# D2.2 - ALDREN Methodology note on energy rating procedure

ANNEX C EUROPEAN VOLUNTARY CERTIFICATE



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### Authors

Jana BENDŽALOVÁ (ENBEE) Johann ZIRNGIBL (CSTB) Daniela MUŠKÁTOVÁ (ENBEE) VERCO – input in template reporting indicators on Calculated and Measured energy performance (Task 2.3) DTU, CSTB – input in template reporting indicators on the Health & Wellbeing - TAIL (Task 2.4) CSTB – input in template reporting energy performance (Task 2.2), financial valuation (Task 2.5), SRI and RenoMap (Task 2.6)

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### Abbreviations

CEN	the European Committee for Standardization
СО	Cost optimal level of energy performance of buildings
EPB standards	${\sf EN}$ and ${\sf ISO}$ standards for the energy performance of building calculation developed under the European Commission's Mandate ${\sf M}/{\sf 480}$ to CEN
EPBD	Directive 2010/31/EU of the European Parliament and of the Council on the Energy Performance of Buildings
EVC	European Voluntary Certificate
IEQ	Indoor environment quality
MS	Member State of the European Union
NZEB	Nearly Zero-Energy Building
PV	photo-voltaic electricity
SRI	Smart Readiness Indicator

# 1 Steps towards energy rating and ALDREN European Voluntary Certificate (EVC)

The ALDREN EVC can be used as a stand alone certificate, to be overtaken by MSs (EPBD [1] Art. 11), by Commission (EPBD Art. 11(9)) or by existing voluntary environmental certification schemes as an energy module.

#### The ALDREN EVC improves the current practice by the following features:

- It provides comparability at EU level by reporting all indicators recommended in CEN EPB standards, that are also harmonised with several existing national and voluntary schemes;
- It fulfils the EPBD requirements on energy performance certificates (Article 11);
- The scale is based on EN ISO 52003-1,-2:2017 [7], [8] with one reference point. It highlights the high performing buildings and it is sensitive enough to show the step-by-step renovation by transition between energy classes;
- A common harmonised calculation methodology based on new CEN standards developed under M/480 or calculation method with results close to CEN standards is required. This improves the level playing field for products, provides comparability of energy performance EU wide and supports the use of EU common products databases;
- Inputs for Annex A to EN ISO 52000-1:2017 [6] allow a transparent description of the choices for the calculation of energy performance;
- A hourly calculation step is required that supports a correct consideration of indoor comfort and correct estimation of the impact of some technologies, e.g. cooling, heat pumps, PV electricity auto-consumed in building and/or exported to the grid;
- A thermal comfort score, with the link to the IEQ categories in EN 16798-1:2019 [9], makes visible the link between the calculated energy use and the respective thermal comfort.
- Climate of building location is used for energy performance calculation based on JRC climate data (TMY) instead of often used one national or regional climate for energy performance certificates. The gap between calculated and actual energy consumption is reduced;
- The recommendation for improvement refers to the renovation roadmap to avoid a lock-in effect in case of a step-by-step renovation. The ALDREN RenoMap (Task 2.6) gives the time sequenced recommendation for improvement towards ALDREN NZEB;
- The operational rating, as an optional page in EVC, is based on measured energy normalisation for climate and use in line with EN 15378-3:2017 [10] for heating and hot water preparation. Energy signature for heating and hot water can be used for self monitoring of energy consumption by building owner;
- Additional indicators as on health & wellbeing (TAIL), financial valuation (including the non-energy benefits and the risk of increased overheads or loss of income in connection with the climate change) and the SRI are reported in the separate optional pages;
- The indicators are as much as possible harmonised with Level(s), especially for energy, IEQ and costs.

In addition to the ALDREN EVC template reported in the following chapters, a dedicated ALDREN NZEB template (green instead of blue) is defined. It gives possibility to refer to more targets and not only to one indicator (e.g. energy class) for definition of ALDREN NZEB.

The ALDREN EVC pages have a modular structure and some can stand alone or can be overtaken by other scheme as a separate module (e.g. energy performance, TAIL, SRI).

#### Notes:

- The detailed protocols for indicators assessment are described in deliverables D2.2, D2.3, D2.4, D2.5, D2.6.
- The ALDREN protocols provide benchmark for energy ratings for **office buildings and hotels**. The scope can be extended to other building categories.

# Key points of the methodology and protocol, the ALDREN scale and unique reference point

Based on the calculation of several model buildings using simulation software with hourly calculation step close to the EPB standards (M/480), the **ALDREN scale** is proposed with the unique reference point per building category for three climates (Warm, Moderate, Cold) (**Table 1**). The energy performance of **ALDREN NZEB** is defined in line with the Commission Recommendation (EU) 2016/1318 [4] on guidelines for the promotion of nearly zero-energy buildings for office buildings. The recommended values by the neZEH initiative [11] were the basis for hotel NZEB definition.

The scale allows to identify the technical potential for building improvement and enables an EU harmonized rating (see Annex 1).

