Craigforth Masterplan

Energy Statement

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Low carbon and energy efficiency features high on the agenda for the Craigforth Masterplan. This is reflected within the proposals to develop a site that is environmentally responsive while also creating healthy, enjoyable, and productive spaces and opportunities.

EXECUTIVE SUMMARY

This Energy 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 (adopted 2018) for the proposed Craigforth masterplan.

The aim of the energy strategy is to identify potential energy solutions that can deliver a low carbon site that not only complies with planning policy criteria but also responds to the UK Governments aspirations for a Net Zero Carbon Society by 2045. To achieve this, Atelier Ten have completed site energy load analysis to understand the thermal and electrical energy demands of the site and the potential technologies that can applied to achieve this vision.

An energy hierarchy process has been outlined within this report that recommends the application of passive design measures to be applied in the detailed design of the individual sites within the masterplan and their buildings. This includes the consideration building orientation, massing, and glazing ratios to minimise primary energy demands. The installation of low carbon and energy efficient equipment has also been highlighted with heat pump technology suggested as a key strategy to deliver planning policy compliance.

The potential for low carbon heat networks has also been investigated, with district heating being a potential solution for the south site and possibly the central site as a result of the building types that occupy these plots (i.e. residential and hotels that have a high heat demand). There are several technologies that could be applied to deliver a low carbon heat network(s). This will be subject to further economic, technical, and environmental analysis of the individual sites.

Opportunities for renewable systems has been considered with photovoltaics likely to feature throughout the development, either as building mounted installations or potentially as an infrastructure installation (e.g. a solar farm). Technologies such as wind turbines and hydro electricity have also been discussed however their feasibility will be subject to further analysis, conducted at the later design stages.

The above strategies will be incorporated within the detailed design of the Craigforth masterplan, its individual sites and buildings in accordance with planning policy and government legislation.

1.0 INTRODUCTION

AIM

Regeneration and renewal provide 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 and low carbon performance plays a key role in the Craigforth Masterplan, and will continue to do so throughout the design, construction, and lifetime of the development.

The aim of this Energy Statement is therefore to outline the potential energy strategies that will help to achieve these objectives, and in doing so provide a response to the Policies 4, 4.1 and 4.3 of the Stirling Local Development Plan.

GENERAL

In the development of this energy strategy, outline energy load calculations have been completed to estimate the masterplans energy demands. From this information, technologies and site wide solutions that will deliver a low carbon development have been identified.

This includes technologies and strategies that can deliver low carbon heat and renewable technologies that can provide clean and renewable energy.

The opportunities of implementing passive design and energy efficient measures for the buildings that will populate the masterplan have also been provided, which can be incorporated into the detailed design of the individual plots.

PROJECT DESCRIPTION

The Craigforth Masterplan consists of three distinct sites as illustrated in Figure 1. These being a northern peninsula consisting of commercial office buildings, central site offering leisure use (e.g. hotels, retail, restaurant) and residential apartments, and southern site providing mostly residential and assisted living accommodation. All three sites are connected via green networks including pedestrian paths and cycle routes.

Figure 1: Proposed Craigforth Masterplan

2.0 PLANNING POLICY CONTEXT

STIRLING LOCAL DEVELOPMENT PLAN

Stirling Local Development Plan 2018 applies to the Craigforth Masterplan 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.

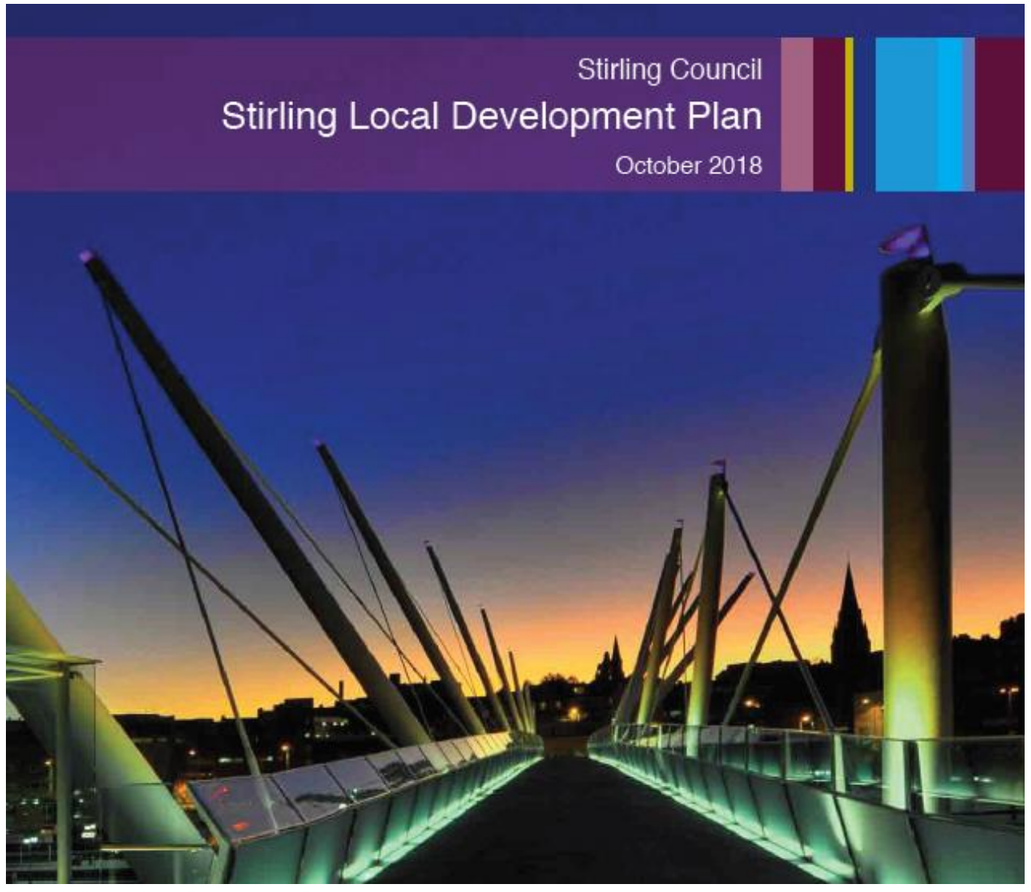


Figure 2: Stirling Local Development Plan

3.0 ENERGY STRATEGY

This section of the report provides an outline energy strategy for the Craigforth Masterplan development in response to the low carbon requirements of Policy 4, 4.1 and 4.3 of the Stirling Local Development Plan.

POLICY CRITERIA

Policy 4.1 of the Stirling Plan requires new developments to achieve the carbon emission reductions set out by the Scottish Building Standards (i.e. the Scottish building regulations) with a low or zero carbon generating technology deployed to provide a 20% reduction in emissions. To demonstrate compliance against this criterion, energy modelling of each building is required to determine the fabric thermal performances, building services systems (i.e. heating, cooling, ventilation, and lighting) and renewable technologies.

For masterplan developments where the building designs are unknown, it is not possible to complete the energy modelling required to demonstrate compliance against the policy criteria. It is however possible to present an outline energy strategy for the masterplan that considers the opportunities for site wide energy efficiency measures as well as building performance characteristics that will assist in the delivery of a low carbon development.

As such the opportunities for passive design, low carbon heating and renewable technologies have been assessed following the energy hierarchy and net zero carbon road map process illustrated in Figure 3 below.

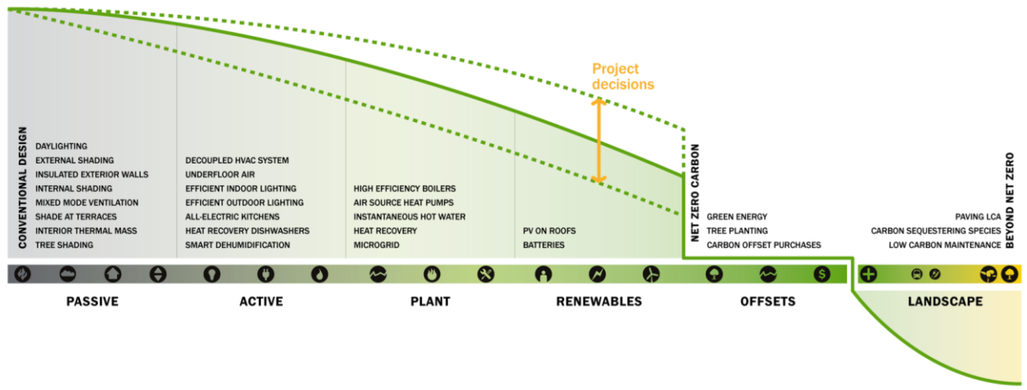


Figure 3: Pathway to Net Zero Carbon

PASSIVE DESIGN

Policy 4 requires the implementation of passive design measures to reduce building primary energy demands. In terms of the Craigforth masterplan, this will be deployed through efficient building positioning, orientation and massing and the implementation planting to provide solar shading and wind buffering. Passive measures will also be deployed in the design of the buildings with high standards of fabric thermal performance, glazing proportions and air tightness targeted. In addition, the opportunities for natural and/ or mixed mode ventilation will be considered providing passive cooling opportunities and reducing energy required by mechanical ventilation systems.

The above will be quantified and assessed through detailed energy modelling of the individual building designs to maximise their passive performances and reduce primary energy demand.

DISTRICT HEATING

Policy 4.3 of the Stirling Local Development Plan identifies the potential benefits of district heating with central energy centres to serve plots with a high heat demand.

For Craigforth, a review of the Scottish Heat Map confirms that there are no nearby local heat networks that the masterplan can connect to as illustrated in Figure 4 below.

There is potential for the creation of a new heat network to serve the masterplan, particularly the southern residential site and potentially the central site. This is since these plots will accommodate buildings that are likely to have sufficiently heat demands that could support district heating. Further environmental analysis is however required to determine whether there is sufficient heat density (i.e. the number, size and proximity of buildings to each other) to support a district heating network for these areas, as significant amounts of energy can be lost through underground pipe work which impacts the efficiency of the system. Similarly, an economic analysis is required to determine the financial feasibility for district heating through a counterfactual assessment.

As the masterplan develops the opportunity for a new district heating system will be investigated that will include input from all stakeholders, including environmental health (air quality and noise pollution) energy providers and utilities.

Figure 4: Scottish Heat Map of Craigforth

ACTIVE SYSTEMS AND PLANT

The UK and Scottish Governments are currently driving heating and transport energy demands towards electrification, which essentially means the traditional combustion of gas, petrol and diesel sources are being phased out for clean electricity provided from solar photovoltaic panels, wind turbines and hydro power.

This trend means heat and transport strategies for Craigforth should look to the future and incorporate clean sources of power. Electric Vehicle (EV) charging points are likely to be one of the biggest demands in a future all-electric scenario which will place additional demands on the electrical infrastructure in and around the area. To reduce the impact of this, the opportunities for demand response and battery storage should be considered to flatten the site energy demand profile (i.e. remove peaks and troughs) as illustrated in Figure 5 for EV charging strategy for office buildings.

In terms of heat generation, the opportunities for heat pumps will be investigated. These could be either local heat pumps serving each individual building or centralised heat pumps serving a district heating network as described in the District Heat section of this report.

The final systems and plant will be subject to further analysis as the masterplan and buildings are developed, however the opportunities for low carbon heat generation and all electric future will be considered in accordance with Policy 4.

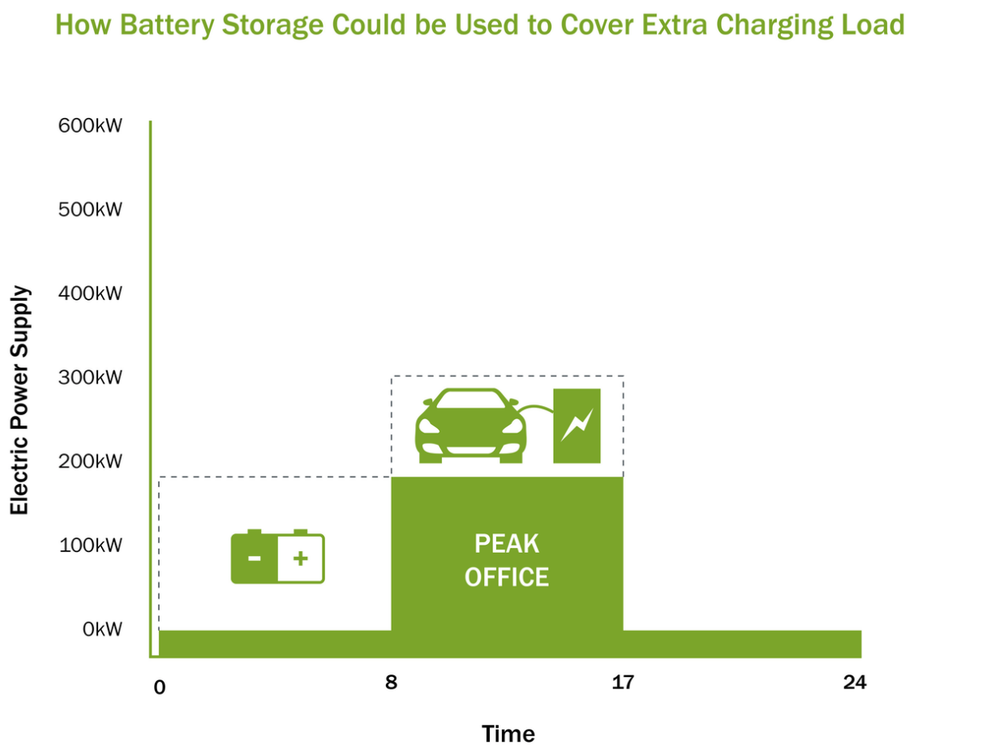
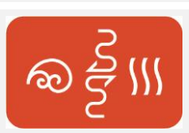
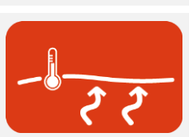


Figure 5: Battery Storage and EV Charging Strategy

4.0 LOW CARBON AND RENEWABLE APPRAISAL

This section of the report presents the results from a low carbon and renewable technology feasibility study for the Craigforth Masterplan development. Further detailed analysis into the economic and environmental performances of each technology as well as their technical application on site will be investigated as the masterplan proposals are developed.

Technology		Description	High Level Technology Feasibility Analysis	Recommendation
	District Heating	Creation of a district heating network to provide piped hot water to buildings within the masterplan.	The creation of a district heating network is a possible strategy for the southern residential site and potentially the central site as the buildings that accommodate these plots will have high thermal demands (i.e. residential/ hotel buildings with space heating demands hot water usage). Economic, technical, and environmental assessments will be undertaken to test the feasibility for district heating to serve these sites. It is unlikely that the north site will have sufficient heat demand or density to support a district heating scheme as these will be commercial office buildings.	
	Air Sourced Heat Pump	Electric powered technology that generates hot water for space heating and domestic hot water using aerothermal heat.	Technology can achieve high efficiencies and aligns with the UKs strategy of decarbonising of heat and moving away from gas combustion in buildings. Technology requires large external areas of condensers which can also have acoustic implications. Currently there is grant funding available (Renewable Heat Incentive) which allows good payback periods to be achieved. Technology can be applied as either a centralised system with district heating or as individual building solution. ASHP are therefore likely to be a key technology in delivering a low carbon masterplan.	
	Ground Source Heat Pumps	Electric powered technology that generates hot water for space heating and domestic hot water using low stored heat within ground (1-2 meters).	Technology achieves higher efficiencies than ASHP however they require large external areas for the installation buried pipework. As such there is a higher capital cost due to ground trenches, however with RHI funding and higher efficiencies (compared to ASHP), good payback levels are achievable. Technology can be applied as either a centralised system with district heating or as individual building solution, however the latter is a more likely application due to the size of the ground area required to install buried pipework.	
	Geothermal Heat Pump	Electric powered technology that generates hot water for space heating and domestic hot water using low stored heat within ground (below 50-200 meters).	Technology achieves higher efficiencies than air and ground sourced heat pumps however there is a significantly increased capital cost due to boreholes at 50-200m depth. The higher efficiencies and RHI funding still provide payback however the periods are generally longer than the ASHP and GSHP. Technology is most likely to form part of a centralised system with district heating due to economies of scale and cost implications if applied at individual building level.	
	Water Sourced Heat Pumps	Electric powered technology that generates hot water for space heating and domestic hot water using water from River Tamar.	Technology would require significant civil works to bring water from the River Fourth to an on-site heat pump. Capital costs, technical and programme implications are likely to make this infeasible at individual building scale. For a centralised system with district heating, technology could be feasible subject to technical, economic and environmental analysis.	
	Biomass	Combustion of biomass fuel (pellets or wood chip) within a boiler to generate hot water for space heating and domestic hot water.	Stirling does not have Air Quality Management Areas (AQMA), so technology is feasible. Biomass does not however align with the UK Government impending legislation to remove fossil fuel combustion in buildings and improving local air quality. Biomass also requires significant space requirements for boilers & fuel stores. Grant funding is available via the RHI and good payback can be achieved subject to the cost of biomass. If deployed at Craigforth, it is likely to be a centralised system with district heating rather than at individual building scale due to the plant space and access requirements.	
	CHP	Combustion of mains gas within an engine to generate hot water for space heating, hot water and electricity.	Although considered as a low carbon technology, it does not align with the UK Government impending legislation to remove fossil fuel combustion in buildings and improve local air quality. Technology could be implemented as supplementary technology in conjunction with heat pumps. There is no grant funding available other than Enhanced Capital Allowances. If deployed at Craigforth, it is likely to be a centralised system with district heating rather than at individual building scale due impending gas legislation. Hotels, care home and assisted living could however support small scale CHP depending on heat demands and building operational profile.	
	High Efficiency Gas Boilers	Gas boiler generating hot water for space heating and domestic hot water.	Although it is a traditional method of heating buildings, it does not align with the UK Government impending legislation to remove fossil fuel combustion in buildings and improve local air quality. Since this legislation has not been drafted, it can be still considered for further investigation at this stage. To reduce the carbon emissions, gas boilers could be paired with a heat pump solution in a district heating configuration.	

