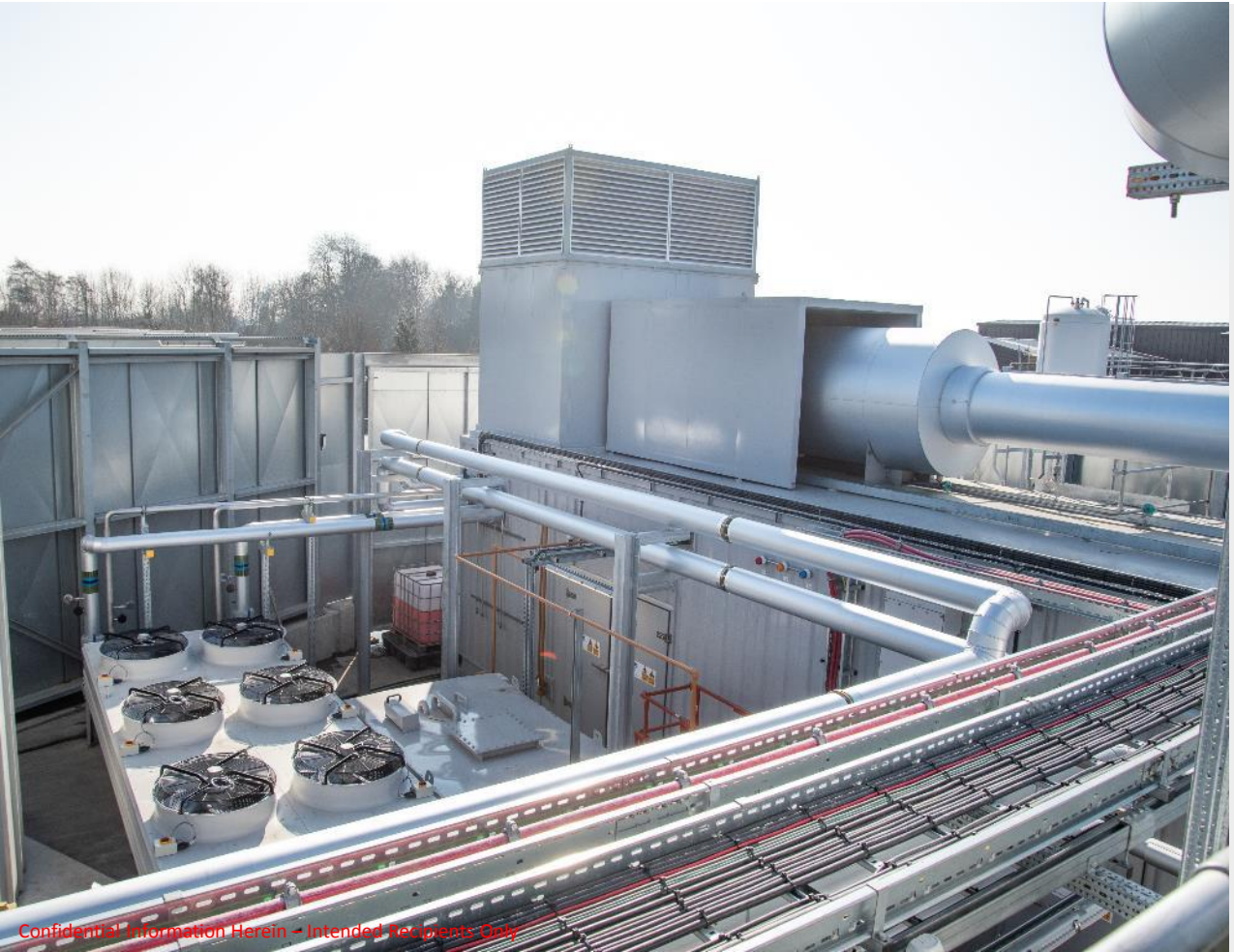
The Changing Energy Mix:
Decarbonise your Energy & Save Money Now



Adam Wray-Summerson

Project & Market Development

Clarke Energy

George Fowkes

Director

BasePower Limited

Michael Smeeth

Global Resiliency Leader

INNIO

Agenda

- Setting the Scene: Energy, COVID & Net Zero Carbon
- The Energy Manager's Role?
- The CHP Energy Centre
- Decarbonisation & The Future for Gas Engines
- Q&A Session

Do you believe that Combined Heat & Power, can form part of your decarbonisation strategy?

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Are energy costs as important to your business as sustainability metrics?

Extremely Important

More Important

About the Same

Less Important

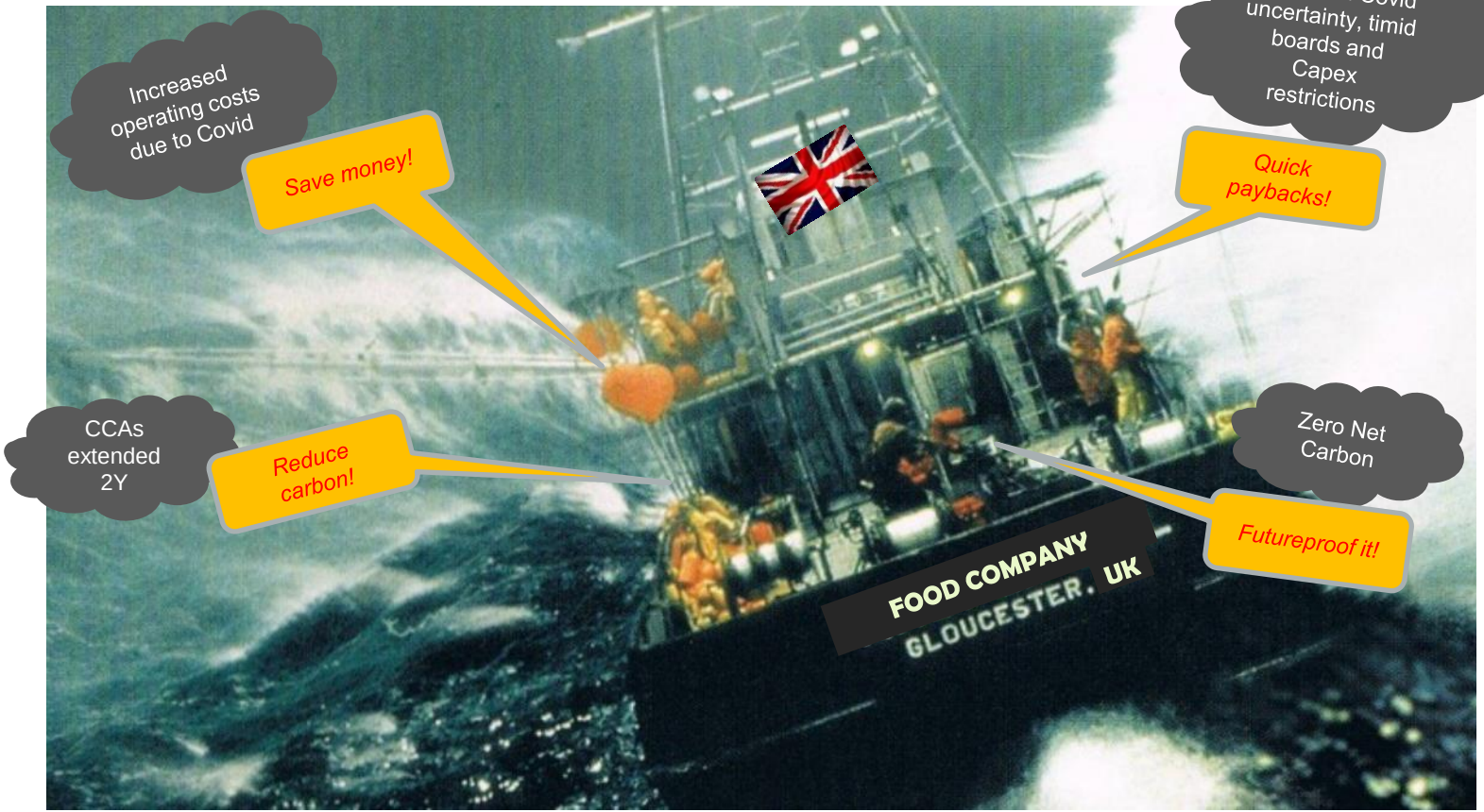
Not Important

The Changing Energy Mix

Food & Drink Federation Webinar
George Fowkes
4th November 2020

Setting the scene

Restricted visibility in 2020



What’s the Energy Manager to do?

