Innovations in development finance and conditioning factors:

BNDES and the fostering of sustainability-related industries in Brazil

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Innovations in development finance and conditioning factors: BNDES and the fostering of sustainability-related industries in Brazil

João Carlos Ferraz*, Luma Ramos** and Bruno Plattek***

Abstract

This article analyses development finance innovations introduced by the Brazilian Development Bank, BNDES, to foster the local wind industry and its suppliers in the 2010s; which factors conditioned its actions; and what the related outcomes were. This is an empirically oriented study based on an analytical framework inspired by the literature which debates the importance of public institution innovation and by the Schumpeterian tradition which highlights the relevance of innovation for economic development. It demonstrates that the alignment of exogenous and endogenous factors to financing agency factors explains the expansion of wind energy and local production capabilities in the related supply industry in Brazil. Technology, market and policy drivers constituted exogenous windows of opportunity, while from an endogenous perspective, BNDES mobilised internal competencies promptly to introduce and implement successive finance innovations to support the development of sustainable industries. It is hoped that this article may be a source of inspiration for those engaged in researching and promoting policy innovations.

Keywords: Development finance, innovation, capabilities, sustainable industries

JEL codes: O13, O16, O25, Q01, Q48

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Introduction

Climate change, as an emerging societal development challenge, which requires new stands and practices from public institutions. Reflections on the nature of adequate public policies are much needed. Ongoing policy experiments must be examined to draw lessons and/or inspire those in charge of bringing about effective public actions.

The focus of this article is on one country, Brazil; one type of institution, the local development bank, BNDES; and one segment of sustainability-related economic activities, the wind energy industry. The objective is to analyse the nature of finance innovations introduced by BNDES in the 2010s to shape and foster the national wind energy and related supply industries; which factors conditioned its actions and what the related outcomes were. Specifically, the questions that guided the analysis are: which policy innovations were put in motion? Which endogenous and exogenous factors were relevant and in which directions did they influence the bank's ability to support the emergence of sustainability-related industries in Brazil? What was the extent of the progress achieved by wind energy and wind energy industry suppliers?

The analytical framework was inspired by the rising literature debating the relevance of public institutions' innovations – i.e., to change processes and products in order to excel in the accomplishment of their missions – especially when facing novel development challenges. This literature applies the concepts of innovation capabilities to policies and public institutions, examines their motivations, and identifies factors favouring or impeding their actions[1]. It also draws on the institutional and political economy perspectives applied to development banks, and on the Schumpeterian tradition of the relevance of innovation for economic development.

Following Karo and Kattel (2018), it is argued that development-oriented finance innovations are influenced by specific exogenous and endogenous conditioning factors. In this case study, the former is related to the international market and technology trends; the local macroeconomic scenario; and the existing political and policy framework. Endogenous factors are the accumulated history of BNDES as a development finance institution; the soundness of its balance sheet and the portfolio of financial instruments; its strategic priorities and its alignment and interactions with federal policy directives; its organisational and process procedures; the capabilities of employees to identify challenges and explore novel solutions to foster emerging economic activities; and its networking connections.

The focus on 'green' industries is purposeful. These are strategic for the sustainable, competitive and inclusive development trajectory of a nation. Investments in sustainable infrastructures are much needed. Bhattacharya et al. (2019) estimate that 70% of the infrastructure required around the world by 2050 is yet to be built, but challenges abound. When new infrastructures, for example the introduction of a new energy source to a market, are policy targets, economic attractiveness is unknown as cost and return references are scarce. When uncertainty prevails in all sorts of areas, from political and policy, and technology and production, through to markets and

[1] For a comprehensive compilation of such literature see Wu, Howlett and Ramesh (2018).

regulation, public institutions have a role in fostering the emergence and consolidation of these activities.

In terms of the societal benefits to be accrued from the results of the related investments, national development banks have a pioneering and relevant role whenever new development challenges emerge. The case of green finance is illustrative. As Samaniego and Schneider (2018), and Studart and Ramos (2016), demonstrate, development banks worldwide have actively supported renewable energies and the mitigation and adaptation to climate change: a significant group of development finance institutions from different countries delivered US$ 95 billion of green finance in 2012 and US$ 134 billion in 2018 (IDFC 2013, 2020). However, knowledge about development finance innovations, and their contributing or blocking factors, is still very scarce and geared towards emerging industries. It is hoped that, from the forthcoming analysis, an inspiration for further research and points of attention for policy advocates and policymakers can be derived.

The article is organised as follows. The first section proposes the analytical framework. The second section examines the exogenous conditions under which BNDES operated during the 2010s. The third section introduces BNDES' missions and capacities, strategic priorities and organisational capabilities, and its involvement in green financing. Section four analyses BNDES' new modes of financing to foster wind energy and its suppliers, and the outcomes of such actions in terms of the industrial profile of these suppliers. Section five discusses the main findings and the last section proposes questions for further research.

1. Development banks, finance innovations and conditioning factors

1.1 Development banks and the fostering of sustainability-related industries

Public finance institutions have an active role to play in the fostering of sustainability-related economic activities. According to the OECD (2017), the main strengths of these institutions are: (i) well-established financing procedures and instruments; (ii) trustworthiness; (iii) linkages with local and international sources of financing; and (iv) the ability to finance projects in the local currency.

National development banks are public financiers. Under political guidance and policy directives, they are executive agencies implementing missions through the design, structuring and financing of projects to promote the development of the regions they operate in. Given the proximity between policy formulation and execution, quite often development banks are also involved in policy design.

To fulfil political and policy mandates, public institutions must have the capability to do so. Wu et al (2015, p. 166) define policy capacity as 'the set of skills and resources – or competencies and capacities – necessary to perform policy functions'. Competencies depend on tacit knowledge, capabilities and resources an institution accumulates over time. Provided competencies exist,

Karo and Kattel (2018) suggest phases of policy execution: agenda-setting, planning, adoption, implementation, evaluation and revision. The rolling out of competencies along these phases requires, as Wu et.al. (2018) suggest, specific competencies from public servants: the capacity to diagnose policy problems and their root causes, design and compare solutions to problems, plan sensible plans for policy implementation and conduct policy evaluation. Such competencies and skills are not only necessary conditions for the efficient execution of mandates, but also inductive elements for possibly improving and even changing, in the sense of innovating, procedures, processes and operational instruments.

At the level of executive agencies, policy directives are translated into corporate priorities. These priorities are made explicit in operational rules and resource mobilisation that can be organised – or not –under the umbrella of policy programmes that favour priorities over non-priorities. In the case of development banks, priorities are revealed as terms of credit and the proportion of concessions to total disbursements. If financed beneficiaries are capable of turning investment projects into productive installations capable of efficiently delivering goods and services to society, the extent of a development bank's contribution to a given policy directive will eventually be revealed.

This article argues that development banks are institutions with missions, priorities, balance sheets, financial instruments, organisational modes and procedures, and competencies of technical staff that make them capable of facing the most prominent challenges associated with the fostering, through development finance innovations, new economic activities through the accumulation of dynamic capabilities (Kattel and Mazzucato 2018). These new activities demand investment – and related financing – under uncertain conditions as projects have no track record of costs and returns. They also may face uninsured demand, infant industry productive risks from suppliers and logistics, and an unestablished institutional and regulatory framework. Uncertainties are even more pronounced if projects occur in environments marked by economic and/or political turbulences.

As suggested by Coutinho, Ferraz and Marques (2015:101), it is 'in these sorts of contexts that development banks can foster markets by making strategic public investments in radical innovations, infrastructure, climate change mitigation and environmental protection.' Mazzucato and Penna (2016) are even bolder, arguing that mission-oriented development finance institutions have a role to play in creating and shaping markets.

To fulfil the development mandate in support of new activities requires changes in established modes of operation by public finance institutions. New activities demand new forms of development financing. That is, the financing of new development challenges implies changes and a long series of acts and procedures, before, during and after a financial concession: how an institution fosters and identifies potential clients; how and under what parameters projects are to be evaluated and selected; the design of adequate terms of credit (interest rates, guarantees, maturities); and following up and evaluating results to further adequate financial conditions for an ever-changing scenario.

