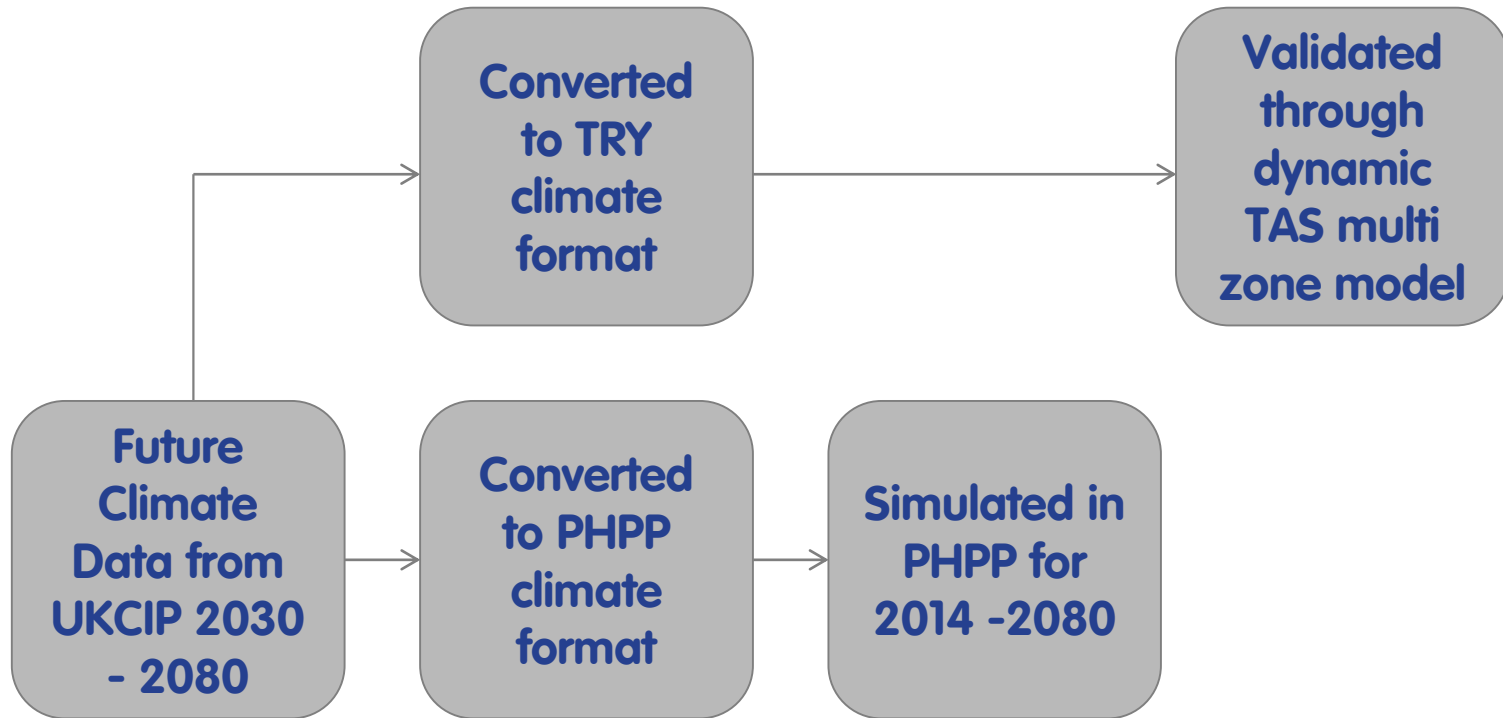


# The Enterprise Centre

## Future Climate Resilience & LCA Carbon Analysis





# ARCHITYPE

## Base Case:

0.3 ACH nat vent, 1 ACH mech extract, 84 Wh/K per m<sup>2</sup> capacity, 0.3 ACH night purge, 2.4m shade on south windows, 4.76 W/m<sup>2</sup> IHG.

Gas heating generator with 95% efficiency and heat pump cooling with COP 3.

## Simulations run to compare:

1. Base case
2. Base case **without mechanical extract in summer**
3. Base case with **2 ACH summer natural ventilation**
4. Base case with **Heat Pump efficiency of COP 4 (400%)**
5. Base case with **2 massive surfaces (108 Wh/K per m<sup>2</sup> capacity)**
6. Base case with all massive construction **(204 Wh/K per m<sup>2</sup> capacity)**

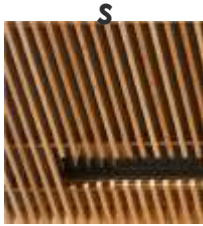
# Thermal Mass in Depth

Structure

Partition

Floors

1.



2.



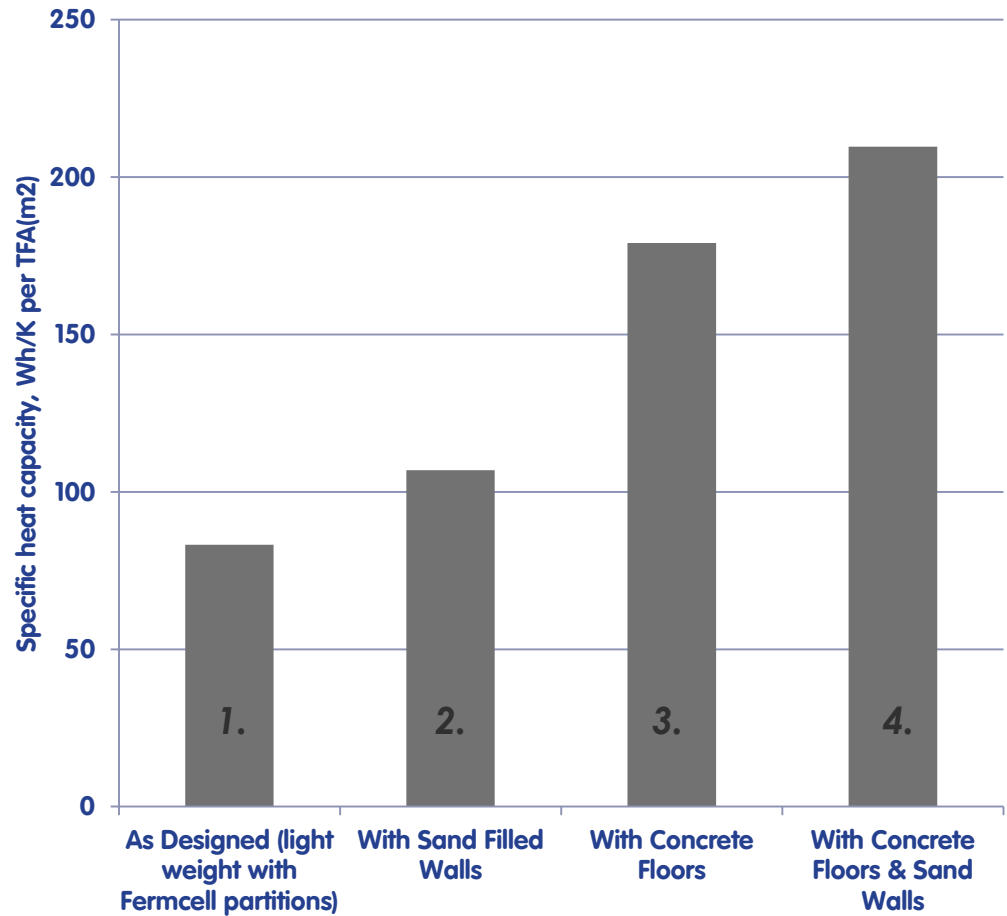
3.



4.

