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Under the Same Sun

A Cross-Country Comparison of Conditions and Policy Supports for Utility-Scale Solar Photovoltaic Projects

Imprint

Under the Same Sun: A Cross-Country Comparison of Condition and Policy Supports for Utility-Scale Solar Photovoltaic Projects

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Under the Same Sun

A Cross-Country Comparison of Conditions and Policy Supports for Utility-Scale Solar Photovoltaic Projects

Executive Summary

Generation costs of solar power plants are determined by various factors. Government policies and regulations play a vital role to make solar competitive.

Utility-scale solar generation costs have declined rapidly in recent years. One of the important drivers is the fall of solar module prices in the last ten years. The module prices, however, are not the only factor that sparks investments in small scale and utility scale solar power plants globally. Our observation finds that governments play an important role to make solar PV more competitive than fossil fuels by setting up national solar targets, providing supporting policy and de-risking instruments, incentivising supply chain, building supporting infrastructure, and putting suitable procurement systems (e.g. auction). The solar PV deployment, therefore, depends on the effectiveness of government policy, regulations, and incentives to address various risks associated with the projects and to expedite the learning curve for solar technologies in the country, making solar power project cheaper over time.

India, Mexico, United Arab Emirates (UAE), and Brazil are among the countries which see record-low bids for solar power projects in recent years. There are several key factors that drive investment and generation costs for large/utility scale solar pv projects reach record-low numbers in these countries, namely location, technology costs (e.g. price of modules and balance of system), project financing structures, fiscal and financial incentives, and procurement models.

Financing cost is an important factor in shaping the project cost structure. Countries observed provide fiscal and financial incentives to reduce the investment cost of solar power projects.

Financing plays an important role in making the generation costs of solar power plants decline over time. Countries observed in this report use various financial incentives and/or fiscal instruments to reduce risks and lower financing costs of solar projects. India, for instance, compensates the high development and financial costs with fiscal incentives. India uses Viability Gap Fund (VGF), mainly coming from the National Clean Energy Fund (NCEF), to cover financing gap and to improve project bankability, securing payment for solar developers.

Country credit ratings also affect the financing costs. The outstanding and excellent credit rating of UAE has made international financial institutions and banks comfortable to finance government-backed projects. As the risk is considered low, the interest rate for the debt is also low. Additionally, as UAE's Dirham is pegged to the USD, currency risks to IPPs are eliminated.

In Mexico, fiscal incentives, such as accelerated depreciation, access to soft loan from international lenders, and advanced auction model resulted in the world's lowest bid without compromising the risk of underbidding. Low financial and development costs and the equity sharing model with state- utilities in UAE have helped bring prices down at auction. In Brazil, extremely low interest loan at 0.9% per annum is available for companies that comply with local content requirement, helping bring costs down and develop local manufacturing capabilities.

Auctions can help bring down solar energy prices. Successful auction requires process transparency, clarity of rules, significant project sizes, and credible bidders to deliver the project.

In four countries observed, solar power prices have been significantly declining at auction. The solar prices at auction in India was about 6.2 cents/kWh in 2015-2016 before drastically falling to 2.2 cents/kWh in 2018-2019 financial year. The Mexican auction resulted in the average of 4.49 cents/kWh of solar power price in 2016 before dropping to the average of 2.06 cents/kWh in in 2017, hitting a record low worldwide in that year. In UAE, solar power price at auction reached 5.84 cents/kWh in 2015 before further dropping to 2.94 cents/kWh (peak price) and 2.42 cents/kWh (off-peak price) in 2016. The latest auction in UAE in 2018 for 950 MW (700 MW CSP plus 250 MW of solar PV power plants) provided low bid prices at 2.4 cents/kWh. Lastly, Brazil, has seen significant drops in its average solar power prices from USDc 8.8/kWh in 2014 to USDc 1.75/kWh in June 2019, becoming a new world record of solar power prices.

The auction design is pivotal to ensure project cost-effectiveness. There are several auction methods, three of them are sealed-bid, descending clock, and hybrid auctions. To make the auction work well, the auctioneer needs to create sufficient competition between project developers, limit extra risks for bidders, curb transaction costs for bidders and the auctioneer, and reduce the possibility of auction winner's failure to deliver project.

In general, a successful auction depends on some factors, namely a robust and clear policy/regulatory framework, clear and transparent processes, effective bidders' pre-qualification, and a credible auctioneer. Additional factors, such as land availability, sizeable projects to bid, minimum or no local content requirement, and guaranteed grid access could also help minimize project risks, improve its feasibility, and attract high quality bidders.

Various factors affect CAPEX and OPEX of the utility scale solar projects in observed countries that influence the electricity generation cost.

The electricity cost of solar power plants are determined by some factors that affect both capital cost and O&M cost and bankability of the project. Geographical situation matters, the higher the solar irradiation, the higher the power output of the plants. Financing cost is a very important factor since it influences cost of capital, even higher than solar irradiation.

Factor	Impact
Solar irradiation	Power output, unit cost, project revenue
Solar module price	Capital expenditure (CAPEX)
Local content requirement	CAPEX
Country credit rating	Premium risk, financing cost
Interest rates	Financing cost
Provision of public lands	Land acquisition risk, land cost
Fiscal incentives	CAPEX and OPEX

Table S1. Various factors affecting cost of electricity of a solar project

Comparison of Basic Conditions in Observed Countries

Properties	Indonesia	India	Mexico	UAE	Brazil
Irradiation (kWh/m^2/day)	3.6-6	6-7	4.6-6.6	6.5	4.5-6.3
Ambient temperature (°C)	26-28	14-34	12-28	18-34	18-27
Relative humidity (%)	75-85	50-80	52-71	55-68	49-79
Annual power output (kWh/Wp)	1,170-1,530	1,400-1,600	1,620	1,753-2,192	1,230
Installed capacity (MW)*	0	24,200	3,000	487	2,193
Ongoing project (MW)**	48	17,700	1,800	2,027	4,920

*) size of Installation >10 MW per project or per location
**) as of April 2019

Comparison of Cost Structure in Observed Countries

Properties	Indonesia	India	Mexico	UAE	Brazil
Solar project price at auction (lowest)	-	USDc 3.49-3.51/kWh	USDc 2.06/kWh (average price)	USDc 2.4/kWh	USDc 1.75/kWh (average price)
Module price ($/Wp)	Local modules: 0.40 - 0.47 (2019) Imported: 0.23-0.37 (2019)	Local modules: ~0.40 Imported: ~0.35 (2017) Local: ~0.25 Imported: ~0.20 (2019)	Imported modules: ~0.64 (2016) ~0.33 (2019)	Imported modules: 0.28 (2018)	Local modules: 0.66 (2017) Imported : 0.472 (2017)
Minimum wage (typical worker)	$3.5-9/day	$3.87/day	$2-5/day	N/A	$8.4/day
Average share of project development cost from total project cost	10%	11.3%	8.6%	6.2%	10%

Comparison of Project Financing Terms in Observed Countries

Properties	Indonesia	India	Mexico	UAE	Brazil
Local bank interest rate	10-12%	9.55-10.75%	10-11% (local) 3-5% (foreign)	2.6-3.6%	0.9% (BNDES)
Country Credit Ratings*	S&P: BBB Moody's: Baa2 Fitch: BBB	S&P: BBB- Moody's: Baa2 Fitch: BBB-	S&P: BBB+ Moody's: A3 Fitch: BBB	S&P: AA Moody's: Aa2 Fitch: AA	S&P: BB- Moody's: Ba2 Fitch: BB-
Debt to equity ratio requirement	70:30	70:30	75:25	70:30	80:20
Local content regulation	40.68%	No	No	No	60% (conditional)

*) as of July 2019

Comparison of Policy Support in Observed Countries

Properties	Indonesia	India	Mexico	UAE	Brazil
Land acquisition	Must sell	Fund available from SECI	No support	Gov. provide land (free)	No information
Grid connection	Developers to build the grid connection. Off-take guarantee (take or pay).	Off-take guarantee. No transmission charges or taxes on transmission losses	Discounts on transmission and grid connection.	Off-take guaranteed. Grid access provided.	Discounts on transmission and distribution costs for solar projects auctioned prior to January 1, 2016.
Fiscal incentive	Import duty, tax holiday, income tax reduction (terms and conditions apply)	VGF, Basic Customs Duty waivers, Limited Indirect Tax	Import duty exemption (previously 15%)	Premium tariff during summer (1.6x off peak) 51-60% project equity share by utility	Exemptions from import taxes and VAT Federal taxes deferral

Comparison of Procurement Model in Observed Countries

	Indonesia	India	Mexico	UAE	Brazil
Model	Tender for pre-selected bidders	Reverse auction	Reverse auction	Reverse auction	Reverse auction
Site selection	Location specific	Location neutral or depends on scheme (i.e. solar park)	Location neutral w/ price signal	Location specific	Location neutral
Project size	Tender specific	Auction specific	No limit	No limit, modifiable from initial bid	No limit

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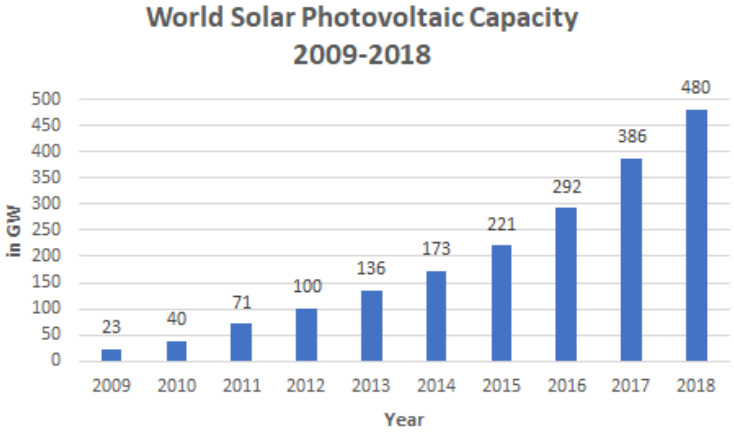
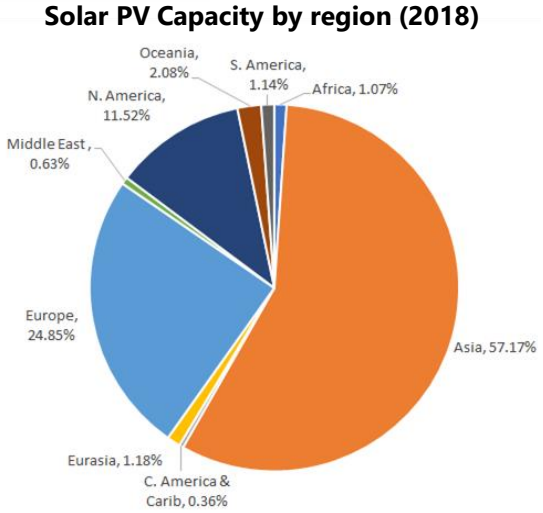
Country Analysis

