

Local Support Team

Community Energy Project:

Preliminary Scoping Report

Hugh Muschamp & Ohad Shachar

22 November 2006

Circulated for discussion

Executive Summary

A steering group of Edinburgh City Council officers, Scottish and UK elected Members, and other local interested parties came together to discuss the opportunities for community energy projects in Edinburgh, with a particular focus on Northern Edinburgh.

The report appears in the context the UK's governments recent energy review and with in the light of the recent Stern Report, stating that CO₂ emissions need to be reduced drastically in order to avoid future economic catastrophe. Achieving such reductions and targets will require significant changes in the production, distribution and supply of energy. The White Paper recognises that action will be required at all levels, by government, business and individuals, and it envisages an important role for communities.

The Decentralised Energy report Powering Edinburgh into the 21st Century (Nov 2006) investigates a range of four energy scenarios for the City of Edinburgh. The Report suggests that a high decentralised energy scenario is the only possible option for meeting the 2050 targets. Potentially, community energy partnerships could play a significant role in the delivery of such energy solutions for the city to meet its aspirations.

This scoping study has been written as a discussion paper for this group. It broadly looks at the mechanisms for and barriers to community engagement in sustainable energy projects. It considers some opportunities for support and finance. Examples of community energy projects are highlighted.

The report will be presented to the steering group as a basis for discussion regarding the potential next steps in considering the opportunities for community energy projects within the City of Edinburgh. A further full feasibility study is recommended as a next stage to this process.

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1. Introduction

Changeworks' Local Support Team agreed to undertake a preliminary scoping study looking at the possibilities for community energy projects in Edinburgh. We would like to recognise the support of steering group partners, and in particular Thirdwave, in the development of this report.

This scoping study will be a brief exploration of potential community energy projects in the city of Edinburgh, and not a feasibility study for a particular scheme or technology. The report will comprise largely of a desktop study that will consider the plausible alternative community structures, and briefly outline the various types of possible technologies that could be applied. The report will make use of current case studies and examples of best practice.

This report aims to present a range of options to be considered by the City of Edinburgh Council Community Energy Project (CEC CEP) group. A more detailed feasibility study could follow if required.

2. Community

2.1. Community engagement in Edinburgh

The essential feature of community engagement is that either individuals or community-based organisations have a stake in the project.

On the surface it may appear that 'community' is easy to define. However, as the UK Government accepts '*deeper attempts to define community comes to the conclusion that there are many types of community*' and '*whatever it is that makes a group of people into a community is elusive and fluid*'¹.

For the purposes of this report communities are defined in terms of people and organisations. Community engagement is usually defined in one of two ways:

- **Community of Locality** - based on a geographical location.
- **Community of Interest** – based on a shared outlook with regard to faith, politics, social interaction, ethnicity or common interests.

The geographical extent of a Community of Locality is limited to a neighbourhood, town, city or county - a well understood and clearly defined area within which most people would perceive that they have a common local identity. It does not extend to regional or national initiatives but instead draws on the strong sense of common purpose that often exists at the smaller scale. As such a community of interest for some projects may extend further than the boundaries of the City of Edinburgh Council into the wider Lothian area. It may involve those who work here, or have an interest in the city such as property, while not actually living within Edinburgh itself.

It should be stressed that these two definitions of community can encompass a range of stakeholder organisations that work with and help serve the community (including national and local government, business, NGOs and charities) as well as the residents of an area or those of a shared community of interest.

Projects may be based on one or other of these types of 'community' or may involve both. Schools, for example may include projects with the local community based around the school (community of locality) or they may include members and families of those that attend the school (communities of interest).

¹ From the Office of Deputy Prime Minister (OPDM), 2003. Note: The OPDM is the predecessor to Department for Communities and Local Government (DCLG)

The community of the City of Edinburgh is broadly defined as the 457,830² inhabitants, 17 percent of which are in income deprivation³, and yet the city boasts one of the highest concentrations of millionaires per capita. About 75% live in flats, ranging from single occupancy to very overcrowded⁴. Edinburgh is both an economic hub in the central belt of Scotland, and a cultural centre of Europe, accounting for a diverse range of professionals

Incorporating the interests of the entire community of the City of Edinburgh is a difficult, if not improbable task. At best, community engagement will involve as many sectors of the community or community groups representing the greater, dynamic Edinburgh community.

Although the Edinburgh Community is defined here within the geographical boundaries of the City (see Map 1), the CEP can be open to a wider range of community, and the potential expansion of CEP projects into other geographical areas is recognised.

Map 1: Edinburgh City Boundaries



² General Register Office for Scotland, Mid population estimates, 30th June 2005.

³ Scottish Neighbourhood Statistics, 2005.

⁴ Communities Scotland, Scottish House Condition Survey, 2002.

2.2. Why engage a community?

Community engagement offers a means of encouraging greater commitment of individuals with services and it gives people a real stake in a project that will benefit their local community. Currently, there is concern about the disengagement of many citizens from active participation in society. This is seen by the decrease in voter numbers and fewer people joining political parties. The Local Government in Scotland Act 2003⁵ requires community engagement and provides the power of wellbeing. The Act provides a statutory framework for the Community Planning process, and makes provision for Ministers to issue guidance about participation in Community Planning.

The real value of participation is seen as stemming from the finding that mobilizing the entire community, rather than engaging people on an individualized basis or not engaging them at all, leads to more effective results⁶. Simply stated, change is more likely to be successful and permanent when the people it affects are involved in initiating and promoting it⁷. In other words, a crucial element of community engagement is participation by the individuals, community-based organizations, and institutions that will directly be affected by the effort.

Mutuals as Energy Service Providers

Although public sector services such as energy are owned by the public, in many cases these "owners" may feel too remote and disengaged from the services that they own. Companies in the private sector on the other hand, are owned by their shareholders but few of them are actively involved. Various ideas are being suggested and attempted to tackle these challenges. Some ideas aim to empower people by giving them a greater sense of ownership and control of such services and goods. These so called '**mutuals**' offer a means of encouraging greater engagement with services by giving people a real stake in projects that benefit their local community or communal goal. With respect to energy services these may be referred to as **Energy Service Companies (ESCO's)** or **energy partnerships**.

There are a wide range of benefits that are attributed to community energy mutuals, these include, but are not limited to the following:

- A direct stake in a local project

⁵ Local Government in Scotland Act 2003., Part 2: Community Planning.

⁶ Braithwaite RL, Bianchi C, Taylor SE. Ethnographic approach to community organization and health empowerment. *Health Education Quarterly* 1994;21(3):407-416.

⁷ Thompson B, Kinne S. Social change theory: applications to community health. In: Bracht N, (editor). *Health promotion at the community level*. Newbury Park (CA): Sage Publications; 1990.

- Attractive financial return to members
- Extended economic benefits for the local area
- Delivery of local energy conservation projects
- Educational support and advise on energy issues.
- Individual commitment to low carbon initiatives.
- Membership of a nationwide network of 'green' co-operatives.
- Meeting the needs of marginalised groups.
- Allowing for long-term behavioural changes in individuals.
- Simply receiving a service such as heat or power.

The developers of the Middelgrunden Wind Farm (discussed below and in Appendix 4 as a case study) identified nine good reasons for local ownership (Box 1). They point out that without the involvement of local people the project would not have been a success⁸.

Box 1:

9 Good Reasons for Local Ownership from the Middelgrunden Wind Farm developers

1. Local ownership results in more installed wind capacity
2. Local ownership creates local dialogue and acceptance
3. Local ownership raises public awareness
4. Local ownership solves problems and conflicts.
5. Private investment promotes cheaper and better technologies
6. Local production demands less transmission lines and saves electricity
7. Local turbines are democratic
8. Local production makes sustainable development understandable
9. Local ownership gives people opportunity to act for sustainable development

Simultaneously, the effective measures and actions that aim to tackle global environmental issues such as climate change, waste prevention, and sustainable transportation require a strong level of engagement and cooperation from and between individuals. The Scottish target for carbon emissions reductions set in Scotland's Climate Change Programme of 2006 will entail "everyone to accept responsibility: we must change our ways and adopt more sustainable patterns of behaviour – and that includes individuals, households, businesses, *community groups* (own emphasis) and voluntary sector"⁹.

⁸ The Middelgrunden Offshore Wind Farm: A Popular Initiative. Available at www.middelgrunden.com

⁹ Scottish Executive, Scotland's Climate Change Programme, 2006. p86.

The UK Government has recently completed an Energy Review, re-examining energy strategies with a view to delivering the four energy policy goals set out in the Energy White Paper (EWP) issued in 2003¹⁰.

These are:

- To put the country on a path to cut the UK's CO2 emissions by 60% by 2050.
- to maintain reliability of energy supplies.
- To promote competitive markets.
- To ensure that every home is adequately and affordably heated.

The White Paper recognises that many energy projects face difficulties securing local support and planning permission. This has been a particular problem for wind energy developments and municipal waste to energy projects. However the White Paper acknowledges the value of community engagement particularly for securing support for renewables. It also sees communities and individuals becoming actively involved: "We see a clear benefit in local communities becoming producers, as well as consumers of energy, establishing and benefiting from local ownership of some forms of generation."¹¹

The Royal Commission on Environmental Pollution (RCEP) has also noted this potential: "Distributed generation offers opportunities to engage local communities and to develop a sense of ownership of, and responsibility for, localised energy production."¹²

The Energy Efficiency and Micro-generation Bill proposed by the Labour MSP, Sarah Boyack, for Edinburgh Central has received cross party backing. With support from a Steering Group representing expertise in energy efficiency, fuel poverty, the renewables industry, climate change and energy policy, the Bill is set to make real progress.

If passed by the Scottish Parliament, the Bill would require all new buildings to include capacity for small-scale electricity generation and provide incentives, such as reduced business rates or reductions on Council Tax, for developments that incorporate certified measures. The Bill would also amend Building Standards to include micro-generation as permitted development, require the Scottish Executive to set targets for micro-generation and for local authorities to consider the role such technology can play in achieving sustainable energy¹³.

