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# 21<sup>ST</sup> ENERGY EFFICIENCY COORDINATION GROUP MEETING AND WORKSHOP

Towards the EPBD Implementation - a practical software approach  
for an EPC calculation

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November 20<sup>th</sup> 2019, Vienna

Simon Wössner

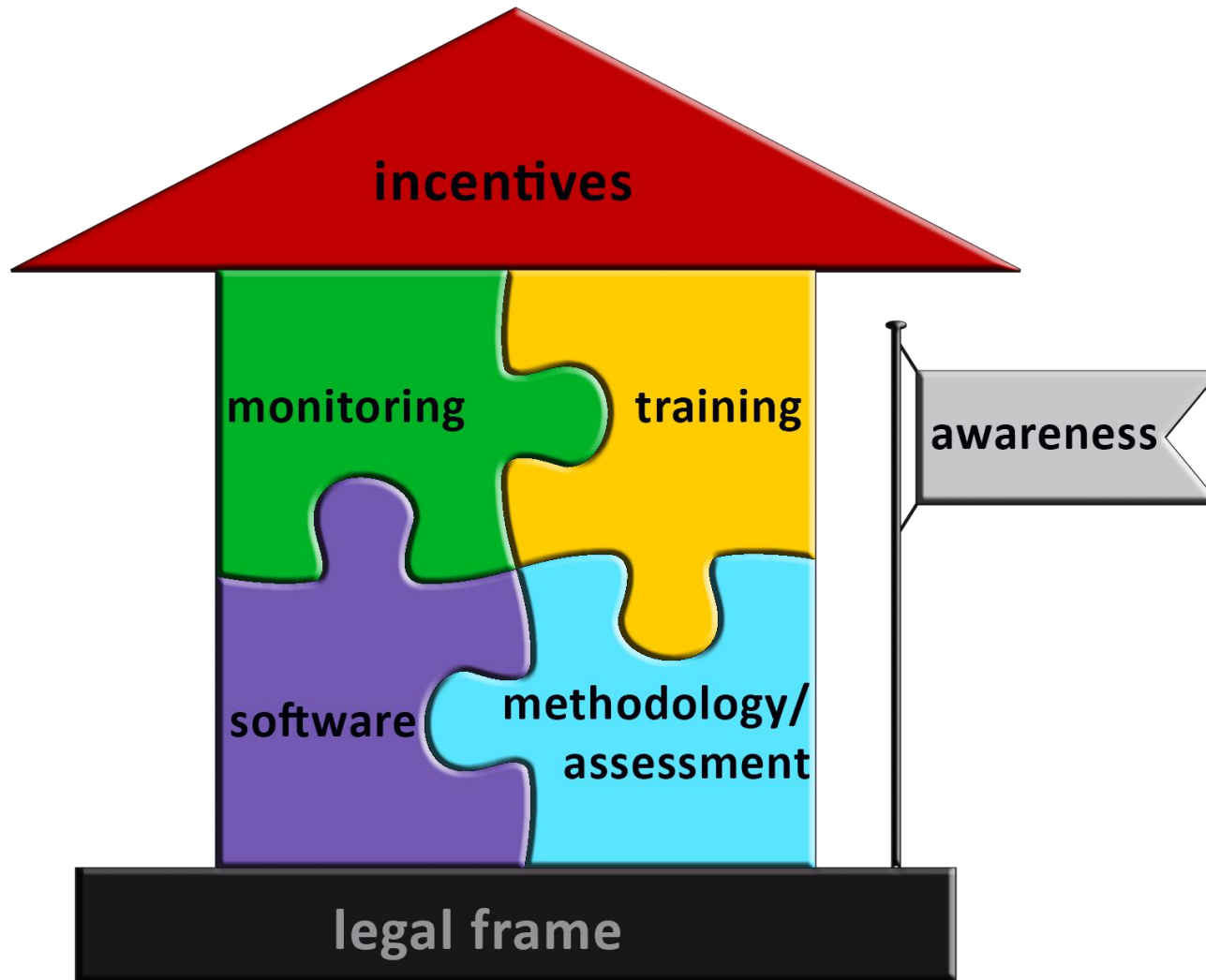
Venue: Energy Community Secretariat

