AUCTIONS AS A POTENTIAL MECHANISM TO ACCELERATE GREEN MINI-GRIDS IN AFRICA

2017

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The objective of our work is to provide a piece of research that will help inform discussions on the viability of auctions as a potential mechanism to support the scale up of Green Mini-Grids ("GMGs") in Africa

Challenge	Objectives & Methodology
Can auctions be a potential mechanism to support the scale up of GMGs in Africa?	1. Analyse green mini-grids, identify the key barriers to growth and different business models 2. Analyse renewable energy auctions and key lessons learned from case studies 3. Combine the detailed analysis to identify – The key requirements for a successful auction in GMG sector – The main green mini-grids business models and their potential scalability – The compatibility of an auction mechanism with scalable business model(s) – Potential recommendations that can maximise the suitability of the auction mechanism to accelerate the scale up of GMGs in Africa
	In order to gather the information for this report we have • Conducted +30 interviews with industry experts • Used existing extensive public literature on auctions and green mini-grids • Leveraged existing Oliver Wyman analysis and experts insights

Our approach considered three main areas of analysis in order to assess the viability of auctions as a potential mechanism to support the GMG sector

	1 Green mini-grids: Barriers and Business Models	2 Role of auctions	3 Auctions as a mechanism to scale up GMGs
Objective	• Analyse green mini-grids, identify the key barriers to growth and different business models	• Analyse renewable energy auctions and key lessons learned from case studies	• Consider viability of auctions as a potential mechanism to accelerate the scale up of GMGs in Africa
Areas of analysis	• Current mini-grid market in Africa • Main stakeholders involved in GMGs • Analysis of the main barriers to GMG expansion and different possible business models • Illustration of economics of GMGs and identification of viability gap	• Detailed review of global auctions in renewable energy • Key elements that define a successful auction • Case studies and key lessons learned from auction processes	• Assessment of suitability of auctions for GMGs • Barriers to expansion that auctions can overcome • Identification of further barriers that auctions might raise • Potential recommendations that can maximise the suitability of the auction mechanism to accelerate the scale up of GMGs in Africa
Key output	• Identification of key GMG barriers • Assessment of importance of key stakeholders for GMGs • Identification of most scalable models for GMG growth • Suggestions of possible tools to bridge GMG viability gap	• Key advantages of auctions • Success factors for renewable energy auctions • Lessons learned from case studies • ‘Dos’ and ‘don’ts’ for renewable energy auctions	• Recommendations as to how auctions can overcome barriers to expansion • Key recommendations for auction design • Assessment of auctions as a suitable mechanism for scaling up GMGs

Contents

Auctions can potentially be used as a mechanism to support GMG scale-up

Mechanism will require strong public support and an investment framework that ensures that the initial auctions address the key sector barriers

1	**Green mini-grids: Barriers and Business Models**	• The present report focuses on the green mini-grid (GMGs) sector in sub-Saharan Africa. In particular we focus on non-household systems that are not connected to the main grid, with sizes ranging from ~10 kW to ~1–3 MW • The main types of stakeholders in GMGs (consumers, governments/regulators, investors, developers/bidders and DFI/Donors) face specific challenges in this sector. But in general terms, the main barriers to GMG scale up are the lack of GMG specific regulations (e.g. tariffs and grid expansion), unproven business models and demand uncertainty • A scalable business model will require an attractive and commercially viable proposition. Given nascent nature of GMGs, in our view the most scalable business model is a public-private hybrid ("PPP") where the public entity supports GMG development
2	**Role of auctions**	• Renewable energy auctions have become increasingly used for large connected renewable projects given advantages regarding real price discovery, flexibility and contractual commitments as well as their ability to result in lower prices • We identified seven key factors for a successful auction with a particular focus on a clear, transparent and enforceable regulatory framework • Our auction deep-dive case studies focused on large scale renewable energy auctions in Africa (Zambia, South Africa) as well as an initial GMG auction/concessions (Brazil, Senegal) – key takeaways included importance of trust in the mechanism, clear auction design and challenges for initial auctions in GMG sector
3	**Potential features in GMG auctions**	• Auctions can potentially be used as a mechanism to support a GMG investment environment that helps overcome some of the main GMG barriers, e.g. defining an auction regulatory framework (incl. cost-reflective tariffs) in advance of wider regulation, centralising initial due diligence and site screening and supporting access to finance • Auctions should reflect low market maturity and avoid excessive complexity and uncertainty • We highlighted the key design elements for an indicative GMG auction and laid out key recommendations including: – Consider pre-auction bidders workshops, simple pre-qualification criteria and fixed sites/clusters that can ensure scale – Initial focus on result based financing of standalone pilot auctions with long term contract tenures (+10 years) – Allow developers to offer ancillary services and cost-reflective tariffs as well as set up a robust framework for impact of grid expansion

1 2 3

Renewable energy is distributed to the end user by five main systems

Our report will focus on the green mini-grids (GMGs), i.e. renewable[1], non-household and off-grid

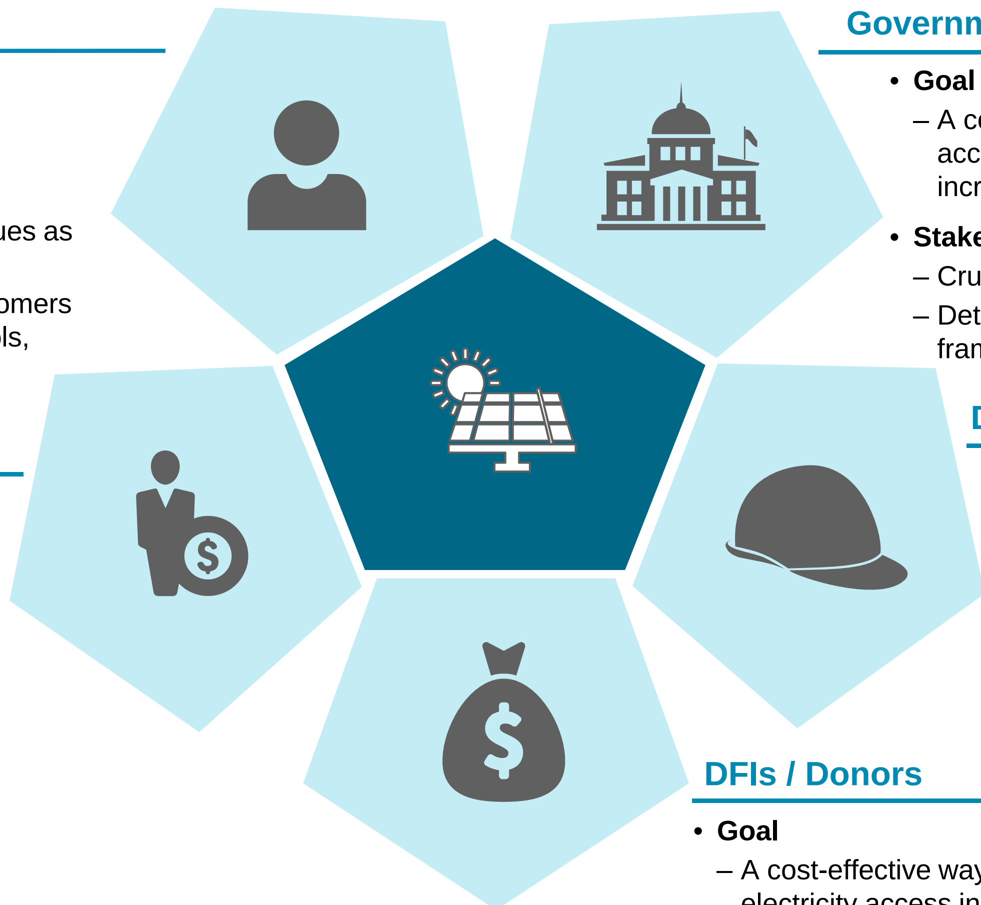
	"Pico-grid" system[2]	Micro-grid system	Isolated mini-grid system	Large off-grid mini-grid system	On-grid system
Typical size	0–10kW	10kW–100kW	100kW–1 MW	> 1 MW	> ~1 MW
Definition	• Isolated power system which usually supplies one or limited number of rural customer(s) without a distribution grid	• Micro-scale electricity generation where produced electricity is fed into a very small distribution grid (usually low voltage and single phase)	• Small-scale electricity generation where electricity is distributed to a limited number of customers via a grid that operates independently of the national grid	• Larger-scale electricity generation with distribution to significant number of customers • Independent from grid but normally compatible with grid	• Generated electricity is fed into the national grid which is run by a national utility or by IPP
Typical features	• Rural areas • Often DC (not grid compatible)	• Rural areas • Can be DC (not grid compatible) or AC	• Typically, semi-rural areas where grid connection is not economically viable • Usually AC compatible	• Near urban areas where grid connection is still not viable • AC	• Urban and near urban areas in developing countries • AC • Large scale
Examples	• Individuals with solar panels on their roofs which are used to power their home • Meshpower, Mera Gau, Devergy	• Powergen, Powerhive, Inensus, Husk Power Systems	• Inensus, Earthspark, Winch Energy	• Mwenga Hydro (Tanzania)	• Main urban centres • Kenya Power • TANESCO

This report focuses on non-household renewable mini-grid systems that are **not** connected to the main grid

1. Hybrids are included under definition of 'renewable' for purpose of this report
2. Excluded from our mini-grid definition given general lack of connected network. Also referred as "household" systems in multiple sources

Source: SE4ALL, Green mini-grid help desk, AfDB, DFID report, Oliver Wyman analysis

There are different types of stakeholders in GMG space, each with specific goals, but all are essential to a successful GMG scale-up



Energy consumers

- **Goal**
  – Cheap, reliable energy
- **Stakeholder importance**
  – Provide the demand and revenues as customers
  – E.g. households, business customers and community services (schools, hospitals, etc.)

Investors

- **Goal**
  – Reliable ROI that appropriately balances risk and return
- **Stakeholder importance**
  – Private investment is needed to help fund developers and scale up of GMG sector

Governments / Regulators

- **Goal**
  – A cost-effective way to increase access to affordable electricity and increase their popularity
- **Stakeholder importance**
  – Crucial for scale-up
  – Determines legal and regulatory framework for GMGs

Developers / Bidders

- **Goal**
  – Clear business proposition which will allow for affordable financing and generate a return
  – Can include equipment providers
- **Stakeholder importance**
  – Build, operate and maintain GMGs

DFIs / Donors

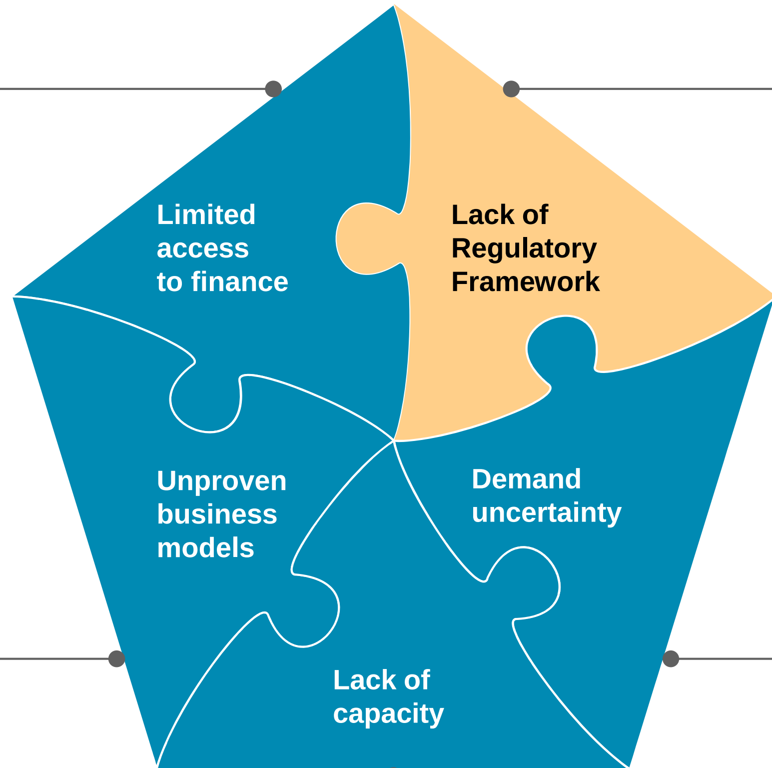
- **Goal**
  – A cost-effective way to improve electricity access in the developing world
- **Stakeholder importance**
  – Needed to help bridge viability gap

Source: Oliver Wyman research and analysis

Main barrier to GMG scale-up is the lack of GMG specific regulations and policies, especially regarding tariffs and grid expansion

Other barriers include unproven business models and demand uncertainty

- Challenging sector to access private finance
  - Lack of predictable cash flows for mini-grids deters investors
  - FX risk – local currency loans with attractive terms are often not available
  - Contracts (offtaker, cost-reflective tariffs) are prone to delays and may not be bankable



- Regulation of tariffs – developers are not able to charge cost-reflective tariffs or access subsidy parity with the grid
- Lack of clarity around what would happen if the grid expands to the mini-grid's area
- Lack of a clear, streamlined licensing and permitting procedure
- Lack of consumer protection, technical regulation and quality of service regulation may further deter investors

- Unproven models in Africa
  - Wide variety of possible models which vary by ownership, size and customer target, each with their own challenges
  - Need to be commercially viable in order to attract any private developers
  - Currently dependent on grants/donors with long term viability challenges

- Lack of skills and experience of public institutions, developers, financial institutions, and local project staff
- Lack of technical assistance and support functions

- Uncertain demand volume profile
  - Highly unpredictable initial demand and demand growth makes accurate business modelling very difficult
  - Lack of clear grid expansion plans in many countries adds further uncertainty
- Carrying out diligence to try to assess demand is challenging and expensive
- Lack of market linkages with communities

Source: Summary of analysis from SE4ALL 2016

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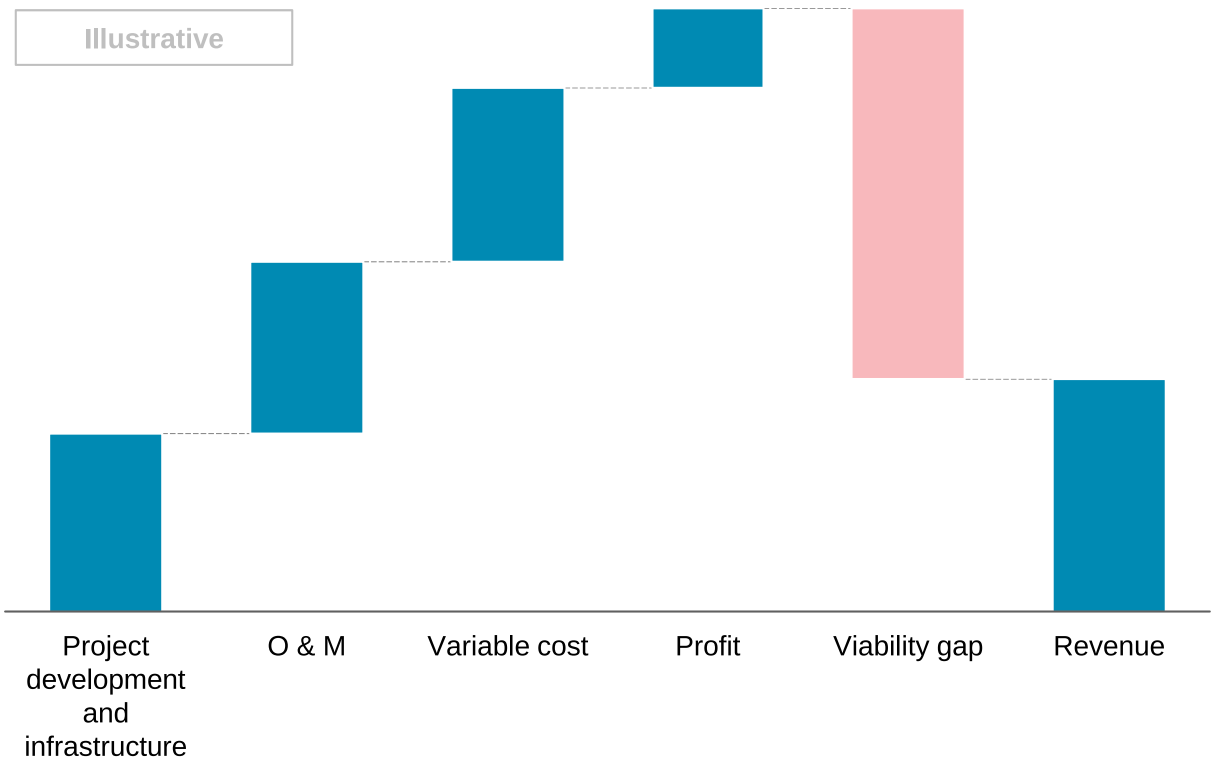
Illustrative financial example of GMG

A combination of financial tools are needed to bridge the gap between the costs of mini-grids and the revenues generated from a uniform tariff

Example of cost / revenue profile for GMG relying on uniform tariff[1]



Comments

- Viability gap between revenues and cost of production needs to be bridged – in the short-term while delivery costs come down, in the long-term to ensure GMGs can access poorest customers
- Bridged by a combination of:
  - Allowing developers to charge cost-reflective tariffs
  - Cross-subsidization (in form FiT to achieve subsidy parity)
  - Ancillary revenues for developer
  - Low interest debt financing
  - Lower profit requirements
  - Grants and donor support
  - Bulk buying units to reduce costs of assets
  - Results based financing
  - Any other cost saving mechanisms

1. Illustrative example based on adjusted hypothetical case given by mini-grid policy toolkit, relying on their base assumptions for cost estimates of 3 systems of 700 kWp PV, 300 kVA diesel, 2.5 MWh C10 battery producing 2420 kWh/d, 79% renewable energy fraction each. 30% debt and 70% equity, no grant funding. Assumes 15 year project duration, 10 year tenure for debt financing, with 8% interest rate and 2 years grace financing. Income tax assumed at 30%. Revenue estimate based on 90% of energy produced each day being used by the end user, having an 80% success rate in tariff collection and a flat tariff of £0.15 (approximately in line with average national tariff paid in 2016 in Kenya) and representative of typical uniform rate. Assumed profit margin of 15% from which shareholders will be paid (no separate cost of equity in calculations).
Source: Mini-grid policy toolkit, Oliver Wyman Research and Analysis

A scalable GMG business model requires a commercially viable proposition

The most scalable business model is a public-private hybrid (“PPP”) where the public entity supports GMG development

	Public	Community	Public-Private Hybrid[1]	Private/“Mini-utility”
Description	• Generation and distribution assets are owned and operated by public utility • Utility typically charges national tariff, cross-subsidizing higher cost electricity with lower cost urban production	• Community / NGO owned generation and distribution assets • Run on a not-for-profit basis • Limited distribution network • Low initial investment and modular	• Some support/involvement from both public and private entities[2] • This can take form of – Outsourcing operation of public assets to private entity – Ownership split of generation and distribution assets – Private ownership with public support in form of funding or a cross-subsidy	• No direct/indirect support from public entity • Generation and distribution owned by private company (at least during concession duration) operating as a mini-utility
Strengths	✓ Cross subsidization possible, though many uniform tariffs are not economically viable ✓ Government typically able to benefit from a lower cost of capital ✓ Economies of scale	✓ Easy to mobilise ✓ Community-centric (high acceptability) ✓ Can be exempt from some regulations ✓ No profit motive so are able to charge tariffs simply to cover costs	✓ Economies of scale (size dependent) ✓ Can leverage public utility’s local experience and regulator access ✓ Leverage private technical/ business skill ✓ Government can achieve lower cost of capital whilst private influence can increase speed and scale	✓ Economies of scale (size dependent) ✓ Focus on financial sustainability ✓ Private financing and capital efficiency ✓ High technical/business skill ✓ Minimal cost for capital constrained governments
Weaknesses	✗ Many utilities are highly capital constrained, meaning they are unable to afford large Capex required to roll out mini-grids at scale ✗ Typically move slower and less dynamic than private sector ✗ Hard to charge cost-reflective tariffs	✗ No/limited economies of scale ✗ Lack of technical/ business skills ✗ O&M challenges ✗ Unlikely to be scalable given lack of economic incentives	✗ No clear tariff/revenue for private role ✗ Lack of clear policy and regulatory framework that defines partner responsibilities ✗ Challenges around aligning the incentives of public and private partner ✗ Public engagement makes it harder to charge cost-reflective tariffs (when affordable)	✗ Might require higher initial capex and cost-reflective revenue ✗ Requires stable regulation and market maturity ✗ Requires higher upfront support to attract investors ✗ Challenges to make it financially viable (subject to ancillary services and/or cross subsidies)
Scalability				

See next page for further details

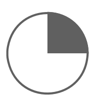
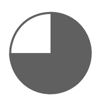
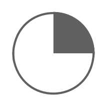
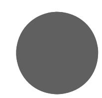
1. Referred to in present document as “PPP”. 2. See next slide for further details

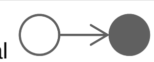
Source: Oliver Wyman research and analysis

Low potential → High potential

A wide range of PPP[1] business models can be considered

Privately owned generation and distribution assets can be the most suited for scaling GMGs

	1. Full public ownership	2. Private generation	3. Private distribution	4. Private ownership with public support
Description	• Public utility / government build and owns generation facility and distribution • Operation of assets outsourced to private sector	• Private sector builds and owns generation, selling power to utility via a PPA • Public utility owns distribution asset and transfers right of use to private	• Public sector owns generation and build/operation is outsourced to private sector • Private sector owns distribution and network assets	• Public sector capital support, e.g. capital grants. • Private sector procures, builds and owns generation and distribution assets
Strengths	✓ Lower cost of capital may lead to lower tariffs ✓ Developer owns customer relationship	✓ Easy method to involve private sector ✓ Grid expansion risk minimised	✓ Private sector may prove more efficient in setting prices and collecting payments from end users	✓ Private financing and capital efficiency ✓ High technical/business skill
Weaknesses	✗ Difficulty finding alignment between private and public parties ✗ Large Capex from government ✗ Having cost-reflective tariffs is particularly challenging given government involvement	✗ Developers are not able to have additional revenue streams from owning customer relationship ✗ Having cost-reflective tariffs is particularly challenging given government involvement ✗ Interface risk	✗ Alignment issues between private and public sectors ✗ Gov. to probably sell electricity below grid price to developer ✗ Having cost-reflective tariffs is particularly challenging given government involvement	✗ Financial support from public entity needs to ensure commercial viability ✗ Requires stable regulation and market maturity ✗ Requires higher upfront support to attract investors
Concessions	• Compatible with some form of concessions where government gives a concession for generation / distribution asset for a set period of time			
Assessment of scalability of PPP model				

Low potential  High potential

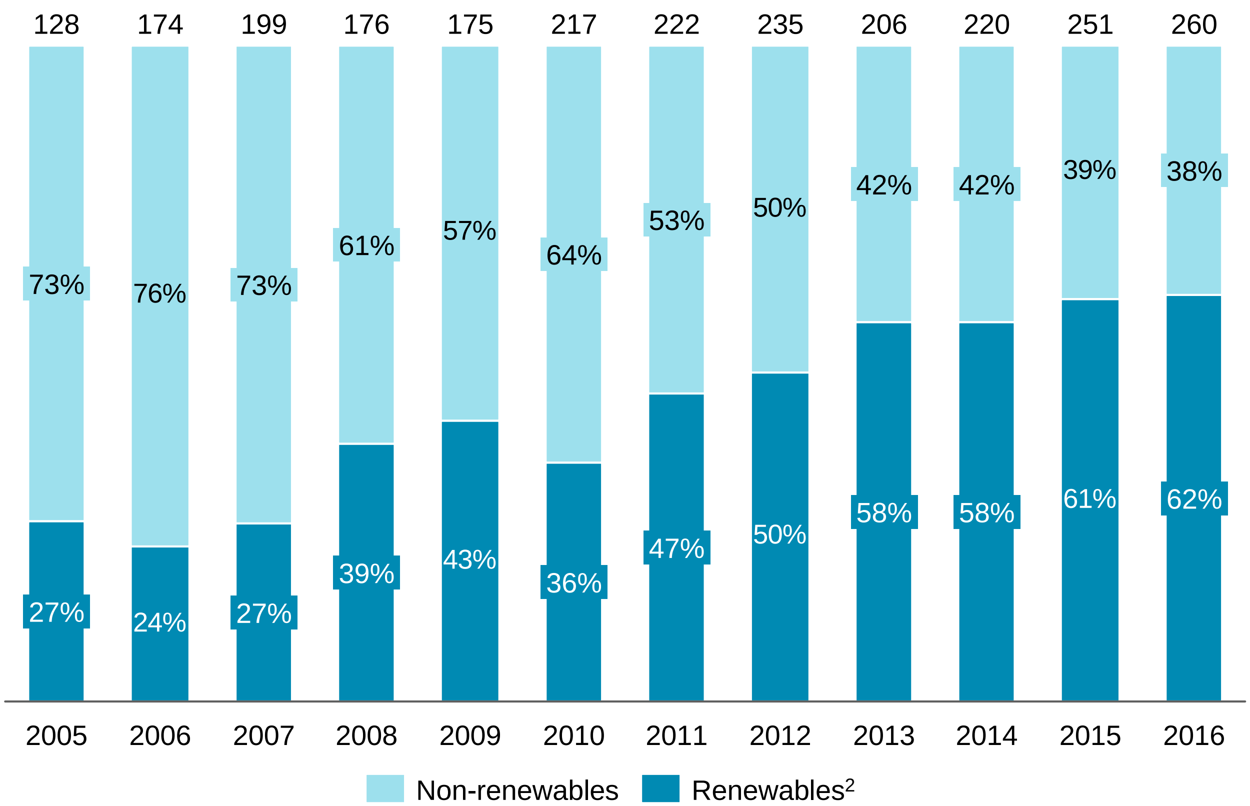
[1] There is no single definition of a PPP. The World Bank defines a PPP as "*a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance*". For purpose of this report, a PPP includes any partnership with participation of a government entity, from asset ownership and risk to only remuneration and/or financial investment.

Source: ESMAP, 2016, Oliver Wyman research and analysis

Significant increase in global renewable energy (RE) generation capacity with sustained future expected growth

RE accounted for over 60% of new power generating capacity added in 2016

Power Capacity Additions[1]
GW, 2005–2016



Comments

- Capacity and output of renewables has continued to grow
- In 2015, for the first time additions of wind power (66 GW) and solar PV (47 GW) exceeded those of hydropower (33 GW)
- In 2016, renewable power represented ~23% of global power capacity[3] . This is forecast to grow to ~46%[4] by 2040
- Note that capacity additions do not consider different load factors, namely lower load factors for renewables

1. IRENA 2017a, REN21, Oliver Wyman Analysis
2. Includes hydro-power
3. IEA, http://www.iea.org/media/publications/weo/WEO2016Infographic.jpg
4. IEA, New Policies Scenario which takes into account current firm policy commitments and further results likely to stem from the implementation of announced intentions

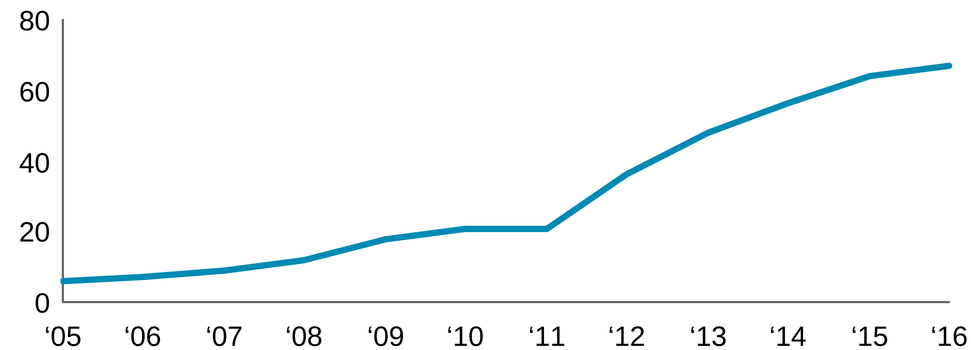
Source: IRENA Rethinking Energy 2017a, IEA, REN21

Increase in use of auctions for scaling up on-grid RE capacity

Auction advantages include real price discovery, flexibility and contractual commitments as well as their ability to result in lower prices

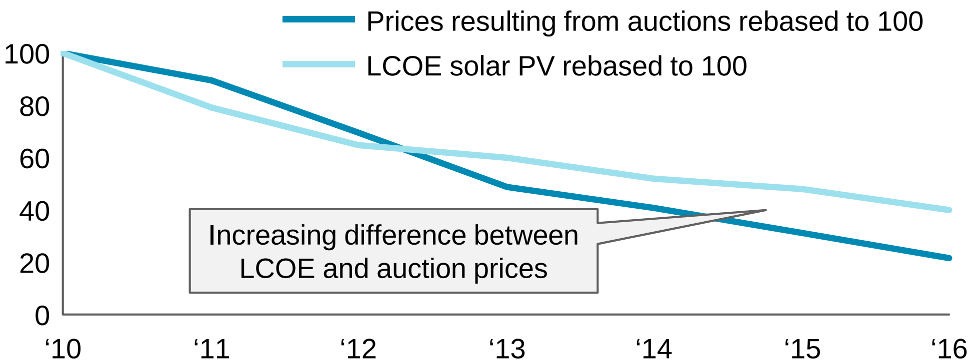
No. countries that have held renewable energy auctions

2005–2016, cumulative[1]



Cost and price for solar PV rebased to 100

2010–2016[2]



Key Advantages

✓ **Real price discovery**
- Brings out real price of what is being auctioned in a transparent and competitive process
- Addresses the problem of information asymmetry between the regulator/government and project developers

✓ **Flexibility**
- Allows possibility of tailoring different elements to suit specific circumstances and goals

✓ **Greater certainty around price and quantities**
- Policy makers can control both the price and the quantity of renewable energy produced by providing revenue guarantees for project developers (similar to FiT) while ensuring that renewable generation targets are met

✓ **Commitments and transparency**
- Results in a contract which clearly states liabilities and commitments of each party

✓ **Capture of reducing technology costs**
- Auctions have allowed governments and consumers to take advantage and realize the benefits of cost reductions more quickly than if contracts, support levels, and/or PPA rates were set administratively

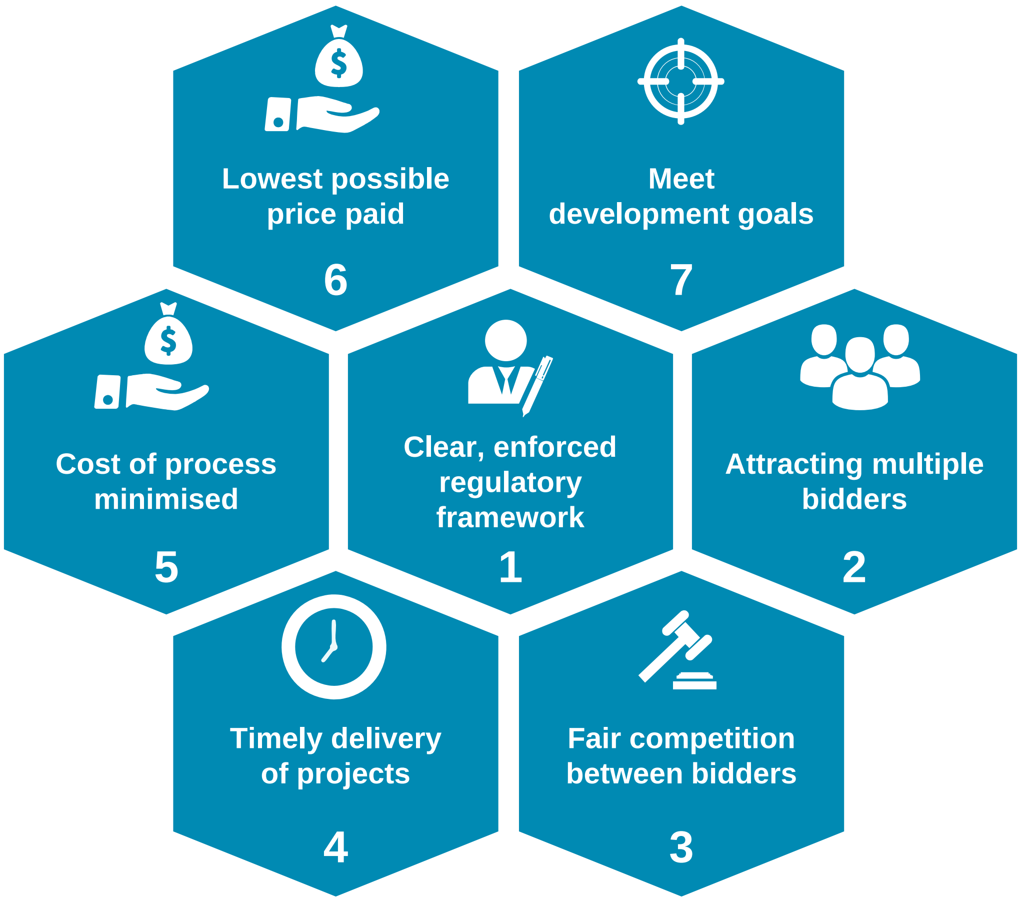
✓ **Efficiency from continued auctions**
- Increasing number of similar auctions reduce transaction costs and repetition increases market confidence in sector

1. REN21, 2005; REN21, 2007; REN21, 2010; REN21, 2011; REN21, 2012; REN21, 2013; REN21,2015. Figures for the years 2006, 2008 and 2009 are estimations from IRENA, 2014 is estimated, 2016 is taken from IRENA Rethinking Energy 2017
2. Estimated using Bloomberg New Energy Finance figures for levelized cost of electricity for Solar PV and IRENA, 2017 for average auction price paid. Reduction in cost not necessarily entirely down to auction mechanism, as some prices from auctions are very low due to e.g. tax credits in USA, whereas this is not taken into account in LCOE.

