

11-12 May 2022
SEC, Glasgow

SECRET

Smart Efficient Compression: Energy and Reliability Targets

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Howden / Royal Academy of Engineering Research Chair in Compressor Technology

City, University of London, UK

School of Science and Technology, Department of Engineering

Centre for Compressor Technology @ Thermo fluids Research Centre



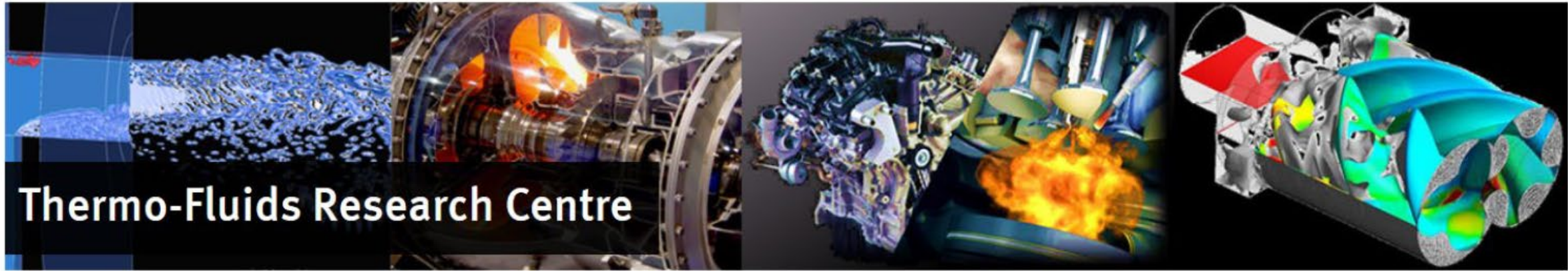
18,000 students - 46% at postgraduate level
from more than 150 countries

- 1894 - Northampton Polytechnic Institute
- 1966 - University created by Royal Charter
- 2016 - City joins the University of London

**Schools: Business, Science and Technology,
Arts and Social Sciences, Law, Health Sciences
Graduate School; Research Centres; Interdisciplinary Centres**



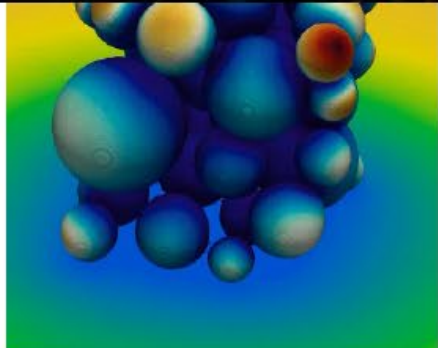
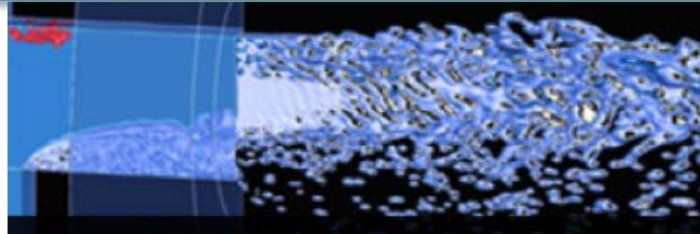
**School of Science and Technology
Department of Engineering
Thermo-Fluids Research Centre, Centre for Compressor Technology**



Thermo-Fluids Research Centre

An internationally leading centre in fundamental and applied research in fluid Flow, heat and mass transfer and fluid-structure interactions

