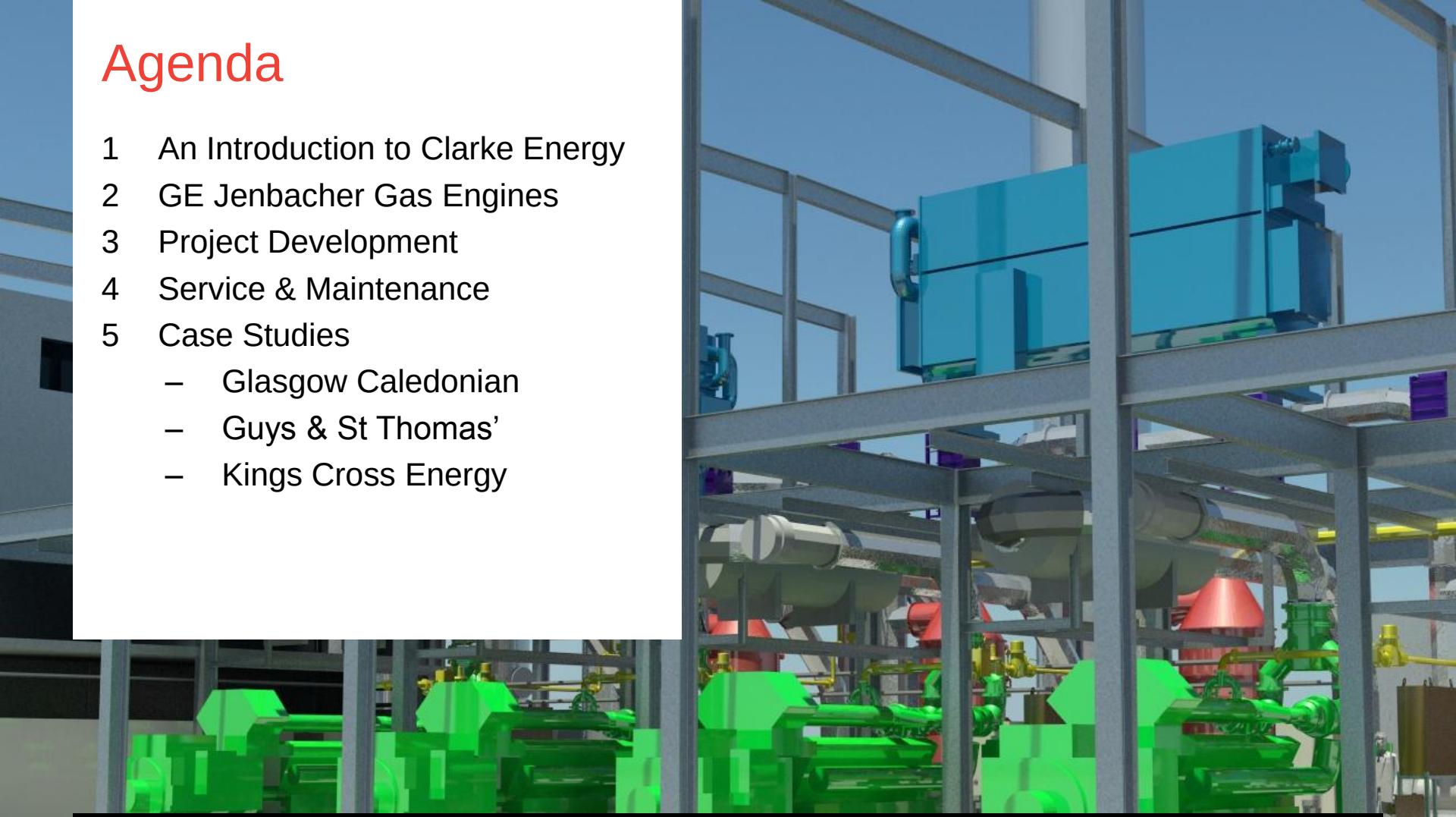
Clarke Energy

Engineer - Install - Maintain

Distributor & Service Provider
Gas Engines

Agenda

1. An Introduction to Clarke Energy
2. GE Jenbacher Gas Engines
3. Project Development
4. Service & Maintenance
5. Case Studies
   - Glasgow Caledonian
   - Guys & St Thomas'
   - Kings Cross Energy



Clarke Energy Case Studies…

Introduction to Clarke Energy

Established **1989** in UK as an engine service company

Group HQ in Knowsley, **Liverpool**

GE Jenbacher Gas Engine distributor

- Presence in 15 territories
- **One product = One focus**

Continuing growth:

