REHVA

Federation of European Heating, Ventilation and Air-conditioning Associations

Address:
Rue Washington 40
1050 Brussels
Belgium

- **www.rehva.eu**
- **info@rehva.eu**
- **Tel: +32 2 514 11 71**
- **Fax: +32 2 512 90 62**

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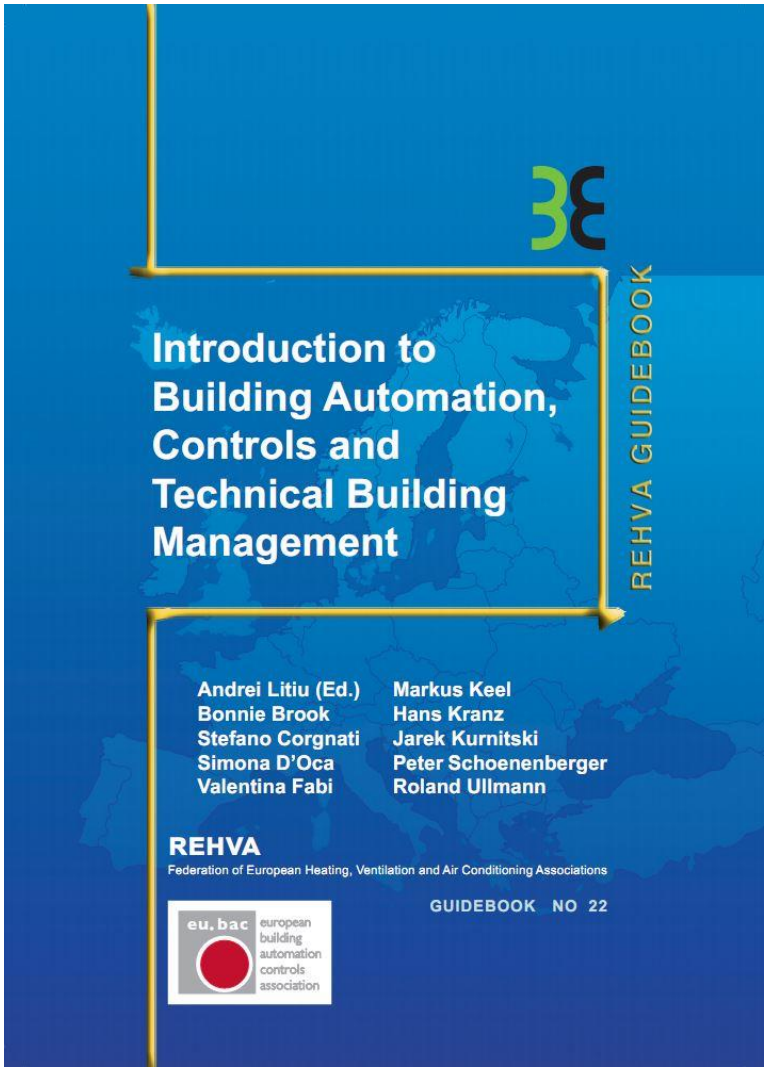
Introduction to building automation, controls and technical building management



Introduction to building automation, controls and technical building management

- Working group:
  - Andrei **Litiu**, *eu.bac, editor*
  - Richard **Beuhorry**, *Somfy, France*
  - Bonnie **Brook**, *Siemens, Switzerland*
  - Stefano **Corgnati**, *Politecnico di Torino, Italy*
  - Simona **D'Oca**, *Politecnico di Torino, Italy*
  - Valentina **Fabi**, *Politecnico di Torino, Italy*
  - Klaus-Dieter **Fuhrmann**, *IMI Hydronics, Austria*
  - Markus **Keel**, *Belimo, Switzerland*
  - Hans R. **Kranz**, *BAC expert, Germany*
  - Jarek **Kurnitski**, *Tallin University of Technology, Estonia*
  - Riika **Liedes**, *Sähköinfo, Finland*
  - Peter **Schoenenberger**, *Sauter, Switzerland*
  - Roland **Ullmann**, *Siemens, Switzerland*

Introduction to building automation, controls and technical building management

- Reviewers:
  - Nejc **Brelih**, *Boydens Engineering, Belgium*
  - Ivo **Martinac**, *Royal Institute of Technology, Sweden*
  - Livio **Mazzarella**, *Politecnico di Milano, Italy*
  - Olli **Seppänen**, *FINVAC, Finland*
  - Paul **Waide**, *Waide Strategic Efficiency, United Kingdom*

Introduction to building automation, controls and technical building management

- This guidebook aims to provide an overview on the different aspects of building automation, controls and technical building management and steer the direction to further in depth information on specific issues, thus increasing the readers' awareness and knowledge on this essential piece of the construction sector puzzle. It avoids reinventing the wheel and rather focuses on collecting and complementing existing resources on this topic in the attempt of offering a one-stop guide. The readers will benefit of several compiled lists of standards and other relevant publications and as well a thorough terminology specific for building automation, controls and technical building management. Gives an excellent background on the principles of sustainable building design and operation.

Introduction to building automation, controls and technical building management

- Among other aspects it captures the existing European product certification and system auditing schemes, the integrated system approach, EU's energy policy framework related to buildings, indoor environment quality, smart buildings and behaviour change related to energy use.
- Although this guide can be very useful for several stakeholders (e.g. industry, designers, specifiers, system integrators, installers, building commissioners, facility managers, energy inspectors, energy auditors, students), being an introduction framework to the topic, it is most useful for those interested in fully grasping the 'why, how and what' of building automation, controls and technical building management.
- It should be noted that this guidebook is not, nor is it meant to be, an absolutely comprehensive knowledge repository on the topic.

