Principles, Practices and Pitfalls of **CHP Systems**

Presented by: Richard Meek, Sales and Technical Support, Shenton Group

This Presentation can contribute towards your CIBSE CPD requirement.
Objectives today

- Practical solutions to help you:
  - Select the right CHP for you
    - Avoid Common Pitfalls
  - Maximise Return on Investment
Agenda

- Drivers
- Core Principle
- Typical design, challenges and solutions
- Maintenance and Finance options
- Case Studies
- Discussion & Close
Drivers

WHY CHP?

- Power Failure
- Planning & Part L Compliance
- BREEAM CFSH
- CHP vs. Other Renewables
- Biogas & Waste Disposal
- Energy Cost Reduction
- Corporate Carbon Reduction

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Core Principle

SIMULTANEOUS PRODUCTION
Key Considerations

- Spatial & Acoustics
- Reciprocating Gas Engine
- G59 & Electrical Infrastructure
- Alternator Making Electricity
- Relationship With BMS
- Capture Waste Heat Energy
- Relationship With Boilers
- Design Philosophy
- Operating Strategy
- Key Considerations
Consider a CHP with a Performance
80 kW Electrical  120 kW Thermal
Consider a CHP with a Performance
80 kW Electrical  120 kW Thermal
Consider a CHP with a Performance
80 kW Electrical  120 kW Thermal

![Graph showing the relationship between thermal and electrical loads over the course of a day. The graph indicates a peak thermal demand of 120 kWt.]
Consider a CHP with a Performance

80 kW Electrical  120 kW Thermal
Consider a CHP with a Performance

- **80 kW Electrical**
- **120 kW Thermal**

![Graph showing the relationship between thermal and electrical loads over time](image)

- **Thermal Demand (kW)**
- **Electrical Demand (kW)**

- **120 kWt**
- **80 kWe**

**Time of day (hours)**

Date: 07/11/2014
Consider a CHP with a Performance

- 80 kW Electrical
- 120 kW Thermal

**Graph:**
- **Time of day (hours)**: 1 to 24
- **Thermal Demand (kW)**: 0 to 300
- **Electrical Demand (kW)**: 0 to 250

- 120 kWt
- 80 kWe
Consider a CHP with a Performance

- 80 kW Electrical
- 120 kW Thermal

7 hours
Impact of Thermal Profile

4,800 kWhrs x 365 days = 1,752,000 / kWhrs year
Impact of Thermal Profile

4,800 kWhrs x 365 days = 1,752,000 / kWhrs year
Impact of Thermal Profile

1,752,000 / kWhrs year
Design Philosophy

Heat Led vs Electricity Led
Design Philosophy

Heat Led

Remember Effect of Electrical Demand

![Graph showing thermal and electrical demand over time]

- Thermal Demand (kW): 120 kWt
- Electrical Demand (kW): 80 kWe

Exporting

Time of day (hours)
Operating Strategy

Lead Boiler / Modulation

Spark Rate
Relationship With Boilers

Poor Mechanical Scheme

Good Mechanical Scheme
Relationship With BMS

Integration with Peripherals

Modulation

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Network Upgrade Costs

DNO Application

Possibility of Rejection
Electrical Infrastructure

Relationship with Mains Power

Breaker Sizing

Cable Infrastructure
Remote Control and Monitoring Systems
Spatial

CDM Regulations!
...and some other common pitfalls...

- Misconceived Dump Rad use
- Illusions regarding value of export power
- Excessive return water temperature
Best suppliers will offer Design consultancy & support services throughout equipment life
Best suppliers will offer

- Design consultancy & support services throughout equipment life

Wide range and integration of all aspects required.
Best suppliers will offer

Integration with existing control & support systems

24/7/365 Maintenance

Compliance with:

Compliance with current & planned legislation

ISO 9001
ISO 14001

GAS SAFE

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• Fully inclusive Maintenance Packages
  • 24/7 Remote Monitoring
  • Next working day response on site
  • Monthly reports
  • Optional 1, 3, 5, 10, 15 year packages
Discount Power Deal

KEY REASONS

- Guaranteed Instant Energy Savings
- No Capital Outlay
- No operating expenditure for the equipment
- Overall reduction in operating costs
- An off balance sheet financial solution
- Increased Cash Flow
- Fully trained and skilled experts to do the work
- Reduce the costs of environmental taxation
- Option to buy your own Gas
Case Study - Energy Legislation Compliance

The Challenge

- New build multi-occupancy development required compliance with Part L, BREEAM, and CFSH as conditions of securing funding.
- Solar PV insufficient
- Biomass Boiler had excessive spatial requirements, and noise limitations precluded trucks delivering wood pellets.
- Ground source heat pumps unsuitable due to multiple buried services, and spatial limitations.
- Air source heat pumps would not match thermal demand profile of building.
- Wind turbines precluded on planning visual grounds.

