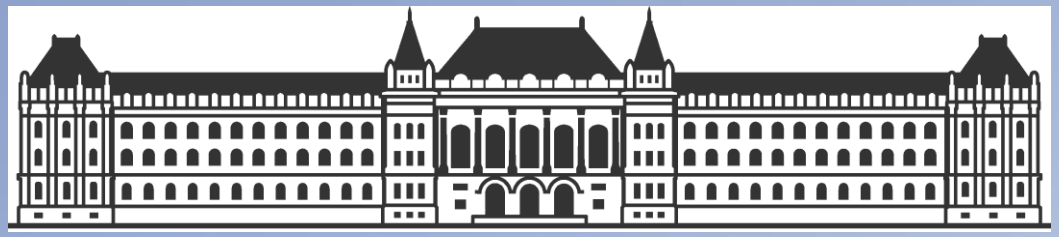

Budapest University of Technology and Economics

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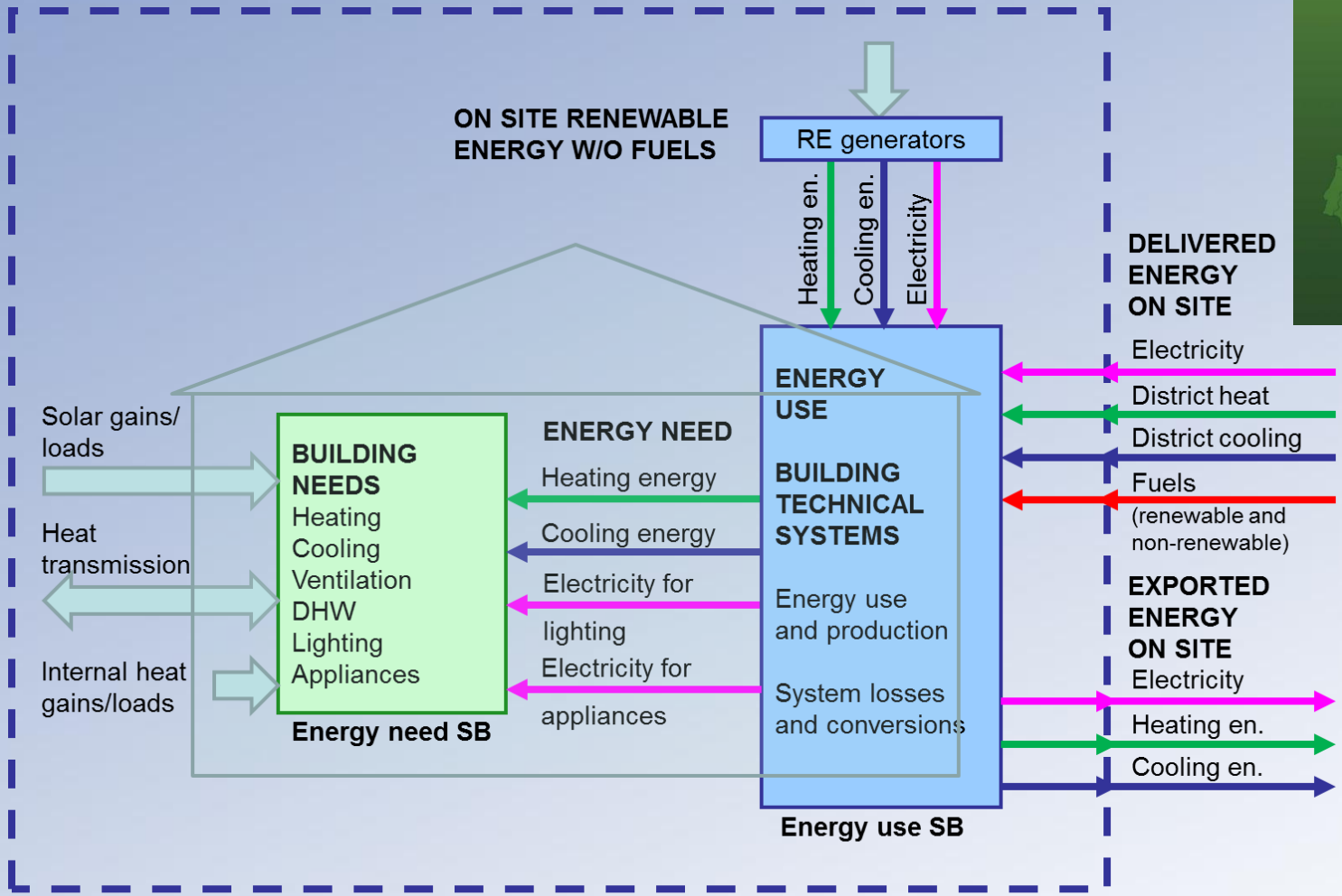
Step to the active smart building with continuous monitoring

