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Using prEN 16212 for improving the comparability of results of bottom-up energy savings calculations

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Evaluation under data uncertainty and ambiguity in calculation procedure

- **calculation of energy savings in energy performance contracting schemes (basis for remuneration)**
- **calculation of ERU under CDM and JI**
- **calculation of energy performance of buildings under the EPBD**
- **calculation of Life-cycle cost of buildings in early planning phases**

➔ **using the lessons learned for the case of energy savings calculation**

Increasing importance of BU energy savings calculation

- **Increasing importance of energy efficiency policy ➔ need for evaluation of policy achievements**
- **ESD requires the to verify the achievement of energy saving targets for MS**
- **Voluntary agreements: Branches need to show their success in achieving targets**
- **Tradable White Certificates: energy savings are allocated with a certain value**

➔ **higher transparency of energy savings calculations needed**

Reasons for incomparability (I)
Level of “gross energy savings”

$$\textit{gross energy savings}_t = \textit{baseline energy consumption}_t - \textit{actual energy consumption}_t$$

- **definition of system boundaries**
- **definition of the baseline situation**
- **quality of input data**

Incomparability due to choice of system boundaries

- **The choice of the “object of assessment” has considerable impact on the result of BU energy savings calculation**

EXAMPLES:

- **every EEI action related to change to/from district heating**
- **replacement of heat by electricity (e.g. heat pumps)**
- **EEI actions that provoke “side effects” in the system (e.g. use of shading devices might lead to increase in artificial lighting)**

Incomparability due to different baseline definitions

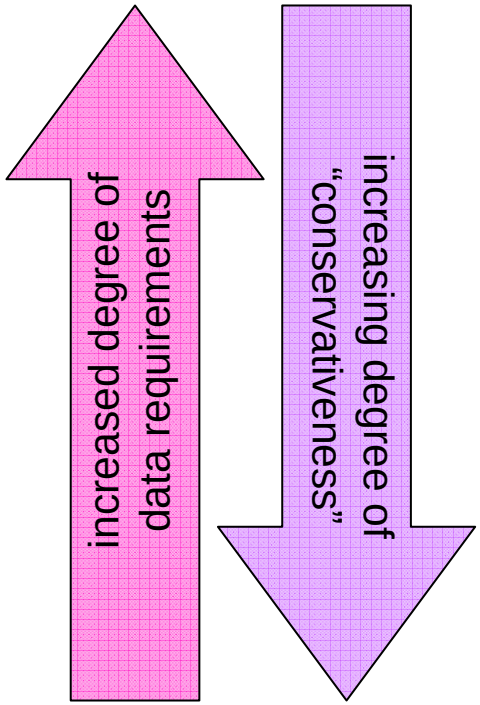
- **Definition of baseline has major influence on the results of BU calculations**

BASELINE OPTIONS according to prEN 16212:

- **“before”-situation**
- **“market average” of a certain technology or energy use**
- **“stock” of a certain technology or energy use**

Incomparability due to differences in quality of input data

- **Use of measured data**
  - additional accompanying data for the necessary adjustment process (e.g. information about weather conditions, usage patterns, plant throughput etc.)
  - direct measurement billing analysis
- **Use of calculated data which are gained by enhanced engineering estimates;**
- **Use of calculated data gained from a deemed estimate prevailingly built on default values**



Reasons for incomparability (II)
"Level 2 origins"

$$\textit{total net energy savings} = \textit{total gross energy savings} - \textit{corrections}_{net}$$

