



crest

centre for
renewable energy &
sustainable technologies

SOUTH PASSIVE 17
PACIFIC HOUSE

CONFERENCE & TRADE SHOW

Christchurch, New Zealand 5th March 2017

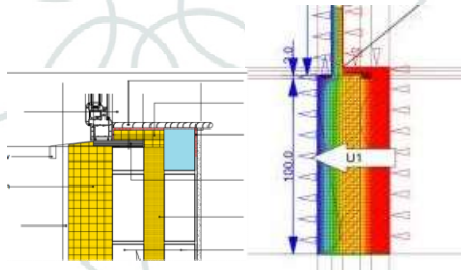
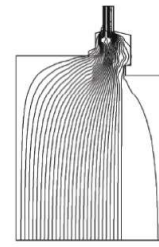
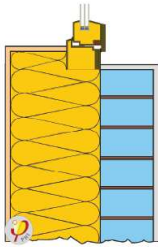
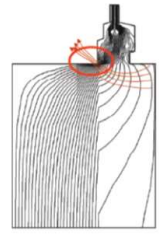
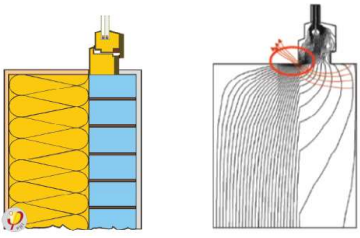
- **CREST since 2013**
- **Passive House Designer since 2014**
- **PhD Studies in Passive House at Queens University Belfast**
- **Director of Passive House Association of Ireland**
- **10 years Experience in the Industry of Sustainable Construction and Renewable Energy**



- Partnership based project
- £2.9m funding through EU Interreg IVa Programme
- Providing R&D support to businesses relating to renewable energy and sustainable technologies
- Key aim was to support 150 SME business across the region
- Three core area's Sustainable Construction, Biotech, Micro generation and storage technology



Magheraveely EnerPHit



Passive Building Structures



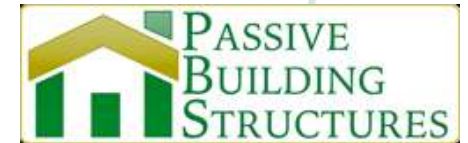
Eco house in West Cork named Home of the Year

Thursday 14 May 2015

[Tweet](#) [Send](#) [Recommend](#) 48



An eco-friendly, split-level house in Castletownbere, West Cork, which combines comfort, clever design and functionality, has won RTÉ One's *Home of the Year*.



CREST Awards to Date

- Sustainable Ireland Awards 2014 - Sustainable building project of the year
- Institute Designers Ireland awards winner 2014 – interior design
- Institute Designers Ireland awards commended 2014 – sustainable design
- A' design award bronze 2014 – interior design
- Action Renewables Association Awards 2015 - The most Environmentally Sustainable Construction Project
- Action Renewables Association Awards 2015 - Best Renewables Installation within the Education, Healthcare and Public Sector



CREST Awards to Date

- RICS awards– 2015 Design through innovation
- Green Gown Awards – 2015 Best Newcomer
- Green Apple Awards 2016 for the Built Environment & Architectural Heritage – National Gold Winner Ireland
- RSUA Design Awards 2016 Sustainability Award
- Green Apple Awards 2016 for the Built Environment Educational Establishments – National Silver Winner UK & Ireland

20 RICS
15 Awards
Highly
Commended

Action Renewables
the renewable energy experts 

 Green Gown
Awards 2015



CREST Pavilion - Overview

First building in the UK and Ireland to have:

1. Passive House Certified



2. BREEAM excellent




3. Net Carbon Zero



Certificate
Certified Passive House Classic

Wicklow County Campus
Clairmont House, Rathnew
Co. Wicklow, A67 X566, Ireland

Authorised by:

Institute
Dr. Wolfgang Feist
64263 Darmstadt
Germany

Pavilion at Crest Centre, South West College
South West College, BT74 4EJ Enniskillen, United Kingdom/
Britain


Client	South West College Killyhevin Industrial Estate BT74 4EJ Enniskillen, United Kingdom/ Britain
Architect	Paul McAlester, The Barn Studio 644 Drummacarney Rd BT63 5LY Portlaoine, United Kingdom/ Britain
Building Services	Thomas Hanna & Co Ltd 74 Main St., Brookborough BT84 4EP Enniskillen, United Kingdom/ Britain
Energy Consultant	Paul McAlester, The Barn Studio 644 Drummacarney Rd BT63 5LY Portlaoine, United Kingdom/ Britain

Passive House buildings offer excellent thermal comfort and very good air quality all year round. Due to their high energy efficiency, energy costs as well as greenhouse gas emissions are extremely low.

The design of the above-mentioned building meets the criteria defined by the Passive House Institute for the "Passive House Classic" standard:

Building quality	This building	Criteria	Alternative criteria
Heating	Heating demand [kWh/m ²]	13 ≤ 15	-
	Heating load [W/m ²]	12 ≤ -	10
Cooling	Cooling + dehumidification demand [kWh/m ²]	- ≤ -	-
	Cooling load [kW/m ²]	- ≤ -	-
	Frequency of overheating (>25 °C) [%]	4 ≤ 10	-
	Frequency of excessively high humidity [%]	0 ≤ 20	-
Airtightness	Pressurization test result (n ₅₀) [1/h]	0.6 ≤ 0.6	-
Non-renewable primary energy (PE)	PE demand [kWh/m ²]	66 ≤ -	-
Renewable primary energy (PER)	PER demand [kWh/m ²]	30 ≤ 60	60
	Generation (reference to ground area) [kWh/m ²]	0 ≤ -	-

The associated certification booklet contains more characteristic values for this building.


Certifier: Tomas O'Leary, Passive House Academy (PHA)

www.passivehouse.com 1460C-1460D_MosArt_PH_20161109_TOK

Certification Documentation

Specific building characteristics with reference to the treated floor area	PHI 0.8		Criteria	Alternative criteria	Fulfilled?	
	Value	Limit				
Space heating	Heating demand kWh/m ²	13	≤	15	10	yes
	Heating load W/m ²	12	≤	-	10	yes
Space cooling	Cooling & dehumidification demand kWh/m ²	-	≤	-	-	-
	Cooling load kW/m ²	-	≤	-	-	-
	Frequency of overheating (>25 °C) %	4	≤	10	-	yes
	Frequency of excessively high humidity (> 65 g/kg) %	0	≤	20	-	yes
Airtightness	Pressurization test result n ₅₀ 1/h	0.6	≤	0.6	-	yes
Non-renewable Primary Energy (PE)	PE demand kWh/m ²	66	≤	-	-	-
Primary Energy (PER)	PER demand kWh/m ²	30	≤	60	60	yes
	Generation of renewable energy kWh/m ²	0	≤	-	-	-

* Credit limit: 0.8 kWh/m² · h for requirement

This building has been awarded the **Quality Approved Passive House**

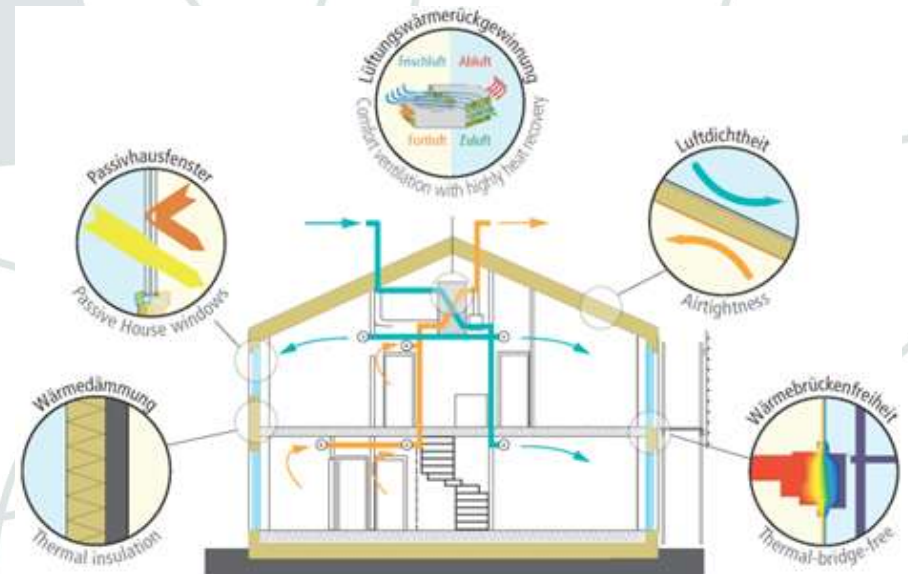
certified by MosArt Ltd.

This certification is based solely on the design data and specifications provided to MosArt Ltd by the client for the purpose of certification. MosArt Ltd has checked and approved the building's energy balances according to these data.

This certification does not cover quality assurance of the construction work or design implementation. MosArt Ltd hereby takes no responsibility for any faults in the above.

