12. Resources

12.1. Environmental Design

The strategy for minimising energy loss and the associated carbon emissions throughout the development can be summarised as follows:

Be Lean - *use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures.*

Be Clean - *exploit local energy resources (such as secondary heat) and supply energy efficiently by connecting to district heating networks.*

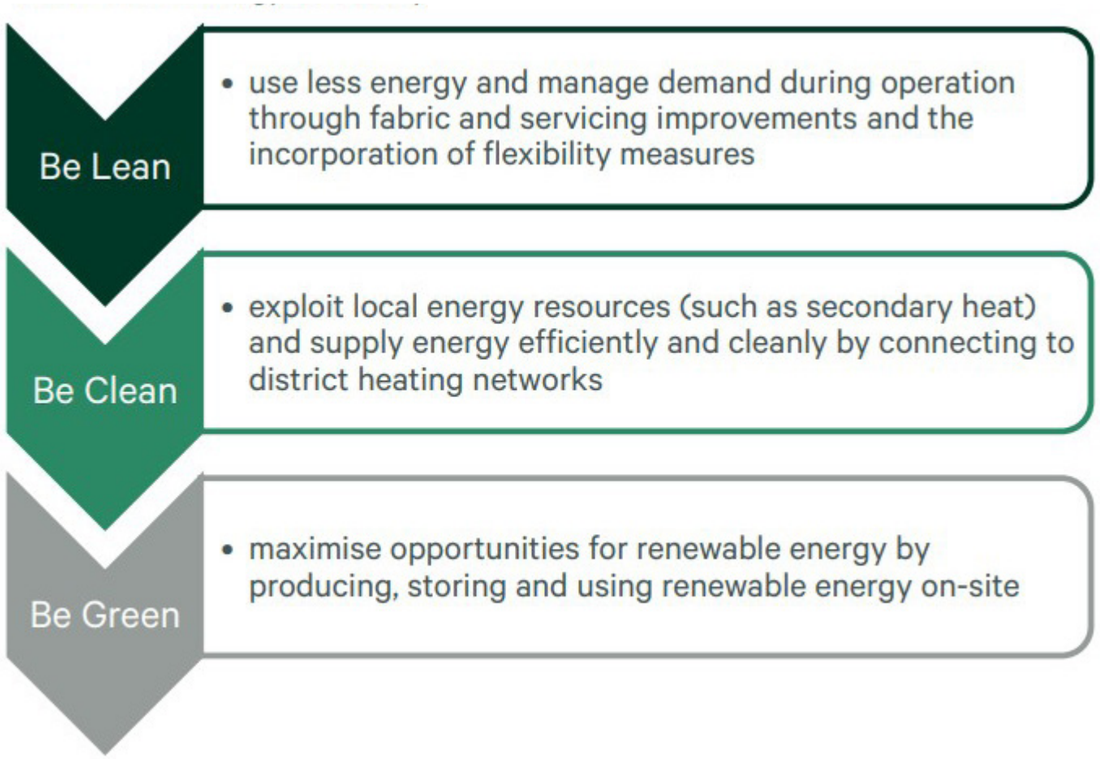
Be Green - *maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.*

The Principles for the scheme are as follows:

- Natural light and ventilation to communal areas in flats
- Reducing hard surfaces and increasing summer shading with green spaces, water and trees near homes
- Use simple building forms which limit thermal breaks
- Reduce embodied carbon during the manufacture, transport and construction of building materials as well as end of life emission

Proposals have carefully considered climate change resilience across both buildings and landscape. Including:

- Mitigating overheating risks for buildings, prioritising passive measures, such as cross ventilation and shading.
- Shading devices on proposed elevations are integrated with the built form/identity and/or the window openings
- Addressing the risk of urban heat island effects and overheating in public spaces through use of landscaping.
- Landscape planting selection for drought resistance (SuDS) to manage surface water, flood risk and designed to anticipate significant changes in rainfall



12.2. Building Design, principles

Buildings are designed to reduce resource consumption and reduce the amount of carbon emitted during construction and in use.