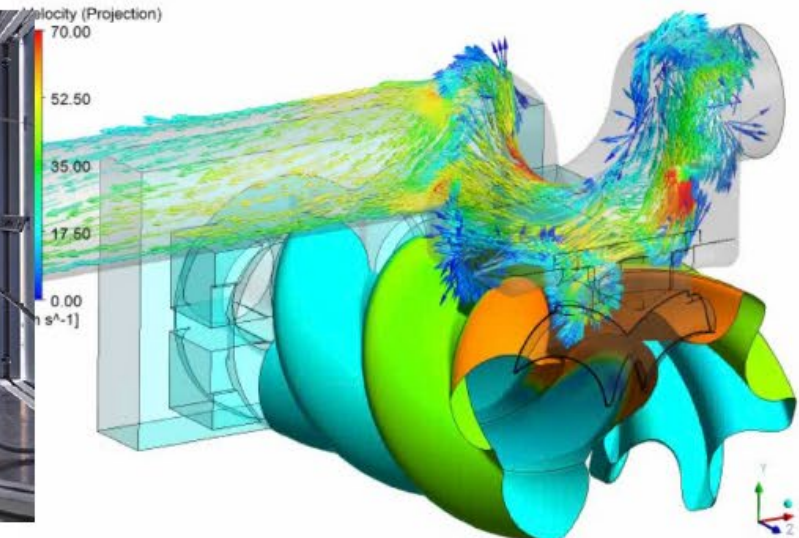
Multi-phase flow



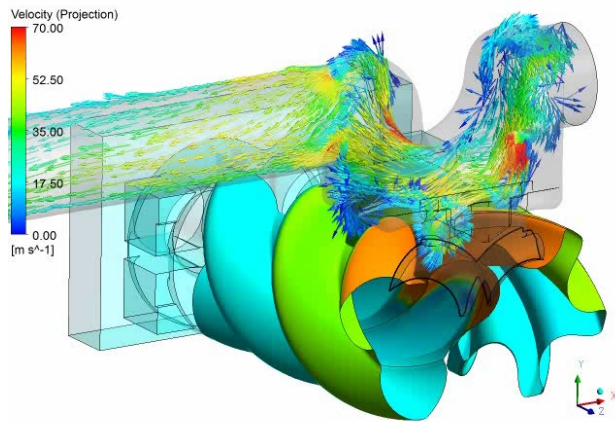
Turbomachinery and Energy Systems



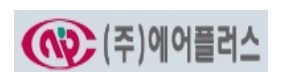
Positive Displacement machines



Centre for Compressor Technology



Selected Research Partners



12th International Conference on Compressors and their Systems

