batteries by using a charging card.²³⁵ This network introduced a sustainable mobility prototype, integrating electric vehicles into the market and promoting electricity creation and use from renewable energy sources, integrating such into the operation and progress of cities and amplifying the benefits of doing so.²³⁶

Additionally, in March 2011, a project was initiated for the extensive implementation of the Electric Smart Grid led by EDP Distribuição SA.²³⁷ The first stage was the implementation of the project, where 30,000 electric power metres (otherwise called ‘energy boxes’) were installed in the city of Évora. The project promoted electric mobility, as well as microgeneration and energy efficiency. This is an innovative project, as consumers have new services, new charging systems and more beneficial rate plans, which allows greater freedom of choice and increases competitiveness. Consumers can also adjust the services to match their consumption needs, and enjoy a speedy, transparent and convenient new services system.²³⁸

Lastly, there are financial incentives for consumers to acquire electric vehicles. The government approved incentives totalling €2,659,000 in 2018 through the Environmental Ministry in context of the Environmental Fund created in 2016.²³⁹ Other tax incentives include exemptions from tax being paid on the acquisition of the vehicle and reduction in circulation tax. In addition, businesses benefit from a reduction in value added tax. Finally, under Decree-Law no. 140/2010 of 29 December, the Portuguese Government promoted the obligation on public and government entities to acquire electric vehicles.

3.6. Demand response

The implementation and execution of demand response (DR) programmes is becoming more important worldwide in energy markets. In an analysis throughout Europe of demand response systems, the Smart Energy Demand Coalition²⁴⁰ emphasised that the only demand response services promulgated in Portugal were interruptibility contracts.²⁴¹ These contracts are only available to consumers with a contracted power above 4 MW, such as large industrial customers, with varying availability and use payments.²⁴² These seem to be viewed as an add-

²³⁴ The Portuguese government created the Commission for the Green Tax Reform in 2014, following the guidelines of the European Union in the sense that fiscal policy should contribute to public budget consolidation and sustainable growth.

²³⁵ See: <<https://www.eltis.org/discover/case-studies/mobie-portuguese-programme-electric-mobility>>

²³⁶ More details at <www.mobie.pt/en/mobilidade-electrica>.

²³⁷ See: <<http://www.edpdistribuicao.pt/en/evora-inovcity>>.

²³⁸ More information on this project can be found at >www.inovcity.pt/en/Pages/homepage.aspx>.

²³⁹ Order no. 1607/2018 in line with Ministry Order no. 468/2010 of 7 July.

²⁴⁰ See: <<https://www.smartenergy.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf>>

²⁴¹ Interruptibility contracts are demand management tools to provide rapid and efficient response to electricity needs activated in response to power reductions.

²⁴² Smart Energy Demand Coalition (SEDC), “Explicit demand response in Europe: Mapping the markets 2017”, (2017), Brussels. Available: <<https://www.smartenergy.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf>>.

on solution for emergencies, rather than the choice when emergencies happen, as system operators have failed to activate the contracts in the many years that they have been available. The exclusion of small-scale consumers, such as residential and small-commercial customers may be said to hinder progress in developing DR programmes in the country.

Additionally, Ministerial Order No. 41/2017 introduced a new method of remuneration for energy generators that provide security services in times of need and set up a scheme for Capacity Payments.²⁴³ The participation of the scheme happens when the market players that provide power capacity in critical periods use electricity generation units or through DR programmes.²⁴⁴ But there is a limit to the participation of DR programmes, as the Ministerial Order imposes a high minimum aggregation threshold of 10MW.

Even though there are some obstacles and a lack of regulatory incentives, new DR programme opportunities have started to arise in the country due to the promotion and introduction of renewable energy sources. The increase on renewable energy is apparent by the surge in wind power from 168 GWh in 2000 to 11,608 GWh in 2015, reaching a total share of 24.7% of the power supplied.²⁴⁵ The first attempt by Portugal to test DR systems was by incorporating pumped hydropower storage in the balancing market, which is shared with Spain. As the country has a high level of renewable energy generation and this type of energy is intermittent and unpredictable, the supply of such reinforces the need to enable and promote DR systems.

Portugal has an active customer participation in the retail electricity market, as seen by the 21% of households switching rate for their electricity supplier in 2016, and it is the highest in Europe.²⁴⁶ Some trial projects related to DR programmes started to complement the introduction of renewable energy, but also to build on automated DR technologies. Some of the DR pilot projects will be outlined to demonstrate the position that the country currently stands.

Control of heating, ventilation and air conditioning (HVAC) systems in public buildings

A demonstration project started between the Portuguese National Laboratory for Energy and Geology (LNEG) and the New Energy and Industrial Technology Development Organisation (NEDO) to improve computerised DR technology and balance out supply and demand at the Lisbon City Hall and other urban amenities in the capital. The project's development had a three-year time period between 2016 and 2019.²⁴⁷

The involved parties were the innovation department from EDP Inovação, together with an IT consulting and outsourcing solution company called Everis, a provider of engineering solutions

²⁴³ Redes Eléctricas Nacionais (REN), "Capacity Payments", (2017). Available at <<http://www.mercado.ren.pt/EN/Electr/ActivitiesServices/CapacityPayments/Pages/default.aspx>>.

²⁴⁴ Diário da República (2017). ECONOMIA - Portaria n.º 41/2017 de 27 de janeiro - Diário da República, 1.ª série — N.º 20 — 27 January 2017.

²⁴⁵ Council of European Energy Regulators (CEER), "Retail markets monitoring report", 21 November 2017, Ref: C17-MMR-83-02. Pp.1-54.

²⁴⁶ Council of European Energy Regulators (CEER), "Retail markets monitoring report", 21 November 2017, Ref: C17-MMR-83-02. Pp.1-54.

²⁴⁷ New Energy and Industrial Technology Development Organization (NEDO), "NEDO Launches a Demonstration Project on Automated Demand Response Technology in Portugal— Aiming for the Stabilization of Power Supply and Demand Associated with the Mass Introduction of Renewable Energy.", 22 November 2016. Available: <https://www.nedo.go.jp/english/news/AA5en_100135.html>.

for the protection, control and management of electricity grids called Efacec Energia and a Japanese air conditioning supplier, Daikin Industries.²⁴⁸

This project's purpose was to remotely control the varying cooling capacity in air conditioners that have a cold air storage operation, and enabling the altering of the output based on renewable supply and demand. This includes a module that forecasts day ahead weather conditions and usage patterns, and the controls of the system will then remotely and automatically adjust electricity consumption based on the data collected. This forecasts day-ahead weather conditions and patterns, which enables the automatic adjustment of electricity consumptions based on the data. The information collected will also go to a virtual power plant (VPP) which will be used by a group of energy retailers to bid on the amount of electricity supply from renewable energy sources.²⁴⁹

Another project called NetEffiCity²⁵⁰ implemented the first consumer-to-consumer electricity sharing system in Portugal.²⁵¹ The parties involved in the project are a technology company with expertise on energy savings and efficiency, VPS – Virtual Power Solutions, together with a research group within the Institute of Engineering at the Polytechnic of Porto, the GECAD - Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development) and a Portuguese energy supplier, Simples Energia.²⁵²

The project was at its trial until mid-2018 in three Portuguese municipalities (Alfândega da Fé, Penela, and Vila Real). The main objective was to show that peer-to-peer energy sharing was feasible as a business model, however the project also intends to develop an automated DR program for remote and automated control of HVAC systems for the participating public structures. It has proposed to use automatic DR models which optimise the attainment of electricity in the energy market, taking into consideration the supply from newly developed renewable sources such as Photovoltaic cells and flexibility from participant public buildings.²⁵³ The financing of this project was done through the Portugal 2020 program under COMPETE 2020 and by the EU under the European Regional Development Fund.²⁵⁴

Control of HVAC loads in banks

An Energy Performance Contract was agreed between VPS and a Spanish bank that operates in Portugal. VPS installed an Active Energy Management System called Kisense across 100

²⁴⁸ New Energy and Industrial Technology Development Organization (NEDO), “NEDO Launches a Demonstration Project on Automated Demand Response Technology in Portugal— Aiming for the Stabilization of Power Supply and Demand Associated with the Mass Introduction of Renewable Energy.”, 22 November 2016.

²⁴⁹ Efacec Power Solutions, “Automated Demand Response Technology in Portugal”, 15 December 2016. Available: < <https://www.efacec.pt/en/automated-demand-response-technology-in-portugal/> > ; See also Daikin, “Daikin Selected for Automated Demand Response Project in Portugal”, 22 November 2016. Available: < https://www.daikin.com/press/2016/161122/press_20161122.pdf > .

²⁵⁰ Virtual Power Networks Efficient Management – Project no. 18015, Call no. 31/SI/2015, SI I&DT

²⁵¹ Lurian Klein, et al., “Community S: An Energy Sharing Approach Towards Energy Systems,” in Proc. 3rd International Conference on Energy and Environment - Bringing Together Engineering and Economics, (2017), pp.697-703.

²⁵² Lurian Klein, et al., “Community S: An Energy Sharing Approach Towards Energy Systems,” in Proc. 3rd International Conference on Energy and Environment - Bringing Together Engineering and Economics, (2017), pp.697-703.

²⁵³ Lurian Klein, et al., “Community S: An Energy Sharing Approach Towards Energy Systems,” in Proc. 3rd International Conference on Energy and Environment - Bringing Together Engineering and Economics, (2017), pp.697-703.

²⁵⁴ Portugal 2020 program under the Operational Program for Competitiveness and Internationalisation. Available at < https://ec.europa.eu/regional_policy/en/atlas/programmes/2014-2020/portugal/2014pt16m3op001 > .

bank branches in the country.²⁵⁵ There are constraints due to the deregulation on DR, however Kisense can perform DR programs in allocated buildings, providing flexibility in services as part of the energy contracts, and promotes microgrids in liberalised energy markets.²⁵⁶ One example is that the platform provides optimised aggregated energy management, load shedding and load shifting of HVAC systems. Due to this platform, the average annual energy cost reduction in 2017 was of 17% by the correspondent bank branches. Systems like these can monetarise on flexibility of peak demand and minimise unnecessary electricity usage.²⁵⁷ DR systems can reduce the price of electricity.

Control of Industrial Loads

The Galp Energy Manager was a project in Portugal associated with DR, which aimed to improve DR systems and energy efficiency in more than 150 small and medium sized sectors in Portugal. The development was coordinated by VPS in partnership with Galp Energia.²⁵⁸ The participating industries identified at least one flexible load to be managed by Kisense, allowing VPS to implement the promotion of load shifting and shedding on loads of small and medium proportions (between 10 and 200 KW) and created on the assessment of energy tariffs and peak hours of supply and demand. This was done automatically through automated DR programs or manually through remote assistance by an energy manager from VPS.²⁵⁹

EDP Distribuição pilots

EDP Distribuição is the main Portuguese Distribution System Operator (DSO) with a large share of the energy market under its control.²⁶⁰ The DSO is managing a demonstration project called InovGrid, a project which implemented a large-scale smart grid in the city of Évora.²⁶¹ The city was the first in the region to have smart metering infrastructure, with around 35,000 smart meters and 340 distribution transformer controllers. Regarding DR, there are 3,500 facilities fitted with Demand-Side Management system. This DR model is consequential as it also monitors electric vehicle charging stations, distributed generation units and primary

²⁵⁵ Lurian Klein, et al., “Cost-Benefit Comparison of a Time-of-Use Tariff and Real-Time Pricing of Electricity Associated with Automated HVAC Load Management Strategies in Bank Across Mainland Portugal,” in Proc. 2017 International Conference on Renewable Energies and Power Quality (ICREPQ), available at <<http://www.icrepq.com/icrepq17/450-17-klein.pdf>>; See also Lurian Klein, “Effectiveness of the introduction of load shifting and Real-Time Pricing on the reduction of bank agencies’ HVAC annual energy bills across Portugal,” In Proc. 3rd Energy for Sustainability International Conference (EfS2017) - Designing Cities and Communities for the Future, 2017.

²⁵⁶ Lurian Klein, et al., “Cost-Benefit Comparison of a Time-of-Use Tariff and Real-Time Pricing of Electricity Associated with Automated HVAC Load Management Strategies in Bank Across Mainland Portugal,” in Proc. 2017 International Conference on Renewable Energies and Power Quality (ICREPQ).

²⁵⁷ Lurian Klein, et al., “Cost-Benefit Comparison of a Time-of-Use Tariff and Real-Time Pricing of Electricity Associated with Automated HVAC Load Management Strategies in Bank Across Mainland Portugal,” in Proc. 2017 International Conference on Renewable Energies and Power Quality (ICREPQ).

²⁵⁸ Salla Annala, et. Al., “Comparison of Opportunities and Challenges in Demand Response Pilots in Finland and Portugal”, 15th International Conference on the European Energy Market, Conference Paper DOI:10.1109/EEM.2018.8469894 (2018).

²⁵⁹ Salla Annala, et. Al., “Comparison of Opportunities and Challenges in Demand Response Pilots in Finland and Portugal”, 15th International Conference on the European Energy Market, Conference Paper DOI:10.1109/EEM.2018.8469894 (2018).

²⁶⁰ 97% of the energy market is controlled by the DSO. Energias de Portugal (EDP), “Inovgrid” (2017). Available at <<https://www.edp.com/en/inovgrid-0>>.

²⁶¹ Energias de Portugal (EDP), “Inovgrid” (2017); See also Grid Innovation, “InovGrid Project - EDP Distribuição”, (2017). Available: <<http://www.gridinnovation-online.eu/articles/library/inovgrid-project---edp-distribuicao-portugal.kl>>.

distribution units in the assessment. This ensures consumers can organise demand-side management based on consumption, electricity generation, electricity rates, generation, responsive loads and distribution.²⁶² This model has also promoted the use of electric vehicles and renewable energy.

The regulation constraints in Portugal have impeded the development of DR systems, and presently interruptibility contracts and capacity payments are the only legislated DR systems, which present limitations. However, the country is seeing the beginning of incorporation of pumped hydropower storage, and there are demonstration projects associated with DR systems that can incentivise discussions and the start of regulation in this area. ERSE should review the energy market in Portugal with the aim to open the market to DR, ancillary systems and balancing markets.

3.7. Electric Storage

Portugal's renewable energy production is increasing, and it is estimated to reach a surplus in the range of 800-1200 GWh by 2020.²⁶³ As renewable energy become more and more relevant, it is crucial to develop efficient storage solutions that are economically viable to enable the use of such energy in the periods of low demand.²⁶⁴ A storage potential of power-to-gas (PtG) technologies of at least 500GWh has been foreseen in Portugal.²⁶⁵ There have been studies made to analyse the power-to-gas storage potential in Portugal, such as the work by Heymann and Bessa²⁶⁶ estimated that the cost of PtG products in the country. Carneiro et al. also foresaw the opportunity of extensive storage in geological formation in the mainland of Portugal.²⁶⁷

In Portugal there are different storage options such as: run-of-the-river and pumped hydro storage type hydropower plants. Pumped hydro storage plants collect substantial amounts of water that can be used in the months with the lowest levels of precipitation, while run-of-the-river have a small storage capacity and the turbines that generate the electricity operate depending on the flow of the river. The pumped hydropower storage plants are the conventional method for the storage of electricity, which were modified to include a system for pumping water from a lower elevation to a higher elevation reservoir. Portugal has a capacity of 2.44 GW of pumped hydro storage installed.²⁶⁸

²⁶² Energias de Portugal (EDP), "Inovgrid" (2017).

²⁶³ Carlos B. Mateus & Ana Estanqueiro, "Regulation of the wind power production: Contribution of the electric vehicles and other energy storage systems.", In Proceedings of the 11th International Workshop on Large-Scale Integration of Wind Power into Power Systems as Well as on Transmission Networks for Offshore Power Plants, Lisboa, Portugal, 13–15 November 2012.

²⁶⁴ Behnam Zakeri & Sanna Syri, "Electrical energy storage systems: A comparative life cycle cost analysis", *Renew. Sustain. Energy Rev.* 2015, 42, pp.569–596.

²⁶⁵ Fabian Heymann & Ricardo B. Bessa, "Power-to-Gas potential assessment of Portugal under special consideration of LCOE.", In Proceedings of the 2015 IEEE PowerTech Eindhoven, Eindhoven, The Netherlands, 29 June–2 July 2015, pp.1–5.

²⁶⁶ Fabian Heymann & Ricardo B. Bessa, "Power-to-Gas potential assessment of Portugal under special consideration of LCOE.", In Proceedings of the 2015 IEEE PowerTech Eindhoven, Eindhoven, The Netherlands, 29 June–2 July 2015, pp.1–5.

²⁶⁷ Júlio F. Carneiro, Catarina R. Matos & Serge van Gessel, "Opportunities for large-scale energy storage in geological formations in mainland Portugal", *Renew. Sustain. Energy Rev.* 2019, 99, pp.201–211.

²⁶⁸ REN, "Technical Data" (2016). Available: <http://www.centrodeinformacao.ren.pt/PT/InformacaoTecnica/DadosTecnicos/REN%20Dados%20T%C3%A9cnicos%202016.pdf>.

In 2015, a global production of 1.16 terawatt-hour (TWh) through pumped hydro storage was reported by Redes Energéticas Nacionais (REN, Lisboa, Portugal). However, there is no further information on values of power production by this means.²⁶⁹

According to the IEA the daily renewable energy output by Portugal regularly exceeds the nation's energy demands and the excesses are used either in pumped hydropower storage plants or exported.²⁷⁰ The excesses of electricity consumed by pumped hydropower storage plants almost tripled in 2015, compared to 2010, with an efficiency of 78%.²⁷¹

Nevertheless, these plants require a big amount of investment and have been linked to detrimental environmental impacts that can create divisive factors.²⁷² To date, pumped hydropower storage plants have been the primary choice in the country to store any surpluses of renewable energy, but decentralised grids can increase the country's storage capacity and help the energy transition, as investment costs, geography and environmental impacts can limit the extension of pumped hydro plants.

For this reason, there has been suggestions to use power-to-gas technologies, specifically power-to-methane. The renewable energy surpluses can be chemically stored as methane, inserted into the natural gas grid or can be stored in reservoirs, such as in salt caverns or even in LNG tanks after being compressed.²⁷³ In Portugal, these power-to-methane (PtM) developments have the advantage of a high capacity of wind power having been installed within the proximity of gas infrastructure, which makes the country very suitable for the implementation of PtM technologies²⁷⁴, insofar as satisfactory carbon dioxide (CO₂) sources are available in close proximity.²⁷⁵

Finally, the Sustainable Porto Santo/Smart Fossil Free Island project also focuses on finding storage solutions. The project aims to not only promote electric mobility, but to create temporary storage through the electric vehicles, as the surplus of renewable energy production is stored in V2G technology to meet the islands peak demands.²⁷⁶ Renault will install second-life electric vehicle's batteries to create electric storage to enable the increase of renewable energy capacity in the island. As per the car company, the island is a "world-first smart island uses electric vehicles, second-life batteries, smart charging and V2G to boost the island's energy independence and stimulate the production of renewable energy (...)"²⁷⁷ This project

²⁶⁹ REN, "Technical Data" (2016).

²⁷⁰ International Energy Agency (IEA), "Energy Policies of IEA Countries: Portugal", 2016 Review, pp. 7-155, p.16.

²⁷¹ Fabian Heymann & Ricardo B. Bessa, "Power-to-Gas potential assessment of Portugal under special consideration of LCOE.", In Proceedings of the 2015 IEEE PowerTech Eindhoven, Eindhoven, The Netherlands, 29 June–2 July 2015, pp.1-5.

²⁷² Shafiqur Rehman, Luai M. Al-Hadhrami & Md. Mahbub Alam, "Pumped hydro energy storage system: A technological review.", *Renew. Sustain. Energy Rev.* 2015, 44, pp.586–598;

²⁷³ Carlos V. Miguel, Adélio Mendes & Luís M. Madeira, "An Overview of the Portuguese Energy Sector and Perspectives for Power-to-Gas Implementation", LEPABE—Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto (2018), pp.1-20, at p.12.

²⁷⁴ Almost 60% of that capacity located less than 5 km to existing or future potential natural gas storage facilities

²⁷⁵ Fabian Heymann & Ricardo B. Bessa, "Power-to-Gas potential assessment of Portugal under special consideration of LCOE.", In Proceedings of the 2015 IEEE PowerTech Eindhoven, Eindhoven, The Netherlands, 29 June–2 July 2015, pp.1-5.

²⁷⁶ See: <<https://www.greentechmedia.com/articles/read/renault-helps-an-island-ditch-fossil-fuels-with-v2g-technology#gs.lycT1Kk>>.

²⁷⁷ See: <<https://www.automotiveworld.com/news-releases/groupe-renault-eem-create-first-smart-island-porto-santo/>>.

may be the pilot needed to help progress V2G technologies in the sense that it will determine whether these are feasible and efficient in meeting the wanted results.

3.8. Data Protection

Recent technological developments such as the introduction of smart metering and smart grid systems may bring complications on further management and development of the energy sector by energy companies when considering data protection rights of consumers. Smart grids and metres are essential for the future of the energy sector to effectively and efficiently manage energy use and supply, with companies being able to respond to local changes of usage due to data information gathered. The EU Smart Grids Task Force has recognised the need for customers to accept the use of smart grids, which requires them to be given control over their energy consumption data.²⁷⁸

Consumers must feel confident that the new technology does not jeopardise the privacy of their personal data, and that such data is kept secure and their privacy respected. The Task Force established an expert group to make regulatory recommendations on privacy, cyber security and data protection in the smart grid environment to deal with issues related to energy. Possible risks of handling data, security and data protection were considered, as well as identifying ownership of data and access rights and responsible parties were identified. A list of recommendations with 10 minimum functioning requirements was presented in the Commission Recommendation²⁷⁹ and included in the General Data Protection Regulation (GDPR)²⁸⁰ to ensure cyber security in smart metering systems.²⁸¹ Article 23 of the GDPR, expressly references smart metres, as the EU realised the data protection and security risks associated, as well as the new potential of the new technology. For continuing innovation and investment to go into smart metres, consumers must be confident in its utility and network operation, and that consumer data will be protected against any breaches of privacy.

Portugal as a member state of the EU must ensure that it follows these principles. The regulatory framework in Portugal for the protection of private identifiable information (PII) results from the direct application of the GDPR. The previous Portuguese Data Protection Act²⁸² (DPA) was introduced in 1998 and revoked when the new DPA entered into force. There is relevant national legislation on PII, such as in article 35 of the Portuguese Constitution, which sets the main principles and guarantees that rule data protection, such as the right to access any computerised data relating, to require its correction and update and to be informed of the use for which the data is intended.²⁸³

²⁷⁸ See: <<https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters/smart-grids-task-force>>.

²⁷⁹ European Commission, “Best Available Techniques Reference Document for the cyber-security and privacy of the 10 minimum functional requirements of the Smart Metering Systems.”, Smart-Grid Task Force Stakeholder Forum, 7 November 2011. Available at <https://ec.europa.eu/energy/sites/ener/files/documents/bat_wp4_bref_smart-metering_systems_final_deliverable.pdf>.

²⁸⁰ EU Regulation 2016/679 of the European Parliament and of the Council of 27 April 2016, on the protection of natural persons with regards to processing of personal data and on the free movement of such data. Available: <<https://eur-lex.europa.eu/eli/reg/2016/679/oj>>.

²⁸¹ European Commission, Recommendation of 9 March 2012 on preparations for the roll-out of smart metering systems. Available at <<https://op.europa.eu/en/publication-detail/-/publication/a5daa8c6-8f11-4e5e-9634-3f224af571a6/language-en>>.

²⁸² Law No. 67/98 of 26 October 1998.

²⁸³ Constituição da República Portuguesa (Portuguese Constitution), VII Revisão Constitucional (Revised), Art.35. Available:<<https://www.parlamento.pt/Legislacao/Paginas/ConstituicaoRepublicaPortuguesa.aspx>>.

The new DPA was passed to Law 58/2019 of 8 August 2019, which implemented legislation for the execution of the GDPR more than 15 months after the EU regulation became effective. The legislation applies to the processing of all personal data carried out in Portugal, notwithstanding the public or private nature of the controller or processor and includes public interest tasks. This includes the energy sector, and even though it may be in the public interest to monitor data from smart metres to predict energy needs, the collector and processor must respect the consumers' data protection rights and have consent for the processing of the data, otherwise the collection and processing of the data will be a serious offence. Penalties can vary between €5,000 to €20,000,000, or 4%, whichever is greater, on companies and a maximum penalty of €500,000 for a natural person.

Other serious offences that energy companies need to avoid include the charging of unreasonable fees to provide information under article 12 of the GDPR, and refusal to provide information collected on an individual. Any data used for other reasons rather than the one it was collected for will have the perpetrator punished for up to a year imprisonment.²⁸⁴ The law further specifies that “anyone who, due to professional confidentiality legal obligations, without legal grounds and without proper consent, discloses in whole or in part personal data” can also face up to one year in prison, and double that for data protection officers or those seeking illegal personal gain.²⁸⁵

3.9. Portugal's electricity interconnections within the EU

The Synchronous grid of Continental Europe is the largest interconnection grid in the world, which connects the electricity transmission from 24 countries and supplies over 400 million customers, mostly in the EU.²⁸⁶ The TSO's operating the grid formed the Union for the Coordination of Transmission of Electricity (UCTE), now part of the European Network of Transmission System Operators of Electricity (ENTSO-E).²⁸⁷

Increasing renewable energy capacity is one of the main pillars within the EU, and Portugal has been performing brilliantly on that front, for example in March 2018, the average of the month's renewable output reached 103.6% from renewables.²⁸⁸ It was calculated by APREN and sustainability NGO ZERO that the successes from the renewable output of March 2018 resulted in 1.8 million less tonnes of CO₂ emissions and savings of €20 million due to not needing to buy ETS allowances. According to them, the wholesale price of electricity would also fall from €43.94 to €39.75 PER MWh.²⁸⁹

However, the country remains isolated in terms of energy as it only shares a land border with Spain. The Portuguese and Spanish electricity markets are completely interconnected; however, Portugal's geographical location may create challenges. The EU's Energy Union has plans to have an internal electricity market to allow the surpluses of energy to be shared from a member state to another depending on demand. This is essential as we move more and more towards renewable energy sources, as storage solutions are still being developed.

As per EU standards, member states must reach a 10% interconnection target by 2020, but both Portugal and Spain are behind that goal. The Iberian Peninsula has reached a 6%

²⁸⁴ Full transcript available at: <<https://dre.pt/web/guest/pesquisa/-/search/123815982/details/maximized>>.

²⁸⁵ Article 46 of Law 58/2019 of 8 August 2019

²⁸⁶ See map for context at: <<https://www.entsoe.eu/data/map/>>.

²⁸⁷ More information available: <<https://docstore.entsoe.eu/news-events/former-associations/ucte/Pages/default.aspx>>.

²⁸⁸ Sam Morgan, “Portugal breaks 100% renewables mark but remains isolated”, Euractiv, 4 April 2018. Available: <<https://www.euractiv.com/section/energy/news/portugal-breaks-100-renewables-mark-but-remains-isolated/>>.

²⁸⁹ Sam Morgan, “Portugal breaks 100% renewables mark but remains isolated”, Euractiv, 4 April 2018.

interconnection rate²⁹⁰ and continues to attempt to overcome its isolation from other member states by using third-party interconnectors.²⁹¹ Energy is already shared between Portugal and Spain, so much that the surplus from the generation of electricity from renewable energy sources improved Portugal's exporting balance.

Electricity is traded between Portugal and Spain in common electricity market called the Iberian Market for Electricity (MIBEL). Within the MIBEL there are two organised markets: the spot market (day ahead and intraday), operated by the Spanish branch of MIBEL (OMIE) and abides by Spanish legislation; and the forwards and derivatives market, operated by the Portuguese branch of MIBEL (OMIP) and which abides by Portuguese legislation.²⁹² The OMIE works as a sole market for Portugal and Spain if the commercially available interconnection capacity between both countries is enough to perform the supply and demand of electricity orders.

The two markets can be separated if there is not enough capacity available, upon which specified prices for the separate markets are created under a market splitting mechanism. The generators in the special regime with feed-in-tariffs can sell their electricity to the supplier of last resort, which they then sell it in the market through open auctions. Since 2016, the exports of electricity to Spain have totalled €700 million by the beginning of 2018. In 2017, the country exported 5,753 GWh worth €299 million, and increase from €260 million in 2016.²⁹³

Portugal, Spain and France have agreed to better interconnection between the three countries and have signed the Lisbon Declaration on energy interconnections.²⁹⁴ This reiterated the support of projects between the two countries and the EU increased the monetary support to €865 million for the construction of interconnections.²⁹⁵ Additionally, the Madrid Declaration signed in 2015 will help the Iberian Peninsula to connect to the Internal Energy Market by removing obstacles to interconnection. These incentives will help the completion of ongoing projects and will drive increases in the rate of interconnection in the region, which will make it possible to reach EU targets.

4. Conclusion and Recommendations

Latvia is progressing slowly, yet steadily, towards a smarter and more decentralized electricity system, following the directions of the EU's Clean Energy Package Regulations and Directives. The objectives presented in the Latvian National Energy and Climate Plan for 2021-2030 demonstrate the country's willingness to progress even further in all five dimensions of the European Energy Union.

While the EU member states' national plans have not yet taken their definitive form, as revised versions of the plans are due to be presented by the end of 2019²⁹⁶ and be assessed in their final

²⁹⁰ European Commission, "Integration of the Iberian Peninsula into the internal energy market", Memo, 27 July 2018, Brussels. Available: <https://ec.europa.eu/commission/presscorner/detail/en/MEMO_18_4622>.

²⁹¹ See: <https://europa.eu/rapid/press-release_IP-18-4621_en.htm>.

²⁹² For more information visit: <http://www.erse.pt/eng/electricity/MIBEL/Paginas/default.aspx>

²⁹³ Mónica Carneiro Pacheco and João Marques Mendes, "Electricity regulation in Portugal: overview.", Thomson Reuters: Practical Law, Resource ID 6-564-1565, pp.1-23.

²⁹⁴ European Commission, "Lisbon Declaration", Available: <https://ec.europa.eu/info/sites/info/files/lisbon_declaration_energyinterconnections_final.pdf>.

²⁹⁵ See: <<https://www.pv-magazine.com/2018/07/30/eu-commits-e578-million-for-iberian-eu-energy-market-integration/>>.

²⁹⁶ European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, "The European Green Deal", Brussels, 11 December 2019, COM(2019) 640 final, p. 6, available at https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

form in June 2020,²⁹⁷ the Latvian plan has been mentioned as a positive example by the European Commission for its detailed estimations about its non-ETS targets and its investment needs.²⁹⁸

As optimistic as this indication is, there are, however, certain aspects that could potentially be ameliorated to achieve the best results possible. For example, as data privacy and cybersecurity in energy and electricity infrastructure already are and will continue to be pressing issues, affecting the lives of millions of citizens, it is imperative that the Latvian policy and legislation develop in a timely manner to counter those issues effectively. In this way, not only will the national energy security be protected, but also the confidence of the consumers towards the employment of new tools will be strengthened.

Regarding Portugal, this article has illustrated the current position of the Portuguese electricity market, especially the decentralised efforts and inclusion of new technological advances in the energy sector. Notably, the country has a high energy dependence on imports of fossil fuels from countries such as Angola, even though it produces a high amount of energy from renewable sources due to the increase of renewable energy capacity in recent years. Portugal should take advantage of its favourable geographical position and weather conditions to create more energy from renewable sources to stop the high levels of dependence on fossil fuel imports to produce energy.

It is evident that it is possible to successfully create decentralized energy grids from the renewable capacity Portugal has, and steadily decrease imports and increase renewable usage until it reaches 100% of production and generation, something that has already been achieved in the most favourable months in the country. The issues associated with increasing renewable capacity and the cessation of energy production with fossil fuels is the intermittent nature of renewable sources and the need to store any surpluses of energy. To this end, there has been an increasing interest in lithium batteries. However, these are not seen as the most efficient option to store power.

There is a storage potential of PtG technologies of at least 500GWh and incentives in legislation can be created to attract investment in new storage facilities. If legislation is clear and precise on the importance and governmental stance of renewable energy sources, then investors will know the direction of the country in this respect and have more confidence in investing in new storage technologies. The government has shown vast support for renewable energy in the last decade, as can be seen by the increase in capacity and various projects aimed to incentivise the use of renewables and alternative storage. Portugal uses hydropower pump storage to store the surplus of energy produced by renewable energy, and as this has been environmentally unsafe, more research and development is needed for new technologies to emerge. Studies have identified that the development of storage solutions from PtG, especially PtM can be beneficial for the country as an efficient storage solution.

²⁹⁷ European Commission, Annex to the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, “The European Green Deal”, Roadmap – Key Actions, Brussels, 11 December 2019, COM(2019) 640 final, p. 2, available at https://ec.europa.eu/info/sites/info/files/european-green-deal-communication-annex-roadmap_en.pdf

²⁹⁸ European Commission, Annex to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, “United in delivering the Energy Union and Climate Action - Setting the foundations for a successful clean energy transition”, Brussels 18 June 2019, COM/2019/285 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1565713062913&uri=CELEX:52019DC0285>

Additionally, Portugal is at an advantageous position in terms of lithium availability, which can be used in the production of batteries, giving the country an opportunity to develop the technology and evolving this market. Furthermore, using increasing amounts of renewable energy may in turn provide with an effective solution for reducing greenhouse gas emissions not only from the energy sector, but also from the transport sector. In 2018, 61% of energy consumption needs were met by renewable energy, however the transport sector is almost entirely powered by fossil fuels due to more conventional vehicles being more dominant in the market, which explains why electricity consumption in the transport sector only amounts to 0.8%.

However, the country has seen many initiatives and projects to promote the use of electric vehicles, and most importantly there has been a scale-up of new installations of charging infrastructure that incentivises people to get electric vehicles, as if the infrastructure is there to charge the vehicles, the public feel more confident in the technology. Examples can be seen in the Electric Smart Grid project in Evora and the Sustainable Porto Santo/Smart Fossil Free Island project. These projects are of great significance as they are testing the feasibility of electric mobility and storage in the country, using the surplus of energy produced by renewable sources and improving infrastructure to ease the transition. Portugal is going in the right direction on electric mobility and storage and should continue to incentivise change in the transport sector in terms of infrastructure, pilot programmes and subsidies where needed.

Successful decentralised electricity markets have many requirements, including the focus on clear responsibilities, the strengthening of subnational capacities and the coordination of mechanisms. However, other conditions can apply such as developing territorial specific policies and allowing for asymmetric decarbonisation – with differentiated responsibilities given to different regions or cities, and especially in metropolitan areas.

Adopting experimental policy practices can aid the country to adapt to decentralised systems more proactively and have a multi-level governance reform, rather than a more drastic major reform of the electricity market. While this would be slower, it would enable a “learn by doing” approach, which can result in reforms of policies or parts of policies that do not achieve the objectives of needed. Portugal has seen a large scale up of renewable energy generation and policies that incentivise its increasing use and generation, as well as regional and private developments that are forming partnerships that will drive rapid change in the country. For the transition towards renewable energy to happen as urgently as needed and as smooth as possible, regional systems must be coordinated and reorganised to run similarly to benefit from decentralisation.

Portugal is heading in the right direction in its decentralisation efforts, however in some areas it needs to make regulation more encouraging for the successful development and application of new technologies, more urgently in enabling demand response programmes and smart metering systems. In demand response programmes, the only legislated area is that of interruptibility contracts, which suppliers are not very keen to use.