includes corrections on

- **free rider effect**
- **double counting**
- **rebound effect**

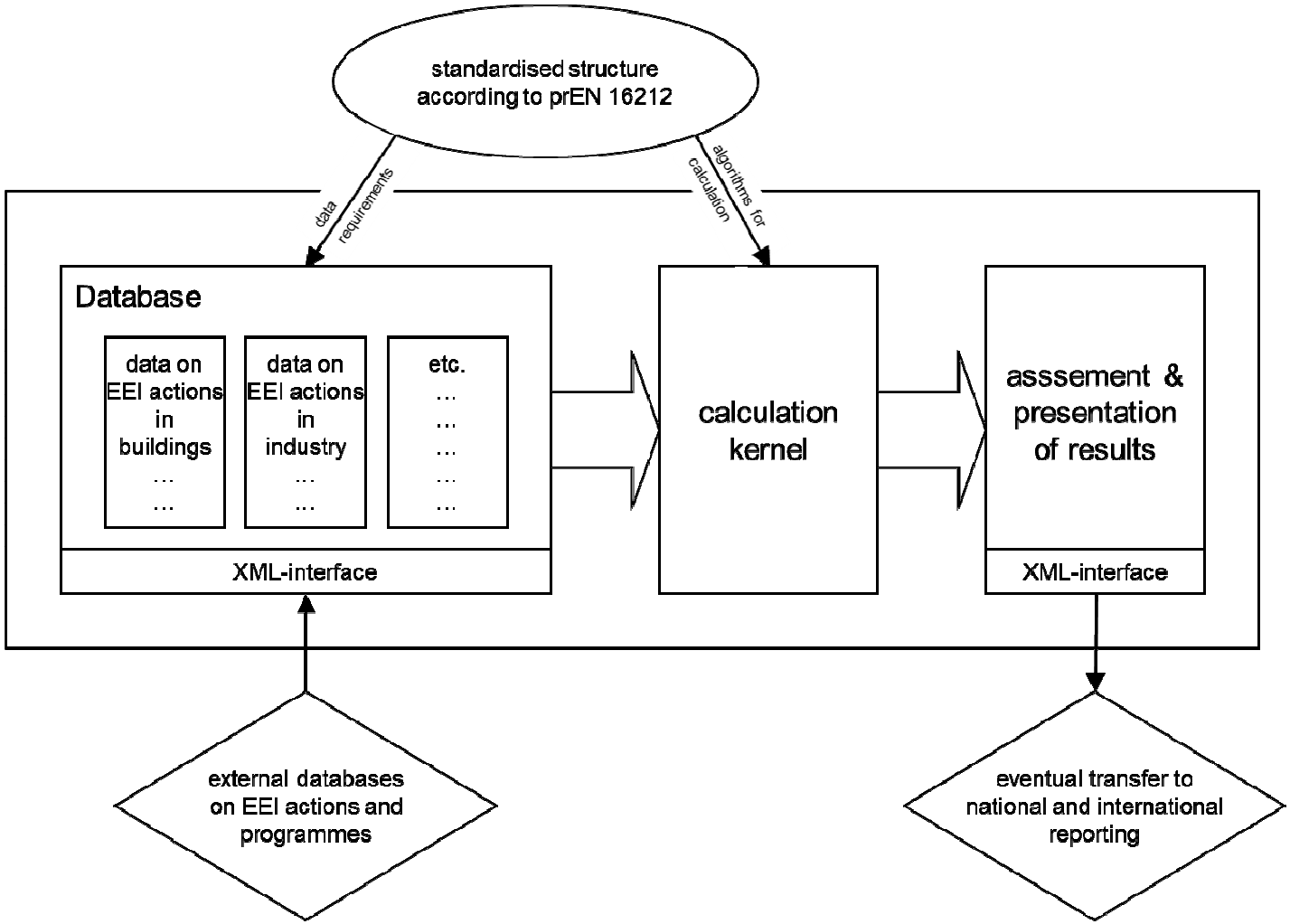
Role of prEN 16212

- **the draft standard addresses the mentioned reasons for incomparability in structured way (steps 1 to 4 with several sub-titles)**
- **For most calculation steps it offers a few options how to solve the issue**
  - baseline definition
  - data quality
  - etc.

