

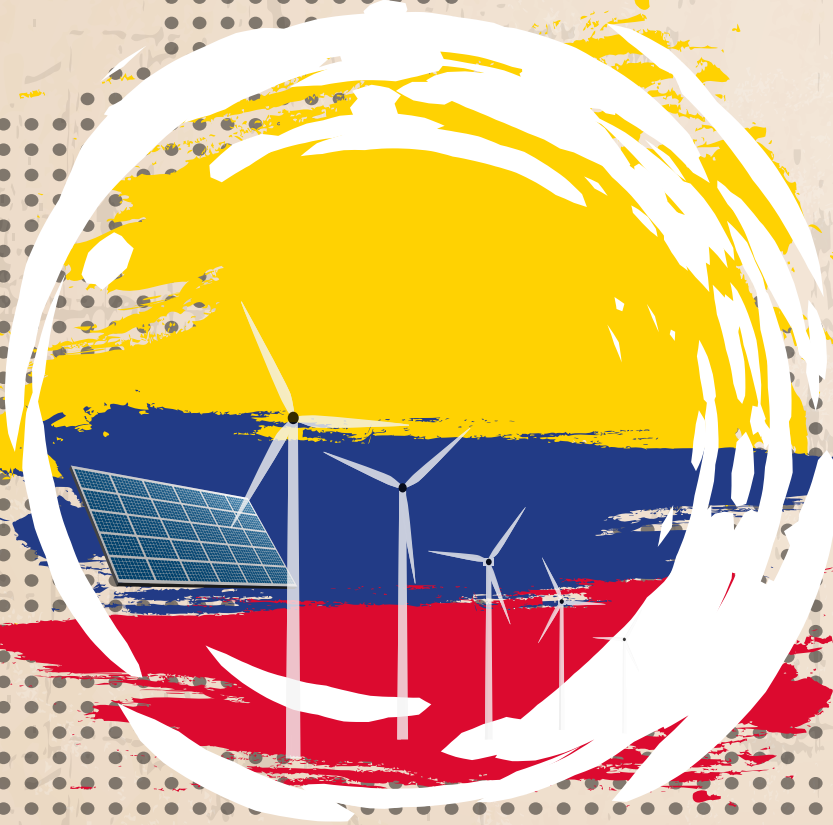


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**IRENA**  
International Renewable Energy Agency

# Renewable energy auctions in Colombia: Context, design and results



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# Contents

<b>KEY FINDINGS</b>	<b>5</b>
<b>1 DESIGN OF RENEWABLE ENERGY AUCTIONS</b>	<b>6</b>
1.1. Auction demand	12
1.2. Qualification requirements and documentation	15
1.3. Winner selection and contract award process	16
1.4. Risk allocation and remuneration of sellers	19
<b>2 RENEWABLE ENERGY AUCTION RESULTS</b>	<b>24</b>
2.1. Participation and competition	25
2.2. Price outcomes	28
<b>3 FACTORS AFFECTING PRICES</b>	<b>32</b>
3.1. Country-specific conditions	34
3.2. Investor confidence and learning curve	34
3.3. Policies supporting renewables	35
<b>4 CONCLUSIONS</b>	<b>38</b>
<b>ANNEX: FLOWCHART OF COLOMBIA'S SECOND RENEWABLE ENERGY AUCTION</b>	<b>42</b>
<b>REFERENCES</b>	<b>44</b>

## FIGURES

<b>Figure 1.</b> Colombia's installed generation capacity (in MW and %) in 2019 .....	<b>9</b>
<b>Figure 2.</b> Colombia's generation share by technology, 1990-2018.....	<b>9</b>
<b>Figure 3.</b> IRENA's auction design framework.....	<b>12</b>
<b>Figure 4.</b> Materials required for a 1 MW solar PV plant, a 50 MW onshore wind plant and a 500 MW offshore wind plan.....	<b>22</b>
<b>Figure 5.</b> Participation rates at different auctions stages in Colombia.....	<b>26</b>
<b>Figure 6.</b> Prices, installed capacity and companies awarded in Colombia's second auction.....	<b>28</b>
<b>Figure 7.</b> Volumes and prices by time slot and technology, awarded at auction or through supplementary mechanism .....	<b>30</b>
<b>Figure 8.</b> Solar PV and onshore wind prices in Latin American renewable energy auctions, 2010-2019.....	<b>31</b>
<b>Figure 9.</b> Factors that shape the price resulting from auctions.....	<b>33</b>
<b>Figure 10.</b> Wind speeds and solar irradiation in Colombia and La Guajira .....	<b>34</b>

## TABLES

<b>Table 1.</b> Criteria to qualify for Colombia's first renewable energy auction in February 2019.....	<b>15</b>
<b>Table 2.</b> Generation projects awarded in Colombia's second renewable energy auction and the supplementary mechanism.....	<b>27</b>
<b>Table 3.</b> Summary of Colombia's second renewable energy auction.....	<b>28</b>

## BOXES

<b>Box 1.</b> Electricity market design in Colombia .....	<b>7</b>
<b>Box 2.</b> Electricity sector governance in Colombia.....	<b>11</b>
<b>Box 3.</b> El Niño and Colombia's rationing crises .....	<b>13</b>
<b>Box 4.</b> Market shares in the Colombian electricity sector .....	<b>14</b>
<b>Box 5.</b> Opportunities to leverage local capacity.....	<b>22</b>

## ABBREVIATIONS

<b>CAC</b>	Market Operation Committee (Comité Asesor de Comercialización del Sector Eléctrico)
<b>CERE</b>	Real Equivalent Cost of Energy (Costo Equivalente Real de Energía)
<b>CNO</b>	Technical System Operation Committee (Consejo Nacional de Operación)
<b>COD</b>	commercial operations date
<b>COP</b>	Colombian pesos
<b>CREG</b>	Energy and Gas Regulatory Commission (Comisión de Regulación de Energía y Gas)
<b>GDP</b>	gross domestic product
<b>GW</b>	gigawatt
<b>GWh</b>	gigawatt hour
<b>ISO</b>	independent system operator
<b>KWp</b>	kilowatt peak
<b>MME</b>	Ministry of Mines and Energy (Ministerio de Minas y Energía)
<b>m/s</b>	metres per second
<b>MWh</b>	megawatt hour
<b>PND</b>	National Development Plan (Plan Nacional de Desarrollo)
<b>PPA</b>	power purchase agreement
<b>PPP</b>	purchasing power parity
<b>PV</b>	photovoltaic
<b>RPS</b>	renewable portfolio standards
<b>SO</b>	system operator
<b>SSPD</b>	Superintendency of Residential Public Services (Superintendencia de Servicios Públicos Domiciliarios)
<b>TFEC</b>	total final energy consumption
<b>TWh</b>	terawatt hour
<b>UPME</b>	Mining-Energy Planning Unit (Unidad de Planeación Minero-Energética)
<b>VRE</b>	variable renewable energy

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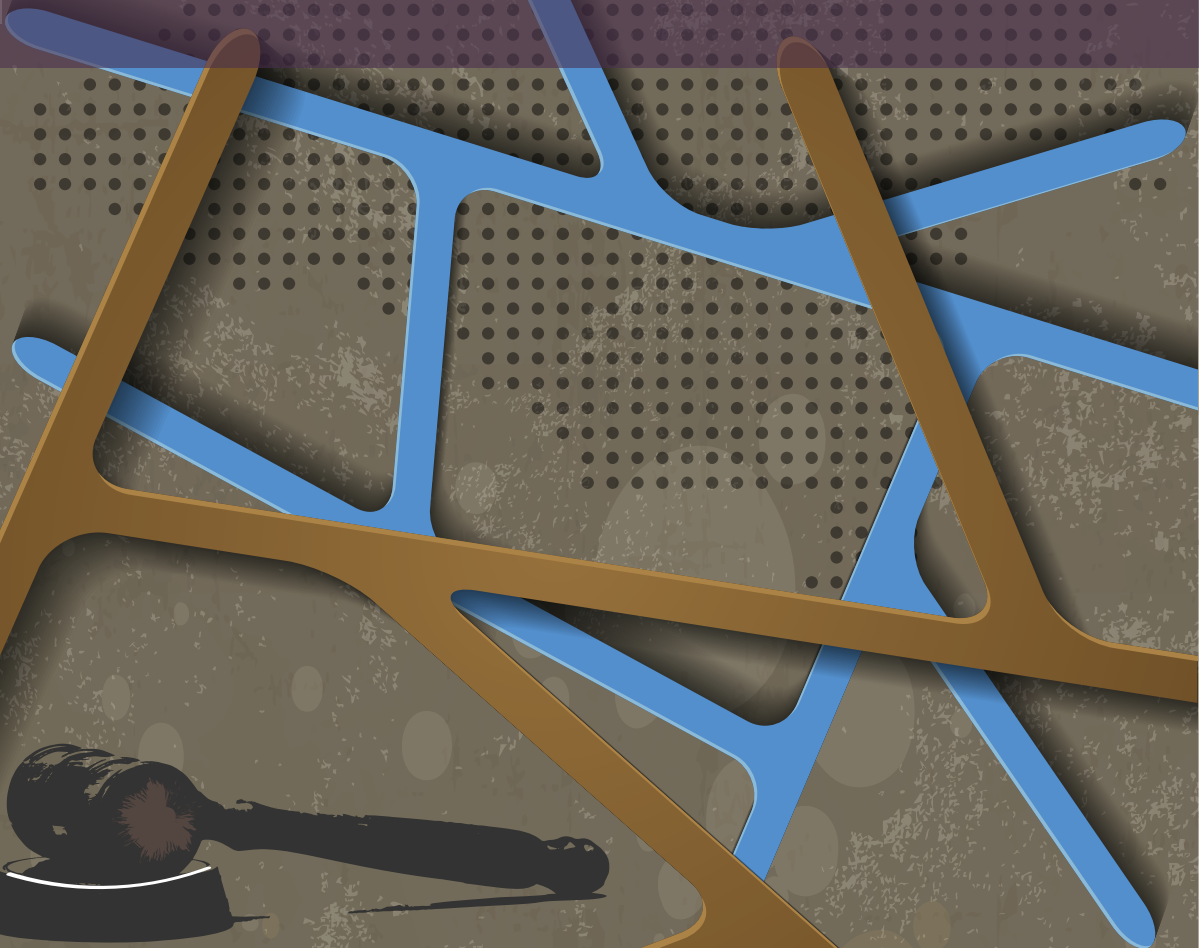
# Key findings

- In 2019, Colombia became the latest Latin American country to deploy renewable energy auctions. The decision, which built on previous experience with firm energy auctions (used to contract conventional energy), came after the unbundled and liberalised market had failed to promote the deployment of non-hydro renewable energy on a large scale.
- Colombia's first renewable energy auction in February 2019 assigned bids between buyers and sellers, but did not award contracts because the auction's competition criteria were not met, even though participation rates were high. Modifications to auction design in all four of IRENA's framework design categories – namely, auction demand, qualification requirements and documentation, winner selection criteria, and risk allocation – allowed the second auction in October 2019 to award contracts.
- The second auction secured around 1.3 gigawatts (GW) of new wind and solar photovoltaic (PV) capacity, which are scheduled to become operational by 2022. This was a positive step towards the diversification of Colombia's installed generation capacity, with solar PV and onshore wind shares expected to increase from less than 1% in 2019 to about 12% by 2022.
- At USD 28.40/megawatt hour (MWh) for solar PV and USD 27.70/MWh for wind, Colombia's weighted average prices were significantly lower than the global average for auctions in 2018. For solar PV, the Colombian figure was half the global USD 56/MWh, while in wind, it was 42% lower than the global USD 48/MWh. A supplementary mechanism saw slightly higher prices: USD 29.07/MWh for solar PV and USD 31.07/MWh for wind.
- The auction's power purchase agreement (PPA) contract price also includes a tariff to cover a reliability charge in the broader electricity market: the real equivalent cost of energy (CERE, costo equivalente real de energía). While generators must return the CERE if they do not provide firm energy, the lowest wind bids came from three projects that were also awarded in firm energy auctions. Bids in renewable energy auctions can be influenced by participation in firm energy auctions, as awarded generators can then retain the CERE and consider it an additional PPA revenue. The CERE's value in October 2019 was USD 17.88/MWh.
- Low prices in auctions can be attributed to Colombia's richness in wind and solar resources; the availability of different fiscal incentives for renewables; and investors' growing confidence in auctions and their enabling frameworks.
- Looking ahead, some auction design elements could be revisited. For instance, the long-term continuity of auctions is uncertain. Systematic auctions that involve a commitment to a longer-term schedule may attract a larger number of bidders, leading to increased penetration of non-hydro renewable energy.
- The La Guajira region, home to the six awarded wind projects and close to 4 GW of other registered non-hydro renewable energy projects, has been historically marginalised and energy-poor. Beyond price discovery, auctions offer the potential to engage communities, contribute to subnational development, foster the development of local industries, create jobs, and include small and new players.



1

# Design of renewable energy auctions



Renewable energy auctions are, by far, Latin America's most widely used policy instrument in the promotion of renewable electricity (IRENA, 2016). Brazil, Chile, Peru and Uruguay were early adopters, while Argentina, Chile and Mexico have innovated auction designs more recently. In 2019, Colombia became the latest adopter, driven by the success of auctions in the region (IRENA, 2019a; Viana, 2020).

Renewable energy auctions were designed to complement Colombia's existing electricity market mechanisms, namely the spot market, bilateral contracts and firm energy auctions. Colombia has had experience with the latter since 2008 (Box 1).



### **BOX 1. ELECTRICITY MARKET DESIGN IN COLOMBIA**

The unbundling of the electricity sector and the adoption of retail competition came in the aftermath of the 1992 El Niño rationing crisis (see Box 3). The aim of these measures was to bring private investment into the generation mix to diversify it, while promoting competition among retailers (and generators) to conclude electricity contracts at prices that were both competitive and adequate to meet demand. The framework for the current market design was created in 1994 under two pieces of legislation: Law 142 (the Public Service Law) and Law 143 (the Power Market Law). The unbundled and liberalised electricity market began operation in 1995.

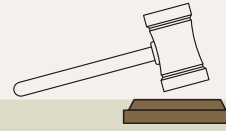
#### **Wholesale market**

Following an announcement of demand requirements by XM (the system operator, see Box 2),<sup>a</sup> generation units and other market participants (including demand side resources, aggregators, and importers) submit bids to XM's virtual platform, which then runs an algorithm to dispatch the system's needs in the most efficient manner (an economic dispatch system). Spot price formation is based on marginal pricing, meaning that the most expensive generator needed to satisfy demand sets the price for the entire running fleet. While the marginal pricing model usually entails multiple nodes, sometimes running into the thousands (and better known as locational marginal pricing), the Colombian system has a single national node. Spot prices have an hourly granularity, with a closing gate on the day before grid operation.

#### **Retail market**

In 2016, Colombia was the only country in Latin America with de facto retail competition (IRENA, 2016). Colombia has two retail markets: regulated and non-regulated. Retail competition is less relevant for regulated consumers than for the non-regulated. Residential households and small-sized businesses are normally classified as regulated consumers and they pay the regulated tariffs established by the Energy and Gas Regulation Commission (CREG) (see Box 2). Non-regulated consumers are those with an average monthly power demand of greater than 0.1 MW in terms of capacity, or 55 MWh in terms of energy (Rudnick and Velásquez, 2019). They must contract electricity from a retailer under a negotiated bilateral contract.

Continued on page 8



### Resource adequacy: firm energy auctions

After the 1992 power rationing experience (see Box 3), policy makers in Colombia explored capacity markets as a scarcity pricing mechanism, implementing the first capacity market for supply adequacy in 1996. That market set low administrative payments to avoid generators' over-dependence on capacity market revenues (Cramton and Stoft, 2007). Alas, the mechanism failed to specify clear generation-level requirements for scarcity situations, and in some cases, power was not dispatched when needed because generators lacked fuel at the time. Moreover, low spot prices and extended periods of hydro abundance discouraged new investments in generation in the broader electricity market (Larsen *et al.*, 2004; Rudnick and Velásquez, 2019).

