# SUSTAINABILITY STATEMENT

ALBION LAND

NETWORK BICESTER PHASE 3

ALBION LAND

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# SUSTAINABILITY STATEMENT

# NETWORK BICESTER PHASE 3
# ALBION LAND

## OUR PROJECT REF: ESC1746


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| P1 | 03 November 2021 | Kim Nguyen | David Scott |
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# EXECUTIVE SUMMARY

ESC has been appointed by Albion Land to produce a Sustainability Statement for the proposed employment development, on land adjacent to Howes Lane, Bicester.

This document supports the full planning application for Phase 3 of the proposed employment scheme which comprises of eleven speculative industrial/warehouse units with associated landscaping, infrastructure and utilities.

The employment scheme is required to address planning policies ESD 1 – 5 and 15, described within The Cherwell Local Plan 2011 – 2031. The policies regard how sustainability should be implemented in both construction of buildings and operation of buildings, which were addressed by implementing/investigating the following…

- Method to display and monitor building energy usage
- Reducing water consumption via installation of water efficient sanitaryware
- Feasibility of incorporating District Energy and Heat Network into the development
- Adaptation and mitigation measures towards climate change
- Passive design solutions to reduce building energy demand
- Sustainable construction methods and materials to reduce Embodied Carbon
- Low and zero carbon technologies to further reduce energy demand and achieve Net Zero Carbon in Operation

To assess how the development shall achieve Net Zero Carbon in Operation, a thermal dynamic simulation software, EDSL Tas Engineering v9.5.1, was used in order to model Phase 3's predicted operational energy performance. A method was formulised to reduce energy demand and then incorporate renewable/zero carbon technologies into the models' systems to offset the remaining operational energy usage and carbon emissions, therefore achieving net zero carbon.

Net zero carbon was achieved by implementing passive design solutions (increased building fabric efficiency), high-efficiency Air-Source Heat Pumps (low carbon technology) and Photovoltaic Panels (renewable/zero carbon technology).

Across the development, **2,940 m²** of photovoltaic panels are required to offset the predicted annual carbon emission and therefore achieve a zero-carbon balance for Phase 3 of the development.

# 1. INTRODUCTION

## BACKGROUND

ESC has been appointed by Albion Land to produce a Sustainability Statement for the proposed employment development on land adjacent to Howes Lane and Middleton Stoney Road, Bicester.

The Statement is to support the employment scheme's full planning application.

This report focus' on the third phase of the employment scheme. Phase 3, comprising of 11 speculative industrial/warehouse units, is subject to planning condition no. 31, set out within the outline planning application 20/03199/OUT for the earlier phases, which requires the submission and approval of the measures which will enable the achievement of zero carbon. The full statement of the condition is as follows:

> *No development shall take place on any phase of development until details of measures (including off-phase and off-site measures if necessary) to achieve zero carbon energy use (as defined in paragraph ET7.1 of the eco-towns supplement to Planning Policy Statement 1) for that phase shall have been submitted to and approved in writing by the local planning authority. The development shall be carried out in accordance with the approved details and the measures approved shall thereafter be retained in an operational condition.*

## DESCRIPTION OF DEVELOPMENT

The development is part of a multi-phase construction programme which includes multiple industrial/warehouse/office units. Phase 3, for which this report relates, consists of eleven E(iii)(g) and/or B2 and/or B8 units, with ancillary offices.


*Figure 1: Illustrative Masterplan (Phase 3 units within the red site boundary). Source: Cornish Architects*

*Table 1: Building Floor Areas. Source: Cornish Architects*

| Building | Ground Floor Area (m²) | Upper Floor(s) (office) Area (m²) | Total Floor Area (m²) |
|---|---|---|---|
| **Unit 1** | 1759 | 195 | 1954 |
| **Unit 2** | 1613 | 179 | 1792 |
| **Unit 3** | 1650 | 183 | 1833 |
| **Unit 4** | 4278 | 476 | 4754 |
| **Unit 5** | 3433 | 423 | 3856 |
| **Unit 6** | 491 | 0 | 491 |
| **Unit 7** | 492 | 0 | 492 |
| **Unit 8** | 412 | 0 | 412 |
| **Unit 9** | 328 | 0 | 328 |
| **Unit 10** | 430 | 0 | 430 |
| **Unit 11** | 600 | 0 | 600 |
| **Totals** | **15486** | **1456** | **16942** |

## PLANNING POLICY & REGULATIONS

The development must achieve zero carbon emission as defined[1] in the adopted SPD and Policy Bicester 1.

There are also key national and local policies applicable to the development, which include: -

- Communities and Local Government; Planning Policy Statement: eco-towns
- NW Bicester Supplementary Planning Document, Adopted February 2016
- The Cherwell Local Plan 2011-2031 – Part 1 Adopted 20th July 2015
- Technology strategy Board; Design for Future Climate – Adapting Buildings Programme (NW Bicester Eco Development)

The above listed documents have been comprehensively reviewed and incorporated into the recommendations, focusing on the following sustainable and energy relevant key principles:

- Incorporate energy monitoring technology
- Ensure efficient building operation in use
- Ensure the building is constructed sustainably via careful material selection and construction methods
- Incorporate the latest energy generation technology
- Ensure the fabric of the building achieves high levels of efficiency

[1] The definition of zero carbon is that over a year the net carbon dioxide emissions from all energy use within the buildings on the development as a whole are zero or below.

# 2. AIMS

The Sustainability Statement shall identify the planning policies, which applies to this development, and address them with a mitigation solution. The relevant planning policies regards implementation of sustainability in the construction of buildings and the operation of buildings.

The particular item that requires a detailed and comprehensive assessment is the site-wide Net Zero Carbon in Operation, which this Statement shall address.

The development shall achieve Net Zero Carbon in Operation by assessing the following areas to educate a strategy:

a. Energy demand and carbon emission assessment which:

    i. Estimates total energy demand in kWh/year

    ii. Estimates hot water usage

    iii. Estimates electrical demands

b. Energy demand and carbon reduction proposals, providing details of how energy demand will be reduced through design and specification

c. Energy generation strategy which specifies energy generation technologies proposed to be used and their outputs in kWh/year

d. The carbon emission balance which provides:

    i. Appropriate carbon factors

    ii. The overall carbon balance of zero or better (i.e. achieving zero carbon)

    iii. If necessary, and if the carbon balance has not satisfied the zero carbon target, then details of local off-site carbon saving measures must be provided with details of the carbon saved

To enable assessment of the above, dynamic thermal modelling shall be undertaken using EDSL Tas v9.5.1 software. EDSL Tas is accredited by the Department of Communities and Local Government for the generation of SBEM and Energy Performance Certificates. It is also a complex modeller of buildings and services systems giving detailed energy consumption and carbon emission figures.

# 3. LOCAL PLANNING POLICY

## POLICY BICESTER 1: NORTH WEST BICESTER

### REQUIREMENT

A Zero Carbon Development, as defined in the Eco-Towns PPS as…

*The policy requirements include the following which are of relevance to this application*

- *Proposals should comply with Policy ESD15*
- *High quality exemplary development and design standards including zero carbon development, the use of low embodied carbon in construction materials, as well as promoting the use of locally sourced materials*
- *All new buildings designed to incorporate best practice on tackling overheating, taking account of the latest UKCIP climate predictions*
- *Demonstration of climate change mitigation and adaption measures including exemplary demonstration of compliance with the requirements of policies ESD1-5*
- *Requirement of real time monitoring systems*
- *Requirement for utilities and infrastructure which allow for zero carbon and water neutrality on the site and the consideration of sourcing waste heat from the Ardley Energy Recovery Facility*

### MITIGATION

**ESD Policies 1-5 & 15**

These items are directly addressed later in this section.

**Low Embodied Carbon/Locally Sourced Materials**

Please refer to Policy ESD 3 mitigation in this section.

**Overheating**

The new building shall be assessed under criterion 3 of the Building Regulations Part L2A compliance tool which aims to limit the effects of heat gains in summer. The calculation tools give a direct pass of fail for all occupied spaces in relation to limiting benchmarks for such items as glazing quantity, glazing performance, orientation to north etc.

By passing this criterion, the building shall demonstrate best practice for tackling overheating.

### Climate Change

The credit relating to climate change has been targeted as part of the BREEAM Assessment and target of 'Very Good' with scope for 'Excellent'. This credit requires thermal comfort to be assessed based upon future predicted climate files to ensure the installed systems can adequately cope with any change in the local climate.

The BREEAM credit 'Wst 05 – Adaptation to Climate Change', which the development shall aim for, requires a risk management and mitigation assessment to how the development can adapt to the affects of climate change, this may include, flood risks, rise in temperatures, cold events, storms and droughts.

The adaptation/mitigation measures taken are listed in Policy ESD 1 and are described in Section 5 – Minimising Water Consumption, Section 6 – Passive Design Analysis, Policy ESD 4, Policy ESD 5 and Section 10 – Energy Generation Strategy.

### Real Time Energy Monitoring Systems

Please refer to Section 4 – Energy Display and Monitoring

### Water Neutrality

Please refer to Section 5 – Minimising Water Consumption

### Ardley Energy Recovery Facility

Within 4km of the site is the Ardley Energy Recovery Facility which produces electricity from the incineration of non-recyclable waste. The facility exports the electricity generated to the national grid which is then freely available via the conventional electricity providers. The facility can also generate waste heat which can be utilised locally via heating water mains.

There is no information available that suggests the heat network currently available from the Ardley site routes is in close proximity to the development in question.

If district heating mains are available from the Ardley Facility, there is potential for the speculative workshop and storage/distribution areas to be space heated and/or cooled via this medium.

Heating could be provided using wet heating coils, mounted within air handling units, to deliver heated air into the speculative workshop and storage/distribution areas.

Cooling could be provided via the use of absorption chillers which convert heating water into chilled water. The chiller then serves wet cooling coils, again mounted in an air handling unit, to deliver cooled air to the speculative workshop and storage/distribution areas.

This provision is not applicable at the current time as the workshop and storage/distribution areas of the buildings shall be shell only.

The office spaces are currently proposed to be heated and cooled via an air source heat pump system which represents the most practical system for this size and type of space. Integration to a heat network is not possible for this type of system so the office spaces will not benefit from any heat network. The efficiency of the air source heat pumps system can still achieve very good efficiency ratings, so we don't assess this non interface potential as a negative.

To facilitate the potential for future heat network delivery, the buildings shall be provided with service ducts capable of supporting the routing of heating mains from the site boundary to the building. This means a clear and unobstructed below ground service strip finishing in service ducts routing through the ground floor slab into the speculative workshop and storage/distribution areas.

For information, the location of the Ardley Energy recovery facility is shown in the image below.


*Figure 2: Relative location of the Ardley Energy Recovery Facility to the New Employment Development*

# NORTH WEST BICESTER SUPPLEMENTARY PLANNING DOCUMENT: SMARTGRIDS

## REQUIREMENT

In relation to the *North West Bicester Supplementary Planning Document,* the statement is:

*The use of smartgrids and low carbon energy storage solutions provide an opportunity to manage demand and supply of renewable and zero carbon energy technologies. Such solutions should be explored further in the energy strategies to support planning applications and masterplanning delivery.*

## MITIGATION

Energy storage, in relation to our development, could come in two forms:

- Smart Grid
- Renewable Energy Management

**Smart Grid**

This form of energy storage is permanently coupled to the electric grid and can offer the following functions:

- Management of peak electric draw (shaving, shifting and smoothing)
- Energy Arbitrage (purchasing/storing energy during off peak/low demand periods)
- Individual or collective draw from the storage
- Voltage support
- Frequency regulation

As our development consists of several commercial buildings, a smart grid would be physically applicable however the only advantage in respect to supplying electric would be a monetary saving for the end user in relation to energy arbitrage. This would not affect the amount of clean electric used or reducing electric consumption.

The advantage of a smart grid for this particular development would be the development wide collection of renewably generated electricity that is in excess of the buildings peak demand. This would offer a facility for collection of ‘over generated’ electric on a development wide basis for use as appropriate to the development demand rather than individual building demand.

The disadvantage to this would be the requirement for a bespoke billing system between the buildings as they will all have individual tenants effectively sharing renewable generation between themselves. Another consideration is the relatively proportional distribution of the photovoltaic system across the development, leaving variations in a building’s generation vs demand being closely matched to the building’s size and PV allocation.

**Renewable Energy Management**

This energy storage system receives renewably generated electric when the generation is greater than the demand but is isolated on a building by building basis. The system then releases the electric when there is later demand, in lieu of grid delivered electric.

This system offers very similar benefits as the smart grid but on a local, building based level.

The main variable to feasibility of a 'local' energy storage system is the buildings electric demand and usage profile.

The following requires investigation before energy storage could be considered:

- 24hr electric usage profile – If demand is low when renewable generation is low, the benefit is reduced
- Peak demand – will the building's peak demand outweigh the peak renewable generation?
- Energy arbitrage – will this offer a competitive payback period on the purchase of storage equipment?

All of the above variables would be greatly affected by the fit out of the speculative workshop and storage/distribution areas of each unit. The scope of potential fit out and subsequent electric demand could vary considerably and therefore it is suggested energy storage systems are considered on a site by site basis and in relating to the tenant fit out.

# POLICY ESD 1: MITIGATING AND ADAPTING TO CLIMATE CHANGE

## REQUIREMENT

In relation to the *Cherwell Local Plan 2011-2031 Part 1: Policy Bicester 1*, the Policy ESD 1 states:

*Measures will be taken to mitigate the impact of development within the district on climate change. At a strategic level, this will include:*

- *Designing developments to reduce carbon emissions and use resources more efficiently, including water (see Policy ESD 3 Sustainable Construction)*
- *Promoting the use of decentralised and renewable low carbon energy where appropriate (see policy ESD 4 Decentralised Energy Systems and ESD 5 Renewable Energy)*

## MITIGATION

### Reduce Carbon Emissions

See Section 9 – Energy Demand Reduction Proposals.

### Resource Efficiency Inc Water Efficiency

Please refer to Section 5 – Minimising Water Consumption and ESS0229-BREEAM NC 2018 Pre-Assessment-20210827

### Decentralised Energy

Please refer to Policy ESD 4 mitigation in this section

### Low Carbon Energy

Please refer to Policy ESD 5 mitigation in this section

# POLICY ESD 2: ENERGY HEIRARCHY AND ALLOWABLE SOLUTIONS

## REQUIREMENT

*In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:*

- *Reducing energy use, in particular by the use of sustainable design and construction measures*
- *Supplying energy efficiently and giving priority to decentralised energy supply*
- *Making use of renewable energy*
- *Making use of allowable solutions*

## MITIGATION

**Reducing Energy Use**

Please refer to Section 9 – Energy Demand Reduction Proposals.

**Decentralised Energy Supply**

Please refer to Policy ESD 4 in this section

**Renewable Energy**

Please refer to Section 10 – Energy Generation Strategy.

# POLICY ESD 3: SUSTAINABLE CONSTRUCTION

## REQUIREMENT

In relation to the *Cherwell Local Plan 2011-2031 Part 1: Policy Bicester 1*, the Policy ESD 3 states:

*All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of this standard should be set out in the Energy Statement.*

*The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability.*

*All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:*

- *Minimising both energy demands and energy loss*
- *Maximising passive solar lighting and natural ventilation*
- *Maximising resource efficiency*
- *Incorporating the use of recycled and energy efficient materials*
- *Incorporating the use of locally sourced building materials*
- *Reducing waste and pollution and making adequate provision for the recycling of waste*
- *Reducing the impact on the external environment and maximising opportunities for cooling and shading (by provision of open space and water, planting, and green roofs, for example); and*
- *Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment*

## MITIGATION

Under the Council's jurisdiction, the new development is required to achieve a BREEAM NC 2018 rating of 'Very Good'. The BREEAM UK New Construction scheme (Building Research Establishment Environmental Assessment Method) is an environmental performance standard which new, non-domestic buildings in the UK can be assessed against. Within the scheme, there are rating benchmarks that a building may achieve through good or best practice, these ratings are:

| BREEAM RATING | % SCORE |
|---|---|
| Outstanding | ≥ 85 |
| Excellent | ≥ 70 |
| Very Good | ≥ 55 |
| Good | ≥ 45 |
| Pass | ≥ 30 |
| Unclassified | < 30 |

Each rating represents performance equivalent to:

- Outstanding: Less than the top 1% of UK new non-domestic buildings (innovator)
- Excellent: Top 10% of UK new non-domestic buildings (best practice)
- Very Good: Top 25% of UK new non-domestic buildings (advanced good practice)
- Good: Top 50% of UK new non-domestic buildings (intermediate good practice)
- Pass: Top 75% of UK new non-domestic buildings (standard good practice)

How a building achieves any of the above ratings is by assessing how it is managed, constructed and operated. This is broken down into categories, which are:

- Management,
- Health and Wellbeing,
- Energy,
- Transport,
- Water,
- Materials,
- Waste,
- Land Use and Ecology, and
- Pollution

Another category is 'Innovation', though it is optional. Each category includes criteria a building may meet to achieve one or more credits. These credits will add up to score an overall BREEAM rating.

For this development, the eleven units are targeting to achieve a BREEAM 2018 rating of 'Very Good', however, there is potential to achieve the 'Excellent' rating. ESC's BREEAM NC 2018 Pre-Assessment for this development accounts for the following…

- Material efficiency (please refer to Section 7 – Reducing Embodied Carbon)
- Use of recycled & sustainably sourced aggregates (please refer to Section 7 – Reducing Embodied Carbon)
- Construction waste management (construction resource efficiency)
- Reduction of energy use & carbon emissions (please refer to Section 8 – Energy Demand Assessment and onwards)
- Energy monitoring (please refer to Section 4 – Energy Display and Monitoring)
- Low carbon design
- Water consumption (reduction in potable water use, please refer to Section 5 – Minimising Water Consumption)

Please refer to ESS0274-BREEAM NC 2018 Pre-Assessment-20210827 document for further information.

In specific response to the itemised sections, the appropriate BREEAM credit has been targeted:

| ITEM | ASSOCIATED AND TARGETED BREEAM CREDIT |
|---|---|
| Minimising both energy demands and energy loss | Ene 01 – Reduction of energy use and carbon emissions |

| ITEM | ASSOCIATED AND TARGETED BREEAM CREDIT |
|---|---|
| Maximising passive solar lighting and natural ventilation | Ene 04 – Low Carbon Design<br>Hea 01 – Visual Comfort<br>Hea 2 – Indoor Air Quality |
| Maximising resource efficiency | Mat 06 – Material Efficiency<br>Wst 01 – Construction Waste Management |
| Incorporating the use of recycled and energy efficient materials | Wst 02 – Use of recycled and sustainably sourced aggregates<br>Mat 01 – Environmental impacts from construction products – Building Life Cycle Assessment |
| Incorporating the use of locally sourced building materials | Mat 3 – Responsible sourcing of construction materials |
| Reducing the impact on the external environment and maximising opportunities for cooling and shading (by provision of open space and water, planting, and green roofs, for example); and | Hea 07 – Safe and healthy surroundings<br>Land use and Ecology Section - |
| Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment | Mat 06 - Material Efficiency<br>Wst 06 – Design for disassembly and adaptability |

# POLICY ESD 4: DECENTRALISED ENERGY SYSTEMS

## REQUIREMENT

In relation to the *Cherwell Local Plan 2011-2031 Part 1: Policy Bicester 1,* Policy ESD 4 states the following…

*The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.*

*A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for all applications for non-domestic developments above 1000m$^2$ floorspace.*

*Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit.*

## MITIGATION

As discussed previously with regard to the Ardley Energy Recovery Facility, district heating mains, whether derived from an energy centre on or local to the site, offer potential for the speculative workshop and storage/distribution areas to be space heated and/or cooled via this medium. The constituent parts for any energy centre can be maximised via the use of biomass fuelled CHP or gas fired CHP (profile dependant) to offer heating and electric supply. It should be considered that the Ardley Energy Recovery Facility is local to the site and already offers waste recovery electrical supply.

Heating could be provided using wet heating coils, mounted within air handling units, to deliver heated air into the speculative workshop and storage/distribution areas.

Cooling could be provided via the use of absorption chillers which convert heating water into chilled water. The chiller then serves wet cooling coils, again mounted in an air handling unit, to deliver cooled air to the speculative workshop and storage/distribution areas.

The office spaces are currently proposed to be heated and cooled via an air source heat pump system which represents the most practical system for this size and type of space. Integration to a heat network is not possible for this type of system so the office spaces will not benefit from any heat network. The efficiency of the air source heat pumps system can still achieve very good efficiency ratings so we don't assess this non interface potential as a negative.

Regarding our specific development, the speculative workshop and storage/distribution areas have potential for a wide range of heating demand, down to and including no heating demand. This makes the feasibility of connection to a local heat network, whether private or public, very difficult to assess at this stage. On the predicted basis that the majority of speculative workshop and storage/distribution areas will either be unheated, or frost protected, the provision and connection to of a decentralised heat network would be unfeasible at this current time.

To facilitate the potential for future heat network delivery however, the buildings shall be provided with service ducts capable of supporting the routing of heating mains from the site boundary to the building. This means a clear and unobstructed below ground service strip.

# POLICY ESD 5: RENEWABLE ENERGY

## REQUIREMENT

In relation to the *Cherwell Local Plan 2011-2031 Part 1: Policy Bicester 1*, the Policy ESD 5 states:

*A feasibility assessment of the potential for significant on-site renewable energy provision (above any provision required to meet national building standards) will be require for all applications for non-domestic developments above 1000m$^2$ floorspace*

*Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit.*

## MITIGATION

Please refer to Section 10 – Energy Generation Strategy.

# POLICY ESD 15: THE CHARACTER OF THE BUILT AND HISTORIC ENVIRONMENT

## REQUIREMENT

In relation to the *Cherwell Local Plan 2011-2031 Part 1: Policy Bicester 1,* Policy ESD 15 states the following…

*Consider sustainable design and layout at the master planning stage of design, where building and orientation and the impact of microclimate can be considered within the layout.*

## MITIGATION

Please refer to Section 6 – Passive Design Analysis and Section 9 – Energy Demand Reduction Proposals.

# 4. ENERGY DISPLAY AND MONITORING

## 4.1 REQUIREMENT

This section of the Energy Statement aims to address the real time energy display requirements of Condition 14 of planning permission reference 20/03199/OUT in respect of the employment component of the development.

Condition 14 states:

*No dwelling or employment building shall be occupied until it has been provided with devices showing real time energy and travel information in accordance with details which shall have been submitted to and approved in writing by the local planning authority prior to the commencement of their construction. The devices shall thereafter be retained in operational condition*

*Reason: To support the delivery of modal shift towards sustainable modes and create high quality, inclusive, sustainable development in accordance with Government guidance contained within the Eco Towns PPS and National Planning Policy Framework.*

## 4.2 MITIGATION

The mechanical and electrical building services shall be provided with energy metering in accordance with Building Regulation's Approved Document Part L2A.

The energy monitoring and metering equipment will be capable of the following features:

- be viewable via a web-based platform providing the user with live data, customisable dashboards and the ability to produce scheduled energy reports. The system will be open protocol and capable of connection to a future BMS system.
- provide feedback to the occupants to allow them to compare actual consumption with set benchmarks and act when consumption rises above the benchmarks or when significant changes occur.
- read and record all meter output signals
- record historical data
- indicate meters on relevant schematics
- graphical representation of demand values and energy consumption.

The following equipment will also be provided to enable the metering system:

- Synapsys SIP+ EMT- IF/ XXXP .The SIP Number of Points is to be selected dependent on the number of electric meters (Allow 15 Modbus Points per Electric meter for tendering purposes).
- Synapsys SYN+/MBus/Conv/XX MBus slice for Gas & water meter monitoring.
- Synapsis SYN/4G/MODEM 4G Modem for remote connection
- Synapsis SYN/ANTENNA/HG (to be installed externally for best performance)
- Pulse to MBus converters shall also be provided as part of the controls installation for the water meters.

The communication protocol for the electric meters will be via Modbus back to the Synapsys SIP+ controller. The Gas and water meters will be connected using Mbus and be connected to the SIP+ via an additional module (Slice).

This system will also have the external temperature be monitored and logged to provide a basis for comparison of the energy metering results. The sensor will be connected to the energy monitoring system.

The meters provided will be connected to a dedicated energy monitoring and performance platform, readable on an easy to-use-portal i.e. tenant IT infrastructure.

The system which would fulfil this requirement is shown overleaf.

The need for real time travel information is considered in the Travel Plan submitted to address Condition 14 of the permission.

SYNAPSYS
BUILDING INTELLIGENCE

New

sipe server

## Overview

Developed in response to requests for a energy monitoring and performance dashboard platform, SIPe server is an easy-to-implement efficient solution that pulls energy, utility consumption and any other data types from SIPe meter loggers or a metering system together in an easy-to-use portal.

Unlike many solutions which are subscription-based, SIPe server uses a simple licence model per user. The system can be configured as required, even across multiple sites accessed via your own server.

Fully customisable, the dashboard and widgets can be designed to your specific needs meaning you can tailor the look and feel to your specific requirements at the specification stage.

## Key benefits of the SIPe server solution

- Multiple sites with multiple points can be monitored and displayed
- Alarming data can be automated and displayed
- Energy, utility and any other data type can be displayed
- Server based for instant access to performance information
- Fully customised dashboard and widgets
- User licence so no ongoing subscriptions
- Displays multiple energy points per page

Images show examples what can be achieved, these are not standard templates.

## Display the data you want, how you want to see it

The SIPe server solution not only monitors and displays energy and utility data but also any other types of data can be displayed on the dashboard. Working closely with Synapsys at the specification stage ensures we understand your requirements and you recieve the dashboard solution fit for your needs.

For more information about Synapsys and our product range please visit www.synapsys-solutions.com.

Alternatively to speak with one of our team in more detail or to arrange a demonstration of our products and solutions, please contact us on 01444 246 128 and we will be happy to discuss your requirements.



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SYNAPSYS
BUILDING INTELLIGENCE

# 5. MINIMISING WATER CONSUMPTION

## 5.1 REQUIREMENT

This section aims to address the requirements of Condition 28 of planning permission reference 20/03199/OUT in relation to the proposed employment development at the Site, which comprises circa 16,873m$^2$ of commercial floorspace.

The condition states:

*No phase of employment development shall commence until details of the measures to be installed in that phase to minimise water consumption have been submitted to and approved in writing by the local planning authority. The development shall be carried out in accordance with the approved details. The measures shall thereafter be retained in an operational condition*

*Reason: The site is located in an area of water stress and to comply with Government guidance contained within the Eco Town PPS.*

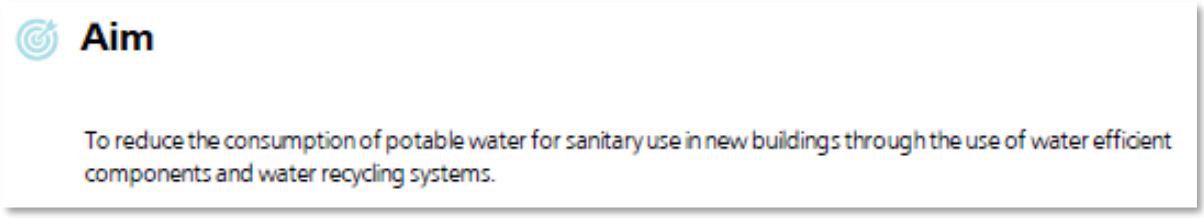
## 5.2 MITIGATION

The site of the proposed development is greenfield land and does not require, or draw, a water load. The new development will draw water for public health use as a minimum. To make the development water neutral would be very difficult as we are working from an existing zero water draw. The eleven units will aim to achieve a good reduction in water consumption via the use of water efficient sanitaryware and fittings. The sanitaryware and fittings shall be the same, equal and approved or better than the fittings shown below…

| Sanitary Fitting | Model & Manufacturer | Flush Volume/ Flow Rate |
|---|---|---|
| WCs | Geberit Sigma concealed cistern | 6/3 litre volume |
| | Ideal Doc M | 4.5 litre volume |
| | | |
| Wash Hand Basin Taps | Ideal Tesi washbasin mixer tap with built-in flow regulator | 5l/min |
| | Ideal Doc M | 4l/min |
| Showers | Triton Omnicare | 8l/min |
| Baths | | |
| Urinals | | |
| Cleaners Sink Tap | Bristan Bib tap with Cottam & Preedy CP961 flow regulator to feeds | 4l/min |
| Kitchen Tap (Kitchenette) | Ideal Standard Concept single Lever Sink Mixer with Cottam & Preedy CP961 flow regulator to feeds | 4l/min |

**BREEAM**

The development is required to achieve BREEAM Very Good 2018 with the capability of achieving Excellent. BREEAM offers a method of calculating water consumption and benchmarking this against a 'standard' installation. This calculation forms part of the Wat 01 section. The aim of this section is:




To achieve credits, a water calculator assesses the water demand for the site and grades this use against a notional 'standard' building. Credits are achieved based on the reduction over the 'standard' water consumption.

The units in Phase 1 and 2 of the employment development achieved two Wat 01 credits by using the sanitaryware and fittings highlighted in the previous table.

# 6. PASSIVE DESIGN ANALYSIS

It is proposed that the building will apply passive design measures to reduce energy demand and consumption. This will be achieved through implementing building fabric with high levels of insulation and good air-tightness, the performance will exceed the worst permissible levels allowable under Building Regulation's Part L.

This is captured in Section 9 – Energy Demand Reduction Proposals, where it highlights the improved building fabric performances, supplementing the energy reduction in parallel with the improved building services efficiencies.

Section 8 – Energy Demand Assessment highlights the worst permissible building fabric used for the base line calculation.

# 7. REDUCING EMBODIED CARBON

## 7.1 REQUIREMENT

This section aims to address the requirements of Condition 17 of planning permission reference 20/03199/OUT in relation to the first phase of development at the Site, which comprises circa 16,942m$^2$ of commercial floorspace.

The condition states:

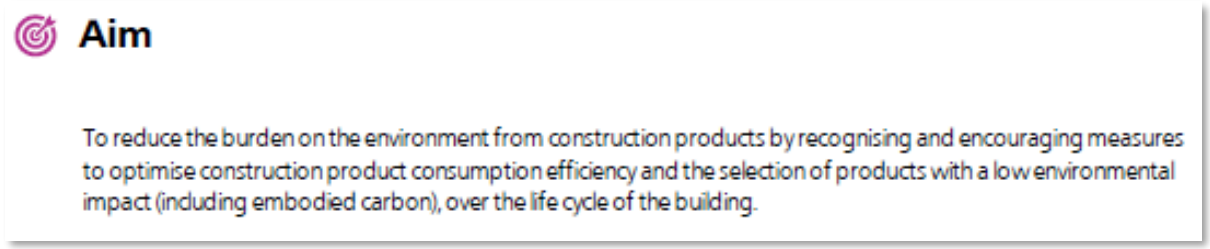
*No phase of employment development shall commence until details of the embedded carbon of its proposed construction materials have been submitted to and approved in writing by the local planning authority. The development shall be carried out in compliance with the approved details.*

*Reason: To ensure the development achieves a reduced carbon footprint in accordance with Planning Policy Statement 1: Eco Towns.*

## 7.1 MITIGATION

The development shall achieve 'Very Good' under BREEAM New Construction 2018 with the future capability of achieving 'Excellent'. A targeted credit for the achievement 'Very Good' is at least 1 credit for Mat 1 - Environmental impacts form construction products – Building life cycle assessment (LCA) section.

The aim of this BREEAM section is:




To achieve credits, the proposed building and its construction materials are modelled against a benchmark building defined by BREEAM. Based on the level of improvement in life cycle analysis (against the BREEAM benchmark standard) credits are awarded accordingly.

We are currently targeting 1 credit for this section which would highlight we are meeting the benchmark life cycle analysis targets for the building construction materials.

Overleaf is the preliminary embodied carbon assessment. This highlights what material(s) contribute the most to the building's embodied carbon during its 60 year life cycle, which is the standard cradle to grave lifespan of a building (i.e. from the extraction and processing of materials to the demolishing of the building and disposing of the materials).

Out of the eleven units in the employment scheme, Unit 4 (shown in Figure 1) was selected for the preliminary assessment. Unit 4's embodied carbon was assessed via the One Click LCA web-application, which is a Life Cycle Assessment and Costs tool used for and complies with BREEAM, LEED and many other certification schemes. Unit 4's results are then pro-rated for the other ten units, based on their gross internal floor area.

*Table 2: Indicative Unit 1 - 11's preliminary embodied carbon results*

| Unit | GIA ($m^2$) | kg $CO_2e/m^2/yr$ | kg $CO_2e/yr$ | kg $CO_2e$ | Tonnes $CO_2e$ |
|---|---|---|---|---|---|
| **1-3** | 5579 | 23.29 | 129,934.91 | 7,796,094.60 | **7,796.09** |
| **4** | 4753 | 23.29 | 110,697.37 | 6,641,842.20 | **6,641.84** |
| **5** | 3814 | 23.29 | 88,828.06 | 5,329,683.60 | **5,329.68** |
| **6-10** | 2207 | 23.29 | 51,401.03 | 3,084,061.80 | **3,084.06** |
| **11** | 600 | 23.29 | 13,974.00 | 838,440.00 | **838.44** |

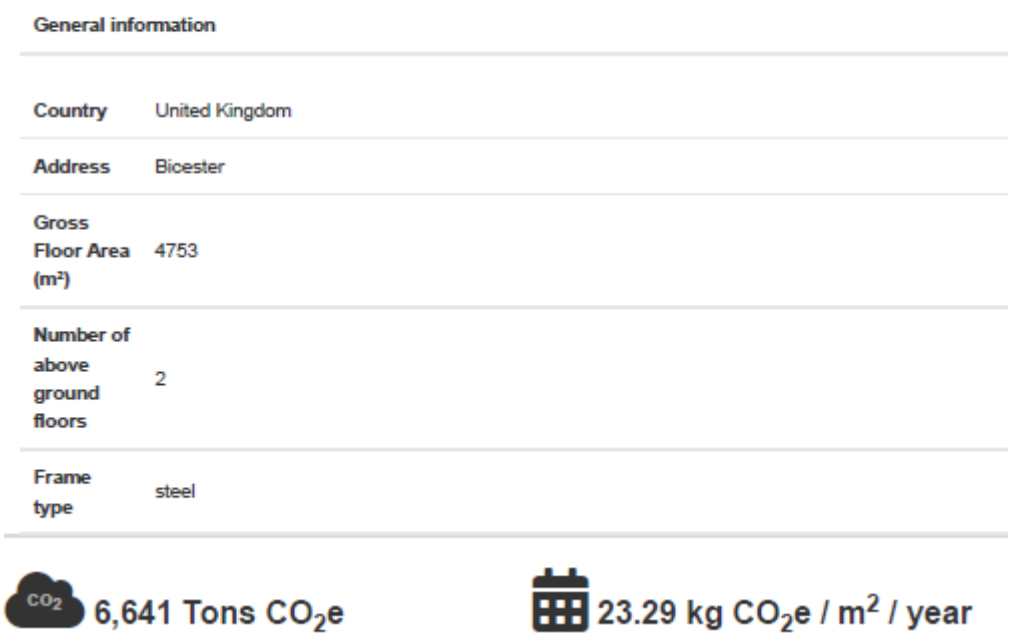



*Figure 3: Unit 4's preliminary embodied carbon results*

# 8. ENERGY DEMAND ASSESSMENT

The initial dynamic simulation performed assesses the predicted annual energy consumption and annual carbon emissions for the development using the minimum permissible fabric, construction and services performances defined by Building Regulations. This assessment and the following assessments will include…

- Predicted regulated energy uses (HVAC equipment, general lighting and daily hot water usage)
- Predicted un-regulated energy uses (Office equipment, lifts and kitchenette appliances)
- External lighting energy use (the site's road/street lighting, car park lighting and services yard lighting)
- Warehouse lighting energy use
- Carbon factor of 0.462 for both the Grid Supplied Electricity and Grid Displaced Electricity (i.e. renewable energy generation)

The upcoming sections will highlight the above.

It is to note that not all of the units will have a thermal dynamic simulation performed, but their energy consumption and carbon emissions shall be based on the 'most similar' unit in terms of building size and office/amenity layout. Unit 1, 4 and 11 will undergo dynamic simulation and their energy consumption per floor area shall be used to calculate the remaining units', the carbon emissions shall be calculated using the carbon factor highlighted above.

The following assumptions for the units that will not have a thermal dynamic simulation are made…

- Unit 1's thermal dynamic simulation results shall be used to calculate Unit 2 and 3
- Unit 4's thermal dynamic simulation results shall be used to calculate Unit 5
- Unit 11's thermal dynamic simulation results shall be used to calculate Unit 6 to 10

# BUILDING ENVELOPE

*Table 3: Minimum Permissible Building Fabric Performance*

| ELEMENT | FABRIC PERFORMANCE |
|---|---|
| All Units Walls U-value | 0.35 W/m².K |
| All Units Internal Office Fire-rated Walls U-value | 0.35 W/m².K |
| All Units Roof U-value | 0.25 W/m².K |
| All Units Windows U-value | 2.20 W/m².K |
| All Units External Door U-value | 2.20 W/m².K |
| All Units Vehicle Access / Dock Doors U-Value | 1.50 W/m².K |
| All Units Windows g-value | 0.40 |
| Ground Floor U-value | 0.25 W/m².K |
| Air Permeability | 10 m³/m²/hr @ 50 Pa |

## MECHANICAL & ELECTRICAL SERVICING STRATEGY

The following servicing strategy for a typical workshop/storage/distribution (with office) was adopted:

- VRV/F air conditioning (air source heat pumps) and mechanical ventilation with heat recovery to the office
- Warehouse/industrial space to be artificially lit and unheated
- Extract ventilation and electric heating to the toilets
- Local small storage electric water heaters for hot water
- LED lighting to all areas

*Table 4: Minimum Permissible Mechanical Services Performance*

| SYSTEM/ZONE | EFFICIENCY |
|---|---|
| Warehouse/Industrial Heating | N/A |
| Air Conditioning (VRV/F air source heat pumps) | Heating CoP = 2.5 Cooling EER = 2.6 |
| Toilet Extract Ventilation | SFP = 0.5 W/(l/s) |
| Mechanical Ventilation | SFP = 1.9 W/(l/s). Heat Recovery Efficiency = 50%. Ventilation Rate = 10 l/s per person |
| Domestic Hot Water Services | Local electric water heaters with 10 litres capacity. |

*Table 5: Minimum Permissible Electrical Lighting Performance*

| ROOM | GAIN ($W/M^2$ UNLESS STATED OTHERWISE) | DESIGN ILLUMINANCE (LUX) | DAYLIGHT CONTROL | PARASITIC POWER ($W/M^2$) |
|---|---|---|---|---|
| Offices | 12 | 500 | N/A | 0.3 |
| Reception | 12 | 300 | N/A | 0.3 |
| Landing | 12 | 300 | N/A | 0.3 |
| Toilets | 12 | 150 | N/A | N/A |
| Warehouse/industrial space | 60 Luminaire Lumens/Circuit Watt | 300 | N/A | 0.3 |
| Car Park & Service Yard | 0.72w/m² | 15 | Yes | N/A |

# REGULATED AND UNREGULATED ENERGY CONSUMPTION

The Chartered Institution of Building Services Engineers (CIBSE) provides guidance on estimating the regulated energy consumption for buildings through their CIBSE: Guide A document. The following figures have been assigned within the model.

## OCCUPANT HEAT GAIN

The heat gain derived from the building occupants directly affects the energy consumption of the air conditioning systems. The more gain, the more energy is required to keep the internal temperature to a comfortable level.

Occupants are assumed to be present within the buildings from 0900 hours until 1800 hours 5 days a week.

*Table 6: Occupant Heat Gains*

| AREA | OCCUPANCY DENSITY (PERSON PER $M^2$) | NO. OF PEOPLE | OCCUPANT GAIN PER PERSON (W) | DIVERSITY FACTOR |
|---|---|---|---|---|
| Office | 10 | - | 75 | 1.0 |
| Reception | - | 2 | 75 | 1.0 |

## EQUIPMENT HEAT GAIN AND ENERGY CONSUMPTION

Two factors are assessed regarding equipment within the building – heat gain and direct energy consumption.

Heat gain from the equipment directly affects the energy consumption of the air conditioning systems. The more gain, the more energy is required to keep the internal temperature to a comfortable level. The equipment also draws a direct electrical load to enable it to operate. Both loads have been assessed using the following parameters:

- The heat gain is 100% of the electrical energy consumption
- The building equipment loads share the same operational schedule as the occupants (0900 – 1800)
- Diversity factor of 1.0 is applied to desktop equipment, i.e. personal computers and desk monitors
- Copy machines and printers will have a default diversity factor of 1.0
- The number of computers and monitors will match the corresponding occupancy

*Table 7: Office Equipment Energy Consumption/Heat Gain*

| ENERGY CONSUMPTION/HEAT GAIN PER UNIT (W) | | | | | | |
|---|---|---|---|---|---|---|
| SPACE | COMPUTER | MONITOR | COPY MACHINE | DESKTOP LASER PRINTER | INKJET PRINTER | LCD TV |
| Offices | 77 | 36 | 350 | 22 | - | - |
| Reception | 77 | 36 | - | - | 15 | 11 |

The offices are assumed to have kitchenette equipment that will give off heat and consume energy. The figures used within the modelling are taken from CIBSE TM37: Design for improved solar shading control.

*Table 8: Kitchenette Equipment Energy Consumption/Heat Gain*

| GAINS (W) | | | | |
|---|---|---|---|---|
| **AREA** | KETTLE | MICROWAVE | REFRIGERATOR | AUDIO VISUAL |
| Unit 6 Office Kitchenette | 44 | 50.2 | 16 | 22 |
| Unit 6 Office Kitchenette | 88 | 107.95 | 16 | 22 |

## LIFTS

Energy consumption via lifts is calculated using guidance from CIBSE Technical Memorandum 54: Evaluating Operational Energy Performance of Buildings at the Design Stage (CIBSE TM54) and CIBSE Guide D: Transportation Systems in Buildings.

The following parameters have been assumed within the modelling:

- The units that have offices will have first-floor offices and Unit 4 will have first and second floor offices therefore there will be some lift usage. Office floor areas are considered to be 'small'.
- As the lifts are primarily for disabled access, the assumed number of trips is 2.
- Standby demand of 51 W shall be used for weekends, taken from Schindler's BREEAM Ene 06 document to Parkway Construction (Main Contractor) for the Phase 1 development. The standby demand is also used for the idle demand.
- Schindler 3300's specific travel demand is 0.42 mWh/(kg.m). Taken from Schindler's BREEAM Ene 06 document for the Phase 1 development.

- Lift door time is taken to be 8 seconds.
- Lift velocity, acceleration and jerk/jolt are taken to be 1.0m/s, 0.3 $m/s^2$ and 0.5 $m/s^3$, respectively.
- The hourly power consumption was calculated to be approximately 123 W.

## RESULTS

By adopting the above building fabric and mechanical/electrical services, Unit 1, 4 and 11 demonstrated following predicted energy and carbon results within the table and graphs below…

*Table 9: Unit 1, 4 and 11 Initial Energy and Carbon Emission Result*

| Building | Annual Energy Consumption (kWh/yr) | Approx. Annual Energy Consumption per Floor Area (kWh/$m^2$.yr) | Annual Carbon Emission (kg.$CO_2$/yr) |
|---|---|---|---|
| Unit 1 | 99,141.34 | 47 | 45,803.31 |
| Unit 4 | 229,212.51 | 47 | 105,896.25 |
| Unit 11 | 29,135.73 | 48 | 13,460.71 |

The approximate energy consumption per floor area are rounded-up to the first whole number (e.g. 46.2 = 47 kg.$CO_2$/$m^2$.yr).

Using the above approximate energy consumption per floor area, Unit 2, 3, 5 and 6 – 11 achieve the following energy consumption and carbon emission…

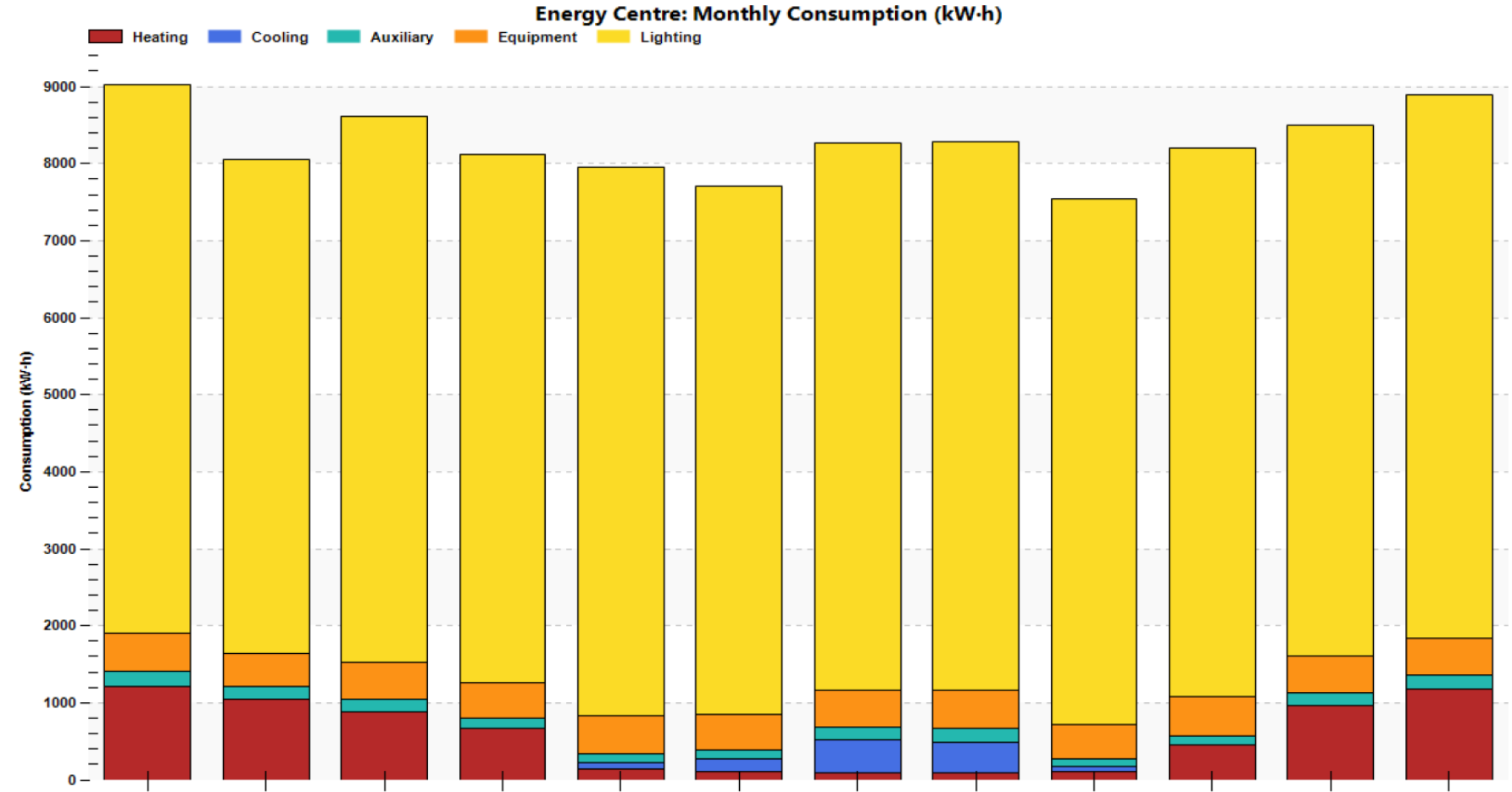
*Table 10: Unit 2, 3, 5 and 6 – 10 Initial Energy and Carbon Emission Result*

| Building | Annual Energy Consumption (kWh/yr) | Annual Carbon Emission ($kg.CO_2/yr$) |
|---|---|---|
| Unit 2 | 83,801 | 38,716 |
| Unit 3 | 86,104 | 39,780 |
| Unit 5 | 179,258 | 82,817 |
| Unit 6 | 23,520 | 10,866 |
| Unit 7 | 23,328 | 10,778 |
| Unit 8 | 19,440 | 8,981 |
| Unit 9 | 15,552 | 7,185 |
| Unit 10 | 20,640 | 9,536 |

Phase 3's site-wide total energy consumption and carbon emission are 809,756.60 kWh/annum and 374,107.56 $kg.CO_2$/annum, respectively. Please note that this excludes external lighting, which will be included in the analysis.

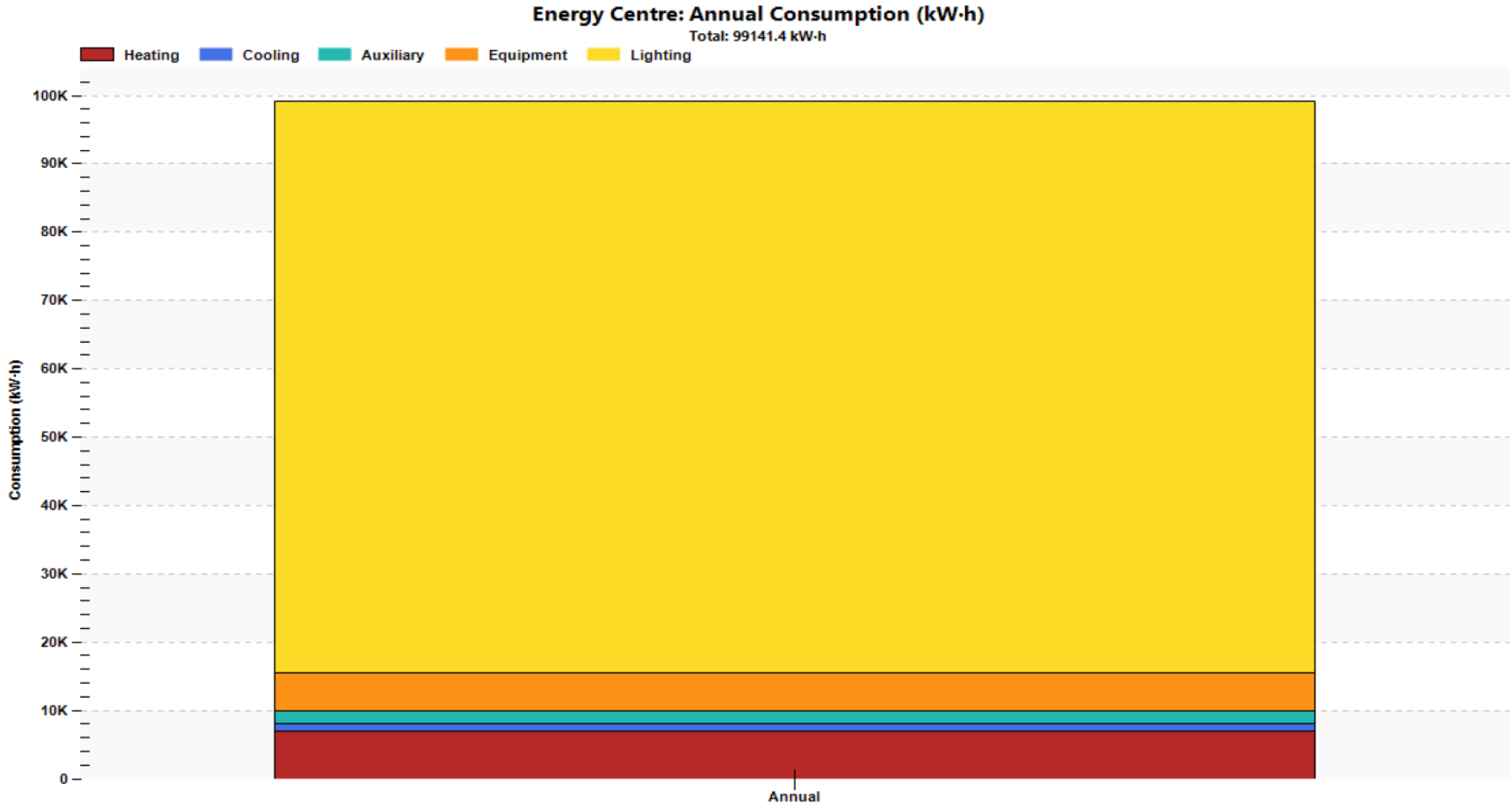
## UNIT 1 ANNUAL ENERGY CONSUMPTION USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

Tas Systems: Simulation Results




| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 1217.8 | 1042.4 | 884.5 | 661.9 | 145.8 | 100.9 | 86.2 | 90.1 | 107.1 | 451.8 | 967.8 | 1184.5 |
| Cooling | 0.0 | 0.0 | 0.0 | 0.0 | 74.7 | 176.6 | 426.4 | 401.0 | 64.2 | 1.7 | 0.0 | 0.0 |
| Auxiliary | 190.4 | 165.6 | 155.4 | 131.6 | 111.8 | 115.2 | 173.4 | 168.4 | 94.9 | 122.2 | 163.4 | 182.1 |
| Equipment | 499.8 | 437.6 | 481.9 | 461.1 | 499.8 | 461.1 | 481.9 | 499.8 | 443.2 | 499.8 | 479.1 | 464.0 |
| Lighting | 7120.2 | 6410.5 | 7093.5 | 6856.9 | 7120.2 | 6856.9 | 7093.5 | 7120.2 | 6830.2 | 7120.2 | 6883.6 | 7066.8 |

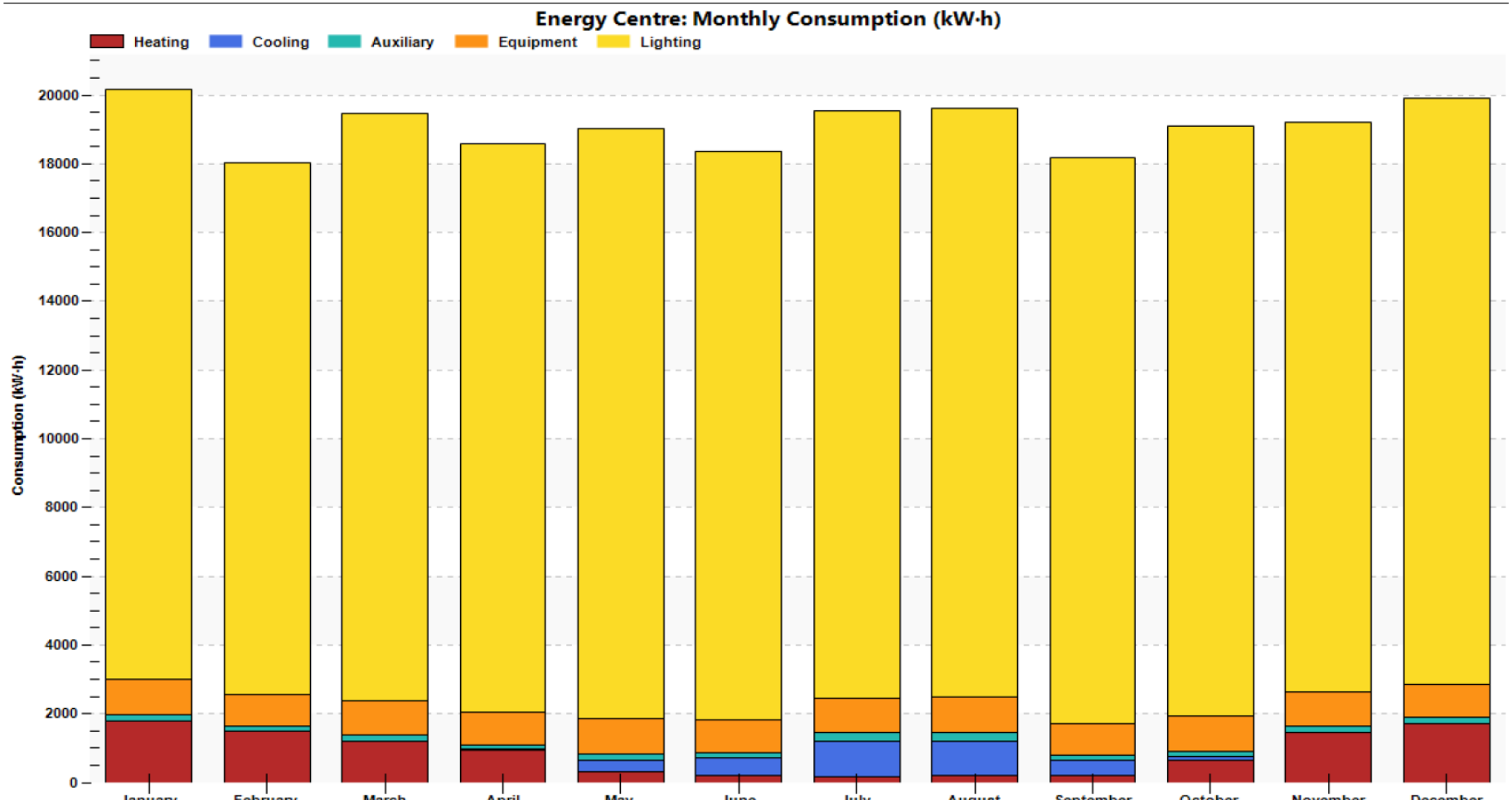
Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 6.9 |
| Cooling | 1.1 |
| Auxiliary | 1.8 |
| Equipment | 5.7 |
| Lighting | 83.6 |

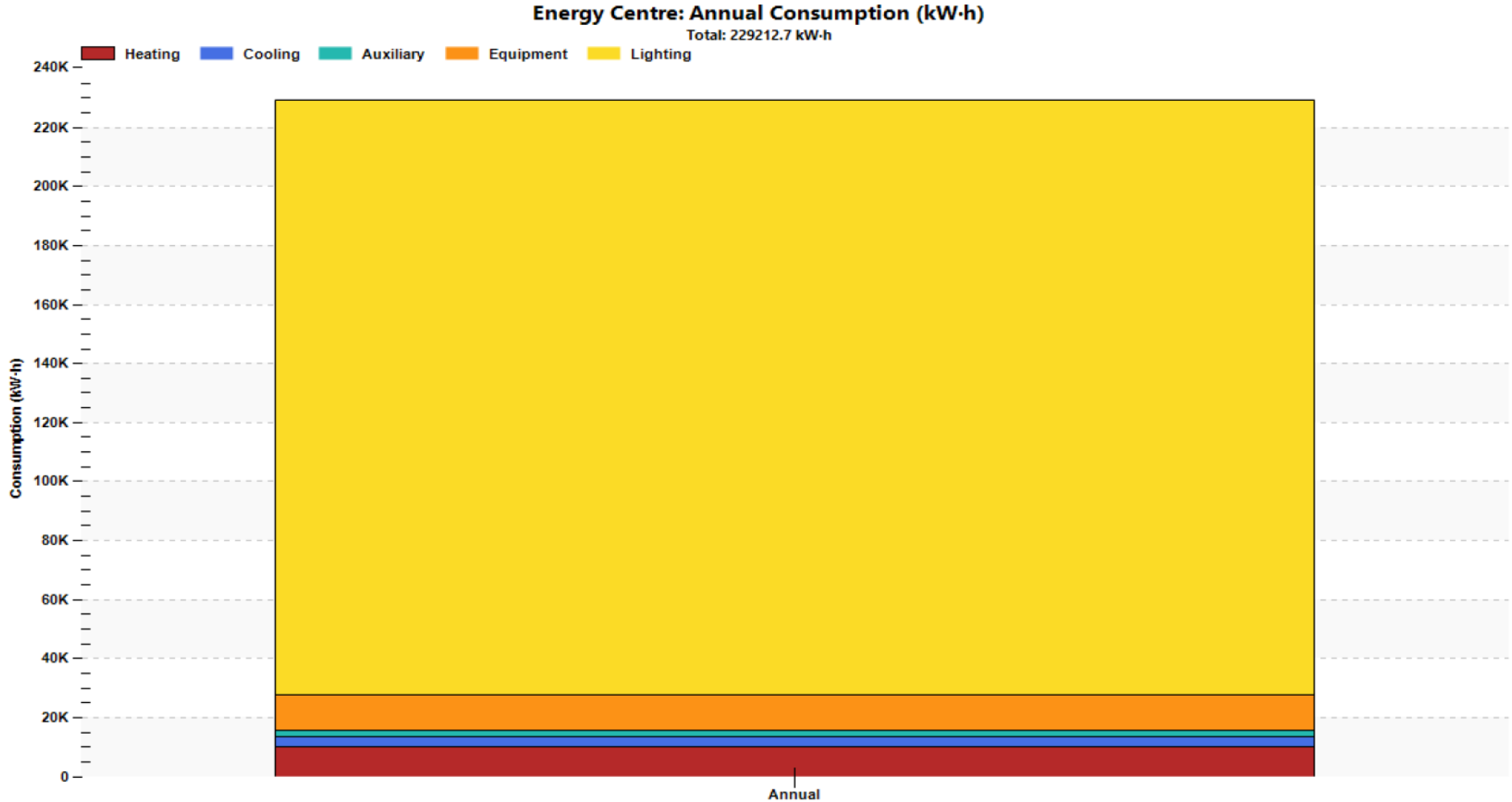
## UNIT 4 ANNUAL ENERGY CONSUMPTION USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

Tas Systems: Simulation Results



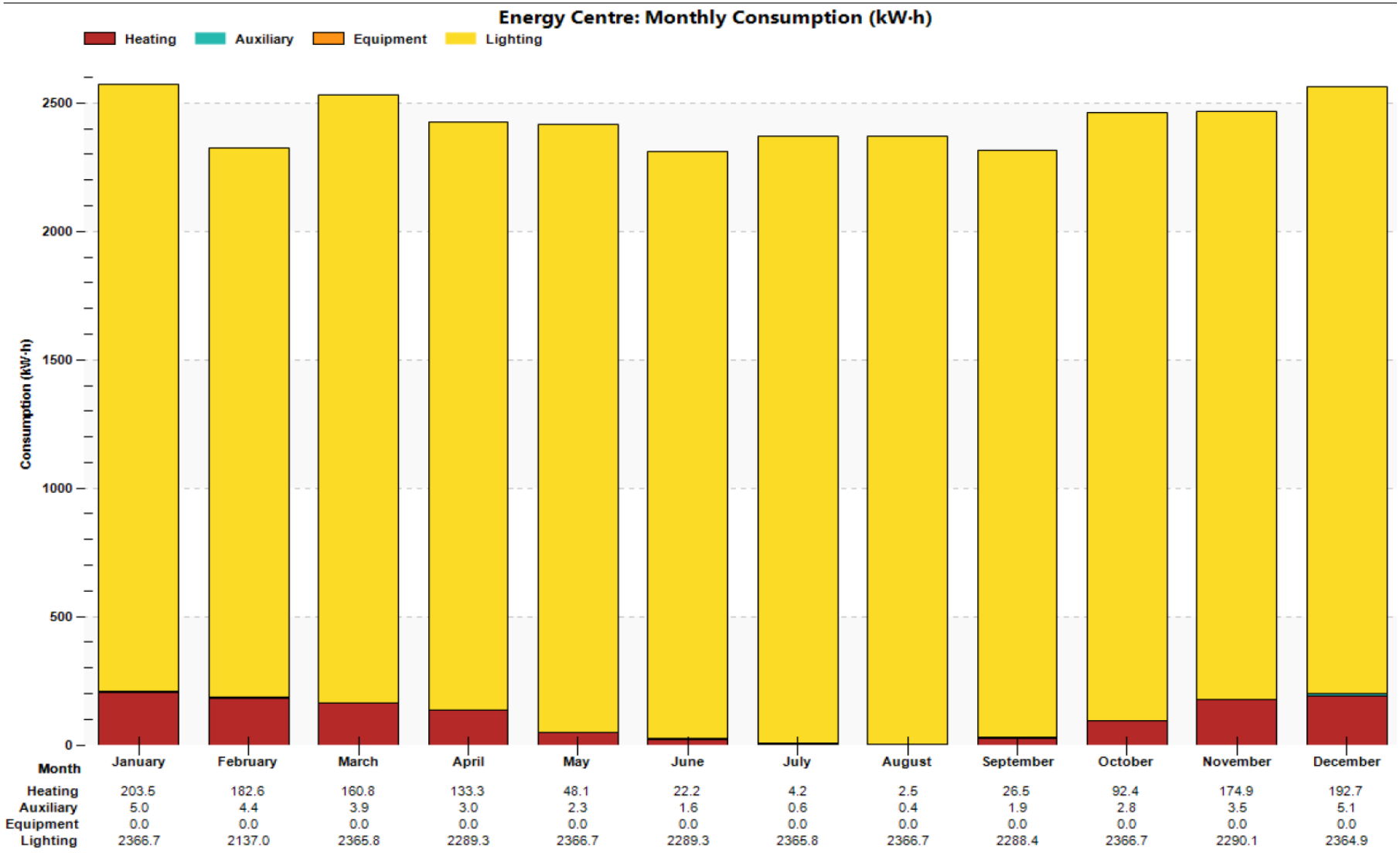

| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 1780.4 | 1484.4 | 1200.7 | 946.0 | 295.1 | 214.3 | 183.3 | 191.5 | 200.8 | 634.3 | 1453.0 | 1695.3 |
| Cooling | 0.0 | 0.0 | 6.4 | 13.1 | 359.3 | 491.7 | 1006.0 | 995.3 | 433.1 | 116.1 | 0.0 | 0.0 |
| Auxiliary | 196.6 | 163.9 | 156.8 | 136.7 | 158.7 | 161.0 | 251.4 | 250.5 | 149.8 | 142.8 | 169.6 | 185.9 |
| Equipment | 1037.5 | 911.8 | 1004.8 | 962.9 | 1037.5 | 962.9 | 1004.8 | 1037.5 | 930.2 | 1037.5 | 995.6 | 972.1 |
| Lighting | 17159.8 | 15455.8 | 17103.8 | 16535.8 | 17159.8 | 16535.8 | 17103.8 | 17159.8 | 16479.8 | 17159.8 | 16591.8 | 17047.8 |

Tas Systems: Simulation Results



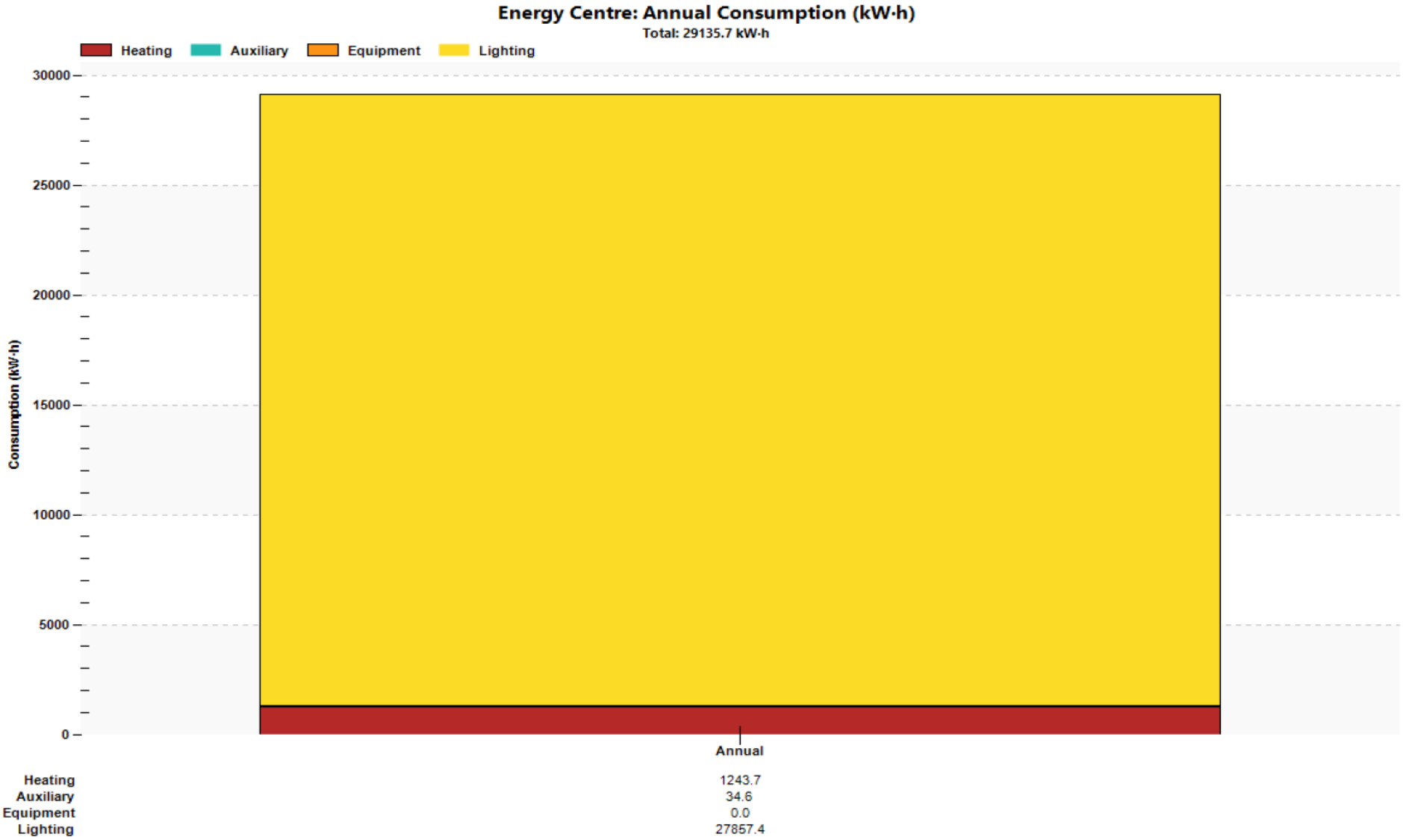
## UNIT 11 ANNUAL ENERGY CONSUMPTION USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

Tas Systems: Simulation Results



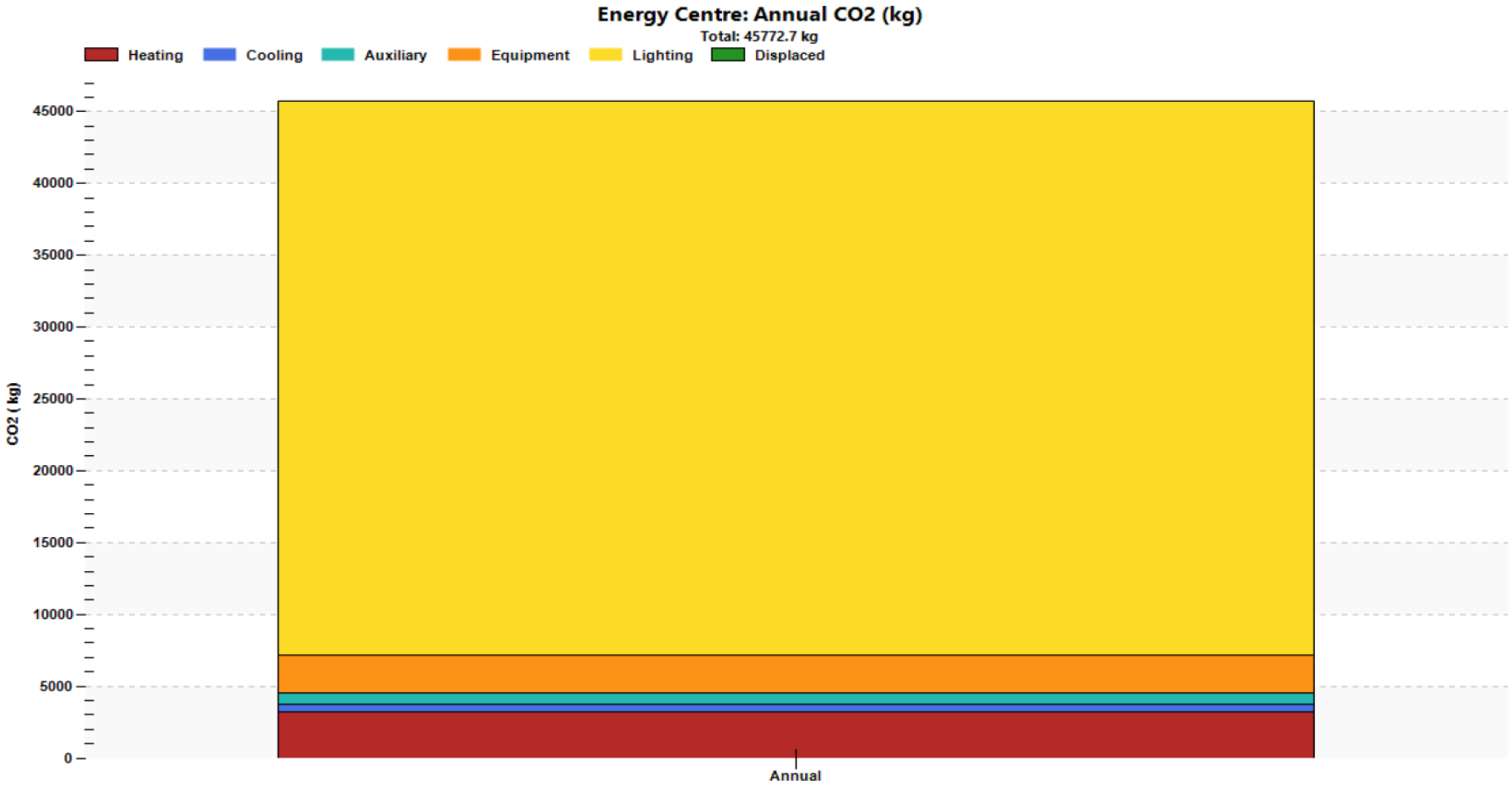

| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 203.5 | 182.6 | 160.8 | 133.3 | 48.1 | 22.2 | 4.2 | 2.5 | 26.5 | 92.4 | 174.9 | 192.7 |
| Auxiliary | 5.0 | 4.4 | 3.9 | 3.0 | 2.3 | 1.6 | 0.6 | 0.4 | 1.9 | 2.8 | 3.5 | 5.1 |
| Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lighting | 2366.7 | 2137.0 | 2365.8 | 2289.3 | 2366.7 | 2289.3 | 2365.8 | 2366.7 | 2288.4 | 2366.7 | 2290.1 | 2364.9 |

Tas Systems: Simulation Results



## UNIT 1 ANNUAL CARBON EMISSIONS USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

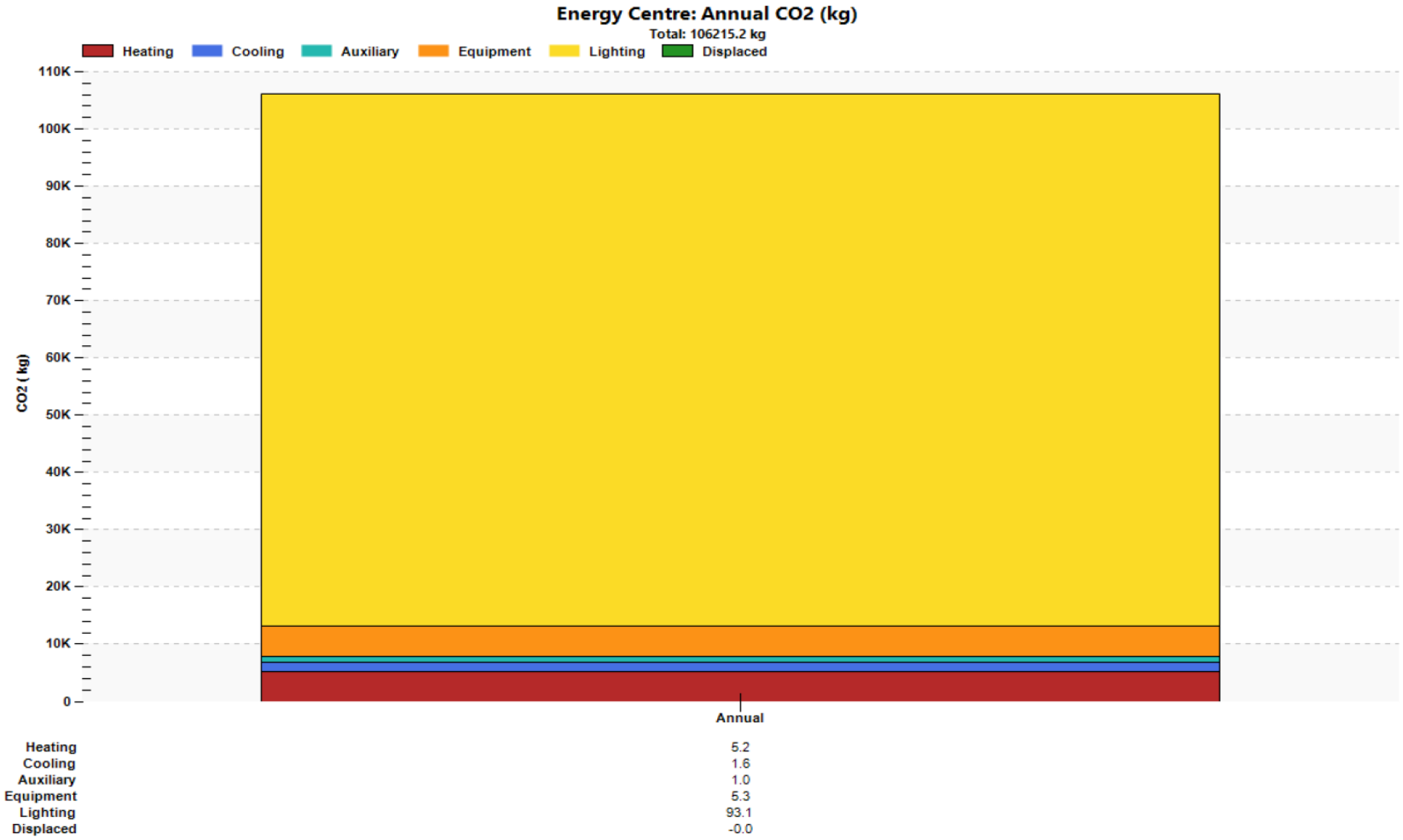
Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 3216.8 |
| Cooling | 526.8 |
| Auxiliary | 820.7 |
| Equipment | 2560.4 |
| Lighting | 38647.9 |
| Displaced | -0.0 |

## UNIT 4 ANNUAL CARBON EMISSIONS USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

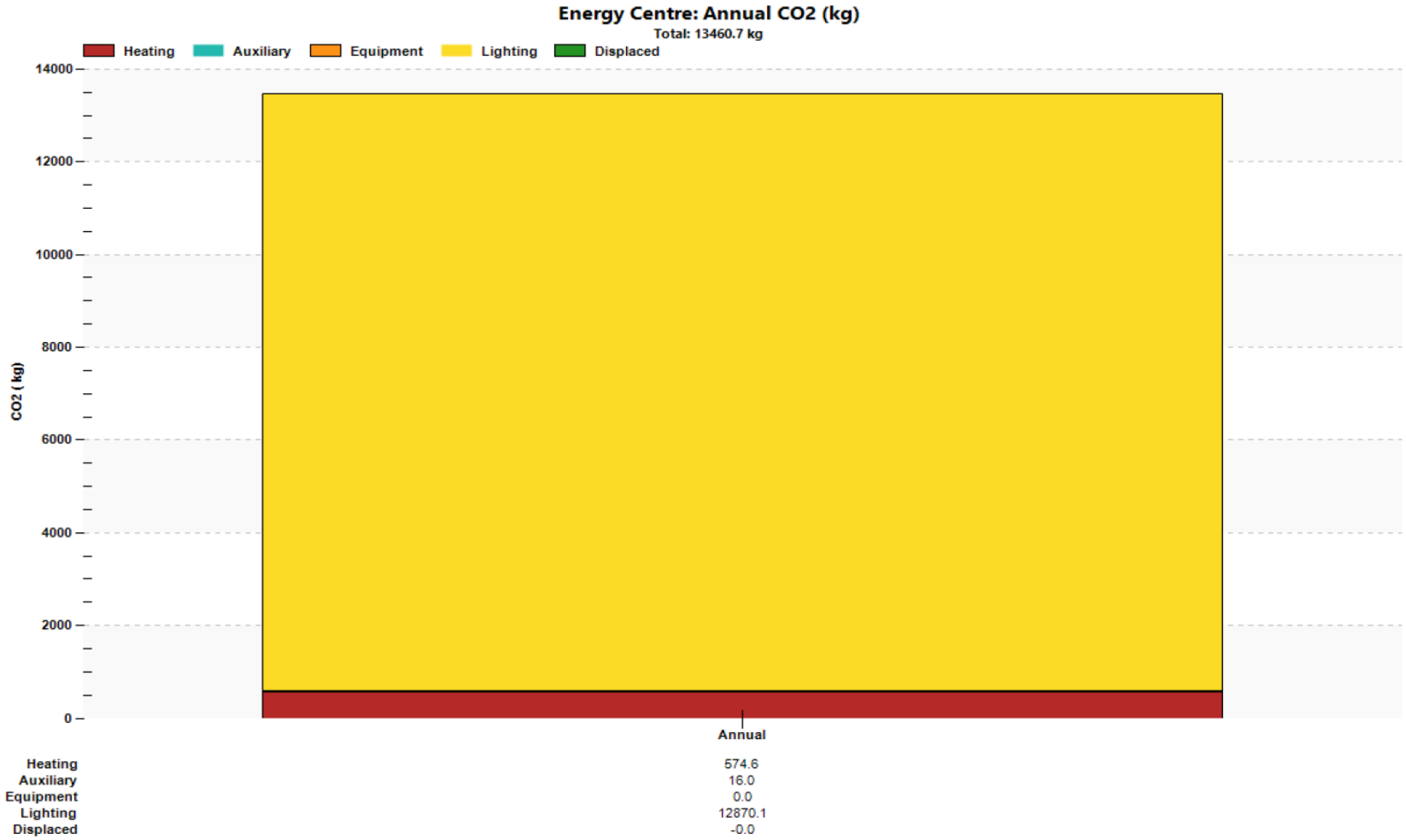
Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 5.2 |
| Cooling | 1.6 |
| Auxiliary | 1.0 |
| Equipment | 5.3 |
| Lighting | 93.1 |
| Displaced | -0.0 |

## UNIT 11 ANNUAL CARBON EMISSIONS USING MINIMUM PERMISSIBLE PERFORMANCE STANDARDS

Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 574.6 |
| Auxiliary | 16.0 |
| Equipment | 0.0 |
| Lighting | 12870.1 |
| Displaced | -0.0 |

# 9. ENERGY DEMAND REDUCTION PROPOSALS

ESC proposes an enhanced building performance strategy that aims to reduce the predicted annual energy consumption and annual carbon emissions for the development using improved and efficient fabric, construction and services performances. These are highlighted in the upcoming sections.

## BUILDING ENVELOPE

*Table 11: Enhanced Building Fabric Performance*

| ELEMENT | FABRIC PERFORMANCE |
|---|---|
| All Units Walls U-value | 0.28 W/m².K |
| All Units Internal Office Fire-rated Walls U-value | 0.28 W/m².K |
| All Units Roof U-value | 0.18 W/m².K |
| All Units Windows U-value | 1.50 W/m².K |
| All Units External Door U-value | 2.20 W/m².K |
| All Units Vehicle Access / Dock Doors U-Value | 1.50 W/m².K |
| All Units Windows g-value | 0.40 |
| Office Ground Floor U-value | 0.22 W/m².K |
| Air Permeability | 3.00 m³/m²/hr @ 50 Pa |

## ENHANCED MECHANICAL & ELECTRICAL SERVICING PROPOSAL

The following enhanced servicing strategy for a typical workshop/storage/distribution (with office) was proposed:

- VRV/F air conditioning (air source heat pumps) and mechanical ventilation with heat recovery to the office
- Warehouse/industrial space to be artificially lit and unheated
- Extract ventilation and electric heating to the toilets
- Local small storage electric water heaters for hot water
- LED lighting with intelligent occupancy and daylighting controls

*Table 12: Enhanced Mechanical Services Performance*

| SYSTEM / ZONE | EFFICIENCY |
|---|---|
| Warehouse/industrial Heating | N/A |
| Air Conditioning (VRV/F air source heat pumps) | Heating CoP = 4.00 Cooling EER = 4.00 |
| Toilet Extract Ventilation | SFP = 0.5 W/(l/s) |
| Mechanical Ventilation | SFP = 1.5 W/(l/s). Heat Recovery Efficiency = 73%. Ventilation Rate = 10 l/s per person |
| Domestic Hot Water Services | Local electric water heaters with 10 litres capacity. |

*Table 13: Enhanced Electrical Lighting Performance*

| ROOM | GAIN (W/M² UNLESS OTHERWISE STATED) | DESIGN ILLUMINANCE (LUX) | DAYLIGHT CONTROL | PARASITIC POWER (W/M²) |
|---|---|---|---|---|
| Offices | 10.0 | 500 | Photocell dimming with manual on/auto off absence detection | 0.2 |
| Reception | 6.0 | 300 | Photocell dimming and manual switching | 0.2 |
| Landing | 6.0 | 300 | Photocell dimming and auto on/off presence detection | 0.2 |

| ROOM | GAIN (W/M² UNLESS OTHERWISE STATED) | DESIGN ILLUMINANCE (LUX) | DAYLIGHT CONTROL | PARASITIC POWER (W/M²) |
|---|---|---|---|---|
| Toilets | 10.0 | 150 | No daylight control with auto on/off presence detection | N/A |
| Warehouse/industrial space | 105 Llm/cW | 300 | Photocell dimming and auto on/off presence detection | 0.1 |
| Car Park & Service Yard | 0.72w/m² | 15 | Yes | N/A |

## REGULATED AND UNREGULATED ENERGY CONSUMPTION

All the regulated and un-regulated energy consumptions and heat gains assigned in the previous calculation were used in the enhanced performance calculation.

## RESULTS

By adopting the proposed enhanced building fabric and services in an attempt to reduce the overall energy demand and carbon emission, the development demonstrated the reduced energy demand and carbon emissions in the table and graphs below…

*Table 14: Unit 1 Energy and Carbon Emission Comparison*

| | Annual Energy Consumption (kWh/yr) | Annual Energy Consumption per Floor Area (kWh/yr) | Annual Carbon Emission ($kg.CO_2/yr$) |
|---|---|---|---|
| Unit 1 Minimum permissible performance standards | 99,141.34 | 47 | 45,803.31 |
| Unit 1 Enhanced performance standards | 34,013.14 | 17 | 15,714.07 |
| Unit 1 Percentage saving | 66% | N/A | 66% |

*Table 15: Unit 4 Energy and Carbon Emission Comparison*

| | Annual Energy Consumption (kWh/yr) | Annual Energy Consumption per Floor Area (kWh/yr) | Annual Carbon Emission ($kg.CO_2/yr$) |
|---|---|---|---|
| Unit 4 Minimum permissible performance standards | 229,212.51 | 47 | 105,896.25 |
| Unit 4 Enhanced performance standards | 71,374.48 | 15 | 32,975.03 |
| Unit 4 Percentage saving | 69% | N/A | 69% |

*Table 16: Unit 11 Energy and Carbon Emission Comparison*

| | Annual Energy Consumption (kWh/yr) | Annual Energy Consumption per Floor Area (kWh/yr) | Annual Carbon Emission ($kg.CO_2/yr$) |
|---|---|---|---|
| Unit 11 Minimum permissible performance standards | 29,135.73 | 48 | 13,460.71 |
| Unit 11 Enhanced performance standards | 7,437.09 | 13 | 3,468.78 |
| Unit 11 Percentage saving | 74% | N/A | 74% |

Using the energy consumption per floor area figures above, Unit 2, 3, 5 and 6 – 10's energy consumption and carbon emissions using the enhanced building services and building fabric are shown in the table below…

*Table 17: Unit 2, 3, 5 and 6 – 10 Initial Energy and Carbon Emission Result*

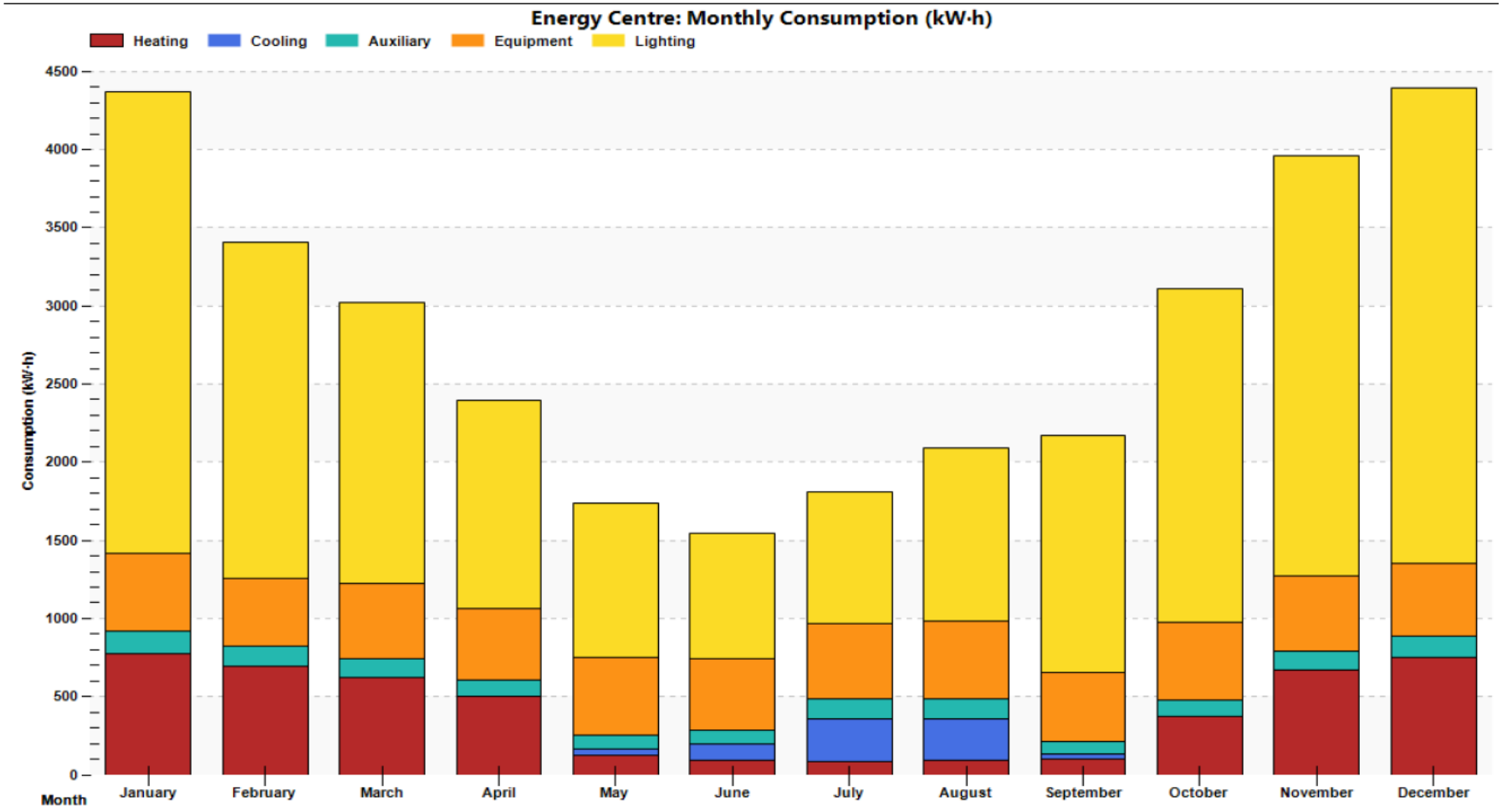
| Building | Minimum Permissible Annual Energy Consumption (kWh/yr) | Minimum Permissible Annual Carbon Emission ($kg.CO_2/yr$) | Enhanced Annual Energy Consumption (kWh/yr) | Enhanced Annual Carbon Emission ($kg.CO_2/yr$) | Percentage Saving (Energy/ Carbon) |
|---|---|---|---|---|---|
| Unit 2 | 83,801 | 38,716 | 30,311 | 14,004 | **64% / 64%** |
| Unit 3 | 86,104 | 39,780 | 23,816 | 11,003 | **72% / 72%** |
| Unit 5 | 179,258 | 82,817 | 57,210 | 26,431 | **68% / 68%** |
| Unit 6 | 23,520 | 10,866 | 6,370 | 2,943 | **73% / 73%** |
| Unit 7 | 23,328 | 10,778 | 6,318 | 2,919 | **73% / 73%** |
| Unit 8 | 19,440 | 8,981 | 5,265 | 2,432 | **73% / 73%** |
| Unit 9 | 15,552 | 7,185 | 4,212 | 1,946 | **73% / 73%** |
| Unit 10 | 20,640 | 9,536 | 5,590 | 2,583 | **73% / 73%** |

Through implementing efficient building services and building fabric with good thermal performances, the units achieve carbon saving greater than 60% and some units achieving savings greater than 70%.

Phase 3's site-wide total energy consumption and carbon emission are 251,916.71 kWh/annum and 116,418.88 $kg.CO_2$/annum, respectively. Please note that this excludes external lighting, which will be included in the analysis.

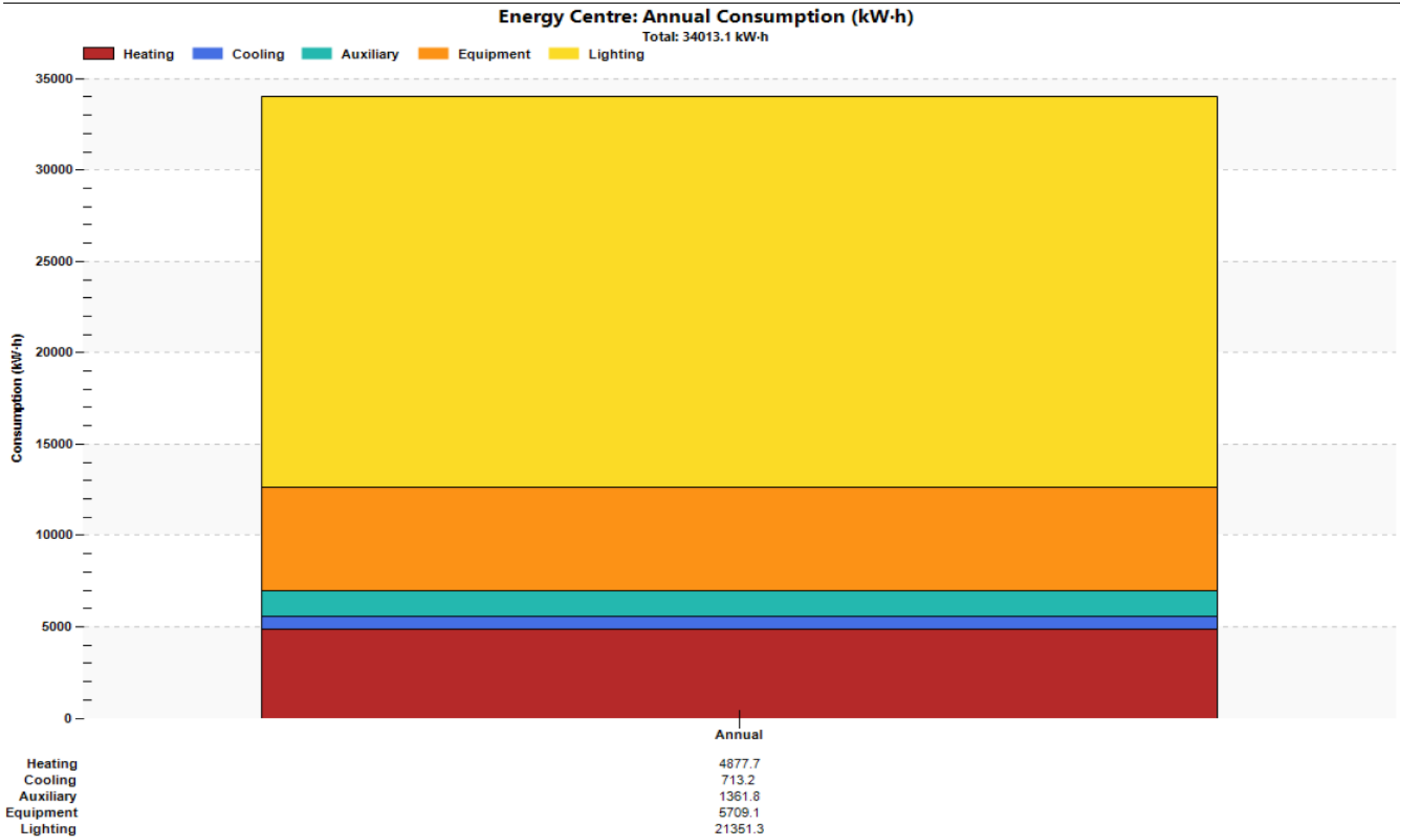
## UNIT 1 ANNUAL ENERGY CONSUMPTION USING ENHANCED PERFORMANCE STANDARDS

Tas Systems: Simulation Results




| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 778.1 | 694.3 | 618.6 | 499.4 | 124.5 | 91.9 | 86.0 | 89.9 | 104.2 | 373.3 | 666.5 | 750.9 |
| Cooling | 0.0 | 0.0 | 0.0 | 0.0 | 38.9 | 106.0 | 268.8 | 267.8 | 31.7 | 0.0 | 0.0 | 0.0 |
| Auxiliary | 141.8 | 125.8 | 122.2 | 105.2 | 86.0 | 84.7 | 132.3 | 128.3 | 74.1 | 100.5 | 124.6 | 136.3 |
| Equipment | 499.8 | 437.6 | 481.9 | 461.1 | 499.8 | 461.1 | 481.9 | 499.8 | 443.2 | 499.8 | 479.1 | 464.0 |
| Lighting | 2949.8 | 2151.2 | 1800.4 | 1330.1 | 988.0 | 804.2 | 839.0 | 1104.6 | 1514.2 | 2134.9 | 2690.8 | 3044.2 |

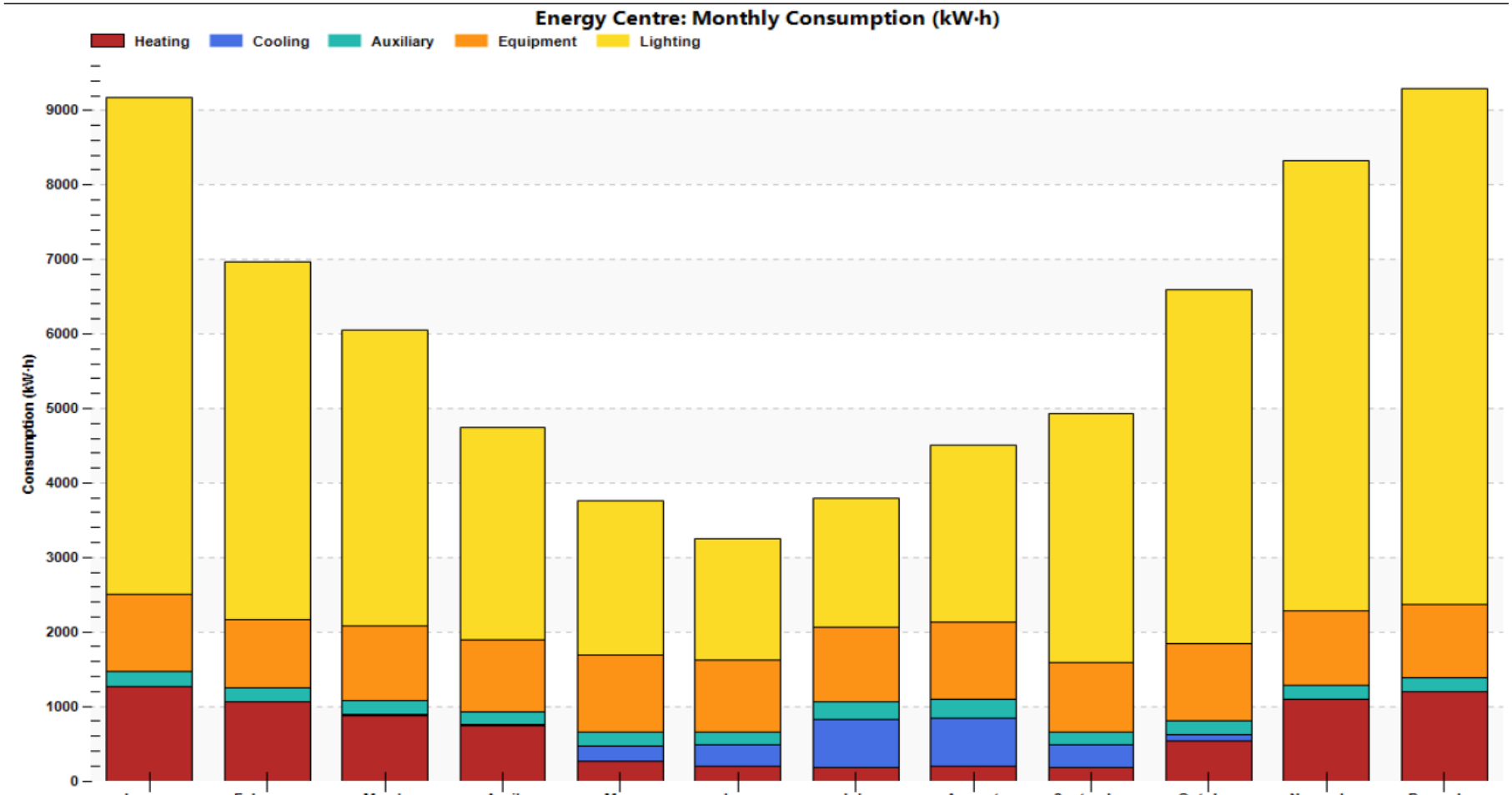
Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 4877.7 |
| Cooling | 713.2 |
| Auxiliary | 1361.8 |
| Equipment | 5709.1 |
| Lighting | 21351.3 |

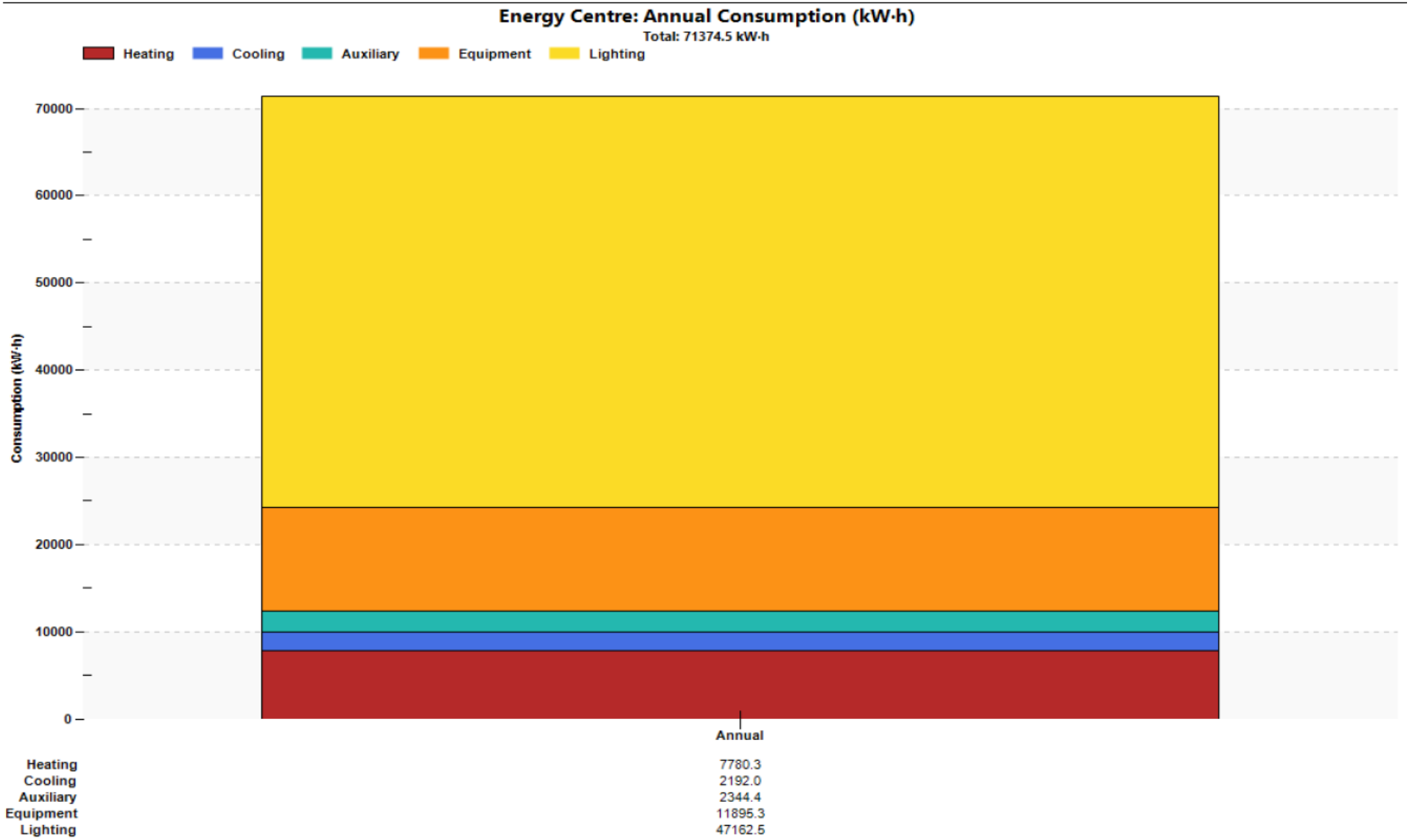
## UNIT 4 ANNUAL ENERGY CONSUMPTION USING ENHANCED PERFORMANCE STANDARDS

Tas Systems: Simulation Results



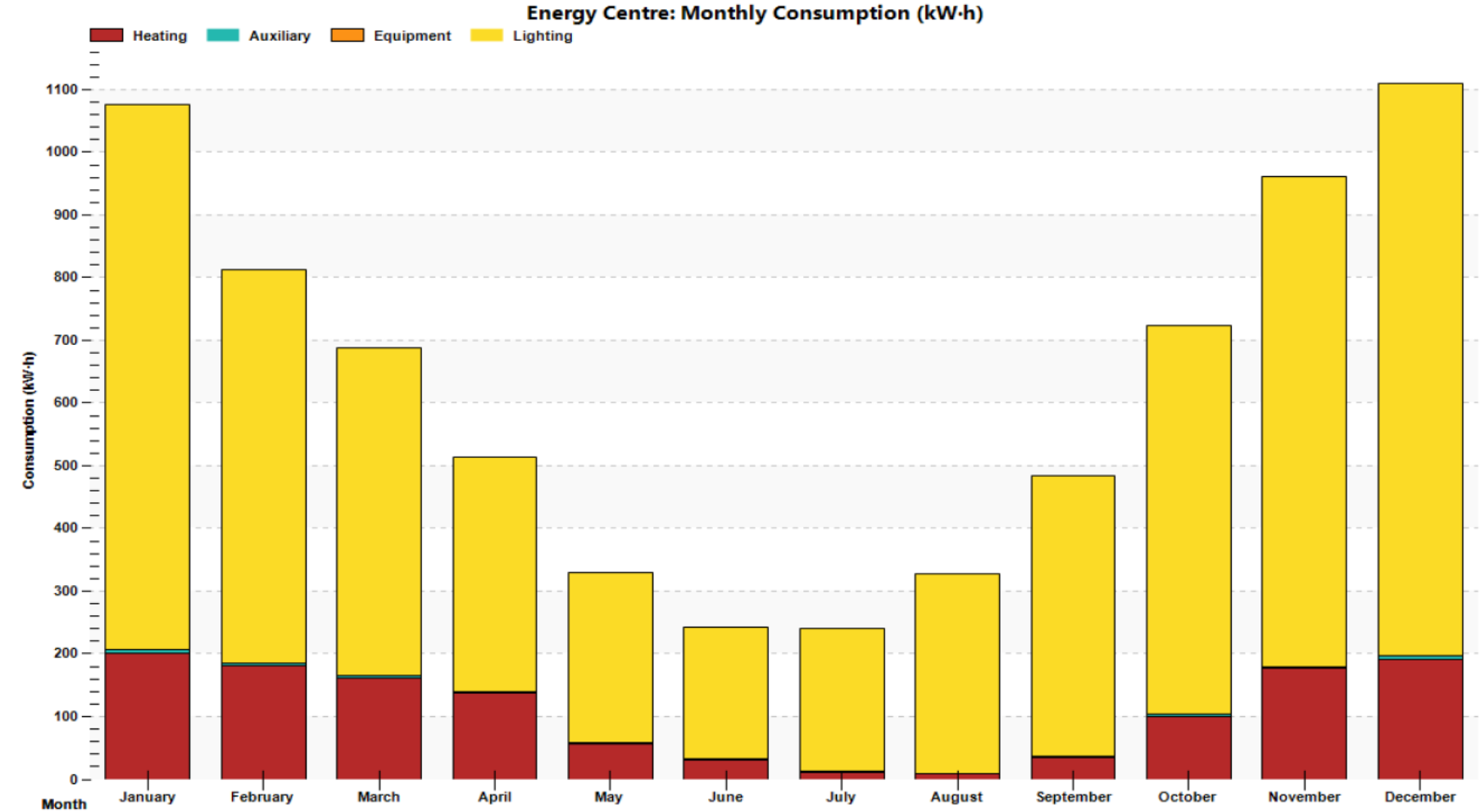

| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 1256.6 | 1065.2 | 881.8 | 737.7 | 257.8 | 198.4 | 183.1 | 191.3 | 186.6 | 540.3 | 1089.2 | 1192.4 |
| Cooling | 0.0 | 0.0 | 5.1 | 12.9 | 211.3 | 290.4 | 635.1 | 656.3 | 298.7 | 82.3 | 0.0 | 0.0 |
| Auxiliary | 210.8 | 179.2 | 185.4 | 172.1 | 184.5 | 173.0 | 243.8 | 249.9 | 171.9 | 183.8 | 194.6 | 195.4 |
| Equipment | 1037.5 | 911.8 | 1004.8 | 962.9 | 1037.5 | 962.9 | 1004.8 | 1037.5 | 930.2 | 1037.5 | 995.6 | 972.1 |
| Lighting | 6675.5 | 4806.2 | 3973.5 | 2855.7 | 2068.3 | 1621.5 | 1723.4 | 2363.8 | 3347.9 | 4746.1 | 6044.3 | 6936.3 |

Tas Systems: Simulation Results



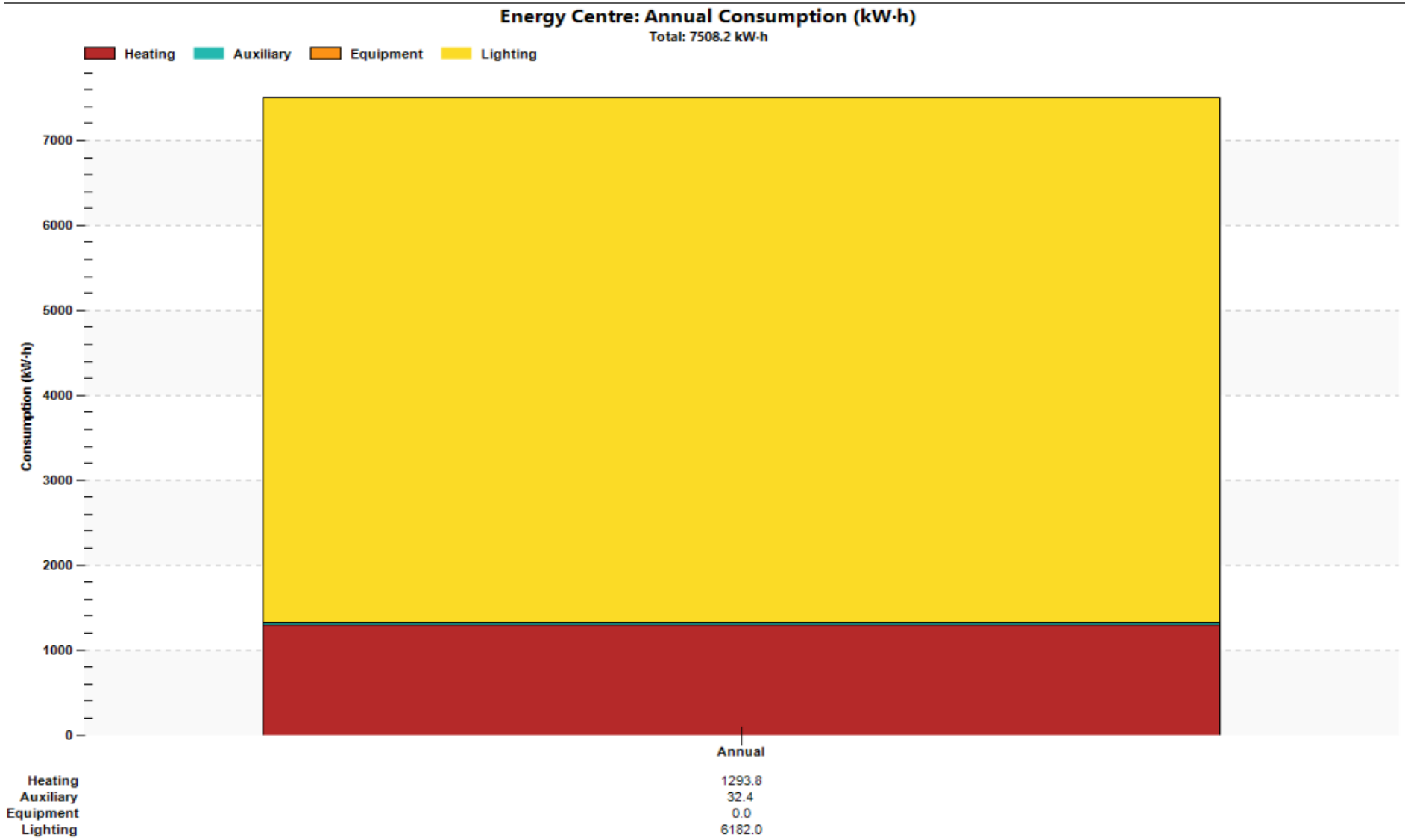
## UNIT 11 ANNUAL ENERGY CONSUMPTION USING ENHANCED PERFORMANCE STANDARDS

Tas Systems: Simulation Results



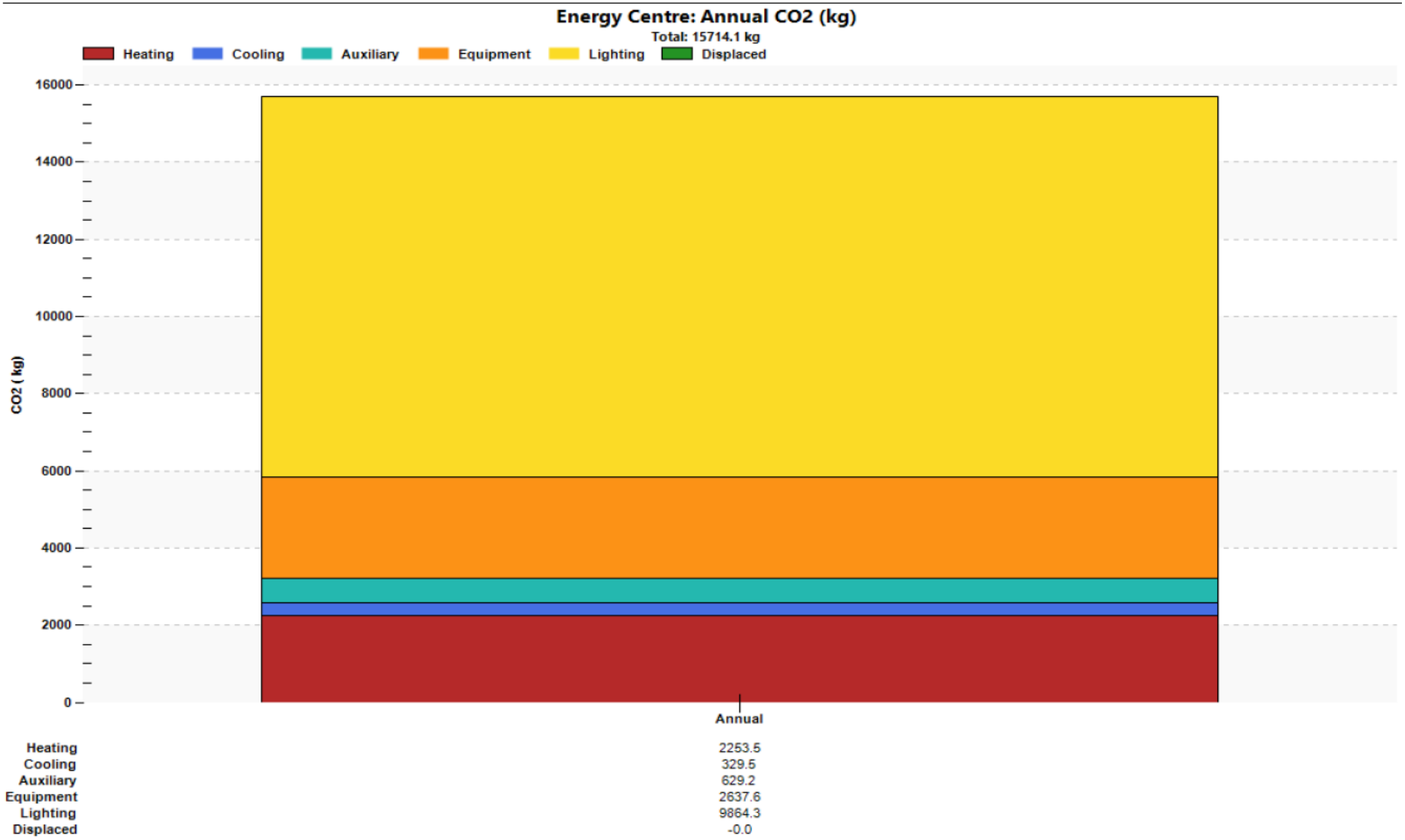

| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heating | 201.8 | 181.8 | 162.3 | 136.7 | 56.1 | 30.1 | 11.5 | 9.1 | 35.1 | 100.4 | 176.7 | 192.0 |
| Auxiliary | 4.4 | 4.0 | 3.5 | 2.8 | 2.4 | 1.7 | 0.7 | 0.5 | 2.0 | 2.9 | 3.2 | 4.4 |
| Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lighting | 868.9 | 626.1 | 522.9 | 374.1 | 270.3 | 210.3 | 228.3 | 317.2 | 446.3 | 621.4 | 781.9 | 914.2 |

Tas Systems: Simulation Results



## UNIT 1 ANNUAL CARBON EMISSIONS USING ENHANCED PERFORMANCE STANDARDS

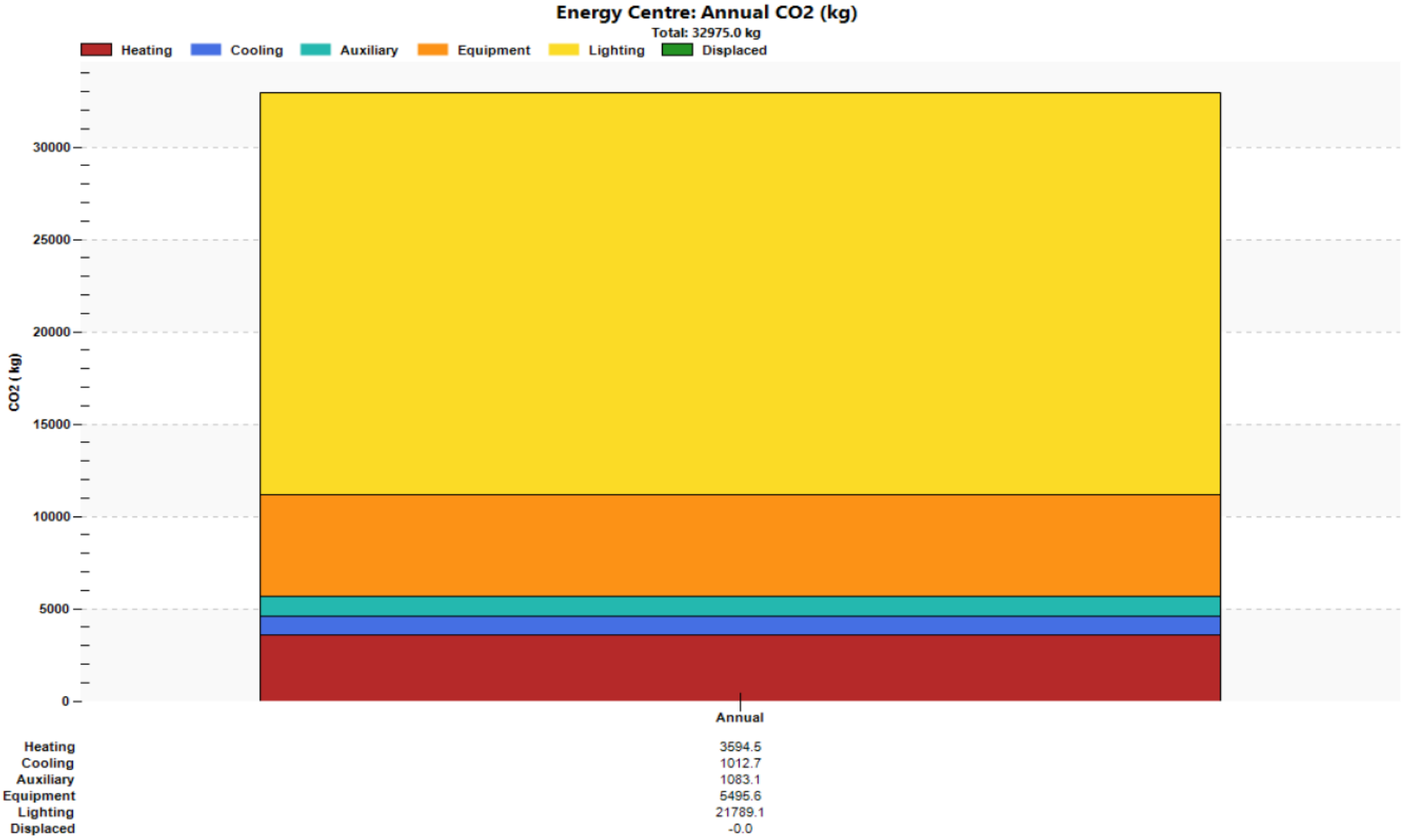
Tas Systems: Simulation Results




| | Annual |
|---|---|
| Heating | 2253.5 |
| Cooling | 329.5 |
| Auxiliary | 629.2 |
| Equipment | 2637.6 |
| Lighting | 9864.3 |
| Displaced | -0.0 |

## UNIT 4 ANNUAL CARBON EMISSIONS USING ENHANCED PERFORMANCE STANDARDS

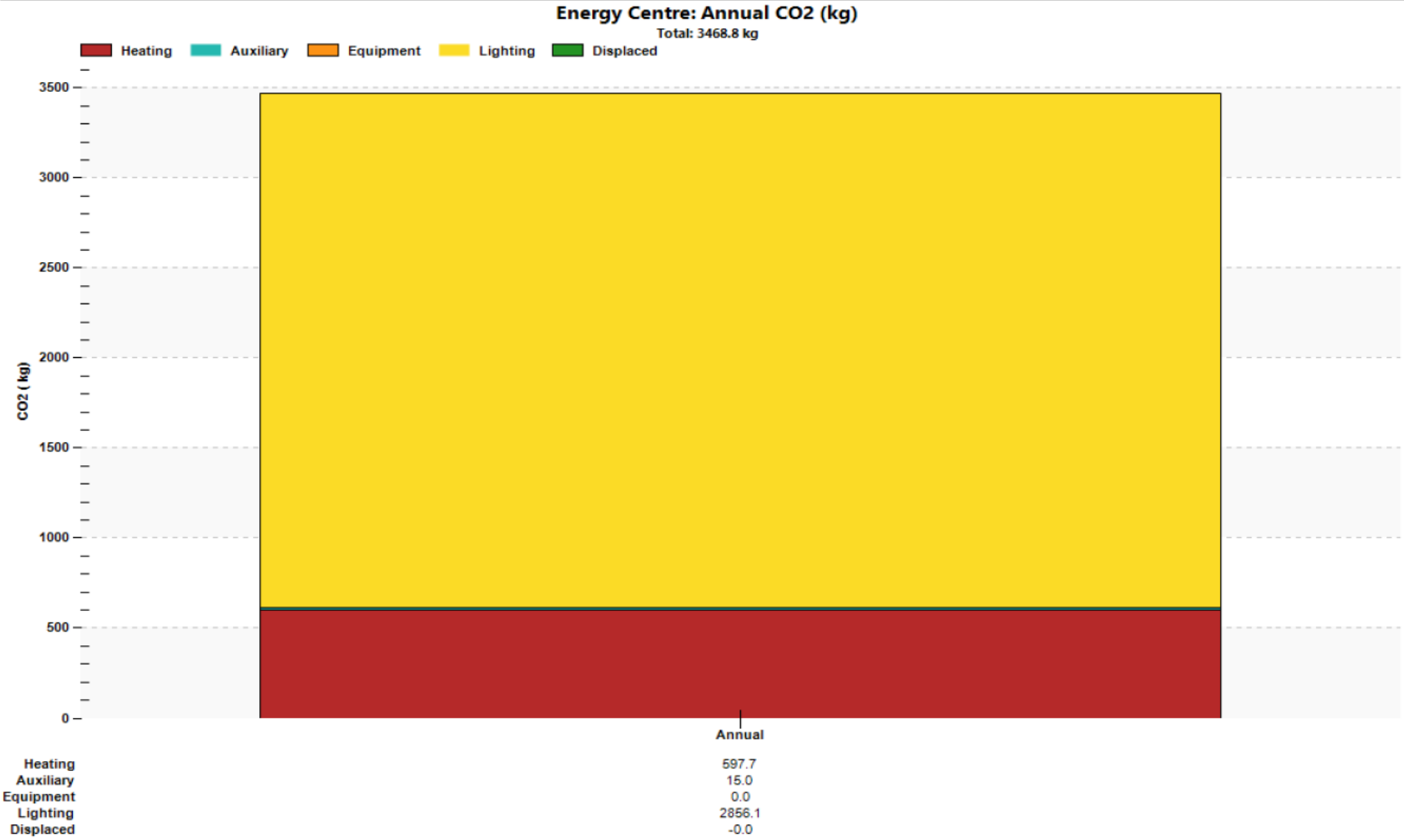
Tas Systems: Simulation Results




| | |
|---|---|
| Heating | 3594.5 |
| Cooling | 1012.7 |
| Auxiliary | 1083.1 |
| Equipment | 5495.6 |
| Lighting | 21789.1 |
| Displaced | -0.0 |

## UNIT 11 ANNUAL CARBON EMISSIONS USING ENHANCED PERFORMANCE STANDARDS

Tas Systems: Simulation Results



# 10. ENERGY GENERATION STRATEGY

The energy consumed by the buildings on the proposed development shall be all electrically generated. The workshop and storage/distribution areas are assumed to be artificially lit and unheated for this assessment. To offset the electricity consumed and achieve a zero-carbon status, a renewable technology generating clean electricity is targeted. Photovoltaic panels are well suited to the proposed units due to their simple design and installation features, utilising the large roof area available.

To offset the electricity consumed, the following photovoltaic panel performance has been allowed:

*Table 18: Photovoltaic panel performance*

| PANEL CRITERIA | VALUE |
|---|---|
| Module Efficiency | 18.05% |
| Surface Reflectance | 0.1 |
| Max Invertor Efficiency | 93% |
| Degradation Factor | 5% |
| Inclination Angle | 6° |
| Orientation from North | Various |

Based on the modelling of photovoltaic panels, Unit 1, 4 and 11's resulting energy generation and carbon offset is shown in the table and graphs below:

*Table 19: PV Energy Generation and Carbon Saving*

| PV provision | Annual Energy Generation (kWh/yr) | Annual Energy Generation per PV Panel Area (kWh/yr) | Annual Carbon Offset ($kg.CO_2/yr$) |
|---|---|---|---|
| Unit 1 300m²@206° from North | 43,000.14 | 140 | 19,866.06 |
| Unit 4 600m²@206° from North | 84,442.80 | 140 | 39,012.58 |
| Unit 11 100m²@121° from North | 13,957.00 | 130 | 6,448.13 |

The energy generation per PV panel area has been rounded down to the nearest multiple of 10 (i.e. 146 kWh/yr is instead 140 kWh/yr). The resulting PV area calculated for the remaining units are then rounded up to the nearest multiple of 50 (i.e. 430 $m^2$ is instead 450 $m^2$).

## BREAKDOWN OF PHOTOVOLTAIC PANEL PROVISION

A breakdown of photovoltaic panel areas allocated to each unit is provided below. Using the above energy generation figures, the remaining units' photovoltaic panel areas and energy generation is also shown. Unit 2, 3, 5 and 6 – 10's energy generation is based on the Annual Energy Generation per PV Panel Area figures.

*Table 20: Individual Photovoltaic Provision for the Phase 2 Units*

| Building | Photovoltaic Panels Applied ($m^2$) | Annual Energy Generation (kWh/yr) |
|---|---|---|
| **Unit 1** | 300 | 43,000.14 |
| **Unit 2** | 250 | 35,000.00 |
| **Unit 3** | 200 | 28,000.00 |
| **Unit 4** | 600 | 84,442.80 |
| **Unit 5** | 450 | 63,000.00 |
| **Unit 6** | 70 | 9,100.00 |
| **Unit 7** | 70 | 9,100.00 |
| **Unit 8** | 70 | 9,100.00 |
| **Unit 9** | 60 | 7,800.00 |
| **Unit 10** | 70 | 9,100.00 |
| **Unit 11** | 100 | 13,957.00 |
| **Total** | 2,240 | 311,599.94 |

The upcoming table highlights the available roof space for the above photovoltaic provision. Both side of each roof pitch is considered to achieve the most benefit from the photovoltaic panels, it is assumed that this area is the total roof area that excludes rooflights (12% of the workshop/storage/distribution floor area, excluding the undercroft space).

*Table 21: Available Roof Area for the Provision of Photovoltaic Panels*

| Building | Available Roof Area (excl. 12% rooflights) ($m^2$) | Photovoltaic Panel Orientation (Clockwise from North) | Photovoltaic Panel Provision ($m^2$) |
|---|---|---|---|
| **Unit 1** | 1,571.3 | 206º | 300 |
| **Unit 2** | 1,433.8 | 206º | 250 |
| **Unit 3** | 1,473.1 | 206º | 200 |
| **Unit 4** | 3,793.2 | 206º | 600 |
| **Unit 5** | 3,066.8 | 206º | 450 |
| **Unit 6** | 431.2 | 121º | 70 |
| **Unit 7** | 427.7 | 121º | 70 |
| **Unit 8** | 356.4 | 121º | 70 |
| **Unit 9** | 285.1 | 121º | 60 |
| **Unit 10** | 378.4 | 121º | 70 |
| **Unit 11** | 528.0 | 121º | 100 |
| **Total** | 13,744.9 | N/A | 2240 |

## PROVISION OF PHOTOVOLTAIC PANELS TO OFFSET EXTERNAL LIGHTING

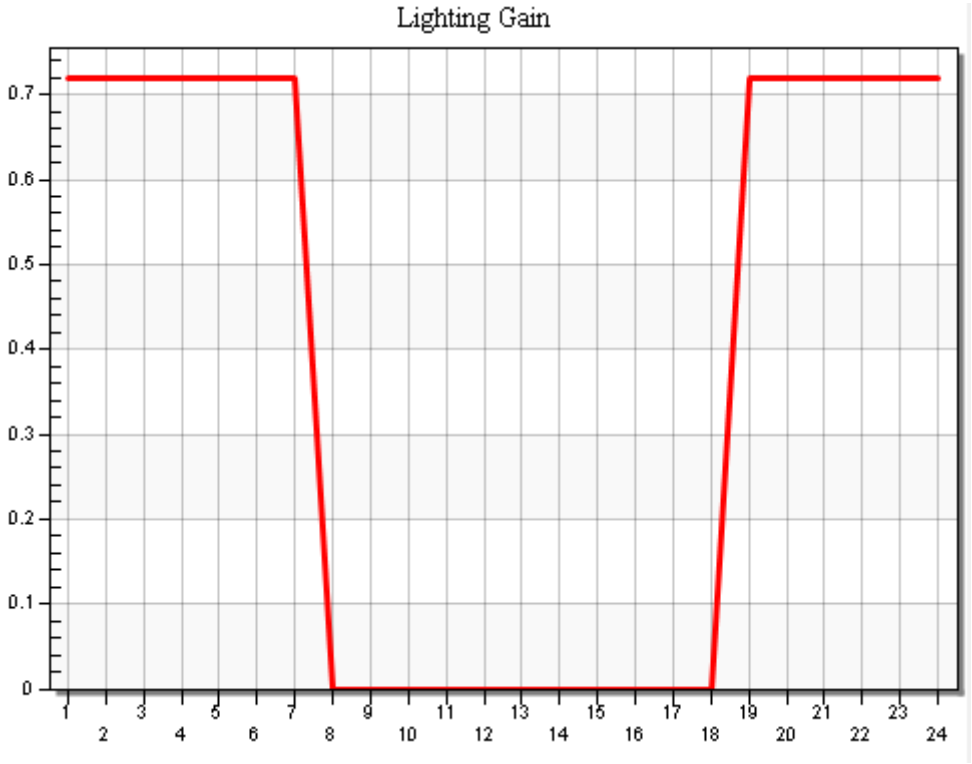
To achieve site-wide net zero carbon in Operation, the energy consumption via the site's external road and service yard lighting systems needs to be included in the energy assessment. Using the external lighting information from the previous phases of this employment development, the following inputs have been applied to the model…

*Table 22: External Lighting's Model Input*

| | Lighting Gain (W/m²) | Design Illuminance (Lux) |
|---|---|---|
| **External Lighting** | 0.72 W/m² | 15 |

| Schedule | | |
|---|---|---|
| **Hour 0-7** | **Hour 7-18** | **Hour 18-24** |
| On | Off | On |

This results in the following profile in the software…




Simulating the above inputs show that the external lighting's energy consumption has a total annual energy consumption of 91,771.2 kWh/annum and a carbon emission of 42,398.3 kg.$CO_2$/annum.

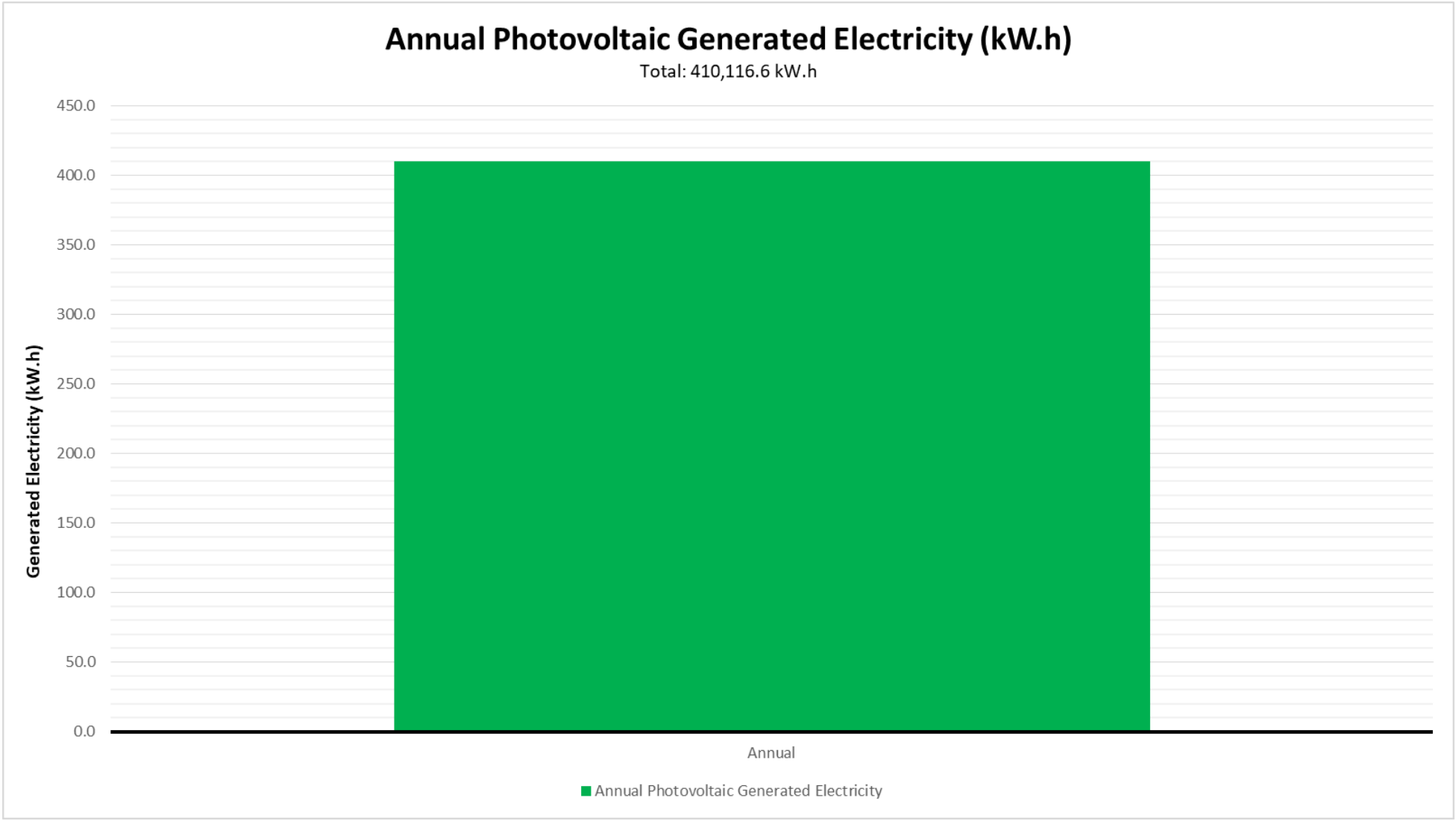
The area of photovoltaic panels required to offset the external lighting's energy and carbon is ***700 m²***. This area of photovoltaic panels shall be spread across each unit, where they will take

a percentage of the ***700 m²*** based on the size of their corresponding roof area. Table 16 shows the total provision of photovoltaic panels for Unit 1 – 11.

*Table 23: Total Provision of Photovoltaic Panels to Unit 1 – 11 to Offset the Carbon Emission from External Lighting.*

| Building | Available Roof Area (excl. 12% rooflights) ($m^2$) | Additional Photovoltaic Panels to Offset the Ext. Lighting's Energy Consumption ($m^2$) | Total Photovoltaic Panel Provision ($m^2$) | New Annual Energy Generation (kWh/yr) |
|---|---|---|---|---|
| **Unit 1** | 1,571.3 | 80 | **380** | **54,466.9** |
| **Unit 2** | 1,433.8 | 73 | **323** | **45,241.7** |
| **Unit 3** | 1,473.1 | 75 | **275** | **38,522.3** |
| **Unit 4** | 3,793.2 | 193 | **793** | **11,1605.3** |
| **Unit 5** | 3,066.8 | 156 | **606** | **84,886.4** |
| **Unit 6** | 431.2 | 22 | **92** | **12,186.5** |
| **Unit 7** | 427.7 | 22 | **92** | **12,186.5** |
| **Unit 8** | 356.4 | 18 | **88** | **11,625.4** |
| **Unit 9** | 285.1 | 15 | **75** | **9,904.5** |
| **Unit 10** | 378.4 | 19 | **89** | **11,765.7** |
| **Unit 11** | 528.0 | 27 | **127** | **17,725.4** |
| **Total** | 13,744.9 | 700 | **2940** | **410,116.6** |

## ANNUAL ENERGY GENERATION FROM PHOTOVOLTAIC PANELS



# 11. CARBON BALANCE

To achieve zero carbon for the development, the calculated carbon emissions (using high efficiency building and system performances) needs to be offset by clean energy generation, in the form of photovoltaic panels. Based on the information highlighted previously in the report, the followings carbon balance has been calculated.

*Table 24: Carbon Balance*

| | **Annual Energy Consumption** (kWh/yr) | **Annual Carbon Emission** (kg.$CO_2$/yr) |
|---|---|---|
| Enhanced Performance Building Construction and Services Incl. External Lighting | 343,687.9 | 158,817.2 |
| Photovoltaic Panels 2940m² | - 410,116.6 | - 189,473.9 |
| **Results** | **-66,428.7** | **-30,656.7** |

*Table 25: Individual Carbon Balance for the Phase 3 Development*

| Building/Zone | Annual Carbon Emission ($kg.CO_2/yr$) | Annual Carbon Offset via Photovoltaic ($kg.CO_2/yr$) | Carbon Balance ($kg.CO_2/yr$) |
|---|---|---|---|
| **Unit 1** | 15,714.1 | 25,163.7 | **-4,152.0** |
| **Unit 2** | 140,04.0 | 20,891.6 | **-2,166.0** |
| **Unit 3** | 11,003.0 | 17,787.0 | **-1,933.0** |
| **Unit 4** | 32,975.0 | 51,561.6 | **-6,037.5** |
| **Unit 5** | 26,431.0 | 39,196.1 | **-2,675.0** |
| **Unit 6** | 2,943.0 | 5,525.5 | **-1,261.2** |
| **Unit 7** | 2,919.0 | 5,525.5 | **-1,285.2** |
| **Unit 8** | 2,432.0 | 5,285.3 | **-1,772.2** |
| **Unit 9** | 1,946.0 | 4,504.5 | **-1,657.6** |
| **Unit 10** | 2,583.0 | 5,345.3 | **-1,621.2** |
| **Unit 11** | 3,468.8 | 8,189.1 | **-2,979.4** |
| **External Lighting (Car Park and Service Yard)** | 42,398.3 | 45,514.7 | **-3,116.4** |

The tables above and graph below demonstrate that zero carbon can be achieved with the use of photovoltaic panels and highly efficient building construction and services specifications.

## ANNUAL CARBON BALANCE