

An aerial photograph of a wind farm. Several white wind turbines are scattered across a patchwork of green and brown agricultural fields. Large, billowing white clouds are visible in the sky, partially obscuring the landscape. The text 'Path to 100%' is overlaid in the center in a large, white, sans-serif font. A short orange horizontal line is positioned to the right of the word 'Path'.

Path to 100%

Path
to 100%

Path to 100%

Efficiency & Flexibility in the Italian Energy System

Panelists



Emanuele Martinelli

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Energia Media*



Marco Golinelli

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*Senior Consultant
Energy & Strategy Group*

**Path
to 100%**



Wärtsilä Energy



Wärtsilä Energy Business is leading the transition towards a 100% renewable energy future. We understand, design, build and serve optimal power systems for future generations. Wärtsilä's solutions provide the needed flexibility to integrate renewables and secure power system reliability – unlocking an optimised energy transition for our customers.

Our offering comprises engine-based flexible power plants, energy management systems and storage solutions. We support our customers over the lifecycle of their installations with services that enable increased efficiency and guaranteed performance. Wärtsilä has 71 GW of installed power plant capacity in 180 countries around the world.

An aerial photograph of a wind farm. Several white wind turbines are scattered across a patchwork of green and brown agricultural fields. Large, fluffy white clouds are visible in the sky, partially obscuring the landscape. The text 'Path to 100%' is overlaid in the center in a large, white, sans-serif font. A short orange horizontal line is positioned to the right of the word 'Path'.

Path —
to 100%

Path —
to 100%



POLITECNICO
MILANO 1863



Il mercato italiano della cogenerazione ed il suo potenziale

Marco Guiducci

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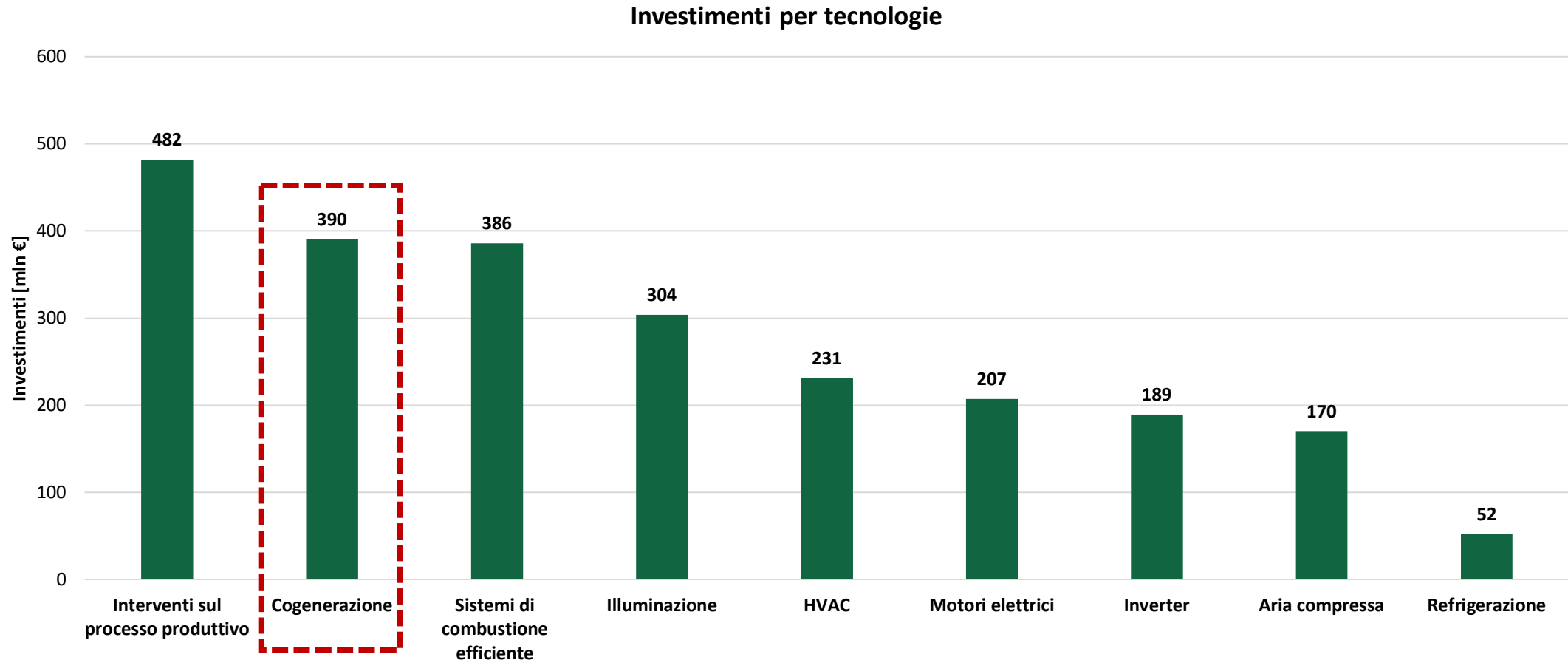
23 giugno 2020



Gli investimenti nel settore industriale

La visione per tecnologie

- I 2.406 mln € di investimenti effettuati in tecnologie hardware nel 2019, si ripartiscono come mostrato in figura.

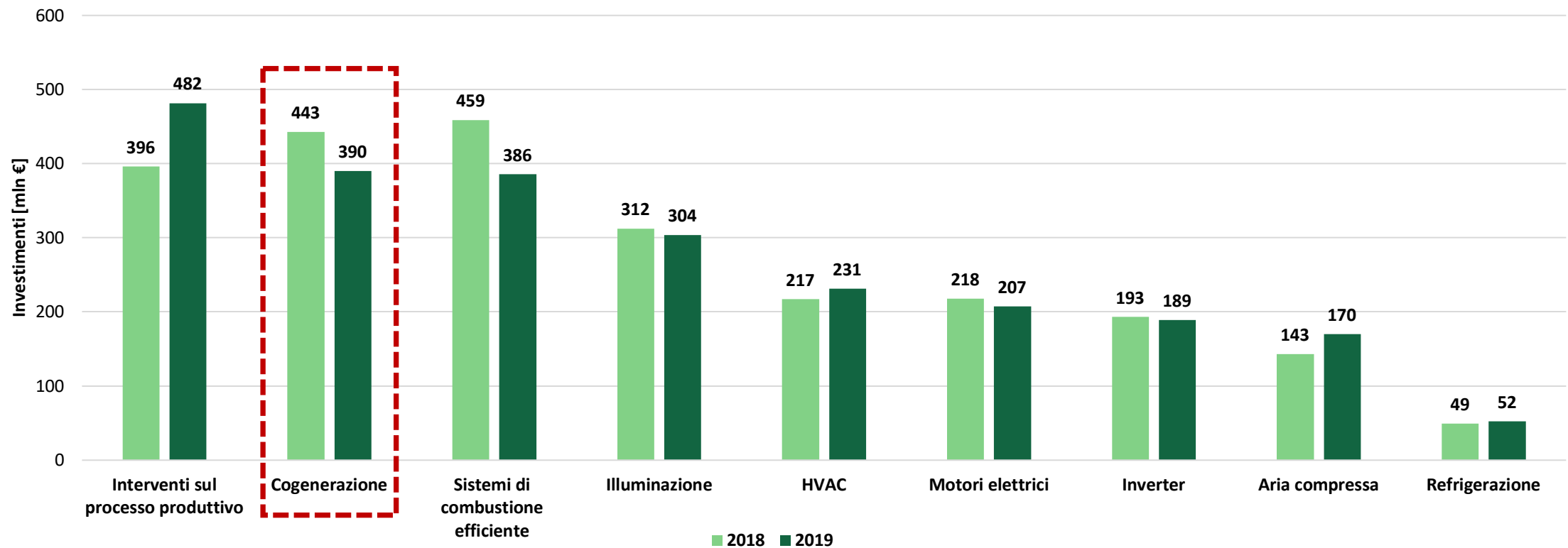


Gli investimenti nel settore industriale

Il trend 2018-2019

- Rispetto al 2018, si registra una contrazione degli investimenti in cogenerazione e sistemi di combustione efficiente. Di contro crescono gli investimenti in aria compressa e nel processo produttivo. Variazioni poco rilevanti per le altre tecnologie analizzate.

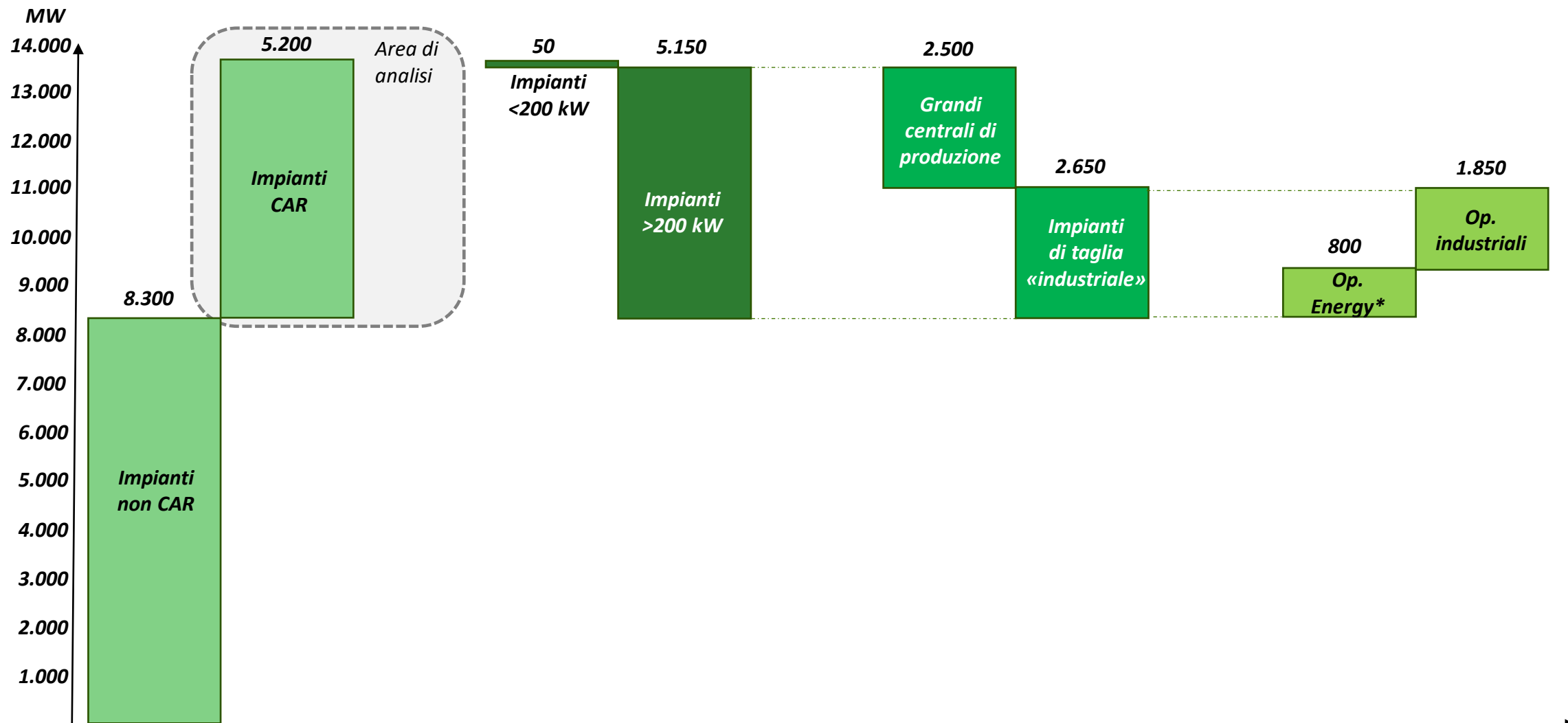
Trend investimenti 2018-19



Variazione % 18% -13% -19% -3% 6% -5% -2% 16% 6%

Analisi database CAR

Mappatura impianti di cogenerazione



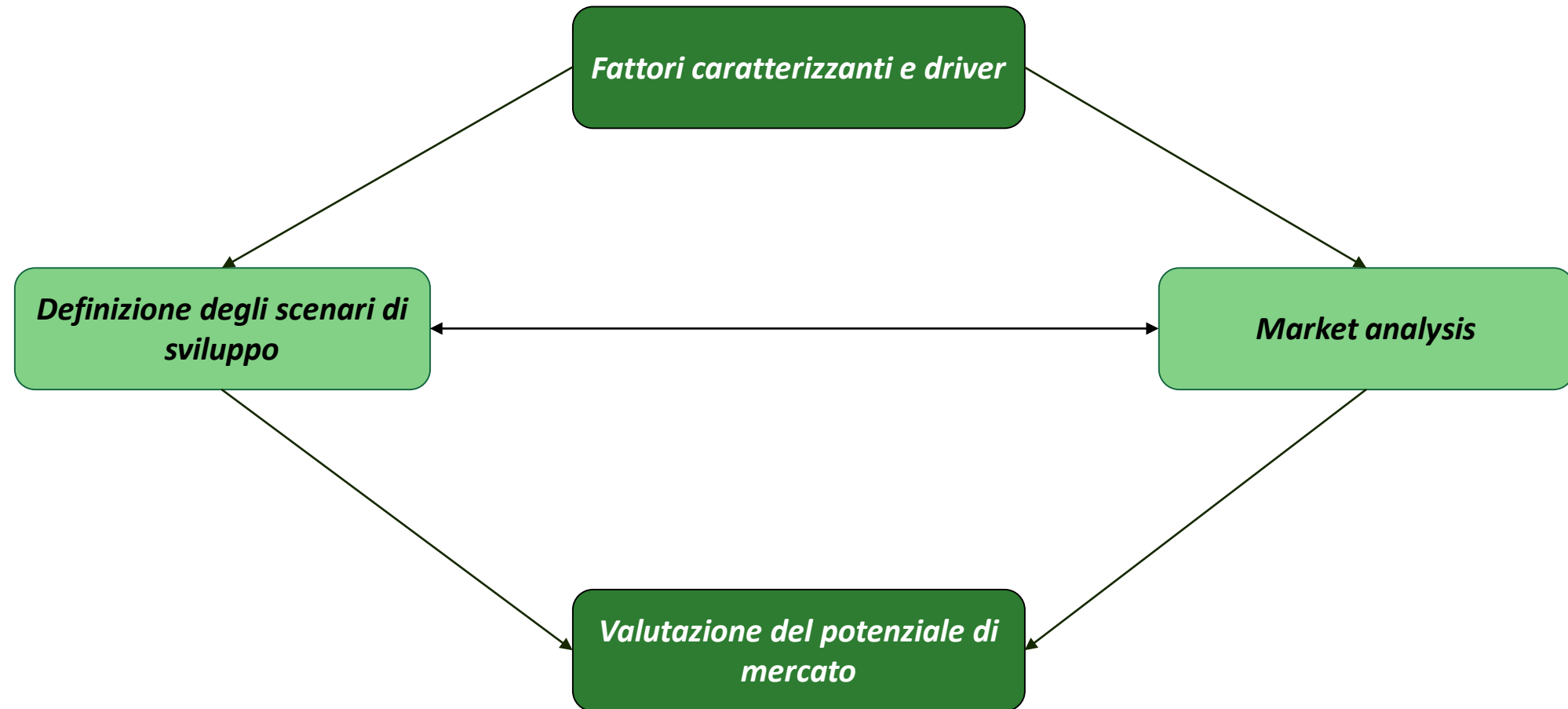
Messaggi chiave

Il mercato ed i player coinvolti

- Continua la **contrazione degli investimenti in cogenerazione**, i quali registrano un **-13% rispetto al 2018**. Contrazione tuttavia limitata rispetto al dato del 2018, anno in cui gli investimenti si erano ridotti del 24% rispetto all'anno precedente. La cogenerazione rimane comunque un **comparto in sofferenza dall'entrata in vigore del Decreto Energivori**, soprattutto per gli impianti di grande taglia.
- **La forte competizione nel mercato della cogenerazione**, cresciuta in particolare negli ultimi anni con l'ingresso dei fornitori specializzati in efficienza energetica come EScO ed Utility, **ha spinto gli operatori a fornire una sempre maggior gamma di servizi correlati alla semplice vendita dell'impianto**. Si sta assistendo quindi ad una trasformazione del mercato con uno **spostamento dal prodotto verso il servizio**.
- La mappatura degli impianti di cogenerazione ad alto rendimento (CAR) ha evidenziato come **il mercato della cogenerazione sia particolarmente frammentato** con più di 200 operatori, suddivisi tra mondo industriale ed energy, detentori di impianti di cogenerazione.