Source: Oliver Wyman analysis, BNEF, 2016, IRENA, 2013, IRENA and CEM , 2015, IRENA, 2017, all sources listed in note 1

Key success factors for RE auctions

We identified seven key factors for a successful auction with a particular focus on a clear, transparent and enforceable regulatory framework



	Objective
1	Clear auction terms and conditions that are aligned to detailed and consistent regulations[1] which enable successful auction processes and project implementation
2	Attracting multiple bidders to ensure competitive tension and desired capacity is met by suitable developers
3	Having a fair competition in which multiple bidders compete in a non-collusive manner in a transparent auction
4	Ensuring that the project is successfully delivered on time after the auction process
5	Minimising the auction costs for all stakeholders
6	Achieving the lowest priced bids or lowest possible subsidy whilst successfully fulfilling other criteria
7	Meeting any developmental goals that have been set

1. Given nascent nature of GMG sector and lack of robust broad regulatory framework, auctions can provide an investible regulatory “micro-climate”

Source: Oliver Wyman research and analysis

Our review of RE auctions identified key "dos" and "don'ts" for renewable energy auctions

Do	Do not
✓ Ensure that auction design is aligned to the regulatory framework	✗ Attempt auctions without some regulatory stability or, if this is lacking, without minimum guarantees from recognised international 3rd parties such as the World Bank
✓ Demonstrate that policy makers have long term commitment to sector expansion	✗ Have very lengthy lead times as this increases speculative bidding
✓ Advertise auctions and their terms and conditions well in advance	✗ Make early auctions very complex for bidders
✓ Discuss and design the auction with developers in mind, trying to meet as many of their needs as possible without compromising any other auction goals	✗ Have opaque rules and winner selection criteria
✓ Set sufficiently high barriers to minimise unreliable bidders and sufficiently low so that multiple bidders are attracted to the auction	✗ Focus purely on incentivising project build without thinking of maintenance and continued operation
✓ Consider how to minimise collusion risk, e.g. set ceiling prices	✗ Have very small scale auctions that significantly limit commercial viability
✓ Have bid bonds and performance bonds to increase the chance that the winning bidder will sign the contract and then deliver the project on time	✗ Set non-specific technical requirements which allow poor quality developers to undercut higher specification bids
✓ Minimise forex, inflation and interest rate risk for developers	
✓ Invest in thorough due diligence of sites	
✓ Have an experienced team overseeing and advising on the auction process	

Source: Oliver Wyman research and analysis

Case study auction deep-dives

Our deep-dives highlight the (i) importance of trust in the mechanism, (ii) clear auction design and (iii) challenges for initial auctions in GMG sector

	Why has this been chosen?	Key lessons learned
Zambia	• Renewable energy auction in Africa with involvement from World Bank which achieved record low prices for Sub-Saharan Africa	• Auctions can be a cost-efficient way to bring international best prices into new markets • International organisations can play an important role in mitigating political and counterparty risk, and reducing the cost of capital • Thorough diligence for site selection is important
South Africa	• Example of a dramatic decline in prices due to multiple auction rounds and changing key auction design elements	• Auctions can be successful in encouraging a significant scale-up in renewable energy projects • Revealing ceiling prices can lead to an anchoring effect as bidders use price cap • Government commitment and private partner friendly policy environment are important
Brazil	• Examples of an off-grid ("*isolated system*") auction in which renewable energy competed	• Proven interest in auctions for mini-grids from renewable sources • Require longer tenures (no RE bids for 5 year PPAs) • Although LCOE might be lower compared to diesel[1], need to consider other advantages from diesel generation, e.g. market experience and reliability
Senegal	• Example of a regional concession model which was competitively tendered	• If multiple agencies are involved in a rural electrification programme, responsibilities of each must be clearly defined to prevent friction between them • Grid expansion is a serious threat for developers • Direct competition between a subsidy-backed utility and private companies should be avoided

1. Other advantages vs diesel generation also include cost on on-going diesel supply (especially to remote locations), air pollution, noise and maintenance requirements

Source: Oliver Wyman research and analysis

The on-grid RE auctions provide key lessons but different challenges for potential GMG auctions

	On-grid renewable energy auctions	GMG auctions
Description	• Utility scale renewable energy projects have been running for over 20 years, and auctions for over 10 years in most developed countries • Auctions are typically for a PPA to supply electricity to the grid at the lowest rate. Utility then charges end user the national tariff rates	• Nascent sector with no GMG specific auction being held to date • Open question as to exactly what will be auctioned with a wide variety of possible business models pivoting around ownership of assets and customer relationship
Lack of proven business models	✗	✓
Threat of grid expansion	✗	✓
High demand risk	✗ (possible risk for some on-grid IPPs)	✓
Ability to charge cost-reflective tariffs is a serious barrier	✗	✓
Requires building of distribution assets	✗ (connection to main grid might be required)	✓
Large scale projects	✓	✗
Large scale multinational developers	✓	✗ (not at the moment but interest in developed country island tenders)
Developer also has retail presence in domestic market	Possible (e.g. integrated utilities with renewable generation)	Preferred by developers

Source: Oliver Wyman research and analysis

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During our interviews, market participants highlighted some concerns regarding the use of auctions within GMG sector in Africa

Main concerns on regulatory and demand uncertainty and transaction costs

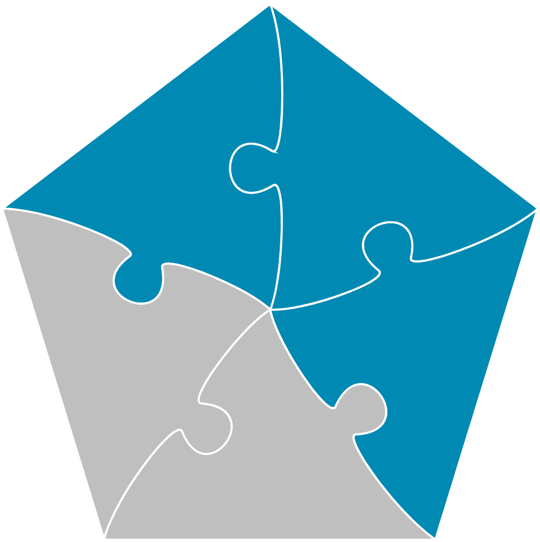
Area	Description	Sub-area	Risk
Policy and Regulations	• Currently the largest area of concern to be addressed in auction process given impact on ability to build and operate mini-grids	• Ability to charge cost-reflective tariffs	
		• Threat of grid expansion	
		• Lack of clear and streamlined licencing procedure and regulation	
Financing	• Challenge to access financing given: – High risk, nascent industry with lack of proven business models – Lack of bankable documents and guarantees	• Auction will need to ensure bankable contracts with credible off-taker and with extended tenures (+10 years)	
		• Limited private investment and equity backing without high return-risk profile within auction parameters	
Business models	• Concern whether auction process will enable mini-grids to be economically viable in the long-term or just focus on short-term objectives • Auctions need to allow developers to have a clear view of the potential business models they can consider according to return-risk profile	• Lack of proven business models	
		• Current dependence on grants/donors	
		• Exposure to off-taker credit risk	
		• Exposure to demand risk	
Site selection	• Uncertainty regarding stakeholder responsible for site selection and the risks this entails was regularly mentioned by developers	• Government carrying out site selection and diligence, providing demand risk guarantee if diligence is proved inaccurate	
		• Independent credible 3rd party carrying out site selection without providing any guarantees	
		• Developer site selection	
Other	• Other key risks mentioned by developers	• High transaction costs in auction mechanism	
		• Potential for long inefficient auction process	
		• Lack of suitably skilled local technicians and operators	

Source: Oliver Wyman research and analysis

Low High

Auction setup will need to consider the key barriers to expansion

Significantly sized auctions with international engagement can directly stimulate a more favourable regulatory and policy environment

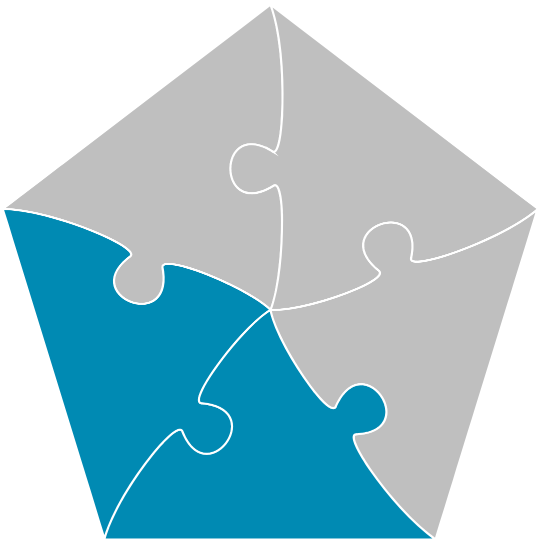


Barrier	Details of how auctions can overcome them
Policy & regulation	• Large scale auctions supported by international bodies such as World Bank could help stimulate government engagement and regulatory change – Unlike individual small scale mini-grids, a larger auction which clusters many sites together (preferably of similar size) can have significant impact on rural energy access through one process. This increases the chance of government and regulatory buy-in • Auctions could be used as a mechanism to test potential changes to regulation and, if successful, act as a precursor to changes – For example, terms such as being able to charge non-uniform tariffs could be included within the main body of the auction terms and if this proves successful, lead to later changes to the regulatory framework
Demand uncertainty	• Centralise site selection process in order to reduce cost of diligence • Market linkages could be improved through governments setting up discussions with local communities as part of the site selection process, allowing communities to opt-in for having a GMG and be included in affordability /willingness to pay assessments
Access to finance	• Auction terms should provide certainty and clear commitments to increase likelihood of affordable finance, e.g.: – Guarantees surrounding possible threats such as grid expansion which decreases investor risk – Having a significantly sized project, overseen by reputable bodies, with a clearly defined bankable contract that defines tariffs and contract duration

Source: Oliver Wyman research and analysis

Auction setup will need to consider the key barriers to expansion

Attracting larger developers will support scale up of technical skills and capacity in GMG market



Barrier	Details of how auctions can overcome them
Lack of capacity	• Best way to increase capacity and skills gained from actually closing projects and carrying out projects • Auctions as a mechanism can: – Increase the number of projects and stimulate local development – Attract international developers who may not otherwise consider developing in those countries – Include local content requirements which can be increased as the local market develops, thus encouraging a gradual increase in local capacities
Unproven business models	• Having proven commercially viable business models will take time • Auctions as a mechanism can: – Help stimulate regulatory change and government buy-in – Set a market derived level of subsidy/tariff at which projects will be able to be commercially viable – Reduce the cost of diligence for developers by centralising costs (and using high quality external advisors for surveys/due diligence, etc.) – Include guarantees around grid expansion and a clearly bankable contract that will decrease financing costs – Set pre-qualification requirements at an appropriate height to ensure that only sufficiently reliable developers are able to bid and thus have the opportunity to prove their business models

Source: Oliver Wyman research and analysis

Auction setup will need to consider the key barriers to expansion

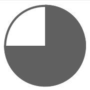
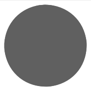
However, important not to add additional barriers for developers, e.g. long process duration and significant transaction costs

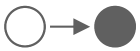
Barrier	Details	How to overcome this barrier
Process duration	• Auctions are complex processes[1] which can take significant front-to-end time: – Auction design and preparation – deciding on all design elements including site selection and winner selection criteria[1] – Bidding process – time from auction announcement to bid submission – Bid analysis – time from bid submission to outcome announcement	• Auction design and preparation – Balance between ensuring the process is well-designed and with clear efficient timetable – Although initial auction design and preparation may be slow (e.g. one year), if done well, future auctions can use previous auctions as a basis which will considerably speed up the process – Slower process if using fixed site selection, as recommended, but will also decrease the time and effort invested by developers in bidding process • Bidding process – Balance between allowing for enough time for developers to carry out work required to submit bids and not delaying the process – This could be streamlined by an online portal which takes developers details and puts them in to standardised bid documentation[2] – Clear articulation/check lists of exactly what is required (e.g. hold bidder workshops) in order to submit an eligible bid will also help to reduce delays • Bid analysis – Standardised bid documentation makes it easier to compare bids on a like for like basis – Analysing whether pre-qualification requirements are met by bidders as bids come in reduces the time between bidding window closing and announcing the results – Simple and transparent winner selection criteria and mechanism
Transaction costs	• Carrying out the required due diligence, hiring advisors, preparing bids, submitting documentation and meeting all pre-qualification criteria can add significant costs, in particular for smaller developers, with no guaranteed return	• Auction design to minimise transaction costs for developers – Predefined regions/sites reduce level of diligence required – Provide bid preparation support to smaller developers (e.g. hold bidder workshops) – Streamline and standardise documentation as much as possible – As mentioned above, online portals with standard documentation templates could minimise time investment for developers and allow for developers to only have to submit their details once even if they bid on multiple auctions[2] • Make auctions sufficiently large that they are economically attractive to developers – Smaller sites should be clustered to allow for economies of scale

1. See Appendix A.1. for the large number of design elements required for an auction. 2. Odyssey is an example of such an online platform.
Source: Oliver Wyman analysis and research

Auctions for GMG sector can have multiple combinations

E.g. reverse auction for the price of electricity generated or the value of the subsidy within tariff

	PPP – Private generation	PPP – Private ownership with public support
Auction possibilities	• Reverse auction based on price per MWh for utility/government to buy generated electricity – Clear and simple reverse auction, as has happened for on-grid auctions which incentivises the developer to produce as much electricity as possible – Terms will need to be specified to prevent over-generation and subject to storage technology in place. This can be done based on demand, a fixed capacity or a fixed number of MWh that will be sold per unit time • Reverse auction for level of Capex support in addition to price per MWh – More complicated as two elements are included in what is being bid for. Mechanism required to synthesis into one price • Fixed price for purchasing energy in PPA and agreed volume, with reverse auction for Capex subsidy – Decreases developers risk of dependence on government over long period of time – If Capex subsidy is significant, it decreases the incentive of the developer to maintain mini-grid	• Reverse auction for level of subsidy above agreed tariff (either uniform tariff or cost-reflective tariff) – Effectively reverse auction for level of feed-in-tariff. Terms need to clearly specify what tariffs are permitted to be charged to end consumers – Note that new connections are key parameter (including cost per connection) • Blend of Capex grant and tariff support – Consider results based financing linked to Capex for connections (grant for fixed cost) – More complex, mechanism will be required to synthesise bids into one price for comparison • Reverse auction for Capex support from government – Decreases developers risk of dependence on government over long period of time – If Capex subsidy is significant, it decreases the incentive of the developer to maintain mini-grid
Most feasible auctioned item	• PPA price of generated electricity	• Value of the subsidy within tariff
Auction suitability		



Source: ESMAP, 2016, Oliver Wyman research and analysis

1 2 3

The initial auctions should reflect the low market maturity and limited sophistication of GMG industry in order to avoid complexity and uncertainty

Auction complexity vs market maturity

Auction complexity: High

Initial auctions in less mature markets can also include a high degree of complexity in order to compensate for potential lack of regulation and policies in place.

Mature auction markets

- High confidence in demand profile
- Tailored auctions that incorporate track record learnings
- Proven business models that are active in market
- Mature and competitive regulations and policies
- Large number of active suppliers and developers
- Trust in mechanism from market stakeholders (consumers, lenders, investors, government/regulators)

Immature auction markets

- Consider significant demand uncertainty
- Pilot auctions
- Strong public support
- Cluster sites for increased scale
- Avoid complex multi-criteria for evaluation
- Enable commercial viability (e.g. results based financing, cost-reflective tariffs)
- Minimise grid expansion risk

Low complexity auctions possible in mature markets but reliant on strong regulations and policies as well as confidence from different stakeholders

Market Maturity: Low – High

GMGs Africa market

- Given GMG is still nascent sector with significant barriers for scale-up, auctions should broadly adopt the initial characteristics
- Initial auctions that can be piloted and refined
- Projects can also be delivered and business models tested as proof of concept regarding GMG scale-up

Source: Oliver Wyman research and analysis

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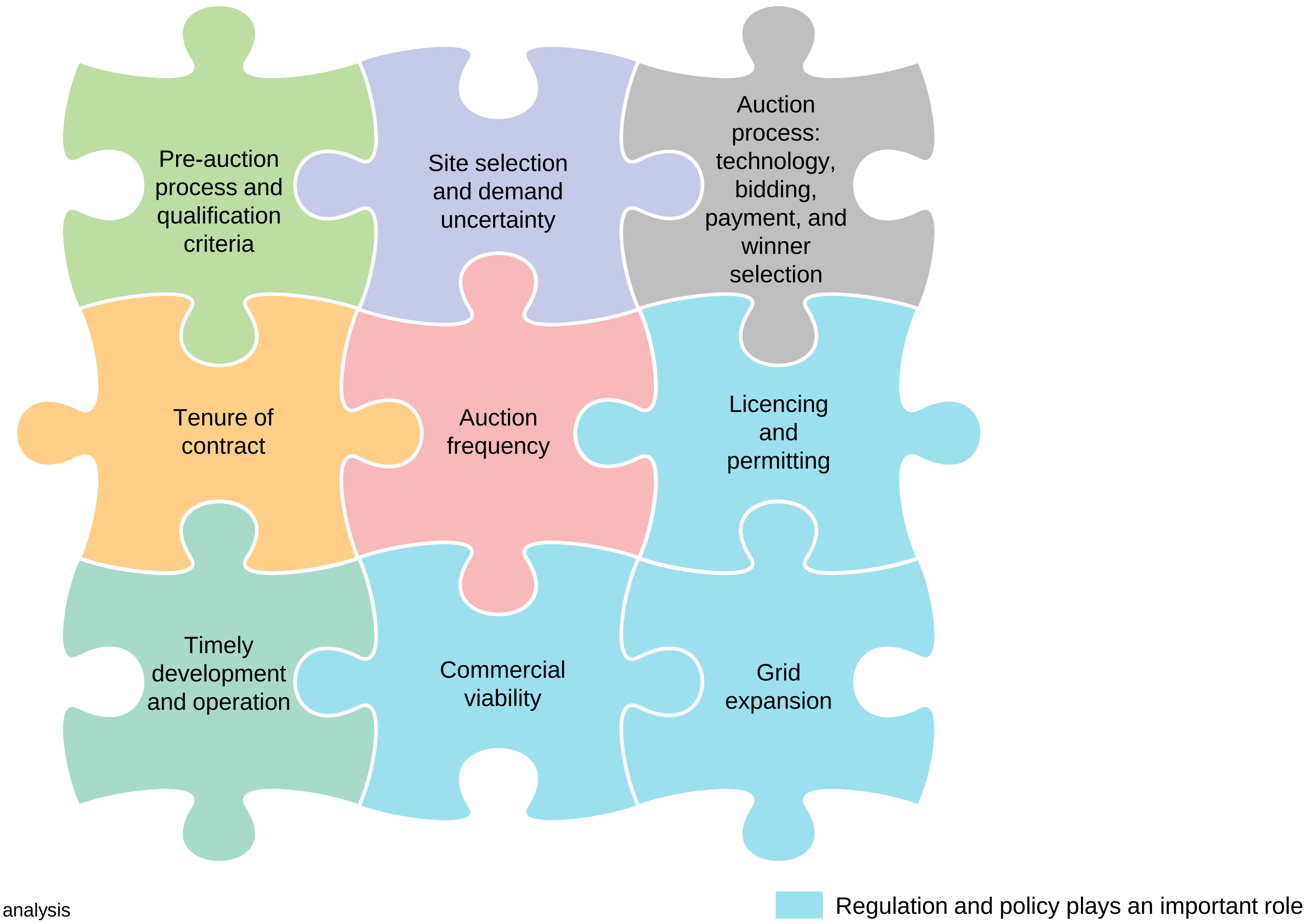
Following discussions with industry experts and developers, we have highlighted nine key design elements for a successful GMG auction



Source: Oliver Wyman research and analysis

Recommendations and trade-offs

Consider pre-auction bidders workshops, balanced and simple pre-qualification criteria and fixed sites/clusters that can ensure scale

	Recommendations	Trade-offs / comments
Pre-auction process and qualification criteria	• Define clear plan regarding **community engagement and willingness/ability to pay** • **Prepare communication plan** in advance (e.g. multi-channel approach) to promote auction • Organise **bidders workshop** to inform potential bidders on project specifics and process. Can also include training for best practice proposal preparation • If possible, **share open information on market potential**, including with lenders/finance	• If contacting developers directly, avoid any suggestion of favouritism • Increased cost and time added to process
	• **Define pre-qualification criteria**, e.g. blend of requirements which minimises low-quality investors and stimulates local development – **Sufficiently high technical requirements** to prevent bidders winning with poor quality specification – **Sizeable bid bond** to ensure only serious developers enter – **Local content requirement suited to individual country** which is steadily increased across auctions as local industry develops – **Low past experience requirements** - Given nascent nature of GMG industry, high past experience requirements will limit growth • Choosing an **experienced team** with a deep understanding of the local market and private sector to set auction qualification requirements	• Having sufficiently high pre-qualification requirements to ensure only reliable, serious developers win the auction whilst not having too high requirements so as to exclude suitable bidders
Site selection and demand uncertainty	• **Site/Community/Region should be fixed** and detailed in auction terms – **Developers could be given opportunity to propose sites for analysis** – **Suitably experienced team** in charge of choosing site/community. This can be done by government/regulators/ 3rd party experts depending on experience • **Ensure community buy-in** – Understand community needs to ensure buy-in for mini-grid by engaging local community before finalising site selection and allowing them to opt-in • **Cluster sites to ensure scale** for developers	• Balancing the relative weight of – Suitability of site for renewable energy source – Size of community being served – Distance from the grid and risk of grid expansion – Level of community buy-in

Source: Oliver Wyman research and analysis

1 2 3

Recommendations and trade-offs

Initial focus on result based financing of standalone pilot auctions with long term contract tenures (+10 years)

	Recommendations	Trade-offs / comments
Auction process	• Given site/community specific auction, **technology specific** auctions are most suitable though not so specific so as to exclude different sub-technologies[1] • Consider **sealed pay-as-bid auctions** • **Minimise complex multi-criteria auctions** – High complexity and low transparency of multi-criteria selection make it unsuitable for initial GMG auctions	• Reducing competition and number of bidders as auction increase specific technology requirements
Tenure of contract	• **Long term contracts (at least 10+ years)** with tariffs ideally linked to a forex metric	• Potential long term uncertainty of counterparty (commitment and responsibility) • Potential government/regulator reluctance to committing to long term contracts
Auction frequency	• **Focus initially on standalone pilot auctions** in order to capture key learnings and evidence proof of concept for GMG auctions • Only **later considering a move to systematic auctions** – Systematic auctions have the benefit of showing government commitment to auctions and encouraging developer investment	• Reducing flexibility of the auctioneer to choose when to hold auctions with announced defined periodic auctions
Licencing and permits	• Consider **licencing exemptions for smaller projects** (e.g. Tanzania) • Licence costs **linked to mini-grid size** • Having a **single licencing national body** that covers all major decisions • Consider land ownership issues upfront in order to avoid later significant delays	• Balancing thorough licencing with speed of overall process - Ensuring that only suitable developers gain permits is balanced with minimising licencing procedure delays

1. For example allow competition between solar PV, solar thermal and solar hybrid technologies

Source: Oliver Wyman research and analysis

1 2 **3**

Recommendations and trade-offs

Allow developers to offer ancillary services and cost-reflective tariffs as well as set up a robust framework for impact of grid expansion

	Recommendations	Trade-offs / comments
Timely development and operation	• Consider **performance bonds** • Appropriately **incentivise continued operation of mini-grid** – Ensuring tariff/return mechanism is still key enabler of successful project – Setting a mechanism to ensure that the developer is committed to the maintenance of the mini-grid	• Setting large penalties for delays of projects or failure to sign contract increases chance of timely delivery but may reduce the number of bidders
Commercial viability	• Consider **result based financing** with clear and transparent process for transfer of capital that is conditioned to the achieved results of the private project • Consider **subsidy parity with grid** when discussing tariff setting mechanism • Enable developers to **charge cost-reflective tariffs where possible** – Regulation should also ensure access for the poorest members of the community – This may be done through a cross-subsidisation model where businesses and high energy users' tariffs subsidize the cost for poorer players • Allow **developers to offer ancillary services to end-users** which can help to stimulate demand, increase their revenues and allow for reductions in electricity tariffs	• Public financing through capital grants can be easier • Defining and agreeing definition of "results" • Having subsidies focussed on initial Capex rather than operating expenses is preferable for developers since it reduces their long term dependence on another party.
Grid expansion	• For initial auctions, **preference for sites/clusters with no risk from grid expansion** • Incentivise assets/infrastructure built in accordance with **technical grid standards** (e.g. AC) so electricity generated from the asset is compatible with the grid in the future • Setup a **grid integration regulatory framework** that considers different integration options: – Allows independently operated mini-grids to be efficiently and transparently connected to the main grid – Enables mini-grid to continue to operate by buying power from and/or selling power to the main grid in such a way that enables commercial viability of the mini-grid – Allowing independently operating mini-grids to sell their grid infrastructure asset to the national utility in an acceptable, transparent and equitable manner	• Lowering risk of grid expansion can mean lower population density and lower demand potential given distance to urbanised/grid-connected areas • Increasing cost and complexity in case of grid technical standard parity

Source: Oliver Wyman research and analysis

1 2 3

In summary, auctions can be a potential mechanism to support the scale up of GMGs in Africa and overcome some of the industry's key barriers

However challenges and trade-offs will need to be considered

Strengths	Weaknesses
✓ Creates forum for developers, governments/regulators and donors/DFIs to come together in a coordinated way	✗ Fails to directly address one of main areas of difficulty which is demand side management and promoting electricity uptake – Demand has proven very difficult to predict even when developers have engaged communities prior to carrying out analysis
✓ Can be used to help to promote regulatory change – Sizeable GMG auctions can help to stimulate government and regulatory change	✗ Can encourage speculation on future energy prices which may lead to risk of underdevelopment
✓ Having centralised diligence can help to reduce overall spend on diligence and encourage developer participation	✗ Setting up an auction process, selecting sites, assigning appropriate pre-qualification criteria and selecting a winner can be a complex, time consuming and costly process
✓ Multi-party engagement can help to reduce risks and decrease financing costs, increasing the chance of developer success	✗ Given relative lack of past experience in GMGs it is challenging to select the best/most appropriate developers by simply using a fixed list of pre-qualification criteria
✓ Attracts developers, adding capacity to the overall market – Large developers who may otherwise not consider entering GMG market, might enter through a structured auction process if sizeable capacity is being offered	✗ Unproven mechanism in GMG space given nascent nature of the sector
✓ Auctions can help to speed up the discovery of commercially viable business models	

Source: Oliver Wyman research and analysis

1.1. Green mini-grids: Barriers

Renewable energy is distributed to the end user by five main systems

Our report will focus on the green mini-grids (GMGs), i.e. renewable[1], non-household and off-grid

	"Pico-grid" system[2]	Micro-grid system	Isolated mini-grid system	Large off-grid mini-grid system	On-grid system
Typical size	0–10kW	10kW–100kW	100kW–1 MW	> 1 MW	> ~1 MW
Definition	• Isolated power system which usually supplies one or limited number of rural customer(s) without a distribution grid	• Micro-scale electricity generation where produced electricity is fed into a very small distribution grid (usually low voltage and single phase)	• Small-scale electricity generation where electricity is distributed to a limited number of customers via a grid that operates independently of the national grid	• Larger-scale electricity generation with distribution to significant number of customers • Independent from grid but normally compatible with grid	• Generated electricity is fed into the national grid which is run by a national utility or by IPP
Typical features	• Rural areas • Often DC (not grid compatible)	• Rural areas • Can be DC (not grid compatible) or AC	• Typically, semi-rural areas where grid connection is not economically viable • Usually AC compatible	• Near urban areas where grid connection is still not viable • AC	• Urban and near urban areas in developing countries • AC • Large scale
Examples	• Individuals with solar panels on their roofs which are used to power their home • Meshpower, Mera Gau, Devergy	• Powergen, Powerhive, Inensus, Husk Power Systems	• Inensus, Earthspark, Winch Energy	• Mwenga Hydro (Tanzania)	• Main urban centres • Kenya Power • TANESCO

This report focuses on non-household renewable mini-grid systems that are **not** connected to the main grid

1. Hybrids are included under definition of 'renewable' for purpose of this report
2. Excluded from our mini-grid definition given general lack of connected network. Also referred as "household" systems in multiple sources

Source: SE4ALL, Green mini-grid help desk, AfDB, DFID report, Oliver Wyman analysis

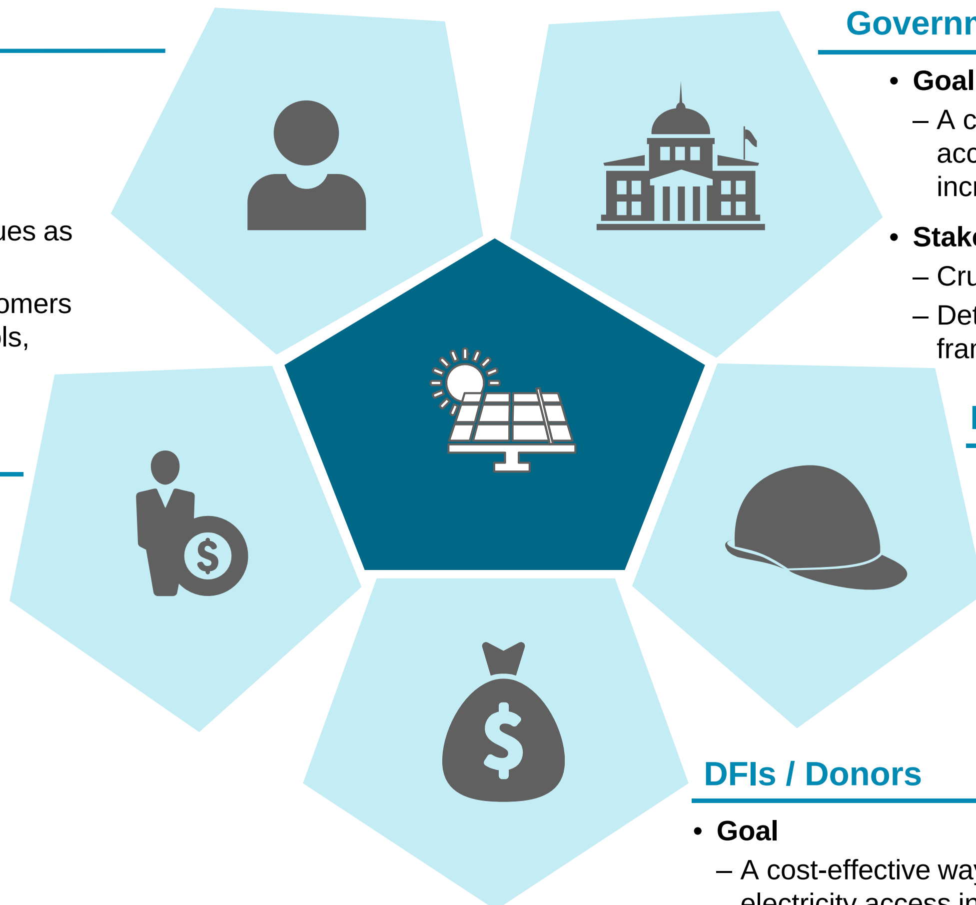
There are different types of stakeholders in GMG space, each with specific goals, but all are essential to a successful GMG scale-up

Energy consumers

- **Goal**
  - Cheap, reliable energy
- **Stakeholder importance**
  - Provide the demand and revenues as customers
  - E.g. households, business customers and community services (schools, hospitals, etc.)

Investors

- **Goal**
  - Reliable ROI that appropriately balances risk and return
- **Stakeholder importance**
  - Private investment is needed to help fund developers and scale up of GMG sector



Governments / Regulators

- **Goal**
  - A cost-effective way to increase access to affordable electricity and increase their popularity
- **Stakeholder importance**
  - Crucial for scale-up
  - Determines legal and regulatory framework for GMGs

Developers / Bidders

- **Goal**
  - Clear business proposition which will allow for affordable financing and generate a return
  - Can include equipment providers
- **Stakeholder importance**
  - Build, operate and maintain GMGs

DFIs / Donors

- **Goal**
  - A cost-effective way to improve electricity access in the developing world
- **Stakeholder importance**
  - Needed to help bridge viability gap

Source: Oliver Wyman research and analysis

Key stakeholders in GMGs

Having Government and Regulator buy-in to GMGs is a crucial component of accelerating growth

	Energy Consumers	Governments/Regulators
Goals	• Cheap, reliable energy	• A cost-effective way to increase access to affordable electricity and increase their popularity
Challenges	• The cost of providing energy to end users in non-urban areas where mini-grids are suitable, is considerably higher than urban areas, making it difficult to receive cheap energy	• Capital constrained utilities do not have the funds to pay for highly capital intensive mini-grid projects
	• A large number of customers want the most electricity in the evenings which is a challenge if GMG is solar powered as it means there needs to be either large batteries or some kind of hybrid technology	• Challenge setting appropriate regulations for a new and rapidly developing industry that encourages private investment whilst preventing exploitation of its citizens – Often capacity constrained with a regulatory framework more suited to utility scale on-grid electricity generation
	• May be frustrated if charged higher than national tariff rates when they know colleagues / friends who pay considerably less for their energy	• Looking for proof that mini-grids are an effective solution to electrification problem and developing a suitable regulatory framework to support this
	• Highly reliable energy requires high quality distribution grid and preferably surplus supply which will further increase the cost of GMG	• Normally sets tariffs based solely on generation costs, however, this fails to take into account significant distribution and maintenance costs of mini-grids
		• Given new nature of GMGs there is a lack of skills and experience in this nascent industry
		• Lack of reliable data on demand for electricity making it difficult to justify/model investments in GMG, and diligence is expensive
Stakeholder importance	• Provide the demand and revenues through buying electricity	• Having government and regulatory buy-in to any GMG programme is crucial for ensuring the scale up of GMGs
		• Without government and/or regulation that allows for the possibility of profitable GMGs, then there will be no private sector engagement

Source: Oliver Wyman research and analysis

Key stakeholders in GMGs

DFIs/Donors play an important role in bridging the viability gap between the cost of GMGs and the revenue they will likely generate

	Investors	Developers	DFIs/Donors
Goals	• Reliable return on investment that appropriately balances risk and return	• Clear business proposition which allows for affordable financing and generates a return	• A cost-effective way to improve access to electricity in developing world
Challenges	• Lack of proven business models, high political and demand risk, means very high return is needed to justify high risk investment. This cannot be offered by developers for whom it is already a challenge to generate a return	• Challenge accessing financing given lack of proven business models, bankable documentation, high risks and lack of regulatory support	• Have significant capital but want to ensure it is appropriately used and will have desired impact • Particularly, there has been a challenge ensuring successful O&M of donor funded GMGs
	• Many developers are unable to charge cost reflective tariffs which makes economical case unviable	• Challenge to make a positive ROI without significant financial support and and/or being able to charge cost-reflective tariffs	• Increasingly looking to RBF[1] to try to ensure that goals are met and to increase the rate of developmental change
	• Challenge finding reliable developers to invest funds with given nascent nature of GMGs and thus lack of proven track record	• Wants regulators to consider total costs (including distribution and maintenance) when assessing tariffs	• Private and governmental engagement is needed to accelerate growth of GMGs in but this has been difficult to attract
	• Concern over lack of grid integration framework		
	• Given new nature of GMGs there is a lack of skills and experience in this nascent industry		
	• Challenges over time consuming process to achieve licences and approvals to set up a mini-grid		
	• Lack of reliable data on demand for electricity making it difficult to justify/model investments in GMG, and diligence is expensive		
Stakeholder importance	• Private investment is needed to help to fund the developers	• Developers are needed build, operate and maintain GMGs	• DFIs and donors are needed to help bridge the viability gap between the cost of building and O&M of mini-grids and the revenue they will likely generate
			• Provide important 'first loss' funding to prove concept and encourage private sector investment

1. Results based financing.

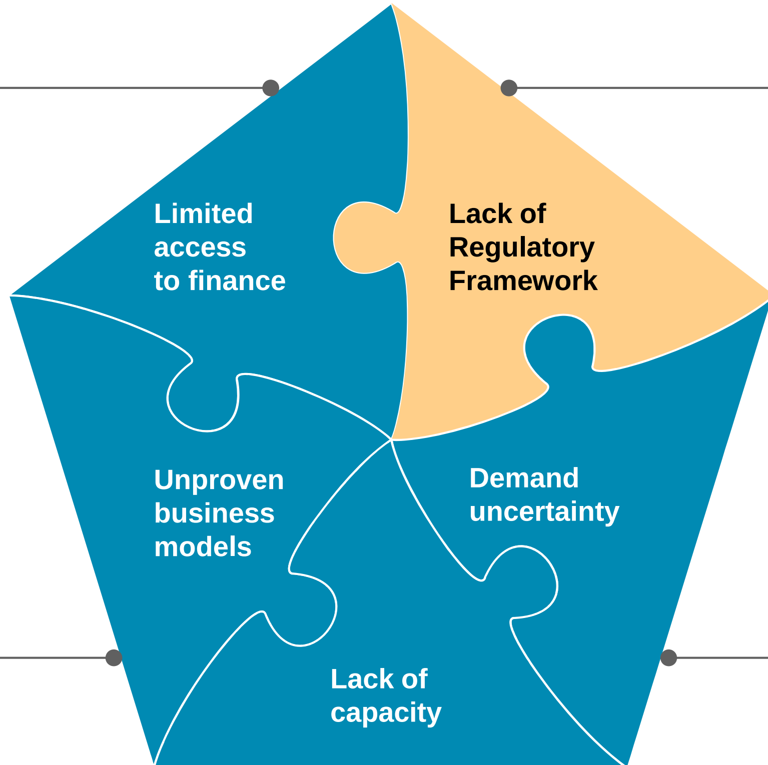
Source: Oliver Wyman research and analysis

