The analysis report of the client's heating system in Southampton, United Kingdom   Geothermal savings

The trial

The Kiko cartridge was installed in the filtration unit at the client building, a substantial 7-storey building in Southampton, UK, on Monday 7th January 2013. The unit was then connected to the heating water system so that the Kiko cartridge was in contact with the water of the heating system.

The historic data

Monthly data for kWh was provided by Skandia for August 2011 to July 2012 covering the following meters:

- Main incoming gas
- Basement Geothermal
- Kitchen

The kitchen meter had stopped working and the data available was unreliable so this meter's data was excluded from the calculations.

The data from these meters for these months is shown in the 'client calcs' spreadsheet, sheet one.

Historic data analysis

The Geothermal kWh in 2012 January to April was 59,011 is lower than the total kWh from the Geothermal from 7th Jan to 30th April 2013 is 77,600. This is because in 2013 only geothermal heating was used whereas in early 2012 both geothermal and incoming gas heating was used, meaning that we have to look at both of these.

Looking at the main incoming gas figures comparing the Jan to April readings in 2012 with the summer reading (Aug 2011 had 20912 kWh used, mainly by the kitchen) then we have an increase in main incoming gas use which would be used for heating as follows:

- Jan 2012 212493 – 20912 = 191,581 kWh
- Feb 2012 217283 – 20912 = 196,371 kWh
- Mar 2012 47748 – 20912 = 26,836 kWh
- April 2012 43226 – 20912 = 22,314 kWh

This gives a total of 437,102 kWh for heating for the first four months of 2012 from incoming gas.

So the total from these incoming gas readings plus the geothermal comes to:

437,102 + 59,011 = **496,113 kWh** for 1 Jan to 30 Apr 2012

Compared to **77,600 kWh** for 7 Jan to 30 April 2013, a reduction of 84% in the kWh usage. According to British Gas consumption should have gone up by around 16% in the first quarter of 2013 compared to the first quarter of 2012 due to the colder conditions in 2013.

Whilst it seems unlikely that we have achieved an 84% reduction by using Kiko, but this is what the bare figures say. Possible factors that could have also influenced the figures are:

1. It is possible that the incoming gas boilers are very inefficient so by using only the geothermal heating some of the efficiency increase could be down to not using these incoming gas boilers in 2013.
2. There was a lower occupancy rate of client building in 2013 compared to 2012, meaning some areas were not heated. However this is likely to have had only a marginal effect as people and their machines also produce their own heat, and the unheated areas would have picked up heat from the heated areas.
3. The figures from the meters used in 2011/12 are untrustworthy. This seems unlikely but can be checked against the utility bills.

Due to these uncertainties we cannot be sure exactly how many kWh were used from the Main Incoming Gas in the first four months of 2012 for heating, although from the figures we can see that it was very substantial when zero was used from incoming gas in 2013.

An 84% reduction in energy used for heating when we should expect around a 16% increase due to the colder weather is a massive improvement that cannot be attributed to the above three points and there has to have been a major effect from the introduction of the Kiko cartridge, but precisely what cannot be determined exactly.

The degree days data

The correct way to compare energy usage reliably against what would have been the case before Kiko was introduced is to compare the energy used per degree day. Degree days is a standard whereby if, for instance, the offices are heated to 20^{O} centigrade and the average outside temperature on that day is 8^{O} centigrade, then the degree days for that day is 12. Measuring the amount of heat in kWh needed to bring the temperate of the building up from 8^{O} to 20^{O} gives the amount of kWh needed per degree day. So as the temperature outside varies then the amount of kWh needed varies each day.

This has been found to be a very reliable way to know how many kWh are needed to heat a building. Although every building is different the relationship between degree days and kWh needed has been shown to be a straight line relationship and this has become an industry standard way to measure the energy efficiency improvements for buildings. Oxford University provide table of degree days for different locations around the UK, including the Solent area.

Client building is heated to approximately 22^{O} centigrade because it is an office, but there is always a residual heat from people in the building and from equipment such as computers, meaning that a couple of degrees needs to be knocked off so the degree days baseline used for client building was the 20^{O} centigrade tables.

