Jamaica: Renewable Generation Procurement Guidelines

Task 2: Proposal of auction design, rules and guidelines

June 2022

PSR

LIST OF ACRONYMS

Acronym	Meaning
BOO	Build, Own and Operate
EOI	Expression of Interest
FIT	Feed in Tariffs
GOJ	Government of Jamaica
GPE	Generation Procurement Entity
ICB	International Competitive Bidding
IRP	Integrated Resource Plan
JAMALCO	Jamaica Aluminum Company Limited
JPSCo	Jamaica Public Service Company Limited
LNG	Liquified Natural Gas
MSET	Ministry of Science, Energy and Technology
OUR	Office of Utilities Regulation
PPA	Power Purchase Agreement
RES	Renewable Energy Sources
RfI	Request for Information
RfP	Request for Proposal
RfQ	Request for Qualification
ROFR	Right of First Refusal
SPV	Specific Purpose Vehicle
TOR	Terms of Reference

1 INTRODUCTION

1.1 Background and objectives

In 2009, the Government of Jamaica (GOJ) identified energy conservation and efficiency, energy diversification and increased renewable energy penetration as key objectives in its National Energy Policy (NEP) 2009-2030. Similarly, the GOJ established a target of 20% renewables on the national grid by 2030. Following the completion of the Integrated Resource Plan (IRP) 10 years later, the GOJ increased its target for renewable energy penetration to 50% by 2037.

In this context, the GOJ has created the Generation Procurement Entity (GPE) through the Electricity Act, 2015, with responsibility for procuring new generation and managing the replacement of generation to meet the national generation demand prescribed by the IRP. In executing its mandate, the GPE is entitled to develop the competitive procurement bidding process and protocols to commence the activities in an open and transparent manner. Therefore, to facilitate the appropriate tasks and decisions by the GPE, the Entity requires international expertise to strengthen its technical capacity to understand best practices and drafting the procurement rules and protocols to attract investments.

In this sense, the GOJ has requested the IDB support to strengthen the GPE's technical capacity and project management skills, as well as assist the GPE and its legal counsel with the drafting of generation procurement rules, undertaking renewable energy procurement, and engineering support services aligned with the IRP. The general objective of this assignment is to support the Generation Procurement Entity (GPE) in developing general guidelines for generation auctions and rules for renewable power plants in line with Jamaica's Integrated Resource Plan (IRP), following international best practices and their necessary adaptations to the Jamaican context.

PSR has over thirty years of experience and a highly international client base. PSR is a globally leading provider of advanced analytical tools and consulting services in electricity and gas; and an active contributor to applied research on cutting-edge optimization solutions, energy policy and power system economics. MRC Spain is part of the MRC Group of companies, a family of ten sister companies that share a common history and operate internationally as a single organization, combining their human resources, technical skills, and geographical presence to better serve clients worldwide. MRC is focused on energy, water, and sustainable growth. Sigla, also part of MRC Group, is specialized in the different aspects of planning, regulations, restructuring, power tariff surveys and engineering works for transmission and distribution and for water and sanitation, including work site inspections. Altogether, the Consulting Team presents a strong experience in auction design and regulation, as well as extensive knowledge of different systems worldwide.

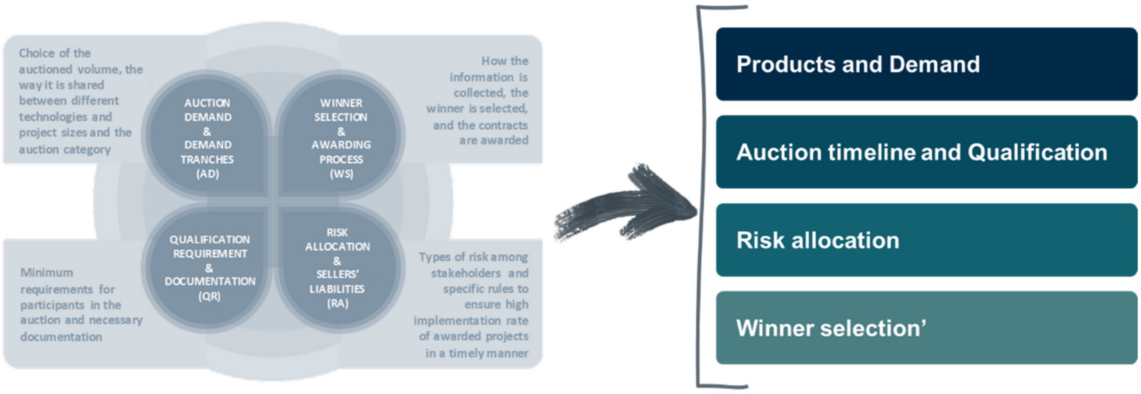
The proposed scope of services comprises five phases, namely (i) Task 1: review of current procurement mechanism; (ii) Task 2: proposal of auction design, rules and guidelines; (iii) Task 3: initial proposal for PPAs and RfPs; (iv) Task 4: support in designing the final PPAs and RfPs; and (v) Task 5: technical report and capacity building.

1.2 IRENA reference methodology

In 2015, the International Renewable Energy Agency (IRENA) published the *Renewable Energy Auctions: A Guide to Design* report. The report presents a framework for analyzing the design of renewable energy auctions and addresses the implications of different design approaches. The structure was later slightly updated in a report published in 2019, named *Renewable Energy Auctions: Status and Trends Beyond Price.* The framework divides the analysis is four different design elements, categorized as (i) auction demand, (ii) qualification requirements, (iii) winner selection process and (iv) sellers' liabilities. Each of these categories incorporates a number of bifurcated and inter-related design choices that must be made by policymakers seeking to implement an auction, and they serve as a helpful guide in the complex landscape of auction design to make sure that key elements are taken into account.

This does not mean that additional considerations cannot be made, although they can sometimes be tied into these four categories. In the current repot, we have highlighted the definition of products and the auction timeline as additions to the main categories. The product definition was combined with the auction demand chapter, as those two concepts are tightly linked. The auction timeline was added to the qualification chapter, as it the one it is mostly related to. The following figure summarizes IRENA's framework and the division of chapter selected by the Consultants for this report. It is worth highlighting that similar models are commonly used in the context of renewable procurement. For example, the Solar Risk Mitigation Initiative (SRMI) uses a similar rationale. This and other examples indicate that there is a general consensus that exists for the good implementation of RE auctions.

Figure 1-1 - IRENA's framework for renewable auction analysis and structure of the current report. Source: Own elaboration.

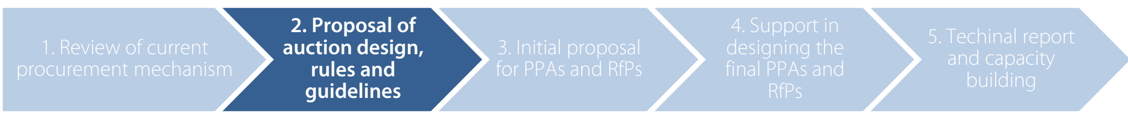


IRENA, 2019

1.3 The present task: Proposal of auction design, rules and guidelines

In the first phase, the Consultants have carried out a detailed review of Jamaica's current auction mechanism, identifying possible gaps and points for improvement. In this second phase, the Consultants will present the recommendations for the Generation Procurement procedures, protocols, rules and award mechanisms. All recommendations will be aligned with international best practices and will be supported by international experiences, but always adapting the mechanism to Jamaica's particular features.

Figure 1-2 - Illustration of the present project's workflow



In this phase, the Consultants will carry out the following activities:

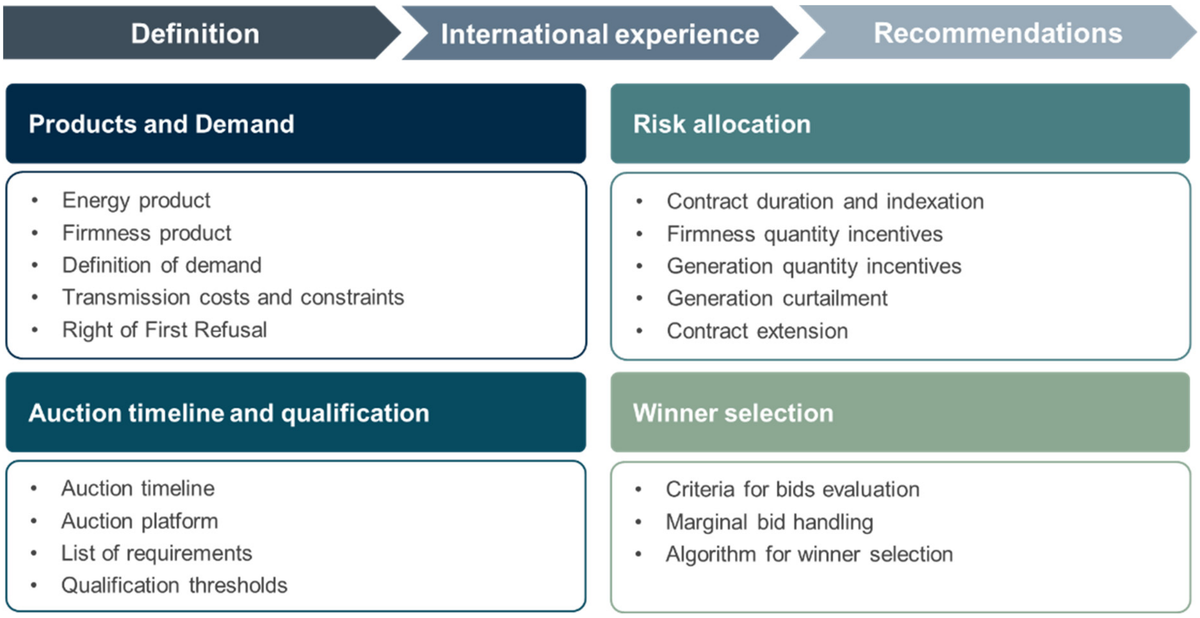
- Characterization and recommendation of the type of auction regarding technology specificity, auctioned product, auction volume, frequency of the auction, among others. This will chiefly be the object of Chapter 2, Auction demand.
- Description and recommendation of qualification requirements for bidders to participate in the auction and their respective liabilities to ensure that the project will effectively be built, such as the level of financial, technical and legal requirements, penalties in case of delay, bid bond and completion bonds,

among others. This will be one of the main purposes of Chapter 3, Auction timeline and qualification processes.

- Characterization and proposal of risk allocation mechanism to auction sellers regarding the PPA design offered in terms of exposure to spot price, mismatch between generation and contracted amount, renewable energy curtailment, contract duration, contract indexation, among others, that best allocates identified the gaps and risks. This will be the main object of Chapter 4, Risk allocation mechanism.
- Description and proposal of a transparent process and algorithm to select auction winners including how the supply-side information is collected, requirements of minimal competition, criteria to rank the bids and select the winners, clearing mechanism and marginal bids, among others. Chapter 5, Winner selection process, will be centered around these topics.

The organization of the report into four major modules was inspired by IRENA's methodology as described in section 1.2: (i) Products and demand, (ii) Auction timeline and qualification, (iii) Risk allocation, and (iv) Winner selection. Each one of the major modules will address a list of topics (or design choices) related to it organized as subsections in each chapter, as summarized in Figure 1-3. Furthermore, each subsection will contain a description of one or more international experiences that illustrates and supports the consultants' recommendation, in addition to the recommendation itself.

Figure 1-3 - Illustration of the organization of the report. Source: Own elaboration.



2 DEFINITION OF THE AUCTION DEMAND

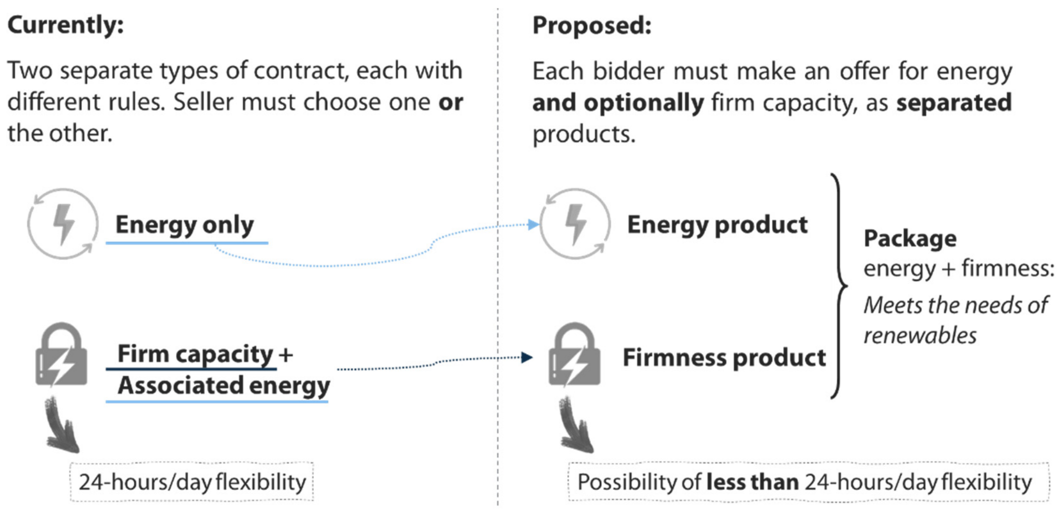
2.1 Definition of products

Electricity can be measured both in terms of nameplate capacity (watts that can be instantaneously delivered) and energy (watt-hours that are delivered in a cumulative fashion over a period of time), and the definition of those products is an essential factor in the design of the auction. Currently Jamaica offers two products in renewable energy auction: an energy-only contract and a firm capacity contract. The latter is associated with energy, which depends on the dispatch by the system operator. In this design, the energy product of a generator that wishes to sell firm capacity remains intrinsically linked to the offer of firm capacity. Furthermore, the concept of firm capacity with associated energy contracts strongly suggests fully dispatchable sources.

Nevertheless, considering the context of renewable technologies, the current design does not seem very adapted for them and this has been reflected in previous auctions results. Some renewable technologies are indeed able to control their own generation and, therefore, ensure that energy will be delivered at specific times of the day, providing reliability to the system. Examples are small hydro plants (whose dams are typically able to control outflow during the day, although over a period of one or two weeks aggregate production essentially only depends on available inflows), variable renewable sources with storage support (where once again the dispatchability is dependent on the size of the storage system), and biomass (plants based on agricultural residue, for example, have some flexibility on when they can choose to generate, but the total amount of fuel available is dependent on the harvest). However, no renewable technology is totally flexible at all hours throughout the year (as a conventional technology is) and, therefore, renewables need to sell some energy at their discretion.

A simple adjustment that could be done in the current design to make it frindlier to renewables is separating the firm capacity and the energy products and allowing "firm capacity" to be more flexible. In other words, the bidder would be able to efine the amount of energy it wishes to sell rather than fully relying on "associated energy". The characteristics of each product will be detailed in chapters 2.2 and 2.3, but the general idea is that each bidder will be allowed to offer a package of both products. For each product the agent will be able to define the amount and price of the offer. Variable renewable sources may offer zero firmness, and in practice would be treated as an energy-only contract. Partially dispatchable renewables (e.g. battery portfolios), however, would be able to sell a "package" of energy and firmness.