RCEPB, Bucharest, 5 June, 2014

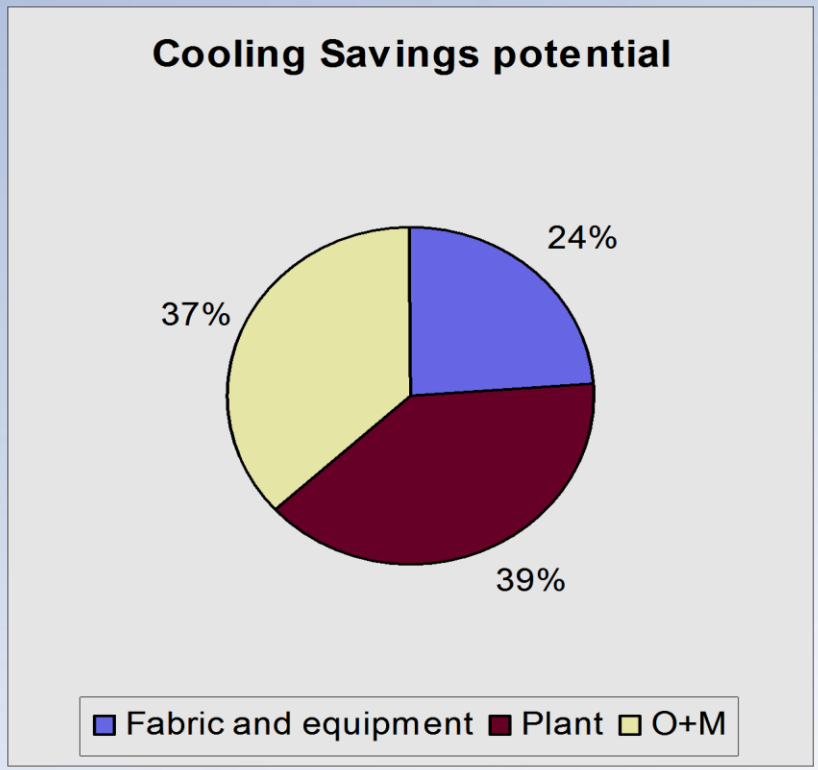
Active smart building



Context: Potential Energy Saving

Potential for savings through:

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



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

EU Directives

- Energy Performance of Building Directive EPBD 2002/91/EC
- Ecodesign of Energy Using Products Directive 2009/125/EC
- Energy Labelling Directive 2010/30/EU
- EPBD „recast” 2010/31/EU
- Energy Efficiency Directive EED 2012/27/EC

Acknowledgements

iSERV Inspection of HVAC systems through continuous monitoring and benchmarking

www.iservcmb.info

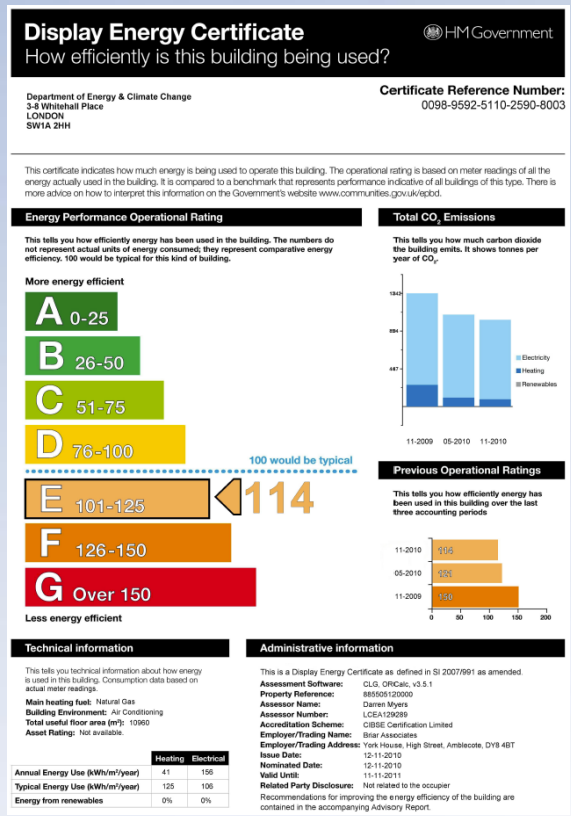
Co-ordinator: Prof. Ian Knight

Cardiff University, UK

2012 - 2014

A 20th Century approach to a 21st Century problem

- Most EU MS Legislation aimed at reducing energy use looks at whole buildings and annual energy use due to the availability of billing meters for most buildings.
- So we know WHAT we are using, but not WHY we are using it.
- Current processes do not show what is possible to achieve with our actual existing building and activity mixes.
- Most organisations JUST comply with legislation, i.e. they spend time and money on compliance exercises but not improving their energy use in a robust manner.



Display Energy Certificate
How efficiently is this building being used?

HM Government

Department of Energy & Climate Change
3-8 Whitehall Place
LONDON
SW1A 2HH

Certificate Reference Number:
0098-9592-5110-2590-8003

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

100 would be typical
114

Less energy efficient

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2

Electricity
Heating
Renewables

11-2009 05-2010 11-2010

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods

11-2010 106
05-2010 121
11-2009 150

0 50 100 150 200

Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual meter readings.

Main heating fuel: Natural Gas
Building Environment: Air Conditioning
Total useful floor area (m²): 10960
Asset Rating: Not available.

	Heating	Electrical
Annual Energy Use (kWh/m²/year)	41	156
Typical Energy Use (kWh/m²/year)	125	106
Energy from renewables	0%	0%

Administrative information

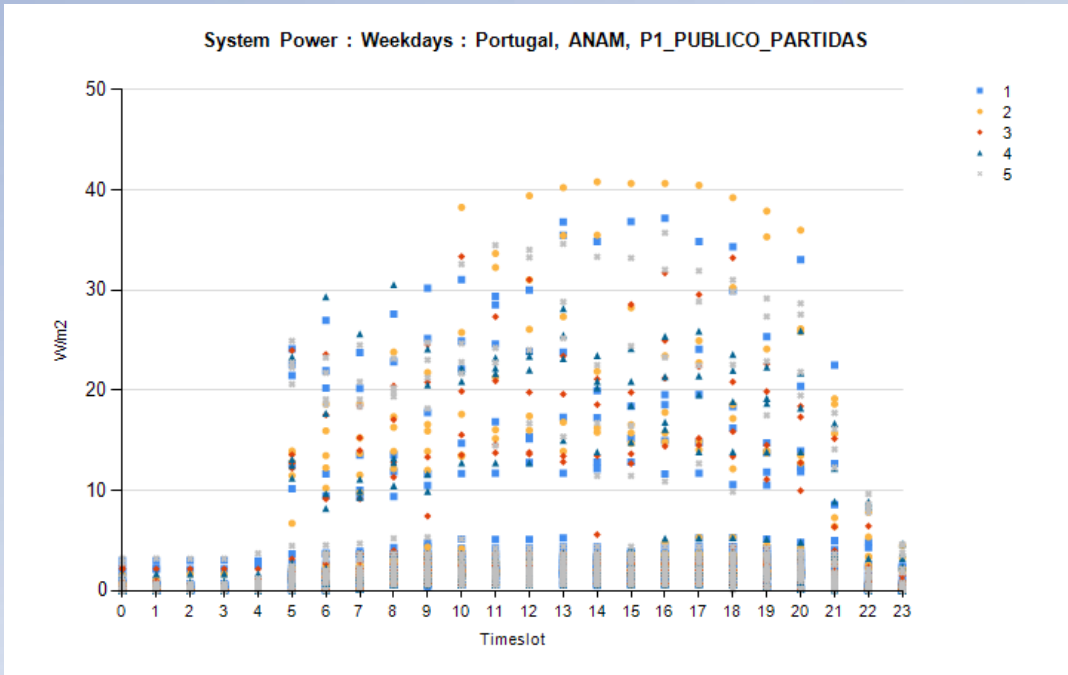
This is a Display Energy Certificate as defined in SI 2007/991 as amended.

