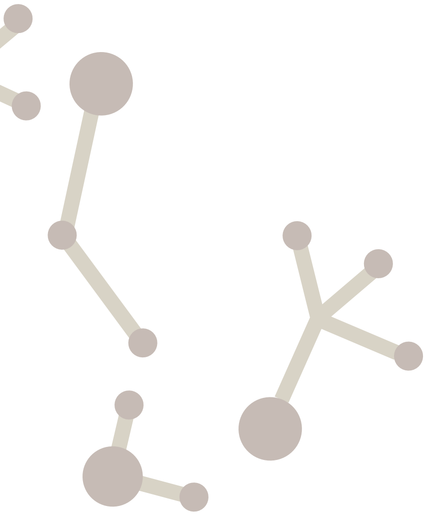
COMMUNITY ENERGY:

PLANNING, DEVELOPMENT AND DELIVERY



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The **TCPA** is an independent charity working to improve the art and science of town and country planning. The TCPA puts social justice and the environment at the heart of policy debate and inspires government, industry and campaigners to take a fresh perspective on major issues, including planning policy, housing, regeneration and climate change. Our objectives are to:

- Secure a decent, well designed home for everyone, in a human-scale environment combining the best features of town and country
- Empower people and communities to influence decisions that affect them
- Improve the planning system in accordance with the principles of sustainable development

For more information see: www.tcpa.org.uk

The Combined Heat and Power Association (CHPA) is the leading advocate of an integrated approach to delivering energy services using combined heat and power and district heating. The Association has over 100 members active across a range of technologies and markets and is widely recognised as one of the leading industry bodies in the sustainable energy sector.

The CHPA works to promote a greater awareness and understanding of CHP and district heating and to create a strong, dynamic and sustainable environment for its members and the communities, businesses and households they serve.

For more information see: www.chpa.co.uk

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PREFACE

Over 60% of the primary energy in fuel is wasted as unwanted heat at power stations. If electricity is generated closer to densely populated areas, this wasted heat can be used to heat buildings through heat networks. This arrangement is called 'decentralised energy'. More and more private and public developers, local authorities, landowners, building operators and communities are becoming 'project developers'. This guide aims to support them in this role.

Wasting energy

Energy for buildings in the UK is currently provided by a highly centralised system. Fuel is burnt in power stations far from centres of population. Heat, produced as a by-product, is dumped into the atmosphere through cooling towers. So, about 60% of the primary energy in the fuel is wasted. From the power station, electricity is distributed over long-distance, high-voltage cables, losing a further 3.5% of its energy on the way (see Figure 1, opposite).

This suited the particular circumstances at the time the power stations were built (after the Second World War). Now, circumstances are different and we need to meet the challenges of:

– dangerous climate change;
– energy security;
– affordability.

Decentralising energy

Recent government policy has mostly been aimed at decarbonising the national grid in order to meet climate change and energy security targets. Under this scenario a growing proportion of our heat, power and transport needs are expected to be met by generating low- and zero-carbon electricity. However, the challenges of achieving **grid decarbonisation**, as it is referred to, are huge, and successfully managing power flows and peaks in demand will require focus on both **decentralised** as well as **centralised energy** generation. By moving the generation of electricity by combustion closer to populated areas, the heat that's normally wasted can be distributed to buildings through **district heating networks**. This means we would no longer need to burn gas in individual buildings for heating and, as the electricity is generated closer to where it's used, less energy is lost during transmission and distribution. If well managed, it can also help to ensure energy is affordable to consumers.

This doesn't mean building large power stations in the middle of towns and cities, but putting smaller generators, using different fuel types, within urban areas. Doing this creates diversity and helps ensure supply security. This, along with small-scale renewable electricity generation, is what we term **decentralised energy**.

Decentralised energy, especially **district heating**, will not be suitable everywhere. We have written this guide to help you identify opportunities and avoid inappropriate investment.

The Mayor of London's decentralised energy target	
Target:	to source 25% of London's energy from decentralised energy by 2025.
CO_2 savings:	3.5 million tonnes per year (as much as the emissions from heating 2.35 million homes).

(*Draft Replacement London Plan, October 2009*)

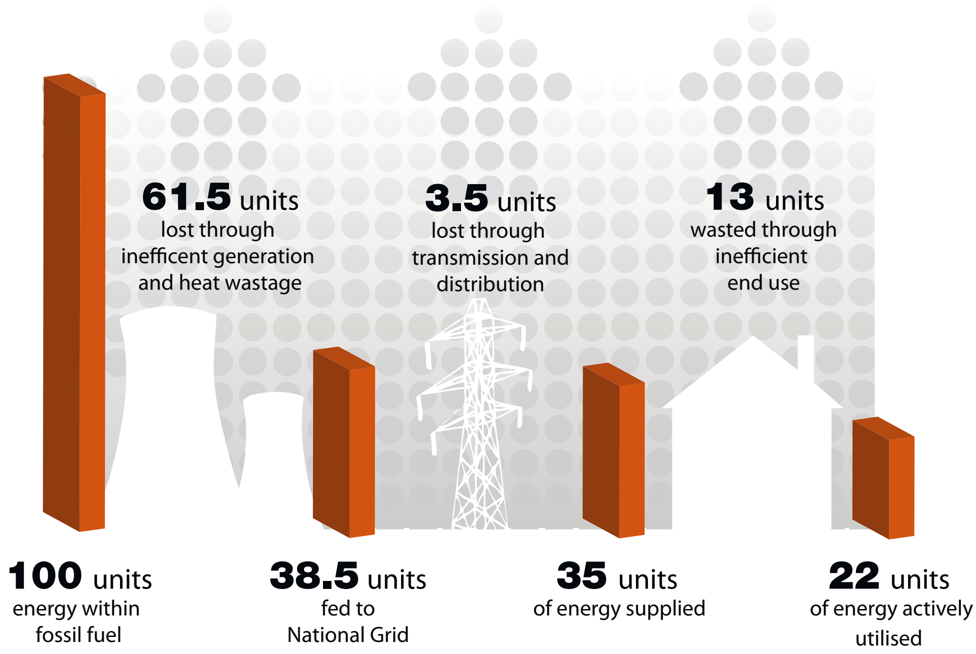


Figure 1: Energy losses are inherent in centralised energy systems.
Based on a diagram by Greenpeace

The changing paradigm

Until now, for a majority of households, businesses and local authorities, energy has been little more than a utility and a bill to pay. Similarly, planners and property developers haven't needed to pay much attention to the energy needed by tenants, residents and owners of buildings. But changes to regulation, concern about climate change, the growing cost of traditional energy and the opportunity to make money from low- and zero-carbon energy are increasingly focussing attention onto **decentralised energy**.

At the same time, **decentralised energy** forms an important part of the government's localism agenda. For the first time, communities, local authorities and other public sector organisations, businesses and land owners are being actively encouraged to become energy producers as well as consumers. The feed-in tariff, forthcoming renewable heat incentive and, for local authorities, changes to the rules which allow them to set up energy companies, have opened up unprecedented opportunities to make money, replace cut budgets and put assets to more productive use, while meeting wider social and environmental objectives. Many are looking to become energy **project developers** themselves. This is localism in action.

Understanding the opportunities for **decentralised energy** and becoming a **project developer** requires detailed information to be made available. Many will be put off by a perceived lack of skills, money or understanding of the project development process. Planning has a crucial role to play in supporting **project developers** in the early stages by mapping energy opportunities and making data available. We've prepared this guide to support planners in this role and to guide **project developers** through the energy project development process.

Using this book

To help you understand the terminology used in this guide, words shown in **bold font** are defined in the Glossary on page 36.

Numbered notes are referenced at the back of the book, on page 38.

Figure 2: Centralised power generation wastes approximately 60% of primary energy in the form of heat rejected into the atmosphere. Decentralised generation captures this heat and is 80-90% efficient

WHO IS THIS GUIDE FOR?

Today, planners and project developers need to consider energy as part of any area or development. They must be able to identify energy opportunities and commission projects. This requires a certain level of understanding in order to ask the right questions, understand recommendations and choose the optimum solution. This guide will help you to do this.

About this guide

This guide will help planners and **project developers** to:

— understand and create or influence **energy maps** (see page 7) and information for use in **masterplans** or development plans;

— recognise where there are opportunities for **decentralised energy**;

— gain an understanding of energy use in buildings and developments;

— translate energy opportunities into financially viable and deliverable low-carbon projects;

— understand the stages of developing an energy project and who is involved in each.

What's in the guide?

Energy must be considered by a wide range of **project developers** – for both commercial and residential developments. The obligation and financial attractiveness of reducing CO_2 emissions and delivering sustainable energy solutions means that there's a growing interest in **decentralised energy**.

Each **project developer** has different objectives, opportunities, resources and levels of understanding of the technologies available.This guide contains the information needed to recognise and understand opportunities for **decentralised energy** which will best meet their objectives. The main focus is on two kinds of energy supply system: **district heating** and **combined heat and power (CHP)**. But much of the guide is equally relevant to low- and zero-carbon energy generally, as well as to Information and Communication Technologies.

Many project developers may prefer to delegate key parts of the process, or even the whole job, to specialist consultancies or companies. However, the customer needs a certain level of knowledge to understand and assess the consultants' recommendations.

Types of project developer

This guide describes the complete process from project inception to delivery and encompasses four broad categories of **project developer**.

— *Local authorities:* recent rule changes mean that local authorities can now sell electricity and become an energy utility in their own right. Together with potential revenues from the feed-in tariff and renewable heat incentive, this presents a unique opportunity to generate new income and fund wider objectives, and energy and CO_2 targets.

— *Communities:* the feed-in tariff is proving to be a powerful incentive for communities to come together and take charge of their own destiny. They are not allowing others to reap the benefits of energy generated on their doorstep. A growing number are owning, managing and financially benefiting from low- and zero-carbon energy, while setting themselves up with secure energy supplies.

— *Other public sector developers:* for example, registered social landlords (RSL), Local Housing Trusts, Community Land Trusts and Arm's Length Management Organisations are major builders and building operators. They, too, can make money from energy projects and play a key role in providing **anchor loads** (see page 18) for a scheme.

— *Propery developers, landowners and building operators:* as part of meeting building regulations obligations they may need to provide energy solutions for buildings, on-site energy networks or land for energy centres. They may also need to contribute physically and financially to the expansion of schemes off-site, via planning obligations, tariffs or **allowable solutions.** Equally, the feed-in tariff and renewable heat incentive are making investment in energy projects financially attractive.

Each of these may play more than one role in a project and there can be numerous points of entry into the stages of development. For example, a local authority might set an area-wide energy vision and play the role of policy maker, so the section on **energy maps** will be of particular relevance. Equally, they may own land and assets and wish to develop or invest in projects themselves. Local authorities and other public sector developers may be key to the viability of a project simply by making **anchor loads** available. A community may decide to take an energy opportunity and cede some or all of the stages of development to third parties. A **property developer** might see a project through all ten development stages or only deliver a small part of a larger scheme, perhaps in partnership with a local authority, energy company or cooperative. A project could be a building-integrated energy system, one that connects a cluster of buildings or a whole town. It could also be a wind farm.

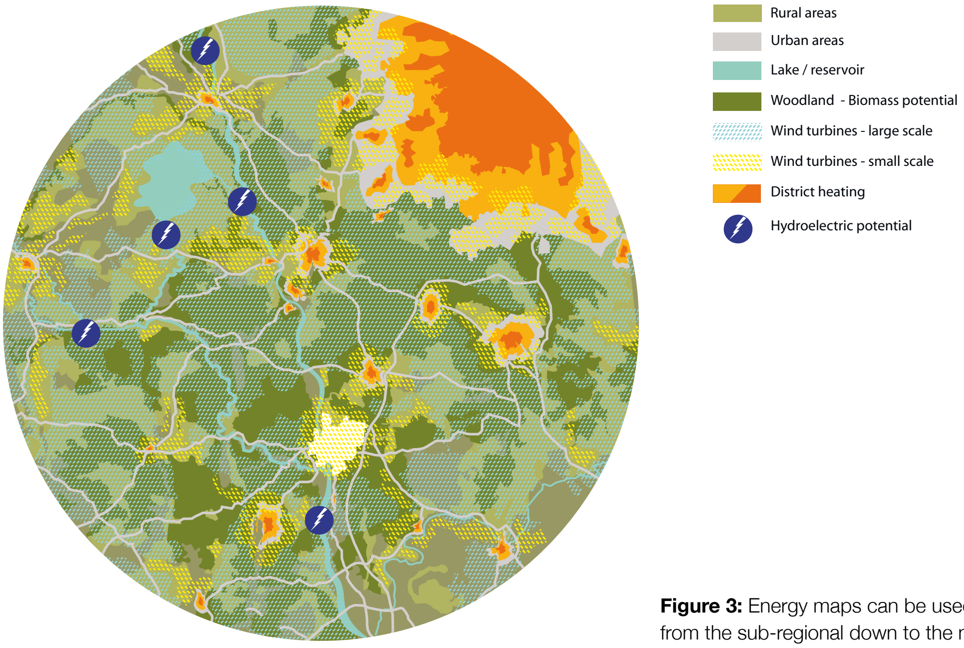


Figure 3: Energy maps can be used to identify opportunities at scales from the sub-regional down to the neighbourhood

Energy as part of place shaping

The potential to generate income from energy, the new rules allowing local authorities to sell electricity and the **allowable solutions**, expected to be introduced as part of building regulations, mean that energy projects will increasingly play an important role in wider place shaping strategies. If well planned and managed, the benefits will be felt by communities in the form of clean energy, income to spend on community projects and cheaper and simpler ways for developers to meet building regulations.

Although the details of the **allowable solutions** have yet to be confirmed by government, each new home could, from 2016, generate revenue of over £5,000 (based on residual emissions of 1.3 – 2 tonnes of CO_2 per year and an **allowable solution** buyout payment by developers of £100 per tonne per year for 30 years, paid in a lump sum). By pooling this money to invest in low- and zero-carbon energy, a community or local authority could create a further revenue stream from the energy generated and spend it on other community projects. If the money were spent on a **district heating network** then developers could reduce their carbon compliance obligations by directly connecting into it.

For **project developers** not wishing to wait until 2016, there is the Community Infrastructure Levy (which may be replaced by an alternative tariff).

Localism in action

The residual CO_2 emissions of a new development of 65 homes built in 2016 might be around 100 tonnes per year and generate £292,000 from **allowable solutions**. A 100kW wind turbine could offset the emissions at a capital cost of £280,000 and bring an annual revenue of around £42,000 from sales of electricity with the feed-in tariff. Income could be managed by the local authority or a community-run **special purpose vehicle** (see Stage 7).

An existing community wishing to invest in the same turbine today could establish a **special purpose vehicle** which funds the capital investment through equity and/or debt. Sales of electricity with the feed-in tariff could generate £49,800 per year to service the debt and create a community income.

Starting points

So how do project developers go about identifying suitable projects or approaches to energy supply? The **energy maps** that are now good practice in the planning process[1] are the ideal starting point. There's an example in Figure 3, above, and more about **energy maps** on page 7.

Energy maps show opportunities and constraints for low- and zero-carbon energy across a given area. They also show where new development is planned and provide a valuable resource for identifying projects.

Ten stages of project development

Once you've identified your opportunity, there are ten development stages to follow to bring it to fruition. These are described in detail in the rest of this guide. The results of each stage can be used as part of an energy strategy for an area, or planning application, or simply as an action plan.

SUMMARY

Types of project developer:

- Local authorities
- Communities
- Other public sector developers e.g. registered social landlords (RSL)
- Property developers

WHAT ARE ENERGY MAPS?

Energy maps can help to identify suitable technologies and approaches to energy generation, distribution and supply; highlight opportunities to link to other projects or share energy centres; and aid decisions about prioritising projects. They form an important part of the options appraisal (Stage 4).

Presenting information

Energy maps[2] are ideal for coordinating and presenting information prepared in Stages one to ten in this guide. They are already being prepared by planning authorities across England in response to national planning policy[3], which demands evidence to support planning policies; they also provide information for local infrastructure plans.

Increasingly, **project developers** are using them too, as a starting point for energy strategies for new developments, regeneration and as a way to highlight possible or priority projects. They can help to identify suitable technologies and approaches; show where it's possible to link to other projects or share energy centres; and help in decisions about phasing.

What can energy maps show?

Energy maps are normally GIS (Geographical Information System)-based and often prepared at the neighbourhood, local authority or sub-regional scale[4].

An **energy map** might be used in a variety of ways.

— ***District heating network:*** a map might reveal an opportunity to create a **district heating network** as part of a regeneration scheme.

— ***Energy strategy:*** a map could form the starting point for the energy strategy for a development by identifying energy options (these will need to be fully appraised in Stages 1 to 4).

— ***Identifying energy solutions:*** a map may be used by a registered social landlord (RSL) to identify likely energy solutions for clusters of poorly-insulated and hard-to-treat properties.

— ***Priority projects:*** the map might point to possible investment opportunities for a **project developer**.

— ***Carbon compliance/allowable solutions:*** the map can highlight nearby energy opportunities that could help a developer meet their **carbon compliance** or **allowable solution** obligations under the building regulations.

— ***Inform growth options:*** energy maps provide information that can aid decisions on the allocation of development sites.

Energy character areas

Energy maps can also be used to define **energy character areas**[5], where the particular characteristics of an area are used to define the appropriate energy solution or planning policy. For example, mature residential suburbs are often lower density areas which have older buildings with poor thermal performance. There's also little mix of use, and ownership is in many hands. An area like this may be most suitable for microgeneration technologies (small, often building-integrated technologies, such as solar power).

In contrast, city or town centre locations have more buildings, old and new, with mixed uses, including offices, shops, hotels and public buildings. While there still may be many different building owners, they usually have rational decision-making processes for procuring their energy services. Areas like this can develop large-scale heating and cooling networks served by **combined heat and power (CHP)** plants.

In this way, **energy maps**, supported by defined **energy character areas**, can help **project developers** make good investment decisions and plans, whether at the single-building, neighbourhood or city scale.

How to prepare an energy map

There's no one defined process for preparing an energy map. The project developer will determine the level of detail necessary. For a given area, a map might include:

- an assessment of existing building energy demands and energy installations as a baseline;
- likely locations of new development at different stages in the planning pipeline, and an assessment of how this will affect energy demands over time;
- the distribution of potential low- and zero-carbon energy resources;
- a **heat map**, including the location of large public buildings and other **anchor loads** (see page 18).

When you get down to the neighbourhood or building scale, more detail can be added ('Data gathering', page 16), or a new map created if there's no district level map. You can then use it to define and appraise an energy project (pages 20–21).

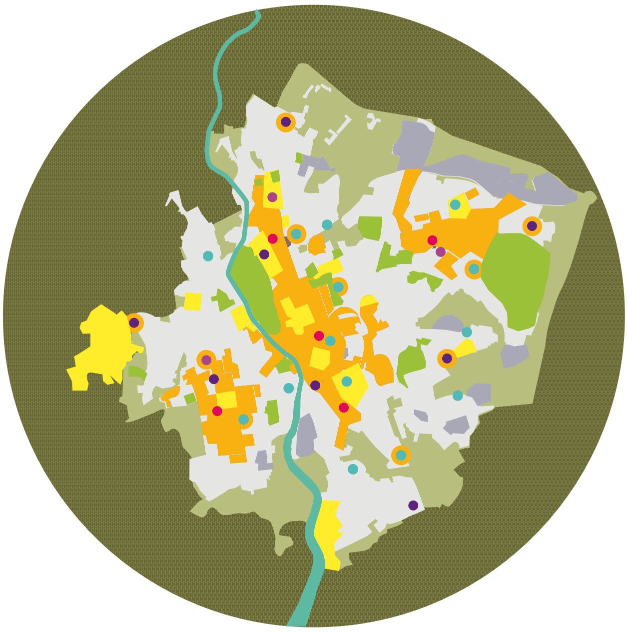


Figure 4: An energy map can be used as the starting point for planning and delivering a scheme by project developers

Using energy maps to influence developments

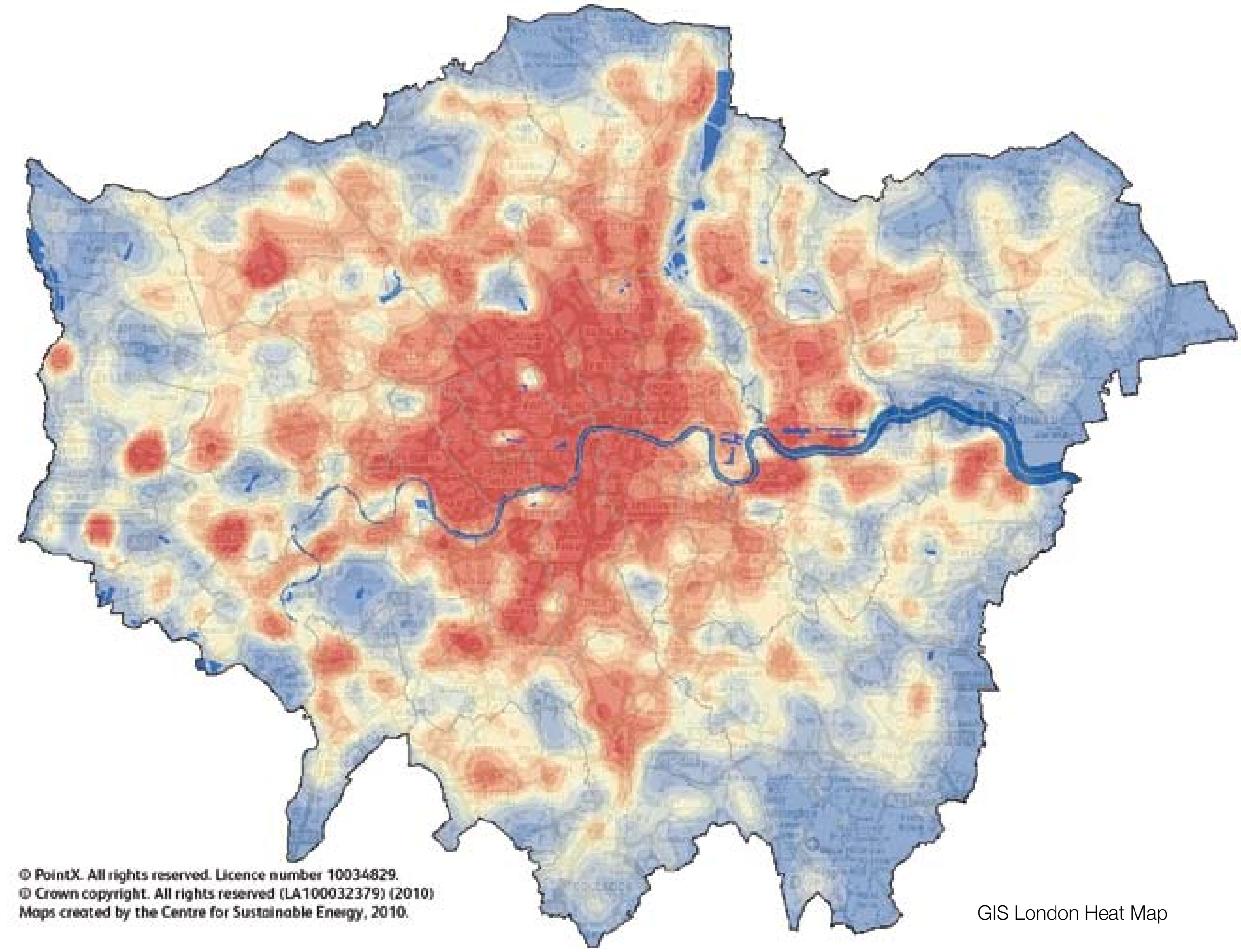
Energy maps prompt us to think about planning and **masterplans** in a different way. For example, at the sub-regional or district scale a good green infrastructure (GI) strategy should inform the local authority's approach to energy by showing appropriate areas for green-infrastructure-related energy generation (such as biomass), identifying urban areas where planting can improve energy efficiency, and excluding inappropriate areas (e.g. where nature conservation or landscape character are concerns). Conversely, the **energy maps** should inform the GI strategy by establishing local need for a particular energy mix.

So you can see how important it is that energy is an early and integral part of the planning and **masterplanning** process.

SUMMARY

Suggested data for an energy map

- Existing building energy demands and energy installations
- Likely locations of new development and resulting energy demand over time
- Low- and zero-carbon energy resource assessment
- **Heat map**



GIS London Heat Map

Case study

Decentralised Energy Master Planning (DEMaP) Programme

The Decentralised Energy Master Planning (DEMaP) programme has been set up by the LDA, working in partnership with Arup, the GLA, London Councils, Capital Ambitions and leading London Boroughs. The main objective of the programme is to enable London boroughs to identify opportunities for decentralised energy and develop the capacity to realise those opportunities. The London Heat Map is the focus of the DEMaP programme, showcasing the existing and potential heat supply, demand and network opportunities across London. www.londonheatmap.org.uk

The DEMaP programme provides technical, planning, financial, legal, commercial, and capacity building support to a number of boroughs based on a trajectory of work packages covering the following three main stages:

Phase 1 *Capacity Building*
Support to boroughs to develop knowledge capacity, planning policies, budgets, and political support to facilitate the delivery of decentralised energy projects. In particular, managing the production of 11 borough heat mapping studies, which have identified opportunities for decentralised energy generation and provide an evidence base to inform planning policy development.

Guidance on the structure and content of DE policies within boroughs' LDF documents has also been provided and advice on wording of section 106 agreements to tie in the policies and evidence base to secure the potential for DE networks through planning.

Phase 2 *Project Feasibility and Options for Procurement*
Technical support and advice to boroughs in order to undertake detailed feasibility studies. The DEMaP team worked with a borough to identify an opportunity to replace boilers with CHP and re-connect to existing district heating infrastructure on a large housing estate in the borough. A feasibility study was match funded by the LDA and the borough to identify the technical and economic viability of delivering this.

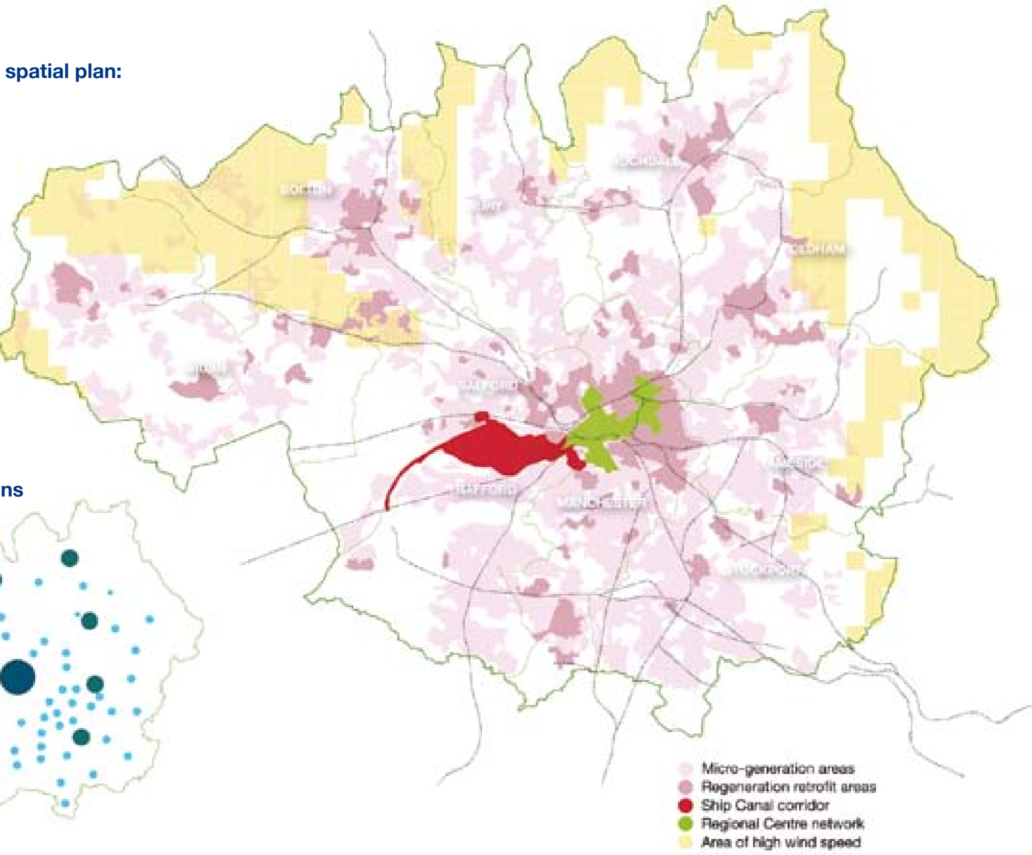
As a result of the DEMaP intervention, the borough established and appointed a Decentralised Energy officer to lead on this, and other potential DE projects in the borough.

Phase 3 *Financial, Legal and Procurement Options*
Support and guidance to boroughs on producing business and financial plans, heads of terms, heat prices, supply contract, and support on producing tender documentation to take projects to market.

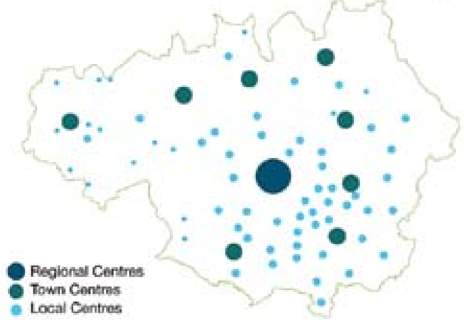
The DEMaP team have also worked with a council to apply for a new energy supply 'lite' licence which could improve the economics of DE projects for their borough. Support has also been provided on establishing a 'buy-out fund' or 'heat infrastructure tariff' for boroughs, based on potential revenue streams such as the Community Infrastructure Levy, Allowable Solutions, and section 106 agreements.

Criteria for collecting as well as spending this money has been developed and is currently being tested within the boroughs.

Moving towards an energy spatial plan: broad areas and locations



Energy opportunity locations



Case study
Greater Manchester and sub-region decentralized and zero-carbon planning

Commissioned by the Association of Greater Manchester Authorities (AGMA), the ‘decentralised and zero-carbon energy planning’ study was carried out by a consortium led by Urbed during 2008–09. The brief was to provide strategic evidence for LDF Core Strategy energy policies and to identify strategic opportunities for energy infrastructure to support delivery of carbon reduction targets.

Step 1: *Identifying strategic energy opportunities*
The study began by identifying the strategic opportunities for low- and zero-carbon sources of energy at a range of scales. The study identified four strategic energy opportunities – micro-generation, energy networks, standalone energy generation and biofuels. Each of these has very different implications for planning and investment.

Broad spatial areas and locations were mapped, including potential sources of waste heat across Greater Manchester and the sub region.

Step 2: *Identifying ‘character areas of change’*
The next step was to identify character areas of change in order to understand the nature of projected new development across Greater Manchester and the sub region.

With input from the ten districts, 13 case studies were selected. They ranged from corridors of development and large mixed-use developments to strategic housing sites and suburban business parks.

For each case study, mini-energy plans were developed to inform a cost–benefit analysis of appropriate technical solutions.

Step 3: *Bringing it all together*
The findings from Steps 1 and 2 were brought together in order to create an indicative energy spatial plan for the City Region. The plan identifies strategic energy opportunity areas and locations for decentralised energy across Greater Manchester and the sub region. These range from power station heat networks to micro-generation areas.

The spatial approach informs LDF Core Strategy energy policies for the ten districts, supported by a framework of targets.

Step 4: *Making the link between planning and investment*
The study highlighted the need for planning to be complemented by innovative approaches to collaboration, funding and investment. Six main themes were identified going forward:

Planning policies

— District planning policies and targets that promote investment in energy opportunities.
— Cross-boundary planning policies that promote investment in energy opportunities that span several district boundaries.
— Infrastructure contribution funds at local, district and city/region scale that pool contributions from developers towards lower-cost community energy infrastructure.

Investment activities

— Public sector commitment to support new energy networks, provide access to low-cost finance and co-ordinate the use of infrastructure contributions.
— Special purpose investment vehicles to provide innovative methods of financing and procuring projects, including public:private vehicles to access longer-term, lower-interest finance,
— Existing network facilitation by gas and electricity network operators in order to manage the cost of connections and to realise the benefits of smart networks.

Stages of development

INTRODUCTION

It's a good idea to take a strategic, long-term perspective on energy provision, starting as existing energy systems approach the end of their lives, or when planning the installation of new schemes. By following a ten-stage process, or 'flightpath', project developers can minimise the risk of poor technology choices and project failure.

Area-wide energy mapping by local authorities

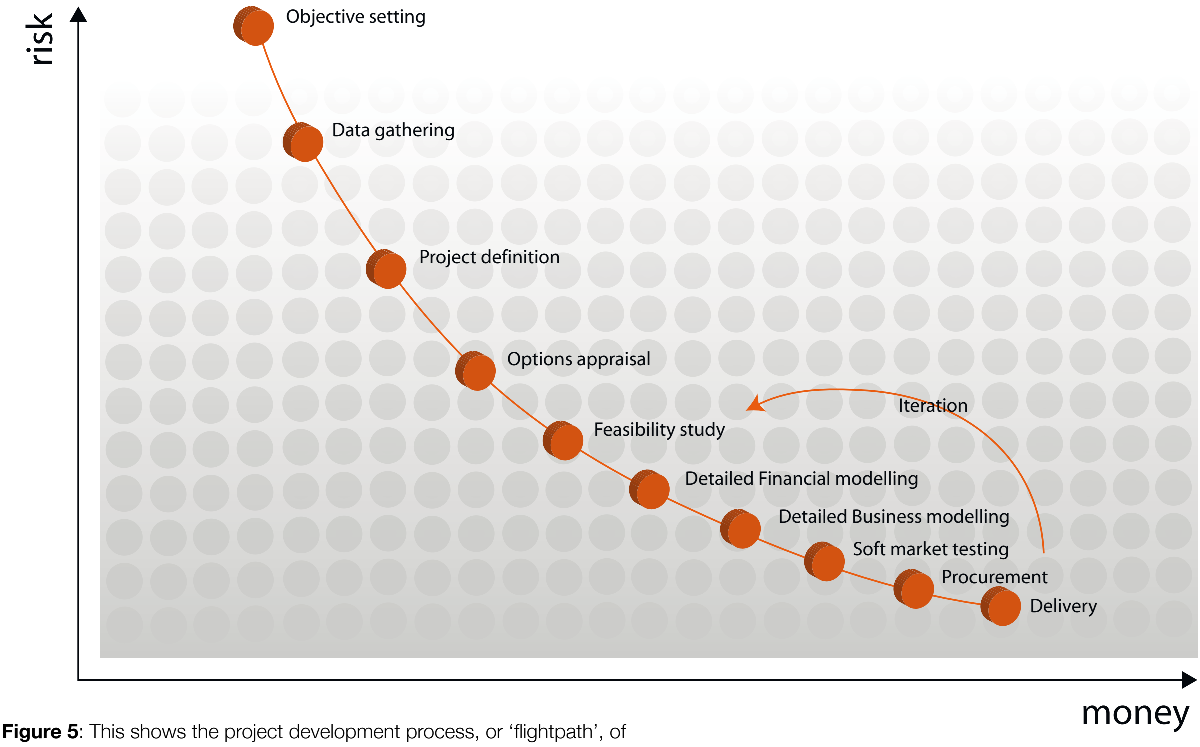


Figure 5: This shows the project development process, or 'flightpath', of a project, illustrating how the risk reduces the further along the process the project proceeds

When to consider energy

In the life of any area, development or building, there are trigger points when energy should be considered. For example:

- when the heating system in an existing building is approaching the end of its life and needs replacing;
- when an existing building is being refurbished, or an area regenerated, there's an opportunity to upgrade the building fabric and energy systems;
- when a new building or development is being planned;
- when the private sector is unable or unlikely to take a lead, a public body might decide to create, or sponsor, a **decentralised energy** network to reduce CO_2 emissions over the long term or to deliver their energy objectives;
- if a community, or building manager, has concerns about energy security, price volatility, long-term cost, or simply wants to make a difference, as with the '**transition towns**';
- purely to make money from sales of energy.

Making the right decision

Generally, a new energy system is expected to last between 12 and 25 years, although the infrastructure may last far longer. The choices made at these trigger points can have long-term repercussions. They may lock an owner, occupier or whole community into one system for a long time, limiting their options in the energy market and tying them in to particular suppliers and equipment. Over time, there will probably be changes in technology and the supply chain which they will not be able to take advantage of. For this reason, flexibility is important and a strategic, long-term perspective on energy supply should be taken as early as possible, as an existing energy system approaches the end of its life, or in planning the installation of new systems.

Energy project 'flightpath'

People familiar with the development of energy projects, both large and small, follow a well-established approach designed to minimise risk. This has a staged trajectory from inception to delivery and forms the basis of the ten stages recommended in this guide. You can see the stages in Figure 5, above.

Overall, the cost of project development can amount to around 10% of the total capital cost of delivering the energy scheme. Each stage has to be resourced, of course, but the risk of project failure reduces the further along the process you go. So, while not prescriptive, the ten-stage approach helps you to avoid spending large amounts of money to no effect.

Importantly, the stages along the flightpath are likely to be iterative. Although financial and business modelling are carried out in detail later, it's important that they are considered from the start and throughout the process. For example, different investors have different expectations of rates of return so understanding the business model at the outset is crucial, particularly where a project developer has choices of different procurement, financing and operation models.

STAGE 1 Objectives setting

Defining objectives for the project at the outset will establish a touchstone against which all later decisions can be taken.

1 Defining objectives

All projects must be financially viable. Beyond this basic assumption, you need to define your objectives from the start. This forces you to address what you're trying to achieve and deal with any conflicts.

1.1 Main areas

The objectives for an energy project fall into three areas.

1.1.1 Carbon dioxide (CO_2) emissions reduction

The government and a majority of scientists agree that the increase in CO_2 in the atmosphere is responsible for changes in climate that will increasingly cause hotter, drier summers; warmer, wetter winters; more extreme weather; and rising sea levels.[6]

The Stern Review[7]

Said that:	Climate change will have a serious impact on the economy and our quality of life.
Concluded that:	Investment of two percent of global gross domestic product (GDP) per annum over the next 50 years is required, to avoid the risk that global GDP will be up to twenty percent lower than it otherwise might be.

Through the 2008 Climate Change Act, the UK Government has committed to reducing greenhouse gas emissions by 80% on 1990 levels by 2050. The Committee on Climate Change advises government on the five-yearly carbon budgets needed to deliver this. The first of these, presented alongside the fiscal budget, will lead to a 34% reduction by 2022.

These targets will only be achieved if all new and existing buildings and neighbourhoods make a substantial contribution to emission reductions. Climate change objectives are increasingly driving local authority policies and decisions, changes to building regulations and standards such as the Code for Sustainable Homes, and will be an important influence on the energy decisions of **project developers**.

Energy systems have a major effect on the overall CO_2 emmissions of a place or building, so choosing a system with the minimum carbon impact is extremely important.

1.1.2 Affordability

The upfront capital costs of some low- or zero-carbon energy systems can be higher than for traditional energy. If this cost is passed onto customers (through bills or service charges), the energy may prove unaffordable. Millions of households already suffer from fuel poverty[8] (being unable to afford adequate energy services), caused by the interaction of low income, poor energy efficiency of buildings and energy systems, and high fuel costs. Consequently, innovative financing mechanisms need to be explored to overcome the high capital threshold and spread the costs over a longer term (see Stages 6 and 7).

Lower income households tend to respond to higher bills by reducing consumption, with potentially adverse impacts upon their health and well-being. Prices will probably rise in the medium to long term as fossil fuel resources decline. Investing in **decentralised energy** systems will mitigate this impact and help keep the energy costs down and more stable for consumers in the long run. For commercial landlords it is easier to let properties with lower energy costs.

At this early stage it is also crucial to understand the **project developer**'s exposure and attitude to risk. This will determine the most appropriate business model in respect of the availability of capital (including the assessment of reasonable return) and of the operating risks. This in turn will provide the means within which affordable energy can be delivered.

1.1.3 Security of supply

Energy is vital to modern life, but the fossil fuels we depend on are finite and now often come from regions of the world over which the UK has limited influence, or which suffer from political instability. Growing demand and dwindling supplies mean prices will become more volatile, which could adversely affect supply.

Importantly, the Government has committed to a binding EU target to supply 15% of total energy from renewable sources by 2020. Government, local authorities and public bodies are keen to encourage new and more diverse energy supplies by introducing **decentralised energy** systems that can use a range of technologies and fuels, and offer greater opportunities for diversity of ownership. They also have the benefit of converting fuel into usable energy more efficiently, so reducing CO_2 emissions and saving fossil fuel reserves.

Most buildings last for 100 years or more. The neighbourhoods in which they sit may last far longer. A secure energy supply is vital to the occupants and businesses throughout the life, and potential different uses, of the building or place.

SUMMARY

Objectives for an energy strategy:

- CO_2 emissions reduction
- Affordability
- Security of supply
- Financial viability

Summary of the strategic options appraisal process

Objectives setting

1. CO_2 emissions reduction
2. Affordability
3. Security of supply
4. Financial viability of the scheme

Data collection

1. Understand the energy thumbprint (see page 19).
2. Collect data on the following:
   — existing energy consumption;
   — likely future energy consumption based on rates of new construction, future growth and improvements to the energy efficiency of existing buildings;
   — the suitability of different low- and zero-carbon technologies;
   — fuel sources and how the energy will be delivered or transported;
   — the pros and cons particular to the location in terms of energy sources, distribution, transport, land use, form and character.

Local authority or project-specific energy map

Local authority energy character area

Define project

1. Set out type of project.
2. Identify partners or stakeholders needed to make the project happen.
3. Collect commitments from potential partners and customers.

Corporate strategies of local authorities, public bodies or private developers

Appraisal of energy options

For each technology, consider:

1. Scale of the development.
2. Parts of the site served, including connection to surrounding development.
3. Annual energy output.
4. Annual CO_2 emissions saving.
5. Implications for site layout and design.
6. Implications for phasing.
7. Key project delivery requirements.
8. Contribution to regulatory and planning requirements.
9. Indicative benefits, including consideration of revenues
10. Indicative project costs.

Preferred energy strategy

STAGE 2 Data gathering

Good quality and appropriate data is the starting point for a successful strategy or project. Some of the data needed at this stage may already be on an energy map. The other types of key data you need to collect are outlined here.

2 Data required

In order to make rational decisions about a new energy generation and distribution system you need to:

- collect data on existing and likely future energy consumption based on rates of new construction and improvements to the energy efficiency of existing buildings;
- consider fuel and power sources and how the energy will be delivered or transported;
- recognise the pros and cons particular to the location in terms of energy sources, distribution, transport, land use, form and character;
- consider the sustainability of different low- and zero-carbon energy technologies.

if a local **energy map** exists, then some of this data will already have been collected. However, more detail is likely to be needed at this stage. The following sets out the data needs using **CHP** district heating as an example.

2.1 Development density

A major part of the cost of an energy system is the distribution system. The shorter the distance it has to travel, the lower the cost, especially for heat. Heat networks are expensive because of the high cost of the specialist pipes needed to carry the heat. The more densely-packed the buildings, and the greater the demand for heating or cooling, the more efficient and viable the network is likely to be.

The Energy Saving Trust suggests that at least 55 new dwellings per hectare are necessary for financial viability[9]. A recent study for DECC suggests a minimum heat density of 3,000kWh per square kilometre per annum[10]. Skilled designers can optimise the layout of a network and minimise the cost if energy is considered at the very start.

2.2 Demand loads

The amount of energy that consumers demand in any building or development is called the **demand load**. This load isn't evenly distributed throughout a day or year. When load variation is shown on a graph over a 24-hour period, it gives a **load profile**.

Load profiles vary depending on what the occupants of a household do. Retired households have a steady **load profile**; weekends and holidays show different profiles according to how people spend them. Some buildings (e.g. hospitals and hotels) are used 24 hours a day and have fairly steady loads.

Daily **load profiles** are put together to form annual **load profiles**. These, as you would expect, show increased demand for energy in winter. The **peak load** is the period of highest demand and the **base load** is the period of lowest demand. The **base load** is never zero as there's demand for hot water and electricity for kitchen 'white goods' at all times.

You need to create **load profiles** for any project so that an energy system of the right size can be designed to meet demand. You can see examples of typical graphs of different types of loads in Figures 6 and 7, opposite.

2.3 Mix of uses

Boilers and generating engines operate most efficiently when there's a steady, smooth load. As you've seen, most individual loads contain 'spikes' of demand. These are like the inefficient use of fuel in a car in 'stop-start' city driving, compared to the greater efficiency of smooth motorway driving. Spikiness also affects maintenance requirements and overall longevity.

Boilers for a single house have to be sized to meet **peak load**. But energy use is only at peak demand for a fraction of the time. So, mostly, boilers are oversized and running below their optimum performance (especially condensing boilers which are most effective after a steady period of demand).

If several houses share a boiler (via a heat network), spikiness gets smoothed out by the overlapping demands of the households. If commercial buildings are added to the network, they smooth the load out even further as they tend to use energy at different times of the day. This gives a smooth load curve over 18 hours. It also raises the level of the **base load**. In this case, the energy system can be designed with a **lead boiler** (or **prime mover**) to provide the **base load**, and a **back-up** or **top-up boiler** to help with the **peak load**. In this system, the **lead boiler** can be a smaller size and run at optimum efficiency a lot of the time, while the **back-up boilers** meet any additional demand.

2.3.1 Cooling

Commercial buildings also often need cooling in the summer. This is usually provided in individual buildings by electric chillers. However, absorption chillers can be connected to a heat network to convert heat into cooling. They aren't as efficient as electric chillers, but their use perfectly complements the drop in demand for heating in the warm months and the energy is used for cooling instead, keeping the overall demand steady all year and avoiding the need to dump heat.

Hourly energy use

Domestic load

6.00 – 7.00am	demand for energy as the household gets up
9.00am	drop in demand as occupants leave for school/work
5.00 – 11.00pm	demand rises as people come home from work

Commercial load

7.30 – 9.00am	demand as people arrive at work
9.00am – 5/6.00pm	demand arches
After – 6.00pm	demand decreases as people leave work

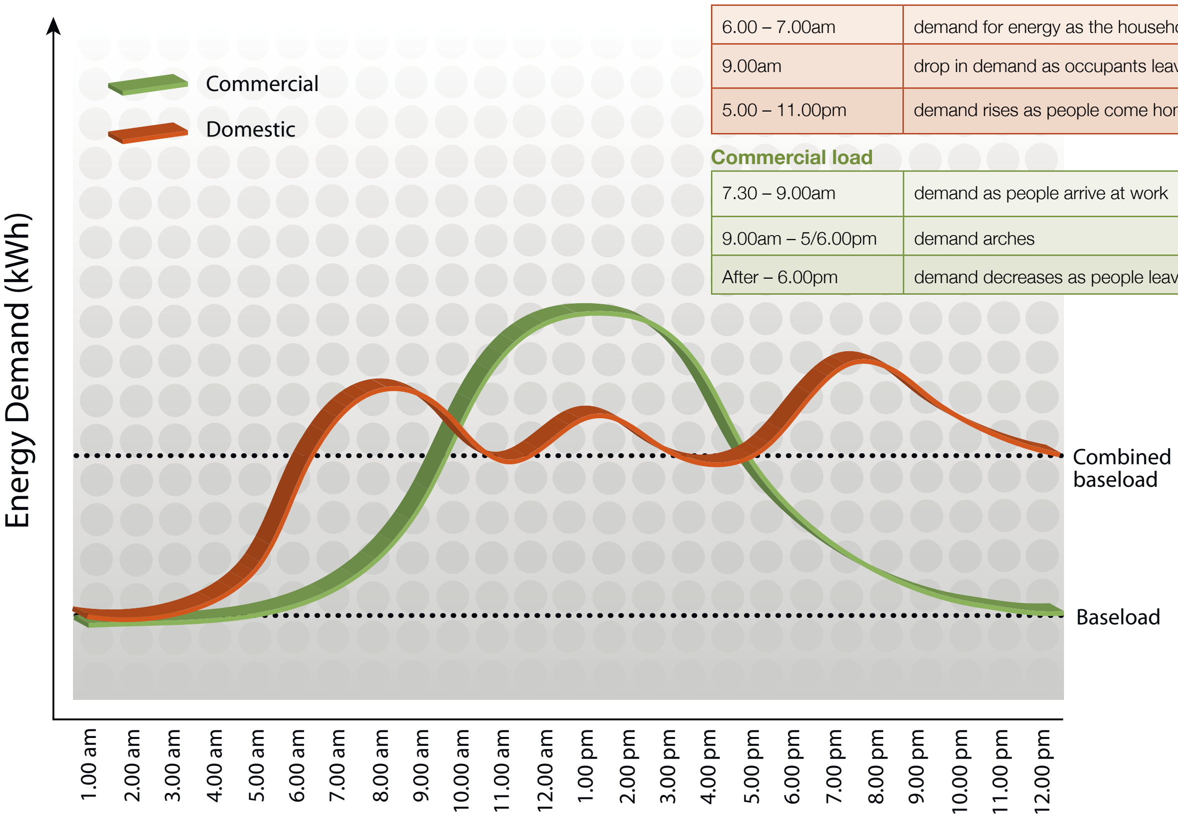


Figure 6: This graph shows a typical domestic and a typical commercial load profile, and how they complement each other

Yearly heating and cooling

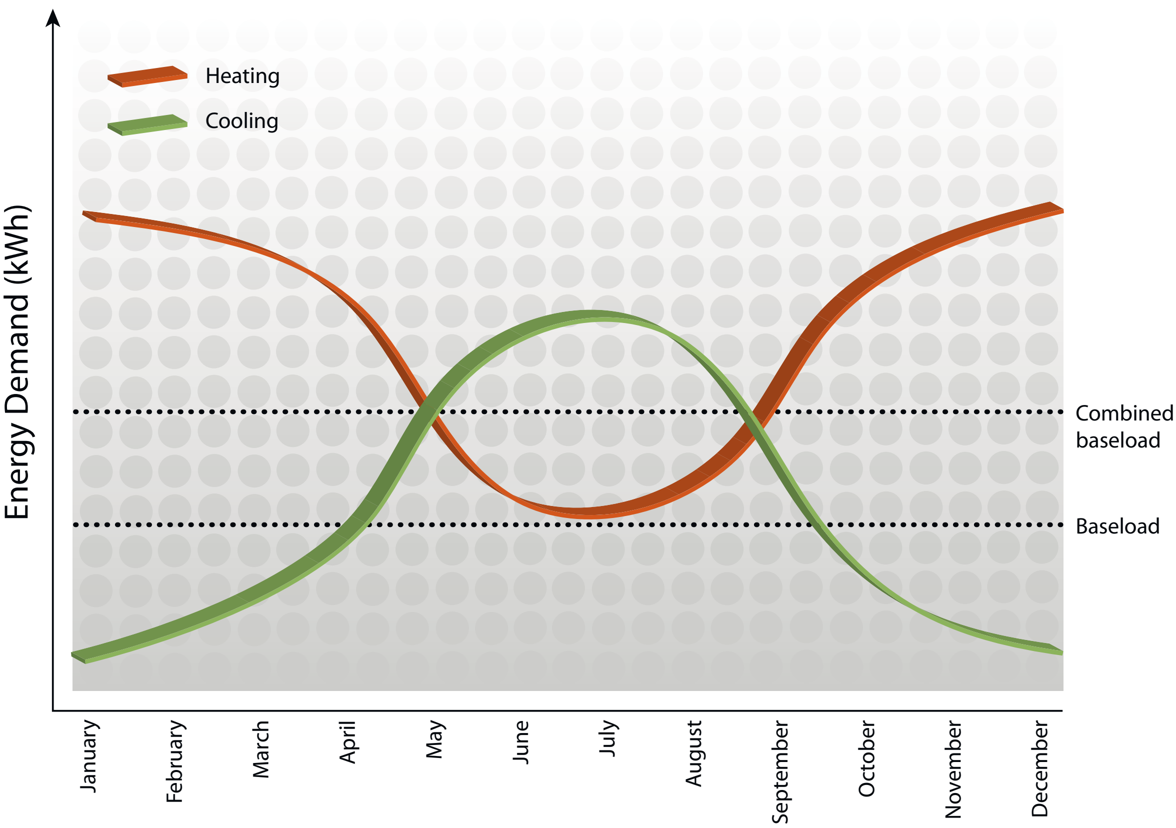


Figure 7: This graph is a typical annual combined heat and cooling load profile. This shows higher heat demand during the winter months and higher cooling demand during summer months when heat demand is low

Figure 8: This shows the interior of the Stockethill plant room, Aberdeen

2.3.2 Load diversity

The mix of uses (or **load diversity**) influences financial viability, and will affect how interested commercial energy services, investors and financiers will be in the project. Wholly domestic developments tend not to be as attractive as mixed-use developments with greater **load diversity**.

The mix of uses in any project is usually decided at the **masterplanning** stage – another reason to think about the energy system early on.

2.4 Age of buildings

The age of the building affects load diversity. Changes to building regulations since the 1980s mean that new houses are more energy efficient and have a relatively low demand for heating except in very cold weather. By 2016, the regulations are expected to require zero-carbon homes; the date is 2019 for non-domestic buildings. This actually presents a problem for people interested in installing communal heat and power systems, since the houses don't create enough heat demand to make a **combined heat and power** system viable. This can be resolved by having a mix of uses and connecting adjacent existing buildings that have poorer insulation, and therefore greater energy demand, via a heat network.

You therefore need to collect data on the age and energy demands of the buildings in the surrounding area. This can be measured using benchmarks or actual energy use data.

2.5 Anchor loads

Certain buildings, such as hospitals, hotels, social housing, prisons, swimming pools and ice rinks have a large and steady demand for energy over 24 hours. Many of these are owned or influenced by the public sector. Public sector estate managers can take a long-term view on energy provision, and increasingly have to try to achieve carbon reductions, energy security and affordable warmth. Buildings like these also often have space available where energy centres could be placed. They therefore make ideal cornerstones for the development of heat networks, and are known as **anchor loads**.

It's a good idea to note any buildings like these in the vicinity of a new development, refurbishment or regeneration scheme, along with information on their demand loads, ownership and any plans for refurbishment.

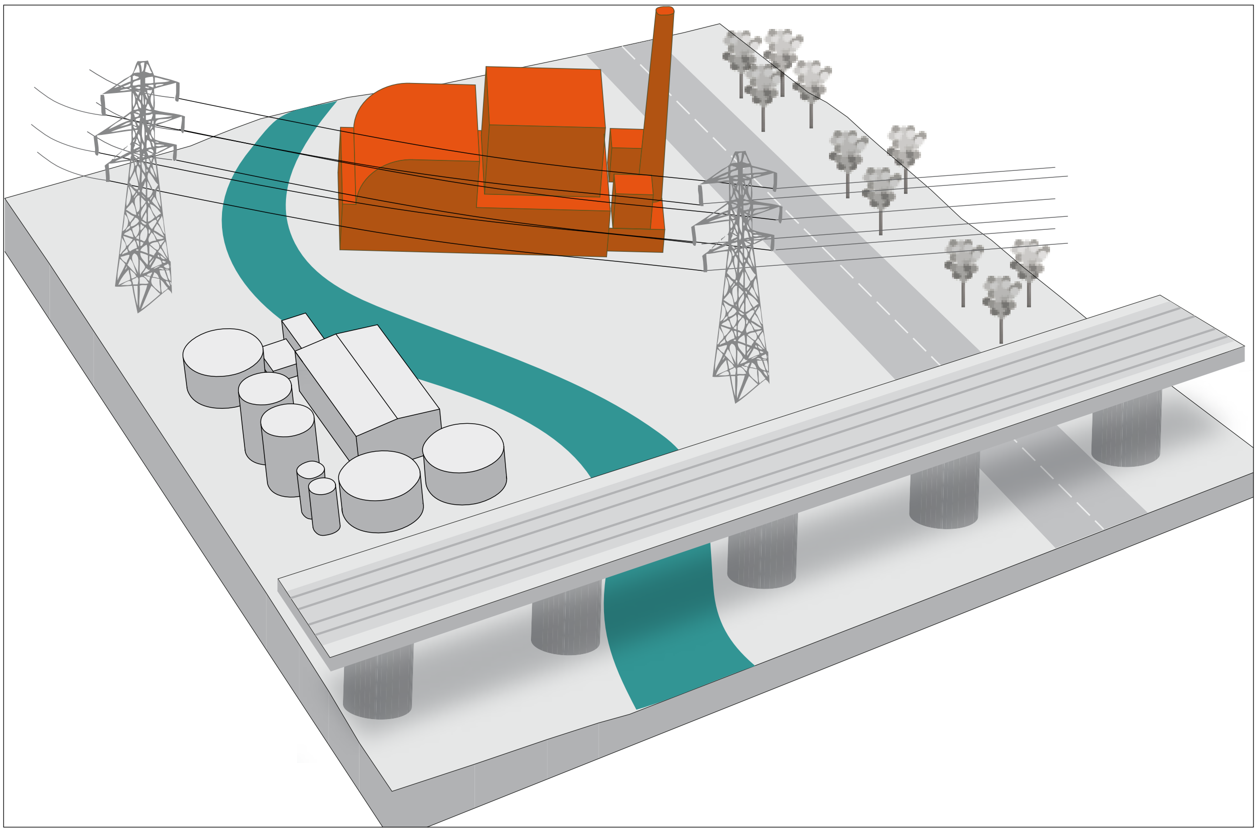


Figure 9: Potential barriers need to be identified and taken into consideration

2.6 Barriers and opportunities

Physical barriers to the development of an energy system might be such things as:

- railway lines
- major highways
- canals
- rivers

These can be overcome, but at some expense. They may also present opportunities (see below). The type of existing energy systems can also be a problem since they may affect how many buildings will sign up to a new heat network.

You may need to gather further information and data to supplement an **energy map** on, for example:

- gas and heat networks and electricity switching stations;
- existing generating plant, including low- and zero-carbon energy sources, power stations, energy from waste plants and industrial processes that are dumping heat;
- transport infrastructure such as canals, rivers, wharves and docks, and railways, which could be used to transport bulky fuels such as biomass.
- the different opportunities and constraints presented by the urban and rural form and character.

2.7 Energy thumbprint

Everything discussed in this section can combine in a variety of permutations to give each location a unique energy thumbprint. The database underpinning the **energy maps** described earlier allows you to present this information, and can be used by a local authority as the basis for defining **energy character areas** (see page 7) as part of an area-wide energy planning exercise.

For all project developers, the energy thumbprint can be used to indicate which energy solution is most appropriate (on-site low- or zero-carbon technologies, or combining loads by connecting buildings via a **district heating network**). Connecting multiple buildings will be more complex than making decisions for one building and so projects need to be clearly defined (see Stage 3).

SUMMARY

Key data required to demonstrate an energy thumbprint

- Development density
- **Demand loads**
- Mix of uses
- Age of buildings
- **Anchor loads**
- Barriers and opportunities

This data can be presented as part of an **energy map**. Local authorities planning area-wide schemes can use it to define **energy character areas**.

STAGE 3 Project definition

You need to secure the support of other stakeholders in order to define the outline of the project well enough to take it to the next stage.

3 Defining your project
The project objectives, together with the collected data, **energy map** and, in the case of local authorities, **energy character areas**, will enable you to define the project. Particularly, its scale, extent, the range of partners needed to make it happen, and their role.

3.1 Collecting commitments
In order to maximise the technical feasibility and financial viability of the project, especially **district heating**, where a critical mass of demand is essential, you will need to gain commitment from partners and potential customers.

If you can collect enough commitments to the project, or memoranda of understanding (agreements to participate in investigating the opportunity further), you can then define the outline of the project well enough to take it to the next stage. Using all the data you have gathered so far, you need to persuade potential partners to agree to participate in the project.

3.2 Selling the idea
The benefit to a **project developer** of opting for a **district heating network** is that it reduces the carbon content of the heat delivered and, over time, improves security of supply by connecting to a range of different fuel types and technologies. The network's ability to help **project developers** meet planning or regulatory requirements will be increasingly important. The inducement for eventual owners or occupiers to join a **district heating network** needs to be that it will be cheaper than traditional systems. Large energy users may also be affected by the **CRC Energy Efficiency Scheme**. Lower carbon heat will reduce their liability under this programme.

3.2.1 Public sector
Public sector organisations, including local authorities, RSLs, ALMOs, health and university estates departments, are now motivated by a range of regulations and policies to reduce the carbon intensity of their buildings. These types of bodies are very likely to instigate **district heating** projects, and they may be willing to make a 'commitment to connect' – providing you with an **anchor load** for the project.

Viability of a project will generally improve with the project's size and diversity of loads. Therefore, partnerships between private and public bodies may well be attractive.

3.2.2 Commercial developments
Some commercial building owners have corporate commitments to reduce carbon, but it's more likely that they'll mainly be driven by the need to meet building regulation or planning requirements, or to reduce the cost of heating and cooling their buildings. They may be unwilling to make a commitment to connect until they know the likely costs:

- the capital cost of connection compared to the cost of installing individual boilers or replacing existing plant;
- the cost in use over time.

Even so, they may be interested enough to sign a 'memorandum of understanding', agreeing to investigate the opportunity further, through an options appraisal or feasiblity study.

The process of obtaining commitments will be more complex for multiple building projects than for a single building. But once you have enough commitments and memoranda of understanding, you can confirm your energy ideas for the project and move forward.

3.2.3 Community developments
Local communities (and their agents in local government and the social enterprise development sector) are also likely to want to benefit from **decentralised energy** systems. Local control of the energy infrastructure will allow local communities to determine pricing and service bundling and to aggregate their demand as consumers to drive down infrastructure costs. Net profit can be re-invested in the business or community and/or distributed as dividend to members, depending on the legal form chosen. As the interests of consumers and communities may not always be absolutely aligned, it is important to define the principal stakeholder(s) and how the benefits will accrue.

3.2.4 Other utility services
There are parallel drivers increasing the demand for other decentralised and bespoke utility infrastructures, notably fibre-to-the-premises/home (FTTP/H), non-potable water supply and waste management. There may be both cost and revenue benefits in projects installing and operating these additional services, which will often share the same cost drivers and consumer-facing billing and accounts service. In defining the energy project, the opportunities and constraints to include within its scope the parallel or future delivery of one or more of these other infrastructures should be taken into account.

STAGE 4 Options appraisal

The next stage is to use all the data to examine energy technology options in order to decide which are the most suitable.

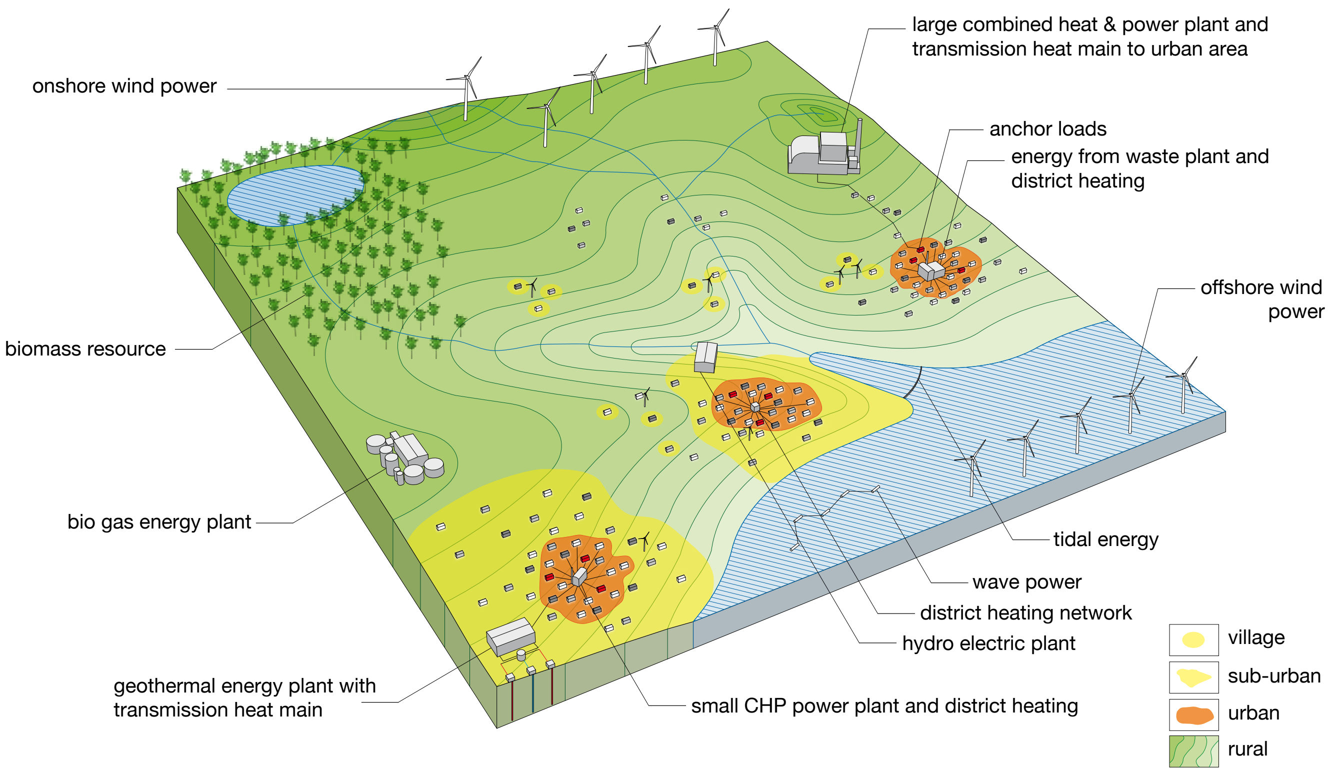


Figure 10: Decentralised energy generation is key to delivering climate change, energy security and affordability objectives

4 Looking at the options

Based on the data collected for the defined project in Stages 2 and 3, together with the **energy map** showing adjacent buildings, you now need to appraise the technical options for meeting the project's energy demands in more detail. This will involve comparing a limited number of typical solutions. You should always include a 'business as usual' case (in other words, the costs if a traditional energy system is installed or replaced) as one of the options. An options appraisal isn't a detailed feasibility study so simple payback methodology may be appropriate at this stage. However, it's important to roughly evaluate the technical feasibility and financial viability of the different options. At a later stage it will be necessary to use more sophisticated financial methodologies

In-house staff may not have the technical expertise to interpret the data in an options appraisal. In which case, you'll need to get hold of a technical consultant. The Carbon Trust's Design and Strategic Design Advice services can help you find accredited consultants[11]. It's important to check the track record of bidders carefully to ensure that they have done similar work before, and to take up references to find out whether previous clients were satisfied.

This process will identify the most cost-effective option. It may be appropriate to consider other services and utilities, such as water, sewage and Information and Communication Technology, at this stage to assess whether it is worth bringing them within the scope of the project.

SUMMARY

To assess technical feasibility

- present project data and **energy map**
- range of options (see page 15 for a checklist)
- include business as usual
- select appropriate financial methodology

STAGE 5 Feasibility study

A feasibility study is a technical exercise to investigate the selected option in detail. It will also provide a high-level assessment of the financial viability of the option.

5 A detailed technical study
Once you've identified the most appropriate technology option, it must be subjected to a detailed technical feasibility study. A feasibility study for a **CHP** and **district heating** project is described here.

5.1 Detailed analysis
The data on heating and hot water loads that has already been gathered needs to be analysed in detail. Feasibility is also affected by:
— ***Age and thermal efficiency of the buildings:*** these must be taken into account. For new buildings this should consider the impact of changes to building regulations.
— ***Phasing:*** for new developments, the phasing must be considered; it can help reveal the optimum route and size of pipes for the network, and good locations for the plant room(s), which might, in turn, influence the phasing plan.
— ***Measurements:*** the length of the network, the height of the buildings and the local topography are used to calculate the temperatures and pressures needed for the network.
— ***Network heat losses:*** how much heat escapes from the pipes between the heat source and the customers.
— ***Connections:*** the type and scale of connections, and pressure breaks between different parts of the network (for example, transmission and distribution), including the customer interface that transfers the heat to the building's internal system.
— ***Land availability:*** appropriate and optimum location for the plant room will need to be determined.
— ***Thermal storage:*** the possibility of thermal storage to provide a buffer in the system and reduce **heat dumping**.
— ***Cooling:*** potential opportunities for combining heating and cooling on the same network.

5.1.1 Boilers
The data on loads is used to specify an appropriately sized **lead**, or **prime mover** to supply **base load**, and **back-up** boilers to meet **peak load**. You will find **CHP** sizing software on the Carbon Trust website: www.carbontrust.co.uk.

5.1.2 Fuel
You need to think about types of fuel and their supply chains, as well as space for the delivery, storage and handling of bulky fuels such as biomass. These issues will help determine the feasibility of low- and zero-carbon **CHP** or heat-only systems.

5.1.3 'Futureproofing'
This includes:
- allowing space for additional plant to cover future expansion of the network;
- a building design that will allow plant replacement and the later fitting of new technologies, such as fuel cells or biomass **CHP**;
- sizing the pipework to accommodate future expansion of the network.

Ideally, these factors should be considered as an integral part of the **masterplanning** process.

5.2 Gradual development
Many projects develop as heat-only projects until the network, and hence the load, is large enough to justify full **CHP**. This is a useful approach in the phasing of new-build projects. Other opportunities for heat production that could augment the project, such as solar thermal, heat pumps and geothermal, as well as sources of waste heat near the project, need to be considered at the same time, since:
- technologies may not be compatible with **CHP**. Solar thermal, for example, might result in an excess of heat in summer;
- different technologies may produce temperatures that are too low for **district heating**.

This gradual approach is in line with visions in a number of energy strategies across England, including the London Plan and Manchester City Council, for the emergence of extensive heat networks over the long term; meanwhile, developments need to be designed to be ready to connect when they are able to do so. Planning policy, informed by **energy maps,** is central to supporting this process and ensuring future customer connections (see Figure 11, opposite).

5.3 Finance

The capital, operational and maintenance costs, along with likely revenues from heat, cooling and electricity sales, should be roughly estimated at this stage, too. Here it will be appropriate to use a more sophisticated financial appraisal methodology, such as whole-life costing, that takes account of future cashflows and discounts them to present-day values. This will help to establish whether the proposed scheme is economically viable, and affordable for customers.

5.4 The optimum solution

The feasibility study may produce a range of scenarios, using different permutations of technologies and design arrangements, in order to identify the optimum technical solution. There is more information on undertaking options appraisals and feasibility studies available from the Carbon Trust[12].

SUMMARY

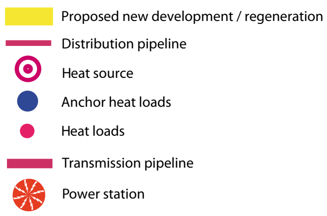
Checklist for **CHP district heating** feasibility study

- space heating, cooling and hot water loads
- phasing of the development (for new-build projects)
- optimum route and size of pipes for the network
- locations for plant room(s)
- length of network, height of buildings, local topography
- network heat losses
- type and scale of connections
- thermal storage
- data on load curves, **base** and **peak loads**
- types of fuel and supply chains
- space for delivery, storage and handling of bulky fuels
- other heat production opportunities that could augment the project
- futureproofing

Figure 11 shows network development

1. Island networks develop around anchor loads, often linked to new development, served by a small heat source

2. Networks expand and larger heat sources start to emerge to meet growing demand



3. Networks begin to link to each other in order to share excess heat capacity. Original heat sources are replaced as they reach the end of their life, potentially with waste heat from a power station. A transition main will carry large volumes of heat over long distances

STAGE 6 Financial modelling

The feasibility study and the financial modelling usually need to be undertaken in a reiterative process. They each inform and have consequences upon the other. However, the modelling undertaken in the feasibility study is relatively crude and now needs to be investigated in detail.

6 Feasibility and finance

Having determined the technical feasibility and crude financial viability of the project, viability needs to be tested in more detail. In many development proposals, factors beyond the site boundary will have a positive impact on the viability of the scheme. For example, linking the development to existing buildings or communities, particularly **anchor loads,** which might make the scheme more attractive to investors.

The type of business model (see page 28) chosen for the project will affect its financial viability. Particular organisations require different internal rates of return. Public sector organisations generally place a greater value on socio-environmental benefits and therefore accept a lower rate of return, whereas private sector, profit-making organisations require a high rate of return. Therefore, it may be appropriate to undertake the financial modelling using a range of rates of return. This will help determine the appropriate business model to deliver the project.

Once again, for complex projects you'll need expert help for this. Some engineering or multidisciplinary consultancies employ expert staff in this area, but accountancy consultants with the relevant expertise may also be helpful. Selling heat is relatively simple, but trading in electricity is extremely complex, involving a wide range of policies, regulations, charges, incentives, taxes and exemptions, so if your project is not designed specifically to use the feed-in tariff or renewable heat incentive, your chosen consultant must be very familiar with this field.

6.1 Aims and objectives

Financial modelling should begin by re-stating the project's aims and objectives.

— ***Financial viability:*** the financial model must have a positive value. At first pass it may not, in which case, adjustments to the business model, innovative financing or further fundraising may be necessary.

— ***Affordability to consumers:*** for non-domestic customers, this may be a competitive offer in comparison to the next-best offer, typically 10–20% less than 'business as usual' (gas supply and cost of plant). Typically, this would benchmark against a basket of alternative energy tariffs. For domestic customers, it may be the 'affordable warmth' threshold of 10% of income.

— ***CO_2 intensity:*** this may be defined in terms of targets and trajectories set by a local planning authority; or may be expressed in terms of the CO_2 per square metre of floor space.

— ***Supply security:*** this has a value to commercial customers.

6.2 Creating a spreadsheet

The next task is to set out all the costs and benefits in a spreadsheet (see Figure 12, opposite). Below are the costs you need to include.

6.2.1 Capital costs

All the capital costs required for the development and delivery of the project, including:

- land for plant room;
- plant: **CHP** engine sized to meet **base load**; **back-up** and **peak boilers** to meet **peak load**, as well as pumps and ancillaries;
- pipes for distribution network;
- consumer hydraulic interface units for bringing heat from the distribution network into the building (not including internal heating system);
- construction and installation costs.

East of Exeter New Growth Point Energy Strategy

5 MW biomass boiler plant and district heating in the town centre (Parcel B)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Capital costs (£'000s)																
CHP plant costs (including energy centre, boilers etc)	-£1,265	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£163
District heating network costs	-£564	-£564	-£564	-£564	-£564	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Cost of heat exchangers	£0	£0	-£116	-£198	-£168	-£66	-£33	-£11	-£11	-£22	£0	£0	£0	£0	£0	£0
Capital offsets (£'000s)																
Boiler plant	£0	£0	£295	£495	£426	£189	£95	£32	£32	£63	£0	£0	£0	£0	£0	£0
Gas connections	£0	£0	£44	£82	£65	£12	£6	£2	£2	£4	£0	£0	£0	£0	£0	£0
Operating costs (£'000s)																
Wood fuel cost	£0.00	£0.00	£0.00	-£14.64	-£36.90	-£63.17	-£92.87	-£97.94	-£101.05	-£101.16	-£109.81	-£109.81	-£109.81	-£109.81	-£109.81	-£109.81
O&M cost	£0	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50	-£50
Revenues (£'000s)																
Revenue from sale of heat	£0	£0	£0	£39	£98	£168	£247	£261	£269	£269	£292	£292	£292	£292	£292	£292
Total cost in year (£'000s)	-£1,829	-£614	-£391	-£211	-£230	£190	£172	£135	£140	£163	£132	£132	£132	£132	£132	£295
Cumulative cost (£'000s)	-£1,829	-£2,444	-£2,835	-£3,046	-£3,276	-£3,086	-£2,914	-£2,779	-£2,638	-£2,475	-£2,343	-£2,210	-£2,078	-£1,945	-£1,813	-£1,518
Net present value (£'000s)	-£1,829	-£2,388	-£2,711	-£2,870	-£3,027	-£2,909	-£2,812	-£2,742	-£2,677	-£2,608	-£2,556	-£2,510	-£2,468	-£2,430	-£2,395	**-£2,324**

Figure 12: Courtesy of Regen SW

6.2.2 Operational costs

All costs associated with the operation of the project over a 25-year term. These are:

- input fuel (natural gas, oil and/or biomass);
- electricity for lighting and pumping;
- maintenance;
- billing and revenue collection, including bad debt provision;
- operational management;
- customer care, including emergency cover;
- capital interest and re-payments;
- insurance;
- business rates;
- Corporation Tax;
- contributions to sinking fund for replacement of the system at the end of its life. To ease the financial burden, it may be that this is introduced after **senior debt** has been discharged;
- legal and financial advisers' fees.

6.2.3 Capital contributions

— ***Debt:*** most **decentralised energy** projects are developed using debt financing. Loans are obtained from banks, based on robust financial models showing positive cash flows over the full term. Repayments are made from revenues. The Green Investment Bank, with government investment confirmed in the 2010 Comprehensive Spending Review, is likely to form an important source of project financing.

— ***Grants:*** over the past decade there have been a variety of grant programmes from local and central government, regional bodies, devolved administrations and the European Union. They cover various aspects of a project, including contributions to development costs (e.g. feasibility studies); contributions to capital costs for specific pieces of equipment (e.g. heat networks or **CHP** plant); funds such as the **Biomass Capital Support Programme** and the Low Carbon Infrastructure Fund; **European Regional Development Funds (RDF)** and low-cost loan programmes, such as **JESSICA**. The European Investment Bank is also interested in investing in low- and zero-carbon projects, although usually only at a very large scale. There are also regulatory mandated programmes, such as the **Community Energy Saving Programme (CESP)**, under which energy companies are obliged to invest in capital costs in return for carbon savings. Increasingly, there's a shift away from grants towards incentives, including the feed-in tariff introduced in April 2010 and the renewable heat incentive which is expected in June 2011.

— ***Connection charges:*** by connecting to a network, buildings or developments will avoid the expense of installing their own system on-site and may therefore be able to contribute towards the cost of a network. This cost might be set at a slightly lower rate than the on-site alternative as an incentive to connect. Often a network will be a cheaper way of complying with local energy and CO_2 planning requirements. This avoided cost must be factored into the connection charge that you set.

— ***Land availability:*** public sector landowners may be open to making land available for plant rooms for free, or at below market values, perhaps as part of fuel poverty or climate change mitigation objectives, or in return for an equity stake in the project or **special purpose vehicle** (a separate company specifically set up to oversee all aspects of development of the energy system – find out more on page 30). Rules governing this are contained within the Treasury Green Book which governs disposal of assets, and in the Best Value – General Disposal Consent 2003.

— ***Section 106 agreements, tariffs and funds:*** Community Infrastructure Levy payments (which may be replaced by an alternative tariff by the new government) can be used to fund energy systems identified in local infrastructure plans anywhere in a district. Section 106 can also be used, but is restricted to funding infrastructure directly related to a development. Additionally, the **allowable solutions** element of a zero-carbon building is likely to take the form of a contribution to off-site energy infrastructure. Local authorities are likely to have a central role in identifying and delivering **allowable solutions**.

– ***Equity:*** this may come from stakeholders in a variety of forms, including cash. Viable schemes will attract private investment of a wide variety of types, in return for an appropriate equity stake. This investment may include equity from consumers and/or communities if some social enterprise legal forms are used, notably Industrial & Provident Societies.

The structuring of financing will have tax implications as debt repayments can be set against tax, whereas dividend payments to equity investors cannot.

Non-discounted cumulative cash flow

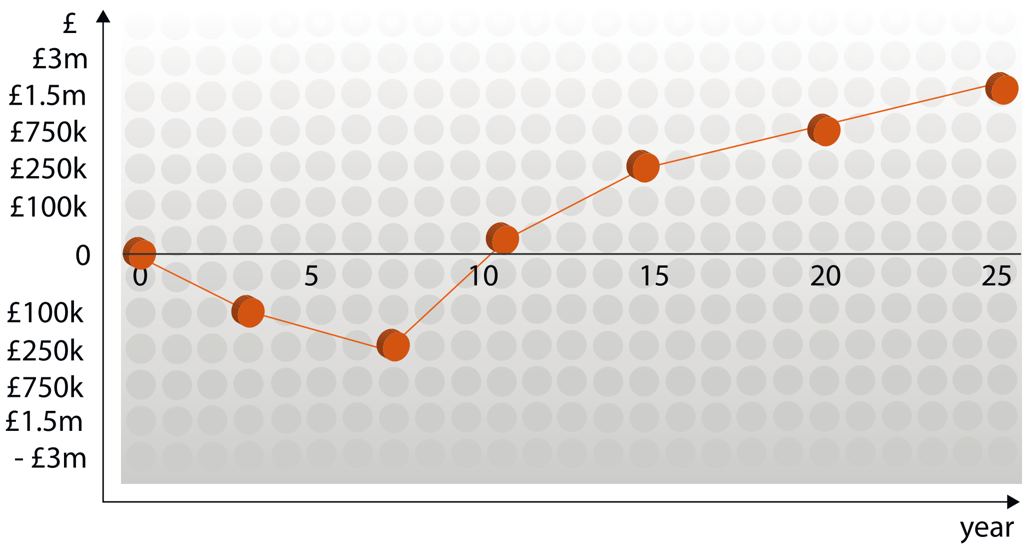


Figure 13:
This graph shows projected cumulative cash flow over a 25-year term

6.2.4 Revenues: income

— ***Electricity trading:*** only applies where plant that generates power is included, such as **CHP**, photovoltaics and wind. Apart from the revenues for the brown electricity, it also includes incentives such as **Levy Exemption Certificates (LEC**s**)**, **Renewable Obligation Certificates (ROC**s**)** and embedded benefits for certain technologies and types of fuel.

— ***Heat charges:*** for the supply of heat to customers.

— ***Standing charges:*** some operators structure their tariffs to include a heat charge for the variable cost of fuel used and a standing charge to cover the fixed cost of the infrastructure. Others roll these two elements into a single unit charge.

— ***Maintenance charges***: this covers maintenance to the plant and network as well as the equipment within the customer's premises.

— ***Renewable heat incentive and feed-in tariff*** – see page 25.

Once this work is complete, the data must be analysed using the assessment methodologies discussed on page 21. At this stage it is most appropriate to use whole-life costing methodology including discounted cash flow. This will tell you if the project is financially viable, including payback of loans and investments, by providing a positive or negative NPV. Simplistically, capital contributions should be offset against capital costs. Income must meet operational costs and leave a surplus for the project to be financially viable. It may be useful to use a range of internal rates of return as this will help identify the most appropriate busines model to deliver the project.

	ESCo	Host organisation
Capital costs		
Cost overrun in construction	✓	
Project over-run	✓	
Damage to property	✓	✓
Sinking fund		
Fuel risk		
Fuel price variation		✓
Financial risk		
Reduction in occupancy	✓	✓
Delay in insurance payments	✓	
Delay in payment of incentives		✓
Non-payment by customers	✓	✓
Technical risk		
Engineering design	✓	
Plant failure	✓	
Operating costs	✓	
Plant efficiency failing to reach design specification	✓	
Plant failing to meet output specification	✓	
Other		
Health and safety	✓	
Force majeure	✓	✓
Planning issues	✓	
Legislative change		✓
Benefits		
Profit	✓	

Figure 14: Example of allocation of risk

6.3 Risk register

The financial model will be vulnerable to a variety of risks. Therefore, a risk register must be developed. Ideally, the risk register is drawn up with other stakeholders in the project, as they may identify risks the project developer has overlooked. The risks then need assessing in terms of how likely they are and how significant the consequences. They can next be designated as high, medium or low risk and allocated to the party best placed to manage them. For risks that remain with the project, strategies must be developed to manage them.

At the end of this exercise, there will be risks outstanding. The financial model then needs to be subjected to a sensitivity analysis of these risks. The key ones are:

- balancing generation and demand, which includes the critical issue of phasing: plant and infrastructure must be installed before demand commences; development phasing must consider the preferred energy strategy at the **masterplanning** stage so that potential issues can be spotted and addressed;
- cost over-run in construction;
- plant efficiencies failing to reach design specification;
- plant failure;
- fuel price variation;
- non-payment by customers;
- delay in payment of incentives (for example, **LEC**s, **ROC**s and feed-in tariff);
- delay in insurance payments for damage to property.

The analysis must look at the likelihood of the risks occurring at various levels. For example, would the project still be financially viable if fuel costs increased by 5%, 10%, 15% and 20%? If it is, then the model is robust. See an example of a risk register in Figure 14, above.

6.3.1 Financial risks

Of course, capital must be expended to build the project before revenues start coming in, unless capital grants are available. This is particularly important where the construction of new developments is phased. It will also affect the type of business model selected to deliver and operate the project.

Projects that fit connections to existing buildings have the advantage that heat loads already exist and can therefore provide a revenue stream from the moment of connection.

Projects financed with debt have to make capital re-payments from the start of the loan. This needn't be a problem. But if it's a lot of capital, and the break-even point is lengthy, it may create cash flow difficulties for the financial model, or even render it unviable.

Projects financed with equity don't have this problem. However, the particular constitutional arrangements for the business mode**l** may limit the use of equity.

Alternatively, the overall capital requirement may be reduced by structuring the business model organisationally so it tenders out the plant room and equipment on a design, build, finance, operate (DBFO) arrangement to a third party.

It's clear that the business mode**l** needs to be considered at the start of the project, and again in detail at the same time as the financial modelling, as one may need to be adjusted in the light of the requirements of the other (see page 28).

STAGE 7 Business modelling

There are four basic business models within the context of decentralised energy projects: private ESCO companies; public ESCO companies; hybrid public/private partnerships; and stakeholder-owned special purpose vehicles. Sources of finance, the roles required to deliver and operate a low-carbon energy project and the proportion of private and public sector involvement must all be considered.

7 Business models

7.1 Risk and objectives

Throughout this guide, we have talked about the importance of the **project devloper**'s attitude to risk and their desire for control. Most organisations wish to minimise their exposure to risk but, as a general rule, risk should be assigned to the parties that are best able to manage it. However, transferring risk can have financial implications. Public sector **project developers** can accept a lower rate of return than private sector ones. They can also access capital at lower rates than private companies, as financiers can be more certain of getting their investment back. Consequently, if a project is transferred from the public sector to a private company, the cost of capital will increase and this may affect the viability of the project.

Furthermore, if the ownership of a project is transferred to a private company, then the host organisation for a project loses control over its future direction. This may not be a problem unless the primary objectives are long-term social or environmental benefits. For example, a local authority may want to develop a **decentralised energy** project as part of the regeneration of a run-down area. Low-cost energy may add to the regeneration package. As such, the authority may be willing to take a long-term view as it knows that if the regeneration is successful it will stimulate economic activity, households will be lifted out of poverty, land values will rise and business rates and council tax receipts will increase. However, a private company cannot take such a long-term view and its investment committee will want a shorter return on its investment.

Alternatively, a private housing developer may wish to engage a private energy company to design, build, own and operate a **decentralised energy** project serving a new development. The primary purpose for the developer is to comply with planning obligations, build it and exit. It will not want a continuing relationship with the occupants through supplying them with energy. However, if the project provides a sufficient rate of return for the energy company this is a reasonable approach.

7.1.1 ESCos

For the reasons given above, it's important for the host organisation to decide on its objectives, what risk it is prepared to accept and how much control if wishes to have over the project in the long term. These considerations will then help it decide on the most appropriate business model to apply to deliver the project.

Such business models are frequently referred to as energy services companies or **ESCo**s. There isn't a single, clear definition of an **ESCo**[13]. However, it generally refers to a business providing a broad range of energy and carbon-management solutions, including the design and implementation of energy-saving projects, energy conservation, power generation and energy supply.

ESCos may be public or private organisations, hybrid public/private entities or third sector organisations, such as residents' cooperatives. The key features of an **ESCo** are that it has a separate budget and business plan from the host organisation and it provides a focused management of the energy projects. The business plan will typically be over a long period and should be sound enough to attract external investment into the project. Below you can see the strengths and weaknesses of the different **ESCo** arrangements.

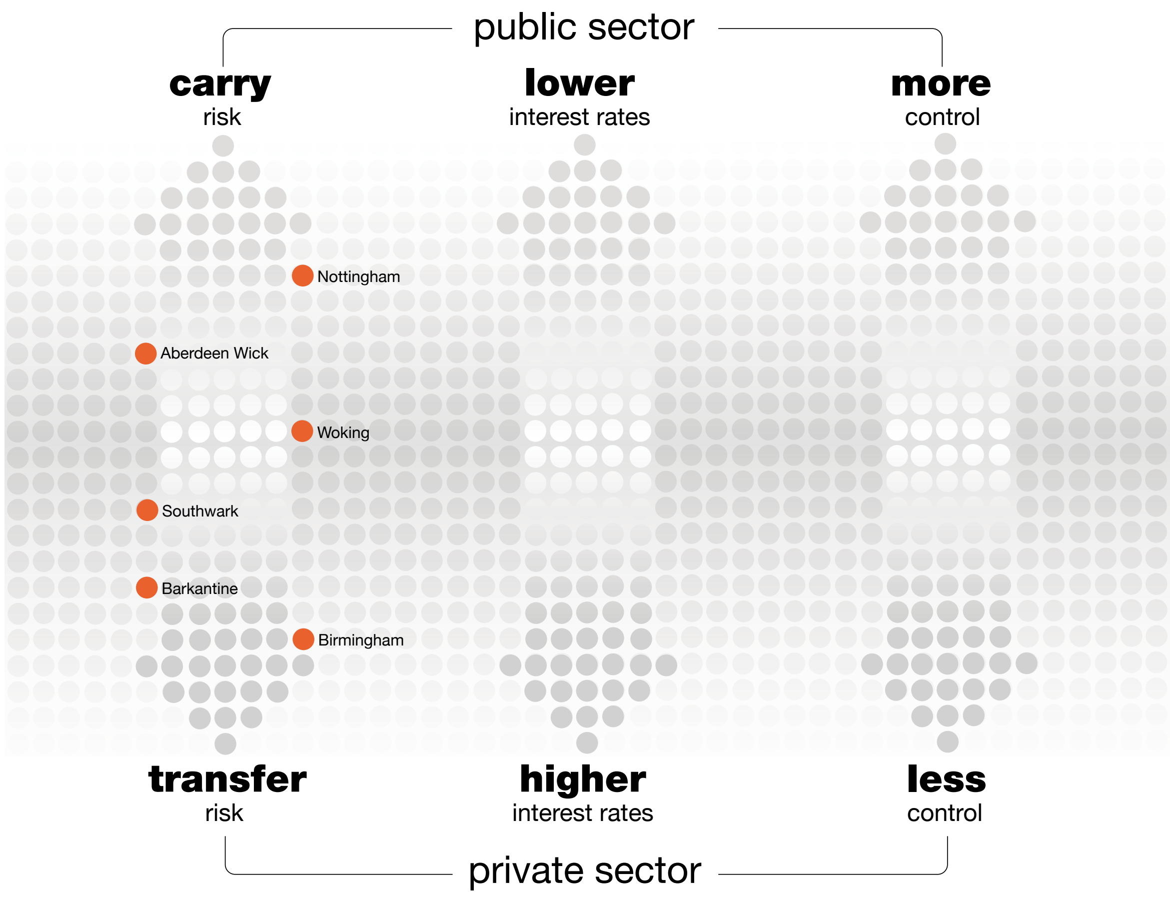


Figure 15: This diagram shows relationship between risk, control and the cost of capital for public and private sector projects

7.2 Private ESCo Companies

There are a number of private companies operating in the energy services market. Recently, larger utility companies have entered this market, either directly or by buying or taking a stake in a specialist company, thus providing solid financial backing. These are profit-making organisations. To interest them, projects need to be big (200–500 housing units), with appropriate densities and/or an attractive mix of uses and loads. Small (less than 200 units), wholly-residential developments may not interest them. This threshold will drop if there's a mixture of loads or a large **anchor load** nearby. These companies can arrange external funding, although the building owners or developers may still need to make a capital contribution for the project to be viable within a reasonable contract length. At a minimum, this is likely to be the cost of providing the 'business as usual' case.

The strengths of this approach are:

- the private company invests and carries the financial risk;
- they bring substantial expertise specific to the technology, with extensive project management skills, enabling them to carry the technical risk;
- they can continue ownership and operation over the long term.

Weaknesses are:

- higher rates of return are required and energy charges may be higher;
- public sector sponsors lose control and are unable to direct future development, particularly for projects with a low rate of return;
- customers are tied into a private company with the risk of monopoly abuse.

7.3 Public ESCo companies

Local Government Miscellaneous Goods & Services Act 1976, Section 11 provides local authorities with the legal power to generate heat and electricity, and powers to purchase, buy, sell and supply heat. However, until recently, it prevented them from selling electricity except when generated in association with the production of heat – i.e. from **CHP** generation. This restriction has recently been removed by the Secretary of State for Energy and Climate Change (DECC, August 2010). This is significant since it allows local authorities to become energy companies.

More recently, the Local Government Act 2000, Section 2, provides power for local authorities to do anything that is in the environmental, social or economic interest of their areas under the well-being power. This was previously restricted to councils rated fair or better. However, they cannot delegate strategic decision-making, which must be retained by the host authority. It also does not provide for trading. This was provided under the Local Government Act 2003, which gave councils the power to charge for services. Although they can recover costs, including a sinking fund for replacement costs, they cannot make a profit.

It *does* allow local authorities to set up a local government trading company that can make a profit from which the council can then receive dividends as a shareholder. Taken together with the well-being power, this is the relevant power for local authorities wishing to establish local energy services companies. One example is Thameswey Energy, owned by Woking Council.

Establishing a trading company provides for a business plan separate from the council as well as a focused management. It can also borrow against its assets and revenue streams. However, any debts are likely to be consolidated into the council's accounts and it therefore carries the financial risk. Thus, the business case should be soundly based on 'invest to save' principles. This also allows it to access capital at close to public sector rates, possibly through 'prudential borrowing'.

Public owned ESCO's will need to be aware of State Aid Rules which prevent them from providing unfair competition to private energy supply companies. In practice this means that the price they offer to sell to private homes or businesses must not reflect the benefit of any public grants or lower public sector interests rates on capital. Determining the price for the sale of energy will therefore need to discount any grants and assume private sector interest rates. This does not apply to selling to public sector consumers or council tenants. State Aid Rules are not fixed but are based on case law and the risk of challenge. It is therefore strongly advisable to seek legal advice on this issue.

Although the ownership may be with the local authority, the technical design, build and operation can be contracted out to specialist private companies, and it may be that the assets are held by the private sector under manufacturer financing arrangements or forward revenue purchase deals from banks. Thus technical and financial risk can be reduced or passed through.

The strengths of this approach are:

- local authority ownership and control ensures close alignment with Council social and environmental policies;
- Council ownership provides covenant strength in obtaining finance, and this will be at a lower cost compared to private sector borrowing;
- dividends can support the delivery of other services;
- future expansion can be co-ordinated and controlled by the Council.

Weaknesses are:

- company is reliant on the financial strength of the Council and it will remain on the Council's balance sheet;
- Council must be rated as fair or better;
- Council carries the financial risk.

7.4 Hybrid public/private arrangements

A hybrid **ESCo** may be established in order to share risk between the public and private sectors and to allow it to access external capital at the lower rates available to the public sector. These hybrids could be structured as joint ventures or as **special purpose vehicles** in which the different parties have a shareholding or membership. It's helpful to think about the different roles necessary for the delivery and operation of a decentralised energy project and assign these to different parties, or indeed, contract them out. Possible roles are set out in 7.6, below:

Establishing a joint venture or a **special purpose vehicle** requires specialised legal assistance. The purposes for the company and its structure will need to be defined in the Memorandum of Understanding and the Articles of Association. Below these, there will be a suite of contracts defining relationships necessary for the provision of the energy services. Although sample contracts are available in various publications, they will inevitably require refining to the specific requirements of the host organisation.

The strengths of the hybrid approach are:

- close alignment with the socio-environmental aims of the public sector;
- greater flexibility than either wholly-public or -private approaches;
- can access capital at lower-cost, public sector rates.

Weaknesses are:

- some risk remains with the public sector;
- liabilities are consolidated into public sector accounts;
- has to comply with public sector procurement procedures.

7.5 Stakeholder-owned special purpose vehicle

This is similar to the hybrid approach, above, except ownership is shared amongst a variety of stakeholders. These may be:

- the customers receiving the energy, for example major building owners within a defined location;
- strategic bodies such as the local authority;
- communities or cooperatives.

This type of vehicle, common in many parts of Europe and the USA, is best suited to schemes where their location, scale and/or nature challenge traditional financing and ownership models, which will often require a risk premium to accept unconventional terms. This option may be well-suited to delivering long-term solutions to areas requiring regeneration or to isolated rural areas. It may also offer greater accountability and transparency. In the near to medium term, a **heat network** will be connected to a monopoly supplier. Owning the network reduces the risk of monopoly abuse. It may also be a useful way of gaining acceptance and buy-in to a scheme, by offering residents or communities a stake in a project.

7.6 Roles needed for a decentralised energy project

— Regulation: establishing and monitoring standards of performance and/or consumer protection across a wide area, such as a town, city or region, with which all decentralised projects in those areas must comply.

— Governance: this is specific to the particular entity and is concerned with providing strategic guidance, stakeholder accountability and high-level relationships.

— Project champion: identification and definition of a project, achieving stakeholder buy-in, initiating technical feasibility studies and financial investment appraisals, initial fundraising, and driving and promoting the project.

— Developer: a more limited engagement with the project concerned with its physical delivery, including design and building.

— Asset owner: the party that owns the actual physical assets. This could be a bank or financial investor.

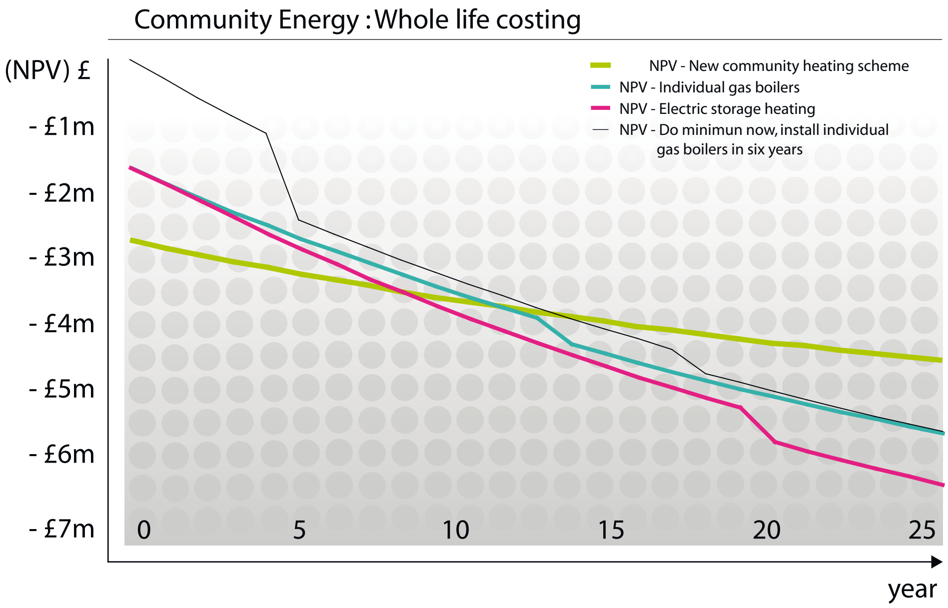
— Operator: responsible for the technical operation of the project.

— Retailer: responsible for the retailing of energy across the project, for example, buying it from the plant room operator, arranging its transportation to the end-consumer and its sale to that consumer.

— Supply chain manager: responsible for the procurement of fuels, equipment and services necessary for the development and operation of the project.

These roles can be organised in different configurations in order to maximise the benefits and outcomes to the different stakeholders in the most cost-effective fashion. For example, Aberdeen City Council has acted as a project champion in developing **district heating** in the city. It established Aberdeen Heat and Power Co. as an arm's length, not-for-profit company limited by guarantee based on membership. This provided a focused management and a business plan and budget separate from the Council. The Council is a member of the company, with representation on the board, and can therefore influence regulation and governance. It also allows the company to access capital at lower-cost, public sector rates.

However, the company owns the assets and is responsible for development, supply-chain management and for operation, although many of these activities are contracted out to the private sector. The company retails electricity to a private energy company and variously retails heat to private customers, but also to the Council which, in turn, retails it to their tenants.



Assessing financial viability

Different methodologies can be used to assess financial viability.

—***Payback:*** gives a simple indication of when investment in a particular technology will break even and begin paying back. This gives a very crude indication of viability and doesn't place a value on future cash flows.

—***Discounted cash flow:*** discounts future costs and revenues at a given rate to bring them back to present-day values.

—***Net present value (NPV):*** uses discounted cash flow to give a project an overall net present value which is either positive or negative. If it's positive, the project is viable. If it's negative, it will need additional capital to bring it to a positive value.

—***Internal rate of return:*** many organisations use a given fixed rate as an internal threshold which projects must meet to be worth further investment.

—***Whole-life costing:*** includes future operating expenditure and capital expenditure as well as avoided costs discounted using NPV (see the graph above).

HM Treasury guidance for public sector investments recommends using a whole-life costing methodology over a 25-year term. This adds up the capital costs for each option as well as taking other costs into account.

—***Operational costs:*** these include fuel, maintenance and replacement costs; the latter must be included because some technologies will need total or partial replacement within a 25-year period.

—***Future costs:*** these are for operations (fuel, maintenance and replacement costs), brought back to present values using NPV at a discount rate appropriate for the type of organisation.

—***Discounting costs:*** including discounting costs avoided, for example, for plant replacement and maintenance.

STAGES 8, 9 and 10
Soft market testing, procurement and delivery

Market testing provides fine-tuning opportunities for the project. Procurement of the necessary services, potentially including assigning a project manager and contractors, and delivery are the final stages to complete.

8 Soft market testing

8.1 Project Information Memorandum

Costs and prices in the financial modelling are, at best, guesses and assumptions. It's therefore a good idea to try to determine if they are correct. If the project will be tendered to the private sector, testing will reveal if there's an appetite in the market to bid for the project as it has been defined. As this is a specialist area, an experienced consultant should be appointed to undertake this activity. The market for energy services is evolving rapidly. It's best to seek advice on the range of services available and who is providing them.

Testing is typically done through a **Project Information Memorandum (PIM)** that contains a description of the project, plus key documents such as the technical feasibility study. This soft market testing also provides a chance to adjust the model to make it more attractive to the market. Many companies are willing to provide **turnkey** contracts, although there's an additional price to pay for this service. These companies also usually have a preferred business model and will subtly encourage clients to adopt it. This may not be suitable and it would be wise to test any offer against your own project aims and objectives, bearing in mind the different strategic objectives of private- and public-sector organisations (see page 29). Often, the same companies are willing to provide discrete elements of the project as separate contracts. This could be for installation of the equipment (plant room and equipment, distribution networks and consumer interface units, including metering), as well as for ongoing operation and maintenance.

It's important to comply with **OJEU** procurement procedures, and it must be made clear that soft market testing doesn't form part of the procurement process.

9 Procurement

9.1 Procurement route

This will depend on the business model selected.

— ***Private-sector route:*** public authorities procuring a private sector company to design, build, own and operate a project will need to follow **OJEU** procurement procedures carefully. They will have to establish an evaluation panel representing a range of skills and expertise, as well as representing appropriate interests within the host organisation. Once again, the services of a specialist consultant will be needed in the preparation of tender documentation based on a refined **Project information Memorandum.** This will then be published in appropriate media as an Invitation to Participate. This is a pre-qualification exercise, in which the financial and technical credibility of potential contractors and/or partners and the relevance of their track record can be evaluated.

A tender list can then be assembled and companies on it invited to submit initial proposals. Companies responding will need to visit the project locations and meet the host organisation to understand the project. In order to ensure impartiality, all visits and meetings should be organised collectively and be open to all pre-qualified companies. Initial proposals can then be evaluated and the tender list focused down to a limited number of companies that are then invited to develop full proposals.

Further meetings and exchanges will then follow. Strict impartiality should always be maintained. Bidders will then submit their best and final offers. After evaluation, a preferred bidder is selected and invited to negotiate. The two parties will identify and agree on key areas for negotiation in a Heads of Terms document. Negotiation will then fine-tune the technical, financial and business model until financial close is achieved

Summary of the project development process

Set overall objectives – see chart on page 15 *(carbon reduction, energy security, cost reduction).*

1. Gather data.
2. Define project – buildings to be served (density levels, load diversity, presence of anchor loads).
3. Options appraisal (consider technical solutions that meet overall objectives for defined project).

→ Other technology

District heating/CHP

1. Implement detailed feasibility study.

→ Not technically feasible
Consider alternative technical solution

Technically feasible

1. Build financial model.

Financially viable

1. Build business model that fits risk transfer and control requirements.

Not financially viable
Adjust level of risk transfer and/or identify other avoided costs and/or further fundraising

Business model

1. Soft market test model (check cost and revenue assumptions).
2. Evaluate procurement model.

Commercial ESCo

1. Prepare documentation *(Project Information Memorandum, invitations to participate, invitations to tender).*

1. Decide evaluation criteria Establish evaluation panel.
2. Award preferred bidder.
3. Final negotiation.
4. Financial close.
5. Contracts commence.

Hybrid

1. Decide on business structure *(JV, EPU, PPP, stakeholder-owned cooperative).*
2. Decide role allocation.

In-house ESCo

1. Procure separate project elements *(plant room, CHP and ancillaries, distribution infrastructure).*

1. Procure operation, maintenance and billing/revenue collection services.

and contracts exchanged and signed. Further information can be found at Good Practice Guide 377: Guidance on procuring energy services to deliver combined heat and power schemes.[15]

— In-house provision route: public authorities can establish in-house entities similar to **Direct Labour Organisations.**

— Hybrid/special purpose vehicles route: local authorities have the *vires* to establish companies in which they have a stakeholding or shares, under the well-being power of the Local Government Act, 2000. Powers to trade are contained in the Local Government Act, 2003. If you take this route, you'll require the services of a specialist lawyer to draw up the documentation to establish the company. If the plans include a public authority, it will still have to comply with **OJEU** procurement procedures and the process laid out above.

— Stakeholder-owned route: the procurement route will depend on who the stakeholders are. If public authorities are involved, again compliance with **OJEU** procurement procedures will be necessary.

10 Delivery

10.1 Delivery

As part of the negotiations with the preferred bidder, they will have set out a project delivery plan, summarised in a GANNT chart. Key milestones will have been agreed in the final contract. You will need to appoint a contracts supervision officer to provide the focus point between the two parties, oversee the delivery of the contract and deal with any problems that may arise. Additionally, project delivery will cause disruption and it will be appropriate to appoint a community-relations or resident-relations officer.

For **district heating** projects you will need to break open roads in order to lay the pipes. Powers to do this are set out under the New Roads and Street Works Act 1991. Disruption is inevitable and you will need to establish close cooperation with the local authority Highways Department.

Lastly, all new energy systems will go through a period of teething problems. These could take up to a year to settle down. It's useful to be mindful of this fact and endeavour to take a long-term view.

Stage	Lead	Data needs and considerations	Support
Preliminary planning Energy opportunities plan/ masterplan	• Sub-national planning body • Local authority • Project developer (masterplan)	• Existing energy demands • Existing energy installations • Location and demands of new development • Resource assessment • Heat map	• Engineering, planning or masterplanning consultants • PAS, ATLAS • Government departments, e.g. CLG, DECC • Other planning bodies or project developers
1 Objectives setting	• Project developer	• CO_2 • Affordability • Security of supply	• PAS, ATLAS • Carbon Trust or EST • Government departments, e.g. CLG, DECC • Other project developers
2 Data gathering	• Project developer	• Don't duplicate data gathered in Stage 2 • Development density • Demand loads • Mix of uses • Age of buildings • Anchor loads • Barriers and opportunities	• Engineering, planning or masterplanning consultants • Carbon Trust or EST
3 Project definition	• Project developer	• Prioritise clusters with maximum density, diversity and anchors, and identify key buildings to be connected	• Engineering consultants
4 Options appraisal	• Project developer	• Detailed analysis of options identified in Stages 1 to 4	• Engineering, planning or masterplanning consultants • PAS, ATLAS • Carbon Trust or EST
5 Feasibility study	• Project developer	• Detailed analysis of data • Technical feasibility • Financial viability • Phasing	• Engineering, planning or masterplanning consultants • Carbon Trust or EST
6 Financial modelling	• Project developer	• Detailed financial viability assessment • Capital cost • Operational cost • Revenue	• Cost or accountancy consultants • Carbon Trust or EST
7 Business modelling	• Project developer	• Project type • Attitude to risk • Desire for long-term control • Regulation • Access to finance and the desired Internal Rate of Return	• Cost or accountancy consultants • Carbon Trust or EST • Legal advisers
8 Soft market testing	• Project developer	• Target audience • Likely customer base	• Engineering consultants • Other project developers
9 Procurement	• Project developer	• Level of public/private sector involvement • Overall scheme viability	• Engineering consultants • Procurement officers • Legal advisers
10 Delivery			

GLOSSARY

aggregate method: proposed method of taking into account the cost-effectiveness of different techniques used together or in isolation to comply with Part L for differing types of non-domestic building. Refer to http://www.communities.gov.uk/publications/planningandbuilding/partlconsultation for details.

allowable solutions: will form part of the zero-carbon buildings requirements under Part L of the building regulations. They are likely to take the form of a financial payment by developers on residual CO_2 emissions after the required building fabric improvements and on-site 'carbon compliance' measures have been undertaken.

anchor load: a large heat load which could connect and potentially provide an early income to a **district heating** project by purchasing heat.

back-up boiler: provides extra energy to support the **prime mover** at **peak load** periods in a heating system.

base load: see **demand load**

carbon compliance: will form part of the zero-carbon buildings requirements under Part L of the building regulations. They require new buildings to achieve CO_2 reductions using on-site low- and zero-carbon energy or direct connection to a heat network.

Carbon Emissions Reduction Target (CERT): a legal obligation on the large energy suppliers to reduce CO_2 emissions from domestic properties in Great Britain. CERT money is spent directly with householders or for funding public sector schemes.

Carbon Reduction Commitment: a 'cap-and-trade' mechanism for large energy users, providing a financial incentive to reduce energy use by putting a price on carbon emissions.

centralised energy: electricity from all energy sources generated specifically to feed into the national grid.

CHP: (see **combined heat and power**)

CIBSE: Chartered Institution of Building Services Engineers: www.cibse.org/

combined heat and power (CHP): generating heat and power (usually electricity) in a single process, by which less heat is wasted, and heat that would normally be released into the atmosphere, rivers or seas is usefully captured and employed.

Community Energy Saving Programme (CESP): programme for delivering 'whole house' refurbishment of existing dwellings through community-based projects. It is funded by the energy generators and suppliers.

Comprehensive Area Assessments: until their abolition in May 2010, these were the assessment mechanism for local authority services, including national indicators on CO_2 emissions. Many local authorities continue to use the indicators.

CRC Energy Efficiency Scheme: (formerly known as the Carbon Reduction Commitment): the UK's mandatory scheme aimed at improving energy efficiency and cutting emissions in large public and private sector organisations.

decentralised energy: (sometimes called distributed energy): heat and power generated from low- and zero-carbon sources primarily for use locally (excess electricity can also feed into the local distribution network).

demand load: the amount of energy consumers demand in any building or development. **Base load** refers to the pre-existing load for a given area or the load to be met by any system under consideration The period of highest energy demand is called the **peak load.**

development plan: parts of the Local Development Framework that have been tested by an examination in public (e.g. Core Strategy) and, until their abolition in June 2010, included the Regional Spatial Strategy.

Direct Labour Organisation: workers employed by a council or other government department, as opposed to being privately employed by a company which has a contract to do the work from the council or government department.

district heating: a system for distributing heat generated in a local centralised location for residential and commercial heating requirements.

district heating network infrastructure: the pipework which connects the central energy plant to the buildings using the heat.

energy character areas: areas that can be defined by their particular characteristics in order to identify an appropriate energy solution or planning policy.

energy map: map showing opportunities and constraints for low- and zero-carbon energy across a given area. They may show different information and be more, or less, detailed, as required. Sometimes referred to as energy opportunities maps or sustainability options plans.

ESCo (Energy Services Company): a business providing a broad range of energy and carbon management solutions, including the design and implementation of energy-saving projects, energy conservation, power generation and energy supply.

European Regional Development Fund (ERDF): set up in 1975, the ERDF has developed into a major instrument for helping to redress regional imbalances.

Feed-in tariff (FIT): under the scheme introduced in April 2010, energy suppliers make regular payments to householders and communities who generate their own electricity from low- and zero-carbon energy.

financially viable: in this instance, financial viability is judged to be achieved where a commercially acceptable Internal Rate of Return can be seen on the **district heating network** over a 30-year investment period.

Global Learning Rates: a method of mathematically representing increasing international production volumes and the associated reducing costs of technologies.

grid decarbonisation: the reduction in CO_2 emissions from electricity entering the national grid by replacing fossil fuels with low- and zero-carbon technologies.

heat dumping: excess (or waste) heat from energy generation or a **district heating network** can either be vented (e.g. through a cooling tower or into rivers, lakes or the sea) or 'dumped' into a store (e.g. a temporary store) for future use, or a swimming pool.

heat map: a map showing locations where heat demand is sufficient to support **district heating**. Often included as part of an **energy map**.

JESSICA (Joint European Support for Sustainable Investment in City Areas): a policy initiative of the European Commission and European Investment Bank. It offers a flexible funding source for Member States to use to bring forward investment.

lead boiler: (See **prime mover**)

Levy Exemption Certificates (LECs**):** non-domestic end-users of energy are required to pay a Climate Change Levy of £4.30 per megawatt hour (MWh) of energy purchased and consumed, or purchase renewable electricity instead of paying the levy. They can also purchase LECs rather than the physical power; the certificates are evidence of electricity supply generated from qualifying renewable sources that are exempt from the Levy. The LECs can be redeemed to suppliers, and then in turn to OFGEM, to demonstrate the amount of electricity supplied to non-domestic customers that is exempt from the Levy.

load diversity: different energy consumers use their energy at different times of day. These are **load profiles**. A variety of different **load profiles** will provide **load diversity**.

load profile: load variation shown on a graph over 24 hours.

masterplan: a diagram or scheme showing how a site or area can be developed or regenerated. Terms such as development brief or design framework are often used. The Urban Task Force described them as establishing a three-dimensional framework of buildings and spaces as well as determining the distribution of uses. Energy would be one element of a masterplan.

OJEU (Official Journal of the European Union): the publication in which all tenders from the public sector which are valued above a certain financial threshold must be published.

peak load: see **demand load**

prime mover: also known as the **lead boiler**, it provides the **base load** in a heating system.

project developer: project developers, for the purposes of this guide, are defined as local authorities, communities, other public sector developers and private developers.

Project Information Memorandum (PIM): a suite of documents describing a **decentralised energy** project for the purposes of procurement.

Regulated CO_2 Emissions: that element of a building's CO_2 emissions which are controlled by Part L of the Building Regulations (space and water heating, ventilation, lighting, pumps, fans and controls).

Renewable Heat Incentive: initially intended to act as a comparable incentive to **FIT**s for heat generators, it has not yet been introduced and the new government is considering its options.

Renewable Obligation Certificates (ROC): the RO is the main support scheme for renewable electricity projects in the UK. It places an obligation on UK suppliers of electricity to source an increasing proportion of their electricity from renewable sources. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

residual emissions: CO_2 emissions remaining from a building once Part L of the building regulations has been complied with.

SAP modelling: Standard Assessment Procedure. This is the methodology which must be used to demonstrate compliance of any new dwellings with Part L of the Building Regulations.

senior debt: debt finance that takes priority in repayment.

shadow price of carbon: this represents the cost to society of the environmental damage caused by a tonne of CO_2 emitted into the atmosphere.

special purpose vehicle: a separate entity created to take ownership and responsibility for an energy project's development and ongoing operation.

TER: Target Emission Rate. The amount of regulated emissions (measured in $kgCO_2/m^2/year$) a new building is permitted to produce in order to comply with Part L.

TM46: Technical Memorandum 46 published by **CIBSE** provides a range of energy consumption benchmarks for non-domestic buildings.

top-up boiler: see **back-up boiler**

transition towns (also known as transition network or transition movement): a movement of community projects designed to equip communities for the challenges of climate change and peak oil.

turnkey energy services: where a lead contractor takes responsibility for a series of subcontractors in order to pull the contract into a single entity.

NOTES

Section: Who is this guide for?

[1] The need to map energy opportunities is implied through the PPS1 Supplement on Planning and Climate Change requirement for an evidence base to support energy policy and targets. The draft replacement PPS 'Planning for a Low Carbon Future in a Changing Climate' makes this explicit.

Section: What are Energy Maps?

[2] Sometimes referred to as sustainability options plans or energy opportunities plans.

[3] DCLG (2007) 'Planning Policy Statement: Planning and Climate Change – Supplement to Planning Policy Statement 1'

[4] Local and sub-regional energy maps have been prepared or are in preparation in Blackpool, North Hampshire (Basingstoke, Rushmoor and Hart), Eastbourne, Cornwall (Camborne, Pool and Redruth AAP), Greater Manchester (10 AGMA authorities), Stockport, Enfield, Bassetlaw, Cannock Chase, Suffolk Coastal.

[5] More information on character areas can be found in Community Energy: Urban Planning for a Low Carbon Future (TCPA/CHPA 2008) www.chpa.co.uk/news/reports_pubs/Community Energy- Urban Planning For A Low Carbon Future.pdf

Section: Stage 1 Objectives setting

[6] See www.metoffice.gov.uk/climatechange

[7] www.sternreview.org.uk

[8] See www.eci.ox.ac.uk/research/energy/fuelpoverty.php for further information

Section: Stage 2 Data gathering

[9] The UK Potential for Combined Heat and Power and Community Heating, www.energysavingtrust.org.uk/uploads/documents/housingbuildings/UK CH potential 20report_CTFinal.pdf

[10] Pöyry/Faber Maunsell (2009) The potential and costs of district heating networks: a report for the Department of Energy and Climate Change.

Section: Stage 4 Options appraisal

[11] www.carbontrust.co.uk/energy/assessyourorganisation/design_advice.htm

Section: Stage 5 Feasibility study

[12] www.carbontrust.co.uk/publications/publicationdetail?productid=GPG388

Section: Stage 7 Business modelling

[13] www.lep.org.uk/uploads/lep_making_escos_work.pdf

[14] see www.hm-treasury.gov.uk/data_greenbook_guidance.htm

Section: Stages 8, 9, 10 Soft market testing etc.

[15] Available from the Carbon Trust www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=GPG377&metaNoCache=1

SPONSORS

Renewables East is the renewable energy agency for Norfolk, Suffolk, Essex, Hertfordshire, Bedfordshire, Cambridgeshire and Essex – the East of England. RE is also contracted to champion the offshore agenda in the East Midlands on behalf of the East Midlands Development Agency.

Our objective is 'to bring the benefits of renewable energy to the East of England'.

The renewable energy sector is growing – fast. We're here to help it grow in the East of England. Success will bring economic benefits, including increased employment and investment, and the development of a secure, competitive and successful renewables market which will benefit us all in ways we may not immediately recognise.

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The Homes and Communities Agency (HCA) is the single, national housing and regeneration delivery agency for England.

Our vision is to create opportunity for people to live in homes they can afford in places they want to live, by enabling local authorities and communities to deliver the ambition they have for their own areas. We achieve this by:

- Understanding the needs and aspirations of people and communities through close working with local authorities on local investment planning
- Enabling local delivery through the channelling of our expertise and investment
- Working effectively with the market, housebuilders, investors and other stakeholders

For more information visit the HCA newsroom at www.homesandcommunities.co.uk

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Vital Energi is a market leader in the provision of cost-effective, low-carbon energy solutions for localised generation, recovery, distribution, metering and management of energy and utilities, including heat, power and cooling.

We work with all Public and Private sector businesses to help them meet regulatory requirements and/or reduce energy consumption to meet targets.

All our customers benefit from Vital Energi's design of their own unique solution, using technologies such as Combined Heat, Cooling and Power (CCHP), Biomass, and Solar.

From blank sheet to operation and maintenance, Vital Energi work through the whole project life to ensure our solutions deliver client requirements.

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URBED (Urbanism, Environment and Design) is an employee-owned consultancy based in Manchester. We specialise in urban design, community engagement, neighbourhood regeneration and sustainable development. We are a value-driven organisation which aims to create cities and urban neighbourhoods that are sustainable socially, economically and environmentally.

URBED's reputation is based on its proven ability to manage action research and to deliver clear, well communicated strategic advice for clients as diverse as the DCLG, Friends of the Earth, Joseph Rowntree Foundation, Greater London Authority, Co-operatives UK, Yorkshire Forward and the TCPA.

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E.ON's Sustainable Energy business – making sense of carbon regulation

E.ON launched its Sustainable Energy business in 2007, to provide low carbon, decentralised energy advice and solutions to businesses seeking cost-effective solutions to meet new Government regulations in carbon reduction.

From housing developers and businesses to local authorities and landlords, we provide a balanced approach, from offering advice, planning and independent surveys, through to solution design, installation, maintenance, billing and customer support.

E.ON provides energy from sustainable sources and technologies, from small micro-generation systems to large, decentralised, community-based energy centres and whole cities. It is part of the E.ON group, one of the world's largest investor-owned power and gas companies.

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The Energy Saving Trust is an independent, UK-based organisation focused on promoting action that leads to the reduction of carbon dioxide emissions – a key contributor to man-made climate change. We are the source of free advice and information for people across the UK looking to save energy, conserve water and reduce waste. We work with local authorities, communities and businesses to facilitate the action needed for a low carbon future.

The Energy Saving Trust offers consultancy services to local authorities and housing associations considering community energy projects. This consultancy advice is provided by Arup, who have considerable experience of all aspects of energy services, from technical feasibility, through to economic modelling, business planning and contract negotiations.

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Dalkia, the European leaders for CHP district heating, electricity and cooling, operate over 800 schemes serving around 3 million homes in 42 countries. Over 500,000 homes benefit from renewable biomass energy and Dalkia also operate biogas, geothermal, solar and waste-fired plants – these save 2.1 million tonnes of CO_2 emissions.

In the UK Dalkia have designed, built, operated and maintained community energy schemes since 1966. To help meet environmental targets and the Code for Sustainable Homes, Dalkia have developed a biomass business that utilises UK-sourced, life-expired wood as fuel for schemes – this lowers landfill, and provides low-cost heat and electricity for residents.

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The Co-operative Bank has been at the forefront of supporting development of the small-scale embedded and renewables energy projects in the UK. Delivering schemes from as far apart as Orkney in the Northern Isles of Scotland to Delabole in Cornwall.

It is committed to the delivery of environmentally sustainable heat and power across a range of sectors from social housing and the NHS to industrial and commercial applications in the private sector.

We have been involved in supporting cogeneration and district heating projects for over a decade now.The Bank has built up considerable expertise in supporting development of CHP and tri-generation projects as well as renewable technologies such as onshore wind, hydro and biomass.

We believe district heating schemes connected to CHP and other sustainable technologies are vital for the UK to move successfully to a low carbon economy, alongside the major renewables schemes, and are determined to continue providing support in this sector for years to come.

ENER-G Combined Power specialises in the design and supply of CHP and Trigeneration systems in the 4kWe to 10MWe range for commercial, industrial, public sector and district heating applications. They can provide a comprehensive turnkey service, including funded options, from initial feasibility study, through to installation and commissioning, followed by ongoing operation and maintenance. ENER-G Switch2 are specialists in the delivery of ESCo solutions including infrastructure, metering and billing. These solutions are well proven in mixed developments and social housing schemes with district networks. ENER-G Group can support schemes with industry expertise at the very earliest stages to provide a practical foundation on which to develop successful projects.

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