CLIMATE CHANGE AND THE CHALLENGES OF ANEEL TO REVIEW THE BRAZILIAN REGULATORY REGULATION OF SOLAR ENERGY SELF-PRODUCTION AND DISTRIBUTION

MUDANÇAS CLIMATICAS E OS DESAFIOS DA ANEEL PARA REVISAR A REGULAÇÃO NORMATIVA BRASILEIRA DAS MICRO E MINIGERAÇÕES DISTRIBUÍDAS DE ENERGIA SOLAR

Claudia Ribeiro Pereira Nunes[1]
Doutora em Direito
Universidad Complutense de Madrid – Madrid/España

ABSTRACT: Climate change requires a change in worldwide energy policy, where the protagonists are renewable energies. This relevance of renewables in the global energy matrix must be understood in the context that the development of the world economy is still based on fossil energy resources, which are finite and polluting. In Brazil, hydro, biomass, wind and solar energy are the main options for expanding the renewable energy matrix. This article aims to analyze the Regulatory Resolution of one of these renewable energies, solar, in the context of the growth of self-production, through which consumers can generate their solar resources electricity to foster debate and point out which rules cause adverse distributional impacts by the net-metering system on it reviews. The research methodology is documentary-historical, and the method is deductive.
KEYWORDS: ANEEL. Climate change. Electricity Distributed Production.

RESUMO: A mudança climática exige uma mudança mundial na política energética onde as energias renováveis são protagonistas. Essa relevância das renováveis na matriz energética mundial deve ser entendida no contexto de que o desenvolvimento da economia mundial ainda é baseado em recursos energéticos fósseis, que são finitos e poluentes. No Brasil, as energias hídrica, biomassa, eólica e solar são as principais opções para a expansão

1 Prof. Nunes held PhD in Law in 2013 and a Master's Degree in Economic Relations Law in 2003, both from the UGF. Graduated in Law at UERJ 91. Currently, Member of the IPCC (Intergovernmental Panel on Climate Change) as an Expert Review of the First Order Draft (FOD) of the Working Group II (WGII). Visiting Fellow at Yale University and Researcher at Universidad Complutense de Madrid. CEO of the Scientific and Technological Society GGINNS - Global Comparative Law: Governance, Innovation, and Sustainability. Collaborating professor at the Masters in Law at UFAM and professor at UNIFLU. As principal investigator of research projects, Prof. Nunes has more than 150 publications and has received numerous scholarships and honours for his work from his universities, government, civil societies, and research institutes. E-mail: claudrib@ucm.es

da matriz energética renovável. Este artigo tem como objetivo analisar o a resolução normativa de uma dessas energias renováveis, a solar, no contexto do crescimento da Geração Distribuída, por meio da qual os consumidores podem gerar sua eletricidade para fomentar o debate e apontar quais regras de compensação causam impactos distributivos adversos em sua revisão. A metodologia de pesquisa é documental-histórica, e o método é dedutivo.

PALAVRAS-CHAVE: ANEEL. Geração Distribuída de Energia Elétrica. Mudança climática.

INTRODUCTION

Renewable energies will be increasingly relevant in the global energy matrix, and the proportion of the sector's growth depends on implementing and maintaining incentive policies for these sources.

Forecasts indicate that the growing competitiveness of solar energy will make it a protagonist in expanding the world's energy matrix. Although centralized solar plants are still conjectured, current technology has allowed a paradigm shift in the electricity sector, with strong growth in solar Regulatory Resolution. 482 of the National Electric Energy Agency – ANEEL, was published in 2012 to reduce the barriers to the connection of distributed micro and mini generation, creating an environment in which this type of generation of small size could be made viable. REN created the Electric Energy Compensation System, which allowed consumers to generate their energy and sell the surplus to distributors in exchange for energy credits.

In this context, the research aims to analyze the regulatory resolution of one of these renewable energies, solar, in the self-production modality. The article also explores the justifications for the proposal to amend the Regulatory Resolution, which, in theory, aims to ensure the sustainable expansion of distributed generation and provide security for investments aimed at the insertion of documentary-historical research and the deductive method.

