Industry Perspective

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Decarbonising through renewable power purchase agreements

UOB

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Executive Summary

October 2022

85% of electricity consumption expected to be green by 2050. The International Renewable Energy Agency (IRENA) projects that to meet the Paris Agreement climate goals, the share of renewable will need to increase from 20% in 2016 to at least 85% by 2050. For the construction and infrastructure sector, this means an increase in renewable energy to at least 18,700 TWh by 2050 from 2,700 Terawatt-hour (TWh) in 2016.

Strong renewable energy capacity growth **in Asia.** Asia accounts for 60% of total global renewable capacity installed in 2021. China accounted for 121 Gigawatt (GW) of the 155GW installed in Asia, with solar making up the bulk of new capacity installed at 53GW.

Climate change unlikely to impede solar installation growth trajectory. With rising global mean surface temperature as well as increased cloud coverage, this will impact the solar photovoltaic (PV) system's efficiency. Despite this, solar PV as a candidate for low-carbon energy transition alternative is unlikely to be curbed as these factors would primarily be offset due to technological improvements and increase in solar irradiance in key solar deployment areas.

Corporate renewable energy procurement to lead renewable energy demand. As sustainability awareness increases amongst investors and customers, procurement of corporate renewable energy is gaining traction globally. As such they are actively exploring a combination of procurement and self-generating renewable energy as part of their decarbonisation strategy.

Benefits of corporates entering into a Power Purchase Agreement (PPA). Corporate buyers and power producers enter into a PPA arrangement typically to reduce cost and revenue uncertainty. However, there are also other factors woven on top of this shared interest that should be mentioned: (1) greening of corporate operations; (2) sensible project economics; and (3) focus on core business competencies to reduce resource wastage.

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Renewable Energy Trends

60%

of 2021's total global renewable capacity installed in Asia

Strong renewable energy capacity growth in Asia

According to IRENA, Asia accounts for 60 per cent of total global renewable capacity installed for 2021. China accounted for 121GW of the 155GW installed in Asia, with solar making up the bulk of new capacity installed at 53GW. Another hot renewable candidate - wind, also experienced strong addition with China again accounting for the lion's share with 47GW of wind capacity installed.

Renewable energy is taking centre-stage at both corporate and national levels

At a national level, policy makers are formulating frameworks to meet international sustainability commitments as ratified in the Paris Agreement. Moreover, near term volatile energy prices, a knock-on effect from the Russia-Ukraine conflict, provided further impetus to build energy independence through onshore and/or offshore renewable energy options.

Pressures for corporates mount with stakeholders calling for clear sustainability targets and decarbonisation strategies. In fact, multiple independent market analyses, spanning across industries, found that companies that have integrated sustainability into their business operations experience higher public market valuation.

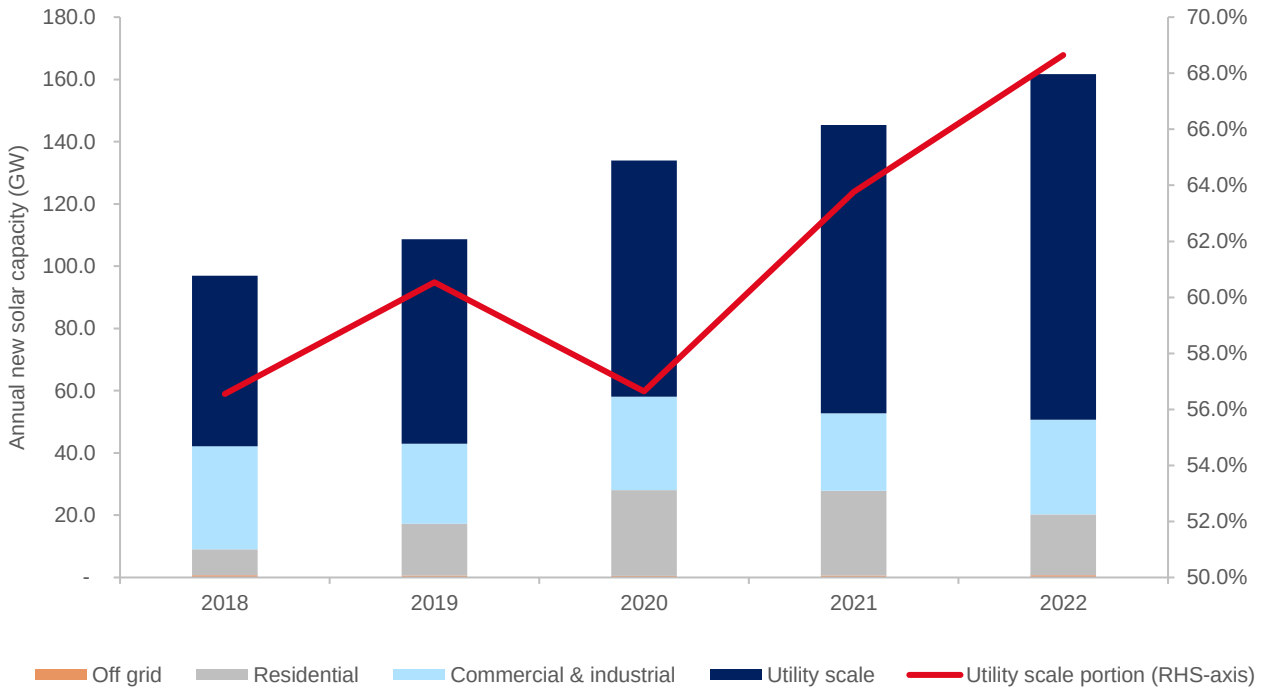
This is because investors view their operations with lower risk profile coupled with higher growth prospects. Procurement of renewable energy is a lever commonly employed as part of corporate's sustainability strategy.