Indonesia, India, Mexico, UAE, and Brazil

Globally, solar PV capacity increases rapidly, more than 50% is in Asia



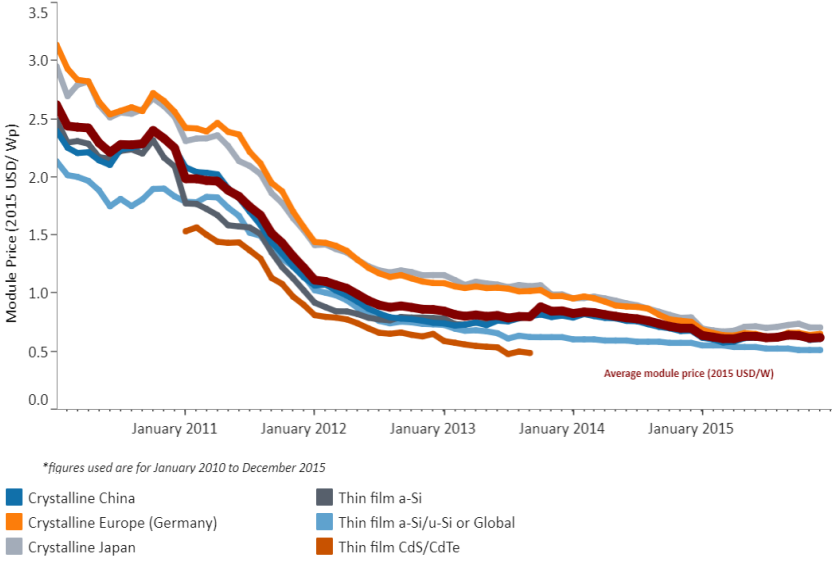


The world's installed capacity of solar PV has been increasing exponentially. In 2009, global solar PV capacity was only 22.6 GW compared to 480.36 GW in 2018. Asia dominated global solar deployment by contributing 57.17%, followed by Europe at 24.85% and North America at 11.52%.

Steady decline in PV module prices drives project costs down in many parts of the world

Global PV module prices have been decreasing steadily, from USD 3.129/Wp (German crystalline) in 2010 to USD 0.53/Wp (Thin film a-Si/u-Si) in 2015. The rapid decline is mainly caused by several factors, such as R&D (increased efficiency), economies of scale, and supportive policy.

This report attempts to explain the latest solar PV development in five countries, namely Indonesia, India, Mexico, UAE, and Brazil, and how the governments in these countries take advantage of lower module prices and provide policy packages to attract investors into their solar energy industries.



INDONESIA

High Global Horizontal Irradiation

3.6-6 kWh/m2/day

Annual power output

1170 kWh/kWp – 1530 kWh/kWp

Average temperature

26 deg C to 28 deg C

Relative humidity

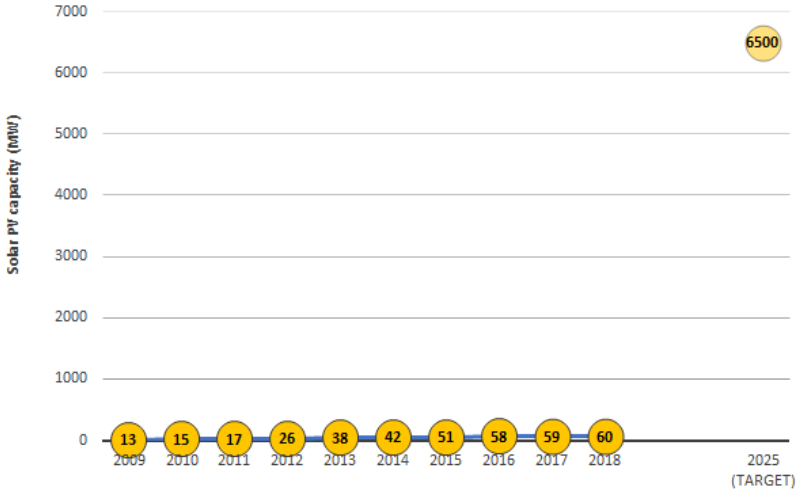
75% - 85%

0 MW total installed capacity (large scale)

There is 95 MW installed capacity, but none is considered as large scale (above 10 MW).

48 MW total ongoing project (contract awarded)

The solar deployment trends are not on track to meet the national solar energy target in 2025



Data from IRENA (2019). Renewable Capacity Statistics 2019.

The National Energy Plan (RUEN) sets that 23% of primary energy mix should source from renewables by 2025 and 30% by 2050. Based on this target, 6.5 GW of solar PV power plants are expected to be built by 2025 and 45 GW by 2050.

By 2018, the total installed capacity of solar PV in Indonesia was lower than 100 MW (95 MW according to ESDM, 60 MW according to IRENA). Looking at the trends, Indonesia is not on track to meet its 6.5 GW solar energy target in 2025.

The latest PLN's Electricity Procurement Business Plan (2019-2028 RUPTL) aims to build almost 2 GW of solar PV power plants by 2028, lower than RUEN target.

High generation cost despite low labour cost and PV module cost

- Local solar manufacturing capacity in Indonesia is still small (500 MW in production capacity). In 2019, local modules (not tier-1 manufacturers) are priced on average at $0.47/Wp, more expensive than imported modules at $0.25-0.37/Wp (include tier-1 manufacturers from China and Europe).
- Labour cost is low in Indonesia. The minimum salary is $3.5-9/day, depending on the region. The average salaries of mid-level engineers are $24-75/day. Labor costs account for less than 10% of total capital cost and around 40% to 45% of total annual operational expenditure.
- Development costs account for maximum 10% of the total project costs, otherwise the project will not be feasible. This is based on the 5 MW Solar PV Project in Kupang. The land acquisition, legal, administrative, and bank fees constitute the development costs.
- No large scale (>10 MW) solar projects are in place in Indonesia. The generation cost of the 5 MW Solar PV Project in Kupang was USDc 25/kWh (2014), much higher than the average costs in other countries (less than USDc 5/kWh). Some factors that might affect the cost include small project size, high system costs in that year, and high financing cost (high interest rate and expected IRR).

High interest rates and high local content requirement keep solar projects costly

- The average interest rates offered by local banks in Indonesia to renewables developers are in the range of 10-12% (in some cases up to 14% - 15%). Local banks perceive renewables projects as risky due to regulatory uncertainties and their unfamiliarity with renewables projects. There is also no concessional financing available for renewables projects, making renewables development difficult in the country.
- The Indonesian government in 2017 set 40.68% local content requirements (LCRs) for on-grid solar generators. All service had to be locally sourced, while 34.09% of materials had to be local. LCRs for solar panels (material) were gradually increased from 40% in 2017 to 60% in 2019. The high LCRs have proven difficult to fulfill as local PV module manufacturers have limited capacity and the locally-produced modules are more expensive than imported modules from China.
- Other issue related to LCRs is that local manufacturers do not have international certifications needed to obtain loan from international lenders. This issue together with high module prices make solar projects in Indonesia not bankable.
- The off-taker of on-grid solar projects in Indonesia is the state-owned utility, PLN. This might reduce the risk to developers but the conditionality of PPA could cause other risks to emerge.

Policy support for land acquisition and fiscal incentives are available

- Land acquisition for power plants that serve public utility is supported by land procurement law. Unwilling landowners can be forced to sell their land and the compensation (money, replacement land, resettlement, stock ownership, etc) is determined by court review. This procedure only applies if land procurement is executed by the government and later owned by the government or state-owned enterprise.
- No supportive policy in grid connection is available. Developers have to build the connection from the power plants to the nearest grid on their own.
- Several fiscal incentives are in place:
  - Import duty exemption for machineries and equipment that are not produced adequately in Indonesia
  - Corporate tax holiday for 5-15 years from the start of commercial production for company with minimum investment of USD 70 million
  - Net income tax reduction of up to 30% of the invested amount, pro-rated at 5% for six years of the commercial production, provided that the assets invested are not transferred out within six years

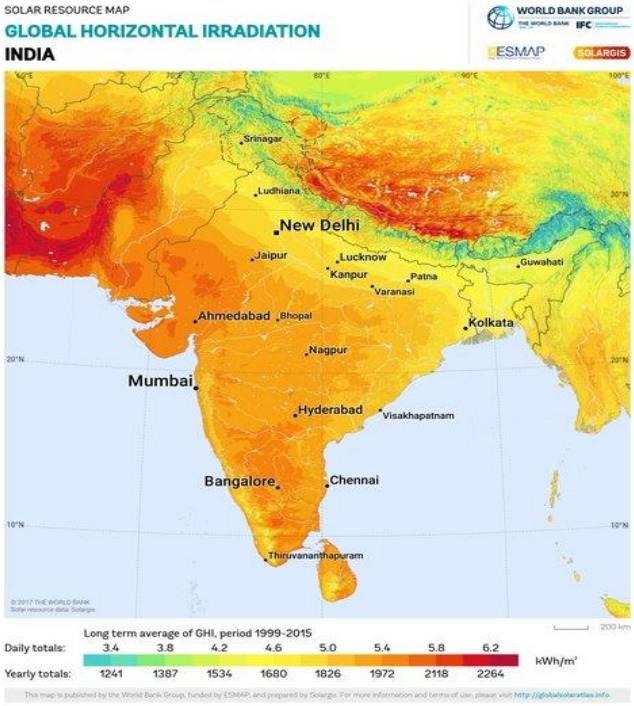
Unattractive tariffs, risk allocation, and BOOT scheme make solar projects not bankable

- PLN as the single off-taker in Indonesia conducts procurements for utility-scale solar projects. The procurement is done through a limited tender process of which only preselected developers are invited to submit. Take-or-pay mechanism is in place, meaning that if the utility cannot absorb the minimum generated power set in the contract, the utility has to pay a compensation. The power procurement is site-specific, determined in the state utility business plan (RUPTL). The size of the project is already determined in the RUPTL.
- The power procurement uses feed-in tariff (FIT) set based on average generation cost of existing power plants (BPP) dominated by coal-based power plants. The benchmarking of FIT against generation costs of coal plants creates unlevel playing field for renewables.
- Projects are built in BOOT (build own operate transfer) scheme with long term off-take contract (PPA), generally over 20 years. With current FIT at 85% of BPP, the cost of asset transfer cannot be covered, making developers object to the BOOT scheme. The BOOT scheme, unattractive tariffs together with unbalanced risk allocation are deemed as barriers to make PPA bankable.

