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EU Directive on the overall energy performance of buildings (EPBD) and its effect on the planning of buildings

Directive 2002/91/EG of the European Parliament and the Commission

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Motivation for Directive (16.12.2002)

- Reduction of the energy demand and the CO2 emission of buildings (space heating and hot tap water amounts to 40% of the total end-use energy demand in Europe)
- Value of buildings not (only) because of the location but also because of the energy demand and the operating costs
- European harmonization of standards for calculation and evaluation (certificates) of energy demand of buildings
- Reduction of emissions by constant maintenance of boilers and air-conditioning systems

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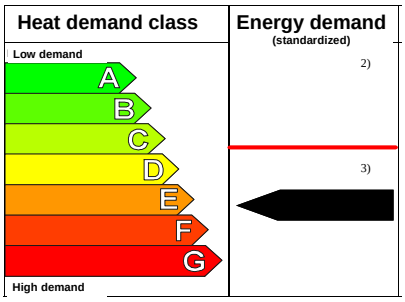
Content of the Directive

- Development of the calculation method (energy demand of heating (EN 13790), cooling (new), lightning (new) and losses of the production- and distribution systems (new)
- Fixing of average, minimum and maximum energy demand of buildings by the national governments
- Development of energy certificates for buildings



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Content of the Directive

- Application for all new and refurbished buildings
  - Private houses: new buildings, (partly)selling, renovation
  - Public buildings: right after the directive comes into force
- Increasing the use of renewable energy sources, combined heat and power plants (CHP) and heat pumps if economically feasible

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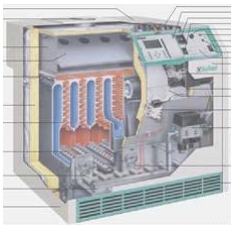
Content of the Directive

- Regularly inspections of boilers (>100 kW every 2 / 4(gas) years; <20 kW every 15 years)
- Regularly inspection of air-conditioning systems
- Inspection by independent specialists



- Set into force by

!!! January 4th 2006 !!!

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Three Levels of Energy-Demand Evaluation

- **Level A**
  Calculation of End-Use Energy demand (predefined user behaviourm, Asset Rating)
- **Level B**
  Measurement of End-Use Energy demand (actual user behaviour, Operational Rating)
- **Level C**
  Estimation of End-Use Energy demand using statistical values for different types, architectures and ages of buildings

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Status of the EPBD development (CEN)

- Mandate to CEN (October 2003) for developing calculation systems
- Affected Technical Committees (TCs)
  - CEN/TC 89 Thermal performance of buildings and building components
  - CEN/TC 156 Ventilation for buildings
  - CEN/TC 169 Light and lighting
  - CEN/TC 228 Heating systems in buildings
  - CEN/TC 247 Building Automation, Controls and Building Management
- Till this time big activities in the standardization bodies

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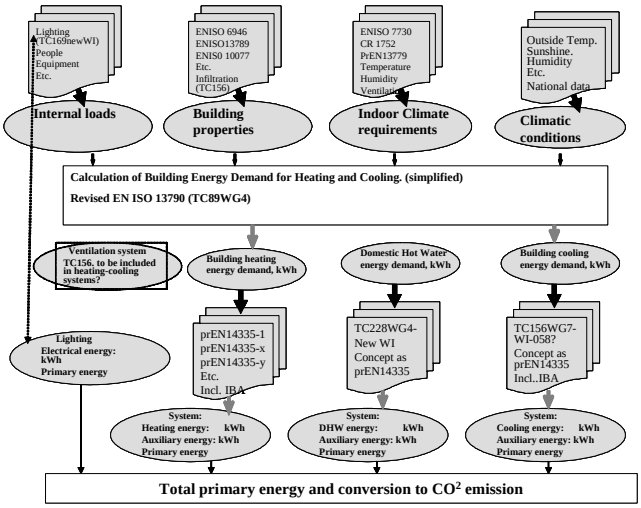
Affected CEN Standards



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Problems at CEN-Regulation

- Tremendous pressure of time (normal time to set up a new CEN standard is 10 years)
- New methods can only be limited verified (single countries, such as Germany had money for this)
- In 2006 there probably won't be harmonized standards
- As the regulation is European law (independent from the CEN) → necessity of national transitional arrangements

