How to write a brief for a heating system for heat pumps, solar thermal and solar photovoltaic projects.

A guide for property owners and installers.

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1. About the author

With a degree in product design and manufacturing, John spent the early part of his career in Australia and Malaysia working in design consultancy designing, for brands such as Whirlpool. Returning to the UK, he took a role with Dyson Ltd, where he became the head of the team that supported current products and later moved into project management for the research and development team. He moved to Applied Energy Ltd as the Brand Manager for the Creda heating and hot water range and later for Xpelair commercial ventilation. In 2008 he moved to Stiebel Eltron UK as the Head of Technical, to set up the UK operation for this large German manufacturer of heating and hot water products. He is the current chairman of the Domestic Heat Pump Association Technical Committee and winner of the “Contribution to Energy Efficiency Award” in the Natwest Energy Efficiency and Renewables Awards 2013.

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Stiebel Eltron provides innovative technology to heat your home, conserve energy and reduce your bills.

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Try our free specification service for heat pumps or contact us today on

0151 346 2300 or email info@stiebel-eltron.co.uk

3. Introduction

This book is designed to help you write a good brief for your renewable heating project. It sets out the key questions that need to be asked to ensure that the choice of design and product will meet the needs of the end user. A good written brief is always a help to protect the interests of all parties in a project because it provides a clear reference of what is expected from the project and a benchmark against which success can be measured.

It isn't necessary to know all about the various technologies on offer to write this brief. If you are an end consumer you should focus on providing the key objectives and desired outcomes of your project. Your installer can help you fill in the technical gaps. This booklet will help you think through what is driving you and the resources you have on site to be taken into consideration when a proposal for the best option is made. It will also help you with evaluating responses to your brief.

If you are an installer then this document provides a useful checklist and framework to help you work with a customer and take to a manufacturer for detailed discussion of suitable technologies and specific products.

At Stiebel Eltron we are always happy to help if you are planning a renewable heating project. We offer a unique free specification service for all our technologies and can help with all other enquiries about integrating our products with other technologies.

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4. Sizing your system

How large and powerful your heating system needs to be depends on a number of different factors. The size and age of the property is the place to start with this process (see table below). As increasing standards in building regulations over the years have led to increased heat retention, newer properties have become more energy efficient and tend to require less powerful heating systems to maintain a comfortable winter temperature. To perform this basic calculation you just need to know the floor area of the property and its age to apply the energy requirements per square metre given below.

Age of house	Energy required for heating
2006-now	45 W/m^2
2002-2005	48 W/m^2
1995-2001	64 W/m^2
1979-1994	135 W/m^2
older than 1979	188 W/m^2

This quick rule of thumb calculation is enough, in many cases, to begin the briefing and quoting process. Before a detailed technical specification is completed and the final selection of technologies made, a full heat loss calculation should be performed on the building using a method that complies with BS EN 12831. This calculation will take into account more factors, such as the material from which the building is made (and how quickly heat passes through that material), the thickness of the walls, how many windows there are (and whether they are double glazed) and so on.

Heat loss calculations are carried out by some installers themselves, whilst others prefer to use specialist consultants. If you want to do it yourself, there are spreadsheets and calculators online – British Standard compliant calculators and spreadsheets for sizing heat pumps for example are available free from the Microgeneration Certification Scheme website at