¹⁰ Department of Trade and Industry, Energy White Paper 2003.

¹¹ Department of Trade and Industry, Energy White Paper 2003, p53.

¹² Royal Commission on Environmental Pollution. Heat the missing link in renewables policy. Press release 11.05.04.

¹³ Press Release, 2006. www.sarahboyack.net

In November 2006 The Powering Edinburgh into the 21st Century Report was launched¹⁴. Although, The City has now increased its targets by announcing its aim to be 'carbon neutral' by 2050, The Report was written with a view to demonstrating a pathway to the UK Government's more conservative target of 60% CO₂ reduction by 2050. The study predicts and compares the CO₂ emissions savings which result from four different energy supply scenarios for meeting the heating and energy needs of all the buildings in Edinburgh. The Report concludes that, amongst other things, only a decentralised energy pathway will allow Edinburgh to reach the 2050 target.

Such a decentralised energy pathway, along with the proposed micro-generation targets, is dependant on the successful implementation of community energy projects.

2.3. Levels & types of community engagement

Various attempts have been made to define different types of community involvement. Among the most widely used of these are the 'ladders' of involvement developed by Arnstein¹⁵. Arnstein's ladder defines 8 levels of community involvement, the highest of which is 'Citizen Control' (refer to appendix 1).

A slightly different classification system is proposed by Wilcox who identifies five interconnected levels of community involvement and argues, unlike Arnstein, that the highest levels of community control may not necessarily be appropriate for all projects. In this way a project with a lower level of community engagement is not necessarily inferior to a project with a higher level of community engagement.

For the purpose of this report, we simplify the classification scheme further into the following three **levels** of engagement:

- **Low** level of community engagement
- **Medium** level of community engagement
- **High** level of community engagement

We consider various case studies that demonstrate these various levels of community engagement

As stated the essential feature of community engagement is that either individuals or community based organisations have a stake in the project.

¹⁴ City of Edinburgh Council, WWF Scotland and Greenpeace. Powering Edinburgh into the 21st Century. Written by PBPow Energy Services Division. November 2006.

¹⁵ Arnstein, S.R. (1969). A Ladder of Citizen Participation, Journal of the American Planning Association, 35(4), 216-224.

This stake may take the form of a range of different options from investments, part-ownerships, to full community ownership and management¹⁶.

For the purpose of this discussion we have identified 5 different **types** of community engagement with respect to energy supply and have positioned each of these onto the simplified ranking levels of community engagement described above. It is important to note that these structures are *not* definitive and are *not* mutually exclusive. Some community engagements will involve two or more of the reviewed types of community engagement. Again we make use of case studies to demonstrate these following types of engagements and any overlaps which may exist.

2.3.1. Local authority ownerships of utilities:

Level of Engagement: Low to Medium

Here the local authority may control either distribution, supply and/or generation of energy. Examples of these are district heating or combined heat and power based, and in these cases the utility will often produce the heat and power, distribute it and sell it, as in the case of the London Borough of Merton. The utilities are run directly by the council or by a board largely appointed by the council. The community benefit from the energy supplied to them.

Local authority ownership of the energy distribution networks follows the more traditional approach to energy generation and specific case studies are not made in this report. Community ownership and engagement are generally at the low level. It must be noted however, that these structure could have a significant degree of engagement with the communities via a sound public participation process.

2.3.2. Co-operatives

Level of Engagement: Medium to High

Co-operatives are made up of small-scale groups of people, generally in the same local area. A co-operative is set up to meet mutual needs and belongs to its members. A co-operative is run democratically on the basis of one member, one vote. Co-operatives share their profits with their members. Shares that members have in a co-operative are of fixed value and withdrawable. Co-operatives are constituted under the Industrial and Provident Societies Act 2002¹⁷.

¹⁶ Types of community involvement is taken from a previous study by Gill Owen of Mutuo entitled *Community Engagement in Energy Through Energy Mutuals*, 2004.

¹⁷ The Industrial and Provident Societies Act 2002

Typically there is a minimum joining fee and a maximum legal investment within a co-operative structure. The examples of co-operatives uncovered in compiling this report are mainly involved in energy generation, and are primarily involved in wind-power, solar and biomass technologies. Energy generated is often used by the members of the co-operative and/or sometimes sold to the local energy utility. The Aberdeen City Council community Heating case study is an example where a co-operative was formed, which went into partnership with the council.

2.3.3. Community Interest Company/social enterprise

Level of Engagement: High

A community interest company (CIC) is a new type of company, designed for social enterprises that want to use their profits and assets for the public good. A social enterprise (SE) is a business with primarily social objectives whose surpluses are principally reinvested for that purpose in the business or in the community, rather than being driven by the need to maximise profit for shareholders and owners. The Isle of Gigha Wind Farm project is an example of a CIC that has a buyers contract with the local energy utility. These schemes generally tend towards the high range of community engagement. Often CICs or SEs would enter into partnership agreements with local authorities and other organisations.

2.3.4. Share-based ownership schemes

Level of Engagement: Medium to High

Share-based ownership schemes involve private investments in energy-generation developments through the buying of shares. These schemes generally range in the medium to high range of community engagement. Ownership may not be based in the locality. These schemes encourage people to participate in developing and supporting larger energy generation projects by purchasing share certificates.

An organisation, usually a cooperative, would plan a medium to large scale power plant, and then invite individuals to contribute by purchasing a share of the plant equivalent to a specific wattage. A minimum and maximum level of investment is generally specified. The cooperative would deliver the project and manage financial and administrative matters, including the seeking of financial support and securing energy sales. The isle of Gigha, and Middelgrunden are examples of such projects.

2.3.5. Partnerships

Level of Engagement: Medium to High

Partnerships can occur between local authorities, NGO's, individuals, private companies and utilities, community cooperatives and organisations. They can

be used to give a community a more obvious stake in a project. Such partnerships generally range in the medium to high range of community engagement. The Middelgrunden Wind Farm in Copenhagen is an example where a community cooperative formed a partnership with a major energy utility.

3. Sustainable Energy

3.1. Defining 'sustainable energy'

Sustainable development as it applies to energy can be viewed as having three main aspects. Firstly, it is concerned with the conservation of energy. Secondly it involves increasing the efficiency of the way we generate, transmit and use energy. Thirdly, it is about substituting polluting fossil fuels with renewable or low carbon sources. All these aspects of sustainable energy can be promoted through community based work. All the projects evaluated in this report, although driven by energy generation, help in the promotion of all the elements of sustainability.

The focus of this report is taken to be projects whose primary goal is the delivery of sustainable energy, rather than those projects which may result in energy saving but whose primary purpose is another element of environmental protection (e.g. waste minimisation or transport projects).

3.2. Range of potential technologies & options

A suite of technological options exist that would contribute to the development of a community energy project. The decentralised energy scoping report launched in November 2006, Powering Edinburgh into the 21st Century¹⁸, discusses a broad range of these technologies. We will not duplicate this body of work, but instead wish to direct the reader to this study to consider the various technologies¹⁹. We have attached a copy of these technologies as our Appendix 2. We have considered some additional technologies and include them here as Appendix 3.

A list of all the considered technologies follows:

- Gas-engine Combined Heat and Power (CHP)
- Biomass CHP
- Buildings-based CHP
- Biomass Boilers
- Solar Thermal
- Photovoltaic panels (PV)
- Wind turbines – small domestic
- Wind turbines – larger farms

¹⁸ City of Edinburgh Council, WWF Scotland and Greenpeace. Powering Edinburgh into the 21st Century. Written by PBPower Energy Services Division. November 2006.

¹⁹ Ibid, pp44-48.

- Water
 - Wave
 - Tidal
 - Hydro
- Ground Source Heat Pumps (GSHP)

3.3. Location

It is worthwhile noting that the type of technology selected depends, amongst other things, on the selected location for the project. The City of Edinburgh has a diverse range of geophysical options within its locality. These range from the shores of Leith, where larger offshore wind or marine technologies may be suitable, to the old town where regulations apply in restricting disruption to existing infrastructure which has significant national heritage implications.

Some of these implications of the planning restriction and conservation areas were assessed in the Powering Edinburgh into the 21st Century Report, and can be viewed here in Appendix 5.

4. Challenges & Support for Community Energy Projects

4.1. Key barriers

Despite the described benefits of community owned energy partnerships, such projects have been relatively slow in their development in the UK. In contrast, other European countries such as Austria and Denmark have been developing and supporting large community energy projects, allowing for such projects to become mainstream. In Denmark for example, 75% of wind power is produced by turbines owned by local associations and individuals. More than 100,000 people are shareholders, with community based energy projects averaging a size of 2 – 5 MW.

In the UK, to date, most community ownership has been of wind power and some biomass schemes. Most of these have been developed since the mid to late 1990's, and the number of schemes remain low.

Some of the key challenges to community energy projects developing in the UK and Scotland were identified by a report issued by Mutuo Consultants. These relate mainly to financial and complexity barriers and are outlined below.

- Firstly, **Raising finances** is often a major problem, particularly for smaller projects and for groups with no track record in the energy market. If finance can be found at all it tends to come at high cost. Many of the schemes developed to date have relied on committed local investors willing to risk their money with uncertain prospects of a return. Operating on this basis is only open to a limited number of projects with wealthy and committed backers and inevitably will limit the size of any of the projects developed.
- Secondly, **securing planning permission** can also be very time consuming and expensive for small organisations without access to in-house lawyers to steer them through the process. Coupled with the first issue above, funding (from the various schemes discussed below) is often only secured after planning permission has been given. All development costs including assessments and project formulation costs (including time costs) must be incurred by the community directly and up-front.
- Thirdly, as mentioned, **community ownership is relatively new** in the UK and Scotland. It is not yet in the mainstream, and groups planning any such projects are still seen as pioneers at best, and as eccentric and over-idealistic at worst. To some extent this may be

changing (with the emergence of community-owned housing for example), yet the idea of getting involved in energy supply may still be viewed as foreign.

