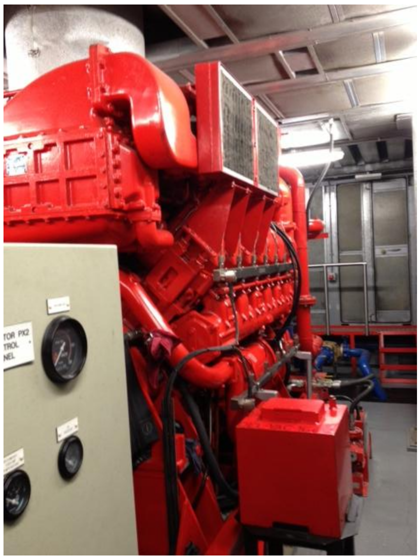
energy saving trust

Supporting the Development of the States of Alderney Island Energy Policy



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1. Executive Summary

The Energy Saving Trust[1] were invited to complete a study supporting the Development of the States of Alderney Island Energy Policy as part of the development of the overall Alderney Strategic Plan. We were invited to review the current state of play and some previous studies on different aspects of energy on Alderney and to conduct a short visit, during which we met with representatives of States and Statesmen, Alderney Electricity Limited, Alderney Commission on Renewable Energy and Alderney Renewable Energy amongst many others. We are grateful to all for the time taken to meet with us and the useful information supplied.

Our report reviews some of the key strategic issues, looks at energy demand issues and then energy supply and makes some recommendations in each of these areas, based on the same three time horizons as the overall Alderney strategic plan. We have included links to other island based energy saving and generation activity to see how others are approaching similar issues and where relevant have made links and suggestions to mainland UK energy policy.

EST has a long history of assisting householders and Governments in reducing energy use and involving local people in making decisions about their energy futures. Our report seeks to provide a way through to a secure, affordable and low carbon energy future – an important aspect of the overall strategic plan, with impacts on the economy, jobs, skills and growth as well the overall positioning of Alderney on these issues.

Our recommendations appear in full in section 5 of the report, but in summary are:

Short-term (0--5 years)

- Heating demand reduction programme
- Review of current electricity supply-
- -
- Energy storage
- Phased grid upgrades

Medium-term (5-10 years)

- Community microgeneration
- Establishing an Alderney Energy Service Company
- Consider viability of phased mothballing/decommissioning of existing oil generators

Long-term (10-20 years)

- UK Government Electricity Market Reform
- Additional community renewables capacity
- Integration with large-scale renewables and links to France and England

[1] For more information about Energy Saving Trust, see: http://www.energysavingtrust.org.uk/About-us/About-us

2. Strategic Issues

Tidal Power

Alderney faces a unique predicament in terms of the production of clean, low cost, secure energy. Even if the precise timing is unsure, the long-term future is known - Alderney Renewable Energy is developing over 3 Gigawatts of tidal power that they are expecting to be on stream from around 2021, with pilot work before then. When fully developed, this represents enough energy to power around 1.8 million homes. Arrangements to supply Alderney are already being made – switchgear to handle supply from tidal power, even in the testing phase, has been installed in the island's power station. The dilemma is therefore in identifying and recommending an energy strategy that has this end point in mind, but that also offers a way out of steeply rising energy prices in the interim.

ARE and Transmission Investment LLP have established a joint venture company which is developing a connection between France, Alderney and Britain. This link, known as FAB Link, will allow energy to be traded between Britain and France and will enable tidal power generated in Alderney's territorial waters to be exported to European markets. Alderney will also be able to receive less expensive energy from Europe via the FAB Link. While the precise subsidy and support regime is not yet clear, a recent EU ruling permitting any member state to obtain renewable energy from outside the EU should qualify ARE for government support.

As the Long Finance website put it: "As for Alderney the strategic benefits are significant, bringing about independence and security of energy supply, capping escalating energy costs, producing a revenue stream for the States on exported electricity and encouraging economic development on the island".

Demographic / Housing issues

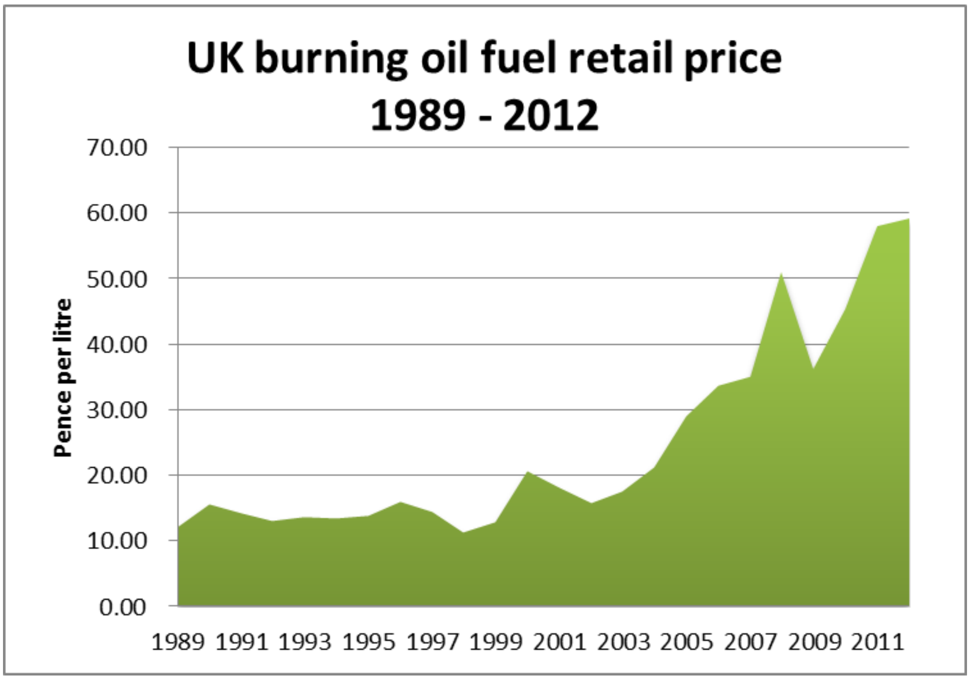
Alderney has an aging population with over 38% of islanders in retirement[2] and only 41% of the population in full-time work. Households without members in full time employment are more likely to have greater need for domestic energy as they spend a greater proportion of their time in the home. This can result in significantly higher fuel bills, and means these households are more sensitive to rises in fuel prices.

