Guide for Designing Contracts for Renewable Energy Procured by Auctions

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Abstract

Auctions to procure long-term contracts with Independent Power Producers are the most common instrument to scale-up the private investment and the deployment of renewable energy sources capacity in the Latin American and Caribbean (LAC) region. The great appeal of auctions derives from their ability to clear fair prices, and because they can be adapted to diverse market designs and recognize the intrinsic value of energy delivered in different areas and time. The auction design, however, is a complex task, that concerns the alignment of different elements such as the auctioned object, the participation rules, the bidding process, the winner definition, the setting price approach (pay-as-bid or pay-as-clear, for example), and, in the special case of procurement for long-term agreements, the contractual clauses. Therefore, the purpose of this guide is to provide knowledge-based support to practitioners involved in the design of energy auctions and power-plant projects targeting the increase in renewable energy sources diffusion. This includes public authorities, project leads, and investment officers for both the public and private sectors; lenders with a role in the design of project and business models; consultants or any third parties hired to carry out analyses for project feasibility and auction design. This guide is part of a broader effort in the energy division to collect and analyze auction results in the LAC [5], and also to place the auctions choice as a mechanism to incentive renewable energies in LAC [3].

This guide complements this effort by focusing on the design of the contract to be auctioned, and it proposes a check list of the key issues that policymakers need to answer when designing the process. Moreover, it suggest some best practices based on examples from previous experience.

Keywords: Auction, energy, infrastructure, renewable, contract design.

SUMMARY

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Introduction

The 21st century started with an impressive wave of Renewable Energy Sources (RES) deployment in the Latin America and Caribbean (LAC) region, including hydropower. According to the International Renewable Energy Agency (IRENA), between 2007 and 2018, the installed RES capacity had increased at a rate of 4.3% per year, while the Non-conventional Energy Sources (NCE) capacity grew more than seven-fold, starting at 7.949 MW in 2007 and reaching 56,618 MW in 2018 [1] [2].

The development of RES in the LAC region was the outcome of continuously growing demand and direct public policies, regulatory reforms, and the continuous decrease of costs for unconventional renewables. Since the late 1990s, many countries had introduced competition into generation and energy trading activities to attract private investment, ensure resource adequacy, and increase access to electricity services. Nevertheless, the LAC region is characterized by significant heterogeneity across countries in the degree to which electricity markets have evolved, regarding private participation and including whether they still have a vertically integrated service provider or had created an independent National Regulatory Authority (NRA) or wholesale and retail markets [3] [4].

Despite these differences, the application of auctions to procure long-term contracts with Independent Power Producers (IPP) is a common instrument in the LAC region to scale-up private investment and the deployment of RES capacity [5] [6] and has been adopted by 16 countries, between 2005 and 2019, including the largest economies in the region. The great appeal of auctions derives from their ability to clear transparent prices and because they can be adapted to diverse market designs and applied both to target a particular technology or to be technologically neutral.

Auctions may be used to procure energy from existing power plants or new power plants still in the project phase, serving as a powerful mechanism to ensure long-term resource adequacy, especially in the case of market with a large share of RES, since the intermittency, the seasonality, and the low operational cost makes developers particularly reluctant to rely on the spot market. Therefore, using auctions to match IPPs to long-term off-takers at set prices reduces risk, improves funding, and enables large long-term investments. Long-term power purchase agreements (PPAs) can provide revenue stability and protect investors from the effects of changes in regulation or market design [5].

Figure 1: RES capacity in LAC

Source: IRENA [1] [2]

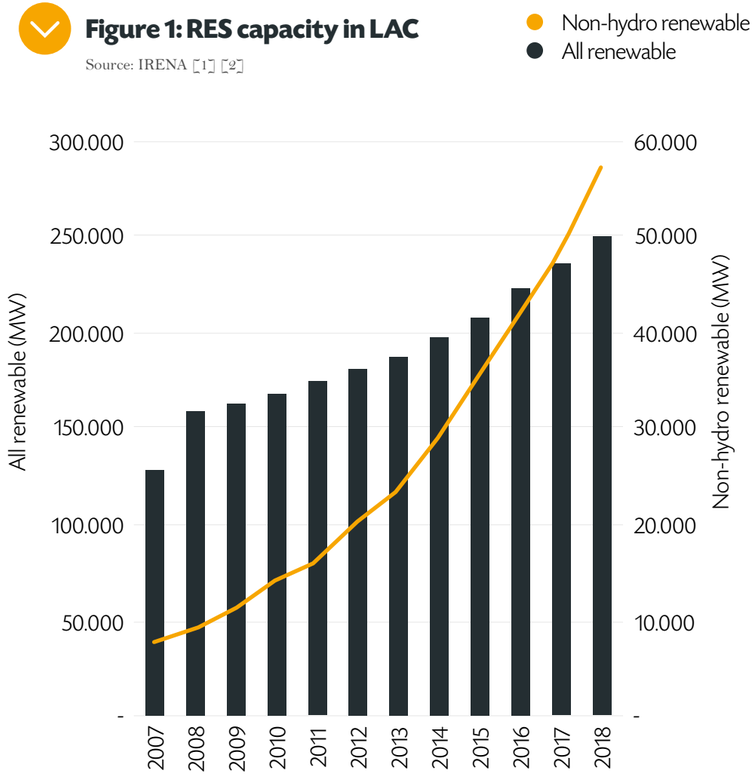


Table 1: Procurement Auctions held in the LAC region.

Source: [6] [7] [8] [9] [10]

Year	Country	Source				
		Hydro	Biomass	Wind	Solar	Neutral
2005	Brazil					
2006	Brazil					
	Uruguay					
2007	Brazil					
	Uruguay					
2008	Brazil					
	Jamaica					
2009	Argentina					
	Brazil					
	Peru					
	Uruguay					
2010	Brazil					
	Honduras					
	Peru					
2011	Brazil					
	Guatemala					
	Panama					
	Peru					
	Uruguay					

Year	Country	Source				
		Hydro	Biomass	Wind	Solar	Neutral
2012	Brazil Costa Rica Guatemala Panama					
2013	Brazil El Salvador Guatemala Jamaica Panama Peru					
2014	Belize Brazil					
2015	Brazil Guatemala Jamaica					

Year	Country	Source				
		Hydro	Biomass	Wind	Solar	Neutral
2016	Argentina					
	Brazil					
	Chile					
	El Salvador					
	Mexico					
	Peru					
	Suriname					
2017	Argentina					
	Bolivia					
	Brazil					
	Chile					
	El Salvador					
	Mexico					
2018	Argentina					
	Brazil					
	Mexico					
2019	Argentina					
	Brazil					
	Chile					
	Colombia					

Objectives

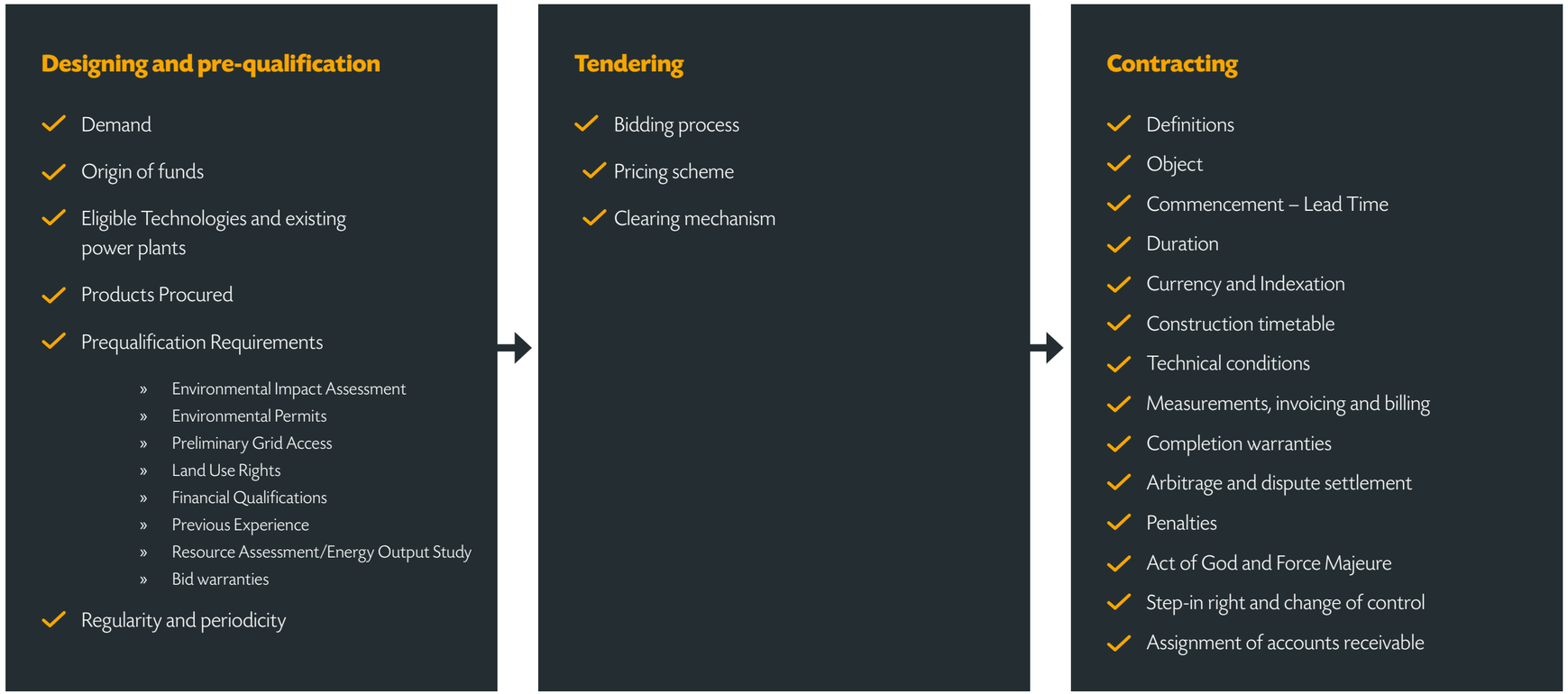
The primary purpose of a procurement auction is to acquire a service or a good at the lowest price possible, given a set of minimum quality requirements. However, when designing energy auctions, policymakers must consider two additional objectives: i) to attract bids from solid, reliable companies that will have the financial ability to build the projects on schedule and to operate the power plants under the contractual conditions; and ii) to ensure that the contracted projects and power plants meet the needs of the system, in terms of capacity, reliability and environmental and social footprint [5].

On the other hand, auction design is a complex set of co-related elements. The design of an auction can affect the competition, the attractiveness of the bidding, the transparency and information disclosure, the contracted price, and other process outcomes.

Auction Design Elements

The assessment of a procurement energy auction design could be done by unbundling it into three groups of elements:

Figure 2: Auction Design Elements



DESIGN AND PRE-QUALIFICATION

The design of electricity auctions must consider three main goals. First, auctions must be attractive enough to investors in order to generate competition and to achieve optimal prices. Second, the auction design must ensure that the bidders are reliable companies that will have the technical and financial ability to build projects on schedule. Third, the auction design should ensure that the right mix of products is awarded in order to achieve the desired outcomes [5].

Demand

The demand for energy to be auctioned may be a fixed amount, determined by a central planning authority or by the aggregation of the demand informed by transmission operators, distribution companies, traders or free consumers and other off-takers, or a price-sensitive volume, in which the amount contracted responds to the prices offered.

Pros and cons of demand aggregation: contracting large volumes in a single auction may accelerate progress toward capacity and generation goals. However, it entails a bigger risk of oversupply and overprice since it will jeopardize the learning opportunities that take place over the course of each tender.