In 2006, the capacity-based remuneration system was changed to a firm energy-based approach. The system was renamed the "Reliability Charge", with XM holding its first auction for generators to supply electricity under this scheme in 2008. Importantly, for these firm energy auctions to succeed, they had to attract generators willing to forgo the opportunity of selling electricity at high prices in the spot market during scarcity periods.

Generators participating in firm energy auctions receive a monthly reliability payment – a minimum fixed cash flow – based on a daily, reliable energy volume, or "firm energy obligation" (OEF, obligaciones de energía firme) that is paid at the awarded auction price (per MWh). This competitively established price is designed to guarantee the availability of the generation resource and is passed on to the final customers. The availability requirements necessary to meet these firm energy commitments (for daily energy delivery) are monitored through primary fuel source supply contracts and/or reserves to guarantee dispatch during scarcity. If not called upon during normal operation periods, the energy can be sold freely, either through bilateral contracts or on the spot market.

During periods of scarcity, energy is compensated at the scarcity price up to the volume assigned in the firm energy auction. The scarcity price is set administratively by the CREG and based on the fossil fuel cost of supplying electricity in stressed scenarios. Surplus volumes can be sold on the spot market or via bilateral contracts.

In sum, consumers pay a fixed premium (capacity/reliability payment) to have the option of "calling" the generator to produce electricity when the spot price is higher than the scarcity price (CREG, 2006).

Until 2018, Colombian firm energy auctions contracted only hydro and fossil fuel power plants owing to their dispatchable capability. In February 2019, XM held a firm energy auction that recognised the contribution of non-hydro renewables to resource adequacy and awarded contracts mainly to wind and solar PV. A detailed analysis of the outcomes of the firm energy auctions is beyond the scope of this report.

### Interconnections

The country has interconnections with Ecuador and Venezuela. While no electricity has been exchanged with the latter country for years, export and import flows with these countries are to be settled by XM according to Colombian market rules. Among the advantages of such regional markets are greater system flexibility (through expansion of the balancing area), improved complementarity of renewable energy generation, better co-ordination in generation planning and reduced system operational costs (IRENA, 2019b). Regional markets need harmonised market rules to ease integration (IRENA, 2019b); discussions of this topic are now gaining ground in Latin America (Beltrán, 2020).

a. Based on 1) a week-ahead demand forecast by XM (for operational planning) and 2) week-ahead demand forecasts by distribution and retail companies. The latter are used for the day-ahead market and can be updated by 8:00 each morning if the companies expect a daily deviation and wish to adjust their weekly forecast accordingly. The companies' forecasts are submitted every Friday, whereas XM issues its forecast every Tuesday.



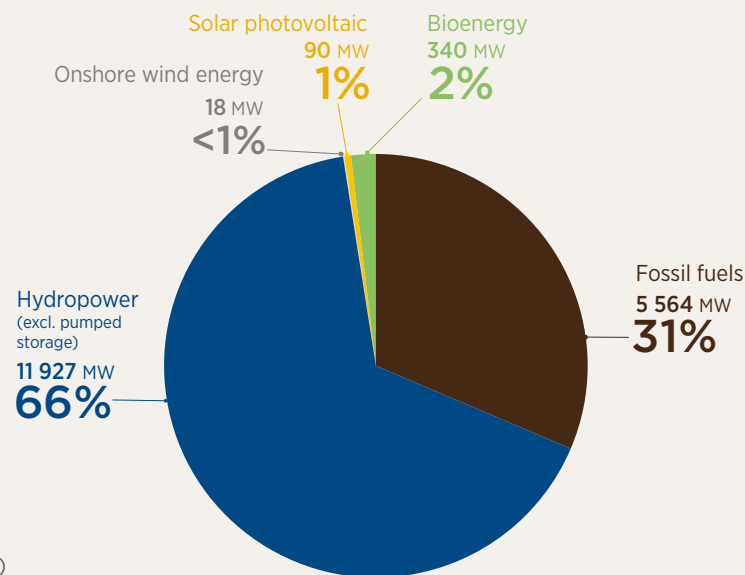
The instruments that preceded renewable energy auctions were insufficient to attract non-hydro renewable energy development on a large scale, as they did not include long-term energy contract mechanisms.

Colombia's electricity sector depends heavily on hydropower. In 2019, the country had 18 gigawatts (GW) of installed generation capacity, of which hydropower accounted for 66%, followed by fossil fuel power plants with a share of about 31% (Figure 1). Heavy reliance on hydropower makes the Colombian system an energy constrained one, meaning that the reliability of supply depends on the amount of energy available over a given period (i.e., the amount of water stored), rather than on

installed capacity. Hydro generation is vulnerable to extreme climate conditions such as El Niño.

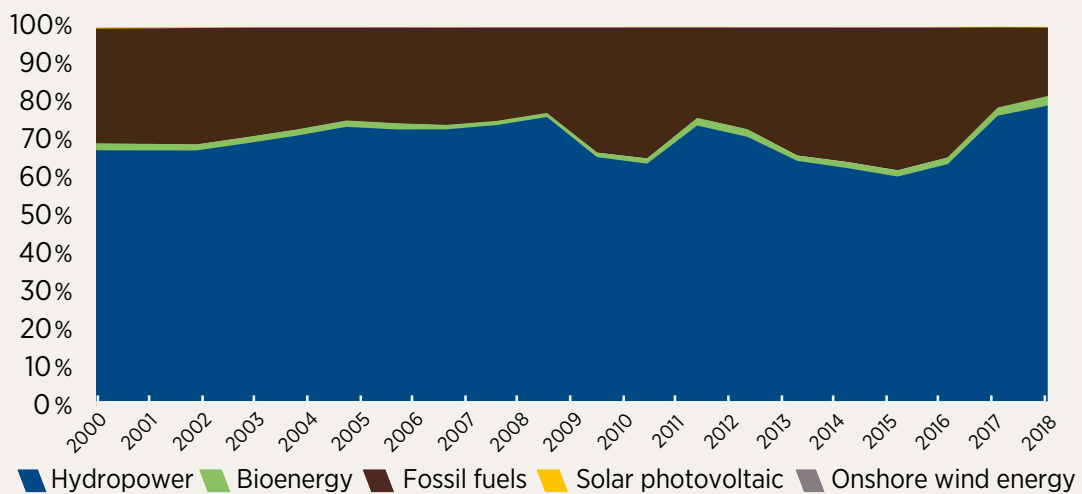
Box 3 (see section 1.1) analyses the wider impacts that El Niño has had in the electricity sector. Regarding electricity generation, between 2015 and 2016, when El Niño strongly affected Colombia, hydro generation fell below 64% of total generation, well below the average of 70% from 2000 to 2018. Fossil fuel generation made up for the decreased output of hydropower (Figure 2). Consequently, CO<sub>2</sub> emissions rose from 15 Mt CO<sub>2</sub> in 2014 to 17 Mt in 2015-16.<sup>1</sup> They fell in 2017 and 2018 - to 11.0 Mt and 13.0 Mt, respectively - when hydropower generation recovered (IEA, 2020a).

Figure 1. Colombia's installed generation capacity (in MW and %) in 2019



Source: IRENA (2020a)

Figure 2. Colombia's generation share by technology, 1990-2018



Source: IRENA (2020a).

<sup>1</sup> Considering electricity and heat producers.



The growth in electricity demand is a matter of concern for policy makers and system operators. Electricity consumption grew apace with the country's economic performance between 1990 and 2017, increasing by 151.7% to reach 73 terawatt hours (TWh).<sup>2</sup> Although Colombia's per capita electricity consumption (1.5 megawatt hours (MWh)/year) is lower than the mean for Central and South America as a whole (2.1 MWh/year) (IEA, 2020a), the system operator, XM, forecasts a supply gap as early as 2022 owing to the pace of load growth and to construction issues at the Ituango large hydro power plant (2 400 MW), where a construction setback in April 2018 caused major delays traced to problems with one of the tunnels used to divert water from the river. The first of eight units at Ituango had been scheduled to begin operations in December 2019; a new target date was initially set for December 2021 (EPM, 2019), but because of the COVID-19 crisis, it is expected that operations (of four units this time) will not start until 2022 (Forbes, 2020). Before the COVID-19 crisis, electricity demand projections pointed to average annual growth of 2.61% between 2019 and 2033, which would increase national demand to 103 486 gigawatt hours (GWh) by 2033 (UPME, 2019a). Amid the crisis, the projections were reviewed and the analysis period was shortened to 2020-26. In the short-term, electricity demand projections for 2020 were decreased by 1.5% - from 74 074 GWh to 72 935 GWh. The adjustment for 2026 was rather small, but increased - from 88 667 GWh to 88 443 GWh - meaning that UPME expects a speedy recovery in electricity consumption (UPME, 2020).

In this context, renewable energy auctions have the potential to support Colombia's energy objectives. Several strengths of auctions stand out.

- Through a power purchase agreement (PPA), auctions can offer sellers stable revenues and thus certainty regarding price - as a feed-in-tariff (FIT) does. In a liberalised and unbundled market, a long-term PPA resulting from an auction can hedge the seller against spot-market variability and improve the bankability of projects. Buyers also reduce their exposure to volatile spot-market prices, while making their spending for energy purchases more predictable.
- Auctions also set quantities of power to help policy makers achieve targets for generation from renewable sources in a manner comparable to renewable portfolio standards (RPS).
- Auctions' ability to discover real prices, if designed to achieve that objective, makes it easier to deploy renewables in a cost-effective fashion.
- Auctions are flexible in design and can help achieve broader policy objectives. Indeed, renewable energy auctions are increasingly being used around the world to achieve objectives beyond price, including timely project completion, integration of variable renewable energy into the power mix, and support for a just and inclusive energy transition. IRENA's study on *Renewable Energy Auctions: Status and Trends Beyond Price* highlights design elements that can support such objectives (IRENA, 2019c).

For these reasons, renewable energy auctions provided Colombia with an opportunity to find new ways to diversify the power supply and increase the resilience of the power sector, while also fostering investor confidence. The first two renewable energy auctions in Colombia were scheduled by the Ministry of Mines and Energy, and were conducted by UPME, the planning unit within the ministry (Box 2). Two auctions took place in 2019.

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<sup>2</sup> Electricity represents 18% of total final energy consumption (TFEC) (IEA, 2020b).

## BOX 2. ELECTRICITY SECTOR GOVERNANCE IN COLOMBIA

Governance of Colombia's electricity sector follows an independent system operator (ISO) model, one often found in fully unbundled and liberalised markets. The sector has five main stakeholders:

- The Ministry of Mines and Energy (MME, Ministerio de Minas y Energía) is responsible for policy making and for leading energy planning in the country, based on studies carried out by the ministry's planning unit, UPME, with inputs from CREG (see below), market players and international institutions.
- UPME's long-term planning for generation and transmission includes studies on how to increase the share of renewables in the generation mix and to attract investment in non-hydro renewable technologies. UPME was the auctioneer in the first two renewable energy auctions, but its involvement in future auctions is uncertain.
- The Superintendence of Residential Public Services (SSPD, Superintendencia de Servicios Públicos Domiciliarios) is Colombia's energy and water authority. Established under the economic reforms of the 1990s, the SSPD enforces competition laws and regulates utilities in the electricity, gas, telecommunications, water and sanitation sectors (OECD, 2016).
- The independent Energy and Gas Regulation Commission (CREG, Comisión de Regulación de Energía y Gas) regulates the power and gas sectors and enforces compliance with market rules to ensure transparency and fairness in competition. One of CREG's current concerns is the ability of generators to exercise market power and drive spot prices up.
- The Company of Market Experts (XM, Compañía de Expertos en Mercados) is the power system operator and market administrator. As the system's pool operator, it is responsible for recording all physical and commercial operations. Despite being classified as a private company, XM has a public role. Transco ISA, a company in which the government has a 62% stake, owns 99% of XM's shares (Rudnick and Velásquez, 2019).

Two other relevant bodies in the Colombian power sector are the Technical System Operation Committee (CNO, Consejo Nacional de Operación) and the Market Operation Committee (CAC, Comité Asesor de Comercialización del Sector Eléctrico). CNO is composed of generation, transmission and distribution companies and supports CREG in regulatory matters, while also working closely with XM on grid operation. CAC supports CREG in overseeing the functioning of the electricity market.



The analysis of auction design elements that follows adheres to IRENA’s framework (IRENA, 2019a; IRENA and CEM, 2015), which classifies design elements into four categories: 1) auction demand, 2) qualification requirements and documentation, 3) winner selection and contract award process, and 4) risk allocation and remuneration of sellers (Figure 3).

These design elements are described below, with the auctions’ outcomes described in chapter 2. Annex 1 depicts Colombia’s second renewable energy auction in a flow chart.

## 1.1. AUCTION DEMAND

### *Product and volumes*

Energy (measured in MWh), not installed capacity (measured in MW), has been the product auctioned in Colombia’s two renewable energy auctions to date. Auctions of energy are in line with an energy constrained system’s needs, as additional MWh can reduce the stress on water reservoirs during extreme climate conditions such as el Niño (Box 3). Such auctions are increasingly common in Latin America, though installed capacity auctions remain the rule globally.

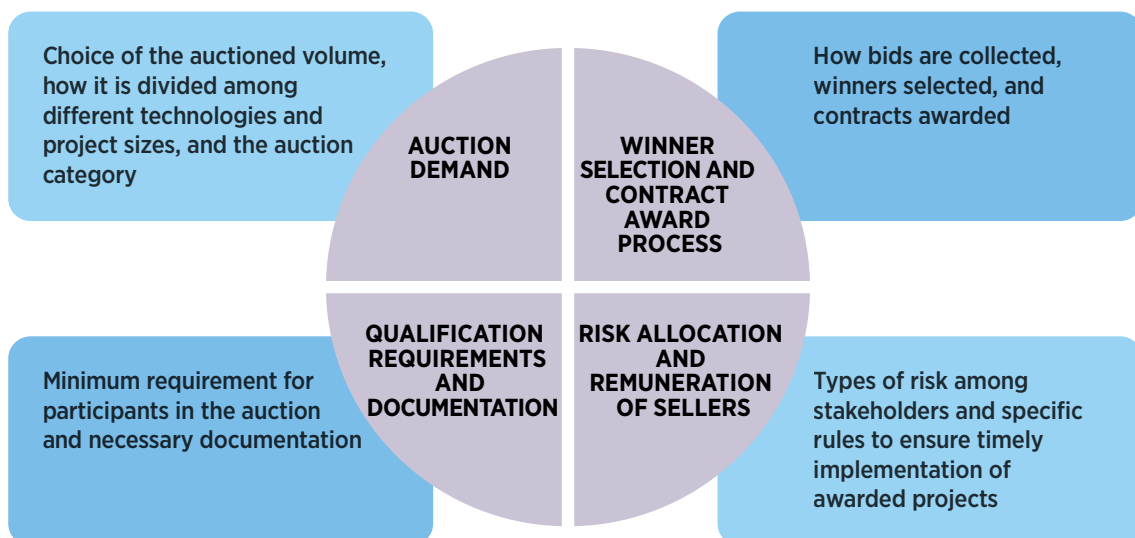
MME set the target demand in terms of MWh/ year in the first auction and MWh/day in the second. As multiple buyers and sellers submit bids, Colombia’s auctions are double-sided (multi-buyer and multi-seller; see section 1.3). The target demand in the first auction was 1.2 TWh/ year, adjusted down from the initial 3.4 TWh/year

that had been announced (Singh, 2019). In the second auction, the target demand was 12 050.5 MWh/day (4.4 TWh/year).