Figure 2-1 - Summary of the recommendation of the separation of products. Source: Own elaboration.



It's worth noting that this type of arrangement would most likely require a revision on the current regulations, which do not foresee the possibility of such "partially dispatchable" firmness as participants in the Jamaican electricity sector. Given the desire to accommodate the physical features of renewable generators in order to make a "net zero" future for Jamaica possible, in the Consultants' understanding such a transition would be worthwhile, and the present report highlights many of the features that would need to be incorporated to the auction design itself in order to make such a change (see, for example, sections 2.3 and 4.2). However, in the interest of allowing sufficient time for accommodating the necessary regulatory changes (which are outside the scope of the present work by the Consultants), it might be preferable to delay to a later stage the full implementation of the firmness product as conceptualized (for example, by focusing on an energy-only auction in the short term).

2.2 Energy product

Energy is the amount of electricity a generator produces over a specific period of time. In this chapter we will detail the design and specifications of this product. In the context of auctions, we will determine the recommendations for the definition of the amount, price and indexation. It's worth noting that, in Jamaica, the Energy product represents a total amount of energy that can be delivered on aggregate over a given period of time regardless of profile and short-term uncertainty – which is a feature that is highly valuable for accommodating renewable energy sources, given their physical features.

International experience

Chilean renewable auctions only offer energy as product, on a basis of total GWh produced in a given year (instead of total MW of nameplate capacity, which is currently used as basis in Jamaica). Given that Chile promotes technology-neutral auctions, it is important to establish a criterion that makes different technology types comparable, contemplating the seasonality and the natural variability between different technologies of generation plants (in addition to other factors such as location and quality of the renewable resource).

Contracts in Chile are valued in US$ per MWh and indexed periodically according to the factor chosen by the auction winner. In that manner, bidders are able to build an indexation formula using a combination of weights for several different indexes (including international fuel prices), although for renewable energy sellers typically choose to be indexed by the United States` Consumer Price Index (CPI).

On November 2017, National Energy Commission (CNE) awarded a power auction to supply 2.200 GWh/year distribution, starting in 2024. The auction ended up with a final price of US$ 32.5/MWh, below the market projections and expectations based in the previous auctions, which reached an average price of US$ 47.6/MWh. The low weighted average price of the auction may be related to the high level of competition, in which 24 firms submitted 193 bids, resulting in a maximum amount of energy which can be awarded of 12109 GWh/year, more than 5 times the auction volume. The mentioned auction ended up being the lowest value of energy in history of the Chilean auctions and also had the highest number of participants.

Recommendations

The energy product should be defined in a generation basis (GWh per annum) instead of nameplate capacity of renewable generators (MW). This is justified by the fact that two power plants with the same installed capacity may have drastically different generations – since the capacity factor is influenced by technology, location, infrastructure, etc. Despite the existence of seasonal and inter-annual natural variability in renewable power production, it is considered that an estimated annual production represents a reasonably accurate representation, with the aggregation over a relatively extended period of time serving to mitigate part of this variability.

In terms of remuneration, the price should be established as a purely variable component (USD/MWh). Note that, even though payments are expected to be made in Jamaican dollars, it makes sense to nominate the bid price in US dollars and to define an indexation to the exchange rate in the auctioned contract in order to mitigate sellers' exposure to foreign exchange rates. The contract model should explicitly define a reproductible process for obtaining the exchange rate parameter that ought to be used to calculate the price adjustment (data source used, what kind of average is made and over which period of time, and how often are adjustments recalculated – e.g. monthly or annually). The bidder should also be able to define what percentage of the price bid should be indexed to the US CPI (the remainder would remain constant in nominal terms, only being adjusted according to the exchange rate).

2.3 Firmness product

The electricity nameplate capacity is defined as the maximum output a generator can physically produce, measured in megawatts (MW). A "firmness" product, often called "firm capacity", is designed to provide reliability to a system, and consists in a maximum generation capacity that a generator ensures that it is able to offer to the system when needed. In the context of renewable generators, the firm capacity is significantly smaller than the nameplate capacity, although this does not mean that renewables are incapable of delivering this kind of reliability product (see section 2.1). Various methodologies have been designed to attempt to estimate renewable technologies' contributions to system firmness, in the context of each individual country.

In the context of Jamaica, it is important to have a design for the firmness product that (i) is compatible with what renewable energy sources able to physically provide, (ii) is compatible with the needs of a system operator in an island (which in particular must be fully self-sufficient), and (iii) does not rely on "spot" market transactions or similar financial commitments (as Jamaica lacks such a market infrastructure). In this chapter we will detail the design and specification of the firmness product, such as recommendations for its functioning, definition of the amount, price and indexation.

International experience

In Mexican auctions, there is a clear separation between three products that can be offered by any of the generators participating in the auction regardless of technology: (i) an "energy" product, (ii) a "capacity" product, and (iii) a product representing "clean energy certificates" for renewable generators. The distinction between energy and capacity in particular is very relevant for the Jamaican reality. In both Mexico and Jamaica, the "energy" product can be understood as a commitment to deliver some amount of "total GWh", with the seller having at least some input over the energy delivery profile in order to account for renewable variability; whereas the "capacity" (or "firmness") product can be understood as a commitment to be available at specific times for delivering electricity (usually at the system operator's request) in order to ensure the system's security of supply.

When preparing their bid for the Mexican auction, each renewable generator is able to make an offer for the energy product and for the capacity product separately – but these offers are treated as a single "package" for the purpose of auction winner selection. This means that a small hydro power plant can offer, for example, a capacity factor of 30% for its energy product availability but a capacity factor of 60% for its capacity product availability – reflecting that this particular generator is confident that it can produce more than average at the hours that are most critical to the system (as hydro power plants tend to concentrate their output at peak demand hours). Other generators with less flexibility of dispatch could use a different strategy, for example offering a 40% capacity factor for the energy product and only 10% for the capacity product.

The Mexican regulation introduces a classification of resources into four different types, according to their ability to contribute to system reliability (and their contributions to system firmness depend on this classification). According to the classification below, note that even renewable plants are able to deliver some level of firmness, which has inspired our recommended design for Jamaica:

- **Firm and dispatchable** resources are represented by most thermal plants and hydroelectric plants. These are the most valuable ones for system reliability, as they can easily increase or decrease their output to facilitate demand following
- **Firm and non-dispatchable** resources are cogeneration units, biomass, and other inflexible thermal power plant (including nuclear and some coal), as well as geothermal. The quantity of electricity these sources produce is generally predictable but the system operator has little to no control over their output.
- **Non-firm and non-dispatchable** resources are typical wind and solar generators – which have variable output and which, in the most usual implementation, cannot be controlled by the system operator.
- **Non-firm and dispatchable** resources are also wind and solar generators, but those that have installed equipment that allows their production level to be reduced (i.e. curtailed) at the operator's request. This type of dispatchability is limited due to the resource's uncertainty, but it is valuable to the system.

Recommendations

The firmness product must provide to the system some kind of reliability at the most critical hours of the day and/or year. Renewable technologies, however, tend to have strong variability and they are not fully dispatchable. Some technologies do have some kind of control of their own generation and, therefore, are able to ensure that energy will be delivered at specific times of the day – nevertheless, it is important to highlight that no renewable technology is totally flexible at all hours throughout the year (as a conventional technology is).

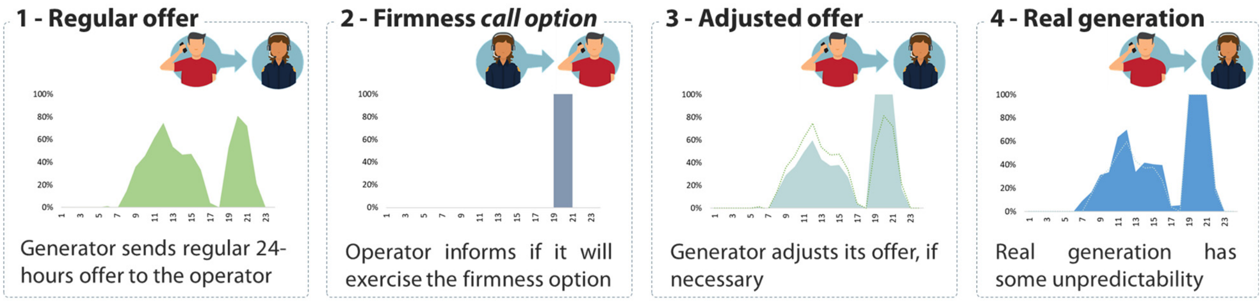
Having the previous considerations in mind, we propose a firmness product that both provides reliability to the system and that is able to accommodate renewable technologies. The recommended product design is similar to a "call option": the generator will bid a maximum number of hours per day that it may be dispatched by the system operator. The system operator will be allowed to request the agent to generate up to the full offered capacity in specific hours of the day (at the operator's discretion), respecting the limit of hours indicated in the bid. In the remaining hours, the generation is flexible and the agent will operate under the regular mechanism in place.

In terms of the definition of the product, the amount will be composed by two components: maximum "dispatchable" generation capacity (in MW) and maximum number of hours of the day that it may be dispatched at full capacity by the system operator (hours/day). The price bid will be a fixed price defined in $/kW.month/(hours/day). As applied in the energy product (see section 2.2), the whole amount will be indexed to the exchange rate, since bids are in USD and payments are in Jamaican Dollars, and the bidder will be able to define what percentage of each price bid will be indexed to the US CPI.

In terms of operational dynamics, the core framework could function as summarized in Figure 2-2. The process starts with the generators presenting its forecasted operation for the day, which can follow any profile in principle (for example, a solar generator can provide an estimate for the solar resource availability in the following day without the need to activate its battery storage; a biomass generator could submit a bid to produce nothing and save its fuel on that particular day; a small hydro plant could offer to produce at a flat capacity factor during the entire day based on its expected inflows). Then, based on its own forecasts of the country's supply-demand balance, the operator will determine if there is the need to "activate" the firmness product. Based on this decision, the system operator will inform the generator the hours of the day it will exercise the firmness product and what is the capacity needed (for example, if a generator sold 10 MW of firmness product with a 2-hour flexibility, the system operator could request "10 MW dispatch between 6:30

pm and 8:30 pm", or "8 MW dispatch between 10 am and 11 am"). After that, the generator is allowed to adjust its generation forecast throughout the day, but it must respect the delivery of the firmness product (for example, a battery-powered system would need to reduce its production at other hours of the day in order to meet the requirement to deliver firm capacity at critical hours). Naturally, the real generation has some natural unpredictability and generation may deviate a little from the initial forecast, although the generator is obliged to deliver the firmness product in the requested hours.

Figure 2-2 - Illustration of the firmness mechanism. Source: own elaboration.



Furthermore, in order to incentivize accurate bidding and respect to the operator instructions, there should be penalizations in place for every hour that the agent does not comply with the operator's order. Our recommendation for the penalization approach is detailed in section 4.2.

It is important to highlight that this model was designed aiming to be inclusive for most renewable technologies. Nevertheless, they do have different features that may not be fully captured by the proposed definition of the firmness product. Batteries, for example, are able to provide multiple services, besides providing energy and firmness. Even though it would be possible to treat them differently, for example awarding projects in specific auctions or remunerating them for additional services, the consultants considered that the proposed firmness implementation adequately incorporates the most important desirable features of dispatchable renewable technologies.

Additionally, it is worth noting that the implementation of such a firmness product may require a revision in the Jamaican regulations, including their grid code, in order to properly accommodate this type of "partially dispatchable" resource that allows renewable plants to deliver firmness. Such a regulatory revision would be outside the scope of the present project, even though the elements provided above can hopefully guide Jamaican authorities on how to organize and prioritize such an endeavor. In case such a regulatory implementation of the firmness product is not deemed feasible to implement – at least in the short term –, the consultants recommend auctions to be carried out as "energy only", following the product that is already present in the Jamaican electricity sector.

2.4 Definition of demand

In this chapter we will discuss the definition of the auction demand and what elements should be taken into account in the process. It is important to highlight that the definition of the auction demand is not simply limited to defining the amount of the products that the system desires, but should also incorporate the following elements:

- A price cap. The maximum price that the buyer is willing to pay for both the energy and the capacity product is an important component of the auction design, and indeed it is an integral part of the consultants' recommended winner selection criterion (see chapter 5).
- Locational restrictions or incentives, related to the ability of the electricity grid to accommodate the proposed renewable projects. This type of adjustment will be explored further in section 2.5.

- Other restrictions or incentives, such as technology-based criteria. Note that this type of technology-specific distinction (such as creating demand bands exclusive to each technology) is not necessary if products are well-defined in a technologically neutral manner (see section 2.1), and therefore in this document it is treated as an optional and non-critical feature.

International experience

In Guatemala, renewable energy auctions are conducted through a first-price mechanism to supply country`s three distribution companies. In addition, the country´s renewable auction procedure may allow bidders to compete for two different products: energy and firm capacity. Both products can be auctioned separately or together, requiring each bidder to declare the prices and quantities it wishes to deliver over the 15-year contract duration. In this context, “virtual offers” are defined by the National Commission of Electric Energy (CNEE) aiming to work as ceiling prices for the energy and capacity contracted. This means that, automatically, if the offered prices surpass the established ceiling, it becomes less costly for the system to leave part of the demand unmet and reject those offers.

With this, Guatemalan renewable auctions are technology neutral, and nothing prevents only one type of technology (or any mix of technologies) from being contracted in a procedure. In 2010, for example, the first auction of this type held in the country awarded only hydropower plants, since this generation composition resulted in the best cost conditions for the system among the bid combinations. To formalize the bid conditions, generators must specify the technology type of the respective plant offering firm capacity and/or energy, as well as the corresponding fuel to which the contract will be indexed.

Another requirement of the renewable auctions in Guatemala is the need to declare the monthly (seasonal) guaranteed energy for all the years that firm capacity is offered. Furthermore, bidders must inform the typical daily distribution of the monthly guaranteed energy of their plants, considering that it can be different for each month of the seasonal year, due to the availability of resources and particular characteristics of the generation plants.

In short, the bidders must declare prices and quantities of generation and firm capacity for each plant offered in the auctions and the procedures are promoted based on the demand growth, in line with the country energy expansion plan guideline.

Recommendations

The two proposed products – firmness and energy – are very different in terms of their definition and service provided to the system. Therefore, it is essential that the demand for each product is defined separately and in the same measure unit than the product – e.g. energy demand should be defined in GWh/year and firmness (firm capacity) demand should be defined in MW * h/d. Furthermore, the demand per product needs to be aligned with the system planning and desired evolution of the generation mix. In this sense, it is important to take into account: (i) the forecasted evolution of demand, (ii) the forecasted evolution of peak demand, (iii) the expected hourly demand profile, particularly at peak hours and peak seasons, and (iv) the expected conventional capacity to be decommissioned, which may affect the system’s dispatchability and seasonal needs.

Currently, the long-term planning document IRP defines the capacity additions per technology (in MW), but also indicates the total renewable generation amount in GWh. Therefore, it would be simpler and even more straightforward to translate the plan into an auction demand for energy product – in the current structure, the technology-specific expansion capacity is translated into a technology-neutral demand for total MW of installed capacity, even though the expected capacity factor of different technologies can vary significantly.

