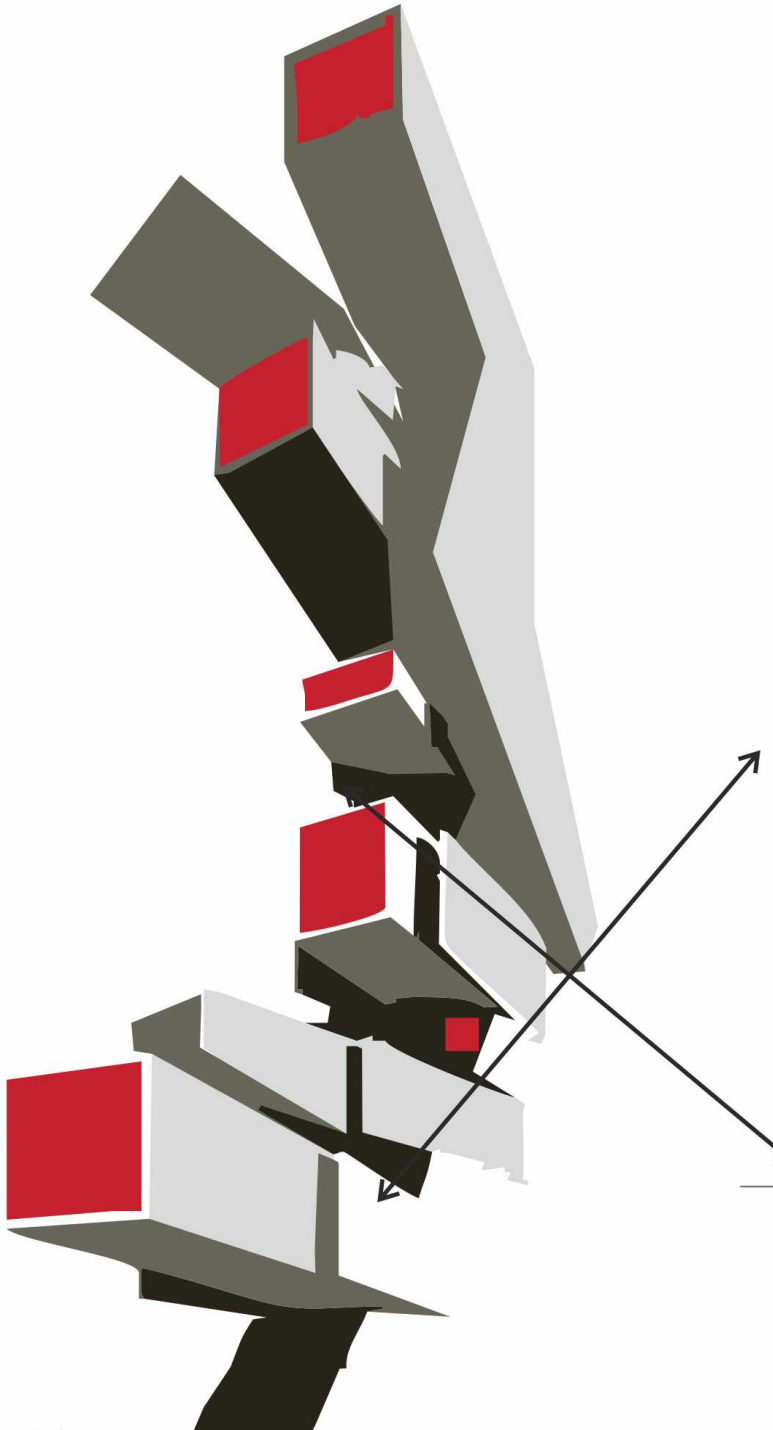


ORGANIZAÇÃO

3º e 4º ENCONTROS NACIONAIS

GESTÃO TÉCNICA CENTRALIZADA

As novas políticas para a Eficiência Energética nos Edifícios e as suas implicações nos Sistemas de Gestão Técnica

A norma EN 15232-1:2017 e sua implicação nos novos projetos de edifícios

Hermano Bernardo

Filipe Tadeu Oliveira

DEE ESTG (IPLeiria)

INESC Coimbra

PATROCINADORES

LISBOA e PORTO **2018**

Antes de 2002:
1990: RCCTE
1998: RSECE

2002	2006	2010	2013	
EU/EPBD 2002/91/EC	**PT/SCE 2006** DL78,79,80/2006	**EU/EPBD** 2010/91/EC	**PT/SCE 2013** DL118/2013	**EU/EPDB** 2018/844
DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings	SCE - RCCTE - RSECE	DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast)	SCE (actualizado) - REH - RECS	DIRECTIVE (EU) 2018/844 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency
	EN 15232:2007		EN 15232:2012	EN 15232-1:2017

A norma especifica:

- Uma lista estruturada de funções de controlo, automação e gestão técnica de edifícios com impacto no comportamento energético dos edifícios

  = um "menu" de funções para o cliente escolher para o SGTC

- Uma metodologia para definir requisitos mínimos de controlo, automação e gestão técnica de edifícios a serem implementadas em edifícios de diferentes níveis de complexidade

  = uma *checklist* onde o cliente escolhe cada função, ou uma classe

- Métodos detalhados para aferir/determinar o impacto destas funções (ou seja, do nível de sofisticação do SGTC) num dado edifício.
  - Estes métodos permitem que os SGTC possam "contar" para os indicadores de eficiência energética dos edifícios.

  = simulação dinâmica multizona de edifícios, ou "algo do género"

- Um método simplificado para uma primeira estimativa do impacto das funções do SGTC no comportamento dos edifícios, considerando tipologias típicas de edifício (hospitais, escolas…).

3.3
building automation and control system
BACS
system, comprising all products, software and engineering services for automatic controls (including interlocks), monitoring, optimization, for operation, human intervention, and management to achieve energy–efficient, economical, and safe operation of building services

3.16
technical building management
TBM
process(es) and services related to operation and management of buildings and technical building system through the interrelationships between the different disciplines and trades

Quem está envolvido na aplicação da norma EN 15232-1:2017

- **Donos de obra, arquitectos, engenheiros**
  - definir as funções a serem implementadas num edifício existente, novo ou renovado

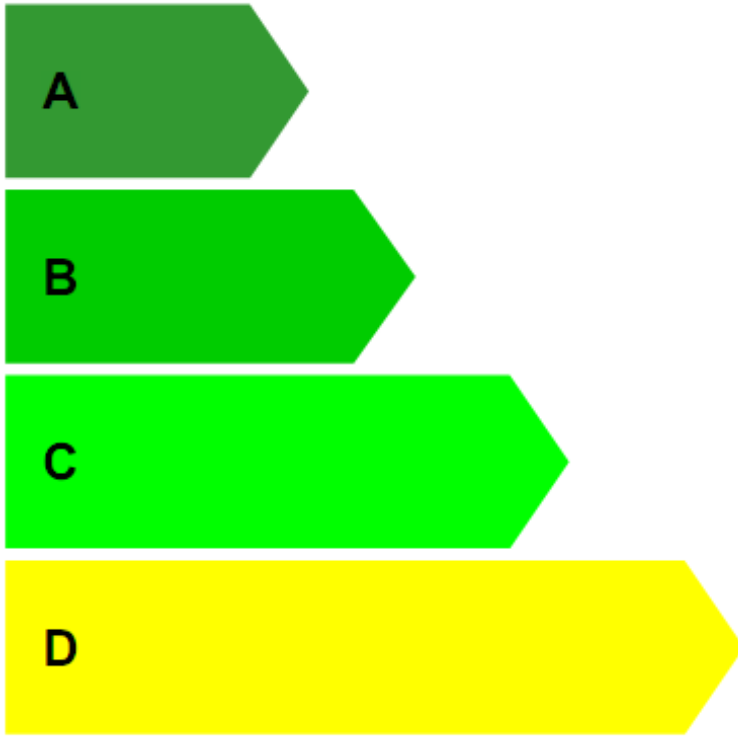
- **Autoridades públicas**
  - definir requisitos mínimos para os SGTC (*BACS and TBM functions*) para edifícios novos e existentes
  - definir procedimentos de inspecção de sistemas técnicos, bem como averiguar se o nível de implementação das funções é apropriado
  - definir métodos de cálculo que levem em consideração os impacto dos SGTC no comportamento energético dos edifícios – incluindo a respectiva implementação em software e a sua utilização pelos projectistas

- **Projectistas**
  - verificar que o impacto dos SGTC é considerado na aferição do desempenho energético do edifício

Classes de eficiência (*5.5 BACS Efficiency Class*)

A norma define quatro classes de eficiência para sistema de gestão técnica:

- **Classe A** - SGTC muito eficiente
  (*high-energy performance BACS and TBM*)
- **Classe B** – SGTC "avançado"
  (*advanced BACS and some specific TBM functions*)
- **Classe C** – SGTC básico
  (*standard BACS*) - padrão
- **Classe D** – "SGTC" não eficiente
  (*non-energy efficient BAC*).
  - Os edifícios com esses sistemas terão de ser *retrofitted.*
  - Não podem ser instalados em edifícios novos.



