



Southeast Asian Solar: Market Outlook and Policy Overview

Stefan Robertsson

31 August 2017



Our name signals our business focus in the Asia Pacific region

Lantau Peak, on Lantau Island in Hong Kong, is also known as Chinese Phoenix Mountain, aptly reflecting the importance of renewal and reinvention to meet new challenges

Introduction to The Lantau Group

31st August 2017

The Lantau Group – Who we are

Energy Economics and Markets

Competition, Markets, Regulation, Policy

Decision Support Analyses

Disputes

Market Analysis

Asset Valuation

Strategy and Advanced Analytics

Offerings:

- Strategic, commercial, and regulatory support
- Ability to connect fuel markets and power
- Analysis-based recommendations
- Highly relevant international experience
- Accessible experts focussed on the region
- Pricing, trends, drivers, risks

Asia Pacific Markets



★ Staff

★ Affiliates

Washington DC

The analysis of power meets the power of analysis

A diverse range of assignments and expertise

Over 200 assignments in last four years

Various advisory mandates to EMA in Singapore (incl. vesting contracts & market power, and fuel mix policy)

Acting as expert witness in legal/contract disputes, including Malaysia PPAs and China (Chongqin) gas contract

Market advisor and modelling to winning bidder for the acquisition of the Edras IPP Portfolio in Malaysia

Developed new load forecasting methodology and mode for large utility in ASEAN

Cost of service and tariff design, and incentive-based regulation in Malaysia

New transmission tariff design and regulations in Vietnam

Gas and LNG market studies in Philippines, Indonesia, and Vietnam

Regional gas switching (power and non-power) study for Asia and MENA

Fuel switching study for gas demand (power and non-power) in Asia and ME

Development of region-wise market model for India wholesale electricity market

Market modeling and market analysis for future VWEM electricity pool market in Vietnam

Market entry strategy in Japanese solar market for international solar power company

Assessment of gas-fired CHP opportunities in Guangdong

Several gas-to-power assessment and market reports local markets/counties in SE Asia for local investors and stakeholders, and international O&G companies)15

Avoided cost analysis and forecast in Vietnam

Alternative fuel use in Mongolia

Several curtailment studies for wind and solar projects in different provinces in China

Transmission system analysis in China

Three market reports for provincial / regional small hydro sector for international IPP and RE investors

Coal-fired power generation and carbon policy in Zhejiang

Strategic assessment of electricity retail and offtake opportunities in Guangxi Province

Modeling and analysis of mini-grid power supply based on solar/wind and energy storage for mining areas in NW Australia

Workshop for international bank for Philippine WESM market and power industry regulations

Regional electricity market report for lenders to greenfield IPP project in Indonesia

Economic analysis for solar-wind Storage –LNG (small scale) applications in Sri Lankan power market

Strategic assessment of electricity retail and contracting opportunities in Guangxi Province China

Valuation and market position of operating IPP projects with PPAs expiring in near/medium term in Taiwan and Malaysia

Small modular nuclear reactors study for three Asian markets

Several solar power market studies for e.g. IFC and PE investor

A broad range of clients



Oil & Gas Companies



Large Users



THE Brattle GROUP



Morgan Stanley



International Aid Agencies



Leading Utilities



Financial Institutions



Market and System Operators



Government Ministries



Regulatory Agencies



Independent Power Producers



HALLIBURTON

Key Messages

- 2016 was a great year for solar power globally – Asia Pac led the world
- But SE Asia was lagging the rest of the world – and 2017 is starting off even weaker
- Despite the excellent fundamentals in SE Asia:
 - Inadequate regulatory framework and policy support in SE Asia
 - Support for solar and renewables are often weak, designed poorly, or keep changing
 - It is not just about the FiT. General industry regulation (and lack of deregulation) often frustrates progress .
- Short term: Exuberance over solar ➤ Action and MW
- Long term: Fundamentals will prevail, and commercial drivers will dominate
- When the solar worm turns, it may do so quickly. But timing is hard to forecast
 - Regulations
 - Commercial drivers
 - And market situation

Overview

1 2016 global solar power snapshot

2 Solar power in SE Asia – The numbers

3 Impact of regulations

4 Fundamentals will drive growth

China lead the world - Four countries in Asia Pac among top eight

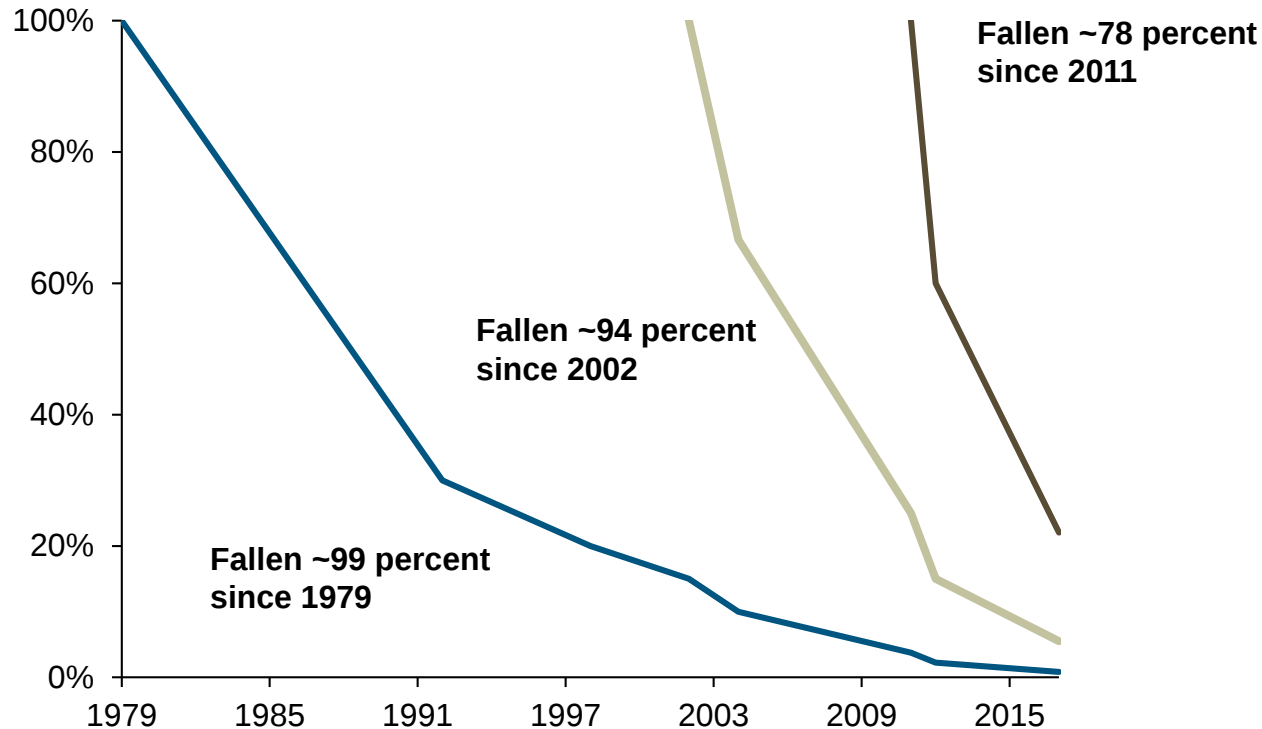
Annual installed capacity for selective countries in 2016				Cumulative installed capacity for selective countries in 2016			
1		China	34.5 GW	1		China	78.1 GW
2		USA	14.7 GW	2		Japan	42.8 GW
3		Japan	8.6 GW	3		Germany	41.2 GW
4		India	4 GW	4		USA	40.3 GW
5		UK	2 GW	5		Italy	19.3 GW
6		Germany	1.5 GW	6		UK	11.6 GW
7		Korea	0.9 GW	7		India	9 GW
8		Australia	0.8GW	8		France	7.1 GW

Source: IEA

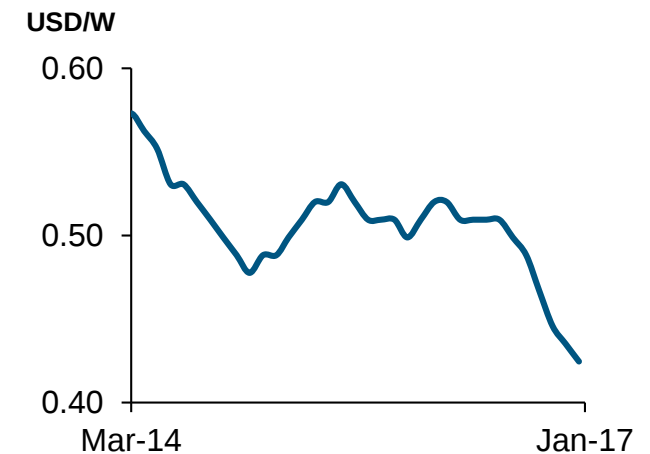
In 2017 China has accelerated, and India has had several record low tariffs

Continued reductions in solar PV module costs are driving solar closer to that ever-elusive goal of “grid parity”

Indexed PV Module Prices 1979-2016

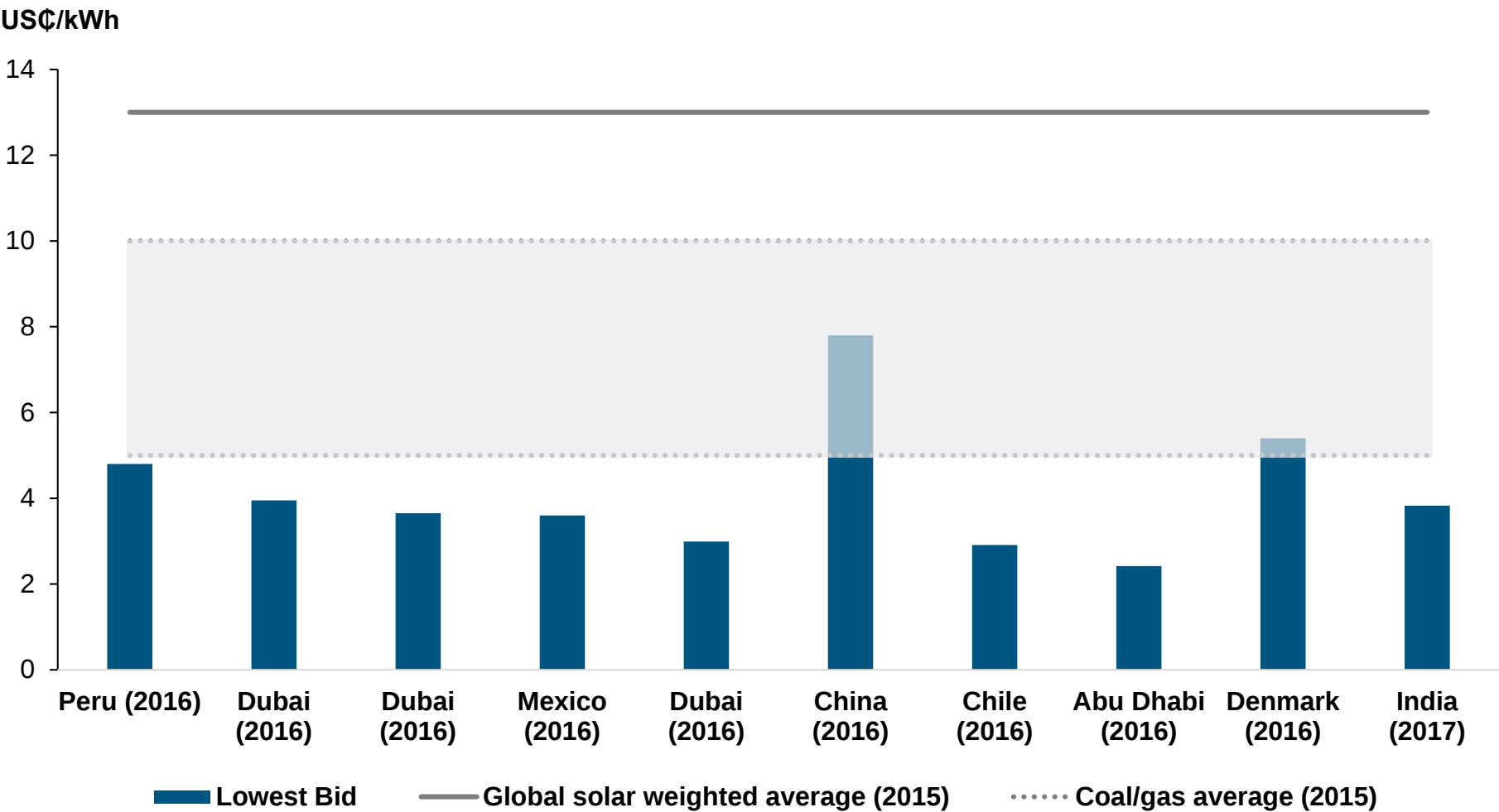


PV Module Prices (USD/W)

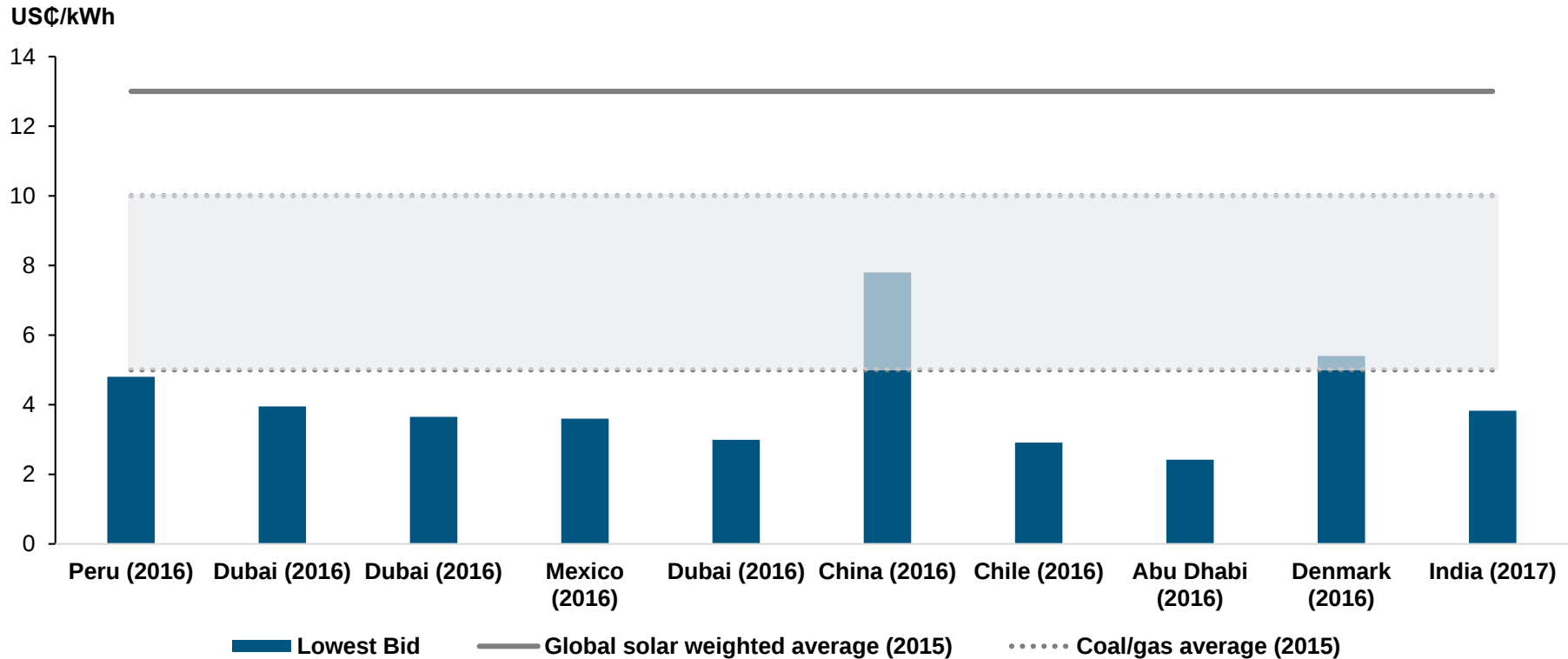


Cost reductions from 2000-2014 averaged about 20 percent annually, but slowed to 10 percent since 2014

Auctions are increasingly displacing FiT regimes – and recent auctions have yielded bids that appear to undercut traditional thermal resources



2016 was solar par[i]ty time!



