RENEWABLES FOR DIESEL-POWERED UTILITIES

ISLAND CASE STUDIES ON OPTIMIZATION

9TH ANNUAL HOMER MICROGRID AND HYBRID POWER INTERNATIONAL

14 OCTOBER 2021

HOMER MICROGRID AND HYBRID POWER | 9TH ANNUAL INTERNATIONAL

SPEAKER

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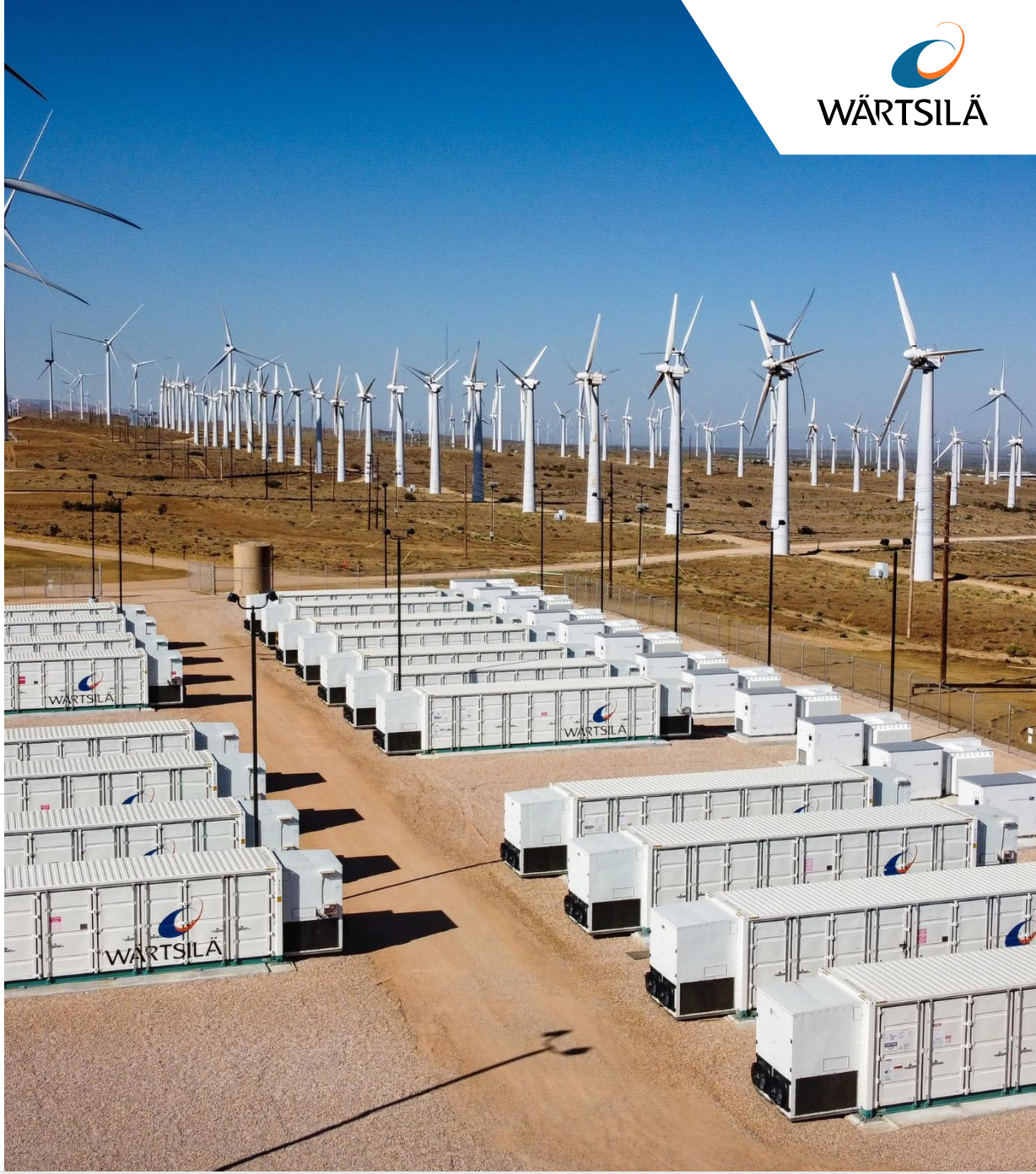
Vice President, Americas