EN 15232-1: 2017

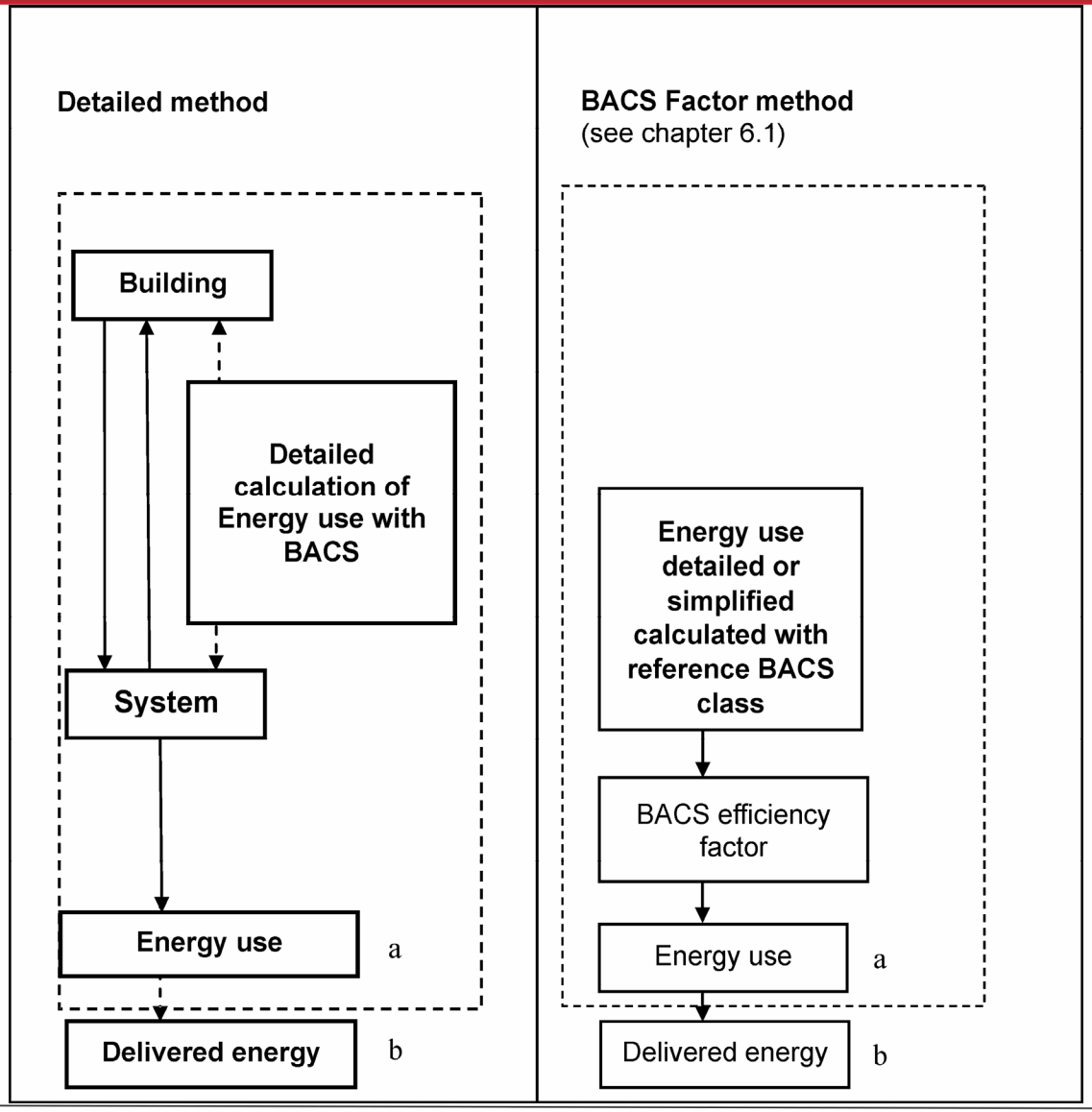
Classes de eficiência (*5.5 BACS Efficiency Class*)

Um edifício pertence à:

- **Classe D**: Se não cumpre os mínimos estabelecidos para a classe C (tabela B.1).
- **Classe C** (referência): Se cumpre os mínimos estabelecidos para a classe C (tabela B.1).
- **Classe B**: Classe C + algumas das funções específicas estabelecidas na tabela 4 da norma.
    - Controladores locais (terminais) têm de comunicar com os controladores principais/sistema
- **Classe A**: Funções de gestão técnica + algumas das funções indicadas na tabela 4 além dos requisitos da classe B
    - "*Demand-controlled*" AVAC (por exemplo, com *setpoints* adaptativos baseados em ocupação, qualidade do ar, etc.)
    - Integração funcional do sistema de AVAC com iluminação artificial, sistemas de sombreamento, etc.

Dois métodos de cálculo

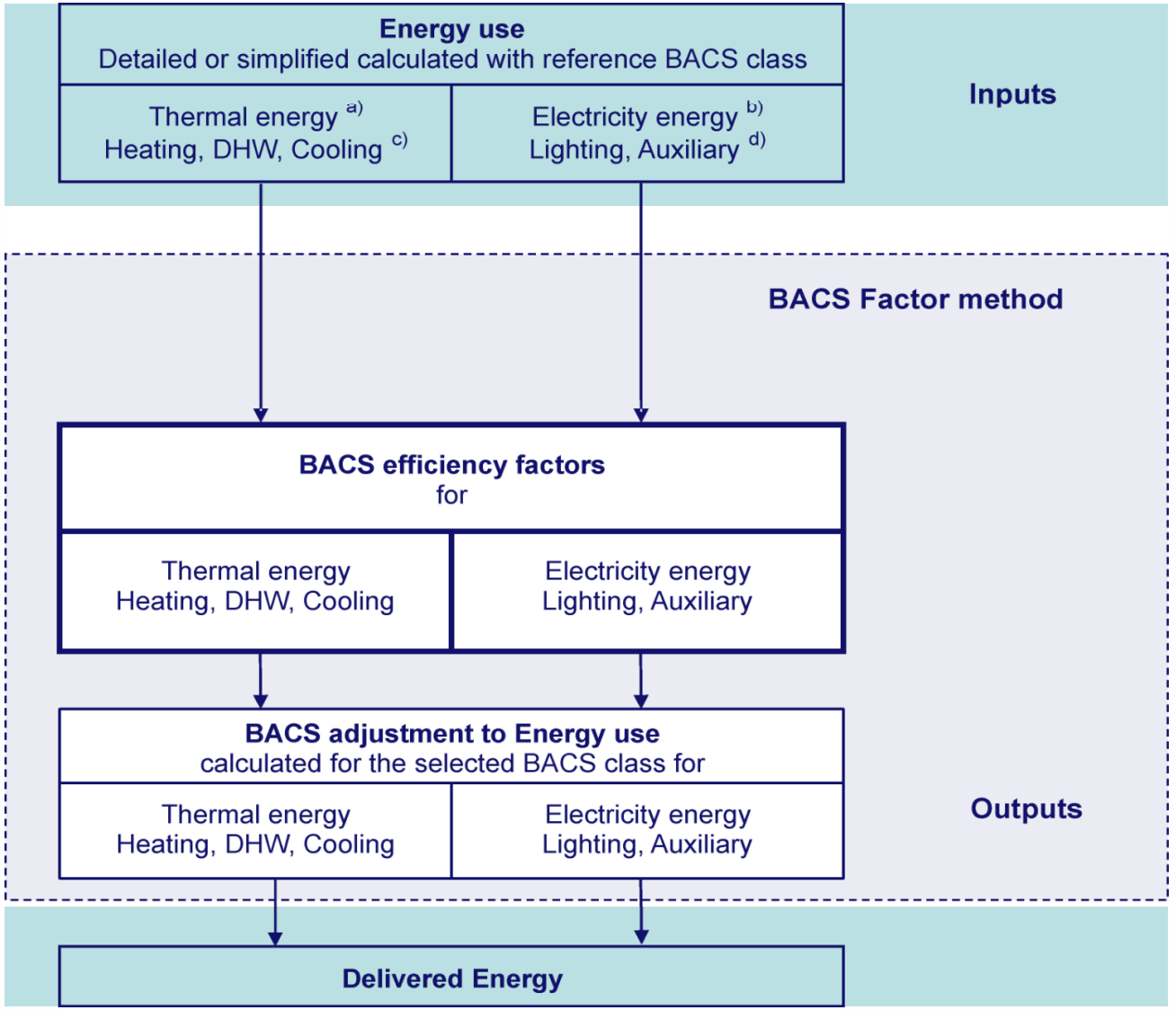
- **Detalhado** (*method 1*)
- **Simplificado**, baseado em factores (*method 2, BACS factor method*)
  =primeira aproximação, estimativa



Método Simplificado

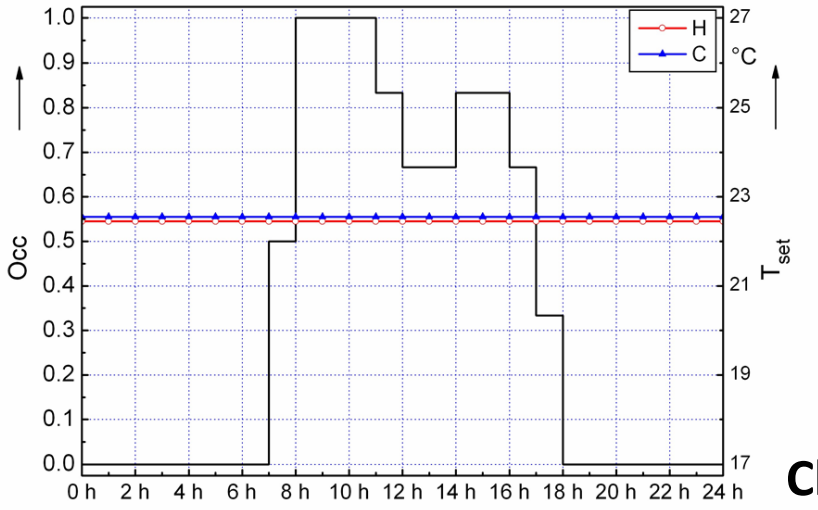
- Baseado em factores que relacionam o comportamento de cada uma das funções (aquecimento, arrefecimento, AQS, etc.) com um valor de referência (classe C, =1)

- Perfis de utilização padronizados (diferenciados por tipo de edifício) a partir da EN15217