1 2 3

Main barrier to GMG scale-up is the lack of GMG specific regulations and policies, especially regarding tariffs and grid expansion

Other barriers include unproven business models and demand uncertainty

- Challenging sector to access private finance
  – Lack of predictable cash flows for mini-grids deters investors
  – FX risk – local currency loans with attractive terms are often not available
  – Contracts (offtaker, cost-reflective tariffs) are prone to delays and may not be bankable



- Regulation of tariffs – developers are not able to charge cost-reflective tariffs or access subsidy parity with the grid
- Lack of clarity around what would happen if the grid expands to the mini-grid's area
- Lack of a clear, streamlined licensing and permitting procedure
- Lack of consumer protection, technical regulation and quality of service regulation may further deter investors

- Unproven models in Africa
  – Wide variety of possible models which vary by ownership, size and customer target, each with their own challenges
  – Need to be commercially viable in order to attract any private developers
  – Currently dependent on grants/donors with long term viability challenges

- Lack of skills and experience of public institutions, developers, financial institutions, and local project staff
- Lack of technical assistance and support functions

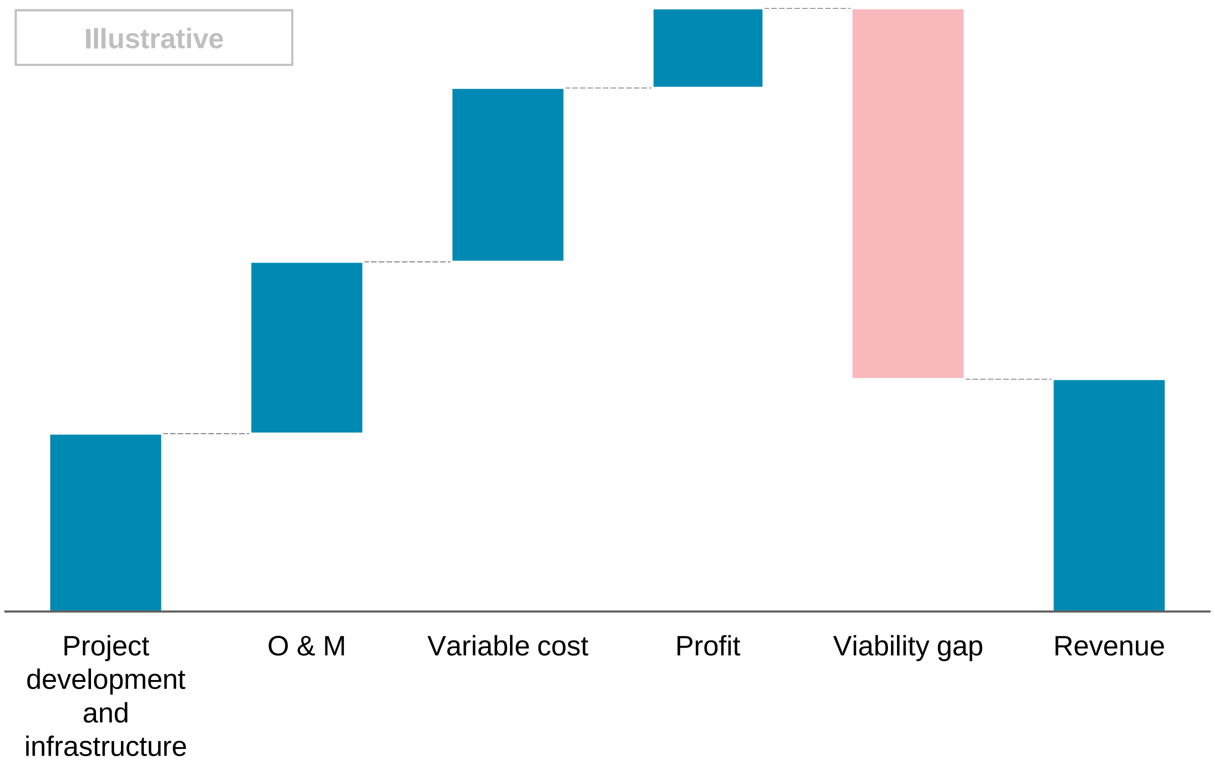
- Uncertain demand volume profile
  – Highly unpredictable initial demand and demand growth makes accurate business modelling very difficult
  – Lack of clear grid expansion plans in many countries adds further uncertainty
- Carrying out diligence to try to assess demand is challenging and expensive
- Lack of market linkages with communities

Source: Summary of analysis from SE4ALL 2016

Illustrative financial example of GMG

A combination of financial tools are needed to bridge the gap between the costs of mini-grids and the revenues generated from a uniform tariff

Example of cost / revenue profile for GMG relying on uniform tariff[1]



Comments

- Viability gap between revenues and cost of production needs to be bridged – in the short-term while delivery costs come down, in the long-term to ensure GMGs can access poorest customers
- Bridged by a combination of:
  - Allowing developers to charge cost-reflective tariffs
  - Cross-subsidization (in form FiT to achieve subsidy parity)
  - Ancillary revenues for developer
  - Low interest debt financing
  - Lower profit requirements
  - Grants and donor support
  - Bulk buying units to reduce costs of assets
  - Results based financing
  - Any other cost saving mechanisms

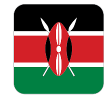
1. Illustrative example based on adjusted hypothetical case given by mini-grid policy toolkit, relying on their base assumptions for cost estimates of 3 systems of 700 kWp PV, 300 kVA diesel, 2.5 MWh C10 battery producing 2420 kWh/d, 79% renewable energy fraction each. 30% debt and 70% equity, no grant funding. Assumes 15 year project duration, 10 year tenure for debt financing, with 8% interest rate and 2 years grace financing. Income tax assumed at 30%. Revenue estimate based on 90% of energy produced each day being used by the end user, having an 80% success rate in tariff collection and a flat tariff of £0.15 (approximately in line with average national tariff paid in 2016 in Kenya) and representative of typical uniform rate. Assumed profit margin of 15% from which shareholders will be paid (no separate cost of equity in calculations).

Source: Mini-grid policy toolkit, Oliver Wyman Research and Analysis

Analysis from SE4All (2016)

Lack of regulatory framework

Time consuming licencing processes, uniform tariffs and lack of regulation to reduce grid expansion are key barriers to expansion

Key barrier	Details	Examples	
Cost-reflective tariffs	• Electricity from mini-grids is more expensive than grid power which leads to questions over who should pay for the extra cost • If private sector developers are to be attracted as is needed to accelerate the growth of GMGs, this cost cannot be borne by them as it precludes them achieving a suitable ROI • One way a positive ROI can be encouraged by allowing developers to charge cost-reflective tariffs. Many African countries are not willing to concede on this, which makes developing GMGs in these countries very difficult[1]	 	• Approved cost reflective tariffs for mini-grids owned by Power Hive • Tariffs for mini-grids below 100kW are exempt from regulatory approval
Licencing and permits	• The high level of bureaucracy and lack of clarity around mini-grid licencing presents serious challenges for developers • Licencing and permitting processes are often designed for large utility-scale projects and thus are too long and costly for mini-grids • Some of our interviewees complained of taking years to receive the relevant approvals	 	• Tariffs below 100kW do not require licencing • The licence for a 10kW mini-grid costs the same as one for a 500kW mini-grid
Grid expansion	• Grid expansion is a serious concern for mini-grid developers due to a number of potential sites being close to the main grid (particularly in countries such as Kenya where it is estimated ~67% of households are less than 600m away from national grid) • Countries often do not have clear or reliable grid expansion plans, nor regulations in place which state what would happen if the grid expanded to join the mini-grid		• Mini-grid operators eligible to receive a one-off payment equivalent to the depreciated book value of the assets plus the total revenue booked over LTM

1. If total cost is past onto the end consumer, tariffs may be too high for customer to pay. Discussions with developers suggest that at least in the medium term in addition to cost-reflective tariffs some kind of grants or low cost results based financing is required to make GMGs financially viable.
Source: Oliver Wyman analysis and research

1 2 3

Analysis from SE4All (2016)

Demand uncertainty and lack of capacity

Experience shows that being able to predict consumer demand is incredibly challenging

Key barrier	Details
Demand uncertainty	• Being able to accurately predict demand is a significant challenge to scaling GMGs – Lack of reliable data around usage and demographics of rural populations in many Sub-Saharan African countries – Even with data for current energy usage it is difficult to predict the impact of the GMG on this usage and how it will change over time – Additional demand uncertainty is added by threat of grid expansion • However, knowing and predicting demand is crucial for –Deciding on the required installation capacity to meet demand –Assessing which technologies are most suitable for GMG –Forecasting revenue streams and assessing business model viability • Developers can carry out their own analysis to assess the demand and try to ensure community buy-in but this has its own challenges – Predicting future demand is fundamentally very challenging – Diligence work can be expensive and time consuming - Developers need to balance the cost of early and lengthy community engagement against risk of future trouble if they do not engage sufficiently to ensure community buy-in
Lack of capacity	• Nascent GMG industry is reflected in lack of experience and skills of public institutions, developers, financial institutions, and local project staff • Public institutions – Often don't have capacity to efficiently manage and regulate development and operation of mini-grids. Many are budget constrained and lack people to execute regulations and laws. Lack of co-ordination among public agencies can cause project delays • Developers – Limited experience with highly complex mini-grids – Many complain of a lack of skilled labour to manage and operate mini-grids. Well-trained and certified electrical engineers and technicians are often in short supply, and experienced local project managers and developers are expensive and hard to find

Weak market data and linkages   Lack of capacity

1 2 3

Analysis from SE4All (2016)

Unproven business models

There is no clear business model which has proven to be successful and commercially viable

Key barrier	Details	Examples
Overview	• Currently no proven business models • There are a wide variety of possible models but none have been a great success	
Public utility model	• Utility owns and manages all aspects of the mini-grid. • Financed by public, typically charges the national tariff, which is cross subsidised by customers connected to main grid • Model is unsustainable for capital constrained utilities	• Assets owned by REA[1], KenGen[2] or KPLC[3] • KPLC[2] operates the system on exclusive concessions; uniform national tariffs
Private	• Private investor owns and operates the mini-grid. Funding comes from a mix of private sources and grants • Challenge of making a return without being able to charge cost-reflective tariffs or having a substantial support from grants or subsidies	• Mesh Power successfully operate solar mini-grids in part due to the ability to charge cost-reflective tariffs
Community model	• Local NGO or community owns and manages the mini-grid for the local community • Typically financed by grants • Tariffs are set to cover operation and maintenance costs, retaining a small percentage to cover replacement parts • Lack of commercial element means they are often budget constrained, and don't generate enough return to scale up. Have experienced problems with maintenance of mini-grid	• In Tungu Kabiri, 200 members of the community each bought a US$50 share in a special purpose company, whilst also receiving donor support • However, inadequate power supply was a challenge for the project
PPP	• Combines features of other models with different parties building, owning, and operating the distribution and generation assets • Challenges around nature of public vs. private partnership.	• Models whereby private sector installs equipment free of charge, operates and maintains the system under a concession • Investment cost is recouped through collecting tariffs from end users

1. Rural electrification authority
2. Leading power producing company
3. Kenya Power and Lighting Company (national utility)

Source: ECA, 2014, SE4All, 2016

Analysis from SE4All (2016)

Limited access to finance

Due to the lack of proven business models and the high risks associated with GMGs, private financing is expensive and scarce

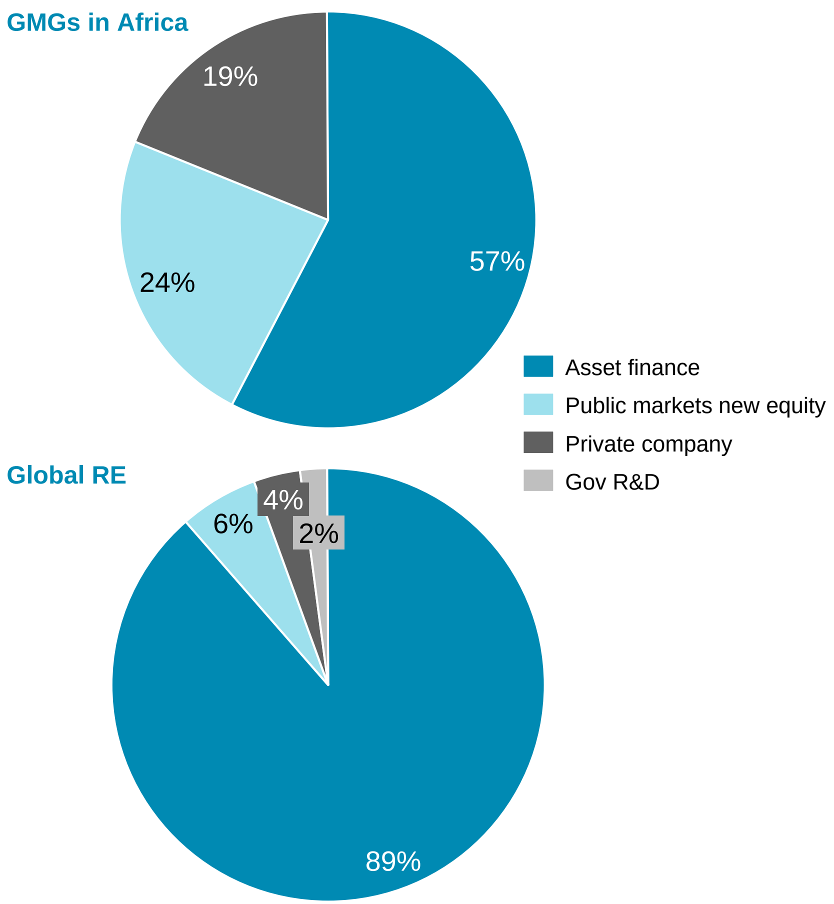
Key barrier	Details
Lack of right capital	• Accessing financing is a significant barrier to mini-grid expansion • Problems include – High administrative burden, inflexibility of grants and lack of viability - Most mini-grids rely on grants and subsidies of at least 30% of investment costs - Transaction costs of applying and managing grants can be high - Long term reliance on grants is not sustainable and leads to many mini-grids falling into disrepair – High interest rates from traditional banks - Given high risk and lack of proven business models and unpredictable cash flows, traditional financing sources (whether in form of project finance or corporate finance) demand very high returns given the increased risk. These interest rates (typically 15–20+%) make profit generation challenging - Furthermore, comparatively small ticket size of many mini-grid transactions makes project finance unsuitable – Private investment funds require proof of concept - There are a number of private investment funds willing to offer results based financing at lower interest rates (6–8%) than traditional financial institutions - These institutions however still require a return and typically need a proof of concept. This can be difficult to provide given high Capex required to run pilots and challenges over bankability
Foreign exchange risk	• Most of the capital cost of mini-grids is in hard currency, while their revenues are in local currency. This currency mismatch creates significant problems for projects funded in dollars or euros
PPAs	• PPAs between mini-grid developers and national utility can take a long time to reach approval • Many utilities in Africa have limited capital, making them a not-sufficiently creditworthy off-taker for the developer to raise financing – If this is the case additional credit guarantees will be required from the host government and/or a DFI to execute the agreement. Gaining this support can be difficult and time consuming, particularly given the relatively size of mini-grids

1.2. Green mini-grids: Business Models

Majority of capital invested in GMGs is still from grants, donors, government subsidies or international financial institutions

"For-profit" capital must be attracted to support GMG scale-up

Sources of capital for GMGs in Africa vs. renewable energy worldwide[1]
2015



For-profit capital has a number of key advantages

- ✓ Efficient cost management
  – Typically leaner and more efficiently deploy resources
- ✓ Technical knowledge
  – Can leverage years of experience in renewable energy markets across the globe
- ✓ Entrepreneurial and innovative
  – Leads to faster innovation and development in renewable energy technology
- ✓ Avoids spending public funds
  – Using for profit capital minimises strained public budgets

However, it also entails key risks which need to be mitigated

Risk	Mitigation
✗ Electricity access not increase as fast as it could be due to focus on profits rather than number of people connected	✓ Appropriate legal and regulatory framework and encourage increased access
✗ Focus on profit maximisation vs full rural electrification	
✗ Cash outflow from country if developed and run by international firms	✓ Local content requirements for any RE projects

1. Global new investments in Renewable Energy, excludes small distributed capacity. Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.
Source: UNEP & Bloomberg New Energy Finance, 2016

A scalable model will require an attractive and commercially viable proposition for private developers and investors (both equity and debt)

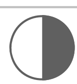
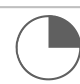
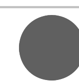
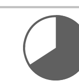
	Main issues for commercial viability
Size	• Potential for economies of scale • Potential for market making • Customer and demand profile
Type of private ownership	• Project and build responsibility • Ownership of generation assets • Ownership of distribution assets
Demand Management	• Demand volatility • Exposure to limited number of key customers • Losses (technical, theft, etc.)
Customer model	• Competition from household and grid • Existence of A(nchor) and B(usiness) customers • Customer purchase capability
Revenue Framework	• Subsidy parity with grid generation • Grid integration framework • Tariff affordability & willingness-to-pay • Additional revenue streams (e.g. micro-finance) • Revenue collection
Cost Structure	• Cost per connection • Service & Maintenance costs • Level of certainty regarding Capex recovery • Economies of scale for Opex • Tax incentives

- What are the main characteristics of each different business models?
  - *Public*
  - *Community model*
  - *Public-private hybrid (“PPP”)*
  - *Private/“Mini-utility”*

Source: Green mini-grid help desk , SE4All Africa Hub, IFC, Oliver Wyman analysis

A scalable GMG business model requires a commercially viable proposition

The most scalable business model is a public-private hybrid (“PPP”) where the public entity supports GMG development

	Public	Community	Public-Private Hybrid[1]	Private/“Mini-utility”
Description	• Generation and distribution assets are owned and operated by public utility • Utility typically charges national tariff, cross-subsidizing higher cost electricity with lower cost urban production	• Community / NGO owned generation and distribution assets • Run on a not-for-profit basis • Limited distribution network • Low initial investment and modular	• Some support/involvement from both public and private entities[2] • This can take form of – Outsourcing operation of public assets to private entity – Ownership split of generation and distribution assets – Private ownership with public support in form of funding or a cross-subsidy	• No direct/indirect support from public entity • Generation and distribution owned by private company (at least during concession duration) operating as a mini-utility
Strengths	✓ Cross subsidization possible, though many uniform tariffs are not economically viable ✓ Government typically able to benefit from a lower cost of capital ✓ Economies of scale	✓ Easy to mobilise ✓ Community-centric (high acceptability) ✓ Can be exempt from some regulations ✓ No profit motive so are able to charge tariffs simply to cover costs	✓ Economies of scale (size dependent) ✓ Can leverage public utility’s local experience and regulator access ✓ Leverage private technical/ business skill ✓ Government can achieve lower cost of capital whilst private influence can increase speed and scale	✓ Economies of scale (size dependent) ✓ Focus on financial sustainability ✓ Private financing and capital efficiency ✓ High technical/business skill ✓ Minimal cost for capital constrained governments
Weaknesses	✗ Many utilities are highly capital constrained, meaning they are unable to afford large Capex required to roll out mini-grids at scale ✗ Typically move slower and less dynamic than private sector ✗ Hard to charge cost-reflective tariffs	✗ No/limited economies of scale ✗ Lack of technical/ business skills ✗ O&M challenges ✗ Unlikely to be scalable given lack of economic incentives	✗ No clear tariff/revenue for private role ✗ Lack of clear policy and regulatory framework that defines partner responsibilities ✗ Challenges around aligning the incentives of public and private partner ✗ Public engagement makes it harder to charge cost-reflective tariffs (when affordable)	✗ Might require higher initial capex and cost-reflective revenue ✗ Requires stable regulation and market maturity ✗ Requires higher upfront support to attract investors ✗ Challenges to make it financially viable (subject to ancillary services and/or cross subsidies)
Scalability				

See next page for further details

1. Referred to in present document as “PPP”. 2. See next slide for further details

Source: Oliver Wyman research and analysis

Low potential → High potential

A wide range of PPP[1] business models can be considered

Privately owned generation and distribution assets can be the most suited for scaling GMGs

	1. Full public ownership	2. Private generation	3. Private distribution	4. Private ownership with public support
Description	• Public utility / government build and owns generation facility and distribution • Operation of assets outsourced to private sector	• Private sector builds and owns generation, selling power to utility via a PPA • Public utility owns distribution asset and transfers right of use to private	• Public sector owns generation and build/operation is outsourced to private sector • Private sector owns distribution and network assets	• Public sector capital support, e.g. capital grants. • Private sector procures, builds and owns generation and distribution assets
Strengths	✓ Lower cost of capital may lead to lower tariffs ✓ Developer owns customer relationship	✓ Easy method to involve private sector ✓ Grid expansion risk minimised	✓ Private sector may prove more efficient in setting prices and collecting payments from end users	✓ Private financing and capital efficiency ✓ High technical/business skill
Weaknesses	✗ Difficulty finding alignment between private and public parties ✗ Large Capex from government ✗ Having cost-reflective tariffs is particularly challenging given government involvement	✗ Developers are not able to have additional revenue streams from owning customer relationship ✗ Having cost-reflective tariffs is particularly challenging given government involvement ✗ Interface risk	✗ Alignment issues between private and public sectors ✗ Gov. to probably sell electricity below grid price to developer ✗ Having cost-reflective tariffs is particularly challenging given government involvement	✗ Financial support from public entity needs to ensure commercial viability ✗ Requires stable regulation and market maturity ✗ Requires higher upfront support to attract investors
Concessions	• Compatible with some form of concessions where government gives a concession for generation / distribution asset for a set period of time			
Assessment of scalability of PPP model	◔	◕	◔	●

Low potential ○ → ● High potential

[1] There is no single definition of a PPP. The World Bank defines a PPP as "*a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance*". For purpose of this report, a PPP includes any partnership with participation of a government entity, from asset ownership and risk to only remuneration and/or financial investment.

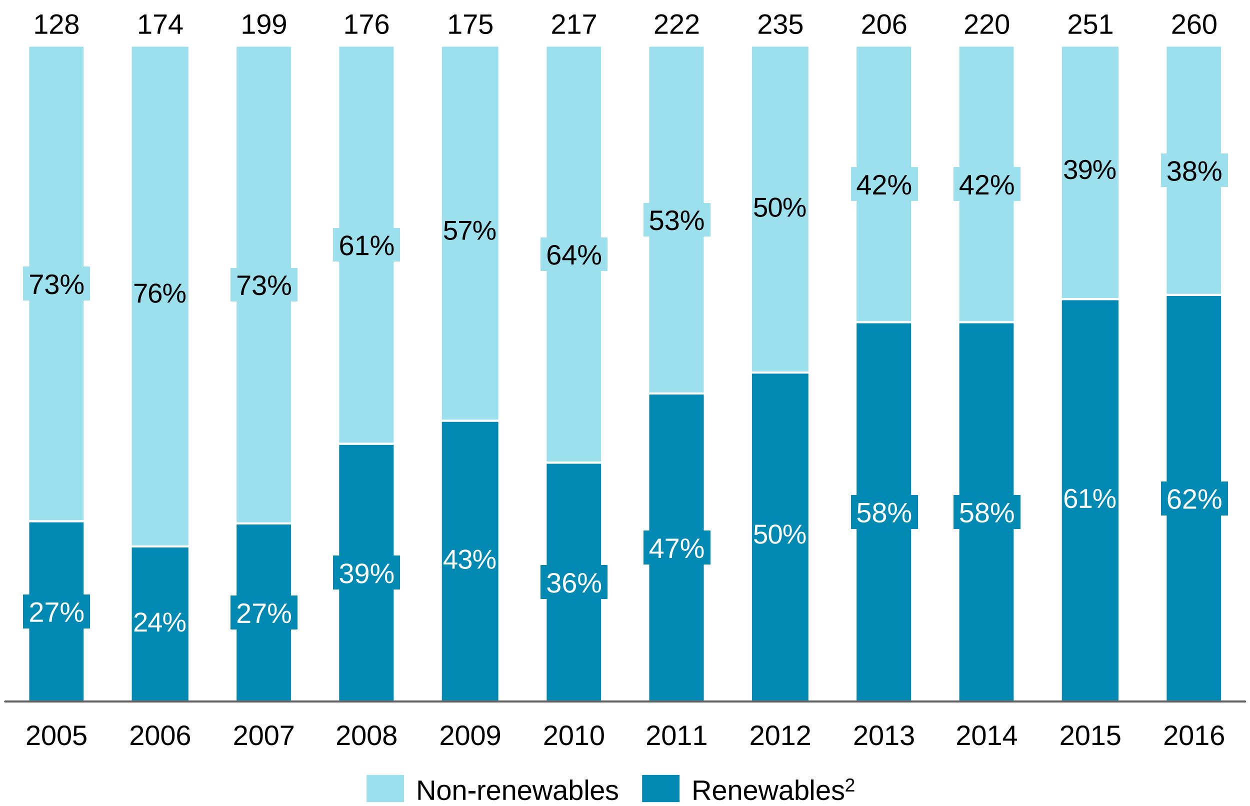
Source: ESMAP, 2016, Oliver Wyman research and analysis

2.1. Renewable energy auctions and requirements for a successful auction

Significant increase in global renewable energy (RE) generation capacity with sustained future expected growth

RE accounted for over 60% of new power generating capacity added in 2016

Power Capacity Additions[1]
GW, 2005–2016



Comments

- Capacity and output of renewables has continued to grow
- In 2015, for the first time additions of wind power (66 GW) and solar PV (47 GW) exceeded those of hydropower (33 GW)
- In 2016, renewable power represented ~23% of global power capacity[3] . This is forecast to grow to ~46%[4] by 2040
- Note that capacity additions do not consider different load factors, namely lower load factors for renewables

1. IRENA 2017a, REN21, Oliver Wyman Analysis
2. Includes hydro-power
3. IEA, http://www.iea.org/media/publications/weo/WEO2016Infographic.jpg
4. IEA, New Policies Scenario which takes into account current firm policy commitments and further results likely to stem from the implementation of announced intentions

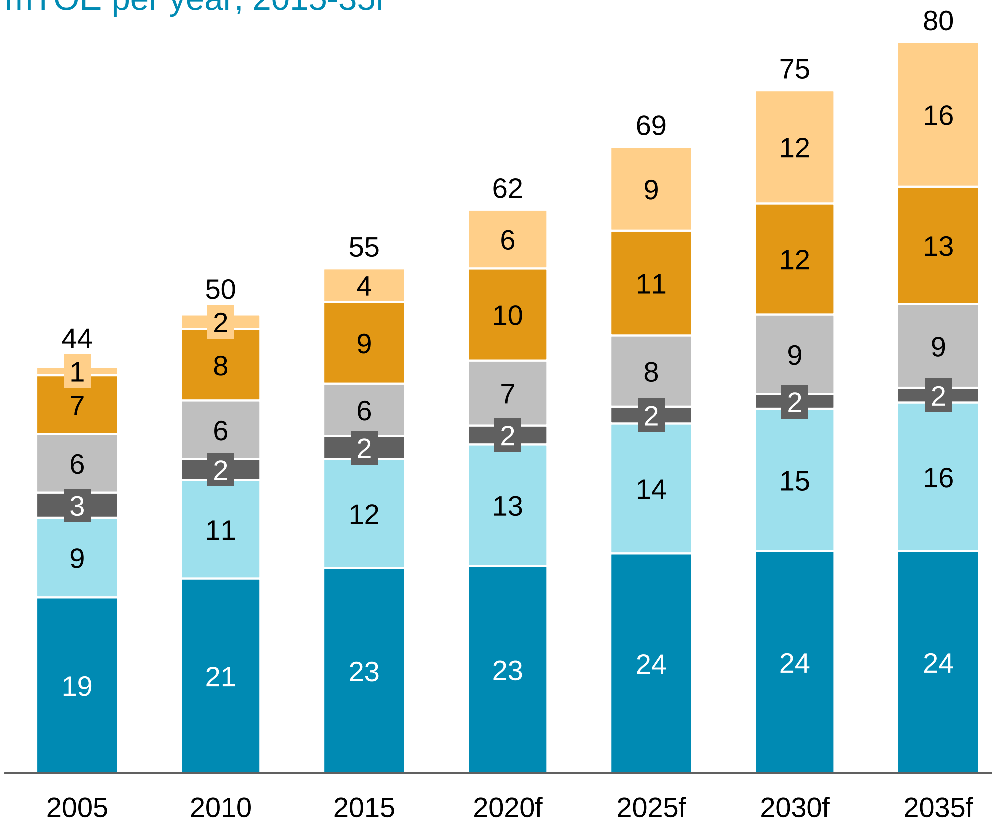
Source: IRENA Rethinking Energy 2017a, IEA, REN21

1 2 3

Renewable consumption is forecast to grow at 10%[1] for the next 10 years, over three times the growth rate of any other energy source

Power consumption[2]

mTOE per year, 2015-35f[3]



	CAGR '05-'15	CAGR '15-'25	CAGR '25-'35f
Other Renewables[4]	16%	10%	6%
Hydroelectricity	3%	2%	1%
Nuclear	-1%	3%	2%
Oil	-2%	-2%	-1%
Gas	3%	2%	1%
Coal	2%	1%	0%

1. Excludes hydroelectricity
2. *"Energy consumption comprises commercially traded fuels, including modern renewables used to generate electricity",* BP Energy Outlook
3. BP Energy Outlook 2017 forecast
4. Includes wind, solar geothermal biomass and biofuels

Source: IRENA Rethinking Energy 2017, BP Energy Outlook 2017

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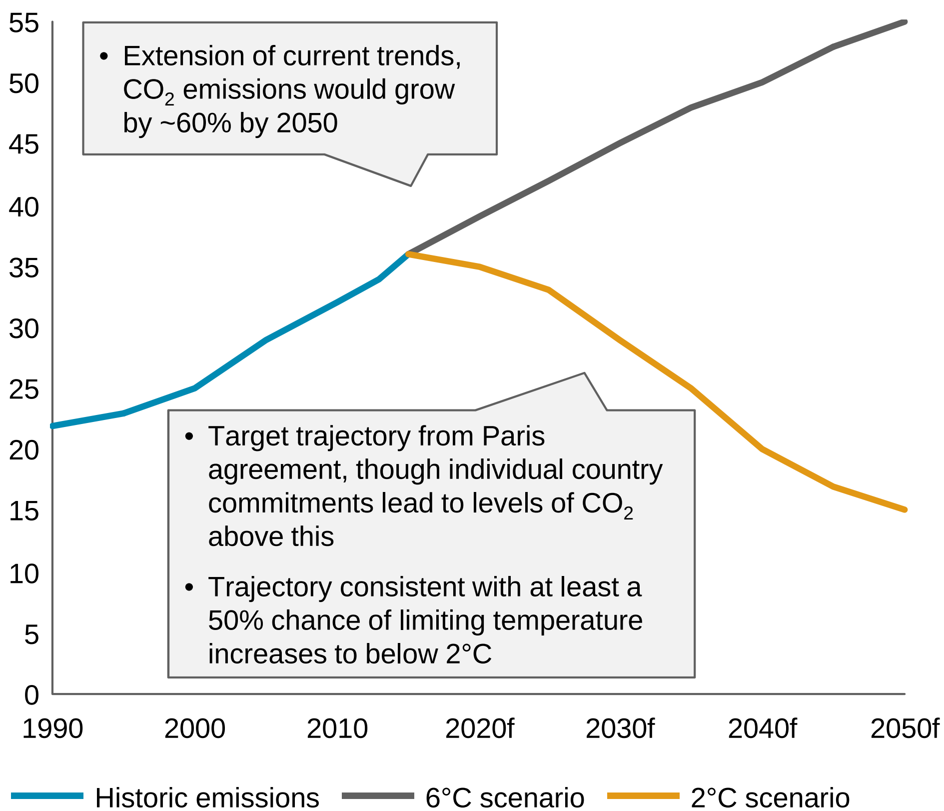
Governments in 195 countries have signed the Paris agreement which sets out ambitious targets to increase renewable energy production and decrease CO_2 emissions

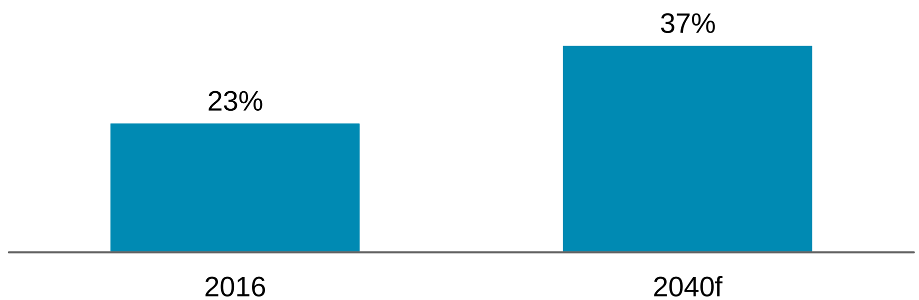
CO_2 Emissions[1]
$GtCO_2$, 1990-2050f



1. IEA Energy Emissions forecasts data, 2017
2. IEA, 2016, http://www.iea.org/media/publications/weo/WEO2016Infographic.jpg
3. World Future Council, 2016
4. UN, 2017

Source: IEA Energy Emissions Forecast, 2017, IEA World Energy Outlook,2016, World Future Council, 2016, IRENA, 2017a

Power generation from renewable energy according to Paris agreement pledges[2]



Comments

- The Paris climate conference governments agreed a long-tern goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels
  – 195 countries signed the agreement and 148 have ratified it[4]
- This will require substantial decreases to overall emissions levels
  – CO_2 levels need to be reduced by 60% by 2050 to limit temperature increases to below 2°C (compared with 2015)

The recent announcement that USA would be pulling out of the Paris Agreement has not been taken into account in any of these figures

In order to meet these targets and encourage renewable scale up, Governments have used a wide variety of mechanisms

	Auctions	Quotas and certificate schemes	Net-metering	Feed in tariffs	Tax Credit	Grants
Description	• Developers bid for electricity contracts in an auction • Public utility provides PPA to guarantee long term generation offtake • PPA can define tariff/subsidy for developer	• Governments set quotas for the minimum share of renewable energy • Certificates are issued per produced unit of electricity and sale of the certificates creates revenue for the operators • Certificates are then traded on a market	• Electricity generators are able to export surplus electricity from renewable energy source to the national grid, and use electricity from the grid when there is a deficit	• Offers contracts to renewable energy producers, normally based on the cost of generation	• An amount businesses are allowed to deduct from their tax bill based on the value of investment in the renewable energy source	• Funding given by governments or charities to directly support development of renewable energy projects
Typical application	• Large scale on-grid projects	• Large scale on-grid projects	• Small scale on-grid projects	• All sizes on-grid projects	• All sizes on and off-grid projects	• Developing world projects of all sizes
Key Advantages	• Transparent and aligns industry and government knowledge • Flexible	• High probability that targets will be met if sufficiently high penalties for non-achievement of quotas whilst no risk of uncontrolled growth	• Additional power without government investment	• Cost-based energy type specific prices enable a diversity of projects (e.g. solar, wind)	• Process is relatively inexpensive and easy to design and administer	• Process is relatively inexpensive • Short timeline
Key Disadvantages	• Risk of underbidding and high cost	• Overall costs are often high due to electricity price and green certificate risk	• Requires grid parity	• Difficult to set price of tariff	• Political pressure	• Difficult to ensure successful use of grant

