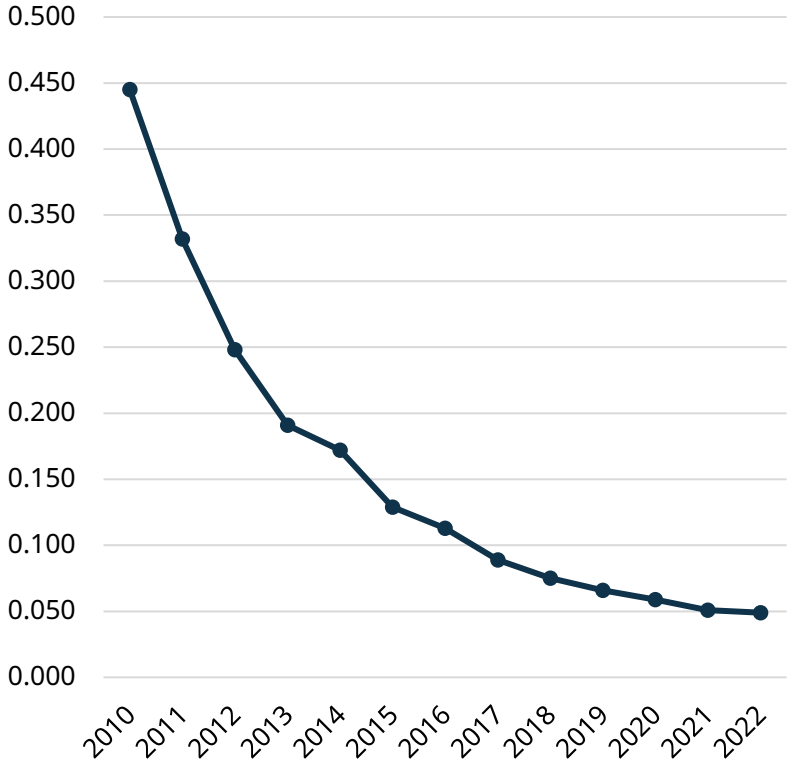
Flexible gas: An enabler of Indonesia's energy transition

Contents

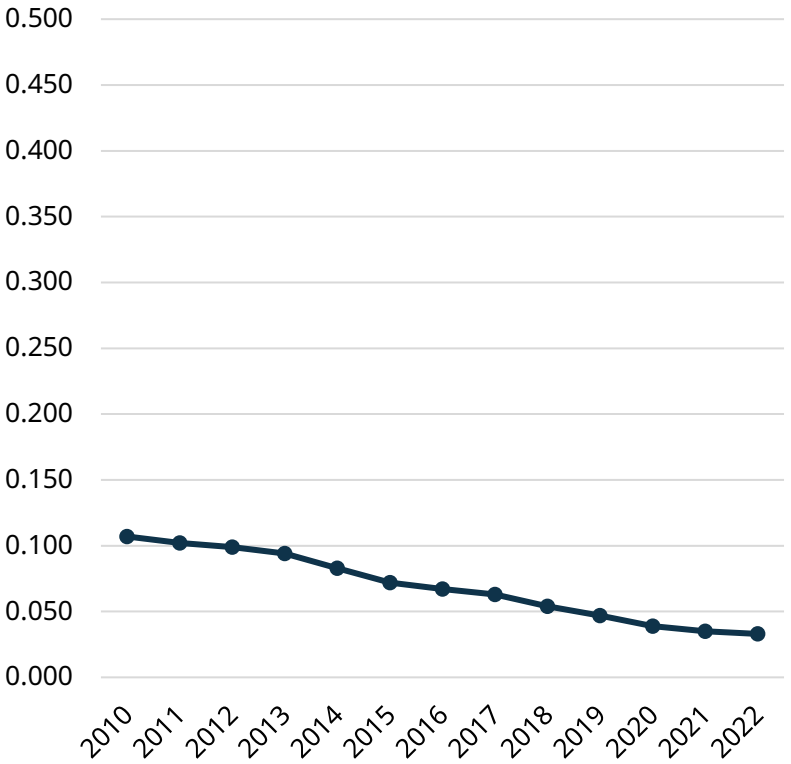
Between 2010 and 2022, Solar and Wind experienced remarkable cost deflation

Levelised Cost of Electricity (LCOE) Solar PV (USD/kWh)



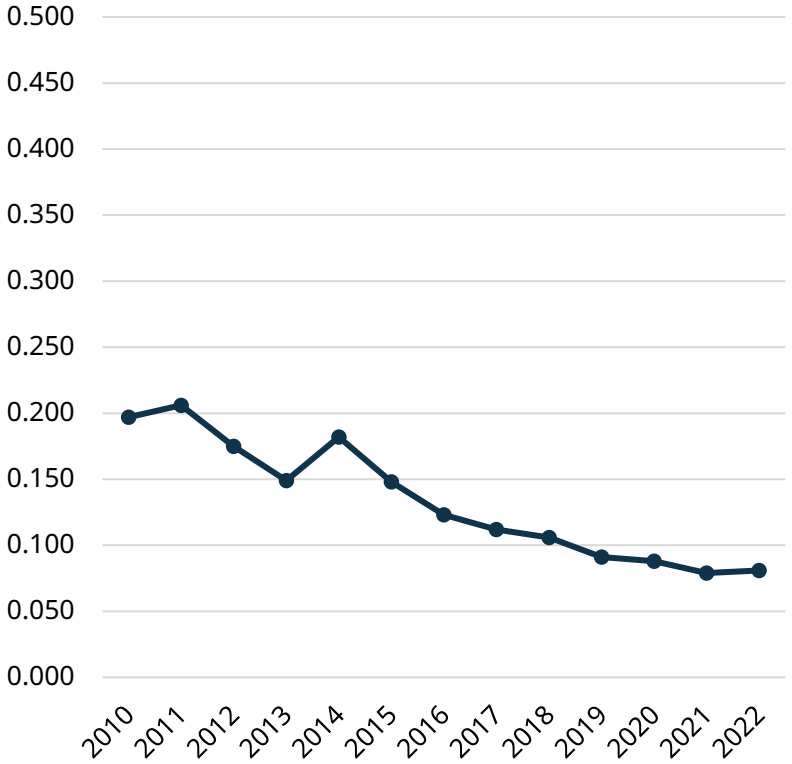
- 89%

Levelised Cost of Electricity (LCOE) Wind Onshore (USD/kWh)



- 69%

Levelised Cost of Electricity (LCOE) Wind Offshore (USD/kWh)

