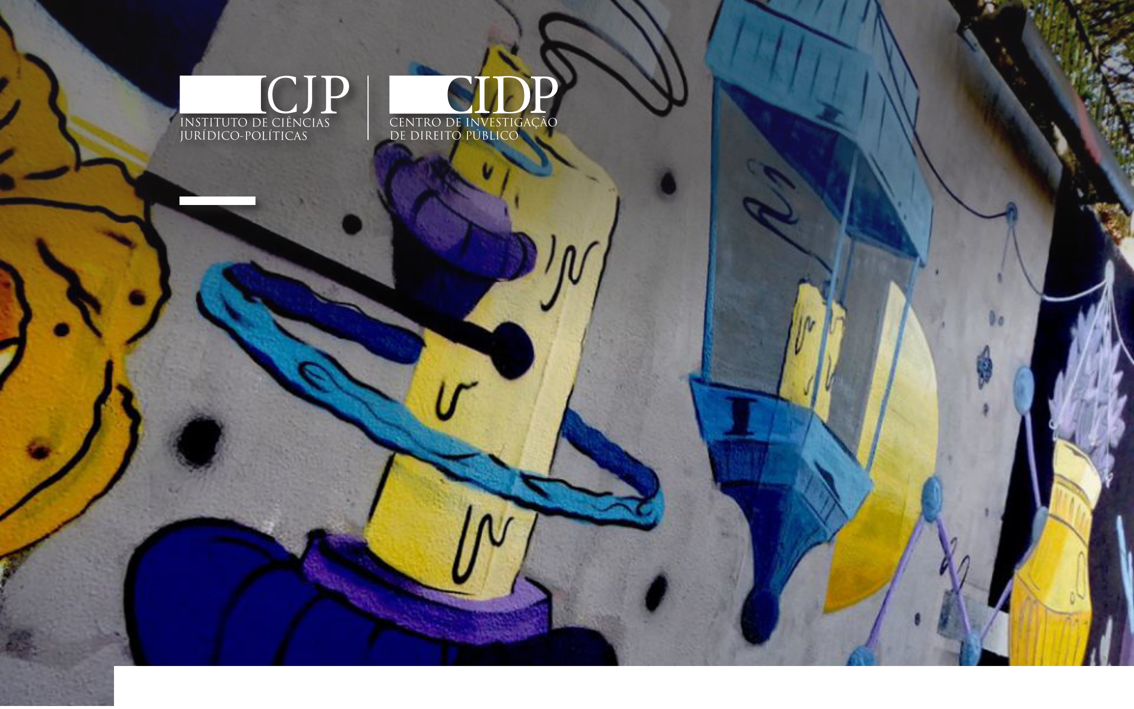

ICJP INSTITUTO DE CIÊNCIAS JURÍDICO-POLÍTICAS
CIDP CENTRO DE INVESTIGAÇÃO DE DIREITO PÚBLICO

Conference proceedings

THE TRANSFORMATION OF ENERGY LAW THROUGH TECHNOLOGICAL AND LEGAL INNOVATIONS

CARLA AMADO GOMES
FRANCISCO PAES MARQUES
(coordinators)

FACULDADE DE DIREITO
UNIVERSIDADE DE LISBOA

FCT Fundação para a Ciência e a Tecnologia

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Foreword

The texts included in this ebook were the base of some of the communications presented at the international seminar organised by the ICJP, with the support of the Academic Advisory Group of the Section on Energy, Environment, Resources & Infrastructure Law of the International Bar Association "The Transformation of Energy Law through technological and legal innovation" on the 12th April 2018, at the Faculty of Law of the University of Lisbon.

We wish to thank to the Academic Advisory Group of the Section on Energy, Environment, Resources & Infrastructure Law of the International Bar Association for having chosen ICJP to co-organise this important event and to congratulate all the speakers for the high quality of the presentations. We take the opportunity to also thank the audience for the questions asked, which enriched the debate.

We hope that this ebook can contribute to help researchers working with these themes and to spread consistent information about technological and legal innovation in the context of Energy Law.

Lisbon, September 2018

Carla Amado Gomes
Francisco Paes Marques

The Transformation of Energy Law through Technological and Legal Innovation

Lisboa, 12 April 2018 - Faculty of Law - University of Lisbon

10.00 a.m. **Introduction and Welcome to the Seminar**

- Carla Amado Gomes
  Assistant Professor - Faculty of Law - University of Lisbon
  Researcher of the Research Centre of Public Law (CIDP)
- Iñigo del Guayo
  Professor - Faculty of Law - University of Almería

Session I. Technology and Energy Transition
Moderator: Prof. Milton Montoya

10.10 a.m. **Energy transition in Qatar and the Middle East: advancing renewable energy technologies as the alternative to fossil fuel use**

- Damilola Olawuyi
  Associate Professor - College of Law and Public Policy
  Hamad Bin Khalifa University (Doha - Qatar)

10.30 a.m. **Low Carbon Energy Transition in Canada: Planning and Legislating in a Diverse Federation**

- Alastair Lucas
  Professor - Faculty of Law - University of Calgary (Canada)

10.50 a.m. **Competitive electricity markets and support-schemes to renewable energies in the European Union**

- Iñigo del Guayo
  Professor - Faculty of Law - University of Almería (Spain)

11.10 a.m. **Coffe-break**

Session II. The impact of Technological Innovation
Prof. Martha Roggenkamp

11.40 a.m. **Colombia's approach to the future of coal-fired electricity generation—climate change demands on national coal development**

- Milton Montoya
  Professor - Faculty of Law - University Externado (Colombia)

12.00 p.m. **The regulatory challenges of energy disruptive technologies**

- Mr. Filipe Matias Santos
  Director of ERSE Legal Department - ERSE

12.20 p.m. **Technological Innovation and Disruptive Lawmaking to Counter Climate Change: Addressing the Challenges to Regulating Hydraulic Fracturing in South Africa**

- Hanri Moster
  Professor - Faculty of Law - University of Cape Town (South Africa)

12.40 p.m. **Discussion**

1.00 p.m. **Lunch**

Session III. Innovation within traditional energy sectors
Moderator: Prof. Hanri Mostert

3.00 p.m. **Greening the European gas sector: the regulation of alternative gases**

- Martha Roggenkamp
  Professor - Faculty of Law - University of Groningen
  (The Netherlands)

3.20 p.m. **Prospects for electricity storage**

- José Juan González
  Professor
  Universidad Metropolitana de México (México, D.F.)

3.40 p.m. **The impact of the blockchain on the energy markets**

- João Marques Mendes
  Lawyer at CMS Rui Pena & Arnaut

Session IV. Electric mobility and Electricity Vehicles
Moderator: Prof. Al Lucas

4.00 p.m. **Electric mobility**

- Manuel Cassiano Neves
  Lawyer at Garrigues Portugal

4.20 p.m. **Electricity vehicles Law and Policy: a comparative analysis**

- Barry Barton
  Professor - School of Law - Waikato University (New Zaeland

4.40 p.m. **Discussion**

5.00 p.m. **Conclusions**

- Francisco Paes Marques
  Assistant Professor - Faculty of Law - University of Lisbon

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Presentation

All contemporary societies rely heavily on energy. Economic growth is closely related to the reliability of energy infrastructure. Development of social civilization drives energy demand. In 2016, world gross electricity production was 2.9% higher than 2015, and global electricity production has grown continuously since 1974, except for between 2008 and 2009, when the economic crisis in OECD countries caused a visible decline in global production[1].

Energy was mainly used to meet the needs for survival in the primitive society. The demand for energy was greatly increased due to the improved quality of human life and primary industrial production in the feudal society. Owing to the accelerated development of social civilization since the industrial revolution, human demand for transport, information and cultural entertainment has been significantly increased, and modern industry demand for energy has reached an unprecedented level.

1 Source: https://www.iea.org/statistics/electricity/.

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In recent years, with a series of ecological and environmental problems arising from wastewater, waste gas and waste residue generated in the development and utilization of high-carbon energy, the ecological demand for energy production and consumption has been included in the energy development process[2]. Electricity generation from fossil fuels fell for the fifth consecutive year in 2017, with generation from total combustible fuels accounted for 59.4% of total OECD gross electricity production (compared to 72.8% for non-OECD). On the green side, electricity generation from renewable sources such as wind (+15.1%) and solar (+21.9%) registered robust growth[3].

Although the fossil energy sources are still plenty in the world, great breakthroughs made in some key technologies and the increasing demand for ecological environmental protection both impel the third time of transformation from oil & gas to new energy sources. Sooner or later, oil, gas, coal and new energy sources will each account for a quarter of global energy consumption in the new era, specifically speaking, accounting for 32.6%, 23.7%, 30.0% and 13.7% respectively. With the increased demand for green ecological environment, natural gas and new energy as clean energy resources will take up a higher share in the primary energy mix[4].

In fact, one of the greatest challenges for 21st century society is the sustainable, low-carbon use of energy. Providing a reliable supply of clean, affordable energy for all raises complex and significant techni-

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2 See CAINENG/QUN/GUOSHENG/BO,"Energy revolution: From a fossil energy era to a new energy era", Natural Gas Industry B, 3, 2016, p. 3.

3 Source: https://www.iea.org/statistics/electricity/.

4 See CAINENG/QUN/GUOSHENG/BO,"Energy revolution: From a fossil energy era to a new energy era", Natural Gas Industry B, 3, 2016, p. 1-2.

cal, social, political, economic, ethical and research integrity issues that must be addressed to ensure continued, sustainable growth and development. Considering the environmental impact of the current energy mix, more sustainable methods of energy conversion and use are essential for the planet[5].

But achieving a low carbon economy involves tackling uncertainty and ambiguity about future energy supply, energy mix, energy use and efficiency. The energy transition faces several challenges, requiring us to overcome political, economic, behavioural, cultural and territorial barriers.

In this context, three technologically important areas of energy research and innovation shoud be mentioned:

i) Energy Efficiency;

ii) Smart Grids and Energy Systems;

iii) Renewables Integration.

These areas are also pillars of the 2016 European Comission´s 2016 winter package and will play a major role in European Union energy integration[6]. This package has the goal to make Europe's Energy Union the

5 See Energy Transition and the future of energy research, innovation and education: An Action Agenda for European Universities, European University Association, December 2017, p. 5.

6 Communication from The Comission *Clean Energy For All Europeans*, 3th November 2016, containing eight proposals: (1) a revised Directive on the Internal Market for Electricity (the 'Revised IMED'); (2) a revised Electricity Market Regulation (the 'Revised Market Regulation); (3) a revised Renewable Energy Directive (the 'Revised RED'); (4) a Regulation on the Governance of the Energy Union (the 'Governance Regulation'); (5) a new Regulation on Electricity Sector Risk-Preparedness; (6) a recast Regulation on the Agency for the Cooperation of Energy Regulators) (the 'ACER Regulation'); (7) a Directive amending the existing Energy Efficiency Directive; and (8) a Directive amending the existing Energy Performance of Buildings Directive.

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world number one in renewable energies and presents an opportunity to speed both the clean energy transition and growth and job creation.

The three technological energy areas mentioned above should face four types of challenges: a) technical; b) social; c) economical; d) and legal/political[7].

Technical challenges should be taken into account: i) the functionality of grid components and distribution of grid dynamics; ii) the interplay of distributed generation/local use networks operation constraints to ensure grid stability and energy efficiency; iii) holistic system analysis and modeling of electrical grids, thermal and gas distribution systems as multisource carrier systems.

Social challenges should be considered: i) the role of consumers in demand and generation; ii) the value of critical energy infrastructure for different consumer types; iii) the social impact of various energy markets; iv) how user involvement affects the energy system: a user engagement with their energy consumption.

Economical challenges should be contemplated: i) optimise market participation for different actors ; ii) propose business models for complex energy systems; iii) create business models for technologies serving different grids.

Finally, from a *political or legal* point of view, it should be stressed: i) the role of regulators and grid codes; ii) identify/propose future improvements according to state differences in regulatory environments; iii) legislation issues and potential multi-scale governance of energy systems; iv)

7 See Energy Transition, p. 22.

how to overcome potential legislation barriers for multi-energy systems and appreciate the importance of legislation and standardization.

I'm sure most of these topics will be debated today and wish for a very productive conference. I would like to thank IBAR for inviting us to host this event and to say that we are at your disposal to welcome you once more in the future.

Francisco Paes Marques

Professor at the University of Lisbon's Faculty of Law

Transition to a Low Carbon Energy Economy: the Legal Agenda

ALASTAIR LUCAS [1]
CHIDINMA B. THOMPSON [2]

Abstract

The transition to a lower carbon energy economy presents challenges for international and domestic law. A legal agenda is required that identifies legal constraints and factors that may impede or facilitate this low carbon energy transition. The example of Canada reveals international and national constitutional legal agenda issues, notably climate change, Indigenous rights and laws affecting energy technology trade that must be addressed. Other potential agenda items include federal-provincial constitutional jurisdiction, public and private law liability, explicit energy planning laws, energy (particularly renewable energy) regulatory regimes, renewable energy and energy conservation laws, and intellectual property laws.

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1 Professor of Law. Director Sustainable Energy Development Program, University of Calgary, Canada

2 Partner, Borden, Ladner Gervais, Calgary, Canada.

Key Words

Canada; cap-and -trade; carbon tax; energy planning; legal agenda; liability; low carbon energy transition; renewable energy; rule of law

I. Introduction

There is considerable evidence that we are in a transition away from major reliance on hydrocarbon energy[3]. This shift toward an economy based largely on renewable and alternative energy is likely to accelerate. What is uncertain are the speed of transition and the relative proportion of hydrocarbon and renewable energy at any particular time. Nor is the length of this transitionary period predictable. While the pace has rapidly increased recently by some national and sub-national governments, it does appear to be a transition measured in decades rather than years at the global level.

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3 Karl Mathiesen, "G7 nations pledge to end fossil fuel subsidies by 2025", *The Guardian*, (27 May 2016), <https://www.theguardian.com/environment/2016/may/27/g7-nations-pledge-to-end-fossil-fuel-subsidies-by-2025> ; James Roberts, "Canadian Entrepreneurs seek path to fossil-fuel-free future", *CBC News*, (November 30, 2015) http://www.cbc.ca/news/technology/canadian-entrepreneurs-seek-path-to-fossil-fuel-free-future-1.3340326 ; Michal C. Moore, "An Energy Strategy for Canada" (October, 2015), Policy Paper, Canadian Global Affairs Institute, The School of Public Policy, University of Calgary Centre for Military and Strategic Studies < http://www.policyschool.ucalgary.ca/sites/default/files/research/anenergystrategyforcanada.pdf>

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A number of factors are critical in this transition. These include:

1. The availability of technology, capital and policy[4] necessary to facilitate and accelerate the transition,

2. The availability of relatively cheap hydrocarbon fuels,

3. The relative cost of energy sources, production and storage, particularly renewable and alternative energy. A key issue may be development of effective and reliable battery technology and other electricity storage techniques[5],

4. The relative risk (particularly environmental and human) associated with alternative energy sources and technologies,

5. The challenges of international law and the relative commitment of governments to moving toward low carbon energy,

6. The evidence concerning environmental sustainability of carbon energy fuels.

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4 Kyung-Ah Park, “3 Drivers of the Low Carbon Economy” in The Low Carbon Economy Report series, Goldman Sachs September 2016 <http://www.goldmansachs.com/our-thinking/pages/3-drivers-of-the-low-carbon-economy.html?mediaIndex=1&autoPlay=true&cid=PS_02_60_07_00_01_16_01&mkwid=AgrT9o82>

5 Dana Hull, “Tesla Powerwalls for Home Energy Storage Hits US Market”, *Bloomberg*, (May 4, 2016) http://www.bloomberg.com/news/articles/2016-05-04/tesla-powerwalls-for-home-energy-storage-are-hitting-u-s-market; Richard Blackwell, “Hyrostor launching compressed air power storage off Toronto Island”, *The Globe and Mail*, November 17, 2015, <http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/hydrostor-launches-compressed-air-power-storage-system-off-toronto-island/article27306527/

Report: “Battery Storage for Renewables: Market Status and Technology Outlook”, International Renewable Energy Agency, (January 2015), <http://www.irena.org/document-downloads/publications/irena_battery_storage_report_2015.pdf>

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II. The Legal Agenda

Technology and the markets are said to be the key drivers of the transition.[6] Policy and regulation are also transitionary factors discussed in the literature. But virtually no direct attention has been given to law. This chapter addresses this deficit, focusing on the role of law in the low carbon energy transition.

In particular, are there legal constraints that affect the transition on its pace and scale? What is the nature and significance of such constraints? We argue that potential constraints include appropriate choices of legal instruments and approaches as well as firmer norms firm norms such as sovereignty, constitutional jurisdiction and protected rights. Focus on legal instruments and approaches involves consideration of public and private rights potentially available to force, facilitate or restrict action in the low carbon energy transition. This also requires consideration of harmonization with instruments in other areas such as trade and investment. Jurisdictional norms require in particular, consideration of land, sea and resource ownership, regulatory and related jurisdiction including energy infrastructure and environmental sustainability. In short, what should be the legal agenda in optimizing paths taken and avoiding barriers in the low carbon transition?

Limited space requires that this chapter identify but stop short of assessing certain issues that are obvious candidates for this legal agenda. These include the regulatory gaps and hurdles relevant to the various

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6 The Low Carbon Economy "Technology in the Driver's Seat" Goldman Sachs Equity Research November 28, 2016 http://www.goldmansachs.com/our-thinking/pages/new-energy-landscape-folder/report-the-low-carbon-economy/report-2016.pdf; Shaping the Canadian Low-Carbon Economy, at 15 and 20.

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forms of renewable energy and to energy conservation and efficiency. Nor do we look at the potentially difficult international trade and intellectual property issues presented by the low carbon transition.

III. Values and Outcomes

Consideration of this legal agenda is framed by two fundamental values. The first is the rule of law. In conceptual legal terms this is the idea that state actions affecting citizens must be based on law – either statute law enacted according to constitutionally mandated norms and processes or law emanating from judicial orders and decisions.[7] More broadly, the rule of law is a standard for testing arbitrariness in state actions.[8] A related value is that of democratic legitimacy – the measure of how well democratic societies accept government decisions taken through public processes.[9]

The second value is that of ecological integrity.[10] This may be seen as

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7 Tom Bingham, "The Rule of Law", (London: Penguin Publishing, 2010).

8 , Martin Krygier, "The Rule of Law: Legality, Teleology, Sociology", (October 2008), RE-LOCATING THE RULE OF LAW, Gianluigi Palombella & Neil Walker, eds. Hart Publishers, Oxford, 2008; UNSW Law Research Paper No. 2007-65.

