

# NEW ERA OF OPTIMIZED POWER SYSTEM PERFORMANCE IN THE MIDDLE EAST

10 JUNE 2020



# AGENDA

## Introduction



**Alexandre Eykerman**

Director, Middle East  
Energy Business, Wärtsilä

[alexandre.eykerman@wartsila.com](mailto:alexandre.eykerman@wartsila.com)

## Global Energy Transition



**Matti Rautkivi**

Director, Strategy &  
Business Development  
Energy Business, Wärtsilä

[matti.rautkivi@wartsila.com](mailto:matti.rautkivi@wartsila.com)

## Middle East Energy Trends



**Patrik Farkas**

Market Development  
Manager, Middle East  
Energy Business, Wärtsilä

[patrik.farkas@wartsila.com](mailto:patrik.farkas@wartsila.com)

## Energy Storage & Optimization



**Giriraj Rathore**

Senior Business  
Development Manager  
Energy Business, Wärtsilä

[g.rathore@wartsila.com](mailto:g.rathore@wartsila.com)



# WÄRTSILÄ ENERGY BUSINESS

Wärtsilä Energy Business leads the transition **towards a 100% renewable energy future**. We help our customers unlock the value of the energy transition by **optimising their energy systems** and future-proofing their assets.

Our offering comprises **flexible power plant solutions**, **energy management systems**, and **storage**, as well as **lifecycle services** that ensure increased efficiency and guaranteed performance. Wärtsilä has delivered **72 GW of power plant capacity in 180 countries** around the world.



**DELIVERED 72 GW POWER  
PLANT CAPACITY IN 180  
COUNTRIES**



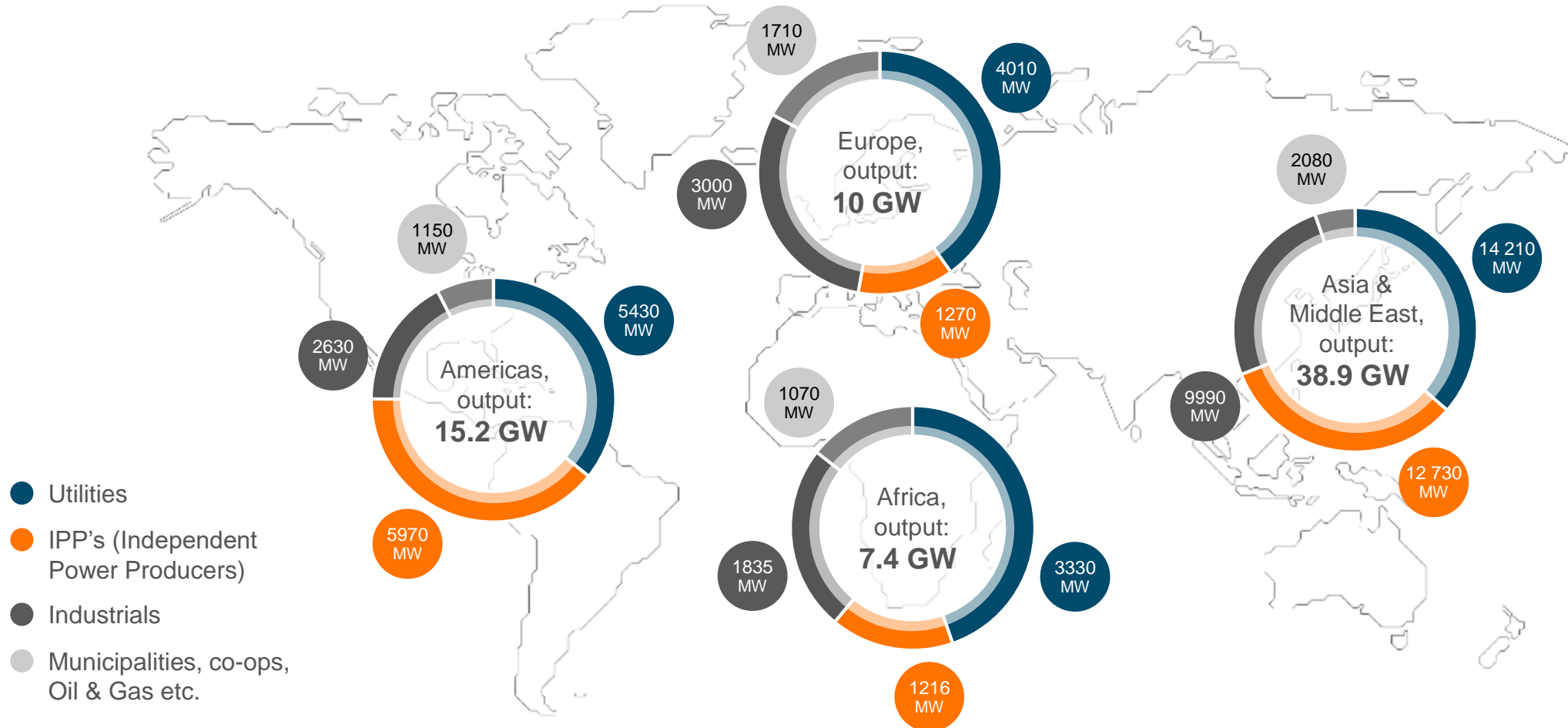
**OVER 70 GLOBAL  
ENERGY STORAGE  
SYSTEMS INSTALLED**



**OUR EXPERTISE CENTRES  
SUPPORT NEARLY 250  
POWER PLANTS GLOBALLY**



# DELIVERED POWER PLANT CAPACITY 72 GW IN 180 COUNTRIES AROUND THE WORLD



## WÄRTSILÄ POWER PLANT FROM THE INSIDE



JORDAN, IPP3 (573 MW)