#100%RenewableFuture
#FlexiblePowerGeneration
#EnergyStorage



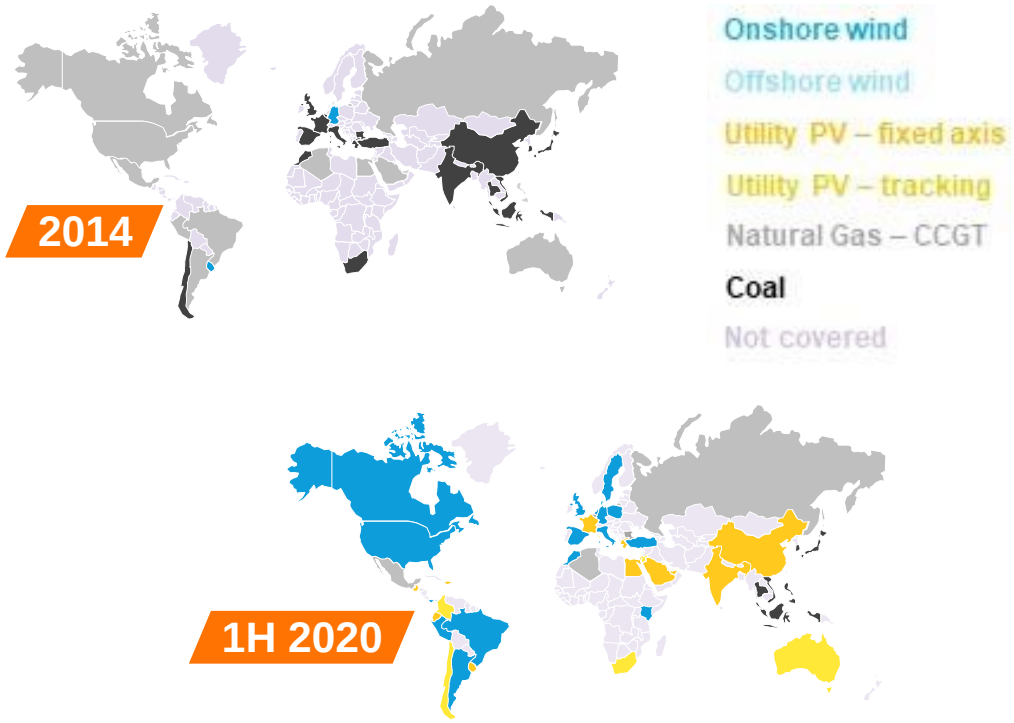
Agenda 14 October 2021

- Renewables Market Drivers
- Island Grids – Utility reality
- Possible Solutions
- Can you make it work?
- Is it real?
- Q&A

Energy market in transition

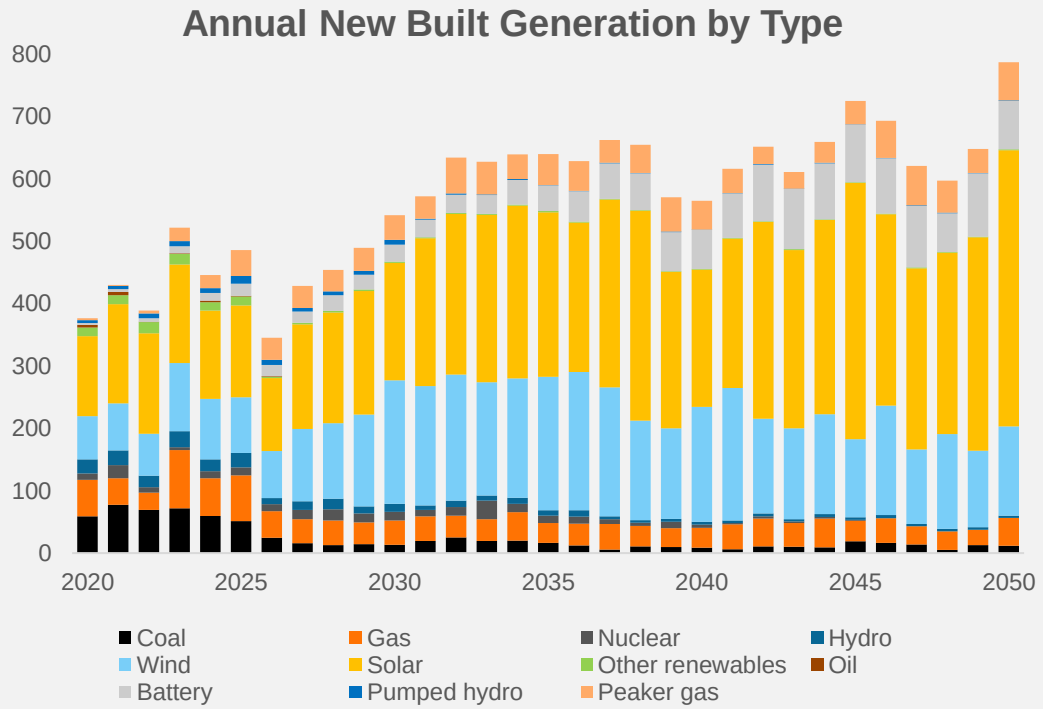
Renewables now the **lowest cost** source of electricity

Over the past decade, renewables have become the lowest cost source of new generation in countries representing over **82% of world GDP**.



Source: BloombergNEF New Energy Outlook 2020

Capital has flowed to renewables; **in 2020, renewables energy projects captured nearly 50%** of all new generation built. By 2030, analysts estimate that to rise to 67%.