Solar – preferred renewable energy in Asia

Solar PV forms part of the decarbonisation strategy for both corporates and governments. With a wide range of deployment, from utility-scale to individual residential homes, there are many deployment opportunities especially in remote and unelectrified areas.

Utility-scale project deployment is expected to lead solar deployment. According to an International Energy Agency (IEA) market outlook report, utility-scale deployment is forecasted to account for up to 70 per cent of new solar capacity in 2022.

Figure 1: Annual new solar capacity added in Asia by segment type

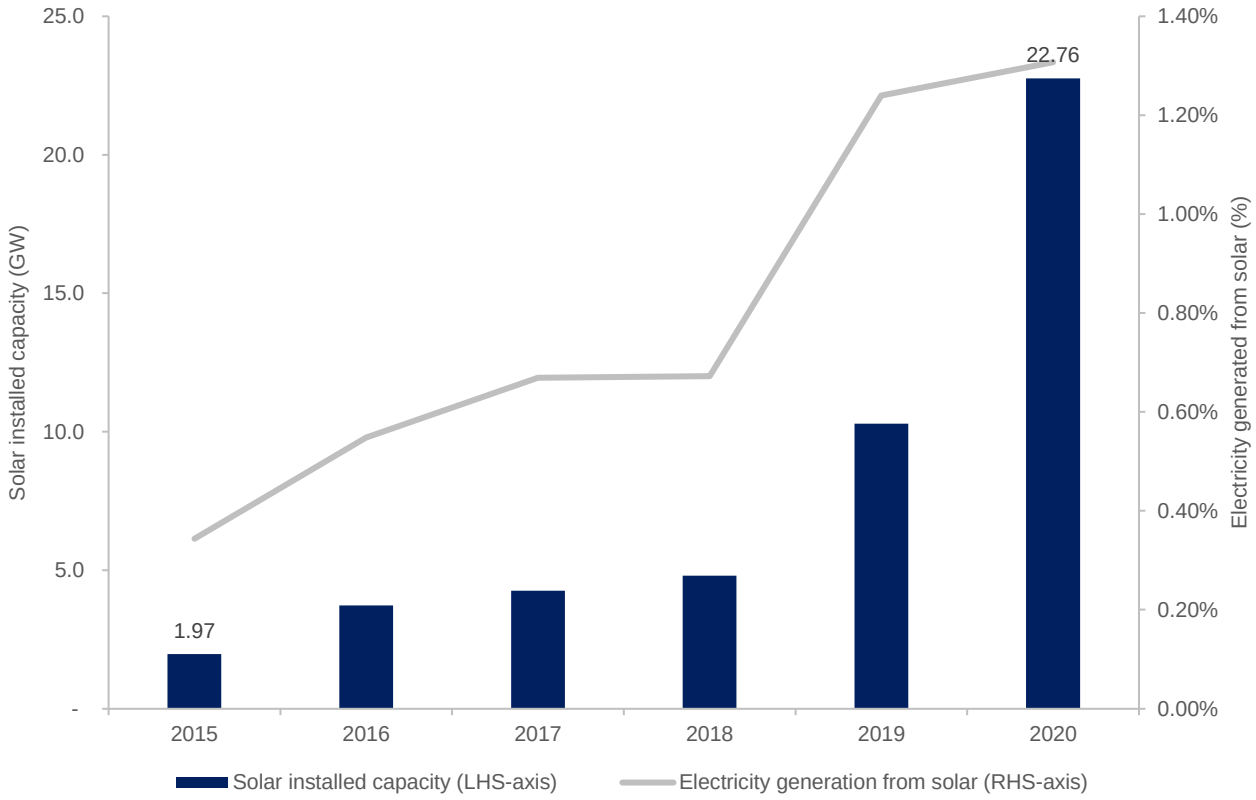


Source: International Energy Agency

63.1% CAGR for solar installed across ASEAN member states (excluding Myanmar)

According to US Energy Information Administration, installed capacity for solar grew 63.1 per cent annually from 1.97GW in 2015 to 22.8GW in 2020 amongst ASEAN member states excluding Myanmar.

Figure 2: Annual solar installation in ASEAN member states excluding Myanmar



Source: US Energy Information Administration

This trend is underpinned by:

- Falling solar panels price;
- Favourable government policies and targets for renewable energy adoption; and
- Lower marginal cost of solar power generation VS fossil fuel power generation

Solar cost has fallen 62% since 2015 and is projected to continue to fall 16% by 2030

Falling solar panels price

Solar cost has fallen 62 per cent since 2015 and is projected to continue to fall 16 per cent by 2030 if current trend continues. The decrease in prices is primarily due to three factors;

(1) Leveraging manufacturing economies of scale;

(2) Improvement in grid technology that allows for better integration of solar; and

(3) Lower cost of financing as risks are reduced with increased awareness around technology performance.

