ATKINS

Passive & Active Design

CIBSE Building Simulations Group

Peter A. Brown CEng, MBA

October 2010

Plan Design Enable

ATKINS

Introduction

Passive & Active Design

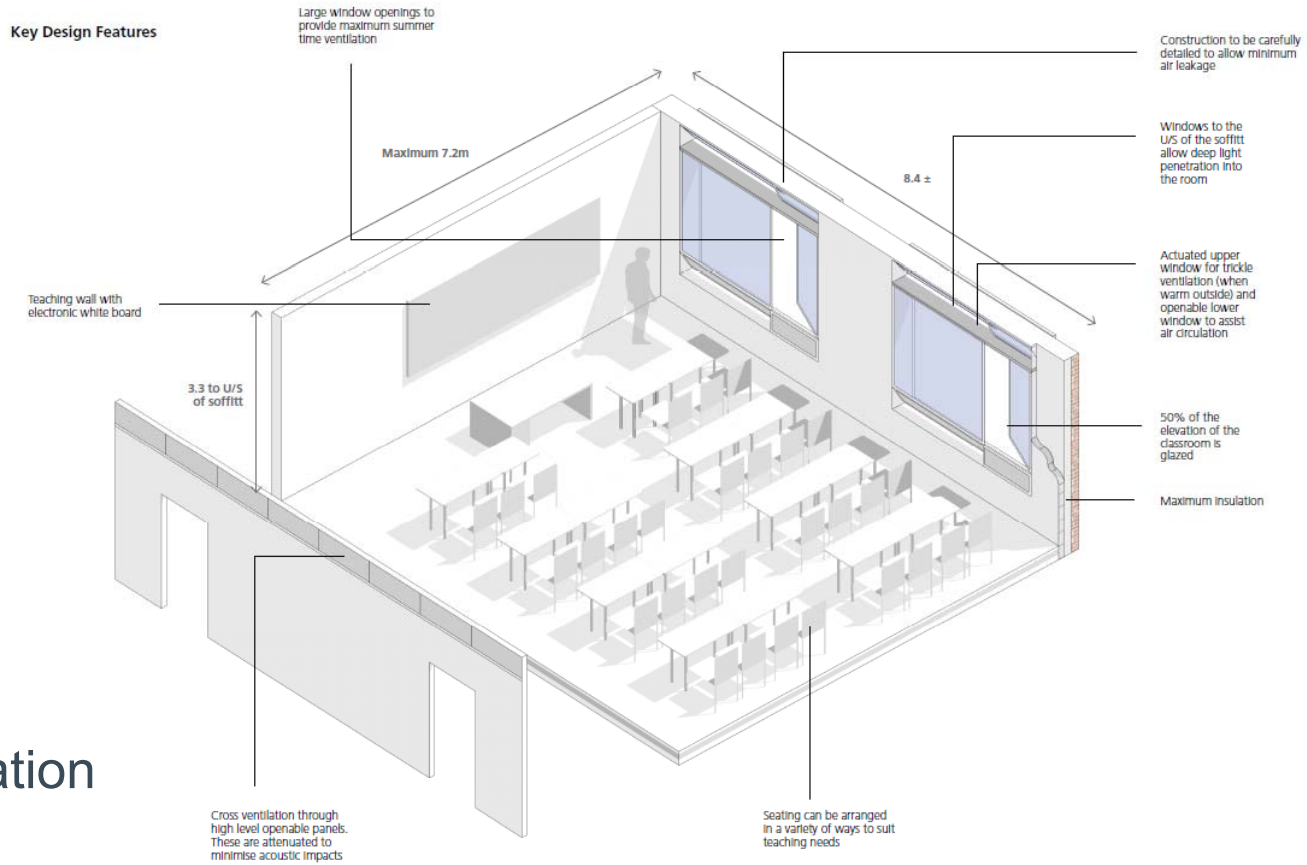
Introduction

What are the interactions between passive and active design?

In the context of a live project

How does simulation add value to the decision making process?

Definitions – Passive Design

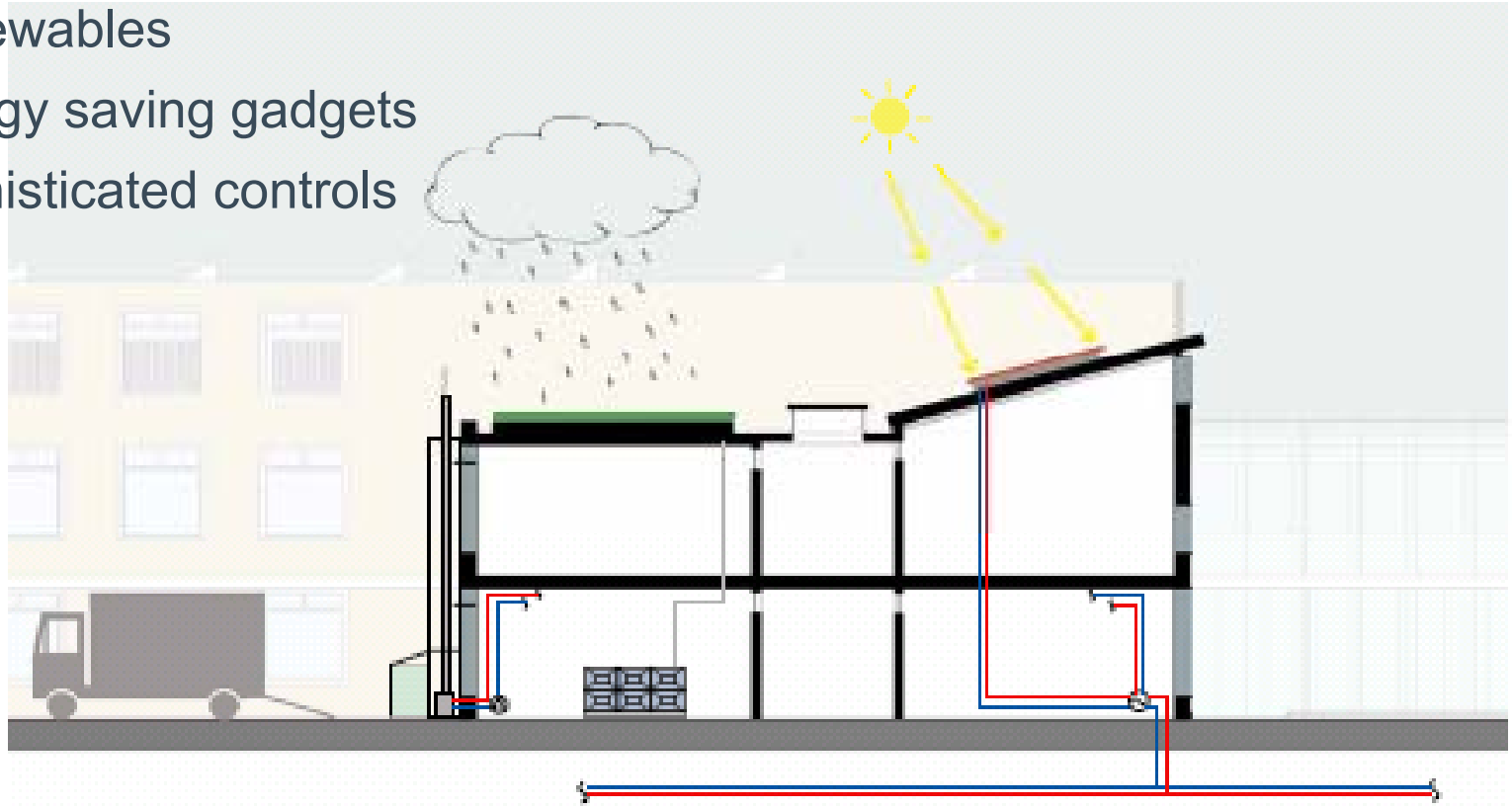


- Insulation
- Air tightness
- Natural light
- Solar gain
- Natural Ventilation

(Basic design elements of a building)

Definitions – Active Design

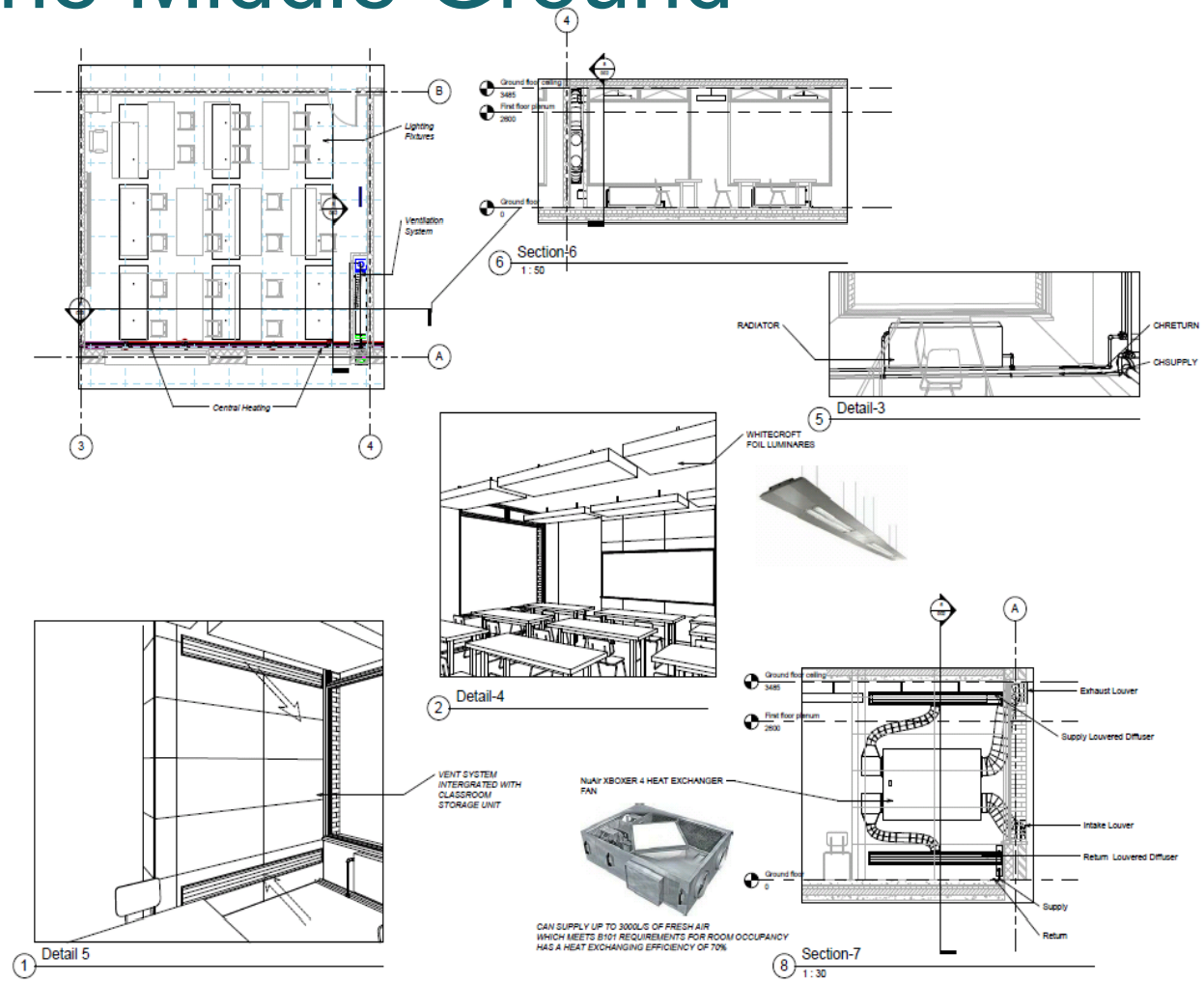
- Renewables
- Energy saving gadgets
- Sophisticated controls



(Adding things to actively reduce Carbon)

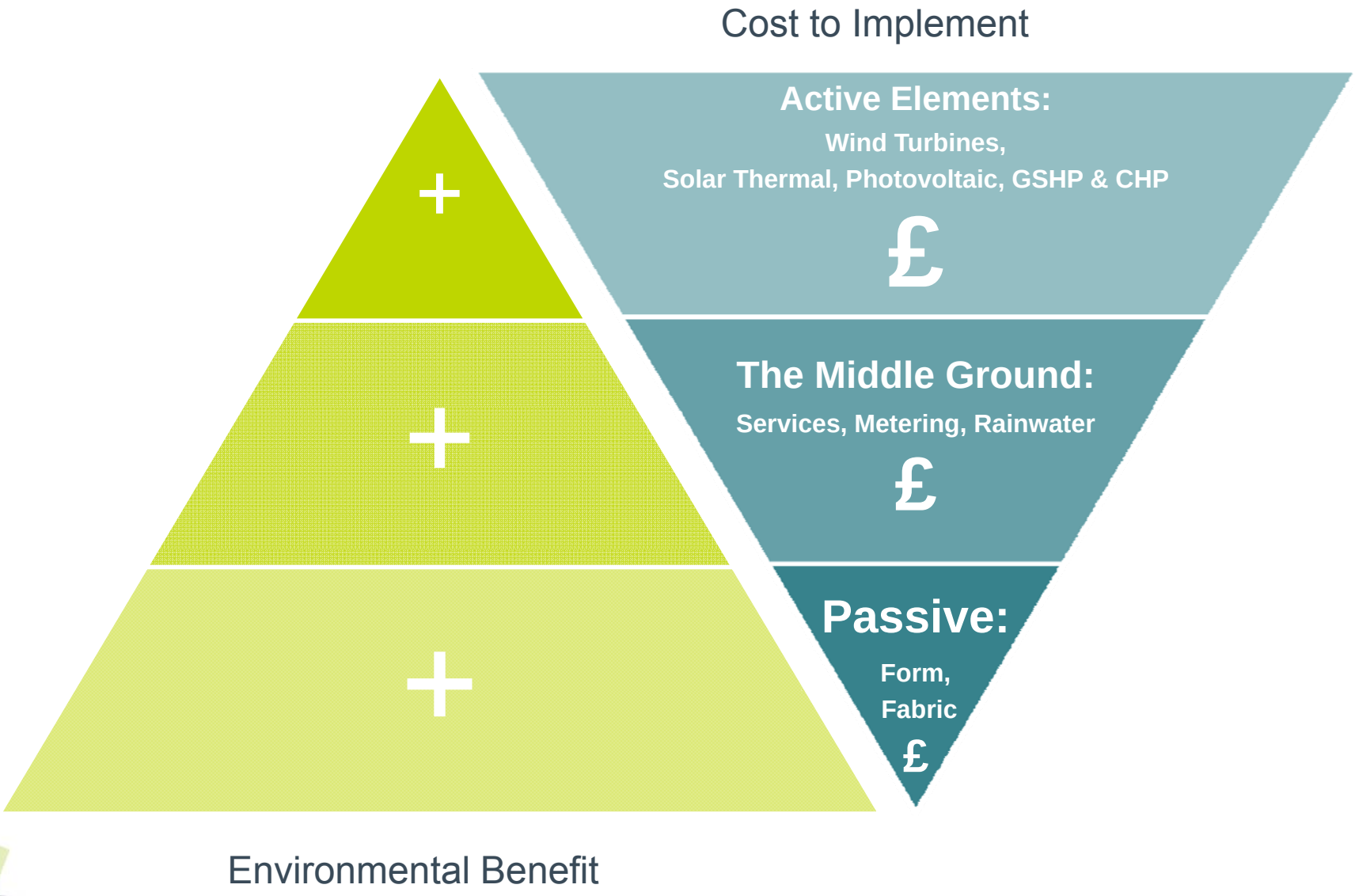
Definitions – The Middle Ground

- Improving efficiency:
  - Boiler efficiency
  - Chiller efficiency
- Heat Recovery
- SFP's
- Lighting efficacy
- Insulating services
- Power treatment
- CHP



(Building services excluding active design elements)

Low Carbon Design Hierachy



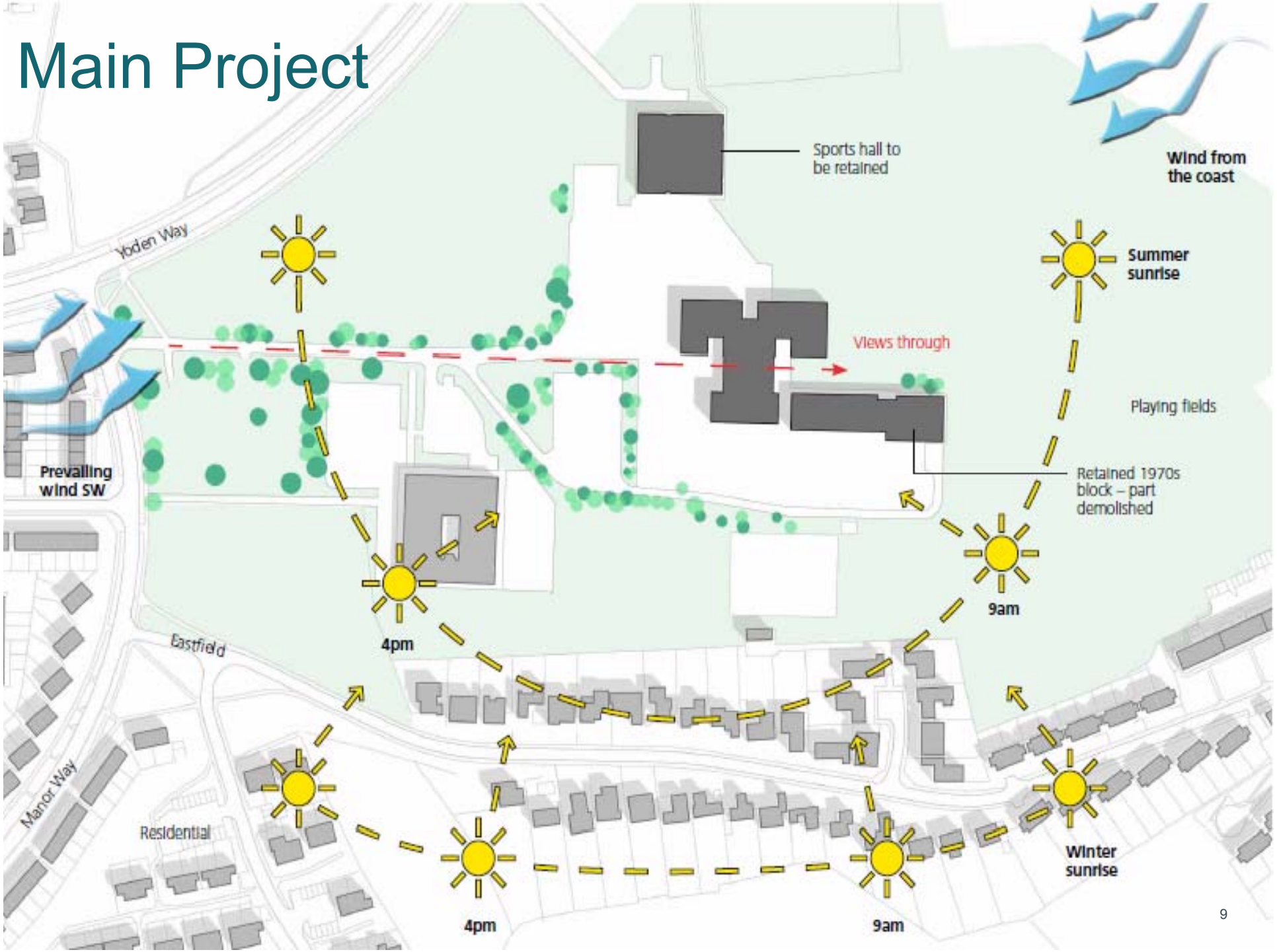
ATKINS

ATKINS

Case Study

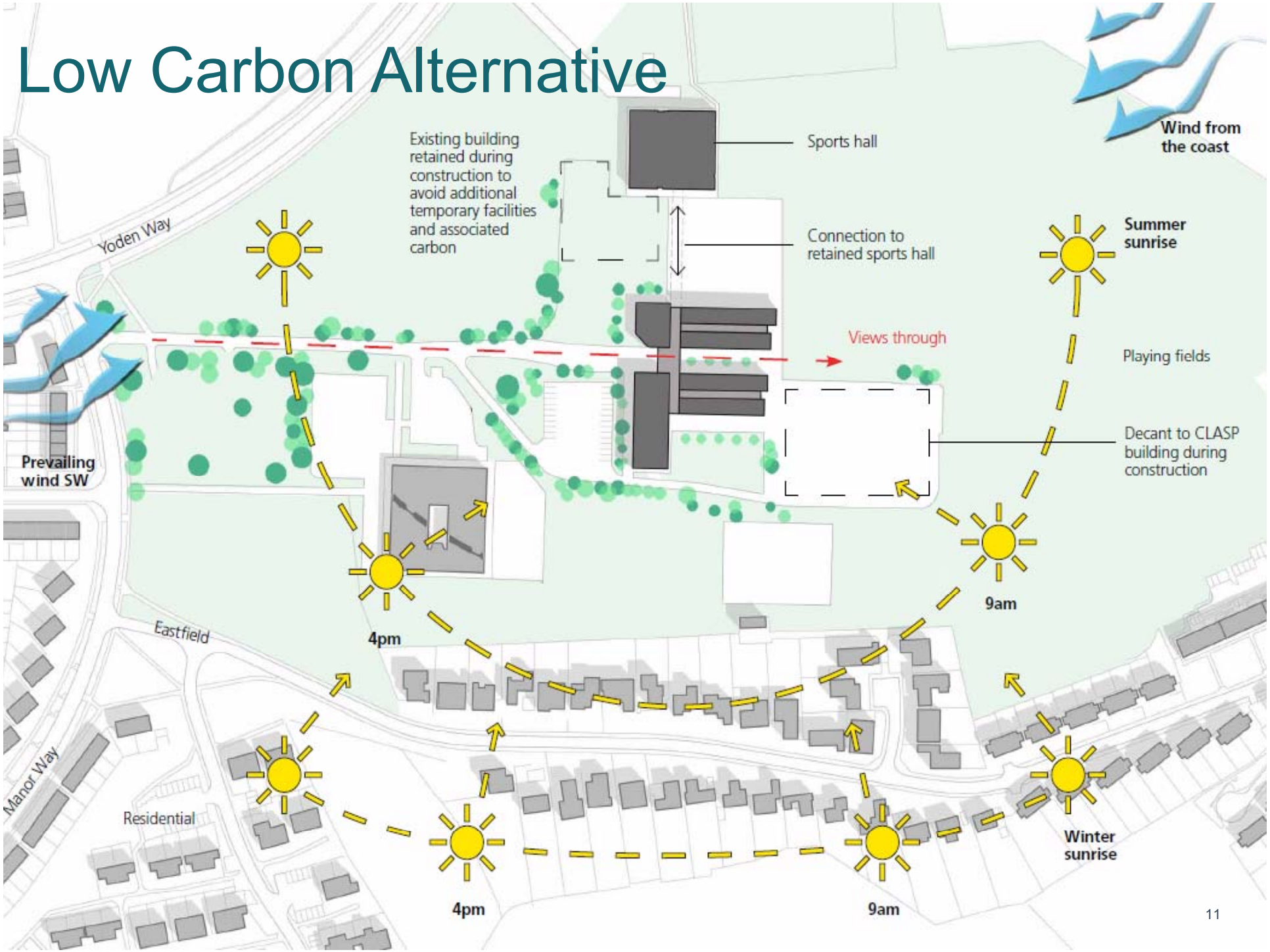
Dene School

Main Project



Main Project

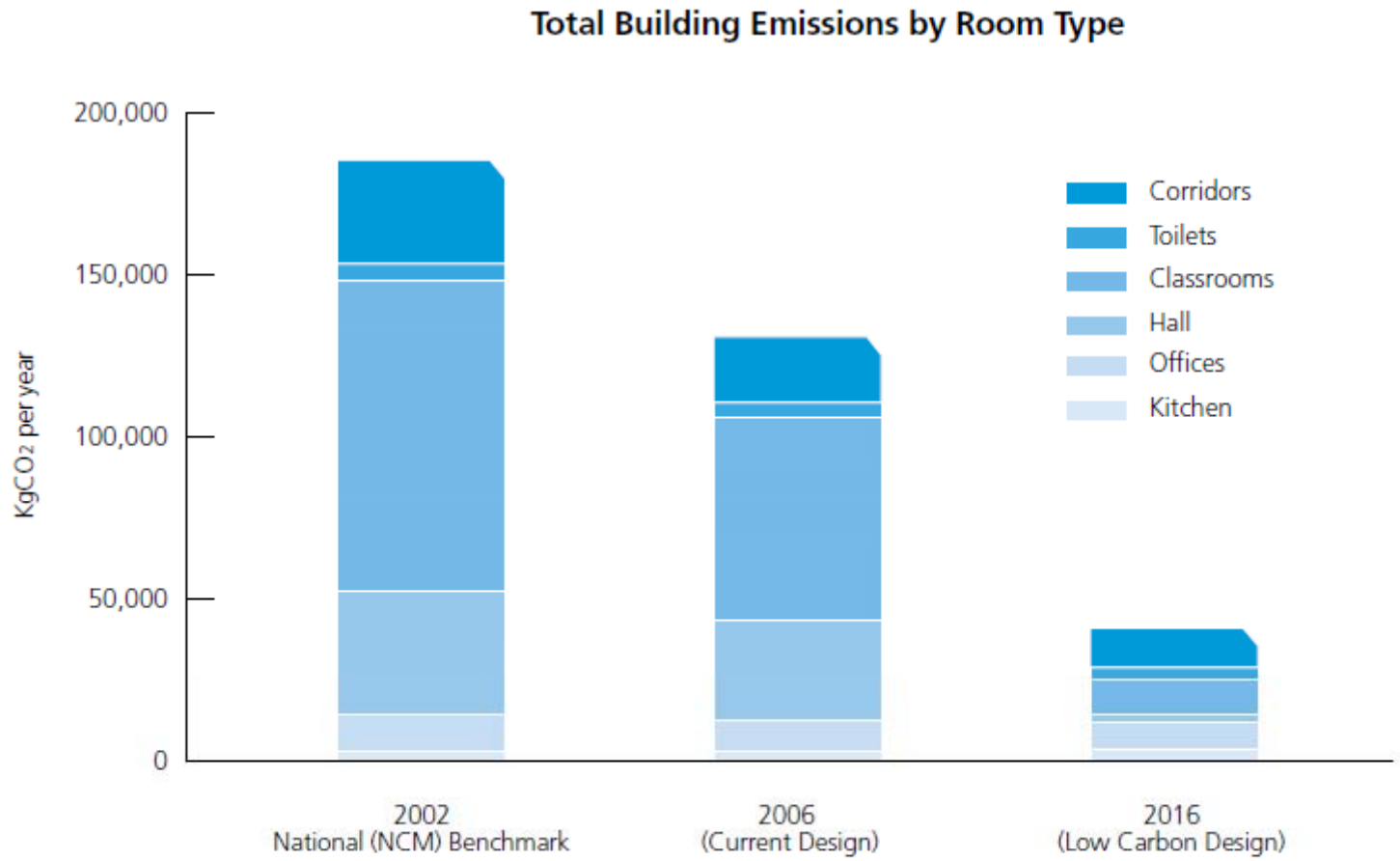
Low Carbon Alternative



Low Carbon Alternative

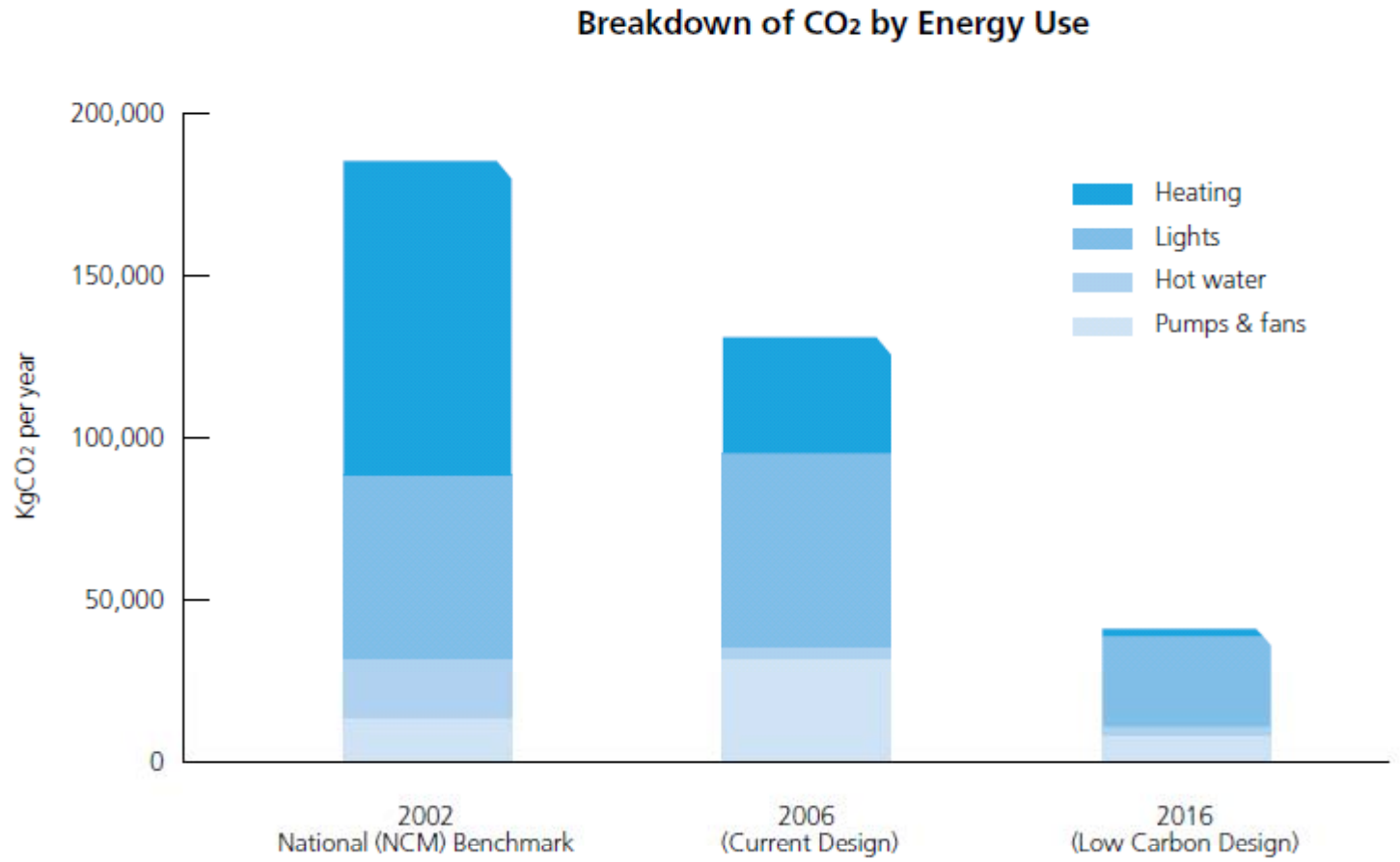
ATKINS

What's Important?



Classrooms make up 50% of the Carbon

What's Important?



Heating makes up 50% of the Carbon

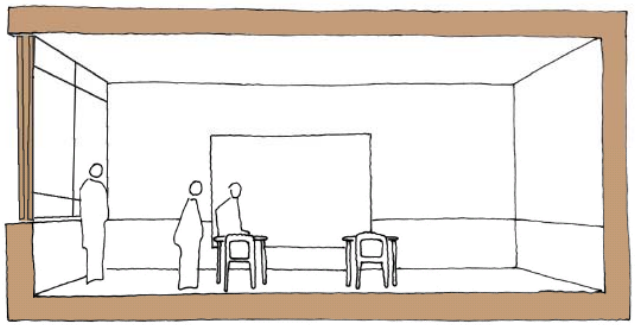
Impacts

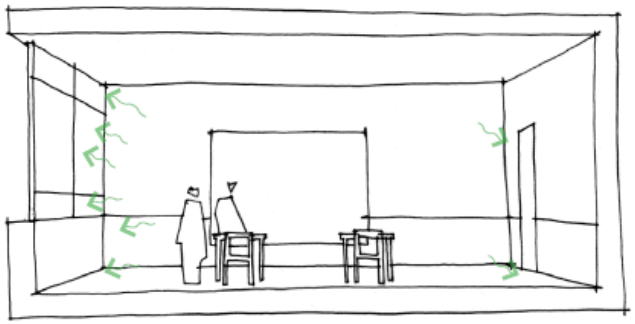
Passive > Active

Heating

By:

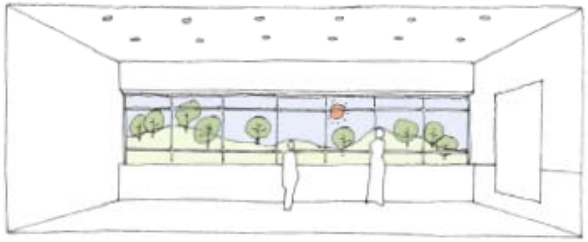
- Increasing insulation
- Reducing air leaks
- Increasing winter solar





We:

- Decrease heating energy by 70%
- Decrease heat loads by 80%
- Introduce a need for Mech Vent



Lighting

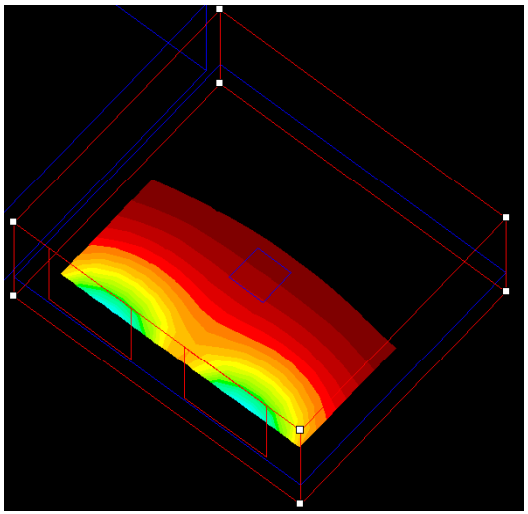
By:

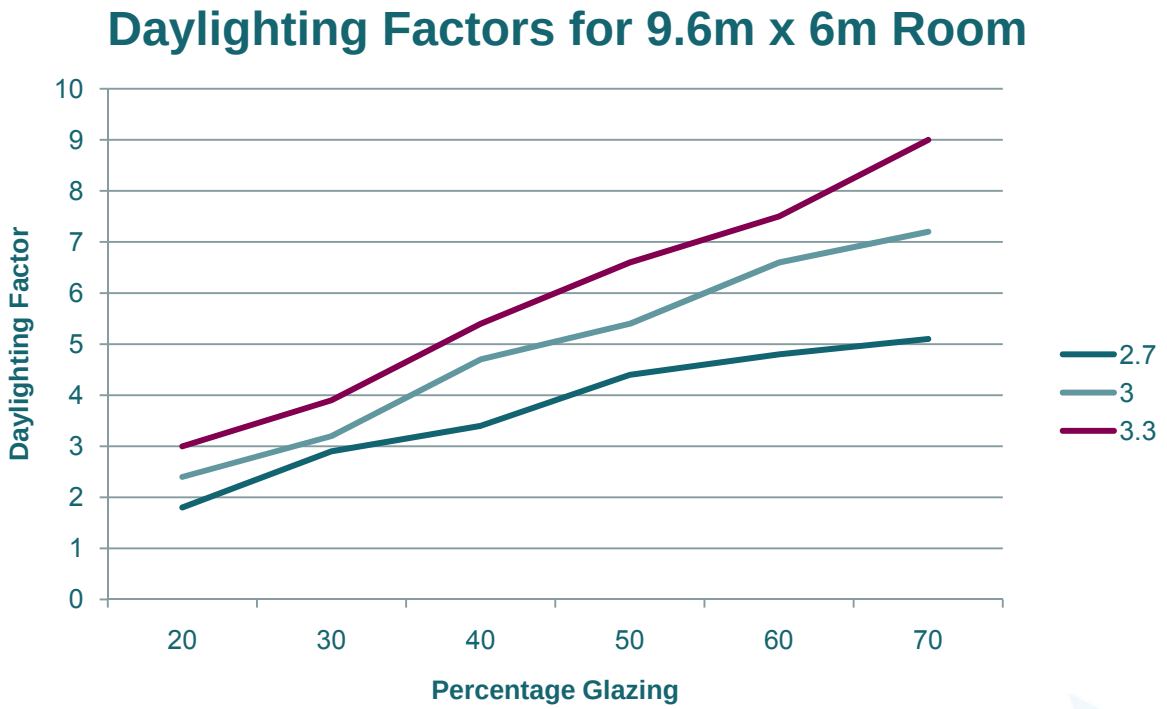
- Increasing glazing
- Introducing rooflights
- Improving internal layouts
- Optimising room size

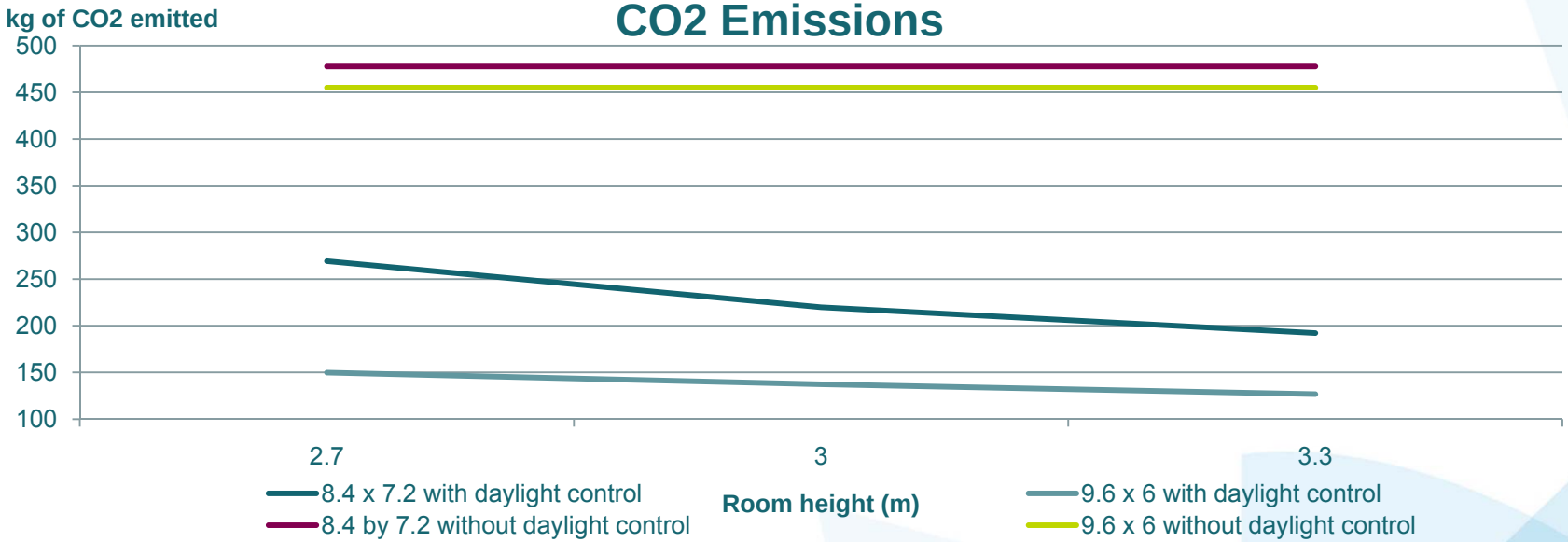
We:

- Double daylight factor to 6.3
- Reduce need for artificial light by 60%
- Introduce a need for sophisticated lighting controls

Lighting




Daylighting Factors for 9.6m x 6m Room
Daylighting Factor
10
9
8
7
6
5
4
3
2
1
0
20
30
40
50
60
70
Percentage Glazing
2.7
3
3.3


kg of CO2 emitted
CO2 Emissions
500
450
400
350
300
250
200
150
100
2.7
3
3.3
Room height (m)
8.4 x 7.2 with daylight control
8.4 by 7.2 without daylight control
9.6 x 6 with daylight control
9.6 x 6 without daylight control

Cooling / Ventilation

By:

- Increasing glazing
- Introducing stacks / internal air flows
- Improving shading
- Reducing need for artificial lighting
- Use thermal mass / removing ceilings

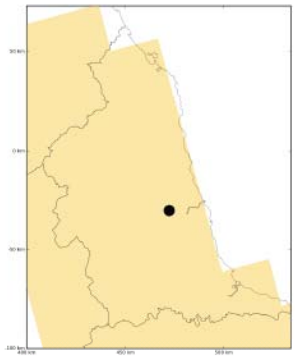
	2010	2080
Hours > 28°c	0	46
Hours > 25°c	15	169
Peak temperature (°c)	27	32

We:

- Remove the need for cooling
- Creates a problem how to manage window opening?

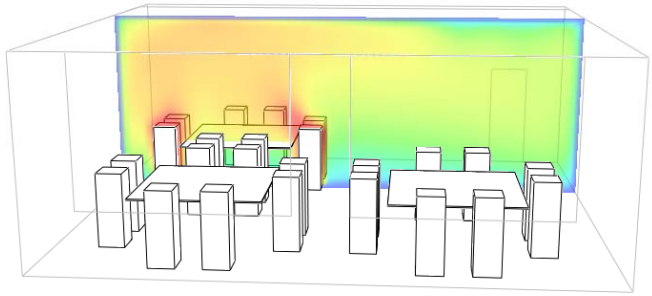
Cooling / Ventilation

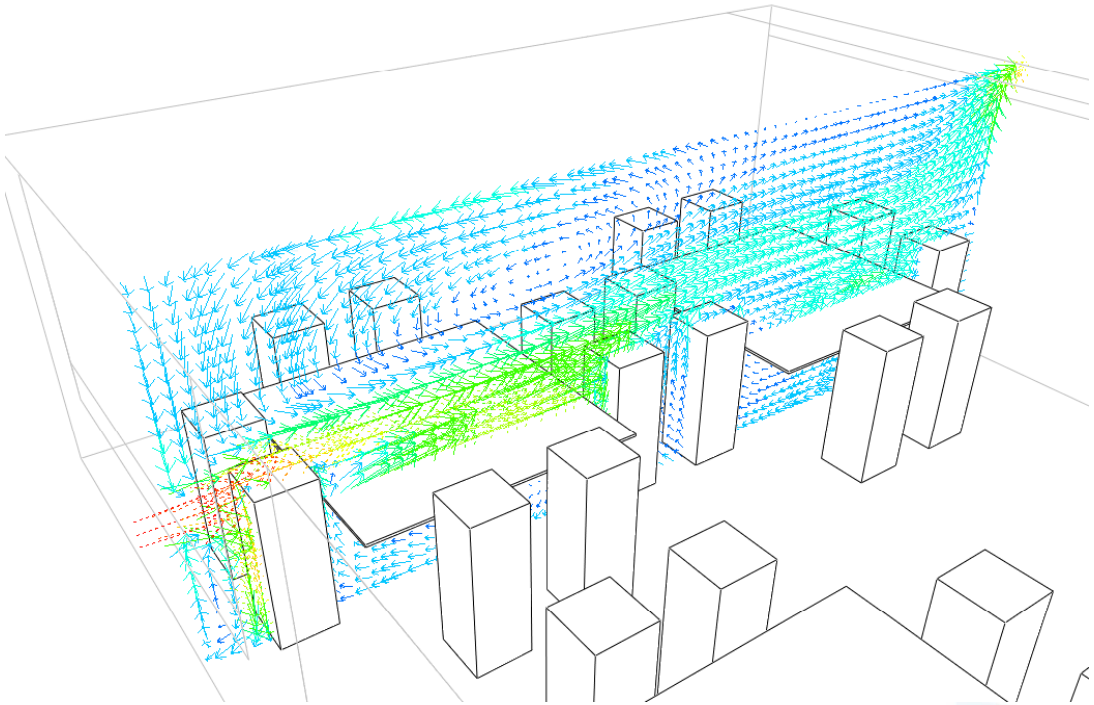
2020

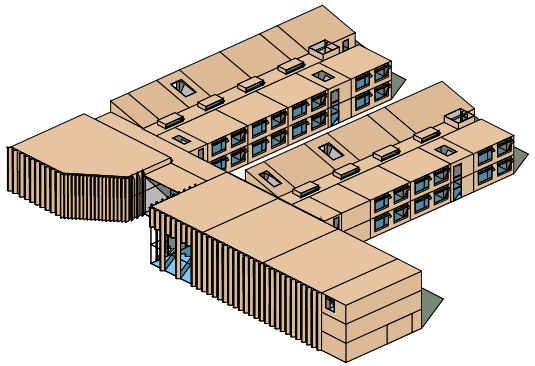


2050

2080





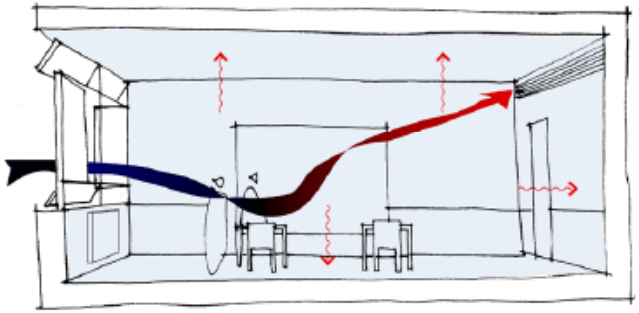


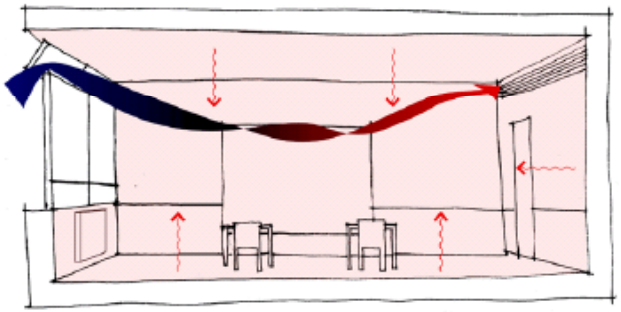
ATKINS

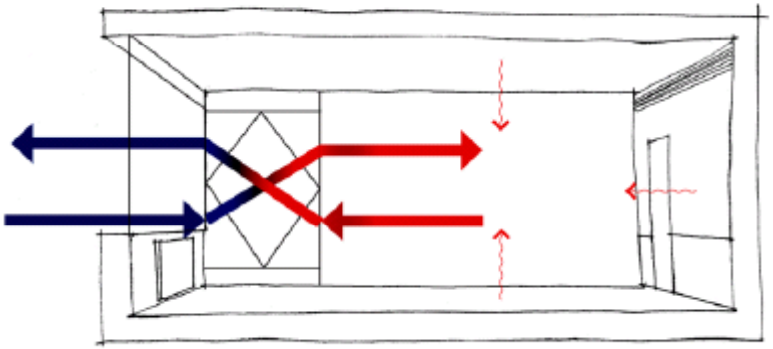
Impacts

Active > Passive

Integrated Controls







By:

- Daylight sensing
- Temperature, humidity & CO_2 control
- Actuated window vents

We:

- Use more daylight (1,109 hours /2,646)
- Quantify daylight switching levels (600 Lux)
- Use demand based heating & vent
- Use night purge
- Which requires good stack driven ventilation

ATKINS

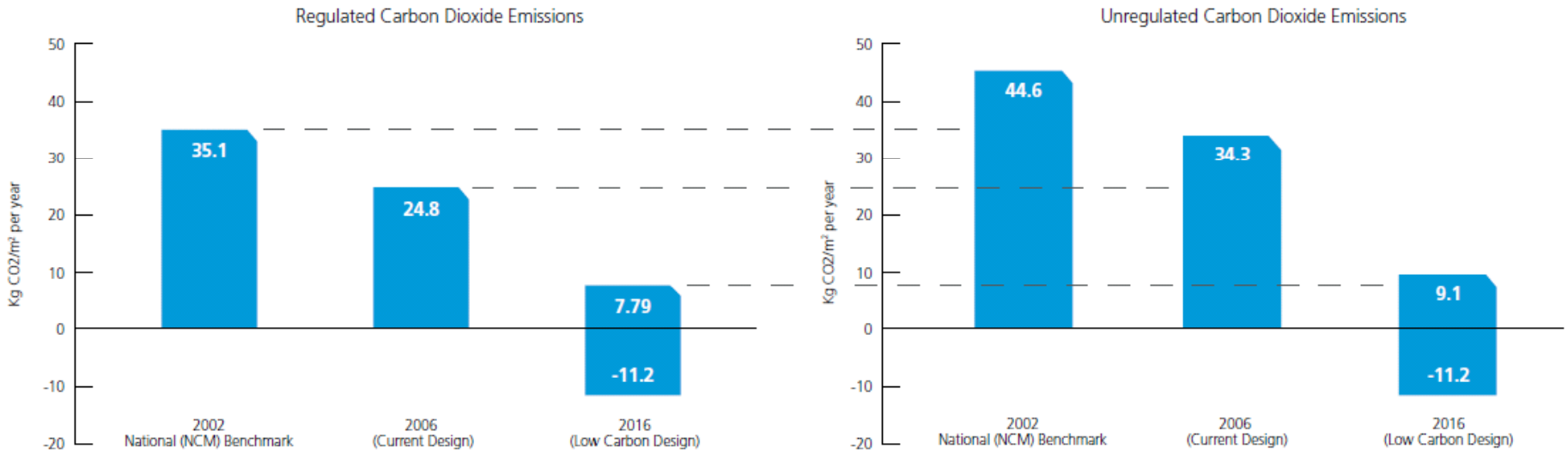
Renewables

By:

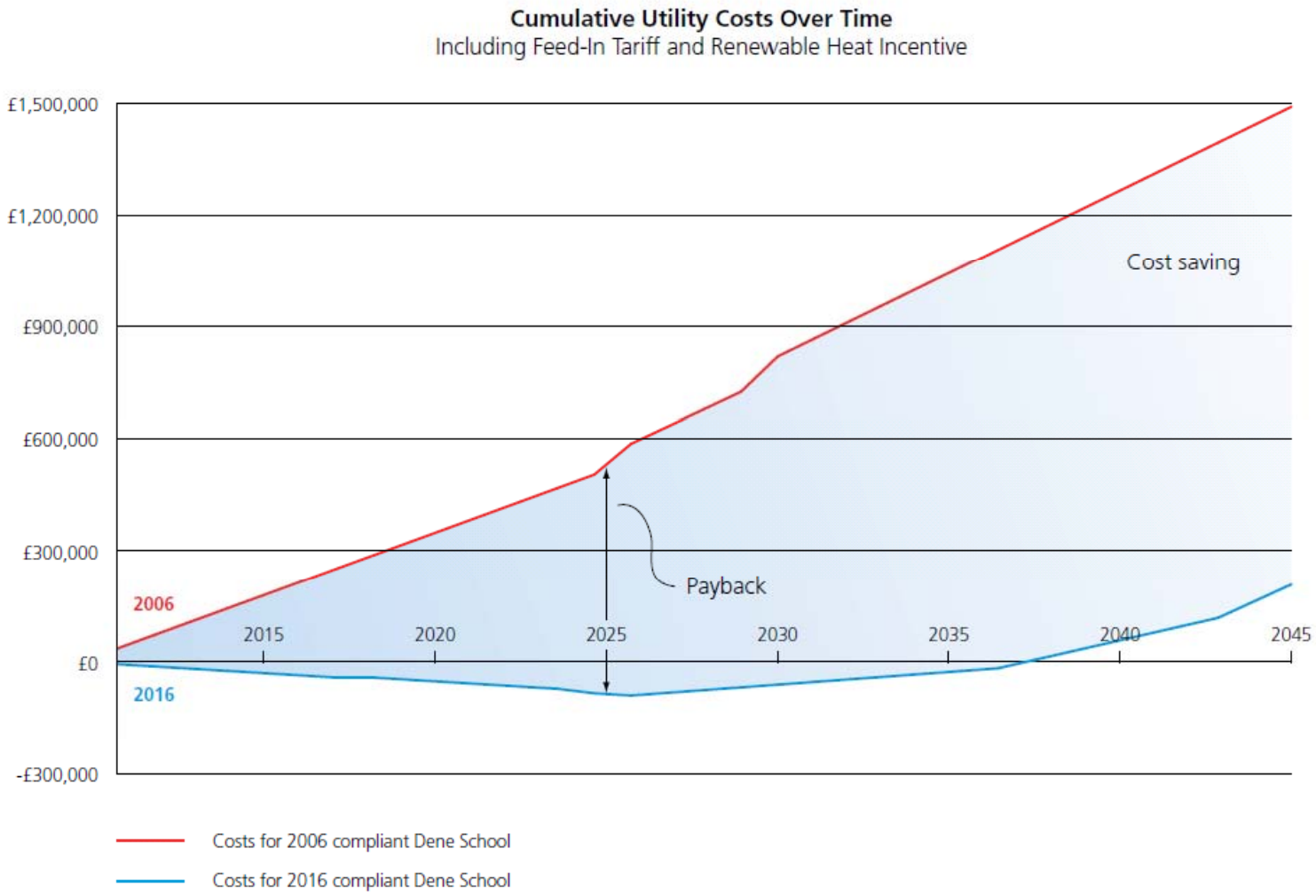
- Specifying Biomass
- Specifying PV

We:

- Get to zero net annual carbon emissions
- Calculate rough payback using Feed-in & RHI



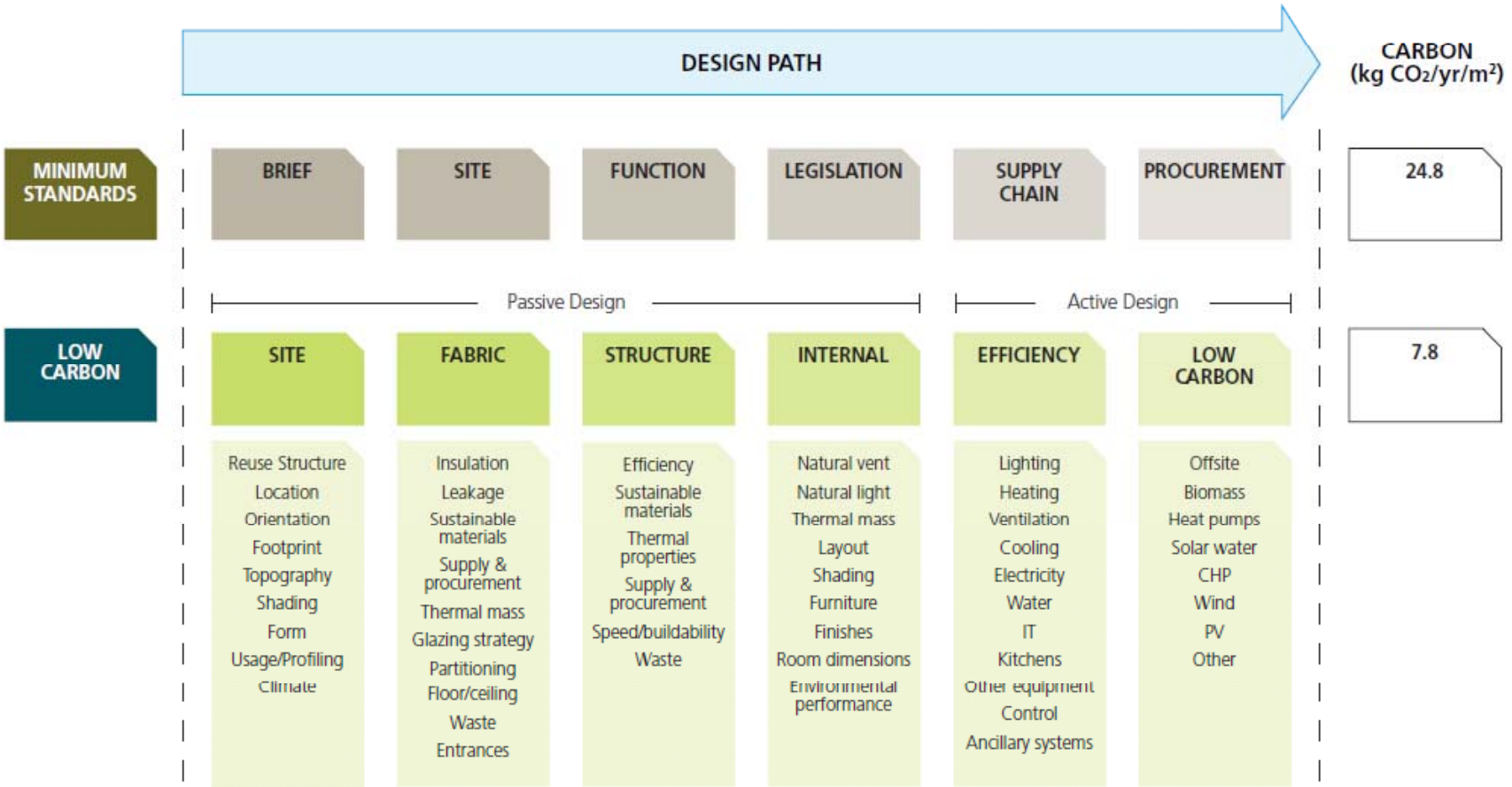
Utility Modelling



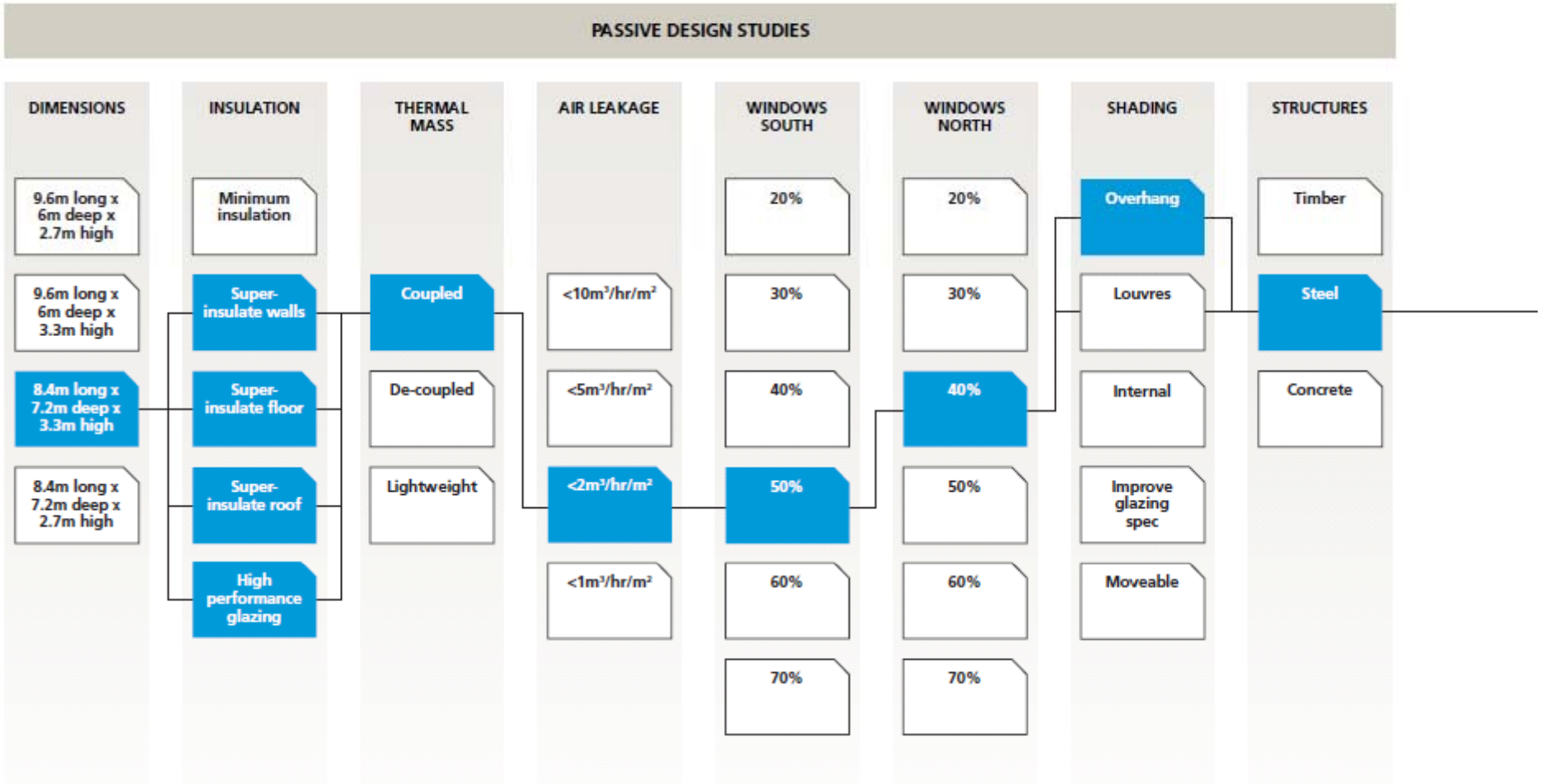
Our Findings

The Design Path

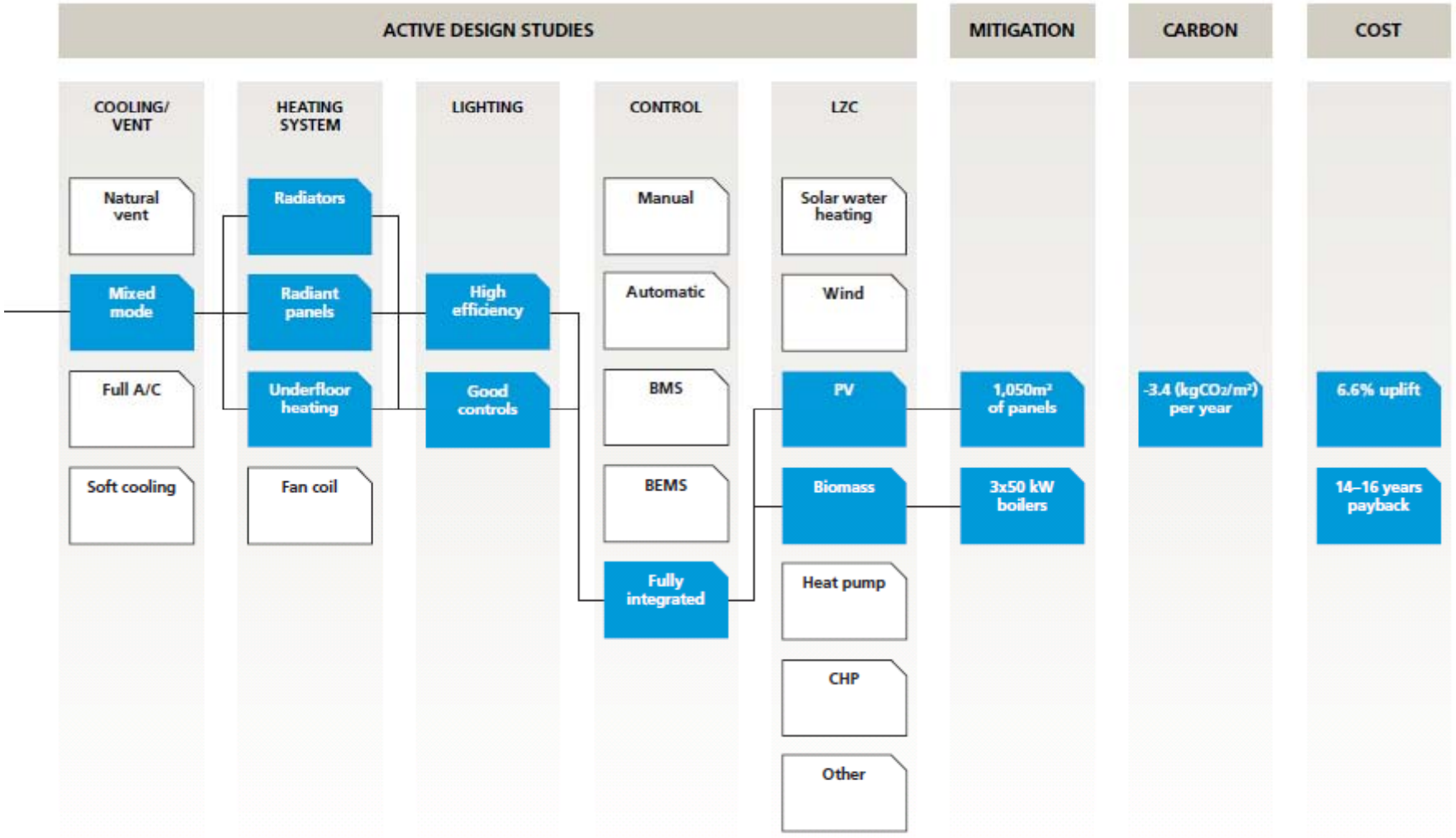
Its Complicated



The Design Path



The Design Path



Conclusion

Passive Vs Active

ATKINS

Low Carbon Buildings
Need Good Passive Design

The Tools

- Simulation:
  - Adds value to the decision making process
  - Helps identify what is important
- The big decisions are made early on
- Tools need to be simple
  - To be understood
  - For answers in hours not weeks
- Therefore we made our own

Atkins' Carbon Tools

ATKINS

Roadmap
Uses mind-mapping techniques to plan business activities in relation to carbon consequences.

Relativity
Creates charts to show the link between carbon determinants and the carbon they produce (or save), and compares scenarios.

Knowledgebase
Calculates, analyses and evaluates low-carbon options using a library of verified carbon data.

Masterplanning
Identifies, quantifies and visualises the carbon impacts of development masterplans.

Buildings
Uses key building factors, services and occupancy parameters to estimate a building's carbon footprint.

Atkins Remote Technology (ArT)
Remotely monitors and controls plant equipment and FM systems to manage a building portfolio's energy use.

Traffic Analysis
Translates existing traffic data into estimates of carbon emissions within a monitored area.

Travel Behaviours
Estimates carbon for journeys to a specific location, and produces journey plans to encourage use of low-carbon transport.

Atkins' Carbon Tools

ATKINS