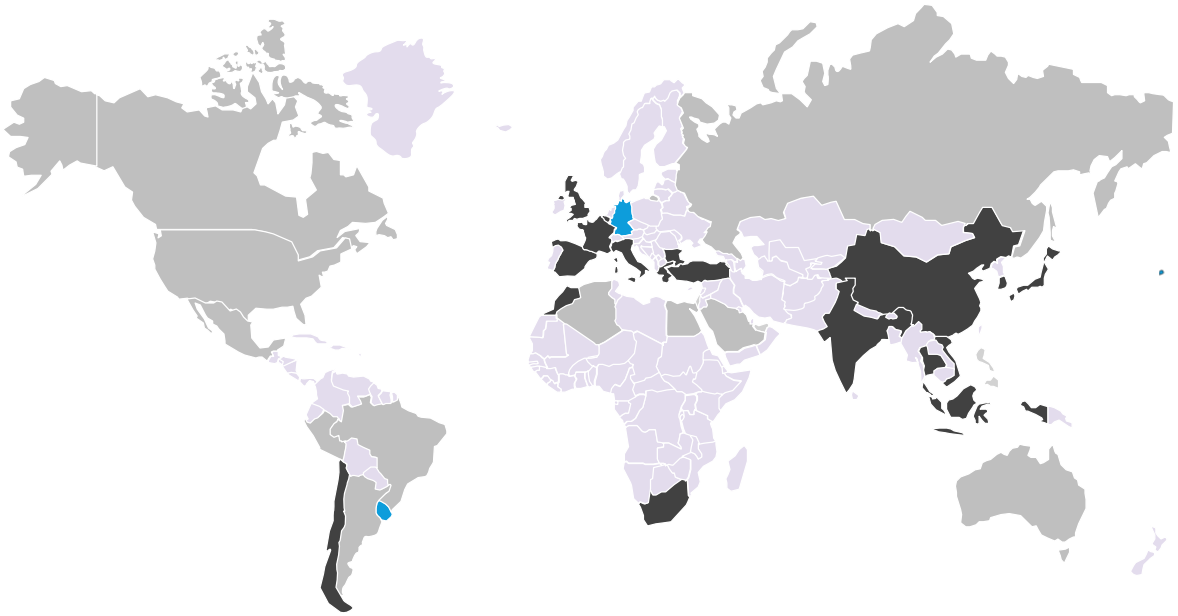


- 59%

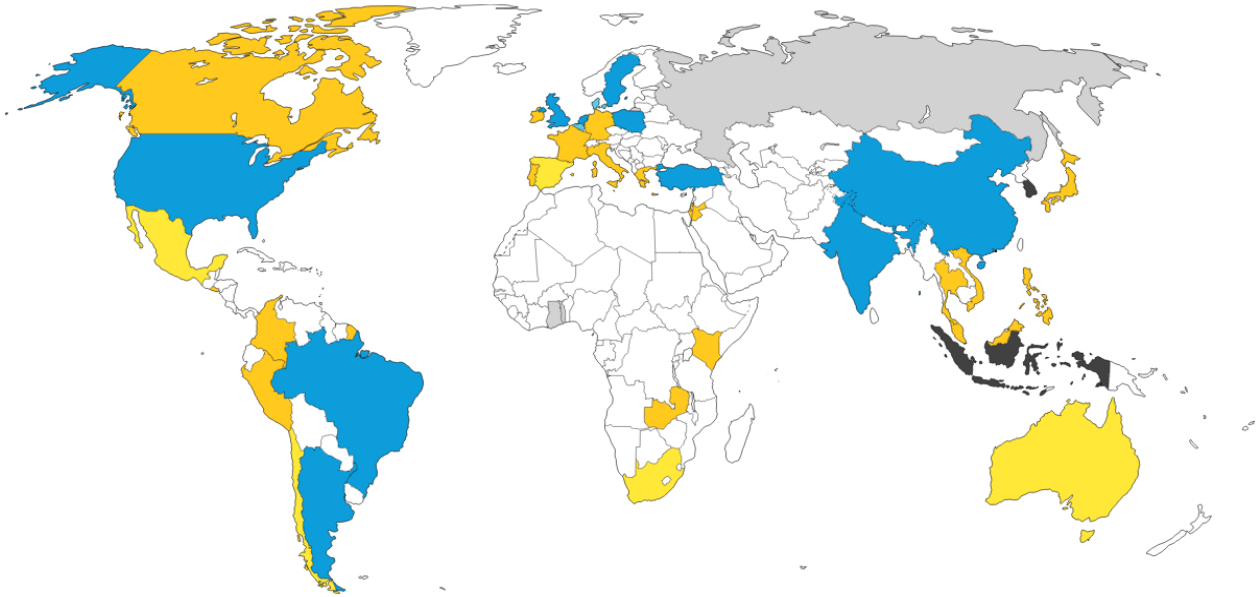
Source: IRENA – Renewable Power Generation Costs in 2022

Renewables is the cheapest source of electricity in countries representing 96% of global electricity generation

Most competitive source of new bulk generation in 2014



Most competitive source of new bulk generation in 2022

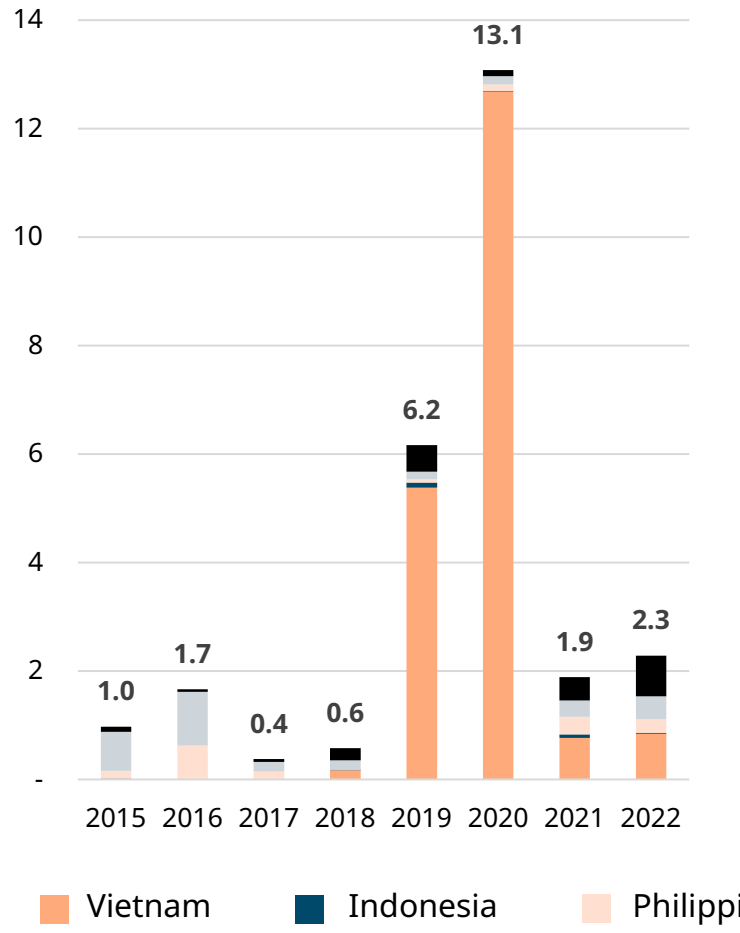


Wind
Solar
Gas
Coal

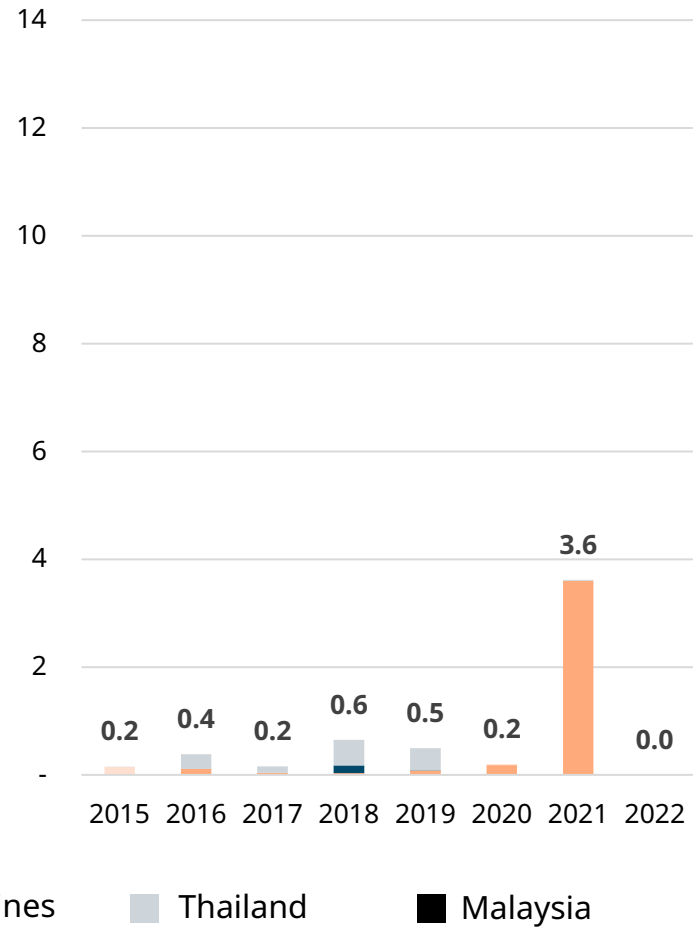
Source: BloombergNEF – 2022 LCOE Update

25 GW of solar PV and wind should be added annually in Southeast Asia

Annual Solar capacity additions (GW)



Annual Wind capacity additions (GW)