Offices

Onices		
Climate zene	ALDREN	ALDREN
Climate zone	REF	NZEB
Warm	70	25
Moderate	130	46
Cold	170	60

Hotels		
Climata zana	ALDREN	ALDREN
Climate zone	REF	NZEB
Warm	200	70
Moderate	270	95
Cold	310	109

 Table 1
 Reference values (REF) for ALDREN scale expressed in kWh/(m².a) of the non-renewable primary energy

The scale and the reference point for benchmarking the energy performance were tested on five office buildings and three hotel buildings of different size and properties located in three climates (Palermo, Bratislava, Helsinki). The proposed scale and reference have been tested also on the real pilot buildings.

The typical meteorological year (TMY) for Europe developed by European Commission, Joint Research Centre (JRC) have to be used for EVC energy performance calculation. The rules for allocation of assessed building to one of 3 climate zones (warm, moderate, cold) for ALDREN rating have been set.

All potential indicators are reported in ALDREN EVC to fit the different schemes and choices by MSs and by existing voluntary schemes. Two indicators are benchmarked by energy class:

- non-renewable primary energy with PV export to grid counted (the main EP indicator).
- non-renewable primary energy with auto-consumption of PV electricity produced on-site, compliant with Level(s).

The ALDREN scale is a non-linear scale with seven main classes (A-G) and with one reference point located on the upper limit of class "D". The reference value is based approximately on the cost optimal level of minimum energy performance requirements calculated by Member States in 2013 that is a comparable level estimated in harmonised way [5]. The ALDREN NZEB is defined by energy class "A" and by three additional indicators (energy needs, expenditure factor for systems and the thermal comfort score). ALDREN NZEB is made visible by green version of the first page of certificate.

To describe the underlying choices for calculation the Annex A of EN ISO 52000-1:2017 [6] has been used. Annex A of EN ISO 52000-1 is an empty template that can be filled in with the national or regional data and choices to describe the national or regional calculation methodology for the assessment of the energy performance of building. For the ALDREN EVC the choices are described in the structure of Annex A to EN ISO 52000-1 in chapter 4 in this report.

The packaged solutions towards deep renovation were applied to model buildings for testing the scale sensitivity and the energy classes' transition by renovation steps (Figure 1). In case of step-by-step renovation the appropriate time sequence of renovation is identified in renovation roadmap towards the main target, the ALDREN NZEB, to avoid a lock-in effect.

Buildings suitable for deep renovation were identified. For these buildings the cost – benefit balance could be potentially achieved during the economic lifespan by investment in renovation.

The overview of the content of EVC is presented in chapter 2 and the template of EVC pages is presented in chapter 3.



Figure 1 Example of ALDREN energy classes transition and energy savings by step-by step renovation from existing building (EX) to NZEB or to the CO level (2013) for two model office buildings in Bratislava





