Federation of European Heating, Ventilation and Air-conditioning Associations

REHVA

Cultura e Tecnica per Energia Uomo e Ambiente AiCARR Associazione italiana Condizionamento dell'Aria, Riscaldamento, Refrigerazione - www.aicarr.org

AiCARR IN MCE 2014

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

# TOWARDS NEARLY-ENERGY RETROFITTED BUILDINGS

Milan, March 19th 2014

Federation of European Heating, Ventilation and Air-conditioning Associations

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

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REHVA vice-president

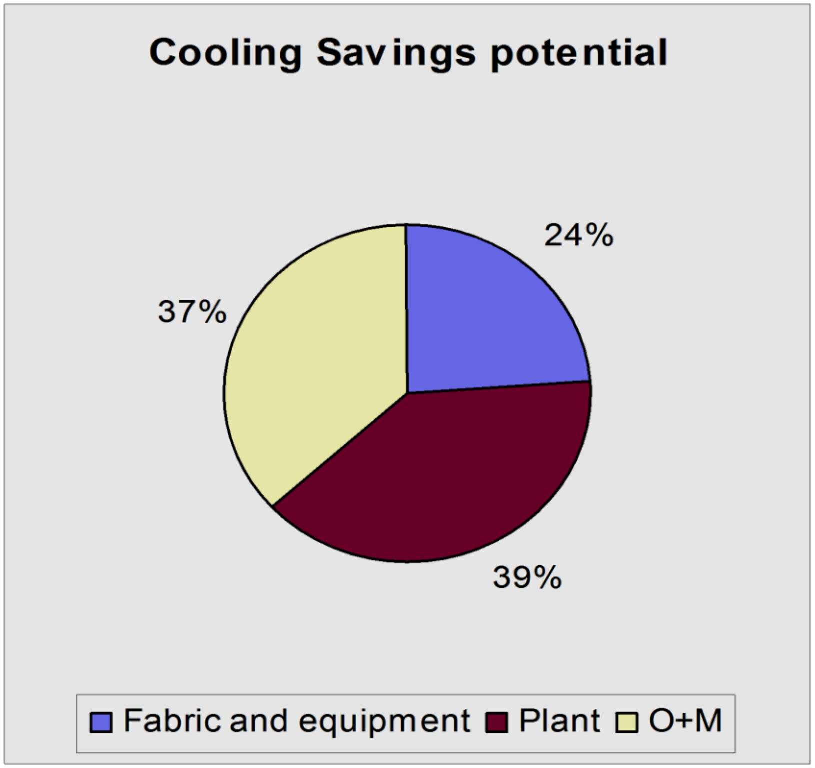
Head of Building Energetics and Building Service Engineering Department, Budapest University of Technology and Economics

magyar@egt.bme.hu

# Potential Energy Saving

Potential for savings through:

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

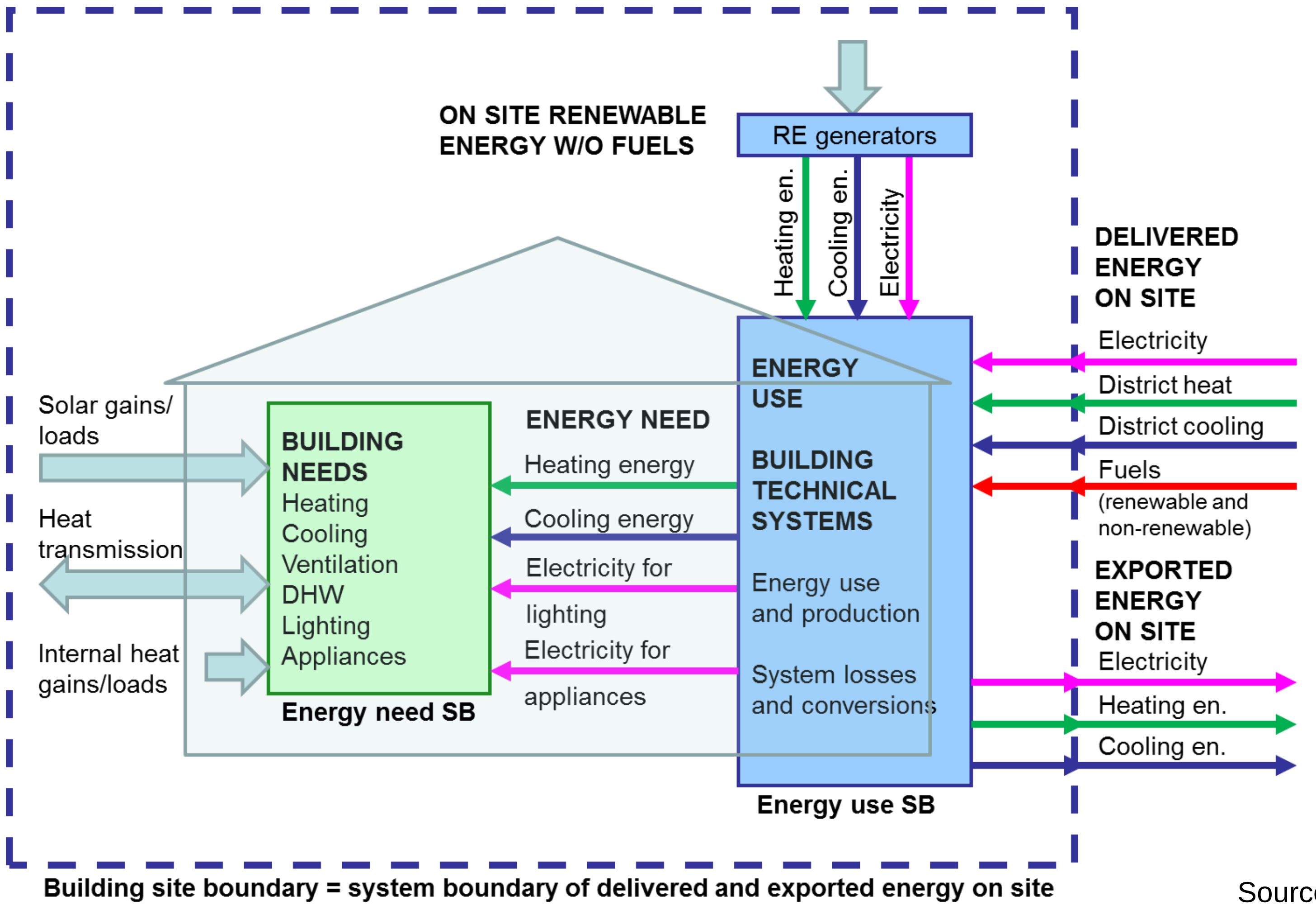



Source: HarmonAC project results.
http://www.harmonac.info/

# 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/m$^2$,K)

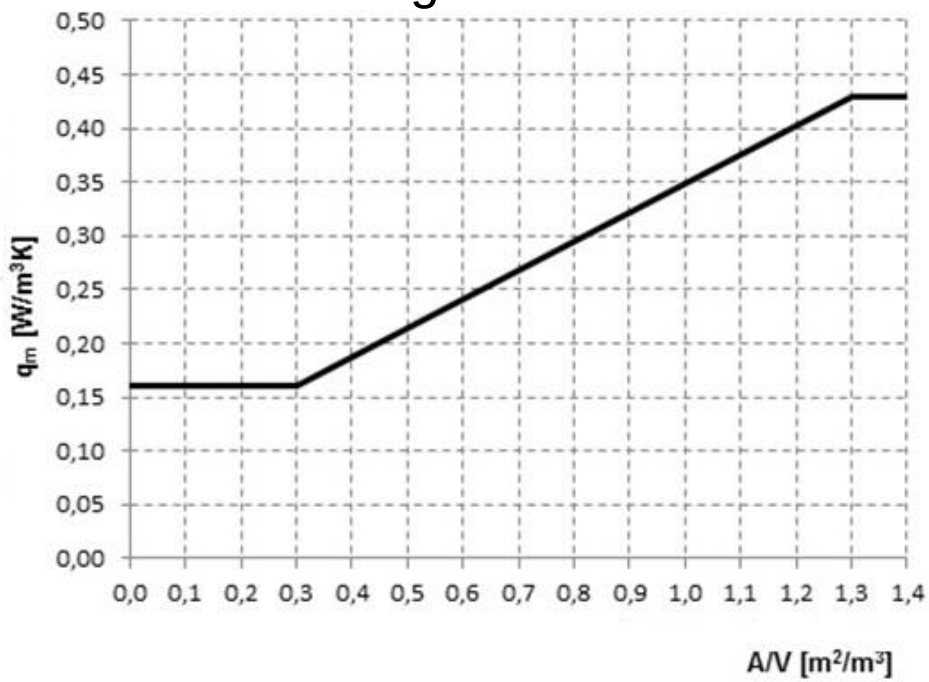
2. The overall average U value (W/m$^3$,K) vc surface to volume ratio