In terms of technology, we suggest maintaining the auction technology neutral, meaning that there are no demand tranches for specific technologies – although it could be easily implemented if there is a specific need.

Additionally, it is important to define the system's maximum willingness to pay for each product, commonly known as price cap. Currently, price caps are defined per technology, but the recommendation is to define one single price cap per product and let technologies compete among themselves.

In order to make the understanding easier, the following figure exemplifies how the demand of the 2012 auction would be defined under the proposed design. The unit of the demand of each product changed and the cap price is defined per product instead of per technology. As previously mentioned, the price cap per product could be substituted by price-quantity curve that expresses the buyer's willingness to pay for each product. It's worth noting that "12 hours per day" flexibility might be excessive given the newly proposed definition of the firmness product presented in section 2.3 – the precise demanded quantity would need to be assessed with more detailed technical studies.

Figure 2-3 - Example of the application of the recommended design to the 2012 auction demand.

Demand in the 2012 auction

Demand for energy only:
- 78 MW / 212.1 GWh

Demand for firm capacity:
- 37 MW / 204,872 MWh

Cap price per technology:

Technology	Cap price - USD/ MWh
Bagasse	151.60
Hydro	111.30
Waste to energy	148.80
Wind	133.60
Utility scale PV	267.30

Demand in the proposed scheme

Demand for energy:
- 212.1 GWh/year

Demand for firmness:
- 37 MW * 12 h/d = 444 MW * h/d

Cap price per product:

Product	Cap price
Energy	300 USD/ MWh
Firm Capacity	12 USD/kW.month/(h/d)

2.5 Transmission costs and constraints

In previous auctions in Jamaica, documents mentioned that "grid costs were to be incorporated" in the bid comparison process. However the methodology by which they were calculated and incorporated was not explicit in the bid documents, and the Consultants have not been able to obtain any detailed information on how exactly this process was carried out (partly due to confidentiality concerns regarding previous auctions' private bids). In this way, generators could not accurately predict on their own how much grid cost impact their project would likely have, and could not estimate how much that component contributed to them not being selected as winners in the auction. This type of perception of a lack of transparency tends to strongly discourage the participation of international bidders (who often have access to foreign capital and who can contribute to increase competition in the auction). Therefore, following the same recommendation of other topics, we emphasize that incentives should be defined and published *ex ante*.

Possible transmission grid limitations can (and should) be properly incorporated into the auction demand and the winner selection process in a transparent and robust manner. These limitations could either be defined as a "hard" constraint (that is, a fixed quantity limitation per zone, additional units beyond this limit do not contribute at all to the total welfare) or as a "soft" constraint (an incentive in price for each zone – implying that expansion in a given zone is discouraged but that if the difference in price is large enough it becomes worthwhile to strengthen the transmission grid to accommodate this expansion).

International experience

Mexico is an example of a country that has implemented both "hard" and "soft" constraints in its representation of the demanded quantity on each zone. Even though the Mexican mechanism is extremely complex (and likely beyond a level of complexity that would be useful for Jamaica), their experience serves to illustrate the wide range of implementations that are possible for handling interconnection limits and/or costs.

There are four different levels of zonal segregation that are defined for each Mexican auction and used to ensure that the auction meets the desired demand: Power Zones (coarsest), Export Subzones, Price Zones, and Interconnection Zones (most granular). The former three types of zone are illustrated in Figure 2-4, and the Interconnection Zones typically refer to individual electrical substations. There are specific mechanisms for handling the auction demand at each level of geographic subdivision, as detailed below. Please note that the number of subdivisions listed below were based on the 2017 Mexican long-term auction, and can change slightly from one auction to the next.

Figure 2-4 – Different levels of zonal classification used in Mexico (2017 auction)

- There are only three Power Zones covering the entire country, which are not electrically connected to one another (the largest Power Zone, the Central Interconnected System or SIC, contains most of the auction's demand). Because no amount of supply in one of these "electrical islands" can help to meet the demand in another, the demand for capacity product is defined at each Power Zone *independently* from one another. Therefore, the treatment of the Power Zones is a particular case of a "hard" constraint.
- There are 39 Export Subzones covering the country (31 in the largest Power Zone), each of which has an associated "maximum amount of energy" that can be delivered. This limit is also applied as a "hard" constraint in the Mexican auction, which applies to the energy product rather than the capacity product (see section 2.1 for more discussions on the distinction between the two products), and on a level of granularity that is more detailed than the Power Zones.
- There are 53 Price Zones covering the entire country, and each Price Zone has a "price bonus" or "price penalty" associated to it, which is applied as a "soft" constraint to represent the fact that new capacity built in some regions (e.g. close to the demand centers) can be significantly more valuable than new capacity built elsewhere (far away or in areas that are already oversupplied). The Price Zone bonuses and penalties are considered in proportion to the amount of electricity sold by each bidder, and they vary between -9.9 $/MWh (a very large bonus for projects located in a particularly undersupplied area in the Baja California peninsula) to +3.2 R$/MWh (a penalty for projects located in an oversupplied area in the country's Midwest). Note that the level of detail of the Export Subzones and of the Price Zones is similar, and it would be possible to conceive a model in which both "hard" and "soft" constraints are associated to the same level of zonal subdivisions (even though this is not the case for Mexico).
- There are thousands of potentially-relevant Interconnection Zones, seeing that each individual substation in Mexico is a potential Interconnection Zone. However, the only subdivisions that play a

role for auctioning purposes are those that have interconnection limits calculated (209 in total). The auction establishes that the total nameplate capacity of generation projects that wish to be placed in a given Interconnection Zone cannot surpass the interconnection limit. This represents a "hard" constraint and is akin to having the system operator certify prior to the auction that there is enough interconnection capacity to accommodate the bidder's project (with some extra flexibility – for example, if there are only 100 MW of interconnection capacity available, the system operator could certify 10 different 50-MW projects, knowing that by the Interconnection Zone criterion at most two could be awarded).

Recommendations

Transmission limitations can be either defined as a hard constraint (quantity limitation per zone) or soft constraints (incentives in price). It is possible to have an auction design with no zonal constraints (the option with the lowest complexity), to apply only hard constraints, only price incentives, or both together. In any case, it is essential that the selected approach is clearly explained in the request for proposal document.

Hard restrictions impose maximum amounts that can be contracted by region. As previously mentioned, it is important to have the limitations explicitly expressed in the auction documents, detailing the maximum amount per product that each zone is able to receive without affecting the system's reliability. This analysis should be focused on major bottlenecks across regions – as the interconnection between the generation facility and the closest substation is typically assumed to be under the responsibility of the project developer. Planned transmission reinforcements expected to come online before the commissioning of the projects may also be considered when defining zonal restrictions, as long as there is a clearly established risk allocation mechanism between the buyer and the seller in case there is a delay in this interconnection coming online (see section 4.4).

Soft restrictions are usually defined as price adjustments that incentivize or disincentivize certain offers. In most cases, the adjustment should be defined based on the marginal additional cost of increasing interconnection capacity between the less-desirable region and the more-desirable region. Once again, it is extremely important to have them defined *ex ante* and published in the request for proposal document. Furthermore, in case soft incentives apply, it is important to take into account the "adjusted price" (rather than the price submitted by each seller directly) when comparing bids, as it will be further detailed in section 5.1.

Even though JPSCo may play a role in the definition of these soft and/or hard constraint parameters for the auction (given their role as transmission system operator), it is important to have their calculations vetted by other independent institutions (such as GPE, the OUR, and perhaps also the Fair Trading Commission) in order to make sure they are fair; as well as transparently publishing this information along with the auction documents. As will be addressed in section 3.5, it is extremely important for the auction mechanism's robustness to ensure that JPSCo is not perceived as having any preferential treatment.

2.6 Right of first refusal

The right of first refusal (RoFR) is a relatively recent legal feature of the Jamaican electricity sector, introduced by the Electricity Act of 2015. The RoFR allows the Single Buyer – JPSCo, the sole utility of the country – to have the first opportunity to replace its existing generation capacity (if and only if JPSCo wishes to decline this priority right, the capacity being decommissioned could be replaced by other private players). The equipment that can be replaced under the RoFR are the ones listed in the Retirement Schedule defined by the MSET, and JPSCo need to satisfy 3 conditions:

- Replacement capacity should be similar to the previous one;

- Generation avoided cost could not be exceeded (projects should be financially attractive);
- New technology should be consistent with the country's Energy Policy.

In this section we will discuss the financial attractiveness and the impact of the RoFR in the auction demand. If should be noted that the Consultants' interpretation is that the RoFR clause only applies to JPSCo's existing generation capacity, and not to renewable generation contracts in general. Therefore, the treatment foreseen for renewable generators at the end of their contractual useful life should not be subject to RoFR, and will be treated separately in section 4.5.

International experience

Seeing that the Right of First Refusal clause is a particular case of Jamaican law, there are not necessarily many countries whose experiences align exactly. It relatively common to have electricity sectors in which both public generators and private generators coexist, and as a consequence it is usually implied that private companies will be responsible for making investments in order to meet part of the electricity generation sector's needs, with the public company being responsible for the remaining necessary investments. Generally speaking, it is more common for the public company to be the "slack variable" (that is, the amount of new investments made by the public company will be whatever is needed to meet the total system needs, after subtracting whatever part of the demand growth that would be met by private generators). However, the practice of reserving a "minimum market size" for the public company (as in the case of Jamaica's RoFR clause) is not unheard of.

For example, in Costa Rica, Law 7200 expands opportunities for private players to participate in the country's generation segment, which up to that point had been dominated by the state-owned company ICE (plus some smaller-scale distributed generation projects in the distribution companies' low-voltage systems). Even though this law played a major role in attractive competitive international investors to the country, it also establishes a limit that private players cannot cover more than 30% of the country's demand. More precisely, up to 15% of the country's demand can be met by small-scale private generation projects (up to 20 MW) contracted directly with ICE (so-called "Chapter 1" projects) and up to an additional 15% purchased by ICE via auctioning processes (so-called "Chapter 2" projects). These maximum participation limits have the effect of protecting ICE's market share, with a similar philosophy as the RoFR, despite the different implementation.

Recommendations

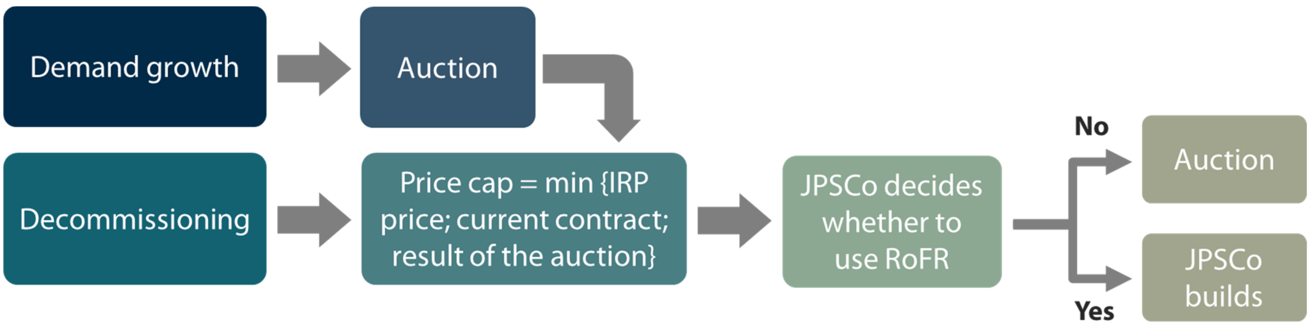
The current definition of the RoFR clause already envisions the need to prove financial attractiveness of the project by means of the "generation avoided cost". The closing price of the most recent auction is used as a benchmark when calculating the generation avoided cost. However, the IRP updates this figure every two years. Nevertheless, when renewable auctions are not a regular occurrence, the IRP estimated price may also be used to update the avoided cost. In this sense, aiming to ensure that JPSCo delivers a project competitive with other players and that its costs reflect the reality of the market, it is recommended to use the *lowest* price between the latest auction result, the current contract price and the avoided cost calculated in the IRP. The only exception to this is in case one of these references is seriously outdated (for example, if there was a shock in the international price of renewable generation equipment since the most recent auction), in which case using the *most recent* reference could be justified.

Another extremely important aspect is the definition of the capacity to be replaced. The current regulation defines that the new capacity should be "similar" to the previous one. However, the evolution in technical definitions and in the technology mix may both lead to changing characteristics. Following the Consultants' recommendation to introduce two different products in the energy sector (see section 2.1), it is important to divide the capacity that needs to be replaced into different demands tranches for each of the products. Therefore, it is important to analyze which services the retiring generator used to provide to the system and to reflect that on the demand to be replaced. This will both ensure that the substitution of the old plant does not have any negative impacts to the system and will allow the retiring capacity to be replaced by a different technology or by multiple different projects.

For example, a retiring 50 MW "peaker" thermal unit that was dispatched for around 2 hours each day could lead to an increased demand for 100 MW×hours/day of firmness product to be awarded to a renewable generator. On the other hand, a retiring 10 MW thermal unit that was dispatched 100% of the time could be substituted by renewable generators offering 8.76 GWh per year of energy-only product (as the most important service provided by this plant is its average output rather than its dispatchability). In practice, given that there isn't a one-to-one correspondence between MW of thermal plants decommissioned and the amount of products offered by renewables that would be needed to replace them (either firmness or energy), in principle the IRP would need to be adapted in order to explicitly determine this correspondence. This would be similar to how, in past Jamaican auctions, demands for the two available contracts were set independently in line with the IRP (the "energy-only" and the "firm capacity with associated energy" products).

It is also important to access the potential impact of the RoFR clause in the auction demand. In case JPSCo decides not to move forward with the RoFR (totally or partially) or does not meet the requirements for replacement, the amount that needs to be replaced should be added to the demand of the next auction – or, alternatively, a new auction may be called in order to fulfill the lacking capacity, in case it is an urgent need of the system and there is no planned auction to be carried out in the short term. The following figure illustrates this process.

Figure 2-5 - Illustration of the Right of First Refusal process. Source: Own elaboration.



3 AUCTION TIMELINE AND QUALIFICATION PROCESS

3.1 Auction timeline

The auction timeline defines the steps of the auction process and the duration of each step. The current process is very long, which may reduce the attractiveness of the auction and prevents it from having a high frequency. In this section, we will discuss the current timeline and proposed some adjustments, envisioning a shortening of the process. Note that we will focus on three main time periods: (i) the period for bid preparation, which represents the crucial time lag for auction participants to analyze candidate projects, prepare all necessary documentation, and submit a bid; (ii) the period for bid evaluation, representing the time between the auctioneer receiving all bids and announcing the auction winners; and (iii) the period for contract signing, representing the time that winners have to sign their contracts and assume the final commitments according to auctioned requirements. The period for bid preparation, being one of the more critical ones, can be subdivided into a period of "pre-analysis" (after an expression of interest, QnA interactions with the auctioneer, and even possibly suggesting some revisions to the terms of reference) and a period for "bid finalization" (after the final round of revisions and until the final bid submission).

