2024 Nigeria Energy Transition Forum

Lagos
Tuesday 5th November 2024

AGENDA

10:00 – 10:15
Forum opening
- Ms Adeliina Suihko, Trade Officer, Embassy of Finland in Nigeria

10:15 – 10:30
Welcoming words
- Mr Kenneth Engblom, Vice President, Africa & Europe, Wärtsilä Energy

10:30 – 11:00
Wärtsilä in Nigeria: Global company, local presence
- Mr Wale Yusuff, Managing Director, Wärtsilä Nigeria

11:00 – 11:30
Business Case: Internal Combustion Gas Engines vs Turbines
- Mr Thomas Bourlière, Senior Manager, Market and Project Development, Wärtsilä Energy

11:30 – 12:30
Panel #1: "Gas - who has it and who wants it?"
- Mr Olufisayo Olukayode Duduyemi, Managing Director, Axxela Power
- Mr Alonge Longe, General Manager, Power Business New Energy, Seplat Energy
- Mr Yashwant Kumar, Managing Director, Paras Energy

12:30 – 12:45: Coffee break

12:45 – 13:15
Wärtsilä's portfolio & future fuels roadmap
- Mr Rasmus Teir, Director, Sustainability & Future Plant Concepts, Wärtsilä Energy

13:15 – 13:45
Panel #2: " Financing gas-to-power projects in Nigeria"
- Mr Ibrahim Ahmed Rufai, Group Head, Chemicals & Industrial Minerals, Bank of Industry
- Mr Daniel Mueller, Chief Operating Officer, InfraCredit

13:45 – 14:00
Conclusions of the Day
- Mr Kenneth Engblom, Vice President, Africa & Europe, Wärtsilä Energy

14:15 : **Lunch and networking**



Forum Opening

Adeliina Suihko
Trade Officer
Embassy of Finland in Nigeria

Welcome to the 2024 Nigeria Energy Transition Forum

Kenneth Engblom
Vice President
Africa & Europe
Wärtsilä Energy

Our purpose

Enabling sustainable societies through innovation in technology and services

Global leader

in innovative technology and lifecycle solutions for the marine and energy markets

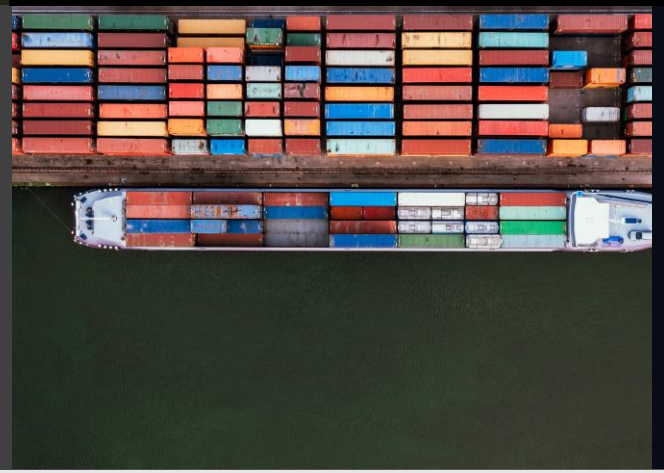
Turnover
6 015 MEUR

Offices in
79 countries

WÄRTSILÄ

2023

R&D Investments
259 MEUR



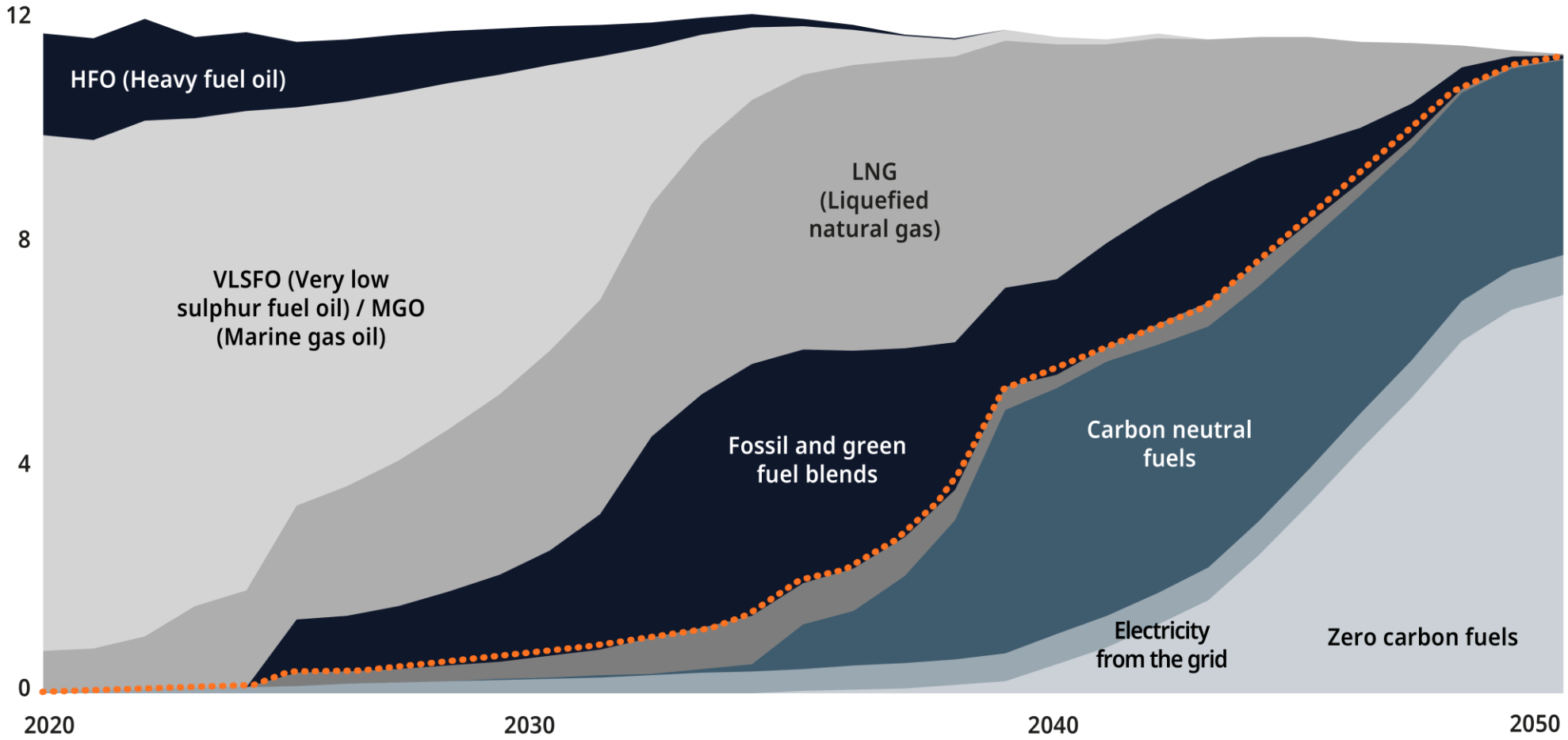
17 800
staff

130
nationalities

Decarbonizing the World

Moving from a single-fuel industry to a multi-fuel one

Distribution of fuel types for Decarbonisation 2050 (1.5C scenario), EJ

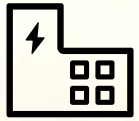


Source: DNV Maritime Forecast 2050 model, Wärtsilä internal estimates

Decarbonisation is feasible with current technologies

Technologies needed for a net zero power system

Wind and solar



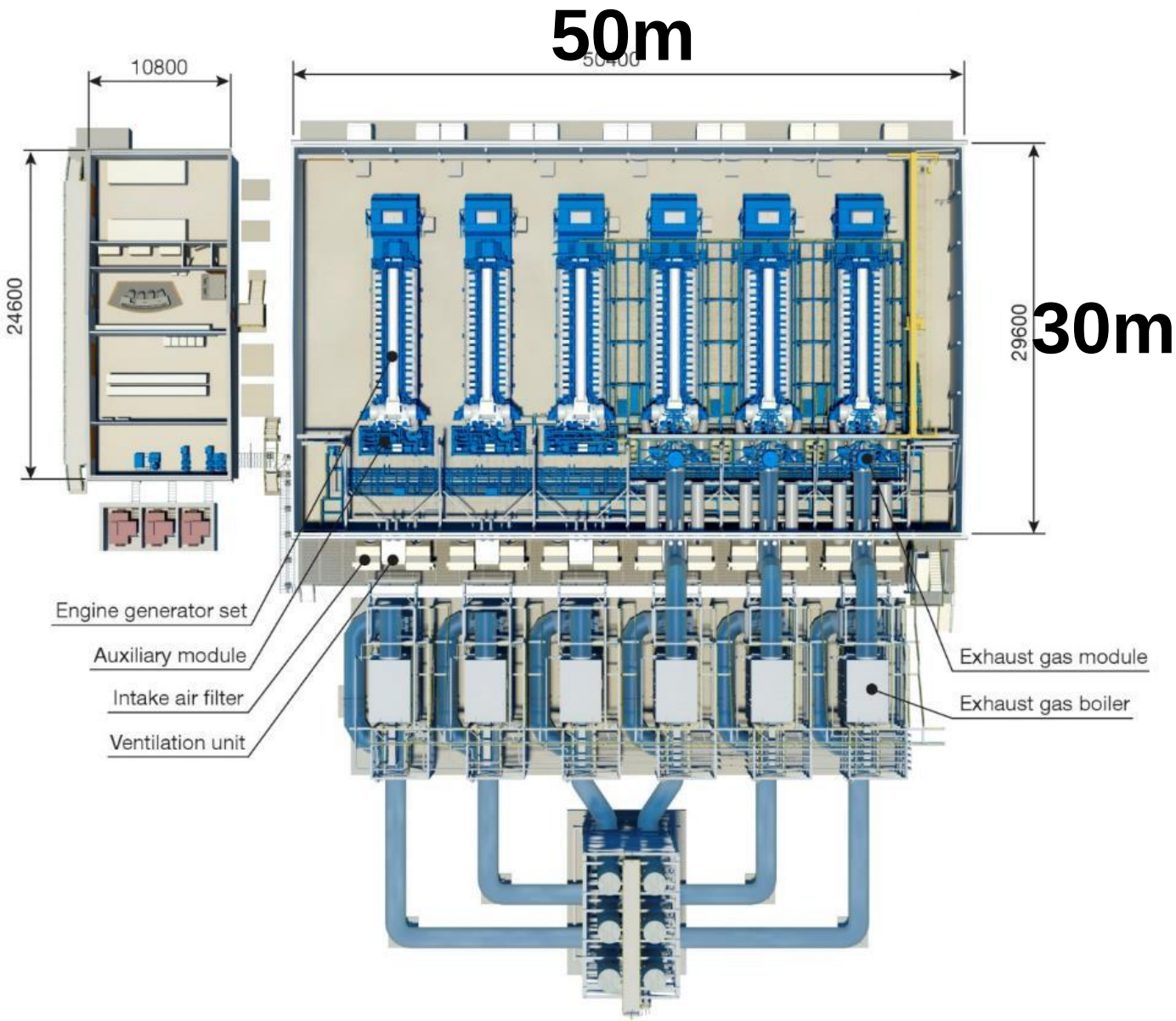
Engine power plants

Energy storage

Sustainable fuels

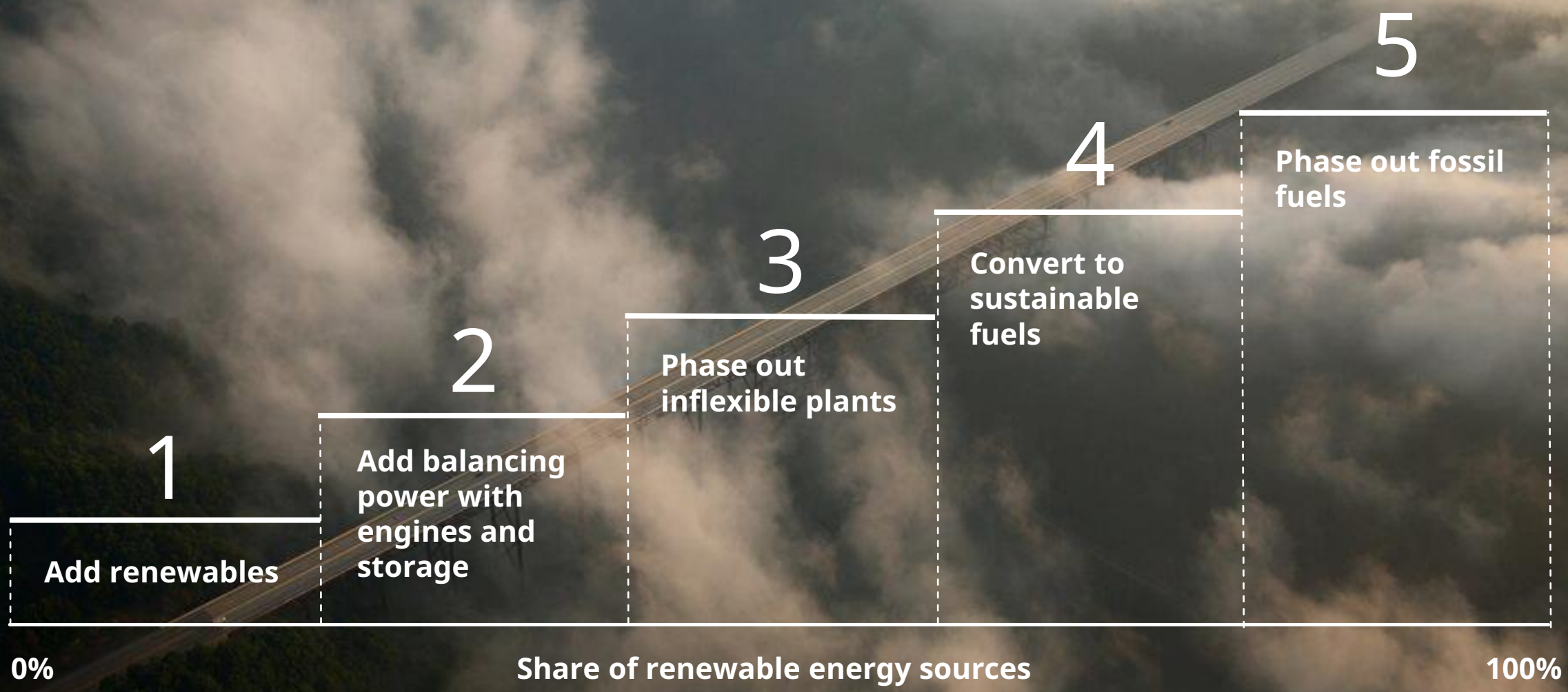
WARTSILA PORTFOLIO WITH LIFECYCLE SUPPORT

110MW Wärtsilä 6 x W18V50SG Power Plant



What are the steps for regions worldwide to reach net zero?