- Fourthly, There are many sources of financial aid and other support that communities can access (some of these are outlined below). However one of the key problems is the **plethora and differing terms** of the schemes that communities need to navigate around. These problems are amplified for those communities interested in heat-based schemes.
- Fifthly, **Securing connection to the distribution grid** raises further complex issues that need to be resolved. This may require the need to negotiate with electricity distribution companies. Small organisations may find it particularly difficult to find sufficient leverage.

As this indicates, a community energy partnership will almost certainly require support from another body such as a local authority in both setting up and project delivery.

All these issues mean that community owned energy projects require a considerable amount of up-front, seed funding to cover project development costs. This funding is difficult to raise from commercial sources at such an early stage of the project. Further, most financing schemes are not modelled to deliver such initial capital grants.

There is also the need to access expertise in legal, financial, and planning issues, along with the knowledge of the various grant schemes and tax allowances and how to apply for these. Most community groups would not be able to deal with these complex issues without having to spend considerable additional sums on consultancy fees.

Community energy projects that are interested in developing **schemes that produce heat** in addition to or instead of electricity, have **further challenges**. There is a lack of effective incentive schemes for such projects. One of the main support mechanism for renewable energy, the Renewable Obligation Scotland (ROS), for example, pays a premium price for those that generate *electricity* from renewable sources (this scheme is discussed below). Such schemes positively disincentivise heat, because as heat is produced, less electricity can be generated, and therefore less income will result. The ROS thereby encourages developers to maximise electricity generation. This problem arises from the ease at which electricity can be measured and sold to electricity suppliers, whereas heat is more difficult and complicated to measure and sell. Hot-ROC's (renewable obligation certificates) are a novel idea of dealing with such issues.

However, Heat needs to be used close to the point of production for it to be efficient. A heat distribution system would need to be in place. Such

distribution networks are not yet commonplace in Scotland, and new network systems would need to be built. The complications, uncertainties, and additional costs would deter investment further. Developers tend towards the easier and more attractive returns of selling electricity.

4.2. Possible support for community energy projects

All initiatives described in this subsection are a mixture of government, private sector, and voluntary schemes that are designed to promote community engagement in energy. Such schemes provide technical support in the form of advice, information, or 'handholding' to community groups, but do not offer financial aid. Section 4.3 of this reports investigates financial aid.

4.2.1. Energy Saving Trust

The Scottish Executive and UK Government fund the Energy Saving Trust (EST) to provide support to encourage energy efficiency and renewable energy. The Trust has at times been able to provide free consultancy on setting up ESCos and similar projects – subject to resources. Their website www.est.org.uk also contains fact-sheets and other information on projects and funding. The Practical Help service offers limited free consultancy to Local Authorities.

4.2.2. Scottish Community and Householders Renewables Energy initiative (SCHRI)

The Scottish Executive has funded the SCHRI via the EST to help realise Scotland's renewables potential and to demonstrate to both individuals and whole communities the direct benefits of these resources.

SCHRI assists the development of community renewable projects via specialist SCHRI Development Officers who provide expertise and by developing networks to drive projects forwards. A team of SCHRI Development Officers signpost communities to UK, and specifically Scottish funding sources and advise on relevant legislative, planning and technology issues to ensure maximum project success. The officers are responsible for providing local advice and project management support to help community groups develop renewable energy projects. SCHRI Development Officers are based in each of the five Energy Efficiency Advice Centre (EEAC) offices in southern and eastern Scotland and at Highlands and Islands Community Energy Company (HICEC) offices in the Highlands and Islands area.

Development Officers work to promote local community renewables by:

- Providing expertise and developing networks to drive projects forward
- Bringing interested parties, skilled advisers and funding parties

- together to develop and implement schemes
- Signposting communities to other UK and Scottish funding sources
- Advising on planning and legislative requirements
- Assisting with selecting appropriate installers and other renewable energy specialists

4.2.3. Community Action for Energy

Community Action for Energy (CAfE) is a programme from the EST that is designed to promote and facilitate local community-based energy projects. Many of these projects are education and information focused, but some concentrate on improving energy efficiency in buildings, whilst others are involved in energy production.

CAfE is a network of people who share a common interest in community energy projects and ideas. CAfE provides a database of community energy projects. Membership of the network is free and by joining communities or individuals can keep up to date with news on community-based energy initiatives. The programme also provides information about funding opportunities, training sessions and other news from the network.

4.2.4. Energy4All

Energy4All provides advice and consultancy support to help others set up wind power co-operatives. It can help groups through the planning process and advise on suitable community ownership structures. Energy4All is uniquely owned by the co-operatives it assists, such as Baywind Energy Co-operative Ltd and Westmill Wind Farm Co-operative Ltd. The idea is that Energy4All will aid in the establishment of energy co-operatives, and as these are established they too will take a share in the organization.

Energy4All offers a combination of industry experience, community involvement, and business acumen providing a package of sector, administrative, and financial services to Co-ops in return for an annual fee.

4.2.5. Forestry Commission Scotland Wood Energy

Forestry Commission Scotland (FCS) supports the creation of an expanding bio-energy sector, and are currently represented on the Forum for Renewable Energy Development Scotland (FREDS). FCS have helped with feasibility studies into several proposed bio-energy projects and have supported and chaired a number of seminars on woodfuel. A dedicated wood-fuel website, www.usewoodfuel.co.uk, provides information on developing wood-fuel energy projects.

FCS have dedicated wood fuel energy advisors, that provide technical support at all levels of the supply chain required for successful wood-fuel energy project implementation.

4.3. Financial support for community engagement

This subsection serves to outline a few grant, loan, tax relief and other mechanisms available from government and other sources that can be accessed for community energy projects. Not all of these schemes are specifically designed for community energy projects, but many have been used by them. Such schemes will depend to a large extent on projects being able to meet other criteria (for example, contributing to urban regeneration). As always funding schemes change regularly and these will need to be reconsidered should a potential project be identified in the future.

This is not an exhaustive list, and many other schemes are available that can be modified for community energy projects, but in an effort to avoid complexity, we have attempted to list the most relevant schemes to community energy projects.

4.3.1. The Renewables Obligation (Scotland) (ROS)

The ROS is the Executive's main policy measure to encourage the development of electricity generation capacity using renewable energy sources in Scotland. The ROS has already provided and will continue to provide, an impetus for the new renewable generating capacity that will be needed to meet the Scottish Executive's ambitious targets that 18% of electricity generated in Scotland by 2010 should come from renewable sources, rising to 40% by 2020.

It works on the basis of Renewable Obligation Certificates (ROCs) being issued to renewable generators based on the amount they output. Suppliers are allowed to comply with ROS in one of two ways; either submit ROCs or pay a buyout fee to OFGEM. The funds raised by suppliers paying the buyout fee is then paid back to the suppliers that complied with the obligation using certificates. This mechanism provides an incentive for suppliers to purchase ROCs.

4.3.2. Scottish Community & Household Renewable Initiative (SCHRI)

SCHRI offers grants to a range of community organisations to help with the installation of a variety of renewable energy technologies. Communities may apply for funding for technical assistance and capital grants for renewable energy equipment installation and associated costs. Technical assistance funding is available to support non-capital projects, such as feasibility or scoping studies and capacity building within a community. The maximum grant is £10,000. Capital grants contribute to the capital costs of a project. The maximum grant is £100,000.

The grant scheme was launched in 2003 and is worth £3.7 million over three years. The amount of funding awarded is determined on a case by case basis with the average grant being in the region of 50 per cent. Projects with exceptional demonstration value or groups with limited resources may be eligible for a higher percentage of funding. All applicants are required to outline contributions from other funding sources and those with substantial investment from other sources will be regarded highly.

The scheme will not fund photovoltaic (PV) installations, or non-automated wood burning stoves.

4.3.3. Low Carbon Building Programme

The DTI's Low carbon buildings programme provides grants for microgeneration technologies for householders, community organisations, schools, the public sector and businesses. The programme is managed by the Energy Saving Trust. The programme, launched in April 2006, has a £30 million budget, and will run over three years. It replaces DTI's Clear Skies and Solar PV programmes. The programme is UK-wide (apart from the Channel Islands and the Isle of Man) and will demonstrate how energy efficiency and microgeneration will work hand in hand to create low carbon buildings.

There are two streams of grants available:

- Stream 1 - these grants apply to smaller projects for home owners and community groups among others.
- Stream 2 - these grants apply to medium and large scale microgeneration projects and will be available to public, not for profit and commercial organisations.

4.3.4. Scottish Power's Green Energy Trust

Scottish Power's renewable energy option is the Green Energy Fund. This works through customers small donations (less than 3p per day) contributing to the Scottish Power Green Energy Trust that support the creation of further renewable facilities, along with helping to further research and development into the technologies that drive the industry. The scheme has donated more than £700,000 so far to more than 75 renewable energy projects. The Trust can provide up to 50% of the project costs, with no upper limit.

The Trust considers all kinds of renewable technologies, including small-scale hydro, wind power, biomass, landfill gas, solar energy and ground source heat pumps. However, applications involving other technologies may also qualify for support.

4.3.5. Bio-Energy Capital Grants Scheme

The Bio-energy Capital Grants Scheme is a joint initiative funded by the Big

Lottery Fund and the Department of Trade and Industry (DTI), with advice and direction from the Department for the Environment, Food and Rural Affairs (DEFRA). The scheme is aimed at installers and suppliers of biomass heating and CHP equipment. It is also aimed at project developers, and organizations that are considering investing in heat and/or CHP projects fuelled by energy crops and other biomass feedstocks.

There is no size limitation on CHP projects, although the maximum amount of grant assistance is capped at £500,000 per application. The total funding available for this round is at least £2 million, and must be spent by the end of March 2010.

4.3.6. Scottish Biomass Support Scheme

The Scottish Biomass Support Scheme is a new capital grant funded scheme aimed at promoting the biomass (primarily wood-fuel) sector in Scotland.