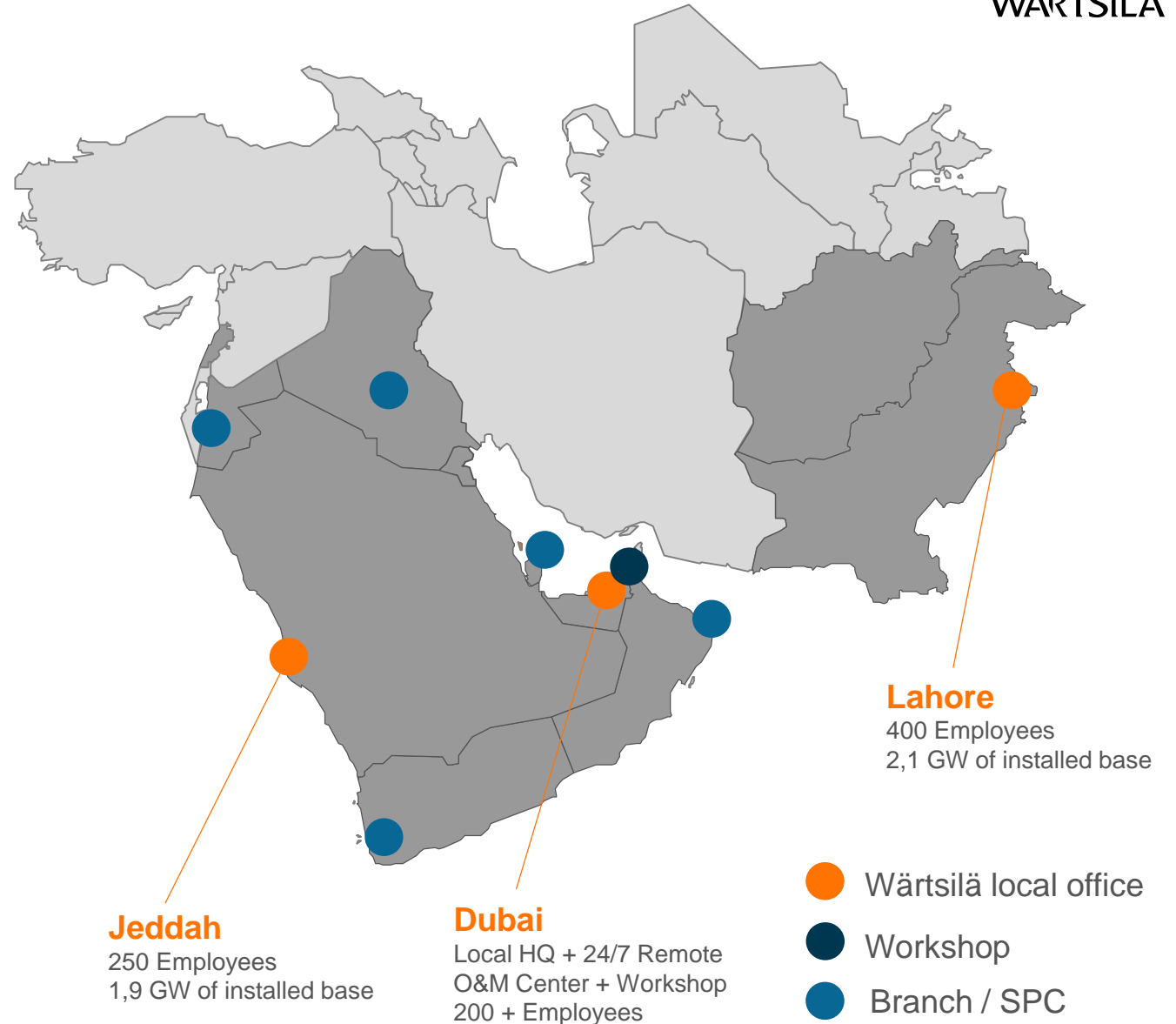




# WÄRTSILÄ BATTERY STORAGE INSTALLATION

# WÄRTSILÄ IN THE MIDDLE EAST

- › Total capacity over **7,200 MW at 300+ installations**
- › **Locally present service** teams with central support from Dubai HQ
- › Over **1,700 MW** of Operation & Maintenance all over the region and increased O&M support from our **Digital Expertise Centre** in Dubai





# WÄRTSILÄ SUPPORTING YOU IN THE ENERGY TRANSITION

## UNDERSTAND

The energy transition unfolding and renewables becoming the new baseload.

## DESIGN & BUILD

Proper planning and smart adaptation will be essential for each country.

## SERVE

The best solutions to accelerate change through flexible power plants, energy storage and smart energy management systems.



# GLOBAL ENERGY TRANSITION



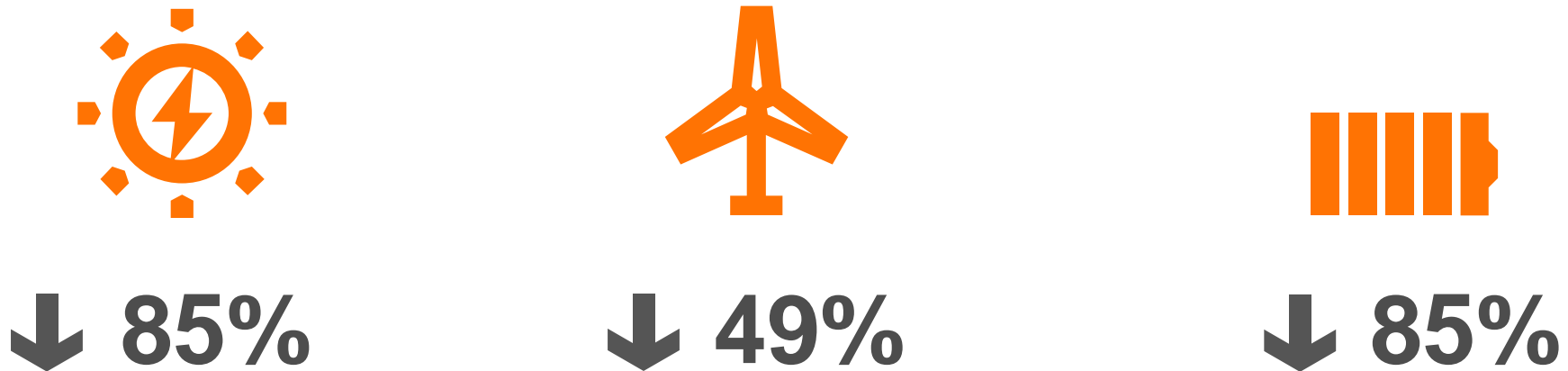
**Matti Rautkivi**

Director, Strategy & Business  
Development, Energy Business, Wärtsilä



# INCREASING COMPETITIVENESS OF RENEWABLES

Renewable energy generation cost since 2010



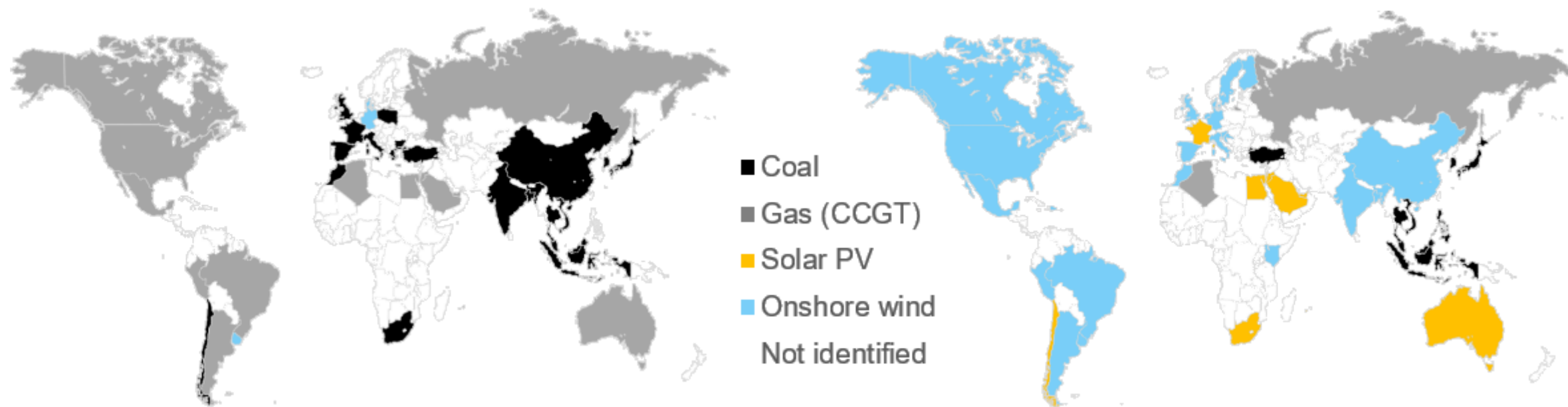
Source: Bloomberg New Energy Outlook 2019



## Renewables are now cheapest new energy source across more than two-thirds of the world...

Most competitive source of new bulk generation in 2014

Most competitive source of new bulk generation in 2019

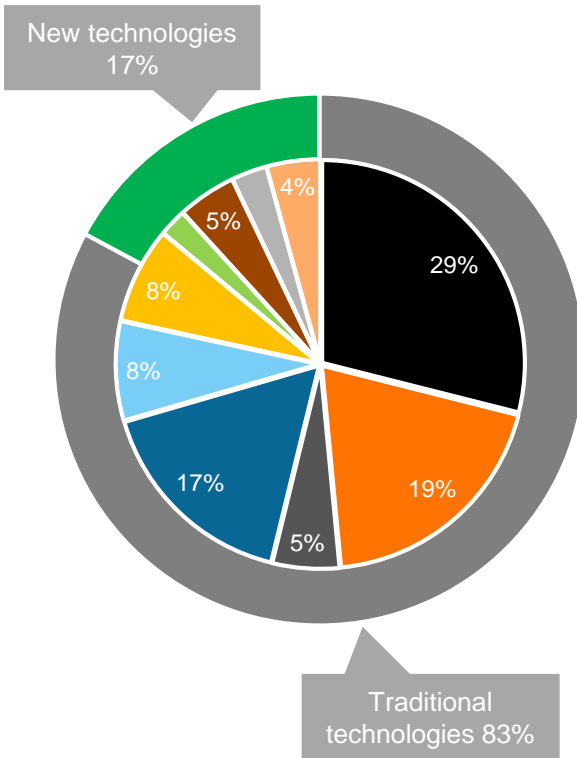


...and by 2030 they undercut existing coal and gas almost everywhere.