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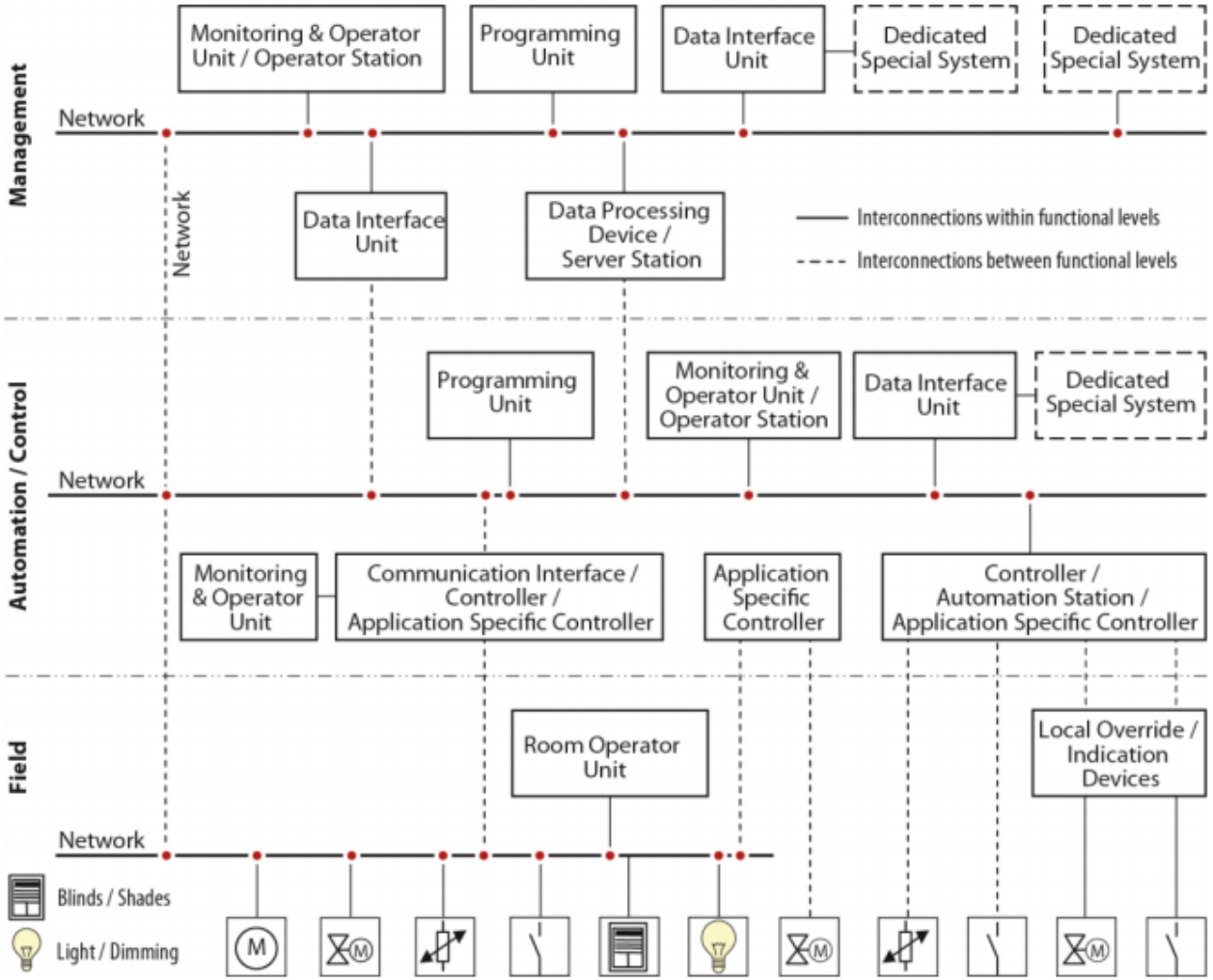
Building automation and controls in a nutshell

- Controls and building automation used in buildings range from simple thermostatic radiator valves, automatic balancing valves, automatic air dampers, thermostats and schedulers to building automation and control systems (BACS), building management systems (BMS), also known as building automation systems (BAS), energy management systems (EMS) and building energy management systems (BEMS).
- In their more complex forms BMS and their related sub-systems may have many thousands of data points controlling non-residential buildings and dispersed estates. Residential controls traditionally have a single room thermostat controlling the boiler and pump on/off, a scheduler to set the stop and start times for heating and domestic hot water systems plus thermostatic radiator valves for room temperature control.

