PART THIRD
ELECTRIC SECTOR

THE ENERGY TRANSITION TO CLEAN TECHNOLOGIES: A DRIVING FORCE FOR MEXICO'S DEVELOPMENT

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I. Introduction

Energy transition is a trend in the global energy sector, consisting of the gradual replacement of the use of fossil fuels by the use of clean sources of energy that are safe, reliable and affordable. In this sense, energy efficiency and renewable energy, the two fundamental pillars of the energy transition, provide an ideal path to achieve most of the greenhouse gas emission reductions required to mitigate climate change.[1]

Understanding the socio-economic footprint of the energy transition is essential for analysis and decision-making. The energy transition cannot be considered an issue isolated from the socio-economic system in which it is deployed. According to the International Energy Agency (IEA), the socio-economic benefits of the transition go beyond an increased per capita Gross National Product (GDP) and even include numerous social and environmental benefits.[2]

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1 IRENA, "Energy Transition", available at: *http://www.irena.org/energytransition.*

2 IRENA, "Global Energy Transition: A Roadmap to 2050", p. 7, available at: *http://www.irena.org//media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_Global_Energy_Transformation_2018_summary_EN.pdf?la=en&hash=2335A542EF74D7171D8EC6F547C77395BDAF1CEE.*

The required breadth of the transition is such that it can only be achieved through a collective process which involves society as a whole. Therefore, universal access to energy is a key component for a fair and equitable transition. Hence, the transition process will only be completed when energy services converge in each and every corner of the planet.[3]

II. A brief history of the energy transition in Mexico

For more than a decade, Mexico has joined the global efforts to build a low-carbon future. In this century, several actions have been carried out to bring about an energy transition to the use of clean energy.

First. The 2007-2012 Energy Sector Program was presented with the aim of fostering the use of technically, economically, environmentally, and socially viable renewable energy sources and biofuels.[4]

Second. The 2009-2012 Special Program for the Use of Renewable Energy was published to propitiate energy security and diversification, establish political policies for the incorporation of renewable energy into the national energy matrix, and reconcile society's energy consumption needs with the sustainable use of natural resources.[5]

Third. In 2010, the Energy Regulatory Commission (CRE) issued the methodology to calculate the rates of the transmission services provided by the Federal Electricity Commission (CFE) to permit holders with power plants using renewable sources or efficient co-generation.[6] Known as "special renewable energy transport rates," these consisted of a single payment based on voltage (low, medium, or high), regardless of the distance between the point of generation and the point of consumption.[7]

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[3] *Ibidem*, p. 11.

[4] INEEL, "El Programa Especial de Energías Renovables", November 2011, available at: *https://www2.ineel.mx/proyectofotovoltaico/FOROFV_2011/FOROFV_MEXICO_2011/JUEVES_10_NOV_2011/03_Lic_Ivan_Benicio_Michel_Duenas_SENER.pdf.*

[5] *Idem.*

[6] Secretaría de Energía, "Resolución por la que la Comisión Reguladora de Energía expide la metodología para la determinación de los cargos correspondientes a los servicios de transmisión que preste el suministrador a los permisos con centrales de generación eléctrica con fuentes de energía renovable o cogeneración eficiente", *Diario Oficial de la Federación*, April 2010, available at: *http://dof.gob.mx/nota_detalle.php?codigo=5139525&fecha=16/04/2010.*

[7] INEEL, *Certificación de cogeneradores eficientes*, 2014, available at: *https://www.ineel.mx//boletin012014/breve02.pdf.*

Fourth. In late 2010, Cancun hosted the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 16). As a result, the Cancun Agreements were approved and established, among other things: i) a registry to correlate the mitigation actions of developing countries with the technical and financial support of industrialized countries; ii) a new 30-billion-dollar green fund in fast-start financing from developed countries; and iii) a process to design the Green Climate Fund, a mechanism to assist developing countries in climate change adaptation and mitigating practices.[8]

Fifth. That same year, the Mexican Accreditation Entity (EMA) launched a program to accredit greenhouse gas (GHG) verifying agencies, making Mexico the first country in Latin America to implement this measure.

