

AiCARR IN MCE 2014

18-19-20-21 MARZO 2014 • FIERA MILANO RHO-PERO

TOWARDS NEARLY-ENERGY RETROFITTED BUILDINGS

Milan, March 19th 2014

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ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY

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Department, Budapest University of Technology and Economics

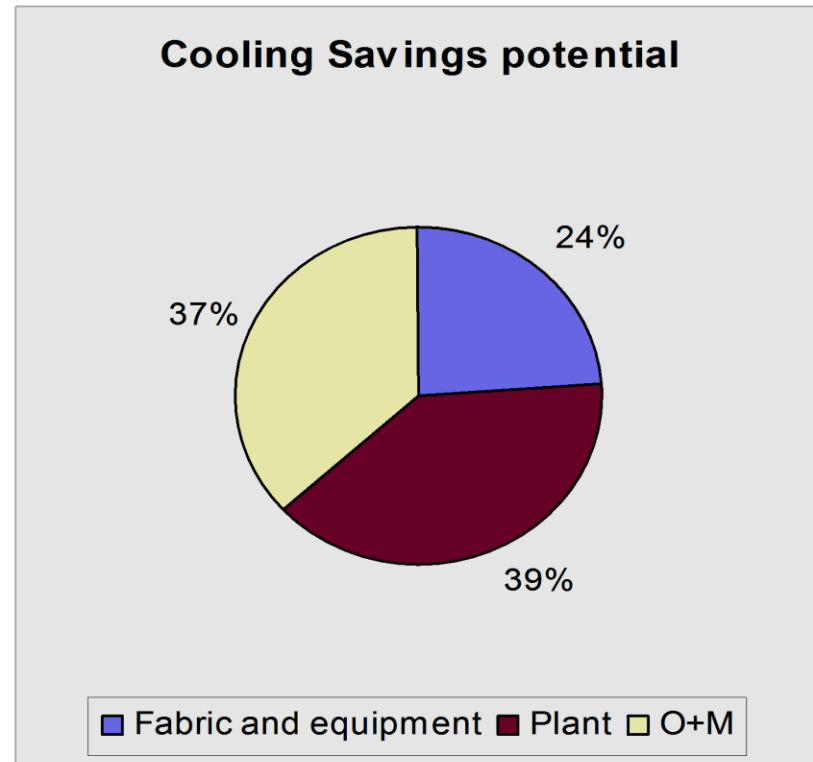
magyar@egt.bme.hu



Potential Energy Saving

Potential for savings
through:

- Load reduction (24%)
- Improved efficiency (39%)
- Better operation (37%)



Source: HarmonAC project results.
<http://www.harmonac.info/>





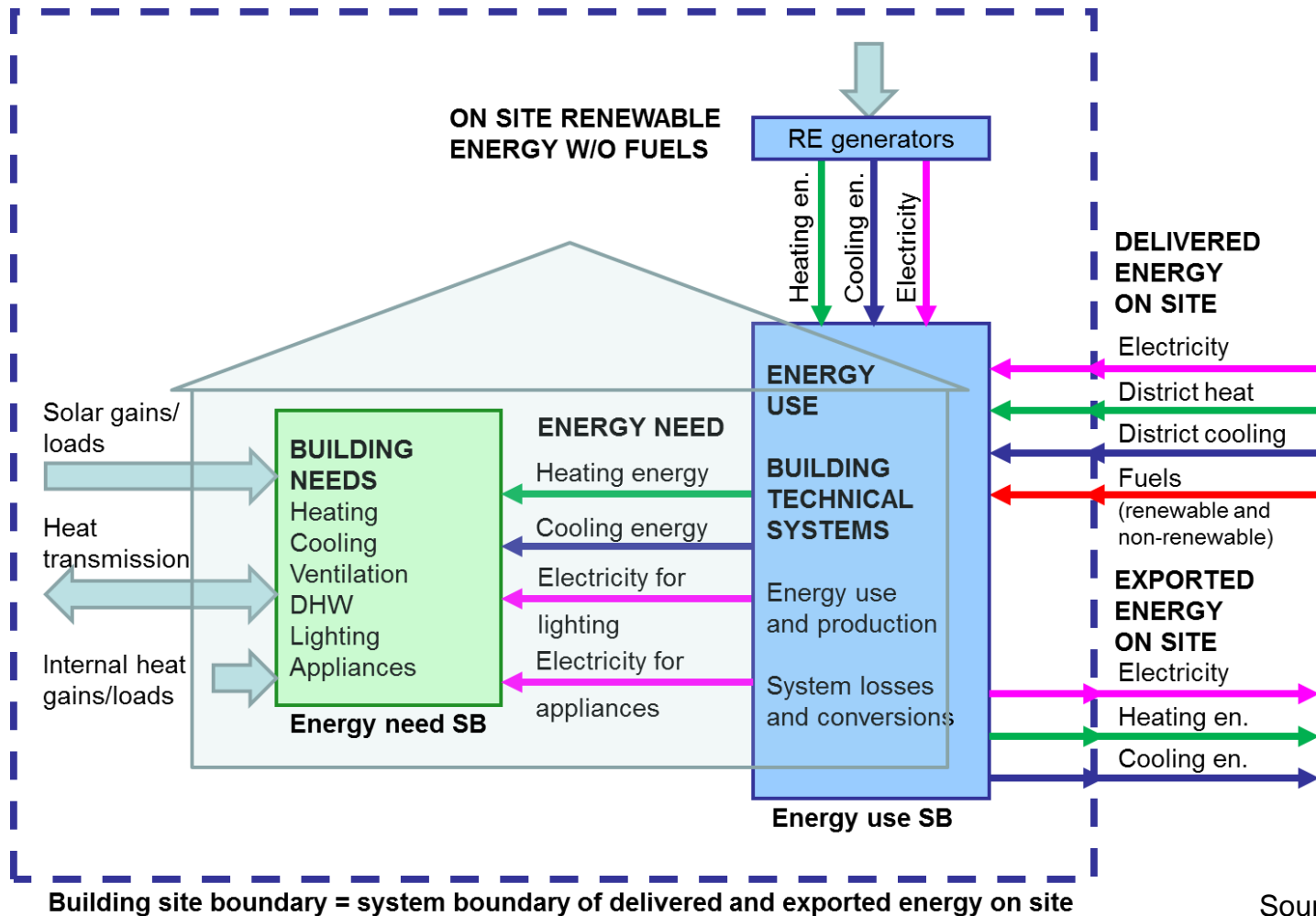
CONTENT

- Nearly zero energy building definition in Hungary
- Case study: SOLANOVA project (2004)
- Case study: new projects (2014)
- Energy saving with monitoring: iSERV project