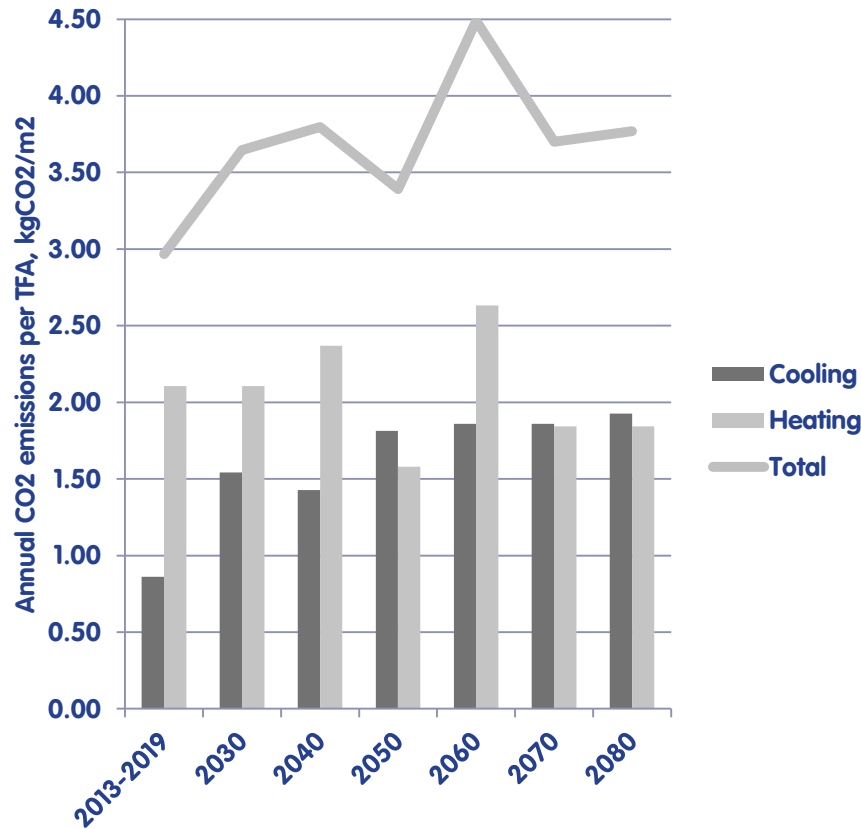


## Specific heat capacity of different construction options for NRP

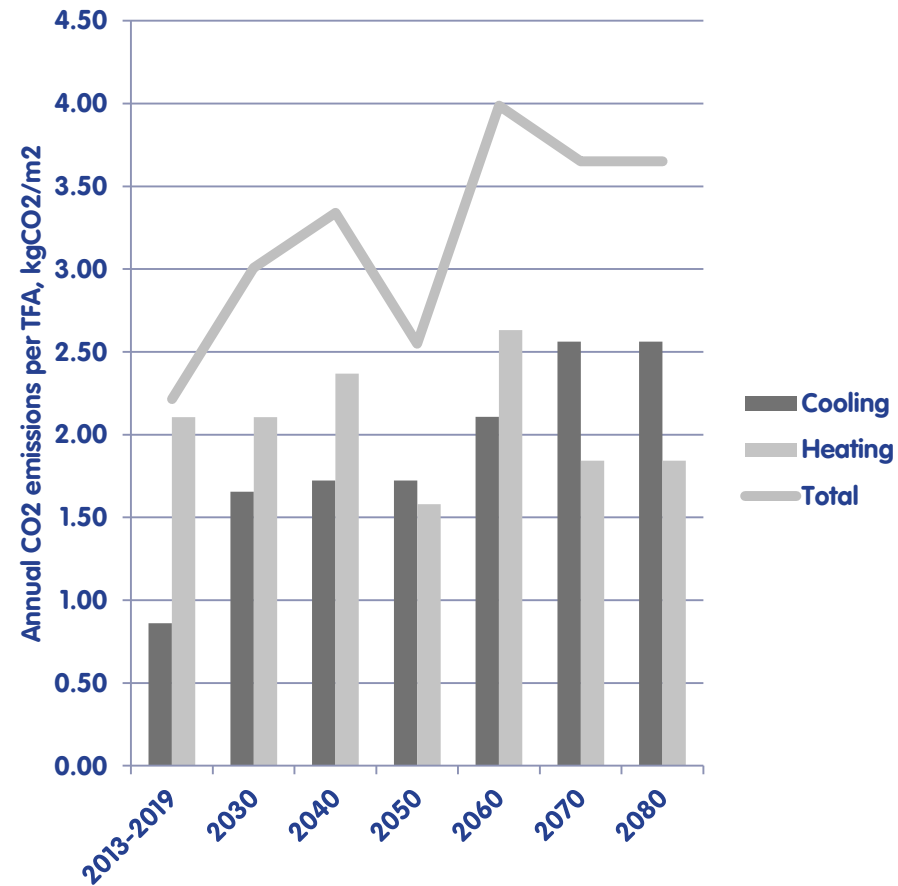


# Detailed Results

**Base case (lightweight, 0.3 ACH nat vent, 1 ACH summer mech boost, 3 COP cooling)**



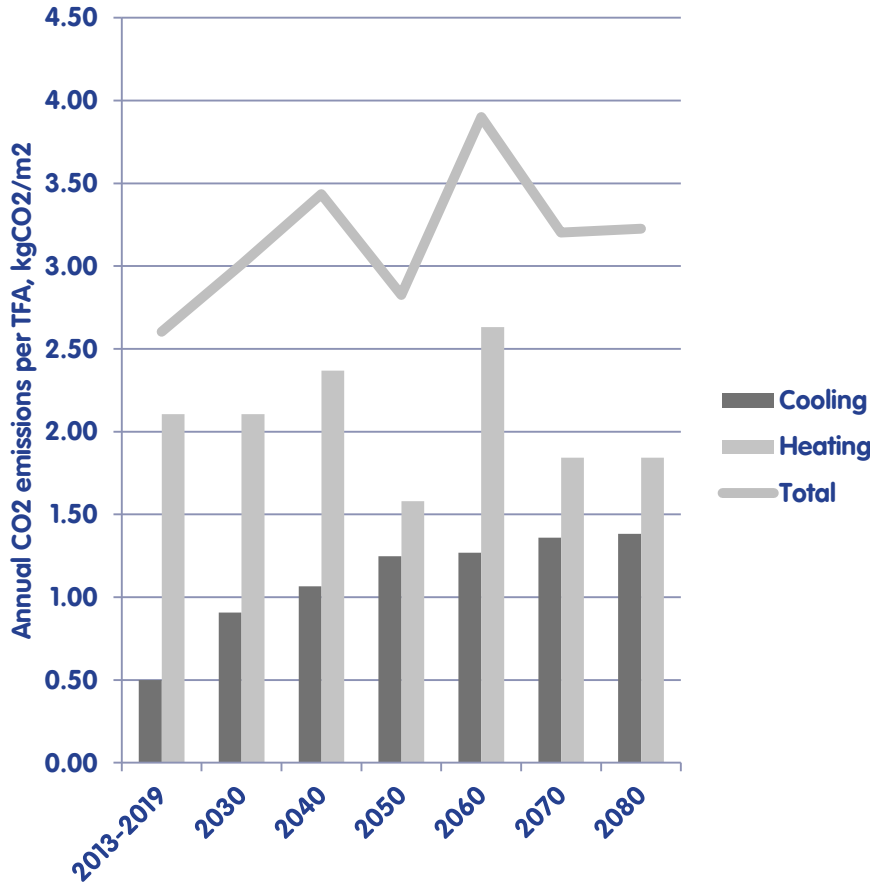
**Base case - without mechanical boost in summer**