City, University of London, UK, 6th – 10th September 2021



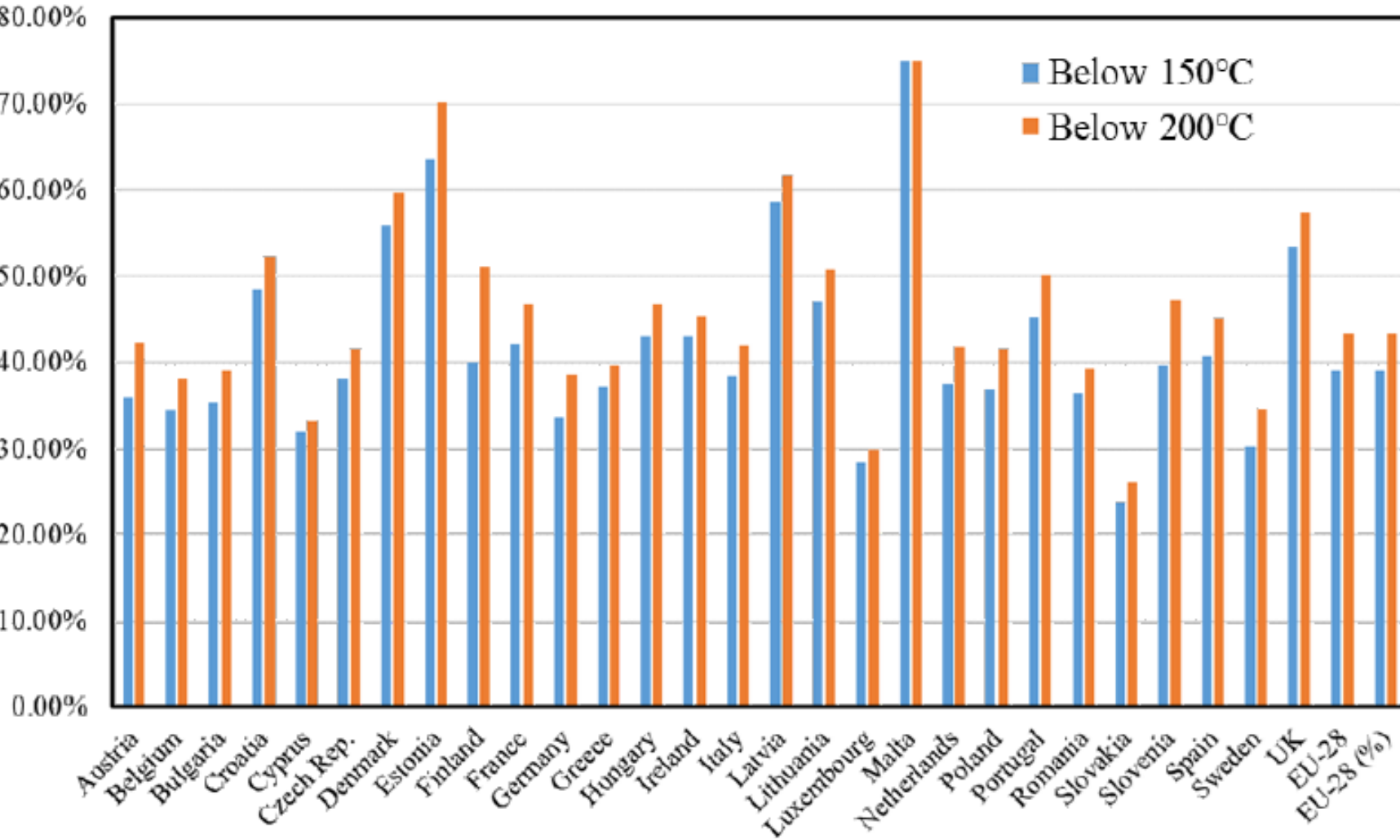
Sponsors and Partners



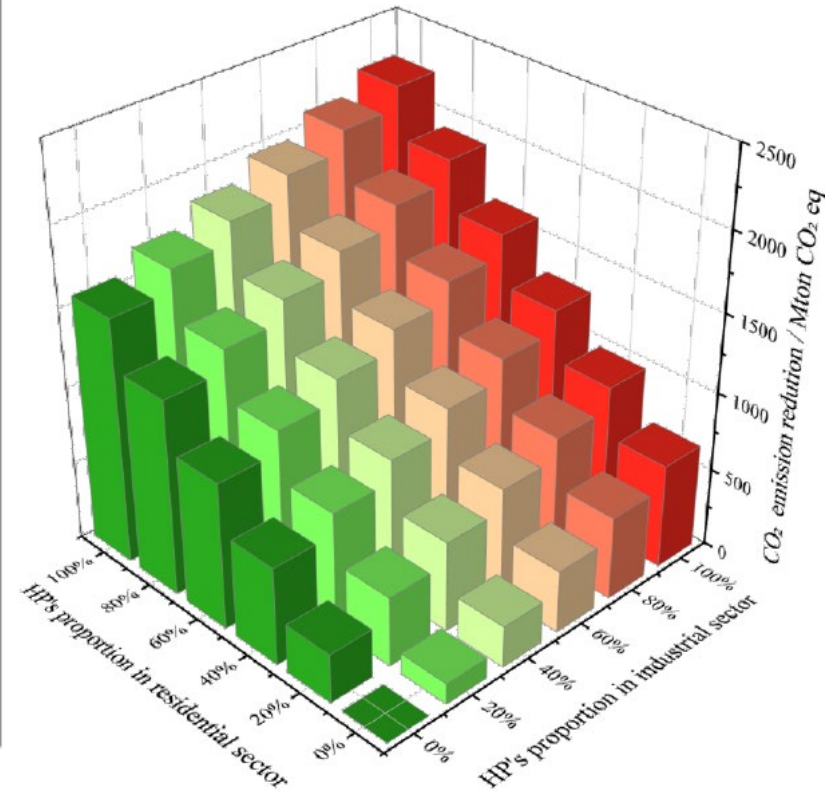
Theme: **SUSTAINABILITY** 193 Delegates from 24 countries
5 key notes, 69 technical papers, 9 Industry talks

Heat – the agenda item – Ruzhu Wang @CityCompressorsConference.