Exploiting manufacturing economies of scale. Solar PV costs have declined over the years due to a combination of lower silicon costs, reduction of labour cost through automation, squeezing of profit margins with more market supply and reduction in resource wastage amongst other factors.

Improvement in grid technology that allows for better integration of solar PV system. Solar PV introduces a new dimension for electricity transmission and distribution. As a distributed power system application, this involves additional grid integration cost within the range of 3 to 33 per cent of solar PV levelised cost of electricity. As technology to enable deployment of distributed power system matures, solar developers can expect future cost to decline.

Lower financing cost as risks are reduced with increased awareness around technology performance

Lower financing cost as risks are reduced with increased awareness around technology performance. However, this may not be true in developing markets where risk profiles are higher.

It should also be noted that **short term prices for PV modules have increased by 35 per cent** during the COVID-19 pandemic from $0.23/W to $0.31/W. The reason for the price increase is attributed to the

(1) Increase in logistics cost due to supply chain disruptions;

(2) Increase in price of raw materials; and

(3) Increased demand for solar deployment.

In the near term, we expect that the prices would continue to remain elevated. However, over the longer term, we expect the structural trend for solar prices to decline with the easing of supply chains and technological improvements.

Favourable government policies and targets for renewable energy adoption

To address climate changes, governments have set national targets along with policies in achieving them. Targets for renewable energy (RE) mix across UOB's key markets are between 8 to 50 per cent depending on accessibility of technology and deployment opportunities. Summary of the national targets and initiatives are noted below.

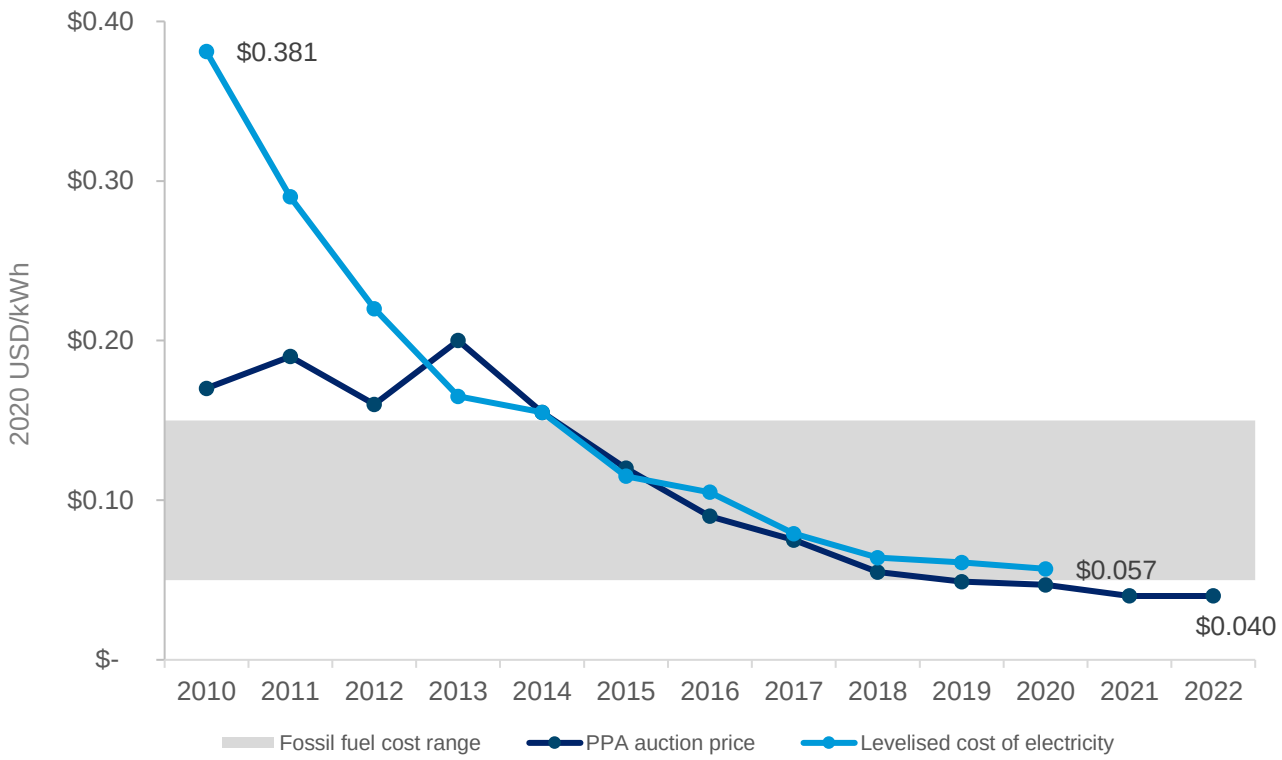
	RE Target	Regulation	RE Capacity/ Investment Growth
 **Mainland China**	**About 20% and 25% of energy to be supplied by non-fossil fuel** by 2025 and 2030.	Competitive auctioning mechanism with cap on capacity quota enables government and investors to increase visibility on project returns and overall long-term growth of solar projects.	Committed to solar and wind power **generation capacity of above 1,200GW** by 2030.
 **Hong Kong SAR**	**10% of electricity generation** to come **from renewable sources** by 2035.	Utility-led feed-in tariff and net metering schemes to encourage deployment of renewable energy especially amongst households.	Outlook remains subdued due to lack of incentive mechanisms. However, the government has earmarked renewable project opportunities for offshore wind.
 **Indonesia**	The National Energy Policy targets a **23% and >51% of total energy mix** by 2025 and 2030 respectively.	The government is working with the Institute of Essential Services Reform on a **US$1bn solar-driven scheme** as a fiscal stimulus to revitalise the economy.	Improved access to financing with growing use of green bonds and sukuk for renewable energies. Strong investment interest in geothermal.
 **Malaysia**	Aims to **achieve 31% and 40% of installed capacity** by 2025 and 2030.	The Green Investment Tax Allowance and Green Income Tax Exemption incentives will be extended to 2023.	Strong solar pipeline (via Large Scale Solar) along with rising investor interest, guides solar to **reach 5.3GW by 2030**.
 **Singapore**	Modest **target of 8% of energy consumption** from RE by 2030.	Carbon tax introduced to reduce GHG emission. Initial rate of US$5/t with aims to **increase to US$10-15/t** by 2030.	Singapore targets to increase solar deployment from the current **262MWp to 2GWp by 2030**.
 **Thailand**	Ministry of Energy has set a **target of 36% of energy consumption** from RE by 2037.	RE purchase scheme key to achieve targets and will be monitored by the Energy Regulatory Commission (ERC).	Strong growth from biomass and solar renewables. Plans to set **up 2.7GW of solar capacity on 9 hydropower dams** by 2037.
 **Vietnam**	The government **targets 15-20% of the its power supply mix from renewable energy** by 2030.	The regulatory environment is relatively unpredictable. Its sudden shift toward auctions and uncertainties could turn away some investors with a lower risk appetite.	Diversify away from hydropower and into solar and wind as preferred renewable energy source. **Target 18.6GW and 18.0GW for solar and wind** by 2030.