The path is similar everywhere.



THANK YOU

"We accelerate the decarbonisation of the marine and energy industries through innovation, focused investments, and selective partnerships, while at the same time decarbonising our own operations."

Håkan Agnevall
President & CEO



Wärtsilä in Nigeria: global company, local presence

Wale Yusuff
Managing Director
Wärtsilä Marine & Power Services Nig. Ltd

Wärtsilä In Africa

7.6 GW Active Engine Base

187 Customers

2.6 GW under LTSA

343 Installations

46 Countries with Active customers

24 years Average age of Installations

Industry
2 GW

IPP's
2.1 GW

Utilities
3.3 GW

Wärtsilä in Africa:

Wärtsilä West & Central Africa:
- Dakar, Senegal
- Doula, Cameroon
- Lagos, Nigeria

✓ 300 employees

Wärtsilä Eastern Africa:
- Nairobi, Kenya

✓ 239 employees

Wärtsilä Southern Africa:
- Cape Town
- Mozambique
- Madagascar

✓ 105 employees

Network Company

Branch / SPC

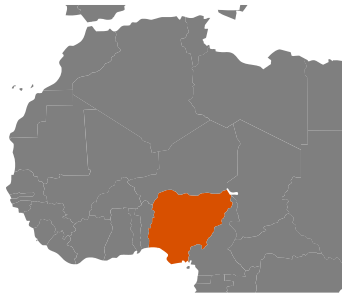
Wärtsilä in Nigeria:

Operating in Nigeria since 2010

Serving >800 MW of Power Plants and 500 MW of Marine installations

over 100 employees

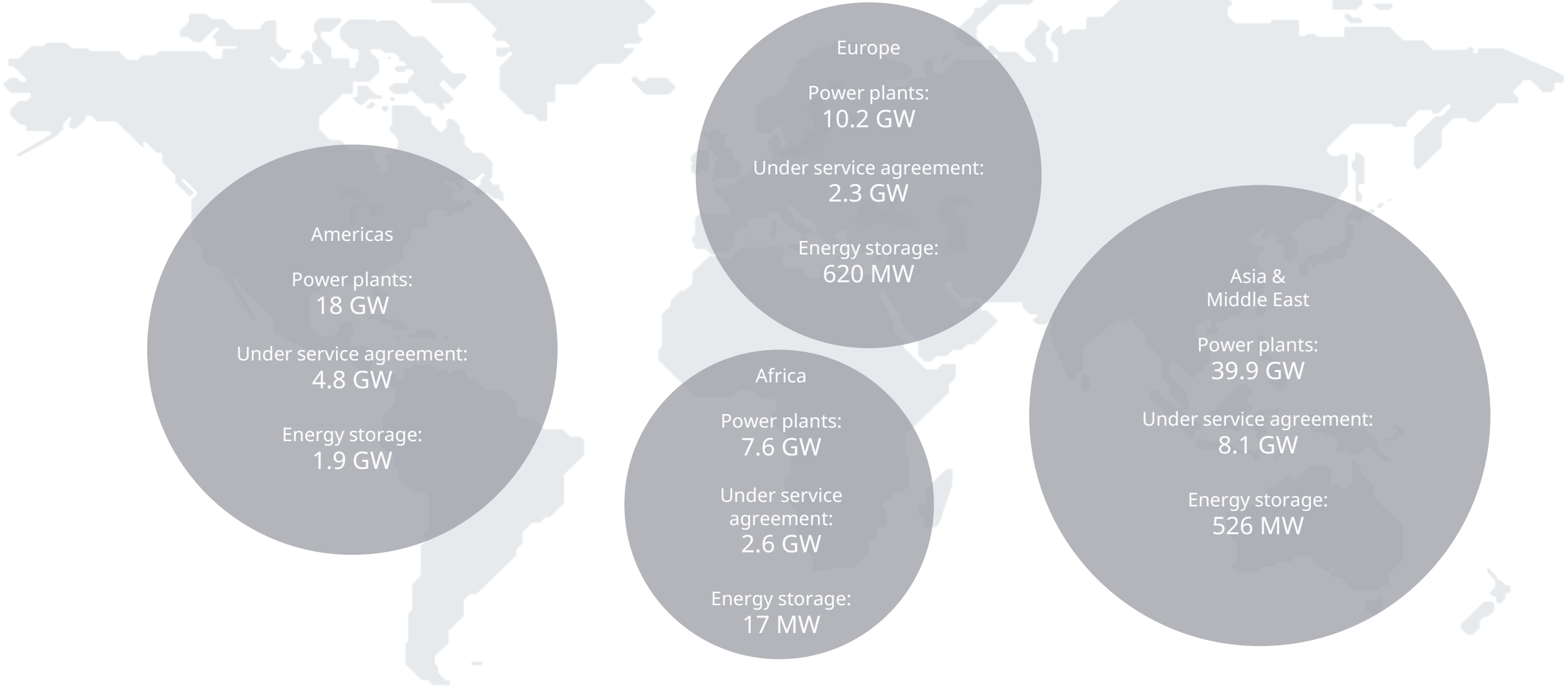
- **Head Office :** Ikeja, Lagos (>30 employees)
- **O&M site :** Cross River State, Calabar (>35 employees)
- **O&M Site :** Ogun State, Ewekoro (>30 employees)
- **O&M Site:** Kogi State, Mopa Ewekoro (>30 employees)



Our team of FS professionals (+20) carry out all maintenance work in situ or onboard, such as:

- Major overhaul and Maintenance work for Diesel, Gas and Dual fuel Engines.
- Engine component machining
- Troubleshooting
- Technical advisory.
- Performance audits of plant and equipment.
- Field Servicing of Propulsion equipment.
- Electrical & Automation upgrades.

We have delivered energy solutions in 180 countries around the world. This includes 76 GW of power plant capacity, of which 17.8 GW are under service agreements, and 3 GW+ of energy storage capacity.



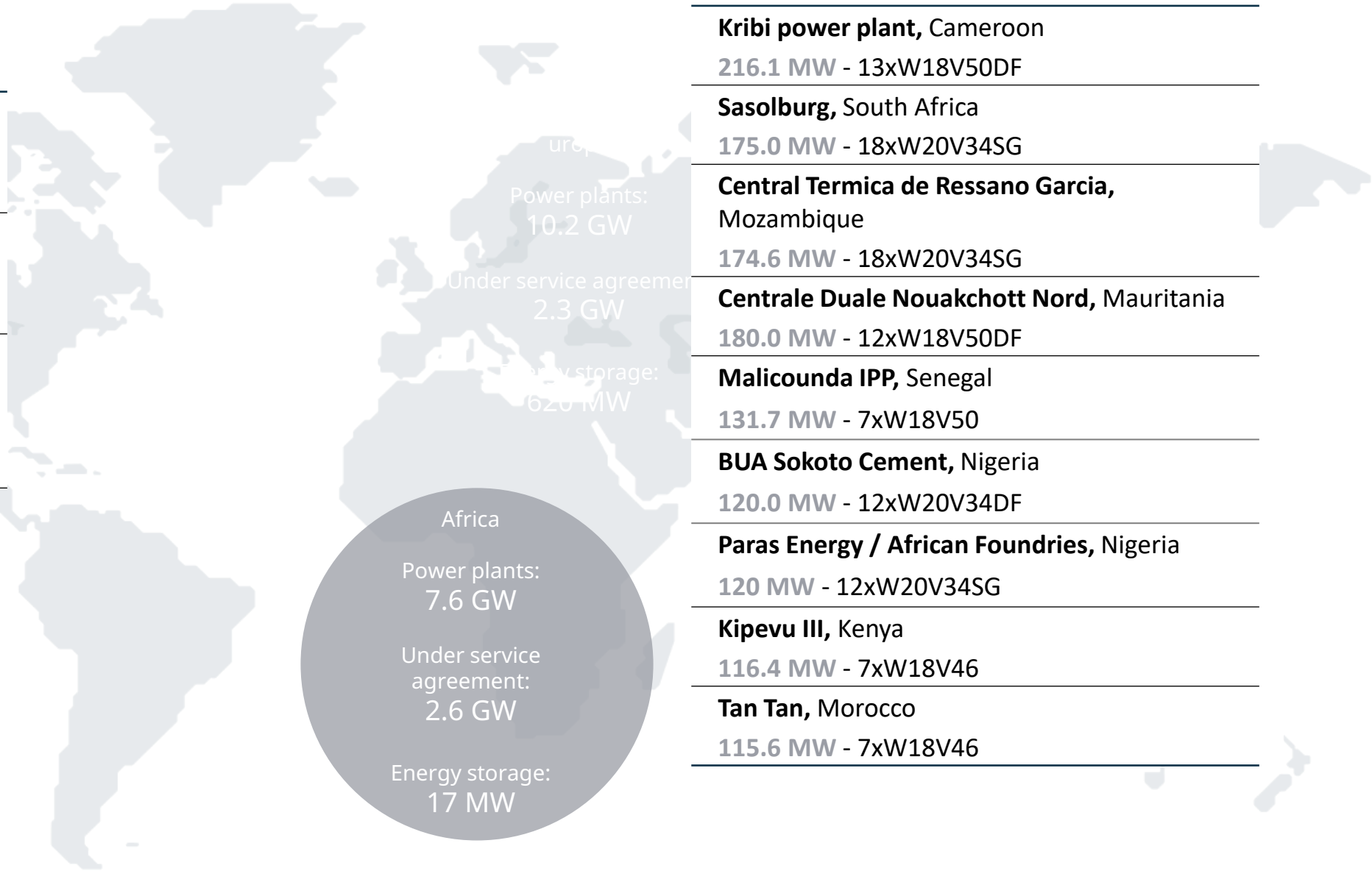
References :

Largest Plants

IPP 3
Amman, Jordan
630.3 MW - 38xW18V50DF

Karadeniz KPS 12
Karadeniz, Turkey
451.0 MW - 24xW18V50

Quisqueya
San Pedro de Macoris, Dominican Rep
431.0 MW - 24xW18V50DF



Largest Plants in Africa

Kribi power plant, Cameroon
216.1 MW - 13xW18V50DF

Sasolburg, South Africa
175.0 MW - 18xW20V34SG

Central Termica de Ressano Garcia, Mozambique
174.6 MW - 18xW20V34SG

Centrale Duale Nouakchott Nord, Mauritania
180.0 MW - 12xW18V50DF

Malicounda IPP, Senegal
131.7 MW - 7xW18V50

BUA Sokoto Cement, Nigeria
120.0 MW - 12xW20V34DF

Paras Energy / African Foundries, Nigeria
120 MW - 12xW20V34SG

Kipevu III, Kenya
116.4 MW - 7xW18V46

Tan Tan, Morocco
115.6 MW - 7xW18V46

WÄRTSILÄ MARINE & POWER SERVICES NIGERIA Ltd

WÄRTSILÄ IN NIGERIA:

First power plants deliverd to Nigeria in 1970s

Operating in Nigeria since 2010

Serving 800 MW of Power Plants and 500 MW of Marine installations

over 100 employees

- **Head Office : 23 Oba Akinjobi Street GRA,** Ikeja, Lagos (>30 employees)
- **O&M site :** Cross River State, Calabar (>35 employees)
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- Technical advisory.
- Performance audits of plant and equipment.
- Field Servicing of Propulsion equipment.
- Electrical & Automation upgrades.