1. Form a team

Finance

- Can navigate the money rules
- Has access to commercial resource
- Don’t need much technical knowledge

Technical

- Already know many opportunities
- Can manage tech and suppliers
- Insufficient time to write good business cases

2. Build momentum through knowledge

Submeter

- Low cost, high gain of expertise
- Heat *and* power
- Campaigns or permanent
- Quick payback from turning stuff off

Early Projects

- Low tech risk
- Known paybacks
- Can be financed
- Gain trust in the process
- LEDs, VSDs, PV

The Combined Heat & Power Energy Centre

Adam Wray-Summerson

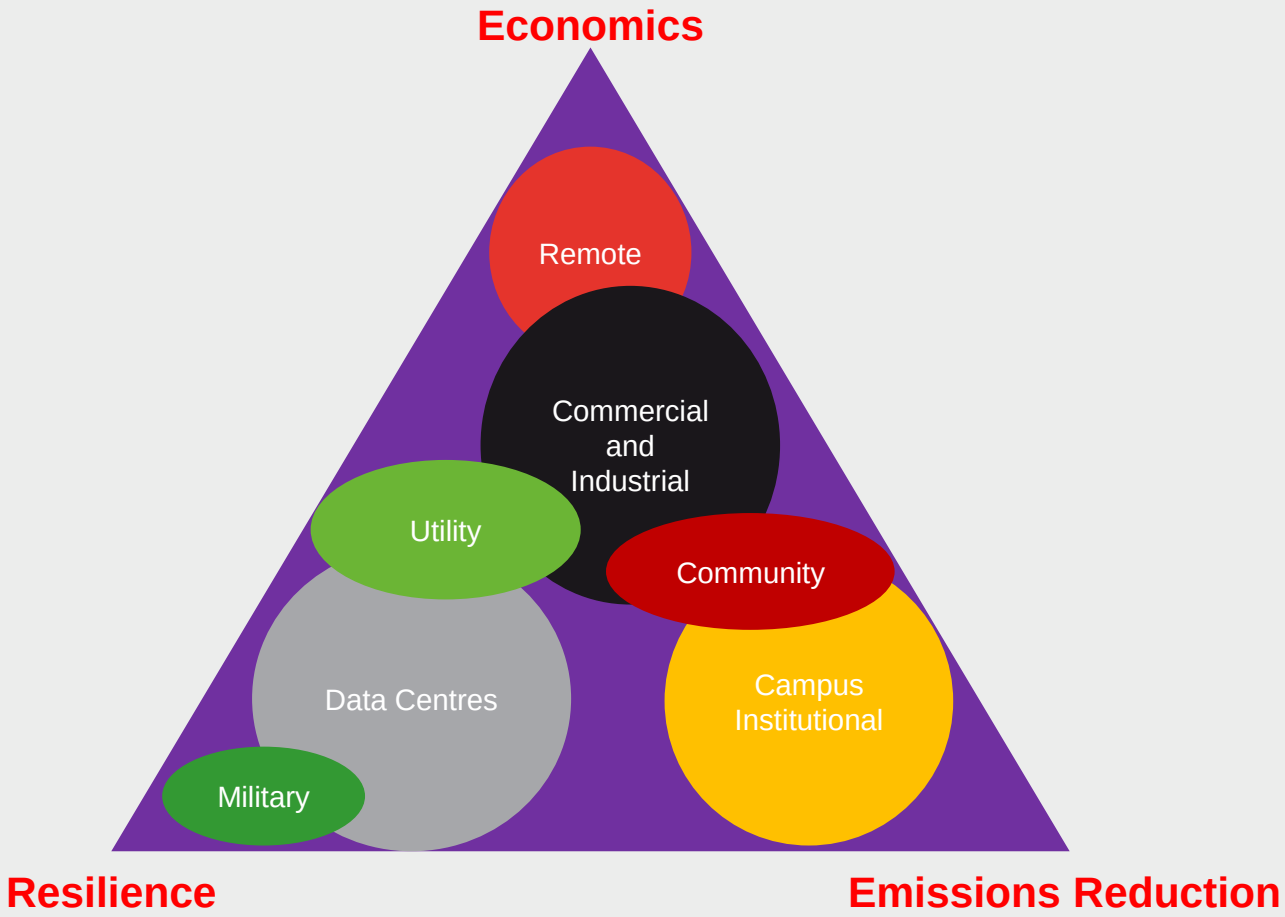
CEng MIMechE MCIBSE MEng(Hons)

Project & Market Development Manager

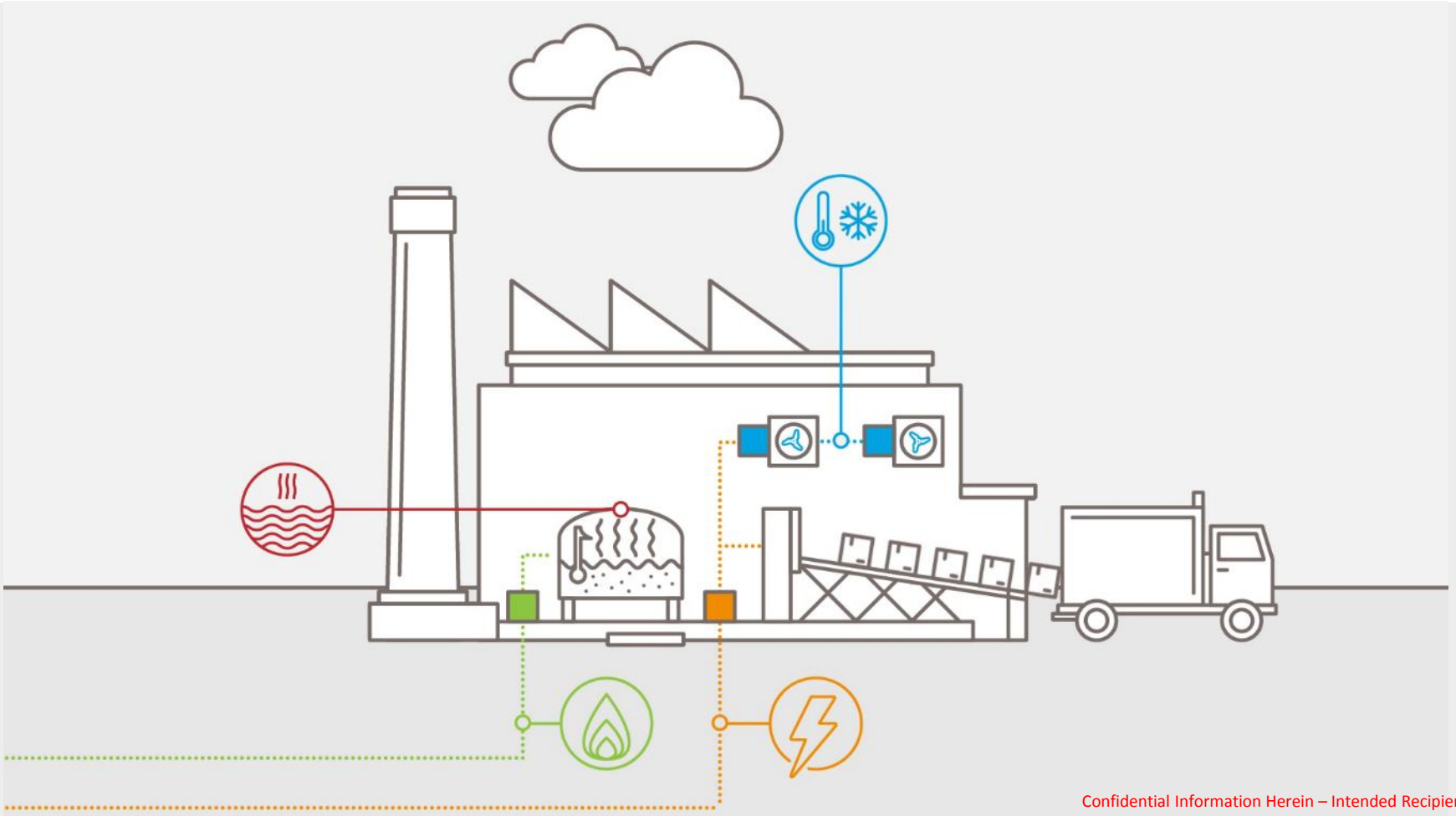
Agenda

- Drivers for CHP
- The Energy Dilemma
- Designing the Solution
- Beyond the Energy Centre
- Example Schemes

