

Macroeconomic barriers to energy transition in peripheral countries: The case of Argentina

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1. Introduction

In mid-2016, the Argentine government launched the RenovAr plan, a public program that sought the rapid incorporation of energy from renewable sources¹ through a series of international tenders for installed power. In an energy mix largely dominated by natural gas, followed by oil, the goal was to move from 2% renewable electricity generation to 20% by 2025. At that time, President Mauricio Macri assured: “*Podemos producir mucha energía renovable, tenemos una gran potencialidad (...) Para mí esto es el comienzo de algo maravilloso, el comienzo de una etapa maravillosa para nuestro país*” [“We can produce a lot of renewable energy, we have great potential (...) For me, this is the beginning of something wonderful, the beginning of a wonderful stage for our country”] (Ámbito, 2016). Just three years later, the program was virtually paralyzed in the midst of the economic-financial crisis that the country was undergoing and that could not be remedied even with the record loan granted by the International Monetary Fund (IMF).

At this point, the question emerged that guides this article: what were the intrinsic characteristics of the RenovAr program that hindered its continuity after the economic-financial crisis in Argentina? This article is part of a more comprehensive investigation into the barriers faced by peripheral countries² to achieve a successful energy transition, although it does not intend to automatically extrapolate its conclusions to other cases.

The transition from the fossil fuel paradigm to the predominance of renewable energy is currently underway in the context of mitigating greenhouse gases (GHG) that cause climate change. Such a process is referred to as energy transition, a structural change in the energy supply and use system (Carrizo et al., 2016); a fundamental, multidimensional, and long-term transformation of the energy sector in a specific techno-institutional context, which includes and affects a wide range of technologies as well as organizational and institutional structures (Kern and Markard, 2016).

Unlike other energy transitions that arose as a result of the emergence of new technologies and resource discoveries, the current transition is a “purposive transition” based on the need to reduce GHG emissions (Kern and Markard, 2016). In that sense, public policies play a key role and require some characteristics to be successful: 1) persistence, since transitions take time, even decades; 2) and, in turn, technological knowledge must be continued and acquired, otherwise it depreciates fast - also, the alignment of policies is key for the multiplicity of factors and the different mechanisms of change that require consistent policy signals free of contradictions (Grubler, 2012). However, economic-financial crises create new barriers to energy transition, as they reduce public support and investment funds for renewable energy (Van den Bergh, 2013).

Likewise, peripheral countries like Argentina face structural issues that place them at a different starting point than central countries and,

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¹ Following the regulations adopted by Argentina, in this paper renewable electricity generation includes wind, solar thermal, solar photovoltaic (PV), geothermal, tidal, wave, ocean current, small hydropower (SH) up to 50 MW, biomass, landfill gas, sewage treatment plant gas, biogas and biofuels (except for the uses provided for in Law No. 26,093).

² Although the categories “developing/developed countries” are regularly used, this article chooses the term “peripheral/central countries”, following the premises of Latin American structuralism, a theoretical current whose referent was the Argentine economist Raúl Prébisch and which developed within the Economic Commission for Latin America and the Caribbean (ECLAC) to reach its apogee in the second post-war period. Structuralist analysis considers the world economy as a system within which the countries of the center and those of the periphery are intrinsically related. Most of the economic problems of the periphery are linked to the specific economic structure that arises from this interaction, due to the tendency of the terms of trade to deteriorate. While the production structure in the center is homogeneous and diversified, the structure in the periphery, in contrast, is heterogeneous and specialized in primary products (Palma, 2009; Prebisch, 1981).

therefore, their transitions must be analyzed, managed, and supported with a higher level of critical reflection (Hansen et al., 2018). As the literature on sustainable transitions in the so-called developing countries points out, there is a greater dependence on the technology, knowledge, and financial resources from the developed ones (Hansen et al., 2018). Another characteristic is less political and economic stability, weaker and inefficient government administrations, and a lack of effective enforcement of government regulations (Wieczorek, 2018).

In this framework, the article aims to analyze the program for the incorporation of renewable energy in Argentina (RenovAr) that was in force between 2016 and 2019, considering the weaknesses of its design that explain why, despite the initial momentum, it went into crisis three years after it started. The working hypothesis is that economic instability became a barrier for an energy transition program that, from its configuration, depended on external financing for its implementation. The analysis of this public policy will allow us to understand what the specific barriers were in terms of energy policy design in Argentina, in order to contribute to the study of the limits to implement long-term energy transition strategies in peripheral countries.

2. Background and policy context

In line with international commitments, in 2016, Argentina adopted the Paris Agreement through Law No. 27,270. In 2014, national emissions were estimated at 364 million tons of carbon dioxide equivalent (MtCO₂eq), representing 0.7% of global emissions (Moreira Muzio et al., 2019). Of these, 53% came from the energy sector, making it the sector with the greatest mitigation potential. According to data from the National Secretariat of Energy, the energy mix is largely dominated by hydrocarbons (87%), close to the world average, but with the particularity that it is concentrated in natural gas with 54%, followed by oil with 23%. Natural gas accounts for 50% of the country's electricity generation, seconded by large-scale hydroelectric power plants. Although this gaseous fuel is less polluting than burning coal (which has a marginal share in the energy mix), one of the national contributions to the fight against climate change is to achieve a greater share of renewable electricity generation to displace thermal power plants.

Despite the great wind, solar, and biomass potential of Argentina, until 2015 the share of renewable energy in electricity generation did not exceed 2% (CADER, 2015). The most important antecedent to RenovAr in the incorporation of renewable sources was the Renewable Energy Generation (GenRen) program, launched in 2009. Three years earlier, Law No. 26,190 on the National Promotion Regime for the use of renewable energy sources to produce electricity had been passed, which established the goal of achieving a renewable contribution of 8% of the national electricity consumption within 10 years from its entry into force. The GenRen enabled the state-owned company Energía Argentina S.A. (ENARSA) to purchase electricity from renewable sources generated by new private enterprises, and for this purpose 1000 MW were put out to tender. The winning companies signed power supply agreements for a 15-year period denominated in US dollars at a fixed price calculated on a project-by-project basis. Contracts were signed for a total of 895 MW, below the set target. At the same time, most of the contracts had difficulties in obtaining financing in the national and international financial system (commercial and multilateral banks) in the context of the 2008 world financial crisis and the local restrictions on access to international credit as a result of the 2001 foreign debt default.

