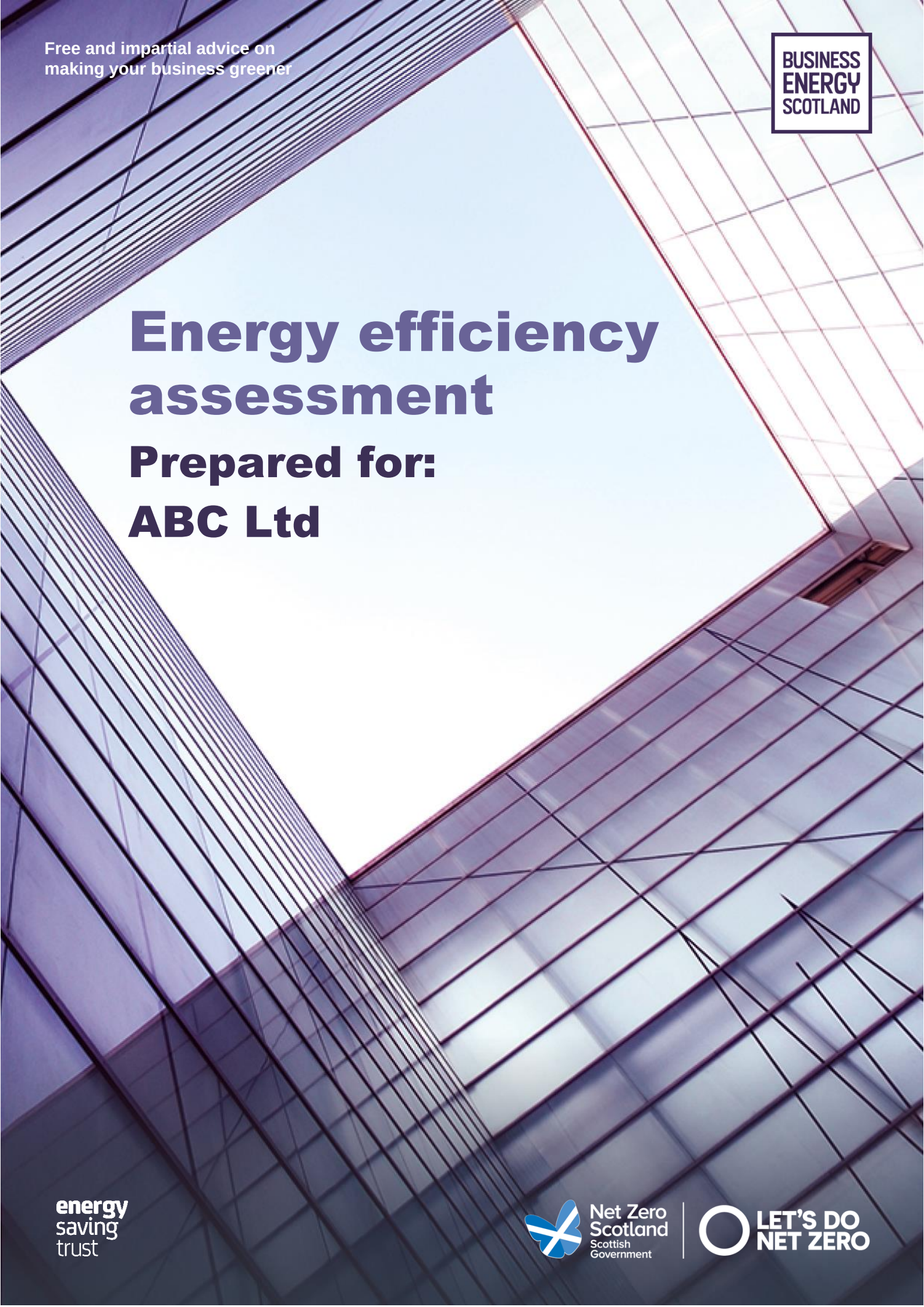
Free and impartial advice on making your business greener

BUSINESS ENERGY SCOTLAND

Energy efficiency assessment

Prepared for:

ABC Ltd



energy saving trust

Net Zero Scotland Scottish Government

LET'S DO NET ZERO

Contents

1 Customer and advisor details

Customer details	
Contact name	Jane Bloggs
Contact job title	Managing Director
Telephone/mobile	1234556789
Email	
Consultant details	
Consultant name	Name Name
Company	Name Name Consultancy Services Ltd
Advisor details	
Advisor name	Name name
Telephone/mobile	111222444
Email	
Service	Business Energy Scotland
Assessment details	
Assessment date	25th May 2022
Report approved by	Douglas Harding
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Business Energy Scotland provides free support to help Scottish small and medium sized-enterprises (SMEs) save energy and reduce their carbon emissions. We identify savings opportunities and can also support the implementation of the opportunities identified. This can include helping to identify suppliers, design and assess the results of quote or tender specifications and identify and secure funding.

Obtaining our support on a particular project does not exclude you from obtaining further support.

2 Executive summary

ABC ltd have asked Business Energy Scotland to carry out a survey of your premises at address 1, address 2, address 3, to assess any savings from energy efficiencies that could be created. The virtual survey was carried out by Name name of Name name Consultancy Services Ltd on 25th May 2022. The main client contact was Jane Bloggs, who is the Managing Director.