Five Passive House Principles

1. **Super Insulation**
2. **Thermal Bridging**
3. **Triple Glazed advanced Windows**
4. **Airtightness**
5. **Mechanical Ventilation with Heat Recovery**

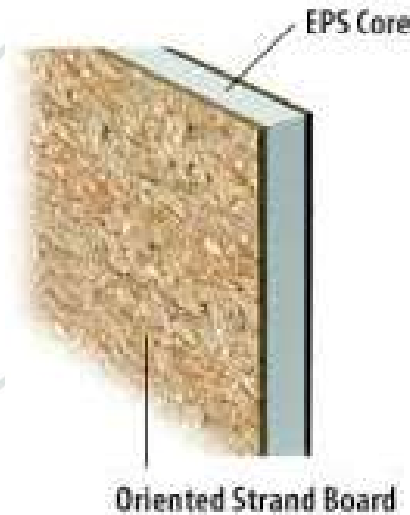


1. SUPER INSULATION

Passive House verification U-VALUES OF BUILDING ELEMENTS

- Floor U-Value: **0.086** W/(m²K)
- Wall U-Value: **0.124** W/(m²K)
- Roof U-Value: **0.160** W/(m²K)

	Passive House	Republic of Ireland	Northern Ireland
Floor – U Value	0.15 W/m ² K	0.21 W/m ² K	0.25 W/m ² K
Wall – U Value	0.15 W/m ² K	0.21 W/m ² K	0.30 W/m ² K
Roof – U Value	0.15 W/m ² K	0.16 W/m ² K	0.20 W/m ² K



Passive House verification
U-VALUES OF BUILDING ELEMENTS

Building: Verillion at Crest Centre

Model of space building element type and all air spaces = Secondary calculation to the right

Assembly No.	Building element description	Area (m ²)	U-Value (W/m ² K)	Thermal Transmittance (W/K)	Percentage of Total Area	Percentage of Total U-Value	Total U-Value (W/m ² K)
1	Concrete Slab Floor	1,000	0.150	150	100%	100%	0.150
2	Wall	1,000	0.124	124	100%	100%	0.124
3	Floorboard	1,000	0.086	86	100%	100%	0.086
4	Roof	1,000	0.160	160	100%	100%	0.160
U-Value: 0.086 (Floor)							47.5

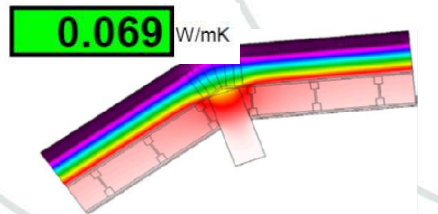
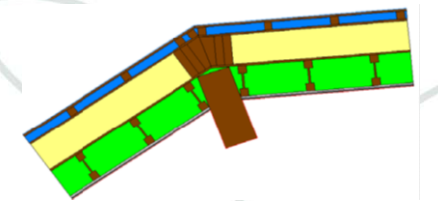
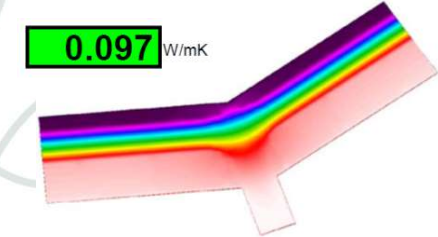
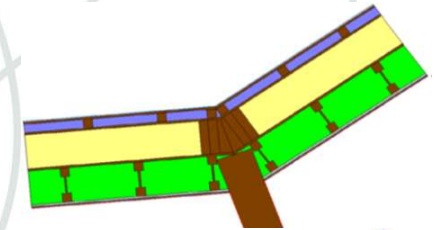
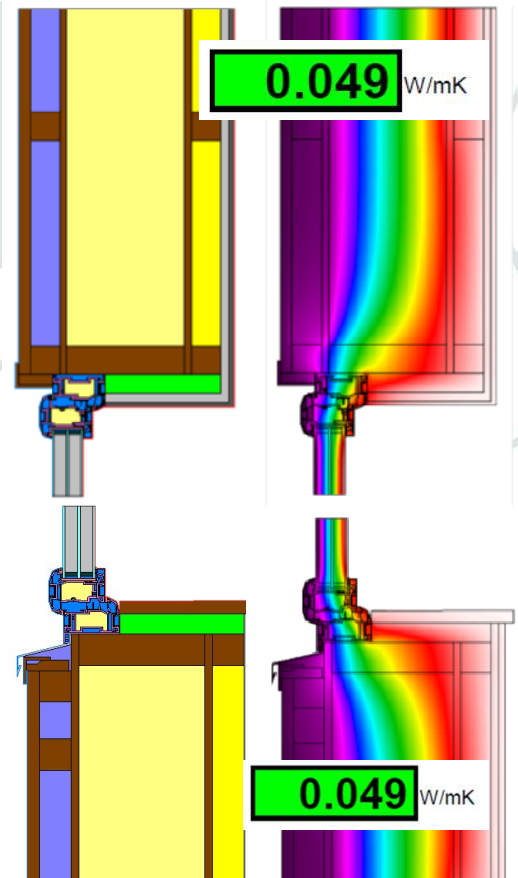
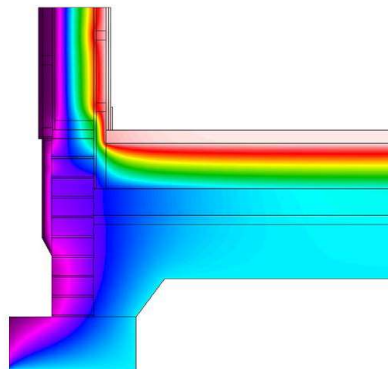
Assembly No.	Building element description	Area (m ²)	U-Value (W/m ² K)	Thermal Transmittance (W/K)	Percentage of Total Area	Percentage of Total U-Value	Total U-Value (W/m ² K)
1	Partition Wall	1,000	0.124	124	100%	100%	0.124
2	Roof	1,000	0.160	160	100%	100%	0.160
3	Floorboard	1,000	0.086	86	100%	100%	0.086
4	Concrete Slab Floor	1,000	0.150	150	100%	100%	0.150
5	Roof	1,000	0.160	160	100%	100%	0.160
U-Value: 0.124 (Wall)							28.9

Assembly No.	Building element description	Area (m ²)	U-Value (W/m ² K)	Thermal Transmittance (W/K)	Percentage of Total Area	Percentage of Total U-Value	Total U-Value (W/m ² K)
1	Partition Wall	1,000	0.124	124	100%	100%	0.124
2	Roof	1,000	0.160	160	100%	100%	0.160
3	Floorboard	1,000	0.086	86	100%	100%	0.086
4	Concrete Slab Floor	1,000	0.150	150	100%	100%	0.150
5	Roof	1,000	0.160	160	100%	100%	0.160
U-Value: 0.160 (Roof)							43.9

2. THERMAL BRIDGING

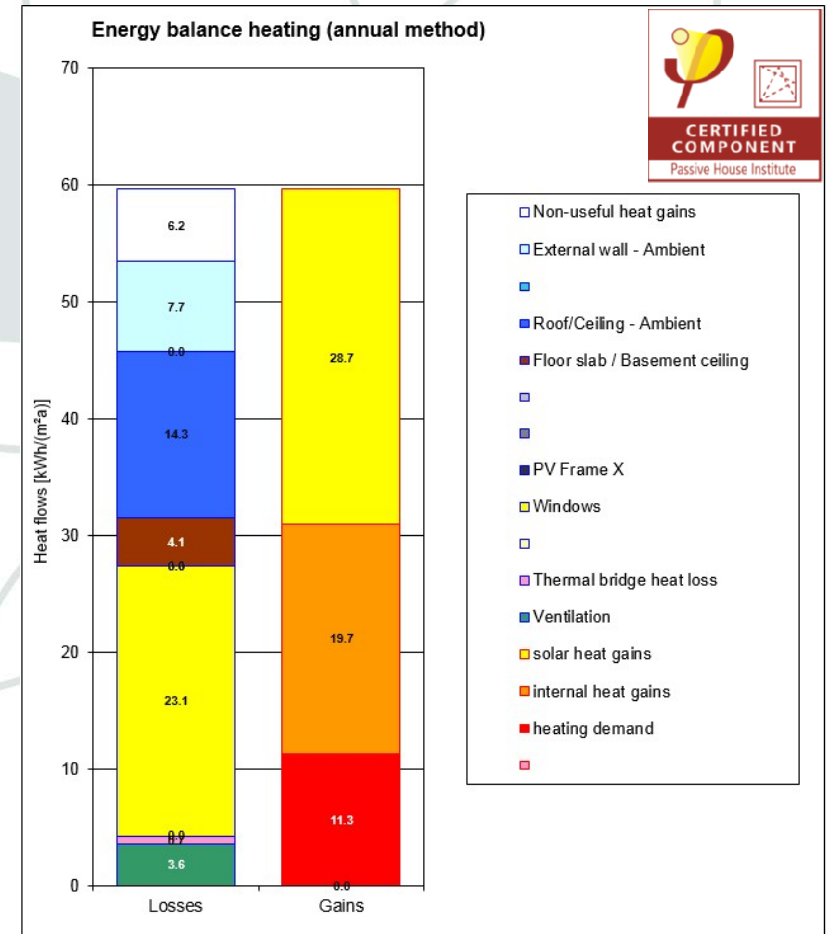
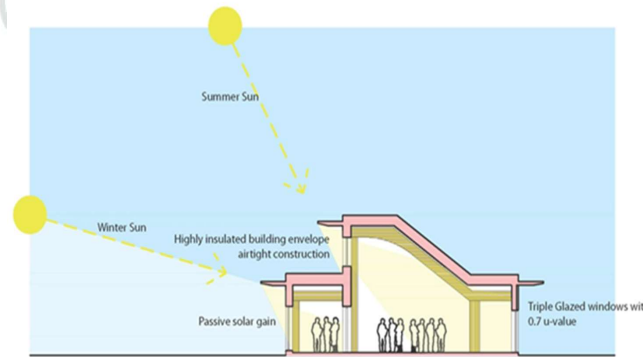
Thermal bridge heat loss for the CREST building

- 1081 Meters of linear thermal bridging
- Total heat loss of 29.0 W/K
- In the Energy Balance Thermal bridging accounts 0.7 kWh/m²/per year