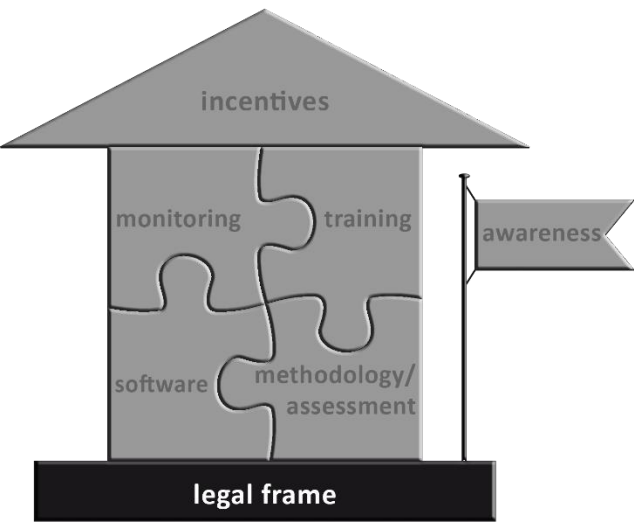
Hans Erhorn

## Building on knowledge

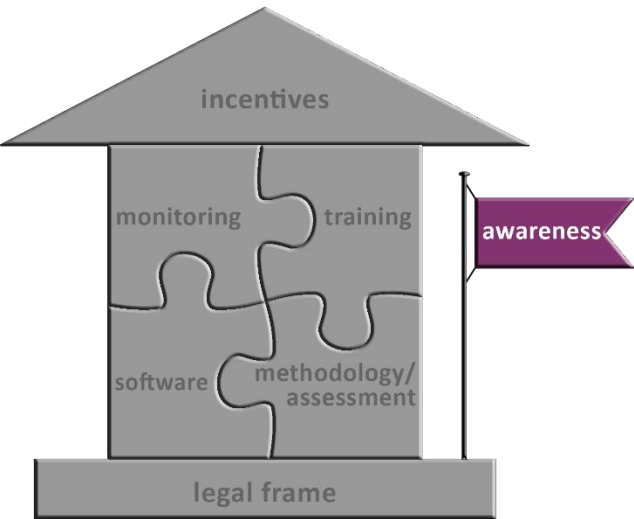


# Bigger picture





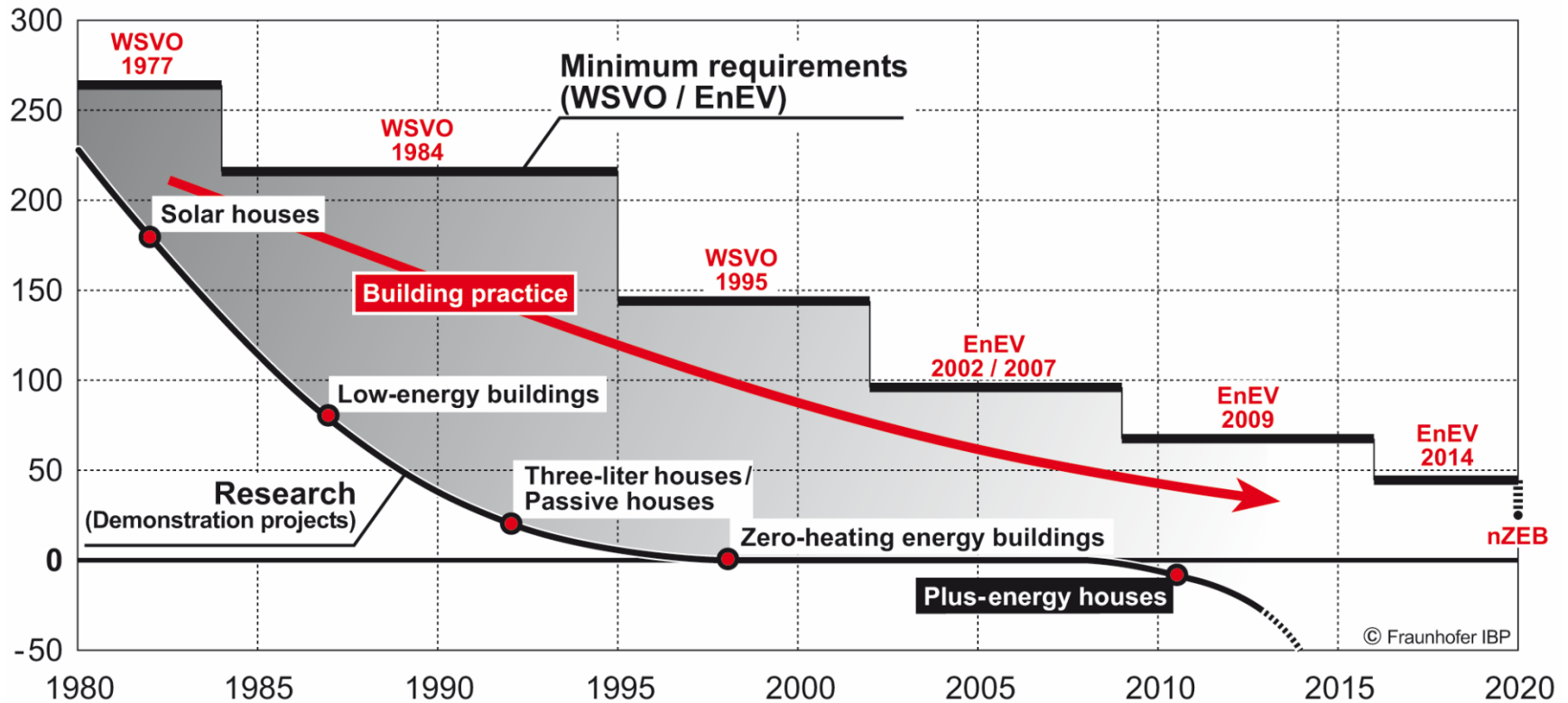
# Legal frame



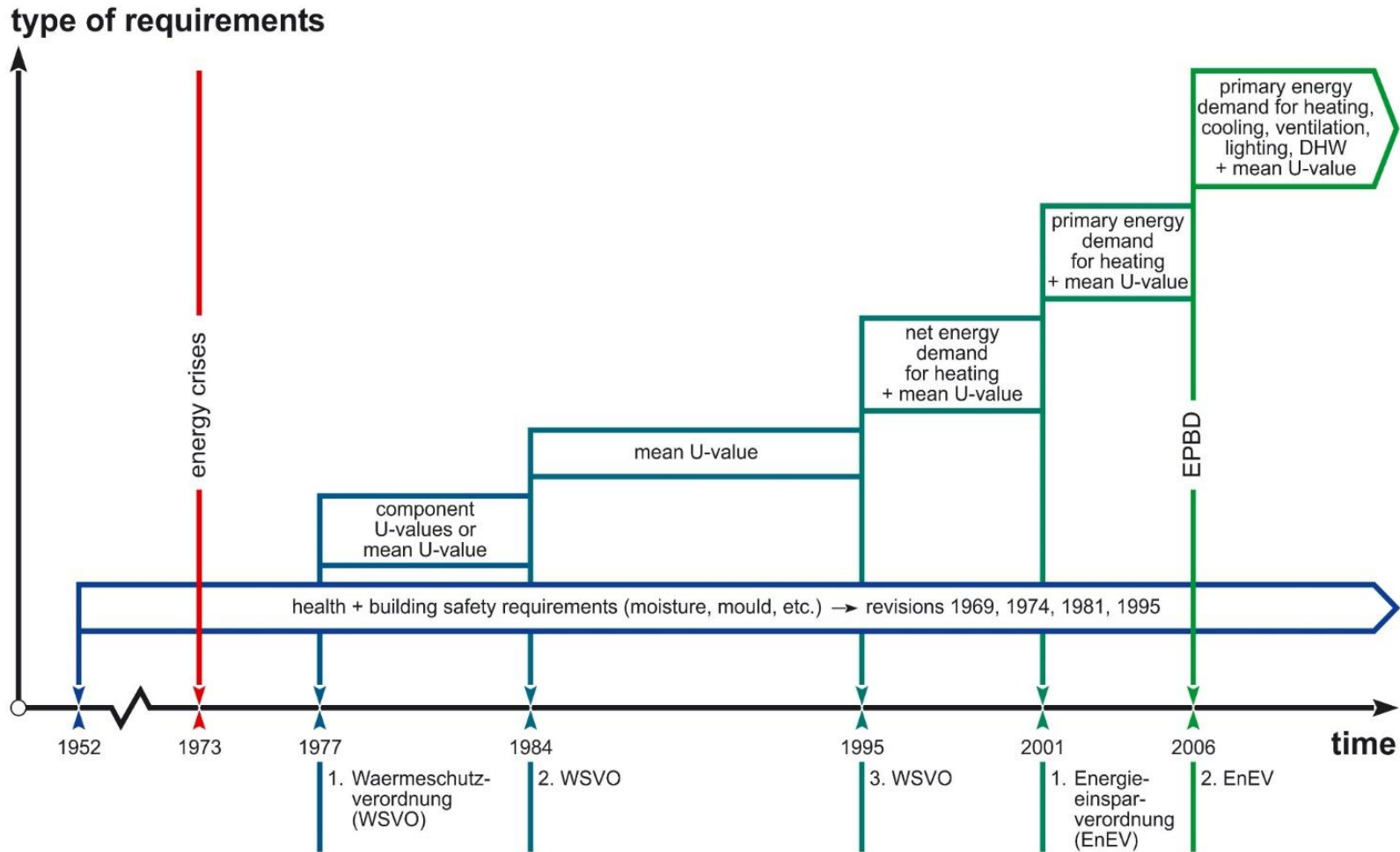
# Background

## Development of Energy-saving Construction

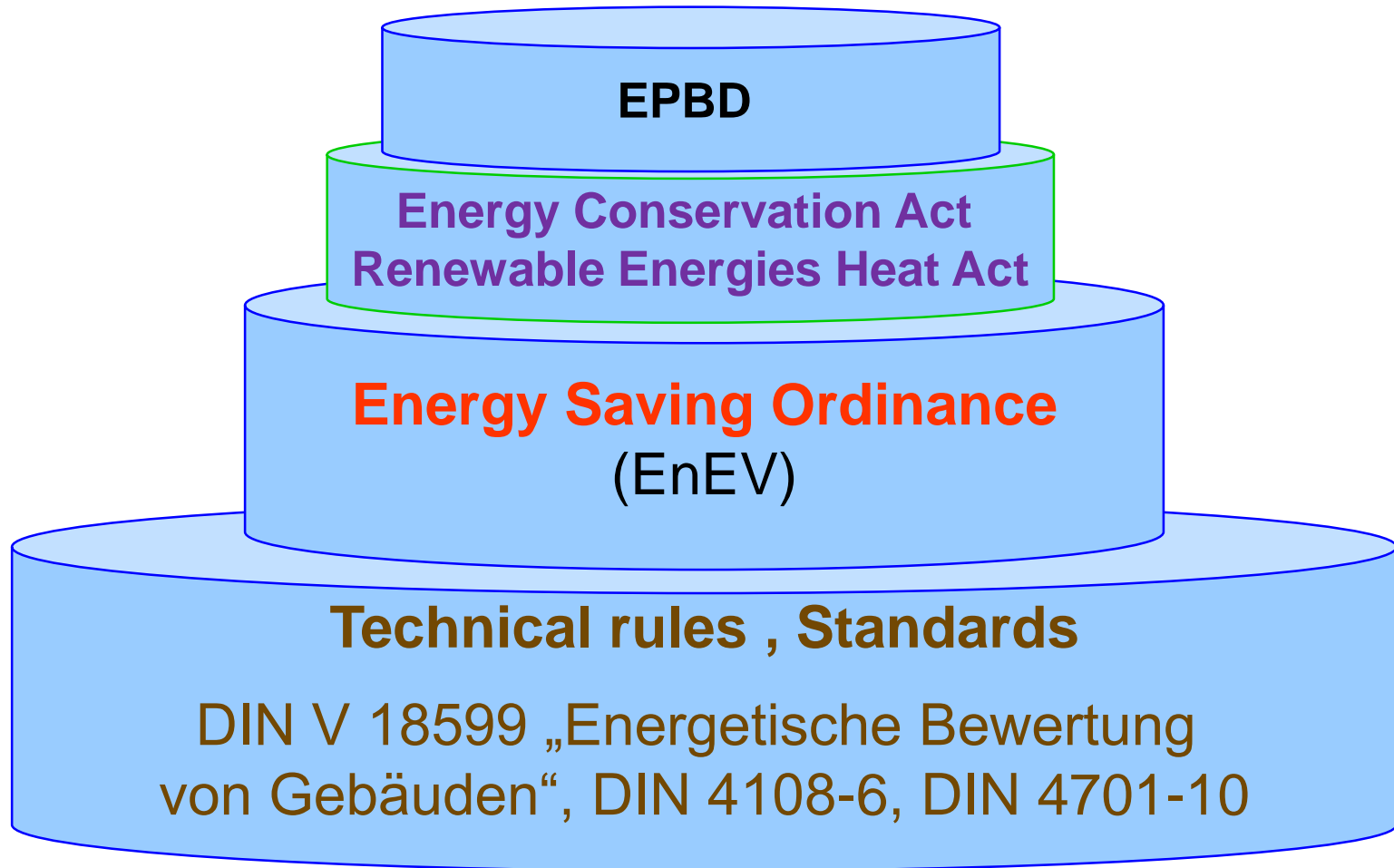
Primary energy need semi-detached house – heating [kWh/m<sup>2</sup>a]