Policies can strongly influence the outcome of solar deployment. In particular, Vietnam experienced the strongest solar growth at 400% CAGR between 2015 to 2020 encouraged by government's feed-in-tariff scheme (FiT). In fact, FiT was the key differentiator that observed more than 6.5GW (out of 9.3GW added in 2020) of solar capacity registered in the final month before expiration of the scheme.

Lower marginal cost of solar power generation VS fossil fuel power generation

According to IRENA power generation projections 2020 report, the levelized cost of electricity (LCOE) for solar PV sits on the lower end of the fossil fuel LCOE bounds. While this does not necessary imply that solar PV is commercially and technically superior to fossil fuel generation under all scenarios, it does suggest that the general direction of solar PV LCOE is a boon for a low-carbon future.

Figure 3: Solar Photovoltaic



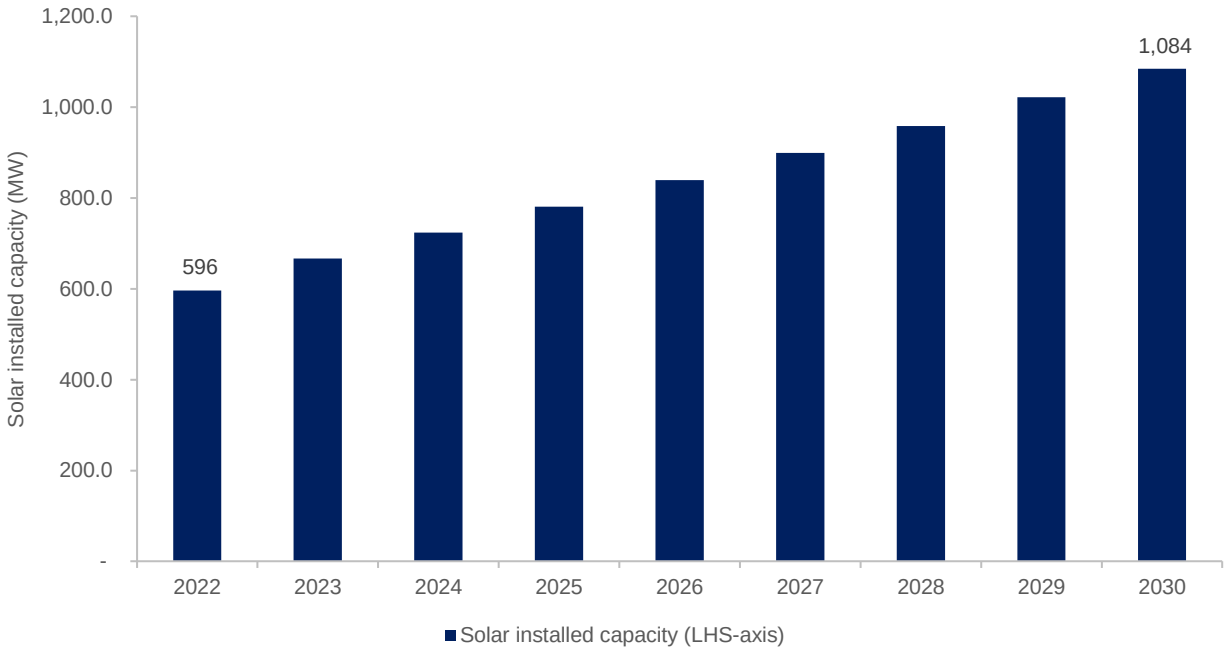
Source: IRENA Renewable Cost Database

Solar PV Trajectory

Climate change unlikely to impede solar installation growth trajectory

Solar PV as a candidate for low-carbon energy transition alternative is unlikely to be curbed by climate change. According to data from Fitch, the global solar installed capacity is forecasted to grow from strength to strength till 2030 with CAGR of 7.77 per cent, as seen in Figure 4.

Figure 4: World solar installed capacity forecast to 2030



Source: Fitch solutions

IPCC models show mixed outcomes with some regions experiencing brightening, while others are dimming. According to IPCC assessment report 6, impact to solar irradiance because of cloud, aerosol and water vapour trends is varied across markets. The model predicts with medium confidence that solar irradiance would decrease in south Asia but increase in east Asia by the mid-century.