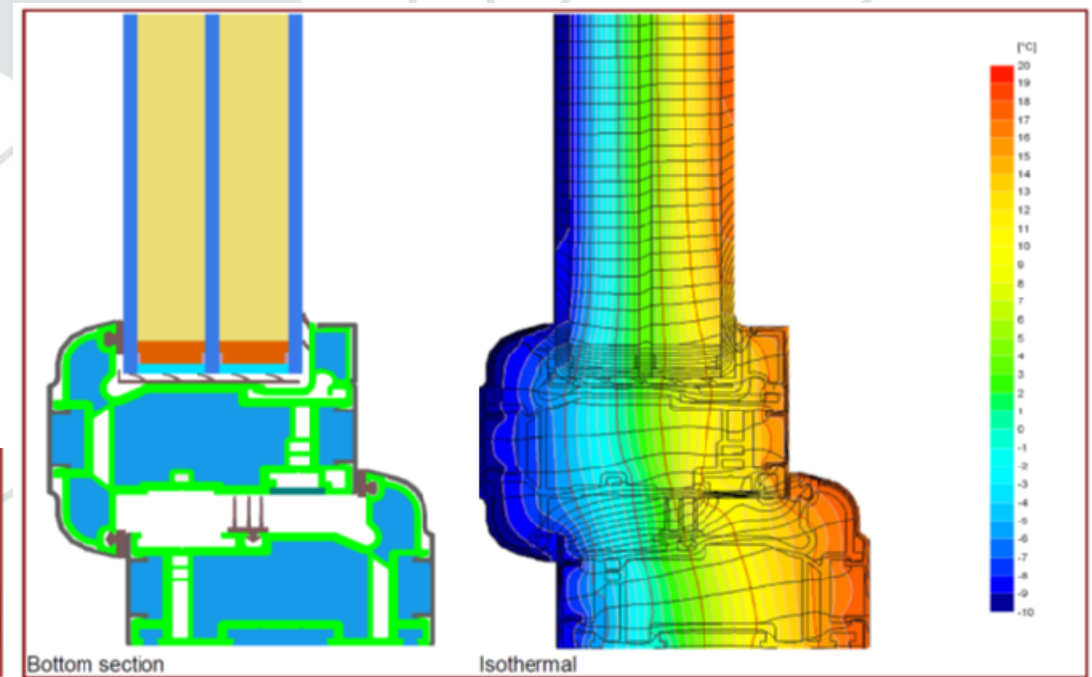
3. WINDOWS

- Largest area of glazing on the building faces south to maximise solar heat gain.
- The actual solar gain according to the PHPP is 28.9 kWh/m²/ per year
- The Windows are actuator controlled windows from the BMS which can provide night time cooling in the summer along with fresh air requirements controlled via co² and RH sensors.



3. WINDOWS

- PassiV AluP+ Window
- U Value 0.76 W/m²K Passive house requirements (0.85 W/m²K)
- Triple glazed window
- Filled with Argon gas
- Warm edge spacer
- Low E soft coat emissivity glass.



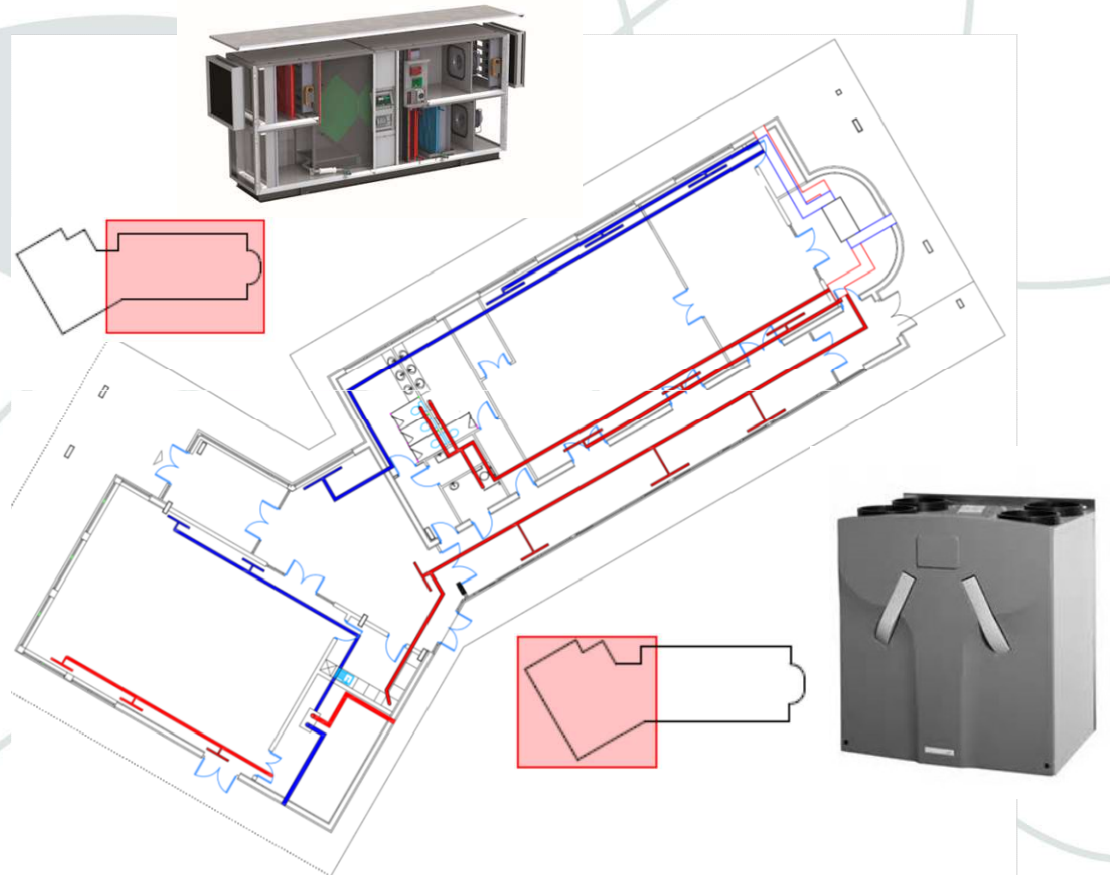
4. AIRTIGHTNESS

- Final test on building 0.6 ac/ per hour, Passive house requirement 0.6 ac/ per hour
- High performance and multi-purpose coated non-woven membrane
- ROI Regulations 6.23 ac per hour PH 10 tim
- NI regulations 8.90 ac per hour PH 15 times



5. MHRV

- Ventilation is catered for by using two heat recovery units which are linked to the BMS system.
- The Building Management System (BMS) is linked to an external weather station, and provides relevant information based on both internal and external readings, which optimises the buildings performance.



5. MHRV

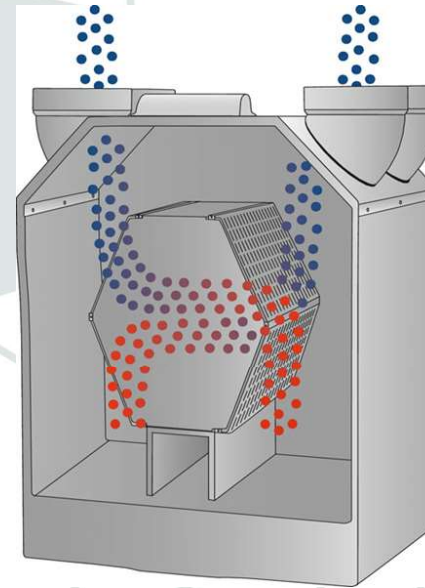
- **Passive house certified product 84% Efficiency Heat recovery**
- **System balanced at Supply and Extract at 81 L/S**

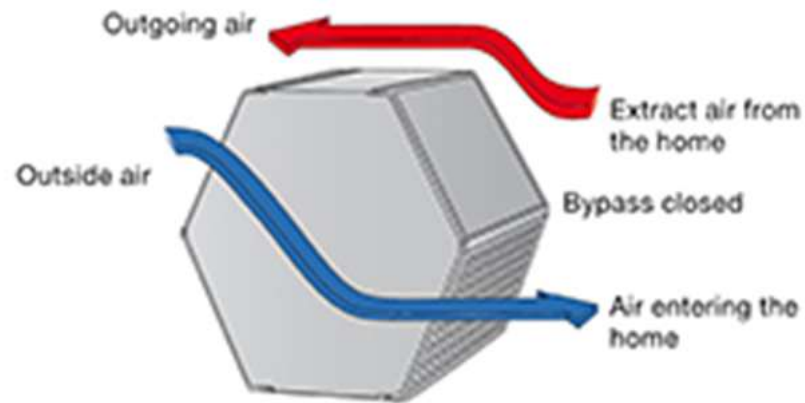
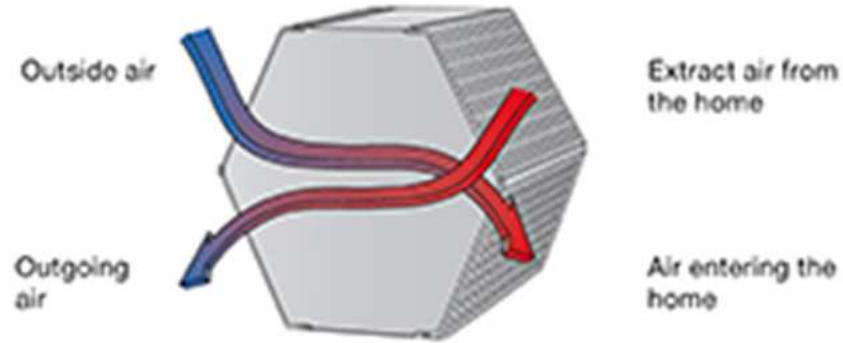
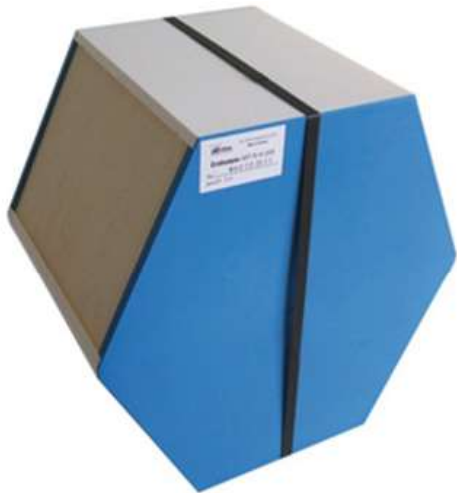
Electric power consumption

