Gas vs. Solar Power Economics in Asia

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The Lantau Group

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strategy & economic consulting

As the cost of solar falls and more capacity enters the system, what effect will this have on traditional mid-merit and peaking generation?

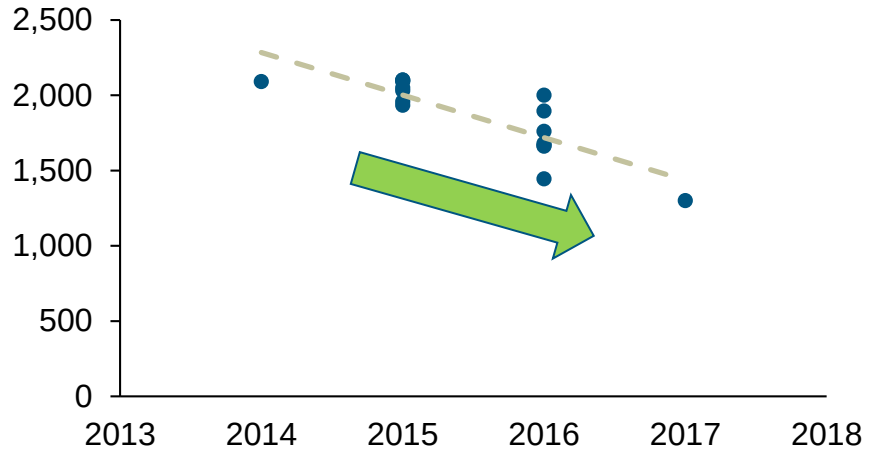
- Solar module costs have dropped substantially
- Renewable penetration has increased in some countries due to policy incentives and lower costs
- While solar generation aligns well with daytime demand, significant solar capacity entry can lead to the 'duck curve' suppressing day-time net demand

Questions:

What effect does high solar penetration have on mid-merit (and peaking) generation (i.e. gas and oil)?

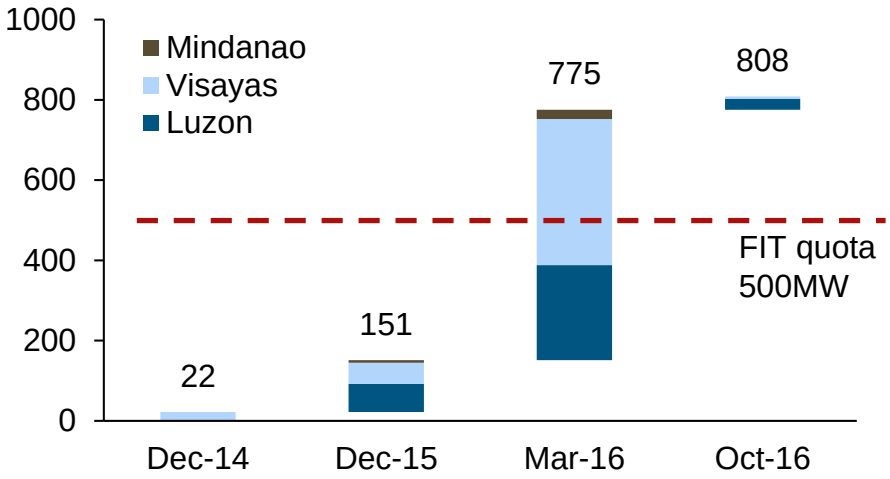
What happens as batteries enter the system?

Indicative Solar CapEx in Philippines (US$/kW)



Source: Media sources

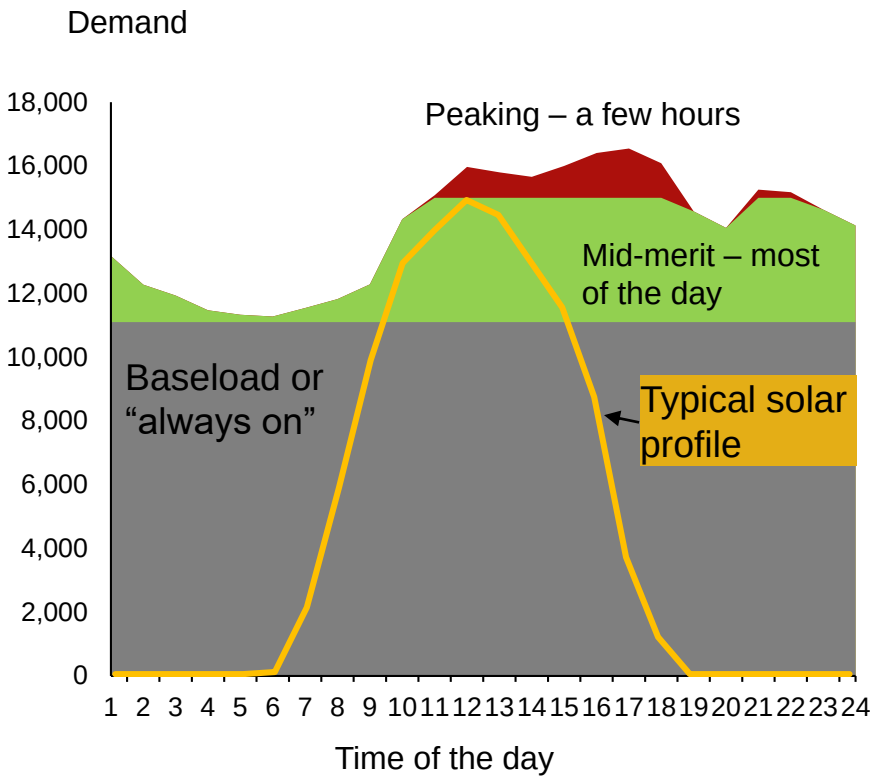
Philippines cumulative new solar entry (MW)