# German history of energy requirements in Buildings

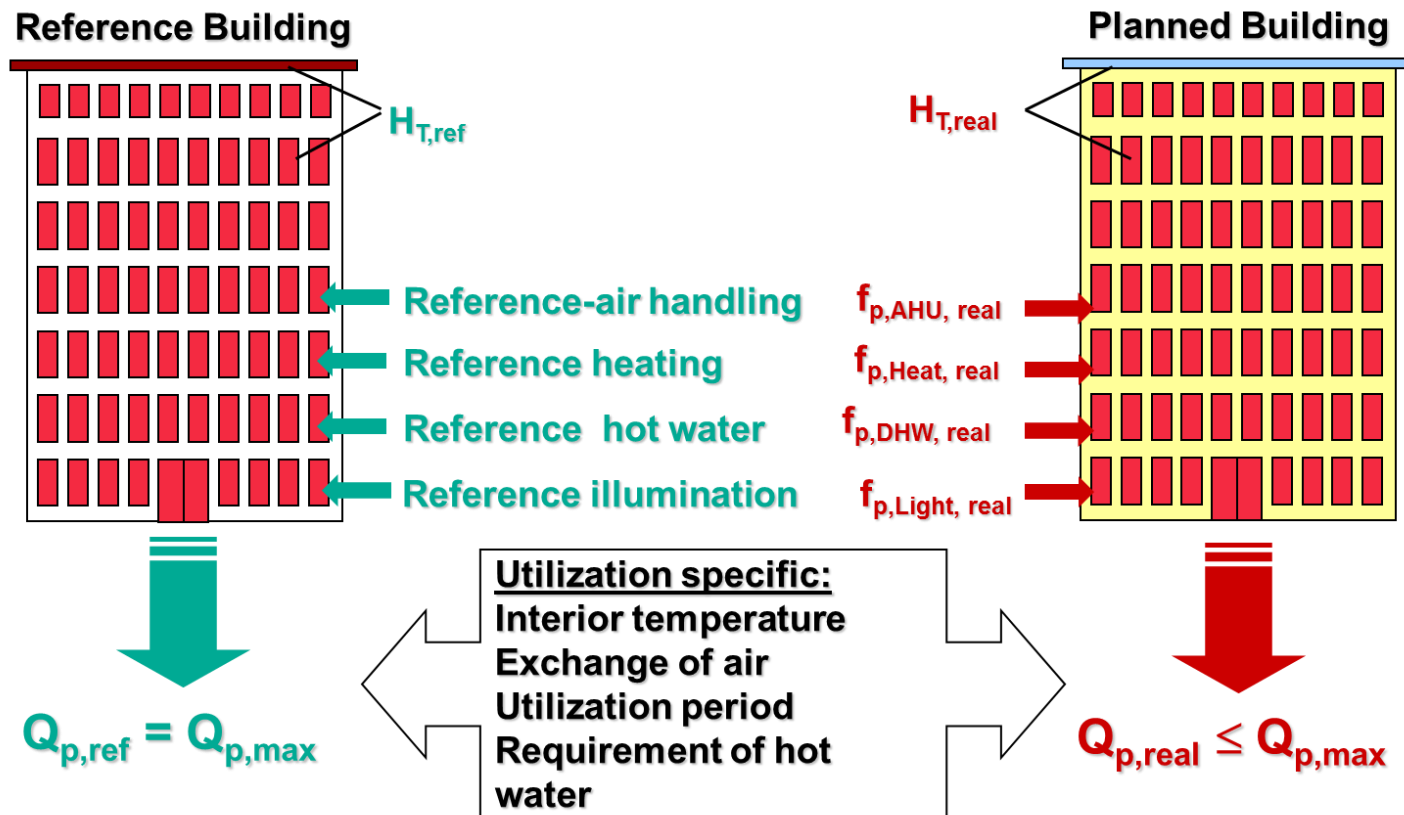


# The implementation of the EPBD in Germany



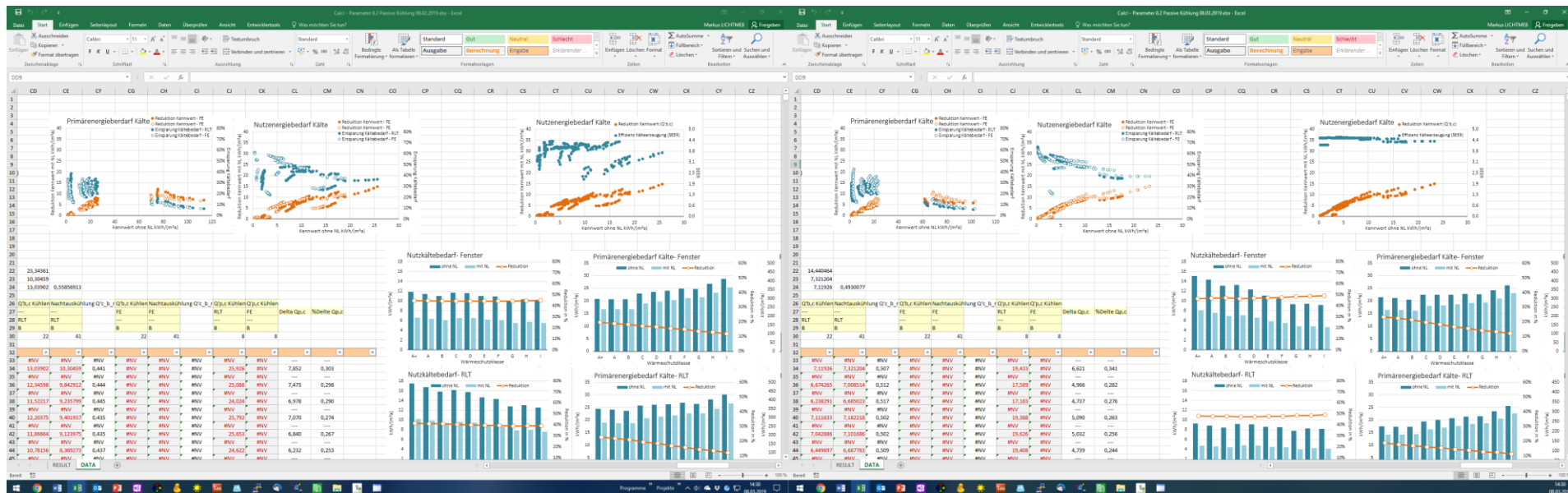
# How to determine the overall energy performance?

Comparison with reference building approach:

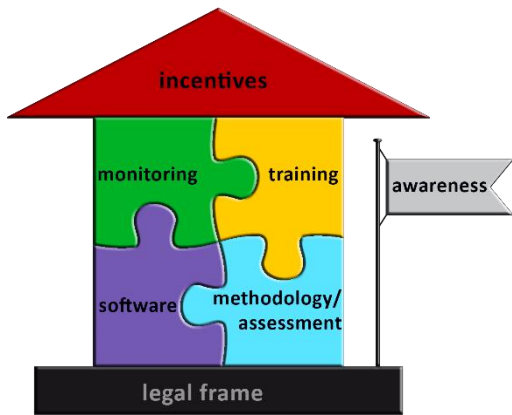


# Cost optimal procedure for setting energy performance requirements for Luxembourg

- Batch calculation tool using the same calculation method as the programme for EPC Calculation.
- Over 5600 variations of buildings, envelope classes and technical systems have been calculated for Luxembourg

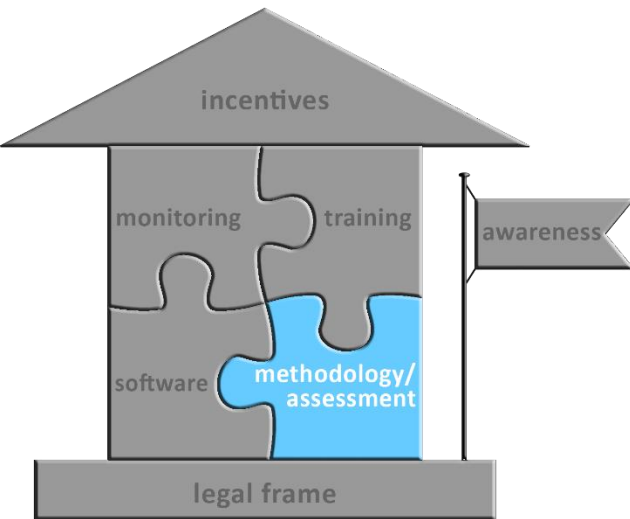






# Questions/ Remarks

# Methodology/ assessment



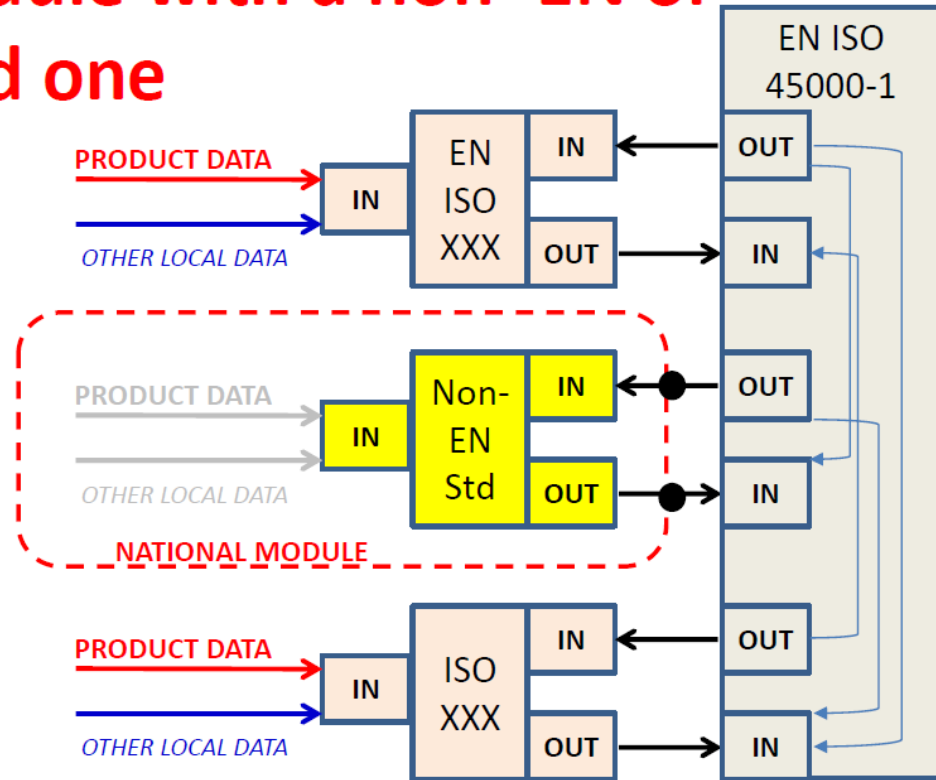
## CEN Series 520xx

Overarching			Building (as such)			Technical Building Systems										
	Descriptions	Standards		Descriptions	Standards		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water	Lighting	Building automation & control	Electricity production
sub1	M1		sub1	M2		sub1	M3	M4	M5	M6	M7	M8	M9	M10	M11	
1	General	EN 15603 CEN/TR 15615	1	General	—	1	General	EN 15316-1	EN 16798-9 CEN/TR 16798-10	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 15316-1	EN 15193-1	EN 15232 CEN/TR 15232	
2	Common terms and definitions, symbols, units and subscripts	EN 15603 CEN/TR 15615	2	Building Energy Needs	EN ISO 52016-1, EN ISO 52017-1 CEN ISO/TR 52016-2 CEN ISO/TR 52017-27, EN ISO 52018-17	2	Needs						EN 12831-3	prEN 15193-1		
3	Applications	EN 15603 CEN/TR 15615	3	(Free) Indoor Conditions without Systems	EN ISO 52016-1, EN ISO 52017-1 CEN ISO/TR 52016-2 CEN ISO/TR 52017-27, EN ISO 52018-17	3	Maximum Load and Power	EN 12831-1	EN 16798-11 CEN/TR 16798-12				EN 12831-3			
4	Ways to Express Energy Performance	EN ISO 52063-1 EN ISO 52063-2	4	Ways to Express Energy Performance	EN ISO 52016-1 CEN ISO/TR 52018-2	4	Ways to Express Energy Performance	EN 15316-1	EN 16798-6 CEN/TR 16798-10	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 16798-3 (EN 13779 rev.) CEN/TR 16798-4	EN 15316-1	EN 15193-1 CEN/TR 15193-2	EN 15232 CEN/TR 15232	
5	Building Functions and Building Boundaries	EN 15603 CEN/TR 15615	5	Heat Transfer by Transmission	EN ISO 13789 EN ISO 13370 EN ISO 6946 EN ISO 10211 EN ISO 14685 CEN ISO/TR 52019-2 EN ISO 10077-1 EN ISO 10077-2 EN ISO 12651 EN ISO yyyyy	5	Emission & control	EN 15316-2 EN 1500 CEN/TR 15500 EN 12098-1 CEN/TR 12098-1 EN 12098-3 CEN/TR 12098-3 EN 12098-5 CEN/TR 12098-5	EN 15316-2 EN 15500 CEN/TR 15500	EN 16798-7 CEN/TR 16798-8 EN 15500 CEN/TR 15500	EN 16798-5 CEN/TR 16798-6	EN 16798-5 CEN/TR 16798-6			EN 15232 CEN/TR 15232	
6	Building Occupancy and Operating Conditions	EN 16798-1 (EN 15251 rev.) CEN/TR 16798-2	6	Heat Transfer by Infiltration and Ventilation	EN ISO 13789	6	Distribution & control	EN 15316-3 EN 12098-1 CEN/TR 12098-1 EN 12098-3 CEN/TR 12098-3 EN 12098-5 CEN/TR 12098-5	EN 15316-3	EN 16798-5 CEN/TR 16798-8			EN 15316-3		EN 15232 CEN/TR 15232	
7	Aggregation of Energy Services and Energy Carriers	EN 15603 CEN/TR 15615	7	Internal Heat Gains	See M1-6	7	Storage & control	EN 15316-5 EN 12098-1 CEN/TR 12098-1 EN 12098-3 CEN/TR 12098-3 EN 12098-5 CEN/TR 12098-5					15316-5 15316-4-3		EN 15232 CEN/TR 15232	
8	Building Partitioning	EN 15603 CEN/TR 15615	8	Solar Heat Gains	EN ISO 52022-3 EN ISO 52022-1 CEN ISO/TR 52022-2 EN ISO yyyyy	8	Generation	EN 12098-1 CEN/TR 12098-1 EN 12098-3 CEN/TR 12098-3 EN 12098-5 CEN/TR 12098-5		EN 16798-13, CEN/TR 16798-14	EN 16798-5, CEN/TR 16798-6	EN 16798-5, CEN/TR 16798-6	EN 16798-5, CEN/TR 16798-6		EN 15232 CEN/TR 15232	EN 15316-4-3 15316-4-4 15316-4-5 15316-4-7
						8-1	Combustion boilers	15316-4-1					15316-4-1			
						8-2	Heat pumps	15316-4-2	15316-4-2				15316-4-2			
						8-3	Thermal solar Photovoltaics	15316-4-3					15316-4-3			15316-4-3
						8-4	On-site cogeneration	15316-4-4					15316-4-4			15316-4-4
						8-5	District heating and cooling	15316-4-5	15316-4-5				15316-4-5			15316-4-5
						8-6	Direct electrical heater	15316-4-6					15316-4-6			
						8-7	Wind turbines									15316-4-7
						8-8	Heatless heating, stoves	15316-4-8								
9	Calculated Energy Performance	EN 15603 CEN/TR 15615	9	Building Dynamics (Thermal mass)	EN ISO 13789	9	Load dispatching and operating conditions								EN 15232 CEN/TR 15232	
10	Measured Energy Performance	EN 15603 CEN/TR 15615 EN 777	10	Measured Energy Performance	---	10	Measured Energy Performance	EN 15378-3					EN 15378-3	EN 15193-1 CEN/TR 15193-2	EN 15232 CEN/TR 15232	
11	Inspection	--	11	Inspection	(existing standards on IR inspection, airtightness, ...)	11	Inspection	EN 15378-1	EN 16798-17 CEN/TR 16798-18	EN 16798-17 CEN/TR 16798-18	EN 16798-17 CEN/TR 16798-18	EN 16798-17 CEN/TR 16798-18	EN 15378-1	EN 15193-1 CEN/TR 15193-2	WI 00247002	
12	Ways to Express Indoor Comfort	EN 16798-1 (EN 15251 rev.) CEN/TR 16798-2	12	-		12	BMS								WI00247005	
13	External Environment Conditions	EN ISO 52010-1 CEN ISO/TR 52010-2														
14	Economic Calculation	EN 15459-1														