Focus of this report

Source: Energypedia, 2017, Oliver Wyman research and analysis

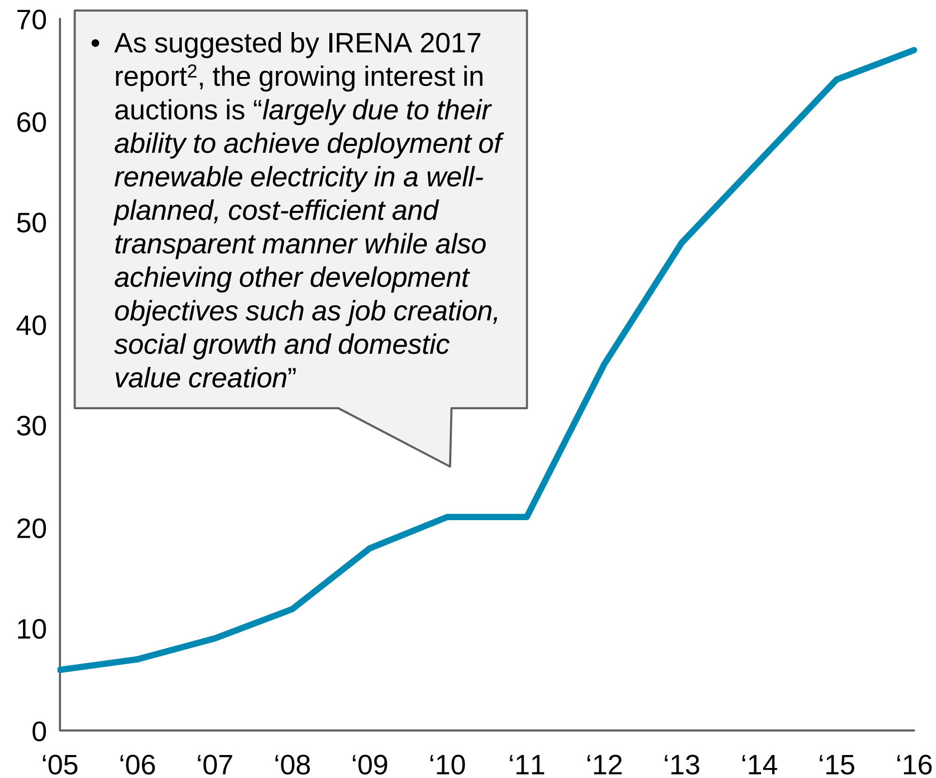
Our focus is on auctions which have become an increasingly popular method for increasing renewable energy projects

Overview of auctions

- IRENA defines renewable energy auctions as:
  - *'Competitive bidding procurement processes for electricity from renewable energy or where renewable energy technology/gies are eligible.'*[3]
- Auctions are highly flexible and can be tailored to suit particular circumstances, however all auctions have 4 key design elements which will be discussed:
  - Auction demand
  - Winner selection
  - Sellers' liabilities
  - Qualification requirements
- The nature of various design elements vary based on:
  - Size and maturity of the market
  - Investor & developer confidence in the market
  - Countries' priorities in terms of volume, location, technology and any other development requirements
- However, we will aim to identify 7 key characteristics that are needed for successful renewable energy auctions

No. countries that have held renewable energy auctions

2005-2016, cumulative[1]



1. REN21, 2005; REN21, 2007; REN21, 2010; REN21, 2011; REN21, 2012; REN21, 2013; REN21,2015. Figures for the years 2006, 2008 and 2009 are estimations from IRENA, 2014 is estimated, 2016 is taken from IRENA Rethinking Energy 2017
2. IRENA, 2017, Rethinking Energy
3. IRENA & CEM, 2015

Source: REN21, 2005; REN21, 2007; REN21, 2010; REN21, 2011; REN21, 2012; REN21, 2013; REN21,2015, IRENA, Re-thinking energy, 2017, IRENA, Renewable Energy Auctions in Developing Countries, 2013

Key advantages of auctions include real price discovery, flexibility and higher process transparency

Advantages	Disadvantages
✓ **Real price discovery** – Brings out real price of what is being auctioned in a transparent and competitive process – Addresses the problem of information asymmetry between the regulator/government and project developers	✗ **High transaction costs** – Comparatively high transaction costs due to administrative procedures required to take part in auctions – Can thus be difficult for smaller players to enter
✓ **Flexibility** – Allows possibility of tailoring different elements to suit specific circumstances and goals	✗ **Risk of underbuilding and delays** – Can lead to overly aggressive bidding which in turn can cause underbuilding and delays
✓ **Greater certainty around price and quantities** – Policy makers can control both the price and the quantity of renewable energy produced by providing revenue guarantees for project developers (similar to FiT) while ensuring that renewable generation targets are met	✗ **Can lead to discontinuous market development** – If auctions aren't linked to a fixed schedule at regular intervals, they may lead to a stop-and-go pattern of deployment – This can prevent investment in local manufacturing facilities and the deployment of a robust supply chain
✓ **Commitments and transparency** – Results in a contract which clearly states liabilities and commitments of each party	
✓ **Capture of reducing technology costs** – Auctions have allowed governments and consumers to take advantage and realize the benefits of cost reductions more quickly than if contracts, support levels, and/or PPA rates were set administratively	
✓ **Efficiency from continued auctions** – Increasing number of similar auctions reduce transaction costs and repetition increases market confidence in sector	

Source: IRENA, 2013, IRENA & CEM, 2015, IRENA, 2017b

Existing analysis by IRENA has identified 4 major design elements, from auction demand to detailed qualification requirements

Analysis from IRENA and CEM (2015)

- Choice of what is being auctioned and how it is shared between different technologies and projects
- This includes decisions around
  – Demand bands
  – Periodicity and commitments
  – Volume auctioned
  – Demand-side responsibilities

- Sets the minimum requirements for participants in the auction
- The main types of requirements are
  – Reputational requirements
  – Technological requirements
  – Socio-economic
  – Requirements around securing grid access
  – Permits and documentation for site selection
  – Financial requirements

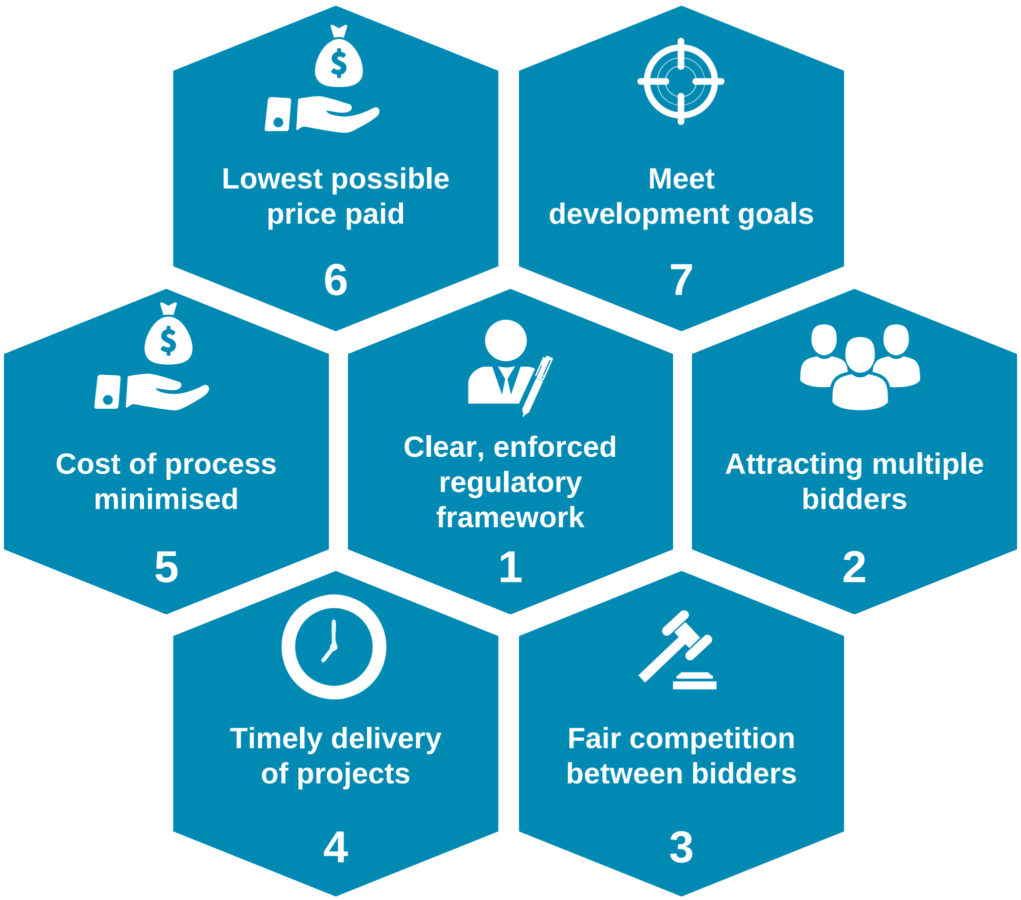
- Decides how the supply curve information is collected and based on what criteria the winner is selected
- Key considerations
  – Bidding procedures
  – Requirements for minimal competition
  – How auction winners are paid – pay-as-bid vs marginal pricing schemes
  – Winner selection criteria
  – Clearing mechanisms

- Sets specific rules to ensure high implementation rate of awarded projects in a timely manner
- Key considerations are
  – Enforcing the commitment to contract signing
  – Remuneration profile and financial risks
  – Nature of quantity liabilities
  – Liabilities for transmission delays
  – Contract schedule
  – Settlement rules and underperformance penalties
  – Delay and underbuilding penalties

Note: See Appendix A.1 for details
Source: IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Key success factors for RE auctions

We identified seven key factors for a successful auction with a particular focus on a clear, transparent and enforceable regulatory framework



	Objective
1	Clear auction terms and conditions that are aligned to detailed and consistent regulations[1] which enable successful auction processes and project implementation
2	Attracting multiple bidders to ensure competitive tension and desired capacity is met by suitable developers
3	Having a fair competition in which multiple bidders compete in a non-collusive manner in a transparent auction
4	Ensuring that the project is successfully delivered on time after the auction process
5	Minimising the auction costs for all stakeholders
6	Achieving the lowest priced bids or lowest possible subsidy whilst successfully fulfilling other criteria
7	Meeting any developmental goals that have been set

1. Given nascent nature of GMG sector and lack of robust broad regulatory framework, auctions can provide an investible regulatory “micro-climate”

Source: Oliver Wyman research and analysis

Each factor has key requirements which will support a successful auction (1/2)

	Key requirements	Key examples[1]
Clear, enforced regulatory framework 1	• Adequate and clear regulatory framework that offers security and stability to investors • Long term commitment from governments to renewable energy encourages developers • Streamlined planning and licencing procedures to avoid delaying project developments • Accountability if regulations are broken • Auction designs that are aligned to the regulatory framework	**Morocco**
Attracting multiple bidders 2	• Well advertised auction • Low barriers to entry – Sufficiently low barriers to attract multiple bidders whilst having stringent enough requirements to ensure a reliable developer wins the project • Developers' requirements are considered	**Zambia**
Fair competition between bidders 3	• Appropriate legal and regulatory framework – Clear rules on collusion, with enforced penalties • Well designed auction – Transparent and consistent. Design features such as not disclosing the volume auctioned can avoid collusive behaviour • Attracting multiple bidders	**Namibia**
Timely delivery of projects 4	• Penalties for project delays • Vetting of developers • Multiple developers – Having multiple developers splitting the volume reduces the risk of severe delays but increases the chance of there being some delay • Consideration of existing regulations and infrastructure to ensure realistic project timelines	**Ireland**

Note: See section 2.1 for details of examples
Source: Oliver Wyman research and analysis

Each factor has key requirements which will support a successful auction (2/2)

	Key requirements	Key examples[1]
Cost of process minimised 5	• Holding multiple auctions simultaneously reduces costs for auctioneer and developers • Repeatable process • Ensuring the auction successfully leads to project development to avoid costs of repeating auctions	Netherlands
Lowest possible price paid 6	• Cheap financing – Special low interest financing for renewable energy projects decreases auction prices • High capacity factors • Minimised risks • Long lead times – Tends to lead to lower prices but increases chance of underbidding • Scheduling multiple rounds – Increases developer confidence and reduces fixed costs per auction • Non-disclosed ceilings • Attracting multiple bidders • Minimal development requirements	Brazil Chile
Meet development goals 7	• Setting realistic goals taking into account – The extent to which local industry is ready to support the projects – How to best build a sustainable local industry corroborated by a long term policy framework • Consideration of loopholes in any policies set • Appropriate choice of mechanism – fixed requirements, multi-selection criteria or a hybrid of the two • Incentives to meet development goals	China

Source: Oliver Wyman research and analysis

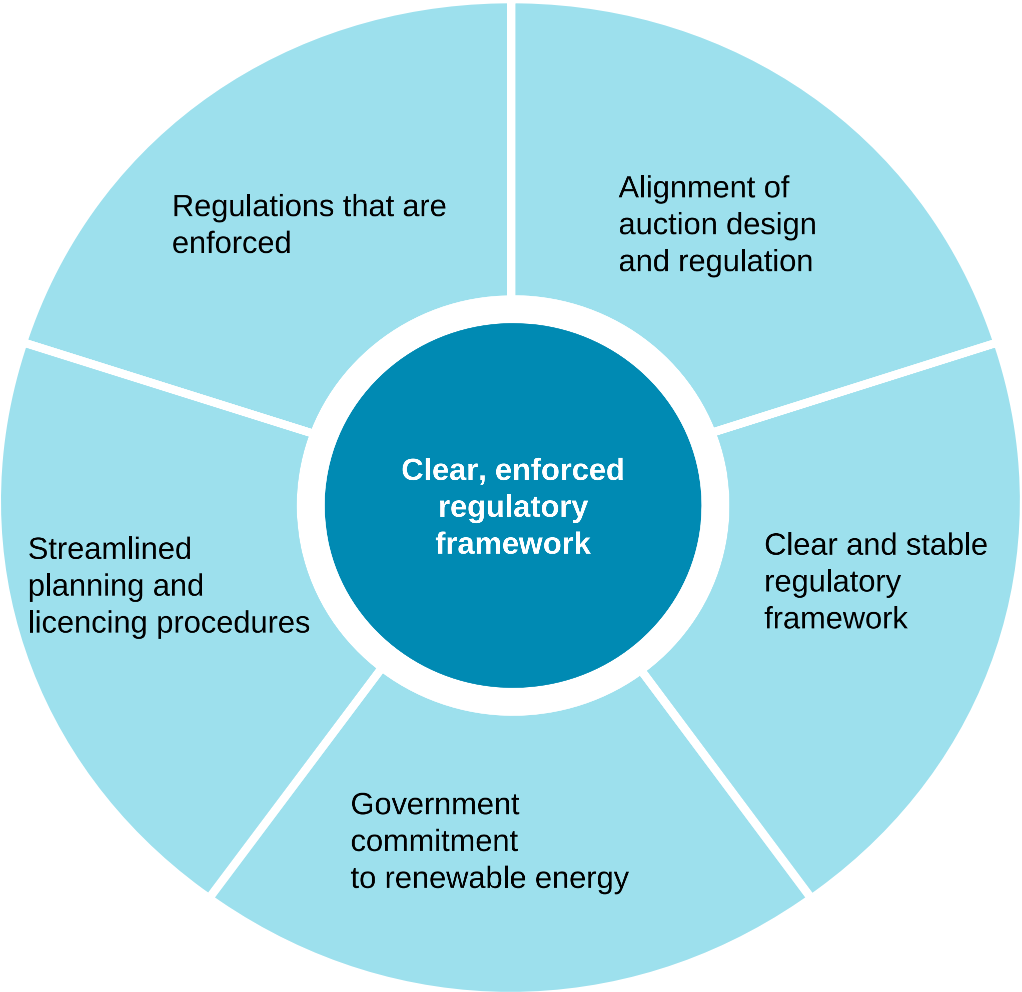
1 2 3

A clear, enforced regulatory framework is crucial in underpinning a successful auction process and its subsequent implementation

Why is it important?

1. Regulations act across the whole process from specifying the parameters allowed for auction design and pre-qualification requirements to the licencing required for developing and operating renewable energy plants.
2. A stable framework gives investors confidence and reduces risk premiums
3. Streamlined planning and licencing procedures can reduce the chance of delays
4. Having a well aligned auction design and regulatory framework increases the chance of a successful process and implementation
5. Ensuring that the regulation is adhered to and enforced is important to give investors' confidence and to avoid developers / auctioneers partaking in illegal or corner-cutting practices such as collusion[1]

What is required?

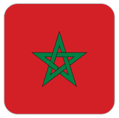


Source: Oliver Wyman research and analysis

1 2 3

As seen in Morocco, Ireland and Vietnam, a stable regulatory framework is a key factor in auction success

Example cases	Details
Morocco	✓ Stable political and regulatory environment and experience with IPPs have been vital in attracting investors ✓ This includes an appropriate legal framework brought about by a range of laws drawing on domestic experiences and best international practice ✓ Ambitious renewable energy goals showing long term commitment – US $9bn Solar Plan targeting 2GW of solar energy capacity by 2020 – 2GW of wind power capacity by 2020 ✓ New institutions were set up to reach energy goals – ONEE (Office National de l'Electricite et de l'Eau Potable). It is the main entity responsible for thermal and renewables (other than solar) IPPs – MASEN, the state-owned agency responsible for solar IPPs – SIE (Société d'Investissement Energétique), which provides partial state financing through direct equity investment or co-investment through a financial partner in project companies – National Agency of Development of Renewable Energy and Efficiency
Ireland	✗ Project realization was severely reduced due to a misalignment between spatial planning and the auction scheme (AER III 1997-98) ✗ While some of the winning bidders had difficulties obtaining planning permits, there were wind parks holding a planning permit but not an AER (Alternative Energy Requirement) contract ✗ This problem could have been resolved by either making the planning permit a pre-qualification requirement or changing the regulatory framework to resolve this issue before the auction
Vietnam	✗ Foreign and private sector involvement on a more permanent basis has been permitted since 2002 but lack of a regulatory regime hindered investments ✗ The World Bank assisted the Phu My 2-2 (715 MW) auction in 1999. The overall auction was largely successful, however, as the World Bank notes 'the finalization of the process, including financial closure, took a long time' which led to the Government of Vietnam being reluctant to repeat it more recently



Conclusions

- Regulatory stability is a key element in attracting investors to participate in auctions
- Long term commitment from governments to renewable energy encourages developers
- Streamlining planning and licencing procedures should be a priority for authorities to avoid delaying project developments
- Aligning the auction design with the regulatory framework can avoid delays

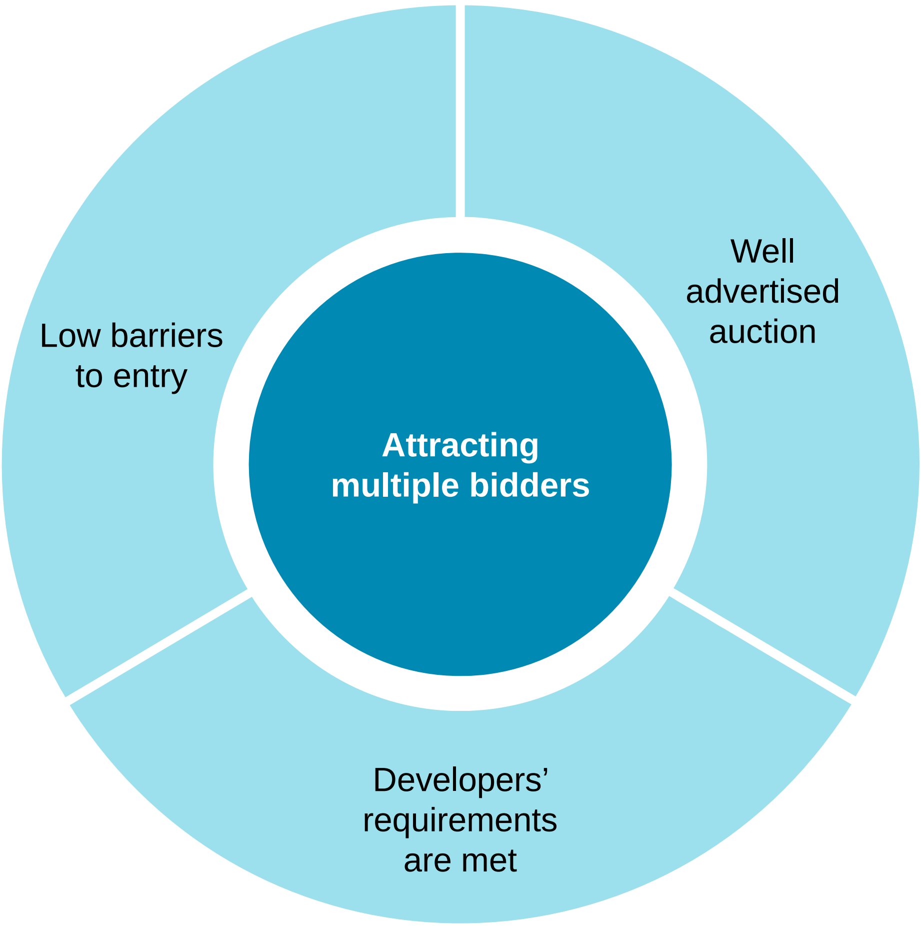
Source: World Bank, 2011, AURES, 2016, IRENA, 2013, Linklaters, 2015, Linklaters, 2013, EWEA, 2015

In order to attract multiple bidders, auctioneers must advertise the auction successfully, fulfil the bidders' requirements as much as possible and set the barriers to entry sufficiently low

Why is attracting multiple bidders important?

1. Without multiple bidders it is not an auction as there is no competitive tension
2. Increasing the number of bidders will normally lower overall prices paid
3. Increasing the number of bidders decreases the risk of effective collusion
4. Without attracting multiple bidders, possible that the volume bid will be lower than the volume auctioned

What is required?



Source: Oliver Wyman research and analysis

Promoting and marketing the auction through multiple channels to attract sufficient interest is a necessary ingredient for auction success

Channels to promote auctions

- Government, Multilateral Development Banks and Utility websites
- Print advertising in relevant publications such as industry magazines
- Email
- Telephone promotion
- 3rd party websites (including industry associations)

Comments

- Multi-channel approach increases chance of tender being recognised by widest possible selection of developers
- Contacting developers directly should be done with caution to avoid any suggestion of favouritism
- Reasonable timing for promotion of auction and ensuring appropriately granular details of what is being auctioned and the process itself is critical for promoting symmetrical information and the entrance of new bidders
  - Needs to allow sufficient time for:
    - Analysis and diligence for the construction of new capacity
    - Appropriate internal approvals
    - Time to fulfil certain pre-qualification requirements such as planning permission for any potential site
    - Filling in auction application form

Source: World Bank, 2011, Oliver Wyman research and analysis

As Zambia showed, minimising the work and cost for developers can deliver impressive results

Developers' desired requirements	Details
Bankable	• Clear documentation that can be taken to financers
Transparent	• Open auction process where the terms are explicit
Guarantees	• Governments may guarantee access to financing as well as the price of contract
Cheap financing	• Achieved through minimising risks • Some markets (e.g. Brazil) had government funded low-cost loans for renewable energy projects
Predictable cash flows	• Clear pricing and idea of cost generation
Stable regulatory framework	• *See detailed case study on Zambia*
Sufficiently high ceiling price	• Disclosing a ceiling price which is too low will detract developers

Scaling solar Zambia

What's offered to developers

- Competitive financing and insurance
- Risk management and credit enhancement
- Bankable project documents

Results

- 49 applications were received
- 11 selected as qualified (based on technical, financial and legal capacity to deliver)
- 7 submitted final proposals
- Bids yielded lowest solar power tariffs in Africa to date

Source: Oliver Wyman research and analysis, Scaling Solar website, IRENA and CEM, 2015, Oliver Wyman research and analysis

Setting the barriers to entry at the appropriate level is crucial to ensure sufficient competition

Overview

Types of barrier	Examples of barriers	Comments
Financial barriers	• High value bid bonds (e.g. Peru requires a bid bond of $ 20,000 / MW of capacity which is lost if the bid is won but the bidder fails to sign the contract, and a performance bond of $ 100,000/MW of capacity installed) • High cost of capital for smaller developers	• It is important to have sufficient barriers in place that the winning bidder will be reliable and ensure completion of the project. However, this needs to be balanced with ensuring enough bidders are attracted to make the auction competitive. • Another problem with bid bonds is that they increase the transaction cost as the auctioneer has to manage a large number of deposits
Other barriers	• High level of diligence required by developers. For example, having to chose the site and do all diligence on it increases the barrier to entry • Stringent reputation and experience requirements • High volume auctions or those which don't limit volumes for each technology	• Setting low barriers in terms of effort for firms encourages smaller players who don't have the resources but adds cost to the auctioneer

Source: IRENA and CEM, 2015, IRENA, 2013,

Examples

South Africa

- First auction was not successful in enhancing competition in part because the volumes auctioned were not limited for each technology
- Second round had much improved competition, partly due to a cap being set on the volume auctioned

China

- Offshore wind auctions which started in 2011. Pre-qualification requirements include:
  - Bidder must be an independent legal entity with net assets that are larger than the capital value of the project
  - Bidder must have an existing wind farm capacity at least as large as the project's capacity
  - Developer must sign a supply contract with a wind turbine manufacturer

Denmark

- Planning an auction for wind farm projects at 6 possible near shore sites for the first round (3 sites likely to be contracted)
- Transmission system operator carried out preliminary surveys and environmental impact assessments of all 6 sites

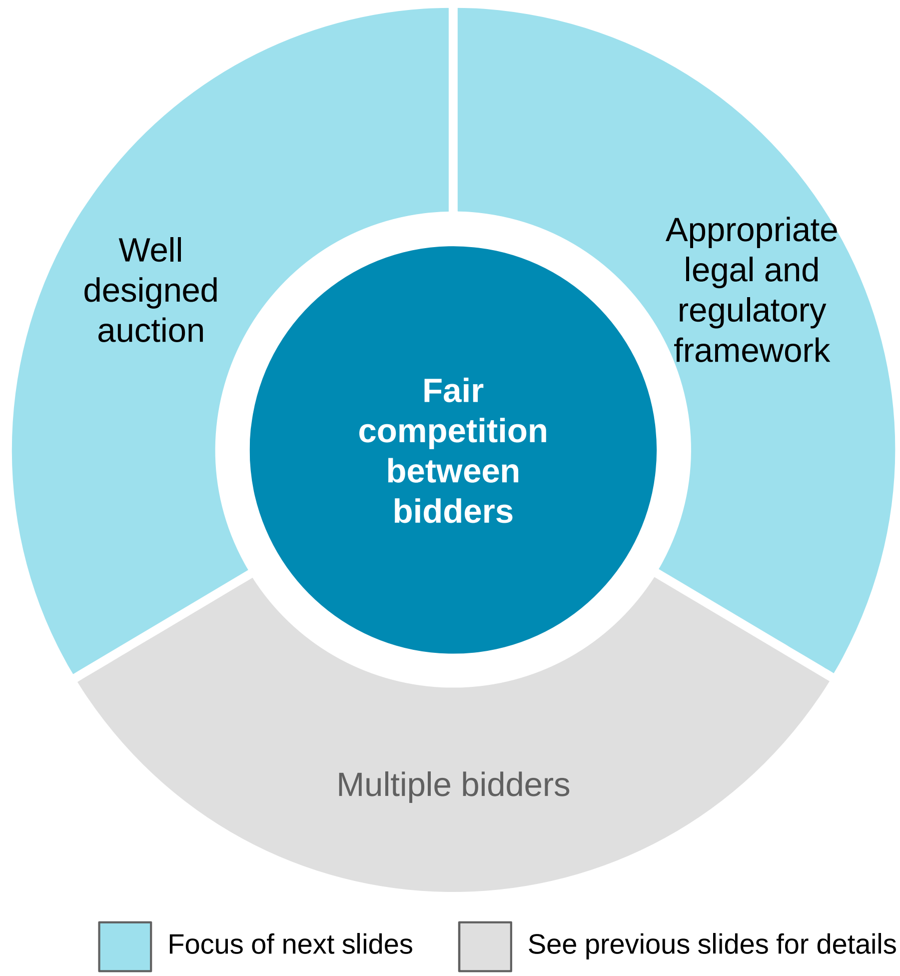
1 2 3

Fair competition between bidders requires an appropriate legal and regulatory framework, a well-designed auction and multiple bidders

Why is a fair competition between bidders important?

1. Fair competition should lead to lower prices being bid since price fixing will be avoided
2. Large reputable developers will be interested in current and future projects if the process is fair and transparent
3. Ethically preferable to have a fair process

What is required?



Source: World Bank, 2011, Oliver Wyman research and analysis

Sealed bid auctions make it more challenging to collude

Type of auction	Description
Sealed bid	• Bidders submit their bids simultaneously with an offer price and quantity. No bidder knows the offer price of other participants (making collusion more difficult). • Bids meeting all mandatory requirements are ranked based on evaluation requirements (price only or price and other metrics) • Starting with the best offers, projects are awarded until the sum of the quantities offered cover the volume auctioned (either each party receives the marginal price (Germany, UK) or it's own bid price (Peru, South Africa))
Descending clock	• Multi-round bids where the auctioneer announces a price for acquiring the renewable energy electricity generated • Bidders bid for the right to provide the quantity of the product they want to supply at the going price announced • Auctioneer progressively lowers the price until the quantity offered matches the desired amount • Typically no project ranking. Auction results in offered quantities for the determined price. • Price (ceiling) discovered at end of process • Average price disclosed at the end of the auction round
Hybrid	• A combination of the sealed bid and descending clock auctions • Descending clock auction, followed by sealed bid • Aims to take advantage of price discovery of descending clock auction and avoidance of collusion between participants in setting the final price in the sealed bid auction

Examples

Morocco

- 160 MW concentrated solar power for Oarzazate I project (2011)
- First price sealed bid auction which aims for the allocation of a single project to one developer

South Africa

- 3,725 MW RE auction (2010)
- Pay-as-bid sealed bid auction which leads to the allocation of multiple units of the same product with different prices to more than one project developer

Italy

- Projects above 5MW must participate in a descending clock auction to be supported with a feed-in premium

Brazil

- Winners of the first stage bid a final price which has to be at least as low as the price in the first stage
- Second stage is held to meet actual demand and ensure there is no collusion in setting the price

Source: AURES, Auctions for Renewable Energy Support in Italy, 2016, IRENA, Renewable Energy Auctions in Developing Countries, 2013

1 2 3

A strong legal system, not revealing ceiling prices and minimising information on auction demand are conducive to a fair competition between bidders

Flow chart illustrating key requirements for fair competition between bidders

Appropriate legal and regulatory framework →

Clear laws and punishments

- Clear regulations specifying what amounts to collusion and its illegality, allowing for harsh punishments for offences

↓

Reliable legal system which will prosecute collusive bidding

Well designed auction →

Transparent and consistent

- Clear rules and criteria which are openly available and do not change detailing requirements for bidders and the winning selection criteria

Design features to minimise collusion

- Avoid revealing too much information on auction demand
- Ceiling prices to prevent exceedingly high prices which may result from collusion

Examples

United Kingdom

- Clear laws about penalties of anti-competitive activity
  - Businesses can be fined up to 10% of their worldwide turnover and sued for damages
  - Company directors can be disqualified from being a director for up to 15 years

Namibia

- National utility NamPower began an auction process in 2013
- After awarding a 35MW project in December 2015, cancelled the tender after reportedly being sued by Enel Green Power for changing tender specifications[2]

Brazil

- Auction's volume is not disclosed to avoid collusive behaviour
- Bidders are simply told:
  - Ceiling price offered for each technology group prior to the auction
  - The auction status, whether it is open (excess supply), or closed (excess demand) after the descending clock phase[1]

1. Brazil's auctions consist of a descending clock auction followed by a sealed bid auction
2. News story accessed on http://allafrica.com/stories/201601141023.html

Source: UK Government website, AURES, 2016, BNEF, 2016, All Africa, 2016

1 2 3

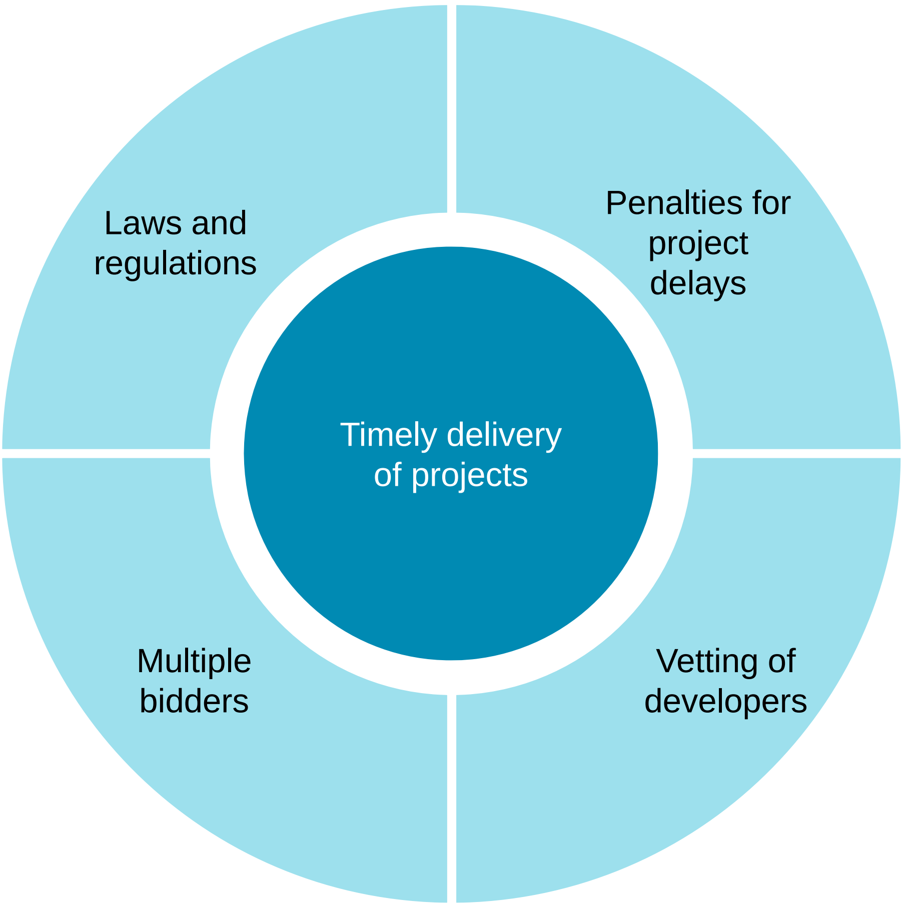
Timely delivery of projects is of central importance to the success of auctions

Why is timely delivery of projects important?

1. Ensure that required electricity demand is reliably met at the right time
2. Without the project actually being delivered, the whole purpose of the auction process is undermined
3. It is common for there to be delays in these projects, so this is an area of which one should be particularly wary

Source: World Bank, 2011, Oliver Wyman research and analysis

What is required?