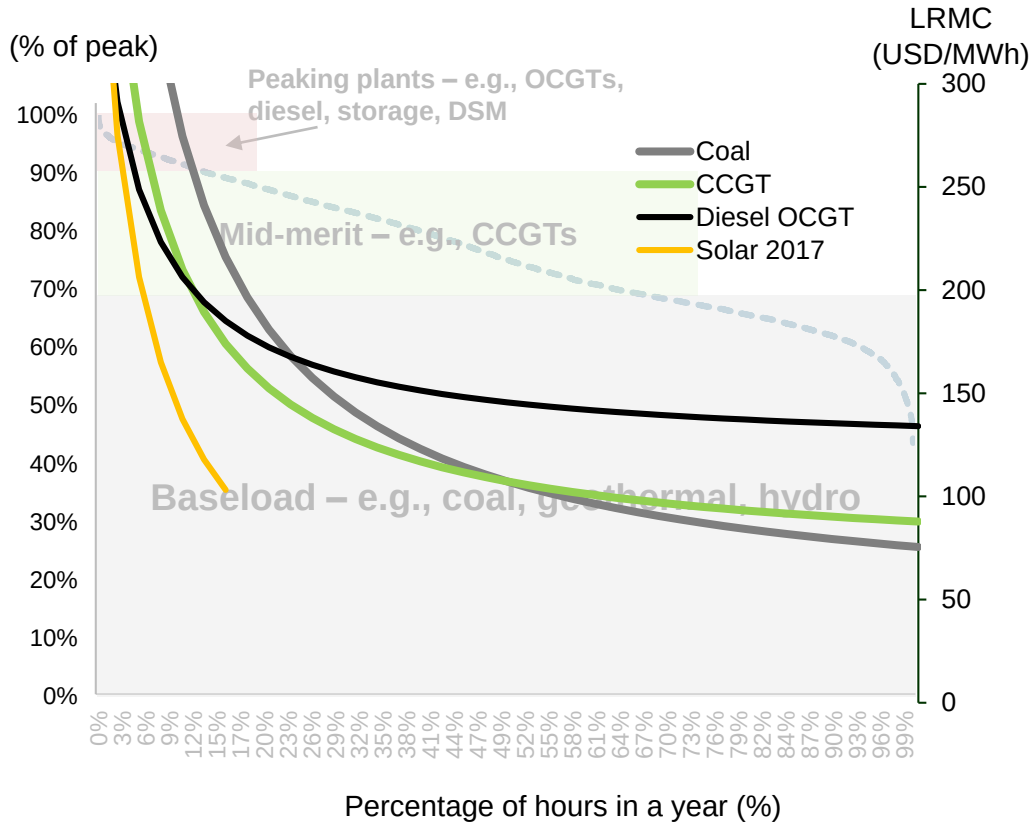
Source: DOE

Mid-merit (and peaking) serve particular areas of demand, but this picture may become obscured as more solar enters generating during daytime peak hours