International experience

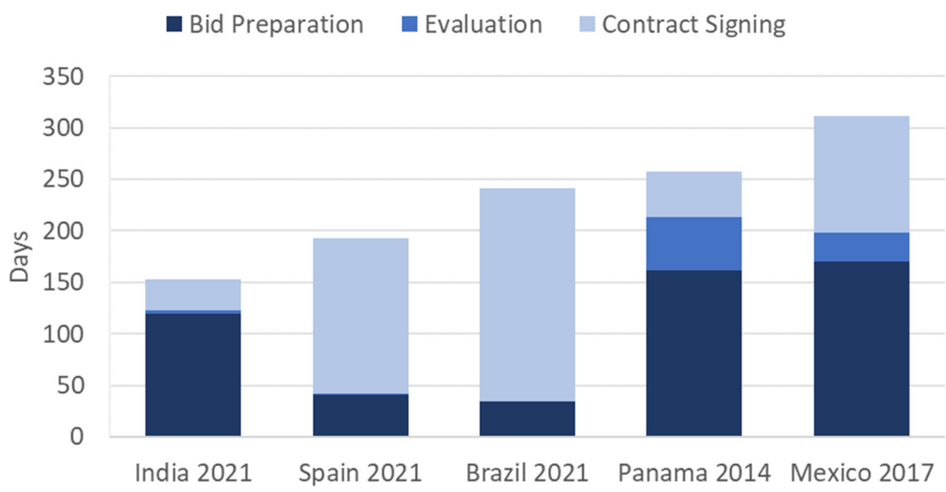
Considering that each country has its own laws and, therefore, is subject to different levels of bureaucracy for the implementation of new energy projects, it is coherent to infer that there are differences regarding the processing time of the auction steps. In that sense, this section presents a comparison between individual examples of auctions held in 5 different countries, considering the 3 main steps between the process of publicizing the procedure terms and conditions and the moment of signing the contract.

Despite our efforts to "standardize" the timeline for each country, differences in the process of each of them mean that there are some caveats attached to the final numbers – although we used an approach that allows for high-level comparisons between countries. In Brazil, for example, the regularity of the auctions (carried out several times per year) and the pre-publication of Ordinances from the Energy Ministry anticipating several elements of the auction's core functioning mean that the period of bid preparation can be relatively short, while usage of an iterative online bidding model implies that the evaluation of bids is carried out on the same day in which they are submitted. In the table below, it is possible to observe that Mexico has the longest interval for the auction process conclusion, with 312 calendar days, of which 170 days are dedicated to the preparation of bids. In the other extreme, India has the shortest process, with a total 153-day duration.

Table 3-1 – Duration (in calendar days) of each of the main steps of the auction process in different countries

	India 2021	Spain 2021	Brazil 2021	Panama 2014	Mexico 2017
Bid Preparation	120	40	35	162	170
Evaluation	3	1	0	51	28
Contract Signing	30	151	207	45	114
Total	**153**	**192**	**242**	**258**	**312**

Figure 3-1 – Visual representation of the total duration of different auctions



Recommendation

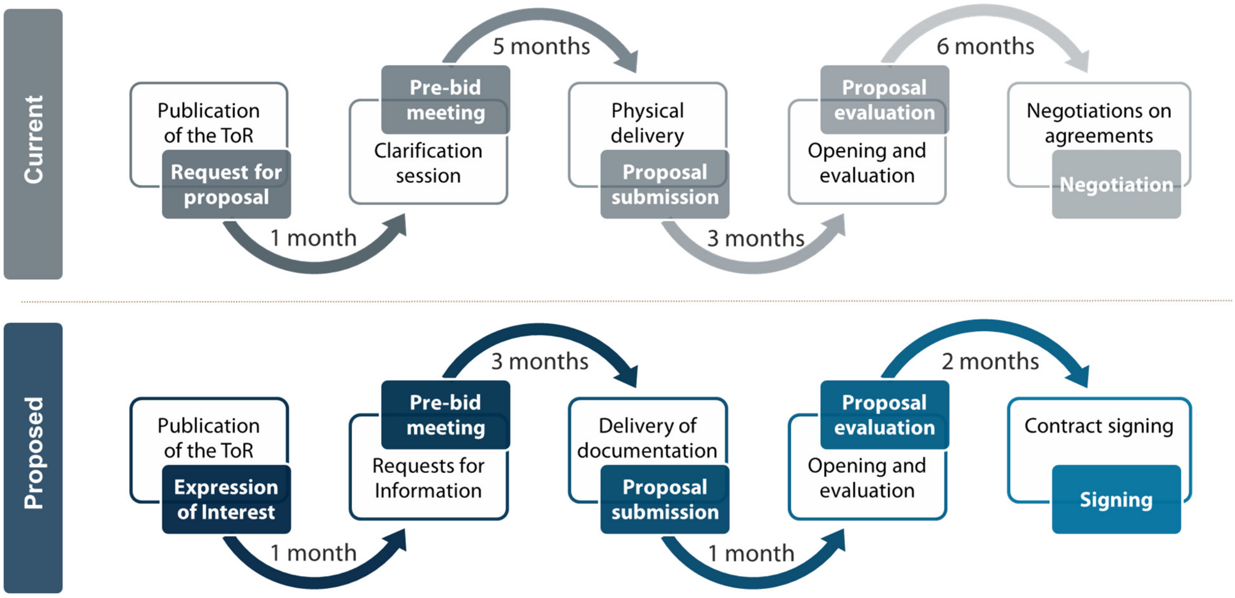
Currently, the process of the auction in Jamaica takes approximately 1.5 years, which is a very long period – as shown by the comparison with the international experiences in the previous section – and contains 5 main steps before awarding the winner. The longest steps are the elaboration of the proposal by the bidders, the analysis process and the negotiation on agreements. The elaboration is usually indeed one of the longest steps, but we believe it could be reduced. The analysis process should be simplified and shortened, and the negotiation phase should probably not exist at all, as all terms and conditions should be very transparently established in the auction documents, including the contract template. Therefore, anyone that puts an offer in the auction would automatically be agreeing with the commercial conditions proposed in the Request for Proposal. In this sense, it is extremely important that for the RfP to be very explicit and precise, and to incorporate the contract model. Furthermore, the qualification and winner selection process should be shortened by simplifying the methodology, as detailed in section 3.3 and in chapter 5 respectively.

Based on the above and on the international experience, the Consultants propose reducing the total time for elaborating the proposal (from the publication of the ToR to the final bid submission, including the time for clarification in a pre-bid meeting) from 6 to 4 months total (of course this would depend on the feasibility of such a timeline both for Jamaican institutions and potential bidders, taking into account bureaucratic considerations and time to get permits). Furthermore, we also recommend reducing the proposal evaluation from 3 to 1 month, and reduce the period between the winner selection and the contract signing from 6 to 2 months, since no negotiations should be needed. Figure 3-2 illustrates and compares the current timeline and the recommendation.

It should be highlighted, however, that the current framework demands the bidder to provide many complex technical analyses, such as technical feasibility study, evidence that there are no impediments to successful delivery and installation of the facilities, environmental impact report, among others. In the 2015 auction, it was also required a detailed project interconnection schedule, showing the proposed interconnection configuration, and costs associated. The amount of technical requirements to be assessed by the bidders on their own certainly makes it harder to reduce the timeline, specially the phase of "elaboration of the proposal". In this sense, it would be interesting to ease a bit the requirements for the qualification or to implement an internal structure that facilitates these studies, as discussed in sections 3.3 and 3.4.

Additionally, it is extremely important to ensure that all winners will be awarded a contract, otherwise potential investors might not be confident enough to participate in the auction. In this sense, it is important to discuss and converge on the auction documentation and the PPA template with the single buyer, who would be the counterparty to the contracts offered in the auction. This could be a phase 0 of the process, before the official launch (incorporating any changes requested by the single buyer before the contract template is made available to the public).

Figure 3-2 – Current *versus* proposed auction timeline. Source: Own elaboration.



3.2 Auction platform

One request that has been frequently seen among participants in the Jamaican auctions is to migrate from the current in-person delivery of documents to a full online process. Additionally, Jamaica already has a web-based platform in place used to support the process of procuring works, services and supplies, the e-Procurement (e-PPS). In this section, we will discuss possible approaches for the auction platform.

International experience

International experiences are generally categorized into two main groups:

- Auctions involving in-person delivery of the necessary documents (typically a Technical Envelope with documents needed for the Qualification phase and a Financial Envelope with the information needed for bid comparison and winner selection). This includes, for example, auctions in Panama and in Chile, and allow more transparency to the bidders regarding the security of their private information.
- Auctions using a specialized online platform in which bidders can log in and submit their information electronically – this category includes countries such as Mexico, Colombia, and Brazil. This type of platform, in addition to consolidating information on the Technical and Financial Envelopes, can sometimes also be responsible for handling the winner selection process in an automated fashion (running an optimization problem with the bidders' electronically-submitted data).

It's worth noting that a "hybrid" auction, in which part of the documentation is submitted online but another part must be submitted in person, is also not unheard of. In Mexico, for example, the bid bond must be delivered in-person (even though all other documentation and even the financial proposal can be submitted online), and after being awarded a contract the bidder must submit physical copies of all documentation that had been submitted electronically for a second round of validation.

Of course, building a specialized online platform is relatively costly, as one needs to ensure that the platform meets strict criteria regarding information security in order to ensure its trustworthiness. However, countries that have implemented liberalized electricity markets typically already have some kind of system that allows this type of functionality (in order to assess electricity measurement results, upcoming payments, and other considerations), and adding auction participation as an additional "service" in an existing platform is much more manageable.

The Consultants are not aware of any countries that have used a general platform for government purchases for handling a centralized auction for long-term electricity contracts (as Jamaica is considering). However, this practice would not be completely without precedence: in the early years of the market liberalization in Brazil, for example, some large industrial consumers in the private sector have launched processes to purchase electricity contracts for themselves using similar existing purchases websites. At the time, there weren't any robust platforms to facilitate this type of negotiation, and a large consumer could be sure to attract a number of bids from potential sellers. Even though this could serve as a potential precedent, it's worth highlighting a few differences between this practice and Jamaica's situation:

- There is a difference of orders of magnitude between an order of purchase organized by a single consumer and an auction that aims to contract enough electricity for the entire country
- A private consumer will typically seek much shorter contracts, which also contributes to a much smaller total value of the contract being negotiated
- A private player can safely rely on any seller being able to meet the entirety of their demand (a request to purchase 10 GWh per year, for example, will likely only attract bids offering to sell the entirety of the 10 GWh demand). This is in contrast with a central auction, in which there can be several winners splitting the target demand, and in which there may be even multiple products being awarded simultaneously (see section 2.4)

Recommendation

e-PPS is a general platform used to support different public procurement procedures. It claims to be designed to support both one-off or repetitive purchases through several dedicated sub-modules providing facilities for user registration, competition notification, bid preparation and submission, online bid evaluation, contract awarding, creation and management of catalogue-based information, placement of electronic purchase orders, electronic invoicing and order tracking. Nevertheless, it is mostly use for one-time payment procurements and relatively small contracts – less than 1% of contracts are over 1million USD and 0 contracts are over 10 million USD. Considering that renewable auctions would be an "unusual" use case for the current website, it is highly important to make sure that the platform is able to support such auctions and to extensively test the required functionalities.

The minimum requirements for the web platform used to hold the renewable auctions are:

- Possibility of more than one document upload per process and ability to keep one of them private. This relates to the financial offer. It is important that it is delivered separately and kept secret from the auctioneer until all bidders go through the qualification process;
- Possibility to input different parameters in the financial offer and check if all of them were fulfilled without knowing their value – also related to the financial offer;
- Validation of security of privacy of data.

Based on the description of e-PPS and on conversation with agents of the sector, it seems that the platform is able to fulfill the requirements previously listed, although they are not the current typical use. In this case, e-PPS is suitable for the renewable auctions, though it needs to be exhaustively tested by GPE.

From the international experience we observe that most countries tend to either use dedicated platforms for carrying out energy auctions or rely on in-person delivery of documents. This is mostly due to the fact that energy auctions have very particular characteristics and patterns that are not easily translated to a general-purpose purchase platform. Nevertheless, and taking into account the preferences of Jamaican stakeholders and potential auction participants, the Consultants believe that the best approach would be to start the online process through e-PPS, of course ensuring that all requirements listed are met and testing them exhaustively. A trial auction with trusted stakeholders would be highly desirable for making sure that the platform works for this case and would also increase the trust of possible investors. In the longer term, as renewable auctions mature, it would be interesting to analyze a possible migration to a new dedicated platform.

3.3 List of requirements

The qualification process contains a list of requirements that need to be met by the bidder in order to have its bid approved as a valid offer. In case these requirements are not met, the financial offer is not even opened, since the bidder is considered not to be able to provide the required services.

The current qualification process is based on a scoring scheme, in which the bidder needs to achieve a target score in order to be approved (as detailed in the Task 1 report). Nevertheless, some aspects of the technical and economic evaluation have a low impact on this total score and the minimum score that needs to be achieved at each stage is only 50%, meaning that in practice many aspects do not need to be fully met by bidders. The scoring scheme also introduces an unnecessary level of complexity to the evaluation process, both from the bidder's standpoint and from the auctioneer's standpoint. Scoring systems can also reduce the transparency of the process– for example, it is unclear how long the period of development and operations of renewable generation projects should be in order to yield the maximum score.

In this sense, we recommend the implementation of only one qualification phase with go/no-go decisions for each of the requirements raised, in which agents must prove their technical and financial capabilities. In this section we discuss the list of requirements that this proposed qualification phase should contemplate.

International experience

Each country defines qualification requirements for participation in electricity auctions based on their own respective needs. Even though all countries have slightly different features in what kind of constraint is imposed, in Table 3-2 we have selected some broad categories of minimum constraints that are applied in different auctions across the world (the same 5 auctions highlighted in section 3.1), serving as inspiration for the Jamaican case. The requirements that were categorized and evaluated are minimum net worth required, existence of projects built or under development, existence of projects with an operating track record, the need to present an engineering project for the generation asset (signed by an expert), the necessity of an environmental license or an operating license, the necessity of a connection permit, and the need to submit a bid bond and completion bond.

The table below summarizes the requirements of each country. It's worth noting that different countries adopt quite different strategies: for example, the Mexican and Spanish auctions require very little disclosure from auction participants, but they rely on the financial liability implied by the bid bond and completion bond (addressed in more detail in section 3.4) in order to ensure that projects will effectively be built. Mexico in particular requires several signed "sworn statements" – for example, the bidder must affirm that they have enough financial capabilities to fulfill the project, and that they have taken the necessary steps to ensure that connecting the plant to the grid is possible (considering the system operator's grid code and interconnection requirements).

