Global Solar Trends and Implications for ASEAN and Vietnam

Sarah Fairhurst

9 November 2018

THE LANTAU GROUP

Or

What to do when technology changes faster than the world can keep up?

Solar PV has been around for a long time

- As a girl, I had a solar powered calculator. It was state of the art. And very expensive. But that was 40 years ago!
- Since then, solar has changed beyond recognition and the industry with it
- For many years, solar was “interesting but much too expensive”
- Later – expensive but close enough to be driven by policy support
- Now – economic in its own right
- However, update is not even around the world – why is that?

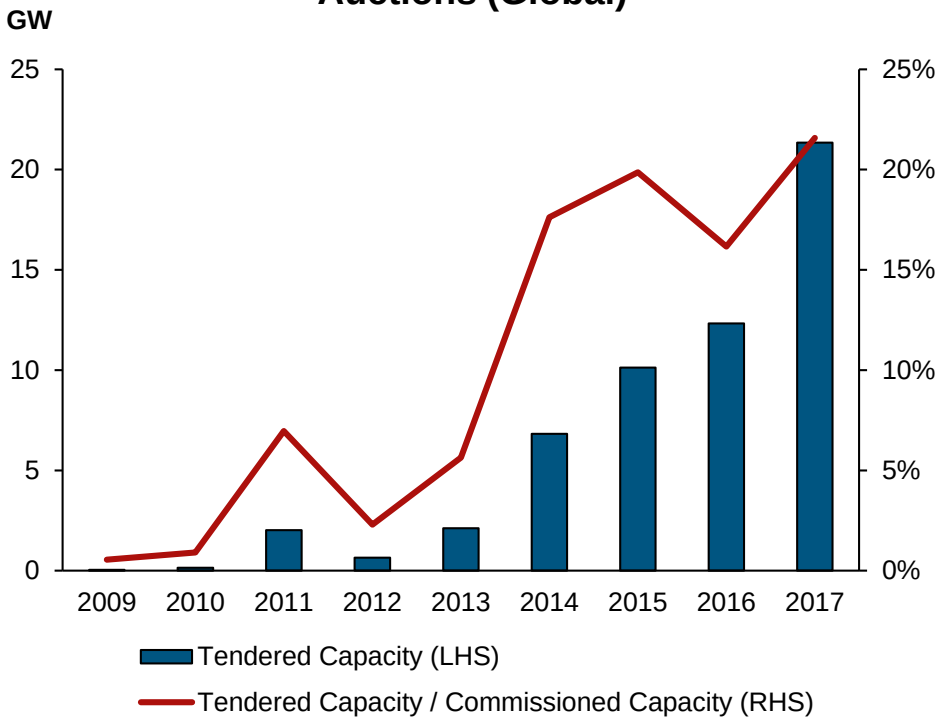
Early adoption was driven by Government incentives

- In-front-of-the-meter, including
  - Feed-in-tariffs
  - tax incentives
  - renewable energy credits
  - among other things
- Behind-the-meter, by Net Energy Metering Schemes, whereby
  - customers would *net* their exports to the grid off of their imports from the grid; where
  - in the case of wholly volumetric rates, this effectively compensates solar at the retail rate, which provided a strong price signal that does not reflect (typically over-estimates) the value of these distributed solar resources

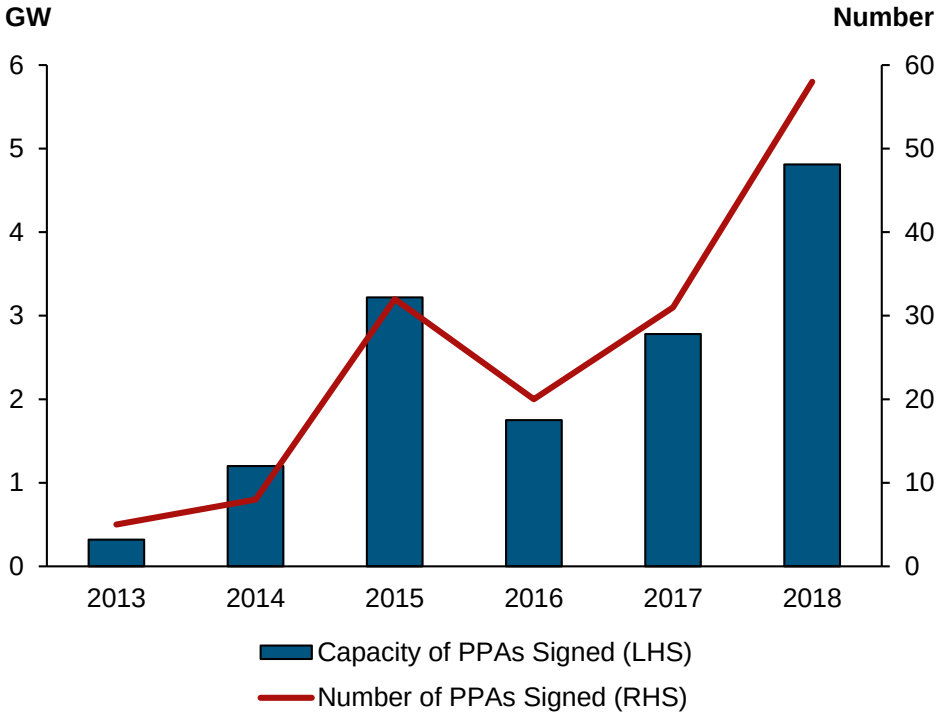
However, in-front-of-the-meter, solar is increasingly being evaluated and adopted on its own economic merits

- In-front-of-the-meter, solar is increasingly procured
  - By utilities, often on economic grounds through tenders/auctions; as well as
  - By end-users, often on economic and CSR grounds through corporate PPAs

Solar Capacity Awarded in Tenders / Auctions (Global)



