



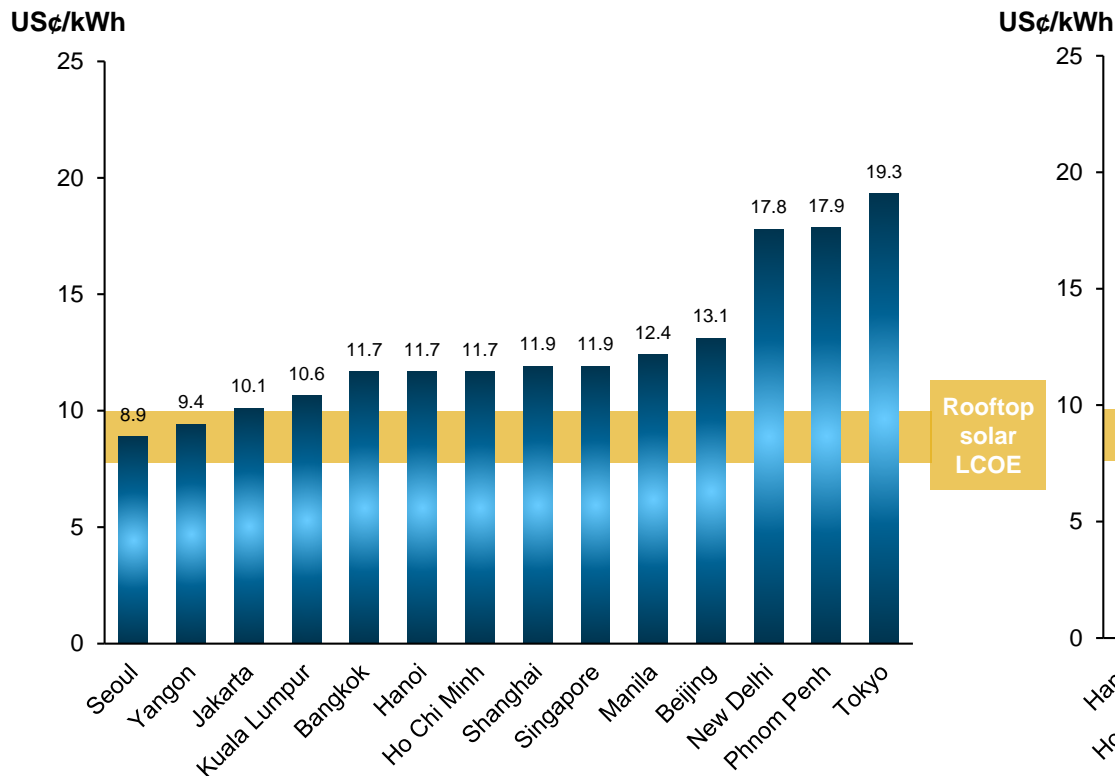
# Corporate PPAs in Southeast Asia: Opportunities & Challenges for C&I Solar

**Chris Starling, The Lantau Group**

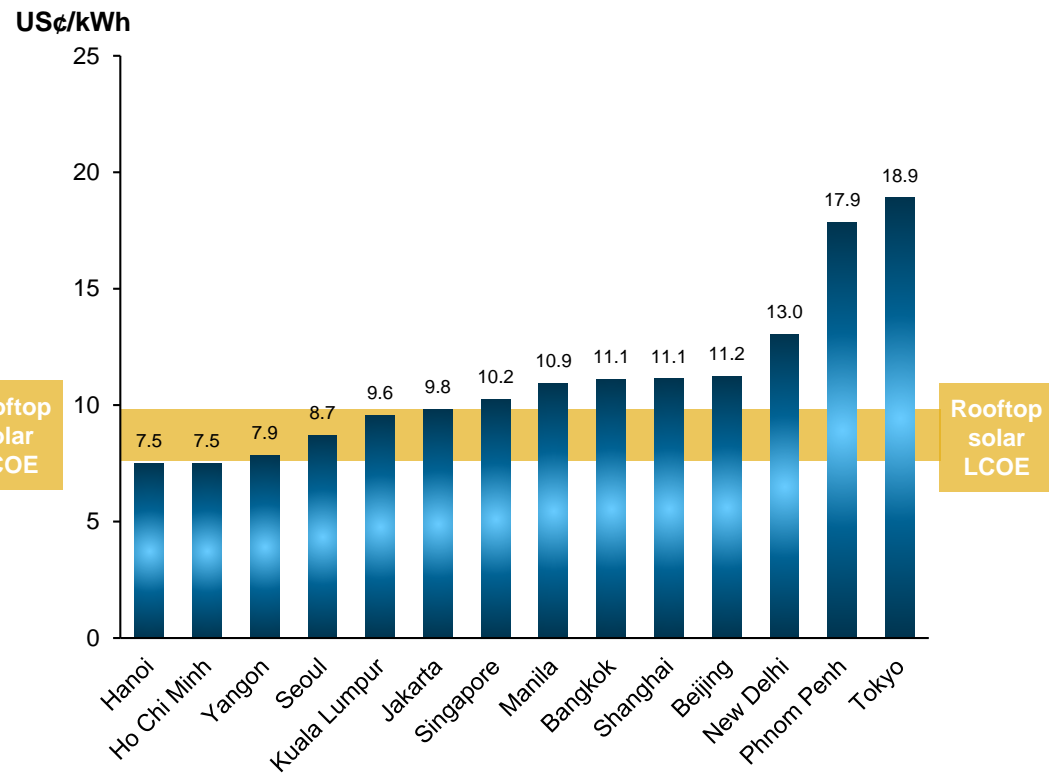
Presented at PowerGen Asia, 19<sup>th</sup> September 2018

Across Asia, rooftop solar is increasingly offering a competitive alternative to grid-tied supply – particularly for the commercial and industrial sectors

Typical Commercial end-user tariff (August 2018)