In the end, the research intents to answer if the alteration of the proposal is justified by the need to balance the energy cost between the consumer who wants to install self-production and other users and distributors on the network.

1 CLIMATE CHANGE AND RENEWABLE ENERGIES

According to the UN, since the 1800s, human activities have been the

main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas. Moreover, burning fossil fuels generates greenhouse gas emissions like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures[2]. In this context, climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. Or by human activities, such as using gasoline to drive a car or coal to heat a building, for example. The greenhouse gas emissions causing climate change in both cases include carbon dioxide and methane[3].

To monitor the climate changes evolution, UN General Assembly endorsed the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988. Its initial task, as outlined in UN General Assembly Resolution 43/53 of 6 December 1988, was to prepare a comprehensive review and recommendations concerning the state of knowledge of the science of climate change, the social and economic impact of climate change, and potential response strategies and elements for inclusion in a possible future international convention on climate[4]. The IPCC presents assessment cycles and delivers Assessment Reports as the most comprehensive scientific reports about climate change produced worldwide. It has also created a range of Methodology Reports, Special Reports and Technical Papers in response to requests for information on specific scientific and technical matters from the United Nations Framework Convention on Climate Change (UNFCCC), governments and international organizations[5]. IPCC advises using renewable energy sources that are plentiful and all around us as fossil fuel substitutes.

According to the UN, Renewable energy is energy derived from natural sources that are replenished at a higher rate than consumed. In developed countries, sunlight and wind, for example, are such sources that are constantly being filled. Generating renewable energy creates far lower emissions than burning fossil fuels.

Renewables are cheaper in most countries and generate three times more

2 UNITED NATIONS. **COP21.** 2015. Available at http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf Accessed on Dez 10, 2021.

3 INTERNATIONAL ENERGY AGENCY (IEA). **Repowering Markets:** Market design and regulation 97 during the transition to low-carbon power systems. OECD, IEA. 2016. Available at http:// www.iea.org/publications/freepublications/publication/REPOWERINGMARKETS.pdf Accessed on Dez 05, 2021.

4 AGRAWALA, S. Structural and Process History of the Intergovernmental Panel on Climate Change. *Climatic Change* 39, 621–642 (1998). DOI: https://doi.org/10.1023/A:1005312331477.

5 AGRAWALA, S. Structural and Process History of the Intergovernmental Panel on Climate Change. *Climatic Change* 39, 621–642 (1998). DOI: https://doi.org/10.1023/A:1005312331477.

jobs than fossil fuels - coal, oil and gas - are non-renewable resources that take hundreds of millions of years to form[6]. When burned to produce energy, fossil fuels cause harmful greenhouse gas emissions, such as carbon dioxide. Consequently, transitioning from fossil fuels, which currently account for the lion's share of emissions, to renewable energy is vital to addressing the climate crisis[7].

2 ELECTRICITY DEVELOPMENT INDUSTRY IN BRAZIL: FROM THE CENTRALIZED PRODUCTION TO SELF-PRODUCTION POSSIBILITY

In the old days, cities did not have electricity; the only light source was the sun. Over time lamps appeared for the public environment, and only the wealthiest houses had their gas system, even though electricity was discovered in the 6th century, when the philosopher Thales of Miletus found a resin that, when rubbed with fur and wool, attracted other objects.

In Brazil, electricity started in 1883, when the first thermoelectric power plant appeared and, in 1889, the first hydroelectric plant.

The growing number of people using electricity requires governments to program continuous increases in the scale of electricity generation, which led to the emergence of centralized power stations connected to consumers through distribution lines to guarantee access to energy and the security of the country's energy system, consequently, the development of a nation[8].

In the 20th century, investing in electricity generation was a state competence, either because of the high investment value or because of the complexity of the operation. In addition, of course, to the difficulties in quantifying the profitable return on this investment. The solution was a centralized production model. Energy is produced by large-scale plants built in regions far from consumer centers. The electricity generated by these plants must be transported over long distances through a complex transmission system until it reaches its final destination[9].

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6 NUNES, C.R.P. As mudanças climáticas a partir da implantação de empresas de capital estrangeiro no Nordeste: estado regulador. In Belchior, Germana; Viegas, Thais. Os impactos das mudanças climáticas no Nordeste brasileiro, 2016, pp. 17-34. Fortaleza: Fundação Sintaf.

7 AGRAWALA, S. Structural and Process History of the Intergovernmental Panel on Climate Change. *Climatic Change* 39, 621–642 (1998). DOI: https://doi.org/10.1023/A:1005312331477.

8 BRAZ, Fabricio; MOREIRA, Leandro. Inteligência Artificial e Energia: aplicações e ponderações ao contexto brasileiro. In: FRAZÃO, Ana; MULHOLLAND, Caitlin. Inteligência Artificial e direito: ética, regulação e responsabilidade - São Paulo: Thompson Reuters Brasil, 2019. p.587-606.

9 BRAZ, Fabricio; MOREIRA, Leandro. Inteligência Artificial e Energia: aplicações e ponderações ao contexto brasileiro. In: FRAZÃO, Ana; MULHOLLAND, Caitlin. Inteligência Artificial e direito: ética, regulação e res-

At the end of the 20th century and the beginning of the 21st century, this model in Brazil, where predominantly state-owned companies were responsible for generating, transmitting, distributing and trading electricity, as well as for operating and planning the expansion of the system, became obsolete because the State needed to reduce its action is to make room for free trade[10].

Furthermore, from the 1970s and 1980s onwards, the centralized production model began to be questioned due to the allocation of risks to consumers; the impossibility of consumer choice; cross-subsidies between consumer groups; tariff manipulation for political purposes; new, more efficient technologies that found regulation an entry barrier; lack of investment capacity of state-owned companies; exhaustion of the investment model and the need to attract private investment[11].

From the 1990s, Brazil, following the worldwide trend of restructuring the electricity sector, promoted the unbundling of the system, with the primary objective of privatizing and enabling the entry of private investment in the electricity production industries, commercialization, distribution and transmission. The choice of the Brazilian Public Administration was to privatize the commercialization and generation of energy, which became sectors subject to free competition, only being supervised. The other activities of the system remained under state monopoly[12]. For the new energy industry, Brazil organized a regulatory system: Law n. 8,987/95; Law n. 9,074/95; Law n. 9,427/96.

As an effect, the new regulatory system creates an autarchy (*Agência Nacional de Energia Elétrica* - ANEEL) to supervise the electrical system, establishes a new energy tariff model, and assigns ANEEL the competence to define the energy tariffs charged by the distributor (art. 3, VIII). ANEEL specifies that the energy tariff will now consist of the total cost of operating the entire energy chain up to the final consumer, subdivided into portion A

ponsabilidade - São Paulo: Thompson Reuters Brasil, 2019. p.587-606.

10 SANCHEZ, Lucas Cardoso. Análise do Impacto da Agenda de Modernização do Setor Elétrico sobre a Viabilidade Econômica de Projetos. Dissertação (mestrado) - Fundação Getúlio Vargas, Escola Brasileira de Economia e Finanças, 2021.

11 SANCHEZ, Lucas Cardoso. Análise do Impacto da Agenda de Modernização do Setor Elétrico sobre a Viabilidade Econômica de Projetos. Dissertação (mestrado) - Fundação Getúlio Vargas, Escola Brasileira de Economia e Finanças, 2021.

12 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Relatório de Análise de Impacto Regulatório n. 0004/2018-SRD/SCG/SMA/ANELL.** 2018. Available at https://www.aneel.gov.br/documents/656877/18485189/6+Modelo+de +AIR+-+SRD+-+Gera%C3%A7%C3%A3o+Distribuida.pdf/769daa1c-51af-65e8-e4cf-24eba4f965c1 Accessed on Dez 09 2021.

(non-manageable costs, such as energy purchase, transmission and sector charges) and portion B (manageable costs)[13].

According to the ANEEL report[14], consumer prices have around 53.5% of expenses. Portion A refers to distribution costs - maintaining the assets and operating the entire distribution system represents only 17% of the tariff costs, and Portion B represents 36,5%. The taxes represent 29.5%. The remainder is profits.

The restructuring of the Brazilian electricity sector ensured free access to the networks for all agents, and the governance of the industry began to be regulated by ANEEL, a National System Operator (ONS) and an Electric Energy Trading Chamber (CCEE) organized. In the end, the biggest consumers with a minimum contracted demand of 3,000 kW were free to choose their electricity supplier, among other modifications[15].

According to the FGV 2016 Report[16], with the climate emergency and the international movement in favor of renewable energies, Brazil finds that it needs to diversify the Brazilian electricity matrix cleanly and safely, which is a challenge in the scope of public policies, mainly because its energy matrix is clean, but causes environmental damage with the construction of giant hydroelectric plants. Furthermore, emphasizes the FGV 2019 Report, there is the hydrological risk arising from the recurrent drought in the last years, with the reduction of the reservoirs of hydroelectric plants and the need for regular dispatch from thermoelectric plants since 2012[17].

Both reports[18] also presented economic data showing a change in consumer

13 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). Regulatory Resolution nº REN N. 166/2005 ANEEL. Available at http://www2.aneel.gov.br/cedoc/bren2005166.pdf Accessed on Jan 03 2022.

14 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). Relatório de Análise de Impacto Regulatório nº 02/2018-SGT/SRM/ANEEL. 2018. Available at https://www.aneel.gov.br/documents/656877/18485189/4+-Modelo+de+AIR+-+SGT+-+Tarifa-Binomia.pdf/ea152997-0f6e-b2d1-d443-8354cd2a380a Accessed on Jan 03 2022.

15 SANCHEZ, Lucas Cardoso. Análise do Impacto da Agenda de Modernização do Setor Elétrico sobre a Viabilidade Econômica de Projetos. Dissertação (mestrado) - Fundação Getúlio Vargas, Escola Brasileira de Economia e Finanças, 2021 and

16 FGV ENERGY. **Análise do Impacto Regulatório na Expansão da MMGD**. Caderno Opinião. Junho. 2019. Available at https://fgvenergia.fgv.br/sites/fgvenergia.fgv.br/files/coluna_opiniao_junho_-_impacto_regulatorio.pdf. Accessed on Jan 06 2022.

17 FGV ENERGY. **Recursos Energéticos Distribuídos**. Cadernos FGV Energia. Maio 2016, ano 3. n.7. p.1-102. Available at https://fgvenergia.fgv.br/publicacao/caderno-de-recursos-energeticos-distribuidos Accessed on Jan 06 2022.

18 FGV ENERGY. Análise do Impacto Regulatório na Expansão da MMGD. Caderno Opinião. Junho. 2019. Available at https://fgvenergia.fgv.br/sites/fgvenergia.fgv.br/files/coluna_opiniao_junho_-_impacto_regulatorio.pdf. Accessed on Jan 06 2022 and FGV ENERGY. Recursos Energéticos Distribuídos. Cadernos FGV Energia. Maio 2016, ano 3. n.7. p.1-102. Available at https://fgvenergia.fgv.br/publicacao/caderno-de-recursos-energeticos-distribuidos Accessed on Jan 06 2022.

behavior that signals a new global trend in energy demand. Technological developments play an important role in changing the behavior of electricity consumers. The consumer uses 24h smartphones and needs more energy. A new expense on a *nouvelle* life stylus with demands energy. Besides, technology has been showing increasingly dynamic consumer behavior. It demands that force public policymakers be more realistic about the price they can extract from their electricity consumption and the quality of the electricity services.

This global trend, linked to the peculiarities of the national electricity matrix, based on predominantly large-scale, centralized hydroelectric production with an integrated transmission system, demonstrates the importance of diversifying available energy resources[19].

As a result, electricity produced from renewable and decentralized sources, especially solar by photovoltaic panels, has become a standard option among Brazilian residential, commercial and industrial consumers since the regulation made by Regulatory Resolution No. 482/2012 of ANEEL.

3 ANALYSES OF SOLAR SELF-PRODUCTION ENERGY: THE ANEEL REGULATORY RESOLUTION AND ITS REVIEW

Self-production is a form of electricity generation that differs from the traditional centralized generation system. In the Brazilian conventional method, large hydroelectric plants produce almost all energy. In Distributed Production, the system is formed by decentralized power generation points distributed through one or several generating systems connected directly to the grid or even located in the consumer unit itself (houses, companies and industries)[20].

Therefore, distributed self-production can be defined as small enterprises that generate electricity in consumer units connected to the distribution network. This is the case of a residence, a company, a farmer or a small industry that installs photovoltaic panels to generate electricity and inject the surplus into the network of a local distributor[21].

19 REIS, Ciro Marques. **Diversificação da Matriz Energética Brasileira:** Caminho para a Segurança Energética em Bases Sustentáveis. Rio de Janeiro: CEBRI, 2015. Available at http://midias.cebri.org/arquivo/diversifica%C3%A7%C3%A3o-matriz-energetica_vol1.pdf Accessed on Dez 17 2021.

20 JOSKOW, P. L. **The difficult transition to competitive electricity markets in the unites states**. In: GRIFIN. J. M. PULLER, S. L. (Ed) Electricity Deregulation: Choices and Challenges. Chicago, IL: University of Chicago Press, 2009.

21 FISCILETTI, Rossana; BORGES, Leticia. A Agenda Brasileira de Industrialização no Século XXI e a Quarta Revolução Industrial. **Amazon's Research and Environmental Law**. Vol 7 (3), 2019, pp. 10-27.

The National Electric Energy Agency (ANEEL), based on the competence to regulate the policies of the electricity sector, published Regulatory Resolution 482/2012 to reduce the barriers to the connection of small distributed to the grid's distribution of electricity and create an environment that encourages this type of small-scale generation[22].

From the amendment promoted by Regulatory Resolution n. 687/2015[23], to stimulate the advancement of distributed generation in the country, making this type of generation more accessible to a more significant number of consumer units, the installation of self-production can be done following the models of (i) local generation; (ii) multiple consumer units; (iii) shared generation; (IV) remote self-consumption.

3.1 THE NET-METERING SYSTEM ISSUE

Solar self-production energy work within the net-metering system or net-metering scope, defined in art. 2, III of Regulatory Resolution n. 482/2012 as a system in which the energy injected with distributed self-production is transferred, through the free loan, to the local distributor and later compensated with the consumption of active electric power[24].

Through the net-metering system, the consumer injects the electricity he generated but did not consume into the distribution network and gets an energy credit to be used when his consumption exceeds his generation.

Indeed, even though the energy generated supplies the consumer-producer unit or prosumer = producer and consumer (a word derived from the English language), the distribution network is necessary to inject energy into the system and use it in periods of intermittence.

The excess energy that the prosumer injects into the network is used to reduce the energy consumed entirely. Consumers in the net-metering system are only subject to paying a minimum amount[25].

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22 Self-production refers to those self-producers with an installed power of up to 75kW. Refers to self-producers with installed capacity from 75 kW to 5 MW. Both can adopt renewable sources of electricity (art 2º, I and II). AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Regulatory Resolution nº 482, de 17 de abril de 2012**. Available at http://www2.aneel.gov.br/cedoc/ren2012482.pdf Accessed on Dez 11, 2021.

23 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Regulatory Resolution nº 687, de 24 de novembro de 2015.** Available at https://www2.aneel.gov.br/cedoc/ren2015687.pdf Accessed on Dez 11, 2021.

24 The net-metering system is an incentive mechanism based on the net-metering system, in which the consumer starts producing energy used to supply the unit's consumption. AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Regulatory Resolution nº 482, de 17 de abril de 2012**. Available at http://www2.aneel.gov.br/cedoc/ren2012482.pdf Accessed on Dez 11, 2021.

25 DANTAS, Stefano Giacomazzi; POMPERMAYER, Fabiano Mezadre. Viabilidade Econômica de Sistemas Fotovoltaicos no Brasil e Possíveis Efeitos no Setor Elétrico. Instituto de Pesquisa Econômica Aplicada (IPEA) –

The net-metering system is a mechanism that gives greater autonomy to the consumer in managing their expenses with electricity in the case of a worldwide trend that aligns with society's aspiration to expand environmental preservation actions[26].

This net-metering system was fundamental for a successfully distributed self-production in Brazil. Since the beginning of the regulation, more than 50,000 generating units have been installed, and after the law was updated by Regulatory Resolution n. 687/2015, the system grew significantly in the country[27].

It is essential to point out that in the net-metering system, the consumer pays a minimum fee that should reimburse the distribution network because prosumers use the network to inject electricity and consume it later[28].

Due to the current tariff model, the minimum amount paid by consumers who enter the net-metering system needs to reimburse the distribution network use sufficiently. This happens because low voltage consumers are not subject to the so-called binomial tariff, characterized by a tariff with a fixed portion, which is characterized by less variation with energy consumption over time, resulting in a fixed revenue and another portion variable proportional to energy consumption[29].

By the Regulatory Resolution n. 482/2012, the difference is borne by distribution companies and, mainly, by other electricity consumers

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Brasília: Rio de Janeiro, 2018 (Texto para Discussão nº 2.388). Avaliable at https://www.ipea.gov.br/portal/images/stories/PDFs/TDs/td_2388.pdf Accessed on 24 nov. 2021.

26 DANTAS, Stefano Giacomazzi; POMPERMAYER, Fabiano Mezadre. Viabilidade Econômica de Sistemas Fotovoltaicos no Brasil e Possíveis Efeitos no Setor Elétrico. Instituto de Pesquisa Econômica Aplicada (IPEA) – Brasília: Rio de Janeiro, 2018 (Texto para Discussão nº 2.388). Avaliable at https://www.ipea.gov.br/portal/images/stories/PDFs/TDs/td_2388.pdf Accessed on 24 nov. 2021.

27 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). Geração Distribuída – regulamentação atual e processo de revisão. 2019. Available at http://www.aneel.gov.br/documents/655804/14752877/Gera%C3%A7%C3%A3o+Dis%20tribu%C3%ADda+%E2%80%93+regulamenta%C3%A7%C3%A3o+atual+e+-processo+de+revis%C3%A3o.pdf/3def5a2e-baef-bb59-2ce1-4f69a9cb2d88. Accessed on Dez 09 2021.

28 SILVA, Rutelly Marques da Silva. **O novo arranjo regulatório proposto pela Aneel para a geração distribuída na consulta pública nº 25, de 2019**. Brasília: Núcleo de Estudos e Pesquisas/CONLEG/Senado, novembro/2019 (Boletim Legislativo nº 82 de 2019). Available at https//www.senado.leg.br/estudos Accessed on Dez 11 2021.

29 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Relatório de Análise de Impacto Regulatório n. 0004/2018-SRD/SCG/SMA/ANELL.** 2018. Available at https://www.aneel.gov.br/documents/656877/18485189/6+Modelo+de +AIR+-+SRD+-+Gera%C3%A7%C3%A3o+Distribuida.pdf/769daa1c-51af--65e8-e4cf-24eba4f965c1 Accessed on Dez 09 2021, and AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Relatório de Análise de Impacto Regulatório nº 02/2018-SGT/SRM/ANEEL.** 2018. Available at https://www.aneel.gov.br/documents/656877/18485189/4+Modelo+de+AIR+-+SGT+-+Tarifa-Binomia.pdf/ea152997-0f6e-b2d1-d443-8354cd2a380a Accessed on Jan 03 2022.

who do not adhere to the net-metering system[30]. The result is an adverse distributional impact because consumers with lower purchasing power need the economic and financial conditions to install distributed self-production. The system is only accessible to consumers with higher purchasing power, residents of medium-sized houses and users with areas for installing equipment far from the place of consumption (SILVA, 2019, p.6).

Thus, the costs of using the distributor's network, the charges and losses of those who use the system are shared by consumers who do not have distributed generation, configuring the so-called cross-subsidy, that is, those who adhere to solar panels need to connect their installation to the system. from a distributor[31]. The self-production uses the entire infrastructure of this distributor, which also accounts for the transit of energy. By the tariff and contractual rules, the distributor's loss of market (for example, when less electricity is consumed through its network) can generate a cost that is allocated to the company's consumers. The market reduction, in practice, causes the costs of providing the service to be shared by a smaller group of consumers.

Distributors claim that the current net-metering system needs to adequately remunerate them for using the distribution network, raising costs for other network users who still need to install their self-production[32]. In effect, consumers who are not supporters of the net-metering system would also be penalized with higher tariffs due to the reduction of the distributors' market.

This set of distortions causes an increase in the tariffs of other consumers, mainly those who need to meet the conditions to adhere to the net-metering system.

The result is a vicious circle that accentuates the incentives for migration and burdens other users, including those with lower purchasing power[33]. To mitigate the adverse distributional effects, purchasing power is

30 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Regulatory Resolution nº 482, de 17 de abril de 2012**. Available at http://www2.aneel.gov.br/cedoc/ren2012482.pdf Accessed on Dez 11, 2021.

31 BOTIJA, F. Energy Market Challengers: The Distributed Generation in the Iberian Peninsula. **Amazon's Research and Environmental Law**, v. 6, n. 3, p. 10-19, Set 29, 2018. DOI: https://doi.org/10.14690/2317-8442.2018v63330

32 FGV ENERGY. **Análise do Impacto Regulatório na Expansão da MMGD**. Caderno Opinião. Junho. 2019. Available at https://fgvenergia.fgv.br/sites/fgvenergia.fgv.br/files/coluna_opiniao_junho_-_impacto_regulatorio.pdf. Accessed on Jan 06 2022.

33 SAUAIA, Rodrigo; KOLOSZUK, MARCOLINO, Rodrigo. Será um retrocesso na geração distribuída? **Revista O Setor Elétrico**. Dez, 2019. Available at https://www.osetoreletrico.com.br/sera-um-retrocesso-na-gera-

a false solution. It is equivalent to a half-price program for Silva, meaning everyone pays a total admission[34]. The author explains that "in the end, the State will have incurred and generated costs for society without solving the problem that motivated the intervention"[35].

Distributed self-production undoubtedly has social and environmental benefits. However, due to the cross-subsidy of the current net-metring system, more than these benefits are needed to confer sustainability characteristics to the existing regulatory arrangement.

Therefore, ANEEL started a processor to change the rules for the need to define a way of valuing the energy injected into the grid by the self-producing because it allows the sustainable growth of distributed generation in the country and the maintenance of investments in the sector without, however, transferring the costs of using the grid from the distributor, the charges and losses of those who use the system to other consumers and distributors. However, it was not function.

The Technical Note n DEA 13/15: Energy Demand 2050 defines six possible alternatives for changing the net-metring system. Compensation would be done differently in each of these possibilities[36].

In the Regulatory Impact Analysis - AIR No. 0004/2018-SRD/SCG/SMA/ANEEL, the alternative presented for the amendment proposes an opportune moment for changing the model of the net-metering system referred to in the text as a trigger, which can be a date or according to the amount of installed power of distributed generation[37].

Alternative 0 means the system continues as it is. The excess energy that the consumer injects into the network is used to reduce the energy

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cao-distribuida/ Accessed on Dez 13, 2021.

34 SILVA, Rutelly Marques da Silva. **O novo arranjo regulatório proposto pela Aneel para a geração distribuída na consulta pública nº 25, de 2019**. Brasília: Núcleo de Estudos e Pesquisas/CONLEG/Senado, novembro/2019 (Boletim Legislativo nº 82 de 2019). Available at https//www.senado.leg.br/estudos Accessed on Dez 11 2021.

35 SILVA, Rutelly Marques da Silva. **O novo arranjo regulatório proposto pela Aneel para a geração distribuída na consulta pública nº 25, de 2019**. Brasília: Núcleo de Estudos e Pesquisas/CONLEG/Senado, novembro/2019 (Boletim Legislativo nº 82 de 2019). Available at https//www.senado.leg.br/estudos Accessed on Dez 11 2021.

36 EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Nota Técnica DEA 13/15**: Demanda de Energia 2050. 2016. Available at http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-245/topico-264/DEA%2012-16%20-%20Ef%20energetica%202015-2024%5B1%5D.pdf Accessed on Dez 10, 2021.

37 AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA (ANEEL). **Relatório de Análise de Impacto Regulatório nº 02/2018-SGT/SRM/ANEEL.** 2018. Available at https://www.aneel.gov.br/documents/656877/18485189/4+-Modelo+de+AIR+-+SGT+-+Tarifa-Binomia.pdf/ea152997-0f6e-b2d1-d443-8354cd2a380a Accessed on Jan 03, 2022.

consumed entirely, considering all tariff components. In Alternative 1, the consumer with generation would pay for the amount corresponding to the transport in the distribution of energy consumed. In Alternative 2, the consumer would start to pay for all the transportation, distribution and transmission for the destroyed amount. Alternative 3 considers the payment of transport and charges. In Alternative 4, in addition to the costs listed in the other options, the consumer with DG would also start to pay for the losses that occur in the transport of energy. And in Alternative 5, the micro or mini generator would pay for all the tariff components except for the portion corresponding to the purchase of energy, which is paid only for the net value of the energy consumed at the end of the month.

According to the National Energy Balance 2019, in addition to changing the net-metering system, there is also the possibility of the new regulation providing for implementing the binomial tariff for low-voltage consumers, including residential ones[38].

However, the new rules must be applied after a transition period to guarantee predictability and regulatory security. According to ANEEL, legal changes would be made, observing legal certainty and a reasonable transition period for the market to adapt to the intended changes[39].

Thus, ANEEL proposes that the current form of compensation be maintained until the distributed self-production installed in each distributor reaches a certain level for remote and local systems (when payment occurs at the same address where the energy is generated).

According to the ANEEL study, it would be possible to maintain Alternative 0 until the micro and mini-distributed generation market consolidates, with the installation of 3.365 GW throughout the country, and then change the net-metering system from to Alternative 1, so that the TUSD Wire B is no longer compensated.

By determining that, after a transition period, all consumers who opt for self-production will pay, with less distortion, for the use of the distribution network, ANEEL mitigates the risk of these users being

38 EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Balanço Energético Nacional 2019** Available at http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-377/topico-470/Relat%C3%B3rio%20S%C3%ADntese%20BEN%202019%20Ano%20Base%202018.pdf Accessed on Jan 06, 2022.

39 EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Balanço Energético Nacional 2019** Available at http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-377/topico-470/Relat%C3%B3rio%20S%C3%ADntese%20BEN%202019%20Ano%20Base%202018.pdf Accessed on Jan 06, 2022.

subsidised by others. Thus, the Agency reduces economic inefficiencies and the adverse distributive impact of the net-metering system. This is the ANEEL understood.

Economic analysts have another understanding[40]. The draft proposed by ANEEL is a considerable setback for the country, taking self-distribution and its market back to the past, and increasing technology paybacks to up to 23 years, which makes many solutions unfeasible.

OUTCOMES AND FINDINGS

Changes to the net-metering system are justified. According to ANEEL, they would balance the rule so that the costs related to the use of the distribution network and the charges are paid by consumers who have distributed generation. Indeed, the modality could continue to develop sustainably without impacting the energy tariff of captive consumers who do not have the system.

The proposal represents a significant imbalance and disincentive for consumers and the electricity distributed generation sector in Brazil, as it devalues by up to 60% the electricity produced on roofs and small plots of land and injects it into the network.

ANEEL studies suggest that the return on investment in a self-production will remain attractive even with the change in rules. Despite the increase in payback, for ANEEL, this would not compromise the self-production market since the viability of the projects would remain, and the market would be more consolidated.

On the other hand, self-production entrepreneurs, especially those in solar self-production, fear that the proposed changes could discourage this market. For them, the current system must be maintained until the market is better consolidated, under the penalty of creating an entry barrier in the sector. Only now, self-production public policies in Brazil do not improve for a sustainability scenario as is possible in a tropical country with sun most days long.

The analysis demonstrates that the proposal to amend Regulatory Resolution n. 482 does not aim to ensure the sustainable expansion of self-production nor provide security for investments to insert new technologies in Brazil.

40 NUNES, C.R.P., The Energy micro-production entrepreneur, Publication on 2016/3/30. In GLOBAL ISSUES Vol. 44 (2) p. 257-298. US: the University of Illinois Publisher, 2016.

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