Pros and cons of demand information: transparency may drive authorities to disclose the total demand before the auction because it may allow a better-informed bid. However, it increases the risk of collusion. Thus, auctioneers may choose not to disclose the total demand until after bids are received to prevent collusion, making it more difficult for the bidders to divide the demand among themselves. [5]

Origin of the buyer funds

The energy may be (1) contracted by private off-takers, (2) acquired by the government or a public authority to ensure resource adequacy and the capacity of the system, or (3) fulfilled public policies objectives through a Renewable Energy Certificate .

- **Private off-takers:** the off-takers pay the price directly to the seller.
- **Government or public authority insurance:** the cost of renewable energy contracts can be transferred to the energy tariff (ultimately to consumers) or financed by the government, mainly through the general budgets of the State.
- **Renewable Energy Certificate (or green certificate):** the application of a levee or the raising of donor funds.

The credibility of the source of the funds is critical to obtaining more competitive offers and to closing project finance resulting in higher project rates [6]. Therefore, investor confidence can be significantly improved through the provision of payment guarantees by the off-takers. Argentina, for example, has the *Fondo para el Desarrollo de Energías Renovables* (FODER), a fund that provides payment guarantees for the sellers [5].

Eligible Technology

The auction can be for a single technology, for a group of technologies or can be technologically neutral[1]. In 2016, the auctions held in Brazil, Peru, and Panama

1. An auction is never completely neutral. Even when many different technologies can bid, the design of the auction, in most of the cases, is more adequate to one technology or to another. Nevertheless, there are some auctions which are designed to embrace a clear effort to level the play field.

were specific (or have a specific contract) to each renewable technology (wind, photovoltaic, PCH, biomass). Chile and Mexico favor the use of technology-neutral auctions, while Colombia has auctions for RES (for a group of technologies).

Technology-specific auctions have the advantage of planning supply diversification [11]. Neutral auctions have the advantage of increased competition and cost reduction [12].

Existing power plants

Considering that the market failures may affect both new and existing power plants, the procurement auction for long-term contracts may allow the competition of existing power plants and new projects on equal terms. This approach is used by Chile, Colombia, Mexico, Panama, and Peru.

On the other hand, the fixed costs of the existing power plants are sunk and, at least partially, recovered. Therefore, it is possible to ensure their feasibility and permeation in the market with short- and medium-term contracts and with lower prices than will be necessary to secure new projects. With this rationale, Brazil has auctions specifically for new projects.

Countries	Approach
Argentina[1]	Group of technologies
Brazil[2]	Technology specific
Chile[3]	Technology neutral
Colombia[4]	Group of technologies
Mexico[5]	Technology neutral
Panama[6]	Technology specific
Peru[7]	Technology specific

Table 2: Technology

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

Countries	Participants
Argentina[1]	New projects and enlargement and retrofit of existing power plants
Brazil[2]	New projects and enlargement of existing power plants
Chile[3]	Existing power plants and new projects
Colombia[4]	Existing power plants and new projects
Mexico[5]	Existing power plants and new projects
Panama[6]	Existing power plants and new projects
Peru[7]	Existing power plants and new projects

Table 3: Existing power plants

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

Products procured

The auctioneer can procure installed capacity or generation, depending on whether energy-only markets will allow participants to cover all fixed and variable costs of generation projects while incentivizing new investment in generation[2]. Mexico calls for both capacity and generation, whereas in Argentina procures only capacity and Peru, Brazil, and Chile, procure only for generation. In Chile, however, the generation is awarded within intraday and seasonal time blocks, which makes intermittent and seasonal renewable technologies more competitive but may discourage participation from other technologies [5].

Pre-qualification requirements

One of the greatest challenges to auction design is to ensure the seriousness of the bids and the contractual commitments. Therefore, the auctioneer can select and impose some criteria on bidders in the form of pre-qualification requirements to ensure that only those that are likely to follow through with the auction process and complete the project within the allotted time frame can participate.

Examples of such requirements include Environmental Impact Assessment, Environmental Permits, Preliminary Land Use Rights and Grid Access, Financial Qualifications, and Previous Experience [5]. Considering the intermittency and seasonality of some energy sources, the auctioneer may also ask for a Resource Assessment or an Energy Output Study that demonstrates the expected generation (or firm energy) given a confidence interval. In Brazil, for instance, wind power plant projects may comply with an Energy Output Study with 90% confidence, while PV solar and small-hydro must comply only with a 50% confidence interval.

Auctioneers may, additionally, ask for participants to provide bid bonds to join the auction. The purpose of this guarantee is to cover the risk that the submitting bidder will not abide by its offer. The guarantee shall be executed if an awarded bidder does not sign the contract.

On the other hand, pre-qualification requirements that are too stringent may reduce competition and jeopardize the efficiency of the auction.

Regularity and periodicity

Participating in auctions have a significant transaction cost, including the cost of preparing and developing the project of the new power plant, and of obtaining all the needed permits and the bid bond and the other financial warranties. If auctions are not part of a periodic and predicable process, the risk of potential bidders is amplified, reducing their participation, and therefore the competition in the auction, increasing the final price [13].

In the case of Mexico and Brazil, auctions have an established annual periodicity. Peru has run four renewable energy auctions in the last five years. In these cases, countries have also benefited from dynamic efficiency driven by the learning curve of IPPs and an increase in the number of bidders participating in the auctions [6]. Crises impacting the energy demand, for example, economic crises or health crises such as COVID-19, can disturb the auction agenda which increases transaction costs and disrupts industry supply chains. The current crisis could be still more disruptive for the supply chain, because it will impact both local markets and international trade as well.

2. For more details on products procured, see also [3].

TENDERING

The Tendering group of elements encompasses the bidding process, the pricing scheme, and the clearing mechanism.

The bidding process defines the rules by which the auctioneer receives the offers and defines the winning bids. The most commonly used designs are (i) sealed-bid auction; (ii) descending clock auction; and (iii) hybrid auctions that combine the two former bid designs.

Regarding, the pricing scheme, there are two main approaches: (i) the pay-as-bid pricing, in which the remuneration is determined by the bid of each participant; or (ii) the pay-as-clear (or second price), in which the price for all participants will be the bid that has cleared the auction (the price needed to match supply and demand).

The clearing mechanism is especially important when generators' bids are bulky and indivisible, which implies that an exact match between supply and demand is not always possible.

CONTRACTING

The contract establishes the conditions that the buyer and the seller must comply with in order to preserve the right to delivery and receive the contracted energy and capacity at the volume and price cleared by the auction. The next sections of this guide focus on the last design element of contracts for procurement RES auctions.

Requirements	Argentina[1]	Brazil[2]	Chile[3]	Colombia[4]	Mexico[5]	Panama[6]	Peru[7]
Environmental Impact Assessment	✓	✓					
Environmental Permits	✓	✓					
CPreliminary Grid Access		✓					
Land Use Rights	✓	✓					
Financial Qualifications	✓	✓	✓		✓	✓	
Previous Experience					✓	✓	✓
Resource Assessment Energy Output Study	✓	✓				✓	✓
Bid warranties	✓	✓	✓	✓	✓	✓	✓

Table 4: Pre-qualification requirements

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

Contract Principles

The contracts have multiple purposes. Primarily, it is both a legal and financial tool that protects both buyer and seller from spot price volatility. Additionally, contracts yield a predictable revenue stream that can be used as collateral for long-term financing of new projects and gives commercial feasibility to existing power plants in markets with significant participation of intermittent RES or of energy sources with low marginal cost. Finally, contracts allocate risks, define liabilities, and offer guidance for action in the case of unanticipated contingencies. Therefore, to fulfill its objects, the contract must be designed with following principles in mind:

1. **Simplicity:** the contract must as simple as possible in order to facilitate the understanding and enforcement of its clauses;

2. **Coherence and comprehensiveness:** the contractual clauses must be coherent with each other and with the regulatory framework and market development. The set of clauses must be adequate, effective and credible, and must ensure a capacity to respond to a changing, fast-paced environment;

3. **Clarity:** the contract must clarify obligations, rights, and responsibilities;

4. **Proportionality:** the contract must provide a fair allocation of risk and liability;

5. **Promotion of compliance:** the contract needs to be self-enforceable, and the potential conflicts of interest must be mitigated by positive economic incentives and the reduction of the administrative costs;

6. **Reality check:** the policymaker or regulator accountable for the contract design must systematically assess the contract fulfillment and the sectorial outcomes to ensure that the intended objectives have been efficiently and effectively achieved. Identified flaws should be solved in a new contract

7. **Funding:** the contract must provide predictability and stability to the IPP cash-flow.

Contractual Clauses

Contracts may be analyzed by dismantling and assessing their various clauses (e.g., the object, the rights, and obligations, the lag period, the contract duration, etc.). All the contract clauses are correlated and dependent. The choice about how to include them into the contracts, consequently, resembles the fitting together of Lego pieces, which must be placed in a way that allows them to fit together, and form a robust instrument that is as effective and efficient as possible considering the regulatory framework and the energy market maturity.

General

Definitions

Contracts are legal instruments that define the exchange of rights and obligations between two or more parties. In this sense, the writing of the contract must be as straightforward and concise as possible, in order to avoid any ambiguity that may result in future litigation.

In this context, it is helpful if the contracts for the delivery of energy and capacity, which are complex agreements, contain a section of definitions, clarifying the meaning of all the acronyms and technical terms encompassed by the contract and necessary for its correct execution.

Object

The object of a contract is the description of the goods or services that will be provided by the seller to the buyer. In the case of the RES auctions, the object may be the delivery of energy, capacity, or both, under certain conditions.

In the case of the Chilean 2019-01 auction, for example, the object of the contract is

Table 5: List of basic contractual clauses

Categories	Clauses
General	Definitions
	Object
Economics	Commencement – Lead Time
	Duration
	Currency and Indexation
Technical, Economic, Environmental and Social Obligations	Construction timetable
	Technical conditions to energy and capacity delivery
	Measurement, invoicing and billing
	Warranties
	Arbitrage and dispute settlement
	Penalties
	Indemnities
	Act of God and force majeure
Financing	Step-in right and chance of control
	Assignment of accounts receivable

the delivery of both energy and capacity to regulated consumers. To this end, the seller must have physical support in an existing power plant or in a project to build a new one.

In turn, the contractual object of the Colombian auction number 02-2019 is the delivery of only energy, but the seller also must back his supply bid with an existing power plant or a power plant projected for construction.

As a third example, the Mexican *Subasta de Largo Plazo* (SLP) 1/2018 auction procures for contracts with three objects: i) energy delivery, ii) capacity delivery, and iii) Clean Energy Certificates (CEL in the Mexican acronym).

Economics

Commencement and Lead Time

The commencement is the moment (year, day, and time) when the delivery of the object of the contract must begin. The lead time is the period between winning the auction and the commencement. For existing power plants, the lead time may be necessary for administrative reasons related to the auction adjudication process and signature of the contract.

In the case of new project procurement auctions, however, the lead time is required to allow enough time for the projects to be implemented and therefore must be compatible with the time required for the entry into commercial operation of the plant, including the necessary time for the IPP to obtain all technical and environmental permits, and for construction. In this way, in auctions where different energy sources and technologies can compete, the lead time must correspond to the longest necessary deployment time.

On the other hand, the longer the lead time, the greater the buyer's risk of demand forecasting and also the risk of paying a higher

Table 6: Lead Time

Countries	Lead Time
Argentina[1]	Maximum of two years. Bidders submit commercial operation dates for projects, and earlier completion is incentivized. The contract period begins on the real date of commercial operation.
Brazil[2]	Existing power plants: between 0 and 5 years
	New power plants: between 3 and 6 years
	RES power plants: between 1 and 5 years
Chile[3]	4 year (1st Auction of 2015) 1 year (2nd Auction of 2015) 6 years (Auction of 2017)
Colombia[4]	3 years (Auction of 2019)
Mexico[5]	Standard of 3 years, but the IPP may bid the commitment to start operation between 2 and 5 years from the auction
Panama[6]	Solar: 2 years
	Wind: 2 years
	Hydro: 6 years
Peru[7]	RES power plants: 2 years

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

price for projects with short construction time whose energy sources still experience significant reductions in costs due to gains in technology and that, therefore, could be procured in the future at a lower price. For these reasons, in jurisdictions that use longer lead times, to reduce the buyer's risk, it is desirable to have a chain of auctions with different lead times and to predict mechanisms for adjustments and sale of energy or capacity surplus such as de-hiring auctions.