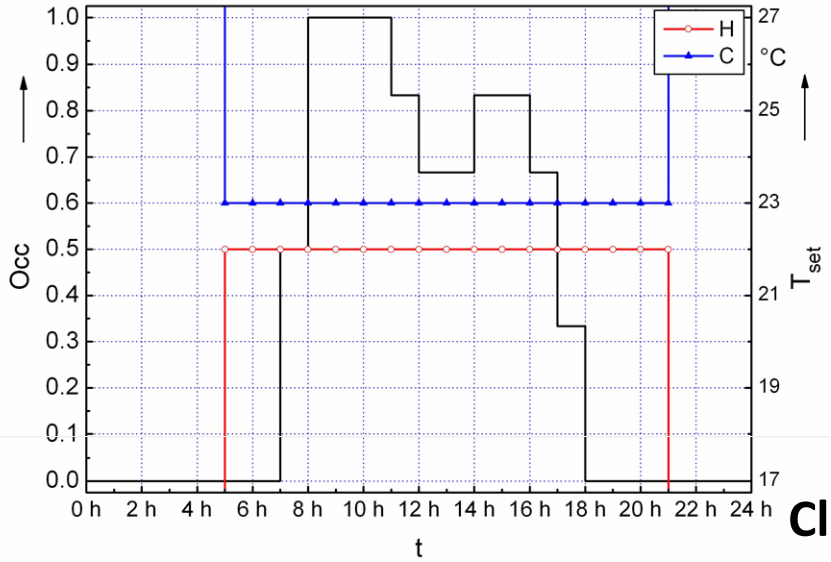


Perfil horário de ocupação (Escritório)

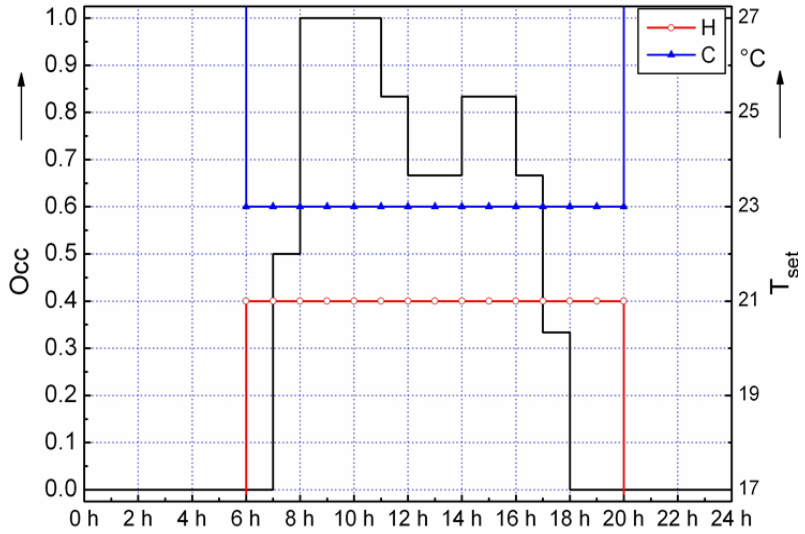
- Controlo de temperatura e ventilação, por classe.



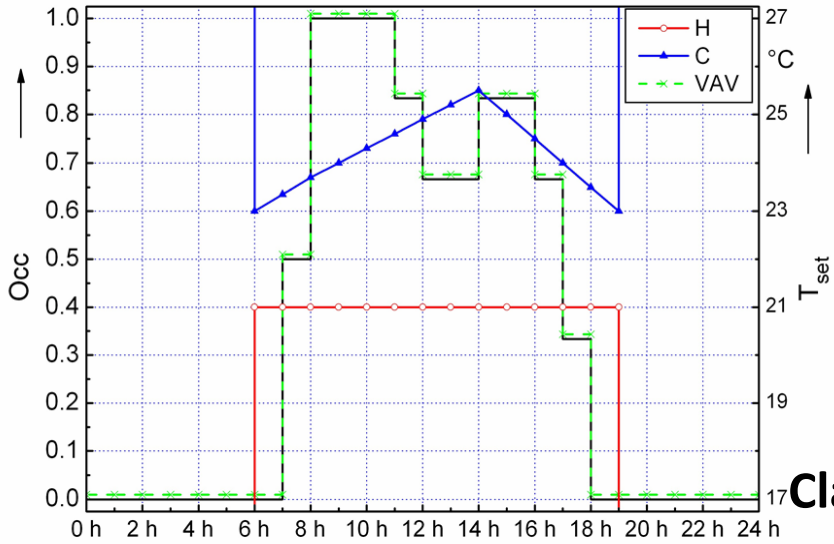
Classe D



Classe C



Classe B



Classe A

Método Simplificado
Estimativa do impacto energético de alteração de classe

- Heating EN 15316 and 13790
- Cooling EN 15255 and 13790
- Lighting EN 15193
- Ventilation EN 15241

$$E_{BAC} = f_{BAC} \cdot E$$

User profile -
Internal heat gains -
Control accuracy and quality -

	Thermal energy				Electrical energy			
Class	D	C	B	A	D	C	B	A
Offices	1,51	1	0,80	0,70	1,10	1	0,93	0,87
Lecture hall	1,24	1	0,75	0,50	1,06	1	0,94	0,89
Education	1,20	1	0,88	0,80	1,07	1	0,93	0,86
Hospitals	1,31	1	0,91	0,86	1,05	1	0,98	0,96
Hotels	1,31	1	0,85	0,68	1,07	1	0,95	0,90
Restaurants	1,23	1	0,77	0,68	1,04	1	0,96	0,92
Wholesale & retail	1,56	1	0,73	0,60	1,08	1	0,95	0,91
Residential	1,10	1	0,88	0,81	1,08	1	0,93	0,92

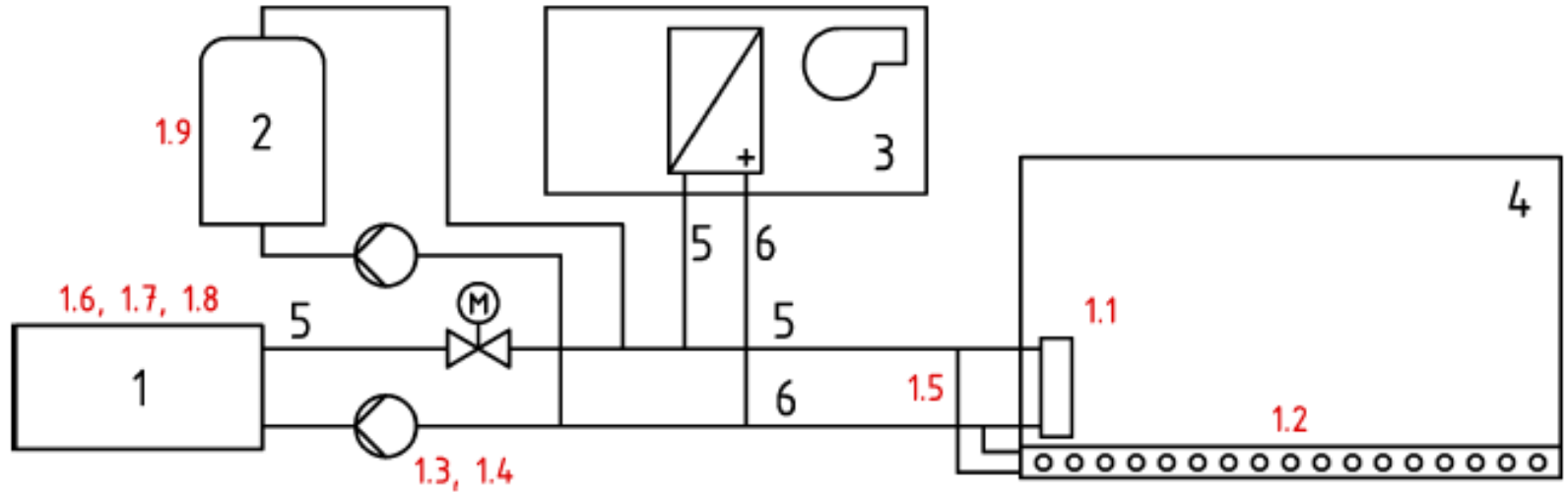
Projecto de edifícios
Obrigação legal de aplicação dos preceitos da EN 15232-1:2017

- Edifícios de serviços (novos ou sujeitos a grande intervenção), potência térmica nominal ≥ 250 kW

- Obrigatório projecto específico para um Sistema de Gestão Técnica Centralizada
  - Além dos restantes requisitos, deverá cumprir com os **mínimos da classe C** (Tabela 5/Tabela B.1)

- Fase de estudo prévio:
  - Pode ser utilizado o método 2, simplificado, de factores *(BACS factor method)*

- Fase de projecto de licenciamento/certificação:
  - Obrigatória a utilização do método 1, detalhado *(Detailed method)*
    - Neste caso, segundo a legislação nacional, corresponde a **simulação dinâmica multizona**
    - Nos casos em que os algoritmos de controlo não sejam possíveis de simular com as ferramentas de simulação dinâmica existente no mercado, podem ser utilizados os factores do método 2



Key

1 heat generator
2 thermal energy storage
3 air handling unit
4 room
5 heating water supply
6 heating water return

NOTE The numbers in red refer to the numbers in Table 4.

