Craigforth North

Energy & Sustainability Statement

atelier ten

Environmental Design Consultants + Building Services Engineers
atelierten.com

ATELIER TEN
226 West George Street
Glasgow
G2 2PQ

T +44 (0) 141 333 0499

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PREPARED BY: FELIPE CASTRO

SIGNED:

DATED: 04.06.2020

CHECKED BY: ALLAN FOY

SIGNED:

DATED: 04.06.2020

APPROVED BY: STEPHEN MCALOON

SIGNED:

DATED: 04.06.2020

NO:	DATE	APPROVED
01	02.07.20	SM

CONTENTS

Sustainability and Low carbon design principles have been a fundamental aspect on the design development of the Craigforth Office building. The project implements passive design measures to reduce the energy demand with high efficient systems and LZCGT applied to minimise operational carbon emissions.

To address wider sustainability issues, the project is also considering BREEAM Excellent Certification.

EXECUTIVE SUMMARY

The Energy and Sustainability Statement provides a response to Primary Policy 4 (Green House Gas Reduction), Policy 4.1 (Low and Zero Carbon Buildings) and Policy 4.3 (Heat Generation) of the Stirling Local Development Plan 2018, for the proposed new office building within the Craigforth masterplan development.

In the development of the buildings energy strategy, Atelier Ten have applied an energy hierarchy process of reducing energy demand through passive measures, applying highly efficient systems, and finally the application of Low Zero Carbon Generating Technologies (LZCGT).

The proposed solution for the Craigforth office building involves high levels of fabric thermal performance, VRF/ ASHP technology as the primary heating and cooling system with mechanical ventilation incorporating heat recovery. In addition to the ASHP technology, a photovoltaic array (circa 145m^2) generating 25 MWh of renewable electricity is proposed. By implementing these measures, the requirements of the above planning policies are achieved, with energy modelling demonstrating a 20% reduction in carbon emissions as required by Policy 4.1 through the application of LZCGT.

Sustainable development also features high on the agenda in the proposals. The building design aims to include the creation of spaces that promote health and wellbeing which will enhance the wellness and productivity of occupants, staff, and visitors. Similarly, high standards in sustainable design and construction will be implemented in accordance with Stirling Local Development Plan, including water conservation, drainage impact, waste recycling, material selection and sustainable transport. In addition, the development is considering BREEAM Excellent certification against the BREEAM 2018 New Construction scheme.

1.0 INTRODUCTION

GENERAL

The report presented below outlines a preliminary low carbon and sustainable design philosophy followed to develop the proposed Craigforth office development. To ensure a sustainable development is achieved, exemplary practice will be applied throughout the design, construction, and operation of the buildings. This includes the design of energy efficient buildings that provide healthy, productive, and positive environments for staff, students, and visitors. The aim of this Sustainability and Low Carbon Development Statement is therefore to outline the sustainability features that will be incorporated into the proposals to achieve these goals, and in doing so provide a response to the Stirling Local Development Plan 2018.

The low carbon energy analysis that was carried out was based on a series of dynamic simulation model (DSM) calculations using thermal modelling software. The proposed office building's energy and building services strategies were developed in line with all the relevant Technical Standards under Section 6 and 7 of the Building Regulations, the government's approved energy National Calculation Methodologies (NCM) and The Chartered Institute of Building Services Engineers (CIBSE) energy and low carbon design guidance.

The report presented below covers the following:

- Planning Policy context.
- Low Carbon Development.
- Sustainability Strategy.

DESCRIPTION

The proposed new office building is situated within the Craigforth masterplan development and aims to provide speculative Grade A office space with flexibility for either a single building occupier or multiple tenants.