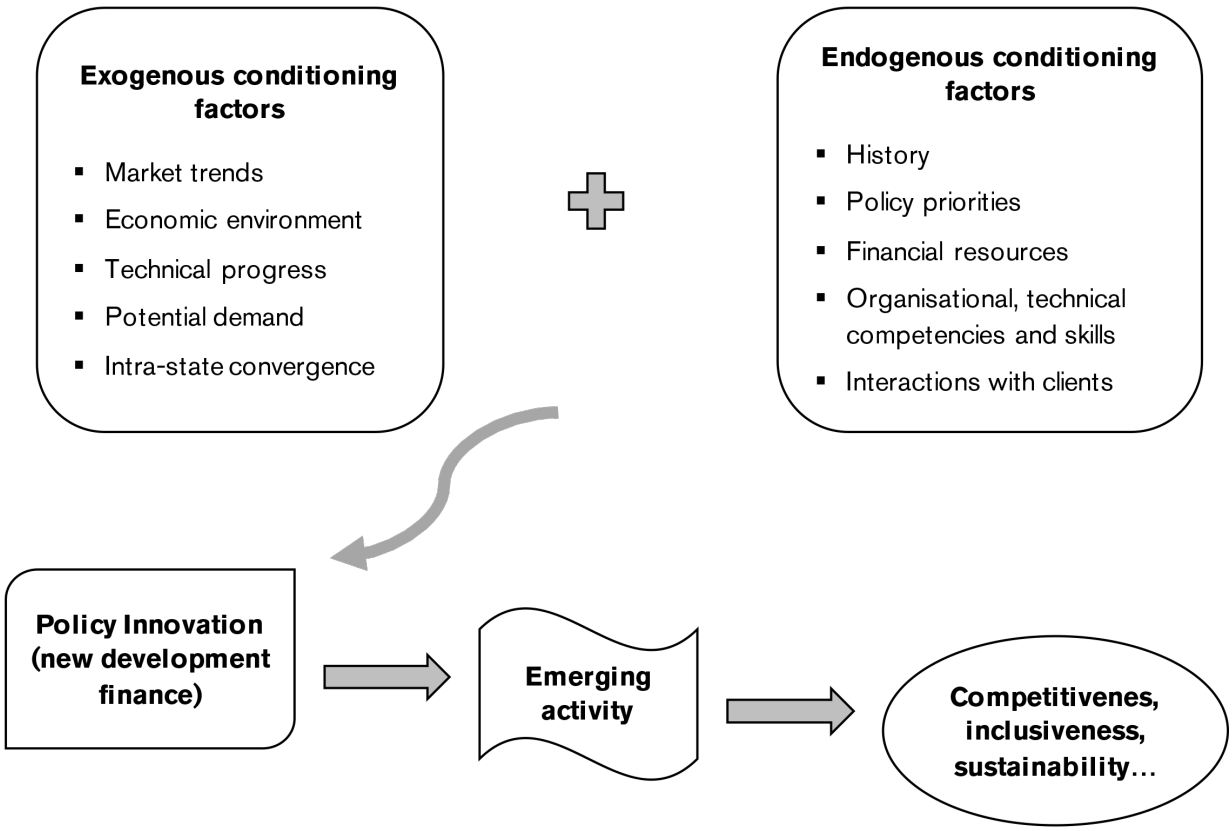
This is the realm of policy innovation in a development finance institution. From a wider perspective, policy innovation is a subject with a long road ahead in terms of conceptual and

empirical investigation. For example, as the profit motive – the essence of a firm´s drive for doing things differently – is not the ultimate mission of public institutions, what would drive them to innovate? For Karo and Kattel (2018), a myriad and complex set of factors influence the process of innovation in public institutions. To organise such variety and complexity, an experimental analytical framework is proposed in the next sub-section to be used in the case study of this article.

1.2 Development finance and conditioning factors

The analytical framework is organised around five interconnected dimensions (Figure 1). Simply stated, (i) exogenous and (ii) endogenous factors condition the design of (iii) a new mode of finance to be put forward for (iv) the fostering of an emerging activity. In time, as investments are turned into products and services (v) the effectiveness dimension – attending to market needs, job creation, competitiveness, reduction in emissions, etc. – of a public finance institution's actions will finally emerge and its mission can be verified.

Figure 1: Development-oriented finance innovations and conditioning factors



Source: Authors

The analytical focus is on the relations between new modes of development finance and a given policy target: the fostering of an emerging economic activity. For that, the nature and potency of innovation in financial products must be duly considered. When a new mode of finance is offered to potential beneficiaries it can be considered as product innovation if conventional definitions of innovation are applied. For the development bank, a new mode of finance implies organisational and process changes. Moreover, such a 'financial product', if and when it is taken up by a beneficiary, may have wide-ranging implications. A financial product is only a means for a firm to realise an investment project and such a project may have implications in terms of the business organisation itself in terms of diversification, verticalisation, changes in product and production processes, new relations with suppliers and customers etc.

For this article, and following Karo and Kattel (2018), factors influencing policy innovations were specified as being located 'internally' or 'externally' to the institution. The first refers to its accumulated capabilities; the latter is associated with the political, technological and economic environment under which it operates.

Discerning the boundaries between exogenous and endogenous factors is a difficult task that can prove to be somewhat arbitrary (de Voogt and Patterson 2019). Events within each category may occur simultaneously and influence or reinforce each other, making it hard to disaggregate the influence of specific factors. Also, there may be spillovers across different domains, as well as factors directly or indirectly influencing a policy action (Howlett and Ramesh 2002). Furthermore, exogenous and endogenous factors occur over different timeframes. For example, some exogenous factors are relatively stable (e.g. a national constitution). Other factors may be dynamic but slow-moving (e.g. the unfolding impacts of climate change, population growth and demographic shifts, and urbanisation and industrialisation patterns), which may impose pressures of different scales of urgency for policymaking. Other exogenous factors may be fast-moving with timescales that demand immediate and extreme policymaking (e.g. Covid-19 and natural disasters). Nevertheless, such analytical separation can be useful to simultaneously assess the relative importance of framework conditions and of the capabilities of a public agency to influence and shape the evolution of an emerging economic activity.

By drawing concepts from the economics of innovation literature, this article places considerable emphasis on the analysis of the endogenous factors – an institution being able and having the capabilities (or not) to introduce new modes of operation or new products. By doing so this becomes possible to evaluate how public institutions innovate, review the outcomes and explore how the Schumpeterian 'entrepreneurial spirit' emerges in a public institution.

It is argued that the innovative spirit in public institutions is likely to be embedded in a collective of individuals who, from within an organisation, read the internal and external environment, perceive opportunities. and introduce and implement changes in established practices (operational procedures, financial instruments, methods of analysis, sources of funding, modes of interacting with policymakers or beneficiaries etc). As they are directly involved in daily operations and act as a group from within an organisation, these individuals are almost always 'nameless' and their

space for being innovators naturally depends on the openness of the leadership to new ideas[2]. In short, most policy innovations come about by design, as explicit efforts to produce them, but their nature is quite specific. According to Howlett (2014), policy innovations come in diverse forms and shapes. Multiple definitions are used to refer to somewhat different meanings of what constitutes an innovation in the policy realm. Some may be short-lived, such as pilot projects never to be scaled up; others are long-lasting. Policy innovations can be new designs to address a pre-existing challenge or an alternative approach to supporting an emerging challenge (Auld et al 2013). They can alter current policy conditions and/or take a distinct procedural orientation. In this sense, and drawing from the Schumpeterian literature, policy innovations are mostly associated with changes in processes and products a public agency offers to society. In themselves they are 'product innovations', but, when taken up, these policy products may imply process changes in the recipient organisation. Still, along with the Schumpeterian tradition, and taking up the policy benefactor and recipient perspectives, policy innovations can be of a radical or incremental nature.