- £201m turnover 2011
- £210m turnover 2012
- **£250m turnover 2013**

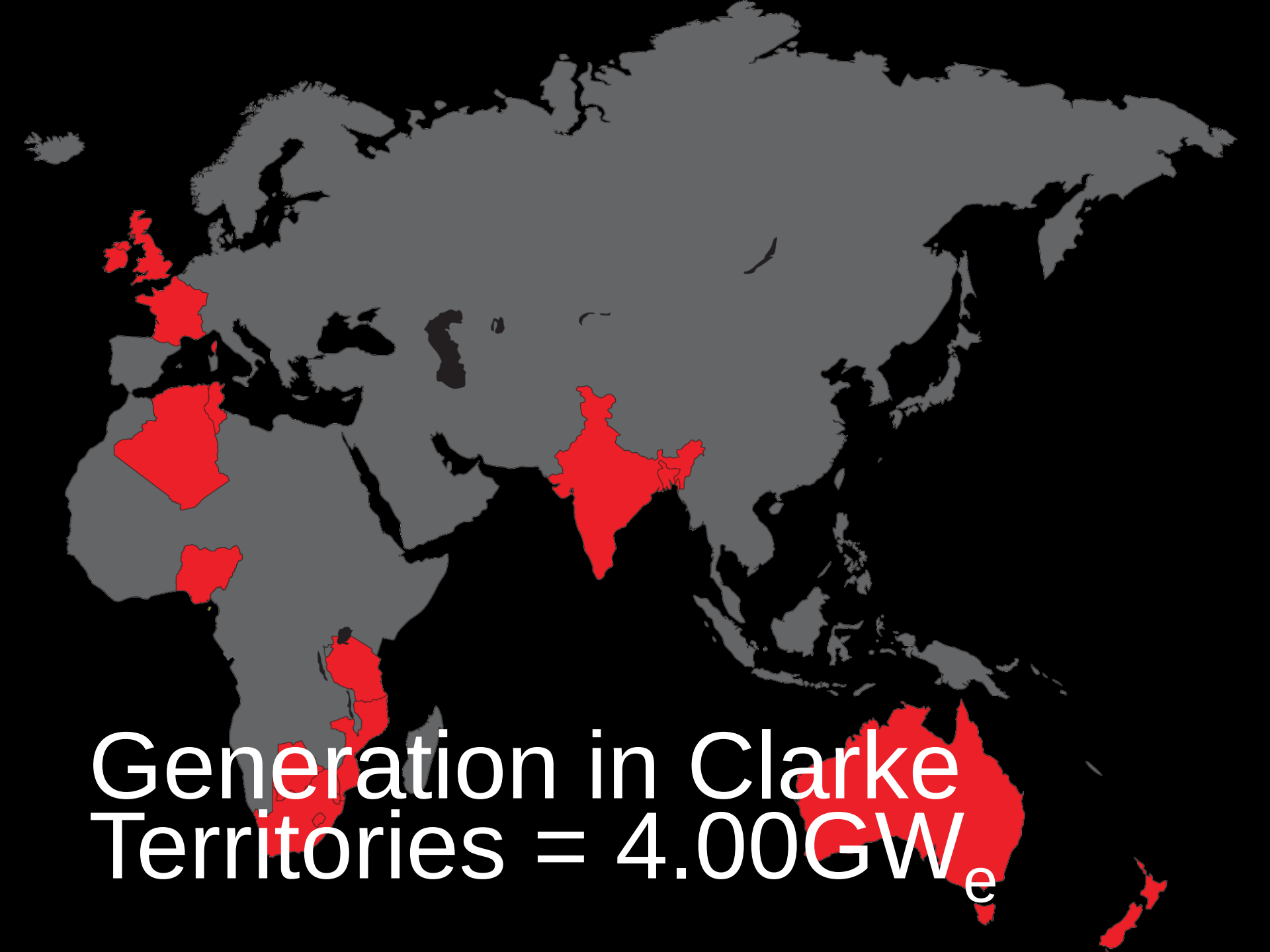
950+ employees worldwide

ISO accreditation:

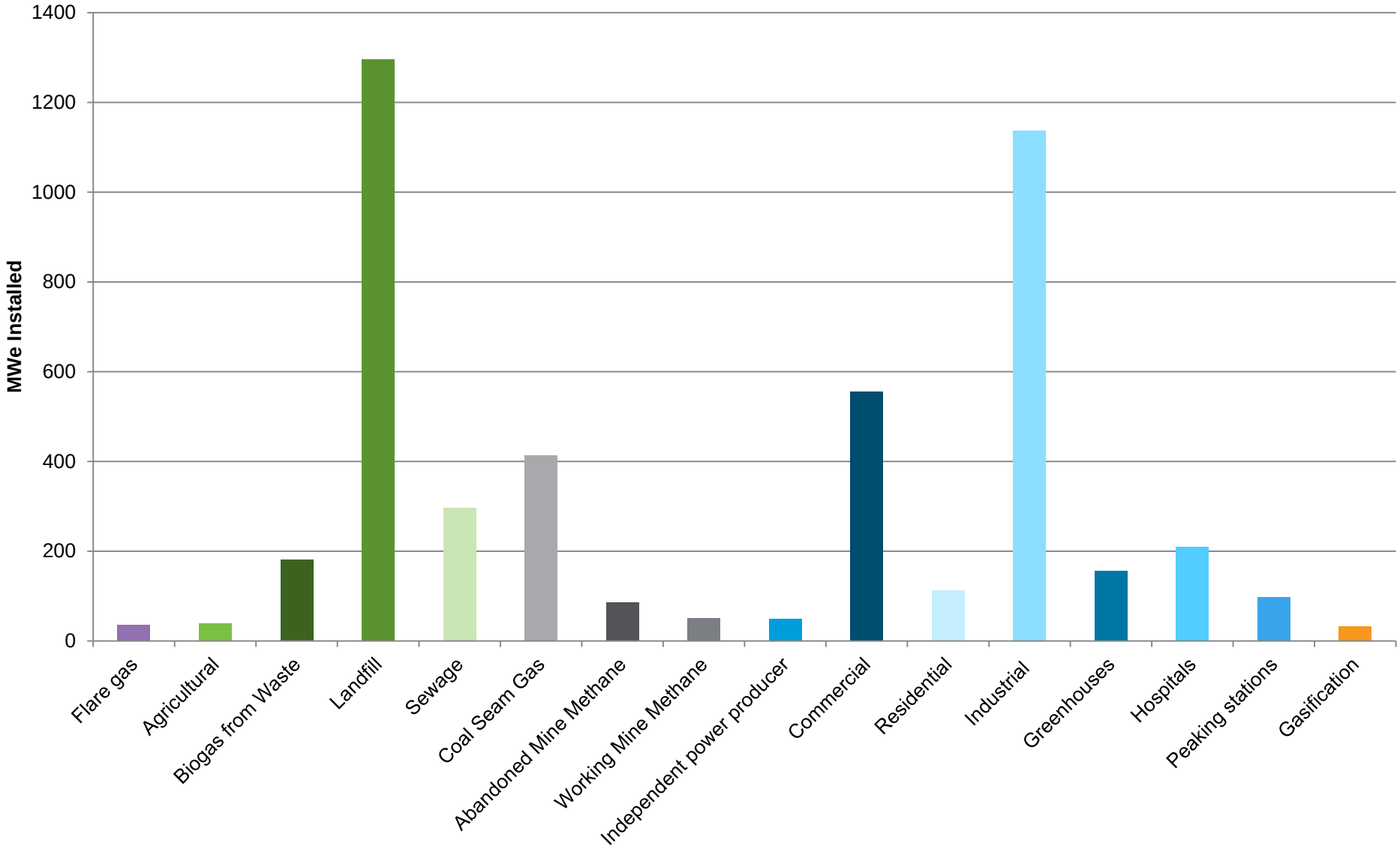
- 9001 Quality
- 14001 Environment

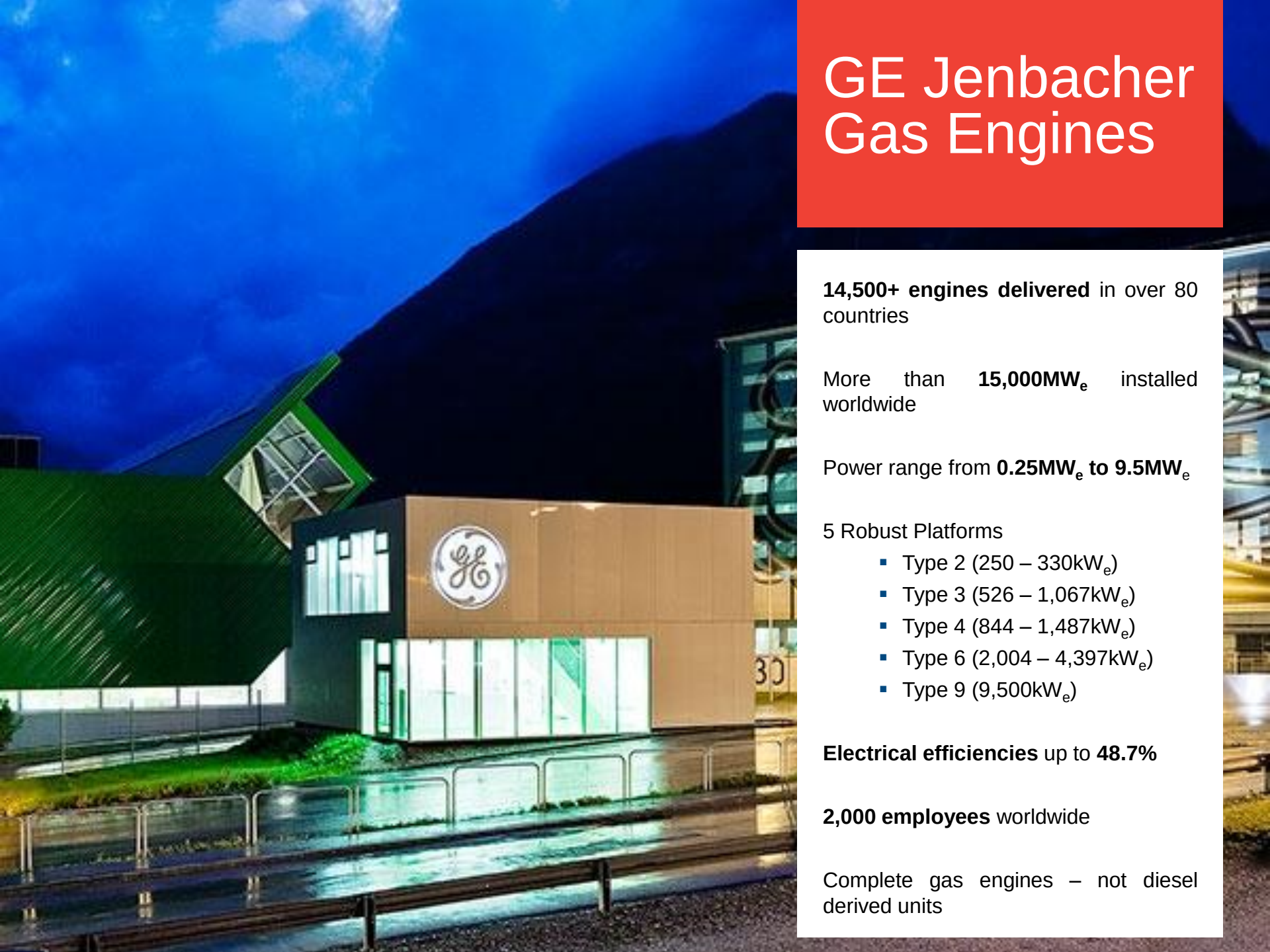
Occupational H&S Management

- 18001


Generation in Clarke Territories = 4.00GW$_e$

Applications





GE Jenbacher Gas Engines

14,500+ engines delivered in over 80 countries

More than **15,000MW$_e$** installed worldwide

Power range from **0.25MW$_e$ to 9.5MW$_e$**

5 Robust Platforms

- Type 2 (250 – 330kW$_e$)
- Type 3 (526 – 1,067kW$_e$)
- Type 4 (844 – 1,487kW$_e$)
- Type 6 (2,004 – 4,397kW$_e$)
- Type 9 (9,500kW$_e$)