Substandard tender design led to low quality solar projects

- In 2013, Indonesian government conducted a solar power tender in the country. The government aimed to award 140 MW of solar power projects in 11 locations, but ended up awarding only 14 MW of solar power projects in 7 locations (Dobrotkova, et.al., 2018). By the end of 2016, only 2 of 7 awarded contracts had reached deployment, accounting for 8 MW.
- The failure of previous tender has been caused by several factors, for instance a strict local content requirement (LCR) without considering local market capabilities, limited access for international companies to participate at auction (required to create a joint venture with local companies) despite the lack of local experience in solar power projects, higher tariffs offered to projects using local PV modules despite limited local PV module production, limited time provided to developers to comply with stringent auction requirements, and the use of local currency without indexation for inflation adjustment (Dobrotkova, et.al., 2018).
- The tender had failed to attract international developers with more experience in developing solar projects which would help bring costs down through their integrated supply chains, access to international lenders, and bulk procurement of PV modules. The substandard auction design used in Indonesia had led to inadequate and low-quality competition which eventually resulted in low-quality solar projects and some failures of project delivery.

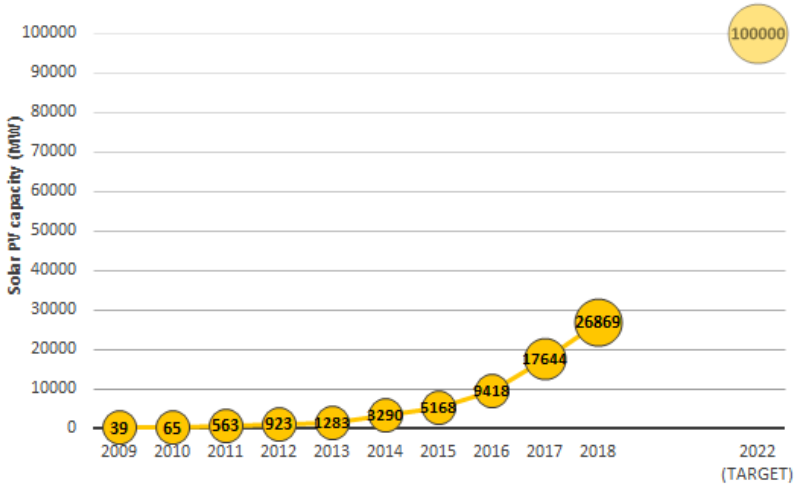
INDIA



High Global Horizontal Irradiation
6-7 kWh/m2/day
Annual power output
1400-1600 kWh/kWp
Average temperature
14 deg C to 34 deg C
Relative humidity
50% -80%

24.2 GW total installed capacity
17.7 GW total ongoing project (contract awarded)

Rapid solar power deployment pushed the government to escalate the solar capacity target to 100 GW



- In 2016, India set a goal to achieve 40% of power plant installed capacity from new and renewable energy by 2030.
- In 2015, the government set the target to install 175 GW of renewable energy by 2022, of which 100 GW will come from solar energy.
- Initially, the target for solar power installed capacity was only 20 GW by 2022 in 3 phases (set by the initial Jawaharlal Nehru National Solar Mission (JNNSM) program in 2010). Due to rapid deployment of solar power during phase I and II, the government increased the target to 100 GW by 2022.

- The JNNSM program consists of two groups: the grid-connected rooftop PV projects (totaling 40 GW) which covers institutional sectors, industrial & commercial sector, and housing sector and the medium (1-500 MW) and large (>500 MW) scale grid-connected PV projects (totaling 60 GW). Large scale projects are further divided into solar park (solar projects that are concentrated in one area), such as Bhadla Solar Park in Rajasthan (2,255 MW, divided into 4 phases), and non solar park (stand-alone projects).

Imposing Renewable Purchase Obligation (RPO) to establish demand for solar energy

To further encourage renewable energy development, the Government of India imposed Renewable Purchase Obligation (RPO) for all states. The RPO makes it compulsory for all large consumers of energy to ensure a certain percentage of the energy mix comes from renewable sources, such as wind and solar. The Government of India has established an annual increase of RPO for solar, from 2.75% in 2016-2017 to 10.50% in 2021-2022, accounting for half of total RPO.

Long Term RPO Trajectory	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Non-solar	8.75%	9.5%	10.25%	10.25%	10.25%	10.5%
Solar	2.75%	4.75%	6.75%	7.25%	8.75%	10.5%
Total	11.5%	14.25%	17%	17.5%	19%	21%

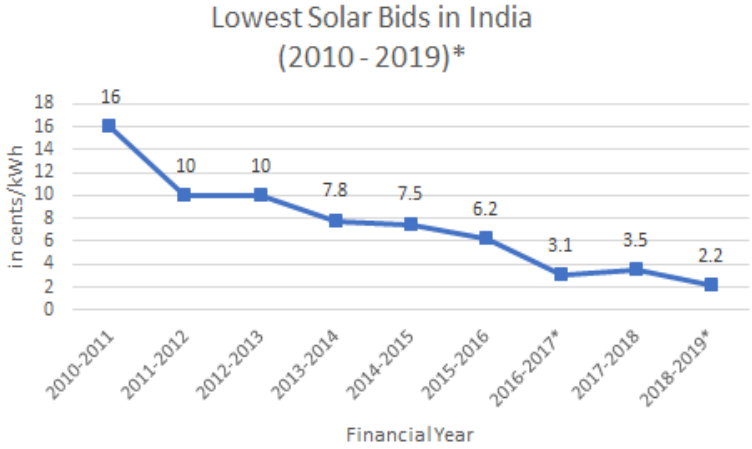
Source: Indian Ministry of Power, 2019

The government does not have a specific way of procuring solar. Furthermore, states are given the autonomy to build their own RE capacity to reach national target. Therefore, solar power in India has followed market mechanism. Auction is the most popular method to meet installation target while keeping price low.

Competitive auctions drive down solar energy prices

INDIA

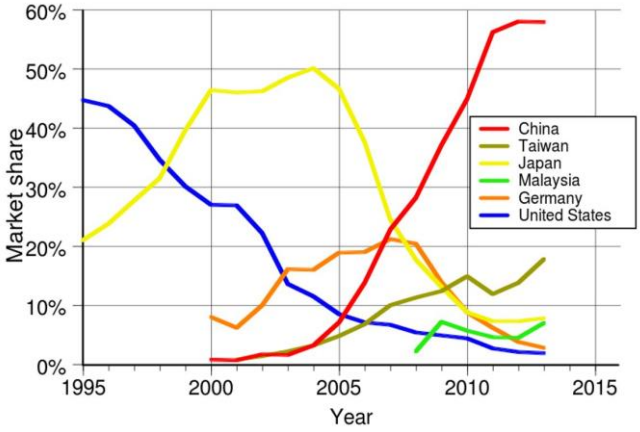
- After the government announced JNNSM in 2010, many solar developers expressed their interest by participating at auction. The first financial year saw a record price of Rs 10.95 ($0.16/kWh) for the National Solar Mission Phase I Batch 1 in Maharashtra. Since then, the tariff has been decreasing annually.
- During the financial year of 2016-2017 and 2018-2019, the lowest solar bids were awarded to solar rooftop developers. Mundra Solar PV Ltd. quoted Rs 2.2 ($0.031/kWh) for a 11.2 MW project on Andaman and Nicobar Islands, which was tendered by SECI in December 2016. Then, by the end of 2018, AMP Solar India quoted a tariff of Rs 1.58 ($0.022/kWh) to install rooftop solar at ten sites in Madhya Pradesh with an estimated capacity of 2.25 MW. The auction was held by Madhya Pradesh Urja Vikas Nigam (MPUVN) Limited for 35 MW grid-connected solar project under RESCO model.



Note: Rupee (Rs) 1 = $ 0.014.
Financial Year in India starts from April to March of the following Year.
Data from : Mercom Capital Group India Solar Market Update, 2019

Duty will not protect domestic producers from import competition

Market for Imported Solar Photovoltaics



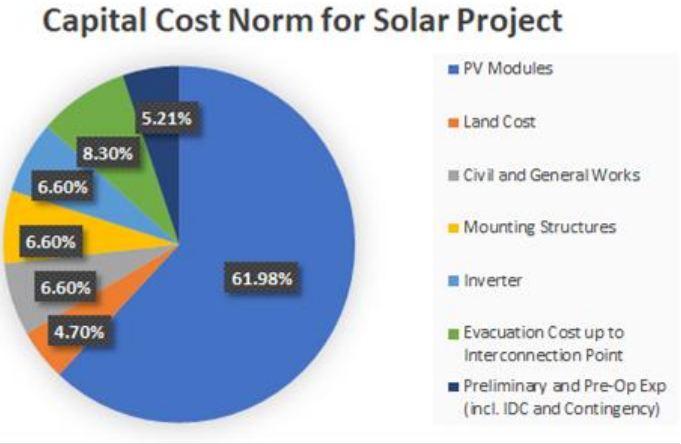
Source: Power Technology, April 2018

More than half solar projects in the country use imported solar panels as they are cheaper than domestic panels. Import market for solar PV is dominated by Chinese modules, which according to the Indian government, was a result of China's dumping activity after US and Europe banned the import of Chinese-made modules (Singh, 2019).

