The cost-effectiveness of renewables – practical experience

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Scope of Workshop

Definitions of cost-effectiveness

Worcestershire County Council's experience with technologies:

- Biomass heating systems
- Ground source heat pumps
- Solar PV
- Solar thermal
- Building-scale wind turbines

A simple spreadsheet approach

Conclusions, discussion and feedback

Defining ‘cost-effectiveness’

Simple payback?
Whole life cycle costing?
Including or excluding grant assistance?
Energy cost savings compared with fossil fuel?
It is important to compare ‘like with like’

“Lifetime cost per tonne of CO2 saved” is my preferred performance benchmark

The cost of CO2 has been set for CRC at £12 per tonne

Practical example – biomass boilers

WCC has a total of 905kW of biomass boilers operational in May 2009

A total of 1,365kW will be on line by October 2009

Approximately 1,800kW predicted by 2011

Predicted annual CO2 reductions ~800 tonnes by 2011

Wood heat costs are currently 9% - 15% cheaper than gas heat, including boiler efficiency factors

The lower fuel and heat costs give rise to ongoing savings compared with fossil fuels such as gas, oil and LPG

These are all dual-fuel installations, include secondary boilers, and compare wood fuels with natural gas, i.e. worst-case figures


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Biomass boilers

County Hall 700 kW chip

King Charles Arts & Dance Centre 20kW pellet

Countryside Centre 25kW chip

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Typical outcomes – wood chip boilers *without* grant funding

County Hall 700kW chip – predicted payback 29 years

Lifetime cost per tonne of CO2 saved = £3.08

Cost per tonne including Carbon Trading effects = **-£23.92**

Countryside Centre 25kW chip – predicted payback 49 years

Lifetime cost per tonne of CO2 saved = £44.29

Cost per tonne including Carbon Trading effects = £32.29

Typical outcomes – wood chip boilers *with* grant funding (1)

Bewdley High 100kW chip – predicted payback in 17 years

25-year lifetime cost of CO2 saved = **-£23.47** per tonne

Cost per tonne including Carbon Trading effects = **-£35.47**

Sutton Park Primary – predicted payback in 20 years

25-year lifetime cost of CO2 saved = **-£16.81** per tonne

Cost per tonne including Carbon Trading effects = **-£43.81**

Typical outcomes – wood pellet boilers *with* grant funding (2)

St John's Library 30kW blown pellet – predicted payback: ***never***

25-year lifetime cost of CO2 saved = £136.49 per tonne

Cost per tonne including Carbon Trading effects = £114.90

Art & Dance Studio 20kW bagged pellet – predicted payback: ***never***

25-year lifetime cost of CO2 saved = £240.73 per tonne

Cost per tonne including Carbon Trading effects = £164.05

Biomass conclusions – what works, and what doesn't?

Wood chip boilers in the range 100-200kW with grant funding **are highly cost-effective** when compared to conventional gas boilers

Costs per kW installed: £246 - £279

Save money on energy costs AND reduce CO2 emissions at no cost

Large wood chip boilers ~700kW without grant funding reduce CO2 at competitive cost, but may have excessive payback periods

Wood pellet boilers in the range 20-30kW are NOT cost effective compared to gas boilers

Cost-effectiveness improves when Carbon Trading is factored in

Compare like with like…

WCC policy is to design dual-fuel installations

Primary boiler: biomass; Secondary boiler(s): gas, LPG, oil

Ratings shared 50:66, 50:75, 50:100 or 50:50:50

Other options that can reduce cost, but at increased risk:

- single or twin biomass boiler only, no secondary boiler
- connection points for mobile boiler in case of breakdown