UTILITY REALITY

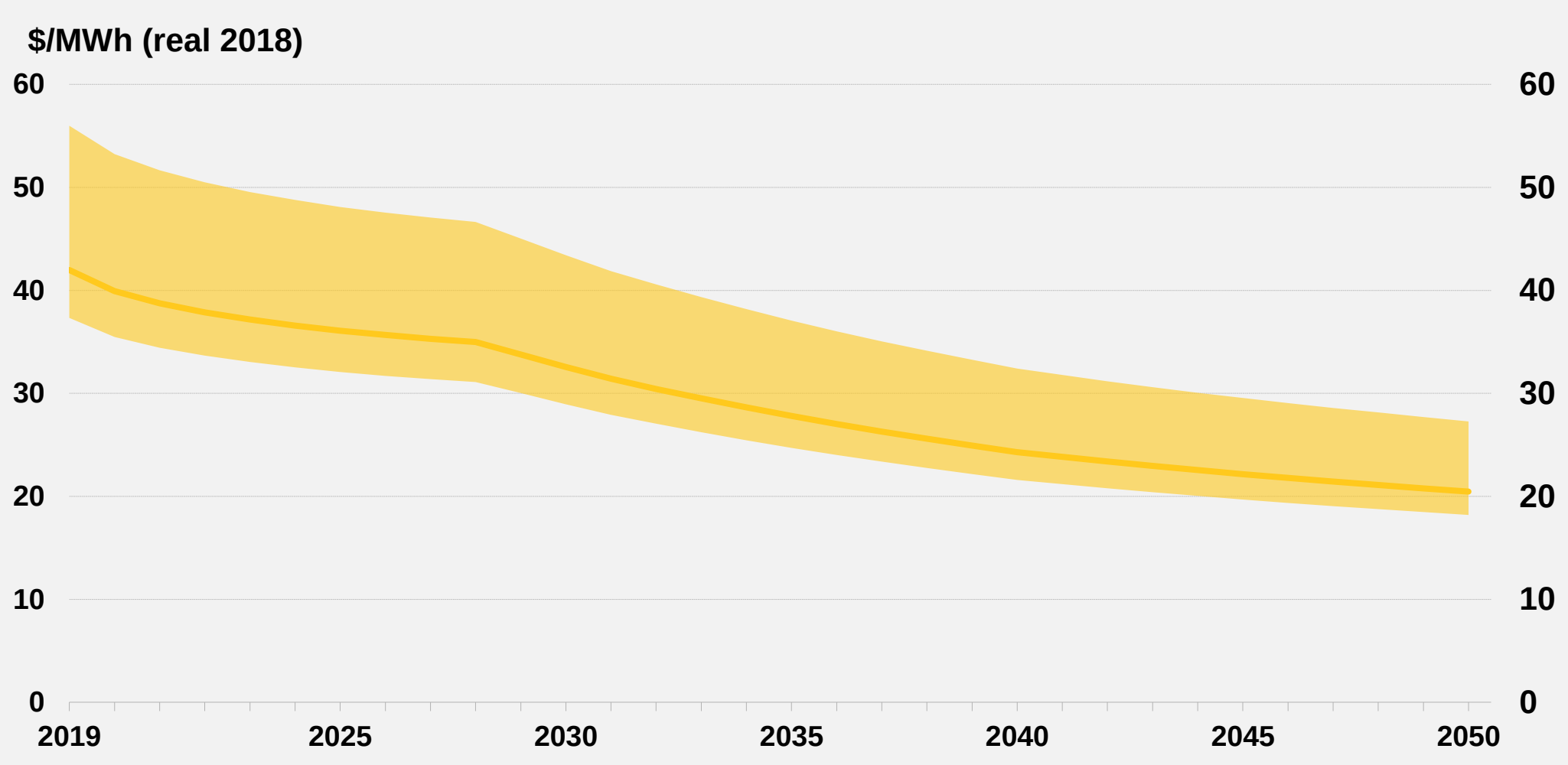
1. KEEP THE LIGHTS ON

2. LOWER THE RUNNING COSTS

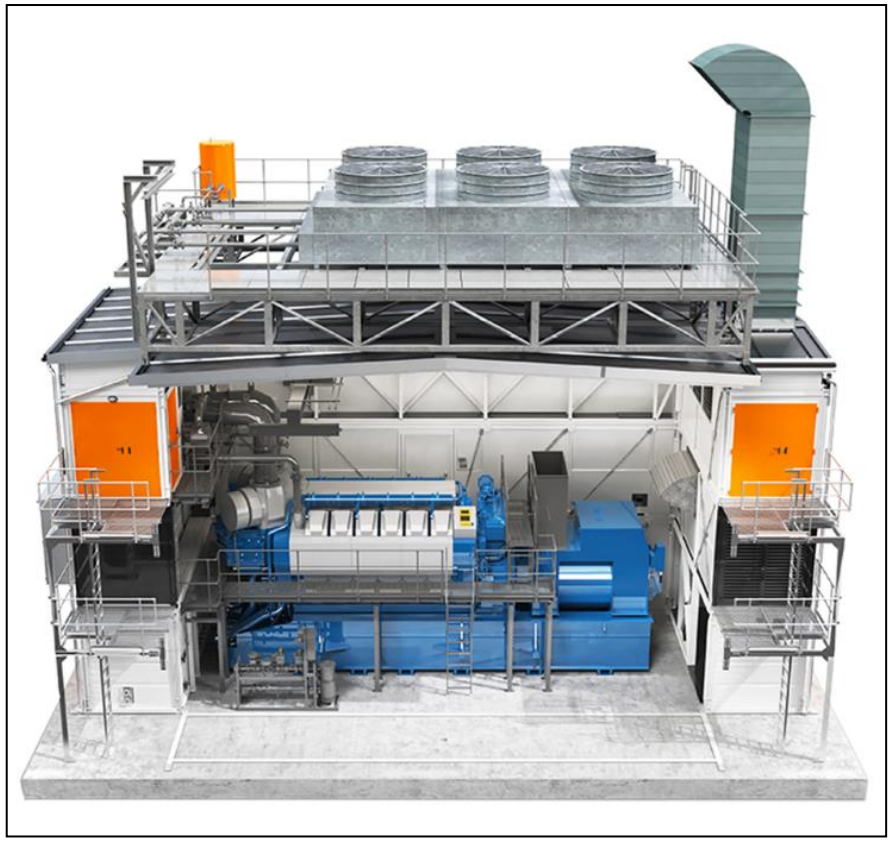
3. FUTURE INVESTMENTS

- DECARBONIZE

SOLAR LCOE ($/MWh)



Source: BloombergNEF



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LOWER GENERATION COSTS (LCOE)
&
LOWER EMISSIONS

EASY ONE, BUT..

ADDING SOLAR

- **Increases spinning reserve requirement**
- **Decreases system stability**

OPTIMISING GENSET OPERATION

- **Less or <u>more</u> engines running?**
  - Maintenance cost reduction?
- **Sufficient GenSet load step capability?**
- **GensSet minimum load requirement?**

→ Curtailment of “free” solar.. ?