To counter the effect of Chinese low-price modules, the government of India imposed a 25% safeguard duty towards the China-imported panels for two years. The effectiveness of the safeguard duty is questionable because the cheapest locally made modules could cost $0.25 to $0.27 per piece and the Chinese modules would cost the same after the imposition of the duty (Chandrasekaran, 2019).

Experts argue that instead of imposing safeguard duty, the government should offer financial stimuli, such as price incentives and subsidized credit for India-made solar modules and domestic module manufacturers (Himatsingka, 2018).

PV modules contributes 62% of benchmarked solar capital cost



There is no available data for real capital cost for solar projects in India, however, the Indian government had made annual benchmark to provide guidelines for solar PV project across the country. Data is only available up to FY 2016-2017, made by the Central Electricity Regulatory Commission (CERC) based on inputs and suggestions provided by solar developers across the nation. The FY 2017-2018 provided benchmark for the capacity from 1 MW to 5 MW only.

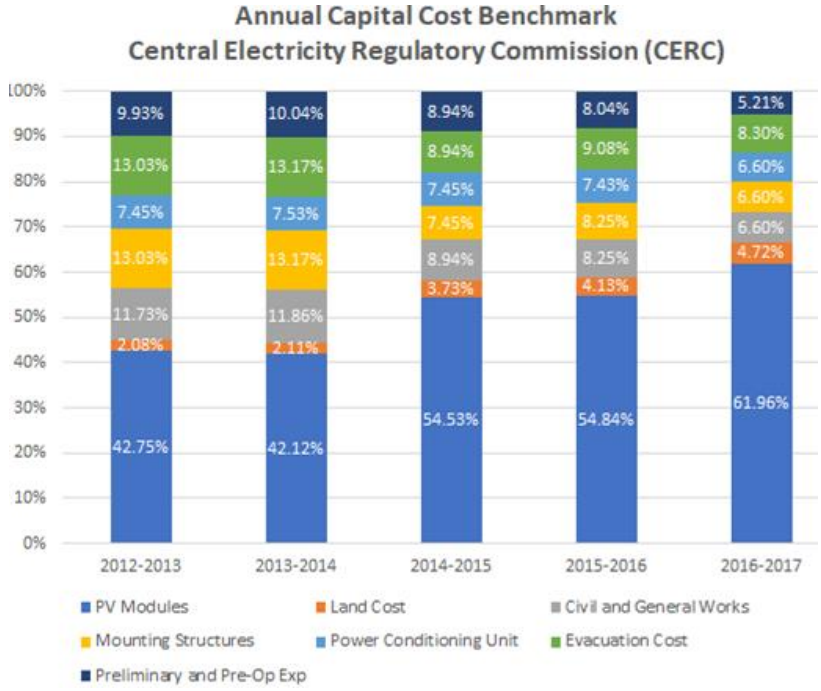
Based on capital cost norm for solar PV projects (FY 2016-2017), total capital cost in a solar project is benchmarked at Rs 53,002,000/MW ($753,820.95/MW). Development cost will take up to 11.3% of total cost, which consists of: civil works (preparation of terrain for digging, levelling and mounting, building approach roads, fencing or boundary wall and arranging water supply) and general works (security of solar farm, setting up of power back-up generator and yard lighting), as well as land acquisition.

Benchmarked solar capital cost declines each year, but the PV module proportion increases

INDIA

CERC has the responsibility of determining the benchmark tariff of each component of the capital cost for solar projects across India (states can choose to follow or create their own benchmark). Over five fiscal years, capital cost had been reduced from USD 1 million/MW to USD 800,000/MW.

PV modules take significant proportion of the total cost and it is increasing annually because of the anticipated rise in module prices due to higher global demand of solar panels in the long run, the price of domestic panels that are considerably higher than imported panels, as well as the needs of additional modules deployed for performance optimization.



Interest rates and risk premium are high, but fiscal incentives are available to make solar projects viable

- Interest rates for RE project fall between 9.55% to 10.75% (higher than the standard interest rate of 6%). The government further regulates that a term loan restricted to 70% of project cost and maximum period of repayment is 10 years, including moratorium of 6 to 12 months from the COD of project and the maximum construction period shall be 12 months from the first disbursement. Furthermore, RE has a risk premium of 6.66% and the debt-to-equity ratio is 70:30, with a spread of 2-8%.
- Indian government requires no local content for the majority of auction volumes. This was a result of a WTO ruling to end a dispute raised by the US over the solar power generation effort.
- To assist with the bankability and risk mitigation, the government has a Viability Gap Funding (VGF) mechanism for economically viable projects, up to 20% of the total cost, and would guarantee payment security for some state auctions. The VGF is mainly coming from the National Clean Energy Fund (NCEF) sourced from levies on coal production and imports.
- The government also provides other fiscal/tax incentives such as limit of 5% for components' GST, exemption of excise duty payments for some imported components, partial or complete Basic Customs Duty waivers for selected components for the manufacturers of solar modules and associated systems, as well as exclusion from inter-state transmission charges or taxes on transmission losses for 25 years from commissioning date.

A special government body and a mandatory dispatch policy are key to solar development

- Solar Energy Corporation of India (SECI) is the government body established to assist the realization of National Solar Mission. One of SECI's responsibility is to facilitate the development of solar parks nationwide. It allows state governments to use unproductive and non-agricultural land to build solar parks. SECI would made funds available for companies to acquire lands and other supporting infrastructures. But each state is also allowed to establish their own RE policy and to develop other solar projects
- In India, site selection for solar projects can be location-neutral (site is selected by developers) or location-specific (determined by the government). Auction would specify project size and the winner(s) would be selected through the price and technical aspects offered during the tender period.
- For grid connectivity, national government is enforcing must-run status on solar projects. However, as the grid connection has been increasing, curtailment is unavoidable. Therefore, the Ministry of Power had established a minimum generation compensation formula in case of curtailment, in which commercial curtailment compensation is limited to 50% and no compensation for technical curtailment. In India, the Central Transmission Utility (CTU) is responsible for planning, maintaining, and operating the transmission network in the country, while the State Transmission Utilities (STUs) have the same functions as CTU but within the state boundary.

Rajasthan's latest auction is among the lowest in the nation

- The State of Rajasthan already built 3 GW solar power capacity to reach the goal of 7 GW by 2022. To achieve the target, the government established RRECL (Rajasthan Renewable Energy Corporation Limited) designed for renewable energy development in Rajasthan. One of RREC's responsibility is land acquisition assistance; it provides a list of villages where low rental land is available for setting up solar projects so that the developers can lease or purchase the land.
- In August 2018, Solar Energy Company of India (SECI) auctioned 750 MW of grid connected solar PV capacity in the state of Rajasthan, however, the proposal submitted reached 2,370 MW. The five winners of the auction have secured tariff of Rs 2.48-2.49/kWh (~USDc3.5/kWh) or close to the national lowest tariff record in Rajasthan's Bhadla Solar Park and in Gujarat at Rs 2.44/kWh.
- There was a fixed ceiling tariff at Rs 2.68/kWh (USDc3.75/kWh) and the auction was technology-neutral (developers can choose any PV technologies). The winners were eligible for a 25 years PPA. Project will be a Build, Own, Operate (BOO) basis, and must achieve financial close within 12 months from the effective date of the PPA and must purchase the identified land within the same timeframe.

Competitive solar tariffs increase the risk of low quality product deliverance and project longevity

INDIA

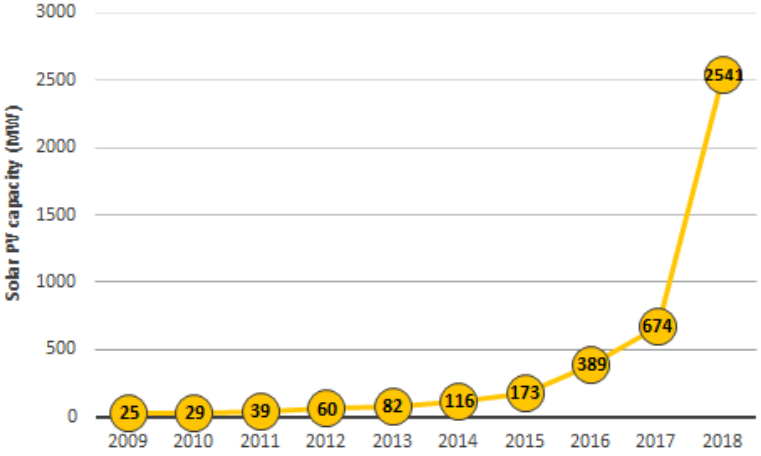
- The ambition to reach the 100 GW target has made the Government of India open several reverse auctions that would drive tariff low but unsustainable. Critics pointed out that winners of the bids are entitled to sign 25-year PPAs with the government, but the price offered would not be able to last as long (Mercom Capital Group, 2016). Unfortunately, the government seems to support the unsustainable auction prices instead of sticking to the current price that is more reasonable and viable in the long term (D'Monte, 2017). Many government bodies in charge of solar power projects argue that they cannot afford a high tariff thus the lowest tariffs are preferred.
- The competition to reduce the price of electricity generated by solar has also caused a shortfall in the quality of modules, inverters, cables, and various installations and equipment provided by developers. Arguably, developers are more interested in building the capacity as cheap and as fast as possible, thus they tend to reduce the maximum warranty periods and ignore the longevity of goods installed (Hall, 2018). As a result, the performance and the safety of each project are questionable.
- Many developers expect to attract a significant demand of electricity and to see further decline of module prices, so they could be making profit out of the project (Deign, 2017). These developers assume an increase in electricity demand and a continuous decline in module price as they participate in bidding (D'Monte, 2017). However in reality, as bid prices decline, developers are less likely to earn money. This phenomenon happened because the actual growth of demand is not as fast and as high as they would have predicted and the decrease of module prices have become stalled in recent years.