Vietnam Indonesia Philippines Thailand Malaysia

25 GW

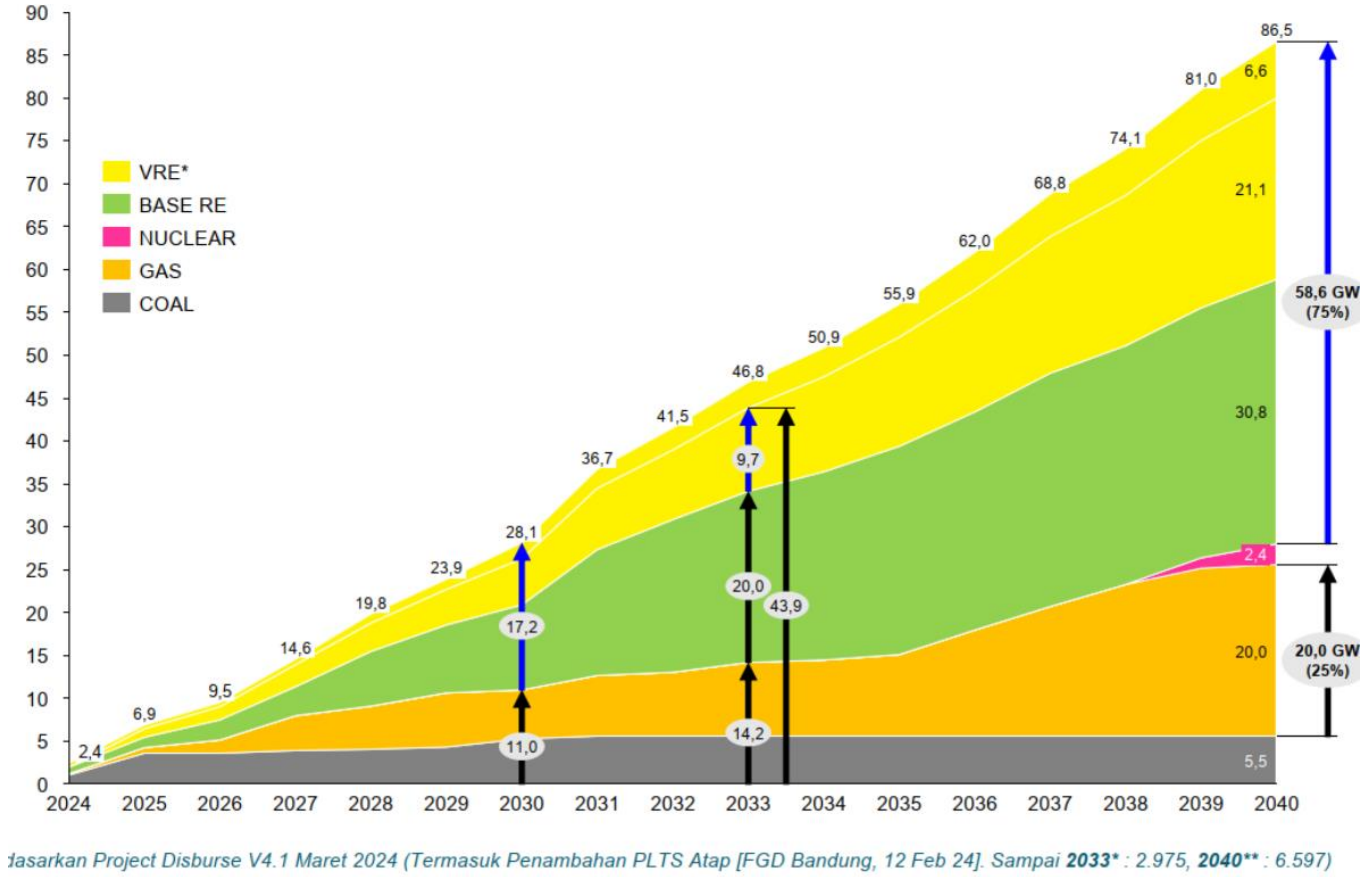
To reach 85% of electricity generation coming from renewable by 2050, more than 17 GW of solar PV and 8 GW of wind should be added in Southeast Asia every year – this is equal to the total installed capacity to date in the region.

Source: IEA – Southeast Asia Energy Outlook 2022

Indonesia gears up to achieve net zero emissions

- Renewable energy: **30 GW by 2033, and 58.6 GW by 2040,** focusing on solar, wind, and renewable baseload (hydro and geothermal).
- **Gas will act as a key transition fuel**, with an additional 9 GW capacity by 2033 and 20 GW by 2040.
- Ensuring system reliability**, PLN emphasizes the importance of flexible generators**, pump storage hydropower, and battery energy storage systems.

Additional Generating Capacity 2024-2040 (GW)
Accelerated Renewable Energy Development (ARED) Scenario



*Berdasarkan Project Disburse V4.1 Maret 2024 (Termasuk Penambahan PLTS Atap [FGD Bandung, 12 Feb 24]. Sampai **2033*** : 2.975, **2040**** : 6.597)*

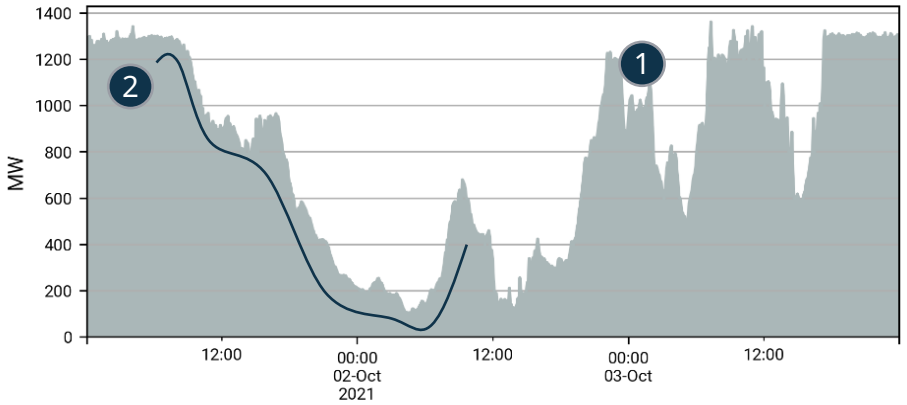
Source: PLN

Wind and solar output vary across all timescales – An example from Australia

1 **Seconds and minutes**

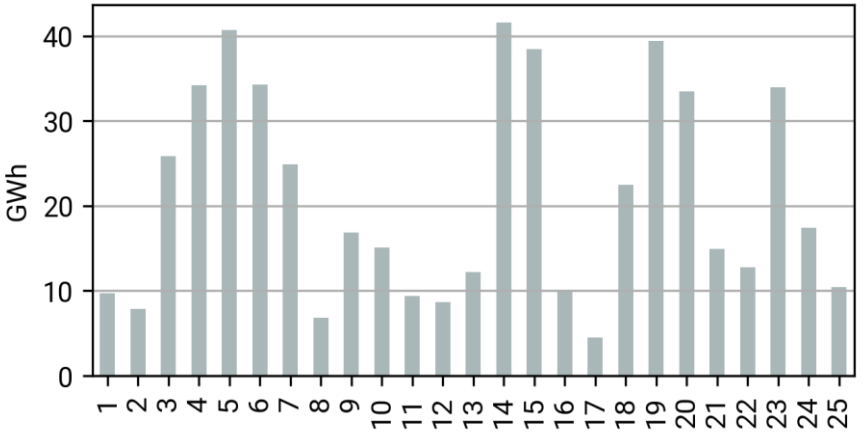
2 **Intraday**

VRE output



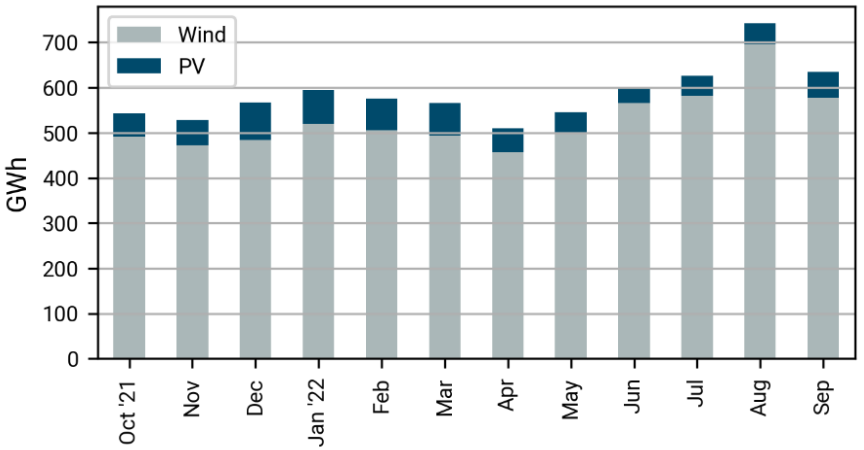
3 **Day-to-day**

VRE daily output, June 2022



4 **Seasonal**

VRE monthly output



Source: Data from Australia National Electricity Market (NEM)

Flexibility is the key to the future power system

Flexibility is the ability of a power system to reliably and cost-effectively manage variability of demand and supply:

- Near instantaneous
- Hourly
- Daily
- Weekly
- Seasonal

Flexible supply

Balancing power plant

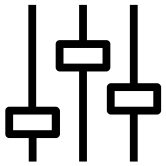
Hydro

Battery storage

Flexible demand

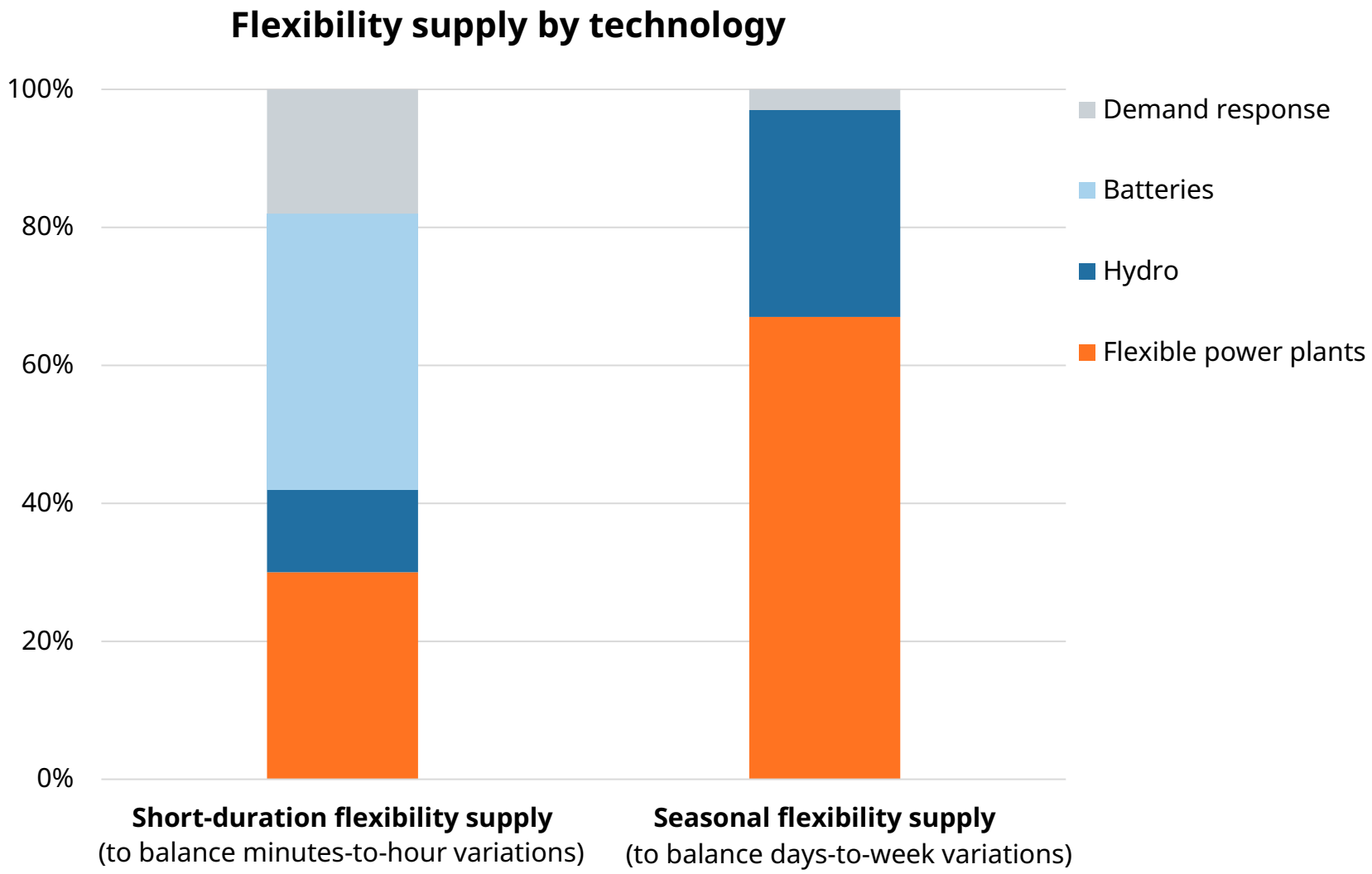
Electrical vehicle

Electrolyser



Demand-side response

Flexibility is needed for both short-duration & seasonal balancing

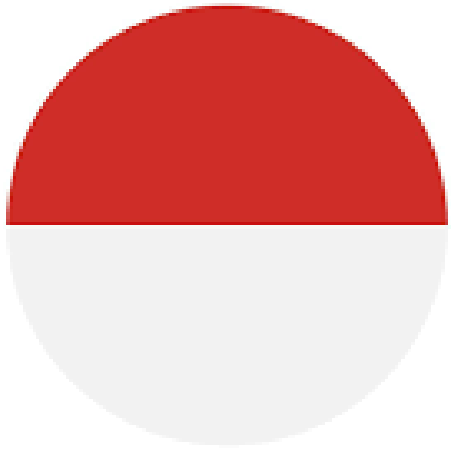


4x

is the increase in flexibility requirements by 2050 due to higher variability in electricity supply and demand

Source: IEA – Managing Seasonal and Interannual Variability of Renewables, 2023

Flexible and scalable balancing power plants in Indonesia, Australia, UK and Argentina