The key drivers are:

- Strategic transformation of the Scottish biomass woodfuel sector market
- Supporting rural economies by creating sustainable green jobs
- Contributing to renewable energy targets
- Maximising carbon savings

£7.5 million of capital is to be allocated and spent by March 2008 with a maximum grant of £400K (unless deemed an exceptional circumstance). For installation, 40% of additional costs (50% for SME's) compared with conventional system are eligible under the scheme. Depending on circumstances, public sector match funding may be allowed, and up to 40% of additional costs of entering the biomass supply chain.

All formally constituted organisations based in Scotland of varying size and structure, (both public and private) are eligible. Projects eligible for SCHRI funding will be encouraged to apply to SCHRI in the first instance. Private householders are not eligible. Funding cannot be given out retrospectively under any circumstances.

Two types of applications:

- Installations - including eligible kit/pipe work and boiler plant.
- Infrastructure - directly related to developing the woodfuel/biomass supply chain

4.3.7. Scottish Enterprise

Scottish Enterprise provides a variety of grant and funding options to companies developing new products and technologies. These generally apply to ground-breaking projects at all levels from research and development all

the way to commercialization. Their website, www.scottish-enterprise.com, contains information on all such schemes.

4.3.8. Community Energy Programme

Although no longer active, the Community Energy Programme provided information, advice and grant funding to support the installation of new and refurbished or expanded community energy schemes across the UK. Capital grants covered up to 40% of total capital costs of implementing a community energy scheme. Final applications, of the £50 million available funds, had to be made by the end of 2005, with intent of spending by March 2007.

The government decided to not extend this scheme, with the suggestion that there are other programmes that more cost-effectively deliver carbon savings. These include the Capital Grants scheme discussed above. The community energy programme funded many of the case studies discussed below.

4.4. Tackling barriers

Although tackling the barriers is not in the remit of this report, we make note of the measures mentioned in the Mutuo Report that could enable the potential for community engagement to be realised²⁰. The measures are based around the development of a community energy unit that would provide key support in the development phase to groups planning energy schemes. Such a unit would potentially:

- Make some direct investment in schemes
- Be able to raise funds for investment in schemes
- Recycle funds through revolving loans
- "Hand-hold" groups through legal, financial, and other hurdles
- Develop model constitutions to be used by community energy projects
- Negotiate standard agreements or protocols that could help smooth certain processes (eg: resolving grid connection and planning with electricity distribution companies)
- Signpost people to other sources of help thereby acting as a "one stop shop"

It is useful to note that in Scotland, the Highlands and Islands Community Energy Company (est. Dec 2004) fulfils some of these suggested roles.

Consideration should be given to the initiation of an education based initiative, which could drive forward community energy work in this locality.

²⁰ Gill Owen. 2004. entitled *Community Engagement in Energy Through Energy Mutuals*. Mutuo Consultants

5. Community project case studies

The following case studies serve to demonstrate the various types of community energy projects discussed above. The first three case studies all occur in Scotland. The London Borough of Merton study serves to demonstrate how the local council took the initiative to drive the local energy programme. The Middelgrunden Wind Farm development illustrates how a large community mobilised behind a large scale wind farm development. For a more detailed story of each of the presented case studies, see Appendix 4.

5.1. The Dancing Ladies of The Isle of Gigha

The initiative to install three 225KW wind turbines on the Isle of Gigha is an example of a share-based community engagement scheme that worked in partnership with Highland Island Enterprise. Funds were acquired through a number of sources namely SCHRI, National Lottery, and a private equity scheme.

Project Details:

Type	Share-based community Interest Company & partnership
Level	High
Technology	<i>Wind turbines</i>
Energy	2.1 Gigawatt hrs per year
CO₂ Savings	
Cost	£440,000
Funding	SHRI, National Lottery, private equity scheme
Stage	<i>Complete</i>

5.2. University of Edinburgh's Combined Heat and Power Scheme (CHP)

Driven by its commitment to sustainable practices, its central heating tradition, the imperative to reduce CO₂ emissions and the need to contain an annual utilities bill approaching £9 million, the University of Edinburgh installed three state-of the art CHP systems on three of its five campuses:

- Pollock Halls: 526 kWe engine serving student residences as a lead boiler – 2003.
- The Kings Building: 2.7MWe engine displaced old steam system + 2 new 7.5MW LTHW boilers serving high base load – 2004.
- George Square: 1.6MWe engine again replaced steam system – but 75 tonne Heat Store and 600kW Absorption Chiller even out load – 2005.

The project received a £5 million grant from the Community Energy Programme, with the balance loaned from the University at 7% interest, allowing for a simple payback of 7 years.

Project Details

Type	Formation of an ESCo, external communities were engaged but were not supportive
Level	Medium
Technology	CHP
Energy	
CO₂ Savings	
Cost	£12million
Funding	Community Energy Programme (40%) and a University Loan
Stage	3 CHP systems complete, with future plans for expansion

5.3. Aberdeen City Council Community Heating

The Aberdeen City Council (ACC) developed a strategic approach to community heating for their existing property upgrades. With the formation of an energy co-operative, Aberdeen Heat & Power Ltd (AH&P), ACC established a CHP scheme that served four of their multi-storey blocks.

Project Details

Type	Co-operative formation and partnership with Aberdeen City Council
Level	Medium
Technology	CHP
Energy	
CO₂ Savings	661 tonnes per annum (42% of do-nothing baseline)
Cost	£1.5million Capital cost
Funding	Community Energy Programme & a bank loan
Stage	Complete

5.4. London Borough of Merton

The London Borough of Merton pioneered the 10% embedded renewables in planning requirements. Under this plan The Borough initiated its borough-wide plan for a district heating power network as part of an urban regeneration strategy for Mitcham.

Project Details

Type	Local authority ownership with good public participation. ESCo formation for financing.
Level	Medium
Technology	Under investigation proposing a Mixed scheme (District Heating Power (DHP), Pyrolysis, and more)
Energy	
CO₂ Savings	Up to 150,000 tonnes over 10 years (forecast)
Cost	£30,000 feasibility costs
Funding	London Development Agency (LDA) for feasibility costs. Other funding to be considered for implementation costs.
Stage	Ongoing

5.5. The Middelgrunden Offshore Wind Farm

The Middelgrunden Offshore Wind Farm is a unique story of how 5 years of work of concerned citizens has resulted in the world's largest co-operatively owned wind development. The co-operative formed a partnership with the local energy utility.

Project Details

Type	Share-based, Co-operatives, Partnership
Level	Medium/High
Technology	Wind turbines
Energy	100 Gigawatt hrs per annum, with the community owning 50.5 Gigawatt hrs per annum
CO₂ Savings	
Cost	€47.6 million
Funding	Pre-subscribed share purchases by the community.
Stage	Complete

5.6. Future Edinburgh projects

It is recognised that there are current projects in the CEC that are in early developmental phases, that may be suitable potential future CEPs.

The Steering group is asked to advise on any such projects and potential sites.

6. Discussion, conclusions & way forward

This report appears in the context the UK's governments recent energy review and with in the light of the recent Stern Report, stating that CO₂ emissions need to be reduced drastically in order to avoid future economic catastrophe. Achieving such reductions and targets will require significant changes in the production, distribution and supply of energy. The White Paper recognises that action will be required at all levels, by government, business and individuals, and it envisages an important role for communities.

The new targets set by The City of Edinburgh Council to become carbon neutral by 2050 will almost certainly require a range of energy efficiency and renewable energy options to meet this target. The Decentralised Energy report Powering Edinburgh into the 21st Century (Nov 2006) highlights a range of approaches to tackle this, and suggests that a high decentralised energy scenario is the only possible option for meeting the 2050 targets. Potentially, community energy partnerships could play a significant role in the delivery of such energy solutions for the city to meet its aspirations.

CEPs may take on various structures, and may engage with their communities on varying levels. Such a project may:

- Be focused on one or more distinct communities (these can be either communities of locality or communities of interest)
- Put the local people and community at the heart of its work and benefit them in terms of energy improvements and other economic, social and environmental gains
- Involve other stakeholders as appropriate and ensures effective partnership working to maximise energy and non-energy benefits for local people
- Lead to wider benefits for local people in terms of employment, health, regeneration, income, capacity-building, and local environmental quality

As such, CEPs could be an effective way of addressing National, Scottish and local targets. They can increase the development or renewable energy, low carbon sources, and broaden the awareness of energy efficiency benefits.

It is clear that there is a range of options for community energy projects that might be appropriate for Edinburgh. Community energy partnerships have the potential to play a strong role in the delivery of energy solutions for the city to meet its aspirations.

This report will be presented to the CEP steering group as a basis for discussion regarding the potential next steps in considering the opportunities for community energy projects within the City of Edinburgh. The steering group are now faced with the following options, including:

- i. Do nothing
- ii. Commission a more detailed Feasibility study
- iii. Engage community on existing proposed project

We would recommend that a fuller feasibility study be undertaken. This could consider the conclusions of the Powering Edinburgh into the 21st Century Report with regard to community energy projects. We would recommend this also looks at large scale wind and tidal power.

APPENDIX 1:

Arnsteins 8 Levels of Participation		
Level 1	Manipulation	These levels assume a passive audience, which is given information which may be partial or constructed
Level 2	Education	
Level 3	Information	People are told what is going to happen, is happening or has happened
Level 4	Consultation	People are given a voice, but traditional power holders still make the decisions
Level 5	Involvement	People's views have some influence, but traditional power holders still make the decisions
Level 6	Partnership	People can begin to negotiate with traditional power holders, including agreeing roles, responsibilities and levels of control
Level 7	Delegated Power	Some power is delegated
Level 8	Citizen Control	Full delegation of all decision-making and action

Arnsteins ladder depicting eight levels of community participation. This hierarchical scheme implies that by being placed down the ladder, schemes of lower community engagement, are inferior to those of higher community engagement.

Adapted from The Benefits of Community Based Energy Efficiency Projects. Report to the Energy Efficiency Partnership for Homes, CAG Consultants, March 2004.