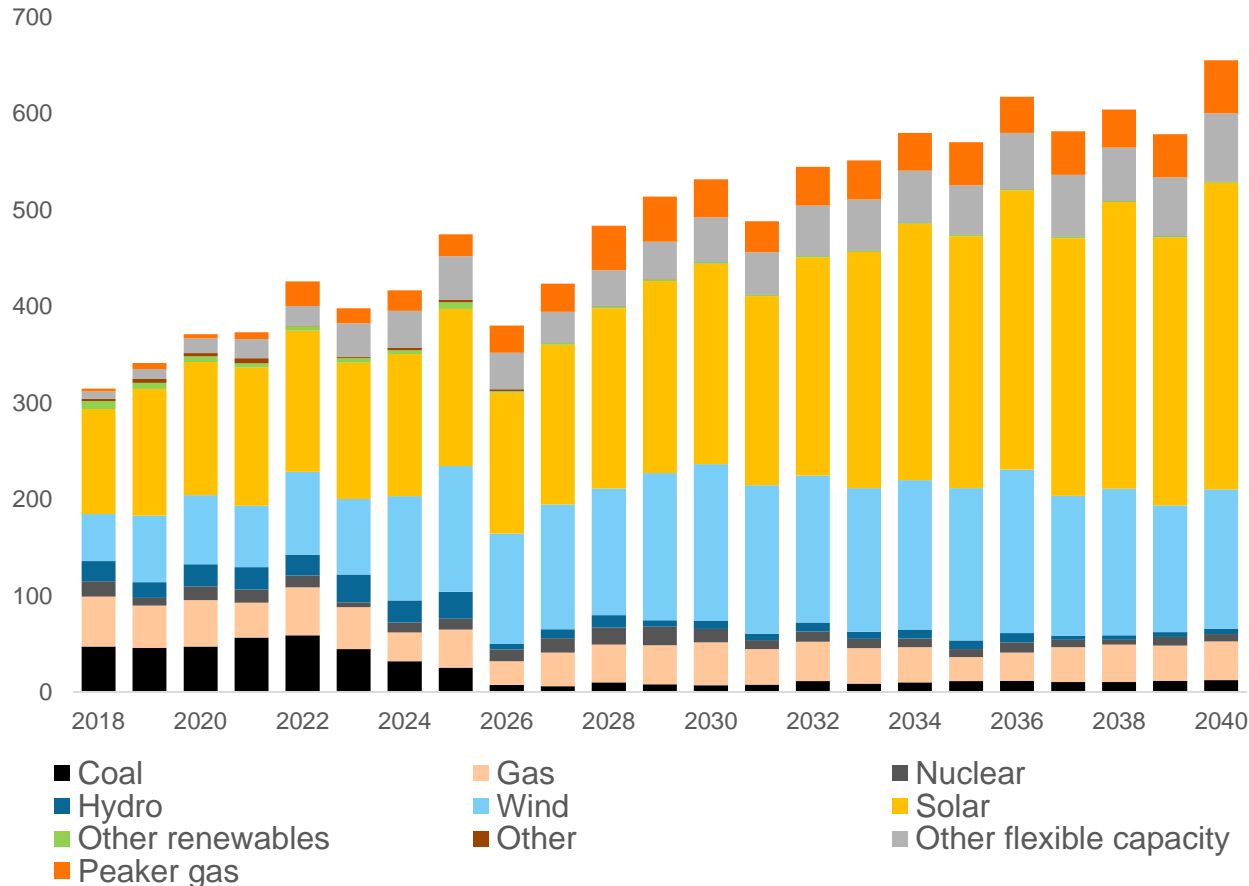


# GLOBAL INSTALLED CAPACITY SHIFTS FROM 57% FOSSIL FUELS TODAY, TO 2/3 RENEWABLES BY 2050

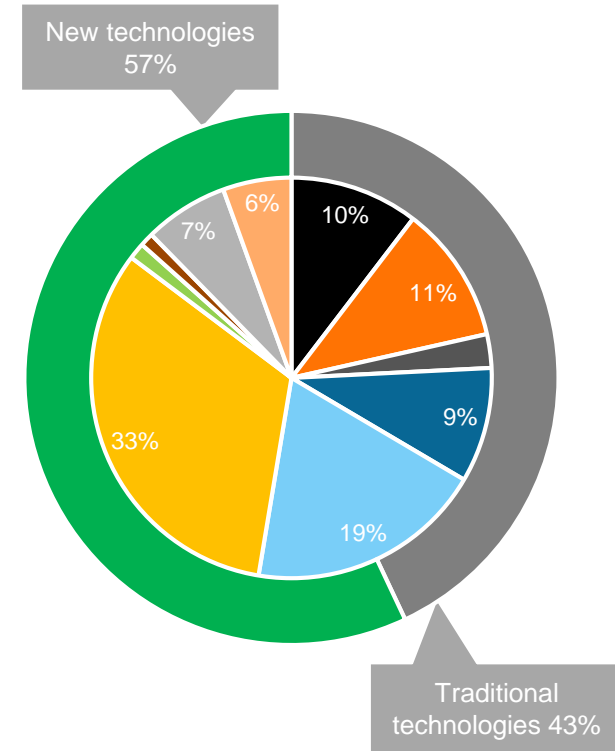
Capacity mix 2018 (7.0 TW)



Annual gross capacity additions 2018-2040 (GW)



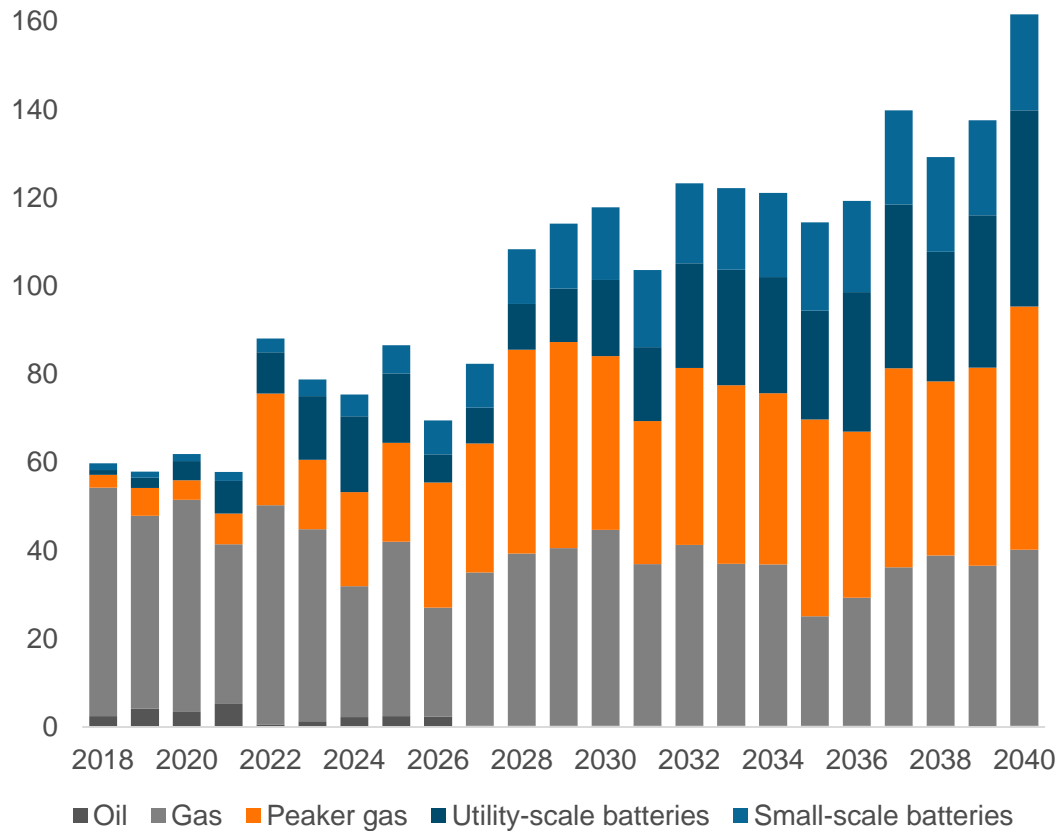
Capacity mix 2040 (15.5 TW)