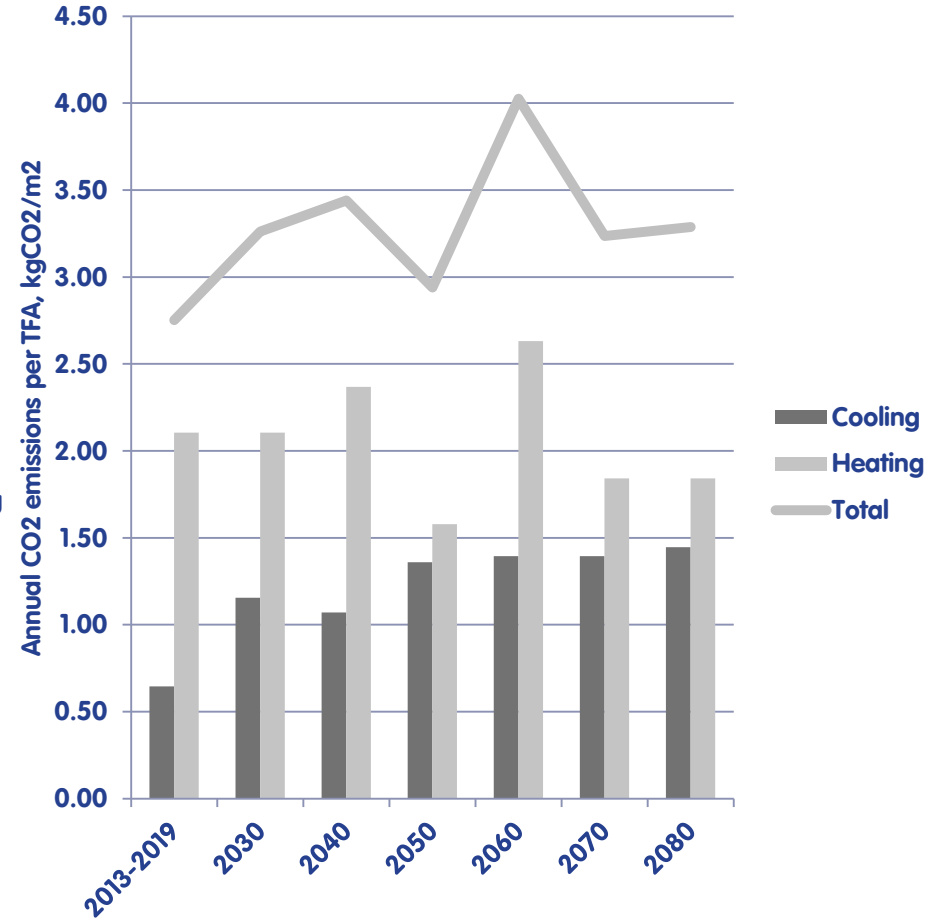


# Detailed Results

## Base case - with 2 ACH summer nat vent

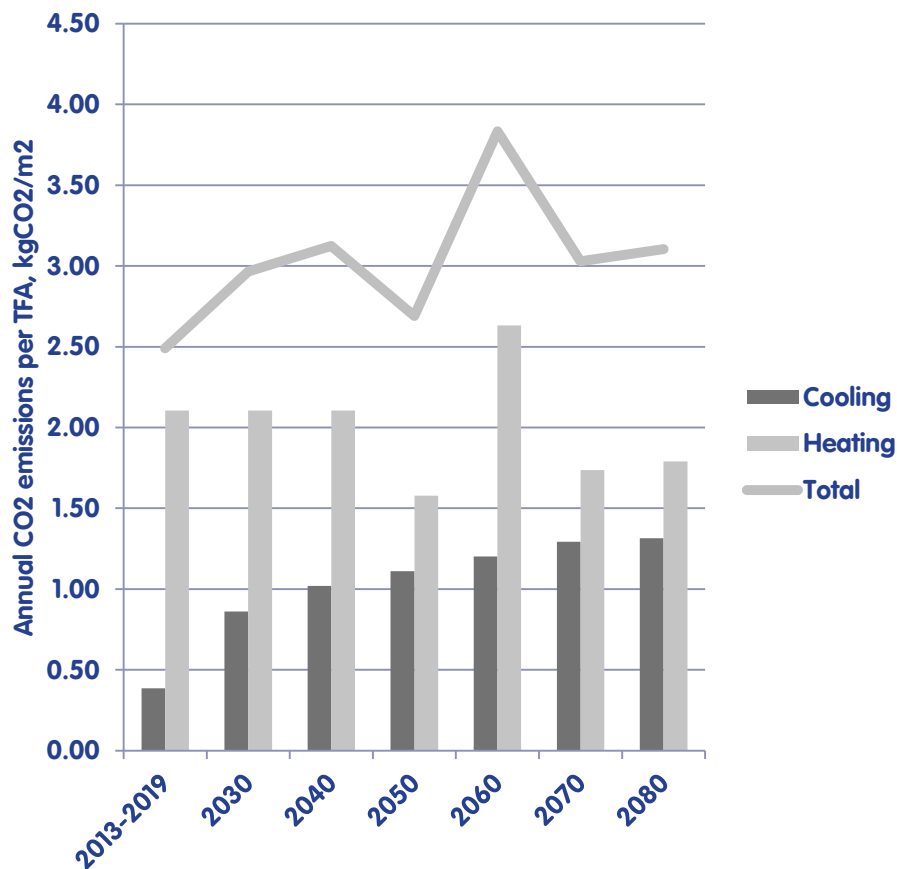


## Base case + 4 COP cooling

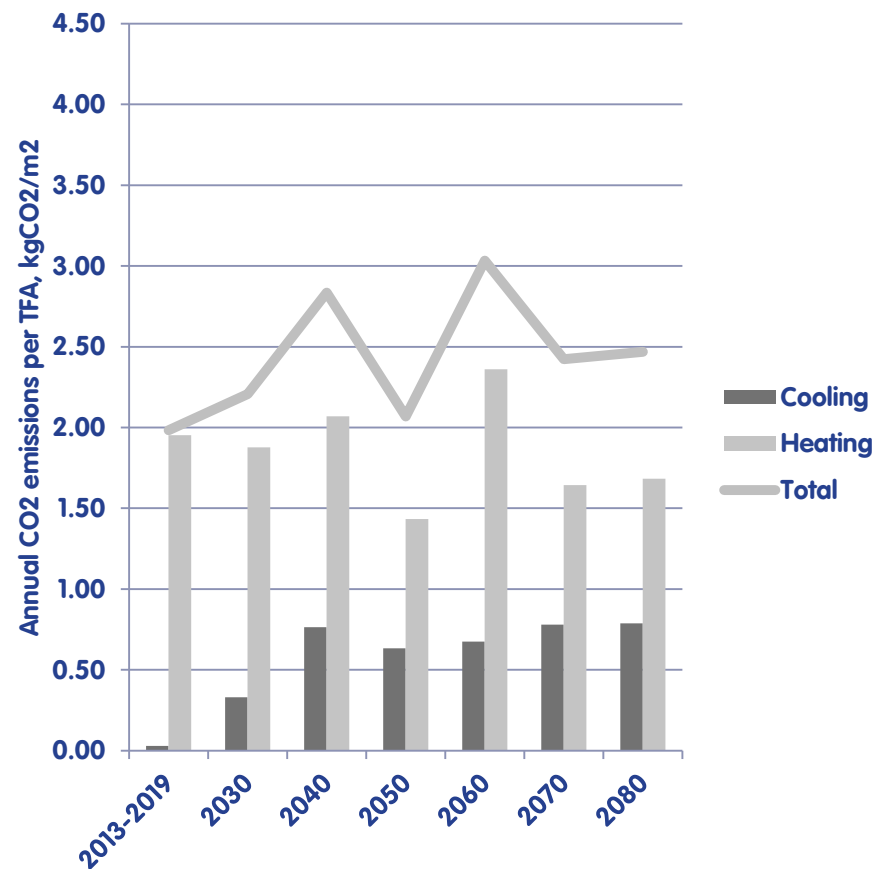


# Detailed Results

## Base case + 2 Massive surfaces (walls)



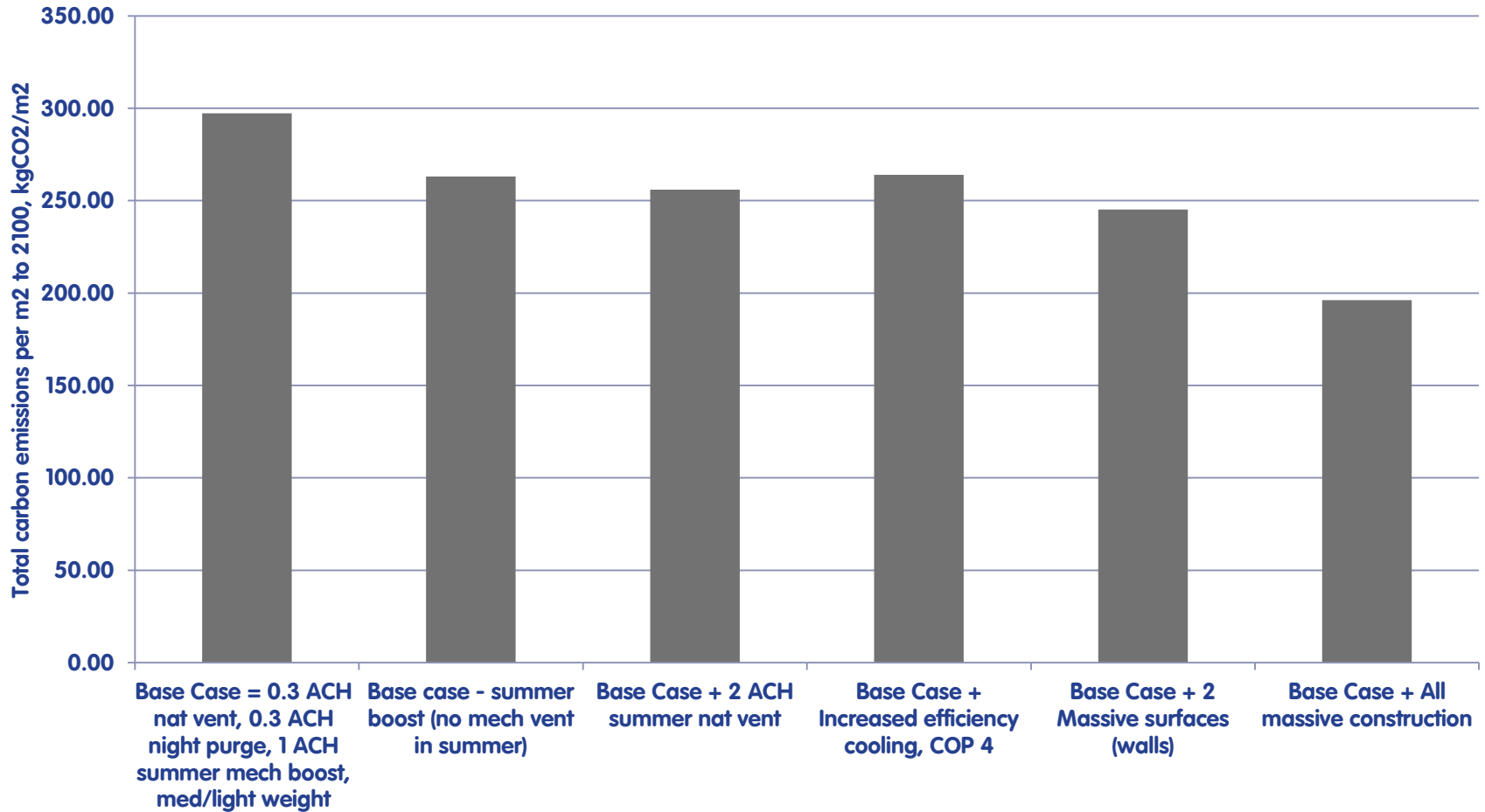
## Base case + All massive construction





# Summary Results

## Total CO2 emissions over 87 yrs for different cooling strategies



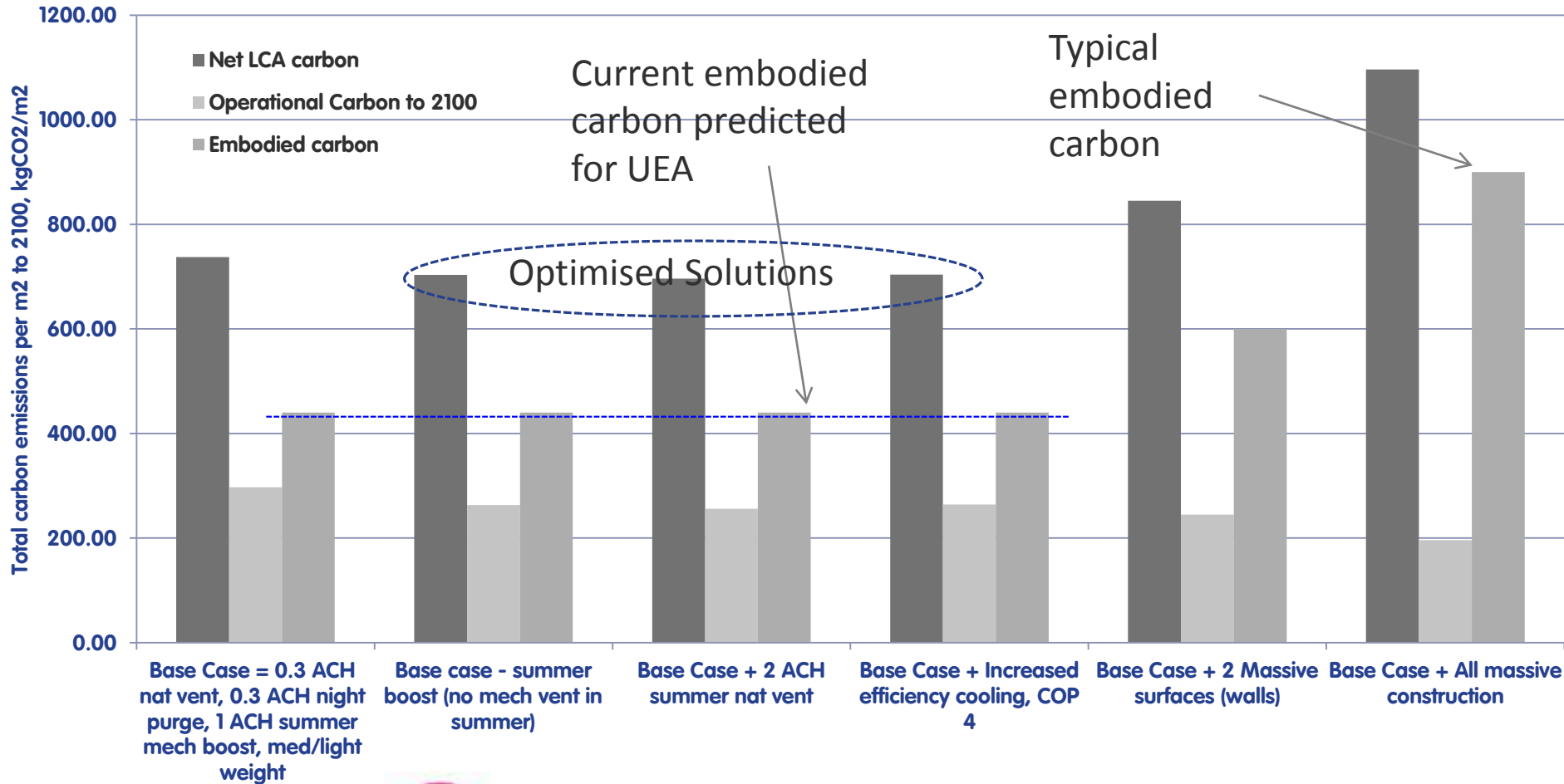
## But...