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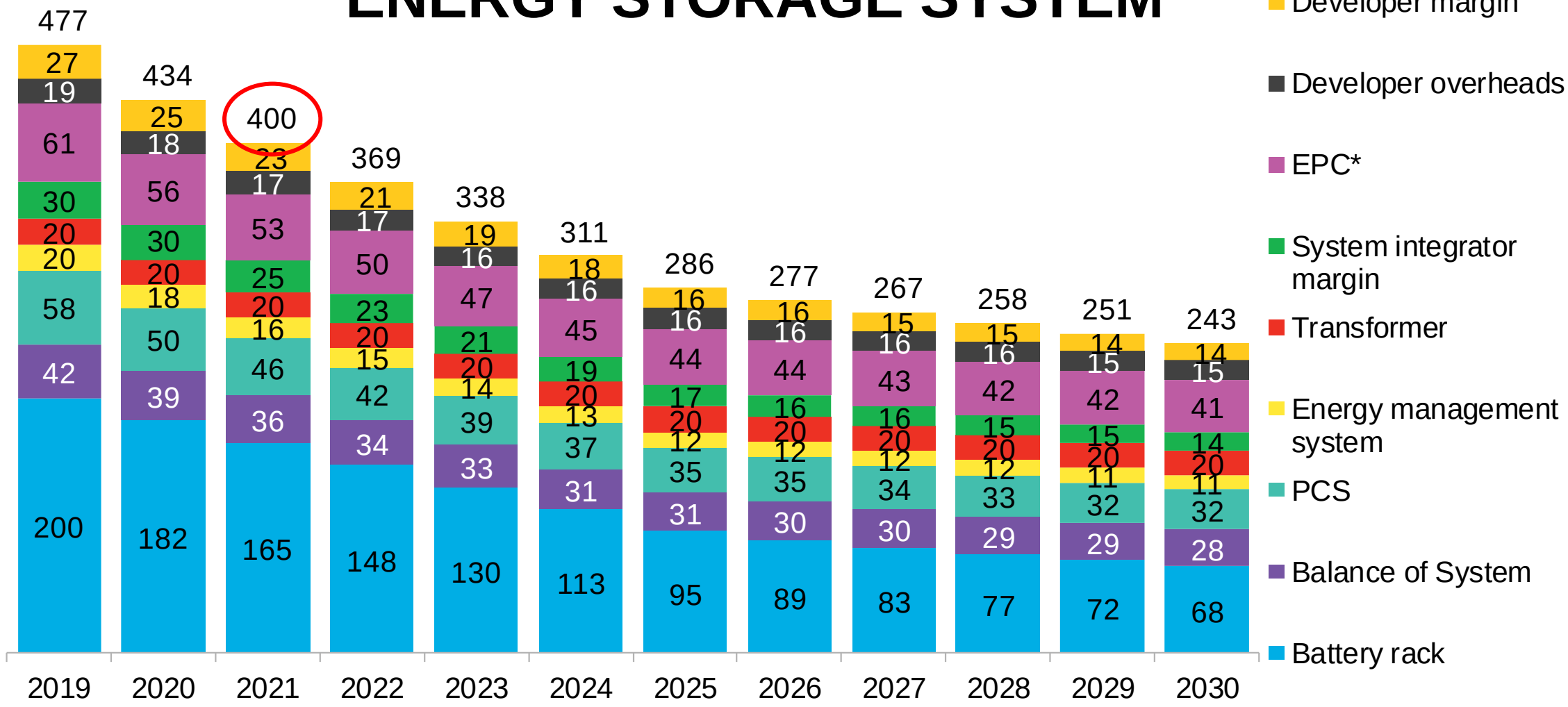
Real 2019 $/kWh

ENERGY STORAGE SYSTEM



Source: BNEF: Fully-installed usable 20MW/20MWh AC ESS at beginning of life

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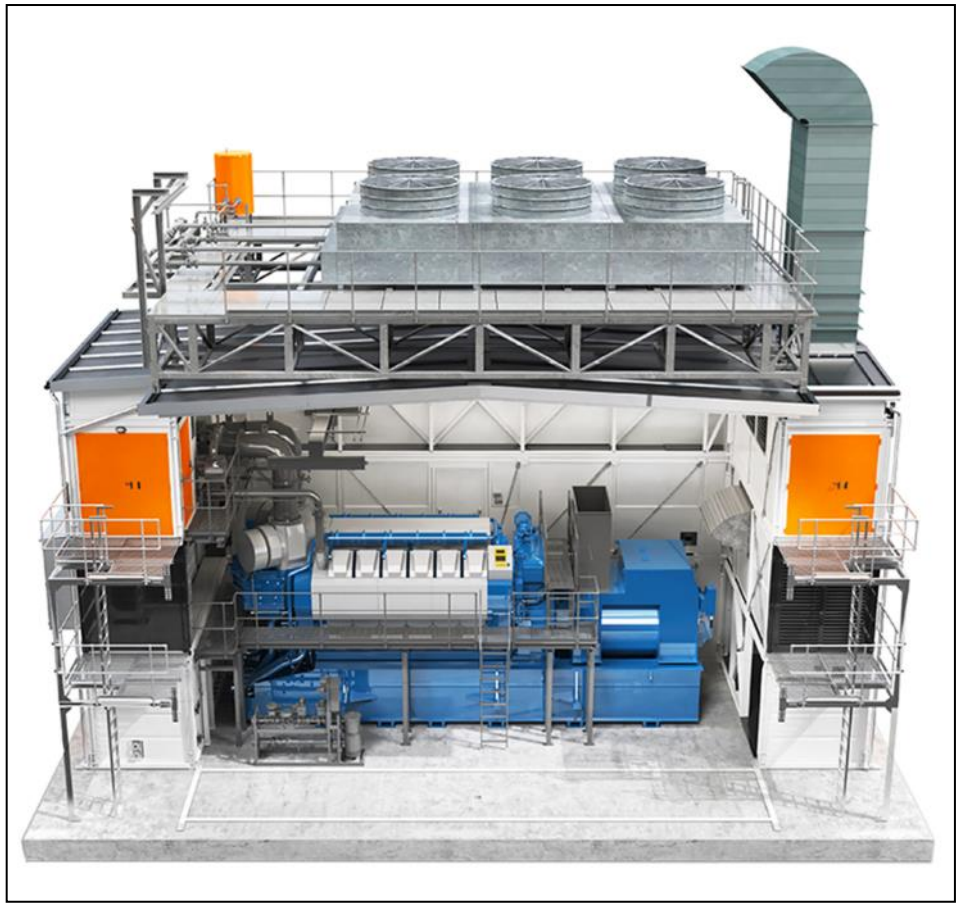