'The homes will be sustainable and low maintenance. A 'fabric first' approach has been employed to reduce heat loss, reducing heat and cooling requirements. Heating and cooling demand will be met by heat pumps supplemented by solar photovoltaic panels to generate the electricity renewably.' CBRE report

The principles adopted are:

- Good building orientation
- Fabric First
- Simple building form
- Passive cooling
- Renewable Energy
- Reduced water consumption

Building Orientation

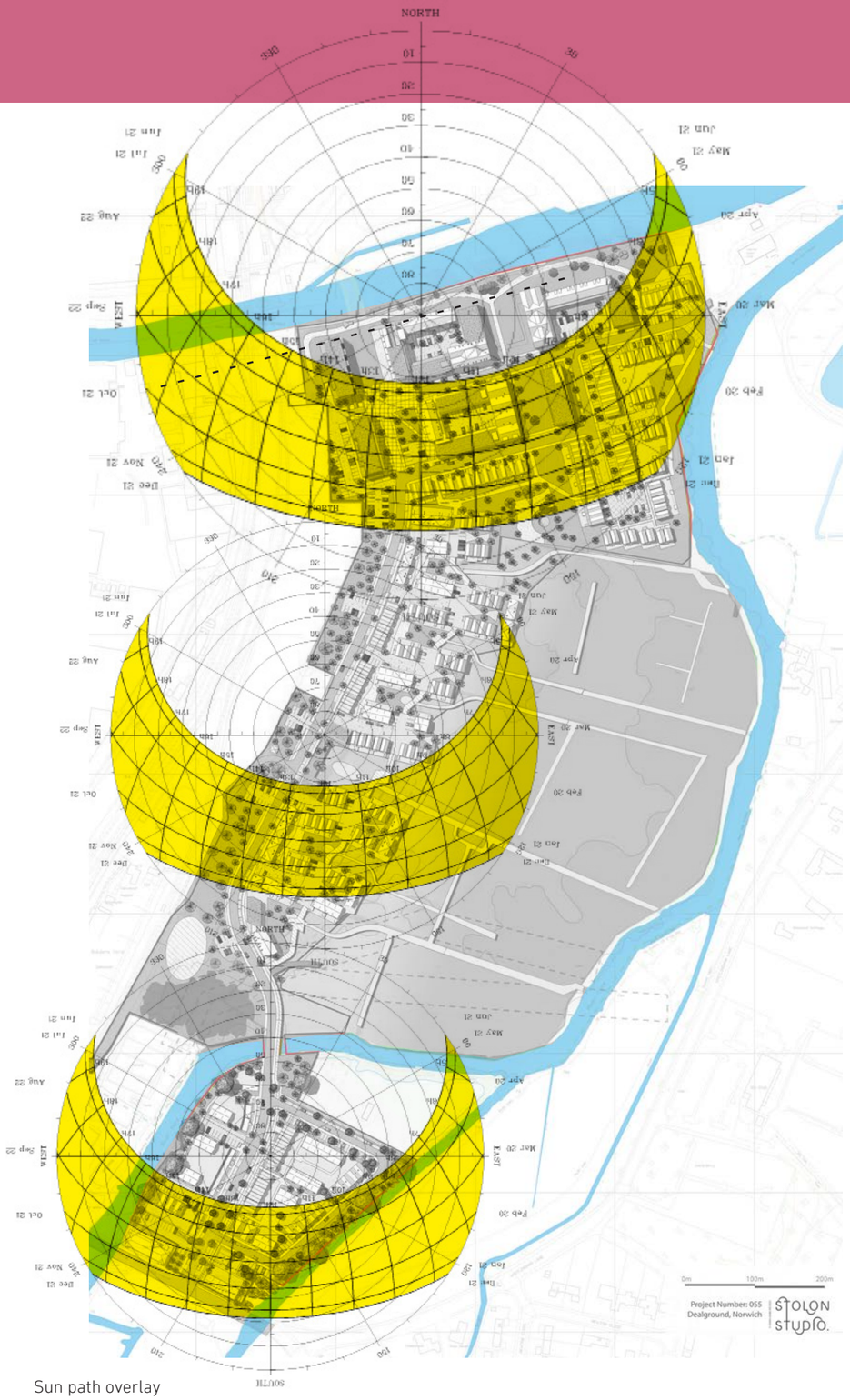
Orientation varies across the proposed development. The proposed design aims to provide all residential areas with adequate levels of daylight for enhanced visual comfort and sunlight for passive heating in winter. The plan opposite shows the sun path at various locations. This shows that along the River Wensum (and the riverfront) will receive sun after 16:30 on March 20th and after 15:00 on June 21. Therefore the slight orientation of due N/S helps with sunlight hours received.
Glazing areas, in particular on south and west facades that are more sensitive to solar gains and have a higher risk of overheating, have been optimised, to balance heat losses, solar gains and daylighting. All houses and most flats are dual aspect so overheating risk is reduced by cross ventilation. Single aspect flats have been orientated east or west as shown opposite and set out below.