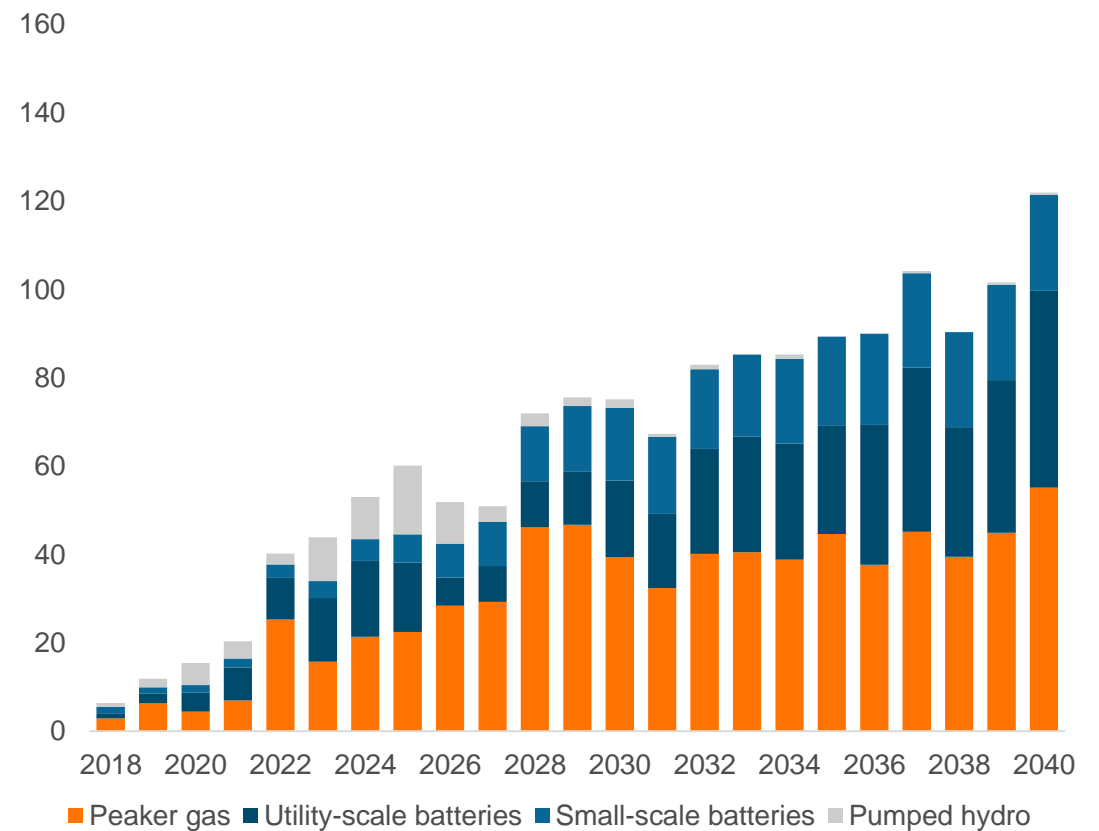
Source: Bloomberg New Energy Outlook 2019

Note: Other flexible capacity includes all possible technologies that are not running on baseload, excluding peaker gas, i.e. could be a combination of storage, interconnections, demand response etc.

## ANNUAL CAPACITY ADDITIONS 2018-2040 (GW)



## ANNUAL FLEXIBLE CAPACITY ADDITIONS 2018-2040 (GW)

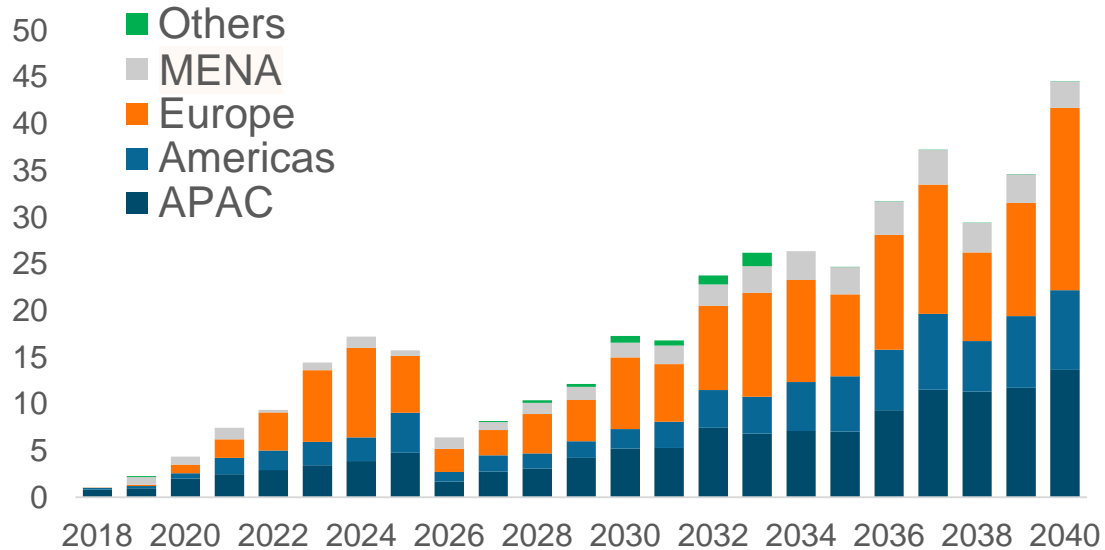


Source: Bloomberg New Energy Outlook 2019

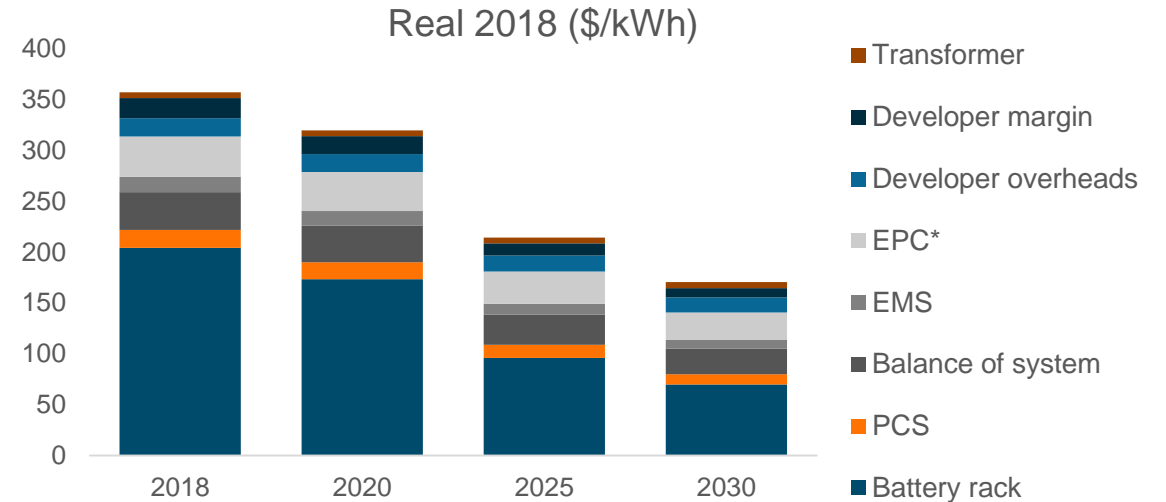


# 122-FOLD GROWTH IN ENERGY STORAGE UNTIL 2040

Utility-scale battery additions (GW) 2018-2040



CAPEX for 20MW/80MWh AC fully installed energy storage system



Source: Bloomberg New Energy Outlook 2019



**WHAT WOULD HAPPEN IF THE PENETRATION OF  
RENEWABLES REACHED A CRITICAL LEVEL?**

**THIS SPRING WE FOUND OUT!**



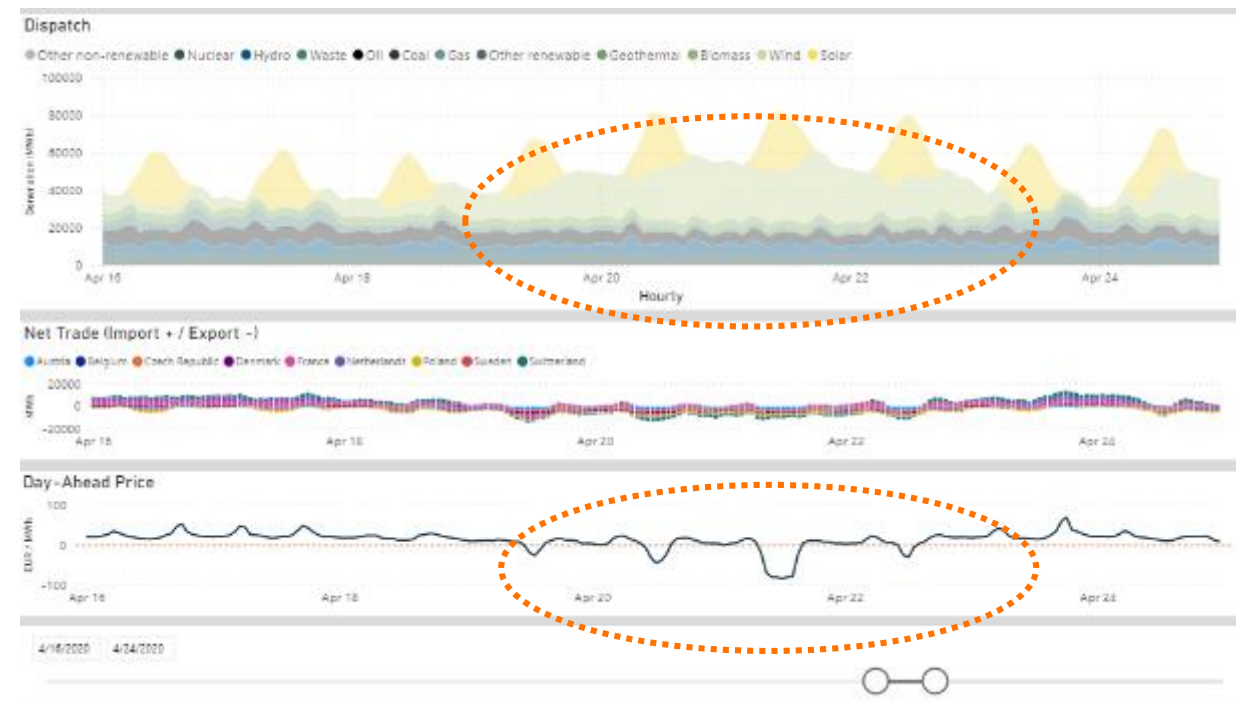
# THE ECONOMY REACTED TO COVID-19, BUT THE SUN AND WIND DID NOT

Germany could have been the first European country to achieve 100% renewable energy generation

5 days in April, Germany had to pay up to €80/MWh to export excess electricity

→ Norway and Austria with more flexible generation fleets were paid to receive green electricity.