Corporate PPAs Signed (USA)*

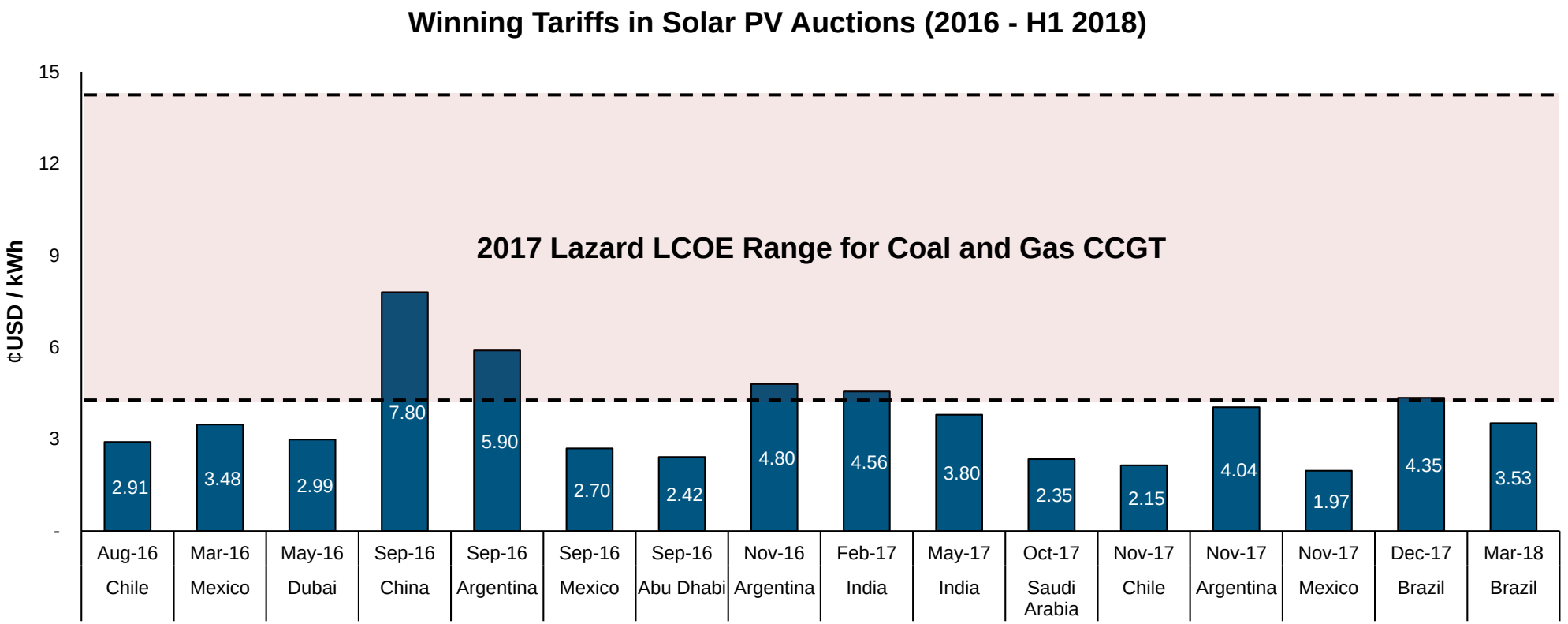


4 Sources: GTM; news reports; TLG analysis

** Corporate PPAs in this instance solely reflect "large, off-site renewable energy projects"*

THE LANTAU GROUP

The increasingly competitive economic position of utility-scale solar can be observed in the outcomes of recent auctions



Falling module costs + Competitive auctions for new capacity + Large volumes creating scale economies + Large firms entering RE business = Solar tariffs 2 US¢/kWh

5 Source: multiple sources for bids; Lazard; TLG analysis

THE LANTAU GROUP

Remuneration of behind-the-meter solar is also increasingly based on its economic merits

- Net Energy Metering schemes are generally becoming less generous
  - Moving away from monthly 'netting' schemes whereby solar is effectively compensated at the full retail rate for often wholly volumetric Residential customer tariffs
  - Moving towards remuneration on an *avoided cost* basis
- The trend is towards *Avoided Cost* and *Value of Solar Tariffs* in many jurisdictions, which are based on the costs that the utility avoids due to exports from these resources
  - Dynamic wholesale rates
  - System Losses
  - Market fees
  - Degree to which solar *reliably* offsets/defers generation and network capacity requirements (and related costs)

Typically considered as wholly 'avoidable'

Degree of 'avoidability' very context-specific

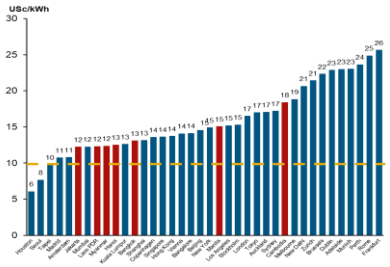
- Tariff structures are also coming under increasing pressure to better-reflect system cost structures, which has become particularly manifest in the push towards higher fixed charges for Residential customers in many jurisdictions

Decision by customers to adopt solar ultimately determined by a basket of economic drivers

- The value for rooftop solar PV depends on four fundamental drivers

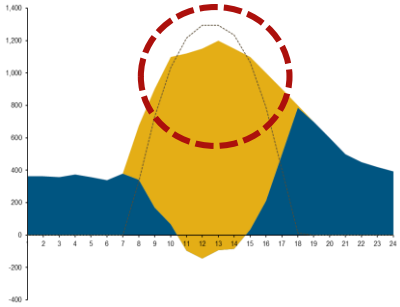
Value Drivers

1 Competing retail tariffs



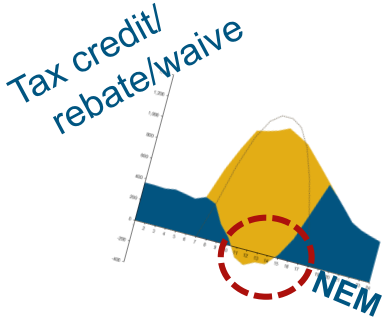
- Higher retail tariffs
- Volumetric (per kWh)
- High and volatile fuel price

2 Customer demand profile



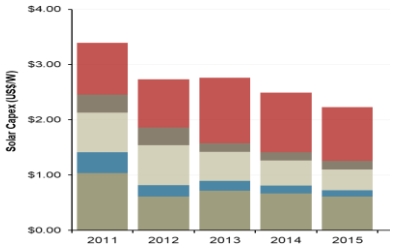
- Strong alignment of load profile with solar generation profile
- Savings from peak shaving if midday demand load