Efficiency loss due to increase in surface temperature more than offset by variation in solar irradiance and efficiency improvement. Increase in surface temperature decreases solar as it reduces the solar PV panel efficiency. However, the reduction in panel efficiency is likely to be offset by advancement as solar panel technology improvement. With cloud coverage expected to reduce at a projected rate of -0.05% per year this would result in a modest increase in solar PV of <3% by end of the century.

Solar PV learning rate

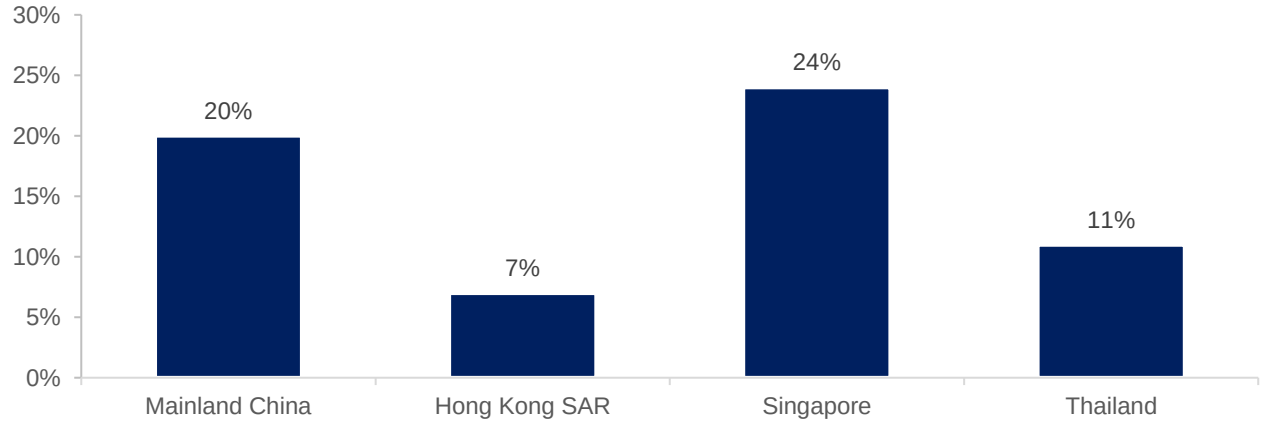
Cost decline for solar PV between 2010 to 2020 has been nothing short of remarkable. Within this period, utility-scale PV has a learning rate of 34 per cent and 39 per cent for installed cost and LCOE respectively. A learning rate of 34 per cent implies that every doubling of installed capacity, the fixed cost declines by 34 per cent. This suggests sizable headroom left for further cost decline as learning rate tends to decay with increased production – a positive implication for solar PV.

Solar offers retail electricity consumers some respite from volatile energy prices

Russia launched their special military operation into Ukraine on 24 February 2022. Since then, a combination of energy prices hikes and volatility has generated tangible concerns regarding energy security.

Increase in electricity prices is felt directly and indirectly throughout Southeast Asia. Retail is electricity prices rose by 20 per cent in some part of China. Over in Hong Kong SAR, retail price increases capped between 5.8 to 7 per cent for 2022 with electricity providers absorbing further cost prices. However, with escalating energy prices, residents were also forewarned that they can expect elevated prices even when fuel prices declines in the future as electricity providers seek to recover their losses through the Fuel Clause Recovery Account. In Singapore and Thailand, retail electricity prices have increased 24 per cent and around 11 per cent respectively.

Figure 5: Increase in electricity prices in Southeast Asia



Source: UOB Analysis

In Singapore, enquires for residential solar installation grew

1.8 times

year-on-year between 2019 to 2021 - indicative of increasing awareness for the benefits of solar PV deployment.