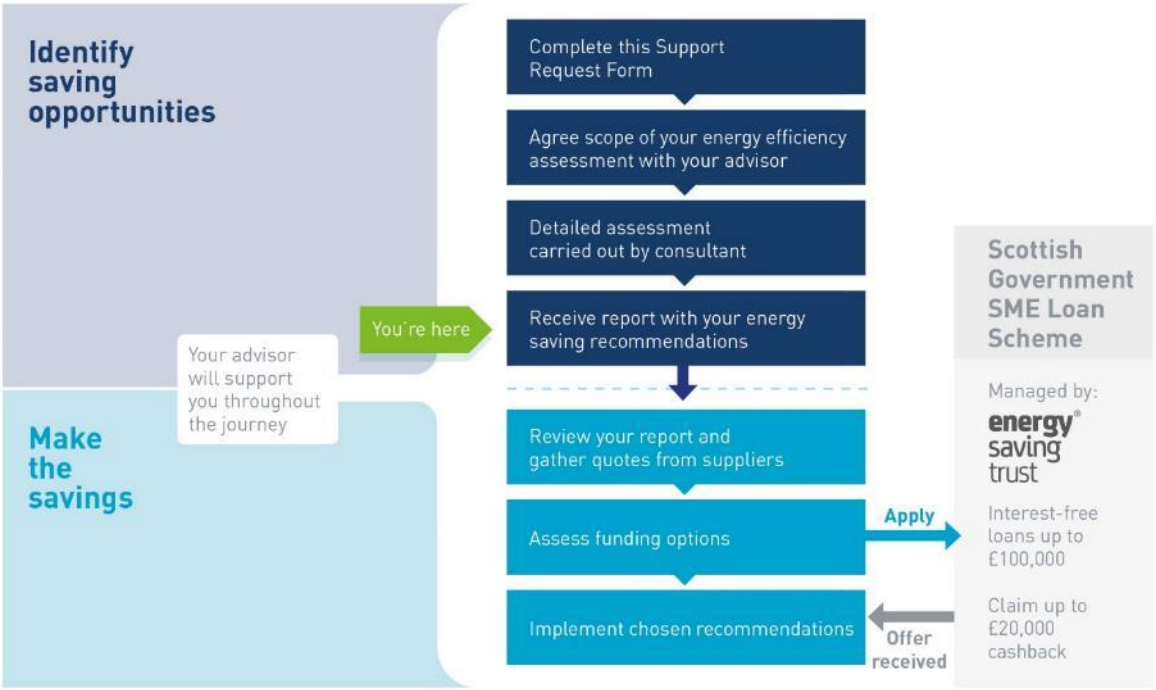
To facilitate future company growth and your commitment to your Net Zero Route Map, you will purchase a redundant warehouse and repurpose it into an energy efficient and energy producing asset, that will allow your company to produce products that are extremely environmentally and socially savvy.

The roof of the existing warehouse will be replaced and at the same time you will install a solar panel array of 232-kWp. A 230-kW Heizomat Biomass Boiler will also be installed to replace the existing oil-fired warm air blowers. You may opt to install a ground source heat pump instead. The electricity and hot water produced will allow a small district heat and electricity scheme to be developed for other site tenants, including company 1 and company 2, helping them achieve their carbon reduction targets and improving their efficiencies.

You also intend to purchase more energy efficient production equipment and also, where possible, capture process heat.

You are seeking support with your energy efficiency and renewable energy investment, as your own investment cash has been severely depleted during the pandemic. You are keen to play your part in a smart, green and digitally enabled recovery in Scotland

The diagram overleaf highlights where you currently are on your journey with us and what the next steps are:



The following detailed energy efficiency opportunities were identified from the survey: -

- **Install a solar PV panel array**

  This measure identified annual savings of £25,576, an annual income of £4,925 and a CO_2e reduction of 38.0 tonnes.

- **Replace warm air blowers with a biomass boiler**

  This measure identified annual savings of £10,339, an annual income of £6,427 and a CO_2e reduction of 26.4 tonnes

- **Replace refrigeration equipment**

  This measure identified annual savings of £14,903 and a CO_2e reduction of 11.8 tonnes

- **Upgrade to a half-hourly (HH) electricity meter**

  This measure identified annual savings of £2,660 and a CO_2e reduction of 2.1 tonnes

The following alternative energy efficiency opportunity was identified from the survey: -

- **Replace warm air blowers with a ground source heat pump**

  This measure identified annual savings of £7,775 and a CO_2e reduction of 22.3 tonnes.

Key actions and next steps

- Review the opportunities identified in this Assessment
- Discuss with your Business Energy Scotland Advisor, who can also advise on funding
- Obtain firm quotations for measures which are to be progressed

3 Your journey to net zero carbon emissions

Scotland has committed to becoming a net-zero society by 2045 which is in line with the advice from the UK Government's independent advisors, the Climate Change Committee.

To help you understand how your enterprise can support that transition, we have identified that your site has the following carbon emissions and we have identified how you can reduce them to support Scotland's net-zero goals:

Annual carbon impact		Equivalent average car miles
Current carbon emissions (tonnes CO_2e[1])	70.31	248,779
Potential carbon reduction	111%	277,041

Note that the total realised carbon saving may be less if all the recommendations from this report are implemented as the potential savings from each recommendation are calculated in isolation from each other. In reality, some measures may affect the potential carbon savings of other measures.

Please note that this analysis does not constitute a full carbon footprint.

[1] CO2e means 'carbon dioxide equivalent'. It is a standard way of presenting the impact considering all associated greenhouse gas emissions.

4 Recommendation table

Recommended opportunities								
	Finance estimates						Annual environmental saving estimates	
	Annual cost savings	Annual income generated	Investment required	Payback	Potential grant	Payback with grant	Energy	CO_2e
Description	**£ (ex VAT)**	**£ (ex VAT)**	**£ (ex VAT)**	**Years**	**£**	**Years**	**kWh**	**Tonnes**
Install a solar PV panel array	£25,576	£4,925	£165,780	5.4	£0		179,104	38.0
Replace warm air blowers with a biomass boiler	£10,339	£6,427	£116,930	7.0	£0		0	26.4
Replace refrigeration equipment	£14,903	£0	£120,950	8.1	£10,000	7.4	55,607	11.8
Upgrade to a half-hourly electricity meter	£2,660	£0	£0	Immediate	£0		9,930	2.1
TOTAL	**£53,478**	**£11,352**	**£403,660**	**6.2**	**£10,000**	**6.1**	**244,641**	**78.3**
Alternative opportunities								
Replace warm air blowers with a ground source heat pump	£7,775	£0	£72,029	9.3	£10,000	8.0	82,200	22.3

Please note that implementing multiple measures may impact on each other and this may result in the realised savings being less than is presented in this report. Unless otherwise stated, the identified savings presented in this report for each measure are calculated independently from other measures. If required, further support can be provided by Business Energy Scotland to quantify the impact of implementing multiple measures where they impact on each other.