APPENDIX 2:

Decentralised Energy Technologies and their Edinburgh Potential.

Taken from *Powering Edinburgh into the 21st Century*

The various technologies that would contribute to meeting these policy objectives are considered in turn below.

1. Gas-engine CHP supplying CH Networks

The main alternative to using centralised power generation is that of CHP, which can be located closer to customers thereby saving transmission costs and allowing the provision of efficient, locally generated heat through CH pipe networks. Gas-engine CHP technology supplying CH networks is well established, particularly in Jutland, Denmark and in the Netherlands. In Edinburgh there are currently no good examples that exist – this is primarily a result of council policy to replace community heating schemes with individual gas boilers in the 1970s and 1980s.

Examples of the conversion of existing housing to CHP/CH can be found across Europe, where significant heating networks were installed during the 1970s and 1980s; here in the UK the CHP/CH system at the Dickens Estate in Portsmouth provides a good example.

Description of technology

Over the last 15 years developments in reciprocating engine technology have been significant. A number of European diesel engine suppliers are now offering spark ignition gas engines designed for use as base-load CHP generators. Efficiencies have improved and emissions have reduced. Engines are available in the size range from 1MWe to 8MWe – we have assumed a 2.2Mwe engine size as being typical for Edinburgh.

Edinburgh opportunities

There is currently very little gas-engine CHP capacity in Edinburgh that is connected to community heating networks, which are of primary importance for the widespread usage of CHP. The city's conservation areas and preservation orders may be a significant barrier to the uptake of community heating. However, the precedent of excavation and disruption of infrastructure and building use has been set by the installation of utilities and communication networks. The laying of pipe networks falls within the same category. CH networks have been successfully installed in heritage-rich cities in Europe such as Copenhagen, Amsterdam and Paris.

Expected market share

The primary market for this technology is the existing building stock reached through newly-built CH networks. The city centre provides the focus for potential in 2025, as relatively high building density and zones of mixed use result in the requisite demands that support community heating with CHP. The high domestic densities in the city centre and in outlying local centres also provide the necessary heat demands. An earlier study, *The UK Potential for Community Heating with CHP* (BRE, 2003), estimated that the potential for CHP for existing buildings in Edinburgh is a total of 134MWe of gas-engine CHP. Under the low DE scenario the potential capacity of 134MWe estimated by the BRE study is considered to be optimistic, and an assumption for potential of 85MWe has been adopted. This is based on the minimum required heat density. Under the high DE scenario, the figure proposed by BRE is broadly consistent with the PB analysis in that the results of the heat density mapping using a lower requirement on heat density suggest that the potential is around 130MWe. This is consistent with an active policy framework from local and national Government that prioritise energy and environmental objectives. The projected capacities for each of new domestic (10MWe) and new non-domestic (8MWe) buildings remain the same.

2. Biomass CHP via CH networks

Fuel resource and type

Biomass is a renewable energy source that has been underdeveloped in the UK. Although the resource available from forestry is more limited than in some other European countries, there is still a significant amount of clean wood waste that is sent to landfill. In the future energy crops such as wood, straw or miscanthus grass may be able to contribute. There is a wood fuel resource within Edinburgh itself, but to supplement that, the Lowland and Borders regions of Scotland have an abundant wood resource, which is close enough to Edinburgh to justify fuel transport.

Description of technology

The technology of biomass CHP using steam turbines in the range 10MWe to 50MWe is well established in the Scandinavian countries, Germany, The Netherlands and Austria. However, most UK experience has been with heat-only boilers or electricity-only production. This must change if Edinburgh is to contribute its share to the ambitious national targets set by the Scottish Executive for renewable energy in Scotland.

Edinburgh opportunities

The analysis is based on a large-scale biomass CHP system proposed for the new waterfront developments at Leith Docks, Western Harbour and Grafton Waterfront, which a) has the scale to warrant adoption of viable biomass CHP technology, b) will have the required density to support extensive CH networks, and c) has the infrastructure to support fuel delivery by boat or rail and will contribute significantly to the mitigation of carbon dioxide emissions in Edinburgh.

Expected market share

The fuel resource available in the areas surrounding Edinburgh provide huge scope for the use of biomass -the limits are exerted by demand. The resource locally available from the Lowlands and Borders is estimated at around 3 million tonnes (dry weight) for wood fuel of the requisite size and quality (see Appendix E). Under the low DE scenario we have assumed a 10Mwe scheme with a 15MW heat output supplying new build developments. For the high DE scenario a 20Mwe scheme with 30MW of heat output is assumed to supply the new build developments and also connect to some of the existing building stock. The demand of the technologies and capacity can easily be met by the locally available wood fuel resource.

3. Buildings based CHP

In some non-domestic buildings connection to a local CH scheme is likely to be less suitable than having a dedicated CHP system on site. On-site systems will also be suitable for buildings not within the reach of CH networks, particularly where the occupants also wanted to secure their electricity supply in case of grid failure. Candidate buildings include:

- hospitals
- prisons
- university campuses
- hotels
- leisure centres
- large retail or office complexes where cooling is required.

Description of technology

The technology normally involves smaller gas engines within the range of 100kWe to 1MWe, although packaged small scale gas turbines of around 100kWe are also available. In the future fuel cells may become commercially available for this application. Recent technological developments have led to smaller CHP units down to 5kWe, which would be suitable for quite small buildings.

Edinburgh opportunities

A number of building CHP systems already exist in universities and hospitals: for example, Edinburgh University, Royal Edinburgh Infirmary and the Western General Hospital. There are also good examples operating in the commercial sector including Scottish Water's Seafield Wastewater Treatment works and several of the large hotel chains. The main applications are expected to be in new build non-domestic buildings and in the larger existing buildings. Under the low DE scenario we envisage 18MWe of CHP capacity in existing buildings, comprising 6 major sites of 2MWe and 20 minor sites of 300kWe. Most of these will be located in outer Edinburgh, outside the CH network areas. In the new-build sector we have assumed nearly 2.5MWe of CHP capacity, principally located in commercial developments. Under the high DE scenario the capacity is developed further in existing buildings to

nearly 27MWe, with no increase in the new-build sector.

4. Biomass boilers

For details of the fuel resource and type, refer to the description under Biomass CHP

Description of technology

The use of biomass boilers for heating is an established technology, the only constraints being availability of suitable fuel, adequate space for fuel delivery and storage and increased labour costs for maintenance and operation compared to conventional gas boilers. As a result of these issues, biomass boilers are more likely to be used in new-build developments.

Expected market share

Under the low DE scenario we have assumed 5.7% of new dwellings and 10% of new non-domestic floor space utilising biomass boilers. Under the high DE scenario 11% of new dwellings and 20% of new non-domestic floorspace are assumed to utilise biomass boilers.

5. Building-integrated low- and zero emission technologies

There is a wide range of low and zero-emission technologies suited to incorporation into properties. Zero emission renewable energy sources include solar thermal and PV units and small-scale wind turbines. Low-emission technologies include gas-fired micro-CHP units.

Description of technology

Domestic CHP

The utilisation of larger-scale CHP to supply the residential sector requires CH networks to deliver the heat. This is cost-effective in areas of high development density, but less so in low-density suburban streets with semi-detached or detached dwellings. Significant research has been devoted to developing a domestic scale CHP unit which would take the place of a conventional boiler and generate around 1kW of electricity and enough heat for space and water heating. At present the Stirling engine and the organic Rankine cycle are the most promising technologies for the coming decade, with an electrical efficiency of around 15% and heat efficiency of around 70%, but they are still far from commercial viability. In the longer term fuel-cell CHP, which offers higher efficiency, may become economically viable.

Renewable heat – solar thermal

Solar thermal systems, using panels fixed to a south facing roof, are designed to provide heat only to a domestic hot-water heating system. They work in conjunction with a conventional heating system which provides top-up capacity, especially in winter. This technology is not normally compatible with CHP (because CHP systems usually have surplus heat available in the summer when solar thermal output is at its highest), although there are a

few systems in existence in which larger solar thermal arrays provide heat to a CH network.

Renewable electricity – photovoltaic panels and wind turbines

Two technologies are considered under this:

- photovoltaic panels (PV) and
- building-integrated wind turbines (BIWT).

The advantages of these technologies include the avoidance of grid losses and the zero-emission energy sources used. The disadvantage of PV is that unshaded surfaces are needed; the disadvantage of BIWT is that the output can be relatively low due to the lower wind velocities in built-up areas.

Expected market share

The fact that the areas of high heat density would be predominantly served by CH networks means that the main opportunities for the micro-generation technologies lie in the outer areas of the city, and outside the majority of the conservation and preservation areas. The degree to which these technologies penetrate the market will depend on local and national Government policy and also the market readiness and cost of these technologies.

Domestic CHP

Under the low DE scenario we have assumed that the current technical barriers will not be overcome by 2025, and therefore there is no capacity included for domestic CHP. Under the high DE scenario we have assumed that from 2010 domestic CHP will gain about a 10% share of the new boiler market, which is estimated to be 1.2 million units p.a. (CT, 2005) for the UK and approximately 7000 units in Edinburgh. This results in nearly 800 units a year in Edinburgh over 15 years (2010 to 2025) which means by 2025 there would be 11,700 units – covering about 5% of the total number of dwellings.

Renewable heat – solar thermal

The main market is considered to be in new dwellings, where the capital cost of the initial installation can be lower than for retrofit and where future planning regulations will require consideration of solar thermal and other renewables. In addition, solar thermal systems will be appropriate for dwellings in outer Edinburgh where CHP and CH are unlikely to be viable. Apart from specialist buildings such as hotels and leisure centres, the non-domestic sector is unlikely to have sufficient summer heat demand to justify solar thermal systems. Under the low DE scenario 3060 dwellings are assumed to have solar thermal systems, representing 7.5% of the new-build total, along with 10,240 existing dwellings, representing 5% of dwellings in the low heat density areas of outer Edinburgh. Under the high DE scenario these numbers are doubled to 6,100 new build dwellings and just under 20,500 in existing dwellings.