The change in time unit change from the first auction to the second was due to the introduction of bidding time slots in the second auction. Generators could submit one or more bids in three different time slots: 1) 00:00 a.m. to 07:00 a.m.; 2) 07:00 a.m. to 05:00 p.m.; and 3) 05:00 p.m. to 00:00 a.m. Importantly, they had to indicate whether 1) all their offers had to be awarded together; 2) their offers depended on one specific offer being awarded; or 3) acceptance of one offer excluded the other (MME, 2019a). Hourly supply slots in the Chilean auctions, for example, reduced developers’ exposure to spot prices, compared with a continuous supply block in which developers would have been required to meet contractual obligations even during periods when their resources were unavailable (IRENA, 2017a). While each time slot in Colombia represented a different delivery risk and spot-price opportunity cost for generators (see section 1.4), buyers’ demand was not tied to them: their offers were for the whole day.

If the target demand was not met, a supplementary mechanism was to be triggered (see section 1.3).

Figure 3. IRENA’s auction design framework



Sources: IRENA (2019a), updated from IRENA and CEM (2015)



### BOX 3. EL NIÑO AND COLOMBIA'S RATIONING CRISES

The El Niño phenomenon has been the main challenge to the Colombian hydro-based electricity sector in recent years.<sup>a</sup> In 1992, droughts caused by El Niño prevented hydro generation from meeting the country's electricity demand. This resulted in a nationwide energy crisis lasting nine months, with power rationing and daily rolling blackouts for eight to ten hours a day in large cities. The severe impacts on the industry and overall economy triggered the liberalisation of the electricity sector in 1994 (see Box 1). More recently, in 2015-16, Colombia faced yet another energy crisis, despite having redesigned the capacity market (see Box 1). This crisis was due to a combination of factors. In addition to low water availability - caused by rainfall falling by 40%, which resulted in a reservoirs' reduction between 60% and 70% - chief among them were technical problems associated with fire damage to a tunnel's circuits at the Guatapé hydroelectric plant, then one of the largest in the country, producing about 4% of total national generation. Another factor was a shortage of fuels (natural gas and diesel). In fact, this shortage exacerbated the financial losses of many thermal generators, as they had to buy electricity at record-high spot prices to make up for their energy supply shortcomings to honour their capacity contracts. Spot prices had spiked to up to USD 400/MWh, compared to previous levels between USD 30-50/MWh. The government had to intervene and provide thermal plants under the capacity mechanism with additional revenues by rising scarcity prices and setting scarcity price floors (WEC, 2020).

In this crisis context, the government avoided rationing by adopting energy saving initiatives. An initiative called "Apagar Paga" ("It pays to turn it off") rewarded customers if they reduced consumption below their historical average, while penalising them if their consumption went up. To guarantee energy supply, the government set a target through the energy and gas regulator, the Energy and Gas Regulatory Commission (CREG, - Comisión de Regulación de Energía y Gas (see Box 2) to save a minimum of 400 GWh during a two-month period. In the end, the initiative saved more than 1 000 GWh (Presidency of the Republic, 2016). Indeed, households responded to the scheme's incentives in great numbers (UPME, 2016a).

Given these experiences, discussions of diversifying the generation mix using Colombia's substantial wind and solar resources have become increasingly pertinent. Several studies have shown that wind and solar resources rise with El Niño, when the system is most stressed (IDB, 2017; UPME, 2016b). These studies backed regulatory proposals to place greater emphasis on the complementarity of non-hydro renewable energy sources, a goal that became one of the requirements of the first auction (see section 1.2).

a. The impact of El Niño goes beyond the electricity sector. El Niño decreased Colombia's GDP by an estimated 0.21% in 2015 (DNP, 2017).

#### *Periodicity*

The Colombian renewable energy auctions are stand-alone, meaning that each is organised individually, with no commitment to future bidding rounds. This includes plans to launch a new auction in 2021.

Stand-alone auctions can be used to test the effectiveness of the scheme while retaining the flexibility to adjust the design and schedule in response to preliminary results and shifts in market conditions. A stand-alone auction can help avoid overcommitment and the risk of lowering investors' confidence if plans are revised, a consideration that applies mainly in smaller countries with less-mature technologies. Systematic auctions, on the other hand, involve long-term planning and precommitment to a

schedule of quantities to be awarded over an extended period. As such, they may potentially attract a larger number of players and advance the penetration of renewable energy (IRENA and CEM, 2015). A systematic auction scheme in Colombia could be a first step in extending plans for non-hydro renewable energy implementation beyond 2022, which is needed to send strong signals to local and international investors (IRENA Coalition for Action, 2020).



### *Demand-side responsibilities*

For UPME to conduct an auction, there needs to be interest from sellers (generators) and buyers (distributors and retailers). In Colombia, both groups are made up of predominantly private firms (Box 4). The creditworthiness of a private buyer can change during the lead time. Off-takers' creditworthiness, lead time and payment guarantees are discussed in section 1.4. Participation in Colombia's renewable energy auctions is voluntary. That said, the introduction of a mandatory 10% energy purchase from non-hydro renewables by 2022 encouraged buyers' participation in the second auction, as this quota must be met through long term contracts and a market based mechanism, namely auctions. Noncompliance will result in sanctions and penalties, which are to be defined by the SSPD (MME, 2019b). Distributors and retailers that did not participate in the auction may be awarded purchase contracts through the supplementary mechanism (see section 1.3).

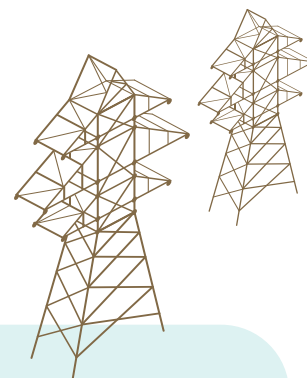
### *Technology-specificity*

The first auction was technology neutral, although with specific requirements that favoured non-hydro renewables (see section 1.2). The second was technology-specific, in particular, renewable-exclusive. That was seen by some market participants as a breakthrough, as Colombia had traditionally taken a low-intervention approach to the power market and prioritised price, an objective usually pursued through technology-neutral auctions. In fact, while the regulation of the electricity market does not

stipulate any type of preference for technology-neutrality, reliability charge auctions historically contracted only dispatchable thermal power plants. It was not until 2019 that contracts for non-hydro renewables were awarded in reliability auctions (see Box 1). To support the introduction of renewable energy into the mix, however, Colombia has joined the countries that are moving away from Latin America's once traditional technology-neutral auctions (IRENA, 2019a).

### *Project size*

Project size limits also changed from one auction to another. In the first auction, only projects of 10 MW and above were allowed to participate; in the second, the threshold was reduced to 5 MW. While the second auction awarded no project near this threshold (the smallest being 75 MW – see section 2.2), reducing project size limits can, in principle, foster the inclusion of small and new players. Ultimately, small-scale actors are drivers of growth, employment and development in many countries and auctions around the world are implementing innovative design elements to encourage their participation (IRENA, 2019a).



#### **BOX 4. MARKET SHARES IN THE COLOMBIAN ELECTRICITY SECTOR**

Generation and retail are mainly private and highly concentrated, with only a handful of players having large market shares.

In generation, about 65% is concentrated in four companies: EMGESA (20%), EPM (20%), ISAGEN (17%) and CELSIA (8%).

Distributors can sell electricity to consumers and thus they also take part in the retail market. Some 68% of the distribution market is concentrated in three companies: EPM (23%), CODENSA (22%) and ELECTRICARIBE (23%). In 2019, ELECTRICARIBE, which was taken over by the government in 2017, was split into two separate companies. Also in 2019, the maximum market share in distribution was increased from 25% to 35%, which allowed EPM to bid for one of the two former ELECTRICARIBE companies.

Transmission is a mix of public-private companies with state, public and private investor participation, but the largest transmission grids in Colombia are mainly private.

Source: XM (n.d.)

## 1.2. QUALIFICATION REQUIREMENTS AND DOCUMENTATION

### *Project-related requirements*

Strict or overcomplicated qualification requirements and documentation can reduce investors' interest in participating in an auction. But if requirements are too lax, project completion and performance can be compromised (IRENA, 2019a). Colombia's first auction had more complicated qualification requirements than the second one.

The first auction's qualification requirements included criteria related to the system's resilience, complementarity, emissions reduction and regional security. To qualify, bidders had to accumulate at least 50 points out of a possible 100, with each of the four reliability-related criteria worth a maximum of 25 points (Table 1). Taking stakeholders' feedback into account (see section 3.2), the second auction discarded these criteria. By shifting from a technology neutral to renewable exclusive auction (see section 1.1), the criteria related to climate change that favoured renewables in the first auction became less relevant.

### *Documentation and technical requirements*

In the first auction, both buyers and sellers had to pay a participation fee of COP 20 million (around USD 6 000) (UPME, 2019b), but the fee was waived for the second. In addition, both parties had to comply with a set of technical, legal and financial

requirements, which were analysed by an UPME evaluation committee. For the sake of simplicity, only the qualification requirements for generators (sellers) are covered in this section.

The legal requirements for sellers to participate in the auctions were: 1) registration of the firm in Colombia and appointment of at least one legally resident staff member to represent the firm in the auction process; 2) formal authorisation of said staff to represent the seller, if the participant was not the owner; 3) a written commitment to become a public service company and a shareholder agreement to be a seller of energy in the Colombian power market; and 4) a written statement that the submitted bids were irrevocable.

The technical requirements were: 1) UPME certification that the project appeared in the registry of electricity generation projects at Phase 2 or above<sup>3</sup>; 2) approval for grid connection; 3) a detailed timeline of the project, notably the construction process adopted to comply with the commercial operations date (COD); and 4) detailed technical information. The latter point relates to the process of obtaining the environmental, social and other permits required by the different national and local authorities.

Finally, financial requirements included proof of enough equity to implement the project and the posting of bid bonds (see section 1.4).

Table 1. Criteria to qualify for Colombia's first renewable energy auction in February 2019

<b>Resilience (25 points)</b>	Enhancement of the resilience and adaptability of the energy system to face variability and climate change events through the diversification of the energy mix.
<b>Complementarity (25 points)</b>	Complementarity of the project's seasonal profiles with hydro resources, both in terms of location and time, to mitigate the effects of variability and climate change events
<b>Emissions reductions (25 points)</b>	Contribution of the project to the reduction of CO <sub>2</sub> emissions in accordance with Colombia's commitments to the Paris Agreement.
<b>Regional energy security (25 points)</b>	Impact on the supply-demand balance and reduction of operational restrictions to promote sustainable economic development and strengthen regional energy security.

Source: based on IRENA (2019a), MME (2018a)

<sup>3</sup> UPME has three different phases for electric power plants. Phase 1 entails a preliminary stage, during which the project is under analysis, with alternatives being considered for location and technical aspects, before gaining grid access. Projects classified as Phase 2 have established their economic, technical and environmental feasibility. Phase 3 are plants in a late stage of design and implementation, with plans that go deeper into engineering details.

In both auctions, the package of technical, legal and financial requirements for both sellers and buyers was labelled the First Envelope. The bid bonds were part of the First Envelope in the first auction, but, in the second, these were required only once the participant's documentation and technical requirements had "prequalified". In both auctions, the Second Envelope contained the bid offers (see section 1.3).

#### *Grid access requirement*

Grid access is an issue in the Colombian electricity market. UPME has assigned grid capacity to stalled projects. This unused capacity hinders grid access by other projects with greater potential to be developed and built.

Conversely, the most challenging technical requirement of the second auction was to secure approval to connect to the grid. In fact, out of 52 wind projects being developed in La Guajira region, only 12 had grid-connection approval and were eligible to enter the auction. Moreover, as of July 2019, the only project that had obtained an environmental license did not have grid-connection approval and thus could not participate (Sanclemente, 2019).

Investments in the transmission grid are needed in Colombia, given that renewable resources are concentrated in a few regions far from demand centres (IRENA, 2018a). But such investments can be the most difficult challenge for an

electricity market (Hogan, 2013). Long lead times – sometimes up to ten years for transmission planning and construction – can create bottlenecks for renewable energy development. Mismatches between transmission capacity and the construction timelines of additions to renewable energy capacity can hamper progress. Therefore, policy makers and system operators must closely co-ordinate plans to expand transmission and generation capacity.

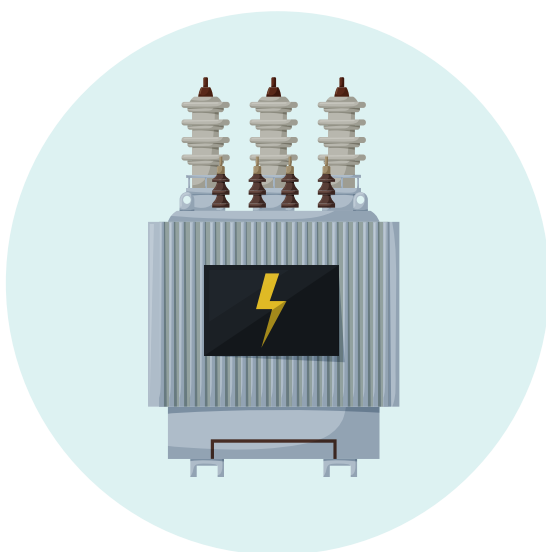
Looking ahead, Colombia's transmission expansion plans do call for La Guajira's new non-hydro generation to be connected to the main grid. In early 2018, the first contract to build transmission lines to interconnect a first wave of clean energy from La Guajira – starting in 2022 – was awarded. In addition, several key transmission grid reinforcements in the Caribbean region, under the Caribe 5 Plan, are contributing to a more robust grid in Colombia's northern regions. Indeed, Colombia's electricity system can handle the integration of solar and wind energy – which are not only non-hydro but also variable renewable energy (VRE) technologies – at higher shares. For instance, an additional 5.5 GW of solar photovoltaic (PV) installed capacity on top of current national plans to add 1.2 GW by 2030 could be integrated into the system with the appropriate transmission grid investment (IRENA, 2018a). This would represent a 74-fold increase from the current solar PV installed capacity of 90 MW (see Figure 1).

The players that met technical, legal and financial requirements (and reliability criteria in the first auction) were deemed qualified to submit bids and undergo UPME's optimisation algorithm.

### **1.3. WINNER SELECTION AND CONTRACT AWARD PROCESS**

#### *Bidding procedure*

The bidding mechanism in the two auctions was a double-sided (multi-buyer and multi-seller), sealed-bid auction. On the day of the auction, the sealed bids are opened and evaluated by UPME, the auctioneer. Compared with an iterative or a hybrid process, this simple method (whether single- or double-sided) is the one most commonly implemented around the world. A weakness, however, is that bidders must disclose their information prior to the auction, which takes







away their ability to react and adjust their bids. Nevertheless, from the auctioneer's perspective, this can be considered an advantage, as it reduces the risk of bid manipulation and allows for price discovery. For the sellers (or buyers), however, disclosing from the start the minimum (or maximum) price they are willing to receive (or pay) in sealed-bid auctions may discourage participation (IRENA and CEM, 2015).

#### *Payment to the winner*

Colombia's auctions follow a pay-as-bid scheme, which is common in other auctions around the world. Indeed, pay-as-bid pricing schemes tend to be more politically and socially acceptable than marginal bidding (where every bidder is paid according to the last accepted bid) and more transparent and binding than non standard pricing schemes (see IRENA and CEM, 2015).

#### *Winner selection criteria*

A double-sided auction complicates the task of matching supply with numerous buyers (Gouras, 2019). In Colombia, the selection of winning bids was based on an optimisation algorithm that, in the first auction, assigned contracts based on price and on the competition criteria, and, in the second, aimed to find the

combination of energy packets (see section 1.1) that minimised contract costs for consumers. The optimisation algorithm for the second auction was developed by Colombians; MME published it on its website (MME, 2019c).