Table 3-2 – Qualitative assessment of countries' criteria applied as minimum requirements for auction participation

	Brazil 2021	India 2021	Mexico 2017	Spain 2021	Panama 2014
Net Worth	YES	YES	NO	NO	NO
Projects built or under development	YES	NO	YES	NO	NO
Projects with operating track record	NO	NO	YES	NO	NO
Engineering Project	YES	NO	NO	NO	NO
Evironmental or operating license	YES	YES	NO	NO	YES
Connection permit	NO	YES	NO	NO	YES
Bid bond and completion bond	YES	YES	YES	YES	YES

Recommendation

As previously mentioned, the Consultants' recommendation is to substitute the current two-phase scoring scheme by one single go/no-go phase. It is important to mention that this is compatible to what is implemented in many electricity systems worldwide and that the current scheme allows for many requests not to be met, as the minimum score if pretty low. In this sense, it is more interesting to implement the go/no-go analysis and make sure that the minimum desired aspects are met by the bidders.

In order from most crucial to least crucial, the Consultants' recommendation is to apply the following requirements:

- A bid bond and a completion bond. These are virtually the only requirement that seems to be almost strictly necessary from the international experience, as they serve as a financial liability that ensures the bidder's commitment.
- A simplified form containing technical information on the project to be developed, such as (i) generation technology, (ii) total nameplate capacity of the generation equipment, (iii) desired grid interconnection point, (iv) maximum capacity that can be injected at the grid connection point, (v) project location (municipality and geographic coordinates), (vi) target dates for key project milestones (such as securing financing, starting construction, starting test operations, and full commercial operations date). Note that more detailed documentation could be required instead of (or in addition to) this form, such as a detailed engineering project.
- A connection permit from the Jamaican grid operator, or a similar document or statement ensuring that there is enough grid capacity to accommodate the new project.
- Some kind of documentation referring to past project development experience. This is not a strictly necessary requirement (only three out of the five international experiences presented do require it), but it does tend to increase the reliability of the auction participants. The Consultants recommend to use as qualification requirement a "sworn statement" template containing basic information for individual past experiences by the potential bidder (including financing sources and contact information for validation), which can be filled in by the bidders.
- A minimum net worth requirement. This requirement fulfills a similar role as the past project experience requirement, and once again it serves to increase the reliability of the auction participants, as well as ease the bankability of the project. Nevertheless, depending on the conditions, it may be taken out, since other requirements such as previous experience may be sufficient for ensuring reliability and bankability.

The list above is a succinct summary of the most common requirements that widely used in the international experience. In this sense, the list can be extended with any other requirements that are deemed necessary for the Jamaican system, particularly with regards to legal requirements and institutional involvement.

3.4 Qualification requirement thresholds

Some of the requirements listed in the previous section have an undefined amount"***X***", which must be set as part of the auction design process. Typically, larger ***X*** implies better quality guarantees (only well-established and reputable companies are able to meet these requirements), but may reduce the number of offers and the competitiveness of the auction (as by definition fewer companies would be able to satisfy the minimum requirements to submit a bid). Therefore, it is important to have a good calibration of those thresholds.

Generally speaking, it is desirable to maintain a reasonable level of "strictness" (neither too high nor too low) for each of the qualification requirements, and these should likely be similar to what was practiced in past Jamaican auctions. However, there weren't clear "thresholds" that needed to be met by participants under the previous auctions' scoring scheme, and therefore the recommendations presented in this section will be based chiefly on an analysis of the international experience.

International experience: Bid bond and completion bond

A "bid bond" is some amount of money that reflects the bidder's commitment to participate in the auction and ultimately sign the awarded contracts in case they end up as the winner. The bid bond is simply refunded to all players that do not win the auction, and for players that do win the auction it is typically replaced by a (higher) completion bond that represents the winner's commitment to actually build the project and deliver electricity under the auctioned contract. If the bidder fails to fulfill these commitments, the bonds are lost – and thus, the higher the bonds, the greater the financial incentive for agents to only submit bids if they can actually honor them. However, there is a cost to making these financial commitments, which may impact bidders' strategy and even the auction's competitiveness.

There is a large diversity in how different countries define the bid bond and completion bond in different auctioning processes, as illustrated in Table 3-3 for the same international experiences highlighted in sections 3.1 and 3.3 plus the addition of Jamaica. In order to make those international implementations more directly comparable, assumptions were made in order to translate each of these formulas into a compound value in US$/kW (see footnotes for considerations on project size, capacity factor, investment cost, exchange rate, quantity and price awarded, etc). India doesn't have a bid bond in the terms previously defined (though it does require non-refundable payments by all bidders that wish to participate in the auction, analogous to the Processing Fee in Jamaican auctions) and has one fo the smaller completion bond, while Spain generally has the highest financial commitments. It's also worth noting that Spain and Mexico have a completion bond that is equal to the bid bond.

Table 3-3 – Countries' criteria for setting the bid bond and completion bond

	Bid Bond	Completion Bond
Brazil 2021	R$7500 per 0.1 MW of average baseload production	5% of declared investment cost
India 2021	Doesn´t have	8 Lakhs/MW
Mexico 2017	Defined in UDIs: 300k + 65k*[MW capacity] + 30k*[GWh/y energy] + 15k*[GWh/y green certificates]	Same as bid bond
Spain 2021	60 €/KW	60 €/KW
Panama 2014	US$ 10/kW	200 US$/kW x Installed Capacity (kW)
Jamaica 2015	1% of investment cost	1% of investment cost for energy-only projects

Table 3-4 – Countries' estimated "standardized" bid bond and completion bond in US$/kW

US$/kW	Bid Bond	Completion Bond
Brazil 2021[1]	6.60	40.00
India 2021[2]	-	12.19
Mexico 2017[3]	38.25	38.25
Spain 2021[4]	51.00	51.00
Panama 2014[5]	10.00	200.00
Jamaica 2015[6]	10.00	10.00

International experience: minimum experience

With regards to minimum experience, Mexico is the one with the strictest requirements, a bidder that wishes to sell in the auction a generation plant with installed capacity X must prove: (i) that they have power plants at the operational stage with similar technologies and total installed capacity at least equal to 33% of X, and (ii) that they have power plants at the end of the financing stage (beginning of the construction stage or later) corresponding to a total installed capacity at least equal to 100% of X. Brazil has a similar minimum experience clause that requires experience with projects representing at least 33% of the awarded installed capacity, but it only applies to very large projects (greater than 300 MW).

[1] Assumptions: wind power plant, 44% capacity factor, 4000 R$/KW investment cost and 5 BRL/USD exchange

[2] Assumptions: 49 MW installed capacity, 800 USD/KW investment cost and 75 INR/USD exchange

[3] Assumptions: 30 MW solar plant, sell 25% capacity factor in energy + green certificates products, sell 5% capacity factor in capacity product, assume 1 UDI (MXV, investment unit) is 6.5 MXN and assume 1 USD is 19 MXN

[4] Assumptions: 0.85 USD/EUR

[5] Assumptions: 30 MW installed capacity, 10 MW maximum equivalent power awarded and 100 US$/MWh maximum power price

[6] Assumption: solar power plant, 1000 USD/kW investment cost

Recommendation

Jamaica seems to have a bid bond and completion bond requirement comparatively lower than most international examples surveyed, and Jamaican authorities should evaluate whether this is indeed the choice they wish to make in order to reduce the financial burden of participating in the country's auctions. However, one change the Consultants would recommend is to establish a bid bond that is more directly proportional to the amount of the product offered, given that it is difficult to have credible estimates of the seller's true investment cost. Furthermore, it is important that the bid bond is established in terms of proposed installed capacity, since it is also hard to define it by energy unit.

The implementation of the minimum net worth and minimum experience clause can similarly be based on the international experiences surveyed, following the stricter requirement routes (Mexico in the case of minimum experience and India in the case of net worth) if Jamaica wishes to prioritize ensuring that the bids will be credible and that the projects will effectively be built. Alternatively, if Jamaica wishes to prioritize inclusiveness and auction competitiveness, adopting lower thresholds (and even eliminating one of the qualification requirements entirely) could also be a feasible strategy.

3.5 Auction competitiveness

The existence of a single buyer in the market that is allowed to participate in auctions and compete with other agents may lead to concerns regarding the auction competitiveness and possible advantages that a single agent may have over others.

It's worth noting that, as long as the auction design is fully transparent and there are no opportunities for preferential treatment by the auctioneer, concerns with uncompetitive practices can be severely mitigated. This is a major reason for the complete "ring-fencing" of the entity responsible for the auction organization as a separate and uninterested party, not connected to the single buyer. In this line, the auction administrator's first priority should be to assure bidders of the transparency and fairness of the process, an effort that should take priority over other auction competitiveness schemes – especially given that the single buyer is likely to also participate in the auction as a seller. In particular:

- There should be no concerns that the Single Buyer might have preferential information about other bidders before submitting their bid.
- There should be no concerns that the Single Buyer might be distorting the estimates of grid costs imposed by the projects in order to give their own projects an advantage. Thus, as stated in section 2.5, all transmission costs and constraints should be known ex ante.
- There should be no concern that the Single Buyer might be receiving preferential treatment during the contract negotiation phase. Therefore, as stated in section 3.1, sellers should have little to know flexibility to negotiate contracts after the auction takes place; and negotiations with the single buyer as a purchaser of electricity should take place ex ante (when the single buyer does not know who would be the sellers).

All of these transparency initiatives would contribute to increase the GPE's credibility, and might even lead to no additional mechanisms being needed to ensure auction competitiveness and fairness.

International experience

In Colombia, although the generation and retailing sectors are competitive (even in the regulated market), vertical integration and self-dealing is allowed. However, the negotiation of the terms of bilateral contracts depends on whether the contracted energy is directed to regulated or free consumers. If it is to supply regulated users, it must carry out an auction that allows the participation of any generator and/or other traders interested in selling energy. Bid participants' offers are evaluated exclusively on the basis of prices, with the bilateral contract being awarded to the agent with the lowest price offered. Contracts with free consumers, on the other hand, are more flexible – their conditions (prices and terms) are freely negotiated between the parties. However, to be classified as a free user, in addition to meeting the minimum consumption requirements, he must be represented by a trader that is responsible for registering him as an agent in the wholesale market.

A single company can also be both parties to the contract (such as, for example, suppliers-generators and suppliers-distributors), by entering into an internal energy contract, however, for the purpose of settlement of transactions in the wholesale market, it acts as two distinct market agents, generator and trader or distributor and trader. Nevertheless, there limitations and specific rules for this type of arrangement, which were recently amended by Resolution 130 of 2019: there is a limit on own purchases by the trader. As of January 1, 2027, vertical integrated retailers will be limited to self-dealing in 10% of their regulated demand (even through auctions). Until 2027, there is a transition path that gradually reduces the allowed amount of self-dealing:

- For 2020 and 2021, the percentage of the supplier's own purchases cannot exceed 50% of its regulated demand;
- For 2022, the percentage of the supplier's own purchases cannot exceed 40% of its regulated demand;
- From 2023 to 2026, the percentage of the supplier's purchases cannot exceed 20% of its regulated demand.

Recommendation

Although the Colombian case is of a different market structure, it is developed to avoid market concentration and competitive advantages. In this sense, a similar mechanism can be used in Jamaica for the single-buyer, by limiting the amount of contracts sold in the auction. However, in order to avoid any criticisms regarding differential treatment, the same rule can be made to apply to all participants: for example, to establish a maximum awarding allowance per competitor.

For example, a single bidder may be limited to be awarded up to 50% of the auction demand. The limit of 50% seems reasonable, as Jamaican renewable auctions usually have a medium demand level leading to the award of only a few participants.

Nevertheless, this limit is only a suggestion and can be adjusted by the authorities. It is possible in particular that imposing this maximum share of awarded contracts may lead to a higher auction price. Therefore, if other mechanisms ensuring the transparency and fairness of the auction are implemented and bidders can credibly be convinced that JPSCo has no preferential treatment, an implementation with no additional constraints on the quantity awarded to auction winners can also be feasible.

4 RISK ALLOCATION MECHANISM

4.1 Contract duration and indexation

One important aspect of PPA structure that directly impacts the results of the auctions is the duration of the proposed contract and how prices are indexed. Longer contracts offer more financial predictability for generators, which ease the process of getting credit and financing from reputable institutions. Allowing prices to be indexed to the main driver of costs help the situation even more. In this sense, in this section we will discuss these two topics based on the international experience and envisioning a contract model with well-defined and simple rules that will give bidders predictability on the contract revenues.

International experience

The Panamanian energy auctions were designed to offer two types of products, capacity and energy, through a winner selection criterion that minimizes the present value of the cost of supplying the demand. Thus, offers must be compared considering indexed costs during the term of the contract. In this context, contract prices are subjected to different indexation parameters depending on the auction products composition. It's worth noting that the Panamanian indexing mechanism is relatively complex, and as such it is not necessarily recommended for implementation elsewhere – though this experience serves to illustrate the scope of different indexation options that are available.

Panamanian contract prices of all technology types only will be indexed in case the contract duration is, at least, two years – shorter-term contracts have a fixed price for their entire duration.

The capacity price component is split into two portions according to the so-called IPF factor (which was equal to 10% in the 2021 auction):

- A portion of the contract (equal to the IPF factor) is indexed according to the variation in the price of 30-year bonds of the United States treasure (which in turn is affected by international interest rates)
- The remainder portion (90% in the 2021 auction) is not indexed at all, and simply remains constant in US dollars for the contract's duration.

Note that this indexation rule is consistent with an expectation that the capacity payment is chiefly aimed at remunerating the investment cost and financing terms for building the power plant.

As the indexation parameters affect the power and energy prices awarded, they also apply to penalties imposed on the auction winners. For example, the monthly firm capacity deficit penalty is valued as a function of three times the offered power price, just like the daily penalty for the auction delay, valued in 6 times the offered power price.

Recommendation

Effectively nominating the contract price in US dollars, as it currently implemented in Jamaica, is a very good approach that improves trust of investors and help attracting foreign companies to invest in the country. Therefore, we suggest maintaining this strategy. However, the remuneration of the contract is done in the local currency (Jamaican dollars) and therefore the whole amount to be paid needs to be indexed to the exchange rate – which is what is already practiced.

The Jamaican contract has also historically included both components that are indexed to inflation (the United States' Consumer Price Index) and components that are not. Envisioning to maintain the general approach, but to simplify the bidding process, we suggest allowing the bidder to define the parcel of the price that will be indexed to the US CPI, without explicitly associating this parcel to particular price components in the bid. It is important to highlight that this fraction should impact the evaluation of bids, since an offer 90% indexed to the CPI has a higher net present value than one only 70% indexed – this will be further discussed in section 5.1.

In terms of contract duration, the current length of 20 years is deemed to be reasonable and in line with international practices.

4.2 Firmness quantity incentives

As detailed in section 2.3, the firmness product is designed to provide reliability to the system. Therefore, it is very important to have a strict penalization scheme for the non-delivery of the product, in order to ensure reliable and accurate bids. It is important that only renewables that are truly able to deliver firmness offer this product (e.g. battery portfolios) and any type of "adventurous" bidding needs to be disincentivized by the non-delivery penalties.

International experience

There are several examples of countries that define a "firmness contract" aimed specifically at thermal plants – that is, one that values full dispatchability and does not include any provisions keeping the plant from being fully dispatched several days in a row (a condition that can be difficult for renewable technologies to meet). In this section we highlight some experiences that are better tailored to renewable technologies, in line with our recommendation for Jamaica.