0.31 Wh/m³

$\eta_{HR,eff}$

84%

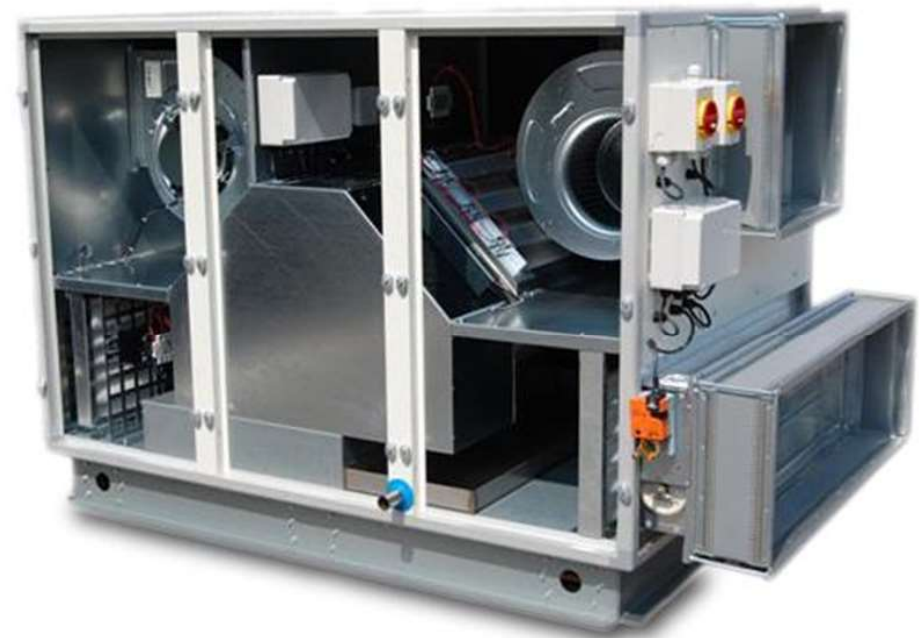




Outdoor Air filter F7
Extract Air filter G4

5. MHRV

- **Passive house certified product 80% Efficiency Heat recovery**
- **System balanced at Supply and Extract at 210 L/S**



**Electric power
consumption
0.45 Wh/m³
 $\eta_{HR,eff}$ 80%**

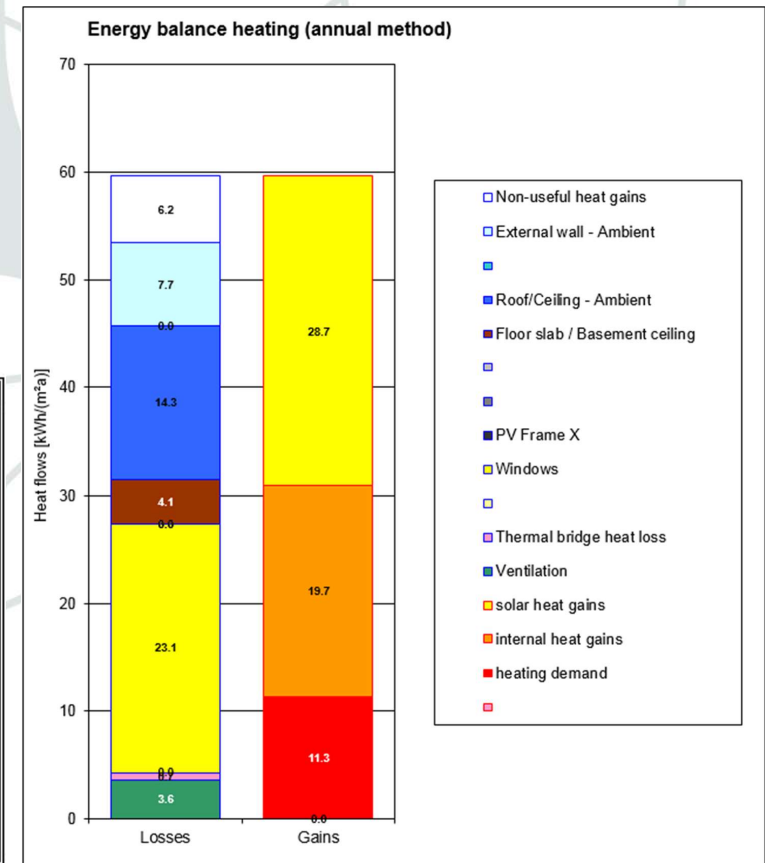


PHPP Energy Balance

- PHPP figures for the CREST building
- Only the red section of the graph is heating
- The rest is free heating from the sun and internal heat gains

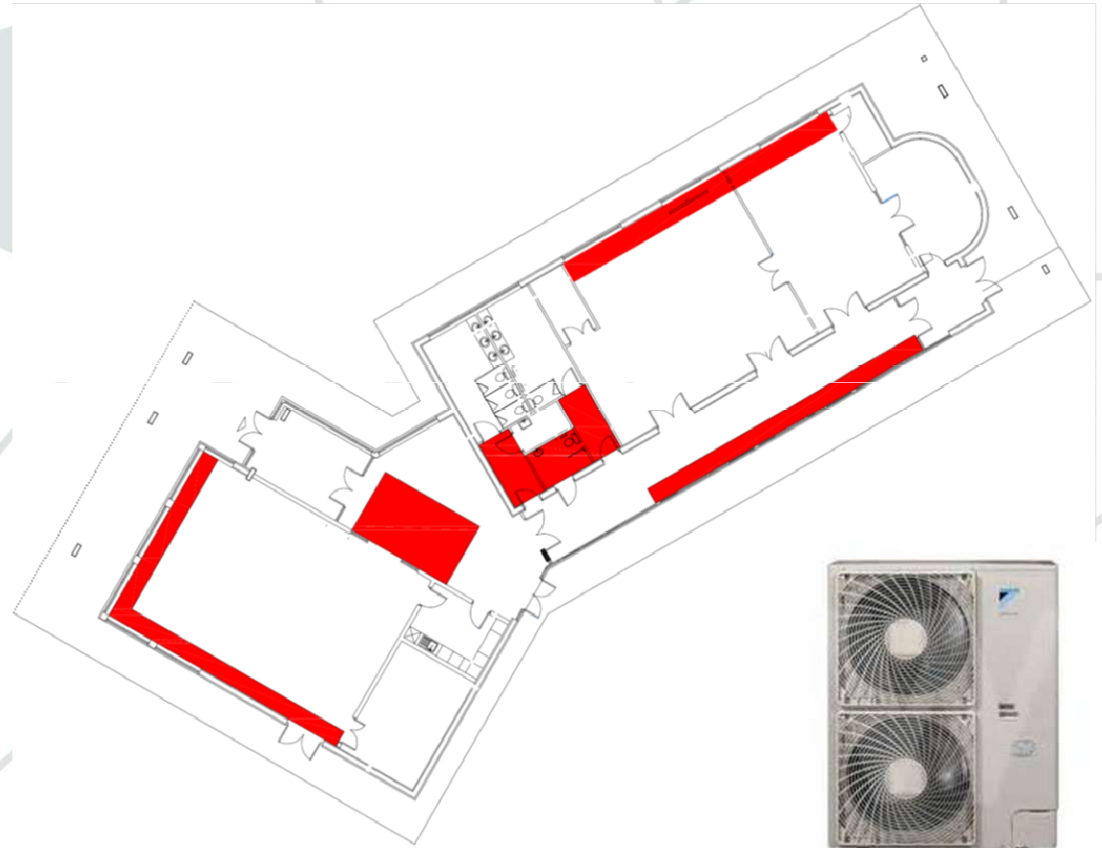
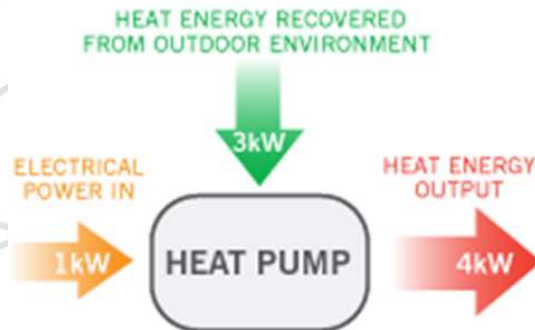
Specific building characteristics with reference to the treated floor area						
				Criteria	Alternative criteria	Fullfilled? ²
Space heating	Treated floor area m ²	455.4				
	Heating demand kWh/(m ² a)	13	≤	15	-	yes
	Heating load W/m ²	12	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-	≤	-	-	-
	Cooling load W/m ²	-	≤	-	-	-
	Frequency of overheating (> 25 °C) %	4	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n ₅₀ 1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m ² a)	66	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m ² a)	30	≤	60	60	
	Generation of renewable energy kWh/(m ² a)	0	≥	-	-	yes