2. Windows of opportunities

2.1 The economic scenario

Investment to GDP in Brazil evolved from around 16% in 2004 to 19% in 2014. Thereafter investments dropped sharply, reaching 15% in 2019, the lowest ratio in 50 years. The evolution of investment to GDP is associated with the different dynamics the Brazilian economy has gone through in the past 20 years due to improvements, and then deteriorations in external and internal conditions. The former is related to the evolution of exports, led by the demand for commodities. In this case, the positive incline is associated with a surge in the demand, especially from China. The negative trend is linked with the aftermath of the international financial crisis. From the internal perspective, to a great extent growth was due to economic policy orientations favouring economic and social inclusion. According to Reis, Araujo and Gonzales (2019), from a demand perspective the country's GDP rates correspond to variations in investment and consumption.

During the investment growth period, energy demand was expanding and then wind energy arrived in the country. In this period, wind energy costs were still relatively high, but competition with other sources was limited. When investment and energy demand receded, wind energy had accumulated competitive advantages and could fulfil the (few) existing calls for investments.

2.2 Market and technology opportunities

Brazil entered the wind energy industry when, internationally, installed capacity was increasing at a high rate – 121GW to 238GW in three years between 2008 and 2011 with continuing expansion

[2] These leaders most probably would fall under the category of 'policy entrepreneurs' or individuals who contribute to policy changes, as proposed by Kingdon (1984). A recent review of the subject may be found in Mintrom (2019).

thereafter. Such expansion meant that energy operators and equipment suppliers were very active everywhere. Also, Brazil entered the industry when demand was momentarily receding in Europe and the USA due to the financial crisis (Basso 2019). At that moment, to keep business running, wind operators and suppliers were actively searching for new markets.

Technical progress provided another window of opportunity. The costs of turbines (representing between 65 and 85% of total investment) have shown a steady downward trend and yields in the technical capacity of turbines have expanded, both at fast rates. According to the Global Wind Energy Council (2020), prices for wind turbines dropped by around 50% between 2008-2009 and 2018-2019. In 2007, a typical wind tower in Brazil was 68 metres tall, and had rotors 66 metres in diameter and turbines with a capacity of 1375 kW. In contrast, in 2018, the technical specifications had almost doubled to 112 metres tall, 120 metres in diameter and 2664 kW capacity (EPE 2019).

2.3 Investment-led public policies

The policy space for wind energy can be divided into three categories: the heritage of the past, infrastructure investment programmes and renewables-related policies.

In 2001 a severe energy crisis stimulated the search for, and introduction of, new energy sources. A long period of drought led to lower energy generation capacity due to decreases in the water levels of hydro plants – the most relevant energy source in Brazil. According to Hunt et al (2018), during the 1990–2000 period, electricity consumption increased 52.3% in contrast with a 41.2% growth in total generation capacity. In 2001, the government introduced measures to reduce electricity consumption by up to 20%.

The opportunity to diversify the grid from hydropower to alternative energy sources was then opened up. Under a new legal framework, by 2004 policy directives were being designed with three objectives: to expand and diversify the energy matrix; ensure the security of supply; and widen the access to energy under affordable tariffs. Market regulations were introduced under which distribution utilities contracted their demand through auctions based on the lowest price and long-term power purchase agreements (PPA) awarded to generators3. PPAs secured the sale of energy generated over a certain period for a fixed price (adjusted annually to the inflation rate), thereby ensuring a steady income flow for energy projects (Marhewka 2016).

The period of positive evolution of investments was also associated with the expansion of infrastructure projects. In mid-2000, the federal government placed political priority on infrastructure investments: the Investment Pilot Project (2005); the Growth Acceleration Program (PAC), implemented from 2007[4]; and the Logistics Investment Program (PIL) of 2012. After Dilma Rousseff's impeachment in 2016, subsequent infrastructure policies were announced, but

[3] Auctions were organised under policy guidelines from the Ministry of Mines and Energy (MME). The regulatory agency, the National Agency for Electrical Energy (ANEEL – the Portuguese acronym), was responsible for setting up ceiling prices.

[4] For a critical appraisal of PAC see Frischtak (2016).

not much has been yet translated into project investments[5]. In the first decade of the 2000s, telecom and transport were the sectors with a higher share of investments and, between 2011 and 2016, transport and energy gained prominence (Frischtak and Morurão 2017).

Advances in energy investments were supported by a well-established and functioning institutional framework, with the participation of policy-setting authorities, long-term planning institutes, regulatory agencies, financing institutions and operational state-owned enterprises. Within such a framework, in 2002 a pilot programme for renewable energy sources, the Program for Alternative Sources of Energy (PROINFA – the Portuguese acronym) was launched. In the initial years, PROINFA proposed cost advantages for renewables vis-à-vis other energy sources using a levy paid by energy customers. Araújo and Willcox (2017) argue that PROINFA introduced a new energy policy including the resolution of conflicts coming from contrasting interests between renewable and traditional energy producers.

In the aftermath of the energy crisis and under a new federal administration (the first Lula period), in 2004 an auction-based process organised energy investment and trading commitments under two modes, each with specific functioning rules[6]:

- A regulated contracting environment (ACR – the Portuguese acronym), fully regulated by the National Agency for Electrical Energy (ANEEL the Portuguese acronym)7. Energy contracting occurs through auctions where a ceiling price is defined alongside the period (usually long term) and volume of energy to be acquired. In the ACR mode, long-term demand was ensured (projects contracted in an auction should deliver electricity in three or five years) and lower tariffs guided the competition process, allowing energy producers to plan and implement investments.
- An unregulated or price-free contracting environment (ACL – the Portuguese acronym) where price, delivery times, duration and volumes of energy are contracted through bilateral agreements between generators and energy distributors, large or unrestricted consumers, importers and exporters of energy.

[5] The so-called Partnership and Investment Program (PPI) was launched in 2017, during Temer´s administration. In March 2020, under Bolsonaro´s government, a new plan (Pro-Brasil) was announced as one of the exit strategies for a post-pandemic period.

[6] A trading chamber, the Electric Power Commercialisation Chamber (CCEE – the Portuguese acronym), became responsible for the registering and processing of the volume of all the energy contracted. Another agency, the National System Operator, became responsible for calculating prices of reference and managing the dispatch of energy.

[7] In the regulated market, ANEEL fixes electricity rates, balancing both fair rates for the public, and the economic and financial needs of the agents responsible for delivering services. In the unregulated market, rates are freely negotiable between the parties. All power purchase agreements must be registered with CCEE, but prices are not disclosed.

The following policy instruments were made available for most renewables projects financed under the regulated market:

- Competitive, lowest tariff for customer-based auctions.
- Long-term power purchase agreements – the operating subsidiaries of the State-owned energy holding, Eletrobras, signed 20 years of energy purchasing contracts under a feed-in tariff mechanism.
- Low-cost investment financing and, under a project finance mode, long-term contracts were taken up as collaterals by BNDES.
- Import and local tax exemptions for the acquisition of capital goods.

As a result, according to Newborne and Welham (2014), renewable energy sources emerged in Brazil in parallel with reductions in energy imports[8]: between 1990 and 2010 the import dependence declined from 25% to less than 10% of the country's total production. Moreover, as demonstrated by Diniz (2018), Brazilian policies successfully stimulated private investments: out of 557 wind farms set up between 2009 and 2014, the private sector contracted 360 while the remaining 197 special-purpose enterprises had some degree of state participation.

2.4 The outcome: wind energy expansion with decreasing unit costs

In the 2010s, 'green' energy sources expanded at a fast pace. Between 2000 and 2016, Brazil doubled its generation capacity to around 170GW of capacity. Wind energy was responsible for 18% of such additional capacity. According to the sectoral association, ABEEólica[9], Brazil has extremely favourable natural conditions for wind energy[10]. For example, the country´s average factor capacity is 46% while the world average stands at 36.3%[11].