According to EU data, 70% of industrial energy consumption is heat energy. **75% below 150 °C.**



Potential for CO₂ reduction from residential and industrial heat pumps



High Temperature Heat Pumps

- It has been estimated that 52% of primary energy consumed worldwide is lost as waste heat in the form of exhausts or effluents, of which 79% is below 300 °C^[1].
- In the UK, industry consumes 20% of the UK's energy, of which 72% of industrial demand is from thermal processes from which 20% (40 TWh/yr) could have the potential for industrial waste heat recovery^[2].
- We are starting project to aid understanding and removing limitations of COMPRESSORS FOR HIGH TEMPERATURE INDUSTRIAL HEAT PUMPS that can efficiently operate to upgrade industrial waste heat, from 50-100 °C to 150-200 °C for effective utilisation within industrial processes.
- Partners: City, University of London, Brunel University, Howden, Innovatium, Econotherm and British Sugar

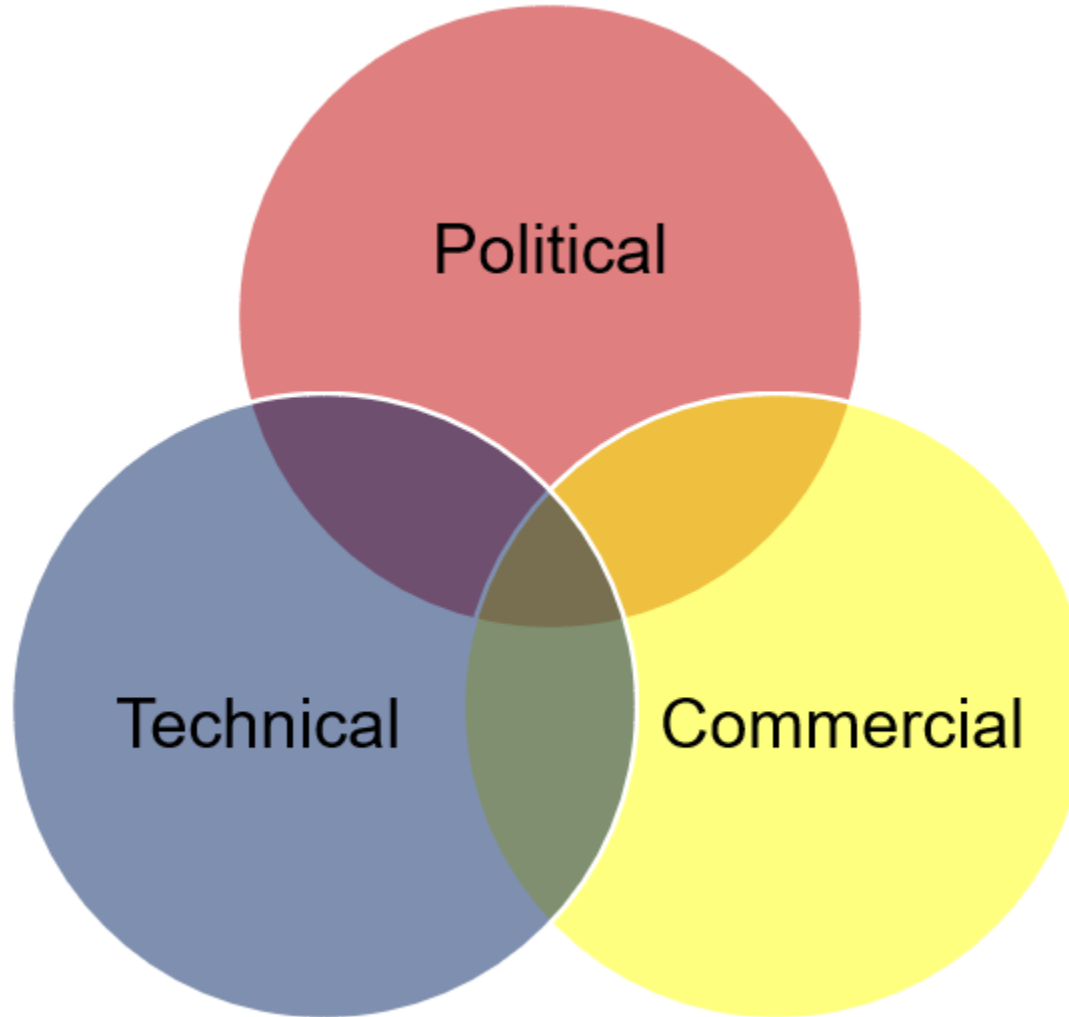
^[1] Forman, C., Muritala, I.K., Pardemann, R., Meyer, B., 2016, *Renew Sust Energ Rev*, 57, 1568—1579.

^[2] Waters, L., 2017, *Energy consumption in the UK*, Technical Report, Department for Business, Energy & Industrial Strategy, London, UK

What Challenges do we face in extending the use of Heat Pumps?