In short, the policies implemented until then had not been able to expand the renewable generation park due to a series of obstacles, ranging from the lack of financing or access to favourable conditions for the projects to the failure to update the electricity tariff in a context of growing inflation and the absence of a network of local companies that could provide the different goods and services of renewable technologies (Bersalli, 2016; Recalde et al., 2015; Sabbatella et al., 2019).

In October 2015, Law No. 26,190 was amended in view of the impossibility of complying with the objectives set forth therein. The

regulatory changes were embodied in Law No. 27,191, which established new goals for the incorporation of renewable energy sources: in a first stage, to reach 8% of the national electricity consumption by December 31, 2017, and, in a second stage, 20% by December 31, 2025, with progressive steps every two years.

In addition to promoting new tax benefits and incentives to incorporate national components, the law created the Trust Fund for the Development of Renewable Energies (FODER) to provide guarantees and financing for investment projects (these instruments will be analyzed in the next section). It was also established for large users (mostly industries) the obligation to incorporate a minimum consumption of electricity from renewable sources in the same percentage and within the same term as those set as a national target. It should also be noted that, for renewable energy, the dispatch priority of run-of-river hydroelectric power plants was established, and that physical power back up was not required. In this sense, the application authority had the mechanisms to ensure the power reserve associated with renewable generation, the cost of which would be absorbed by the entire system.

In order to achieve the legislated goals, the Mauricio Macri government regulated the law through Decree No. 531/2016, which made viable the implementation of three instruments to achieve the dictated goals: the RenovAr program, Resolution No. 202/2016³ and the Term Market for Electricity from Renewable Sources (MATER)⁴.

The RenovAr program consists of a public bidding mechanism for the purpose of evaluating projects submitted by domestic or foreign legal entities and eventually awarding contracts for the supply of electricity generated from renewable sources with CAMMESA, the firm that manages the national electricity dispatch. Between 2016 and 2018, four rounds of energy power auctions were held. With Resolution No. 136/16, Round 1 was launched in July 2016, and in seeking to contain the proposals that had not been awarded, Round 1.5 (Resolution No. 252/16) was launched in October that year. Based on the great interest aroused in these first rounds, in October 2017, Round 2 was launched (Resolution No. 275/17) and, finally, in November 2018 Round 3 was promoted. The latter was called MiniRen, and it aimed toward small-scale projects. Given the existing capacity and transportation restrictions in high and extra high voltage lines and with the purpose of contributing to greater stability in the grids, it meant to bring generation closer to demand thus decreasing electricity losses and to promote regional development.

The contracting modality for the winning projects was through a power purchase agreement (PPA), in which the consortia of companies are responsible for the implementation of the projects, for solving the financial mechanisms and for the reliability of the power generation system for the 20-year term of the contract (Table 1). For this purpose, prices were established in dollars and the contracts were signed by CAMMESA as representative of the demand side (distributors and large users of the wholesale electricity market), and the consortium that owns the parks, on the supply side.

The procedure for the selection and awarding consisted of ranking the projects based on the price offered and, in the event of a tie condition, the percentage of Declared National Component (DNC) was

³ Through Resolution No. 202/2016, ten contracts that had been entered into in previous bids, which for different reasons had not achieved commercial license, were readjusted. The contractual conditions are like the RenovAr program, but with prices considerably lower than those originally subscribed.

⁴ The MATER was created by Resolution 281-E/2017 and enables large users with an annual demand greater than 300 kW to purchase energy through free negotiation with electricity generating companies.

Table 1
Summary of the main features of the RenovAr program.

ANALYSIS DIMENSION	DESCRIPTION
Type of Program	Energy auctions through international public tenders.
Type of Contracts	Power purchase agreement (PPA). 20-year contracts for the supply of electricity from renewable sources with CAMMESA.
Tenders, Projects and Power	4 tender rounds, with 198 projects approved for 4741 MW of power: 2595 wind, 1839 PV, 268 bioenergy and 39 small hydropower (SH).
Energy Prices	Reference prices set in dollars, adjusted by two factors. a) "annual adjustment factor": predefined coefficient of around 1.7% per year, which indexes prices over the 20 years of the contract; b) "incentive factor": seeks to accelerate the installation of wind farms by establishing a 20% increase over the reference price from 2017, which decreases and becomes negative from year 15 of the contract. The combination of both factors determines that the prices actually paid for the projects will always be higher than those initially offered.
Project Financing Guarantees	The offers had to demonstrate a Minimum Net Worth of US\$250,000 per MW of Capacity Offered. This encouraged the active participation of the international financial system as a backup for the projects.
Local Financing	The national government implemented a trust fund called FODER to provide guarantees and credits to the projects against their electricity supply contracts. In turn, the World Bank granted guarantees for US\$480 million for rounds 1 and 1.5 and for US\$250 million for round 2 for a term of 20 years to guarantee the payment of energy in the event of CAMMESA's non-compliance.
Investment incentives	1. Early reimbursement of Value Added Tax (VAT). 2. Accelerated amortization of wealth tax on goods or infrastructure works. 3. Offsetting of losses against profits. 4. Deduction of the financial burden of financial liabilities. 5. Dividends or profits distributed by the holders of the projects are not subject to a wealth tax.
Technology import regimes	A special regime with low tariffs was approved for the import of the main goods of each technology: wind turbines, solar panels, trackers, and inverters, among others.
Participation of domestic industry	A Tax Certificate was implemented as an incentive to incorporate local products, which was not mandatory. To obtain the certificate, at least 60% of the electromechanical works of the projects had to have a national component, excluding civil works, logistics and transportation. The Tax Certificate could represent up to 20% of the value of the park and could be used for the payment of project taxes.

Source: Author's own elaboration.

established as a secondary criterion. However, the one that prevailed was the first one and the DNC was constituted as an economic incentive rather than a stimulus to national production (Aggio et al., 2018)⁵. Not only a specific strategy was not implemented for national wind technology companies such as IMPSA and NRG Patagonia, but also national equipment and components did not have adequate financial instruments in the local market, so they found themselves at a disadvantage with respect to competitors with access to external financing (Roger et al., 2017). The financing of the initial investment for the purchase of equipment was carried out with different combinations: through the participation of multilateral banks, export credit agencies, public or private banks, contributions from equipment suppliers and capital contributions from project owners (Santamaría, 2019). Among the most used financing instruments is project finance, in its "non-recourse loan" version, under which the repayment of the work is made with the cash

⁵ In the case of wind energy, the NDC calculation methodology was more inclined to add profitability to international technologist wind farm projects that reach the percentage needed to obtain the certificate and less to be a determining factor for these activities to be based in the country (Aggio et al., 2018).

flow generated by the project once it is launched, with only the project itself as collateral. Since it is not the project's shareholders who provide guarantees to the loan, it is not possible to implement it under any type of economic context: international lenders evaluate certain macroeconomic conditions and political-institutional stability to determine its viability (Martínez de Hoz and Blanco, 2018).