1 2 3

Strict vetting and reasonable penalties help to ensure timely project delivery

Mechanisms to ensure timely delivery of project

Type of mechanism	Details
Penalties for project delays	• Project delays can come: – Between winning auction and signing of PPA – From signing of PPA to completion of the project • Having clear penalties for these delays acts as a deterrent to developers
Vetting of developers	• Strict requirements on developers, only choosing those which have proven track records decreases chance of delays and vetting building plans for feasibility
Multiple developers	• Allocating the volume to multiple developers reduces the risk of not meeting demand but increases the risk of there being some delay
Laws and regulations	• Clear laws and regulations which ensure developers and auction designers are fully aware of the parameters they are operating within • Delays can be avoided by proper consideration of existing regulations and infrastructure to ensure that the project timelines are realistic

Examples

Denmark

- Anholt auction (390-400 MW, 2010), first renewable energy auction in Denmark with penalties for delays following previous auctioned projects being delayed (9 months and 8 months[1])
- Penalties in case of delayed grid connection for the first and last turbine
  - First turbine had a deduction from guaranteed price of up to (~3% of contracted price)
  - Last turbine led to a fine of up to €53.7M (if more than a year delayed)
- Project was delivered 5 months late

Peru

- Project developers deposit a bid bond of $ 20,000/Mw of capacity installed which is lost if the bid is won but the bidder doesn't sign the contract
- Performance bond of $ 100,000 / MW of capacity installed
- Penalties are deducted from bonds if delays occur for more than two consecutive quarters

Brazil

- Developments have been delayed due to time taken for environmental permits for sites

Ireland

- After high non realisation rates in AER III (Alternative Energy Requirement) due to problems with planning permissions. Bidding projects in AER V were required to have secured planning permission

1. 8 month delay from the initial schedule, delay came from original consortium pulling out and thus the auction had to be repeated

Source: AURES (2016), Ireland, Instruments and Lessons Learnt, AURES (2015), Denmark, Instruments and Lessons Learnt, IRENA (2013), IRENA (2015)

1 2 3

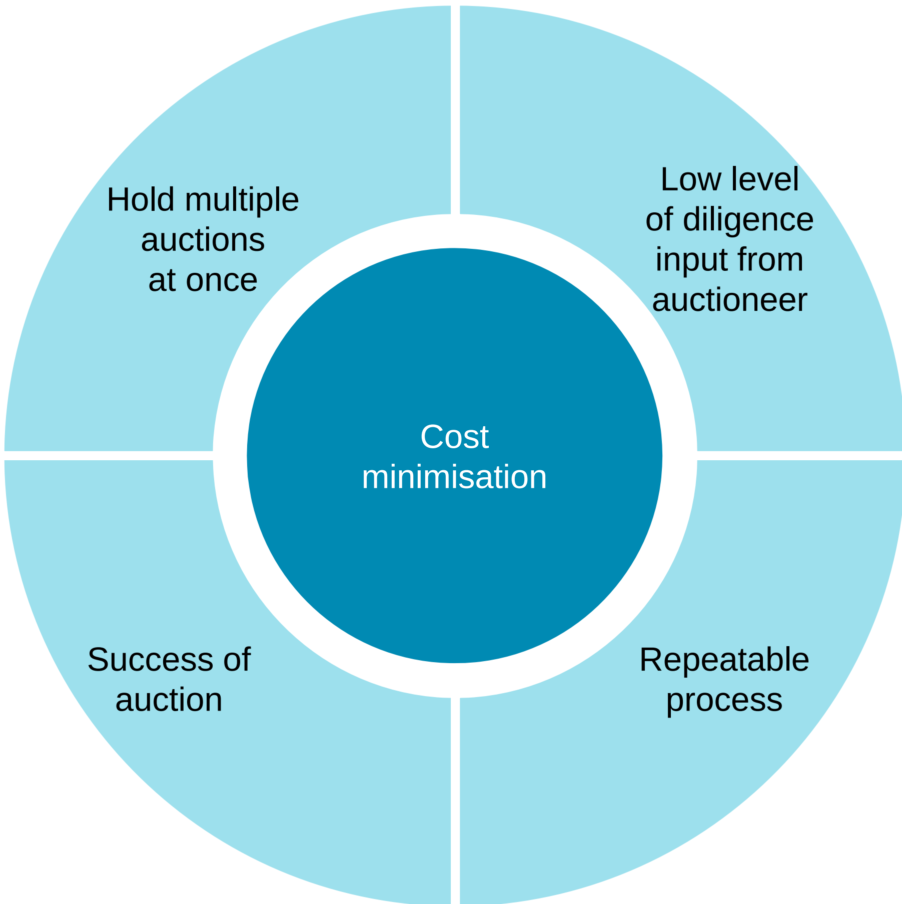
Minimising transaction costs for both auctioneer and bidders is essential particularly when auction volume/capacity is low

Why is minimising the cost of the auction important?

1. One of the weaknesses of auctions is that there are potentially higher costs in comparison to other mechanisms, given the greater complexity in comparison to other schemes

2. Minimising the cost of the process leaves more funds for the government to support renewable energy projects or to spend on other programmes

What can be done?



Source: World Bank, 2011, Oliver Wyman research and analysis

These mechanisms should all be used with caution to ensure that cost isn't minimised at the expense of attracting fewer bidders or having a poor winner of the project

Methods to minimise process costs

Type of mechanism	Description	When this cost saving mechanism should be used
Multiple auctions at once	• Reduce costs for auctioneer and developers	• Large confidence in the auction design / method, since it entails losing learning opportunities
Low level of diligence input from auctioneer	• Making developer choose the site for the development and apply for permits at their own cost	• Large developer demand
Repeatable process	• Same model repeat yearly reduces costs as allows for repeated use of processes and documentation	• Sizeable energy demand
Success of auction	• If the auction has to be repeated due to signing of contract falling through, this adds expense for the auctioneer	• Always – though as discussed, the mechanisms used need to be sufficiently soft to still attract multiple developers

Examples

Peru and South Africa

- Offer multi-technology auctions where a number of technology specific auctions are held in parallel
- This induces economies of scale and reduces transaction costs
  - Similar principles and requirements for all technologies reduce the developers' cost to bid on multiple projects
  - Auctioneers' costs around qualifying suppliers and organising procedures could also be lowered

Netherlands

- Requires bidders to possess an environmental permit, have written permission of the owner of the land/location and have conducted a feasibility study
- Having the developer choose a location and conduct analysis into that location's suitability decreases auctioneer's cost

Denmark

- In the Anholt tender in 2011, a standby agreement was put into the terms which obliged the second bidder to be stand-by for 6 months and take-on the project with the same time schedule and their bid price if the winner opts-out

Source: AURES (2015), Support in Denmark: Instrument and Lessons Learnt, AURES (2016), Lessons Learnt from International Experiences, IRENA (2015), IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Auctions have succeeded in reducing prices paid for renewable energy generation by end-users and/or governments and local utilities

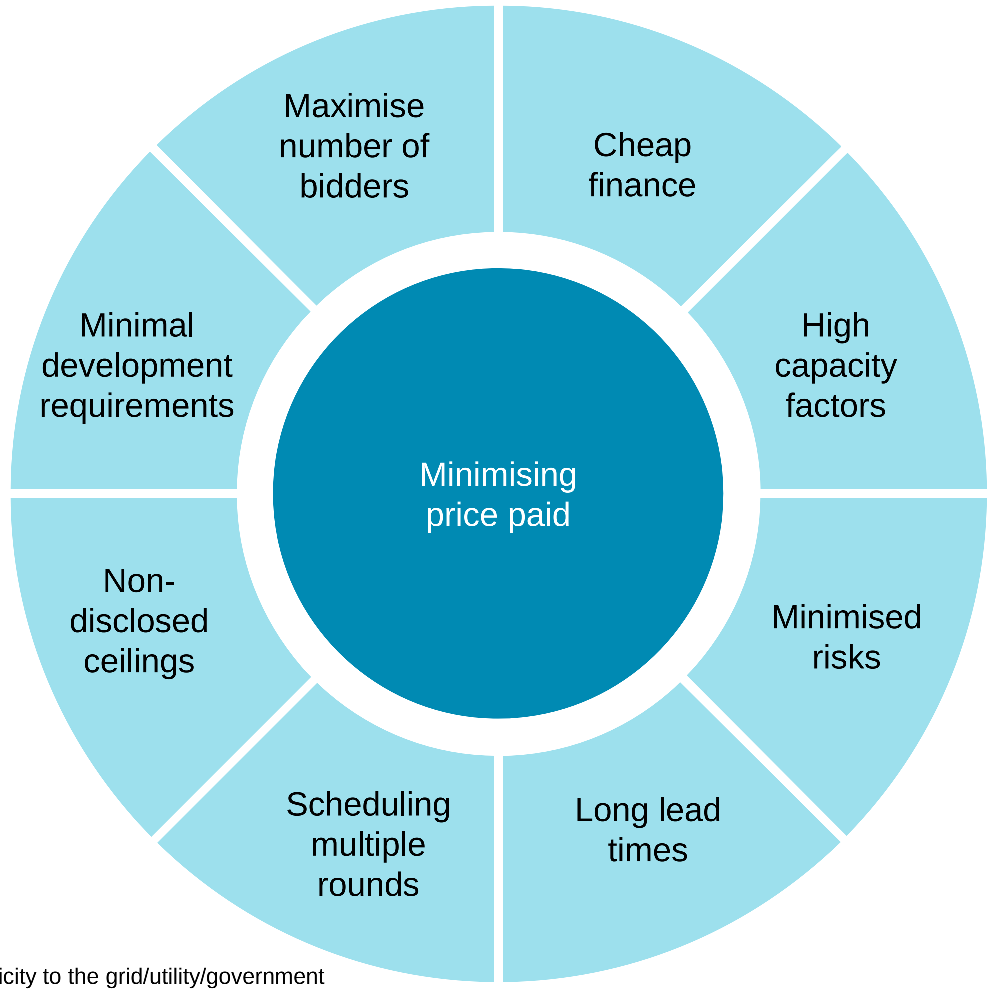
Why is minimising the price paid important?

1. One of the motivations for using auctions is its ability to reduce the overall price paid for renewable energy vs. other mechanisms

2. Depending on the structure of the auction[1], a lower price paid may lead to lower prices for the end users. This is particularly important for projects where the goal is affordable energy for the end users

3. Depending of structure[2], it can also reduce the cost to the government or utility

What can be done?



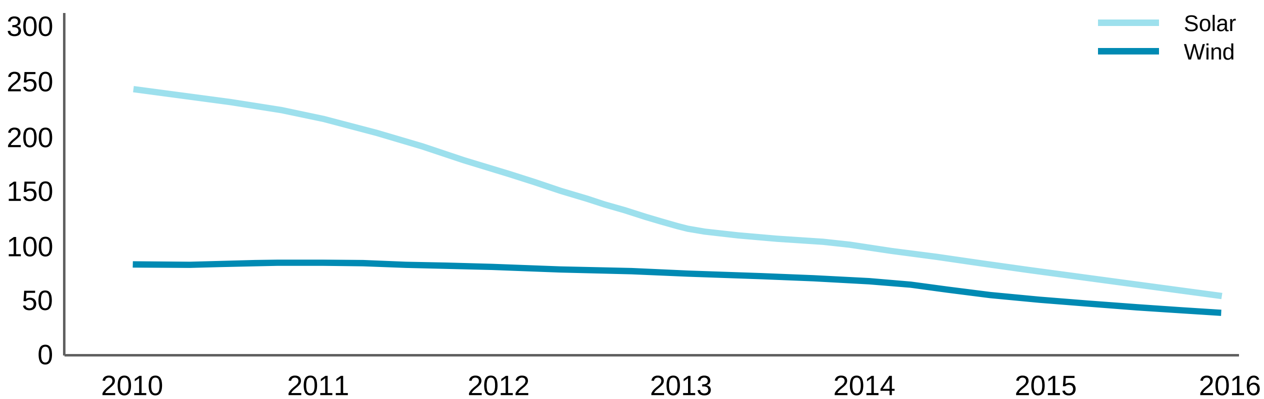
1. If what is being auctioned is the final price to charge end user
2. If, as is normally the case, what is being auctioned is the price at which to sell the electricity to the grid/utility/government

Source: Oliver Wyman research and analysis

Auctions have been successful at reducing the price paid for energy over time

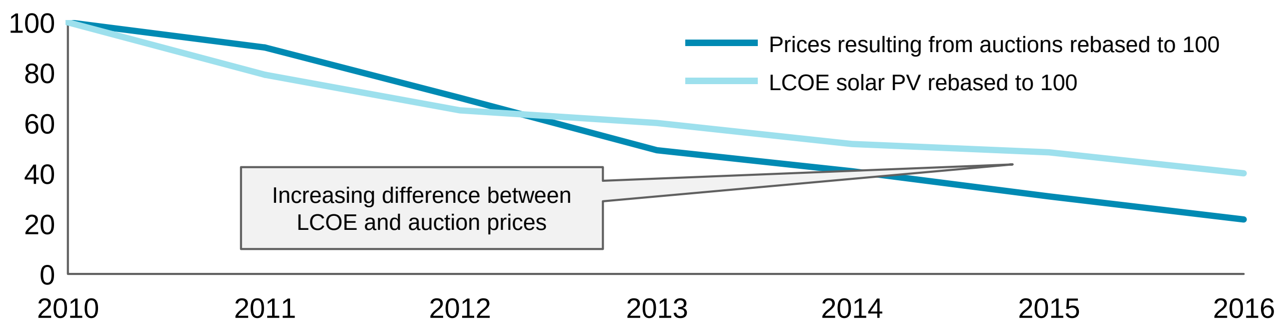
Average price resulting from auctions

2010-2016[1], USD/MWh



Cost and price for solar PV rebased to 100

2010-2016[2]



Comments

- Auctions have witnessed a sharp decline in the prices paid resulting from auctions
  - This is in part due to falling energy costs
  - The bottom graph on the LHS illustrates that the falling price of auctions actually fell faster than the LCOE for solar PV, suggesting that there are other factors contributing to this decrease in prices paid
  - Yuen's research suggests this additional falling price is primarily due to increased competition[3]

Bloomberg New Energy Finance estimates there is a **'30% reduction in renewable energy project tariff when a country shift from a feed-in tariff or green certificate programme to its first auction'**

1. IRENA (2017),
2. Estimated using Bloomberg New Energy Finance figures for levelized cost of electricity for Solar PV and IRENA average auction price paid. Reduction in cost not necessarily entirely down to auction mechanism, as some prices from auctions are very low due to e.g. tax credits in USA, whereas this is not taken into account in LCOE.
3. Yuen (2014)

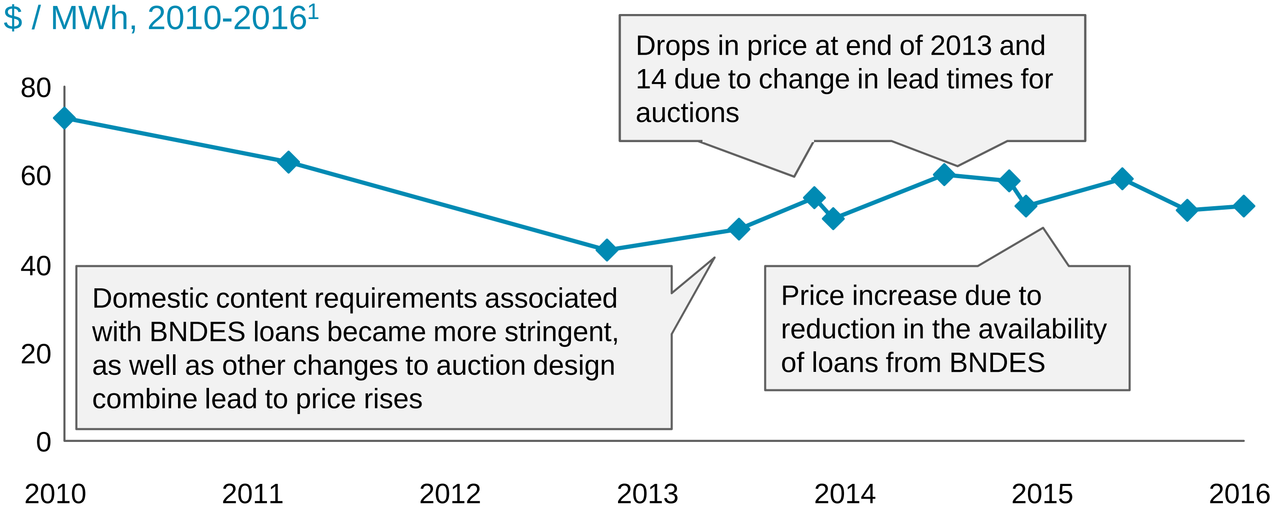
Source: BNEF Research Note: Auctions and prices, 30 October 2015. https://www.bnef.com/core/insight/13183, IRENA, 2017b

1 2 3

Having cheap finance available and higher capacity factors can lead to lower bid prices

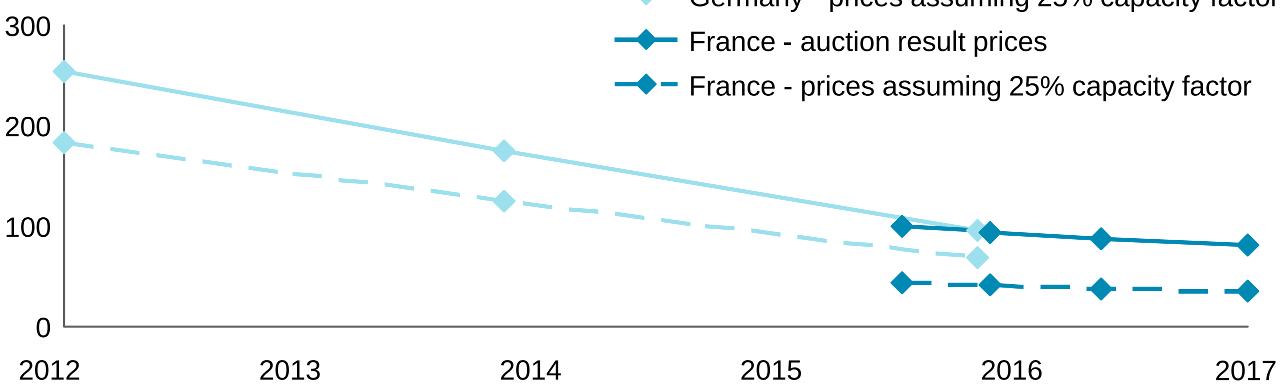
Onshore wind energy auctions in Brazil

$ / MWh, 2010-2016[1]



Solar prices in France and Germany

$ / MWh, Actual vs. adjusted results, 2012-2016[2]



Comments

- Cheap financing such as that provided in Brazil can reduce the price bid in auctions
- Solar generator's revenue is proportional to its generating capacity, and doubling capacity should thus allow the selling price to be halved whilst yielding the same revenues
- The bottom chart on the LHS, shows the dramatic effect that changes in capacity factor can have on the price paid
  - Capacity factors in Germany are typically 11% and in France they are ~18%
  - This is in contrast to Chile where the capacity factor is 29% (record lowest price at $ 29.1 / MWh)

1. IRENA, 2017b
2. IRENA, 2017b, based on data from BNEF, 2016

Source: IRENA 2017b, BNEF, 2016

1 **2** 3

Limiting risks for developers reduces the price paid but this often comes with the trade-off of increasing the risks and cost for the auctioneer

Overview

Mechanism	Description
Contract risks from penalties	• If investors are exempt from risks such as production uncertainty they can incorporate a lower risk premium into their bid • However, leniency may increase risk of delays
Political and macro-economic risks	• If the country is perceived as a high risk environment developers will build in risk premiums into their financial models as will financers • One way this can be partially mitigated is by a clear legal and regulatory framework
Inflation and interest rate risk	• Those auctions which reduce interest rate risk and inflation risk are likely to be more attractive to developers
Currency exchange risk	• Having development contracts in $s or the currency of the financing reduces the currency exchange risk
Avoid risk of collusion	• Collusive behaviour is likely to push prices up • *See fair competition slides*
Off-taker risk	• Developer wants to be sure that the off-taker will honour the terms of the auction • If utilities are creditworthy they can provide sufficient guarantees. Alternatively the government can invest itself or could provide the guarantee.
Contract scheme risk	• Risk for investors can be reduced by opting for a contract for procurement, engineering and construction of a power plant without an obligation to operate it over an extended period of time (e.g. Morocco wind and hydro auctions in 2010)

Examples

India

- Uttar Pradesh ran an auction attempting to attract developers with a shorter than normal state contract duration (10 vs 25 years) and a contract not indexed to inflation
- Results
  - Perceived negatively by bidders from increased uncertainty and ultimately there was insufficient demand to cover the auction demand entirely
  - Lower competition led to higher prices

Chile

- Auction contracts are in $ and adjusted periodically to US CPI helping to protect developers from interest and inflation risks

Dubai

- Solar auction in 2014
- Dubai Electricity and Water Authority had a 51% share in the project
- This security helped to contribute to the second lowest price being paid for solar energy[1] at the time

1. Second to USA, whose prices are artificially low due to tax credits which reduce the cost of installation by ~30%, when this is factored in Dubai becomes the lowest priced solar energy

Source: IRENA and CEM, 2015, IRENA, 2017b

Longer lead times, commitments to multiple rounds and carefully chosen ceilings can all reduce the price paid

Overview

Mechanism	Description	Comments
Scheduling multiple rounds	• Commitment to a particular auction schedule, increases developer confidence and reduces fixed costs from decreasing market research costs per auction	• Consideration needs to be given whether auctions are the appropriate mechanism before committing to multiple rounds
Lead times	• Longer lead times tends to lead to lower prices since it is possible for investors to speculate on decreases in investment costs between when they submit their bids and project delivery • They also decrease the risk of developers incurring fines for delays	• Longer lead times increases the chance of underbidding from speculative bids by developers
Ceilings	• Disclosing the ceiling price before the auction can increase the price bid due to an anchoring effect whereby bids are grouped around the ceiling[1]	• The downside of not disclosing ceilings is that bids that are close to the ceiling price are excluded
Attracting multiple bidders	• Having a number of bidders who compete on price will lead to lower prices • *See detailed slides regarding multiple bidders*	• Reducing barriers to entry to attract many bidders increases the risk of project delays and underbidding
Development requirements	• Specifying other requirements such as local content requirements can increase costs and thus increase bid prices	

Examples

South Africa and India

- Committed to multiple rounds
- In South Africa, between first and second rounds, number of bids increased 49%, the price dropped 39% for solar, and 23% for wind
- In India, total capacity offered increased 100% and the price dropped by 28%

Brazil

- At the end of 2013 and 2014, two sets of auctions were held, the first in each set was for project delivery in 3 years, the second in 5 years
- We see a 6% and 10% drop between these auctions, highlighting that longer lead times tend to decrease price paid

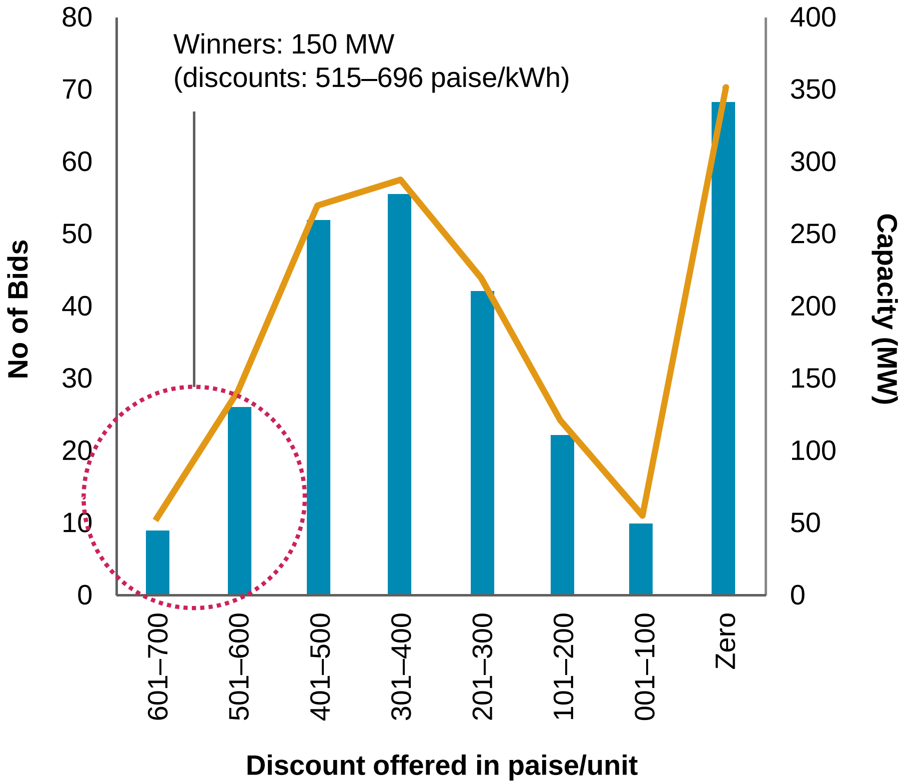
South Africa and India

- In South Africa in August 2011, ceiling prices were disclosed and no capacity limit was set other than the target for the entire auction
  - Contract price was high due to anchoring effect and lack of competition
- These two factors were changed to subsequent rounds and the prices fell dramatically
- Disclosure of ceilings in India in National Solar Mission auctions in 2010 and 2011, led to a high number of bids (~35%) offering the maximum allowed price
  - However, the auction had a sufficiently large number of other bids that the end price was well below the ceiling[1]

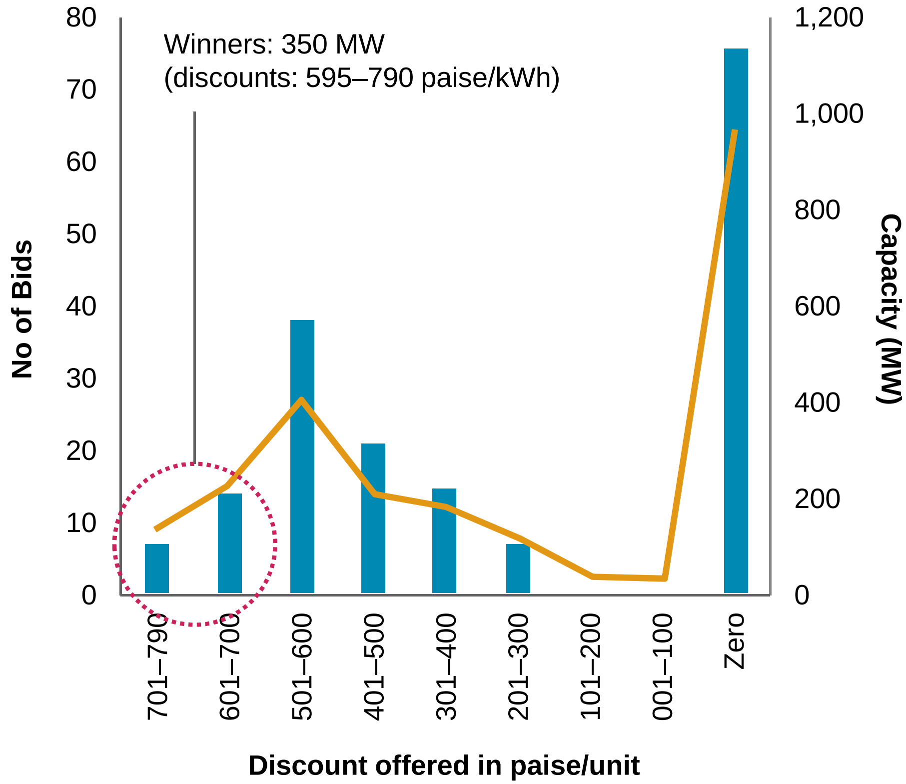
1. See next slide for example
Source: IRENA and CEM, 2015, IRENA, 2017b

Bids for PV projects in India[1] when ceilings were disclosed, reveal a high number of bids next to the ceiling

Bids for photovoltaic projects in India's NSM Phase I Batch I



Bids for photovoltaic projects in India's NSM Phase I Batch II



1. OBS: a discount of 100 Paisa per kWh (as shown in the horizontal axis of the figure) corresponds to approximately US$16/MWh at an exchange rate of 62 INR/US$. The ceiling price (corresponding to an offered discount of zero) was approximately equal to US$298/MWh in the Batch I auction (figure on the left), and to US$256/MWh in the Batch II auction (figure on the right)

Sources: IRENA, 2013, Rycroft, 2013, Eberhard, Kolker, Leigland, 2014, Elizondo-Azuela, Barroso et al., 2014), Ministry of New and Renewable Energy, 2012

Successful fulfilment of development goals requires realistic consideration of local market maturity and careful thought into the long term impact

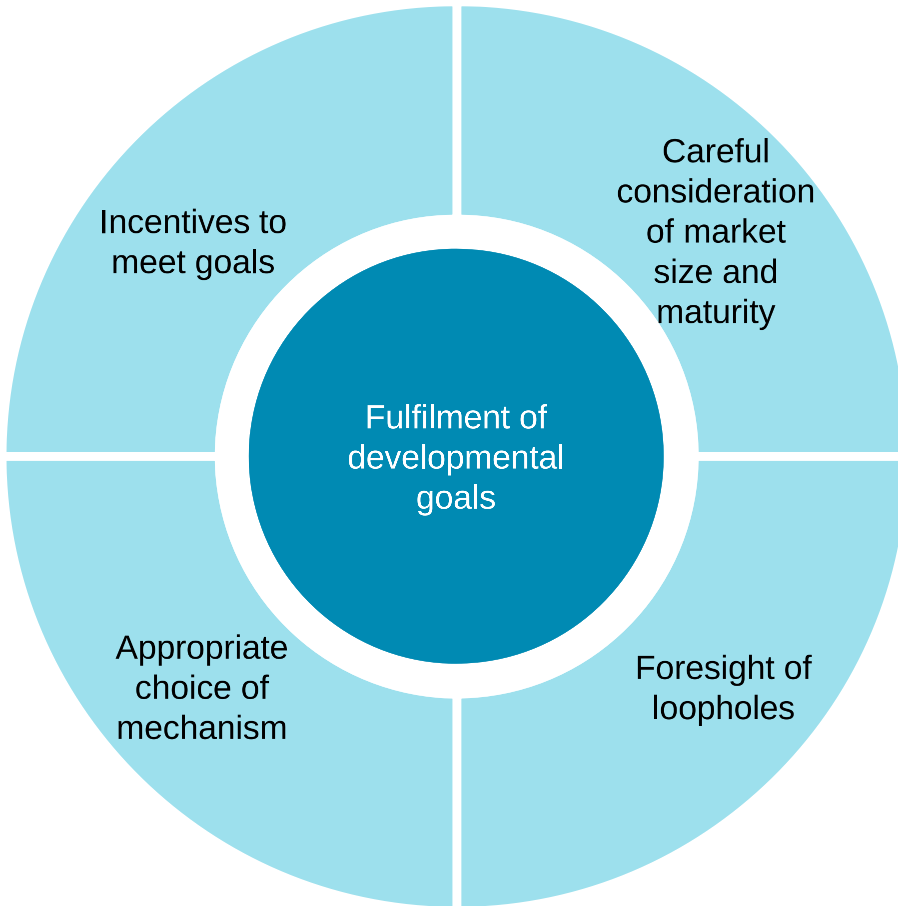
Why is it important to fulfil development goals?

1. Part of the goal of the auction is often to also fulfil developmental aims
2. For example, can include social improvements, development of local technical/business skills, local material supply, job increase, etc.

What methods are currently used to ensure bids fulfil developmental goals?

1. Requirements: Specific requirements are laid out in auction terms other than price which have to be met
2. Mutlti-selection criteria: Bids are evaluated not just on price paid but on a number of other metrics which can be given different weightings
3. Hybrid: A number of minimum floors are established and credit is given to anything which goes above those floors

What are the key considerations factors?