Figure 2 The main pages of the EVC template



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Hererence moor area (GA) A <sub>6</sub> 7 Building volume related to GIA	1000 Teal billion     1010     101     1010     101	ovasion FAE7 V. 1/m	party 0.30		Syste	em Desi	cription - actual building	Recommenda	tions for improvement
m <sup>2</sup> Construction nigh <i>1</i> , (average)	m 3.1 Number of	oors above the ground	5		Measuremen	FCU units for a individually co	2 zones (N/S) ntrolled FCU units	cooled chiller for AHI Individually controlled	U), Heat / cold transfer: VRF d cassette units
Number of degree-days K day	ating 2/01 Set p	Number of neated days win inclintema: temperature neati no intema: temperature neati	ner 212 Ing 20°C		VENTILAT	control	Description - actual buildin	g Recomm	endations
Operation schedules	Serp Serp	int internal temperature cooli icx internal temperature cooli	ing 20 °C ing 30 °C		Type of syst	em: er	Netural ventilation	DOAS, DOV	<u> </u>
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DESCRIPTIO RECOM AFTER BUILDING BUILDING Service, quant Energy need - Heating Energy need - Cooling Energy need - Lighting Energy need - Lighting Energy need - Lighting Energy need - Lighting Energy need - Lighting Ari-conditioning Ventilation DHW Lighting Ventilation DHW Lighting Non-renewable primary en (balance with exported energy Non-renewable primary en (balance with exported energy Non-renewable primary en (balance with exported energy Non-renewable primary en Kon-Periona energy pri Produced renewable Energy class CO, emissions Produced renewable Energy class CO, emissions	N OF BUILDING MENDATIONS POTENTIAL EI REALIZATION OF F INTERPOLICIES IN INTERPOLICIES INTERPOLICIES IN INTERPOLICIES INTERPOLICI	AND TECHNI COR IMPROVI NERGY SAVINGS ECOMMENDED P Technic Saving Sav	Bit         Bit           01.0         0.1           0.1         0.1           0.2         0.2           0.1         0.1           0.2         0.2           0.1         0.1           0.1         0.1           0.2         0.2           0.1         0.1           0.2         0.2           0.1         0.1           0.2         0.2           0.1         0.1           0.2         0.2           0.2         0.2           0.2         0.2           0.3         0.2           0.3         0.2           0.3         0.2           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3           0.3         0.3	MS / Savings % 55% 55% 62% 46% 55% 62% 46% 55% 62% 46% 55% 62% 46% 55% 62% 46% 55% 55% 62% 47% 55% 62% 47% 55% 55% 73% 55% 73% 73% 73% 73% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 100% 73% 100% 10% 1	(Cer Deep re Heating Cooling Veriliation OHW Lighting Final energy Nenevable ( Primary energy labs Primary energy labs Primary energy labs Primary energy labs ( # RENOVATION # RENOVATION	ived from RenoMap in  enovation po  rvice  use use use use use volution vo	RENOVATION RC Rethodology in ALDREN Eu (Optional) tential urrent state: 100 10 10 10 10 10 10 10 10 10 10 10 10	DADMAP           iiding Renovation P           iiding Renovation P           www.im*yy         Saving           (%)         83,5%           2         56,5%           2         76,4%           2         76,4%           2         76,4%           3         87,3%           2         76,4%           3         87,3%           2         76,4%           3         87,3%           20,0%         100,0%           20,0%         135           9,1%         135           13,8%         75           27,3%         40	Passport, task 2.6)
DESCRIPTIO RECOM AFTER BUILDING BUILDING Service, quant Energy need - Keating Energy need - Cooling Energy need - Cooling Energy need - Lighting Energy need - Lighting Energy need - Lighting Energy need - Lighting Ari-conditioning Ventilation DHW Lighting Ventilation DHW Lighting (Self used produced energy) Final energy use Non-renewable primary en (balance with exported energy Non-renewable primary en (balance with exported energy Produced renewable Energy Class CO, emissions CO, emissions CO, emissions	N OF BUILDING MENDATIONS POTENTIAL EI REALIZATION OF F INTERPOLICIES AND	AND TECHNI COR IMPROVI NERGY SAVINGS ECOMMENDED P 1 1 1 1 1 1 1 1 1 1 1 1 1	Bit         Savings           WMEASURES         Savings           WMMUN(m:.a)         20.1           20.1         6.2           0.2         0           0.1.0         6.1           3.8         0.8           0.2         0           0.1.0         1.1           3.8         0.8           0.2         1.1           1.17         1.2           1.17         1.2           1.17         1.2           1.17         1.2           1.17         1.2           4.8         0.37 Ref           5.0         B           8.7         0.00 Montel North           0.00 Montel North         1.00 Montel North           0.00 Montel North         1.00 Montel North	MS / Savings 55% 55% 55% 62% 40% 55% 62% 40% 55% 62% 40% 55% 73% 73% 73% 73% 73% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 73% 100% 100% 73% 100% 10	(Cer Deep re Heating Cooling Variliation OHW Lighting Final energy Primary energy labs Primary energy labs Primary energy labs Primary energy labs Primary energy labs Primary energy labs Renovative	ived from RenotAliap in  enovation po  rvice  cuse covation po  use covation po  use covation  use covation  vorden	RENOVATION RC Rethodology in ALDREN Eu (Optional) tential urrent state: 100 1 10 110 1	DADMAP           Diding Renovation P           iiding Renovation P           iiding Renovation P           Whitin*y           State           Whitin*y           State           P           State           P           State           P           State           P           State           P           State           P           State	Passport, task 2.6)
DESCRIPTIO RECOM AFTER BUILDING BUILDING BUILDING Service, quant Energy need - Keating Energy need - Cooling Energy need - Liphing Energy need - Liphing Energy need - Liphing Energy need - Liphing Cooling Ari-conditioning Ventilation DHW Liphing Physes (DHW, heating) Physes (DHW, heating) Physes (DHW, heating) Physes (DHW, heating) Physes (DHW, heating) Physes (DHW, heating) Physes (DHW, heating) Exported energy Non-renewable primary en (balance with exported energy Produced renewable Produced renewable Energy class CO, emissions Thermal environment aff or standard use (1-best, 4-worse)	N OF BUILDING MENDATIONS POTENTIAL EI REALIZATION OF F INTERPOLICIES AND A CONSTRUCTION OF F	AND TECHNI COR IMPROVI NERGY SAVINGS ECOMMENDED P 10 10 10 10 10 10 10 10 10 10	ICAL SYSTE EMENT 3/3 MEASURES SWINGS WHI(m:a) 20.1 0.2 0.1 0.2 0.2 0.1 0.2 0.1 0.2 0.1 0.2 0.1 0.2 0.1 0.2 0.2 0.1 0.2 0.1 0.2 0.1 0.2 0.1 0.2 0.2 0.1 0.2 0.1 0.2 0.2 0.1 0.2 0.2 0.2 0.1 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	MS / Savings 5 5 5 5 5 5 5 5 5 5 5 5 5	(Der Deep re Hasting Cooling Venitation DHW Lighting Final energy Renewable Primary en Energy labe Primary Renewable and Renewable and Renewab	ived from RenoMap n  enovation po  rvice  rvice rvice  rvice  rvice  rvice  rvice  rvice  rvice  rvice  rv	RENOVATION RC           Rethodology in ALDREN European (Optional)           tential           urrent state           100           100           100           100           100           100           100           100           100           100           100           100           100           100           24           200           155           155           150           155           155           150	DADMAP           DADMAP           iiding Renovation P           iiding Renovation P           80/350           83,5%           2           61,1%           2           66,1%           2           76,4%           2           76,4%           8           9,1%           13,6%           27,3%           40           27,3%           40           k           27,3%	Passport, task 2.6)
DESCRIPTIO RECOM EUILING Building category Energy need - Heating Energy need - Cooling Energy need - Cooling Energy need - Liphing Energy need - Liphing Energy need - Liphing Energy need - Liphing Cooling Ari-conditioning Ventlation DHW Liphing Ventlation DHW Liphing Cooling Ari-conditioning Ventlation DHW Liphing (Energy Class) Exported energy Exported energy Exported energy Exported energy Exported energy Co-emissions (export) ki Energy Co-emissions (export) aris Co-emissions Energy Class) Co-emissions Co-emissions Thermal environment aff or standard use (1-best, 4-worse) Building name: Covert G Address: Rue de r	N OF BUILDING MENDATIONS POTENTIAL EI REALIZATION OF F INTERPOLICIENT ALLES POTENTIAL EI REALIZATION OF F INTERPOLICIENT INTERPOLICIEN	AND TECHNI COR IMPROVI NERGY SAVINGS ECOMMENDED P tel After renovator 105 - 2 - 2 - 1 - 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2	Savings           WHASURES           Savings           WHYIMT.a)           20.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.1           0.2           0.2           0.2           0.2           0.2           0.2           117.2           1.1.7           121.2           23.6           Temesures           Extrantional           B           0.37 Ref           Extraded           5.0           B           0.37 Ref           Extraded           5.0           8.7           0.000000 Routs           0.2           6.42           0.00000 Routs           0.000000 Routs	MS / Savings 5 5 5 5 5 5 5 5 5 5 5 5 5	(Cer Deep re Hasing Cooling Venitation DHW Encycles Encycles Primary en Primary Renewable Encycles Renewable Renewab	wwed from RenoMap in  enovation po  rvice  rvice  c  c  c  c  c  c  c  c  c  c  c  c	RENOVATION RC nethodology in ALDREN Eu (Optional) tential urrent state 100 100 100 100 100 110 100	DADMAP           iiding Renovation P           iiding Renovation P           iiding Renovation P           Whitin" y           Saving           (Whitin" y           Saving           (Whitin" y           Saving           (Whitin" y           Saving           (Whitin" y           Saving           (Saving           (Whitin" y           Saving           (Saving           (Saving           (Saving)	Passport, task 2.6)
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*Figure 4 Recommendations for improvement of EP (link to RenoMap)* 