	Solar Thermal	Building mounted solar collectors that generate domestic hot water.	As building fabric becomes more thermally efficient, hot water use for washing and cleaning is becoming one of the largest energy demands in modern buildings. There is likely to a sizable domestic hot water demand within the masterplan particularly for the residential buildings, so solar thermal systems at building level are a potential option. The technology does however have a high capital and maintenance costs effecting payback periods even though the technology is eligible for grant funding under the RHI. As such PV potentially offers a more effective use of roof space for solar generating technologies. It is unlikely that solar thermal collectors will be an economic or technical solution for district heating.	
	Photovolatic Panels	Building mounted solar photovoltaic panels to generate renewable electricity	Technology constantly generates electricity (during daylight hours) reducing energy use from the national grid and thus reducing the buildings CO_2 emissions. PV also offers good paybacks (6-8 years) and can be integrated with battery storage allowing building to be less grid dependant. PV can be applied at building level or as a large scale masterplan renewable installation (i.e. a solar farm). There is no grand funding for PV, however there is an export guarantee payment for any electricity exported to the grid. PV in some form (whether at building level or masterplan scale is likely to feature within the sites energy strategy).	
	Wind Turbines	Free standing mast mounted wind turbine to generate renewable electricity	Technology constantly generates electricity (where there is sufficient wind) reducing energy use from the national grid and thus reducing the site and its buildings carbon emissions. Medium scale wind turbines have high capital and maintenance costs however payback can be reasonable (15 years), even without grant funding. If deployed at Criagforth it is likely to be at masterplan/ site level rather than individual building installations due to the capital costs, technical and environmental implications.	
	Hydroelectricity	Use of hydropower plants capture the energy of falling water to generate electricity	Technology constantly generates electricity reducing energy use from the national grid and thus reducing the site and its buildings carbon emissions. Capital costs, technical and programme implications are likely to make this infeasible at individual building scale. It is however a potential solution at masterplan level feasible subject to technical, economic and environmental analysis.	

 Technology recommended  Technology is a potenital solution  Technology not recommended

5.0 CONCLUSIONS

The Craigforth masterplan addresses the core energy efficiency and low carbon measures that will allow the detailed design of the development plots (and their buildings) to incorporate the aims and objectives of the Stirling Local Development Plan (2018).

This includes placing an emphasis on passive design strategies at site and building level to minimise the masterplans overall energy demands. Analysis of the anticipated site energy demands suggest that a low carbon district heating network(s) could be feasible for the mostly residential southern site, and potentially the central site. The feasibility of district heating is however subject to further economic, environmental, and technical analysis.

In terms of low carbon and renewable technologies, it is anticipated that heat pumps and solar photovoltaics will be feature within the master plan as site wide infrastructure solutions or at individual building level. There are opportunities for other technologies such as biomass, wind and hydro-electricity which will be considered as the masterplan design progresses.

It can therefore be concluded that the proposed Craigforth masterplan responds well to the low carbon requirements of the Stirling Local Development Plan.