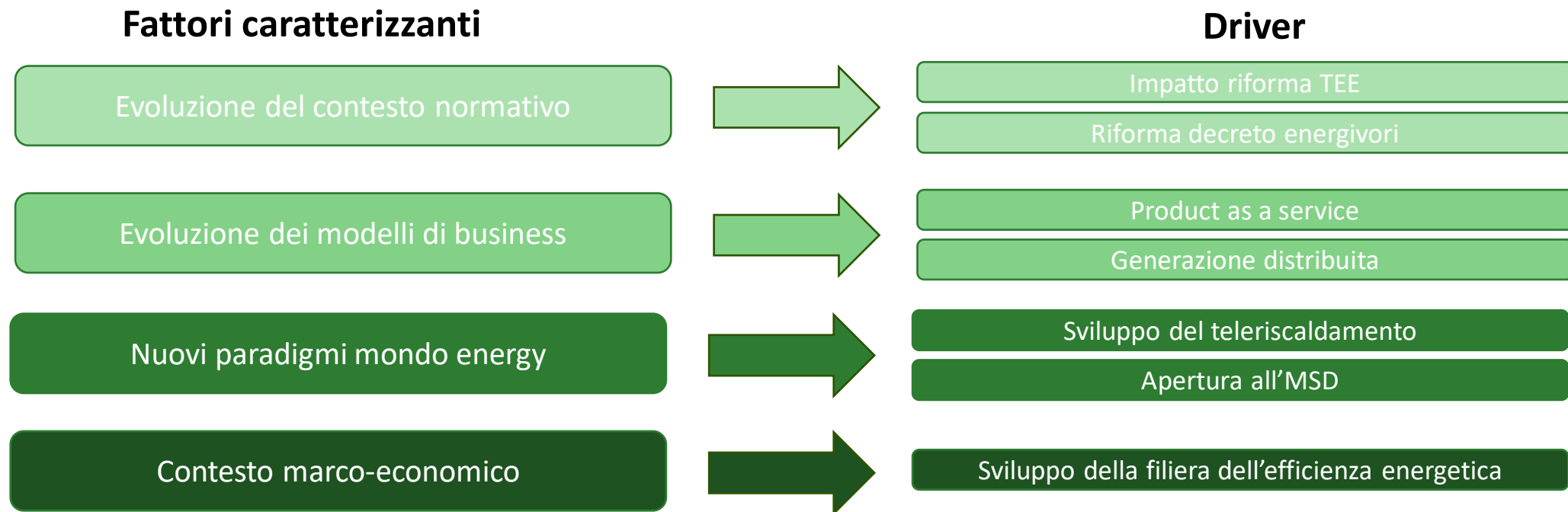
Stima del potenziale della cogenerazione al 2025

Metodologia



Fattori caratterizzanti e driver

- Per l'identificazione dei driver che si stimi abbiano il maggior impatto sul mercato della cogenerazione, sono state condotte delle interviste dirette sia con operatori di mercato (fornitori di tecnologia ed ESCo), sia con gli operatori industriali con la maggior attitudine all'utilizzo di impianti cogenerativi (cartaria e alimentare).
- A valle delle informazioni raccolte sono stati identificati 7 driver principali, che a loro volta possono essere categorizzati in 4 fattori caratterizzanti.



Definizione degli scenari di sviluppo

Criteri di valutazione

- Ogni driver identificato **ha un'influenza diversa sugli scenari di sviluppo**. Per questo motivo ad ogni driver è stato assegnato un punteggio su **una scala da -5 a +5**, dove il punteggio -5 indica un impatto fortemente negativo mentre +5 indica un impatto fortemente positivo.
- I punteggi assegnati per ogni driver per i differenti scenari sono:

	I		II		III		IV
Fattori caratterizzanti	Evoluzione del contesto normativo		Evoluzione dei modelli di business		Nuovi paradigmi mondo energy		Contesto macro-economico
Driver	Impatto riforma TEE	Riforma decreto energivori	Product as a service	Generazione distribuita	Sviluppo del teleriscaldamento	Apertura all'MSD	Sviluppo della filiera dell'efficienza energetica
Scenario ottimistico	2	3	2	2	1	3	3
Scenario as is	1	0	1	1	0	1	1
Scenario vincolato	-1	-1	-1	0	0	0	0

Market Analysis

Suddivisione per taglia e settore

- L'impatto dei driver selezionati varia anche in base all'ambito di applicazione, dove l'ambito viene definito dal binomio taglia/settore.



- Con un criterio di valutazione simile rispetto a quello usato per i fattori caratterizzanti, **l'impatto dei vari driver sugli ambiti di applicazione viene valutato su una scala da 0 a 5**, dove 0 indica impatto nullo mentre 5 indica un impatto elevato.

Riforma decreto energivori			
Taglia/settore	Industria	Terziario	Residenziale
Grande	5	0	0
Media	4	0	0
Piccola	2	0	0

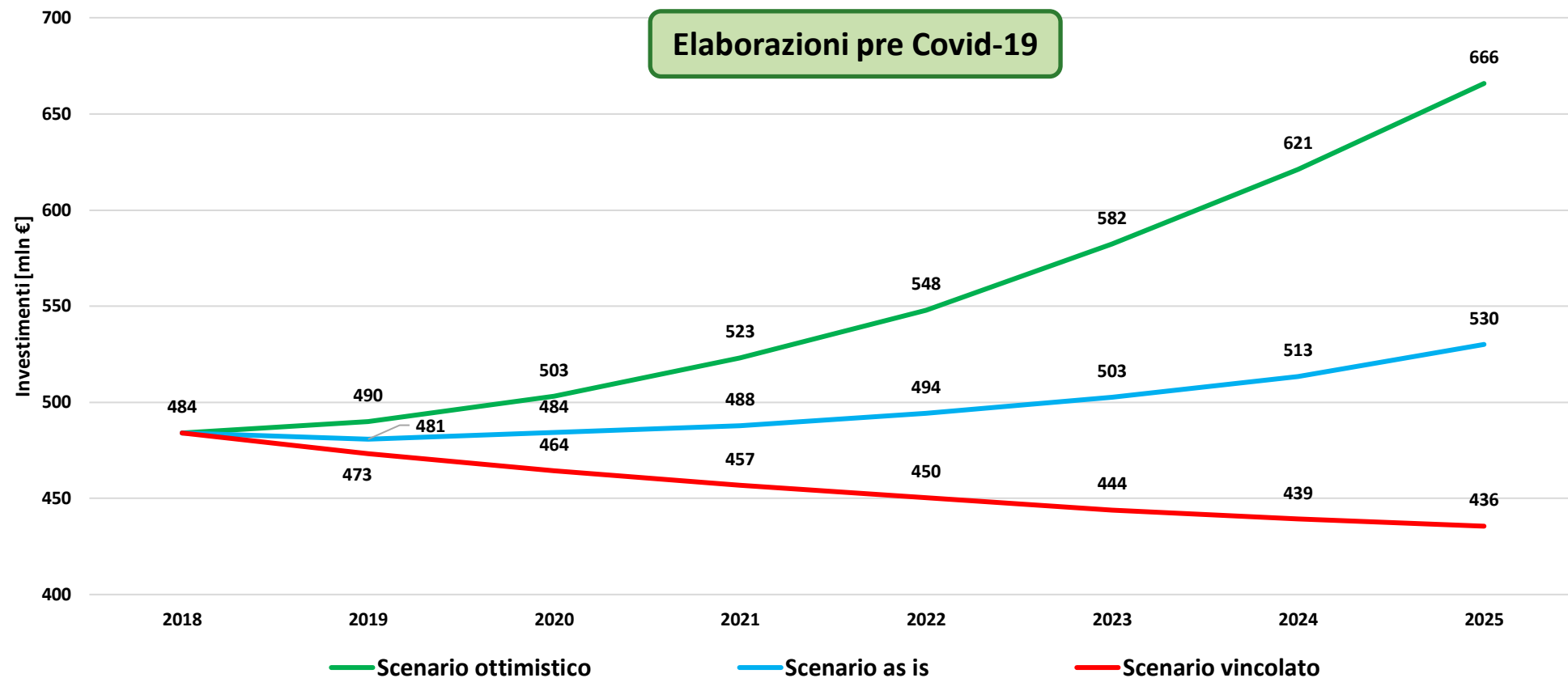
L'impatto del decreto energivori è non rilevante per quanto riguarda il settore terziario e residenziale mentre **ha un impatto molto elevato sul comparto industriale**. Anche nel comparto industriale, **l'impatto tuttavia varia in funzione della taglia del cogeneratore**, con un impatto elevato sulle grandi taglie rispetto alle medio-piccole.

- L'interpolazione dei punteggi assegnati ai driver per i vari ambiti (settore e taglia) di applicazione definiscono l'eventuale crescita/decrecita del volume di affari.

Potenziale di mercato al 2025

Overview

- È interessante sottolineare come in termini di volume di affari, **i 3 scenari si discostino in maniera significativa in particolare dal 2023 in poi**. In generale, la differenza tra lo scenario vincolato e lo scenario as is risulta meno marcata rispetto alla differenza tra lo scenario as is e lo scenario ottimistico.



Messaggi chiave

Gli scenari attesi e le sfide future

- Dopo 2018 di forte contrazione, causata principalmente dall'introduzione del decreto energivori, si stima che **anche nel prossimo biennio si assisterà ad un periodo di stagnazione negli investimenti in cogenerazione**. Comparto che non sconta semplicemente un quadro legislativo avverso, ma che ha anche raggiunto una certa maturità e necessita di nuovi sbocchi per poter riprendere la crescita.
- Crescita che **potrebbe essere trainata dall'offerta di nuovi modelli di business da parte degli operatori** e dalla **diffusione della micro cogenerazione** nel breve termine, e dalla **partecipazione al Mercato dei Servizi di Dispacciamento** nel lungo periodo. Rimane un settore, che necessiterebbe comunque di un cambio di marcia dal punto di vista normativo per poter ripartire perlomeno nel breve termine.
- È interessante anche osservare come il **peso dei driver principali cambi radicalmente nell'arco temporale**. Se nel breve termine, i driver che maggiormente influenzeranno gli investimenti nel settore industriali sono a livello normativo, ed in particolare una eventuale ripresa o no del mercato dei TEE, nel lungo termine i 2 principali driver saranno l'apertura all'MSD e la capacità dei fornitori di offrire un servizio integrato insieme alla vendita del prodotto.
- Vista la particolarità del momento che stiamo vivendo, è infine importante sottolineare come **al momento sia estremamente complesso fare delle previsioni che risultino robuste su quello che sarà lo sviluppo dei prossimi anni**. Ad esempio, il *Green Deal* europeo al termine del COVID sarà applicato con ancora più vigore e avrà un ruolo pivotale nella ripresa? O al contrario le risorse originariamente previste saranno dirottate su altri strumenti per sostenere la ripresa? In questo momento di transizione è ancora arduo rispondere a tali quesiti.



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TOWARDS A 100% RENEWABLE ENERGY FUTURE

Path
to 100%



DRIVERS FOR A 100% RENEWABLE ENERGY FUTURE

MITIGATING
CLIMATE CHANGE

TARGETS FOR
RENEWABLES AND
DECARBONISATION

RAPIDLY DECREASING
PRICE OF RENEWABLES

ELECTRIFICATION
INCREASES
ELECTRICITY DEMAND

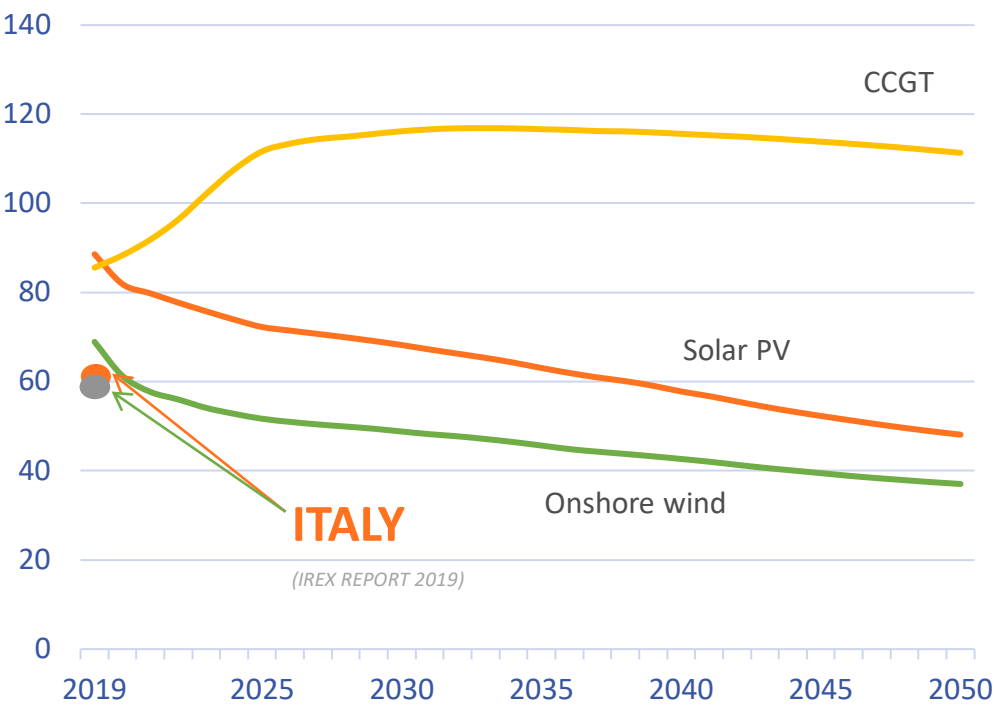
INCREASING PUBLIC
RESISTANCE AGAINST
FOSSIL FUELS

Path
to 100%

RENEWABLES HAVE REACHED A TIPPING POINT GLOBALLY

UNITED KINGDOM

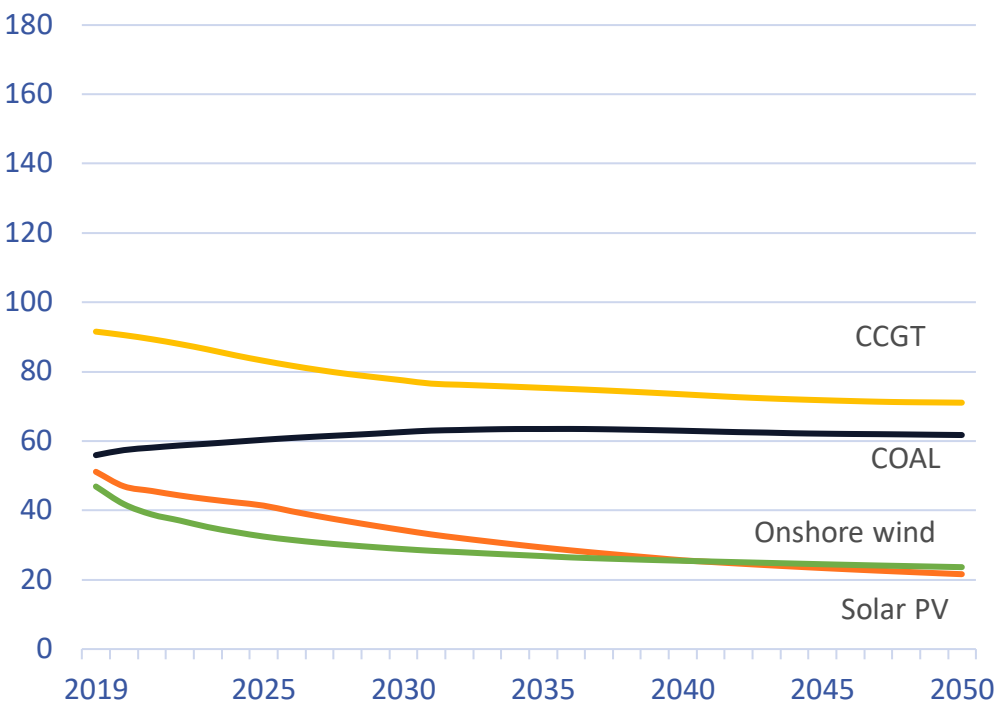
LCOE (\$/MWh, 2018 real)



Source: Bloomberg New Energy Finance, Note: LCOE are based on realized capacity factors.