9 Including avoiding path dependency based on policy history and perceived societal weight: Philippe Aghion, Cameron Hepburn, Alexander Teytelboym and Dimitri Zenghelis, "Path dependence, innovation and the economics of climate change", Centre for Climate Change Economics and Policy (November 2014) < http://newclimateeconomy.report/2015/wp-content/uploads/2016/04/Path-dependence-and-econ-of-change.pdf; Jenny Palm, "Development of sustainable energy systems in Swedish municipalities: A matter of path dependency and power relations", Local Environment 11:4 (2007), pages 445-457, Godwin Uyi Ojo, "Prospects of localism in community energy projects in Nigeria". Local Environment 19:8 (2014), pages 933-946.

10 Shaun Fluker, "Ecological Integrity and the Law: The View from Canada's Na-

an applied aspect of the broader concept of sustainability. It is the idea that ecological systems, of which humans are a part, have inherent resilience limits that must be respected if serious consequences are to be avoided. Carbon reduction is a major factor in slowing the rush toward ecological limits. The normative basis for addressing ecological integrity is respect for biophysical processes that has been described in the public land context as a "land ethic".[11]

Another useful perspective that enhances understanding of how law may work to facilitate a low carbon energy transition is that of reflexive law. As Gunther Teubner explained, the… "role of law is not substantive regulation but the procedural and organizational structuring of 'autonomous' social processes".[12] Thus legal change is not a purely independent and internal process but engages mutually with its external environment, the latter in our case being the body of science, ideas, political thought and policies driving the low carbon energy transition.

IV. Legal Constraints and Impacts on Transition Efforts

While regulation and policy are key players in the low carbon transition, there are embedded legal constraints that pose challenges for

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tional Parks", SSRN Posted 19 January, 2009 ; Kay J., Regier H., "Uncertainty, Complexity and Ecological Integrity: Insights from an Ecosystem Approach" (2000), in P. Crabbe, A. Holland, L. Rsyzkowski and L. Westra (eds), *Implementing Ecological Integrity: Restoring Regional and Global Environmental and Human Health,* Kluwer, NATO Science Series, Environmental Security pp. 121-156.

11 Aldo Leopold, *A Sand County Almanac* (New York: Ballantyne, 1970) at 237-264.

12 "Substantive and Reflexive Elements in Modern Law" (1983) 17 *Law and Society Review* 239, 277.

a sustainable carbon energy transition. They hinder development of a comprehensive energy strategy at all levels to this end. In fact, it has been argued that the global regulatory landscape for low carbon technologies remains fragmented and volatile, regardless of the Paris Agreement,[13] given that policies will be established at the national and sub-national level, will be piecemeal and with incentives tied to specific sectors and technologies rather than more general measures.[14]

It was also argued that the volatility is contributed by political controversy in many countries, adjustments in response to evolving technology and market conditions, and regulatory innovation and contagion.[15]

First, there will be differences in the support for low carbon technologies across geographies and industries as well as differences in choice of regulatory instruments. Therefore, changes in the political leadership of the country will contribute to repeated changes and discontinuities in policies and regulation in this respect.[16] In the United States, an example among others, President Donald Trump has proposed a new executive order to undo the Obama administration's Clean Power Plan, an environmental regulation that restricts greenhouse gas emissions by 32 percent by 2030 compared to 2005 levels at coal-fired power plants.[17] Second, policy-makers are also regularly adjusting targets and regulations to changing technologies and market conditions.[18] Third, through

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13 Equity Investor's Guide to a Low Carbon World at 4.

14 Key Takeaways from the Paris Agreement, at p.6.

15 Equity Investor's Guide to a Low Carbon World at 26 and 32.

16 Equity Investor's Guide to a Low Carbon World at 32.

17 The Globe and Mail, "Trump to undo Obama plan to curb global warming, EPA chief says" WASHINGTON — The Associated Press, Published Sunday, Mar. 26, 2017.

18 Equity Investor's Guide to a Low Carbon World at 32.

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regulatory innovation and learning, policymakers experiment with different types of policy instruments, and frequently adopt elements of policies that appear to be successful in other countries.[19]

The result of regulatory instability is that a boom-bust pattern develops in the growth of low carbon technologies creating significant risk and uncertainty for markets.[20] Navigating such uncertain and fragmented complex regulatory landscape poses considerable challenges for investors and companies.[21] The following paragraphs discuss the legal norms that constrain the development a consistent low carbon transition strategy. This is done at the international, national and subnational levels. Discussion focuses on sovereignty and international law challenges then looks at national and subnational challenges using the example of Canada. For Canada, significant additional constraints are constitutional jurisdiction in its federal system and constitutionally protected indigenous rights and title to land. These latter are not discussed here.

A. Sovereignty and the Challenges of International Law

The concept of sovereignty is the cornerstone of public international law.[22] It accords a state exclusive control over its territory, permanent population and other aspects of its domestic affairs, and the corollary duty not to intervene overtly or covertly in the affairs of other states

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19 Equity Investor’s Guide to a Low Carbon World at 32.

20 Equity Investor’s Guide to a Low Carbon World at 33.

21 Equity Investor’s Guide to a Low Carbon World at 33.

22 Hugh M. Kindred and Phillip M. Saunders et.al., *International Law Chiefly as Interpreted and Applied in Canada* 7th ed. Toronto, Emond Montgomery Publications Ltd., 2006 at 33.

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and their exclusive domestic jurisdiction.[23] One of the sources of international law, as the rules to which states are willing to subject their sovereignty, is law-making (multilateral) treaties[24] which define, codify or restate the law to govern the ongoing conduct of all the parties in the relevant subject area and intend to create binding legal obligations.[25] However, as a result of the concept of sovereignty, state parties must formally express their consent in order to be legally bound to perform the treaty's obligations through signature, ratification or accession.[26] Based on the voluntary consent of parties, the principle of *pacta sunt servanda* (legal undertakings by states must be performed in good faith) prevents states from invoking their sovereignty to renege on their treaty obligations, until terminated or suspended in accordance with the terms of the treaty, consent of the parties or operation of law of treaties.[27]

However, the concept of sovereignty prevents treaties from binding non-parties.[28] For parties, there are few generally applicable remedies for material breach (other than by recognized methods of termination) of treaties. These include termination or suspension of the treaty by other or all of the parties, reparation (where possible), and self-help/

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23 Subject to international protection of human rights. Kindred and Saunders et.al., at 33.

24 See Article 38 of the Statute of the International Court of Justice, 26 June 1945, Can. T.S. 1945 No. 7 (entered into force 24 October 1945).

25 John H. Currie, *Public International Law* Toronto: Irwin Law Inc., 2001 at 103 and 108.

26 Currie, at 119; *Vienna Convention on the Law of Treaties*, 23 May 1969, 1155 U.N.T.S. 331, Articles 7-17.

27 Articles 26, 46-53 *Vienna Convention*; Currie, at 129-131, 144-151.

28 Currie, at 136.

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countermeasures within justifiable limits and proportionality.[29] Permissible countermeasures include suspension of legal obligations of economic or political character owing to the offending state.[30] There is a lack of peaceful law enforcement mechanism that do not depend, for their jurisdiction, on the consent of all parties involved in the dispute to continued perception of self-interest by some states in pursuing unilateral remedial options.[31]

Further, the breach of a multilateral agreement may not directly harm any state but may nevertheless undermine the effectiveness of the legal regime as a whole.[32] It therefore remains the case that the international legal system is not always perceived as effective.[33] This is the main challenge for international law. Based on these challenges, it has been argued that while the Paris Agreement is a positive sentiment on key low carbon technologies, it is not a global rulebook on emissions as there is no formal enforcement mechanism for the new voluntary national targets set by each of the countries themselves.[34]

B. National Energy Planning Challenges

While there is little doubt that national planning toward a low carbon energy transition is desirable, Canada's federal system and the variety of provincial energy mixes make this difficult. Some federal initiatives have

29 Currie, at 156, 401-402, 408-413.

30 Currie, at 413.

31 Currie, at 412.

32 Kindred and Saunders et.al., at 719.

33 Currie, at 412.

34 Key Takeaways from the Paris Agreement, at 1

been taken on matters were federal jurisdiction and ability to provide leadership is reasonably clear. This includes motor fuel standards[35], environmental assessment of energy projects[36] and certain environmental matters such as fish and marine environment protection[37], and emissions from federally regulated sources.[38]

The result is that provinces (with federal encouragement) have taken the lead in developing low carbon energy plans.[39] This approach and the planning tools used is an important element in the transition. Included are Ontario's Long Term Energy Plan[40], Alberta's Climate Leadership Plan[41], BC's Climate Leadership Plan,[42] and Quebec's 2030 Energy Policy[43] To the extent that a federal plan exists, it sets aspirational overall

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35 E.G.,*Gasoline Regulations*, SOR/90-247.

36 Under the *Canadian Environmental Assessment Act*, SC 2012.

37 Under the *Fisheries Act*, RSC 1985 c F-14.

38 E.G., *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*, SOR/2010-201; *On-Road Vehicle and Engine Emission Regulations* , SOR/2003-2

39 Adrian Morrow and Greg Kennan, "Ontario to Spend $7-billion on sweeping climate change plan", *Globe and* Mail, (May 16, 2016) < http://www.theglobeandmail.com/news/national/ontario-to-spend-7-billion-in-sweeping-climate-change-plan/article30029081/>, Justin Giovannetti and Jeffrey Jones, "Alberta Carbon plan a major pivot in environmental policy", *Globe and Mail* (November 22, 2015) < http://www.theglobeandmail.com/news/alberta/alberta-to-release-climate-change-policy-at-edmonton-science-centre/article27433002/>, http://www.climatechange.gc.ca/default.asp?lang=en&n=64778DD5-1

40 Achieving Balance: Ontario's Long Term Energy Plan, 2016, online: < http://www.energy.gov.on.ca/en/ltep/achieving-balance-ontarios-long-term-energy-plan/ >

41 Alberta's Climate Leadership Plan 2016, online: http://www.alberta.ca/climate-leadership-plan.cfm

42 Online < http://climate.gov.bc.ca/

43 Quebec's 2030 Energy Policy, online: <https://politiqueenergetique.gouv.qc.ca/wp-content/uploads/Energy-Policy-2030.pdf> visited April 6, 2017.

GHG targets, addresses sources clearly within federal jurisdiction.[44] This, along with the provincial initiatives, forms the basis for the June, 2016 clean energy goal announcement by the Canadian, US and Mexican leaders at their Ottawa summit.[45]

Ontario's Plan[46] includes energy conservation measures, renewable energy to make up approximately half of the province's installed electricity capacity by 2025, clean energy imports, appropriate siting for large energy infrastructure, electricity transmission enhancements and nuclear generating station refurbishments. As for oil and gas, these fuels are understood to be, "essential to Ontario's economy and quality of life".[47] This was after initial Plan announcements stated that natural gas had no future power generation role.[48] The province has also adopted standards for evaluating major oil and gas pipeline projects. In the overall context of the Plan, the clear implication is that the latter are transitional energy sources during the renewable energy expansion and implementation of planning and conservation measures.

Alberta's Plan[49] involves implementing a carbon tax, along with a cap on oil sands GHG emissions, reducing methane emissions 45% by 2025, and accelerating phase out of coal fired electricity generation. The aim

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44 Federal Climate Change Strategy, Online: http://www.climatechange.gc.ca/default.asp?lang=En&n=72F16A84-1

45 Shawn McCarthy, "Trudeau, Obama and Pena Nieto agree to emission-reduction goals at summit", The Globe and Mail online, June 29, 2016.

46 *Supra*, n 68.

47 *Ibid* at 61.

48 Adrian Morrow, "Ontario's climate plan backs off earlier draft's natural gas phase-out" *Globe and Mail* (June 08, 2016) <http://www.theglobeandmail.com/news/national/ontario-unveils-details-of-climate-change-policy/article30347049/>

49 Supra n 69.

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is to promote the energy efficiency necessary to reduce GHG emissions significantly, while supporting the provincial oil and gas industry. Like Ontario's Plan, the objectives are consistent with a transition to a lower (but not negligible) carbon energy economy.

Both Plans are expressed in policy documents. Ontario's in particular is relatively detailed, addressing various energy sources, conservation, regional planning, energy innovation, and Aboriginal consultation. But in both cases, plans and announcements alone will not suffice. This is not only a policy exercise. New statutes and statutory amendments are needed to provide the legal authority, public duties, specific requirements and prohibitions necessary to implement the Plans – to make them legally binding and enforceable. It is essential that the legislative and executive lawmaking processes be engaged. The rule of law[50] demands no less.

The Ontario Energy Statute Law Amendment Act, 2016[51] is the implementing statute for the Long Term Energy Plan. It amends the 2008 Green Energy Act[52] to specify required government agency actions. The provincial cabinet is empowered to require by regulation that any public agency or prescribed person prepare and submit to the energy ministry an energy "conservation and demand management plan"[53] and to achieve prescribed targets and energy standards[54]. Amendments to the Electricity

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50 In the Dicean sense. See: Denise Meyerson, "The Rule of Law and the Separation of Powers" MqLJ 1 (2004), <http://www.austlii.edu.au/au/journals/MqLJ/2004/1.html>

51 SO 2016 c 10.

52 *Green Energy Act*, 2009, SO 2009, c 12, Sch A.

53 *Supra* n 3.

54 *Ibid*.

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Act[55] provide powers and impose duties on the minister to prepare a long term energy plan,[56] and issue necessary directives to the Independent Electrical System Operator and the Ontario Energy Board.[57] .

Alberta's Act[58] spells out the new carbon levy, including timed increases, and a system of rebates to certain persons. Also expressed are details of coal fired electricity generation plant retirements and timing, as well as powers of cabinet to establish an oil sands emission cap. For all of these initiatives, amendments to or possibly replacement of the Specified Gas Emitters Regulation[59] will be required. The Government of Alberta passed the *Oil Sands Emissions Limit Act*[60] in force December 14, 2016 which set out the proposed annual 100 Mt emissions limit on greenhouse gas emissions in the oil sands sector.[61] On November 3, 2016, the Government of Alberta released the *Climate Leadership Regulation*[62] which provides further information on how the carbon levy will be implemented and administered in Alberta.

Alberta's *Renewable Electricity Act*[63] was proclaimed on March 31, 2017 bringing into force Alberta's Renewable Electricity Program, sets

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55 *Electricity Act, 1998*, SO 1998, c 15, Sch A.

56 *Ibid*, s 7.

57 See Ontario Ministry of Energy, Ontario's Long-Term Energy Plan: online < http://www.energy.gov.on.ca/en/ltep/> accessed 6 April, 2017.

58 *Supra*, n 69.

59 *Specified Gas Emitters Regulation*, Alta Reg 139/2007.

60 SA 2016, c O-7.5.

61 C. Thompson et.al, "Alberta Government Introduces Legislation Mandating Cap on Greenhouse Gas Emissions from the Alberta Oil Sands" The Resource BLG Energy Law Blog < http://blog.blg.com/energy/Pages/Post.aspx?PID=260>

62 A.R. 175/2016.

63 SA 2016, c R-16.5.

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the 30 per cent of renewable electricity target and allows for the development of interim targets for the program. In addition, it ensures that environmental protection is in place for all large renewable projects, including wind and solar projects, under the program. Alberta's Renewable Electricity Program targets the development of 5,000 megawatts of renewable electricit supported by carbon revenues from capacity by 2030. The projects are selected by a competitive process and funded by private investments large industrial emitters.[64]

British Columbia's 2016 Climate Change Plan,[65] which builds on its carbon tax legislation[66] and its largely hydro electricity generation, features a major role for LNG, the consequence of major proposed LNG projects in the province. It includes increasing the low carbon fuel standard and a package of transportation efficiency improvements, methane reduction and powering oil and gas production and processing with natural gas, and built environment efficiency standard increases. All of this is with a view to the provincial 2050 GHG target of 80% below 2007 levels.

C. Potential Liability

Several major areas of potential private and public liability are highly relevant to low carbon energy transition. One is public law "liability" of government and its agencies to act according to law. This encompasses legal action by persons affected by government action intended to achieve (or hinder achievement of) low carbon energy goals. These

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64 Government of Alberta, "New jobs, investment to come from renewables" Mar 24, 2017.

65 *Supra* note 113.

66 SBC 2008 c 40.

actions may be based on substantive rights to have government and its regulatory agencies act within legal authority – particularly powers or duties under energy, environment and related statutes.[67] Alternatively, or additionally, these public law actions may seek to enforce rights in affected members of the public to fair and transparent procedures by governments and their agencies in decisions that affect low carbon energy transition.[68]

The consequence of successful legal actions of this kind will be nullification or variation of government decisions to issue (or refuse to issue) approvals to private persons or entities concerning activities relevant to carbon energy production or use. All of this is the province of administrative law, particularly that part governing appeal or judicial review of government decisions. Other legal and regulatory gaps and uncertainties, include:

- Renewable energy regimes.
- Energy conservation and efficiency.
- Intellectual property laws.
- International trade concerning energy technology.

D. Federal Government Actions

In October 2016, Canada took two major steps towards the implementation of its climate change policy – ratification of the Paris Agree-

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67 E.g. *Big Loop Cattle Co Ltd v. Alberta (EUB),* 2010 ABCA 328; *Berger v. Alberta (ERCB),* 2009 ABCA 158.

68 Allan Ingelson, ed, *Canada Energy Law Service, Alberta*, para 682-682b.

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ment and a proposed pan-Canadian benchmark for carbon pricing to be implemented by 2018.[69] At the 2015 United Nations Climate Change Conference in Paris, France ("COP21"), which resulted in the Paris Agreement, Canada committed to a 2030 target of a 30% reduction below 2005 levels of emissions. To achieve Canada's international commitments the Government of Canada adopted the Pan-Canadian Approach to Pricing Carbon Pollution.[70]

Then on November 21, 2016, the Government of Canada announced the amendment of its *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*,[71] to accelerate the phase-out of traditional coal-fired units across Canada. The amendment requires all traditional coal-fired units to meet a stringent performance standard of 420 tonnes of carbon dioxide per gigawatt hour (tCO2/GWh) by no later than 2030. Traditional units are those that don't use carbon capture and storage that traps carbon dioxide and stores it so it can't affect the atmosphere.