The majority of householders on the island are owner occupiers (77%) with 15% privately renting and only 5% renting from the state. Therefore improvements to the housing stock are reliant on encouraging home owners and landlords that it is in their interests to improve the energy performance of their own homes.

Over half (51%) of homes on Alderney were built after 1965, and are therefore likely to be eligible for easy to install, and inexpensive cavity wall insulation that could significantly reduce household energy bills.

[2] STATES OF ALDERNEY HOUSING NEEDS SURVEY; Tetlow King (2008) and Census 2013

Fuel Prices and Infrastructure Considerations



The chart above shows historic burning oil fuel retail prices - In addition to these price concerns, there are also additional infrastructure considerations. -

-AEL informed us that - costs could increase if sub-stations were upgraded to handle energy generated from renewables. The costs of upgrading infrastructure are borne by individual bill payers and bills are split between a standing charge and a unit price. There is scope for States to work with AEL to review the balance between the standing charge and the variable unit price of energy. With only 1,900 residents, the costs per resident of upgrades may be high. For this reason, our recommendations around renewable energy generation are based around upgrading one sub-station to accommodate renewable electricity and allowing the community to invest in the renewable power generation.

There are parallels with Alderney's water infrastructure, in which States have taken an investment for the benefit of the whole island community. Doing similar on energy would be costly, but would also allow pilot projects to proceed against an annually agreed work plan.

Due to high energy prices we encountered concern about fuel poverty on the island. The UK government has revised its definition of fuel poverty to include any household with an income 60% below the national median and required fuel bills above average. A formal definition of fuel poverty for Alderney may not be practicable to establish or necessary. However as fuel bills make up a significant proportion of all household's expenditure we would recommend that any policies that may affect fuel prices consider and try to ameliorate negative impacts on low income and vulnerable households as these can be most susceptible to the impacts of fuel poverty. Possible solutions to fuel poverty issues, may include providing social electricity tariffs to households meeting vulnerability criteria, or subsidized heating fuel allowances.

These issues are being tackled in social new build on Alderney, Alderney Housing Association's new build properties are being constructed to high thermal performance standards[3] – this presents the opportunity to use these properties as case studies and to write up some of the detail of construction materials and techniques and (with appropriate consent from residents) to monitor energy use on an ongoing basis to show what can be achieved.

While on the island, there was no suggestion that there was a lack of skills – either on the island, or accessible from Guernsey or farther afield. Indeed, while we making our visit, Insulate-It from Guernsey[4] had visited Alderney and instead of insulating their one expected property, wound up doing work on six. There are also existing solar hot water systems in a handful of properties on the island and Hamon architects advised that they had specified (but that was ultimately not installed) a PV system as part of a refurbishment job.

Other Island and Community energy related projects and reports

As noted during our visit, there are other similar projects that have been established and work delivered by the community energy sector on business models that may be of interest. The reports linked to below are thought to be particularly relevant and provide some useful examples of what can be achieved:

The NGO Forum for the Future produced a guide for local government and local communities to setting up and operating revolving loan funding schemes. This may be useful when thinking about both home insulation improvements and potential renewable energy installations - http://www.forumforthefuture.org/project/funding-revolution/overview

The island of Eigg has been at the forefront of parts of the community energy movement, aiming for renewable self-sufficiency in energy terms, with a small population base. Their site also hosts some discussion about other islands' efforts to go green - http://islandsgoinggreen.org/about/eigg-electric/

The Isle of Wight Eco Island scheme also sets out a community led vision of what a sustainable Isle of Wight looks like, with detailed annual objectives in support of an overall vision.

Other schemes have set up renewable energy generation technologies and then sought to sell shares to the local population to recoup the cost of installation. These include: Resilient energy - http://www.resilientenergy.co.uk/, Abundance Generation - https://www.abundancegeneration.com/, Low Carbon West Oxford - http://www.lowcarbonwestoxford.org.uk/images/documents/lcwo/lcwo-low-carbon-living-v1a.pdf, Bath and West Community Energy - http://www.bwce.coop/ and Brixton Energy - https://brixtonenergy.co.uk/.

It is worth noting that others have sought to ring fence a certain proportion of income from renewables to recycle this revenue into energy efficiency programmes, such as the South West Scotland energy agency - http://www.ashden.org/files/Energy%20Agency%20SW%20Scotland%20case%20study.pdf. OVESCO are also an interesting example of a community owned and operated energy service company, both providing renewable energy and seeking to help people make energy savings - http://www.ovesco.co.uk/

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[3] http://www.aha.org.gg/Newsletter%20Autumn%202011.pdf
[4] http://www.yourlocaltradesmen.co.uk/cavity-wall-insulation/vale/guernsey.html

EST has some experience in these areas, we administer a programme in Wales to provide community renewables - Y'nnir Fro - http://www.energysavingtrust.org.uk/wales/Communities/Finding-funding/Ynni-r-Fro-programme

It is worth noting that a number of the examples above have been in receipt of grant funding to establish themselves and the majority have also made use of feed in tariff and other support available in the UK for the generation of renewable energy. While this level of financial support may not be currently be available on Alderney, the approaches taken and business models may be of interest in the medium to long term. UK Government is consulting on a new community energy strategy and keeping a watching brief on developments emerging from that may also be worthwhile.

3. Energy Demand

Electricity Demand vs Heating Demand

High energy prices on Alderney are of concern to many of the stakeholders EST spoke to. Electricity prices in 2012 were 31.16p/kWh[5] more than double that of average UK mainland domestic customer. Heating oil, which constitutes the main space heating fuel for the island is 78.41 pence per litre roughly 18 to 20p per litre more expensive than UK mainland prices.

With - all of the island's electricity supply -coming from oil generators and given that oil prices have risen and are set to remain high for the foreseeable future, Alderney Electricity Ltd claim that a reduction in electricity demand is unlikely to result in a reduction in overall fuel bills for its customers. -AEL informed us, a high proportion of electricity supply costs are due to fixed costs and are not related to the price of oil. These include the cost of infrastructure and oil storage maintenance as well as staff and administrative costs. Furthermore given the relatively small number of households on Alderney AEL are not able to take advantage of economies of scale for fuel oil as it imports a relatively small amount each year. Furthermore, even with the introduction of renewable energy, Alderney's diesel generators must operate - which means the generators must always burn fuel.