Sixth. In 2011, Mexico became a member of the International Renewable Energy Agency (IRENA), an inter-governmental organization dedicated to promoting the adoption and sustainable use of renewable energy around the world. Currently, this organization is made up of 159 countries (including Mexico) and the European Union.[9]

Seventh. In 2012, Mexico chaired the G20 and hosted the Leaders' Summit at which the heads of State of the twenty largest economies in the world acknowledged the need to include green growth and sustainable development policies in their structural reform agendas, in addition to reiterating their commitment to rationalize and phase out inefficient fossil fuel subsidies that encourage overconsumption.

With these actions, 51,073 GWh of clean energy were generated in 2012, representing 17.3% of the country's total generation, where hydroelectric energy accounted for 10.8%, nuclear energy for 3%, geothermal energy for 2%, wind energy for 1.1%, biomass for 0.4% and solar energy for 0.0007%.[10]

Subsequently, a key milestone in triggering investment in clean energy projects that would contribute to the implementation of the energy transition and thereby ensure a low-carbon future for all was the approval of the Energy Reform between 2013 and 2014.

In this context, the Energy Transition Law (LTE) was passed in 2015 in order to regulate the sustainable use of energy, as well as obligations regard-

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[8] Centro Mario Molina, "Acuerdos de Cancún, COP16", available at: *https://centromariomolina.org/acuerdos-de-cancun-cop16/*.

[9] International Renewable Energy Agency, "IRENA Membership", 2018, available at: *https://www.irena.org/irenamembership*.

[10] Information from the CRE.

ing clean energy and reductions in polluting emissions from the electrical industry while upholding the competitiveness of productive sectors.[11]

This law established the national goal of generating 35% of the country's energy from clean sources by 2024.[12] Additionally, the LTE ordered the drafting of a Transition Strategy to Promote the Use of Cleaner Technologies and Fuels as the guiding framework for the national policy on medium- and long-term clean energy obligations and sustainable energy use. The Strategy, published in December 2014, proposed clean energy generation goals of 37.7% by 2030 and 50% by 2050.[13]

In 2015, Mexico participated in the COP 21, which resulted in the Paris Agreement, ratified by the Mexican Senate on September 21, 2016. Through this instrument, Mexico pledged to meet the targets set out in its Intended Nationally Determined Contributions (INDC): a 25% unconditional reduction of its GHG and short-lived climate pollutant emissions by 2030, and an up to 40% conditional reduction subject to a global agreement establishing an international carbon price, access to financial resources and technological transfer.[14]

For Mexico to meet its national clean generation goals and multilateral emission reduction commitments, the Electrical Industry Law (LIE) published as part of the 2014 energy reform, created Clean Energy Certificates (CELs). Issued by the CRE, a CEL is a certificate that accredits the production of one megawatt-hour (MWh) from clean energy and serves to comply with the obligations established by the Ministry of Energy (SENER) associated with consumption in charging stations.

Between 2015 and 2018, the SENER and the National Energy Control Center (CENACE) held three long-term auctions in which CFE, and other suppliers purchased CELs, energy and power —at the most competitive prices worldwide— to fulfill their obligations. As a result, over the next three years, 70 new power plants were to be built in 19 states, adding 7,600 MW to Mexico's current generation capacity (Map 1). The risk of these

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[11] Secretaría de Gobernación, Decreto por el que se expide la Ley de Transición Energética, *Diario Oficial de la Federación*, December 2015, available at: *http://dof.gob.mx/nota_detalle.php?codigo=5421295&fecha=24/12/2015*.

[12] *Idem*.

[13] Secretaría de Energía, *Estrategia de transición para promover el uso de tecnologías y combustibles más limpios*, 2016, available at: *https://www.gob.mx/cms/uploads/attachment/file/182202/20161110_1300h_Estrategia_CCTE-1.pdf*.