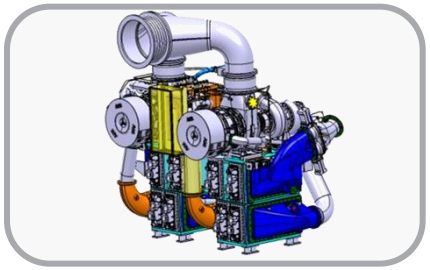
Electrical efficiencies up to **48.7%**

2,000 employees worldwide

Complete gas engines – not diesel derived units

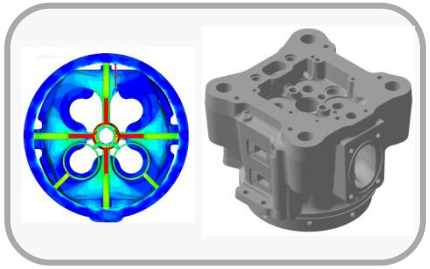
Advanced Gas Engine Technology

Individual Cylinder Control

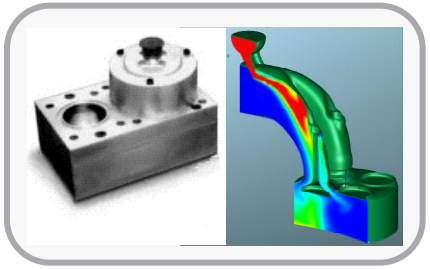


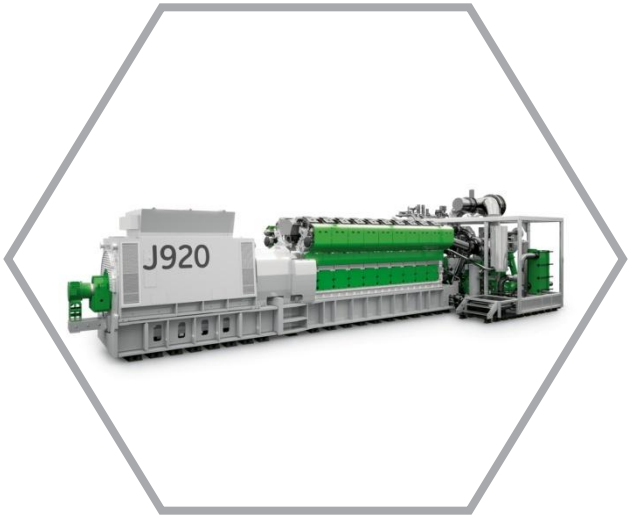
Two stage turbocharging

Advanced Cooling System

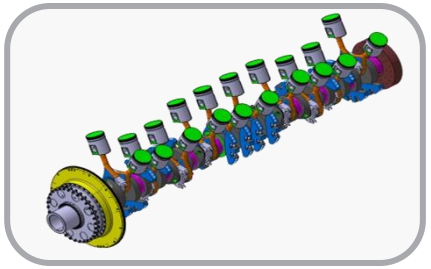


Port Injection

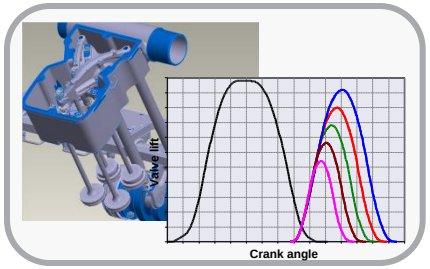




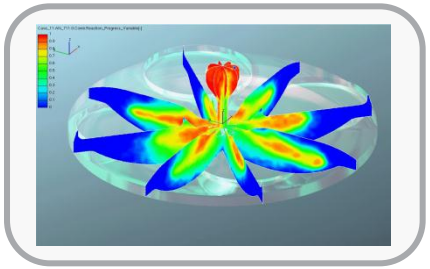
Superior Crank Train Design



Advanced Valve Timing



Rapid Burn Combustion



Grid Code Capability

Emissions Control

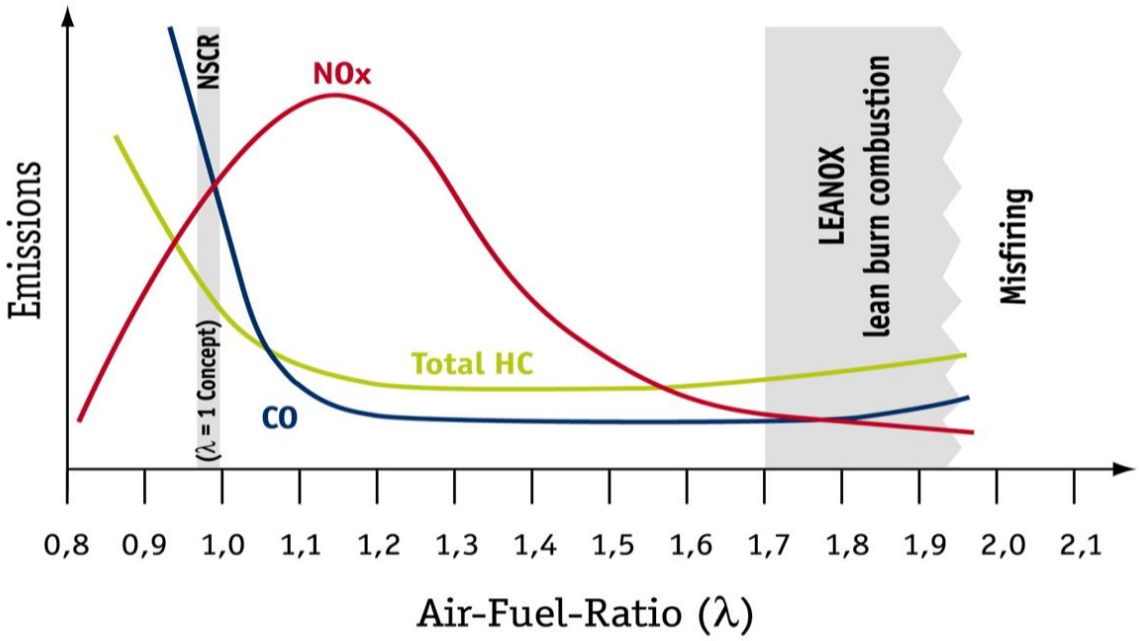
To achieve European guideline emission levels it is necessary to change from a **Stoichiometric air-fuel ratio** to a **“lean burn” concept**