Figure 5 The measured energy, building in-use (optional)



Note: Values and data reported in the templates of ALDREN EVC pages are just examples and do not provide consistent values between individual pages.





## **OVERVIEW OF ENERGY PERFORMANCE**

### Delivered energy, exported energy, thermal comfort

Service	Energy need kWh/(m².a) /	Energy	carrier	Delivered en energy c	ergy per arrier
technical systems description	expenditure factor**	Description	f <sub>Pnren</sub> / f <sub>Pren</sub> // f <sub>Ptot*</sub>	Amount kWh/a	Amount kWh/(m².a)
Space heating:	Q <sub>H;nd</sub> = 20	gas	1.1/0/1.1	<mark>Е</mark> н; <i>сг,і</i>	22
Humidification		electricity	2.3/0.2/2.5	Ен;cr,i	2
11111		Carrier j		EH;cr,i	
	$\varepsilon = 1.2$	Total use			24
Cooling:	Q <sub>C;nd</sub> =	Carrier 1		Ec;cr,i	
dehumidification		Carrier j		Ec;cr,i	
745	= 3	Total use			
Ventilation	Q <sub>V,;nd</sub> =	Carrier 1		<b>E</b> ∨; <i>cr,i</i>	
(22)		Carrier j		Ev; cr,i	
	= 3	Total use			
Air-conditioning may be also represented	Q <sub>ac,;nd</sub> =	Carrier 1		Ev; cr,i	
by the inclusion of energy for Humidification /or dehumidification under Heating and Cooling	-	Carrier j		Ev; cr,i	
respectively	= 3	Total use			
Hot water preparation:	Q <sub>W;nd</sub> =	Carrier 1		Ew;cr,i	
	-	Carrier 2		Ew;cr,i	
-	= 3	Carrier j		Ew;cr,i	
Link Com	0 10	l otal use	2 2/0 2/2 5		10
Lighting:	$Q_L = 16$	electricity	2.3/0.2/2.5	EL;cr,i	16
and the second se	0.1 = 3	Total use			16
Other:		Carrier 1		Eo;cr,i	
		Carrier j		E <sub>O;cr,i</sub>	
Total Gual an annual a	0 00 111	Total use			10
lotal final energy use	Qnd=36 E=1.11				40
Renewable energy production (on-site) $E_{pr}$ ,		PV	0/1/1	Epr,cr,1	-12.0
		Carrier <i>j</i>		<i>E<sub>pr,cr,k</sub></i>	
Renewable energy production by on-site production	uction self-used	PV	0/1/1	Epr;use:cr.1	-4.0
E <sub>pr;used</sub>		Carrier <i>j</i>		Epr;use;cr,k	
Sum of produced renewable energy (self-us	ed) <i>E</i> we;pr;used;an				-4.0
Exported produced renewable energy (on-sit	te) E <sub>exp</sub>	PV	2.3/0.2/2.5	Eexp;cr,k	-8.0
	_	Carrier j		Eexp;cr,k	
Sum of exported produced renewable energy	y <b>E</b> <sub>we,exp;an</sub>				-8.0