Falling module costs



Competitive auctions for new capacity



Large amounts of solar panels and solar MW

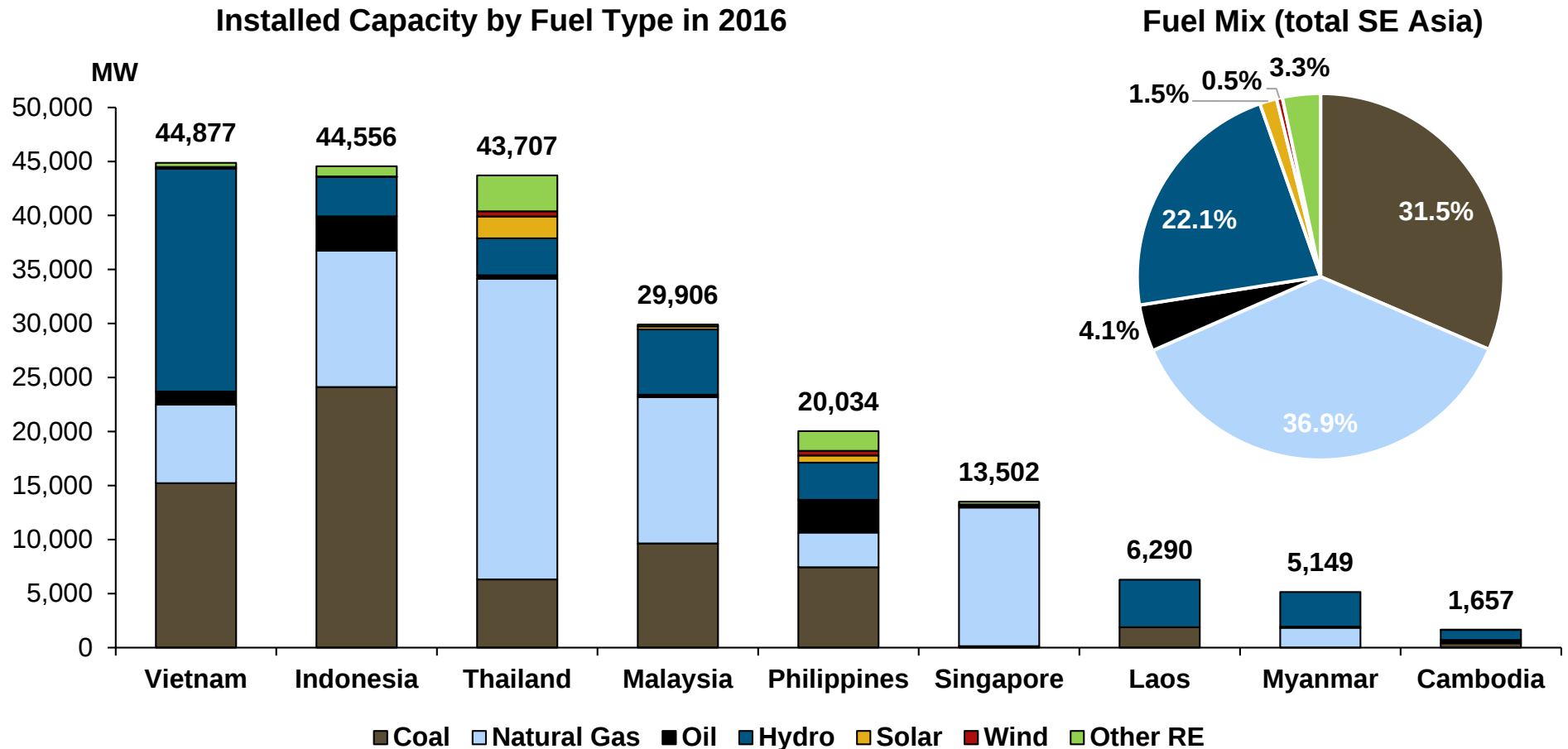


Solar tariffs < 3 US\$/kWh

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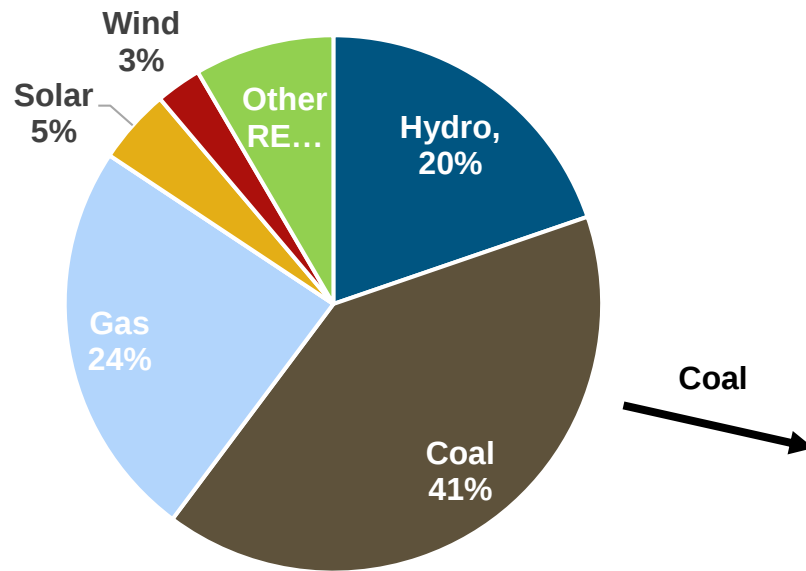
SE Asia generation mix – Overall diversified but differences between countries



Solar power accounts for around 1.5% of total generation capacity in 2016

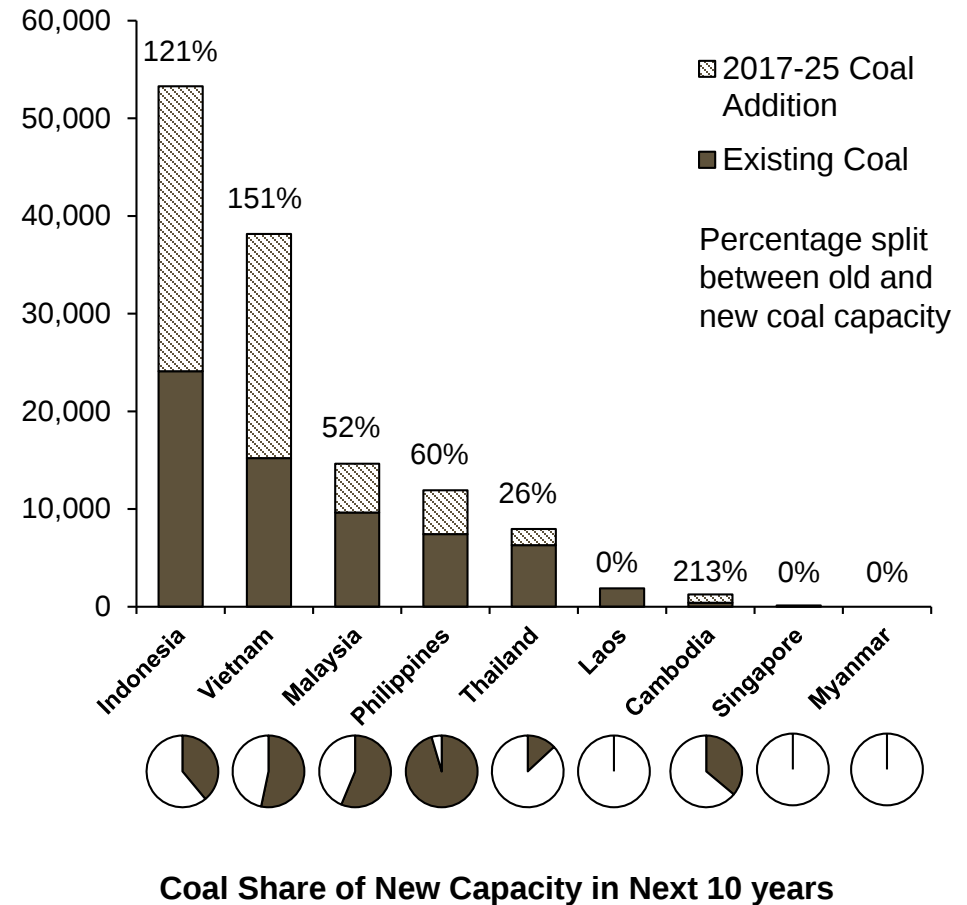
Official Power development plans suggest a decade of coal coming up

SE Asia Total Capacity Addition 2017-25



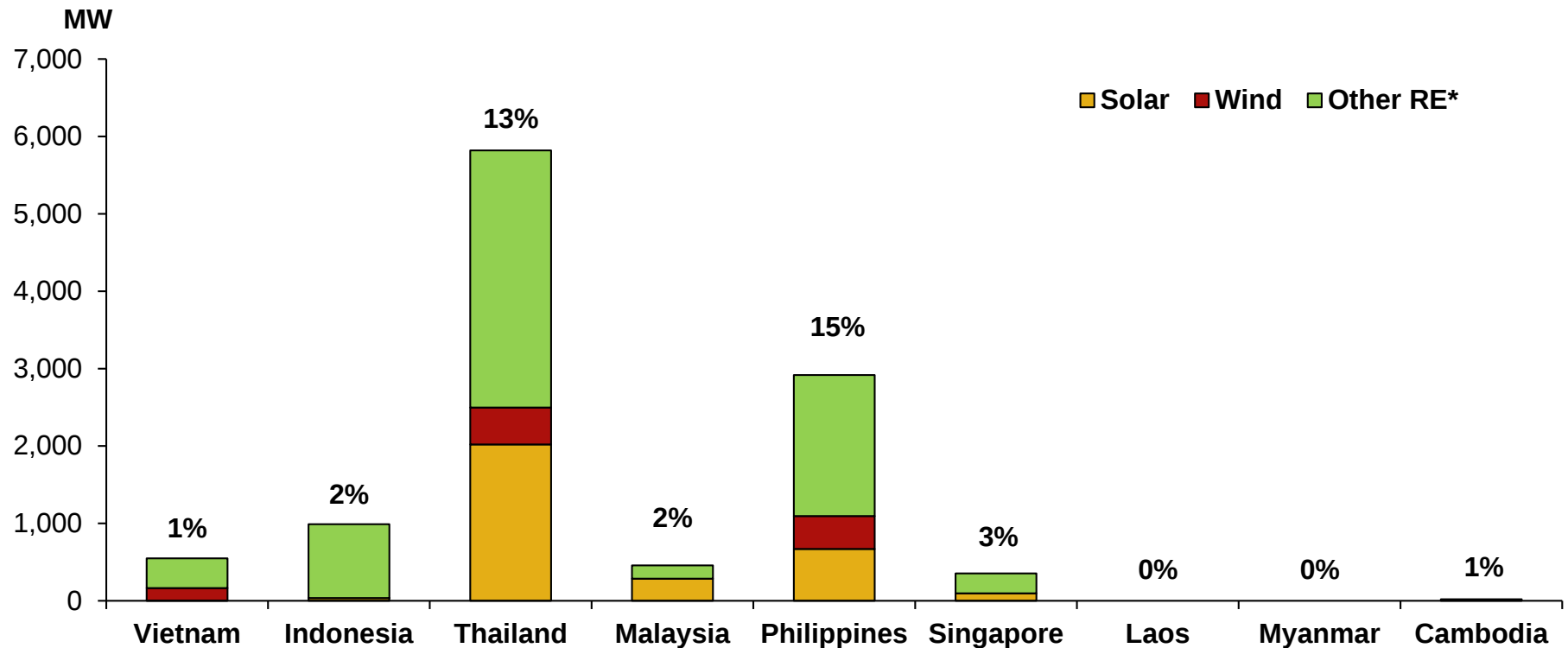
Despite relatively favorable economics for solar, the coming decade looks pretty much like “business as usual”

SE Asia Coal Existing and Capacity Additions 2017-25



In terms of SE Asia installed capacity, biomass leads solar and wind combined

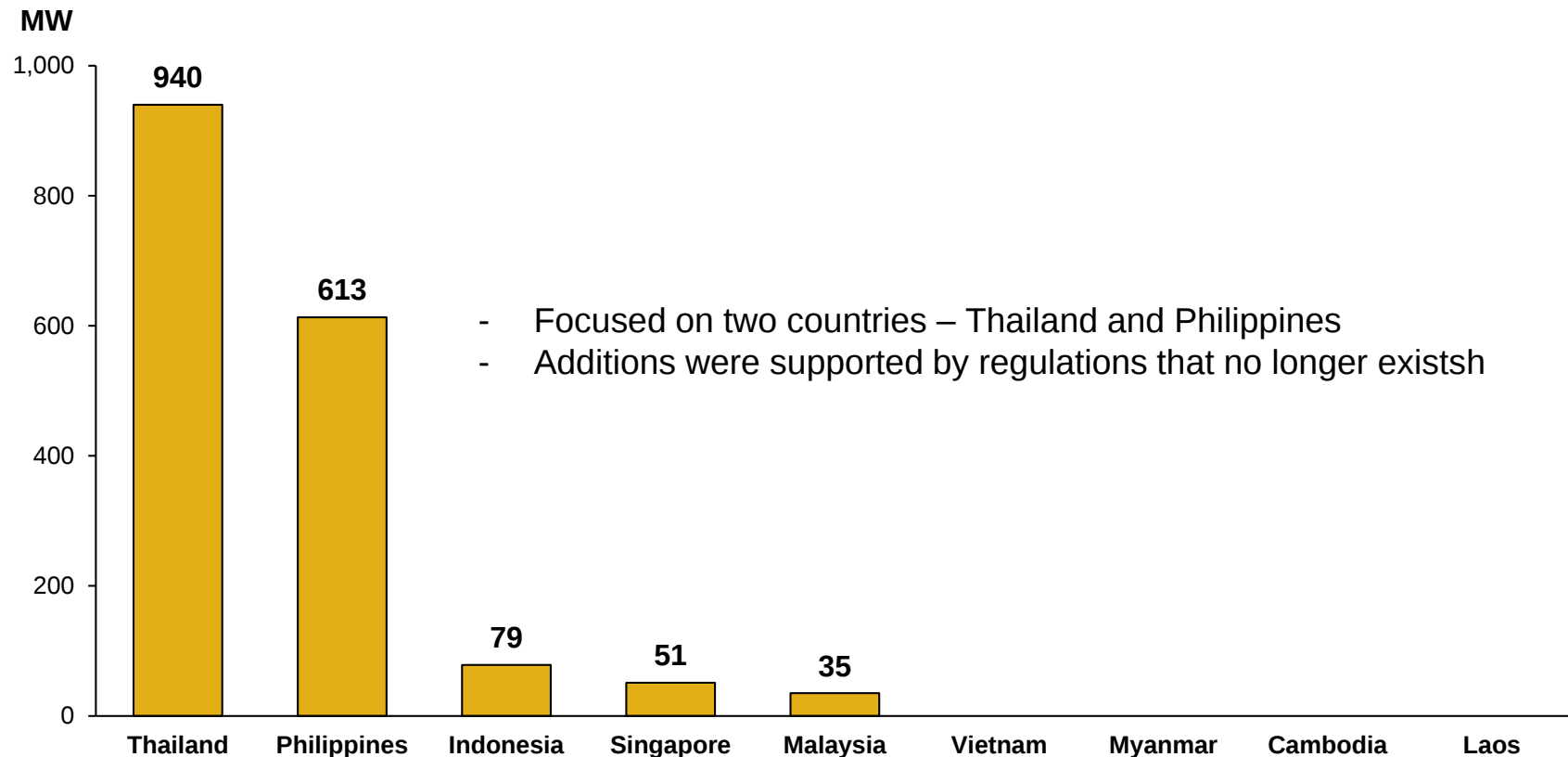
RE Installed Capacity (excl. hydro) in 2016 (percentage relative to total installed capacity)