- Does not take into account embodied carbon to achieve heavy weight construction!

# ARCHITYPE

# Operational Results + Embodied Carbon

## LCA CO2 emissions, operational & embodied, for different cooling strategies



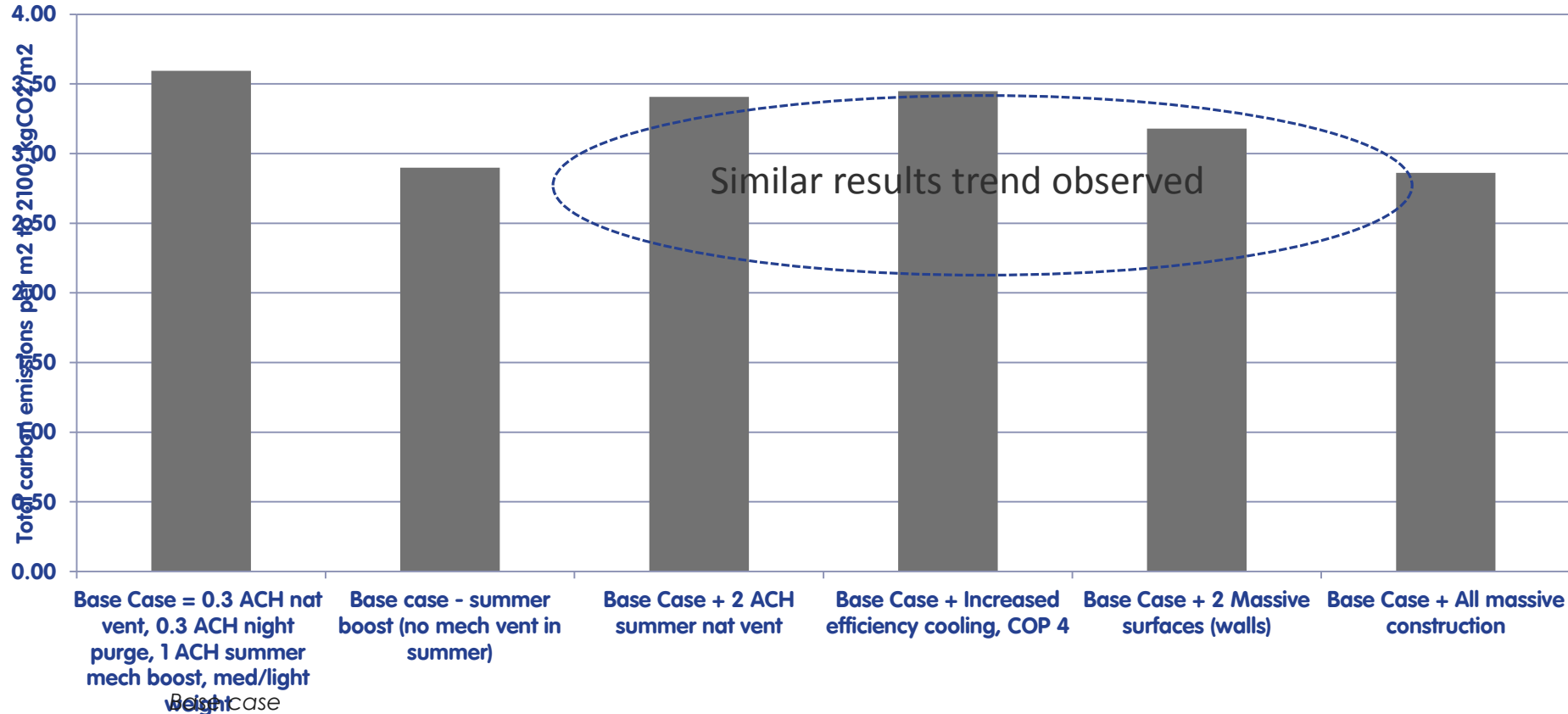
# But...

- What if it gets colder?
- **Do sensitivity analysis** – Manchester is consistently on average 1 degree C colder than Norwich each month.



# Cold Weather Sensitivity Analysis

## 2013 Annual CO2 emissions for different cooling strategies, MANCHESTER





# Our Solution - Materials

Masses of local sustainably sourced timber to lock up carbon

Low carbon slab and FF screed with 70% ggbs cement replacement to minimise carbon impact of slab