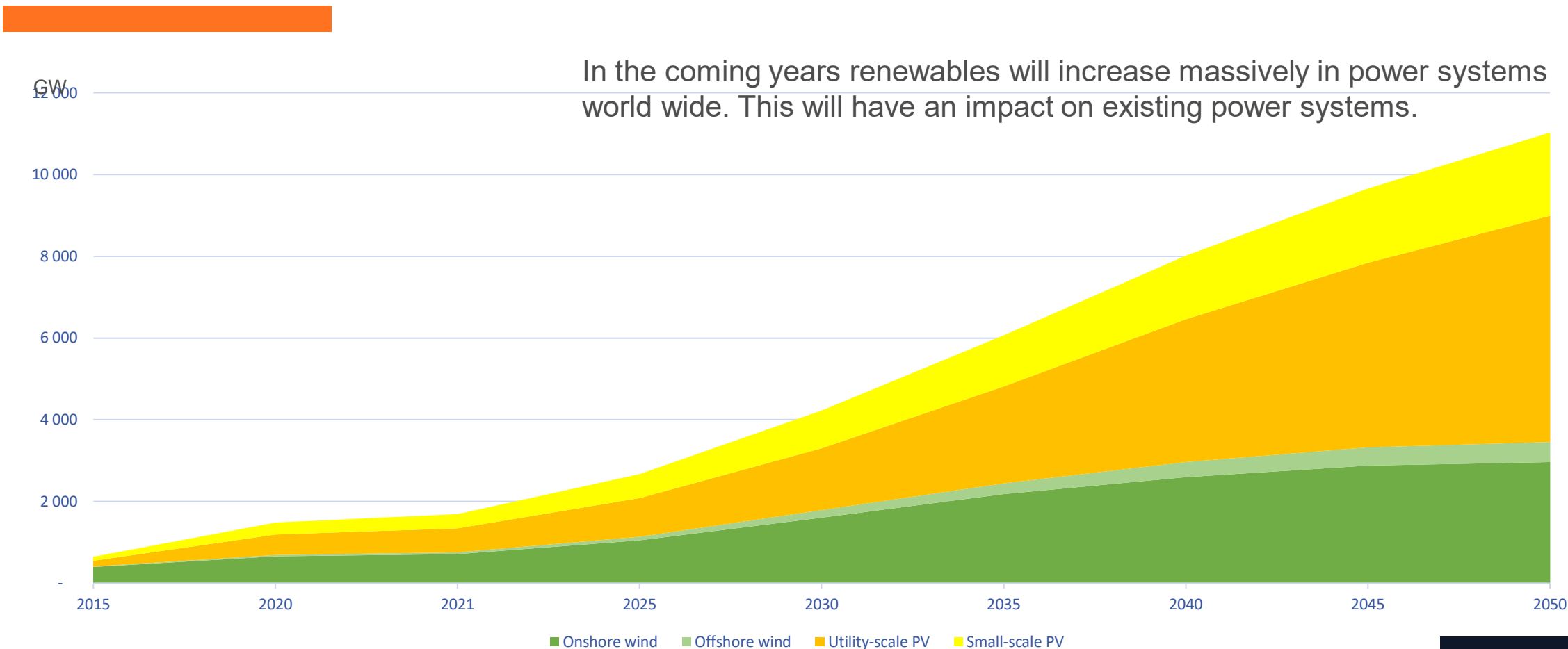
CHINA

LCOE (\$/MWh, 2018 real)



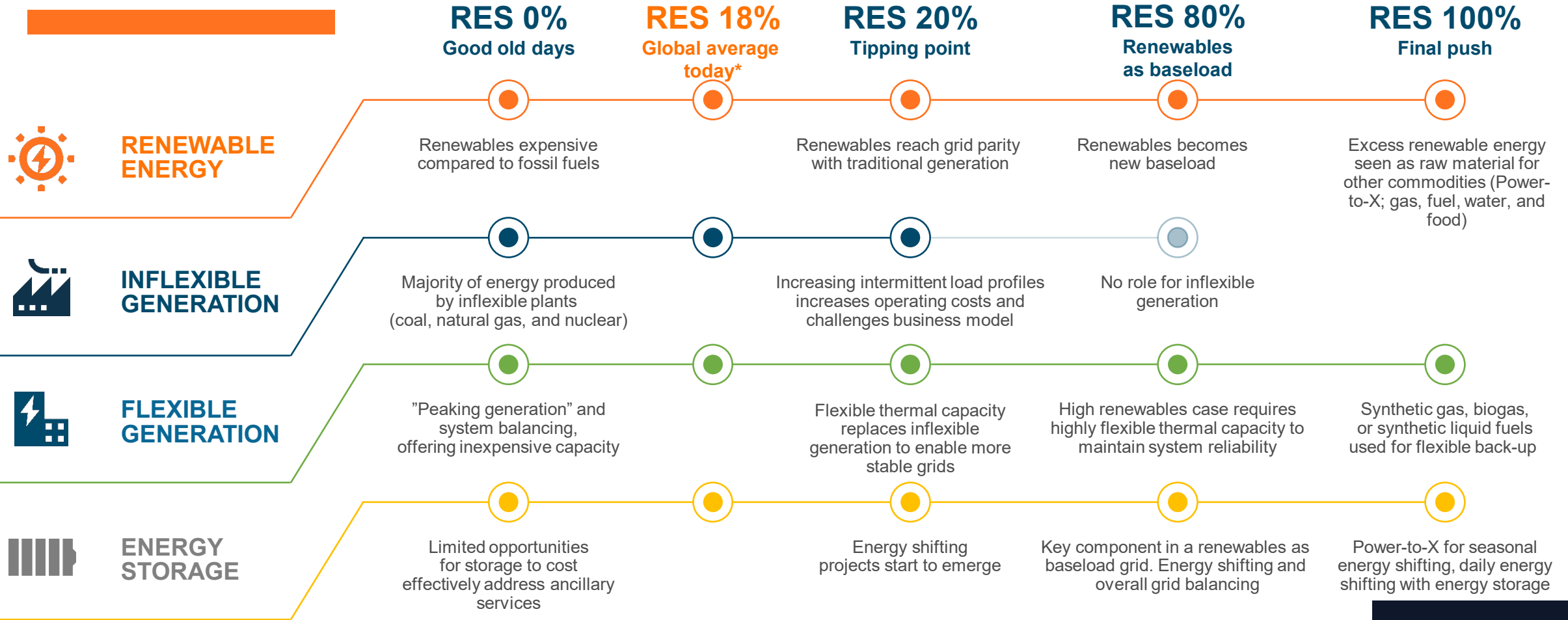
Source: Bloomberg New Energy Finance, Note: LCOE are based on realized capacity factors.

Global Cumulative wind & solar capacity



Source: Bloomberg New Energy Finance 2019

The path to a 100% renewables energy world

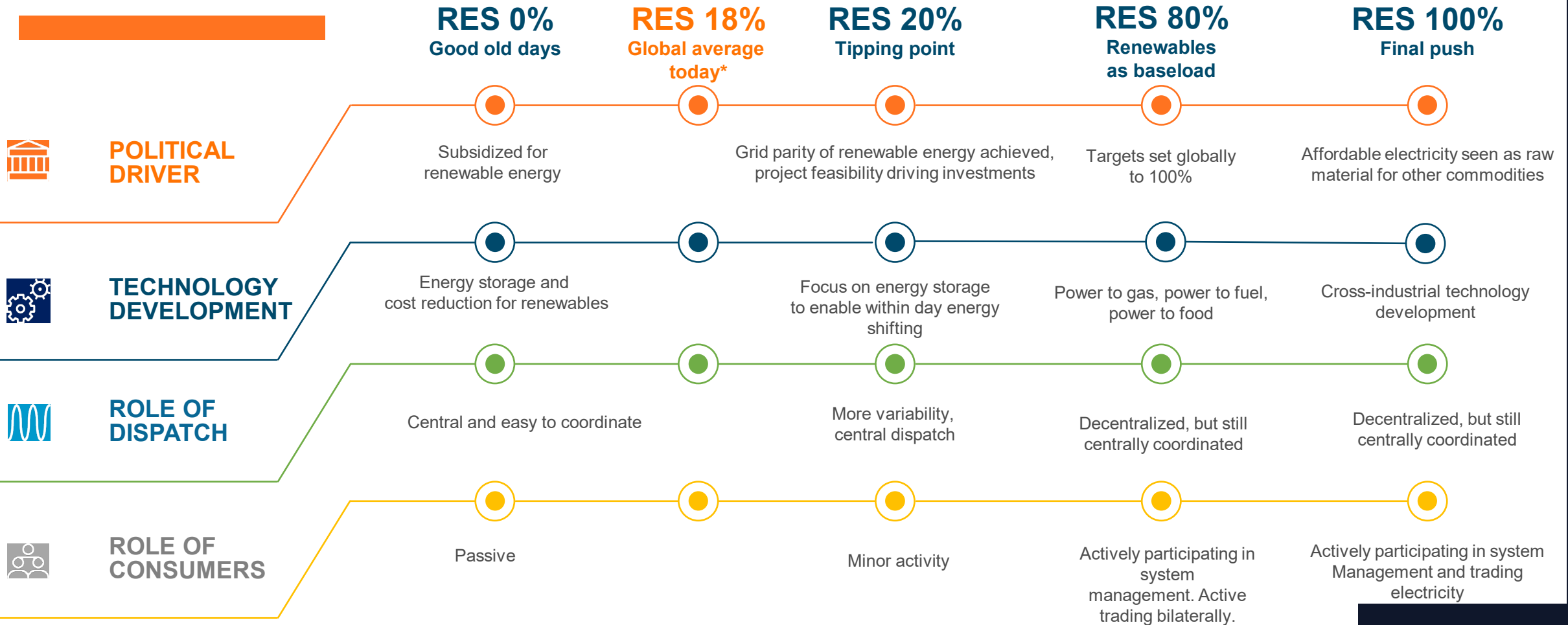


Source: BNEF New Energy Outlook, 2019

RES = global production capacity of renewable energy sources (wind and solar)

Path
to100%

The path to a 100% renewables energy world



Source: BNEF New Energy Outlook, 2019

RES = global production capacity of renewable energy sources (wind and solar)

Path
to 100%

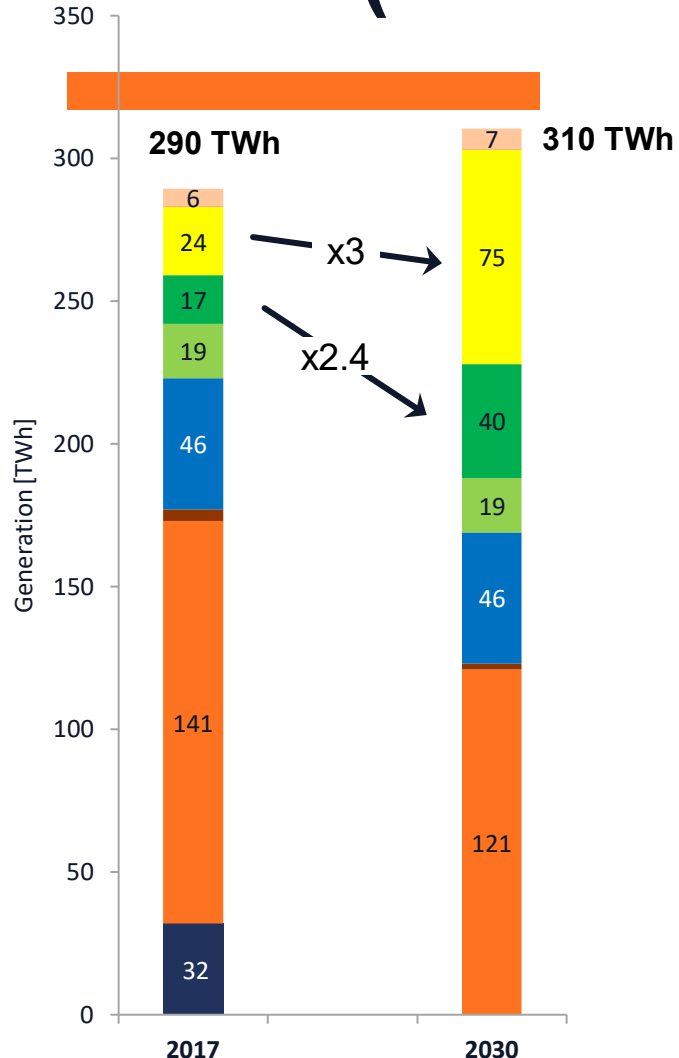


ITALIA

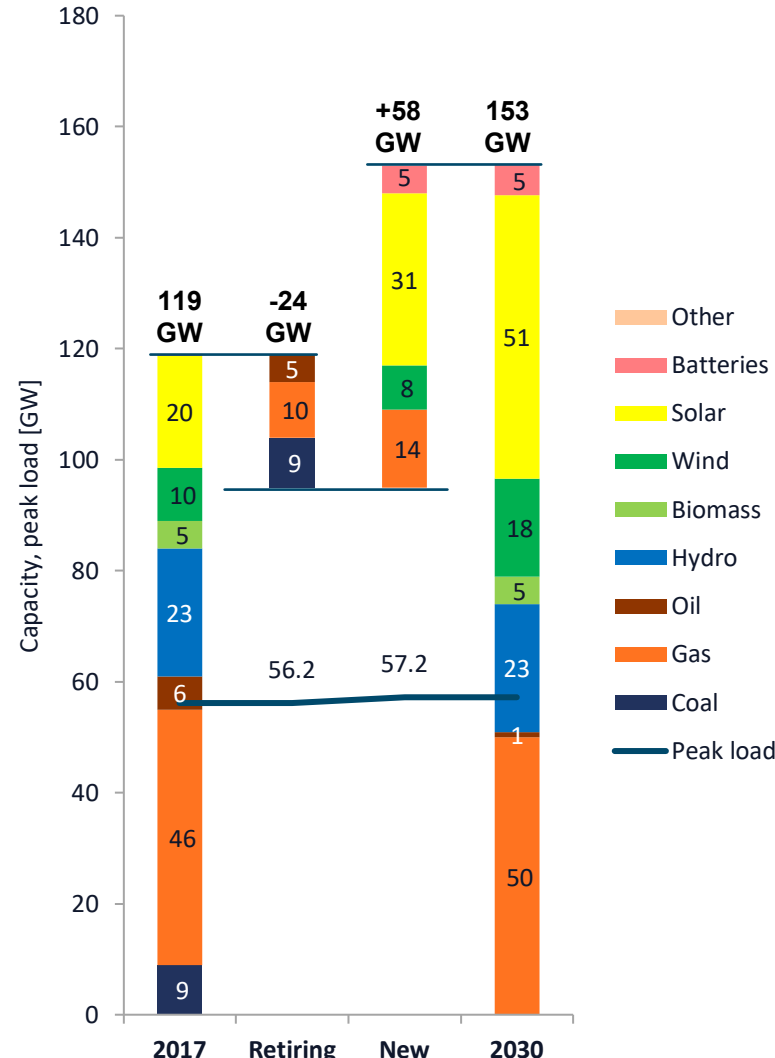
Assessing requirement for additional **flexibility**

Path
to 100%

NECP (PNIEC) ITALY 2030



ENERGY MIX



CAPACITY MIX

- Coal phase-out by 2025
- Present government in favor of coal phase-out
- Should be replaced by solar and wind only
- It is acknowledged by Terna that flexible gas will be needed

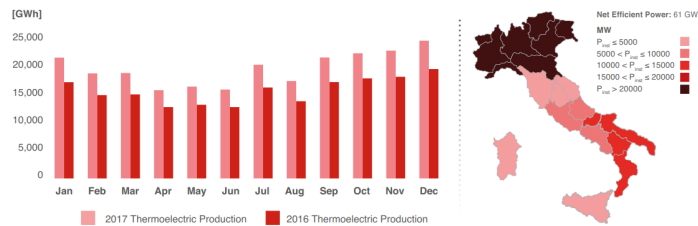
Flexibility will be needed to integrate renewables

Source: Terna

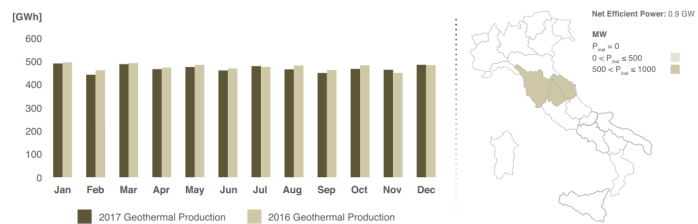
Path to 100%

Generation capacity's transmission challenge

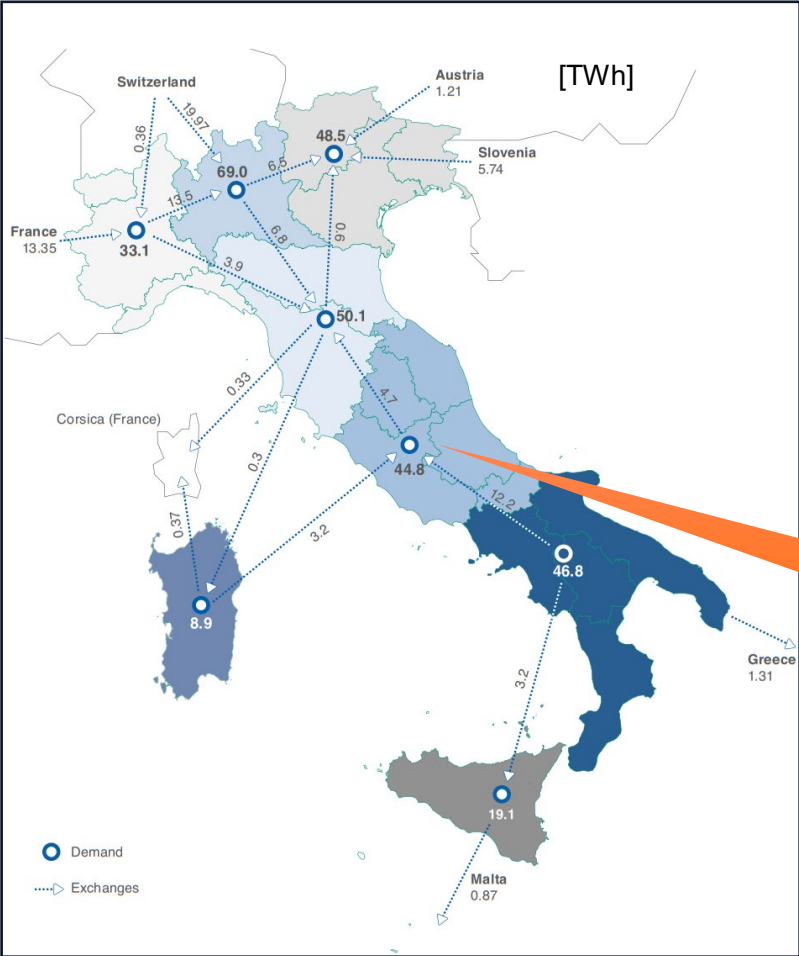
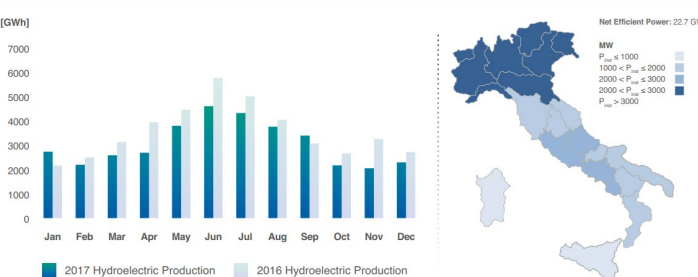
THERMOELECTRIC PRODUCTION AND CAPACITY