Source: Oliver Wyman research and analysis

There are a range of factors that policy makers should take in to consideration whilst setting developmental requirements

Key factors that should be considered in setting developmental goals

Consideration factors	Description
Careful consideration of market size and maturity	• Analysis should be carried out to determine to what extent the local industry is ready to support the size of the projects being auctioned, and any requirements set accordingly • Local content requirements might lead to the establishment of plants in locations where they are not cost competitive on a global scale • If local demand for equipment is reduced, these plans may be unable to compete • Thus careful consideration should be given to how to build a sustainable local industry corroborated by a long term policy framework
Foresight of loopholes	• Loopholes in requirements specified must be considered to ensure that the winning bid fulfils the auctioneer’s desired developmental goals
Choice of appropriate mechanism	• See previous slide for details of three main mechanisms • Consideration should be given to whether requirements should be fulfilled at any price or if it should be balanced with cost
Incentives to meet goals	• Legally binding details of quantifiable developmental goals in contracts • Additionally, these requirements could form part of the ‘performance bond’

Source: Azuela and Barroso, 2011, IRENA, 2017b, IRENA, 2013

Examples

Brazil

- Wind projects in Brazil required 60% of the equipment and 90% of services to be local for the project developer to receive low cost funding from the Brazilian National Development Bank (BNDES)
- This 60% became a bottleneck to wind generation development, given that Brazil only had one local wind manufacturer at the time

China

- Contribution of local content is normally a %age of the total project cost through equipment and services
- If set in this way, it provides a loophole for developers to fulfil their local procurement from services without purchasing local equipment, which could hinder development of local industries since there is little or no job creation in manufacturing and R&D sector
- To avoid this and develop their manufacturing industry China specified in 2005 onshore wind auctions minimum requirements specifically for locally manufactured equipment

Three mechanisms are used to fulfil local development goals in auctions: requirements, multi-criteria selection and hybrid

Overview

Mechanism	Description	Strengths	Weaknesses
Requirements	• Specific requirements are laid out in auction terms other than price which have to be met	• Ensure that development goals are met	• May sacrifice price
Multi-criteria selection	• Bids are evaluated not just on price paid but on a number of other metrics which can be given different weightings	• Flexibility to balance price with a range of other metrics	• Can be difficult to chose right balance of weighting criteria
Hybrid	• A number of minimum floors are established and credit is given to anything which goes above those floors	• Balances fixed requirements with multi-selection criteria	• Most complex

Source: IRENA (2015), IRENA (2017b), Oliver Wyman analysis and research

Examples

China

- 2003 auction had 50% local content requirement and counted for 20% bid evaluation
- 2005 auction had 70% local content requirement and counted for 35% of bid evaluation
- 2006 auction wind power manufacturers were required to participate in bids
- 2009, requirements on local content abolished.
- By 2012, 4 of the top 10 manufacturing companies were Chinese (27% market share)

France

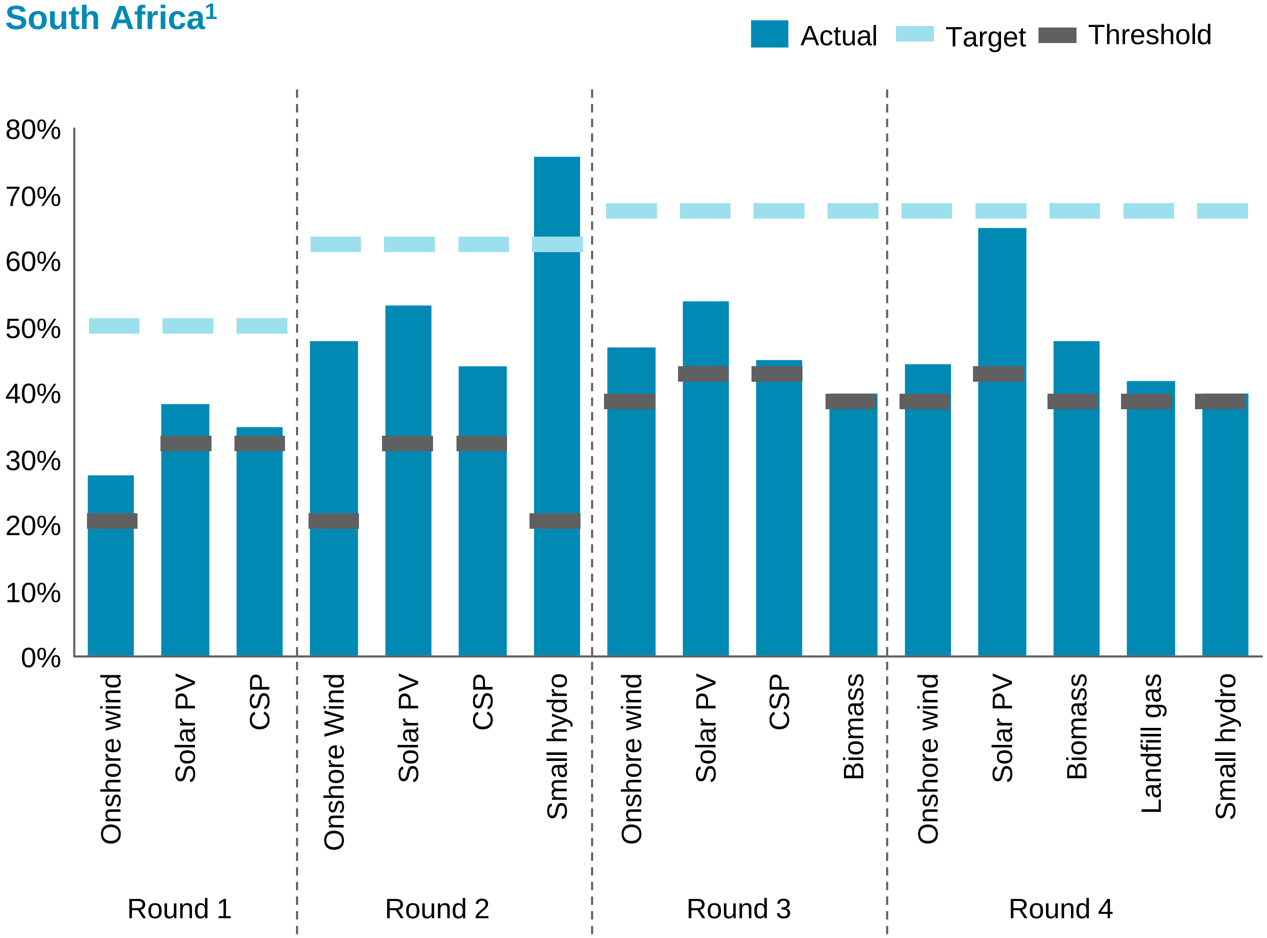
- Bids are evaluated on a range of factors:
  - Price per kWh and economic advantages of the project
  - Long term benefits of chosen technology
  - Technical and financial reliability
  - Environment aspects
  - Local stakeholder opinion
  - Contribution to R&D

South Africa

- Thresholds are set in qualification phase for different indicators such as local content and local job creation
- For second phase bids are graded based on their compliance with each economic development feature, based on a target level for each variable (well above thresholds)
- Ten points were awarded for achievement between threshold and target level and another 10 points for achievements above target levels
- Overall selection criteria was split 70/30 between price and development goals

Initially high local content requirements are difficult for developers to meet, but this becomes easier over time as local industry develops

Local content requirements and achievements across bidding rounds in South Africa[1]



Comments

- In the first round the thresholds were only just met
- Second round offers had high levels of local content, well exceeding thresholds, as the first auction had pushed local industry growth
  - This then stabilised around 45% for the majority of later bids
- Initially the local content requirements led to higher prices, however this then reduced as the local industry developed
- In order to minimize increase in price from development requirements, increasing development requirements over multiple rounds is an effective method

1. Taken from Submitter, CCRED and Montmasson-Clair, Gaylor and Das Nair, Reena, The Importance of Effective Economic Regulation for Inclusive Growth: Lessons from South Africa's Renewable Energy Programmes (2015)

Source: In addition to the above, IRENA, (2017)

Our review of RE auctions identified key “dos” and “don’ts” for renewable energy auctions

Do	Do not
✓ Ensure that auction design is aligned to the regulatory framework	✗ Attempt auctions without some regulatory stability or, if this is lacking, without minimum guarantees from recognised international 3rd parties such as the World Bank
✓ Demonstrate that policy makers have long term commitment to sector expansion	✗ Have very lengthy lead times as this increases speculative bidding
✓ Advertise auctions and their terms and conditions well in advance	✗ Make early auctions very complex for bidders
✓ Discuss and design the auction with developers in mind, trying to meet as many of their needs as possible without compromising any other auction goals	✗ Have opaque rules and winner selection criteria
✓ Set sufficiently high barriers to minimise unreliable bidders and sufficiently low so that multiple bidders are attracted to the auction	✗ Focus purely on incentivising project build without thinking of maintenance and continued operation
✓ Consider how to minimise collusion risk, e.g. set ceiling prices	✗ Have very small scale auctions that significantly limit commercial viability
✓ Have bid bonds and performance bonds to increase the chance that the winning bidder will sign the contract and then deliver the project on time	✗ Set non-specific technical requirements which allow poor quality developers to undercut higher specification bids
✓ Minimise forex, inflation and interest rate risk for developers	
✓ Invest in thorough due diligence of sites	
✓ Have an experienced team overseeing and advising on the auction process	

Source: Oliver Wyman research and analysis

Case study auction deep-dives

We focused on large scale renewable energy auctions in Africa (Zambia, South Africa, Senegal) as well as initial GMG auction (Brazil)

		Why has this been chosen?
	**Zambia**	• Renewable energy auction in Africa with involvement from World Bank which achieved record low prices for Sub-Saharan Africa
	**South Africa**	• Example of a dramatic decline in prices due to multiple auction rounds and changing key auction design elements
	**Brazil**	• Examples of an off-grid (“*isolated system*”) auction in which renewable energy competed
	**Senegal**	• Example of a regional concession model which was competitively tendered

Source: Oliver Wyman research and analysis

Case study auction deep-dives

Our deep-dives highlight the (i) importance of trust in the mechanism, (ii) clear auction design and (iii) challenges for initial auctions in GMG sector

	Key lessons learned
 **Zambia**	• Auctions can be a cost-efficient way to bring international best prices into new markets • International organisations can play an important role in mitigating political and counterparty risk, and reducing the cost of capital • Thorough diligence for site selection is important
 **South Africa**	• Auctions can be successful in encouraging a significant scale-up in renewable energy projects • Revealing ceiling prices can lead to an anchoring effect as bidders use price cap • Government commitment and private partner friendly policy environment are important
 **Brazil**	• Proven interest in auctions for mini-grids from renewable sources • Require longer tenures (no RE bids for 5 year PPAs) • Although LCOE might be lower compared to diesel[1], need to consider other advantages from diesel generation, e.g. market experience and reliability
 **Senegal**	• If multiple agencies are involved in a rural electrification programme, responsibilities of each must be clearly defined to prevent friction between them • Grid expansion is a serious threat for developers • Direct competition between a subsidy-backed utility and private companies should be avoided

1. Other advantages vs diesel generation also include cost on on-going diesel supply (especially to remote locations), air pollution, noise and maintenance requirements

Source: Oliver Wyman research and analysis

Zambia market overview

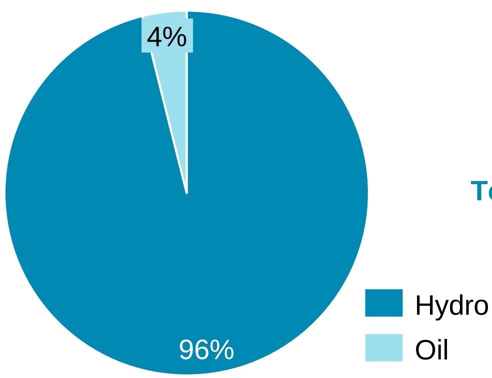
Country overview[1]

Overview: low middle income sub-Saharan African country with an economy reliant on copper exports

Population: 16.2 MM, predicted to growth of 43 MM by 2050

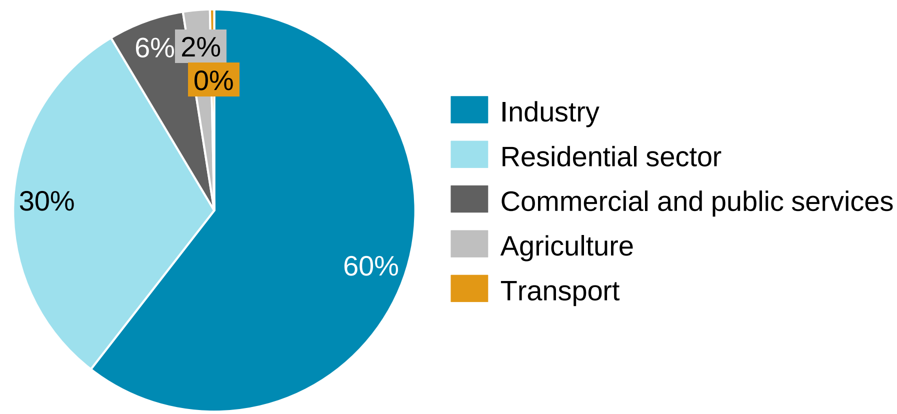
GDP per capita: $1490 (2015) down from $1750 (2013) largely due to falling copper prices

Electricity production in Zambia[2]



Total capacity: ~2,400 MW

Uses of electricity[3]



Zambia has a serious lack of electricity supply and connections

- Only 25% urban population has access to electricity[4]
- 3% rural access to electricity[4]
- Severe droughts means hydropower is operating at a third of normal capacity and there are 8 hour rolling blackouts for those that do have electricity[5]
- Demand for electricity continues to grow 200 MW annually[6]
- There is thus strong demand for electricity which is not being met by the current supply
- Scaling Solar is attempting to fulfil some of this demand in an environmentally friendly and cost-effective way

1. AURES report, 2017 relying on World Bank figures
2. Power Africa in Zambia (2016) and Zambia Invest (2017)
3. AURES (2017)
4. Power Africa in Zambia (2016)
5. BNEF (2016)
6. GLI (2017)

Scaling Solar Zambia auction design

Overview and objectives

- One stop shop program aiming to make privately funded grid-connected solar projects operational within 2 years at competitive tariffs
- Objectives
  - Balanced agreements and bankable project documents
  - Credit-approved term sheets for financing, political risk insurance and partial risk guarantees
  - Competition, transparency and speed

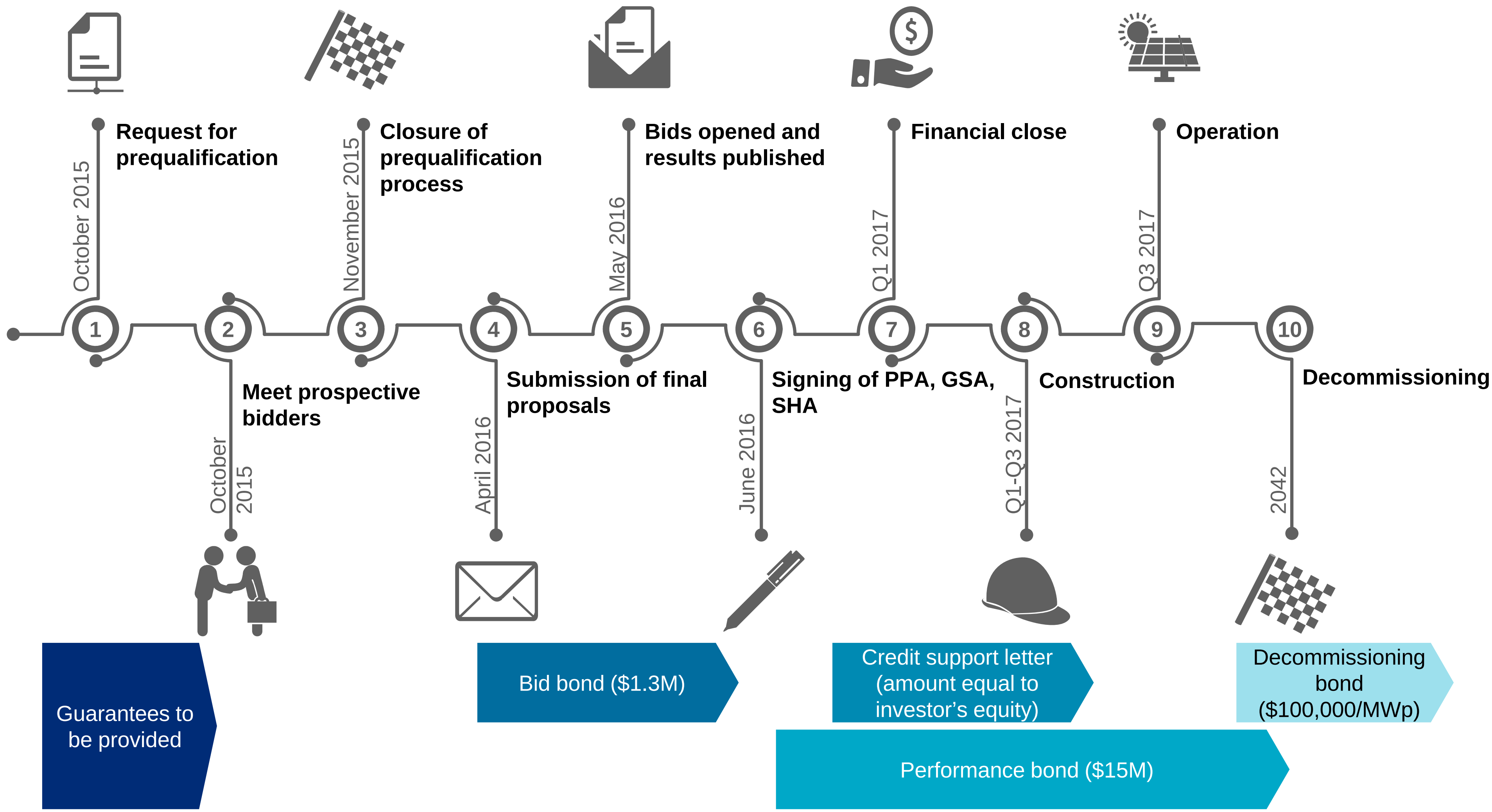
Auction features

- Lowest price sealed bid auction
  - No other selection criteria are considered post-qualification
- Pre-chosen sites in Southern Zambia
- Capacity is auctioned – max. of 50 MW
  - Winning lowest price is a $ denominated price per KWh which will remain fixed for 25 years (not inflation adjusted)
- No ceiling price
- Strict qualification criteria including: experience, expertise & financial requirements

Key parties	
IDC[1]	• Investment holding company owned by Zambian government • Helps with evaluation, pricing and lowering investment risk profile by acting as a co-investor • Local Zambian participating ensured through their taking a 20% shareholding in each of the two project companies • IDC's interests are offered to Zambian investors as a preferential offer
World Bank Group	• Financing for power plant's development and construction will be provided by investors or through packages from the World Bank • IFC supervised process from beginning to end, it also acted as lead transaction advisor to the Zambian government • Payment guarantee is given by IDA (US$15–20 MM for first 100 MW)
ZESCO	• State owned utility which is the off-taker
Key contracts	
PPA	• PPA with ZESCO (Purchaser), under which the Seller will, subject to a set of operational performance standards detailed in the PPA, sell to Purchaser all of the electrical energy generated by the Project
GSA	• GSA with the Government of Zambia, where the government will undertake to provide certain protections and other support to Project

1. Institutional Development Corporation of Zambia
Source: AURES, 2017, Oliver Wyman research and analysis

Scaling Solar Zambia timelines and guarantees



Source: ENEL Presentation, AURES, 2017

Qualification criteria

Technical Requirements

- Prospective Bidders shall be required to demonstrate experience of developing, constructing and operating at least one of the following (each a Technical Criterion) and to submit proof thereof:
  - One or more grid-connected solar photovoltaic power plants in Africa with a minimum aggregate capacity of 25 MW;
  - One or more grid-connected power plant(s) of any technology in Africa with a minimum aggregate capacity of 75 MW;
  - At least three grid-connected solar photovoltaic power plants, each in a different country anywhere in the world with a minimum aggregate capacity of 100 MW; or
  - One or more grid-connected power plant(s) of any technology anywhere in the world with a minimum aggregate capacity of 1,500 MW (IDC 2015, p.12).

Financial Requirements

- Prospective bidders are required to register with IDC and formally purchase RFQ document for a non-refundable fee of K1,000 (~$0.2)
- A Prospective Bidder shall be required to satisfy one of the following two financial prequalification criteria (each a Financial Criterion):
  - (a) if the Prospective Bidder comprises a single entity, such entity shall have had (i) a Net Worth of at least US$75m or equivalent and (ii) a Net Worth to Total Assets ratio of at least 15%, in each case as at the end of each of the most recent two full financial years for which audited financial statements are available as at the deadline for responding to this RFQ; and
  - (b) if the Prospective Bidder is a Consortium, then: (i) the Anchor Sponsors shall (A) between them have had a Net Worth of at least US$75m or equivalent and (B) each have had a Net Worth to Total Assets ratio of at least 15%; and (ii) the Lead Sponsor shall have had (A) a Net Worth of at least US$37.5m or equivalent and (B) a Net Worth to Total Assets ratio of at least 20% (IDC 2015, p.13).
- Bid bond at time of submission $1.6 MM (6 months)
- Decommissioning bond one year before termination of PPA $100,000/MWp (2 years)
- Performance bond from signing of PPA $15 MM (26 years)

Source: AURES (2017)

Results and lessons learned

Results

48 solar developers attracted

11 were qualified

7 submitted final proposals

- Bids ranged from ¢6.02/kWh to ¢10.6/kWh

2 winners

- NEON/First Solar project @ ¢6.02/kWh
- Enel Green Power @ ¢7.84/kWh

Lessons Learned

- Auctions can be an effective and cost-efficient way to introduce solar energy in sub-Saharan Africa
- In order for this to happen international organisations play an important role in mitigating political risk, counterparty risk and reducing the cost of capital
  - Zambia gov bonds current yield around 14%, and $ denominated bonds 10-12%. BNEF estimated in April 2016 that debt in Zambia needs to pay 11.7% interest and projects need to offer an ROE of 14.7%
  - With World Bank support it is estimated that this could come down to as low as 6% for the cost of debt, and 10% for cost of equity for Zambian projects
- Guarantees, reducing the amount of diligence required by developers, strict pre-qualification requirements and standardised contracts to eliminate negotiation of PPA can lead to the world leading players being attracted to projects in developing countries
- Site selection, if being done by the auctioneer must be done thoroughly. There were complaints about one of the sites chosen by the IDC as being ‘not flat and having rocks…the last site you would choose to do a solar project’[1]
  - Location of this site ended up being changed after the auction procedure. This will impact investor’s confidence for auctions in the future

1. Eckhouse and Hirtenstein (2016), reporting criticisms stated by ENEL Green Power Head of Business Development
Source: BNEF, 2016, Scaling Solar website, AURES 2017

1 2 3

South Africa country overview

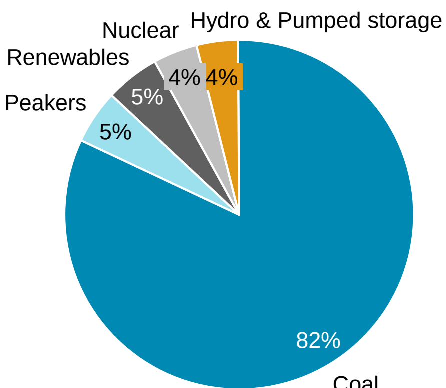
Country overview[1]

Overview: Upper middle income country which is one of the world' leading mining and metal processors

Population: 55 MM, slow growth expected to reach 75 MM in 2050

GDP per capita: $5,691 down from $8,000 peak in 2011

Electricity production[2,3]



Total installed capacity: ~45,000MW

1. World Bank data
2. South African Renewable Energy IPPP – lessons learned, 2016
3. Usaid
4. Yuen, 2014
5. REIPP, 2016

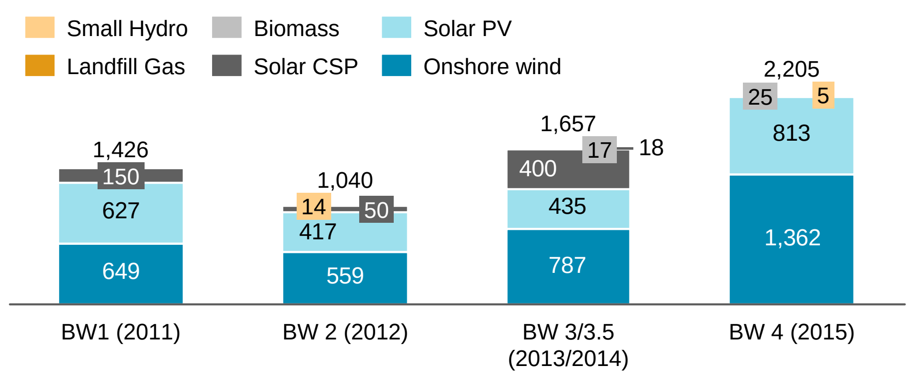
Source: Those listed above

Electricity market

- South Africa has one of the highest electrification rates in the continent with 85% of the population having access to electricity
- ESKOM, the state-owned power company, generates ~95% of the electricity and is responsible for most transmission and distribution
- The Government has been attempting to diversify its energy mix and attract more IPPs to the sector
  - In 2008 it introduced a REFIT programme which was then replaced by the Renewable Energy Independent Power Producer Procurement (REIPP) programme in 2011
  - REFIT programme led to not a single renewable IPP project being started, by contrast 6,327 MW of capacity have been awarded through auctions since 2011[4] (under REIPP programme)

REIPP programmes capacity auctioned, by energy type[5]

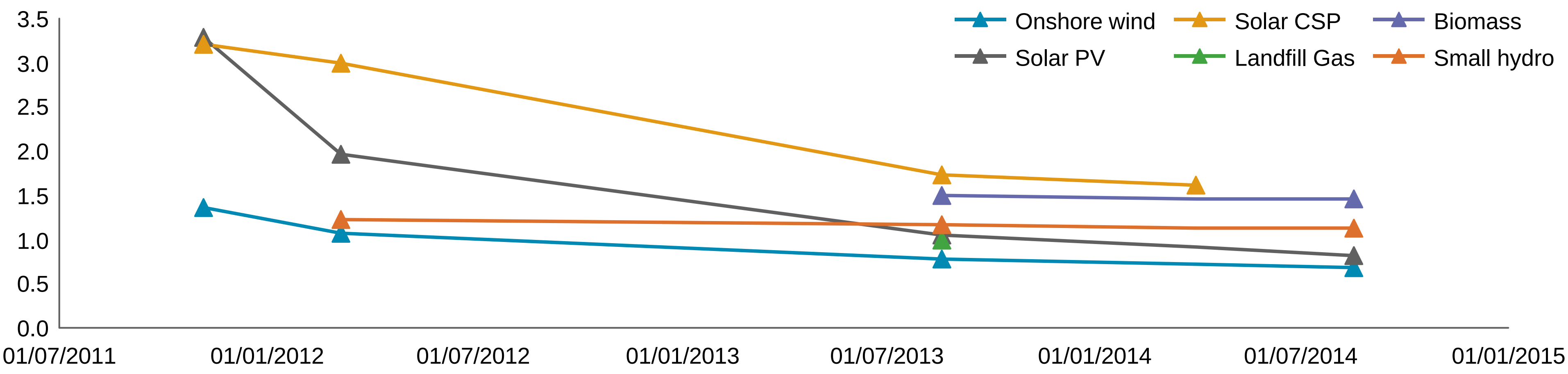
2011–2015



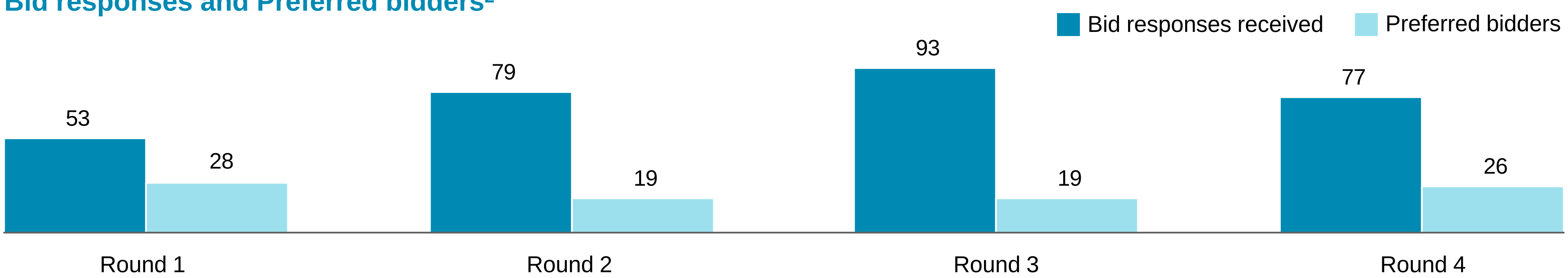
Renewable energy auctions in South Africa have seen a dramatic decrease in prices, whilst competition has increased

Average winning bid prices[1]

ZAR/kWh



Bid responses and Preferred bidders[2]



1. Data from http://sastela.org/wp-content/uploads/2015/10/DoE-REIPPPP-for-South-Africa.pdf , dates used are by submission date
2. Montmasson-Clair & das Nair, 2015

The falling prices were primarily driven by increased competition and reduced technology costs according Yuen's analysis

	Factor	Description
1	Increased competition	• Project developers, investors and EPC providers reduced margins to be able to offer increasingly low-priced auction bids • Short time between RFP and the deadline for bid submission meant many interested developers were unable to participate in REIPPP 1
2	Reduced technology costs	• Since 2009 the LCOE of solar PV and wind have fallen 85% and 66% respectively[1]
3	Economic downturn in more established RE markets	• The economic downturn in 2008 in other markets, led to increased investor interest in South Africa • As one investor said, 'the situation in the renewable energy market at the time was simply a choice of finding new markets or finding a new job'[3]
4	Reduced transaction costs for bidders from repeat submissions	• Transaction costs for developers decreased as returning compliant bidders do not need to reinvest in obtaining necessary documentation in the second round
5	Increased investor confidence and learning curve	• Proven track record of successful early auctions reduces risk premiums in pricing models and thus leads to lower bids
6	High first round prices from poor auction design	• Disclosed ceiling prices led to grouping around the ceiling and thus high prices • A large volume being auctioned at once without caps led to decreased competition • Change from one-off tender to a rolling series of bid rounds, increased investor and developer confidence and competition
7	Domestic industry being underdeveloped	• Local content requirements in the first round contributed to higher prices, with subsequent reductions as the local industry developed

1. Lazard, https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf , Utility scale solar seven year percentage decrease
2. Based on Yuen's analysis on Renewable Energy Auctions in South Africa. 9 out of 10 interviewees believed the impact of competition to be superior to reduced technology costs in reducing bid prices in REIPPPP. Additionally, all respondents mentioned these two factors as the main drivers.
3. Yuen, 2014

Source: Those listed above and Allen & Overy, 2015

Main drivers of reducing price[2]

The auctions are seal pay-as-bid with stringent requirements ensuring the developers have guaranteed financing before the auction

Design element	Description
Auction demand	• Multiple item auctions done by capacity, with ceilings for specific technologies
	• Regularly scheduled auctions
	• Sites are selected by the developers
Winner selection	• Sealed, pay-as bid auction, where winner is selected based on weighted criteria: 70% for the price offered and 30% for their additional contribution to economic development (over and above minimum requirements)
Sellers' liabilities	• Committed to signing a pre-advertised 20-year PPA and IA, bidders submit R100,000 per MW which is lost and R200,000 per MW for preferred bidders. Development fee of 1% of total cost
	• Off-taker is Eskom, whilst the government provides a guarantee over the PPA payment obligations
Qualification requirements	• A range of requirements covering project structure, legal, land use, environmental consent, financial, technical, value for money and developmental requirements[1] – In particular, bidders had to submit bank letters showing that financing was lock-in. This effectively outsourced the diligence to the banks
	• Bond requirements (detailed above)

Source: Campbell, 2012, AURES, 2016, Eberhard, 2014, Montmasson-Clair & das Nair, 2015

1 2 3

Analysis from Eberhard (2014, 2016)

Existing analysis identifies 11 key elements of success in these auctions

	Element	Description
1	Program resources	• By successfully accessing funding from sources like the DBSA, donors, and National Treasury jobs fund, then establishing a mechanism to capture fees from closed projects, the program was able to remain largely off the formal government budget through the first three bidding rounds
2	Quality of transaction advice	• DOE IPP unit selected experienced local and international transaction advisors who were successfully able to transfer international best practice in PPPs and renewable energy procurement into the South Africa context
3	Program size	• As the largest national IPP program ever attempted in Africa. The program immediately caught the attention of the global energy development industry, particularly because the European markets had been in decline
4	Exemption from PPP regulations	• IPPs were exempted from national PPP regulations. This avoided IPPs having to address South Africa's complex and time-consuming PPP rules which would have dramatically slowed progress
5	Non-negotiable program characteristics	• Non-negotiable PPAs and IAs were made available to bidders along with other tender documents and the standardized set of financial data that the bidders were required to provide for evaluation models • All bids were required to be fully underwritten with debt as well as equity.
6	Political support	• Benefitted from high level political support, including Zuma's commitment to green energy in COP21 and South Africa's hosting of COP17
7	Guarantees	• Sovereign guarantees in the Implementation Agreements backing Eskom's purchase of power from the renewable energy projects, increased investor confidence
8	Institutional setting	• Ad hoc status of DOE IPP unit, allowed and encouraged an operating approach that emphasised problem solving to make the program successful
9	REIPP management team	• Team had extensive experience working with the private sector. They had excellent working knowledge of PPP contracts; experience managing consultants, and credibility with both public and private sector stakeholders
10	Management style	• DOE IPP unit had none of the kind of mistrust of private business that sometimes characterizes other government agencies in South Africa
11	Qualification requirements	• High qualification requirements, have helped lead to all winning bids reaching financial close. This included requirements for commercial banks to undertake a thorough DD process before bids are offered

The elements of auction success, along with the other findings, can be translated into 7 broad lessons

	Lessons learned	Explanation
1	Transition from FIT to auctions does not have to be problematic	• FITs may have already created a base for RE energy market which is useful for the successful functioning of an auction scheme, and auctions may help these tariffs come down sharply
2	Competition should be maximised	• Short time spans between auction announcements and deadline for bid submission, local content requirements and having a high capacity auctioned at once can have a negative impact on competition
3	Revealing ceiling prices can increase prices	• There can be an anchoring effect around the ceiling prices if they are revealed prior to the auction
4	High transactions cost may be worth it	• Transaction costs were higher for the government and bidders than they would have been for a REFIT program, particularly given the stringent requirements. • However, it resulted in 6.3GW of capacity being awarded to developers since 2011 and dramatically falling prices, when the REFIT program in the two years it existed didn’t lead to a single development
5	Government support and policy is important for success	• Having strong Government backing for renewable energy and a policy environment favourable to private partners can help to deliver successful auction results
6	Stringent requirements around financing can deliver impressive results	• All projects auctioned to date in South Africa have reached financial close and some are already delivering power to the grid • This is in part due to the requirements for commercial banks to undertake a due diligence of projects prior to bids being offered
7	The value of an experienced team running the auction should not be underestimated	• An experienced team with a knowledge of a good knowledge of PPP agreements and private sector experience increases developer and investor confidence and can lead to a well designed auction process

Source: Eberhard, 2014, 2016, IRENA, 2013, 2016, AURES, 2016

1 2 3

Brazil market overview

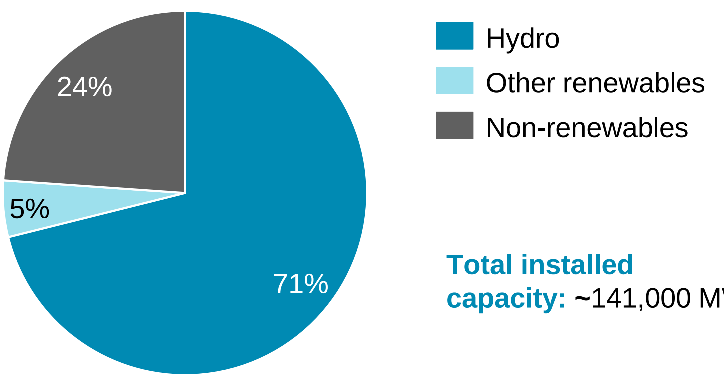
Country overview[1]

Overview: Upper middle income

Population: 208 MM, slowing growth projected to be 238 MM in 2050

GDP per capita: $8,539 down from $13,000 peak in 2011

Electricity production in Brazil[2]



Total installed capacity: ~141,000 MW

1. World Bank
2. EMIS
3. IEA, World Bank
4. University of Texas IRENA
5. BMI

Source: Listed above and Oliver Wyman analysis

Uses of electricity/Electricity market

- Brazil generates the 3rd highest amount of electricity in the Americas, behind only the USA and Canada, and 99.7% of the population has access to electricity[3]
- Brazil is mainly relying on hydraulic energy, which accounts for ~70% of its current generation. The 24% non-renewables is split between
  – Natural gas (~10%)
  – Coal (~5%)
  – Nuclear (<5%)
  – Liquids (<5%)[3]
- South-eastern Brazil has been experiencing a 3 year drought which was exacerbated by EL Nino. This water shortage led to a fall in hydro-electric output, so generation from other fuels increased[4]

Renewable energy programme and auctions[5]

- Brazil has a strong energy project pipeline, in particular in the power plants and transmission segments
  – BMI expects power plants and transmission grids sector value to grow ~3.1% in next ten years
  – RE leading the growth, with substantial pipeline of wind projects and increasing interest in solar
- RE auctions began in 2007
  – New energy auctions are carried out twice a year
  – Reserve energy auctions are carried out sporadically at government’s discretion

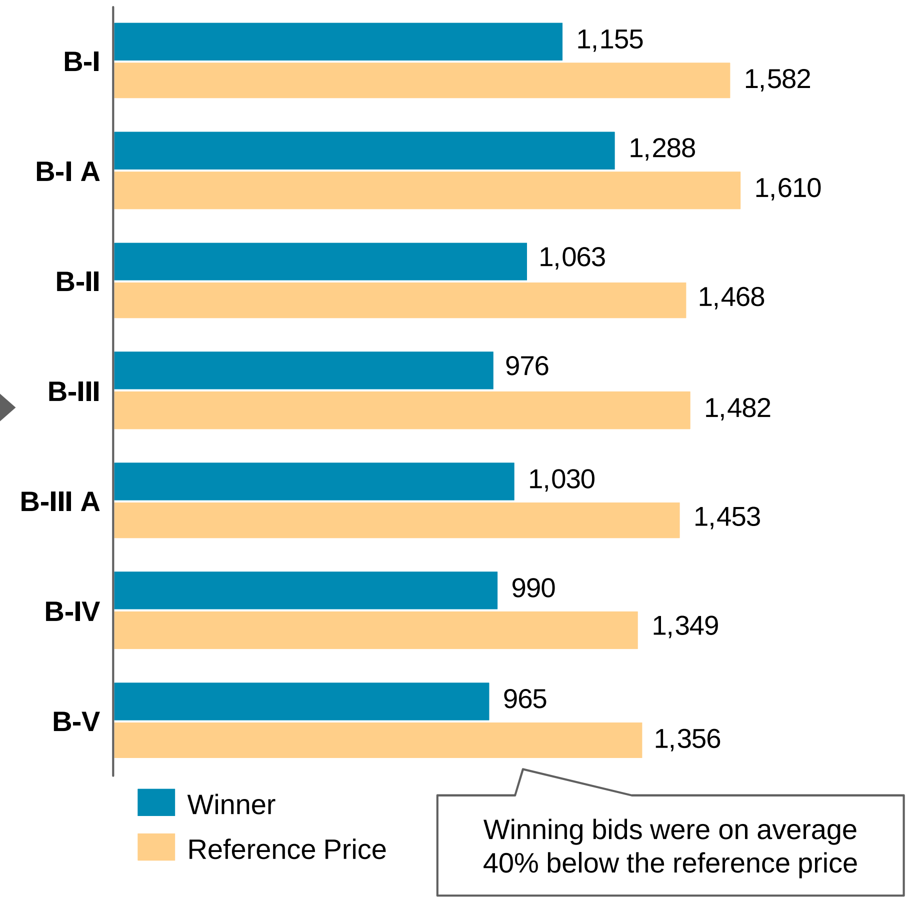
Brazil completed their 2nd auction for "*isolated systems*" in May 2017 – the auction delivered bids on average 40% below the reference price