Fabric First (from CBRE)

'*Building fabric of enhanced thermal properties is proposed for the scheme to reduce heat losses as far as practical and cut energy demand for heating. Low U-values, exceeding the Part L standards, and robust construction details are proposed to reduce heat losses further.*

Eliminating thermal bridging is critical for reducing heat demand and complying with the Part L Fabric Energy Efficiency Target. The Part L guidance in limiting thermal bridging by applying insulation continuously, thus avoiding any breaks, and using less conductive materials, will be followed to achieve a low y value. Certified thermal details and products should be used to ensure building fabric is designed to the highest standards. At this stage, performance targets following Government approved details (Scottish Building Standards) have been used with regards to psi-values.' CBRE

Full details are provided in the CBRE report.



Sun path overlay

12.3. Building Design, principles

Materials

Materials that have a lower embodied carbon will be prioritised. This will be balanced against the material longevity and therefore the carbon should be considered over the building lifetime. Tiles and brick and have a lower embodied energy than metal cladding. On taller buildings metal roofs are preferable to tiles on the basis of longevity and reduced maintenance / scaffolding access. Building designs are efficient in their use of steel and concrete framing. This will reduce financial cost as well as carbon cost.

Building Form

Building designs have sought to be efficient in their form and layout to reduce heat loss. The ratio of external envelope to floor area will be considered, either as Heat Loss Form Factor (HLFF) or Surface to Volume Ratio (SVR).

Taller buildings with more compact footprints will achieve better HLFF and SVR than smaller buildings with more sprawling footprints or with stepped plans.

'A mid-terrace house, for example, has a lower proportion of external wall and therefore a smaller heat loss area than a detached house of the same habitable floor area, and its energy consumption will be lower for that reason alone. Similarly, a home with a simple, compact plan shape (such as a rectangle) will have a lower energy consumption than one with a more complex outline such as an L-shaped or T-shaped plan.' source: The challenge of shape and form, NHBC See image opposite

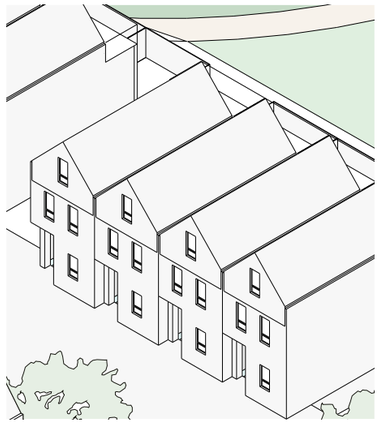
A smaller thermal envelope will reduce the potential for heat loss/gain. Efficient use of the built form, such as habitable roof spaces result in a better Form Factor. Separated semi-detached or detached buildings result in poor Form Factors. See table opposite.

The proposed design avoid complex, irregular forms, to reduce energy demand

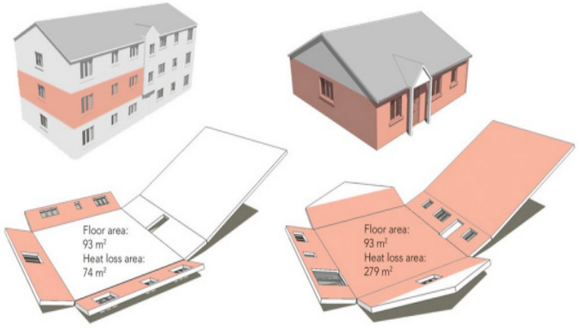
	Type	Form Factor	Efficiency
	End mid-floor apartment	0.8	Most efficient
	Mid-terrace house	1.7	
	Semi-detached house	2.1	
	Detached house	2.5	
	Bungalow	3.0	Least efficient

Form Factors for different home typologies. (source: The challenge of shape and form, NHBC)

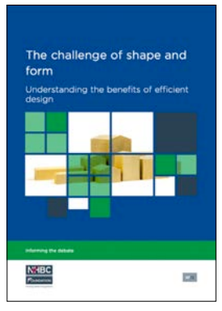
Example House Types from Wensum Edge and The Views



Example House Types from Wensum Edge



'Unfolded' structures with their heat loss areas shaded orange. End mid-floor apartment (left), bungalow (right) (source: The challenge of shape and form, NHBC)



Passive Design

Passive design aims to reduce the need for mechanical heating or cooling through layout, form and natural ventilation and daylighting. Solar orientation has been described above. Therefore, the main aim of passive design is to achieve good daylight and reduce overheating. The main approaches are cross and stack ventilation and shading. Cross ventilation is provided in all dual aspect units and on corner units.