Your Business Energy Advisor can support you to implement the recommendations we have suggested in this report.

Where appropriate, our finance estimates include a cashback grant from the Scottish Government's SME Loan scheme. Please see Appendix 3 for further details on the SME Loan scheme and cashback grant, including eligibility criteria.

5 Current energy consumption at your site

Estimated current annual energy use				
Resource	**Cost**	**Consumption**	**Units**	**CO_2e emissions (Tonnes)**
Electricity - day	£37,808	132,398	kWh	28.11
Electricity - night	£15,391	66,199	kWh	14.06
Gas Oil	£15,600	109,600	kWh	28.14
TOTAL	**£68,799**	**308,197**	**kWh**	**70.31**

Note:

- The costs in this table include standing charges and other costs including, where relevant, charges such as the Climate Change Levy.
- When calculating the potential savings of opportunities, unit costs which include standing charges have been used to calculate these as the standing charges make up a very small proportion of the total cost.
- The CO_2e emissions detailed above are not equivalent to a carbon footprint for the site.
- It may be beneficial to you to renegotiate your energy contracts if you are going to significantly change your consumption. It is also good practice to regularly review your energy tariffs to ensure they meet your requirements. By changing your tariff or supplier you may be able to decrease your energy costs. Contacting your current supplier to check you are on the most appropriate tariff can be a good place to start. We can also direct you to organisations that provide energy switching advice.

6 Recommended and alternative energy efficiency opportunities

6.1 Install a solar PV panel array

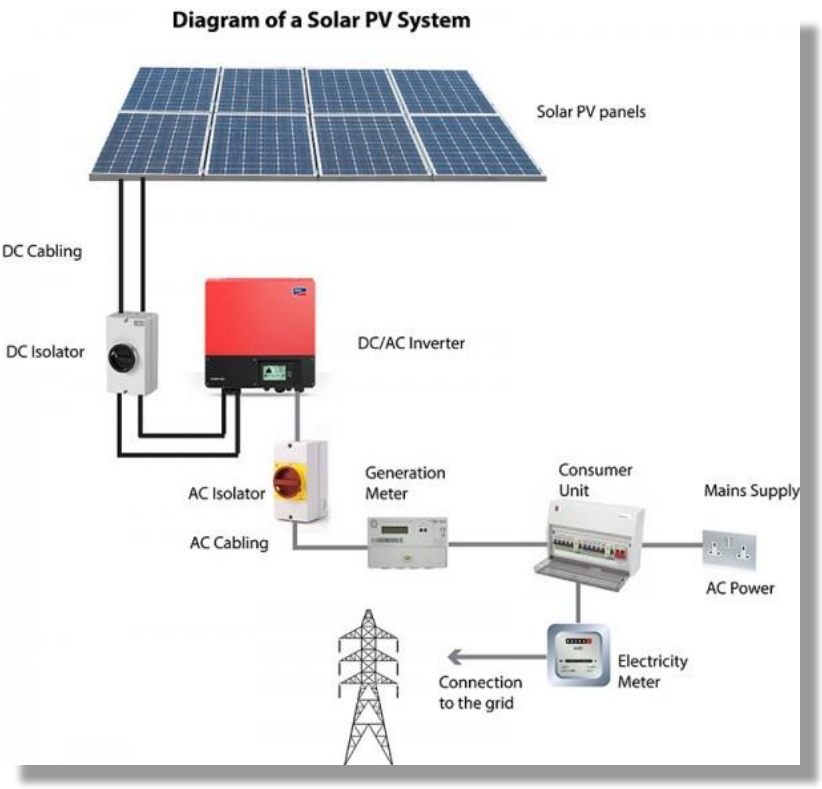
6.1.1 Project description and recommended solution

There is currently no renewable source of electricity generation on the site you are moving to and you are keen to explore the possibility of installing a roof-mounted solar PV panel array on the roof of the warehouse. There appears to be a large amount of suitable roof space available, some of which can be seen in the photo at Figure 1 below.

Figure 1 - warehouse suitable for solar PV panel array

The size of array you choose is determined by your level of electricity consumption, available roof-space and your budget.

Figure 2 - basic diagram of a solar PV system



Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy would then flow through the building's electrical panel and would be distributed accordingly.

The way a solar PV system works, along with its main elements, is illustrated in the diagram at Figure 2 opposite.

6.1.2 Benefits, costs and finance

Smart Export Guarantee (SEG)

The Feed-In-Tariff closed to new applicants on 1 April 2019, barring a few exceptions. The Feed-In-Tariff paid homeowners and businesses on a fixed per kilowatt-hour basis over a set period of time for the electricity generated by eligible renewable energy technologies. There is however a new payment system which came into force in 2020, called the Smart Export Guarantee *(SEG).* This will pay homeowners and businesses for electricity exported to the National Grid which has been generated by eligible renewable energy technologies. The level of payment and length of contract is expected to vary depending on the purchaser of the electricity. The upper rate paid varies and further information on the Smart Export Guarantee can be found here[2]. The Solar Trade Association also provides a useful resource which includes a league table of current export rates and the suppliers who offer them. It can be viewed here[3].