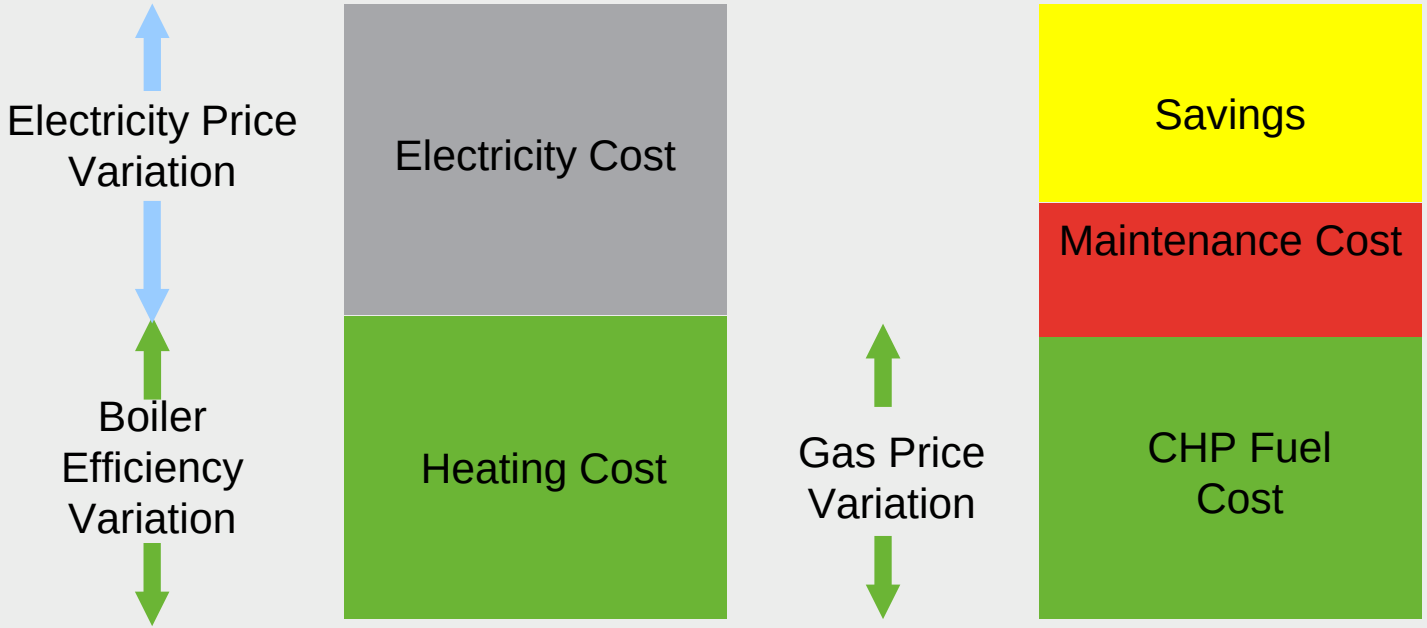
Traditional Drivers for CHP



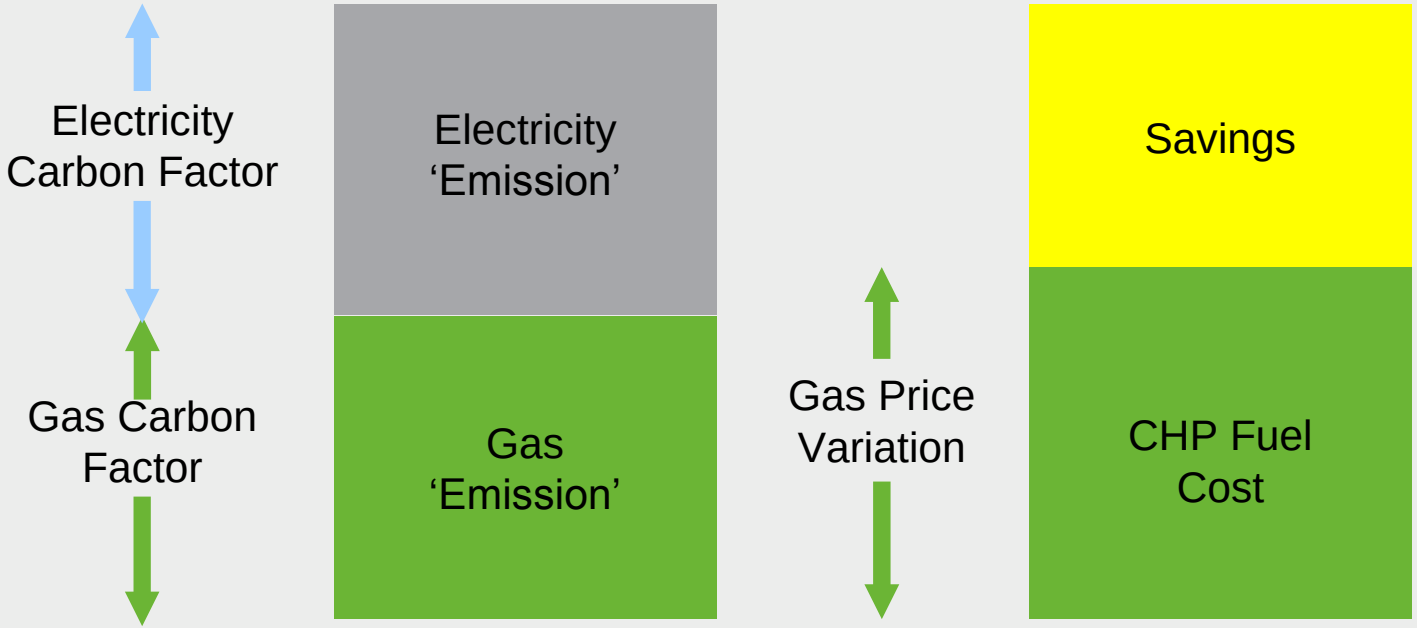
The Energy Dilemma



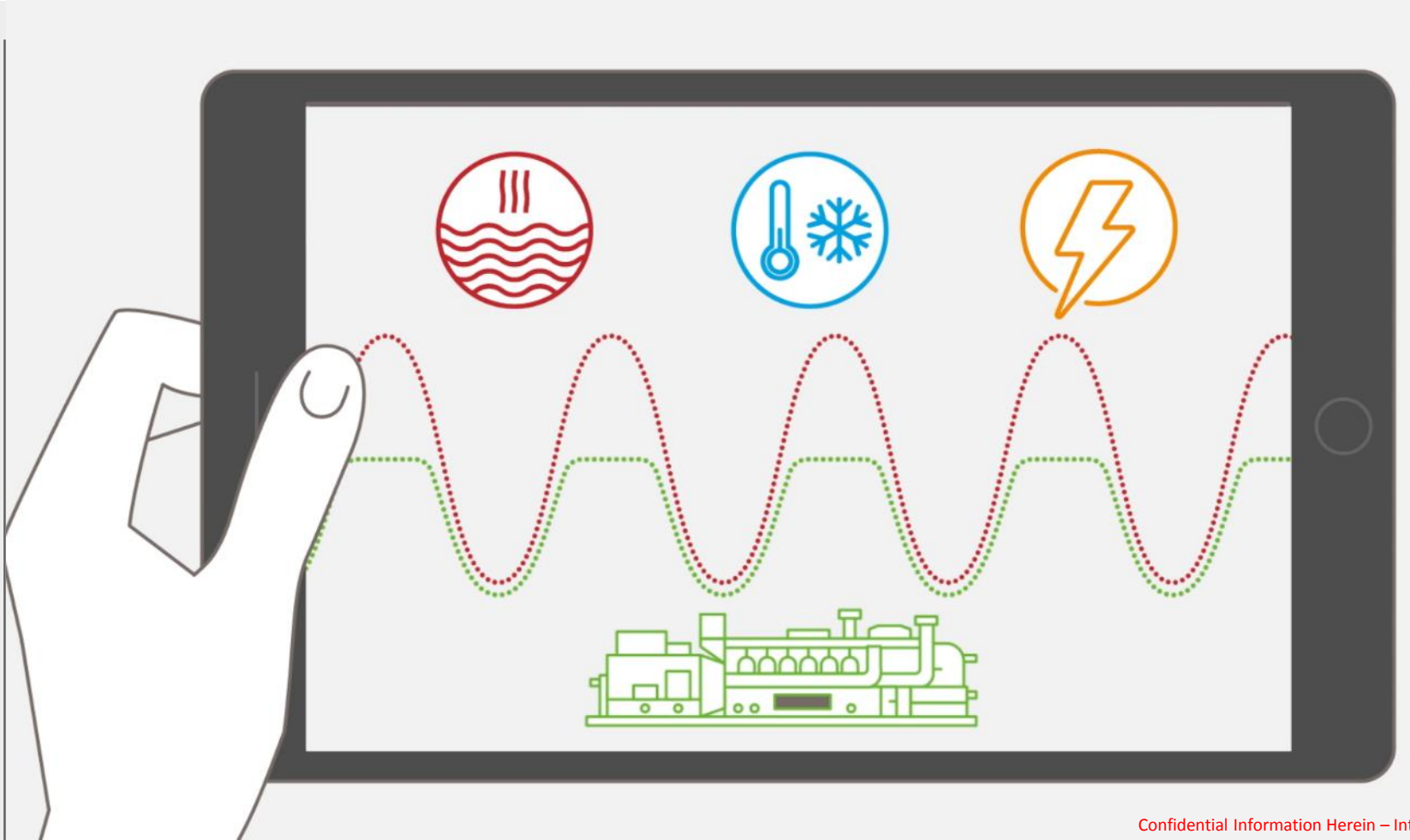
Spark Gap / Spark Spread

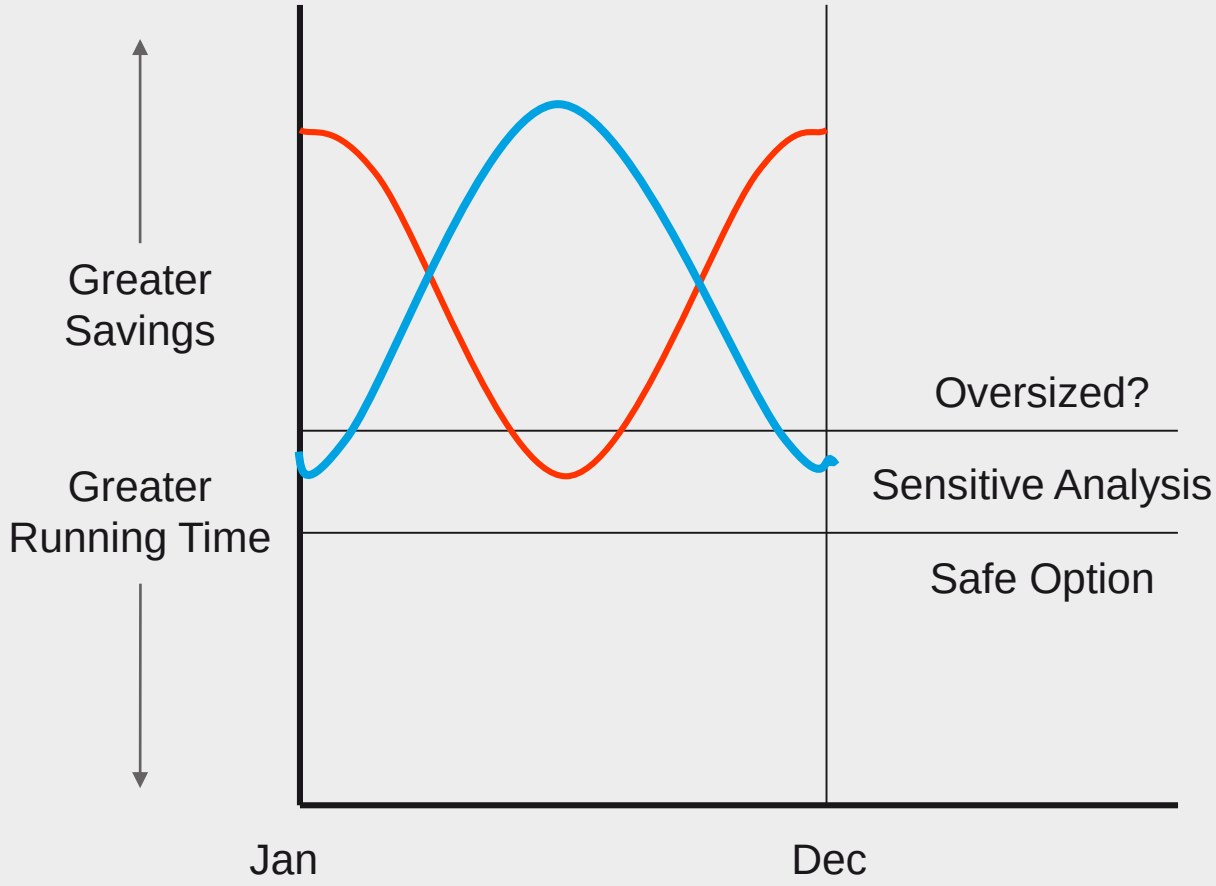


Carbon Savings

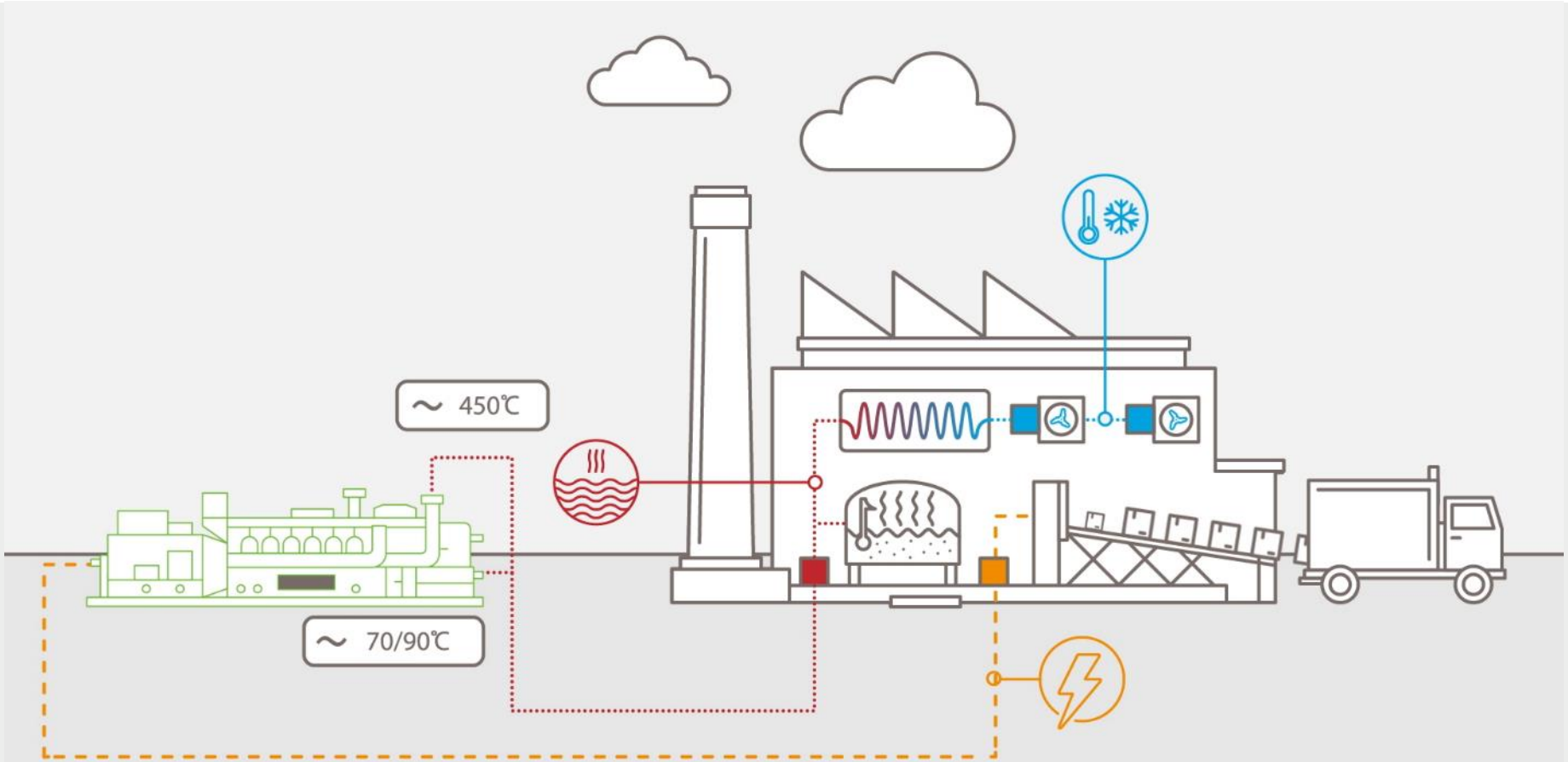


Detailed Feasibility Analysis





CHP – The Core of the Energy Centre



Maximising Equipment Availability

- In-country commissioning support
- Maintenance agreements supported by field-service engineers
- Site-based operation and maintenance
- Manufacturer certified trainers
- Remote monitoring and diagnostics capability
- In-country manufacturer approved spare parts inventory
  - £10m in the UK
  - £30m across the group