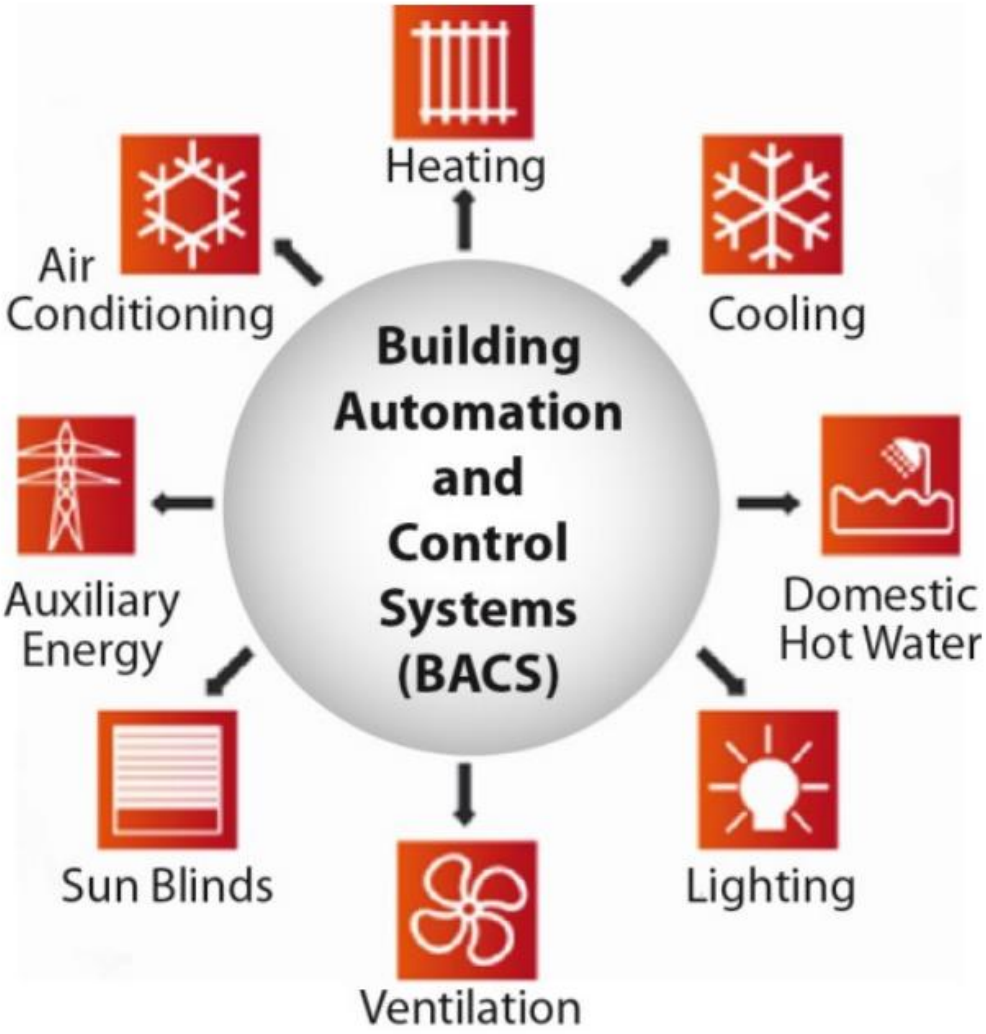
EN 15232 defines 4 BAC classes of functions

- **Class D** corresponds to a BACS that is not energy efficient. Buildings with such systems shall be retrofitted. New buildings shall not be built with such systems.
- **Class C** corresponds to standard BACS – minimum functions shall be implemented
- **Class B** corresponds to advanced BACS with some specific TBM functions – building automation functions plus some specific functions shall be implemented in addition to class C. Room controllers shall be able to communicate with a building automation system;
- **Class A** corresponds to high-energy performance BACS and TBM – Technical building management functions shall be implemented in addition to class B. Room controllers shall be able to demand control building services.

Generic architecture model for BAC network and its different levels



The overarching role of building automation and control systems



New mindset is necessary for achieving operational energy performance

- A different way of designing a building's HVAC system is required so that, starting from the design stage, the balance between energy efficiency and operational efficiency should be considered. There is no use in applying advanced systems if they are not designed or operated to their full potential or if they are incorrectly installed or used.
- BA systems are still not being used to their full potential to lower energy consumption in buildings. Maximising this potential could provide a significant opportunity for the construction community to significantly lower building operation costs and to create new jobs for the continuous optimization of buildings.
- Educating and improving the skills of the supply chain will overcome the challenge related to the complexity of BACS and will enable better utilization of BACS.

Ensuring Indoor Environment Quality (IEQ) during the operation phase

- Indoor environmental quality (IEQ) and energy use in buildings are closely related. A building's energy performance requirements shall not sacrifice its adequate level of IEQ, which in turn is necessary for the planned activities to take place in the built environment.
- Building automation and controls are responsible for the control of indoor environment quality parameters. A building without such systems or with poorly performing systems will not maintain these parameters appropriately, resulting in poor energy performance and unsatisfied occupants, be it in the residential or non-residential sectors.
- Several factors should be considered in the design and operation of building services, focusing mainly on room temperature, indoor air quality, ventilation, humidity, lighting and blinds (as used to provide variable protection from solar radiation).

IEQ as part of voluntary certification schemes

In LEED for New Construction and Major Renovations aspects of IEQ are assigned 16 credit points out of 100 and includes the following:

Prereq-uisite	**Minimum IAQ performance**	Required
Prereq-uisite	Environmental tobacco smoke control	Required
Credit	**Enhanced IAQ strategies**	2
Credit	Low-emitting materials	3
Credit	Construction IAQ management plan	1
Credit	IAQ assessment	2
Credit	**Thermal comfort**	1
Credit	Interior lighting	2
Credit	Daylight	3
Credit	Quality views	1
Credit	Acoustic performance	1

In LEED for Existing Buildings: Operations & Maintenance the IEQ categories are assigned 17 credit points and includes the following:

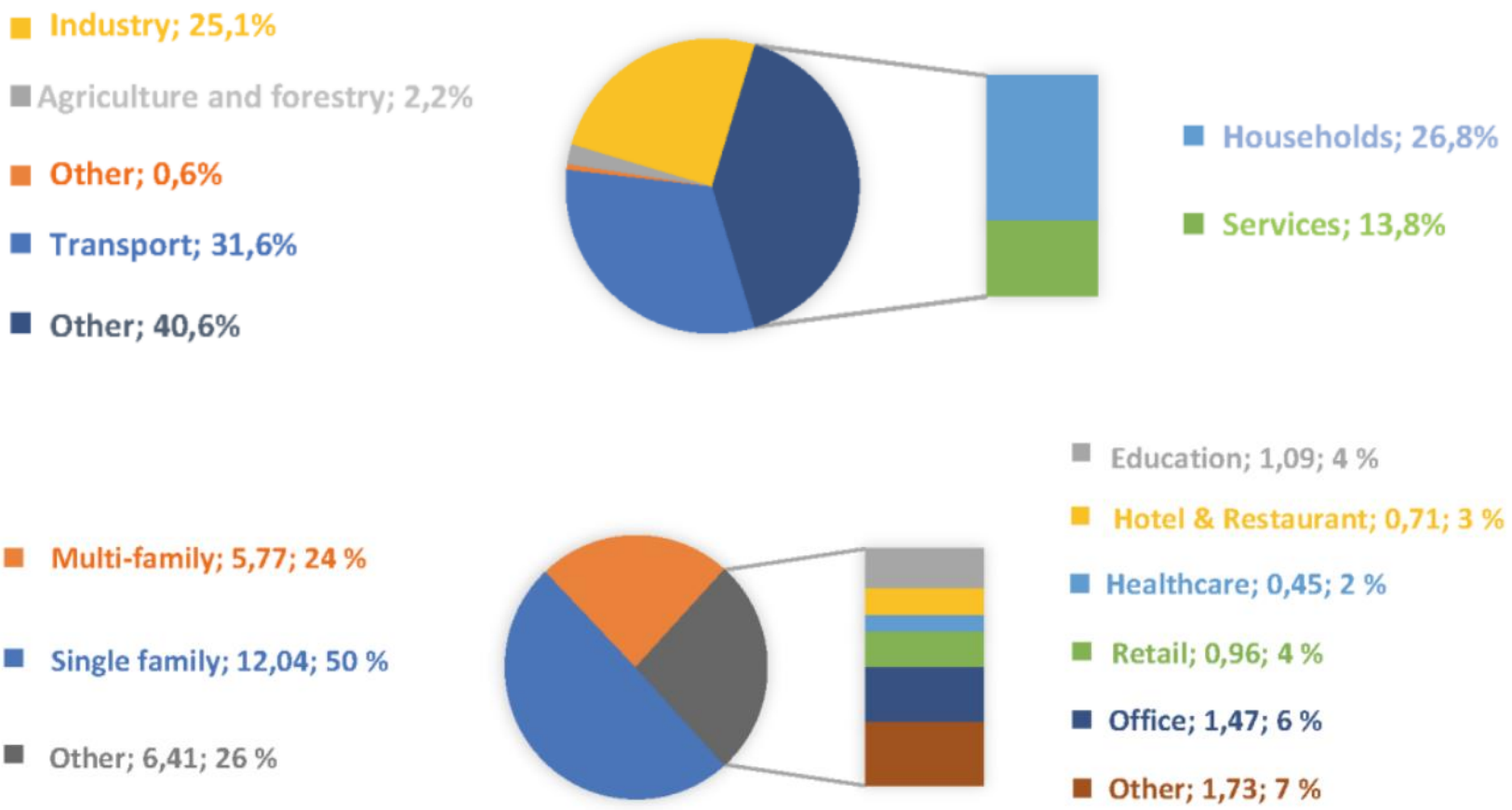
Prereq-uisite	**Minimum IAQ performance**	Required
Prereq-uisite	Environmental Tobacco Smoke Control	Required
Prereq-uisite	Green cleaning policy	Required
Credit	IAQ management program	2
Credit	**Enhanced IAQ strategies**	2
Credit	**Thermal comfort**	1
Credit	Interior lighting	2
Credit	Daylight and quality views	4
Credit	Green cleaning-custodial effectiveness assessment	1
Credit	Green cleaning - products and materials	1
Credit	Green cleaning - equipment	1
Credit	Integrated pest management	2
Credit	Occupant comfort survey	1

Energy policy and treaty law in the EU and the set targets

	First stage	Second stage	Third stage
Time frame	Mid-1950s to late 1980s	Late 1980s to mid-2000s	Since mid-2000s
Legal frame-work	• European Coal and Steel Community (1951) • Atomic Energy Community (1957)	• Single European Act (SEA) (1987) • Treaty of Maastricht (TEU) (1992)	• Treaty of Lisbon (2007)
Focus of EU energy policy	• Energy security • Common market	• Environmental policy integration (EPI) principle • "Relaunch" of the common market • Energy as priority matter	• Functioning of energy markets • Energy supply • Energy efficiency • Renewable energy • Interconnection of energy networks

Climate and energy strategy and targets	Greenhouse gas emissions	Renewable energy	Energy Efficiency
2020 climate and energy package	20% (from 1990 levels) – binding	20% – binding	20% (improvement) – non-binding
2030 climate and energy	At least 40% (from 1990 levels) – binding	At least 27% – binding	30% (improvement) – non-binding
2050 low-carbon economy	80% (from 1990 levels)	N.A.	N.A.

