CARBON FUTURES

NIMMO DRIVE

STATEMENT ON ENERGY

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CARBON FUTURES (CONSULTANCY) LTD

The Whisky Bond, 2 Dawson Road, Glasgow G4 9SS
E / enquiries@carbonfutures.co.uk T / 0141 280 8022
www.carbonfutures.co.uk

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EXECUTIVE SUMMARY

This Statement of Energy (SoE) outlines the responses to the sustainability and energy policies of the Glasgow City Council Development Plan (CDP) in relation to the proposed development at Nimmo Street, which is located in Govan, Glasgow.

The energy requirements for the development are summarised as follows:

- Compliance with Section 6 (Energy)
- Compliance with Section 7 (Sustainability) Aspect Gold Level 1
- Compliance with Section 7 (Sustainability) Aspect Silver Levels 2 to 8 (inclusive)
- 20% reduction in CO2 emissions to be achieved from Low and Zero Carbon Generating Technologies (LZCGT)

The low energy and carbon design measures outlined in this report provide design options that will ensure compliance with Glasgow City Council's CDP5 Resource Management policy.

Achieving the required 20% reduction in carbon emissions from LZCGT and the overall 27% CO2 improvement, will mean the adoption of one of the following technologies as the heat source to serve the development:

LZCGT		HEAT NETWORK	VIABILITY	NOTES
Photovoltaics		*Heat Network May Not Be Viable*	✓	Due to grid limits further investigation at design stage required. Battery storage should be considered to maximise usable generated electricity.
Solar Thermal			✗	Technology not recommended due to poor outputs and high capital costs.
Micro-wind Turbines			✗	Technology not recommended due to space limitations and high capital cost.
Biomass			✗	Technology not recommended due to air quality, plant space and management concerns.
CHP			✗	CHP not included within CDP 5 LZCGT list.
Heat Pumps	Air Source		✓	Individual ASHP for each dwelling or utilising a heat network to distribute heat from a central ASHP system.
	Ground Source		?	Utilising a heat network to distribute heat from a central GSHP system. Further investigation is required.
	Shared-Loop		?	Shared-loop utilising ground source bore-holes feeding individual internal heat pumps. Further investigation is required.
	Water Source		✗	The River Clyde is the closest body of water, however at 0.5 miles away, it is unlikely the infrastructure could be installed.
Hydro Electricity			✗	The River Clyde is the closest body of water, however at 0.5 miles away, it is unlikely the infrastructure could be installed.
Heat Recovery			✓	Technology should be considered to reduce heat consumption, however will not provide a 20% carbon reduction on it's own.

Initial assessment has determined that a communal / shared loop heating system, rather than a district heat network, would be a more accurate description of any potential common heating solution. Please refer to Section 5.0 of the report where each LZCGT has been considered against a communal / shared loop configuration.

However, if a communal / shared loop heating system is not deemed suitable, a low carbon development will still be created using an individual dwelling / building solution. This will be achieved using an enhanced fabric performance approach to reduce the space heating demand and by incorporating energy efficiency measures. Consideration will also be given to the use of non-gas heat generation equipment.

To reduce the size of the heating system it is important to consider the fabric specification in an effort to reduce heat demand. Enhancement of fabric U-values and reduced air infiltration rates will be incorporated into the overall energy strategy to achieve this.

During the detailed design at warrant stage, SAP Calculations will be produced to demonstrate how dwellings will meet the carbon reduction requirements of Policy CDP 5 'Resource Management' of the Glasgow City Development Plan (CDP).

1.0 | INTRODUCTION

This report has been prepared to support the planning application for the proposed Nimmo Drive development in the Govan area of Glasgow. The development site is currently occupied by Elderpark Community Centre and the Mac Ventilation Warehouse on the opposite corner. Both existing buildings are to be demolished to make way for the development of 45 new-build flatted dwellings.

The development falls under the Glasgow City Plan and specifically Policy CDP5, in relation to energy and sustainability. The report outlines the viable measures to be considered as part of the development's energy conservation strategy.

By adopting a sustainable approach to design, construction and operation, coupled with compliance with CDP5 Resource Management, the development will provide attractive, vibrant and low energy homes for the future.

To ensure the delivery of a sustainable development, the 'Lean, Clean, Green' energy hierarchy will be adopted. This fabric-first approach is used to reduce energy demand before considering the use of Low and Zero Carbon Generating Technologies (LZCGT) as described within this report.

Fig 1 - Proposed Nimmo Drive development located in the Govan area of Glasgow

2.0 | STATUTORY AUTHORITY REQUIREMENTS

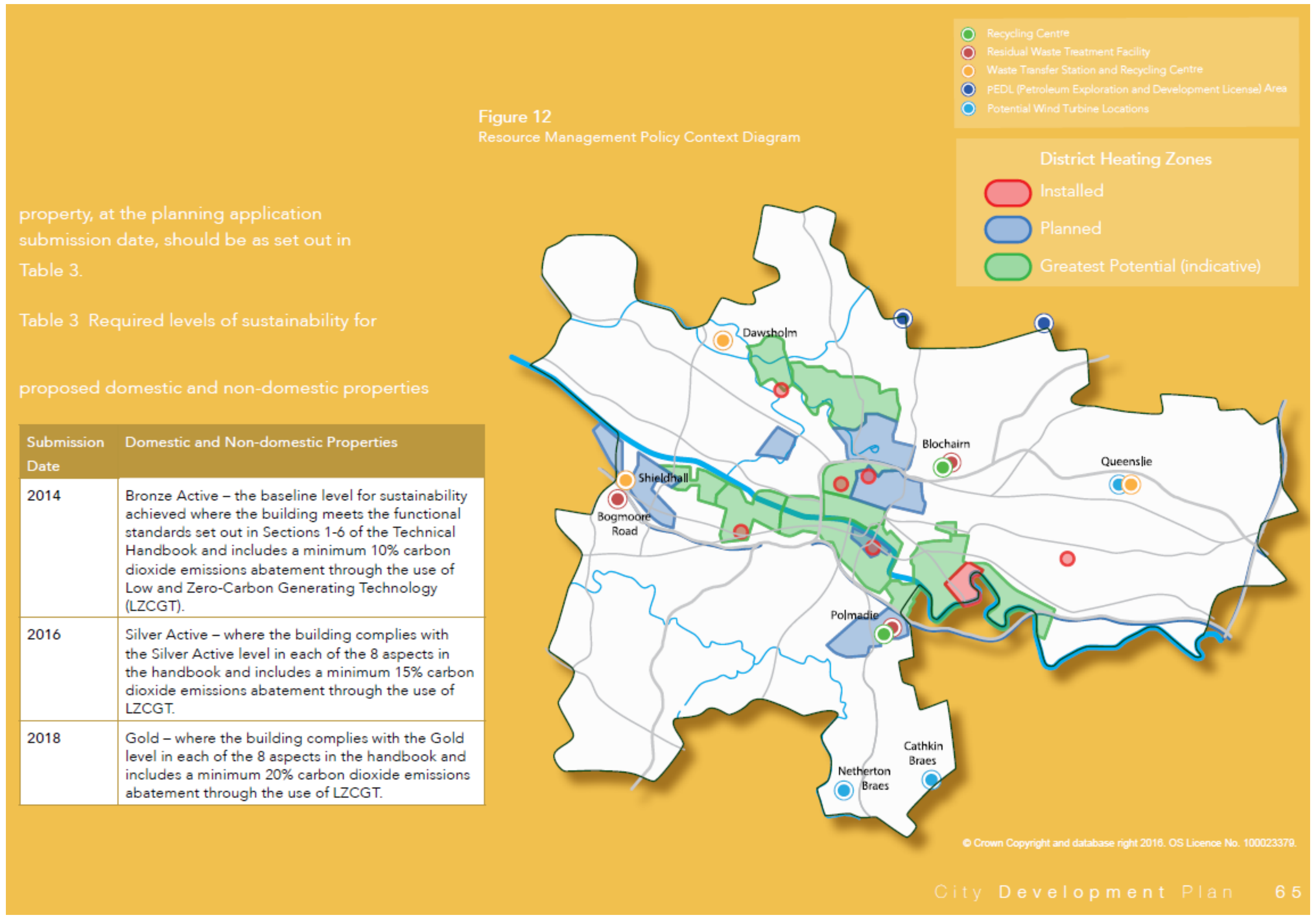
A key role of the planning system is to respond to the challenges of climate change and to help Scotland move towards a zero carbon economy.

To that end, City Development Plans (CDP) provide guidance and policy to ensure developments incorporate energy and sustainability measures. Glasgow's City Development Plan was adopted by Glasgow City Council on 29 March 2017. Their energy policy is outlined within policy CDP5 and Supplementary Guidance SG5.

POLICY CDP5 – RESOURCE MANAGEMENT

The policy aims to ensure that Glasgow:

- Supports energy generation from renewable and low carbon sources;
- Promotes energy efficient design and use of low and zero carbon generating technologies in new development;
- Makes efficient use of energy generation and / or industrial processes by supporting combined heat and power systems and district heating networks;
- Benefits from secure supplies of low carbon energy and heat.



property, at the planning application submission date, should be as set out in Table 3.

Table 3 Required levels of sustainability for proposed domestic and non-domestic properties

Submission Date	Domestic and Non-domestic Properties
2014	Bronze Active – the baseline level for sustainability achieved where the building meets the functional standards set out in Sections 1-6 of the Technical Handbook and includes a minimum 10% carbon dioxide emissions abatement through the use of Low and Zero-Carbon Generating Technology (LZCGT).
2016	Silver Active – where the building complies with the Silver Active level in each of the 8 aspects in the handbook and includes a minimum 15% carbon dioxide emissions abatement through the use of LZCGT.
2018	Gold – where the building complies with the Gold level in each of the 8 aspects in the handbook and includes a minimum 20% carbon dioxide emissions abatement through the use of LZCGT.