Once each PPA was signed, a schedule was established with milestone dates for the progress of the works: (a) financial closing, (b) start of construction, (c) scheduled start of execution, and (d) commercial license. The dates could not be modified without CAMMESA's prior consent, except in the event of a fortuitous event or *force majeure* (which deadline could be extended for a period equal to the duration of the event) or in case the seller requested an extension to reach the dates of financial closing, start of construction or scheduled start of execution (up to sixty days from the corresponding scheduled date) and the date of commercial license (up to 180 days from the scheduled date), but without prejudice to the successful tenderer's obligation to pay the applicable penalty.

3. Methodology and data

The research strategy is framed within a case study which allows, unlike the comparative method, to focus on a single case and examine it intensively (Lijphart, 1971). These studies tend to be rich in evidence, which allows to analyze a variety of relevant factors and to elaborate a coherent argument (Sovacool et al., 2018). The aim is not only to analyze the design and implementation of an energy transition policy, but also to identify the barriers faced by peripheral countries, paying attention to the relationship between macroeconomic stability and energy policies.

To that end, the collection and analysis techniques are framed within the framework of documentary research (Valles Martínez, 1999), using two types of secondary sources of information. The first type includes quantitative data on power and prices of the renewable energy auctions of the 198 projects awarded in the four tender rounds, which were obtained from public information of the National Secretariat of Energy and CAMMESA. Likewise, we consulted statistical sources of countries in the region and international energy organizations to make comparisons of auction prices between different countries in the same period of time. To analyze the macroeconomic performance, we constructed a data series of the Emerging Markets Bonds Index (EMBI) of Argentina to compare it with the average of Latin America based on information from JP Morgan, in order to use this data as a context indicator to understand the process of increased interest rates of the projects. This information was accompanied by the reference interest rate in Argentina established by the Central Bank of the Argentine Republic (BCRA) for the period in which the financing strategies of the companies operating in the country were developed. Finally, based on the periodic publications of the Exchange Balance of the BCRA, we worked with the evolution of net indebtedness and net foreign direct investment of the electricity sector in the period analyzed, which, in the context of the scarcity of public information per project, serves as a proxy to analyze the trends and sources of financing of the RenovAr program projects.

The second type contains qualitative data from the terms and conditions of the four rounds of the program, and from the review of the awarded supply contracts published in the Argentinean Official Gazette. This information enabled us to trace a timeline in the execution of the program, distinguishing between the acquisition dates of the projects and the signing of the contracts, the construction period of the renewable energy parks and their commercial license date, which is determined as the month in which they begin to sell electricity to the national grid. In this sense, the review of the work progress status of the projects that have not yet been licensed was approached both through public information from the National Secretariat of Energy and specialized sites (*Energía Estratégica* and *Econojournal*, among others) and interviews to key informants, which allowed corroborating the status of the projects

until August 2021.

4. Results

As mentioned earlier, the four rounds of RenovAr were carried out between 2016 and 2018. Considering the results, there is no doubt that the program design was effective in attracting a large number of projects to the country, as 198 projects were awarded for a total power of 4741 MW, with a highly concentrated distribution in wind (55%) and PV (39%), and with a marginal participation of different technologies such as bioenergy and PAHs, with 6% and 1%, respectively (Fig. 1).

The analysis of the prices offered and approved deserves several observations. First, between Round 1 and Round 2 there was a marked decrease in both wind and PV, which allows inferring that as the rounds went on, confidence in the mechanisms grew and the bids became more competitive⁶. This was not the case in Round 3, since the projects were of low power, the amortization of the installation costs of the wind farms implied higher prices for the energy offered. Secondly, the average price achieved in wind and PV project tenders was lower than the average cost of energy in the Argentine wholesale electricity market between 2016 and 2018, which stood at US\$72.8/MWh (Fig. 1).

However, when reviewing the prices offered under the RenovAr program in relation to auctions in other countries in the region during the same years, the comparison yields disparate results. In wind technology, in 2017 the bids received by Chile were US\$32/MWh average (García de Fonseca et al., 2019: 95), which means a price 40% lower than Round 1.5 and 22% lower than Round 2; while those received by Peru in 2016 were on average US\$38/MWh (García de Fonseca et al., 2019: 172), which places it at a similar price to that obtained in Round 2 in Argentina. In PV technology, Brazil obtained prices of US\$35/MWh in the last rounds of the 2018 A-4 auction, bids that were 18% lower than those of Argentina in Round 2 (the lowest of all rounds) while in Mexico they started at US\$ 48/MWh in 2017 until receiving bids for US \$21/MWh only a year and a half later (García de Fonseca et al., 2019: 55), almost half the price offered in Round 2.

These higher local prices in Argentina are explained by a combination of a variety of causes. Among the main ones are a) access to capital markets with higher interest rates than neighbouring countries. As recorded in the balance sheets of one of the main electricity generating companies and main investor in renewable energy, GENNEIA, in January 2018 the company issued Negotiable Obligations with a rate of 8.75% to, among other things, expand the Madryn Wind Farm. b) The instabilities of the Argentine economy which, according to the interviews conducted, lead many projects to seek amortization in a shorter term than the estimated for similar projects developed in countries of the region. c) The greater experience in renewable energy tenders of the countries of the region with respect to Argentina, which impacted on better knowledge of the processes, technologies, and performance of the projects.

It is worth clarifying that these prices offered in the RenovAr program are the initial ones and based on the two adjustment factors described in Table 1 (annual adjustment factor and incentive factor), the prices actually received by the projects will always be higher than those initially offered, a situation that may further widen the gap with other countries in the region. Indeed, although the prices originally offered for PV and wind technology were lower than the cost of the system in Argentina and were generally above the prices offered in the Latin American countries reviewed, it is also true that the prices received in the four rounds in Argentina were substantially lower than the prices offered under the GenRen program (Recalde et al., 2015). This price reduction between the two programs was in line with the international

⁶ In Latin American and Caribbean countries that have implemented regular auctions, prices have become progressively more competitive, as they have favored economies of scale (OLADE, 2020).

drop in the installation costs of renewable energy parks, mainly for PV technology (IRENA, 2020).