Criteria for definition of nZEB for public buildings



Source: REHVA



Nearly zero energy building definition in Hungary

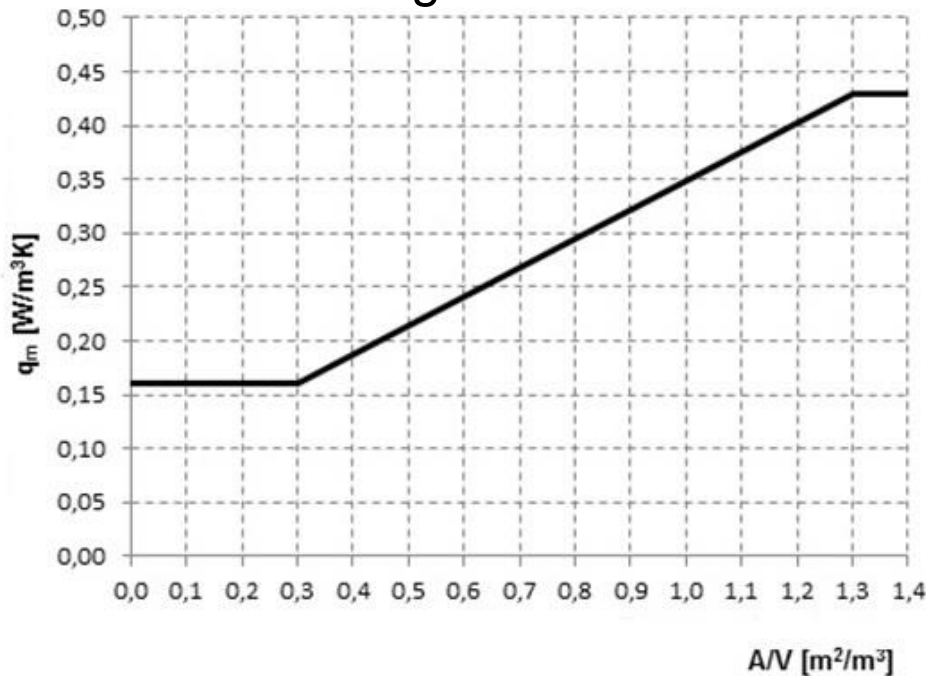
1. Maximum for U values of building elements from 2018
(wall: 0,25; roof: 0,17; window 1,1 W/m²,K)
2. The overall average U value (W/m³,K) vs surface to volume ratio
3. Specific primary energy consumption (kWh/m²,a)
requirements vs surface to volume ratio
4. RES min 25 %



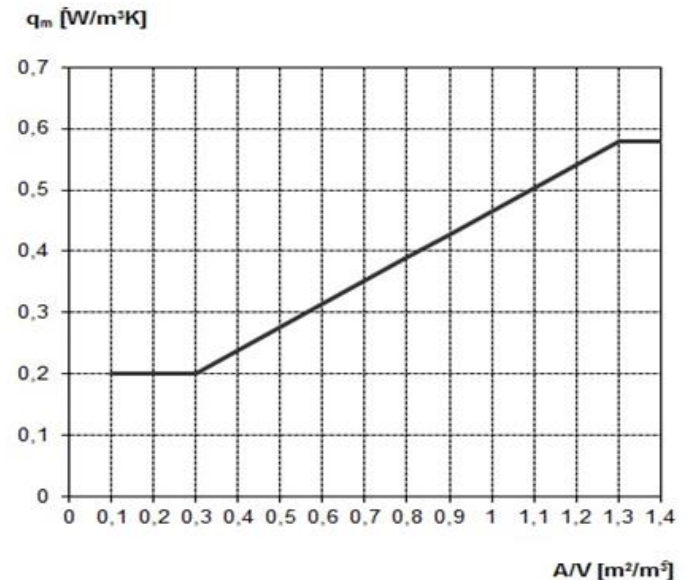


NEARLY ZERO ENERGY BUILDINGS

The overall average U value



From 2018

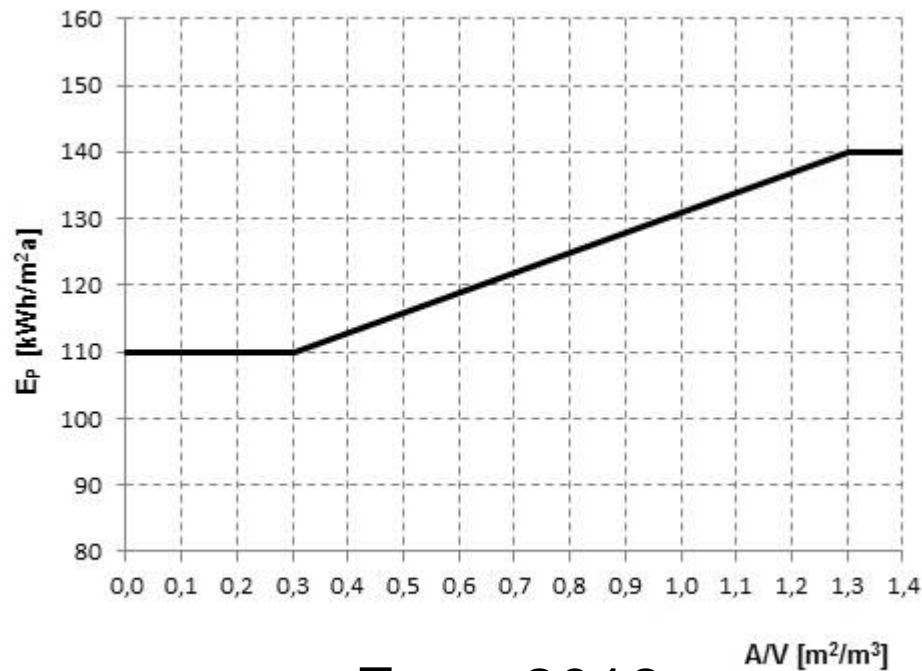


Now

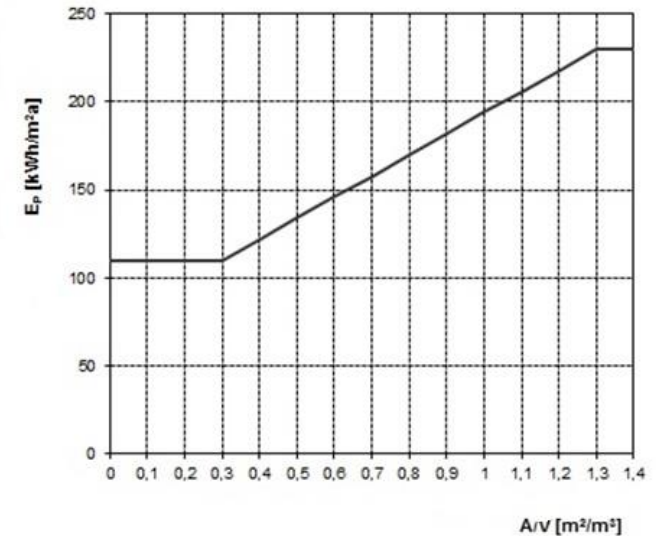


NEARLY ZERO ENERGY RESIDENTIAL BUILDINGS

Specific primary energy consumption



From 2018



Now



Comfort requirements MSZ EN15251

Type of building or space	Category	Temperature range for heating, °C	Temperature range for cooling, °C
		Clothing ~ 1,0 clo	Clothing ~ 0,5 clo
Residential buildings, living spaces (bed room's living rooms etc.) Sedentary activity ~1,2 met	I	21,0 -25,0	23,5 - 25,5
	II	20,0-25,0	23,0 - 26,0
	III	18,0- 25,0	22,0 - 27,0
Residential buildings, other spaces (kitchens, storages etc.) Standing-walking activity ~1,5 met	I	18,0-25,0	
	II	16,0-25,0	
	III	14,0-25,0	
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditorium, cafeteria, restaurants, class rooms, Sedentary activity ~1,2 met	I	21,0 – 23,0	23,5 - 25,5
	II	20,0 – 24,0	23,0 - 26,0
	III	19,0 – 25,0	22,0 - 27,0
Kindergarten Standing-walking activity ~1,4 met	I	19,0 – 21,0	22,5 - 24,5
	II	17,5 – 22,5	21,5 – 25,5
	III	16,5 – 23,5	21,0 - 26,0
Department store Standing-walking activity ~1,6 met	I	17,5 – 20,5	22,0 - 24,0
	II	16,0 – 22,0	21,0– 25,0
	III	15,0 – 23,0	20,0 - 26,0





Comfort requirements MSZ EN15251

Table B.5 - Example of ventilation rates for the residences. Continuous operation of ventilation during occupied hours. Complete mixing

Category	Air change rate ^a		Living room and bedrooms, mainly outdoor air flow		Exhaust air flow, l/s		
	l/s,m ² (1)	ach	l/s, pers ^b (2)	l/s/m ² (3)	Kitchen (4a)	Bathrooms (4b)	Toilets (4)
I	0,49	0,7	10	1,4	28	20	14
II	0,42	0,6	7	1,0	20	15	10
III	0,35	0,5	4	0,6	14	10	7

^a The air change rates expressed in l/s/m² and ach correspond to each other when the ceiling height is 2,5 m.