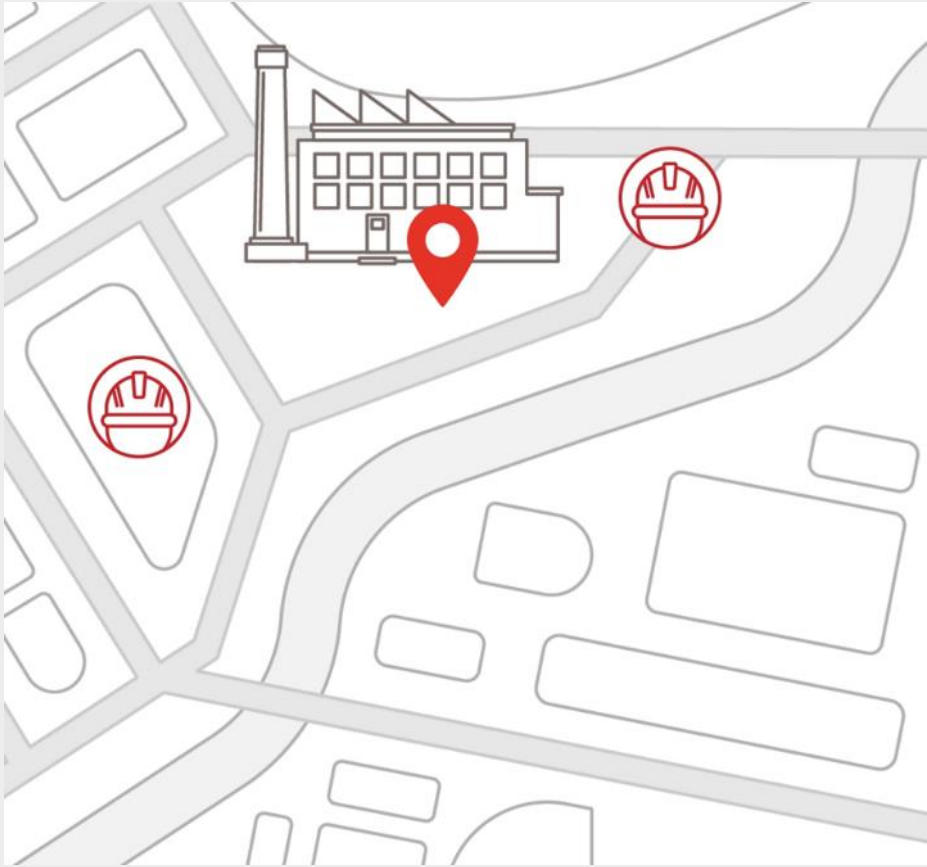
Local, Equipped, Field-Service Engineers

100

Field-service engineers split into 12 geographical regions

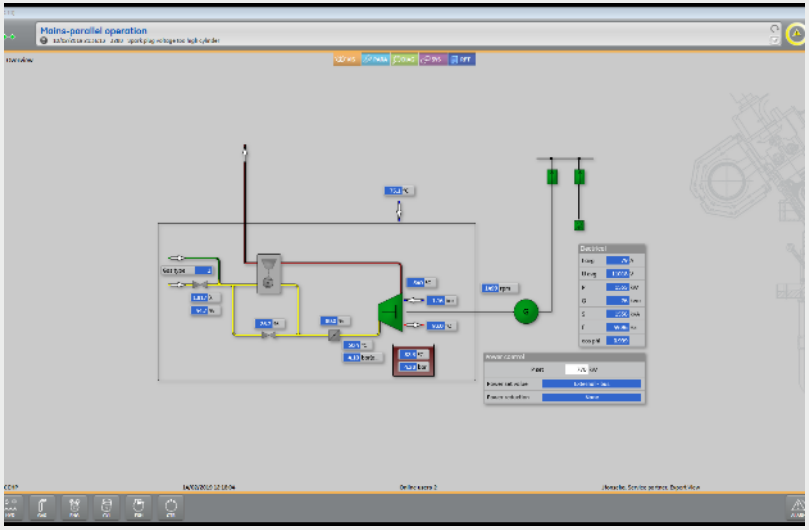
Further support from:

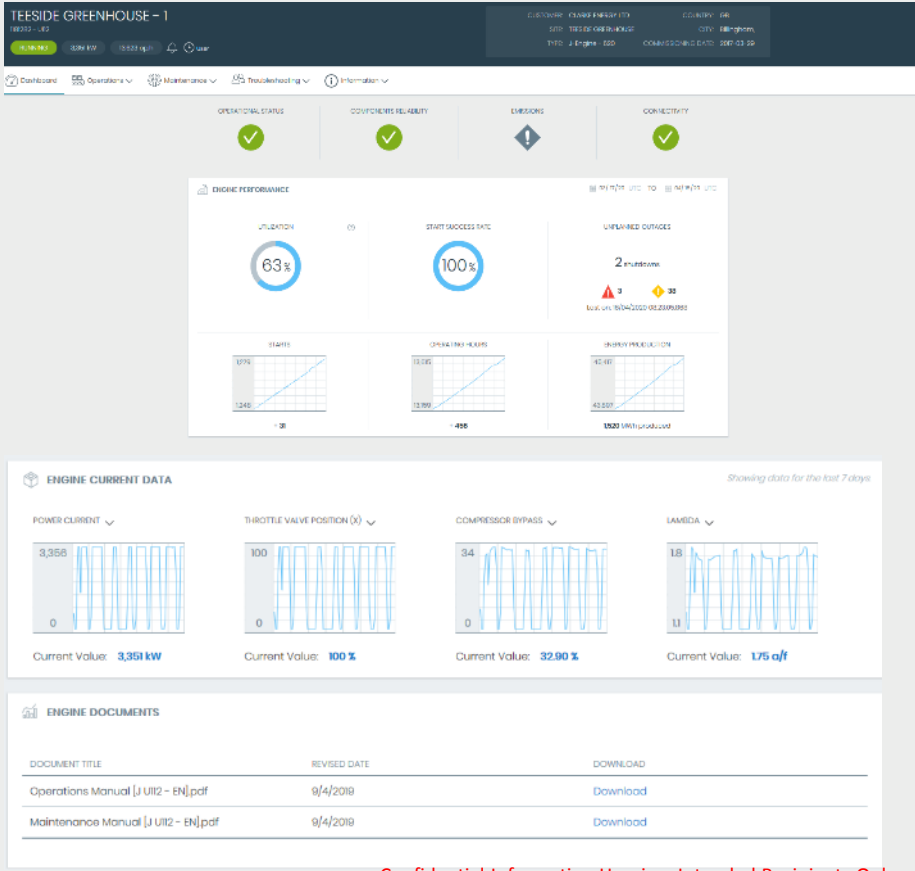
- Workshop & Overhaul Teams
- Warehouse & Parts Team
- Cylinder Head Refurbishment
- Apprentices
- Commissioning & Support



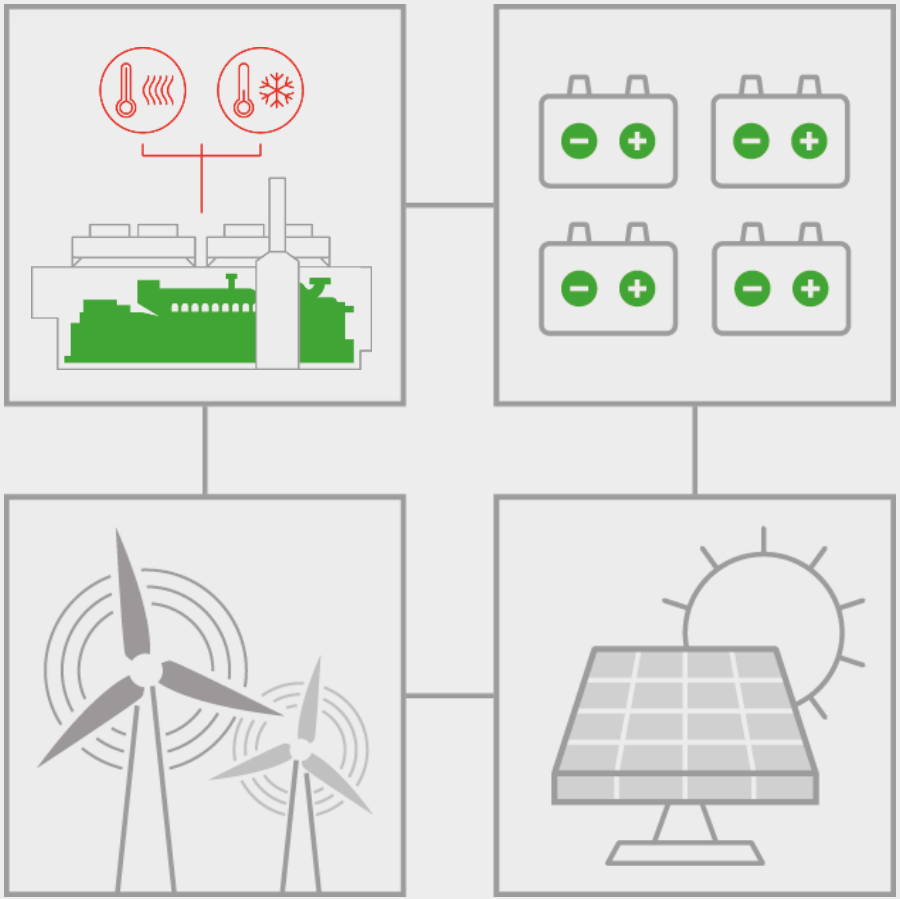
Online Monitoring

- myPlant provides online asset visibility
- Data / parameter trending
- Service reporting
- Remote access to engine control system
- Data enables us to predict potential issues using analytical software – making our service teams more efficient in prioritising work loads