In 2006, the amount invested in wind energy was US$ 113.1 million; in 2015, US$ 5.1 billion; and, in 2019, US$ 3.4 billion. Total investments in wind energy between 2006 and 2019 amounted to US$ 35.64 billion, representing around 55% of all new renewable investments in this period (ABEEólica 2020).

In 2019, total wind power generation capacity in Brazil amounted to approximately 15.4 GW, an increase of more than 15-fold in comparison to 2010. In that year, the country was in eighth place in the wind sector international league in terms of total installed capacity. Figure 2 shows the yearly evolution of installed capacity in the regulated and unregulated markets. The regulated environment predominates; price-free contracting was relevant in the odd year (2014). From 2016 onwards price-free contracting takes a stable share of around 300 MW while, in 2020, just about 1 GW of capacity is expected to come from such a mode of contract. For many pundits, the high relative importance of 2020 would be a sign of an upcoming strong trend[12].

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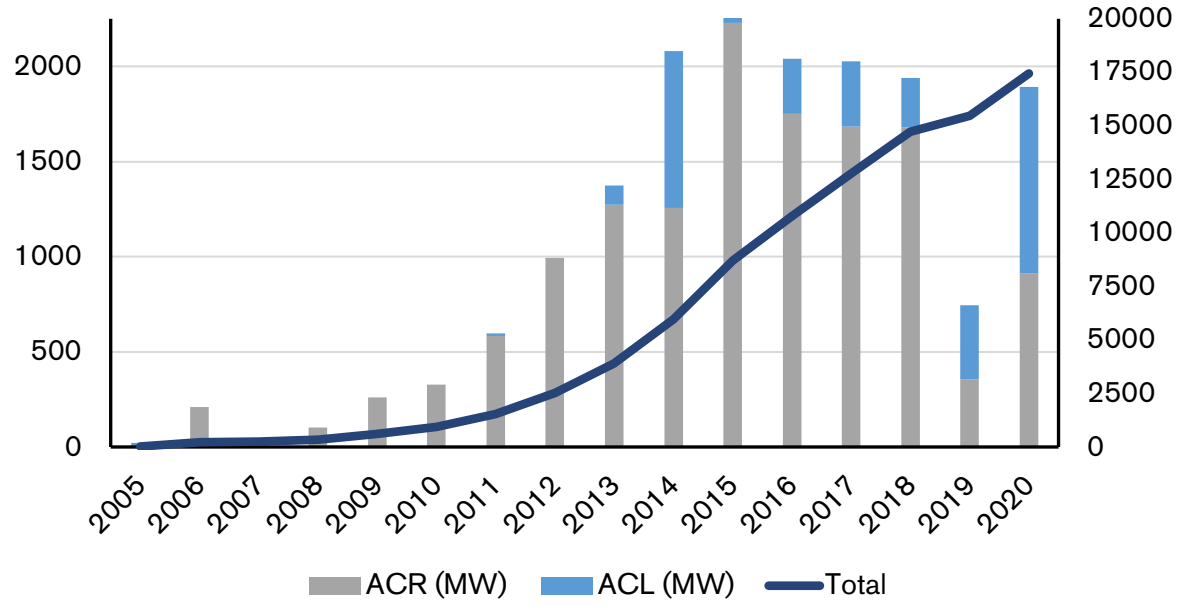
[8] Energy imports came especially from Paraguay, Brazilian partner in the Itaipú hydropower plant.
[9] ABEEólica at the Brazilian lower house, December 2019: https://bit.ly/2On2IPO.
[10] According to Bradshaw (2018), wind is complementary and compatible with hydro-based electricity systems. In the Northeast -where most farms are installed, wind generation is higher when hydroelectric plants operate at low capacity during the dry season.
[11] Capacity factor: ratio between the effective production of a plant and the maximum total capacity.
[12] https://bit.ly/2Q1F9wE

Figure 2: Wind energy installed capacity in Brazil (MW) by trading environment – 2005-2020*



Source: ANEEL/ABEEólica (2020). * 2020 projections

Concurrently with expansion was the fall in unit investment costs. According to the energy planning agency, EPE (2019), between 2001 and 2018, investment costs per kW decreased by 44%, from US$ 3258 to US$ 1823 (2018 US$/kW prices). During the first wind energy auctions (2007 and 2008) average costs were R$ 8262/kW (around US$ 3800), while in 2019 average costs were R$5066/kW (around US$1650)[13].

Also, and following international trends, the capacity of each unit of power generation increased significantly: the average wind turbine power increased from 1.3 MW in 2007 to 1.9 MW in 2010 and 2.6 MW in 2018. In 2018, 92% of investment projects submitted for auctions had turbines of over 110 metres in diameter[14].

As to the project implementation phase, while in 2007-2008 the average length of time proposed for the setting up of towers and wind turbines was 13 months, by 2018-2019 this period was reduced to approximately four months (EPE 2019). By 2016, 150,000 people were directly employed in the industry, an equivalent of 15 jobs per MW. Around 6000 towers were operational in Brazil in 2018, mostly in the (poor) Northeast region, due to its very favourable wind conditions. Wind parks, so far, through land leasing agreements, have benefited around 4000 families (ABDI, 2018). The observed expansion of wind energy in Brazil also contributed to avoiding CO_2 emissions. Between 2012 and 2019 around 78.5 million tons of carbon pollution were avoided by the increase in wind energy generation (ABEEólica 2020).

[13] Reductions in total installed costs vary by country and when large-scale commercial deployment starts. China (1996-2018), India (1991-2018) and the United States (1984–2018) have experienced the largest declines in total installed costs – 56%, 66%, 66% respectively.

[14] The choice of power for each project depends on local conditions and, therefore, varies between countries or even different regions in the same country.

In short, during the 2002-2019 period, three phases of the industry development can be distinguished: (i) initiation (2002-2009), when substantial growth in energy demand can be observed, renewable energy enters the policy agenda and the competitive-based auction is put forward; (ii) acceleration (2009-2015), when energy demand is still expanding at a fast rate under competitive auctions, especially under the regulated market mode, with a strong and predictable demand resulting in substantive energy contracting, under favourable terms for renewable sources; and (iii) transition (post-2015), when amidst a general economic slowdown and consequent fall in investment rates, energy demand is slack and the volume of energy to be contracted under the regulated market (ACR) decreases while, proportionally, price-free contracts (ACL) increase. Through these years the expansion in installed capacity in wind energy was observed alongside decreasing unit costs and increasing turbine power, all with important socio and environmental benefits. Taking the periodisation as a reference, the next sections will explore in detail the role played by BNDES, the main source of financing behind such progress.

3. BNDES missions, competencies and green financing

3.1 Missions and financial capacities

BNDES was established in 1952. According to the bank's statute, in place until July 2019, its mission is to finance investment projects in support of the country's development. As an executive agency, alongside the evolution of the Brazilian economy, BNDES has historically followed political and policy directives coming from different administrations, thus assuming specific and different roles. In time BNDES became a diversified financial institution, providing loans directly or through commercial banks, grants (for social, cultural and technological development) and equity (through investment funds or by directly taking a position in state-owned or private firms).

Since the late 1980s, BNDES' main sources of funding were 'quasi-public' funds derived from proceeds coming from workers´ insurance (known as PIS-PASEP and FAT – the Portuguese acronyms) and from returns of outstanding loans and equity investments, bond issuance and/or borrowing from multilateral institutions[15]. Yet between 2009 and 2014, the National Treasury provided long-term and low-cost loans for BNDES totalling US$ 197 billion[16]. Such capital injections allowed BNDES to extend loans at rates consistently below other prevailing rates. Cost differentials were expressive: in 2016, on average, the BNDES rate (TJLP – the Portuguese acronym) was set at 7.8%, compared to an 11.5% rate for a ten-year Brazilian Treasury Bond (NTN-B) and 14% for the market rate (SELIC). Clearly, through these years BNDES was able to substantially lower investment costs in Brazil.