In the case of Brazil, the auctions to procure new power plants have a lead time of 6 to 3 years. So, the distribution companies, the buyers in the Brazilian regulated energy auctions, are allowed to exchange energy among themselves or sell the surplus in the unregulated market to adjust deviations in demand forecasts through de-hiring auctions.

Allowing the alteration of some technical characteristics of the contracted project reduces the risk of technological obsolescence. In the Brazilian case, the change of the projects for wind and photovoltaic plants is the rule and not the exception. For this purpose, the bases of the Brazilian auction expressly provide for this possibility, informing the conditions under which the changes must be requested for approval by the regulatory agency.

According to the rules of the Brazilian A-6[3] of 2019 auction, it is possible to change the installed capacity, the type, and quantity of generating units, and the connection point of the power plant, and to anticipate the power plant operation and sell energy into the Brazilian wholesale market.

Technical changes, however, must conform to environmental permits, cannot modify the energy source initially indicated, and may not compromise the fulfillment of contractual obligations assumed in the auction, such as the amount of energy and capacity negotiated, the date of commencement and the duration.

The rules of the auction also expressly establish that all risks and costs associated with changes in the technical characteristics and the operational anticipation of the project are the exclusive responsibility of the seller and may not be passed on to the buyers.

Another alternative to mitigate the risk of early obsolescence is to allow projects with shorter construction periods to anticipate their operation. The expected revenue to be earned with the anticipation also contributes to the reduction of the price cleared by the auction.

Duration

The duration of the contract corresponds to the delivery period of the object and starts at the commencement date.

As mentioned above, the primary purpose of the auctions carried out in the LAC region is to ensure the energy resources adequacy in the long term. That is obtained by improving the overall attractiveness of the investment and facilitating the access to financing by providing long-term contracts to hedge the generators' risk against the volatility of spot market prices.

Therefore, the contract duration should be long enough to provide investors in new generation projects with some cash-flow stability and predictability during the time required for loan maturity. Consequently, the contract duration should reflect the capital intensity of the technology, the modality of the project financing, and the discount rate involved[4] [14].

3. In Brazil, an auction A-6 refers to the lead time of 6 years.

4. The more distant future income is from the present; the lesser is its impact on the net present value.

Table 7: Duration

Countries	Contract duration
Argentina[1]	20 years
Brazil[2]	Existing power plants: between 1 and 15 years
	New power plants: between 15 and 30 years
	RES power plants: between 10 and 30 years
Chile[3]	Up to 15 years
Colombia[4]	Between 10 and 20 years
Mexico[5]	Energy: 15 years
	Power capacity: 15 years
	Combined energy and power capacity: 20 years
Panama[6]	Solar: 20 years
	Wind: 20 years
	Hydro: 20 years
Peru[7]	Up to 20 years

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

The benefits to consumers of long-term contracts for existing power plants, however, are not so evident. If on the one hand, consumers can gain protection from spot price variations, on the other hand, the energy transition process in the LAC region has shown that the insertion of RES can be carried out at prices below the requested by conventional existing power plants, especially with fossil sources, whose operating cost is generally higher.

Therefore, it may be appropriate to continuously check the trade-off between the convenience of use and the shortest possible duration in order to favor the chance of having new projects more affordable than the existing ones, subjected to the risk of future lack of capacity if the term of the contract is not long enough to ensure the resource adequacy.

In a context of demand crises such as the one provoked by the COVID-19, the obligation of long-term contracts is a protection for the generation companies; however, it places the risks mostly at distribution companies. The crisis may generate liquidity constraints in the medium term, and in the longer term these costs are usually pass through to consumers through tariff revisions (in the subsequent periods).

Currency and Indexation

Long-term contracts in developing countries often require the existence of indexing clauses linked to the dollar or to national inflation indexes. There are two main reasons for indexing contracted prices. First, many LAC countries have persistent and volatile inflation rates. In this context, indexing seeks to maintain the real value of the IPP revenues along with the cash flow. Thus, the feasibility and risk analysis of the project, especially for obtaining funding, can be accomplished without the

need for forecasts about expected inflation. The allocation of the inflation risk on the consumer side reduces the value of bids and the final price of the auction.

The second reason for using indexing formulas is related to the reduced capacity to produce equipment locally or with a low liquidity of the national capital market. In both cases, the investor will need to procure alternatives for equipment and funding in the international market and, consequently, will be exposed to variations in the exchange rate.

Another question concerning indexation is whether to use a single formula to index all the contracts procured in the auction, or to allow agents to include the required indexation within their bid. The latter approach, used, for example, in Chile, creates a challenge when comparing different bids because their competitiveness in the long term varies broadly according to the parameters chosen [14].

In such a context, the approach for indexation clauses in auctioned contract in the LAC region varies greatly, including in the cases of best practices covered in this guide, indicating that indexation is relevant to contract design, but that its features are strongly impacted by the country market structure and regulatory framework.

Technical, Economic, Environmental and Social Obligations

Construction timetable

The construction timetable establishes the main milestones that the IPP must meet in order to deliver the contracted object on the commencement date. Its inclusion in the auctioned contracts aims to allow the purchaser (and the lender) to monitor the risk of the contracted object not being

Table 8: Delivery obligation

Countries	Currency and Indexation	Period
Argentina[1]	Argentinian pesos indexed to US Dollar.	Monthly
Brazil[2]	Brazilian Reais indexed to the Brazilian consumer inflation	Annual
Chile[3]	US Dollars indexed to a formula with the seller's selection of index for energy price and inflation. The seller may choose among four indexes for energy price and the Consumer Price Index (USA)	Semiannual
Colombia[4]	Colombian Pesos indexed to the Colombian producer inflation	Monthly
Mexico[5]	Mexican Pesos indexed to the US Dollar exchange rate and the US and Mexican inflations	Monthly
Panama[6]	Panamanian Balboas or US Dollars indexed to the Panamanian consumer inflation	Monthly
Peru[7]	US Dollars indexed to the US inflation	Annual - Applied only if accumulated inflation exceeds 5%

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

delivered on the scheduled date, and to adopt alternative measures to mitigate the impact of the lack of energy or capacity.

Infrastructure investments are characterized by significant upfront expenditures, which are made during the development and construction phases. These expenditures must be met by equity and financing and will be recovered only in the future with revenues generated during the operation phase.

Therefore, the cash flow of a new power plant will be negative during the development and construction phases — exactly the moment when the project is subject to higher risks. Cost overruns permit cancellation, difficulties in land acquisition, environmental and social licensing, and constraints in the access to the transmission grid, among other factors, may significantly delay the start of operations [14] [15].

Table 9: Risks Associated with Infrastructure Assets

Source: OECD [15]

<table>
<tr><th>Risk Categories</th><th>Development Phase</th><th>Construction Phase</th><th>Operation Phase</th><th>Termination Phase</th></tr>
<tr><td rowspan="3">Political and regulatory</td><td colspan="2" rowspan="2">Contract renegotiation</td><td rowspan="2">Change in tariff regulation</td><td>Contract duration</td></tr>
<tr><td>Asset transfer</td></tr>
<tr><td colspan="3">Currency convertibility</td></tr>
<tr><td colspan="4">Change in taxation</td></tr>
<tr><td rowspan="2">Environmental and Social</td><td colspan="2">Environmental and social review</td><td rowspan="2">Cancellation of permits</td><td rowspan="2">Decommission</td></tr>
<tr><td colspan="2">Longer permitting process</td></tr>
<tr><td rowspan="6">Technical</td><td colspan="3">Governance and management of the project</td><td rowspan="4">Termination value different from expected</td></tr>
<tr><td colspan="3">Environmental</td></tr>
<tr><td>Project feasibility</td><td rowspan="2">Construction delays and cost overruns</td><td rowspan="2">The qualitative deficit of physical structure</td></tr>
<tr><td>Archaeological</td></tr>
<tr><td colspan="3">Technology and obsolescence</td></tr>
<tr><td colspan="4">Force Majeure</td></tr>
<tr><td rowspan="7">Business</td><td colspan="4">Enforceability of contracts, collateral, and security</td></tr>
<tr><td>Prefunding</td><td colspan="3">Default of counterparty</td></tr>
<tr><td colspan="2" rowspan="3">Financing availability</td><td colspan="2">Refinancing risk</td></tr>
<tr><td colspan="2">Liquidity</td></tr>
<tr><td colspan="2">The volatility of demand/market risk</td></tr>
<tr><td colspan="4">Inflation</td></tr>
<tr><td colspan="4">Real interest rates</td></tr>
<tr><td colspan="4">Exchange rate</td></tr>
</table>

Thus, considering the importance of the security of energy and capacity supply, the IPP is usually overseen by a public authority (an independent regulatory agency or another branch of the government). The inspection usually seeks to ensure the proper pace of construction and the fulfillment of the conditions of the technical and environmental permits.

Construction delays and failures to comply with the regulatory obligations imply the issue of penalties. However, considering that the project has no cash generation at the construction phase, it is essential that the public authority responsible for the oversight and enforcement of penalties ensures the right of contestation and defense before requiring the payments of the fines, and considers the application of alternative penalties such as:

- The execution of the bond completion;
- The suspension of the right to participate in energy auctions until all projects under construction have regulatory compliance; and
- The prohibition from participating in energy auctions and contracting with the government for a specified period.

Also, considering the difficulty and the cost of monitoring the construction of several projects, it is possible to require the IPPs to contract with an independent audit firm to certify the proper pace of implementation of their projects, as is the Chilean experience.