[14] Secretaría de Relaciones Exteriores, "México presenta su INDC para el periodo 2020-2030", March 2015, available at: *https://embamex.sre.gob.mx/hungria/index.php/es/noticias/7-noticias-de-mexico/238-mexico-presenta-su-indc-para-el-periodo-2020-2030*.

projects is assumed by the developer and the service is only paid until it is operational.

By October 2020, 74.6% of the capacity associated with the three long-term auctions have started operating in more than six Mexican states (together they represent an installed capacity of 5,049 MW).[15]

On July 31, 2019, SENER and CENACE announced the cancellation of the fourth long-term auction, which would have meant an estimated investment of 4 billion dollars and increased the current generation capacity to 3,800 MW. As of July 2022, the mechanism to replace auctions to promote large-scale deployment of clean energy in Mexico has not been disclosed.

On February 2021, the Executive Branch sent to Congress an initiative to amend the Electricity Industry Law giving preference to CFE fuel-based plants over new renewable plants in the dispatch of electricity. It was approved and later suspended by federal judges that same year.[16] The constitutionality of the law was discussed by the Supreme Court in April 2022 and was one vote short from being expelled from the law Mexican system (it got 7 and not 8 out of 11 votes to be declared unconstitutional). Later, in June and July 2022 two federal competition judges suspended its effects for general purposes based on the 7 Supreme Justice votes that considered it unconstitutional for going against competition or the human right to have a clean environment. Therefore, the law that prevails as of August 2022, is the one that was approved in 2014.

Based on the actions implemented in the last decade, 65,299 GWh of clean energy were generated during 2018, which represented 19.5% of the country's electricity generation, where hydroelectric energy accounted for 9.4%, followed by nuclear energy with 4.1%, wind energy with 3.6%, geothermal energy with 1.6%, biomass with 0.6%, and solar energy with 0.2%.[17]

In the future, the challenge of consolidating a safe clean energy sector with a social focus continues; that is, by 2024, clean energy development and deployment in Mexico will reach every corner of the country.

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15 Secretaría de Energía, "Avanza en 2 años la transición energética con el Gobierno de México en forma ordenada", December 2020, available at: *https://www.gob.mx/sener/articulos/avanza-en-2-anos-la-transicion-energetica-con-el-gobierno-de-mexico-en-forma-ordenada*.

16 A constitutional amendment was sent to Congress in October of 2021 to set the privilege of the state-owned company CFE in the electric sector not only as a supplier but also as a marketer. It also added to the then suspended law, the suppression of the independent regulators of electricity and upstream. The amendment had not enough votes and was discarded in April 2022.

17 A CRE preliminary estimate at the end of 2018.

III. The current state of the energy transition in Mexico

Although the energy sector in Mexico is known for historically having an oil-based tradition of which Mexicans should feel proud, under the perspective of energy security, Mexico needs to diversify its energy sources and identify the great opportunities that now exist in terms of clean energy.

As of April 2019, Mexico has almost 280 clean energy plants in 30 states, which represents an installed capacity of 24,000 MW, or 30% of the country's total (Map 2).[18]

Thus, most of the clean energy installed in Mexico comes from 100 hydroelectric plants representing 16%[19] of the country's total capacity and 1% of the world's hydroelectric capacity.[20]

Similarly, even though only 6% of Mexico's installed capacity today comes from 51 wind power plants, the country has a plant capacity factor ranging between 20% and 50%, which is competitive even when compared to leading countries like Argentina and New Zealand, which have plant capacity factors close to 50%.[21]

Moreover, despite having 5 geothermal power plants in operation, amounting to 1.3% of the country's installed capacity, Mexico is recognized worldwide as one of the countries with the highest geothermal energy potential, along with the United States, the Philippines, Indonesia, Turkey and New Zealand. [22]

Meanwhile, nuclear energy has an 11% share in the world's electrical energy as a result of the 450 nuclear reactors currently in operation. The United States and France are the countries with the highest number of installed nuclear energy plants —99 and 58, respectively— while Mexico has just one plant located in the state of Veracruz, which represents 2% of the country's installed capacity.[23]

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18 Information from the CRE at the end of 2018.