Excepting Thailand and the Philippines, solar and wind capacity comprise less than one percent of the total generation capacity in SE Asia

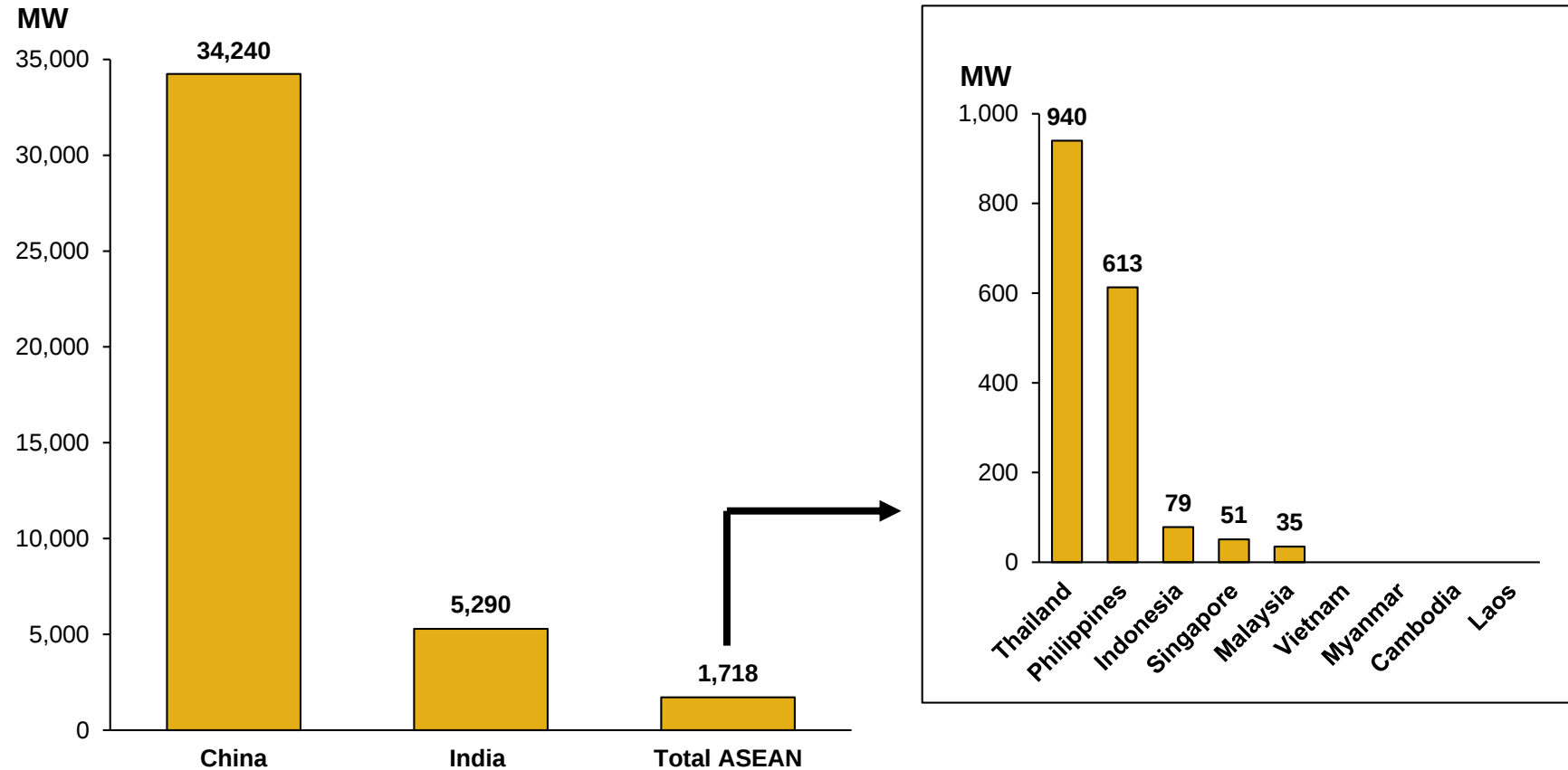
About 1.7 GW of solar power was built in SE Asia in 2016

Solar Capacity Additions in 2016



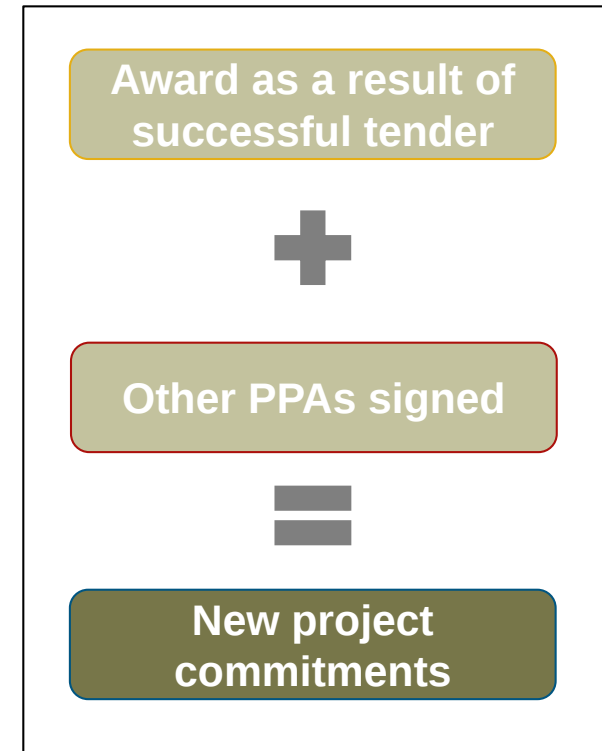
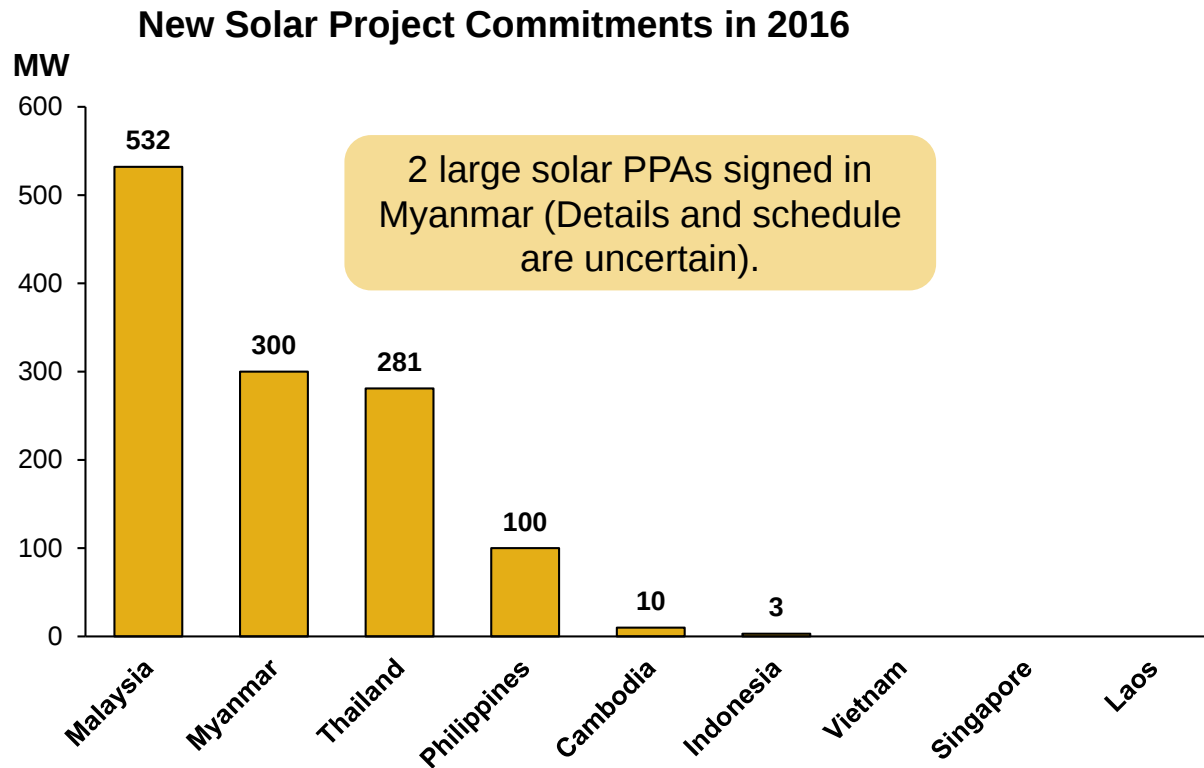
How impressive was 1.7 GW?

1.7 GW of new solar additions in SE Asia pale relative to China and India



In China and India policy and regulations supporting 2016 capacity additions remain
(China additions in 2017 is already at 34 GW for first 7 months)

New solar project commitments slowed in 2016 - just 1.2 GW

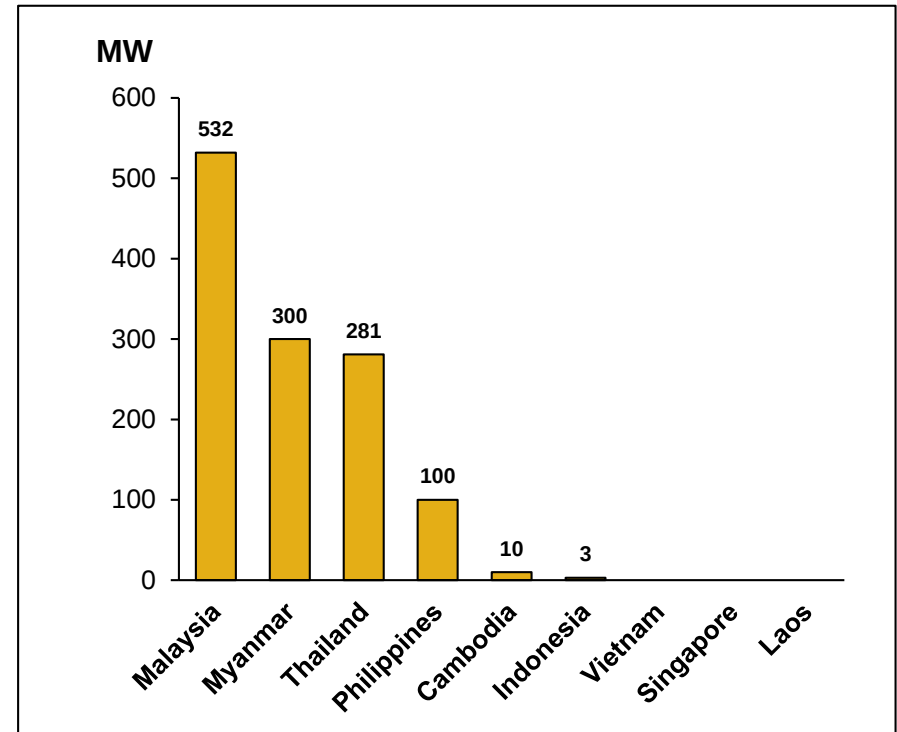
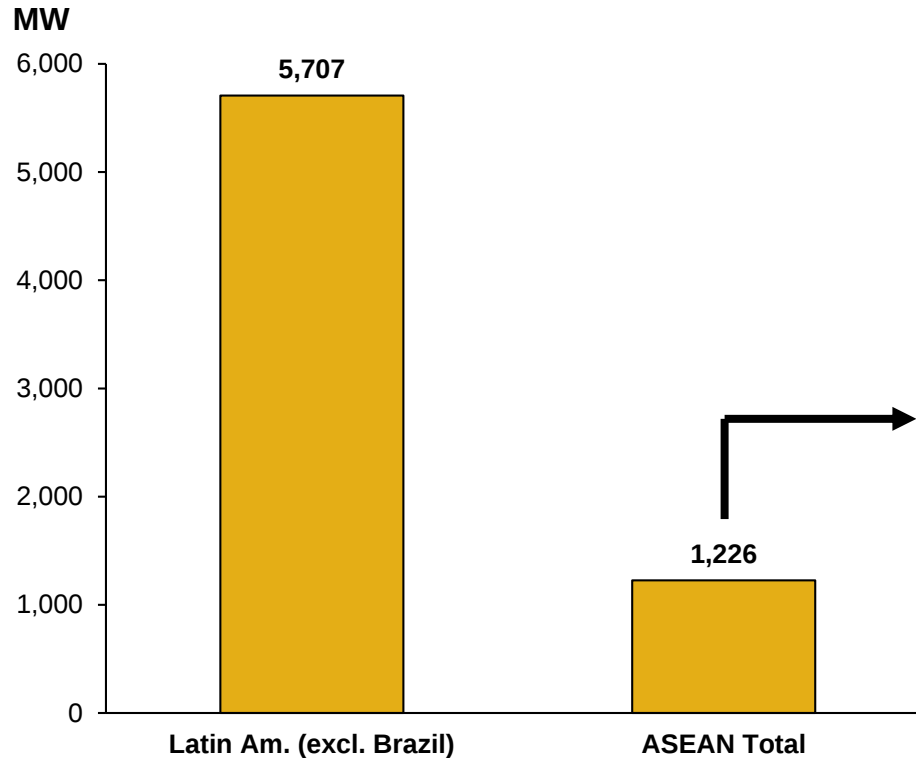