Technical conditions to energy and capacity delivery

The energy generation of some RCE, such as photovoltaic, wind, varies during the year according to the season and sometime during

Figure 3: Contract with a flat annual obligation

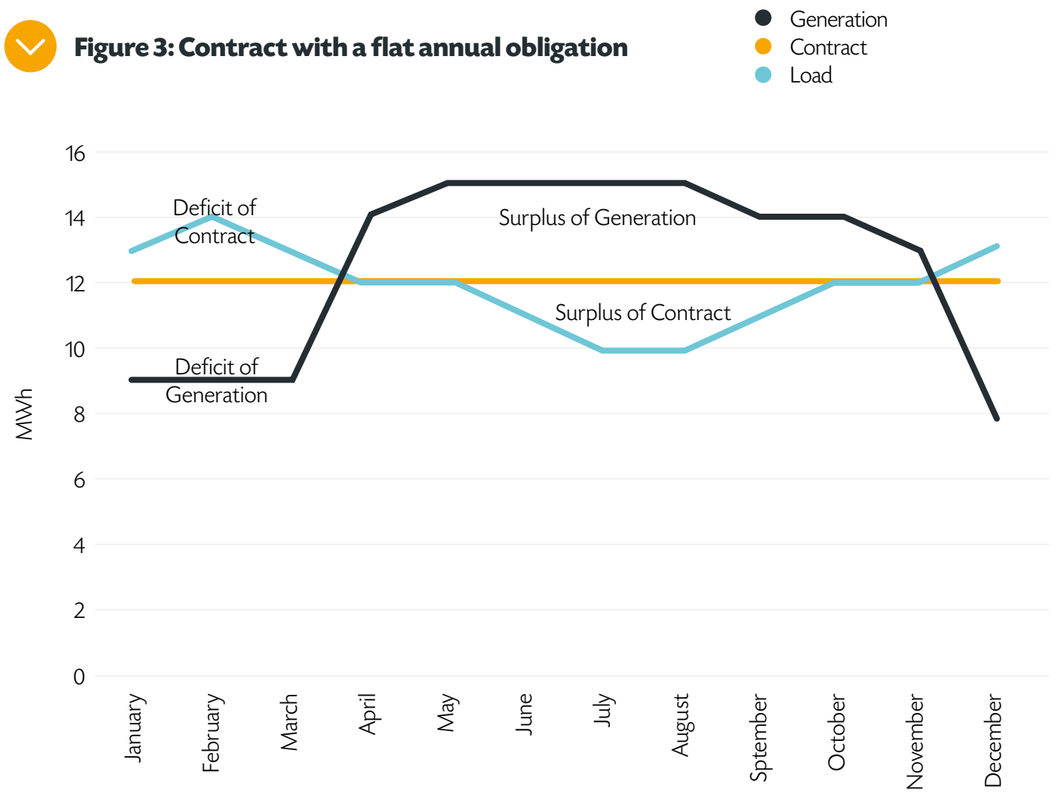


Figure 4: Contract with the delivery obligation following the generation

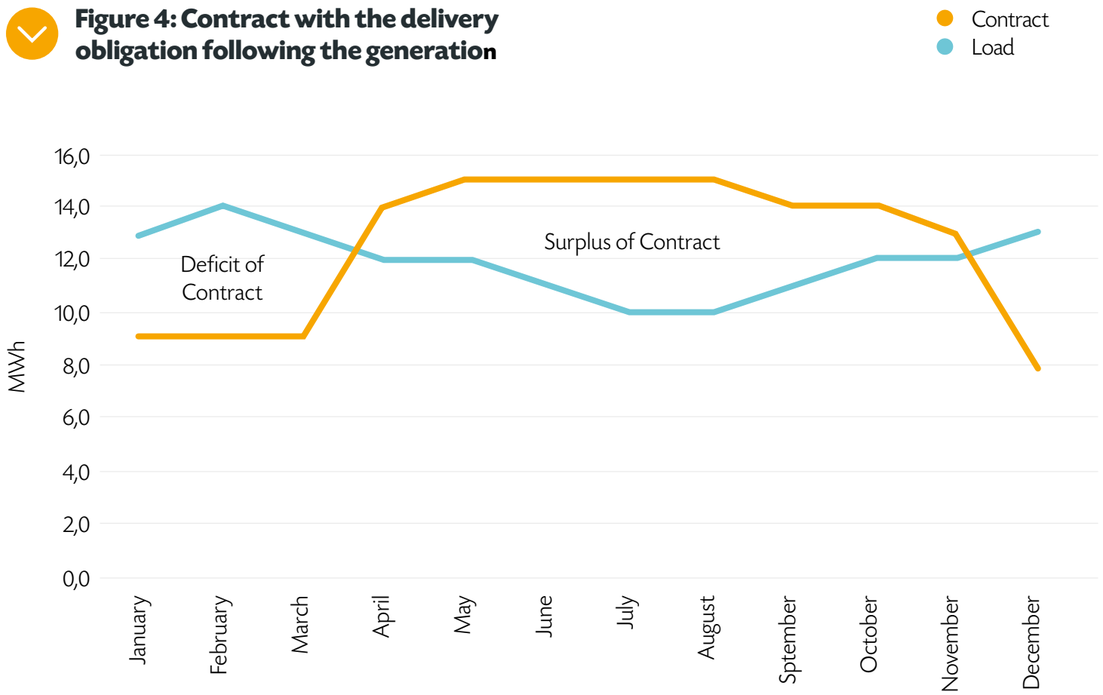
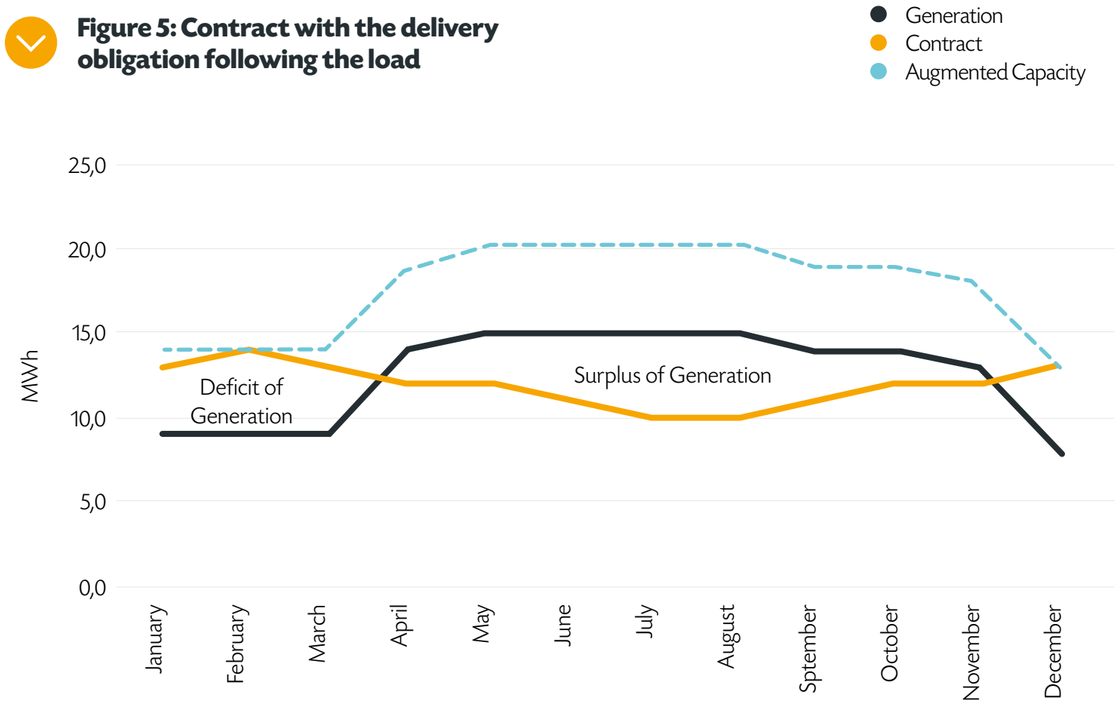


Figure 5: Contract with the delivery obligation following the load



the day. They also have little operational control and are usually dispatched to deliver all possible energy to be generated and absorbed by the network. The energy supply curve of these sources may not correspond to the buyer's demand, and there is a risk of energy surplus or deficit throughout the year and over the course of a day. Consequently, the contract must indicate the conditions of energy and capacity delivery and determine the liability of each party.

The first option is to set the contractual obligation according to a fixed (or flat) annual amount of energy and capacity. With this arrangement, it is possible for both the off-taker and the generator to bear deficits and surplus of contractual energy that could be procured or sold into the market or computed for annual balancing. Figure 3 shows a hypothetical case for a contract for 144 GWh/year that aims to meet a Brazilian typical wind generation seasonality with a load while also taking the Brazilian market seasonality into consideration as well.

The second alternative is to set contractual obligations according to the seasonality of the generation. In that case, the purchaser bears alone the risk of market exposure and may buy and sell the contractual imbalance into the market or procure a portfolio of sources that are complementary or that contain dispatchable sources such as hydroelectric plants with reservoirs and thermoelectric plants to mitigate the cost of the market exposure risk.

The third choice is to set the contractual obligation according to the seasonality of the load. Therefore, the seller bears the market risk that can be mitigated by the installation of additional capacity without

the contractual cover, which can be sold into the spot market or on short-term contracts.

Depending on the conditions of energy and capacity delivery, some technologies can be benefited, even in a "neutral auction". This definition plays an important role in the potential of the investor to enter the bids, as it changes costs and risks for the different kinds of technology. It explains, as in some cases, how the auction adapts the delivery condition to the technology. However, it also may distort the technological neutrality goal.

In the case of Brazil, for example, the hydropower plants must deliver energy according to the load seasonality and the photovoltaic plants according to their expected generation. The wind power plants, in turn, came to need to deliver energy according to the load seasonality from 2019, until then the delivery obligation as stipulated according to the expected generation.

As a second example, in the Peruvian contract, the IPP delivers energy according to the generation. If the monthly generation is higher than the contractual obligation, the surplus is remunerated by the average short-term marginal cost in the power plant connection bar. On the other hand, if the monthly generation is smaller than the contractual obligation, the energy price will be reduced by a factor equal to the ratio between the energy produced and the energy contracted, but the IPP will not be exposed to the spot market price.

In other countries, such as Chile and Colombia, the price of contracted energy has different values for each hour of the day, which means that energy delivered according to the load curve is more valuable.

Table 10: Delivery obligation

Countries	Delivery obligation
Argentina[1]	Capacity
Brazil[2]	Delivery of energy generated by hydro and wind power plant according to the buyer load curve and by biomass and solar according to the generation curve
Chile[3]	Delivery of active and reactive energy, and capacity generated by the contracted power plant according to pre-agreement time blocs for light, medium, and peak load
Colombia[4]	Delivery of energy generated by the contracted power plant according to specific hourly prices cleared by the auction
Mexico[5]	Delivery of energy, capacity or of Clean Energy Certificates generated by the contracted power plant according to the generation curve
Panama[6]	Delivery of energy generated by the contracted power plant according to the buyer load curve
Peru[7]	Delivery of energy generated by the contracted power plant according to the generation curve

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

Measurement, invoicing and billing

The measurement, invoicing, and billing clause sets the timeline for the payment activities and the deadlines, and the conditions for challenging the values. charged It is also an important element in the risk allocation in the contracts. It also allocates responsibilities and the costs of measurement. There are several choices among the LAC countries.

Under the Colombian Contract, for example, the seller charges the buyer monthly by presenting the invoice with the percentage of the electricity generated by the ideal dispatch of the power-plant. The invoice must be delivered within twelve business days.

In the event of imbalances between the ideal and real dispatch by the Commercial Exchange System Administrator (Administrador del Sistema de Intercambios Comerciales - ASIC), the seller must submit adjustment notes to the corresponding invoice in the following month. The adjusted amount will be corrected according to the DTF interest rate (the basic interest rate certified by the Colombian Bank of the Republic)

The buyer, in turn, must pay the invoice within fifteen business days. In case of late payment, the amount will be corrected according to the highest interest allowed by the regulation.

In the event of an invoice error or discrepancy, the buyer must notify the seller in writing within three business days and pays the noncontroversial part of the invoice. If the debts were wrongly disallowed, the buyer must pay the amount corrected by the annual tax equivalent to the DTF, but a fine of five percent. Finally, If the parties cannot agree on the correct invoice amount within sixty days, the dispute will be settled by arbitration.

Penalties

The non-fulfillment of contract commitments may result in penalties that may have the form of a contractual fee for non-compliance, price rebate, or the early termination of the contract. The economic effect of the contractual non-fulfilment should be high enough to dissuade the IPP from intentionally choosing not to comply with the contract but, at the same time, should not be so excessive as to jeopardize the feasibility of the project. The purpose of the penalty is to create an incentive for compliance and not compensate for the losses of the buyer. Therefore, the application of fees and price rebates should be associated with a correction factor that diminishes with the duration of the unavailability. This approach ensures that these agents continue to have an incentive to fulfil their contract once they have reached the penalty cap [14].

An alternative is to include a healing period in the contract. The Brazilian and Colombian contracts, for example, establishes that if there is an event of non-compliance or a specific cause of early termination that is temporary or that might be overcome, a chance to remedy the situation shall be granted to the IPP.