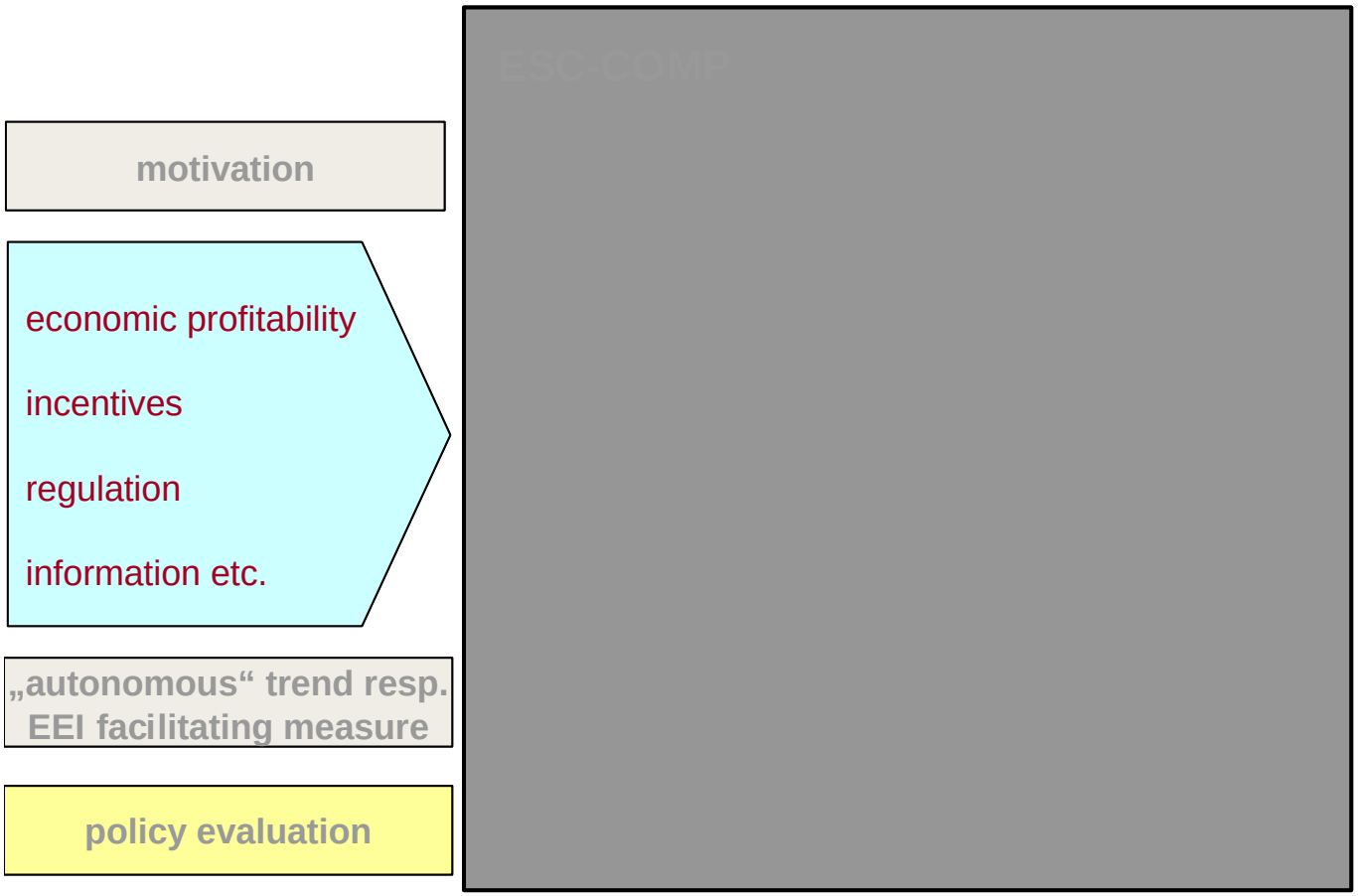
➔ **no harmonisation in BU calculation, but contribution to better comparability of results**

➔ **professional tool is required to be able to handle the complexity**

ESC-COMP as proposed way



ESC-COMP (1): Object of assessment



“quantitative“ part of the evaluation

ESC-COMP (2)
Standardised calculation kernel

makes sure that…

- **…for all similar EEI actions the same algorithms are applied**
- **…possibility to "switch" between different calculation options**
  - Definition of the baseline
  - Choice of the system boundaries and aggregation level
  - Different quality levels of input data etc.
  - Application of correction factors for double counting, multiplier effect, free-rider effect etc.

ESC-COMP (3)
Database for input data

- **calculation kernel – differentiated into various calculation options defines the set of input data needed**

➔ **database structure**

- **link to existing databases**
  - many of the required data will be already available at the national level
  - standardised data transfer
- **possibility to “switch” between different data sets**
  - data set for measured data;
  - data set for enhanced engineering estimates
  - data sets for deemed estimates prevailingly built on default values

ESC-COMP (4)
Evaluation of results

- **transparent presentation of the results derived from applying different calculation options**
- **first step: comparing results for specific EEI actions using the same calculation option**
  - comparison over time
  - comparison between actors
  - absolute values or specific benchmarks
- **second step: comparing the differences derived when applying different calculation options**

Case study boiler exchange:

Calculation option 1: Measured data based on billing analysis

	unit	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
gross floor area	m2	850	1.560	2.011	619	770	1.233	1.756	550	1.178	912
Baseline measured											
	MWh/a	205,3	281,7	333,6	182,0	197,3	243,4	372,4	149,0	200,4	210,7
	%	100%	95%	90%	98%	100%	82%	89%	97%	95%	95%
		2970	3020	3400	3100	3550	2970	2970	3480	2970	2970
After boiler exchange measured											
heat consumption measured / a	MWh/a	164,2	216,9	270,2	151,0	151,9	206,9	309,1	114,7	176,3	183,3
usage indicator	%	100%	97%	92%	95%	100%	86%	85%	90%	100%	95%
yearly heating degree days		3119	3141	3570	3131	3621	3119	3119	3619	3119	3119
heat consumption total / a adjusted	MWh/a	158,0	206,4	254,9	154,1	149,5	190,7	309,9	119,0	162,0	176,3
	MWh/a	47,3	75,4	78,8	27,9	47,8	52,7	62,5	30,0	38,4	34,4
					Total for all EEI actions assessed					MWh/a	**495,1**
					specific energy savings					kWh/m2	43,3

