Capital Markets Day 2018

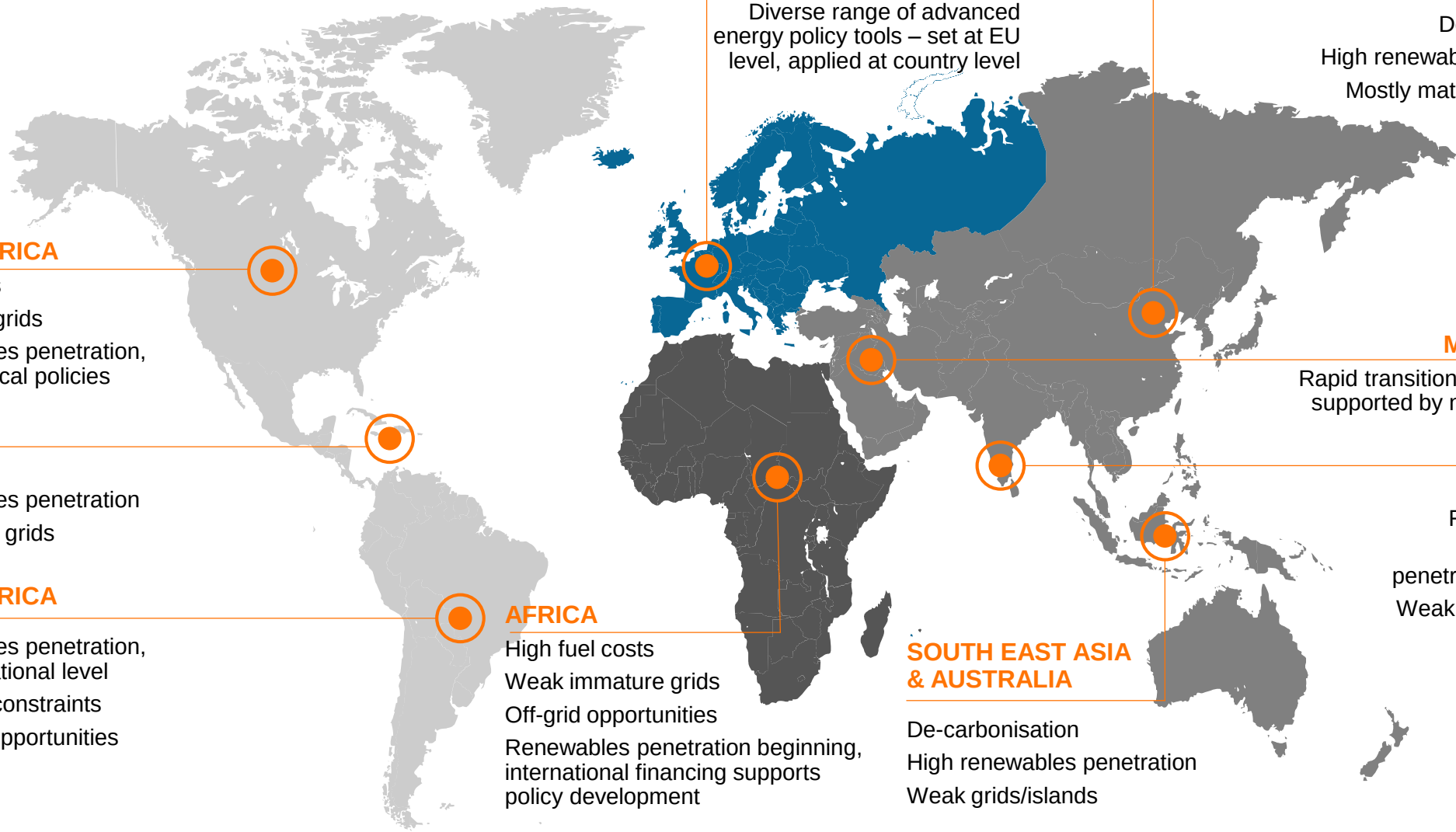
WÄRTSILÄ

ENERGY SOLUTIONS: ENGINES AND STORAGE ARE UNLOCKING A 100% RENEWABLE ENERGY FUTURE

Javier Cavada,

President, Energy Solutions & Executive Vice President

Global power industry trends



EUROPE

Low fuel costs

Mature stable grids

High renewables penetration

Diverse range of advanced energy policy tools – set at EU level, applied at country level

