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The Microturbine: Why A Gas Engine May At Last Be Of Benefit To The Horticulture Industry.

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British Gas

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- **The former company, *'British Gas'*, was always seen as the major promoter of end-use technologies**
  - Domestic
    - Condensing Boilers
    - CO Sensors
  - Industrial
    - Regenerative Burner
    - Synthetic Natural Gas (SNG)

British Gas – The History

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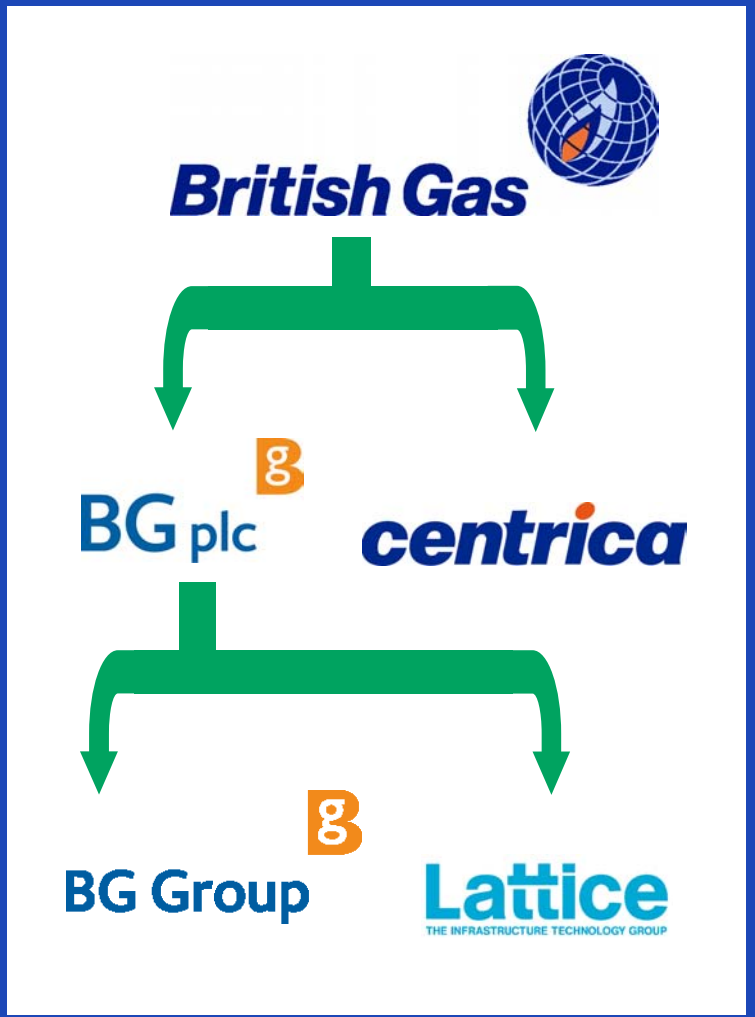