\*f<sub>Pnren</sub>: electricity = 2.3, gas=1.1, wood=0.2, solar=0

 $K_{CO2e}$  (kg/kWh) electricity = 0.42, gas=0.22, wood=0.04, solar=0 \*\*The expenditure factor  $\varepsilon$  is the reciprocal value of the efficiency

### **Overview on energies**

Delivered net energy kWh/(m².a) Gas 22 Electricity 18	Energy use (per service)
Produced energy kWh/(m².a)         On-site (PV):       12.0         from it - self-used 4.0       - exported 8.0         Produced renewable EP on-site self-used kWh/(m².a):       4.0         Used renewable EP from nearby kWh/(m².a): DH*PEFren,DH 0	
Reference floor area (GIA) $m^2$	5000

Reference floor area (GIA) m <sup>2</sup>	5000
Net internal floor area (NIA) if relevant m <sup>2</sup>	4750
Building volume (related to GIA) m <sup>3</sup>	20 000

#### **Building name:** Address:

*f*<sub>Ptot</sub>: electricity = 2.5, gas=1.1, wood=1.2, solar=1



Informative (if relevant): Non-renewable primary energy based on national primary energy factors		E <sub>Pnren</sub> only for elf-used nergy)	E <sub>Pnren</sub> (balance with exported energy)
Non-renewable primary energy <i>E</i> <sub>Pnren</sub> kWh <sub>EP</sub> /(m <sup>2</sup> .a)			
Climate locality, city (TMY):	Brati	slava (Jl	RC TMY)
Latitude, Longitude, Altitude	ноо		
Building category: ( Parcel No: (	ffice	buildii	ng

No. of energy certificate: 00001/SK\_0001/2019

Cadaster:

ALDREN

# THE HEALTH & WELLBEING INDICATORS CALCULATED AND MEASURED ENERGY PERFORMANCE FINANCIAL VALUATION OF RENOVATION ACTION SMART READINESS INDICATOR

# **THE HEALTH & WELLBEING INDICATORS**

(Derived from methodology in ALDREN Task 2.4)

(Optional)

### Overall quality of indoor environment

I – High	
II – Medium	
III – Moderate	
IV – Low	



### T-A-I-L

	Category
Thermal environment	
Acoustic environment	1
Indoor air quality	3
Lighting (visual) environment	3
TAIL	1

### Quality of T-A-I-L

# 🕂 T – Thermal environment

Temperature	
Relative humidity	

### I – Indoor air quality

**Building name:** 

Address:

Ventilation	
Carbon dioxide	
Formaldehyde	
Benzene	
Particles (PM2.5)	
Radon	
Relative humidity	
Visible mould	

### A – Acoustic environment

Noise level

### L – Light, visual environment

Illuminance	
Daylight factor	

Building category: Parcel No: Office building Cadaster:

001/2017 ALDREN

# **THE HEALTH & WELLBEING INDICATORS**

(Derived from the methodology in ALDREN Task 2.4)

(Optional)

Example from pilot building

### Overall quality of indoor environment



### T-A-I-L

	Category
Thermal environment	4
Acoustic environment	4
Indoor air quality	3
Lighting (visual) environment	3
TAIL	IV



### T – Thermal environment

	Room #1	Room #2	Room #3	Room #4	Room #5
Air temperature	4	4	4	4	4
TAIL-T building	=	4			

### I – Indoor air quality

	Room #1	Room #2	Room #3	Room #4	Room #5
CO2	1	4	1	3	2
Ventilation rate	0	0	0	0	0
Air relative humidity	4	2	3	3	3
Visible mold	0	0	0	0	0
Benzene	2	2	2	2	4
Formaldehyde	1	2	1	1	1
Radon	1	0	0	0	0
PM2.5	2	2	2	2	2
TAIL-I building	=	3			

– Acoustic		Room #1	Room #2	Room #3	Room #4
	Noise level	4	4	4	4
	TAIL-A building	=	4		

L –	Light
-----	-------

**Building name:** 

Address:

Α

L Light	(in lux)	Room 1	Room 2	Room 3	Room 4	Room 5
	Min	307	241	229	565	228
	Max	730	464	1145	998	685
	SCORE	3	1	4	4	1

Building category: Parcel No: Office building Cadaster:

No. of energy certificate: 00001/SK\_0001/2017

ALDREN

# CALCULATED AND MEASURED ENERGY PERFORMANCE

(Derived from methodology in ALDREN Task 2.3)

(Optional)

### For offices

In order to achieve a Verified EVC, the measured consumption for all significant EVC end uses must fall within 25% of the predicted value

A significant end use is defined as an end use with total consumption accounting for over 10% of the total EVC consumption measured in  $kWh/m^{2}$ .

These are highlighted in blue in the "End use" column of the table.