NORTH EAST ASIA

De-carbonisation

High renewables penetration

Mostly mature stable grids

NORTH AMERICA

Low gas prices

Mature stable grids

High renewables penetration, regional and local policies

MIDDLE EAST

Rapid transition to renewables, supported by national policies

CARIBBEAN

High fuel costs

High renewables penetration

Weak islanded grids

SOUTH ASIA

High fuel costs

First-time power

Renewables penetration beginning

Weak immature grids

SOUTH AMERICA

High renewables penetration, policy set at national level

Transmission constraints

Many off-grid opportunities

AFRICA

High fuel costs

Weak immature grids

Off-grid opportunities

Renewables penetration beginning, international financing supports policy development

SOUTH EAST ASIA & AUSTRALIA

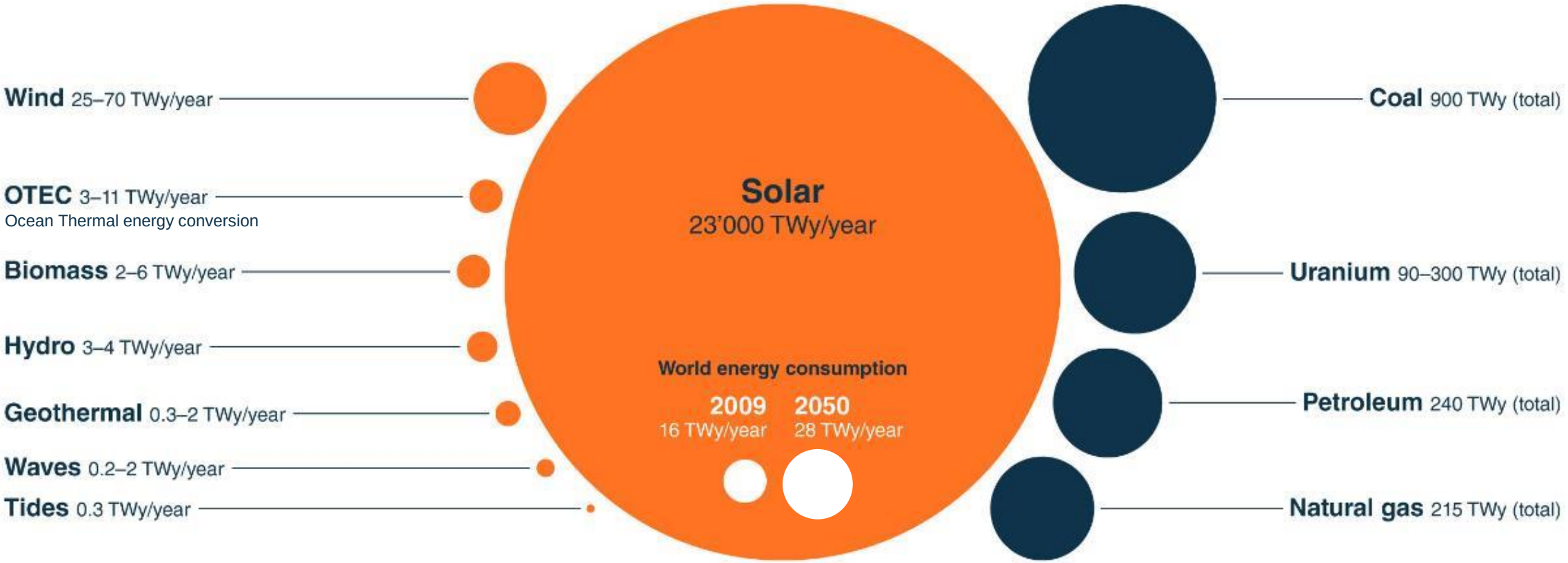
De-carbonisation

High renewables penetration

Weak grids/islands

There is significant potential in renewable energy to cover demand

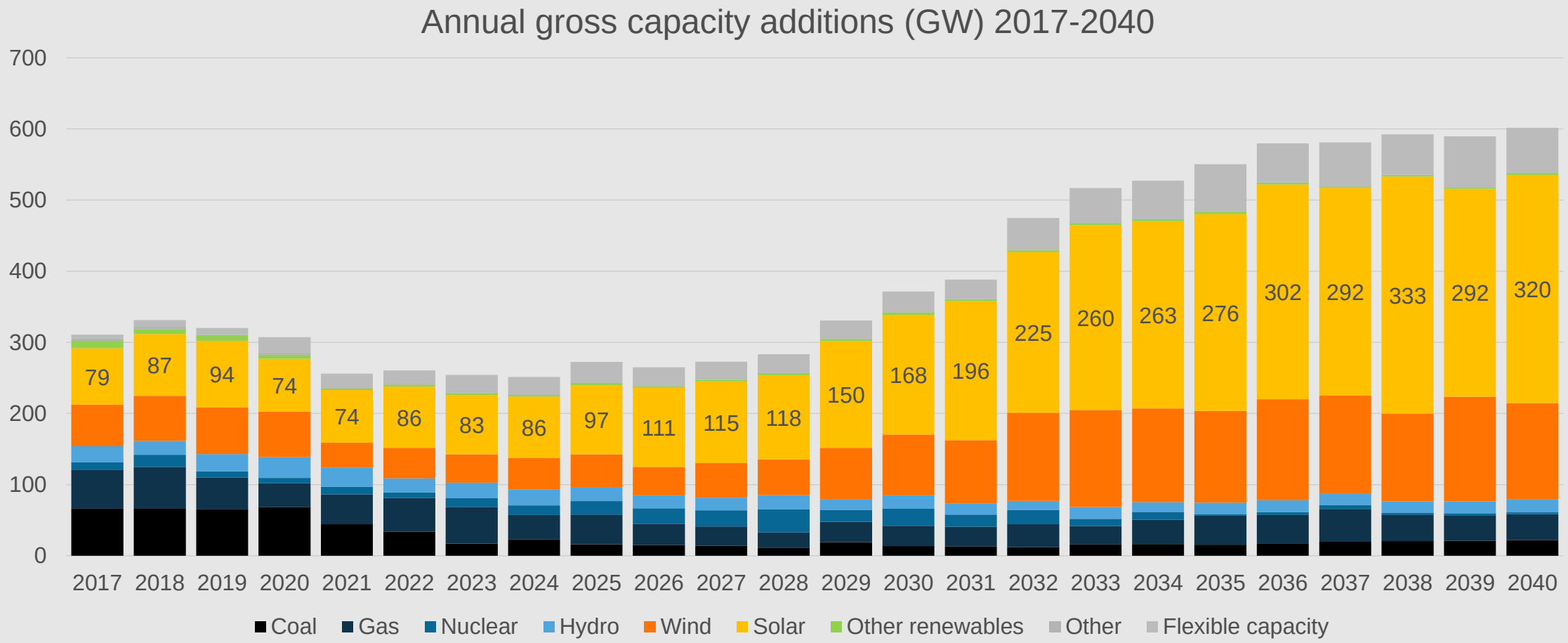
Engines and storage will provide the required reliability and ensure affordable cost of power systems



Estimate of the finite total energy reserves vs the potential from renewables per year.
Source:Atmospheric Sciences Research Center, at the State University of New York at Albany, 2018

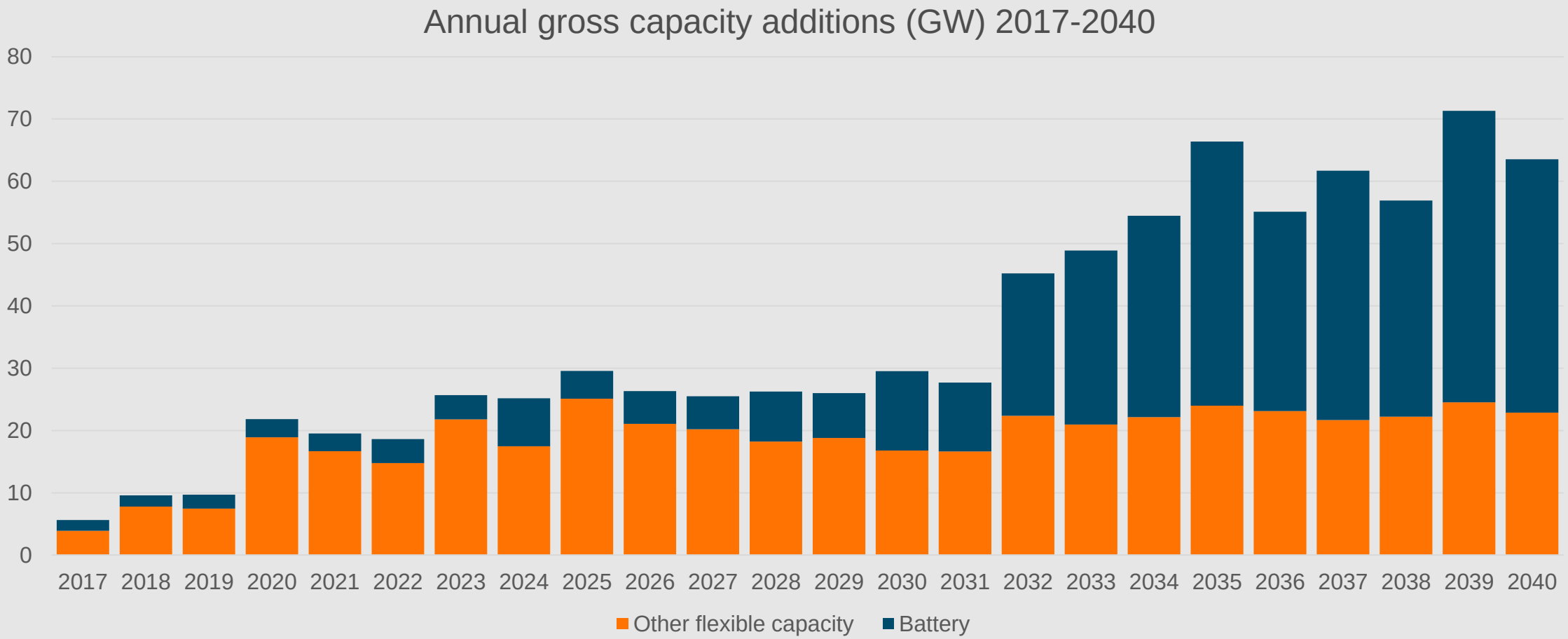
Wind and solar cumulative installed capacity will increase from 14% to 47% by 2040…

Engines and storage enable the transition



Source: Bloomberg New Energy Outlook 2017

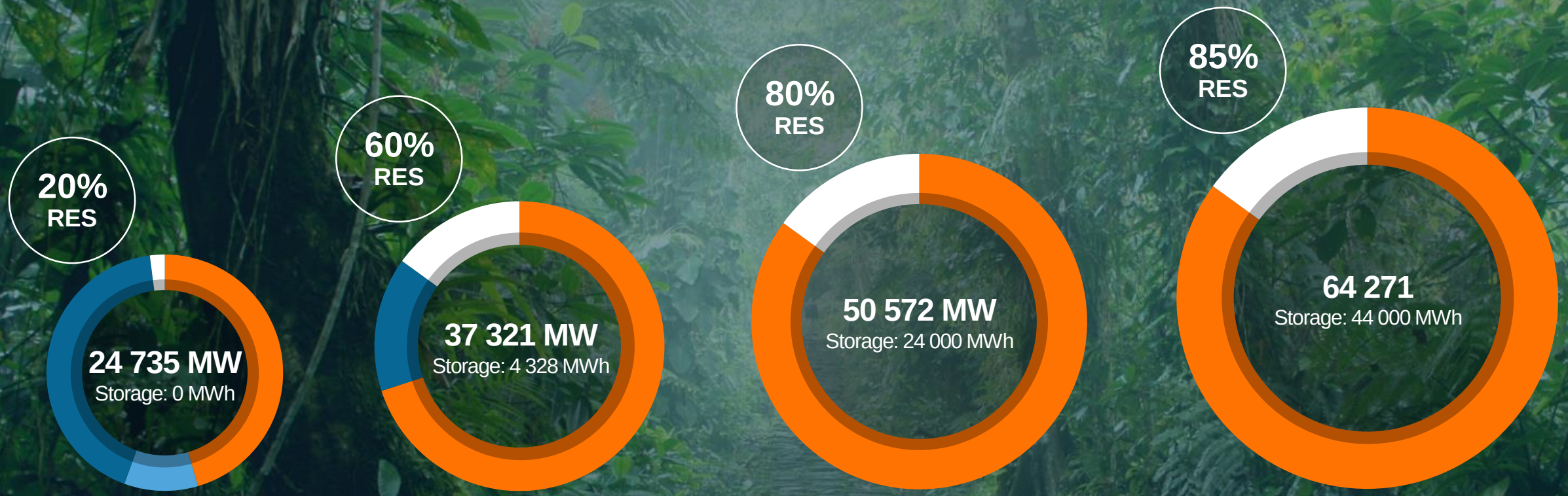
…supported by growing flexible capacity



Source: Bloomberg New Energy Outlook 2017

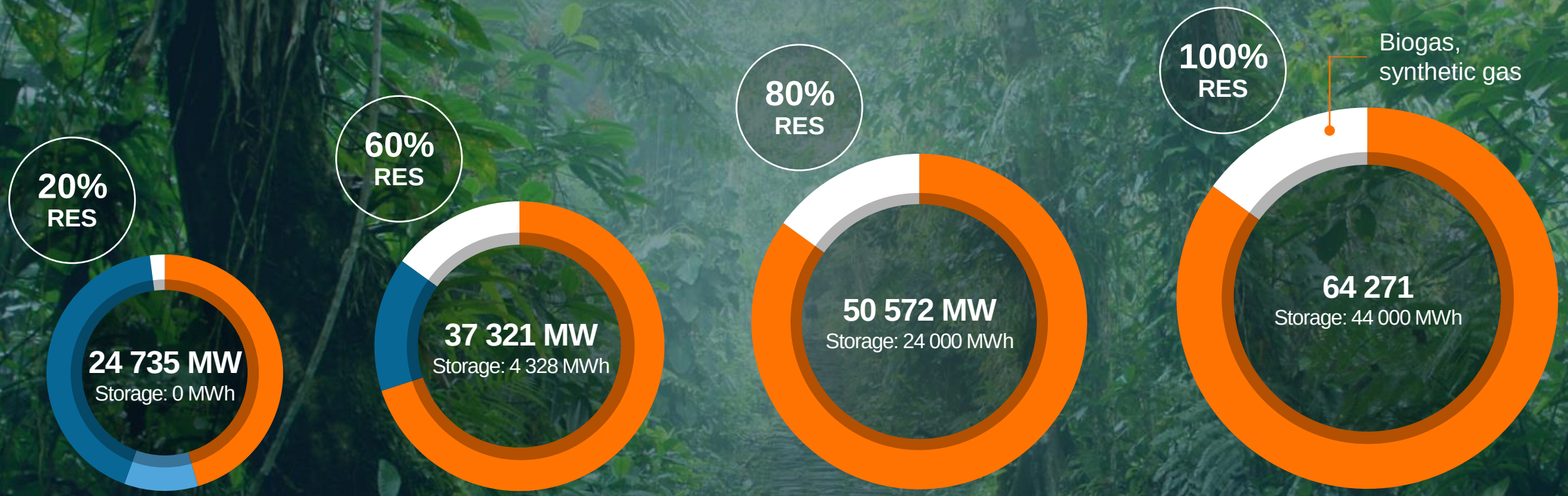
Other flexible capacity: non-baseload technologies to ensure reliability - e.g. flexible gas plants, demand response, non-battery storage technologies

The optimal path towards 100% renewable energy system

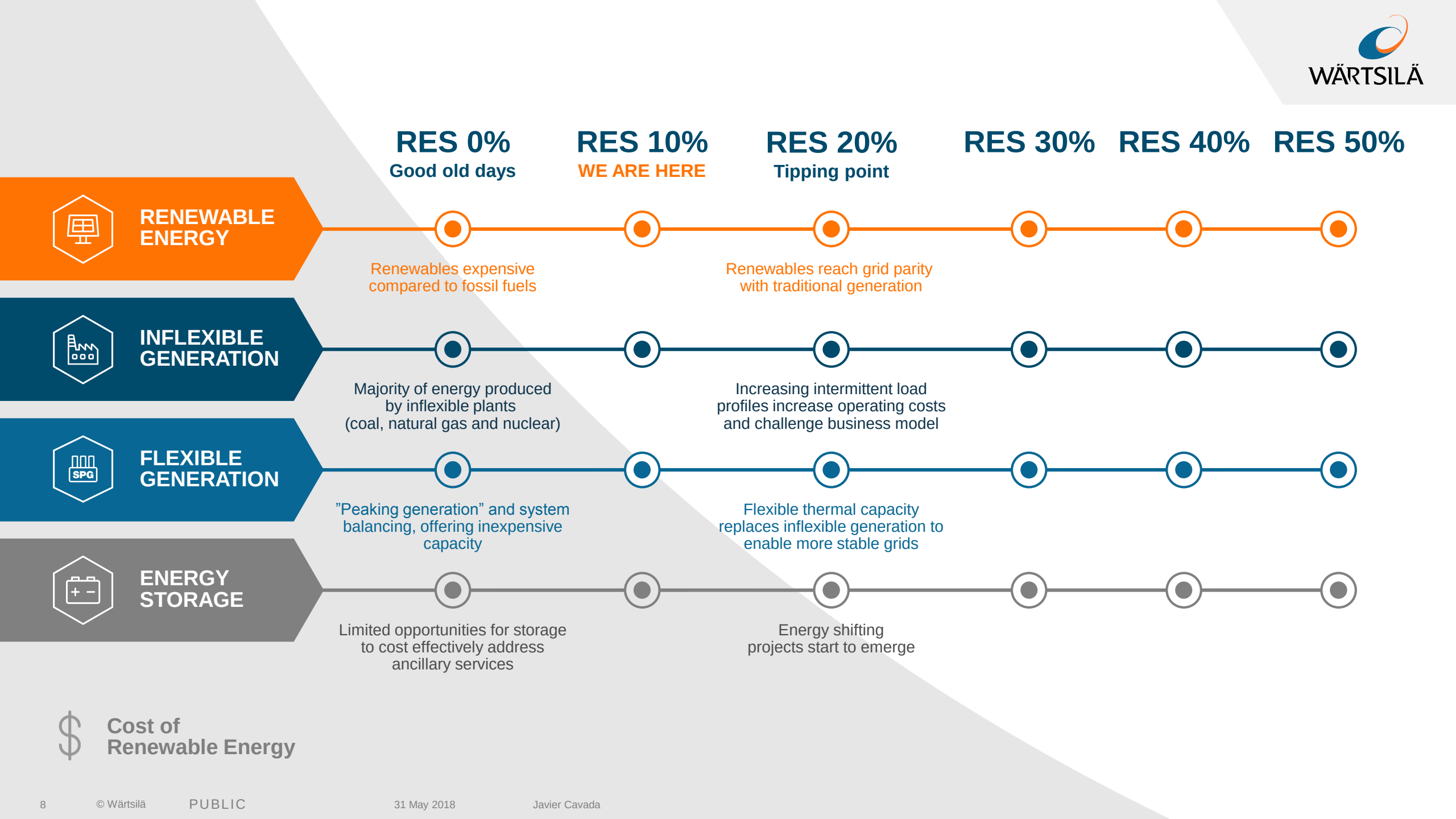


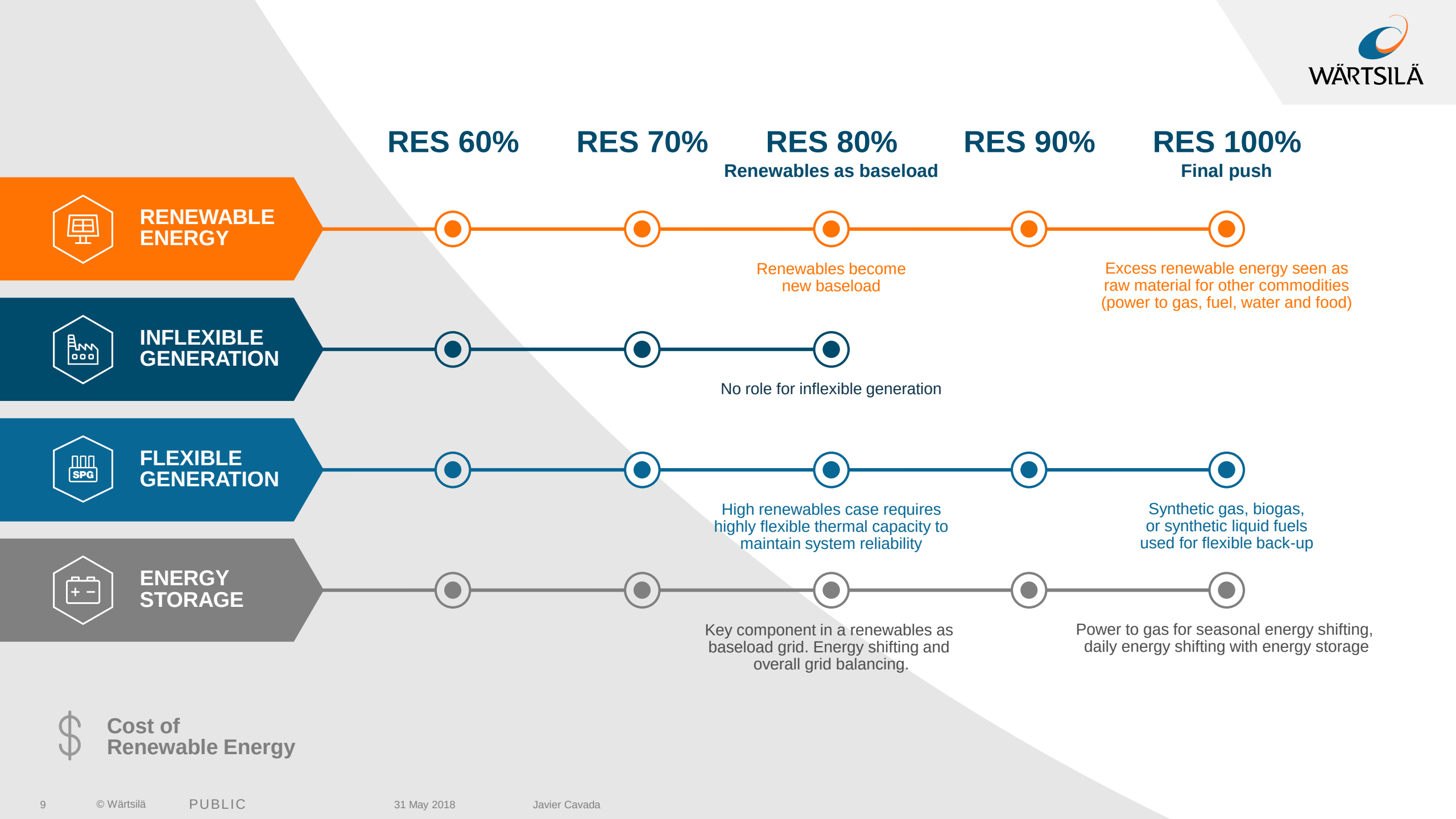
Source: Wärtsilä Energy Solutions, 2018

The optimal path towards 100% renewable energy system



Source: Wärtsilä Energy Solutions, 2018


RES 0%
Good old days
RES 10%
WE ARE HERE
RES 20%
Tipping point
RES 30%
RES 40%
RES 50%
RENEWABLE ENERGY
Renewables expensive compared to fossil fuels
Renewables reach grid parity with traditional generation
INFLEXIBLE GENERATION
Majority of energy produced by inflexible plants (coal, natural gas and nuclear)
Increasing intermittent load profiles increase operating costs and challenge business model
FLEXIBLE GENERATION
SPG
”Peaking generation” and system balancing, offering inexpensive capacity
Flexible thermal capacity replaces inflexible generation to enable more stable grids
ENERGY STORAGE
Limited opportunities for storage to cost effectively address ancillary services
Energy shifting projects start to emerge
Cost of Renewable Energy


RES 60%
RES 70%
RES 80%
Renewables as baseload
RES 90%
RES 100%
Final push
RENEWABLE ENERGY
Renewables become new baseload
Excess renewable energy seen as raw material for other commodities (power to gas, fuel, water and food)
INFLEXIBLE GENERATION
No role for inflexible generation
FLEXIBLE GENERATION
SPG
High renewables case requires highly flexible thermal capacity to maintain system reliability
Synthetic gas, biogas, or synthetic liquid fuels used for flexible back-up
ENERGY STORAGE
Key component in a renewables as baseload grid. Energy shifting and overall grid balancing.
Power to gas for seasonal energy shifting, daily energy shifting with energy storage
Cost of Renewable Energy

ENERGY SOLUTIONS THE LEADING ENERGY SYSTEM INTEGRATOR

ENGINE POWER PLANTS

Ultra-flexible internal combustion engine based power plants

ENERGY STORAGE AND INTEGRATION

Utility-scale energy storage solutions and advanced software

RENEWABLES

Utility-scale solar power plants, solar-engine, storage+hybrid solutions

GAS INFRASTRUCTURE

Small and medium scale liquefaction plants, terminals and distribution

TUCSON ELECTRIC POWER, ARIZONA

LARGE INVESTOR-OWNED UTILITIES ARE INVESTING IN SMART POWER GENERATION TOGETHER WITH ENERGY STORAGE

- Wärtsilä was selected to provide a **Smart Power Generation** natural gas power plant with up to 200 MW of capacity
- Greensmith Energy provided 10 MW/2.5 MWh **energy storage system** to Tucson Electric Power in 2016
- Improved overall **efficiency** of the plant, reduced **emissions** of nitrogen oxides by approx. 60% → about 350 tons p.a.
- Engines require **minimal amounts of water** for cooling
- Ability to respond quickly and reliably to the variable production of **renewable resources**

AGL ENERGY LIMITED, AUSTRALIA

THE FIRST UTILITY-SCALE RECIPROCATING ENGINE POWER PLANT IN AUSTRALIA'S NATIONAL ELECTRICITY MARKET

- Wärtsilä will deliver a 211 MW **Smart Power Generation** power plant to AGL
- Flexibility of our power plants is a **key enabler** for utilities in an electricity market with high share of renewable energy
- Flexibility rewarded in the National Electricity Market, which drives **investment in flexible gas as well as energy storage**
- The new power plant will improve the **reliability and security** of supply in South Australia
- AGL is planning to **replace Liddell coal plant** with renewables and additional 750 MW of flexible gas capacity

Our smart energy vision

The energy landscape is in transition towards more flexible and sustainable energy systems. **We envision a 100% renewable energy future.**

Wärtsilä is leading the transition as the **Energy System Integrator** – we understand, design, build and serve optimal power systems for future generations.

Engines and storage will provide the needed **flexibility** to integrate renewables and secure **reliability**.

THANK YOU

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