Renewable electricity – photovoltaic panels and wind turbines

We expect the main market to be in the new-build nondomestic sector where the high cost of the PV can be offset by avoided costs for high-quality

cladding materials and where concerns over noise from wind turbines will not be as relevant. Moreover, electricity demand for this sector is highest during the daytime, which is obviously compatible with PV. Under the low DE scenario we have assumed that:

10% of the electricity demand of new non-domestic buildings is met from PV and BIWT

- 10% of new dwellings will have PV or BIWT installed
- 1.3% of existing dwellings will have PV or BIWT installed.

Total installed capacity for the entire new-build sector is assumed to be 7MWe of BIWT and nearly 8MWe of PV. Total installed capacity (at a much lower density) for existing buildings is assumed to be just over 2.5Mwe of BIWT and 1.3MWe of PV. Under the high DE scenario we have assumed that:

- 20% of the electricity demand of new non-domestic buildings is met from PV and BIWT
- 20% of new dwellings will have PV or BIWT installed
- 2.6% of existing dwellings will have PV or BIWT installed

Total installed capacity for the entire new-build sector is assumed to be 14MWe of BIWT and 15.5MWe of PV. Total installed capacity for existing buildings is assumed to be just over 5MWe of BIWT and 1.6MWe of PV.

APPENDIX 3:

Larger Wind:

Wind turbines produce electricity by using the natural power of the wind to drive a generator. The wind is a clean and sustainable fuel source, it does not create pollution and it will never run out. Wind energy technology is developing fast, turbines are becoming cheaper and more powerful, bringing the cost of renewably-generated electricity down. Europe is at the hub of this high-tech industry. Although conventional sources of power dominate the energy needs of European countries, wind energy is growing rapidly. Renewable energy sources currently provide nearly 5.4% of the European Union's primary energy needs¹ and have the potential to provide much more.

Commercial turbines range in capacity from a few hundred kilowatts to over 2 megawatts. The crucial parameter is the diameter of the rotor blades - the longer the blades, the larger the area 'swept' by the rotor and the greater the energy output. At present the average size of new machines being installed is now super megawatt, 1.3-1.85MW, and there are larger machines on the market. The trend is towards moving to these larger machines as they can produce electricity at a lower price.

There are many different turbine designs, with plenty of scope for innovation and technological development. The dominant wind turbine design is the up-wind, three bladed, **stall controlled**, constant speed machine. The next most common design is similar, but is **pitch controlled**. Gearless and variable speed machines follow, again with three blades. A smaller number of turbines have 2 blades, or use other concepts, such as a vertical axis.

The comparison of energy used in manufacture with the energy produced by a power station is known as the 'energy balance'. It can be expressed in terms of energy 'pay back' time, i.e. as the time needed to generate the equivalent amount of energy used in manufacturing the wind turbine or power station.

The average wind farm in the UK will pay back the energy used in its manufacture within six to eight months, this compares favourably with coal or nuclear power stations, which take about six months. Wind energy is one of the cheapest of the renewable energy technologies. It is competitive with new clean coal fired power stations and cheaper than new nuclear power. The cost of wind energy varies according to many factors. An average for a new onshore wind farm in a good location is 3-4 pence per KWhr, competitive with new coal (2.5-4.5p) and cheaper than new nuclear (4-7p). Electricity from smaller wind farms can be more expensive.

Factors against wind farm developments:

- There is a perception that wind farms are noisy and are eyesores.
- The construction of a large wind energy facility is also far from ecologically benign in previously undeveloped locations. It requires wide straight flat roads, a large hole filled with tons of steel and concrete to secure each giant assembly, clearing of trees in wooded areas and a transformer and power lines for each turbine.
- Siting wind farms offshore can address these objections in some cases while raising other issues, such as dangers to navigation and the possible adverse effect of low-frequency vibration on aquatic life.
- Wind farms are known to cause significant fatalities to birds and bats in certain areas. Siting generally takes into account bird flight patterns. Although night flying bird patterns are not entirely known, further research and the precautionary principle could mitigate fatalities.
- Wind turbines are detected by primary radar at airports and cause “flickering” in the pilots line of site, and are thus opposed near an airport.

Factors for wind farm developments:

- Land-based wind energy has the potential of covering world's total energy consumption.
- The energy consumption for production, installation, operation and decommissioning of a wind turbine is usually earned back within 6 months of operation.
- After decommissioning wind turbines, even the foundations are removed.
- Conventional and nuclear plants also have sudden unpredictable outages. Statistical analysis shows that 1000 MW of wind power can replace 300 MW of conventional power.
- More recent wind farms have their turbines spaced further apart, due to the higher capacity of the individual wind turbines. They no longer have the cluttered look of the early wind farms.
- The modern turbine is quieter than its predecessors owing to improvements in the blade design.
- Studies show that the number of birds and bats killed by wind turbines is negligible when compared with other human activities such as traffic, hunting, power lines and high-rise buildings.

Source: British Wind Energy Association (www.bwea.com), and Consumer Utility Service (www.cus.net)

Water

Water from the seas and rivers can provide large amounts of clean energy basically in three ways: Wave power, Tidal power and Hydro power.

Waves are created in the oceans by winds which in turn are driven by the sun by differential heating of the earth's surface. Usable electric power must then be generated by devices such as the "Nodding Duck" (developed at *University of Edinburgh*), "Clam" (developed at *Coventry University*) or the "Pelamis" (developed by *Ocean Power Delivery Ltd* in Edinburgh). The initial costs are high and further development is needed. The UK has fallen behind some other nations due to government decisions in the past.

Tidal power is also associated with the seas but the moon is the main cause of tides. The energy can be harnessed most easily where there is an estuary. Apart from high constructional costs (estimated at around £10 billion), the creation of a tidal barrage on such a system would have an environmental impact on wildlife. Conservationists oppose such schemes for this reason but the counter argument says that while some habitats would be destroyed (for example those of waders) others would be created for different species. A relatively recent development is tapping the resources of underwater tidal currents.

Hydro power is available by creating dams in stream and river flows. Hydro power generation is an established technology and maybe as much as one fifth of the world's electricity is generated this way, which is slightly more than by nuclear generation. The major factor weighing against it is the environmental impact. Because hydro schemes have a known record, the evidence is indisputable. Where large dams have been constructed, large areas of land are drowned. The results can be lethal for local wildlife and catastrophic for the human inhabitants of that area who become displaced en masse. Very often beautiful landscapes are destroyed and valuable archaeological sites made inaccessible for ever.

There are ways of mitigating such catastrophes such as consultation with the affected population and relevant experts before decisions are made, accompanied by suitable compensating actions afterwards. The severity of the aftermath of dam creation is related to the size of the project, where large projects create widespread, serious problems. Therefore hydro schemes could be more acceptable in some cases, if there were several, small distributed systems rather than one big one, unfortunately fragmented systems normally are less efficient.

There are now more devices being examined than were previously

envisaged, including under-water turbines which take advantage of tidal currents that exist in river estuaries such as the *Severn*. Additionally the idea of *Tidal Lagoons* has been introduced. These would trap water and release it in a controlled way through turbines. If these methods could be developed successfully the potential is there for very large scale energy production which could make a significant difference to the energy sourcing in the UK. One big factor in the favour of recent marine technologies is that they do not suffer from the criticism of being environmentally visually unattractive, like wind farm, and their output are somewhat more reliable.

In summary: Water power is, in principle, clean and genuinely renewable. Nevertheless **there can be serious drawbacks where water power is generated on a large scale.**

There are high financial cost, or perhaps this is better described as political will which, often amounts to the same thing. With major projects which require massive R and D investment before profits can be realised, national leadership is often needed to create the impetus to reach an 'escape velocity'.

Ground Source Heat Pumps

Although we may not know it heat pumps are very familiar to us - fridges and air conditioners are two examples. Ground source heat pumps (GSHP) transfer heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water.

For every unit of electricity used to pump the heat, 3-4 units of heat are produced. As well as ground source heat pumps, air source and water source heat pumps are also available.

How does it work?

There are three important elements to a GSHP:

1) **The ground loop.** This is comprised of lengths of pipe buried in the ground, either in a borehole or a horizontal trench. The pipe is usually a closed circuit and is filled with a mixture of water and antifreeze, which is pumped round the pipe absorbing heat from the ground.

2) **A heat pump.** This has three main parts:

- the evaporator - (e.g. the squiggly thing in the cold part of your fridge) takes the heat from the water in the ground loop;
- the compressor - (this is what makes the noise in a fridge) moves the refrigerant round the heat pump and compresses the gaseous refrigerant to the temperature needed for the heat distribution circuit;

- the condenser - (the hot part at the back of your fridge) gives up heat to a hot water tank which feeds the distribution system.

3) **Heat distribution system.** Consisting of under floor heating or radiators for space heating and in some cases water storage for hot water supply.

What options are available?

The ground loop can be:

- a) borehole;
- b) straight horizontal - trench costs less than a borehole, but needs more land area;
- c) spiral horizontal (or 'slinky coil') - needs a trench of about 10m length to provide about 1kW of heating load.

How much does it cost?

Installation

A typical 8kW system costs £6,400-£9,600 plus the price of connection to the distribution system. This can vary with property and location.

Running costs

The efficiency of a GSHP system is measured by the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Typical CoPs range from 2.5 to 4. The higher end of this range is for under-floor heating, because it works at a lower temperature (30-35°C) than radiators.

Based on current fuel prices, assuming a CoP of 3-4, a GSHP can be a cheaper form of space heating than oil, LPG and electric storage heaters. It is however more expensive than mains gas. If grid electricity is used for the compressor and pump, then an economy 7 tariff usually gives the lowest running costs

APPENDIX 4:

1. The Dancing Ladies of Ghia

The Isle of Gigha Heritage Trust was established in 2002 when the islanders of Gigha took the historic step of buying their island – taking it into community ownership. The Trust is the body that runs the island, with islanders contributing as members and Directors.