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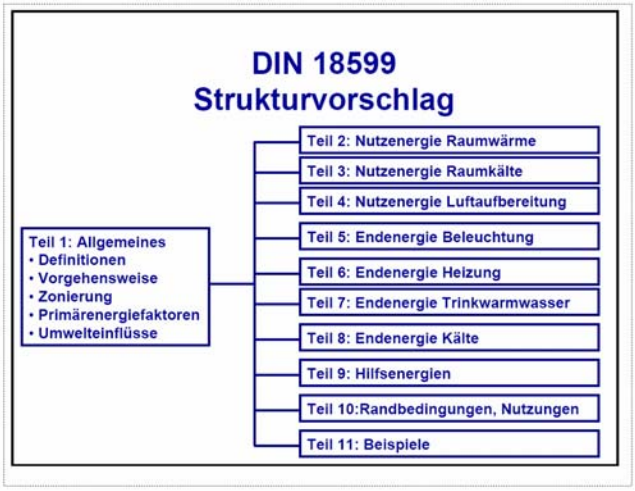
German National Activities



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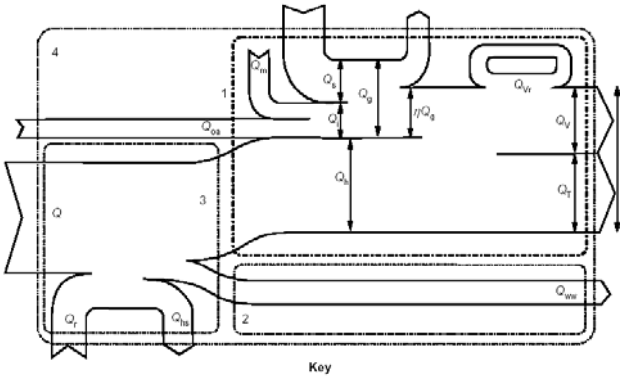
Energy Flow in Buildings by En ISO 13790



Key

Q	energy use for heating
Q_{os}	heat from other appliances
Q_r	recovered energy
Q_{ls}	losses from the heating system
Q_m	metabolic heat
Q_s	passive solar gains
Q_i	internal gains
Q_g	total gains
$\eta\, Q_g$	useful gains
Q_h	heat use
Q_V	ventilation heat loss
Q_{Vr}	ventilation heat recovery
Q_T	transmission heat loss
Q_{ww}	heat for hot water preparation
Q_L	total heat loss
1	boundary of the heated zone
2	boundary of the hot water system
3	boundary of the heating plant
4	boundary of the building

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Calculation of the monthly demand for heating and cooling based on prEN 13790

Calculation of energy use for space heating according to EN 832 or prEN 13790 (monthly method)

Heat losses Q_l

Heat gains Q_g

$\eta = f\left(\frac{Q_g}{Q_l}, \tau\right)$

$Q_{g\ useful} = \eta \cdot Q_g$

Gains useful for heating

$Q_h = Q_l - \eta \cdot Q_g$

Heat use for space heating

Q_h

Room heating demand

Calculation of energy use for space heating and cooling for determine the energy demand of the air conditioning system

$Q_{g\ not\ useful} = (1-\eta) \cdot Q_g$

Gains not useful for heating

$Q_c = Q_{g\ not\ useful}$

Room cooling demand

Prof. Dr. L. Rouvel
Extraordinarius für Elektrische Gebäudeenergietechnik

Stand: 12.01.04

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Approach Germany Non-residential Buildings , User Profiles

Einzel- und Gruppenbüro — 1

		von	bis
Nutzungszeiten			
Tägliche Nutzungszeit	[Uhr]	7:00	18:00
Nutzungstage pro Jahr	[d/a]	250	
Tageslichtstunden	h/a	77	
Nachtlichtstunden	h/a	77	
Tägliche Betriebszeit RLT	[Uhr]	5:00	19:00
Betriebstage RLT pro Jahr	d/a	250	
Tägliche Betriebszeit Heizung	[Uhr]	5:00	19:00 (nicht abgesenkt)
Betriebstage Heizung pro Jahr	d/a	250	

Raumkonditionen (sofern Luftbehandlungsfunktion vorhanden)

		Auslegungswert	Monats-mittelwert
Raumtemperatur	[°C] Heizung	20	21
	[°C] Kühlung	26	24

		Min	Max
Zuluftfeuchte	[g/kg]	6	11

Hygienischer Mindestaußenluftvolumenstrom (Normen)

Personenbezogen	[m³/(h Person)]	40
Flächenbezogen	[m³/(h m²)]	4

Mech. Außenluftvolumenstrom (Praxis)		von	bis
Luftwechsel	[h-1]	2	3
Luftwechsel nur Luft	[h-1]	4	6

Beleuchtung			
Beleuchtungsstärke	Lux	500	(Wartungswert)
Höhe der Nutzebene	m	0,8	
Minderungsfaktor	-	0,92	
Abwesenheitsfaktor Beleuchtung	-	0,3	
Minderungsfaktor Geb.-betriebszeit	-	0,7	