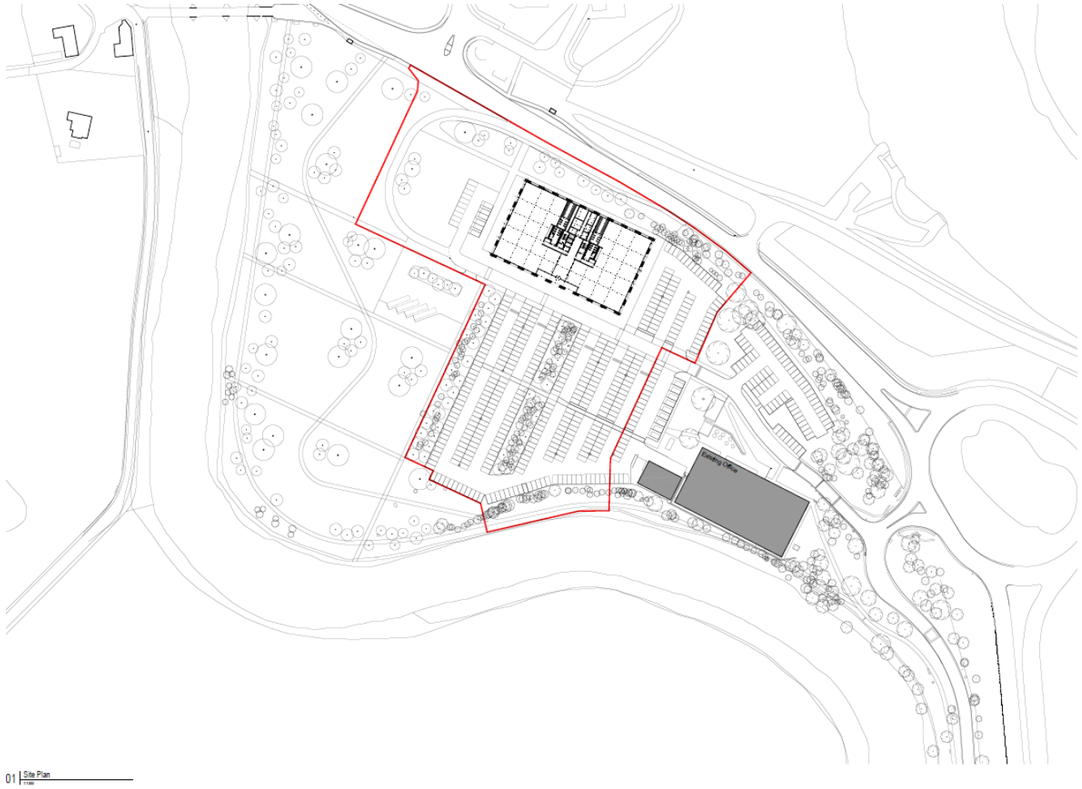


Figure 1: Craigforth Proposed (North) Site

2.0 PLANNING POLICY CONTEXT

LOCAL PLANNING

Stirling Local Development Plan 2018 applies to the Craigforth proposal. The development plan was officially adopted in October 2018 which sets out the policies and proposals for the development and use of land across Stirling. Primary Policy B Climate Change adaptation and Mitigation outlines the council's response to low and zero carbon and sustainable development with the following key objectives required for new developments:

Primary Policy 4: Greenhouse Gas Reduction
All developments should:

- Be in sustainable locations (with reference to the proposed main use or mix of uses, and existing or proposed infrastructure capacity).
- Optimise accessibility to active travel opportunities and public transport. In particular, planning permission should not be granted for significant travel-generating uses at locations which would increase reliance on the car and where:
    - direct links to local facilities via walking and cycling networks are not available or cannot be made available;
    - access to local facilities via public transport networks would involve walking more than 400m; or
    - a transport assessment does not identify satisfactory ways of meeting sustainable transport requirements.
- Employ sustainable construction materials and methods, and provide energy and heat efficient accommodation with design and layout of buildings optimising passive environmental gains (solar, shelter, water use, etc.)
- Where feasible meet energy and heat requirements by on-site renewable generation and/or by linking to local area networks.

Policy 4.1 Low and Zero Carbon Buildings
All new buildings must be designed so that at least 15% of the carbon dioxide emissions reduction standard set by Scottish Building Standards is met by the installation and operation of low and zero-carbon generating technologies. This percentage will increase to 20% in 2019.

Policy 4.3: Heat Generation
The Council will support the renewable generation of heat either in standalone locations or as an integral part of new or existing developments. Where the non-renewable generation of heat is proposed, the Council will support these developments only where greenhouse gas emissions are significantly reduced, form part of a carbon capture or where it can be demonstrated that there are plans for conversion to renewable or low carbon sources of heat in the future.

All new heat generating developments and developments of high heat demand should, where possible, co-locate and the possibility of developing heat networks should be investigated. Where appropriate, the design of new development should take account of the potential to connect with local heat networks. Where heat networks are not viable, micro-generation and heat recovery technologies within or associated with individual properties will be encouraged.

PROJECT TARGETS

In response to the above planning policies, the Craigforth office development will achieve compliance with Section 6 (Energy) of the Scottish Technical Standards by applying passive measures and highly energy efficient systems and plant. In addition, LZCGT that provide a 20% abatement will be included within the buildings design.

The opportunities for district/ community heating will also be investigated. Where these are not feasible, low carbon heat generating technologies will be applied, incorporating heat recovery systems.