While retail electricity tariff is stickier in markets like Malaysia and Indonesia, it suggests that an uneven shouldering of energy prices is borne by either the government or commercial industries. Hence, consumers may experience the price hike indirectly through increased tax rates or price inflation of goods or services provided by the commercial industries.

There is also growing interest from homeowners for solar PV systems. In Singapore, enquires for residential solar installation grew 1.8 times year-on-year between 2019 to 2021[1] - indicative of increasing awareness for the benefits of solar PV deployment. According to data from Singapore's Energy Market Authority, the number of installed solar PV system on residential grew from 927 to 1,432 representing 14.9MW of installed capacity at the end of 2020.

Corporate renewable energy procurement to lead renewable energy demand

As sustainability awareness increases amongst investors and customers, procurement of corporate renewable energy is gaining traction globally. As such they are actively exploring a combination of procurement and self-generating renewable energy as part of their decarbonisation strategy.

Gaining momentum of corporate renewable energy procurement. As of early 2018, corporates have procured renewable energy in 75 markets with markets in Europe and North America accounting for the majority. Such corporates are also keen to green their energy at their headquarters as well as in their operating facilities. This presents an opportunity within the region where operating facilities and regional headquarters are located.

Corporate renewable energy procurement is not industry specific. The trend of corporate renewable energy procurement spans multiple industries which is indicative of a systemic trend. IRENA's analysis of corporate renewable energy procurement found that the Materials sector accounts for majority of renewable electricity consumption, while the Financial sector has the highest share of electricity procured from renewables.

[1] *Data extracted from UOB U-Solar programme*

Corporates carrying their weight through RE100 pledge

RE100 is a global corporate renewable energy initiative to accelerate decarbonisation of electricity at scale. Currently, there are more than 370 registered members who have made commitments towards **greening 100% of their electricity by 2050 or earlier.**

RE100 is committed to decarbonizing electricity at scale. Restrictive policies and market structure are commonly cited by RE100 members as hurdles that impede procurement of renewable electricity. RE100 addresses this through their policy works by advocating, on behalf of their members, for positive change at a local and policy level to remove regulatory red tapes.

RE100's footprint from walking the talk

Limited or lack of supply and regulations are the common barriers for procurement of renewable electricity in Japan, Mainland China, Republic of Korea and Singapore

44.7% of the total electricity consumed by RE100 members in 2021 were sourced from renewables. As of Jan 2022, RE100's 349 members consumed 340TWh of electricity in total, more than United Kingdom – the 12th highest global electricity consumer. Of this 340TWh, 152TWh or 44.7% was-sourced from renewables – an encouraging trend with share from renewables doubling from 2015.

In 2020, 28% of electricity (equivalent to 42TWh of renewable energy) was procured via power purchase agreements amongst RE100 members. This represented an increase from 2019's 26%. Purchases within the North American market made up the majority, contributing to 42% of total renewable electricity procured by RE100 members.

62% membership growth in Asia-Pacific. Amongst registered members, Japan, Mainland China, Republic of Korea and Singapore were cited as markets where procurement of renewable electricity remains challenging. The survey also highlighted these common challenges faced across member markets: (1) lack of procurement options; (2) limited supply available; and (3) some form of regulatory barriers.

Source: RE100

Corporate Power Purchase Agreement

Energy sector generating almost

66%

of CO_2 emission

With the energy sector generating almost two-thirds of CO_2 emission, it is obvious that renewable energy will play a material role in decarbonisation. Through corporate procurement of renewable energies, this can shift valuable investment resources into this sector to accelerate adoption.

Opportunity for renewable corporate power purchase agreements

Electricity consumption continues to climb. According to IRENA, the commercial and industrial sector accounts for almost two-thirds of CO_2 emission in 2016 and is projected to reduce to 54 per cent by 2050. The reduction in share is due to improvements in energy efficiency coupled with on-going electrification most notably within the transportation sector. However, electricity consumption for the Construction and Infrastructure sector is projected to grow 1.45% CAGR between 2016 to 2050 (13,500 TWh in 2016 to 22,000 TWh in 2050).

85% of electricity consumption expected to be green by 2050. IRENA projects that to meet Paris Agreement climate goals, the share of renewables will need to increase from 20 per cent in 2016 to at least 85 per cent by 2050. For the Construction and Infrastructure sector, this means an increase in renewable energy to at least 18,700 TWh by 2050 from 2,700 TWh in 2016.

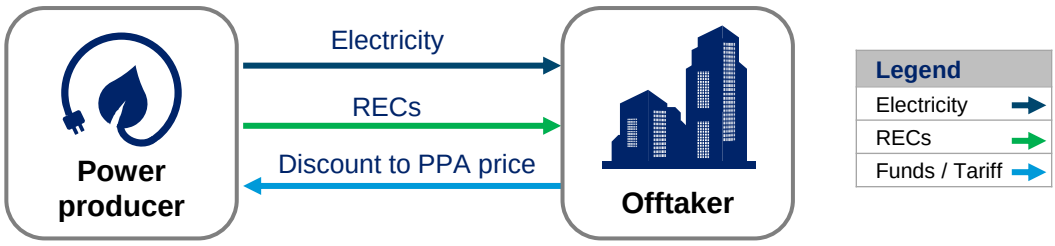
Types of PPA

Corporate power purchase agreement (PPA) is a long-term contractual agreement between a power producer and a corporate buyer for the purchase of electricity. Corporate PPAs can generally be structured into three types of PPA:

- Private-wire PPA;
- Physical / sleeved PPA; and
- Synthetic / virtual PPA.