Technical:

- High T = High P
(Choice of fluid)
- High P
(Requires High Pressure compressor)
- Low MW = Lower P but
Higher V
(Larger and more costly system)



Commercial:

Challenge is the trade-off between improved efficiency and higher costs
“Brutal Economics”

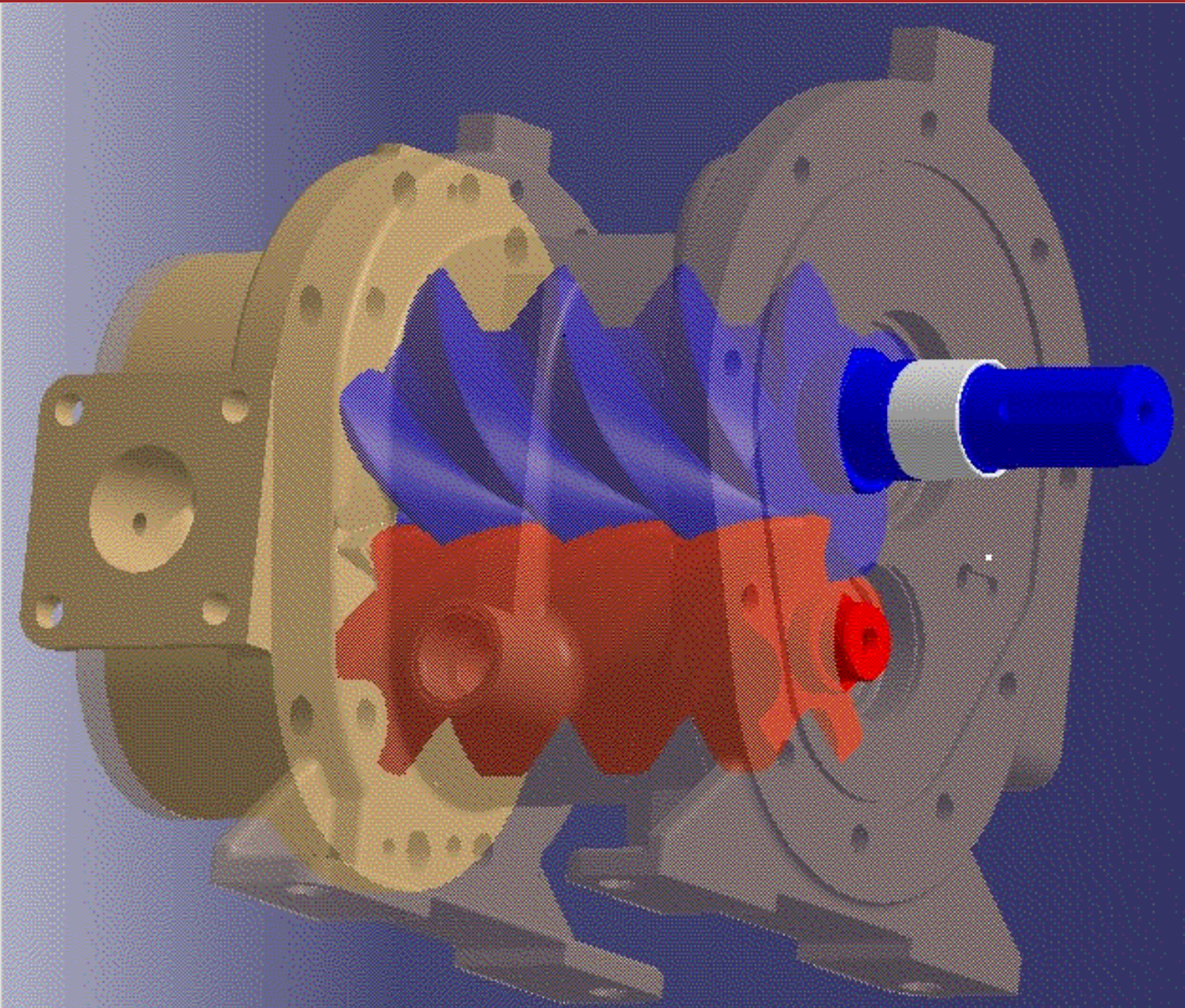
Political:

Energy taxing

Spark ratio =
Cost of electricity /
Cost of Gas

Spark ratio in the UK > 5,
highest in Europe.