In turn, both countries apply fees together with the early termination penalty. In the case of Colombia, the party that had given cause to early termination of the contract must pay a fee equivalent to 20% of the remaining contract value

In the Brazilian contract, early termination is combined with a fee equivalent to 30%

of the remaining financial obligation of the contract, limited to three years, according to the following equation:

Equation 1

$Fee = min(30\% \times PV \times VECR; 3 \times PV \times VEC)$

where:

PV: contracted price ($/MWh);

VECR: the total remaining energy that was supposed to be delivered until the end of the contractual duration (MWh);

VEC: the amount of energy that was supposed to be delivered in a year (MWh).

Panama and Brazil also have penalties for delays in power plant operation. The Panamanian penalty is given by the difference between the marginal cost and the contractual price multiplied by a factor of 0.7, according to the following equation:

Equation 2

$Pins = (PAD.CMS - PrE) \times PE \times 24hours \times 0.70$

where:

Pins: the daily penalty for delay of the energy supply ($)

Pad. CMS: the daily arithmetic average of the Marginal Cost of the System ($/kWh);

PrE: Contractual price of Energy Offered ($/kWh);

PE - Equivalent Power (kW).

This contractual penalty, however, will not be applied on the days that the marginal cost is equal or smaller than the contracted price.

Table 8: Penalties

Countries	Penalties
Argentina[1]	A penalty fine of USD1,388/MW-day for delayed capacity. Supply shortfalls to a certain extent can be rolled over to the next year, beyond the contractual limit a USD60/MWh fine applies.
Brazil[2]	A price rebate for construction delay. The payment for the contracted energy will be set accordingly to the lowest value among (i) the contractual price reduced by 15%; (ii) the average of the spot price during the month; and (iii) the cost of the energy procured by the sellers in the energy market to fulfill their contractual obligation
	The obligation to procure an equivalent amount of the 'non-delivery' energy
	Early termination of the contract and fee of 30% of the remaining financial obligation of the contract, limited to three years
Chile[3]	A mechanism to deferring the start of supply
	Early termination of the contract
	A price rebate for under-production or delays equivalent to the difference between the spot price and the contract price
Colombia[4]	Early termination of the contract plus penalty fee of 20% of the remaining contract value
Mexico[5]	Early termination of the contract
	A penalty fine for operation delay at the value of 5% of the monthly payments under the contract
Panama[6]	A penalty fine for construction delay and power plant unavailability at the value of 70% of the difference between the marginal cost and the contractual price.
Peru[7]	Early termination of the contract

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

In the Brazilian contracts, the penalty for the delay is a price rebate. The payment for the contracted energy will be set accordingly to the lowest value among (i) the contractual price reduced by 15%; (ii) the average of the spot price during the month; and (iii) the cost of the energy procured by the sellers in the energy market to fulfill their contractual obligation.

In turn, the energy generation risk related to the variability of energy sources is better addressed through the obligation to procure an equivalent amount of the undelivered energy or capacity in the market.

Warranties

Warranties are financial instruments that fulfill the function of ensuring contractual compliance that complement penalties.

The main modalities of guarantees usually required in RES contracts are [6]:

- **Surety and performance bonds:** surety and performance bonds are a financial guarantee, usually provided by a bank or an insurance company, that compensate the buyer if the IPP does not perform the contract to completion, or does not comply with the construction timetable, or with quality standards.

- **Completion bond:** A completion bond is a financial contract that ensures that the power plant will be completed even if the IPP runs out of money or if any measure of financial impediment occurs during the construction of the project.

- **Report of Risk Assessment:** The bidders must periodically submit an updated risk classification report issued by Credit Rating Agency that demonstrates the financial soundness of a project and their capacity to assess financing and to support the investment.

The surety and performance bonds are generally required at the contract signing and retained throughout the entire duration. The guaranteed value, however, can be reduced after the commercial operation. The completion bond is usually returned with the beginning of the commercial operation of the power plant. The Report of Risk Assessment can also be released after the commercial operation.

The risk of the operation phase is usually lower than of the construction, and it is generally related to the power plant performance in terms of efficiency and failure rates. In the case of seasonal and intermittent sources, however, it is also necessary to consider the probability of the energy source variations due to climatic events affecting the biomass crop, the rainfall and wind regime, and the solar incidence.

The equipment performance risks are usually addressed by surety and performance bonds, which are applied whenever the IPP does not reach the standard defined in the contract, while admitting a small margin of tolerance (the penalty cap).

Arbitration and dispute settlement

Considering that energy and capacity contracts are complex and subject to unanticipated uncertainties, it is important to establish the possibility of resolving disputes through arbitration. The arbitration instrument is usually faster than the judicial and administrative courts and ensures that the arbitrators will be experts. All the Countries with best practices

Table 9:
Warranties

Countries	Warranties
Argentina[1]	Bid bond: $35,000/MW offered. Returned to unselected projects or once the performance bond has been deposited (for selected projects).
	Completion bond: $250,000/MW. Increased by 20% in the case of each milestone missed by 60 days. The bond shall be returned upon commercial operation.
Brazil[2]	Bid bond in the amount of 1% one percent of the investment, according to EPE's[5] technical qualification
	Performance bond in the amount of 5% of the investment declared by the winner
	Assignment of buyer's accounts receivable to the seller
Chile[3]	Report of Risk Assessment with a risk rating equal to or greater than BB +
	Civil liability insurance for damages to third parties
	Catastrophe insurance
	Completion bond
	Buyer payment guarantee
Colombia[4]	Bid bond in the amount equivalent to the maximum amount of energy available to sell in a year multiplied by USD 0.0425/kWh
	Surety bond in the amount of 30% of the annual value of the contract
	Buyer payment guarantee in the amount of 30% of the annual value of the contract
Mexico[5]	Bid bond in the amount of UDI* 300,000 plus UDI 65,000/MW, UDI 30/MWh and UDI 15/CEL (Clean Energy Certificate)
	Surety bond in the amount of UDI 65,000/MW, UDI 30/MWh and UDI 15/CEL
	Civil liability insurance for damages to third parties
Panama[6]	Bid bond in the amount of USD 10/kW of installed power
	Surety bond in the amount of USD 200/kW of installed power
Peru[7]	Bid bond
	Surety bond in the amount of USD 250/kW of installed power. After the completion of 75% of the construction, the surety bond will be reduced by 50%.

Sources: [1] Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA) – www.portalweb.cammesa.com. [2] Ministério de Minas e Energia (MME) – www.mme.gov.br. [3] Comisión Nacional de Energía (CNE) – www.cne.cl. [4] Unidad de Planeación Minero Energética (UPME) – www.upme.gov.co. [5] Centro Nacional de Control de Energía (CENACE) – www.gob.mx/cenace. [6] Empresa pública de transmisión eléctrica (ETESA) – www.etesa.com.pa. [7] Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) – www.osinergmin.gob.pe.

* UDI (Unidad de Inversion). A unit of account equal to about 6.287 MXN (around US$0.32) in Sept. 2019

5. The Energy Research Office (EPE in its Portuguese acronym) a state-owned company that supports the Brazilian Ministry of Mines and Energy (MME) with studies and research on energy planning.

included in this guide have arbitration clauses to dispute settlement in their contracts.

Indemnities

The indemnity clause establishes the scope of the liability of each party concerning the damages caused by the failure to comply with the contract, especially in the case of early termination. The indemnity clause also establishes the responsibility concerning economic, social, and environmental damages caused to third parties.

Act of God and force majeure

The act of god and force majeure clause limits the party's responsibilities and the effects of non-compliance in terms of penalties, indemnities, and warranties enforcement.

FINANCING

In order to allow the IPP to use the contract cash flow as a collateral for credit in the project finance scheme, the contract must have explicit clauses that establish the conditions and procedures for the change of the control of the project or the step-in right of the lender to intervene in the execution and administration of the project to ensure its completion.

Additionally, the auctioned contract may require the purchasers to present a payment surety bond to the IPP, such as in the examples of Chile and Colombia. The contract can also require the buyer to assign part of its receivable amount to be at the IPP disposal, in a specific bank account, in case of payment delay, as in the case of the "Contratos de Constituição de Garantias - CCG" used in Brazil to provide lender additional guarantee over the project cash-flow.

Case Study – Brazil

The Brazilian electricity system was originally organized around state-owned companies. The distribution service was provided by monopolist companies owned by local state or municipal governments, while generation and transmission were mainly supplied by ELETROBRAS, owned by the federal government, and by CESP, CEMIG, CELG, and COPEL, owned by the governments of São Paulo, Minas Gerais, Goiás, and Paraná, respectively, among others. The federal government held the exclusive power to legislate on energy and was responsible for coordinating the dispatch of power plants and calculating the tariff for end users.

The state model worked well until the second oil shock in 1979 and the deepening of the Brazilian fiscal crisis. The depth and duration of the crisis exhausted the public funding capacity over the decade of 1980, which precipitated the first Brazilian institutional reform in 1995, with the Act 8,987 that regulated the privatization of the distribution, transmission and generation companies. The reform of the Brazilian energy market was complemented by the Acts 9,074; 9,427, and 9,648, which laid the foundations for the activities of the IPP and the energy-free consumers, created the National Electric Energy Agency (ANEEL, in its Portuguese acronym), the Independent System Operator (ONS) and the Wholesale Energy Market (MAE).

However, for several circumstantial and structural reasons, the institutional model designed in 1995 was not able to guarantee a secure supply, and the Brazilian consumers faced the rationing of energy in 2001. Consequently, on March 15, 2004, the federal government approved the act 10,848, which started the second institutional reform of the Brazilian energy system.

The main purposes of the second reform were to ensure fair energy rates and secure energy supply [16]. Regarding the security of supply, the second reform of the Brazilian energy system promoted [17]:

a. The segregation of the Regulated Contracting Environment (ACR), specifically for the distribution companies that procure energy contracts to supply the captive consumers, and the Free Contracting Environment (ACL), where the IPPs, the energy traders and the free consumers can trade energy.

b. The use of a chained auction scheme to procure energy for the purpose of supplying energy to the captive consumers of the ACR, with a sequence of decreasing lead time auctions (see Figure 2);

c. The long-term focus of the energy contracting in the ACR, in order to reduce the volatility of the price and enable the use of accounts receivable arrangements as collateral for project financing;

d. The obligation of contractual coverage by distributors and free consumers, leaving the spot market only for imbalances;

e. The obligation to back all contracts with firm energy[6] certified by the Brazilian Ministry of Mines and Energy (MME) in each power plant;

f. The creation of the Electrical Sector Monitoring Committee and of the Energy Research Office (EPE) to oversee the reliability of the energy and capacity and to support MME with studies and research on energy planning.

6. In Portuguese "garantia física."

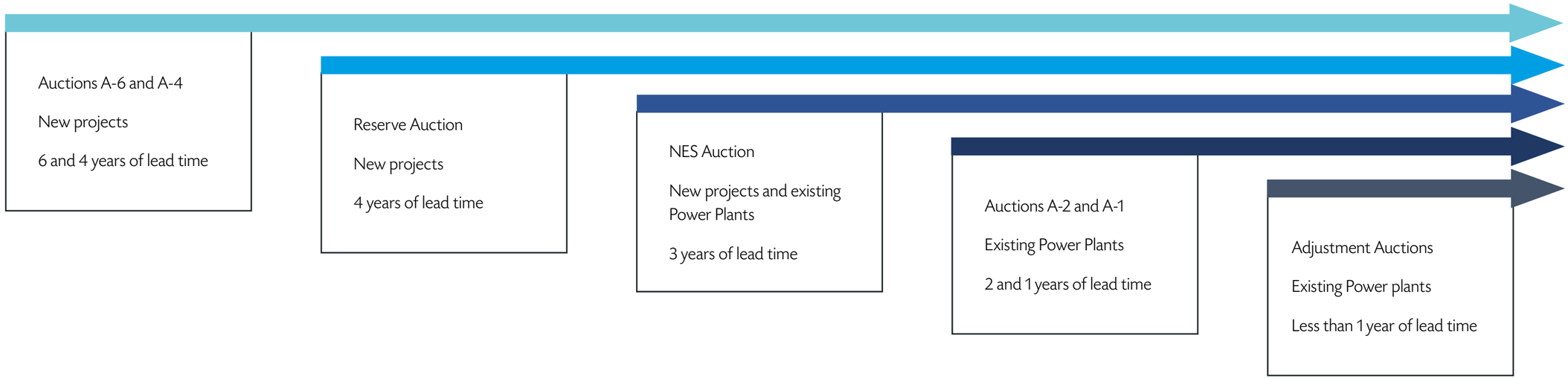
The rationale of this new regulatory framework is to rely on contracts as inducers of the system resource adequacy. If the system is entirely contracted and contracts have physical coverage, then supply reliability is assured within the "supply risk" defined in the calculation of the physical coverage capacity certificate for each plant [16].