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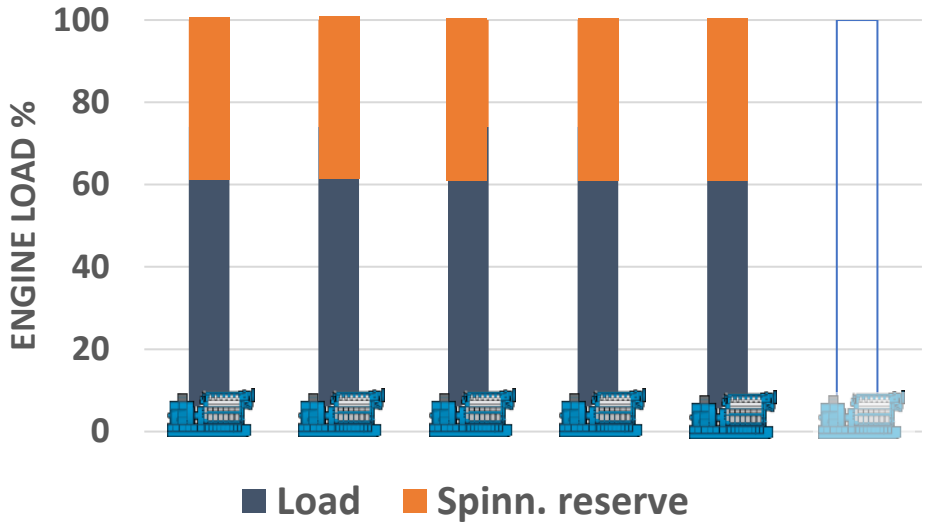
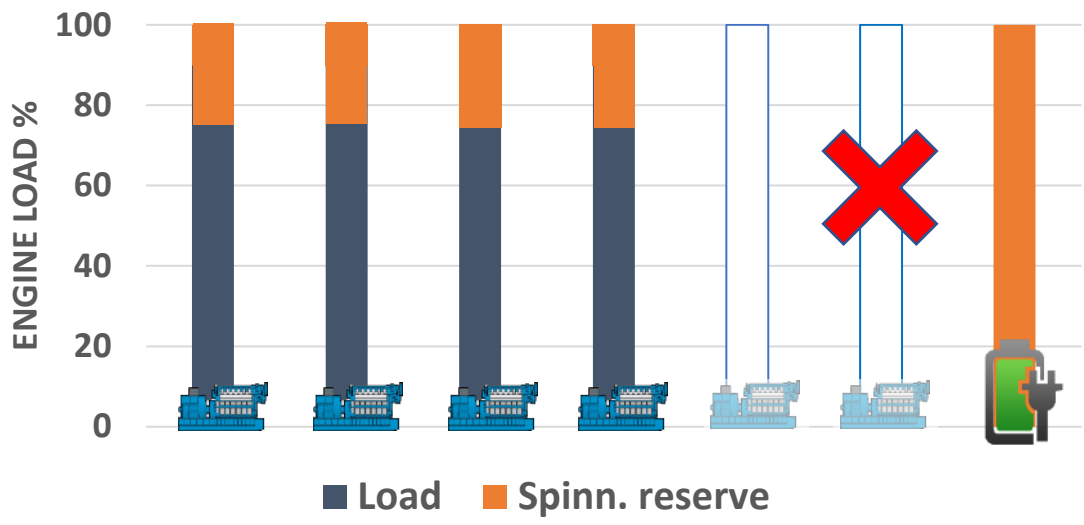
OPTIMISED ENGINE OPERATION
LOWER EMISSIONS & GRID STABILITY

ENGINES (n+1)



- Average load point **62%**
- Average efficiency **41.7%**
- Engine running hours **7 300h**
- Transient load capacity **G2**

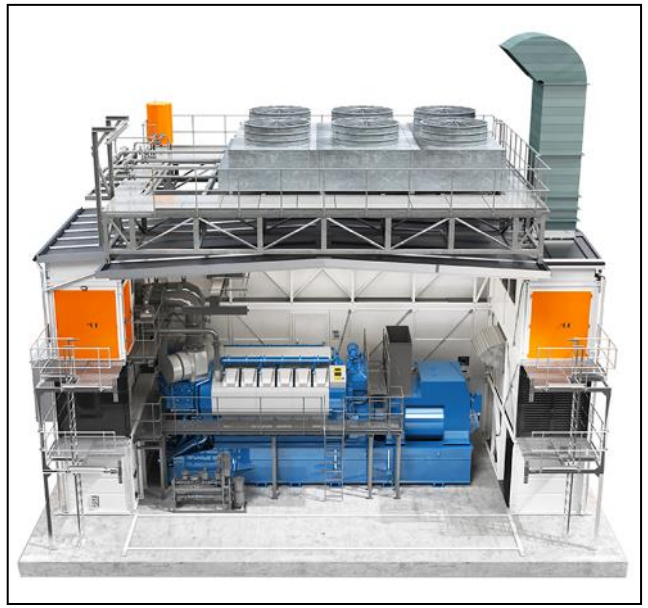
ENGINES & ESS



- Average load point **78%**
- Average efficiency **42.7%**
- Engine running hours **5 840h**
- Transient load capacity **G3**
- **Lower emissions**

PAYBACK TIMES can be 2-3 yrs !

TRIPLE-HYBRID !