AEL –informed us that a reduction in overall electricity demand on the island would lead to an increase in cost per unit of electricity supplied as the fixed costs would still need to be covered. The distributional and economic impact that a reduction in the islands electricity consumption could be examined further, however until the proposed FAB (France, Alderney, Britain) electricity link is built and tidal energy comes online there may be limited scope for near term reduction in electricity costs with the present infrastructure.

For the reasons illustrated above in the near term the most guaranteed means of reducing household's energy costs would be to focus on reducing heating fuel demand, ie oil.

Insulation and heating systems

Improving the thermal efficiency of homes has numerous benefits as well as directly reducing fuel costs for householders. Improving insulation and heating systems not only reduces demand for fuel, in particular oil, but improves the comfort of a home lowering the risk of health issues associated with cold homes, particularly amongst older and vulnerable households.

- ### Energy efficiency measures

Loft and roof insulation

Around 26% of heat lost in an uninsulated home is through the roof. As a result this is one of the first areas to focus on when improving a home with noticeable results to the household. Insulating lofts can be a relatively easy and inexpensive job to do which can even be carried out by households as a DIY task. Often the most complex task is clearing the loft space to be ready for insulating. It is recommended that homes with lofts should have around 250-300mm of loft insulation. Many homes may already have some level of loft insulation below this, or old insulation that has compressed over the years. These can

[5] http://www.alderney-elec.com/html/charges.php Accessed 10th July

easily be topped up with additional insulation to bring them to the recommended level. Homes with living space in the roof or parts of buildings with ‘flat roofs’ that do not have loft a loft space can also be insulated internally or externally. However this is more costly than loft insulation and requires professional installation.

Cavity Wall Insulation

Around 33% of heat is lost through walls in an uninsulated home. Generally homes built after the 1920s will have cavity walls and in general only newer homes will have insulated walls. Evidence of whether a home’s cavity has been insulated can be observed using a borescope or sometimes through access points to the cavity (ie around electricity meters or in lofts). The process of insulating cavity walls is relatively quick and inexpensive. Cavity wall insulation can significantly reduce fuel bills (see below), however it may not always be suitable in walls exposed to driving rain such as exposed coastal areas as it can form a bridge for penetrating damp to enter the internal wall. In which case solid wall insulation may be a more suitable alternative.

Solid Wall Insulation

Solid walls, and hard to treat cavity walls can be insulated either internally or externally. The process is more costly and labour intensive than cavity wall insulation but can significantly reduce energy demand and reduce heating costs. Provided appropriate ventilation is considered when insulating solid walls, insulation can reduce problems associated with damp.

Condensing Oil Boilers with improved heating controls

Homes with older oil boilers can make significant savings by switching to modern condensing boilers with heating controls such as a timer, room thermostat and thermostatic radiator valves (TRVs). It is recommended that insulation improvements are made before installing a new boiler as a better insulated home will not require as big a boiler, which can cut down the cost of installation and reduce overall fuel usage. Heating controls mean households can more easily manage when and which areas of the home are heated. This reduces wasted by not constantly less frequently used areas of the home and maintains the home at a stable comfortable temperature. Good guidance on how to use heating controls is essential to ensure that households are able to use their systems efficiently.

Floor Insulation

Around 8% of heat is lost through the floor in an uninsulated home. Some older homes with suspended timber ground floors can be insulated relatively cheaply if there is access to the ground floors from a cellar. If not floor boards will need to be removed in order to be insulated. Solid floor insulation, can be more expensive and labour intensive, but is worth considering when ground floor rooms are being renovated.

Draught Proofing

Draught proofing reduces uncontrolled ventilation in the home and can be relatively inexpensive to undertake. As much as 12% of heat in an uninsulated home is lost as a result of draughts. Draught proofing can substantially improve the thermal comfort of a home. It can be undertaken by professionals, but can also, good with guidance, be carried out as a DIY activity. Draught proofing should focus on gaps around windows, doors, between floorboards, walls and ceilings.

Solar water heating

Unlike solar photovoltaic (PV) panels, solar thermal panels contribute directly to the reduction of water heating demand. Solar water heating is less expensive than solar PV, and can provide up to a 3rd of a households annual hot water demand. Solar water heating is best suited to larger households with higher demand for hot water.

- ## Assessing the potential

For a comprehensive understanding of the potential for energy efficiency measures across the residential and hospitality sector of Alderney the forthcoming housing stock survey should take into account questions around properties insulation levels and heating systems. It is recommended that the surveyors have some training in how to assess the thermal properties of a building so that they are able to recognise the potential for improved measures.

For individual households, online tools such as the Energy Saving Trust's Home Energy Check[6] could be developed to provide an Alderney specific action plan to improve thermal performance. The energy check can provide guidance on what measures are suitable for each home, how much the measures are likely to save and how much they are likely cost. In addition this can give additional information and guidance about physically installing measures.

- ## Packages of measures

To illustrate the potential costs and savings to households in Alderney in the annex are some costed thermal efficiency improvement examples that could be made to typical Alderney properties with their included savings and payback times. The top three house types in Alderney are Detached (31%), Bungalows (24%) and terraces (18%), for each of these house types we have modelled three potential packages of cost effective energy efficiency measures. The costs of these measures are representative of GB mainland prices thus only indicative of what might be possible for Alderney.

These packages included in the annex demonstrate indicative fuel bill savings for households between £300 to £1,500 per year with payback periods for installing the measures ranging from 2.5 to 12 years.

- ## Non-domestic building thermal performance

Although where energy use is apportioned may differ in non-domestic buildings the majority of measures outlined above would be suitable for these properties. For hospitality businesses In particular heating and hot-water costs can form a significant part of an organisation's expenses. For smaller businesses reducing heating costs is a risk free and easy way to improve profit margins without a great deal of capital expenditure. And given that for many of these businesses have longer heating periods, the payback period for these measures is likely to be much shorter. Furthermore being able to promote a business's "green" credentials can be a great attraction for new customers.

- ## Reducing electricity demand

As highlighted previously an overall island wide reduction in electricity demand, with current electricity supply infrastructure, may lead only to a limited reduction in electricity fuel bills in the medium term.

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6 http://hec.est.org.uk/

However reducing electricity usage can help to reduce peak demand, potentially cutting the number of generators in use at these times. It could also benefit more vulnerable households who may pay proportionally more of their income on electricity.