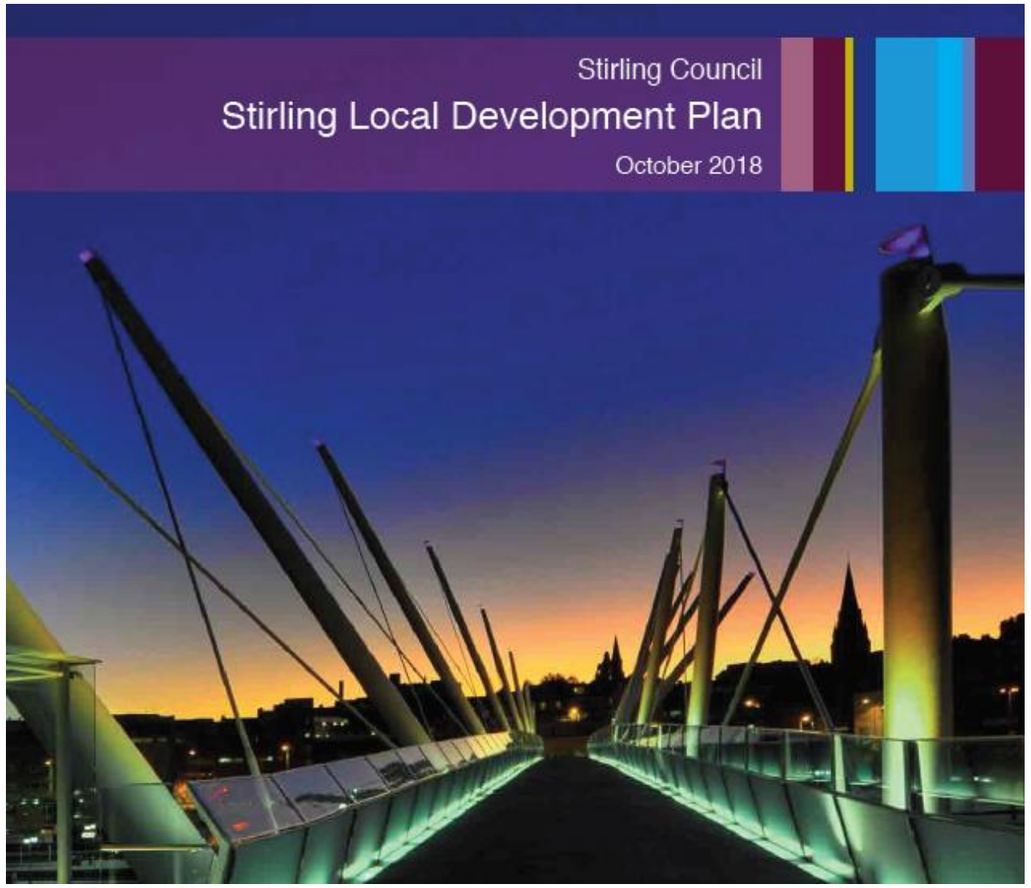


Figure 2: Stirling Local Development Plan

3.0 DISTRICT HEATING APPRAISAL

This section of the report presents the results from district heating analysis for the proposed Craigforth office development, in accordance with Policy 4.3 (Heat Generation).

HEAT MAP AND EXISTING/ PROPOSED HEAT NETWORKS

The Scottish Government Heat Map (Figure 3) illustrates that the development is in a low heat density area of between 0 – 2,500,000 kWh. The heat map also confirms that there are no existing district heating networks available that the office can connect to.

Since there are no local district heating networks available for the proposed Craigforth office development can connect to, the buildings energy strategy will therefore include low carbon heat generating technologies that incorporate heat recovery systems as per the guidance of Policy 4.3.

Figure 3: Scottish Heat Map of Graigfourth Area

4.0 ENERGY STRATEGY

This Section of the report presents the energy and low carbon measures proposed in response to Primary Policy 4 (Green House Gas Emissions).

ENERGY HIERARCHY

The proposed development aims to minimise carbon emissions to the atmosphere arising from the operations of and within the building.

To minimise CO_2 emissions, the following energy hierarchy has been applied to the design strategy of the development:

1. Minimising energy consumption through passive design measures
2. Supplying energy efficiently through active systems
3. Maximising energy generation from on-site Low and Zero Carbon Generation Technologies (LZCT) energy sources

The three principles outlined above have been applied in sequence and systematically in the development of the proposal. These are illustrated in the following sections.

PASSIVE DESIGN MEASURES

The energy efficient building design of the proposed development will minimise the need for energy in operation while maximizing the comfort of users during the lifetime of the building. The integration of passive design principles will enable the building to be less reliant on HVAC systems and minimize dependence on artificial lighting, taking advantage of natural energy flows to maintain visual and thermal comfort.

To limit heat losses across the building envelope a number of measures have been implemented. These include highly efficient built form and high levels of insulation and airtightness. Solar control glass has also been applied to minimise solar heat gains to reduce energy required for cooling. Daylight into the building has been maximised through the specification of glazing with a high visible light transmittance. The performances applied go significantly beyond building regulations compliance and have applied the latest innovative insulation and glazing products to reduce the building reliance on fossil fuels.