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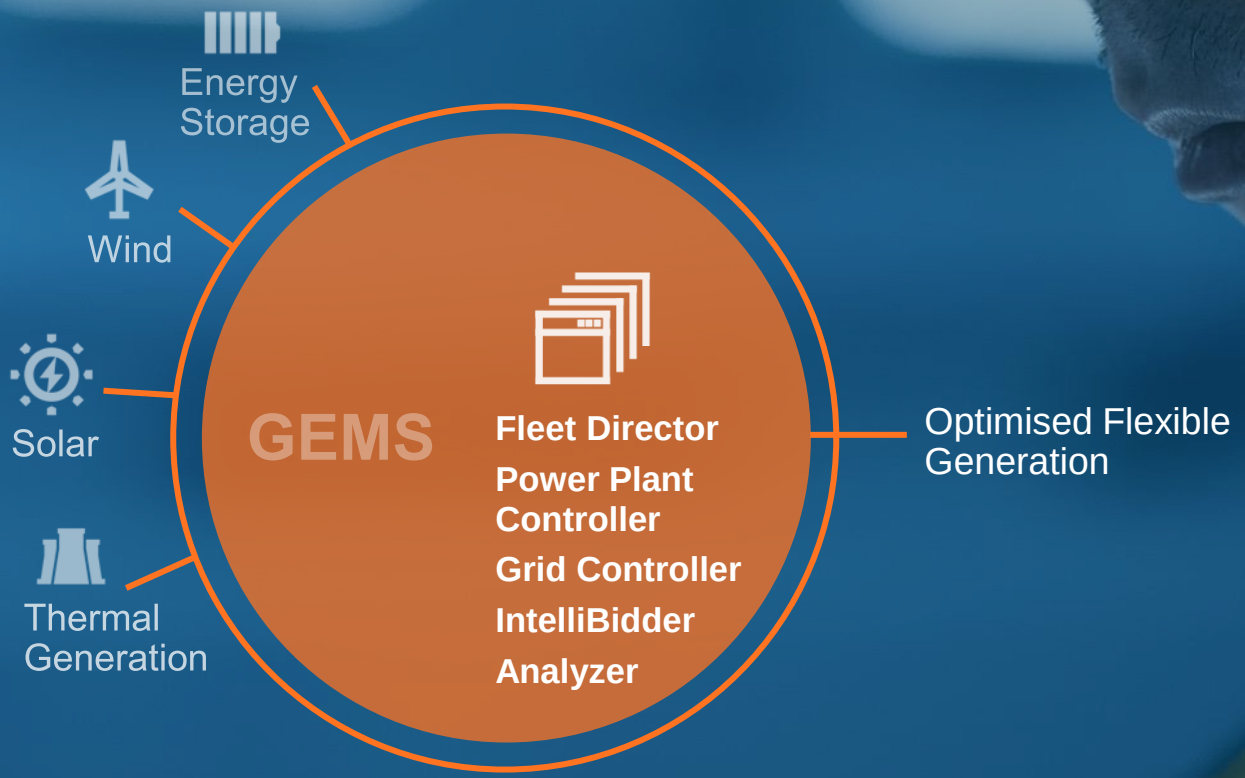
GEMS Digital Energy Platform



What is GEMS?

A suite of proprietary software products developed for building, monitoring and intelligently operating power plants and energy resources

GEMS Solutions Suite

GEMS: The leading energy system management platform

Optimises all generation assets

Secure, flexible, scalable

Deployed in **70+** projects globally

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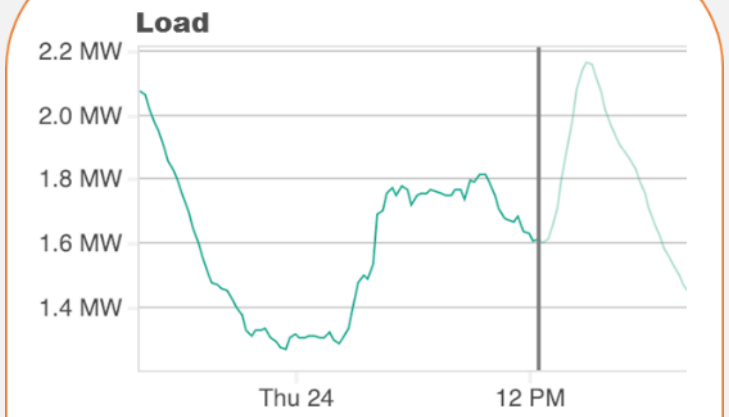
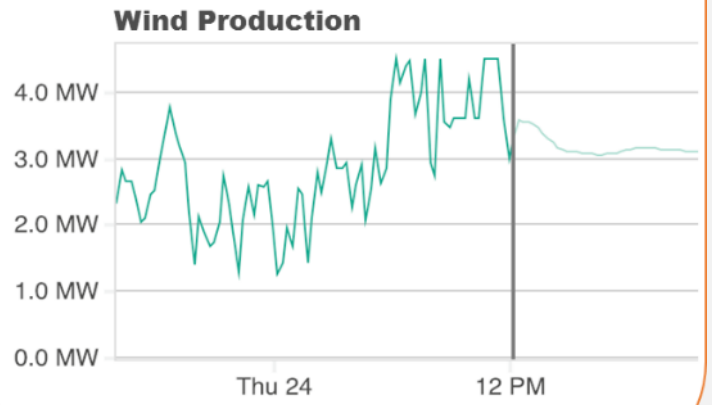
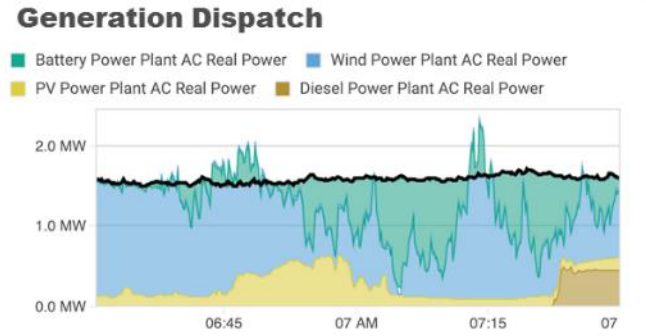
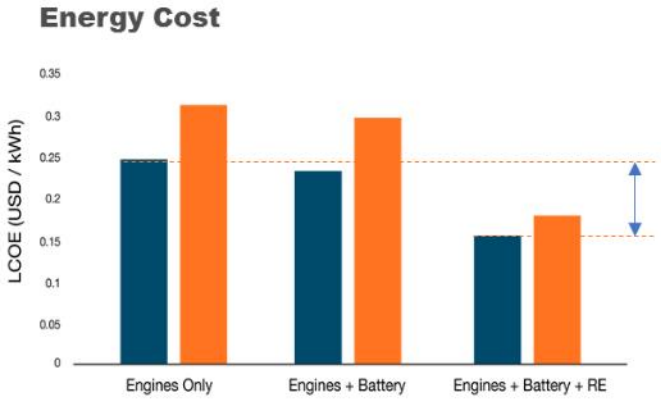
Forecasting 15mins