This results in lowest **NOx**, **CO** and **HC** emissions

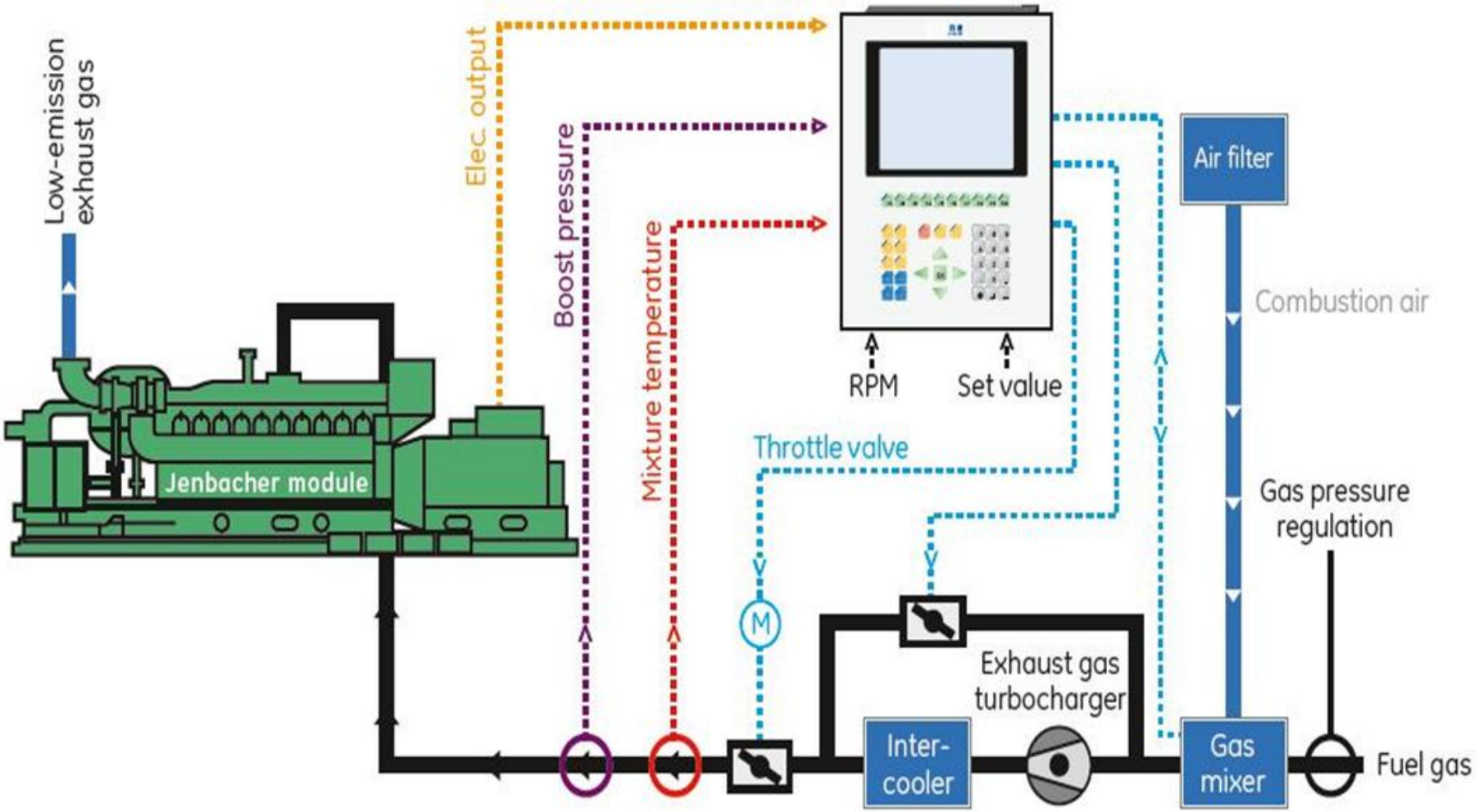
The GE Jenbacher patented **LEANOX** controller is the **most reliable** gas-engine emission control system **available**

The system relies on the constant relationship between:

- **engine output**
- **air/fuel mixture temperature**
- **boost-pressure**

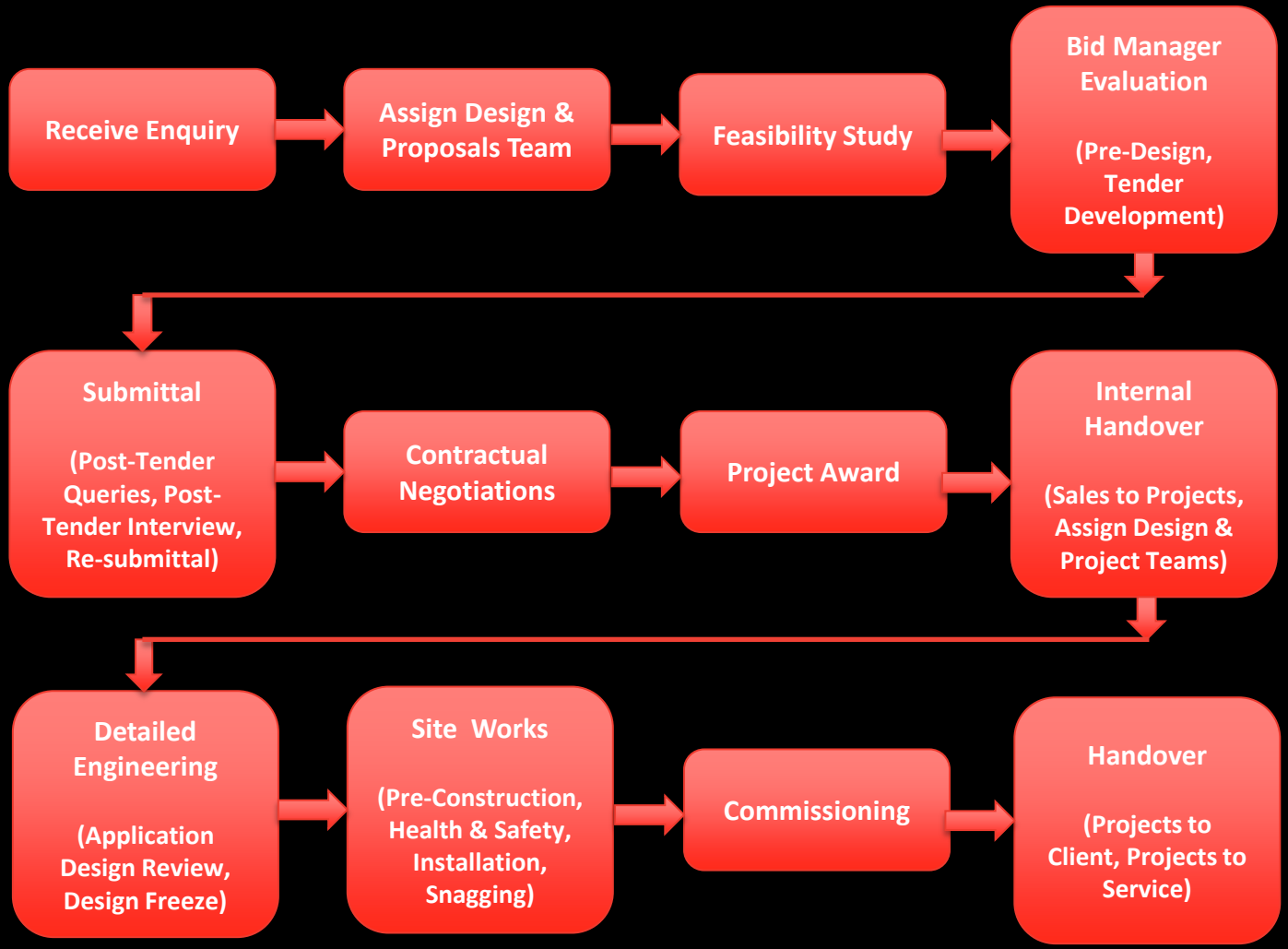


Lean Burn Combustion Control - LEANOX



Benefits

- **Efficiency**
- **Reliability**
- **Durability**



Project Development

Feasibility Analysis

A **detailed feasibility** study is **essentia**l

To fully appreciate the scheme **chilled water demand** needs assessing

To realise maximum benefit, operation needs to be maximised – **availability** and **reliability** key

Analyse a **suppliers' strength of business**

Consider what **assumptions** have been used

Assess full **life-cycle** and **CO_2 savings**

Optimum Sizing

Design Consideration

Consider all **implementation issues** carefully:

- Layout
- Balance of plant
- Mechanical interfaces
- Electrical interfaces
- Thermal interfaces