Hourly demand profile

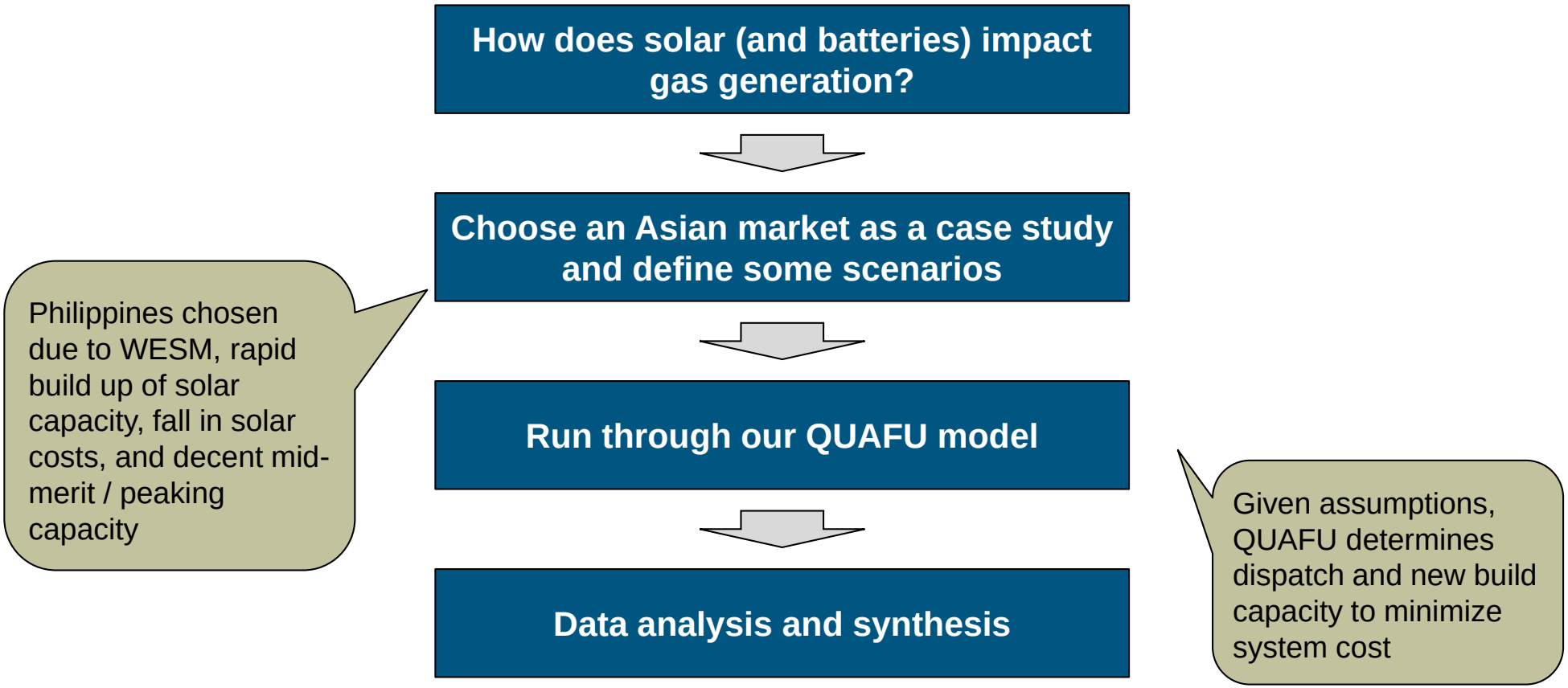


Load-duration curve



Everything starts with the need to meet demand…
Dispatch is about how to meet the load in the least cost way

We used our QUAFU model to test the impact of falling solar costs on the mid-merit (and peaking) market in the Philippines as an illustration



Two cases were considered: Solar only (no batteries) and hence lower CapEx; and Solar/Battery which is able to capture the evening peak

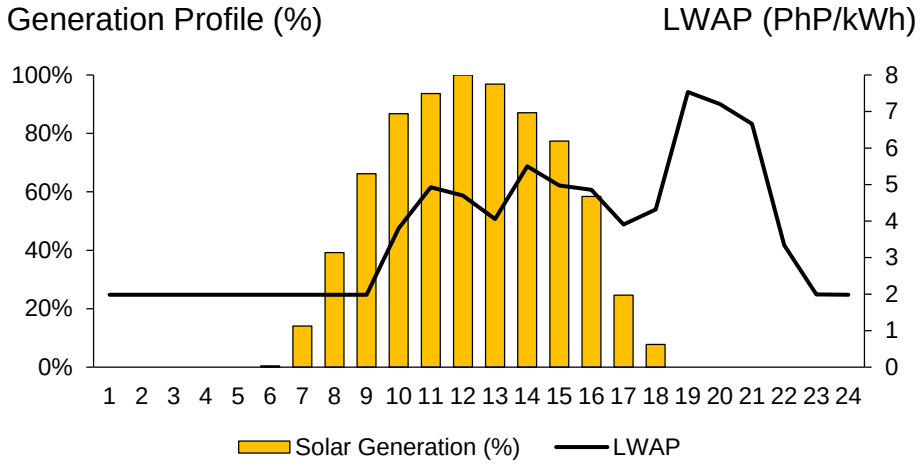
Solar Only Scenarios

- No Battery System included
- Typical solar generation profile
- Four solar module cost reduction scenarios assumed (**Base, Sol_CapEx↓, Sol_CapEx↓↓, Sol_CapEx↓↓↓** which assume increasingly aggressive Capital Cost reductions)

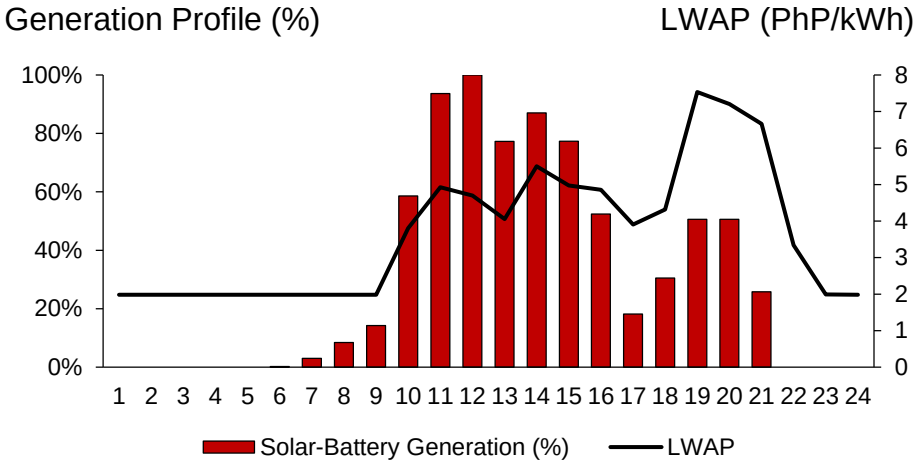
Solar and Battery Scenarios

- 2kWh Li-ion Battery System included for every 1kW solar system from 2020 (only solar until 2020), which charges from solar generation only (not grid)
- Generation profile adjusted to include generation for evening peak where LWAP is elevated
- Same solar reduction costs assumed while separate battery costs (also reducing over time) added