Figure 12
Resource Management Policy Context Diagram

Fig 2 – Extract of CDP5 Resource Management from Glasgow's City Development Plan

Planning applications submitted under the Glasgow Development Plan post 2018 are required to provide a Statement on Energy (SoA) demonstrating compliance against Section 7 (Sustainability) Gold Level in each of the 8 aspects. However, it is acknowledged that there are currently valid technical constraints to achieving a number of the Gold Level aspects that would challenge the viability of a development. To continue to fulfil their statutory requirement of delivering a lower carbon developments, the council have agreed to alternative options to comply with Gold Level and these are outlined as per Supplementary Guidance SG5 below:

2. Alternative Gold Level Options: Domestic

For domestic developments, there are 3 options for achieving Gold level compliance to the satisfaction of the aims of CDP 5: Resource Management. All of the options require the development to meet Gold Aspect 1 as a minimum which relates to Carbon Dioxide Emissions: an improvement of 27% against the Target Emissions Rate (TER) required by the 2015 Building Regulations (equivalent to a 42.8% improvement on 2010 standards and a 60% improvement against 2007 standards) plus the required minimum of 20% carbon emissions abatement through the use of LZCGT. These options will be required to be certified by an Independent Approved Certifier of Design. A Statement of Energy, utilising the template provided in SG5, will be required for the planning application, however, overall compliance will be dealt with as a suspensive planning condition which is then verified by Building Control at the Building Warrant stage.

The 3 options are as follows:

Alternative Gold Level Options: Domestic		
Option 1 Gold Hybrid	**Option 2 Nearly Zero Emissions**	**Option 3 Net-Zero Carbon**
Achieve Gold Aspect 1, along with Silver Active Level Aspects 2-8 inclusive	Achieve Passivhaus energy performance requirements with Gold Level Aspect 1 and Silver Active Level Aspects 4-8 inclusive	Achieve Platinum Level Aspect 1 and Silver Active Level aspects 2-8 inclusive
PLUS: All will be required to include a minimum 20% carbon dioxide emission abatement through the use of low and zero carbon generating technologies, except certified Passivhaus developments which are exempt.		

DISTRICT HEATING

Policy CDP 5 supports the application of district heating networks based on low carbon and renewable sources, including waste heat and CHP. The policy outlines the zones of the city that the council believe have the greatest potential for district heating and is where the planners are looking to implement the policy in the first instance. This drive towards low carbon heat networks aligns with the recent Scottish Government public consultations (Scottish Energy Strategy and the Climate Change Plan) which aim for 94% of non-domestic buildings to be supplied via low carbon heat networks. Similarly, the district heating aspect of Policy CDP 5 agrees with the low carbon heat objectives of the Glasgow City Energy and Carbon Masterplan, and the Scottish Government Heat Policy Statement.

To comply with this requirement, new applications must submit to the planning authority, a district heating (DH)/heat network (HN) evaluation that is specific to the development. This requires the applicant to investigate any existing or proposed DH/HN that the development could utilise using the Scottish Heat Map, and the Energy and Carbon Masterplan as a resource. Where there are no DH/HN local to the development, an appraisal investigating the opportunity for the development to install its own DH/HN is required, including an analysis of anticipated site heat, cooling and electricity loads.

To assist in the development of SoE reports, the council have published Supplementary Guidance document 5 (SG5), which has been applied in the energy calculations outlined in Section 6.0 of this report.

CDP 5 does not reference communal / shared heat loops or differentiate them from heat networks, however this system would still fall within the parameters set out within CDP 5 in terms of efficiently distributing energy and heat from LZCGT means.

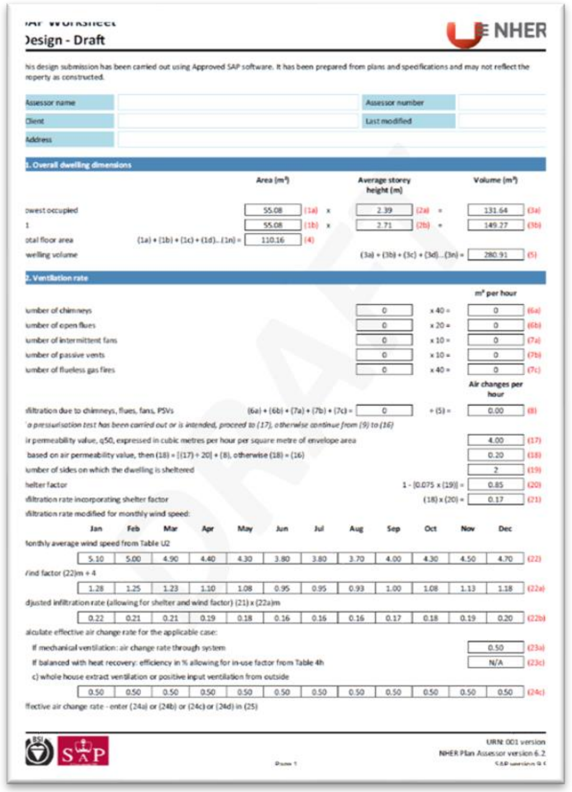
SECTION 6 (ENERGY)

The Dwelling Emission Rate (DER) must meet or exceed the Target Emission Rate (TER).

The Standard Assessment Procedure (SAP) is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessment of a dwelling's energy performance needed to underpin energy and environmental policy initiatives.

SAP assesses how much energy a dwelling will consume, when delivering a defined level of comfort and service provision. The assessment is based on standardised assumptions for occupancy and behaviour. This enables a like-for-like comparison of dwelling performance. Related factors, such as fuel costs and emissions of carbon dioxide (CO2), can be determined from the assessment.

SAP quantifies a dwelling's performance in terms of energy use per unit floor area, a fuel-cost-based energy efficiency rating (the SAP Rating) and emissions of CO2 (the Environmental Impact Rating). These indicators of performance are based on estimates of annual energy consumption for the provision of space heating, domestic hot water, lighting and ventilation. Other SAP outputs include estimate of appliance energy use, the potential for overheating in summer and the resultant cooling load.



AP Worksheet
esign - Draft

his design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the roperty as constructed.

ssessor name		Assessor number	
lient		Last modified	
ddress			

. Overall dwelling dimensions

		Area (m²)			Average storey height (m)		Volume (m³)	
owest occupied		55.08	(1a)	x	2.39	(2a) =	131.64	(3a)
1		55.08	(1b)	x	2.71	(2b) =	149.27	(3b)
otal floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	110.16	(4)					
welling volume						(3a) + (3b) + (3c) + (3d)...(3n) =	280.91	(5)

. Ventilation rate

				m³ per hour	
umber of chimneys		0	x 40 =	0	(6a)
umber of open flues		0	x 20 =	0	(6b)
umber of intermittent fans		0	x 10 =	0	(7a)
umber of passive vents		0	x 10 =	0	(7b)
umber of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
filtration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

ir permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00	(17)
based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
umber of sides on which the dwelling is sheltered		2	(19)
helter factor	1 - [0.075 x (19)] =	0.85	(20)
filtration rate incorporating shelter factor	(18) x (20) =	0.17	(21)

filtration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
onthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
ind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
djusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(22b)

alculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

ffective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

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NHER Plan Assessor version 6.2

Fig 3 – Example SAP Calculation Worksheet

SECTION 7 (SUSTAINABILITY)

The specified level of sustainability for a dwelling should be selected from the following:

- Bronze or Bronze Active
- Silver or Silver Active
- Gold

The aim is for balance in the setting of upper levels because sustainability is considered in the round rather than focusing on issues of energy or carbon emissions clauses 7.1 — 7.1.1. Reaching upper levels should be a valid target for any new development, regardless of size or location. Generally, levels have been set to avoid individual aspects that could upset applications which might otherwise meet all of the other aspects of sustainability.

The first optional upper level 'Silver' offers substantial benefits in a range of sustainability aspects which should be achievable by a sector of the mainstream market. The second optional upper level 'gold' is a more demanding target, initially aimed at those intent on pursuing best practice.

Buildings that exceed a gold sustainability level are also welcomed. A third upper level called 'platinum' has been reserved for further recognition within the building standards system. At present, only the aspect of carbon dioxide emissions has been defined for this level.

Buildings that exceed Bronze, Bronze Active, Silver, Silver Active or Gold levels by achieving a higher level criteria in one or more of the aspects are welcome. This additional achievement will be reflected on the sustainability label. However the achievement of the next upper level will only be recognised once all aspects of that particular level have been included. The award of an overall upper level depends upon meeting all aspects, rather than allowing trade-offs to achieve a score, reinforcing the fact that sustainable outcomes rely on holistic integrated design.

All dwellings must meet the functional standards set out in Sections 1-6 of the Scottish Building Standards. This combined with the CDP5 requirement to achieve Gold Hybrid and a 20% reduction in carbon emissions from LZCGT, means that the dwelling will comply with Silver Active as a minimum.

3.0 | LEAN MEASURES

A ‘fabric first’ approach to building design involves maximising the performance of the components and materials that make up the building fabric itself, before considering the use of mechanical and electrical building services systems. This can help to reduce capital and operational costs, improve energy efficiency and reduce carbon emissions whilst reducing ongoing maintenance costs.

Buildings designed and constructed using a fabric first approach should aim to minimise the need for energy consumption through methods such as:

- Orientating dwellings to optimise solar gain
- Enhancing fabric U-values
- Minimising thermal bridging in construction detailing
- Enhancing the performance of key components such as windows and doors
- Maximising air-tightness whilst ensuring thermal comfort

Focusing on the building fabric is generally considered to be more sustainable than relying on energy saving products, or renewable technologies, which can be expensive and may or may not be used efficiently by occupants. Integrating energy efficiency into the building envelope can also decrease the requirement for occupant interaction with complex controls and new technologies, reducing the reliance on the end user to achieve the desired energy performance of buildings.