The Solution

- Pair of Micro T30 Natural Gas CHPs eliminated all the above practical issues.
- 2 smaller modulating units enabled accurate matching to the thermal demand profile, maximising the running hours as much as 7000 hours p.a.
- Ultra low NOx units allowed emissions performance well below planning requirements.
- Water cooled alternators enabled use of fully sealed engine housing, giving 60 dB(A) @ 1m, allowing installation into plant room just below resident bedroom.
- Total efficiency over 95% gives a CO2 reduction of over 150 tonnes p.a.
- Development easily met the compliance requirements of Part L, BREEAM, & CFSH
Case Study - Substantial Energy Reduction

The Challenge

• Large Leisure Centre / Casino / Aqua-park part owned by local council, and part self-financed, needed to substantially reduce energy costs.
• Energy costs had risen to over 40% of operating overheads in last 5 years.
• Local council under pressure to demonstrate carbon reduction across its property stock.
• Profitability under scrutiny from local voters.
• Need to reduce energy consumption without limiting customer experience.
• Also, the facility was approaching the limit of available mains power, thus impeding future growth.

The Solution

• Selection of 200 kWe Natural Gas Cento Indoor Acoustic unit.
• Thermal demand carefully modelled to ensure heat output could be utilised.
• Dump radiator installed to permit electrical peak lopping even when limited thermal demand available. This allowed future-proofing of the incoming electrical supply.
• Narrow compact footprint of Cento design allowed lifting through the limited space in plant room roof.
• Unit now providing 3,000 MWhrs per year to offset grid electrical and thermal energy.
Feasibility desktop study

Powertherm Savings Calculator V13.3

<table>
<thead>
<tr>
<th>ELECTRICITY</th>
<th>Day Unit</th>
<th>Rate p/unit</th>
<th>Cost</th>
<th>Night Unit</th>
<th>Rate p/unit</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Meter 1</td>
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<td>9.2210</td>
<td>£137,981.02</td>
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<tr>
<td>Meter 2</td>
<td>£</td>
<td></td>
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<td>£</td>
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<tr>
<td>Meter 3</td>
<td>£</td>
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<td>£</td>
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<tr>
<td>Meter 4</td>
<td>£</td>
<td></td>
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<td>£</td>
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<td>Totals</td>
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<td></td>
<td>£137,981.02</td>
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<td>£</td>
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Total Units Used Per Year: 1,496,378
Blended Electrical Tariff: £0.0922
Total Existing Cost Per Year: £137,981.02
+ Climate Change Levy @ Cost / kWh: £0.00430
Total Existing Electrical Cost Per Year: £144,411.26

<table>
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<th>GAS</th>
<th>kWhrs</th>
<th>Rate p/kWh</th>
<th>Cost</th>
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<tr>
<td>Totals</td>
<td>1,525,409</td>
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<td>£37,219.98</td>
</tr>
</tbody>
</table>

Blended Gas Tariff: £0.0244
Total Existing Cost Per Year: £37,219.98
+ Climate Change Levy @ Cost / kWh: £0.00046
Total Existing Gas Cost Per Year: £37,921.97

<table>
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<tr>
<th>Capital Cost For Payback Analysis Purposes</th>
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<tr>
<td>Equipment Cost</td>
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<tr>
<td>Installation Cost</td>
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*Includes gas CCL reduction of 2.754 GJ from the DECC Good Quality CHP Scheme

Number of Units: 1
Powertherm Model: T30
Electrical Output kW: 30
Thermal Output kW: 62
Total Output kW: 92
Overall Efficiency %: 95.5%

Cost of Electricity After Powertherm: £121,249.53

Other Gas Uses on Site: £1,357,614
Hot Water Developed by Boiler kWhrs: £811,614
Powertherm Running Hours / Year: £8,000
Heat Produced by Powertherm kWhrs: £496,000
Electricity Produced by Powertherm kWhrs: £240,000
Gas Used Per Year to Run Powertherm kWhrs: £770,681
Maintenance Cost Per Hour: £0.60

Saving on Powertherm
Original Total Energy Costs: £168,921.23
New Total Energy Costs*: £154,482.23
Saving Potential Per Year+: £13,411.79
Number of Years Payback: 3.13
Total Tonnes of Carbon Saved Per Year: 86.73

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Thank you for joining us for this CPD Presentation