As with the qualification requirements, the winner selection criteria for the first auction were complex. After winners were provisionally identified, competition criteria were analysed. These included: "1) a participation index to limit the share of players owning both generation and distribution companies and bidding on both sides; 2) a concentration index used to detect high concentrations of bids from a limited number of players; and 3) a dominance index establishing a market-share limit for a winning bid." The concentration and dominance indices went unmet. Thus, while the auction matched sellers' with buyers' bids, it did not award any contracts. For the second auction, the only criterion was that one bidder could not be awarded more than 40% of the volume (IRENA, 2019a).

Neither buyers nor sellers had any say about which counterparty would be matched with their offers.

### Ceiling prices

CREG set the auctions' undisclosed ceiling prices. In the first auction, this applied to individual sale offers and was set at COP 192/kWh<sup>4</sup> (USD 61.63/MWh). In the second auction, the individual bid ceiling price was COP 200/kWh<sup>5</sup> (USD 58.20/MWh), but CREG also established a ceiling price for the weighted average of the awarded bids at COP 160/kWh (USD 46.56/MWh).

### Clearing mechanism and marginal bids

In the first auction, participants' last bids could be assigned marginally,<sup>6</sup> so that the volume targets could be met. The provision for marginal assignment offered demand and supply flexibility (see IRENA and CEM, 2015). Nevertheless, the marginal selling bids could be awarded only if the energy to be assigned was greater than the minimum annual average energy quantity declared by the seller (UPME, 2019b). With the introduction of time slots in the second auction (see section 1.1), participants' bids remained flexible. Buyers could be assigned energy packets in different time slots, or in only one slot, but could never exceed the daily energy demand bid they had submitted (MME, 2019a).

In the second auction, if the awarded energy were below the target demand, a supplementary mechanism would be implemented the next day to close the gap. The mechanism essentially worked as a second phase of the auction. This allocated the remaining demand between the participating generators (non-awarded generators as well as remaining energy from awarded generators) and the companies serving regulated consumers in the retail market, which needed to comply with the sector's mandatory energy purchases. Thus, at this stage, buyers were given the opportunity to purchase energy even though they had not entered the auction. This would be the case if, through their contractual agreements, they had not secured the 10% non-hydro renewables purchase requirement, and if their average regulated demand in the previous two years (in MWh/day) was larger than the quantity to be assigned through the supplementary mechanism (MME, 2019d). Sellers' bids became non-divisible at this stage.

In the end, the supplementary mechanism had to be invoked (see chapter 2). After award, both sellers and buyers were expected to present additional guarantees.



<sup>4</sup> 1 COP = 0.000321 USD in February 2019.

<sup>5</sup> 1 COP = 0.000291 USD in October 2019.

<sup>6</sup> Meaning that the bids could be adjusted from their original offer. In other words, the bids are divisible, compared with "bulky bids", which are indivisible. See IRENA and CEM (2015) for more details.

## 1.4. RISK ALLOCATION AND REMUNERATION OF SELLERS

### *Commitment bonds*

Guarantees in the form of commitment bonds are often introduced in auctions to minimise the incidence of undercontracting and underbidding (see chapter 2 of IRENA, 2019a), and the Colombian auctions were no exception. A commitment bond may be crucial to ensuring an auction's success and discouraging the underperformance of a project, but if its terms are too strict, the bond requirement may also discourage some participants from entering the auction.

In Colombia, both buyers and sellers had to submit commitment bonds as financial guarantees. In particular, both buyers and sellers had to present a bid bond (*garantía de seriedad*). In addition, buyers had to present a payment guarantee (*garantía de pago*) in favour of the sellers, while sellers had to present a performance bond (*garantía de cumplimiento*) and a start-up guarantee (*garantía de puesta en operación*).

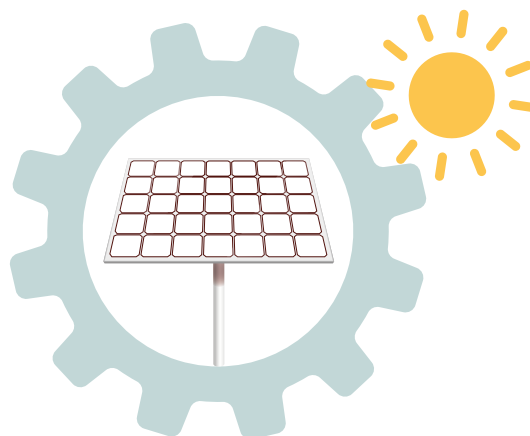
In the first auction, generators had to provide a bid bond of COP 135/kWh (USD 0.0425/kWh) multiplied by the annual mean energy for sale. Stakeholders indicated that for many of them, the bid bond amounts were quite high and, in some cases, difficult to obtain on short notice, particularly for state-owned players. Consequently, for the second auction, the bid bonds were reduced: generators had to provide a bid bond of COP 135/kWh (USD 0.0425/kWh) multiplied by 10% of the maximum energy quantity for sale (in kWh) in a year. Similarly, buyers in the first auction had to multiply COP 135/kWh by the maximum annual average energy; in the second, the factor was 5% of the maximum energy bought in a year. Sellers could have their bid bond being confiscated if they did not sign the PPA, or if they did not present the performance bond and/or start-up guarantee. Similarly, a buyer's bid bonds could be confiscated in the event of non-signature of the PPA, or if the payment guarantee was not presented.

The buyers' payment guarantee was given after the award stage. It had to cover the equivalent of 30% of one year of supply, to be renewed annually. In the Colombian context, this guarantee is particularly relevant for improving off-takers' credibility, as multiple buyers are awarded contracts and the sellers have no say in their match. Importantly, the creditworthiness of a buyer can change considerably over a two-year lead time. The payment guarantee can be invoked if a buyer delays payment by more than five days.

Buyers that had not participated in the auction, but were assigned in the supplementary mechanism (see section 1.3) did not have to present bid bonds, only payment bonds, before signing their contracts.

The sellers, in turn, when signing the PPA, had to provide a performance bond of 30% of the energy in one supply year multiplied by the respective awarded price. Once the plant starts supplying, the percentage is reduced to 20%. The performance bond can be cashed out if the seller fails to honour the contract (see the section on settlement rules below).

The start-up guarantee's objective was to minimise construction delays and underbuilding, since most of the projects in the auction were to be new power plants. With that in mind, CREG requested a guarantee equivalent to 10% of the value of the contract for one supply year. This guarantee could be confiscated if the project was delayed by more than two years, or if it built a lower installed capacity than that submitted in the auction. Importantly, and beyond the two years' cushion this guarantee provides, any delay affects the seller, as its COD is registered with XM and any deficit from that date must be covered on the spot market (see the section on settlements rules below).



### *Contract schedule: lead time and contract duration*

The COD of the first auction was December 2021, and January 2022 in the second. Although the two auctions took place eight months apart (February and October 2019), the COD was extended by only one month, effectively reducing the lead time and increasing the probability of project delay (see chapter 2 of IRENA, 2019a). Nevertheless, the various guarantees described above lower the probability of project noncompletion, with a potential trade-off of lower participation.

Between the first auction and the second, the contract duration was extended from 12 years<sup>7</sup> to 15 years. Longer PPAs improve projects' bankability and thus developers' risk perception. From the buyers' side, a long PPA is a hedge against the variability of the spot market, although there is a possibility of cheaper prices in the future.

Even with the extension, Colombia's contract duration is shorter than in other markets, where 20-year contracts are often offered. Short durations require generators to assume risks upon expiration, but in a liberalised market like Colombia's, generators will be able to continue selling electricity to the market (IRENA, 2019a).

### *Remuneration and financial risks*

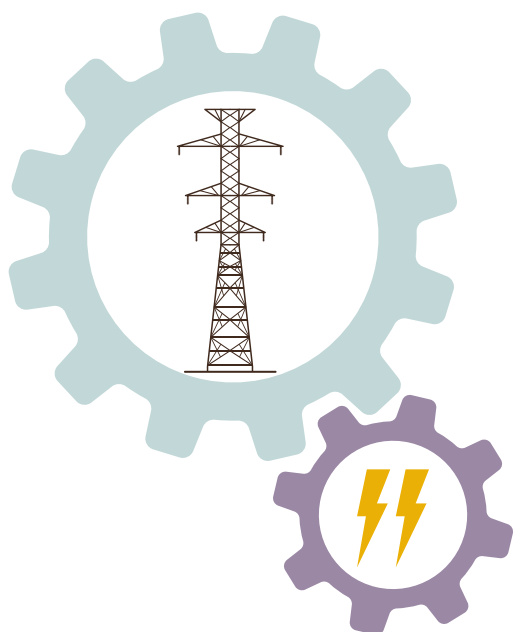
The long-term PPA price included the awarded price and the real equivalent cost of energy (CERE, *costo equivalente real de energía*). The CERE enters the daily economic dispatch offer as a fixed cost, and covers the reliability charge assigned to each generator to pay the firm energy auctions' awarded generators (see Box 1). All generators in the wholesale market, including those participating in auctions, act as collectors of the reliability charges. If they do not provide firm energy, they must reimburse the amount in full (or prorated in case they do partially) to XM, who publishes the CERE on a monthly basis. The CERE value in October 2019 was COP 61.72/kWh (USD 17.88/ MWh) (XM, 2020a). Ultimately, bids in renewable energy auctions can be influenced by participation in firm energy auctions, as awarded generators can then retain the CERE. The CERE then becomes an additional revenue stream in the renewable energy auction's PPA. Three awarded wind projects in Colombia's second renewable energy auction had also been awarded in firm energy auctions, and these three projects were awarded with the lowest wind bids (see section 2.2).



<sup>7</sup> Initially planned for 10 years (Singh, 2019).

The contracts were awarded in local currency (COP/kWh) and indexed to monthly inflation. The former rule may expose generators to currency risks if their project costs are largely denominated in foreign currencies (IRENA, 2019a) and may limit funding opportunities. Sound macroeconomics and healthy financial markets (World Bank, 2019a, 2020a, 2020b and 2020c) may decrease this risk perception among investors in Colombia. Allowing developers to choose between contracts denominated in local or hard currency, as auctions in Mexico do, may also reduce risk perceptions and increase investor confidence – at the cost of requiring buyers, and ultimately consumers, to assume greater risks. Balancing risk allocations among various auction stakeholders will be crucial if Colombia is to scale up renewables (IRENA Coalition for Action, 2020).

Developing and strengthening local renewable energy industries may help reduce currency risks by lowering reliance on imported equipment and material. IRENA's series of reports on leveraging local capacity examines the material and human resource requirements for developing robust industries in solar PV, onshore wind and offshore wind (Box 5).



### *Quantity liabilities*

Perhaps the most significant change that improved generators' risk perception between the first and second auctions was the replacement of take-and-pay contracts (where the buyer's obligation to pay is not unconditional, but contingent upon the need for the electricity) with take-or-pay.

Under a take-or-pay model, the buyer assumes greater risks by committing to paying for electricity even when it is not consumed (see chapter 3 of IRENA, 2019a). In Colombia, the financial obligation is registered at XM. In turn, generators have the obligation to generate the contracted amount of energy during the chosen time slot. Deficits or surpluses – calculated on an hourly basis – are settled at the spot price (see below). In other words, both generators and buyers are exposed to some merchant risks (see chapters 2 and 3 of IRENA, 2019a). Importantly, the buyers cannot pass on the auction's prices to consumers if they do not deliver the energy, which may be likely during periods of low demand. With that in mind, the MME trained buyers to prepare their purchase offers to avoid overcontracting.

### *Settlement rules and penalties*

In the first auction, generators were allowed to roll over an energy deficit of up to 10% to the following year's balance, if the generator delivered at least 80% of the energy. If, in the following year, the generator failed to close the rolled-over deficit and meet its energy commitments, the performance bond (see above) would be confiscated (MME, 2018a). Because differences are settled in the spot market, the second auction did not stipulate longer settlement periods; instead, participants had to take this risk into account when submitting their bids.

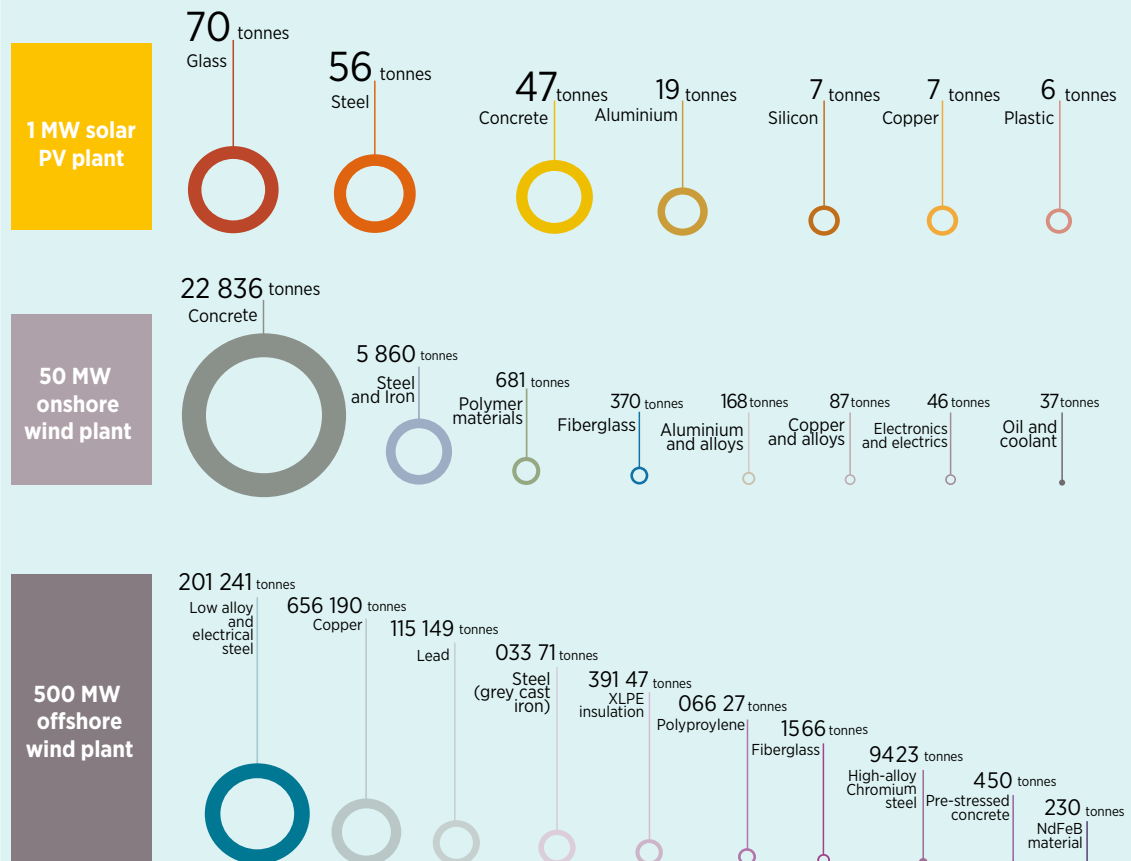
The objectives of the above change were twofold. First, the second auction's approach simplified contract management and aligned the commercial operation with the current market design (see Box 1). Second, risk perceptions among power generators were expected to be improved by reducing generation performance uncertainties and allowing generators to hedge against spot-price risks through bilateral and financial agreements to settle deficits.

## BOX 5. OPPORTUNITIES TO LEVERAGE LOCAL CAPACITY

Existing local industrial capacity can be leveraged for the growing renewable energy value chain. To maximise value creation from a domestic wind industry, for example, capacities already existing in industries such as concrete, steel, polymers and fiberglass must be built upon. This leverage of local capacity can include the expertise, as well as the raw materials and intermediary products needed to manufacture wind components such as blades and towers.