[2] https://www.ofgem.gov.uk/environmental-programmes/smart-export-guarantee-seg

[3] *https://solarenergyuk.org/resource/smart-export-guarantee/*

Based on your shift patterns and the size of array you are looking to install *(232-kWp)*, I estimate that 50% of electricity generated could be used on site. For that reason, I recommend you consider registering for the Smart Export Guarantee to sell exported electricity. On site use would increase if you implement a district electricity system, which provides neighbouring tenants on site with solar PV generated electricity.

Based on the assumptions made in Appendix 1, Section 1.1, installing a 232-kWp solar PV panel array could reduce annual electricity use by 179,104 kWh. This would result in an annual saving of £25,576 and annual SEG income of £4,925. Annual CO_2e emissions would be reduced by 38.0 tonnes and, based on a budget cost of £165,780, a payback period of 5.4 years would result.

Financial support for installing eligible energy efficiency and/or renewable energy equipment in Scotland is available through the SME Loan scheme. This offers eligible SMEs, (including charities), interest-free loans from £1,000 to £100,000 for individual measures and packages of linked measures that have a payback period of 20 years or less. Loan repayments are made over an 8-year period.

Solar PV technology does not qualify for any of the cashback grants currently on offer, since it is classed as a renewable technology.

This report is regarded as a qualifying report for the SME Loan scheme if required. Download the SME Loan application form: https://businessenergyscotland.org/smeloan.

If you decide to apply for an SME Loan then the interest foregone on your loan, and any grant received, are regarded as state aid under EU-UK Trade and Cooperation Agreement. An estimate of how much aid this might equate to is provided in Appendix 2. Please see Appendix 3 for further details on the SME Loan and cashback grant.

6.1.3 Risks and alternative solutions

The main factors to consider when installing solar PV panels are orientation, pitch and shading.

Orientation

South facing roofs are ideal in the Northern Hemisphere, since the sun is always slightly to the south, even in the height of summer when it is high in the sky. That said, east-facing or west-facing roofs are still suitable, since the reduction in efficiency is not large. Your warehouse pitched roof appears to be east-west facing. Whilst not optimal, this would still be suitable for an array and results in a lower estimated yield.

Pitch

The ideal pitch angle for the panels is 30-45 degrees off the horizontal. This is to ensure the panels gain as much sunlight as possible in the morning and evening as well as during the middle of the day. Mounting frames are used to achieve the optimum pitch angle for panels fitted on flat roofs. Your pitched roof appears to provide a suitable pitch angle.

Shading

Shading can cause a huge reduction in efficiency, which is why a shading analysis is important to carry out prior to proceeding with an installation. Shading simply means obstruction of the sun by surrounding houses, trees and other features. Most installations come with a single inverter, which means if one panel is affected by shading, all the other panels will be similarly affected. There appear to be wooded areas immediately to the south and east of the warehouse. A shading analysis would confirm if this is likely to cause an issue with shading.

Types of solar PV panel

There are 3 main types of panels you can install.

Monocrystalline solar cells (made from single crystals grown in isolation) are the most efficient at 15-22%, but they are also the most expensive type of solar cell. Your quotation assumes this type of cell is supplied.

Polycrystalline cells are cheaper than monocrystalline, but their efficiency is lower at just 13-17%.

The cheapest solar cells of all are amorphous solar cells, which also have the bonus of being more efficient in low-light (an advantage here in Scotland). However, they are the least efficient overall at 9%.

Other things to consider

Solar PV panels are inexpensive to maintain, but must be kept clear of debris such as dust, leaves, snow etc. Regular cleaning of the panels is therefore important to maximise their efficiency. You should discuss an effective maintenance program with quoting contractors, to ensure an optimum yield is maintained.

The load bearing properties of the roof should be assessed by quoting contractors to make sure it is able to support the weight of an array this size. If necessary, the roof may need to be strengthened. Since you are intending to replace the warehouse roof, this should be taken into account when designing the new roof.

Contractors tendering for the work should be certified under the MCS (micro-generation certification scheme). A list of local MCS contractors can be found by searching here[4].

Since the cost for this measure will be greater than £25,000, you will need to supply at least 2 quotations with your SME Loan application. You can choose which quotation to accept.

A yield of 772 kWh per kWp per year has been assumed for your roof space. This is based on the Photovoltaic Geographical Information System (PVGIS) modelling tool. You can view and use the online tool here[5] .

6.2 Replace warm air blowers with a biomass boiler

6.2.1 Project description and recommended solution

The warehouse you are relocating to is heated by 4 x 36kW Powrmatic oil-fired warm air heaters. One of the heaters can be seen in the photo at figure 3 below.

These heaters collectively use ~10,000 litres of oil *(white diesel)* per year. You are keen to consider a low carbon alternative to heat the warehouse and possibly provide a district heating solution for neighbouring tenants.

Figure 3 - one of your existing Powrmatic warm air blowers

[4] https://mcscertified.com/find-an-installer/

[5] https://re.jrc.ec.europa.eu/pvg_tools/en/#PVP

You are considering two options; a biomass boiler & ground source heat pump technology.

You have already received a quotation for a second-hand biomass boiler, which has a Non-Domestic Renewable Heat Incentive *(RHI)* agreement attached to it. The RHI is a government environmental programme that provides financial incentives to increase the uptake of renewable heat by businesses, the public sector and non-profit organisations. It closed to new entrants on 31st March 2021. However, you could still benefit from this incentive by purchasing a boiler such as the one you have been quoted for, which has an existing RHI agreement in place.

Biomass boilers work by burning biological matter and outputting the resulting heat for use in heating systems. Wood pellets, chips, logs or other biological materials are fed – automatically, semi-automatically, or by hand – into a combustion chamber where they are ignited. The hot gas and air produced by this process travel through a flue, and are then passed through a heat exchanger, which transfers the heat to the water used in the property's central heating system. The excess heat is also stored in a thermal tank *(also called a buffer vessel)*. NB. Biomass boilers can usually easily be integrated with existing space, under floor and water heating systems.