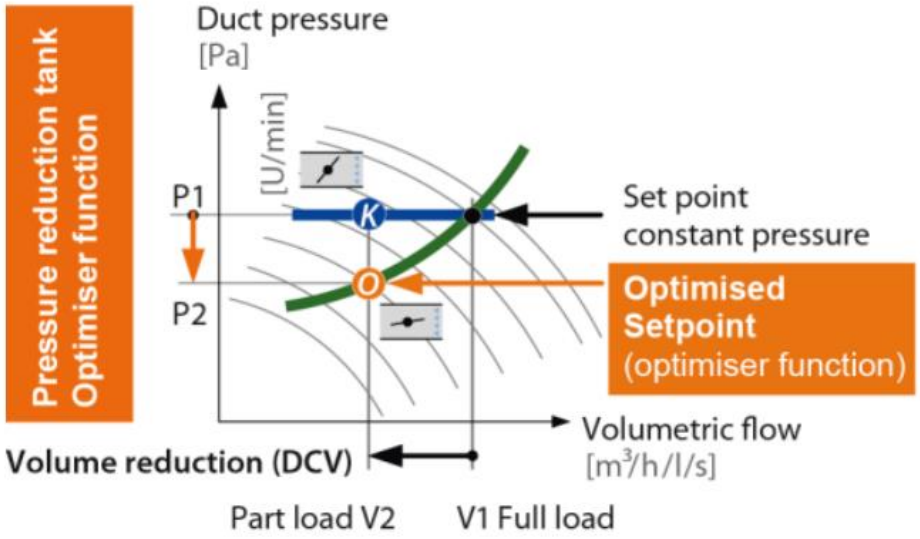
Energy use in Europe

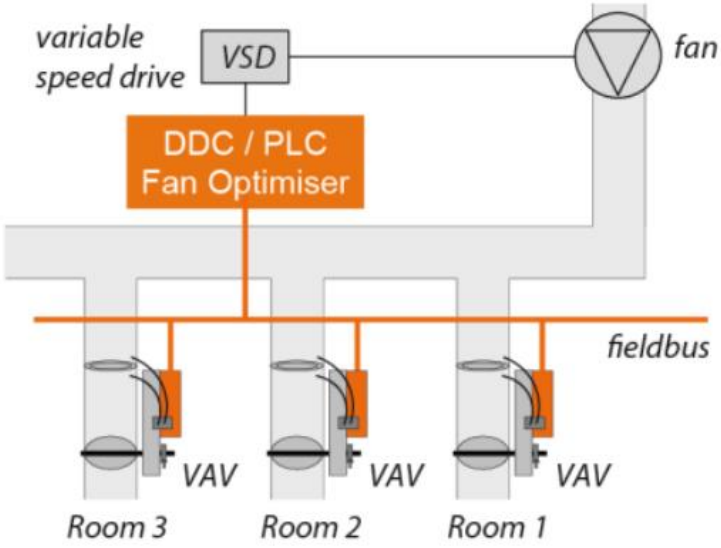


BAC can play a key role in supporting the EU's energy and climate objectives

- Empowering building occupants to control their energy consumption and energy bills;
- Closing the gap between designed and actual energy performance of buildings and optimizing the energy performance of technical building systems, thus preventing energy waste so reducing gas imports, mitigating energy poverty and cutting GHG emissions;
- Acting as an monitor of all technical building systems (e.g. HVAC, lighting, solar shading, appliances);
- Facilitating the integration of on-site renewable energy sources (nZEBs);
- Enabling demand side flexibility;
- Contributing to changing consumer behaviour towards energy use;
- Improving indoor environmental quality (with the resulting positive impact on health, well-being, comfort and productivity).

Fan Optimiser – the pressure feedback volumetric flow control system

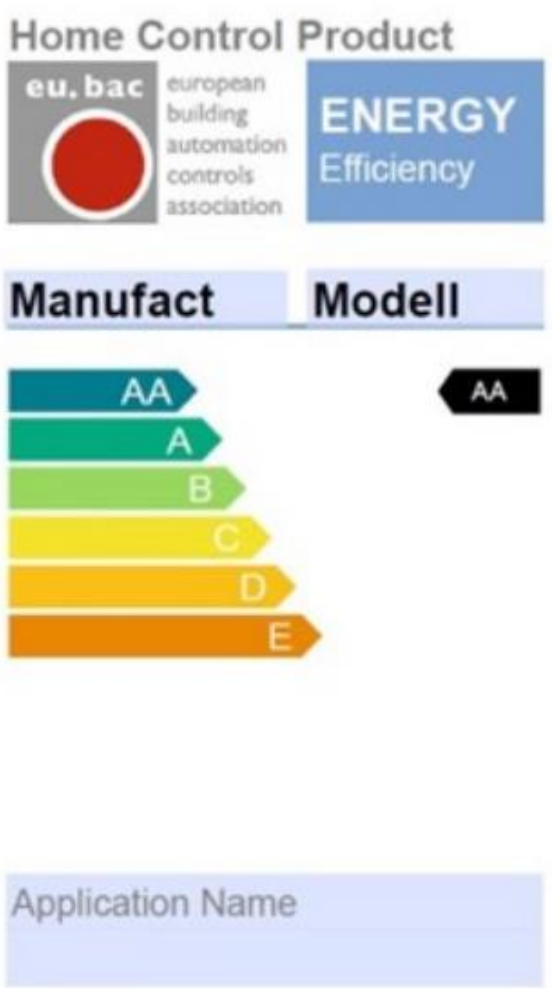


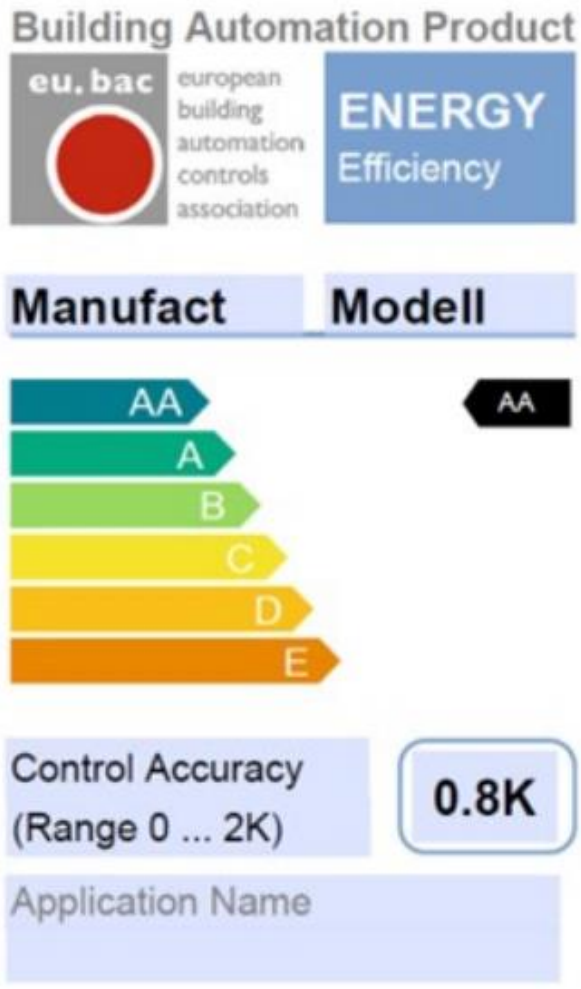


Integration requirements significantly influence the following project phases

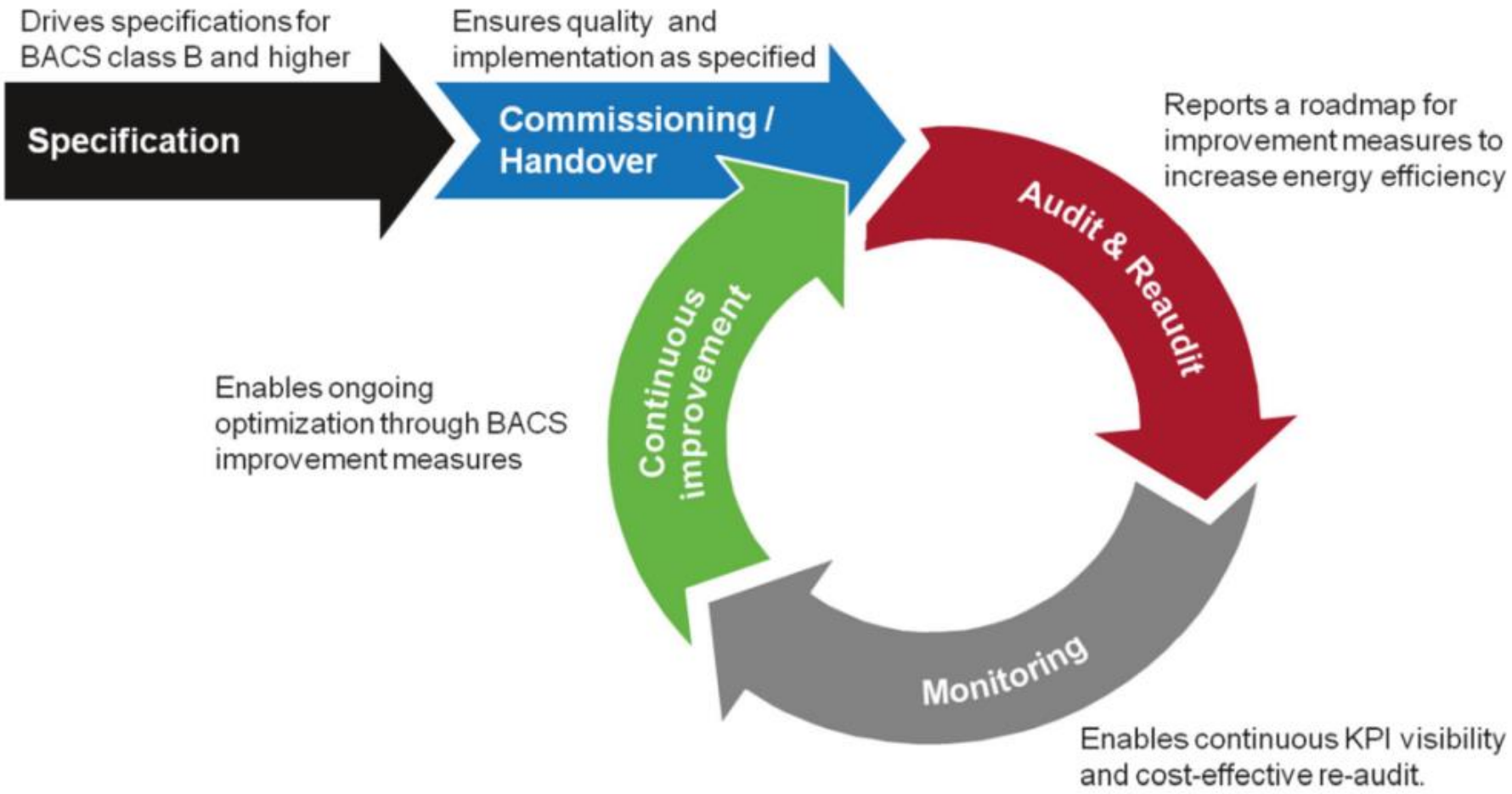
- Design: Determination of project requirements and development of design documents including technical specifications;
- Engineering: Detailed functional and hardware design;
- Installation: Installing of the BACS and integrated systems including components;
- Commissioning: Commissioning of the BACS and integrated systems including components;
- Completion: Handover, acceptance and project finalization;
- Operation: This is the phase during which the BACS and integrated systems will be utilised.