MEXICO

High Global Horizontal Irradiation
4.6-6.6 kWh/m2/day
High Annual power output
1620 kWh/kWp
Average temperature
12 deg C (January) to 28 deg C (June)
Relative humidity
52% (April) -71% (September)

3 GW total installed capacity (since 2013)
1.8 GW total ongoing project (COD 2019)

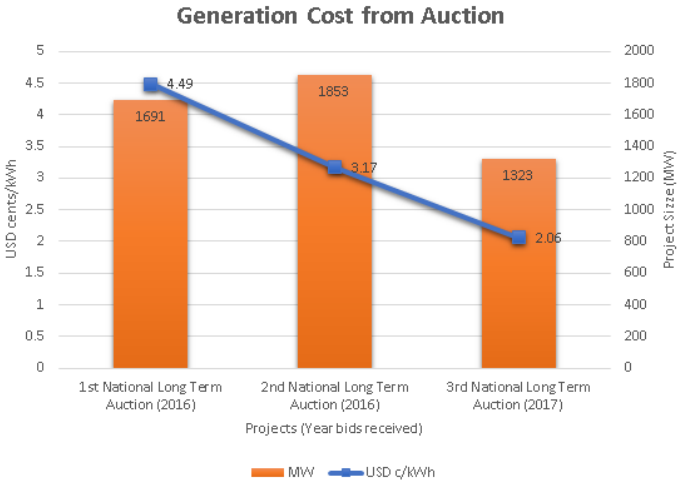
Steep increase in solar PV installed capacity since the first auction in 2016

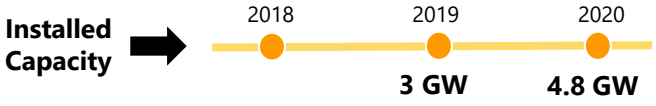


Data from IRENA (2019). Renewable Capacity Statistics 2019.

- In 2012, the Mexican government enacted the National Energy Strategy (2012-2026) which set specific goals to generate power from non-fossil fuel energy sources. This medium term goal is divided into three terms: 25% share by 2018, 30% share by 2021, and 35% share by 2026. The non-fossil fuel energy sources include hydropower, wind, geothermal, bioenergy, and solar PV.
- The National Energy Strategy contributes to the target of Climate Change Law, aiming to reduce 30% Greenhouse Gas (GHG) by 2020 and 50% GHG reduction by 2050.

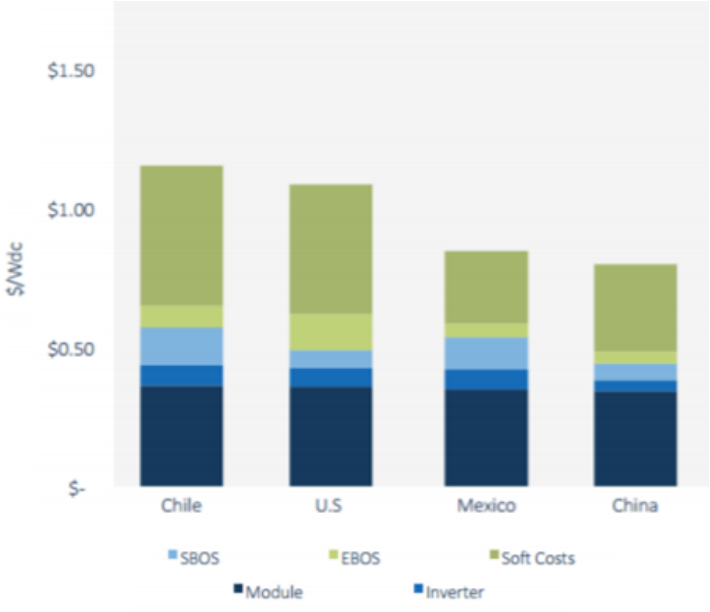
Mexico has seen a rapid decline in solar power prices at auctions





- Solar power average prices from the last three long-term auctions have seen a rapid decline from USDc 4.49/kWh to USDc 2.06/kWh, a 54% decline in more or less one year. The lowest bid on the last auction by Neoen International hit a record low worldwide in that year at USDc 1.92/kWh for 375 MW solar PV capacity.
- The decline is mainly due to declining global module costs. In a typical solar project in Mexico, the module costs take almost 50% of total project costs. Since there are no major local solar module manufacturers, Mexican solar projects use imported modules which have seen a price decline from $0.64/Wp in 2016 to $0.33/Wp in 2019.
- Mexico has awarded 4.8 GW of solar PPAs from the three auctions, 3 GW have been operating and the remaining 1.8 GW are expected to come online by the end of 2019.

Lower cost of solar PV projects in Mexico is caused by lower soft costs



- The main factors affecting the competitiveness of solar power auctions in Mexico are high irradiation, mild temperature, fiscal incentives, and low soft costs.
- Soft costs in Mexico are much lower than other countries like the US, Chile, and China. Soft costs include financing, marketing, labor, other non-technological, and development costs.
- Labor costs are low, even among developing countries. Minimum salary is $2-5/day, while salary for low skilled worker is $7-19/day and high skilled worker is $23-30/day.
- Development costs are around 8.6% of project costs and include permitting, grid interconnection, engineering and development overhead, land, preparation, and transmission costs.

Attractive financing and policy scheme drive investments in solar PV industry

MEXICO

- The annual interest rate in Mexico using traditional source of finance (through commercial banks) depends on the standard interest rate set by local banks, which falls around 10%-11% in 2018. Developers also have the option of borrowing from US banks with loan tenor of 15 years or longer and obtain a rate between 3%-5% (as of 2018) if they are a blue-chip company or a publicly listed company. Furthermore, maximum debt to equity ratio in a typical project is 75:25.
- CENACE operated a wholesale electricity market (MEM) to allow private entities to produce and sell electricity as well as to compete with CFE and with each other. MEM consists of short-term markets, medium-term auctions, long-term energy auctions, Financial Transmission Rights (FTR) auctions, a capacity balancing market, and clean energy certificates market.
- Clean energy certificates called CEL are available as market-based incentive, in which large consumers (those with estimated demand of over 1 MW) and electricity traders (including the state-owned utility, CFE) are required to purchase energy from clean sources at the least 5% of the total electricity consumption. The proportion will increase to 5.8% in 2019 and is projected to reach 13.9% by 2022. Failure to meet obligations or supply contract will result in sanctions and penalties from the government. CELs can be used as a signal for investors regarding the value of new clean energy investments by time and location.

Various incentives are directed to benefit green energy companies

MEXICO

- The 15% import duty for PV modules was lifted since 2018 since PV modules are considered as part of a generator instead of a generator by itself (the duty is imposed for generators).
- Accelerated Depreciation: acquisition of assets (machinery and other equipment) are subject to accelerated depreciation and Net Operating Loss (NOL), which can offset corporate income taxes for a period of 10 years. This only applies if the corporate's main core business is renewable energy, with income from renewable energy represents at least 90% of the corporate's total income.
- Green Energy CUFIN: companies can distribute dividends without paying any corporate tax during NOL period (since they do not have any taxable income, which is required to determine the eligibility of tax-free dividends).
- RE projects can incur debt for more than the maximum 75:25 ratio, thus it is decided that debt acquired to finance RE infrastructure must not be taken into consideration when determining the total amount of debt if the debt incurred between related parties. Any entity that has any participation in developer's equity can be considered a related party. Therefore, third-party lenders can lend any amount of debt to the developer as long as it has a share in the developer's equity.
- The Energy Regulatory Commission of Mexico (Comisión Reguladora de Energía, CRE) also offers 50-70% discounts for power transmission and grid connection for RE plants larger than 500 kW.

The Mexican power sector reform has helped lower power generation costs

- The 2013 Energy Reform marked the liberalization of Mexican energy sector. Private companies can participate as generators and buyers of electricity. CENACE (National Center of Energy Control), founded in August 2014 as a decentralized public body to operate the national electricity system and market, in cooperation with Mexico's Ministry of Energy (SENER) organized Mexico's first three long term clean energy auctions in 2016-2017. The reform mandated the use of auctions as a way to contract energy generation, which later will contribute to the declining generation costs in the country (Yaneva, Tisheva, Tsanova, 2018)
- Three energy auctions have been held since 2016. There were 7 companies secured contracts in the first auction with average cost at USDc 4.49/kWh, 16 companies secured contracts in the second auction (USDc 3.17/kWh), and 5 companies secured contracts in the third auction (USDc 2.06/kWh). It appears that the reform (through the mandatory auction system) has helped bring down the generation costs. The fourth auction was postponed in 2018 and later cancelled in early 2019. This move follows the new administration policy to increase the role of state-owned utility (CFE) in the generation sector.
- CFE was the only off-taker for the first two clean energy auctions in 2016. The third auction (2017) allowed private companies to participate as buyers. The financial credibility and the risk of default of market participants are overseen by the Clearing House (CC). The CC matches the bid from generators and utilities and sign contracts with them. CC will not be the contract guarantor, but only to administer contracts and perform credit analyses.

Mexico applies advanced auction scheme and strict requirements for bidders

- There are 3 categories of long-term auctions in Mexico: firm capacity (MW), clean energy (MWh), and clean energy certificates (CEL) (MWh) auctions. Firm capacity auctions are technology-neutral, while clean energy and CEL auctions are limited only for clean energy. PPA contract is 15 years for firm capacity and clean energy auctions, and 20 years for CEL auctions. There is also medium-term auction that applies for firm capacity and clean energy for 3 years contract period.
- The auctioneer requires bidders to showcase their technical and financial capabilities by submitting site-specific documentations (resource assessment and grid access) and bid bonds. The bond values reach USD 93,000 plus USD 20,000/MW for capacity firm, USD 9/MWh for energy, and USD 4.5/MWh for CEL. On top of that, generators are also obliged to submit performance bonds to cover penalties when performance targets (construction and operation) are not met.
- The auction scheme allows developers to choose their site locations (location-neutral auctions). There are no limits of project size. The winner of the auction is determined by the CENACE's algorithm formula which is based on several criterias, such as price, locational price signal, hourly adjustment factors, volume of energy, capacity, and certification. Price is, however, prioritized among other criteria, hence not all demand auctioned will be awarded a contract. The use of algorithm makes the auction system in Mexico relatively more advanced than auction systems in other countries.