3 Policy & Regulation



- Tax credit/rebate/waive
- FIT and net metering policy

4 Cost of rooftop solar installations



- Lower overnight capital cost
- Lower financing cost

Factors that increase solar value

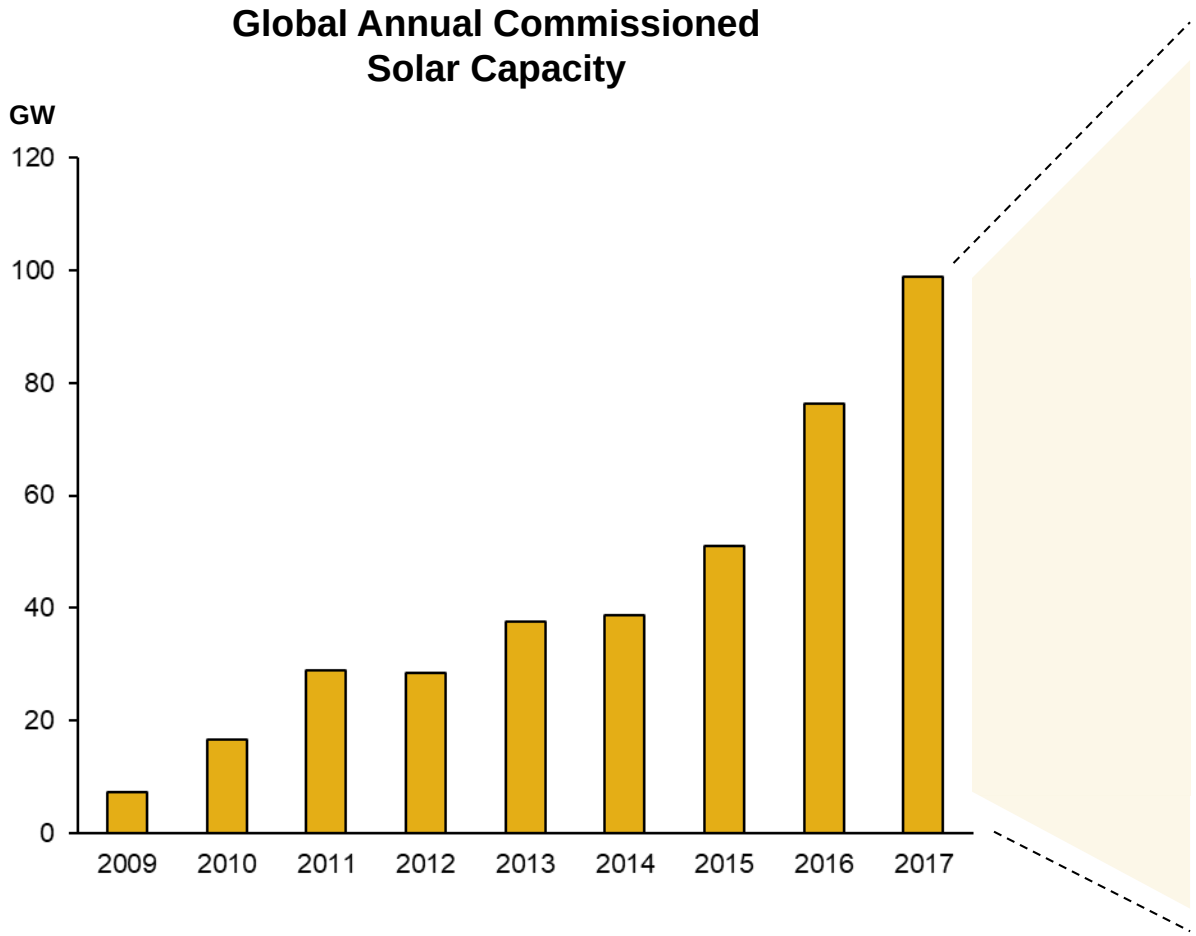
THE LANTAU GROUP

The solar business is evolving to enable solar to overcome hurdles, optimise value, and ultimately expand opportunities across heterogenous markets

Hurdles	
Solution Set	**Expanding possibilities for ownership / purchasing structures** • Consumer-owned • Leasing • Corporate PPAs • Solar + Retail • Aggregate ownership • Standard PPAs **Considering all system connection points** • Behind-the-meter (eg solar rooftop) • LV Network (eg 'Community Solar') • MV and HV Network (eg corporate and standard PPAs) **Increasingly robust financial structures** • Greater access to debt and equity markets (generally higher gearing possible) • Liquid markets for solar assets, eg RECs; tax credits

Different permutations in the solution set allow for different allocations of risk and reward while fitting into the constraints of different local contexts

These trends have culminated in the rapid acceleration of solar adoption



New solar power capacity (2017)			
		World	**93.8 GW** (+21.2)
1		China	**53.1 GW** (+18.5)
2 (▲)		India	**9.6 GW** (+5.4)
3 (▼)		USA	**8.2 GW** (-3.1)
4 (▲)		Japan	**7.0 GW** (-1.3)
5 (▲)		Turkey	**2.6 GW** (+2.0)
6 (▼)		Germany	**1.7 GW** (+0.8)
7 (▲)		Australia	**1.2 GW** (+0.4)
8 (▲)		Korea	**1.1 GW** (+0.2)
9 (▲)		Brazil	**1.0 GW** (+0.9)
10 (▼)		UK	**0.9 GW** (-1.5)

THE LANTAU GROUP

However, this is not without some issues

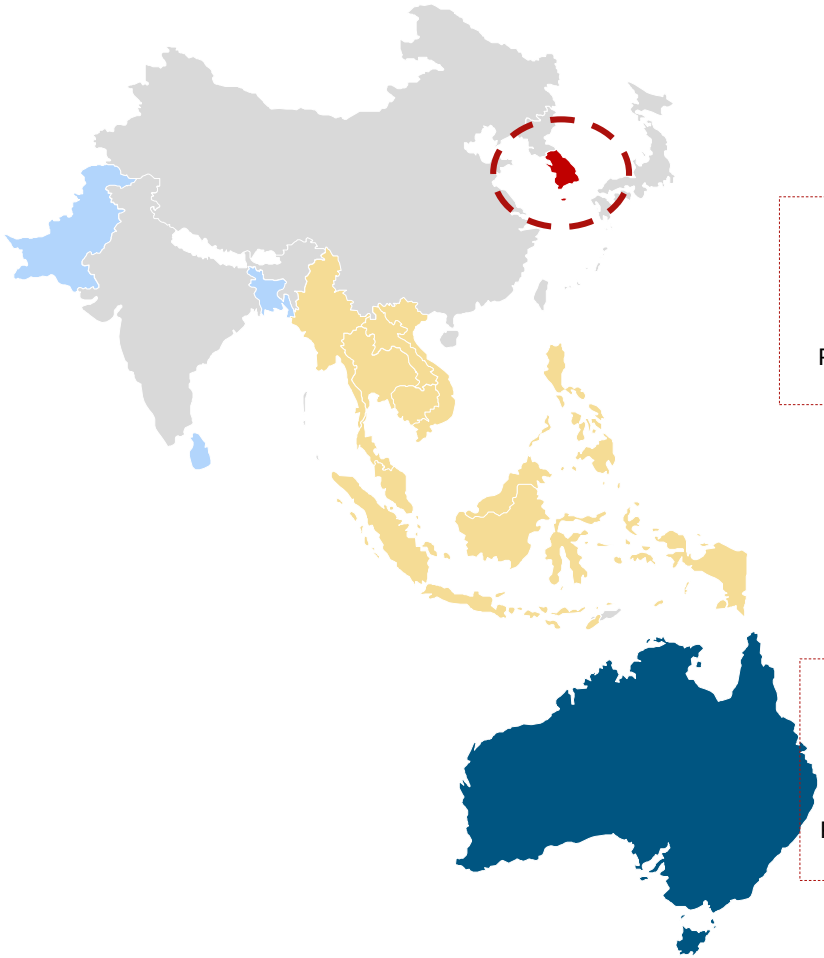
- Increasing intermittent generation in Europe and Australia has caused system security issues
- Dealing with intermittency is the new challenge

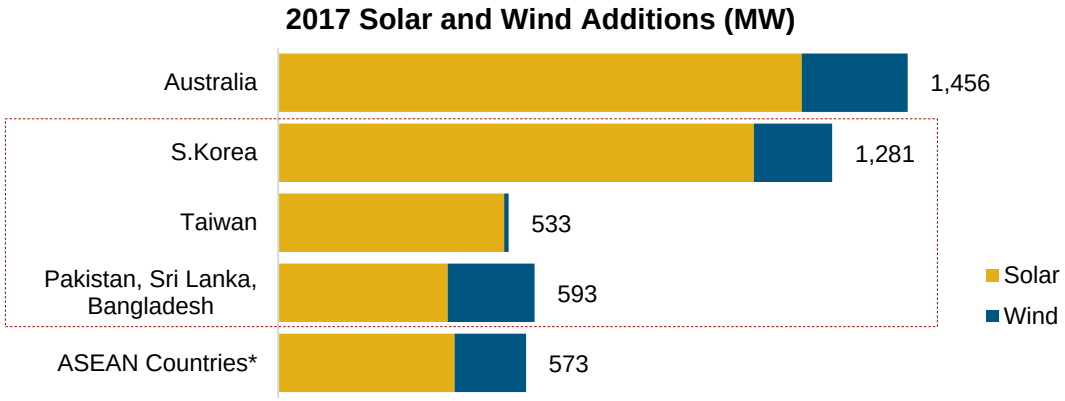
- But where there is a challenge, people rise to the challenge
- Opportunities exist for flexible generation – gas-fired engines, turbines, batteries, pumped storage