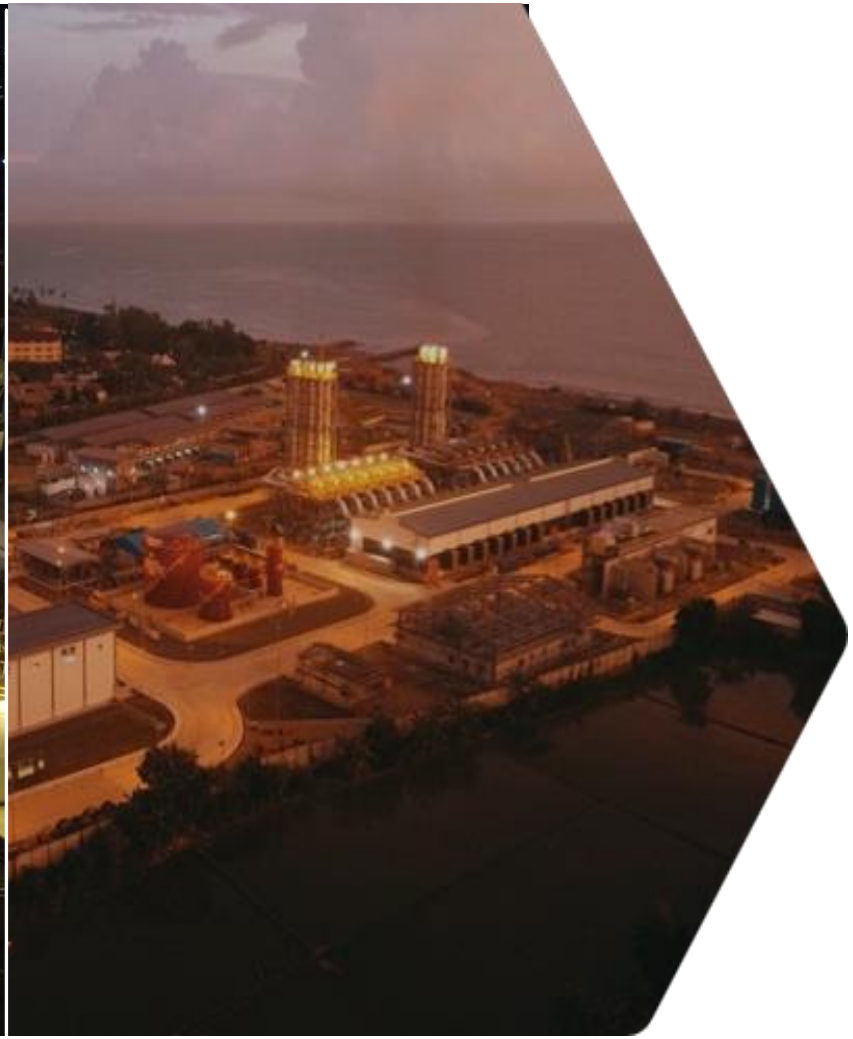



Balancing Power Plants in Indonesia

Arun / 184 MW

Pesanggaran Bali / 200 MW

PT PLN Lombok / 135 MW



Barker Inlet Power Station (BIPS)
An operational thermal balancer in Australia

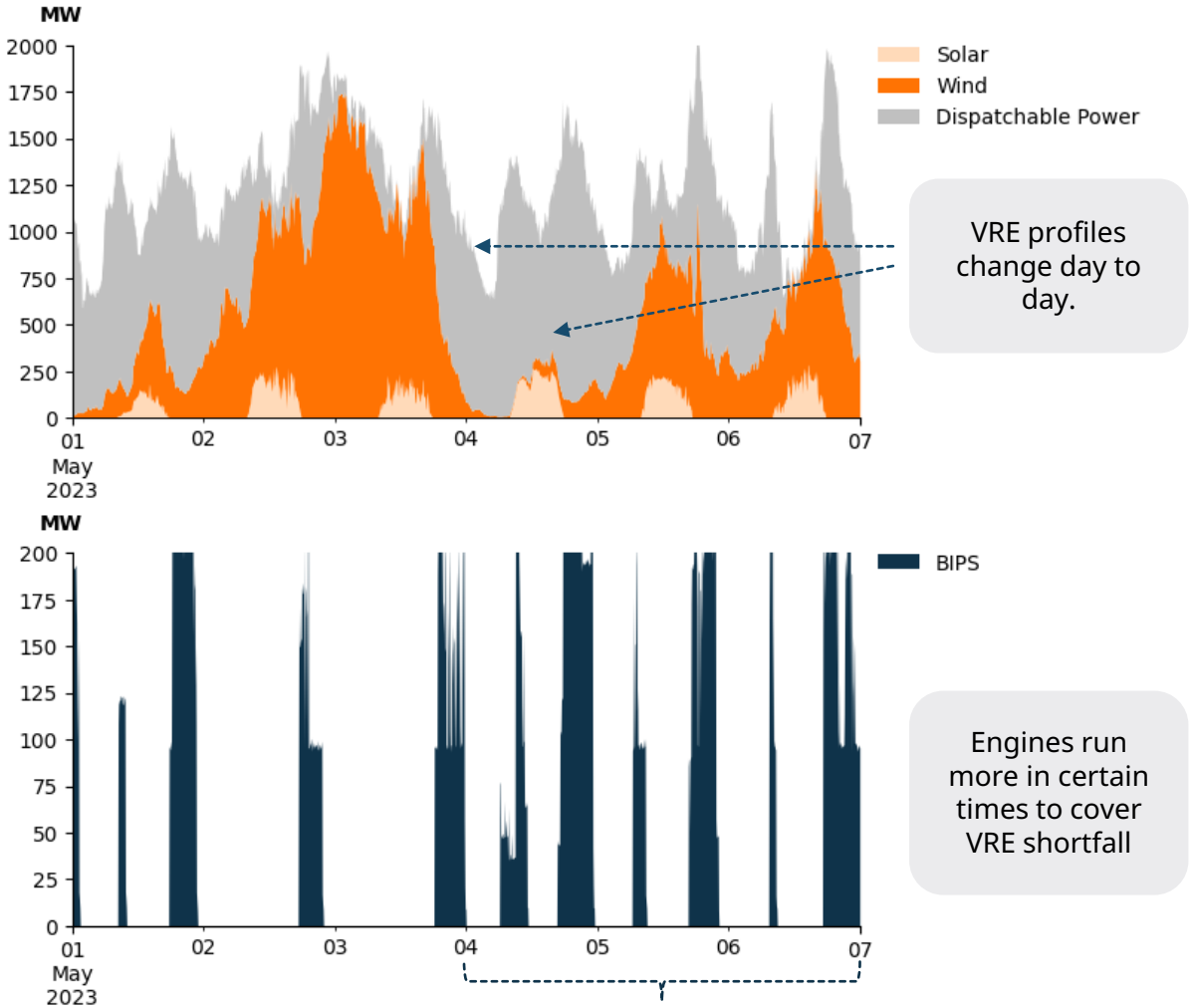
Customer	AGL Energy Limited
Gensets	12x Wärtsilä 50DF
Net capacity	211 MW
Fuel	Dual fuel – primarily natural gas, capable of liquid fuel
Delivery	December 2019
Scope	EPC with 10-year maintenance services agreement

> The influx of utility-scale renewables and rooftop solar means there's a greater need for highly flexible, firming energy sources which can be activated at a moment's notice during times of high demand.
>
> - AGL Energy

Flexible Gas Project of the Year
Asian Power Awards 2020

BIPS: Covering instances of variable renewable energy intermittency

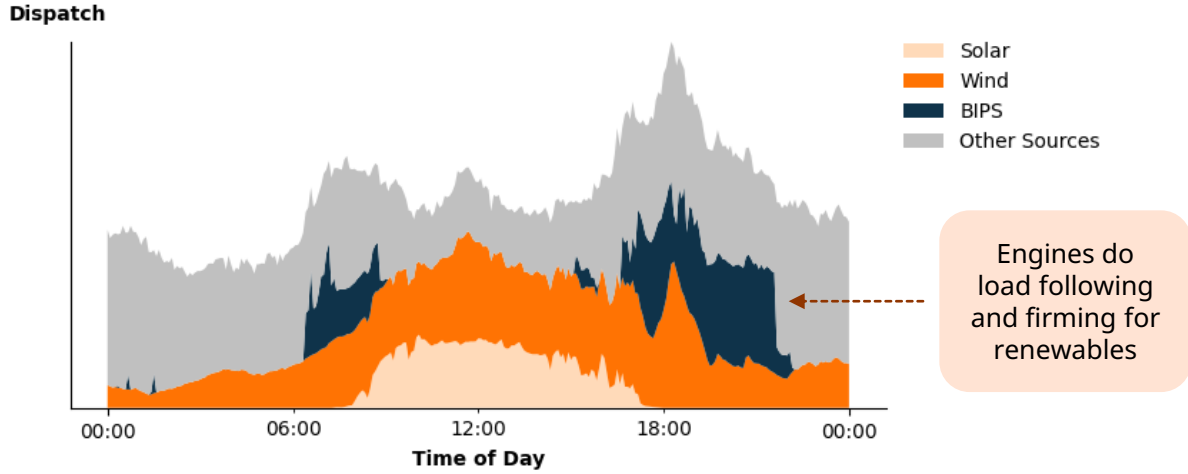
Intermittent VRE and BIPS dispatch, May 1 – 7, 2023



VRE profiles change day to day.

Engines run more in certain times to cover VRE shortfall

Serving net operational demand with BIPS



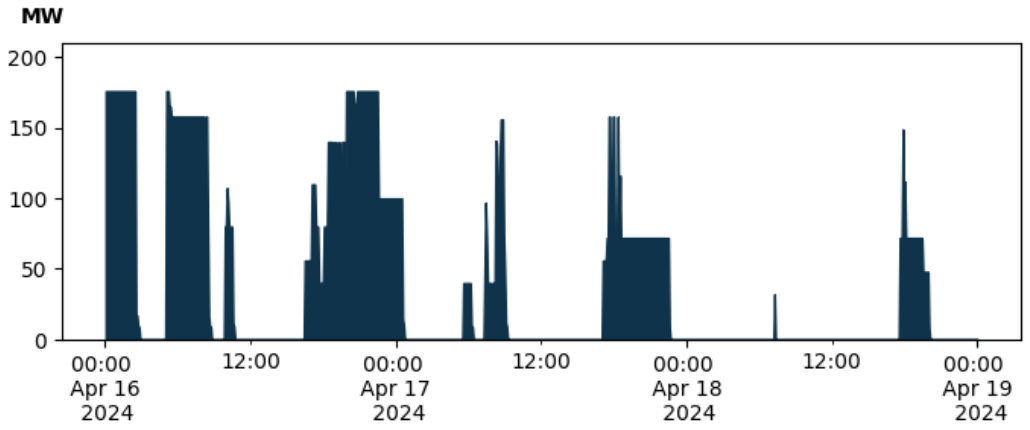
Engines do load following and firming for renewables

Optimise your renewables portfolio with engines

- Firm, stable and reliable power
- Easily adapt to varying load demand
- Renewables can run in full without curtailment

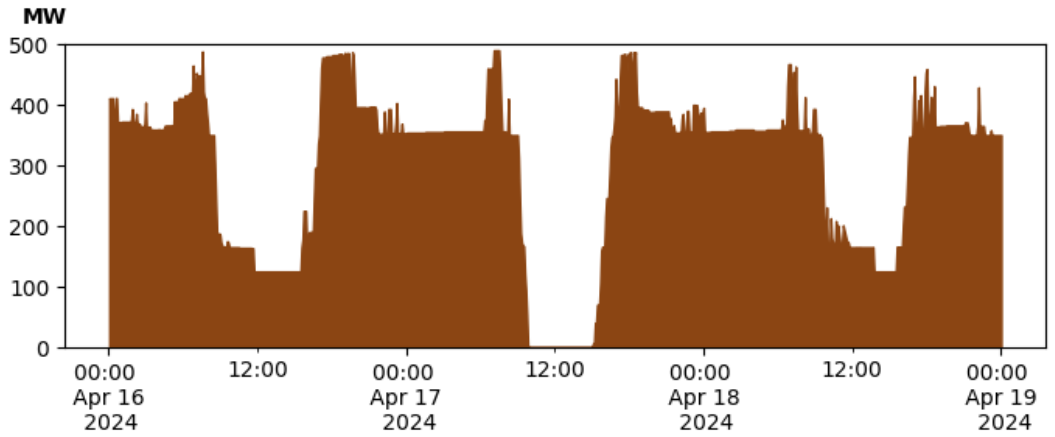
Barker Inlet plays a unique role compared to other assets in the region