Figure 3 — Space heating system

Tabela 4 (excerto)

Descrição das funções BAC/TBM, com os respectivos níveis de complexidade

1.6	Heat generator control for combustion and district heating	HEAT_GEN_CTRL_CD	M3–8
		The goal consists generally in minimizing the heat generator operation temperature	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	
1.7	Heat generator control (heat pump)	HEAT_GEN_CTRL_HP	M3–8
		The goal consists generally in minimizing the heat generator operation temperature and by this in maximizing the heat generator efficiency	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	

Tabela 4 (excerto)

Descrição das funções BAC/TBM, com os respectivos níveis de complexidade

1.9	Sequencing of different heat generators	HEAT_GEN_CTRL_SEQ	M3–8
		This control function only applies to a system with a set of different heat generator sizes or types including Renewable Energy Sources	
	0	Priorities only based on running time	
	1	Control according to fixed priority list: e.g. heat pump prior to hot water boiler	
	2	Control according to dynamic priority list (based on current efficiency and capacity of generators)e.g. solar, geothermal heat, cogeneration plant, fossil fuels)	
	3	Control according to dynamic priority list (based on predicted and current load, efficiency and capacity of generators)	

Tabela 4 (excerto)

Descrição das funções BAC/TBM, com os respectivos níveis de complexidade

Automatic control				
1	Heating control			
1.1	Emission control		HEAT_EMIS_CTRL_DEF	M3–5
		The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for type 1 one function can control several rooms		
	0	No automatic control of the room temperature		
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098–1 or EN 12098–3; one system can control several rooms		
	2	Individual room control: By thermostatic valves or electronic controller		
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature setpoint)		
	4	Individual room control with communication and occupancy detection: Between controllers and BACS; Demand control/occupancy detection (this function level is usually not applied to any slow reacting heat emission systems with relevant thermal mass, e.g. floor heating, wall heating)		

Tabela 5 (excerto)

Correspondência das funções BAC/TBM com a classe

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
Automatic control										
1	Heating control									
1.1	Emission control									
	The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for type 1 one function can control several rooms									
	0	No automatic control	x				x			
	1	Central automatic control	x				x			
	2	Individual room control	x	x			x	x		
	3	Individual room control with communication	x	x	x	x[a]	x	x	x	x[a]
	4	Individual room control with communication and occupancy detection (not applied to slow reacting heating emission systems, e.g. floor heating)	x	x	x	x	x	x	x	x

[a] In case of slow reacting heat and cool emission systems, e.g. floor heating, wall heating, etc. functions 1.1.3 and 3.1.3 are allocated to BAC class A.

EN 15232-1: 2017

Projecto de edifícios
Definição de funções para o sistema de gestão técnica (BAC/TBM)

Uso das tabelas 4 e 5

- As funções a implementar devem ser assinaladas pelo proprietário, dono de obra ou outro, com uma marcação junto da respectiva linha.

- A correspondência com as classes A, B, C e D (tabela 5) podem auxiliar na escolha da função pretendida.
  - Por exemplo, para obter classe B a marcação deve ser colocada numa linha onde a coluna correspondente à classe B esteja assinalada

- Em alternativa, pode ser apenas indicada uma classe, sendo implementadas as funções mínimas que garantem essa classe.

Projecto de edifícios
Definição de funções para o sistema de gestão técnica (BAC/TBM)

Exemplo

- Uma divisão ampla climatizada por uma UTA
- Aquecimento/arrefecimento por meio de permutadores de calor (água-ar)
- Requisito: BAC Classe B

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
AUTOMATIC CONTROL										
4	**VENTILATION AND AIR CONDITIONING CONTROL**									
4.1	Supply air flow control at the room level								←	
	0	No automatic control								
X	1	Time control								
	2	Occupancy detection								
4.2	Room air temp. control (all-air systems)									
	0	on-off control								
	1	variable control								
X	2	Demand control								
4.3	Room air temp. control (Combined air-water systems)									
	0	No coordination								
	1	Coordination								
4.4	Outside air (OA) flow control									
	0	Fixed OA ratio/OA flow								
	1	Staged (low/high) OA ratio/OA flow (time schedule)								
X	2	Staged (low/high) OA ratio/OA flow (occupancy)								
	3	Variable control								
4.5	Air flow or pressure control at the air handler level									
	0	No automatic control								
	1	On off time control								
X	2	Multi-stage control								
	3	Automatic flow or pressure control (without reset)								
	4	Automatic flow or pressure control (with reset)								

Projecto de edifícios
Definição de funções para o sistema de gestão técnica (BAC/TBM)

Exemplo

- Uma divisão ampla climatizada por uma UTA
- Aquecimento/arrefecimento por meio de permutadores de calor (água-ar)
- Requisito: BAC Classe B

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
4.6	Heat recovery control: icing protection									
	0	Without icing protection								
X	1	With icing protection								
4.7	Heat recovery control: prevention of overheating									
	0	Without overheating control								
X	1	With overheating control								
4.8	Free mechanical cooling									
	0	No automatic control								
	1	Night cooling								
X	2	Free cooling								
	3	H,x- directed control								
4.9	Supply air temperature control									
	0	No automatic control								
	1	Constant set point								
X	2	Variable set point with outside temperature compensation								
	3	Variable set point with load dependent compensation								
4.10	Humidity control									
	0	No automatic control								
	1	Dewpoint control								
	2	Direct humidity control								

Projecto de edifícios
Definição de funções para o sistema de gestão técnica (BAC/TBM)

- Funções de controlo/monitorização não instaladas no edifício podem não ser consideradas, mesmo que constem dos requisitos para uma determinada classe

  Exemplo: na classe B, um edifício sem sistema de arrefecimento não requer a instalação de *"individual room control with communication"*, apesar deste ser requisito para classe B.

- O projectista pode justificar adequadamente a opção por não instalar um determinado tipo de controlador ou função, por exemplo, demostrando que não existe benefício na sua aplicação.

  Exemplo: se o projectista demonstrar que a carga térmica de uma zona depende apenas da temperatura exterior e pode ser compensada apenas com um controlador centralizado, pode prescindir do controlo local por válvula termostática ou controlador electrónico, requerido pela classe C

Projecto de edifícios
Definição de funções para o sistema de gestão técnica (BAC/TBM)

- Se alguma das funções da tabela 4 não for aplicável a algum edifício, não será considerada no cálculo da classe energética do SGTC

- Para a definição da classe energética do BAC, apenas as funções de impacto relevante devem ser consideradas

  - Se uma função, ainda que presente, não tem impacto substancial na energia utilizada para aquecimento, arrefecimento, ventilação, AQS ou iluminação, não será considerada na determinação da classe energética

  - Consumos abaixo de 5% do total do edifício são interpretados como não tendo impacto substancial

Projecto de edifícios
Algumas questões adicionais / notas / desafios

- Um SGTC tem impacto directo nos consumos energéticos de um edifício
  - Nomeadamente na classe energética do edifício
- A normativa legal apenas impõe SGTC classe C para potência térmica nominal ≥ 250 kW, mas…
  - Pode ser necessário implementar um SGTC de classe superior a C para obter os mínimos para a certificação energética pelo SCE
- Em edifícios com potência térmica nominal inferior a 250 kW, ainda que não legalmente exigido
  - Pode ser necessário implementar um SGTC de classe C ou superior em edifícios para obter os mínimos para a certificação energética pelo SCE

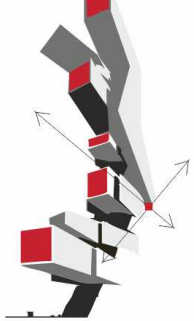
Projecto de edifícios
Algumas questões adicionais / notas / desafios

- Será que os SGTCs actuais conseguirão corresponder a esta normativa?
- Isto constitui um desafio à forma de projectar / implementar SGTCs
  - Simples evolução/actualização ou será necessária mudança radical de paradigma?
- Os actuais *softwares* de simulação dinâmica não estão preparados para a simulação de grande parte das funções (fundamentalmente as da classe A)
  - A norma prevê a necessidade de actualização das funções destes programas e uma possível abordagem para o *interface*

> *Software developers can develop software user interfaces enabling to input the list of and TBM functions which are implemented according to Table 4.*
>
> *They can provide a simplified input mode based on the class of functions A, B, C, and D according to Table 5*

Projecto de edifícios
Algumas questões adicionais / notas / desafios

- Integração com sistemas de gestão de energia (ISO 50001:2018)
- Contributo para o *Smart Readiness Indicator* (indicador de aptidão para tecnologias inteligentes), definido na versão revista da EPBD - **Diretiva (UE) 2018/844**
- Aplicação aos *nearly-zero Energy Buildings* (nZEB)
- Integração com as *Smartgrids*
  - *Demand-response* (resposta dinâmica da procura): *Load shifting* (desvio de consumos), *Load shedding* (deslastre de cargas), etc.
  - Integração de renováveis
  - Armazenamento de energia
  - Integração com o veículo eléctrico.