ENERGY EFFICIENT SYSTEMS

Services have been specified that significantly exceed compliance with Section 6 (Energy) of the Scottish Technical Standards. This has been achieved though energy efficient lighting systems and controls, as well as efficient HVAC and DHW plant and equipment.

Details of the systems applied are provided in Table 1, which includes performance of ASHP chillers, heat recovery ventilation lighting and controls. The latest innovative technologies have been applied within the energy model to reduce energy consumptions and CO_2 emissions to ensure the building uses energy as efficiently and cleanly as possible.

LOW CARBON TECHNOLOGIES

The opportunities to install LZCGT have been examined in Section 5 (Low Carbon and Renewables Appraisal) of this report. The outcomes of this conclude that photovoltaic panels are the most appropriate for the proposed development.

Table 1: Applied Energy Strategy

ELEMENT OR SYSTEM	MODELLED PARAMETERS/ PERFORMANCES
FABRIC THERMAL PERFORMANCE	
External Wall – U-Value	0.11 W/m²K
Heat Loss Floor U-Value	0.16 W/m²K
Roof U-Value	0.13 W/m²K
Glazing U-value	1.30 W/m²K
Building Air Permeability	5 m³/h.m² @ 50Pa
GLAZING PERFORMANCE/ SOLAR SHADING	
Glazing G-value	0.30
Glazing Light Transmittance	0.7%
BUILDING SERVICES INFORMATION	
Office M&E Efficiencies	• VRF fan coil system (SCoP 4 SEER of 4.5). • Mechanical ventilation with 70% heat recovery efficiency. • AHU SFP 1.9 W/ls. • High performing lighting to offices (1.2W/m²/100lux) with daylight dimming & occupancy sensing control.
Core M&E Efficiencies	• Electric panel heaters to lift lobbies and toilets • Mechanical ventilation with 70% heat recovery efficiency to toilets. • AHU SFP 1.9 W/l/s • LED lighting to core areas (refer to BRUKL report for applied luminous efficacy)
Domestic Hot Water	• Electric point of use
LZCGT Technologies	• HVRF & 145m² PV

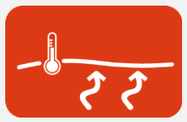
5.0 LOW CARBON AND RENEWABLE APPRAISAL

This section of the SoE presents the results from a low carbon and renewable technology feasibility study for the Craigforth office 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.

Table 2: Craigforth Office LZCGT Feasibility Study

Technology			LZCGT Study	Feasibility
	Photovoltaic Panels	Building mounted solar photovoltaic panels to generate renewable electricity	• PV panels provide a renewable source of electricity. • Operating and maintenance costs for PV panels are low compared to other renewable energy systems. • Roof access will be required as photovoltaics require maintenance and cleaning. • Cost effective technology to reduce CO_2 emissions which can achieve payback. • The yield of the system has yet to be estimated and should be explored further during the next stage of development. • Technology recommended.	
	Solar Thermal Heating	Building mounted solar collectors to generate domestic hot water for use in each building	• The outputs from solar thermal systems installed in Scotland tend to be low. The capital cost of the system may result in a poor pay pack – a varying occupancy profile can have major effect. • A benefit is that this system would qualify for payment under the non-domestic Renewable Heat Incentive. • Potential technology however there are cost and technical issues to be investigated further.	
	Wind Turbines	Free standing mast mounted micro wind turbine to generate renewable electricity	• Installation of technology subject to Scottish Power approval for embedded generators. • High capital cost, and ongoing maintenance costs associated with technology. • Can be contentious planning issues, particularly due to aesthetics, noise and environmental/ wildlife impacts. • At this stage, this technology is not recommended.	
	Biomass	Use of wood biomass or biofuel to generate hot water for space heating and DHW.	• Boilers require tall flues several meters tall to comply with the Clean Air Act and can result in air quality issues particularly in city centre locations. • System requires a significant amount of plant space for thermal stores, fuel stores and auxiliary plant. • System is costly to install and maintain. • Biomass does however receive payments against the non-domestic Renewable Heat Incentive however it is not suited to the development. • Technology not recommended.	
	CHP	Combined generation of heat and power from a single fuel source	• Installation of a CHP requires large up-front capital investment. • Demand profile must be stable all year round to suit ideal operation of CHP plant. • Combustion within cities is a major cause of air pollution. • Financially intensive. • High maintenance and capital cost. • Technology may not achieve Carbon dioxide neutrality due to the fuel/electricity carbon contents. • Technology not recommended.	