Auction overview and key features

- 3.4% of Brazil's electricity generation is not connected to the national main grid and designated as "isolated systems", located mostly in the Amazon
- Energy regulator ANEEL auctioned 290 MW of capacity for isolated systems in order to provide with power 55 municipalities
- Projects selected in the auction were granted 5 year PPAs when grid connection was expected (lots type "A") and 15 year PPAs for remaining projects
- The auction was technology neutral
- BNDES provided special financial conditions for renewable energy projects selected in the auction
  - Low-interest loans
  - Potential allocation of BRL 200 MM (c. US$60 MM) for financing of projects selected
- In total 36 different projects applied to the auction
- The winning bids were on average 40% below the reference price – a clear indication of high interest in the auction and capacity available

Winning bid price vs. Reference Price

BRL/MWh, per lot

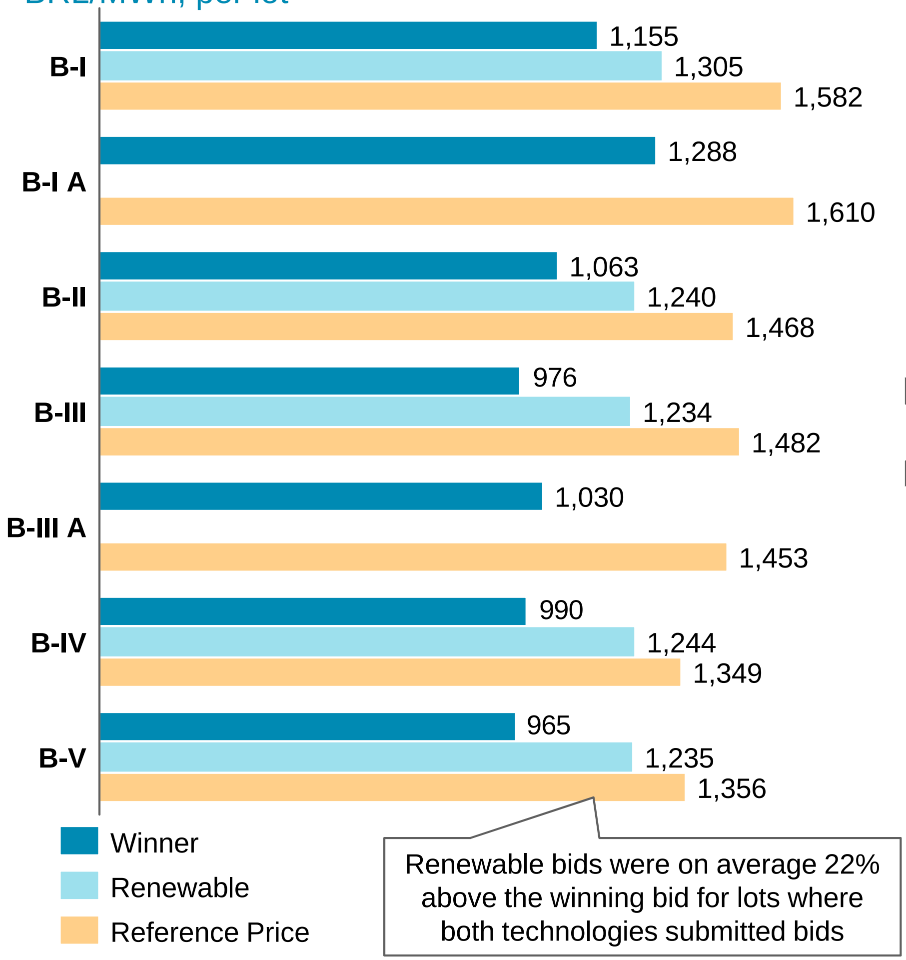


Source: EPE, ANEEL, BNDES, Ministério de Minas e Energia do Brasil, Oliver Wyman analysis

Although the auction was technology neutral and renewable energy had financial support, solar PV-based bids failed to win any lot and were on average 22% above the winning bid price

Winning bid price vs renewable bid price

BRL/MWh, per lot



GMG bid price = average of bid prices of Cons. Voltália and Guascor (latter only for lot B-IV and B-V)
Source: EPE, ANEEL, BNDES, Ministério de Minas e Energia do Brasil, Oliver Wyman analysis

Key findings

- Prior to the auction launch, the government estimated that solar PV+ battery projects would have a 8% lower LCOE advantage when compared to local diesel-generation even considering higher initial investment costs
- Although several renewable projects applied (solar PV and hybrid solar-diesel), all winning bids were diesel-generated supply projects
- Interestingly, no solar-PV project was bid for type "A" locations where PPA on offer was for 5 years and the grid was expected to arrive
- Renewable bids were on average 22% above the winning bid. Some of the potential reasons
  - Experienced diesel generation companies in the region, with multiple sites (and economies of scale) and knowledge of the supply chain
  - Higher diesel cost estimates for hybrid solar projects (e.g. Guascor)
  - Exchange rate uncertainty, with higher impact on solar PV projects that require more imported equipment (even though diesel prices would also probably increase)
  - Lack of local skilled and experienced teams regarding solar PV for isolated systems

Senegal market overview

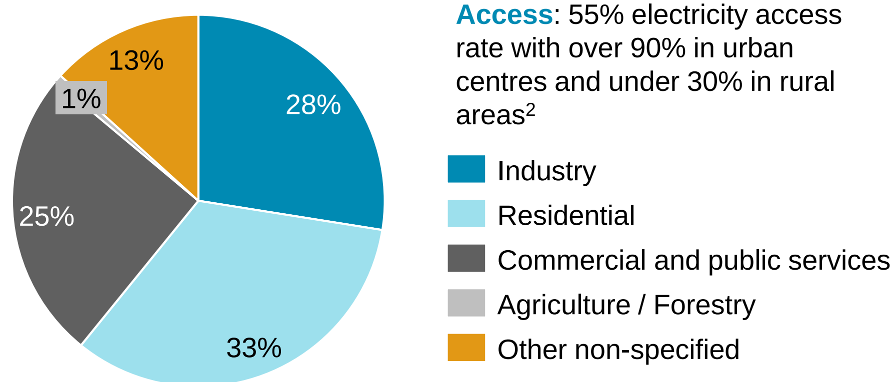
Country overview[1]

Overview: Low income country with limited natural resources.

Population: 15MM forecast to be 32 MM in 2050[1]

GDP per capita: $958 down from $1,052 in 2014

Electricity consumption[2]



Access: 55% electricity access rate with over 90% in urban centres and under 30% in rural areas[2]

Electricity production in Brazil[2]

- Senegal has a total installed capacity of ~731MW[2]
  - Electricity generation is overwhelmingly diesel and gas, both of which need to be imported
  - Installation of new coal and diesel generation and newly discovered offshore gas reserves is expected to keep up with rising demand[3]
  - Currently hydropower has been partly exploited and contributes 54 MW to the power mix
  - Solar PV has been used in new mini-grids and to retrofit existing ones

Renewable energy programme and auctions[5]

- Senegal has a large solar energy resources. Over most of the country solar irradiation is above 2,000 kWh/m^2/year
- Going forward there is political will to have 15% of generation capacity from renewables by 2020
- Rural electrification runs on a concessions program whereby ten distinct rural electrification concession areas can be awarded to bidders in a competitive tender
  - 10 rural electrification concessions have been legally created
  - 6 concessions were awarded between 2008-2013
  - 3 concessions have started electrification activities in 2017

1. Population Pyramid and World Bank
2. IEA, 2015
3. RECP – Africa-EU Renewable Energy Cooperation Programme

Source: Listed above and Oliver Wyman analysis

Analysis from BNEF (2017)

Senegal's concession programme failures and lesson learned

Details of the programme

- Senegal started a comprehensive rural electrification programme 15 years ago
  - Main programme was 10 regional concessions which were competitively tendered
  - Additionally, this was accompanied by Senelec's grid extensions and small, local initiatives
- Ministry of Energy developed three separate entities to work towards rural electrification
  - SREA – in charge of developing a detailed rural electrification programme
  - ESRC – regulates production, transmission and distribution of electricity, has the power to issue concession and licences to micro-grid developers and pico-solar product distributors
  - Senelec – holds the monopoly of transmission, distribution and retail of electricity on the main grid, and is expected to actively pursue grid extensions in remote areas

Results

- 10 rural electrification concessions were created
- 6 joint ventures between foreign and local firms were awarded concessions in which they could generate and retail electricity
- 3 concessions have started electrification activities in 2017
  - Private concessions have varied in their approach of delivery models, from relatively centralized approaches to micro-grids and stand-alone solar kits

Lessons Learned

- Having multiple agencies involved as was adopted in Senegal, may have been designed to accelerate the electrification, but led to friction between different stakeholders.
  - Having one agency that oversees all mini-grid development will avoid the risk of slowing electrification progress from having conflicting agencies
  - Similarly better rules clarifying exactly which agency is responsible for each area would avoid micro-grid relocation and keep transaction costs down to a minimum
  - Another option is breaking down the concession areas into smaller units which larger concession holders and local initiatives could trade with each other
- Unplanned grid extension leads to the stranding of micro-grid assets and detracts future developers
- Imposing tariff caps on concessions while allowing cross-subsidized tariffs from Senelec has put severe pressure on the economics of concession holders.
  - Allowing private actors and a subsidy-backed national company to compete directly is not a recipe for a healthy market.
  - To compensate for this Senegal will soon distribute a subsidy to private operators to compensate them for these distortions
- Slow development of an electrification framework leads to dramatically reduced interest from investors and developers

Source: Bloomberg New Energy Finance, 2017

3 Design elements for a successful GMG auction

1 2 3

The on-grid RE auctions provide key lessons but different challenges for potential GMG auctions

	On-grid renewable energy auctions	GMG auctions
Description	• Utility scale renewable energy projects have been running for over 20 years, and auctions for over 10 years in most developed countries • Auctions are typically for a PPA to supply electricity to the grid at the lowest rate. Utility then charges end user the national tariff rates	• Nascent sector with no GMG specific auction being held to date • Open question as to exactly what will be auctioned with a wide variety of possible business models pivoting around ownership of assets and customer relationship
Lack of proven business models	✘	✓
Threat of grid expansion	✘	✓
High demand risk	✘ (possible risk for some on-grid IPPs)	✓
Ability to charge cost-reflective tariffs is a serious barrier	✘	✓
Requires building of distribution assets	✘ (connection to main grid might be required)	✓
Large scale projects	✓	✘
Large scale multinational developers	✓	✘ (not at the moment but interest in developed country island tenders)
Developer also has retail presence in domestic market	Possible (e.g. integrated utilities with renewable generation)	Preferred by developers

Source: Oliver Wyman research and analysis

During our interviews, market participants highlighted some concerns regarding the use of auctions within GMG sector in Africa

Main concerns on regulatory/demand uncertainty and transaction costs

Area	Description	Sub-area	Risk
Policy and Regulations	• Currently the largest area of concern to be addressed in auction process given impact on ability to build and operate mini-grids	• Ability to charge cost-reflective tariffs	
		• Threat of grid expansion	
		• Lack of clear and streamlined licencing procedure and regulation	
Financing	• Challenge to access financing given: – High risk, nascent industry with lack of proven business models – Lack of bankable documents and guarantees	• Auction will need to ensure bankable contracts with credible off-taker and with extended tenures (+10 years)	
		• Limited private investment and equity backing without high return-risk profile within auction parameters	
Business models	• Concern whether auction process will enable mini-grids to be economically viable in the long-term or just focus on short-term objectives • Auctions need to allow developers to have a clear view of the potential business models they can consider according to return-risk profile	• Lack of proven business models	
		• Current dependence on grants/donors	
		• Exposure to off-taker credit risk	
		• Exposure to demand risk	
Site selection	• Uncertainty regarding stakeholder responsible for site selection and the risks this entails was regularly mentioned by developers	• Government carrying out site selection and diligence, providing demand risk guarantee if diligence is proved inaccurate	
		• Independent credible 3rd party carrying out site selection without providing any guarantees	
		• Developer site selection	
Other	• Other key risks mentioned by developers	• High transaction costs in auction mechanism	
		• Potential for long inefficient auction process	
		• Lack of suitably skilled local technicians and operators	

Source: Oliver Wyman research and analysis

Low High

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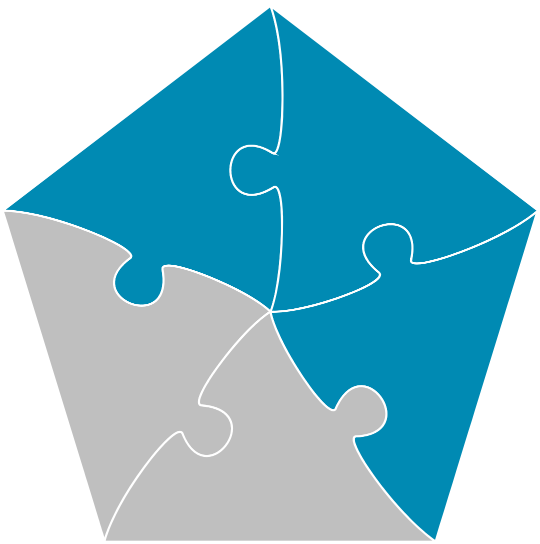
Auction setup will need to consider the key barriers to expansion

Significantly sized auctions with international engagement can directly stimulate a more favourable regulatory and policy environment

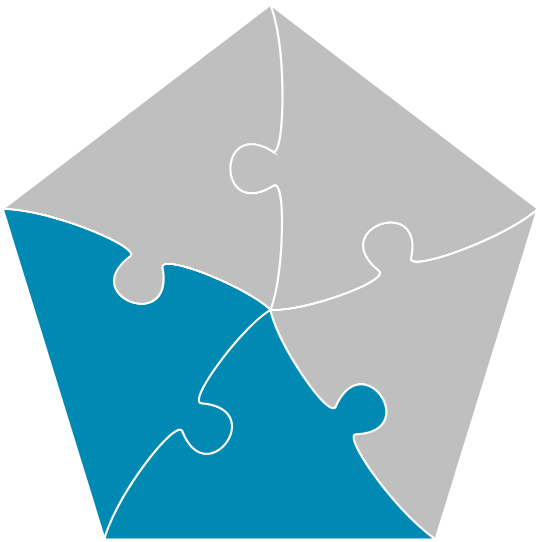


Barrier	Details of how auctions can overcome them
Policy & regulation	• Large scale auctions supported by international bodies such as World Bank could help stimulate government engagement and regulatory change – Unlike individual small scale mini-grids, a larger auction which clusters many sites together (preferably of similar size) can have significant impact on rural energy access through one process. This increases the chance of government and regulatory buy-in • Auctions could be used as a mechanism to test potential changes to regulation and, if successful, act as a precursor to changes – For example, terms such as being able to charge non-uniform tariffs could be included within the main body of the auction terms and if this proves successful, lead to later changes to the regulatory framework
Demand uncertainty	• Centralise site selection process in order to reduce cost of diligence • Market linkages could be improved through governments setting up discussions with local communities as part of the site selection process, allowing communities to opt-in for having a GMG and be included in affordability /willingness to pay assessments
Access to finance	• Auction terms should provide certainty and clear commitments to increase likelihood of affordable finance, e.g.: – Guarantees surrounding possible threats such as grid expansion which decreases investor risk – Having a significantly sized project, overseen by reputable bodies, with a clearly defined bankable contract that defines tariffs and contract duration

Source: Oliver Wyman research and analysis

Auction setup will need to consider the key barriers to expansion

Attracting larger developers will support scale up of technical skills and capacity in GMG market



Barrier	Details of how auctions can overcome them
Lack of capacity	• Best way to increase capacity and skills gained from actually closing projects and carrying out projects • Auctions as a mechanism can: – Increase the number of projects and stimulate local development – Attract international developers who may not otherwise consider developing in those countries – Include local content requirements which can be increased as the local market develops, thus encouraging a gradual increase in local capacities
Unproven business models	• Having proven commercially viable business models will take time • Auctions as a mechanism can: – Help stimulate regulatory change and government buy-in – Set a market derived level of subsidy/tariff at which projects will be able to be commercially viable – Reduce the cost of diligence for developers by centralising costs (and using high quality external advisors for surveys/due diligence, etc.) – Include guarantees around grid expansion and a clearly bankable contract that will decrease financing costs – Set pre-qualification requirements at an appropriate height to ensure that only sufficiently reliable developers are able to bid and thus have the opportunity to prove their business models

Source: Oliver Wyman research and analysis

1 2 3

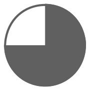
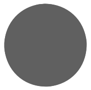
Auction setup will need to consider the key barriers to expansion

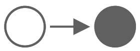
However, important not to add additional barriers for developers, e.g. long process duration and significant transaction costs

Barrier	Details	How to overcome this barrier
Process duration	• Auctions are complex processes[1] which can take significant front-to-end time: – Auction design and preparation – deciding on all design elements including site selection and winner selection criteria[1] – Bidding process – time from auction announcement to bid submission – Bid analysis – time from bid submission to outcome announcement	• Auction design and preparation – Balance between ensuring the process is well-designed and with clear efficient timetable – Although initial auction design and preparation may be slow (e.g. one year), if done well, future auctions can use previous auctions as a basis which will considerably speed up the process – Slower process if using fixed site selection, as recommended, but will also decrease the time and effort invested by developers in bidding process • Bidding process – Balance between allowing for enough time for developers to carry out work required to submit bids and not delaying the process – This could be streamlined by an online portal which takes developers details and puts them in to standardised bid documentation[2] – Clear articulation/check lists of exactly what is required (e.g. hold bidder workshops) in order to submit an eligible bid will also help to reduce delays • Bid analysis – Standardised bid documentation makes it easier to compare bids on a like for like basis – Analysing whether pre-qualification requirements are met by bidders as bids come in reduces the time between bidding window closing and announcing the results – Simple and transparent winner selection criteria and mechanism
Transaction costs	• Carrying out the required due diligence, hiring advisors, preparing bids, submitting documentation and meeting all pre-qualification criteria can add significant costs, in particular for smaller developers, with no guaranteed return	• Auction design to minimise transaction costs for developers – Predefined regions/sites reduce level of diligence required – Provide bid preparation support to smaller developers (e.g. hold bidder workshops) – Streamline and standardise documentation as much as possible – As mentioned above, online portals with standard documentation templates could minimise time investment for developers and allow for developers to only have to submit their details once even if they bid on multiple auctions[2] • Make auctions sufficiently large that they are economically attractive to developers – Smaller sites should be clustered to allow for economies of scale

1. See Appendix A.1. for the large number of design elements required for an auction. 2. Odyssey is an example of such an online platform.
Source: Oliver Wyman analysis and research

Auctions for GMG sector can have multiple combinations
E.g. reverse auction for the price of electricity generated or the value of the subsidy within tariff

	PPP – Private generation	PPP – Private ownership with public support
Auction possibilities	• Reverse auction based on price per MWh for utility/government to buy generated electricity – Clear and simple reverse auction, as has happened for on-grid auctions which incentivises the developer to produce as much electricity as possible – Terms will need to be specified to prevent over-generation and subject to storage technology in place. This can be done based on demand, a fixed capacity or a fixed number of MWh that will be sold per unit time • Reverse auction for level of Capex support in addition to price per MWh – More complicated as two elements are included in what is being bid for. Mechanism required to synthesis into one price • Fixed price for purchasing energy in PPA and agreed volume, with reverse auction for Capex subsidy – Decreases developers risk of dependence on government over long period of time – If Capex subsidy is significant, it decreases the incentive of the developer to maintain mini-grid	• Reverse auction for level of subsidy above agreed tariff (either uniform tariff or cost-reflective tariff) – Effectively reverse auction for level of feed-in-tariff. Terms need to clearly specify what tariffs are permitted to be charged to end consumers – Note that new connections are key parameter (including cost per connection) • Blend of Capex grant and tariff support – Consider results based financing linked to Capex for connections (grant for fixed cost) – More complex, mechanism will be required to synthesise bids into one price for comparison • Reverse auction for Capex support from government – Decreases developers risk of dependence on government over long period of time – If Capex subsidy is significant, it decreases the incentive of the developer to maintain mini-grid
Most feasible auctioned item	• PPA price of generated electricity	• Value of the subsidy within tariff
Auction suitability		



Source: ESMAP, 2016, Oliver Wyman research and analysis

The initial auctions should reflect the low market maturity and limited sophistication of GMG industry in order to avoid complexity and uncertainty

Auction complexity vs market maturity

Auction complexity: High

Initial auctions in less mature markets can also include a high degree of complexity in order to compensate for potential lack of regulation and policies in place.

Mature auction markets

- High confidence in demand profile
- Tailored auctions that incorporate track record learnings
- Proven business models that are active in market
- Mature and competitive regulations and policies
- Large number of active suppliers and developers
- Trust in mechanism from market stakeholders (consumers, lenders, investors, government/regulators)

Immature auction markets

- Consider significant demand uncertainty
- Pilot auctions
- Strong public support
- Cluster sites for increased scale
- Avoid complex multi-criteria for evaluation
- Enable commercial viability (e.g. results based financing, cost-reflective tariffs)
- Minimise grid expansion risk

Low complexity auctions possible in mature markets but reliant on strong regulations and policies as well as confidence from different stakeholders

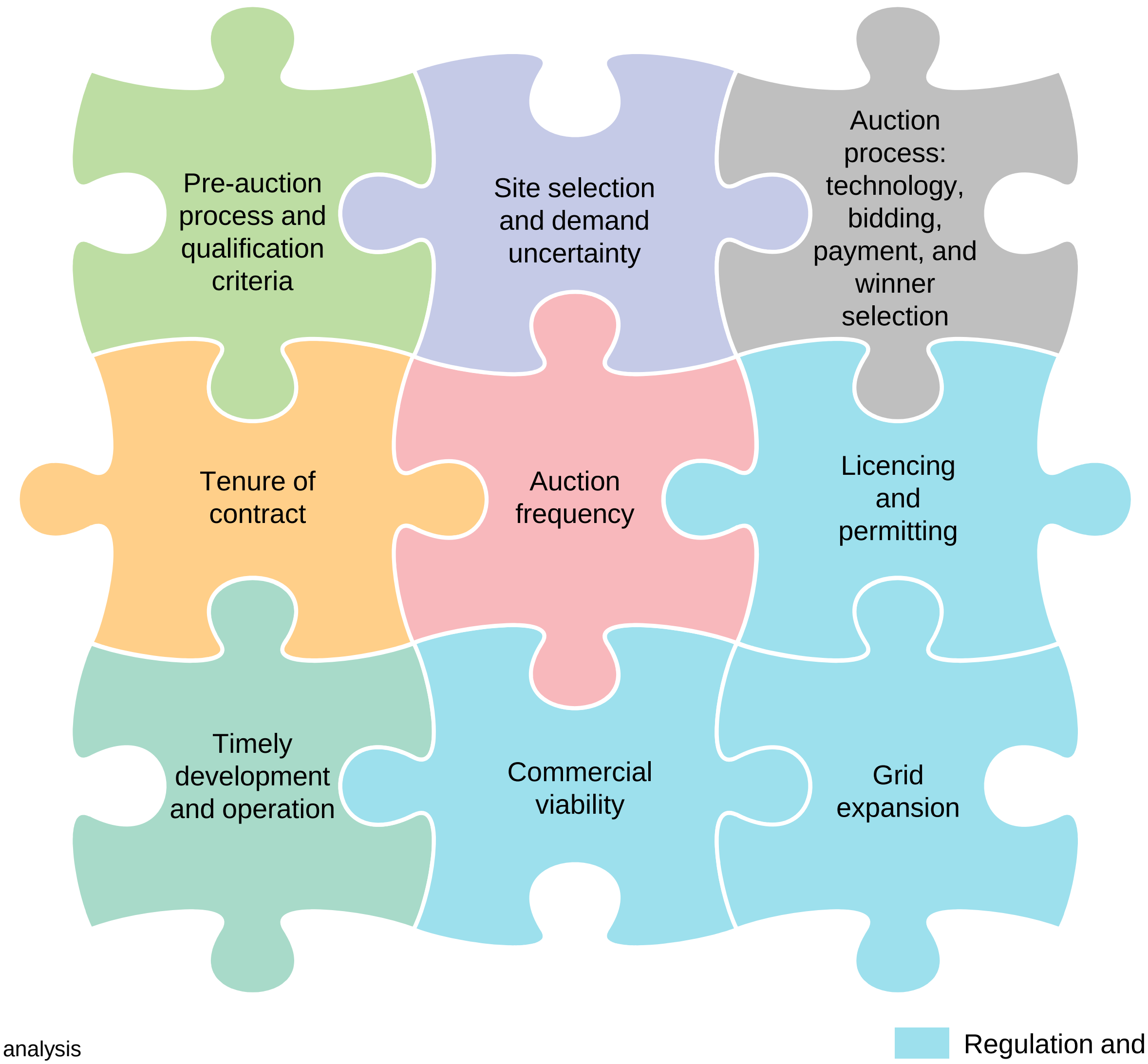
Market Maturity: Low – High

GMGs Africa market

- Given GMG is still nascent sector with significant barriers for scale-up, auctions should broadly adopt the initial characteristics
- Initial auctions that can be piloted and refined
- Projects can also be delivered and business models tested as proof of concept regarding GMG scale-up

Source: Oliver Wyman research and analysis

Following discussions with industry experts and developers, we have highlighted nine key design elements for a successful GMG auction



Source: Oliver Wyman research and analysis

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Develop a clear engagement and communication plan with all the relevant stakeholders during the pre-auction process

Overview

- Nascent nature of GMG sector and lack of detailed proven GMG experience - auctions should enable early engagement with communities and developers/bidders
- Community engagement is key in order to develop understanding of local support for projects, potential demand and willingness/ability to pay
- In order to attract multiple bidders, auctioneers must advertise the auction successfully and align with bidders' expectations and requirements as much as possible

Zambia

- Scaling Solar developed a one stop shop program aiming to support privately funded grid-connected solar project
- IFC provided experienced team with in-depth understanding of the process and the required international standards for bankable contracts
- Prior to closure of prequalification process meeting with prospective bidders to clarify requirements and criteria
- Clear and transparent bidder consultation and access to relevant market information, e.g. site selection and potential

Recommendations

- Choose an **experienced team** with a deep understanding of the local market and private sector
- Define clear plan regarding **community engagement and willingness/ability to pay**
- **Prepare communication plan** in advance (e.g. multi-channel approach) to promote auction
  - Reasonable timing for promotion of auction and ensuring appropriately granular details of what is being auctioned and the process
  - Promote symmetrical information to attract bidders

  Organise **bidders workshop** to inform potential bidders on project specifics and process
  - Clarify pre-qualification criteria
  - Can also include training for best practice proposal preparation
- If possible, **share open information on market potential**, including with lenders/finance

Clear pre-auction engagement with stakeholders

Easy → Difficult

Source: Scaling Solar website, AURES, 2017, Oliver Wyman Research and Analysis

1 2 3

Define set of pre-qualification criteria at the appropriate height

Delicate balancing act, particularly given the relative lack of experienced GMG developers

Overview

- Successfully placing pre-qualification requirements at a correct level will ensure that only serious and reliable developers win the auctions whilst still qualifying enough developers to ensure a fair competition between bidders
- This balance is particularly challenging given the relative lack of large pool of developers and bidders with proven GMG experience

Brazil

- Need to fulfil a number of technical requirements, including, an environmental licence, preliminary grid access authorisation, and financial qualifications
- No past experience requirements make Brazilian auctions more inclusive, and have likely allowed for a high rate of projects to pass qualification stage (~75%[1] vs. e.g. 23% for Scaling Solar in Zambia[2])
- However, delayed projects with ~70% of the contracted capacity from wind auctions (that should have started operations in 2013) being delayed for more than a year – one reason put forward linked to low threshold for past experience

Morocco

- Strict past experience criteria in 2011 solar auction including requiring bidders to have won a past bidding process for at least 45 MW, led to just 4 of only 12 bids being pre-qualified

Comments

- Given nascent nature of GMG sector, stringent past experience requirements should be avoided. However, it is important to have some mechanisms in place to filter out unsuitable developers, e.g.:
  - Bid bonds – where bidders have to submit a sizeable deposit, e.g. subject to bidder signing the contract
  - Licencing requirements – bidders must have already attained the relevant licences before auction process
  - Financial requirements – this could take a number of forms such as a requirement for bidders to have net assets larger than the capital value of the project (e.g. China's wind auctions)
  - Feasibility analysis – bidders financial models are scrutinized by industry expects to see if they are realistic

Recommendations

- **Define appropriate pre-qualification criteria** in line with the market and intended profile of developers. The requirements should ideally be binary (you either pass them or fail).
- Consider blend of pre-qualification requirements – including but not limited to **technical, financial (e.g. bid bond), local content and past experience**
- Note that past experience criteria should be relatively relaxed due to limited number of players with significant GMG experience

Define set of pre-qualification criteria

Easy → Difficult

1. Based on the results of all RE auctions in Brazil up to 2014. 2. BNEF, 2016
Source: ECOFYS, 2016 , IRENA., 2015., Listed above, Oliver Wyman Research and Analysis

1 2 3

Ensure that appropriate sites are selected for the auction

Overview

- Ensure that appropriate sites are selected for the mini-grid development
  - Potential capacity for renewable energy source (higher capacity factors will lead to lower prices)
  - Unlike with on-grid projects, the mini-grid is dependent on its isolated group of users, so ensuring the area has sufficient demand is crucial
    - As mentioned, engage local communities to confirm their needs and interest in mini-grids to ensure that they fully understand the value proposition
  - Diligence costs associated with choosing sites increase transaction costs for developers
- The selection of sites can be driven by the developer, the auctioneer or a combination of both. Sites can be auctioned individually or clustered
  - Developers could be given opportunity to propose sites for analysis

Examples

Zambia

- Scaling Solar had specific pre-selected site in Southern Zambia in Lusaka South Multi-Facility Economic Zone
- Reduced barriers to entry in terms of diligence and the investor's liability of securing land but there were complaints over the sites that were ultimately selected.

China

- Onshore wind auctions (+2003), were site-specific.
- Government was responsible for securing land and environmental permits, but the costs were borne by the bidders.

Denmark

- 2015 near shore wind auction, bidders were presented with a choice of 6 sites pre-selected by the government
- TSO carried out environmental impact and preliminary surveys for all sites
- Only 3 of the sites are expected to be contracted

Peru

- Solar auctions specify the desired technology and determine the price but no site is specified

Source: Oliver Wyman research and analysis, IRENA, 2015, IRENA, 2013, Scaling Solar website

Have a fixed list of locations being auctioned
Fixed list will ease comparison of different auction bids

	Fixed site auction with specific locations	Fixed settlement auctions	Flexible site auction, where number of sites chosen from fixed list	Site agnostic auctions with certain criteria
Description	• Auction sites are fixed by auctioneer who carries out basic diligence to determine suitability of locations • No choice from developers over site	• Auctioneer specifies which settlements are required to be supplied electricity but leaves it to developer to pick specific location of power supply	• Shortlist of sites listed by auctioneer from which developers choose preferred site(s) to bid on	• Auctioneer does not specify where the mini-grid is going to be placed but only volume auctioned / people served
Strengths	• Clear specification of sites • Easy to compare bids • Easier to ensure community buy-in • Reduced barriers to entry for developers given government diligence • Allows for permits/permissions to be put in place specific locations for development	• Allows for developers to leverage competitive advantages choosing specific sites whilst still allowing for clear comparison of bids and ensuring community buy-in	• Developers have increased flexibility to cherry pick based sites from list of possible options • Easier to have multi-technology auctions	• Site agnostic allows for developers to fully leverage own market knowledge • Potential for lowest prices paid and widest diversity of bids given this freedom • Easiest to have multi-technology auctions
Weaknesses	• Heavily dependent on quality of diligence for selected sites • Limits possibilities of multi-technology auctions • High government involvement can lead to time delays	• Focus on settlements may neglect diligence of suitability of potential specific sites	• Challenge comparing bids and setting out appropriate winning selection criteria • Difficult to engage local communities	
Assessment	• Strong potential for successfully attracting bidders and allowing a fair competition providing the sites/settlements have been well chosen		• Possible but not recommended given challenges over comparison of different sites	

Recommendation

Source: Oliver Wyman research and analysis

Define clear and transparent site selection process

Allow for engagement of local communities and developers

Site selection mechanism

Potential sites considered by government, developers can propose their own sites with basic details of these sites for government analysis

↓

Local communities of potential sites are contacted to gauge their interest/demand in having a mini-grid installed

↓

Based on discussions and suitability, a final list of sites is decided

↓

If sites are small, sites are geographically and technologically clustered and auctioned

Risks	Mitigations
• Delays / slow process, given multi-stage site selection	• Clear time window for submission of potential sites and dates for final list of sites being published
• Poor site selection leads to decreased engagement from developers	• Experienced and credible team with private sector experience responsible for choosing sites
• Lack of engagement from local communities	• Clear articulation of value proposition and selection of communities that mini-grids have potential to have a serious positive impact
• Lack of developer interest due to nature of clustering	• Ensure that clusters are suitable for the same type of technology and geographically close.