Solar Generation and Luzon Diurnal LWAP



Solar Battery Generation and Luzon Diurnal LWAP

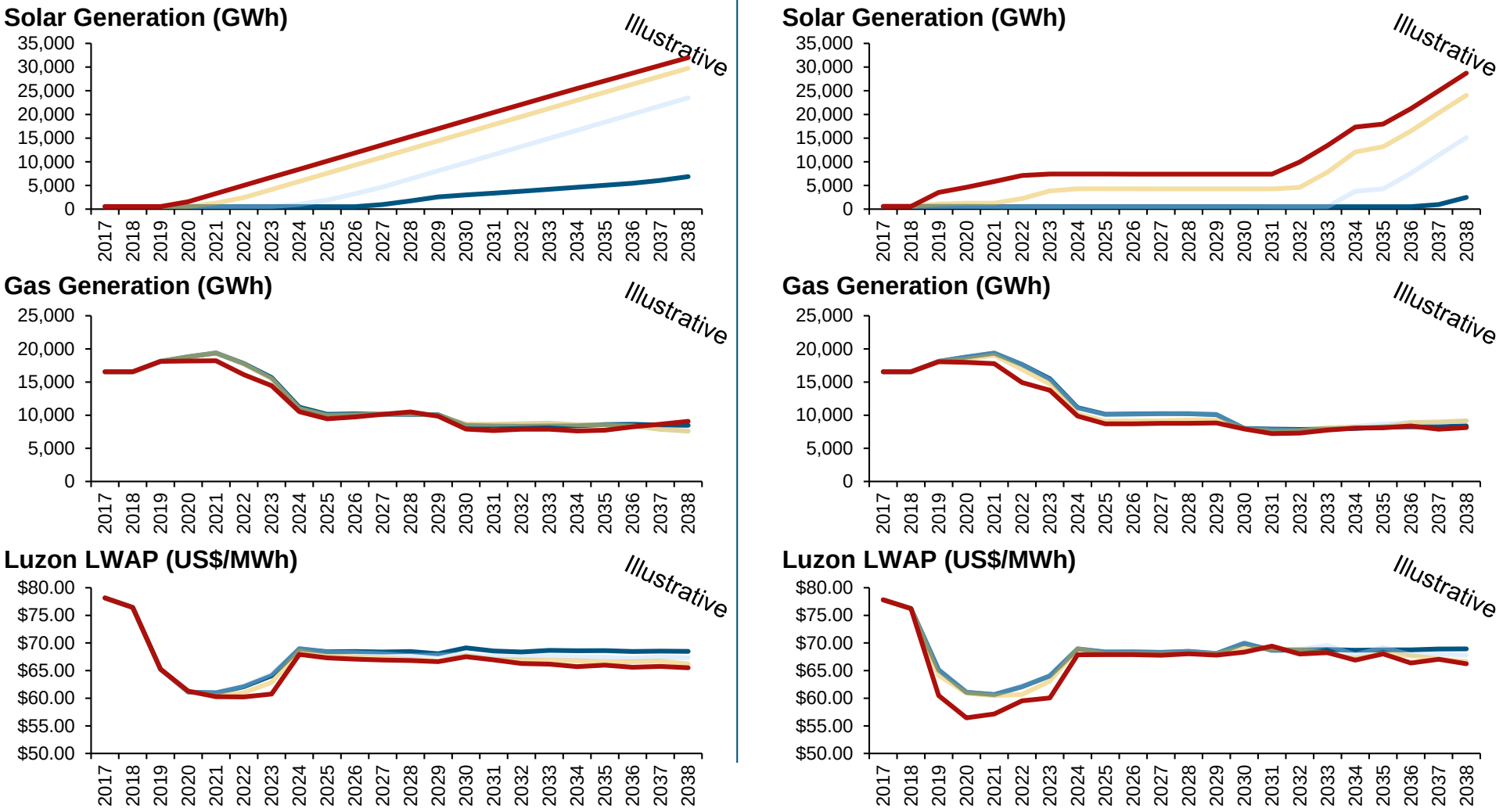


Decision on dispatch and new entry determined by QUAFU

At first glance, it appears that the additional solar entry and generation has a limited effect on gas-fired generation other than slightly lowering LWAPs

Solar Only Scenarios

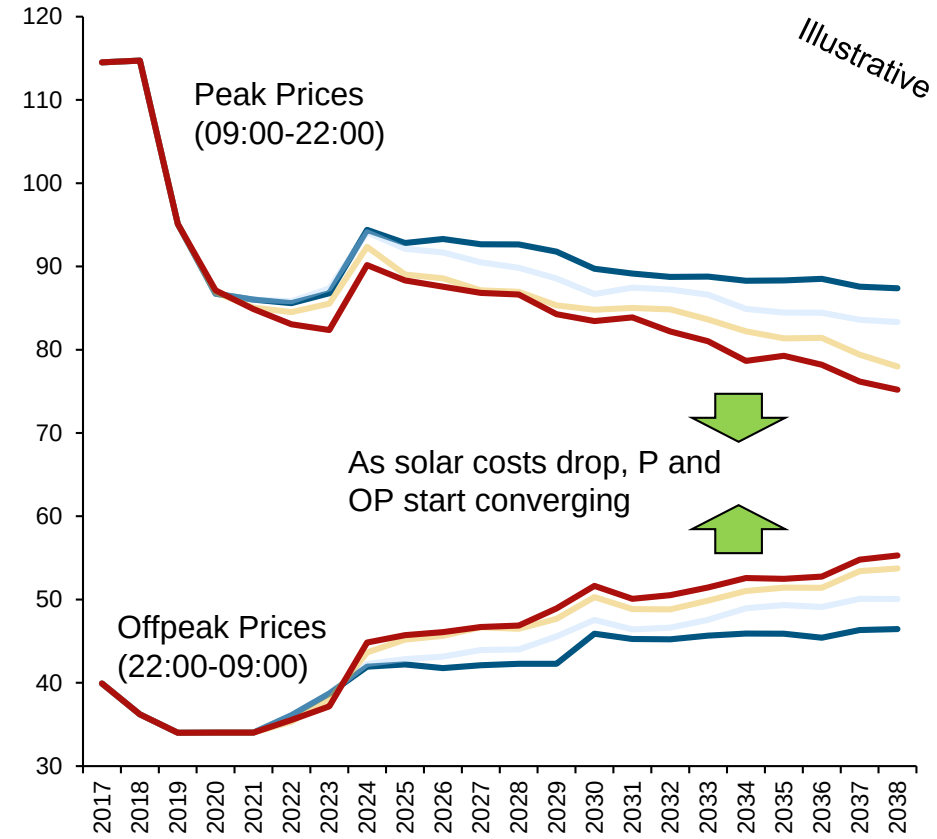
Solar Battery Scenarios



The peak and offpeak prices start converging as solar module prices fall and higher amounts of solar capacity enters the system