ICE perform rapid start-stops, part-loading and load following



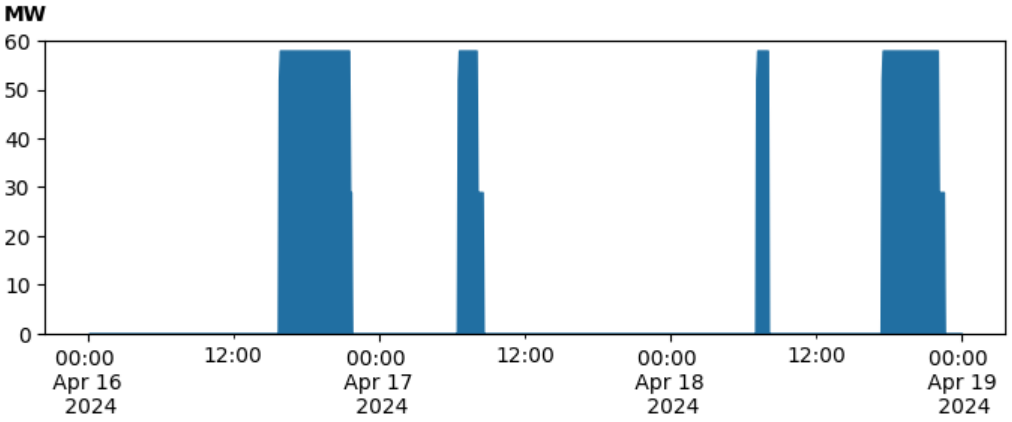
- Barker Inlet – 210MW
  12x W18V50-DF

CCGTs take time to ramp up and down, constrained by minimum load



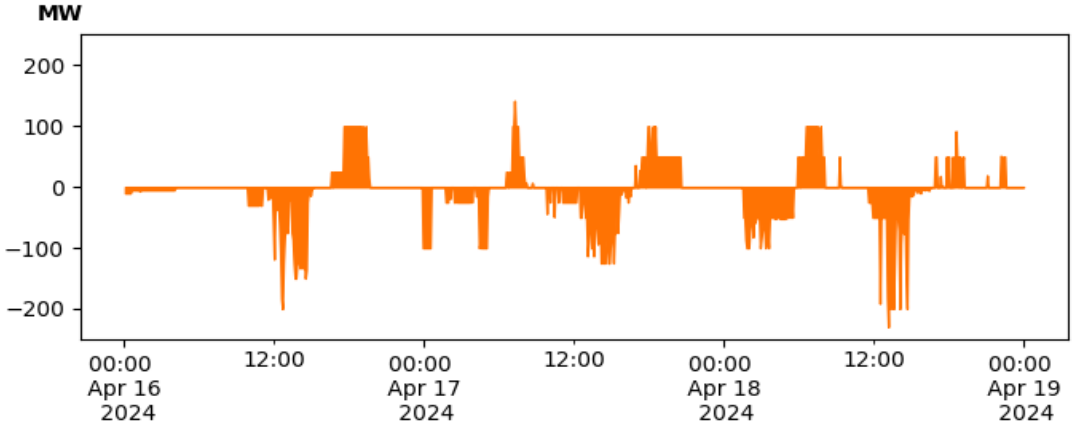
- Pelican Point – 485MW
  2+1 ABB GT13E2

Aeros and other OCGTs provide peaking power in an on-off pattern



- Quarantine 1 and 3 – 58MW
  2x LM2500

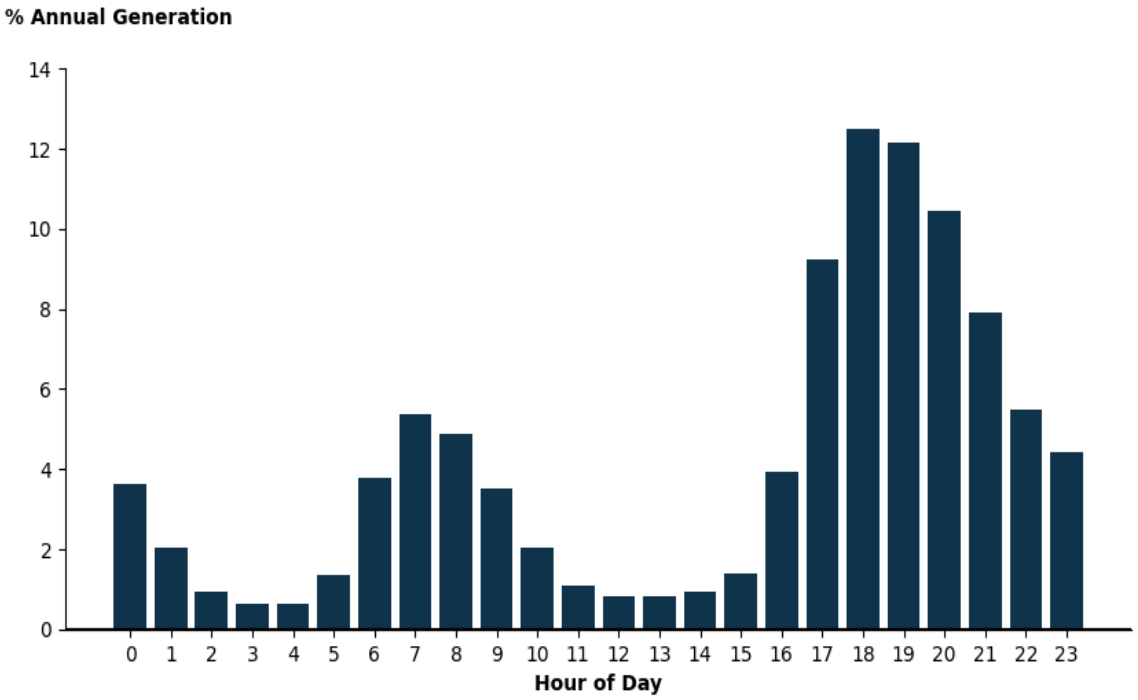
BESS perform rapid energy-shifting, load-following and FCAS



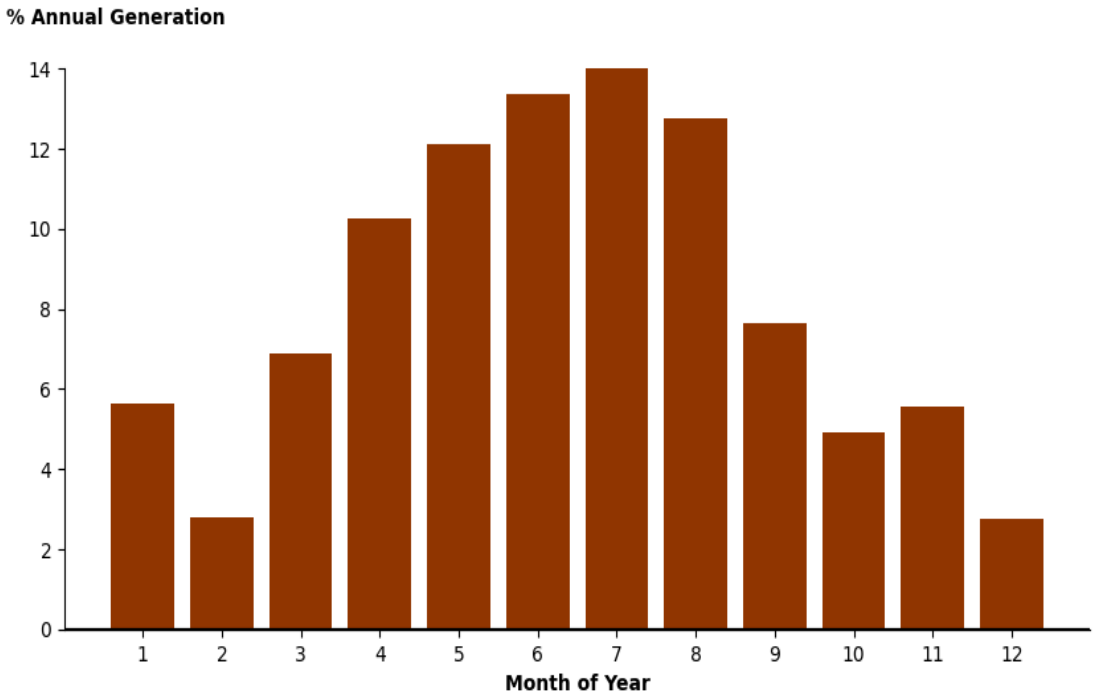
- Torrens Island Battery – 250MW
  BESS (1 Hour)