Understand **integration** with **existing services**

- **System resilience**

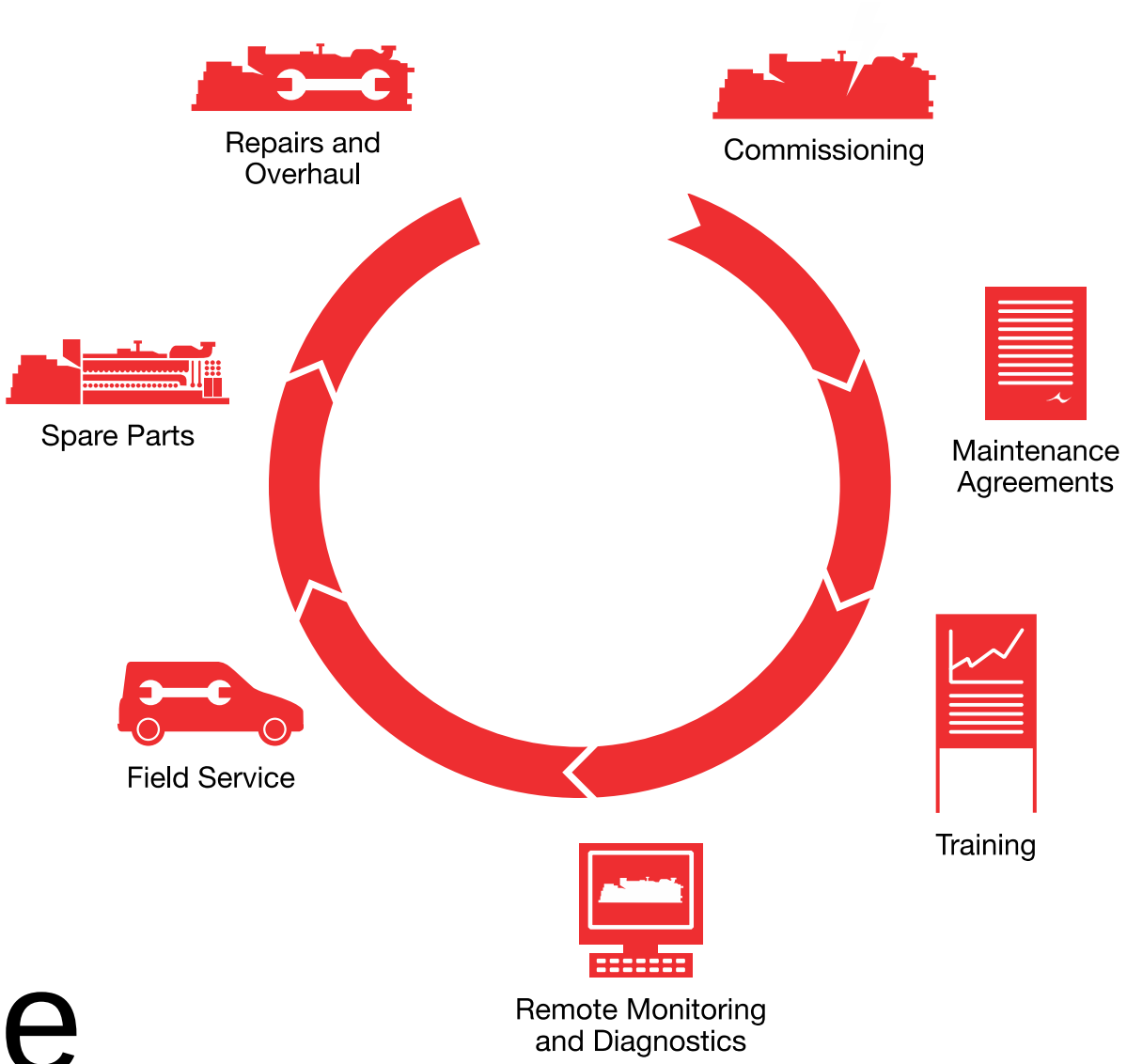
Planning requirements

Grid connection application

Dispersion modeling

Implications to overall **programme**

Service Lifecycle



On-Going Maintenance

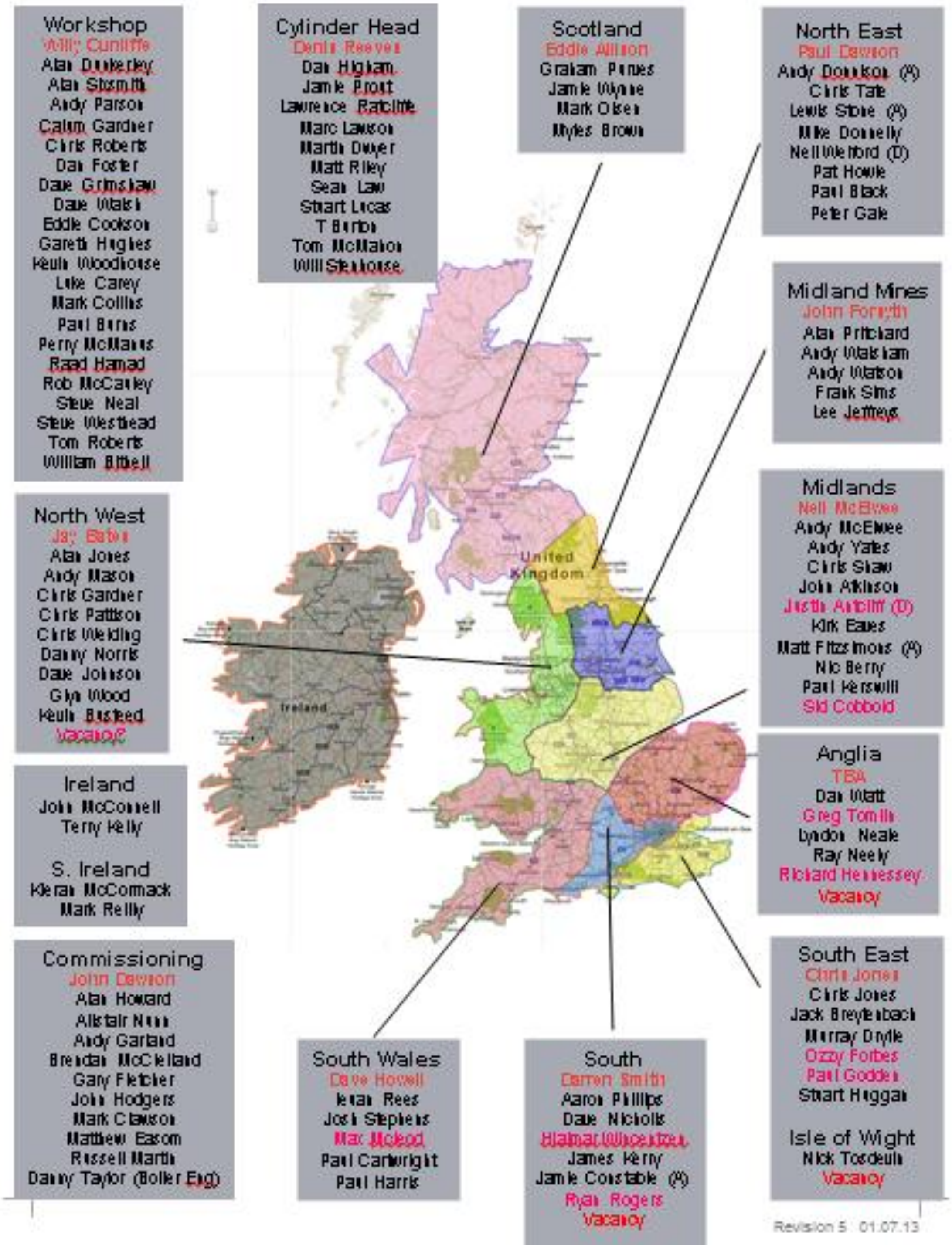
Formal maintenance contract:

- Safeguards **operation**
- **Availability** guarantees
- Damages associated with non-**performance**
- Different terms and **options** available

Due diligence essential:

- Financial **stability**
- Ability to guarantee **parts availability** & price
- **Investment** for the future
- Track **record**
- In-territory **support**
- Skilled & equipped **service engineers**