BUILDING FABRIC

For new-build development, establishing a robust fabric strategy from the outset is crucial and necessary for the following reasons:

- To help reduce energy demand where use of low carbon equipment (LCE) may reduce carbon dioxide emissions but not energy consumption, and
- To ensure that a good level of fabric insulation is incorporated in construction, especially to elements that would be difficult or costly to upgrade in the future.

Non-repeating thermal bridging at the junctions of building elements and around openings in the building envelope form part of the calculation of energy performance in the Standard Assessment Procedure (SAP). Heat loss through such junctions, if poorly designed and constructed can contribute significantly to the overall heat loss through the insulation envelope.

Where a balanced and practical approach is taken to reducing energy demand in new dwellings, a consistent and good level of fabric insulation will limit heat loss through the building envelope.

The table below displays the maximum permissible U-values as stipulated within Section 6 (Energy) of the 2020 Scottish Building Standards. The U-values on the proposed development should be considerably better than these to improve the fabric efficiency and reduce energy demand.

MAXIMUM FABRIC U-VALUES		
Element	**Area-Weighted**	**Individual Element**
Ground Floors	0.18 W/m^{2}K	0.70 W/m^{2}K
External Walls	0.22 W/m^{2}K	0.70 W/m^{2}K
Party Walls	0.20 W/m^{2}K	N/A
Roofs	0.15 W/m^{2}K	0.35 W/m^{2}K
Openings	1.60 W/m^{2}K	3.30 W/m^{2}K

THERMAL BRIDGING

Scottish Building Regulations now require that thermal bridging be considered in energy assessment calculations. As more stringent legislation and energy awareness has led to increased insulation levels, heat losses due to thermal bridging have become increasingly important. The heat loss associated with these thermal bridges is expressed as a linear thermal transmittance (Ψ-value).

The insulation envelope of any heated building should be designed and constructed to limit heat loss through thermal bridging. The key areas of concern are:

- Repeating thermal bridging within building elements, and
- Non-repeating thermal bridging at the junction between building elements and at the edges of building elements where openings in the envelope are formed.

Whilst repeating thermal bridges are taken into account through U-value calculations, a separate assessment is required for non-repeating thermal bridges.

To determine the value for heat loss arising from non-repeating thermal bridging, designs are assessed to identify the various junction types. Each junction is then assigned a Ψ-value for each junction type, based upon the following options;

- Input ‘default’ Ψ-values for each junction listed within Appendix K of SAP 2012
- Input ‘accredited’ Ψ-values for each junction by following the principles of ‘Accredited Construction Details’, or other published and substantiated construction detail sets
- Input ‘calculated’ Ψ-values for each junction. Calculation must be performed by a person with suitable expertise and experience following the guidance set out in BR 497

The use of ‘default’ Ψ-values will have a significant detrimental effect on the assessed performance of a building. Using ‘accredited’ Ψ-values will improve thermal performance; however, these details only reflect a limited number of construction methods. It should be noted that where details do not conform exactly to the Accredited Construction Details, they must be modelled using thermal simulation software in accordance with the associated conventions and standards.

By calculating the specific heat loss of each junction, you can accurately reflect the thermal performance of the building, whilst optimisation can lead to a significant improvement in thermal performance over ‘default’ and ‘accredited’ figures.

As well as significant cost savings across a project, accurately analysing the thermal bridging can give confidence that there won’t be any post-occupancy issues relating to condensation or mould growth.

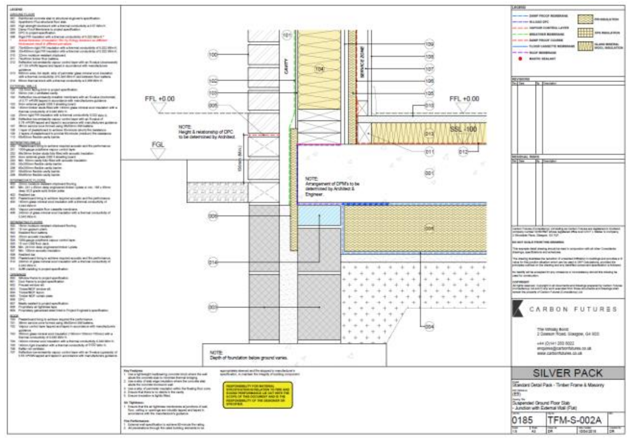


Fig 4 – Example Construction Detail

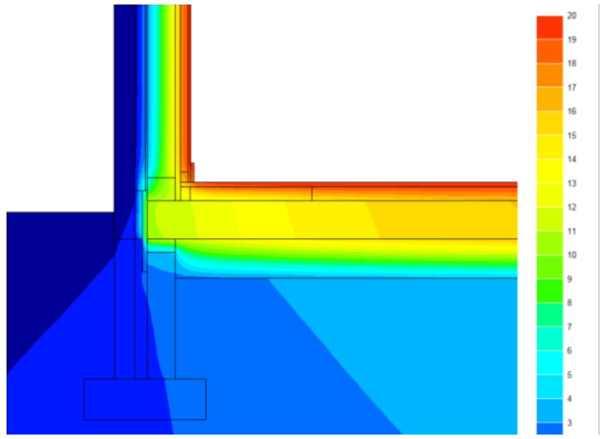


Fig 5 – Example Heat Flow Image

AIR-INFILTRATION

Addressing infiltration in new dwellings can significantly reduce heat loss and result in lower carbon dioxide emissions. This can provide flexibility when applying the methodology used to meet the TER for carbon dioxide emissions (see Section 2.0 of this report).

To limit heat loss, any heated building should be designed to limit air infiltration through the building fabric. This is done by providing a continuous barrier that resists air movement through the insulation envelope and limits external air paths into each of the following:

- the inside of the dwelling or building consisting of dwellings
- the 'warm' side of insulation layers
- spaces between the component parts of exposed building elements, where such parts contribute to the thermal performance of the element.

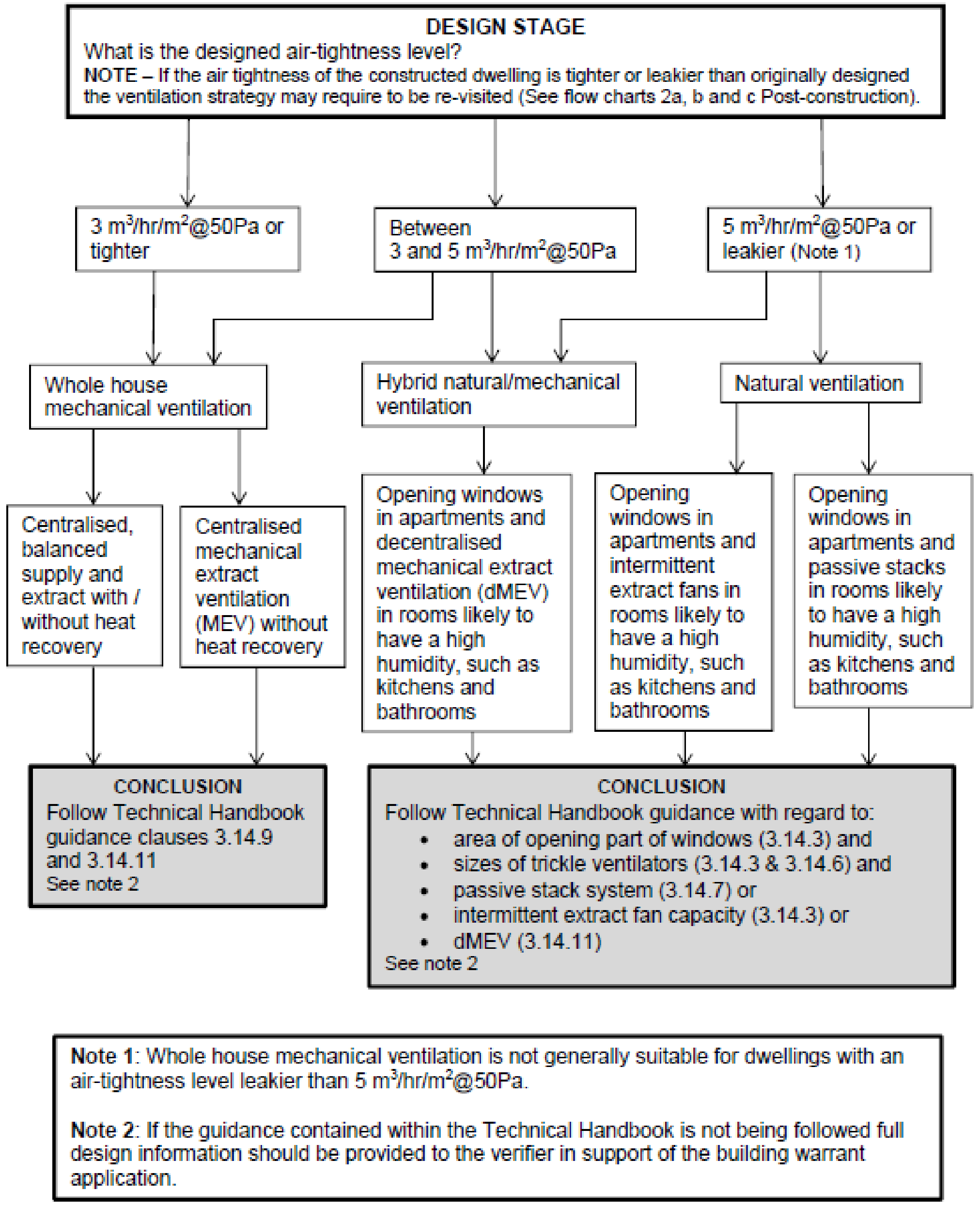
Building Standards recommend that buildings are designed to achieve a value of 10 m³/h.m² @ 50 Pa or better to allow a balanced approach to managing building heat loss.