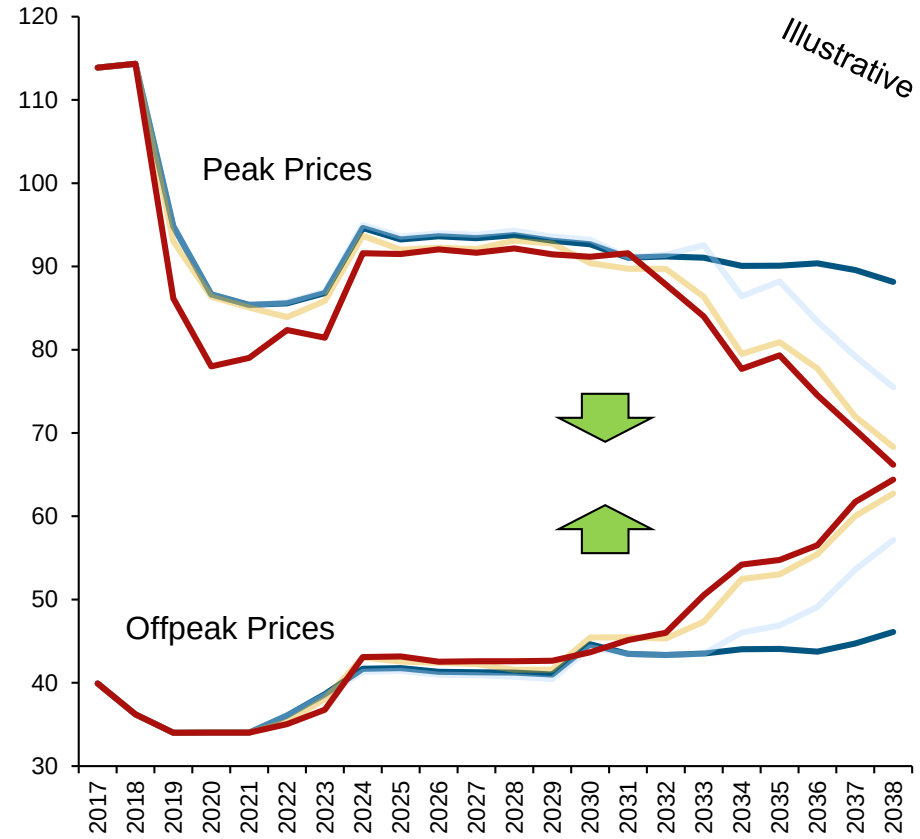
Solar Only Scenarios

Luzon Peak and Offpeak LWAP (US$/MWh)