The second-hand system you have been quoted for is a Heizomat RHK-AK 230 biomass boiler. This system has an estimated annual load of 647,220 kWh based on operating 2,814 hrs per year. This is a significantly greater load than that required to heat the warehouse, which is currently 109,600 kWh and you are keen to explore using the biomass boiler as a district heating system which could also benefit neighbouring tenants on site.

6.2.2 Benefits, costs and finance

Based on the assumptions made in Appendix 1, Section 1.2, replacing your warm air blowers with a 230-kW biomass boiler, would not reduce annual energy use. However, it would result in an annual saving of £10,339, annual RHI income of £6,427 and annual CO_2e emissions would be reduced by 26.4 tonnes. This is based on serving the heat demand of the warehouse only. The system itself is capable of producing almost 5 times the amount of heat required, so this surplus heat could be used to benefit neighbouring tenants on site. Based on a budget cost of £116,930, a payback period of 7.0 years for heating the warehouse alone would result.

Due to the fact that this is a second-hand biomass boiler which has an existing RHI agreement attached to it, it would not qualify for support from the SME Loan Scheme described in section 6.1.2. It may qualify for support from the Energy Saving Trust's district heating team and you should approach them for further guidance.

6.2.3 Risks and alternative solutions

When considering biomass versus GSHP, you should carefully consider the following general risks associated with biomass boilers.

Delivery access for biomass feedstock should be considered, along with a method for fuelling the biomass boiler *(automatic or manually fed)*.

You should consider the security of supply for your fuel source.

Installation of a biomass unit should be undertaken by an experienced contractor.

Emissions and combustion of the feedstock should be assessed, to ensure the feedstock and emissions are compliant regarding RHI and environmental permits.

There are important safety features on batch boilers that must be considered and technical product issues to ensure efficient boiler operation.

Sawdust must not build up and enter the boiler, or there may be a risk of explosion

Due to the aggressive nature of the feedstocks when combusted, the lifespan of units can be shorter than conventional boilers and a detailed financial model including possible repair and replacement is recommended before investing in biomass. It is important to know how old the boiler you are being quoted for actually is.

Your thermal store can be key to keeping running costs down and having sufficient capacity. Boiler and thermal store need to be correctly-sized for your particular site by suitably qualified persons. Oversized boilers cost more and may not perform so well.

I recommend you monitor fuel input and ensure an RHI-compliant heat meter is included to measure heat output. This helps you to evaluate the boiler's actual efficiency and would be required for you to collect the RHI scheme payments.

You should try to get the installer to give a minimum performance guarantee.

Solution alternative – replace warm air blowers with a ground source heat pump (GSHP)

Project description and recommended solution

You are also considering the option of replacing your warm air blowers with a ground source heat pump *(GSHP)*.

Benefits, costs and finance

Figure 4 - example of a GSHP trench-loop circuit

A GSHP circulates a mixture of water and antifreeze around a loop of pipe, called a ground loop, which is buried under land surrounding the building. Heat from the ground is absorbed into the fluid and then passes through a heat exchanger into the heat pump. An illustration of this is shown in the photo at Figure 4 opposite. The ground stays at a fairly constant temperature under the surface, so the heat pump can be used throughout the year. The length of the ground loop depends on the size of building and the amount of heat required. Longer loops can draw more heat from the ground, but need more space to be buried in. If space is limited, a vertical borehole *(or boreholes)* can be drilled instead.

A rule of thumb is that a standard GSHP trench loop system needs roughly twice the total floor area of the building from every storey.

The estimated reduction in heating costs for the warehouse has been shown in Appendix 1, Section 1.3. The amount of electricity used by a GSHP is based on its Seasonal Coefficient of Performance *(SCOP)*. A SCOP of 4 has been assumed, which means for every 4 kWh of heat output, the GSHP uses 1 kWh of electricity.

Based on the assumptions contained in Appendix 1, Section 1.3, installing a GSHP could reduce annual energy consumption by 82,200 kWh. This would save you £7,775 per year. A quotation has been received for £72,029. This would result in a payback period of 9.3 years and a reduction in annual CO_2e emissions of 22.3 tonnes.

This opportunity would qualify for support through the SME Loan Scheme described in section 6.1.2.

For renewable heat measures, the Scottish Government is offering a 75% cashback grant to SME Loan recipients for a limited time while funds last. Loan recipients may receive 75% of their project cost back, up to a maximum of £10,000. This cashback grant would be additional to any received for non-renewable energy-saving measures. This measure should qualify for the 75% cashback grant. In that case, your net investment would fall to £62,029 and the payback would shorten to 8.0 years.

Risks and alternative solutions

When considering biomass versus GSHP, you should carefully consider the following general risks associated with GSHP's and your proposed installation.

It can be disruptive to excavate and reinstate or drill bore holes. Trench loops can be expensive to replace/fix if there are any issues.

If using a trench loop, avoid 'slinky' loops. 'Kettle-element' loops are more efficient, especially in the long term.

Boreholes need to be sufficiently far apart to avoid depleting ground of heat over time.

Boreholes are more expensive than ground loops.

Planning permission will be required.

The actual SCOP/SPF of the overall heating system is lower than the SCOP/SPF of the heat pump itself and may differ to that mentioned in the report, and other external variables can influence the efficiency of the GSHP.

As heat pumps provide lower temperatures than traditional boiler systems, they are most effective when the building's heat losses are minimised by ensuring good levels of insulation and that good draught-proofing, around windows and doors, is in place. A heat pump is therefore only likely to be viable if good heat loss reductions are also implemented in the areas to be heated.

Installing a heat pump in a poorly insulated building will result in a lower efficiency of the heat pump, resulting in lower savings and potentially an inadequate heat supply. This is important to consider given that you will be heating a warehouse. You are proposing several improvements to the thermal envelope, which would be essential for a GSHP to be a viable heating solution.