BIPS: Serving reliable power in times of need

BIPS Daily Operating Profile, Jan 1 2020 – Dec 31 2023



BIPS Monthly Operating Profile, Jan 1 2020 – Dec 31 2023



1,400 annual running hours on average

Plant adjusts seamlessly to load demand and price signals

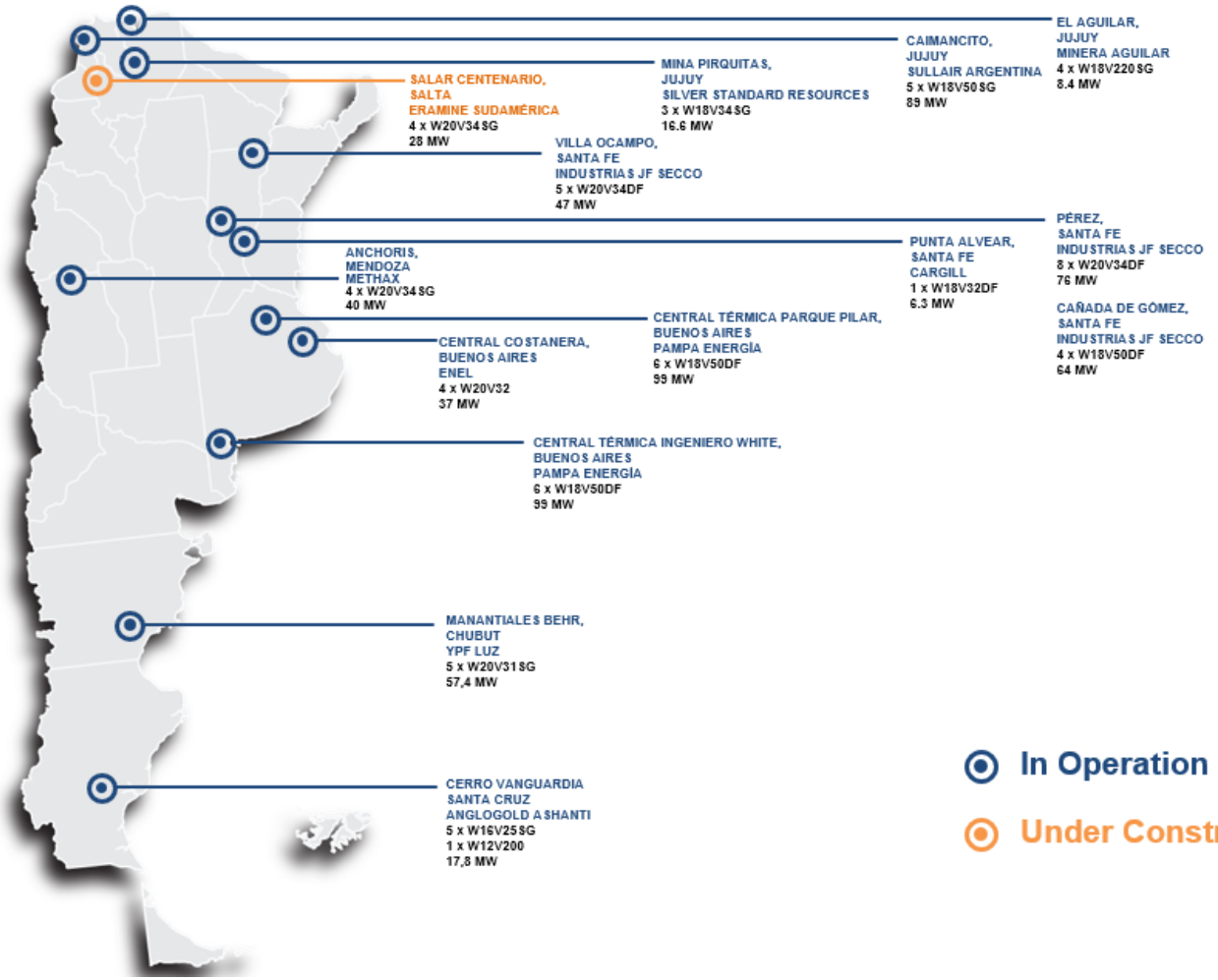
Consistent supply for regular peaks

~62% of all daily hours occur during morning and evening peaks

Seasonal balancing for winters

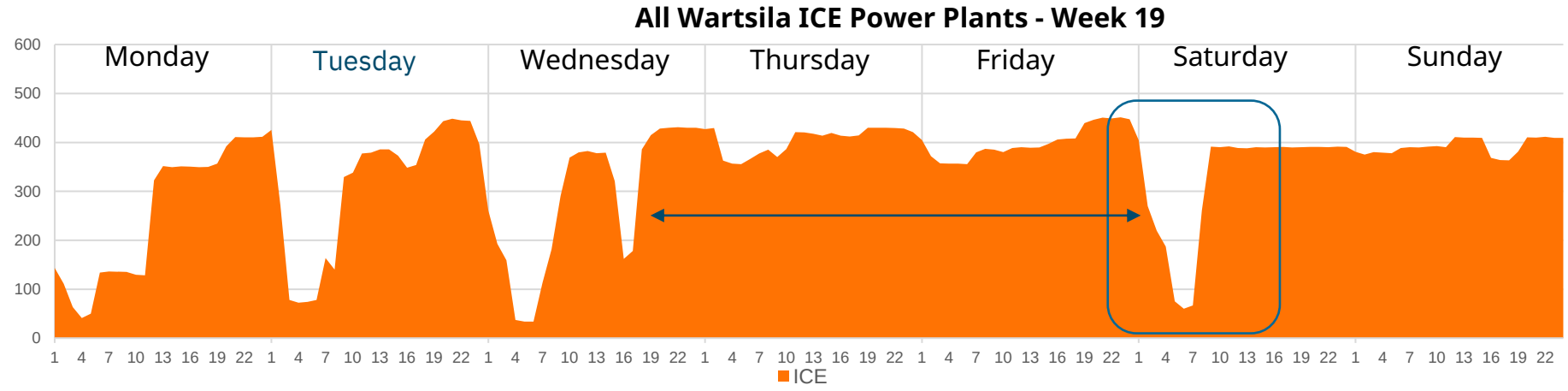
~54% of all annual hours occur during May – August

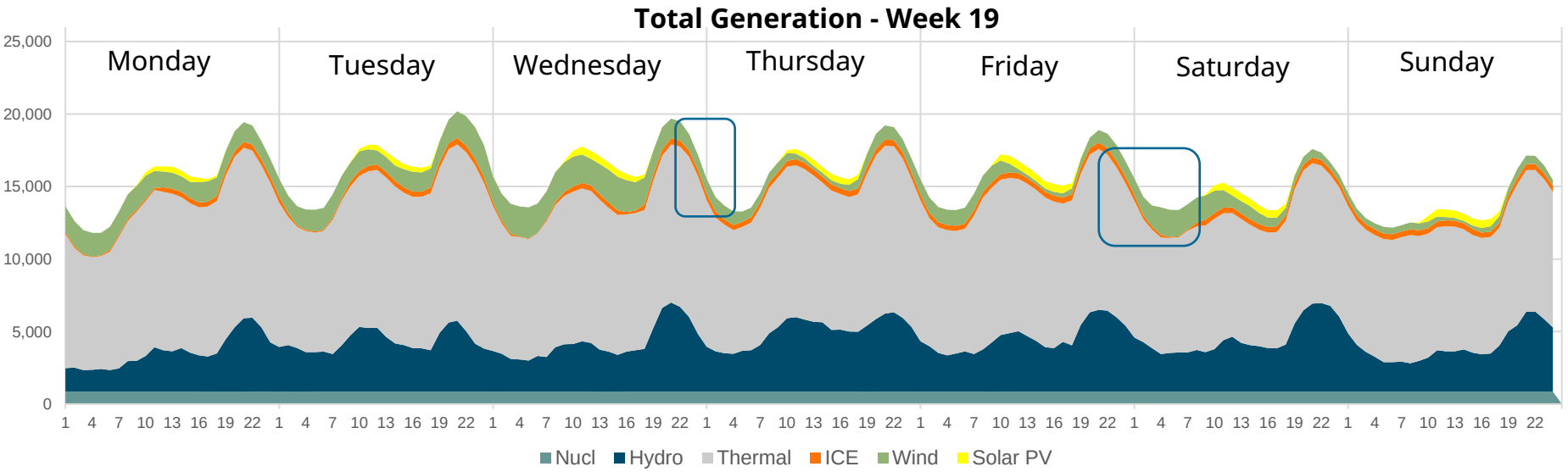
Wärtsilä has more than 650 MW installed capacity in Argentina