In this context, the Brazilian chained auction scheme prioritizes the procurement of new projects to meet the increasing demand[7].

Existing power plants were supposed to cover the present load and are procured by specific auctions with one month of lead time, and are of short- and medium-term duration since their fixed costs are expected to be sunk and partially recovered.

The deviations between load forecasts made for the new project auctions and the market behavior are also acquired by specific adjustment auctions, which procure short-term contracts (up to two years).

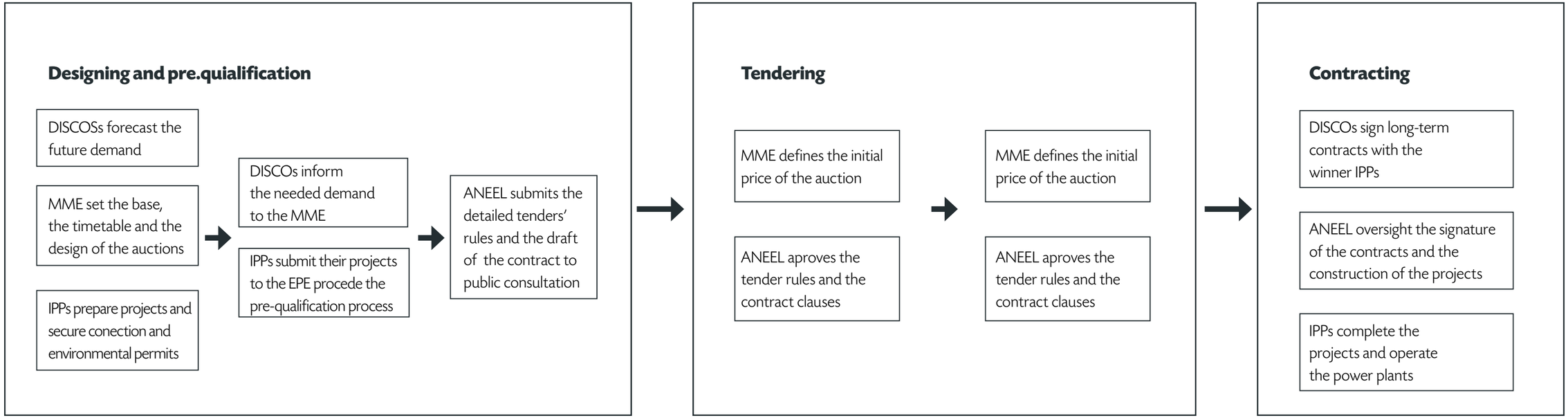
Figure 4: The Brazilian auction chain



Originally, the auctions for new projects may have a lead time of five or three years and duration between fifteen and thirty years.

Figure 5: Brazilian Auction Scheme

Source: IPEA [21]



The adequacy of the capacity is ensured by auction for reserve energy.

Finally, the auction chain is completed by a specific auction to procure RES power plants, specially designed to foster RES technology development before it can be procured directly by the conventional new project auctions.

These auctions were designed to provide long-term contracts to new power plants and facilitate their financing via the modality of project finance, where lenders provide the loans based upon the projected cash flows of the project rather than on the balance sheets of its sponsors.

The Brazilian regulated auctions can procure within two categories of contract, depending on the allocation of the generation risk. The first category is the contract for "energy quantity," in which the IPP bears the entire generation risk, including the imbalances caused by the centralized dispatch commanded by the Brazilian Independent System Operation (ONS) that has the mandate to optimize the use of the energy resources with a tight pool approach. This means that the IPPs have no control over the economic decision to produce energy. The unconventional RES will produce all available energy that can be injected in the grid, while the thermal and hydropower plants will be dispatched by the ONS according to the output of a computational model that minimizes a function of future cost based on the value of the water storage in the hydropower plants reservoirs. Therefore, in a contract for energy quantity, the sellers may deliver the contractual amount of energy even if they are not dispatched by the ONS. In that case,

they must procure energy in the spot market and must make up the difference between the contracted and the spot market price.

On the other hand, in the second category, the contract is for energy availability, and the IPPs bear the ordinary risks of equipment reliability and performance but are not obliged to procure energy in the market when they are not dispatched. This second contract category was originally designed to complement thermal power plants and resembles the capacity mechanism known as 'reliability option' or with the financial concept of a "call options" since the IPPs receive a fixed payment (premium) in exchange for the obligation that their generation capacity will be available when some given strike price is reached.

The energy quantity contract was initially restricted to hydropower plants that in Brazil have a specific scheme to mitigate the risk of contractual exposure due to the centralized dispatch (Mecanismo de Realocação de Energia – MRE), while all the other sources are contracted within the availability category.

This approach aims to reduce investor risk and support RES penetration and was backed by the Brazilian Development Bank (BNDES) that has been offering finance to new power plants with better conditions than is accessible to other sectors. The BNDES actual finance conditions for RES in October 2019, for example, covers 100% of the expenditures for equipment at the cost of an administrative spread of 1.05% over the Brazilian long-term interest rate, ten years of maturity and a grace period of 2 years [18]. Worth noting that the standard conditions to finance infrastructure is limited to 80% of the expenditures for equipment and have an administrative spread of 1.42% over the long-term interest rate, ten years of maturity and a grace period of 2 years [19].

Besides, to support RES deployment, the Brazilian regulation provides a discount of at least 50% on transmission and distribution tariffs for distributed RES power plants and a tax exemption on imports of renewable equipment (wind turbines, photovoltaic panels, etc.).

In other words, the new regulatory framework was designed to foster huge amounts of investment in the necessary generation capacity expansion to meet with a fast-growing demand at the lowest cost possible [16].

As a result, the Brazilian regulated auctions have contracted 9,571 TWh of energy between December 2004 and October 2019, negotiating more than USD 456 billion and enabling investments of around USD 36 billion. Regarding only RES projects, the total of new capacity contracted is 32 GW, with an investment of 3 billion[8] [20].

Figure 8 demonstrates that the penetration of both biomass and wind sources in Brazil was accompanied by a 40% reduction in the price of energy between December 2005, for biomass, and December 2009, for wind, and December 2012. The reduction of wind prices is partly explained by the worldwide reduction of the equipment costs, resulted from technological advances and economies of scale, but also reflects the development of local investment capacity. Additionally, the period was characterized by a gradual reduction of the capital cost in

8. The values are converted by the exchange rate of R$4.15/USD, verified at October 15th, 2019.

Figure 8: RES capacity contract by the Brazilian auctions[9]

Source: CCEE [20]

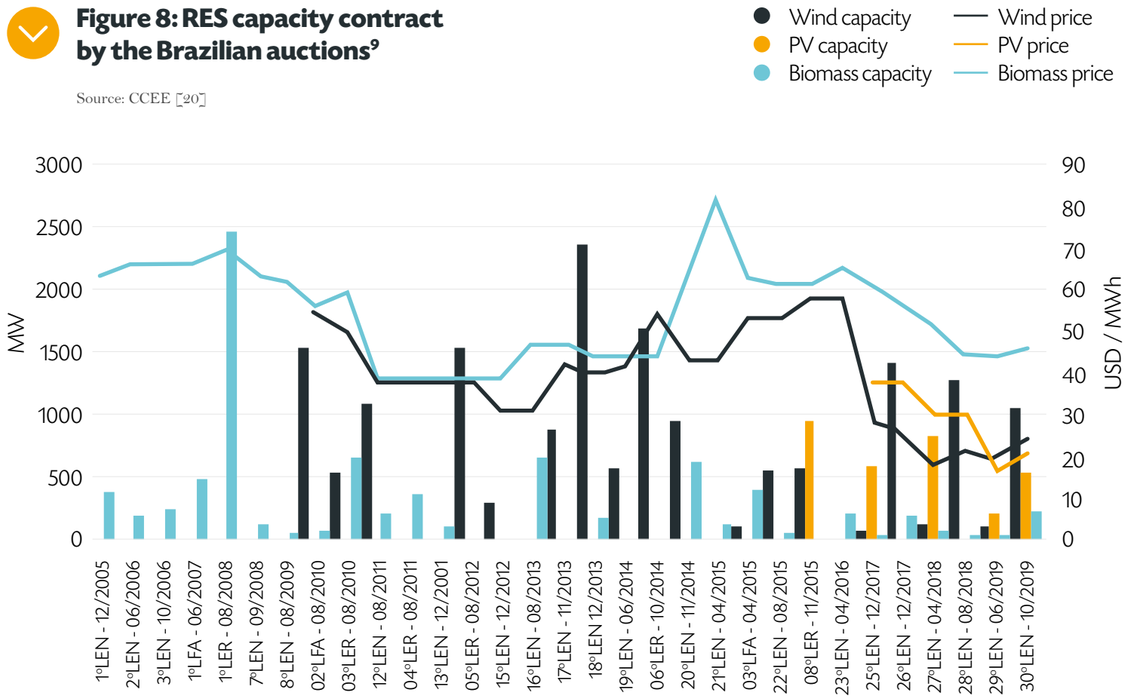
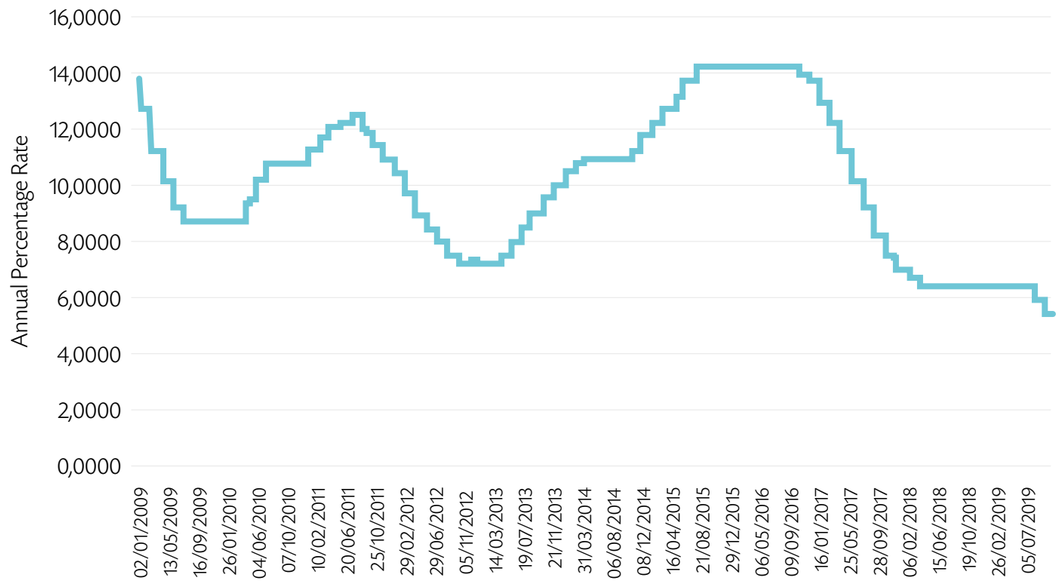


Figure 9: SELIC interest rate in Brazil (Brazilian basic interest rate)

Source: IPEA [21]



Brazil, which help with the reduction of investment costs in both technologies.

