



CLEAN ENERGY **auctions** **IN LATIN AMERICA**

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Contents

4

INTRODUCTION

9

AUCTION DESIGN
ELEMENTS

31

AUCTION
OUTCOMES

53

CONCLUSIONS

55

REFERENCES



Introduction

HISTORY OF CLEAN ENERGY AUCTIONS IN LATIN AMERICA AND THE CARIBBEAN

Long-term power supply auctions are an increasingly popular instrument worldwide for attracting renewable energy investment while cutting prices, increasing energy security, reducing emissions, and achieving other policy goals. Latin America has been at the forefront of using auctions to develop renewable energy capacity. Some of the world's first successful renewable energy tenders were held in the region—in Brazil in 2005 and in Uruguay in 2006.¹ These countries remain leaders in renewable energy expansion globally, and Brazil continues to hold regular auctions. It has now held more than 40 in which renewable energy sources were eligible.² While Uruguay has not held a recent auction, its previous tenders played a critical role in developing a power matrix that is 26% fueled by wind.³

These leaders have been gradually joined by a number of other nations. In 2009 Peru held the region's first auction open to solar energy and it has since held four renewable-specific tenders.⁴ Mexico joined in 2015 following the liberalization of its energy sector, holding three clean energy auctions that yielded record-low bid prices and were heralded internationally as successes. Renewable technologies have proven highly competitive even in Chile's technology-neutral tenders, spurred by an innovative system of intraday generation time blocks. In Argentina, the RenovAr program's tenders have contracted 4.5 GW of renewable capacity since 2016, driven by ambitious renewable energy goals.

Meanwhile, several Central American countries, though small, have auctioned large quantities of renewable energy relative to their demand. A 2010 auction in Honduras contracted 250 MW of clean

energy (including large hydroelectric projects and cogeneration), equal to more than 10% of current installed capacity.⁵ El Salvador, which has an installed capacity of just 1.9 GW, has contracted 285 MW of renewable capacity in three privately run auctions since 2013.⁶ Guatemala has held two auctions open to renewables—one had a 50% renewables quota and one was specific to renewables including large hydro.⁷ Since 2011 Panama has held tenders specifically for wind and solar technology, as well as a technology-neutral tender in which solar projects won contracts.⁸ Tenders for renewable energy have also been held in Costa Rica, Nicaragua, and Belize.⁹ In the Caribbean, Jamaica is pioneering renewable energy auctions.

Thus, with the addition of Colombia in 2019, at least 15 nations in Latin America and the Caribbean have developed and held renewable power tenders tailored to their

specific goals. Auctions are a leading tool for facilitating clean energy investment. Since 2015, projects exceeding US\$46.8 billion of investment and 27 GW of new installed renewable capacity have been awarded through auctions in this report's case study countries. They have contributed to Latin America's position as a leading destination for renewable energy investment—in 2015, three of the top ten global markets were Brazil, Mexico, and Chile.¹⁰

A MARKET-LED APPROACH TO RENEWABLE ENERGY INVESTMENT

The increasing global popularity of renewable energy auctions (they have now been used in around 70 countries or more¹¹) is owed to their effectiveness as a market-led approach that can attract large amounts of investment for multiple projects without providing expensive subsidies. In these competitive processes,

auctioneers (in all the cases in this study, government agencies or ministries) seek to contract long-term power supply from bidders that offer proposals to provide a certain installed capacity or quantity of generation for a fixed time period. Project developers submit bids to provide electricity at a given price per unit. The government or other offtakers (like transmission and distribution companies) sign power purchase agreements (PPAs) with the winners—often (but not always) the bids that offer the lowest prices. Provided that measures are taken to maximize competition and prevent collusion, placing companies in direct competition can produce lower prices than might otherwise be realized using concession agreements, while achieving a variety of other policy objectives. The design of auctions can vary significantly, with important effects on the number and quality of bidders and the quantity and price of energy that is ultimately purchased.

Thus, auctioneers seek to engineer the process to best suit their specific objectives.

Various mechanisms have been used to promote renewable energy generation. For example, feed-in tariffs (FITs) have been the predominant instrument for facilitating renewable energy expansion in Europe. These guaranteed prices for power producers, which often amount to large subsidies, have been widely used in the incipient stages of renewable technology development, especially in Germany, Spain and elsewhere in Europe.¹² They facilitated the development of the renewables industry, technological advances, and cost reductions, to the benefit of other regions, including Latin America and the Caribbean. But although they provide an incentive to renewable energy generation, which in the past had higher costs than conventional generation, FITs are difficult to design and ultimately costly for governments.

One of the main problems of FITs is the asymmetry of information between the government or regulatory agency and the market. It is very difficult for the entity setting the FIT to calculate the fair rate for the investor and the consumer. The challenges were evident in Spain, which in 2009 spent around US\$3.6 billion on solar PV subsidies (50% of support for renewable electricity) even though solar PV provided just 12% of renewable generation and 2.5% of total generation.¹³ Among the flaws in the FIT design were an over-generous rate structure that awarded companies higher rates of return than intended, not decreasing subsidies in line with falling costs, and not imposing capacity quotas.¹⁴ The cost of the program and Spain's recession led to a retroactive cut of FITs in 2010 at the great expense of investor trust.¹⁵ In Germany, where FITs were the primary mechanism to bring 41 GW of solar capacity into operation by 2016 (the

second-most of any country)¹⁶, consumers have had to pay over \$200 billion extra since 2000.¹⁷ In 2015 Germany adopted auctions, and much of its promised FIT support is set to expire in the 2020s.¹⁸ Other mechanisms used to promote renewable energy generation include cap and trade systems and carbon taxes.

As renewable technologies have become more competitive with conventional generation, auctions have become the preferred mechanism for attracting investment. Though most auctions in Latin America have been technology-specific, renewables have won substantial shares of the contracts even in technology-neutral auctions like those held in Chile, rendering subsidies superfluous. The rapid rate of auctions uptake and the private sector's keen participation indicate that the use of auctions proffers multiple benefits to policymakers, consumers and investors.

BENEFITS OF AUCTIONS FOR POLICYMAKERS AND THE PRIVATE SECTOR

A key advantage of auctions is that they can signal long-term policy goals and a stable investment environment, providing regulatory certainty and transparency. This is especially the case if auctions are held on a consistent schedule and announced well ahead of time, as in Brazil. They can also facilitate long-term government planning by improving forecasting of power prices and capacity and enable policymakers to achieve results quickly.

Auctions also enable governments to pursue their own more specific energy goals. They are flexible enough in their design to achieve a wide range of policy objectives.

For one, auctions can serve as a tool to diversify the power matrix in order to

improve energy security and reduce price volatility. Latin America generates over 50% of its power from large hydroelectric plants.¹⁹ However, additional potential hydro capacity is dwindling mainly due to local opposition to the social and environmental costs of building large dams. With electricity demand set to swell 91% between 2016 and 2040,²⁰ attracting non-conventional renewable energy sources (mainly wind, solar, biomass, geothermal, and small hydroelectric plants) is a priority in many Latin American countries. Brazil faces especially high levels of hydrological risks—3/4 of its power comes from hydroelectric dams,²¹ many of which have been below average levels for five straight years²²—and has held at least nine reserve auctions (for backup power capacity).²³ Jamaica's diversification to renewables is part of a strategy to reduce high dependence on oil imports and the resultant vulnerability to oil price fluctuations.²⁴

It also seeks to diversify by geographic location to reduce aggregate variability of intermittent renewable sources.²⁵ Diversification can be achieved through quotas for specific technologies or through auctions only open to specific technologies. Auctions can also increase energy access. In 2014, Peru held one of the world's first auctions for off-grid solar energy,²⁶ and Brazil has also held several off-grid tenders.

Governments can also use auctions to lower prices through competition between all technologies. In its 2017 technology-neutral auction, Chile achieved a 75% decrease in average price relative to its 2013 auction.²⁷ The price of solar energy significantly undercut even that of coal, which provides about 40% of the country's electricity generation.²⁸ Auctions are effective in reducing prices because they facilitate real price discovery. Since the real costs of projects are unknown to regulators and policymakers,

more competitive auctions drive prices down closer to cost. In contrast, when designing feed-in tariffs, policymakers have little information on project costs and the level of support necessary for projects to be viable. This creates opportunities for developers to capitalize on information asymmetries and demand higher prices than needed.

Policymakers can also pursue emissions-reduction objectives through auctions. Argentina's renewables-only RenovAr auctions are part of efforts to achieve 20% renewable electricity by 2025.²⁹ Mexico's cap-and-trade system has been incorporated into its auctions, in which Clean Energy Certificates can also be traded. Peru sets its auction volumes in line with its goal of maintaining a non-conventional renewable share of 5% of the power matrix.³⁰

In addition, auctions have been employed to catalyze local economic development.

Uruguay has included provisions requiring 20% local content in its wind auctions,³¹ and in Brazil, preferential financing from the national development bank BNDES is contingent on a minimum share of local content.

For investors, the long-term PPAs offered in electricity auctions reduce the dependence on short-term markets in which the rate of return on large capital investments is uncertain.³² The intermittency of some renewable sources, as well as the difficulty of competing with hydropower, which offers low prices over long periods, makes developers particularly reluctant to rely on the spot market.³³ Matching generators to long-term offtakers at set prices also reduces risk and enables large long-term investments. Long-term PPAs can provide revenue stability and protect investors from the effects of changes in regulation or market design. Furthermore, regularly held auctions make the entire market more attractive to investors by

increasing predictability and facilitating long-term planning.

POTENTIAL DISADVANTAGES OF CLEAN ENERGY AUCTIONS

Despite the many benefits of clean energy auctions, this mechanism may not be the right approach for all countries, and policymakers should carefully consider the advantages and disadvantages of clean energy auctions in order to select the best approach.³⁴ While auctions help to promote competition and transparency, they also often imply high transaction costs for both the government and participants. Auctions have sometimes been touted by governments as a way to take concrete action to promote renewable energy, but it can be costly to organize and manage the highly complex process (though these costs are greatest for the first auction held and decline with experience). For bidders, auctions

often involve cumbersome administrative procedures, such as the process to meet prequalification requirements that can be very costly and create barriers to participation, particularly for small or newer players. Auctions controlled by government entities are also susceptible to governance problems, such as incentives to overuse or to underuse them for political reasons. This was evident in Mexico when a new administration with a different ideological bent came into power and chose to suspend auctions despite three successful tenders. Finally, auctions take place within a broader context and are impacted by external factors, such as the overall investment climate of the country, the credit risk profile of the off-taker, the size of the market, the availability of transmission and distribution infrastructure, and the renewable energy resource potential. Therefore, if the broader environment is not favorable to auctions, they may not represent the best policy tool.

IMPROVING THE UNDERSTANDING OF AUCTIONS IN LAC

Though auctions have grown popular in Latin America, they are a complex mechanism and are not always totally successful. The shortcomings of newcomers like Colombia, whose first renewable energy auction failed to attract enough bidders to meet competition requirements, demonstrate the need for an improved understanding of auction design and of how policymakers should evaluate tradeoffs to ensure auction results meet the specific goals of a given country. Even experienced countries like Brazil and Peru continue adapting their auction structure in response to the lessons they have learned to improve their efficacy.

Factors that reduce the number of players, like burdensome prequalification requirements and penalties, insufficient

government guarantees, and auctioning too much volume (thus reducing the ratio of bidders to demand) can threaten auction competition. On the other hand, insufficient generator guarantees and prequalification requirements and penalties that are too lax can lead to project delays, underperformance, and non-completion, or speculative bidding, in which companies participate in an auction in case costs decrease, dropping out or abandoning projects if they do not. The possibility of collusion between companies is another risk that must be mitigated.

Thus, auction design is complex, highly subject to tradeoffs, and consequentially highly context-dependent. In February 2019, Colombia annulled the results of its first long-term power auction after determining that there were too few bidders, then later acknowledging that its concentration rules had been too

stringent for the size of the auction. It also announced that it would lengthen the PPAs offered from 12 to 15 years. Countries such as Colombia that are making their first forays into renewable energy auctions, as well as countries seeking to improve the systems they have in place, can benefit from a comparison of auction designs in countries throughout the region and an examination of how different strategies have yielded different outcomes.

This study will examine the design and outcomes of recent government-led long-term power auctions with participation from non-conventional renewable sources in six countries in Latin America and the Caribbean: Brazil, Chile, Mexico, Argentina, Peru, and Jamaica. Because of rapidly changing conditions in the market for renewable energy, especially wind and solar power, only auctions initiated in 2015 or later were included. An examination of the

key auction design elements in each case is followed by an analysis of the outcomes, including the level of participation from both foreign and domestic firms, prices achieved, amount of energy contracted, and degree to which projects were completed on time.

Auction Design Elements

When designing electricity auctions, policymakers have to consider a number of objectives. There are three main goals auctions must strive to achieve. First, auctions should be attractive enough to obtain interest from investors in order to generate competition and create a competitive process to achieve optimal prices. Second, the auction design must ensure that it attracts bids from solid, reliable companies that will have the

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. This generally includes ensuring that supply is equal to demand and, for many Latin American countries, increasing the share of non-conventional renewable energy in the electricity matrix.



GENERATING COMPETITION

SELECTION PROCESS

The selection process is a critical element to designing a competitive auction. In a pay-as-bid auction, winners receive their offer price (as opposed to the market-clearing price). All countries in the study use pay-as-bid pricing. In a static sealed bid auction, bidders simultaneously submit a single-price sealed bid. The bid amounts and prices are unknown to all the other bidders. All of the countries use a static auction except for Brazil, which uses a hybrid auction combining elements from static and dynamic (multiple-phases) models.

LENGTH AND CURRENCY OF CONTRACTS

In most of the cases considered here, companies and governments sign power purchase agreements (PPAs) for 20 years. In certain Brazilian auctions, the contracts

are for 25 or 30 years, and in Mexico, they are for 15 for the energy component and 20 for the clean energy certificates component. Companies generally prefer the certainty that is afforded by longer contracts. Thus, longer contracts increase investor interest thereby increasing competition. On the other hand, governments may prefer to hedge against the risk of unforeseen changes in electricity demand or cost reductions (far from impossible given the pace of renewable technology development) by signing shorter contracts. Other studies analyzing electricity auctions in the entire Latin American region have also found that the average contract length is 20 years.³⁵

Especially in emerging markets, pricing contracts in local currency implies exchange rate risk for investors. Local currency depreciation is particularly costly when the project's inputs must be paid for in US dollars. In most Latin American countries,

developers have to import renewable energy equipment as it is not built domestically. In Argentina, for example, the peso lost 58% of its value relative to the US dollar over 2017 and 2018³⁶, which would have negatively impacted renewable energy projects. For this reason, in Peru, Jamaica, Chile, and Argentina, PPAs are denominated in or indexed to US dollars. In Mexico, companies may choose to index their payments in pesos to Mexican inflation or the peso-dollar exchange rate, and in Brazil, the contract currency is the Brazilian real. In most countries, prices are periodically indexed to inflation.

GRID CONNECTION COSTS

Grid connection cost allocation is an important issue for renewable developers, particularly because site selection is limited by the availability of natural resources such as solar irradiation and strong winds.

At the same time, reducing or eliminating grid connection costs for renewable energy developers is a form of subsidy, as renewable energy projects are not exposed to the true economic costs. In all of the countries in the study, generators are responsible for the cost of grid connection, but some countries like Brazil offer reduced transmission costs for renewables.

GUARANTEES TO REDUCE RISK FOR DEVELOPERS

Investor confidence can also be significantly improved through the provision of guarantees by off-takers, for example, through a take-or-pay clause (in which all the contracted energy must be purchased even if it is not used) or a fixed revenue for a certain period. Such measures can shift the risk of low demand away from the generator. Companies will also be more likely to sign PPAs at competitive prices

if the off-taker is reputable or can provide payment guarantees. All six countries in the study offer some form of guarantee for developers, but the approach varies significantly. In Brazil, for example, the investor receives full payment for the amount of energy contracted even if demand is lower. If the generation is higher than the amount contracted the generator can sell the surplus in the spot market.³⁷ Argentina has the Fondo para el Desarrollo de Energías Renovables (FODER), a fund that provides payment guarantees.

AUCTION FREQUENCY AND TIMELINE

Auctions held at regular intervals or scheduled well in advance can improve long-term confidence in a country and encourage bidders to invest the time and resources necessary to familiarize themselves with the market. Of the countries considered in this analysis,

Brazil provides the most predictability. For years, at least two auctions have been held annually. In March 2019, the Ministry of Mines and Energy released the schedule of the next six auctions through the end of 2021.³⁸ Peru, Chile and Argentina have also had fairly consistent auctions. Mexico held three annual auctions between 2015 and 2017 but has not held any auctions since.

LENGTH OF TIME BETWEEN AUCTIONS AND COMMERCIAL OPERATION

The lead time between the conclusion of an auction and the date by which projects are required to operate can affect both competition within the auction and rates of completion and delays.³⁹ Auctions with longer lead times are more attractive to developers. Lead times that are too short can result in low on-time completion, complicating energy planning. When projects are delayed companies may face

heavy penalties or start legal disputes with the government to avoid penalties. However, if the process allows too much lead time, especially without strong penalties, companies may bid competitively to see if technology prices will continue falling and ultimately decide not to see a project through. The lead time varies by country based on the length of permitting processes, grid interconnection, and other factors. In Mexico, for example, projects were given between 2 and 3 years to come online, while in some Brazilian auctions, projects are given as long as 6 years.

ATTRACTING QUALITY BIDDERS

PREQUALIFICATION REQUIREMENTS

One of the greatest challenges to auction design is to ensure that companies go on to obtain financing and actually build their projects on time. The auctioneer can impose criteria on potential bidders 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. Prequalification requirements can deter speculative bidding. Examples of such requirements include land use rights and environmental permitting for the project site proposed, proof of a site's resources, grid connection studies or even a grid access permit, a history of having constructed and operated a project of the size proposed, proof of sufficient assets or credit rating to finance the project, and a fee for access to the auction rules.

On the other hand, prequalification requirements that are too stringent may reduce competition by providing an insurmountable barrier to entry for small or new (yet competent) potential bidders. Prequalification requirements vary widely in the countries studied. Below we summarize the prequalification requirements for the countries studied. For example, Brazil requires developers to demonstrate preliminary grid access, environmental permitting and impact assessments, land-use rights and financial qualifications but has no requirements related to track records. Mexico has similar requirements to Brazil but also asks developers to demonstrate experience with a similar project to the one proposed. Chile and Peru are highlighted as the countries with fewer requirements for bidders.

GUARANTEES TO REDUCE RISK FOR OFF-TAKERS

Auctions without financial guarantees can be compromised by speculative bidding, in which bidders participate in order to see if market conditions improve, for example, due to a reduction in technology costs, only to drop out or decline to sign a contract if they do not improve. This is a real risk, especially given the rapid rate of decline in solar PV costs. Bid bonds, deposited by participants with their bids and only returned once a contract is signed or their project is not selected, can disincentivize such behavior. All the countries in the study required a deposit of some size to participate.

Penalties for noncompliance and delays can help increase project realization rates.

In all the countries in this study, penalties are imposed both for underperformance (not providing the agreed-upon generation or capacity) and delays. Auctioneers can also collect completion bonds, which are only returned upon successful completion of the project, to discourage project abandonment. All of the countries in the study impose completion bonds.