Key to end use validation:

GREEN All values for this end use meet 25% variance criterion

AMBER RED

End use meets 25% variance criterion, but this end use & fuel combination exceeds 25% variance

End use exceeds 25% variance criterion due to high variance in this end use & fuel combination

		EVC under actual conditions	Measured	Variance measured vs. EVC under actual conditions	Variance measured vs. EVC under actual conditions
Fuel	End use	kWh/m²	kWh/m <sup>2</sup>	kWh/m²	%
Electricity	Space Heating	0.0	0.0	0.0	0%
Electricity	Hot water	6.0	8.0	2.0	33%
Electricity	Cooling	18.0	21.0	3.0	17%
Electricity	Fans	16.0	14.0	-2.0	-13%
Electricity	Pumps	3.5	4.0	0.5	14%
Electricity	Controls	2.0	2.1	0.1	5%
Electricity	Humidification	0.0	0.0	0.0	0%
Electricity	Lighting (internal)	23.0	21.0	-2.0	-9%
Fossil fuel	Space Heating	60.0	55.0	-5.0	-8%
Fossil fuel	Hot water	10.0	7.0	-3.0	-30%
Heat	Space Heating	0.0	0.0	0.0	0%
Coolth	Cooling	0.0	0.0	0.0	0%
Heat	Hot water	0.0	0.0	0.0	0%
All	EVC uses	139	132		

EVC verified?

Verified

Building name: Address: Building category: Parcel No: Office building Cadaster:

ALDREN

# FINANCIAL VALUATION OF RENOVATION ACTION

### Valuation of proposed Energy Related Investments

(Derived from methodology in ALDREN Task 2.5)

### (Optional)

· · · ·		Scenarios			
Paramete	r *	Best case	Most likely case	Worse case	
Efforts (€)	Initial investment cost				
	Losses due to renovation (vacancy, productive time, renting)				
	Other (please complete rows) (maintenance costs, operation costs, taxes,)				
Benefits (€)	Running cost - savings				
	Maintenance cost savings				
	Operation (insurance, tax, servicies) savings				
	Energy costs savings				
	GHG Costs savings				
	Additional benefits:				
	Renting rate – income increase				
	Occupancy – income increase				
	Other benefits (please complete rows)				
Energy price rise (%)					
Discount rate including risk (%)					
Other economic parameters (please complete rows)					
Calculation period (years)					
Residual value at the end (€)					
The Net Present Value (NPV) (€)					

\* Please report all relevant Efforts and Benefits for evaluated building

Note:

- The analysis is related to the Recommendations for improvement in this Common European Voluntary Energy performance certificate.
- Reported data are calculated using Protocol for Task T2.5 or according to standard prEN 17463

## Risk indicator (overall building)

Performance Medium risk	Management Low risk
Easy to upgrade High risk	Market uptake Very high risk

Building name: Address: Building category: Parcel No: Office building Cadaster:

No. of energy certificate: 00001/SK\_0001/2017

Demonstration graph for scenarios

# FINANCIAL VALUATION OF RENOVATION ACTION

### Valuation of proposed Energy Related Investments (ERI)

(Derived from methodology in ALDREN Task 2.5)

### (Optional)

### Example from pilot building

Scenarios analyses for parameters with the strongest impact on the NPV of energy related investment (ERI)

Deremeter *		Scenarios			
Fai		Best case	Most likely	Worse case	
Initial Efforts (€)	Initial investment cost	591 300 €	657 000 €	722 700 €	
	Losses due to renovation				
	(productive time, renting)				
Annual Efforts (€)	Higher maintenance costs for				
	installed devices				
	Other (please complete)				
	Total annual losses (€)	<i>€</i>	. €	. <i>€</i>	
Annual Benefits (€)	Running cost - savings	<u> </u>		,	
	Maintenance cost savings	2 625 €	2 500 €	2 375 €	
	Operation (insurance, tax, services) savings				
	Energy costs savings (€)	29 295 €	27 900 €	26 505 €	
	Energy export income (€)				
	GHG, CO2 Costs savings	4 251 €	4 049 €	3 847 €	
	Additional benefits:				
	Renting rate – income increase				
	Occupancy/vacancy – income increase	10 500 €	10 000 €	9 500 €	
	Other benefits (please complete)				
	Total annual benefits	46 671 €	44 449 €	42 227 €	
Energy price variation (+increase, -decrease) (%)					
Discount rate including risk		3%	3%	3%	
Other economic parameters					
(please complete)					
Calculation period (years)		20	20	20	
The Net Present Value of the ERI (€)	(for proposed renovation action)	664 515 €	661 289 €	628 224 €	
Balance with investment	(Investment includes the heating system replacement at the end of the lifespan)	73 215 €	4 289 €	- 94 476 €	

Note:

The analysis is **related to the recommendations for improvement** in this European Voluntary Certificate. Reported data are calculated using Protocol for Task T2.5 or according to standard EN 17463

Energy prices in €/kWh:Gas0.079Electricity from grid0.12District heating0.08Electricity export0.12

### Sustainability Risk Indicator

Performance	Management
High risk	<b>Medium risk</b>
Easy to upgrade	Market uptake
<b>Medium risk</b>	<b>Medium risk</b>