# Our Solution – Nat. Ventilation >2ACH

# ARCHITYPE



Stack ventilation via central atrium

Openings behind louvres on GF to allow large open area without security risk



Large window opening (reversible) to allow >2ACH

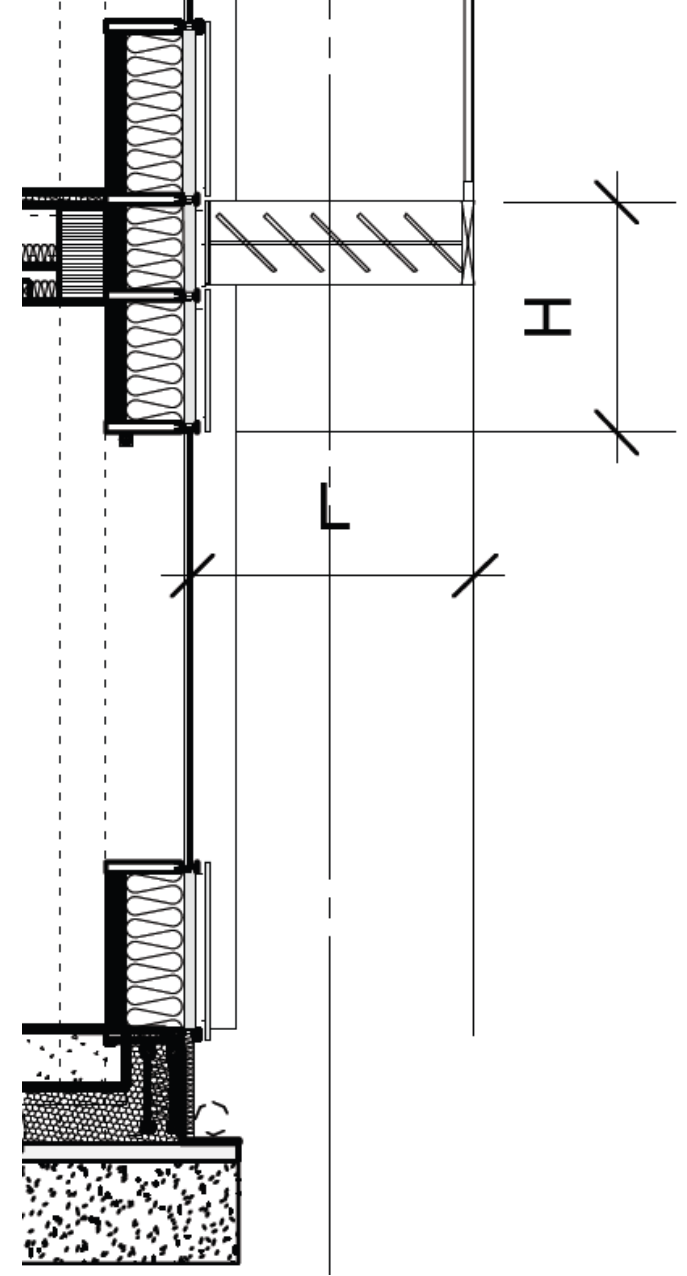


# Shade Optimisation

*Analysis into shade optimisation for future climate scenarios.*

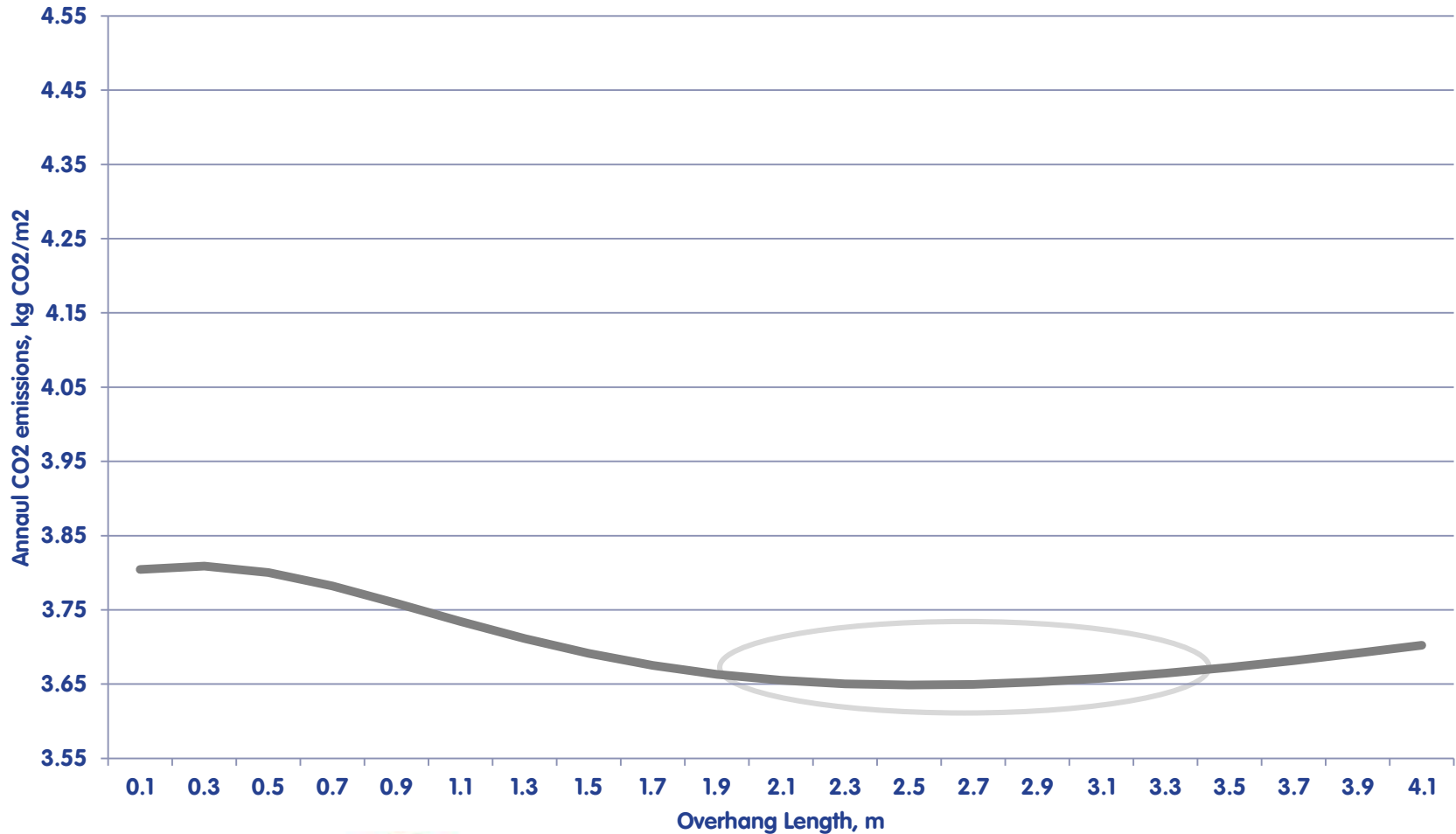
***Simulations run to compare:***

1. Shade length,  $L$
2. Shade height above window,  $H$



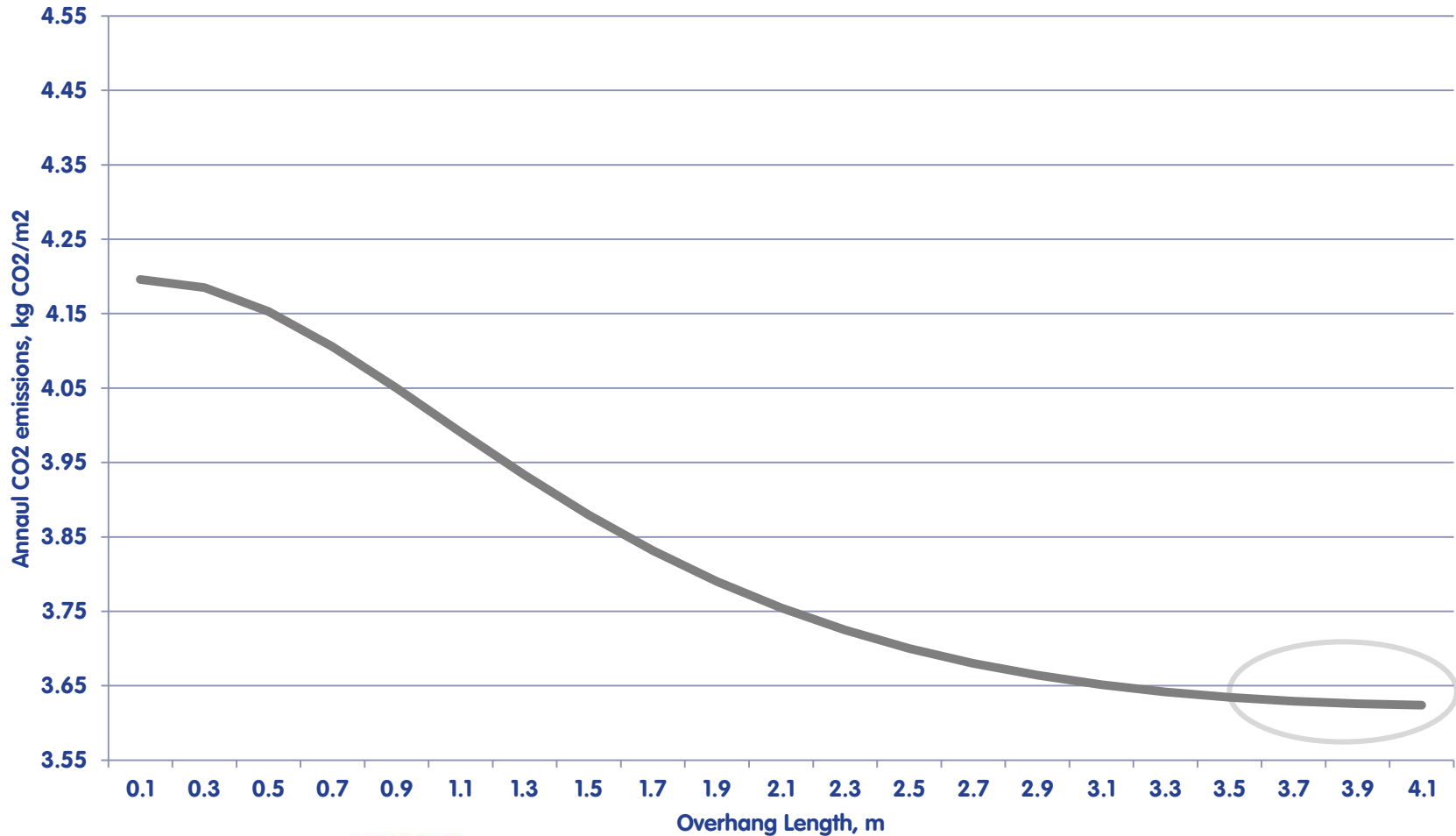