In 2013, however, the price trends reversed, and wind energy prices returned to the initial USD60/MWh level in November 2015, while the biomass price reached a peak of USD81/MW in November 2014. Two effects contributed to the price hike.

First, the growth in the number of projects facing construction delays and the bankruptcy of a large local equipment provider has increased investors' risk perception. Second, the return of inflation acceleration in Brazil also reversed the lowering trend in the Brazilian basic interest rate (Sistema Especial de Liquidação e de Custódia – SELIC), making financing scarcer and more costly.

Finally, the entry of photovoltaic energy into the market and the return of the interest rate reduction process, from 2015, gave new impetus to the reduction of energy prices in Brazil.

On the other hand, the emphases of the Brazilian model on procuring through new power plants in the project phase implies a residual risk of delay or bankruptcy of the IPP and third parties involved in the project. The qualification phase existing in the Brazilian auction mitigates part of the risk, given that the IPP must prove the feasibility of the project by presenting environmental permits and financial guarantees.

Figures 10, 11, and 12 present the situation of 374 power plants in construction in October 2019 and show the capacity (in MW) deployment to comply with the

9. According to the exchange rate at the date of the auction.

Figure 10: PV power plant compliance with construction timetable

Source: ANEEL [22]

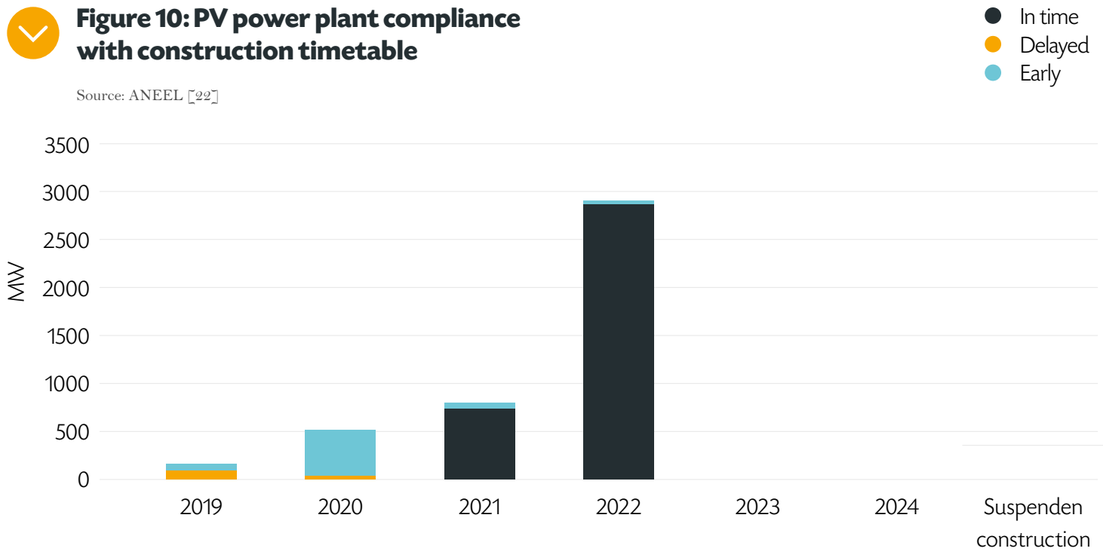


Figure 11: Wind power plant compliance with construction timetable

Source: ANEEL [22]

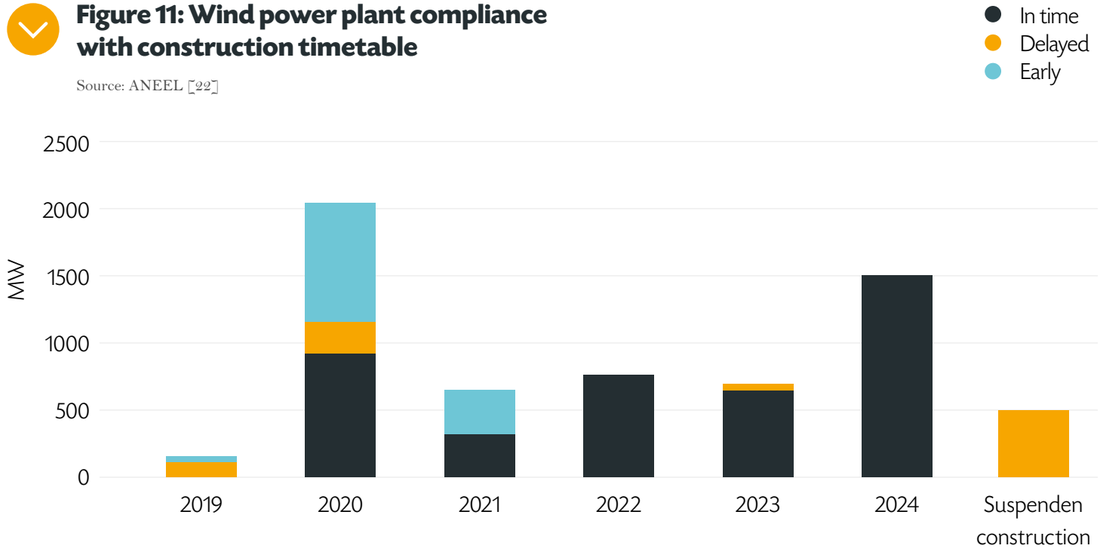


Figure 12: Biomass power plant compliance with construction timetable

Source: ANEEL [22]

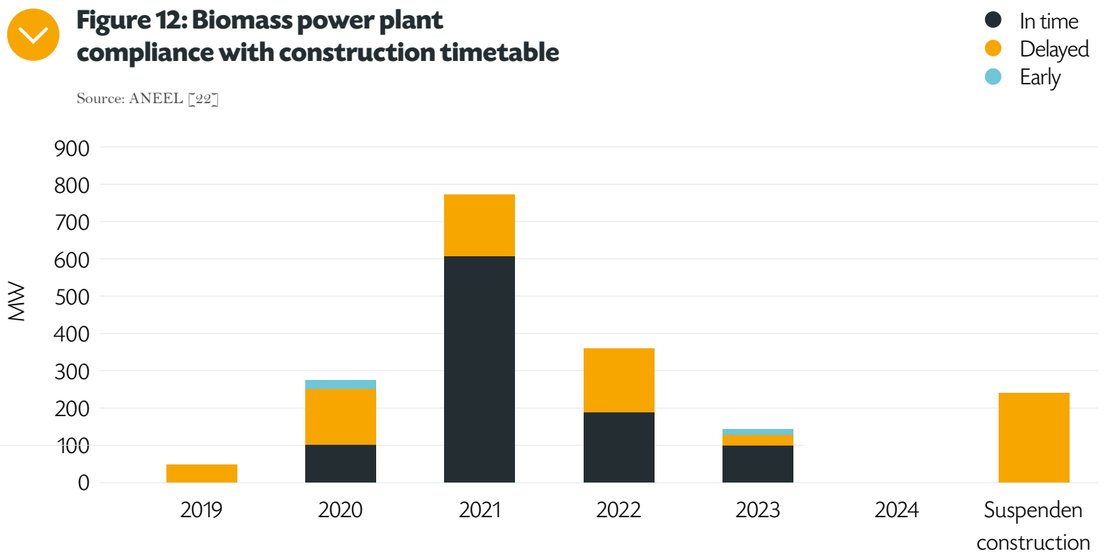
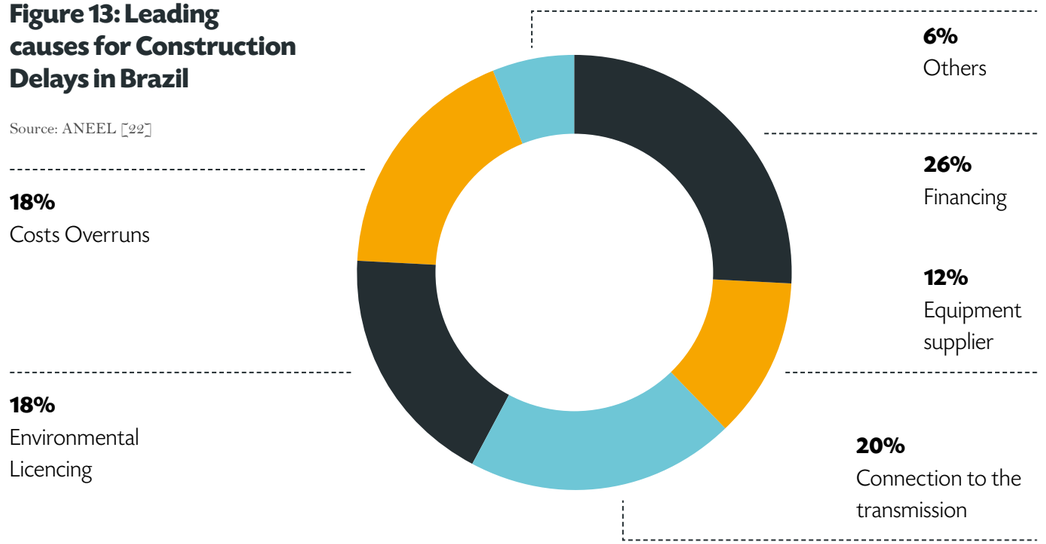


Figure 13: Leading causes for Construction Delays in Brazil

Source: ANEEL [22]



contracted timetable. About 7% of the photovoltaic, 30% of the wind, and 50% of the biomass power plants are delayed. More relevant, 14% of the wind and 12% of the biomass power plants don't even have a probable date of completion, indicating a strong probability that the contracts will be terminated early.

The leading causes of delays are i) the construction costs overrun; ii) the unanticipated difficulty of obtaining financing (the second and third stage environmental permits); iii) the connection to the transmission system, and iv) problems with equipment suppliers.

The failure of the investor to measure all project risks and costs is known in the literature as "the winner's curse" and cannot be completely avoided [23]. But there are some approaches to the design of the auction and the contracts that can mitigate these effects.

First, the bases of the bidding, the draft contracts, and all the information necessary for the investor to elaborate on their bidding strategy must be made available well in advance.

Second, the auction design may help to reduce the winner's curse risk. The time and money spend to prepare the projects and participate in the auction are a sunk cost and may influence bidders' strategy. The higher the sunk cost, the greater the risk aversion of losing the auction, and the greater the aggressiveness of the bidder. Aggressive bidders think that it is more important not to risk losing the auction than to seize a small gain by slightly increasing the bid. Consequently, the auctioneer may expect lower prices under a pay-as-bid sealed auction than under a pay-as-clear auction, but in this scenario the trade-off will be a higher risk due to the winner's curse. On the other hand, a pay-as-clear auction will extract less surplus from the seller and result in slightly higher prices but reduces the winner's curse risk.

In the case of Brazil, the auctions have two phases and hybrid designs. In the first phase, the participants submit a single bid with the price and the amount of energy offered. With this information, to ensure competition, the auctioneer may adjust the demand for each kind of contract, and will start the auction's second phase in which participants submit bids with decreasing prices, following the dynamic of an inverted English Auction. Thus, if the initial offer and demand are tight and the competition low, the auction first phase will be determinant to set the price, resulting in an outcome similar to the canonical pay-as-bid sealed auction. On the other hand, if the competition is high, the winner and the price will be determined mostly by the second phase, and the outcome will be similar to a pay-as-clear auction.