² Empty field: Data missing; "-" : No requirement



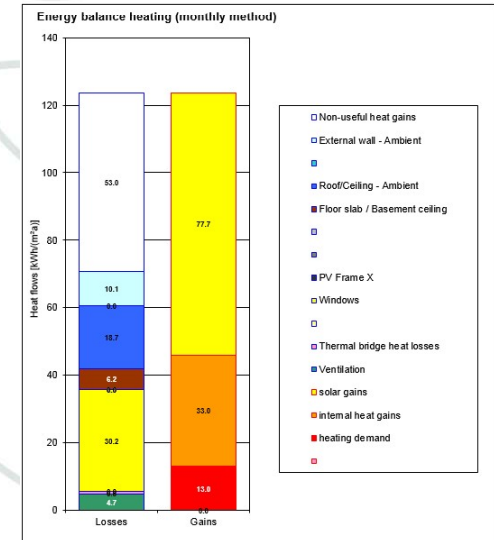
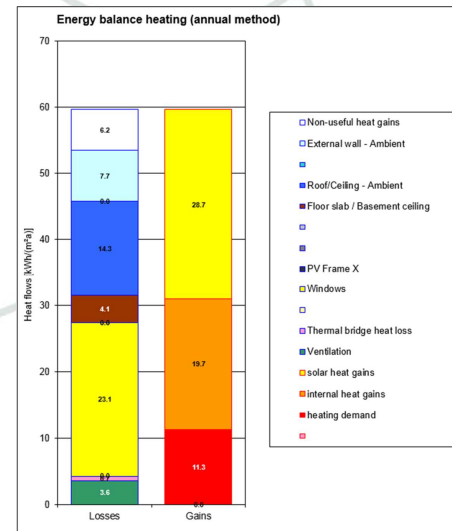
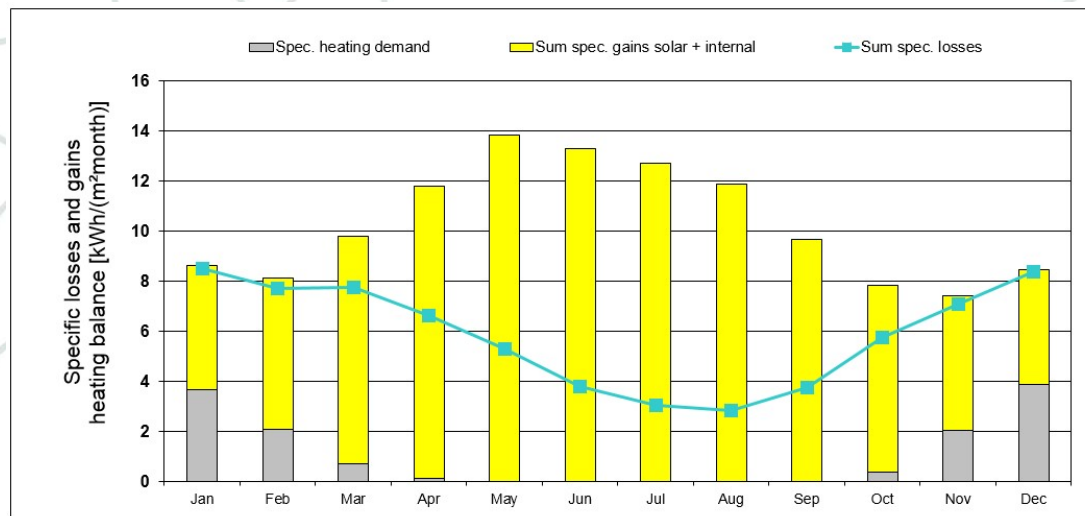
Air to Water Heat Pump

- Under floor heating is located in strategic areas
- Capacity 11.0kW
- PHPP predicted Space Heating supplied by Heat Pump 5902 kWh/a
- Electric Consumption 2231 kWh/a
- SPF 2.66

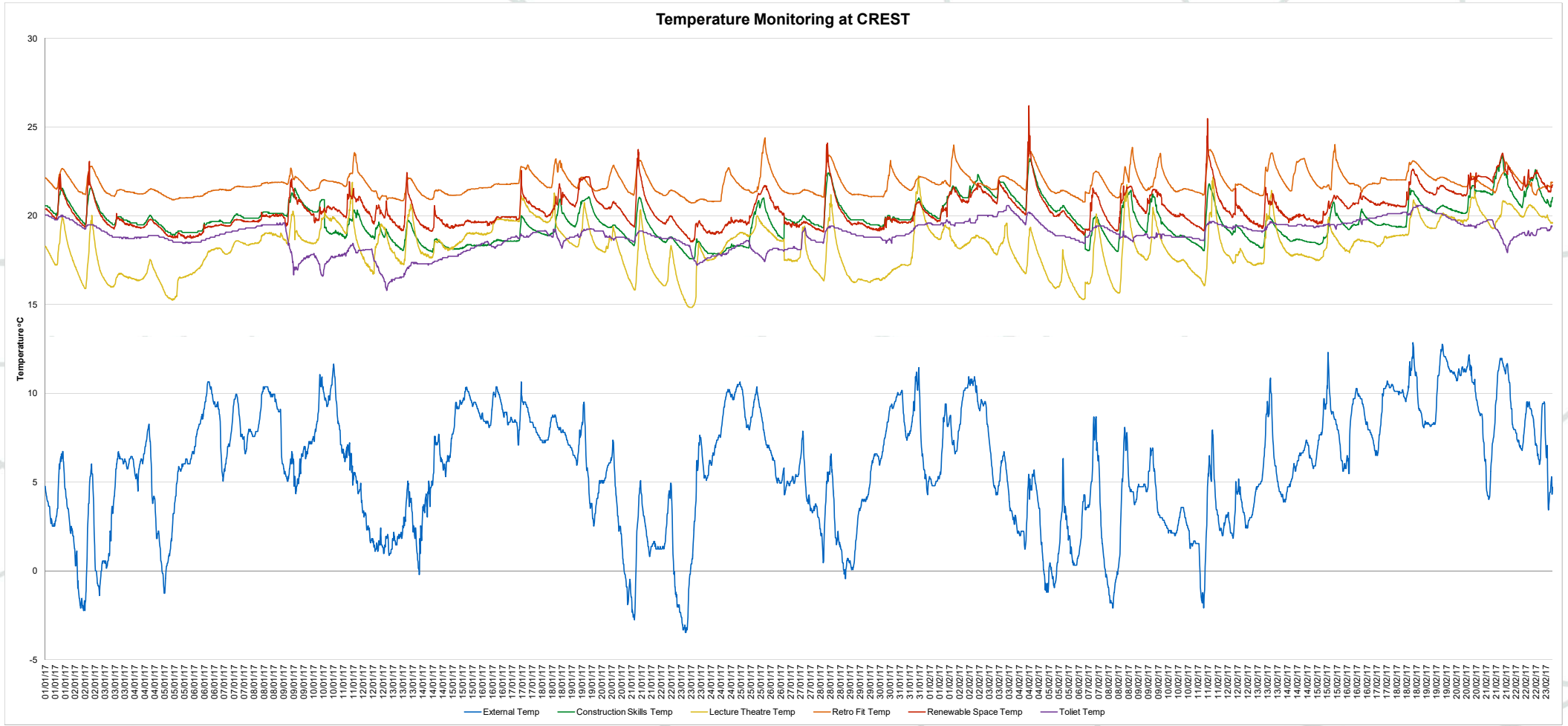


Post Occupancy Monitoring

- **Monthly method 13.0 kWh/(m²a) or 5,902 kWh/a. •South West College Average 103 kWh/(m²a)**
- **Annual method 11.3 kWh/(m²a) or 5,138 kWh/a. •Heating costs £7,030/a for 455m² Building**
- **Year 1 recorded 11.6 kWh/(m²a) or 5,283 kWh/a. •Year 1 cost £792.45**
- **Year 2 recorded 12.1 kWh/(m²a) or 5,488 kWh/a. •Year 2 cost £823.20.**

