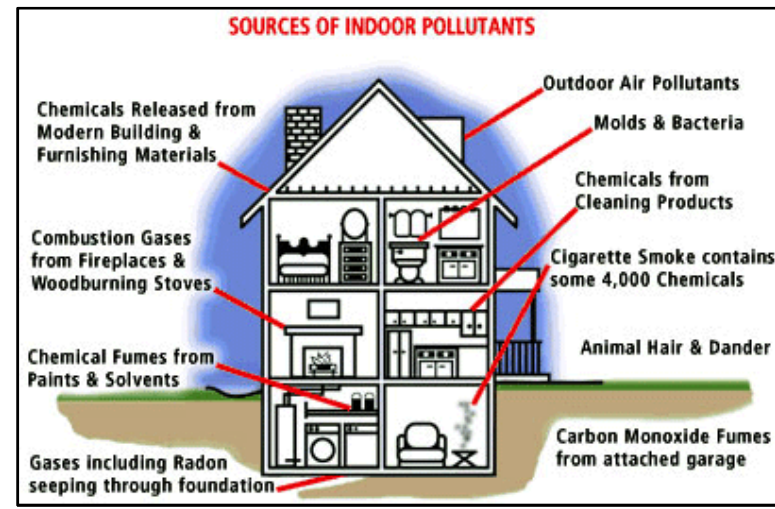
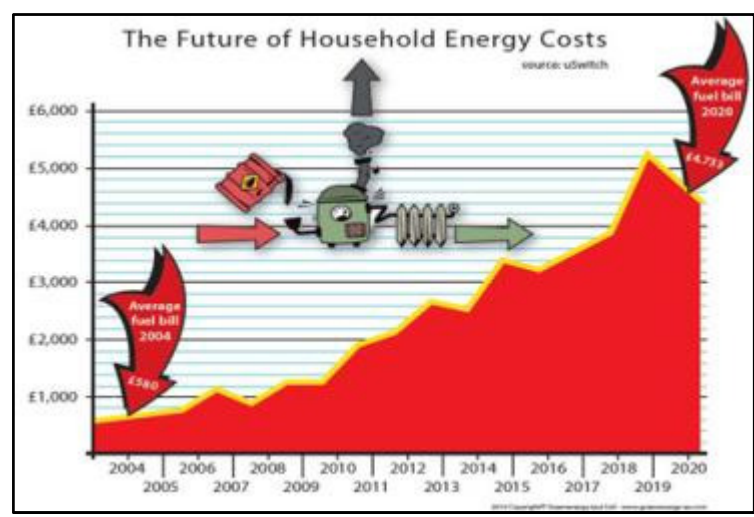
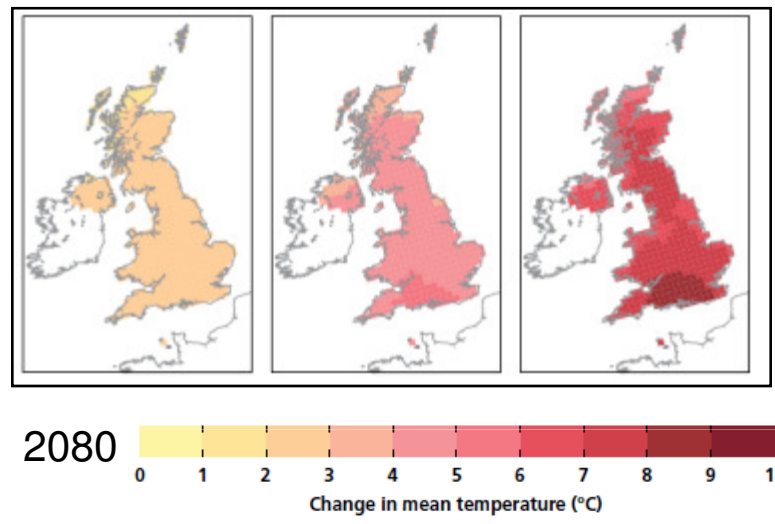




# Riccarton Ecovillage

# Research Drivers

- Climate Change
- Health
- Fuel Poverty



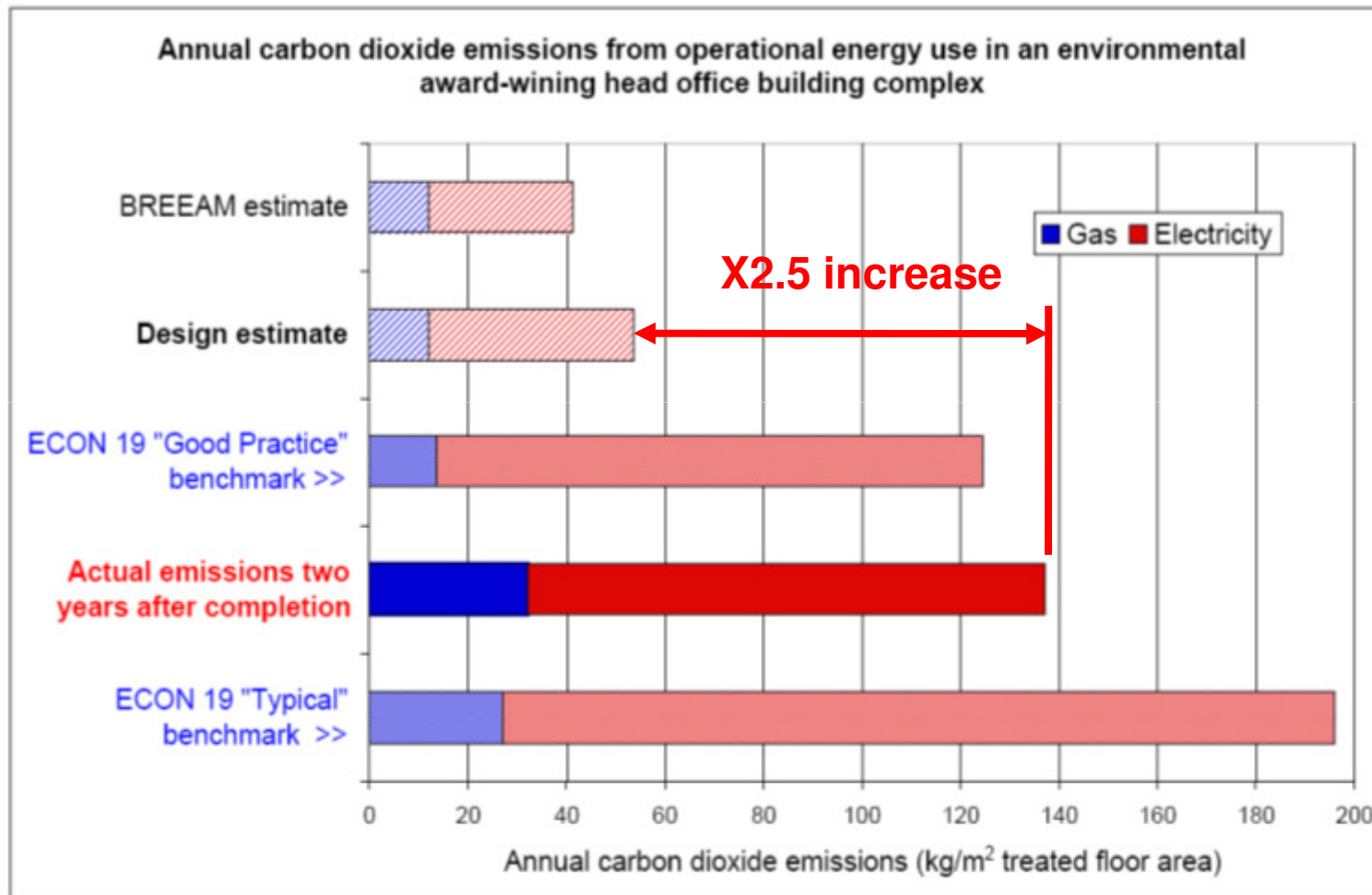


# Context: Policy

## UK Carbon Reduction Timeline



# The Credibility Gap





# House Types and Emissions

Table 4c: Housing Stock Distribution by Type (millions)

Year	Semi detached	Terraced	Flat	Detached	Bungalow	Other	Total
1970	5.79	5.57	3.00	1.91	1.39	0.32	17.99
2000	6.87	6.42	4.46	3.84	2.04	0.07	23.71
2001	6.80	6.63	4.55	3.88	2.01	0.07	23.93
2002	6.86	6.69	4.59	3.91	2.03	0.07	24.15
2003	6.89	7.03	4.15	3.99	2.27	0.03	24.37
2004	7.04	6.96	4.01	4.19	2.32	0.04	24.56
2005	6.79	7.18	4.23	4.32	2.24	0.07	24.82
2006	6.98	7.25	4.25	4.32	2.18	0.09	25.08
2007	7.04	7.07	4.22	4.64	2.32	0.08	25.36
2008	6.74	7.33	4.78	4.41	2.30	0.08	25.64

**Carbon Emissions**    **41 Mt**    **44 Mt**    **29 Mt**    **26.5 Mt**    **14 Mt**    **0.5 Mt**    **155 Mt**

# Introduction:

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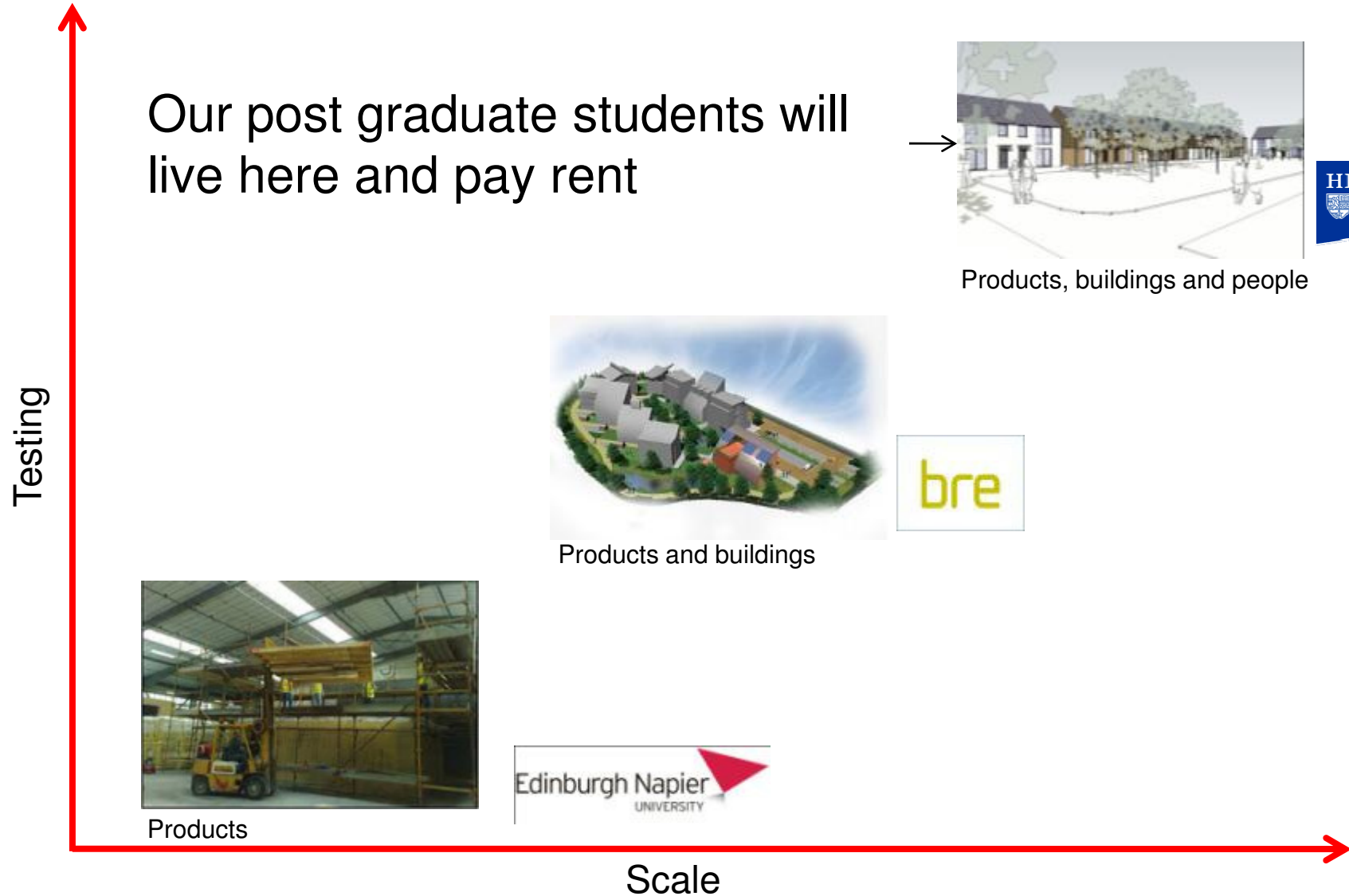
## A WORLD LEADING STANDARD TEST FACILITY FOR LOW CARBON RESEARCH

- Government Policy to deliver new *Affordable* housing that meets 2016 Zero Carbon Emission Targets
- HWU will deliver first class science in support of this policy
- By investigating the system performance of **construction, technology** and **human behaviour**
- Significant Knowledge Transfer opportunities for construction industry benefit

**There is a significant need for additional student accommodation on campus**



# Context: Scottish Precedents







# Research Agenda

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## **Living Laboratory**

10 no. 2013 and 2016 Homes

*Thermal Mass and Wall Construction performance*

## **Lightweight 2016 Housing Hub**

40no. 2016 Code 6 Timber Frame Homes

*Natural Ventilation v Mechanical ventilation Heat Recovery*

## **Heavyweight 2016 Housing Hub**

40no. 2016 Code 6 Heavyweight Homes

*Adaptive Thermal mass and Energy Use*

*Ecovillage becomes Domestic Soft Landings Case Study*



# Research Method

Technology Strategy Board  
Building Performance Evaluation  
Method used as base tool

**Year 1-** Occupants live in single house type

**Year 2-** Occupants move from the natural houses to mechanical ventilation houses and vice versa

Paired t-test (or perhaps an Analysis of Covariance).

40 homes gives a power of 0.83 assuming a correlation of 0.8.

Lightweight

Heavyweight

20no.  
(60 occupants)  
**Lightweight Natural Ventilated Homes**

20no.  
(60 Occupants)  
**Heavyweight Naturally Ventilated Homes**

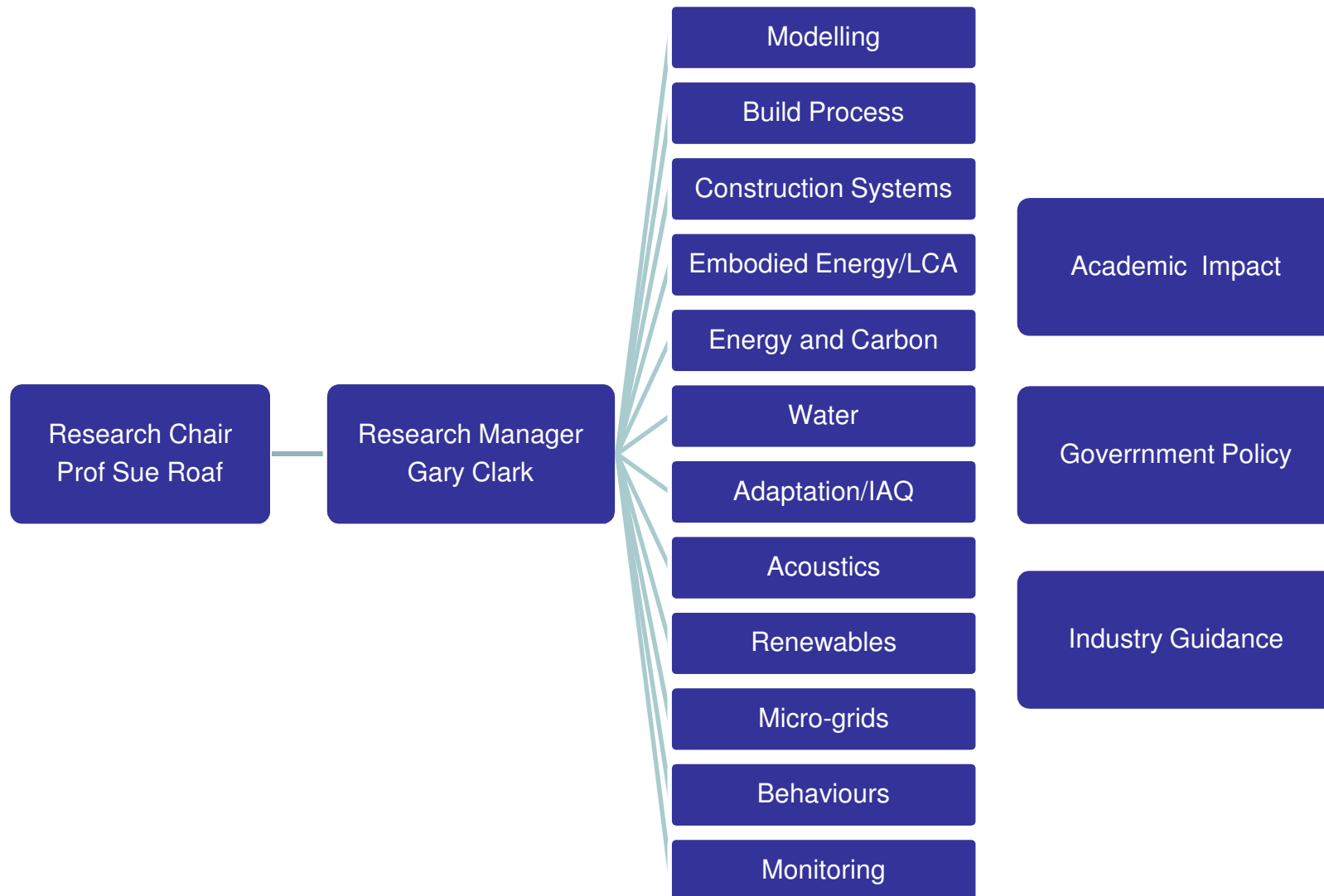
20no.  
(60 Occupants)  
**Lightweight Mechanically Ventilated Homes**

20no.  
(60 Occupants)  
**Heavyweight Mechanically Ventilated Homes**

10no.  
(20 Occupants)  
**Living Lab Homes**

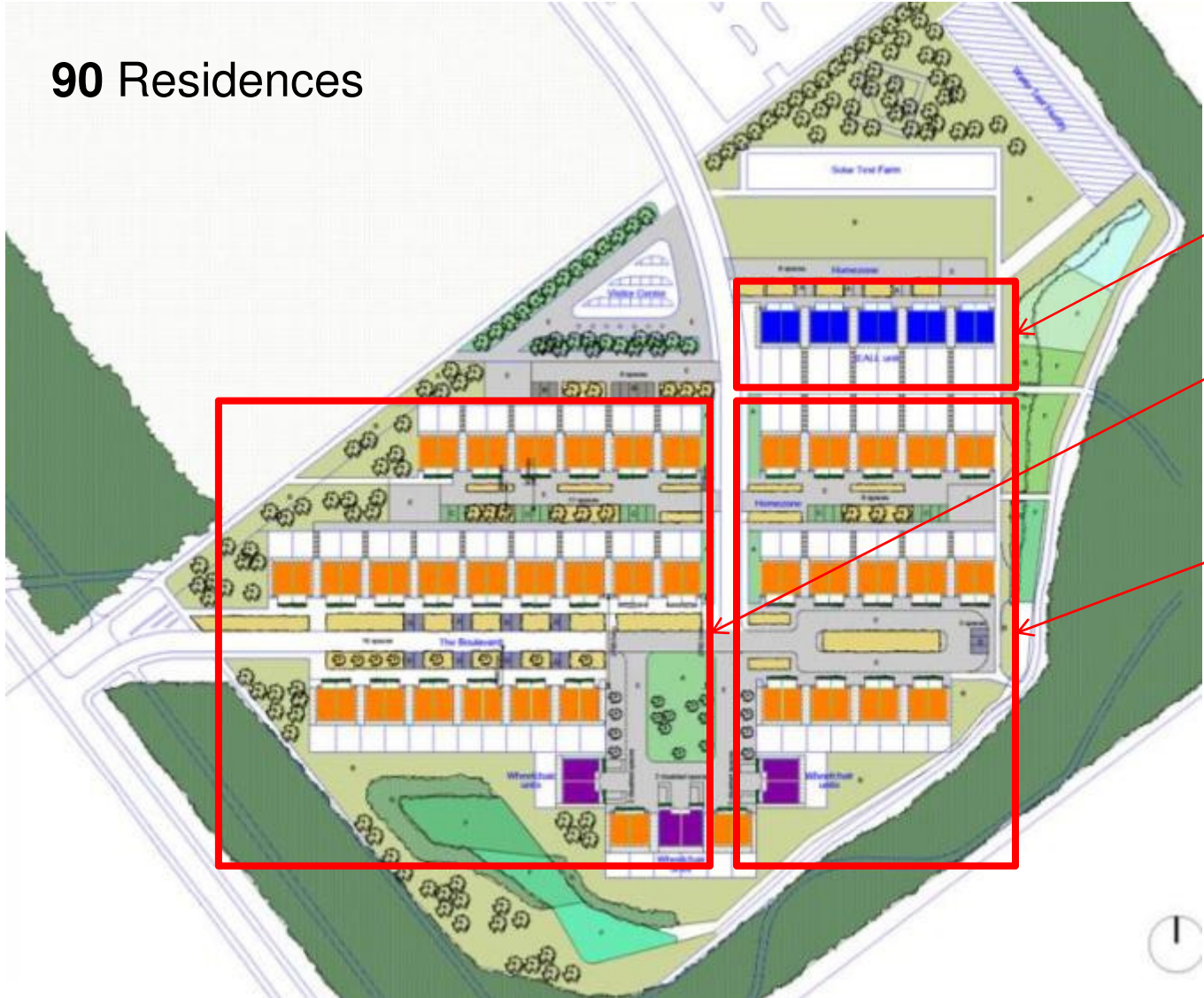


# Holistic Research Aims



# Stage C Site Plan

90 Residences



Living Lab

Lightweight  
2016 Housing  
Hub

Heavyweight  
2016 Housing  
Hub





# Construction Types

House Type	Code Level	Construction	Thermal Mass	Heating System
A1	2013 (Code 4)	Block Cavity Wall	Heavy	Heat Pump+
A2	2013 (Code 4)	Block Cavity Wall	Heavy	Gas Boiler
B1	2013 (Code 4)	Block with External Insulation	Medium	Heat Pump+
B2	2013 (Code 4)	Block with External Insulation	Medium	Gas Boiler
C1	2013 (Code 4)	Timber Frame	Light	Heat Pump +
C2	2013 (Code 4)	Timber Frame	Light	Gas Boiler
D1	2016 (Code 6)	Passivhaus SIPS	Light	Heat Recovery
D2	2013 (Code 4)	Passivhaus SIPS	Light	Gas Boiler
E1	Pre 1918	Brick and Stone	Heavy	Gas
E2	2016 (Code 6)	Brick and Stone	Heavy	Heat Pump +

# Performance Specification

Parameter	REALL 2013 Specification	HUB 2016 Specification
Scottish Building Standards: Dwelling Emission Rating	2013- DER 25% reduction from 2010 TER	2016- DER 100% reduction from 2010 TER
Scottish Building Standards: Robust Detailing Standard	Gold	Gold
Scottish Building Standards: Sustainability Rating	Gold	Platinum
Code for Sustainable Homes: Rating	Code 4	Code 6
Wall U-value	0.15	0.1
Roof U-value	0.15	0.05
Floor U-Value	0.15	0.1
Windows U-Value	1.4	0.8
Doors U-Value	1.4	0.8
Average U-value		
Thermal Bridging	0.15	0.07
Fresh Air Supply (l/s/person)	8	8
Air Permeability (m <sup>3</sup> /m <sup>2</sup> /h)*	4	2
Daylighting Distribution		
Potable Water Use per person		
England and Wales Part F Indoor Air  Mould growth	Nitrogen dioxide Carbon monoxide VOCs No visible mould on external walls in a properly heated building	As 2013

# SAP Modelling: IESVE

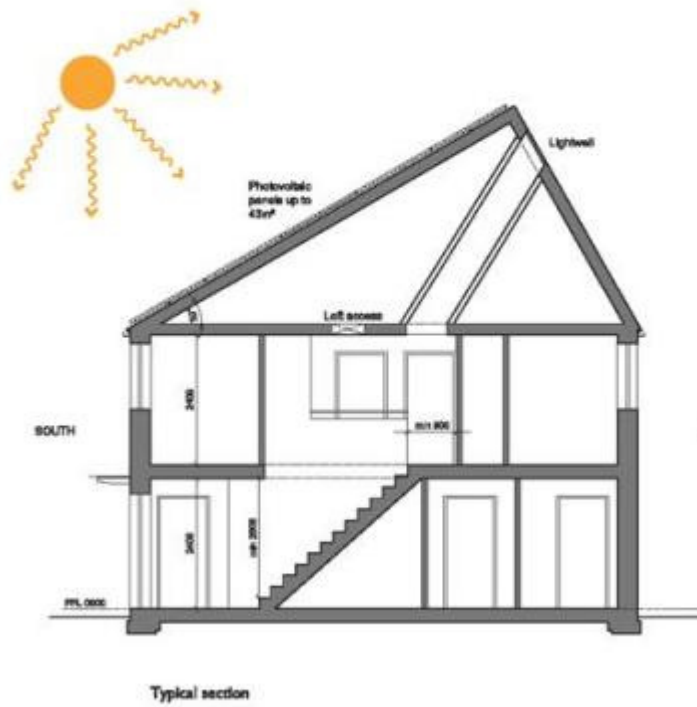
Energy Use	Carbon Emissions													
	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1	F2	G1	G2
	kg.CO2/m2/yr										kg.CO2/m2/yr			
TER	16.13	24.22	16.13	24.22	16.13	24.22	16.13	24.22	16.13	24.22	24.22	24.22	24.22	24.22
Space Heating	6.21	9.03	6.21	9.03	6.21	8.36	6.05	3.77	29.28	4.68	4.94	3.22	4.94	3.22
Water Heating	5.38	7.22	5.38	7.22	5.38	7.22	5.38	4.18	5.24	4.20	3.27	4.18	3.27	4.18
Pumps + Fans	0.72	0.96	0.72	0.96	0.72	0.96	0.72	2.87	0.72	3.59	0.96	2.87	0.96	2.87
Lighting	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28
PVs	-9.11	-11.96	-9.11	-11.96	-9.11	-11.04	-9.28	-31.28	0.00	-33.12	-30.36	-31.28	-29.44	-31.30
PV (m2)	10.00	13.00	10.00	13.00	10.00	12.00	10.00	34.00		36.00	33.00	34.00	32.00	34.00
DER	5.31	7.53	5.31	7.56	5.31	7.79	5.31	-18.18	37.52	-18.4	-18.91	-18.74	-18.00	-18.76
SAP rating (band)	93(A)	93 (A)	93 (A)	93 (A)	93 (A)	93 (A)	93 (A)	117 (A)	69 ( C)	118 (A)	118 (A)	118 (A)	117 (A)	118 (A)

Scottish Regulations Year	2013 (44% improvement)							Code 6						
Improvement	67%	69%	67%	69%	67%	68%	67%	YES	n/a	YES	YES	YES	YES	YES



# Typical Section-Elevation



# Elevation Types



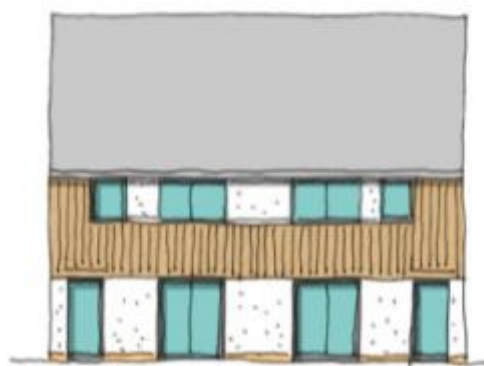
Brick and Block



External Render



Traditional Stone



Timber Frame



Timber SIPS Panel



Brick and Block

# Riccarton Eco-village

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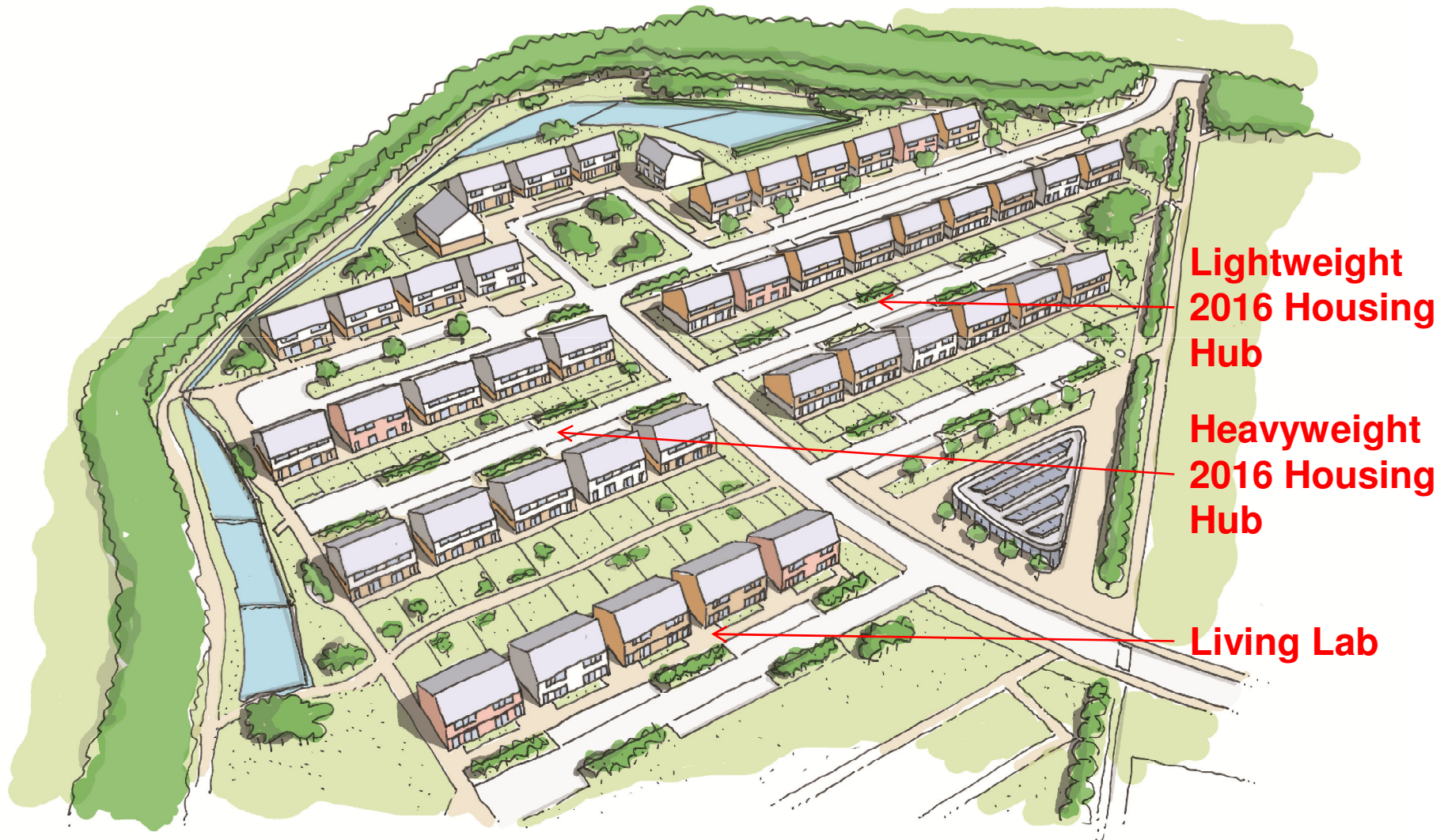
# Riccarton Eco-village

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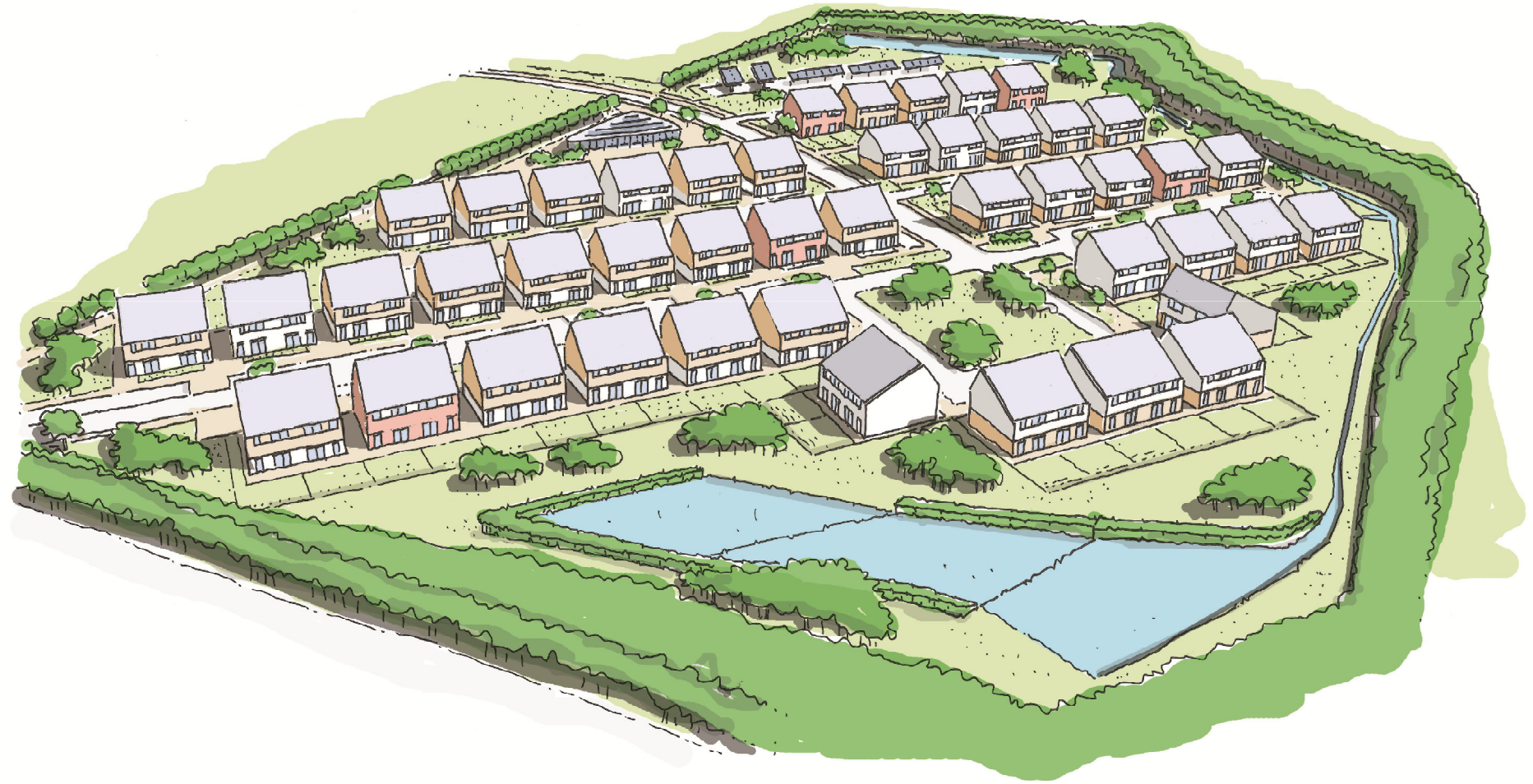


# Riccarton Eco-village





# Riccarton Eco-village











# Visitor Centre

Showcase for Research

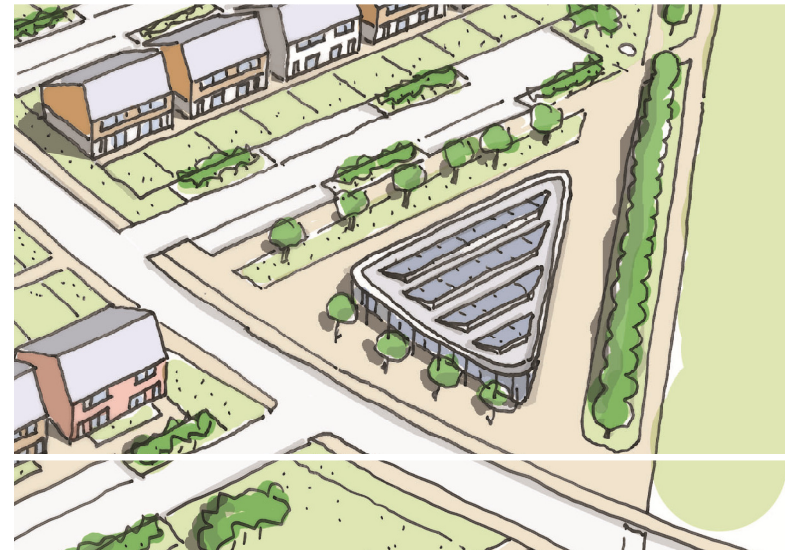
Venue for Seminars

Virtual Simulation Venue

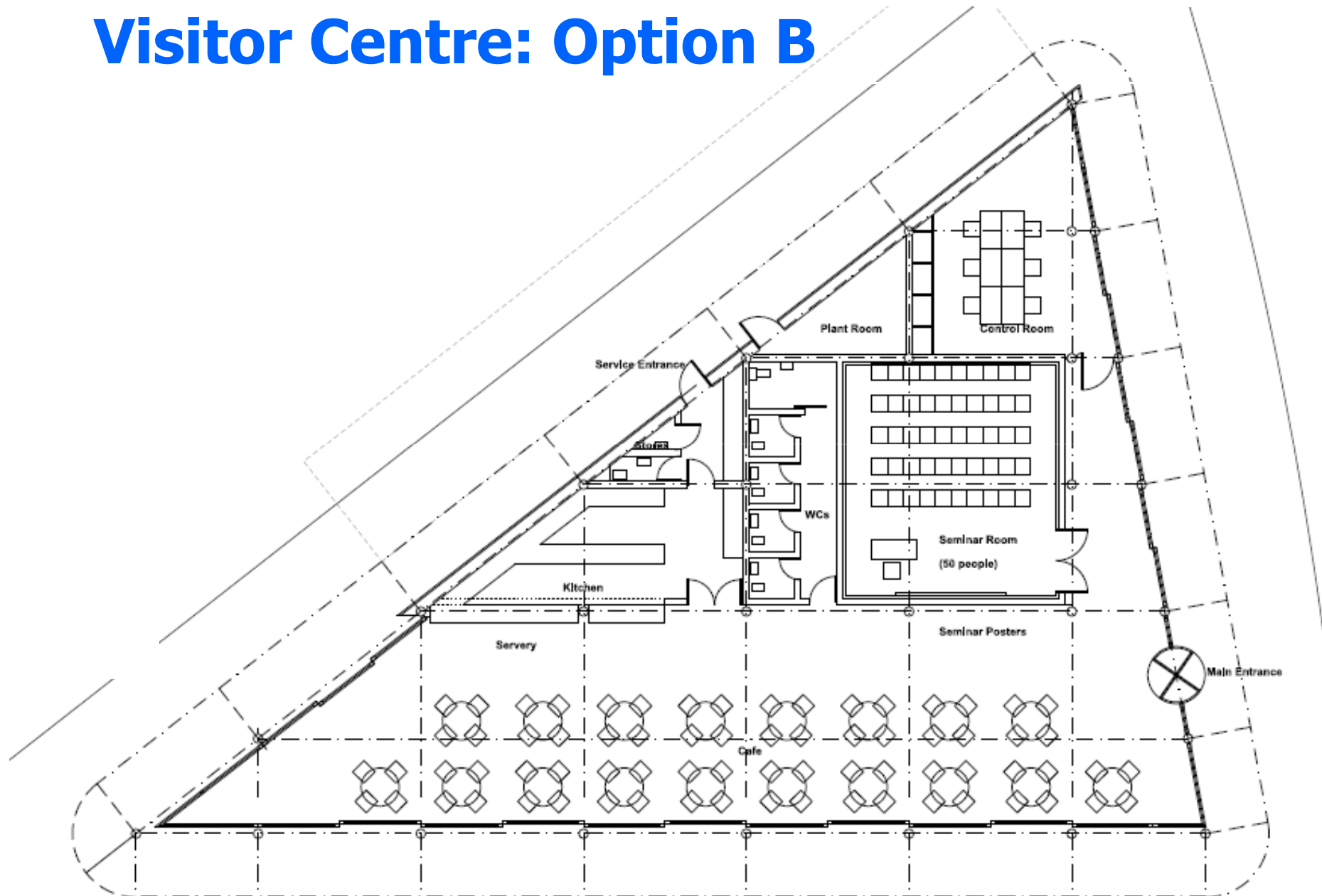
Resource for Researchers

Place for Students

Possible Zero Carbon  
Micro-brewery?



# Visitor Centre: Option B





# Riccarton Eco-village

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- REALL will build all major low carbon construction types to future targets now
- All types will be subject to rigorous Energy, Occupant Satisfaction and IAQ POE
- REALL will become an open source reference trial for use by European Industry and Governments
- REALL will trial domestic Soft Landings procurement process
- REALL offers industry the chance for integrated product testing and a high profile route to market

**REALL is Heriot Watt research contribution to Scottish Low Carbon Economy**





# Riccarton Ecovillage