Case study boiler exchange

Calculation option 2: Enhanced estimate

	unit	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
gross floor area	m2	850	1.560	2.011	619	770	1.233	1.756	550	1.178	912
Baseline calculated											
[redacted]	kWh/m2a	115,0	86,2	95,4	140,0	122,0	94,9	101,3	129,0	103,0	110,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
[redacted]	kWh/m2a	103,0	102,2	93,0	96,6	105,0	99,8	95,7	103,0	99,6	100,2
heat demand calculated /m2a	kWh/m2a	233,0	203,4	203,4	251,6	242,0	209,7	212,0	247,0	217,6	225,2
heat consumption total / a	MWh/a	198,1	317,3	409,0	155,7	186,3	258,6	372,3	135,9	256,3	205,4
After boiler exchange calculated											
net heat demand calculated	kWh/m2a	115,0	86,2	95,4	140,0	122,0	94,9	101,3	129,0	103,0	110,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
losses of heating system calculated	kWh/m2a	65,9	55,0	57,3	63,9	50,1	52,3	49,7	60,0	55,6	44,0
heat demand calculated /m2a	kWh/m2a	195,9	156,2	167,7	218,9	187,1	162,2	166,0	204,0	173,6	169,0
heat consumption total / a	MWh/a	166,5	243,7	337,2	135,5	144,1	200,0	291,5	112,2	204,5	154,1
deemed energy savings measured	MWh/a	31,5	73,6	71,8	20,2	42,3	58,6	80,8	23,7	51,8	51,3
					Total for all EEI action assessed					MWh/a	**505,6**
					specific energy savings					kWh/m2	44,2

Case study boiler exchange

Calculation option 3: Deemed estimate with default values (1)

baseline: “before”-situation

	unit	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
gross floor area	m2	850	1.560	2.011	619	770	1.233	1.756	550	1.178	912
Baseline default											
[redacted]	kWh/m2a	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
[redacted]		1,90	1,90	1,90	1,90	1,90	1,90	1,90	1,90	1,90	1,90
heat demand default /m2a	kWh/m2a	218,5	218,5	218,5	218,5	218,5	218,5	218,5	218,5	218,5	218,5
heat consumption total / a	MWh/a	185,7	340,9	439,4	135,3	168,2	269,4	383,7	120,2	257,4	199,3
After boiler exchange default											
net heat demand default	kWh/m2a	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
performance ratio of heating system		1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55
heat consumption default /m2a	kWh/m2a	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3
heat consumption total / a	MWh/a	151,5	278,1	358,5	110,3	137,3	219,8	313,0	98,0	210,0	162,6
deemed energy savings measured	MWh/a	34,2	62,8	80,9	24,9	31,0	49,6	70,7	22,1	47,4	36,7
					Total for all EEI action assessed					MWh/a	**460,4**
					specific energy savings					kWh/m2	40,3

Case study boiler exchange:

Calculation option 4: Deemed estimate with default values (2)

baseline: market average

	unit	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
gross floor area	m2	850	1.560	2.011	619	770	1.233	1.756	550	1.178	912
Baseline default market average											
net heat demand default	kWh/m2a	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
		1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,70	1,7
heat demand default /m2a	kWh/m2a	195,5	195,5	195,5	195,5	195,5	195,5	195,5	195,5	195,5	195,5
heat consumption total / a	MWh/a	166,2	305,0	393,2	121,0	150,5	241,1	343,3	107,5	230,3	178,3
After boiler exchange default											
net heat demand default	kWh/m2a	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
hot water demand default	kWh/m2a	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
performance ratio of heating system		1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55	1,55
heat consumption default /m2a	kWh/m2a	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3	178,3
heat consumption total / a	MWh/a	151,5	278,1	358,5	110,3	137,3	219,8	313,0	98,0	210,0	162,6
deemed energy savings measured	MWh/a	14,7	26,9	34,7	10,7	13,3	21,3	30,3	9,5	20,3	15,7
					Total for all EEI action assessed					MWh/a	**197,3**
					specific energy savings					kWh/m2	17,3

Conclusions (1)

- **a strict harmonisation of BU calculation (throughout Europe) is not feasible, but comparability can be improved**
- **increase in comparability of BU energy saving calculations brings benefits**
  - better evaluation of energy efficiency policy with a solid and transparent quantitative basis
  - preparation for cross-national tradability of White Certificates

Conclusions (2)

- **ESC-COMP approach is proposed**
  - as professional IT-Tool with (web-)database
  - standardised calculation kernel
  - possibility to “switch” easily between calculation options
- **ESC-COMP would complement already existing tools**
  - MURE: comprehensive overview on different kinds of energy efficiency programmes and facilitating measures around Europe
  - ODYSSEE: standard approach for the calculation of top-down savings

Thanks for your attention!

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