3º e 4º ENCONTROS NACIONAIS de GESTÃO TÉCNICA CENTRALIZADA

As novas políticas para a Eficiência Energética nos Edifícios e as suas implicações nos Sistemas de Gestão Técnica

Table 5 — Function list and assignment to BAC efficiency classes

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
Automatic control										
1	Heating control									
1.1	Emission control									
	The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for type 1 one function can control several rooms									
	0	No automatic control	x				x			
	1	Central automatic control	x				x			
	2	Individual room control	x	x			x	x		
	3	Individual room control with communication	x	x	x	x[a]	x	x	x	x[a]
	4	Individual room control with communication and occupancy detection (not applied to slow reacting heating emission systems, e.g. floor heating)	x	x	x	x	x	x	x	x
1.2	Emission control for TABS (heating mode)									
	0	No automatic control	x				x			
	1	Central automatic control	x	x			x	x		
	2	Advanced central automatic control	x	x	x		x	x	x	
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control	x	x	x	x	x	x	x	x
1.3	Control of distribution network hot water temperature (supply or return)									
	Similar function can be applied to the control of direct electric heating networks									
	0	No automatic control	x				x			
	1	Outside temperature compensated control	x	x			x	x		
	2	Demand based control	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
1.4	Control of distribution pumps in networks									
	The controlled pumps can be installed at different levels in the network									
	0	No automatic control	x				x			
	1	On off control	x	x			x	x		
	2	Multi-Stage control	x	x	x		x	x	x	
	3	Variable speed pump control (pump unit (internal) estimations)	x	x	x	x	x	x	x	x
	4	Variable speed pump control (external demand signal)	x	x	x	x	x	x	x	x
1.5	Intermittent control of emission and/or distribution									
	One controller can control different rooms/zones having same occupancy patterns									
	0	No automatic control	x				x			
	1	Automatic control with fixed time program	x	x			x	x		
	2	Automatic control with optimum start/stop	x	x	x		x	x	x	
	3	Automatic control with demand evaluation	x	x	x	x	x	x	x	x
1.6	Heat generator control (combustion and district heating)									
	0	Constant temperature control	x				x			
	1	Variable temperature control depending on outside temperature	x	x			x	x		
	2	Variable temperature control depending on the load	x	x	x	x	x	x	x	x
1.7	Heat generator control (heat pump)									
	0	Constant temperature control	x				x			
	1	Variable temperature control depending on outside temperature	x	x			x	x		
	2	Variable temperature control depending on the load	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
1.8	Heat generator control (outdoor unit)									
	0	On/Off-control of heat generator	x				x			
	1	Multi-stage control of heat generator	x	x	x		x	x	x	
	2	Variable control of heat generator	x	x	x	x	x	x	x	x
1.9	Sequencing of different heat generators									
	0	Priorities based on fixed priority list	x				x			
	1	Priorities only based on loads	x	x			x	x		
	2	Priorities dynamically based on generator efficiency and characteristics	x	x	x		x	x	x	
	3	Load prediction based sequencing (various parameters)	x	x	x	x	x	x	x	x
1.10	Control of Thermal Energy Storage (TES) operation									
	0	Continuous storage operation	x				x			
	1	2-sensor charging of storage	x	x			x	x		
	2	Load prediction based storage operation	x	x	x	x	x	x	x	x
2	Domestic hot water supply control									
2.1	Control of DHW storage charging with direct electric heating or integrated electric heat pump									
	0	Automatic on/off control	x				x			
	1	Automatic on/off control and scheduled charging enable	x	x			x	x		
	2	Automatic on/off control and scheduled charging enable and multi-sensor storage management	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
2.2	Control of DHW storage charging using hot water generation									
	0	Automatic on/off control	x				x			
	1	Automatic on/off control and scheduled charging enable	x	x			x	x		
	2	Automatic on/off control, scheduled charging enable and demand-based supply temperature control or multi-sensor storage management	x	x	x	x	x	x	x	x
2.3	Control of DHW storage charging with solar collector and supplementary heat generation									
	0	Manual control	x				x			
	1	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2)	x	x			x	x		
	2	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2) plus demand based supply temperature control or multi-sensor storage management	x	x	x	x	x	x	x	x
2.4	Control of DHW circulation pump									
	0	No control, continuous operation	x				x			
	1	With time program	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
3	Cooling control									
3.1	Emission control									
	The control function is applied to the emitter (cooling panel, fan-coil unit or indoor unit) at room level; for type 1 one function can control several rooms									
	0	No automatic control	x				x			
	1	Central automatic control	x				x			
	2	Individual room control	x	x			x	x		
	3	Individual room control with communication	x	x	x	x[a]	x	x	x	x[a]
	4	Individual room control with communication and occupancy detection (not applied to slow reacting cooling emission systems, e.g. floor cooling)	x	x	x	x	x	x	x	x
3.2	Emission control for TABS (cooling mode)									
	0	No automatic control	x				x			
	1	Central automatic control	x	x			x	x		
	2	Advanced central automatic control	x	x	x		x	x	x	
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control	x	x	x	x	x	x	x	x
3.3	Control of distribution network chilled water temperature (supply or return)									
	Similar function can be applied to the control of direct electric cooling (e.g. compact cooling units, split units) for individual rooms									
	0	Constant temperature control	x				x			
	1	Outside temperature compensated control	x	x			x	x		
	2	Demand based control	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
3.4	Control of distribution pumps in networks									
	The controlled pumps can be installed at different levels in the network									
	0	No automatic control	x				x			
	1	On off control	x	x			x	x		
	2	Multi-Stage control	x	x	x		x	x	x	
	3	Variable speed pump control (pump unit (internal) estimations)	x	x	x	x	x	x	x	x
	4	Variable speed pump control (external demand signal)	x	x	x	x	x	x	x	x
3.5	Intermittent control of emission and/or distribution									
	One controller can control different rooms/zones having same occupancy patterns									
	0	No automatic control	x				x			
	1	Automatic control with fixed time program	x	x			x	x		
	2	Automatic control with optimum start/stop	x	x	x		x	x	x	
	3	Automatic control with demand evaluation	x	x	x	x	x	x	x	x
3.6	Interlock between heating and cooling control of emission and/or distribution									
	0	No interlock	x				x			
	1	Partial interlock (dependent on the HVAC system)	x	x	x		x	x	x	
	2	Total interlock	x	x	x	x	x	x	x	x
3.7	Generator control for cooling									
	The goal consists generally in maximizing the chilled water supply temperature									
	0	Constant temperature control	x				x			
	1	Variable temperature control depending on outside temperature	x	x	x		x	x	x	
	2	Variable temperature control depending on the load	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
3.8	Sequencing of generators for chilled water									
	0	Priorities only based on running times	x				x			
	1	Priorities only based on loads	x	x			x	x		
	2	Priorities based on generator efficiency and characteristics	x	x	x		x	x	x	
	3	Load prediction based sequencing	x	x	x	x	x	x	x	x
3.9	Control of Thermal Energy Storage (TES) operation									
	0	Continuous storage operation	x				x			
	1	Time-scheduled storage operation	x	x			x	x		
	2	Load prediction based storage operation	x	x	x	x	x	x	x	x
4	Ventilation and air-conditioning control									
4.1	Supply air flow control at the room level									
	0	No automatic control	x				x			
	1	Time control	x	x	x		x	x	x	
	2	Occupancy detection	x	x	x	x	x	x	x	x
4.2	Room air temp. control (all-air systems)									
	0	on-off control	x				x			
	1	variable control	x	x			x	x		
	4	Demand control	x	x	x	x	x	x	x	x
4.3	Room air temp. control (Combined air-water systems)									
	0	No coordination	x				x			
	1	Coordination	x	x	x	x	x	x	x	x
4.4	Outside air (OA) flow control									
	0	Fixed OA ratio/OA flow	x	x			x			
	1	Staged (low/high) OA ratio/OA flow (time schedule)	x	x	x		x	x		
	2	Staged (low/high) OA ratio/OA flow (occupancy)	x	x	x		x	x	x	
	3	Variable control	x	x	x	x	x	x	x	x
4.5	Air flow or pressure control at the air handler level									
	0	No automatic control	x				x			
	1	On off time control	x	x			x	x		
	2	Multi-stage control	x	x	x		x	x	x	
	3	Automatic flow or pressure control (without reset)	x	x	x	x	x	x	x	x
	4	Automatic flow or pressure control (with reset)	x	x	x	x	x	x	x	x
4.6	Heat recovery control: icing protection									
	0	Without icing protection	x				x			
	1	With icing protection	x	x	x	x	x	x	x	x
4.7	Heat recovery control: prevention of overheating									
	0	Without overheating control	x				x			
	1	With overheating control	x	x	x	x	x	x	x	x
4.8	Free mechanical cooling									
	0	No automatic control	x				x			
	1	Night cooling	x	x			x	x		
	2	Free cooling	x	x	x	-	x	x	x	-
	3	H,x- directed control	x	x	x	x	x	x	x	x
4.9	Supply air temperature control									
	0	No automatic control	x				x			
	1	Constant setpoint	x	x			x	x		
	2	Variable setpoint with outside temperature compensation	x	x	x		x	x	x	
	3	Variable setpoint with load dependant compensation	x	x	x	x	x	x	x	x

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
4.10	Humidity control									
	0	No automatic control	x				x			
	1	Dew point control	x	x			x	x		
	2	Direct humidity control	x	x	x	x	x	x	x	x
5	Lighting control									
5.1	Occupancy control									
	0	Manual on/off switch	x	x			x			
	1	Manual on/off switch + additional sweeping extinction signal	x	x	x		x	x		
	2	Automatic detection (auto on)	x	x	x	x	x	x	x	
	3	Automatic detection (manual on)	x	x	x	x	x	x	x	x
5.2	Light level/Daylight control									
	0	Manual (central)	x				x	x		
	1	Manual (per room/zone)	x	x			x	x		
	2	Automatic switching	x	x	x		x	x	x	
	3	Automatic dimming	x	x	x	x	x	x	x	x
6	Blind control									
	0	Manual operation	x				x			
	1	Motorized operation with manual control	x	x			x			
	2	Motorized operation with automatic control	x	x	x		x	x		
	3	Combined light/blind/HVAC control	x	x	x	x	x	x	x	x
7	Technical home and building management									
7.1	Setpoint management									
	0	Manual setting room by room individually	x	x			x			
	1	Adaptation from distributed/decentralized plant rooms only	x	x	x		x	x		
	2	Adaptation from a central room	x	x	x	x	x	x	x	
	3	Adaptation from a central room with frequent set back of user inputs	x	x	x	x	x	x	x	x
7.2	Runtime management									
	0	Manual setting (plant enabling)	x	x			x			
	1	Individual setting following a predefined time schedule including fixed preconditioning phases	x	x	x		x	x		
	2	Individual setting following a predefined time schedule; adaptation from a central room; variable preconditioning phases	x	x	x	x	x	x	x	x
7.3	Detecting faults of technical building systems and providing support to the diagnosis of these faults									
	0	No central indication of detected faults and alarms	x	x			x			
	1	With central indication of detected faults and alarms	x	x	x		x	x		
	2	With central indication of detected faults and alarms/diagnosing functions	x	x	x	x	x	x	x	x
7.4	Reporting information regarding energy consumption, indoor conditions									
	0	Indication of actual values only (e.g. temperatures, meter values)	x	x			x	x		
	1	Trending functions and consumption determination	x	x	x		x	x	x	

			Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
	2	Analysing, performance evaluation, benchmarking	x	x	x	x	x	x	x	x
7.5	Local energy production and renewable energies									
	0	Uncontrolled generation depending on the fluctuating availability of RES and or run time of CHP; overproduction will be fed into the grid	x	x			x	x		
	1	Coordination of local RES and CHP with regard to local energy demand profile including energy storage management; Optimization of own consumption	x	x	x	x	x	x	x	x
7.6	Waste heat recovery and heat shifting									
	0	Instantaneous use of waste heat or heat shifting	x				x			
	1	Managed use of waste heat or heat shifting (including charging/discharging TES)	x	x	x	x	x	x	x	x
7.7	Smart Grid integration									
	0	No harmonization between grid and building energy systems; building is operated independently from the grid load	x	x			x	x		
	1	Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting	x	x	x	x	x	x	x	x

[a] In case of slow reacting heat and cool emission systems, e.g. floor heating, wall heating, etc. functions 1.1.3 and 3.1.3 are allocated to BAC class A.