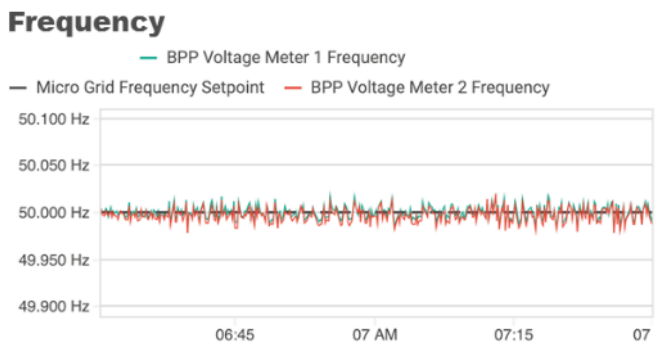


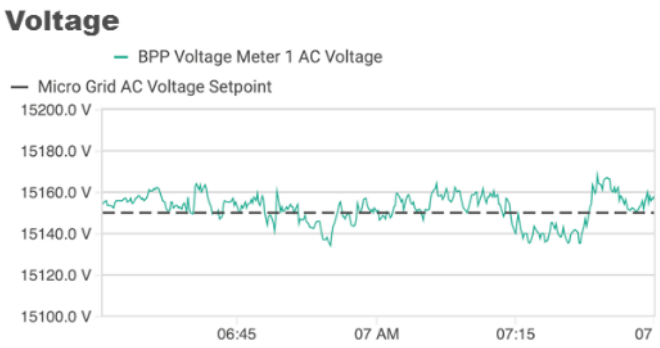
Rolling Dispatch Optimisation 5mins



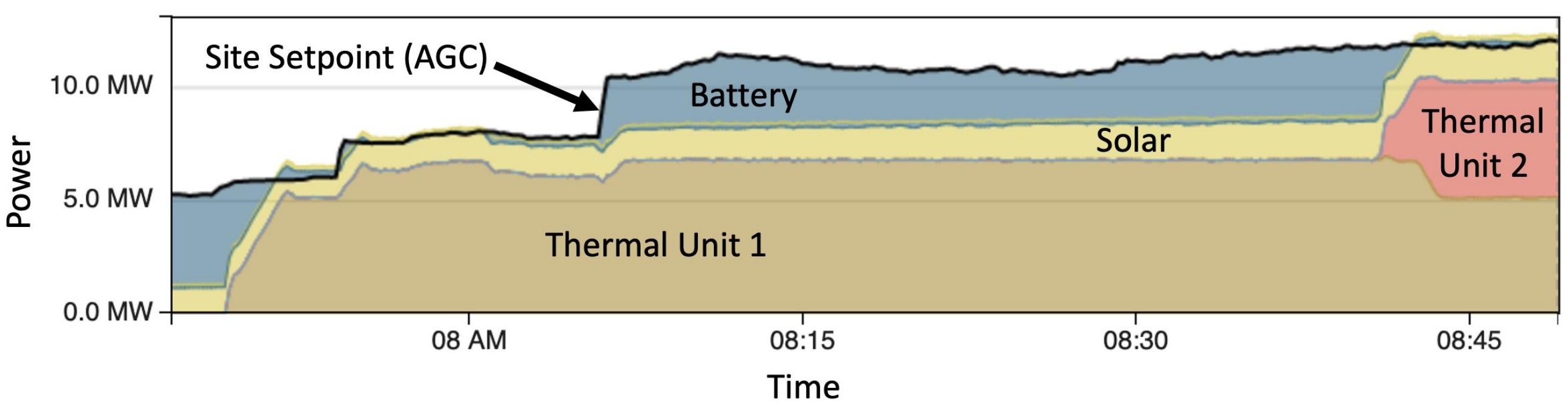


Real-time Controls 150ms





Hybrid Power Plant: ENGINES + STORAGE + RE



IS THIS REALITY TODAY?

Flexibility to improve island grid stability

Engine+ hybrid solution will address VIWAPA's need for a power generating facility that can burn both propane and light fuel oil, as well as deliver **improved system reliability** with state-of-the-art energy management technology**—GEMS**

First dual-fuel hybrid power plant contract, the Randolph Harley Power Plant Project

GEMS will use **weather and load forecast** to optimally dispatch all assets

St. Thomas peak load: 65 MW

GEMS and storage will improve grid reliability, and reduce fuel consumption, engine run hours, and LCOE

The plant is expected to be in full operation by Spring 2022

GEMS to integrate all assets in the island (installed capacity ~200 MW), including distributed solar located on neighbouring St. John island.