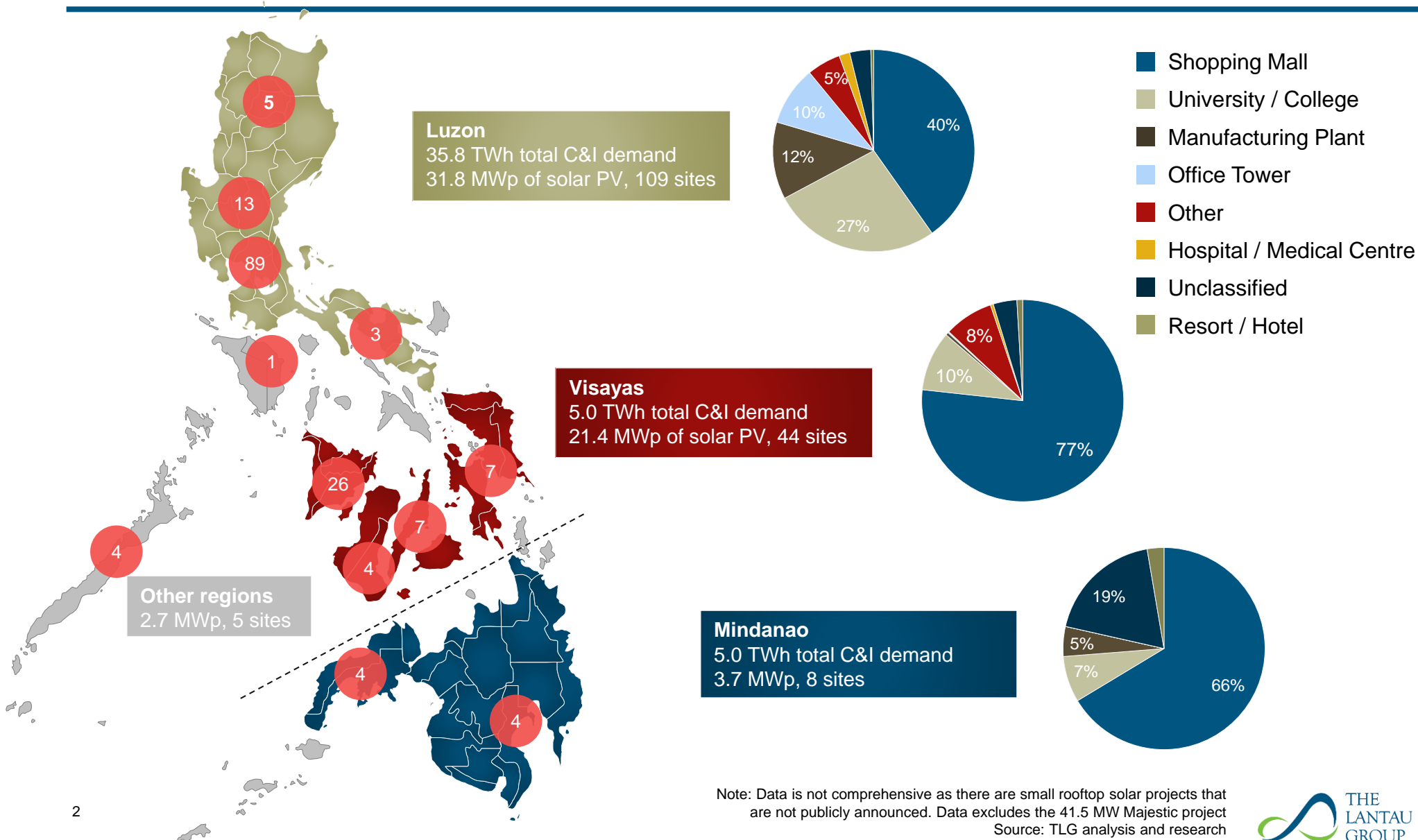


Typical Industrial end-user tariff (August 2018)



For end-users, solar PV adoption is guided by ‘socket parity’ rather than ‘grid parity’

The existing C&I solar market has grown hugely since 2016, with over half of installed capacity located in Luzon

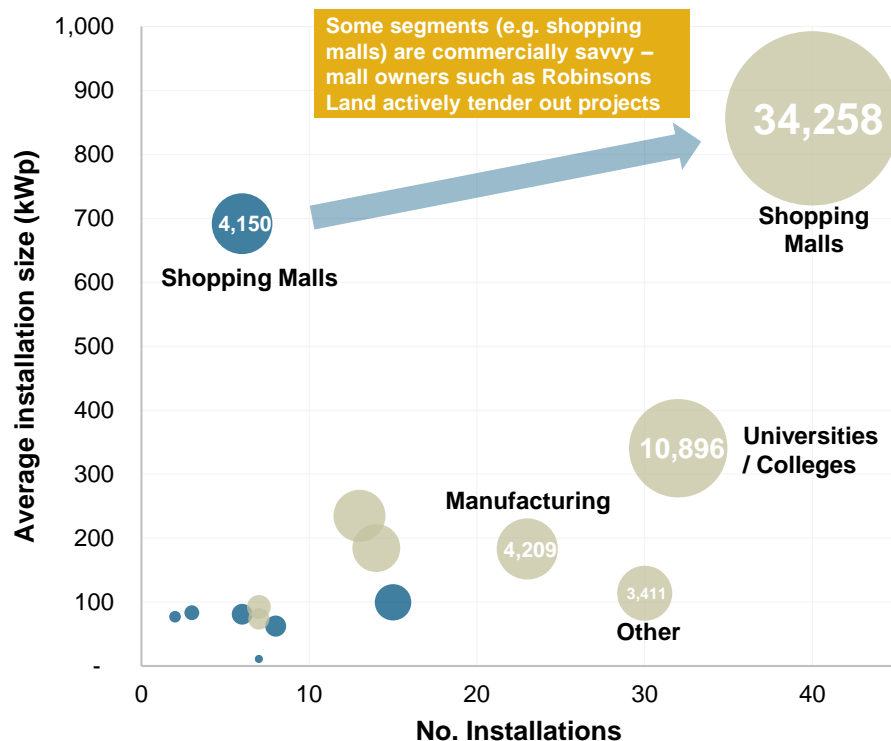




# Certain markets (and types of customer) are seeing rapid growth in market size

## Trend in C&I rooftop solar by segment

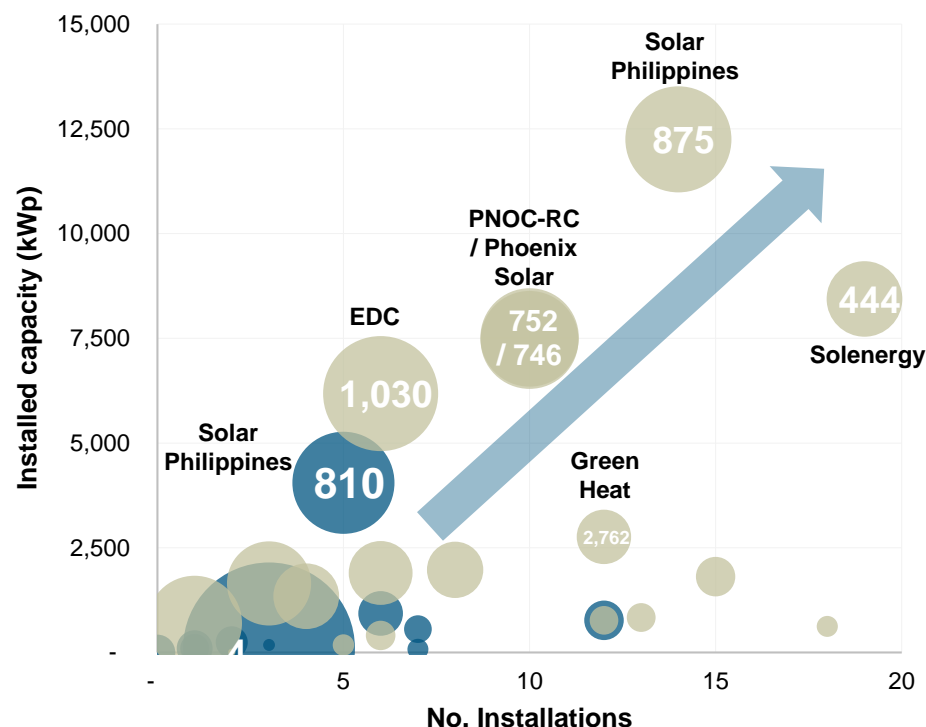
Size of bubble represents net capacity (Opex & Capex)



Growth in the overall C&I rooftop solar market has been led by the shopping mall segment, which accounts for a 58% share of total C&I capacity

## Trend in C&I rooftop solar by participant

size of bubble represents average project size



The four largest Opex players now account for 61% of the total C&I solar market

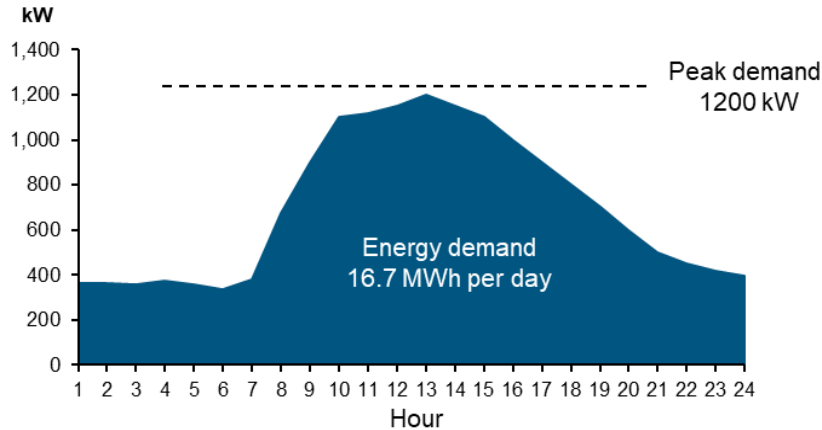
● as of Q1-16 ● as of Q1-18

# With few exceptions, economics is invariably driving rooftop solar uptake across Asia – four key factors drive the value of C&I solar

	Description	Factors that increase the value of solar PV
1 <b>Competing retail tariff and/or cost of on-site generation</b>	<ul style="list-style-type: none"> <li>Represents the cost of the existing / default option for potential customers</li> <li>Depends on location and tariff type (segment) of potential customers, as well as multiple extrinsic factors such as fuel prices</li> </ul>	<ul style="list-style-type: none"> <li>Higher retail tariffs</li> <li>Volumetric (per kWh) transmission &amp; distribution charges</li> <li>High and volatile fuel prices</li> </ul>
2 <b>Customer demand profile</b>	<ul style="list-style-type: none"> <li>Determines (i) the ability of solar PV to reduce peak demand charges (per kW), as well as (ii) the potential exports back to the grid of surplus generation</li> </ul>	<ul style="list-style-type: none"> <li>Strong alignment of load profile with solar generation</li> <li>Stable daily average load across the year</li> </ul>
3 <b>Policy and regulation</b>	<ul style="list-style-type: none"> <li>Influences the value of solar PV installations (e.g. subsidies), as well as the cost of competing options (e.g. through tariff design)</li> </ul>	<ul style="list-style-type: none"> <li>Tax credit/rebate/waiver on equipment costs</li> <li>FIT and net metering policies to monetise generation</li> </ul>
4 <b>Cost of solar installation</b>	<ul style="list-style-type: none"> <li>Determines the competitive position of solar PV</li> </ul>	<ul style="list-style-type: none"> <li>Lower overnight capital cost</li> <li>Lower financing cost</li> <li>Higher technical lifetime</li> </ul>

For end-users, the value of rooftop solar is principally derived from energy displacement and the reduction of demand charges

Very large commercial power user without rooftop solar

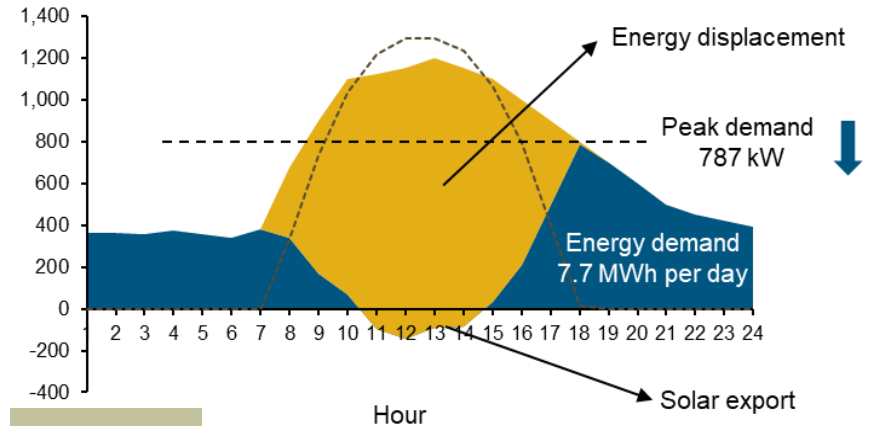


### Option 1

#### Cost of purchasing ALL electricity from the DU

- Energy charge (kWh): energy demand is 19.5 MWh per day
- Capacity charge (kW): based on peak demand of 1,200 kW

Very large commercial power user with 2 MWp rooftop solar



### Option 2

#### Cost of purchasing electricity from the DU with rooftop solar

- Cost of the rooftop solar system
- Electricity purchase from the DU:
  - Energy charge (kWh): energy demand is 7.7 MWh per day
  - Capacity charge (kW): based on peak demand of 787 kW

#### Value of the rooftop solar to the customer

- Energy displacement
- Peak demand reduction
- Solar export to grid (*remuneratory benefit varies*)

# Tariff structure extent to which end-users can use solar PV to avoid variable and fixed charges – is determined by tariff structure

Meralco monthly tariff table (December 2017)

	Generation	Transmission		Distribution		Supply charge		Metering charge		SL	UC-ME	UC-EC	UC-SCC	UC-SD
	per kWh	per kWh	per kW	per kWh	per kW	per kWh	per cust/mo	per kWh	per cust/mo	per kWh	per kWh	per kWh	per kWh	
GSA-200kWh	4.6045	0.7375	-	1.0012	-	0.5085	16.73	0.3377	5	0.4369	0.1561	0.0025	0.1938	0.0265
GSA-300kWh	4.6045	0.7375	-	1.3183	-	0.5085	16.73	0.3377	5	0.4369	0.1561	0.0025	0.1938	0.0265
GSA-400kWh	4.6045	0.7375	-	1.6175	-	0.5085	16.73	0.3377	5	0.4369	0.1561	0.0025	0.1938	0.0265
GSA-401kWh	4.6045	0.7375	-	2.1387	-	0.5085	16.73	0.3377	5	0.4369	0.1561	0.0025	0.1938	0.0265
GSB	4.6045	-	217.15	0.1368	237.15	-	371.48	-	362.34	0.4369	0.1561	0.0025	0.1938	0.0265
GP-Medium	4.6045	-	246.62	0.1368	237.15	-	845.17	-	849.44	0.4369	0.1561	0.0025	0.1938	0.0265
GP-Large	4.6045	-	246.62	0.1368	237.15	-	3,505.46	-	3,525.12	0.4369	0.1561	0.0025	0.1938	0.0265
GP-VLarge	4.6045	-	246.62	0.1368	237.15	-	12,726.30	-	12,075.11	0.4369	0.1561	0.0025	0.1938	0.0265
GP13.8kV-Medium	4.6045	-	270.85	0.0513	182.66	-	845.17	-	849.44	0.1846	0.1561	0.0025	0.1938	0.0265
GP13.8kV-Large	4.6045	-	270.85	0.0513	182.66	-	3,505.46	-	3,525.12	0.1846	0.1561	0.0025	0.1938	0.0265
GP13.8kV-VLarge	4.6045	-	270.85	0.0513	182.66	-	12,726.30	-	12,075.11	0.1846	0.1561	0.0025	0.1938	0.0265
GP34.5kV-Medium	4.6045	-	308.56	0.0513	182.66	-	845.17	-	849.44	0.1846	0.1561	0.0025	0.1938	0.0265
GP34.5kV-Large	4.6045	-	308.56	0.0513	182.66	-	3,505.46	-	3,525.12	0.1846	0.1561	0.0025	0.1938	0.0265
GP34.5kV-VLarge	4.6045	-	308.56	0.0513	182.66	-	12,726.30	-	12,075.11	0.1846	0.1561	0.0025	0.1938	0.0265
GP115kV-Large	4.6045	-	225.7	0.0513	143.32	-	3,505.46	-	3,525.12	0.0522	0.1561	0.0025	0.1938	0.0265
GP115kV-VLarge	4.6045	-	225.7	0.0513	143.32	-	12,726.30	-	12,075.11	0.0522	0.1561	0.0025	0.1938	0.0265
GHMSCI*	4.6045	0.8218	-	0.8667	-	-	278.59	-	278.46	0.4369	0.1561	0.0025	0.1938	0.0265

Residential  
T&D is per kWh

Commercial & Industrial  
T&D is per kW

All customer classes  
Generation is per kWh

T&D tariff design: Residential and GHMSCI are volumetric based; other users are mostly demand based

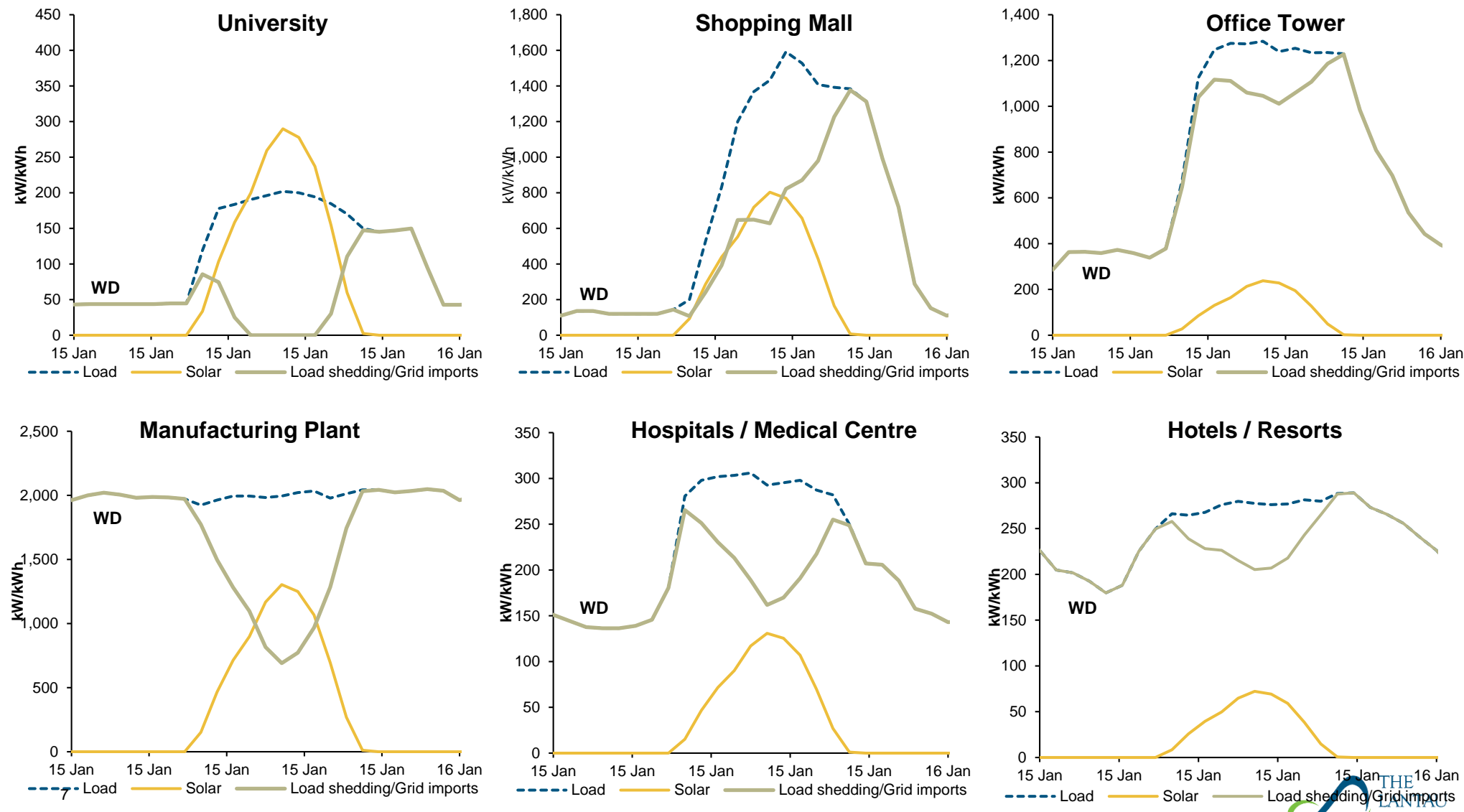
Volumetric base

Most of the T&D charges are fully variable on a kWh basis for residential, small commercial and public hospitals, but not for larger customers

^ GSA – General service A (demand < 5 kW); GSB – General service B (demand > 5 kW, < 40 kW); GP (General Power) – Medium (demand < 200 kW); GP – Large (demand < 750 kW); GP – VLarge (< 10,000 kW). Note: There are other charges or levies (including Feed-in Tariff Allowance charges (0.183/kWh) lifeline rate subsidy (0.0859/kWh), Senior citizen subsidy (0.0001/kWh), and various taxes (as of Dec-17: Gen – 11.49%, Trans – 0.58%, System loss (SL) – 9.99%, UC – 0%, others – 12%). \* GHMSCI = Government Hospitals, Metered Street Lighting and Charitable Institutions

# 'Volume savings and peak shavings'

... alignment of solar's diurnal generation with end-user's load profile matters



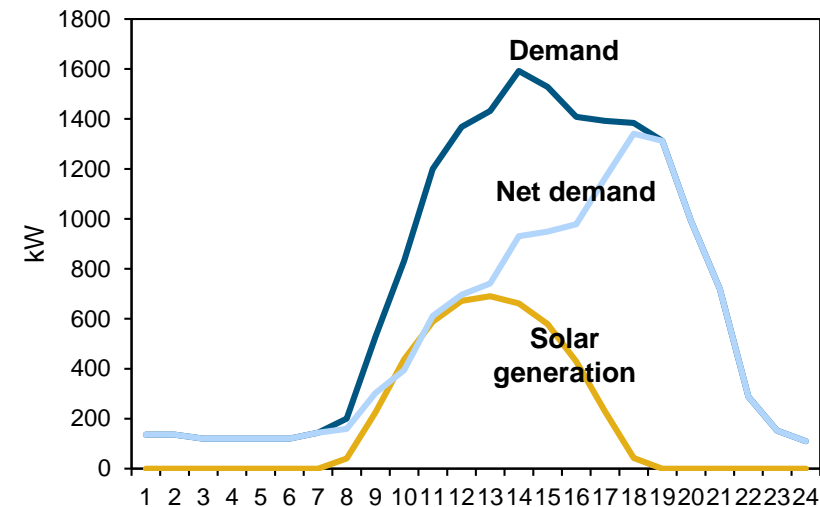


# LCOE analysis assumptions for shopping malls

Illustrative

Parameter	Value
Facility type	Shopping mall
Facility peak demand (kW)	1,592
Solar capex (USD/kW)	850
Solar opex (USD/kW/year)	8.5
Lifetime (years)	25
Solar capacity factor (%)	13.7%
Installable solar capacity (kW)	1,056
WACC (%)	9.64%
Cost of Equity (%)	12.07%

Average demand and solar generation



## Tariff class and related information

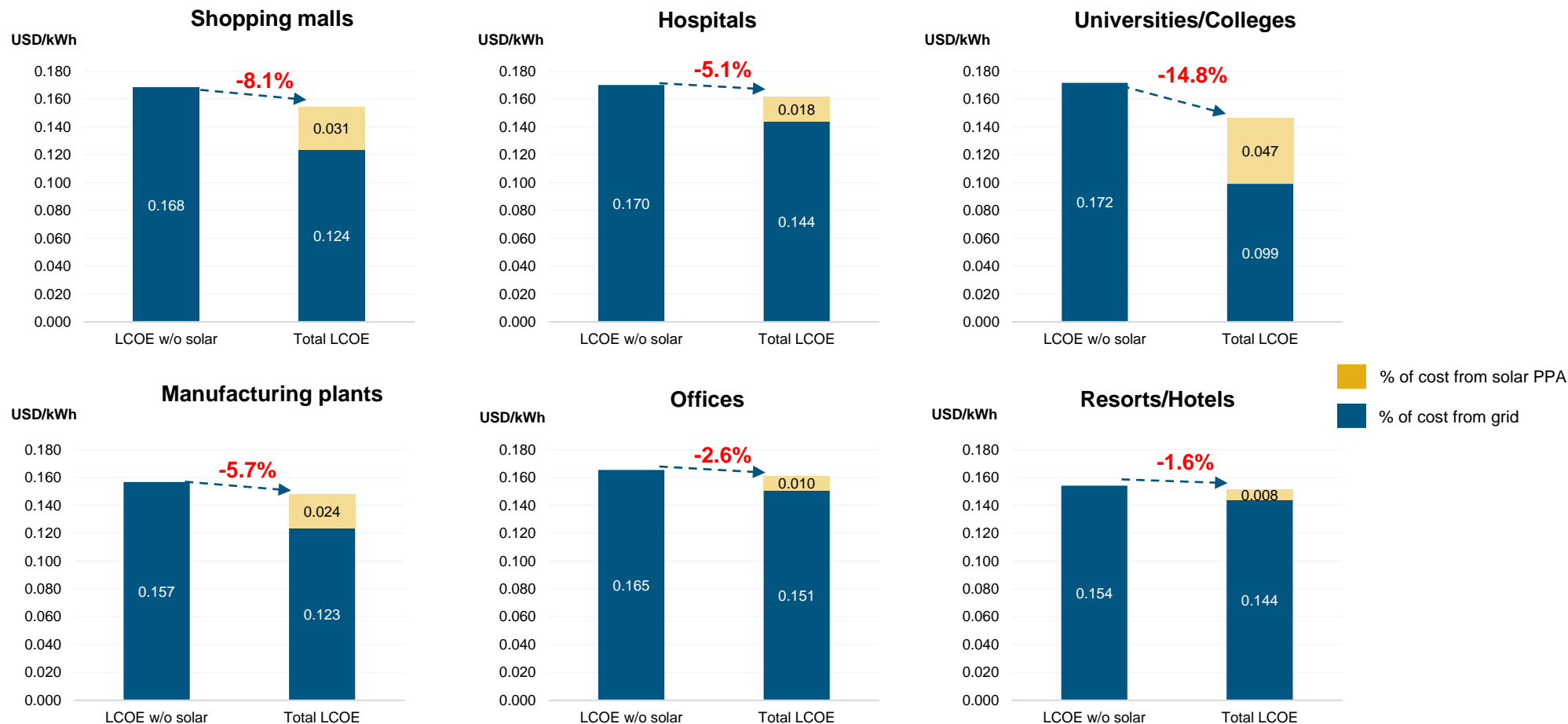
Tariff	Generation	Transmission		Distribution		Supply charge		Metering charge		SL	UC-ME	UC-EC	UC-SCC	UC-SD
	per kWh	per kWh	per kW	per kWh	per kW	per kWh	per cust/mo	per kWh	per cust/mo	per kWh	per kWh	per kWh	per kWh	
GP-VLarge	5.024	-	246.62	0.1368	237.15	-	12,726.30	-	12,075.11	0.4369	0.1561	0.0025	0.1938	0.0265

## Comments

- Demand profile is based on data of shopping malls from the Philippines.
- The peakiness of the load profile of shopping malls during the day time aligns well with solar generation (both weekday and weekend), though it clearly is not suitable during the evening peak hours (until about 8 or 9pm).

Note: the LCOE analysis has been undertaken using the WACC. Generation charge increased to account for higher tariffs of DUs and ECs seen across the Philippines

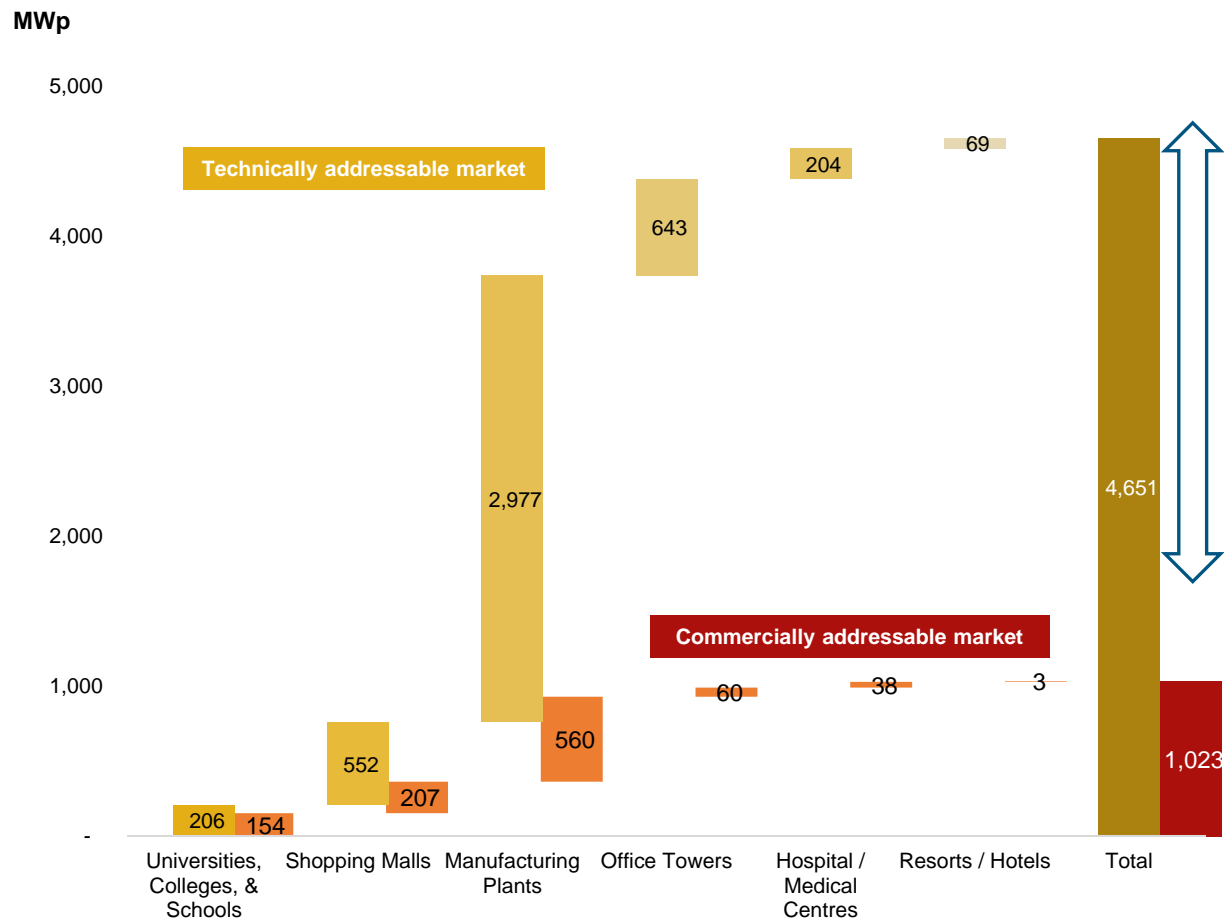
Universities/colleges, shopping malls, and manufacturing plants typically see the greatest benefit from installing rooftop solar



In the near-term, growth in the C&I market is likely to continue to be, by triangulating segments that have (i) high energy usage and (ii) 'peakier' daytime loads that increase the propensity to avoid fixed charges, and which are (iii) situated in geographic locales where DU and EC tariffs are particularly high, such as the Visayas

# How do you translate favourable economics into commercially addressable opportunities in the market?

## Addressable size of total C&I rooftop solar market in the Philippines<sup>^</sup>



- In the Philippines, we conservatively estimate the addressable size of the C&I rooftop solar market to be in the region of 1 GWp, but with significant variation across C&I segments.
- Shopping malls and universities / colleges are segments of the C&I market where a generally higher proportion of the technical market size is commercially addressable.

• Note that, owing to the structural integrity of roofs, developers we engaged with in the Philippines cited a figure of 10-15% of identified opportunities stalling due to the quality of roofs

In theory, firms can access the market through a number of business models - each determines how risks are allocated between parties

		1 Consumer-owned	2 Solar leasing	3 Corporate PPA
		<i>Owner uses electricity from owned system</i>	<i>Fixed monthly payment</i>	<i>Linked to solar production with unit charge per kWh</i>
Customers	Pay	Upfront cost for the system	Fixed monthly payment	Electricity cost / rate (fixed or variable or linked to competing offers)
	Receive	Solar power with no additional payment	Solar power at a fixed payment	Solar power at a an electricity rate
Sellers	Pay	-	Panel	Panel
	Receive	-	Fixed payments	Variable payments (depending on rate agreed and production)
Who owns the panel?		Consumer	Varied	Varied
Who gets the right of surplus solar power?		Consumer	Varied	Varied
		<div> <div>‘Capex model’</div> <div>‘Opex models’</div> </div>		

Let's focus a bit more on corporate PPAs in the Asian context...

PPA models also provide flexibility for sellers to use different kinds of contractual pricing (i.e. indexation) to cater to the need of different customer segments

	Type of power purchase agreement (PPA)				
	DU-linked	Fuel-linked	WESM linked	Fixed/kWh	Declining
<b>Precedents / competitor focuses</b>	Solar Philippines, GreenHeat	RE developers for geothermal and wind projects	Developer with a portfolio of renewables	Developer with a portfolio of renewables	Utility-scale solar developer
<b>Key advantages for Seller</b>	Easy to sell <i>(simple proposition)</i>	Competitive with key competing fuels such as coal and gas <i>(inter-fuel competition)</i>	Remain competitive with market	Known per kWh income	Remain competitive if panel price drop <i>(intra-solar competition)</i>
<b>Key risks to Seller</b> <i>(such as market risks and competitiveness)</i>	No control over DU tariff <i>(expected to decline in the near- and medium-term)</i>	Price volatility	<ul style="list-style-type: none"> <li>Price volatility inherent in WESM <i>(expected to decline considerably)</i></li> <li>More difficult to explain/sell to customers</li> </ul>	<ul style="list-style-type: none"> <li>FX risk <i>(if not fully US\$ linked)</i></li> <li>Outcompeted <i>(newer solar &amp; other options)</i></li> </ul>	<ul style="list-style-type: none"> <li>Headline price shock of initial tariff</li> </ul>
<b>Targeted customer groups</b>	Moderately sized non-sophisticated customers <i>(such as schools / universities / hospitals and even shopping malls)</i>	Large sophisticated customers <i>(such as shopping malls)</i>	Very large directly connected* sophisticated customers <i>(large shopping malls / industrial etc)</i>	Customers adverse to fuel & other price risks <i>(such as schools / universities / hospitals)</i>	Customers who worry about solar panel getting cheaper <i>(such as some DUs)</i>

The PPA model benefits from flexibility of pricing design similar to a power retail contract to attract customers, making it more attractive than the fixed leasing model to both sellers and customers



# As a result, the competitive landscape is shifting

## Rooftop FIT Players (own/operate)



Majestic Energy Corp.

1.5  
MWp

41.3  
MWp

## EPC



## Solar leasing



## Sample existing Solar PPA customers

*Local connections and project referrals are a key driver of business development*







## Existing competition (solar PPA providers)



## Competition from potential future providers of PPAs








# The extent to which different rooftop business models are allowed across Asian markets varies considerably (1 of 2)

	Consumer-owned	Solar leasing	Corporate PPA	Solar + Retail	Net Metering
	Owner uses electricity from owned system	Fixed monthly payment	Linked to solar production with unit charge per kWh	Bundle solar production with retail contract to serve customers' need	Ability to monetise surplus solar generation
 Philippines	Yes	Yes <i>Orix Metro, OrionGroup</i>	> 500kW by end-2018 <i>Solar Philippines; EDC; GreenHeat</i>	Emerging <i>Not yet being used in the Philippines</i>	Yes <i>&lt;=100kW (remunerated as credit on electricity bill)</i>
 Thailand	Yes	Yes <i>e.g. SPCG</i>	Yes <i>Cleantech Solar, Constant Energy, and Impact Solar with Big C Supercenter</i>	Not permitted	Pending approval <i>Purchase rate is likely to be at THB 2.6/kWh or less</i>
 Malaysia	Yes	Yes <i>e.g. Plus Solar, Helios, REC, Sun Power</i>	Not permitted	Not permitted	Yes <i>75% of the end user's peak demand</i>
 Indonesia	Yes	Only domestic firms	Partly permitted <i>Outside of PLN franchise (e.g. Cikarang)</i>	Not permitted	Residential only <i>30kW limit</i>

The 'corporate PPA Model' is emerging but is still limited by the idiosyncrasies and regulatory context within each Asian market

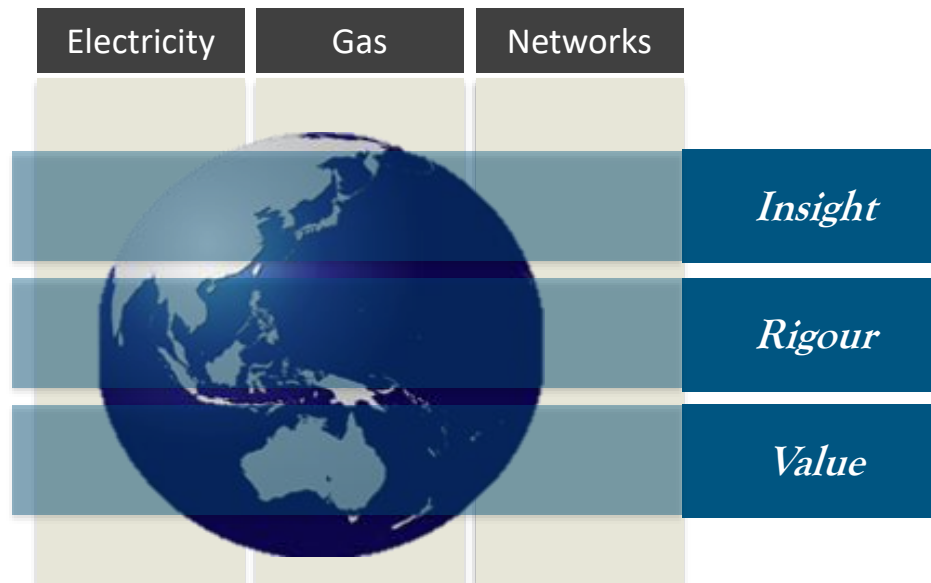
# The extent to which different rooftop business models are allowed across Asian markets varies considerably (2 of 2)

	Consumer-owned <i>Owner uses electricity from owned system</i>	Solar leasing <i>Fixed monthly payment</i>	Corporate PPA <i>Linked to solar production with unit charge per kWh</i>	Solar + Retail <i>Bundle solar production with retail contract to serve customers' need</i>	Net Metering <i>Ability to monetise surplus solar generation</i>
 Vietnam	Yes	Potentially <i>Under discussion</i>	Potentially by end-2018 <i>Being evaluated by ERA</i>	Not permitted	Yes <i>Paid at same rate as the FIT (adjusted for forex)</i>
 Cambodia	Yes	Yes <i>Kamworks</i>	Yes <i>Cleantech Solar</i>	Not permitted	Potentially <i>Regulations appear to be open to net metering</i>
 China	Yes	Yes <i>GCL and CHINT</i>	Yes <i>Via Energy Performance Contracting scheme (e.g. GCL)</i>	Potentially <i>After distributed energy trading scheme is officially launched</i>	Yes <i>&lt;=6MW</i>
 Japan	Yes	Yes <i>DMM Solar, SB Energy Corp, Ecosystem Japan Co, Aqura Home Co,</i>	Yes	Partly permitted <i>Retail contract with renewable energy is allowed</i>	Phased out
 Singapore	Yes	Yes <i>Solareo, Helios, Sun Electric</i>	Yes <i>Sunleap and Microsoft</i>	Yes	Yes <i>Cap is not specified</i>

The 'corporate PPA Model' is emerging but is still limited by the idiosyncrasies and regulatory context within each Asian market

# Thank you

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