Some Customers

BUA Cement – Sokoto Plant

Sokoto, Nigeria

120.0 MW - 12xW20V34DF

Lafarge Cement – Ewekoro Plant

Ewekoro, Nigeria

99.7 MW - 6xW18V50DF

Lafarge Cement – Mfamosing Plant

Mfamosing, Nigeria

98.3 MW - 6xW18V50DF

Paras Energy

Ogijo, Nigeria

70.0 MW - 7xW20V34SG

African Foundries

Lagos, Nigeria

64.1 MW - 7xW20V34SG

Wempco

Lagos, Nigeria

51.6 MW - 6xW20V34SG

Oshogbo Steel Co.

Oshogbo, Nigeria

41.6 MW - 4x18TM410 + 12SW280

Customers-contd

BUA Cement – OBU Cement Plant

Edo State, Nigeria

70.0 MW – 7 x W20V34DF

Mangal Cement – Mopa Plant

Kogi State, Nigeria

50.0 MW - 5x20V34DF

VIPL- Victoria Island

Lagos, Nigeria

30.0 MW - 3xW20V34SG

Nestle Plc- Agbara

Ogun Sate, Nigeria

13.1 MW - 3xW9L34DF

NNPC Towers-Abuja

FCT, Nigeria

17.1 MW - 4xW9L34DF

Flour Mills of Nigeria-Apapa

Lagos, Nigeria

14.4 MW - 2xW9L34DF + 1 x W12V34DF

Pulkit Steel-Ikorodu.

Lagos, Nigeria

20.0 MW – 2xW20V34SG

Tempo Foods and Packaging-Ota

Ogun State, Nigeria

5.3MW – 1xW18V32DF

WIDE RANGE OF EXPERTISE AND SERVICES

Marine Business

Energy Business

Engine services

Propulsion services

Electrical and automation services

Boiler services

Environmental services

Seals and bearings services

Service agreements

Service projects

Training services

CUSTOMER REFERENCES

EXAMPLES OF PROJECTS IN NIGERIA

Lafarge, Ewekoro

- Customer: LafargeHolcim
- Configuration: 6 x W50DF multi-fuel plant
- Total output: ~100 MW
- Fuel: Natural gas / HFO
- Scope: EPC and O&M
- Delivery: 2010

Unicem, Calabar

- Customer: LafargeHolcim
- Configuration: 6 x W50DF multi-fuel plant
- Total output: ~100 MW
- Fuel: Natural gas / HFO
- Scope: EPC and O&M
- Delivery: 2013

Paras Energy, Ogijo

- Customer: Paras Energy
- Configuration: 12 x W20V34SG gas plant
- Total output: ~120 MW
- Fuel: Gas
- Scope: EEQ and M Agreement
- Delivery: 2013

BUA Cement, Sokoto

- Customer: BUA International Ltd
- Configuration: 5 x V34DF multi-fuel plant
- Total output: ~50 MW
- Fuel: Gas / HFO
- Scope: EEQ
- Delivery: 2021

COMMUNITY ENGAGEMENT

Early November 2021, a donation was made to Fund an Inter-house Sport event of Lagos State Model Nursery and Primary School very close to our office in Lagos.

This is a continuous support provided to the schools as last year we supported them with COVID-19 prevention kits during the wake of the pandemic

SUPPORTTING STAKEHOLDERS IN CRITICAL TIMES-NIS COVID 19 SUPPORT

we supported the NIS with COVID-19 prevention kits during the wake of the pandemic, this action went a long way in presenting the spread of the pandemic in the immediate community.

SUPPORTING EDUCATION IN OUR COMMUNITY

Wärtsilä Nigeria donated a fully-loaded container of Marine equipment and tools to Petroleum Training Institute(PTI), Warri Delta State Nigeria

The school run several specialized courses in petroleum technology with an excellent staff team who is committed and dedicated to ensure each and every student achieves high standard.

The marine resources are useful for training and enable more courses to be offered by the school, such that encourage job readiness.

Education provides the people with continuity, hope for the future, and perhaps also a better understanding of each other, which could one day help end the cycle of violence in…..

Marko Vainikka, Director, Corporate Relations and Sustainability, Wärtsilä

GIVING THE GIRL-CHILD A VOICE

In collaboration with a Non-governmental organization- She Forum Africa, Wärtsilä Nigeria supported some indigent girls from grassroots communities during one of the NGO's initiatives- "Her Tuition, Her Voice" Education Enrollment Campaign.

The focus is to promote healthy conversations and solutions that will help address persisting issues surrounding the health, safety, and economic advancement of women and girls.

To invoke a re-awakening on current realities by advancing solutions on how women can recover better, stronger, and more sustainably, including people living with disability.

ENCOURAGING CREATIVITY IN YOUTHS

Wartsila supported the 2021 Pride Lagos Creative Enterprise- a youth empowerment initiates in relation to innovation, creativity and education organized by Pride Multi-media Ventures.

We funded some youths to attend the seminar and gain relevant skills, display creative talents which could be used to empower themselves financially and get off the job seeker's market.

Get to know our people and our 190-year story on social media.

www.wartsila.com/about/190

Internal Combustion Gas Engines vs Gas Turbines

Thomas Bourlière
Senior Manager
Market and Project Development
Africa & Europe
Wärtsilä Energy

Thomas.bourliere@wartsila.com

Agenda

Internal Combustion Gas Engines vs Gas Turbines: Why is the choice obvious?

1

Commercial & Industrial Sector

How Reciprocating Internal combustion Engines support C&I Sector?

2

Utility and Renewable Integration

The Role of Reciprocating Internal combustion Engines in Energy Transition and its strength versus CCGT

Wärtsilä, a reliable partner in the Commercial & Industrial segment

Wärtsilä engines provide competitive solutions for industrial actors

	Efficiency at 100% load	Efficiency at 50% load	Single generator size
	45 % on NG 43% on HFO/LFO	45 % on NG 43% on HFO/LFO	7-10 MW
	37.5 % on NG 34% on HFO/LFO	32 % on NG 27% on HFO/LFO	25-45 MW

For a 60 MW plant running 8,000 hours p.a.

Wärtsilä ICE saves c.2.7m$ per year compared to OCGT solution

Gas price: 6USD/GJ

Engine power plants

The perfect fit for the heavy-duty industry

Scalability: Sizes of Wärtsilä Power Plants range from 20 to 600 MW. The power plants can easily be developed in phases according to development needs.

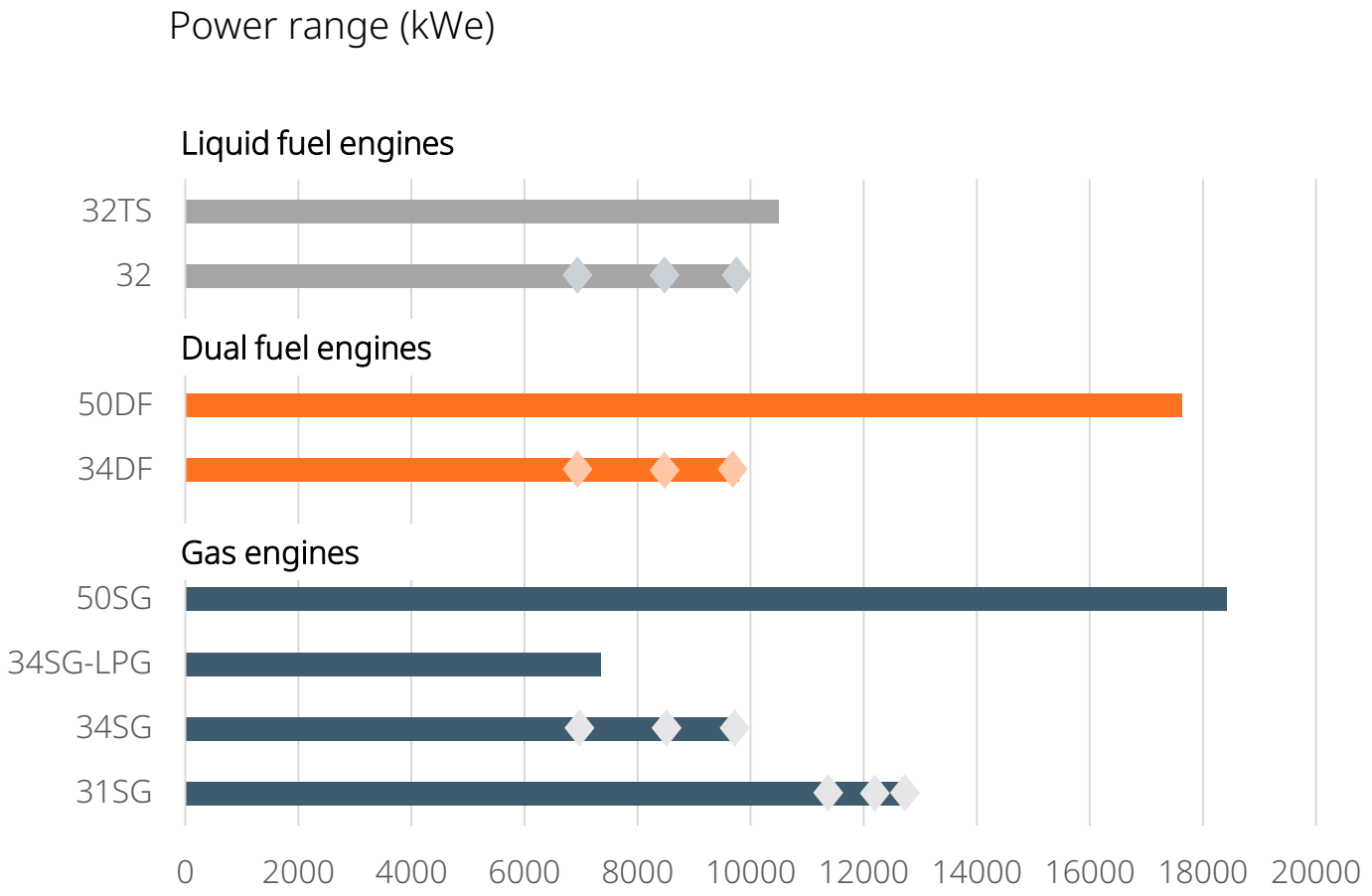
Ability to run at high load along wide operation range: Thanks to modular approach you can run at high load/efficiency through wide operation range.

Limited ambient condition derating: Wärtsilä power plants operate in 50-55°C conditions, maintaining their guaranteed output and efficiency.

Fuel flexibility: Internal combustion engines can operate at high efficiency on any available fuel (NG, HFO, LFO) and will be able to run on Hydrogen in the near future.

Fast track projects: Thanks to standardisation, internal combustion engine power plants can be deployed in 15-18 months.

Support decarbonisation: Optimal integration of collocated renewable energy through strong flexibility capacity. Ramp-up (down) to full (zero) load in less than 2 minutes, start and shutdown in 30 seconds.



Benefits of Wärtsilä offerings for the heavy-duty industry

Stable power generation in rough conditions

Lower levelised cost of energy

Lower environmental footprint

Efficiency in operations

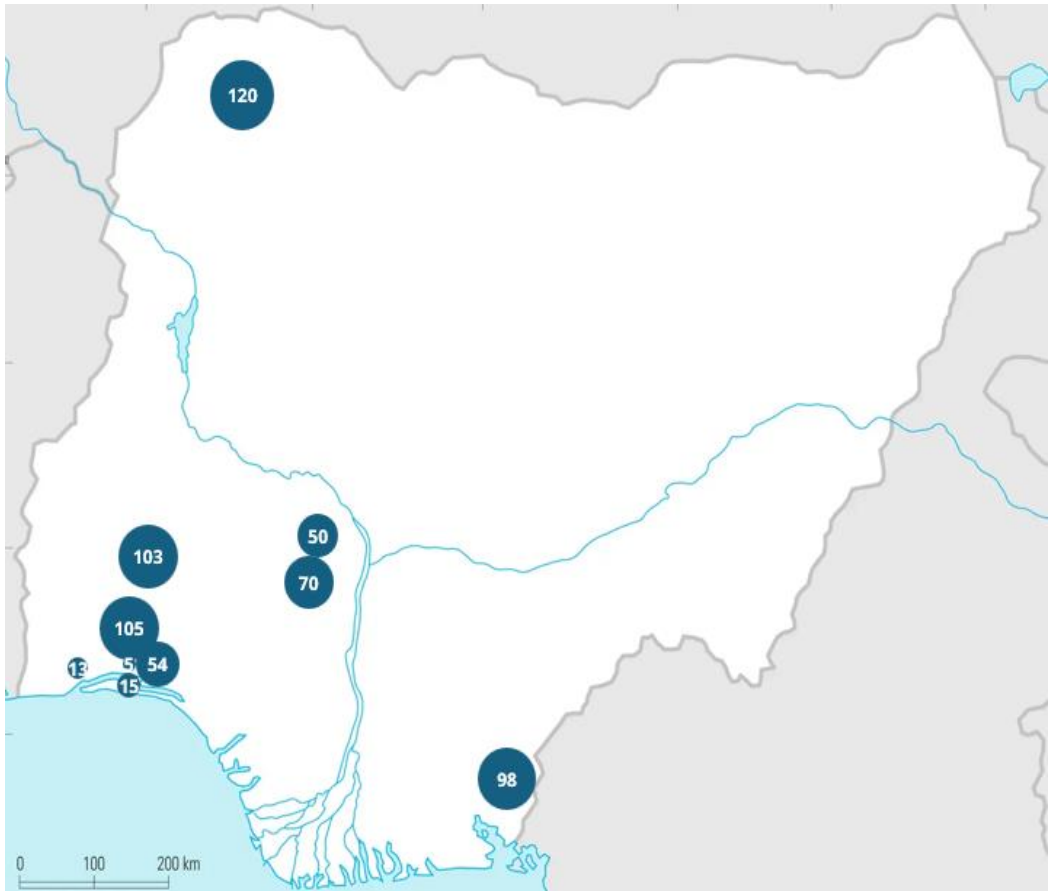
Tailored solutions

Wärtsilä C&I footprint in Nigeria

- Since 2008, Wärtsilä has provided more than 630MW to Commercial and Industrial clients in Nigeria. More than half of this capacity (c.360MW) is under agreement with Wärtsilä.
- Wärtsilä is serving a wide spectrum of industries in the country including cement, steel & alloy, pulp & papers and food & beverage.