[15] In environment-related funding, since 2008 a REDD+ mechanism has been in place – the Amazon Fund – a donor-based fund provides grants for the sustainable development of the Brazilian Amazon. Since then the Fund has supported over 100 projects worth US$ 700 million. In 2017, BNDES issued US$ 1 billion green bonds in the US market to finance wind energy projects. In July 2019 it was qualified to raise funds with the Green Climate Fund.
[16] For an analysis of this operation see Ferraz and Coutinho (2019).

Given the strengthening of its asset base and its capacity to provide low-cost loans, BNDES had a relevant role in supporting investments in Brazil in the 2000s[17]. According to its effectiveness report, between 2007 and 2015, on average, its concessions backed 20% of total Brazilian investments. Infrastructure as a priority was enforced and took up a fifth of total loans in the same period (BNDES 2016).

After Dilma Rousseff's impeachment in July 2016, macroeconomic policies assumed a conservative stance. Political and policy directives were explicitly and increasingly aimed at diminishing the role of BNDES, which until then had been prominent. Two main determinations were used: (i) to reduce the bank´s balance sheet by requesting the anticipation of payments of standing long-term loans from the Treasury; and (ii) to increase the costs of loans. As a result, while in 2013, the peak year of its disbursements, BNDES conceded R$ 190.4 billion of finance, in 2019 this amounted to R$ 55 billion.

Even though it is a development-oriented institution, as a financial institution BNDES is regulated in much the same way as commercial banks are in terms of cautionary capital indicators it must adhere to (Basel indices, for example). In fact, and despite fully complying with the existing regulatory regime, BNDES has a long and recognised ability to discriminate against unsound projects, a fact revealed by its low default rate (2.12 % in 2018) and good financial performance (net profit of R$ 6.7 billion in 2018).

3.2 Priorities, processes and capabilities

Between 2007 and 2016, BNDES' alignment with public policies was made explicit in its corporate planning. Infrastructure, capital goods acquisition and smaller firms were given the highest priority, translated as: (i) disbursements goals to be achieved each year; (ii) allocations of human and organisational resources; and (iii) financing conditions. Prioritisation went even further and within each sector or policy subject, additional differentiations were made. Sanitation projects enjoyed better financing conditions, for example, compared to highways; greenfield highway projects, though, deserved more favourable conditions compared to brownfield projects. The discrimination criteria relied on the potential contributions to the development of a given project in terms of, for example, externalities and social returns.

Historically, BNDES accumulated technical autonomy to accomplish missions with the support of a legal framework. According to Colby (2013:238) 'outside actors did not have the legal authority to influence particular hiring or loan-making decisions.' It is also worth mentioning that this was a period of stability in BNDES' leadership and technical staff had the assurance of strategic directives to follow[18]. BNDES' technical autonomy found resonance in its procedures: project approval decisions were segregated from credit risk assessment decisions; and financial

[17] This new role was similar to practices undertaken by many countries around the world in the wake of the financial crisis, even though the role each national development bank played, funding mechanisms and policy priorities, was specific to each country (Griffith-Jones 2016).
[18] The quality of BNDES staff is widely recognised. To some extent this feature reveals a Weberian institution where entrance is merit-based and evolution over time is via a career-based scale.

concessions followed a strict hierarchy with impersonal and collegiate decision-making. Such division of labour can be further illustrated by an account of its process flow and decision-making.

The banks financing operations are divided into two main groups: direct and indirect or first and second tier. Direct operations are awarded directly by the BNDES. Indirect operations are those in which BNDES provides the funding for an accredited financial institution, which then forwards it on to the finance beneficiary. In operations of this sort, project evaluation and credit risk are taken up by the accredited institution. On average and for a long time, BNDES disbursements have been approximately divided equally between first and second-tier operations.

Until 2018, any project to be directly financed by BNDES, including most financing of renewable projects, had to follow four stages. First, a project proposal, still in a preliminary format, was submitted by a potential client to two different teams of specialists. Within the Planning Area, the project was evaluated in terms of its alignment with strategic priorities as well as its technical and financial coherence. In parallel, and independently, the Credit Risk Assessment Area evaluated the creditworthiness of beneficiaries and priced its risk. These segregated assessments were submitted for a first-stage approval to a Project and Credit Evaluation Committee, composed of deputy executive directors.

Second, a project with positive recommendations (approximately one-third of the projects did not pass this stage) followed on to a sectoral or thematic Operational Area (such as a Social and Environment Development Area). The potential client had to develop its project proposal further, which was then screened by a team of legal, technical, and financial specialists, working under recommendations made by the Project and Credit Evaluation Committee.

Third, once a project proposal – including financing conditions, executive projects, environmental licenses and guarantees – was considered to be completed by the Operational Area and certain implementation-related milestones had been explicitly defined, it was submitted to the BNDES Executive Board for a final decision.

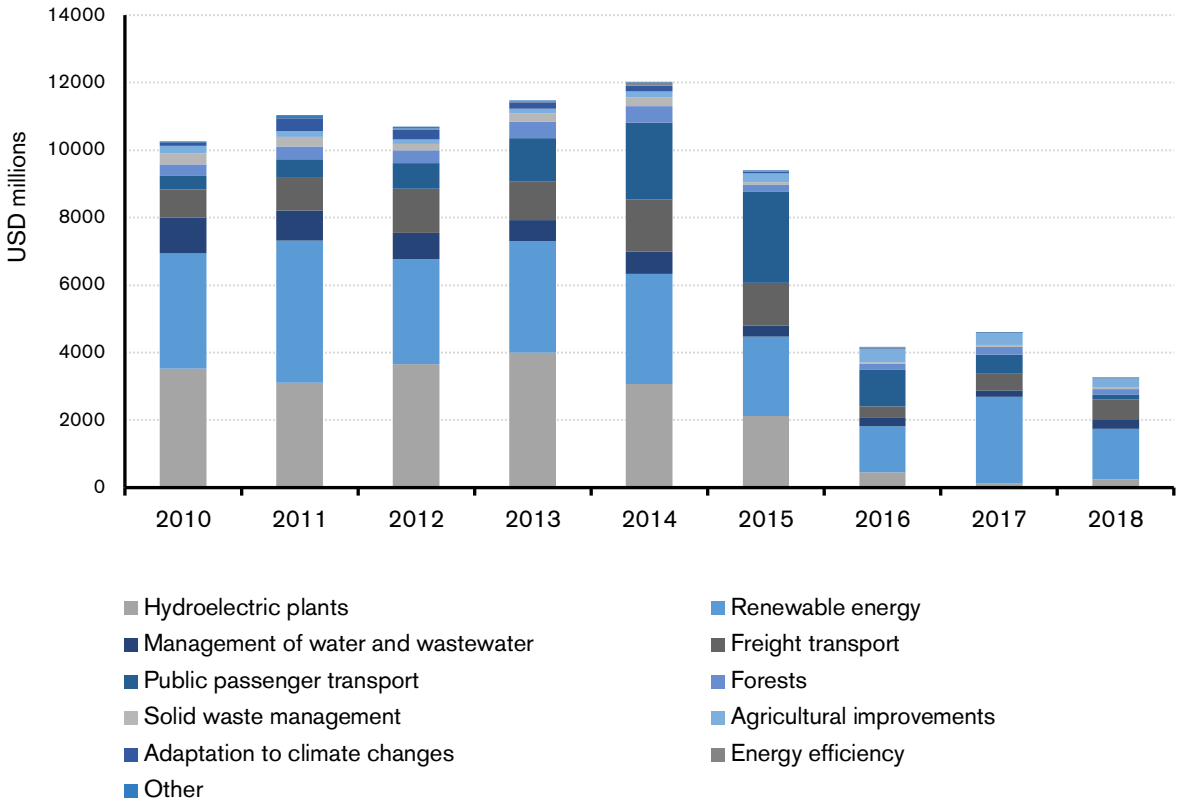
At the fourth stage – project implementation – disbursements were made only after the demonstration and verification of completion of a given milestone. Therefore, the granting of financing was parallel to the monitoring of physical and financial events associated with the execution of a project. Most projects were designed under a logical framework allowing for the Operational Area, with the support of an oversight group within the Planning Area, to monitor project results. Such a monitoring process would then provide feedback information for the bank's planning and operational learning processes.