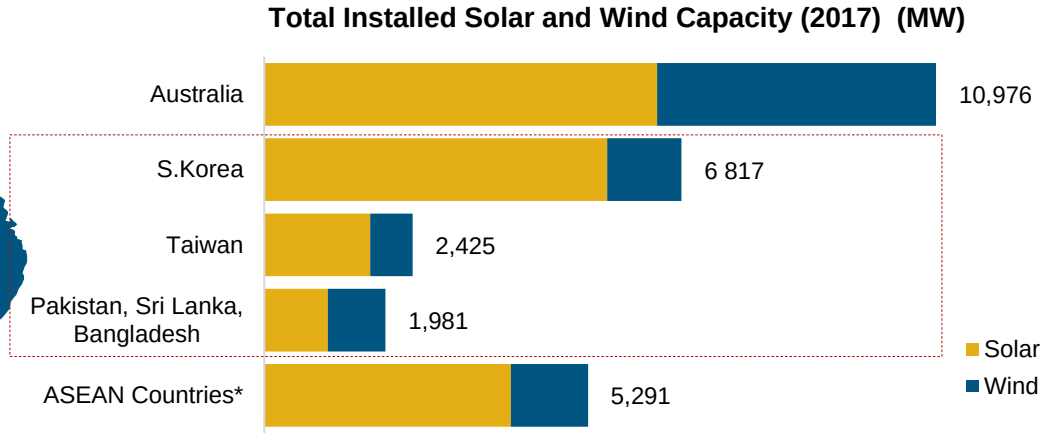
- Some new paradigms – including an increasing view that 100% secure supply of electricity is “the old way of thinking”

But most of this is outside the scope of this talk ☹… so back to Asia

ASEAN has lagged behind the world and the rest of Asia despite good solar resources (not even considering China and India)







Note: * ASEAN Countries indicated in the charts include Indonesia, Lao PDR, Myanmar, Cambodia, Malaysia, Viet Nam, Philippines, Thailand
Source: IRENA

THE LANTAU GROUP

In Southeast Asia, generally lagged in regulatory frameworks in support of solar

Malaysia – Regulatory leader

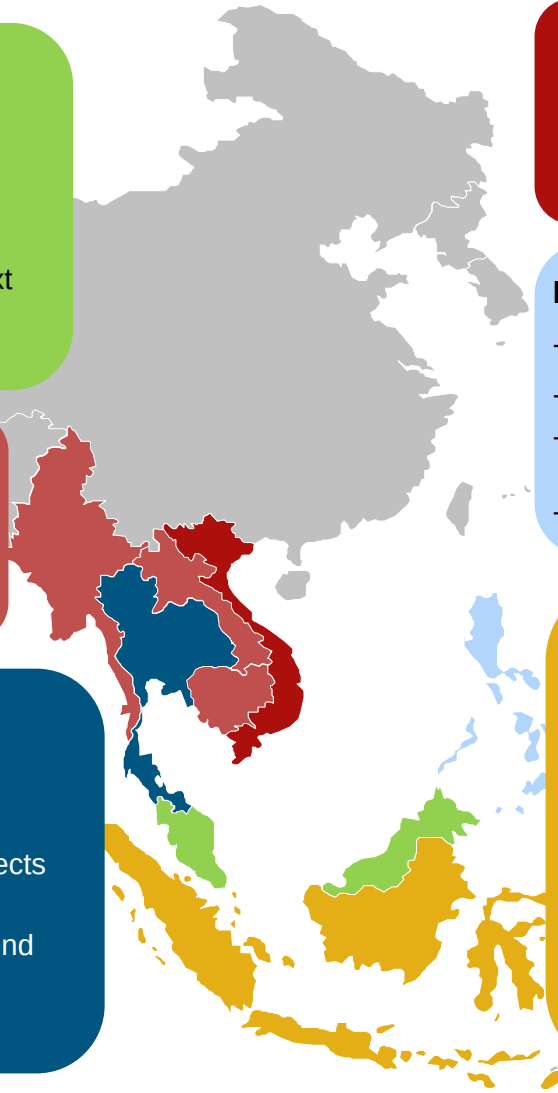
- FiT program phased out.
- Replaced by bidding and net metering
  - Auction 450MW (2016) / 460MW (2017)
  - Net metering 500 MW (2016-2020)
- But Limited transparency for long term and next step

Minor Mekong – No specific solar / wind regulations at all

- No FiT or developed RE schemes
- Negotiated ad hoc PPAs

Thailand – "If it isn't broken – break it"

- Solar leader - But progress has stalled
- 2015-16 round of solar awards for <5MW projects using lucky draw
- 2017 tender focused on hybrids centered around biomass