➤ 100 Standards in 11 modules with approx. 50% Technical Reports (TRs)

# Replacing a module with a non- EN or EN-ISO-standard one

- Possible thanks to the modular structure
- ... but the I/O structure has to be respected
- Needed info can be found both in the accompanying XLS and in the specific I/O clauses in the EN or EN-ISO standard



**Set of EPB standards: unambiguous but flexible**  
(allowing national choices, boundary conditions and input data)

➔ Each EPB standard contains:

- **Annex A (normative):** template for choices and input data needed for using the standard
- **Annex B (informative):** informative default choices and input data
- In general:
  - Each individual user of the EPB standard is free to create his/her own data sheet according to the template of Annex A  
(~ replace the default choices and values of Annex B)

# EPBD Appendix 1

- The 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 (further on referred as EPBD) defines the determination of the energy efficiency and the calculation methodology. It defines that “Member

**Committee for Standardisation (CEN). This provision shall not constitute a legal codification of those standards”.**

EN 15250-1, EN 15250-2, EN 15250-3, and EN 15250-4, developed under mandate M/480 given to the European Committee for Standardisation (CEN). This provision shall not constitute a legal codification of those standards”.

(b) point 2 is replaced by the following:

- ‘2. The energy needs for space heating, space cooling, domestic hot water, ventilation, lighting and other technical building systems shall be calculated in order to optimise health, indoor air quality and comfort levels defined by Member States at national or regional level.

# National foreword - Germany

Expertenföderung-Beuth-Hans-Eichom-Könr.7725231-L.Nr.8311841001-2018-02-22 19:15

αυτiαγs μ/480 ενστάνει.

DIN EN ISO 52016-1 ist eine Internationale Norm und CEN ISO/TR 52016-2 ist der diese Norm begleitende Technische Bericht mit weiteren informativen Inhalten zur Bewertung der Energieeffizienz von Gebäuden.

In Deutschland wird die Richtlinie 2010/31/EU des Europäischen Parlaments und des Rates über die Gesamtenergieeffizienz von Gebäuden im Wesentlichen durch das nationale Energieeinsparrecht umgesetzt. Das nationale Energieeinsparrecht nimmt datierte nationale und Europäische Normen und nationale Vornormen in Bezug, die für die Umsetzung in Deutschland festgelegt wurden.

Die Anwendung im Zusammenhang mit dem Energieeinsparrecht für Gebäude ist in Deutschland durch die dortigen Festlegungen definiert.

1

Die Regelungen des deutschen Energieeinsparrechts sind mit dem Normenpaket des EPBD-Normungsauftrags M/480 und den dort in Bezug genommenen Internationalen und Europäischen Normen systematisch nicht vollständig und identisch abbildbar. Bei Anwendung der Normen des Normungsauftrags ist weder bei der Vorgehensweise, noch beim Ergebnis, noch bei der Bewertung des Ergebnisses die Identität mit dem deutschen Energieeinsparrecht erreichbar. Der nationale Anhang NA soll Hilfestellung geben, indem er Zusammenhänge zwischen Regelungen des deutschen Energieeinsparrechts und korrespondierenden, vergleichbaren oder ähnlichen Regelungen des Normenpakets inklusive der dort in Bezug genommenen Internationalen und Europäischen Normen aufzeigt.

2

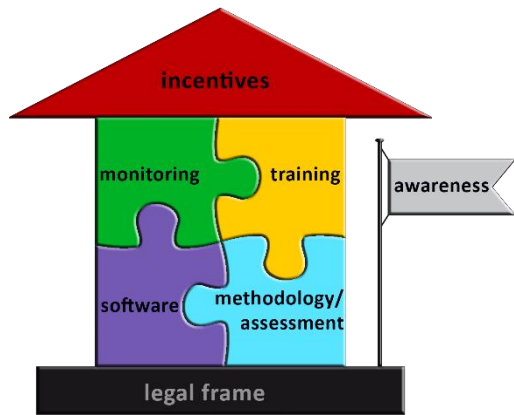
Currently the standards of mandate 480, also considering the national dependencies A, may not be used for calculations regarding the laws on energy savings in buildings.

4

2

Derzeit ist das Normenpaket des EPBD-Normungsauftrags M/480, auch unter Berücksichtigung der Verweisungen auf nationale Regelungen in den jeweiligen nationalen Anhängen NA, in Deutschland nicht für die Zwecke des Energieeinsparrechts anwendbar.

Zusätzlich zu den in 6.5.8.3 genannten Normenverweisungen können Kennwerte für Fenster-, Türen- und Vorhangfassadenelemente aus folgenden Quellen entnommen werden: hEN, europäische harmonisierte

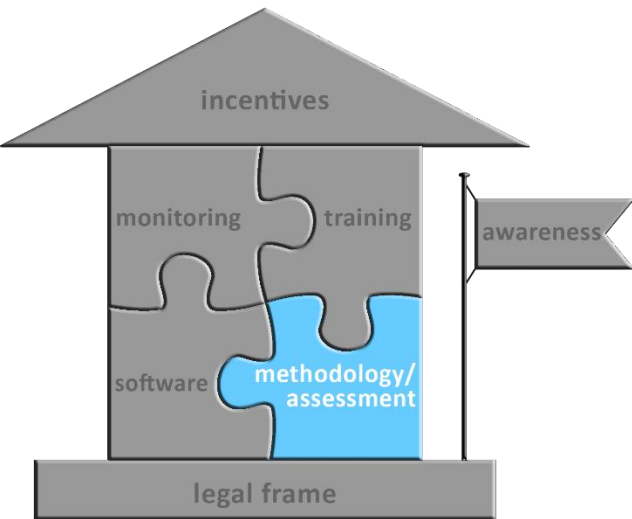


# Questions/ Remarks



# Methodology/ assessment

## DIN V 18599



# The German calculation approach -DIN V 18599

## Energy demand of buildings

Joint working group of standardisation committee for buildings and buildings envelope (NABau), technical systems (NHRS) and lighting (FNL)

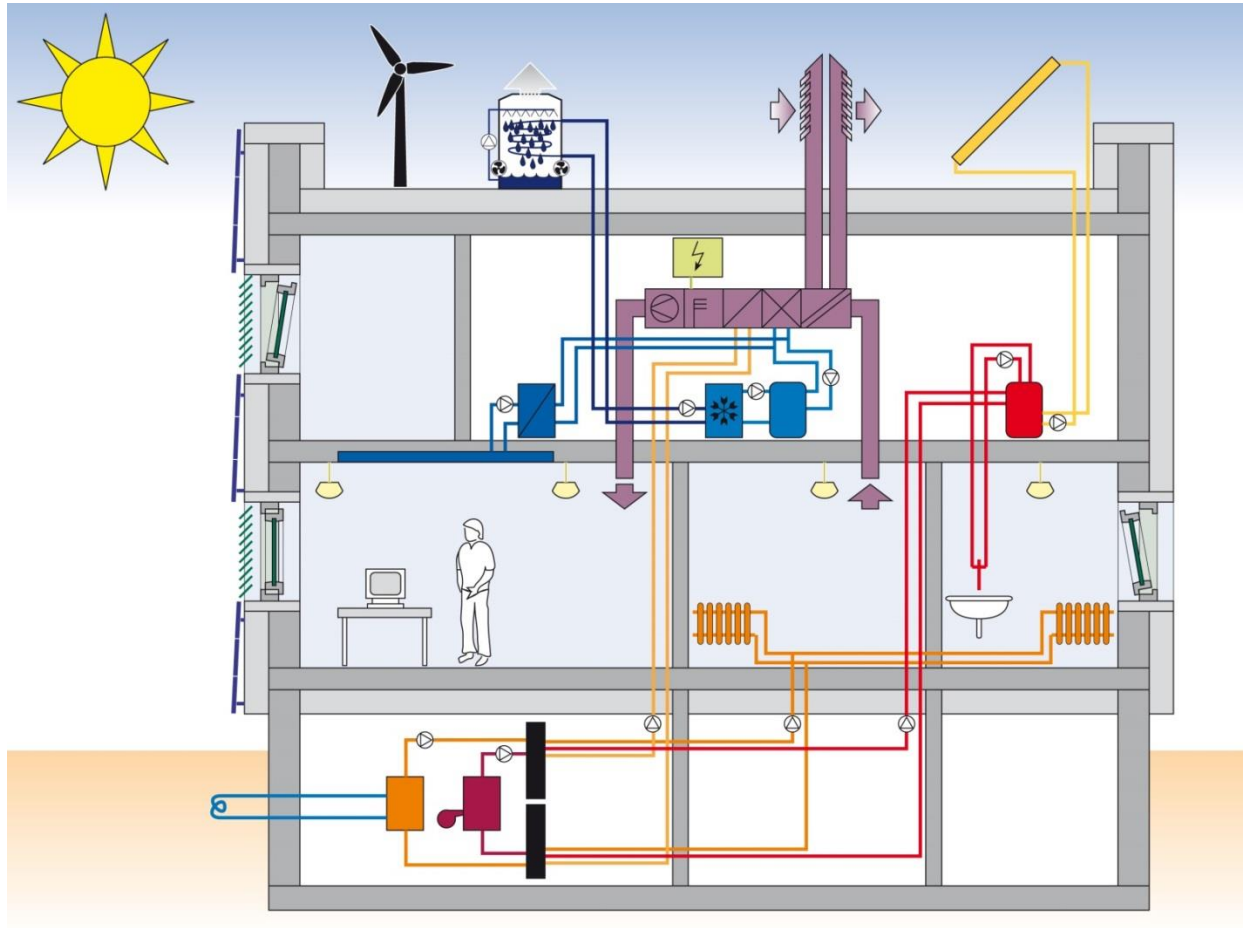
Main features:

- Final energy demand for heating / hot water demand / ventilation / lighting / cooling / building automation
- Produced energy from renewables
- Energy need, energy use, delivered energy, primary energy and CO<sub>2</sub> demand for building services

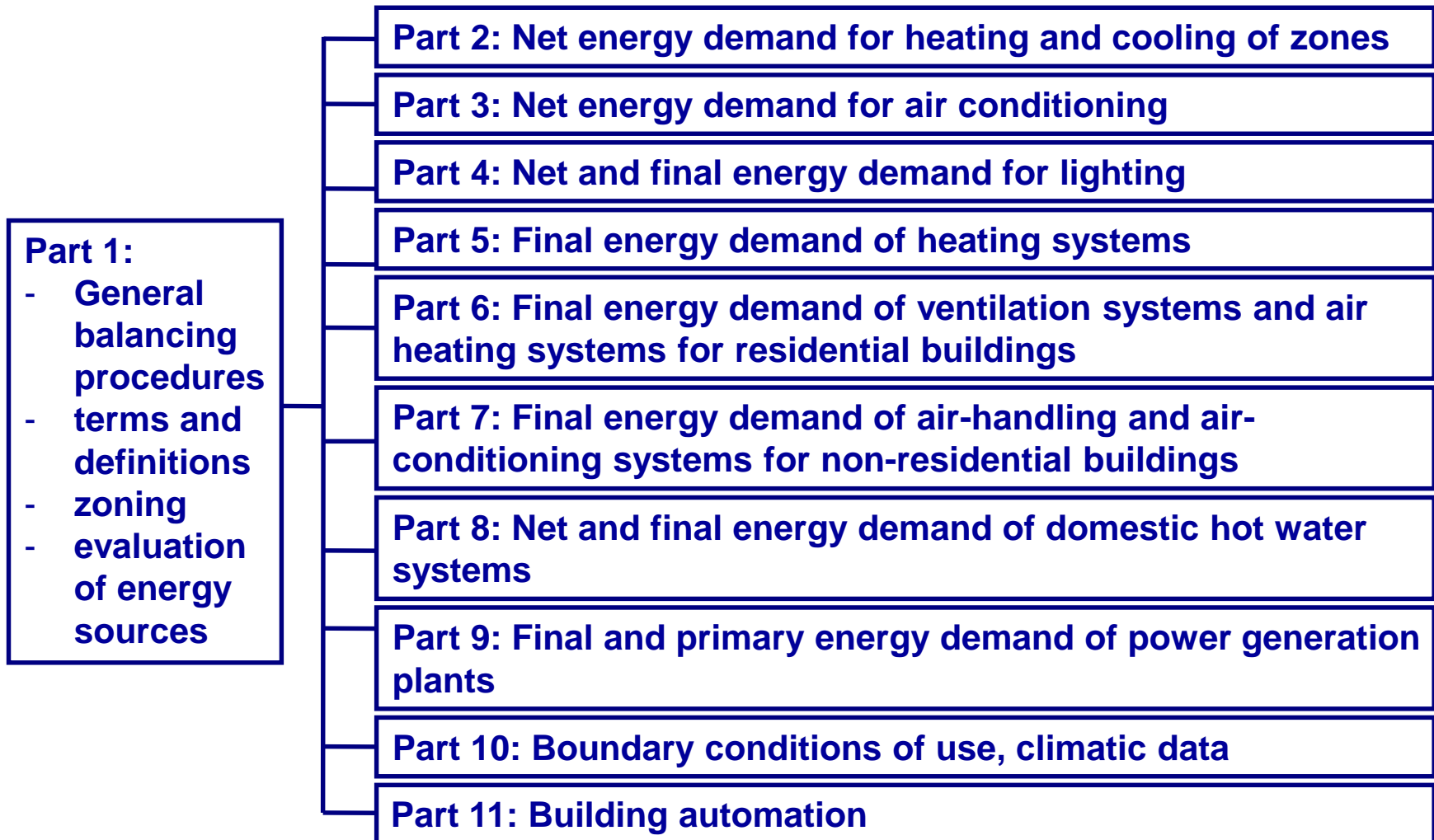
Basics

- use of existing rules as far as possible
- take care of european harmonisation
- use simplifications for certification as much as possible
- uniform holistic approach for all building types and ages

# Holistic calculation approach for overall energy performance calculation – DIN V 18599



# Structure of DIN V 18599















# User profiles

- User profiles define indoor quality/comfort requirements
- May not be changed for EPC calculations  
(at least in Germany, Luxembourg and Montenegro)
- Ensure that requirements/comfort level of buildings are comparable

Operating times	Start and end of building use	-	o'clock	7:00	18:00		
	Annual days of use	$d_{nutz,a}$	d/a	250,0			
	Total hours with daylight while operating hours	$t_{day}$	h/a	2543,0			
	Total hours without daylight while operating hours	$t_{night}$	h/a	207,0			
	Start and end of operation for ventilation and cooling system	-	o'clock	5:00	18:00		
	Annual days of use ventilation, cooling system and heating system	$d_{nutz,a}$	d/a	250,0			
Temperatures	Start and end of operation for heating system	-	-	5:00	18:00		
	Set temperature heating	$\Theta_{i,h,soll}$	°C	21,0			
	Set temperature cooling	$\Theta_{i,c,soll}$	°C	24,0			
	Minimum design temperature heating	$\Theta_{i,h,min}$	°C	20,0			
	Maximum design temperature cooling	$\Theta_{i,c,max}$	°C	26,0			
	Temperature reduction for reduced operation	$\Delta\Theta_{i,NA}$	k	4,0			
Humidification requirement	-	-	-	mit Toleranz			
Ventilation	Minimum person-related ventilation (fresh air) volume flow	$V_A$	$m^3/(h \text{ person})$	40,0			
	Minimum area-related ventilation (fresh air) volume flow	$V_A$	$m^3/(h \text{ m}^2)$	4,0			
	Minimum external air-supply volume flow for buildings	$V_{A,Geb}$	$m^3/(hm^2)$	2,5			
	Relative absence HVAC	$C_{RLT}$	-	0,3			
	Partial operation factor to account for HVAC related to the building operating time	$F_{RLT}$	-	0,7			
	Lighting	Maintained illumination	$E_m$	lx	500,0		
Working height		$h_{Ne}$	m	0,8			
Reduction factor (percentage of area that needs to have the full illumination level)		$k_A$	-	0,8			
Relative absence (1-simultaneity factor)		$C_A$	-	0,3			
Room index		$k$	-	0,9			
Reduction factor occupation lighting		$F_t$	-	0,7			
Reduction factor for lighting of vertical areas		$k_{VB}$	-	1,0			
Occupant density		Occupant density	-	-	low	medium	high
	-	-	$m^2 \text{ per person}$	18,0	14,0	10,0	
Internal heat sources	max specific power	-	-	full operating hours	low	medium	high
	due to person (70W per person)	-	$W/m^2$	h/d			
	Appliances	-	$W/m^2$	6,0	3,9	5,0	7,0
	Heat gain per day	-	$Wh/(m^2d)$	6,0	2,8	7,1	15,0
Building automation	Summand Automation	$\Delta\Theta_{EMS}$	-	D	C	B	A
	Factor for adaptive temperature control	-	-	0,0	0,0	-0,5	-1,0
	-	-	-	1,00	1,00	1,35	1,35

# Comparison with other standards (ASIEPI, 2008)

country													
demand depend. Ventilation					✓	✓							
decentralized ventilation			✓	✓		✓						✓	✓
passive double façade		✓	✓			✓			✓				
active double façade		✓				✓							
innovative paints						✓		✓				✓	
air tightness products	✓	✓	✓	✓		✓			✓	✓			
micro CHP	✓	✓		✓		✓						✓	
absorption heat pump		✓		✓	✓	✓						✓	✓
gas driven heat pump		✓			✓	✓						✓	
heat recovery	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
countercur. heat exchanger	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
DC ventilators	✓	✓	✓	✓	✓	✓			✓	✓		✓	
energy management systems				✓		✓					✓	✓	
daylight sensors		✓	✓	✓	✓	✓			✓			✓	
presence detection			✓	✓	✓	✓			✓			✓	
3-pane glazing	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Insulated frames	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
sun screening glass			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

# Modifications / international applications

## ■ Luxembourg

- for non-residential buildings (DIN V 18599:2007 / update to DIN V 18599:2018 in progress)
- Modifications in national regulation RGD (PV / Simplifications / ...)
- Use of german climate / user profiles

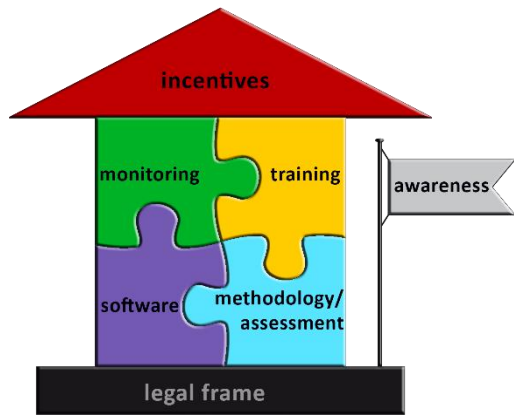
## ■ South Korea

- for non-residential buildings (DIN V 18599:2007)
- Thinking about update to DIN V 18599:2018