Electrical Appliances

Fig 2. shows the average split of annual electricity usage across households involved in the Defra / EST 2012 household electricity study. Reducing electricity consumption from appliances can be tackled in two ways: Firstly by using appliances that are most efficient, and secondly by encouraging efficient behaviour.

Fig 2. Split of annual electricity usage in non-electrically heated homes. Household Electricity Study 2012[7]

Cold appliances	16%
Cooking	14%
Lighting	15%
Audio visual	14%
ICT	6%
Laundry	14%
Water heating	7%
Other	4%
Unknown	10%

Cold appliances

Cold appliances tend to use the largest amount of electricity in the home. This is because they are one of the few electrical appliances that are intentionally left on all day. Encouraging households to replace any old inefficient cold appliances with smaller and more efficient appliances will help them to reduce energy costs and also reduce the island's base load electricity demand. Replacing a C rated 250 litre fridge-freezer with an A+++ rated appliance would save 379 kWh of electricity a year, which based on Alderney's 2012 tariff would save just under £120 a year.

Laundry appliances

Whilst laundry appliances form a significant proportion of an average household's electricity, overall consumption varies considerably according to use of these appliances. Households that own and regularly use tumble dryers are likely to have higher energy consumption than those that don't. Whilst

[7] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17359

marginal savings can be made by replacing older appliances with more efficient appliances households can more easily reduce electricity from these appliances by behavioural measures (ie washing at lower temperatures, drying clothes outside).

Low energy lighting

Lighting accounts for around 18% of a typical household's electricity consumption. With the improvement of low energy lighting, nearly all old fashioned incandescent and halogen bulbs can be replaced by efficient alternatives. Compact Fluorescent Lighting (CFL) is generally the least expensive form of low energy lighting. Newer LED bulbs are more expensive; however with recent improvements in technology to the quality of light they produce, these can significantly reduce power consumption and are a good alternative to halogen spotlights. With high electricity costs in Alderney, payback periods for low energy lighting would be very short.

• Raising awareness and behavioural change

Alongside reducing energy consumption by improving the thermal efficiency of homes and installing more efficient appliances, encouraging energy saving behaviour can help to significantly reduce energy demand. Encouraging effective behaviour change requires advice that is: 1. Trust worthy; 2. Relevant and or personalised; 3. Demonstrates tangible benefits to the audience.

Our recommendations for behavioural advice should centre around:

1. Understanding how to use heating system controls;
2. Efficient hot water usage;
3. Avoiding standby;
4. Efficient use of wet appliances.

Real time displays

Real time energy monitors feed-back to households instanteously the amount of electricity that the household is using at any one time. These are relatively cheap (from £30 - £100) and can help to educate households about the relative consumption of various appliances. They can also help householders to identify "phantom" electricity usage from appliances they didn't realise were on (eg electric immersion heaters left on all the while).

Supporting households and business make energy efficient choices

Few households or business are likely to be aware of the extent to which energy efficiency measures can benefit them, Furthermore, few will know what measures might be suitable for their circumstances or where to go to and how to go about getting these improvements installed.

An advice service for Alderney about energy efficiency could help residents to become more aware of the benefits of energy efficiency and encourage the uptake of measures. The states of Jersey run a scheme for its residents offering tailored advice, a grant scheme for energy efficiency measures as well as guidance on where to go to install energy efficiency measures[8], Contact with the service could help

[8] http://www.gov.je/Environment/GenerateEnergy/Energyefficiency/Pages/AboutEnergyService.aspx

Alderney in developing a similar scheme by understanding the challenges faced and the benefits acquired from the scheme.

4. Energy Supply

- **Current Energy supply on Alderney – Key Challenges**
- **Electricity**

Demand

Current electricity demand on Alderney generally varies between 1.1MW and 0.4MW. There are higher peaks of 1.3MW during the summer as tourism increases the load on the network. Total annual electricity demand was - 7300 MWh in 2010 and 7000MWh in 2011. The weekly average electricity consumption is around 135MWh with a peak weekly demand of 150 MWh. The majority of electricity demand is from residential properties and small businesses and services such as the hospital and the power plant itself. There are no major industrial loads at present.

Current power generation

Alderney currently sources all of its electricity from a series of oil-fired generators. These generators are sometimes the smaller generators-run in parallel to match electricity demand and there is currently no energy storage within the system. The newest generators were bought when electricity demand was rising (around 1.650 MW) so the system is over-sized for current demand. There are three newer 2MW generators and four older generators (2 x 750kW and 2 x 450kW). -

The current generators -require an overhaul every 9000 hours of operation at cost of £50,000-£60,000 per generator, this work is already done in-house, avoiding the cost of bringing in external contractors and building the skills base within AEL but major overhauls carried out every 27,000 hours are carried out by MAN Diesel & Turbo in the UK. These overhauls will cost approximately £120,000 each.

There are 13 oil tanks at the site which provide a 3 week reserve of oil on top of predicted demand for the period upto the next delivery. These tanks are refurbished on a 7 year cycle with 2 tanks per year being refurbished. The cost of this refurbishment is £25,000 per tank.

Electricity Cost

Current electricity costs are around 31p/kWh from the existing oil-fired generation plant. This cost is separated into a standing charge and a lower per unit fuel cost. AEL is not a profit-making enterprise so this price reflects the running costs of the current generators, infrastructure and AEL itself and replacement capex.

- **Heating**

Oil is the most common heating fuel on Alderney with an annual consumption of 2.7 million litres in 2010 and 2.2 million litres in 2011. Bottled LPG gas and electricity are also used. There are a few domestic solar hot water systems installed on households on the island. There is currently no district heating on Alderney. Oil is delivered to Alderney six times per year and heating oil is sold by AEL currently at 78.41p/litre.

- ## Addressing the energy infrastructure challenge

Infrastructure issues

–Parts of the existing -network infrastructure is up to 70yrs old. It currently cannot support electricity being fed back into the grid from microgeneration in certain circumstances. There are 21 substations -on the network, 4 of these have recently been upgraded, the –remaining substations --require upgrading in the future. AEL inform us the cost of upgrading network assets -to accept electricity from microgeneration systems –could be substantial and -depending on where microgeneration is introduced and the size of microgeneration, distribution cables may also need to be renewed to maintain power quality. AEL estimate that to update the electricity distribution network across the Island to allow for distributed generation would require additional capital, above their present 10yr programme of £200,000 capital expenditure per year. -

Power generation and infrastructure review.