# Shade Length Optimisation

## 2013, Overhang length effect on CO2 emissions pa



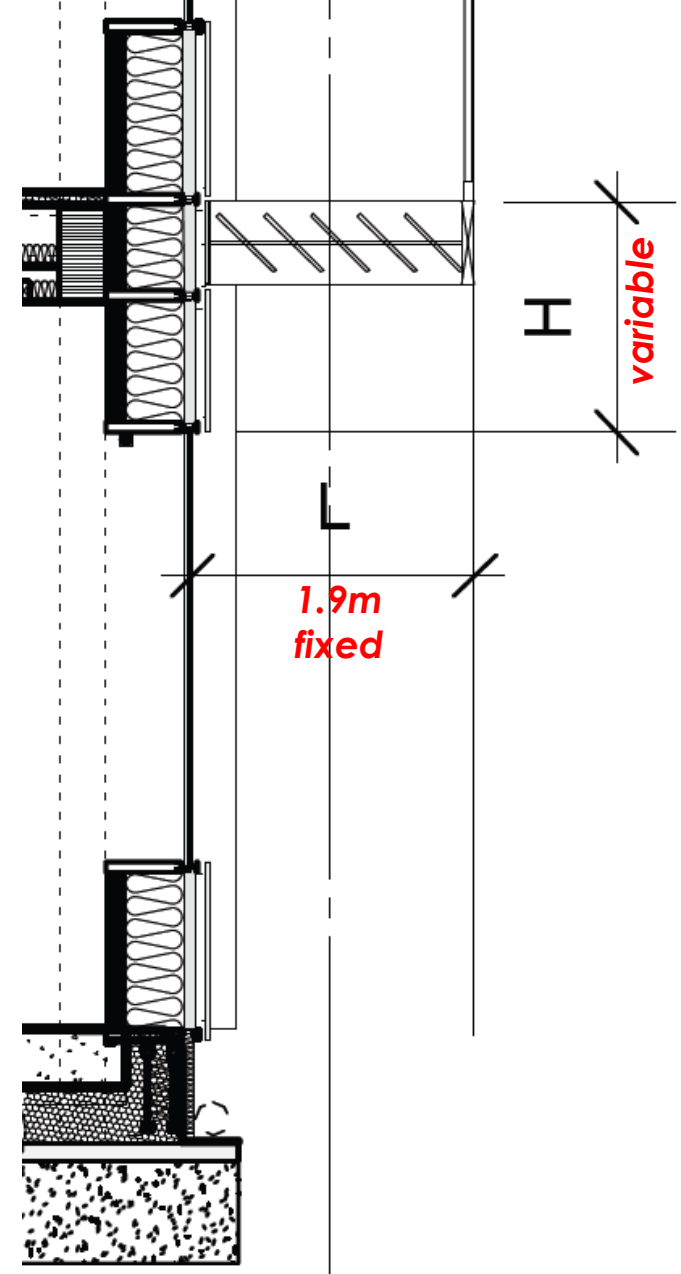
# Shade Length Optimisation

## 2070, Overhang length effect on CO2 emissions pa



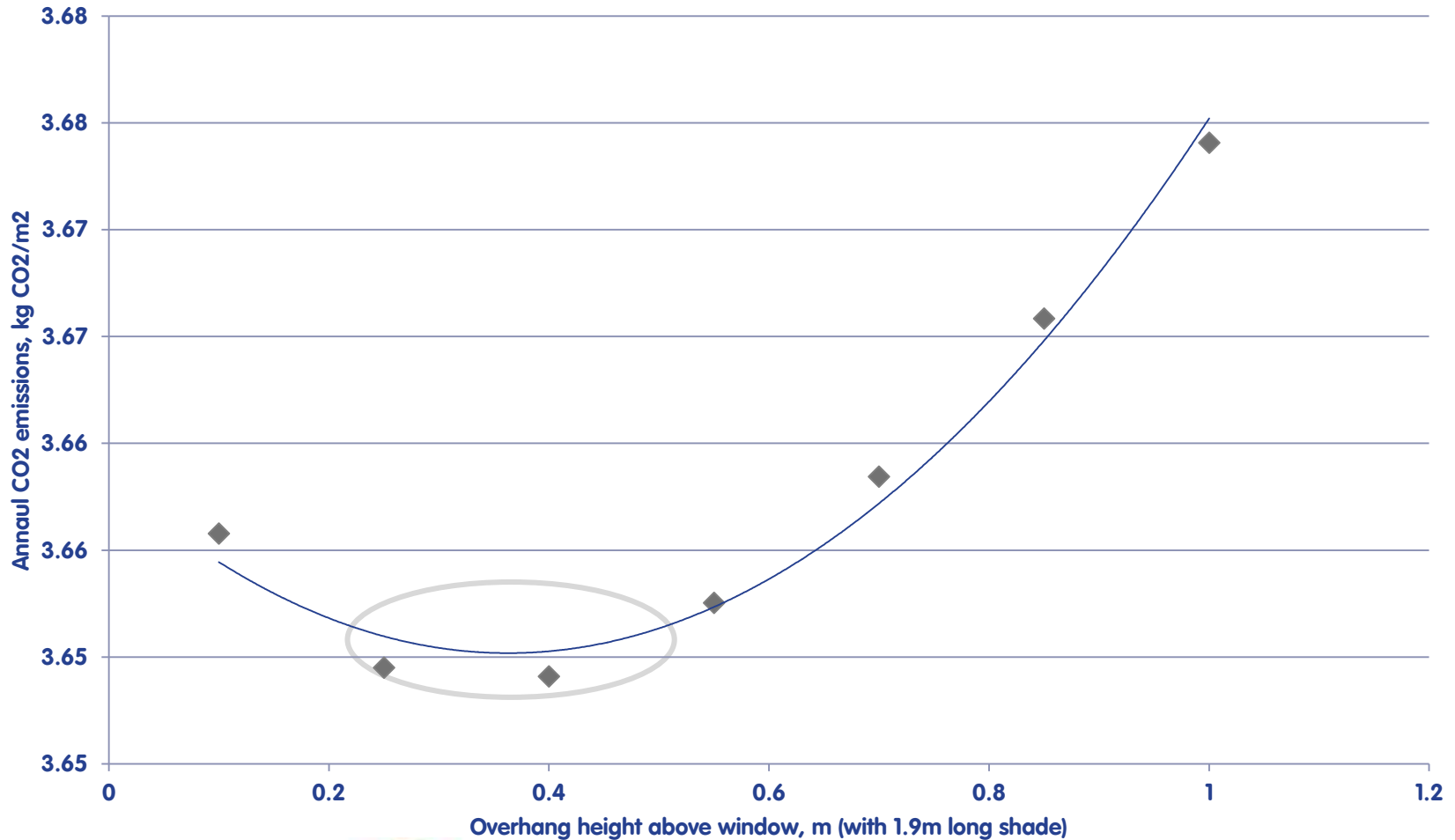
# Shade Height Optimisation

*Based on 1.9m long shade on south windows.*



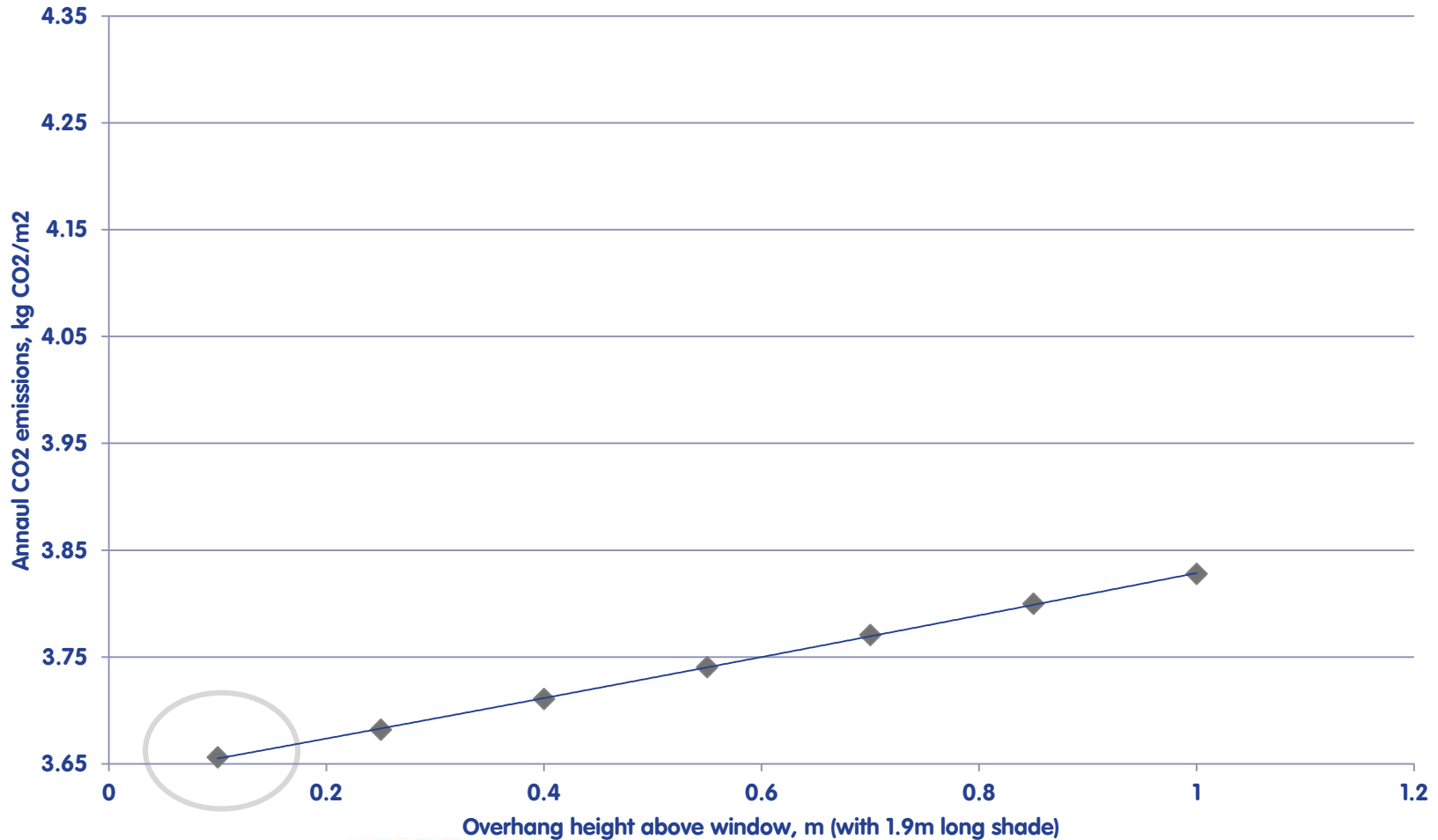
# Shade Height Optimisation

## 2013, Shade height impact on CO2 emissions

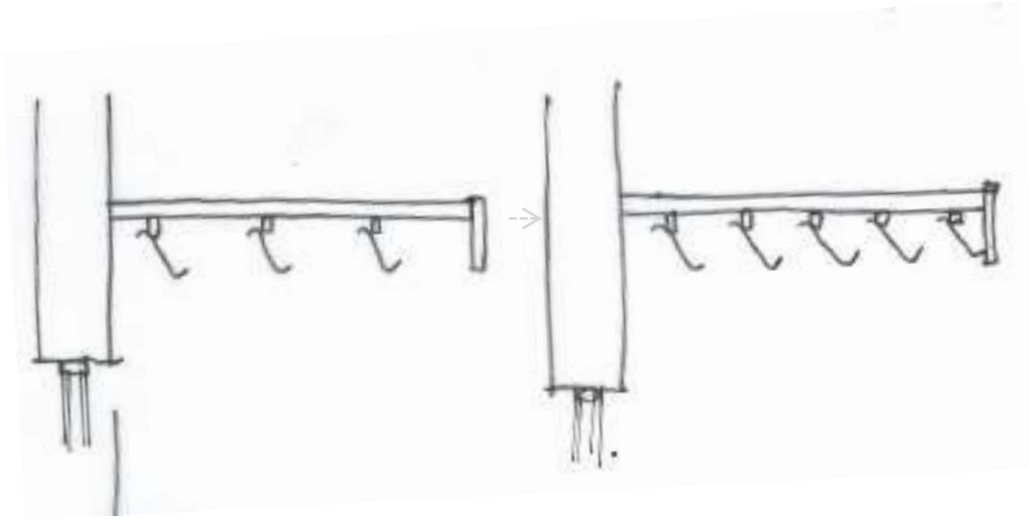


# Shade Height Optimisation

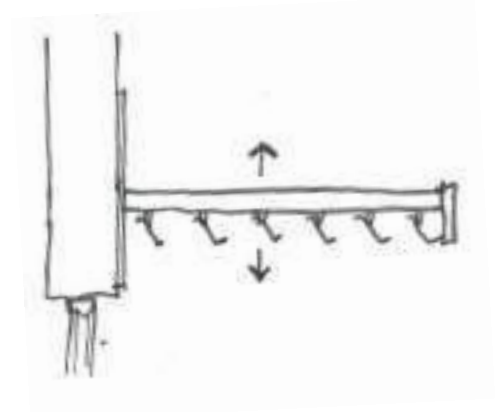
## 2070, Shade height impact on CO2 emissions