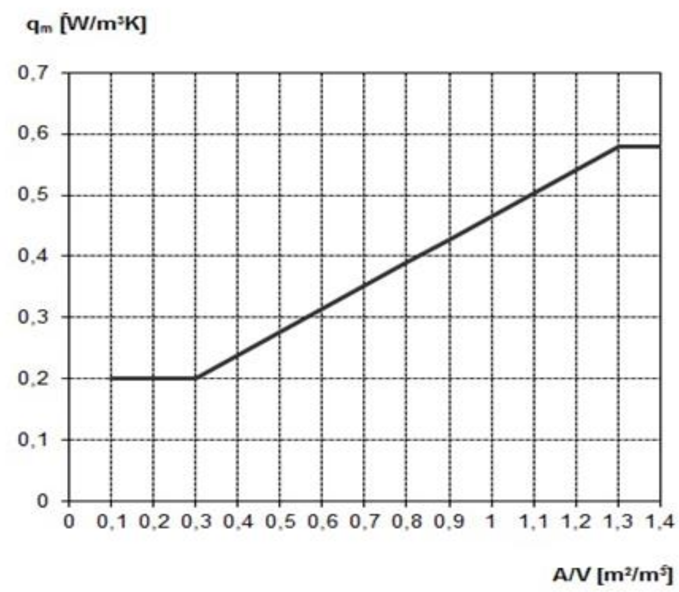
3. Specific primary energy consumption (kWh/m$^2$,a) requirements vs surface to volume ratio

4. RES min 25 %

# NEARLY ZERO ENERGY BUILDINGS

The overall average U value



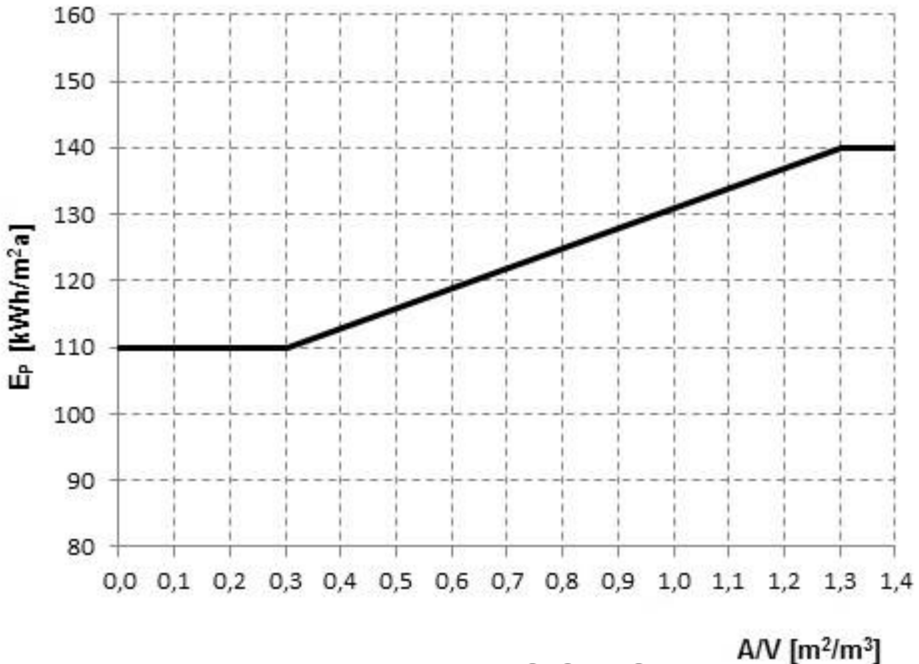




From 2018

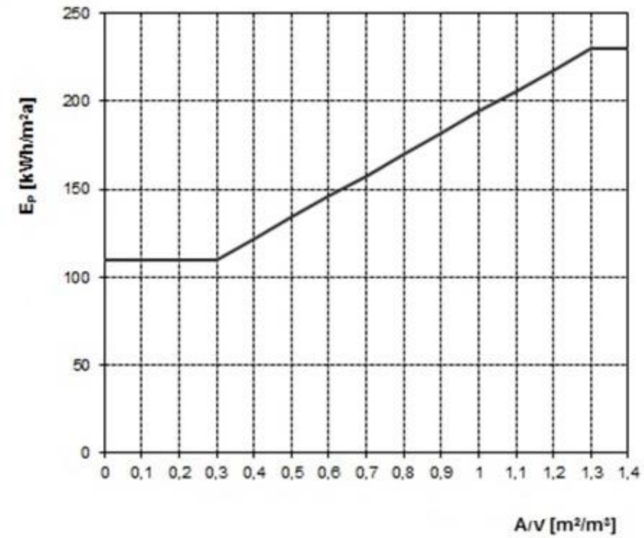
Now

# NEARLY ZERO ENERGY RESIDENTIAL BUILDINGS

Specific primary energy consumption




From 2018




Now

REHVA

# Comfort requirements MSZ EN15251

| Type of building or space | Category | Temperature range for heating, °C<br>Clothing ~ 1,0 clo | Temperature range for cooling, °C<br>Clothing ~ 0,5 clo |
|---|---|---|---|
| Residential buildings, living spaces (bed room's living rooms etc.)<br>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.)<br>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,<br>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<br>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<br>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 $l/sm^2$ 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.