Vietnam – Regulations slow in coming and problematic

- No solar FiT / PPA before 2017
- RE PPAs not internationally financeable

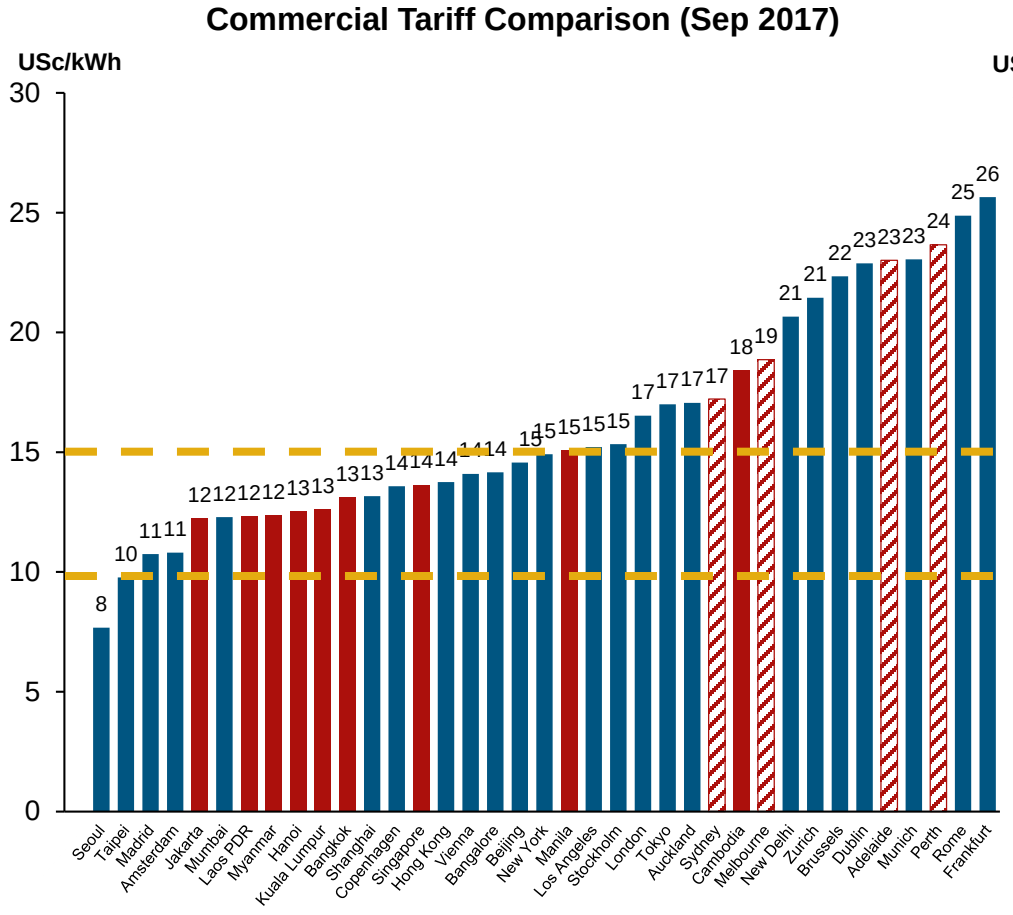
Philippines – Slowed but not stopped

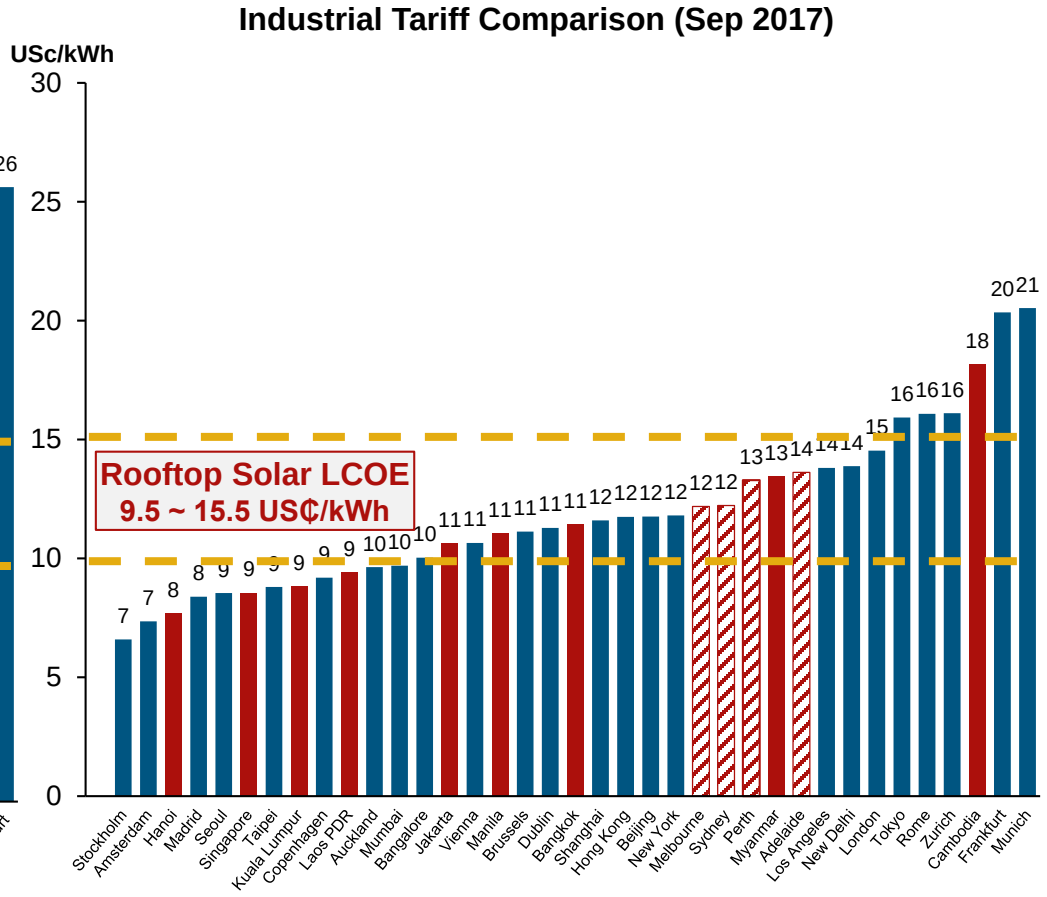
- FiT "one off" – No follow up quotas
- FiT quotas announced in 2014, filled up in 2015
- Developers without quotas sitting on 'stranded" development projects
- Bilateral PPAs signed, but ERC approvals are delayed

Indonesia – Constant regulation changes

- No solar or wind projects in operation
- General PPA standards were revised 3-4 times in 2017 (and no official template PPA for solar and wind)
- First solar tender announced is still pending (after one year)
  - 2017 May: First tender announced – but still pending
  - H2 2018 first solar PPA signed
  - Negotiated wind PPAs used as template for solar

While low and subsidized retail tariffs further reduce the desirability of solar





In many cases, Residential tariffs in the region are even lower due to cross-subsidies from C&I customers

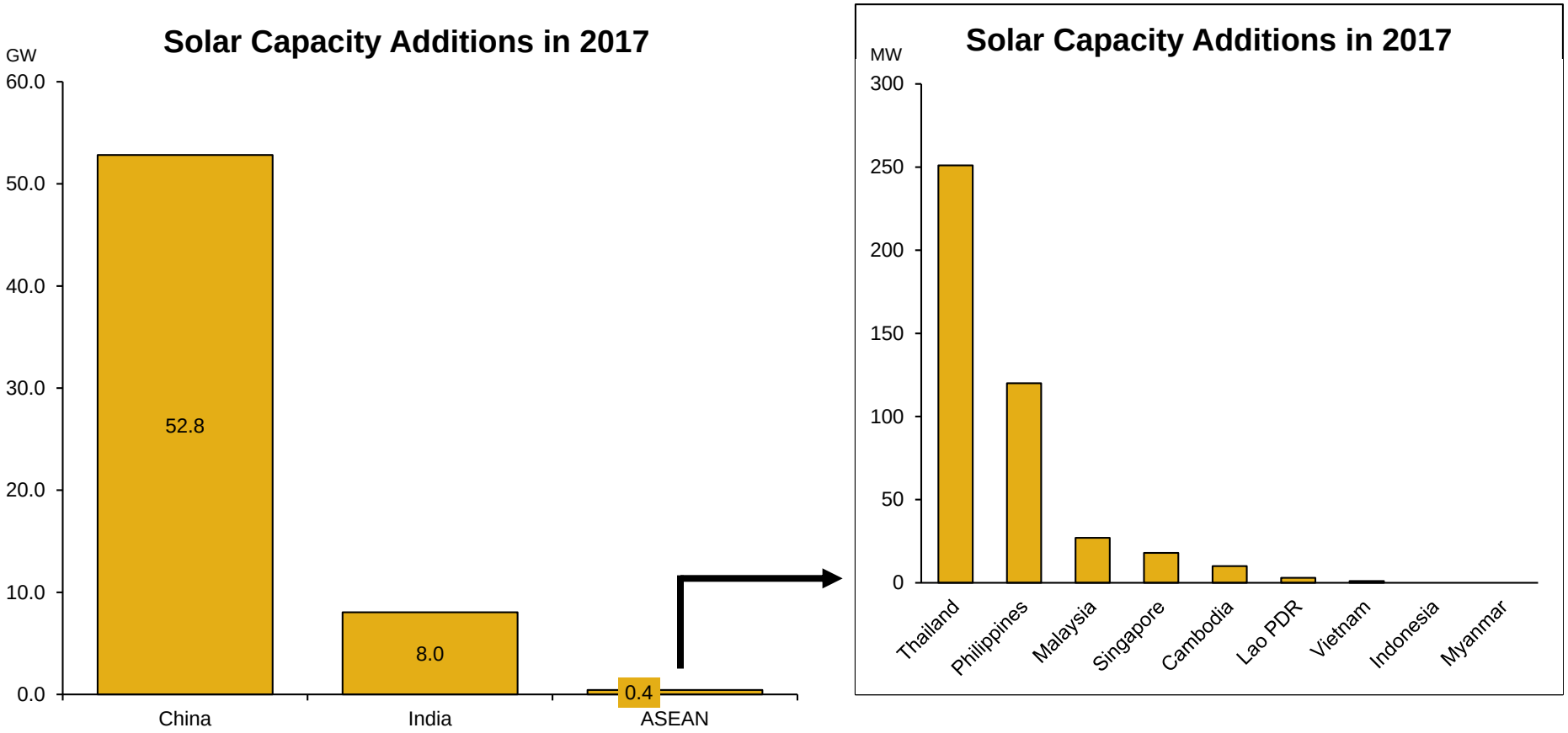
Note: Commercial Tariff consumption based on demand of 1,061 kW and 596 GWh pm, Industrial Tariff based on demand of 4,816 kW and 2,992 GWh pm.