Client	Type	COD	MW
BUA Obu	Cement	2024	70
Mangal Industries	Cement	2024	50
BUA Sokoto	Cement	2022	120
Flour Mills Power	Other	2018	15
Tempo	Pulp, papers	2011	5
Ewekoro	Cement	2011	103
Nestle	Food	2010	13
African foundries	Steel, alloy	2010	105
Unicem Mfamosing	Cement	2009	98
Wempco	Steel, alloy	2008	54

- C&I Power Plants (MW)



Proven Solutions Empowering Nigeria's Industrial Leaders

EWEKORO
NIGERIA

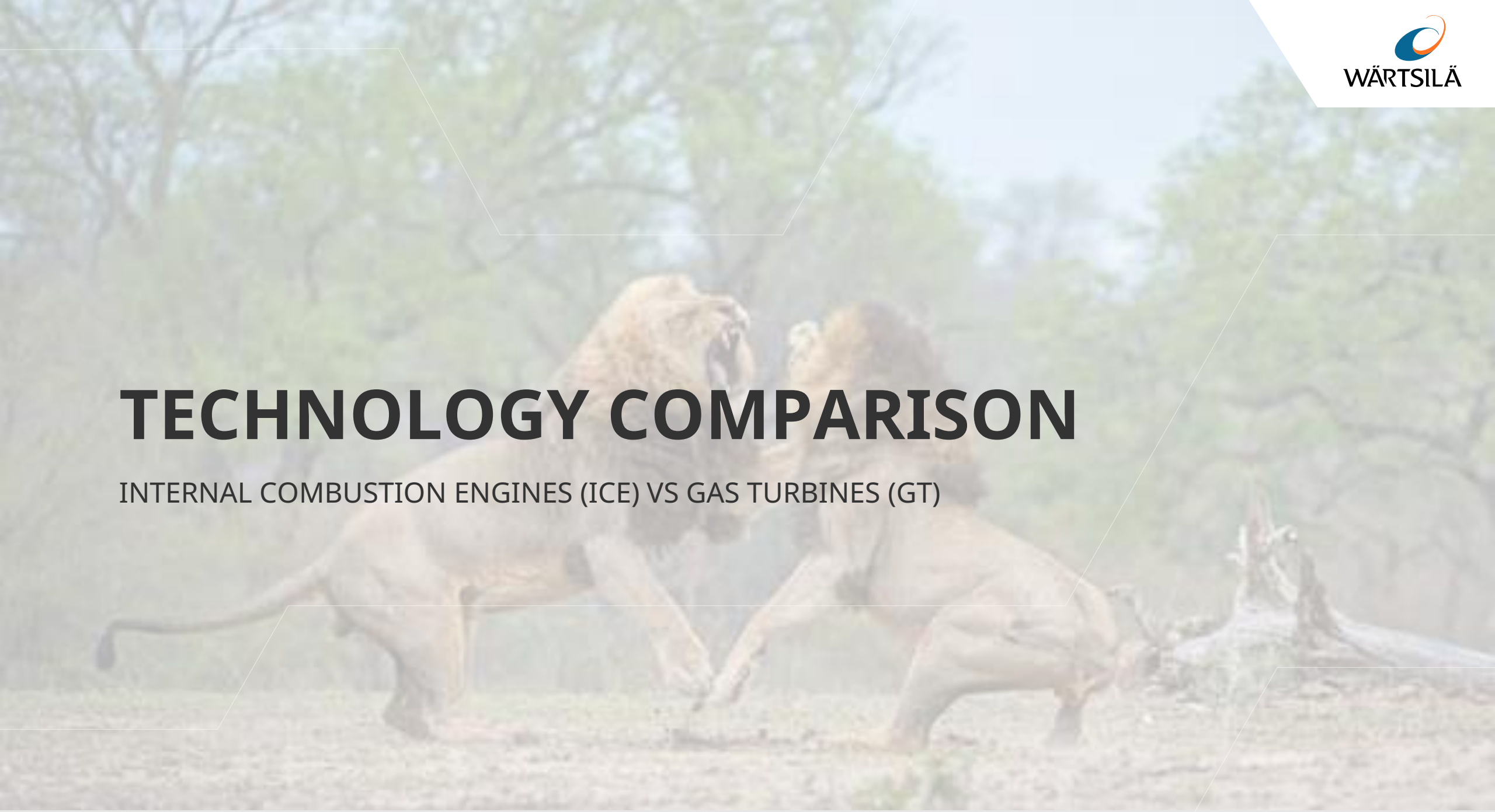
Customer	Lafarge Africa Plc
Type	Wärtsilä W18V50 based power plant
Operating mode	Baseload
Gensets	6 x W18V50DF
Total output	103 MW
Fuel	Natural Gas (NG) / LFO as Back-Up
Scope	Engineering, procurement & construction (EPC)
Lifecycle solution	Operation & Maintenance (O&M) agreement **renewed until 2026**
Delivery	2011

More than 398,000 cumulated running hours since the power plant was commissioned in 2011.

Lanre Opakunle
Strategic Sourcing Director, Power & Gas
Lafarge – Holcim Group

"We have benefited significantly from the efficient way by which Wärtsilä has operated and maintained this plant for the past ten years, and we had no hesitation in extending the agreement for a further five years. An uninterrupted reliable supply of electricity is essential to our production, and having our own power plant, built, operated and maintained by Wärtsilä, gives us this assurance

How Wärtsilä can enhance grid stability and support renewable energy integration?



TECHNOLOGY COMPARISON

INTERNAL COMBUSTION ENGINES (ICE) VS GAS TURBINES (GT)

INTRODUCTION OF COMPARED TECHNOLOGIES

COMBINED-CYCLE GAS TURBINES

General Electric 9F.04 1-1-1

CAPEX[1] at 15°C[2]: **1,300 EUR/kW**

Output at 15°C: **406 MW**

Variable O&M[3]: **4$/MWh**

Efficiency: **GT PRO by Thermoflow**

Siemens SGT-800 2-2-1 x 3

CAPEX at 15°C: **1,300 EUR/kW**

Output at 15°C: **463 MW**

Variable O&M: **4$/MWh**

Efficiency: **GT PRO by Thermoflow**

GAS ENGINES

Wärtsilä 24 x 18V50SG

CAPEX at 15°C: **1000 EUR/kW**

Output at 15°C: **437 MW**

Variable O&M: **6$/MWh** (incl. major OHs)

Efficiency: **Wärtsilä technology**

[1]CAPEX: Capital Expenditure estimate from level 0. [2]Other parameters considered: altitude 0m, methane number 100 for gas turbines, 80 for gas engines, cooling method for gas turbines is air cooled condenser.
[3]O&M: Operation & Maintenance.

AMBIENT CONDITIONS IMPACTS PLANT OUTPUT

To properly assess technologies efficiency and actual cost, **they need to be compared in real ambient conditions**

ISO conditions

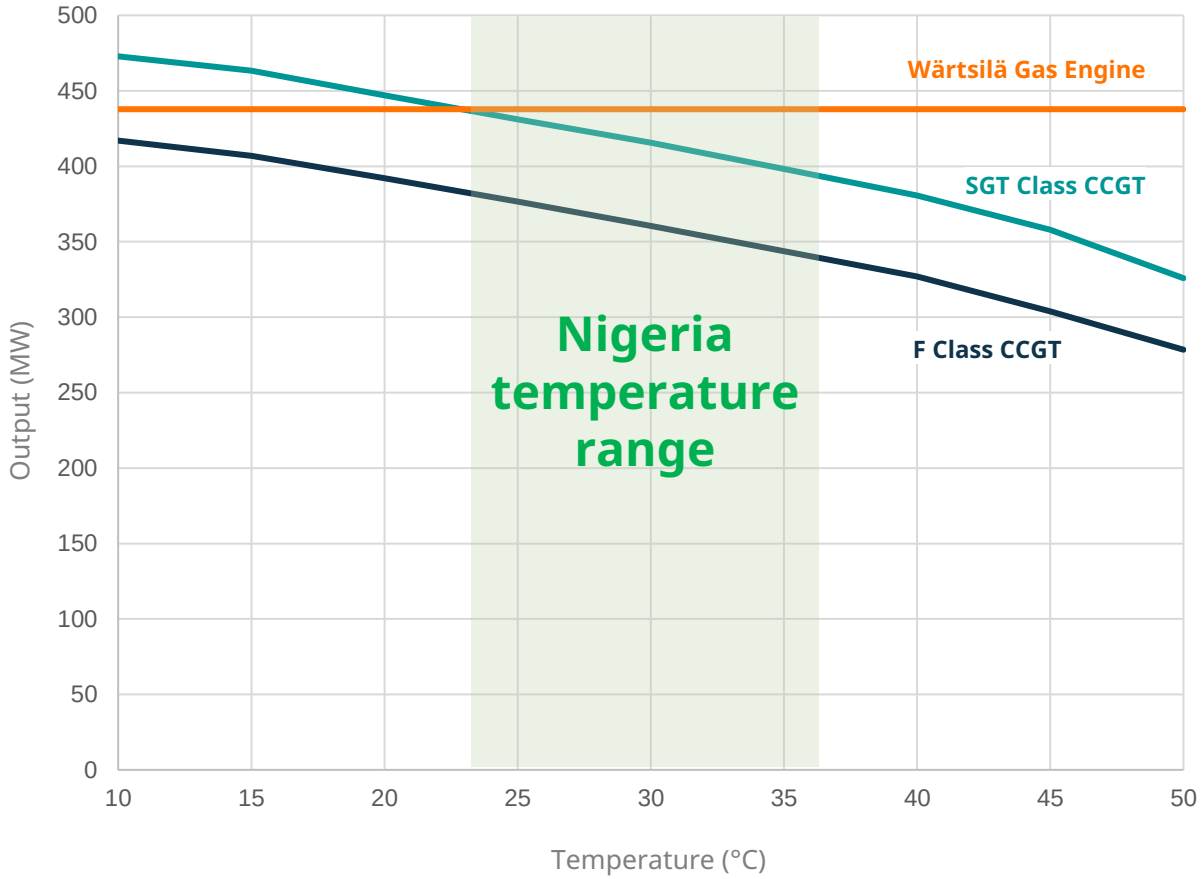
- Temperature: **15°C**
- Relative humidity: **65%**
- Load: **100%**

Nigeria average ambient conditions

- Temperature: **28°C**
- Relative humidity: **80%**
- Load: **100%**

Engines' output tend to vary less than turbines' in higher temperature environment

Graph: Output variation according to temperature conditions



[1]Lagos Weather conditions considered [2]CCGT: Combined-Cycle Gas Turbines. [3]OCGT: Open-Cycle Gas Turbines.