For a typical 50 MW onshore wind facility, almost 23 000 tonnes of concrete are needed for the foundations, and nearly 6 000 tonnes of steel and iron for the turbines and foundations. The requirements for offshore wind are similar (Figure 4). Manufacturing the main components of a wind turbine requires specialised equipment, as well as the welding, lifting and painting machines used in other industries, such as construction and aeronautics. The foundations also require the use of specialised equipment including rolling, drilling and welding machinery. Special vessels and cranes are used to move these big structures. Examining these and further requirements provides insights into the industrial capabilities that can be leveraged and enables policymakers to set appropriate country-specific local content requirements.

Figure 4. Materials required for a 1 MW solar PV plant, a 50 MW onshore wind plant and a 500 MW offshore wind plant



Source: IRENA (2017b, 2017c, 2018b)

Note: Box extracted from IRENA (2019a). XLPE = Cross-linked polyethylene, NdFeB = neodymium magnet

PPA contracts can be terminated if generators do not deliver energy under the PPA's terms and conditions, or if buyers commit a payment default. Despite provisions for parties to extend the contract for up to 18 months in case of delays, or to mediate and terminate the contract without legal repercussions, the party that causes the termination must pay a penalty equivalent to 20% of the total contract value (MME, 2019e). Moreover, there is a provision for force majeure events, in accordance with the Colombian Civil Code (Article 64). The affected party has three days after the force majeure event to communicate to its counterparty that the contract will be suspended for the length of the event. The contract will, however, be extended by the length of the suspension. If the event does not cease in 180 days, the contract is terminated.

#### *Liabilities for transmission delays*

The liabilities of grid connection are a concern of renewable energy generators around the world (IRENA, 2019a).

In Colombia, after obtaining requisite approvals, the generator is responsible for connecting to the grid. The transmission companies are legally obligated to facilitate the connection and provide, if necessary, technical reinforcement for high-voltage connections (SSPD, 2018). As seen in section 1.2, projects need connection approval from UPME before they can participate in an auction. UPME is the entity responsible for issuing connection permits and for assigning rights to inject and transport energy in the Colombian grid (SSPD, 2018).

In neither auction did the contracts or other documents indicate the consequences of a transmission line not being available once a project is built. Normally, with the support of CREG, UPME handles grid connections on a case-by-case basis and has approved connections to more than 120 non-hydro renewable projects outside the auctions – amounting to an additional 7 700 MW of installed capacity (Djunisic, 2020). As such, generators may fear that these new incorporations could stress the system and make it more difficult for auctioned projects to gain access to the grid. Their heightened risk perceptions may then lead them to bid higher prices.





# 2

## Renewable energy auction results





Colombia conducted two renewable energy auctions in 2019. The first, in February 2019, assigned bids between buyers and sellers, but did not award any contracts because competition criteria were not met (see section 1.3). Participation rates were promising, however, leading authorities to accelerate discussions on holding a second auction.

In October 2019, the second auction awarded around 1.3 GW of new wind and solar PV capacity. This represented a positive step toward diversifying Colombia's generation mix. Importantly, weighted average prices in Colombia were significantly lower than global weighted average prices in 2018 – by half in solar PV and by 42% in wind. All in all, perceptions of the second auction's outcomes were positive.

## 2.1. PARTICIPATION AND COMPETITION

As noted, the first auction successfully assigned bids, but did not award any contracts because the criteria related to market concentration and dominance were not met (see section 1.3). Yet even so, policy makers were encouraged by the interest that private players had demonstrated in renewable energy auctions, leading them to accelerate discussions on holding a second auction.

Fifteen generators and 12 buyers expressed interest in participating in the auction, with 17 solar projects, four wind projects and one biomass project. Eight developers qualified,

one of them with two bids (for a total of nine qualified bids). The eight developers made it through the participation round, but the one with two qualified bids ended up submitting only one, for a total of eight sales bids participating. Similarly, all eight qualifying buyers participated, submitting 12 purchase offers (from among the 14 that qualified).

The second auction's design changes included an additional "prequalification" for the First Envelope submission. They also included the ability to register on a digital platform and attracted a greater number of participants in each of the auction's stages. This was true for both buyers and generators (Figure 5).

As a first step, generators (sellers) and buyers interested in the second auction had to request access to UPME's electronic auction platform. Thirty-nine generators and 29 buyers obtained a user ID and password to access the platform.

Second, participants had to present the First Envelope containing evidence of compliance with the legal, financial and technical requirements described in section 1.2. This step was completed by 27 generators (56 sale offers) and 26 buyers (one purchase offer per buyer). Of these, one generator (six sale offers) and two buyers failed to prequalify upon review.

The next step was to present bid bonds; 18 generators (38 sales offers) and 23 buyers did so. This stage saw the highest number of generators dropping out of the auction, suggesting that even

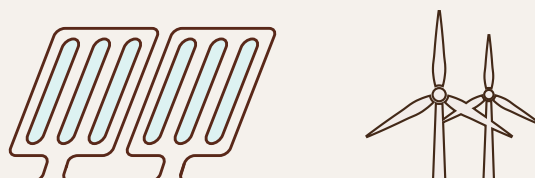
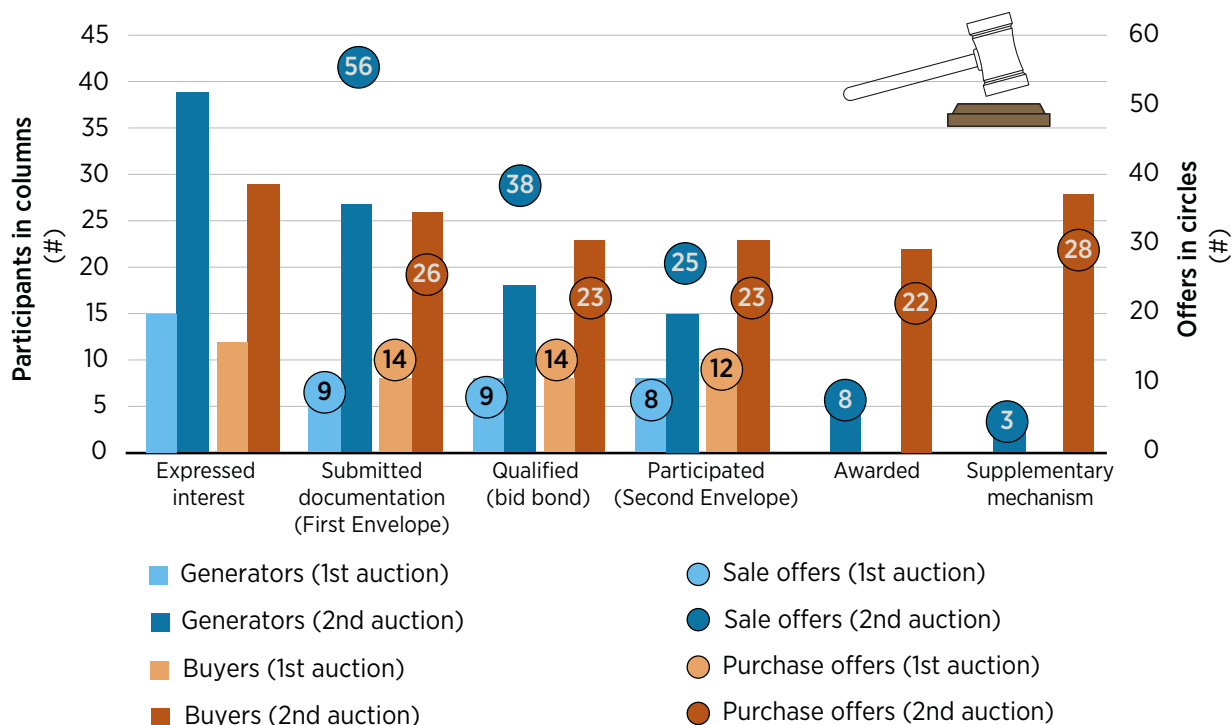


Figure 5. Participation rates at different auctions stages in Colombia



Source: UPME (2019c; 2019d; 2019e; 2019f; 2019g; 2019h; 2019i; 2019j), Energía Estratégica (2019), MME (2019f)

Note: In the first auction, the bid bond was part of the First Envelope. Thus the number of participants and offers depicted are the same for the “Submitted documentation” and “Qualified” categories. See section 1.2 for more details on the differences between the auctions in the contents of the First Envelope.

though the bonds had been revised downward from the first auction (see section 1.4) and were required only after qualification (see section 1.2), they remained a barrier to participation.

The process of submitting bids on the electronic platform was known as the presentation of the Second Envelope. Fifteen generators (25 sale offers) and 23 buyers presented bids. Initially, eight sale offers from seven different generation companies were awarded 10 186 MWh/day. Four companies received awards: TRINA, with three subsidiaries; EDP Renovables, with two subsidiaries; CELSIA, with two bids; and JEMEIWAA KA’I, with one. Twenty-two buyers were to buy their energy. No company was awarded more than 40% of the total volume, meeting the competition criterion (see section 1.3), but only a handful of developers received awards, a concentration that mirrors that of the broader electricity market (see Box 4). Yet renewable energy auctions can attract small and new players through modifications in their design (see chapter 4 of IRENA, 2019a).

The fact that the volume target of 12 050.5 MWh/day was not met (see section 1.1) triggered the supplementary mechanism (see section 1.3), under which more energy was awarded to two previously awarded projects and one new project from an already awarded company, JEMEIWAA KA’I. The mechanism added only 75 MW of installed capacity, but contracted 1 864 MWh/day.

As one would expect in a second clearing round, the awarded prices were higher (Table 2). Notably, the number of buyers awarded in the supplementary mechanism (28) was greater than the number that qualified (23). Section 1.3 explains how the supplementary mechanism reaches out to commercialisation companies beyond those that expressed interest in the auction. The supplementary mechanism’s volume was allocated among 10 awarded buyers that were not on track to reach their 10% non-hydro renewable energy mandatory purchase quota voluntarily, and another 18 buyers that had either been rejected at some stage of the auction or had not participated at the outset.

All in all, the auction’s outcomes were seen as positive, as they promise to increase installed

Table 2. Generation projects awarded in Colombia's second renewable energy auction and the supplementary mechanism



Technology	Company	Project	Installed capacity (MW)	Total MWh/day	Price COP/kWh	Price USD/MWh
Wind	EDP Renovables (Eolos Energia)	Beta*	280	2 628	93.98	27.35
Wind	CELSIA	Camelias	250	1 009	103.97	30.26
Wind	Renovables (Vientos del Norte)	Alpha*	212	2 040	88.48	25.75
Wind	JEMEIWAA KA'I	Casa Eléctrica*	180	2 461	97.88	28.48
Wind	CELSIA	Acacia 2	80	276	101.97	29.67
Solar PV	TRINA (Campano)	El Campano	108	596	99.91	29.07
Solar PV	TRINA (Cartago)	Cartago	99	615	93.81	27.30
Solar PV	TRINA (San Felipe)	San Felipe	90	560	99.21	28.87
<b>Total</b>			<b>1 299</b>	<b>10 186</b>		

Technology	Company	Project	Installed capacity (MW)	Total MWh/day	Price COP/kWh	Price USD/MWh
Wind	CELSIA	Acacia 2	**	816	108.96	31.71
Wind	JEMEIWAA KA'I	Apotolorru	75	1 025	105	30.56
Solar PV	TRINA (Campano)	El Campano	**	23	99.91	29.07
<b>Total</b>			<b>75</b>	<b>1 864</b>		

Source: UPME (2019c, 2019h, 2019j), Gubinelli (2019a and 2020)

Note: The final PPA contract price also includes the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). It is not included in this table because it must be returned if the generators do not provide firm energy. The three lowest wind bids, however, came from projects that were also awarded in firm energy auctions. See section 1.4 for more information on the CERE.

\*Power plant also awarded in firm energy auction

\*\*Power plant already indicated on the first stage's winning list; capacity is not included to avoid double counting.

capacity of solar PV and wind 40-fold by 2022, compared to 2019 (MME, 2019g). They should also accelerate the diversification of Colombia's generation mix, as, according to the MME, they will help increase non-hydro renewable energy participation from less than 1% in 2019 to about 12% by 2022.

Moreover, renewable energy auctions have exceeded the government's expectations by promising to meet the target of adding 1.5 GW

of non-hydro renewable energy in less than the four years allotted (Semana, 2019). The amount of investment that auctions have attracted (with firm energy auctions are also taken into account) is estimated to be USD 2.2 billion. Five thousand construction jobs are expected to be created (Semana, 2019; Reuters, 2019). As a result, Colombia jumped nine places, year-on-year, in the May 2020 Energy Transition Index tracked by the World Economic Forum.



## 2.2. PRICE OUTCOMES

Initially, the weighted average price for five wind projects was COP 95.2/kWh (USD 27.70/ MWh) and COP 97.6/kWh (USD 28.40/MWh) for three solar PV projects. The supplementary mechanism's prices, particularly for wind, were higher: COP 106.8/kWh (USD 31.07/MWh) for wind and COP 99.9/kWh (USD 29.07/MWh) for solar PV. If taken together, this would bring the auction's weighted average prices up to COP 97.3/ kWh (USD 28.31/MWh) for wind, but with little impact on the price of solar, given the smaller quantity (Table 3). While the final PPA contract price adds the CERE, COP 61.72/ kWh (USD 17.88/MWh) in October 2019, to these awarded prices, generators not awarded in firm energy auctions have to reimburse the CERE to the system operator XM (see section 1.4). That said, the three wind projects with the lowest bids had also been awarded contracts in firm energy auctions (see Table 2), suggesting these generators considered part of the revenues from firm energy auctions, namely the CERE

they would be able to retain, to submit more competitive bids, in terms of price.

Economies of scale seem also to play a role in the prices. Two of the three largest projects offered the lowest wind prices, while the third was offered at a price that fell between two other bids submitted by the same company (see triangles in Figure 6). The smallest project awarded was 75 MW and this had the second highest bid.

By time of day, the weighted average price for wind was COP 94.5/kWh (USD 27.50/MWh) for 2 754 MWh/day in the 00:00 a.m. to 07:00 a.m. slot; COP 95.8/kWh (USD 27.88/MWh) for 5 135 MWh/day for the 07:00 a.m. and 05:00 p.m. slot; and COP 93.7/kWh (USD 27.30/MWh) for 525 MWh/day for the 05:00 p.m. to 00:00 a.m. slot. Solar PV was awarded only between 07:00 a.m. and 05:00 p.m. at COP 97.6/kWh (USD 28.40/MWh) for 1 771 MWh/day.

In the supplementary mechanism, wind was awarded at COP 106.4/kWh (USD 30.96/MWh) for 693 MWh/day in the first time slot; COP 106.5/ kWh (USD 30.99/MWh) for 910 MWh/day in the second time slot; and at COP 109/kWh (USD 31.72/MWh) for 238 MWh/day in the third. Solar PV was awarded at COP 99.9/kWh (USD 29.07/MWh) for 23 MWh/day in the second time slot (Figure 7).