As noted elsewhere, in order to achieve Alderney's goals of more affordable, secure and sustainable energy supply there is a need to review current power generation to address the issue of unit price increasing if the number of units sold decreases. -

AEL are currently investigating several aspects before introducing any size of DG (distributed generation) onto the network.

The DG assessment plan includes:

Documentation of all AEL assets - AEL are in the process of documenting all network assets. Determining their condition and appropriateness for DG integration is essential for future planning of the network.

Cost benefit analysis – An analysis will be carried out to calculate the cost benefit of DG. The WADE model calculates the costs and benefits of meeting the needs for additional electricity generating capacity over the coming years using distributed instead of centralised generation.

Optimization - To accommodate increasing levels of DG, the development of the distribution network will require investment to transform it from a passive network to an active network, planning and design will prevent sterilization of the network.

Impact study of DG upon the Island - Assessing the impact of various quantities of domestic micro-generation on the low-voltage distribution network, requires detailed simulation of the existing networks and time-varying power demands. DIgSILENT software will construct a model of our actual distribution network, and simulate minute-by-minute demands, determining where micro-generation could be deployed. The resulting model will provide a platform to assess the implications of highly distributed power systems and look at the network response to demand side management.

Active Network Design - The present passive network doesn't allow any operational management. An Active network allows automated operation and management. Alderney will require a specific design based on software models to create a safe and secure network suitable to accommodate DG.

Planning process and application procedure for connection - AEL and The States of Alderney. All prospective users of DG will be required to discuss their plans before starting work with both AEL and the States of Alderney. A Planning process will be drawn up to ensure all requirements both technical and environmental are addressed.

Determine connection charges for DG - The principles of charges for connection onto AEL's network should facilitate non discriminatory access, equal treatment of all participants and pricing of the system to reflect costs imposed by users.
Certified Installer Registration - There will be a requirement for Installers of SSEG to belong to a recognised Certification Scheme such as MCS to ensure that appropriate Standards are met and maintained.
Determine Feed in Tariff - There are many types of feed in tariff. An investigation into the support level and purchase obligation will be carried out to ensure a transparent and fair system for all our customers.

Community microgeneration priority area

One option to enable earlier adoption of distributed renewable energy generation would be to run a phased programme of upgrades to the distribution network, prioritised according to potential for microgeneration. This could enable a more affordable limited upgrade in one area of the island to happen.

This area could then be the focus for community renewable energy projects. A simple example of this might be installation of larger scale PV systems on commercial roofs. Economies of scale could be realised and the delivery model could allow local residents and businesses to buy into the system, owning part of (or shares in) a community system rather than a system on their own roof. Installation of battery storage would be needed to make this model viable as solar energy generated during the day could be stored for use in evening and morning peaks so its intermittency would not need to cause additional problems for AEL in managing supply and demand. The same model could be applied to other renewable energy technologies in particular wind energy.

The location of the community microgen priority area should be chosen on the basis of:

- having good potential for installation of PV on un-shaded south-facing roofs, or as ground-mounted arrays
- having a substation that could be upgraded to accept feed-in from microgen
- having the opportunity to cost effectively upgrade the network between the priority area and the energy storage facility
- ideally the area should also encompass potential wind energy sites for possible future development

Future options for energy supply on Alderney

At present the key constraint to deployment of electricity generating microgeneration systems is the inability of the electricity infrastructure to support electricity being fed back into the grid. There are 3 potential solutions to this situation:

1. Use batteries to store generated electricity. The PV or wind energy system is not connected to the grid but powers the end user directly, storing excess power in batteries for use when generation is low or zero.

2. “Dump” excess heat electricity into a heat store via a heating element and use it for water heating. A larger capacity, well insulated hot water tank can be installed with an electric heating element connected to the wind or PV system. When generated energy exceeds demand the excess electricity can power the element, providing water heating.

3. Upgrade the network to allow power to be fed into the electricity network. This process could be phased with an early upgrade in an area suitable for installation of community scale renewables

Solar Photovoltaics (PV)

The “Study to convert the island of Alderney into a Green Island”[9] outlines the potential for PV on Alderney under a number of different scenarios. It looks at different levels of deployment on households and businesses across the island and gives a useful idea of the potential impact of PV. -

In the interim households could utilise PV systems that are not grid connected but use battery storage, these systems are becoming more affordable as battery back-up for PV becomes more commonplace.

It is also possible to buy PV systems that “dump” excess power into a heat store for water heating via an immersion heater. The heat store should be well insulated, enabling it to retain its temperature until hot water is needed. Given Alderney’s high fuel cost this could be a viable option for households wanting to invest in PV before a grid connection is possible.

Both the above options would enable domestic use of PV without a connection back into the grid (and the ability to feed power back into the network). However if either of these options were taken forward at any scale then AEL feel that this would necessitate an increase in the unit price for electricity to compensate and enable generation costs to be covered.

Community PV

-Another potential solution - would be to upgrade one area of the electricity generation network - and focus deployment of PV in that area. Larger arrays could be installed as a community project with residents and/or local businesses having the opportunity to buy in through share ownership in a larger project or through direct ownership. This could enable investment in PV from individuals and organisations unable to install PV on their own buildings. -

Installing PV at community scale can lead to some economies of scale. For example a 100KW system might cost around £115,000 (at £1100-£1200 per kW for systems in the 100kW-300kW range compared to around £1250-£2000 for a domestic system) plus possible infrastructure costs. One important point to note is that, in the short term, PV prices are likely to rise due to an increase in the cost of imported Chinese panels. However there has been a very clear downward trend in the cost of PV systems over the last decade or more with prices for PV having halved within the last year to 18 months. The overall trend is likely to be a continued reduction in price, with occasional increases as demand outstrips capacity.

Using a 953kWH per installed KW as an estimate of output (NREL PV Watts tool[10]), approximately 745 kW of PV would provide around 10% of the island’s current annual electricity demand over the course of

[9] Jaguaribe “Study to convert the island of Alderney into a Green Island”, Cranfield University 2012

a year. The capital cost of a series of 100-300kW arrays adding up to 745 kW might be between £820,000 and £900,000 at current prices, but the cost could be spread by building capacity steadily with a number of smaller installations and allow investment from local residents and businesses. The avoided electricity cost (at 31p/kWh) would be over £220,000 per year.