^b The number of occupants in a residence can be estimated from the number of bedrooms. The assumptions made at national level have to be used when existing, they may vary for energy and for IAQ calculations.





Solar-supported, integrated eco-efficient renovation of large residential buildings and heat-supply systems

University of Kassel
TU of Budapest

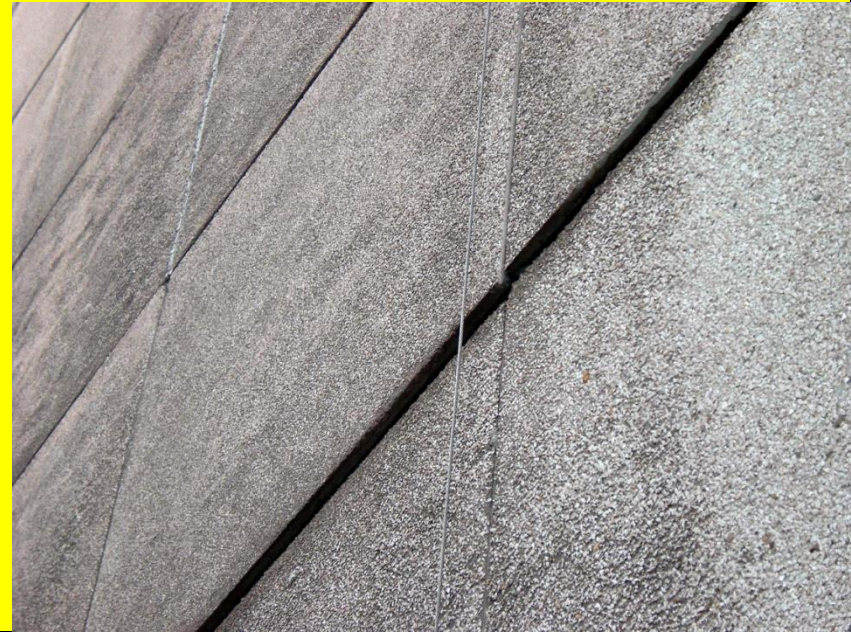
<http://www.solanova.eu/>

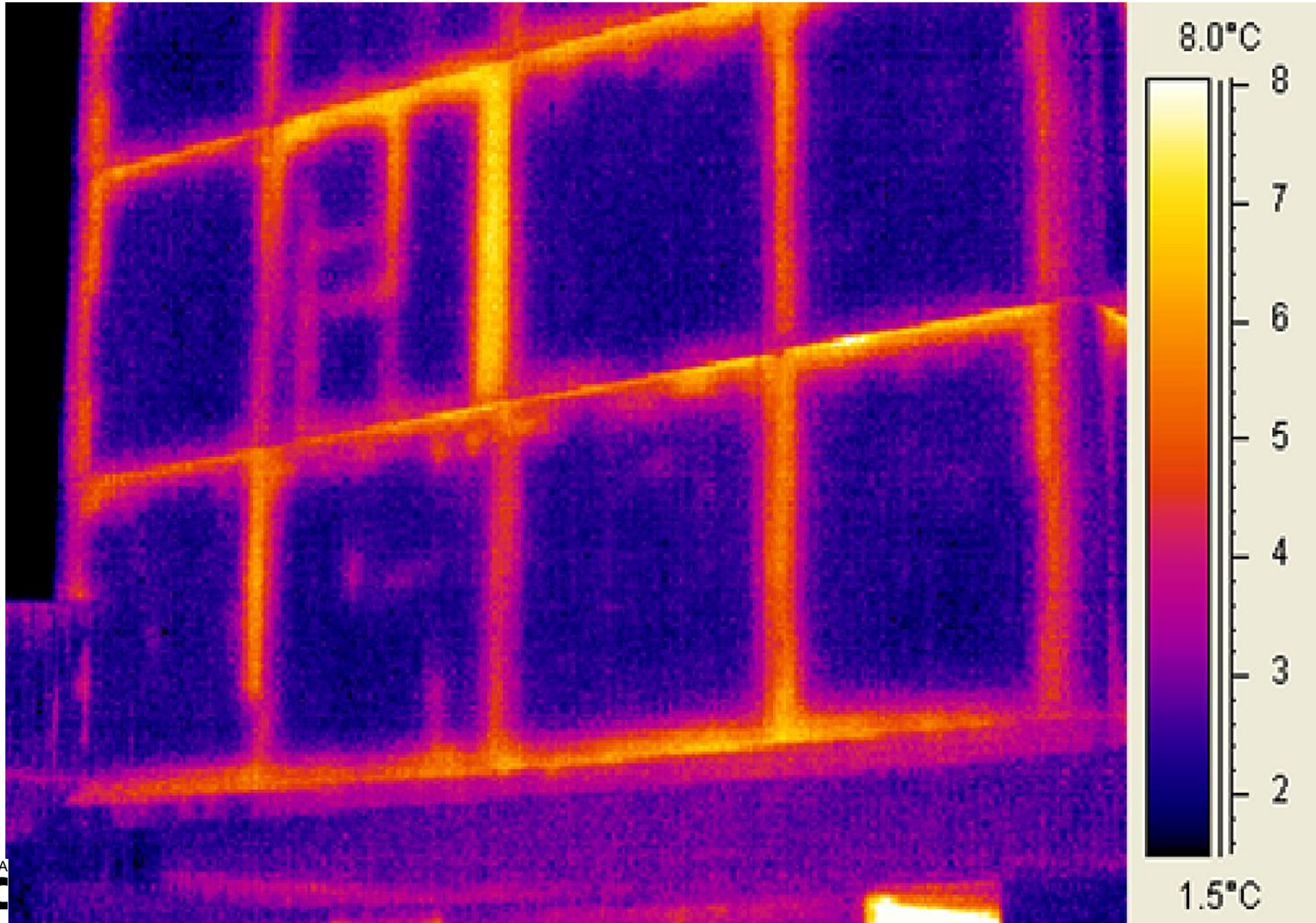
FP 5 of EC, 2004

Dunaújváros, Hungary

Sources of SOLANOVA: Miklos Osztróluczky

$$U_{\text{wall}} = 1,80 \text{ W/m}^2\text{K}$$





ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY





16 cm insulation



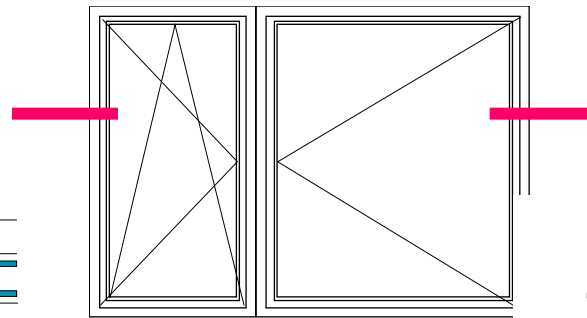
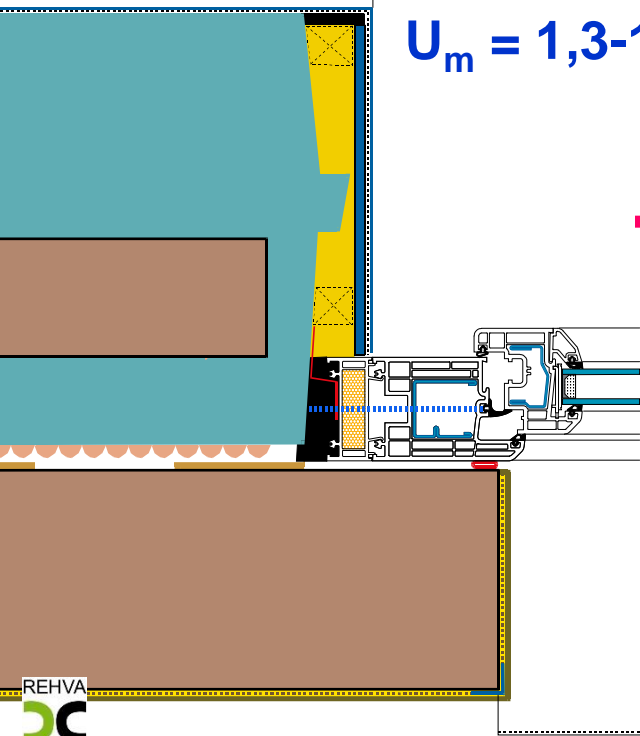
ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY



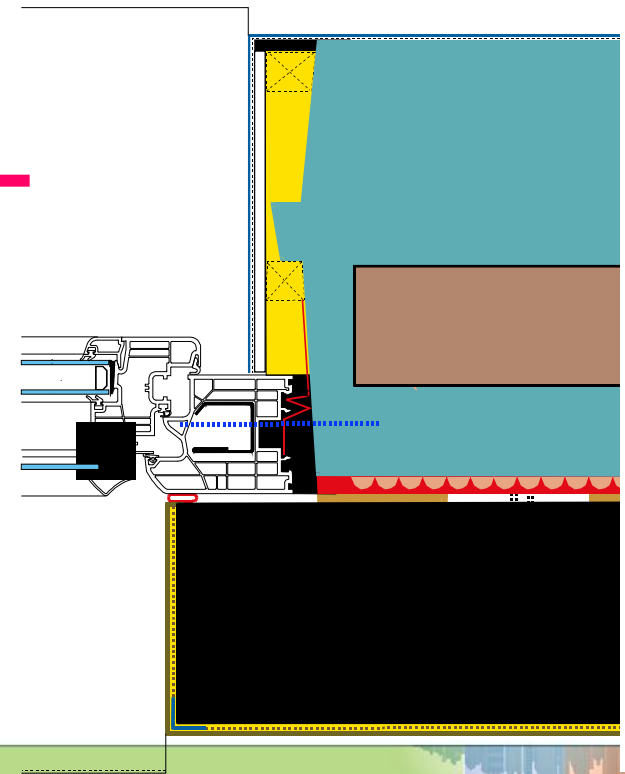


Windows

**INTERNORM
COMPACT+**
 $U_m = 1,3-1,4 \text{ W/m}^2\text{K}$

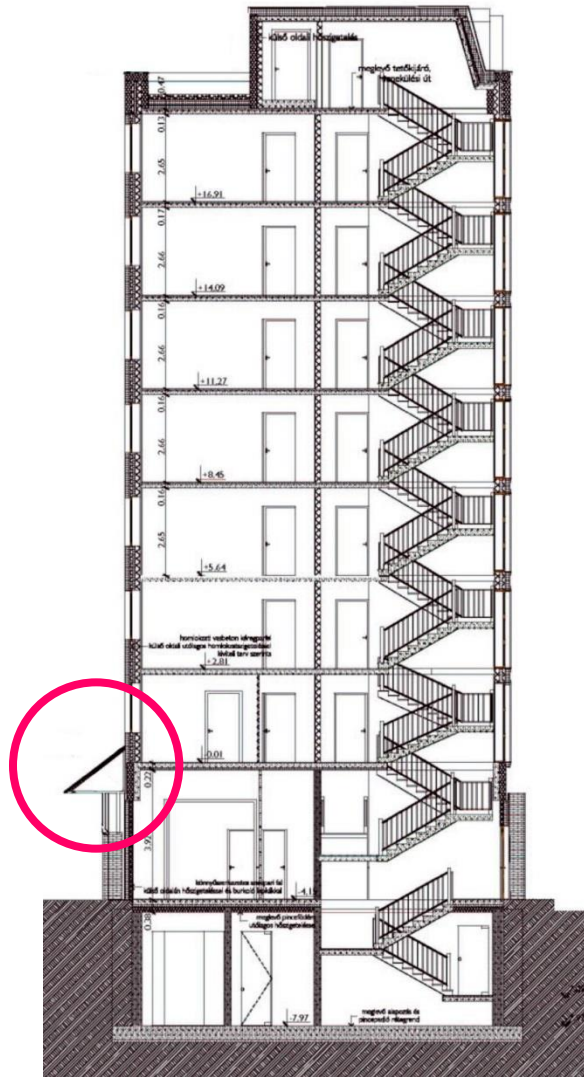


**INTERNORM
DIMENSION4 CR**
 $U_m = 1,0 \text{ W/m}^2\text{K}$

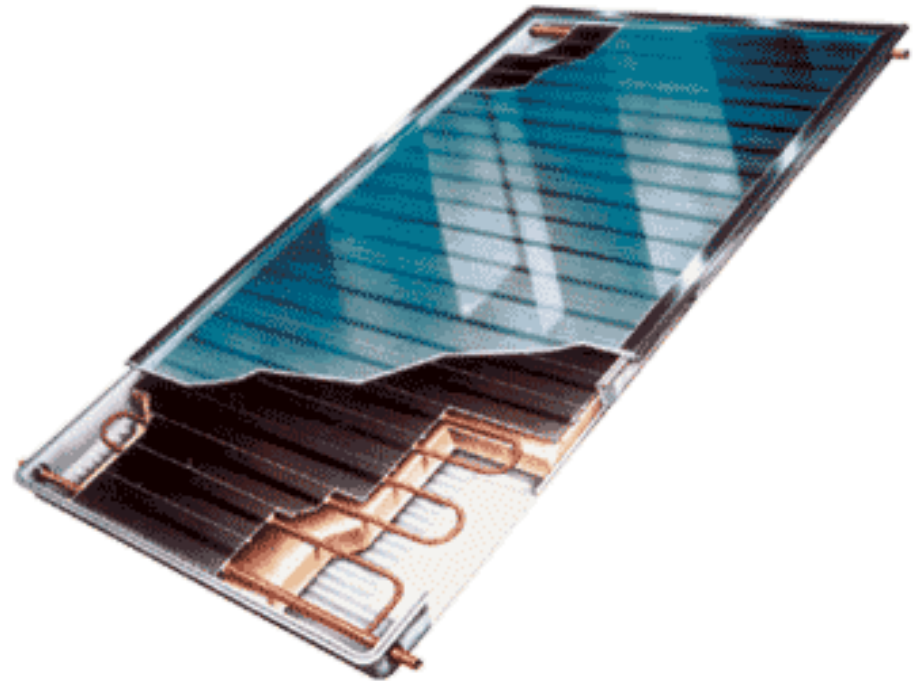


ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY



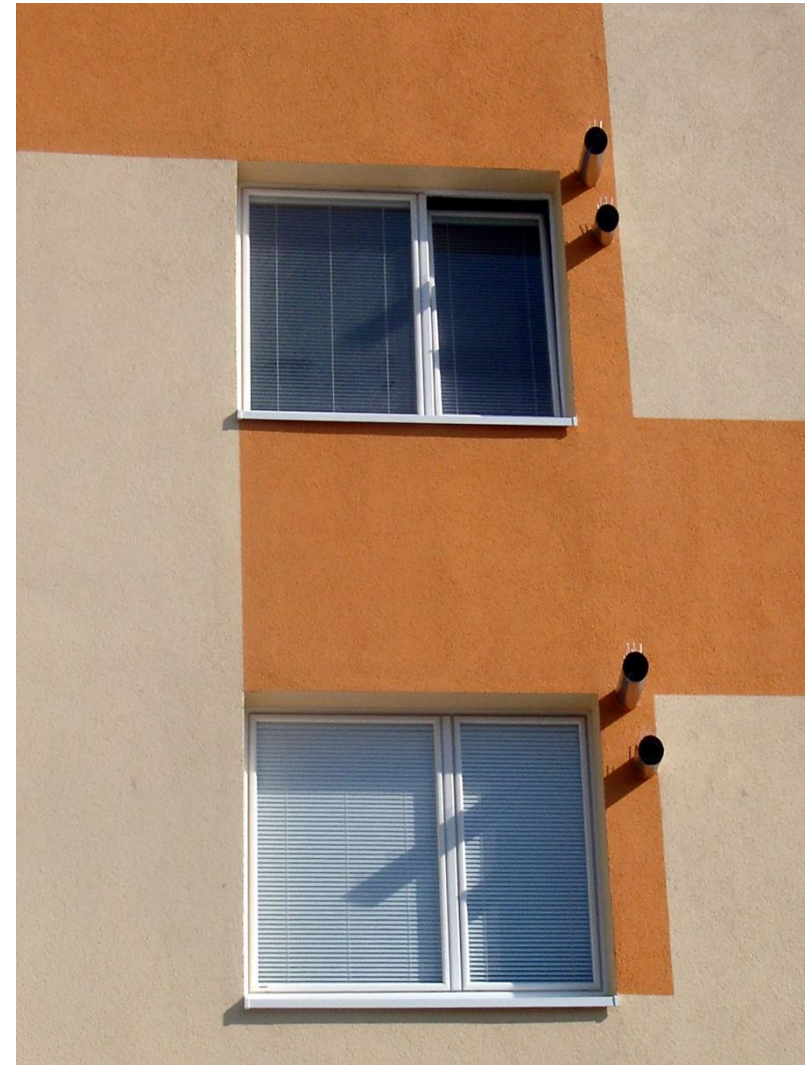


Solar collectors



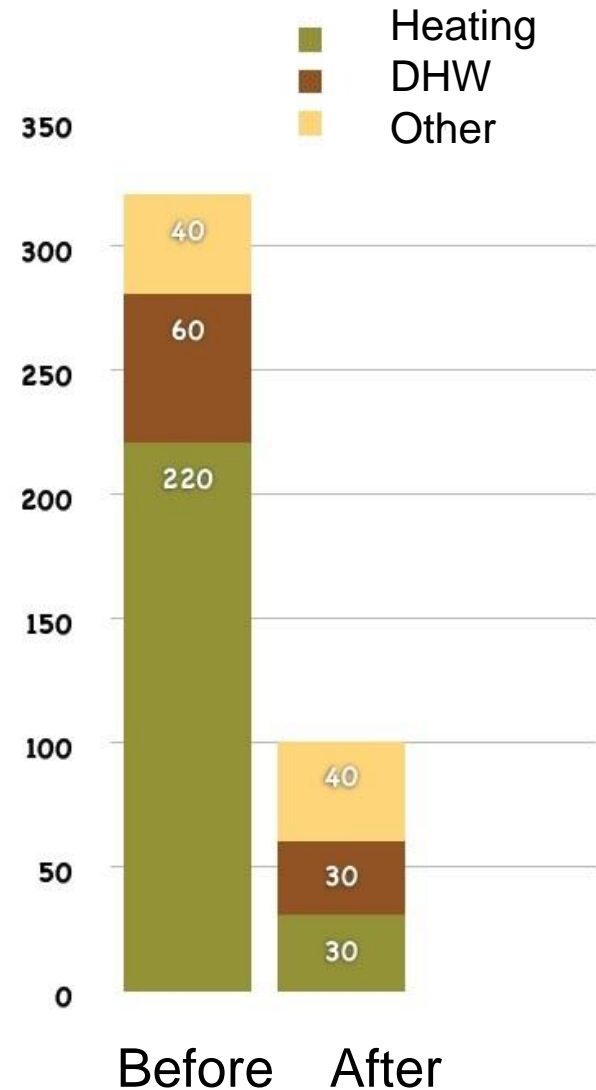
ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY



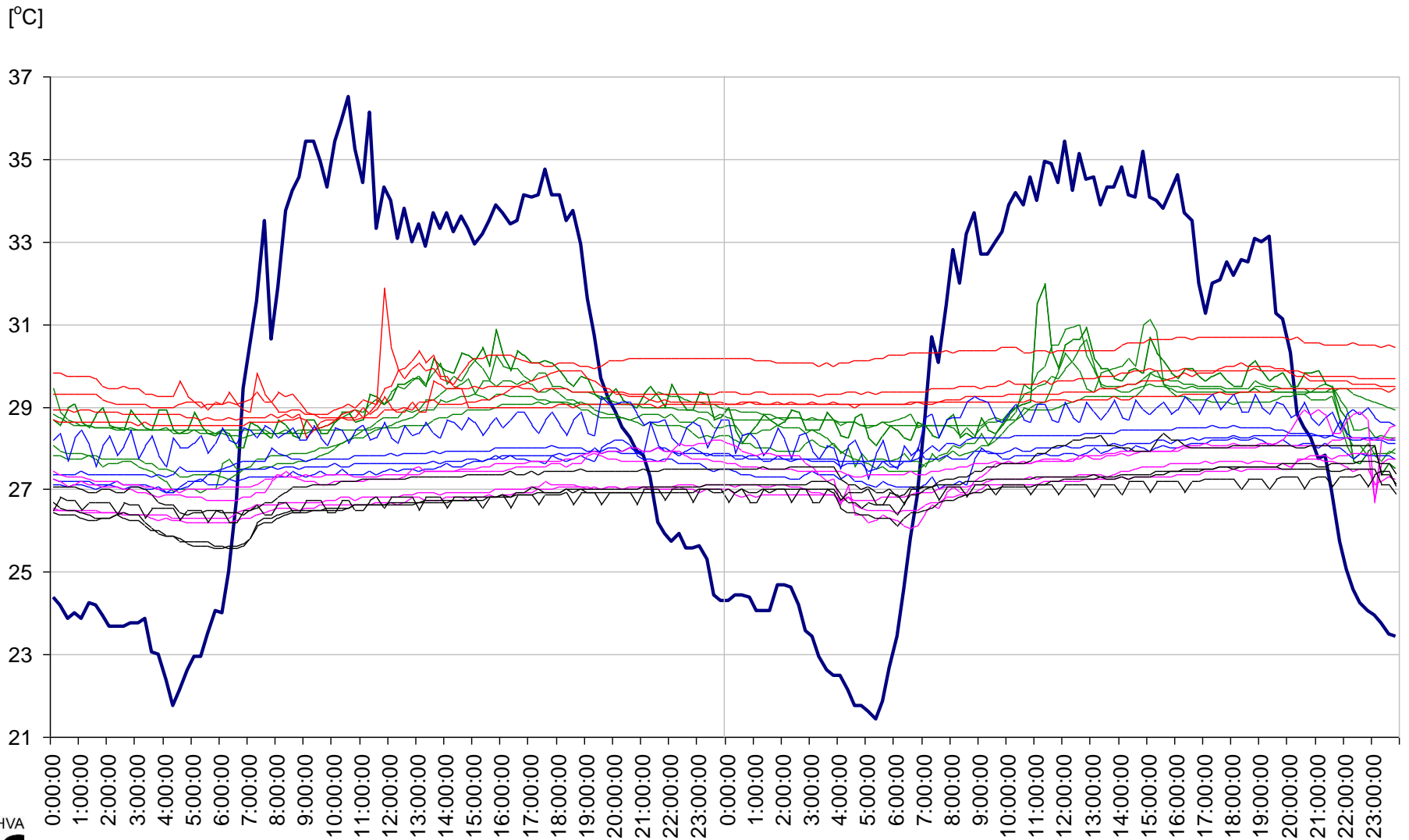




Energy consumption in kWh/m²,a

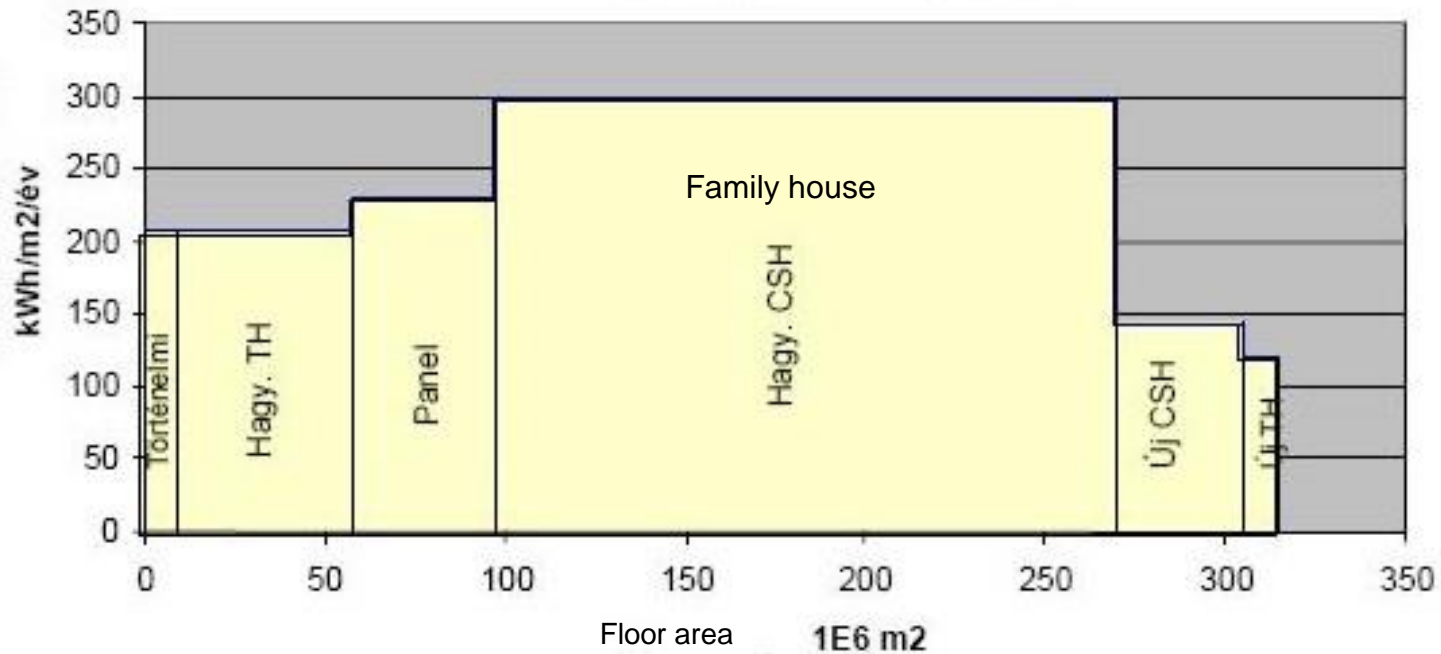


ENERGY RETROFITTING OF PANEL RESIDENTIAL BUILDINGS FOR NEARLY ZERO ENERGY BUILDINGS IN HUNGARY





Hungarian residential building stock





New pilot study, based on the Solanova project results - under design, 2014



Veszprem, Hungary

Built in 1974

20 levels

130 apartments

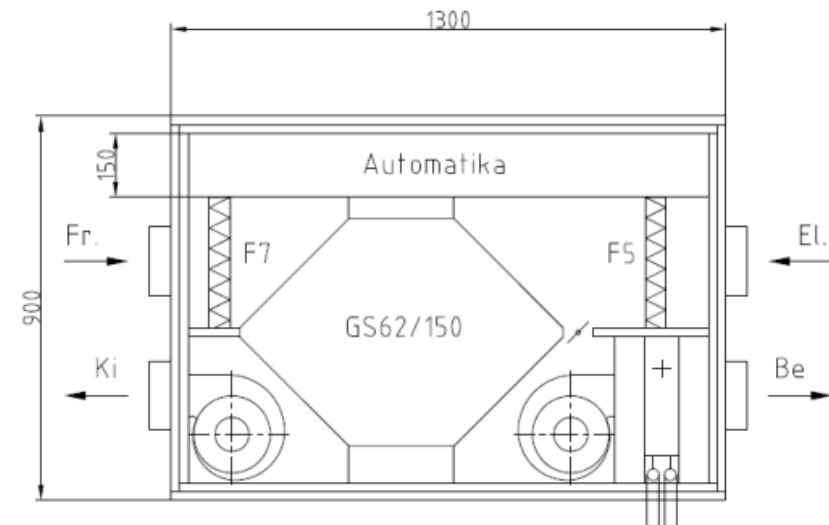
$E = 168 \text{ kWh/m}^2, \text{a}$ (F category)

Built using industrialised
technology



Energy retrofitting:

- Insulation of the wall (20 cm $U=0,2 \text{ W/m}^2, \text{K}$)
- Insulation of the roof ($U=0,16 \text{ W/m}^2, \text{K}$)
- Change the windows
- Solar shading
- Heat recovery for ventilation



- 20 % of DHW with thermal solar panels (38 pcs)
- PV in the all South side (252 pcs, 50 kWp, 37.200 kWh/a)