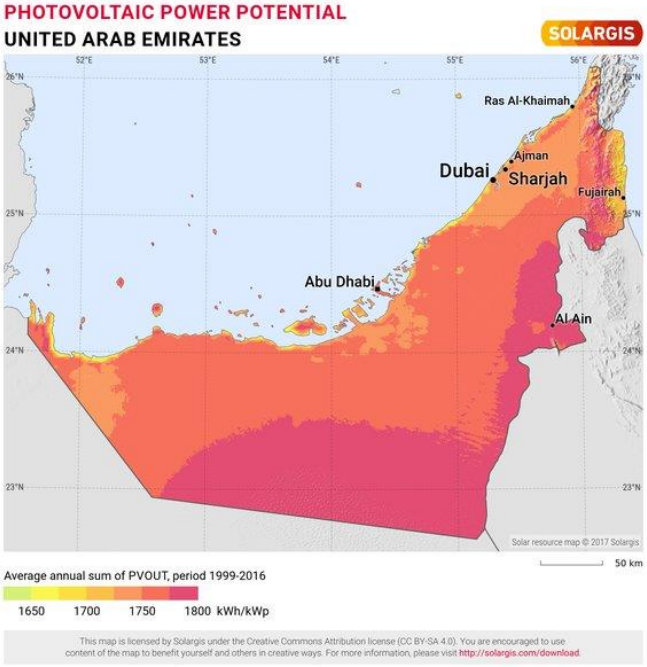
Locational signal is applied to encourage auction bids in certain areas

- Locational signal plays an important role in the winner selection criteria. In the first auction, location signals were used to incentivize bids in areas with large gap between supply and demand without specifically considering renewable resources available in those areas. Locational signals were determined and announced to the developers before the auction. The use of locational signals has proven effective in encouraging power plant development in these areas (IRENA, 2017)
- In the second auction, renewable resources availability became the main driver for site selection. The adjustment factor was reduced by about 95% compared to the one used in the first auction.

- Adjustment factors have negative value for areas where developers are encouraged to bid (large supply-demand gap or high renewables resources) and vice versa. The actual bid amount is added or discounted by the adjustment factor during bid evaluation.

Source: IRENA (2017).

UNITED ARAB EMIRATES



High Global Horizontal Irradiation

6.5 kWh/m2/day

Annual power output

1753–2192 kWh/kWp

Average temperature

18 deg C to 34 deg C

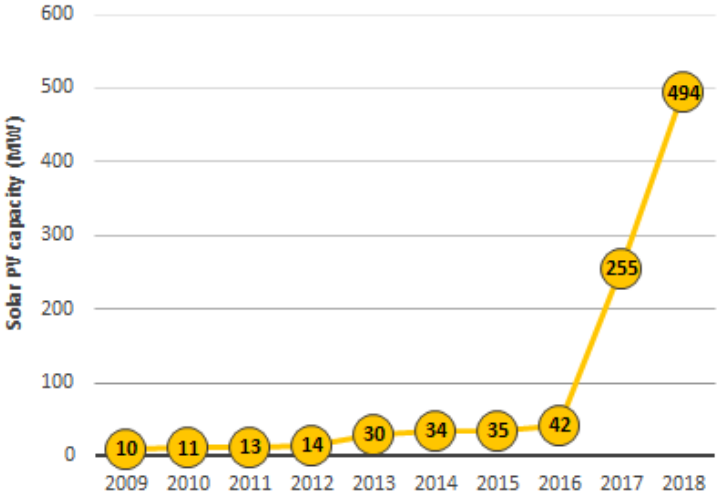
Relative humidity

55% - 68%

487 MW total installed capacity
2027 MW total ongoing project (contract awarded)

UAE sets ambitious target for clean energy share in 2050

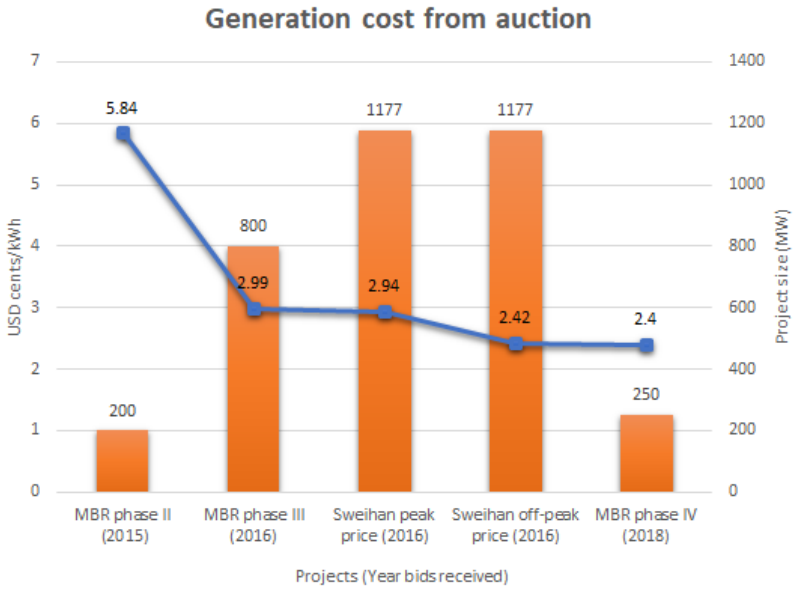
UNITED ARAB EMIRATES



Data from IRENA (2019). Renewable Capacity Statistics 2019.

- In 2017, UAE Energy Strategy 2050 was launched, targeting 50% of electricity generation in 2050 to be supplied from clean energy sources (44% renewables and 6% nuclear). Solar capacity is expected to be 44 GW in that year. This target could reduce 70% of GHG emission, thus saving AED 700 billion by 2050.
- In 2015, Dubai set its own Clean Energy Strategy. It targets clean energy to contribute 7% of total power generation by 2020, 25% by 2030, and 75% by 2050. The emirate is expected to surpass the target by achieving 8% of renewable energy generation by 2020.

Generation cost has halved since first auction took place in 2015



Data from IRENA (2019). Renewable Energy Market Analysis: GCC 2019

- UAE has seen several record low bids in their auctions. Generation cost of USDc 5.84/kWh was record-breaking in 2015. Mohammed bin Rashid Maktoum (MBR) Phase III even saw 3 record low bids in the process. The last one was USDc 2.42 in Abu Dhabi (Sweihan).
- Low generation cost is driven by the high solar irradiation and availability of unused land in the desert areas, government support policies, low financing costs, size of projects, and auction design.

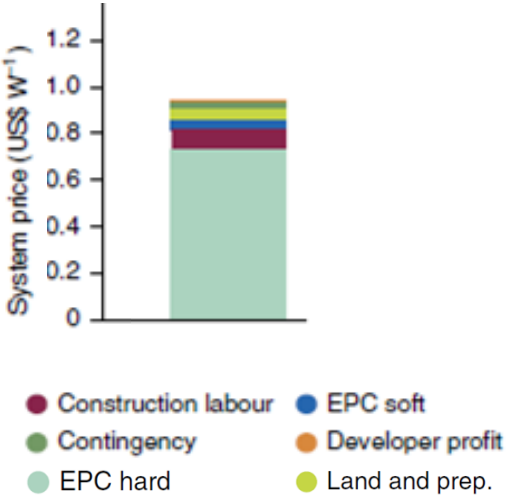
Attractive financing and government support helped drive down solar generation cost

UNITED ARAB EMIRATES

- UAE possesses attractive financing scheme with low interest rate (2.6-3.6%) and long tenor (over 20 years). In MBR Phase II, the loan tenor was 27 years. In all projects, the debt to equity ratio is at least 70:30, and even reached 86:14 in MBR Phase II.
- This attractive financing scheme is possible due to low risk perception and policy support. To minimize the risk, 51-60% of the project's equity is owned by state utility, therefore off-take by state utility is guaranteed. Projects are built in BOO (build, own, operate) model with long term off-take contract (20-25 years) to ensure the sustainability of the project. However, Abu Dhabi is currently considering to liberalize the electricity market, including relaxing the off-take guarantee.
- To further support solar projects, land, permits, and grid access are provided without any fees as part of site-specific auction. No local content requirement also allows cheaper imported solar panels to be used in the projects.
- Additionally, UAE's currency is pegged to the USD. Consequently, there is no risk of volatile exchange rate for the developers. However, this has implication to the fiscal policy of the UAE. For example, the interest rate hiked by the Fed in the end of 2018 has pushed the Central Bank of the UAE to also increase their interest rate to maintain monetary stability.

Development cost is low due to government support policies

- UAE has no major local manufacturers of solar module. In all major projects, foreign contractors and EPC were used. Modules are imported at low cost (around $0.28/W in 2018) due to low import duty.
- Although no minimum salary is in place, labor cost is relatively cheap compared to Western Europe or North America, but higher than other developing countries. Average salary for junior engineer is $33-100/day, while more senior engineers in manufacturing industry earn $60-270/day.
- The share of development cost in total project cost is estimated to be around 6.2% (including 0.3% land preparation, 3.9% profit margins, and 2% contingencies). This low development cost can be achieved through some forms of "subsidies". Land cost, permits, and resource assessment are considered free (although no public statement on this).



