

Low Carbon Industrial Units



Introduction

This document sets out a framework for reducing the carbon emissions associated with the operational energy consumed by industrial buildings.

The base approach considers the 3 key areas below:

1. Energy reduction
2. Renewable energy supply
3. Remote offset

We outline 5 possible levels of commitment to carbon reduction (with an increasing capital investment) working towards zero operational carbon for the base build Cat A and the Cat B operation.

Level 1 Office and shell warehouse

Level 2 Office and warehouse with lighting

Level 3 Office and warehouse with lighting and gas heating

Level 4 Office and warehouse with lighting and heat pump heating (all electric building)

Level 5 Office and warehouse with lighting, heat pump heating plus an offset contribution to the operation process

Base approach

Energy Reduction

1. Building envelope design and specification
2. High efficiency systems
3. Smart controls and monitoring

The base approach begins with reducing the energy consumed by the building through better design.

The envelope performance and specification is optimised using Dynamic Simulation Modelling software.

Further reductions are targeted through the improvements in the efficiency of the internal environment systems and with the incorporation of controls which ensure the energy is delivered and expended only when essential for correct functioning of the building.

Monitoring system provide the data needed to further optimise the building energy consumption.

To move towards a neutral energy and carbon balance for the building the next stage involves the selection and incorporation of on site renewable energy generation.

Energy storage is then considered in order to minimise the energy which needs to be exported to the grid improving the return on the generation investment

Remote offset is the final stage which deals with the residual energy and carbon offset needed to reach a particular target by establishing an offsite contribution.

Renewable Energy

1. On site Renewable Energy Generation
2. On site Energy Storage

Remote Offset

1. Carbon neutral energy suppliers
2. Carbon credits
3. Off site renewable energy generation

Level 1

Building Specification

Office with heating, cooling and lighting
Shell warehouse

Energy Reduction

Good practice envelope
Heat pump heating and cooling to office
LED Lighting
Smart controls for lighting, heating and cooling

Energy Generation

Roof mounted PV's – Approx 1% of roof area

Level 2

Building Specification

Office with heating, cooling and lighting
Warehouse with Lighting

Energy Reduction

Good practice envelope
Heat pump heating and cooling to office
LED Lighting
Smart controls for lighting, heating and cooling

Energy Generation

Roof mounted PV's – Approx 9% of roof area
Optional Battery storage optimised to improve PV payback

Level 3

Building Specification

Office with heating, cooling and lighting
Warehouse with Lighting and gas heating

Energy Reduction

Good practice envelope
Heat pump heating and cooling to office
LED Lighting
Smart controls for lighting, heating and cooling

Energy Generation

Roof mounted PV's – Approx 27% of roof area
Optional Battery storage optimised to improve PV payback

Level 4

Building Specification

Office with heating, cooling and lighting
Warehouse with Lighting and heat pump heating

Energy Reduction

Good practice envelope
Heat pump heating and cooling to office
LED Lighting
Smart controls for lighting, heating and cooling

Energy Generation

Roof mounted PV's – Approx 15% of roof area
Optional Battery storage optimised to improve PV payback

Level 5

Building Specification

Office with heating, cooling and lighting
Warehouse with Lighting and heat pump heating
Operation and process energy include in the assessment

Energy Reduction

Good practice envelope
Heat pump heating and cooling to office
LED Lighting

Smart controls for lighting, heating and cooling

Energy Generation

Roof mounted PV's to supply the building load
Additional PV's to supply the operation and process energy - requires an assessment of the process. Output is limited by the roof area
Optional Battery storage optimized to improve PV payback

Additional measures

Passive

Higher specification envelope to reduce energy - Insulation (walls, roof and slab), doors, roof lights, glass, solar shading and air permeability
Introduction of a south facing hot wall

Active

Solar hot water generation
Wind turbine generation
Biofuel electricity and heat generation
Hydrogen fuel cell technology

Energy Generation

PV's
Wind turbine generation
Electricity energy supply from renewable generation sources
Tree planting for carbon capture

Indicative Parameters and Costs

Based upon a case study of a typical 150,000 sqft unit with office content

Parameter	Level 1	Level 2	Level 3	Level 4
	Office Only	Office + Warehouse Lighting	Office + Warehouse Lighting + Warehouse Gas Heating	Office + Warehouse Lighting + Warehouse VRF Heating
IES Energy kWh/m2	29.25	11.86	33.63	19.14
kWh/annum reqd	22,099	168,269	477,140	271,557
PV Area m2 reqd	165	1,256	3,561	2,027
PV system kW peak	26	201	570	324
Cost	£20,000	£150,000	£430,000	£250,000
Annual energy cost saving @ £0.14/kWh	£3,000	£23,000	£67,000	£38,000
Payback years @ £0.14	6.4	6.4	6.4	6.4
PV as % of warehouse roof area	1%	9%	27%	15%
Carbon Reduction Co2Tonnes/annum	11	87	248	141
Carbon Reduction 15 years Co2Tonnes/annum	172	1,310	3,715	2,114

Basis of the study

The information is based upon a case study of a typical 150k sqft unit with office content. On site renewable generation is based upon roof mounted photo voltaic panels.

The parameters and costs are indicative are intended to inform the basis of a decision to conduct a more detailed site specific appraisal.

Carbon Factors 0.519 kg Co2/kWh

PV Output 134 kWh/m2/Annum

PV Cost £120/m2

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