In Mexico, there is a "capacity product" defined in the regulation, that can be negotiated in contracts (independently of electricity) and that is associated with the ability to deliver electricity at the tightest-demand hours of the year. For the purpose of the capacity settlement, there is a distinction between "firm" generators (for which it is assumed that they are always able to deliver their available capacity) and "non-firm" generators (which are assumed to be non-dispatchable and only contribute with their actual generation). Non-firm generators can contribute with the capacity product in a "portfolio" sense, as they are likely to be generating at the tightest-demand hours (thus reducing the amount of firm capacity that needs to be committed). Because "firm" generators are not required to be actively producing, the amount they tend to offer in the capacity market is much higher, and they must be subject to scrutiny in order to ensure that firm generators truthfully inform the operator about their ability to deliver available capacity at peak hours. In order to meet this goal, the Mexican mechanism includes a "penalty for non-supplied request" which essentially applies a 10-fold penalty for each unit of non-delivered electricity at critical hours (if this capacity was declared available by the generator, dispatched by the system operator, but physically not delivered). For example, if the generator delivered its committed firm capacity in 98% of the hours but failed to deliver in 2% of the hours, they will only be remunerated in proportion to 78% of their firm capacity commitment ($98\% - 10 \times 2\%$)[7].

Recommendation

As reinforced in this section, it is important to have a strict penalization scheme in place for the firmness products. Analyzing international practices, the Mexican experience seems like a simple and efficient approach. The Mexican electric market recently went through a reform, leading to the implementation of modern mechanism, and has been very successful in energy auctions since. In this sense, we suggest using the same logic of a penalization equivalent to ten times the non-delivery. Adapting this approach to the firmness product design proposed in section 2.3 would lead to the following formula:

[7] The exact mechanism is detailed in the "Manual de Mercado para Balance de Potencia", section 5.5.3 and Example 8 (page 28)

$$\text{Payment}^{\text{F}} = \text{Quantity}^{\text{F}} \times \text{nhours}^{\text{F}} \times \text{Price}^{\text{F}} \times \left[1 - \mathbf{10} \times \underbrace{\frac{\sum_h \text{FailedDelivery}_h^{\text{F}}}{\sum_h \text{Quantity}^{\text{F}} \times \text{Activation}_{\text{h}}}}_{\text{\% of missed firm capacity delivery}}\right]$$

This means that each MW per hour of non-delivery of the firmness product is penalized as 10 MW per hour were not delivered. We suggest calculating and settling differences every year, although other periods of time could be easily implemented.

4.3 Generation quantity incentives

Differences between the energy generation established in the contract and the delivered amount are also negative for the system. Under-deliveries of energy may lead to a tighter supply-demand balance of the system and harm system planning efforts. Over-deliveries, may also have a negative impact on the system equilibrium and reliability by increasing the risk of renewable energy curtailment, and they may also lead to greater expenses than forecasted by the buyer. On the other hand, some level of variation is expected, since renewable technologies have inherent uncertainty. Therefore, it is desirable to establish reasonable limits for deviations.

Many systems with renewable auctions have a spot market implemented and can deal with these deviations through settlements in the market (that is, whenever a renewable generator produces excess electricity or has shortfalls compared to the contract level, the difference is settled at the spot price). However, because this is not the case of Jamaica, there is the need to implement such a quantity incentive scheme into the contract itself, in order to incentivize accurate estimates of expected yearly production in the auctions.

International experience

Note that, even though a "simple" implementation of an incentive scheme for over- and under-delivery of electricity could be envisioned, in practice it is common to incorporate additional considerations on exemptions and payment profile that make the description of the mechanism more complex. For example, Peru is a country that implements both over- and under-delivery penalties, and its payment scheme can be summarized as follows:

- Net electricity deliveries have a "baseline" remuneration level equal to the Awarded Price, up to an annual limit equal to the Awarded Energy.
- Above the Awarded Energy, net electricity deliveries are remunerated at the short-term electricity market price (that is, the generator becomes subject to spot market risk). This illustrates a "penalty for over-delivery", as excess energy sales are remunerated at a different price. Even though this price is not necessarily lower (it will depend on the market conditions at the time the plant is effectively producing), it is less certain for the generator.
- If the "ideal" electricity production (that is, net electricity deliveries plus any curtailed electricity where the generator is not held responsible) in a given year is lower than the Awarded Energy, the Awarded Price is reduced in the same proportion (by the application of a so-called "Correction Factor"). That is, a generator that produces only 90% of the Awarded Energy (assuming no curtailment) will also be remunerated at 90% of the Awarded Price.
- Starting on the end of the first year, the generator may request a reduction in their Awarded Energy for the following year. This allows a generator to avoid a significant recurring penalty in case the plant's output was initially overestimated.

It's worth noting that in Peru there is no "tolerance" for over- or under-delivery: a generator that produces 1% above the Awarded Energy will have 1% of its revenue dependent on the spot price, and a generator that produces 1% below the Awarded Energy will have its Awarded Price reduced by 1%. The contract model in Peruvian auctions also foresees how exactly the invoices and payment schedule will be carried out each month, and how it is affected by the mechanisms detailed above.

Another example that is less dependent of a market-driven electricity spot price are the reserve energy auctions for wind power in Brazil (carried out between 2009 and 2015). The Brazilian mechanism includes provisions for exchanging surpluses and credits between consecutive years to mitigate the risk of over- and under-delivery, but in very simple terms the contract terms can be summarized as follows:

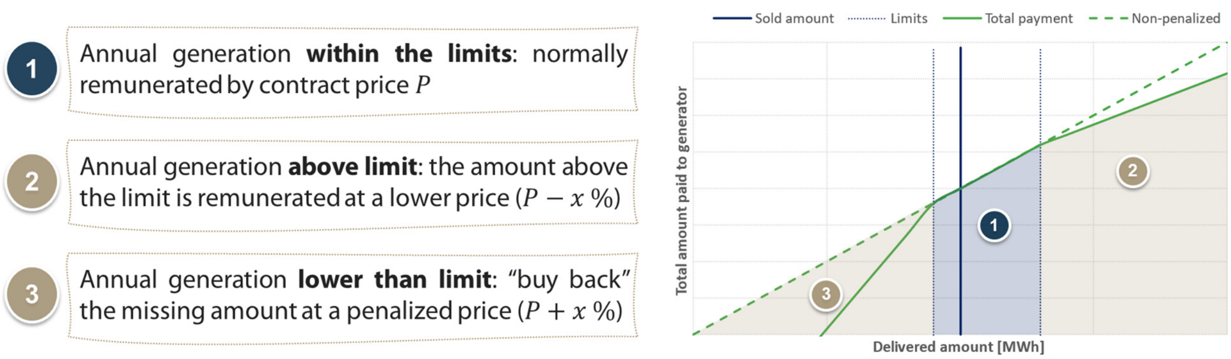
- Whenever a generator produces 90% of their awarded contract or less, the generator must "re-purchase" an amount of electricity equal to this shortfall at a price equal to the Awarded Price plus 15%
- Whenever a generator produces 130% of their awarded contract or more, the generator is remunerated for this surplus delivery at a price that is equal to the Awarded Price minus 30%

Recommendation

As mentioned, some level of control over the delivered amount of energy product is desirable. In this sense, a penalization scheme could be implemented in order to have predictability over the delivered amount (incentivize bidders to bid accurately). It is interesting, however, to establish some reasonable limits, so that only deviations "far away" from the original estimate are penalized, since renewable generation is naturally variable.

The proposed scheme of penalization is to reduce the remuneration price of amounts that surpass the upper limit and to penalize under-deliveries by establishing a clause that oblige the generator to "buy-back" the missing generation (only up to the lower limit) by an increased price. The following figures illustrates the proposed mechanism, with parameters equal to the ones used in Brazil: an upwards-tolerance of 30% and upwards-penalty of 30%, and a downwards-tolerance of 10% and downwards-penalty of 15%. That is, over-delivery (above 130% of the contracted amount) is remunerated at 70% of the price and under-delivery (below 90% of the contracted amount) has to buy-back at 115% of the contract price. Nevertheless, the penalization factors can be adjusted to different levels or even eliminated.

Figure 4-1 - Proposed energy product quantity incentive. Source: Own elaboration.



As an example, we can assume a generator that sold 100 MWh at 100 $/MWh. Then, we can analyze two sample situations involving penalties:

a) Delivery of only 70% of the contract amount:

In this case, the generator would receive the payment for the lower limit amount → $100\ MWh * 90\% * 100 \frac{\$}{MWh} = \$\ 9{,}000$

However, it would need to be buy-back the missing amount $\rightarrow -(90\% - 70\%) * 100MWh * 115\% * 100\frac{\$}{MWh} = -\$2{,}300$

This would lead to an average price for the delivered amount of 95,71 $/MWh or 67,10 $/MWh if we considered the whole sold amount.

b) Delivery of 160% of the contract amount:
In this case, the generator would receive a lower price for the amount that surpasses the upper limit $\rightarrow 100\ MWh * 130\% * 100\frac{\$}{MWh} + 100\ MWh * (160\% - 130\%) * 100\frac{\$}{MWh} * 70\% = \$\ 15{,}100$
This would lead to an average price for the delivered amount of 94,37 $/MWh instead of the original 100 $/MWh.

Settlements should be carried out on a yearly basis, comparing the total annual amount actually delivered with the amount committed in the bid. It's worth noting that the tolerance bands (up to 30% over-delivery and up to 10% under-delivery) serves to mitigate the risk to the investor and accommodate natural interannual variability of renewables. It would also be possible to allow further flexibility to the seller, for example by allowing them to declare an adjustment of up to 2% in the estimated generation for the following year over the contract's duration, so that degradation and possible technical or environmental changes can be incorporated.

4.4 Generation curtailment

Curtailment is defined as a reduction in the output of a generator from what it could otherwise produce given available resources, typically on an involuntary basis (e.g. due to failures, transmission constraints, availability of resources different than planned etc.). Although curtailment is not currently a problem in Jamaica, it is a very important topic that usually comes up as renewables' participation in the generation mix grows. Therefore, as auctions offer long-term contracts, it is a topic that should ideally be addressed in PPA clauses.

International experience

The International Renewable Energy Agency (IRENA) led the Open Solar Contracts project, with the participation of others key market-leading energy stakeholders, to design a PPA template that covers key elements that must be agreed between a solar project developer and a buyer. In that sense, the agreement shall be universally applicable and efficiently designed for small and medium-sized, grid-connected solar photovoltaic projects, and in particular should promote a balanced risk allocation to the agents.

As renewable energy curtailment is an increasingly important topic in modern electricity systems, the document highlights those situations in two different sections, establishing curtailment scenarios and describing agent's obligations when the facilities' capacity to supply electricity is affected for some factor over which the generator has no control.

Events that affect the ability of the facility to generate and deliver energy to the delivery point occurred from the commercial operational date onwards (or from the "deemed" commercial operational date onwards if there was a justified delay out of the seller's control) are considered curtailment events by this PPA template. In those cases, there is a limit that establishes a maximum liability for the contract seller – up to this maximum limit, any curtailment events that occur are entirely under the seller's responsibility (this is therefore a quantifiable risk that ought to be taken into account by the seller in their bidding strategy).

In case this limit is surpassed, the buyer must compensate the project developer with payments on and from the operational date that the curtailment started until normal operations resume. The amount to be paid to the project developer shall be based on the *estimated* solar generation at the time (in turn the estimated solar generation depends on other parameters such as capacity, guaranteed performance ratio and actual solar irradiation). Also, it is important to highlight that the referred document doesn't raise a specific suggestion for this limit, giving this responsibility to the public policy developers according to each country's necessity and bidders' risk appetite.

Recommendation

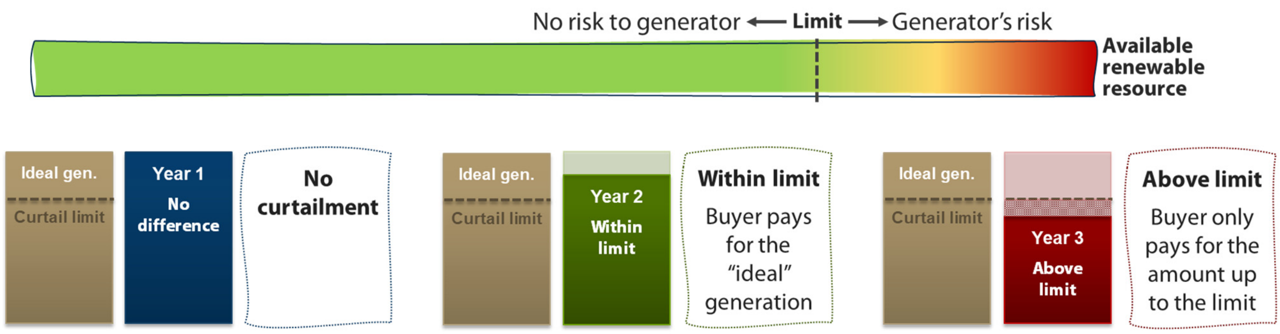
There are many approaches for handling with curtailment risks. Some systems leave all risks to the buyer, others to the seller, but a division of the risk seems very reasonable. It is important to highlight, however, that all risks allocated to the generator will be somehow priced an added to its financial offer. Therefore, the greater the risks that the generator will face, the more likely it is to get higher prices for the product in the auction.

Taking into account the previous arguments, the Consultants recommend dividing the curtailment risks between buyer and seller in following the guidelines from the international experience presented. In this approach, a curtailment allowance level is set. Whenever the curtailment level remains within this limit, the buyer is responsible for buying all curtailed amount, as it was normally delivered. However, the buyer is responsible for paying only up to the allowance level. Therefore, whenever the curtailment amount surpasses the allowance level, the difference between the total curtailment and the allowance level is the responsibility of the generator – meaning that it will not be remunerated for this portion.

It is also very important to highlight that this strategy is only recommended when renewable generators are given priority dispatch. In other words, it is assumed that thermal generators will not be given any priority and will not be dispatched before renewables – or, at the very least, unless there is some kind of well-justified restriction in the transmission system that demands so. Furthermore, as defined in the beginning of the section, only forced reductions in the generation due to external factors are considered as curtailments, meaning that any reductions required by the own generator will not be included in this clause.

In the figure below we illustrate the proposed approach and present a simple example of the mechanism.

Figure 4-2 - Illustration and example of the proposed mechanism for addressing curtailments. Source: Own elaboration.



4.5 Contract extension

The issue of a possible contract extension in the awarded contracts relate to a broader issue on how exactly one should handle differences between the "true" useful life of long-lived assets and their "contractual" useful life. The precise terms that will apply at the end of the contract affects the so-called "residual value" perceived by the bidder – and in case there isn't enough clarity on what terms exactly will be applied, the bidder will need to make a risky bet. For example, if the bidder considers that they are likely to be remunerated beyond the end date of the contract, they may consider a higher residual value when preparing their bid, and if this expectation fails to materialize the project will end up being less profitable than originally anticipated. Similarly, if the bidder conservatively considers a residual value equal to zero, but later is awarded a contract extension, they will end up receiving a windfall profit. In order to avoid both types of situations (unduly harming investors or over-remunerating them), terms at the end of the contract that affect the residual value should be made explicit *ex ante*. In this section we will detail the recommendations for those terms.