Screw Compressor – Rotary Positive displacement machine



Compressors or Expanders are the “heart” of every:

- Industrial and commercial air compression system
- Refrigeration, Air Conditioning or Heat Pump system,
- Process, Oil & Gas transport system
- Waste heat recovery system, etc

17% electrical energy produced in developed countries is used for compression

25% energy in USA during summer is used for refrigeration and air-conditioning

80% of new industrial compressors are screw compressors

83% screw compressors are Oil injected

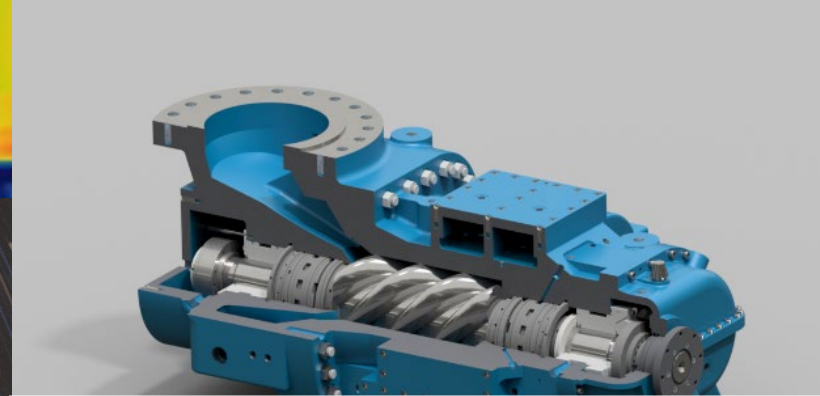
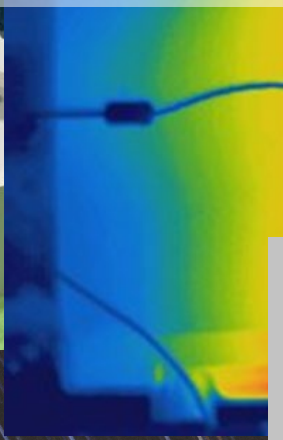
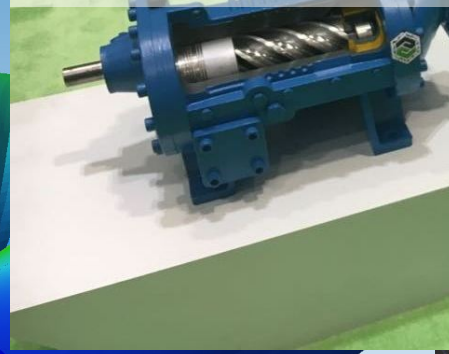
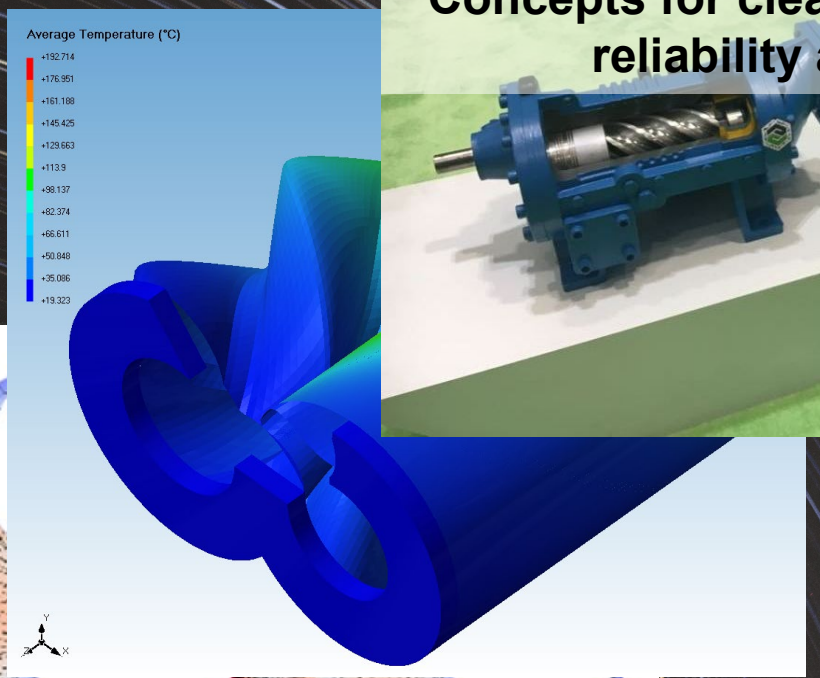
17% are oil free or water injected