Roof space for solar PV projects is frequently rented from the building owner. If this model were taken forward it would be important to address rental agreements at an early stage to avoid any issues with roof rental rates suddenly rising as the grid is upgraded and PV projects become possible. An alternative solution would be to establish ground-mounted PV arrays.

Heat pumps

In the short term widespread use of heat pumps on Alderney is unlikely due to the price of electricity. -

However when the tidal energy scheme and the interconnector link are installed the viability of heat pumps could be transformed as electricity prices drop. In addition to the basic cost per unit advantage that is likely to arise at that point, heat pumps would have the advantage of using a native renewable energy source, so not requiring the shipment of fuel to the island (incurring additional costs and risk of leaks or spillage) and providing a near zero-carbon heat source.

It is recommended that a watching brief be kept on heat pump technology for the time being with a view to developing a deployment strategy ahead of projected drops in electricity prices in response to implementation of industrial scale renewables and/or the interconnector project .

Solar hot water

The deployment of solar water heating is not constrained by the current energy infrastructure as it only provides on-site energy to reduce water heating costs (energy yield generally assumed to be 50-60% of annual water heating demand).

Solar water heating could be included in the mix of energy efficiency measures to be promoted as part of the island-wide retro-fit programme suggested in the section on energy efficiency. Due to its relatively long payback period solar water heating should be promoted as an advanced measures for properties that have already undergone fabric insulation and basic heating system upgrades, except in applications with very high hot water demand.

Micro wind

Small scale wind power (below 50kW) could be utilised on Alderney. In the short term the technology will be constrained by where it is possible to connect to the electricity network and planning constraints. In general this is likely to mean that wind turbines will need to be of a scale whereby the energy yield is sufficient to justify the investment in infrastructure required to connect the system to the network.

In the medium term (3-5 years) it may be possible to install micro-wind turbines in the area around the first phase of the network renewal alongside community PV.

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[10] http://photovoltaic-software.com/pvwatts.php

Biomass heating

Wood-fuelled boilers and stoves could provide heating in some limited applications. A small amount of wood chip fuel could be sourced from management of woodland on the island, this might be best used for heating a community building or business with a steady heat demand (such as a school with facilities used by the community in the evenings). Wood pellet heating systems can be very suitable for domestic properties as well as community and commercial buildings. However this would rely on being able to source a supply of pellets at a reasonable cost which is likely to be difficult in the short term given the cost of transporting small shipments to the island.

- ## Medium to large scale renewable energy

Wind Energy

As noted in the "Study to convert the island of Alderney into a Green Island"[11] a single or small cluster of commercial scale wind turbines could make a substantial contribution to or even meet all of the island's energy demands (including heat as well as electricity). The scenarios in the study focus on delivering the whole of the island's energy demand (including heat as well as electricity) from wind energy, with a contribution from solar PV.

The key constraints for development of such a project would be:

- Nature conservation; in particular avoiding bird strikes from the native seabird population
- Public perception; opposition to wind power, chiefly but not exclusively on aesthetic grounds has had a high profile recently
- Identifying a viable site with appropriate spacing from dwellings
- Ensuring no negative impact on the airport (such as radar signals)
- Ensuring adequate energy storage capacity is in place and upgrading the electricity network to connect the wind energy system

Alderney Commission for Renewable Energy are currently carrying out a "Regional Environmental Assessment of Renewable Energy", this will include reviewing the potential impact of wind energy on the native bird population (including the Ramsar site). The results of this study should inform any further work on wind energy. Depending on those results a range of options for using the island's wind energy resource could be developed (with options for different scales and numbers of wind turbines). This could then inform coverage of wind energy in any future public consultation around energy. An initial scoping report document on this project can be found on ACRE's website library[12].

Commercial scale wind turbines are by far the most economic option with potential to have the largest impact on energy use on the island. As noted by Jaguaribe[13] a cluster of 2-3 large (hub height of 100-140 metres) commercial wind turbines could meet the entire annual energy (including heat and

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[11] Jaguaribe "Study to convert the island of Alderney into a Green Island", Cranfield University 2012
[12] http://www.acre.gov.gg/library.php
[13] Jaguaribe "Study to convert the island of Alderney into a Green Island", Cranfield University 2012

electricity) demand of the island. A single commercial scale turbine could provide more than enough electricity to match the island's electricity demand only. In both cases this assumes that sufficient energy storage capacity and/or backup generation is in place to deal with the intermittent supply from the turbine. A commercial scheme such as this could potentially be financed entirely by the private sector or delivered as partnership between AEL and a wind energy developer. If a viable scheme could be identified that would meet planning and environmental requirements then substantial private sector investment is likely to be available. A local share offer could also be run to give residents the opportunity to invest in the scheme. There are number of specialist organisations which could help to manage delivery of a local share issue.

If larger scale wind turbines are not possible due to the constraints outlined above there may be opportunities to deploy smaller wind turbines alongside community PV. Medium-scale turbines are available with ratings in the 100s of kW, these have a similar appearance to commercial scale wind turbines but are shorter with a hub heights generally being in the range of 35-80 metres and blade length also being much shorter than larger turbines. Micro-scale turbines are also available with ratings in 10s of kW down to a few kW. The hub height of these turbines tends to be around 10 metres on average.

Anaerobic digestion of organic waste (AD)

Organic waste can be digested to produce methane which can be burned for electricity or heat generation or compressed and used as a vehicle fuel. Alderney has a number of sources of organic waste that could be used as feedstock including:

- Animal and process waste from a dairy farm
- Animal waste from pig farms (with a total of around 250 animals)
- Green and kitchen waste from the island's residents (green waste is currently estimated at 250 tonnes/yr but the some of this will be woody material unsuitable as a feedstock)
- Human waste from the 1900 residents (part of which is currently treated and part is dumped raw)

A more detailed review of the quantity of waste from each of these sources is needed to determine the appropriate scale of digestion for Alderney, but the process can be conducted at a wide range of different scales from small on-farm units to municipal scale. A study of available feedstocks should also consider health implications of mixing feedstocks and, where viable, consider location of the digester and transport of waste.

Based on the indicative numbers provided above, it is likely that only a small "farm-scale" biodigester would be possible on the island. Such a system could still make a meaningful contribution to electricity and heat generation on the island as well as management of organic waste.

Most commercially available systems in the UK tend to be combined heat and power systems generating both electricity and heat. AD systems also produce both solid and liquid residue which can be used as a fertiliser or soil conditioner.