3.3 Green financing

Between 2010 and 2014 financial concessions for green financing increased from US$ 10 to US$ 12 billion; between 2016 and 2018 concessions dropped to around US$ 4 billion a year on average, due to the retrenchment of investments and following policy directives to retract BNDES from its until then prominent role in development finance (Figure 3). For the 2010-2018 period, the highest disbursements went to renewable energy (32.6% of the total), followed by hydroelectric plants and public transport (26.4% and 12.6% respectively). Changes over the years suggest a trend towards alternative renewable energies: while in 2010 the hydroelectric plant

share was 34.4%, it fell to only 7.3% in 2018. Meanwhile, the renewable energy sector increased its share from 33.3% in 2010 to 46.3% in 2018.

Figure 3: BNDES financing for the 'green economy', 2010-2018, US$ million



Source: BNDES

Since its foundation, the financing of energy has been a BNDES priority. From an international comparative perspective, according to Bloomberg/NEF (2020), BNDES' 2004-2019 accumulated debt portfolio in clean energy was the highest in the world, having reached US$ 31.3 billion, closely followed by Santander and MUFG. The portfolios of other entities such as the European Investment Bank, KfW, Mizuho Financial and Société Générale were situated between US$ 11 and US$ 19 billion.

Regarding wind energy, BNDES participated with some level of financing in 80% of the 15.5GW projects implemented between 2006 and 2019. As disbursements amounted to US$ 15.2 billion during the same period, BNDES leveraged US$ 28.5 billion of investments (Table 1).

Table 1: Wind energy in Brazil 2006-2019: capacity, investments and BNDES financing

Wind energy 2006-2019: capacity, investments and BNDES participation	GW and US$ billion	Features
Installed capacity	15.5 GW	Accumulated capacity from all auctions
Installed capacity with some level of BNDES support	12.4 GW	BNDES participated in the financing of about 80% of all wind park projects
Total investments in wind parks	US$ 35.6 billion	Project development, land lease, towers, blades, wind turbines, assembling services
BNDES disbursements for wind parks	US$ 15.2 billion	BNDES financed 53% of total investments

Source: BNDES

As the share of capital goods acquisition in wind parks is somewhere around 80% of total investments, from Table 1 it is possible to deduce that between 2006 and 2019 the size of the Brazilian market for wind energy suppliers amounted to US$ 28.5 billion. Proportionally then, out of BNDES' US$ 15.2 billion disbursements, it is reasonable to assume that around US$ 12.7 billion was directed to equipment acquisition, an equivalent of 42.7% of total capital expenditure during the 2006-2019 period. The following section will analyse how BNDES used such a market opportunity to foster local suppliers.

4. Innovations in development finance

4.1 Converging the financing of wind energy with the fostering of supply industries

Throughout its history, BNDES has managed to define and implement terms of credit adherent to the characteristics of different long-term investment projects. This was also the case for wind farms. For the regulated market, where energy transaction conditions were well-known, loans had an average term suitable to the investment maturity of projects and the repayment capacity of borrowers, while collaterals were the parks themselves (with payback capacity anchored in firm demand as defined by the auctions) since almost all disbursement were in the project finance mode. In time, as the economic importance of the unregulated market increased, BNDES had to adjust its development finance to its specific conditions.

Besides supporting wind farm projects, BNDES used its established development finance instruments and practices to foster industrial development. To benefit from BNDES local currency funding, investors had to comply with a long-standing financing condition: capital goods had to be acquired from local suppliers[19]. In turn, through an accreditation process, suppliers had to comply

[19] Regardless the origin of companies' capital.

with the publicised rules of local content. Local content policies have been practiced for the past 40 years by BNDES-FINAME[20] (Miguez 2020).

Wind projects are a good case of how development finance innovations 'pulled' for wind park investments and 'pushed' for the development of a local supply industry. For wind parks, BNDES had to adapt modes of financing to the inherent features of regulated and unregulated markets. At the same time, as the wind energy value chain was relatively new to the country, and since capital goods make up to 80% of total investment in a typical wind farm, BNDES had to change accreditation mechanisms to face the infant nature of the supply industry.

During the industry initiation phase (2002-2009), BNDES' participation in wind energy finance was very limited, both in the financing of projects and the induction of the supplier industry. 'Traditional' accreditation procedures were followed, benefiting only a few devices, such as towers and blades, which were already being produced locally. Between 2009 and 2015, during the industry acceleration stage, BNDES provided significant financing support for wind park investors. For wind energy suppliers two development finance innovations were successively introduced, thus changing 'traditional' accreditation procedures. Turbine assemblers benefited, but on the condition that equipment must be delivered in time for the requirements of wind park projects. After that, during the transition period (post-2015) BNDES introduced changes in terms of credit, with built-in flexibility in terms of guarantees to cope with shorter duration ACL contracts, and new accreditation rules were announced.

4.2 Innovations in development-oriented finance: the support for wind park projects

Until 2016, most energy contracts were traded in the regulated market (ACR). Auction winners signed long-term (up to 20 years) contracts with ensured volume and based on feed-in tariffs indexed to consumer price indices. In contrast, BNDES offered loans of up to 70% of the total investment cost, to be paid in (up to) 16 years. The cost of loans was based on the TJLP rate (see section 3.1) plus a 0.9% spread per year (Gornsztejn 2012). These favourable conditions were anchored on the project finance mode of contracting, where the project itself, plus the long-term power purchasing agreement (PPA), independently of energy delivery, were used as the bank´s guarantees. By then, very few ACL (unregulated market) contracts were financed by BNDES. As these ACL contracts were of short duration, BNDES incorporated a sectoral price parameter (Difference Liquidation Price or PLD – the Portuguese acronym) in the financial model for the uncontracted energy to restrain project leverages[21]. As this amount of energy was generally small, the impact on credit modelling was insignificant.

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[20] From a financial perspective, the Special Industrial Financing Agency (FINAME) is a separate entity. From a legal perspective, it is a full BNDES subsidiary. From an operational perspective, FINAME´s activities are conducted within BNDES' organisational structure.

[21] *PLD* is the reference price for the settlement of possible differences in contracted, generated and consumed volumes of energy. PLD is *calculated and disclosed by the National System Operator with a weekly periodicity* for *the Electricity Trading Chamber* (CCEE). *It is not a market price (as bilateral prices are contract confidential), but an estimated price based on operational marginal costs with* energy costs optimisation and security of supply as references.

Since 2016, a shift in the mode of energy trading towards an increase of ACL contracts has induced BNDES to adapt its development finance mode. On the one hand, as mentioned above, economic recession and the fall in energy demand led to more modest volumes of ACR-type of auctions. On the other hand, when wind park operators offered, in 2016, the low level of R$ 90.00 per MW/h, energy consumers became interested in settling contracts in the unregulated market, even if the contracts were of shorter duration. As prices remained at low levels, in 2018 more than 2 GW of wind capacity was transacted under the free market, compared to 1.25 GW in the regulated market. In 2019 more than 2 GW was sold in the ACL, compared with 1.13 GW in the regulated market.

The timing mismatch – a long maturation investment wind park project relying on shorter-term demand for energy – imposed financing challenges for BNDES. It became necessary to simulate prices and define guarantees for periods longer than those prevailing in the energy contracts which triggered the wind park investment. The bank had to design a new model of financing to cover potential periods of non-contracted amounts of energy. Taking into account the long life span of a wind park, BNDES initially assumed, as a pilot proposal for its terms of credit, an energy price threshold, called PLD Support, defined at R$ 90/MWh, the 2016 lowest ever contracted energy price. Such a reference price was to be applied to any amount of non-contracted energy during the whole operational horizon of a wind park (up to 30 years), thus allowing for the long-term estimation of the project cash flow and, consequently, the sizing of credit with compatible payment terms.