The Trust soon founded a trading subsidiary known as Gigha Renewable Energy Limited, which established the UK's first grid-connected local community owned wind farm in December 2004. The Gigha Windfarm consists of three recommissioned Vestas V27 wind turbines, each with an installed capacity of 225 kilowatts. The three windmills combined produce approximately 2.1 gigawatt hours of electricity a year, approximately two thirds of the island's electricity requirements. This landmark project meets all of Gigha's energy needs, exporting the surplus to the mainland, and providing an annual net income to the community of around £80,000.

The £440,000 project was supported through a combination of grant funding, loan funding and equity. A grant of £82,000 from the Scottish Executive's Scottish Community and Household Renewables Initiative (SCHRI), administered by Highlands & Islands Enterprise (HIE). A grant of £50,000 came from the Fresh Futures, Sustainable Communities Project Fund (National Lottery funding administered by Forward Scotland. Commercial loan finance of £148,000 was provided by Social Investment Scotland a unique partnership between Scotland's four biggest banks and the voluntary and public sectors, providing loan finance and business support to social enterprises and voluntary organisations which have the potential to take out a loan but do not fully fit the lending criteria of commercial banks. The loan has to be repaid over a five year period at a fixed rate of interest.

Equity holdings in the Windfarm of £80,000 and £40,000 were taken by Highlands and Islands Enterprise and the Isle of Gigha Heritage Trust, with the equity currently held by HIE being bought back by the Heritage Trust after five years. £40,000 was invested through a community "sister" organisation through the buying of shares. With the exception of the grant funding, the project is a purely commercial one.

The money generated from green electricity sales (entirely to Green Energy UK) pays for the turbines' upkeep and funding development projects on the island. Over the first eight years of the project, a capital reinvestment fund of approximately £160,000 will be built up, to ensure that the windfarm is financially sustainable, providing a sufficient amount of returns to replace the

machines when required, without recourse to further grant, equity or loan finance.

The financial model that has been developed to underpin the project is very robust and capable of widespread replication by communities throughout Scotland, so it is anticipated that many more community windfarms can be based on the Gigha model.

Community members were consulted at each stage through a series of meetings held throughout the development of the project. The Gigha community has named the turbines '*Creideas, Dòchas and Carthanna*', the Gaelic names for '*Faith, Hope and Charity*' and collectively call them '*The Dancing Ladies*'.

2. University of Edinburgh

The University of Edinburgh has a long history of pro-active action on energy conservation. These activities have paid off for the University of Edinburgh. Since 1989, more than 5 percent of the university's utilities spend has been invested each year in energy efficiency projects delivering cumulative savings of £6 million. From 1990 to 2004, energy costs were reduced by 5 percent in real terms while student numbers have doubled to nearly 23,000 and building area has increased by 25 percent.

The University has Environmental, Sustainability and Utilities policies all driving reductions in carbon emissions and plays an active part in national networks to share best practice among the university community.

Driven by its commitment to sustainable practices, its central heating tradition, the imperative to reduce CO₂ emissions and the need to contain an annual utilities bill now approaching £9 million, the University of Edinburgh installed three state-of the art CHP systems on three of its five campuses since 2003. Aging steam systems have been replaced with high-efficiency boilers and three spark-ignition gas engines with 85 percent overall efficiency. Currently serving more than half of the university's 5.5 million sq ft of property, the new systems lie two to three miles apart and are not interconnected. The university has a 10-year operation and maintenance contract with Clarke Energy, UK agents for the GE Jenbacher engines, which undertakes all routine maintenance and has engineers on 24-hour call to respond to any engine problems.

The three systems are outlined below:

Pollock Halls of Residence

Installation of a 526 kWe GE Jenbacher gas reciprocating engine to operate as the lead boiler. Already in place were three 2 MW dual-fuel (natural gas and light oil) shell-and-tube boilers that continue to provide top-up and standby heating capacity. Since installation, the Pollock Halls system has cut annual CO₂ emissions by 450 tonnes and reduced noise nuisance in an adjacent conference suite. The £1 million project was funded in part through a £250,000 grant from the Community Energy Programme.

King's Buildings

Next, the University of Edinburgh turned its attention to the 45-year-old steam heating plant and distribution network at its King's Buildings campus. The entire former system – comprising four boilers with combined capacity of more than 80,000 lb/hr of steam, plus steam pipes in walkway ducts – was stripped out early in 2003 to make way for the CHP technology, installed later the same year. The new equipment includes a 2.7 MWe gas reciprocating engine and two 7.5 MWth low-temperature hot water boilers with low-nitrous oxide burners. A new highly insulated low-temperature distribution system was also installed in the existing ductwork and the duct

covers replaced. For this installation more than 1.4 km (0.87 mi) of steel pipe was employed – all insulated in situ with mineral fiber insulation sealed in a flexible cover

Serving nearly 30 buildings, the system reduced CO₂ emissions by more than 2,600 tonnes in its first year of operation. The CHP system reduced fuel bills by £450,000 per year in the short term, with even greater savings achieved when reduced employee costs are taken into account. Financing sources for this £4.3 million CHP project included a second Community Energy grant of £1.63 million.

George Square

The third CHP project, completed in 2005, included replacing 50-year-old steam boilers with a trigeneration system to heat and cool the George Square campus. The new equipment includes a 1.6 MWe gas-fired GE Jenbacher 612 CHP engine; two 6 MW and one 3MW low-temperature hot water boilers; a 600 kW absorption chiller exploiting byproduct heat to cool specialist laboratories in summer; and thermal storage. Fourteen buildings were originally connected to the system. Another seven are to be added over the next five years, as their electric under-floor systems are displaced as part of a major refurbishment of 1960s-era academic buildings. This expansion has already begun, with heating and cooling pipes laid to the Main Library in summer 2006.

This innovative £7 million installation was supported by a £2.7 million Community Energy Programme grant. The importance to the university of optimizing overall energy efficiency is reflected in the fact that £1.9 million of the budget was allocated to internal building controls. In its first full year, the trigeneration system saved £220,000 in energy costs and 1,250 tonnes of CO₂ emissions. When running to optimize electricity production annual savings of nearer £500,000 will be attained.

Remote Management

A vital component of Edinburgh's three CHP systems is the university's Building Energy Management System (BEMS) and associated controls, which allow building heating and ventilation equipment to be remotely controlled to optimize comfort conditions while minimizing energy costs. There are now more than 350 microprocessor-controlled BEMS panels in university buildings, monitored and managed from computers in Estates & Buildings maintenance offices. The BEMS is used as the primary determinant of whether the engines fire and at what rate – set to meet all site power loads while retaining a small inflow from the grid. In other words, each engine is run in non-island, non-exporting mode

Future Directions

The University of Edinburgh had at one time considered a major extension of its George Square system but has postponed the effort indefinitely in light of the current gas market fluctuations. While no additional CHP plans are in the works at this time, the university remains committed to ongoing

sustainability improvements to its energy infrastructure. One major proposal is a biomass-fired district heating system that will serve buildings at the Easter Bush Veterinary Centre five miles south of the city. This is to be considerably expanded to house an entirely new School of Veterinary Studies and associated research institute. This system could potentially be fired using surplus forest industry byproducts, providing a zero-carbon heat source for the growing campus.

Although the Community Energy Programme has ended, the university continues to participate in a carbon management partnership program offered by The Carbon Trust in Scotland, the organization's local office. Through this partnership, the university receives a small amount of funding support for consultancy and advice on two ongoing initiatives: (1) an energy reduction campaign – titled 'Switch and Save' – to engage all staff and students and (2) installation of an automatic utilities metering, monitoring and targeting (AMR) system to facilitate the devolution of the whole utilities budget down to schools and departments across the university by 2008.

On a day-to-day basis, the ESO continues to help the university minimize its environmental impact and maximize its energy efficiency. It plays an active part in national networks to share best energy practices with other U.K. universities. And it maintains its innovative approach to building a sustainable university, determined to stay a successful international research leader for another 400 years.

3. Aberdeen

In October 2000 Aberdeen City Council (ACC) decided to commission and fund an initial feasibility study into multi-storey community heating with Combined Heat and Power (CHP) to see if this would be a suitable option for their multi-storey properties. The aim was to establish what level of funding would be available to ACC and to explore the feasibility of a suitable group of multi-storey properties for a potential scheme. This group of properties comprised 7 multi-storey blocks of flats in the **Seaton** area of the city. These properties were chosen because:

- They were close together, reducing the capital expenditure necessary for distribution systems, and
- Their existing warm-air electric heating systems would be due for upgrade in the near future.
- There were also 7 additional blocks of flats nearby which would enable the scheme to be extended at a later date.

One of the recommendations of the report was the creation of a 'not-for-profit' organisation to fulfil the financing requirements for the heating of the multi-storey stock.

To achieve its objectives ACC needed to gain a clearer picture of the current condition of its 8,100 properties, and an in-depth study, including an energy audit, was carried out. From the surveys of all the buildings an understanding of total costs for repair, maintenance and like-for-like replacement over a 30-year period was established. This provided a useful datum for the appraisal of potential options. The consultants produced an original plan of 59 clusters (buildings in close proximity to one another that can be connected to a central CHP). Stockethill was identified as the most suitable cluster. It comprises 288 flats, in 4 multi-storey blocks. The flats had electric storage heating, which had been installed in the 1970's. 70% of the residents of these dwellings were estimated to be in fuel poverty. The tenure of these properties was 98% council tenants and 2% owners. The dwellings, with their existing electric heating, had a low average National Home Energy Rating (NHER) of 3.3. All potentially viable upgrading options were considered.

Although the the most attractive, CHP with overcladding would have been prohibitively expensive in capital terms for ACC. They therefore opted for CHP only. This would improve the NHER to 6.0, reduce tenant heat costs by about 40% and reduce CO₂ emissions by about 40%.