These results suggest that the solar generators' strategy was conservative: they offered their quantities in the slot where the sun shines the most, so as to avoid the risk of having to purchase shortages on the spot market at variable prices

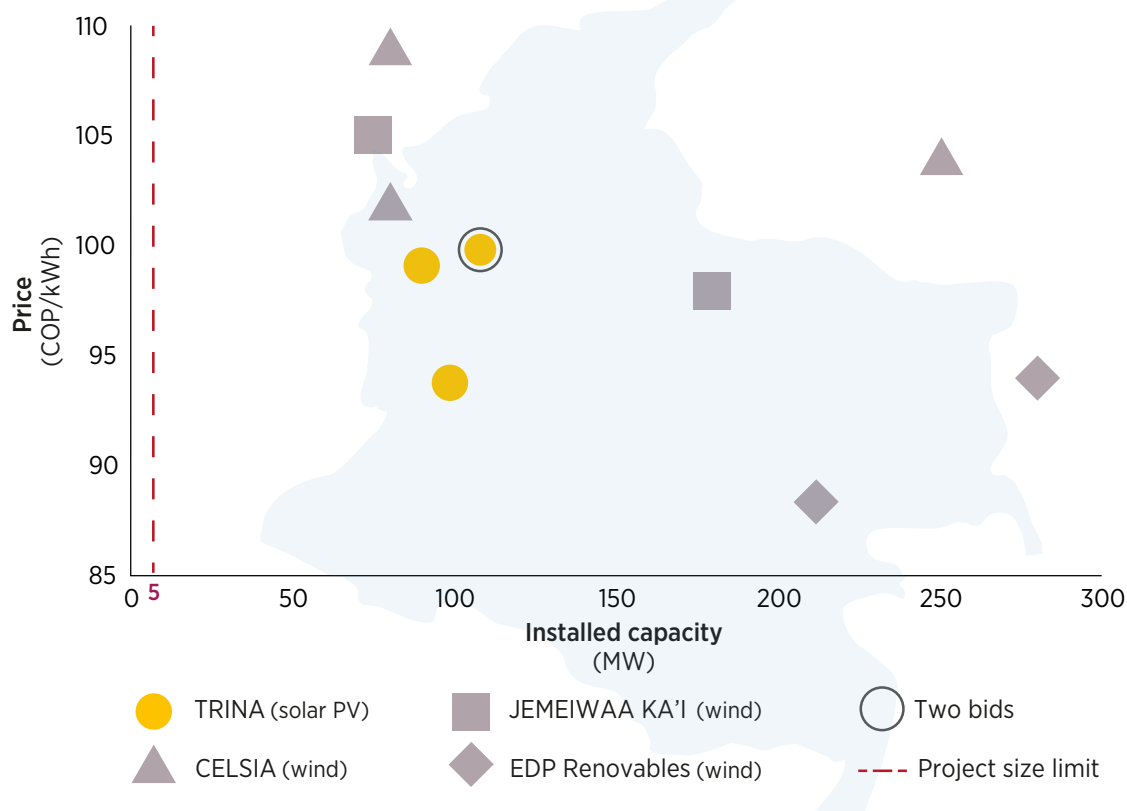
Table 3. Summary of Colombia's second renewable energy auction

Technology	MWh/day			Weighted average price, COP/kWh (USD/MWh)		
	Award stage	Supplementary mechanism	Total	Award stage	Supplementary mechanism	Total
Wind	8 414	1 841	10 255	95.2 (27.70)	106.8 (31.07)	97.3 (28.31)
Solar PV	1 771	23	1 795	97.6 (28.40)	99.9 (29.07)	97.6 (28.40)
<b>Total</b>	<b>10 186</b>	<b>1 864</b>	<b>12 050</b>			

Source: UPME (2019c, 2019h, 2019j)

Note: The final PPA contract price also includes the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). It is not included in this table because it must be returned if the generators do not provide firm energy. The three lowest wind bids, however, came from projects that were also awarded in firm energy auctions. See section 1.4 for more information on the CERE.

Figure 6. Prices, installed capacity and companies awarded in Colombia's second auction



Source: UPME (2019c, 2019e, 2019h, 2019j), Gubinelli (2019a, 2020)

Note: The final PPA contract also includes the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). It is not depicted in this graph because it must be returned if the generators do not provide firm energy. The three lowest wind bids, however, came from projects that were also awarded in firm energy auctions. See section 1.4 for more information on the CERE.

for other slots (Sanclemente, 2019). In contrast, wind power developers seem to have adopted a riskier position by submitting most of their bids for the first two time slots. They therefore expected to supply electricity in the evening from the spot market at potentially higher prices (Manrique, 2019).

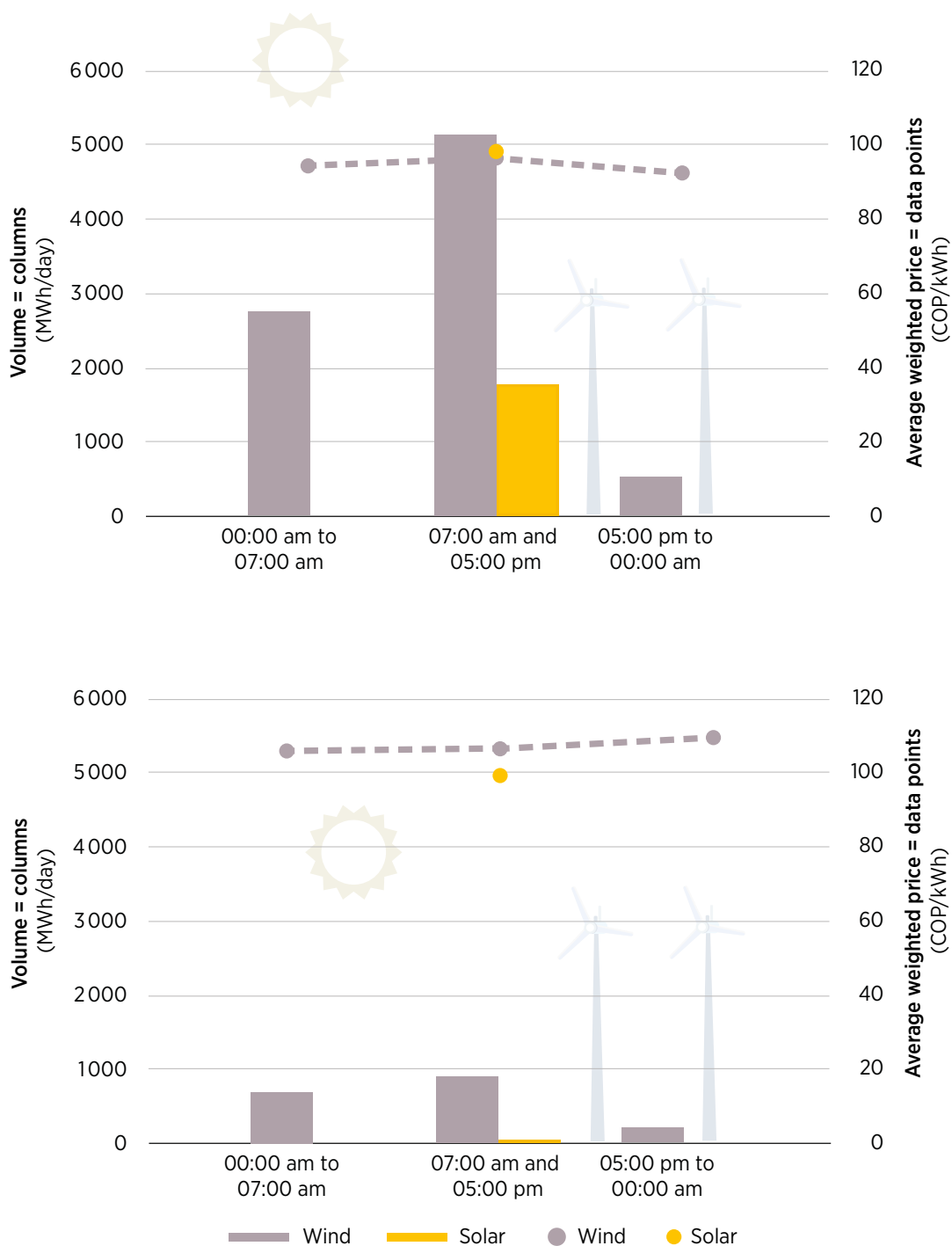
The auction's average awarded prices of COP 95.2/kWh (USD 27.70/MWh) for wind and COP 97.6/kWh (USD 28.40/MWh) for solar PV, or the combined COP 95.65/kWh (USD 27.83/MWh)<sup>8</sup> UPME has published, were about 40% below the average ceiling price of COP 160/kWh (USD 46.56/MWh) (see section 1.3) and about COP 50/kWh (USD 14.55/MWh) below the average for bilateral PPAs (Bellini, 2019; Ini, 2019). These comparisons, however, do not take into account the CERE (see section 1.4). At COP 156.9/kWh (USD 45.58/MWh) for wind and COP 159.3/kWh (USD 46.28/MWh) for solar PV, the final PPA auction prices were about a quarter lower than the weighted average cost of bilateral contracts in the regulated market in

October 2019 (COP 209.56/kWh) (XM, 2020b). Without the CERE (see section 1.4), Colombian prices were significantly lower than the average prices observed in auctions around the globe in 2018 – by almost a half in solar PV (compared with USD 56/MWh) and 42% lower in wind (compared with USD 48/MWh) (IRENA, 2019a). Auction prices in Colombia were also among the most competitive in the Latin American and the Caribbean region (Figure 8).

The main caveats in comparing auction prices between countries is that auction outcomes in each country depend on many factors, such as macroeconomic context, energy policy and auction design. Thus, an international price comparison does not necessarily determine whether an auction was successful. To that end, a deeper analysis of the factors affecting price would be needed, while always keeping in mind the ability of auctions to advance complementary development goals beyond reductions in electricity prices.

<sup>8</sup> Exchange rate of COP 3 430/USD 1.00 on October 21, 2019.

Figure 7. Volumes and prices by time slot and technology, awarded at auction (top) or through supplementary mechanism (bottom)

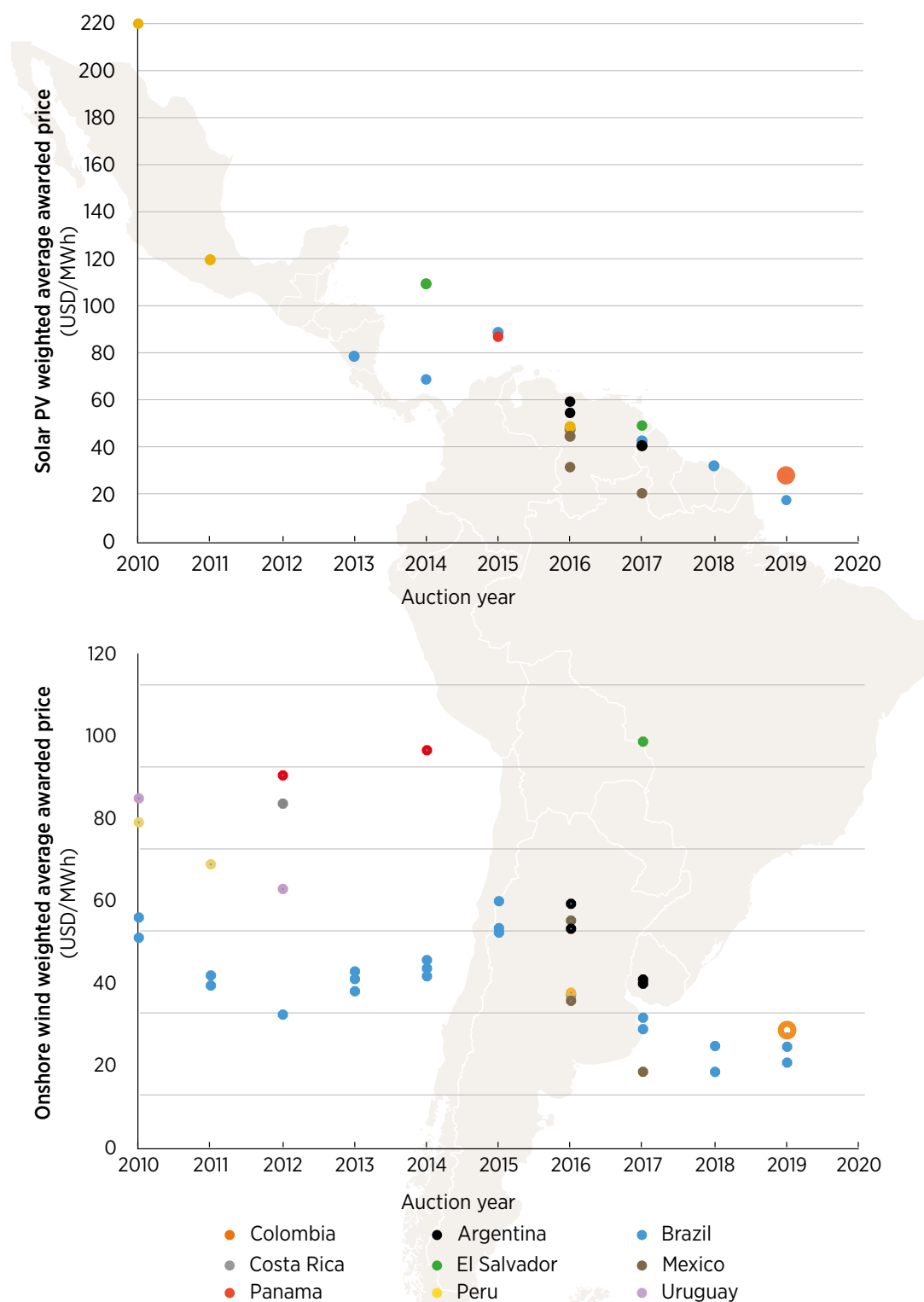


Source: UPME (2019c, 2019e, 2019h)

Note: The final PPA contract price also includes the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). It is not depicted in this graph because it must be returned if the generators do not provide firm energy. The three lowest wind bids, however, came from projects that were also awarded in firm energy auctions. See section 1.4 for more information on the CERE.



Figure 8. Solar PV and onshore wind prices in Latin American renewable energy auctions, 2010-2019



Source: IRENA (n.d.), BNEF (2019), PSR (n.d.).

Note: The Colombian final PPA contract price also includes the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). It is not depicted in this graph because it must be returned if the generators do not provide firm energy. The three lowest wind bids, however, came from projects that were also awarded in firm energy auctions. See section 1.4 for more information on the CERE. Chile and Guatemala are not included, as their auction prices are not broken down into solar PV and wind. Brazil has conducted many solar PV and onshore wind auctions, but their outcomes have been greatly affected by idiosyncratic factors unique to the Brazilian context. Thus, they may not be comparable to other countries. IRENA (2013, 2017a, 2019b) and IRENA and CEM (2015) discuss some of these outcomes at length. The region's downward trend does not change significantly when graphing USD at purchasing power parity (PPP)/MWh. Naturally, however, countries' prices change. Colombia's solar PV and onshore wind prices are USD PPP 69.67/MWh and USD PPP 67.95/MWh, respectively, but the strength of the currency is beyond the scope of this analysis.