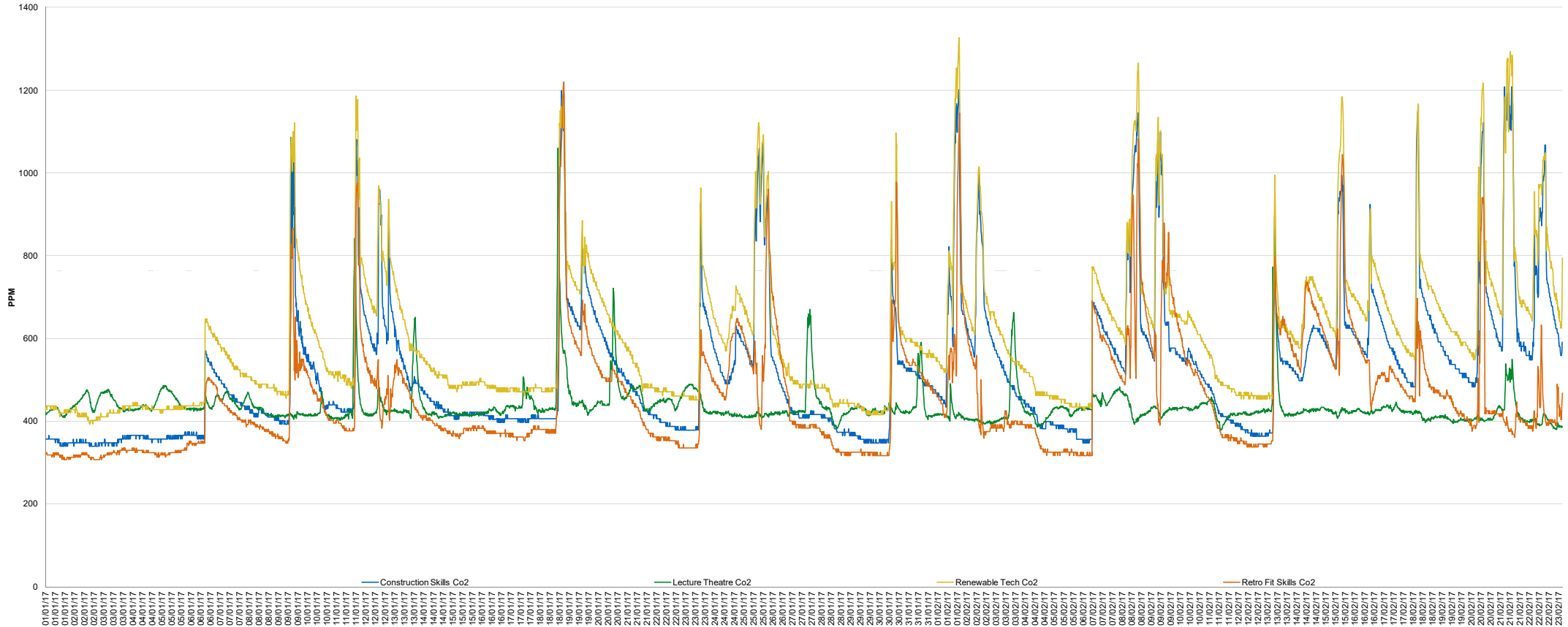


Post Occupancy Monitoring

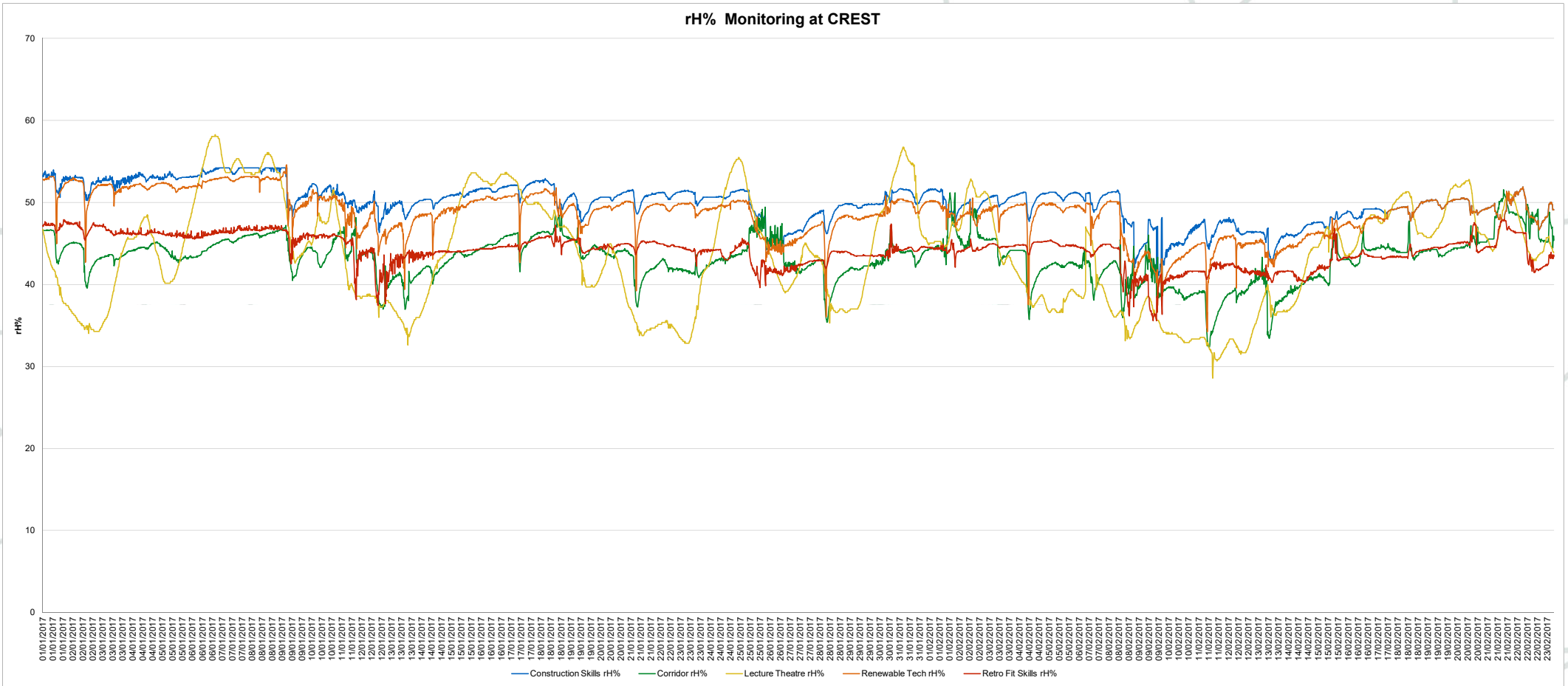


Post Occupancy Monitoring

CO₂ Monitoring at CREST



Post Occupancy Monitoring



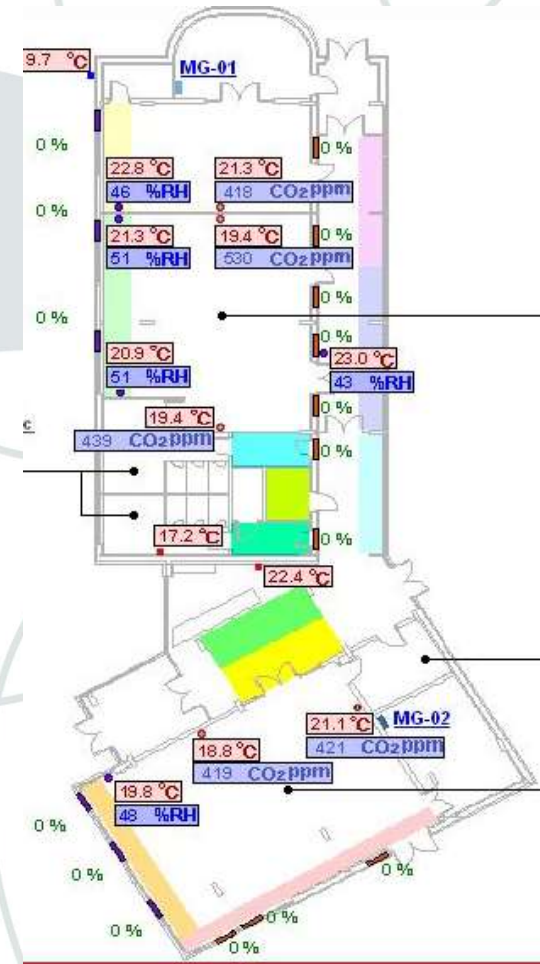
Post Occupancy Monitoring

Room	Temperature Average
Construction Skills	19.73
Lecture Theatre	18.25
Retrofit Skills	21.78
Renewable Skills	20.34
Toilet	18.89
Corridor	22.4
Centre Average Temp	20.23

External Average Temperature 5.8°C

Room	Co2
Construction Skills	521
Lecture Theatre	434
Retrofit Skills	455
Renewable Skills	601
Centre Average	502.75

Room	RH%
Construction Skills	49.9
Lecture Theatre	43.5
Retrofit Skills	48.6
Renewable Skills	44
Centre Average	46.5



CREST Pavilion - BREEAM



BREEAM® UK Code for a Sustainable Built Environment
www.breem.org

Final Certificate
This is to certify that:
CREST
South West College
Technology Skills Centre
Killyhevlin Industrial Estate
Lough Yoan Road, Fermanagh
BT74 4EJ

has been assessed to:
BREEAM New Construction 2011: Education (Fully Fitted)

by a licensed assessor for **South West College** and has achieved a score of **76.6%**
Excellent ★★★★★

Certificate Number: **BREEAM-0059-6965** Issue: **01**

19 April 2016 Date of Issue <i>Richard Moore</i> <small>Signed on behalf of BRE Global Ltd.</small>	Ecoteric SDS Limited Assessor Company Richard Moore Licensed Assessor
Gavin Dunn Director, BREAM	RM56 Assessor Number
SWC, Cavan Innovation & Technology Centre, IT Sligo, Dumfries and Galloway College Developer	P J Treacy & Sons Ltd Principal Contractor
Paul McAllister Architect	Giffin Hughes Project Management
Cuilinn Group Ltd Building Services	MosArt Ltd Passive House Certifier
Dimensions LOM Coordinator	George Dawson Ltd Structural Engineer
Lester Acoustics Acoustician	

This certificate is issued by BRE Global Ltd to the Licensed Assessor named above based on their assessment of data provided by the client and verified at the time of Assessment.
This certificate remains the property of BRE Global Ltd and is issued subject to terms and conditions - visit www.breem.com/conditions
To check the authenticity of this certificate visit www.greenbook.co.uk/verify, scan the QR Tag or contact us: 01206 310000 ext 1033 (24 hr helpline)
BREAM is a registered trademark of BRE (see Building Research Establishment Ltd. Community Trade Mark 0278917)

bre

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CREST Pavilion - BREEAM

BREEAM New Construction 2011: Education (Fully Fitted)

Overall Score: 76.6%
Rating: Excellent



Category Scores	0	10	20	30	40	50	60	70	80	90	100	
Management	64											
Health and Wellbeing	79											
Energy	80											
Transport	27											
Water	100											
Materials	62											
Waste	83											
Land Use and Ecology	80											
Pollution	69											
Innovation	50											



Solar PV

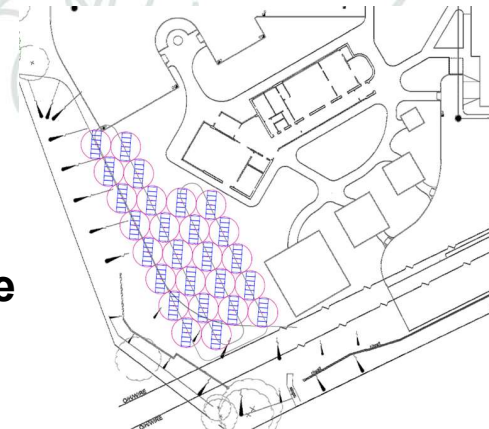
In order to become classified as carbon neutral all the building mechanical and electrical services are provided electrically is make best use of the power.