^ Calculations take into account electricity charges, adjustment of imbalance costs or changes in fuel prices (such as ICPT in TNB tariff), renewable energy surcharges, and sales tax, energy tax and any other exercise duties or levies applicable to electricity consumption. Forex adjustments reflect exchange rates in Sep 2017 calculation based on a typical large industrial customer with annual consumption of 26,254 GWh and demand of 3,000 kW and a typical small commercial customer with annual consumption of 277,360 kWh and demand of 42 kW

 Source: TLG analysis

THE LANTAU GROUP

Vietnam has even lagged ASEAN to date…although recent developments mean it could catch up fast

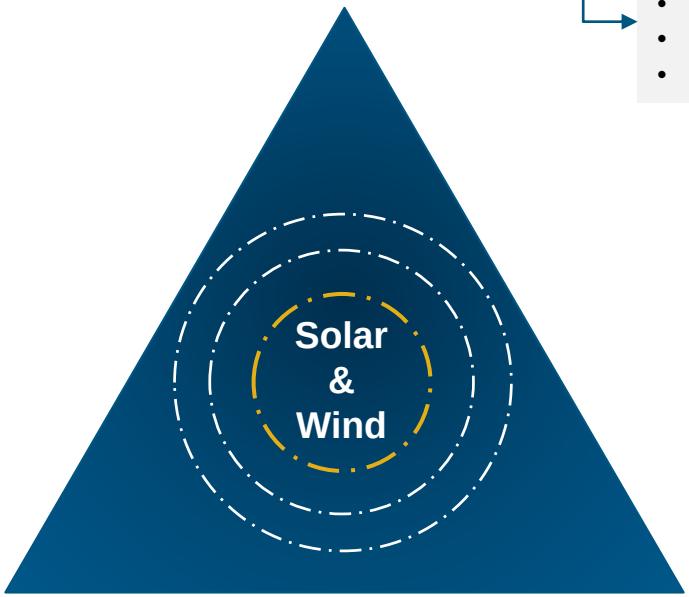


China and India had record years in 2017 – SE Asia region declined from 2016

 Sources: TLG Analysis; MNRE, EPPO, SEDA, EMA, DoE, WWF, RUPTL, News Announcements

So how do we assess the likely trends from here? Start with the fundamentals

Assessing / Projecting Future Solar and Wind Potential in a Market



Need for power!

- Projected supply demand balance
- Demand growth
- Planned projects
- Degree of regional interconnection

Longer term analysis with energy storage

Regulatory Framework

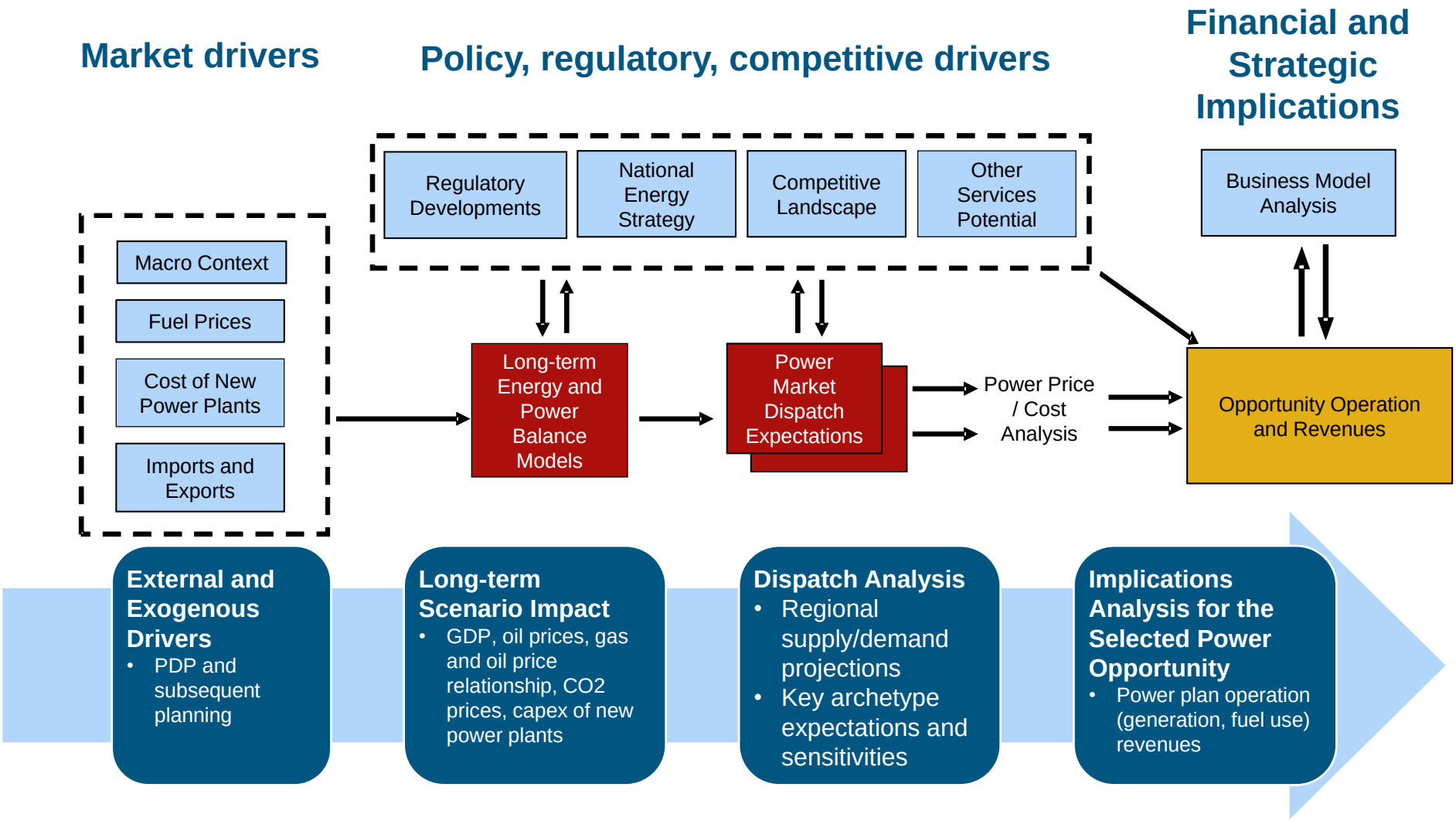
- S&W targets
- FiT
- RPO/GPO other RE incentives
- End-user tariff
- General industry regulation
- Market structure