# 3

## Factors affecting prices



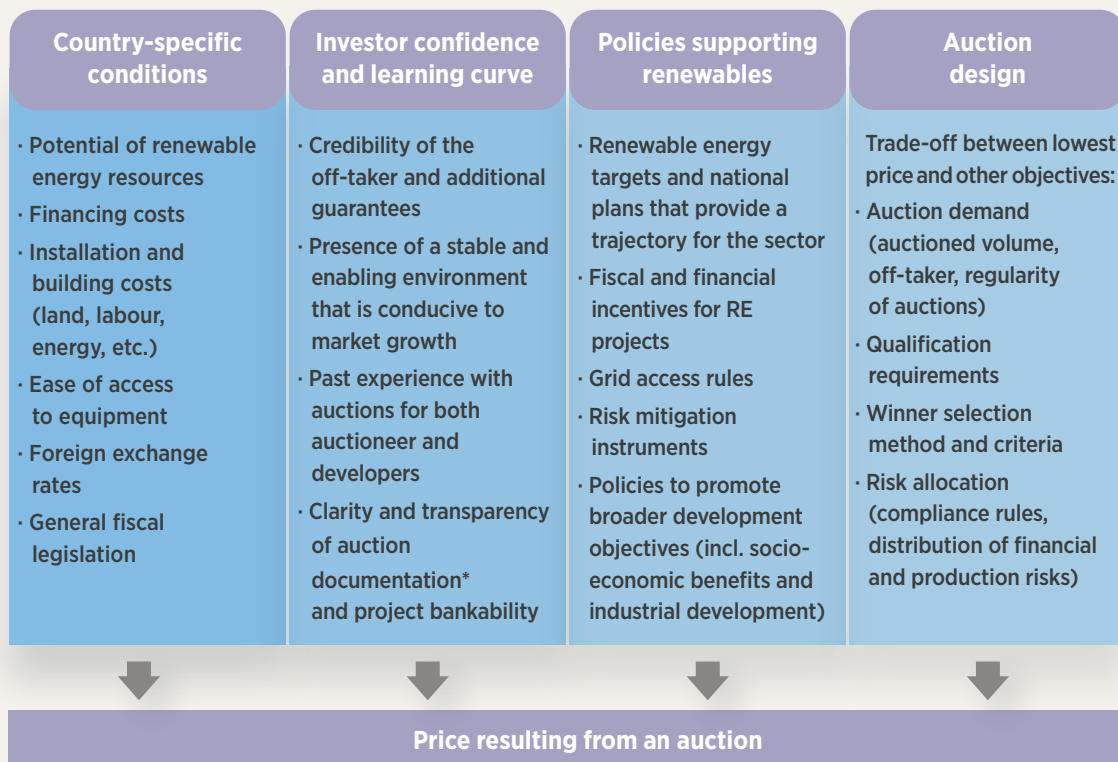


As discussed above, the prices awarded in Colombia's second renewable energy auction were not only competitive globally, but also within a resource-rich region with low soft costs.<sup>9</sup> A combination of factors drives auction prices. These can be grouped into four categories: 1) country-specific conditions, such as resource availability, power market design, and the costs of finance, land and labour; 2) the degree of investor confidence, which may be related to

the experience of the bidder and auctioneer and credibility of the off-taker; 3) other policies related to renewable energy, including clear targets, grid policies, priority dispatch, and local content rules; and 4) the design of the auction itself, taking into consideration the trade-offs between obtaining the lowest price and achieving other objectives (Figure 9). An analysis of the three first categories follows. The auction design element was analysed in chapter 1.



Figure 9. Factors that shape the price resulting from auctions



Source: IRENA (2019c)

\* The Open Solar Contracts by IRENA and Terawatt Initiative provide freely available standardised contract documentation designed to streamline project development and finance processes for solar PV projects. Visit <https://opensolarcontracts.org/> for more information.

<sup>9</sup> Soft costs include financing costs, system design, permitting, incentive application, customer acquisition and margin. See IRENA (2020b) for more details.

### 3.1. COUNTRY-SPECIFIC CONDITIONS

#### Potential of renewable energy resources

Colombia is near the equator and is rich in solar radiation. Nonetheless, only three of the nine awarded projects are solar PV. The six awarded wind projects are all in the northern state of La Guajira, an area with exceptional wind resources. Indeed, the northeastern coastal area can experience annual average wind speeds in the range of 8.50 metres per second (m/s) to 9.75 m/s and up to 14 m/s, one of the highest speeds in the world (Figure 10).

Naturally, resource-rich countries allow projects to be more competitive and this reflects in lower prices – all else being equal – than in other, less well-endowed countries.

#### Other advantages

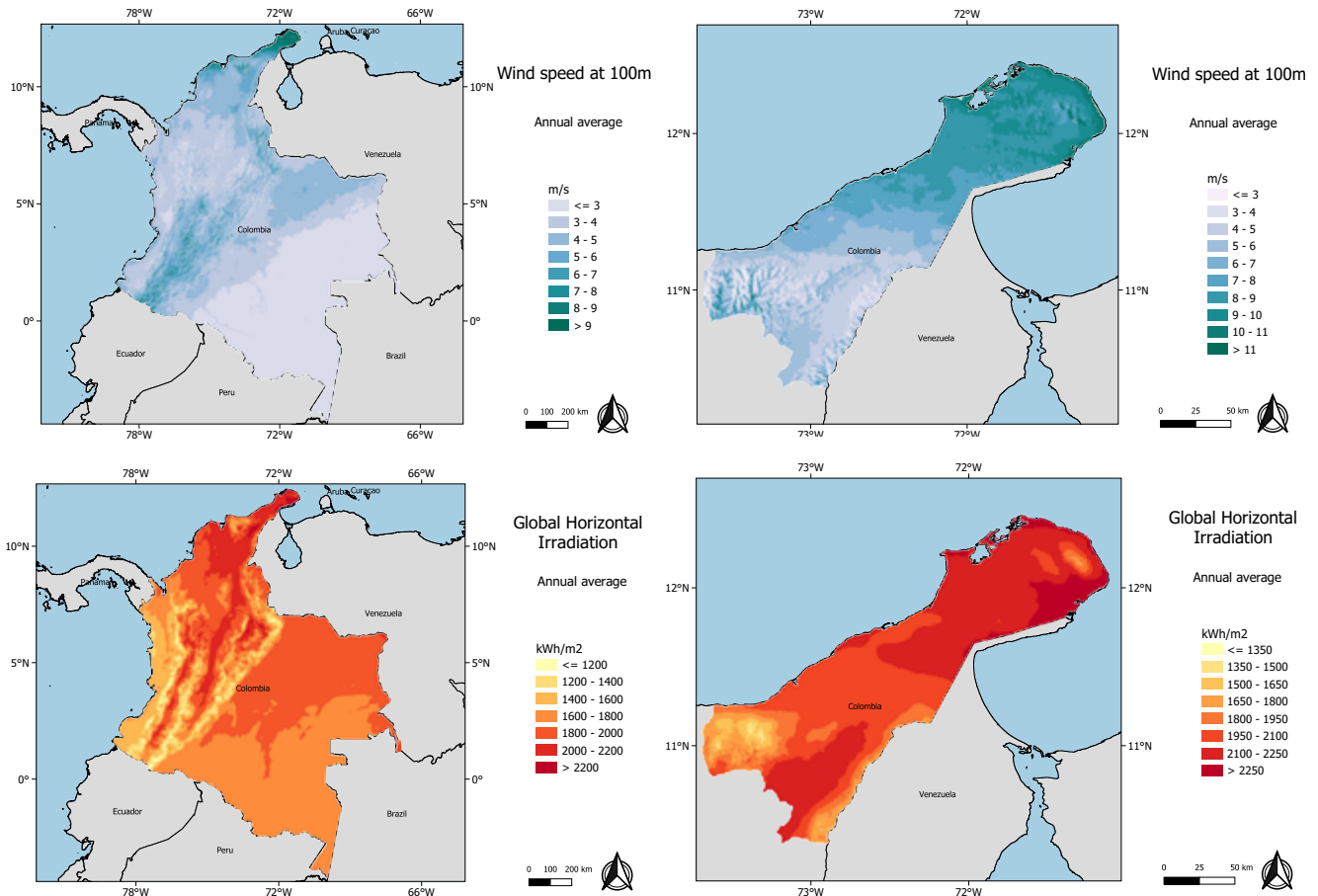
Other country-specific conditions in Colombia also enable low prices. The country has relatively low installation and building costs, a sound macro-economic environment (World Bank, 2019a, 2020a, 2020b and 2020c), and projections of stable exchange rates in the short and medium term (Gouras, 2019). Colombian banks also have vast experience in financing energy infrastructure projects, making the transition to renewable energy projects smoother – although slightly more expensive than if financing were in US dollars (Gubinelli, 2019b).

### 3.2. INVESTOR CONFIDENCE AND LEARNING CURVE

#### Off-taker credibility and additional guarantees

The off-takers (buyers) are predominantly private (see Box 4) and typically multiple (see section 1.1). While concerns over creditworthiness deteriorating over the auction’s lead time could be a factor for developers, the auctioneer, system

Figure 10. Wind speeds and solar irradiation in Colombia (left) and La Guajira (right)



Source: IRENA and DTU (n.d.); World Bank (2019b).

Note: Copy in IRENA’s “Global Atlas for Renewable Energy” web platform.

Disclaimer: The boundaries shown in these maps do not imply official endorsement or acceptance by IRENA.

operator and policy makers, several guarantees have been put in place to improve developers' confidence. These are discussed in section 1.4.

#### *Presence of a stable and enabling environment*

Colombia has had a stable electricity market structure since the 1990s (see Box 1), a factor sending positive signals to investors. Nevertheless, renewable energy auctions initially encountered resistance and opposition from the incumbents. Given the increasing acceptance of renewable energy auctions globally, however, the use of this mechanism enabled Colombia to demonstrate its commitment to opening the market to large-scale non-hydro renewables.

The MME consulted extensively with stakeholders and advisors on the most suitable auction design and on how the policy reflected in the auction could best be implemented to ensure continuity after the change in administration. A stable policy framework backed by strong political commitment is crucial to ensure the long-term success of auctions (IRENA, 2019a).

#### *Past experiences with auctions and learning curve*

As previously mentioned, Colombia's renewable energy auctions in 2019 were its first, but the country had had previous experience with firm energy auctions (see Box 1).

Moreover, investors' confidence has been strengthened by a series of public hearings in which MME and the auctioneer (UPME)

implemented suggestions from both society and the industry regarding auction design (e.g., time bidding slots and relaxation of the competition criteria). Other topics, such as indexing contracts in hard currency, were also discussed, but not implemented.

Further hearings focused on addressing questions related to grid connection and making presentations to investors and other potential auction participants to clarify the process. Importantly, draft contracts were shared to collect perceptions from potential participants about the risks, strengths and weakness of the long-term agreements (MME, 2019h).

#### *Clarity and transparency of auction documentation*

Transparency is another essential element in creating a successful auction mechanism. UPME has launched a website that provides complete auction documentation, including applicable laws and regulations. In addition to adding credibility to the process, the website's comprehensive documentation also allows stakeholders (investors, banks, and society in general) to better understand the mechanism. Similar websites have been launched in Brazil and Mexico.

### **3.3. POLICIES SUPPORTING RENEWABLES**

#### *Renewable energy targets and national plans*

Since 2014, the country has added to its generation expansion plans targets for the deployment of non-hydro renewables. The Generation Expansion Plan 2017-31 sets the latest targets for non-hydro renewable power using two scenarios based on different levels of economic growth. One of the scenarios targets 4 205 MW; the other, 3 202 MW (UPME, 2017).



Launched in 2015 and updated in 2020, UPME's National Energy Plan 2050 set the framework under which the national energy policy is to be developed and implemented. This plan reflects the need for a more diverse and reliable energy supply, more robust pricing mechanisms to support demand, and energy efficiency measures. It also reflects greater regional and global energy integration, with a focus on generating value around the energy sector. In one of the most feasible scenarios explored in the plan, non-hydro renewables – specifically wind, solar PV and geothermal – represent a 10% share of installed capacity by 2028 and generate between 2.5% and 7.5% of the mix (UPME, 2015). The National Development Plan (PND, Plan Nacional de Desarrollo) 2018-22, published and approved by congress in May 2019, has also acknowledged the importance and potential of non-hydro renewables (and energy efficiency). As a result, the development plan underscores that these programmes are to receive special attention from the MME (Gobierno de Colombia, 2019).

#### *Deployment instruments*

By 2016, and unlike other Latin-American countries, Colombia had not developed regulatory instruments to promote renewable energy deployment in the power sector, such as auctions, feed-in-tariffs/premiums, RPS or certificate systems. The country had, however, put net-metering in place (IRENA, 2016).

This changed in 2018, as Decree 570 established the blueprints for long-term PPAs through renewable energy auctions. Decree 570 was supported by Resolutions 40791 and 40795, issued later the same year, to provide operational guidance for the upcoming auctions. Moreover, the National Development Plan for 2018-22 imposed an 8% to 10% mandatory energy purchases of non-hydro renewables for retailers and distributors, starting in 2022. That action resembles an RPS and is to be enforced by SSPD. No causal relationship between targets, plans, renewable energy deployment instruments and low auction prices has yet been established. Concerns have been expressed that mandatory energy purchases would drive auction prices up. Another worry was that these would be anti-competitive – favouring specific players

or technologies – and counter to consumers' interests (Acolgen *et al.* 2019). But it will not be possible to assess their impact on prices until after 2022, when they are to be put in place.

#### *Fiscal and financial incentives*

Law 1715/2014 aimed to foster new additions of non-hydro renewable capacity by using tax breaks, fee exemptions for equipment imports, and the creation of dedicated funds for investments in renewables and energy efficiency (López *et al.*, 2020). In 2017, Decree 348 detailed the procedures necessary to request and obtain the benefits stipulated in Law 1715/2014.

In 2016, UPME issued Resolution 045, which included value-added tax (VAT) exemptions on machinery, equipment, and labour costs for non-hydro renewable energy projects. Similarly, import tariffs were exempted on machinery, equipment, and materials alongside a boosted depreciation rate of up to 20% per year (UPME, 2016c). Tax incentives were also provided over income tax, allowing a maximum deductible amount of 50% of the total investment costs within five years (López *et al.*, 2020). Furthermore, Resolution 045 also aims to ease the process of grid-connection for power plants and establishes regulations for systems up to 100 kilowatt peak (kWp) to sell surplus electricity (net metering).

The PND expanded the income tax deduction for non-hydro renewables from five to 15 years and thus the rate to 150%. It also exempted from VAT solar panels and, more generally, equipment for solar and wind generation, while also eliminating the import tariff for renewable projects (Semana, 2019).

These fiscal incentives may well have helped drive auction prices down.

#### *Policies to promote broader development objectives*

Auctions can be designed to promote community participation, improve regional development, and foster the equity and inclusiveness of the energy transition, although there are trade-offs between achieving socio-economic objectives and procuring electricity at low prices (IRENA, 2019a). To date, policies to promote broader development objectives have not been part of Colombia's auction design.



Yet a fair and just energy transition is very relevant in Colombia, as inhabitants of the province of La Guajira, home to the six wind projects awarded in the October 2019 auction, are energy-poor: 28% lack electricity services, with this rising to 60% in the province's rural areas (MME, 2018b; Semana, 2019). The province's energy poverty has triggered community opposition to large-scale renewable energy projects, and some projects, such as EPM's wind farm, have been halted (Semana, 2019). Renewable asset deployment in Colombia must involve environmental and socio-economic impact assessments on local communities. This can be done by fostering local community participation, including consultation on project permitting and development (IRENA Coalition for Action, 2020).

Auctions and other deployment policies are effective in supporting a just and inclusive energy transition only if introduced in co-ordination with integrating policies and enabling policies. The latter must link five crucial types of policies: 1) industrial policies that aim to leverage and enhance domestic capabilities; 2) education and skills policies that increase technical capacities and technological learning; 3) labour market policies that facilitate labour opportunities, rights and mobility; 4) financial policies that encourage revenue streams that benefit more people; and 5) social protection measures that provide support for vulnerable workers and their communities and

prevent them from shouldering an unfair burden during the energy transition.

A just and inclusive energy transition cannot occur in isolation. It interacts with socio-economic structures and has ramifications for macroeconomic stability, trade, investment, supply chains, production capacity and employment (IRENA, 2020c). In fact, new employment opportunities are among the benefits that renewable energy projects and auctions can promote, thus helping alleviate the unemployment challenges that Colombia faces (World Bank, 2020b; DANE, 2020a, 2020b). Newly created jobs must be equitably distributed within the population – in terms of gender, ethnic minorities and marginalised groups – and must be sustainable and significant for those employed (IRENA, 2019a).

Employers need a workforce with the skills and knowledge to support the sector's development. As the energy transition phases out the coal industry, appropriate education and training policies will be needed to retrain and reskill coal miners. In addition, labour market policies and social protection measures must be put in place to help miners who lose their jobs find new livelihoods (IRENA, 2019a; IRENA, 2020c; World Bank, 2018; World Bank, ESMAP, and SERIS, 2019).