**Legacy systems generate legacy results.**



Visit Wärtsilä Energy Transition Lab: <https://www.wartsila.com/energy/transition-lab>

# MIDDLE EAST ENERGY LANDSCAPE



**Patrik Farkas**

Market Development Manager,  
Middle East, Energy Business, Wärtsilä



# GROWTH DRIVERS

Hydrocarbon export enabled the steep economic growth of the Middle East and still represents the backbone of GCC's economy

- › **Transformation:** molecule-export based economies → higher value add economies
- › Foundation of growth: **low-cost & sustainable power supply**
- › Economic diversification through **energy intensive industries**



# CHANGE DRIVERS



**LOWEST COST  
VARIABLE  
RENEWABLE  
ENERGY**



**POWER-WATER  
PRODUCTION  
DECOUPLING**



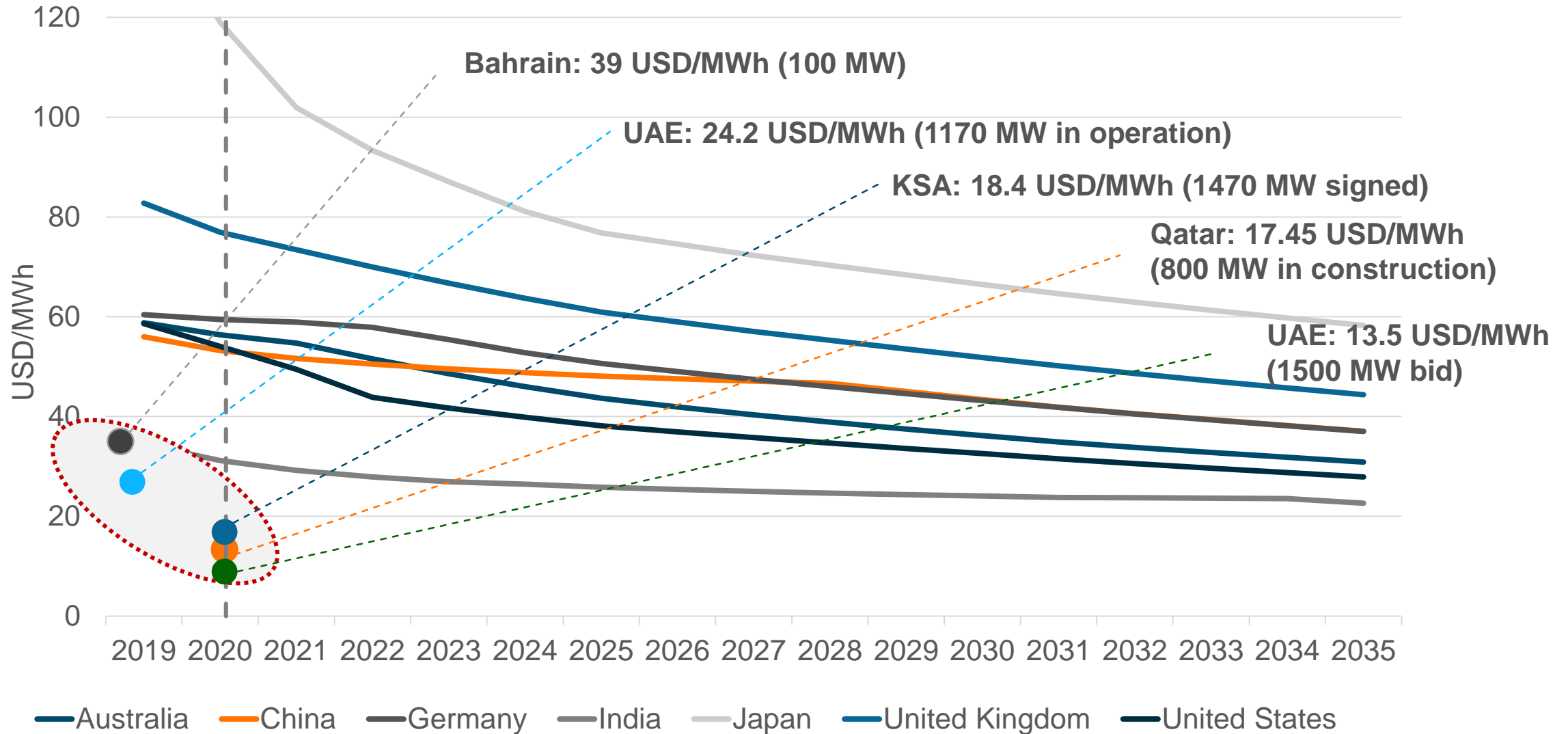
**FISCAL  
EFFICIENCY**



**REPLACEMENT  
OF AGEING  
FLEET**



Solar PV LCOE forecast



Source: Bloomberg New Energy Outlook 2019



# CHANGE DRIVERS



**LOWEST COST  
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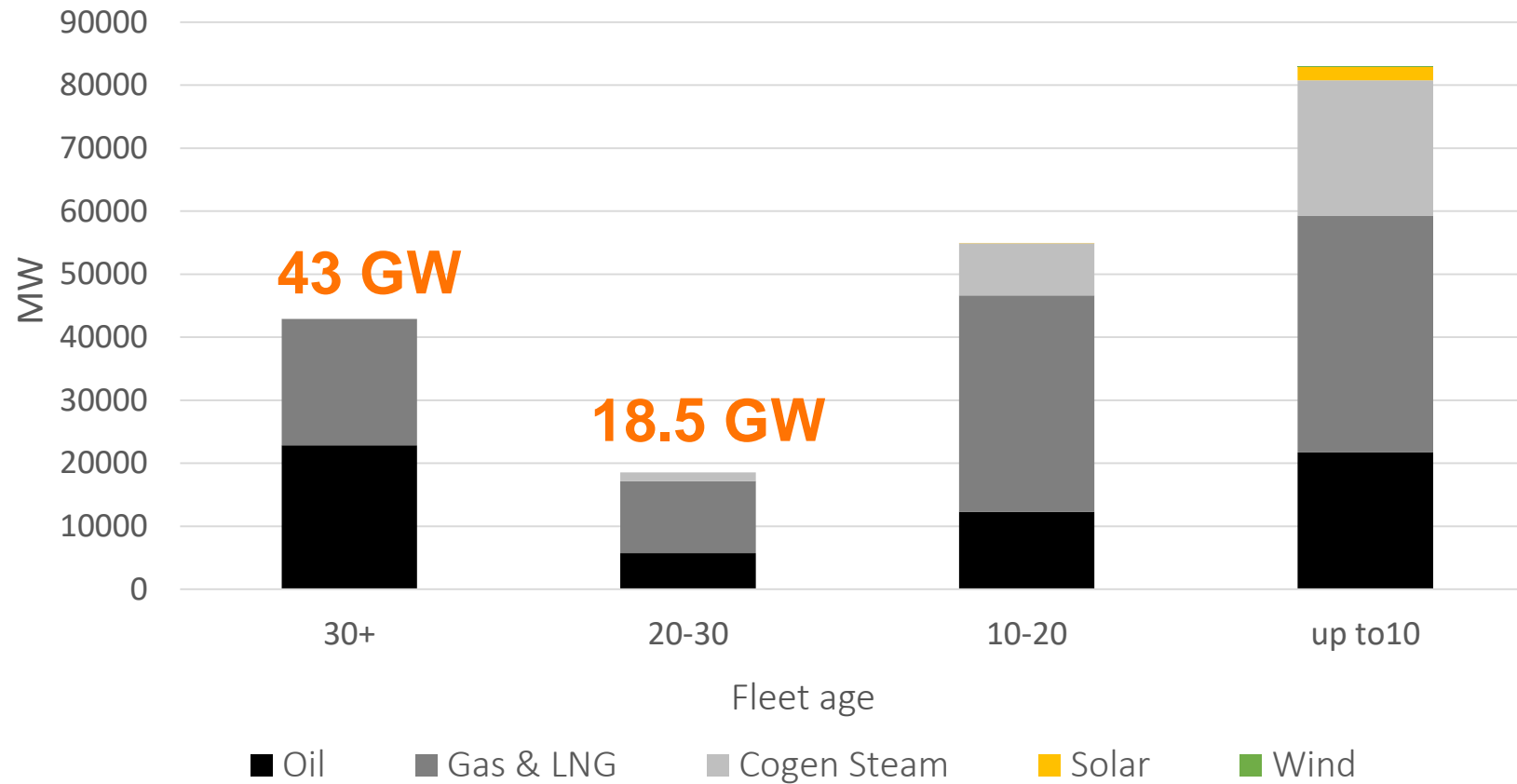