Source: TLG Research

New commitments < New additions → Shrinking solar pipeline

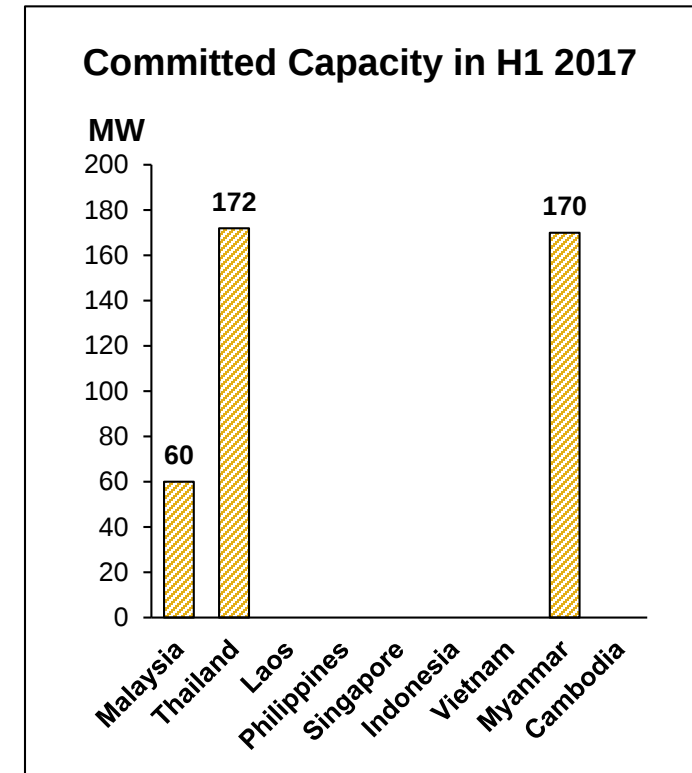
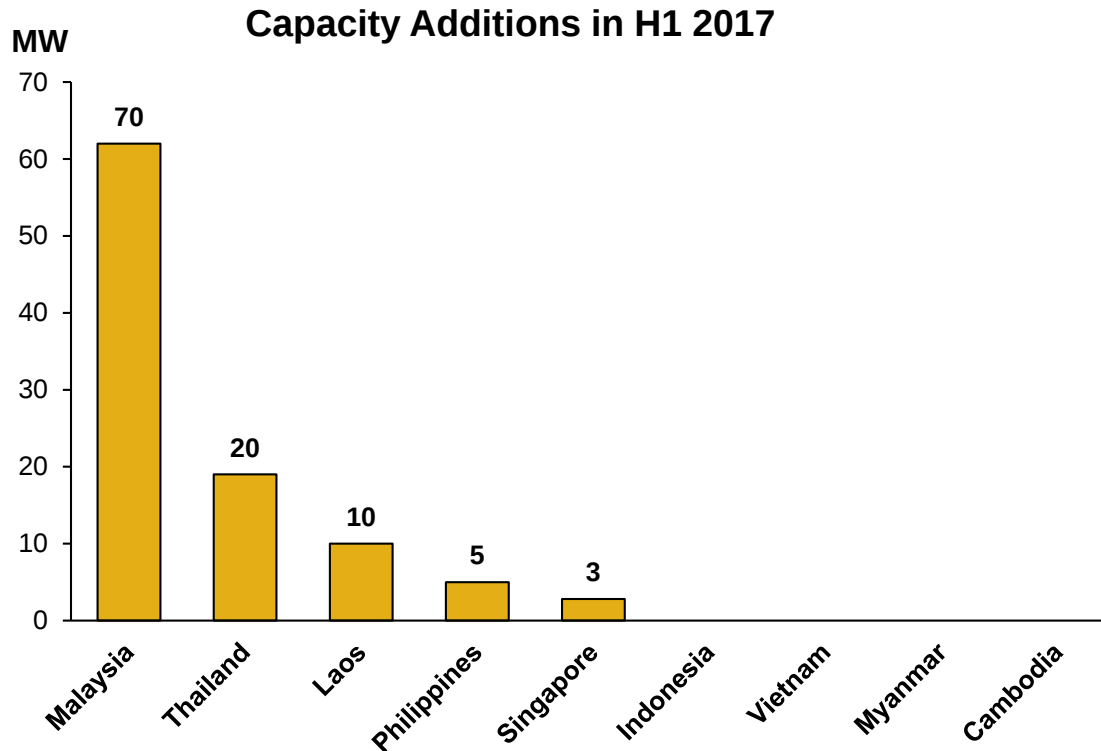
How impressive was 1.2 GW of new solar commitments?

New Solar Project Commitments in 2016



Commitments in Latin America (excluding Brazil) 4-5x SE Asia
SE Asia well down global solar league tables

And 2017 for solar is off to a slow start...

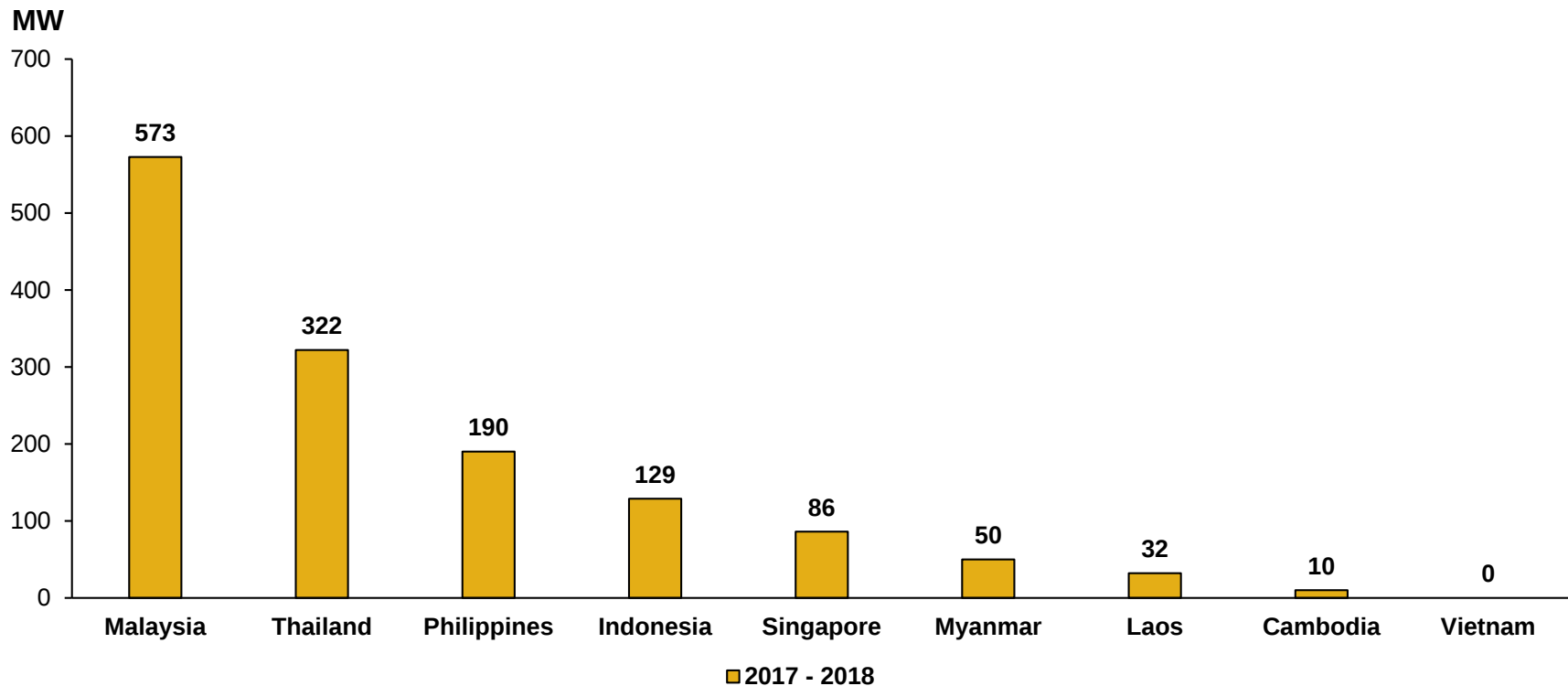


Source: TLG Analysis; EPPO, SEDA, EMA, DoE, WWF, RUPTL

New solar additions across all of SE Asia not much more than 100 MW

We project new solar additions through 2018 to be approximately 1.4 GW

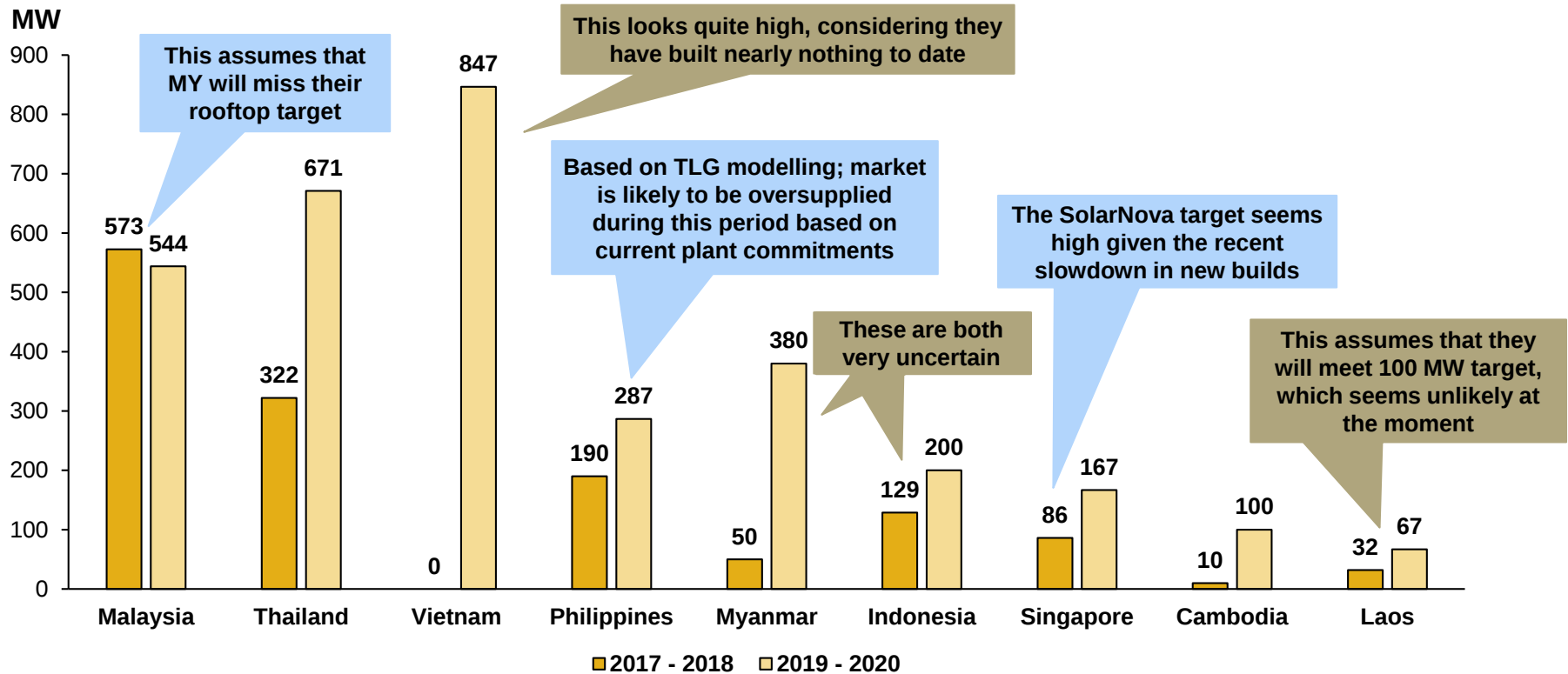
Additional Installed Capacity (2017-2018) for Selected Asian Countries



Given current slow activity, new capacity additions in 2017-2018 will almost certainly be limited

New solar additions up to 2020 may be less than 5 GW (1.25 GW p.a.)

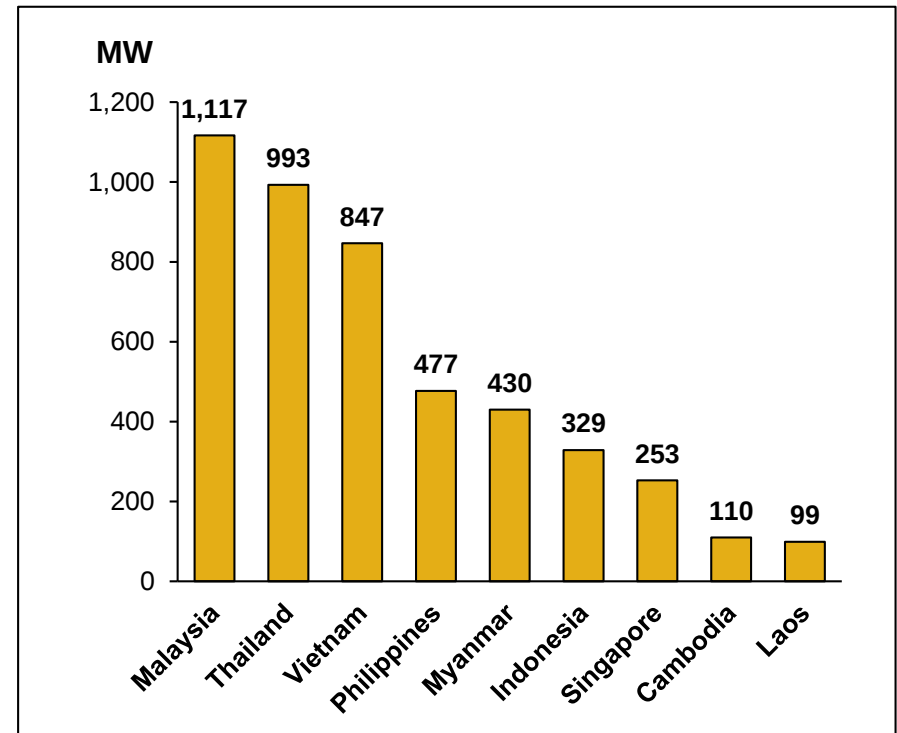
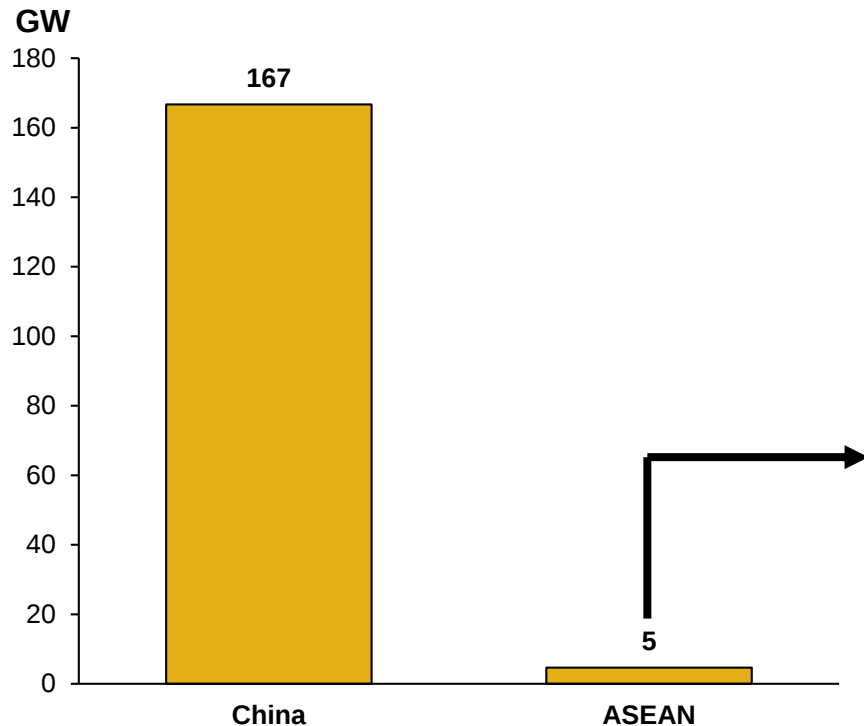
Additional Installed Capacity (2017-2020) for Selected Asian Countries



Difficult to project when solar power will start to accelerate. Progress may be moderate up through 2020.