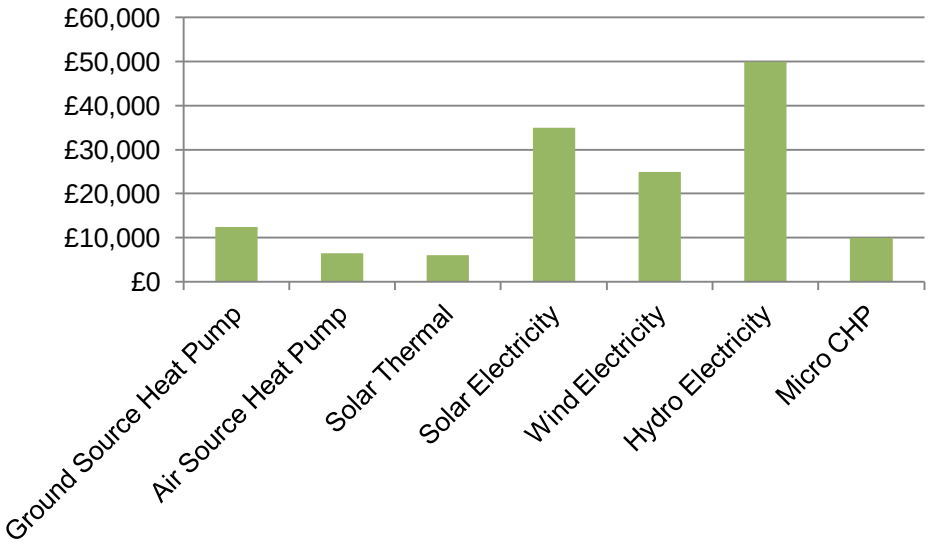
http://www.microgenerationcertification.org/mcs-standards/reference-materials/heat-pump-reference-materials.

5. Setting a budget

You may already know exactly what you have in the pot to spend on this project. But you may not know if this will limit your choices or gives you lots of scope to do extras. Alternatively, you may just be allocating budget from an overall build cost, and need to know what to put aside.

To help you with this, here are some basic rule of thumb costs for installed technologies.

Average installed costs of a 10kW system



Obviously these can vary considerably dependent on the complexity of an installation and many variables that surround each installation, but they do give an idea of how technologies compare.

Biomass boilers are not typically installed on a small scale so you can't compare costs at 10kW as costs for a 100 kW system are around £50-70,000.

6. Understanding the impact and space requirements of different technologies

If this is a new build project then it is vital to ensure that your architect and builder are briefed to consider the space requirements for renewable technologies at the beginning of the project. Very often we see clients who have left this too late in the design and planning process and find that they have not allowed enough room for the technology they require. To this end, it is worth spending some time familiarising yourself with the impact and requirements of different heating technologies as early as possible in your project. These requirements might influence your overall design. Here are just a few facts that might be relevant as an example:

- Biomass boilers require significant storage space for the fuel. Even the average home may need room for a large dedicated shed with access for deliveries.
- Installing a ground source heat pump may mean digging up land to install a ground loop collector (and you will attain 25W per square metre and up to 50 W per linear metre of borehole so you need to calculate if you have enough suitable land for your needs).
- Air source heat pumps, on the other hand, often have a relatively small footprint and are easy to install; but tend to produce slightly more noise than ground source machines. This needs to be a consideration when thinking about the positioning of the outdoor unit.
- To make significant contribution to hot water production you will need at least 5 square metres of un-shaded south facing roof for solar thermal panels.

A solar collector and two medium sized air source heat pumps installed externally

Collector for ground source heat pump and a pump installed in a utility area

7. The project drivers and objectives

New build

If you are building a new property then you will be driven largely by the building standards and regulations that you are required, or choose, to meet. Planning permission for new build is by law subject to meeting Part L building regulations for the conservation of heat and power (see http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/approved) .

Local planning authorities may also enforce their own additional requirements, an example being Merton in London, where the "Merton rule" requires new developments of ten homes or more to generate at least 10% of their energy needs from on-site renewable energy equipment. Some authorities also require compliance to the Code for sustainable homes (http://www.breeam.org/page.jsp?id=86) which is a more holistic approach to sustainability, it includes such considerations as whether you use local materials and whether there is storage or parking for bikes.