Ingeniero White, Bahia Blanca, Argentina

FLEXIBLE OPERATION IN BALANCE WITH WIND

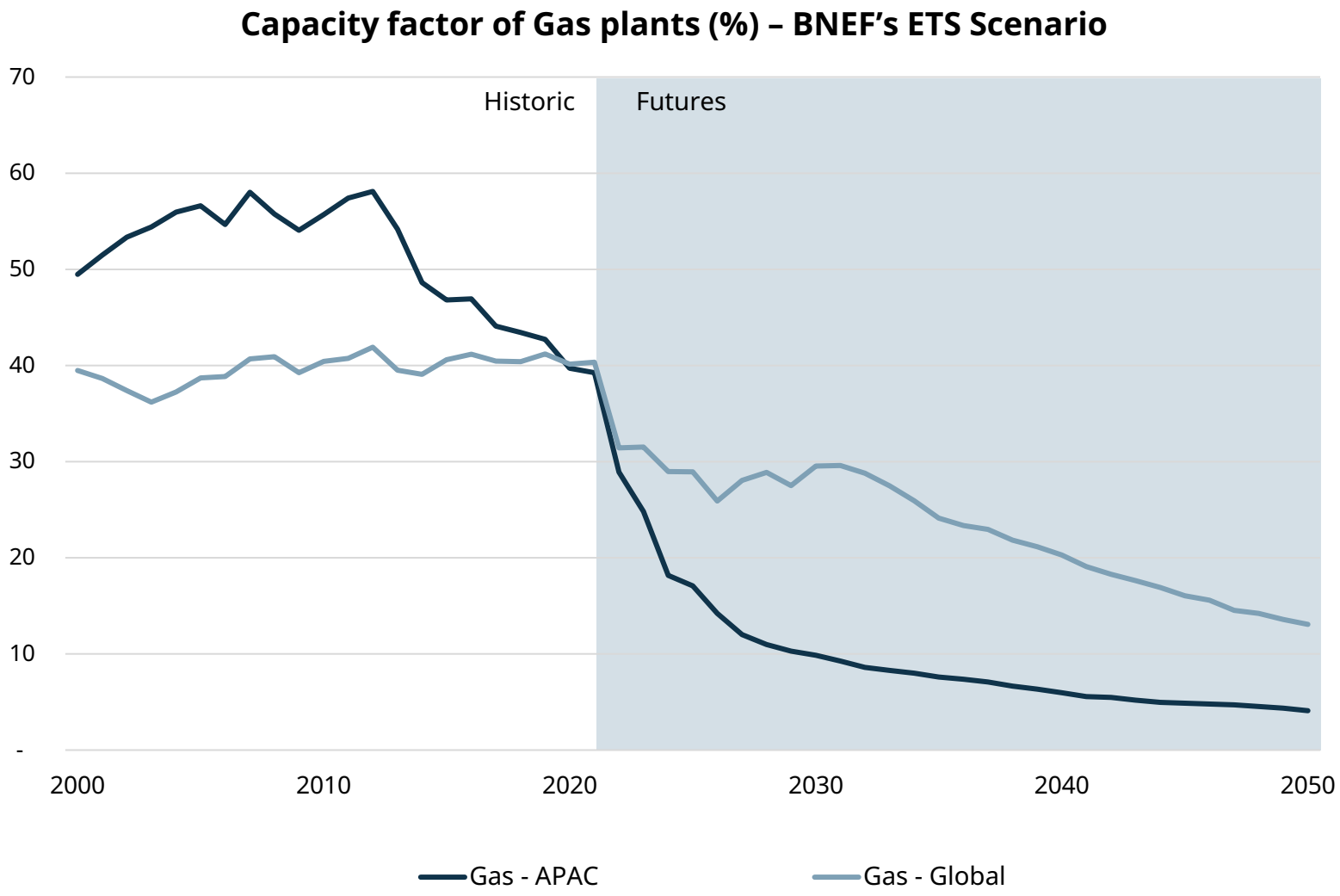




1. Steady wind production Monday-Wednesday allows engines to operate on peaking/balancing profile
2. Low production of wind begins on Wednesday night leading to continuous ICE operation Wednesday night through Saturday morning
3. Large influx of wind at 22:00 on Friday. Dispatch operator orders engines to shut down

Source: CAMMESA

The role of gas is changing: from baseload to balancing



Consequences of non-flexible systems:

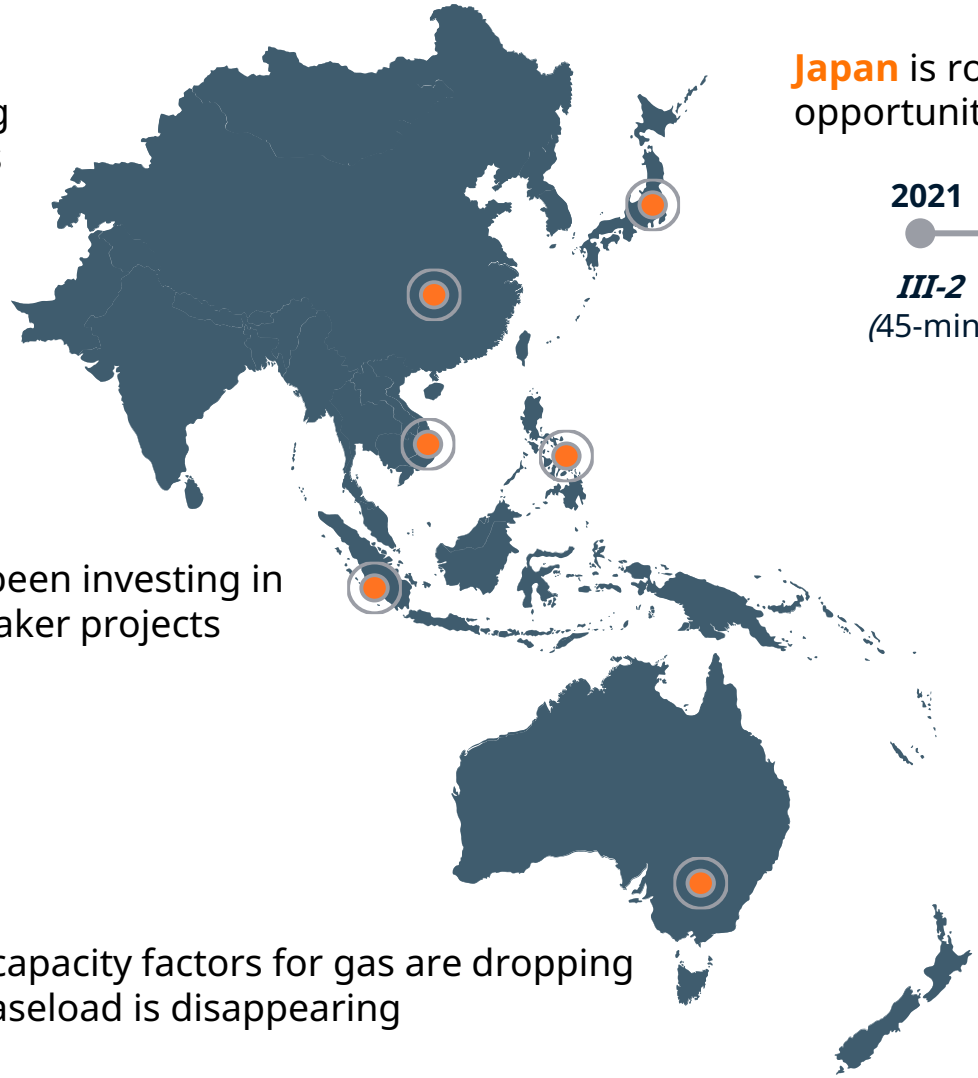
- Instability
- Blackouts
- Renewables curtailment
- Higher system costs

As renewable increases its share, gas-fired power plants will have declining capacity factors, reaching 5-15% in 2050.

Source: BloombergNEF – New Energy Outlook 2022

Countries are making significant efforts to introduce more balancing power plants

In **China** the need for balancing and the market mechanisms are developing quickly. A new policy guidance requires generation companies to add 15% balancing capacity for new-build renewable projects.



Japan is rolling out new balancing markets with opportunities for fast ramping gas plants.

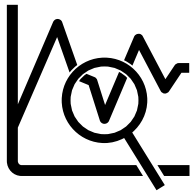
2021	2022	2024
III-2 *(45-min)*	***III-1*** *(15-min)*	***II-1*** *(5-min)* ***II-2*** *(5-min)* ***I*** (10 sec)

Indonesia has been investing in flexible gas / peaker projects

Philippines and **Vietnam** will see more renewables added to their systems, creating a need for flexible capacity and balancing. **Vietnam's approved** Power Development Plan 8 recognises the role of flexible gas.

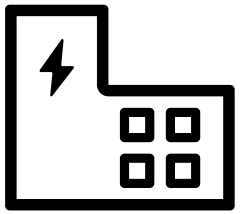
In **Australia** the capacity factors for gas are dropping and traditional baseload is disappearing

Internal Combustion Engine (ICE) power plants: Crucial for Indonesia



Increased need for balancing solutions

As the amount of renewables will increase in Indonesia (30GW by 2033 and 60GW by 2040), flexible balancing solutions will be needed to ensure stability and reliability.



Engines as balancing capacity

Wärtsilä's 5GW existing ICE plants will offer essential balancing power to enable Indonesia to integrate more renewable energy sources, cut costs and CO2 emissions.

(To be continued in the next presentation)


WÄRTSILÄ