MODULARITY ENABLES HIGH EFFICIENCY AT LOWER LOADS

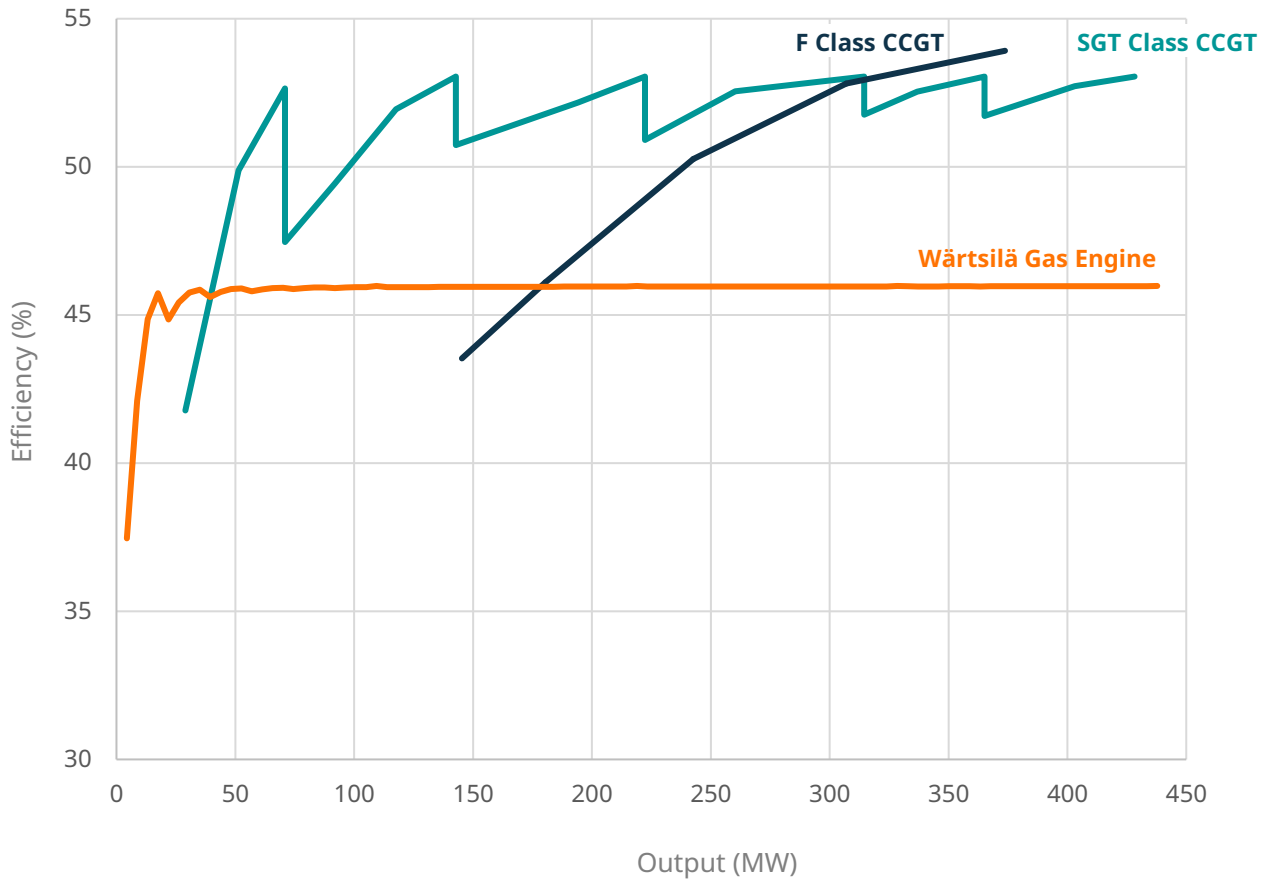
In addition to ambient conditions, plant load must be tailored to local context. Considering Nigeria's long-term ambitions for renewables, power plants will have to ramp up and down and start and stop to support renewable penetration.

Plant capacity factor will be around 50% once renewables kicks in and power plant load may have to vary from 20-100%.

Benefits of modularity:

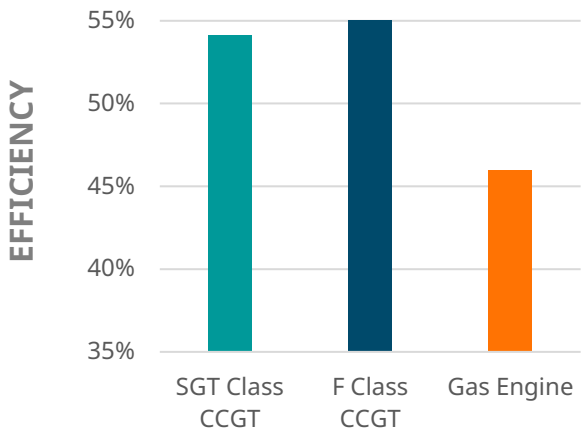
- Modularity enables **efficient operation** during partial loading as some units can be switched off completely instead of lowering the output of the all plant.
- Modular design increases the **reliability** of the power plant as a trip of one unit has only minor effect on the total output.
- High part-load efficiency supports the integration of renewables
- Modular engine power plants can be built in phases.

Graph: Efficiency variation according to output in South African conditions

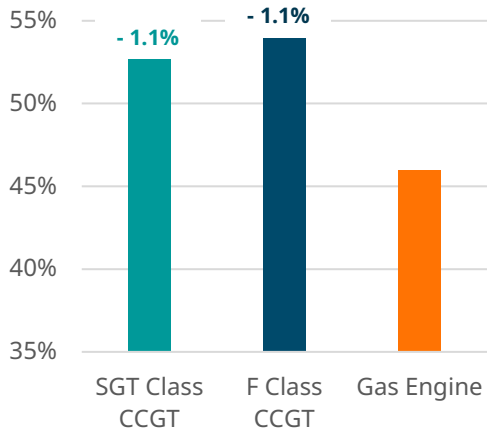


WÄRTSILÄ ENGINES ARE TAILORED FOR LOCAL CONDITIONS

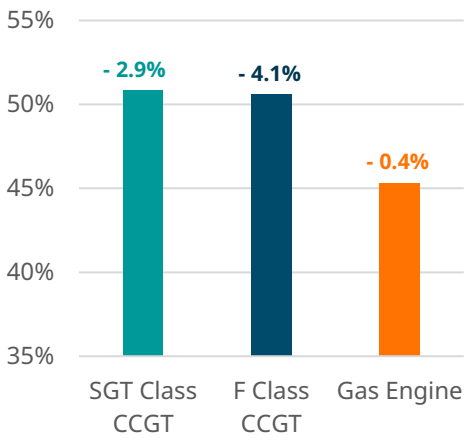
ISO conditions

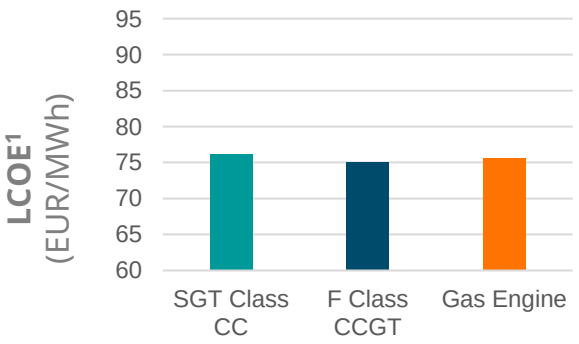


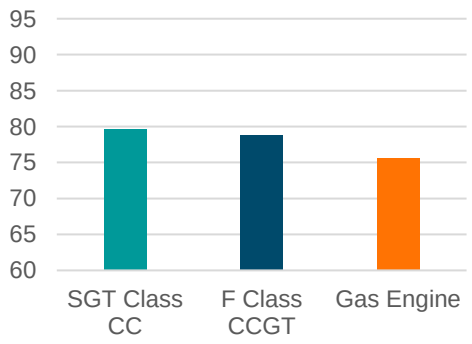
Nigeria ambient conditions[2]
(variations vs. ISO conditions)

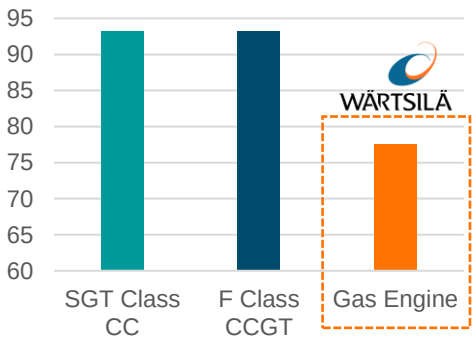


Nigeria conditions & 70% load[2]
(variations vs. ISO conditions)









For 400 MW Power station running at 70% load and 7,000 RH (56% C.F.)

Internal Combustion Engines (ICE) would allow an annual saving of 6 MEUR

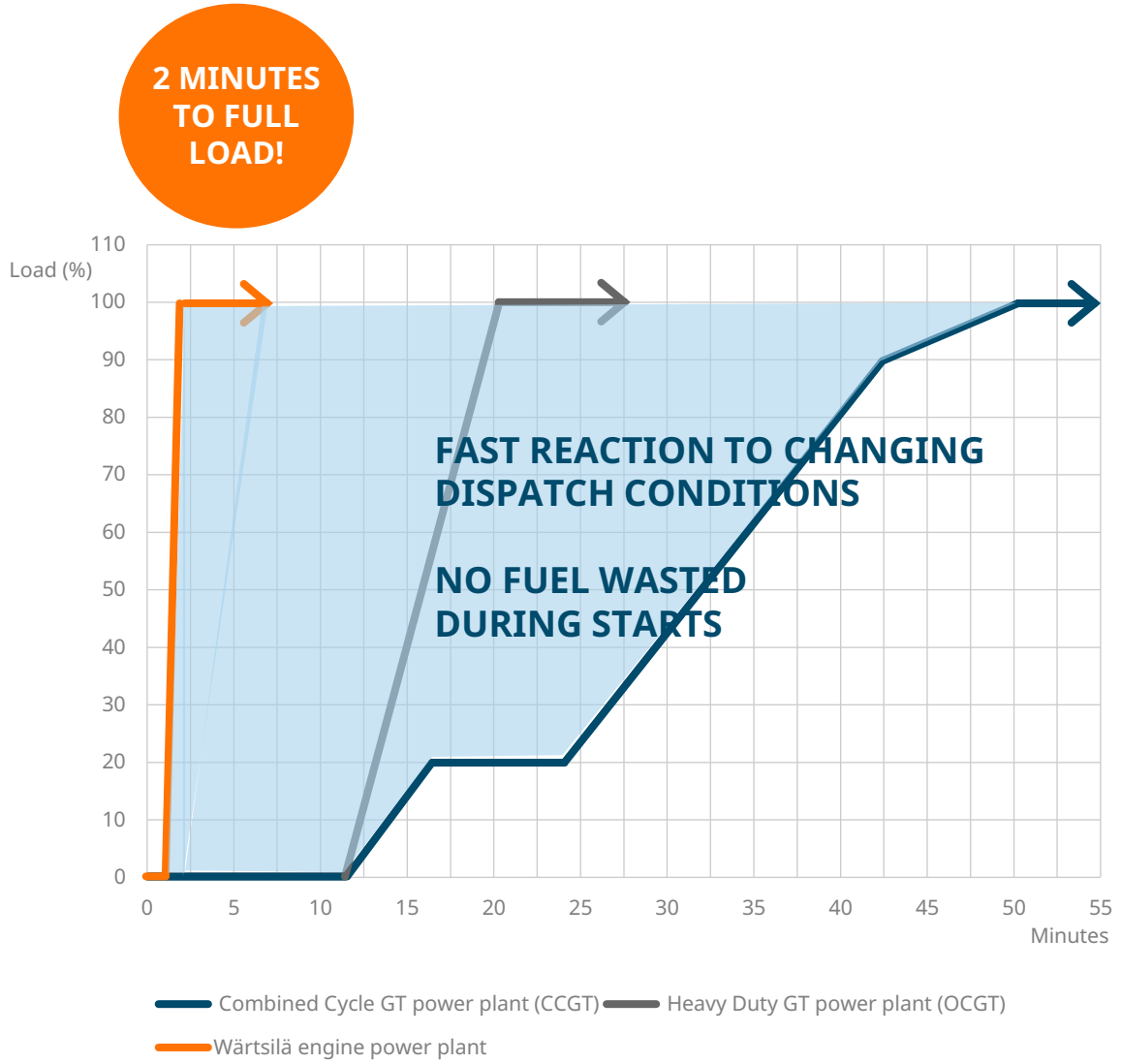
[1]LCOE: Levelised cost of Energy. Financial parameters used for LCOE: lifetime 20 years; WACC 11%; Fuel price 10 EUR/GJ; 7,000 running hours p.a.; gas turbine start costs not incl.
[2]All technical parameters for gas turbines optimised for temperature of 26°C. [3]p.a.: per annum.

WÄRTSILÄ QUICK START-UP HAS SEVERAL BENEFITS

Power plant flexibility is a vital to manage variability in electric loads and provide grid support services. One measure of this flexibility is ramp rate – the rate at which a power plant can increase or decrease output.

- Dispatch decisions can be postponed to get latest weather forecast data.
- Enable reacting to sudden changes in the demand.
- Quick response to forced outages of other power plants.
- Quick start-up can provide back-up for renewables in non-spinning mode.
- Low fuel usage during the start-up.