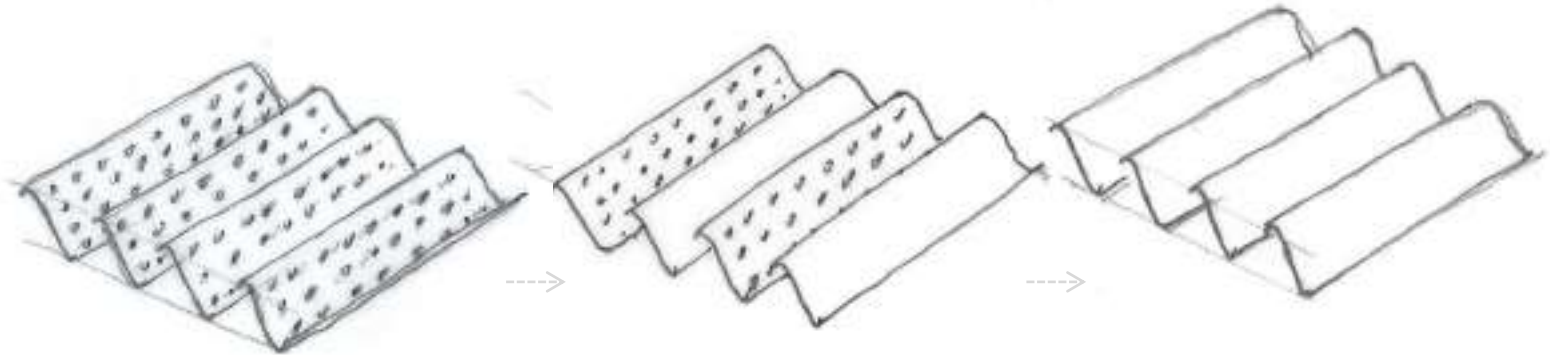
# Potential Solutions for Flexibility



**1. Increase Density**



**2. Move Shade Up / Down**

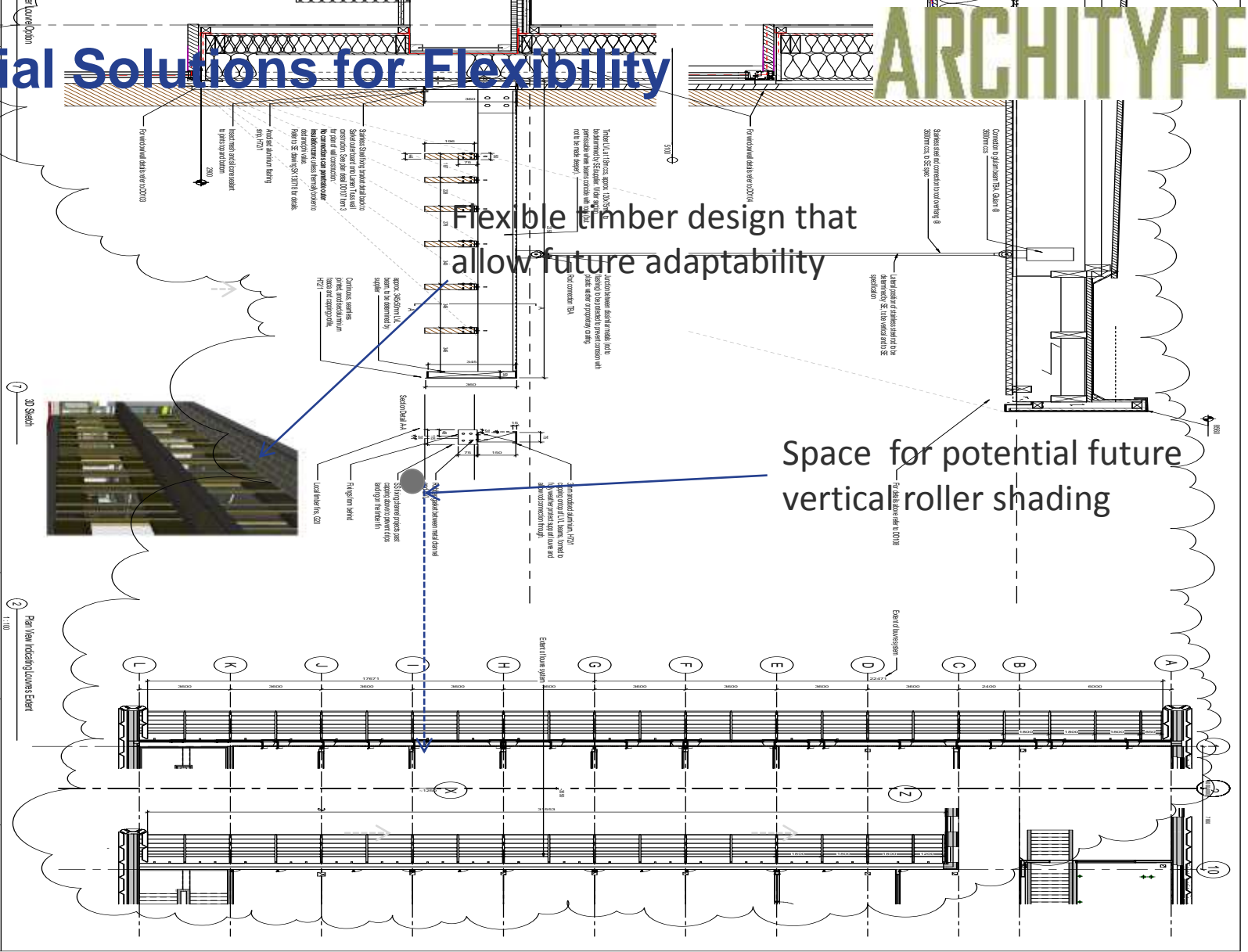


**3. Increase / Decrease Porosity**



# Potential Solutions for Flexibility

# ARCHITYPE



<b>ARCHITYPE</b> ARCHITECTURAL DESIGN & CONSTRUCTION	
Project: USA Embassy Low Carbon Building Project Client: USA (Major) Steel Architect: Architectural Louve Project No: 5991-00292 Issue: 3 Date: 16 October 2014 Drawn by: JF Checked by: CS	Scale: 1:100 Date: 16 October 2014 Drawn by: JF Checked by: CS

# Our Solution – Heat Gains

# ARCHITYPE

- Lecture theatre almost no south glazing and has ASHP cooling integrated
- High occupancy rooms on north façade
- Optimised shading every where else (designed for future adaption)