It is important that building users understand how to operate heat pump system efficiently and effectively to avoid it costing more to run than alternative systems. In particular, you must understand that low-temperature heat will be delivered and if you increase the temperature of heat delivered, it can be very costly.

Thermal store can be key to keeping running costs down and having sufficient capacity.

The system will be more expensive if there is no wet system in place.

Heat pumps and thermal store need to be correctly-sized for the particular site in question by suitably qualified persons

I recommend you install an electricity submeter for your heat pump, as well as a heat meter to measure heat output. That way, the actual SCOP of your heat pump can be monitored.

Since the cost for this measure will be greater than £25,000, at least 2 quotations will be needed for your SME Loan Application.

6.3 Replace refrigeration equipment

6.3.1 Project description and recommended solution

The Carbon Trust provides an in-depth resource on energy efficiency for refrigeration equipment, which can be viewed here[6]. This is extremely relevant to your operation and is well worth a read. Based on this study, we could reasonably assume that refrigeration accounts for at least 70% of your site's total electricity use.

Your refrigeration plant is extensive and comprises of 6 compressors which serve 2 containers and 1 small container, the Brakes freezer, ice cream freezer, & milk chill. The compressors are old and many are past the end of their useful life. As such, they are operating very inefficiently and are energy intensive. Your refrigeration pant also uses dated refrigerant gases which have higher GWP's *(global warming potentials)*. Some of your existing compressors can be seen in the photos at Figure 5 overleaf.

Figure 5 - some of your existing compressors

[6] https://www.carbontrust.com/resources/refrigeration-guide

You should consider replacing your refrigeration equipment. This will achieve significant reductions in carbon emissions and electricity costs.

6.3.2 Benefits, costs and finance

By renewing your refrigeration equipment, based on the Carbon Trust Refrigeration Guide, you should expect energy use to be reduced by at least 40%. Replacing your existing R404a refrigerant gas with R449a gas, will reduce energy use by 12% alone. R449a is a lower GWP alternative refrigerant. GWP stands for Global Warming Potential and is a calculation based on the greenhouse potency of the gas in relation to carbon dioxide. Specifically, GWP measures how much energy one ton of gas will absorb relative to the emissions of an identical amount of CO_2. The GWP for R449a is 1397, compared with R404a which is 3922. New compliant energy efficient compressor technology and new evaporators with ErP efficient fans will also help to reduce energy use.

Based on the assumptions contained in Appendix 1, Section 1.4, replacing your refrigeration plant should reduce annual electricity use by 55,607 kWh. This would save £14,903 per year and reduce annual CO_2e emissions by 11.8 tonnes. You have obtained a quotation which totals £120,950. This gives a payback period of 8.1 years.

This measure should qualify for the SME Loan Scheme described in section 6.1.2.

For eligible non-renewable energy efficiency measures, the Scottish Government is offering a 30% cashback grant to SME Loan recipients for a limited time while funds last. Loan recipients may receive 30% of their project cost back, up to a maximum of £10,000. This measure should qualify for the 30% cashback grant. In that case, your net investment would fall to £110,950 and the payback would shorten to 7.4 years.

6.3.3 Risks and alternative solutions

Installation of new refrigeration equipment falls under a multitude of legislation including F-Gas and fire safety. As such, this work should be undertaken by an experienced and Gas Safe qualified industrial refrigeration engineer. A list of suitably qualified engineers in your local area can be found by searching the Gas Safe register here[7].

The equipment supplied should be acceptance tested in accordance with HVCA publication Standard Specification for Building services Vol .2 CIBSE. The systems should be fully tested and commissioned

You should explore additional energy-saving options with your installer, such as linking evaporators and interior lights to chiller and freezer doors. This would mean when the doors are open, cold air would not be blown out of the chillers and freezers and the lights would only be switched on when the doors were open.

Since the cost for this measure will be greater than £25,000, at least 2 quotations will be needed for your SME Loan Application.

6.4 Upgrade to a half hourly (HH) electricity meter

6.4.1 Project description and recommended solution

We discussed your electricity meter. It is shown as a Profile Class 04 on your MPAN, which means it is a non-domestic Economy 7 meter. You understand the meter at the site you are relocating to, may be of a similar type. Your annual electricity consumption is just under 200,000 kWh. For supplies which use over 100,000 kWh per year or have a peak load electricity usage above 100 kW, half-hourly metering is required. This is Profile Class 00.

Half-hourly metering enables you to see how much electricity you are using throughout the day and night. Readings are collected and stored every 30 minutes. Electricity suppliers provide online portals where you can visual your electricity use and run various reports. This helps you to see what you are using when and often throws up some unexpected findings.

You should ask your electricity supplier to change your Profile Class to 00 and replace your Economy 7 meter with a half-hourly meter.

[7] https://www.gassaferegister.co.uk/find-an-engineer/

6.4.2 Benefits, costs and finance

With the benefit of half-hourly metering and a pro-active approach to energy management, you should be able to reduce your electricity use by at least 5%. This will be achieved by a range of energy conservation measures.

Based on the assumptions contained in Appendix 1, Section 1.5, upgrading to a half-hourly electricity meter could reduce annual electricity use by 9,930 kWh. This would save £2,660 per year and reduce annual CO_2e emissions by 2.1 tonnes. There is no cost associated with this measure, so the payback for any savings achieved would be immediate.

There should be no cost associated with his measure, so no finance is required.

6.4.3 Risks and alternative solutions

There should be no risk associated with this measure, as you should already have a half-hourly meter in place, due to the level of your electricity use. A detailed picture of your energy use, can help you to understand where and when you use electricity and to make reductions and conserve energy.

7 Conclusion

You have a sound net zero strategy in place and are working towards achieving it. You asked for advice and support with a low carbon heating system, energy efficient refrigeration and on-site renewable electricity generation.