Ensure successful site selection

Easy → Difficult

Source: Oliver Wyman research and analysis

1 2 3

Assess potential demand profile for site selection

Demand forecasts remain a big challenge and require a bottom up analyses and plan for proactive action to stimulate demand

Overview

- GMG dependency on a particular population/community for demand
- Robust analyses regarding size of current and future demand, the load profile and customer willingness to pay
  - Knowing the required installation capacity to meet demand
  - Assessing which technologies are most suitable
  - Forecasting revenue streams and analysing business model viability
- Demand forecasts remain one of the key challenges for GMGs: many of the GMGs sites are in rural areas with limited data on demographics and data on impact of existence of a mini-grid

Tanzania

JUMEME RURAL POWER SUPPLY

- Developer Jumeme carried out intensive process to select appropriate sites for their mini-grids
- This included detailed landscape and demographic analyses to select suitable villages, discussions with local authorities, and a detailed demand assessment. Each potential customer was interviewed from a final shortlist of sites.
- The first sites chosen were on islands on Lake Victoria, in part due to their lack of exposure grid expansion risk
- However, energy off-take by households remained substantially lower than in the demand forecast. Energy off-take by the productive use is in line with the expectation/demand assessment (or even beyond)

Comments

- Early mini-grid experiences led to developers over-estimating demand. This has led to two outcomes
  - Developers decreasing capacity build
    - Some developers are moving to building smaller sites where they predict supply will clearly outstrip demand. Once they see the demand, then developers can increase the capacity of the generation assets to respond to demand.
  - Developers stimulating demand profile
    - Proactive measures to actively stimulate demand

Recommendations

- **Cluster sites to ensure scale** for developers
- Bottom up demand profiling is recommended, with sensitivity analysis to highlight margins for error. Key metrics include: population density, average income, current energy source, uses and spend.
- Consider sites with high levels of productive use and identify potential anchor customers
- Try to “create” demand , e.g. ancillary services (e.g. micro-financing), education on GMG benefits vs. kerosene and encouraging local business development through training, financing or some other means
- Capture lessons from previous household demand overestimation

Assess potential demand profile for site selection

Easy → Difficult

Source: Oliver Wyman research and analysis, expert interviews

1 2 3

Consider technology specific auctions for early auctions

Adopt agnostic sub-technology (i.e. no preference between solar PV or solar hybrid) to attract more bidders

Overview

- GMG auctions can be technology specific or technology neutral
- Setting the technologies for auctions will have an impact on which developers can bid for the project and the ultimate price paid
- Site selection needs to be considered as pre-selected sites will likely limit the possible technologies

Brazil

- 2017 "isolated systems" auction was a technology neutral site specific auction in Amazon region
- Bids were received from diesel, solar PV and hybrid solar-diesel developers
- However, no renewable energy lots won with renewable bids being on average 22% higher than the winning bid[1]
- Technology neutral auctions reduce the risk of under-contracting

Denmark, Morocco & South Africa

- These are all examples of countries which hold technology specific auctions
- In South Africa, a number of technology specific auctions are held in parallel to induce economies of scale and reduce transaction costs
- Technology-specific auctions can reduce future prices due to resulting development of chosen technology and provide additional guidance to developers

Comments

- Given the unique dynamic of mini-grids, and previous recommendations regarding specific sites, it is likely that certain specific technologies will be more suited to the auction.
- A technology specific auctions provides clear guidance to potential developers and allows for a balancing of renewable energy source types, but limits the number of potential bidders.
- In contrast, technology neutral auctions will likely increase competition but at the expense of risking becoming inadvertently dependent on one renewable energy technology.

Recommendations

- **Pre-determined fixed site selection** naturally lends itself to **technology specific auctions**. However, given the desire to initially attract the largest number of bidders possible, it is encouraged to leave the auctions technology neutral[1]. Furthermore, it may be realistic also to allow the inclusion of non-fully green energy sources such as solar / diesel hybrids given the current limitations of batteries.
- When selecting sites, they should be clustered so as to be suitable for technology specific developers (e.g. a hydro location should not be bundled with one which is only suited to solar)

Consider technology (neutral vs. specific) for auction

Easy → Difficult

1. Here understood in context of GMGs to only include renewable energy technologies
Source: Oliver Wyman research and analysis, IRENA, 2015, ANEEL, EPE, BNDES

There are three main bidding and payment mechanisms that could be used for a GMG auction

Overview

- The mechanism used to submit bids has a significant impact on the success of the auction. Unlike on-grid auctions where multiple bidders can win one auction, it is likely that only one developer will win each site / cluster of sites.
- There are three main types of bidding mechanisms and payment mechanisms used:
  - Bidding mechanism
    - Sealed bid
      - Bidders submit bids simultaneously with offer price and quantity. No bidder knows offer price of other participants.
    - Descending clock
      - Auctioneer announces a price at beginning of each round, bidders indicate capacity they will offer at that price. Price is gradually reduced until supply meets demand.
    - Hybrid
      - Combination of above two mechanisms. Typically descending clock followed by a sealed bid.
  - Payment mechanism
    - Pay-as-bid
    - Marginal pricing schemes
      - Uniform pricing where the bidders are paid the price of the most expensive of the accepted bids
    - Non-standard pricing
      - Catch-all phrase for other types of pricing scheme, typically involving some ex-post negotiations

Examples

UK

- Marginal pricing descending clock auctions for capacity market
- Auctions start with £/kW offers and gradually reduce until the minimum price is reached at which the supply of capacity offered by bidders is equal to the volume required. Highest price offered by a winning bidder is the price paid to all bidders

Brazil

- Carries out descending clock auction which is terminated when overall supply matches the auction's demand plus an adjustment factor unknown by bidders
- Bidders successful in first round proceed to a sealed pay-as-bid auction phase, where bidders cannot offer a price higher than the ceiling price from the previous phase
- The second phase has led to bids being further lowered (up to 16% difference in prices vs. first round[1]). However, there are concerns over the length of time such a process takes and increased chances of underbidding.

India

- Rajasthan, Tamil Nadu, Andhra Pradesh and Odisha adopted a non-standard pricing scheme for their sealed bid auctions
- The final contract price was given by the lowest bid offered in the auction. Bidders willing to accept this price were awarded the PPA
- Mechanism reduced prices but also led to significant unmet demand as a large number of bidders refused to sign the PPA

1. Auctions between 2009 and 2014

Source: ANEEL 2015, IRENA, 2015

Consider sealed pay-as-bid auction for GMGs

Sealed pay-as-bid helps minimise political risk and is well understood by developers and lenders

	Strengths	Weaknesses
Sealed bid	• Simple • Most commonly used, so developers understand mechanism • Least susceptible to collusion	• Bidders required to disclose minimum price may detract developers • Lack of transparency
Descending clock	• Highly transparent • Potential for truer price discovery, though evidence suggests developers rarely revise their bids over the course of the auction	• More complex than sealed bid • May be more susceptible to collusion given information is revealed about bids
Hybrid	• Allow for some price discovery as well as easier to implement pay as bid pricing	• Most complex and time consuming
Pay-as-bid	• Most commonly used • Appealing from political standpoint	• More complex bidding strategy as estimating other players' bids is important
Marginal pricing	• By making project developers' remuneration independent from their price bid, bidders are encouraged to disclose their actual costs.	• Possibility of losing social and political support from perception that auction mechanism leads to unnecessarily high prices
Non-standard pricing	• Auctioneer may be able to negotiate a better deal post-auction with selected developer	• Ex-post negotiation undermines auction process • Perception of being not as fair

Recommendations

- A **sealed bid, pay-as-bid auction** is well understood by developers and is transparent
  - Due to higher cost of production for GMGs vs on-grid projects, GMGs already face increased political risk around being able to charge cost-reflective tariffs
  - A transparent and clear bidding and payment mechanism will reduce political risk
- The increased complexity of hybrid auctions and marginal pricing are more suited for mature markets
- Given nascent nature of GMG market, simpler mechanisms should be favoured

Set bidding and payment mechanism

Easy → Difficult

Source: IRENA, 2017, IRENA, 2015, Oliver Wyman Research and Analysis

Adopt a simple multi-criteria evaluation mechanism

Minimise high complexity and low transparency when defining the auction criteria in initial GMG auctions

Overview

- Clear communicated evaluation criteria allows developers to prepare their bids to the auctioneers' demands
- There are three main types of evaluation criteria in RE auctions
  - Minimum price auctions (Peru and India among others)
    - Lowest price bid that qualifies wins
  - Adjusted minimum-price auctions (see example below)
    - Correction factors are used to compare different bids on the same basis, used in competitive auctions that may involve products with very different characteristics
  - Multi-criteria auctions (France and South Africa and others)
    - Introduce additional criteria in the comparison of bids other than price, such as a quantification of the bidders' reputation and offering bonuses for using locally manufactured goods

Brazil

- Uses minimum-price criteria as well as a 'correction factor' which correlates the power plant's production and the average spot price profile
- When the plant generates mostly at times when the spot price is high, the adjustment will turn into a bonus, whereas when the plant generates mostly at times when spot price is low, this adjustment will turn into a penalty

Comments

- Minimum price auctions
  - Main advantages regarding transparency and simplicity
  - In this method, it is important to have sufficiently high pre-qualification requirements to ensure that any other objectives such as quality equipment and local content requirements are met
- Adjusted minimum-price auctions
  - Key benefit regarding comparability of bids with different products and technologies in the same auction on a like-for-like basis
- Multi-criteria auctions
  - Can become complex and more difficult to describe to developers
  - Benefit of being able to assign relative weight to each of a large number of factors in one bid

Recommendations

- Initial auctions should **adopt a simple multi-criteria mechanism** that can include additional criteria to price, e.g. number of connections or community development targets
- A highly complex mechanism should be avoided and detailed technical/financial criteria can be stipulated during pre-qualification
- Minimum price auctions could also be used given simplicity

Choose appropriate evaluation mechanism

Easy → Difficult

Source: IRENA, 2017, IRENA, 2015, Oliver Wyman Research and Analysis

1 2 3

Offer long term (bankable) contracts

Long term contracts, 10+ years, will support auction attractiveness for developers and lower prices

Overview

- The contract length has a clear bearing on the economics and risk exposure for the developer
- Choosing the appropriate tenure for the length of auction will increase developer engagement and reduce bid prices

India

- Uttar Pradesh conducted an auction in 2013 where the contract duration was reduced from 25 to 10 years and not indexed to inflation.
- After 10 years project developers were able to sell electricity at the market price
- The 10 year PPA was perceived negatively by bidders due to uncertainty in remuneration after end of the PPA. Also, not having contracts linked to inflation simply led to developers having to price in inflation risk into bids
- The result of these factors, coupled with the difficult financial situation of the state's distribution company, led to an insufficient number of bids to cover auction demand, and higher prices than other auctions at the time (~25% higher than the average price paid in 2013 auctions)[1]

Uruguay

- Contract length proposed by bidders and could be between 10 and 20 years
- In order to minimise risks and increase project bankability, all submitted proposals asked for a 20 year PPA

Comments

- A common strategy for on-grid auctions is to calibrate the duration of the contract so it is as close as possible to the generation assets useful life
  - This avoids burden of the developer estimating the plant's residual value once the contract terminates
- Consider typical financing maturity given by banks (and align when possible) and exposure to forex and inflation risk. For example, inflation risk can be mitigated by having tariffs linked to some inflation metric.

Recommendations

- **Long contracts of 10+ years** are recommended to increase bankability, taking into account useful life of generation assets
- Contracts which allow for prices linked to inflation are preferable as this reduces risk for developers and will likely lead to lower prices
- Forex risk is difficult to manage given local tariffs in domestic currency. One way to mitigate is for bids to be submitted in an international currency such as USD in order to allow developers/lenders to hedge currency exposures

Define tenure of auction contracts

Easy → Difficult

1. Using analysis taken from IRENA and CEM, 2015 which notes "*due to the very different nature of the auctioned products, several assumptions needed to be made in order to obtain reasonably comparable values*." Thus the 25% figure should be interpreted only as a rough estimate rather than an exact value.

Source: IRENA and CEM, 2015, Oliver Wyman research and analysis

1 2 3

Focus initially on standalone pilot auctions

Committing to systematic auctions in nascent GMG space is not recommended until the use of auctions has been tested

Overview

- The frequency of auctions has a direct impact on overall price bid and investor confidence
  - Systematic auctions
    - Auctioneer commits to multiple rounds of auctions over a sustained period of time
  - Standalone one-off auctions
    - One-off auctions where no long term schedule of auctions is announced and carried out on an ad-hoc basis

South Africa and India (certain states)

- Committed to multiple rounds
- In South Africa, between first and second rounds, number of bids increased 49%, price dropped 39% for solar, and 23% for wind
- In India, total capacity offered increased 100% and the price dropped by 28% across rounds

Dubai and Peru

- Used standalone auctions
- Provided governments the flexibility to adjust the auctioning schedule in response to any shifts in market conditions

Comments

- Standalone auctions have the significant benefit of giving auctioneers flexibility over auction schedules. This allows them to respond to previous auctions results in attracting bidders and developing projects
  - Avoids any scenario whereby the government over-commits and has to revise its prior commitment, damaging investor confidence
- However, standalone auctions magnify the stop-and-go characteristic of auctions and make it more difficult for developers and manufacturers to plan
- Systematic auctioning can increase investor confidence as it shows a long term commitment. This allows developers and manufacturers to plan longer term. Furthermore, having a steady stream of projects rather than an a periodic influx helps the government promote the development of local industries

Recommendations

- **Initially focus of small standalone auction** to test whether auctions will work as a mechanism in scaling up GMGs
- Once/if initial auctions prove successful, **later consideration of systematic auctions** that can be beneficial for helping to reduce prices and give investors confidence. Note that governments should be pragmatic and avoid over-committing

Define auction frequency and schedule

Easy → Difficult

Source: IRENA, 2017, IRENA, 2015, Oliver Wyman Research and Analysis

Create an efficient streamlined licencing process

Efficiency and potential exemptions will help to ensure timely delivery of projects and increase developer interest

Overview

- Licences and permits are normally required for the generation, distribution and supply of electricity. The licensing process can be very time consuming and require a wide range of documentation
- Having an efficient licencing and permitting procedure will attract developers and prevent delays in the delivery of the projects

Kenya

- Three different government agencies are involved in providing licences and permits (Ministry of Energy, ERC and the county government)
- Additionally approvals may be required from the National Environmental Management Authority, Ministry of Lands (for way leaves), Water Resource Management Authority (for hydro) and the Kenya Civil Aviation Authority (for wind)
- This can lead to lengthy delays in receiving licences

Mali

- In contrast, Mali has one agency (AMADER) that makes all major decisions on mini-grids. According to the research of Energy4Impact and INENSUS "*this has played a big part in the successful deployment of mini-grids in the country*"
- Projects under 20kW do not require licences

Comments

- There are two central areas for licencing mini-grid auctions
  - The legal framework and mechanism
    - Having a sufficiently thorough licencing procedure to ensure that the developer meets environmental and experiential requirements is normally balanced against speed of process
  - Licencing's role in the auction
    - Auctions which require licences to be held prior to the procedure increase barriers to entry for developers but reduce project delay risk

Recommendations

- Consider **licensing exemptions for smaller projects** (e.g. Tanzania)
- The appropriate balance between thoroughness and speed will vary by auction, however a number of factors should be encouraged:
  - A **single licencing national body** as in Mali is preferable
  - Licence costs should be **linked to mini-grid size**
  - Single licence applications for multiple sites should be permitted
- Licencing role in auctions
  - If auction process is sufficiently aligned with regulatory framework, award licences to winning bidders. This avoids developers submitting similar information twice and decreases delay risk

Create an efficient licencing process

Easy → Difficult

Source: Energy4Impact, 2016, Oliver Wyman research and analysis, IRENA, 2015

Consider performance bonds to ensure timely project delivery

Focus should also be given to financial incentives for developers to continue to operate and maintain the GMG

Overview

- Essential to include mechanism to ensure the timely delivery and continued operation of mini-grids
- Mini-grids, in part due to their historic dependence on grant funding, have often failed to be properly maintained and operated once the grid and generation asset has been developed
- It is particularly important that auctions attempt to address this issue to ensure that not only mini-grids are developed on time but also maintained over the lifetime of assets (and contracts)

Peru

- Bid bond of USD 20,00 / MW of capacity installed is lost if bid is won but bidder fails to sign the contract
- Performance bond of USD 100,000 / MW of capacity installed. If construction delays occur for two consecutive quarters, penalties are deducted. In case of delays to COD bond is increased by 20% over outstanding amount

Zambia

- For 2016 Scaling Solar auction a bid bond of USD 1.3M was required (USD 13,000 / MW) and a performance bond of USD 15 M (USD 150,000 / MW)

Comments

- Scaling Solar had lower bid bonds but higher performance bonds than in Peru, perhaps reflecting increased concern with project delays
- Typically large on-grid auction projects do not experience problems with the continued maintenance of sites given commercial implications for developers
- Auction should consider steps to ensure continued operation , e.g. :
  - Ensure developers are financially incentivised to continue operating and maintaining the GMG
    - A bond mechanism where developer receives penalties for failing to continue to generate electricity
    - Pay back is based on power generation and/or connections
  - Trade-off regarding what assets are funded via grants/subsidies. If grants/subsidies are focussed on Capex then the developer will be less exposed to risks of losing this funding but also will have less incentive to ensure the successful operation of the grid.

Recommendations

- **Consider performance bonds** and bid bonds to ensure serious developers and help to encourage a timely delivery of projects
- Special attention should be given to **incentivising continued maintenance and operation** of the GMG

Ensure timely project development and operation

Easy → Difficult

Source: IRENA, 2015, AURES, 2016, Oliver Wyman Research and Analysis

1 2 3

Support long-term commercial viability of GMGs

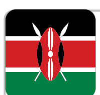
Allow developers to charge cost-reflective tariffs and offer ancillary services to end-customers

Overview

- Electricity generated from mini-grids is usually more expensive than central grid power - however comparisons need to be on like-to-like basis (e.g. consider grid public subsidies and utility business model)
- Private investors need to make an ROI, and consequently require government subsidies, cost-reflective tariffs and/or grants to become viable and bridge the current viability gap. Without the possibility of a positive ROI, private investors will not participate.

Tanzania

- Tariffs for mini-grids below 100kW are exempt from regulatory approval
- If 15% of customers complain, projects are subject to an ex-post review
- Unregulated tariffs however are even more exposed to political and legal risk. For example, politicians may promise to lower tariffs and introduce new regulations forcing developers to cut tariffs



Kenya

- Powerhive are the only firm to gain approval to charge cost-reflective tariffs for mini-grids
- Company was required to submit financial models and tariffs for approval by Energy Regulatory Commission (ERC)

Comments

- Challenges with each of the main sources of project income
  - Government subsidy: Often have little spare capital and committing to subsidising mini-grids can be perceived as expensive. Reliance on subsidy over operation of mini-grid is high risk for developer.
  - Customer: Challenges with charging tariffs above the uniform grid tariff and government reluctance to allow high(er) tariffs pass on to end-consumers due to monopoly concerns and political reasons
  - Grants: Dependence on grants is not viable long-term and particularly challenging if grants are being used to subsidise ongoing tariffs

Recommendations

- Consider **result based financing** linked to auction objectives
- Consider **subsidy parity** with existing grid and enable developers to **charge cost-reflective tariffs** where possible
- Tariffs charged to end consumer should be lower than alternatives (e.g. diesel generation, kerosene). However, debate whether charging tariffs higher than uniform tariff is sustainable in the long-term
- Businesses should be able to **offer ancillary services** to end users in order to increase revenues and allow for reductions in tariffs

Support long-term commercial viability of GMGs

Easy → Difficult

Source: ESMAP, 2016, IRENA, 2016, Oliver Wyman research and analysis

1 2 3

Limit risks from grid expansion

Adopt simple measures to address expansion concerns, e.g. site selection with no expansion risk and setup regulatory framework

Overview

- A major concern amongst developers is that the grid will expand to the mini-grid and the developer will lose revenue as customers move to electricity provide via main grid
- Without appropriate guarantees in place to manage grid expansion risk, auction participation will be reduced and/or bid prices increased
- This risk is particularly significant in countries where the majority of the population are located relatively close to the main grid
- With the appropriate regulation and auction specifications the risk of grid expansion from developers can be mitigated and a fair mechanism for any financial compensation can be reached

Uttar Pradesh, India

- If grid expands in Uttar Pradesh the mini-grid operator can
  - (i) Continue to operate as before
  - (ii) Continue as before and sell excess electricity at the state mandated FIT via a PPA
  - (iii) Sell all electricity generated from mini-grid at state mandated FIT via a PPA
- In addition, the operator will have the option to transfer the distribution network assets, though not the generating assets, to the distribution company
- Valuation of distribution assets is based on the straight line depreciated value of assets. The initial book value is set at the cost that would have been incurred by the distribution company in the year of commissioning of the mini-grid

Comments

- It is important to have clear mechanisms to address the concerns of developers around grid expansion
- This could include
  - Choosing sites which are so isolated (e.g. on islands) that grid expansion would never be feasible
  - Clear articulation of any grid expansion plans
  - Government guarantees that the grid will not be expanded before end of useful life of the project being auctioned
  - A financial compensation mechanism should the grid expand is detailed in the terms of the auction agreement

Recommendations

- **Preference for sites/clusters with no/minimum risk from grid expansion**, in particular in initial standalone pilot auctions
- Build assets which generate AC electricity that have been built to the required **technical grid standards** to ensure grid compatibility
- When this is not possible, setup **clear grid integration regulatory framework** and guarantees should be in place, e.g.
  - Clear mechanism for grid connection
  - Allow developer to sell power to grid at agreed commercial terms
  - Define terms for asset sale/disposal

Limit risk from grid expansion

Easy → Difficult

Source: UPERC, 2016, IRENA, 2015, Stanford, 2016, SE4All, 2016, Oliver Wyman research and analysis

Recommendations and trade-offs

Consider pre-auction bidders workshops, balanced and simple pre-qualification criteria and fixed sites/clusters that can ensure scale

	Recommendations	Trade-offs / comments
Pre-auction process and qualification criteria	• Define clear plan regarding **community engagement and willingness/ability to pay** • **Prepare communication plan** in advance (e.g. multi-channel approach) to promote auction • Organise **bidders workshop** to inform potential bidders on project specifics and process. Can also include training for best practice proposal preparation • If possible, **share open information on market potential**, including with lenders/finance	• If contacting developers directly, avoid any suggestion of favouritism • Increased cost and time added to process
	• **Define pre-qualification criteria**, e.g. blend of requirements which minimises low-quality investors and stimulates local development – **Sufficiently high technical requirements** to prevent bidders winning with poor quality specification – **Sizeable bid bond** to ensure only serious developers enter – **Local content requirement suited to individual country** which is steadily increased across auctions as local industry develops – **Low past experience requirements** - Given nascent nature of GMG industry, high past experience requirements will limit growth • Choosing an **experienced team** with a deep understanding of the local market and private sector to set auction qualification requirements	• Having sufficiently high pre-qualification requirements to ensure only reliable, serious developers win the auction whilst not having too high requirements so as to exclude suitable bidders
Site selection and demand uncertainty	• **Site/Community/Region should be fixed** and detailed in auction terms – **Developers could be given opportunity to propose sites for analysis** – **Suitably experienced team** in charge of choosing site/community. This can be done by government/regulators/ 3rd party experts depending on experience • **Ensure community buy-in** – Understand community needs to ensure buy-in for mini-grid by engaging local community before finalising site selection and allowing them to opt-in • **Cluster sites to ensure scale** for developers	• Balancing the relative weight of – Suitability of site for renewable energy source – Size of community being served – Distance from the grid and risk of grid expansion – Level of community buy-in

Source: Oliver Wyman research and analysis

Recommendations and trade-offs

Initial focus on result based financing of standalone pilot auctions with long term contract tenures (+10 years)

	Recommendations	Trade-offs / comments
Auction process	• Given site/community specific auction, **technology specific** auctions are most suitable though not so specific so as to exclude different sub-technologies[1] • Consider **sealed pay-as-bid auctions** • **Minimise complex multi-criteria auctions** – High complexity and low transparency of multi-criteria selection make it unsuitable for initial GMG auctions	• Reducing competition and number of bidders as auction increase specific technology requirements
Tenure of contract	• **Long term contracts (at least 10+ years)** with tariffs ideally linked to a forex metric	• Potential long term uncertainty of counterparty (commitment and responsibility) • Potential government/regulator reluctance to committing to long term contracts
Auction frequency	• **Focus initially on standalone pilot auctions** in order to capture key learnings and evidence proof of concept for GMG auctions • Only **later considering a move to systematic auctions** – Systematic auctions have the benefit of showing government commitment to auctions and encouraging developer investment	• Reducing flexibility of the auctioneer to choose when to hold auctions with announced defined periodic auctions
Licencing and permits	• Consider **licencing exemptions for smaller projects** (e.g. Tanzania) • Licence costs **linked to mini-grid size** • Having a **single licencing national body** that covers all major decisions • Consider land ownership issues upfront in order to avoid later significant delays	• Balancing thorough licencing with speed of overall process - Ensuring that only suitable developers gain permits is balanced with minimising licencing procedure delays

1. For example allow competition between solar PV, solar thermal and solar hybrid technologies

Source: Oliver Wyman research and analysis

1 2 3

Recommendations and trade-offs

Allow developers to offer ancillary services and cost-reflective tariffs as well as set up a robust framework for impact of grid expansion

	Recommendations	Trade-offs / comments
Timely development and operation	• Consider **performance bonds** • Appropriately **incentivise continued operation of mini-grid** – Ensuring tariff/return mechanism is still key enabler of successful project – Setting a mechanism to ensure that the developer is committed to the maintenance of the mini-grid	• Setting large penalties for delays of projects or failure to sign contract increases chance of timely delivery but may reduce the number of bidders
Commercial viability	• Consider **result based financing** with clear and transparent process for transfer of capital that is conditioned to the achieved results of the private project • Consider **subsidy parity with grid** when discussing tariff setting mechanism • Enable developers to **charge cost-reflective tariffs where possible** – Regulation should also ensure access for the poorest members of the community – This may be done through a cross-subsidisation model where businesses and high energy users' tariffs subsidize the cost for poorer players • Allow **developers to offer ancillary services to end-users** which can help to stimulate demand, increase their revenues and allow for reductions in electricity tariffs	• Public financing through capital grants can be easier • Defining and agreeing definition of "results" • Having subsidies focussed on initial Capex rather than operating expenses is preferable for developers since it reduces their long term dependence on another party.
Grid expansion	• For initial auctions, **preference for sites/clusters with no risk from grid expansion** • Incentivise assets/infrastructure built in accordance with **technical grid standards** (e.g. AC) so electricity generated from the asset is compatible with the grid in the future • Setup a **grid integration regulatory framework** that considers different integration options: – Allows independently operated mini-grids to be efficiently and transparently connected to the main grid – Enables mini-grid to continue to operate by buying power from and/or selling power to the main grid in such a way that enables commercial viability of the mini-grid – Allowing independently operating mini-grids to sell their grid infrastructure asset to the national utility in an acceptable, transparent and equitable manner	• Lowering risk of grid expansion can mean lower population density and lower demand potential given distance to urbanised/grid-connected areas • Increasing cost and complexity in case of grid technical standard parity

Source: Oliver Wyman research and analysis

1 2 3

In summary, auctions can be a potential mechanism to support the scale up of GMGs in Africa and overcome some of the industry's key barriers

However challenges and trade-offs will need to be considered

Strengths	Weaknesses
✓ Creates forum for developers, governments/regulators and donors/DFIs to come together in a coordinated way	✗ Fails to directly address one of main areas of difficulty which is demand side management and promoting electricity uptake – Demand has proven very difficult to predict even when developers have engaged communities prior to carrying out analysis
✓ Can be used to help to promote regulatory change – Sizeable GMG auctions can help to stimulate government and regulatory change	✗ Can encourage speculation on future energy prices which may lead to risk of underdevelopment
✓ Having centralised diligence can help to reduce overall spend on diligence and encourage developer participation	✗ Setting up an auction process, selecting sites, assigning appropriate pre-qualification criteria and selecting a winner can be a complex, time consuming and costly process
✓ Multi-party engagement can help to reduce risks and decrease financing costs, increasing the chance of developer success	✗ Given relative lack of past experience in GMGs it is challenging to select the best/most appropriate developers by simply using a fixed list of pre-qualification criteria
✓ Attracts developers, adding capacity to the overall market – Large developers who may otherwise not consider entering GMG market, might enter through a structured auction process if sizeable capacity is being offered	✗ Unproven mechanism in GMG space given nascent nature of the sector
✓ Auctions can help to speed up the discovery of commercially viable business models	

Source: Oliver Wyman research and analysis

A-1 Appendix – Renewable energy auction design elements

Analysis from IRENA and CEM (2015)

1 Auction Demand

Specific demand bands

- Demand bands relate to how the renewable energy demand is split based on different criteria such as technology, size, location
- There are three main types of demand band
  - Exclusive demand bands
    - Separate capacity targets are allocated to two or more renewable energy products in such a way that the demanded quantities do no compete
  - Competitive demand bands
    - Different products compete on equal terms for the capacity
  - Partially competitive demand bands
    - Combination of the above two methods

Periodicity and commitments

- Whether you commit to a one-off auction or a regular schedule of auctions
- Standalone
  - Used to achieve economies of scale, mainly in smaller countries with less mature technologies
- Systematic auctions
  - May attract a larger number of bidders, leading to gradual renewable energy penetration

Source: IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Volume auctioned

- Key input into the auction process, which should be consistent with renewable energy policies and electricity system's technical capability
  - Fixed auctioned volume
    - Volume is clearly specified
  - Price-sensitive demand
    - Volume is based on a price-sensitive demand curve
  - Multi-criteria volume setting
    - Volume is based on a combination of price-sensitive demand curve and other factors such as which renewable energy sources are being used

Demand-side responsibilities

- The auctioned product will involve some payment stream to the project developer once the renewable plant comes online
- It is important for the developer to be assured that the auctioneer will keep their side of the contract. There are consequently decisions to be made in terms of
  - Selection of contract off-taker – who is responsible for keeping their side of the contract and are they sufficiently creditworthy.
  - Allocation of costs to consumers – are they passed on to consumers, is there a subsidy mechanism or are they taken on fully by the government or utility
  - Defining contracting scheme – is it an EPC auction or PPA

Analysis from IRENA and CEM (2015)

2 Winner selection

Bidding procedure

- Collecting supply side information, includes three main methods
  - Sealed bid process – all bid information is provided directly to the auctioneer
  - Iterative process including descending clock auction – bid information is disclosed gradually during the auction
  - Hybrid process[1]
    - Involve a combination of the characteristics of the other two types of auction. Typically involves a descending clock phase followed by a sealed-bid phase.

Requirements of minimal competition

- There are two main mechanisms used to ensure some competition
  - Maximum awarded capacity constraints prevents a single player from dominating the auction
  - Ceiling price mechanisms – "anti-monopoly" mechanism, preventing dominant players from bidding high

Payment to the auction winner

- Pay-as-bid pricing – most commonly implemented where bidders pay the price they bid
- Marginal pricing schemes – uniform pricing where the bidders are paid the price of the most expensive of the accepted bids
- Nonstandard pricing schemes – catch-all phrase for other types of pricing scheme, typically involve some kind of ex-post negotiation between the auctioneer and the auction winner

Source: IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Winner selection criteria

- How to rank the bids and select winners, is at the core of an auction, there are typically three mechanisms used
  - Minimum-price auctions
    - Classical implantation in which the lowest price bid that qualifies wins
  - Adjusted minimum-price auctions - using a "correction factor"
    - Correction factors are used to compare different bids on the same basis, used in competitive auctions that may involve products with very different characteristics
  - Multi-criteria auctions
    - Introduce additional criteria in the comparison of bids other than price, such as some quantification of the bidder's reputation and offering bonuses for using locally manufactured content

Clearing mechanism

- Clearing the auction's supply and demand. This happens where individual projects are large in size and non-divisible, making a perfect balance of supply and demand unattainable. Balancing can be done through
  - Flexible demand schemes – auction quantity accommodates inflexible price-quantity bids
  - Supply-side flexibility – the bidder announces how the contracted quantity may be revised prior to the auction
  - Ex-post adjustments – other adjustments after the auction to match supply and demand. This can lead to re-opening of negotiations and thus undermine the auction process.

3 Sellers' Liabilities

Commitment to contract signing

- Commit to signing PPA either enforced by no specific commitments at the bidding round or bid bonds

Remuneration profile and financial risks

- Aims to avoid financial risks (usually inflation and FX) that might affect remuneration
  - Straightforward escalation – typically involves one straightforward index which it adjusts the remuneration to accordingly
  - Hybrid contract indexation – typically takes into account more than one index. For example, auction priced could be "split" in to two portions for subsequent years, one escalated to one index, second portion according to another index
  - Variable remuneration profile

Nature of quantity liabilities

- Defines the nature of commitment assumed by the project developer, which is directly related to the allocation of risk
  - Capacity – least amount of commitment from the developer's side, since they are independent from the plant's actual output. This type of scheme may be required to ensure that generation facilities meet minimum availability standards
  - Energy – high level of responsibility as commit to provide a certain quantity of electricity throughout the contract's duration
  - Financial oriented agreements – developers commit to a certain generation profile. Any deviations between the actual plant generation and quantity committed is settled in real time at the spot price

Assigned liabilities for transmission delays

- The liabilities can be assigned to the project developer or to another agent (TSO, the central planning agency, *etc.*)

Source: IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Contract schedule

- Lead time – time granted for plant construction – can be measured from the point of contract signing rather than from the time of the auction
- Contract duration – commitment length – common to calibrate the duration to the plant's likely useful life
- Post-contract provisions – associated with the way project developers may account in their financial models for any residual revenues from their investment after the contract's termination

Settlement rules and underperformance penalties

- Critical obligations with an effect on the plant's remuneration, addressed as
  - Temporal aggregation clauses – how often the power plant's performance is assessed in order to determine whether its remuneration must be revised
  - Over-and underperformance penalties
  - Revisions of contracted quantity – way to adjust the project developer's remuneration according to the actual performance of the power plant

Delay and underbuilding penalties

- Penalties for delays and underbuilding
  - Completion bonds – common to partially execute the completion bond in case of delays related to specified intermediary milestones
  - Delay-specific penalties
  - Contract resolution clauses - specify that the contract awarded will be terminated in case of delays above a certain threshold

Analysis from IRENA and CEM (2015)

4 Qualification requirements

Reputation requirements

- Requirements to ensure that the bidder is suitably reputable, these may include
  - Legal compliance with relevant local laws
  - Proof of financial health, proving that the bidder is sufficiently solvent to complete the project
  - Disclosure of agreements and partnerships
    - Requires bidders to disclose not only partner companies in the bidding consortium but also service providers and other contractors for the project. In particular disclosure of the manufacturer of the renewable energy equipment may be required
  - Past experience requirements
    - Indication that the bidding company has successfully completed other similar projects

Technological requirements

- Requirements that specify particular technological requirements might include
  - Renewable energy generation source specification
  - Equipment specification
    - Aims to ensure that the country's renewable energy resources will be developed using state-of-the-art and quality equipment
  - Project size constraints of bids
    - Minimum size constraints can be used to limit administrative work, and benefit from economies of scale
    - Maximum size constraints can be used to encourage participation of local developers

Source: IRENA and CEM (2015), Renewable Energy Auctions – A Guide to Design

Socio-economic development instruments

- Any local development requirements. These might include
  - Empowerment and employment requirements
  - Local content requirements – aimed to promote local industry

Production site selection and documentation

- Clear definition is required of
  - Site selection responsibility
  - Location constraints
  - Site specific documentation requirements

Securing grid access

- Definition of how physical access to the electricity grid will be ensured and what is required
  - Different kinds of requirements to secure access to grid
    - No grid access permit required
    - Requiring a permit as a requirement for auction entrance, and projects that demand grid expansion are allowed
    - Grid access permit required, and only those project that do not demand grid expansion are permitted

Financial requirements

- To ensure the bidder is seriously committed to the process deposits are often required at the time of bidding (bid bonds) which are only not refunded if the party wins the auction and then fails to sign the contract
- Following winning of auction deposits are other required to ensure successful timely development and successful operation of the renewable energy plant

A-2 Appendix – Interviewees and Bibliography

We have conducted interviews with key experts at 30 different organisations

Organisation	Organisation (contd.)
AFDB	Philae Advisory
AURES, Technical University of Denmark	PowerGen Kenya
Carbon Trust	Powerhive
DFID	PSR
ECREEE	Rafiki Power
Energy 4 Impact	Rift Valley
Fluidic Energy	Self-energy
GERES	Shell Foundation
GiZ	SNV
Inensus	US AID
IRENA	US AID / Power Africa
Jumeme	Virunga Power
KPMG Brazil	Wageningen University
NERA	Welthungerhlife
Odyssey	World Bank

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QUALIFICATIONS, ASSUMPTIONS AND LIMITING CONDITIONS