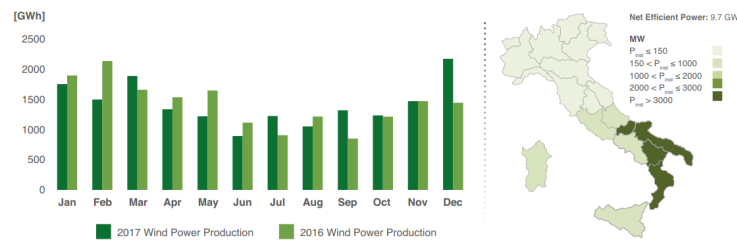
GEOTHERMAL PRODUCTION AND CAPACITY



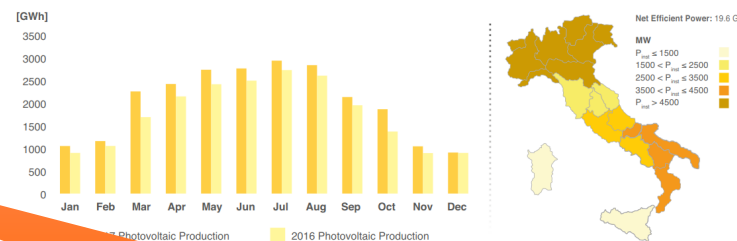
HYDROELECTRIC PRODUCTION AND CAPACITY



WIND PRODUCTION AND CAPACITY



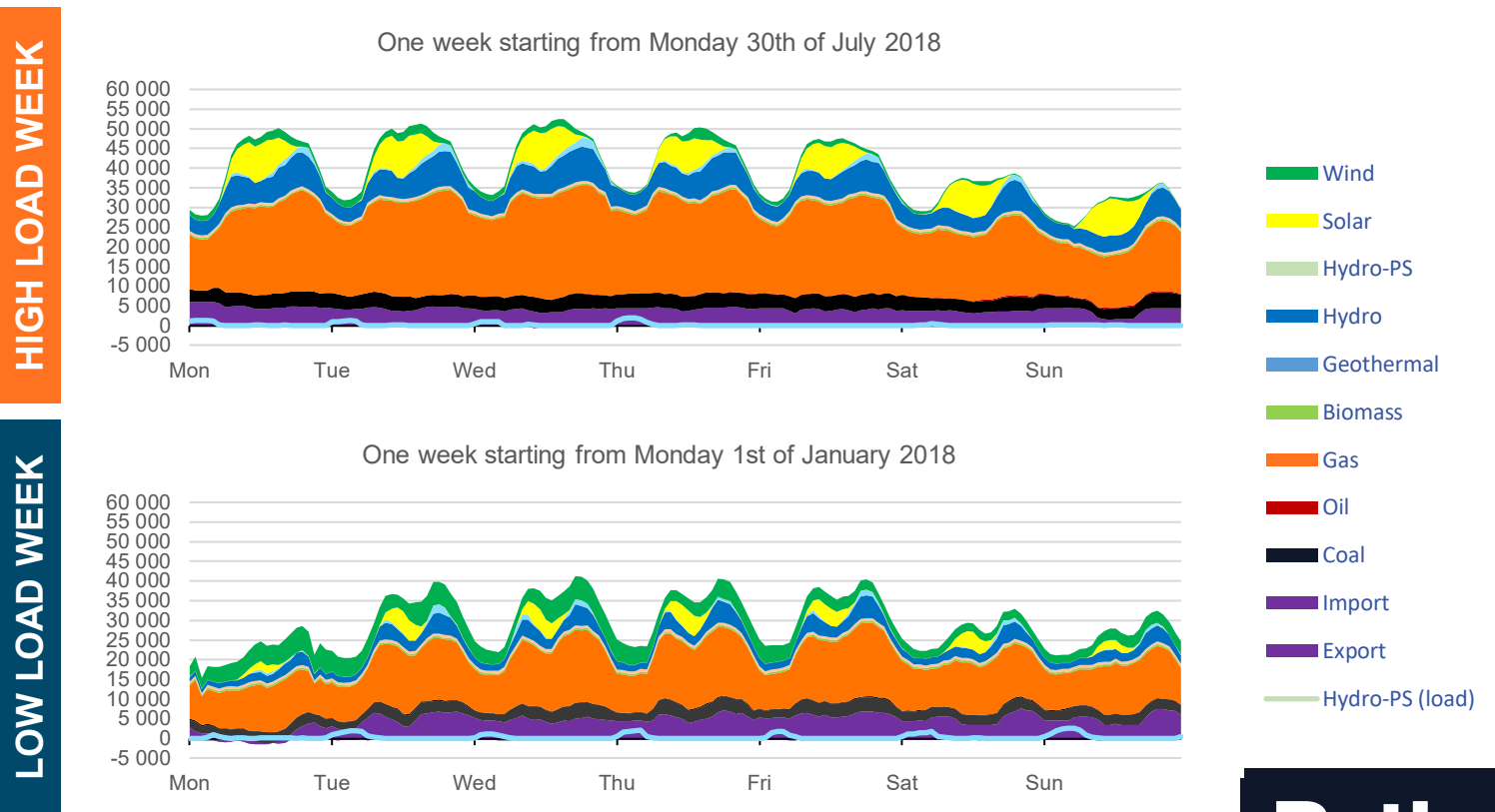
PHOTOVOLTAIC PRODUCTION AND CAPACITY



A lot of wind and solar concentrated in south. Congestion in transmission system between Center-South – Center-North zones

Significant cycling of gas generation

- Highest load during summer due to air conditioning
- Gas turbines are cycling between 5 and 15 GW each day
- Main source of flexibility is gas, hydro and interconnectors

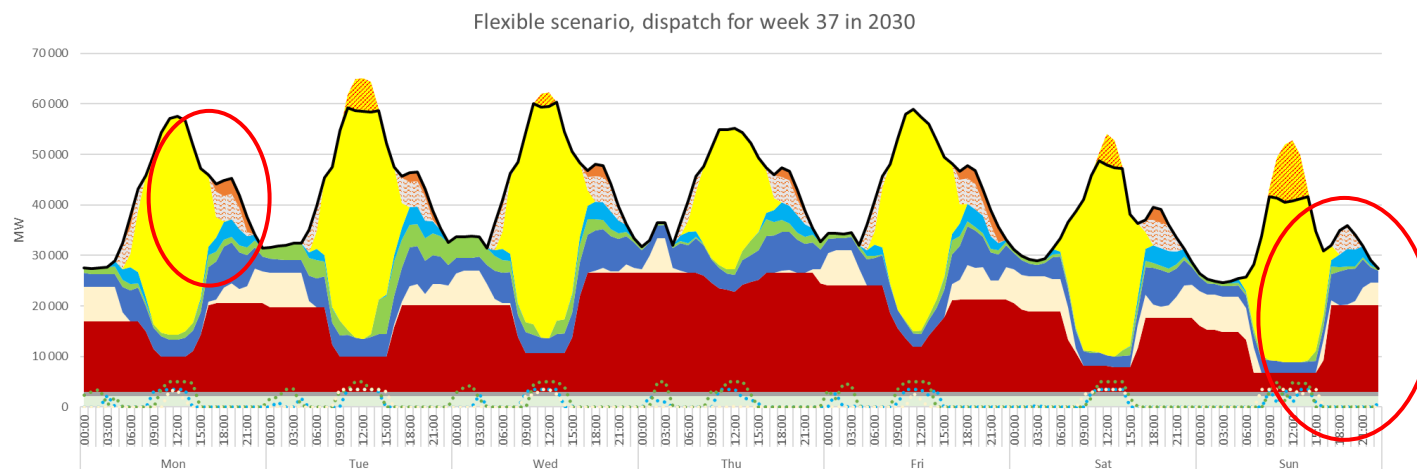
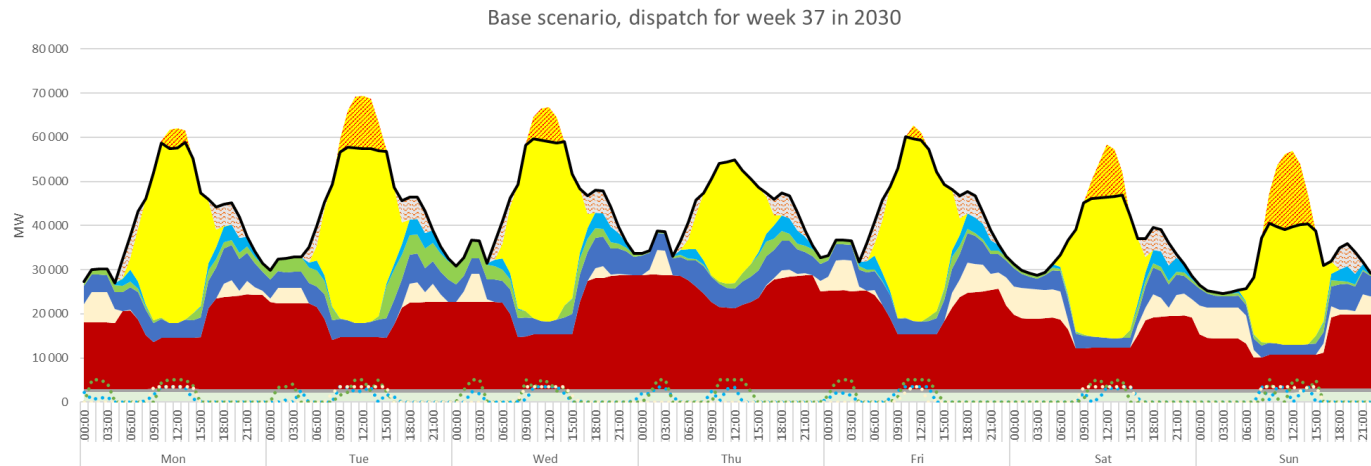


PLEXOS Italy 2030 Assessing requirement for additional flexibility

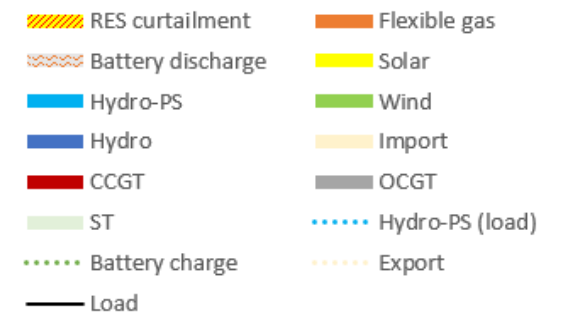


- Base scenario represents NECP in 2030
- 0 GW of new flexible gas capacity
- The analysis includes 11 additional scenarios; Each scenario incrementally adds new flexible capacity
- Operation of the Italian power system is optimised hour-by-hour for all 12 scenarios separately
 - All operational costs are included in the model
 - Investment costs for the new capacity are included in total cost

Benefits from a more flexible power system



- High output of both solar and wind combined with lower demand results in overgeneration
- Overgeneration can be absorbed e.g. with BESS, pumped hydro storage or exporting
- NECP plans include 5 GW BESS
- Emerging technologies e.g. Power-to-X, other industries



Assessing requirement for additional flexibility

RES utilisation increases with more flexible capacity

- Lower operational costs for the whole system

Total system cost includes investment into new capacity

- Overall cost-optimal point balances between better RES utilisation and fixed costs

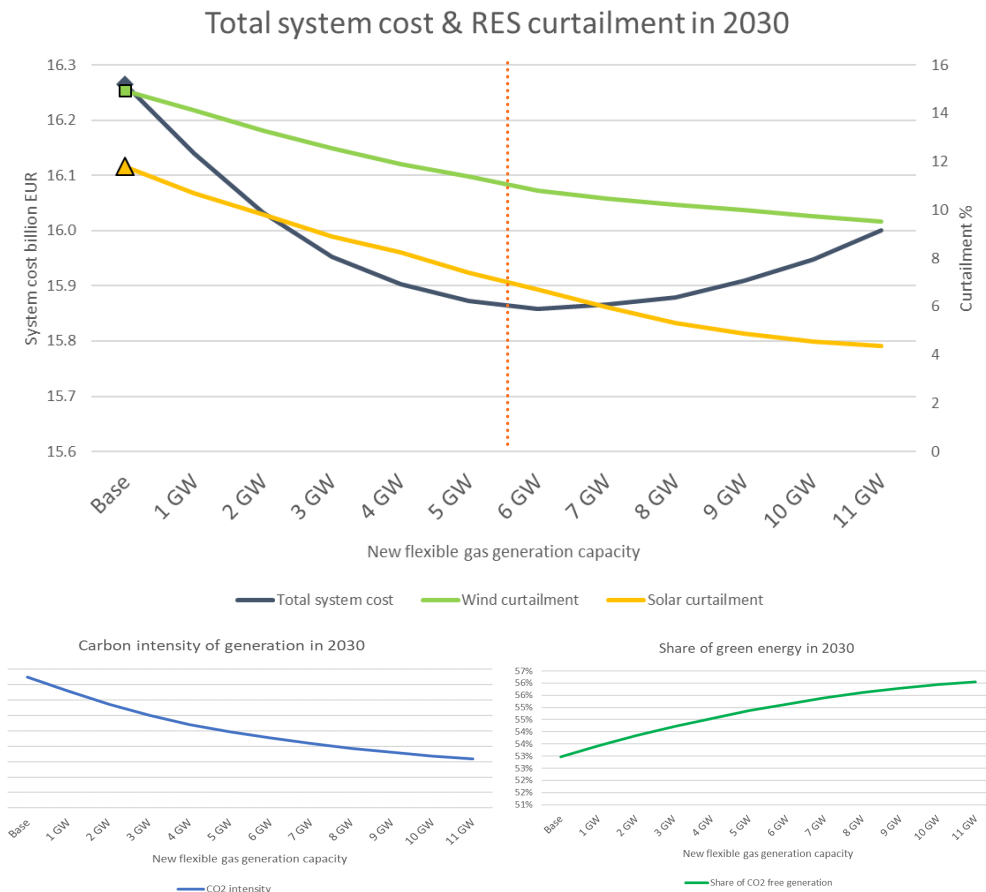
Scenario with 6 GW of new flexible generation capacity has lowest total cost for the Italian power system - "Flexible scenario"

Better utilisation of RES means more generation with same installed capacity

- Over 55% share of CO2 free generation in Flexible scenario

More carbon free generation results in less carbon overall carbon emissions

- 12% lower carbon intensity for total generation

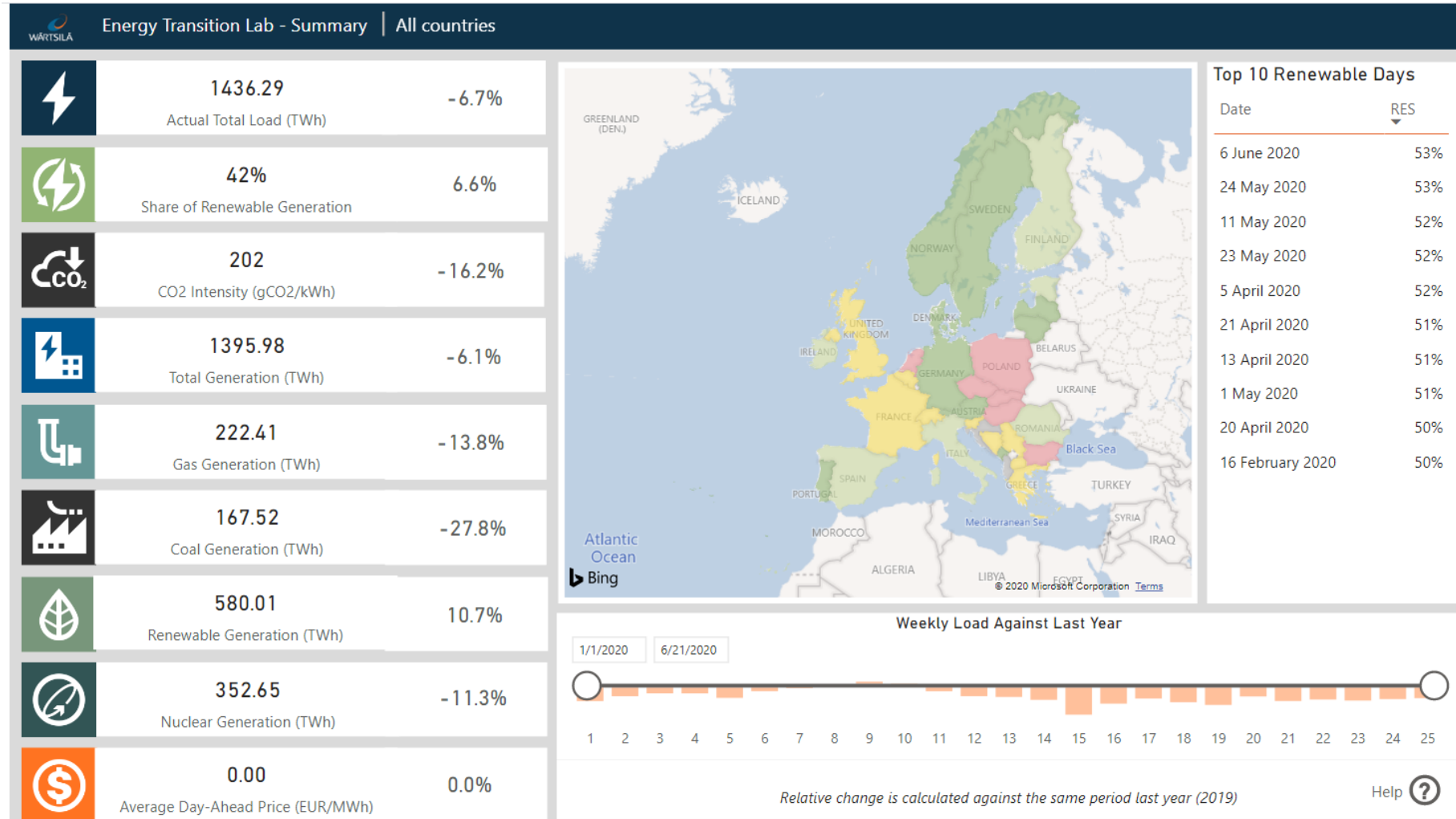


Annual savings
400 million EUR

Path
to100%

Wärtsilä Energy Transition Lab

<https://www.wartsila.com/energy/transition-lab>



Path
to100%

An aerial photograph of a wind farm. The landscape is a patchwork of green and brown agricultural fields. Several white wind turbines are scattered across the fields. The sky is filled with large, white, fluffy clouds. The overall tone is bright and clean, emphasizing renewable energy.