**REPLACEMENT  
OF AGEING  
FLEET**



# 61 GW GENERATION CAPACITY NEAR RETIREMENT AGE

Age distribution of power plants in GCC by fuel



Source: S&P Global - World Electric Power Plants Database, 2020 March

# CROSSROADS

**ECONOMIC  
DIVERSIFICATION**

**LOW COST  
RENEWABLES**

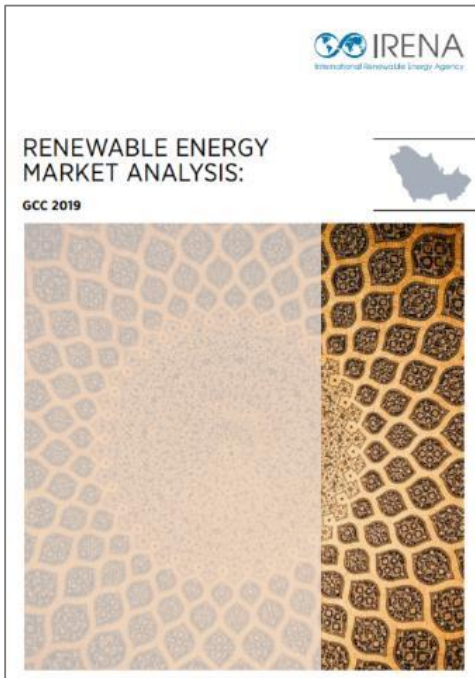
**WATER-POWER  
NEXUS**

**REPLACEMENT OF  
AGEING FLEET**

**OIL  
ECONOMICS**

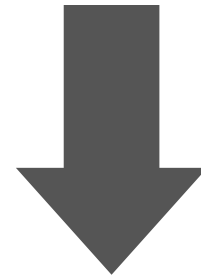


# 10 UNITS WITH LOWEST LCOE\* ≠ LOWEST SYSTEM LCOE



” It should be noted that **lower LCOE does not necessarily entail lower system costs, if structural changes to increase system flexibility are not adopted**” – IRENA 2019

Cost of electricity



Value of balancing and ancillary services



Leadership challenge: **“World-class leader in lowest-cost sustainable electricity”**

\*LCOE: levelized cost of electricity

# UTILITY 2.0



**Giriraj Rathore**

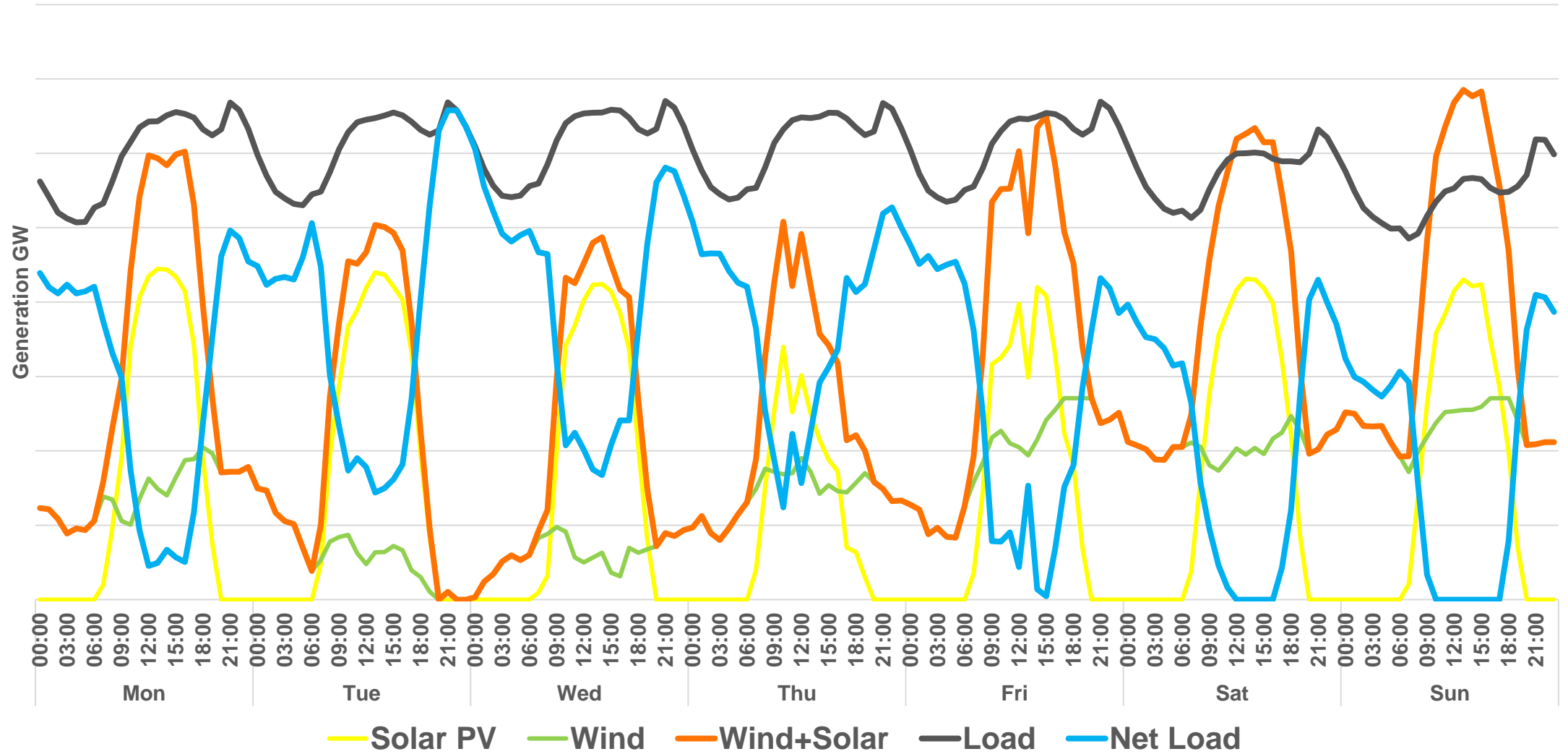
Senior Business Development Manager  
Energy Business, Wärtsilä