As a consequence of the RenovAr program, 44% of the growth in installed power generation capacity between 2015 and June 2021 was explained by renewable energy, years in which the country's generation capacity in the different sources grew 26.5% by incorporating 8889 MW of power. The various rounds of the program allowed the installed capacity of renewable energy to increase from 2% to 11% in the period analyzed (Fig. 2).

Although the increase in the share of renewable energy in the electricity mix was considerable in comparison to 2015, the 12% target for 2019 stipulated by Law No. 27,191 was not met. And this situation of non-compliance with the goals set by the law is aggravated by the slowdown of the program produced toward the end of 2018.

If, in the first two rounds carried out in 2016 (Round 1 and Round 1.5), 59 projects ended up being awarded (after receiving a much higher offer of proposals submitted), it was not until Round 2 developed the following year that 89 projects would end up being awarded, an amount 51% higher than the sum of the first two rounds. This was mainly due to the trust built around the RenovAr program after the first bidding rounds, which had been successful in terms of call for bids, administrative procedures and PPA contract awards.

Nevertheless, as shown in Table 2, the possibility of obtaining the "financial closing"⁷ of the projects became more difficult as the bidding rounds went by. In Round 1, nine out of ten projects were able to obtain the necessary financing, guarantees, and collateral to sign contracts with CAMMESA and start the engineering stage of the projects, but for the projects awarded in Round 2 this figure dropped to 5 out of 10 projects.

The difficulties in the financial closure of the projects were reflected in a drop in the percentage of projects approved as the bidding rounds continued. In fact, as of August 2021 (the last month with information available before the closing of this article), 105 of the 198 projects were still not commercially licensed. However, the information is clear in pointing out that as the economic crisis worsened, as it will be analyzed below, the number of projects that had not been licensed grew. Thus, while 83% of Round 1 projects started operating, only 2% of Round 3 projects were able to commercialize energy.

When disaggregating the information of the projects that were not licensed, we can see that between the different rounds the percentage of projects under construction remains between 14% and 20%, but the percentage of projects that have not started work (more than 3 years after being awarded) and those that have had the work stopped or the contract rescinded are the ones that show the greatest expansion as the analysis of the different rounds progresses. Thus, 74% of Round 3 projects did not start work and 8% had their contract revoked or had problems with the start of work as a result of the economic crisis and, since March 2020, the Covid-19 pandemic.

5. Discussion

5.1. The interest's articulation at the launching of the RenovAr program

It is relevant to understand the rapid implementation of the RenovAr Program the interest's articulation that coincided since the beginning of 2016.

A first factor was the voting with a large majority of Law No 27,191 in September 2015. In the House of Representatives there were 191 legislators present out of a total of 257, of which 178 voted in favour, 8

⁷ "Financial closing" means when the park developer finances the performance of its obligations with secured debt provided by secured creditors or when it is financed through debt or equity contributions provided by its direct or indirect shareholders. Available at: https://www.argentina.gob.ar/sites/default/files/programa_renovar_ronda_1_pliego_de_bases_y_condiciones.pdf. Accessed September 6, 2021.

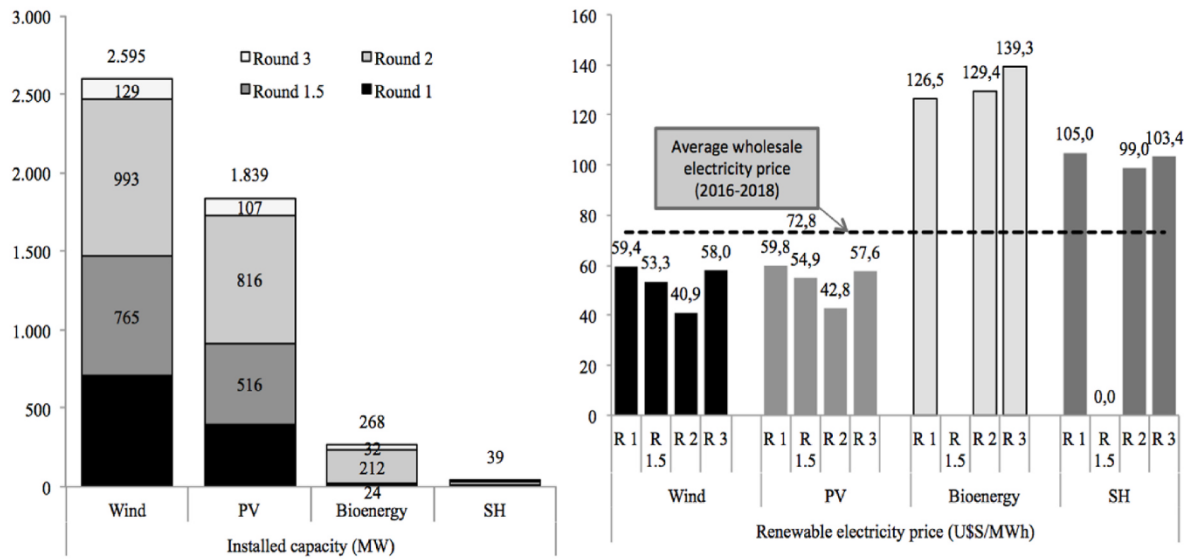


Fig. 1. Installed capacity and contract prices in the different rounds of the RenovAr program by type of technology (in MW and US\$/MWh)
Source: Author's own elaboration based on CAMMESA data.