Private-wire / on-site PPA

Private-wire / on-site PPA involves the direct sale of electricity from the power producer to the corporate buyer with the power generating asset located on the rooftop or next to the corporate buyer's off-taking site. The electricity generated is usually completely supplied to the corporate buyer.

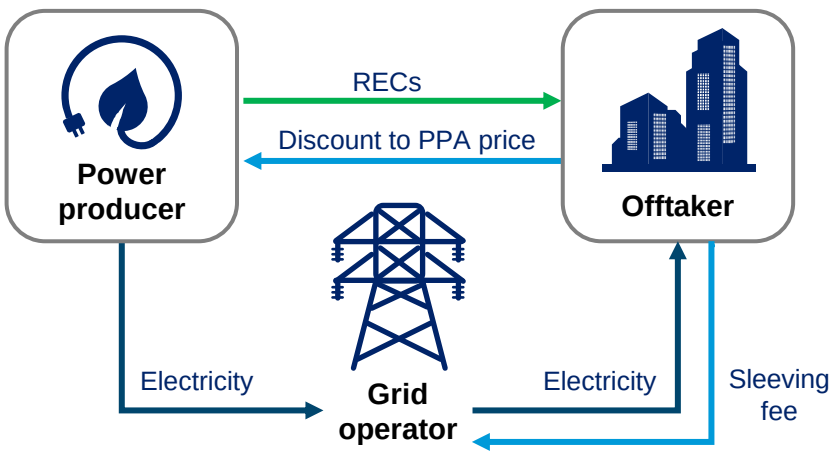


MFP Solar has entered into an on-site PPA with Proton. Commissioned 24 weeks ahead of schedule, this project boost a 12MW where electricity generated is supplied to Malaysia's first national car manufacturer Perusahaan Otomobil Nasional Sdn Bhd (Proton). The electricity is procured by Proton at a stipulated PPA tariff rate that provides revenue and cost certainty to both the power producer and demand offtaker respectively.

In developing ASEAN markets, landlords of facilities with large roof spaces (e.g. industrial parks), are benefitting from 'behind-the-wall' roof optimisation. This method spreads electricity load across tenants that have differing usage levels. By doing so, electricity cost is lowered, compared to utility cost, and the landlords are able to earn a portion of the spread.

Physical / sleeved PPA

Physical / sleeved PPA involves the notional delivery of electricity between the power producer and the corporate buyer, facilitated by the grid operator. Under this arrangement, the power generating asset and the corporate buyer have to be connected to the same grid transmission network with the grid operator "sleeving" a portion of the electricity to the corporate buyer's off-taking site.

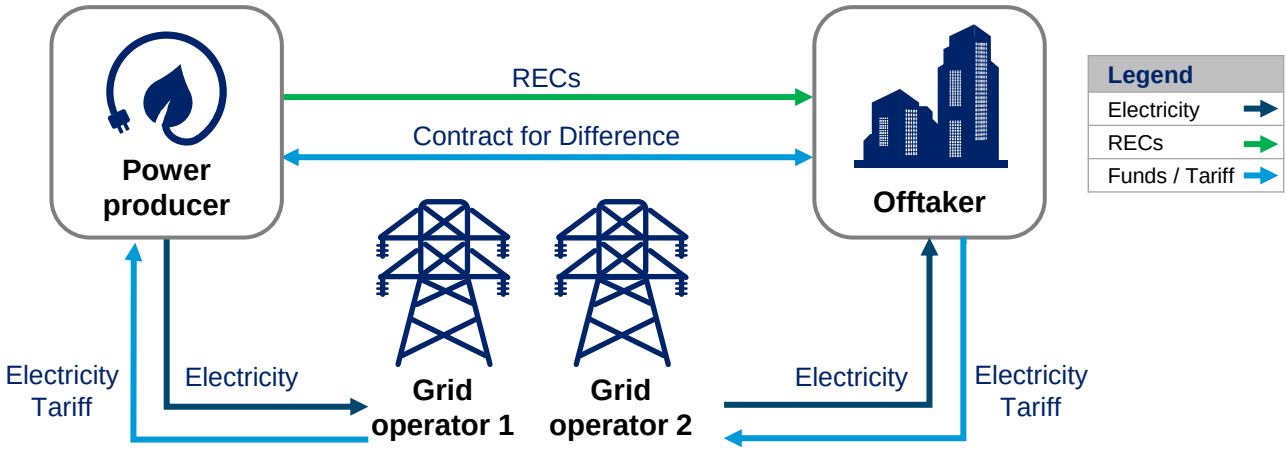


Generally, corporates prefer physical / sleeved PPA over virtual PPA in this region as accounting principles under IFRS generally requires corporates to create derivative accounts. An example of a physical / sleeved PPA is the **Melbourne Renewable Energy Project**. Back in 2017, the City of Melbourne aggregated the power purchasing demand of 14 offtakers (ranging from local governments, learning institutions to corporations) and engaged in a sleeved PPA with a newly built renewable energy facility. The success of the first phase inspired a second phase - with different offtakers and power producer which started operating July 2020.