Practical example - Ground Source Heat Pumps with vertical boreholes

Red Hill Primary School 130kW – predicted payback in **107 years**

25-year lifetime cost of CO2 saved = **£168.48** per tonne

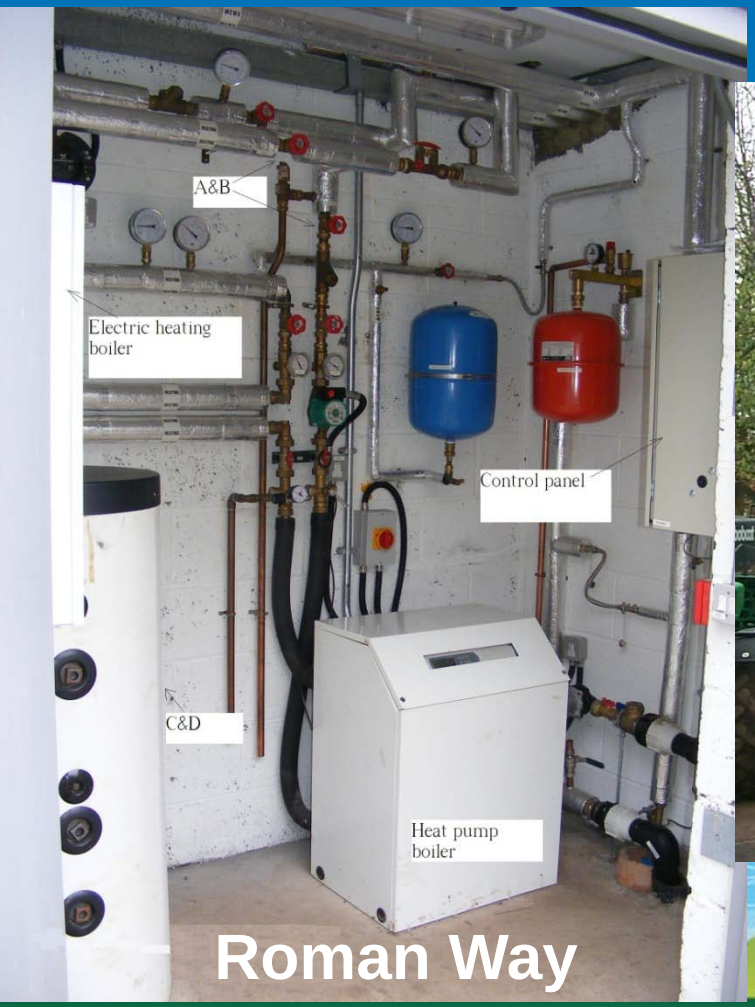
Cost per tonne including Carbon Trading effects = **£156.48**

Roman Way Children's Centre 14kW – predicted payback **114 years**

25-year lifetime cost of CO2 saved = **£183.80** per tonne

Cost per tonne including Carbon Trading effects = **£171.80**

Ground Source Heat Pumps



Roman Way

Red Hill Primary School

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GSHP conclusions – what works, and what doesn't?

Ground source heat pumps with vertical boreholes are a low-energy solution and reduce CO2 emissions

However, due to the high cost of peak-rate electricity, the operational cost savings are marginal

Costs per kW installed: £778 - £1,307

All sizes of heat pump seem to have excessive payback periods

Ground source heat pumps are NOT cost effective compared to biomass boilers for typical school heating systems

GSHP is the second-choice LZC technology if biomass is not feasible

Practical proposals – Solar Photovoltaic and Solar Thermal

Bromsgrove Childrens' Home PV – predicted payback in **14 years**

25-year lifetime cost of CO2 saved = **-£233** per tonne

Includes 50% grant funding, feed-in tariff and ROCs - **proceeding**

Chadsgrove School solar thermal – predicted payback **280 years**

25-year lifetime cost of CO2 saved = **£805** per tonne

Retro-fit into hydrotherapy pool, no grant funding **– did not proceed**

Solar conclusions – what works, and what doesn't?

Solar PV systems *can* be cost-effective, with substantial grant funding and a suitable feed-in tariff and ROCs

Costs per kWp installed: £1,000 upwards with grant funding

£3,000 upwards without grant funding

Solar thermal systems do NOT appear to be cost effective compared to gas for typical school centralised HWS systems, even with typical grant funding, due to the low value of the heat produced

Solar thermal systems *may be* cost-effective for swimming pool heating purposes, if displacing electricity or oil

Practical example – small Wind Turbines

The Fairfield Primary School 3kW – predicted payback in **90 years**

25-year lifetime cost of CO2 saved = **£201.55** per tonne

Cost per tonne including Carbon Trading effects = **£189.55**

The Chantry High School 6kW – predicted payback in **80 years**

25-year lifetime cost of CO2 saved = **£170.54** per tonne

Cost per tonne including Carbon Trading effects = **£158.54**

Small Wind conclusions – what works, and what doesn't?

Small building-scale wind turbines are NOT cost-effective

Costs per kWp installed: £2,667 - £6,000 at this scale

Whilst wind turbines are typically seen as the leading 'green' technology, below 50kWp they compare poorly with other renewables

However the 'green image' provided by a wind turbine can be of value

Cost-effective wind turbines start at about the 1MW size

A spreadsheet-based approach to sensitivity analysis

With so many variables, it is difficult to predict life-cycle performance of alternative technologies

Spreadsheet permits easy testing of sensitivity to variation in energy costs, capital costs, grant funding and carbon trading

The spreadsheet provided is ‘work in progress’ and is being used on an ongoing basis within WCC to analyse performance

A copy is available from pnharris@worcestershire.gov.uk 01905 766406

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Questions and Discussion

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