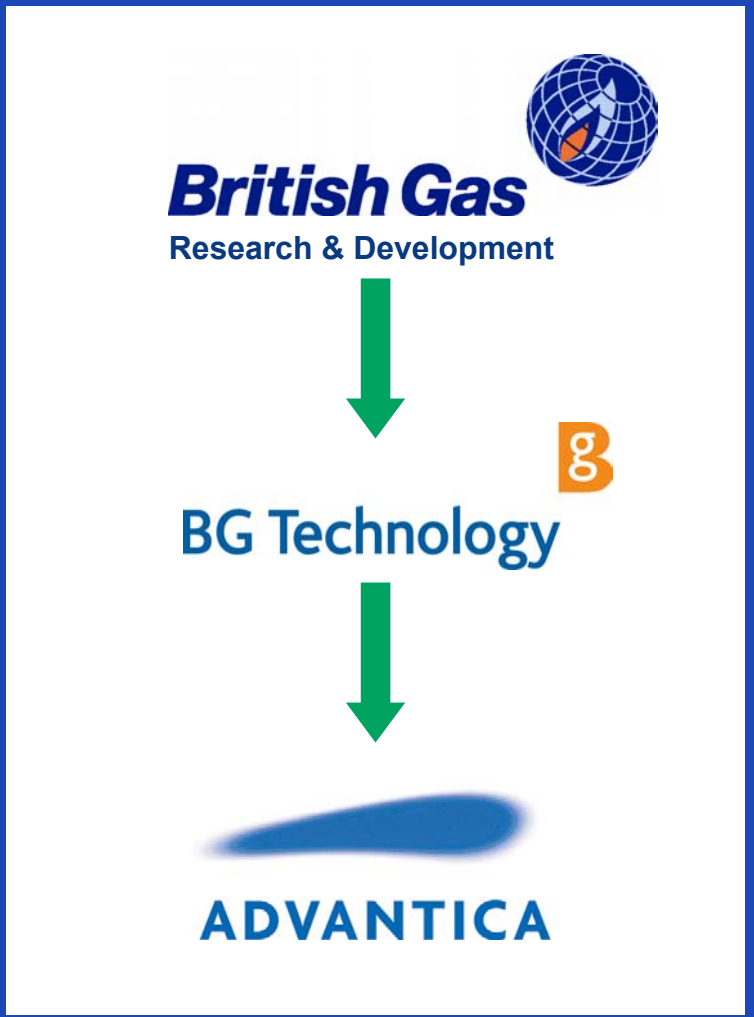

Natural Gas – The basics

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- **Key utilisation aspects of Natural Gas**
  - Natural Gas has always seen as a ‘clean’ fossil fuel in terms of its combustion products
  - Plentiful and local (North Sea) supply made it ideal for widespread use in stationary and vehicular applications

Concentrated research in natural gas utilisation technologies

British Gas Research

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- **Utilisation research focused towards multi-generation technologies:**
  - Cogeneration
    - Combined Heat & Power (CHP)
  - Trigeneration
    - Heat/Coolth/Power
  - Renewables
  - Natural Gas Vehicles (NGV)
  - Photovoltaics

Reciprocating Gas Engines

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- **Advantages**
  - Range of sizes
  - Wealth of experience with reciprocating technology
  - Intrinsic efficiencies are high (28 – 35%)
  - Operate at distribution gas delivery pressures (120 – 150 mbar)
- **Disadvantages**
  - Poor emission characteristics
  - Frequent maintenance
  - Reliability issues

Larger Gas Turbines

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- **Advantages**
  - Good power to heat ratio (2:1)
  - Ideal for combined cycle applications (CCGT = combined cycle gas turbine)
  - Cost effective at certain sizes (>2 MW of electricity)
  - Dry low-NO_x combustion techniques
- **Disadvantages**
  - Non-recuperated i.e. exhaust gas doesn't heat incoming gas
  - High gas-delivery pressures (>15 bar i.e. 1.5 MPa)
  - Complex
  - Very sensitive to ambient conditions

History with Gas Engines

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- **Gas Engines promised good cost-effective performance**
  - Usually based on reciprocating technology
  - Cheap installation
  - Some sites acted as thermal hosts with electrical export
- **In practice**
  - Engines were not as reliable as expected
  - All usually required expensive exhaust gas clean-up if CO_2 loading was required in greenhouses
  - Sites began to lose control of the installation
  - Some schemes were terminated before the end of their useful life

History with Gas Engines (cont)

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- **The Horticulture Industry**
  - Found the ‘thermal host concept’ for choosing the size of gas engines restrictive with respect to crop flexibility i.e. sizing based on the thermal requirement of a particular crop could be very restrictive and inefficient when growing a different crop
  - Export of surplus electricity became less cost effective
  - Suffered with poor reciprocating engine reliability
  - Developed a resistance to ‘new’ CHP technology

Microturbine ~ New or Old

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- **Small-scale gas turbine generators became a commercial reality in the mid-1990s**
  - Offering
    - 15 – 300 kW of electricity size range
    - Flexibility
    - Very low emissions
    - Good CHP potential (1.7:1 Power/Heat Ratio)
    - Small Footprint
  - Issues
    - Gas boosting required
    - Higher capital expenditure than equivalent reciprocating engine
    - NEW ~ ‘Here We Go Again’ market resistance