WÄRTSILÄ'S ROLE AS THE ENERGY SYSTEM INTEGRATOR

Path
to 100%

FUTURE-PROOF FLEXIBILITY SOLUTIONS AVAILABLE ALREADY TODAY

RES 18%
Global average today*
2019

RES 20%
Tipping point
2025

RES 80%
Renewables as baseload
2040

RES 100%
Final push
2050



Future-proof **flexible power plants**



Energy storage with industry the leading energy management system (GEMS)



Energy services that support customer needs along the energy transition



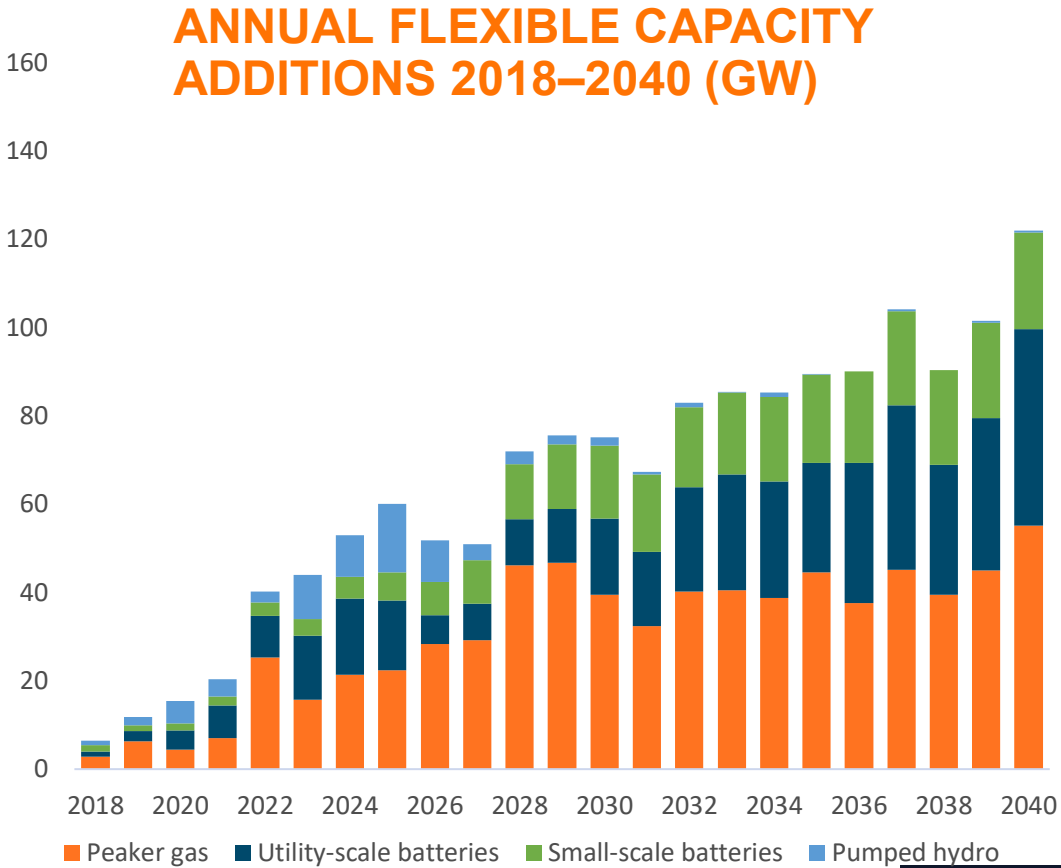
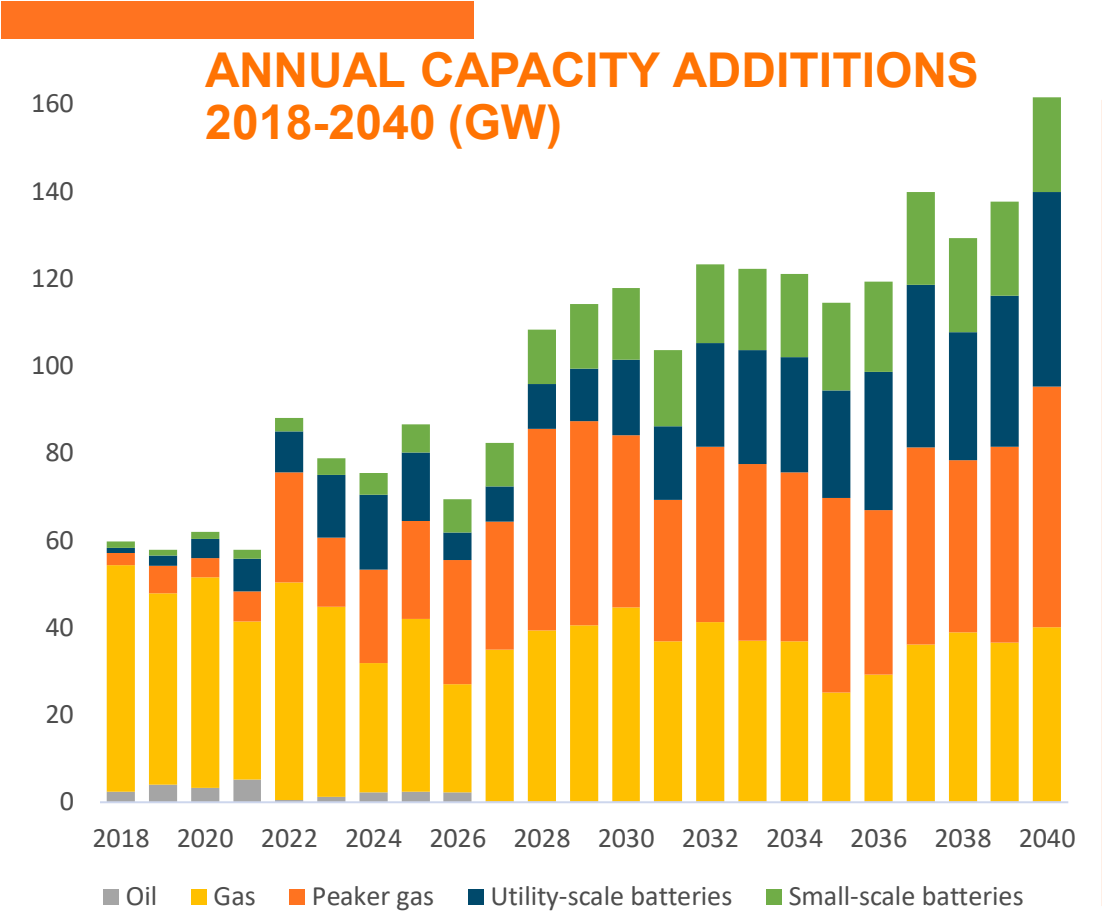
Constantly seeking **new innovations** for an optimised energy transition

Source: BNEF New Energy Outlook, 2019

RES = global production capacity of renewable energy sources (wind and solar)

Path
to100%

Rapid growth forecasted for flexible solutions



Source: Bloomberg New Energy Outlook 2019

DECARBONISING FUELS

The demand for renewable synthetic fuels are growing significantly as industries are seeing it as a way to decrease their carbon footprint.

Technologies for replacing fossils exist already today. Power-to-X is a process which allows the creation of carbon neutral renewable synthetic fuels.

In the future, fossil fuel will be replaced by these renewable synthetic fuels as they lower the impact on the climate.

POWER-TO-X UTILISING ELECTRICITY FROM RENEWABLES

INPUT

ELECTRICITY
FROM RENEWABLE
ENERGY SOURCES

WATER (H_2O)
SPLIT INTO
 $\text{H}_2 + \text{O}_2$

CARBON DIOXIDE
(CO_2) CAPTURED

PROCESS

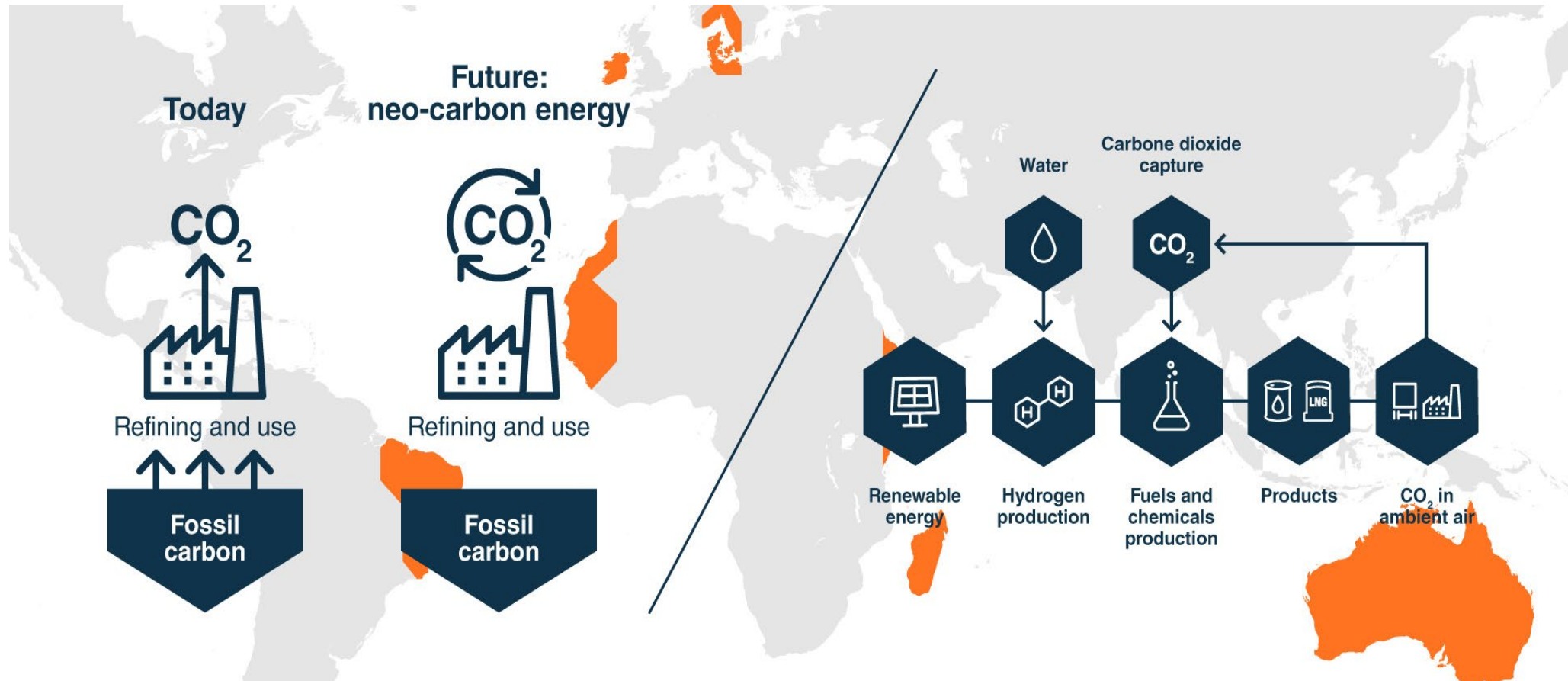
POWER-TO-FUEL

OUTPUT

CARBON NEUTRAL
RENEWABLE
SYNTHETIC FUEL

Path
to100%

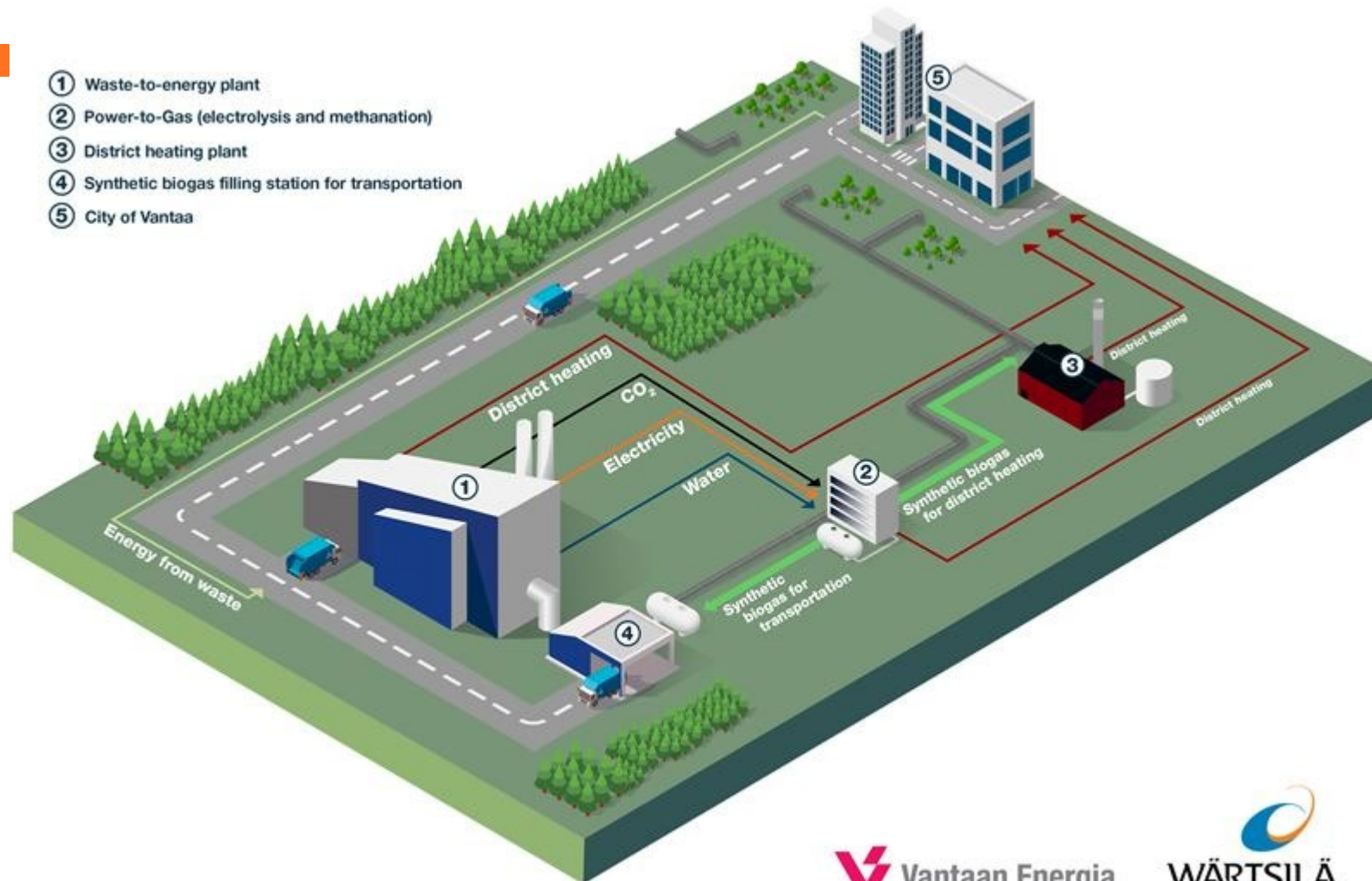
Potential energy – Power to Gas



And the impact to the role of gas in the future

Power to X - synthetic biogas

- ① Waste-to-energy plant
- ② Power-to-Gas (electrolysis and methanation)
- ③ District heating plant
- ④ Synthetic biogas filling station for transportation
- ⑤ City of Vantaa



FLEXIBLE POWER PLANTS

Provide the best means of support to the power system by offering the highest degree of flexibility, enabling major savings, and creating an optimised response to rapid changes in intermittent generation.

