TOWARDS A SUSTAINABLE ENVIRONMENT:

Green buildings and renewable energy options.
Hundreds of the world's top renewable energy experts, researchers and academics converged on the 11th World renewable energy congress in Abu Dhabi between September 25–30, 2010.

More than 600 participants from 100 countries presented papers and discussed major issues related to climate change and environment and green technology. The congress topics included: Biomass conversion technology; fuel cell, hydrogen, and intelligent energy systems; geothermal applications; low energy architecture; ocean energy; photovoltaic technology; radiation and solar materials; solar thermal; wind energy; energy and gender-equitable development; and policy and strategy.

The event is supported by a number of international agencies, including the United Nations and the European commission. Shane Colclough of Ulster University made a much appreciated presentation of the Scandinavian Homes project with seasonal store of solar heat in a super passive house. To read his presentation, please go to the next page.

About the World Renewable Energy Congress / Network (WREC/WREN) WREN is a major non-profit organisation registered in the United Kingdom with charitable status and affiliated to UNESCO. It maintains links with many United Nations, governmental and non-governmental organisations. Established in 1992 during the second World Renewable Energy Congress in Reading, UK, WREN is one of the most effective organisations in supporting and enhancing the utilisation and implementation of renewable energy sources that are both environmentally safe and economically sustainable. This is done through a worldwide network of agencies, laboratories, institutions, companies and individuals, all working together towards the international diffusion of renewable energy technologies and applications. Representing most countries in the world, it aims to promote the communication and technical education of scientists, engineers, technicians and managers in this field and to address itself to the energy needs of both developing and developed countries.

www.wrenuk.co.uk

The Passiv Haus combined with Solar Energy Store – Critical Success Factors

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Presentation Outline

- Theory
  - What is a Passive House?
  - Method of analysis
  - Winter space heating demand and Solar Resource
- Practice
  - The Passive House Installation being monitored
  - Inter Seasonal Thermal Energy Storage considerations
- Summary & Conclusion

Matching Space Heating Demand and Solar Resource

The Theory

Passiv Haus: The Home of the Future?