The Microturbine ~ The essentials

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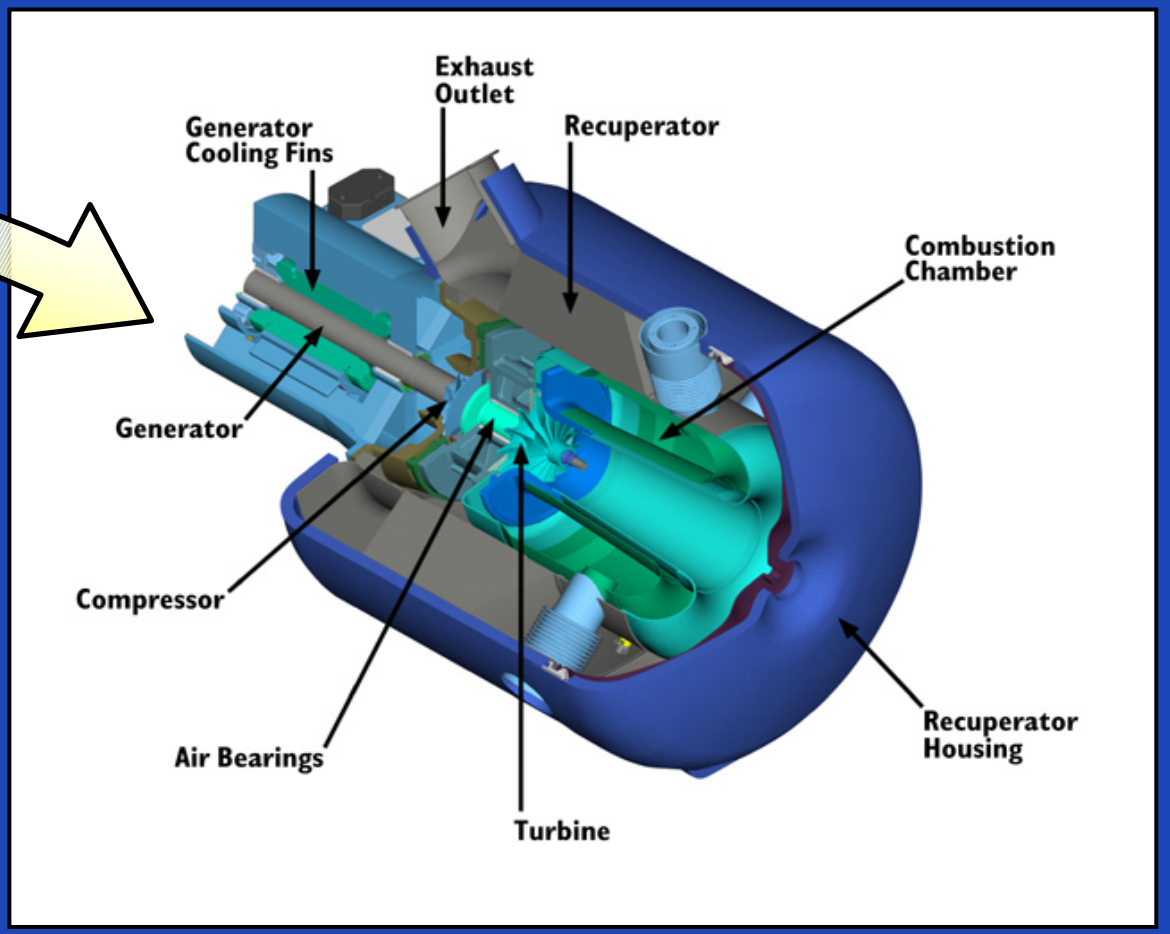