Table B.1 — Minimum BAC function type requirement

			Residential	Non-residential
Automatic control				
1	Heating control			
1.1	Emission control			
	2	Individual room control	x	x
1.2	Emission control for TABS (heating mode)			
	1	Central automatic control	x	x
1.3	Control of distribution network hot water temperature (supply or return)			
	Similar function can be applied to the control of direct electric heating networks			
	1	Outside temperature compensated control	x	x
1.4	Control of distribution pumps in networks			
	The controlled pumps can be installed at different levels in the network			
	1	On off control	x	x
1.5	Intermittent control of emission and/or distribution			
	One controller can control different rooms/zones having same occupancy patterns			
	1	Automatic control with fixed time	x	x

			Residential	Non-residential
		program		
1.6	Heat generator control (combustion and district heating)			
	1	Variable temperature control depending on outside temperature	x	x
1.7	Heat generator control (heat pump)			
	0	On/off control of heat generator	x	x
1.8	Heat generator control (outdoor unit)			
	1	Multi-stage control of heat generator	x	x
1.9	Sequencing of different heat generators			
	1	Priorities only based on loads	x	x
1.10	Control of Thermal Energy Storage (TES) charging			
	1	2-sensor charging of storage	x	x
2	Domestic hot water supply control			
2.1	Control of DHW storage charging with direct electric heating or integrated electric heat pump			
	1	Automatic on/off control and scheduled charging enable	x	x
2.2	Control of DHW storage charging using heating water generation			
	1	Automatic on/off control and scheduled charging enable	x	x
2.3	Control of DHW storage charging with solar collector and supplementary heat generation			
	1	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2)	x	x
2.4	Control of DHW circulation pump			
	1	With time program	x	x
3	Cooling control			
3.1	Emission control			
	2	Individual room control	x	x
3.2	Emission control for TABS (cooling mode)			
	1	Central automatic control	x	x

			Residential	Non-residential
3.3	Control of distribution network chilled water temperature (supply or return)			
	Similar function can be applied to the control of direct electric cooling (e.g. compact cooling units, split units) for individual rooms			
	1	Outside temperature compensated control	x	x
3.4	Control of distribution pumps in networks			
	The controlled pumps can be installed at different levels in the network			
	1	On off control	x	x
3.5	Intermittent control of emission and/or distribution			
	One controller can control different rooms/zones having same occupancy patterns			
	1	Automatic control with fixed time program	x	x
3.6	Interlock between heating and cooling control of emission and/or distribution			
	1	Partial interlock (dependent on the HVAC system)	x	x
3.7	Different chiller selection control			
	The goal consists generally in maximizing the chiller operation temperature			
	1	Variable temperature control depending on outside temperature	x	x
3.8	Sequencing of different chillers			
	1	Priorities only based on loads	x	x
3.9	Control of Thermal Energy Storage (TES) operation			
	1	Time-scheduled storage operation	x	x
4	Ventilation and air-conditioning control			
4.1	Supply air flow control at the room level			
	1	Time control	x	x
4.2	Room air temperature control (all-air systems)			
	1	variable capacity control	x	x
4.3	Room air temperature control (air–water systems)			
	0	No coordination		x
	1	Coordination	x	

			Residential	Non-residential
4.4	Outside Air flow control			
	0	Fixed OA ratio/OA flow	x	
	1	Staged (low/high) OA ratio/OA flow (time scheduled)		x
4.5	Air flow or pressure control at the air handler level			
	1	On off time control	x	x
4.6	Heat recovery control: icing protection			
	1	With icing protection	x	x
4.7	Heat recovery control (prevention of overheating)			
	1	With overheating control	x	x
4.8	Free mechanical cooling			
	1	Night cooling	x	x
4.9	Supply air Temperature control			
	1	Constant setpoint	x	x
4.10	Humidity control			
	1	Dew point control	x	x
5	Lighting control			
5.1	Occupancy control			
	0	Manual on/off switch	x	
	1	Manual on/off switch + additional sweeping extinction signal		x
5.2	Light level/Daylight control			
	0	Manual (central)	x	x
6	Blind Control			
	1	Motorized operation with manual control	x	
	2	Motorized operation with automatic control		x
7	Technical home and building management			
7.1	Setpoint management			
	0	Manual setting room by room individually	x	
	1	Adaptation from distributed/decentralized plant rooms only		x

			Residential	Non-residential
7.2	Run time management			
	0	Manual setting (plant enabling)	x	
	1	Individual setting following a predefined time schedule including fixed preconditioning phases		x
7.3	Detecting faults of technical building systems and providing support to the diagnosis of these faults			
	0	No central indication of detected faults and alarms	x	
	1	With central indication of detected faults and alarms		x
7.4	Reporting information regarding energy consumption, indoor conditions			
	0	Indication of actual values only (e.g. temperatures, meter values)	x	x
7.5	Local energy production and renewable energies			
	0	Uncontrolled generation depending on the fluctuating availability of RES and or run time of CHP; overproduction will be fed into the grid	x	x
7.6	Waste heat recovery			
	0	Instantaneous use of waste heat or heat shifting	x	x
7.7	Smart Grid interaction			
	0	building is operated independently from the grid load	x	x

Table 4 — BAC and TBM functions having an impact on the energy performance of buildings

Automatic control				
1	Heating control			
1.1	Emission control		HEAT_EMIS_CTRL_DEF	M3–5
		The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for type 1 one function can control several rooms		
	0	No automatic control of the room temperature		
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098–1 or EN 12098–3; one system can control several rooms		
	2	Individual room control: By thermostatic valves or electronic controller		
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature setpoint)		
	4	Individual room control with communication and occupancy detection: Between controllers and BACS; Demand control/occupancy detection (this function level is usually not applied to any slow reacting heat emission systems with relevant thermal mass, e.g. floor heating, wall heating)		

1.2	Emission control for TABS (heating mode)	HEAT_EMIS_CTRL_TABS	M3–5
	0	No automatic control of the room temperature	
	1	Central automatic control: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose set-point is dependent on the filtered outside temperature, e.g. the average of the previous 24 h.	
	2	Advanced central automatic control: This is a central automatic control of the TABS zone that is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature heating set-point). "Optimal" means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as low as possible to reduce the energy demand for heating.	
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control: a) Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency - typically 6 h on/off cycle time - or with a slow frequency, corresponding to 24 h on/off cycle time. If the TABS is used for cooling, intermittent operation with 24 h on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold. b) Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature set-point is corrected by the output of a room temperature feedback controller, to adapt the set-point to non-predictable day-to-day variation of the heat gain. Since TABS reacts slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone. c) Advanced central automatic control with intermittent operation and room temperature feedback control	
1.3	Control of distribution network hot water temperature (supply or return)	HEAT_DISTR_CTRL_TMP	M3–6
		Similar function can be applied to the control of direct electric heating networks	
	0	No automatic control	
	1	Outside temperature compensated control: Actions generally lower the mean flow temperature	
	2	Demand based control: e.g. based on indoor temperature control variable; Actions generally lower the mean flow temperature	

1.4	Control of distribution pumps in networks	HEAT_DISTR_CTRL_PMP	M3–6
		The controlled pumps can be installed at different levels in the network. Control is to reduce the auxiliary energy demand of the pumps.	
	0	No automatic control	
	1	On/off control: switch on and off automatically, pumps run with no control at maximum speed	
	2	Multi-Stage control: Speed of pumps is controlled by a multi-step control	
	3	Variable speed pump control: constant or variable Δp based on pump unit (internal) estimations	
	4	Variable speed pump control: variable Δp following an external demand signal, e.g. hydraulic requirement, ΔT, energy optimization	
1.5	Intermittent control of emission and/or distribution	HEAT_DISTR_CTRL	M3–5 / M3–6
		One controller can control different rooms/zones having same occupancy patterns	
	0	No automatic control	
	1	Automatic control with fixed time program: To lower the operation time	
	2	Automatic control with optimum start/stop: To lower the operation time	
	3	Automatic control with demand evaluation: To lower the operation time	
1.6	Heat generator control for combustion and district heating	HEAT_GEN_CTRL_CD	M3–8
		The goal consists generally in minimizing the heat generator operation temperature	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	
1.7	Heat generator control (heat pump)	HEAT_GEN_CTRL_HP	M3–8
		The goal consists generally in minimizing the heat generator operation temperature and by this in maximizing the heat generator efficiency	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	