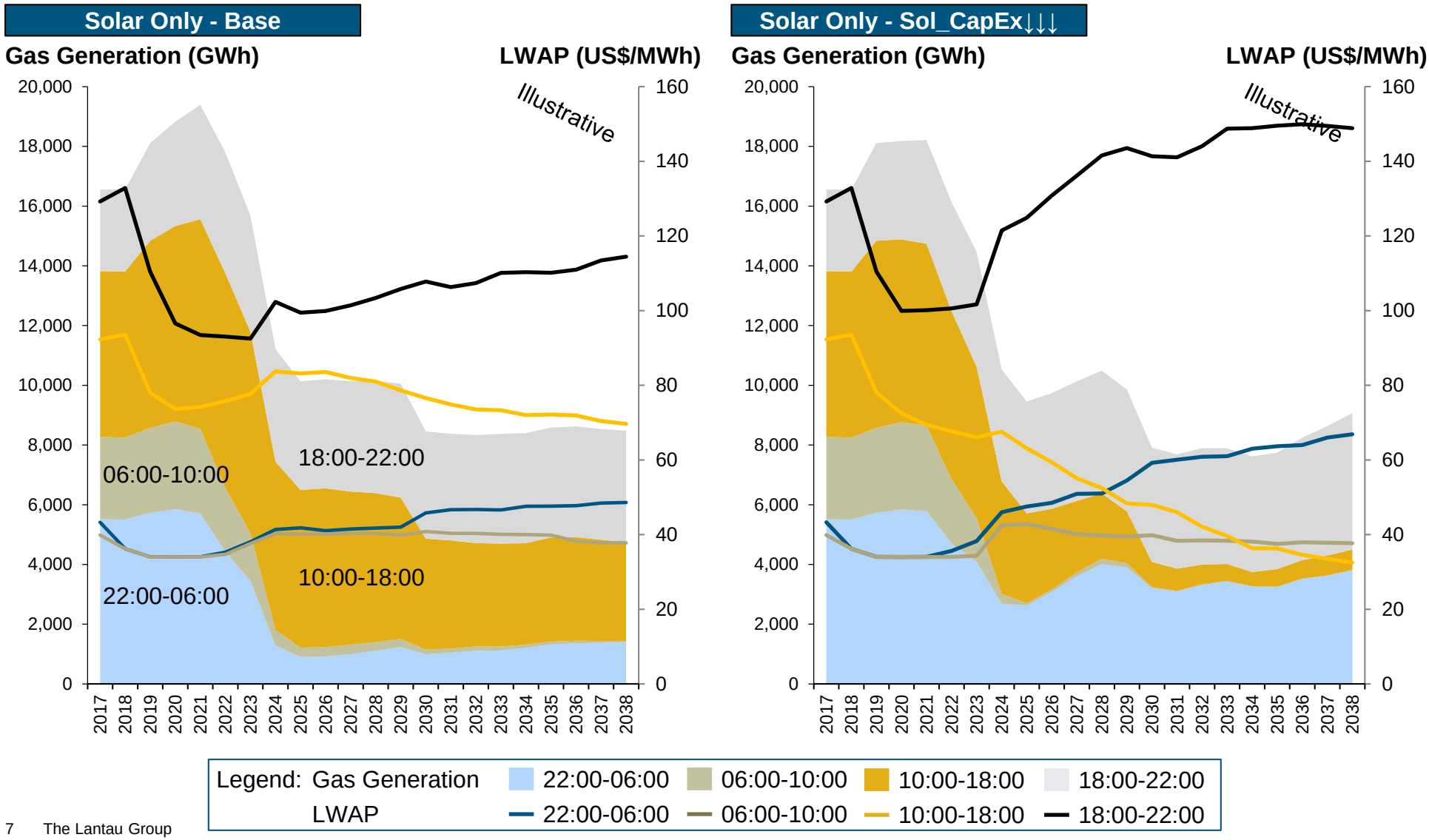
Solar Battery Scenarios

Luzon Peak and Offpeak LWAP (US$/MWh)