19 CRE estimate.

20 Secretaría de Energía, "PRODESEN Programa de Desarrollo del Sistema Eléctrico Nacional, 2018-2032", available at: *https://www.gob.mx/cms/uploads/attachment/file/331770/PRODESEN-2018-2032-definitiva.pdf.*

21 "Proceedings of the National Academy of Sciences of the United States America", available at: *http://www.pnas.org/content/106/27/10933/F7.expansion.htm.*

22 Secretaría de Energía, "PRODESEN 2018-2032", available at: *https://www.gob.mx/cms/uploads/attachment/file/331770/PRODESEN-2018-2032-definitiva.pdf.*

23 *Idem*.

Likewise, although today merely 2% of Mexico's installed capacity comes from 44 photovoltaic power stations, some Mexican states have a higher average daily solar radiation then some of the European cities that pioneered this technology. For example, Leipzig, Germany, has an average daily solar radiation of 2.7 kWh/m^2,[24] while Veracruz, one of the states with the lowest average daily solar radiation in Mexico, has 4.1 kWh/m^2. Furthermore, the solar radiation that 3.4% of the territory of Veracruz receives in one month could generate the energy needed to supply all of Mexico with electricity.[25]

Last but not least, Mexico has 78 biomass power plants that represent 1% of its total installed capacity. However according to the IEA, bioenergy from liquid biofuels and biogas will spearhead the growth of renewable energy consumption worldwide by 2023, due to its expanding use in the heating and transportation sectors.[26]

It should be noted that by 2021, it was expected that more than 200 new clean energy plants would be set up in 30 states in Mexico, providing an additional install capacity of 19,5000 MW,[27] which would help Mexico reach the national target of clean generation by 2024 (Map 3). This would depend on four factors: the consolidation of a transparent and functional wholesale electricity market; the development of sufficient transmission and distribution infrastructure; the massive deployment of distributed generation and the effective social management of infrastructure projects.

In this sense, the CRE, as the regulator of the entire electricity sector's value chain and the authority of the market, has overseen setting the regulatory bases required to achieve these objectives. On the one hand, the regulatory framework for transmission and distribution issued by the CRE seeks to minimize uncertainty by guaranteeing non-discriminatory open access and encouraging safe, long-term investments for the expansion and modernization of the electricity grid that will enable to free up congested corridors and the insertion of new, clean energy into the grid.

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[24] European Commission, "Photovoltaic Geographical Information System", available at: *http://re.jrc.ec.europa.eu/pvg_download/map_pdfs/G_hor_DE.pdf.*

[25] CRE estimate with data from Solargis, "Download solar resource maps and GIS data for 180+ countries", available at: *https://solargis.com/maps-and-gis-data/download/mexico.*

[26] Reuters, "Bioenergy Leads Growth in Renewable Energy Consumption to 2023: IEA", available at: *https://uk.reuters.com/article/us-iea-renewables/bioenergy-leads-growth-in-renewable-energy-consumption-to-2023-iea-idUKKCN1MH123.*

[27] Comisión Reguladora de Energía, Permisos de generación otorgados por la CRE, a partir de 2014, a centrales eléctricas que entrarán en operación antes de 2021.

On the other hand, in March 2017, the CRE updated the regulatory framework for distributed generation to encourage the deployment of this form of electricity supply for users.[28] By April 2019, there were 94,893 contracts for solar roof systems, which represents an installed capacity of 693 MW and an estimated investment of 1.17 billion dollars.[29] It is noteworthy that since 2012 the number of solar installations has practically doubled annually. If this trend continues, by 2023, there will be 600,000 solar roof systems. In other words, distributed generation in Mexico will have grown by 1000%.[30]

The CRE has been one of the institutions driving the energy transition towards the use of clean technologies, whose continuity and consolidation are aligned with its long-term mission to guarantee the conditions required for the availability of quality and competitive-priced energy in Mexico.