Essentially, part L of building regulations will require your home or property to meet a standard of energy efficiency laid down by the government. To achieve this standard, you need to follow a process. An accredited assessor must enter the details of your building into industry standard software, the output of which is a TER (target emissions rate – this is the target for the carbon emissions of your building) which you must hit. This may be by such measures as improving your glazing or insulation or using renewable heating systems. Because renewable heating systems use less carbon, they help you hit your score and offset less efficient features of your

design. Once you hit the target you get a SAP (standard assessment procedure) certificate, which says that your design meets Part L, allowing you to progress your planning application (provided there are no extra requirements).

For commercial buildings the process is similar but a different assessment standard is usually applied – this is the SBEM / BREAM Standard (building research energy assessment model) for commercial buildings.

Your first challenge is to find out which regulations you will be subject to. The best place to start is your local planning authority. If simply meeting the minimum standards required is your aim, then the first part of your brief is to state this – and what percentage you need from your renewable system to hit your TER.

You may however choose to meet a more stringent standard than that required by your local planning authorities, to future proof your home against rising costs or because you wish to be as green as possible. Well recognised standards for greener homes include the Code for Sustainable Homes and the Passive Haus Standard (the gold standard for green homes) If this is what you wish to achieve then read on into the next section regarding retrofit homes, where we cover these project drivers in more detail.

Retrofit homes

It would be unrealistic to require existing properties to meet the energy efficiency standards of new buildings every time they made a change (although debate about how this might be at least partially enforced rumbles on).

Without the stick of building regulations to meet, the government uses the carrot of incentive schemes to encourage owners of older properties to decrease their carbon footprint (whilst rising fuel costs provide another incentive to cut costs). Thus return on investment both by saving on fuel bills, and an income from incentive schemes, becomes a key driver for many owners of older homes considering new technology. Many of us decide to make greener choices out of a growing sense of responsibility for our environment – and deciding which of these two motivations is primary in your project will be the key to getting the technology choice right.

Return on Investment

If receiving a return from an incentive scheme is your key objective then there are a few key things that your project must include:

Firstly you will need MCS approval for your installation. Any product you choose must also have MCS approval prior to installation and your installing contractor must be MCS approved as it is the installer who submits the installation for MCS approval by OFGEM.

To qualify for the Renewable Heat Incentive (due for launch in 2014) or the Renewable Heat Premium Payment, the whole property will need to be brought up to a certain standard of energy efficiency with minimum levels of loft and wall insulation (with the exception of solid wall properties). Your MCS approved installer will also complete the submission for these payments.

Achieving RHI / RHPP standards can be a challenge for older homes and you will need an energy assessment to prove that you qualify, however if you can achieve the criteria then the returns can be extremely good.

You can of course still get a good return simply from the savings you achieve against your current bills, or by selling surplus electricity generated back to the grid. The key to gaining the best savings is to look at where your energy use is greatest (see section 5) and choose the right technology to supply that need.

Return on Investment for a specific site

The resource and restrictions you have on site will also contribute to the opportunities available to maximise return on investment and lower the carbon footprint of the project.

For example:

If you have lots of land you may be able install a highly efficient ground source heat pump with a ground loop as opposed to a generally less efficient air source heat pump

If you can place the collector loop for your heat pump in water, because you have a well, river, lake or access to the coast on site, you will have the option an even *more* efficient water source heat pump.

Lots of land may also give you the opportunity to have a large solar array for electricity generation, which can pay not only in terms of saving electricity, but win you payments for surplus electricity fed back into the grid. To install solar panels on a roof top you will require an expanse of roof that is un-shaded and south facing.

Having a weak domestic single phase electric supply may limit your options for heat pump products – having a commercial three phase supply will widen them.

If there are planning restrictions on your property, because it is listed or in a conservation area, these are important to highlight at the early stages of a project too.

In an existing property, the technology being displaced also has a bearing, as for example heat pumps typically give a great ROI if you have a suitable property currently being heated by oil or LPG. If you have mains gas, the cost savings will be less compelling.