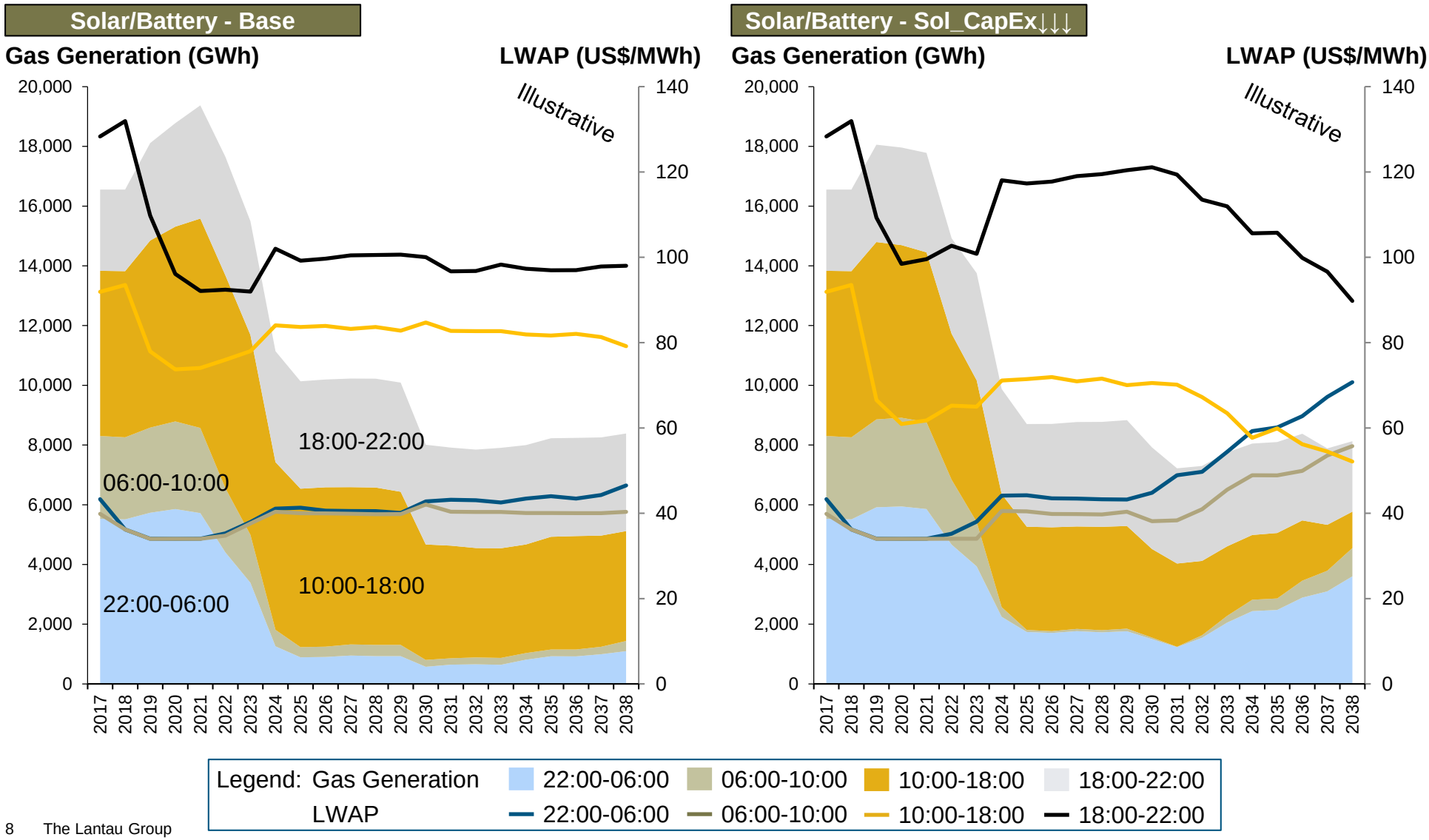


Legend: Base | Sol_CapEx↓ | Sol_CapEx↓↓ | Sol_CapEx↓↓↓

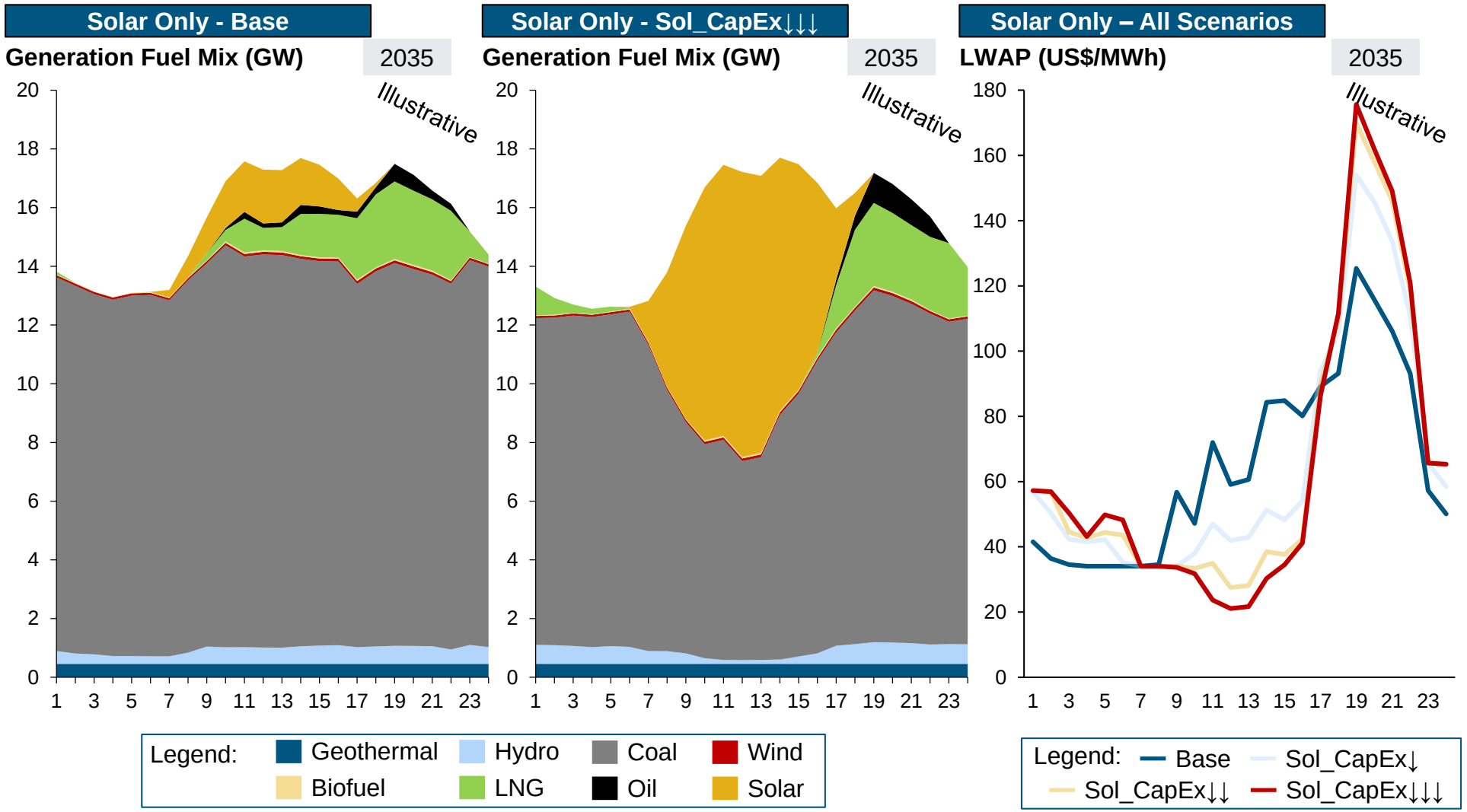
Higher solar penetration shifts gas generation to serve more evening peaks and overnight load, leading to higher evening peak and overnight offpeak LWAPs increase