Low air infiltration rates will contribute to energy performance but should not be so low as to adversely affect the health of occupants or the building fabric. There is, therefore, a need to establish dwelling performance by test to demonstrate compliance in both these respects.

Evidence from testing of dwellings, constructed to the 2007 and 2010 Accredited Construction Details (Scotland) and of similar constructions elsewhere in the UK, indicates that air-tightness levels of 5 to 7 m³/h.m² @ 50 Pa or better are readily achievable and can be exceeded unintentionally.

Lower air infiltration rates, of less that 5 m3/h.m2 @ 50 Pa, may give rise to problems with internal air quality and condensation unless this is addressed through planned ventilation. Accordingly, where design infiltration rates are proposed below this rate, reference should be made to additional measures needed to ensure air quality under Standard 3.14 of the Domestic Technical Handbooks on the provision of ventilation within dwellings.

Air-tightness testing should be carried out on new dwellings to demonstrate that air infiltration rates deliver both the stated design level under this guidance and that the proposed ventilation strategy remains appropriate Air leakage is the uncontrolled movement of air in to and out of a building which is not for the specific and planned purpose of exhausting stale air or bringing in fresh air.



Note 1: Whole house mechanical ventilation is not generally suitable for dwellings with an air-tightness level leakier than 5 m³/hr/m²@50Pa.

Note 2: If the guidance contained within the Technical Handbook is not being followed full design information should be provided to the verifier in support of the building warrant application.

Fig 6 – Domestic Ventilation Flowchart (Design Stage)

4.0 | CLEAN MEASURES

Following the reduction of energy demand, consideration should be given to reducing energy consumption through energy efficiency measures. This is typically achieved by improving the energy efficiency of building services equipment over the Building Standards minimum recommendations.

SPACE & WATER HEATING

Outlining Scotland’s first long-term housing strategy, the Scottish Government have published the 'Housing to 2040' document, which sits alongside the ‘New Build Heat Standard’ and 'Heat in Buildings Strategy' consultation papers to deliver statutory targets for climate change and fuel poverty focussing on the use of ‘Zero Direct Emissions’ heating.

As outlined within each publication, the key points for new-build homes include:

- Review of Section 6 (Energy) standards in 2021 and 2024;
- Development of new regulations which will require new buildings consented from 2024 to use zero direct emissions heating;
- All new homes delivered by Registered Social Landlords and local authorities to be zero emissions homes by 2026;

ZERO DIRECT EMISSIONS

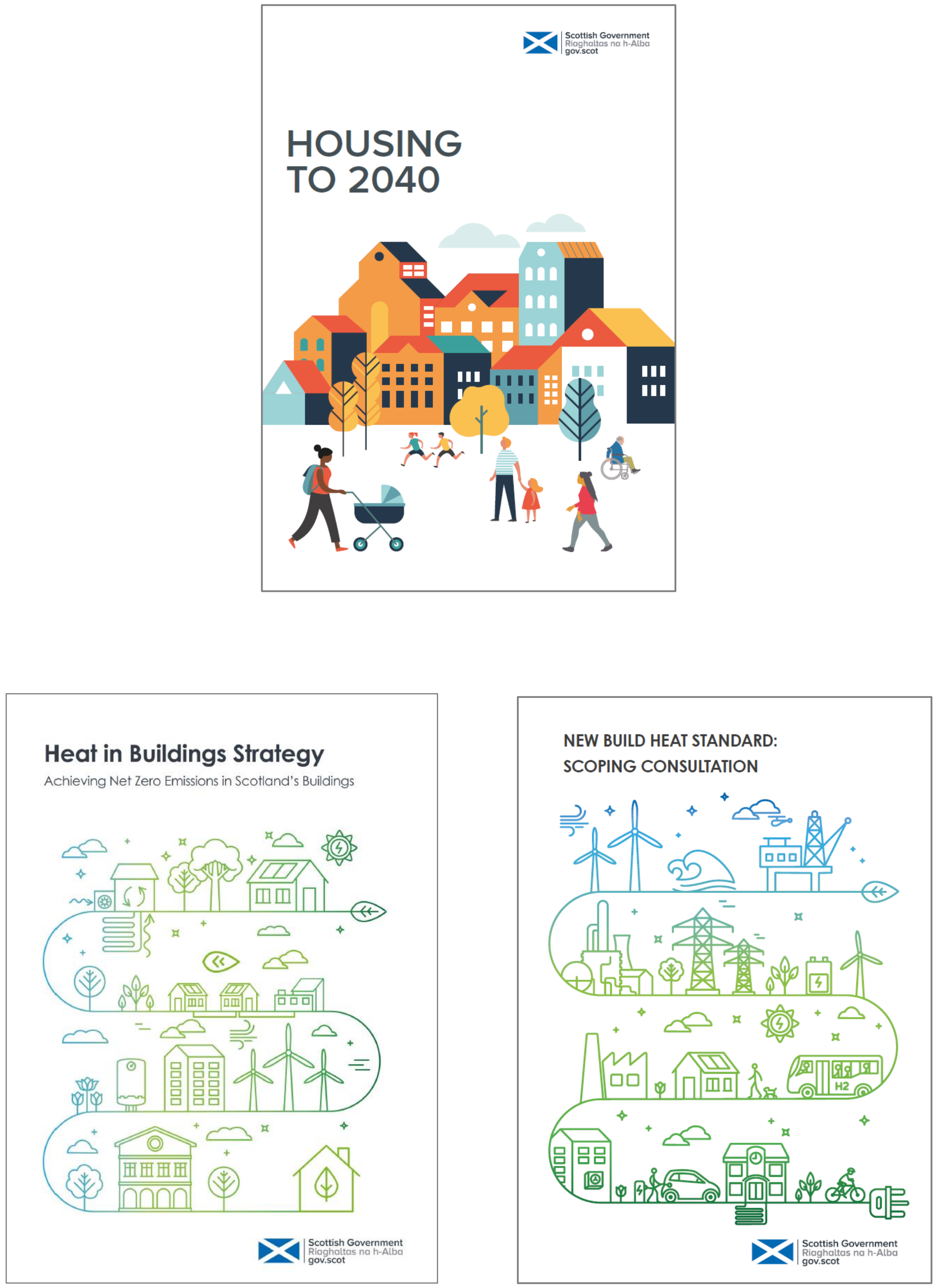
It is proposed that electricity and thermal energy from heat networks would be considered ‘zero-rated’ i.e. considered to produce zero direct emissions at the point of heat consumption.

Direct point of use emissions means any indirect or upstream greenhouse gas emissions that are produced during the generation or distribution of purchased thermal or electrical energy – which is delivered via a heat network or heat produced from grid electricity – would be considered out of scope.

In line with relevant government and local authority policies and legislation, the energy strategy for this development will consider a range of low carbon and zero-rated emission technologies to provide space and water heating, as noted in the table below. The choice of system will also be influenced by the outcome of the Low Carbon & Renewable Technology Appraisal (see Section 5.0 of this report).

SYSTEM	INDIVIDUAL	COMMUNAL	‘ZERO-RATED’ TECHNOLOGY
All-Electric	■	□	■
Heat Pump (All Varieties)	■	■	■
Solar Thermal	□	□	■
Heat Recovery	■	■	■
Combined Heat & Power	□	■	□
Community Heating		■	□

■ Suitable Technology □ Possible Technology (Dependent on Additional Factors)



Scottish Government
Riaghaltas na h-Alba
gov.scot

HOUSING TO 2040

Heat in Buildings Strategy
Achieving Net Zero Emissions in Scotland’s Buildings

Scottish Government
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NEW BUILD HEAT STANDARD:
SCOPING CONSULTATION

Scottish Government
Riaghaltas na h-Alba
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Fig 7 – Scottish Government ‘Housing to 2040’ (top right), Scottish Government ‘Draft Heat in Buildings Strategy’ (bottom left) and Scottish Government ‘New Build Heat Standard’ (bottom right)

VENTILATION

All buildings require to be ventilated so that the air quality within the building is not a threat to the health of the occupants or the building itself. This is achieved by the process of changing air in an enclosed space. A proportion of the air in the space should be regularly withdrawn and replaced with external air. Dwellings are generally ventilated through a combination of both “purpose provided ventilation” and “fortuitous infiltration”.

Purpose provided ventilation is the controllable air exchange between the inside and outside of a dwelling by means of a range of natural ventilating devices including windows and trickle (background) ventilators or mechanical devices such as extract and supply fans. Fortuitous infiltration is the uncontrollable air exchange between the inside and outside of a dwelling due to pressure differences caused by wind and temperature variations. The air movement may occur through a wide range of air leakage paths through imperfections in the building structure such as cracks and gaps between building elements.