The following information from case studies gives some indication of the scale of generation that may be possible from Anaerobic Digestion.

The South Shropshire Biodigester developed by Biocycle South Shropshire and Biogen Greenfinch Ltd was designed to process 5,000 tonnes of household kitchen waste (later changed to sorted kitchen waste to improve consistency of feedstock) per year. The system runs a combined heat and power plant which produces 2600 MWh/yr of heat and 1500 MWh/yr of electricity (rated at 190kW e and 315kWth)[14].

An example of a micro-scale Anaerobic Digestion plant might be a 15kW system costing around £150,000, fed by waste from around 150 cows (source www.farmingfutures.org.uk).

Wood heating

As noted earlier, the wood fuel resource on Alderney is fairly modest so may be best used in woodchip heating for community buildings or businesses on the island.

Tidal

Alderney Renewable Energy are currently developing a major Tidal Energy scheme. When completed this will be a groundbreaking, strategically important renewable scheme providing substantial amounts of electricity to France and England as well as providing the island's electricity supply. The interconnector for the scheme will also open up opportunities to buy electricity from France or England. The target date for the beginning of the scheme is currently 2020. A 300MW installation is planned, with the capacity to increase this substantially (the interconnector capacity will be 1.4GW).

Although this scheme will immediately solve electricity supply problems on the island it would be prudent, for energy planning purposes, to allow for further delay to the tidal array given the scale of the scheme and the innovation involved.

In planning interim measures (such as network upgrades, installing energy storage and community renewables) we would recommend liaising with Alderney Renewable Energy to check for any opportunities to share resources.

[14] www.greenfinch.co.uk

5. Recommendations

Short-term (0- 5 years)

Heating demand reduction programme

Develop and implement a programme of work focused on reduction of demand for heating, through insulation, solar hot water installations and other measures. From our initial visit, this would seem to present fewer short-term issues than a focus on electricity supply and demand. This recommendation is then supported by three specific actions

a) Use the forthcoming house condition survey to add some questions about home insulation and heating systems, with States of Alderney to put EST in contact with the team devising the survey. Use the results of the survey when they are available to prepare and run an insulation/heating programme making the most of economies of scale (work management and bulk buy discounts). Where possible, this should then lead to a quantification of carbon and fuel bill savings and some public reporting.

b) Offer support and advice on the optimal use and programming of existing systems – for those homes where the installation of new equipment may be cost prohibitive or technically challenging, offer a programme of tailored advice through appropriate channels. This should also explore links to other Channel Islands energy efficiency schemes and services.

c) Prepare a small number of in-depth quantified case studies to show the scale of the energy bill savings that can be achieved. Use the AHA new build to high efficiency standards (and the Governor's house refurbishment) to detail costs of installation of insulation measures and consequent expected reductions in energy bills

Review of current electricity supply

The aim of this project would be to determine costs of the current system and to review options for reducing the cost and environmental impact of electricity generation on the island. The review should include a cost benefit analysis and consideration of life-cycle costs including maintenance, fuel, operating costs and risks. It should seek to develop a range of options with packages of measures that might include:

- Battery (or other technology) storage of electricity to improve demand/supply management
- Options for operational regimes with the existing plant
- New electricity generation plant including integration of community-scale renewables
- Network management technology (to monitor demand and match supply

The study should seek to develop a robust business case for any capital investment required to inform decision-making.

It should also consider whether savings from any reductions in operation and maintenance of the existing systems could be re-invested microgeneration or other capital projects to further reduce generation costs. Municipal borrowing to invest in electricity grid reinforcement/improvement and a States-owned community energy generation scheme could also be explored.

Consult on options for future energy generation on Alderney

A public consultation could be carried out based on the findings of the various studies carried out to date (including the study of current supply outlined above)

(1-3 year time horizon)

Energy Storage

If the review of energy supply options identifies a strong case for investment in energy storage and capital could be made available then a system could potentially be deployed well within a 2 year timeframe. Throughout this process we would recommend liaising with ARE who also require some battery storage for their tidal project. There may be opportunities to share resources to bring down the cost of a storage system and avoid duplication.

Phased grid upgrades

Until the network is upgraded, microgeneration installations will not be able to feed power back into the electricity network, they will- be limited to providing on-site power direct into the homes or organisations they serve or into battery storage.

There are long-term plans to upgrade the electricity infrastructure. Although the additional cost to facilitate the use of microgeneration is significant, it will be most economic to carry out the work while the network is being upgraded- if possible.

One solution to enable earlier deployment of microgeneration systems could be to plan a phased upgrade to the electricity network, targeting areas suitable for the deployment of microgeneration in the early phases of the upgrade work. This could create microgeneration development zones allowing a “community-based” approach to microgeneration in the upgraded areas, with larger communal systems being installed rather than individual household systems.

- ## Medium-term (5-10 years)

Community microgeneration

As outlined in the section on PV a community PV system could be established enabling residents to invest in a communal system that is connected to an upgraded section of the electricity network. This would be most effective if electricity storage was installed first to reduce the impact of intermittent supply from the PV.

The same approach could be taken with wind energy if turbines could be connected to parts of the grid that have been appropriately upgraded.

Alderney Electricity Limited

As noted elsewhere, implementation of any substantial energy saving or microgeneration measures on Alderney would directly impact the viability of the AEL. This impact could be managed by developing the organisation's business model so that it is able to benefit economically from uptake of energy efficiency, microgeneration and renewable energy measures. AEL could become an "Energy Service Company" selling energy efficiency measures, microgeneration systems and renewable energy hardware to help manage and meet the island's energy demand rather than simply selling fuel and electricity.

Plans are already in place to develop the organisation into an energy billing/supply company once grid and tidal electricity is available through the France – Alderney – Britain link and there is no longer a need to run the oil generators.

Phased mothballing/decommissioning of existing oil generators

The review of costs and operation of the current electricity generation system alongside options for energy storage may identify opportunities to decommission or mothball part of the current generation capacity to reduce fuel and maintenance costs.

- ## Long-term (10-20 years)

UK Government Electricity Market Reform

Lobby UK Government around their "Call for Evidence on Renewable Energy Trading", a part of the UK Government's Electricity Market Reform proposals. ACRE have already responded. If successful, this would open up the possibility of income streams from renewable power generation subsidies (currently ROCs, but changing to Contracts For Difference and electricity strike prices in the longer term under EMR proposals) for any renewable energy generated by Alderney (on or off shore). This opens up a wealth of new possibilities and a long-term income stream that could be capitalised to provide a much needed source of income to support the island's energy infrastructure and generation capacity.