International experience

There are several examples of countries that establish clear terms for the remuneration of assets beyond contract duration ex ante (thus providing clear signals to bidders regarding how they should estimate the residual value). Broadly speaking, some of the main routes that could be taken are as follows:

- A first possibility would be to signal that the bidder would be able to continue to own and operate the asset even after the contract expires, but at that point the bidder would have to negotiate new sale terms with a new buyer. This type of approach is most common in liberalized electricity markets, where bidders can be confident that the price of electricity at that point in time will be driven by market forces between electricity buyers and sellers (even if the price level itself has some built-in uncertainty). Countries such as Colombia and Mexico adopt this approach, and generators typically do incorporate a terminal value when designing their bidding strategies for the auction.
- A second possibility is to make it clear that the generator will be awarded no extra revenue after the end of the contract date, and therefore a terminal value equal to zero should be considered. This is most common in "Build-Operate-Transfer" types of agreement, in which a state-owned company typically retains the asset afterwards (several countries have made this type of arrangement in electricity generation, including Turkey and Vietnam). Another possibility is a "forced decommissioning" of the asset at the end of its useful life, rather than transferring to another company (oil-fired peaking units that are no longer valuable to electricity systems are sometimes decommissioned in this way, for example).
- A third possibility would be a decrease in the remuneration of the asset once its contractual useful life ends. It is very common for regulated capital-intensive assets to have contracts of this type (for example, transmission lines and pipelines in Spain and other countries), in which beyond the contract end date the seller's remuneration is reduced to only cover their operating, maintenance, and administrative costs. In the generation sector, Chinese wind power auctions establish an auctioned price that is only valid for the first 30,000 "equivalent full load" hours of operation (around 11 years at typical wind capacity factors) – beyond that point, electricity was to be sold at the "average electricity market price". Brazil also applied such a mechanism to reduce the remuneration of hydro power plants beyond the first 30 years of operation to be equal to the O&M cost (though it should be noted that, contrary to our recommendation, in the Brazilian case there wasn't clarity on what the mechanism would be at the time of signing).

A fourth possibility is the renewal of the contract at "full price", without any discount. This type of remuneration scheme is usually justified by the notion of an asset "replacement value" and the idea that payment should be based on the estimated price of a *new* asset that provides the same service (seeing that, if the asset were to be decommissioned, a similar one would need to be built in its place). For example, in Chile, transmission lines are remunerated based on an annuity value and an estimate of the replacement value regardless of the asset's actual age. This type of mechanism tends to yield a high residual value (which should be taken into account by investors when making their offer strategies).

Recommendation: New renewable contracts

The recommendation for the contract extension clause is to provide a Preferred Renewal scheme for the contract holder. This would give the generator the option to renew its contract for up to 15 years at a discounted price, since the capital costs would already have been remunerated at this time. It is important to mention that no modifications would be done in the contract terms – all obligations would remain as originally agreed. This applies also for modifications in the delivered amount and penalties – even for upgrades in the delivered amount. On the other hand, the contract would not request any modification on the assets.

One aspect that should be clear is that contract extension envisions only to take advantage of the equipment's useful life (when it exceeds the contractual time) and add the possibility of a positive residual value, that may lead to lower bids in the auction. Any additions in capacity or replacement of equipment that needs to be retired should be procured via auctions. This ensures that energy prices will always be compatible with the physical and economic reality of the country, and also improves the auctions' competitiveness.

Regarding the discount that is to be applied in the tariff for the extension, it may vary and depends on the aggressiveness of the buyer. A very aggressive buyer could establish a very large discount (for example, a 75% reduction in the contract value), arguing that this would be sufficient to cover sellers' operational and maintenance cost – although this approach also carries the risk of sellers not wishing to renew contracts once their contractual terms end (forcing the buyer to purchase new capacity at a higher price). On the other extreme, if the discount is too low, the contract renewal becomes less attractive for the buyer.

Nevertheless, it is extremely important that all terms for the renewal are defined at the auction documents, more specifically in the contract template – including the discount factor that ought to be applied in case of contract renewal.

Recommendation: Old renewable contracts

Existing renewable energy contracts, awarded through previous auctions, did not spell out any explicit criteria for renewal – and therefore, negotiations with the contract holders will be necessary regardless. There is currently no reason to expect one way or another whether contracts should be renewed or if the renewable capacity should be decommissioned (and replaced with new capacity sold via auctions, most likely). However, it would be possible to point to the clause of the new renewable contracts and offer similar "take it or leave it" terms for preferred contract renewal (including the application of a discount factor). Because the sellers had no reason to consider a positive residual value when calculating their bids in past auctioning processes, , the discount in price may even be a little more aggressive for those contracts. In case negotiations break down, it is possible to treat the decommissioning renewable capacity as additional demand for new renewable auctions.

5 WINNER SELECTION PROCESS

5.1 Net present value-based bid evaluation

The proposed design for Jamaican auctions allows for the combination of the energy only and firmness products into packages at the seller's discretion. Furthermore, the bidding strategy also allows agents to propose the share of the price of each product that will be indexed to the US CPI. Therefore, the comparison of the bids will demand an adjustment of prices that will result in same-base costs. In this section, we will discuss how this should be handled.

International experience

It's worth noting that not all countries differentiate between different types of indexation for the purpose of bid comparison. For example, in the Israeli auction for solar-plus-storage facilities carried out in 2020, the bid price can be indexed to either US dollars, euros, or new Israeli Shekels in any proportion, and the sellers' choice of combined weights plays no role for bid comparison purposes. However, this is generally not advised, especially when some of the indexation options involve greater risk and/or greater growth rates than others.

Chile is an example of a country that went from considering no adjustment factors for different indices to incorporating them explicitly into the winner selection mechanism. The so-called levelized price is used in Chile to decide the most advantageous offer to the system, and it can be calculated using the offered price and the projections of the relevant indices. The purpose of this calculation is to compare contracts indexed to different factors. In this context, contracts indexed to fuel prices are more expensive than those indexed to the US CPI, as long as the fuel prices projection grows faster than the Consumer Price Index. This type of adjustment prevents sellers from adopting more speculative strategies, such as selecting higher levels of indexation to fast-growing fuel indices than what would be suggested by their true cost breakdown in order to secure higher profits. There is at least one historical case of a winner that adopted such a strategy in older Chilean auctions that did not incorporate these corrections in their levelized cost calculations.

Panama and Mexico are also examples of countries that incorporate the indexation rules into the auctioned price for the purpose of bid comparison. There have also been recent discussions about CAPEX price indexation to certain commodities (such as steel and polysilicon), related to the recent spikes in solar CAPEX as a possible mitigation measure – even though this is a relatively novel approach, it is something that could be explored further.

Recommendation

It is not totally clear how prices are compared in recent Jamaican auctions, nor how indexation and other factors may impact bid comparison. However, as reinforced throughout this document, it is very important to ensure that the auction documents are very explicit and transparent in all aspects, so that investors feel comfortable in participating in the process – especially newcomers and foreign investors. In this sense, it is essential that the algorithm for bid comparison and every detail of the evaluation is explicitly detailed in the RfP.

As the products have different price units, it is important to calculate the levelized cost of each product (energy and firmness, abbreviated by the letters E and F respectively). This is a very common practice in energy auctions, as exemplified in the international experience. Furthermore, as bids may have different indexation rules, it also important to consider the net present value (NPV) of each component. This is also a good practice in case competing projects have different degradation factors and also incorporates different offers of availability for the firmness products. Combining those two leads to a levelized cost formula that considers the NPV of each component, as detailed below:

$$\mathrm{LevCost^E} = \frac{\mathrm{NPV(Quantity^E{\times}Price^E)}}{\mathrm{NPV(Quantity^E)}} \qquad \mathrm{LevCost^F} = \frac{\mathrm{NPV(Quantity^F{\times}nhours^F{\times}Price^F)}}{\mathrm{NPV(Quantity^F{\times}nhours^F)}}$$

Additionally, as discussed in section 2.5, it is possible to have soft restrictions represented by incentives in the price bids. In this case, whenever soft incentives apply, it is important to take into account the adjusted price in the levelized cost formulas, which are typically represented by a simple \$-per-MWh or \$-per-kW parameter defined ex ante. That is, desirable locations would receive a reduction in their bid price and undesirable locations would receive an increase for the purpose of bid comparison, yielding an "adjusted price". Beyond this substitution of the bid price by the adjusted price, the levelized cost expressions remain the same:

$$\mathrm{LevCost^E} = \frac{\mathrm{NPV(Quantity^E{\times}\mathbf{AdjPrice^E})}}{\mathrm{NPV(Quantity^E)}} \qquad \mathrm{LevCost^F} = \frac{\mathrm{NPV(Quantity^F{\times}nhours^F{\times}\mathbf{AdjPrice^F})}}{\mathrm{NPV(Quantity^F{\times}nhours^F)}}$$

Finally, bids should be compared based on the levelized costs of each product.

5.2 Marginal bid handling

One important aspect of the winner selection process is the non-divisibility of offers. In this type of scenario, it is important to define what to do when the marginal bid adds too much to the total contracted amount (e.g. the total demand is for 100 GWh of energy product, but the offers available are all 30 GWh each). There is a tradeoff between over-contracting, leading to higher costs for the system (i.e. purchasing 4 of the offers available, totaling 120 GWh and a 20 GWh surplus), and not attending the auctioned demand, which may lead to reliability issues or create the need of a new auction (i.e. purchasing 3 of the offers available, totaling 90 GWh and a 10 GWh deficit). The tradeoffs involved are made even more complex by the existence of two products, as it is possible to be over- or under-contracted in each of the energy and firmness products independently. In this sense, it is important to have a clear rule for handling the marginal bid, otherwise it may lead to very long negotiations with bidders. This is the main topic of this section.

International experience

As described in section 2.4 renewable auctions in Guatemala involve two types of products, energy and firm capacity, that can be actioned together or separately. In that context, the winner selection is based on a mathematical expression that seeks to minimize the cost purchases of both products for end consumers, while also considering the "opportunity cost" of leaving part of the auction demand unmet. In simple terms, the auctioneer's objective function can be represented as follows:

$$\underset{\mathrm{Quantity}_{kt}^{\mathrm{E}}\ \ \mathrm{Quantity}_{kt}^{\mathrm{F}}}{\text{minimize}} \sum_{kt} \left(\mathrm{Quantity}_{kt}^{\mathrm{E}} \times \mathrm{Price}_{kt}^{\mathrm{E}}\right) + \left(\mathrm{Quantity}_{kt}^{\mathrm{F}} \times \mathrm{Price}_{k}^{\mathrm{F}}\right)$$

Where:

- $\mathrm{Quantity}_{kt}^{\mathrm{F}}$ is the firm power (MW) for period *t* and power plant *k*
- $\mathrm{Price}_{k}^{\mathrm{F}}$ is the price of power (US\$/kW-month) offered for plant *k*
- $\mathrm{Quantity}_{kt}^{\mathrm{E}}$ is the energy (MWh) offered in period *t* by power plant *k*
- $\mathrm{Price}_{k}^{\mathrm{E}}$ is the price of energy (US\$/MWh) for period *t* and plant *k*

One of the offers submitted with the index $k = 0$ is actually a "virtual offer" submitted by the National Comission of Electric Energy (CNEE) as a ceiling price for bids. Those offers are defined for each technology encompassed in the referred auction, acting as a cost if the quantity contracted is less than the auction demand. If it is not possible to meet exactly the demanded quantity, the optimization problem will find the best bid combination able to supply the demand, minimizing overall costs, including those of eventually not attending full demand. Because it is possible to meet the entire auction demand with virtual offers only, the auction always has a feasible solution.

Guatemala has already held three renewable auctions. PEG 1, in 2010, awarded only hydropower plants which 198 MW of firm power were contracted from a power demand of 800 MW. In 2012, PEG 2 awarded other renewable technologies, including hydro, solar, wind, biomass, and other sources that totalized a firm power of 421 MW. Finally, PEG 3 was held in 2013 and contracted 250 MW from multiple sources.

Recommendation

A simple strategy for handling the marginal bid is using the maximum willingness to pay of the buyer (cap price of each product defined in the auction demand stage) to calculate the price of not attending demand. In this way it is possible to quantitively compare the cost of not meeting demand with the cost of over-contracting a product, like it was done in Guatemala.

One important step of this mechanism is to define the price cap of each product (a topic that was addressed in section 2.4). Very high cap prices may lead to substantial over-contracting, which incurs in very high costs to the buyer, which are typically passed through to clients. On the other hand, setting low cap prices can lead to a situation of significant under-contracting, which could have a very negative impact in the system reliability. Under-contracting events can be addressed by carrying out a second “extraordinary” auction to fulfill the unattended demand, which may not be as harmful in case the country is already ahead of schedule for meeting renewable electricity goals.

5.3 Algorithm for winner selection

Finally, with adjusted prices in hand, it is important to have a clear process for the winner selection. This process needs to address all system needs, considering for example any hard grid constraints (as discussed in section 2.5) as well as the processes defined in section 5.2 for addressing various combinations of bids and their corresponding underlying tradeoffs. between over-contracting one product or under-contracting another. Furthermore, envisioning a seamless introduction of the new auctioning scheme, it should be relatively easy to implement. This section will present the Consultant’s recommendation for the winner selection process.

International experience

In Panama, long term generation auctions are conducted by the national transmission company (ETESA). For selecting the auction winners, the auctioneer (ETESA) first ranks all bids according to their levelized cost of energy, from lowest to highest – which allows comparing contracts with different energy delivery quantities and schedules (see section 5.1). Then, they evaluate different possible combinations of these bids, calculating: (i) the total cost of that particular portfolio (combination of bids) and (ii) the percentage of auction demand that is met by that combination. ETESA will select the combination of bids that results in the lowest evaluated price, up to covering the procurement targets indicated in the auction notice, with some flexibility for adjustments by ETESA during the evaluation process (according to criteria established in the auction documents).

As an example, the table below illustrates the winner selection process for ETESA 03-14 solar auction, held in 2014. The rows are the 9 bidders that presented the lowest levelized prices, ordered from the smallest to the biggest price – the top row is the lowest. The columns show the 12 bid combinations evaluated by ETESA. As may be seen from the last row, combinations 1, 2, 5, 6, 9 and 10 did not meet the procurement target (less than 100 in the bottom row). In addition, the auction documents establish a maximum overcontracting limit of 15%, which is violated by combinations 3, 4, 7 and 12 (all yield a total of 115 or more in the bottom row). Among the remaining combinations evaluated (8 and 11), the eighth is the one with the lowest price and thus was the one chosen. It may be noted that bids 3 and 6, despite being individually cheaper than bid 7, are not part of the winning combination 8.