SOLANOVA

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

University of Kassel
TU of Budapest

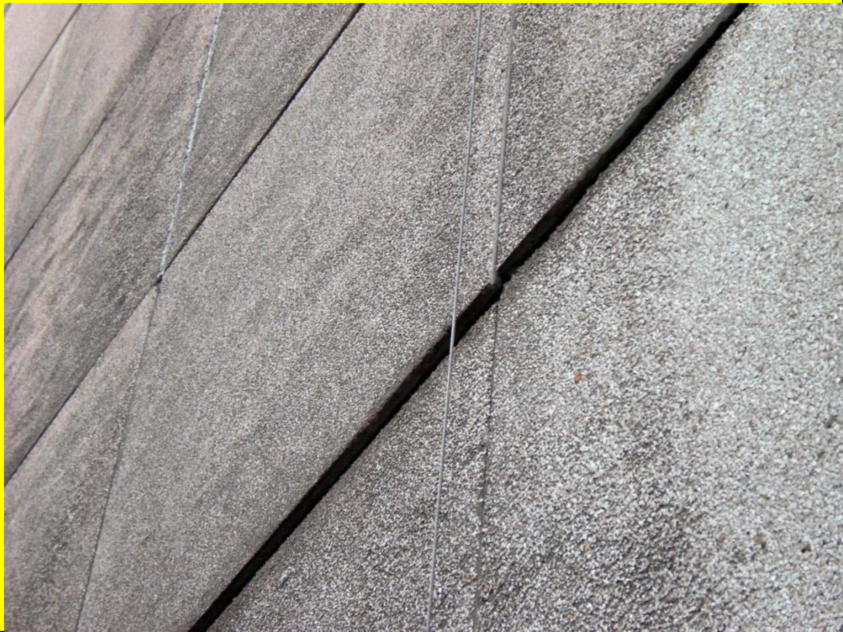
http://www.solanova.eu/

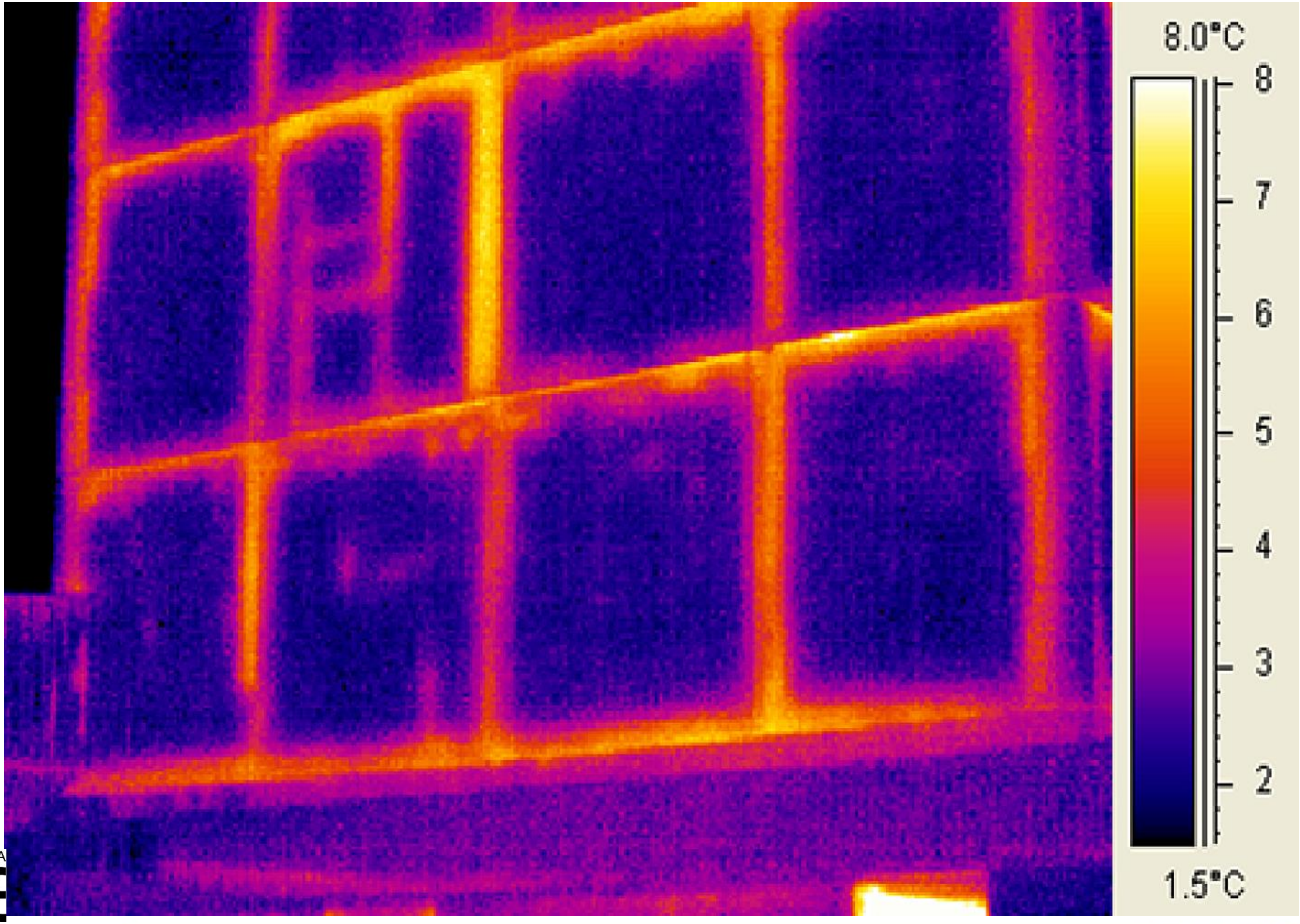
FP 5 of EC, 2004

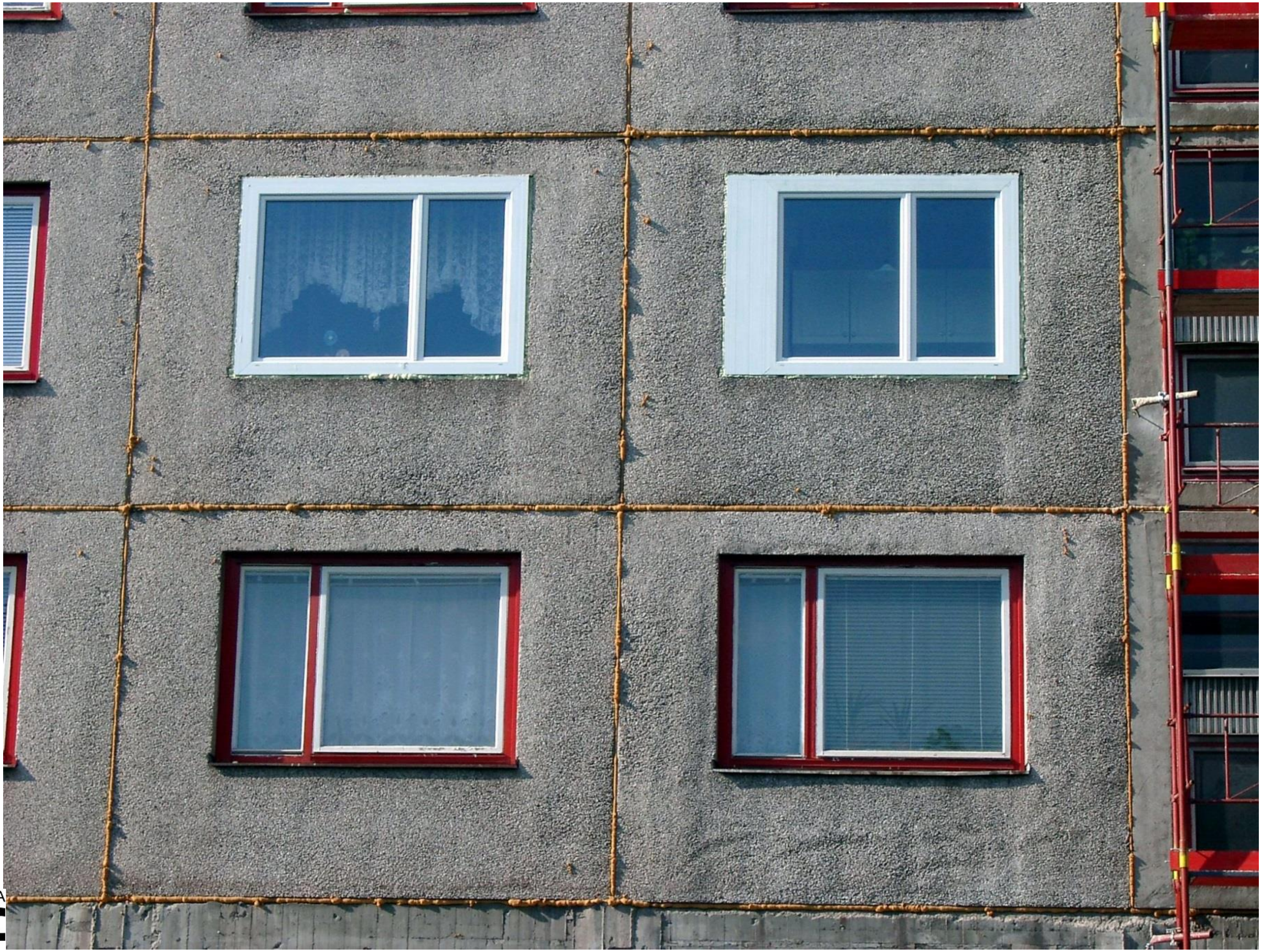
Dunaújváros, Hungary

Sources of SOLANOVA: Miklos Osztroluczky