Roll out wider upgrades to electricity supply network

The phased upgrade to the electricity supply network could be continued, improving security of supply for a larger proportion of the population and enabling wider deployment of microgeneration and community renewables technology.

Additional community renewables capacity

Drawing on the findings of previous studies and the public consultation the amount of renewables capacity on the island could be increased through installing any of the following:

- Additional PV capacity on commercial roofs or as a standalone PV farm
- One or more wind turbines at a scale deemed appropriate following environmental impact studies and the public consultation
- A possible mini heating or combined heat and power system using Methane from Anaerobic digestion. Review options for incorporating this into a heat network with potential for integrating other heat sources such as wood fuel from management of woodland on the island or coppicing or waste heat from fossil fuel generating plant (as pre-heat due to its low temperature).

Integration with large-scale renewables and links to France and England

The current projected date for commencement of the tidal project is 2020 with the electricity network connections to France and England happening over a similar timescale. The planned tidal power system would make Alderney a strategically important exporter of renewable energy as well as offering grid electricity from France and England. On-island renewable energy systems installed under the previous stages of the strategy would continue to provide increasingly affordable energy (as the capital costs are paid off) on the island as well as recycling wealth within the local economy and providing resilience in the event of any delays to implementation of the interconnector and tidal array or issues with those systems in future.

Annex: Modelled energy savings for 3 archetype Alderney

Property type	**Pre 1900 3 Bedroom Detached**
Floor Area	95 sqm
Floor Type	Suspended timber
Wall	Granite Solid Walls
Roof	Pitched, loft conversion no insulation
Heating System	D-rated Oil fired Central Heating
Windows	Double Glazed Wooden pre 2002
SAP rating	G
Space heating	33,686 kWh
Secondary heating	2,470 kWh
Water heating	4,387 kWh
Pumps and fans	230 kWh
Lighting	586 kWh
Annual oil costs	£2,896
Annual electricity costs	£1,024
Total annual heating and lighting costs	£3,920

Package 1:	
Measure	Install cost
Solid wall insulation	£9,599
Oil condensing boiler	£2,602
Suspended wooden floor insulation	£742
Thermostatic radiator valves or additional thermostatic controls	£300
Install remaining low energy lighting	£28
Total installation costs:	£13,270
Annual fuel bill saving:	£1,340
New SAP rating	D
Payback time	9.9 years

Package 2:	
Measure	Install cost
Oil condensing boiler	£2,602
Suspended wooden floor insulation	£742
Thermostatic radiator valves or additional thermostatic controls	£300
Install remaining low energy lighting	£28
Total installation costs:	£3,672
Fuel bill saving:	£800
New SAP rating	F
Payback time	4.6 years

Package 3:	
Measure	Install cost
Oil condensing boiler	£2,602
Install remaining low energy lighting	£28
Total installation costs:	£2,630
Fuel bill saving:	£623
New SAP rating	F
Payback time	4.2 years

Property type	**1980s 3 Bedroom Bungalow Detached**
Floor Area	50 Sqm
Floor Type	Uninsulated concrete
Wall	Uninsulated cavity walls
Roof	Pitched roof 25mm loft insulation
Heating System	Oil fired Central Heating
Windows	Double Glazed Wooden pre 2002
SAP rating	E
Space heating	11,578 kWh
Secondary heating	849 kWh
Water heating	5,661 kWh
Pumps and fans	230 kWh
Lighting	348 kWh
Annual oil costs	£1,311
Annual electricity costs	£445
Total annual heating and lighting costs	£1,756

Package 1:	
Measure	Install cost
Loft insulation top-up	£300
Cavity wall insulation	£332
Thermostatic radiator valves or additional thermostatic controls	£300
Install remaining low energy lighting	£25
Total installation costs:	£957
Fuel bill saving:	£392
New SAP rating	D
Payback time	2.4 years

Package 2:	
Measure	Install cost
Loft insulation top-up	£300
Cavity wall insulation	£332
Install remaining low energy lighting	£25
Oil combi-condensing boiler	£2,825
Total installation costs:	£3,482
Fuel bill saving:	£539
New SAP rating	D
Payback time	6.5 years

Package 3:	
Measure	Install cost
Cavity wall insulation	£332
Install remaining low energy lighting	£25
Solid floor insulation	£742
Loft insulation top-up	£300
Total installation costs:	£1,399
Fuel bill saving:	£406
New SAP rating	D
Payback time	3.4 years

Property type	**Early 1900s 3 bed end terrace**
Floor Area	86 Sqm
Floor Type	Suspended timber
Wall	Granite Solid Walls
Roof	Pitched roof 25mm loft insulation
Heating System	Oil fired Central Heating
Windows	Single glazed wooden windows
SAP rating	E
Space heating	21,671.00 kWh
Secondary heating	1,926 kWh
Water heating	3,510 kWh
Pumps and fans	230.00 kWh
Lighting	546.78 kWh
Annual oil costs	£1,915
Annual electricity costs	£600
Total annual heating and lighting costs	£2,516

Package 1:	
Measure	Install cost
Loft insulation	£319
Suspended wooden floor insulation	£742
A-rated glazing	£2,202
New insulated external doors	£947
Thermostatic radiator valves or additional thermostatic controls	£300
Low energy lighting	£23
Total installation costs:	£3,263
Fuel bill saving:	£557
New SAP rating	E
Payback time	5.9 years

Package 2:	
Measure	Install cost
Loft insulation	£319
Suspended wooden floor insulation	£742
Thermostatic radiator valves or additional thermostatic controls	£300
Solar hot water system	£4,800
Install remaining low energy lighting	£23
Total installation costs:	£6,161
Fuel bill saving:	£515
New SAP rating	E
Payback time	12 years

Package 3:	
Measure	Install cost
Loft insulation	£319
Solid wall insulation	£7,202
Suspended wooden floor insulation	£742
A-rated glazing	£2,202
New insulated external doors	£947
Thermostatic radiator valves or additional thermostatic controls	£300
Solar hot water system	£4,800
Install remaining low energy lighting	£23
Oil combi-condensing boiler	£2,825
Total installation costs:	£16,535
Fuel bill saving:	£1,456
New SAP rating	C
Payback time	11.4 years