In relation to environmental licensing, in Brazil, the process is decentralized and multidisciplinary. This means that according to the type of activity involved and extent of the expected environmental impacts, the administrative process will be performed by environmental agencies and public authorities (accountable for public policies on health, jobs, and historical and archeological protection) at the municipal, state or federal level.

The network of environmental agencies and public authorities forms the Environmental National System (Sistema Nacional de Meio Ambiente - SISNAMA),

10. As a general rule, most RES projects will be under state jurisdiction.

which is coordinated by the Ministry of Environment (Ministério do Meio Ambiente - MMA) and has a deliberative body (Conselho Nacional do Meio Ambiente – CONAMA) to establish the directives to the licensing process.

According to the CONAMA Resolution 237/1997, the environmental licensing starts with the investor registering its project in the environmental agency having jurisdiction over the location and over the kind of economic activity of the project[10] with the presentation of the Activity Description Sheet and the Environmental Impact Declaration.

After receiving and processing the information registered by the investor, the Environmental Agency prepares the Term Of Reference (TOR) for the environmental licensing, which establishes whether the project will follow a normal or a simplified licensing process and defines the scope of the environmental studies and the report that must be presented by the investor to obtain the permits.

In the normal process, the investor must prepare a full Environmental Impact Assessment (Estudo de Impacto Ambiental – EIA) and the accompanying Report (Relatório de Impacto Ambiental – RIMA), and must conduct public hearings with the local communities that may be affected by the project before receiving the Preliminary Permit (Licença Prévia – LP). These confirm the environmental feasibility of the project and establish the conditions (additional studies or countermeasures to mitigate the environmental impact) for acquiring the Construction Permit (Licença de Instalação – LI). In the simplified process, the investor has to prepare only a Simplified Environmental Report to obtain the Construction Permit directly.

In both cases, the investor must comply with the Construction Permit conditions to receive the Operation Permit (Licença de Operação) and conclude the environmental licensing.

In order to reduce the environmental risk, the Brazilian auction scheme has a pre-qualification phase where the investors must present, at least, a Preliminary Permit. However, some features of the Brazilian environmental process make the licensing very long, complex, and uncertain. Indeed, a report by the legislative consultancy of the Brazilian Federal Senate pointed out the main flaws of the environmental licensing process [24]:

a. The Environment Impact Assessments and Reports Extensive focuses on the negative impact of the project ignoring the positive aspects;

b. The excessive imposition of conditioning factors and mitigating actions by the public authorities;

c. The multiplicity of actors with discretionary power;

d. The frequent judicialization;

e. The absence of a strategic environmental policy;

f. The scarcity of systematized environmental data and public information;

g. The excess of bureaucracy, and the use of vague terms such as “low environmental impact” and “directly or indirectly affected area” in the resolutions and guidelines provided by CONAMA and MMA.

Finally, despite observing a logical sequence, the Preliminary, Construction, and Operation Permits are not bonded. Thus, any public authority involved in the licensing process may request further studies and revise its previous understanding regarding the permits at any time, especially if an environmental or archaeological finding is identified. Thus, environmental risk in Brazil is highly relevant and difficult to mitigate.

Regarding the problems with the connection in the transmission grid, because the auction provides full knowledge about the power plants to be built ahead of time, the Brazilian public authorities responsible for the planning and tendering of new transmission lines (the Ministry of Mines and Energy – MME, EPE, and ONS), initially favored the approach of waiting for the output of the generation auction to finalize the transmission expansion plan and start the tender process. Despite seemingly advantageous on paper, the original approach proved to be unfeasible in the case of an auction with a lead time shorter than five years and results in delays in achieving the transmission lines and substations need to connect the new power plants to the grid. Consequently, since 2013, except for auctions with a lead time equal to or longer than 5 years, the winner will be selected by the lowest price, considering the transmission constraints at each access point.

In relation to the latter common cause of delay in Brazil, the company IMPSA founded WPE in December 2006 to produce wind and hydroelectric equipment in Pernambuco. In December 2012, WPE already had a major player in Brazil, and had concluded contracts amounting to more than USD 1,200 million for supplying equipment to the main Brazilian companies in the energy sector. However, at the end of the first semester of 2014, the economic and financial situation of WPE began to deteriorate, so that in June, 2014, its risk rating was lowered to BB (non-investment grade - more prone to changes in the economy) by the Fitch rating agency. After delays in the payment of international debts, its ranking was again lowered in July, 2014, this time to CCC (currently vulnerable and dependent on favorable economic conditions to meet its commitments), and in October, 2014, there was a new demotion to DDD (defaulted on obligations). Finally, on December 5, 2014, WPE requested judicial reorganization to avoid bankruptcy. The immediate outcome was the interruption of the delivery of all contracted equipment, amounting to an installed capacity of 1,580 MW, which impact was a decisive factor in the delaying the construction of 26 projects with 579.2 MW [25].

This kind of risk is also difficult to avoid in the context of a procurement auction for a new power plant project, but its impacts on consumers can be reduced by the monitoring the contractual schedule and the supervision of construction by a public authority, as in the case of ANEEL in Brazil, or by independent auditors, as in case of Chile.

Main Takeaways

- **Takeaway 1:** Auctions to procure contracts with Independent Power Producers are an efficient instrument to scale-up the private investment and the deployment of renewable energy sources capacity, and has been adopted by the largest economies in the LAC region;

- **Takeaway 2:** Auctions are an effective and efficient instrument to reveal prices under uncertainty and can be adapted to different market designs.

- **Takeaway 3:** Contracting for power plants in the project phase provides cash-flow predictability, improves the power plant conditions to access finance, and ensures resource adequacy and energy security.

- **Takeaway 4:** Auctioned contracts must be as straightforward and concise as possible in order to avoid the ambiguities that may result in future litigation.

- **Takeaway 5:** The lag between the auction and the contractual commencement (the lead time) must correspond to the longest time necessary for the deployment of a new power plant, including the obtaining of all technical and environmental permits, and the construction.

- **Takeaway 6:** The contract duration should be long enough to provide investors in new generation projects with some cash-flow stability and predictability during the time required for the loan maturity. Consequently, the contract duration should reflect the capital intensity of the technology, the modality of the project financing, and the discount rate involved.

- **Takeaway 7:** Indexation clauses are relevant to contract design and impact the auction outcome, but their variability indicates that the indexation clause design must reflect the market structure and regulatory framework.

- **Takeaway 8:** Since the generation of unconventional RES varies during the year according to the season and sometimes over the course of a day, the contract must establish the conditions to adjust the amount of payment or different prices for the energy delivered depend on the month or on the hour of day.

- **Takeaway 9:** Contracts shall clearly provide the liability for the most common risks, the exposure limits for each party involved, and the procedures to be followed in the event of a claim.

- **Takeaway 10:** The non-fulfillment of contract commitments may result in implicit and explicit penalties. One example of an implicit penalty is the obligation of the IPP to procure an equivalent amount of the 'non-delivery' energy or capacity in the market to honor its contract. An explicit penalty may have the form of a contractual fee for non-compliance, price rebate, or the early termination of the contract.

- **Takeaway 11:** The purpose of the penalty is to create an incentive for compliance and not compensate for the losses of the buyer.

- **Takeaway 12:** The requirement of financial guarantees is also an alternative to incentive-based contractual compliance.

- **Takeaway 13:** Considering that energy and capacity contracts are complex and subject to unanticipated uncertainties, and it is important to establish the possibility of resolving disputes through arbitration. The arbitration instrument is usually faster than the judicial and administrative courts, and ensures that the arbitrators will have great expertise.

- **Takeaway 14:** The activities of energy generation and trade are usually subject to extensive regulation. In this context, it is of note that the obligations established in the contract are subordinated to the regulation update. Therefore, the seller and the buyer shall always comply with current regulations. On the other hand, the original economic and financial balance of the contract must also be ensured.

References

1. International Renewable Energy Agency - IRENA, “Renewable Capacity Statistics,” Irena, Abu Dhabi, 2017.

2. International Renewable Energy Agency - IRENA, “Renewable Capacity Statistics,” IRENA, Abu Dhabi, 2019.

3. Lopez Soto, D., Mejdalani, A.;Nogales, A; Tolmasquim, M.; Hallack M. (2019). Advancing the Policy Design and Regulatory Framework for Renewable Energies in Latin America and the Caribbean for Grid-scale and Distributed Generation. Inter-America Development Bank - IDB, Washington, 2019.Caribbean for grid-scale and distributed generation,” Inter-America Development Bank - IDB, Washington, 2019.

4. Inter-American Development Bank - IDB, “Institutional Governance and Performance in the Electricity Sector in Latin America and the Caribbean,” IDB, Washington, 2018.

5. L. Viscidi and A. Yépe, “Clean Energy Auctions in Latin America,” Inter-American Development Bank - IDB, Washington, 2020.

6. Factor, “Subastas de electricidad procedente de fuentes de energía renovable en América Latina y Caribe,” Factor, Bilbao, 2017.

7. REN21, “Global Status Report,” 2017.

8. REN21, “Global Status Report,” 2018.

9. REN21, “Global Status Report,” 2019.

10. “Climatescope,” BloombergNEF, 2019. [Online]. Available: http://global-climatescope.org/.

11. P. del Río, M. C. Haufe, F. Wigan and S. Steinhilber, “Overview of Design Elements for RES-E Auctions,” *EU Horizon, 2020,* 2015.

12. G. Cunha, L. A. Barroso and B. Bezerra, “Lessons learned from the auction-based approach to integrate wind generation in the Brazilian electricity market,” *Council on Large Electric Systems - CIGRE,* 2014.

13. P. del Río and P. Linares, “Rethinking auctions for renewable electricity support,” *Renewable and Sustainable Energy Review,* no. 35, pp. 42-56, 2015.

14. C. Batlle, P. Mastropietro, P. Rodilla and I. Pérez-Arriaga, “The System Adequacy Problem: Lessons Learned from the American Continent,” in *Capacity Mechanisms in the EU Market*, Oxford, Oxford University Press, 2015, pp. 119-139.

15. Organization for Economic Co-operation and Development - OECD, “Mapping of Instruments and Incentives for Infrastructure Financing: A Taxonomy,” OECD, Paris, 2015.

16. M. T. Tolmasquim, Novo modelo do setor elétrico brasileiro, Rio de Janeiro: Synergia Editora, 2014.

17. T. B. Correia, E. Melo, A. M. da Costa and A. J. Silva, “Trajetória das reformas institucionais da indústria elétrica brasileira e novas perspectivas de mercado,” *Revista Economia,* vol. 7, pp. 607-627, 2006.

18. Banco Nacional de Desenvolvimento Econômico e Social - BNDES, “FINAME Energia Renovável,” October 2019. [Online]. Available: www.bndes.com.br. [Accessed 2019].

19. Banco Nacional de Desenvolvimento Econômico e Social - BNDES, “FINAME - BK Aquisição,” October 2019. [Online]. Available: www.bndes.com.br. [Accessed 2019].

20. Câmara de Comercialização de Energia Elétrica - CCEE, “Resultado Consolidado dos Leilões,” October 2019. [Online]. Available: www.ccee.org.br. [Accessed 2019].

21. Instituto de Pesquisa Econômica Aplicada - IPEA, “IPEADATA,” 2019. [Online]. Available: www.ipeadata.gov.br. [Accessed October 2019].

22. Agência Nacional de Energia Elétrica - ANEEL, “ANEEL,” 2019. [Online]. Available: www.aneel.gov.br. [Accessed 2019].

23. V. Krishna, Auction Theory, Elsevier, 2002.

24. R. M. Hofmann, “Gargalos do Licenciamento Ambiental Federal no Brasil,” Consultoria Legislativa - Senado federal, Brasília, 2015.

25. Agência Nacional de Energia Elétrica - ANEEL, “Nota Técnica nº 309/2016-SCG/ANEEL,” ANEEL, Brasília, 2016.