One year later an incremental change was introduced, which became known as a 'price support' mechanism. The bank updated its reference of value to a (higher) range of existing energy purchase agreements lasting up to four or five years, and the new benchmark was defined at values between R$130 to R$110 per MWh. By doing this, investors benefited and loans could be taken up. In contrast, BNDES assumed a riskier position relative to ACR and the previous PLD model, while maintaining its commitments to the long-term financing of the industry, thus fulfilling its development mandate. This price support mechanism was launched in November 2019 and up to July 2020 BNDES had disbursed US 73 million under this new scheme.

4.3 Innovations in development-oriented finance: the fostering of wind energy suppliers

As mentioned previously, since the very beginning of the history of wind energy in Brazil, in 2002 BNDES' accreditation policies went through four successive phases. For any investment project to be financed by the institution, regardless of the sector, the focus of the first and the last accreditation was capital goods. The second and third modes of accreditation were designed specifically for wind energy suppliers. The direction of change was towards an increasing density of capabilities required from equipment producers.

The first mode corresponded to the period up to 2009 and was a legacy of 40 years of practice: accreditation was based on a ratio of costs of components and weight of equipment to its sale price – or cost and weight to sales accreditation. By the early 2000s, such a ratio was set at 60%, regardless of the type and complexity of the equipment. The remaining 40% could be sourced

from abroad. As mentioned previously, between 2002 and 2009, in the case of wind energy projects BNDES only financed components already produced in the country, such as steel-based towers.

As the demand for wind energy increased between 2009 and 2012, BNDES designed and implemented an instrument to foster the localisation of wind turbine manufacturers. A Firm Level Progressive Accreditation (FPA) was implemented through a bilateral agreement between BNDES and a given supplier, and milestones were set to gradually increase local production. Such a procedure, which had been put into practice previously in other segments, was an innovation for wind energy suppliers. It led to the initial set-up of turbine production facilities by 11 firms and created the first steps of a firm-level learning process[22]. For BNDES this was also a learning stage in terms of getting acquainted with international best practices, technical and cost features of products, components and production, and the conditions of Brazilian-based value chains.

Between 2012 and 2018, during the expansion of wind energy investments, a sectoral accreditation procedure, the Sector Progressive Accreditation (SPA) was implemented. This was an evolution over the previous instrument, FPA, and financial innovation in two senses. First, for the first time in its history, BNDES developed and implemented a sectoral-based accreditation process, ending the one-to-one mode of accreditation and inaugurating similar procedures for all manufacturers. Second, the reference for progressiveness shifted away from a cost and weight to sales ratio towards the sophistication level of devices, minimum-efficient scales of production and potential backward linkages. That is, the economics of production and the technological complexity of equipment became the references for the definition of minimum levels for the localisation of production:

- For technology, simple components with well-established facilities, such as steel-based towers, were set up, but existing technical levels were ramped up. For turbine manufacturers the focus was on the localisation of metal mechanical parts for which local suppliers were already available.
- For middle-range components, the focus was to increase assembly capabilities and, gradually, to expand the acquisition of locally produced components with higher levels of sophistication. The chemical components for the fibreglass for blades is an example.
- For high-technology devices without a standing industrial base but with potential local competencies, lower levels of localisation were accepted against gradual increases in local content, as was the case of electromechanical energy conversion package components.
- For segments with extremely high technological density and without potential local capacity (or minimum efficient scale), imports were allowed. This was the case for digital-based controls.

In 2018, BNDES proposed a new accreditation instrument, valid for all capital goods producers. The Cost and Qualifier Based Accreditation (CQBA) was designed as a general FINAME policy. The CQBA was based on two components: a local to total cost ratio (LTCR) and a set of

[22] Wobben, Gamesa, GE, Vestas, Impsa, WEG, Alstom, Siemens, Acciona, Suzlon and Führlander – the only locally owned company was WEG, an electrical engineering corporation just entering the wind energy sector. Subsequently, some of these manufacturers were disqualified for not meeting the established milestones.

technology and capability-related qualifiers (TCQ). Local costs considered the costs of inputs and components, including services and labour directly allocated to production. In the denominator a relevant change was introduced: it no longer had the selling price as a reference as the cost and weight to sales ratio had. Such a formulation was a relevant innovation for two main reasons: manufacturers' profit margins were removed from measuring local content and the provision of indirect services associated with manufacturing was included.

The technology and capability-related qualifiers (TCQ) represented another relevant innovation. It was aimed at assessing and valuing technology and capability-related aspects of the equipment and the company respectively. Qualifiers were not mandatory for accreditation, but when fulfilled, they added to the CQBA. Five qualifiers were considered, each with objective thresholds: (i) technological complexity of the equipment; (ii) corporate investments in innovative activities; (iii) export propensity of the companies; (iv) technical qualification of the labour force; and (v) value-added. A CQBA of at least 50% was the requirement for a company´s equipment to be accredited by BNDES. Such proportions can be reached in two ways. The first alternative is simply to have a 50% local to total cost. The second alternative is to have a LTCR between 30% and 49% with the difference to 50% being composed of the technology and capabilities qualifiers, TCQ.

The new mode of accreditation was launched in 2018 and was designed to have the sophistication and capabilities of the Brazilian capital goods industry as a reference. It was also the result of BNDES' evaluation of the pros and cons of its 40-year practice and the learning from previous experiences of doing things differently with the accreditation in support of wind energy investments. Accordingly, some sectoral differentiation was embedded in the new policy, which, for example, largely follows the previous sectoral policy for the sophistication levels of the technology-related qualifier for wind energy suppliers.

Although even more complex than the cost and weight to sales ratio, the Cost and Qualifier Based Accreditation, if effectively implemented, has a higher potential to induce a more resilient local capital goods industry. Its implementation, however, requires effort and perspicacity from the industry and BNDES. On the one hand, significant efforts are required to adapt systems and generate the required increase in the amount and quality of information needed for an accountable accreditation. On the other hand, the economy is immersed in and aggravated by the pandemic scenario, so the demand for capital goods is very slack. Recognising the existing lack of activity and the fact that many corporations are taking actions towards downsizing and demobilising teams, BNDES is implementing this new policy in a phased mode that can last up to three years, enabling the joint consideration of competency levels, and effective and potential demand, in different segments.

4.4 The industry that came about: Brazilian wind energy suppliers

A relatively large and complex wind energy supply industry emerged in Brazil under the attractive terms of credit provided by BNDES (Table 2).

Table 2 – The Brazilian wind energy supplier industry: some structural features

Supply chain	More than 100 companies in the supply chain
	Six wind turbine production facilities, one locally owned
	Mechanical engineering firms entered the wind energy segment
	Relocation of industrial capacity from the southeast to the northeast
Jobs (2016)	15 jobs per MW (around 150,000)
Production costs	Declining costs with growth in the volume of production
	Exports and cost competitiveness of some components
Technology and quality levels	Similar to best practices
Wind turbine average power	Above 2 MW and growing, below Germany and Denmark, superior to China, India, EUA
Capabilities	Production and testing of new (international) models
Delivery times	From two to less than one year.
Cost to investors	Still higher than the international average

Source: Adapted from Araújo and Willcox (2017) and ABDI (2018)

Such an industry profile is the outcome of ten to 15 years of continuous development and, through the years, the dynamics of competition have also changed the industry profile. Wind turbine producers, mostly subsidiaries of foreign firms, adopted different localisation strategies. Some companies verticalised the production phases of electromechanical energy conversion devices. Other firms qualified local suppliers or attracted international partners for the same devices. Some wind turbine manufacturers withdrew permanently or left and re-entered the market. Others merged globally and achieved a relevant share of the national market.

Given the importance of the manufacture of large equipment or components (such as blades and towers) being located relatively close to wind parks, the development of the industry also caused a regional decentralisation of manufacturers. Although the state of São Paulo has remained the primary hub of the metal-mechanical base, some companies have established themselves in the Northeast and South regions.