The Report identifies detailed opportunities to reduce energy consumption by 244,641 kWh each year. An annual saving of £53,478, and an annual income of £11,352 result, for an investment of £403,660. These opportunities arise from installing a solar PV panel array, replacing warm air blowers with a biomass boiler, replacing your dated refrigeration equipment and upgrading to a half-hourly electricity meter. A payback period of 6.2 years and a reduction in CO_2e emissions of 78.3 tonnes result.

The Report also identifies an alternative opportunity to replace your warm air blowers with a ground source heat pump.

Many of the opportunities identified, qualify for support from the SME Loan Scheme. The scheme provides access to unsecured, interest-free loans from £1,000 - £100,000 repayable over a term of 8 years. The capital expenditure required for your project far exceeds the funding available through the SME Loan Scheme. However, you can make targeted use of the scheme, as part of a larger overall funding program.

8 Disclaimer

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9 Confidentiality

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10 Appendix 1 – Supporting calculations

1.1 Install a solar PV panel array

Summary for a 232-kWp solar PV panel array

Yield assumed from survey is **772 kWh / kWp**
Therefore, annual electricity generated = 772 kWh x 232 kWp = **179,104 kWh**
Assumption – onsite utilisation would be 50%, so 50% of electricity generated would be exported to the grid.

Annual electricity utilised on site = 179,104 kWh / 2 = **89,552 kWh**
Cost reduction from electricity utilised on site = 89,552 kWh x £0.2856* = **£25,576**
Annual electricity exported to grid = 179,104 kWh / 2 = **89,552 kWh**
Income from electricity exported to grid 89,552 kWh x £0.055** = **£4,925**

* This is your actual day unit rate payable from 1st January 2022
** This is an indication of what you could expect to receive from the SEG scheme

Quotation for a 232-kWp array = **£165,780**

Summary
Estimated annual electricity generation = **179,104 kWh**
Reduction in annual cost = £25,576 + £4,925 = **£30,501**
Reduction in CO_2e emissions = 179,104 kWh x 0.212330 / 1000 = **38.0 tonnes**

1.2 Replace air blowers with a biomass boiler

Summary for a 230-kW biomass boiler

Existing heating system
4 x 36-kW Powrmatic warm air blowers are used
Total output = 4 x 36-kW = **144 kW**
Volume of heating oil used per year = **10,000 litres**
Calorific value for white diesel = **10.96**
Therefore, annual energy use = 10,000 litres x 10.96 = **109,600 kWh**
Current cost per litre (delivered) = **£1.56**
Therefore, current annual heating cost = 10,000 litres £1.56 = **£15,600**

Scenario (for warehouse only) – replace with a biomass boiler
Annual heat demand = **109,600 kWh**
Load per tonne of fuel *(wood pellets)* = **2,500 kWh**
Therefore, quantity of fuel required per annum = 109,600 kWh / 2,500 kWh = **43.84 tonnes**
Annual heating cost based on £120 per tonne = 43.84 tonnes x £120 = **£5,261**

Quotation for biomass boiler = **£116,930**

Summary
Estimated annual energy reduction = **0 kWh**
Reduction in annual cost = £15,600 - £5,261 = **£10,339**
Annual RHI income (Tier 1) = 109,600 kWh x £0.057 = **£6,427**
Reduction in CO_2e emissions =
[(109,600 kWh x 0.256790 / 1000) – (109,600 kWh x 0.015130 / 1000)
28.1 tonnes – 1.7 tonnes = **26.4 tonnes**

1.3 Replace air blowers with a ground source heat pump (GSHP)

Summary for a 100-kW GSHP

Existing heating system
4 x 36-kW Powrmatic warm air blowers are used
Total output = 4 x 36-kW = **144 kW**
Volume of heating oil used per year = **10,000 litres**
Calorific value for white diesel = **10.96**
Therefore, annual energy use = 10,000 litres x 10.96 = **109,600 kWh**
Current cost per litre (delivered) = **£1.56**
Therefore, current annual heating cost = 10,000 litres £1.56 = **£15,600**

Scenario (for warehouse only) – replace with a GSHP
Annual heat demand = **109,600 kWh**
GSHP Co-efficient of Performance (COP) = **4.0**
Therefore, annual electricity used by GSHP = 109,600 kWh / 4 = **27,400 kWh**
Annual electricity cost for GSHP = 27,400 kWh x £0.2856 = **£7,825**

Quotation for GSHP = **£72,029**

Summary
Estimated annual energy reduction = **109,600 kWh – 27,400 kWh = 82,200 kWh**
Reduction in annual cost = £15,600 - £7,825 = **£7,775**
Reduction in CO_2e emissions =
[(109,600 kWh x 0.256790 / 1000) – (27,400 kWh x 0.212330 / 1000)]
28.1 tonnes – 5.8 tonnes = **22.3 tonnes**

1.4 Replace refrigeration equipment

Current scenario
Assumption – Based on The Carbon Trust study referred to in section 6.3.1, electricity use by refrigeration is estimated as 70% of total use.
Total annual electricity use = **198,597 kWh**
Therefore, annual electricity use by refrigeration = 198,597 kWh / 100 x 70 = **139,018 kWh**
Annual refrigeration running cost = 139,018 kWh x £0.268* = **£37,257**

*This is the weighted average unit rate you pay for electricity. It is based on the actual split between day and night use, for which different unit rates are paid. It includes the CCL (climate change levy) charge.