Table 5-1 – Example of the process for comparing different portfolios and selecting a winner in Panama

		Combination 1	Combination 2	Combination 3	Combination 4	Combination 5	Combination 6	Combination 7	Combination 8	Combination 9	Combination 10	Combination 11	Combination 12
Bid	1	X	X	X	X	X	X	X	X	X	X	X	X
	2		X	X	X	X	X	X	X	X	X	X	X
	3			X	X								
	4				X	X	X	X	X		X	X	X
	5						X	X	X	X		X	X
	6							X					
	7							X	X	X	X	X	X
	8											X	X
	9												X
Combination Price (USD/MWh)		80.2	83.8	86.5	87.3	85.5	86.3	92.7	87.3	86.1	86.6	87.9	90.4
Average procurement percentage throughout the contract period (%)		39.9	76.4	116.8	131.8	91.4	97.5	185.9	103.0	88.0	96.8	105.9	116.8

Recommendation

The Consultants' recommendation for the winner selection is a combination of the international experiences in Panama (described above) and in Guatemala (described in section 5.2). The idea is that the auctioneer would select different possibilities of combinations of bids and compare the total cost of each combination in order to find the most attractive one. Any unattended demand should be priced at the product's cap price. It is also important to highlight that any hard restrictions in the physical system should also be taken into account. This means that, if the two bids with the lowest price are located in the same region or substation that, in turn, has a hard restriction, it may not be possible to award both projects.

The following figure presents a small example case. For simplicity, all firm capacity offers and firm capacity demand are assumed to be defined at 1 h/day (see section 2.3 for more details).

Figure 5-1 - Example of demand and bids for illustrating the winner selection mechanism. Source: Own elaboration.

Auction demand

- 1,100 MWh of energy at a max price of 100 $/MWh
- 50 MWh/d of firm capacity at a max price of 10 $/kW.month/(h/d)

Bids

- **Bid 1:** 400 MWh at 50 $/MWh (energy only)
- **Bid 2:** 200 MWh at 60 $/MWh (energy only)
- **Bid 3:** 30 MWh/d at 5.5 $/kW.month/(h/d) + 540 MWh at 80 $/MWh
- **Bid 4:** 30 MWh/d at 6.0 $/kW.month/(h/d) + 360 MWh at 90 $/MWh

The main question is which offers to select, as there is no combination that would perfectly fit the demanded amounts. For exemplifying the evaluation procedure, the following figure details the analysis of the combination of bids 1, 2 and 3.

Figure 5-2 - Detail analysis of one combination of offers. Source: Own elaboration.

Auction demand

- 1,100 MWh of energy at a max price of 100 $/MWh
- 50 MWh/d of firm capacity at a max price of 10 $/kW.month/(h/d)

Bids

- **Bid 1:** 400 MWh at 50 $/MWh (energy only)
- **Bid 2:** 200 MWh at 60 $/MWh (energy only)
- **Bid 3:** 30 MWh/d at 5.5 $/kW.month/(h/d) + 540 MWh at 80 $/MWh
- **Bid 4:** 30 MWh/d at 6.0 $/kW.month/(h/d) + 360 MWh at 90 $/MWh

Option 2: Generators 1, 2 and 3

Bid 1 = 400 * 50 = 20,000

Bid 2 = 200 * 60 = 12,000

Bid 3 = 540 * 80 + 30 * 5.5 * 1,000 * 1 * (12/24) = 43,200 + 82,500

Missing energy = Max{1,100 – 400 – 200 – 540, 0} * 100 = 0

Missing capacity = Max{50 – 30, 0} * 10 * 1,000 * 1 * (12/24) = 100,000

Total = 257,700

Certainly, this process needs to be repeated for each combination that has a chance of being the most cost-effective choice. For example, there is no sense in calculating the cost of the combination of bids 1, 2 and 4, as it would certainly be more expensive than bids 1, 2 and 3 – as bid 4 has higher prices and leads to a greater amount of not-attended energy when compared to bid 3 in this portfolio. Applying this analysis to all pre-selected potentially interesting combinations of bids, we are able to compare the total cost of each package, as illustrated in the following figure.

Figure 5-3 - Example of analysis of combinations in the proposed winner selection mechanism. Source: Own elaboration.

Auction demand

- 1,100 MWh of energy at a max price of 100 $/MWh
- 50 MWh/d of firm capacity at a max price of 10 $/kW.month/(h/d)

Bids

- **Bid 1:** 400 MWh at 50 $/MWh (energy only)
- **Bid 2:** 200 MWh at 60 $/MWh (energy only)
- **Bid 3:** 30 MWh/d at 5.5 $/kW.month/(h/d) + 540 MWh at 80 $/MWh
- **Bid 4:** 30 MWh/d at 6.0 $/kW.month/(h/d) + 360 MWh at 90 $/MWh

Option 1: Generators 1 and 3
261,700

Option 2: Generators 1, 2 and 3
257,700

Option 3: Generators 1, 3 and 4
268,100

Option 4: Generators 2, 3 and 4
260,100

After comparing the pre-selected candidate combinations, the auctioneer would conclude that the option of contracting bids 1, 2, and 3 is indeed the most cost-effective according to the pre-established criteria. It is interesting to highlight that this option leaves half of the firmness demand unattended, but it still more attractive, even though the offer from 4 is lower than the cap price (because the cost of over-contracting the energy product would surpass the benefit of fulfilling the energy demand).

One important characteristic worth highlighting is that the goal is to select the combination of bids that yields the lowest *total cost* for the system. This means that that the combination may contain one offer that is greater than other that was left out. This may occur, for example, when the lower-cost offer is for a greater amount of energy or capacity product that would lead to an over-contracting (which would end up being costlier for the system). In other words, there is a trade-off between size and price. In particular, bigger projects tend to lead to lower energy prices due to economies of scale, but a smaller size power plant may prove to be more attractive regardless, even though its costs is higher. This is a very important dynamic to explain in the auction documents, so that generators understand the system needs and design their offers accordingly. One mechanism that is already in place that can help candidates manage this trade-off is using alternative bids to represent projects of different size.

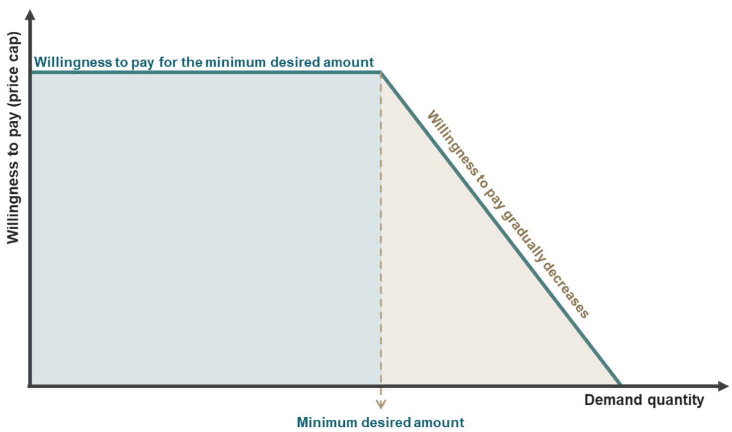
6 POSSIBLE FUTURE REFINEMENTS

There is a trade-off between simplicity of implementation and level of detail of mechanism designs. Therefore, there were some concerns that were not explicitly incorporated in the proposed auction design, as they are currently not too significant for Jamaica (but may become in the future). Nevertheless, such elements could be incorporated in later years, as Jamaican renewable energy auctions gain maturity and provide confidence to participants.

Some examples of future refinements that could be explored further in later auction iterations are listed below:

- Allow competition between renewable and conventional technologies. This would expand the concept of technology neutrality even further and allow any project to bid in energy auctions. This is usually applied in systems that don't necessarily have a strong preference for increasing the participation of renewables in the system and are focused on attending demand at the lowest total cost (but it is possible to explicitly incorporate a preference for renewables in a technology-neutral auctions, such as with a "clean energy certificate" product).
- Refinements in various methodologies for calculating "adjusted prices" for the purpose of bid comparisons (as highlighted in section 5.1). In addition to the grid-related soft constraints discussed in section 2.5, refinements may also be focused, for example, on incorporating hourly profiles of generation, seasonality, and other features of different generation technologies.
- Take into account other types of firmness delivery. The current design is focused on the need for dispatchability on a day-ahead basis and on increasing output in order to meet the peak demand. However, there are other types of "firmness" that could prove desirable, such as flexibility for intra-day dispatch and even the *downward* flexibility of dispatch, that could be addressed through auctions as well.
- Implementing a (transparent) optimization software for comparing bids. The winner selection process could be solved through an optimization model, instead of calculating the cost of the combinations manually as proposed in section 5.3. For the current design, the manual calculations work fine, as the problem is quite simple – the main complexities are the number of possible combinations and the possibility of alternative bids. However, as additional constraints and/or products are added to the design, the complexity of the problem increases and an optimization software becomes more suitable.
- Introduce price-quantity curves for system demand. With this type of design, the buyer has greater flexibility to describe its willingness to pay. For example, the system may strongly prefer to buy up to 80% of the required amount even if the price is higher than expected (so for this portion the willingness to pay will be greater). However, for amounts over the 80% target, the willingness to pay may gradually reduce. The following figure illustrates an example of the application of a price-quantity curve for demand.

Figure 6-1 - Illustrative example of a price-quantity curve of demand. Source: Own elaboration.



7 CONCLUSION

In this report, associated with task 2 of the project "Jamaica: Renewable Generation Procurement Guidelines", the Consultants have presented the recommendations for the Generation Procurement procedures, protocols, rules and award mechanisms to be implemented by GPE. For each topic, a related international experience was presented to support the recommendation.

7.1 On transparency and flow of the auction mechanism

One of the main recommendations that was repeatedly mentioned and reinforced throughout the report is that the documents of the auction, more specifically the RfP and the PPA model, should address all related topics in a transparent and detailed manner. This includes detailing the evaluation mechanism, presenting all formulas used to adjust and compare bids, define the handling of the marginal bid and all other criteria for winner selection, address possible future controversies (such as curtailment and extension of contracts), etc. Whenever suitable, presenting an example of applications can be desirable, in the auction document itself or at least in the clarification sessions.

As for the qualification process, the main recommendation is to simplify the qualification analysis and shorten the auction timeline, which currently envisions a length of 1.5 years. For the analysis, the current score-based steps seem complex, and it is difficult to communicate the auctioneers' most critical requirements to proponents. The suggestion is to replace this process by a simpler step that details a clear list of requirements that should be met on a go/no-go basis. It is important, though, to maintain a similar level of strictness as the previous scheme. Furthermore, focusing on clear rules and mechanisms, and on elaborating a detailed and transparent auction document should prevent the negotiation phase to exist, also helping to shorten the process.

After the qualification phase, the bid evaluation process should be limited to ranking bids. Nevertheless, there might be a need for adjusting prices so that they are comparable. This should lead to having same-based costs for both products and prices that already incorporate incentives and differences in indexation. It is also important that all formulas used to adjust bids are explicitly described in the RfP. The recommended methodology for comparing bids is to calculate the levelized cost of the bids using the net present value of each component, and also applying any of the applicable price incentives. Finally, the auctioneer should select some number of "candidate" combinations of bids and evaluate the total cost for the system of each one of them. The combination that leads to the lowest total cost should be the winner. In this process, any combination that implies in not attending the whole demand should price the missing amount by the price cap of the product (calculated in the demand definition phase). In this way, both trade-offs between the products and between over- and under-contracting (price and sizing) would be addressed.

7.2 On the auction products

In terms of products, the recommendation was to have two separate products, one for energy and one for firmness (or firm capacity). This would mean that the firm capacity product would no longer include an associated energy, allowing bidders to define the amount of each product they wish to offer. This flexibility would help adapt the firmness products to different renewable technologies and would allow a trade-off analysis to help proponents define the optimal sizing of their projects – especially in the case of hybrid projects, such as solar power plants coupled with batteries.

In order to incentivize the declaration of accurate quantities in the offers, some quantity incentive schemes should be implemented. For the energy product, the recommendation is to apply a discounted price for remunerating substantial over-deliveries and to impose a buy-back scheme at a penalized price for significant under-delivery. In order to accommodate the natural variability of renewable energy, limits should be explicitly defined and settlements should be carried out on an annual basis.

Considering the existence of two different types of products, demand should be defined separately for each product. It is also very important that it remains aligned with the system long-term planning and desired evolution, such as national renewable targets. Price caps should be defined by product, so that there is no difference of treatment among technologies. Furthermore, a price cap per product would represent the system's willingness to pay for each product.

Still on the demand subject, even though JPSCo has priority under the Right of First Refusal clause, the demand of each auction may be affected by JPSCo's choice not to move forward with replacement projects (voluntarily eschewing the RoFR). In case of urgency, a new auction could be organized to procure the missing capacity. It is important, though, that the amount to be replaced is divided into two demand tranches – a demand for energy and a demand for firmness. In terms of economic attractiveness of JPSCo's replacement project, the suggestion is to use the result of the latest auction as a benchmark. The other clauses should remain intact.

7.3 On the firmness product

The firmness product was redesigned aiming to be compatible with what renewable technologies are able to provide and still offer reliability to the system. The proposed methodology is of a "call option" scheme that would allow the system operator to request a delivery of energy up to a maximum capacity for a few hours of the day. This design is very flexible and would support different technologies with distinct dispatchability levels to offer firmness to the system, probably improving the offer of the firmness product by renewable technologies.

For firmness, the penalization scheme should be stricter, as the non-delivery of this product harms the reliability of the system. In this sense, the recommendation is to apply a penalization that implies in a loss of revenue for the generator equivalent to ten times the actual non-delivery. As for curtailment, the recommendation is to divide the risk between buyer and seller, by establishing an allowance level of curtailment. Up to this amount, the responsibility is of the buyer. Extra curtailments that surpass this limit is the responsibility of the generator.

7.4 Final considerations

Overall, the Consultants have put together an auction design that should address most of the Jamaican system's needs, while striking a fair balance in terms of complexity between the increasing challenges of the energy transition and the familiarity and receptiveness of the new auctioning scheme by potential bidders and stakeholders. Furthermore, future refinements could be easily implemented given enough time.

One of the main messages is to focus on a very transparent process. The more investors understand the auction scheme and the PPA design, the more confidence they will have for participating in the process. Nothing should be left to negotiations, everything should be very clear in the auction documents. This should help attracting newcomers and possibly foreign investors, improving the competitiveness of auctions – ultimately leading to lower awarded prices and, consequently, lower costs for final consumers.

One issue that has been raised is whether the proposed design is implementable, particularly with regards to the introduction of a firmness product with features to better accommodate renewables' physical characteristics. Even though Jamaica already implements a distinction between the "energy-only" product and the "firm capacity with associated energy" product, it is true that implementing the firmness product as envisioned may require additional adaptations (in the regulation, in the grid code, in the IRP, as well as getting potential bidders on board for offering renewable-backed firmness), and that such efforts could take time.

With this in mind, in case Jamaican institutions consider such an implementation infeasible for their short-term goals, the Consultants' recommendation would be to focus on the energy product exclusively for renewable technologies in Jamaica's next auction(s), and in the meantime to start the discussions that would be required for the implementation of a renewable-friendly firmness product.