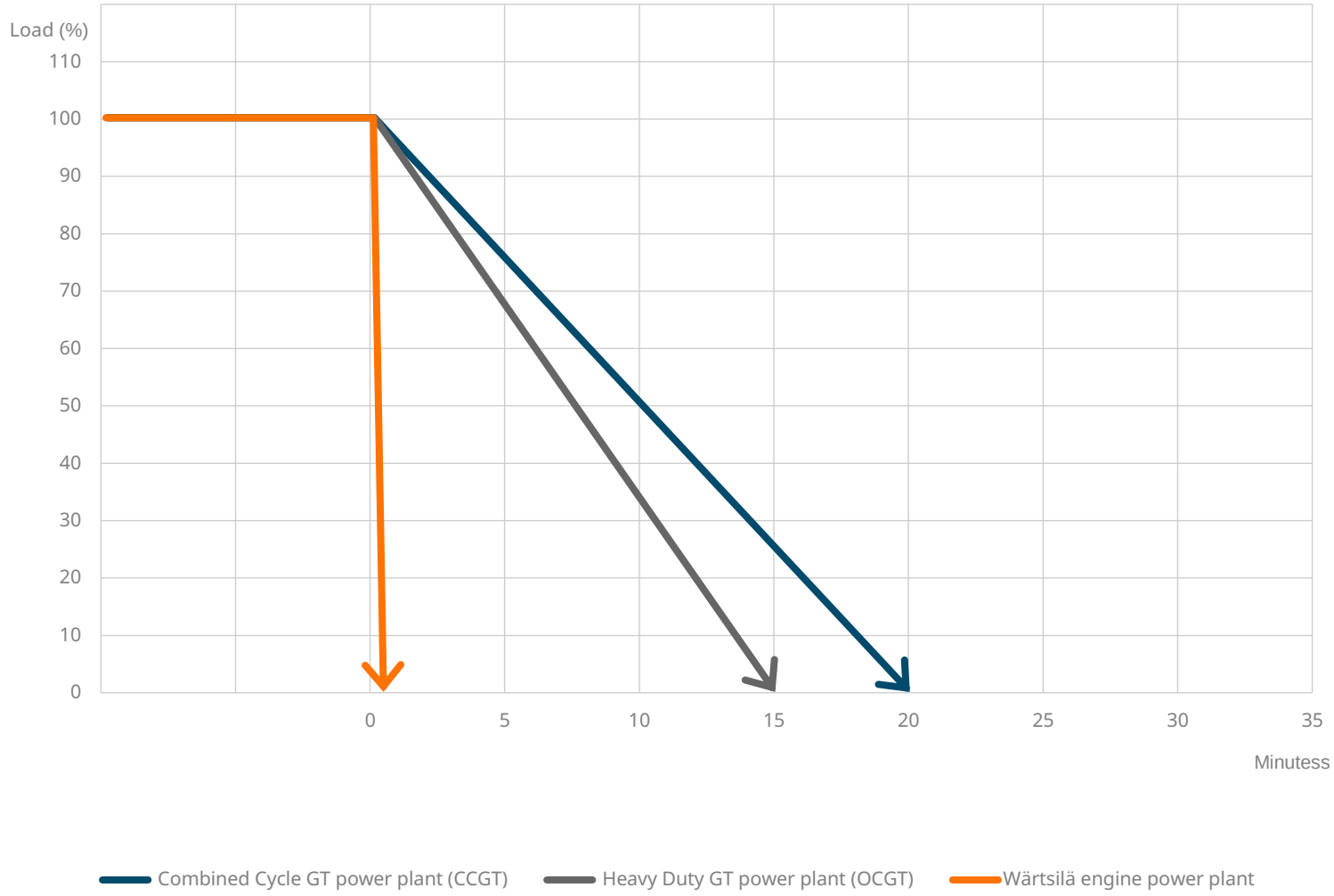
Wärtsilä engines can ramp up at over 100%/minute, much faster than gas turbines, providing ultra-responsive power that is needed to integrate renewable energy and maintain the stability of the grid.



SWITCHING OFF ENGINES TAKES VERY LITTLE TIME

- Engine power plants can be switched off immediately after the wind starts blowing or the sun starts shining
- Enables reacting to sudden changes in the demand
- Allows for several start-ups and stops per day
- No fuel is wasted when power is not needed

Wärtsilä engines can be switched off almost immediately, providing ultra-responsive power that is needed to integrate renewable energy and maintain the stability of the grid.



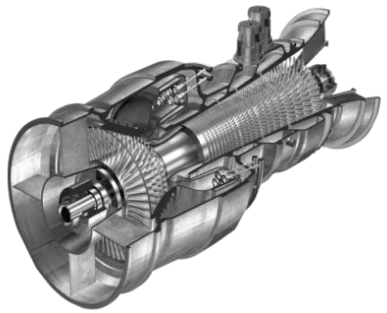
ENGINE POWER PLANT MAINTENANCE IS WELL SUITED FOR FLEXIBLE OPERATION

GAS TURBINES:

- GT maintenance needs are affected by several factors
- In steady base load operation on gas, maintenance schedule follows actual operating hours
- Factored hours & starts modify GT maintenance intervals → OPEX
- Equipment needs to be sent to OEM workshops for major overhauls – extra transportation and downtime

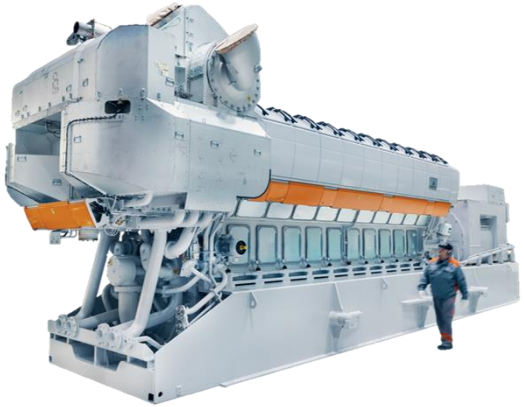
MAINTENANCE SCHEDULE IS AFFECTED BY:

- Starting & stopping
- Cyclic and peaking operation mode
- Liquid fuel operation
- Number of trips
- Cyclic operation with daily starts can result in significant maintenance cost increase



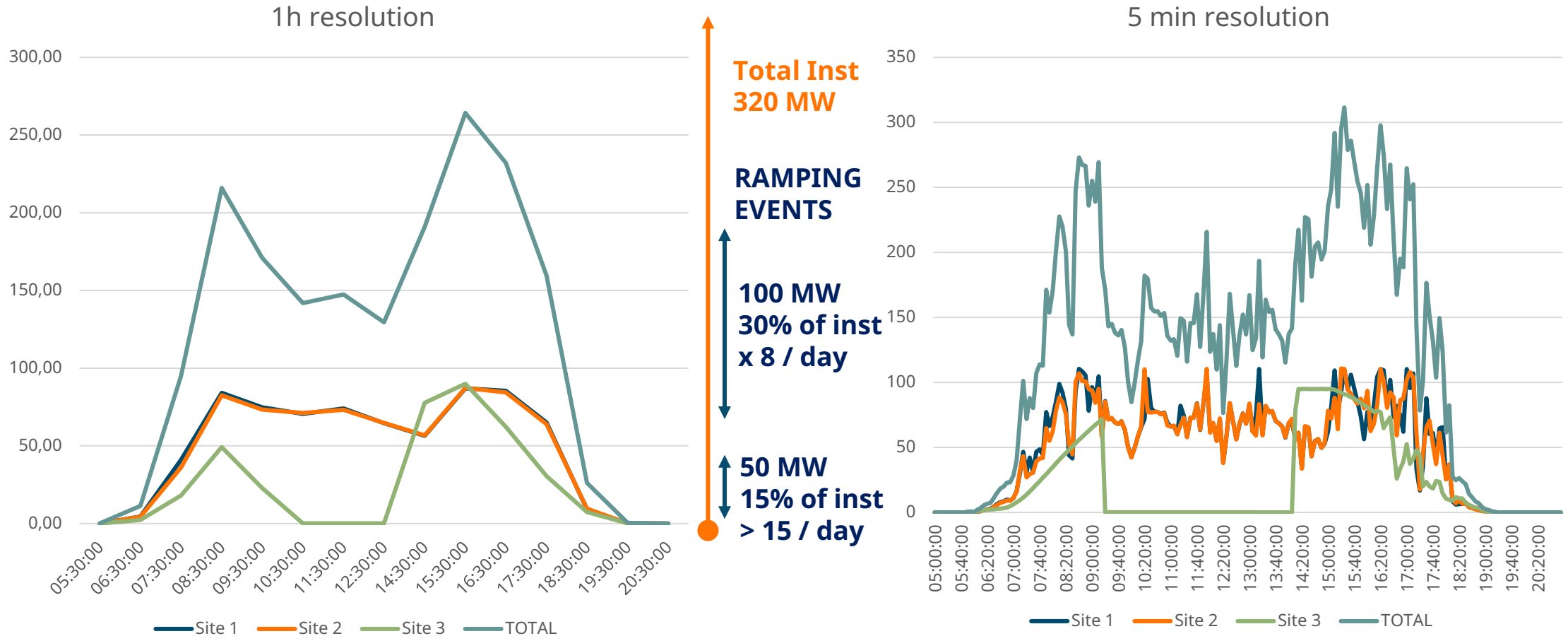
ENGINE POWER PLANTS:

- Cyclic operation and frequent starting have no impact on maintenance schedule and cost
- Multiple unit plant configuration enables sequenced maintenance of the units so that only 5-10% of the production capacity is lost
- All the maintenances can be done at site, no need to send the equipment back
- **No factored hours**
- **No factored starts**
- **No factored stops**
- **No factored trips**
- **No factored ramp-up**

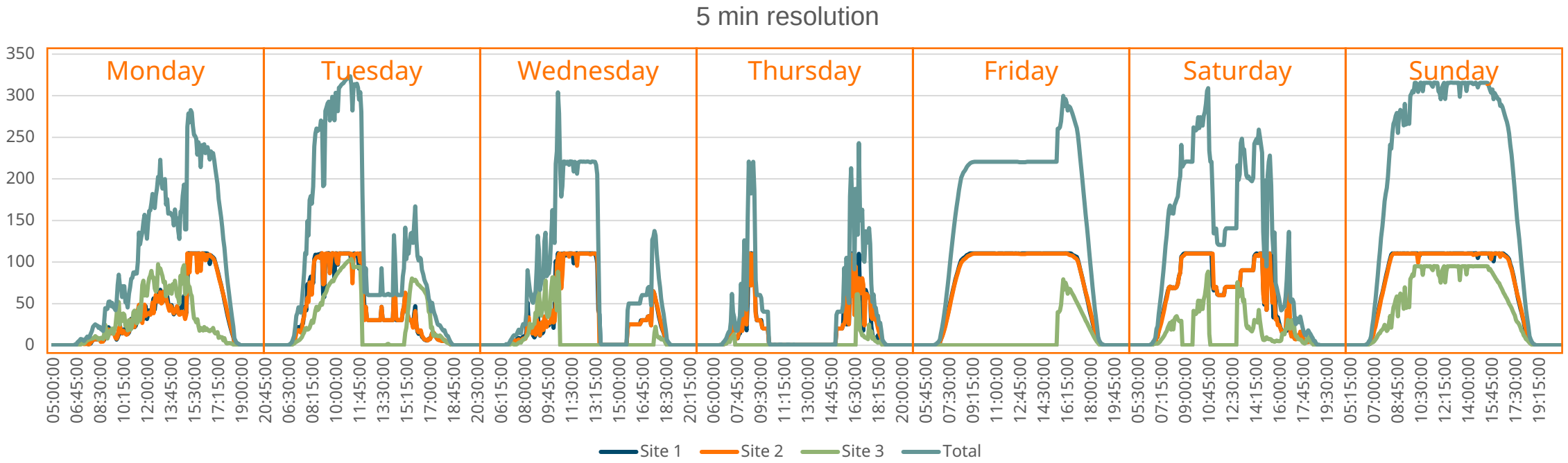


WHY FLEXIBILITY IS NEEDED

SOLAR PROFILES AND THE IMPORTANCE OF FLEXIBILITY



ILLUSTRATIVE WEEKLY SOLAR PROFILE



Analysis over a typical week :