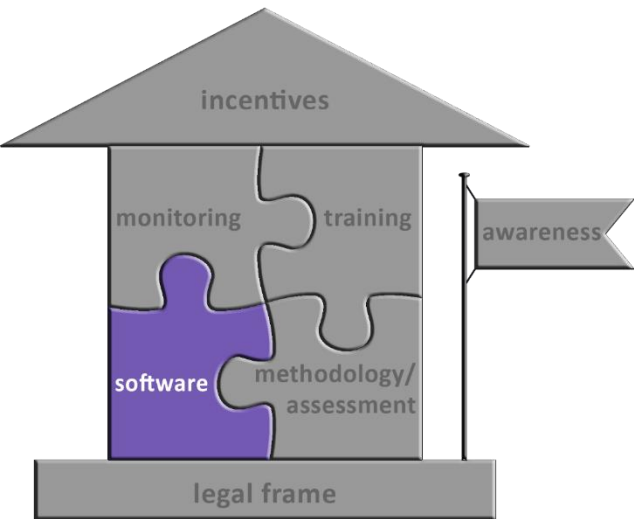
# Modifications / international applications

- Montenegro
  - DIN V 18599:2018 used for national software
  - Modifications
    - 2 or 3 climate zones
    - User profiles are adjusted to montenegrin conditions
- General
  - DIN V 18599 in progress of being translated to English
  - pre standard in order to keep the standard up to date easier
  - can be referenced in regulations of other countries without licence fees to DIN





# Questions/ Remarks



# Software

# ibp18599kernel: calculation library for DIN V 18599



- Calculation library for DIN V 18599
  - First release in November 2005, now Version 5 in development
  - Included in most German calculation programmes for calculating the energy performance
  - Included is DIN V 18599 2007, 2011, 2016 and 2018 ; EnEV 2007, EnEV 2009, EnEV 2014/2016, GEG 2020
  - Automatic generation and calculation of the reference building for Germany and Luxembourg
  - Constantly validated, improved and updated
  - Currently adaption for Luxembourg and Montenegro in progress

# ibp18599kernel: calculation library for DIN V 18599 quality control procedures



Vergleichsberechnung der Softwarehersteller

## 3.0 Vergleichsberechnungen der Softwarehersteller

Prüfgebäude Wohnbau EFH	Berechnung	BKI	MISYS	unhofer-IBP	igemath	Kern	luchter	wa-Soft	CLAR-IPUTER	VISION-ORLD	ZUB-systems
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### Anlage zu den Merkblättern

Energieeffizient Sanieren - Kredit (151/152),  
 Energieeffizient Sanieren Investitionszuschuss (430),  
 Energieeffizient Bauen (153)



### Liste der Technischen FAQ

1.09	Softwareversion DIN V 18599	Für die Berechnung von KfW-Effizienzhäusern nach der DIN V 18599 sind ausschließlich die unter dem Link <a href="http://www.nachhaltigesbauen.de/leitfaeden-und-arbeitshilfen-veroeffentlichungen/veroeffentlichungen-din-18599.html">www.nachhaltigesbauen.de/leitfaeden-und-arbeitshilfen-veroeffentlichungen/veroeffentlichungen-din-18599.html</a> aufgeführten Softwareanwendungen sowie deren Folgeversionen zugelassen.	151, 430 153
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Gefördert durch:

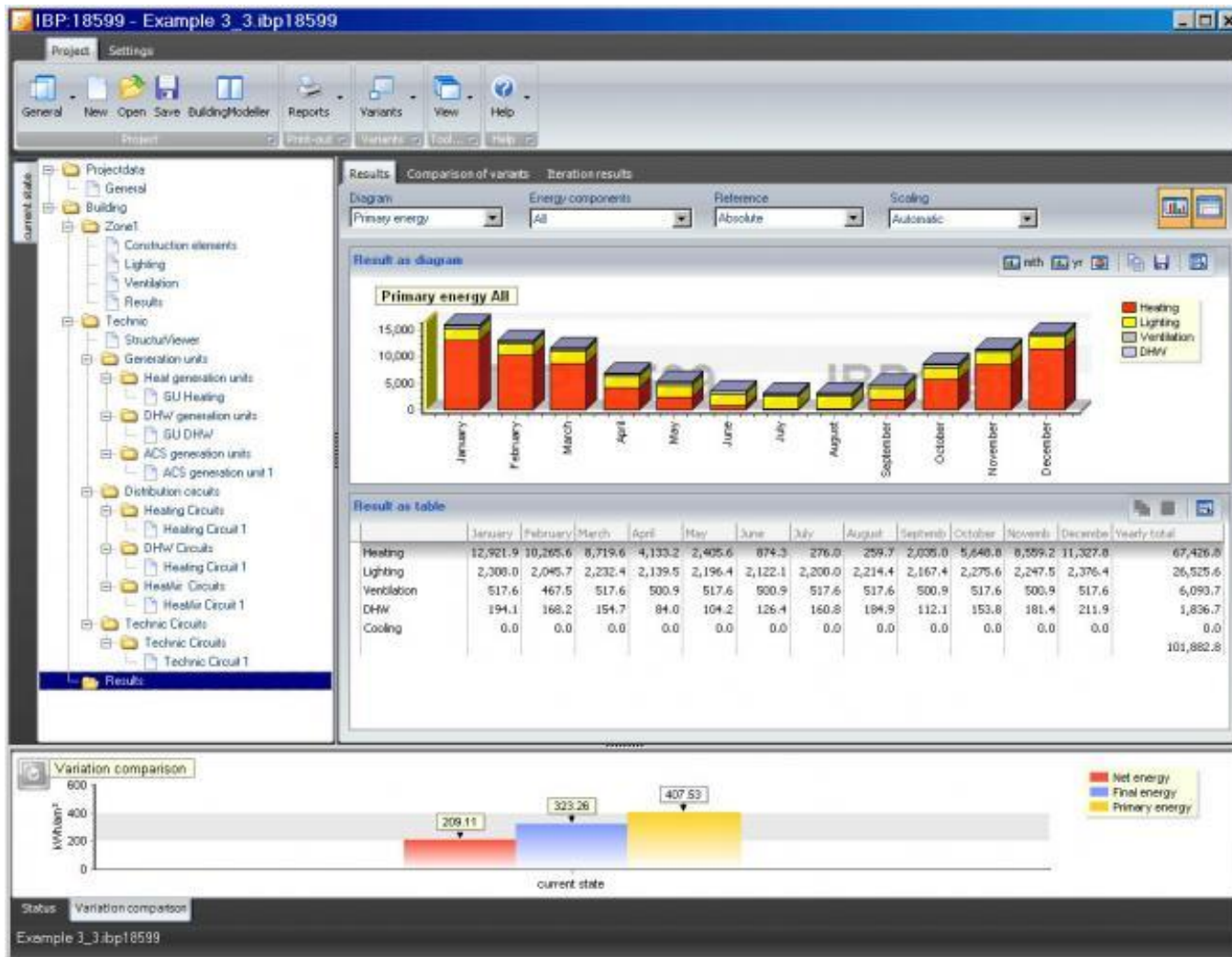


aufgrund eines Beschlusses  
des Deutschen Bundestages

# IBP:18599 Software for Germany - Characteristics

- Aiming at energy efficiency specialists
- Showing all final and intermediate results
- Designed for in depth analysis of the calculated energy demand
  
- Mode for certification
  - Fixed user profiles, fixed climate, generating EPCs and uploading it to the registry for automated checks
- Mode for consulting
  - User profiles can be adapted
  - 15 climates zones available

# IBP:18599 Software for Germany



# IBP:18599lux Software for Luxembourg - Characteristics

- Based on the German programme
- Several simplifications included: building envelope defined for whole building and distributed to zones / HVAC assistant
- Reference building and EPC according to RGD 210
- Aiming at nearly zero energy buildings (NzEBs)
  
- Mode for certification
  - Fixed user profiles, fixed climate, generating EPCs and uploading it to the registry for automated checks
- Mode for consulting
  - User profiles can be adapted
  - 15 climates zones available

# IBP:18599lux Software for Luxembourg

IBP:18599 Luxemburg - Nachbau.ibp18599

Projekt Einstellung

Allgemein Neu Öffnen Speichern BuildingModeller Anlagenassistent Nachweise und Berichte Varianten RGD ab 2019 Ansicht Hilfe

Projekt Assistenten Ausdruck Varianten Modus Toolboxes Hilfe

Istzustand

- Projektdateien
  - Allgemein
  - Gebäude
  - Variantebeschreibung
  - Bauteileingabe
  - BuildingModeller
  - Bilanzzonen
    - Einzelbüro 1
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Einzelbüro 2
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Besprechung
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Verkehrsräume
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - WC und Sanitärräume
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse

Bauteile

Bauteile	Bruttofläche	Nettofläche	U-Wert	Zone	Orientierung
FA (Wand + Fenster) Süd	200,00	113,60	0,140		Süd
FE Süd		86,40	0,840		
FA (Wand + Fenster) West	147,00	90,70	0,140		West
FE West		56,30	0,840		
FA (Wand + Fenster) Nord	200,00	139,50	0,140		Nord
FE Nord		60,50	0,840		
FA (Wand + Fenster) Ost	147,00	99,30	0,140		Ost
FE Ost		47,70	0,840		
Wa unbeh Süd		10,30	0,140		Süd
Wa unbeh West		17,00	0,140		West
Wa unbeh Nord		10,30	0,140		Nord
Wa unbeh Ost		17,00	0,140		Ost
Boden		294,00	0,175		
Dach		294,00	0,120		Süd

Allgemein

Allgemeine Einstellungen

Bezeichnung Bauteil: FA (Wand + Fenster) Süd

Bauteiltyp: Außenwand

Angrenzend an: Außenluft

Fläche [m²]: 200,00

Neigung [°]: Vertikal

Ausrichtung: Süd

Aufbau: -

U-Wert [W/m²K]: 0,140

Nachbau.ibp18599 in E:\Projekte\IBP 18599lux\Support\2019\_01\_24\



# IBP:18599lux Software for Luxembourg

IBP:18599 Luxemburg - Nachbau.ibp18599

Projekt Einstellung

Allgemein Neu Öffnen Speichern BuildingModeller Anlagenassistent Nachweise und Berichte Varianten RGD ab 2019 Ansicht Hilfe

Projekt Assistenten Ausdruck Varianten Modus Toolboxes Hilfe

Istzustand

- Projektdateien
  - Allgemein
  - Gebäude
    - Variantebeschreibung
    - Bauteileingabe
    - BuildingModeller
  - Bilanzzonen
    - Einzelbüro 1
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Einzelbüro 2
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Besprechung
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - Verkehrsräume
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse
    - WC und Sanitärräume
      - Bauteile
      - Beleuchtung
      - Belüftung
      - Ergebnisse

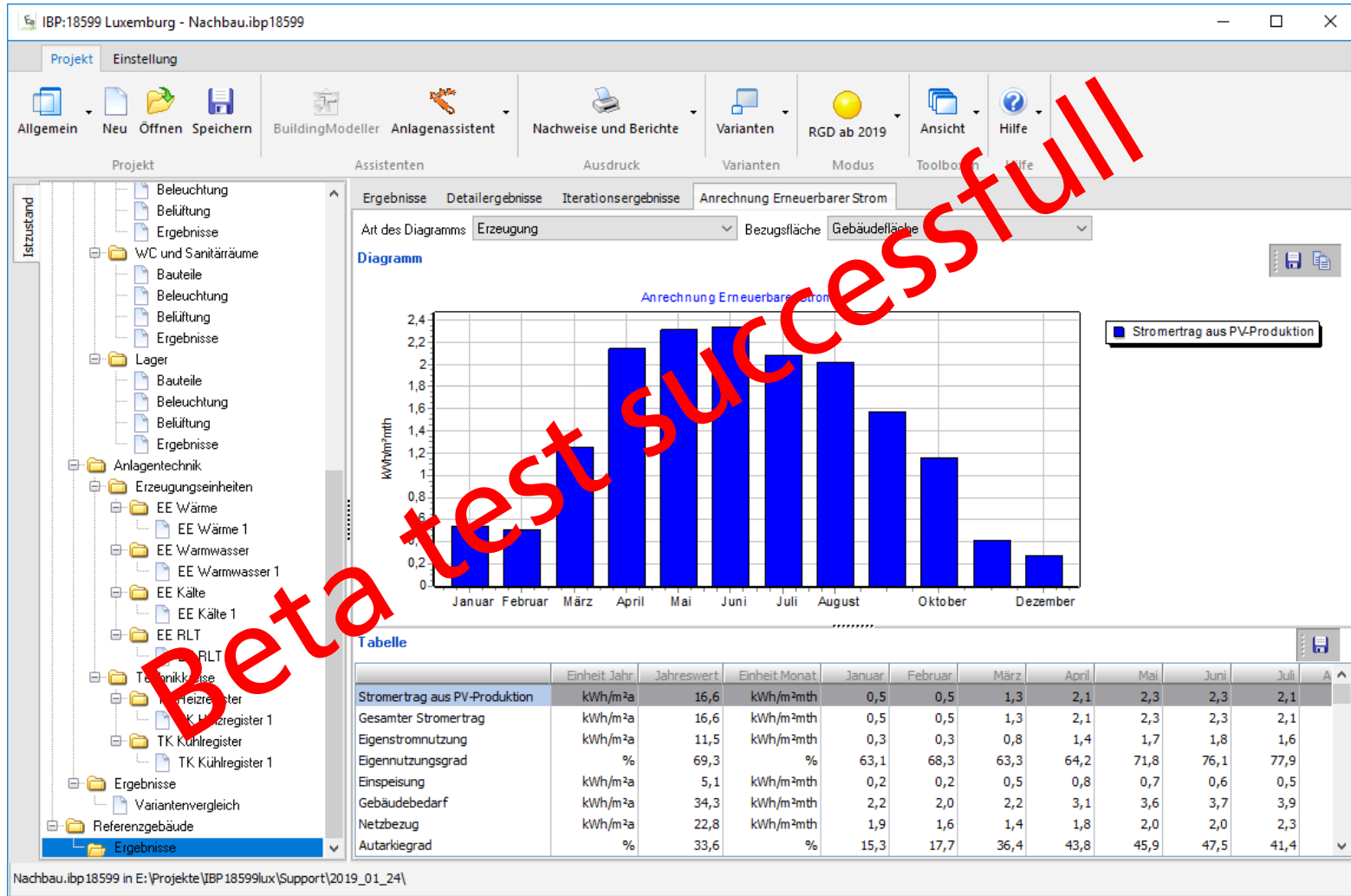
Hüllflächenverteilung

		Fläche im gesamten Gebäude [m <sup>2</sup> ]	Flächenanteil in der Zone			Fläche in der Zone [m <sup>2</sup> ]
			kein	vorhanden	detailliert	
<b>Außenwand</b>		497,70	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	201,87
<b>Dach</b>		294,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	119,25
<b>Fußboden</b>		294,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	119,25
<b>Fenster</b>	<i>II</i>	60,50	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	0,00
	<i>IO</i>	0,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0,00
	<i>O</i>	47,70	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	19,35
	<i>SO</i>	0,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0,00
	<i>S</i>	86,40	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	35,04
	<i>SW</i>	0,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0,00
	<i>W</i>	56,30	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	22,84
	<i>IW</i>	0,00	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0,00

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# IBP:18599lux Software for Luxembourg



# EPC Software Montenegro – Characteristics

- Currently in development (Cooperation Ministry of Economy / Directorate for Energy Efficiency, Montenegro/IBP/ Fichtner/KfW)
- Release expected begin of 2020
- Tailored to Montenegrin needs
  - Three Climate zones
  - User Profiles adapted to Montenegrin rulebook
  - Typical constructions
- Generation of Montenegrin Energy Performance Certificate will be included
- Upload to national registry of EPCs is foreseen
- Multilingual support built in, the software *EPC Software Montenegro* will be available in English and Montenegrin language

# EPC Software Montenegro – Characteristics

- Completely new software and not based on existing German software
- Main goal was to enable energy auditors to calculate energy demand with the new software with a very gentle learning curve
  - Input similar to calculations with EN ISO 13790
  - Expert mode included (especially for HVAC part)
- Ensure calculation is in accordance with the rulebook/national regulations without necessarily having to look at the rulebook/national regulations for the calculation itself
  - User profiles with all requirements on temperatures, occupancies, lighting levels, air volume flows, etc. included
  - HVAC efficiencies not an input to the calculation, but a result of the calculation

# EPC Software Montenegro – Costs, licence and timeframe

- Custom tailored software for a specific country, not a “one for all” software!
  - Regular phone calls with ministry
  - Consulted by an experts panel from Montenegro (Architects and HVAC specialists)
  - EPC for country will be included, upload to registry possible
- Additional services included for Montenegro
  - Check of climate, user profiles
  - Cooling study on impact of hourly calculation

# EPC Software Montenegro – Costs, licence and timeframe

- The energy auditors can download and use the software free of charge!
- Initial costs for developing the software less than 200.000€
- Maintenance contract can be offered in various levels (regular maintenance / with or without third level support/...)
- Major updates with added functionality possible based on expenses (Fraunhofer is a non-profit organization!)
- Work started 04/2019, Beta Version for field test ready 12/2019

# EPC Software Montenegro

The screenshot displays the EPC Software Montenegro interface for a new project. The main window is titled "EPC Software Montenegro - New project \*". The interface includes a navigation pane on the left, a main data entry area, and a help pane on the right. A green box highlights the "Mode for:" section, which lists two calculation modes: "certification" (fixed user profiles) and "consumption" (free conditions). A green arrow points from the "Instant update of results" box to the "Instant results" section at the bottom, which shows a table of energy values and a stacked bar chart.

**Mode for:**

- certification: fixed user profiles, etc to ensure calculation is done according to laws / rulebooks
- consumption: not measured consumption, but calculation with free conditions (user profiles can be adapted)

**Instant update of results**

**Instant results**

Total net energy	32,57 kWh/(m <sup>2</sup> a)
Total delivered energy	0,00 kWh/(m <sup>2</sup> a)
Total primary energy	0,00 kWh/(m <sup>2</sup> a)

Net energy bar chart: Heating (blue), DHW (red), Cooling (green), Steam (purple), Lighting (light blue), Ventilation (orange), Auxiliary energy (grey).

**Project data:**

- Name of project:** Name of the project
- Additional info:** Additional info as optional information
- Address of the building:** Address of the building
- Postcode / city:** Postcode and city of the building
- Building owner:**
  - Name of building owner:** Name of building owner
  - Address of building owner:** Address of the building
  - Postcode / city:** Postcode and city of the building owner
- Energy Auditor:**
  - Name of energy auditor:** Name of energy auditor
  - Energy auditor registration number:** Energy auditor registration number. This is currently just a placeholder until the registration scheme is finalized.
  - Registrar number for this EPC:** Registrar number for this EPC. This is currently just a placeholder until the registration scheme is finalized.
  - Address of energy auditor:** Address of energy auditor



# EPC Software Montenegro

Na osnovu čl. 21 i 29 Zakona o energetskej efikasnosti („Službeni list CG“, broj 29/10) Ministarstvo ekonomije, uz saglasnost Ministarstva održivog razvoja i turizma, donijelo je,

## PRAVILNIK

### O MINIMALNIM ZAHTJEVIMA ENERGETSKE EFIKASNOSTI ZGRADA

#### I. OSNOVNE ODREDBE

##### Predmet

##### Član 1

Ovim pravilnikom utvrđuju se minimalni zahtjevi po pitanju energetske efikasnosti zgrada, vrste zgrada koje u skladu sa namjenom ne moraju da ispunjavaju minimalne energetske karakteristike i metodologija izračunavanja energetskih karakteristika zgrada.

**Tabela 3: Infiltracija (orijentacione vrijednosti)**

Minimalne vrijednosti		Infiltracija $n$ [ $h^{-1}$ ]		
Svi tipovi zgrada (radno vrijeme/van radnog vremena)		0.5 / 0.3		
Procijenjene vrijednosti prema stanju i položaju objekta		Infiltracija $n$ [ $h^{-1}$ ]		
Stanje zgrade	Otvoren	Umjereno otvoren	Veoma zaklonjen	
Prozori i spoljašnji zidovi u lošem stanju	1.4	0.9	0.55	
Prozori i spoljašnji zidovi u normalnom stanju	0.9	0.6	0.5	
Prozori i spoljašnji zidovi dobro zaptiveni	0.6	0.4	0.3	
Infiltracija na osnovu Blower-door Testa		Faktor položaja objekta ( $K_{Po}$ )		
* $n_{pp} = 15 \cdot K_{Po}$		1.4	1.0	0.7

#### Infiltration

Location of building

Very sheltered

Condition of building

Windows and façade walls in bad condition

#### Infiltration

Location of buil... Very sheltered

Condition of bu... Windows and façade w...

Air change rate... 0,50 1/h

EPC Software Montenegro - New project \*

Project

Show Net energy

English

Disclaimer

Single family house

In accordance ... 0,05 W/(m²K)

#### Construction w...

Light 30,00 Wh/(m²K)

#### Infiltration

Location of buil... Moderately open

Condition of bu... Windows and façade w...

Air change rate... 0,60 1/h

#### Building geome...

Results

Name Value And Unit

#### Detailed results...

Type of building Single family house

Is the building ... No

Calculate as sin... No

#### Heat bridges

Not in accorda... 0,00 W/(m²K)

#### Construction w...

Heavy 0,00 Wh/(m²K)

#### Infiltration

Location of buil... Moderately open

Condition of bu... Windows and façade w...

Air change rate... 0,60 1/h

#### Building geome...

Net floor area 50,00 m²

Heated/cooled ... 50,00 m²

Net volume 0,00 m³

Gross volume 0,00 m³

#### Building Autom...

Heating Class C

Overall effi... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

DHW Class C

Overall effi... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Cooling Class C

Overall effi... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %

Efficiency o... 0,00 %



# EPC Software Montenegro

The screenshot displays the EPC Software Montenegro interface. The main window is titled "EPC Software Montenegro - New project \*". The interface includes a menu bar with options like "Project", "File", "Calculation for EPC", "Result options", "Language", and "Help". A navigation pane on the left shows a tree view of the project structure, including "Building", "Building envelope", "Zone 1", and various elements like "Lighting", "Ventilation", and "HVAC wizard".

The central "Main" pane features a "Construction elements" table with the following data:

str Name	Area [m <sup>2</sup> ]	U value [W/(m <sup>2</sup> K)]	Max U value [W/(m <sup>2</sup> K)]	Orientation	Incline
New external or internal wall	75,00	0,80	0,60	South	Incline 90
New roof or upper completion	150,00	0,40	0,40	South	Incline 30
New floor or lower completion	5,00	0,50	0,50	Horizontal	Horizontal
New transparent element	5,00	2,00	0,80	South	Incline 90

A green callout box with an arrow points to the "Max U value" column, containing the text: "Check maximum U-values according to rulebook".

Below the table is a "Transparent envelope element" configuration panel with the following settings:

- Name of element: New transparent element
- Type of element: Window / glazed door
- Total area (including possibly existing windows): 5,00 m<sup>2</sup>
- Reduction factor frame: 5,00
- Orientation: South
- Incline: Incline 90
- Glazing: Single glass (colorless, flat float glass)
- Frame: Metal
- Spacer: Aluminium
- Sunscreen: Jalousie, lamellae that can rotate, rear venti...

The bottom section shows "Instant results" with the following energy values:

- Total net energy: 147,40 kWh/(m<sup>2</sup>a)
- Total delivered energy: 246,61 kWh/(m<sup>2</sup>a)
- Total primary energy: 260,17 kWh/(m<sup>2</sup>a)

A stacked bar chart displays the energy breakdown for Net energy, Final energy, and PrimaryEnergy. The legend includes: Heating, DHW, Cooling, Steam, Lighting, Ventilation, and Auxiliary energy.

The bottom left corner shows a warning icon and the number "42". The bottom right corner has "Results" and "Help" buttons.

# EPC Software Montenegro

EPC Software Montenegro - New project \*

Project

New Load... Save... Save as... Print reports Calculation for EPC

Show Net energy English Montenegroin About User manual

Results as absolute values Language Help

Navigation

Project Building Building envelope Zone 1 Envelope elements Lighting Ventilation Results for this z. HVAC wizard Heating Circuit heating 1 New heating ... Unit heating 1 New boiler DHW Circuit DHW 1 Unit DHW 1 Heating Stora... Cooling Circuit cooling 1 New cooling e... Unit cooling 1 Ventilation Circuit AC 1 New AC emiss... Unit AC 1 Renewable Power Results for the building

Main

Operation mode of the wizard for the technical systems

The wizard for technical systems can set up generators, units, distributions, pipes, pumps, storages etc. for heating, cooling, hot water and/or ventilation.

Only the wizard is used to define the technical systems. No details are shown.

The wizard is used to start and a refinement is possible or even required

The wizard is not used at all

Three modus (wizard / use wizard to start detailed modelling / no wizard at all)

Heating and hot water systems

Select the heating system

Select the system

Select the control

System schedule

area; P-controller with design proportional range  $X_p = 2k$ ; 70/55 °C-interpretation; central system; horizontal distribution within the thermal envelope; Internal cables; G

Instant results

Total net energy 147,40 kWh/(m²a)

Total delivered energy 246,61 kWh/(m²a)

Total primary energy 260,17 kWh/(m²a)

Net energy

Final energy

PrimaryEnergy

Heating DHW Cooling Steam Lighting Ventilation Auxiliary energy

Results

Name Value And Unit

Detail results systems

Heating generation

Unit heating 1 Efficiency 0,73

Total Efficiency 0,73

Hot water generat...

Unit DHW 1 Efficiency 0,94

Total Efficiency 0,94

Cooling generation

Unit cooling 1 Efficiency 3,10

Total Efficiency 3,10

Tabela 9: Tipični godišnji koeficijenti efikasnosti generatora toplote za grijanje (GH),  $\eta_{GenH}$

Gorivo	Peć/Kotao	$H_{GenH}$
Tečno gorivo	Liveni (prije 1970)	60%
	Mehanički raspršivač	70-78%
	"Standardni" (Mid-efficiency)	83-89%
Električna energija	Centralno	100%
	Konvencionalni	55-65%
Prirodni gas, TNG	"Standardni" (Mid-efficiency)	78-84%
	Kondezacioni	90-97%
	Konvencionalni	45-55%
Čvrsto gorivo	Savremeni	55-65%
	Najmoderniji	75-90%

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Instant results Status

Results Help

# EPC Software Montenegro

EPC Software Montenegro - New project \*

Project

File: New, Load..., Save..., Save as..., Print reports, Calculation for EPC

Show: Delivered energy by energy carrier, Net energy, Delivered energy, Delivered energy by energy carrier, Primary energy

Language: English, Montenegrin

Disclaimer, About, User manual, Help

Navigation: Project, Building, Building envelope, Zone 1, Envelope elements, Lighting, Ventilation, HVAC wizard, Heating, Circuit heating 1, New heating..., Unit heating 1, New boiler, DHW, Circuit DHW 1, Unit DHW 1, Heating Stora..., Cooling, Circuit cooling 1, New cooling e..., Unit cooling 1, Ventilation, Circuit AC 1, New AC emiss..., Unit AC 1, Renewable Power, Results for the building

Main

Chart

Table

Name	Total kWh/(m²a)	January kWh/(m²mth)	February kWh/(m²mth)	March kWh/(m²mth)	April kWh/(m²mth)	May kWh/(m²mth)	June kWh/(m²mth)	July kWh/(m²mth)	August kWh/(m²mth)	September kWh/(m²mth)	October kWh/(m²mth)	November kWh/(m²mth)	December kWh/(m²mth)	
Electricity (Thermal 35%) + ...	2,72	0,41	0,35	0,34	0,24	0,09	0,09	0,09	0,09	0,09	0,09	0,22	0,33	0,39
Heating	1,68	0,32	0,27	0,25	0,15	0,00	0,00	0,00	0,00	0,00	0,00	0,13	0,25	0,30
DHW	1,04	0,09	0,08	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,09
Cooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Steam	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Lighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Auxiliary energy	2,72	0,41	0,35	0,34	0,24	0,09	0,09	0,09	0,09	0,09	0,09	0,22	0,33	0,39
Additional building electric	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Instant results

**Total net energy** 147,40 kWh/(m²a)

**Total delivered energy** 246,61 kWh/(m²a)

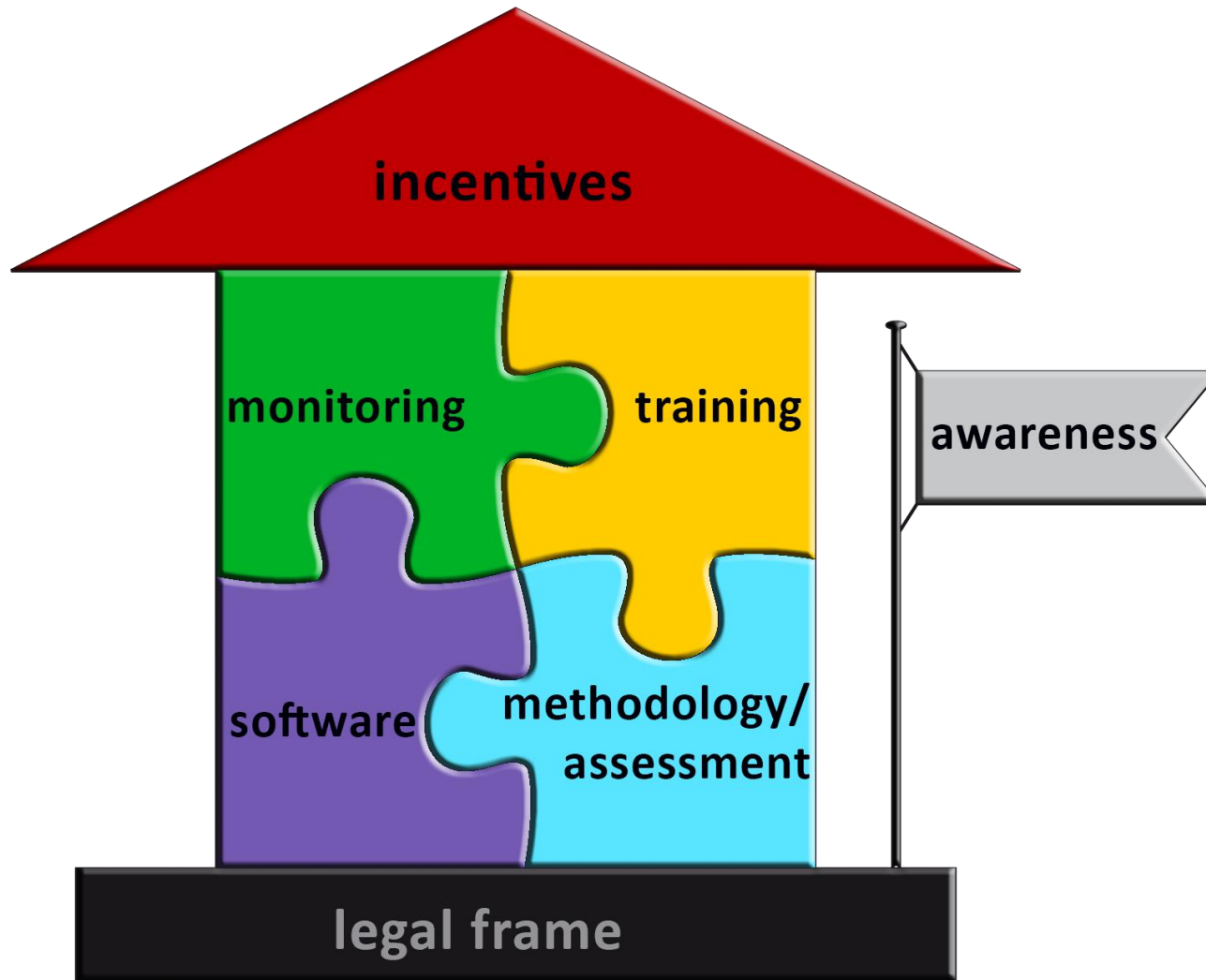
**Total primary energy** 260,17 kWh/(m²a)

Instant results Status

Results Help

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# Bigger picture





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