Source: Apostoleris (2018)

Estimated cost structure of solar plant project in UAE

UNITED ARAB EMIRATES

Module cost (USD/Watt)	0.28
Inverter cost (USD/Watt)	0.08
Tracker + BOS (USD/Watt)	0.22
Sales tax (%)	0
Construction labour (USD/Watt)	0.07
EPC markup (%)	5
Land acquisition (USD/acre)	0
Land preparation (USD/acre)	10,000
Permit (USD)	0
Interconnection cost (USD//Watt)	0

Transmission line (USD)	0
Contingency (%)	3
Developer margin (%)	0.5
Operation cost (USD/MW/year)	10,000-15,000
Debt fraction (%)	80
Debt interest (%)	3.5
Return on equity (%)	10
PPA term (years)	25
Annual yield (kWh/kW)	2,836
Capex (USD/Watt)	0.95
LCOE (USDc/kWh)	2.85

Source: Apostoleris (2018)

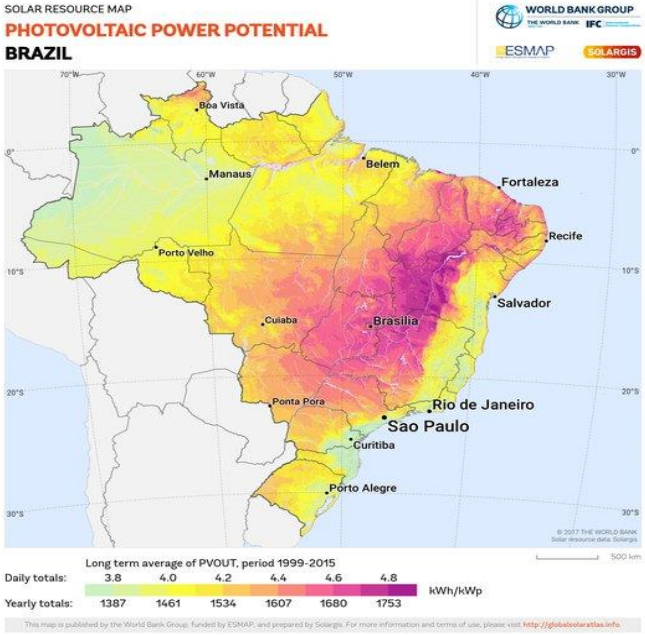
Strict financial and technical evaluation are important to avoid underbidding in auction

- All auctioned projects in UAE are site-specific. The government selects and prepares the construction sites. It seems that the land is provided at no cost, although not publicly stated by the government. However, there are documents mentioning that there is land lease agreement required between IPP and state utility. Grid access is provided as part of site-specific auction.
- Auctions are designed to incentivize electricity generation that complements existing generation capabilities. Auction for the 1177 MW Sweihan project was designed to incentivize maximum generation during summer (June-September) which is remunerated at 1.6 times as much as the energy delivered during the remaining year. This led to a contract of 2.42 USDc/kWh for non-peak months and 2.94 USDc/kWh for peak months.
- Auctions apply strict financial and technical requirement during prequalification and evaluation to avoid underbidding. In MBR Phase III auction, 97 parties expressed interest, 14 were prequalified and invited to submit bids, and only 5 submitted their bid.

Economics of scale played an important role in UAE's low solar generation costs

- In UAE, there is no limit on project size. In MBR Phase III project, 800 MW contract was awarded to a single consortium. This will improve the economics of scale, but could also leave the government vulnerable to risk if the developer fails to deliver the electricity. This also might drive other developers out of market.
- UAE implements ex-post adjustment option. This implies that agreed project size can be different from the initial offer to achieve a lower price. Project size can also be adjusted after the contract is awarded. In MBR Phase II, initial capacity auctioned was 100 MW. The bidder submitted USDc 5.98/kWh for 100 MW and option for a lower price at a higher capacity. The final agreement was USDc 5.84/kWh for 200 MW. In MBR Phase IV, the PPA was amended to add 250 MW of solar PV on top of 700 MW CSP.

BRAZIL



High Global Horizontal Irradiation

4.5-6.3 kWh/m2/day

Annual power output

1230 kWh/kWp

Average temperature

18 deg C to 27 deg C

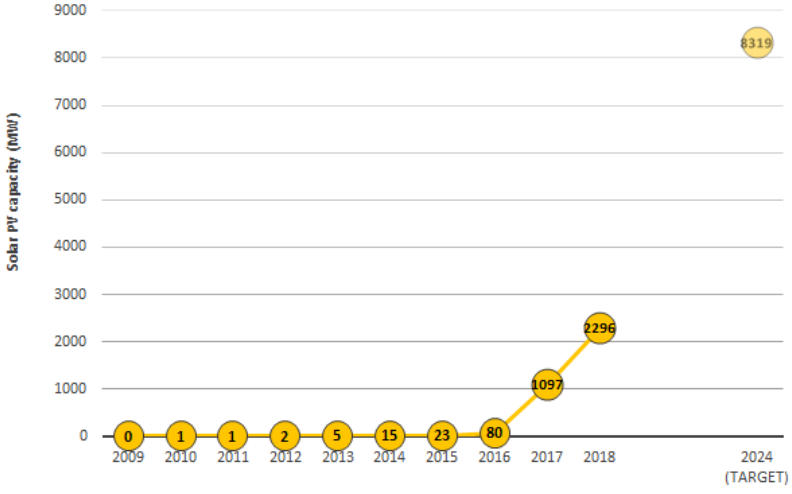
Relative humidity

49% -79%

2056 MW total large scale installed capacity by 2018

2728 MW total ongoing project (contract awarded)

Brazil is expected to reach its solar energy target

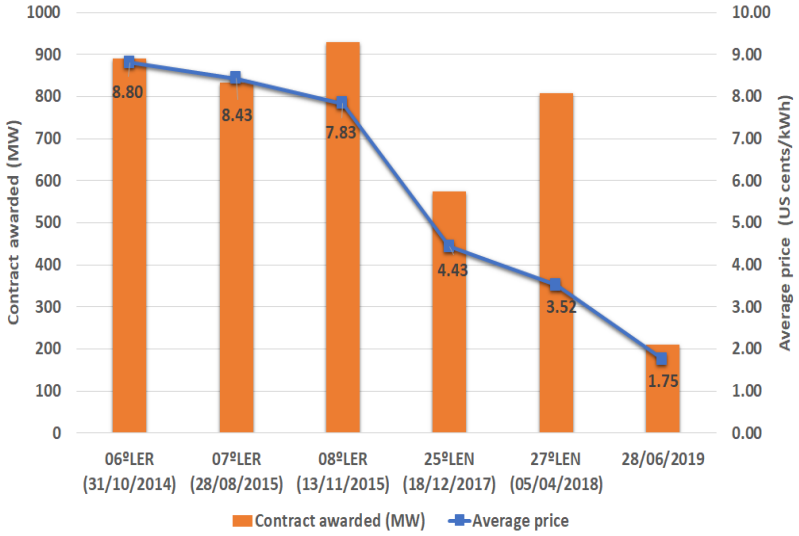


Data from IRENA (2019). Renewable Capacity Statistics 2019.

- The Brazilian government, through its 10-year National Energy Expansion Plan (PDE 2024), aims to increase the share of non-hydropower renewables to 27.7% of total installed capacity in 2024.
- Hydropower is expected to remain the primary source of electricity in the country, totaling 111.5 GW in 2024 or accounting for almost half of total installed capacity in that year.
- Solar power capacity is expected to increase to 8.3 GW by 2024, accounting for 3.7% of total installed capacity in that year. Considering current trend in the Brazilian solar industry, it is likely that Brazil will achieve its solar energy target.

Auctions have helped bring solar energy prices down at an unprecedented pace

BRAZIL

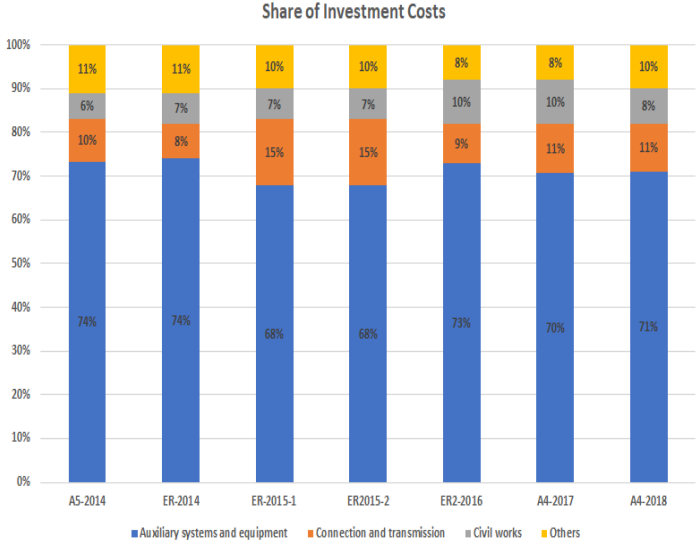


Sources: CCEE, BACEN, ANEEL

- The average solar power prices in Brazil have been rapidly declining from USDc 8.8/kWh in 2014, when the first solar auction took place in the country, to USDc 1.75/kWh in 2019, giving a 80% decline in five years. The lowest bid in 2019 reached USDc 1.688/kWh, breaking the previous world's record low with prices under 2 cents.
- The low solar energy prices at auctions are mainly caused by the declining solar module costs and higher capacity factor (EPE, 2018).
- Other factors that may have contributed in this trend are lower interest rates offered by the Brazilian Development Bank (BNDES) and competition among developers.

Lower global solar module prices have largely contributed to lower investment costs in Brazil

- While the Brazilian government keeps supporting the establishment of local solar PV manufacturing industry, most solar projects in the country still use imported modules due to its lower prices. In 2017, local modules were priced on average at $0.66/Wp compared to imported modules at $0.472/Wp (include taxes).
- In the last three years, the share of module costs in the equipment costs had been declining from 63% in 2016 to 57% in 2018, following the downward trend in solar module prices worldwide.
- The costs of land, social and environmental actions, indirect costs, assemblies and tests, logistics, and insurance contribute to 10% of total investment costs.
- As the equipment costs make up 70% of investment costs of a typical solar project in Brazil, the lower global module prices have helped make the solar energy more competitive in the country.



Source: EPE, 2018

Financial support has been instrumental in accelerating solar deployment in Brazil

- The growth in Brazilian solar industry has been largely propelled by financial support provided by the government. Through Brazilian Development Bank (BNDES), the government provides a concessional financing with an interest rate of 0.9% per year for solar projects, this is much lower than the average loan interest rate in the country that reached 53.57% in April 2019. The maximum participation of BNDES is 80% of total investment costs with loan tenor up to 24 years (including grace and amortization periods) and the debt to equity ratio of minimum 80:20.
- To access this soft loan, developers need to comply with the 60% local content requirement (LCR) for equipment and services. Although the LCR is relatively high, most solar projects in Brazil obtained loans from BNDES since the bank provides the lowest interest rate in the market. Through this financing scheme, the bankability of solar projects is high.
- In addition to the financial incentives, Brazilian government also provides federal taxes deferral for importing and selling equipment, machines, and services used in the infrastructure projects (including solar projects) and exemptions from import taxes and state VAT (ICMS) for some equipment used in the solar projects (valid through 2021).