Solar & Wind Generation Cost

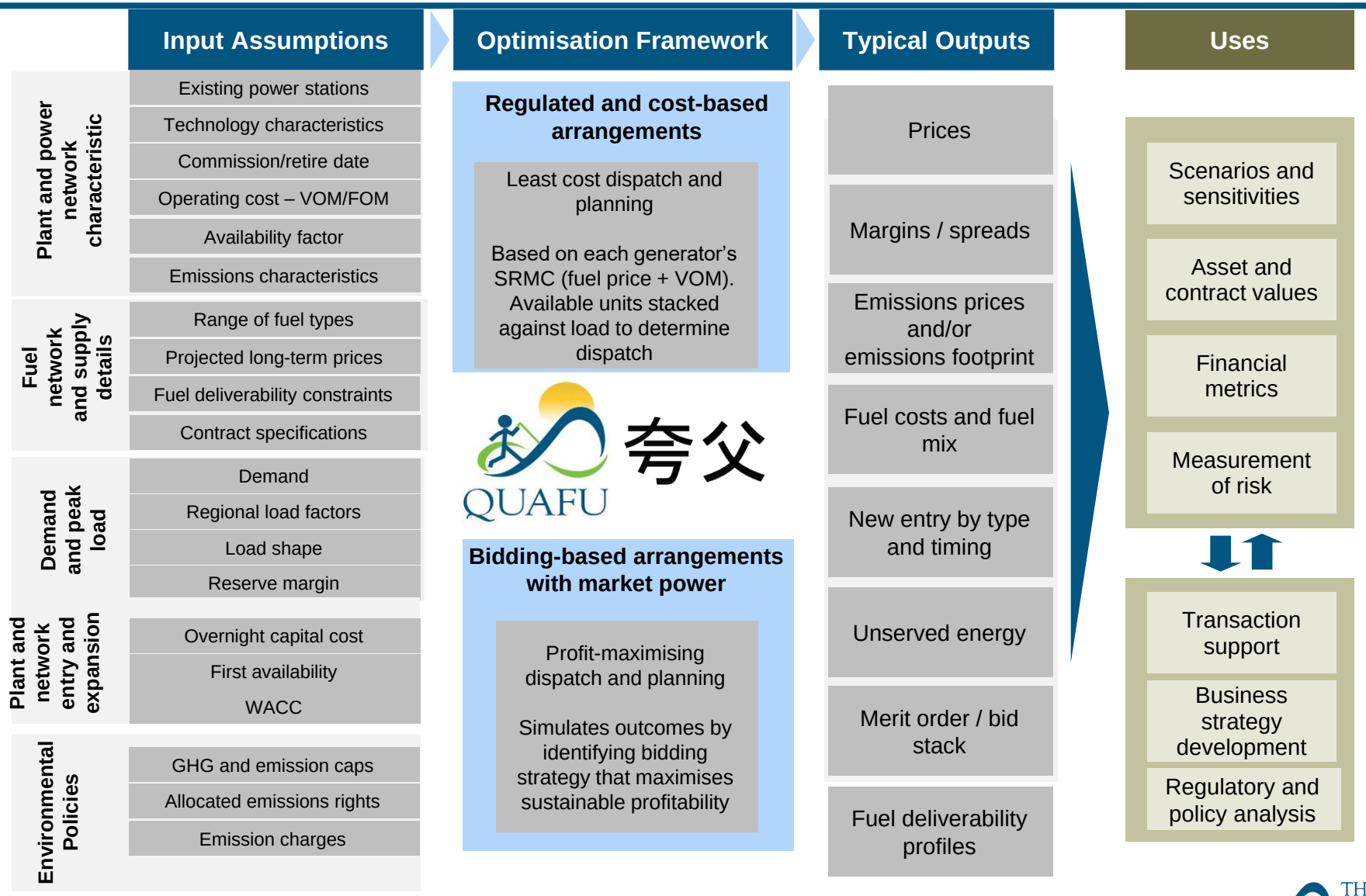
- Relative LRMC of S&W
- S&W resource
- Seasonality – S&W resource / other generation / demand load
- Diurnal profile – coincidence S&W resource vs demand load

THE LANTAU GROUP

And then work through the implications



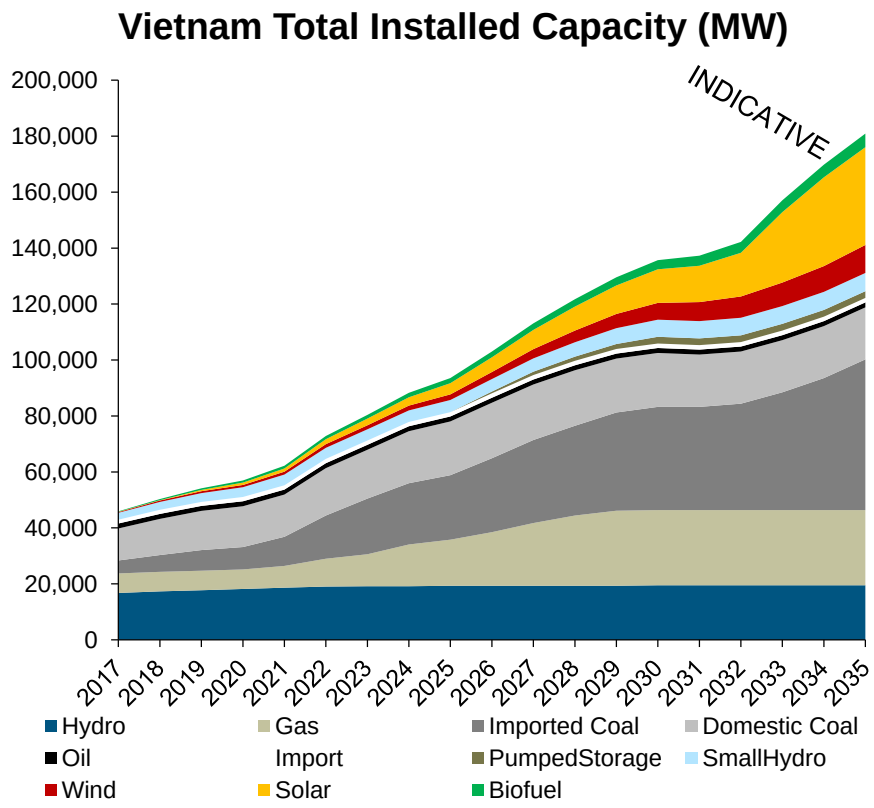
We also have a model which allows us to see which new plant is economic