A study conducted on the Sigma Home at BRE's Innovation Park in 2008 concluded that 'The passive solar stack and automatic window at the top of the house proved key to preventing peak day overheating. Passive solar stack ventilation provides effective mitigation of overheating without compromising security and is likely to be commonplace in future "zero carbon" homes. An automatic rooflight above the stair is proposed in all houses to aid *stack ventilation.*

Solar shading is provided by baffles on south west facing windows where necessary.

Renewable Energy

The 'fabric first' approach will reduce heat loss, reducing heat and cooling requirements. Residual heating demand is best met by heat pumps supplemented by solar photovoltaic panels (PVs) to generate the electricity renewably. Individual heat pumps are preferred for houses to reduce heat losses in pipe runs and give direct responsibility. Communal heat pumps are proposed in apartment blocks to maximise the efficiency of the system and to reduce clutter.

Energy use will be reduced through the thermal envelope, services (including lights and pumps) as well as through the use of high efficiency /low-power fittings. Hot water will be provided via heat pumps or solar thermal panels. PVs will provide renewable power. These are illustrated on the following pages.

The graph opposite shows how this strategy reduces carbon emissions over energy efficiency alone to the site.

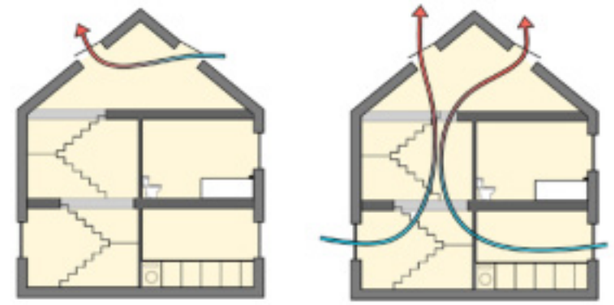
Water

Water consumption will be reduced through efficient fittings such as low-flow dual flush WCs, flow regulated taps and showers, smaller & shallower baths and reduced water consumption fittings. Water butts will be provided for all houses to irrigate gardens. Rainwater harvesting is used in the larger buildings..

Solar Panel Arrays

AHUs in communal areas

AHUs in gardens



Passive Ventilation (source: The challenge of shape and form, NHBC)

Table 1: Regulated carbon dioxide emissions (site-wide)

	Carbon emissions rate	
	$tnCO_2$ per annum	% Reduction from baseline
Baseline: Part L 2021 of the Building Regulations Compliant Development	693.5	-
Proposed scheme: After energy demand reduction & renewable energy	214.4	69%

Site wide carbon emissions (source: CBRE)

12.4. Renewable Energy: Wensum Edge

To meet the energy requirements for Building Regulations the strategy is to use a combination of Heat Pumps and Solar Panels. This will far exceed the minimum 10% renewable energy target set by the planning conditions. The approach is set out below and in the accompanying energy statement by CBRE.

Houses

Solar panels are to be located on the most optimum roof surface. This is indicated on the plans opposite.

Air Handling Units (AHU) are located within back gardens of the units or to the front in discreet housing units.

Apartment Blocks

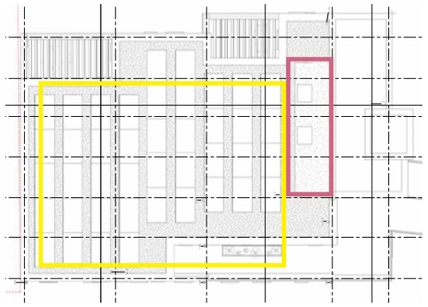
Communal heat pumps with air handling units (AHUs) are located on the roof
AHUs are to be set back from the roof edge and concealed by the raised parapet so they are less visible from the street,

An area of flat roof is proposed on each block to accommodate solar panels and green roofs. They are also designed to be accessible for maintenance.

The plan opposite indicates the provisional layout within the Wensum Edge.

Rooftop AHUs for apartments and duplexes. NB they are to be concealed and not on show like this.

