Modernising Island Grids with Smart Hybrid Systems: A Case Study from Indonesia

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This is Wärtsilä

Towards a 100% renewable energy future

Two centuries of innovation since 1834

18,300 people

230 locations

130 nationalities

77 countries

6,449 net sales, MEUR

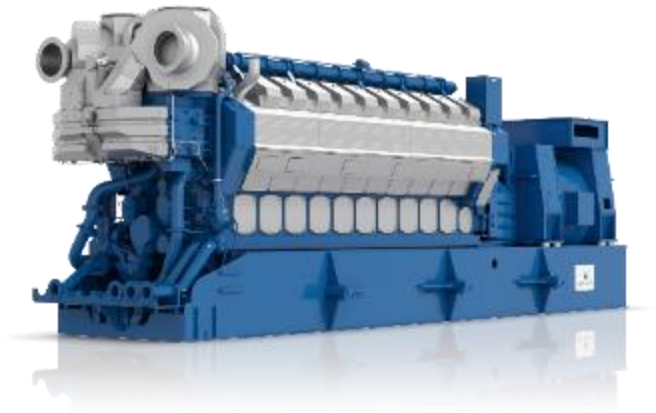
53% service sales of total

Figures from 2024

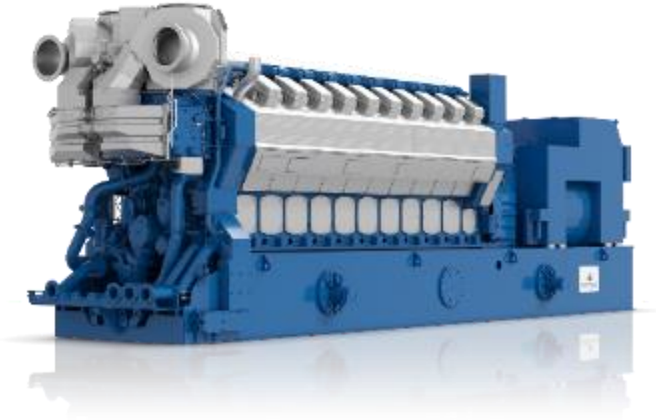
Wartsila engine portfolio

Medium Bore Size (31-34 cm)

Wärtsilä 31 platform: 11 - 12 MW
DF & SG



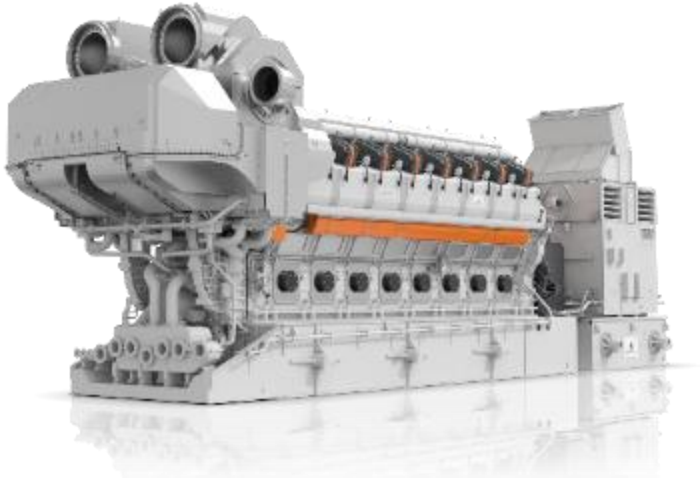
Wärtsilä 32 platform: 5 - 10 MW
LFO & HFO



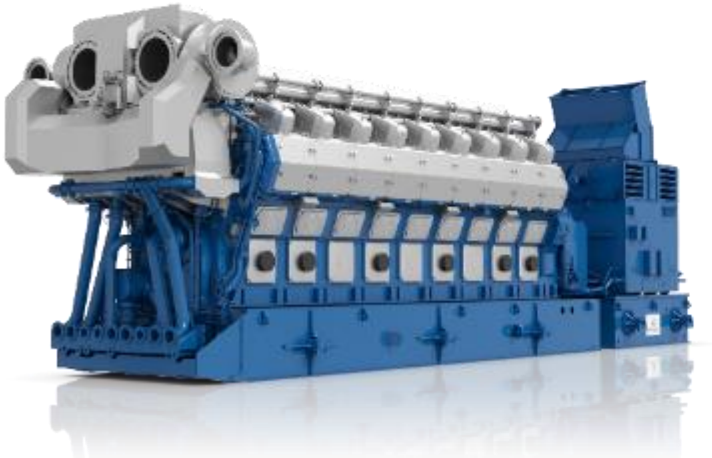
Wärtsilä 34 platform: 5 - 10 MW
DF & SG

Large Bore Size (46-40 cm)