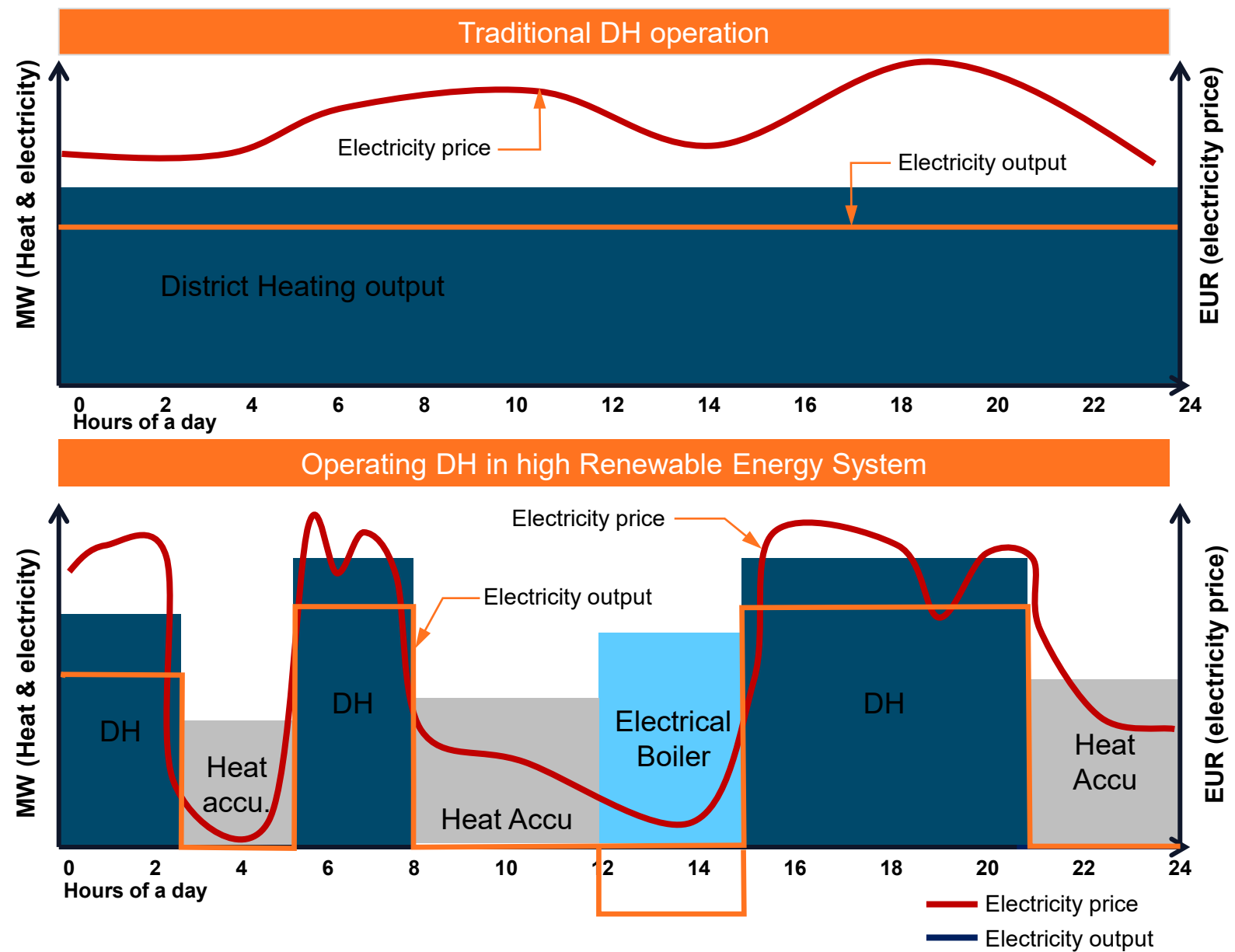
ENERGY
EFFICIENCY

FUEL
FLEXIBILITY

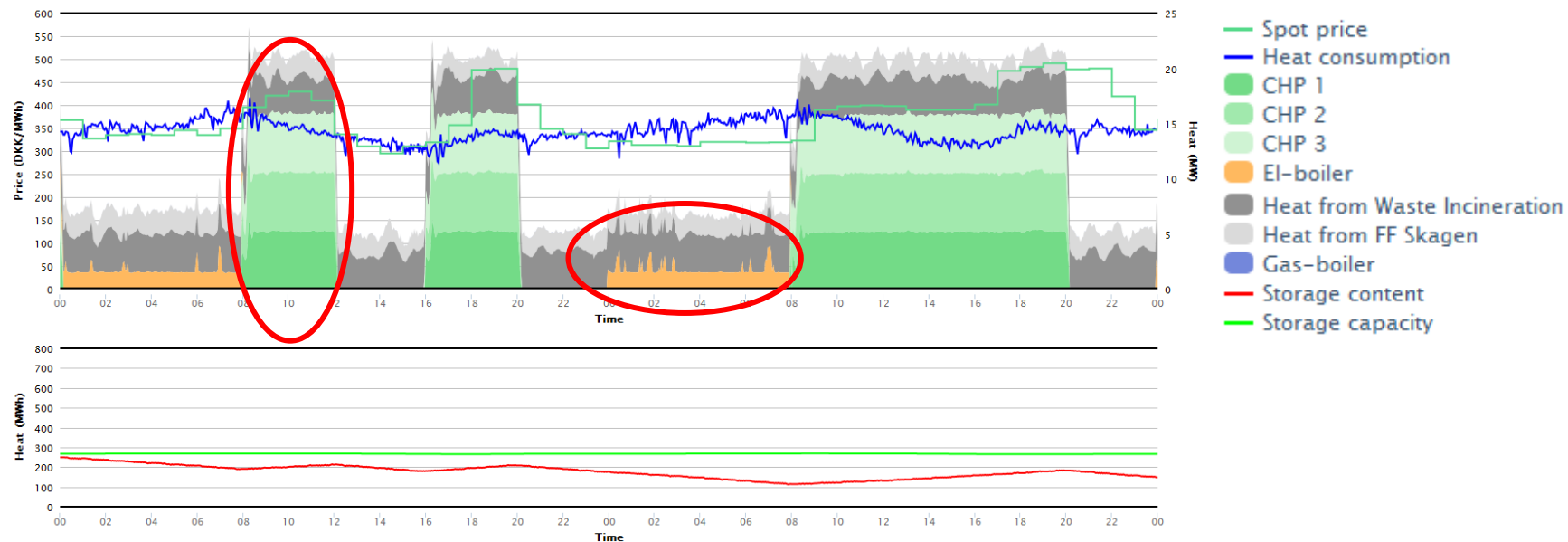
OPERATIONAL
FLEXIBILITY

Path
to100%

Dynamic District Heating (DDH)

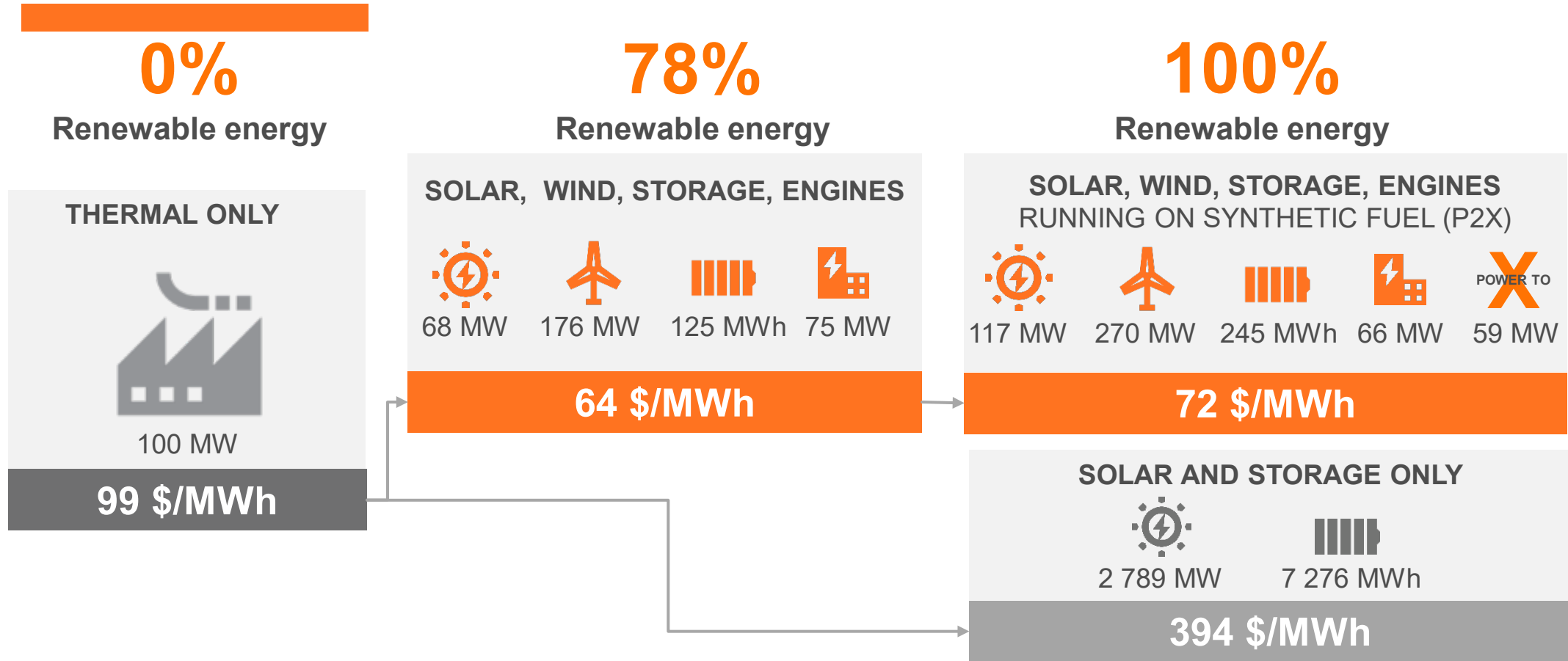


Skagen District Heating, Denmark



<http://www.emd.dk/desire/skagen/>

TOWARDS 100% RES – GERMANY 100 MW SYSTEM IN 2030



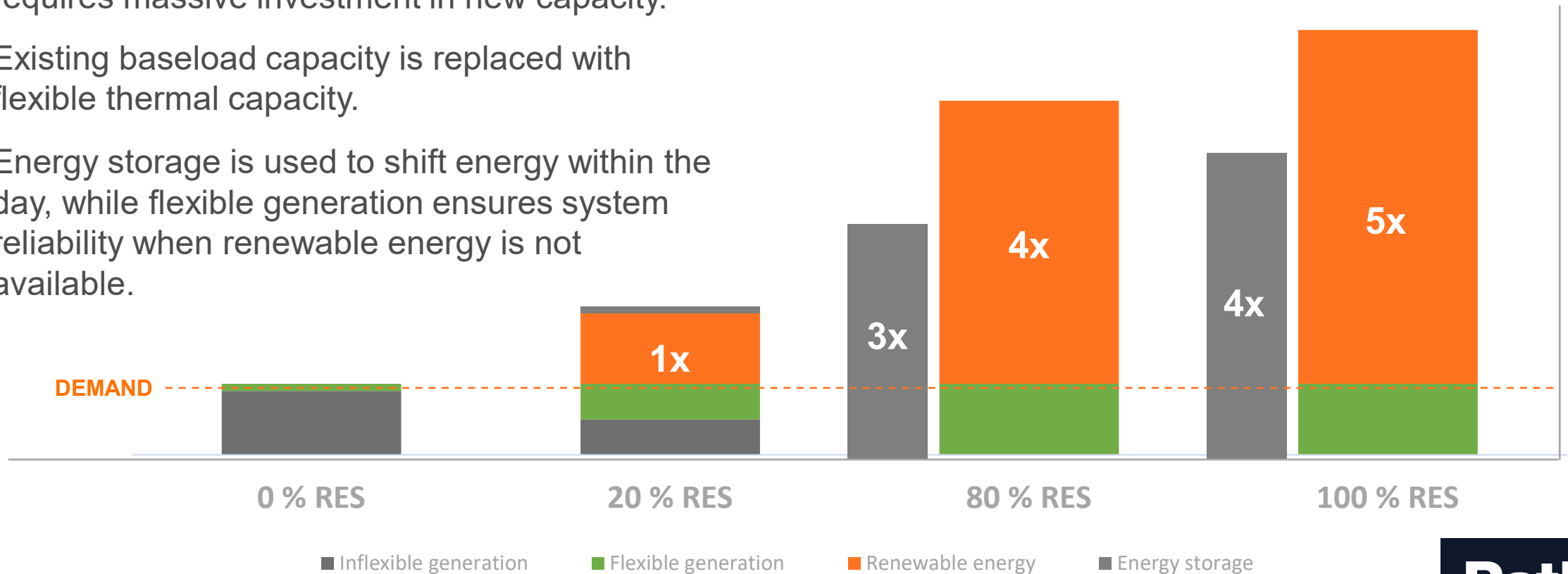
OPTIMISED TRANSITION with the right flexibility

Capacity vs peak demand

The transition to a 100% renewable system requires massive investment in new capacity.

Existing baseload capacity is replaced with flexible thermal capacity.

Energy storage is used to shift energy within the day, while flexible generation ensures system reliability when renewable energy is not available.



Wärtsilä energy storage & optimisation

The world's leading hybrid power systems provider integrating thermal, renewables and storage

Wärtsilä Energy Business

Global energy storage leader and engine-based power plants systems optimiser with 650+ MW deployed or under contract globally

Best-in-Class Control

Powered by advanced GEMS Solutions Suite technology, designed to optimise battery life and maximise battery monetisation strategies

A Hybrid Future Realised

Unprecedented capabilities to integrate and manage assets into a unified energy future—engines, solar, wind, and energy storage



180
Countries

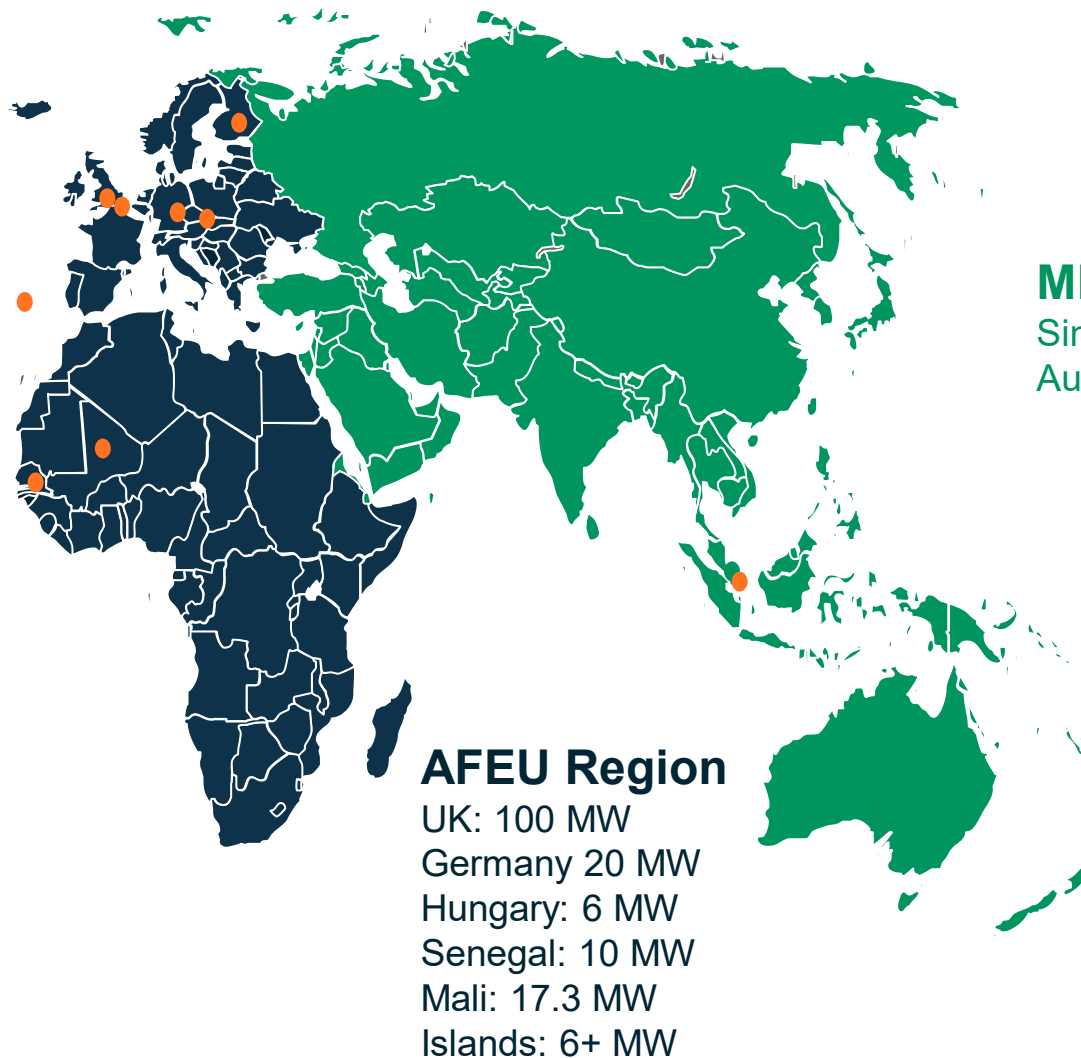
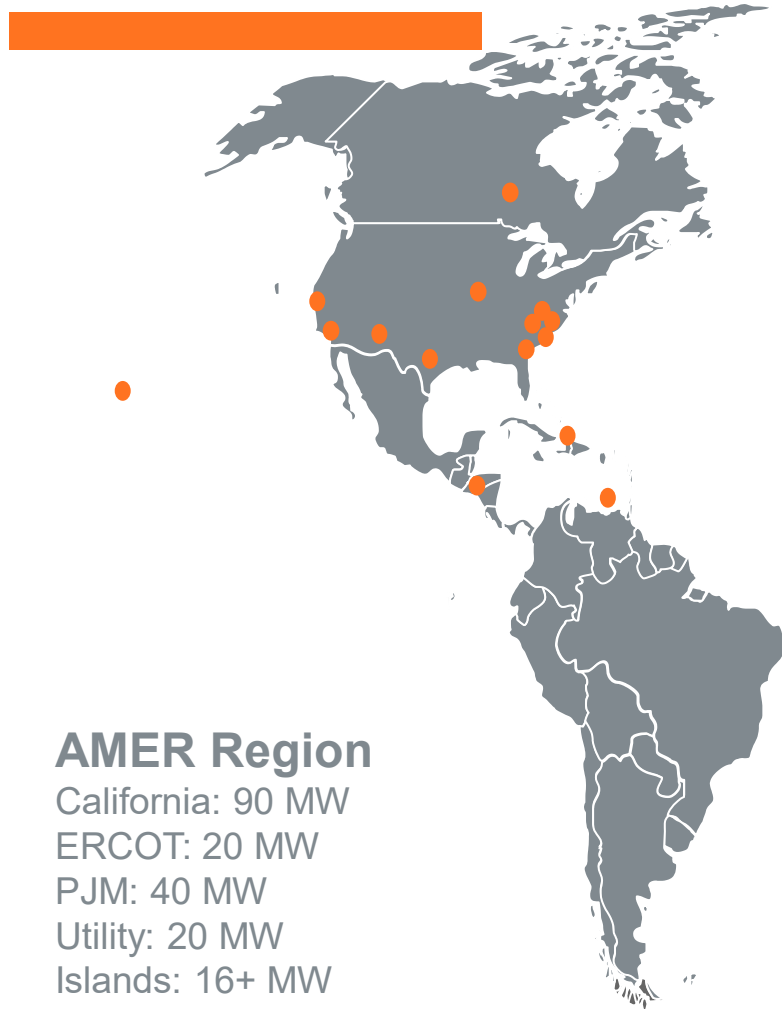
70
GW
Generated