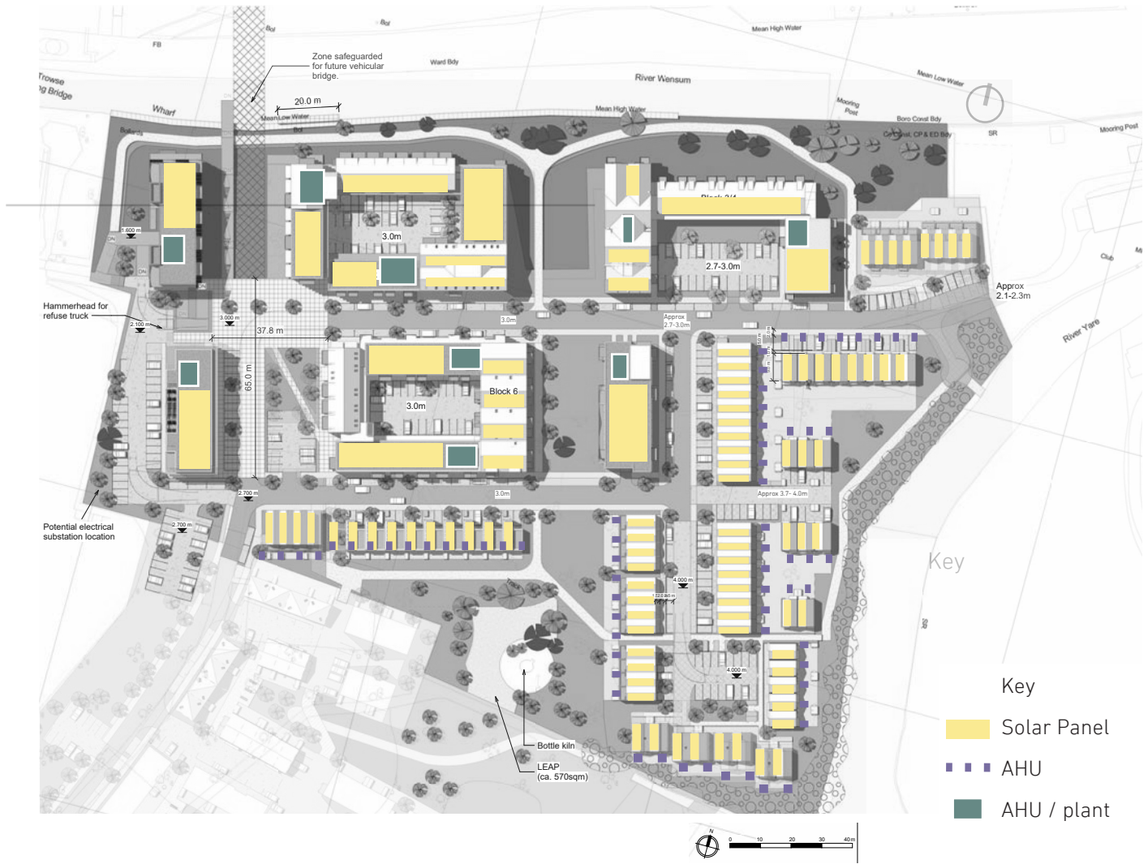
Solar PVs + Living Roof for apartments



Typical placement of AHUs and solar panels on roof

Elevation	Orientation in degrees from north												
	West			SW		South			SE				East
	270	255	240	225	210	195	180	165	150	135	120	105	90
Horizontal	90	90	90	90	90	90	90	90	90	90	90	90	90
10 deg	89	91	92	94	95	95	96	95	95	94	93	91	90
20 deg	87	90	93	96	97	98	98	98	97	96	94	91	88
30 deg	86	89	93	96	98	99	100	100	98	96	94	90	86
40 deg	82	86	90	95	97	99	100	99	98	96	92	8	84
50 deg	78	84	88	92	95	96	97	97	96	93	89	85	80
60 deg	74	79	84	87	90	91	93	93	92	89	86	81	76
70 deg	69	74	78	82	85	86	87	87	86	84	80	76	70
80 deg	63	68	72	75	77	79	80	80	79	77	74	69	65
90 deg	56	60	64	67	69	71	71	71	71	69	65	62	58

Solar Panel Orientation Chart



Indicative renewable energy strategy

12.5. Renewable Energy: Yare Edge and The Views

Solar panels are to be located on the most optimum roof surface. This is indicated on the plans opposite. These also show indicative locations for the Air Handling Units (AHU). These are mostly within the back gardens of the units. A linear cycle shed with integral AHU housing has been designed for the houses in the Views to maintain a discreet form facing onto the shared spaces.