Synthetic / virtual PPA

Synthetic / virtual PPA uses a financial derivative to facilitate the sale of electricity between the power producer and corporate buyer. Both parties agree to a strike price and market reference price with the difference being cash-settled. The corporate buyer would also procure the ownership of the renewable energy certificates generated by the power producer for renewable power generating assets.

A unique feature of this PPA is that both the buyer and producer do not need to be connected to the same electricity transmission grid or even in the same country. While this feature allows for cross-border PPAs to be inked, there is a general reluctance in uptake from RE100 companies in ASEAN. This is mainly due to the lack of a recognised accreditation body that is able to unequivocally certify the "greenness" of the procured electricity.



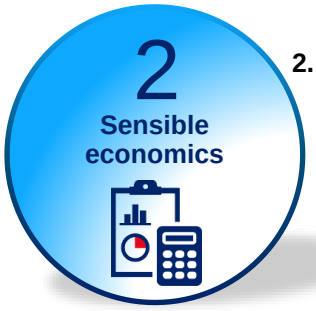
Facebook engages in a virtual PPA with Sunseap. Under this virtual PPA arrangement, Facebook buys renewable energy credits from the excess electricity generated from Sunseap's SolarNova4 projects. The excess electricity generated will also be utilised to support Facebook's operations in Singapore including their first custom-built data-centre in Asia[2]. In fact, the signing of this virtual PPA is the second PPA agreement reached between Sunseap Group and Facebook.

[2] https://www.sunseap.com/sg/news/2021/sunseap-and-facebook-sign-multi-year-agreement-for-solar-energy-from-singapores-largest-offshore-floating-project.html

Benefits of corporates entering into a PPA

Corporate buyers and power producers enter into a PPA arrangement with the intention of securing financing and to build new renewable generating assets. However, there are also other factors woven on top of this shared interest that should be mentioned:

1. **Greening of corporate operations.** A corporate renewable PPA can help buyers in reaching their sustainability targets. An increasing number of corporates have set sustainability targets through organisations such as RE100, or independently. Entering into a renewable PPA can help corporate buyers meet their sustainability commitment of using green energy to power their operations. Purchase of renewable energy is typically one of the lowest hanging fruits for a corporate's decarbonisation strategy.



2. **Sensible economics.** Both the corporate buyer and power producer have interest in ensuring that the economics for entering into a PPA is sensible when structured appropriately, normally at a prescribed discount rate to the retail electricity tariff. From the corporate buyer's perspective, this grants them visibility into future electricity prices. Whereas from the power producer's perspective, revenue certainty can be a pivotal in whether the project can be bankable or not.

3. **Focus on core business competencies to reduce resource wastage.** By transferring the risk of owning and operating power generating assets to the power producers, corporate buyers can refocus their attention to their core business competencies. This also allows power producers to exploit economies of scale and optimise for operational efficiency. Both these actions would optimise the allocation of resources thereby reducing wastage – a win-win situation for both buyer and seller.

However, a typical speed bump for corporate renewable energy procurement is the materiality of energy cost as a function of their business cost. This is especially true for corporates where energy cost is a necessary but not-yet material business cost. For these corporations, it is likely that they possess neither the technical nor financial expertise that allows them to pursue renewable energy or may develop bias in perceiving risk in the procurement of renewable energies. Oftentimes, these corporates would require external consultants which may layer additional cost and create un-sensible project economies when evaluating the project in totality.

Tailored Green Solutions for the Industry

UOB is committed to a sustainable future and has a framework aligned with the UN Sustainable Development Goals.

UOB recognises the importance of a sustainable future and is committed to driving the change for smarter cities. In order to support this initiative, we have introduced the UOB's Smart City Sustainable Finance Framework (UOB SCSFF), for green sustainability-linked loans, deposits and trade facilities. This framework revolves around 7 key areas which are deemed essential for smart cities to be effective and efficient.

Companies that are keen to embark on this journey and tap on opportunities available from the development of smart cities can contact us to see how UOB can simplify sustainable financing for you.

Conclusion

Falling solar installation prices. Solar cost has fallen 62% since 2015 and is projected to continue to decline another 16% by 2030 if current trend continues. The decrease in prices is primarily due to 3 factors (1) leveraging manufacturing economies of scale; (2) improvement in grid technology that allows for better integration of solar; and (3) lower cost of financing as risks are reduced with increased awareness around technology performance.

Solar expected to increase its contribution towards power generation. With falling levelised cost of electricity as well as wide range of deployment opportunities, solar is likely to be the preferred choice of renewable energy for powering remote areas and/or value-add towards under-utilised space by both corporates and policymakers.

As corporates execute their decarbonisation strategies, **renewable corporate power purchase agreements are likely to increase in demand.** Flexibility in execution of PPAs will enable corporates to rapidly procure renewable energy as they decarbonise their business operations to meet stakeholders demands for sustainability targets.

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