Beyond the Energy Centre



Groupe Lactalis

Natural gas fuelled, second largest dairy company worldwide

Combined heat and power (Electricity, hot water and steam)

Stranraer, Scotland

$2MW_e$

1 x Containerised JMS612

Cranswick PLC

Natural gas fuelled power generation

Combined heat and power
(Electricity, hot water and steam)

Preston, England

$2MW_e$

1 x Containerised JMS612

Cook-Chill Food Manufacturer

Natural gas fuelled power plant

Combined cooling, heating and power (Electricity, chilled water, hot water and steam)

$2.7MW_e$

1 x Containerised JMS616

Girvan Distillery

Biogas Combined Heat & Power

Girvan Scotland

4 x J420 and 1 x J620 with hot water and steam

$8.7MW_e$

Powering Resilient Manufacturing

Michael Smeeth

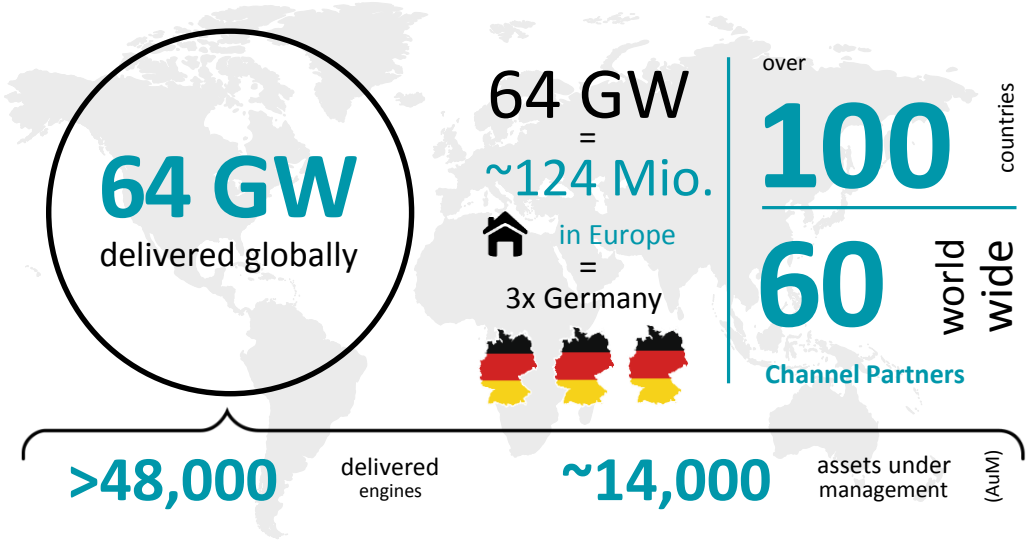
Global Resiliency Leader

Agenda

- Innio
- Gas Engine Innovation
- Natural Gas Fuelled CHP
- The Future?

INNIO at a glance

INNIO's technology gives businesses and communities around the world the ability to generate reliable and efficient power at or near the point of use.



Reciprocating engines

0.2 MW to **10 MW**

High efficiency & fuel flexibility

- Natural gas
- Oilfield power
- CHP
- Special gas applications

Jenbacher & Waukesha

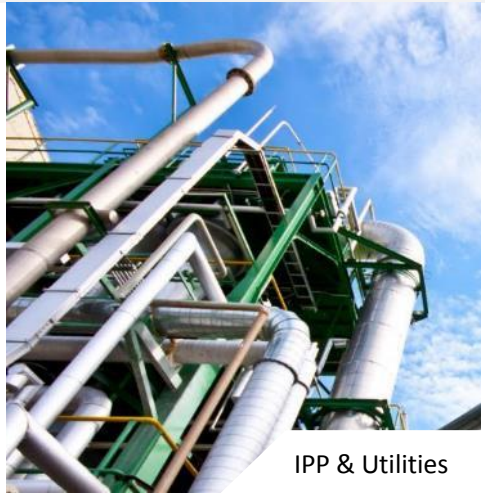
focused on power generation, gas compression and services

Advantages

Overall efficiency of 90% or more | Durability | 90+ years experience | Fast start capability | Fuel flexibility | Life cycle services

INNIO provides customers of all types the ability to generate reliable, sustainable power **whenever and wherever** it is needed.


Greenhouse


IPP & Utilities


Oil & Gas


Grid firming


Steel


Agriculture & Food Processing


Renewable Energy


Waste-to-Power


Commercial & Industrial Buildings

INNIO Jenbacher supporting the “Energiewende”

International Trends … „3 D‘s“

Decarbonization

- High electrical efficiency
- >90% fuel utilization with CHP
- Pioneer with renewable fuels (biogas, etc.)
- Hydrogen as future carbon free fuel
  up to 60%(v) today
  100% until 2021

Decentralization

- Power generation at the point of use
- Alternative to grid
- Balancing volatility of RES
- Flexible operation
- Hybrid with Solar PV
- Microgrids

Digitalization & Big Data

- **myPlant*** … engine monitoring
- Data analytics
- Condition based maintenance
- Outage management
- Fleet management
- Reliability, availability, performance

Jenbacher products as an integral asset and pioneer for the Energiewende

Innovative gas engine technology

1st Jenbacher* gas engine

1st Waukesha* gas engine

1st Jenbacher* cogeneration module

Production of the 1st Waukesha* VHP* series of engines for the gas compression segment

1st Jenbacher* LEANOX* gas engine

Introduction of the J620, the world's smallest 20-cylinder gas engine in the 3 MW power range

Introduction of venerable VGF* gas engines for high-speed screw compressors

Release of Waukesha* Engine System Manager (ESM*) control system for rugged field applications

World's 1st 24-cylinder 4 MW engine, the J624

Introduction of the 275GL* engine, offering high horsepower for compressor stations

World's 1st 2-stage Jenbacher* gas engine

Introduction of J920 FleXtra gas engine entering the large gas engine space and demonstrating highest electrical efficiency in its class

Launch of 616 stationary diesel engine

50.1% el. efficiency milestone on INNIO's type 9 engine platform in a test environment

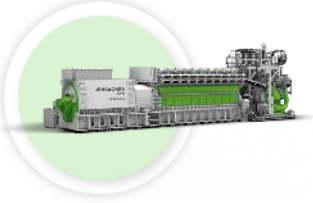
Launch of Waukesha* VHP Series Five

1930s | 1957 | 1967 | 1979 | 1985 | 1997 | 2001 | 2007 | 2010 | 2013 | 2014 | 2015 | 2019

* Indicates a trademark

Jenbacher product portfolio (natural gas)

Jenbacher J920 FleXtra

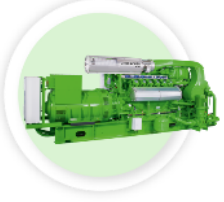


- V20 cylinder; 1,000/900 rpm (50/60 Hz)
- **Electrical output:** 10.4 MWe (50 Hz), 9.3 MWe (60 Hz)
- **Electrical/total efficiency:** 49.1/>90% (50 Hz), 49.9/>90% (60 Hz)
- **Fast start:** 2-minute startup capability
- **Delivered engines:** ~40
- **Launch date:** 2013

Jenbacher Type 6

- V12, V16, V20 cylinder; 1,500 rpm (50/60 Hz)
- V24 2-stage turbocharged
- **Electrical output:** 1.8 – 4.5 MWe (50 Hz)
- **Electrical efficiency:** up to 47%
- **Fast start version:** 45-sec (J620)
- **Delivered engines:** ~5,500
- **Launch date:** 1989 (J624 in 2007)

Jenbacher Type 4

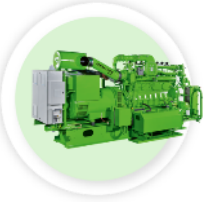


- V12, V16 and V20 cylinder: 1,500/1,800 rpm (50/60 Hz)
- **Electrical output:** 0.8 – 1.5 MWe (50 Hz)
- **Electrical efficiency:** up to 44%
- **Delivered engines:** ~4,900
- **Launch date**: 2002

Jenbacher Type 3

- V12, V16 ,V20 cylinder; 1,500/1,800 rpm (50/60 Hz)
- **Electrical output:** 0.5 - 1 MWe (50 Hz)
- **Electrical efficiency:** up to 41%
- **Delivered engines:** ~10,100
- **Launch date:** 1988