Microturbine ~ Basic Cycle

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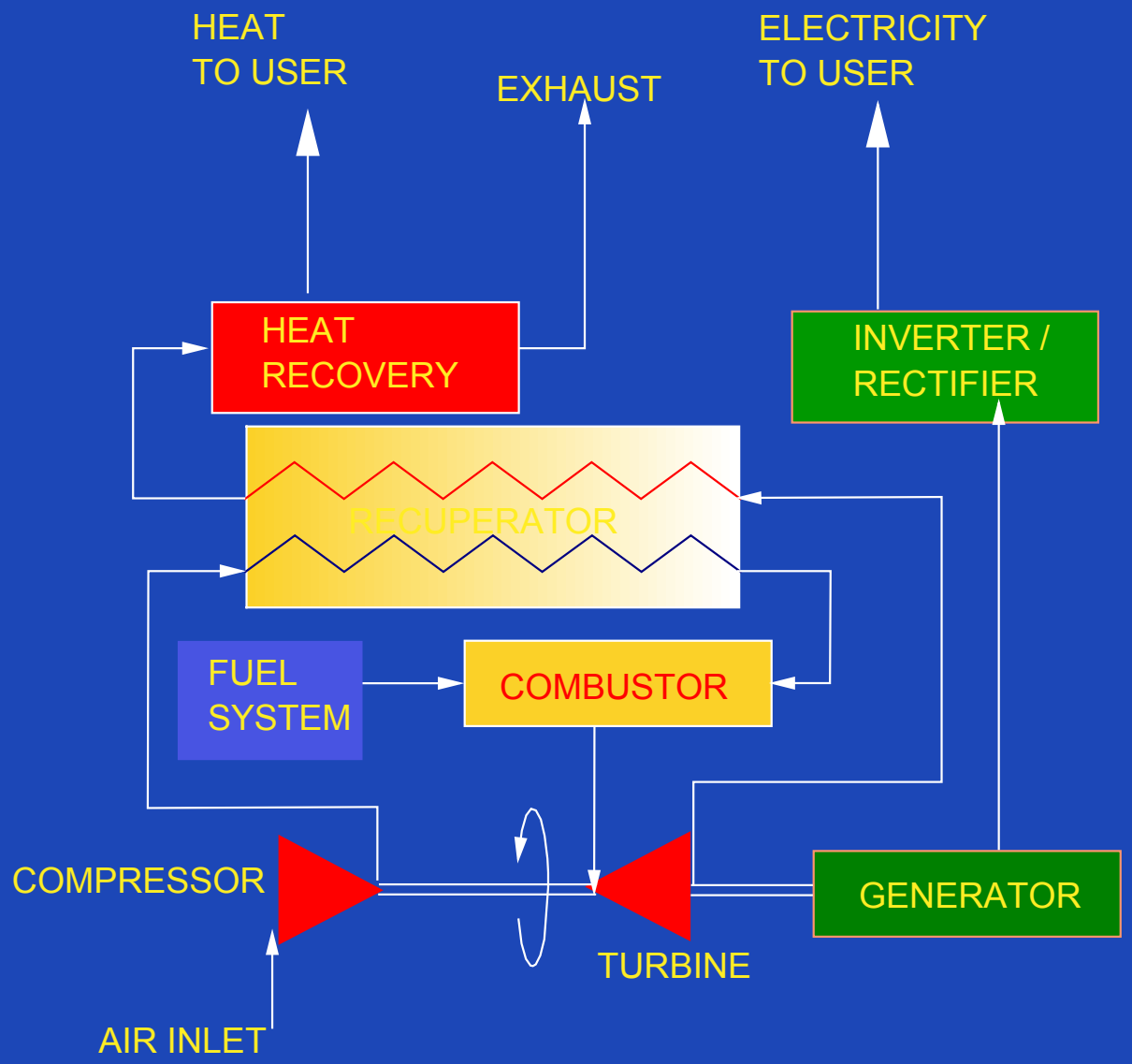

Performance

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- **Evaluation of in-service microturbine performance exhibited**
  - 26 to 28% electrical efficiency
  - Robust performance
  - Wide range of user configurations
  - Remote diagnostics and monitoring reduced turbine downtime
  - User-maintained initiative with respect to turbine operation

Early Adopter

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- **Horticulture market is generally characterised by**
  - Highly efficient operations
  - Technically advanced
    - Utilising the latest computer control equipment
  - Articulate
  - Well informed
  - Vertical and horizontal integration

Early Adopter

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- **11 acre (4.5 ha) site**
- **Single 30 kW of electricity generator**
  - Completed 6000 hours runtime
  - Exhaust into greenhouse without any gas clean-up
  - Shown to offer considerable like-for-like savings
  - Site-controlled operation of turbine to suit greenhouse crop

Summary

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- **Microturbine has shown**
  - Potential in the Horticulture Industry
    - Offering power and heat for the site (no export)
    - Good long-term performance
    - Flexibility
    - Real Savings