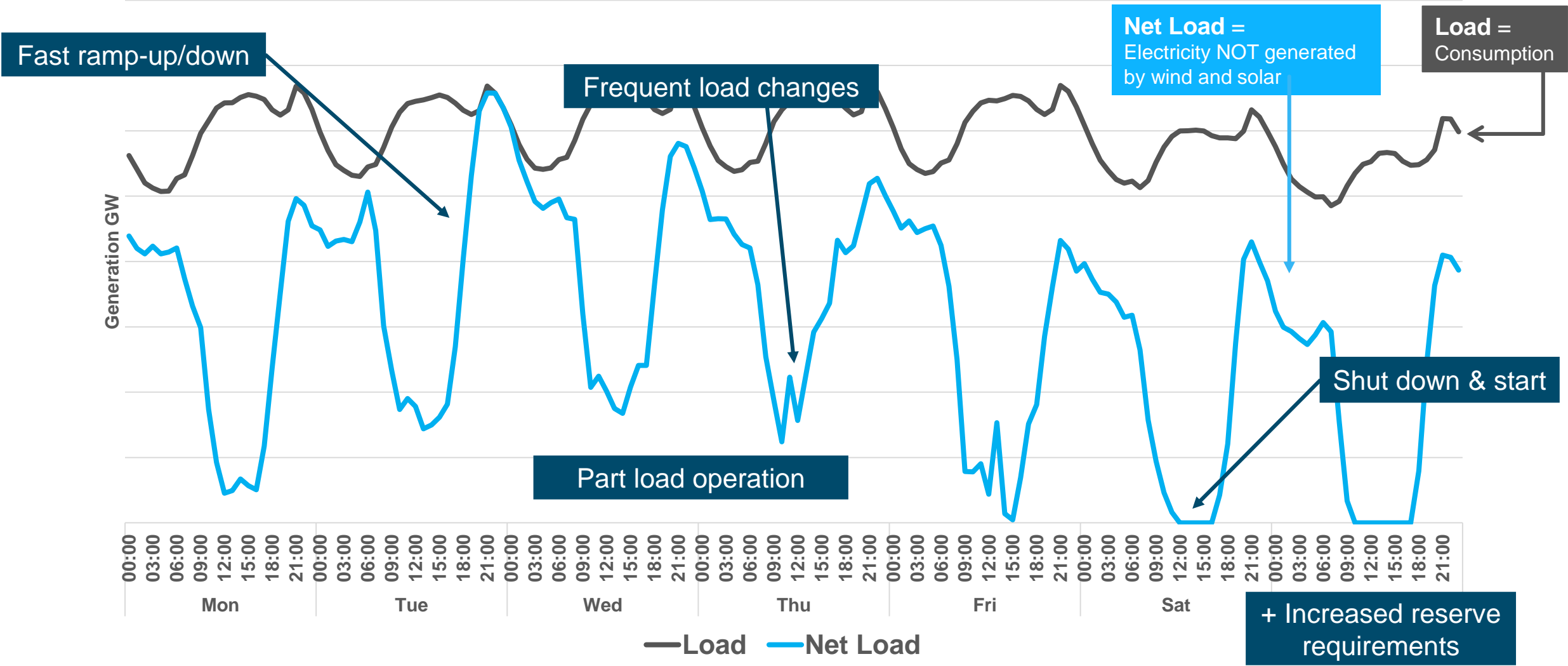
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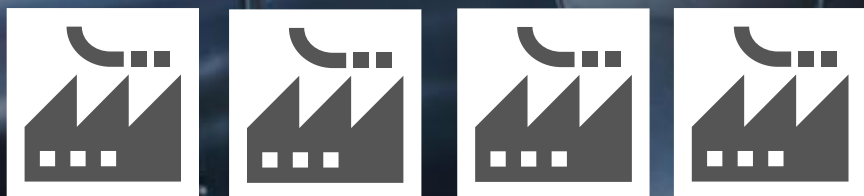


# LARGE POWER PLANTS (WITH A STEAM CYCLE) ARE NOT DESIGNED TO OPERATE ALONG THE BLUE CURVE!





## CHANGING POWER MIX



## POWER PLANT FLEXIBILITY

Part load efficiency

Minimum Stable Load

Start cost

Start-up time

Minimum up & down time

Fuel consumption at start-up

Cycling cost



# MUSANDAM IPP, OMAN

## 120 MW

**HIGH  
EFFICIENCY**

in high temperature  
conditions  
~47%

**FAST  
RAMPING**

2 minutes to full load

**MODULAR  
DESIGN**

10-20 MW unit size

**FUEL  
FLEXIBILITY**

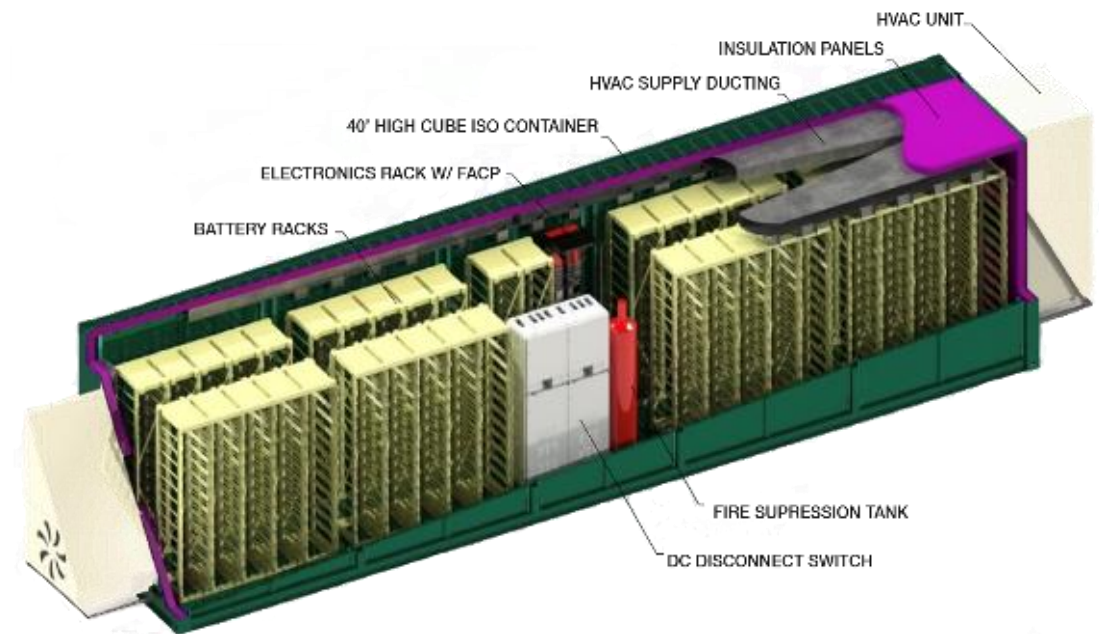


” A **grid scale large energy storage**, converts the energy from a grid-scale power network into a storable form that can be converted back to electrical energy when needed.”

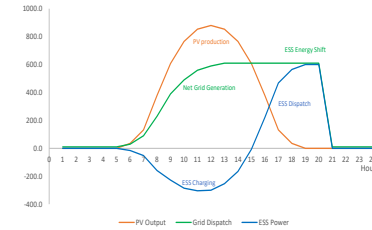
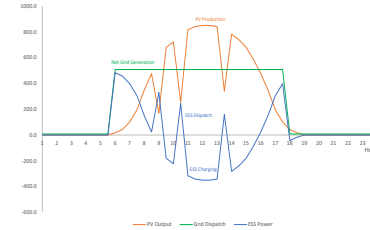
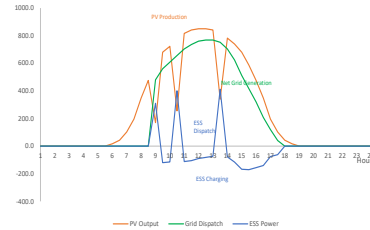
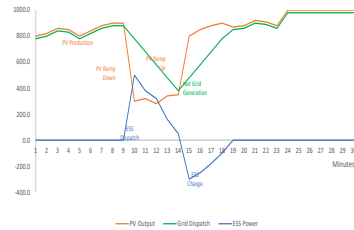
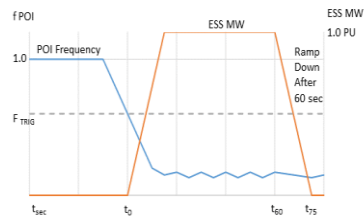
Storage is a powerful asset that adds **flexibility** and **reliability** to the grid.

## BATTERY ENERGY STORAGE

1. Fast response to match supply and demand.
2. Makes the system more flexible.
3. Improves capacity utilization of thermal power units.
4. Reduced CAPEX & OPEX.
5. Contribution to ancillary services.