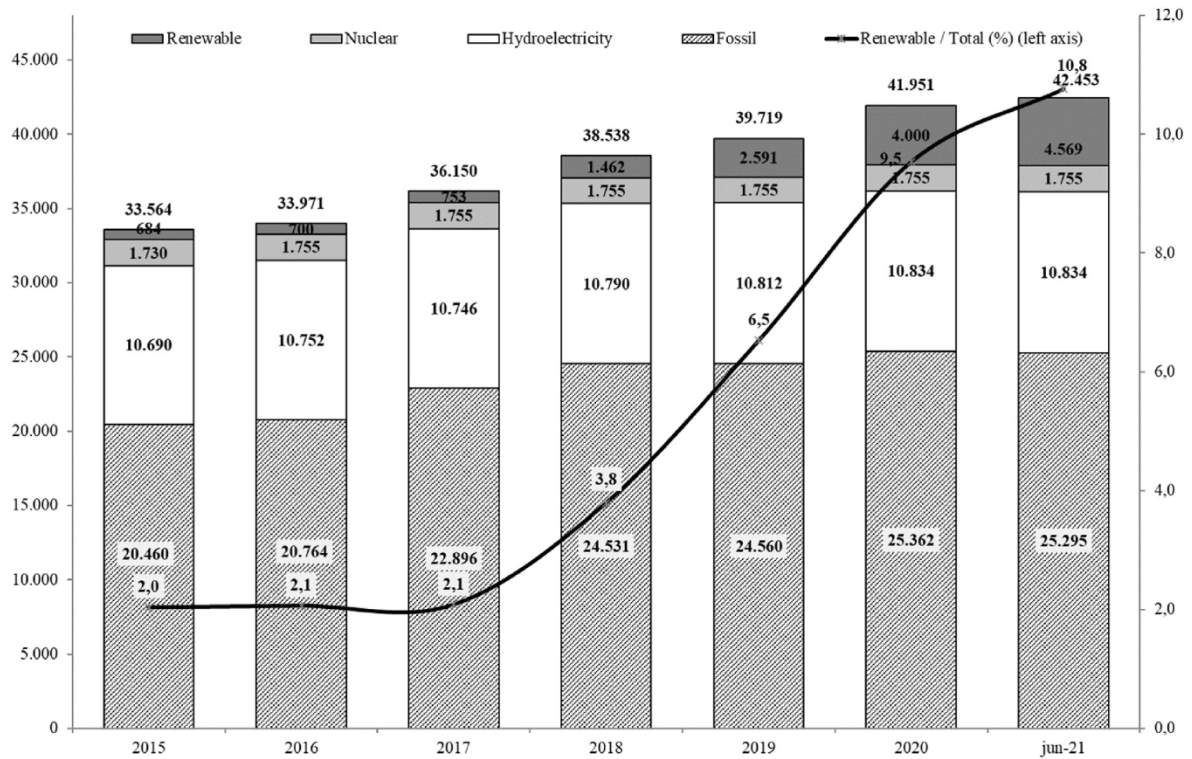


Fig. 2. Evolution of installed electric power by technological source and share of renewables in total power, 2015–June 2021 (in Mw and %)
Source: Author's own elaboration based on CAMMESA data.

Table 2

Evolution of the status of RenovAr program projects, 2016–August 2021, in numbers and percentages.

	Round 1 (2016)	Round 1.5 (2016)	Round 2 (2017)	Round 3 (2018)	Total
Number of projects	29	30	89	50	198
% compliance with financial closure	89,7	73,3	54,8	s/d	65,4
Operating projects (%)	82,8	70,0	44,9	2,0	43,4
Not operating projects (%)	17,2	30,0	55,1	98,0	53,0
No start of construction	0,0	6,7	27,0	74,0	27,3
Under construction	13,8	20,0	20,2	16,0	18,2
Contract terminated/work slowed down/cancelled	3,4	3,3	7,9	8,0	6,6
No information	0,0	0,0	2,2	0,0	1,0
Total projects (%)	100	100	100	100	100

Source: Author's own elaboration based on data from CAMMESA and the Secretariat of Energy.

ainst and 4 abstentions. As in few parliamentary voting on relevant economic issues, consensus prevailed over partisan differences, something quite unusual for parliamentary activity in Argentina. Secondly, the resolution of the controversies in the New York Court on the debt restructuring (2005 and 2010) by the payment of the Holdouts (this is exhaustively developed in the following section), allowed public policies to have a marked pro-market bias, different from the orientation of the former governments between 2003 and 2015. This situation was presented as a business opportunity for the private sector, and renewable energy auctions were one of the government's most prominent policies at the international level, which contributed to a large influx of international private financing to invest in the RenovAr Program. Another visible support from the international community was the endorsement provided by the World Bank in the form of financial guarantees to sustain the commitments in the PPAs (Table 1). Furthermore, the design of RenovAr allowed a significant tariff reduction to import the main capital goods of the different renewable energy technologies (Aggio et al., 2018). In fact, this policy prioritized the rapid expansion of renewable installed capacity to meet the objectives of Law No 27,191, rather than the promotion of national industry in the renewable energy.

The combination of these factors contributed to the local companies' investment in the RenovAr Program. Moreover, the favourable international climate regarding auction policies, and the number of projects awarded in the first rounds of the RenovAr, led to the establishment in Argentina some subsidiaries of the world's leading companies in wind power technology: Vestas and Nordex Acciona. However, they only assembled imported parts with the local integration of the wind turbine tower. Although this made it possible to increase the installed capacity in the short term, it had little leverage effect on the economy due to the low job creation and the almost null impact on national suppliers. Also in PV technology, five of the ten largest tracker suppliers in the world, which together account for 58% of the global supply for 2018 (Wood Mackenzie, 2019), registered national content verified (NCV)⁸ in the Register of Suppliers and Goods of National Origin for the Renewable Energy Sector (REPROER) of the National Institute of Industrial Technology (INTI). They are Nextracker, PV-Hardware, Soltec, Nclave and Convert. But as in wind technology, although there is a large local

⁸ This registration in REPROER was a requirement to be a supplier of goods and services in RenovAr projects with NCV. If the minimum percentage of NCV was achieved, this allowed the projects to access the tax benefits described in Table 1.

production capacity of metallic structures, the specific technology, and value-added goods of the trackers (such as motors, sensors, controllers and software) were imported and provided by the leading international companies, which means no technological spillovers in the local productive system.

In this context favourable to renewable energies, oil companies operating in the local market, both national and international, did not establish an obstruction strategy to the renewable energy programs, and some of them even joined the auctions. Three cases are presented only for illustrative purposes. Pan American Energy (PAE), the national company that is the second largest oil producer in the country and whose half of the shares belong to British Petroleum, obtained the Garayalde Wind Farm in Round 1 of RenovAr, a project with 7 wind turbines and a power of 24.15 MW. In Round 2 it was adjudicated the wind farms Chubut Norte III and IV, with 32 wind turbines for a total installed capacity of 140 MW. YPF, the centenary national company and main hydrocarbon producer, joined the MATER with two projects: the Manantiales Behr wind farm, which has 30 wind turbines and 99 MW, and the Los Teros I and II wind farms, with a total of 175 MW of power generated from 45 wind turbines⁹. Even Pampa Energía, a national company with participation in most of the local energy market¹⁰, obtained projects both in Round 1 of RenovAr (Pampa Energía I Wind Farm, which provides 100 MW from 29 wind turbines) and in MATER (Pampa Energía II and III Wind Farms, with a total power of 106 MW generated from 28 wind turbines).