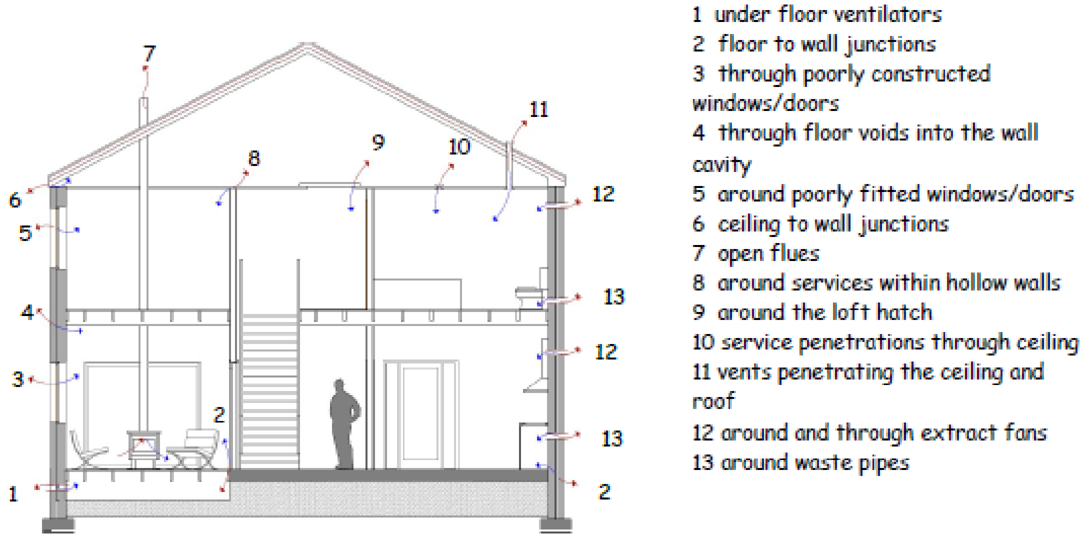


Fig 8 – Infiltration paths from Scottish Government ‘Domestic Ventilation Guide’

Reducing the amount of fortuitous infiltration that occurs within a dwelling can play a significant part in reducing carbon emissions by minimising both the amount of warm air leaking from the dwelling and the amount of cold air entering into the dwelling. However, this air movement has traditionally contributed to the ventilation strategy of dwellings. Reducing the overall fortuitous infiltration rate of a dwelling, for example below 5 m^3/h/m^2 @ 50 Pa, may necessitate the adoption of an alternative ventilation strategy to achieve satisfactory ventilation of the dwelling. A more air tight building also places a greater need for “purpose provided ventilation” to deliver satisfactory air quality within a dwelling.

A mechanical ventilation system normally relies on air movement generated by a powered fan. The effectiveness of a mechanical ventilation system relies on the design, appropriate product/component selection, installation, workmanship, commissioning, maintenance and the awareness of the correct operation of the system by the occupier of the dwelling. In systems where air is mechanically introduced into the building, treatment by filters may improve the quality of the indoor air but they must be cleaned/replaced at the correct intervals.

Mechanical ventilation systems commonly include:

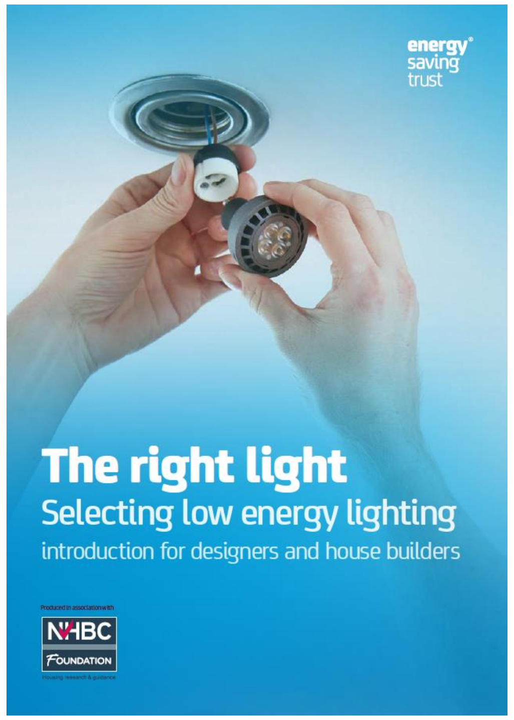
- Localised mechanical extract ventilation with natural supply (e.g. bathroom fan with trickle ventilator)
- Decentralised Mechanical Extract Ventilation (dMEV) with a natural supply – individual continuously operating (low rate) extraction units with boost facility, usually within wet rooms (kitchens, bathrooms, etc)
- Centralised Mechanical Extract Ventilation (cMEV) with a natural supply – providing “whole house” ventilation
- Balanced Mechanical Supply and Extract (e.g. Mechanical Ventilation with Heat Recovery (MVHR)) – providing “whole house” ventilation

The design of the proposed ventilation system should be in accordance with the Building Standards Domestic Ventilation Guide and the Domestic Building Services Compliance Guide.

LIGHTING

Artificial lighting can account for a substantial proportion of the electricity used within a building. Appropriate lighting design (including use of natural daylight) can reduce carbon dioxide emissions and running costs, and can also reduce internal heat gains.

Guidance on the efficiency of fixed internal and external lighting is given in the Domestic Building Services Compliance Guide for Scotland. Further guidance on selecting the appropriate low energy lighting specification can be found within the Energy Saving Trust’s publication, ‘The Right Light: Selecting low energy lighting – introduction for designers and house builders’.


energy saving trust

The right light
Selecting low energy lighting
introduction for designers and house builders

NHBC Foundation

Fig 9 – Energy Saving Trust Publication: ‘The Right Light’

5.0 | GREEN MEASURES

This section of the SoE presents the results from a low carbon and renewable technology feasibility study for the development to identify technologies that are appropriate for the development. Fuel cells have been excluded from the assessment due to the infancy of this technology which would result in a significant technical, commercial and economic risk to the project.

Prior to the installation of electrical generating technologies, the local Distribution Network Operator (DNO) must be contacted to establish existing power flow arrangement of their electrical network and it's suitability to accept parallel connectivity from local embedded generators (e.g. photovoltaics, wind turbines, CHP). For this development, the DNO is Scottish Power Energy Networks (SPEN) who have classified the local network as a Green Zone, which means all operational factors are within tolerable limits and so opportunities may exist to connect additional Distributed Generation without reinforcing the network (subject to detailed studies).

	Photovoltaics	Building mounted solar photovoltaic panels to generate renewable electricity	• Installation of technology subject to Scottish Power approval for embedded generators. • Currently development site is in a Green Zone, meaning connection back to the electricity grid is likely. • Option to feed landlord areas from communal PV array or provide PV panels for each unit. • Technology may be considered in conjunction with battery storage to maximise generation usage. • The EPC ratings for the units will not take benefit of the PV if electrical generation goes to the landlord. • Potential solution which should be further investigated.	👍
	Solar Thermal Heating	Building mounted solar photovoltaic panels to generate domestic hot water for use in each building	• The outputs from solar thermal systems installed in Scotland tend to be low. • Capital cost of the system result in a poor pay pack. • Additional plant space will be required within each dwelling to install the hydraulic arrangements of a solar thermal system. • Technology not recommended.	👎
	Wind Turbines	Free standing mast mounted micro wind turbines to generate renewable electricity	• Installation of technology subject to Scottish Power approval for embedded generators. • Currently development site is in an Amber Zone, meaning that there may be some limitations on connection back into the grid. • Can provide large amounts of electrical generation, offsetting gird purchases and which provide a good payback on the technology. • High capital cost, and ongoing maintenance costs associated with technology. • Requires significant amount of space to allow maintenance access. • Can have contentious planning issues, particularly due to aesthetics, noise and environmental / wild life impacts. • Technology not recommended.	👎
	Biomass	Use of wood biomass or biofuel to generate hot water for space heating and domestic hot water	• Boilers require tall flues several meters tall to comply with the Clean Air Act. • Can result in air quality issues. • Large fuel storage space required with suitable space for delivery vehicles. • Glasgow City contains a number of Air Quality Management Areas (AQMAs) that are subject to restrictions, however the site currently falls out with restricted areas. • Technology not recommended.	👎
	CHP	Combined generation of heat and power from single fuel source	• Gas CHP is not listed within the CDP 5 approved LZCGT list. • Technology not recommended.	👎
	ASHP	Use of thermodynamic refrigeration cycle to generate hot water using air as a heat sink	• Technology does not require large areas of ground. • Packaged units allow for a more cost-effective option compared to GSHP. • Performance dependent upon ambient air temperatures (higher temperatures recommended). • Acoustic attenuation required to address noise from ASHP units. • System can work with individual units serving each dwelling or as a communal heating solution. • Potential solution as a communal heating system which should be further investigated.	👍

	GSHP (horizontal)	Use of thermodynamic refrigeration cycle to generate hot water from a ground heat sink	• Technology requires large area of ground for the installation of ground loops. • Capital cost of technology tends to be high due to ground works required. • Performance dependent upon ground conditions. • Ground temperature less stable at lower depths which can reduce efficiency of system. • Technology not recommended.	👎
	Shared-Loop GSHP (vertical)	Use of thermodynamic refrigeration cycle to generate hot water using deep geothermal boreholes	• Technology has a high capital costs due to borehole drilling costs and civils work. • Technology requires area of ground for the installation of boreholes. • Ground temperature very stable at borehole depths which provide and efficient heat pump performance. • Solution as a communal heating solution serving individual heat pumps or as a heat network from a large central GSHP system. • Heat network solution to be further investigated.	🔍
	WSHP	Use of thermodynamic refrigeration cycle to generate hot water using a body of water as a heat sink	• The River Clyde is the closest body of water, however at 0.5 miles away, it is a significant distance from site and it is highly unlikely infrastructure could be installed across numerous roads and private land boundaries. • Technology has a high capital costs due to civil works required. • Technical and program risks with co-ordinating approvals/ works with relevant stakeholders (e.g. SEPA, GCC, British Waterways Scotland etc.). • High maintenance costs and fault issues, particularly if the system is open loop (i.e. debris from river getting into the system). • Technology not recommended.	👎
	Hydro-electricity	Use of moving water to generate electricity	• The River Kelvin is the closest body of water, however at 300-400m away, it is a significant distance from site and it is highly unlikely infrastructure could be installed across numerous roads and private land boundaries. • Technology has a high capital costs due to civil works required to install the turbine/ generator. • Technical and program risks with co-ordinating approvals/ works with relevant stakeholders (e.g. SEPA, GCC, British Waterways Scotland etc.). • Technology not recommended.	👎
	Heat Recovery	Use of waste heat recovery or waste water heat recovery systems	• Flue gas heat recovery recuperates heat from gas fired boiler flue exhaust gases. This system is only viable if gas boilers are considered. • Waste water heat recovery uses the residual heat from the waste shower water to preheat the incoming cold feed. • Vertical waste water heat recovery pipe systems are most efficient and commonly used in houses. • Horizontal waste water heat recovery systems are primarily used in flats. • Both systems should be assessed to ensure they deliver a sufficient efficiency to meet the requirements of Aspect Silver Level 3. • Potential solution which should be further investigated.	👍