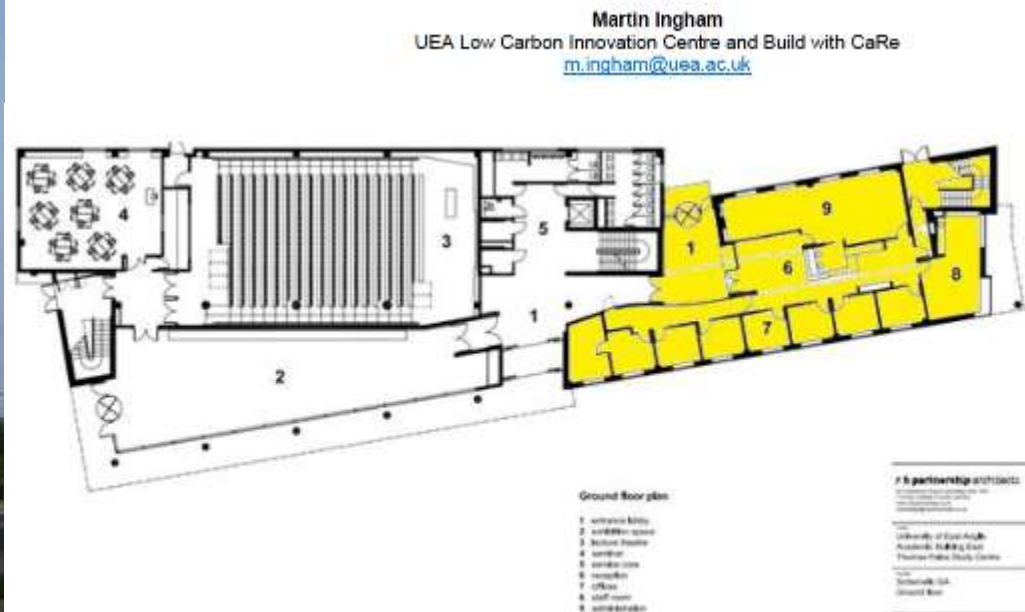


# DHW Estimation for High Occupancy

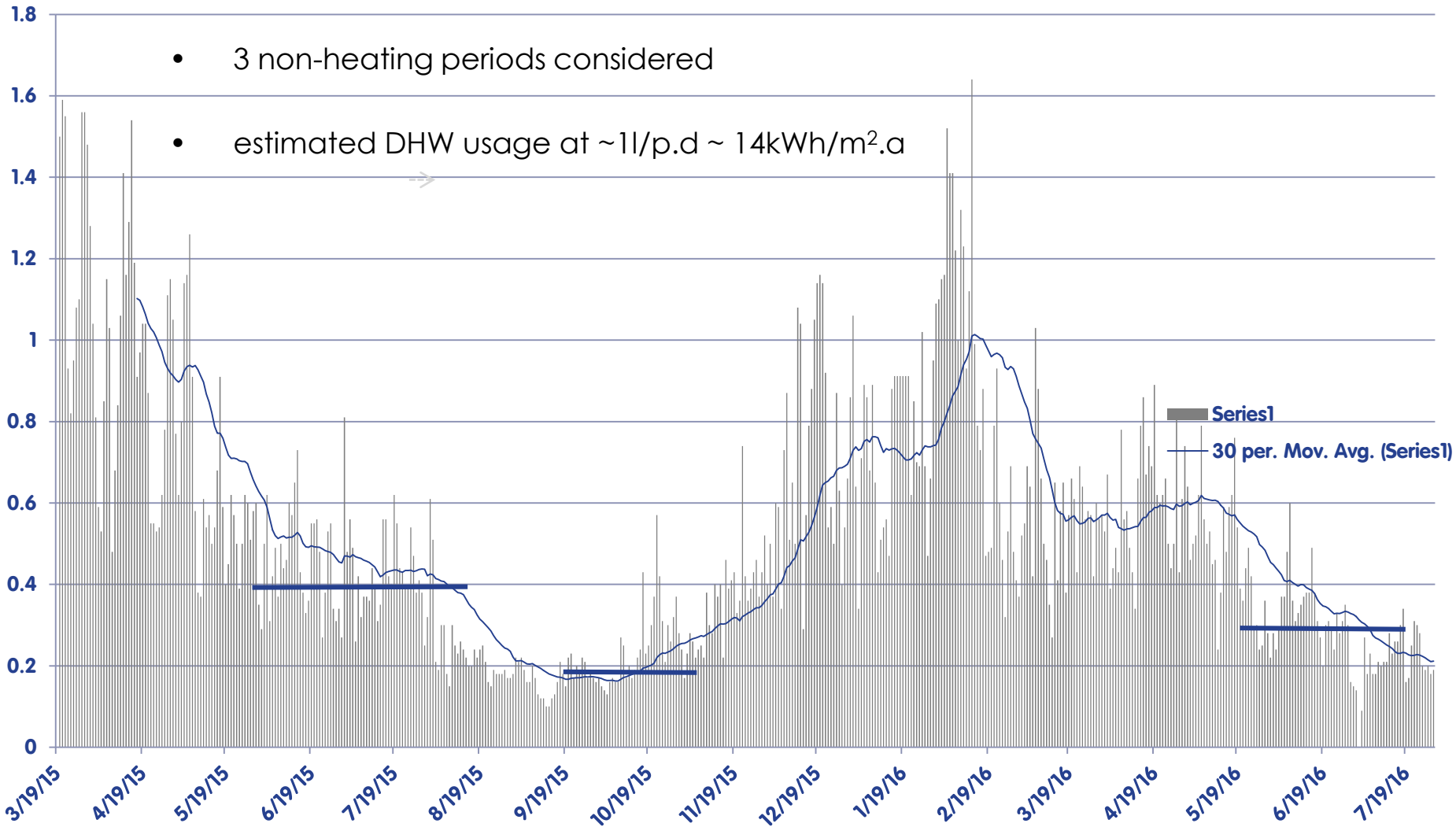
- Very high occupancy building – 575 people time average over occupied hours
- Makes PHPP very sensitive to DHW estimation  
→
- Wolfgang's suggestion to base on existing building use

## Thomas Paine Study Centre How it Works

March 2012

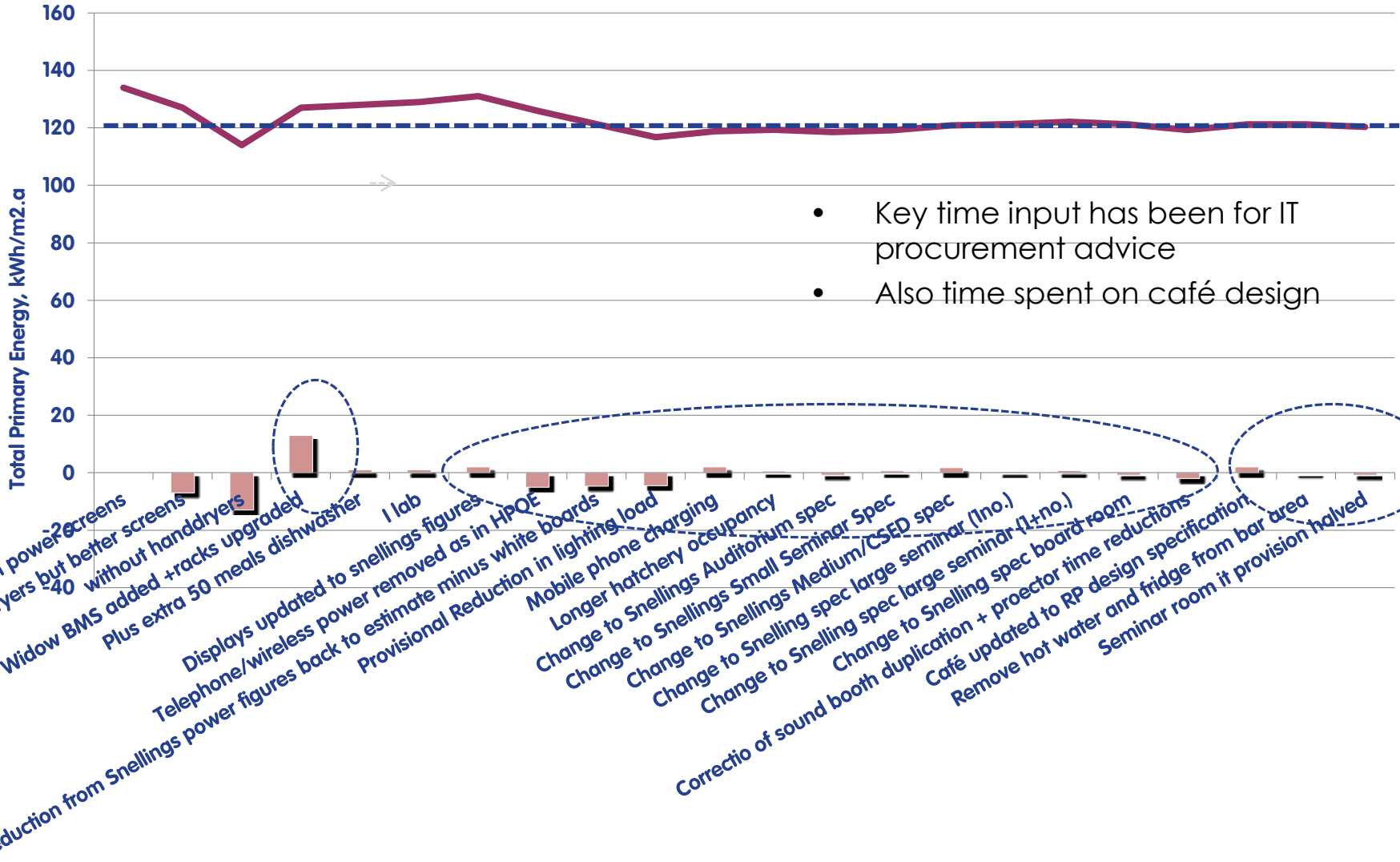


# Data-mine Thomas Paine DHW Use





# PE Tracker



- Key time input has been for IT procurement advice
- Also time spent on café design

# PE Strategies

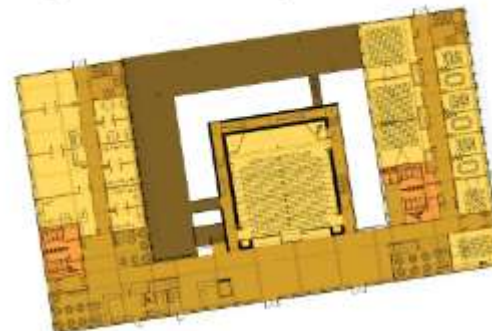
- LED screens rather than projectors
- Low energy racks and servers
- Enclosed display fridges
- Task focussed lighting to BS EN:12464

# ARCHITYPE

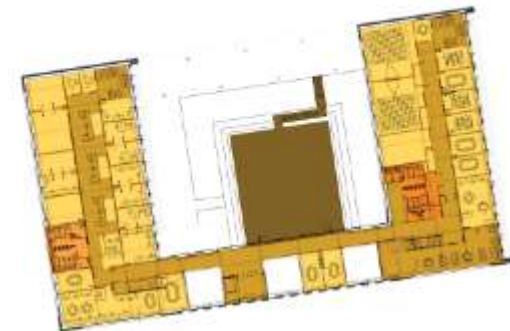


University of East Anglia - NRP Enterprise Centre  
Energy Distribution - Evening

**BDP.**



Ground level



First floor level

#### Illuminance Criteria:

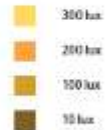
Each floor plate has been defined according to four typical criteria. These typical criteria will be superseded within each individual room according to task requirements. These are described in detail in each room type in the second section of this document.

Individual tasks are required to be lit to higher levels, where these are to be restricted to the designated areas of task only. For example toilet suites are lit to 300lux to the sink area only, with an average illuminance of 100lux to the central floor.

Evening illuminance will make a transition from daytime artificial to artificial lighting requirements for the entire space. With the addition of PIR energy consumption through lighting will still remain low as building usage begins to depreciate through the evening. Using BS EN 12464-1 as the basic guideline, illuminance levels will only be reduced to the levels shown on the task area required allowing for reduced lighting in room circulation and a comfortable working environment. In areas where furniture layouts are flexible the level of lighting shown is required for the entire space.

Particular attention will be made to evening territories between adjacent spaces, as well as the transition from the exterior. An illuminance and control strategy has been developed as part of this report. Step changes in illuminance between adjacent spaces have been selected to aid visual adaptation when moving through the spaces.

#### Key Plan:



Snelling



# On Site Yesterday

# ARCHITYPE





# 1<sup>st</sup> Batch of Windows

# ARCHITYPE