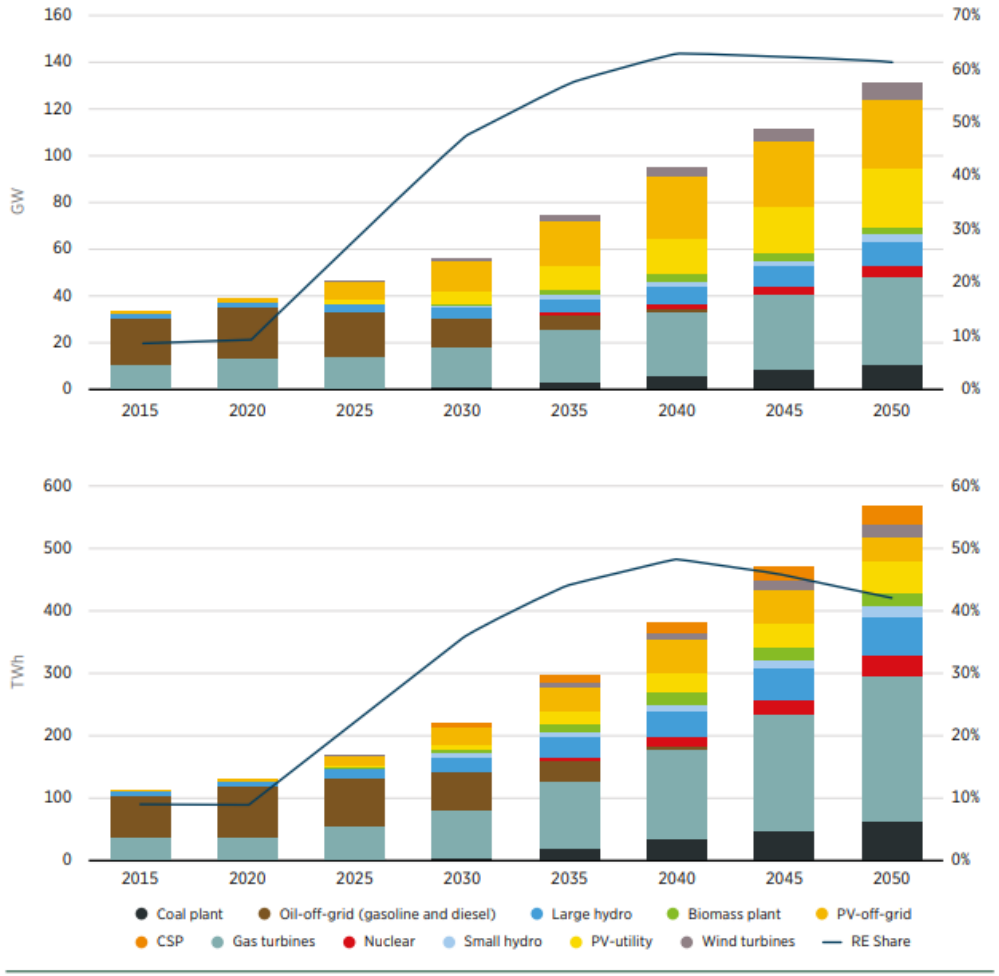
Ramping event of 15% of total installed capacity (50MW) => ~30 per week

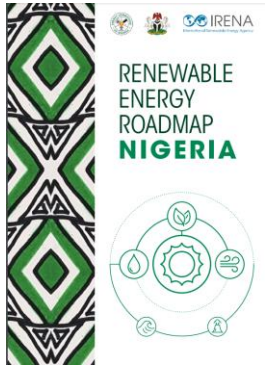
Ramping event of 30% of total installed capacity (100MW) => ~10 per week

520 - 1560 per year

NIGERIA EXPECTED FLEXIBILITY NEEDS

Figure 27 Centralised and decentralised power generation capacity and generation under current plans and policies





Within the next 10 years Nigeria expects to have renewable installed capacity of:

7 GW of Solar PV

18 GW of Off-Grid Solar PV

Based on previous slides Nigeria's need for **Ultra Flexible capacity should be:**

2-4 GW with 750-1500 starts per year

(10-20% of Renewable Capacity)

Source: *Renewable Energy Road Map Nigeria 2023 – IRENA/Energy Commission of Nigeria*

Any questions?

Thomas BOURLIÈRE
Senior Manager
Market and Project Development
Africa & Europe
Wärtsilä Energy

Thomas.bourliere@wartsila.com

Panel: “Gas: who has it and who wants it?”

- **Mr Olufisayo Olukayode Duduyemi**
  - Managing Director
  - Axxela Power
- **Mr Alonge Longe**
  - General Manager
  - Power Business New Energy, Seplat Energy
- **Mr Yashwant Kumar**
  - Managing Director
  - Paras Energy

Moderated by Wale Yusuff, Managing Director, Wärtsilä Marine & Power Services Nig. Ltd



Wärtsilä's Sustainable Fuel Roadmap & Portfolio Update

Rasmus Teir
Director, Engine Power Plants Technology
Wärtsilä Energy

Our purpose

Enabling sustainable societies through innovation in technology and services

We are shaping the green transition in marine and energy with our advanced technologies, expertise in sustainable fuels and lifecycle service offering.

Decarbonising the energy industry with renewables and balancing power

1

Adding more renewables into the power mix.

Decrease running hours of inflexible power plants.

2

Adding flexible engine power plants & storage to balance the intermittency of renewables.

Continue adding renewables supported by flexibility.

3

Phasing out inflexible power plants running on coal.

Utilise Power-to-X and flexible balancing engine power plants to provide carbon-neutral long-term storage.

4

Accessing sustainable fuels and converting all remaining power plants to run on them.

5

A 100% renewable energy future is here

It is based on renewables, energy storage, and balancing engine power plants running on sustainable fuels.

Innovation and R&D investments as change drivers

260 MEUR R&D investment

representing 4.3% of our net sales.

2,900 patents & applications

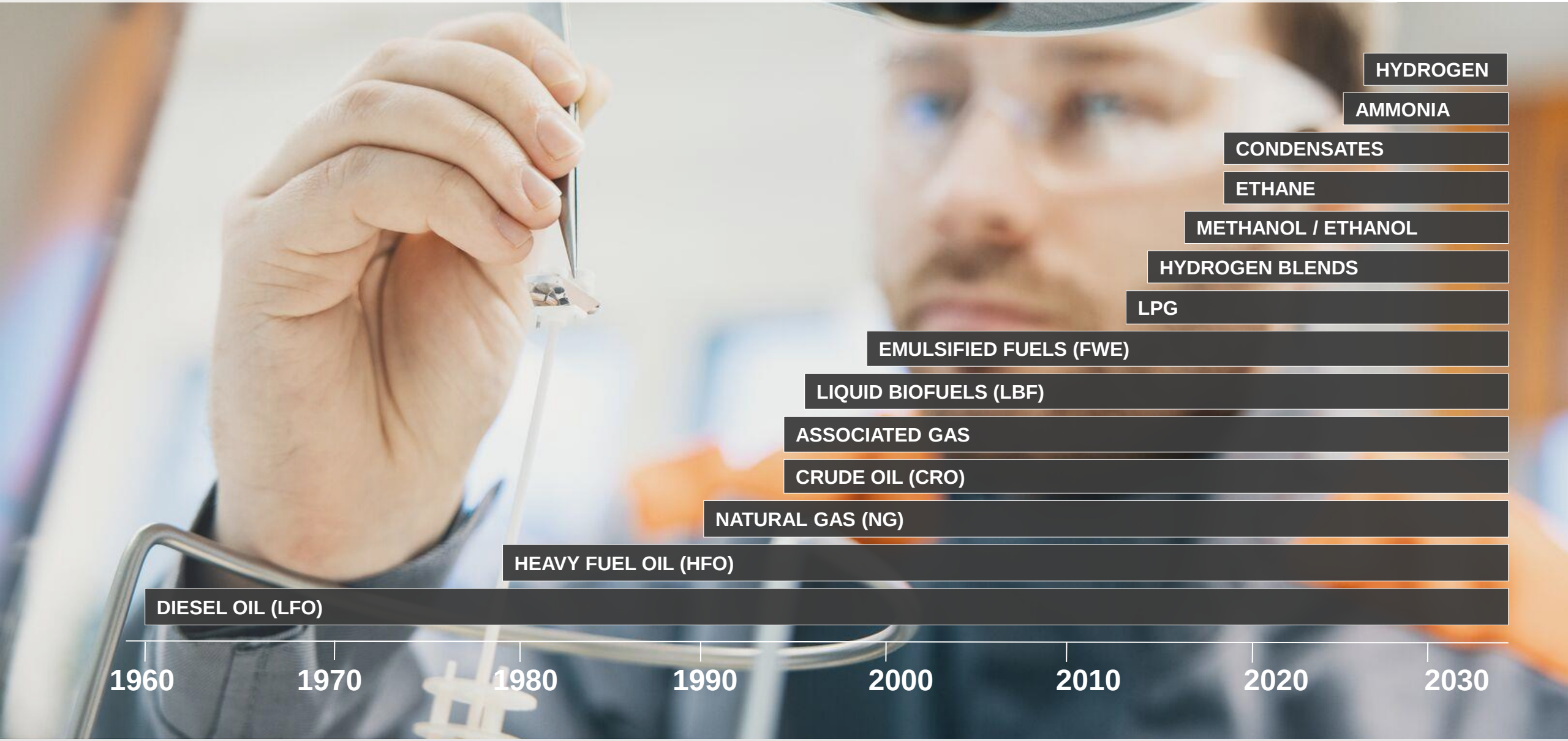
of which 43% are classified as technologies that reduce or eliminate GHG emissions (since 2013).

> 1,000 ideas & inventions

from our colleagues through the internal innovation program.

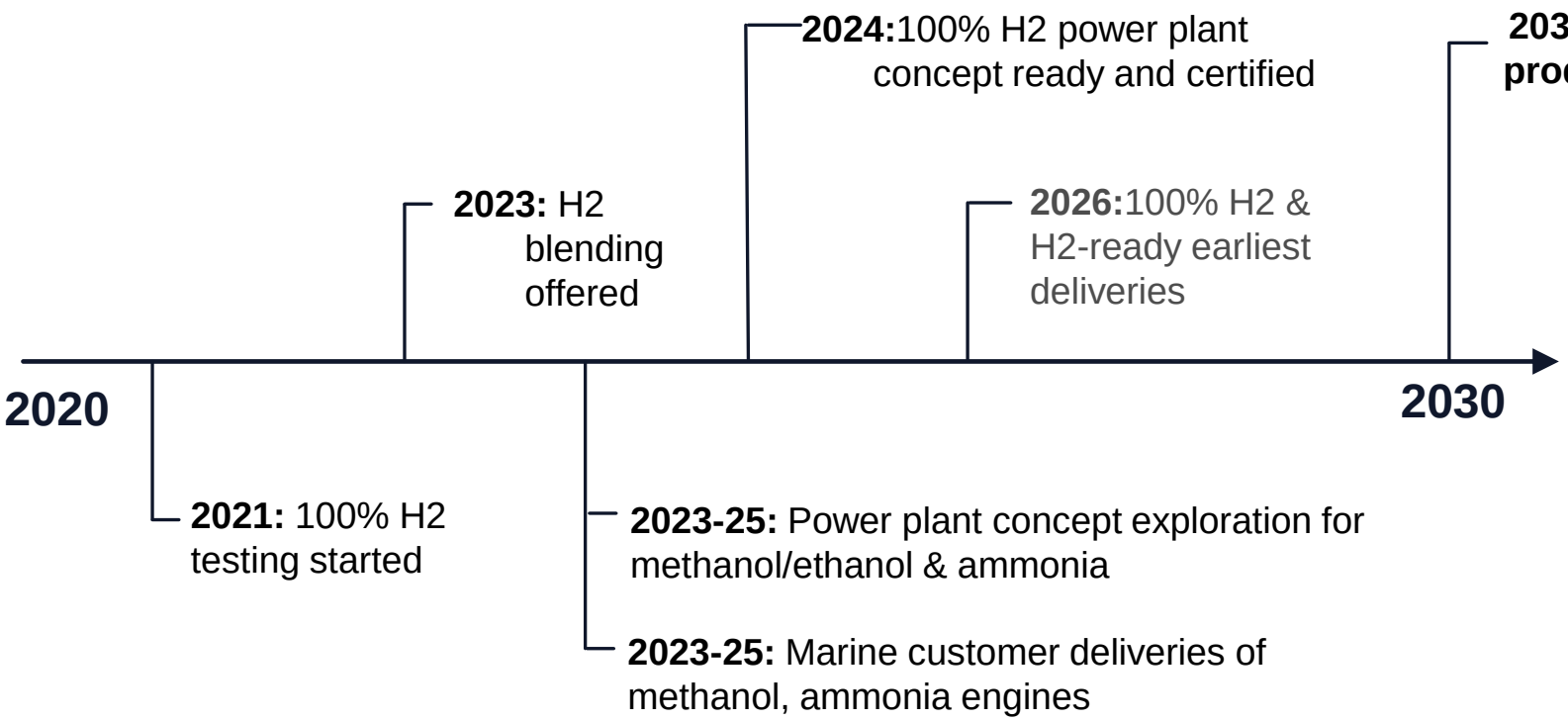
Figures from 2023

Wärtsilä has a long history of introducing new fuels



Wärtsiläs *Set for 30* sustainability targets

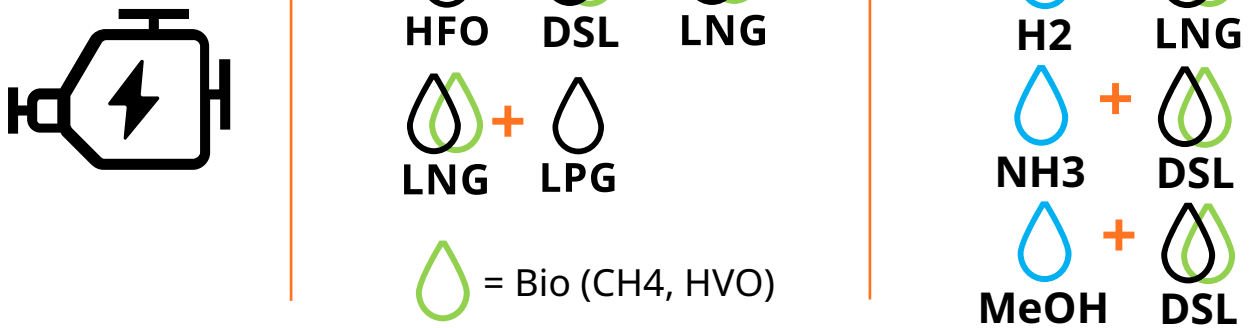
- We will become carbon neutral in our own operations by 2030.
- We will provide a product portfolio that will be ready for zero- carbon fuels by 2030.