👍 Technology recommended

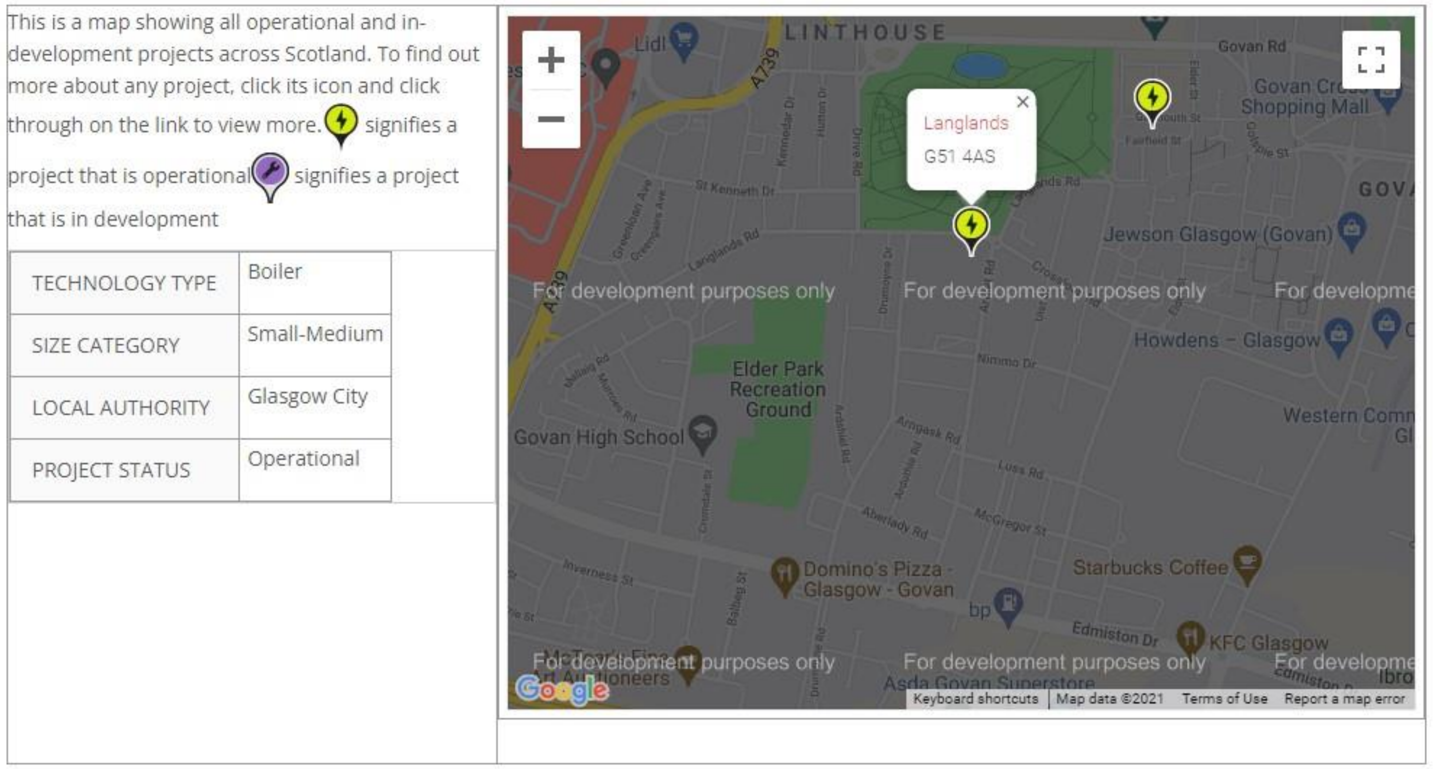
👎 Technology not recommended

🔍 Technology to be investigated further

6.0 | DISTRICT HEATING APPRAISAL

EXISTING HEAT NETWORKS

The District Heating Scotland interactive website was used to check if there are any district heating networks in operation or in development close to the site. Whilst there is one operational network in the vicinity of the site, it is approximately 400m away and the capacity of this network is currently unknown. A new installation would therefore be required, should a district heating solution be pursued.



This is a map showing all operational and in-development projects across Scotland. To find out more about any project, click its icon and click through on the link to view more. ⚡ signifies a project that is operational 🔧 signifies a project that is in development

TECHNOLOGY TYPE	Boiler
SIZE CATEGORY	Small-Medium
LOCAL AUTHORITY	Glasgow City
PROJECT STATUS	Operational

Fig 10 – Existing Heat Networks from District Heating Scotland Map

HEAT MAP AND PROPOSED HEAT NETWORKS

At the time of writing this report, the Scotland Heat Map was current unavailable whilst the Scottish Government move it to a new provider. Nevertheless, it is anticipated that the site is in a medium to high heat density area of the city with an annual heat demand of 100 to 625 MWh per 50m².

During the early project stages, where designs have still to be finalised, the feasibility of a new heat network can be considered using a high-level assessment. Linear Heat Density (LHD) calculations were therefore carried out, similar to a process used in other successful schemes across Scandinavia and the UK, to assess the viability of a heat network at the development.

Linear heat density considers the heat demand of a proposal and the length of pipework required to connect to or create a heat network. A linear heat density of 4 (or more) MWh/m/year would indicate that a heat network is likely to be viable.

$$\text{Linear heat density (MWh/m/year)} = \frac{\text{Total annual heat demand (MWh/year)}}{\text{Length of Network (m)}}$$

The preliminary heat demand of the development was calculated to be 162MWh/annum, including a 10% allowance for heat losses across the primary heating network.

The indicative network route of 105m has been calculated, based on a roof top plant on each block.

The linear heat density was therefore calculated as follows:

$$\text{Linear heat density} = \frac{\text{Total annual heat demand (MWh/year)}}{\text{Length of Network (m)}}$$

$$\text{Linear heat density} = \frac{162\text{ MWh}}{105\text{ m}} \qquad 1.54\text{ MWh/m/year}$$

The results of this study suggest that a heat network may not be financially viable, however, should there still be a desire to proceed with a centralised installation for each block, the LZCGT feasibility study has identified the following technologies as potentially viable:

- Air Source Heat Pump
- Ground Source Heat Pump (Shared Loop)

A communal option should be assessed further during detailed design once the heat map has been reactivated and wider / adjacent site opportunities evaluated.

7.0 | CONCLUSION

This report has been prepared to support the planning application for the proposed Nimmo Drive development in the Govan area of Glasgow. The development site is currently occupied by Elderpark Community Centre and the Mac Ventilation Warehouse on the opposite corner. Both existing buildings are to be demolished to make way for the development of 45 new-build flatted dwellings.

The development falls under the Glasgow City Plan and specifically Policy CDP5 in relation to energy and sustainability. Planning applications submitted under the Glasgow Development Plan post-September 2018 are required to provide a Statement on Energy (SoA) demonstrating compliance against Section 7 (Sustainability) using one of the three Gold Level options, whilst also including a minimum 20% carbon emissions abatement through the use of Low and Zero Carbon Generating Technologies (LZCGT).

In accordance with CDP5 of the Glasgow City Plan, the feasibility of a heat network has been investigated and although initial results indicate that there is little opportunity for a district heating network, a communal / shared heating loop system would be an appropriate heating option. CDP 5 does not reference communal / shared heat loops or differentiate them from heat networks, however this system would still fall within the parameters set out within CDP 5 in terms of efficiently distributing energy and heat from LZCGT means.

A ‘fabric first’ approach to building design will be pursued. This involves maximising the performance of the components and materials that make up the building fabric itself, before considering the use of mechanical or electrical building services systems. This will help to reduce capital and operational costs, improve energy efficiency and reduce carbon emissions whilst reducing ongoing maintenance costs.

Following the reduction of energy demand, consideration will be given to reducing energy consumption through energy efficiency measures. This will be achieved by improving the energy efficiency of building services equipment over the Building Standards minimum recommendations.

The outcome of the Low Carbon & Renewable Technology Appraisal provides a range of low carbon and zero-rated emission technologies to consider for the provision of space and water heating and renewable energy generation. This has identified the following technologies for further investigation during the detailed design of the project:

- All-Electric Systems
- Air Source Heat Pumps
- Ground Source Heat Pumps (vertical / shared loop)
- Photovoltaics
- Heat Recovery

There is currently one existing heat network in this area, however as it is approximately 400m away and of an unknown size, connection to this network is viewed as unviable. A communal / shared heating loop configuration would potentially be appropriate and will be investigated further during the design stage.