According to Ferreira (2017), Brazilian suppliers of wind turbines and their components are competitive in quality and delivery time, and turbines incorporate the best available technologies. Yet, the cost of Brazilian equipment is relatively high when compared with the international average.

Local capabilities have been geared towards following strict technical specifications and delivery times to match the use of equipment. Efforts have been directed towards adapting equipment to local conditions, in parallel with the attention, at the production process level, to ensure delivery times as well as to the adaptation of assembly lines to local value chain conditions. These efforts have led to incremental innovations that were economically significant, as the large majority of

wind turbines have shown operational technical efficiency. The locally owned producer, WEG, has naturally been engaged in the local development of new turbines, with the support of a recently acquired North American specialist firm. Given the prevailing high energy factor, some of the foreign-owned firms have tested and introduced their new products into Brazil. However, by and large, throughout the wind energy supply industry value chain, innovation capabilities – the ability to design and produce new devices nationally that are at least equivalent to international references – are still limited.

Such a stage of development reflects the fact that corporations are strategically oriented to comply with immediate local demand, under the pressure of the obligations of public auction contracts: the policy framework and the modes of BNDES' development finance with their primary concern for the expansion of energy capacity and the operationalisation of installations. In this sense, the auction policy framework and the corresponding financing by BNDES were focused more on the capacity to deliver equipment and less on investments in innovation capabilities. For example, at BNDES, innovation capabilities were explicitly taken up only after 2018, with the new accreditation methodology, and there were few signs of a long-term strategy to place Brazilian based wind energy suppliers in the international innovative league.

5. Discussion

This article has provided evidence about how relevant development banks can support emerging sustainability-related activities through innovative finance[23]. The main message is that success in policy innovation is not a natural process. Financial innovations depend on the alignment of a complex web of intervening exogenous and endogenous factors.

Exogenous factors – technology, market, demand and policy drivers – created temporary windows of opportunity, demanding and opening up the space for innovations in development finance. Specifically, the favourable conditions were: the availability of international operators of and manufacturers for wind parks; improvements in the cost and the technical aspects of turbines; an economic climate inductive of energy demand; and the coherence of policy directives and the convergence of actions by the relevant executive agencies. Without adequate framework conditions wind energy in Brazil would probably not have taken off. Even if a development-oriented finance institution had been present, its isolated actions would have found little resonance in the real economy.

The presence of favourable exogenous factors would not alone create the conditions to ensure the growth of the wind industry and the emergence of a local supply industry without a development-oriented finance institution. For that, this article has provided evidence about the strategic role played by the mission-oriented financial institution to lower, temporarily, the

[23] Nonetheless, as the role of capital markets in the financing of sustainable industries is becoming increasingly relevant, research along similar lines as the one carried out in this paper are worth taking up.

investment costs of projects (and later to provide market-oriented solutions), and to shape the emergence and consolidation of a local supply industry.

The analytical framework and the access to qualified information provided an adequate comprehension of the evolution of BNDES' dynamic capabilities. The mobilisation of capabilities resulted in different financial innovations, ensuring BNDES' historical mission of 'pulling' investment projects and 'pushing' local industrial development in Brazil was successful.

For the support of the wind park investments during the initiation period, the windows of opportunity were PPAs of long duration and foreseeable prices as they provided a solid demand for relatively low-risk investment finance. In this scenario, BNDES' credit instruments were quickly adapted to the features of the wind industry to lead the sector ramp-up period. The mechanisms were incremental innovation over existing practices.

As market dynamics changed, and unregulated and shorter-term contracts came to the fore, BNDES had to shift its instruments. It did this by incorporating market price references into its financial modelling to avoid a potential mismatch between investment maturity and contract duration. By doing so, the institution took up riskier positions. As financial modeling and credit risk evaluation parameters evolved, this could be considered as a new product in its portfolio and also a process innovation. In this sense, such a market-oriented instrument is a disruption relative to the 'tranquil waters' of PPA contracts. As market-oriented contracts are likely to increase in the years to come, BNDES will be well-positioned to remain a relevant institution for supporting sustainable-related investment projects.

To foster local suppliers, the historical policy orientation has remained firmly in place: to benefit from BNDES' terms of credit, investment projects must be sourced from accredited local suppliers. However, the modes of accreditation did change substantially. During the industry´s initial years, a 40-year conventional policy was enforced and a limited number of local producers benefitted, but the strong wind energy investment drive provided sufficient demand for further industrial development through the attraction of producers of more sophisticated equipment. Traditional instruments had to be changed to facilitate industrial learning, while the level of localisation was limited by the pertinent quality and delivery times of wind energy operators. Gradual changes were introduced up to the point when a new sectoral approach in accreditation procedures was designed and implemented, and this had the capabilities of firms as the reference for localisation. Further ahead and having, among other cases, the wind energy experience to guide it, BNDES produced a very advanced accreditation method based on the dynamic capabilities of firms and sectoral features.

The opening-up of the innovation box of a public mission-oriented institution provided content to disentangle the intricacies associated with the concept of policy capacity. Development-oriented finance innovations resulted from (i) strategic priorities aligned with policy directives; (ii) a strong balance sheet capable of absorbing liabilities; (iii) organisational procedures allowing for the segregation of (impersonal) credit and project evaluation; (iv) the successful design and implementation of adequate terms of credit and accreditation procedures, successively changing them to match the industry evolution; (v) the availability of finance on a scale sufficient to attend a

growing demand; and (vi) the construction of reliable and trustworthy network connections with relevant actors (public and private).

Behind such complex processes, a method of collective decision-making was in place backed up by a qualified team of professionals with the knowledge and network connections to learn and duly explore and evaluate economic, financial, market and technology opportunities to foster economic development. The last point is relevant for the growing body of work that seeks to understand how bottom-up processes of networked or interacting interventions – state-led and society-led at multiple scales – might prove effective for facing up to climate change challenges (Hoffmann 2011). As with the works of Wu et al (2015), Howlett (2014), and Karo and Kattel (2018), these findings further contribute to enquiries about the nature of public innovation and how policy capabilities to innovate are put in motion.

6. Conclusions

This article has analysed the nature of innovations in development finance introduced by BNDES to shape and foster the Brazilian wind energy and supplier industry in the 2010s; what factors conditioned its actions; and what the outcomes of such development actions were. To address these questions an analytical framework was developed and an empirical exercise carried out. Three main considerations are put forward in this concluding section.

First, the wind energy sector could become a pilot for guiding BNDES navigation amidst the dire straits of low economic growth. It could also contribute to the preparation for a strong future trend in which socioenvironmental sustainability becomes a beacon for development. For that, BNDES will need to strengthen its development finance innovation capabilities.

Second, the experimental nature of this exercise provides valuable lessons. Alongside the elaboration of this article, research queries were finetuned *pari passu* with the need for further empirical investigation; as they were addressed and new information gathered, questions were sharpened up and new responses drawn into the analysis. That is, the very inquiry into how to approach the issue of policy innovations – in this case new modes of development finance – and the exploration of their relevant constituent elements demanded a flexible approach. However, one condition had to be fulfilled: the anchoring of the analytical framework in certain concepts, drawn from the literature debating the ability of public institutions to innovate from an institutional and political economy perspective, and the Schumpeterian tradition on the relevance of innovation for economic development.

Lastly, further conceptual and empirical research on policy innovation and capacities, and their conditioning factors, is much needed. Valuable experiences do exist and deserve investigation, but additional evidence is needed to understand the relevance of public institutions explicitly investing in innovative capabilities to better serve their missions. From a conceptual perspective, the research agenda on public innovation capabilities must be extended. Which concepts from the innovation theory are useful and can be further adapted for the understanding of policy innovations? Which are not? What motivates public institutions to innovate when designing and/or implementing policies? How to systematically organise the inter and intra flow of causal relations

among political decisions, policy directives, dynamic capabilities, innovations and social economic consequences? It is hoped that this article may inspire further work to address these and/or new research questions.

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