	Ground Source Heat Pumps	Use of the 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. • Technology not recommended.	
	Air Sourced Heat Pump	Use of the thermodynamic refrigeration cycle to generate hot water using air as a heat sink	• System provides low carbon heat and less installation/ plant space compared with ground and geothermal heat pumps. • VRF Heat pumps can provide both heating and cooling. • ASHP can be applied to generate domestic hot water. • Technology recommended in the form of VRF heat pump system.	
	Water Sourced Heat Pump	Use of hydropower plants capture the energy of falling water to generate electricity.	• System provides low carbon heat and can also provide cooling • Technology has a high capital costs due to civil works required to install heat exchanger within the River Fourth • Technical and program risks with co-ordinating approvals/ works with relevant stakeholders (e.g. SEPA, ECC, coastal water groups etc.) • High maintenance costs and fault issues, particularly if the system is open loop (i.e. debris from the river getting into the system) • Technology not recommended due to the above	
	Hydroelectricity	Use of hydropower plants capture the energy of falling water to generate electricity	• 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, ECC, coastal water groups etc.) • High maintenance costs and fault issues due debris from the river effecting the operation/ performance of the turbine/ generator. • Technology not recommended due to the above.	

 Technology Feasible, Suitable and Recommended.  Potential technology; further investigation required.  Technology not recommended

6.0 ENERGY ANALYSIS

This Section of the report presents the results from the Section 6 compliance calculations for the proposed Craigforth office development. The calculations have been undertaken to identify the energy performances and technologies required to achieve compliance with Section 6 with a LZCGT providing a 20% reduction in carbon emissions, as required by Policy 4.1.

ENERGY MODELLING

The proposed development will be subject to complying with Section 6 (Energy) of the Scottish Technical Handbooks. Section 6 of the building regulations requires all new non-domestic buildings to achieve minimum performances in respect to carbon emissions from heating, cooling, ventilation and lighting energy consumptions. With each revision of Section 6, the government has implemented more stringent CO_2 emission targets roughly in line with incremental changes proposed in the 2007 Sulivan Report - 'A Low Carbon Buiulding Strategy for Scotland'.

Atelier Ten have completed a Section 6 model for the proposed development, to identify the fabric and energy performances required to comply with Section 6 (as outlined in Table 1). This involves calculating the Building Emission Rate (BER) and Target Emission Rate (TER), where compliance is achieved provided the BER is less than or equal to the TER (The BER and TER values are the $kgCO_2/m^2$ emissions for the actual building and a building regulation compliant building respectively).

The Section 6 model was created using IES VE dynamic simulation software as illustrated in Figure 4.

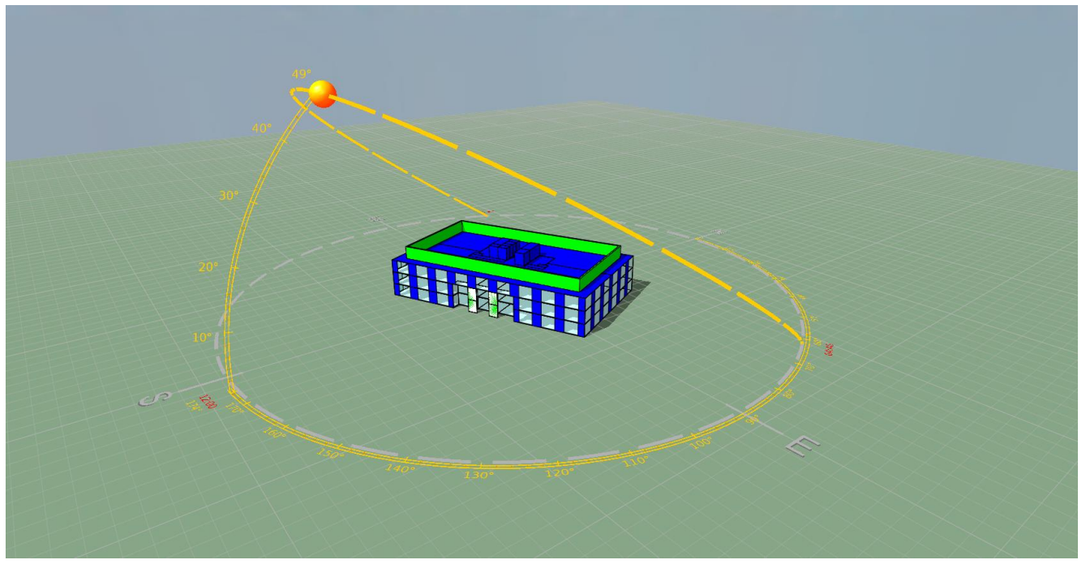


Figure 4: Section 6 Model of Proposed Development

SECTION 6 & POLICY 4.1 COMPLIANCE

The BER and TER for the building is presented in Table 3 below. The BER and TER results illistrate that compliance with Section 6 is achieved (i.e. the BER < TER).

Table 3: Energy Modelling Results

HVAC System	Renewable Technology	BER/ TER Results	Section 6 Compliance Achieved
VRF with MVHR	VRF (ASHP) & 145m² PV	TER = 12.4 BER = 10.2	✓

Table 4 below presents the calculation demonstrating that the proposed LZCGT solution of VRF (ASHP) and PV achieve the required 20% carbon reduction of Policy 4.1. It should be noted that to quality the renewable heat generated by the VRF (ASHP), this has been benchmarked against a natural gas boiler.

Table 4: Policy 4.1 Calculation & Results

Step	Calculation	Results
1.0	The Target Emissions Rate (TER), which is an output from the calculation.	12.4 $kgCO_2/m^2$
2.0	The Building Emissions Rate (BER), which is the predicted CO_2 emissions for the actual proposal, which includes the low and zero carbon generating technology (LZCGT).	10.2 $kgCO_2/m^2$
3.0	Re-calculation of the BER without the low and zero carbon generating technologies.	13 $kgCO_2/m^2$
4.0	The percentage reduction in carbon due to renewables: [(1-(step 2 ÷ Step 3)) x 100]	21.5%
Policy 4.1 compliance achieved		✓

7.0 SUSTAINBILITY STRATEGY

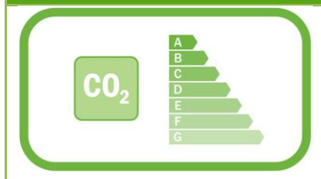
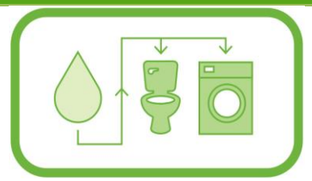
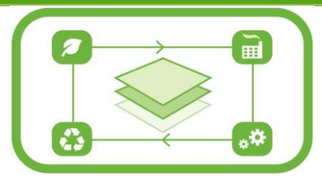
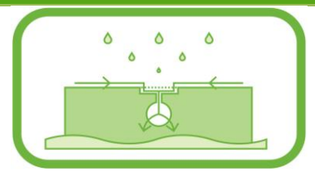
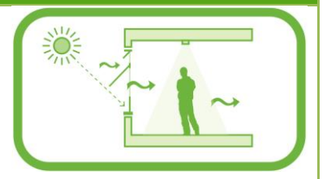
This new office development, within a wider masterplan, provides the ideal opportunity to implement the sustainable principles that enhance the social, economic and environmental values for future generations. It is this reason why sustainability plays a key role in the development and will continue to do so throughout the design, construction and lifetime of the site.

To achieve best practice standards in sustainable design and construction, the following performance measures have been targeted:

- BREEAM 2018 Excellent Certification
- Low carbon and energy efficient design
- Considerate Constructors Exemplary Standards

To ensure the proposed Craigforth office development provides a legacy for future developments in the area, the sustainability features demonstrated below will be applied throughout the development.

Table 5: Craigforth Office Sustainability Strategy

ENERGY & CO2 EMISSIONS	WATER	MATERIALS	SURFACE WATER RUN - OFF	WASTE	POLLUTION	HEALTH & WELLBEING
						
The proposed office building will be designed to minimise the carbon emissions associated with the operational energy consumption. A full computer thermal simulation analysis has been undertaken for the building proposed. This model has assessed and honed the optimum combination of U-Valve, air tightness and glazing performance to deliver the best possible passive design. Further calculations to monitor the energy performance of the buildings throughout the design process will be undertaken to ensure energy goals and targets are achieved. Energy efficient light fittings and controls will also be specified throughout the development, both internally and externally. Sub-metering will be installed to facilitate the monitoring of substantial energy uses and low energy lifts will be specified.	To minimise the consumption of potable water in sanitary applications, water efficient fixtures and fittings will be installed in all buildings. This will include low flush toilets and low flow taps and showers. Water metering will also be installed to encourage monitoring and benchmarking of water consumption. Leak detection systems will be installed within the building in order to ensure leaks do not go undetected. Similarly water shut off systems to toilets will be considered throughout the development to minimise the risk of taps and showers being left on after use. Landscaping will also be carefully selected to minimise the requirement for irrigation systems.	Responsibly sourced materials for key building elements, including thermal insulation materials, and finishing elements will be specified, wherever feasible. Additionally, any timber used in these elements will be legally sourced (e.g. FSC certified). The intention is to select materials from local suppliers or from manufacturers who can provide an environmental management system (EMS) certificate (e.g. EMAS/ISO14001 certificate).	Surface water run-off storage and attenuation measures and Sustainable Drainage Systems (SUDs) will be considered to reduce and delay the discharge of rainfall run-off to public sewers and watercourses.	A Site Waste Management Plan (SWMP) will be developed and implemented according to best practice. This will enable reduction and effective management of construction site waste. Recycled and/or secondary aggregates (if this can be reasonably procured) will be used in construction, thereby reducing the demand for virgin material. Adequate dedicated storage space for non-recyclable and recyclable waste generated by the building's occupants and visitors will be provided. This will enable appropriate management of waste disposal during building operation.	Insulating materials with a Global Warming Potential (GWP) less than five will be used where technically and financially feasible. This will contribute to reduce blowing agent emissions associated with the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials. Night time light pollution will be minimised through the appropriate location and selection of external luminaires and light controls during detailed design. Potential noise from the project affecting nearby noise-sensitive buildings will be reduced by adopting noise attenuation measures, if required.	Best practice levels of thermal, visual and acoustic comfort will be achieved throughout the building, including public areas. Similarly, a balanced approached to ventilation and energy performance will be applied to ensure healthy internal environments are achieved without significant energy penalties. Low emitting VOC materials will also be specified where possible. Internal and external lighting will be also designed in line with best practice for visual performance and comfort. All water systems in the development will be designed in order to reduce the risk of legionellosis in operation and water fountains will be considered to ensure occupants remain hydrated while visiting the building.

8.0 CONCLUSIONS

This Sustainability and Low Carbon Development Statement provides a response to the Stirling Local Development Plan (2018), for the proposed Craigforth office development. Specifically, the report responds to Primary Policy 4 (Green House Gas Reduction), Policy 4.1 (Low and Zero Carbon Buildings) and Policy 4.3 (Heat Generation).

In terms of Policy 4.3, the site is not within a high heat density area and there are no nearby existing district heating networks that the building can connect to (as defined by the Scottish Heat Map). As a result, the buildings energy strategy will adopt low carbon heating technologies (i.e. VRF ASHP) with heat recovery.

In the design development of the building, an energy hierarchy process has been applied to reduce the buildings energy demand and carbon emissions. This includes the application of high standards of fabric thermal performance, energy efficiency systems (heating, cooling, and lighting) and the inclusion of LZCGT (these being VRF ASHP and PV). These strategies align with the requirements of Primary Policy 4.

Section 6 energy modelling has been completed to demonstrate that the proposed energy strategy achieves compliance against Section 6 (Energy) of the Scottish Technical Standards. In addition, the modelling confirms that the LZCGT proposals of VRF ASHP and 145m² of PV provides the 20% reduction in carbon emissions as required by Policy 4.3.

To address the wider issues of sustainability (e.g. water conservation, materials, ecology etc.) the development is considering adopting BREEAM Excellent certification. A sustainability strategy outlining proposals has been provided within this report.

9.0 APPENDIX A

This appendix contains the energy modelling BRUKL report generated for Section 6 (Energy) building regulation compliance.

Apache Specification Information

Scottish Building Regulations 2015 Section 6 Guidance
Carbon Dioxide Emissions, U-Values, Air Permeability, and HVAC

Project name

6473 Craigforth (Proposed)

Date: Thu Jun 04 10:56:04 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12.0

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12.0

Compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Agent details

Name: Atelier Ten

Telephone number:

Address: , ,

1- Predicted CO2 emission from proposed building

1.1	Calculated CO2 emission rate from notional building	12.4 KgCO2/m2.annum
1.2	Target CO2 Emission Rate (TER)	12.4 KgCO2/m2.annum
1.3	Building CO2 Emission Rate (BER)	10.2 KgCO2/m2.annum
1.4	Are emissions from building less than or equal to the target?	BER =< TER YES

2- The performance of the building fabric and the building services systems

2.1 How do the U-values compare with Section 6 guidance?

The building follows guidance in Scottish Building Regulations 2015

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Limit}$	$U_{i\text{-}Calc}$	Surface where this maximum value occurs*
Wall	0.27	0.11	0.7	0.2	00000040:Surf[9]
Floor	0.22	0.16	0.7	0.16	00000001:Surf[0]
Roof	0.2	0.13	0.35	0.13	00000002:Surf[1]
Windows**, roof windows, and rooflights	2	1.3	3.3	1.3	00000033:Surf[0]
Personnel doors	2	-	3.3	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	1.5	-	No Vehicle access doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m2K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m2K)]
$U_{i\text{-}Limit}$ = Limiting individual element U-values [W/(m2K)]
$U_{i\text{-}Calc}$ = Calculated individual element U-values [W/(m2K)]

* There might be more than one surface exceeding the limiting standards.
** Display windows and similar glazing are not required to meet the standard given in this table.