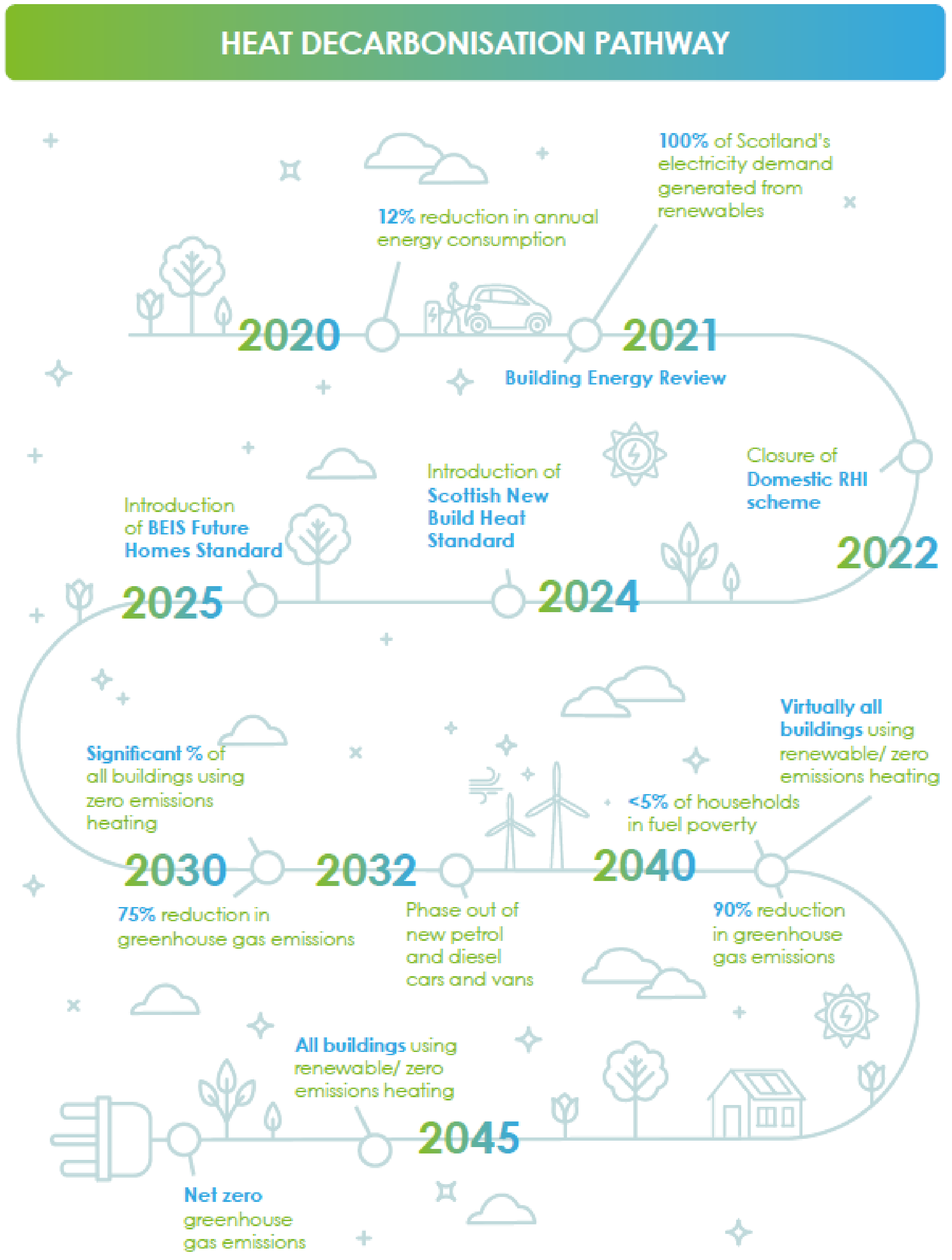
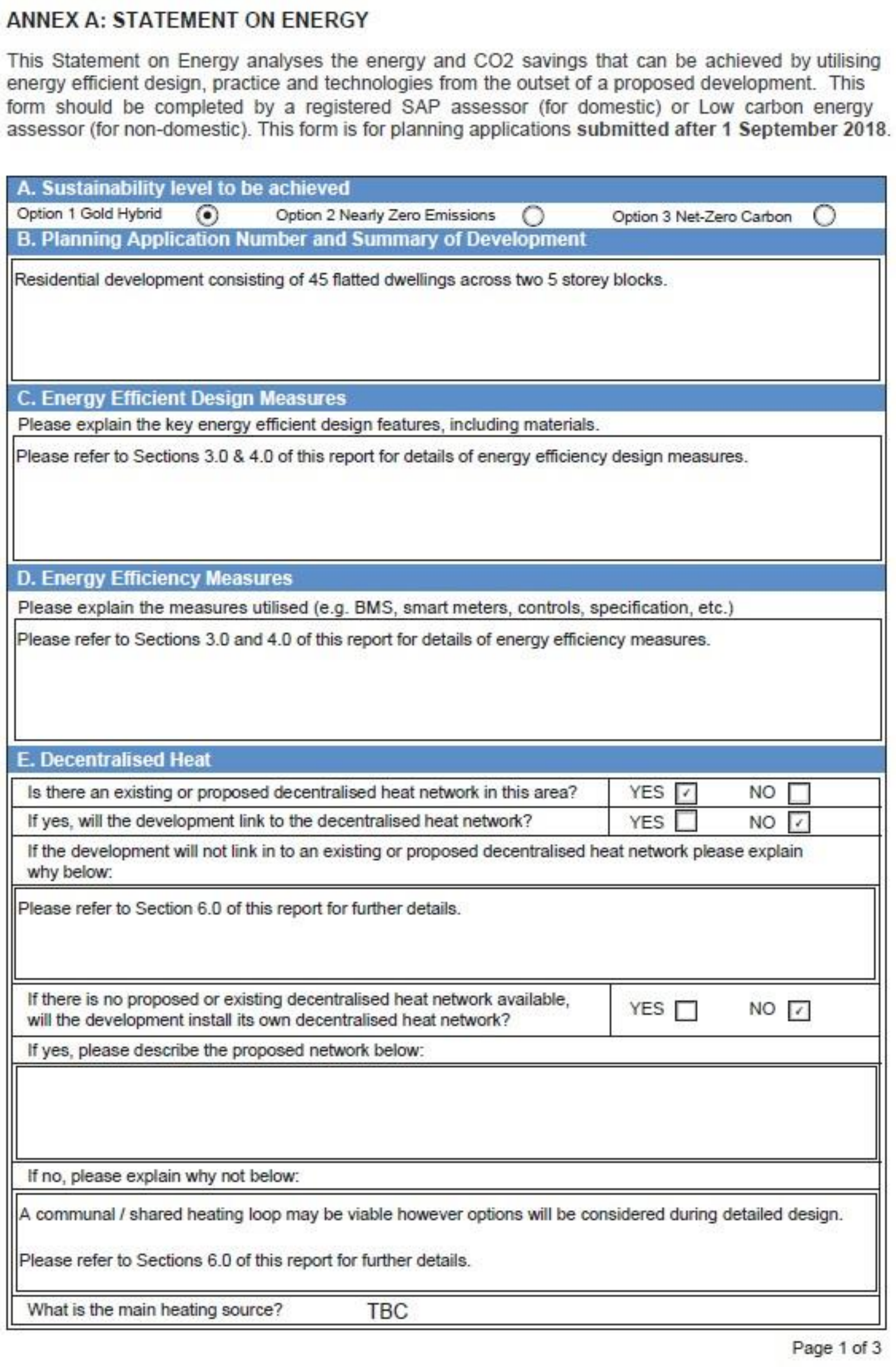


Fig 11 – Heat Decarbonisation Pathway from Scottish Government ‘New Build Heat Standard’

APPENDIX A | **SG5 STATEMENT ON ENERGY**



ANNEX A: STATEMENT ON ENERGY

This Statement on Energy analyses the energy and CO2 savings that can be achieved by utilising energy efficient design, practice and technologies from the outset of a proposed development. This form should be completed by a registered SAP assessor (for domestic) or Low carbon energy assessor (for non-domestic). This form is for planning applications **submitted after 1 September 2018**.

A. Sustainability level to be achieved

Option 1 Gold Hybrid ● Option 2 Nearly Zero Emissions ○ Option 3 Net-Zero Carbon ○

B. Planning Application Number and Summary of Development

Residential development consisting of 45 flatted dwellings across two 5 storey blocks.

C. Energy Efficient Design Measures

Please explain the key energy efficient design features, including materials.

Please refer to Sections 3.0 & 4.0 of this report for details of energy efficiency design measures.

D. Energy Efficiency Measures

Please explain the measures utilised (e.g. BMS, smart meters, controls, specification, etc.)

Please refer to Sections 3.0 and 4.0 of this report for details of energy efficiency measures.

E. Decentralised Heat

Is there an existing or proposed decentralised heat network in this area?	YES ☑	NO ☐
If yes, will the development link to the decentralised heat network?	YES ☐	NO ☑

If the development will not link in to an existing or proposed decentralised heat network please explain why below:

Please refer to Section 6.0 of this report for further details.

If there is no proposed or existing decentralised heat network available, will the development install its own decentralised heat network?	YES ☐	NO ☑

If yes, please describe the proposed network below:

If no, please explain why not below:

A communal / shared heating loop may be viable however options will be considered during detailed design.

Please refer to Sections 6.0 of this report for further details.