Howden since 1854

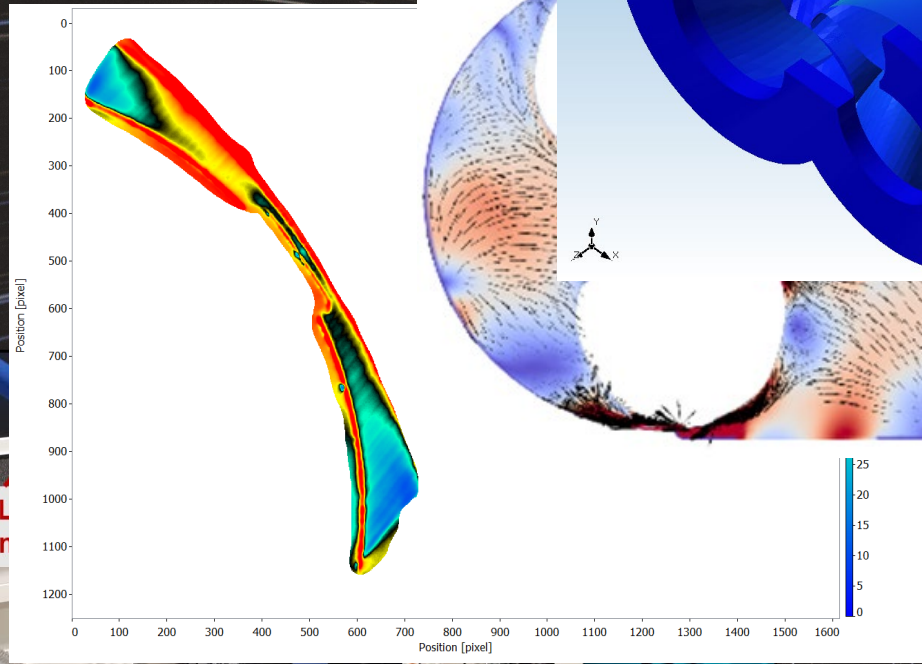
- World leader in gas handling technologies
- Manufactured the world’s first operational screw compressor in 1930’s, and
- further developed the technology in the 1960s with the introduction of the oil injected twin screw compressor.

Concepts for clearance management to improve reliability and efficiency using IoT

Physics of conjugate heat transfer in clearances

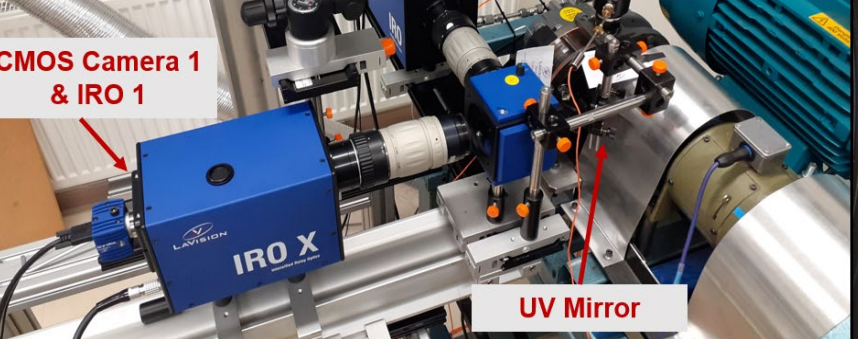


Commercial smart, reliable and efficient rotary PD machines



UV L
guidin

CMOS Camera 1
& IRO 1



SECRET





Industrial Consortium **CERES**

Compressors and Expanders in futuRe Energy Systems



Through CERES, City's Centre for Compressor Technology provides a forum for industry and academia to coordinate pre-commercial (TRL 1-3) research on industry-relevant technologies for the energy transformation sector.

**Contact us to
join and make
a difference**

<https://blogs.city.ac.uk/ceres/>





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13th International Conference on Compressors and their Systems

11th– 13th September 2023
City, University of London

Preceded by a short course on Computational Fluid
Dynamics in Rotary Positive Displacement Machines
9th –10th September 2023

**Sponsorship options
available**