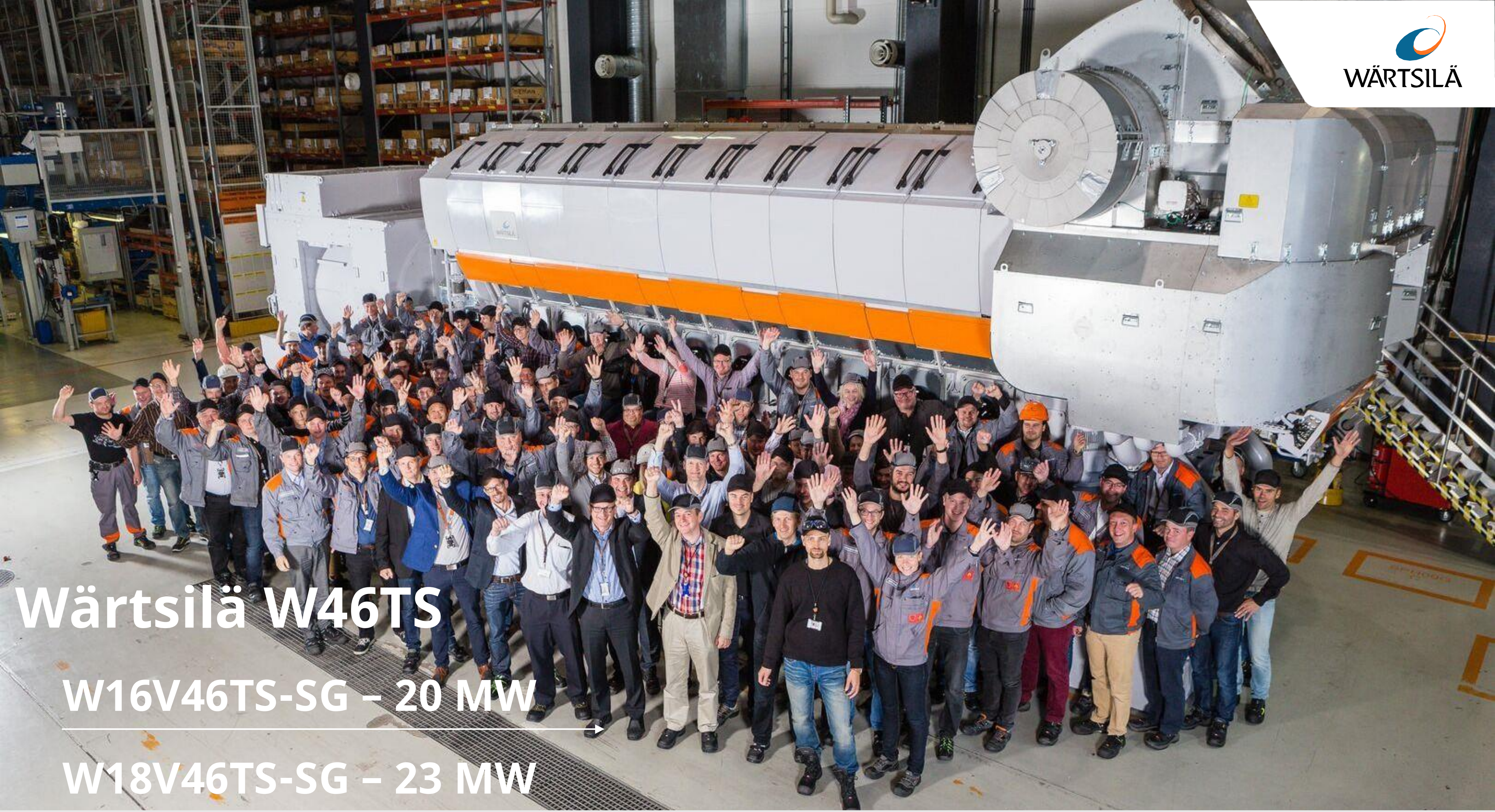
SG = Pure gas engine
DF = Dual Fuel Engine



Wärtsilä 46TS platform: 20 to 23 MW
DF & SG



Wärtsilä 50 platform: 18 MW
DF & SG



Wärtsilä W46TS

W16V46TS-SG – 20 MW

W18V46TS-SG – 23 MW

Gas								Liquid
	Natural gas Biogas Biomethane e-Methane	Ethane	Propane (LPG)	Hydrogen 25 vol-% in blends up to natural gas	Pure hydrogen	LFO Diesel Biodiesel HVO	Crude oil	HFO Bio-oils
Wärtsilä 31SG	●			●	●1)			
Wärtsilä 34SG	●	●	●	●				
Wärtsilä 50SG	●	●		●				
Wärtsilä 31DF	●					●		
Wärtsilä 34DF	●					●		●
Wärtsilä 50DF	●					●		●
Wärtsilä 32						●	●	●
Wärtsilä 50						●	●	●

1) Hydrogen ready engine available in 2026

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Fuel efficiency and fuel-flexible technology ensure the most future-proof solution

The decarbonised future will involve multiple fuels. Besides traditional fuels, our engines can run on:

Green Fuels available for Wartsila Portfolio:

- Ammonia
- Bio-methane
- Bio/renewable diesel
- E-diesel
- E-methane
- Hydrogen
- LNG
- LPG
- Methanol/ethanol


PLN – Dual Fuel Power Plant
3 x W16V34DF - 20 MW
Nabire - Indonesia Papua

PLN – Dual Fuel Power Plant
6 x W20V34DF - 50 MW
Jayapura - Indonesia Papua

Lihir Gold Mine Power Barge

Papua New Guinea

Customer	**New Crest Mining**
Type	Floating Power Plant
Operating mode	Baseload
Gensets	8 x Wärtsilä 20V32
Total output	72 MW
Fuel	LFO, HFO
Scope	Engineering, procurement & construction (EPC)
Delivery	2012

Estrella del Mar II is Wärtsilä's first combined-cycle power barge

A Case Study from Lombok Island, Indonesia

Lombok Island - Indonesia

- Lombok Island – one of the main holiday destinations in Indonesia. Located next to Bali
- Isolated grid, peak demand 450 MW
- Strong desire to add and increase renewable power share in the generation mix
- First renewable step - 20 MW solar PV was added recently

135MW Lombok power plant

- Owner: PLN. Delivered year: 2019
- 135MW Engine Power Plant with steam turbine
- 13 pcs. Wartsila 34 Dual Fuel (LNG & LFO)

Power Plant's Function - Initially:

- Providing baseload and peaking
- Supporting frequency control

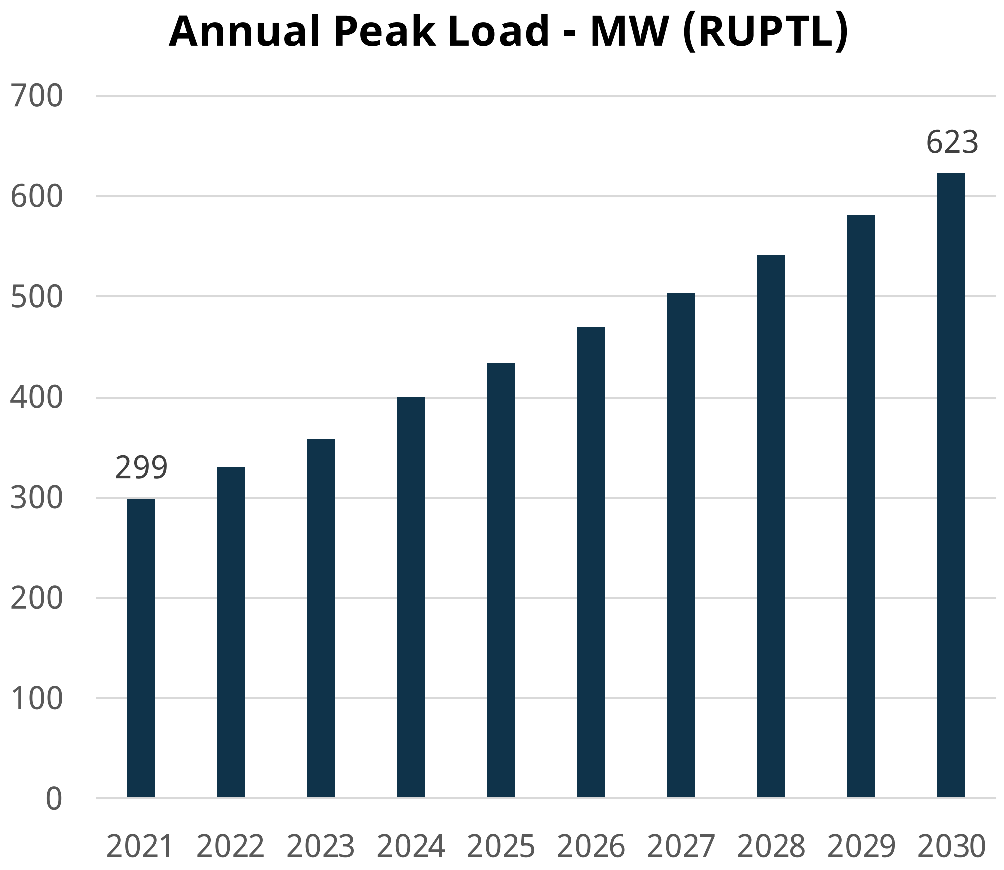
- **Power Plant's Function – After Modification:**
- Balancing solar power's intermittency
- Enabling even more solar PV capacity in the future
- Future-proof solution for modern power system

Operation & Maintenance Agreement with Wartsila:

- First 5 years 2010-2024
- Extension 3 years 2025
- Wartsila team doing operation and maintenance