The main critics of RenovAr were organized around two characteristics of the program. Firstly, from the productive point of view, the program was criticized for the lack of both a national purchasing policy and incentives to develop a network of local suppliers of goods, services, and technologies in the renewable energy value chain. These critics were mainly organized by the Cluster of Industries and Technologies of Renewable Energies of Argentina (CITERA), which gathered many of the companies that produce capital goods and technologies for the renewable energy field in Argentina. On the other hand, the main opposition political parties, together with several social organizations, opposed the fixing of nominal and increasing tariffs in dollars during the 20-year term of the PPAs. Although these critics were maintained throughout the entire period, in the first two years they did not manage to break the atmosphere conducive to the rapid implementation of the RenovAr Program.

In summary, RenovAr managed to attract diverse support from national companies and the international financial community. Moreover, several oil companies submitted projects in the different renewable energy programs (MATER and RenovAr), even though before they could be considered the main victims of an energy transition policy towards low-carbon economies. In other words, it is possible to say that the interest's articulation around the RenovAr Program did not become a political barrier to the implementation of Argentina's energy transition strategies.

5.2. The RenovAr program stoppage

Beyond the interest's articulation prone to give momentum to the

⁹ These projects supply part of the company's own consumption as well as that of other large industrial companies, such as Toyota, Ford, Coca-Cola, Nestlé, Profertil, Holcim, Santander, among others.

¹⁰ Pampa Energía operates 13 production areas in the hydrocarbon upstream, has a shareholding in TGS, one of the two trunk gas pipelines in the country, and in Refinor, the only refinery located in the northern part of the country. In the electricity sector, Pampa Energía operates fossil power plants, holds concessions for almost 15 thousand kilometers of transmission lines and 57 transformer stations, directly operating 85% of the country's high voltage lines, and was the majority shareholder of Edenor, the electricity distribution company with the largest number of users in the country, which was sold in 2020.

RenovAr Program in 2016 and 2017, the economic crisis that deepened since the second quarter of 2018 becomes a central element to explain the main barriers that the RenovAr Program faced and help to understand the difficulties to implement energy transition's policies in Argentina.

The triumph of Mauricio Macri's government in the 2015 elections marked a break in the economic policy implemented between 2003 and 2015¹¹. A few days after taking office, the executive branch released the exchange controls that had been in place since 2011 and there was a 50% devaluation of the local currency. The new monetary policy left behind the objective of productive and employment expansion in order to prioritize the fight against inflation, setting downward targets for the following years¹². Despite the rigid monetary policy implemented from the Central Bank of the Argentine Republic (BCRA), the increase in the exchange rate accelerated the inflationary process, which went from 26.4% per year in 2015 to 40.3% in 2016 (CIFRA, 2017).

According to the President of the BCRA, Federico Sturzenegger, the interest rate was the central instrument in the fight against inflation, since it would allow regulating the surplus of money in the economy based on its increase or decrease (Sturzenegger, 2018). Unlike previous governments that used the exchange rate as an anchor against inflation, the new authorities pointed out that the value of foreign currency would be adjusted based on supply and demand. In this way, the policy was changed from one of "administration" of the exchange rate to a "flexible" one. According to the BCRA, the higher demand in the foreign exchange market could be compensated by an increase in the interest rate, restricting the circulation of pesos, which would temper the devaluation of the currency (Sturzenegger, 2016).

At the same time that it modified the monetary policy, the Executive Branch advanced in other deregulations of the financial sector: exchange controls for the acquisition of foreign currency were removed (Resolutions 3819/15 and 3.821/15); bank reserve requirements were eliminated and the 120-day permanence terms for the entry of short-term capital from abroad were reduced (Resolution 3/15); it was extended to 365 days, then to 10 years and finally the obligation to liquidate foreign currency generated by exports was repealed (Resolution 91/2016 and Decree 893/2017) and private investors were enabled to purchase Central Bank Bills (LEBACs) that were previously restricted to banks.

In short, the elimination of existing controls in the foreign exchange market, in the financial sector and in foreign trade, together with the sharp increase in interest rates, generated a massive inflow of capital into the economy, which allowed the exchange rate to stabilize (Fig. 3)¹³. At the same time that the obligation to liquidate foreign currency was removed, after Mauricio Macri's administration resolved the conflict with the so-called "vulture funds,"¹⁴ a massive process of foreign indebtedness began which, during the first three years of administration, increased liabilities in foreign currency by US\$120 billion, equivalent to 20% of the gross domestic product in 2017. According to the then Minister of Economy Prat Gay, the country was entering a "debt-led growth," which allowed it to reinsert itself in the international markets, improve relations with central countries and, under a favourable context for investments, be in better conditions to refinance the debt at

¹¹ To review these policies, we recommend Basualdo (2020), Abeles et al. (2013), Gerchunoff and Rapetti (2016).

¹² For an analysis of these measures in other countries in the region, we recommend García Solanes and Torrejón-Flores (2012).

¹³ These investments took advantage of the short-term carry trade with yields of 16% in dollars from the purchase of LEBACs, which in the early years had an annual interest rate between 25% and 38% Mander, (2017).

¹⁴ After the default was declared in December 2001, Argentina restructured its foreign debt with private creditors in 2005 and 2010. However, about 7% of the creditors decided not to enter the swap. Part of them, investment funds that buy defaulted debt, initiated legal actions in New York and had a favourable ruling in 2012. Despite several negotiations by the Argentine government, until 2015 this conflict had not been resolved (Barrera and Bona, 2017).

decreasing rates (Bona and Barrera, 2021)¹⁵.

In this initial phase of macroeconomic stability, the RenovAr program was launched, during which the first three rounds of projects (1, 1.5 and 2) were awarded. However, 27 months after the new administration started and four months after the launching of Round 2, Argentina entered a new economic crisis¹⁶. The capital outflow that began in April 2018 and which intensified in the following months (Fig. 3) had notable impacts on the economy through two channels. On the one hand, from a strong devaluation of the currency, which totalled 592% in just four months; on the other, from an increase in the cost of capital, with rises in the internal reference rate from 27% to 84% and in the EMBI, which from being equivalent to that of Latin America, in May 2019 was 2.2 times higher and at the end of 2019 was 6.3 times higher (Fig. 3). Even despite having received a historic loan from the IMF of around USD 45 billion, the outflow of reserves was of such magnitude that in September 2019 they had to restore the exchange controls that had been removed in the first few months of the government's administration.