COMPARISON OF AUCTION REQUIREMENTS

Comparison of Auction Requirements

	Brazil	Chile	Mexico	Argentina	Peru	Jamaica ^a
Preliminary Grid Access	X					
Environmental Permitting	X			X		
Environmental Impact Assessment	X			X		X
Land Use Rights	X			X		X ^d
Financial Qualifications (Ex. Net worth, credit rating, evidence of financing past projects)	X	X	X	X		X
Previous Experience (Project Technology)			X		X ^b	X
Previous Experience (Project Size)			X			X
Resource Assessment/Energy Output Study	X			X	X	X
Grid Interconnection Study	X ^c			X		X

a. These criteria are considered prior to projects being evaluated economically. There is no prequalification phase per se. (b.)At least two years of experience in electricity generation.

c. Conducted by system operator and EPE to determine capacity of substations and grid. Then a preliminary auction phase is held for access to connection points.

d. “Evidence of ability to secure use of site”

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ACHIEVING TARGETED OUTCOMES

ELIGIBLE TECHNOLOGIES

All of the countries in the study have established policy objectives to expand clean energy sources, and the auction design can influence whether this policy goal is achieved. The choice of whether to allow all technologies to compete in an auction (technology-neutral) or only certain ones (technology-specific) is a tradeoff that depends on the auction objectives. Technology-neutral auctions reduce the risk of unmet demand and increase the chance that the most cost-effective projects will be selected. Technology-specific auctions, or the division of demand by technology, enables governments to meet emissions reduction targets, hedge price and resource risks through technological diversification, and reduce import dependence. Of the countries examined here, only Chile does not hold technology-specific auctions for clean energy. However, its auction design

is favorable to renewables, which tend to win large shares of the contracts in any case. The rest limit participation to certain technologies, usually renewable energy or non-conventional renewable energy (NCRE), which excludes large hydropower projects. Several countries, including Brazil, Mexico, and Argentina, also provide other renewable energy incentives, such as reduced transmission costs, carbon credits, and tax breaks. Other studies on auction design have found that in the Latin American region more broadly, the vast majority of countries hold technology specific auctions.⁴⁰

Some countries are also looking not only to expand clean energy installed capacity but also to develop the local clean energy supply chain. Within the auction, technology may also be subject to quotas for local content to facilitate the development of local supply chains and provide broader socioeconomic

benefits. While there is no eligibility requirement based on local content in the countries studied, it provides a major advantage in Brazil and Argentina, where it is required for preferential financing, and it is a selection criterion in Argentina. With the exception of Brazil, in the countries examined here, the local manufacturing sector for renewable energy products is generally weak.

PRODUCTS OFFERED

The auctioneer can call for bids for 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—if not, a capacity market is needed to allow generators to recover fixed costs. Mexico offers both capacity and generation, whereas in Argentina and

Jamaica only capacity was offered, and in Peru, Brazil, and Chile, only generation. In Mexico, the clean energy certificates (CELs) used in its cap-and-trade system are also traded, both by companies due to receive CELs for new renewable energy projects and by companies with CELs from existing projects. In Chile, generation is awarded within intraday and seasonal time blocks, a feature that makes intermittent and seasonal renewable technologies more competitive but may discourage participation from other technologies, even in the blocks less favorable to renewables.

VOLUME OFFERED

Contracting large volumes in a single auction may accelerate progress toward capacity and generation goals. However, in the case of less experienced auctioneers, it may fail to take advantage of the learning that takes place over the course of each

tender and lead to oversupply. Volume can be limited by geographic location to reduce transmission congestion risk and overall intermittency and disperse socioeconomic benefits. A maximum project size constraint can similarly increase geographical dispersion and reduce congestion risk, grid expansion costs, environmental impacts, and domination by large companies. Conversely, a minimum size can ensure that the benefits of scale are maximized.

Countries may implement price-sensitive volume, in which the amount contracted responds to the prices offered. Countries may also choose not to disclose the total capacity sought until after bids are received to prevent collusion. In most countries, including Mexico and Brazil, the off-takers self-report their expected demand, which is the basis for the volume set in auctions. All six countries include a volume ceiling in their auctions to avoid oversupply but only

Chile, Jamaica and Peru disclose the volume. Peru also began disclosing the price ceiling in its most recent auction after it received too many bids that were over the ceiling.

COUNTRY CASE STUDIES

BRAZIL

Brazil has by far the most energy tenders under its belt—more than 60 since 2004.⁴¹ Brazil relies on hydroelectric dams for over 70% of power generation, but in recent years droughts and local opposition to new hydroelectric dams has motivated the government to seek to add alternative generation sources. Brazil's most recent long-term energy plan aims to maintain current levels of hydro generation while increasing the share of non-hydro renewables, particularly solar. The goals of Brazil's electricity auctions are to diversify the electricity mix, adding more nonhydroelectric capacity, and to improve energy security by adding new generation capacity.⁴²

It holds three types of auctions for energy from new projects, each with different objectives related to

expanding non-conventional renewable energy generation and ensuring reliable, affordable energy supply.⁴³

- **Energia Nova:** The most frequently held, “new energy” auctions are technology-specific (though they were technology-neutral in the past) and have the objective of increasing the supply of energy for distributors. Since 2011 these have generally been held twice a year. As of 2017, one A-4 auction and one A-6 auction are held each year (for operation beginning four years and six years after the contract is signed, respectively). Prior to 2017, A-3 and A-5 auctions were held. The September 2019 auction will be the first A-6 tender to allow solar energy because of the technology's shorter implementation times.
- **Fontes Alternativas:** A less common design, these “alternative source”

auctions aim to increase participation of wind, biomass, and small hydro in the energy matrix. Only three have been held since 2007 with the last one occurring in 2015. In this design, the off-taker specifies the total amount of alternative energy required in the auction. Once all bids are collected, each alternative source is allocated a volume equal to the percentage of that source's contribution to total bids. For example, if the off-taker specifies it will purchase 100 MW of renewable sources and the amount bid by technology is 600 MW of wind and 400 MW of biomass, then 60MW of the 100MW purchased will come from wind and 40 MW will be allocated to biomass.

- **Energia de Reserva:** “Reserve energy” auctions are meant to increase energy security

and so far have only been used to contract renewable energy.

In addition to holding alternative energy auctions, Brazil provides incentives for renewable energy through reduced transmission costs. Developers are responsible for most costs associated with interconnection, including upgrades to grid infrastructure. However, renewable energy technologies enjoy discounts on transmission and distribution tariffs (50% for wind and 80% for solar). Through technology specific auctions and other incentives Brazil has succeeded in diversifying its energy matrix.

Brazil is the only country in this study to use a hybrid auction process with two phases. This is a more complicated auction process which could deter some investors but does not appear to have lowered competition in Brazil, possibly

because of the large size of the market. The government created the hybrid system in an effort to improve competition after an earlier auction design was determined to potentially incentivize companies to collude.

- **Phase 1 (Sealed-bid):** Bidders submit sealed bids with a price (which must be below a ceiling price announced by ANEEL prior to the auction) and quantity. “Temporary winners” are selected beginning with the lowest-priced bids, increasing in price until the auction demand is met. The volume is not disclosed to encourage the most favorable bids.
- **Phase 2 (Descending clock):** The bidders that were not selected are given three to five minutes to submit a bid to displace a “temporary winner” by offering a price that is lower by a

minimum amount determined by the auctioneer. The process is then repeated until no bidder is willing to displace a “temporary winner.” At this point, the winners of the auction are determined.

Depending on the auction and technology, PPAs are signed for 15-30 years (up to 35 for reserve energy). Contracts are priced in Brazilian reais and indexed to inflation. In an incentive to bidders, project developers may receive compensation for overproduction by selling a portion of energy generated on the spot market.⁴⁴

Prior to 2017, the electricity regulator and auctioneer, ANEEL, would first offer a ceiling price, with bidders submitting the amount of energy they would provide at that price. No bidder could revise this initial quantity for the rest of the auction.⁴⁵ The ceiling price would then be lowered, with bidders exiting or remaining

in at their initial quantity, until auction supply only exceeded demand by a factor known to the auctioneer alone. A sealed-bid phase would then commence, with bidders submitting a price at which to provide their initial quantity that could not exceed their bid from the end of first round. This process was abandoned in favor of the new process because bidders could tacitly agree to exit at a high price in the first round, thus artificially raising the ceiling price for the second phase.

Brazil has looser prequalification requirements than some of the other countries, which widens the pool of potential companies participating in the auction. Prequalification criteria include preliminary grid access, environmental permitting, an environmental impact assessment, proof of land use rights, and financial

qualifications such as demonstrating a net worth of at least 10% of the project’s estimated cost.

Brazil requires guarantees and imposes penalties to discourage developers from delaying or canceling projects. To participate in the first phase of the auction, bidders must submit a guarantee equivalent to 1% of the project’s estimated cost. This bond must be increased to 5% to continue in the second phase. Bonds are returned after the auction, or after the contract is signed, in the case of winners (though winners must then submit a 5% construction bond).

SELECTED AUCTION FEATURES, BRAZIL

Auction Frequency and Timeline	• New energy: Generally twice a year • Alternative sources: Irregular, ad hoc • Reserve auctions: Irregular, ad hoc	Sources:
Products Offered	• Generation. Tradable firm energy certificates (FECs) are issued by the MME to back all generation contracts and indicate the level of supply that a generator is obligated to provide. Their purpose is to ensure supply in the absence of a formal capacity market.	
Eligible Technologies	• “New energy” auctions are technology-specific with allowed technologies varying by auction (for instance solar was excluded from A-6 auctions until 2019). • Alternative sources auctions have been limited to wind, small hydro, and biomass. • For reserve auctions, the permitted technologies vary by auction.	• Cirino dos Santos, Ana Cláudia. “La Regulación De Las Subastas De Nueva Capacidad Renovable y Los Resultados Obtenidos: Caso Brasil.” ANEEL, October 3, 2018.
Contract Length	• Alternative sources: New sources: 15-30 years, existing sources: 1-15 years • New energy: 15-30 years • Reserve: 15-35 years	• Hochberg, Michael, and Rahmatallah Poudineh. Renewable Auction Design in Theory and Practice: Lessons from the Experience of Brazil and Mexico. Oxford: Oxford Institute for Energy Studies, April 2018. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/04/Renewable-Auction-Design-in-Theory-and-Practice-Lessons-from-the-Experiences-of-Brazil-and-Mexico-EL-28.pdf.
Time between Auction and Energy Delivery	• Alternative sources: New sources: <3-7 years, existing sources: <1-2 years • New energy: Generally January 1 of 4 or 6 years from the auction year (previously 3 or 5) but can vary between 3 and 7 • Reserve: Variable, <3-7 years	• Augusto Barroso, Luiz et al. Renewable Energy Auctions in Latin America and the Caribbean. Spain: Factor and Global Environment Facility, 2017. https://www.wearefactor.com/docs/RE_LAC.pdf.
Currency and Indexing	• Priced and paid in BRL, indexed annually to domestic inflation.	
Guarantees for Buyers	• Bid bond: To participate in first phase of the auction, 1% of project’s estimated cost. To participate in second phase this is increased to 5%. Depending on the auction, returned after contracts are signed or certain milestones are completed. • Completion bond: Winners must submit a bond of 5% of the project’s estimated cost, which the government may claim if project delays exceed one year. • Penalties: In the event of a 10% or greater difference in contracted energy and annual generation, penalties are applied which depend on the type of auction and energy source. For delays, the penalty is applied considering the amount of undelivered energy is 100%.	
Guarantees for Sellers	• Additional unexpected and excess generation may be sold to the spot market.	
Responsible for Grid Interconnection Costs	• Generator	
Local Content Requirements	• No formal requirement, but low-cost financing from BNDES is contingent on minimum local content and is important for projects to be competitive.	
Roles of Different Parties in Auction Process	• ANEEL, the power market regulator, leads the auction process. • Ministry of Mines and Energy defines auction guidelines and volume (using forecasts from distribution companies, the offtakers). • CCEE (electricity market operator) calculates distribution tariffs, manages contract settlement and auction administration. • EPE (the Energy Research Company) is responsible for the qualification process. • These four organizations work together as a committee.	

CHILE

Highly dependent on imports of coal, oil, and natural gas, Chile has introduced an aggressive strategy to diversify its energy matrix in order to improve energy security and reduce power sector related greenhouse gas emissions. Chile's National Energy Strategy prioritizes the expansion of non-conventional renewable energy sources, including biomass, geothermal, small hydro plants, solar, tidal and wind energy.⁴⁶ Chile has held auctions on a near-annual basis since 2006.

Though its auctions are technology-neutral, they also include a unique element that puts renewable technologies on a more equal footing. Contracts for generation are awarded for intraday and quarterly blocks as well as for 24-hour generation (the specific combination depends on the auction). This allows solar and wind producers to account for intraday and seasonal variability and submit bids for the

blocks for which they are most competitive. The auction objectives are to ensure energy supply at competitive prices while achieving sustainability goals. Auctions are held around five years before the energy supply they contract is to be provided.

Bidders can offer combinations of blocks, including blocks that are conditional on the selection or non-selection of others. Bidders also offer an indexation formula that is considered by the auctioneer, which takes into account the effects of inflation, and in the case of fuel-based generation, changes in fuel prices are considered. Bids are ordered using the levelized price (that is, taking into account the indexes and projections of fuel prices). The ceiling price is unknown, and if offers are not below it they flow into a second round.⁴⁷ Final winners are the lowest price derived from adding up offers from Rounds 1 and 2.⁴⁸ 20-year PPAs with distribution companies are signed and denominated in US dollars indexed to inflation.

Chile enforces the least stringent pre-requirements of the countries examined here, opening the auction to a wide range of players, but imposes hefty penalties for lack of completion. Bidders must meet minimal credit rating requirements and establish a specific-purpose company in Chile, but there are no local content requirements, an attractive feature to many international developers. Bids must be accompanied by an explanation of how existing and projected generation sources will provide the volume being bid, their connection points and production history (if applicable), and the bidder's commercial and financial background, including balance sheets and income statements.

If the generator is not yet registered in Chile it must post a bid bond of 200 Unidades de Fomento (UF, an inflation-adjusted unit of account—this quantity is equivalent to about \$7800 in July 2019) per

GWh being offered. It is returned upon 25% completion of the project or non-selection.

A completion guarantee of 600 UF/GWh (around \$47,000) is deposited upon selection and if the project is not completed during the first year of projected supply, it is confiscated. Project construction is monitored, with fines of 15 UF/GWh (around \$588) imposed for missing two milestones. Developers must also maintain a credit rating of at least BB+ and purchase insurance for construction and operation of the plant.

There is an allowance for contract prices to be revised in response to regulatory changes. Contracts can also be transferred to other entities provided approval from the regulator. Projects can also be postponed for up to two years for a fine of 10 UF/GWh per month of delay.⁴⁹ The penalty for under-delivery or delays is the difference between the spot price and the contract price.

SELECTED AUCTION FEATURES, CHILE

Auction Frequency and Timeline		Usually once per year
Products Offered		Generation
Eligible Technologies		Technology-neutral
Length of Contracts		20 years
Time between Auction and Energy Delivery		2015/02: 1/1/2017 (1 year, 2 months after winners announced) 2015/01: 1/1/21 (4 years, 4 months after winners announced) 2017/01: 1/1/24 (6 years, 2 months after winners announced)
Currency and Indexing		Priced and paid in USD. Periodically adjusted to US CPI. Bidders may design own indexation formulations, weighting inflation against other factors such as fuel prices (in the case of non-renewable generation).
Guarantees for Buyers		- Bid bond: If the generator is not yet registered in Chile, 200 Unidades de Fomento* (UF)/GWh offered. Returned upon non-selection or 25% completion of project. - Completion bond: 600 UF/GWh, confiscated if project is not completed during first year of projected supply. Project construction is monitored and a fine of 15 UF/GWh imposed for missing two milestones. Developers must maintain a BB+ credit rating and purchase insurance for construction and operation of the plant. - Penalties: For under-production or delays, the difference between the spot price and the contract price for undelivered energy.
Guarantees for Sellers		- No purchasing commitment (i.e., not take-or-pay): generator assumes demand risk. - Projects can be postponed for up to two years for a fine of 10 UF/GWh per month of delay. Within the first three years after signing the contract, generator may abandon the contract (if on the grounds of third-party liability) by paying 360 UF/GWh for the last year's supply. - Contracts can be transferred to third parties. - Prices can be revised in the event that certain changes, including tax-related, create a 2% variation in capital or operation costs.
Responsible for Grid Interconnection Costs		Generator
Local Content Requirements		None
Roles of Different Parties in Auction Process		The CNE (National Energy Commission) coordinates auctions on behalf of distribution companies, the buyers.

*An inflation-adjusted unit of account—1 UF equals around 28,000 CLP in Sept. 2019, or around US\$39.50.

Sources:

- Resolución Exenta No 849, Resolución Exenta No 849 § (2016). <https://www.cne.cl/wp-content/uploads/2016/12/Res-Ex-N%C2%B0849-Bases-Licitaci%C3%B3n-2017-01.pdf>
- BloombergNEF. “Chile.” Climatescope 2018. <http://global-climatescope.org/results/CL>
- del Río, Pablo. “Auctions for Renewable Energy in Chile: Instruments and Lessons Learnt.” AURES, July 2017. http://auresproject.eu/sites/aures.eu/files/media/documents/chile_final.pdf.

MEXICO

Mexico is a newcomer to energy auctions. Until 2013 its power sector was monopolized by the Comisión Federal de Electricidad (CFE), its state-owned and fully integrated utility. A constitutional reform that liberalized the nation's energy sector allowed for long-term power supply auctions, of which three have been subsequently held since 2015.

Mexico's long-term power supply auctions have sought both to increase energy supply at low prices and to boost the share of clean energy in the power matrix to 35% by 2024, with interim targets.⁵⁰ As such, auctions are limited to "clean energy" (which includes renewables, as well as nuclear energy and efficient cogeneration). They also trade, in addition to capacity and generation, Clean Energy Certificates (CELs by their initials in Spanish), the accounting mechanism used by Mexico's cap-and-trade system.

Mexico's auction selection process has only one phase, which makes the process more

simple for bidders. In a sealed-bid process, bidders submit one or more indivisible packages of capacity, generation, and/or CELs, the purchase of which may be conditional upon the result of the bidder's other packet(s). The offers include the location of the project and the date of commercial operation, the price(s), and whether indexation of the prices to Mexican inflation or the peso-dollar exchange rate. The ceiling price is not known beforehand.

Adjustments are then made to bid prices based on the project location to spread the socioeconomic benefit of offers geographically and avoid congestion on transmission lines. For intermittent energy, the hours of generation are also considered in order to match supply and demand. The "adjusted" prices are then compared to award projects, but since the auction is pay-as-bid, the prices in the offers are the ones actually paid.

The auction is static—this comparison of offers by the auctioneer is the only phase. Contracts are thus awarded for PPAs of 15 years (20 for

CELs). The price offered in the bid is periodically adjusted according to a formula selected by the bidder that weights variations in the peso/dollar exchange rate and both inflation rates.

Mexico has relatively low prequalification requirements, and participants must only show previous experience and financial stability. Technical prequalification requirements include experience in building and operating a project similar to that proposed within the past 10 years, using a similar technology, and with total capacity of at least 1/3 of the proposed project.⁵¹ Bidders must also demonstrate having successfully acquired financing for a project of equal or greater size (or multiple projects that add up to that size). Fees must also be paid to CENACE, the power regulator/auctioneer, for auction rules and evaluation. Resource assessments and grid connection plans must be submitted with the bids. A bid bond is collected and returned to the unselected bidders. For the winners, it is used to cover interconnection fees and the remainder is returned. Mexico's system for calculating bid bonds could result in low bid

bonds compared to other countries because it includes a fixed fee irrespective of the number of bids submitted by the same generator and allows participants to reduce the amount by securing an early interconnection agreement.

The signing of contracts is accompanied by the depositing of performance guarantees by generators, which is returned incrementally as the project progresses. It is reduced to 80% when financing is acquired, to 70% when it begins to operate, and to 50% when it begins to operate commercially. Purchase guarantees are also provided by off-takers (see table).⁵²

Delays in commercial operation are subject to penalties unless they are due to noncompliance by the municipal, state, or federal government, a transmission or distribution company or CENACE, or to an unexpected delay in interconnection. The bidder must pay a penalty equivalent to 5% of the monthly payments under the PPA as well as an increase in the performance guarantee. Delays in reaching milestones such as financing result in an increase of the performance bond.

SELECTED AUCTION FEATURES, MEXICO

		*A unit of account equal to about 6.287 MXN (around US\$0.32) in Sept. 2019.
		Sources:
Auction Frequency and Timeline	• Once a year from 2015-2017	- Bases de Licitación de la Subasta de Largo Plazo SLP-1/2017, Bases de Licitación de la Subasta de Largo Plazo SLP-1/2017 § (2017). https://www.cenace.gob.mx/Docs/MercadoOperacion/Subastas/2017/07 Bases Licitacion SLP2017 v08 05 2017.zip. - Astolfi, Paul et al. “Mexico’s Clean Energy Auction: Material Provisions of the Power Purchase Agreements .” Mayer Brown, March 31, 2016. https://www.mayerbrown.com/-/media/files/perspectives-events/publications/2016/03/mexicos-clean-energy-auction-material-provisions-o/files/get-the-full-report/fileattachment/160331-update-energy-mexico-prjfin.pdf. - Hochberg, Michael, and Rahmatallah Poudineh. Renewable Auction Design in Theory and Practice: Lessons from the Experience of Brazil and Mexico. Oxford: Oxford Institute for Energy Studies, April 2018. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/04/Renewable-Auction-Design-in-Theory-and-Practice-Lessons-from-the-Experiences-of-Brazil-and-Mexico-EL-28.pdf. - del Río, Pablo. “Auctions for Renewable Support in Mexico: Instruments and Lessons Learnt.” Auctions for Renewable Support in Mexico: Instruments and Lessons Learnt. AURES, July 2017. http://auresproject.eu/sites/aures.eu/files/media/documents/mexico_final.pdf. - Matsuo, Tyeler, and Tobias Schmidt. “The Challenge of Local Content in Renewable Energy Markets.” Green Growth Knowledge Platform. German Development Institute / GIZ, n.d. https://www.die-gdi.de/fileadmin/user_upload/pdfs/veranstaltungen/2018/20180618_green_transformation/The_challenge_of_local_content_in_renewable_energy_markets_AP_TM_TS.pdf.w
Products Offered	• Capacity, generation, Clean Energy Certificates	
Eligible Technologies	• Renewable energy including large hydro, nuclear energy, efficient cogeneration.	
Length of Contracts	• 15 years (20 for CELs)	
Time between Auction and Energy Delivery	• Proposed commercial operation dates can be up to one year before or two years after Standard Date of Commercial Operation (SDCO). • First auction: 3/28/16 (2 years after winners announced). • Second auction: SDCO of 1/1/19 (2 years 3 months after winners announced). • Third auction: SDCO of 1/1/2020 (2 years 1 month after winners announced).	
Currency and Indexing	• Priced and paid in MXN. Seller can choose monthly indexation to Mexican inflation or the MXN/USD exchange rate.	
Guarantees for Buyers	• Bid bond: 300,000 unidades de inversion* (UDIs) per bidder plus 65,000 UDIs/MW of capacity offered, 30 UDIs/MWh of generation, and 15 UDIs/CEL. USD or MXN. For winning bids, used to cover any interconnection fees, with the remainder returned. • Performance guarantee: 65,000 UDIs/MW, 30 UDIs/MWh, 15 UDIs/CEL. Can be reduced or increased according to whether milestones are met. • Penalties: Delays in commercial operations as indicated in the bid incur a 5% penalty of the monthly payments under the PPA.	
Guarantees for Sellers	• Performance guarantee of 32,500 UDIs*/MW of capacity, 15 UDIs/MWh of generation, 7.5 UDIs/CEL.	
Responsible for Grid Interconnection Costs	• Generator	
Local Content Requirements	• None. There are local content requirements, however they are not part of the auction process but rather general requirements from the economy ministry.	
Roles of Different Parties in Auction Process	• CENACE (power system operator) convenes, organizes, and coordinates auctions. • CRE (the Energy Regulatory Commission) sets ceiling prices for products. • CFE (the public utility) was the only buyer in the first two auctions, but private companies participated in the third auction. Purchase bids as well as generation bids are collected by CENACE, which seeks to award winners to maximize economic surplus and optimize factors like location, load, and exchange rate.	

ARGENTINA

Though Argentina experimented with renewable energy auctions as far back as 2009,⁵³ the RenovAr program for renewable energy auctions, initiated in 2016, has been the country's flagship instrument for attracting renewable capacity. The tenders are rooted in Argentina's national objective of a 20% renewable power matrix by 2025⁵⁴ and thus are open only to renewable technologies.

In a sealed-bid process, Argentina uses two price-adjustment mechanisms to produce an "Adjusted Offered Price"⁵⁵ for the purpose of comparing offers. Prices are multiplied by a "loss factor" that corresponds to the transmission losses associated with the interconnection point selected (this information is known to the bidders). Bid prices are also reduced by \$0.15/MWh for each anticipated month of early operation ("early" meaning before the two-year maximum), making projects with earlier estimated completion dates more competitive. Projects are then ranked by these adjusted prices and selected until demand is met, with ties being broken in favor of the project with a greater share of local content. An undisclosed ceiling price is also set. Demand bands are fixed for

each technology, and any unfilled demand can be substituted by excess supply from another technology.

PPAs of 20 years are then signed, with payment in Argentine pesos (for the corresponding amount in USD using the previous business day's exchange rate), indexed to USD. When PPAs are signed, generators must deposit a performance bond of \$250,000/MW. The off-taker (the state company CAMMESA) must also post a liquidity guarantee of at least 12 months of payments, and a termination guarantee provides generators with the option to sell the project to the government under certain circumstances, including non-payment over a certain period, early termination of the PPA, certain legislative changes, breach of a court judgment under the dispute resolution clause by the off-taker, or a loss of convertibility/transferability of the Argentine peso to other currencies or countries.⁵⁶

Obtaining financing is extremely challenging in Argentina due to high interest rates. In addition, CAMMESA and other government entities lack investment grade ratings because of the country's 2001 default on sovereign bonds. To mitigate risk to investing in renewable energy

projects in Argentina, the government offers payment guarantees backed by the World Bank through a renewable energy development fund called FODER. FODER also provides the termination guarantees as well as long-term loans, interest rate subsidies and equity contributions to projects. Though contracts are priced in USD, payments are made in Argentine pesos, which may nonetheless be an unattractive feature for foreign firms on account of the currency's volatility.

Argentina provides incentives for local content, including priority access to FODER financing for IPPs, tax credit on locally supplied capex for IPPs with 30% local content, and incentives for domestic suppliers and manufacturers. In addition, in the auction selection process, if the adjusted prices are tied, higher local content is used as a tiebreaker.

Argentina imposes rigorous prequalification requirements and incentives for on-time completion of projects. Prequalified companies must prove minimum assets of \$500,000 per MW on offer as well as proof of rights to the site, environmental approval, a resource assessment (at least 12 months for wind measurements), energy output studies, a grid

connection study, and previous experience building and operating a project of the technology being offered of at least 1/3 the size.⁵⁷ It must also have begun the process for authorization as an electricity market agent. A bid bond of \$35,000 per MW offered is collected for each project. It is returned to non-selected projects and returned to selected projects once the performance guarantee has been deposited.

On-time completion is incentivized by a unique payment scheme in which the PPA payments are frontloaded. For example, for RenovAr 1, prices paid to projects for operation in 2017 were multiplied by 1.20, an "incentive factor" decreasing to 0.80 beyond 2035. An explicit penalty is also imposed for underproduction or a delayed start. A production deficit of a certain degree can be carried over to the next year, but a greater deficit incurs a fine of \$160/MWh.⁵⁸

Argentina faces challenges with a shortage of grid capacity to bring new renewable energy projects online. The costs of grid interconnection must be shouldered by the project developer. The government plans to undertake grid upgrades, including more than 5,000 kilometers of new transmission lines, in order to facilitate these projects.

SELECTED AUCTION FEATURES, ARGENTINA

Auction Frequency and Timeline	Roughly annually	Sources: - Programa RenovAr Ronda 1 Pliego de Bases y Condiciones, Programa RenovAr Ronda 1 Pliego de Bases y Condiciones § (2016). https://www.argentina.gob.ar/sites/default/files/programa_renovar_ronda_1_-_pliego_de_bases_y_condiciones.pdf. - International Renewable Energy Agency. Renewable Energy Auctions: Analysing 2016. Abu Dhabi: IRENA, 2017. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Jun/IRENA_Renewable_Energy_Auctions_2017.pdf. "Law 27.191 Program to Promote the Use of Renewable Energy in Electricity Generation." IEA, March 1, 2018. https://www.iea.org/policies-andmeasures/pams/argentina/name-158841-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdhBpZD0iYnJlYWVjcVtYiL-PGE-gaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXV-vOyAsYSBocmVmPSlvcG9saWNpZXNhbm-RtZWZzdXJlcy8iPlBvbGljaWVzIGFuZCB-NZWZzdXJlczwvYT4gJnJhcXVvOyAsYSBocmVmPSlvcG9saWNpZXNhbmRtZWZzdXJl-cy9yZW5ld2FibGVlbmVyZ3kvIj5SZW5ld2FibG-UgRW5lcmd5PC9hPjwvbmF2Pg..
Products Offered	Capacity	
Eligible Technologies	Solar, wind, biomass, biogas, small hydro	
Length of Contracts	20 years	
Time between Auction and Energy Delivery	Maximum of two years. Bidders submit commercial operation dates for projects and earlier completion is incentivized. Contract period begins on the real date of commercial operation.	
Currency and Indexing	Priced in USD, paid in ARG at the USD/ARG exchange rate of the business day prior to payment.	
Guarantees for Buyers	- Bid bond: \$35,000/MW offered. Returned to non-selected 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. Returned upon commercial operation. - Penalties: \$1,388/MW delayed capacity per day delayed. Supply shortfalls to a certain extent can be rolled over to the next year, beyond a certain degree a \$160/MWh fine applies. - An annual incentive factor, which decreases with time, is applied to the prices paid in each calendar year. For example, for RenovAr 1, prices paid to projects for operation in 2017 were multiplied by 1.20, decreasing to 0.80 beyond 2035. (4) (Not a guarantee per se but a system that does in a sense penalize later project completion).	
Guarantees for Sellers	Renewable energy development fund FODER provides payment guarantees. Termination guarantees backed by the World Bank (provided in cases of non-payment, breach of court judgement under dispute resolution clause by offtaker, lack of convertibility or transferability of Argentine peso, changes in certain laws, expropriation of project or early termination of the PPA).	
Responsible for Grid Interconnection Costs	Generator	
Local Content Requirements	No minimum requirement, but local content level is factored into the selection rules and provides priority access to FODER financing and tax credit.	
Roles of Different Parties in Auction Process	- CAMMESA (the Compañía Administradora del Mercado Mayorista Eléctrico Sociedad Anónima) is the auctioneer and buyer on behalf of distribution companies and large users of the wholesale electric market. - FODER (the Fondo para el Desarrollo de Energías Renovables) provides payment guarantees, which are accumulated by the Ministry of Energy and Mining through charges to consumers. - The World Bank guarantees payment for the project in the event of contract termination.	

PERU

Peru's renewable energy auctions are driven by the objective of maintaining a 5% share of renewable energy (other than hydro) in the country's power matrix, though it lacks more ambitious long-term goals.⁵⁹ Every two years, the need for an auction is considered, and if one is held, the volume of energy to be contracted by wind, solar, and biomass sources is equivalent to 5% of final energy consumption from the previous year.

In Peruvian auctions, only generation is contracted. In general, its auction process is simple and transparent, a feature that should attract potential participants. The selection process is comprised of various phases. In the first, qualifying bids are organized by technology and ordered by price, selected from lowest to highest price until the demand for each technology is

met. Solar and wind energy bids are ordered based on the point of interconnection and selected in that order as long as their price does not exceed the maximum price for the technology. If there is unmet demand for any technology, a second phase is held in which bidders may submit a lower price than in their initial offer. In the third phase, hydroelectric projects are selected using the process of ranking by price, but there is no possibility of a fourth phase if there is unmet hydro demand.⁶⁰

Bidders submit two envelopes, one of which contains the regulatory requirements, including the environmental report, sworn declarations, and project location, budget, and power. The second contains the price and amount of energy being offered, as well as the minimum percentage of energy that must be contracted if the full amount is not awarded. In the 2016 auction, the ceiling price was disclosed to the bidders for the

first time because in previous actions many bids were far above the ceiling price and thus excluded.

Peru has relatively low levels of prequalification requirements. Preselection relies heavily on financial requirements but eschews some standard requirements such as pre-feasibility studies and planning permits⁶¹. Qualified bidders must have subscribed and paid-in share capital of at least \$100,000 per MW of the project as well as at least two years of experience in electricity generation. Resource assessments of at least one year must also be submitted.⁶² Bidders must pay \$5,000 to acquire the tender specifications and deposit a bid bond of \$50,000/MW.

Selected projects deposit a \$250,000/MW construction guarantee and sign a PPA with a fixed end date 20 years after the referential date of commercial operation.

Actual commercial operation can begin before that date, but if it begins more than two years after that date the contract is cancelled and the guarantee lost. Quarterly progress reports are filed, and if delays occur for two consecutive quarters, penalties are deducted from the guarantee. Milestones including financial closing and start of construction are included in the contract, and if they are missed, the guarantee is increased. Developers are responsible for grid costs.

Peru has hefty under-production penalties. Once the project is in operation, any shortcoming in the contracted amount of electricity results in a reduction of the guaranteed rate by the same percentage for that year. For example, if a producer generates only 85% of the contracted electricity in a given year, they will receive only 85% of the guaranteed rate for all electricity sold that year.⁶³

SELECTED AUCTION FEATURES, PERU

Auction Frequency and Timeline	• Need for an auction to maintain a 5% share of renewable energy is evaluated every two years
Products offered	• Generation
Eligible Technologies	• Biomass, wind, solar, small hydro
Length of Contracts	• 20 years
Time between Auction and Energy Delivery	• December 31, 2018 (2 years, 9 months after winners announced). Contract period begins on this day regardless of whether project is operational. Contract can be cancelled if operation does not begin by 2 years after this date.
Currency and Indexing	• Priced and paid in PEN, payment indexed to PEN/USD exchange rate and USD inflation.
Guarantees for Buyers	• Bid bond: \$50,000/MW returned upon contract signing. • Completion bond: \$250,000/MW. Increased by 20% in the case of delays. Forfeited if project not operational by 12/31/20. • Penalties: Any shortcoming in the contracted amount of electricity results in a reduction of the guaranteed tariff by the same percentage for that year. For example, if a producer generates only 85% of the contracted electricity in a given year, he/she will receive only 85% of the guaranteed tariff for all electricity sold that year.
Guarantees for Sellers	• Guaranteed remuneration level for 20 years. Energy is sold to the spot market and any difference between spot market prices and guaranteed remuneration are covered by charges to users of the transmission network.
Responsible for Grid Interconnection Costs	• Generator
Local Content Requirements	• None.
Roles of Different Parties in Auction Process	• Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin) is the auctioneer. • The Ministry of Mines and Energy is the offtaker.

Sources:

- International Renewable Energy Agency. Renewable Energy Auctions: Analysing 2016. Abu Dhabi: IRENA, 2017. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Jun/IRENA_Renewable_Energy_Auctions_2017.pdf.
- Bases Consolidadas para la Cuarta Subasta de Suministro de Electricidad con Recursos Energéticos Renovables, Bases Consolidadas para la Cuarta Subasta de Suministro de Electricidad con Recursos Energéticos Renovables § (2015). http://www.osinergmin.gob.pe/seccion/centro_documental/energias-renovables/Subastas/Bases_Consolidadas_4taSubasta.pdf.

JAMAICA

Jamaica holds auctions for renewable energy on an ad hoc basis, the most recent of which sought 37 MW in 2015 to fill the unmet demand from a prior auction for 115 MW that concluded in 2014. The original auction was called in large part due to rising oil prices and a desire to reduce Jamaica's high dependence on oil imports.⁶⁴ Reliability and energy security are related objectives. In addition, Jamaica aims to increase renewable energy by 2030, as renewables make up only 10% of current installed capacity.

The selection criteria gives priority to a project's impact on the grid and location as well as its contribution to reliability and security of supply. Each stage has very specific selection criteria and the winner is chosen not only based on price but also on its ability to meet these objectives. Evaluation of the projects consist of three stages. Projects that pass each stage advance to the next. In the first stage,

applicants are evaluated on the likelihood of their ability to implement the project and are scored according to weighted criteria for experience, ability to finance the project, technical capability and qualifications of employees, and ability to implement the project in a timely manner. Each of these criteria requires documentation to support more specific weighted criteria (for example, track record in renewable power projects in places similar to Jamaica, credit reports, CVs of employees, etc.).

The second stage examines the technical feasibility of the project using similar weighted scoring for factors such as the history of the proposed technology's successful commercial use, proof of resources, suitability of the site and degree of grid modification required, design of the facilities, construction, operation, and maintenance arrangements, support to the grid, and environmental compliance.

Projects that pass the first two stages will be compared economically to determine the one best positioned to provide reliability and security at least cost to consumers. The selected companies sign a 20-year PPA that begins the date of the project's commissioning.

Proposals must include a proposed rate model outlining fixed and variable prices. Prices are quoted in USD but paid to the developer in the corresponding quantity of Jamaican dollars. Adjustments to inflation of the US dollar are made annually and to the exchange rate monthly or annually, depending on the rate component. Certain rate components may be indexed to reflect changes in costs due to factors outside the developer's reasonable control.

Generators must specify their interconnection arrangement in their proposal and are responsible for all related costs. These costs, including for network upgrades, must be included in the proposal

in addition to a detailed interconnection schedule. The degree of grid modification beyond interconnection is considered in stage two of the selection process.

Jamaica's auction design is unique in that it has no prequalification requirements. Rather, the first stage of the project evaluation process involves stringent analysis of the bidders' credentials. To deter winners from abandoning or delaying projects, the selected companies must pay a non-refundable fee of \$8,000, in addition to a proposal security of 1% of the expected total capital cost of the proposed project. Within ten days of signing the contract companies must provide a performance security deposit of 1% of the expected total capital cost (5% for firm capacity projects). A construction security deposit of the same amount must also be posted within 30 days of the beginning of construction. Regarding delays and underperformance, liquidated damages will be assessed against the developer, but no further detail is provided.⁶⁵

SELECTED AUCTION FEATURES, JAMAICA

Auction Frequency and Timeline	As needed	Source: REQUEST FOR PROPOSALS for Supply of up to 37 MW (Net) of Electricity Generation from Renewable Energy Resources on a Build, Own and Operate (BOO) Basis, REQUEST FOR PROPOSALS for Supply of up to 37 MW (Net) of Electricity Generation from Renewable Energy Resources on a Build, Own and Operate (BOO) Basis § (2015). http://www.our.org.jm/ourweb/sites/default/files/documents/sector_documents/rfp_supply_of_up_to_net_37_mw_electricity_generation_from_renewable_energy_resources_-_july_31_2015_final.pdf.
Products offered	Capacity	
Eligible Technologies	Renewables only (not specified)	
Length of Contracts	20 years	
Time between Auction and Energy Delivery	- Proposed commissioning date (energy only) 12/28/18 (2 years 8 months after winners announced) - Proposed commissioning date (firm capacity) 12/27/19 (3 years 8 months after winners announced)	
Currency and Indexing	Priced in USD, paid in JMD. Adjustments to USD inflation rate made annually and to the exchange rate monthly or annually, depending on the rate component. Certain rate components may be indexed to reflect changes in costs due to factors outside the developer’s reasonable control.	
Guarantees for Buyers	- Bid bond: 1% of expected total capital cost of the proposed project - Completion bond: For “energy only” projects like the one awarded, 1% of the expected total capital cost. - Penalties: For “energy only” projects, liquidated damages will be assessed for shortfalls in initial or ongoing capacity (magnitude not specified).	
Guarantees for Sellers	N/A	
Responsible for Grid Interconnection Costs	Generator	
Local Content Requirements	None. Use of local labor is a selection criterion but carries very little weight.	
Roles of Different Parties in Auction Process	- Office of Utilities Regulation (OUR), a multi-sector regulatory agency, coordinates the auction - The Jamaica Public Service Company (JPS), which owns Jamaica’s transmission and distribution grid, is the offtaker.	

How Auctions Made Uruguay a Renewable Energy Leader



Though Uruguay has not held a renewable energy auction within the chronological scope of this study, its experience dates further back than any other country in the region and yields some valuable lessons. Despite its size (less than 3.5 million inhabitants), in 2015 it ranked fourth in renewable investment in Latin America at around \$1.1 billion (Brazil, which led the region with \$7.1 billion that year, has almost 60 times as many inhabitants). After starting with almost no non-conventional renewable energy generation in 2007, in 2013 it received more renewable energy investment relative to GDP than any other nation.² It has not held an auction since that year due to a lack of additional power demand or export capacity, and investment has dropped off since its peak in 2015. However, Uruguay boasts 98% carbon-free electricity generation, of which wind accounts for 26%, one of the highest shares in the world.³ At times, Uruguay's

power matrix is almost entirely fueled by wind energy. Auctions have played an indispensable role in the country's remarkable energy transition.

Uruguay's rapid uptake of renewable power generation, especially wind energy, is motivated by years of dependence on hydroelectric dams (which have been subject to increasing hydrological risk and limited potential for additional capacity) backed by oil-fired thermal generation (which is subject to price risk and totally dependent on imports). It held Latin America's first auctions for renewable energy in 2006 and 2007. One of those auctions was open to wind power and contracted 20 MW, and the other allowed wind, biomass, and small hydro, awarding 20 MW each to wind and biomass (no small hydro bids were received due to poor hydrological resources⁴). Wind auctions in 2010 and 2011 contracted 150 MW each. Most recently, a 2013 solar-specific auction

awarded around 200 MW of capacity in an effort to further diversify the grid.

Uruguay's auction design and investment environment make the country an attractive market for wind energy. Uruguay's advantages include a state-owned utility, (UTE, which is the auction off-taker) with a strong credit rating and the nation's status as a stable democracy with no history of default.⁵ PPAs are priced in USD, transferring currency risk to UTE, and indexed to inflation. In response to financing delays due to banks requesting proof of wind resources, UTE began collecting such data in various regions with the third wind auction in 2010, in order to disseminate it to auction participants. Given an initially limited history of renewable energy development in Uruguay, companies can offer PPAs of between 10 and 20 years (most offers have been for 20). Finally, wind resources are ample. As a result of these favorable conditions, wind auctions have been

competitive—between 2006 and 2011 all auctions awarded the full capacity that was sought, and in 2011, offers totaling six times the auctioned demand helped produce a price reduction of 26% over the previous year.⁶

Uruguay's wind auctions utilize a sealed-bid process with physical delivery. They are conducted in one round, without prequalification, awarding the projects with the lowest prices first until all the capacity is awarded. There is no minimum number of offers or ceiling price, but the regulator reserves the right to abandon the auction if prices are not sufficiently low. Projects are limited to 50 MW in size and limitations are imposed for intake at geographic nodes, both because of grid limitations and to disperse the socioeconomic benefits of projects. This geographic distribution also has the effect of increasing the general reliability of wind resources. In 2010, only one project could be awarded per bidder,

and in 2011 this was changed to more than one, for up to 100 MW per bidder. All projects are subject to a 20% local content requirement (project developers have claimed that this has reduced the number of bids), and companies that exceed that quota are granted a higher price. Though not the case in the first auctions, a clause was added to more recent PPAs that obliges companies to accept cuts in cases of grid constraints rather than being paid for the undelivered energy as before.

Uruguay's wind auctions also have robust measures for ensuring project completion and avoiding long delays. Of the 10 projects awarded between 2006 and 2011, only one was cancelled and nine are operational. In the first place, companies can only participate if they have previously developed a plant of similar size to that being offered and can demonstrate financial solvency. To acquire the auction documents, companies must pay a fee (for the 150 MW wind auctions, US\$10,000), which may help dissuade speculative bidding. A bid bond

of 5% of the expected revenue from the first half of the contract is also required of all bidders, and winners must deposit a completion bond upon signing that is equal to 15% of the expected revenue over the first half of the contract. 80% of this is returned after six months of operation, with the remaining 20% returned after completion of the contract and environmental restoration of the project site. Interconnection studies must be provided by the bidders, who are also responsible for interconnection costs and grid expansion costs, if necessary. Finally, higher prices have been used to incentivize earlier project completion.

A couple of innovations on the conventional auction structure are noteworthy. Following the 2011 auction, having effectively used the process as an instrument for price discovery, the government then offered the average price of winning bids (\$63/MWh) as a feed-in tariff to losing bids, thus contracting an additional 650 MW of capacity at a

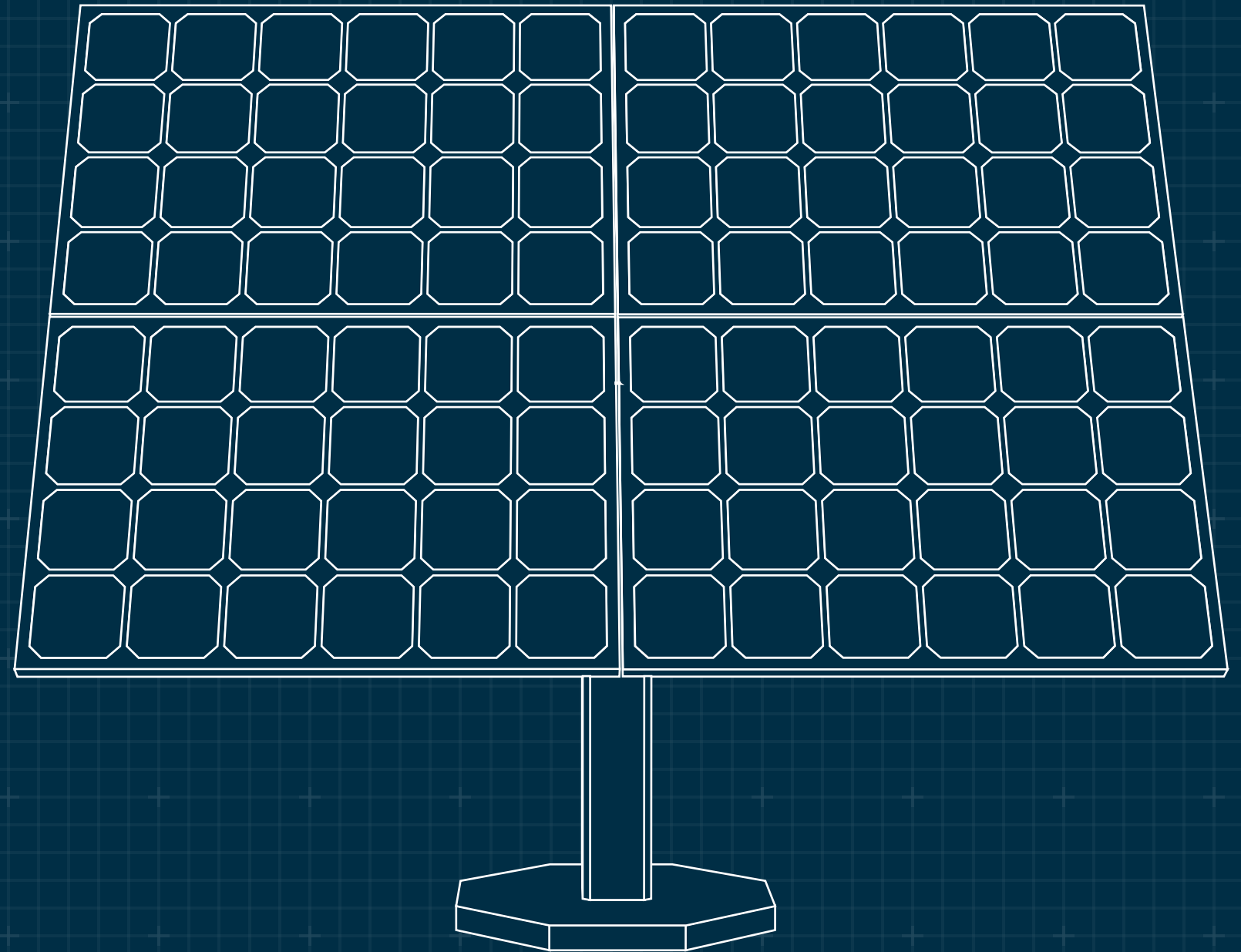
low price. In a 2013 auction for a 70 MW park, UTE provided the site and auctioned the construction of a wind park, which it would lease for 20 years with the option to purchase afterward. The transfer of wind resource risk to UTE brought the price down even further than in the auctions.

In sum, Uruguay's auction structure has been successful in contracting all offered capacity, keeping delays brief (a matter of months, not years), limiting cancellations, and reducing power prices. Diversification of the electricity matrix has been achieved—in 2017, installed capacity reached more than 1.5 times its 2010 value, and installed hydro and non-renewable capacity had in fact decreased.⁷ The share of thermal plants in generation was down to 2%, from 35% in 2012,⁸ and the grid's vulnerability to drought has been reduced by 70%, according to officials, reducing outages.⁹ Sound auction design and the ability to learn and adapt from previous auctions has been crucial to Uruguay's ascent to global leadership in renewable energy.

- 1 IRENA. Renewable Energy Market Analysis: Latin America. Abu Dhabi: IRENA, 2016. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Market_Analysis_Latin_America_2016.pdf.
- 2 Thwaites, Joe. "How Uruguay Became a Wind Power Powerhouse." World Resources Institute, September 26, 2018. <https://www.wri.org/blog/2016/03/how-uruguay-became-wind-power-powerhouse>.
- 3 BloombergNEF. "Uruguay." Climatescope 2018. <http://global-climatescope.org/results/UY>.
- 4 REN21. Renewable Energy Tenders and Community [Em] power[ment]. Paris: REN21 Secretariat, 2017. <https://www.ren21.net/wp-content/uploads/2019/06/LAC-Report.pdf>.
- 5 Watts, Jonathan. "Uruguay Makes Dramatic Shift to Nearly 95% Electricity from Clean Energy." The Guardian. Guardian News and Media, December 3, 2015. <https://www.theguardian.com/environment/2015/dec/03/uruguay-makes-dramatic-shift-to-nearly-95-clean-energy>.
- 6 Augusto Barroso, Luiz et al. Renewable Energy Auctions in Latin America and the Caribbean. Spain: Factor and Global Environment Facility, 2017. https://www.wearefactor.com/docs/RE_LAC.pdf.
- 7 BloombergNEF. "Uruguay." Climatescope 2018. <http://global-climatescope.org/results/UY>.
- 8 BloombergNEF. "Uruguay." Climatescope 2018. <http://global-climatescope.org/results/UY>.
- 9 Watts, Jonathan. "Uruguay Makes Dramatic Shift to Nearly 95% Electricity from Clean Energy." The Guardian. Guardian News and Media, December 3, 2015. <https://www.theguardian.com/environment/2015/dec/03/uruguay-makes-dramatic-shift-to-nearly-95-clean-energy>.

Auction Outcomes

By implementing renewable energy auctions, the countries presented in this study have benefited from the rapid reductions in solar and wind technology costs across the board. This is reflected in the dramatic decreases in the electricity prices contracted through auctions in the last few years. Auctions have awarded a large share of projects to renewable energy sources, especially wind and solar, at low prices by international standards, even in cases where fossil fuels are also competing. This seems to suggest that wind and solar have achieved grid parity in many markets. The number of bids received far exceeded the number of projects awarded in most auctions, suggesting a high level of competition.

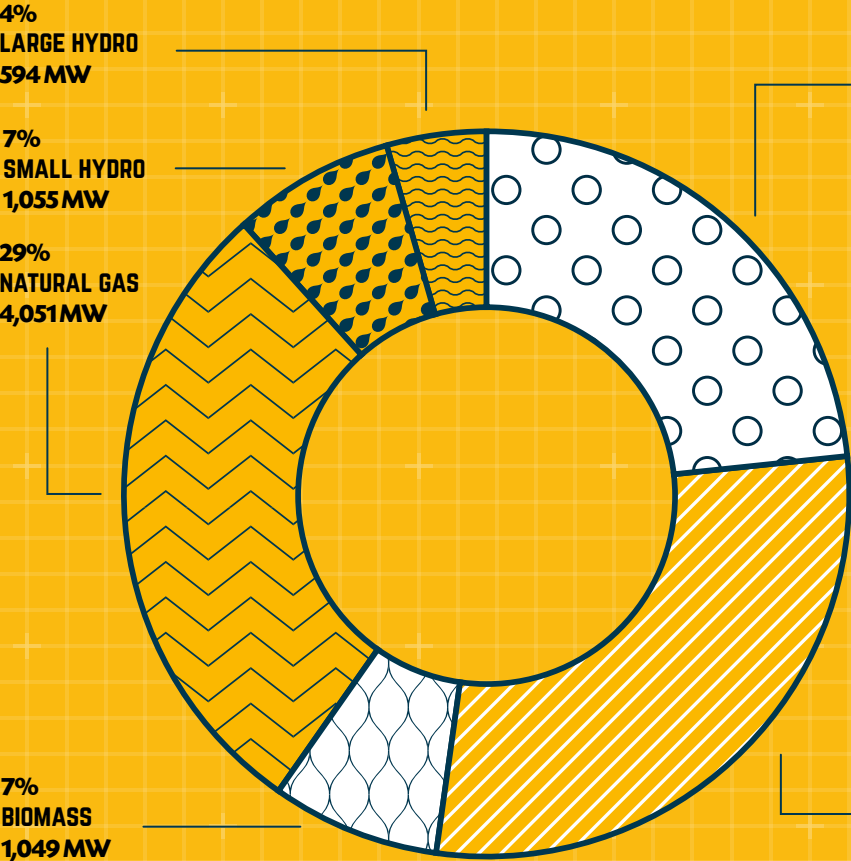


BREAKDOWN OF NEW PROJECTS WINNING CONTRACTS BY COUNTRY AND TECHNOLOGY (2015-JUNE 2019)

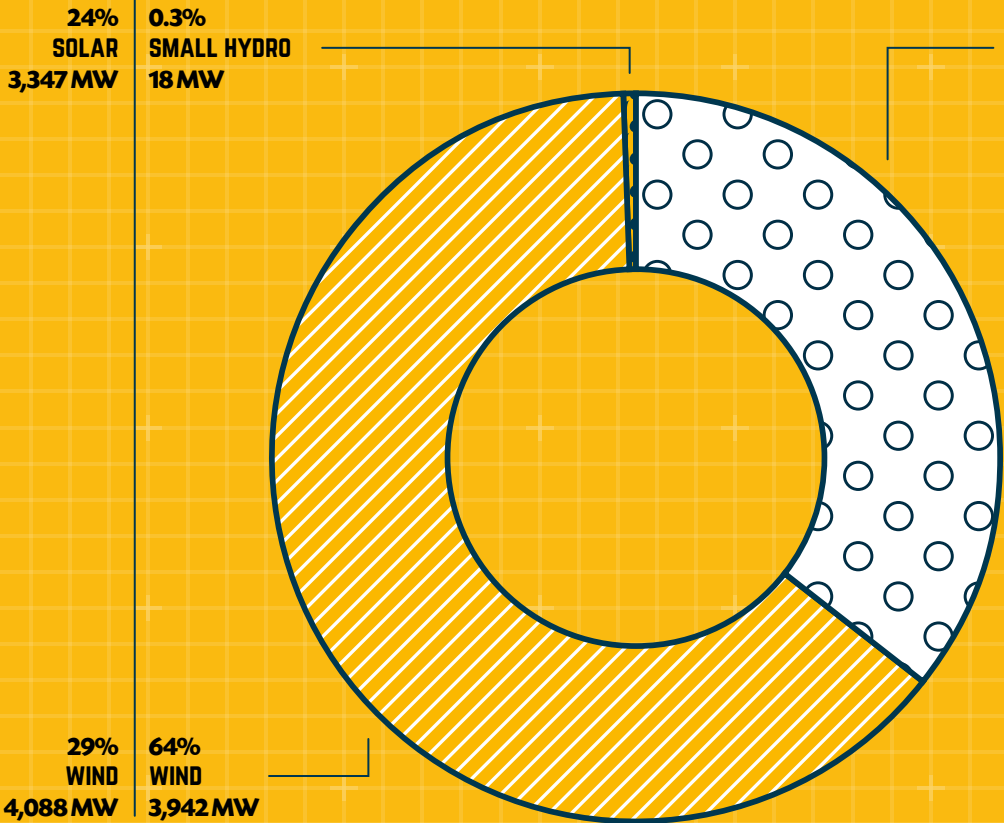
Source:

- ANEEL
- CNE, company bid documents
- Nance, Peter. "Initial Results from the Mexico Electricity Reform, 2013-18." In Mexico's New Energy Model. Wilson Center Mexico Institute, 2018. https://www.wilsoncenter.org/sites/default/files/initial_results_from_the_mexico_electricity_reform_2013-18.pdf.

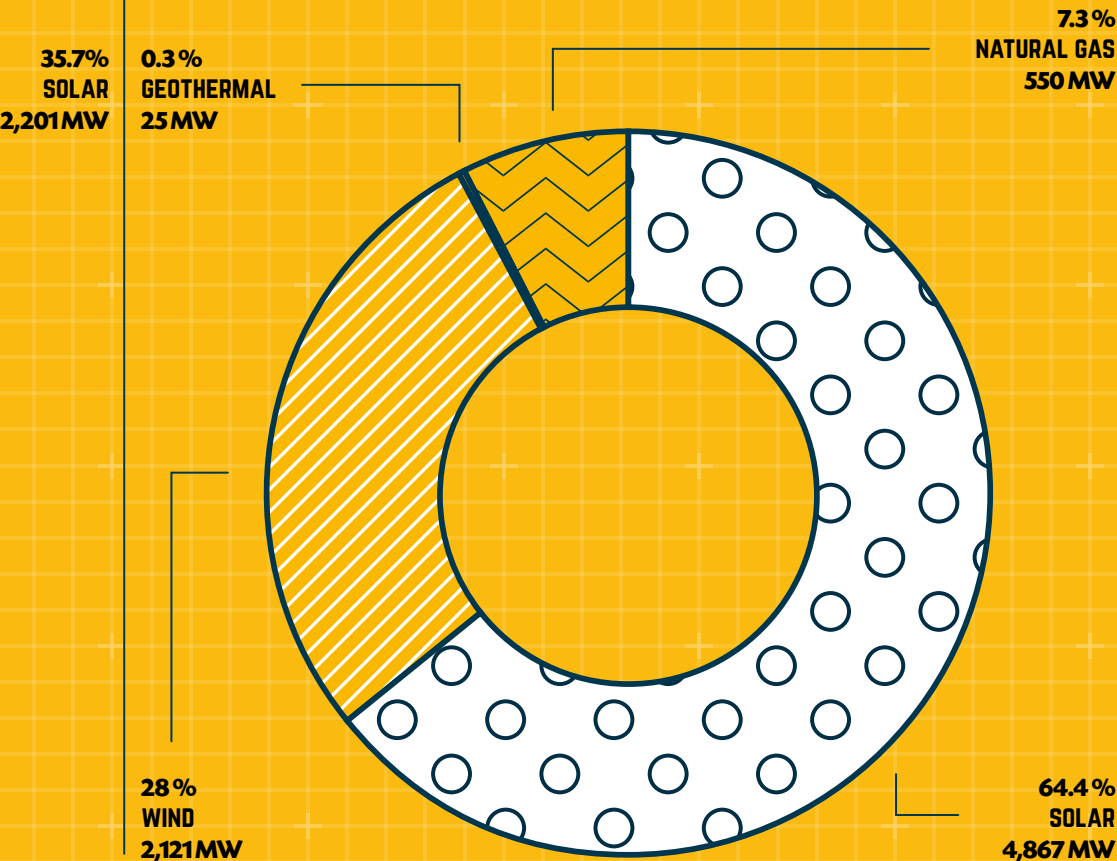
Brazil
(14,185 MW)



Chile
(6,161 MW)



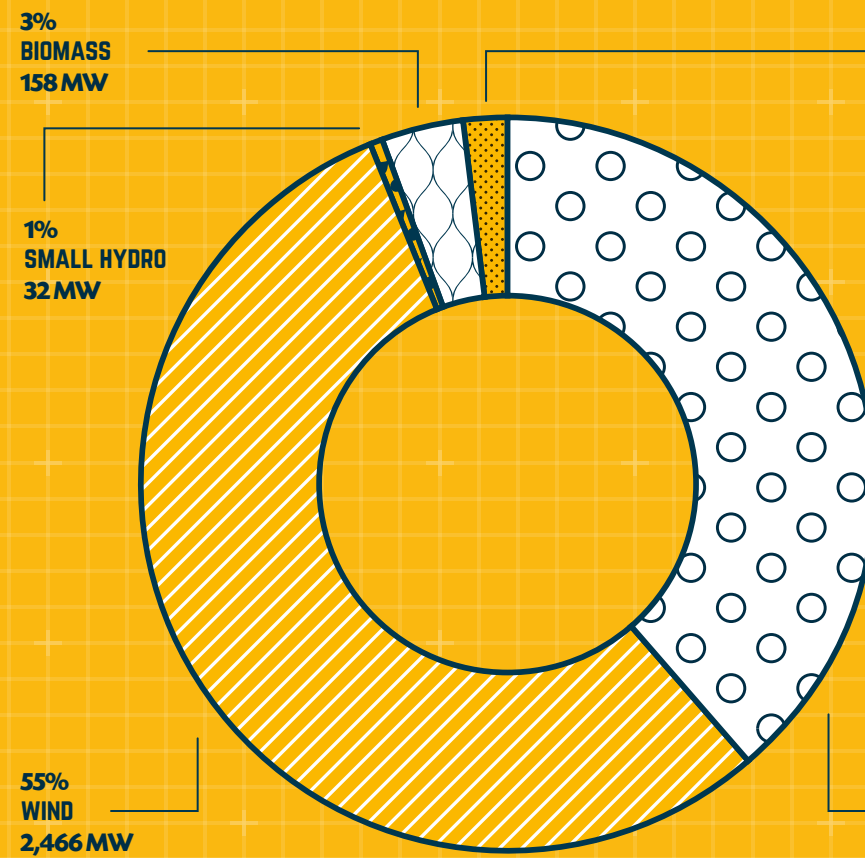
Mexico
(7,563 MW)



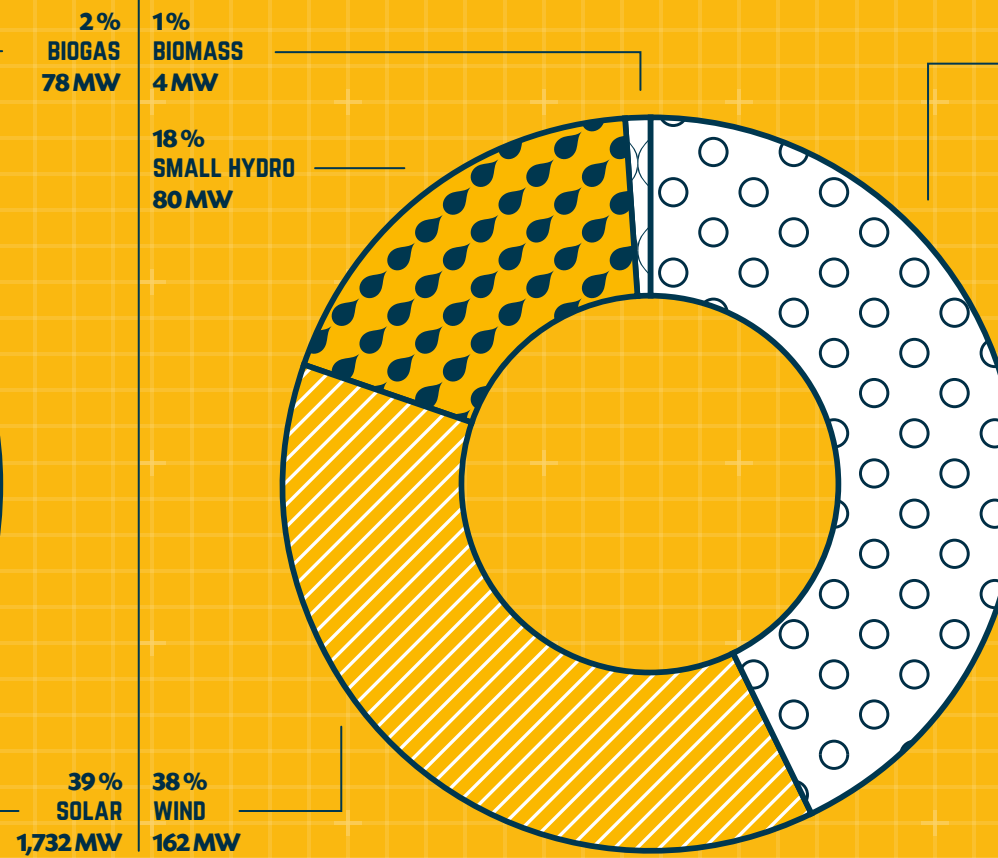
Source:

- Ministerio de Energía y Minería
- OSINERGMIN
- OUR

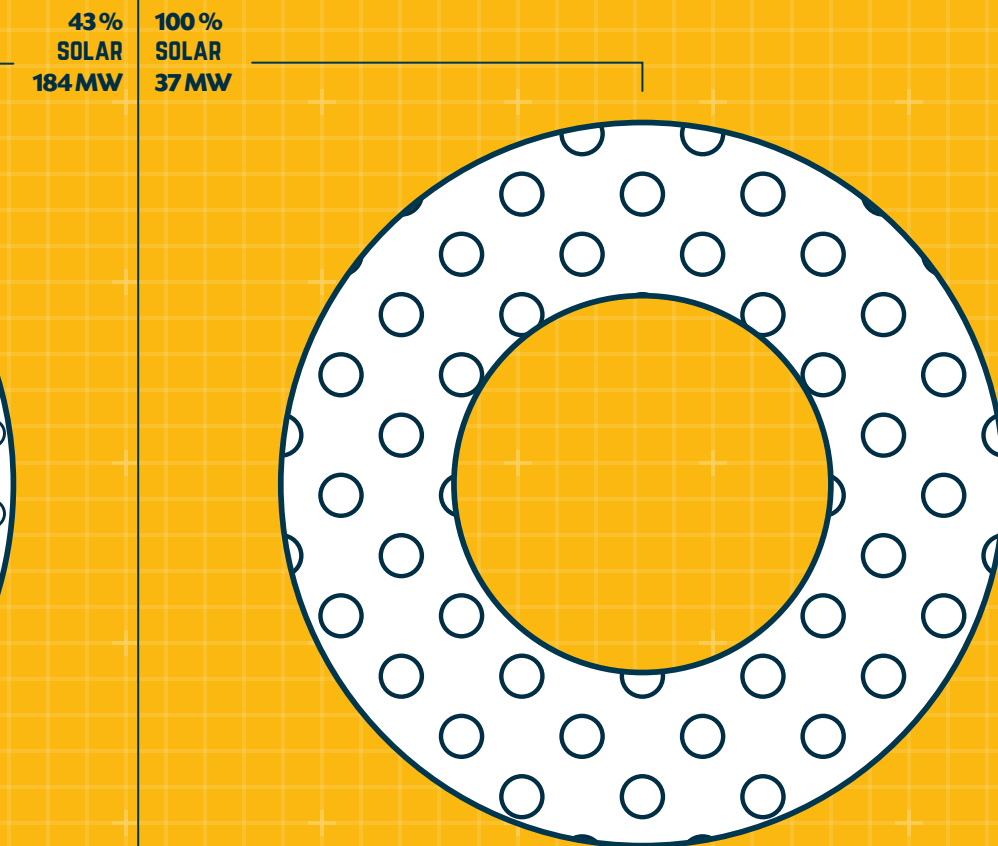
Argentina (4,466 MW)



Peru (430 MW)



Jamaica (37 MW)



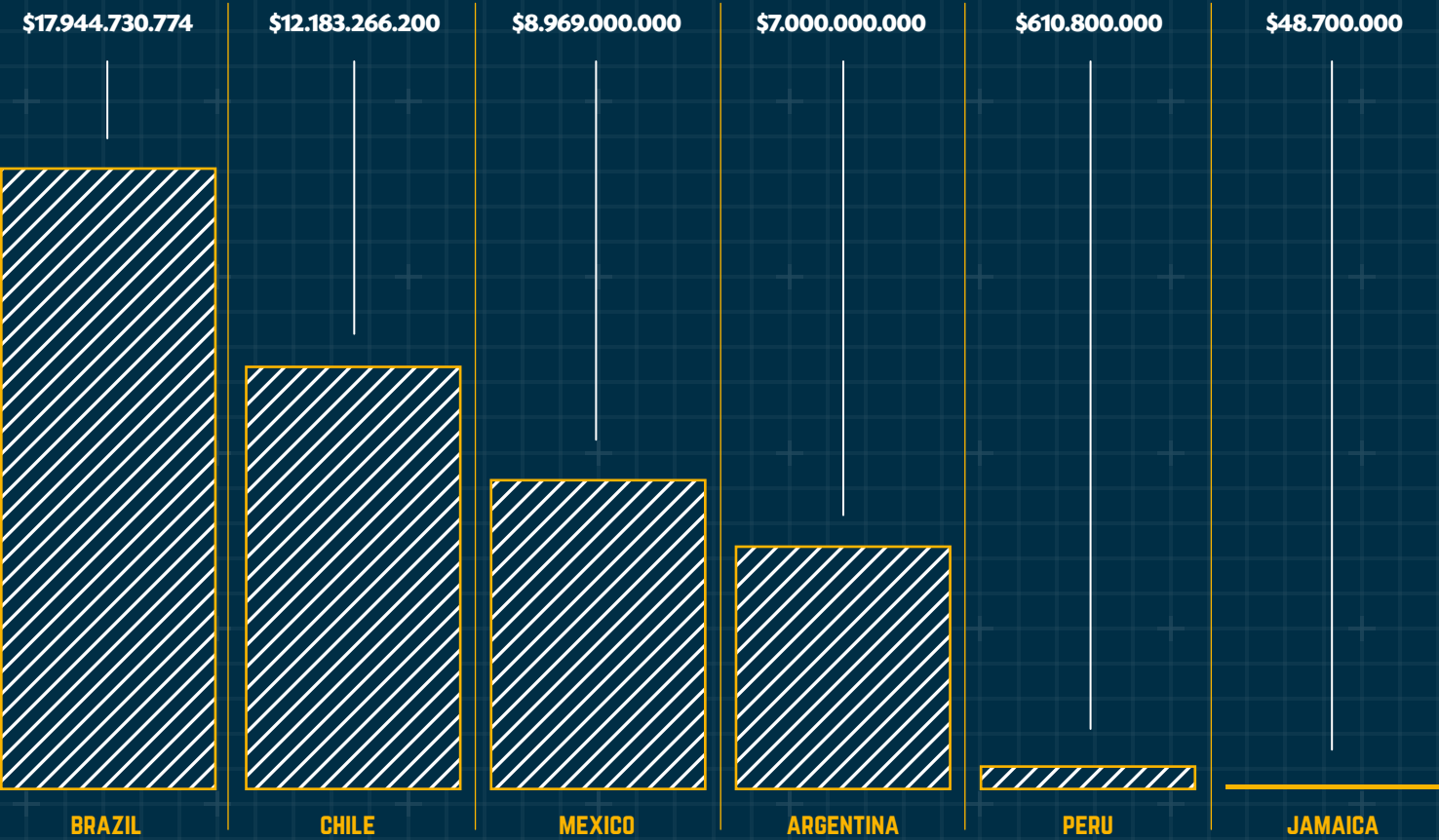
Estimated investment expected from projects winning auctions is \$46.8 billion.

The vast majority of renewable projects were less than 40 MW in size. The greatest share was between 20 and 40 MW.

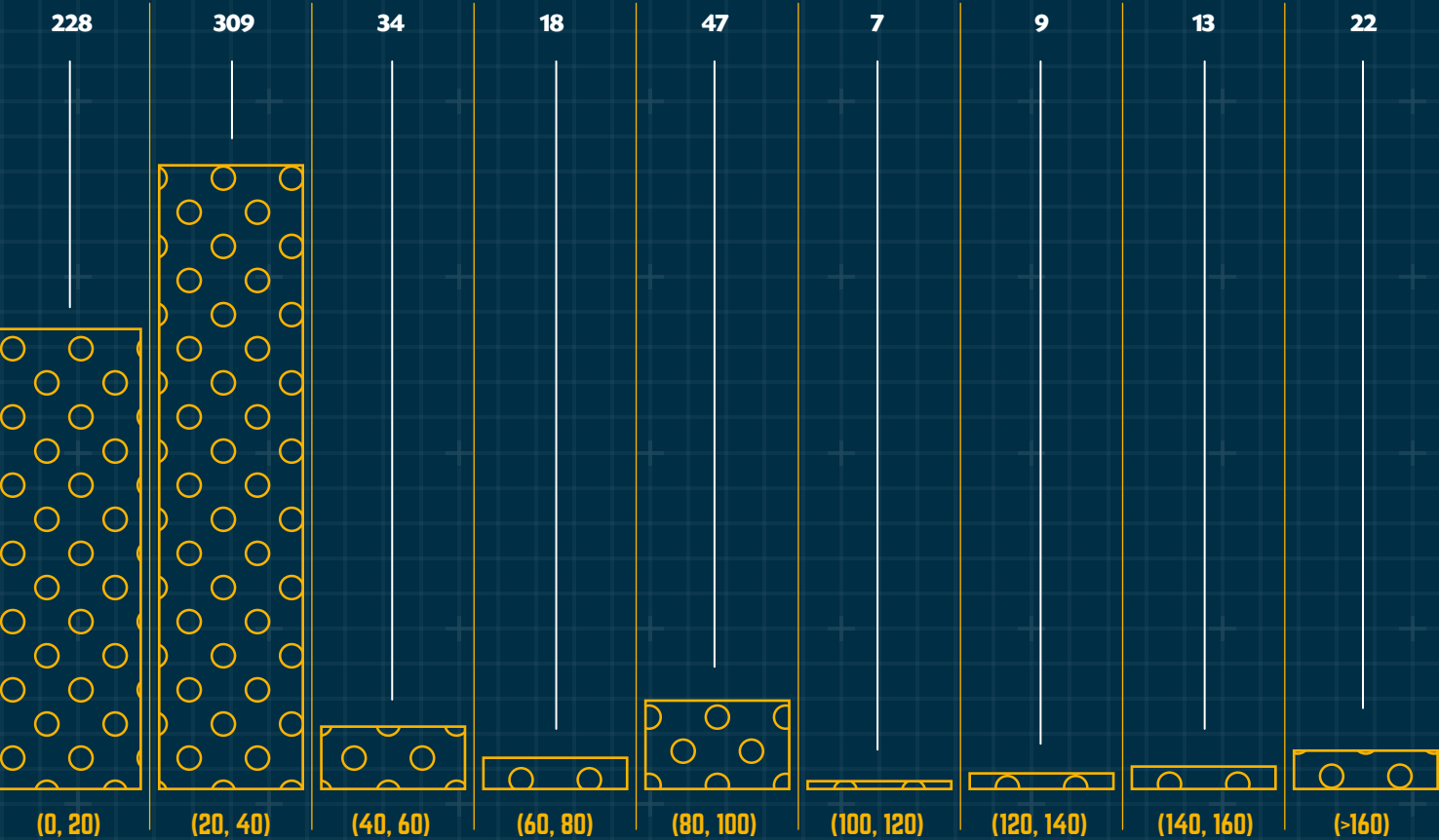
Sources:

- ANEEL, ACERA, SEIA, CRE, MINEM (Argentina), OSINERGMIN, OUR, press reports

Estimated Expected Investment from Auction-Winning Projects, 2015-6/2019



Distribution of Renewable Projects by Size (MW), All Auctions



BREAKDOWN OF PROJECTS BY FOREIGN AND DOMESTIC COMPANIES, SELECT AUCTIONS

Large international firms have been major participants in general, and have dominated in Chile, Mexico, and Peru, contributing major investments. In Argentina and Brazil, domestic firms have played a greater role.

Sources:

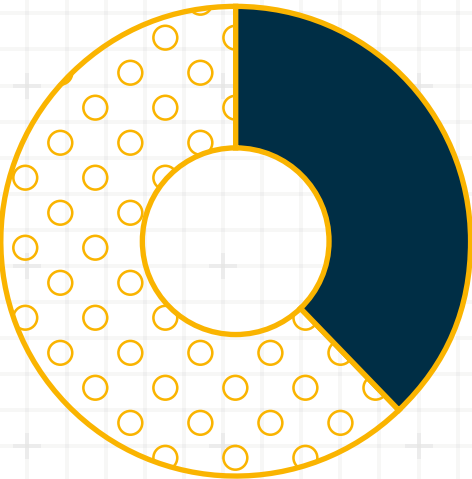
- ANEEL, CNE, Zumma Energy Consulting, MINEM (Argentina), OSINGERMIN, OUR, company website, press reports

Brazil

(22nd New Energy Auction)

62% Projects run by local companies

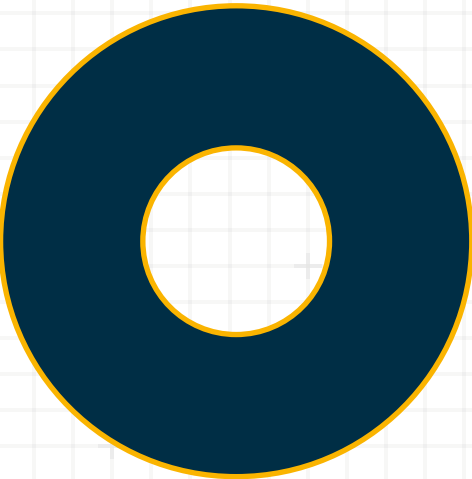
38% Projects run by foreign companies & their subsidiaries



Chile

(Auction 2015/02)

100% Projects run by foreign companies & their subsidiaries

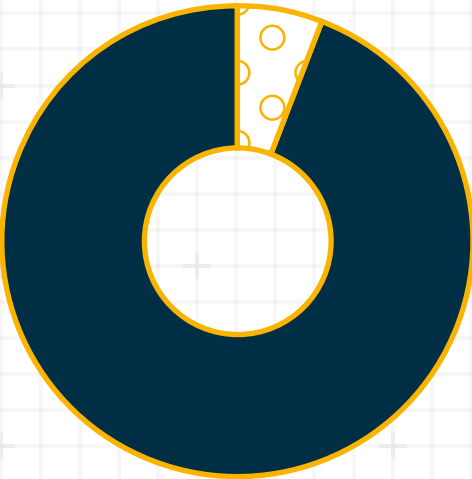


Mexico

(1st Long-Term Power Auction)

6% Projects run by local companies

94% Projects run by foreign companies & their subsidiaries

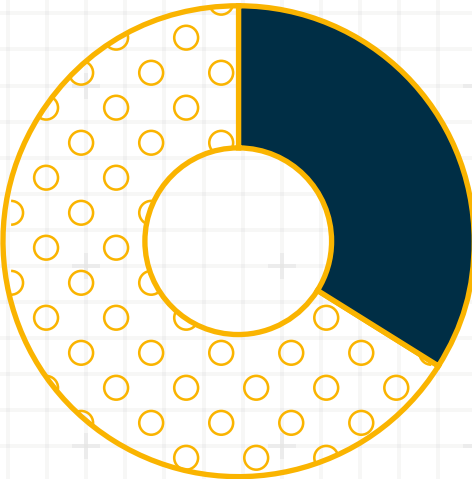


Argentina

(RenovAr 1)

66% Projects run by local companies

34% Projects run by foreign companies & their subsidiaries

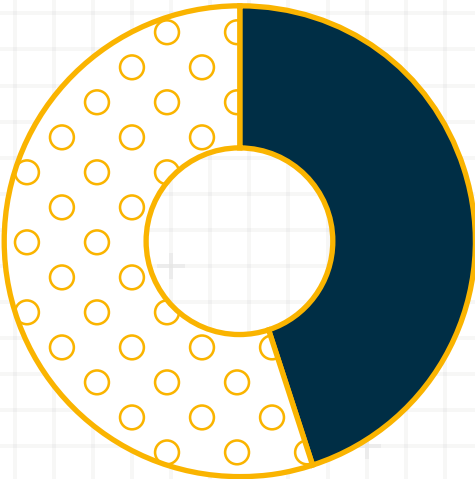


Peru

(4th Renewable Energy Auction)

55% Projects run by local companies

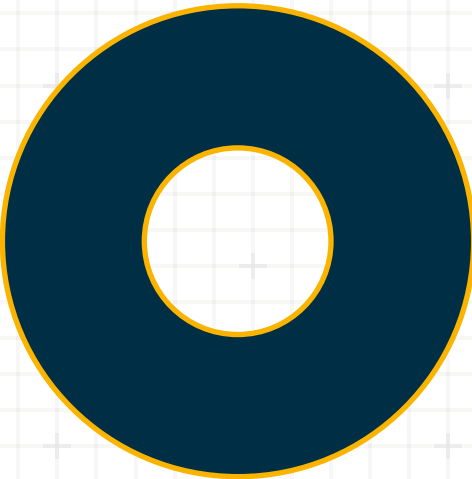
45% Projects run by foreign companies & their subsidiaries



Jamaica

(37-MW Renewables Auction)

100% Projects run by foreign companies & their subsidiaries

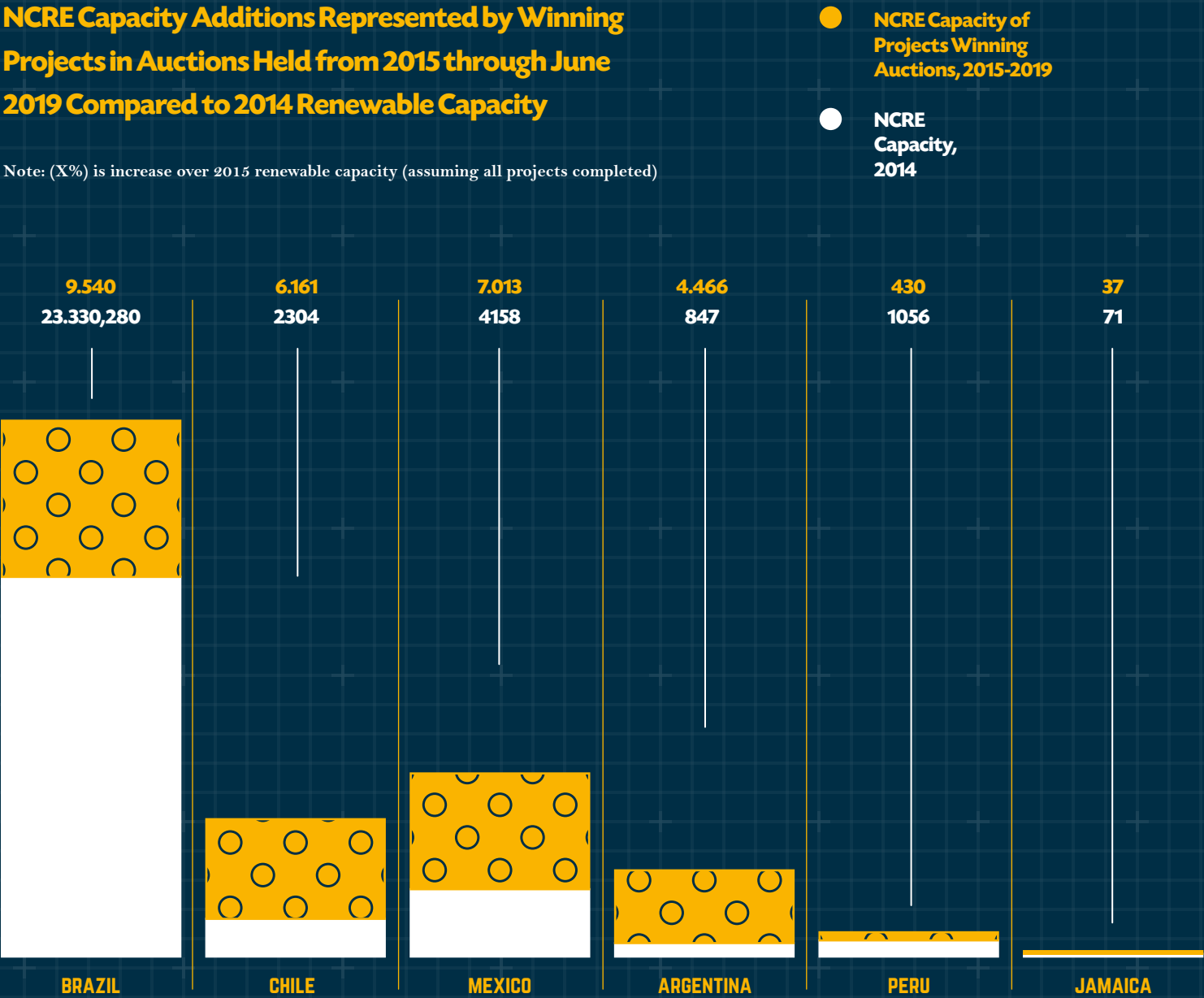


The amount of non-conventional renewable capacity awarded has been large, when compared both to existing non-conventional renewable capacity and to overall capacity within each country

(see graphs). In other words, if all of the projects awarded in these auctions come online, it will add significant non-conventional renewable energy capacity to the system in every country.

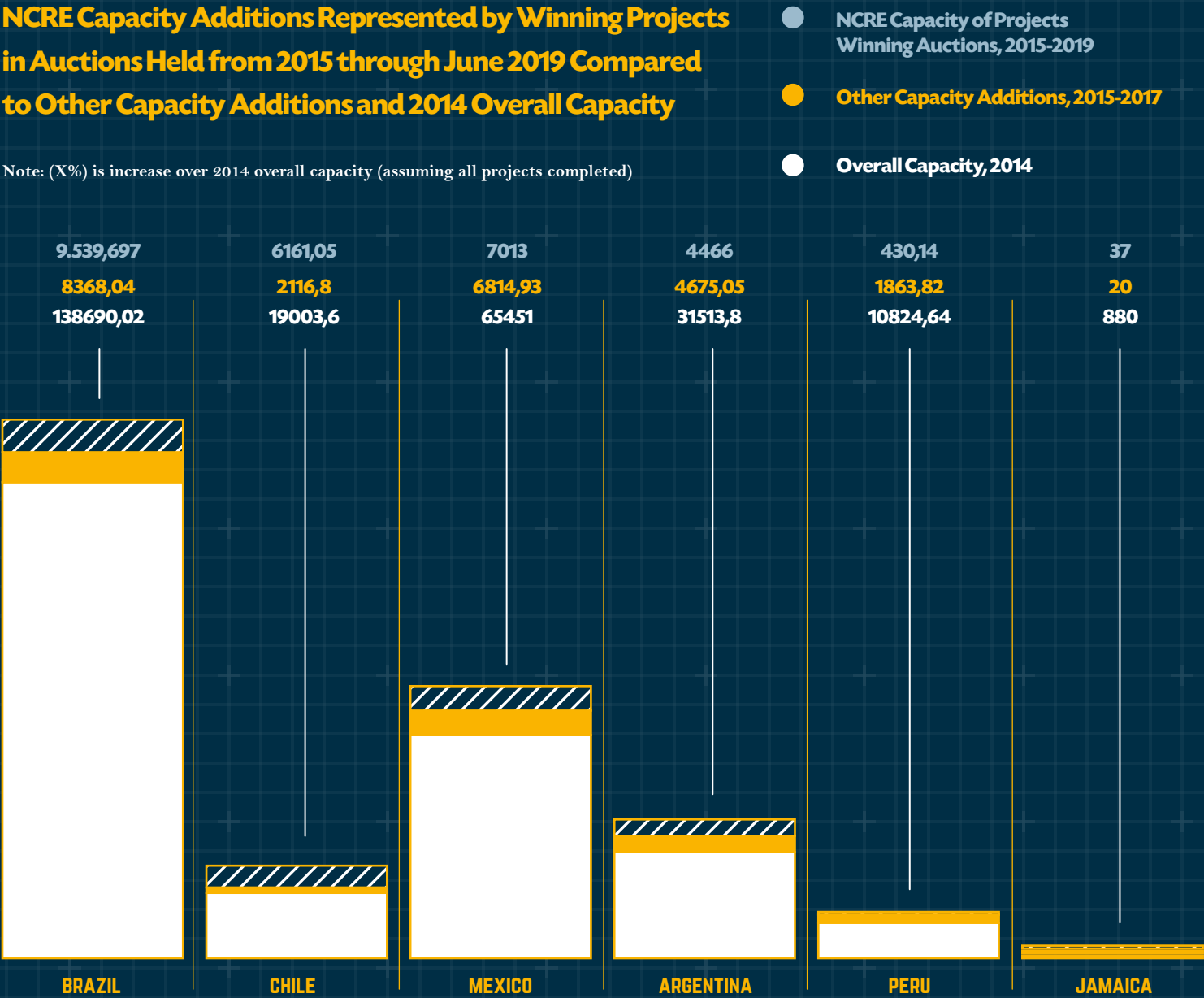
NCRE Capacity Additions Represented by Winning Projects in Auctions Held from 2015 through June 2019 Compared to 2014 Renewable Capacity

Note: (X%) is increase over 2015 renewable capacity (assuming all projects completed)



NCRE Capacity Additions Represented by Winning Projects in Auctions Held from 2015 through June 2019 Compared to Other Capacity Additions and 2014 Overall Capacity

Note: (X%) is increase over 2014 overall capacity (assuming all projects completed)



Source:

- Authors' calculations (winning projects), Climatescope (2014 renewable capacity)
- Authors' calculations (winning projects), Climatescope (2014 overall capacity and 2015-2017 other capacity additions)

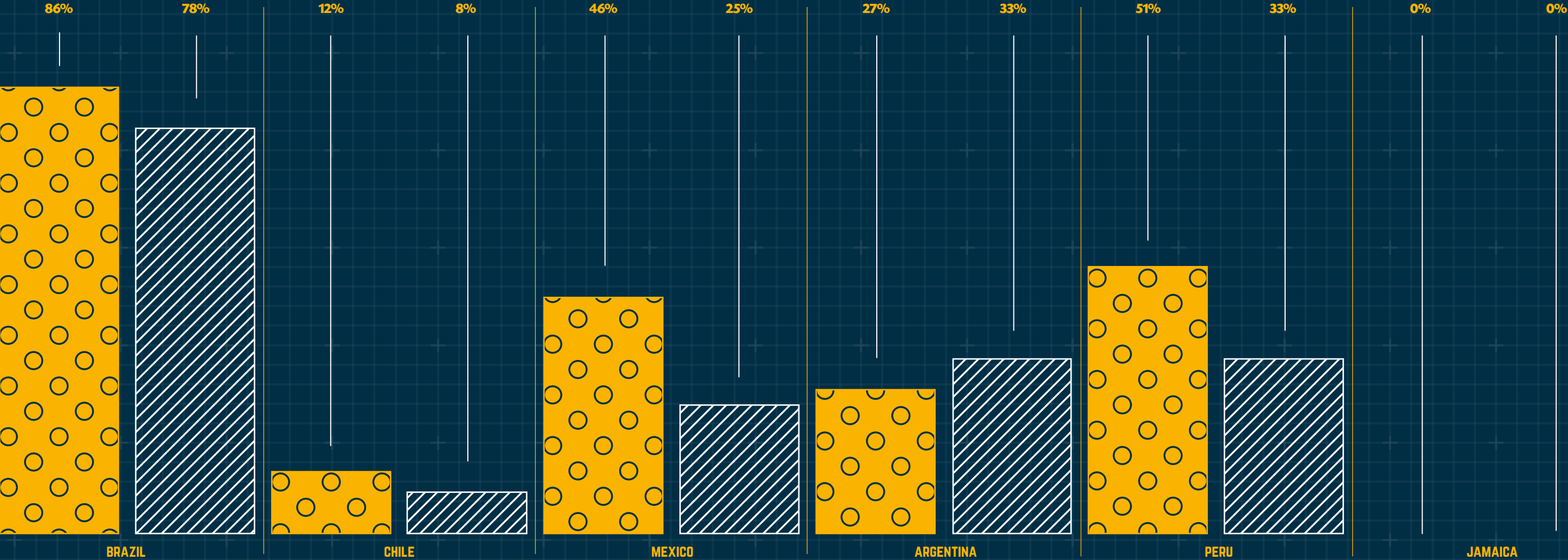
However, the statuses of the projects awarded in the first auctions scheduled to reach completion in each country (starting in 2015) demonstrate high rates of delays. Only a third or less of projects were completed on time in five of the six countries. The exception was Brazil which saw high on-time completion rates (though this high rate could be anomalous).

**% On-Time Completion
by Country/Auction**

- **% Capacity Completed on Time**
- **% Projects Completed on Time**

Sources:

- Press reports, press releases, auction results and company bids (original expected completion dates)



Of 43 delayed projects awarded in the first auction within the time period in each country, 37 experienced delays of more than 6 months and many are still incomplete. In many cases, delays drag out over a year. The causes of these delays vary between cases, but among them are failure to obtain local consent, delays in transmission network expansion, difficulty obtaining financing, and supply bottlenecks. Very few projects have been abandoned, suggesting that speculative bidding is not a major factor. However, the number of delays may be a result of prequalification requirements or delay penalties that are too lax or lead times that are too short. Though there exists a tradeoff between prequalification requirements and competition, as countries continue to adapt their auction structure, they should be aware of what factors

are stalling project completion and attempt to determine how additional requirements such as upfront land use rights and environmental permitting or more stringent reputation requirements could affect auction results.

The following sections analyze results from auctions for each country discussed above. The analysis examines the number of bids offered versus winning bids, profiles of winning companies, and technologies and prices awarded in order to assess the level of competition achieved. The analysis also evaluates the project status and completion rates for each project within the auction. As demonstrated in the table below, the auctions awarded a total of roughly 32,000 MW of new projects and would nearly double NCRE capacity compared to 2014 if all the projects come online.

Summary of Auctions for all Countries Studied 2015 - June 2019	
MW new projects	32,842.26
Solar	12,368.89
Wind	12,778.57
Geothermal	25.00
Natural gas	4,601.32
Biomass/biogas	1,289.45
Small hydro	1,184.84
Large hydro	594.20
MW new NCRE projects	27,646.75
2014 NCRE capacity (MW)	31,766.34
Ratio MW new NCRE projects : 2014 NCRE capacity	0.87
2014 overall capacity (MW)	266,363.06
Ratio MW new NCRE projects : 2014 overall capacity	0.10
Non-NCRE capacity additions, 2015-2017	22,967.14
Expected investment (USD)	\$46.8 bn

Sources: Authors’ own calculations, Climatescope (2014 capacity and 2015–2017 non-NCRE capacity additions)

BRAZIL

Brazil's large market, long history of energy auctions, renewable energy incentives and generally predictable auction schedule attracted a large number of bidders. It held very competitive auctions that led to low renewable energy prices despite local content requirements for low interest loans and pricing in local currency that disadvantaged foreign firms compared to local players. Brazil also had a very high project completion rate following its 2015 A-3 new energy auction—although other analysis has revealed higher levels of delays, suggesting this auction may not be representative.⁶⁶ Since 2015, Brazil's auctions have attracted estimated investment of almost US\$18 billion and new installed capacity of more than 14 GW.

In the 2015 New Energy A-3 auction, 371 prequalified projects totaling over

8,000 MW⁶⁷ were registered— despite prequalification requirements including an environmental license and, for wind projects, at least three years of measurements— and 29 were awarded. Wind energy was the predominant technology awarded, accounting for 80% of the capacity of awarded projects. Small hydro, natural gas and biomass each took smaller shares.

Brazil had the highest percentage of local company participation of the countries analyzed, with 62% of projects run by local companies and 38% run by foreign companies and their subsidiaries. 19 of the winning projects were submitted by just three local companies. Although Brazil has no formal local content requirement, low-cost financing from state development bank BNDES is contingent on minimum local content. This approach encourages participation from local

manufacturers but may also raise costs as it discourages companies from purchasing the cheapest equipment if it comes from outside of Brazil.⁶⁸

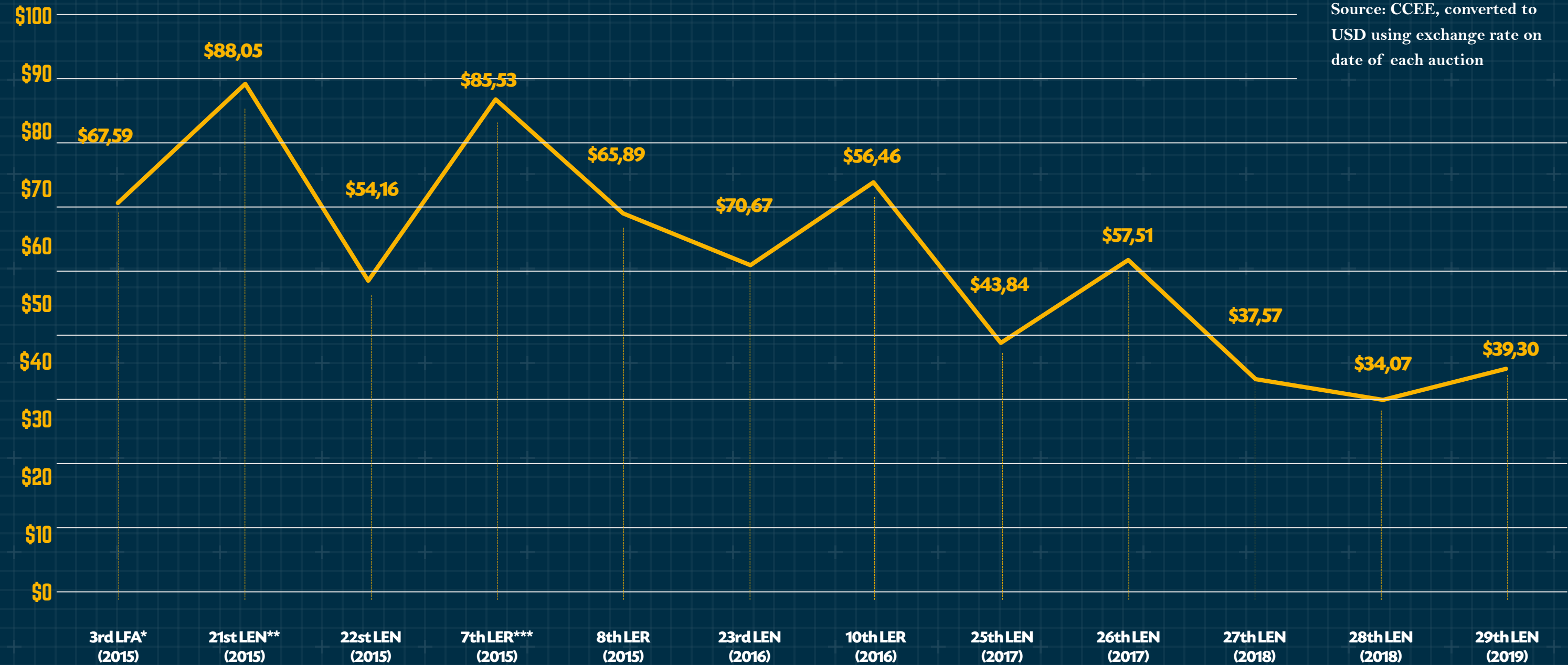
The denomination of contracts in Brazilian reais represents the most significant deterrent to investors. Even with inflation indexing, the currency exchange risk can make imported equipment priced in USD prohibitively expensive in some cases. Increases in auction prices from 2012-2015 reflect this challenge, as does the cancellation of most of the solar projects awarded in a 2014 auction.⁶⁹ However, dollarizing energy prices represents a major macroeconomic risk in the event of local currency devaluation and Brazil has made the decision that this risk outweighs the additional attractiveness that dollarized contracts would mean for investors.

Among the auctions compared in this study, Brazil had the highest on-time project realization rate. Of the 29 new projects awarded in the 2015 A-3 auction, all are in operation but one, a biomass plant that was disqualified after the auction.⁷⁰ 22 of the 29 came into operation on schedule. However, historical on-time completion has been poor, and these auctions may have been anomalous. Just 14% of the wind projects scheduled to be in operation by March 2016 were operational on time, and 29% experienced a delay of at least one year, according to consultancy factor.⁷¹ 70% of these delays were due to corresponding delays in transmission construction, which in turn were owed at least in part to delays in environmental authorization.⁷² Further analysis of the effectiveness of completion guarantees is on ANEEL's agenda in the coming years.⁷³ Administrative capacity should also be expanded to expedite the permitting process.

Average Price (USD/MWh), BRAZILIAN AUCTIONS 2015 - 6/2019

*LFA = Alternative sources
auction **LEN = New energy
auction ***LER = Reserve
energy auction

Source: CCEE, converted to
USD using exchange rate on
date of each auction



Summary of Brazilian Auctions 2015-2019	
GWh/yr contracted	59,270.16
Solar	7,854.22
Wind	15,121.51
Biomass	3,446.18
Natural gas	27,071.03
Small hydro	4,325.69
Large hydro	1,451.53
2014 NCRE generation (GWh/yr)	78,858.96
Ratio NCRE GWh/yr contracted : 2014 NCRE generation	0.39
2014 overall generation (GWh/yr)	590,541.00
Ratio NCRE GWh/yr contracted : 2014 overall generation	0.05
ΔGWh/yr generation from non-NCRE sources, 2015-2017	-39,661.35
MW new projects	14,185.21
Solar	3,347.48
Wind	4,087.93
Biomass	1,049.45
Natural gas	4,051.32
Small hydro	1,054.84
Large hydro	594.20
2014 NCRE capacity	23,330.28
Ratio MW new NCRE projects : 2014 NCRE capacity	0.41
2014 overall capacity	138,690.02
Ratio MW new NCRE projects : 2014 overall capacity	0.07
Non-NCRE capacity additions, 2015-2017 (MW)	8,368.04
Expected investment (USD)R	\$17.94 bn

Average price / MWh (USD)R	
3rd LFA* (2015)	\$67.59
21st LEN** (2015)	\$88.05
22st LEN (2015)	\$54.16
7th LER*** (2015)	\$85.53
8th LER (2015)	\$65.89
23rd LEN (2016)	\$56.46
10th LER (2016)	\$70.67
25th LEN (2017)	\$43.84
26th LEN (2017)	\$57.51
27th LEN (2018)	\$37.57
28th LEN (2018)	\$34.07
29th LEN (2019)	\$39.30
Change in average price between 2015 A-5 (21 LEN) and 2019 A-4 (29 LEN) auctions	-55%

Sources: ANEEL, CCEE, Climatescope

*LFA = Alternative sources auction **LEN = New energy auction ***LER = Reserve energy auction

^at BRL-USD exchange rate on date of auction

CHILE

In its three auctions since 2015, Chile succeeded in meeting all the auctioned demand each time, which it did not achieve in its auctions from 2006 to 2014. It saw a particularly steep drop in average winning prices: from \$79.3/MWh in 2015 to \$32.5/MWh in 2017, placing its prices among the most competitive internationally. Despite the technology-neutral nature of its auctions, solar and wind bids have produced the lowest prices, a phenomenon facilitated by the innovative awarding of generation during intraday blocks. In the second auction of the period, wind and solar projects also won more than 40% of the volume for continuous generation.⁷⁴ In the most recent auction, which incorporated quarterly blocks, the awarded prices did not differ between the quarters, so switching from intraday to quarterly blocks didn't actually impact

auction results. Chile allows a long lead time of five years for project completion (similar only to Brazil), which may allow for more speculative lowering of prices in anticipation of falling technology costs.

Several factors have made Chile's auctions attractive to investors and competitive. For one, its solar and wind resources are abundant, and of solar in particular it has among the greatest potential of any country. Chile has set ambitious renewable energy targets and announced auctions in 2019 and 2020, providing long-term confidence in the market. Chile is generally considered to be one of the lowest-risk markets in the region, with a high credit rating and a history of openness to private investment. Contracts are denominated in USD.

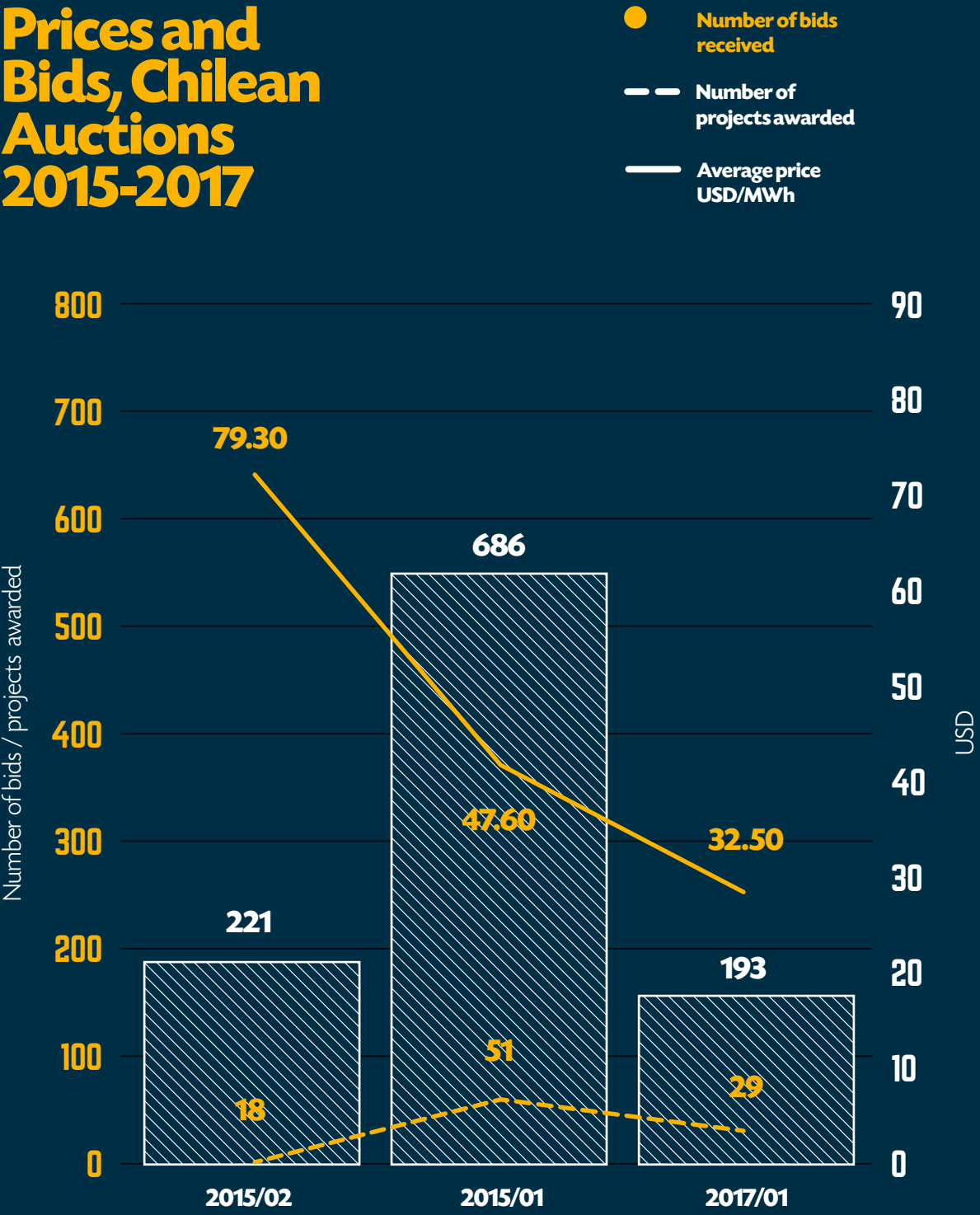
The 2015 auction for generation to begin in January 2017 attracted 221 bids and

awarded 19 contracts to five companies—all European and US companies.⁷⁵ The new wind and solar projects awarded contracts that amounted to 1206 MW of capacity and \$4 billion of investment. The winners committed to provide generation from 13 new projects—five wind and eight solar, including Latin America's first concentrated solar power (CSP) plant, to be constructed by Spain's Abengoa in the Atacama Desert.

Chile has a poor completion rate for this auction, perhaps due to its minimal prequalification requirements and penalties, although developers are required to pay bid bonds, completion bonds and penalties for non-completion. The CSP project, originally slated for operation at the end of 2018, is now expected to come online sometime in 2020. Two solar parks of a combined 64 MW are no longer being built, the generation

contract having been transferred to another company. Four projects are in varying stages of operation, and the only project to deliver energy according to the schedule in its offer had already been permitted at the time of the auction.

Prices and Bids, Chilean Auctions 2015-2017



Summary of Chilean Auctions 2015/01, 2015/02, and 2017/01	
GWh/yr contracted	15,829.90
Solar	876.90
Wind	6,096.60
Solar/wind	1,572.00
Solar/wind /geothermal	1,180.00
Conventional energy/NCRE mix	6,104.40
2014 NCRE generation (GWh/yr)	8,307.00
Ratio NCRE GWh/yr contracted* : 2014 NCRE generation	1.17
2014 overall generation (GWh/yr)	69,870.00
Ratio NCRE GWh/yr contracted* : 2014 overall generation	0.14
GWh/yr generation from non-NCRE sources, 2015-2017	-1,613.33
MW new projects	6,161.05
Solar	2,201.41
Wind	3,941.64
Small hydro	18.00
2014 NCRE capacity (MW)	2,303.80
Ratio MW new NCRE projects : 2014 NCRE capacity	2.67
2014 overall capacity (MW)	19,003.60
Ratio MW new NCRE projects : 2014 overall capacity	0.32
Non-NCRE capacity additions, 2015-2017 (MW)	2,116.80
Expected investment (USD)	\$12.18 bn
Average price / MWh (USD)	
2015/02	\$79.30
2015/01	\$47.60
2017/01	\$32.50
Change in average price over three auctions	-59%

Source: CNE, company bids, ACERA, SEIA, Climatescope, AURES

MEXICO

Mexico's three long-term power auctions drew significant investor interest thanks to the large quantities of energy on offer, the existence of concrete renewable energy goals to provide long-term visibility, and CFE's credibility as an off-taker (it was the only off-taker in the first two auctions and for 91% of the energy in the third auction). In fact, the Mexican auctions were the three largest in the region in terms of resulting added capacity. Established international players were present in all three auctions and won large shares of the generation offered, but winners also included some newcomers and emerging developers.

Though no auction awarded all the generation sought, average prices were some of the lowest ever seen, driven down by falling costs for wind and solar. The average price per megawatt hour dropped

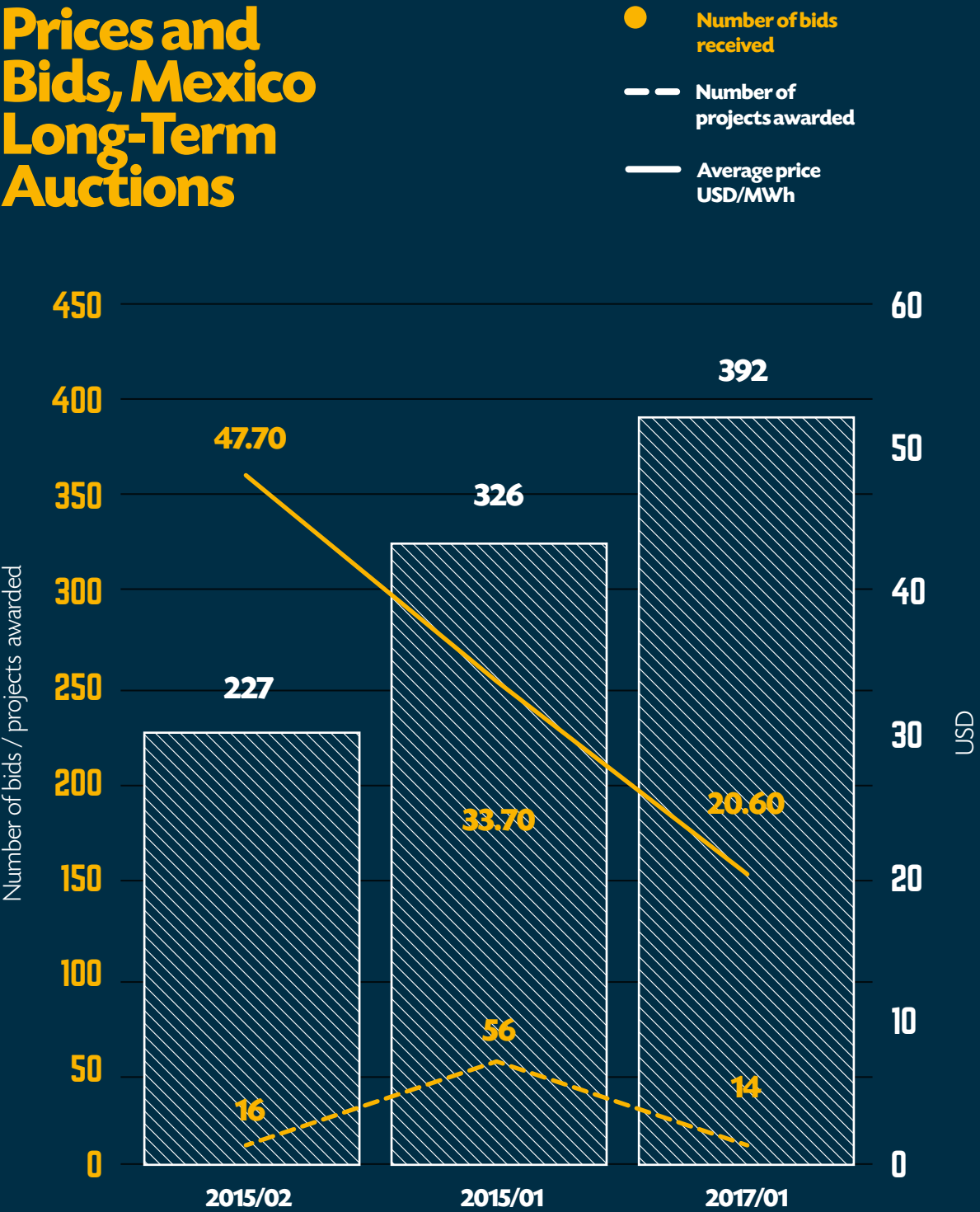
by more than half from almost \$48 in the first auction to less than \$21 in the third auction. Almost \$9 billion of investment and new capacity of 7.6 GW were expected from the projects awarded across the three auctions.

The number of bids offered compared to the number of winners testifies to the competitiveness of the tenders. In the first auction, 16 projects won out of 227 bids offered, and the amount of energy offered by prequalified bidders was 20 times what was ultimately awarded. Solar energy was the clear winner, with 74% of energy sold, and the remaining 26% wind.⁷⁶ Foreign companies and their subsidiaries dominated the first auction, winning 94% of projects. No capacity in this auction was awarded, likely because the ceiling price was too high.

However, project realization has been less impressive. Of the 16 projects awarded

in the first auction, all of which had delivery dates in 2018, just over half are in operation and only four were completed during the time frame indicated in their offer. Nine of 16 are (or were, before they were completed) more than a year behind schedule. Failure to win the approval of local communities is notorious in Mexico because of a communal land ownership structure that makes negotiation difficult in some regions with major renewable potential. At least two of the delayed projects have been forced to relocate because they could not obtain community consent,⁷⁷ and a third was suspended by a judge for an insufficient community consultation process.⁷⁸ Requiring bidders to present land-use rights with their offer, as is done in some other countries, would represent a significant barrier to entry and reduce competition, but would improve completion times. Some of these projects may yet be cancelled.

Prices and Bids, Mexico Long-Term Auctions



Summary of Mexico’s First, Second, and Third Long-Term Power Auctions	
MW contracted	1,755.00
Solar	194.00
Wind	211.00
Natural gas	1,350.00
GWh/yr contracted	19,806.39
Wind	7,712.00
Solar	11,895.63
Geothermal	198.76
2014 NCRE generation (GWh/yr)	15,842.65
Ratio NCRE GWh/yr contracted : 2014 NCRE generation	1.25
2014 overall generation (GWh/yr)	301,463.00
Ratio NCRE GWh/yr contracted : 2014 overall generation	0.07
/GWh/yr generation from non-NCRE sources, 2015-2017	21,119.24
MW new projects	7,563.00
Solar	4,867.00
Wind	2,121.00
Geothermal	25.00
Natural gas	550.00
2014 NCRE capacity (MW)	4,158.00
Ratio MW new NCRE projects : 2014 NCRE capacity	1.69
2014 overall capacity (MW)	65,451.00
Ratio MW new NCRE projects : 2014 overall capacity	0.11
Non-NCRE capacity additions, 2015-2017 (MW)	6,814.93
Expected investment (USD)	\$8.969 bn
Average price / MWh + CEL (USD)	
First auction (2015)	\$47.70
Second auction (2016)	\$33.70
Third auction (2017)	\$20.60
Change in average price from first to third auction	-57%

Sources: CRE, CENACE, Climatescope, <http://www.renewableenergymexico.com/mexicos-third-long-term-electricity-auction-the-results-and-the-comparison/>, https://www.wilsoncenter.org/sites/default/files/initial_results_from_the_mexico_electricity_reform_2013-18.pdf, Zumma Energy Consulting

ARGENTINA

Despite a difficult economic situation, Argentina's RenovAr program has succeeded in convening oversubscribed and competitive auctions, contracting almost 4.5 GW of energy⁷⁹ and attracting expected investment of US\$7 billion⁸⁰ in just three years. Average prices have not been record-breaking but have been competitive by international standards. The average price across the three auctions was \$54.7/MWh. The high level of interest in Argentina's auctions is no doubt owed in part to the robust system put in place to reduce financial risk given the state's history of default and the current economic crisis.

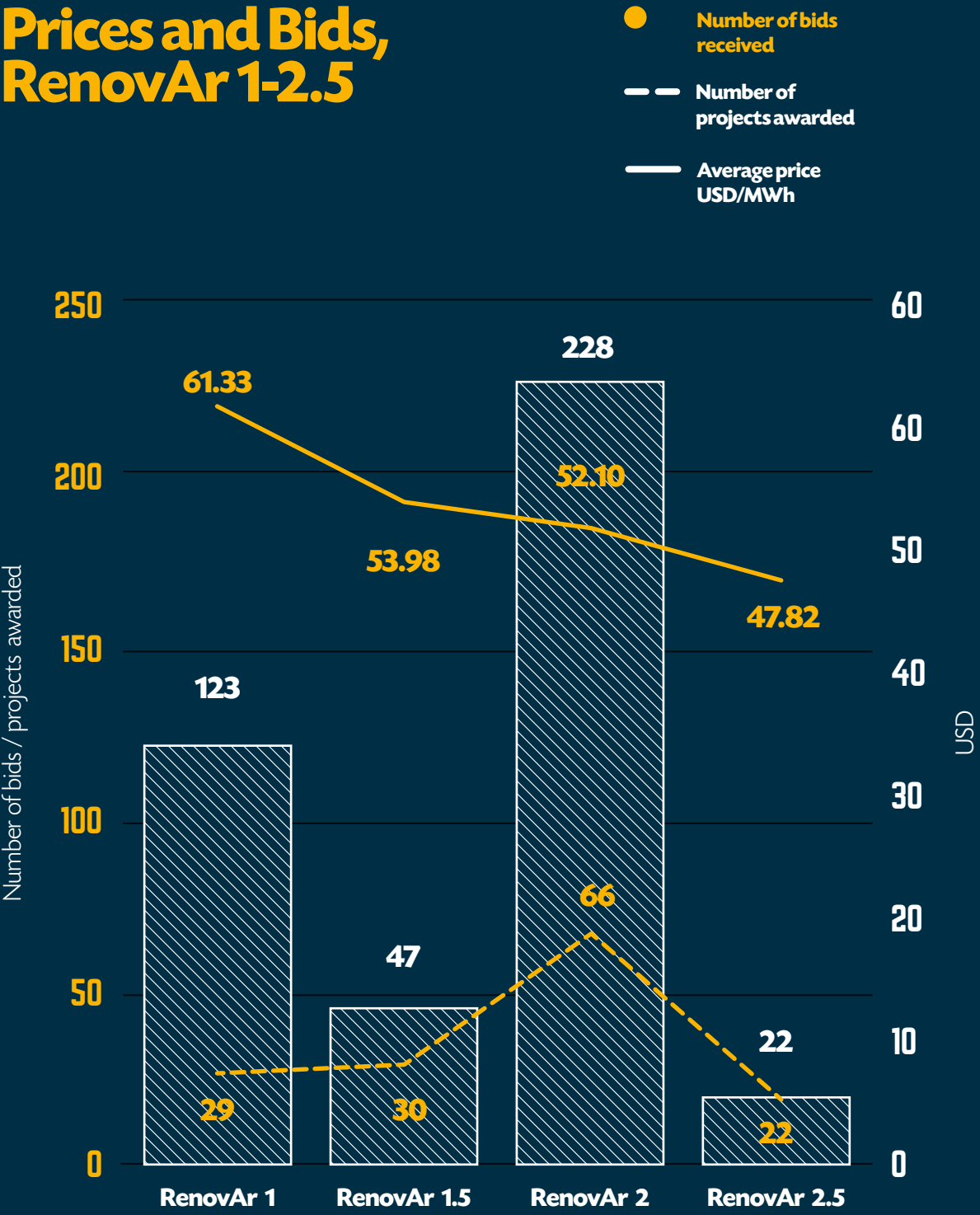
The first auction, which took place in late 2016, sought to contract 1 GW but received 123 offers totaling 6.3 GW. Thus, the auction volumes for wind and solar energy

were exceeded and another round, RenovAr 1.5, was held for unsuccessful first round bidders. The goal was once again exceeded, and an additional 1.3 GW contracted. In these combined phases, 59 projects were awarded out of 168 bids received. The auction was dominated by wind projects, which won 62% of energy sold, and solar projects, with 35% of energy sold.⁸¹

The first RenovAr round was not dominated by foreign firms as in other countries. In fact, 300 of the 400 MW of solar contracted were won by JEMSE, a firm owned by the state of Jujuy, and Argentine companies accounted for almost 400 MW of wind energy, more than half the capacity awarded. Chinese, British, German, and Spanish companies also took home contracts. Despite local ownership, however, local content was only 14% in RenovAr 1, increasing to 18% in RenovAr 1.5 and 30% in RenovAr 2.