Product certification and labelling
eu.bac cert

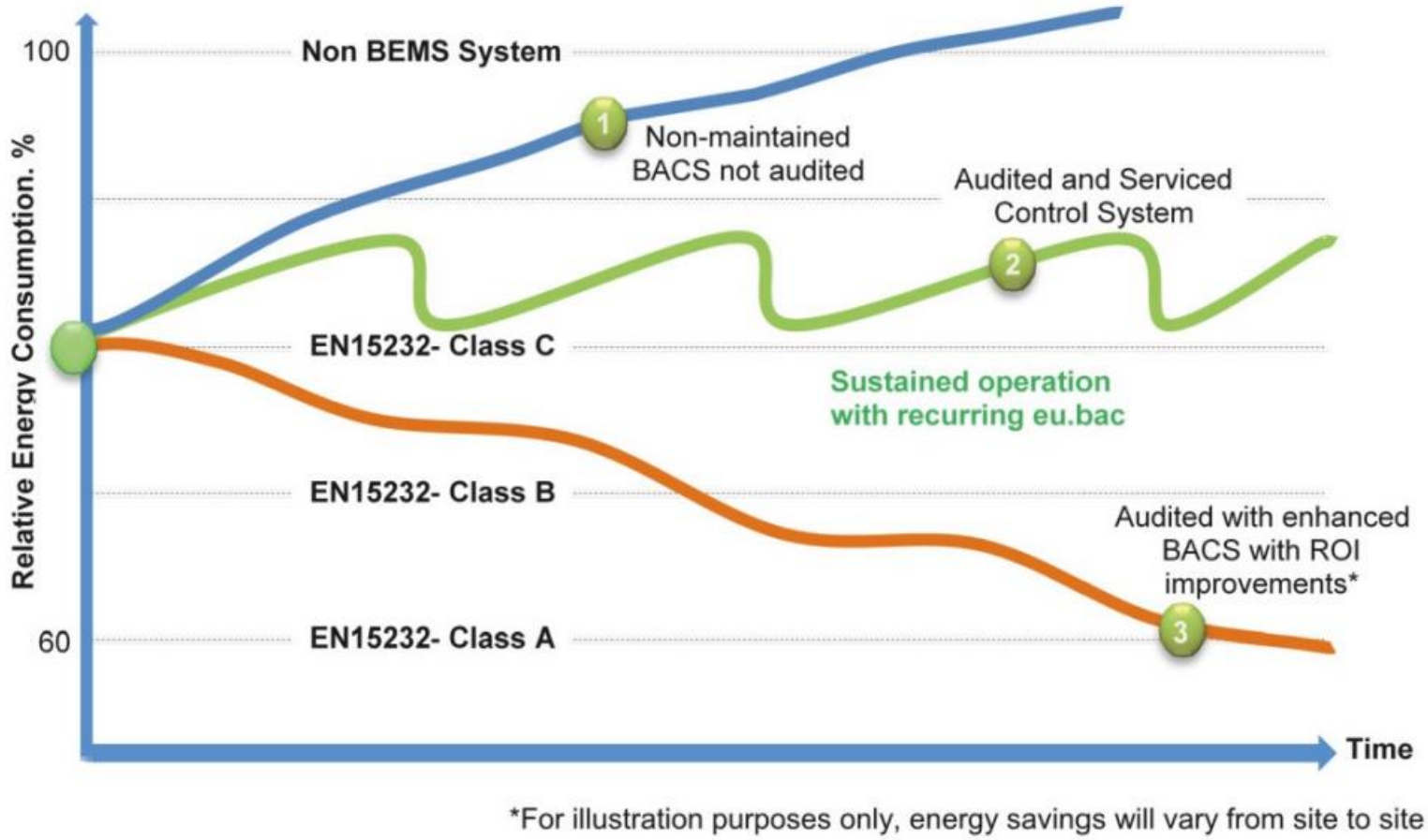




eu.bac system for new and existing buildings

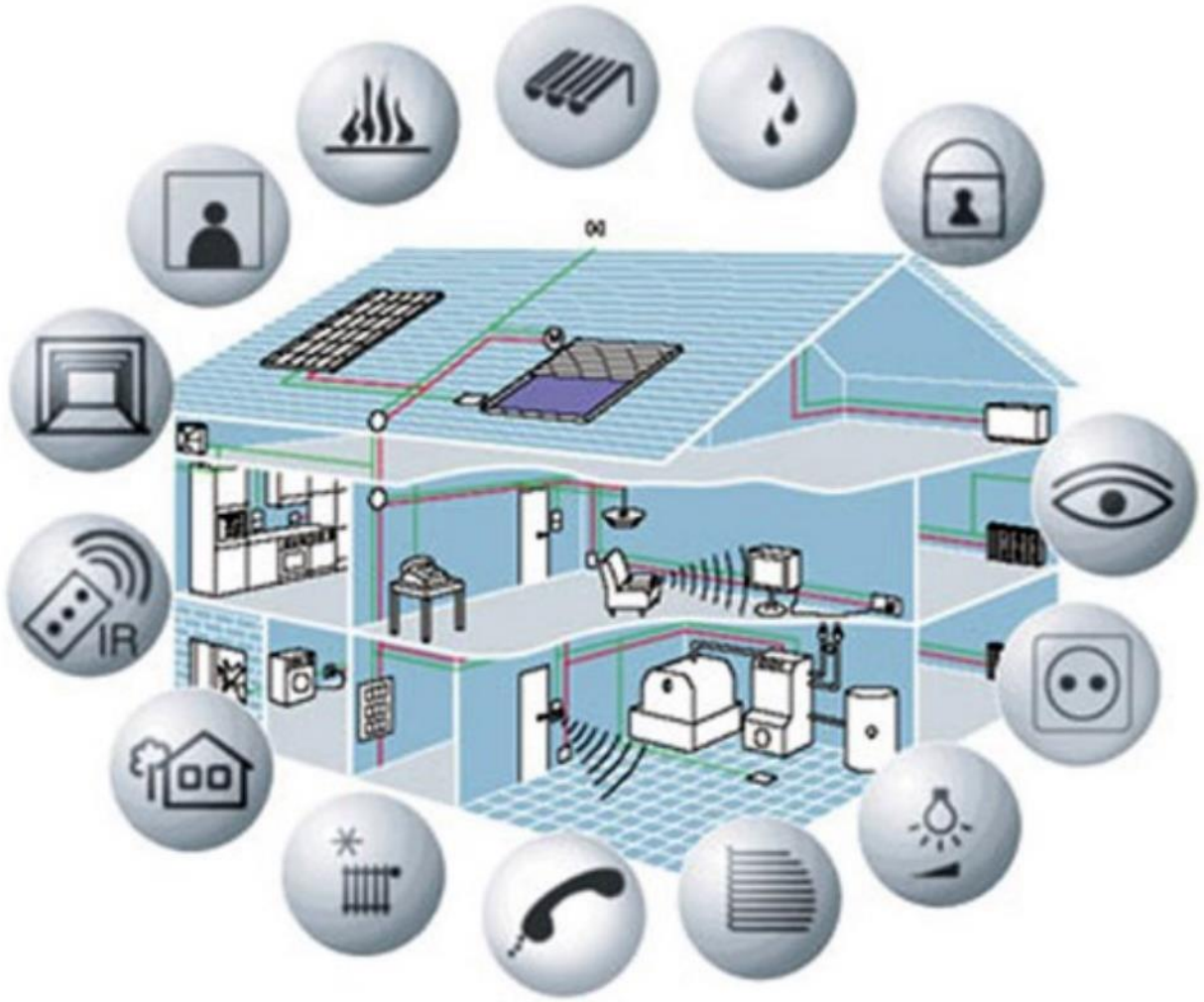


eu.bac system audits sustain the energy-efficient control of building systems



*For illustration purposes only, energy savings will vary from site to site

‘Smart buildings’ concept includes not only efficient and demand sequenced controls



Aspects recognized for having and impact on occupants' perception of comfort

- In both office and residential buildings, users' understanding and acceptance of building automation systems and controls is a fundamental requirement for successfully achieving the energy efficiency potential of such smart technology. If the control logics of the building automation system are based only on energy-saving requirements, the resulting indoor environmental conditions may not be perceived as "comfortable" by the occupants. Optimising both energy efficiency and occupants' needs and their perception of comfort is needed.
  - Environmental factors (e.g. climate);
  - Social factors (e.g. open-plan office or single office);
  - Physiological factors (e.g. gender, age);
  - Psychological factors such as feeling in control inside the living space.

Persuasive technology

- A recurring observation in the literature on smart buildings is of the increasing application of real-time feedback to inform occupants about their environmental conditions and energy usage.
- Rapid feedback to inform occupants of improving comfort conditions. However a correctly functioning system is crucial to maintain perceived comfort and satisfaction with systems.
- Quickly responding building operators are important to perceived comfort.
- Feedback to occupants that confirms a system is functioning is particularly crucial for thermal systems, which normally experience a lag between control input and a change in the indoor environment.
  - The ecological implication of smart metering and smart devices is mostly seen only as a positive side effect within a larger package; it remains unclear whether this will stand-alone as a genuine driving factor in purchasing decisions.

Case studies of best practice & Terminology

- Please note that due to length restrictions you shall not find in the hard copy guidebook the 'Terminology' sub-chapter and the 'Case studies of best practice' chapter. However, these have been made available for easy downloading on both REHVA and eu.bac websites as follows:
- **Case studies of best practice**

  http://www.rehva.eu/fileadmin/guidebooks/CaseStudies.pdf

  http://www.eubac.org/downloads/annexes-rehva-gb-22-introduction-to-bac/index.html
- **Terminology**

  http://www.rehva.eu/fileadmin/guidebooks/Terminology.pdf

  http://www.eubac.org/downloads/annexes-rehva-gb-22-introduction-to-bac/index.html

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