IV. Clean energy as a driving force for social development

As seen above, the 21st century energy model advocates the transition from the use of fossil fuels to the development and deployment of clean technologies. This change of paradigm in Mexico could have a positive impact on the population in the short and medium-term. Therefore, establishing policies, regulations or programs aimed at sustainable development and a low-carbon future is how clean energy emerges as an array of new opportunities for communities lagging behind socioeconomically.

This includes social participation by means of programs that promote universal access to energy, energy efficiency and consumer empowerment. Some examples are given below:

> Access to solar energy by installing solar roof systems. In this way, users can reap several of its benefits, such as i) reducing emissions harmful to the environment and health; ii) favoring the household economy given that the regulatory framework makes it possible to reduce electricity consumption from

[28] A second generation of regulation for community distributed generation was approved in 2019 by the regulator. That piece of regulation was never published in the Official Gazette.

[29] Estimated data from the CRE at the end of 2018, based on information provided by CFE Distribution.

[30] García Alcocer, Guillermo, "El sol sale para todos", *El Universal*, September 17, 2018, available at: *http://www.eluniversal.com.mx/cartera/el-sol-sale-para-todos.*

the CFE network while selling surplus, and iii) providing access to electricity in remote areas. To do this, electricity is being provided to rural communities and marginalized urban areas by extending the CFE grid and installing solar panels as part of the Universal Electricity Service Fund (FSUE), which was established in 2016.[31]

The 2014-2018 National Program for the Sustainable Use of Energy (PRONASE), designed by the SENER and the CONUEE, has a section devoted to Energy Efficiency Programs, which includes support programs for end users to encourage the replacement of low efficiency equipment and systems with those with better energy performance, such as the "*Ahórrate una luz*" program.[32] This program is a SENER initiative, financed by the World Bank and operated by the Fideicomiso para el Ahorro de Energía Eléctrica [Trusteeship for Electrical Energy Saving] (FIDE) with the support of the CONASUPO [National Company for Subsidies for the Population] Commercial Distributor and Trade Promotion (DICONSA). Its goal is to deliver 14,000,000 energy saving lamps free of charge in DICONSA stores to the inhabitants of towns with fewer than 100,000 inhabitants as a way to help their household finances, reduce their energy consumption and contribute to protecting the environment.

The National Workers Housing Fund Institute (Infonavit) has made a Green Mortgage available to its beneficiaries.[33] This is optional and can be requested if the beneficiary wants to buy air-conditioning systems, solar water heaters, voltage optimizers and photovoltaic systems connected to the grid. With the savings obtained from installing these technologies, the loan is paid back in a way that does not affect household finances.

In the future, it is necessary to strive to strengthen the social dimension that not only incorporates the participation of the population in implementing small, medium and large-scale projects, but also makes communities aware of the benefits these can provide, such as citizen empowerment; the gradual reduction of their electrical consumption and, therefore, their light

[31] Secretaría de Energía, "El Fondo del Servicio Universal Eléctrico FSUE, tiene como objetivo alcanzar para 2018 el 99% de la cobertura eléctrica nacional", November 13, 2017, available at: *https://www.gob.mx/sener/articulos/el-objetivo-del-fondo-de-servicio-universal-electrico-es-alcanzar-para-2018-el-99-por-ciento-de-la-cobertura-electrica-nacional?idiom=es*.

[32] The name of this program is a play on words in Spanish since "luz" can mean both "light" or "electricity" and "money". Therefore, it is implied that the beneficiaries of this program will "save on electricity" and "save money". Secretaría de Energía, "Concluyó el programa ahórrate una luz con la entrega de 39, 799, 447 lámparas ahorradoras", December 22, 2017, available at: *https://www.gob.mx/sener/articulos/concluyo-el-programa-ahorrate-una-luz-con-la-entrega-de-39-799-447-lamparas-ahorradoras*.

[33] Infonavit, "Hipoteca Verde", 2018, available at: *http://portal.infonavit.org.mx/wps/wcm/connect/infonavit/trabajadores/cuido_mi_casa/hipoteca+verde*.

bill; and a positive impact on people's health and the environment by replacing conventional sources like wood with photovoltaic energy through solar roof systems.

In this way, the transition to clean technologies with a social approach enhances energy security, supports economic growth and competitiveness, and reduces energy poverty in addition to contributing to mitigating climate change. Hence, this is a fundamental issue that must be an intrinsic part of any discussion on the future of the energy sector in Mexico.

V. What is missing?

Although significant progress has been made in the energy transition toward the use of clean energy in Mexico, much remains to be done.

One of the main challenges to be met is the variable or intermittent nature of renewable energies, like photovoltaic and wind. That is, unlike constant conventional technologies such as coal, gas, diesel and hydroelectric energy, intermittent technologies are characterized by being variable and strongly dependent on daily weather conditions. As these technologies reach higher levels of penetration, the intermittency associated with them can become important, thereby affecting the reliability of the electrical system and therefore the country's energy security.[34]

In this sense, the incorporation of electrical energy storage systems would represent a way to solve the problem of intermittency and guarantee energy supply security while diversifying the energy matrix. The idea is that by storing the energy extracted from these renewable resources, it can be available when the user requires it. This presents the challenge of having the exploitable, socially sustainable, and sufficient reserves of materials such as lithium and cobalt, which are the basic raw materials for manufacturing storage batteries.[35]

To understand the importance of consolidating an efficient storage market, it is enough to look at California. One of its main milestones evolved from an event taking place in October 2015, when a massive natural gas leak broke out at the Aliso Canyon terminal outside Los Angeles. This leak

[34] Pica, André, "Los desafíos de la utilización de energías renovables no convencionales intermitentes", Pontificia Universidad Autónoma de Chile, August 2015, available at: *https://politicaspublicas.uc.cl/wp-content/uploads/2015/09/N%C2%B0-81-Los-desaf%C3%ADos-de-la-utilizaci%C3%B3n-de-energ%C3%ADas-renovables-no-convencionales-intermitentes.pdf.*

[35] A first generation of regulation for energy storage was approved in 2019 by the regulator but was never published in the Official Gazette.

put the state's energy and environmental security at risk, so the state regulator approved the installation of more than 100 MW in storage projects.[36] In other words, in the face of such emergencies, storage technologies have proven to be a fast and effective solution.

In this way, California has taken a leading role in the installation of large-scale storage projects. Proof of this is that it set a goal to have 1,325 MW of storage capacity by 2020. According to the US Department of Energy, California has high renewable energy standards and incentives for installation. In 2016 alone, more than 25,000 people worked in the energy storage industry in the state.[37]

In Mexico, a growth potential of 2,333 MW has been identified in the storage market over the next ten years.[38] Given that storage is seen as a means to integrate renewable energies, this set of technologies can have a positive impact on its development and deployment in the country. Therefore, on January 29, 2019, the CRE adopted an agreement that defines and recognizes the various services that storage technologies can offer to the electricity system. This agreement is the first step towards the consolidation of a robust regulatory framework that will allow for the use of all the benefits storage can bring to the electricity system and for remuneration to be based on that value.

The fact that storage technologies are cheaper and more reliable not only leads to benefits for the electricity sector but will also revolutionize the transportation sector. With the lower cost of batteries and electricity, the prices of cars with electric motors have become increasingly more competitive.

It is estimated that by 2040, 33% of all the vehicles on the road worldwide will be electric. Moreover, with greater adoption of this type of vehicle, 7.3 million barrels of fuel will no longer be used for transportation every day.[39] It is worth noting that, in 2017 alone, more than 1 million electric cars were sold, with China leading with more than half of global sales.[40]

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36 *The New York Times*, "A Big Test for Batteries", January 14, 2017, available at: *https://www.nytimes.com/2017/01/14/business/energy-environment/california-big-batteries-as-power-plants.html*.

37 U.S. Department of Energy, "2017 U.S, Energy and Employment Report", available at: *https://energy.gov/downloads/2017-us-energy-and-employment-report*.

38 Quanta Technology, "Feasibility Study for Large Scale Energy Storage Systems in Brazil, Colombia and Mexico", 2017, Project performed by Quanta Technology for ISA, under USTDA financial support.

39 Bloomberg New Energy Finance, "Electric Vehicle Outlook 2018", 2018, available at: *https://bnef.turtl.co/story/evo2018?teaser=true*.

40 IEA, "Global EV Outlook 2018", available at: *https://www.iea.org/gevo2018/*.

Since 2016, 692 electric vehicles[41] have been sold in Mexico, while 1,894 electric vehicle charging stations have been installed in the country.[42] Additionally, in order to facilitate their adoption, Mexico has various incentives to encourage the use of electric vehicles. At the federal level, the New Car Tax (ISAN) exemption has been implemented. Moreover, the CFE has made it easier to install a separate meter, which makes it possible to separate the vehicle's electricity consumption from that of the rest of the household (avoiding thus a significant increase in its electricity bill). At state level, incentives have been implemented, such as the exemption from paying *tenencia* [a special car tax], exemption from the smog check inspection, the "E" decal, green license plates and preferential parking with charging facilities.[43]

In order to accelerate the deployment of this type of technology, in 2018 the CRE issued a regulation that makes it easier to install and run public electric vehicle charging stations nationwide.

VI. Conclusions

While Mexico is committed to a cleaner future, the energy transition is a trend that was gaining greater importance every day until 2019, and is part of not only a national effort, but of a global transformation.

Decarbonization must be achieved in a way that promotes continuous and sustainable economic growth. In other words, new investment in the energy sector can help drive growth. The aggressive pursuit of energy efficiency helps reduce energy poverty and improve access to energy. New technologies that enable marked improvements in energy efficiency are possible, even at the household level.[44]

The social implications of decarbonization can be very promising insofar as there are opportunities for communities and individuals to become directly involved in developing suitable actions to reduce their energy consumption and, as a result, polluting emissions into the air.

In this way, governments play a critical role in bringing about this inclusion through targeted energy access programs for marginalized communi-

41 With information from the Asociación Mexicana de la Industria Automotriz, at the end of 2018.

42 Programa de Ahorro de Energía del Sector Eléctrico. Information as of July 2018.

43 ChargeNow, "Beneficios para los vehículos eléctricos en México", available at: *http://www.chargenow.mx/incentivos-para-vehiculos-electricos-en-mexico/*.

44 The Solutions Journal, "Decarbonizing the World Economy", May 2016, available at: *https://www.thesolutionsjournal.com/article/5698/*.

ties; regulations that democratize the adoption of clean energy for all kinds of users; tax credits or incentives that encourage the adoption of sustainable technologies in homes and buildings; energy efficiency programs to reduce energy consumption throughout the country; and communication campaigns to inform rural and urban populations of the benefits of the energy transition.

With the efforts carried out from 2000 to 2019, we can now say that the foundations have been laid, and the energy transition is underway if the authorities support it again. In the future, the government, industry, and society in general must work hand in hand to consolidate the development of a clean, safe energy sector with a social dimension, which will trigger investments and sources of employment that will benefit Mexican families and the national economy.

The 2018-2024 Federal Administration has publicly stated its intention to continue advancing Mexico's transition to clean energy. The National Development Plan (NDP) included a focus on low-carbon technologies among its priorities. Nevertheless, a discussion on the instruments state or market based, to achieve a significant pace is still needed.

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