650+
MW Global
Storage Systems
*deployed or awarded

**Path
to 100%**

WÄRTSILÄ global energy storage projects

**650 MW+ in operation,
deployed or contracted**
Highlighted Projects



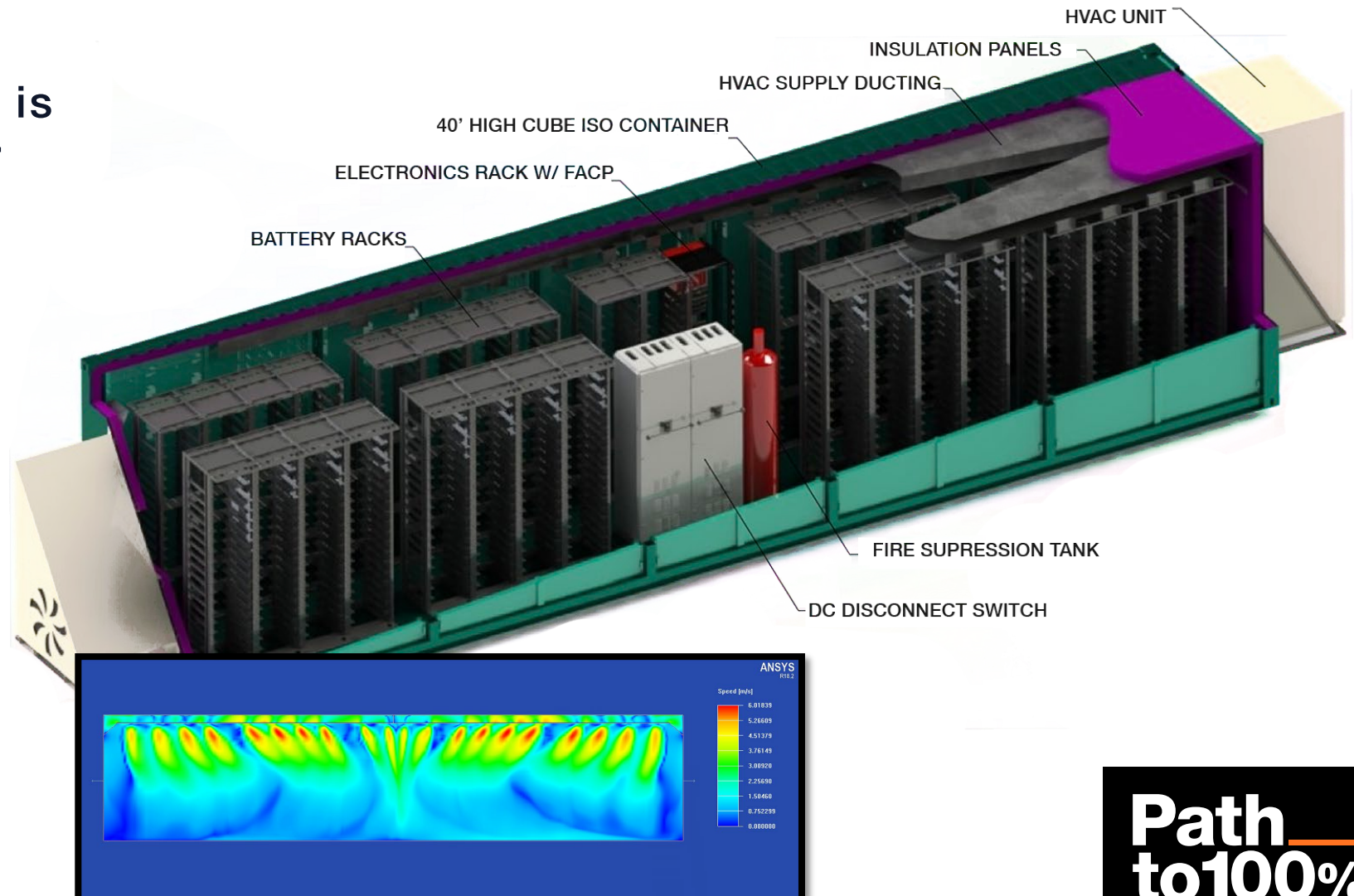
MEA Region
Singapore: 2 MW
Australasia: 200 MW

GRIDSOLV MAX – 40ft Containerized Solution

Our standardized container is a cost effective solution for meeting customer energy needs while adequately protecting their hardware assets

Key elements:

- Battery Modules and BMS
- Safety system
- Fire system
- Power distribution
- HVAC systems
- Comm network
- DC connections

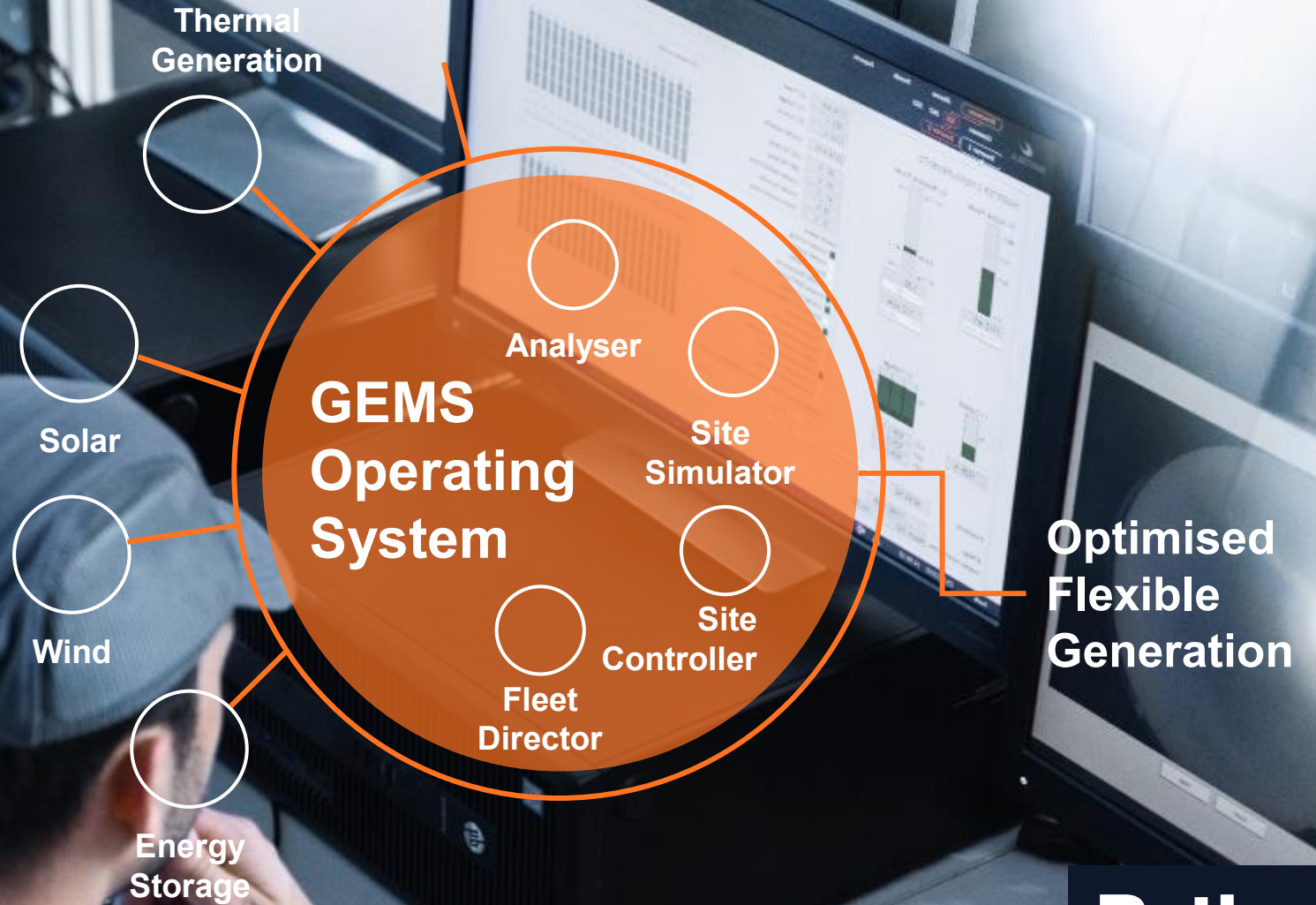


GRIDSOLV QUANTUM – Modular Solution



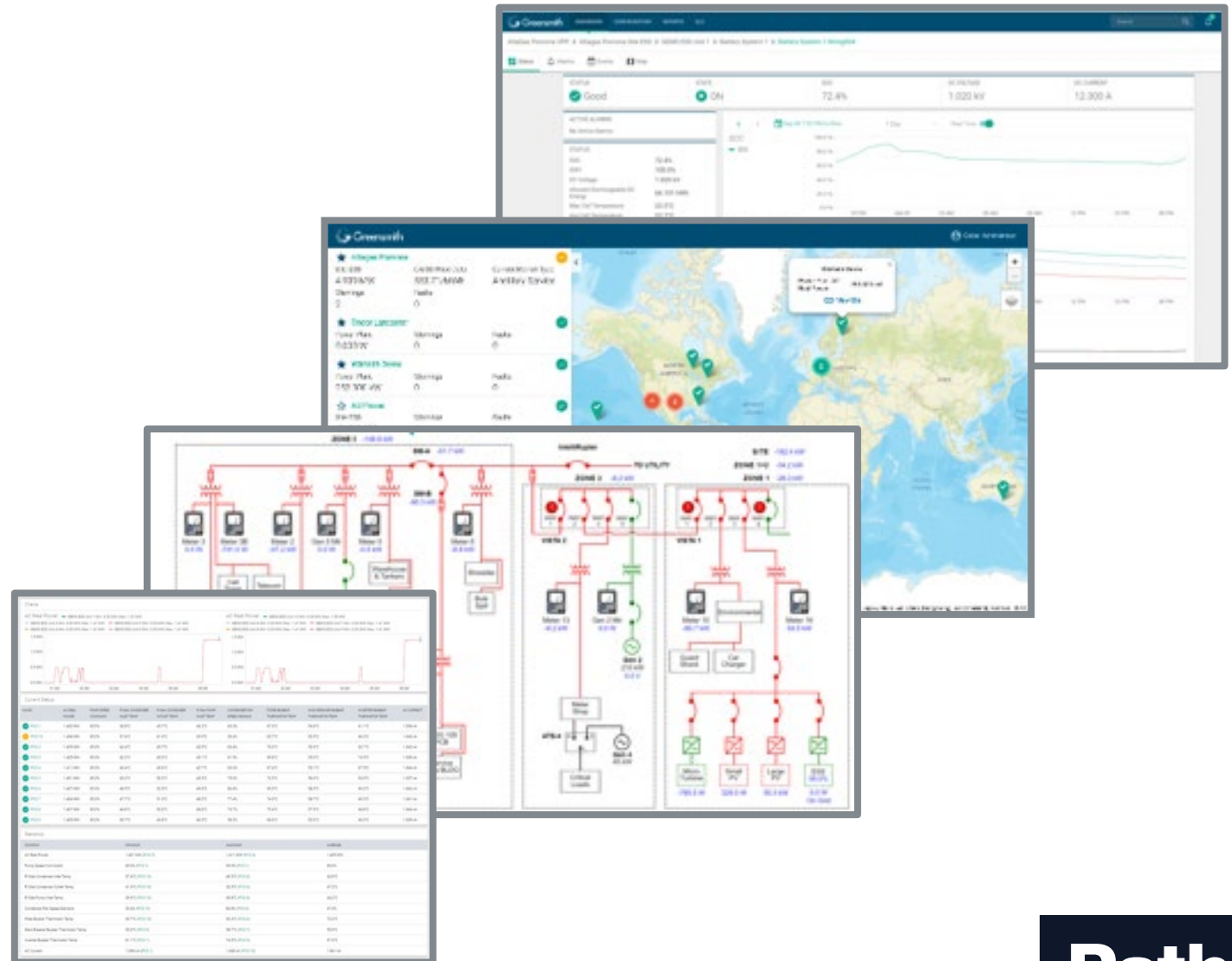
GEMS SOLUTIONS SUITE

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

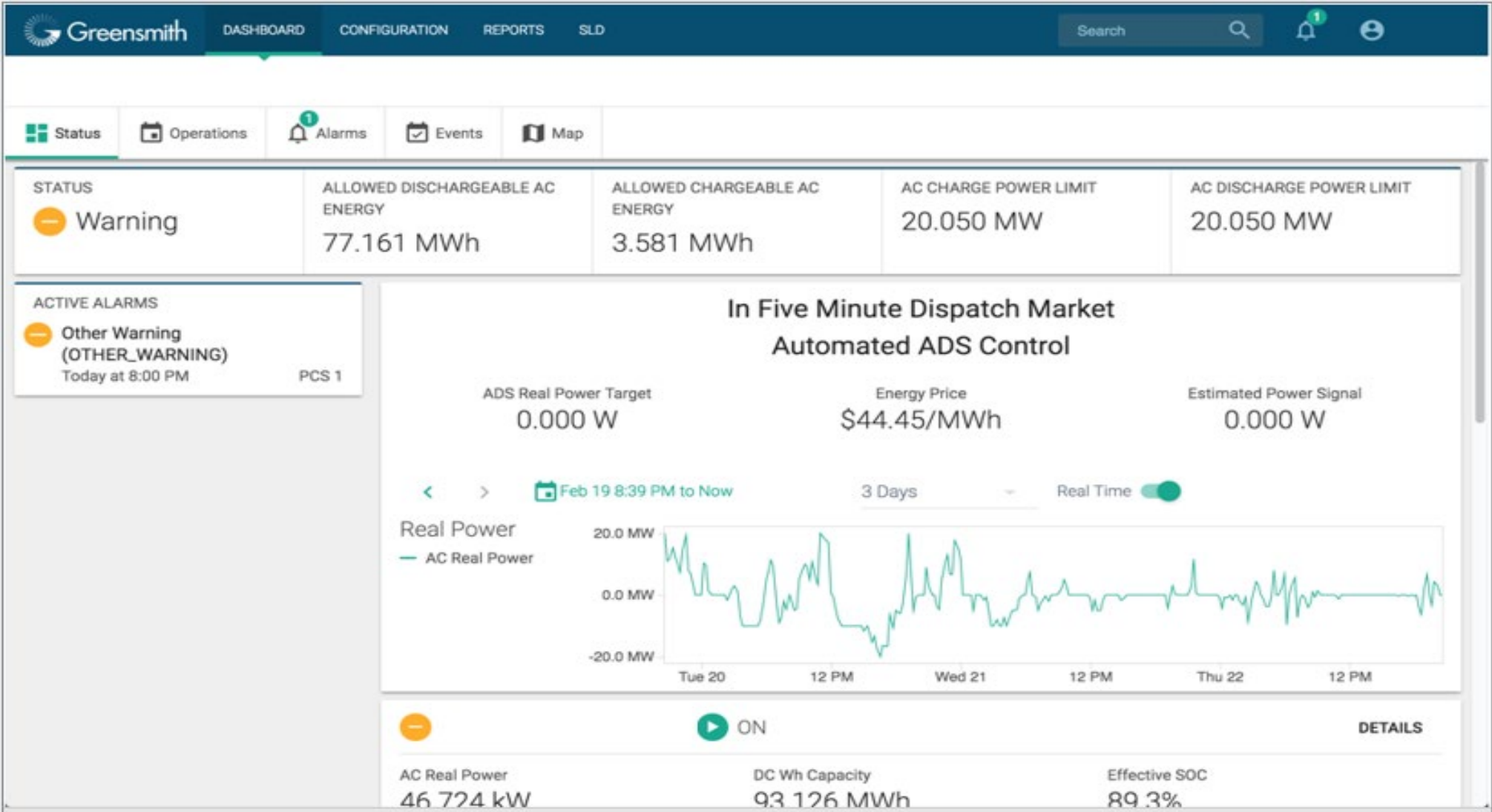


GEMS User Interface

- Real-time Data Streaming
- Data Visibility
 - Global Fleet
 - Site System
 - Device
- Data Reports
- Push Notifications
- Third Party Data Integration



GEMS Dashboard



CONTOUR GLOBAL, **BONAIRE (CARIBBEAN)**

6 MW/6 MWh Island Grid

GRID CONTROL, INTEGRATION
& OPTIMISATION



The **existing thermal 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

- Boosts **wind penetration from ~20% to 33%** with addition of energy storage and GEMS control system
- Will eliminate the dependency on HFO; **fuel consumption decreased by 5%**
- Delivers both economic and environmental benefits; **CO2 emission decreased by 8%**
- GEMS software controls the island grid of Bonaire, an **island of 19,000 inhabitants**.