Engine Power Plants – Ultimate Fuel Flexibility

- Reciprocating internal combustion engines can **combine a variety of fuels**.
- **Multi-fuel engines can instantaneously switch fuels** while maintaining full output and high efficiency.

FUEL COMBOS



The Wärtsilä 31 H2-ready Power Plant Launched (2024)

Developed by Wärtsilä and certified by 3rd party for 100% hydrogen

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD

H_2-READINESS CONCEPT CERTIFICATE

The Certification Body of
TÜV SÜD Industrie Service GmbH
Energy and Systems

certifies, that the hydrogen readiness concept for the bidding phase of newly built and retrofitted power plants using the 31SG engine of the company

WÄRTSILÄ

WÄRTSILÄ Oyj Abp
Hiililaiturinkuja 2
00180 Helsinki, Finland

complies with the requirements
as defined in the TÜV SÜD guideline:

Certification Guideline H_2-Readiness of Gas Engine Power Plants,

Edition 2023 Rev.1.

The hydrogen readiness concept meets the requirements for the certification of hydrogen readiness for 100 vol.-% hydrogen.

This Certificate is based on the Audit Report 500604631 Rev.2 dated 07.06.2024.

This Certificate is valid till 10.06.2027.

Certificate – Register-No.: KC/500604631/32/24

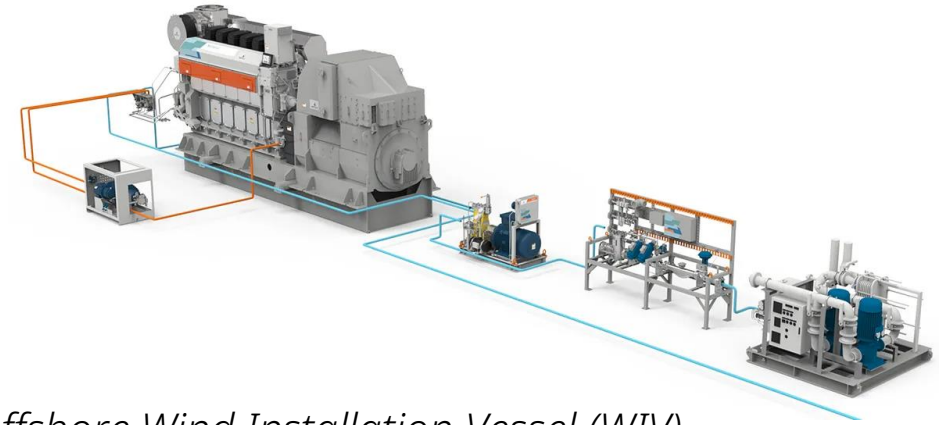
Munich, 11.06.2024

Dr. Thomas Gallinger
Technical Certifier
Certification Body Energy and Systems

Katrin Hausmann
Certification Body
Energy and Systems

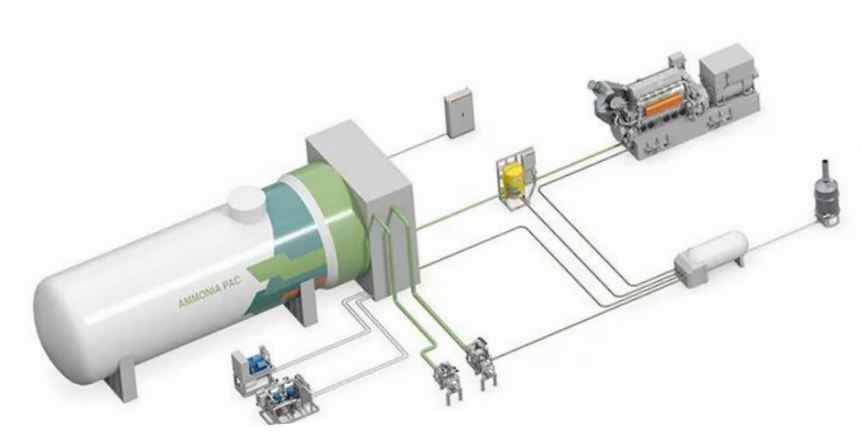
Wärtsilä Marine Delivering Methanol and Ammonia Solutions

Wärtsilä 32 Methanol for Van Oord (2022)
- Including methanol fuel supply system



Offshore Wind Installation Vessel (WIV)

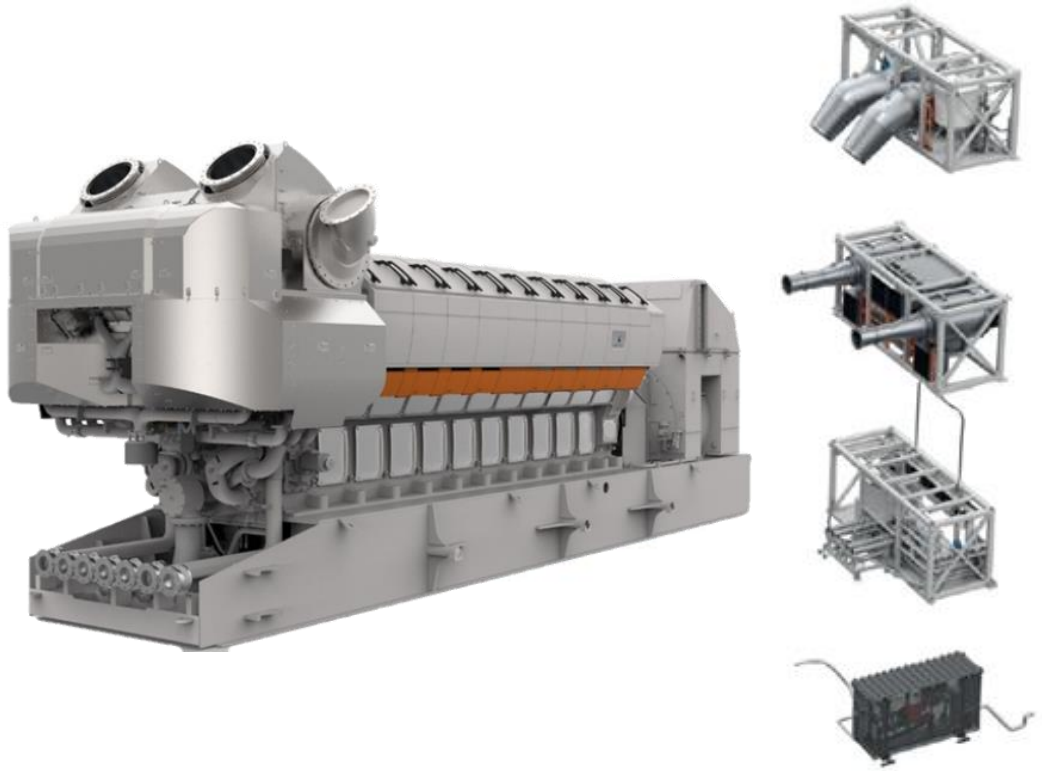
Wärtsilä 25 Ammonia for Eidesvik (2024)
- Including ammonia fuel supply system



Offshore Platform Supply Vessel (OSV)

The Wärtsilä 31 – Class Leading Performance

- Output: up to **12.7 MW**
- Efficiency: up to **52.2%***
- Loading rate: **100% in 2.5 minutes**
- **Unlimited starts & stops**
- **Multiple fuel options including 25% H2, 100% H2**
- **Various performance configurations for best fit**
- **Portfolio of pre-engineered aux modules**
- **Over 250 engines sold, 1+ million running hours**



Engine Family	W31SG Natural Gas				W31DF	W31H2
Design Stage	A Base-rated “All-rounder”	A2 Efficiency-optimised	B Power-optimised	SG-H2 Hydrogen-ready	A4 Multi-fuel	H2 100% hydrogen

**ISO3046 (5% tol)*

The New Wärtsilä 46TS Sets the Benchmark for Large Plants

Nominal Output

20.4

MW 16V

22.9

MW 18V

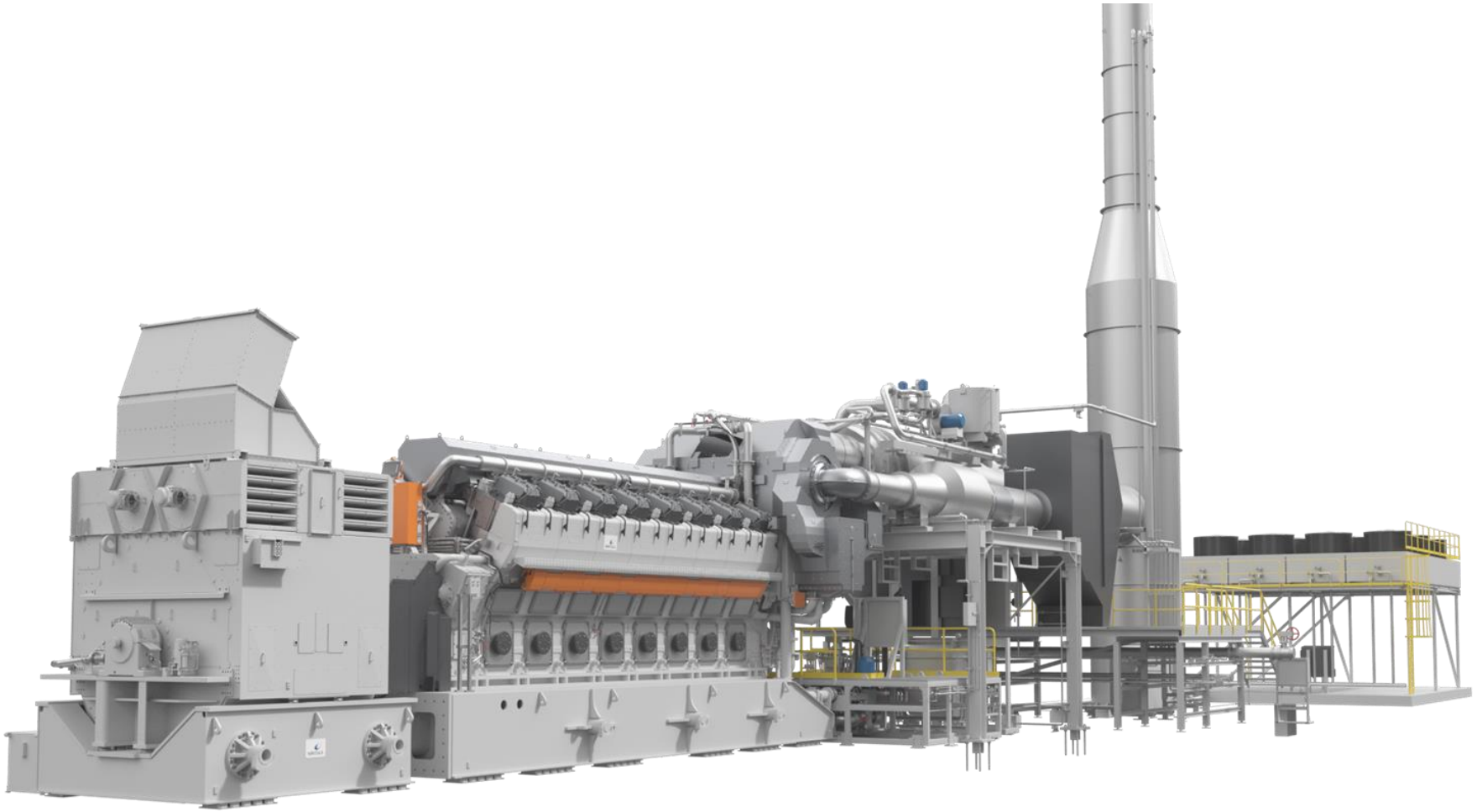
Electrical efficiency

50.7%*

Dual fuel

51.3%*

Spark gas



*ISO3046 (5% tol)

Rasmus Teir
Director, Engine Power Plants Technology
Wärtsilä Energy
rasmus.teir@wartsila.com

Panel: “Financing gas-to-power projects in Nigeria"

- **Mr Ibrahim Ahmed Rufai**
  - Group Head, Chemicals & Industrial Minerals
  - Bank of Industry
- **Mr Daniel Mueller**
  - Chief Operating Officer
  - InfraCredit

Moderated by Thomas Bourlière, Senior Manager, Market and Project Development, Africa & Europe, Wärtsilä Energy



Conclusions of the Day

Kenneth Engblom
Vice President
Africa & Europe
Wärtsilä Energy