1.8	Heat generator control (outdoor unit)	HEAT_GEN_CTRL_OU	M3–8
		The goal consists generally in maximizing the heat generator efficiency	
	0	On/Off-control of heat generator	
	1	Multi-stage control of heat generator capacity depending on the load or demand (e.g. on/off of several compressors)	
	2	Variable control of heat generator capacity depending on the load or demand (e.g. hot gas bypass, inverter frequency control)	
1.9	Sequencing of different heat generators	HEAT_GEN_CTRL_SEQ	M3–8
		This control function only applies to a system with a set of different heat generator sizes or types including Renewable Energy Sources	
	0	Priorities only based on running time	
	1	Control according to fixed priority list: e.g. heat pump prior to hot water boiler	
	2	Control according to dynamic priority list (based on current efficiency and capacity of generators)e.g. solar, geothermal heat, cogeneration plant, fossil fuels)	
	3	Control according to dynamic priority list (based on predicted and current load, efficiency and capacity of generators)	
1.10	Control of Thermal Energy Storage (TES) charging	HEAT_TES_CTRL	M3–7
		The TES is part of the heating system.	
	0	Continuous storage operation	
	1	2-sensor charging of storage	
	2	Load prediction based storage operation	
2	Domestic hot water supply control		
2.1	Control of DHW storage charging with direct electric heating or integrated electric heat pump	DHW_STRG_CTRL_EL	M8–7 / M8–8
	0	Automatic on/off control	
	1	Automatic on/off control and scheduled charging enable	
	2	Automatic on/off control and scheduled charging enable and multi-sensor storage management	
2.2	Control of DHW storage charging using hot water generation	DHW_STRG_CTRL_HG	M8–7 / M8–8
	0	Automatic on/off control	
	1	Automatic on/off control and scheduled charging enable	
	2	Automatic on/off control, scheduled charging enable and demand based supply temperature control or multi-sensor storage management	
2.3	Control of DHW storage charging with solar collector and supplementary heat generation	DHW_STRG_CTRL_SOL	M8–7 / M8–8
	0	Manual control	
	1	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2)	
	2	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2) plus demand based supply temperature control or multi-sensor storage management	
2.4	Control of DHW circulation pump	DHW_CIRC_CTRL	M8–6
	0	No control, continuous operation	
	1	With time program	
3	Cooling control		
3.1	Emission control	CLG_EMIS_CTRL_DEF	M4–5
		The control function is applied to the emitter (cooling panel, fan-coil unit or indoor unit) at room level; for type 1 one function can control several rooms	
	0	No automatic control of the room temperature	
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098–1 or EN 12098–3	
	2	Individual room control: By thermostatic valves or electronic controller	
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature setpoint)	
	4	Individual room control with communication and occupancy detection: Between controllers and BACS; Demand control/occupancy detection (this function level is usually not applied to any slow reacting cool emission systems with relevant thermal mass, e.g. floor cooling)	
3.2	Emission control for TABS (cooling mode)	CLG_EMIS_CTRL_TABS	M4–5
	0	No automatic control of the room temperature	
	1	Central automatic control: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose set-point is dependent on the filtered outside temperature, e.g. the average of the previous 24 h.	

	2	Advanced central automatic control: This is a central automatic control of the TABS zone that is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature cooling set-point). "Optimal" means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as high as possible to reduce the energy demand for cooling.		
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control: a) Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency - typically 6 h on/off cycle time - or with a slow frequency, corresponding to 24 h on/off cycle time. If the TABS is used for cooling, intermittent operation with 24 h on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold. b) Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature set-point is corrected by the output of a room temperature feedback controller, to adapt the set-point to non-predictable day-to-day variation of the heat gain. Since TABS reacts slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone. c) Advanced central automatic control with intermittent operation and room temperature feedback control		
3.3	Control of distribution network chilled water temperature (supply or return)	CLG_DISTR_CTRL_TMP	M4–6
		Similar function can be applied to the control of direct electric cooling (e.g. compact cooling units, split units) for individual rooms	
	0	Constant temperature control	
	1	Outside temperature compensated control: Actions generally raise the mean flow temperature	
	2	Demand based control: e.g. based on indoor temperature control variable; Actions generally raise the mean flow temperature	
3.4	Control of distribution pumps in hydraulic networks	CLG_DISTR_CTRL_PMP	M4–6
		The controlled pumps can be installed at different levels in the network	
	0	No automatic control	
	1	On off control: To reduce the auxiliary energy demand of the pumps	
	2	Multi-Stage control: To reduce the auxiliary energy demand of the pumps	
	3	Variable speed pump control: constant or variable Δp based on pump unit (internal) estimations to reduce the auxiliary energy demand of the pumps	
	4	Variable speed pump control: variable Δp following an external demand signal, e.g. hydraulic requirements, ΔT, energy optimization to reduce the auxiliary energy demand of the pumps	
3.5	Intermittent control of emission and/or distribution	CLG_DISTR_CTRL	M4–5 / M4–6
		One controller can control different rooms/zones having same occupancy patterns	
	0	No automatic control	
	1	Automatic control with fixed time program: To lower the operation time	
	2	Automatic control with optimum start/stop: To lower the operation time	
	3	Automatic control with demand evaluation: To lower the operation time	
3.6	Interlock between heating and cooling control of emission and/or distribution	CLG_GEN_CTRL	M4–8
		To avoid at the same time heating and cooling in the same room depends on the system principle (e.g. cooling panel/heat emitter, TABS/ventilation, several indoor units)	
	0	No interlock: the two systems are controlled independently and can provide simultaneously heating and cooling	
	1	Partial interlock (depending on the HVAC system): The control function is set up in order to minimize the possibility of simultaneous heating and cooling. This is generally done by defining a sliding setpoint for the supply temperature of the centrally controlled system	
	2	Total interlock: The control function enables to warranty that there will be no simultaneous heating and cooling.	
3.7	Generator control for cooling	CLG_GEN_CTRL	M4–8
		The goal consists generally in maximizing the chiller water temperature	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: This includes control according to room temperature	
3.8	Sequencing of different chillers (generators for chilled water)	CLG_GEN_CTRL_SEQ	M4–8
		This control function only applies to a system with a set of different chiller sizes or chilled water generator types including Free Cooling and/or Renewable Energy Sources	

	0	Priorities only based on running time		
	1	Fixed Sequencing based on loads only: e.g. depending on the generators characteristics, e.g. absorption chiller vs. centrifugal chiller		
	2	Priorities based on generator efficiency and characteristics: The generator operational control is set individually to available generators so that they operate with an overall high degree of efficiency (e.g. outside air, river water, geothermic heat, refrigeration machines)		
	3	Load prediction based sequencing: The sequence is based on e.g. COP and available power of a device and the predicted required power.		
3.9	Control of Thermal Energy Storage (TES) charging		CLG_TES_CTRL	M4–7
		The TES is part of the cooling/chilled water system.		
	0	Continuous storage operation		
	1	Time-scheduled storage operation		
	2	Load prediction based storage operation		
4	Ventilation and air-conditioning control			
	This section is for building energy systems that bring air into the building: both ventilation and air conditioning systems. Heating and Cooling of air requires additional heating and cooling devices. Control functions related to heating/cooling systems are defined in sections 1 and 3 resp.			
4.1	Supply air flow control at the room level (e.g. fan on/off)		VENT_RMFLOW_CTRL	M5–5
	Control of supply air flow related to occupancy (availability of air flow, i.e. fan on/off control)).			
	0	No automatic control: The system runs constantly (e.g. manual controlled switch)		
	1	Time control: The system runs according to a given time schedule		
	2	Occupancy detection: The system runs dependent on the occupancy (light switch, infrared sensors etc.)		
4.2	Room air temperature control by the ventilation system (all-air systems; combination with static systems as cooling ceiling, radiators, etc.)		VENT_RTEMP_CTRL	M5–5 / M5–6
	Room air temperature depends on air flow (4.1, 4.5) as well as supply air temperature (4.9). This control function is related to a closed loop controller for the room air temperature acting on the air flow or supply air temperature. It can work with or without an additional static heating system (radiators etc.). Minimum air flow rates are maintained.			
	0	On-off control: fixed air flow rate and fixed supply air temperature at the room level; Room temperature setpoints are set individually.		
	1	Continuous control: either air flow rate or supply air temperature at the room level can be varied continuously ; Room temperature setpoint s are set individually		
	2	Optimized control: Minimum energy demand by optimized control. Both air flow rate as well as supply air temperature at the room level are controlled dependent on heating/cooling load.		
4.3	Coordination of room air temperature control by ventilation and by static system		VENT_RTEMP_COORD	M5–5 / M5–6
	Interaction of the different systems has to be coordinated.			
	0	Interaction is not coordinated, e.g. closed loop controllers are dedicated to each system to maintain the room air temperature independently.		
	1	Interaction is coordinated, i.e. only one system is controlled by a closed loop controller for the room air temperature and the other system conditions the room only to that extent that allows the closed loop controller to benefit from internal and external heat gains.		
4.4	Outside air flow control		VENT_OAFLOW_CTRL	M5–6 / M5–8
	This control function is applied to ventilation systems that allow varying the OA ratio or flow respectively.			
	0	Fixed OA ratio/OA flow: The system runs according to a given OA ratio, e.g. modified manually.		
	1	Staged (low/high) OA ratio/OA flow: depending on a given time schedule		
	2	Staged (low/high) OA ratio/OA flow: depending on the occupancy, e.g. light switch, infrared sensors etc.		
	3	Variable control: The system is controlled by sensors which detect the number of people or indoor air parameters or adapted criteria (e.g. CO_2, mixed gas or VOC sensors). The used parameters shall be adapted to the kind of activity in the space.		
4.5	Air flow or pressure control at the air handler level		VENT_AHUFLOW_CTRL	M5–6 / M5–8
	0	No automatic control: Continuously supplies of air flow for a maximum load of all rooms		
	1	On off time control: Continuously supplies of air flow for a maximum load of all rooms during nominal occupancy time		
	2	Multi-stage control: To reduce the auxiliary energy demand of the fan		
	3	Automatic flow or pressure control without pressure reset: Load dependent supplies of air flow for the demand of all connected rooms.		
	4	Automatic flow or pressure control with pressure reset: Load dependent supplies of air flow for the demand of all connected rooms (for variable air volume systems with VFD).		