Personenbelegung	gering	mittel	hoch
Maximale Belegungsdichte m²/Person	18	14	10

Interne Wärmequellen	Vollbenutzungs-stunden [h/d]	max. spezifische Leistung [W/m²] tief	mittel	hoch
Personen (70 W/Person)	6	3	5	7
Arbeitshilfen*	6	4	7	15
Wärmezufuhr pro Tag [Wh/(m² d)]		42	72	132

Anmerkungen

* tief / mittel / hoch entspricht 50 / 100 / 150 W/Person für Arbeitshilfen

Einzelhandel (mit Kühlprodukten) — 6

		von	bis
Nutzungszeiten			
Tägliche Nutzungszeit	[Uhr]	8:00	20:00
Nutzungstage pro Jahr	[d/a]	300	
Tageslichtstunden	h/a	77	
Nachtlichtstunden	h/a	77	
Tägliche Betriebszeit RLT	[Uhr]	6:00	21:00
Betriebstage RLT pro Jahr	d/a	300	
Tägliche Betriebszeit Heizung	[Uhr]	6:00	21:00 (nicht abgesenkt)
Betriebstage Heizung pro Jahr	d/a	300	

Raumkonditionen (sofern Luftbehandlungsfunktion vorhanden)

		Auslegungswert	Monats-mittelwert
Raumtemperatur	[°C] Heizung	20	21
	[°C] Kühlung	26	24

		Min	Max
Zuluftfeuchte	[g/kg]	6	11

Hygienischer Mindestaußenluftvolumenstrom (Normen)

Personenbezogen	[m³/(h Person)]	20
Flächenbezogen	[m³/(h m²)]	-

Mech. Außenluftvolumenstrom (Praxis)		von	bis
Luftwechsel	[h-1]	-	-
Luftwechsel nur Luft	[h-1]	-	-

Beleuchtung			
Beleuchtungsstärke	Lux	300	(Wartungswert)
Höhe der Nutzebene	m	0,8	
Minderungsfaktor	-	0,93	
Abwesenheitsfaktor Beleuchtung	-	0	
Minderungsfaktor Geb.-betriebszeit	-	1	

Personenbelegung	gering	mittel	hoch
Maximale Belegungsdichte m²/Person	6	5	4

Interne Wärmequellen	Vollbenutzungs-stunden [h/d]	max. spezifische Leistung [W/m²] tief	mittel	hoch
Personen (70 W/Person)	9	12	14	18
Arbeitshilfen *	17	-12	-10	-8
Wärmezufuhr pro Tag [Wh/(m² d)]		-132	-56	-28

Anmerkungen

* Kühlmittel sind Wärmesenken, falls Wärmelast außerhalb des Raumes abgeführt wird. Ansonsten Standardwert von 5 W/m²

Kühlmittel haben am Wochenende geringere Vollbetriebszeit > angenähert durch 300 Nutzungstage mit jeweils 17 h/d Vollbetriebszeit

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Approach Germany Final Energy Demand for Air-Conditioning

Variationsparameter

Code	Feuchteanforderung	Code	Befeuchter-Typ	Code	WRG-Typ	Code	WRG-Größe
0	keine	0	Verdunstung nicht regelbar	0	keine	0	45 %
1	mit Toleranzbereich	1	Verdunstung regelbar	1	reine Wärmeübertragung	1	60 %
2	ohne Toleranzbereich	2	Dampfbefeuchter	2	Wärme- und Feuchteübertragung	2	75 %

Aus insgesamt $3^4 = 81$ Kombinationsmöglichkeiten wurden 46 sinnvolle Varianten identifiziert !

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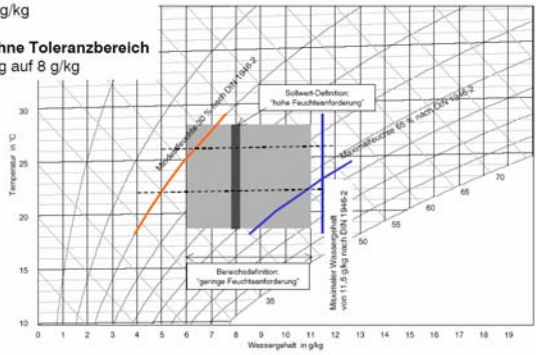
Approach Germany
Final Energy Demand for Air-Conditioning

Sollwerte Raumluftfeuchte

1. **keine Anforderungen**
2. **Feuchteanforderung mit Toleranzbereich**
   - Befeuchtung auf 6 g/kg
   - Entfeuchtung auf 11 g/kg
3. **Feuchteanforderungen ohne Toleranzbereich**
   - Be- und Entfeuchtung auf 8 g/kg