Scenario – replace condensers, compressors, evaporators, controls & refrigerant
Assumption - Replacing this equipment should reduce electricity use by 40%
Therefore, reduction in annual electricity use = 139,018 kWh / 100 x 40 = **55,607 kWh**

Quotation for measure = **£120,950**

Summary
Reduction in annual electricity consumption = **55,607 kWh**
Reduction in annual cost = 55,607 kWh x £0.268 = **£14,903**
Reduction in CO_2 emissions = 55,607 kWh x 0.212330 / 1000 = **11.8 tonnes**

1.5 Upgrade to a half-hourly electricity meter

Current scenario
Annual electricity consumption = **198,597 kWh**
Annual electricity cost = **£53,199**

Scenario – upgrade to a half-hourly electricity meter
Assumption – monitoring and evaluation of half-hourly electricity use, should enable you to reduce consumption by ~**5%**

Therefore, reduction in annual electricity use = 198,597 kWh / 100 x 5 = **9,930 kWh**

Summary
Reduction in annual electricity consumption = **9,930 kWh**
Reduction in annual cost = £53,199 / 100 x 5 = **£2,660**
Reduction in CO_2 emissions = 9,930 kWh x 0.212330 / 1000 = **2.1 tonnes**

11 Appendix 2 – Subsidy controlee/state aid information

Advice from Business Energy Scotland

The advice that has been provided in this report is funded with support from Scottish Government but is NOT classed as aid under the EU-UK Trade and Cooperation Agreement or European Commission's de minimis state aid regulations.

If you would like further advice to implement the recommendations or to look at further opportunities, then contact your advisor and they will help you. This support is also NOT classed as aid delivered under the EU-UK Trade and Cooperation Agreement. This means that the advice you receive does not count towards the limits that are set on Special Drawing Rights under the EU-UK Trade and Cooperation Agreement.

Funding from the SME Loan

If you decide and are eligible to apply to the SME Loan scheme for interest-free financial support then the interest foregone on your loan, and any grant received, are regarded as an exempted subsidy under Article 3.2(4) of the EU-UK Trade and Cooperation Agreement (which replaces de minimis aid under Commission Regulation (EU) 1407/2013 (general de minimis), Commission Regulation (EU) 1408/2013 (production of agricultural products) and Commission Regulation (EU) 717/2014 (fisheries and aquaculture products)).

The value of the interest foregone will depend on which measures you apply for and whether a grant is available however we have estimated the potential value of the Special Drawing Rights that could apply to the recommendations made if there was no grant or cashback grant:

Estimated special drawing rights associated with accessing the SME Loan					
Item	**Description**	**Investment required**	**Potential SME loan**	**Interest rate applied**	**Interest forgone**
1	Install a solar PV panel array	£165,780	£100,000	0%	£21,535.23
2	Replace refrigeration equipment	£120,950	£100,000	0%	£21,535.23

The information provided above is just an estimate and does not include any Special Drawing Rights aid resulting from any supporting grants. The actual state aid that applies will be supplied to you in the offer letter from Energy Saving Trust's SME Loan team if you decide to apply for the loan.

There is a ceiling of £325,000 Special Drawing Rights for subsidies provided to any one economic actor under this Article over a 3-year period. Any Article 3.2(4) subsidies (or similar aid, including “de minimis” aid granted prior to 31 December 2020 under Commission Regulation (EU) No 1407/2013) awarded to the Grantee will be relevant if the Grantee wishes to apply, or has applied, for any Article 3.2(4) subsidies.

12 Appendix 3 – SME loan and cashback information

The loan

Scottish small and medium-sized enterprises (SMEs) can apply for an interest-free loan, funded by the Scottish Government, of between £1,000 and £100,000, repayable over eight years, to help pay for energy efficiency projects.

Eligible measures can also receive a cashback grant of up to £20,000.

What can it be used for?

A Scottish Government SME Loan can be used to finance the installation of eligible energy efficiency systems, equipment or building fabric, including:

- Heating, ventilation, and air conditioning upgrades.
- Renewable technologies such as replacing a boiler to an air source heat pump.
- Improving insulation, draught-proofing, double or secondary glazing.
- Installing solar panels, wind turbines and wood-burning stoves.

Who is eligible?

The loan is available to Scottish businesses that fall within the EU definition of Small and Medium-sized Enterprise (SME), including not-for-profit organisations and charities.

Key eligibility criteria include:

- The organisation has been trading for at least 12 months.
- The organisation is not owned by or owns 25% of another organisation.
- The organisation passes the credit check carried out by Energy Saving Trust.
- The payback for individual measures or a package of linked measures have a payback period of 20 years or less.

This report is regarded as a qualifying report for the SME Loan scheme if required.

Download the SME Loan application form here: https://businessenergyscotland.org/smeloan.

Can I get a cashback grant?

Currently, eligible installations can qualify for a cashback grant:

- 30% of eligible costs up to a maximum of £10,000 can be claimed by qualifying applicants for permitted energy efficiency measures.
- 75% of eligible costs up to a maximum of £10,000 can be claimed by qualifying applicants for any air/ground/water source heat pump, biomass boiler or solar thermal renewable heating technologies.
- 0% is applied to other renewable electricity generating technologies, such as solar PV and wind turbines.

A maximum of £20,000 cashback can be awarded to a single business for eligible technologies and across all of their SME applications (previous or current).

Where cashback is awarded, the available loan amount will be reduced accordingly. For example, where £10,000 cashback is awarded, the maximum available loan amount will be £90,000; and where £20,000 cashback is awarded, the maximum available loan amount will be £80,000.

How do I apply?

You can request an application form from your advisor who will be able to assist you with completing it and can check it over before it is submitted to Energy Saving Trust, which manages the loan on behalf of Scottish Government.

Key things to note

The SME Loan cannot be applied for retrospectively, so you cannot carry out work and then secure the loan afterwards.

The quote(s) you obtain for implementing the measures must meet the following criteria:

- Be on company-headed paper or have a company stamp.
- Be addressed to the applicant at the correspondence address for the application. This must also include the business name.
- Have the installation address on the quote.
- The details of the measures to be installed must match the measures applied for with a breakdown of the cost of the improvement.
- Include the total cost of the installation with VAT breakdown if applicable.
- Must be dated.

For more information

0808 808 2268

businessenergyscotland.org

support@businessenergyscotland.org

@busenergyscot

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