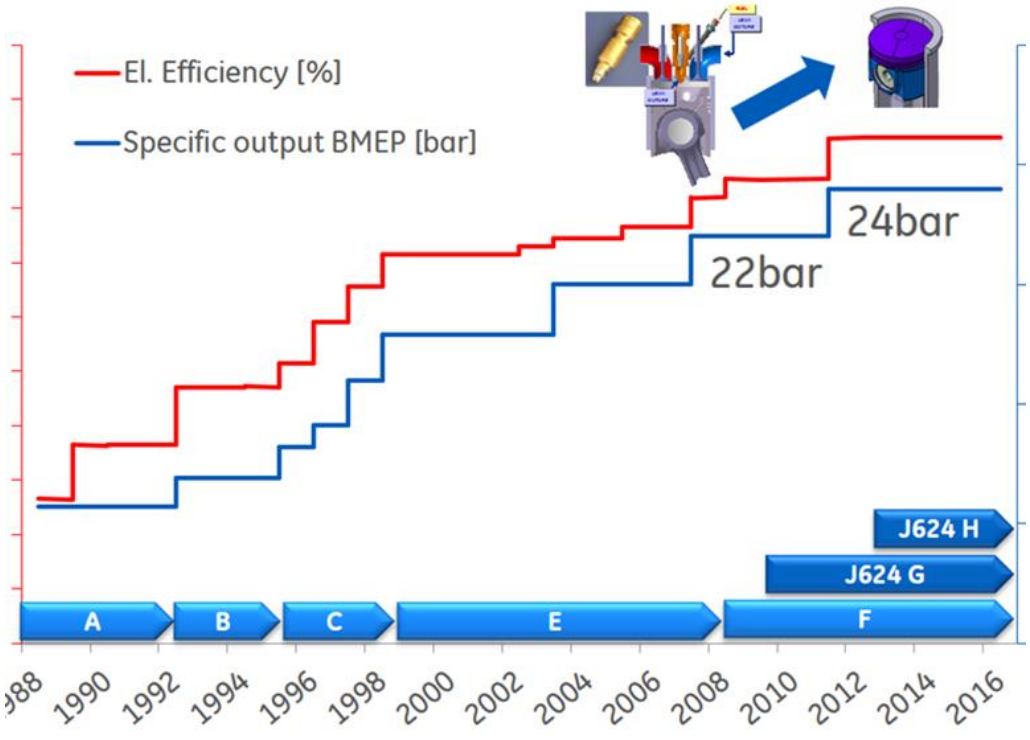
Jenbacher Type 2



- L8 cylinder; 1,500/1,800 rpm (50/60 Hz)
- **Electrical output:** 250 - 330 kWe (50 Hz)
- **Electrical efficiency:** 39%
- **Delivered engines:** ~1,200
- **Launch date:** 1976

5 platforms w/ 12 products from ~300kWe up to 10MWe

Ongoing Development – Driving Efficiency

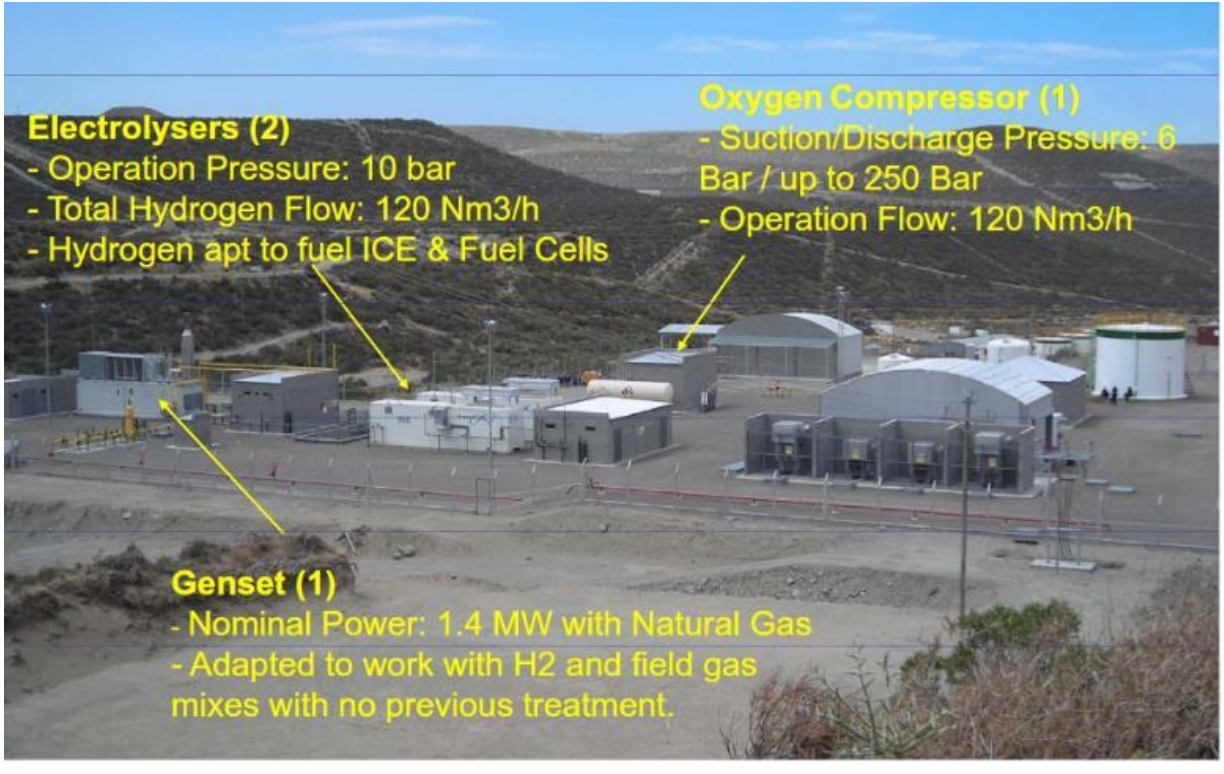


Helping Coca-Cola to reduce CO_2-emissions

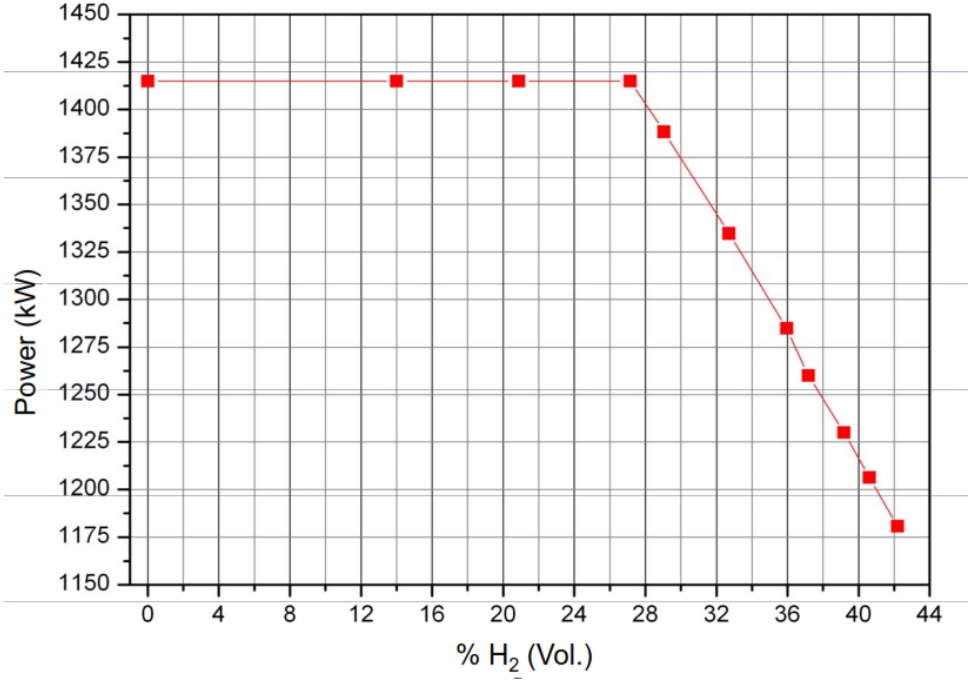
Coca-Cola Hellenic Bottling plants throughout Europe use INNIO's Jenbacher* CHP engines, reducing operational costs and eliminating up to 40% of their annual emissions. For instance, in Coca-Cola Hellenic's Romania bottling facility two J620 engines are supplying a total of 6 MW.