Other opportunities may arise if you have a process with recoverable heat on site. An example might be a bakery with large ovens; waste heat might be recoverable to supply space heating or DHW to nearby offices. Stiebel Eltron have even supplied solutions to projects recovering heat from waste water pipes and silage silos (though there is a balancing act with the latter not to rob too much heat and stop the natural and desired decomposition of the grass!).

In the checklist at the end of this document you will find a full list of points to consider and detail in your brief.

Lowering your carbon footprint

Believe it or not if you really want to be green, you may not be led to the same choice of technology as you would if your sole objective is to achieve a ROI. If a ROI is your key objective you would probably never build a house to the Passive Haus standard (although arguably you may have a more valuable asset at the end than if you had not. It is debatable whether the increase in value of the property would make up for the extra costs involved in the build).

The key consideration here is to look at the environmental resources you have on site and where your energy use is greatest.

8. Where is energy use greatest?

Properties use energy in five key ways:

- Domestic Hot Water
- Electrical Appliances
- Space Heating
- Pool Heating
- Process Heating (e.g. bakeries heating large gas ovens, a chocolate factory melting chocolate).

You might already be painfully aware of the particular activity in your home or business that uses the most energy; it is, however, always worth taking stock. You may discover, for example, that your hot water requirements are a very low percentage of your total energy costs. In this case solar thermal panels will give you very little benefit in terms of savings on your bills.

Let's look at space heating:

We spoke above about how to estimate the right size of heater for your property. How much you use that heater depends on a number of factors including your lifestyle and the level of insulation in your property. In a retrofit situation the best way to work out where the energy use is greatest is to look at your bills from previous years. To understand how much of a domestic fuel bill is being used for hot water vs space heating you can use the following rules of thumb:

Find out how much fuel you have bought in kWh by dividing the unit cost by the volume of fuel bought (or ask your energy supplier for this figure).

For domestic hot water allow a usage of 850 kWh of this total per person in the household per year.

For offices allow 90 kWh per year.

Obviously if you are the owner of a leisure centre with showers, a hairdressing business, or another business with more unusual hot water use patterns, then this simple rule won't work for you – you will need some consultation to establish the breakdown of your usage. If you call or email us at Stiebel Eltron we can help you with this.

Here's a simple example for a home with 3 inhabitants:

My oil bill is £1000 a year.

I buy oil at 6.5 pence per kWh

I have consumed 15,584 kWh (which is 1000 divided by 6.5 pence or 0.65)

There are 3 people living in the property so 2550 kWh is hot water usage (which is 3 x 850)

The balance, which is 12,835 kWh is therefore for space heating

In this example it is clear that space heating uses far more energy than hot water, and this is where we should focus first on applying a renewable technology.

Your electricity bill will already be in kWh (sometimes referred to as units of electricity). Thus once you have worked out your heating and hot water usage in KWh it should be simple to compare the figures to see where energy usage is greatest.

9. When is the seasonal energy use greatest?

For most heating applications this is obviously going to be the colder months of the year. However, some seasonal businesses, such as caravan parks, have peaks of demand for hot water in the summer. You might also want to heat your swimming pool mostly in the summer. As heat demand is generally greatest in winter the performance of some inverter driven heat pumps, for example, is optimised for cold weather so would not be ideal for such as project. Solar thermal panels obviously supply more hot water in summer than in winter, and on/off type air source heat pumps can be more efficient in warmer conditions too. Be sure that you specify in your project when your peak usage occurs, and check with a manufacturer that specific products will work well in the prevailing conditions.

Small domestic air source heat pump installed externally

10. Performance requirements

Daily heating patterns

The first thing to consider here is the pattern of usage for your area of greatest energy demand. If we take an example of this being space heating in winter for domestic use, then users may have a pattern that looks similar to this:

6am heating set to come on to daytime temp of 21C just before family gets up.

8.30 am switch off as they head out to work and school.

The heating comes back on at 4.30pm as the children come home from school and switches off (or to the night time set back temperature of 18 C) at 11pm.

This kind of intermittent heating pattern is typical in UK homes with heating by a fossil fuel boiler with radiators. It has become common practice to oversize boilers to allow them to heat properties up quickly in this manner. Heat pumps however are sized exactly to meet the needs of the property for maximum efficiency according to government guidelines. I would therefore recommend setting a heating programme to reduce the temperature by 4 degrees when you are out, rather than switch it off altogether. It is important to understand your existing heating pattern and make sure that you also understand the most effective way to operate a new system – and how much you are prepared to conform to a new way of working.

Another consideration is whether you can make use of cheaper off-peak electricity for some of your needs.

Response times & heat emitter choice for heating systems

Linked to your heating pattern will be your requirements for response times. If you are keeping an intermittent heating pattern similar to that used with a gas boiler, you will need a system that can deliver a fast response time to bring your property back up to a comfortable temperature quickly. Fossil fuel or solid fuel boilers are good at this because they are oversized for the property as a matter of course. If you want a

heat pump system to do this you will need to deliberately oversize it as it is normal to specify them exactly the right size for a property.

You will need to think about your heat emitters and heating pattern in conjunction with your technology choice. If you are in an existing property you may need to think about whether you want to keep some or all of your existing emitters – possibly compromising your efficiency and performance of your new system - or face the disruption and cost of installing a new emitter system. Choice of emitters is of course also an aesthetic decision; you may not wish to rip out ornate Victorian cast-iron radiators in an old house, alternatively you may not want to have fan coil radiators cluttering up your minimalist new build when you can have invisible underfloor heating.

The MCS heat emitter guide (available online) is a detailed resource for installers that allows them assess the appropriateness of emitters for use with heat pumps.

Controls

One final consideration is whether you want or need more advanced controls for your system.

Stiebel Eltron, have a range of heat pumps with an internet service gateway that allows remote tracking of performance, system control, and can automatically contact your service engineer if it detects a fault.

Zone controls are another consideration – do you need to heat parts of a property at different times or to different temperatures?

District heating systems allow individual billing from one central heating source for multiple occupancy buildings or groups of holiday cottages for example.

11. Template for a renewable heating/hot water system brief

Outline of project:

Project is:

e.g. domestic/commercial, new build/retrofit etc.

Project is for:

e.g. heating system/pool heating/hot water supply/electricity generation etc.

System being replaced is:

e.g. gas boiler

Budget:

(you may choose to share this or not with your potential contractors in the first instance, but you should have an idea of this for your own purposes at this point)

Project Objectives:

(delete and annotate as appropriate)

Buildings must meet the following standards: Part L /Code for Sustainable homes/ Passiv Haus

TER is...we require XX points from a heating/electrical system or % of building requirements to be supplied by renewable energy

MCS approval required for installation (detail which incentive scheme you think you might qualify for)

Return on investment: project must pay back within x years?

Running costs savings/targets.

Site resources and restrictions:

Single phase electrical supply: yes/no

Three phase electrical supply: yes/no

South facing roof space (un-shaded): yes/no and size if applicable

Land and plant room available: (detail how much) e.g. 3 acre field, large garden with outhouses, basement in house etc

Water resources: yes/no – if yes what type: well, river, stream, pond, sea. Do you already have permission from the environment agency to extract water?

Planning restrictions: listed building/conservation area etc.

Recoverable process heat: yes/no (if yes, provide detail)

When is energy use greatest? (e.g. daytime/night time or summer/ winter etc.)

What emitters are currently in use? Do any of these units need to be kept?

What is the current energy use pattern/heating pattern? Does the client understand and accept any need to change this?

Is there a target recovery time for hot water tanks or response time for heating to reach target temperatures from setback temperatures?

Does the client want particular controls? (e.g. zone heating, remote operation, district heating controls etc.)

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