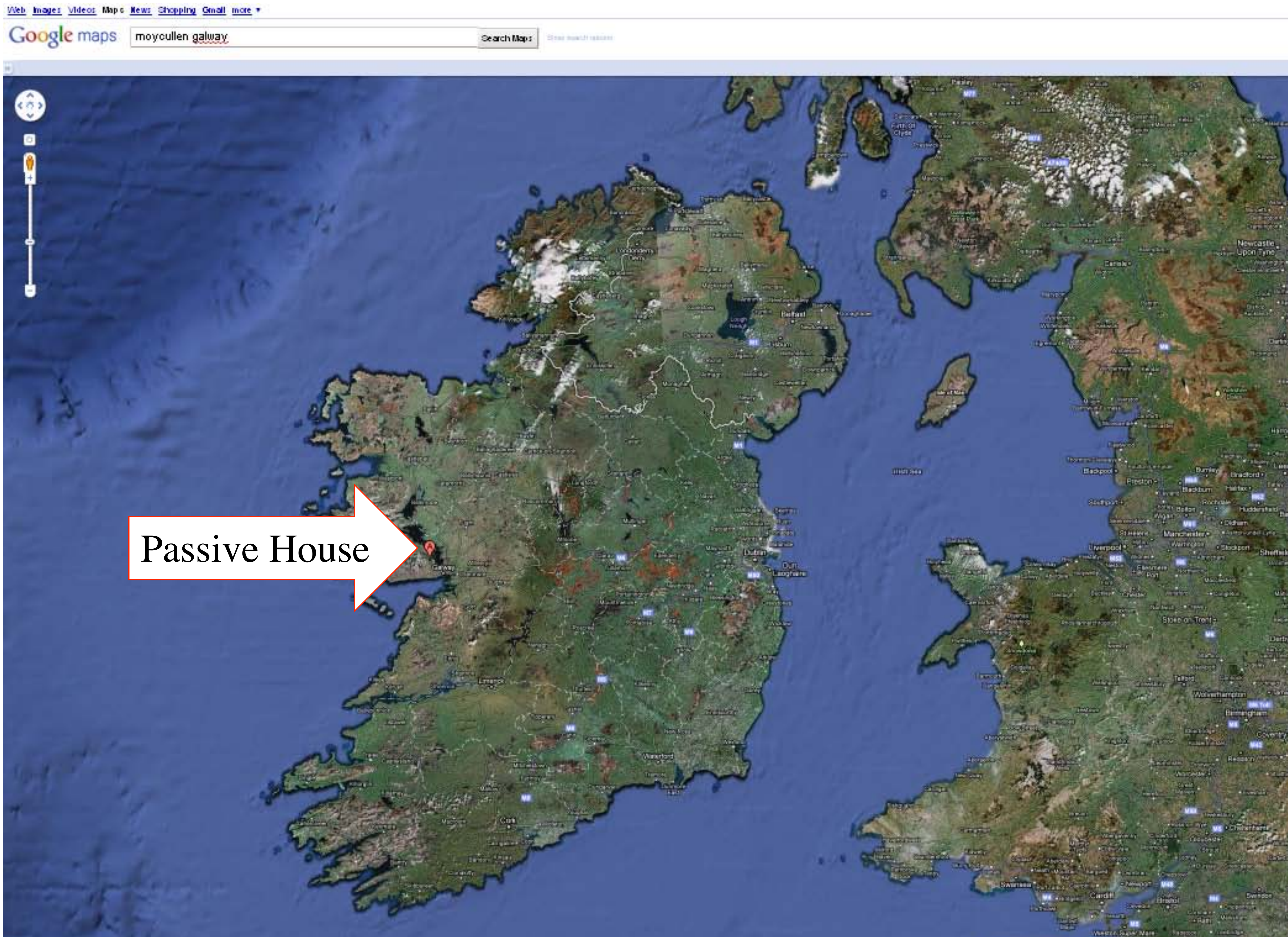
Background

- Originated in Sweden in 1988
- Concept tested in Darmstadt Germany in 1991
- PassivHaus Institut founded in 1996 by Dr Wolfgang Feist
- Over 30,000 built worldwide

Requirements:

- Specific Space Heat Demand max. 15 kWh/(m^2a),
- Peak load <10W/m^2
- Pressurisation Test Result n50 max. 0.6 air changes per hour
- Entire Specific Primary Energy Demand max. 120 kWh/(m^2a) incl. domestic electricity.

Location of Passive House


Web Images Videos Maps News Shopping Gmail more
Google maps
moycullen galway
Search Maps
Passive House
Belfast
Dublin
Galway
Newcastle Upon Tyne
Liverpool
Manchester
Blackpool
Preston
Stoke on Trent
Birmingham
Cardiff
Swansea
Wolverhampton

Method of analysis

- Passive House Planning Package (PHPP) based analysis
- Validated PHPP model for actual Passiv Haus constructed in Galway validated by German Passiv Haus Institute
- Space Heating from "Monthly Method" worksheet
- Monthly solar space heating fraction calculated
  - SolarDHW worksheet gives kWh/m^2
  - PHPP Conversion factor, 6m^2 Solar array
- House "Located" in various cities & conclusions drawn

Dublin Vs Frankfurt

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Dublin					**Specific Space Heating Demand**	**8.5**	**Whr/m2/a**				**Frequency of Overheating**	**0**	**Ef**
				Months requiring heating	**10**							**No. of mths where solar contributes >10% of space htg reqt**	**10**
		Months requiring >10kWhr htg			**8**								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Reqts	425	366	213	65	13	1	0	0	1	35	276	436	1832
Incident Solar/m2	38	50	96	135	161	151	162	133	109	73	41	26	1174
Net Solar Available	79	104	200	281	334	314	337	277	226	152	84	55	2444
Surplus/deficit	-346	-262	-13	215	321	313	337	276	225	117	-191	-381	612
% of Dmd met	19	28	94	429	2591	22564	0	0	16950	439	31	13	133

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Frankfurt					**Specific Space Heating Demand**	**16**	**Whr/m2/a**				**Frequency of Overheating**	**0**	
				Months requiring heating	**8**							**No. of mths where solar contributes >10% of space htg reqt**	**5**
				Months requiring >10kWhr htg	**7**								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Reqts	943	594	356	53	2	0	0	0	0	76	513	890	3426
Incident Solar/m2	34	65	96	133	155	145	162	150	120	77	43	25	1206
Net Solar Available	72	134	200	277	323	302	338	313	249	161	89	52	2511
Surplus/deficit	-871	-459	-156	224	321	302	338	313	249	85	-424	-838	-915
% of Dmd met	8	23	56	524	0	0	0	0	0	212	17	6	73