Building name: Address: Building category: Parcel No: Office building Cadaster:

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# SMART READINESS INDICATOR

### SRI Score classifies the building's smart readiness



### The total score is based on average of total scores on 7 impact criteria:



### **IMPACT : Grid Flexibility**

		Current	Score	Potential score after improvement			
TOTAL IMPACT SCORE (weighted	average of 9 do	main scores)	25	%	57%		
DOMAINS	WEIGHTINGS	Building maximum reachable score	building score depending on smart services	DOMAIN SCORE in %	building score depending on smart services	DOMAIN SCORE in %	
Heating system	41%	9	4	44%	7	78%	
Domestic Hot Water	12%	6	3	50%	3	50%	
Cooling system	19%	9	0	0%	2	22%	
Controlled ventilation	0%	0	0	-	0	-	
Lighting	0%	0	0	-	0	-	
Electricity: renewables & storage	3%	9	5	56%	6	67%	
Dynamic Envelope	0%	0	0	-	0	-	
Electric Vehicle Charging	5%	3	-2	-67%	-2	-67%	
Monitoring & Control	20%	10	1	10%	8	80%	

Recommendations to improve the flexibility score of the building :

- Integrate controls based on grid signals for : HVAC generators, DHW storage

- Integrate controls optimising the use of locally generated electricity or availability of Renewable Energy Sources - Installation of Demand Side Management systems, connected with Monitoring & Control systems (TBS)

Building name: Address: Building category: Parcel No: Office building Cadaster:

ALDREN

DESCRIPTION / RECOMMENDATIONS FOR IMPROVEMENT OF BUILDING AND TECHNICAL SYSTEMS

# DESCRIPTION OF BUILDING AND TECHNICAL SYSTEMS / RECOMMENDATIONS FOR IMPROVEMENT 1/3

BUILDING AND CLIMATE COND	ITIONS		
Building category	Office bui	lding	
Mixed use – category 2	category	%	
Mixed use – category 3	category	%	
Year of construction:	2000	Year of last renovation	:
Reference floor area (GIA) Ab m <sup>2</sup>	3197	Level of renovation	
Building volume related to GIA $V_{\rm b}$	9628	Shape factor A <sub>E</sub> / V <sub>b</sub> 1	/m
m <sup>3</sup>			
Construction high $h_k$ (average) m	3.1	Number of floors above	e the ground
Location for climate data:	JRC	Average externa	al temperature winter
Number of degree-days K.day		Number of	of heated days winter
heating	2791	Set point internal	temperature heating
cooling	50	Set back internal	temperature heating
Operation schedules		Set point internal	temperature cooling
		Set back interna	temperature cooling