Assessment Software: CLG, ORCalc, v3.5.1
Property Reference: 88850512000
Assessor Name: Darren Myers
Assessor Number: LCEA129289
Accreditation Scheme: CIBSE Certification Limited
Employer/Trading Name: Briar Associates
Employer/Trading Address: York House, High Street, Ambelcote, DY8 4BT
Issue Date: 12-11-2010
Nominated Date: 12-11-2010
Valid Until: 11-11-2011
Related Party Disclosure: Not related to the occupier

Recommendations for improving the energy efficiency of the building are contained in the accompanying Advisory Report.

A 21st Century approach to a 21st Century problem

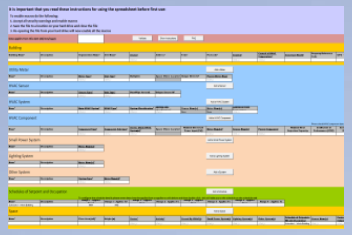
- New data sources now allow us detailed insights into how energy is used at sub-hourly intervals and by end uses.
- This level of detail is sufficient to provide confidence in what needs to be done to reduce energy use.



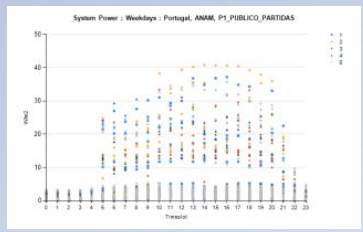
- iSERV utilises these new data sources to show how such a new approach might work - from defining the buildings through to how it might work with legislation.

The iSERV recipe

A Spreadsheet

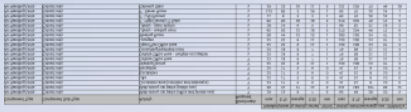


\+ Sub-hourly data

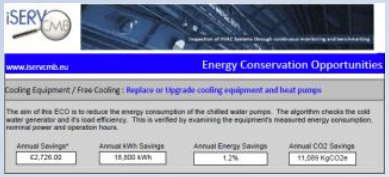


\+ A database

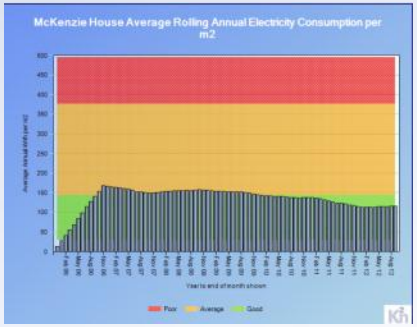
\+ Component benchmarks



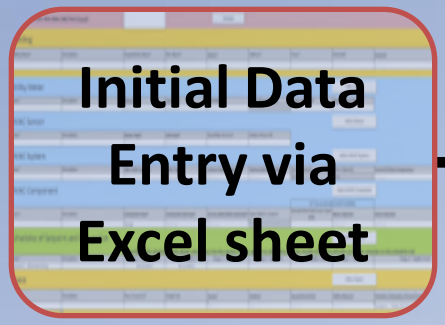
\+ Targeted reports

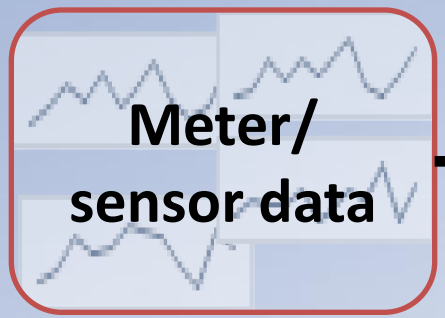


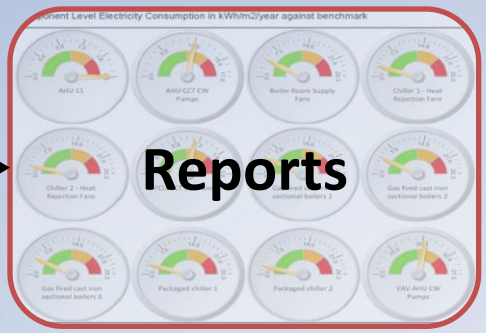
= Energy savings

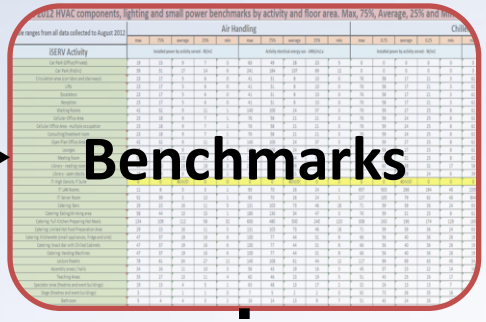


Overview of basic process



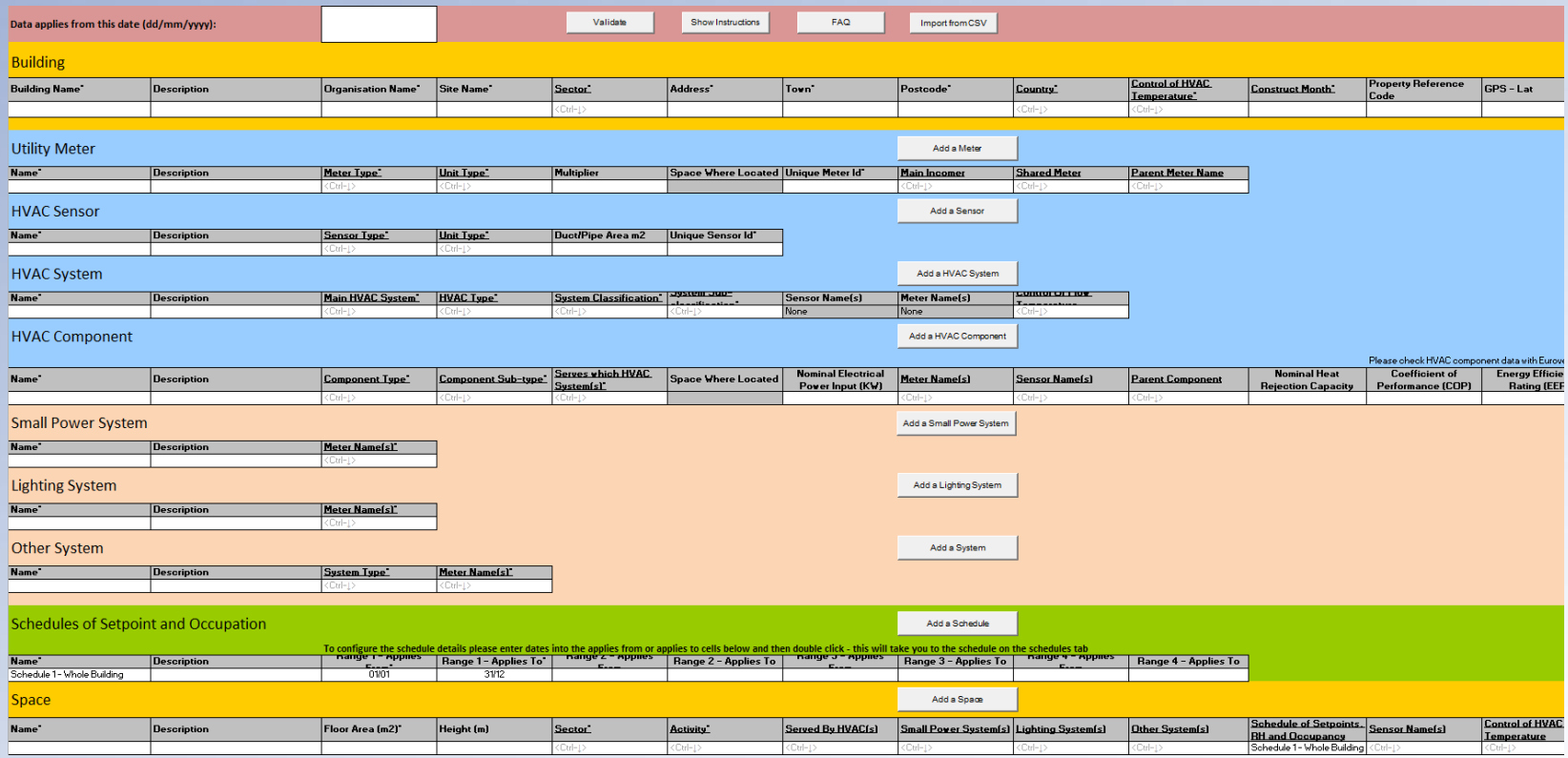






Collate information on the building

- iSERV has set up a spreadsheet to act as a data collection focus for the building, meters and services physical elements
- The spreadsheet also acts as a means of **connecting** all the elements together



Data applies from this date (dd/mm/yyyy):

Validate | Show Instructions | FAQ | Import from CSV

Building

Building Name*	Description	Organisation Name*	Site Name*	Sector*	Address*	Town*	Postcode*	Country*	Control of HVAC Temperature*	Construct Month*	Property Reference Code	GPS – Lat
				<Ctrl-j>				<Ctrl-j>	<Ctrl-j>			

Utility Meter — Add a Meter

Name*	Description	Meter Type*	Unit Type*	Multiplier	Space Where Located	Unique Meter Id*	Main Incomer	Shared Meter	Parent Meter Name
		<Ctrl-j>	<Ctrl-j>				<Ctrl-j>	<Ctrl-j>	<Ctrl-j>

HVAC Sensor — Add a Sensor

Name*	Description	Sensor Type*	Unit Type*	Duct/Pipe Area m2	Unique Sensor Id*
		<Ctrl-j>	<Ctrl-j>		

HVAC System — Add a HVAC System

Name*	Description	Main HVAC System*	HVAC Type*	System Classification*	System Sub-Classification*	Sensor Name(s)	Meter Name(s)	Control of Flow Temperature*
		<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	None	None	<Ctrl-j>

HVAC Component — Add a HVAC Component

Please check HVAC component data with Eurov

Name*	Description	Component Type*	Component Sub-type*	Serves which HVAC System(s)*	Space Where Located	Nominal Electrical Power Input (KW)	Meter Name(s)	Sensor Name(s)	Parent Component	Nominal Heat Rejection Capacity	Coefficient of Performance (COP)	Energy Efficie Rating (EEF
		<Ctrl-j>	<Ctrl-j>	<Ctrl-j>			<Ctrl-j>	<Ctrl-j>	<Ctrl-j>			

Small Power System — Add a Small Power System

Name*	Description	Meter Name(s)*
		<Ctrl-j>

Lighting System — Add a Lighting System

Name*	Description	Meter Name(s)*
		<Ctrl-j>

Other System — Add a System

Name*	Description	System Type*	Meter Name(s)*
		<Ctrl-j>	<Ctrl-j>

Schedules of Setpoint and Occupation — Add a Schedule

To configure the schedule details please enter dates into the applies from or applies to cells below and then double click - this will take you to the schedule on the schedules tab

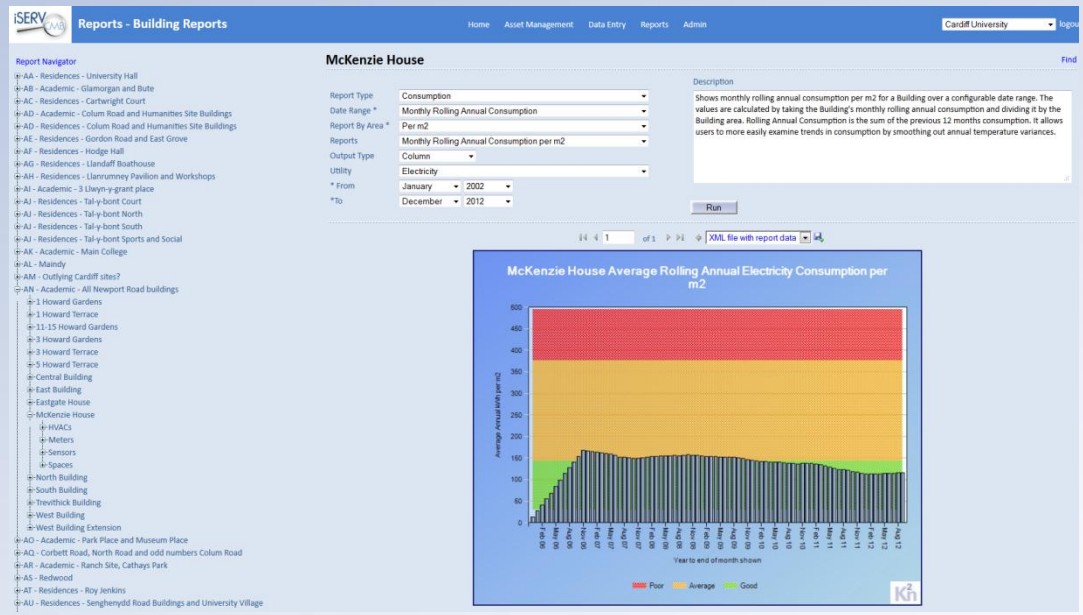
Name*	Description	Range 1 – Applies From*	Range 1 – Applies To*	Range 2 – Applies From*	Range 2 – Applies To	Range 3 – Applies From*	Range 3 – Applies To	Range 4 – Applies From*	Range 4 – Applies To
Schedule 1 - Whole Building		01/01	31/12						

Space — Add a Space

Name*	Description	Floor Area (m2)*	Height (m)	Sector*	Activity*	Served By HVAC(s)	Small Power System(s)	Lighting System(s)	Other System(s)	Schedule of Setpoints, BH and Occupancy	Sensor Name(s)	Control of HVAC Temperature
				<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	<Ctrl-j>	Schedule 1 - Whole Building	<Ctrl-j>	<Ctrl-j>

Database

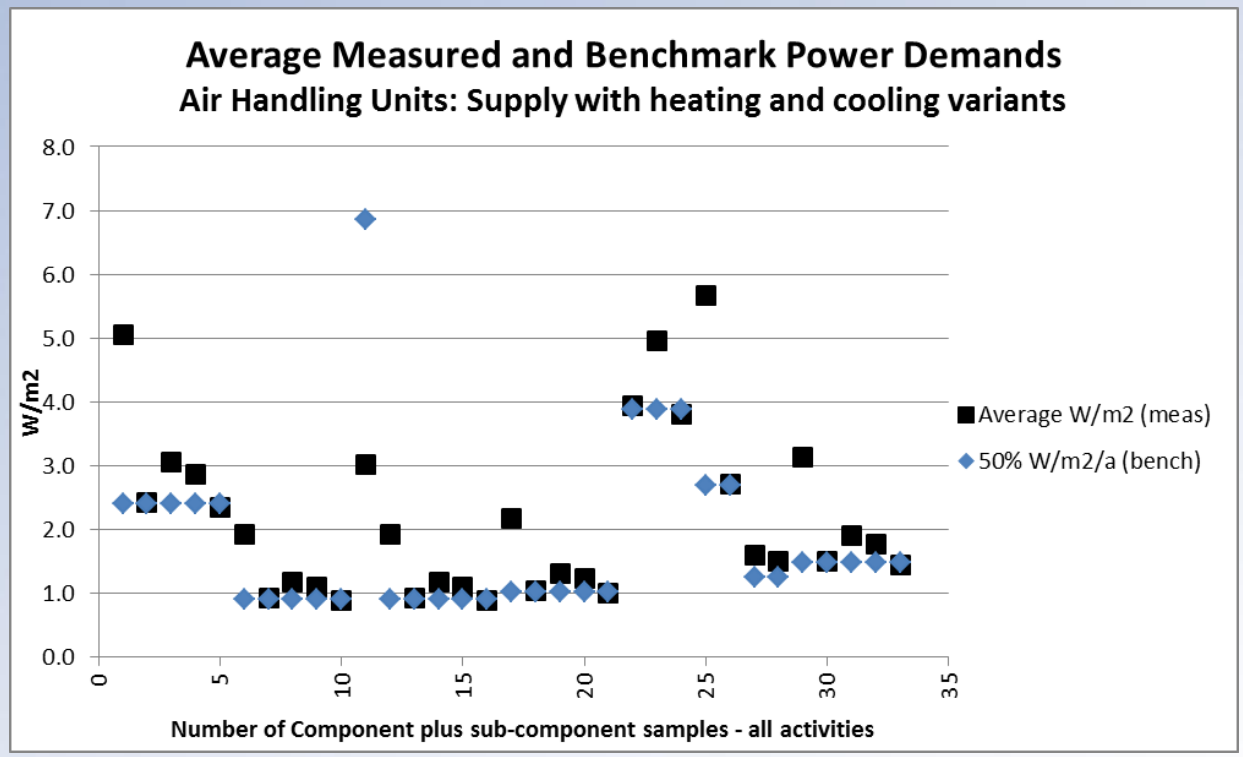
- A bespoke database has been written for the project
- Based on a commercial product
- Acts as the focus for the iSERV project elements:
  - Data collection
  - Benchmark use
  - Benchmark generation
  - Reports
  - Energy Conservation Opportunity algorithms



Benchmarks

Three types of benchmark being produced and explored:

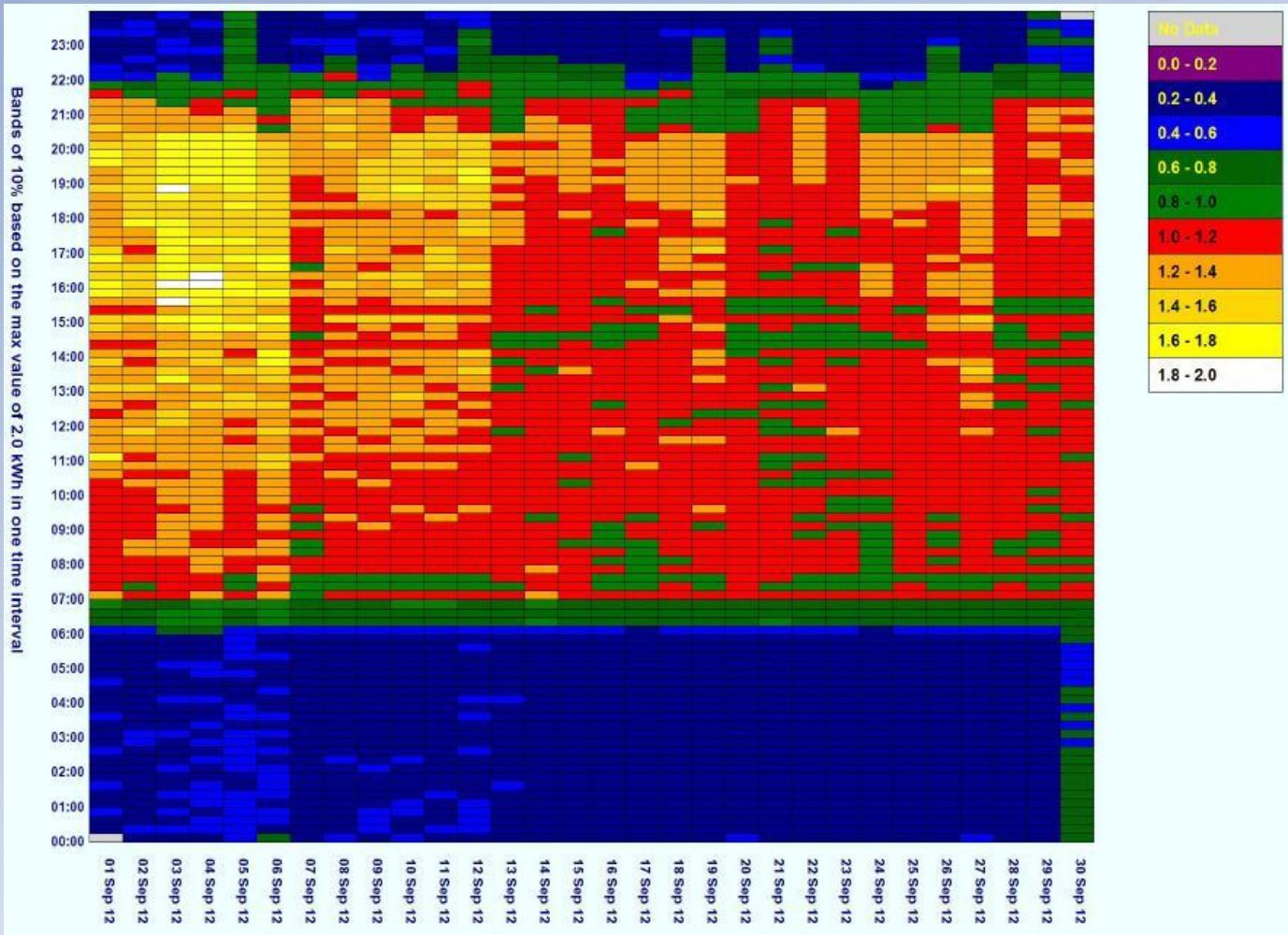
- Annual energy/m^2 – $kWh/m^2.a$
- Monthly energy/m^2 – $kWh/m^2.month$
- Power demands/m^2 – W/m^2



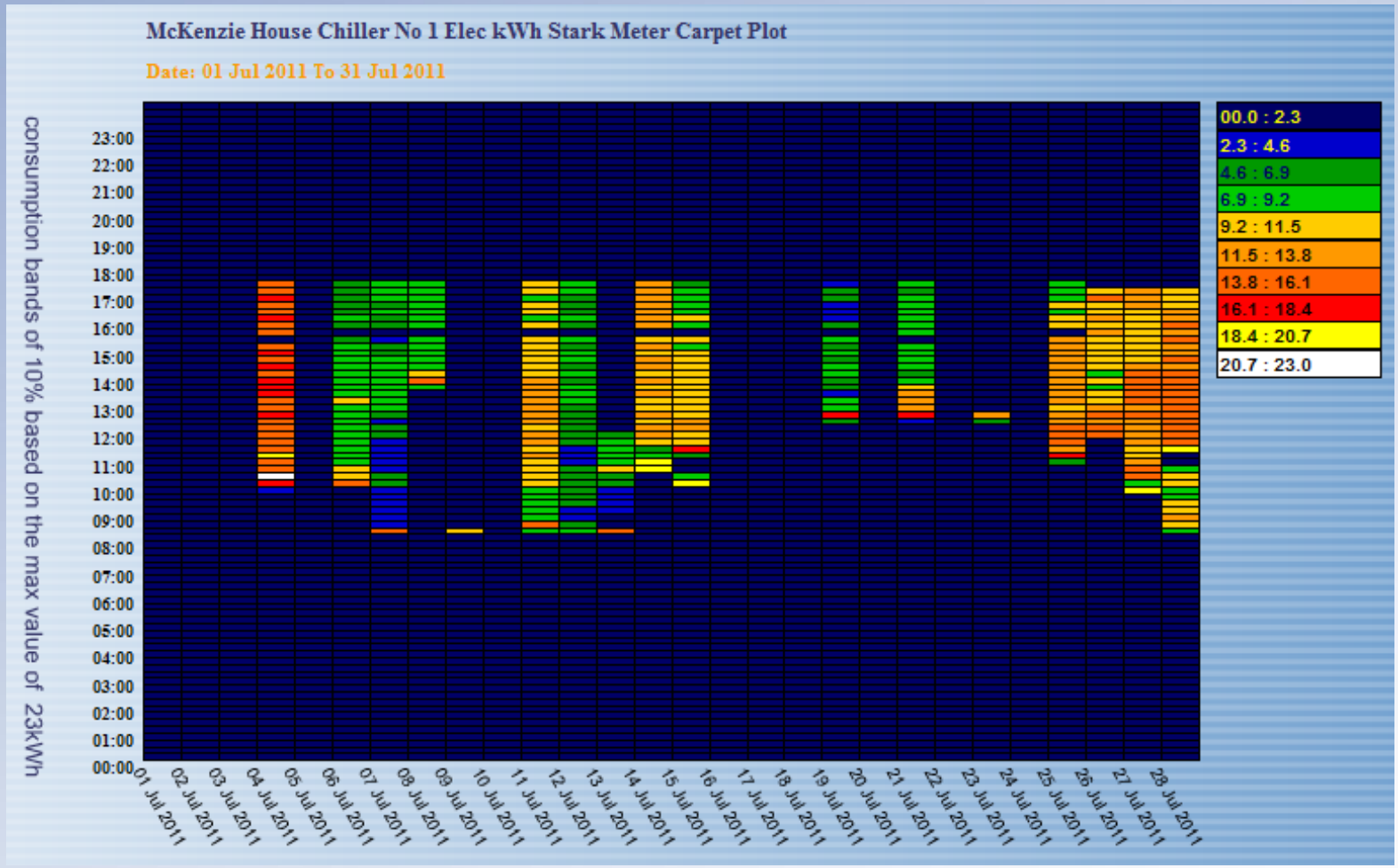
Three ways to save energy – regularly show performance

- Regularly show performance against benchmarks derived from the spreadsheet description of the building and services
- Benchmarks will evolve over time as the buildings / components providing data change their performance – so benchmarks always reflect current practice

Identification of Energy Conversation Opportunities (ECOs)

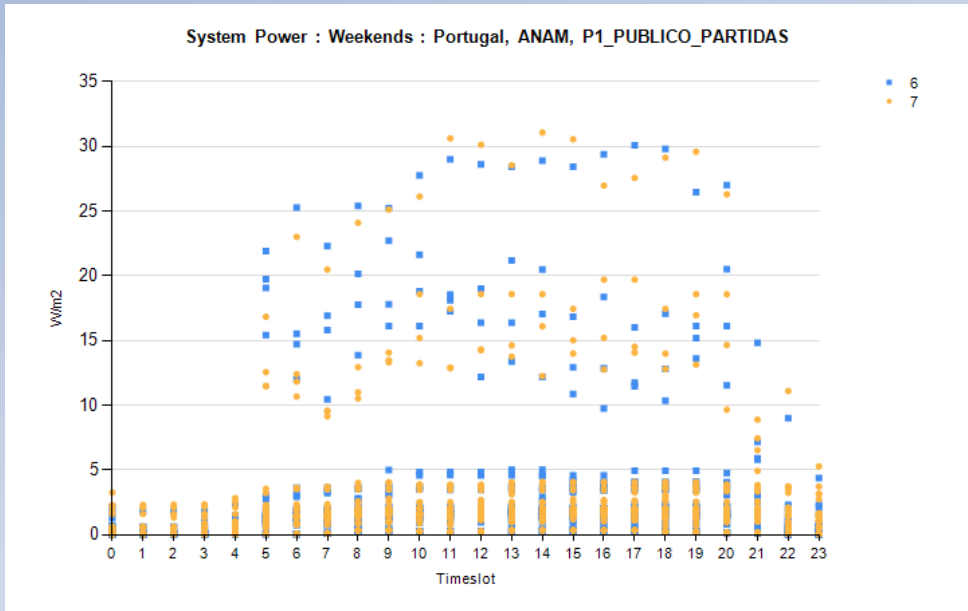


Identification of Energy Conversation Opportunities (ECOs)



Three ways to save energy – better control of existing plant

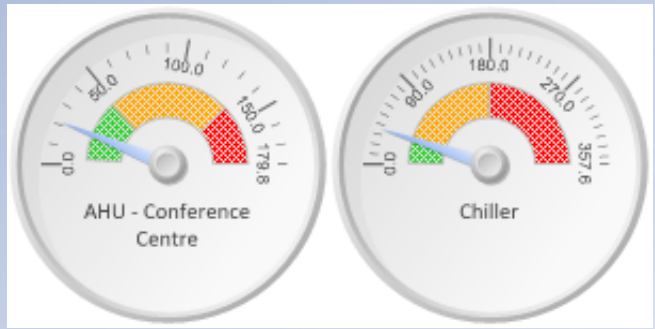
- Better control of what you already have e.g. use of ECO algorithms or scatter graphs/carpet plots to identify when systems and components are running outside of expected hours

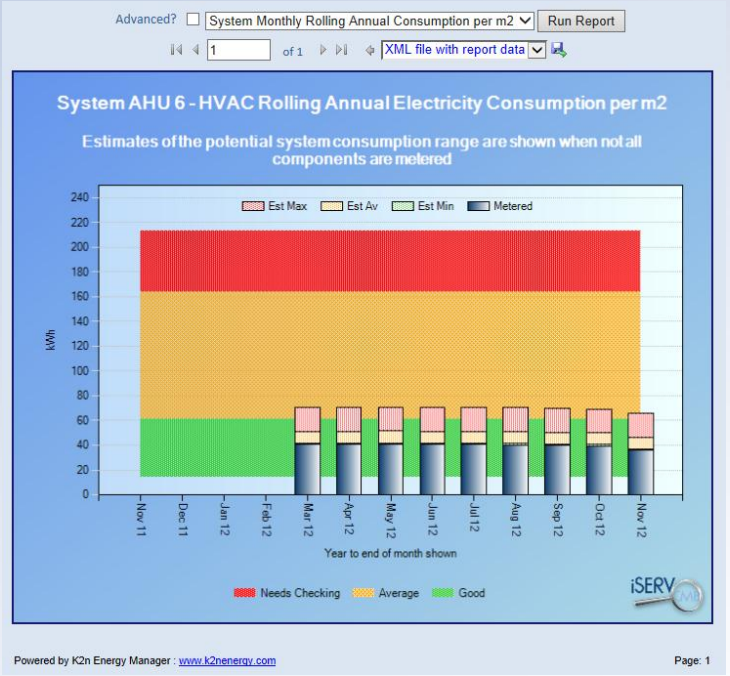


- Clearly shows what could be controlled better
- Can use the data directly to calculate potential savings

Three ways to save energy – install more efficient equipment

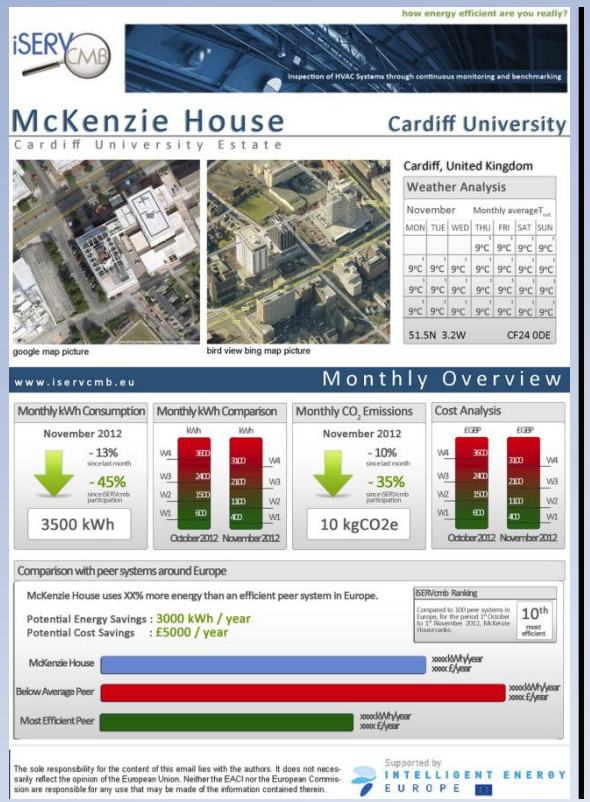
- **Install more efficient equipment**. Even if equipment is well controlled it may well require more power when in use than more modern equipment
- Benchmarks based on power demands when in use can help show this difference and when equipment might benefit from being upgraded

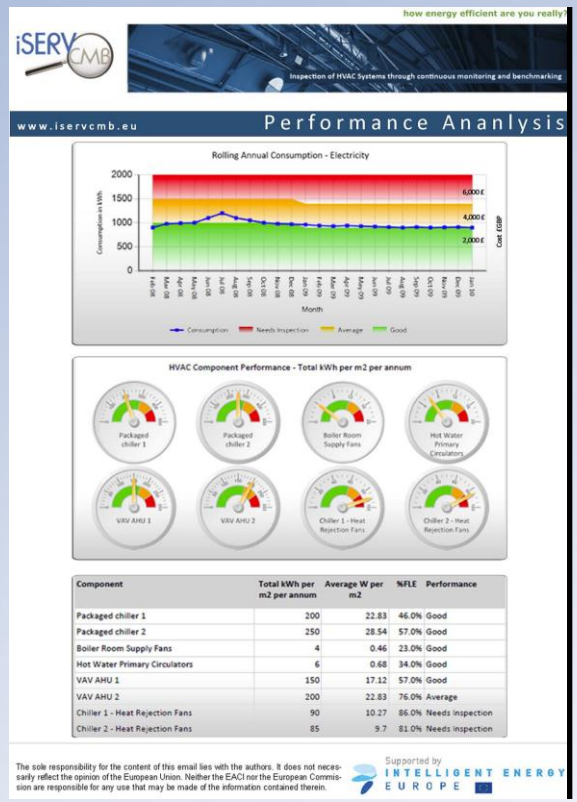


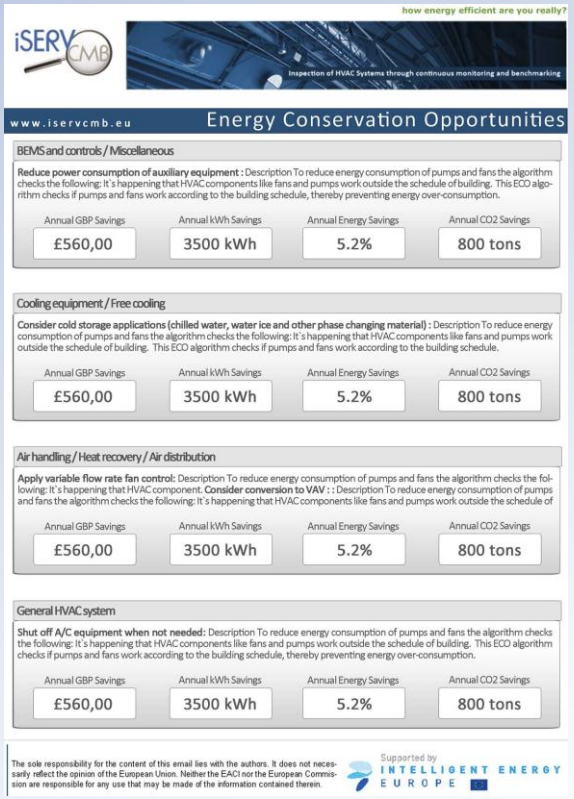


Reports

- 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







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
- Success in reducing HVAC energy use is providing the confidence and finance (from savings) to tackle other electrical use as well

Monitoring - Conclusions

- Monitoring brings:
  - Clarity and Certainty;
  - Proven energy and cost savings to the end user and MS;
  - End user engagement and ability to contribute to 2020 targets;
  - Proof of impact achieved;
  - Increased use of energy efficient products;
  - Ability to use Smart Metering data which is coming.

- As a commercial prospect monitoring makes sense already.

- Monitoring is a step to nZEB, zero energy buildings and active buildings.

Thank you your attention!

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www.iservcmb.info