Financing the Scheme

From the initial feasibility report it was recommended that ACC set up a separate 'not-for-profit' company to develop and manage CHP schemes across Aberdeen. A legal agreement between ACC and the company Aberdeen Heat and Power Limited (AH&P) was then drawn up. This committed ACC to provide funding of £215,000 per year to AH&P to ensure that any

bank loan taken out for capital costs can be repaid. The Board of AH&P consists of ACC representatives, tenant representatives and up to 6 unpaid independent directors with varied and relevant expertise.

The separate company arrangement benefits ACC by facilitating capital investment in the stock, accelerating the refurbishment programme and spreading the capital cost over several years. ACC successfully applied to the Community Energy Programme for grant funding., and due to the annual contribution of ACC,AH&P were successful in securing a favourable rate of interest for a bank loan to cover the remaining 60% of the capital. ACC are also accessing Energy Efficiency Commitment (EEC) money.

Implementation

An energy centre was built close to one of the 4 multi-storey blocks. It houses a 210kWe gas fired reciprocating engine CHP unit and 2 x 700kW [thermal] gas fired boilers for peak load and back-up. The heat is distributed to the 4 blocks via pre-insulated underground pipes, which comprise the heat network, with each unit having a new internal distribution system.

About half of the electricity produced by the CHP unit will be sold to dwellings served by the heat network – with the remainder being sold to other customers. Community heating from a central plant can keep maintenance costs down - no individual gas safety certificates need to be produced or servicing carried out; therefore fewer visits are required to individual properties.

ACC consulted with their tenants throughout. As the process was an improvement, rather than a repair, the tenants were able to choose whether or not to have the new heating installed. Of the 288 flats, 21 tenants did not want the system. Most of the refusals were from tenants suffering from ill health concerned about disturbance, and were given the opportunity to change their minds towards the end of the contract period. Flats without the system would have it installed once the property becomes void.

Tenants were consulted before agreement was reached that a flat-rate would be charged for heating weekly. In December 2003, a supply of heat was delivered to the first property, with AH&P charging ACC £4.25 per flat per week for the heating. ACC decided to charge the tenants £4.75 per week, in an effort to account for bad debt. This charge is reviewed annually to reflect actual use, debts, voids and surplus or shortfall from the previous year. AH&P also operate a Code of Practice for services to its customers as is currently required of any direct energy supplier.

The 6 property-owners in Stockethill were consulted throughout the process and all agreed to have the heating system installed. Their main concerns regarding the upgrade of their heating systems were the capital cost and the possibility of large maintenance bills in the future. To alleviate these concerns ACC are charging them a weekly flat rate of 50p towards long-term

maintenance costs. ACC also offered the leaseholders a loan to cover the cost of installation - the repayments being lower than their actual saving in heating costs. There is also the benefit that ACC still 'own' the heating systems. Should any of the other properties be sold under the right to buy there will not be any problems with a 'clean title'.

Lessons learnt so far and the future

From this entire process the main lessons that ACC have learnt are:

- The need to approach the process strategically
- Whole life costing is the best way to establish the real cost and Best Value
- External specialist assistance is essential
- Due to the development workload it is advisable to delegate an individual to champion the project and keep it moving
- An arm's length company arrangement enables acceleration of refurbishment plans

AH&P are already looking towards the next set of clusters for the development of CHP. ACC have applied for a 50% grant towards a feasibility study from the Community Energy Programme for the next cluster in the Seaton area scheme. This scheme will also include a primary school and the potential to link with University buildings and a leisure complex.

4. London Borough of Merton District Heat and Power in Mitcham

The London borough of Merton which pioneered the planning requirement for 10% embedded renewables in new buildings, is now breaking fresh ground with plans for a borough-wide district heat and power (DHP) network. In October 2005 the council awarded PB Power and Element Energy a £30,000 contract for a feasibility plan.

The first part of the network will be installed in Mitcham in the socio-economically depressed south east of the borough. The area is deemed the most suitable for a DHP scheme with its mix of industrial premises, social housing, community buildings, a leisure centre, and open spaces with little underground infrastructure. Two more 'island clusters', in Morden and Colliers Wood, are planned to come on stream shortly afterwards.

The network is designed to be driven by a series of combined heat and power units and augmented by a range of renewable technologies and energy efficiency systems. It will be a 'trigeneration system', delivering electricity, hot water and air conditioning to users.

As well as looking at natural gas and hydrogen fuel cells to power the system, Merton is examining the innovative use of pyrolysis, an environmental technology commonly used in Japan but in its infancy in the UK. Pyrolysis produces a form of methane called syngas, which could be fed into a fuel cell to run the CHP. The first CHP machines are expected to be up and running by 2008, and the first three island clusters (accounting for 25% of the borough), to be in operation by 2010. Another three potential clusters have been identified and the intention is for the system to be available throughout the borough within 10 years. The scheme is expected to cut carbon dioxide emissions by about 150,000 tonnes when it is fully up and running.

The intention is to create a scheme that could be replicated across London, and eventually link in with DHP systems in adjacent boroughs.

5. Middelgrunden Wind Farm

The idea of the Middelgrunden wind project was born in a group of visionary people in Copenhagen already in 1993. However it took seven years and a lot of work before the first cooperatively owned offshore wind farm became a reality. Today the 40 MW wind farm with twenty modern 2 MW wind turbines developed by the Middelgrunden Wind Turbine Cooperative and Copenhagen Energy Wind is producing electricity for more than 40,000 households in Copenhagen.

In 1996 the Danish Energy Authority began mapping the wind potential in the Copenhagen area, and the Copenhagen Environment and Energy Office organised a working group of local citizens who were interested in wind energy. This became a cooperative which took the idea forward, and a proposal with 27 turbines was presented to the public. At that time had mapped the Middelgrunden shoal as a potential site for wind development, but it was not given high priority by the civil servants and the power utility. Nevertheless the Parliament supported the idea and made funding available for further investigations. These developments together with strong public support from 1000 members of the newly established cooperative and cooperation with the local utility – Copenhagen Energy - cleared the road for the project.

From 1997 to 1999 two visualizations and an Environmental Impact Assessment Study were carried out and a large public debate took place in connection to the public hearings. Following the first public hearing the original proposal of 27 turbines in three rows was changed. Instead it was decided to place 20 turbines in a slightly curved line. The wind farm had since been developed on a 50/50 basis, with 10 turbines to be owned by Copenhagen Energy and 10 turbines to be owned by the cooperative.

The public grant also covered an analysis of the organizational and economic aspects of the cooperatively owned part of the project, since the cooperative did not possess any financial means at these early planning stages.

Originally the total investment budget of the Middelgrunden Offshore Wind Farm was 46 million euro. The signed contracts were cheaper than the budget, but extra costs were added during the construction and the total investment ended up at about 48 million euro, not including costs for establishing the cooperative and administration costs of Copenhagen Energy. The actual building costs had been approximately 5% more expensive than budgeted. This was mainly due to more expensive foundations than the budget in the signed contract. The case was submitted for arbitration and was only closed late 2002.

The cooperative's ten 2 MW turbines were sold in 40,500 shares, each representing an annual production of 1,000 kWh. The total investment budget of the cooperative was 23 million euro and each share was offered at

570 euro. The number of shares offered was decided as based upon 90% of the guaranteed production. All shares had to be paid up front in order to follow the constitution of the cooperative, according to which the cooperative could not contract debt. The cooperative had organised attractive loan offers with two different banks. But less than 5% of the shareholders made use of this opportunity. The only security demanded by the banks was the project itself and income from electricity production. The loans were offered with a variable interest rate of 7.40- 7.45%, a term of 10 – 15 years and a small fee of 40 euro per loan

A comprehensive information and planning process took place, and an in-depth analyses had to be undertaken to visualise the impact of 20 turbines due to their proximity to Copenhagen. The first public hearing was held in During the process the cooperative was in contact with 50-100,000 people including relevant authorities, NGOs and many future shareholders of the cooperative. 10,000 local people pre-subscribed for shares. This proved strong local support and helped in the approval phase. In December 1999 the final approval was given and finally during 2000 the wind farm rose from the sea. By October 2000, 100% of the private shares were sold.

Private people have been a driving force in this project, like in the successful development of Denmark as a leading nation in wind technology. The working group, the management of the cooperative, Copenhagen Energy and the former Mayor of Environment Bo A. Kjeldgaard made huge efforts to bring the project to a success.

APPENDIX 5

Implications of Planning Restrictions and Conservation Areas

Taken from Powering Edinburgh into the 21st Century

The introduction of infrastructure associated with the adoption of DE should be entirely possible while respecting Edinburgh's heritage status and associated planning restrictions. Other prominent historic cities, such as Amsterdam and Copenhagen, have installed large-scale community heating networks without aesthetic damage, and existing planning regulations in Edinburgh have not prevented similar infrastructural changes such as the installation of telecommunications networks.

As a city of significant historic importance, Edinburgh has recognised areas in which regulations apply in respect of a) restricting disruption to existing infrastructure, particularly in respect of temporary alteration of the aesthetic qualities of the built or natural environment and b) permanent structural or aesthetic modifications to the exterior of buildings of a certain vintage or design. The City Council seeks to protect and enhance these areas through the application of statutory and non-statutory policies and guidance when considering development projects.

The location of multiple sites with World Heritage status in the centre of Edinburgh also places an obligation and stringent rules of operation on planning departments and engineering organisations to work closely together to ensure their preservation. The engineering works necessary to enable installation of the pipe networks that comprise community heating will involve some excavation of paved and cobbled road surfaces in Edinburgh and possibly minor modifications to buildings. A strong policy commitment to improve existing energy infrastructure could work within planning regulations to ensure that building energy use and its reduction contribute to achieving carbon emission cuts.

It is also clear that the micro-generation technologies that are improving and becoming more readily available are of vital importance in contributing to the same goal, and therefore that their use should be widely encouraged where appropriate. The degree to which they are appropriate is measured here by a) whether their installation competes with that of CHP and community heating and b) how their installation affects the aesthetic qualities of the building(s) on which they are installed. It should be possible, with careful siting, to incorporate DE technologies in all areas of the city.