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schiller engineering

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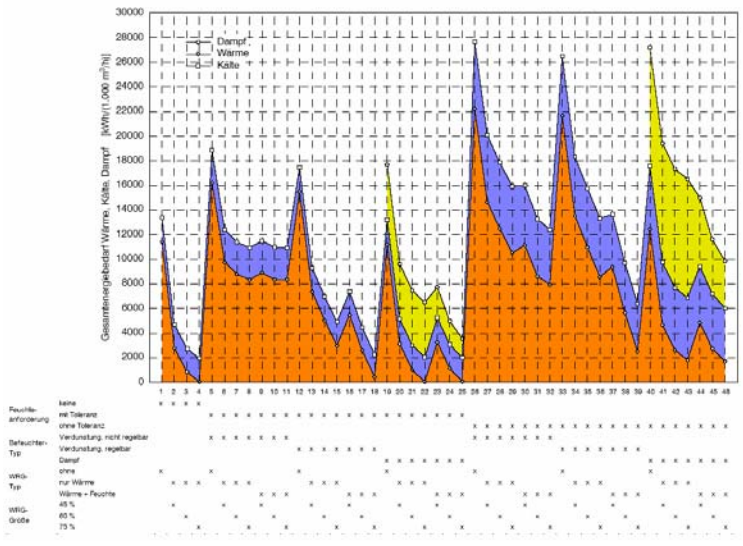
Approach Germany
Final Energy Demand for Air-Conditioning



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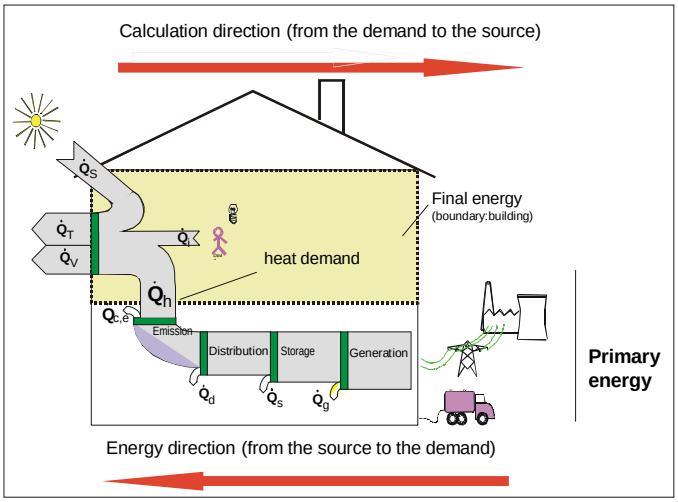
Approach Germany
Calculation of Final, End-Use and Primary Energy Demand



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What about Austria???

- National implementation via the Austrian Institute for Building technology (OIB) and the Austrian Energy Agency (EVA) and national regulation
- Generally following the processes, which were discussed by CEN and the German DIN 18599 (Three Levels, monthly approach for calculation)
- In Austria there will be 3 levels (calculation, measuring, estimating out of catalogue) of energy demand determination – similar to Germany

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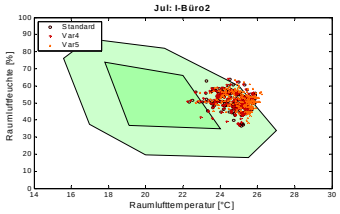
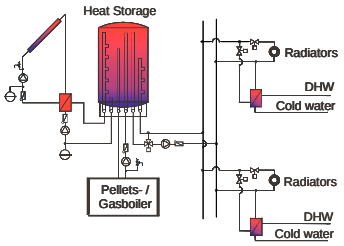
What can't be done with the calculation via EPBD

- Heating / cooling load



- Statistic about over-temperature



- Detailed effects of complex hydraulics and controls

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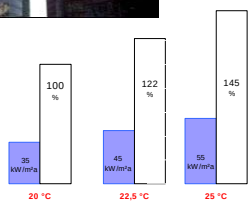
What can't be done with the calculation via EPBD

- Effect of complex calculations (big sunspaces, double skin facades)

- Consideration of user-behaviour (window-ventilation, attendance, internal loads …)



Space heating energy for varying indoor air temperature in a Passive house

- Worst/best case scenarios regarding climate

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Effects of the EPBD on the Design Process of Buildings

- Energy demand for heating and cooling will be relevant already in architectural competitions.
- As the first sketch of the architect fixes about 40 % of the energy demand of the building, integrated design approaches (architect, civil engineer, mechanical engineer...) will become relevant
- Building codes and subsidy schemes will use the EPBD certificates.
- Detailed questions to the building still need dynamic building simulation.

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Further upcoming EU-regulations

- **Draft Standardization Mandate to CEN, "Development of horizontal standardized methods for the assessment of the integrated environmental performance of buildings" (into force presumably 12/2007)**
- **Directive on energy end-use efficiency and energy services (into force presumably 6/2006). (1 % increase of end-use energy efficiency per year)**
- **Thematic strategy for urban environment (sustainable building) (KOM(2004)60, 11.02.2004**