The Tracking System maximizes energy production by 30% to 40%

45 kW system

4 kW wall mounted

49 kW Capacity on Site



 **QBotix**
Solar powered by robotics

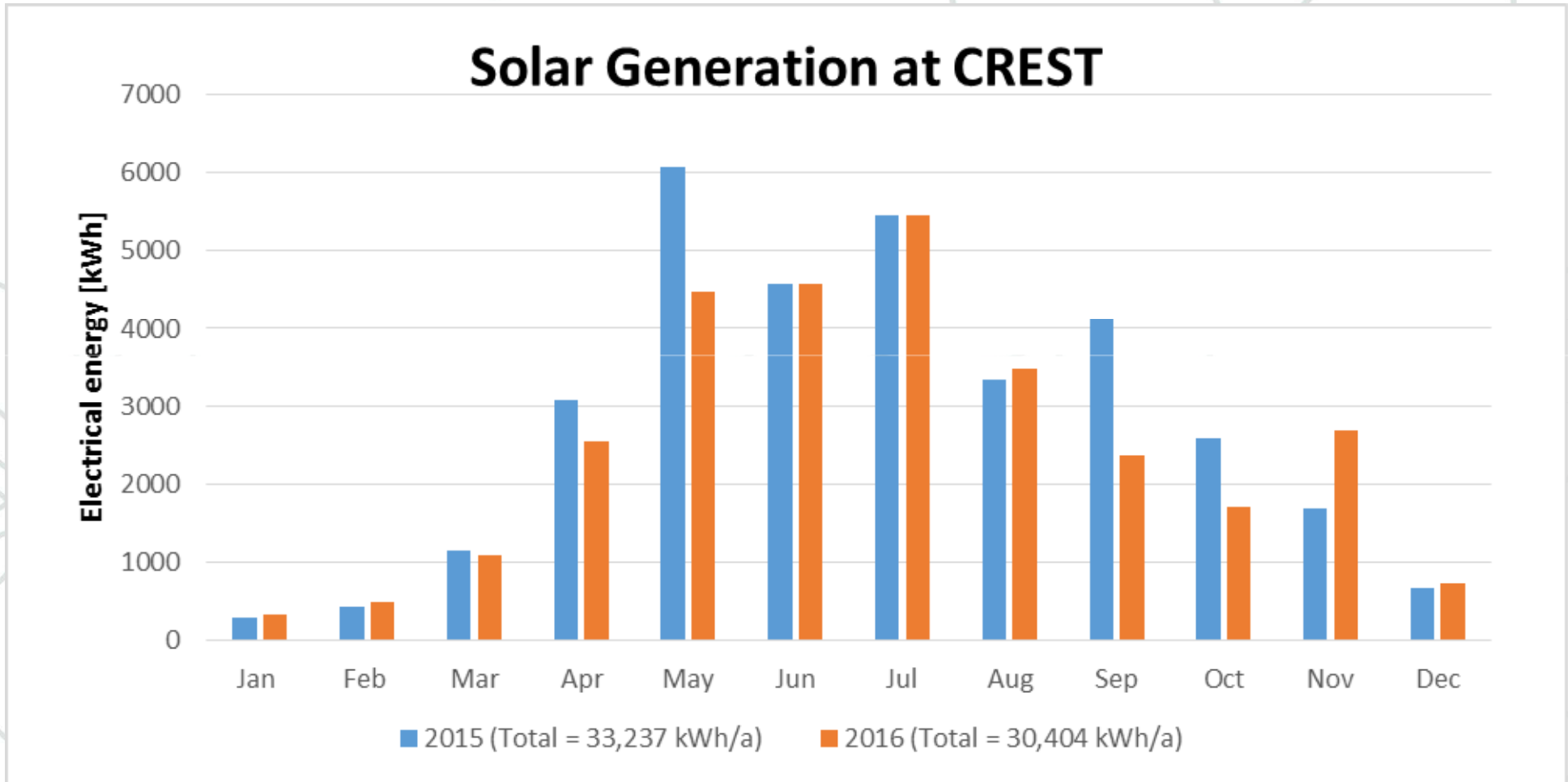
QBotix is the pioneering company to use mobile, autonomous and rugged robots in the operation of solar power plants. Our goal is to make solar energy competitive with conventional energy through balance of system innovations.



The Robotic Tracking System™ (RTS)



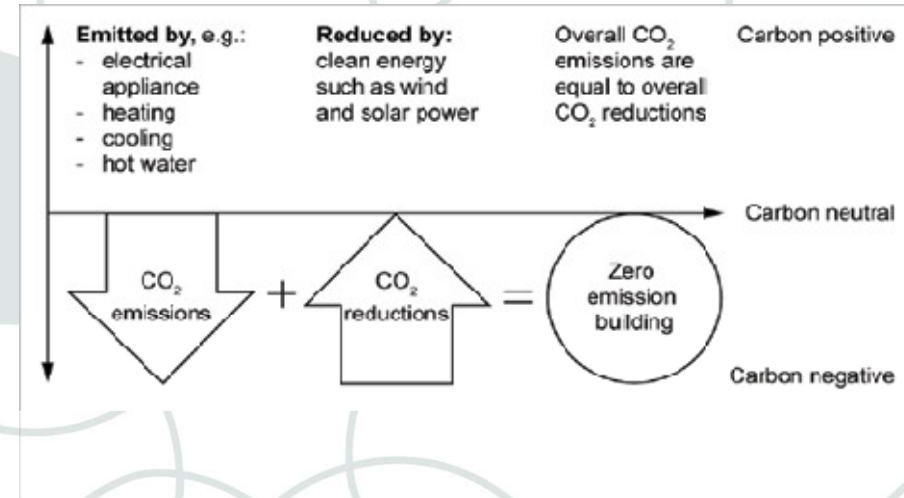
Solar Monitoring



Post Occupancy Monitoring

Specific building characteristics with reference to the treated floor area						
	Treated floor area m ²			Criteria	Alternative criteria	Fullfilled? ²
Space heating	Heating demand kWh/(m ² a)	455.4	≤	15	-	yes
	Heating load W/m ²	12	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-	≤	-	-	-
	Cooling load W/m ²	-	≤	-	-	
	Frequency of overheating (> 25 °C) %	4	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n ₅₀ 1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m ² a)	66	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m ² a)	30	≤	60	60	
	Generation of renewable energy kWh/(m ² a)	0	≥	-	-	yes

² Empty field: Data missing; '-': No requirement



Primary Energy demand 66 kWh/(m²a) = **30030 kWh/a**

Year 1 Solar Generation 33,237 kWh/a = **3207 kWh/a** +

Year 2 Solar Generation 30,404 kWh/a = **374 kWh/a** +



Battery Energy Storage

The battery power rating (nominal) of 10kW

Heat Mats & Temperature Control

Arbarr LiFePO4 Battery Packs

BMS System



eckko



Project Costs

Substructure	71,227.36
Frame, SIPS Panels & External Wall Cladding	291,632.50
Roof	184,154.30
Windows & Doors	58,959.15
Internal Partitions	14,623.00
Internal Doors	22,685.00
Floor Finishes	36,119.55
Ceiling Finishes	6,262.80
Wall Finishes	6,961.80
Fixtures & Fittings	51,663.00
Services	228,831.00
Total Building Cost	973,119.46

Total £973,119.46 / £2069m²

PV System	90,000.00
Battery Storage	70,000.00

Total £1,133,119.46 / £2138m²

Lessons Learned

- **Air tightness on site was the biggest challenge – Contractor no prior experience.**
 - **Corridor has a little to much solar gain tends to overheat in spring – reduced heating demand**
 - **For a building like this, training in the use of the BMS is essential.**
 - **BMS system is problematic in particular the automatic windows.**
 - **We would advocate less sophisticated controls.**
 - **Building performance as modelled by PHPP.**
 - **PHPP provides a robust design tool for accurate design.**
 - **Post occupancy research to date provides evidence of excellent IAQ**
 - **Passive House building standard is an excellent vehicle for achieving zero energy buildings.**
-