The detailed meter reading and degree days are shown in the 'Client calculation sheet three. By summarising the data by week and by month the amount of kWh needed per degree day can be compared. Taking January 2014 as the baseline (despite the fact that Kiko would have brought some improvements even in January), the reduction in kWh required to heat the building per degree day was;

- January 2013 0% (baseline month)
- February 2013 9.94% fewer kWh per degree day
- March 2013 24.03% fewer kWh per degree day
- April 2013 27.00% fewer kWh per degree day compared to January.

This shows a gradual improvement in heating efficiency over the months of the trial. This is likely to continue, including a further improvement when the system is next flushed of what will now be very dirty water full of scale that has been cleared off the pipework, valves and heat exchangers.

The cost savings

Taking the total degree days for 2012 as the annual amount for an 'average' year (although 2013 is likely to be higher due to the colder weather), this was 3270.457 degree days in 2012. Taking the efficiency of the system as measured in January 2013 as 54.6036 kWh per degree day then for a year we get:

3270.457 x 54.6036 = 178,578 kWh

Taking the efficiency of the system as measured in April 2013 as 39.86 kWh per degree day then the equivalent of this efficiency over the full year is:

3270.457 x 39.86 = 130,362 kWh

This gives a saving of:

178,578 – 130,362 = 48,216 kWh over the full year.

At 3.74 pence per kWh for the geothermal this comes to a **saving of £1,803 pa**.

In fact this is more likely to be a saving of the incoming gas as the incoming gas does not have to be switched on any more because the geothermal can cope. So for instance saving the same amount of kWh on the incoming gas side at 10 pence per kWh the **saving would be £4,822 pa**.

In addition there are savings from:

- A reduced carbon tax levy
- Reduced maintenance costs as the system will no longer need to be cleaned out regularly and fewer chemicals (if any) will be needed to reduce scale
- Reduced repair costs as things like heat exchangers, valves, pumps and pipework is kept clear of scale at all times and need to be replaced less frequently
- Reduced need to power the heating pumps as the energy transfer is more efficient
- Longer longevity of the boiler due to a reduced load and due to scale not being present.

A reduction in the Carbon tax levy

Natural gas is equivalent to 0.1836 kg Carbon Dioxide per kWh. As Kiko is enabling the client not to use the incoming gas for heating, so a saving of 48,216 kWh from the above is equivalent to a saving of 8,852 kg Carbon Dioxide. At £0.012 per kg Carbon Dioxide this comes to a **saving of £106 pa** from the carbon levy.

kiko TECHNOLOGY

Reduced maintenance costs

Saving on regular clean outs of the system and the need for fewer chemicals **should save at least £1,000 pa.**

Reduced repair costs

With fewer expensive repairs needed, such as for heat exchangers, valves and pumps this should also **save £1,000 pa**.

Reduced need to power the heating pumps

As the energy transfer is more efficient and there is less heating water volume needed to be pumped. If the annual kWh used by the heating water pumps is of the order of 10,000 kWh, then a 27% saving would be 2,700 kWh, which at 10p per kWh would be a **saving of £270 pa.**

Greater longevity of the boiler and heating system

The lifetime of boilers is around 15 to 20 years. With a lower loading and scale issues removed it is estimated that boilers using Kiko water will last at least 25% longer. If a boiler costs £50,000 then over 20 years that is equivalent to £2,500 pa. if it lasts 25 years then that is equivalent to £2,000 pa, a **saving of £500pa.**

TOTAL SAVINGS

•	Reduced kWh used of geothermal energy	£1,803 pa
•	Reduced carbon tax levy	£ 106 pa
•	Reduced maintenance costs	£1,000 pa
•	Reduced repair costs	£1,000 pa
•	Reduced power to the heating pumps	£ 270 pa
•	Greater longevity of the boilers	£ 500 pa
	TOTAL SAVINGS:	£4,679 pa

Sharing these savings 50/50 as per the Kiko agreement would mean a cost of £2339:50 per annum to Client for a saving of at least this amount to the Client.

The savings of 84% compared to the previous have not been used in these calculations of savings although there is a real and substantial cost saving to Client from this. In addition the incoming gas system can be more or less totally used only as a backup the savings from using Kiko are in fact likely to be much higher than the £4,679 pa identified.

This could also be part of a major publicity exercise to show how client is acting and innovating to reduce its carbon footprint, be a responsible company and save money all at the same time.

By Kiko Technology Limited
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