# ENERGY STORAGE SOLVES MULTIPLE PROBLEMS FOR UTILITIES



Frequency Response

Ramp Rate Control

Renewables Smoothing

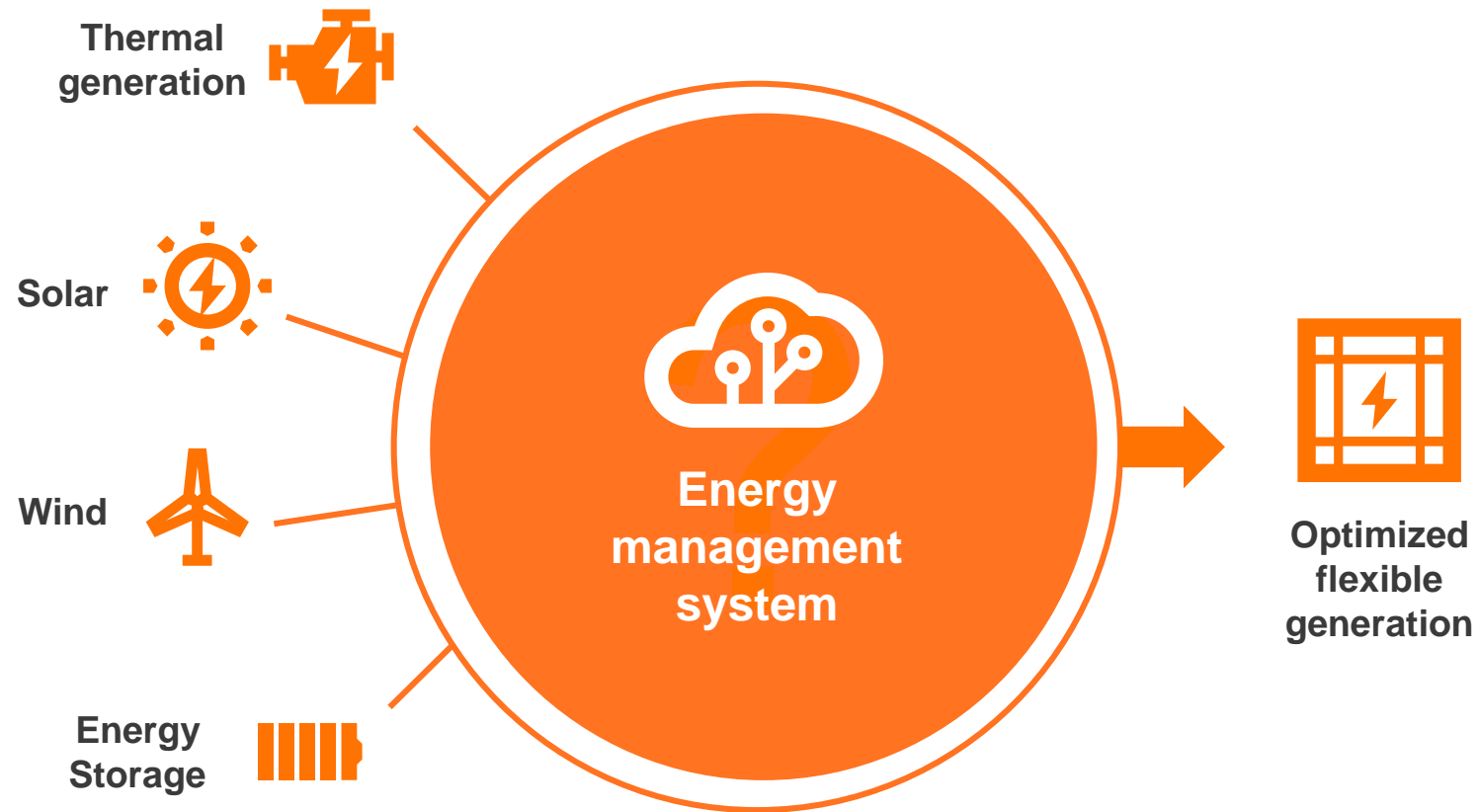
Renewables Firming

Renewables Shifting

ESS Application	Description	ESS Sizing
Frequency Response	Corrects over and under frequency	15-30 minutes
Ramp Rate Control	Mitigates ramping at generation source	30-45 minutes
Renewables Smoothing	Maintains approximate solar curve	1 hour +
Renewables Firming	Creates firm committed load shape	2 hours +
Renewables Shifting	Shifts solar to evening hours with or w/o commit	4 hours +



# ENERGY MANAGEMENT SYSTEM – THE CRITICAL LINK

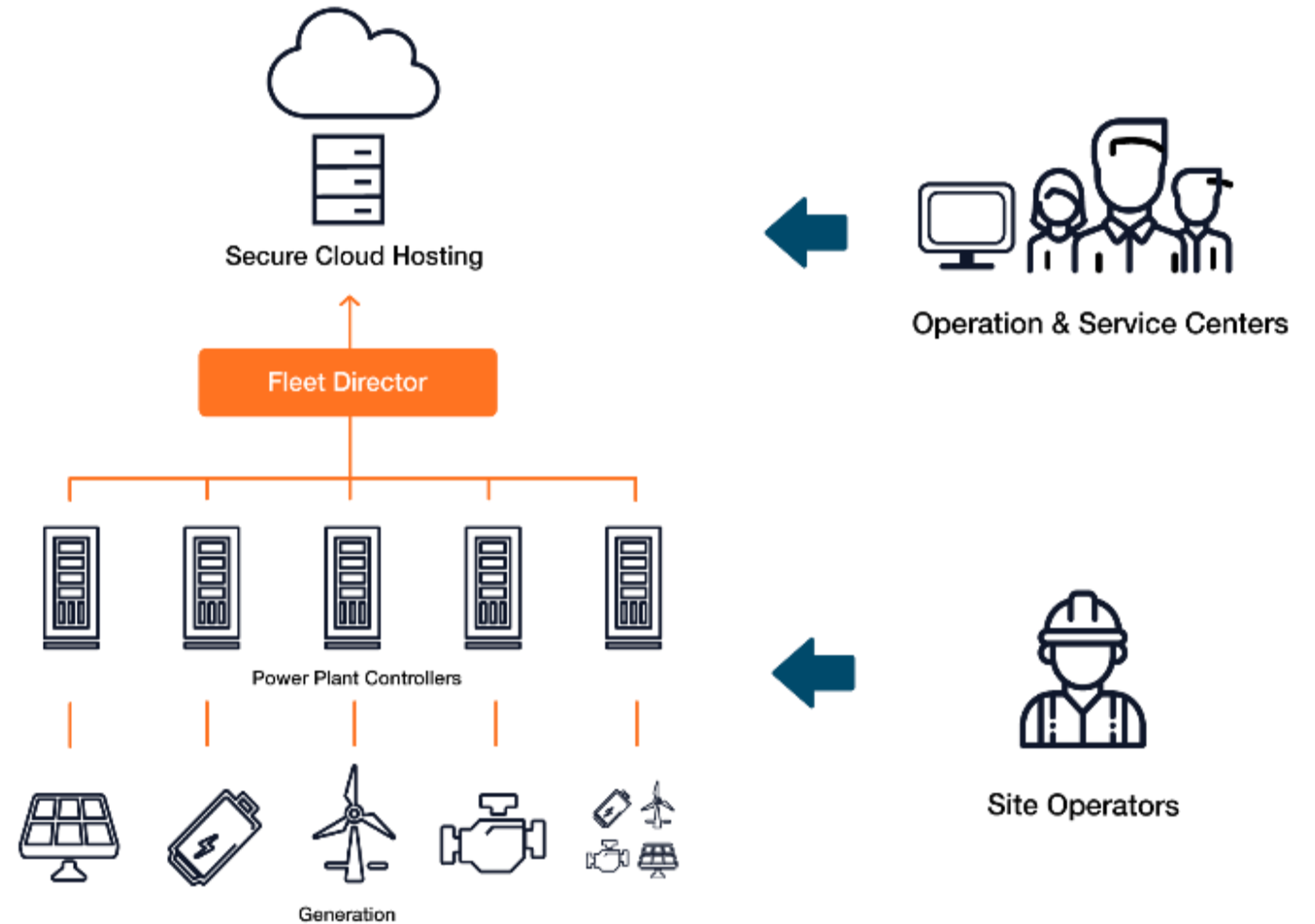


An effective EMS should have the following capabilities:

1. **Data driven:** It should be able to gather granular data and process it for further optimization.
2. It should have **the capability to handle multiple assets**, while being technology agnostic.
3. It should be **scalable** to manage increased asset portfolio.

## GEMS SOLUTION SUITE

- › GEMS is the **leading energy system management platform**
- › A suite of proprietary software products for building, monitoring and intelligently operating power plants and energy resources
- › Optimizes **all generation assets**
- › Secure, flexible, and scalable
- › Deployed in **70+ projects** around the world







# ENABLING 100% RENEWABLES FOR THE ISLAND OF GRACIOSA

**Transforming and enabling a “renewables as baseload” grid with energy storage, wind, solar and engines.**



Hybrid renewable power plant enables 1MW of PV Solar, 4.5MW Wind and 6MW/3.2MWh battery energy storage solution.



Integrates renewable energy sources while simultaneously optimizing multiple generating assets.



PPA based on fuel savings. GEMS optimizes multiple assets to eliminate dependence on 17,000 litres of diesel per month.



Delivers both economic and environmental benefits.

# REPRESENTATIVE DEPLOYMENTS



 **20MW Frequency regulation**



 **20MW Capacity + RA**



 **2 x 50MW/50MWh Grid balancing**



 **2MW Grid deferral**



**CA, USA** **70MW/70MWh  
Renewables integration**



 **10MW Solar + Storage**



# ENABLING SUSTAINABLE SOCIETIES WITH SMART TECHNOLOGY



**WÄRTSILÄ**