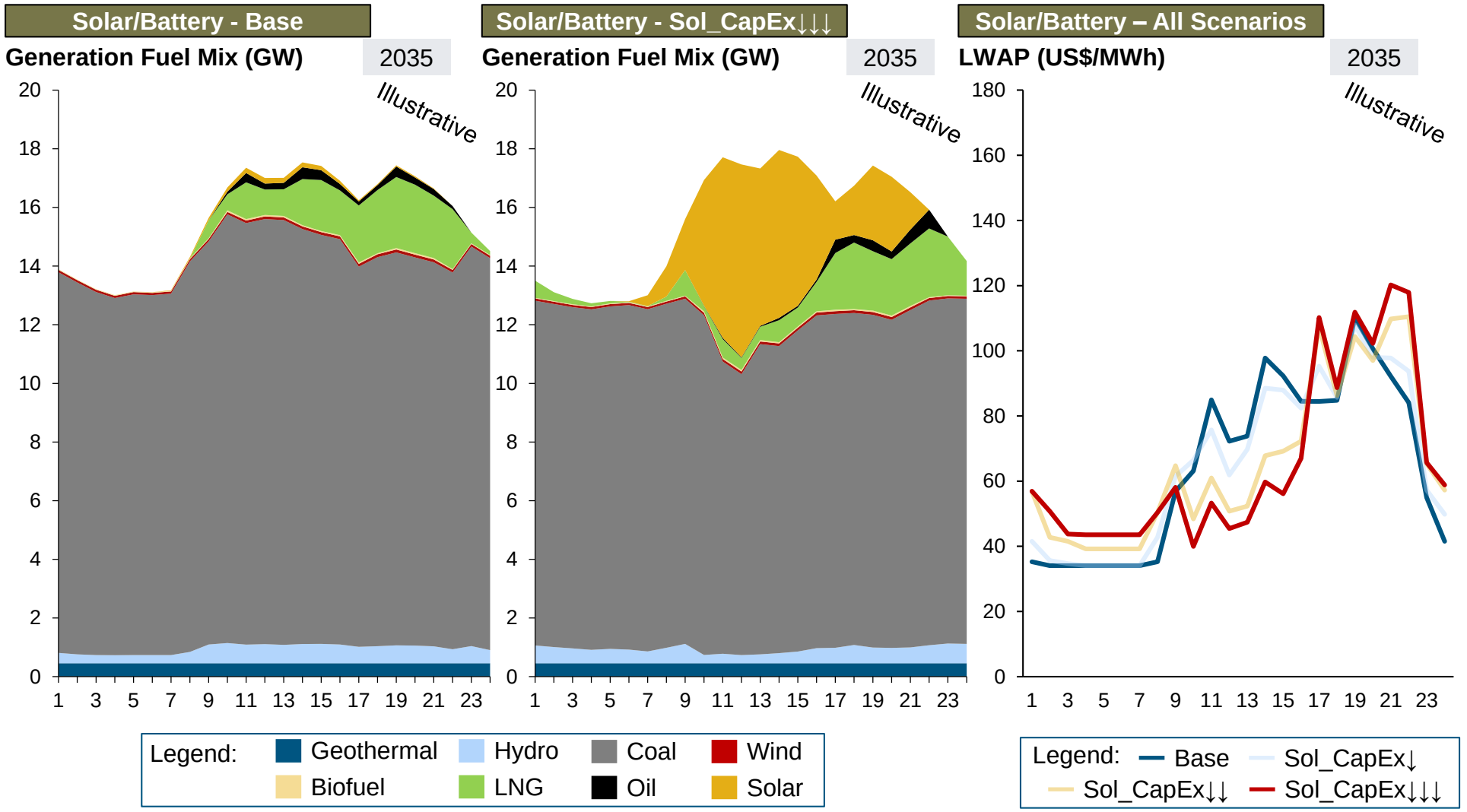
Evening peak prices drop while overnight prices rise as solar-battery systems enter. Gas generation increasingly serves overnight loads



Under aggressive solar CapEx cost reduction scenarios, solar starts accounting for a large proportion of day time generation. Day time average LWAP starts falling, while evening prices begin spiking significantly



Although less solar-battery systems enter the system under the aggressive scenario (due to the addition of battery costs), solar still accounts for a large portion of generation, and evening peak prices appear less extreme

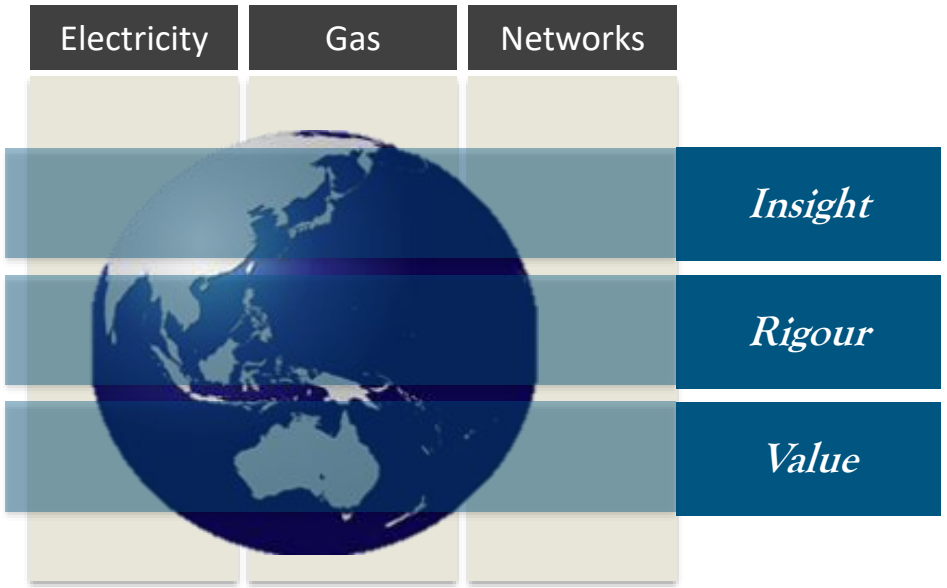


So, what does all of this mean for different players? Flexibility of peakers and mid-merit plants appear to be recognised with solar only scenarios, while this appears less certain when batteries enter the system

	Solar Only Scenarios	Solar Battery Scenarios
Peaking Plants	• Total oil generation increases by 20% (CF~9% vs 7% for base) • Oil generate in evening peak (>75%) and overnight (~20%)	• Total oil generation reduced by 13% (CF ~7% for both) • Oil generation mostly split between overnight and evening, and some daytime
Mid-merit Plants	• Total gas generation increases by 7% (CF~18% for both) • Gas generate in evening peak (>40%) and overnight (~50%)	• Total gas generation reduced by 3% (CF ~18/19% for both) • Gas generation mostly split between overnight (>40%) and evening (~30%), and split over rest
Baseload Plants	• Total coal generation grows over years but in 2038 is reduced by 23% relative to base case, with CF of 76% vs. 86% for base	• Total coal generation grows over years but in 2038 also reduced by 19% relative to base case, with CF of 83% vs. 86% for base

Please remember the solar capital cost reductions assumed in Sol_CapEx↓↓↓ were aggressive!

Thank you



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