A **36MW** of **Wärtsilä engines** and a **9MW/18MWh energy storage** system to be delivered to the U.S. Virgin Islands Water and Power Authority (VIWAPA) on the island of St. Thomas

LPG LFO

First installation of Wärtsilä LG engines with the capability to burn **both liquid petroleum gas (LPG)** and **light fuel oil (LFO)**

Grid control, integration and optimisation

Boosts wind penetration from ~20% to 33% with addition of energy storage and GEMS control system

Eliminates the dependency on HFO; **fuel consumption decreased by 5%**

Delivers both economic and environmental benefits; **CO_2 emission decreased by 8%**

Dispatch optimisation, solving unit commitment

Tertiary control, **secondary** control

Spinning reserves compliance (N-1)

Load forecasting, **renewable forecasts**

Grid forming **battery inverters**

ESS rated power **less than average island load**

Spinning reserves, automatic (un)curtailment of renewables, and automated engine dispatch for the island of Bonaire, population ~19,000

The **existing power plant** is running on 5 HFO engines, 3 back up diesel engines

The **6 MW/6 MWh energy storage** system includes batteries, inverters and power electronics

Integrates 13 **wind** turbines while simultaneously optimising multiple generation assets

Spinning reserve, frequency regulation and black-start for a Central American island

GEMS will control the utility's energy system, including earlier delivered Wärtsilä **engines**, and **solar PV**

The addition of storage and GEMS to RECO's generation resources will provide additional **flexibility** to integrate renewables

The storage system will provide **virtual spinning reserve** capacity needed to maintain stability of the grid and **black-start capabilities**—particularly important for the **energy security** of an island

The solution will be delivered on a fast-track basis, expected to be operational before the end of 2020

Wärtsilä's total installed power capacity in Honduras is approximately 500 MW

10 MW/26 MWh energy storage solution to a power plant on the Caribbean island of Roatán

The existing **28 MW** plant was delivered on an EPC contract by Wärtsilä in 2017

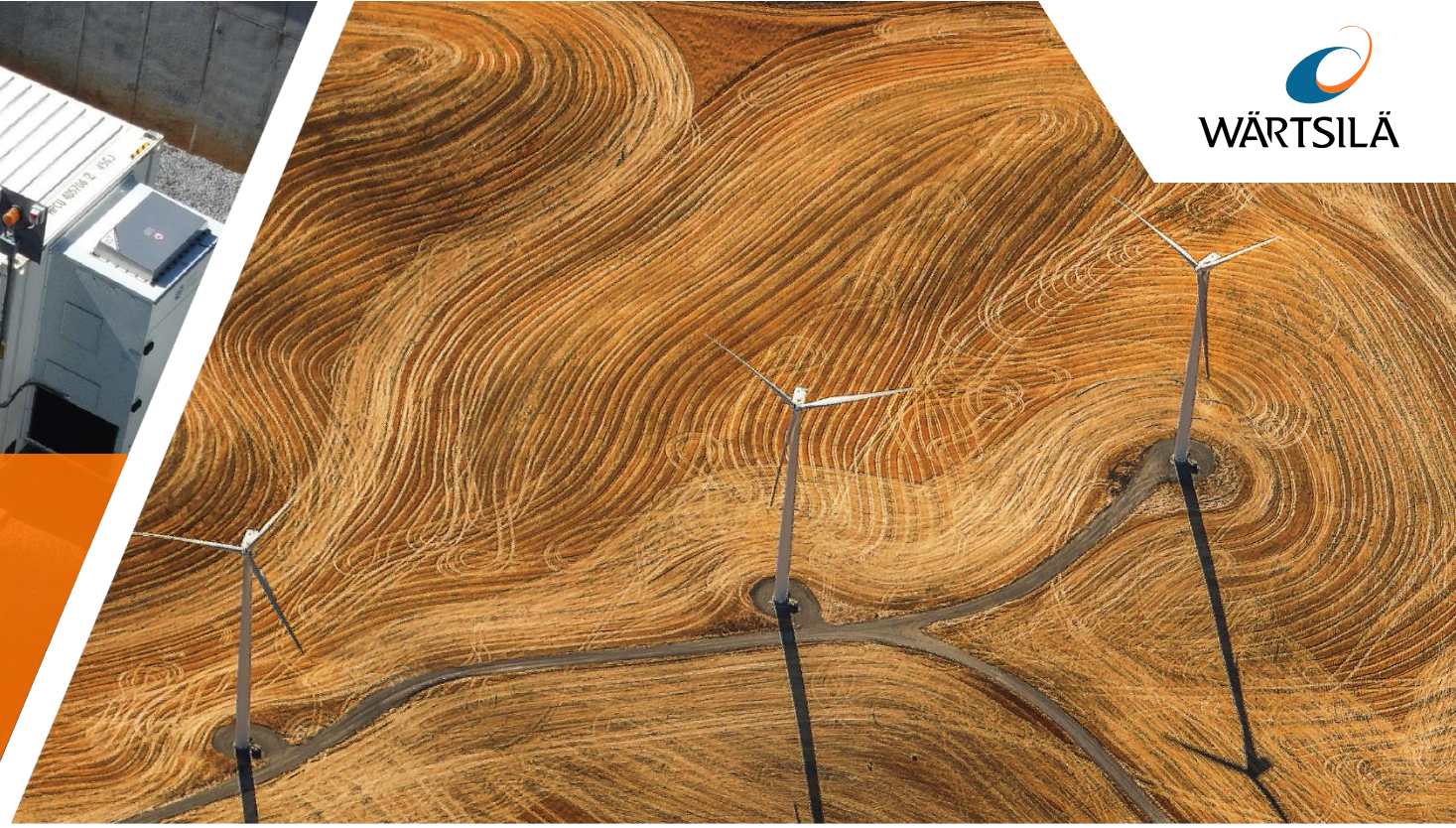
Grid control, integration and optimisation

- Boosts **renewable energy consumption**
- **Eliminates the dependency** on 17,000 liters of diesel per month
- Delivers both **economic and environmental benefits**
- **Dispatch optimisation**, solving unit commitment
- **Tertiary** control, **secondary** control
- **Spinning reserves** compliance (N-1)
- Load forecasting, **renewable forecasts**
- Grid forming **battery inverters**
- Capable of operating grid **without diesel gensets running**

Enabling 100% renewables for the island of Graciosa, population ~4,000

The Graciosa Hybrid Renewable Power Plant will enable **1 MW** of **solar, 4.5 MW** of **wind power** and **6 MW/3.2 MWh energy storage**

Integrates renewable energy sources while simultaneously optimising multiple generation assets



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Enabling a 100% renewable energy future

Introduce disruptive, **game-changing** software products and technologies to the global power industry

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