The crisis had an impact on the economy, the energy sector and the RenovAr program. Fig. 4 presents the data on net indebtedness and net foreign direct investment in the electricity sector. Although it is not restricted to RenovAr, this program was the one that drove the largest investments in that stage, since it accounts for almost half of the additional installed capacity in the period under analysis (Fig. 2). The information is clear in pointing out that the first two years of the program generated strong capital inflows to increase the installed power of the system, which was leveraged, almost exclusively, with external indebtedness. The crisis unleashed in 2018 is reflected in a drop in access to new credits as a consequence of the increase in the cost of external capital due to the increase in the EMBI: in 2018, capital inflows through this channel were barely 10% of the previous year.

The rise in the local reference interest rate and Argentina's EMBI complicated the financial closing of projects and, therefore, the start and execution of several of the works, as shown in Table 2. This is how one of the main developers of renewable projects expressed it in October 2018: "With this country's risk (EMBI), it is impossible to get private financing below 14%" (Bellato, 2018). In addition to the doubling of the interest rate, there were restrictions on access to foreign currency imposed in 2019 to curb the outflow of international reserves, which made it difficult to pay equipment suppliers and complicated the financing structure with foreign banks, generating cost overruns for the financial structure originally conceived in the RenovAr Projects (Santamaría, 2019).

6. Conclusion and policy implications

Peripheral countries find multiple obstacles to designing and executing public policies that promote their own energy transition. The process towards energy matrices decarbonization in peripheral

¹⁵ This high exposure of the local economy to international market fluctuations, which increased the vulnerability of the economy, occurred in an adverse external context: (a) the economic recession that Brazil, Argentina's main trading partner, had been facing since 2011; the announcement made by the US Federal Reserve in 2016 of an interest rate hike, which usually generates capital seeking better quality assets ("fly to quality"); and in 2017, the beginning of the trade war between the United States and China, which brought turbulence in global trade (CIFRA, 2016, 2017).

¹⁶ Recent research argues that the policy of deregulation of the capital and financial account and of the financial and foreign exchange market in combination with an increase in the interest rate attracted speculative capital that was internally valorized through the purchase of LEBACs. When internal and external conditions changed, these peso positions were unwound and they accessed foreign currency to exit the Argentine economy, triggering the economic crisis that began with an escalation of the exchange rate (Bona and Barrera, 2021; Cantamutto and López, 2019).

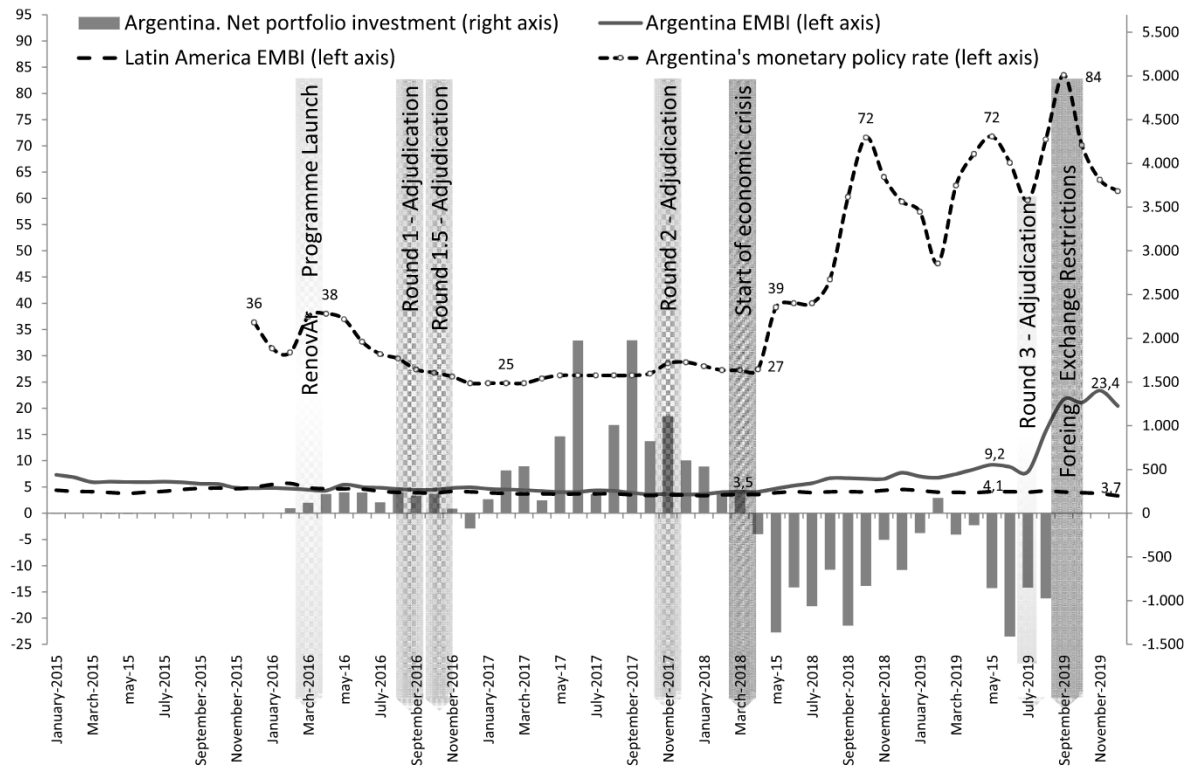


Fig. 3. Evolution of the EMBI (Emerging Markets Bonds Index) in Argentina and Latin America average; net portfolio investment and the monetary policy rate in Argentina, Jan. 2015–Dec. 2019
 Source: Author's own elaboration based on data from the Central Bank, the Secretariat of Energy and JP Morgan Chase.