Energy saving: 70 %





iSERV Inspection of HVAC systems through
continuous monitoring and
benchmarking

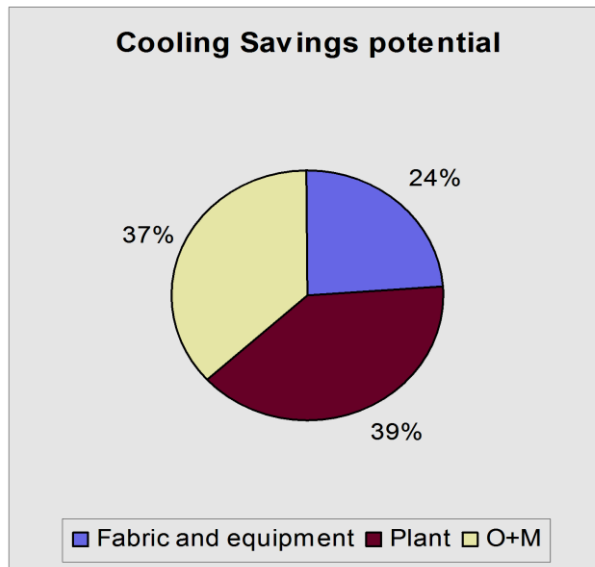


www.iservcmb.info

Co-ordinator: Prof. Ian Knight

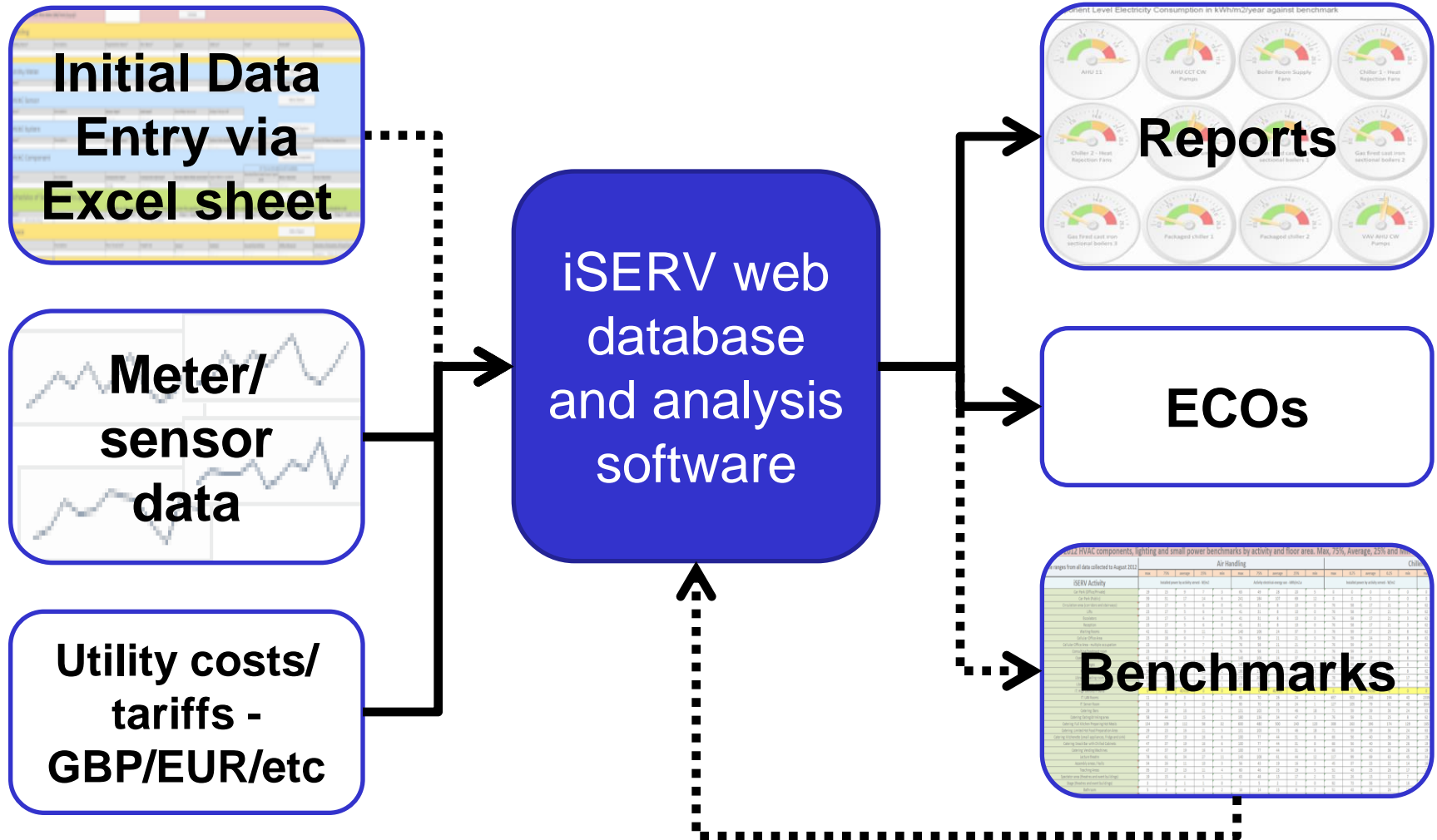
Cardiff University, UK

2012 - 2014





Overview of basic process





Collect information on the building

Floor area and activity for each space in the building

Networked utility meters and sensors, and where they serve

Unique Identifiers for the sub-hourly data to be collected from these meters and sensors

All HVAC Components and where they serve

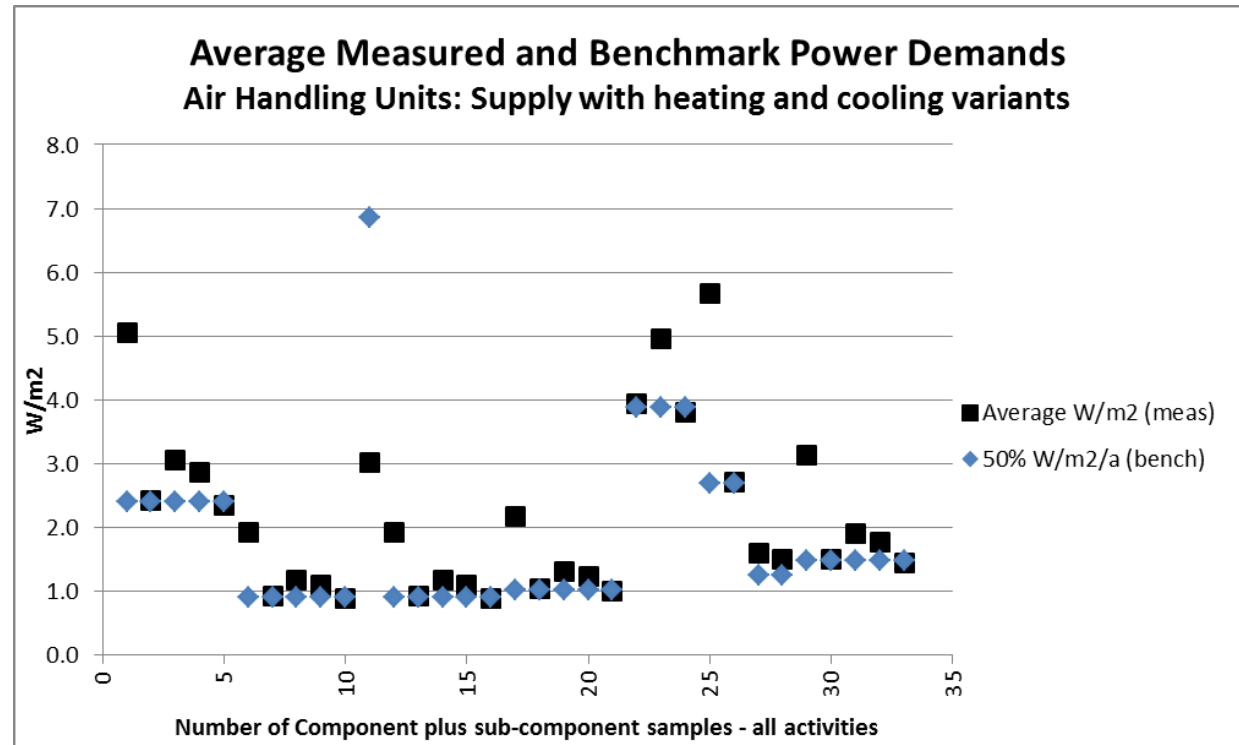




Benchmarks

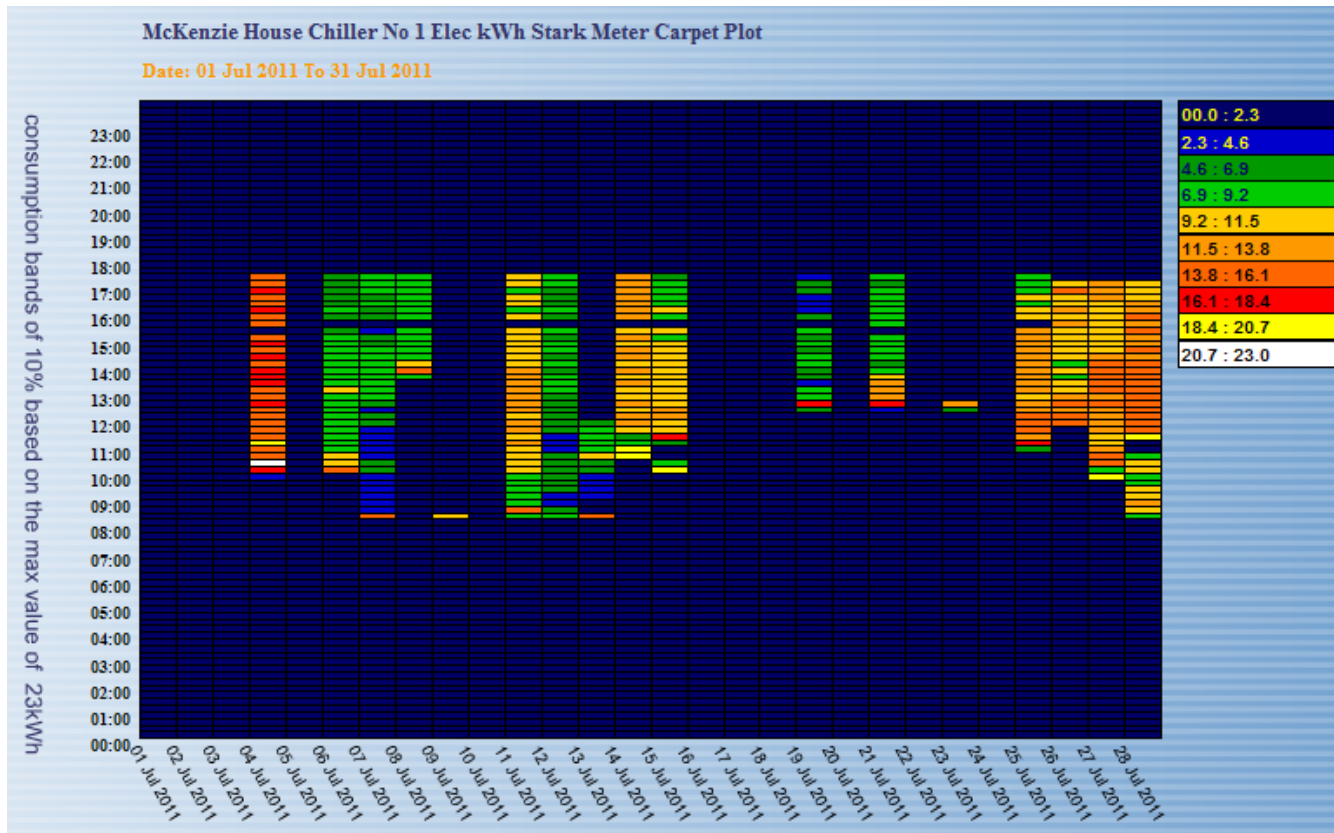
Three types of benchmark being produced and explored:

- Annual energy/m² – kWh/m².a
- Monthly energy/m² – kWh/m².month
- Power demands/m² – W/m²





Identification of Energy Conversation Opportunities (ECOs)





Reports

The key is to not just present meter data but to interpret it with respect to the situation in the real building.

A number of report sets are being trialled to see which provide the information in the best form to allow decisions.

how energy efficient are you really?

iSERV CMB
Inspection of HVAC Systems through continuous monitoring and benchmarking

McKenzie House

Cardiff University Estate

Cardiff, United Kingdom

Weather Analysis

November		Monthly average T _{air}					
MON	TUE	WED	THU	FRI	SAT	SUN	
9°C	9°C	9°C	9°C	9°C	9°C	9°C	9°C
9°C	9°C	9°C	9°C	9°C	9°C	9°C	9°C
9°C	9°C	9°C	9°C	9°C	9°C	9°C	9°C
9°C	9°C	9°C	9°C	9°C	9°C	9°C	9°C
9°C	9°C	9°C	9°C	9°C	9°C	9°C	9°C

51.5N 3.2W CF24 0DE

google map picture bird view big map picture

www.iservcmb.eu

Monthly Overview

Monthly kWh Consumption	Monthly kWh Comparison	Monthly CO ₂ Emissions	Cost Analysis
<p>November 2012</p> <p>-13% seasonal month</p> <p>-45% save on remote participation</p> <p>3500 kWh</p>	<p>Nov 2012</p> <p>Nov 2011</p> <p>Nov 2010</p> <p>Nov 2009</p> <p>Nov 2008</p> <p>Nov 2007</p> <p>Nov 2006</p> <p>Nov 2005</p> <p>Nov 2004</p> <p>Nov 2003</p> <p>Nov 2002</p> <p>Nov 2001</p> <p>Nov 2000</p>	<p>November 2012</p> <p>-10% seasonal month</p> <p>-35% save on remote participation</p> <p>10 kgCO₂e</p>	<p>October 2012</p> <p>November 2012</p> <p>Cost per kWh (CPKWh)</p> <p>3000 3100 1/4</p> <p>2800 2900 1/3</p> <p>2600 2700 1/2</p> <p>2400 2500 2/3</p> <p>2200 2300 3/4</p> <p>2000 2100 1</p> <p>1800 1900 1 1/4</p> <p>1600 1700 1 1/2</p> <p>1400 1500 1 3/4</p> <p>1200 1300 2</p> <p>1000 1100 2 1/4</p> <p>800 900 2 1/2</p> <p>600 700 3</p>

Comparison with peer systems around Europe

McKenzie House uses 300% more energy than an efficient peer system in Europe.

Potential Energy Savings : **3000 kWh / year**

Potential Cost Savings : **£5000 / year**

McKenzie House : **3000 MWh/year**

Below Average Peer : **1000 MWh/year**

Most Efficient Peer : **1000 MWh/year**

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how energy efficient are you really?

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Performance Analysis

Rolling Annual Consumption - Electricity

HVAC Component Performance - Total kWh per m² per annum

Component	Total kWh per m ² per annum	Average W per m ²	NFE	Performance
Packaged chiller 1	200	22.83	46.0%	Good
Packaged chiller 2	250	28.54	57.0%	Good
Boiler Room Supply Fans	4	0.46	23.0%	Good
Hot Water Primary Circulators	6	0.68	34.0%	Good
VAV AHU 1	150	17.12	57.0%	Good
VAV AHU 2	200	22.83	76.0%	Average
Chiller 1 - Heat Rejection Fans	90	10.27	66.0%	Needs Inspection
Chiller 2 - Heat Rejection Fans	85	9.7	81.0%	Needs Inspection

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how energy efficient are you really?

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Energy Conservation Opportunities

BEMS and controls / Miscellaneous

Reduce power consumption of auxiliary equipment: Description To reduce energy consumption of pumps and fans the algorithm checks the following: It's happening that HVAC components like fans and pumps work outside the schedule of building. This ECO algorithm checks if pumps and fans work according to the building schedule, thereby preventing energy over-consumption.

Annual GBP Savings	Annual kWh Savings	Annual Energy Savings	Annual CO ₂ Savings
£560,00	3500 kWh	5.2%	800 tons

Cooling equipment / Free cooling

Consider cold storage applications (chilled water, water ice and other phase changing material): Description To reduce energy consumption of pumps and fans the algorithm checks the following: It's happening that HVAC components like fans and pumps work outside the schedule of building. This ECO algorithm checks if pumps and fans work according to the building schedule.

Annual GBP Savings	Annual kWh Savings	Annual Energy Savings	Annual CO ₂ Savings
£560,00	3500 kWh	5.2%	800 tons

Air handling / Heat recovery / Air distribution

Apply variable flow rate fan control: Description To reduce energy consumption of pumps and fans the algorithm checks the following: It's happening that HVAC component. Consider conversion to VAV: Description To reduce energy consumption of pumps and fans the algorithm checks the following: It's happening that HVAC components like fans and pumps work outside the schedule of building. This ECO algorithm checks if pumps and fans work according to the building schedule, thereby preventing energy over-consumption.

Annual GBP Savings	Annual kWh Savings	Annual Energy Savings	Annual CO ₂ Savings
£560,00	3500 kWh	5.2%	800 tons

General HVAC system

Shut off A/C equipment when not needed: Description To reduce energy consumption of pumps and fans the algorithm checks the following: It's happening that HVAC components like fans and pumps work outside the schedule of building. This ECO algorithm checks if pumps and fans work according to the building schedule, thereby preventing energy over-consumption.

Annual GBP Savings	Annual kWh Savings	Annual Energy Savings	Annual CO ₂ Savings
£560,00	3500 kWh	5.2%	800 tons

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Monitoring savings: Case Studies

Building electrical savings of between 19% to 33% p.a.

Building electrical savings/m² between 61 to 100 kWh/m²/a

In economic terms:

- Measured recurrent savings of 9 to 14 EUR/m²/a
- Recorded 'one-off' setup costs between 0.1 to 2 EUR/m²
- Estimated 0.1 – 3 EUR/m²/a to maintain.
- Net returns between 7 – 13 EUR/m²/a

The savings actually achieved in these buildings indicate more significant ACTUAL savings could be achieved in the wider building stock.





CONCLUSION

- Nearly zero energy definition
- Is it possible to achieve nearly zero energy building with energy retrofitting (SOLANOVA).
- Cost optimal?
- Energy saving with continuous monitoring (iSERV)