# $U_{wall}$ = 1,80 W/m²K




8.0°C
8
7
6
5
4
3
2
1.5°C

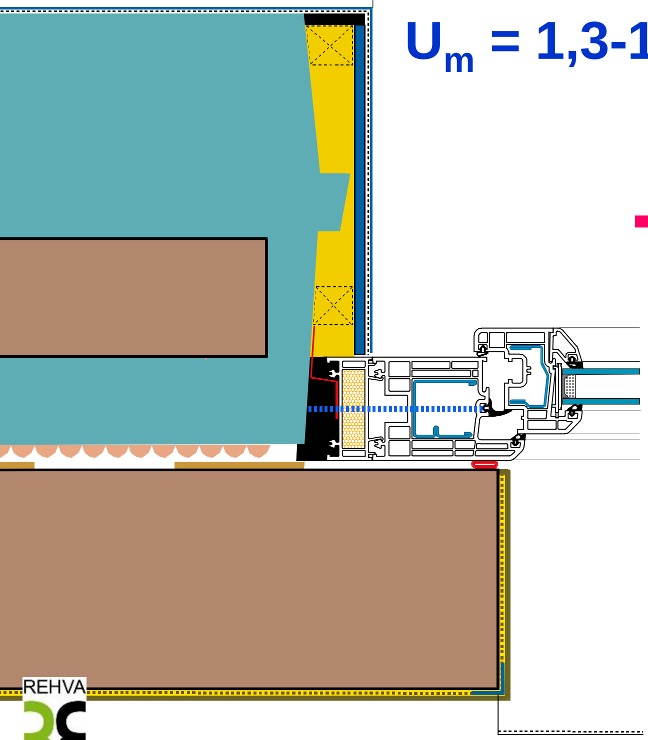


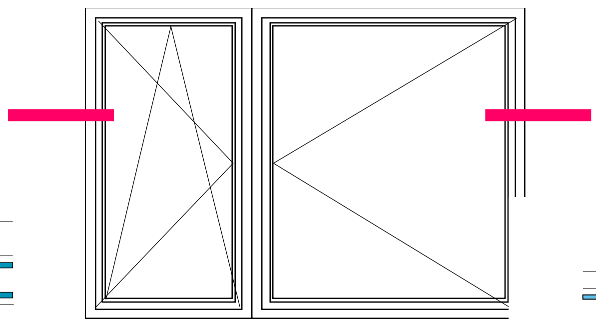
16 cm insulation

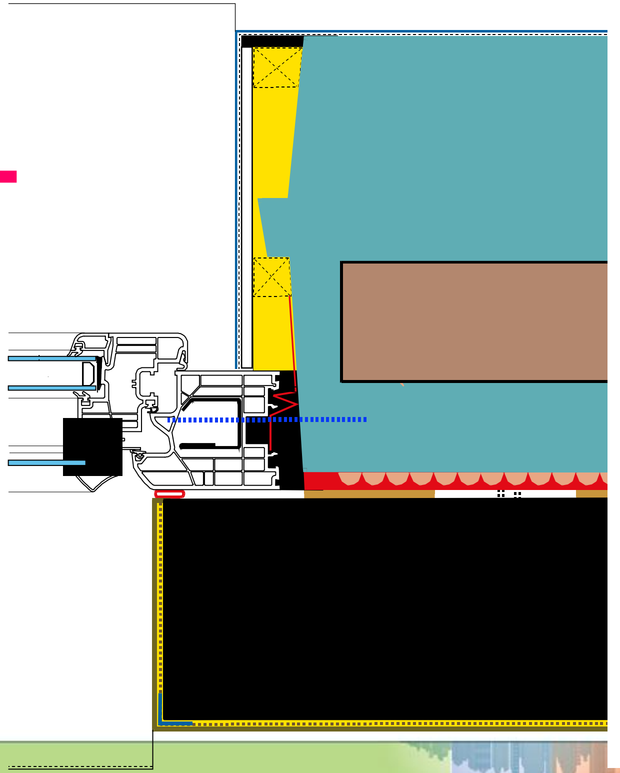
# Windows

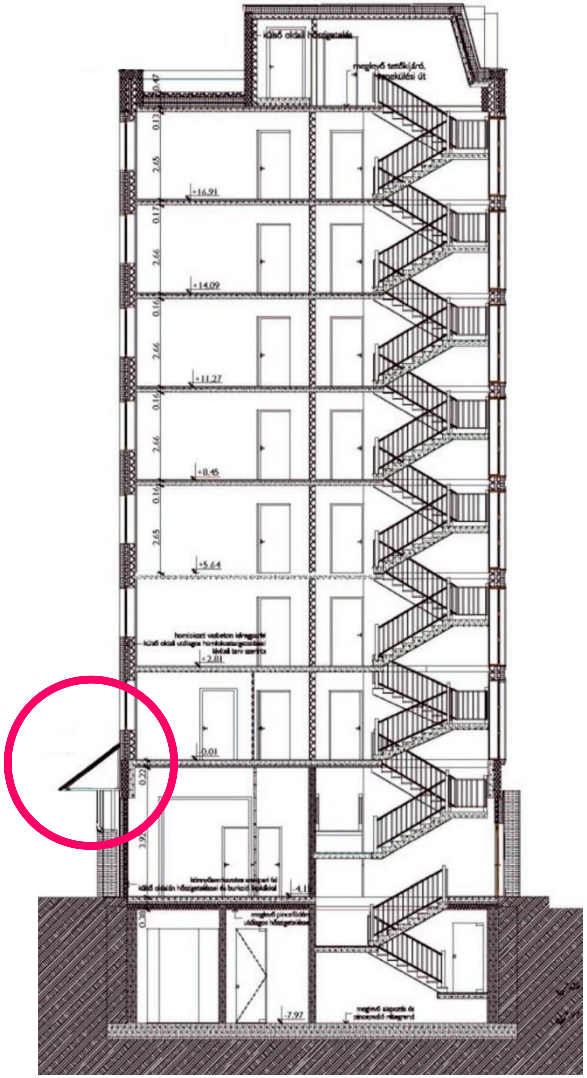
**INTERNORM**
**COMPACT+**
**$U_m$ = 1,3-1,4 W/m²K**

INTERNORM
DIMENSION4 CR
$U_m$ = 1,0 W/m²K

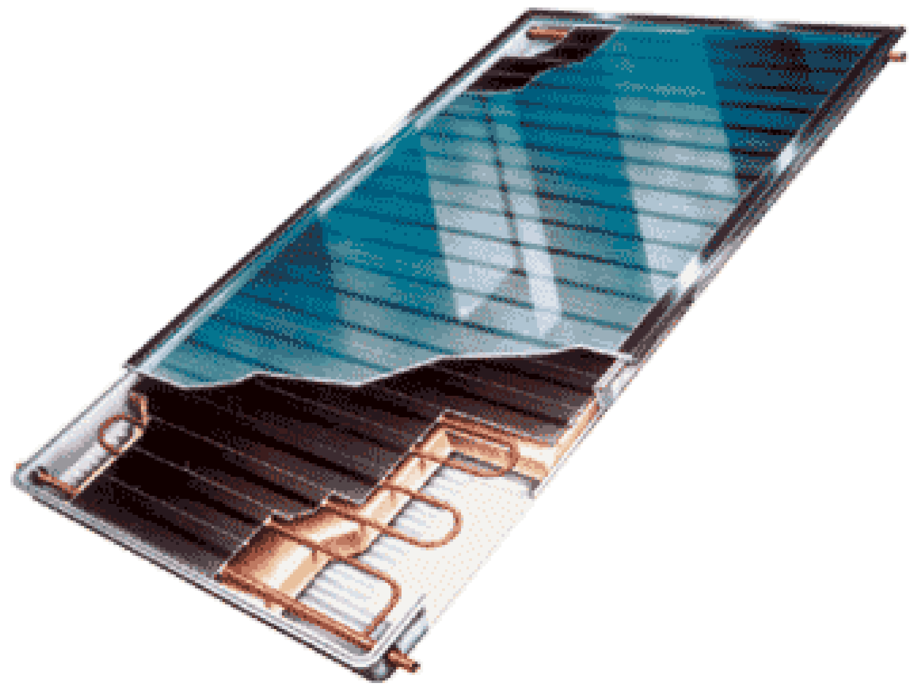


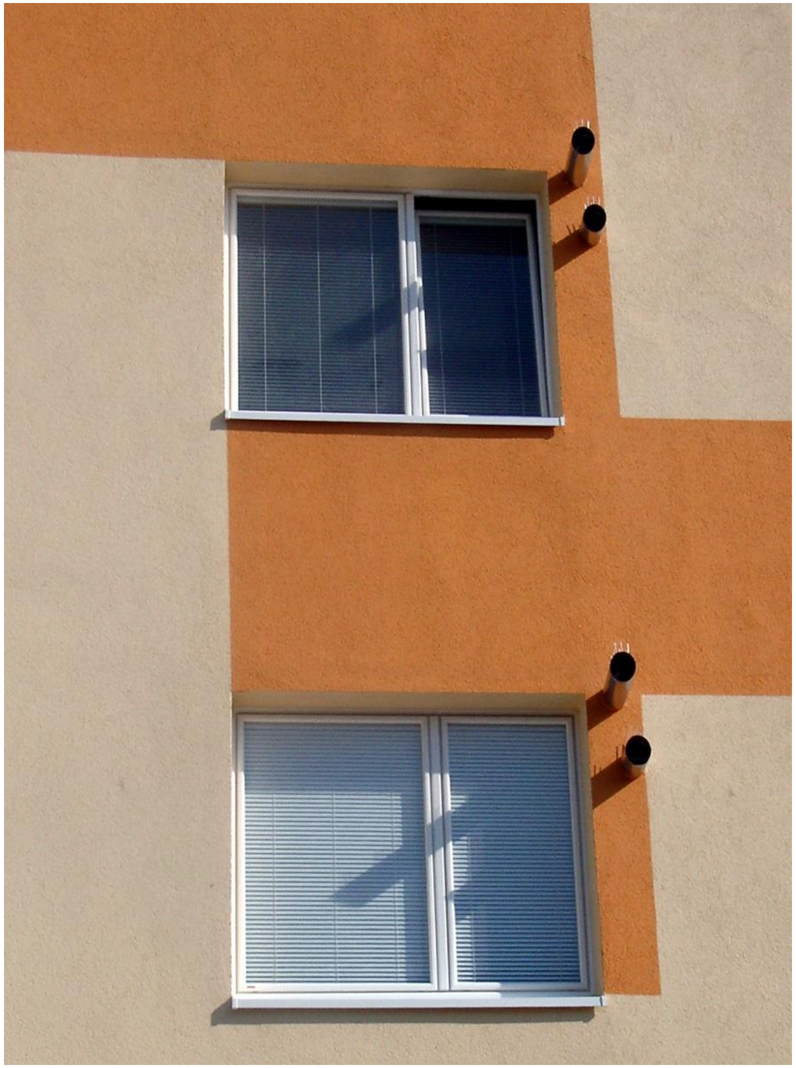




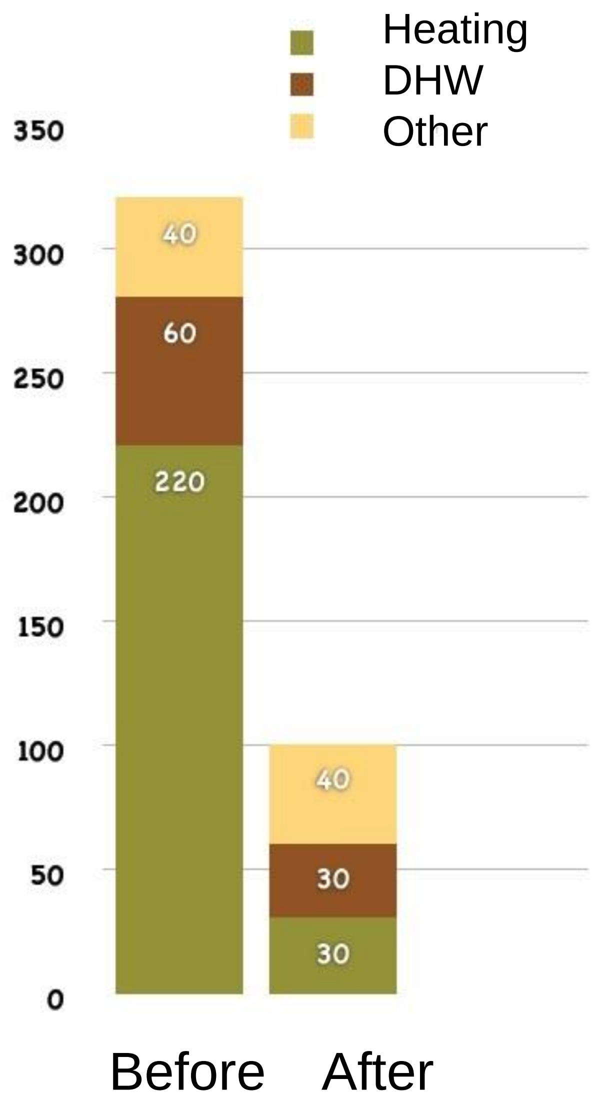


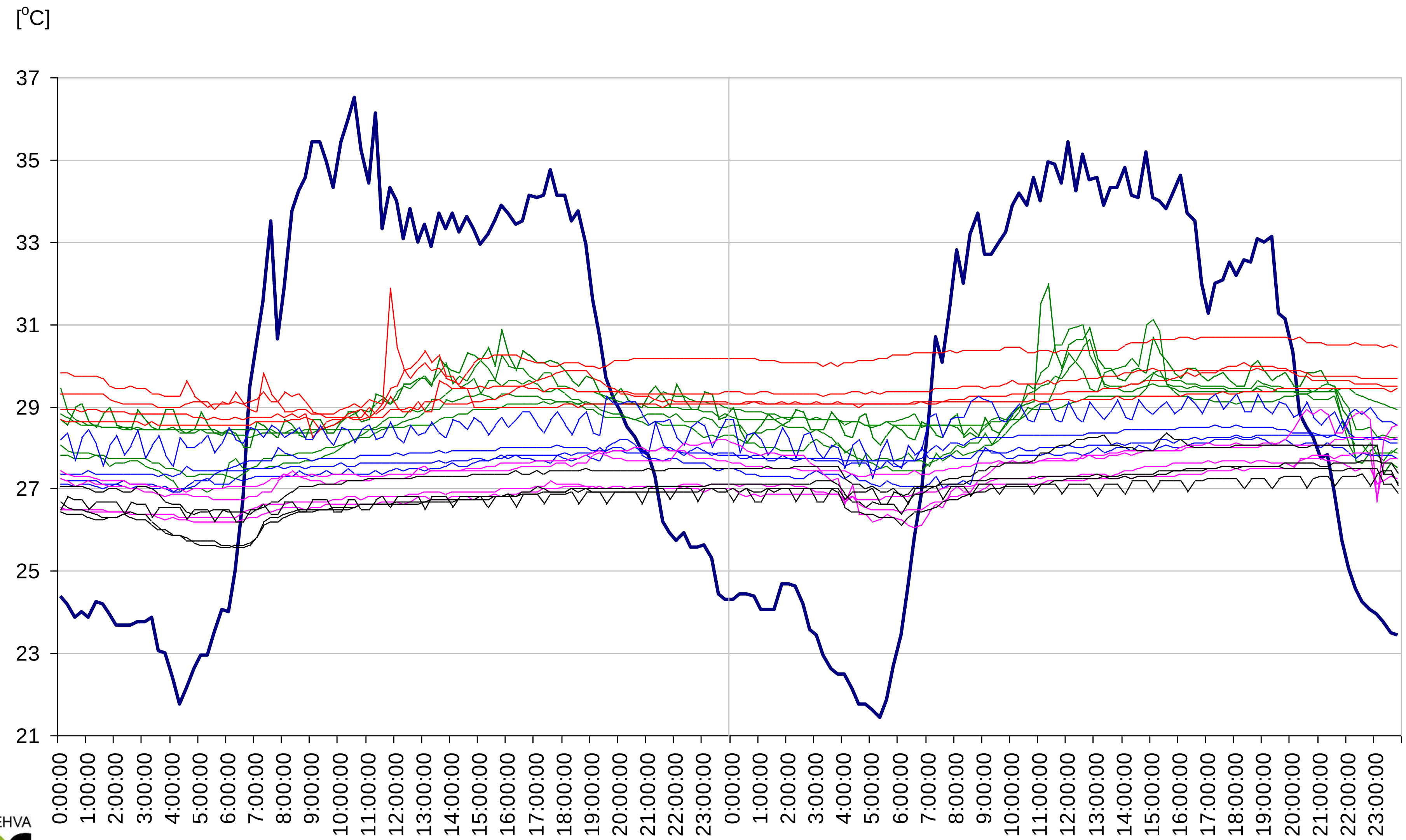
# Solar collectors





# Energy consumption in kWh/m2,a




[°C]
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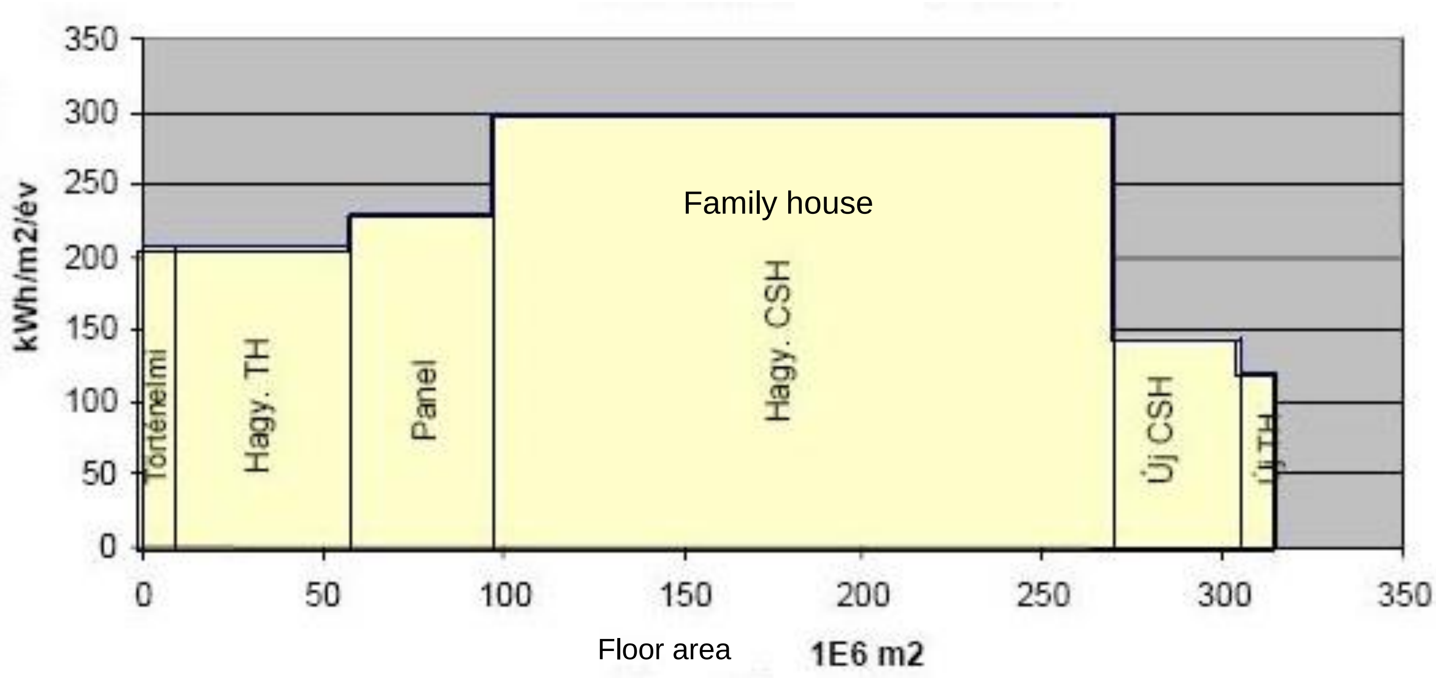
# Hungarian residential building stock



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

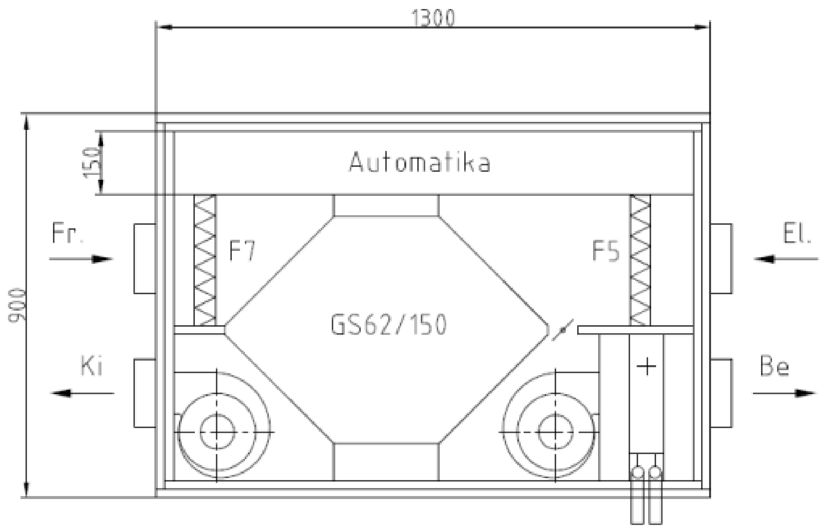
Veszprem, Hungary

Built in 1974
20 levels
130 apartments
E = 168 $kWh/m^2$,a (F category)

Built using industrialised technology

# Energy retrofitting:

- Insulation of the wall (20 cm U=0,2 W/m$^2$,K)
- Insulation of the roof (U=0,16 W/m$^2$,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 %

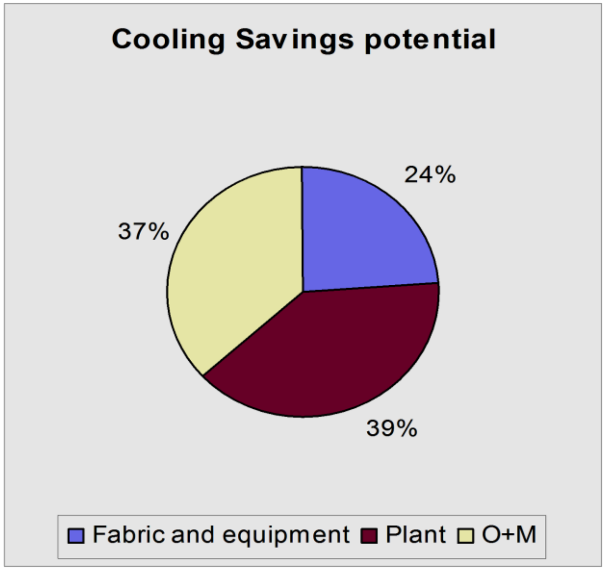
iSERV Inspection of HVAC systems through continuous monitoring and benchmarking

www.iservcmb.info

Co-ordinator: Prof. Ian Knight

Cardiff University, UK

2012 - 2014

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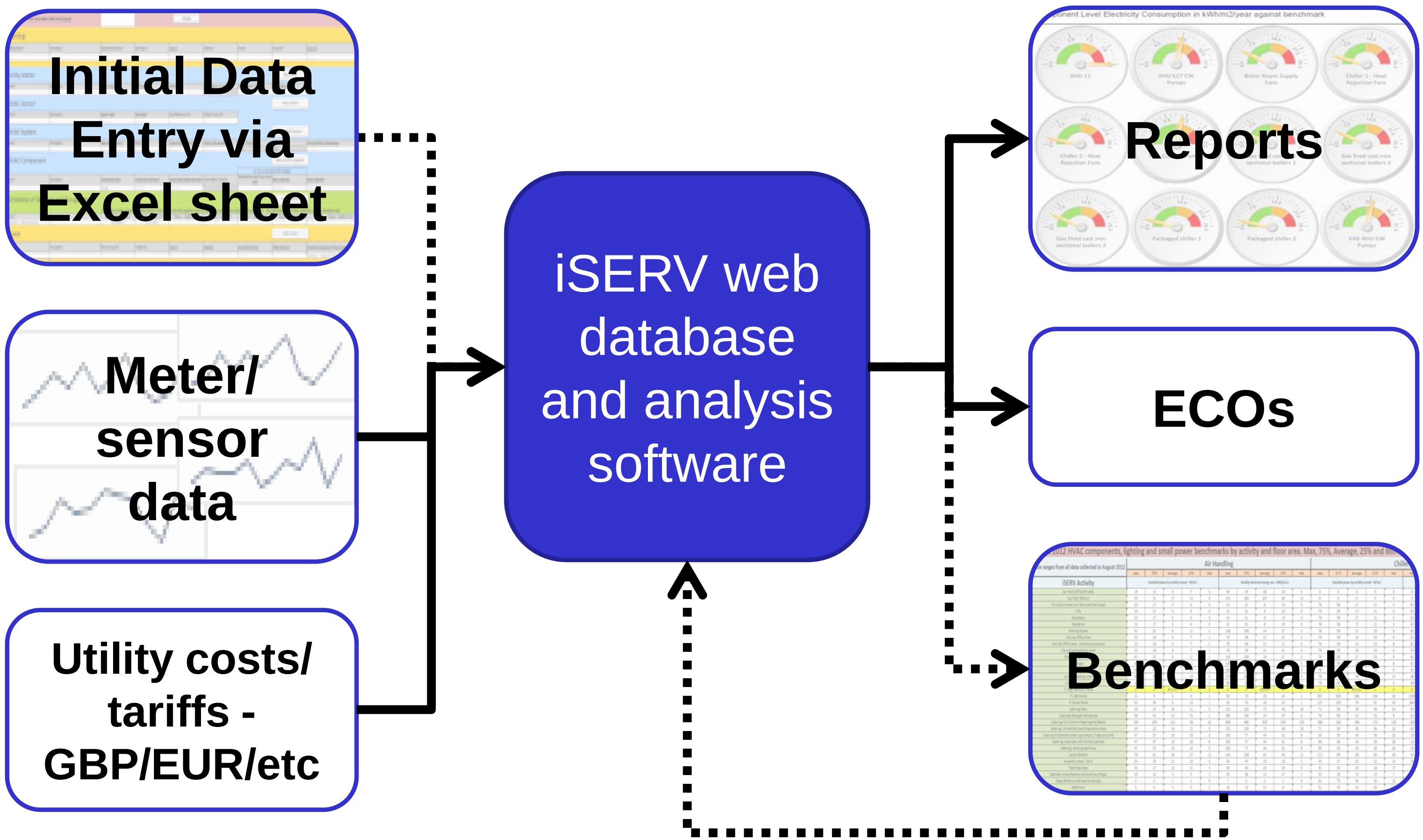
# Overview of basic process



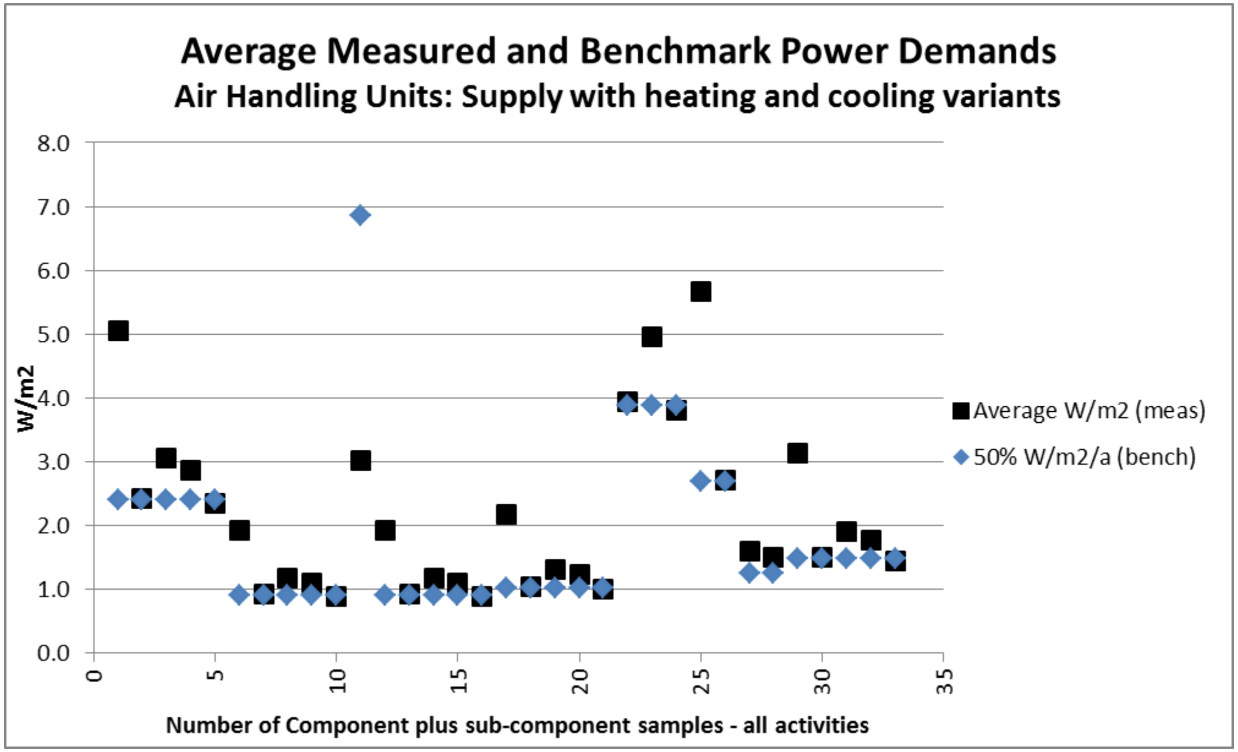
# Collect information on the building

- 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

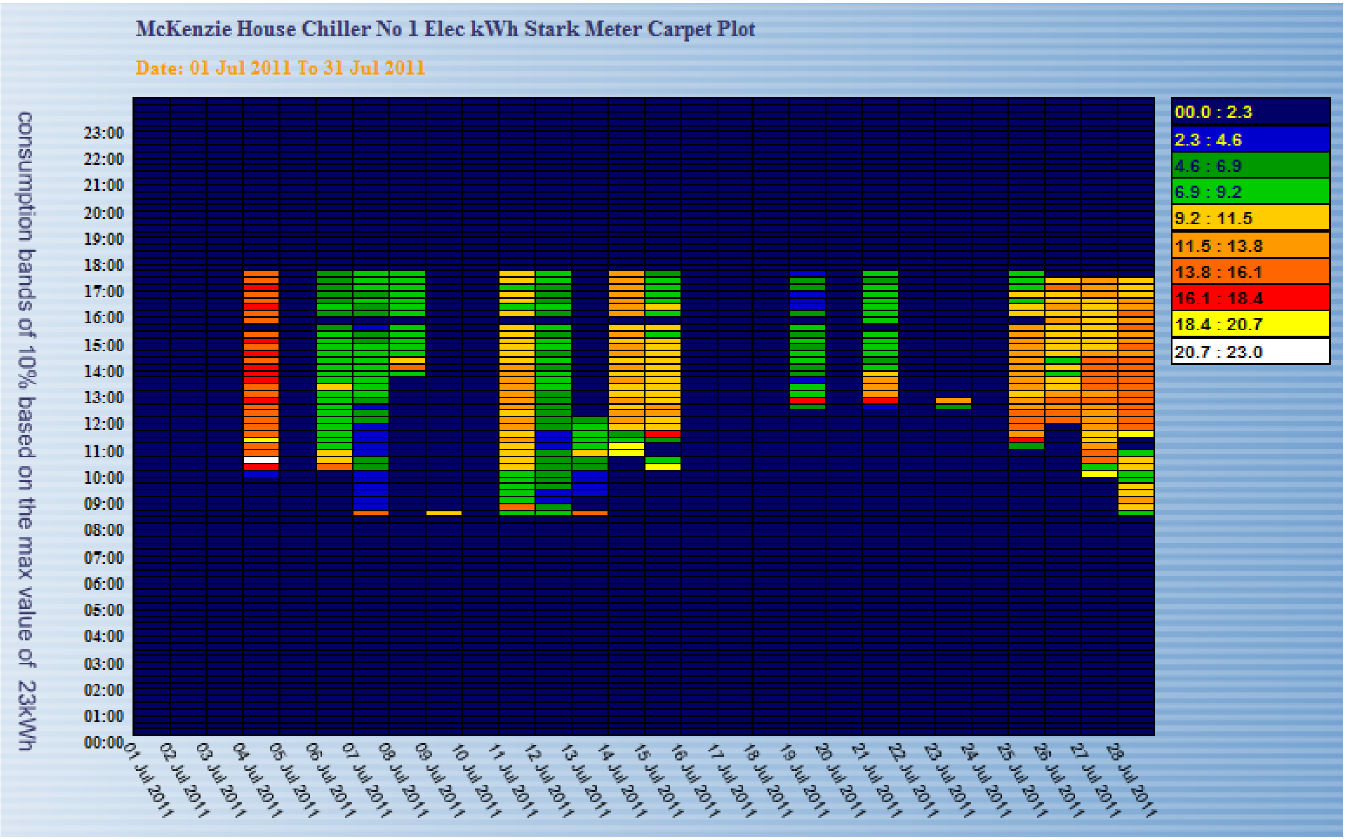

# Benchmarks

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



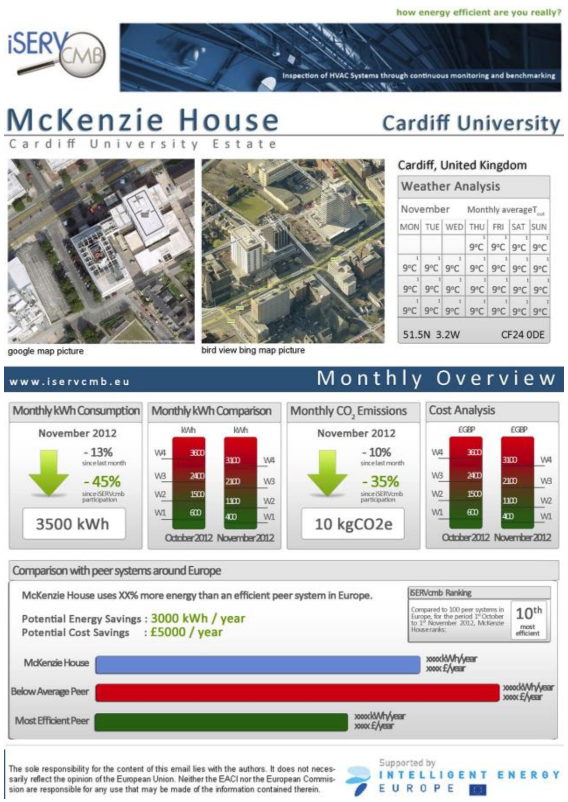
# Identification of Energy Conversation Opportunities (ECOs)

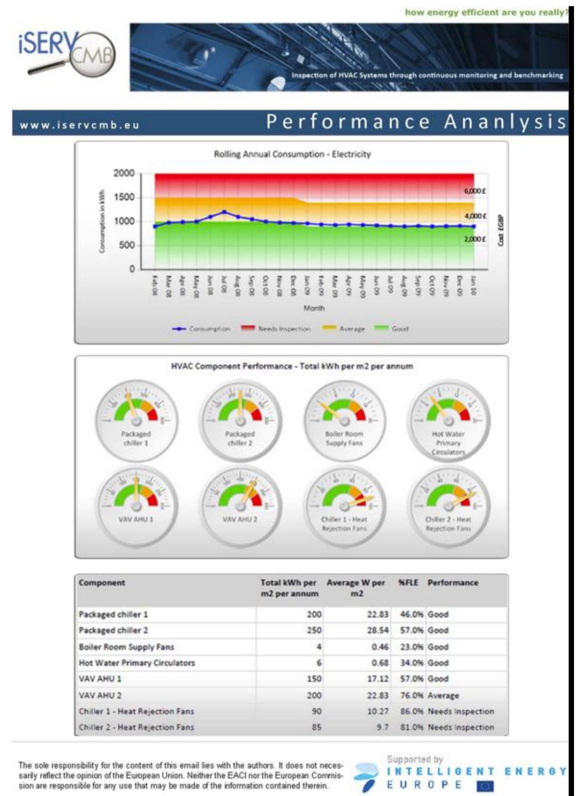


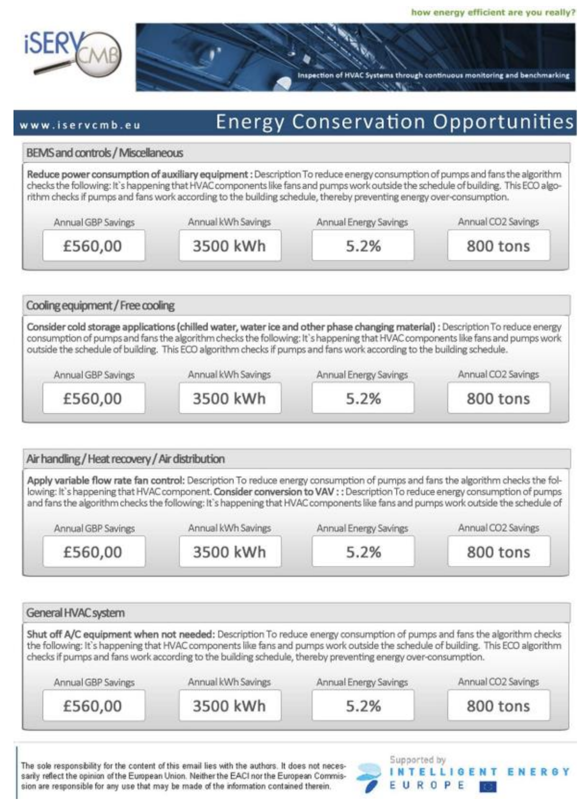
# Reports

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.



# Monitoring savings: Case Studies

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

Building electrical savings/$m^2$ between 61 to 100 kWh/$m^2$/a

In economic terms:

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