Reliability and **availability** key to realising **return on investment!**


Workshop
Willy Cunliffe
Alan Dunkerley
Alan Stosmith
Andy Parson
Calum Gardner
Chris Roberts
Dan Foster
Dave Grimshaw
Dave Walsh
Eddie Cookson
Gareth Hughes
Keith Woodhouse
Luke Carey
Mark Collins
Paul Burns
Perry McManus
Raad Hamad
Rob McCauley
Steve Neal
Steve Westhead
Tom Roberts
William Bithell
Cylinder Head
Denis Reeves
Dan Higham
Jamie Prout
Lawrence Ratcliffe
Marc Lawson
Martin Dwyer
Matt Riley
Sean Law
Stuart Lucas
T Burton
Tom McMahon
Will Stenhouse
Scotland
Eddie Allison
Graham Purves
Jamie Wynne
Mark Olsen
Myles Brown
North East
Paul Dawson
Andy Dounson (A)
Chris Tate
Lewis Stone (A)
Mike Donnelly
Neil Welford (D)
Pat Howle
Paul Black
Peter Gale
Midland Mines
John Forsyth
Alan Pritchard
Andy Walsham
Andy Watson
Frank Sims
Lee Jeffreys
Midlands
Neil McElwee
Andy McElwee
Andy Yates
Chris Shaw
John Atkinson
Justin Antcliff (D)
Kirk Eaves
Matt Fitzsimons (A)
Nic Berry
Paul Kerswill
Sid Cobbold
North West
Alan Jones
Andy Mason
Chris Gardner
Chris Pattison
Chris Welding
Danny Norris
Dave Johnson
Glyn Wood
Keith Busfeed
Vacancy?
United Kingdom
Ireland
Ireland
John McConnell
Terry Kelly
S. Ireland
Kieran McCormack
Mark Reilly
Anglia
TBA
Dan Watt
Greg Tomlin
Lyndon Neale
Ray Neely
Richard Hennessey
Vacancy
Commissioning
John Dawson
Alan Howard
Alistair Nunn
Andy Garland
Brendan McClelland
Gary Fletcher
John Hodgers
Mark Clawson
Matthew Eason
Russell Martin
Danny Taylor (Boiler Eng)
South Wales
Dave Howell
Ieuan Rees
Josh Stephens
Max Mcleod
Paul Cartwright
Paul Harris
South
Darren Smith
Aaron Phillips
Dave Nicholls
James Kerry
Jamie Constable (A)
Ryan Rogers
Vacancy
South East
Chris Jones
Chris Jones
Jack Breytenbach
Murray Doyle
Ozzy Forbes
Paul Godden
Stuart Huggan
Isle of Wight
Nick Tosdevin
Vacancy
Revision 5 01.07.13

UK Universities…

Site	Commissioned	Config.	Engine	No. of units	Total MW_e Installed
Dundee University	1997	JMS	320	3	3.0
Edinburgh University – Pollock Halls	2003	JMS	212	1	0.5
Edinburgh University – Kings Buildings	2003	JMS	620	1	2.7
Edinburgh University – George's Square	2005	JMS	612	1	1.6
Southampton University	2005	JMS	420	2	2.8
Aberdeen University	2007	JMS	612	1	1.6
University of Liverpool	2009	JMS	620	1	3.3
Glasgow Caledonian University	2013	JMS	412	1	0.8
Edinburgh University – Holyrood Road	2013	JMS	420	1	1.4
				12	18

UK Hospitals…

Site	Commissioned	Config.	Engine	No. of units	Total MW_e Installed
Freemans Hospital	1997	JMS	612	2	3.0
North Tyne Hospital	1999	JMS	612	1	1.0
Western General Hospital	1999	JMS	320	1	1.0
Royal Victoria Hosptial	2001	JMS	616	2	4.0
Hartlepool Hospital	2003	JMS	420	1	1.4
Lincoln Hospital	2003	JMS	420	1	1.4
Christie Hospital	2004	JMS	420	1	1.4
Broadgreen Hospital	2005	JMS	616	1	2.2
Ormskirk Hospital	2006	JMS	320	1	1.1
Kingston Hospital	2007	JMS	420	1	1.4
Portsmouth Hospital	2008	JMS	612	2	3.3
Freemans Hospital	2008	JMS	420	1	1.4
University Hospital Wales	2009	JMS	616	2	4.4
Pilgrim Hospital	2009	JMC	312	1	0.6
Guys Hospital	2009	JMS	620	1	3.0
St Thomas Hospital	2009	JMS	620	1	3.0
Royal Preston Hospital	2009	JMS	612	1	1.8
Queen's Hospital	2010	JMS	312	1	0.5
Kings Cross College Hospital	2010	JMS	616	1	2.4
Kings Cross College Hospital	2010	JMS	612	1	1.8
Great Ormond Street Hospital	2011	JGMC	420	2	1.4
Musgrove Hospital	2012	JMS	208	1	0.3
Freemans Hospital	2013	JMS	420	2	3.0
Barnsley Hospital	2013	JMS	416	1	1.1
				30	42.9

Glasgow Caledonian

Client:	Crown House Technologies
Commissioned:	2013
Equipment:	1 x JMS412GS-N.L

Key success factors:

- Knowledge and expertise of Sales team in preliminary design phase with building design consultant
- Project delivery and implementation experience
- Product capability

Glasgow Caledonian

Output:	845kW$_e$
Heat Recovery:	865kW$_{th}$ LTHW @ 90°C
Total Fuel Efficiency:	86.5%
CHP Quality Index:	~140
Annual Savings:	£250k per year 750tonnes CO_2 per year


DANGER
CAUTION
Jenbacher
gas engines

Guy’s & St. Thomas’ Hospitals

Client:	G&ST Hospital Trusts
Commissioned:	2009
Equipment:	2 x JMS620GS-N.L

Key success factors:

- Service support and infrastructure, particularly in central London
- Flexibility of heat recovery circuits
- Design innovation to meet stringent space requirements

Guy's Hospital

Output:	3,041kW$_e$
Heat Recovery:	1,393kW$_{th}$ LTHW @ 85°C 1,010kW$_{th}$ MTHW @ 130°C
Total Fuel Efficiency:	76.16%
CHP Quality Index:	~130
Annual Savings:	£1m per year 6,000tonnes CO_2 per year

St. Thomas' Hospital

Output:	3,041kW$_e$
Heat Recovery:	1,393kW$_{th}$ LTHW @ 85°C 1,800kg/h steam @ 9barg
Total Fuel Efficiency:	75.50%
CHP Quality Index:	~128
Annual Savings:	£1m per year 5,500tonnes CO_2 per year

Kings Cross Energy Centre

Client:	Metropolitan Kings Cross
Commissioned:	2012 & 2014
Equipment:	2 x JMS612GS-N.L

(3rd engine planned for 2016)

Key success factors:

- Service support and infrastructure
- Product understanding and technical support
- Attractive finance package

Kings Cross Energy Centre

Output (per engine):	2,000kW$_e$
Heat Recovery: (per engine)	1,864kW$_{th}$ LTHW @ 95°C
Total Fuel Efficiency:	85.00%
CHP Quality Index:	~130

When complete the energy centre will provide 100% of the thermal demand and 80% of the electrical demand of the 60 acre site

Contact

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Distributor & Service Provider
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