Photo credit: PLN

Lombok grid



Annual Growth Rate about 9%

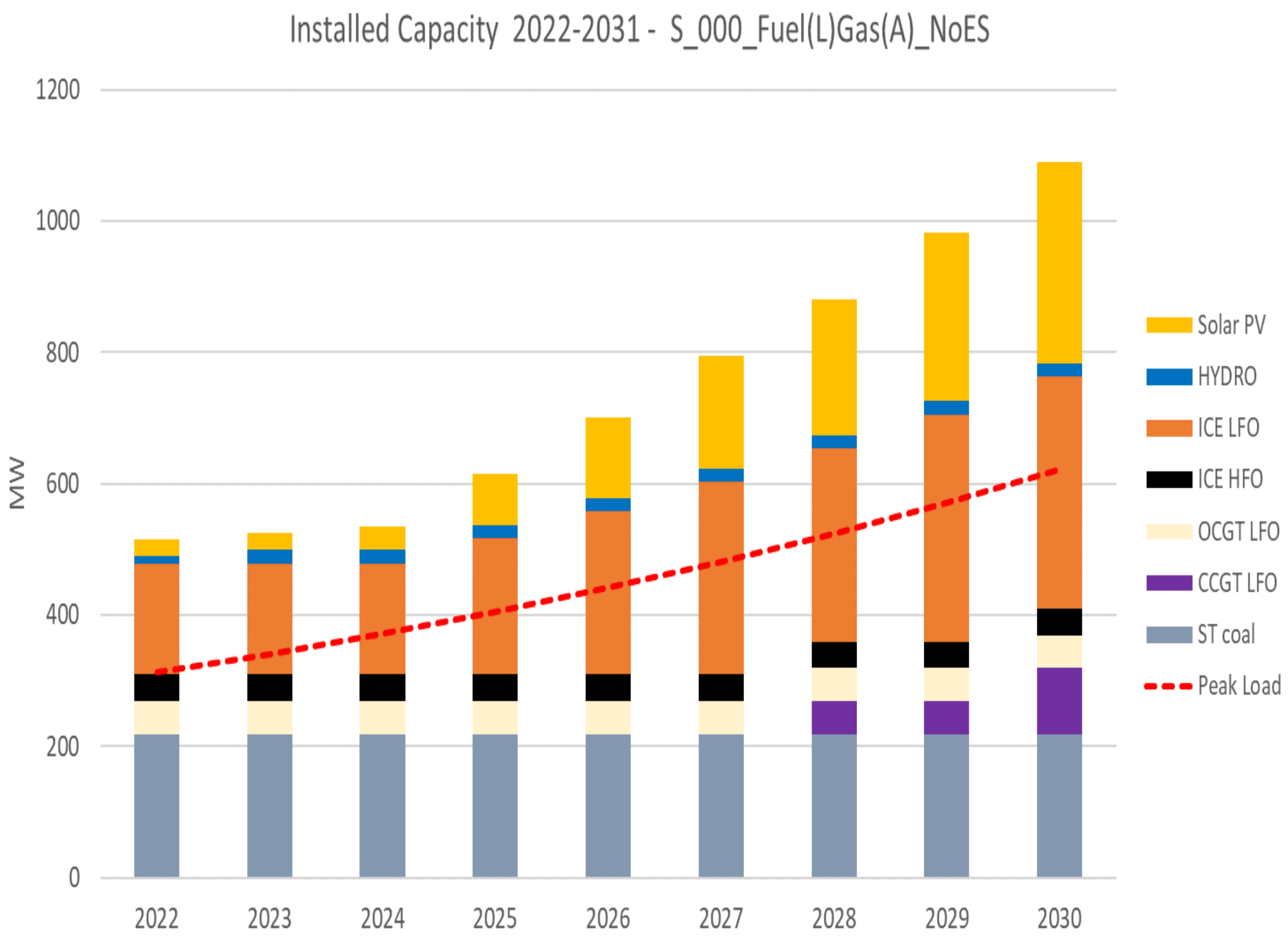
Existing capacity

Power Plant	Technology	Fuel	Units	Capacity [MW]
PLTU JERANJANG 1-3 (FTP1)	ST	Coal	3	69.0
PLTU LED 1-2	ST	Coal	2	50.0
MPP JERANJANG 1	OCGT	LFO	1	50.0
PLTD AMPENAN	ICE	HFO	6	30.7
PLTD PAOK MOTONG	ICE	HFO	2	10.0
PLTD TAMAN	ICE	LFO	3	4.1
PLTMGU Lombok Peaker	ICE	LFO/Gas	13	136.0
HYDRO	-	-	-	11.3
SOLAR	-	-	-	20.5

Committed capacity

Power Plant	Technology	Fuel	Capacity [MW]
BMPP Sambelia	ICE	LFO/Gas	28
PLTU FTP2 (unit 1)	ST	Coal	50
PLTU FTP2 (unit 2)	ST	Coal	50
Solar	-	-	5
Hydro	-	-	10

PLEXOS modelling for Lombok's power system



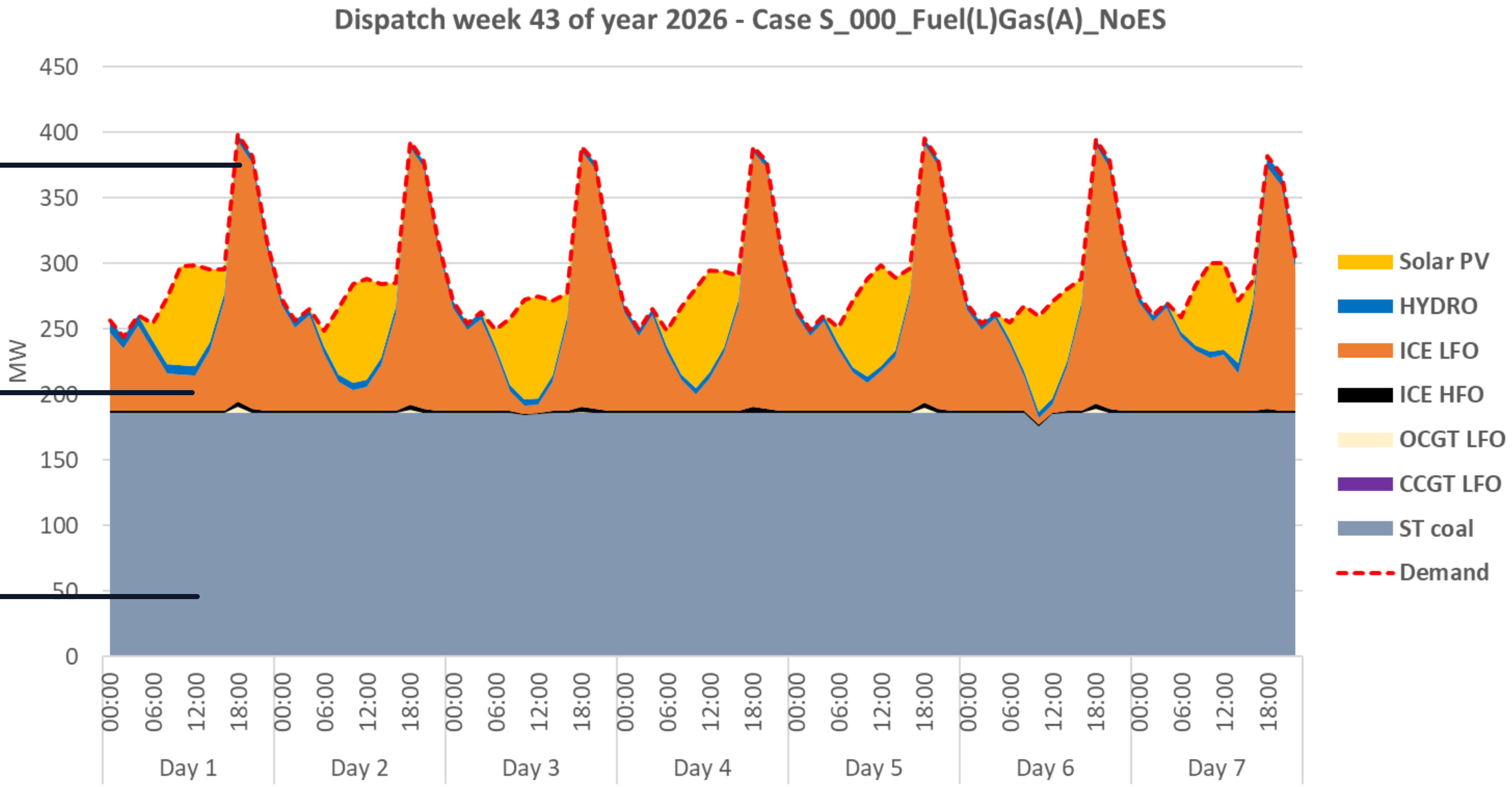
- With the support from PLN, we optimized Lombok's future power system using PLEXOS.
- The results recommended an annual investment in 40-50 MW of solar PV and reciprocating engines (ICE) for balancing.
- Share of RE generation increases gradually and could reach 17% by 2030, while coal generation only accounts for 48% in 2030.

Snapshot - Lombok’s dispatch graph in the year 2026

ICE ramps up to meet the peak load when there is no solar

ICE ramps down when solar output is high

Baseload generation from coal



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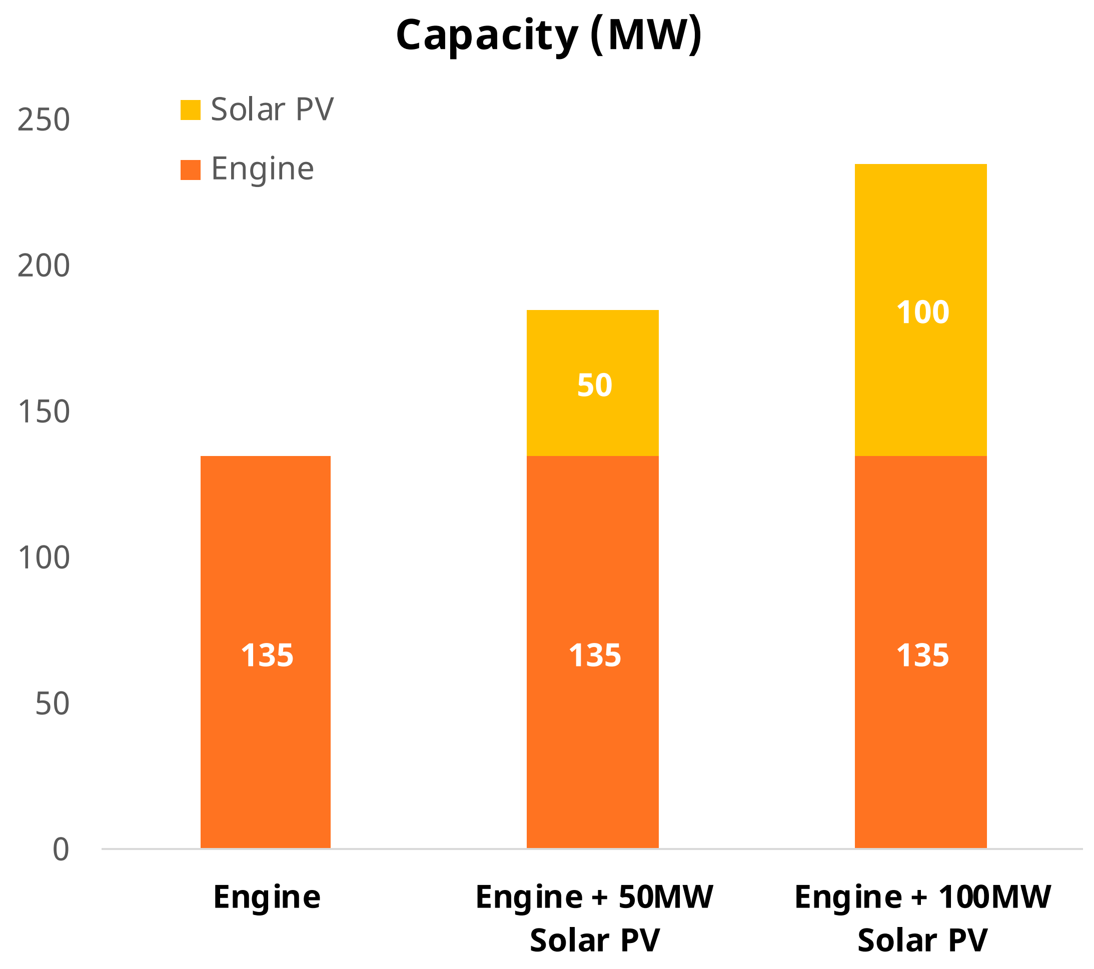
How can the Lombok engine power plant help integrate more renewables into the system?

Lombok case study – assumptions and scenarios

Assumptions:
Testing the impact of integrating more solar PV into the system with the existing engine to meet Lombok's load profile.

Scenarios:
Comparing the cost (LCOE) and emissions of three different options:

- Stand-alone existing engine
- Existing engine with 50MW of new-built solar PV
- Existing engine with 100MW of new-built solar PV



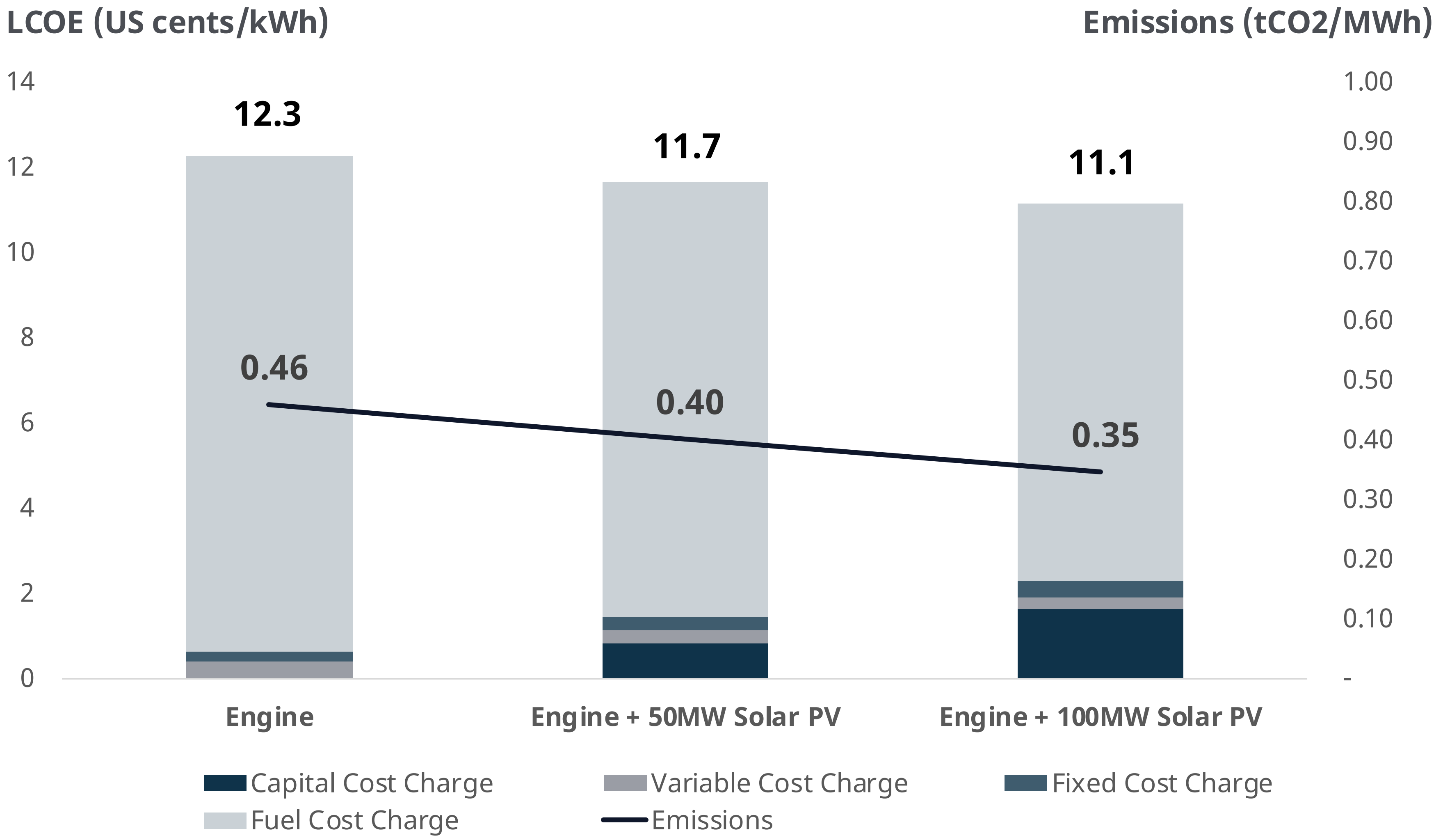
How can hybrid power plants provide baseload power?

Hybrid power plants can be defined in various ways. Here, a Hybrid is defined as a combination of Variable Renewables and Flexible Gas Engines to meet a given load profile as an alternative to traditional baseload assets.

Objectives:

- Dispatchable power
- Available and reliable
- Minimal carbon (Towards Net Zero)

Levelized Cost of Electricity (LCOE) & Emissions

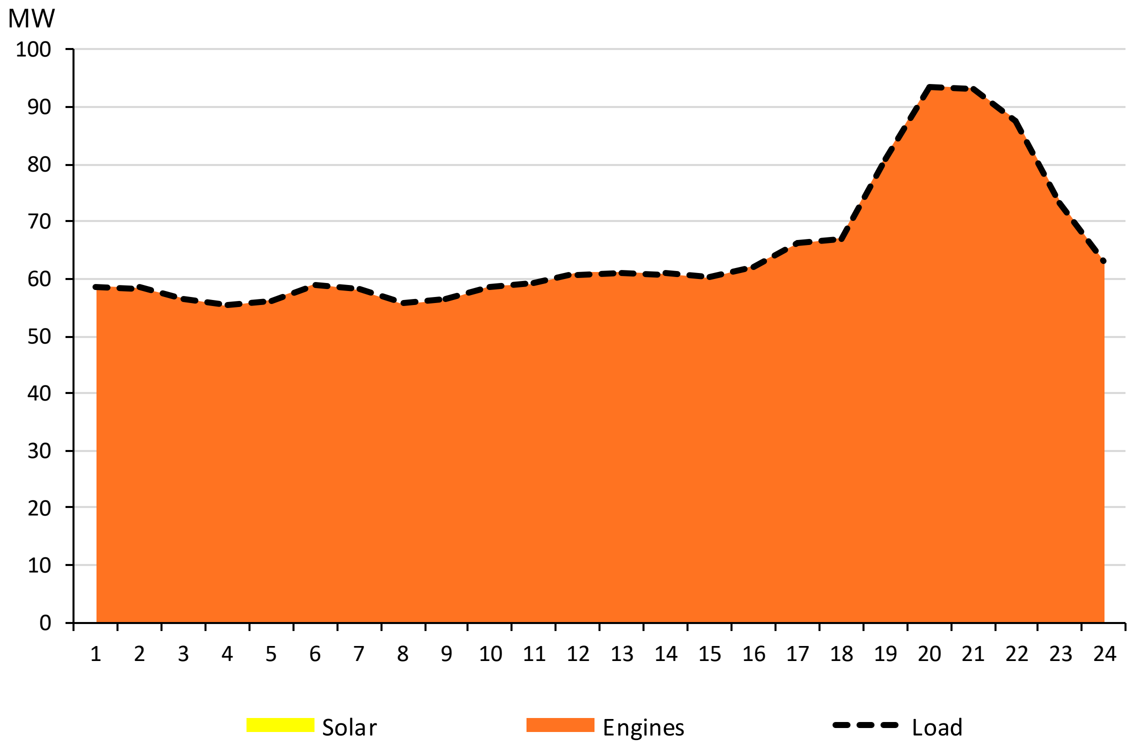


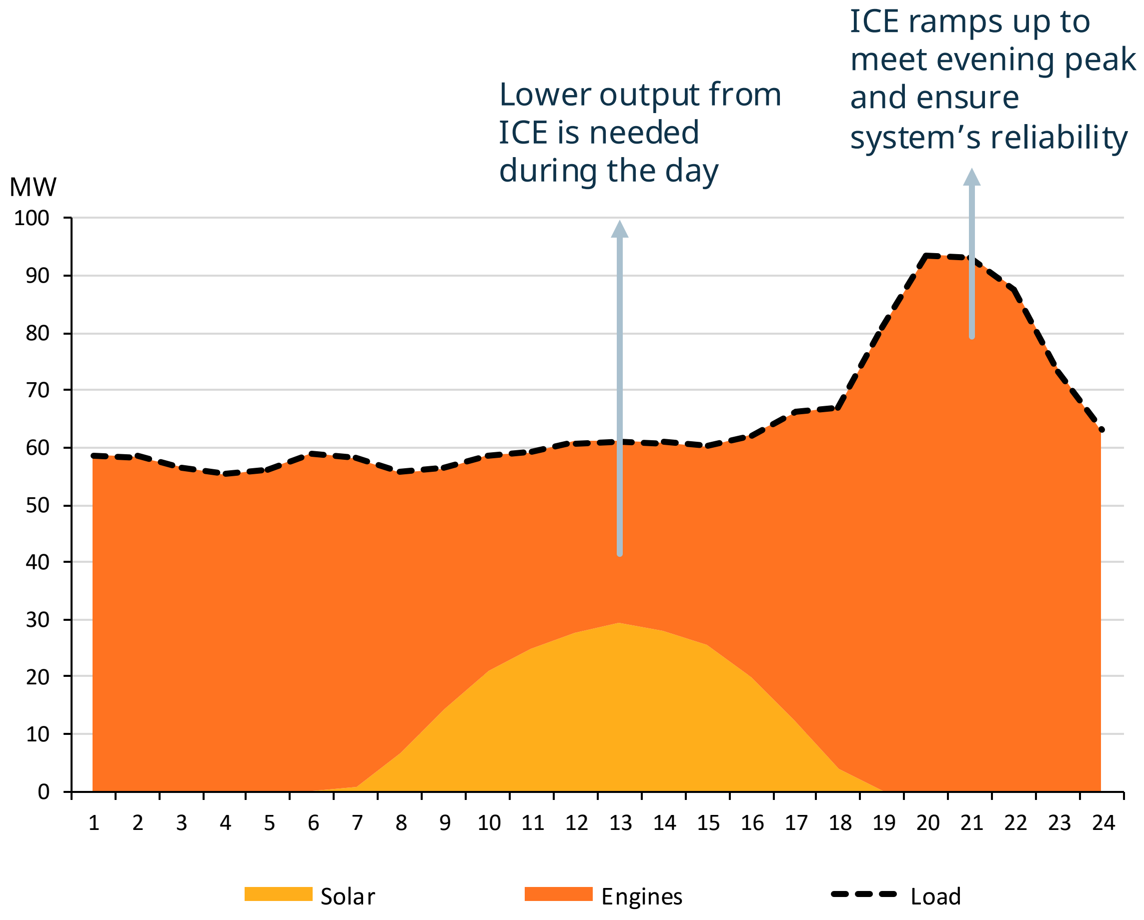
The existing Lombok engine can balance renewable output and enable more solar additions to the system

7.4 MUSD

In annual savings if pairing engine with 100MW of solar PV

Lombok case study – Dispatch graph





Note: Load profile comes from Lombok's historical data

Conclusions

✓ Benefits of a hybrid system (balancing engine + solar PV):

- Reduced generation costs
- Higher system availability & reliability
- Lower emissions

✓ The 135MW engine power plant in Lombok, Indonesia, is a versatile asset and can be a catalyst to enable more solar PV additions to the island due to:

- Engines' Fast ramping, fast startup and shutdown time
- Engines' Fuel flexibility
- Engines' High efficiency at different load levels

✓ This case offers a real-world reference for islands on how flexible thermal assets can accelerate the energy transition while ensuring system reliability.

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