# 4

# Conclusions



Colombia's liberalised and unbundled electricity market was not conducive to the deployment of large-scale non-hydro renewable energy. But diversification of the country's hydro-reliant electricity sector has become increasingly relevant to guard against power shortages tied to the effects of weather and climate on the water supply. In view of Colombia's vast and cost-competitive wind and solar resources, the share of solar and wind energy in the country's generation mix could be substantially increased by 2030 from its meagre share of 0.08% in 2018. Raising the share will depend critically on investments in the transmission grid (IRENA, 2018a).

At a low share of generation, variable resources such as wind and solar are not difficult to integrate into the power system, but as their share rises, the integration challenge cannot be avoided. Failure to adapt policy design – including the design of auctions – to evolving system needs has the potential not only to aggravate integration issues, but also to raise long-term system costs (IRENA, 2019a; IRENA Coalition for Action, 2020).

Globally, renewable energy auctions are increasingly being adopted both to boost the deployment of variable renewable energy resources and to ease their integration into the power system. Auctions can also help ensure timely project completion, and can be designed to support a just and inclusive energy transition (IRENA, 2019a). Although Colombia had previous experience with firm energy auctions, it conducted its first renewable energy auction only in 2019, becoming the latest country in Latin America to adopt these. From the seller's side, long-term PPAs resulting from auctions are a hedge against spot-market variability and can improve a project's bankability. Buyers also reduce their exposure to volatile spot-market

prices, while making their energy spending more predictable. Moreover, from the buyers's and policy maker's side, such PPAs help achieve renewable targets in a cost-effective fashion, while increasing competitiveness and reliability. While Colombia's first auction in February 2019 resulted in bids being assigned between buyers and sellers, the auction's competition criteria were not met and no contracts were awarded. Participation rates were promising, however, leading the authorities to accelerate discussion on holding a second auction in October of the same year. That event was a success, underscoring a main attribute of auctions: their flexibility in design and the presence of a learning curve that improves outcomes.

Regarding auction demand, the second auction shifted from a technology-neutral format to one exclusive to renewables. The second auction also introduced bidding time slots, decreased the project size limit (from 10 MW to 5 MW) and policy makers introduced mandatory energy purchases to foster voluntary participation.



Furthermore, the auctioneer relaxed qualification requirements for the second auction, discarding the first round's criteria related to system resilience, complementarity, emissions reductions and security. Similarly, the second auction waived participation fees. Securing approval to connect to the grid remained a challenging technical requirement, becoming an entry barrier not only for auctions, but also for the broader electricity sector. If implemented, Colombia's current transmission expansion plans should help to relax this constraint, but the process and regulations involved in assigning grid capacity may need to be revisited to prioritise projects with the greatest probability of coming online. Renewable energy auctions can support project timely completion if their design 1) includes compliance rules to ensure that awarded projects are completed on time and delivered as bid (IRENA and CEM, 2015); 2) accounts for the limitations of the sector (IRENA, 2019a); and 3) is aligned with an enabling environment capable of supporting project development (IRENA, IEA and REN21, 2018). If too strict, however, compliance rules may discourage participation.

Winner selection criteria were also redesigned. The first auction's three competition criteria (which were not met, ruling out contract awards) were streamlined into one criterion: no bidder could win more than 40% of the awarded volume. In addition, a ceiling price for the weighted average awarded price was introduced, on top of the individual bidding ceiling price. A supplementary mechanism was designed in case the initial target demand was not met. The bidding mechanism in the two auctions was double-sided (multi-buyer and multi-seller), which can complicate the task of matching supply with numerous buyers. For this task, the optimisation algorithm used for the second auction was developed by Colombian nationals.

Concerning risk allocation, some of the commitment bonds were reduced, following feedback from stakeholders. The PPA's contract duration was extended from 12 to 15 years. Perhaps the most significant change, however, was the shift from take-and-pay contracts to take-or-pay. The buyers in the second Colombian auction assumed the obligation of paying the contracted amount to generators regardless of consumption. Any difference is to be settled on the spot market, whereas the first auction stipulated yearly settlement periods. These changes improved generators' risk perceptions.

The second auction's outcomes, which so far have been viewed as positive, have moved Colombia closer to its target of 1.5 GW of non-hydro renewable energy by 2022. As a result of the second auction, 1.3 GW of solar PV and wind projects will be deployed at average prices of COP 97.6/kWh (USD 28.40/MWh) and COP 95.2/kWh (USD 27.70/MWh), respectively. The supplementary mechanism saw slightly higher prices: COP 99.9/kWh (USD 29.07/MWh) for solar PV and COP 106.8/kWh (USD 31.07/MWh) for wind. The amount of investment that auctions have attracted (when firm energy auctions are also taken into account) is estimated to be USD 2.2 billion. Five thousand construction jobs are expected to be created.

Importantly, the final PPA contract price also includes a reliability charge tariff, the CERE, which in October 2019 was COP 61.72/kWh (USD 17.88/MWh). The CERE was not added to this report's price analysis, as it must be returned if the generators do not provide firm energy. That said, the three lowest awarded wind bids came from projects that had been also awarded in firm energy auctions, suggesting that these generators may have considered the CERE revenue to submit more competitive bids in terms of price.





Without the CERE, Colombian prices were significantly lower than the average prices observed in auctions around the globe in 2018: by almost a half in solar PV (where the 2018 global average was USD 56/MWh) and by 42% in wind (USD 48/MWh) (IRENA, 2019a). These low prices can be attributed to Colombia's rich wind and solar resources – La Guajira region has one of the highest wind speeds in the world – and the availability of myriad fiscal incentives for renewables. In addition, increased investor confidence in the auctions, resulting from open channels of communication with the auctioneer and a transparent process, also helped keep prices low.

Looking ahead, some auction design elements could be revisited. For instance, Colombia's two renewable energy auctions have been standalone – that is, no commitment was made to hold future bidding rounds. Non-hydro renewable energy implementation plans beyond 2022 are needed to send strong investment signals to both local and international investors (IRENA Coalition for Auction, 2020). Systematic auctions that involve a commitment to a longer-term schedule may attract a larger number of bidders, leading to increased competition and deeper penetration of non-hydro renewable energy.

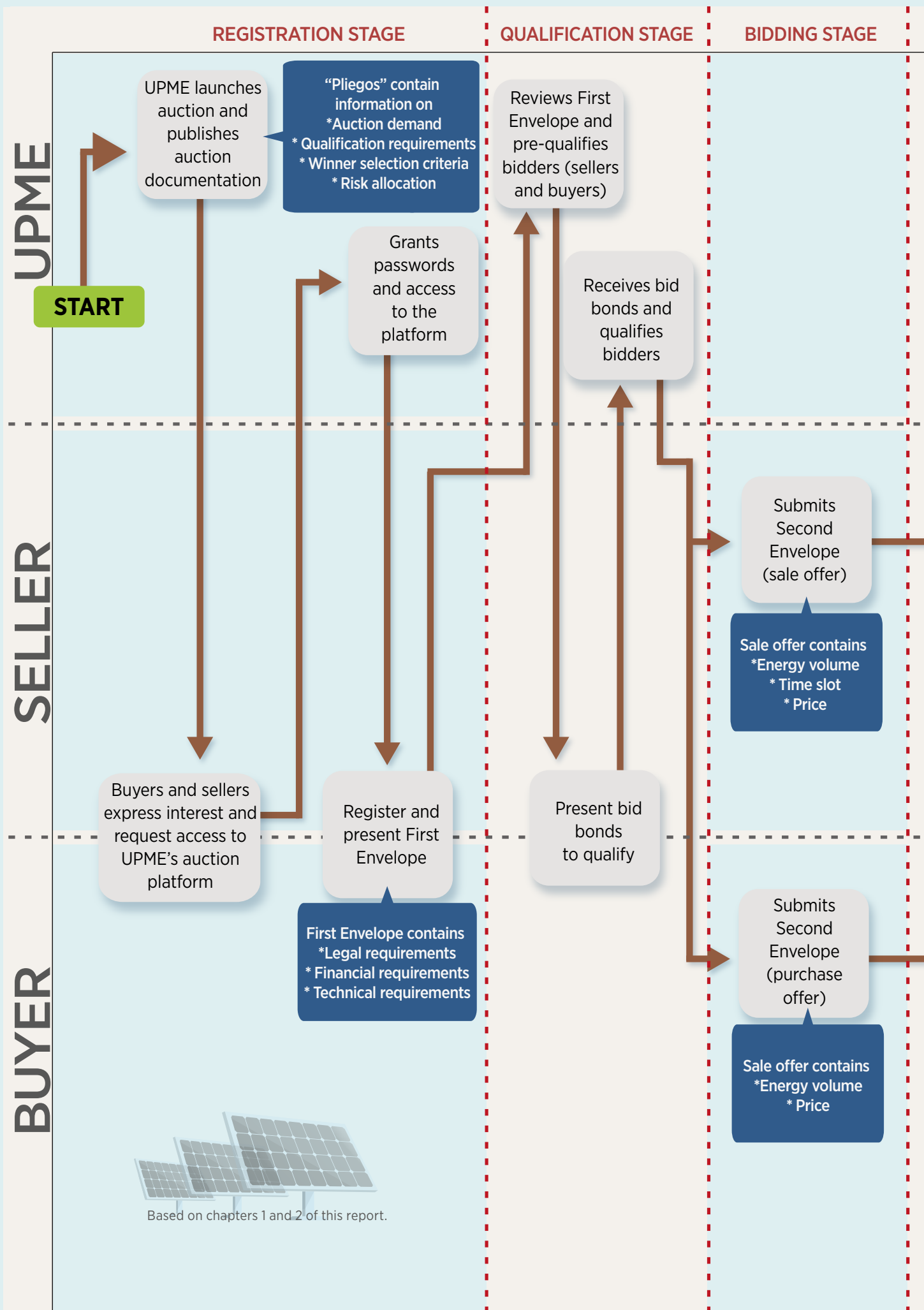
Auctions' flexibility allows them to be designed to support a just and inclusive energy transition. With this in mind, future renewable energy auctions in Colombia could seek to include small and new players – for example, by establishing winner selection criteria that compensate small and new developers beyond their pricing offers (see chapter 4 of IRENA 2019b). In addition, La Guajira, home to the six wind projects awarded in the second auction and close to 4 000 MW of other registered non-hydro renewable energy projects, has been historically energy-poor, which

no longer need be the case. Renewable energy auctions can foster community participation and social acceptance, boost regional development, and ensure the equity and inclusiveness of the energy transition (see chapter 4 of IRENA 2019b). A just and inclusive energy transition in Colombia will have to address a gradual phase-out of the coal industry. To that end, it will be critical to retrain and reskill coal miners to prepare them for jobs in the renewable energy sector. In addition, labour market policies and social protection measures will be needed to help miners who lose their jobs find new livelihoods (IRENA, 2019a; IRENA, 2020c; World Bank, 2018; World Bank, ESMAP, and SERIS, 2019).

Achieving a just and inclusive transition depends on an equitable allocation of opportunities so as to raise the chances that positive outcomes will be broadly shared, that adverse effects will be minimised, and that any misalignments between positive and negative dynamics are proactively addressed. The deployment of renewable energy presents ample opportunities to achieve broader economic and social objectives. Alas, to date, deployments have too often sidestepped such questions. If appropriately designed, renewable energy auctions offer the potential to foster the development of local industries, create jobs, include small and new players, engage communities, and contribute to subnational development (IRENA, 2019a). That this potential has to date gone largely unexploited need not remain the case. Indeed it should not.

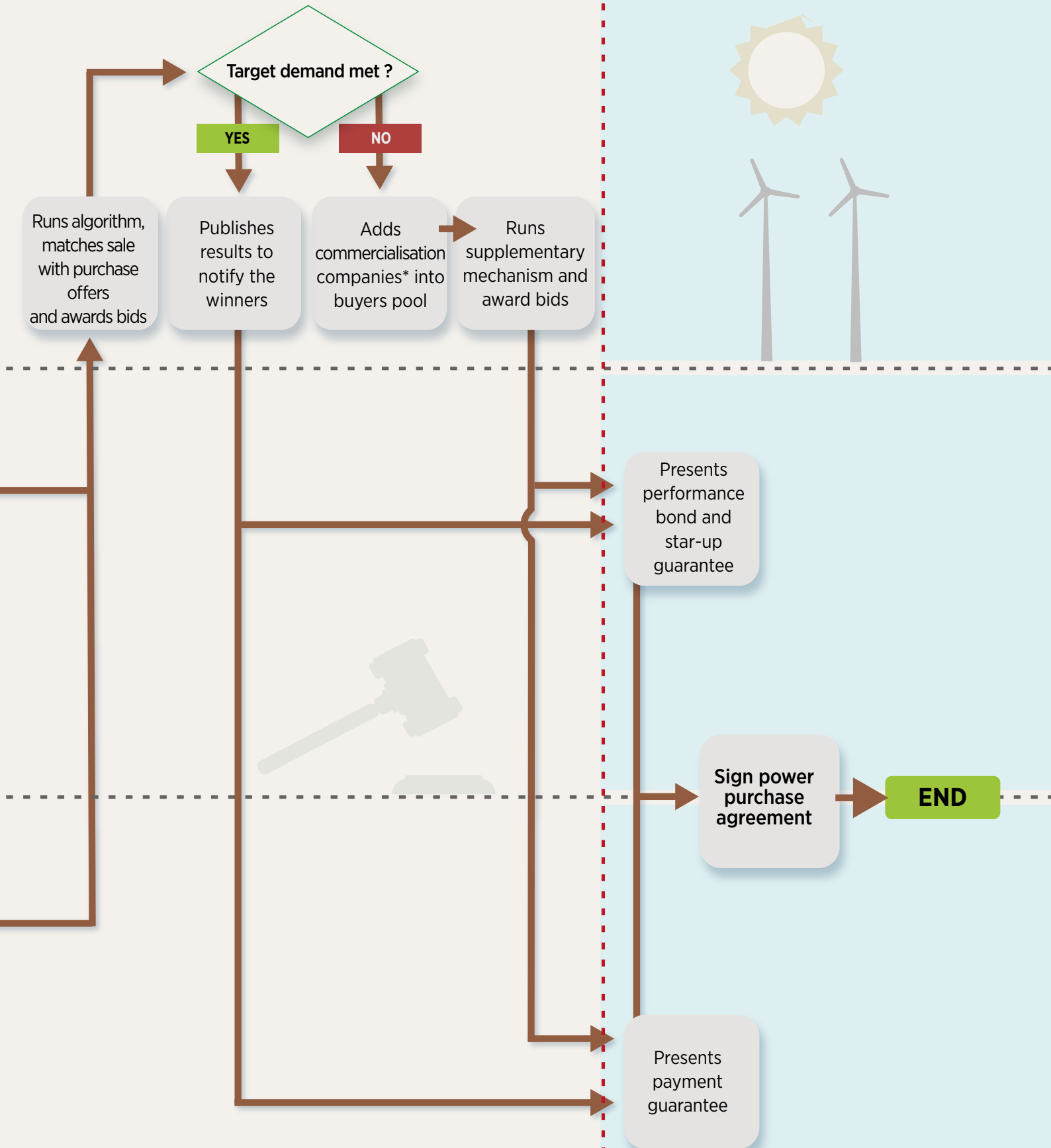


# ANNEX: FLOWCHART OF COLOMBIA'S SECOND RENEWABLE ENERGY AUCTION



AWARDING STAGE

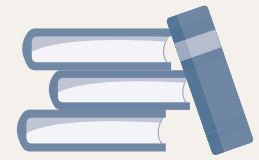
CONTRACTING STAGE



\* Retail and distribution companies that serve regulated consumers and had not participated in the auction



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