The federal benchmark includes the following elements:

(a) all jurisdictions will have carbon pricing by 2018;

(b) pricing will be applied to a common and broad set of sources to ensure effectiveness and minimize interprovincial competitiveness effects. At a minimum, carbon pricing should apply

69 C. Thompson et.al, "The New Federal Carbon Pricing Policy – Roadmap to a Pan-Canadian Energy Strategy?" The Resource BLG Energy Law Blog <http://blog.blg.com/energy/Pages/Post.aspx?PID=245>

70 Environment and Climate Change Canada, Backgrounder <http://news.gc.ca/web/article-en.do?nid=1132169&tp=930> 2016-10-03

71 SOR/2012-167.

to substantively the same sources as British Columbia's carbon tax;

(c) Provinces and territories will have the flexibility to choose how they implement carbon pricing by (i) an explicit price-based system (as in British Columbia and Alberta), or (ii) a cap-and-trade system (as in Ontario and Quebec);

(d) for jurisdictions with an explicit price-based system, the initial price will be a minimum $10 per tonne of carbon pollution in 2018 and will rise to $10 a year to reach $50 per tonne in 2022. For Provinces with cap-and-trade the number of available pollution permits will decrease every year, based on both: (i) a 2030 target equal to or greater than Canada's 30% reduction target; and (ii) annual cap cuts through to 2022 that correspond, at a minimum, to the projected emissions reductions resulting from the carbon price set per year in price-based systems;

(e) Revenues realized remain in provinces and territories of origin to be used according to their needs, including addressing impacts on vulnerable populations and sectors and supporting climate change and clean growth goals;

(f) the federal government will introduce an explicit price-based carbon pricing system that will apply in jurisdictions that do not meet the benchmark. The federal system will be consistent with the above principles and will return revenues to the jurisdiction of origin;

(g) Provinces and territories are expected to provide regular, transparent and verifiable reports on the outcomes and im-

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> pacts of carbon pricing policies; and (h) the framework will be reviewed in five years (2022) to ensure that it is effective and to confirm future price increases. The review will account for actions of other countries in response to carbon pricing and permits or credits imported from other countries.[72]

Problems have been highlighted with the federal plan including limited clarity on how two different pricing methods - carbon tax and cap-and-trade – may be consistently measured for compliance purposes, and potential jurisdictional and constitutional challenges including indirect taxation of provincially owned resources by the federal government and constitutional immunity.[73]

V. Conclusion

The legal agenda for the low carbon energy transition is a matter of push and pull. "Push" involves new and amended legislation to facilitate low carbon initiatives. This requires attention to the fact that policy development is only a first step. The rule of law requires legal instruments that bind governments and citizens. "Pull" means guiding proponents (including governments) around potential legal hurdles and through confusing legislative gaps. Part of this is skirting or resolving potential private and public law liability.

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72 The New Federal Carbon Pricing Policy – Roadmap to a Pan-Canadian Energy Strategy.

73 The New Federal Carbon Pricing Policy – Roadmap to a Pan-Canadian Energy Strategy; Sections 91(3) and 125 of *The Constitution Act*, 1867; *Reference re Proposed Federal Tax on exported Natural Gas* [1982] 1 S.C.R. 1004.

However, Parliament and Legislatures are supreme only within their respective subjects of constitutional authority. Further, constitutional protections, as well as (in Canada) Aboriginal and treaty rights, present absolute legislative limits; though these may ultimately have to be determined by the courts. It is within these parameters that the legal agenda for the low carbon energy transition must be constructed and implemented.

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Support mechanisms for renewable energies and competitive markets in the forthcoming Directive of the European Union[1]

IÑIGO DEL GUAYO CASTIELLA[2]

Abstract:

The EU is working hard to promote the use of renewable energies for the production of electricity. A milestone in that path was the 2009 European Directive on renewable energies. This Directive imposes upon Member States the obligation to put in force legislation supporting the use of renewables. The EU is currently reviewing the 2009 Directive. Among other reforms, the future Directive will ask Member States to have support schemes which are fully compatible with competitive markets. This will be possible, in turn, because lowering technological costs of renewable technologies. At the same time, it will ask Member States to give stability to said support schemes, to avoid regulatory uncertainty and, thus, promote, investment.

1 This paper reproduces the introduction and the two final subsections of my Chapter Support for Renewable Energies and the Creation of a Truly Competitive Electricity Market. The Case of the European Union, at Zillman, D., Godden, L., Paddock, L., Roggenkamp, M., Innovation in Energy Law and Technology: Dynamic Solutions for Energy Transitions, Oxford University Press, Oxford 2018, pp. 305-320.

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Key words

Renewable energies, technology, European Renewables Directive

1. Introduction

This paper addresses how the EU is currently considering a change in the existing legal framework for renewable energies, one aspect of which will be an obligation imposed upon Member States to design support schemes that are fully compatible with competition law. This development demonstrates that technology innovations that have led to decreased costs for renewables such as wind and solar are leading to legal innovation in how governments approach subsidies for these technologies.

Within EU's energy policy, renewable energy satisfies both the goal of security of supply (they are national energy sources) and the goal of sustainability (they do not generate greenhouse gases or GHG). When a systematic European Union (EU) policy for the promotion of renewable energy was first introduced at the end of the 20th century, it was mainly based on governmental support. This approach indicates that renewable energy was not the most economically efficient method of providing energy (at least when externalities are not taken into account) and that policy

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makers believed the promotion of renewable energy could not be left to free play of demand and supply within an energy market. This depends on several factors, the maturity of technology being the main one.

Actually, under the initial approach of EU law to renewable energy (but also today), Member States were allowed to support domestic energy sources, including renewable energy, as an exemption to a free market. The first Electricity Internal Market Directive (1996) allowed Member States to impose public service obligations related to environmental protection and to the security, regularity, quality, and price of supplies.[3] This approach was confirmed and expanded by the second Internal Market Directive (2003)[4]. The third Electricity Internal Market Directive (2009) also permits Member States to employ tendering schemes for new capacity, taking into account the interests of environmental protection and the promotion of emerging technologies[5]. By means of these provisions, the Directives try to create a space for renewables energy within a liberalized electricity market.

Legal problems arise because the Electricity Internal Market Directives do not provide any guidance about the wider EU legal framework: which support schemes are compatible with competition law (including State aids rules) and which schemes should be avoided as they violate

3 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, OJ (1996) L 27/20.

4 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, OJ (2003) L 176/37.

5 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, OJ (2009) L 211/55.

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the fundamentals principles of the Treaty? This is being shaped by several decisions of the Court of Justice, as this Chapter analyses.

The legal analysis of existing and future support schemes, at national level, must be done in light of a rather unexpected rapid technological cost decrease in recent years. According to the International Renewable Energy Agency's (IRENA) report renewables have benefited from a cycle of falling costs. The EU's renewable energy targets for 2020 have played a vital role in lowering renewable energy costs globally, creating a steady demand for cost-effective renewable energy. The RES Directive initiated a virtuous cycle in which support policies stimulate increased deployment, which in turn resulted in technological improvements, as well as continual cost reductions. From 2010-2015, the average cost for new onshore wind plants fell by 30 per cent and average costs for new utility scale solar PV installations decreased by 75 per cent. Utility scale solar PV projects are now competitive against peaking gas generation[6].

Due to these cost decrease, governmental support becomes less important. It must be noted that renewable energies are not the only fuels to be subsidised by European Economic Area (EEA) country governments. In 2014 the estimated total public support for coal and natural gas amounted to EUR 16 billion in 2012 in the EU, against EUR 11 billion for solar and wind energies combined. A recent EEA report identified that fossil fuels continue to receive 53.3% of public support for energy sources, whereas renewable energy (including biofuels) obtains 40.5% of the public support.. Accordingly, the EEA report indicated that the support aimed at renewable energy did not alter the competitive position between renewables and fossil fuels[7].

6 Renewable Power Generation Costs in 2014, IRENA, 2015.

7 Energy support measures and their impact on innovation in the renewable en-

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2. The forthcoming renewable energies Directive

The European Commission launched in 2016 the so called *winter package*, containing a number of legislative proposals within the energy field. Among those initiatives there is a proposal[8].

2.1. Towards support schemes that are compatible with competition

There is a wide consensus in the EU about the relevance of developing a market that is a better fit for renewables. Future support schemes should be market-based and granted through a competitive process, with a clear shift away from feed-in tariff. Support mechanisms should encourage greater market responsiveness, resulting in gradually decreasing support levels as technologies become mature[9].

Article 3 of the 2009 RES Directive states that in order to meet the renewable energies targets, Member States may, inter alia, apply support schemes. There is no further detail on how those schemes must be designed in order to comply with EU law. There is, however, a provision which declares that Member States have the right to decide to what ex-

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ergy sector in Europe, EEA Technical report, No 21/2014

8 *Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast) (Text with EEA relevance):* Brussels, 23.2.2017 [COM(2016) 767 final/2; 2016/0382 (COD)]; corrigendum: this document corrects document COM (2016) 767 final of 30.11.2016*;* at https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition.

9 In 2016, the European Commission conducted a public consultation in search of authoritative opinions when drafting a new Renewable Energy Directive to replace the 2009 one. This public consultation has shown the consensus mentioned in the text: https://ec.europa.eu/energy/sites/ener/files/documents/Summary%20RED%20II%20Consultation.pdf

tent they support energy from renewable sources that is produced in a different Member State, «*without prejudice to Articles 87 and 88 of the Treaty*» (former Articles 87 and 88 are current Articles 107 and 108 of the TFEU, and devoted to State aids).

Article 4 of the revised Directive is devoted to financial support for electricity from renewable sources. It includes further detailed specifications on how those schemes must be designed. Any future support is subject to State aid rules. Support schemes are an instrument to reach the EU renewable target, since there are no mandatory targets for member States in the future Directive. In accordance with future Article 4, support schemes for electricity from renewable sources must comply with four conditions:

i) be designed so as to avoid unnecessary distortions of electricity markets;

ii) ensure that producers take into account the supply and demand of electricity as well as possible grid constraints;

iii) integrate electricity from renewable sources in the electricity market; and

iv) ensure that renewable energy producers are responding to market price signals and maximise their market revenues (actually, an increasing number of Member States allocate support in a form where support is granted in addition to market revenues[10]).

10 Recital no 15.

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In summary, support schemes should be provided in a form that is as non-distortive as possible for the functioning of electricity markets[11]. With regard to procedure, Member States must ensure that support for renewable electricity is granted in an open, transparent, competitive, non-discriminatory and cost-effective manner. Finally, Article 4 imposes upon Member States the obligation to assess the effectiveness of their support for electricity from renewable sources at least every four years. This provision doesn't mean that the level of support must be changed every four years, but rather that decisions on the continuation or prolongation of support and design of new support is to be based on the results of the assessments.

There is disagreement among incumbents on the geographical scope of support schemes. Many sector incumbents consider that strategic planning must be allocated at national level, but there is the need of a stronger guidance from the European Commission. The preferred option by stakeholders (34 percent) is a gradual alignment of national support schemes through common EU rules to avoid markets distortions. Moving towards even further integration by introducing an EU-wide level support scheme, or a regional support scheme, is supported by 24 percent and 12 percent of the respondents respectively.

Actually, the *Florence Electricity Forum* called in June 2016 for common rules on support schemes and for more regionalised and market-based approaches[12]. The European Commission is of the opinion that

11 Ibidem.

12 European Commission, 31st EU Regulatory Forum, "Draft Conclusions", 13th-14th June 2016. See further Hancher, L. y Guayo, I. del, The European Electricity and Gas Regulatory Forums, at Barton, B., Barrera-Hernández, L.K., Lucas, A.R. and Ronne, A. (editores), «Regulating Energy and natural Resources», Oxford University Press, Oxford 2006,

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the national character of support schemes prevents exploring the full benefits of European market integration. However, political considerations such as the preference to keep investments within a Member State may prevail, even if they were to result in a less cost-effective outcome[13].

2.2. Support for electricity generated from renewable energies in other Member States

All Member States started their support schemes by excluding non-domestic renewables from access to the support schemes. Some stakeholders are currently willing to move further and consider a progressive opening of national support schemes to energy producers in other Member States under some conditions such as, for instance, an obligation of physical delivery of the electricity, or having a bilateral cooperation agreement in place. Keeping national level support schemes that are only open to national renewable energy producers is the preferred option only for a minority. Member States generally believe that cross-border participation of support schemes should occur on a voluntarily basis. Overall, the development of a concrete framework for cross-border participation is generally welcomed.

Article 5 of the revised Directive imposes upon Member States the obligation to open support for electricity generated from renewable sources to generators located in other Member States, under particular conditions. Cross-border participation is the natural corollary to the development of the EU renewables policy, with a EU level binding target

pp. 243-261.

13 See footnote no 32. Commission Staff Working Document: REFIT evaluation of the Directive 2009/28/EC…, o.c., p. 6.

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replacing national binding targets[14]. The draft Directive states that support for at least 10 percent of the newly-supported capacity in each year between 2021 and 2025 and at least 15 percent of the newly-supported capacity in each year between 2026 and 2030 is open to installations located in other Member States.

Support schemes may be opened to cross-border participation through, inter alia, opened tenders, joint tenders, opened certificate schemes or joint support schemes. These ways of allocation of renewable electricity must be subject to a cooperation agreement setting out rules for the cross-border disbursement of funding, following the principle that energy should be counted towards the Member State funding the installation. By 2025 the Commission must assess the situation and may propose to increase the above mentioned percentages.

Other measures have been considered by the European Commision:

a) the support at EU-level of research, innovation and industrialisation of innovative renewable energy technologies;

b) the creation of a EU-level financial support to renewable energy projects (a specific guarantee Fund);

c) enhancing EU level regulatory measures;

d) sharing among Member States best practices, information and updated guidelines;

e) the establishment of requirements on market players to include a certain share of renewable energy;

14 Recital no 17.

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f) the creation of EU-level incentives (for example, an EU-wide or regional auction of renewable energy capacities); and

g) enhanced infrastructure investments, smart grids and stor age system.

2.3 The need of stable frameworks. Support schemes and legal certainty

There is a wide consensus in the EU about the need for a stable and predictable EU legal framework for renewables. The EU legal framework must be developed in such a way that there is a reinforcement of the investment protection regime, going beyond the requirements of the Energy Charter Treaty[15]. The need for more harmonised rules on support schemes at the EU level provide investors with more visibility and certainty and facilitates a cost-effective achievement of the 2030 target.

In some Member States, favourable remuneration schemes led to high investments, sometimes reaching levels rather unexpected by Member States. This led to budget concerns in several cases, pushing Member States towards unexpected policy changes. A number of Member States (e.g. Bulgaria, Czech Republic, Italy, and Spain) adopted unexpected changes to the financial incentives for existing renewable energy projects and suspended support for new projects.

Adjustments of support schemes to new market conditions were made too abruptly in some cases, or even retroactively. Most Member States reduced the feed-in tariff for solar PV or decided to change to a feed-in premium (e.g. the United Kingdom) in order to adapt support

15 See www.encharter.org

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to the reduction in technology costs and make schemes more market-based. This resulted in market uncertainty and had negative effects on investors. Retroactive changes to support schemes should be prevented. In past years, many complaints were addressed to the European Commission in relation to retrospective and other changes in national support schemes occurring in various Member States, and/or discriminatory measures against renewable energy operators. Those complaints claimed violations of the RES Directive (based on insufficient action by Member States to achieve renewable targets) and of general principles of EU law.

Since the Directive does not prescribe the use of support schemes, there were no sufficient grounds in most cases to initiate legal action. In accordance with the European Commission's view «*market based schemes also increase investor certainty since support mechanisms are more transparent and predictable and less exposed to unilateral government decisions (e.g. modification of support conditions for existing installations)*»[16].

Article 6 of the revised Directive states that without prejudice to adaptations necessary to comply with State aid rules, Member States shall ensure that the level of, and the conditions attached to, the support granted to renewable energy projects are not revised in a way that negatively impacts the rights conferred thereunder and the economics of supported projects.

The European Commission explains that renewables support should be stable and avoid frequent changes, since they have a direct impact on

16 Commission Staff Working Document: REFIT evaluation of the Directive 2009/28/EC..., o.c., pp. 4, 5, 17 and 37.

capital financing costs, the costs of project development and therefore on the overall cost of deploying renewables in the EU. Member States should prevent the revision of any support granted to renewable energy projects from having a negative impact on their economic viability, and should promote cost-effective support policies and ensure their financial sustainability[17].

2.4 Reference to the Spanish case and the stability of support schemes

The situation experienced by renewable operators in Spain in past years must be avoided. The Spanish Government created an attractive framework for companies investing in renewable energy sources by means of a Royal Decree passed in 2004, which not only linked the premium to the average price of KWh in the pool, but also fixed high percentages for premiums. In the light of this norm, much renewable generation was installed, particularly installations working with wind and solar photovoltaic.

The Spanish economic crisis, that included a recession, a crisis in the financial system and its institutions, and a drastic reduction of energy demand, aggravated the so-called electricity deficit. This deficit meant the accumulation during one decade (2002-12) of annual imbalances between revenues and costs of the electricity system that created a structural deficit. The bad financial situation endangered the proper functioning of transport and distribution activities. Although the Spanish electricity sector was liberalized in 1997, there are regulated tariffs paid by domestic and small commercial customers. In fixing tariffs, the government was not cost-oriented, keeping electricity prices artificially

17 Recital no 18.

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low, the result being that there is a cumulative deficit as a result of the difference between regulated tariffs and the cost that should be paid by a customer in the liberalized market.

In other words, electricity producers were forced to sell electricity at regulated prices which did not cover costs. The economic deficit was, therefore, the cumulative difference between the cost for companies to generate electricity and the charge that they are allowed to charge for it. The deficit had reached overwhelming accounts in 2010. Subsidies to renewable energy are among the costs of the electricity system covered by regulated prices.

Consequently, Spanish electricity policy from 2008 to 2013 was dominated by legislative and regulatory measures directed towards fighting and mitigating the pernicious consequences of an increasing electricity deficit, accelerated from July 2007, by a lowering of energy demand due to the economic crisis. Spanish Governments from 2008 to 2012 reduced subsidies to existing renewable installations and suppressed subsidies to new installations. The Government passed a number of legislative measures directed, among other objectives, towards reducing the subsidies paid to existing installations generating electricity from renewable sources and suppressing subsidies to new installations.

Constant changes of the regulatory framework for renewable energy sources and, in particular of subsidies, created conflict between investors and the government. Under the 1998-2010 supporting framework, significant amounts were invested in photovoltaic plants, as well as in other renewable plants, not only by Spanish companies and individuals but also by foreign investors. Since changes were included within Royal Decrees passed by the government, incumbents appealed to the Supreme Court against those governmental norms passed to develop the above referred to parliamentary acts, as well as other new governmental norms related to subsidies for renewable energies.