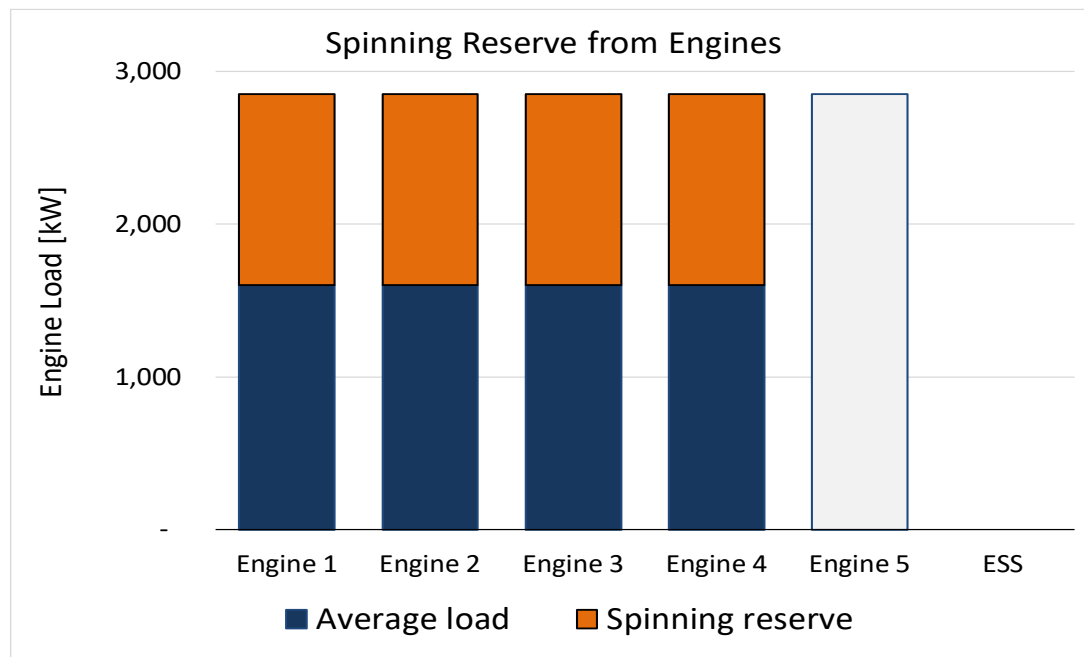
Path
to100%

CONTOUR GLOBAL BONAIRE (CARIBBEAN)

Change in Operations

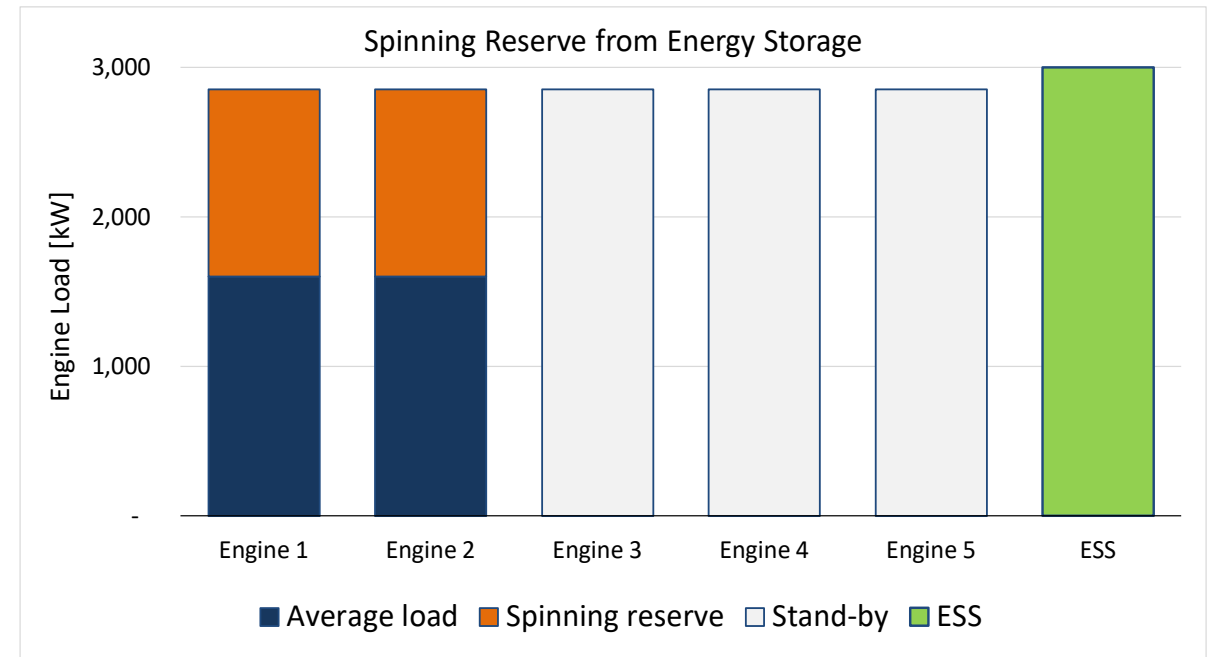
Example hour: 12 MW Load, 9 MW Wind, 4.5 MW Spinning Reserve Requirement

Before



- Engines : 6.4 MW; reserves: 5 MW
- Wind 5.6 MW
- Wind curtailment: 3.4 MW
- Engines operate at minimum load: 1.6 MW each

After



- Engines power: 3.2 MW; reserves: 2.5 MW
- Wind power: 8.8 MW
- Wind curtailment: 0.2 MW
- Energy storage reserves: 3 MW

7 MW/2.3MWh Island Grid

GRID CONTROL, INTEGRATION & OPTIMISATION



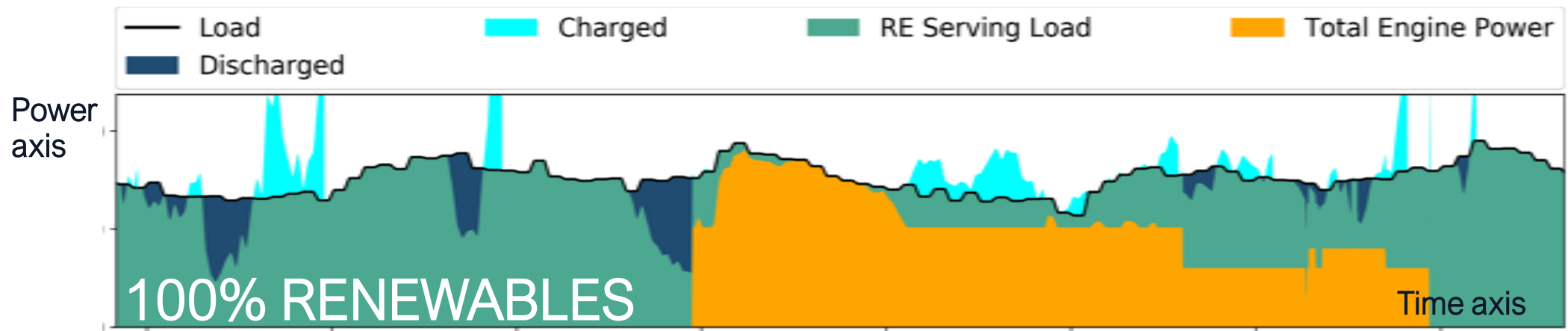
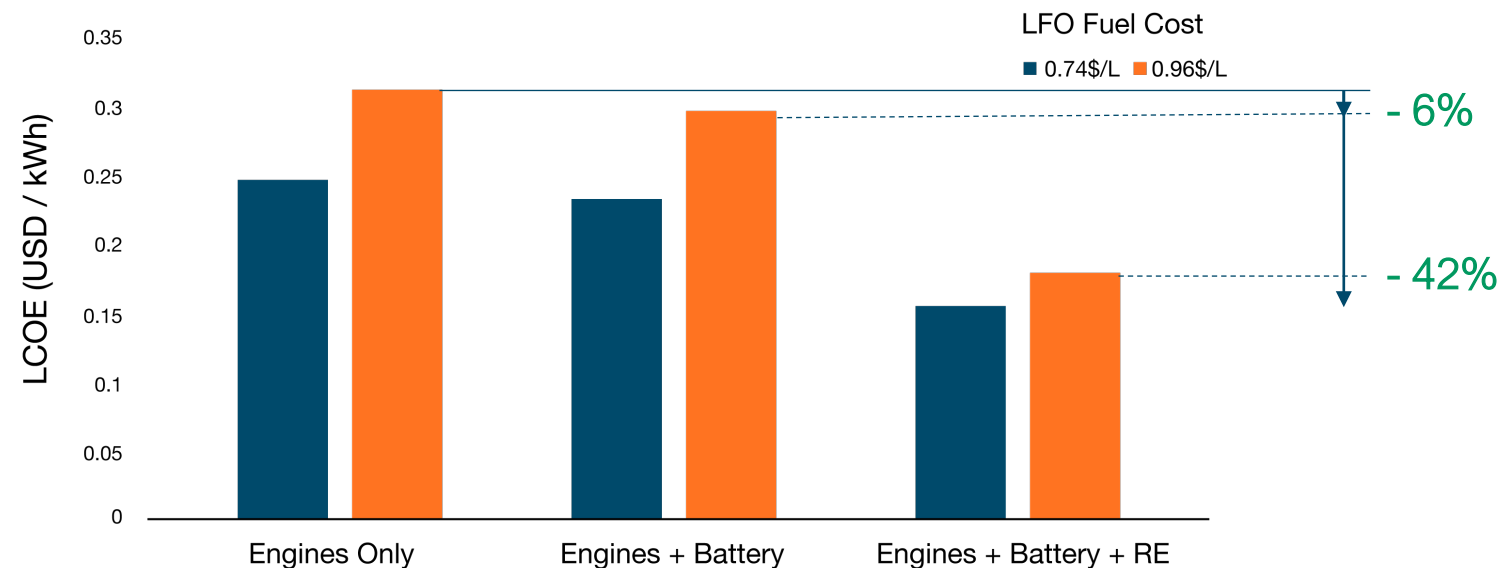
The Graciosa Hybrid Renewable Power Plant will enable **1 MW** of **solar**, **4.5 MW** of **wind power** and **6 MW / 3.2 MWh energy storage**



Integrates renewable energy sources while simultaneously optimising multiple generation assets

- Boosts **renewable energy consumption** from 15% to 65% once the plant is fully operational in late 2018
- Will **eliminate the dependency** on 17,000 liters of diesel per month
- Delivers both **economic and environmental benefits**

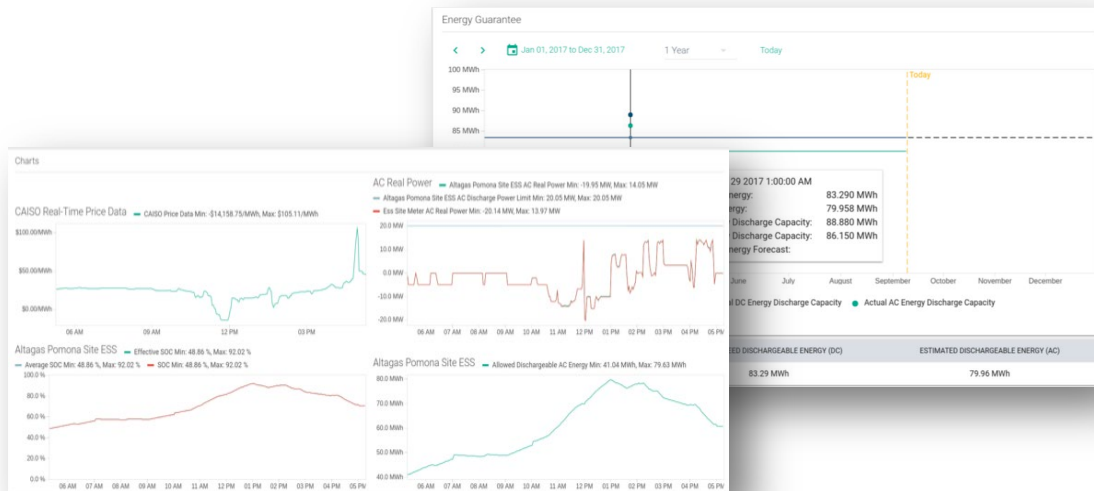
Financial Drivers and 100% RENEWABLES



20 MW/80 MWh Grid-



- The Pomona Energy Centre's **20 MW / 80 MWh energy storage** system was constructed in record time



CAPACITY & FREQUENCY REGULATION

- Five months NTP to COD!
- **Multiple Revenue Streams:**
 - CAISO Resource Adequacy (capacity contract for 4-hrs Discharge)
 - CAISO Regulation Markets (Ancillary Services Regulation up and down)
 - Real-time Market Arbitrage

Wärtsilä future-proofing value proposition

+

+

CLIENT PARTNER
PJM

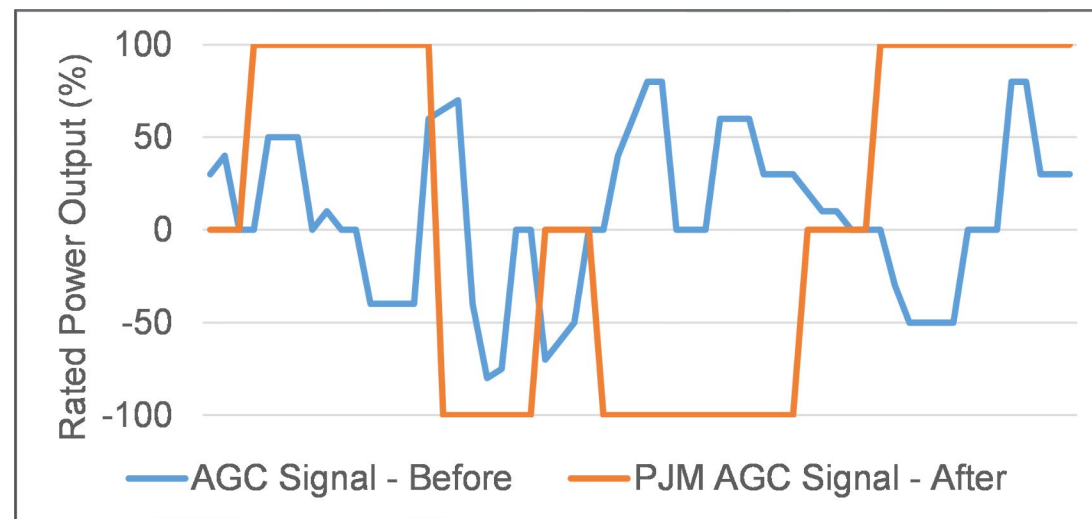
DEPLOYMENT
62 MW / 53 MWh ESS

SOLUTION
Reg D and Reg A

KEY TAKEAWAY
Transformational agility

January 2017 PJM changes regulation AGC signal without notice presenting significant challenge to 250 MW battery investments.

- Energy neutrality from 15 minutes to 30 minutes
- Energy throughput up 62%
- More frequent full charge / discharge calls



Wärtsilä future-proofing value proposition

Wärtsilä's future-proofing software allows PJM Systems to respond more effectively to changes. These metrics directly impact battery system revenue.

CLIENT PARTNER
PJM

DEPLOYMENT
62 MW / 53 MWh ESS

SOLUTION
Reg D and Reg A

KEY TAKEAWAY
Transformational agility

	Other PJM Storage Systems		Wärtsilä PJM Systems	
2017 Signal Pattern Change	Before	After	Before	After
Performance Score	85-95%	80-90%	97%-98%	93-95%
Availability	92%	<90%	100%	100%
Rated Capacity (as percent of original)	100%	50%	100%	66.6%
Downtime for system update after change	>1 week		5 minutes	

Path

to 100%