* Indicates a trademark

Hychico, Argentina site



Hychico, Argentina site



J420

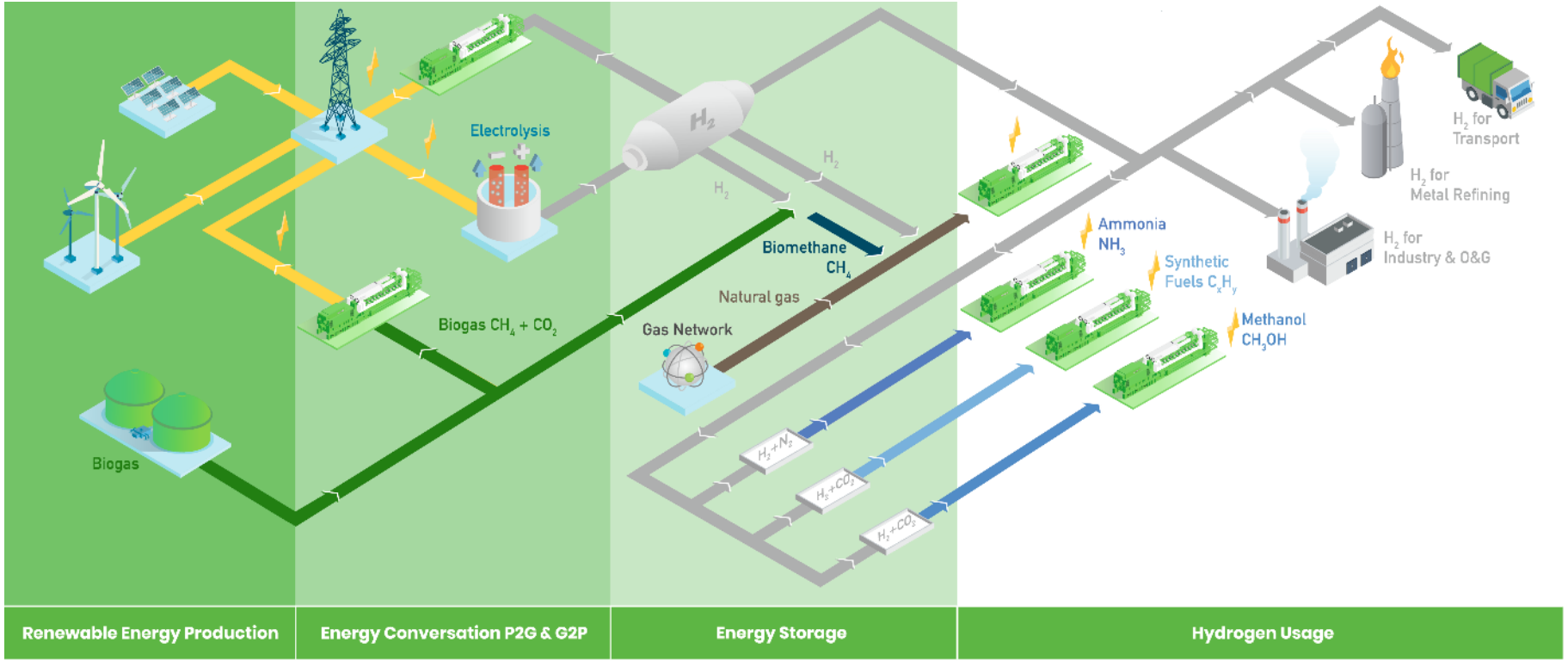
Pel_nom = 1,415 kWe (Bmep19bar)

Base gase: domestic NG MN~100!

Delivery 2008

Controlled hydrogen blending NG / H2 (0 - ~40Vol%)

The role of Jenbacher gas engines in a renewable (hydrogen) world



Jenbacher gas engine solutions for H_2

A

H_2 in natural gas pipeline

Low H_2 blending
Optimized for NG
<5%v H_2[1]

Medium H_2 blending
broadband product
15-25%v H_2[1]

B

H_2 local admixing

Special gas engine
operational optimized
up to ~60%v H_2[1]

NG / H_2 engine
dual gas engine 100%v
NG / H_2[1]

C

Pure H_2

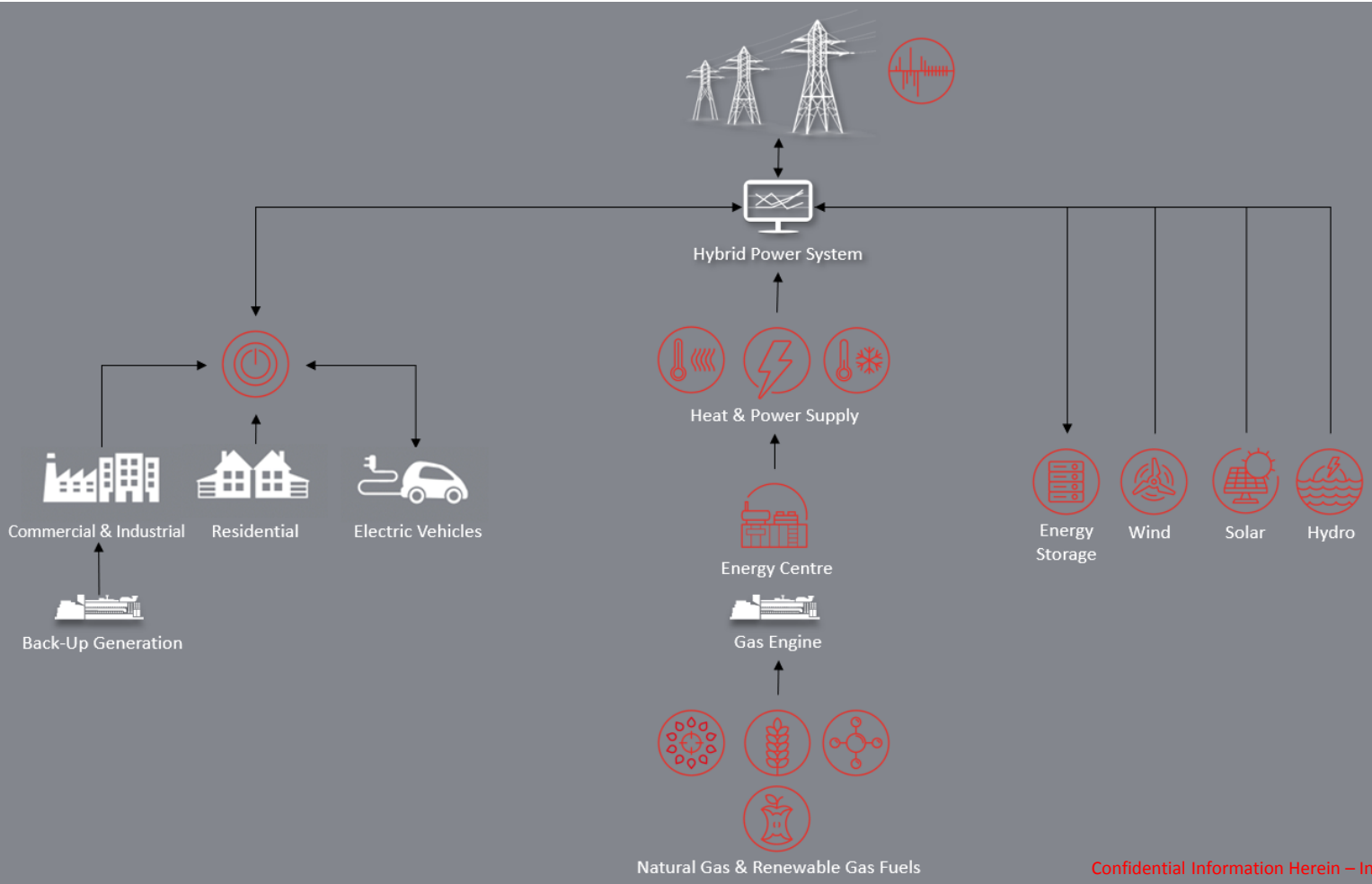
H_2 engine
hydrogen engine (H_2)
100%v H_2

Summary

- H_2 or H_2-blending to NG changes gas attributes significantly for internal combustion engines (ICE) and need to be addressed
- **Controlled** blending of H_2 to pipeline gas in certain limits improves combustion but reduces knocking resistance of gas mixture (MN)
- **Uncontrolled** blending of H_2 to pipeline gas is a challenge to existing & new engines
  - Broad band product vs optimized product
  - Emission compliance
  - Compliance w/ technical standards (grid codes, energy balancing, …)
- Existing engines can be converted for H_2 blending or 100% H_2 – details to be checked case by case
  - Engine type & version
  - Rate of change (RoC)
  - Base gas quality (Methane number MN), gas blending signal, …
- Safety concept of engine and site must be checked according local requirements
- Current intentions of gas industry to enlarge the WI range is an additional hurdle

CHP as the Platform for Future Decarbonisation

Integrated / Hybridised Power System



Do you believe that Combined Heat & Power, should be utilised as an enabling technology on the path to net zero?

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Would you consider reducing energy costs, through deployment of CHP?

Absolutely

Potentially

Indifferent

Doubtful

Highly Unlikely

Questions & Answers Session