Applicants' main arguments were linked to the retroactive character of the norms, which was prohibited by the Spanish Constitution. Applicants argued that the Royal Decrees violated the legal principle of protecting legitimate expectations and that, in summary, they were in opposition to the constitutional principle of legal or juridical certainty. It was also argued that the decrease of subsidies was against the legal principle of reasonable remuneration contained in the Electricity Sector Act of 1997.

In a number of decisions from 2010 to 2016, the Supreme Court rejected the applicants' arguments. In particular, the Court denied changes were of a retroactive character, since they were simple regulatory changes for future generation. The Court also denied a violation of the legal provision of reasonable remuneration by the 1997 Electricity Act, and found no arguments to support the opinion that legitimate expectations had been violated, since the measure were applied to a regulated sector, and companies only suffered the consequences of regulatory risks. On one occasion at least, the Court admitted that the conduct of the government on the issue had led to poor regulation, although bad regulation is not necessarily an illegal regulation.

A new support scheme was put into force by the Spanish Electricity Act 2013[18], followed by subsequent legal developments. The main aim of this Act was to put an end to the electricity deficit. In that regard, it meant the end of subsidizing production, in favour of subsidizing investment[19].

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18 Act no 24/2013, 26 December 2013.

19 See further: H Vedder, M Roggenkamp, A Ronne and I del Guayo, *EU Energy Law*, in Roggenkamp, Redgwell, Ronne and Del Guayo, *Energy Law in Europe*, Oxford University Press, 3rd edition, Oxford 2016; A McHarg and A Rønne, *Reducing Carbon-Based Generation: Is The Answer Blowing In The Wind?* in D Zillman, C Redgwell, Y Omorogbe and L Barrera-Hernandez (eds), *Beyond the Carbon Economy: Energy Law in Transition* (OUP, Oxford 2008); and H T Anker, BE Olsen, and A Rønne *Legal Systems and Wind Energy* (Kluwer Law Int 2009).

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Several claims were submitted against the Kingdom of Spain in international arbitration institutions, since some foreign investors were of the opinion that by reducing subsidies to renewable energy sources, Spain has not fulfilled its international obligations (both under bilateral investment agreements and under the Energy Charter Treaty). The first two claims were rejected by the Stockholm Chamber of Commerce in 2016[20]. The third one was issued by the International Centre for the Settlement of Investment Disputes (ICSID), whereby Spain lost the first international arbitration process over cuts to renewable energy subsidies.

The award of 4 May 2017 is in favour of the British company *Eiser Infrastructure Limited* and its subsidiary *Energia Solar Luxembourg*. The ICSID considered the Spanish government actions to be a violation of Article 10 of the Energy Charter Treaty, thus depriving the company of fair and equitable treatment. There are dozens of cases pending at the ICSID. As opposed to the Stockholm decisions, which dealt with solar photovoltaic energy and changes done in 2010 and 2011, the ICSID case deals with thermal-solar and the radical changes done in 2013.

3. Concluding remarks

The decarbonisation of the energy systems opens to renewable energies the key role in the future energy mix. In past fifteen years the European Union has become a worldwide leader in the field of renewable energies. Germany, Denmark and Spain have had a remarkable importance in such trend. From the beginning, EU law on renewable energies

20 See Guayo, I. del, La Carta Internacional de la Energía en 2015 y las energías renovables (a propósito del Laudo de 21 de enero de 2016), en «Cuadernos de Energía», núm. 47 (2016), pp. 50-56.

was based on the assumption that the only way to promote the use of renewable energies was some kind of governmental subsidy. This could have the form of feed-in-tariffs or/and premiums, which, in turn, were often recollected from prices paid by electricity customers. This created an atmosphere among which the promotion of renewable was nothing but an exemption (a huge one) of free market. Although these subsidies were similar to subsidies for more traditional energy sources and they might have been needed early in the development of renewables, the assumption that subsidies are needed is no longer valid. On the contrary, it is clear now that support schemes must be aligned with competition among energy producers and suppliers.

When the procedure to create an internal market for electricity started in the EU, there was little consideration to renewable energies within the EU law. They gained momentum when the first renewable energies Directive was passed in 2001 and reached its climax with the 2009 RES Directive. This Directive became a good instrument to foster at EU level the use of renewable energies for electricity generation purposes. It addressed the problems this kind of energy was experiencing at that time.

Eight years later, it is clear that several changes are needed in the text of the 2009 Directive. This explains why the European Commission has drafted a new Directive, as a key component of the so called *2016 Winter Package*. Several of the expected changes are related to support schemes, either to guarantee that they are stable, or to impose upon Member States the obligation to choose a scheme which is compatible with competition. The rapid decrease of costs associated with renewable installations and the maturity of technology (solar and wind, mainly) operate towards the suppression of any governmental subsidy which gives to renewable energies a privileged position.

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Amidst the governmental rhetoric of some governments which back the 2015 Paris Agreement but increase the use of, for example, national coal, some sort of support schemes in favour of renewable energies is not only acceptable, but also desirable. The future RES Directive of the EU tackles this problem with a express call to support schemes compatible with competition law. It also contains new and explicit reference to the need of stable support frameworks whose change is subject to foreseeable procedures. Finally, the proposed Directive indicates that legal innovation must continue to track technology innovation including changes in cost of technology, as well as market conditions which may allow innovations in the way government support schemes relate to the market.

The regulatory Challenges of Disruptive Energy Technologies [1]

FILIPE MATIAS SANTOS [2]

Abstract

This article analyses the impact of new technologies in the energy sector. The ongoing energy transition brings new challenges that must be addressed by energy regulators. The key elements of the current transformation are identified and briefly explained. Subsequently, seven possible regulatory responses are forecasted.

Keywords

Energy regulation, energy transition, disruptive energy technologies, regulatory challenges

1 The content of this article is personal and does not reflect the official views of ERSE.

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I. Introduction

The energy sector is changing. After decades of petroleum dominance, the energy core businesses are moving from hydrocarbons to electrons[3].

The ongoing energy transition is shaped by i) the growth of decentralised renewables sources; ii) the role of electric vehicles; iii) smart demand response; and iv) the blurring distinction between supply and demand. At the same time, the grid also needs to change to cope with the so-called fourth industrial revolution.

In the first part of this article, these four key elements of the transformation of the power system are identified and briefly explained.

Keeping in mind these challenges, the second part of the paper forecasts how energy regulators may address them. At this stage, the paper will outline the role that energy regulators may have in promoting capital investments in digital infrastructures; facilitating and deploying distributed energy resources, prosumers and storage, whilst considering privacy and cybersecurity issues; empowering consumers and promoting the achievement their expectations; enhancing demand side response; promoting energy efficiency and enabling market conditions for the deployment of electric vehicles.

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3 TRICKS, Henry – «Clean power is shaking up the global geopolitics of energy», The Economist, 15 Mar 2018.
«Royal Dutch Shell and Total flirt with becoming utilities», The Economist, From Mars to Venus, 28 Mar 2018.

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II. Energy Transition

Since the Industrial Revolution, fossil fuels have powered economies. Among the different energy commodities, petroleum increasingly played the central role, being the most important natural resource. In fact, comparing to other fossil resources like coal or natural gas, petroleum is powerful, easy to ship, easy to store and easy to turn into different products (fuel and products).

The "petroleum age" has been characterised by concentration and geopolitics. Standard Oil Company, founded by John D. Rockefeller, one of the world's first and largest multinational corporations, dominated the oil products market initially[4]. After 14 May 1911, when the US Supreme Court ordered the dissolution of Standard Oil Company, ruling it was in violation of the Sherman Antitrust Act[5], the petroleum industry was most influenced (from the mid-1940s to the mid-1970s) by the so-called "seven sisters", i.e. the multinational oil companies of the "Consortium for Iran". Four of these supermajors companies remain (BP, ExxonMobil, Chevron (Texaco), and Royal Dutch Shell), competing mostly against OPEC (oil cartel) and some relevant state-owned oil companies[6].

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4 INKPEN, Andrew, MOFFETT, Michael H. – *The Global Oil & Gas Industry*, Management, Strategy & Finance, PennWell, USA, 2011, Pages 3-6 and 53-78. Another interesting fact is that Standard Oil was one of the first companies which began to employ lawyers in their business (in-house lawyers), establishing one of the first legal departments – cf. EUROPEAN COMPANY LAWYERS ASSOCIATION – *Celebrating 30 years of ECLA* (About ECLA: a European Lawyers' History), 26 September 2013.

5 WILGUS, Horace Lafayette – *The Standard Oil Decision: The Rule of Reason*, University of Michigan Law School Scholarship Repository, https://repository.law.umich.edu/cgi/viewcontent.cgi?article=1924&context=articles

6 FATTOUH, Bassam, POUDINEH, Rahmatallah, WEST, Rob – *The rise of renewables and energy transition: what adaptation strategy for oil companies and oil-exporting countries?*, The Oxford Institute for Energy Studies, May 2018. INKPEN, Andrew, MOFFETT, Michael H. – *The Global Oil & Gas Industry*, Management, Strategy & Finance, PennWell,

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The relevance of petroleum in the legal world led to the materialisation of doctrine to evoke the existence of a "*lex petrolea*"[7] as a distinct, and distinctive, group of rules that govern (or might govern) international petroleum transactions and relationships, alongside applicable national and international law.

However, it is not a big risk to stay that this "petroleum age" has, in fact, run its course. Despite the fact that petroleum is resilient – it has already "survived" atomic energy – it is most likely that we are experiencing an important energy transition[8]. For a large variety of reasons, energy markets are changing. Existing sources are being replaced by new forms of energy, changing the global energy mix. Some of the game changers are worth mentioning. It is incontrovertible that fuel fossils provoke pollution and that one day they will be depleted.

On these grounds, climate global warning plays a relevant role in the promotion of renewable sources, in order to achieve decarbonisation (cf. Paris Agreement and EU Clean Energy for all Europeans Package[9]),

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USA, 2011, Pages 69, 367-367 and 442-444.

7 About "lex petrolea" in a critical review: DAINTITH, Terence – *The Journal of World Energy Law & Business*, Volume 10, Issue 1, 1 March 2017, Pages 1-13.

8 TRICKS, Henry – «Clean power is shaking up the global geopolitics of energy», The Economist, 15 Mar 2018.

«Royal Dutch Shell and Total flirt with becoming utilities», The Economist, From Mars to Venus, 28 Mar 2018.

9 The Clean Energy Package for all Europeans Package includes legislative proposals for a Directive on the promotion of the use of energy from renewable sources (recast); amending Directive 2012/27/EU on energy efficiency; proposal for a Regulation on the Governance of the Energy Union (amending diverse Directives); proposal for a Directive and a Regulation on the internal market for electricity (recast); Proposal for a Regulation on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC; and a Proposal for a Regulation establishing a European Union Agency for the Cooperation of Energy Regulators (recast). It also includes a Proposal amending Directive 2010/31/EU on

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which is in line with the environmental sustainability concerns (the third goal of the so-called "energy trilemma"[10]). Another relevant driver is that renewable electricity generation technologies have matured. Nowadays, they are efficient and competitive. At the same time, natural gas markets, through LNG[11] and shale gas, are expanding. Renewable sources as well as natural gas (in efficient combined-cycle power plants - CCGT) can both be used to produce electricity.

So, electricity which can be generated by many different sources, and contribute to decarbonising the economy, is playing an increasing role in energy markets. Electricity is safety, secure and multi-purpose, as the growing role of electronic equipment, home appliances and electric vehicles demonstrate[12]. The electrification of society can be a matter of lifestyle too. Finally, some of the biggest oil consumer countries, like China, are attempting to make a transition from an energy intensive to a service-led economy (which means less energy

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the energy performance of buildings, which has already been published (new Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency).

10 MACNAUGHTON, Joan – *Climate-Energy Security Nexus: Role of Policy in Building Resilience to Climate Change*, World Energy Council, 4 November 2015. About the increasing focus oil industry on safety and the environment *vd.* INKPEN, Andrew, MOFFETT, Michael H. – *The Global Oil & Gas Industry*, Management, Strategy & Finance, PennWell, USA, 2011, Pages 157-158, 160-161, 289, 394, 428-451, 463, 465 and 536-553.

11 According to Bloomberg data, there was record LNG demand growth in 2017. Global LNG demand rose 25 million metric tons per annum (Mmtpa) in 2017 to reach 285MMtpa, recording the highest annual growth since the Fukushima incident in 2011 that resulted in a surge in Japan's LNG demand.

"Global imports of LNG will set a new record this year on the back of 7.2% growth. A further surge in demand to 2030 will be driven by environmental measures in China, rising power generation in South and Southeast Asia, and a reduction in domestic gas production in Europe."

12 PÉREZ-ARRIAGA, Ignacio J., *Regulation of the Power Sector*, Springer Link, 2013.

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consumption) and are deploying renewables and gas (namely shale gas and a pipeline from Russia).

Thus, the energy core businesses are moving from hydrocarbons to electrons (electricity is to become – by far – 'The' energy driver for the coming decades)[13]. There is a decarbonisation-growth of decentralised renewable generation in the energy mix, energy efficiency and conservation matters are growing and R&D is being undertaken on energy storage solutions. Unsurprisingly, therefore, a growing number of oil companies are creating rebranding strategies (to become "greener") and making a business orientation towards electricity[14].

This electrification enhancement is fed by (decentralised) renewable sources, based on an endless number of producers. This means that, compared to the "petroleum age", access to energy is increasingly going to be competitive, harder to monopolise. At the same time, the traditional dependence on grids to connect generation to consumption may be decreasing, without prejudice of the grid's relevance in terms of the cooperation between regions and communities.

In parallel, the grid also needs to change in response to the current movement: industry 4.0, the so-called fourth industrial revolution. The world has achieved much with mechanisation, waterpower, steam power (first industrial revolution), with mass production, assembly line,

13 DOBBENI, Daniel, GLACHANT, Jean-Michel, VINOIS, Jean-Arnold «The new EU Electricity Package, repackaged as a Six Hands Christmas Wish List...», Policy Briefs; 2017/27; Florence School of Regulation; Energy, 2017

14 "Statoil", the Norway national oil company, is now "Equinor", and is developing not only oil & gas, but also wind and solar energy around the world. The same with the Danish "Dong Energy" rebranded to Ørsted. The Spanish company "Gas Natural Fenosa" is now "Naturgy". Oil companies like Total, Repsol and Shell are deploying renewable resources and/or investing in electricity supplier companies.

and electricity (second industrial revolution), with the introduction of computers and automation (third industrial revolution) and, now, it is dealing with the progress made by cyber-physical systems. This brings artificial intelligence, cognitive computing, big data, data exchange, cloud computing, the internet of things, etc. Naturally, the electricity grids must take advantage of these new advances.

At this point, four key elements of the transformation of the power system can be identified[15]. Firstly, growth of decentralised renewables sources. Secondly, the rollout of smart charging of electric vehicles. Thirdly, the smart demand response and its relevance in the balancing market. Lastly, the blurring distinction between supply and demand (consumers have started to produce electricity in order to consume and to sell, injecting it into the grid, and have transmuted into "prosumers").

The advent of the integration of variable renewable sources brought a rise in small-scale distributed generation[16], which is "greener", more competitive and more secure (reducing external dependence and minimising security of supply risks) but, unfortunately, it is also intermittent. As a matter of fact, new resources like solar, and wind power are considered non-dispatchable because their electrical output cannot be used at any given time to meet society's fluctuating electricity demands, and the grid requires a permanent balance between injection and consumption. The R&D being carried out on new ways of storage hope to mitigate or even overcome intermittency disadvantages.

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15 INTERNATIONAL ENERGY AGENCY – *Digitalization & Energy*, OECD/IEA, 2017, p. 89-100.

16 Not only wind and solar plants, but also bioenergy power plants, small solar-cell power plants, small wind turbines, rooftop solar cells arrays, micro turbines.

The transport industry, with relevant intersection with energy markets, traditionally moved by fossil fuels, is also changing. There is an automatization and electrification movement. Electric vehicles are no longer prototypes and for reasons of decarbonisation (avoiding scandals with false low carbon emissions), tax incentives, innovation and market appetite for the greener cars, electric vehicles sales are growing, meaning more electricity consumption and smart charging of electric vehicles are needed.

Traditionally, energy market regulation is focused on the supply-side. However, attending to the *total cost of ownership* concept, new investments can be quite efficient considering their *payback* period. Industry is becoming more efficient, using digital technologies and automatization processes that could lead to further energy savings with shorter payback periods. And that is possibly going to be done "beyond the plant fence", connecting industrial operations based in different locations. Buildings are getting smarter using sensors and algorithms that auto-programme heating and cooling services[17]. Less electricity consumption could represent a lower investment need in order to fulfil the (lower) peak load, including less investment in grid capacity. Some consumers can be available, in return for payment, to consume less during peak hours in case of scarcity. Demand-side response is taking on a bigger role in electricity markets. Under these circumstances, smart demand response could be relevant in the balancing markets.

Lastly, the integration of decentralised variable renewable sources mentioned above makes anyone a potential producer. Matching this reality with the possible participation of smart demand-side response,

17 INTERNATIONAL ENERGY AGENCY – *Digitalization & Energy*, OECD/IEA, 2017.

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magnified by the industry 4.0 movement, it is not hard to understand that there is a blurring distinction between supply and demand and that some consumers become producers ("prosumers"). The more optimistic believe that peer-to-peer trading will be a reality, making use of blockchain. Final customers could organise themselves in local energy communities and be relatively independent from the grid, using the (traditional) system only as a backup[18]. In this context, adequate smart metering is crucial to active consumption needs without cross-subsidisation[19].

As a punctual conclusion, one can say that these key elements bring with them the need for additional flexibility measures, a better grid, helped by new technologies and regional cooperation[20], in parallel to a dis-intermediation phenomenon of energy services.

III. Regulatory Challenges

The energy sector is changing, as illustrated above. Driven by technological changes, new business models, behaviour insights applied to policies, and a decarbonisation agenda, it is expected that power mar-

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18 Local energy communities that operate a network should be regulated as a DSO and have the same obligations on service delivery and consumer rights – cf. COUNCIL OF ENERGY EUROPEAN REGULATORS (CEER) – *Renewable Self-Consumers and Energy Communities*, CEER White Paper series (paper # VIII) on the European Commission's Clean Energy Proposals, 27 July 2017.

19 COUNCIL OF ENERGY EUROPEAN REGULATORS (CEER) – *Renewable Self-Consumers and Energy Communities*, CEER White Paper series (paper # VIII) on the European Commission's Clean Energy Proposals, 27 July 2017.

20 DOBBENI, Daniel, GLACHANT, Jean-Michel, VINOIS, Jean-Arnold «The new EU Electricity Package, repackaged as a Six Hands Christmas Wish List...», Policy Briefs; 2017/27; Florence School of Regulation; Energy, 2017.

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kets will be increasingly flexible, more decentralised and interdependent, where suppliers (and aggregators) may offer differentiated services to consumers in a more diverse commercial environment. Innovation of existing services may flourish in retail (switching services, apps), favoured by the use of smart devices, demand response services and the increased capability of energy storage and efficiency business models.

Consequently, energy regulation, traditionally focused on the grids, will continue to play a role especially in terms of the cooperation between regions and communities. However, the centre of gravity is moving and energy regulators, naturally, should be capable of addressing the new challenges.

The traditional core national regulatory tasks are centred on the grids. According to European law, most of the national regulatory powers are related to the grid. For instance, regulators fix the network tariffs (allowed revenues, preventing cross-subsidies), assure third-party access to the grid, monitor investment plans of grid operators, certify transport system operators (preventing conflicts of interest), prevent grid congestion (network bottlenecks), and implement capacity allocation mechanisms. At European level, the regulators' role, within ACER – Agency for the Cooperation of Energy Regulators, is also focused on the grids. Cross-border issues and disputes related to interconnections, Projects of Common Interest (i.e. incentives for new cross-border infrastructure), Network Codes (regulating the grid and interconnections) and the ten-year network development plan, as well benchmarking, are some of the most relevant European tasks.

The energy transition and changes previously mentioned that are reshaping the power sector demand a regulatory response. Anticipating

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the process, possibly regulators could[21] accurately promote capital investments in digital infrastructure, facilitate distributed energy resources, prosumers and storage (whilst considering privacy and cybersecurity issues), empower consumers and promote the achievement of their expectations, enhance demand side response, promote energy efficiency and enable market conditions for electric vehicles.

As regulators have the responsibility to fix the network tariffs, they may promote capital investments in digital infrastructure, giving the right incentives for the deployment of smart grids (including meters). This means a bidirectional communication grid. The new investments must be well scrutinised, according to reliable cost-benefit analyses and payback periods.

Incentives and regulations could also be designed in order to facilitate distributed energy resources, "prosumers" and storage. Enhancing a better grid operation and eliminating barriers, customers may achieve cost reductions and reduce environmental impacts.

It should not be forgotten that all these changes imply a huge use of software and data, including personal data. Therefore, privacy and cybersecurity concerns should be considered by energy regulators in their activities.

Regulators should also be able to understand the world of active consumers, for whom personalisation and the "internet of things" is important. Consumer rights should be protected and enforced through penalties and fines. Differentiated services should be incentivised, en-

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21 Regarding regulator challenges, see SAVENIJE, Davide, «The 10 greatest challenges the utility industry faces today», Utility Dive, July 16, 2013.

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abling the customer to choose additional services (e.g. using apps to remotely control energy at home) or be paid for some service (e.g. selling energy produced by local consumers or availability to not consume in capacity markets).

Demand-side response should be facilitated by regulators. To achieve this goal, regulators may approve dynamic tariffs which are time-based pricing (prices can even vary between times of low and high electricity production / demand). This will make it possible for consumers to adjust electricity consumption during periods of peak demand (interrupt / reduce load / store).

Regulators may promote energy efficiency. The first and most effective way to do so is ensuring that tariffs are in fact cost reflective. In addition, regulatory programmes to address information asymmetries as well as to implement tangible measures could be implemented.

Market conditions for electric vehicle should be achieved. By promoting integration with the power system and the rollout of smart charging, avoiding cross-subsidies and enabling the participation of electric vehicles in demand-side response, regulators may contribute to good results.

The aforementioned key elements could, in some way, reshape the power sectors all around the world. Notwithstanding the global approach, course the changes will naturally differ significantly from country to country, depending on how much infrastructure is already in place and the investment needs, as well as their national affordability.

V. Conclusion

Energy is really changing and, consequently, regulation is facing new challenges. Businesses are moving from hydrocarbons to electrons and, at the same time, new technologies are possibly reshaping the power system.

Electricity regulation, traditionally focused on the grids, will continue to play a role, especially in terms of the cooperation between regions and communities. Notwithstanding, the centre of gravity of the system is moving and there is a new phenomenon of dis-intermediation.

Energy regulators should monitor new realities and produce appropriate regulation to carry out the best results, enhancing the movements that bring benefits to consumers.

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Regulation of Electricity Storage in Mexico

JOSE JUAN GONZÁLEZ [1]

Abstract

This paper analyses the inconsistences and contradictions of Mexican legislation in regard to energy storage. The survey includes the identification of energy storage as a discrete activity different from but boned to generation, transmission, distribution and supply. The analysis also discusses if energy storage must be considered an activity reserved to the state or an activity open to private investment. Finally, the study proposes to innovate regulating energy storage as an specific link of the energy supply chain.

Key words

Energy; Storage; Electricity Supply Chain; Mexican Law

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I. Introduction; II. Concept; III. Mexico's experiences in Energy storage; IV. Energy Storage Legal Framework in Mexico: A. Energy Storage in the electricity supply chain; B. Energy storage as part of generation of electricity activities; C. Energy Storage as a part of transmission and distribution activities; V. Energy Storage: liberalized or strategic activity?; A. Generation as a liberalized activity; B. Energy storage as a strategic activity; VI. Energy storage as a separate licensed activity; VII. Conclusions

I. Introduction

Mexico has assumed the commitment of transitioning from a carbon-based economy to a low-emissions economy in a series of international documents, such as the Paris Agreement, adopted in 2015 at the COP 22 of the United Nations Framework Convention on Climate Change, as well as in the Agreement for Implementation of a Cooperation Program on Smart Grids, signed during the Second Clean Energy Ministerial held in Abu Dhabi in 2011.

In the same vein, the National Plan of Development 2013-2018,[2] the National Strategy of Energy 2013-2027,[3] the National Strategy of Climate Change –vision 10-20-40--,[4] the Special Climate Change Program (PECC), the Sectoral Program of Energy (SPE) 2013- 2018[5] and the Sec-

2 Diario Oficial de la Federación, 20 May 2013.

3 Diario Oficial de la Federación, 21 May 2013.

4 Diario Oficial de la Federación, 3 Jun 2013.

5 Diario Oficial de la Federación, 13 December 2013.

torial Program of Environment and Natural Resources 2013-2018, [6] propose the idea of reducing CO2 emmissions by replacing fossil fuels for other renewable energies (environmentally sustainable).[7]

In concordance with the mentioned plans and programs, the General Law on Climate Change (LGCC) establishes the commitment to generate 35% of electricity from clean energy by 2024, as well as the goal of reducing GHG emissions by 30% from the baseline by 2020 and 50% by 2024.[8] In the same line, the Energy Transition Law (ETL) establishes that by 2018, 25% of electricity has to be generated by renewables sources, by 2021 30% and by 2014 35%.[9]

However, a major obstacle to the expansion of the renewable energy industry in Mexico is that sources are usually available under certain climatic conditions that give rise to intermittency and are often located at remote sites generation, thus energy storage has a relevant role to play in energy transition and to achieve the Mexican government's goals regarding greenhouse gas emissions reduction. Nevertheless currently the Mexican legal framework regulating energy storage is confusing. As it will be explained in this paper.

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6 Diario Oficial de la Federación, 12 December 2013.

7 According to the International Agency f Energy, due to fossil fuels consumption, Mexico´s CO2 emissions increased in 330% from the period 1971 to 2010. CO2 Emissions from Fuel Combustion Highlights, IEA Statistics, International Energy Agency, 2012, pág. 48.

8 Article transitory 2.

9 Article transitory 3.

II. Concept

Electric energy storage (ES) has been defined as the capability of storing electricity or energy to produce electricity at any point in time, using a range of technologies, and then to release it for use during other periods when the use or cost is more beneficial.[10]

Even when in some jurisdictions energy storage is considered as type of generation asset,[11] it is important to note that energy storage systems can be located through the whole electricity supply chain.[12] Energy storage systems includes: Consumer-located storage; Generator-located storage and Storage in transmission and distribution grids. As an official report states:

The benefits of electricity storage systems cross the boundaries between the power system value chain (generation, transmission, distribution and end-use) in both grid and off-grid systems. This means electricity storage systems cannot be addressed with a single policy covering the different possible locations and services. [13]

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10 ES is perfectly suited to provide this service by absorbing electric energy (charging cycle) whenever there is too much generation for a given demand and by injecting electric energy into the power grid (discharging cycle) when there is too little generation.

11 It happens for instance in the European Union. See: 'Smarter Network Storage. Law carbon network Fund. Electricity storage in GB. SNS4.13-Interim Report on the Regulatory and Legal Framework.' Uk, Pöyry/Uk Powers Networks. Available at http://poyry.co.uk/sites/www.poyry.co.uk/files/smarter-network-storage-lcnf-interim-report-regulatory-legal-framework.pdf

12 Zhenguo Yang and others says that "Indeed, EES is an established, valuable approach for improving the reliability and overall use of the entire power system (generation, transmission, and distribution [T&D])." Zhenguo Yang, et al. 'Electrochemical Energy Storage for Green Grid. Chemical reviews. Pacific Northwest National Laboratory,' Richland, Washington 99352, United States. September 1, 2010. dx.doi.org/10.1021/cr100290v | Chem. Rev. XXXX, XXX, 000–000

13 IRENA, op cit, p. 7

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From an economic perspective, given that the electricity demand varies from time to time and its prices change accordingly, being higher at peak-demand periods than at off-peak periods; energy storage could reduce electricity costs by storing electricity obtained at off-peak times when its price is lower, for use at peak times instead of electricity bought then at higher prices. Besides, energy storage systems could help to maintain and improve power quality, frequency and voltage. [14] Finally, energy storage systems support users when power network failures occur due to natural disasters.

III. Mexico´s experiences in Energy storage

Mexican experience in electricity storage has not been significant yet. To a date, few projects in this matter have been developed, as for instance, the *San Juanico* Hybrid Power System. *San Juanico* is a fishing village with approximately 120 homes and more than 400 people in the Municipality of *Comondu, Baja California Sur*.

San Juanico's first autonomous diesel generator began operating in 1980. The 205-kW generator supplied power for 3 to 4 hours a day. The average load was about 50 kilowatts (kW), and the observed peak demand was about 75 kW. During that time, customer energy use was not metered. Each customer paid the same fee (50 pesos/month). Additionally, 23 homes in the village were equipped with small gasoline-powered generators that provided power for refrigerators and other appliances.[15]

14 See 'Electrical Energy Storage. White paper', available at http://www.iec.ch/whitepaper/pdf/iecWP-energystorage-LR-en.pdf. Last visit 29 April, 2017.

15 See: Dave Corbus, Charles Newcomb and Zeke Yewdall. San Juanico Hybrid Power System Technical and Institutional Assessment (2004), available at http://www.nrel.gov/docs/fy04osti/36270.pdf

In April 1999, the Arizona Public Service Company (APS) and the Federal Commission of Electricity of Mexico (FCE) installed a hybrid power system in *San Juanico* to provide 24-hour power.

The system is composed of a Trace HY-100 inverter with an integrated peak power tracker for a 17-kW PV array. A nominal 240VDC flooded lead-acid battery bank consisting of 7 strings of 350 amp-hour batteries in parallel (nominal 2450 amp-hrs) provides energy storage. Ten Bergey 1 Excel wind turbines (about 70 kW total) are connected to the DC side of the electrical system. An 80-kW diesel generator carries the village load and charges the batteries when the renewable systems cannot meet the load. The diesel generator is dispatched by the Trace inverter controller and charges the batteries via a rectification circuit within the inverter. Approximately 20% - 35% of the village's electricity is supplied by the renewable energy systems.

Energy storage has been also considered in Mexico as a strategy to mitigate the effects of variability of intermittent resources based generation plants. The Project of Energy Storage for the Photovoltaic Central of *Santa Rosalía II, Baja California* is an example of this strategy. [16]. The project consists of storing in batteries the surplus power of the plant with intermittent resource at a time when demand is lower than generation and realise energy when resource is available, allowing a more constant generation, generating few problems in the network and having greater capacity of manoeuvre in case of failure.[17]

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16 See: Saldivar Urquiza Gaffie and Zapata López Ángel Antonio. 'Proyecto de almacenamiento de energía para la central fotovoltaica Santa Rosalía II DE 4 MW.' GEOTERMIA. REVISTA MEXICANA DE GEOENERGÍA · ISSN 0186 5897 Volumen 28, No.1 Enero-Junio 2015 Pp.21-27.

17 In la Paz, Baja California the corporation Grupotec developed a Photovoltaic Pant including a system of electricity storage.

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Other forms of energy storage have been introduced in energy projects in Mexico. For instance, mechanical Energy storage systems in the Hydropower plant Chicoasen *II* in Chiapas, in the South of Mexico; flywheels in the airport of Mexico City and hydraulic pumping to complement wind generation in the State of Chiapas.

However, before the Energy reform of 2013, Mexico´s government tried to deal with the intermittency in the availability of electricity produced from renewable energies by creating the Power Bank by RCE. It is an energy exchange mechanism that allows the "virtual storage" of energy generated in any time-period and not consumed by users, so that it can be "delivered" in other periods for up to 12 months. Virtual storage consists of delivering the electricity surpluses received by Grid Operator from any generator to other end users and them compensate this excess of electricity with future generator’s deficits. The energy bank is based on the Interconnection *Contract for Power Generation Plants with Renewable Energy or Efficient Cogeneration* and its Annexes, particularly in Annex F-RC *Procedures and parameters for calculation of payments to be made by the Parties under the Agreements related to this Contract for Energy Sources*.[18] In concordance with article Transitory of the new Energy Transition Law the bank has disappeared.

IV. Energy Storage Legal Framework in Mexico

Although the Constitutional reform of 2013 did not directly refer to ES (transitory Article 18), the constitutional amendment Decree requires the Executive Power to incorporate into the National Program for

18 Diario Oficial de la Federación, 28 April 2010.

Sustainable Use of Energy a *transition strategy* aimed at promoting the use of cleaner technologies and energies. So, it is possible to consider that energy storage fits well into such category and, that it could help to promote the use of renewable sources of energy.

Under such constitutional basis, in 2014 the *Strategy of Transition for Promoting Use of Cleaner Technologies and Combustibles* was published –as part of the National Program for Sustainable use of Energy 2014-2018–. In 2015, based on transitory article 18 of the mentioned constitutional reform, the Federal Congress passed the Law for Energy Transition (LET). Article 14, section III of LET states that it corresponds to the Ministry of Energy to elaborate and publish the Special Program for Energy Transition and the National Program for Sustainable Use of Energy. Under such new legal basis, in 2016 and updated version of the Strategy of *Transition for Promoting Use of Cleaner Technologies and Combustibles* was published.

The updated version of the Strategy refers to energy storage as a mechanism to support the operation of electric vehicles and grids working with intermittent sources such as renewables, and distributed generation (Chapters 3.1.3.3.3 and 7.4.2.).

In this context, electricity storage has a potentially important role to play as a source of flexibility in the future capacity mix. Greater flexibility will be needed to manage the unpredictability and variability of intermittent generation. The following sections will analyze the legal framework governing energy storage in Mexico.

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A. Energy Storage in the electricity supply chain

The Mexican energy legislation does not yet explicitly recognize electricity storage as a discrete activity or asset class, unlike in the case of hydrocarbons industry, neither the Mexican constitutional nor secondary legislation (Electricity Industry Law and Energy Transition Law) refer to energy storage as a specific part of the electricity industry.

Articles 25, 27 and 28 of the Mexican Constitution (as amended in 2013) split the electricity supply chain into four distinct layers: generation, transmission, distribution and supply. In the same avenue, pursuant to article 2 of the Electricity Industry Law (EIL), electricity industry comprises those activities of generation, transmission, distribution and supply of electricity power, planning and control of the National Electric System and control operation of the wholesale electricity market. In consequence, energy storages could be regulated only if considered as a part one of these stages, otherwise it could be considered as unregulated activity.

The above mentioned constitutional provisions also split electricity industry activities into two categories: strategic activities reserved to the nation –transmission and distribution of electricity–, and non-strategy activities open to private parties' investment –generation and supply–. Given that Mexican electricity legal framework does not clarify whether storage is a subset of generation activities –as it happens in some jurisdictions– or it should be considered as a part of transmission and distribution activities, it is not possible to clarify whether electricity storages is a strategic or a non-strategic activity and, thus, whether private investors can own and operated energy storages systems.

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Indeed, when considering whether storage can be treated as generation or as part of transmission and distribution assets, a case can be made either away. The following sections discuss this issue.

Electricity sector is ruled by articles 25, 27 and 28 of Mexican Constitution, as amended in 2013, the Electricity Industry Law (2014) , the Energy Transition Law (2014) , the Climate Change Law (2012), regulations of these laws issue by the Executive, and several administrative regulations issued by regulatory agencies. Among these administrative regulations, it is important to mention the *Rules of the Market (RM)*. The RM govern the wholesale electricity market and are composed of two documents: The *Basis of Electricity Market* (BEM) and the *Operational Rules of the Market* (ORM).[19]

The BEM are a regulatory body issued by the Regulatory Commission of Energy (RCE) that is composed by a series of administrative provisions of a general character aimed at establishing those principles that rule design and operation of the *wholesale electricity market,* whereas the ORM are those criteria, guides, guidelines, handbooks and procedures aiming at defining operative processes of wholesale electricity market, issued by the National Centre for Energy Control (NCEC).

B. Energy storage as part of generation of electricity activities

While the EIL does not include energy storage as a distinct activity, the *Basis for the Electricity Market* (BEM*)* treats it as a type of genera-

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19 In addition to establishing the procedures for conducting the whole-sales transactions, the RM must establish the minimum requirements to be a market participant, determine the rights and obligations of market participants, define the way activities must be coordinated between transporters and distributors and define mechanisms for disputes resolution.

tion asset. Base number 3 establishes the procedure that those interested in participating into the wholesale electricity market should follow up to obtain its registration as market participants and its accreditation to carry out transactions in such market.

Specifically, section number 3.3.21 of Base number 3, holds that "all energy storage equipment must be registered as generation plants and a generator must represent them into the electricity market."[20] In consequence, according to the BEM, is it possible to argue that energy storage is a type of generation asset. However, this consideration is not clearly backed up by the EIL.

Indeed, Article 3; section IV of EIL defines generation plant "as those facilities and equipment that, in a given site, make possible to produce electricity and associated products." As we have already mentioned, energy storage is the capability of storing electricity or energy to produce electricity. So, again, when considering whether storage can be treated as generation of electricity activity, a case can be made either away. On one hand, it is possible to argue that first part of the generation plant concept provided by the EIL does not include the capability of storing electricity but just energy to produce electricity. On the other hand, it is possible to say that storage could fit well into the idea of those associated products mentioned by the second part of the definition.

However, definition of associated products provided by Article 3, section XXI of LEI does not grant enough legal foundation to conclude

20 It has been mentioned that in the UK this default treatment of storage as type of generation is an accident of history rather than a deliberate design choice. Smatter networks storage law carbon network. Electricity storage in Great Britain. SNS4.13 Interim reports on the regulatory and legal framework.

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that energy storage is a subset of such associated products. The mentioned provision considers as associate products those products linked to the operation and development of the electricity industry that are necessary to get the efficiency, quality, reliability, continuity, security and sustainability of the National Electrical System. Among associate products the law mentioned the following: potency, associated services, clean energies certificates, transmission financial rights, transmission and distribution services and operational control of National Electricity System, as well as any other products and collection rights that define the BEM. As it can be seen, storage is not specifically mentioned in this list of associated products.

Conversely, energy storage could be treated as subset of generation if we assume that it is an essential mechanism to meet the efficiency, quality, reliability, security and sustainability of the Mexican Electricity System, even when it is not mentioned in the list of associated products. But in any case, the EIL does not clearly consider energy storage as a part of the energy generation process.

C. Energy Storage as a part of transmission and distribution activities

A joint analysis of EIL and ETL allows us to assert that energy storage is more linked to transmission and distribution activities than to generation of electricity and, therefore that energy storage is part of those strategic areas reserved to the state. Two arguments support this idea.

First, the Energy Transition Law (ETL) considers energy storage as a part of transmission and distribution activities given that this law deals with ES when regulating smart grids (article 37 to 42).

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Second, the EIL defines smart grids as those electricity networks that integrates advanced technologies for measurement, monitoring, communication and operation, among others, to improve efficiency, reliability, quality or safety of the National Electrical System (article 3, section XXXIV).[21]

In addition, the ETL, empowers the Ministry of Energy to issue the *Program for Development of the National Electric System* and as part of the *Smart Grids Program.*

The ETL has the purpose of regulating the sustainable use of energy as well as those obligations of Electricity Industry regarding clean energies and reduction of pollutant emissions (article 1). To get these aims, this law introduces a series of instruments. Among these instruments, the law refers to the *Smart Grids Program* (articles 37 to 42).

An electricity network enabled by the Smart Grid will significantly increase its efficiency, flexibility and reliability, allowing the integration of new technologies of supply and demand to provide users new products and services.[22] So, it is possible to argue that energy storage devices fit well into such technologies.

According to article 37 of the ETL, the *Program of Smart Grids* aims to support the modernization of the National Transmission Network and General Distribution Networks, in order to maintain a reliable infrastruc-

21 According to an official document, in its most basic sense, smart grid means a set of technology of Information applications (IT) for generation, transmission, distribution and final use of electricity. Often it is referred as "smart grid" or the "internet of energy."

22 Regulatory Commission of Energy, 'Marco regulatorio de la red Eléctrica Inteligente en México' (2014) p 4-19.

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ture and ensure that it satisfies the electric demand in an economically efficient and sustainable way, and that it facilitates the incorporation of new technologies that promote electricity sector costs reduction, provision of additional services through their networks, clean energy and distributed clean generation. To get such aim, the Program shall to identify, evaluate, design, establish, and implement strategies, actions and projects in regard electricity networks (article 38).

The ETL estates that, every three years the National Centre for Energy Control (NCEC) with the support of the RCE, carriers, distributors and suppliers, must prepare and propose to the Ministry of Energy a *Program of Smart Electricity Grids* (articles 39 and 40).

In accordance to Article 37 of the mentioned law, the *Smart Grids Program* aims to support the modernization of the National Transmission Network and General Distribution Networks in order to maintain a reliable infrastructure and to ensure that it satisfies the electric demand in an economically efficient and environmentally sustainable way, facilitating the incorporation of new technologies that promote electricity sector costs reduction, provision of additional services through their networks, clean energy and distributed clean generation. To achieve this, the Program must identify, evaluate, design, establish, and implement strategies; actions and projects regarding electricity networks (Article 38).

For those reasons, it is possible to consider that in harmony with ETL, electricity storage is an activity very bonded to transmission of electricity. This argument finds support in Article 38, section IX of ETL, which states that the *Program of Smart Grids* shall to implement actions aimed at introducing smart grids, including energy storage, and so, according to this law energy storage is considered as part of smart grids. The mentioned provision words:

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> Article 38. The *Program of Smart Grids* shall to identify, evaluate, design, establish and implement strategies, actions and projects in the field of electricity networks, among which the following may be considered:
>
> [...]
>
> IX. The development and integration of advanced technologies for the *storage of electricity* and Technologies to meet peak demand.

In consequence, the joint analysis of the EIL and ETL allows to conclude that contrary to what BEM states, Mexican energy laws considers ES as part of transmission and distribution activities and as a result it cannot be conducted by private parties.

V. Energy Storage: liberalized or strategic activity?

Given that energy storage is not considered yet as a different and specific asset of the electricity industry, it just can be indirectly regulated by applying the legal framework already governing other stages of the electricity supply chain.

As it has been also discussed, whereas administrative regulations consider electricity storage as a subset of generation of electricity, legislation states that it is part of transmission and distribution activities. The following sections discuses on the legal consequences of taking one or another option.

A. Generation as a liberalized activity

Treating energy storage as a subset of generation implies that, on one hand it is part of the non-strategic activities of the electricity sector and, on the other, that the only rules that govern ES are the following.

Firstly, in harmony with Article 4 of the EIL, generation of electric energy is service that is provided under a free competition regime. However, generation of electricity –and so storage of electricity– could require of a permit granted by the RCE. Article 17 of the EIL points out that a permit granted by the Regulatory Commission of Energy is required for generation of electricity in two cases:

(a) When electricity is generated by power plants with a capacity equal o superior to 0.5 megawatts; or

(b) When electricity is generated by power plants represented by a generator into *the wholesale electricity market* without taking care of the size of the plant.

In consequence, according to the mentioned Article 17, permit is not required when two conditions converge: a) energy storage equipment does not have a capacity of generation equal or superior to 0.5 Mw and, b) such equipment do not operate into the wholesale electricity market.

In addition, according to the BEM to electricity storage systems requires to be register as generators.

Secondly, generation of electricity -- as well as transmission, distribution, supply and operational control of the National Electrical System— is an activity of public utility and will be subject to public and universal service obligations in terms of EIL and other applicable provisions. Among others, is an obligation of public and universal service to grant open access to the National Transmission Network and the General Distribution Networks under not unduly discriminatory basis.

Thirdly, generation, transmission, distribution, marketing and supply of primary inputs for the electric industry will be carried out independently among them and under conditions of strict legal separation (Article 8).

In consequence, the currently in force legal regimen of ES is weak.

B. Energy storage as a strategic activity

The EIL considers transmission and distribution of electricity as a public service of social interest and public order (Articles 27 and 42) that only can be conducted by carriers and retailers. This law also stated that only *Productive State Corporations* or their subsidiaries are allowed to operate as carriers and retailers.[23] In terms of Article 26 of the EIL, carriers and retailers are responsible for operating the National Transmission Network and General Distribution Networks.

Currently, the only *State Productive Corporation* operating in the Mexican electricity sector is the Federal Commission of Electricity (FCE). In this regard, article 5 of the Law of the Federal Commission of Electricity, also passed in 2014, states that 'the Federal Electricity Commission aims to provide, in accordance with applicable law, the public service of transmission and distribution of electricity, on behalf of the Mexi-

23 According to fraction LIV of Article 3 of the Act Carriers State Productive Corporations or its subsidiaries, which provide the Public Service of Electricity Transmission whereas, terms of fraction XXI of that provision, retailers are State Productive Corporations or their subsidiaries, which provide the Public Service of Electricity Distribution.

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can State'. So, transmission and distribution of electricity are currently monopolized by the FCE but in the future, it can change if, as expected, more *Productive State Corporations* are created. It corresponds to FCE to operate the National Transmission Network and General Distribution Networks but the National Centre of Electricity Control (NCEC) oversees controlling and regulating the National Electric System.

In accordance to Article 26 of the EIL, the NCEC has the power of issuing *instructions* aimed at regulating operation of grids by carriers and retailers. [24] In the same way, due to transmission and distribution are activities of a public service character, in terms of article 27 of EIL; their conduction is subjected to *the General conditions for public services of transmission and distribution of electricity* to be issued by the RCE. [25]

In addition to the above mentioned, article 37 of the Regulation under the EIL states that the public service of transmission and distribution is ruled by the *general character adminsitrative regulations* issue by the RCE in regard reliability, continuity, safety and sustainability.[26]

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24 On 02 of 08 of 2015 the CENACE published the Criteria that establishes the specific characteristics of the infrastructure required for the interconnection of Power Plants and Connection of Loading Centers.

25 On February 16, 2016, Resolution No, RES / 948/2016 was published in the Official Gazette of the Federation by which the CRE Issue Administrative Provisions of General Character in Open Access and the Provision of Services on the Network National Transmission and Distribution Networks of Electric Power.

26 Such general conditions have the objective of defining rights and duties of providers and users and must include at least: (a) Applicable tariffs; (b) Characteristics, scope and modalities of the service; (c) Criteria, requirements and publicity of information to provide open and non-discriminatory access; (d) Credit conditions and suspension of services; (e) Scheme of penalties and compensations for non-compliance with contract commitments; (f) Conditions that, in its case, could be modified by agreement with specific users, under the condition it does not represent discriminatory practices and they are extensive to similar users; and (g) Procedure for transmitting complaints.

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In consequence, if ES is considered as an asset of transmission and distribution activities, no private participation in storage is allowed.

VI. Energy storage as a separate licensed activity

Given that ES can occur at any stage of the electricity supply chain, it cannot be addressed neither as generation asset nor as transmission activity. Instead dedicated policies are needed for each of these application areas. At the same time, policies need to ensure consistency and consider the broad scope of regulatory options for electricity storage systems (including grid codes, pricing mechanisms and the creation of new markets) [27].

VII. Conclusions

Regulation of energy storage in Mexico is unclear and contradictory. ES is associated to both generation and transmission and distribution activities and so, it can be considered at same time as strategic and as non-strategy activity.

This lack of clarity is because administrative regulation equates energy storage systems with generation plants, while legislation seems to give more arguments in favour of linking energy storage with smart grids.

27 In Italy, Art 36, paragraph 4, decree law 93/11 allows the TSO and DSOs to build and operate batteries and in Belgium, the law allows some level of control by TSD and DSO son electricity storages facilities.

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In addition, neither generation nor transmission and distribution legal regimens fully rule all the issues associated to this activity.

This discussion, which for the moment is only theoretical and has not been implemented in practice, could be eliminated simply by modifying the Law of the Electricity Industry to include energy storage as a specific non-strategic activity and subject to its own licensing system.

The impact of blockchain on energy markets

JOÃO MARQUES MENDES

Abstract

Blockchain is a ledger that allows for the carrying out of transactions and storing of information thereof. However, unlike traditional databases, blockchain decentralized: information is not centrally stored by government agencies or large corporations but is kept, instead, across a network of computers owned by, virtually, any participant, which validate transactions according to predetermined rules and that are permanently synchronized among each other.

Due to this innovative concept, together with the heavy encryption and mathematical algorithms which help making blockchain secure, it is expected that, in time, blockchain may eliminate or at least reduce the importance of middlemen, reducing transaction costs and allowing new business models on energy markets based on peer-to-peer transactions. Together with the Internet of Things, blockchain may allow for

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each household or community to program its options as to when and where to buy or sell electricity at any given moment.

The technology is still recent and immature and faces important technological, practical and legal challenges, which require solutions before it is prepared for widespread adoption. Nevertheless, it has the potential to carry us to a new era of transacting, to an extent which is still unpredictable. Therefore, testing, openness and collaboration between all agents (including government, regulator and markets agents) are needed in order to prove this potential.

Keywords

blockchain, energy, innovation, digitalization.

I. Introduction

We live in an increasingly electrified world. Electricity has been invading areas that were fueled by other forms of energy, such as transportation or heating. The generation of electricity is also becoming increasingly decentralized and decarbonized. Instead of the large power plants of the past, the investment is now channeled to small or medium-sized wind, hydro and solar power plants, which will satisfy most of future energy needs. These are some of the main trends in the current electricity system, as identified by the World Economic Forum[2]. The other one is digitalization.

Digitalization has conquered every economic activity and the electricity sector is no exception. A revolution of electricity networks is foreseeable, which will make them more digital, bidirectional and smart, accommodating the large-scale integration of self-production, if electricity (with a tendency to self-sufficiency), storage of electricity, electric vehicles and a series of devices which, connected to the internet, will be able to communicate with the network[3].

But the digitalization of the electric sector may not consist only of a reinvention of its physical components. A software innovation regarding grid management may join this hardware reinvention. This is where blockchain comes in.

II. Definition of blockchain

Blockchain is technically known as Distributed Ledger Technology. It is a data storage and validation technology that differs from traditional technologies in that it is decentralized. This means that, instead of storing the data in a single location (computer or set of computers), it stores them simultaneously and in permanent synchronization across in the computers of all users connected to the network, which validate at eve-

2 World Economic Forum, "*The Future of Electricity – New Technologies Transforming the Grid Edge*", March 2017, available in https://www.weforum.org/reports/the-future-of-electricity-new-technologies-transforming-the-grid-edge.

3 *Idem*.

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ry moment the transactions made therein, according to pre-determined rules (a consensus protocol) and in a transparent fashion[4].

Most people know this technology from being the platform underpinning Bitcoin. But, in fact, blockchain may be used to store and trade any digital asset (such as a cryptocurrency or a digital certificate) but also digital representations (or tokens) of physical assets. It is a ledger: it keeps a continuous (ever-growing) and complete record of data and transactions. It is a digital ledger.

But what makes blockchain different is that it is a decentralized or distributed ledger, meaning that it is maintained simultaneously across a network of computers or nodes (i.e. virtually any user of blockchain), in permanent and automatic synchronization with each other – meaning it is equally replicated in a network of nodes. It is not centralized. No party controls the storage or validity of the data. It does not also depend on any single node – one node may disconnect and the system remains[5].

Despite being a technology in its infancy, the virtuality of blockchain is its potential to allow direct peer-to-peer transactions without the need for a middlemen[6]. This is due to three main features: a highly secure and reliable means of validation and storage of data, the fact that it is open and transparent and its ability to automate trade through smart contracts.

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4 See, for a more technical description of the technology, *v.g.* the paper "*Distributed Ledger Technology & Cybersecurity – Improving information security in the financial sector*" of the European Union Agency for Network and Information Security" of December 2016, available in https://www.enisa.europa.eu/publications/blockchain-security.

5 *Idem*.

6 Describing this potential of blockchain, see World Energy Council, "*The Developing Role of Blockchain, White Paper, Version 1.0*", available in https://www.worldenergy.org/wp-content/uploads/2017/11/Blockchain_full-paper_FINAL.pdf, pages 10 and seq.

Firstly, blockchain may be able to offer a secure and reliable platform, theoretically tamper-proof to the parties or any third party, for three main reasons:

a) **The records are secured through cryptography (i.e. encrypted).** Each user has a public and private key – the latter acting as its private signature. Keys guarantee legitimacy of the signing user. Also, if a record is subsequently altered, the signature ceases to be valid;

b) **Because it is a chain of blocks, as the name states.** Each transaction (together with other contemporary transactions) is verified by all nodes – which notably control is the party that owns the asset – and then bundled into a block. Blocks are time-stamped and inextricably linked (or chained) to previous blocks through cryptographic locks. This makes it virtually impossible for anyone (even the parties to a transaction) to falsify its history without it being detected and corrected by the other nodes[7];

c) Finally, due to the fact that it is a shared or decentralized ledger, each node keeps a copy of the ledger and they are automatically in sync. If the "*chain*" is tampered in any of the nodes, the remaining nodes will, in theory, automatically detect it and correct it, replacing the flawed chain by the authentic one. A hacker would have to control the majority of the nodes to interfere with this[8].

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7 See, for a further and more technical description of these first two features, Wulf. A. KAAL and Craig CALCATERRA, "*Crypto Transaction Dispute Resolution*", 2017, pages 15 and seq., available in https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2992962.

8 In a similar sense, see Francisco MENDES CORREIA, "*A tecnologia descentralizada de registo de dados (Blockchain) no sector financeiro*", in "*FinTech – Desafios da Tecnologia Financeira*", Almedina, 2018, pp. 69 and seq.

Secondly, blockchain is aimed at being an open and transparent platform. Data stored therein can be audited and seen by anyone (or anyone allowed to do so). As such, it is said that blockchains create an immutable audit trail that can be seen but cannot be altered, by anyone[9]. This is why it may allow peer-to-peer transacting without the need for a middleman, as it is able to create trust between parties who do not know each other – that is why it was called the "*trust machine*" by *The Economist*[10]. Blockchain can drastically reduce the "*cost of trust*"[11].

Thirdly, blockchain may also underpin smart contracts (which are not exclusive of blockchain but may be leveraged by it) and automate trading. Smart contracts are computer codes which intend to replicate a contract, with the difference that the code self-executes and self-performs on the basis of verification of objective conditions (*e.g.* a contract that ensures payment when electricity or natural gas is transferred). The code is deterministic and basically says "*do something if something happens*": it triggers transfer of an asset or payment on the basis of certain objective assumptions which the parties undertake to accept. Blockchain may provide the reliability to the information on the basis of smart contracts.

Usually, blockchains are divided into two different types – public or permissioned – which in summary are typically differentiated as follows:

a) Public blockchains are typically described as bearing the following characteristics: (*i*) every user can join, (*ii*) they are anonymous and (*iii*) there is no central authority;

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9 Although data may be encrypted, so as to ensure privacy.

10 See the article "*The trust machine*" on https://www.economist.com/leaders/2015/10/31/the-trust-machine. See also

11 As stated in MIT Technology Review, "*Blockchain*", Vol. 121, no. 3, May / June 2018, p. 12.

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b) Private blockchains, probably the most appropriate for a regulated sector such as the energy sector have the following characteristics: (*i*) sponsors agree on the rules of admission of third parties (*e.g.* licensed entities), (*ii*) participants may be known within the network, (*iii*) there may be a controlling authority or administrator, and (*iv*) there may be governance tailor-made rules (*e.g.* validation of smart contracts codes by regulatory authority, automatic notification of relevant elements of trade to regulators and grid operators, etc)[12].

As already stated above, however, blockchain is in its infancy and is not yet a mature technology. Some relevant shortcomings – technology and practical – have been identified to currently existing blockchains, of which we would highlight the following:

a) Security with speed and scalability. Public blockchains are typically more secure, as transactions are processed and store in more "nodes", but slower and less scalable, at least at the current state of the art. Permissioned blockchains lose part of the decentralized nature of blockchains (making them closer to traditional centralized databases) but offer more scalable and faster solutions. Solving this problem – security (understood here as the guarantee of the authenticity of the information) with scalability – will be crucial for the development of the technology[13];

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12 For a more detailed description of each type of blockchain, see v.g. the paper on "*Blockchain in logistics – perspectives on the upcoming impact of blockchain technology and use cases for the logistics industry*", 2018, DHL Trend Research and Accenture, available in https://www.logistics.dhl/.../glo-core-blockchain-trend-report.pdf.

13 See article "*The place where life hangs by a chain*" in the MIT Technology Review, abovementioned, pages 49 and 50.

b) Privacy. Blockchain is an open and transparent platform. Conciliating transparency with privacy (necessary *e.g.* when there is an exchange of personal data) is not easy and may require heavy encryption, with the risk of making the technology inefficient;

c) Interoperability. There is no such thing as a single blockchain; instead there will be many blockchain platforms and blockchain-based applications. They will have to be interoperable, to ensure communication between platforms and migration of data. Common standards should exist[14];

d) Consumption of electricity. Processing of transactions currently entails the consumption of large amounts of electricity, though alternatives to the consensus protocols of validation of transaction are already being developed[15];

e) Lack of awareness and trust. This will only be accomplished through testing (from small environments to larger ones) to demonstrate the security of the platform and create widespread trust in the platform.

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14 Regarding the need for common standards of blockchain, see "*Blockchain beyond the hype: What is the strategic business value*", McKinsey & Company, June 2018, available in https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value.

15 Regarding the consumption of electricity, see the article "*The little coin that ate Quebec*" on pages 35 and seq. of the MIT Technology Review, abovementioned.

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III. Possible impacts of blockchain on the energy sector

Blockchain may radically change the way we transact in all sectors, by eliminating middlemen and ensuring automation. The energy sector is not an exception. Although in many cases it will require severe testing and the extent to which this technology will be used cannot be anticipated, there are some cases which can be used as possible examples[16].

Blockchain applications in the electricity sector are already being tested in several areas across the world, notably in the areas of wholesale marketing without intermediaries (*e.g.* the Enerchain platform), network monitoring (for example, the platform developed by GridSingularity), charging of electric vehicles (application which is being tested, *e.g.*, by RWE) or issuance of green certificates, guarantees of origin or other cryptocurrencies to reward the generation of renewable energy.

Within traditional energy trading, blockchain may allow peer-to-peer wholesale trading and automate trading in wholesale markets and actually eliminate middle-men.

In fact, blockchain may provide a secure platform ensuring instant matching and settlement of trades, as well as provide price transparency. Also, being a shared ledger, it may allow mutual recordkeeping (avoiding the need for duplication of statements and reconciliation) and automatic reporting. This could result in faster transactions, more efficiency, less costs.

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16 For examples of blockchain uses in the energy sector, see, *v.g.*, "*What every utility CEO should know about blockchain*", McKinsey & Company, 2018, available in https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/what-every-utility-ceo-should-know-about-blockchain#0 and "*Can blockchain help us to address the world's energy issues*", World Economic Forum, 2018, available in https://www.weforum.org/agenda/2018/01/how-can-blockchain-address-the-worlds-energy-issues/.

There is currently already a project using blockchain in energy trading – the *Enerchain project, launched by Ponton*[17]. Some of the major European utilities are testing it.

Also, smart contracts may greatly optimize the supply chain regarding gas and oil trading, notably by enabling the tracking of assets (through objective information, provided by QR codes, GPS or an accepted third party), and, through smart contracts, may render contracts self-enforceable, with automatic transfer of title and automatic payments, reducing the risk of disputes[18].

However, the use of this technology which most impresses is the possibility of peer-to-peer transactions between producers and consumers (or prosumers) in micro-grids, that are, networks installed in a given community which may operate independently and in parallel with the public network, even if they are physically connected to it. The logic of micro-grids lies essentially in the efficiency they provide and the large-scale investments they are able to avoid[19].

Innovation will strike the electricity sector hard, taking the shape of distributed energy generation, electric mobility, energy storage, etc. A

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17 See https://enerchain.ponton.de/. In order for a more detailed description of the potential of these platforms, see https://www.ponton.de/downloads/mm/Potential-of-the-Blockchain-Technology-in-Energy-Trading_Merz_2016.en.pdf.

18 See *v.g.* Deloitte's "*Blockchain: Overview of the potential applications for the oil and gas market and the related taxation implications*", April 2017, available in https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-oil-gas-blockchain-article.pdf.

19 See *v.g.* "*Use Cases for Blockchain Technology in Energy & Commodity Trading*", PwC, 2017, available in https://www.pwc.com/gx/en/industries/assets/blockchain-technology-in-energy.pdf and "*Blockchain – an opportunity for energy producers and consumers*", PwC, 2015, available in https://www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf.

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whole new universe of devices will have sensors allowing them to connect to the internet, communicate and transact with each other (the internet of things)[20]. This will contribute to create – and simultaneously require – smarter electricity networks, where demand can be managed (demand management), designed to receive electricity from each consumer and to flow electricity both ways.

At the same time, the expected profusion of producers-consumers (already baptized as prosumers), will require – or at least recommend – solutions in order to accommodate the integration of the same in the energy networks. An ideal solution to face this challenge would be one that, due to being open-source and accessible, have the capability of being adopted at a large scale, such as blockchain.

As stated in the MIT Technology Review, "*the internet of things, which it's hoped will have billions of interacting autonomous devices forging new efficiencies, won't be possible if gadget-to-gadget microtransactions require the prohibitively expensive intermediation of centrally controlled ledgers*"[21]. Blockchain is key to enable this transformation.

Blockchain, depending on its evolution and ability to overcome its challenges, can arguably be the software underpinning this paradigm shift, ensuring secure peer-to-peer and machine-to-machine trading, while giving devices a shared platform they may work with. Meanwhile, internet of things will help to digitalize assets, allowing a digital twin of each electron to be represented on a blockchain. They form a powerful tandem in creating an internet of energy.

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20 Describing the internet of things, see Hélder FRIAS, "*A Internet de Coisas (IoT) e o mercado segurador*", in "*FinTech – Desafios da Tecnologia Financeira*", Almedina, 2018, pp. 219 and seq.

21 See MIT Technology Review abovementioned, page 14.

Peer-to-peer transactions are already being tested by several companies and startups: Brooklyn Microgrid project allows sale of electricity from neighbor to neighbor and the Power Ledger Project, in Australia[22]. Connect neighbors and allow them to sell their surplus electricity and at what price and to securely track it.

On the other hand, the fact that the recent legislative package presented by the European Commission on 30 November 2016, called the Winter Package, has foreseen the concept of local energy communities, consists in a signal favoring energy management at the local level[23].

Even without micro-grids, blockchain-based applications may eventually allow the bypassing or the modification of the role of energy suppliers. In fact, digital applications constructed upon smart contracts (which automate proceedings and eliminate costs and time) may allow for consumers to remotely manage the acquisition of electricity directly in wholesale markets from producers (even out of their community), at a cheaper price. Grid + is developing a digital agent (called the smart agent) consisting in an always-on application to programmatically buy and sell electricity directly on wholesale markets. This may cause traditional suppliers to become mainly technology-service providers in the future[24].

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22 See https://lo3energy.com/ and https://powerledger.io/, respectively. There are other examples, v.g. in Japan – see https://cleantechnica.com/2018/07/09/peer-to-peer-solar-energy-trading-trial-in-japan-will-use-blockchain-solar-power-energy-trading-trial-in-japan-using-blockchain/.

23 See, in this regard, European Commission's Joint Research Centre paper "*Blockchain in Energy Communities*", 2017, available in http://publications.jrc.ec.europa.eu/repository/bitstream/JRC110298/del.344003.v09(1).pdf.

24 See https://gridplus.io/.

Blockchain allows for issuance and trade renewable-energy certificates or certificates of origin, as well as emission allowances or any other cryptocurrencies to be allocated to energy generators. Sensors in generating facilities may record generation data and issue certificates automatically, which can afterwards be traded.

Allowing for the management of a smart grid is another important possible use of this technology. Blockchain-based applications may provide real-time information as to supply and demand of distributed generation devices (at least), allowing a more seamless management of the balancing of the grid. infrastructure in real time.

Energy networks and infrastructure can also be remotely controlled and monitored in real time through smart contracts, which would signal when to make *e.g.* maintenance actions, and could automatically notify providers to carry the same.

Finally, blockchain, together with smart contracts, can provide automatic charging of electric vehicles and payment of the costs thereof.

IV. Legal and regulatory issues raised by blockchain

Blockchain involves a completely different logic from traditional software and platforms, causing several legal and regulatory challenges to be raised. Its decentralized nature, without a central party securing the data, raises control and liability issues and anonymity in public blockchains may cause difficulties in determining the applicable jurisdiction and applicable law. The automation of trading provided by computer codes (smart contracts) also raises several challenges to blockchain providers and users. Right now, with the absence of laws regarding this reality, there are many questions and very few answers. We will try to outline only some of these questions[25].

First, blockchain may raise applicable law and jurisdiction issues when they involve trading of users from different countries or anonymous, in that this may render the place of the transaction (and even the location of the parties) difficult to determine[26]. The fact that information stored in a blockchain is not stored centrally but in several nodes enhances this problem, which may be more easily tackled in private or permissioned blockchains than in public anonymous blockchains.

Second, blockchains will, themselves, be subject to applicable laws, notably to mandatory and overriding provisions from the legal systems to which a given blockchain has relevant connection elements. Legislation will have to be enacted to deal with this issue and clarify which provisions blockchain has to comply with. Preferably, legislation should be supranational, in order to introduce uniform criteria in this regard.

Third, the incorporation of legal concepts and provisions into computer code will be probably necessary. This also raises issues, notably how to turn sometimes imprecise or subjective legal language in something purely objective. It also recommends caution: as automation may render smart contracts to self-perform and self-execute (being possible

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25 Raising some similar questions to those addressed here and other, see v.g. DLA Piper's "*Blockchain: background, challenges and legal issues*", 2017, available in https://www.dlapiper.com/en/uk/insights/publications/2017/06/blockchain-background-challenges-legal-issues/, and Pels Rijcken & Droogleever Fortuijn, "*White paper: Legal aspects of blockchain*", available in https://www.pelsrijcken.info/media/563915/whitepaper_blockchain_engels.pdf.

26 Addressing this issue and supporting blockchain internal dispute resolution mechanisms, see Wulf. A KAAL and Craig CALCATERRA, "*Crypto Transaction Dispute Resolution*", abovementioned.

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difficult to reverse), perhaps experiences should start from simple and straightforward contracts. Also, it may be asked whether smart contracts, despite being computer codes, will have to comply with general contractual clauses standards (and other consumer legislation) and be subject to inhibitory actions.

Fourth, the enforcement of judgements in blockchain may also be an issue. How are judgements reflected in a blockchain? Do courts or a specific public entity have special permission to include data in blockchain? Or are the parties condemned to *v.g.* reverse a trade with compulsory fines?

Fifth, liability issues are also paramount. It is expected that blockchain taylor-made solutions are developed on the basis of the original blockchain software underpinning bitcoin, which was made available by its creators as open source software[27]. That will certainly be the case for permissioned blockchains. Will blockchain service providers or vendors be legally (even if not contractually) liable towards users, *v.g.* in case of code errors? If they are not, users are render unprotected. Should they be, will it lead them to engage in solutions which allow for some control or monitoring of the blockchain, in order to manage liability risks (what would go against the very nature of blockchain)? At first, it is expected that blockchain solutions are developed and tested in collaboration by companies and agents of a given sector, so as to eliminate liability issues.

Sixth, blockchain also raises data privacy issues, notably how to ensure the right to be forgotten in a platform, which has perennially and

27 The bitcoin software was made available by its creator (or creators) pursuant to the MIT licence, a model of licence that allows any person to copy or modify the software at no cost or condition except for the mentioning of this copyright. See https://opensource.org/licenses/MIT and https://bitcoin.org/en/bitcoin-paper.

inalterability as essential vectors or how, in general,to guarantee compliance with personal data laws in a decentralized platform under the control of nobody[28].

Finally, energy sector-specific issues may also be raised, notably how blockchains will address and comply with regulatory requirements, which may require all agents of the sector to be into it (so as, *v.g.*, for regulated network tariffs to be paid). Will this require permissioned blockchains? How will they work, *e.g.* how will permission be granted and transactions be validated? Notably, will the regulator have to be the controlling body of the relevant blockchain(s) and validator of every single transaction? As MIT Technology Review states, "*a permissioned system may make its owners feel more secure, but it really just gives them more control, which means they can make changes whether or not other network participants agree—something true believers would see as violating the very idea of blockchain*" and endangering authenticity and security issues[29].

V. Conclusion

As a conclusion, blockchain is a relatively new but promising technology which may radically change the way we trade and allow new forms of trading, especially in sectors with many middlemen such as the energy sector. The technology is still in its early stage and faces big challenges ahead. But no one should afford to stay out of this possible revolution: openness, collaboration and experiences are needed.

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28 See article 17 of Regulation (EU) no. 2016/679, of the European Parliament and of the Council (General Data Protection Regulation).

29 See MIT Technology Review abovementioned, page 41.

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Electric Vehicle Law [1]

BARRY BARTON [2]

Abstract

The article examines law and policy efforts to encourage the uptake of electric vehicles (EVs). It argues that although EVs have significant public benefits in most situations, the benefits should not be overstated. Electric vehicles are still vehicles, and many of the most important policy levers for EVs also promote improvements in the conventional vehicle fleet. The reasons for slow uptake of EVs are examined, along with the policy options available to law makers to favour EVs and improve their uptake by vehicle purchasers.

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1 This article draws on research part of which was published as B. Barton and P. Schütte, *Electric Vehicle Policy: New Zealand in a Comparative Context* (CEREL Research Report, 2015) and as B. Barton and P. Schütte, "Electric vehicle law and policy: a comparative analysis" (2017) 35 Journal of Energy and Natural Resources Law 147-170, doi 10.1080/02646811.2017.1262087.

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Key words

Electric vehicles; energy efficiency

1. Introduction

Electric vehicles are attracting a good deal of attention in policy and law reform. They open up exciting ways of preserving the mobility that people value highly while responding to some of the adverse effects of transport. But significant barriers remain, above all price, and EVs have not yet entered the mass market. This article examines law and policy efforts to encourage the uptake of EVs. While EVs have significant public benefits in most situations, the benefits should not be overstated; electric vehicles are still vehicles, and many of the most important policy levers for EVs also promote improvements in the conventional vehicle fleet.

2. The benefits of electric vehicles

The public benefits that EVs offer are considerable. Transport emissions are a major source of anthropogenic greenhouse gases, 23 per

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cent of global carbon dioxide (CO_2) emissions.[3] The transport sector, which is mostly motor vehicles, is a large one and in many countries its emissions are growing rapidly. The use of EVs will generally displace the use of ICVs that produce GHG emissions; but the value of the displacement depends on how the electricity fuel is produced. Some countries have a high proportion of renewable generation, making them prime candidates for switching to EVs. The climate benefits of EVs could increase dramatically over time, from over 125 million tons CO_2 per year in 2030 to over 1.5 billion tons CO_2 per year in 2050.[4] EVs allows the global fleet to achieve approximately 40 per cent lower carbon emissions than a highly efficient ICV fleet (and 70 per cent lower carbon than a business-as-usual fleet) in 2050. The greatest EV climate benefits will first be reaped in Europe and parts of the United States, but in the longer term in China and other emerging markets.

Energy efficiency is directly linked to climate change mitigation, but has numerous advantages of its own, in reducing energy costs and reducing the adverse effects of energy supply activities and infrastructure. EVs are about four times as efficient as conventional ICVs at using the energy delivered to the vehicle to overcome vehicle road load.[5] Air pollution from motor vehicles is another problem; it causes premature mortality, extra hospital admissions, and restricted activity. However the air quality benefits of switching to EVs will depend on the general qual-

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3 J D Miller and C Façanha, *The State of Clean Transport Policy: A 2014 Synthesis of Vehicle and Fuel Policy Developments* (International Council on Clean Transportation [ICCT], 2014) p 6.

4 N Lutsey, *Global Climate Change Mitigation Potential from a Transition to Electric Vehicles* (ICCT Working Paper 2015-5, 2015).

5 N Lutsey, *Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments* (ICCT, 2015) p 7.

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ity of a nation's vehicle fleet and what an EV replaces. For example, in respect of particulate emissions from vehicles, EVs may be no better than well-regulated modern passenger ICVs, because non-exhaust sources (ie wear of tyres, brakes and roads, and resuspension of road dust) account nearly all the particulate matter produced by the car; and because heavier cars produce more of these emissions, and EVs are about 24% heavier than their ICV equivalents.[6]

In truth, EVs do not solve all problems. EVs are still motor vehicles. They need highways and cause congestion, so promoting them will not reduce travel times or solve problems of urban form. They may compete with public transport for policy effort and public funds, and perpetuate old transport practices.[7] One recent study suggests that the overall external costs of EVs in Germany are little better than those of ICVs if one includes the costs of accidents, air pollution, climate change, noise, and congestion.[8] The advantages are argued to depend strongly on the electricity generation portfolio and potentially the charging strategy.[9] A valuable framework for thinking about transport policy and the place of EVs in it is 'avoid, shift, and improve' putting an emphasis first on 'avoid'

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6 V Timmers and P Achten, "Non-exhaust PM Emissions from Electric Vehicles" (2016) 134 Atmospheric Environment 10. Their review shows that 90% of PM_{10} and 85% of $PM_{2.5}$ come from non-exhaust sources; and that EVs are approximately 24% heavier than ICV equivalents. Note that particulate emissions from vehicles do not include GHGs or other gases, and do not include emissions from the fuel supply system such as electricity generation.

7 D Rees, 'Could Electric Cars be Bad for the Environment?' blog post 5 November 2014, www.energycultures.org.nz.

8 P Jochem, C Doll and W Fichtner, "External Costs of Electric Vehicles" (2016) 42 Transportation Research Part D 60.

9 A Abdul-Manan, "Uncertainty and Differences in GHG Emissions between Electric and Conventional Gasoline Vehicles with Implications for Transport Policy Making" (2015) 87 Energy Policy 1.

policy to slow travel growth, such as through city planning, 'shift' which moves travel to more energy efficient modes such as public transport, active transport (walking and cycling), and 'improve' reducing the energy consumption and emissions of all travel modes.[10] EVs only address 'improve.' Electricity as a fuel has adverse effects on the environment even when generated from renewable energy sources such as hydro, geothermal, and wind power.

3. Barriers to the uptake of electric vehicles

In spite of their advantages, on a global scale not many EVs are being bought. Why is the uptake of EVs slow? In general the main barriers for the introduction of EVs as a mass market product today are as follows.[11]

(i) The higher capital cost of EVs in comparison with ICVs.[12] This is an obstacle even though costs are coming down, and even though the total cost of ownership over the lifetime of the vehicle is often less than that of an ICV.[13] Furthermore, advances in the fuel efficiency of ICVs reduce relative attractiveness of EVs.[14]

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10 IEA, *Energy Efficiency Market Report 2014*, p 60, citing Deutsche Gesellschaft für Internationale Zusammenarbeit, 'Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)' (Eschborn, 2004).

11 Also see Element Energy, *Pathways to High Penetration of Electric Vehicles* (Report for Committee on Climate Change, 2013) p 21; S Steinhilber, P Wells and S Thankappan, 'Socio-Technical Inertia: Understanding the Barriers to Electric Vehicles' (2013) 60 Energy Policy 531.

12 Lutsey, *Transition* above n 3 p 9 cites a cost differential of US $8,000-$16,000.

13 Battery costs, which can be half of an EV's cost, have dropped from US $900/kWh in 2007 to $380, and still dropping: S Nyquist, 'Peering into Energy's Crystal Ball' McKinsey Quarterly July 2015.

14 Deloitte Touche Tohmatsu Ltd, *Unplugged: Electric Vehicle Realities Versus Consumer Expectations* (2011) available www.deloitte.com, p. 16.

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(ii) The shorter driving range of an EV in combination with times required to charge the vehicle, although in fact the great majority of daily car trips are well within EV driving ranges.[15]

(iii) The need for a better-developed charging infrastructure.[16]

(iv) The incomplete internalization of the negative external effects of ICVs by policy action. Without effective action on the GHG emissions and air pollution caused by ICVs, in the form of price measures or regulatory requirements, the comparative benefits of EVs are insufficiently valued.

4. The different policy options for electric vehicles

A comparative analysis of the law of a variety of countries produces useful insights into EV policy.[17] The different policy instruments can be considered in turn. There is a growing body of studies from around the globe that assess the effectiveness of government policies on EVs. They tell a strong and consistent story about the barriers to EV uptake and

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15 IEA / Electric Vehicles Initiative, *Global EV Outlook* (2013) p 26. See also National Research Council, Committee on Overcoming Barriers to Electric-Vehicle Deployment, *Overcoming Barriers to Deployment of Plug-In Electric Vehicles* (2015); Deloitte, above n 12 p 6.

16 IEA, *Global EV Outlook* above n 13 p 25; J Perdiguero and J L Jiménez, 'Policy Options for the Promotion of Electric Vehicles: a Review' (Institut de Recerca en Economia Aplicada Regional i Pública, 2012) p 7 et seq.; S Lemon and A Miller, *Electric Vehicles in New Zealand: From Passenger to Driver?* (Christchurch: Electric Power Engineering Centre, 2013) p 5.

17 See Barton and Schütte (2016) for a full analysis of Norway, California, Germany, New Zealand, Australia and France.

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the success of policy measures to overcome them. In a recent literature review, Nic Lutsey of the International Council on Clean Transportation (ICCT) identified the best-practice design principles that emerge.[18] The consensus he found is that, although regulatory standards for fuel efficiency are necessary, along with research and development, they are insufficient without complementary policies and incentives:

- Fiscal incentives to defray the incremental upfront cost; non-fiscal incentives such as preferential road, parking and lane access to provide benefits to vehicle users.
- Engagement with electricity utilities for EV charging rates and infrastructure; utility involvement in EV financing and vehicle-to-grid technology.
- Deployment of public and workplace charging networks
- Placement of EVs in car-sharing fleets, and encouragement of longer-range EVs.
- Information and awareness actions.

a) Price support to address the cost of electric vehicles

Price support, fiscal incentives, or subsidies are generally regarded as important to produce any significant uptake of EVs, in order to deal with the price barrier. Price measures can be justified on economic grounds

18 Lutsey, *Transition*, above n 3, pp 21-25, 32. Similarly see Element Energy, above n 9 p 124; International Energy Agency, *Energy Efficiency Market Report 2014*, p 73; U Tietge, P Mock, N Lutsey and A Campestrini, *Comparison of Leading Electric Vehicle Policy and Deployment in Europe* (ICCT white paper, 2016).

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to correct for the negative externalities of ICVs.[19] A number of studies show convincingly that EV price support or incentive measures need to be well designed in order to produce results.[20] First, they need to be big enough to make a difference; small subsidies will benefit purchasers but will not change their behaviour. Secondly, incentives need to be available immediately at the time of sale; consumers have a short pay-back outlook on the investment. (For example, sales tax waivers work much better than income tax credits.[21]) Thirdly, incentives need to be in place for long enough to send a clear message to automakers and importers. Fourthly, incentives should be linked to the relevant externality, such as the vehicle's CO_2 emissions, and should apply to the entire vehicle fleet and not only to EVs; conventional ICVs cannot be put to one side. The effects of taxation also need to be taken into account.[22]

Incentives should be designed with a view to social equity and distribution; if they are clumsily designed they will be regressive and only

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19 S B Peterson and J Michalek, 'Cost-effectiveness of plug-in hybrid electric vehicle battery capacity and charging infrastructure investment for reducing US gasoline consumption' (2013) 52 Energy Policy 429 at 437.

20 Lutsey, *Transition*, above n 3 p 23; National Research Council, above n 13 p 119; Element Energy above n 9; L Jin, S Searle and N Lutsey, *Evaluation of State-Level U.S. Electric Vehicle Incentives* (ICCT, 2014); J R DeShazo, "Improving Incentives for Clean Vehicle Purchases in the United States: Challenges and Opportunities" (2016) 10 Rev Env Economics and Policy 149.

21 K Gallagher and E Muehlegger, 'Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology' (2011) 61 J Env Ecs & Management 1. Most purchasers expect to recoup the initial price premium of an EV within three years: IEA, *Global EV Outlook*, above n 13 p. 30.

22 European Federation for Transport and Environment, *CO_2 Emissions from New Cars in Europe: Country Ranking* (2014); C Brand, J Anable, M Tran, "Accelerating the Transformation to a Low Carbon Passenger Transport System: The Role of Car Purchase Taxes, Feebates, Road Taxes and Scrappage Incentives in the UK" (2013) 49 Transportation Research Part A 132.

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help the well-to-do buy EVs.[23] There is no point, and a good deal of harm, in allowing public funds to be disproportionately transferred to wealthy new car buyers who would have purchased clean vehicles anyway. Even apart from social equity, emission reductions will be greater if incentives reach low-income consumers, because they tend to drive more polluting vehicles, drive them further, and exhibit less propensity to buy clean vehicles.[24]

Overall, policymakers have much evidence that the question of vehicle price cannot be ignored, and that price support incentives are essential and effective. They also have cogent evidence about the design of incentives.

b) Efficiency standards: fuel efficiency or GHG emissions regulation

EVs look like a viable option only if the adverse effects of ICVs are controlled, so we need to consider the regulatory pressure on all kinds of vehicle. The great majority of the world's vehicle sales – eighty-five per cent – are subject to efficiency standards, whether in the form of fuel efficiency, fuel economy, or GHG emissions.[25] These standards have proved to be highly cost-effective in cutting CO_2 emissions and producing fuel savings. Between 2000 and 2010 they improved new vehicle fuel efficiency by 20 per cent in OECD countries and 10 per cent in other countries.[26]

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23 M Nilsson and B Nykvist, "Governing the Electric Vehicle Transition – Near Term Interventions to Support a Green Energy Economy" (2016) 179 Applied Energy 1360.

24 DeShazo, above n 18.

25 Miller and Façanha, above n 1. We follow their use of the term 'efficiency standards' to refer collectively to targets for fuel consumption, fuel economy, and CO_2 or GHG emissions: p 4. The standards are directly related in their effect.

26 IEA, *Energy Efficiency Market Report 2014*, pp 70-71.

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We have seen these standards in the laws of several jurisdictions. The American 'CAFE' standards – corporate average fuel efficiency standards – are among the pioneers, introduced to tackle air pollution in California but now also part of the response to climate change. In the European Union, the CO_2 standards that were put in place for cars in 2009 set an overall fleet average target for 2015 of 130 g/km, which accelerated reductions considerably; in 2006 the average was about 160 g/km.[27] It is expected that the standards that have been agreed on to take effect in 2020 will produce a 25 per cent reduction in fuel consumption, and that the fuel savings will actually be larger than the cost of compliance, resulting in net savings of between €80 and €295 per ton of CO_2 avoided. Both the American and European standards are very cost-effective and are credited with putting significant pressure on the ICV fleet.[28] The regulatory pressure on ICVs makes EVs a more attractive option for suppliers and for purchasers.[29] Efficiency standards have been found to be a key driver for the deployment of EVs in the United States and Europe.[30]

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27 ICCT, *EU CO_2 Emission Standards for Passenger Cars and Light-Commercial Vehicles* (Policy Update January 2014).

28 As to the USA: D. Kodjak, *Policies to Reduce Fuel Consumption, Air Pollution, and Carbon Emissions from Vehicles in G20 Nations* (ICCT, 2015) p. 19. As to Europe: ICCT, *EU CO_2 Emission Standards for Passenger Cars and Light-Commercial Vehicles* (Policy Update January 2014). The current EU Regulations, including the tightening of the standards in 2020, are Regulation (EC) 443/2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles, [2009] OJ L140/1, as amended by Regulation (EU) 333/2014 to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars, [2014] OJ L103/15.

29 Miller and Façanha, above n 1, pp 26 and 53.

30 Kodjak, above n 26 p 19; Element Energy, above n 9, pp 81 124-27; Tietge et al, above n 16 p 7.

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However there is some complexity in the relationship between efficiency standards and EV uptake. One feature of efficiency standards that is crucial, but in our view insufficiently understood, is that they operate as averages. They require each manufacturer or importer for each model year to sell a fleet of vehicles that, when measured overall, meets the regulatory standard. The positive side of this averaging is that it gives the vendors flexibility to continue to offer low-efficiency vehicles, provided that they are balanced with high-efficiency ones. But it may reduce the power of efficiency standards to increase EV numbers. In Europe, although increasingly stringent CO_2 regulation incentivizes EVs, the automakers already have dozens of ICV models that meet the 2021 emission standard, so they do not need to produce EVs to meet it.[31] Similarly in the United States, the Congressional Budget Office concludes that the federal tax credits for the purchase of EVs may produce little or no reduction in gasoline consumption or GHG emissions because with CAFE standards the vehicle suppliers can match the greater EV sales numbers with greater numbers of low-economy vehicles.[32] The inference is that vehicle efficiency standards may not on their own ensure the mass-market adoption of EVs, and, equally, that price support for EVs may not reduce GHG emissions.

In turn, that presses us to ask what really matters, the GHG reductions, or the EV sales? We suggest that the answer is both. ICVs will be part of the vehicle fleet for a very long time and it all needs to be as efficient and low in emissions as possible; and that efficiency standards are the best means to that end. Equally, looking further ahead, we need

31 Tietge et al, above n 16.

32 Congressional Budget Office, *Effects of Federal Tax Credits for the Purchase of Electric Vehicles* (Washington, September 2012) p 12.

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to promote technology diffusion for EVs and other ultra-low emissions vehicles that will be required for an entirely new kind of mobility future.

c) Price on carbon

Also relevant are measures that put a price on GHG emissions, in the form of a carbon tax or emissions trading scheme. We have already noted arguments that conceptually carbon pricing and pollution pricing are more directly targeted at the negative externalities.[33] However there seems to be a good case for policy action on both vehicle purchase decisions and subsequent vehicle use decisions. The two activities are quite different and different policy instruments are needed to influence them. It is not a case of unnecessary duplication. There is firm evidence that carbon pricing on its own is not enough to overcome all barriers to cost-effective energy use actions.[34]

d) Feebates

Feebates are interesting as a policy instrument that can address both the price barrier and fuel efficiency at once. Feebates are generally recognized in the literature of environmental economics and policy,[35] and in relation to motor vehicles the best example is the French bonus/malus scheme. A feebate rates each model for its GHG emissions or efficiency performance, usually at the point of initial import or manufacture, so

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33 DeShazo, above n 18.

34 L. Ryan, S. Moarif, E. Levina, R. Baron, *Energy Efficiency Policy and Carbon Pricing* (IEA, 2011); IEA, *Energy Efficiency Market Report 2014*, p 70.

35 T T Tietenberg and L Lewis, *Environmental and Natural Resource Economics* (10th ed, 2015) p 437.

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that better vehicles get rebates and worse ones must pay fees.[36] The reward is tangible and immediate. A true feebate is self-financing; fees received from above the 'pivot point' are balanced by the rebates paid below it. (The pivot must therefore be reset periodically as technology changes and as ambition grows.) Revenue neutrality is attractive politically; a feebate is not a subsidy or a tax. It is likely to be attractive in terms of social equity; it is less likely than most systems to put good quality vehicles out of the reach of poor families. A feebate is technology-neutral; it influences the purchase of ICVs and EVs alike, and encourages hybrids, fuel cells, and hydrogen vehicles as well. It will generally give EVs favourable ratings especially where electricity generation is low-carbon.

e) Charging facilities

Among the barriers to the uptake of EVs are their short driving range in comparison with ICVs and the need for a better-developed charging infrastructure, even though most of the car trips that people make actually are well within EV driving range. Most EV charging can be done at the owner's residence, using ordinary electrical outlets for a full charge overnight.[37] However there is also a role for a network of public charging facilities that provide a rapid recharge.

f) Public awareness and ancillary regulation

Research shows that consumers and fleet managers are not well informed about EVs, and that a number of perceptual factors contribute

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36 J. German and D. Meszler, *Best Practices for Feebate Program Design and Implementation* (ICCT, 2010); Element Energy above n 9 p 97 also emphasizes feebates.

37 National Research Council, above n 13, pp 82-87.

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to consumer uncertainty and doubt about them, particularly the total costs of ownership over time, battery durability, and the driving range concern that we have just considered.[38] Educational and information measures are therefore essential.

g) Industry policy

Brief mention should be made of the strategy that we have noted in some countries with large automotive industries, investing substantially in supply-side innovation, especially by providing automakers with research and development funding. France, Germany and the United States are examples. Such countries often also put public funding into the demand-side environmental policies that encourage the diffusion and uptake of EV technology.[39]

5. Conclusion

It is clear that EVs offer public benefits in relation to climate change, air pollution, energy efficiency and energy security – even though the incidence of the benefits is not the same everywhere.

Two insights emerge that are more novel and perhaps contentious. The first is that EV policy and transport policy diverge at key points. Electric vehicles are still vehicles. They do not reduce journey times, the num-

38 Lutsey, *Transition*, above n 7, p 24; National Research Council, above n 13, p 51.

39 J Wesseling, "Explaining Variance in National Electric Vehicle Policies" (2016) Environmental Innovation and Societal Transitions, in press.

ber of cars on the road, or the demand for new roading. They produce about as much particulate matter air pollution as ICVs. EVs themselves need to evolve, for example by making reductions in vehicle weight. If EVs are understood still to be vehicles, we see that public effort and resources invested in them may not be the best investments that society can make in transport; public transport, shared transport and active transport, for example, may produce better results. EV initiatives should find their place within the "avoid, shift, improve" framework. An undue focus on EVs may unduly perpetuate longstanding but outmoded conceptions of vehicle use and ownership. Electrification needs to find its place in relation to connected and autonomous vehicles – CAVs – that are likely to be EVs but with self-driving capabilities that may transform human mobility, and suddenly seem to be emerging as a reality.

The second insight is that EV policy and climate change policy also diverge at key points. A switch from petroleum to electricity as a fuel will reduce GHG emissions under most generation mix scenarios. EV policy measures need to be coordinated with a shift towards renewable energy production, carbon pricing and other GHG measures. We have seen that efforts to promote EVs are undercut if ICVs are not exposed to the real cost of their negative externalities. However the swiftest cheapest reductions in GHG emissions from road transport may not come from EVs, but from better ICVs, vehicles using biofuels or hydrogen fuel cells, or from public and active transport.

These insights seem to bring us to the familiar policy criteria of efficiency and equity. Efficiency causes us to ask whether EV-specific measures, such as auto industry research and development support, price incentives or bus-lane privileges, are the most cost-efficient way to obtain benefits in transport management or in GHG emission reductions.

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Whether they are good value for money in the use of public funds and resources is a proposition that needs to be justified. The fact that EV policy diverges from transport policy and climate change policy is apparent. It has often been said that policymaking should avoid picking winners and favouring one technology in addressing a general problem.[40] On the other hand, as we have noted it may be desirable, even essential, to support the longer-term emergence of EVs as a technical option, even though it is an expensive one in the short term.

The equity criterion seems very relevant as well; it causes us to ask whether a measure such as EV price support is a regressive subsidy, if it fails to change behaviour and merely redistributes income towards purchasers who are already affluent. Equity tensions will also appear dramatically if bus users complain that EV users entitled to use bus lanes are slowing down public transport. Social equity therefore presents a real challenge to policy makers.

On the whole it is reasonably clear that EVs have a role in transport and greenhouse gas emission reductions in a sustainable society, and the sooner that they can make their contribution in substantial numbers, the better. It will take careful policymaking and law reform to ensure that they do so.

40 M J Trebilcock and J S F Wilson, 'The Perils of Picking Technological Winners in Renewable Energy Policy' p 343 in G Kaiser and B Heggie, eds, *Energy Law and Policy* (Toronto: Carswell, 2011).

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