4.6	Heat recovery control: icing protection	VENT_HRICE_CTRL	M5–5
	This control function is to avoid icing of the heat exchanger.		
	0	Without icing protection control: There is no specific action to avoid icing of the heat exchanger	
	1	With icing protection control: A control loop enables to warranty that the exhaust air temperature leaving the heat exchanger is not too low to avoid frosting	
4.7	Heat recovery control: prevention of overheating	VENT_HRHEAT_CTRL	M5–5
	This control function is to avoid overheating at the heat recovery unit.		
	0	Without overheating control: There is no specific action to avoid overheating	
	1	With overheating control: During periods where the effect of the heat exchanger will no more be positive a control loop between “stops” and “modulates” or bypass the heat exchanger	
4.8	Free mechanical cooling	VENT_FREECOOL_CTRL	M5–8
	0	No automatic control	
	1	Night cooling: The amount of outside air is set to its maximum during the unoccupied period provided: 1) the room temperature is above the setpoint for the comfort period; 2) the difference between the room temperature and the outside temperature is above a given limit; if free night cooling will be realized by automatically opening windows there is no air flow control	
	2	Free cooling: Both the amount of outside air and recirculation air are modulated during all periods of time to minimize the amount of mechanical cooling. Calculation is performed on the basis of temperatures	
	3	H,x-directed control: The amount of outside air and recirculation air are modulated during all periods of time to minimize the amount of mechanical cooling. Calculation is performed on the basis of temperatures and humidity (enthalpy).	
4.9	Supply air temperature control at the AHU level	VENT_AHUSAT_CTRL	M5–5
	There might be several supply air temperatures in an air conditioning system: the supply air temperature at the outlet of the AHU, the supply air temperature at the outlet of central re-heaters as well as supply air temperature at the room level (terminal re-heat boxes). This control function is about how to determine the supply air temperature setpoint (in case there is one) at the air handler level not how to control the temperature (e.g. control of heat emission at the water-to–air HX).		
	0	No automatic control: No control loop enables to act on the supply air temperature;	
	1	Constant setpoint: A control loop enables to control the supply air temperature, the setpoint is constant and can only be modified by a manual action	
	2	Variable setpoint with outside temperature compensation: A control loop enables to control the supply air temperature. The setpoint is a simple function of the outside temperature (e.g. linear function)	
	3	Variable setpoint with load dependent compensation: A control loop enables to control the supply air temperature. The setpoint is defined as a function of the loads in the room. This can normally only be achieved with an integrated control system enabling to collect the temperatures or actuator position in the different rooms	
4.10	Humidity control	VENT_HUM_CTRL	M6–5 / M7–5
	The control of the air humidity may include humidification and/or dehumidification. Controllers may be applied as “humidity limitation control” or “constant control”		
	0	No automatic control: No control loop enables to act on the air humidity	
	1	Dew point control: Supply air or room air humidity is expressed with the dew point temperature and reheat of the supply air to bring the relative humidity to the setpoint	
	2	Direct humidity control: Supply air or room air humidity; a control loop enables the supply air or room air humidity at a given setpoint. The setpoint is either fixed and predefined by the user or an fluctuating optimal value at a minimum energy but within min/max limits of room air condition	
5	Lighting control		
5.1	Occupancy control	LIGHT_OCC_CTRL	M9–5
	0	Manual on/off switch: The luminaire is switched on and off with a manual switch in the room	
	1	Manual on/off switch + additional sweeping extinction signal: The luminaire is switched on and off with a manual switch in the room. In addition, an automatic signal automatically switches off the luminaire at least once a day, typically in the evening to avoid needless operation during the night	
	2	Automatic detection Auto On/Dimmed Off: The control system switches the luminaire(s) automatically on whenever the illuminated area is occupied, and automatically switches them to a state with reduced light output (of no more than 30 % of the normal 'on state') no later than 10 min after the last occupancy in the illuminated area. In addition, no later than 20 min after the last occupancy in the room as a whole is detected, the luminaire(s) is automatically and fully switched off Auto On/Auto Off: The control system switches the luminaire(s) automatically on whenever the illuminated area is occupied, and automatically switches them entirely off no later than 10 min after the last occupancy is detected in the illuminated area	

	3	Automatic detection Manual On/ Partial Auto On /Dimmed Off: The luminaire(s) can only be switched on by means of a manual switch or automatically by occupancy detection sensor located in (or very close to) the area illuminated by the luminaire(s), and, if not switched off manually, is/are automatically switched to a state with reduced light output (of no more than 30 % of the normal 'on state') no later than 10 min after the last occupancy in the illuminated area. In addition, no later than 20 min after the last occupancy in the room as a whole is detected, the luminaires are automatically and fully switched off Manual On/ Partial Auto On /Auto Off: The luminaire(s) can only be switched on by means of a manual switch or automatically by occupancy detection sensor located in (or very close to) the area illuminated by the luminaire(s), and, if not switched off manually, is automatically and entirely switched off by the automatic control system no later than 20 min after the last occupancy is detected in the illuminated area	
5.2	Light level/Daylight control (daylight harvesting)	LIGHT_LEVEL_CTRL	M9–5
	0	Manual central: Luminaires are controlled centrally, there is no manual switch in the room/zone	
	1	Manual: Luminaires can be switched off with a manual switch in the room	
	2	Automatic switching: The luminaires are automatically switched off when more than enough daylight is present to fully provide minimum illuminance required and switched on when there is not enough daylight.	
	3	Automatic dimming: The luminaires are dimmed down and finally fully switched off when daylight is available. The luminaires will be switched on again and dimmed up if the amount of daylight is decreasing.	
6	Blind control		
6.1	Blind control	BLIND_CTRL	M2.5/M2.8/M9–5
	There are two different motivations for blind control: solar protection to avoid overheating and to avoid glaring		
	0	Manual operation: Mostly used only for manual shadowing, energy saving depends only on the user behaviour	
	1	Motorized operation with manual control: Mostly used only for easiest manual (motor supported) shadowing, energy saving depends only on the user behaviour	
	2	Motorized operation with automatic control: Automatic controlled dimming to reduce cooling energy	
	3	Combined light/blind/HVAC control: To optimize energy use for HVAC, blind and lighting for occupied and non-occupied rooms	
7	Technical home and building management		

	The Technical Home and Building Management enables to adapt easily the operation to the user needs. One shall check at regular intervals that the operation schedules of heating, cooling, ventilation and lighting is well adapted to the actual used schedules and that the setpoints are also adapted to the needs. – Attention shall be paid to the tuning of all controllers this includes setpoints as well as control parameters such as PI controller coefficients. – Heating and cooling setpoints of the room controllers shall be checked at regular intervals. The users often modify these setpoints. A centralized system enables to detect and correct extreme values of setpoints due to misunderstanding of users. – If the Interlock between heating and cooling control of emission and/or distribution is only a partial interlock. The setpoint shall be regularly modified to minimize the simultaneous use of heating and cooling. – Alarming and monitoring functions will support the adaptation of the operation to user needs and the optimization of the tuning of the different controllers. This will be achieved by providing easy tools to detect abnormal operation (alarming functions) and by providing easy way to log and plot information (monitoring functions).		
7.1	Setpoint management	BMS_SP	M10–12
	Management, set back and adaptation of BAC setpoints according to the room/zone operating modes		
	0	Manual setting room by room individually	
	1	Adaptation from distributed/decentralized plant rooms only	
	2	Adaptation from a central room (e.g. work station, web operation; room operating units are excluded)	
	3	Adaptation from a central room (e.g. work station, web operation; room operating units are excluded) with frequent set back of user inputs	
7.2	Runtime management	BMS_RT	M10–12
	Adaptation of system/plant operating hours according to given time schedule and/or calendar		
	0	Manual setting (plant enabling)	
	1	Individual setting following a predefined schedule including fixed preconditioning phases	
	2	Individual setting following a predefined schedule; adaptation from a central room (e.g. work station, web operation; room operating units are excluded); variable preconditioning phases	
7.3	Detecting faults of technical building systems and providing support to the diagnosis of these faults	BMS_FD	M10–12
	0	No central indication of detected faults and alarms	
	1	With central indication of detected faults and alarms	

	2	With central indication of detected faults and alarms including diagnosing functions	
7.4	Reporting information regarding energy consumption, indoor conditions	BMS_RPR	M10–12
	0	Indication of actual values only (e.g. temperatures, meter values)	
	1	Trending functions and consumption determination	
	2	Analysing, performance evaluation, benchmarking of indoor environment and energy	
7.5	Local energy production and renewable energies	BMS_RES	M10–12
	Managing local renewable energy sources and other local energy productions as CHP		
	0	Uncontrolled generation depending on the fluctuating availability of RES and or run time of CHP; overproduction will be fed into the grid	
	1	Coordination of local RES and CHP with regard to local energy demand profile including energy storage management; Optimization of own consumption	
7.6	Heat recovery and heat shifting	BMS_HRC	M10–12
	Using of waste heat recovery on the building level and heat shifting		
	0	Instantaneous use of waste heat or heat shifting	
	1	Managed use of waste heat or heat shifting (including charging/discharging TES)	
7.7	Smart grid integration	BMS_SG	M10–12
	Interactions between building and any smart grid including demand side management		
	0	No harmonization between grid and building energy systems; building is operated independently from the grid load	
	1	Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting	