Wood Fuel Heating in Kent Schools

Key lessons learnt from Wood Chip installations at:

Valley Park Community School, Maidstone

&

St Augustine's Catholic Primary School, Tunbridge Wells

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Executive Summary and Conclusion:

This paper aims to record the planning and installation of woodchip heating in two Kent Schools and to record the lessons learned from the projects.

In particular the procurement process, costs and funding, savings and benefits are analysed, and Key Lessons/Recommendations are recorded to help inform any future plans around biomass in the KCC estate.

These projects have provided two working examples of wood fuel heating in Kent schools. They provide a financial saving to the schools and reduce CO_2 emissions from heating by around 90%. The projects have also helped develop the local wood fuel supply chain and put money into the local economy which would otherwise be spent with large multinational energy companies.

The capital costs were high and the capital costs per tonne of CO_2 saved does not compare favorably with traditional energy saving projects such as automatic lighting controls or lighting replacements, heating control improvements or insulation. Wood heating does however produce a much deeper cut in CO_2 emissions than most energy saving improvements.

It is clear from the analysis of costs and savings that financial arguments alone do not provide a case for wide scale roll out of retrofit woodchip heating across Kent Schools. However it should be borne in mind that in certain circumstances the economics are much improved - such as the following scenarios:-

- In buildings with higher and more constant heat load such as care homes
- If oil/gas prices rise significantly above current levels and wood chip price is stable
- In ‘new builds’ where the capital costs should be lower
- In completely new BSF schools where Govt. requires very low carbon emissions
- The Renewable Heat Incentive (RHI) may introduce a significant improvement to the economic case in future installations.

Ultimately, as with many renewable energy options, Biomass needs to be considered on a site by site basis taking consideration of the rapidly changing economic scenario and the practical issues at the site.

The Key Lessons Learned/Recommendations should be taken on board while planning future Biomass boilers.

Background – Why Biomass?

The South East is the most wooded region of England. Kent is no exception and in particular has many thousands of acres of sweet chestnut coppice. Although the resource is great, traditional industry demands (such as from pulp mills) have waned in recent years and the south east has one of the lowest presences of processing industry in the UK. These factors combined have led to a situation whereby much of the woodland resource has not been managed for many years. Wood fuel heating presents a viable solution to two significant problems – reducing carbon emissions and strengthening the rural economy through demand for wood fuel.

Modern woodfuel boilers are highly efficient, clean and smokeless. Automated woodfuel systems provide value to a low value product, keep the 'energy pound' in the local economy, create jobs, promote improved woodland management, reduce reliance on fluctuating fossil fuel prices, are carbon neutral and can have cheaper running costs than mains gas.

With growing concerns about future energy costs, security of supply and the contribution of traditional fuels to Climate Change, wood fuel or biomass was identified as an alternative worth exploring.

With the above in mind KCC set the Towards 2010 Target 42 which included the requirement *"Trialing the use of bio fuels and other new technologies"*

Site Selection:

In 2006 KCC commissioned Creative Environmental Networks (CEN) to carry out a Biomass and renewable energy feasibility study on around 50 Kent schools known to have boilers approaching the end of their life.

CEN examined practical issues such as access for fuel delivery vehicles, space for woodchip storage and space in boiler rooms for larger biomass boilers.

The study identified 22 which were viewed as feasible and these were rated between 1 and 5 (easy to hard). During the surveys Valley Park Community School in Maidstone and St Augustine's Catholic Primary in Tunbridge Wells expressed high levels of interest and were both keen to be pilot schools. Since both had rated highly in the feasibility study these two sites were selected as pilots.

Overview of Projects:

The two projects differ in terms of fuel delivery technology, size, procurement process and project management, allowing useful comparisons to be drawn. Following is a brief overview of each project.

Valley Park Community School - Maidstone

Design at Valley Park was carried out by Econergy and influenced by the initial feasibility survey produced by CEN. This resulted in the two 500kW oil boilers being replaced with a 500kW gas and a 500kW Froling Turbomat Woodchip boiler manufactured in Austria. Fuel delivery is by hook lift bin – chosen because there was no space within existing boiler room for woodchip storage. The old oil tank rooms were situated away from the boiler house and so were not useable for woodchip storage.

Sufficient space was available for an extension to be built for wood chip storage but the hooklift bin outside the boiler room was judged a better overall solution. The hooklift bin links by auger to a silo which holds around 3 days of woodchip, allowing time for the hooklift bin to be taken away and refilled.

The boiler is fed by auger from the silo.

Fuel is supplied from John Leigh-Pemberton's estate (Torry Hill Farm) via South East Wood fuels at a price of approximately 2.7p/kWh. The woodchip travels approximately 12 miles.

St Augustine's Catholic Primary School – Tunbridge Wells

Design work was commissioned by the school and carried out by MCA. Unlike Valley Park, St Augustine's are limited for wood chip delivery space. A chip store was constructed inside the old Oil tank room but due to ground levels there is no easy access for woodchip to be tipped into the store and no space for a Hooklift Bin. The solution taken was to tip woodchip from a tipping tractor-trailer into a metal trough. An auger at the bottom of the trough draws the chip into a blower, which blows the chip through a duct into the chip store (the old oil tank room). Wood chip is drawn from the store into the boiler by a further auger.

A 150kW chip boiler and 200kW gas boiler were installed to replace two existing boilers of unknown capacity.

Fuel is supplied by the Neville Estate in Eridge, approximately 3.5 miles away via a contract direct with the school at an initial price of £21.93 per cubic meter of G50 hardwood – which is equivalent to around 2.49 p/kWh. The school has now shifted to G50 softwood at £16.36 per cubic meter from the same source. The softwood option is cheaper but will have a lower calorific value i.e. less energy per cubic meter. Therefore the softwood price is equivalent to around 2 p/kWh.

Procurement:

Valley Park Community School

Valley Park is a Community school meaning that boiler replacements would normally be funded and managed by KCC – it was therefore natural for KCC to oversee the entire procurement and installation under a similar management process to a standard boiler replacement.

After speaking to a number of biomass specialists, other customers, and attending various biomass seminars, the KCC Energy team judged that the marketplace was very light on genuine expertise and experience and it was therefore very important to work with a recognized specialist for the pilot projects. Econergy were identified as one of the leading specialists in the field with greatest experience of installations of the type being considered. Econergy was commissioned in March 07 to produce a full design and costing to enable KCC to seek funding sources and set budgets, this was supplied in April 07.

The decision was taken by the School and CFE to go ahead with the project using various funding sources (discussed later). Mouchel as the KCC consultant covering Maidstone were instructed in September 2007 to manage the project.

It was hoped that since the project was a pilot of specialist nature which no contractor on the KCC approved list has significant experience of, econergy could be selected as the main contractor. However, the decision was taken that this would not meet procurement rules and the project must be tendered, and so Mouchel were asked to prepare tender documents and run a tender for a main contractor based on the design provided by econergy.

The tender process was completed in April 08 and one of the tenderers provided a low price based on using a Hertz boiler rather than the Froling boiler specified by Econergy. The decision was then taken to retender the project giving all tenderers the opportunity to quote on their own specification of boiler rather than that specified by econergy.

It was then realised/clarified that one of the main funding sources (the Low Carbon Building Programme) required that installations be carried out by an approved biomass specialist from the ‘Greenbooklive’ list.

At this time (May 08) KCC were faced with the choice of either accepting the best price based on main contractor using econergy for the biomass elements or postpone the project to the following year and require a new procurement process, and risk losing grants. Long boiler lead times limited the time available for further consideration and the decision was taken to proceed with the lowest combined price of GM Mechanical as main contractor and econergy as biomass specialist sub-contractor.

The project was completed in December 2008.

St Augustine's Catholic Primary School

St Augustine's is a Voluntary Aided school and as such decisions around boiler replacements and finance fall on the Archdiocese of Southwark. The school and Archdiocese were happy to progress with the biomass project, managed by a school Governor (David Glynn) with extensive project management experience.

Terry Whitlock and Terry Hurley of KCC visited David Glynn at the start of the project to be satisfied that proper plans and procedures were being taken to ensure KCC's interest was protected.

The procurement process was managed by David Glynn including preparation of Tender Documents. MCA were appointed as consultants/project managers for all works within the boiler house, Tugwell Heating as main Mechanical Contractor and Rural Energy as Biomass specialist sub-contractor.

Installation took place during 2008 and wood fuel was used from October 08.

The procurement exercise was more straightforward at St Augustine's partly because they were not relying on a Low Carbon Building Programme Grant and hence were less restricted on contractor choice. It may also be that the school felt less constrained by Procurement rules than KCC were with the Valley Park project.

Costs and Funding:

Valley Park Community School

GM mechanical / econergy	-£388,000
Mouchel fees	-£27,000
Total cost (including 10% provisional sum)	**-£415,000**
CFE - judged as costs of standard replacement	£125,000
Govt. Low Carbon Building Programme Grant	£93,000
KCC biomass pot	£167,000
edf grant	£30,000
Funds allocated	**£415,000**

St Augustine's Catholic Primary School

Total cost (148k from Pinnacle for standard gas, plus 70k for biomass from Wood Energy)	**-£218,000**
From LCVAP and School (judged as standard boiler replacement cost)	£148,000
Grant from KCC Biomass pot	£70,000
Funds allocated	**£218,000**

Valley Park has proved to be a much more expensive Capital Project than St Augustine's for the following reasons:

1. Larger heat demand and so larger boilers required
2. More expensive delivery system (hook lift bin arrangement)
3. More expensive project management route (Mouchel)
4. At Valley Park we may have an underestimate of what a standard like for like Oil boiler replacement may have cost – which makes the Biomass capital cost appear artificially high.

Capital Cost Comparison per installed kW

	Valley Park School	St Augustines School
Capital cost per installed kW Biomass elements only	£580/kW	£466/kW
Capital cost per installed kW Whole project	£415/kW	£623/kW

Benefits and Savings Summary:

Valley Park Community School

Total Capital Cost	£415,130
Additional Capital Cost for Biomass elements	£280,068
Additional Capital cost less external grants	£157,068 i.e. additional cost to KCC
Fuel cost savings per annum (oil to biomass)	£10,200
Payback (additional capital / fuel cost saving)	15 Years (inc grants)
Total Carbon saving (over 17.5 year persistence)	1977 Tonnes CO_2
Extra Capital Cost per tonne of carbon saved (use 17.5 years persistence)	£142 per Tonne CO2 saved

St Augustine's Catholic Primary School

Total Capital Cost	£192,364 NB: No management fees
Additional Capital Cost for Biomass elements	£81,397
Additional Capital cost less external grants	£81,397
Fuel cost savings per annum (oil to biomass)	£5,591
Payback (additional capital / fuel cost saving)	15 Years (no external grants)
Total Carbon saving (over 17.5 year persistence)	761 Tonnes CO_2
Extra Capital Cost per tonne of carbon saved (use 17.5 years persistence)	£107 per Tonne CO2 saved

Note: Oil and Wood chip fuel prices used are the current prices. If Oil increases more quickly than Biomass in future then the savings will increase and payback will decrease e.g. if oil prices double then paybacks will be halved.

The 'Persistence' is a figure from the Carbon Trust and is an estimate of the number of years over which the saving will be made.

Valley Park is paying a higher price for their fuel due to the greater distance from fuel source, and more expensive delivery vehicle. St Augustine's fuel is delivered direct by the woodland owner by tractor and trailer whereas Valley Park's is delivered through a third party using a hook lift vehicle. This improves St Augustine's payback figure and demonstrates the importance of local fuel supply.

The Cost, Savings and Payback figures in the tables are fairly self explanatory. The cost / tonne of CO_2 is a measure used to compare cost effectiveness of energy saving or renewable energy projects. The KCC/Salix Energy Loan Fund which is aimed at short payback (low hanging fruit) projects must have a cost per Tonne CO2 saved of less than £100/Tonne. So both biomass projects are a more expensive way of saving CO_2 than Energy Saving projects covered by the Energy Loan Fund.

From April 2011 Govt. plan to introduce a Renewable Heat Incentive (RHI) which will provide financial payment for renewably generated heat. These projects are unlikely to benefit from the RHI, but projects installed from April 2011 forward will do.

Display Energy Certificate Ratings and the Carbon Reduction Commitment

Since biomass has very low Carbon emissions compared to oil or gas it makes a significant improvement to the DEC rating. It is estimated that heating using biomass rather than oil will lead to approximately a 50 point improvement i.e. taking an E grade to a C grade, or a D grade to a B Grade.

From April 2010, KCC along with other large public and private organizations will be mandated to take part in the Carbon Reduction Commitment (CRC). The CRC will provide KCC with financial bonus or penalties according to whether it manages to reduce its overall Carbon emissions. The two biomass projects discussed here are not large enough to have significant impact on KCC's overall CRC position but wider use of biomass in the KCC estate certainly could help improve KCC's CRC position.

Key Lessons Learned / Recommendations:

Procurement process

Difficulties were encountered throughout the Valley Park project which were partly caused by the rushed procurement process. The procurement process should be identified and agreed with all interested parties well before commencement. Biomass specialists should be identified and placed on a select list to ensure that competitive choice can be made between contractors with relevant experience and expertise.

Fully understand conditions imposed by grant giving bodies (particularly relating to approved contractors and products).

Specialist contractors

Biomass installations are significantly different from standard oil or gas heating installations. Therefore specialists or contractors with considerable biomass experience should be used.

It's preferable to use a biomass specialist as the main contractor or have the main contractor select and employ the biomass specialist rather than the client (KCC) select the Biomass Specialist and Main Contractor separately. The set up at Valley Park led to responsibility for a number of technical issues falling between the Main Contractor and Specialist.

Project management

The level of management required for both projects was significantly higher than that of a standard gas or oil installation. At Valley Park the project was managed by Mouchel while St Augustine's was effectively managed at no cost by the school Governor (David Glynn). It's important to note that the lower cost management route used at St Augustine's is unlikely to be repeatable as very few schools will be able to draw upon a Governor with the relevant skills and time commitment.

When planning project management of a Biomass project its important to take account of the additional time/resource requirement and the need for experience with Biomass.

Costs, Savings and Payback
Biomass projects require higher capital input. The costs at Valley Park rose considerably higher than the initial indication provided by Creative Environmental Networks (CEN) back in 2007. The 'additional cost of biomass' indicated by CEN for Valley Park was £150k whereas the actual additional cost before grants was £280k and £157k after grants.

Because of the higher capital costs it becomes even more important to correctly size the Biomass boiler. At Valley Park the system is oversized to allow for future growth in the school and expansion of the heat network from the biomass boiler so that the extra capacity will be used.

The Simple Payback (additional capital cost/savings) at both sites is estimated at around 15 years which is considerably higher than the 6 to 11 years indicated by CEN in 2007.

Although both sites have very similar apparent payback their costs and savings are quite different i.e. Valley Park had higher capital cost and higher woodchip fuel price but grants were attracted which offset the higher capital cost. The ideal would be an amalgamation of both projects i.e. correctly sized boiler, very local low cost woodchip supply, and maximum capital support from external grants.

The projected cost of Oil and Gas has a major impact on the savings and hence payback calculation. If Oil and Gas prices rise significantly in future then the savings increase and payback decreases. I.e. the case for woodchip improves.

Woodchip Supply
Valley Park is paying around 35% more for Wood Chip than St Augustine's. This is because St Augustine's are taking wood direct from a local woodland owner delivered by tractor and trailer whereas Valley Park's woodchip is delivered from approximately 12 miles away via a third party.

These price differences highlight the importance of very local fuel sources. It is imperative to consider the fuel source and cost when assessing Biomass project feasibility.

Boiler Sizing and 'Back up'

Both projects use a mixture of one Wood Chip and one Gas boiler. It is not true to say that the Gas boiler is a 'back up' to the Biomass boiler since the total installed heating capacity has not been increased.

It is however judged as a sensible approach to install this mix of Gas and Biomass to provide greater fuel security and a more robust heating system. If one or other fuel was not available it is expected that the schools would still be adequately heated using the other fuel on all but the coldest winter days.

Grants and Funding
Grants from Government, utility companies or charitable trusts make a significant difference to the economics of a Biomass project and should be sought wherever possible. However different grant sources run on different timetables and few are guaranteed so it will usually be necessary to make the decision to progress with a biomass project before it is known how much grant funding will be attained. It is therefore imperative that a budget is available with a contingency allowing for the possibility that no grant funding is achieved.

Looking forward it is likely that Government grants for biomass boilers will reduce or disappear and be replaced by a Renewable Heat Incentive (RHI). The RHI will provide a significant financial payment for each unit of heat produced by biomass. This is likely to mean that capital borrowing of some sort will be required to fund new projects and should support the provision of biomass projects through Energy Services Companies (ESCO). ESCOs can fund and manage the installation of biomass boilers and recover the costs by selling heat to the client and claiming income from the RHI.

System Maintenance
Maintenance costs for Biomass Systems are higher than for Gas or Oil, for example the annual servicing cost at Valley Park is expected to be around £5k per annum rather than around £2k per annum for the Oil boilers. Biomas heating systems are more expensive to maintain because they generally include larger numbers of moving parts and equipment such as motors to transfer fuel from the store into the boiler.

There are also issues around availability of spares for boilers produced outside the UK, and a lack of suitably qualified local maintenance contractors. These are issues which are more likely to be overcome as the number of installations increase and can also be eased by favouring the use of common boilers and similar designs to other local installations.

As well as the higher cost annual servicing there is also a greater requirement for maintenance/management of the biomass plant by on site personnel e.g. occasional emptying of the Ash Bin, checking for blockages in feed systems, monitoring fuel levels. Many primary schools have low levels of engineering expertise amongst caretaking staff, this isn’t conducive to operating a biomass heating system.

These higher servicing costs and greater requirement for onsite management must be considered at Biomass feasibility stage.