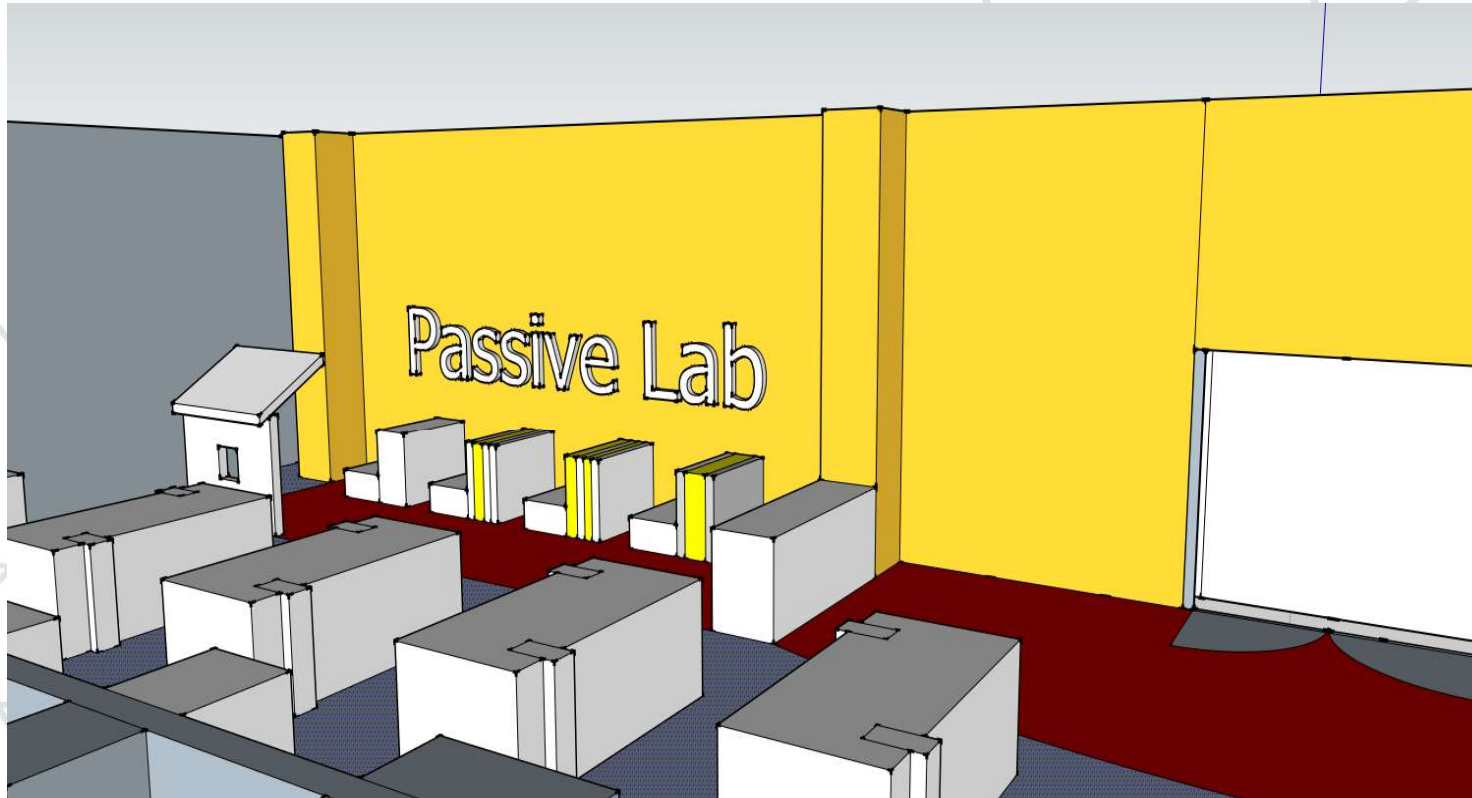
Centre of Excellence



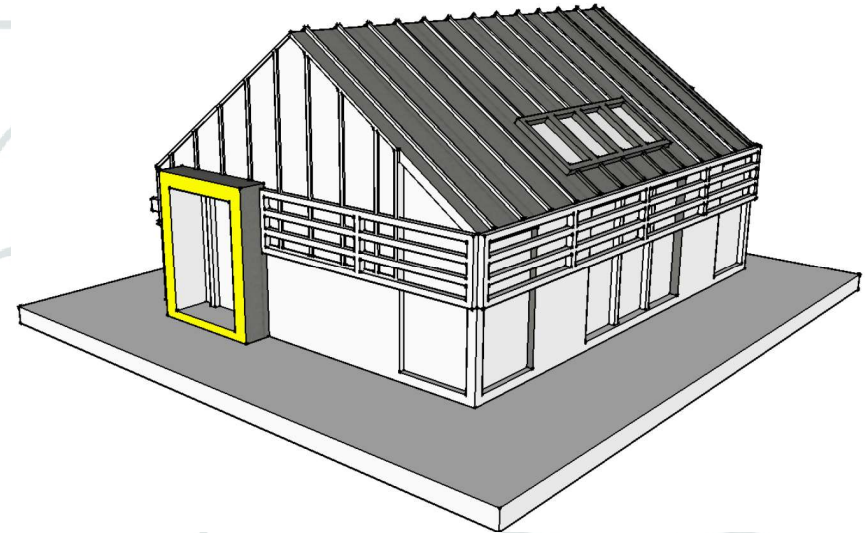
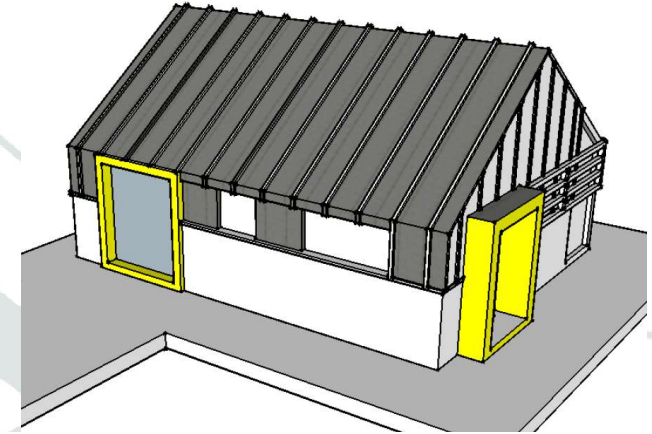
- Summer 2016 CEPHD Course completed 3rd June 11 students
- Summer 2016 CEPHT Course completed 17th June 16 students
- Spring 2017 CEPHT Course completed 18th February 13 Students
- Spring 2017 CEPHD Course due to be completed 11th March 11 Students





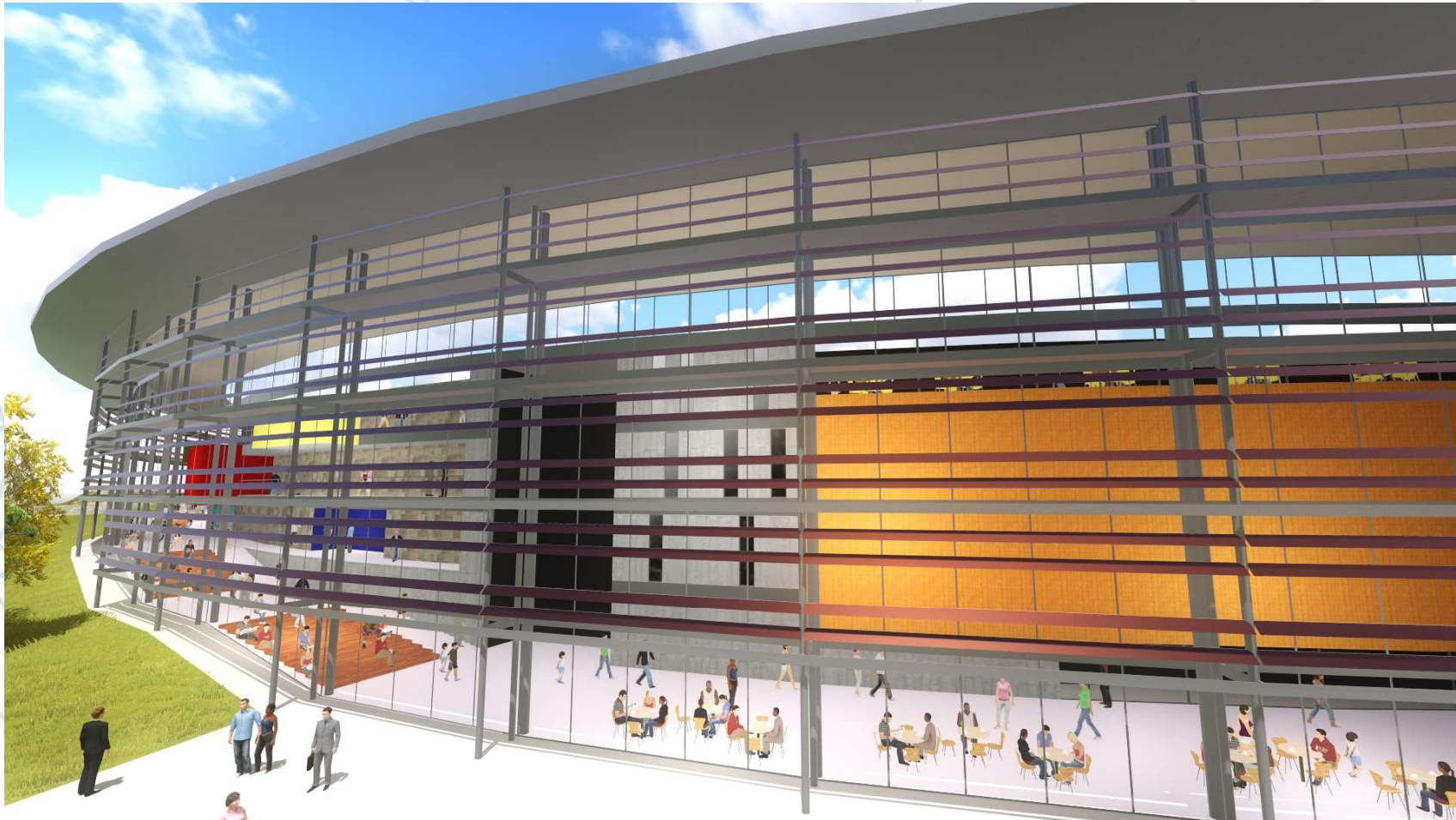


NZEB Retrofit Project



Erne Campus Project





Erne Campus Project

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**SOUTH PASSIVE
PACIFIC HOUSE 17**
CONFERENCE & TRADE SHOW



THANK YOU

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**South West
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 Queen's University
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