Solar Fraction for Galway PH

Location	Specific Space Heating Demand {kWh/m2/a}	Number of Months requiring Space Heating	Number of months requiring >10kWh space heating	Number of Months with Solar Fraction >10%	Surplus (+) / Deficit (-) of Solar Energy for Space Heating {kWh}	Percentage of Space Heating Demand met by Solar {%} – Annual Solar Fraction
Dublin, Ireland	8.5	10	8	10	612	133
Glasgow	15.3	11	8	9	-1040	68
Paris, France	10.8	8	7	8	285	112
Freiburg, Germany	12.3	8	7	8	37	101
Copenhagen, Denmark	18.1	9	7	7	-1293	67
London, UK	11.6	8	7	6	-146	94
Marseille, France	1.2	6	3	6	3607	1507
Vienna, Austria	13.3	7	7	6	-91	97

Revisiting Supply Vs Demand

Dublin						Specific Space Heating Demand	8.5 Whr/m2/a					Frequency of Overheating	0	Ef
					Months requiring heating	10							No. of mths where solar contributes >10% of space htg reqt	10
			Months requiring >10kWhr htg			8								
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
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% of Dmd met		19	28	94	429	2591	22564	0	0	16950	439	31	13	133

- Sum of monthly deficit is 1,193kWh spread over 5 months
- The summer surplus of 1,804kWh can be fed to Seasonal Store
- Note Analysis based on 6m^2 panels rather than installed capacity of 10.6m^2

Conclusion 1

Pattern of PH space heating Demand matches Solar resource in Ireland

- Solar resource in Ireland can make a significant contribution to space heating demand given CSF's:

- The relatively long space heating season in Ireland

  combined with

- The relatively low maximum space heating loads

Solar combined with Passive House

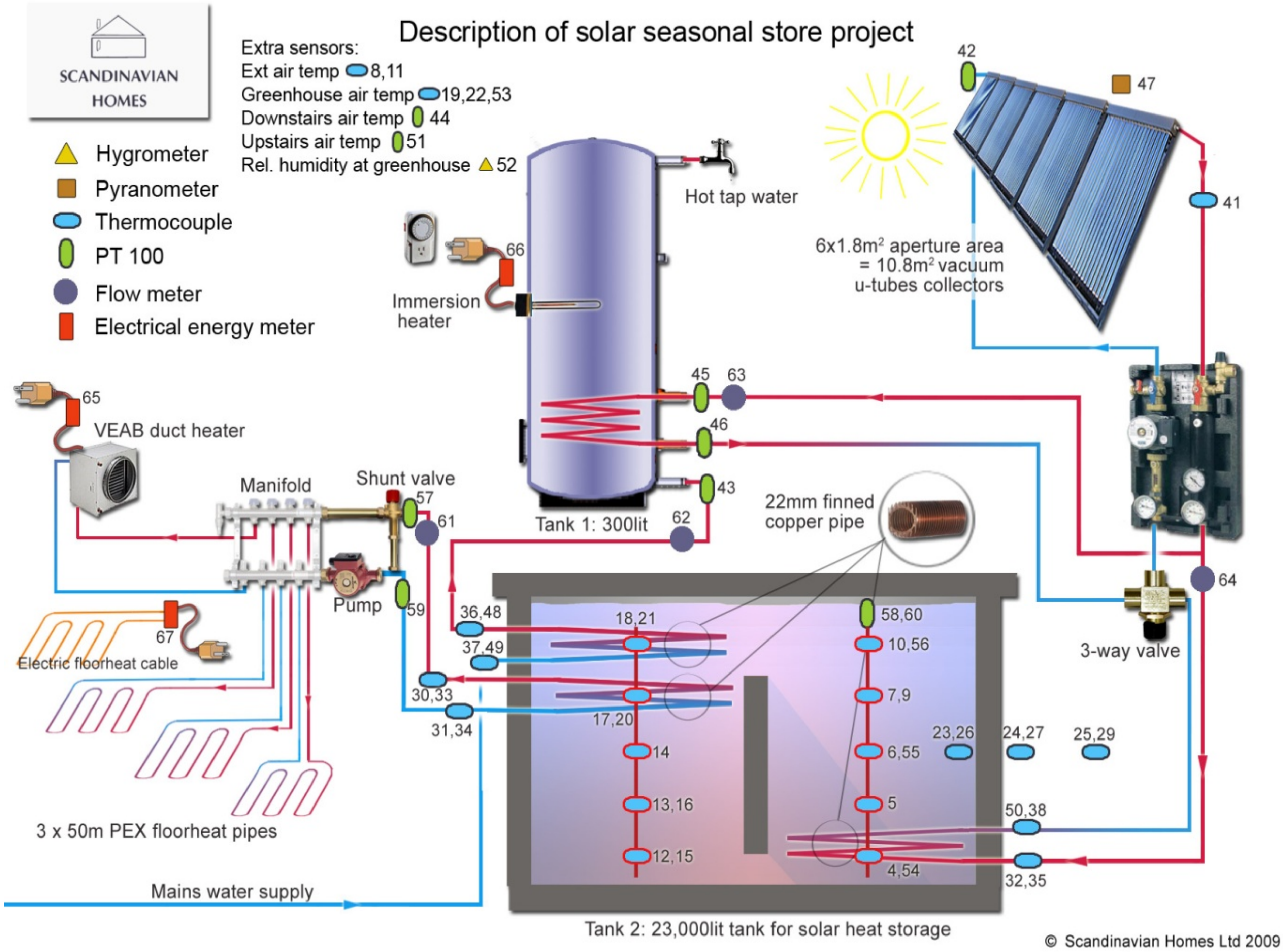
In practice

Results from installation in Galway, West Coast of Ireland

University of ULSTER
Centre for Sustainable Technologies

Passive House & Solar Store in Galway, west coast of Ireland

- Scandinavian Homes based in Moycullen, Galway, Ireland
- www.scanhome.ie Lars Pettersson
- Passive House: <8.5kW/m^2/a
- 10.8m^2 Solar Collectors
- 300 lit DHW tank
- 23m^3 Water Tank used as a TES medium
- University of Ulster has monitored the project since June 2009


SCANDINAVIAN HOMES
Description of solar seasonal store project
Extra sensors:
Ext air temp 8,11
Greenhouse air temp 19,22,53
Downstairs air temp 44
Upstairs air temp 51
Rel. humidity at greenhouse 52
Hygrometer
Pyranometer
Thermocouple
PT 100
Flow meter
Electrical energy meter
Hot tap water
Immersion heater
66
42
47
41
6x1.8m² aperture area = 10.8m² vacuum u-tubes collectors
65
VEAB duct heater
Manifold
Shunt valve
57
61
45
63
46
43
62
Tank 1: 300lit
22mm finned copper pipe
64
3-way valve
Pump
59
67
Electric floorheat cable
36,48
37,49
30,33
31,34
18,21
17,20
14
13,16
12,15
58,60
10,56
7,9
6,55
5
4,54
23,26
24,27
25,29
50,38
32,35
3 x 50m PEX floorheat pipes
Mains water supply
Tank 2: 23,000lit tank for solar heat storage
© Scandinavian Homes Ltd 2009

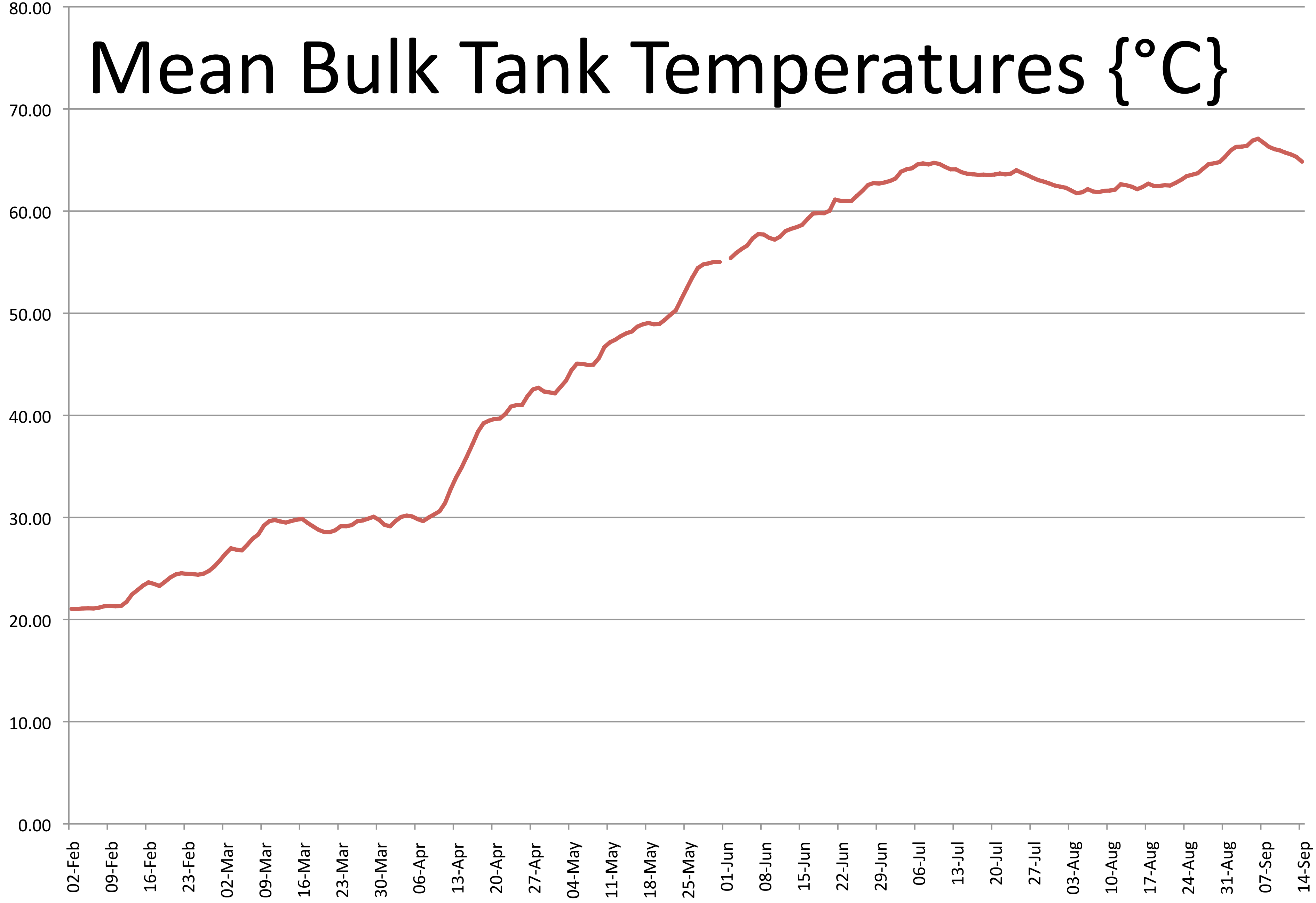
Insulation extends to 600mm

600mm Insulation was applied to top, sides and bottom

Results to date

- Tank installed June 2009
- Monitoring of 65 sensors with results output every 10 minutes
- Spreadsheet with 12,500 entries per day being analysed
- DHW Solar Fraction measured at 95% (albeit low drawdown)
- Space Heating Demand met in Nov & Dec 2009 from tank temp of 46°C
- Max Tank temperature 67°C Sept 2010, despite dullest July on record in 2010 & poor direct solar radiation in Aug 2010

Mean Bulk Tank Temperatures {°C}



Seasonal Store Performance

	Actual Performance									Predictions		
Month	**jan**	**feb**	**mar**	**apr**	**may**	**jun**	**jul**	**aug**	**sep**	**oct**	**nov**	**dec**
Ave MBTT {°C}	25	22.9	28.9	36.3	48.9	59.4	63.7	62.9	64.5	63	55	40
Soil Temp {°C}	10	8	9.1	11.3	14.6	18.2	19.9	20.6	19.6	19	18	17
Tank Losses {kwh}	108	107	143	180	247	297	315	305	323	317	266	166
Potential Daily Temp Loss {°C}	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.2

- Tank losses amount to 2773kWh over the year
- This compares with a useful storage of 1,500kWh

- There is a need for
  1. High Insulation levels for the Seasonal Store
  2. Correct dimensioning of Solar array
  3. Integration with low temperature heating eg HRV

Conclusion 2

Inter- Seasonal Storage can store required shortfall for winter months

- Critical Success Factors:
  - Insulation given tank losses of 60% – 70%
  - Integration with appropriate heating system which makes use of low temperatures

Summary

- Theory and practice demonstrate potential for Solar Space Heating in Northern Maritime Climate
- Further work required to optimise

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