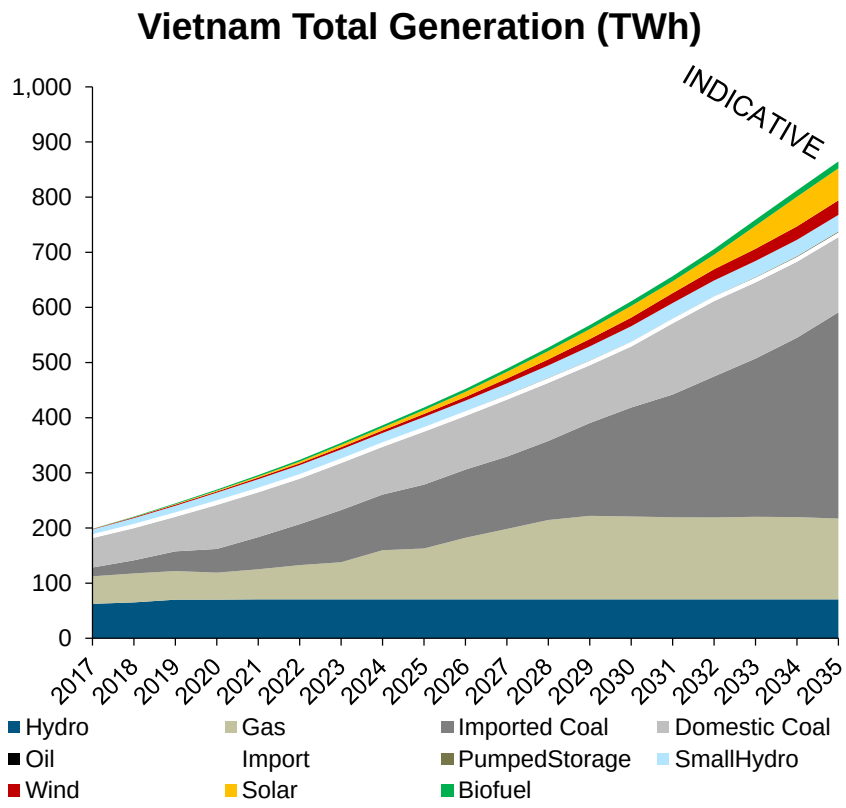


QUAFU – 夸父 in Chinese characters – is a legendary character in a Chinese folk tale. Quafu chases the sun in order to relieve the suffering of his people from a harsh drought. Chinese grandparents relate this story to their grandchildren in order to inspire them to keep chasing their goals.

THE LANTAU GROUP

Using our model, we see coal generation still expected to dominate the foreseeable future in Vietnam, bucking regional and global trends



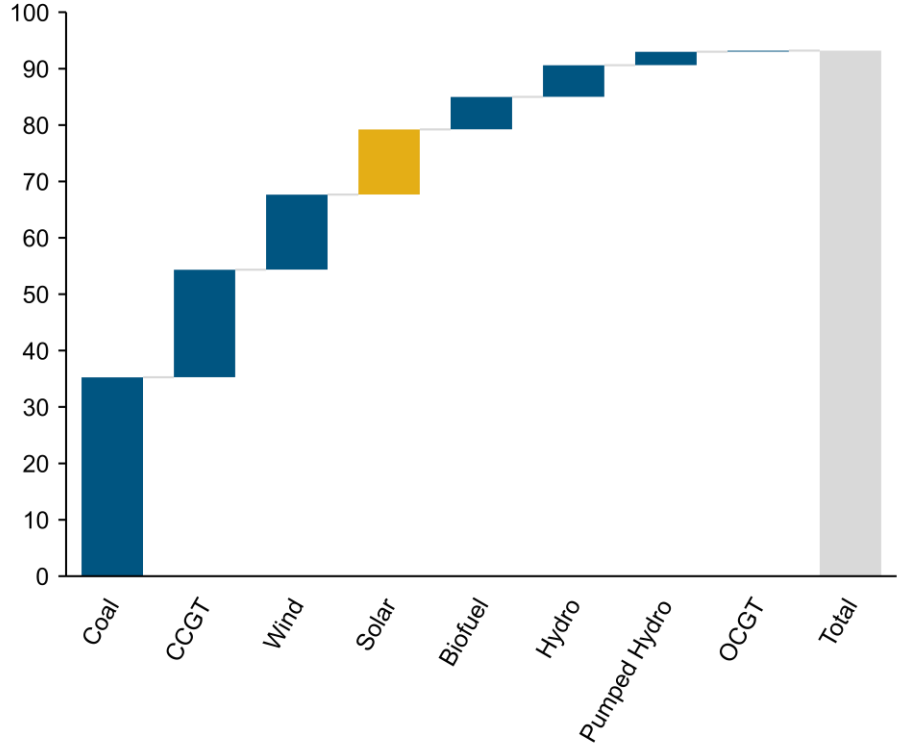


- Coal is expected to continue playing a key role in meeting rapid demand growth in Vietnam
- However, under our base assumptions we see large amounts of solar capacity enter the system

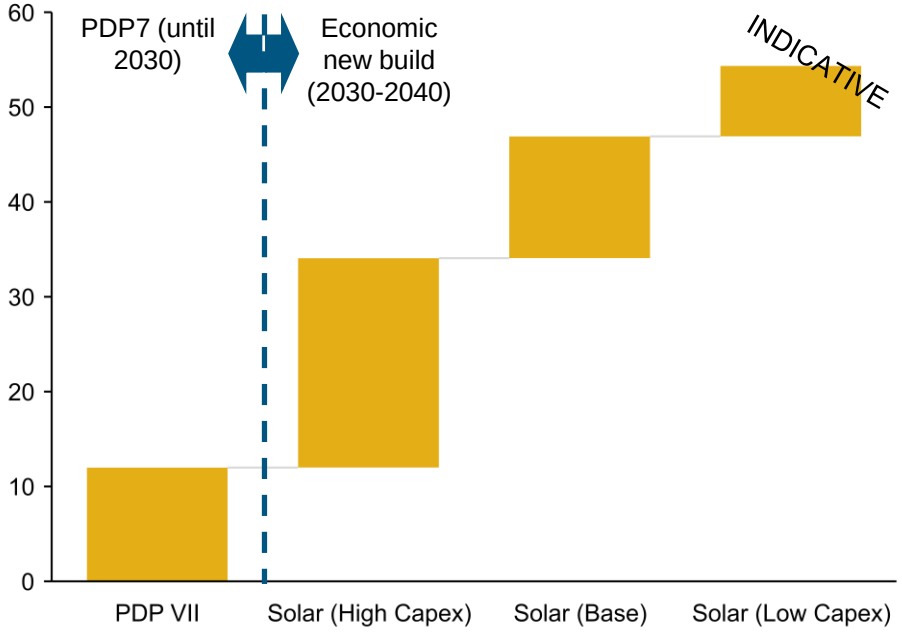
 Source: TLG analysis

In this example, we plug in the PDP 7 solar capacity entry to 2030, but large amounts of economic entry are expected as costs fall in the future

PDP7 Committed Capacity Entry to 2030 (GW)



Projected Solar Capacity Entry to 2040 (GW)



- Solar capacity additions included in the PDP7 (2016) only assume 12,000MW by 2030, though actual development may end up significantly higher thanks to support schemes
- In the longer term, and as capital costs decrease further, Vietnam could see significantly high amounts of economic solar enter the system particularly in the South and Central regions which have favourable irradiance

 Source: TLG analysis

In summary

- Solar is here to stay
- But the technology has moved faster than the ability to keep up with it
- In places with high uptake – such as Europe and Australia – the cutting edge innovations are in system security and managing intermittence
- In ASEAN, the cutting edge is on improving regulatory frameworks and ensuring that the economics of solar are not lost in the subsidy-laded power systems

- This time last year in Vietnam, solar seemed doomed. Today, we see the sun again. Next year, who knows?