There are a few pilot programmes taking place that may signal a change in direction on the importance the country is giving to this technology. In relation to the interconnection with the Spanish electricity market, Portugal is still below the target implemented by the EU. However, there are projects being financed by the EU to improve the interconnectivity issue that are expected to resolve it. This may not be resolved in time for the 2020 deadline; nevertheless, it could meet the 2030 target of 15% interconnection. The country should increase its efforts in energy efficiency to avoid losses of during transference to the shared grid, which can aid increased interconnectivity within the Iberian Peninsula. In light of this, the remaining will

focus on specific recommendations for the continuing development of the technologies that aid decentralisation efforts.

As this article noted, there is no regulatory framework available in Portugal for the development of smart metering systems, which is why the government needs to introduce policies and incentives to accelerate the benefits this technology can have. The roll-out of smart meters is of global importance and it started in 2009. Siemens is one of the suppliers of the new smart meters to EDP Distribuição, which is installed at the client's homes in a phased strategy. It is expected that by 2020, 80% of customers' home-installed meters will be smart, gradually replacing the analog meters. It is important to ensure that all homes will be equipped with the new technology, as most Portuguese households still have the analog meters. The change of technology will be important in order to raise awareness in households on the density of energy used daily, which can also change attitudes towards how energy is used by the general public.

This may also influence the way energy is created as customers choose to switch suppliers based on their usage of energy for generation of electricity. There needs to be a variety of service providers that are willing to provide the services related to the vast introduction of this technology, however it is unlikely that more players will join if there are no clear regulatory and policy incentives by the government and other public authorities. Smart meters may also pose a privacy issue as personal data is being collected for the purposes of keeping records of energy supply and demand to help meet the required needs. The direct applicability of the GDPR can help protect the consumers where their data privacy is at stake in this circumstance and some would say that adding national regulation may create confusion and regulatory uncertainty. However, it should be noted that adding national stringency to this area may be beneficial as this technology is at its infancy and the public should be further protected against any privacy breaches that may occur.

As seen by current projects in the country such as in Evora and Porto Santo Island, the country is heavily invested in promoting electric mobility. These projects are good pilots to demonstrate how electric mobility could help in other regions of Portugal, testing the feasibility, efficiency and reliability of this technology. It may help identify any problems within the technological difficulties the vehicles may have, as well as how well the infrastructure set-up, such whether the locations of charging points are easy to get to and easy to use, and even economic considerations such as whether it is feasible and competitive for end-consumers to use electric vehicles instead of conventional ones.

As these projects are having positive results in their objectives, more infrastructure should be introduced around the country to incentivise the use of electric vehicles, such as more charging points. If the infrastructure is there and electricity increasingly becomes more affordable, coming from renewable resources rather than by imported fossil fuels, it would make sense for the public to see the benefits and switch to this environmentally friendly technology, especially considering the financial assistance the Portuguese government provides on their acquisition and related tax exemptions. The experiences from these projects can help create parallel projects in the public transports sector, where not many pilot projects have incorporated electricity created by renewable energy. This not only would improve air quality and comply with GHG emission reduction targets imposed by the EU and other international treaties, but it would help reduce the high TFC and TPES that the transport sector uses.

Regarding demand response (DR) programmes in Portugal, they are in their infancy. However, there are a few pilot projects currently being tested. DR is important for establishing peak demand trends, helping estimate the supply and demand needs of a country and making tariffs more dynamic. In Portugal, impeding deregulation constraints are hindering the progress of

DR systems, with only interruptibility contracts and capacity payments being the only legislated way to implement DR programmes. Both these options have limited participation and a surge of demonstration projects seems to be the way the country is trying to develop this technology. Once there has been a sufficient roll-out of smart metering systems in households and businesses, then the DR sector can really take-off as DR policies work better if the supply sector has reached the needed level of development and modernisation.

Furthermore, DR can be influenced by the introduction of obligations and responsibilities to the involved entities in the energy sector. For example, responsiveness projects can be introduced which can target large consumers and create patterns of supply and demand needed. As EDP is the main TSO in the country, there could be an introduction of a guideline by the TSO to the remaining TSO's in the autonomous regions, which could create legitimate enforcement measures to facilitate responsiveness.

As for storage, finding storage solutions is a global challenge at the present time and the delays and costs to its development may significantly hinder the low-carbon transition. Increasing renewable energy capacity and usage will only provide effective and efficient results if the surpluses of energy produced can be stored at low-demand times to be used at high-demand times. This is especially important in Portugal as the daily renewable electricity output exceeds national demand, and the surpluses of such electricity are exported or stored in pumped hydropower plants. The storage sector provides for an opportunity for Portugal to develop a new market and possibly be an exporter of such technology (or components of such) as the country benefits from large lithium reserves.

Presently, the storage options in the country consist of pumped-hydropower storage from power stations and dams, which have thrived in the past few years, but due to their environmental footprint and the amount of investment capital needed, may no longer be the viable solution. There have been studies on the possibility of PtG implementation in electricity storage. Decentralised units would contribute for the increase of the country's storage capacity, and to this end PtG will be an effective solution as there is an increase of use of natural gas, offering the possibility to integrate the electricity and natural gas grids. The way it would work is that the renewable energy would be stored chemically as methane, which could be used at the site they were stored or injected into the natural gas grid or stored in reservoirs such as LNG tanks (after compressed). This would benefit the wind capacity already installed in Portugal, as 60% of such infrastructure is located within a five-kilometre radius of existing or future gas infrastructure.