What is the main heating source? TBC

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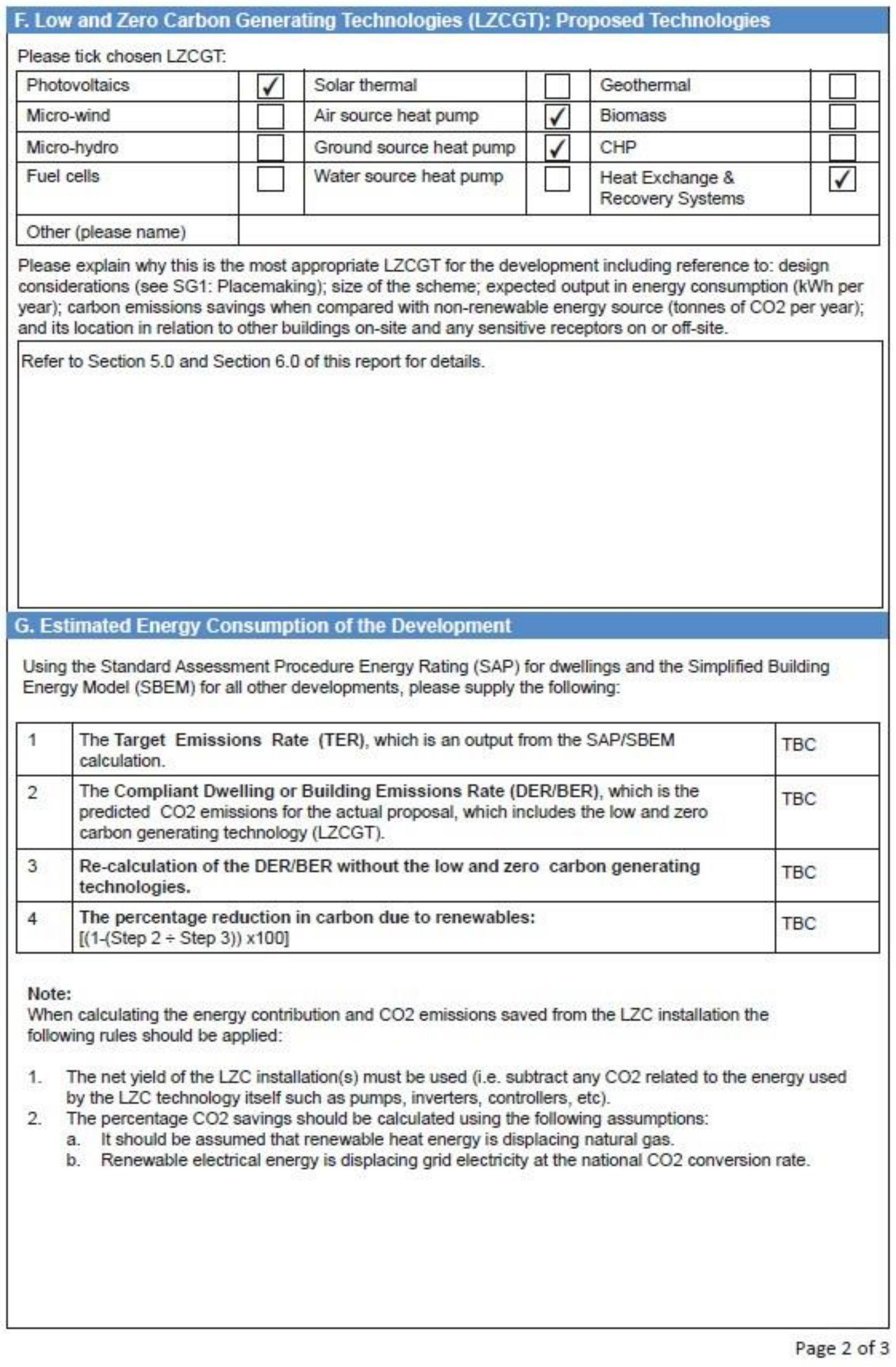

F. Low and Zero Carbon Generating Technologies (LZCGT): Proposed Technologies

Please tick chosen LZCGT:

Photovoltaics	☑	Solar thermal	☐	Geothermal	☐
Micro-wind	☐	Air source heat pump	☑	Biomass	☐
Micro-hydro	☐	Ground source heat pump	☑	CHP	☐
Fuel cells	☐	Water source heat pump	☐	Heat Exchange & Recovery Systems	☑
Other (please name)					

Please explain why this is the most appropriate LZCGT for the development including reference to: design considerations (see SG1: Placemaking); size of the scheme; expected output in energy consumption (kWh per year); carbon emissions savings when compared with non-renewable energy source (tonnes of CO2 per year); and its location in relation to other buildings on-site and any sensitive receptors on or off-site.

Refer to Section 5.0 and Section 6.0 of this report for details.

G. Estimated Energy Consumption of the Development

Using the Standard Assessment Procedure Energy Rating (SAP) for dwellings and the Simplified Building Energy Model (SBEM) for all other developments, please supply the following:

1	The **Target Emissions Rate (TER)**, which is an output from the SAP/SBEM calculation.	TBC
2	The **Compliant Dwelling or Building Emissions Rate (DER/BER)**, which is the predicted CO2 emissions for the actual proposal, which includes the low and zero carbon generating technology (LZCGT).	TBC
3	**Re-calculation of the DER/BER without the low and zero carbon generating technologies.**	TBC
4	**The percentage reduction in carbon due to renewables:** [(1-(Step 2 ÷ Step 3)) x100]	TBC

Note:
When calculating the energy contribution and CO2 emissions saved from the LZC installation the following rules should be applied:

1. The net yield of the LZC installation(s) must be used (i.e. subtract any CO2 related to the energy used by the LZC technology itself such as pumps, inverters, controllers, etc).
2. The percentage CO2 savings should be calculated using the following assumptions:
   a. It should be assumed that renewable heat energy is displacing natural gas.
   b. Renewable electrical energy is displacing grid electricity at the national CO2 conversion rate.

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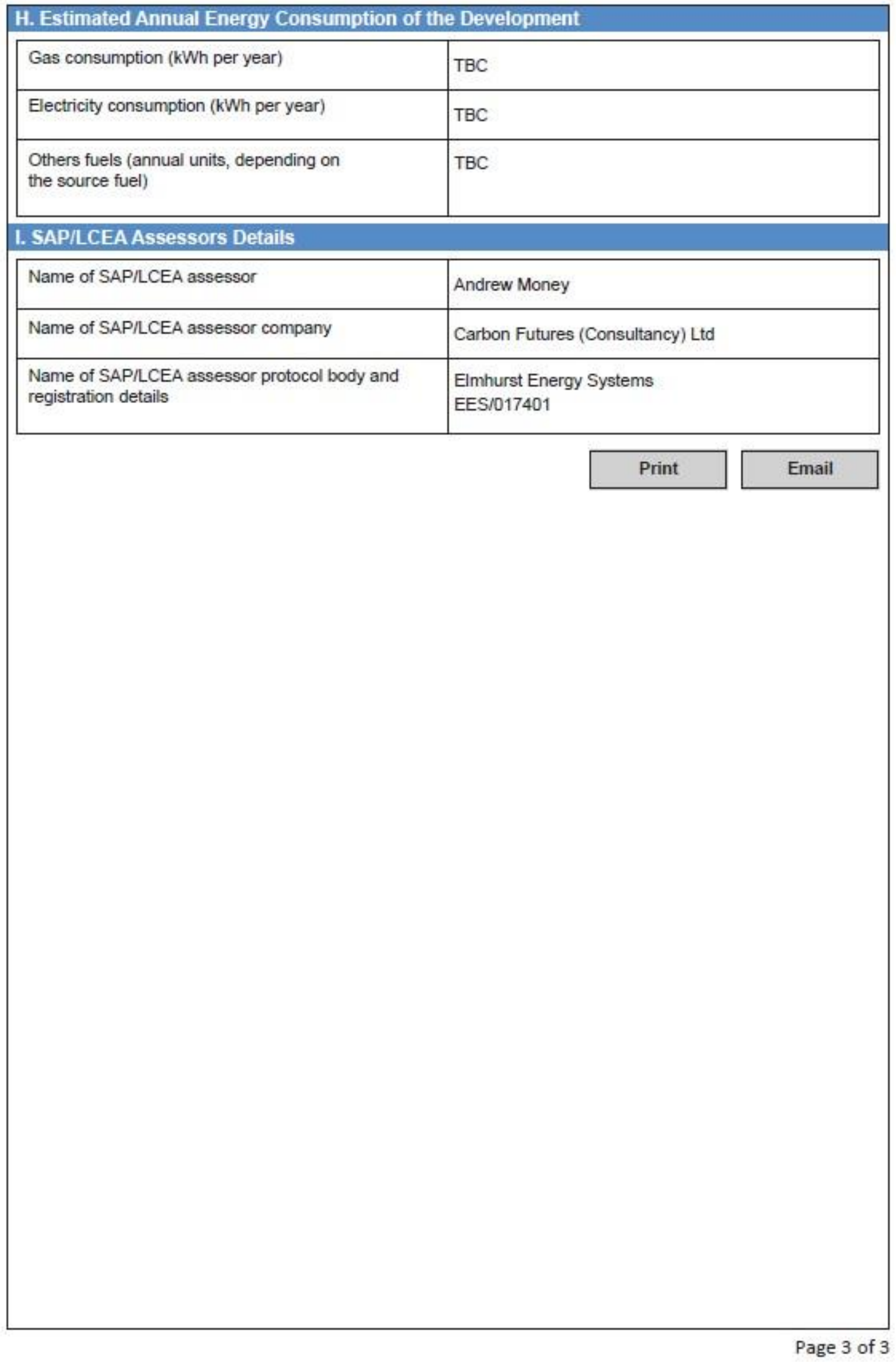

H. Estimated Annual Energy Consumption of the Development

Gas consumption (kWh per year)	TBC
Electricity consumption (kWh per year)	TBC
Others fuels (annual units, depending on the source fuel)	TBC

I. SAP/LCEA Assessors Details

Name of SAP/LCEA assessor	Andrew Money
Name of SAP/LCEA assessor company	Carbon Futures (Consultancy) Ltd
Name of SAP/LCEA assessor protocol body and registration details	Elmhurst Energy Systems EES/017401

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