To impose Local Content Requirement effectively, government provides incentives

- The LCR imposed by BNDES is specifically targeted for components and production processes required to manufacture solar PV modules and system (electrical components, inverter, support/fastening units + module) (Transfer LBC, 2015). There are three types of LCR: basic, optional, and premium, with each type of LCR has its own score (in percentage).
- The basic items will score 40-60%, optional 5-30%, and premium 5-30%. The criteria and list of items that fall into each LCR type are released by BNDES. The total score will be calculated and used as the basis of BNDES to determine the amount of financing provided to a project. The score is called as Factor N (Nationalization Factor).
- The BNDES's Progressive Nationalization Program (PNP), which will be effective from 2014 to 2020, aims to stimulate solar PV manufacturing industry in Brazil. The PNP is divided into three periods: 2014 - 2017, 2018 - 2019, and 2020 onwards; each period has specific items required to be locally assembled or manufactured. The impact of this program has been seen in Brazil as more foreign PV module manufacturers established their factories in the country.
- It is worth noting that LCR used in Brazil is imposed gradually, starting from local assembly requirement to local production requirement. BNDES also provides soft loan to developers that comply with LCR.

Lessons Learned

- Geographic condition matters, particularly solar irradiation which determines the power output of solar PV. Higher solar irradiation will generate higher amount of energy, thus higher revenue for the developers. This, in the end, drives down solar generation costs. For instance, annual solar power output (kWh/kWp) in UAE is about 1.5 times higher than Indonesia, therefore UAE can generate the same revenue from power production as Indonesia with only 70% of the electricity price.
- Project risks have to be minimized to reduce financing cost. This can be achieved through several ways, such as long term PPA contract, off-take guarantee by the utility, or shared equity with state holding company. This results in low interest rate and long tenor loan.
- In case of high interest rate, fiscal incentive is necessary to compensate. Many forms of fiscal incentives can be applied that are not currently in place in Indonesia: Viability Gap Fund, accelerated depreciation, or equity sharing with utility company. These incentives, however, have to be specifically targeted for companies with renewable energy sector as their core business. In case of Mexico, the incentive is only applicable for companies with 90% income from renewable power generation.
- Other incentives to reduce land acquisition and permit costs (eg: government provides lists of available land, zero cost of land), reduced grid connection costs, and resource assessments from the government are also important.
- Economies of scale are of great significance. Large scale projects can lead to lower prices than small scale projects. Big projects also tend to attract international lenders which provide more attractive financing scheme, making renewables more competitive.

Lessons Learned (2)

- BOOT scheme could only be applied if the land used to build the power plants is owned by the utility.
- Locational signals shall not only based on fossil fuel price. The potential of renewable resources (level of irradiation) and the size of electricity demand should also be taken into consideration.
- Energy retailers and large energy users should be required to buy/use certain percentage of renewable energy through renewable portfolio standard (RPS) mechanism. It is also possible to arrange renewable energy certificate scheme as a market-based incentive.
- LCR is important to promote domestic manufacturing of solar components. However, government needs to incentivize compliance with LCR. In the case of Brazil, there is an exceptionally soft loan (0.9% per annum) available for developers complying with LCR. Imposing LCR without adequate incentives will only increase generation costs of solar power. For example, India saw an increase in solar module costs after 25% import tax is applied for imported modules since almost half of the modules available in market are imported.
- The development of local manufacturing facilities are important to reduce reliance on imported equipment, influence of foreign countries' policy on their PV module exports, and vulnerability to currency fluctuations.
- A special body is needed to regulate procurement auction (eg: CENACE, SECI). In addition, auction should be liberalized to include offtakers other than PLN (eg: industries, large consumers, etc).
- To help reduce solar investment costs, the government might lower soft costs, for instance through lowering or even eliminating cost of financing, land acquisition, permit, and connection.

Auction Design

Lessons learned from other countries reveal that auctions can help bring down solar power prices. To take advantage of auction, the government should focus on the auction design. Any flaws in the auction design can lead to failures. The following are key factors in setting up a good auction (Tiedemann, n.d.):

- **Sufficient competition between project developers.** The auctioneer needs to minimize the risk of market power and market concentration to ensure a high level of competition among project developers. A concentrated market occurs when only a small number of bidders participate at auction or when few bidders have dominated the market and hence can influence the output of the auction.
- **Limit extra risks for bidders.** The auctioneer needs to limit the bid risk and penalty risk. The bid risk is a risk of developers not being selected at auction in spite of the pre-development costs borne by them. The penalty risk is a risk of auction winners not being able to deliver their projects on schedule, hence they have to pay penalties. All these risk costs will be included in the bids which will then influence the bid prices revealed by bidders.
- **Curb transaction costs for bidders and the auctioneer.** The administrative requirements in the auction can increase project costs. The developers may choose not to participate in the auction when transaction costs are higher than the projected profits. This will lead to low competition and market concentration by larger players.

Auction Design (2)

- **Reduce the possibility of auction winner's failure to deliver the project.** Auction winners may fail to deliver the project if their bidding prices do not show the true costs of the project (underestimated costs). This may happen when bidders make incorrect estimates of uncertain parameters such as technology prices and interest rates.
- **Transparent process and clear auction rules**. The auctioneer needs to set clear and fair auction rules for all bidders and lays transparent processes to decrease the risks to developers and lenders. Any additional information or adjustments during the auction shall be disseminated equally to all bidders.
- **Pre-qualification of bidders**. To avoid underbidding at auctions, the government needs to enforce strict technical and financial compliance rules. The bid bonds requirement can help eliminate bidders that do not have sufficient financial capabilities to absorb financial risks (e.g. unexpected increase in module prices) in solar projects. This will help ensure that all awarded contracts can be delivered.
- **A credible auctioneer**. The auctioneer is responsible for setting up the auction, receiving and evaluating the bids, and sometimes signing a PPA with the auction winners. In a single offtaker market (vertically integrated), an independent regulatory agency may act as the auctioneer. Meanwhile, countries with liberalized market may choose independent system operator as the auctioneer. In both cases, an independent and credible entity should be appointed as the auctioneer.

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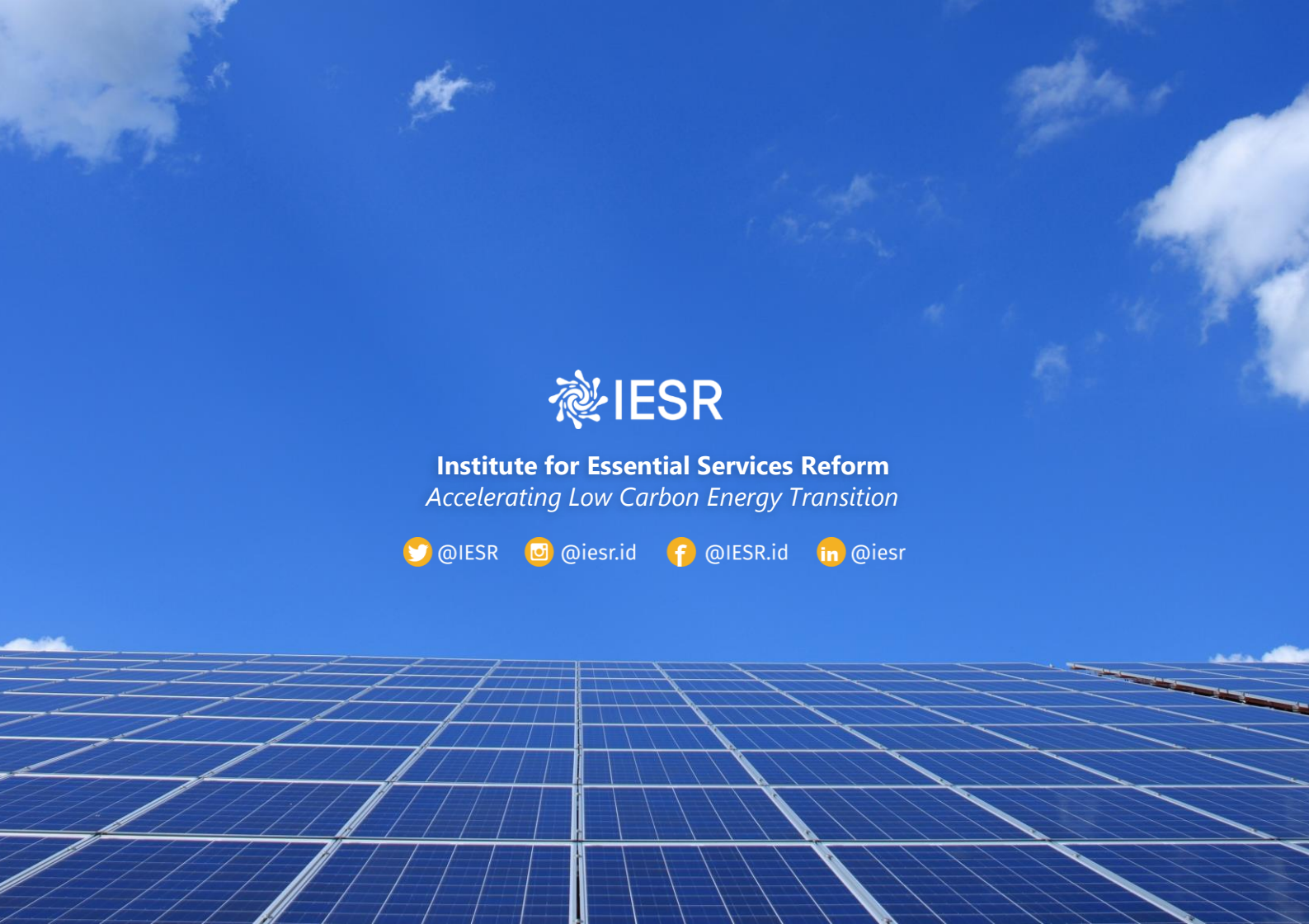
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