Compared to China capacity additions

Additional Installed Capacity (2017-2020) for Selected Asian Countries



China just adjusted (!) its 2020 solar target from >110GW to >240GW

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- 3 **Impact of regulations**
- 4 Fundamentals will drive growth

The lack of effective policies and regulations for solar is region-wide – both across SE Asia region and across the regulatory framework

Malaysia

- Current SE Asia exception.
- FiT program phases-out
- Solar replaced by bidding and net metering
 - 450 MW auction in 2016
 - 460 MW auction in 2017
 - Net metering 1000 MW through 2020

Vietnam

- New Solar FiT in 2017 of \$93.50/MWh
- Template PPA still not finalized
- Rooftop net metering scheme announced in 2017, but detailed regulations still outstanding
- Financeability issues – draft PPA, EVN credit, FX availability

Minor Mekong

- No FiT or developed RE schemes
- PPAs negotiated on ad hoc basis. Few have been signed, and often progress/schedule is uncertain

Thailand

- SE Asia leader in solar power – but changing regulations have slowed progress
- 2016 round of solar project awards was not a success
- New round of solar bids in 2017 was scaled down, and details unclear for a new biomass program hybrid

Philippines

- FiT quotas for solar projects announced in 2014 were filled in 2015. No plans for new FiT quotas
- Developers without quotas sitting on “stranded” development projects
- But deregulated power market provides options for non-FiT projects

Indonesia

- No utility-scale solar project in operation
- 3 sets of regulations in 12 months
- Up to recently no template PPA, or even structured solar program

There are a number of incentives, some of which are theoretical

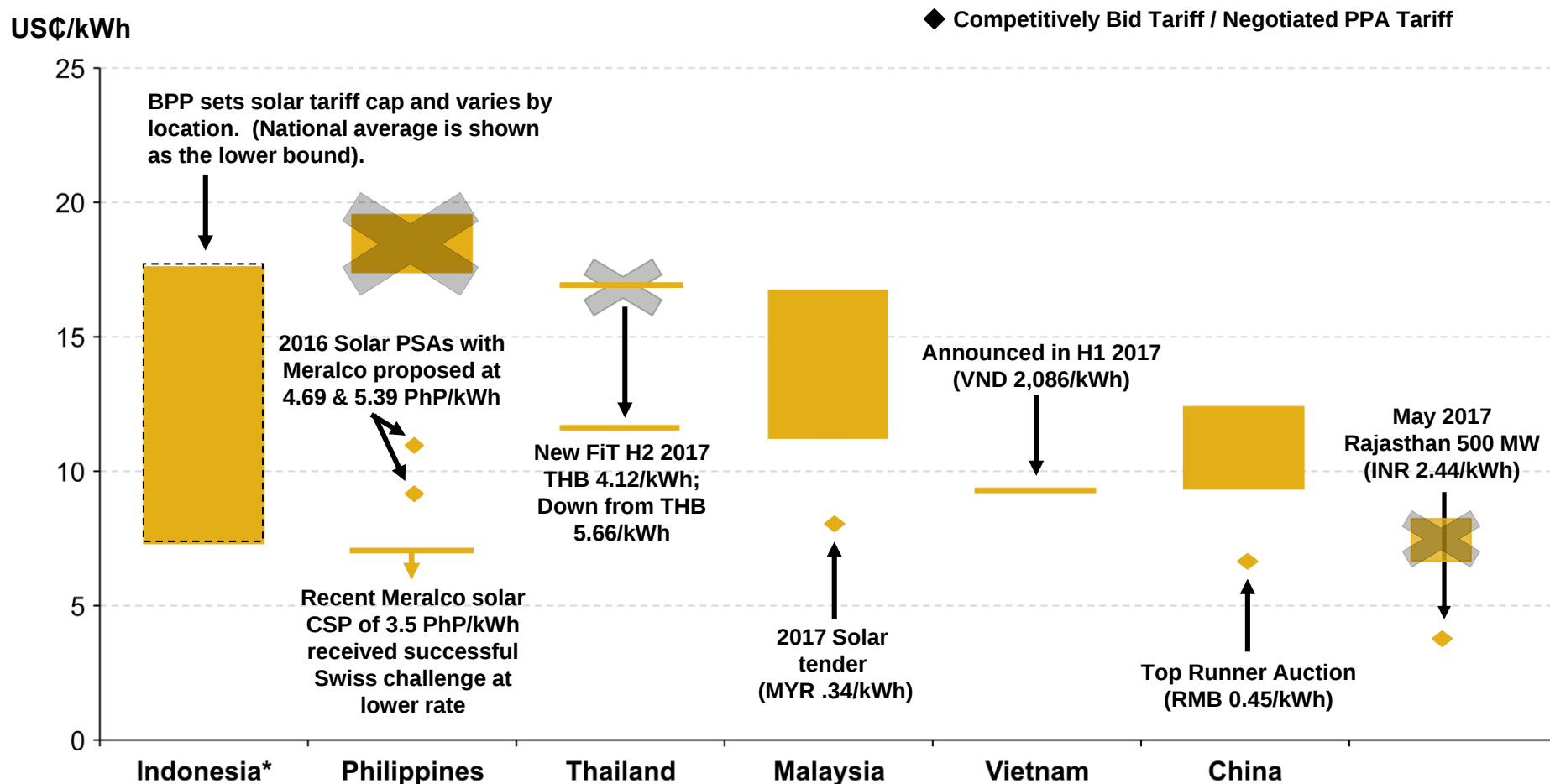
	Template PPA	Curtailement /Deemed Generation	FiT	Auction / Tender	Purchase/ Generation Obligation	Rooftop Exports	T&D Access/ Pricing	Peak Pricing
Philippines	N/A							
Vietnam								
Indonesia								
Malaysia								
Thailand								
Singapore	N/A	N/A	N/A	N/A	N/A		N/A	
China	N/A							
India								

 = Regulatory measure for solar

 = Regulatory measure considered / WIP

 = Regulatory measure cancelled

Solar FiT (and other tariffs) vary considerably – but the level of the tariffs are only part of the story



Why is the Indian solar power program a success while the solar FiT is essentially irrelevant?

Focusing only “Renewables Regulations” may mean missing the forest for the trees.

Weak renewables regulations is only part of the regulatory problem for solar and wind power in SE Asia. Broader industry regulations are often road blocks in the way of commercial drivers for solar and wind power.

Subsidized end-user tariffs are a major roadblock to generation investment – for renewables or indeed for any type of generation

- Electricity prices are highly politicized in many SE Asia countries, with high prices deemed to risk economic growth and contribute to political unrest
- Many countries lack transparent tariff regulations that mandate fair cost recovery
- Failure to set retail tariffs at compensatory levels has led to major subsidies across the region (Philippines and Singapore being the notable exceptions)
- Large subsidies necessarily create a financially weak utility off-taker (e.g., PLN in Indonesia, PVN in Vietnam), which creates issues with financing – particularly for small and numerous RE projects
- Moreover, the fact that retail tariffs do not cover project costs creates a financial disincentive to sign solar and wind PPAs where the FiT is (perceived) higher than the alternative (which is usually coal) – as utilities lose money on all generation and lose more if the cost is higher
- Subsidized tariffs lessen any financial incentive for end users to adapt rooftop solar, since the electricity cost savings are diminished by the subsidy

Ability of utility to pass through RE and other costs to end user tariffs varies – and this matters!

-  Robust pass-through of RE costs
-  RE tariff adder to fund RE– but not sufficient
-  Limited cost pass-through support for RE

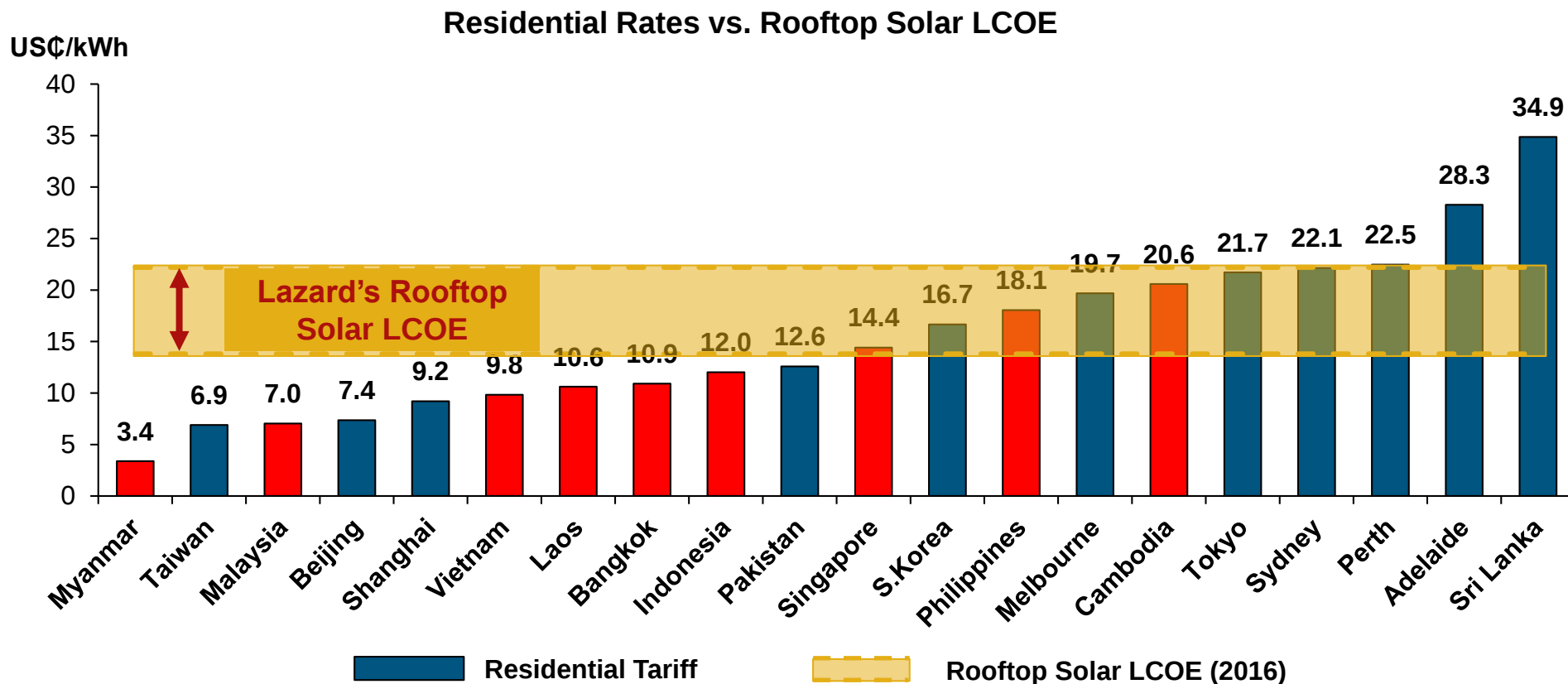
Thailand and Malaysia: Relatively successful in implementing renewables. Off-taker has not been a problem.

Indonesia: PLN lack incentives signing PPAs where costs cannot be passed through. Look at discrepancy in future solar capacity between National energy plan (RUEN) and PLN's development plan (RUPTL) - 6.5GW vs <1GW in 2025

Vietnam: EVN credit support is key issue

Philippines: Lack of political will to increase retail tariff or “RE adder”

Rooftop solar could be an early driver for solar power in SE Asia – since utility tariffs rather than wholesale costs set the implicit energy value



No FiT is required where tariffs are high enough, and it avoids financing and grid issues – but only locations without subsidies would benefit

Rooftop solar compensation mechanisms – Low hanging fruit that is developing

	Description
China	Rooftop power exports receive price above retail electricity tariff. Base load wholesale tariff (varies by province), plus an additional 0.42 RMB/kWh (US Cents 6-7/kWh)
India	Depends on State
Thailand	Self-use only at the moment; net metering regulations in progress
Philippines	Self-use; exports to the grid receive displaced cost credit
Vietnam	New regulation provide for exports that receive credit to off-set consumption (accounted for on an annual basis); Price for excess electricity to be confirmed
Malaysia	Exports receive credit to off-set consumption (accounted for on a 24 month basis); exported electricity compensated at displaced cost rate based on customer voltage level
Indonesia	N / A
Singapore	Differs for contestable and non-contestable customers: - Contestable off-set own-use, and compensated at displaced cost - Non-contestable off-set own-use, paid based on nodal prices for exports

Deregulation and electricity market reform can be the most effective form of support for renewable energy

All of these can facilitate the entry of economic renewables, as seen in the Philippines and Singapore

Deregulation and wholesale market reform supports investment in renewables

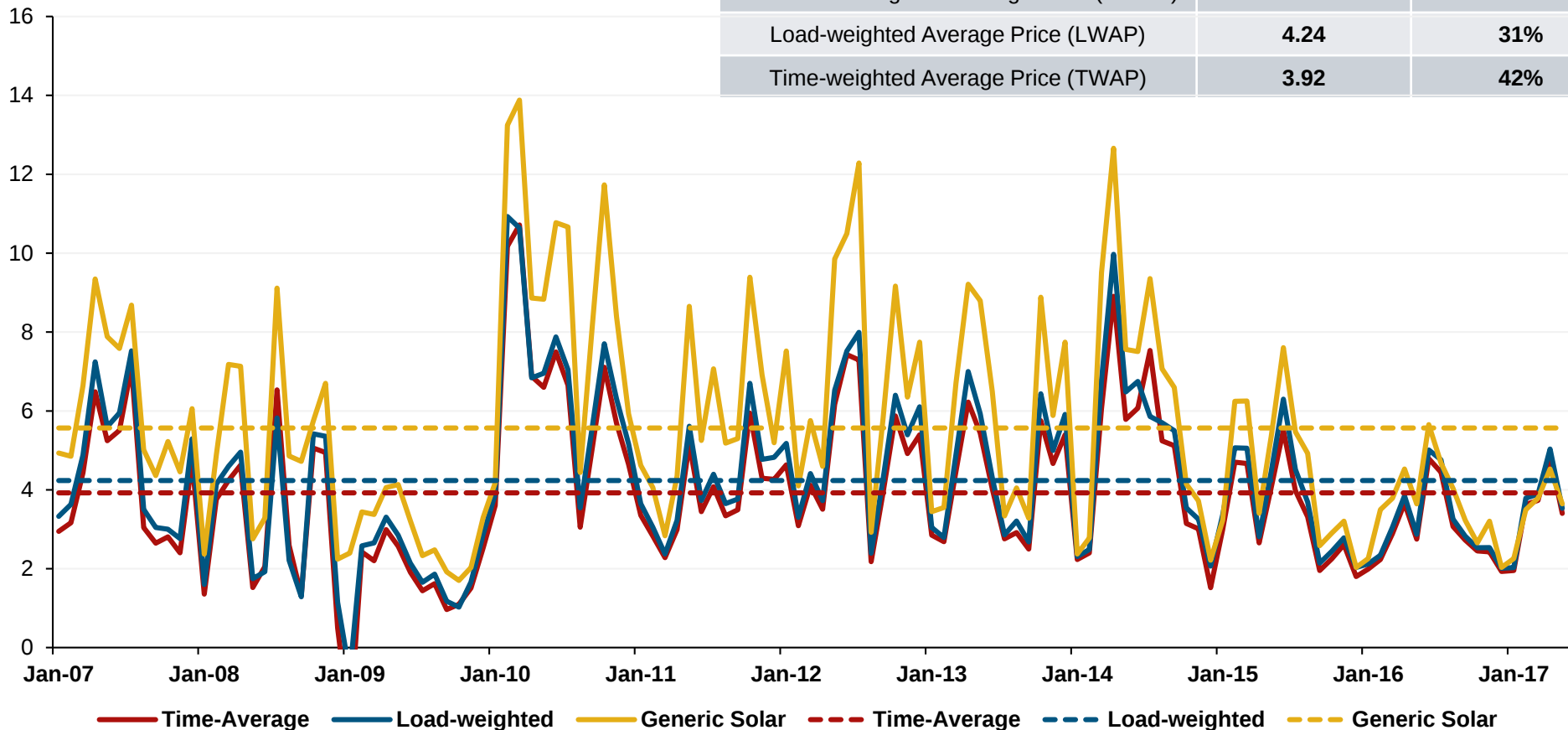
- **In a pool market there are price signals for the value of power at different times of day.** In a deregulated electricity pool market, the price for electricity is higher when demand is higher. In SE Asia, demand is high in the middle of the day when solar generation is high.
- **Unbundling the traditional utility structure reduces conflict of interest.** Reduced conflicts of interest reduce investment risks associated with grid access, dispatch and curtailment.
- **An open electricity market with many buyers takes away dependence on a single buyer – particularly one controlled by the government.** This reduces reliance on a government guarantee of the off-taker and harnesses commercial incentives to pursue efficiencies.
- **Corporate PPAs for renewables become easier.** If third-party access to transmission is available, generators and customers (or retailers) can efficiently contract for new capacity.
- **Commercial developers are equal-opportunity investors.** They can mobilize to develop small-scale resources in ways that state-owned enterprises cannot (or, at least, do not).

Is the most effective regulatory mechanism for supporting growth of renewable energy simply a workable wholesale market?