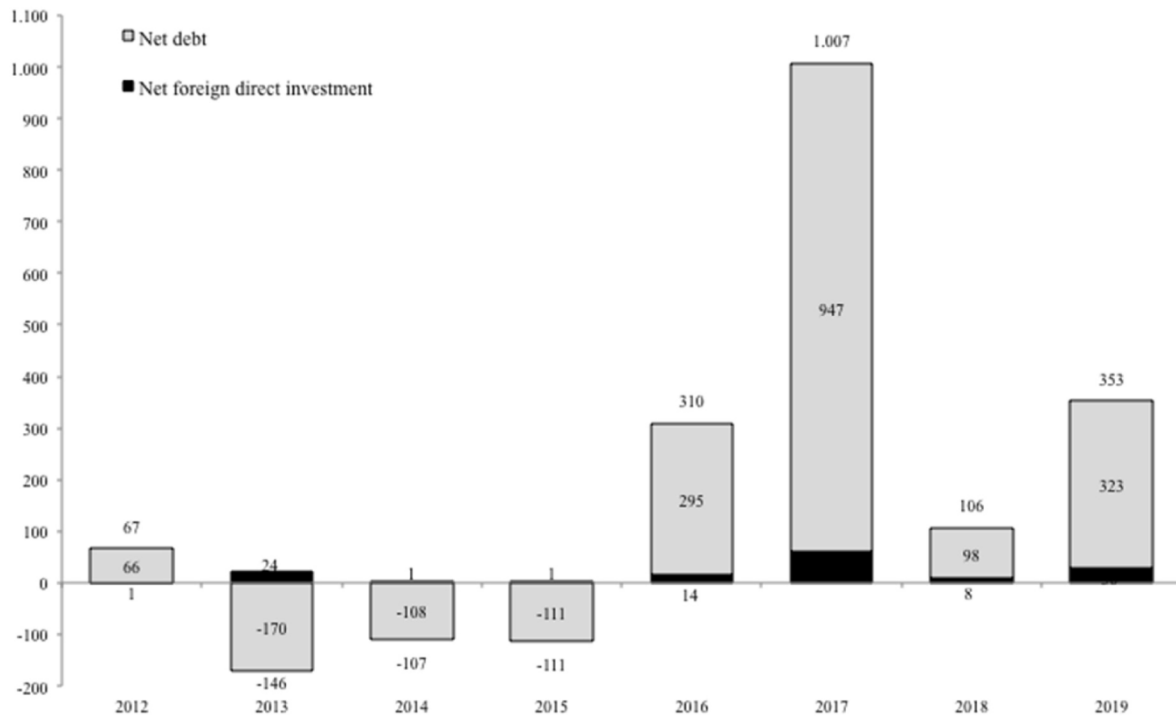


Fig. 4. Evolution of net indebtedness and net foreign direct investment of the electricity sector in the Central Bank's Foreign Exchange Balance, 2012–2019 (in millions of dollars)
 Source: Author's own elaboration based on Central Bank data.

experiences not only involves techno-institutional challenges, which include and affect a wide range of technologies, organizational and institutional structures, but also involves the complexity of linking the energy system to the functioning of the economy as well as of the society.

Argentina set a series of goals that contemplate the expansion of renewable energies in the electricity matrix as one of the central objectives in the strategy to mitigate the effects of climate change. Among the instruments designed, the RenovAr Program stands out. However, beyond the initial achievements, and counting that the interest's articulation around the RenovAr Program did not become a political barrier to its implementation, the program was paralyzed during the third year of operation and there are still 105 of the 198 projects to be commercially released, many of them with serious financial problems to complete the stages. The PPA contract modality is designed for the installation of the projects that depend almost exclusively on cheap financing from abroad in order to cover the cost structure of the value chain of the projects. This modality did not find the macroeconomic conditions that would give the projects the medium-term sustainability. Under this auction modality, the reference interest rate was central to assessing the expected profitability of the projects. When the crisis broke out in the country in 2018, the financial equation of the companies that participated in the auctions was disrupted; it shows the divergence between the design of economic policy (which increased the external vulnerability of the economy) and the design of the RenovAr.

Indeed, the case study made it possible to analyze the close links between the economic structure and the energy system of a country. In peripheral countries, whose local capital markets are often limited and unable to finance large infrastructure works,¹⁷ their dependency on international private financing becomes a condition of possibility to leverage an energy transition. In these cases, macroeconomic instability is usually a barrier to give continuity to public policies designed for the long term. The high dependency on the dynamics of the international economy, added to the economic vulnerability of peripheral countries such as Argentina, draws attention to the limits of market mechanisms to maintain the public policies necessary to sustain strategies towards sustainable societies over time.

Based on these conclusions, three types of recommendations are formulated for the Argentine case. First, it is necessary to align the energy policy with the macroeconomic policy based on a long-term National Energy Plan that allows the incorporation, gradually but sustained over time, of renewable energies into the national matrix. The National Energy Plan guidelines and specific goals must consider the restrictions of the external sector of the economy, the energy price structure, and its impact on the macroeconomy. In addition, it must provide for the growing participation of national goods and services suppliers that may be financed in local currency.

The second recommendation is the implementation of differentiated mechanisms for incorporating new renewable power in the electricity sector. Although the auction mechanism was effective to incorporate large wind and PV parks, it is necessary that the new tenders for these technologies also point to smaller-scale projects, compatible with the reasonable increase of the participation by local industry. In the bio-energy segment the institutionalization of a “permanent window” for the presentation of projects could be explored, under the feed-in mechanism subject to local requirements. Finally, the national public bank should create long-term credit lines with subsidized rates to increase the solar distributed generation in industrial establishments and mainly homes (both rural and urban). Among other benefits, it would allow increasing the penetration of renewable energies without the

¹⁷ Few peripheral countries have a public bank to promote infrastructure development, institutions that allow them to be in better conditions to finance these works, such as the case of Brazil and the Brazilian Development Bank (BNDES).

expensive investment in high voltage lines, that currently are at the limit of their electrical transmission capacity.

Third and last recommendation, based on the financial restrictions seen in recent years, two mechanisms are recommended to increase the investment in renewable energy projects. One option would be the state's issuance of “dollar linked” bonds (securities that are issued in local currency and that are adjusted by the value of the United States currency) plus an attractive interest rate. The aim of these bonds is both to capture part of the economic surplus that is regularly used to acquire foreign currency (which leaves the local financial system by being deposited in a safe deposit box or invested in assets outside the country) and to repatriate capital from local residents living abroad. A part of these bonds should be acquired by the Sustainability Guarantee Fund of the National Social Security Administration (ANSES), which is the sovereign pension fund administered by the national State. This financing strategy could be stipulated both in the annual budgets of the Federal State and in the National Energy Plan. As a second option, the Argentine State should be active both in attracting resources through multilateral and bilateral climate funds and green bonds, as well as in promoting the debt swaps for climate action with creditors of multilateral organizations and with debts bilateral.

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Mariano A. Barrera: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing. **Ignacio Sabbatella:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing. **Esteban Serrani:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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