The contracts for RenovAr 1 were signed in early 2017 and should have entered commercial operation a maximum of two years later. Excluding projects under 2 MW in size, only around a third of projects have entered operation. Reasons for delays have varied: one wind park had to be combined with another because of conflict with an indigenous community on the original site,⁸² the bankruptcy of a German wind turbine manufacturer affected two projects,⁸³ and JEMSE's 300 MW Caucharí solar park is delayed due to delays in government-led expansion of transmission capacity.⁸⁴

Prices and Bids, RenovAr 1-2.5



Summary of RenovAr 1, 1.5, 2, and 2.5 Auctions

MW contracted (new projects)	4,466.00
Solar	1,732.00
Wind	2,466.00
Small hydro	32.00
Biomass	158.00
Biogas	78.00
2014 NCRE capacity (MW)	846.80
Ratio MW new NCRE projects : 2014 NCRE capacity	5.27
2014 overall capacity (MW)	31,513.80
Ratio MW new NCRE projects : 2014 overall capacity	0.14
Non-NCRE capacity additions, 2015-2017 (MW)	4,675.05
Expected investment (USD)	\$7 bn
Average price / MWh (USD)	
RenovAr 1	\$61.33
RenovAr 1.5	\$53.98
RenovAr 2	\$52.10
RenovAr 2.5	\$47.82
Change in average price between RenovAr 1 and 2.5	-22%

Source:

- MINEM
- MINEM, Climatescope, Energía Estratégica

PERU

Though Peru's renewable energy target of 5% is lower than in the other countries in this study and the auctioned volumes are lower, several factors contributed to the international attention that Peru's fourth auction received. The expectation of an auction every two years (except in the case of oversupply⁸⁵) provide a degree of long-term certainty in the market. Further, Peru is experienced in auction design and has adapted in response to past experiences. For instance, the 2016 auction was the first one in which the ceiling price was disclosed. In previous auctions, many bidders had been disqualified for bidding above the ceiling price. Peru also has no local content requirements and mitigates currency and inflation risk by indexing contracts paid in the local currency indexed to the sol-dollar exchange rate and the USD inflation rate, provides preferential

grid dispatch, and only requires resource assessments of at least one year. The devaluation of the Peruvian sol, which has decreased local costs such as for labor, also likely makes the investment environment more attractive for foreign firms.⁸⁶

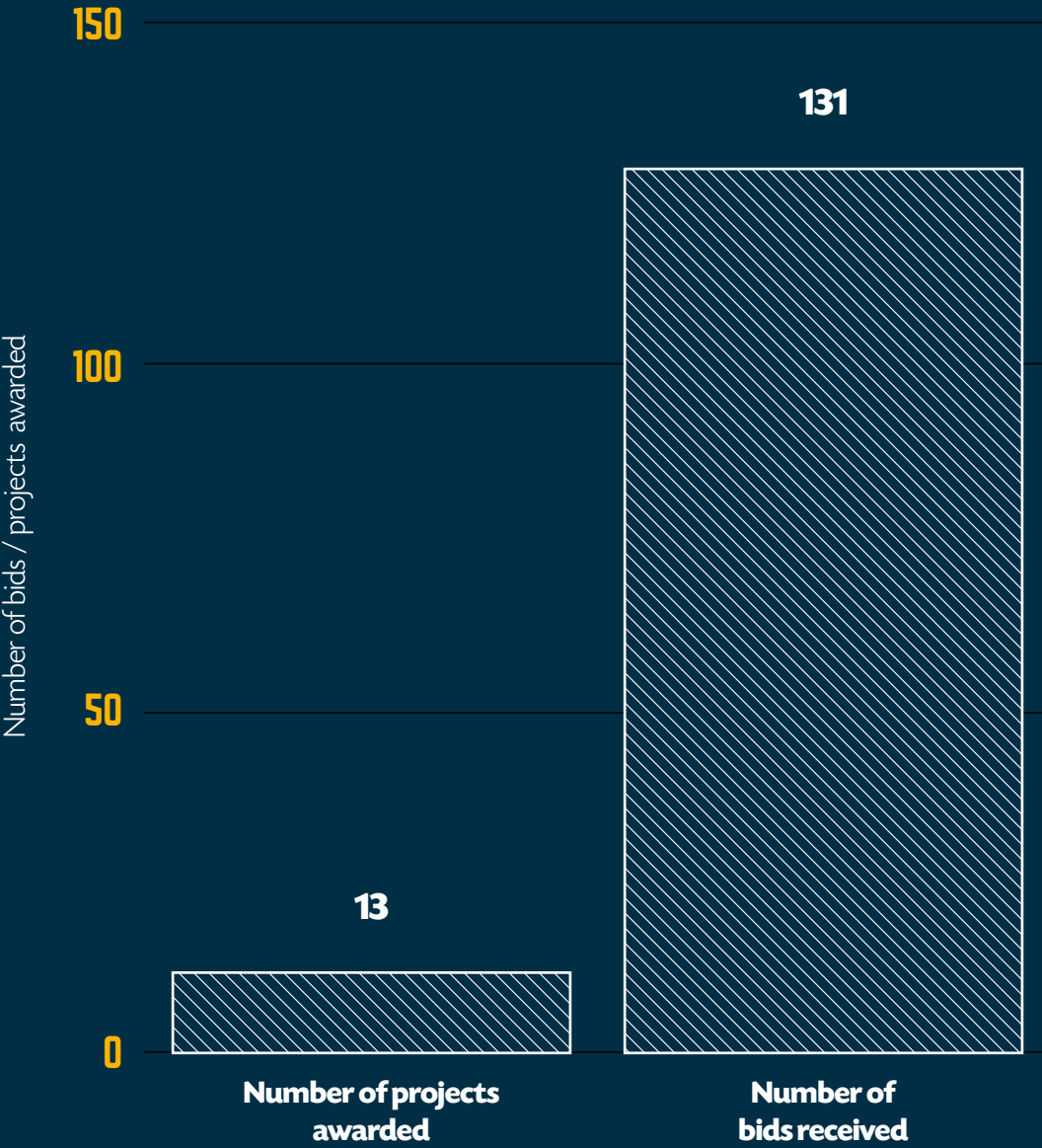
Peru's fourth renewable energy tender (the only auction within the study timeframe) awarded tenders for virtually all the generation sought and produced impressive prices—an average of \$37.49/MWh for wind energy and \$48.39/MWh for solar energy. Both phases of the auction attracted many bids. In the first phase, one wind and one solar project were selected, out of 34 and 48 bids, respectively. Two biomass projects were also selected. In the second phase, three of 20 projects were selected (one solar and two wind). However, bids were highly concentrated in the hands of Enel, which contributed 24 wind bids and 17 solar bids. For both wind and solar, the

10 lowest-priced bids in the first round were submitted by Enel and GDF Suez (now Engie). However, firms from South Korea, Spain, Canada, and France, also competed, and in the second phase, in which bidders lowered their prices, Spain's Grenergy won two wind contracts by lowering the prices by 21% and 27%, joining Enel and Engie as auction winners. Peruvian firms won five of the six small hydro projects awarded.⁸⁷ The awarded projects drew expected investment of \$611 million and combined capacity of 430 MW.⁸⁸

About half of the 13 awarded projects are in operation, of which three were finished on time (Engie's solar park, one of Enel's two wind farms, and a hydroelectric plant). Enel's other wind farm came online just two months behind schedule, bringing the percent of completed capacity above 80% by the end of 2018, the referential date of commercial operation in the auction

rules. Grenergy's wind parks did not meet their financing deadline and are projected to come online almost two years late.⁸⁹ Having raised construction bonds over the course of its auction history,⁹⁰ Peru has managed to mitigate delays relative to the other countries in this study.

Projects Awarded vs. Bids Received, Peru 4th Renewable Energy Auction



Summary of Fourth Peruvian Renewable Energy Auction

GWh/yr contracted	1,739.17
Solar	523.40
Wind	738.60
Small hydro	448.17
Biomass	29.00
2014 NCRE generation (GWh/yr)	4,264.76
Ratio NCRE GWh/yr contracted : 2014 NCRE generation	0.41
2014 overall generation (GWh/yr)	45,128.61
Ratio NCRE GWh/yr contracted : 2014 NCRE overall generation	0.04
GWh/yr generation from non-NCRE sources, 2015-2017	4,165.59
MW new projects	430.14
Solar	184.48
Wind	162.00
Small hydro	79.66
Biomass	4.00
2014 NCRE capacity (MW)	1,056.46
Ratio MW new NCRE projects : 2014 NCRE capacity	0.41
2014 overall capacity (MW)	10,824.64
Ratio MW new NCRE projects : 2014 overall capacity	0.04
Non-NCRE capacity additions, 2015-2017 (MW)	972.32
Expected investment (USD)	\$610.8 mn
Average price / MWh (USD)	\$43.07

Source:

- OSINERGMIN
- OSINERGMIN, Climatescope

JAMAICA

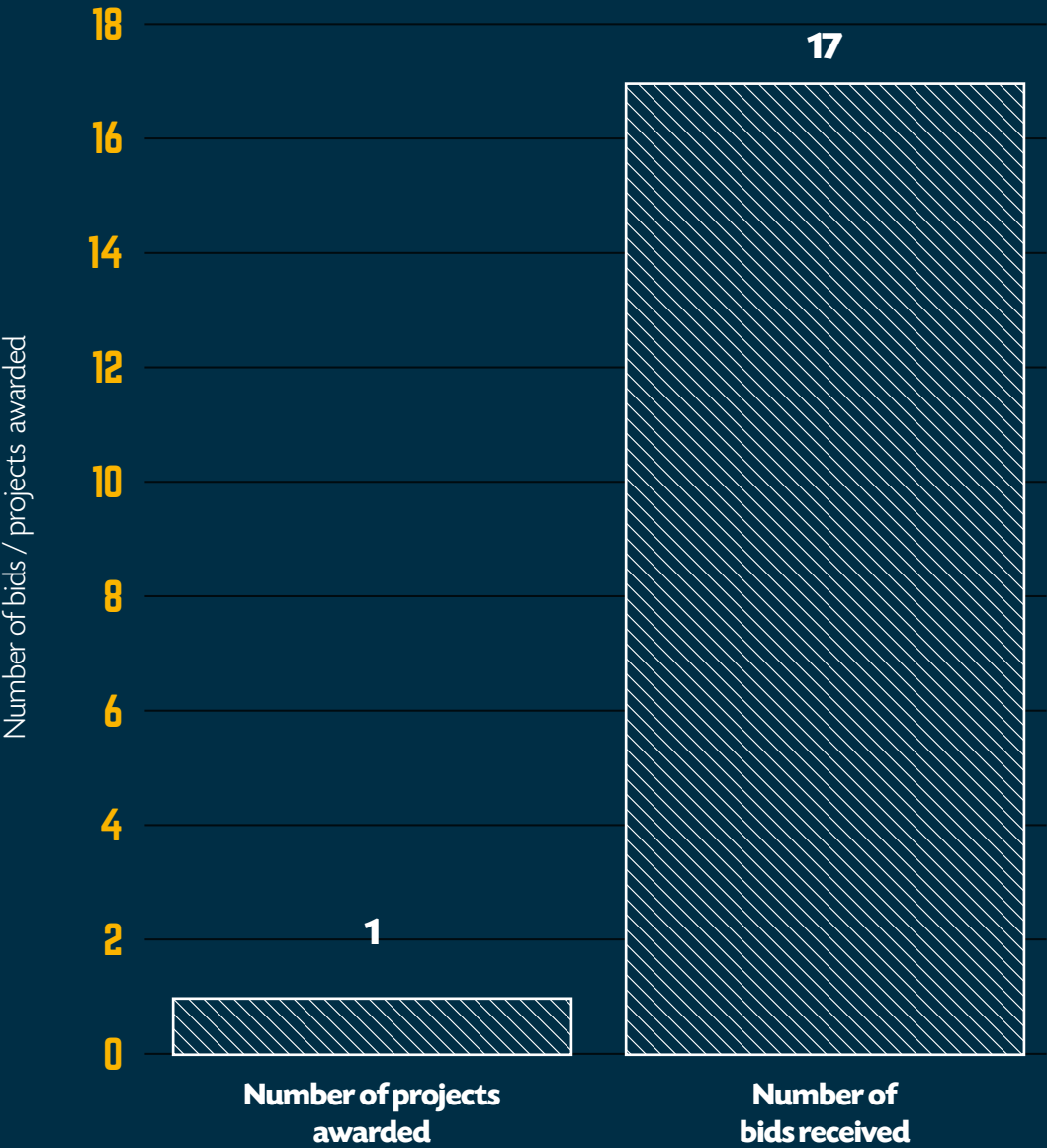
Jamaica’s most recent auction attracted 17 bids from 10 companies⁹¹, with the winning bid agreeing to produce solar energy at a price of \$85.40/MWh. The 37 MW solar project had an estimated investment of \$48.7 million.

The price is very high relative to those achieved for solar in other countries, which could stem in part from low competition. Two of the ten companies had not submitted their proposal securities at the time of bid opening,⁹² and international firms only accounted for four of the bids,⁹³ including the winner, which was majority-owned by the French company Neoen. The low volume on offer (just 37 MW) and the fact that Jamaica’s government at the time of the auction had a Caa2 credit

rating from Moody’s (very high credit risk)⁹⁴ likely played a role in the limited participation and high price awarded.

The awarded project became operational six months after the proposed commissioning date in the Request for Proposals. It is unclear if it was contractually obligated to deliver energy by that date and the terms of the auction are vague in terms of delay penalties, merely indicating that “liquidated damages will be assessed.”⁹⁵ Of the auctions in this study, Jamaica’s is unique in this respect—all other countries impose an exact fine depending on the quantity of undelivered energy or the length of the delay. More certainty regarding delay penalties could create a more credible incentive to on-time completion.

Projects Awarded vs. Bids Received, Jamaica 37-MW Renewable Auction



Summary of Jamaican 37-MW Renewable Energy Auction

MW contracted (new projects)	37

Solar	37

2014 NCRE capacity (MW)	71

Ratio MW new NCRE projects : 2014 NCRE capacity	0.52

2014 overall capacity (MW)	880

Ratio MW new NCRE projects : 2014 overall capacity	0.04

Non-NCRE capacity additions, 2015-2017 (MW)	20.00

Expected investment (USD)	\$48,7 mn

Average price / MWh (USD)	\$85.40

Source:

- OUR
- Climatescope, Jamaica Gleaner

Learning from Experience: The Case of Colombia



Colombia's highly-anticipated first renewable energy auction fell short of expectations in its first attempt in February 2019. However, adapting its contract structure to be more attractive to developers, incorporating elements from other auctions in the region, and using regulation to increase NCRE demand combined for a successful second take. In October 2019, three solar and six wind projects were awarded contracts, totaling an expected 1.473 GW of new NCRE capacity by 2022, up from 50 MW at the time of the auction.^{2,3} The winning projects are expected to require US\$2.2 billion in investment and provide energy at a price of around US\$27.6/MWh⁴, about 38% lower than average generation costs from bilateral contracts.⁵

After the February auction for non-conventional renewable energy failed to meet minimum competition requirements, the Colombian government made several

key changes to ensure the success of the second iteration. For one, they increased the contract length from 12 years to 15, ensuring developer revenues for a longer period. In addition, Chile's innovative time block structure was adopted, dividing the day into blocks from 12am-7am, 7am-5pm, and 5pm-12am to allow developers of intermittent renewables to make offers compatible with their generation curve. The government also introduced take-or-pay contracts, meaning revenues are guaranteed even in the event of low demand, and buyers and sellers of energy simultaneously submitted sealed-bid offers in order to match supply and demand in the absence of a single off-taker. Finally, regulations introduced the month before the auction, which will enter into force in 2022 and impose a minimum 10% renewable quota on distributors to be bought through contracts of at least 10 years, boosted demand for the auction.⁶

Thus, by holding a failed auction and a successful one in the same year, Colombia demonstrated the potential of appropriate auction design to positively alter outcomes and identified some of the most important incentives for both developers and off-takers. Colombia was able to tailor an auction with results representing great progress toward its renewable energy goals.

¹ CIRCULAR EXTERNA No. 046-2019, CIRCULAR EXTERNA No. 046-2019 § (2019). http://www1.upme.gov.co/Normatividad/Circular_046_2019.pdf.

² CIRCULAR EXTERNA No. 047-2019, CIRCULAR EXTERNA No. 047-2019 § (2019). http://www1.upme.gov.co/Normatividad/Circular_047_2019.pdf.

³ "Día Histórico Para Las Energías Renovables En Colombia: Por Primera Vez, La Energía Del Sol y Del Viento Llegará, a Precios Más Bajos, a Los Hogares Colombianos." Ministerio de Minas y Energía, October 22, 2019. <https://www.minenergia.gov.co/en/web/10180/1332?idNoticia=24146550>.

⁴ Bellini, Emiliano. "Colombia's First Solar and Wind Power Auction Brings Average Price of \$0.027/KWh." *pV magazine International*, October 23, 2019. <https://www.pv-magazine.com/2019/10/23/colombias-first-solar-and-wind-power-auction-brings-average-price-of-0-027-kwh/>.

⁵ "Día Histórico Para Las Energías Renovables En Colombia: Por Primera Vez, La Energía Del Sol y Del Viento Llegará, a Precios Más Bajos, a Los Hogares Colombianos." Ministerio de Minas y Energía, October 22, 2019. <https://www.minenergia.gov.co/en/web/10180/1332?idNoticia=24146550>.

⁶ Bellini, Emiliano. "Colombia Imposes Renewables Quota on Power Distributors." *pV magazine International*, September 16, 2019. <https://www.pv-magazine.com/2019/09/16/colombia-imposes-renewables-quota-on-power-distributors/>.

Conclusions

The clean energy auctions implemented by Latin American and Caribbean countries in this study adopted a wide range of design features intended to promote competition, attract qualified players and achieve a variety of policy objectives, including greenhouse gas emissions reductions in the power sector and energy security. The outcomes for these countries vary significantly. Moreover, factors that are external to the auction design, such as the

overall investment climate of the country, the credit risk profile of the off-taker, the size of the market, the availability of transmission and distribution infrastructure, and the renewable energy resource potential, also influence auction participation and outcomes. Nevertheless, some trends clearly emerge, which provide a basis for broad policy recommendations.

All of the countries analyzed sought to attract private investment through various measures. In most of the cases, companies and governments signed power purchase agreements for 20 years. Contracts of fewer than 20 years may deter investors, as their project would require a faster pay back period and higher rate of return. Brazil's auctions were successful despite having contracts priced in local currency. However, Brazil is the largest market in the region with a long history of renewable energy tenders. In most cases, smaller Latin American and Caribbean countries that may struggle to attract investment should price contracts in US dollars, though they must weigh the macroeconomic risk that this represents, as any currency devaluation could stoke inflation if electricity is priced in dollars.

Most of the countries witnessed significant delays in project completion in the period studied. This suggests that countries organizing auctions should consider strict prequalification requirements as well as bid bonds, completion bonds and other penalties. Specifically, prequalification requirements may need to include detailed environmental and land-use pre-feasibility studies, as multiple projects were delayed due to failure to obtain environmental permits or community consent. Governments can also provide

developers with more of this information upfront to facilitate pre-feasibility studies. Auctioneers should also require that project proposals include clear plans for grid connection, as lack of transmission capacity was another driver of delays and incompleteness of projects. Governments also need to invest in improving grid infrastructure.

Although several of the auctions studied limited participating projects to specific clean energy technologies, it may not be necessary to hold renewable energy-only auctions. Wind and solar projects dominated most of the auctions, even beating fossil fuels on price. However, some countries may want to encourage specific technologies in order to better balance competition between intermittent renewable energy sources to boost energy security. Design features that encourage geographic dispersion of projects can also improve energy security.

International firms won most of the contracts where special incentives for local companies were absent. If expanding local supply chains and strengthening local companies in the sector is an objective, targeted incentives, such as low interest rate loans, may be needed. However, strict local content requirements could reduce

participation, particularly in markets where the local supply chain is weak. Brazil's auctions were successful despite strong incentives favoring local companies. But, Brazil boasts a large market and strong domestic manufacturing sector for renewable energy equipment.⁹⁶ For most other countries in Latin America and the Caribbean, it would be difficult to replicate this model, so newcomers should make sure that local content requirements are realistic and can be met by local industry without excessively penalizing developers.

Setting volume to match supply and demand and manage the load curve is a critical aspect of auction design. In most countries, the off-takers self-report their expected demand, which is the basis for the volume set in auctions. All six countries in the study include a volume ceiling in their auctions to avoid oversupply. In countries with a sparse track record in designing auctions, the volume and price ceiling may need to be disclosed to give bidders sufficient information to submit proposals that can compete.

As this study demonstrates, electricity auctions are an effective mechanism to attract investment in non-conventional renewable energy sources, particularly wind and solar. Yet, many countries in the region have little or no history of holding electricity auctions

to promote clean energy and remain very reliant on large hydro and thermal generation. Large hydro, oil products and coal together make up approximately 70% of electricity generation in Central America, for example. Shares of wind and solar remain very small, but there is significant potential for growth. Central American, Caribbean, and some South American countries should consider holding regular clean energy auctions to expand non-conventional renewable energy capacity to meet growing power demand and diversify their energy sources. The small markets of Central America and the Caribbean, as well as larger countries with nascent non-conventional renewable energy sectors such as Ecuador and Colombia, could benefit from introducing electricity auctions modeled on the most successful features employed elsewhere in Latin America.

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