ENGINES AND STORAGE ARE UNLOCKING A 100% RENEWABLE ENERGY FUTURE

NORDEA BREAKFAST SEMINAR

Javier Cavada,
President, Energy Solutions & Executive Vice President
Global power industry trends

**NORTH AMERICA**
- Low gas prices
- Mature stable grids
- High renewables penetration, regional and local policies

**CARIBBEAN**
- High fuel costs
- High renewables penetration
- Weak islanded 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

**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

**MIDDLE EAST**
- Rapid transition to renewables, supported by national policies

**SOUTH ASIA**
- High fuel costs
- First-time power
- Renewables penetration beginning
- Weak immature grids
Wind and solar cumulative installed capacity will increase from 14% to 47% by 2040…

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
Cost of Renewable Energy

**RES 0%**
Good old days

- Renewables expensive compared to fossil fuels

**RES 10%**
WE ARE HERE

- Renewable reach grid parity with traditional generation

**RES 20%**
Tipping point

- Increasing intermittent load profiles increase operating costs and challenge business model

**RES 30%**

**RES 40%**

**RES 50%**

- Flexible thermal capacity replaces inflexible generation to enable more stable grids

**Inflexible Generation**

- Majority of energy produced by inflexible plants (coal, natural gas and nuclear)

**Flexible Generation**

- "Peaking generation" and system balancing, offering inexpensive capacity

**Energy Storage**

- Limited opportunities for storage to cost effectively address ancillary services

- Energy shifting projects start to emerge
Renewables become new baseload

No role for inflexible generation

High renewables case requires highly flexible thermal capacity to maintain system reliability

Key component in a renewables as baseload grid. Energy shifting and overall grid balancing.

Excess renewable energy seen as raw material for other commodities (power to gas, fuel, water and food)

Synthetic gas, biogas, or synthetic liquid fuels used for flexible back-up

Power to gas for seasonal energy shifting, daily energy shifting with energy storage
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
We continue to strengthen our position in addressable markets

Source: McCoy Power Report. Includes GT-based gas and liquid-fuelled, <500 MW power plants with prime movers above 5 MW. Includes estimated output of steam turbines for combined cycles (factor 0.5 for industrial turbines, 0.25 for aero). Oil & Gas projects not included. Other combustion engines not included – data not available.
Good development in Energy Solutions’ order intake

First quarter development
Total EUR 414 million (405)

- Utilities: 33%
- Independent power producers: 67%
- Industrials: 0%

First quarter order intake by fuel in MW
- Oil: 48%
- Gas: 52%

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Wärtsilä was selected to provide a Smart Power Generation natural gas power plant with up to 200 MW of capacity.

Greensmith Energy provided a 10 MW/2.5 MWh energy storage system to Tucson Electric Power in 2016.

Improved overall efficiency of the plant, reducing 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.
• 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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