2.2 Air permeability

Air Permeability	This building's value
m3/(h.m2) at 50 Pa	5

2.3 Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Toilets_EPH + MVHR

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	0	0.7
Standard value	N/A	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- Circulation_EPH + Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

3- Office_VRF + MVHR

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	3.2	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
00 WCs_West	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Cleaners Cupboard	-	-	0.4	-	-	-	-	-	-	-	N/A
00 WCs_East	-	-	-	1.9	-	-	-	-	-	-	N/A
01 WCs_West	-	-	-	1.9	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
01 Cleaners Cupboard	-	-	0.4	-	-	-	-	-	-	-	N/A
01 WCs_East	-	-	-	1.9	-	-	-	-	-	-	N/A
02 WCs_West	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Cleaners Cupboard	-	-	0.4	-	-	-	-	-	-	-	N/A
02 WCs_East	-	-	-	1.9	-	-	-	-	-	-	N/A
03 Cleaners Cupboard	-	-	0.4	-	-	-	-	-	-	-	N/A
00 Office_East	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Lockers/Showers_East	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Lockers/Showers_West	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Office_West	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Office	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Office	-	-	-	1.9	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00 WCs_West	-	60	-	289
00 Escape Stair_West	-	70	-	142
00 Stair Lobby_West	-	110	-	46
00 Cleaners Cupboard	83	-	-	43
00 Circulation_West	-	61	-	173
00 Escape Stair_East	-	115	-	66
00 Stair Lobby_East	-	82	-	81
00 Circulation_East	-	68	-	89
00 WCs_East	-	60	-	288
01 WCs_West	-	60	-	289
01 Escape Stair_West	-	115	-	64
01 Stair Lobby_West	-	110	-	46
01 Cleaners Cupboard	83	-	-	43
01 Circulation_West	-	61	-	173
01 Escape Stair_East	-	115	-	66
01 Stair Lobby_East	-	82	-	81
01 Circulation_East	-	68	-	118
01 WCs_East	-	60	-	288
02 WCs_West	-	60	-	289
02 Escape Stair_West	-	115	-	64
02 Stair Lobby_West	-	110	-	46
02 Cleaners Cupboard	83	-	-	43
02 Circulation_West	-	61	-	173
02 Escape Stair_East	-	115	-	66
02 Stair Lobby_East	-	82	-	81
02 Circulation_East	-	68	-	89
02 WCs_East	-	60	-	288

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
03 Escape Stair_West	-	115	-	64
03 Stair Lobby_West	-	110	-	46
03 Cleaners Cupboard	83	-	-	43
03 Escape Stair_East	-	115	-	66
03 Stair Lobby_East	-	82	-	81
00 Circulation (Bikes)_West	-	70	-	153
00 Circulation_Plant Area	-	63	-	183
00 Circulation (Bikes)_East	-	70	-	153
00 Office_East	132	-	-	4681
00 Lockers/Showers_East	-	60	-	187
00 Lockers/Showers_West	-	60	-	186
00 Domestic Water Services Plantroom	99	-	-	120
00 Telco Room	131	-	-	50
00 RF Room	103	-	-	101
00 Landlord Comms	127	-	-	73
00 Main Elec Switch Room	115	-	-	78
00 UPS Switch Room	131	-	-	50
00 Office_West	132	-	-	4590
00 Entrance Lobby	-	60	-	833
01 Office	131	-	-	12288
02 Office	131	-	-	11677

3- The solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Office_East	NO (-9.6%)	NO
00 Office_West	YES (+2.8%)	NO
01 Office	NO (-9.5%)	NO
02 Office	NO (-5.9%)	NO

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	8526.1	8526.1
External area [m^2]	9309	9977.5
Weather	GLA	GLA
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	3372.13	3384.59
Average U-value [W/m^2K]	0.36	0.34
Alpha value* [%]	10.12	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential schools
	Residential Institutions: Universities and colleges
	Secure Residential Institutions
	Residential spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	5.13	5.6
Cooling	2.07	4.43
Auxiliary	6.9	1.96
Lighting	6.46	15.51
Hot water	2.64	2.51
Equipment*	40.68	40.68
TOTAL**	**23.21**	**30.02**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	2.9	5.4
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	65.97	85.54
Primary energy* [kWh/m^2]	67.77	87.66
Total emissions [kg/m^2]	10.2	12.4

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	40	27.4	3	2.4	7.5	3.73	3.2	4	4.5
	Notional	15.9	69.5	2.7	5.1	2.1	1.66	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	15.4	0	5.4	0	6.9	0.8	0	1	0
	Notional	25.5	0	7.5	0	2.5	0.95	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	89	0	30.9	0	0	0.8	0	1	0
	Notional	134.8	0	39.5	0	0	0.95	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type