Solar generation tends to be more valuable than the average unit of electricity given its coincidence with high daytime demand; This value can be realised in the WESM

Comparison of System Average and Solar Prices in the Luzon Grid (Jan 2007 – May 2017)*

PhP/kWh



Note: * Approximate average prices; certain assumptions had to be made about ex-post WESM price corrections; we used the solar profile of a 'generic' solar plant in Luzon to derive this GWAP
Source: TLG analysis; PEMC

State-owned integrated utilities (e.g., EVN, PLN, EGAT, TNB) embody multiple conflicts of interest that act to restrict investment in renewables

- **Single Buyer –**

- Big is beautiful – small RE projects are unlikely to receive Government support
- Traditional thermal projects are favored because they are well understood and cause fewer issues from a system standpoint

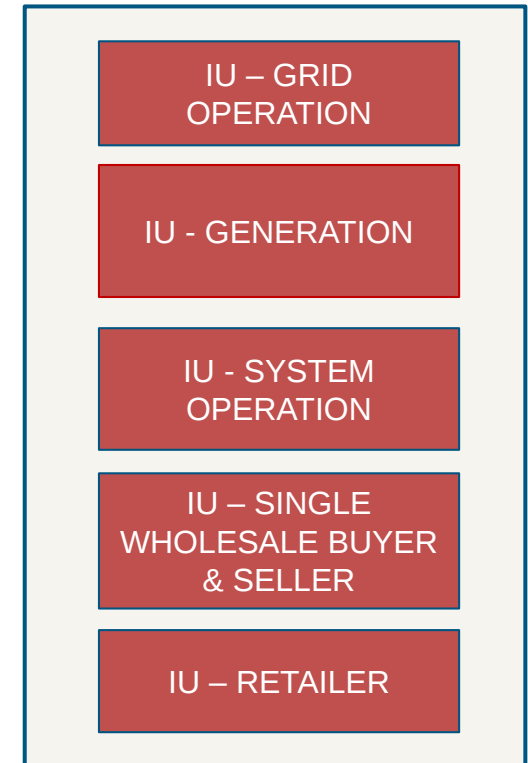
- **Grid Operation –**

- Renewables are often located far from load centers, and appropriate network cost allocation principles are not well-developed – so utilities often oppose RE projects because they must bear uncompensated network costs
- Renewables compete with utility generation, so utilities have an incentive to block access

- **System Operation –**

- Combined role as generator and system operator creates natural incentive to skew dispatch toward traditional thermal resources
- Natural conservatism of system operators – combined with the inherent intermittency of renewables – gives them an excuse to keep thermal units running for “stability” reasons

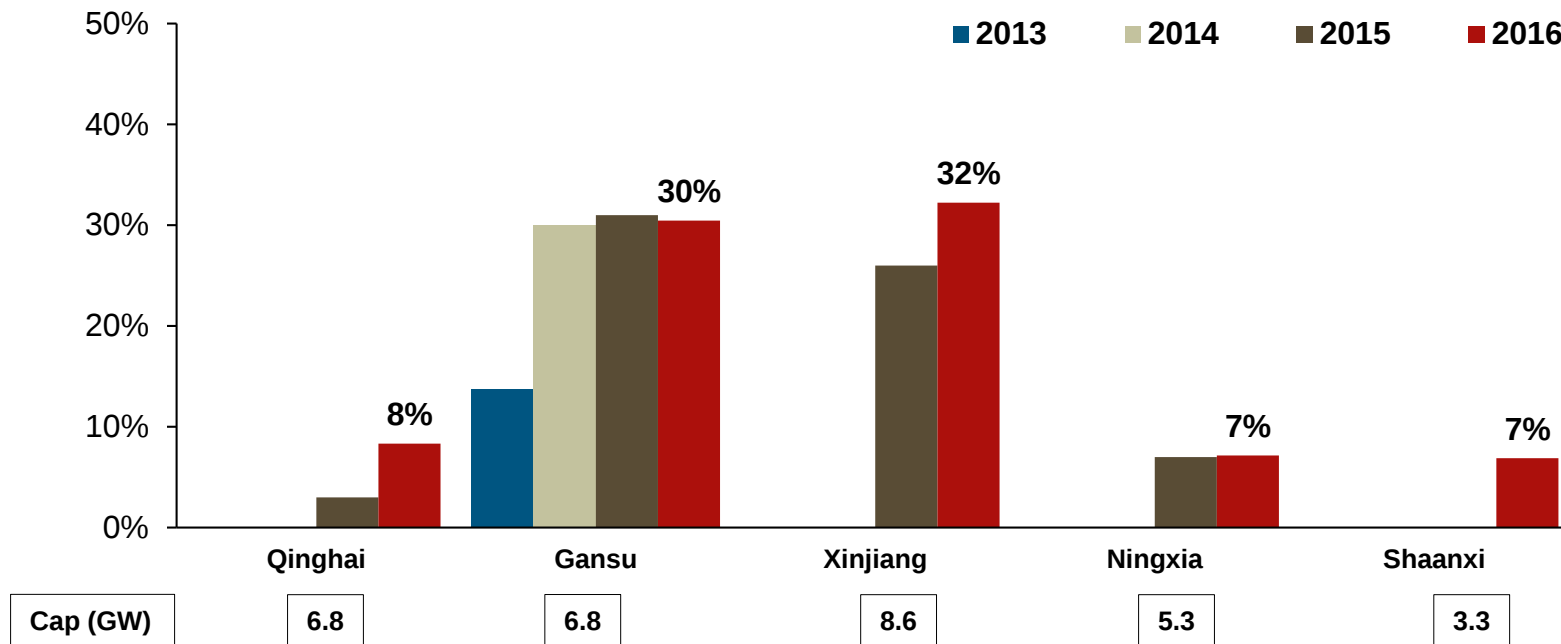
Integrated Utility Multiple Roles / Same Entity



In some SE Asia markets curtailment risk is a major financing issue for solar projects
And that is before curtailment has occurred, and before there is any projects are in operation

China solar curtailment is not just caused by a lack of transmission capacity Over investment in coal capacity has led to economic curtailment of solar

Solar Curtailment Rates in 5 Key Provinces



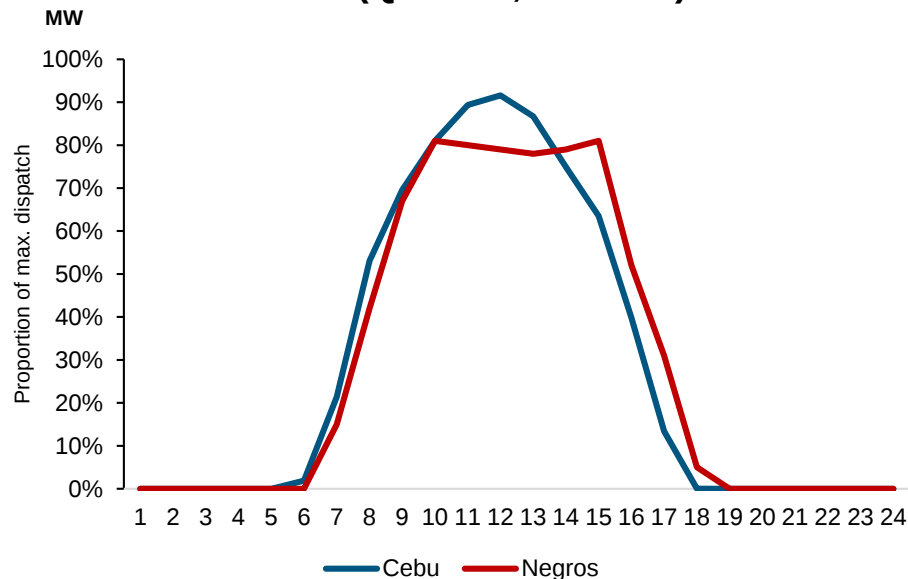
Source: NEA, Northwest China Energy Regulatory Bureau and TLG research from news reports.

- Curtailment in China are made worse by construction of too many coal fired projects.
- No Independent System Operator enforces dispatch according to policy, that gives renewables preference.
- Concerns over coal fired power plants' financial position when their operating hours shrink, have resulted in "sharing" of load between coal and renewables, forcing solar and wind curtailment.

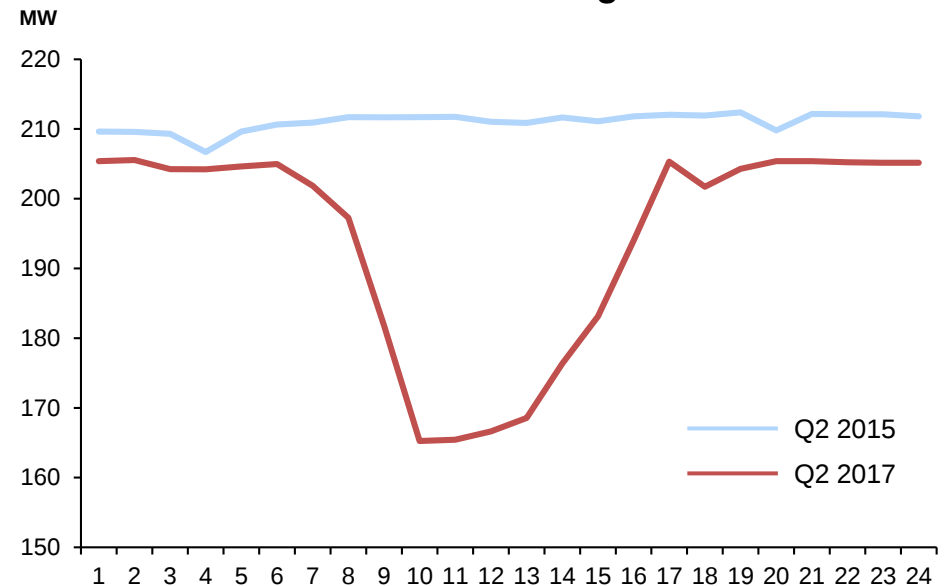
Negros-Panay in the Philippines - Solar genration squeezing existing generation when System Operator adhered to priority dispatch for solar power

- Nearly 300 MW of solar power entered the Negros grid in March and April of 2016, adding to existing 50 MW of installed solar power.
- Peak demand was only 314 MW in 2016
- The load profile for existing coal and geothermal generation changed dramatically, because of solar genration preferred dispatch
- Even inexpensive and clean geothermal power had to ramp down during solar hours

Average Solar Generation Profile: Negros vs. Cebu (Q1 2017, rebased)



Average Hourly Geothermal Generation in Negros



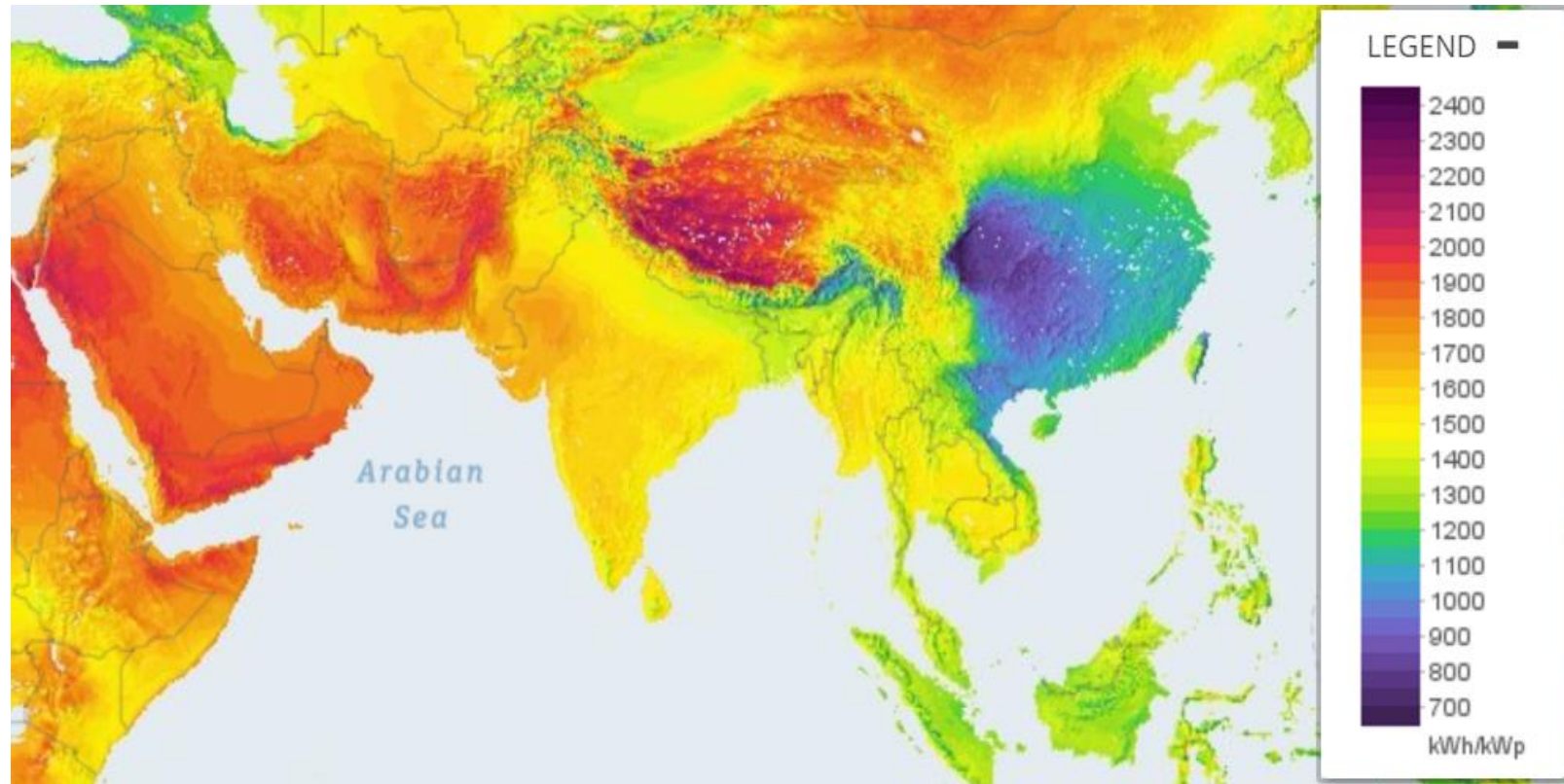
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Fundamentals and economics will drive solar and wind growth in SE Asia ...eventually

Death and taxes are not the only things that are certain in the future.
More solar and wind power in SE Asia is inevitable.

Southeast Asia is blessed with generally good solar resources



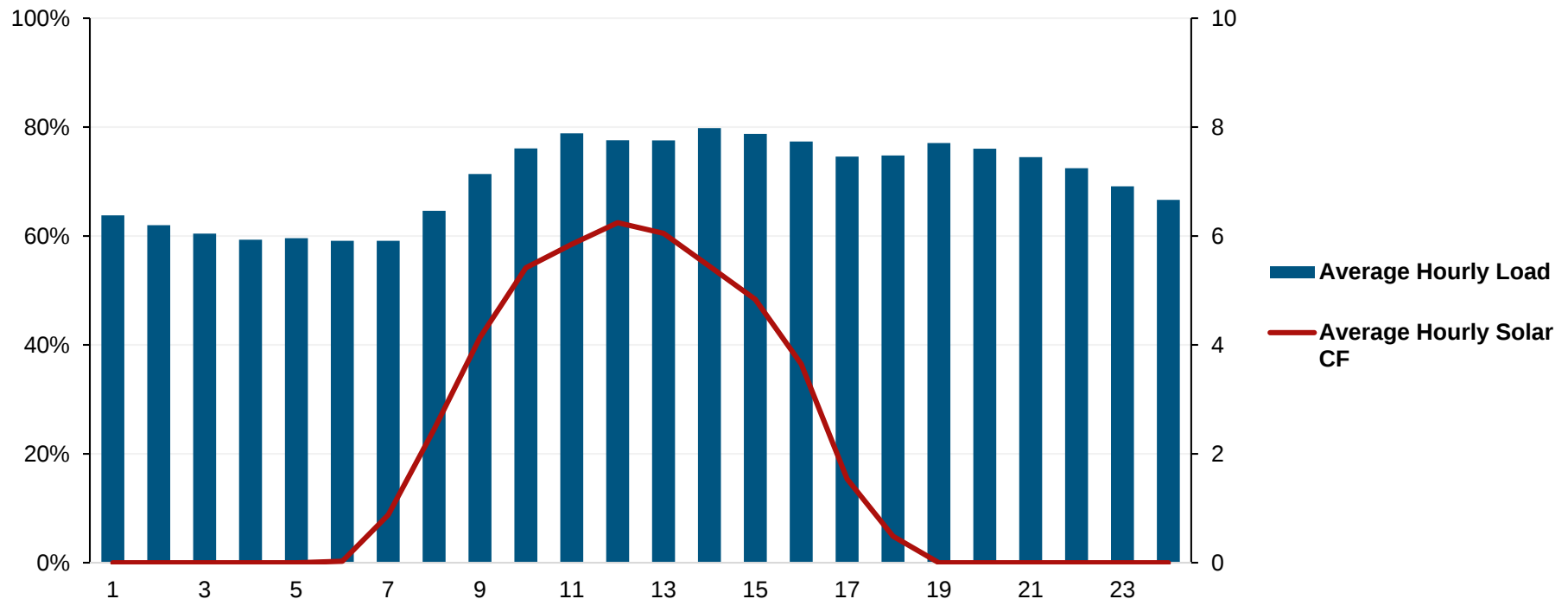
SE Asian solar resources are not on a par with those in the GCC states or Rajasthan in India
But they are better than South / East China

In much of SE Asia, peak solar output overlaps hours of peak demand

- Graph shows demand and solar resource profile for Luzon Philippines. Similar profiles exist in most markets in Southeast Asia..

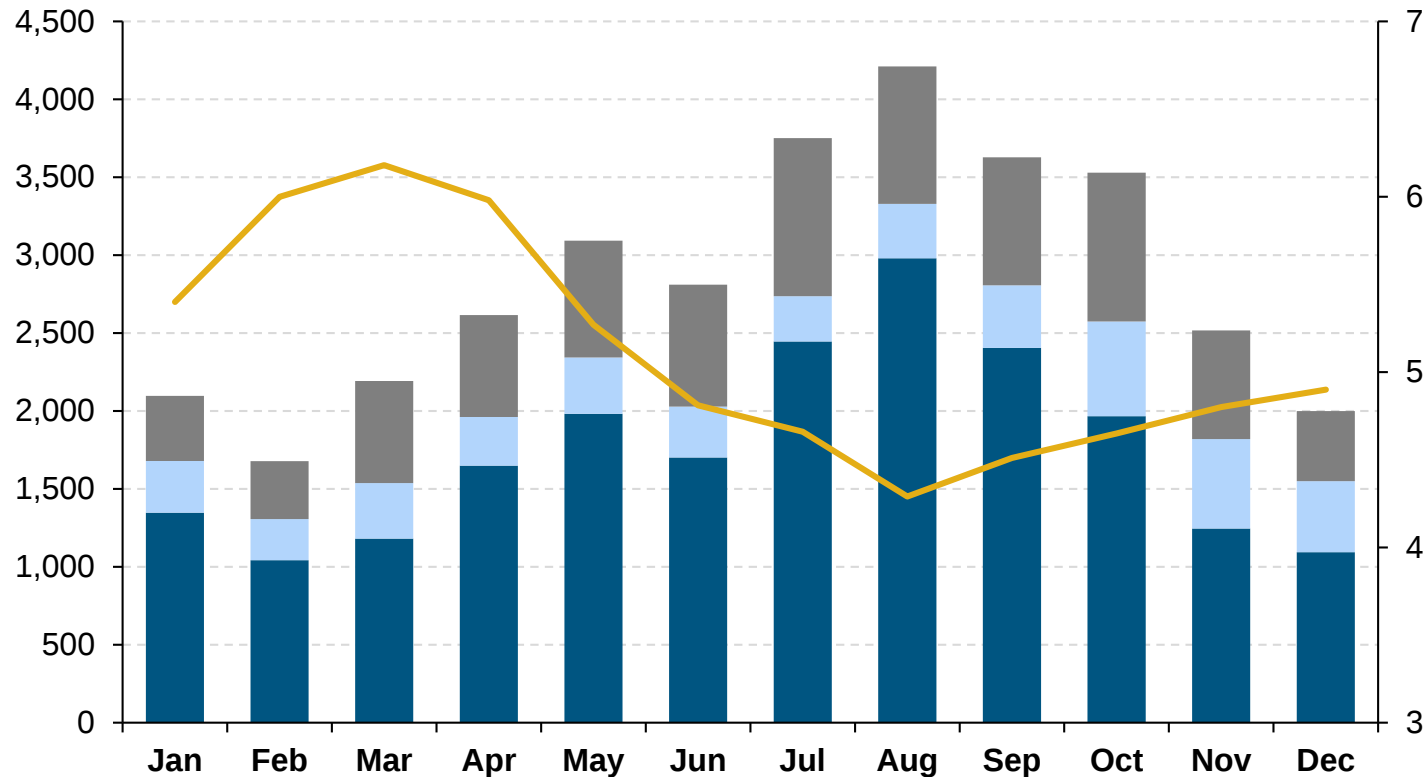
Hourly Solar Generation Profile and Alignment with Luzon Demand (2016)

GW



Seasonal counter-cyclicality with hydro power in Vietnam will favour development of solar power

Average Hydro Generation
(GWh, 2011-2015)

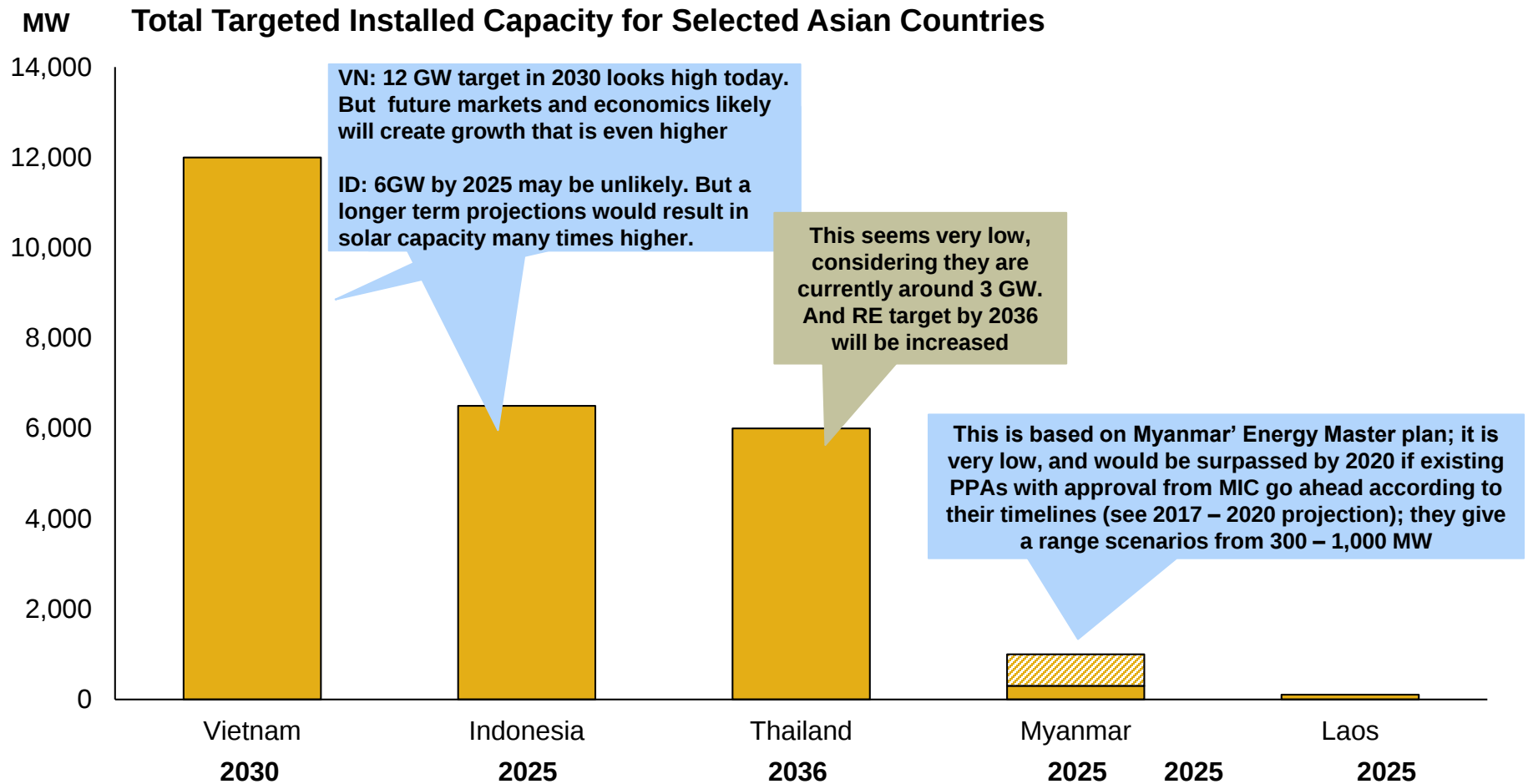


Solar Irradiance
(kWh/m²/day)

- Series1 Hydro – North
- Series2 Hydro – Central
- Series3 Hydro – South
- Series4 Solar Irradiance
- Dak Nong

Solar resource highest during dry months when much of Vietnam's hydro capacity is not available or limited (35% of total generation capacity)

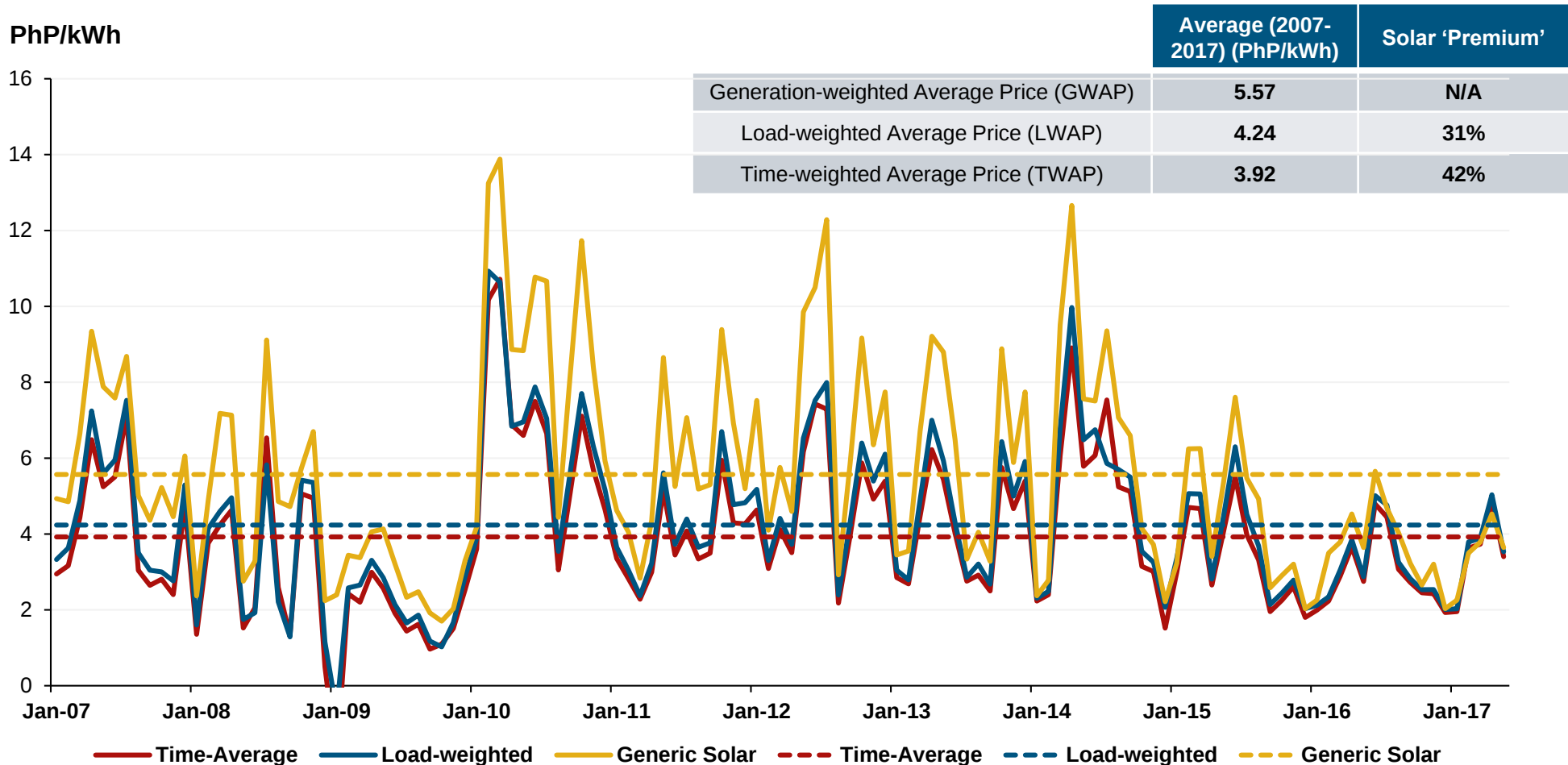
Official long-term plans will very likely be exceeded



Note: Malaysia's target represents target in Peninsular Malaysia. Singapore and Cambodia do not have specific long term solar development target. Philippines' target is from TLG modelling.
Source: TLG Analysis ; EPPO, SEDA, DoE, RUPTL , ST, IREP

Solar generation tends to be more valuable than the average unit of electricity given its coincidence with high daytime demand; This value can be realised in the WESM

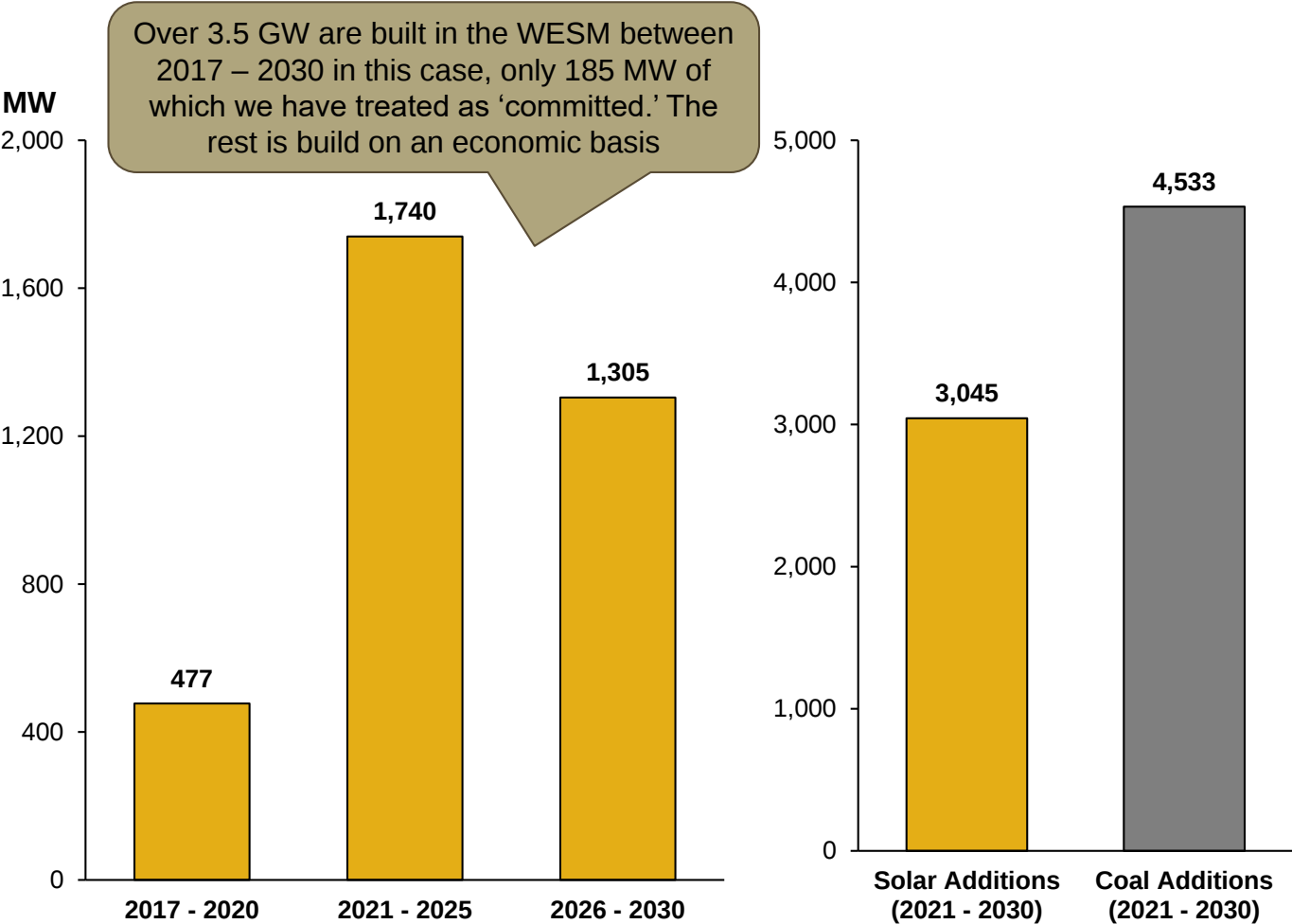
Comparison of System Average and Solar Prices in the Luzon Grid (Jan 2007 – May 2017)*



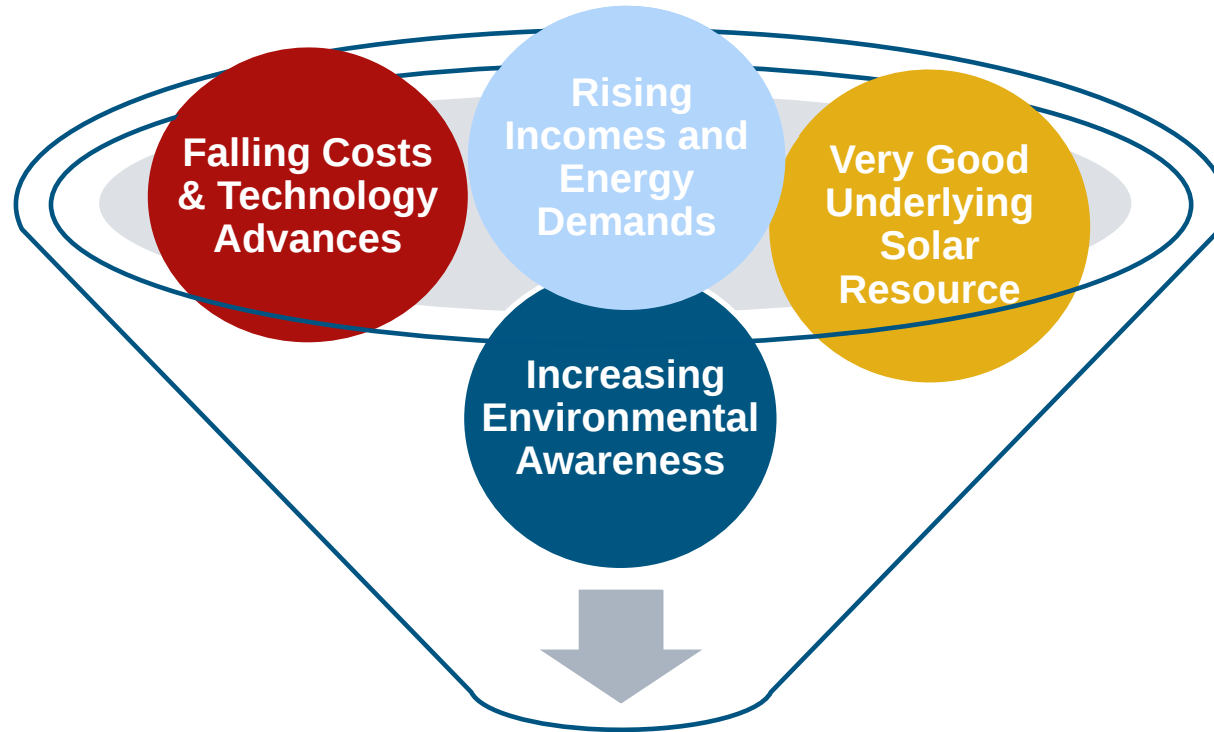
Note: * Approximate average prices; certain assumptions had to be made about ex-post WESM price corrections; we used the solar profile of a 'generic' solar plant in Luzon to derive this GWAP
Source: TLG analysis; PEMC

On pure economics (without specific regulatory support) solar power in the Philippines will represent the second biggest source of new capacity through 2030

Indicative Analysis of Projected Solar and Coal New Build in the WESM (2017 – 2030)*



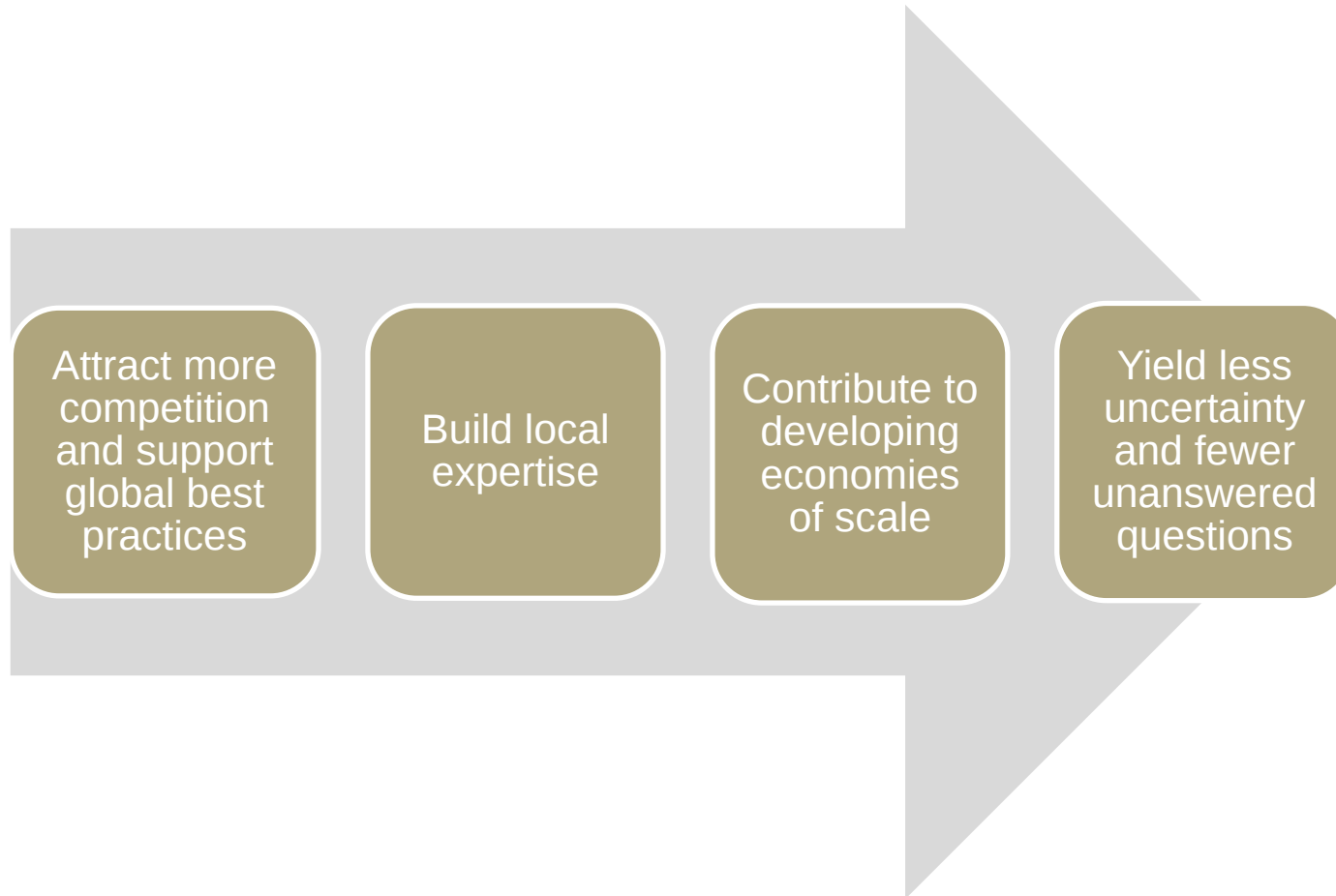
In the short run, government policy will dictate investment – in the long run, however economic fundamentals will be the main drivers



Solar and wind power MW are likely to exceed current long-term targets

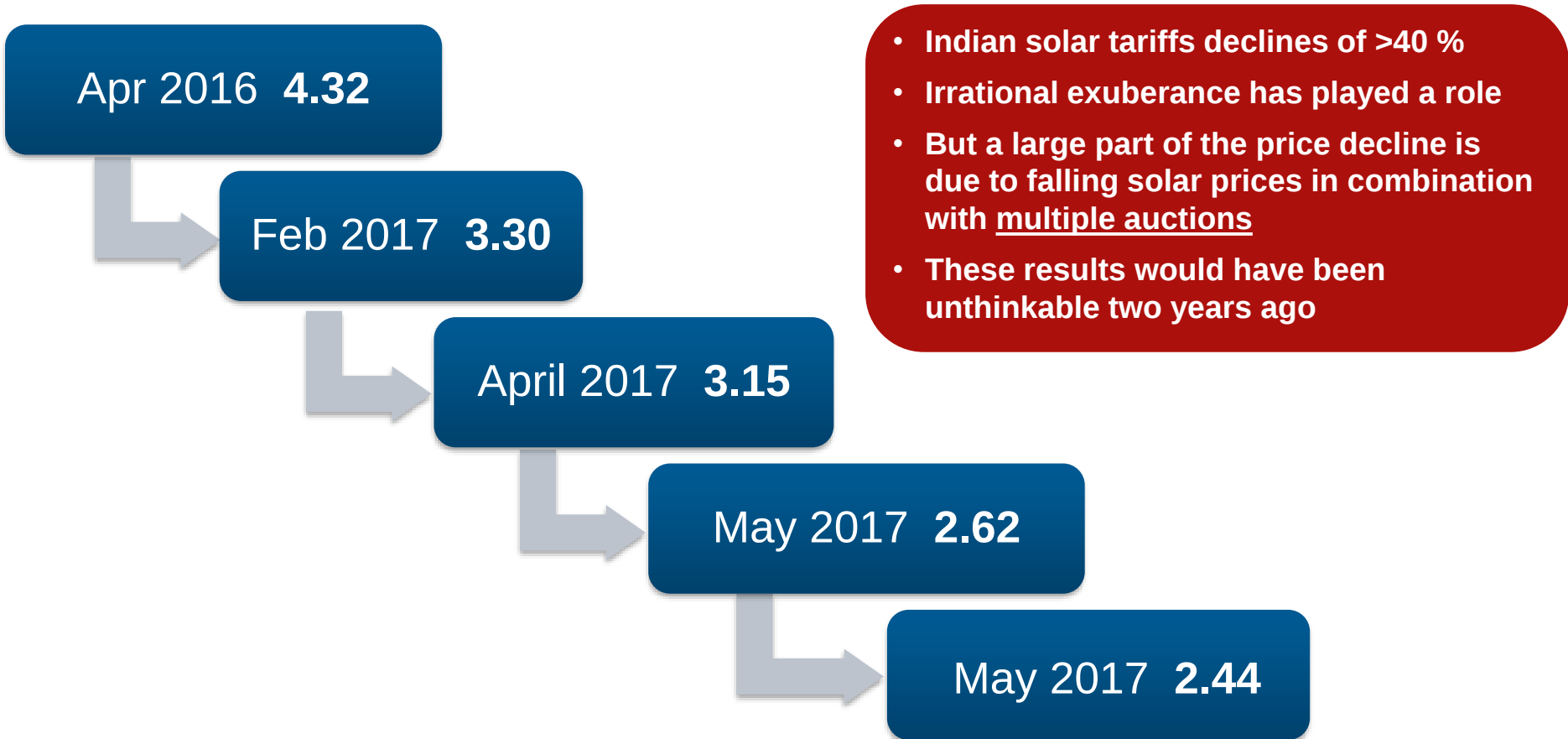
In the next decade renewables will change the electricity industry
But GOOD regulations will make it happen both sooner and in a better way

Missing in Southeast Asia - Long-term consistent government policies that support continuous project opportunities over time can reduce costs and lessen overall investment risks



Moreover, reliance on market mechanisms (i.e., auctions) unambiguously yields greater efficiency benefits

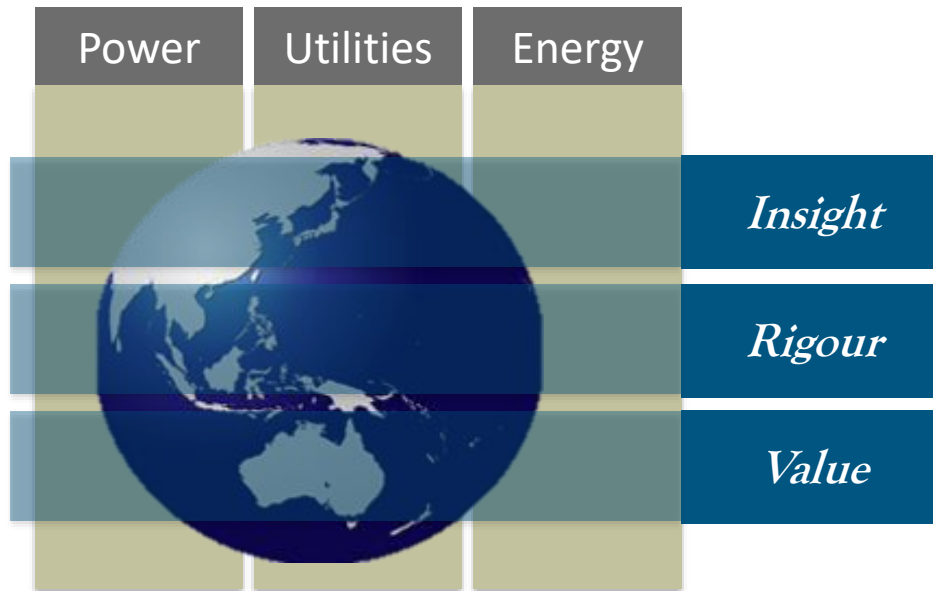
Indian solar auctions: The world's best worst best case study - rapidly falling costs (but too fast?)



Final remarks

- Long term solar power will be grow
- But when is long term? By 2020? By 2024? It is hard to project when the “worm turns” and additions of solar power accelerates.
- But when momentum changes the rate of new solar capacity likely will increase very quickly (e.g. India, Australia, Mexico)
- Regulations will be important for short term potential for solar power, and help build momentum.
- “Overbuild” of thermal generation may delay entry of renewals – despite economic rationale
 - Vietnam planning for 10-15 GW in only 2-3 years
 - Philippines over supply until 2020-2022
 - Indonesia plans for coal generation have changed

Thank you!



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