3.86 °C 212 20 °C 18 °C 26 °C 30 °C

### THERMAL ENVELOPE

Construction	Descrip	tion - actual building	U <sub>m</sub> W/(m².K)	Recommendations for improvement	U <sub>m</sub> W/(m².K)					
External walls:	Reinforced c	oncrete walls 250 mm with	0.276	Walls (except street view): 50 % + TI	0.165					
<b>D</b> (	MW 150 and	a 100 mm	0.391	MW 100 mm	0.202					
Roof:	Ceiling to the	il insulated e unheated space (5 <sup>th</sup> floor):	0.214 1.129	Additional insulation of ceiling to	0.155					
	Ceiling abov	<b>ve the exterior</b> : TI MW 140	0.262	Additional insulation of ceiling above exterior	0.176					
Opening structures:	Plastic frame Ug = 1.4 W/( W / (m <sup>2</sup> .K).	es, double glazing. m².K), plastic frame Uf = 1.6	1.65-2.07	Glazing replacement to triple glazing Ug = 0.7 W/(m².K)	1.05- 1.47					
g-value, shading	g- value, sha	ding yes	0.67	g- value, shading yes	0.35					
Floor on the ground/basement	Floor above EPS 60 mm boards 50 mi	the unheated garage: TI in the floor and the combi m from the bottom	0.313							
Ventilation:	Natural venti	lation		Heat recovery unit						
Ventilation.	Air flow rate	e qve,k [ m³/h/m² ], air		Air flow rate qve,k [ m³/h/m² ], air						
Ventilation heat			1		1					
recovery unit:	- Eniciency			Enciency						
Other:										
0011		Other:								
SPACE HEATING SYSTEMS		Description - actual	building	Recommendations	mm					
SPACE HEATING SYSTEMS Type of heating syste	em:	Description - actual Centralised low temperature	building e gas boilers	Recommendations VRF system + SPLIT (for AHU)	TIII					
SPACE HEATING SYSTEMS Type of heating syste Generation:	em:	Description - actual Centralised low temperature Low temperature gas boiler.	building e gas boilers s	Recommendations VRF system + SPLIT (for AHU) Electric	TIIII.					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier:	em:	Description - actual Centralised low temperature Low temperature gas boiler. Gas	building e gas boilers s	Recommendations VRF system + SPLIT (for AHU) Electric Cooling medium, air	TIIII					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective	em: e metering	Description - actual Centralised low temperature Low temperature gas boiler Gas Collective metering	<b>building</b> e gas boilers s	Recommendations         VRF system + SPLIT (for AHU)         Electric         Cooling medium, air         Collective metering	IIII					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types	em: e metering	Description - actual Centralised low temperature Low temperature gas boilers Gas Collective metering Remotely controlled thermo for individual ECU emitters	building e gas boilers s stat valves	Recommendations           VRF system + SPLIT (for AHU)           Electric           Cooling medium, air           Collective metering           Remotely controlled VRF emitters, central adjustment of temperature	IIII					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types Smart metering syste	em: e metering	Description - actual Centralised low temperature Low temperature gas boiler Gas Collective metering Remotely controlled thermo for individual FCU emitters	building e gas boilers s s stat valves	Recommendations         VRF system + SPLIT (for AHU)         Electric         Cooling medium, air         Collective metering         Remotely controlled VRF emitters, central adjustment of temperature	IIII					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types Smart metering syste System	em: e metering ems	Description - actual Centralised low temperature Low temperature gas boiler Gas Collective metering Remotely controlled thermo for individual FCU emitters escription - actual buildi	building e gas boilers s stat valves ng	Recommendations         VRF system + SPLIT (for AHU)         Electric         Cooling medium, air         Collective metering         Remotely controlled VRF emitters, central adjustment of temperature         Recommendations for improv	rement					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types Smart metering syste Space heating system	em: e metering ems 2-pipe hydro FCUs and fli circuit for ve offices - FCU	Description - actual Centralised low temperature Low temperature gas boiler. Gas Collective metering Remotely controlled thermo for individual FCU emitters escription - actual buildi onic balanced system, 3 circui oor heating) for two zones (S/ entilation equipment. Heat emi Us, electric convectors at stair	building e gas boilers s stat valves stat valves ng ts (2 for N), one ssion in cases	Recommendations           VRF system + SPLIT (for AHU)           Electric           Cooling medium, air           Collective metering           Remotely controlled VRF emitters, central adjustment of temperature           Recommendations for improvement of temperature           Change of heat source to VRF system + SPLIT (for AHU) Without circle pumps (see Ventilation/Air-conditioning	rement VRF ulation					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types Smart metering syste Space heating system Measurement, automation, control ( <u>Link to SRI)</u>	em: e metering ems 2-pipe hydro FCUs and fil circuit for ve offices - FCU Boiler contro control of ind individual ro emitters, van	Description - actual Centralised low temperature Low temperature gas boiler. Gas Collective metering Remotely controlled thermo for individual FCU emitters escription - actual buildi onic balanced system, 3 circui oor heating) for two zones (S/ ntilation equipment. Heat emi Us, electric convectors at stair of with weather compensated / dividual heating circuits by 3-v om remote controlled valves a riable speed pumps	building e gas boilers s stat valves stat valves ng ts (2 for N), one ssion in ccases /equithermic vay valves, at FCU	Recommendations           VRF system + SPLIT (for AHU)           Electric           Cooling medium, air           Collective metering           Remotely controlled VRF emitters, central adjustment of temperature           Recommendations for improve           Change of heat source to VRF system           system + SPLIT (for AHU) Without circle           pumps (see Ventilation/Air-conditioning           Weather compensated/equithermic corr           units, individual room remote control	rement VRF ulation u) btrol of VRF					
SPACE HEATING SYSTEMS Type of heating syste Generation: Energy carrier: Individual or collective Thermostat types Smart metering syste Smart metering syste Space heating system Measurement, automation, control ( <u>Link to SRI</u> ) Building name: Address:	em: e metering ems 2-pipe hydro FCUs and fl circuit for ve offices - FCU Boiler contro control of ind individual ro emitters, van	Description - actual Centralised low temperature Low temperature gas boiler. Gas Collective metering Remotely controlled thermo for individual FCU emitters escription - actual buildi onic balanced system, 3 circui oor heating) for two zones (S/ intilation equipment. Heat emi Us, electric convectors at stair ol with weather compensated / dividual heating circuits by 3-v dividual heating circuits by 3-v eriable speed pumps	building a gas boilers s stat valves stat valves ng ts (2 for N), one ssion in cases /equithermic vay valves, at FCU Building of Parcel No	Recommendations           VRF system + SPLIT (for AHU)           Electric           Cooling medium, air           Collective metering           Remotely controlled VRF emitters, central adjustment of temperature           Recommendations for improvemental adjustment of temperature           Change of heat source to VRF system system + SPLIT (for AHU) Without circle pumps (see Ventilation/Air-conditioning           Weather compensated/equithermic cor units, individual room remote control           category:         Office building Cadaster:	vement VRF ulation throl of VRF					

# DESCRIPTION OF BUILDING AND TECHNICAL SYSTEMS / RECOMMENDATIONS FOR IMPROVEMENT 2/3

COOLING		Description - actual building		Recommendations	. J.
Type of system:		Air-cooled chiller	VRF	+ SPLIT (for AHU)	SK
Energy carrier:		electricity	elec	tricity	742
Measurement, automa	tion, control	Individually controlled	Indiv	vidually controlled cassette units	
,	, 				
System	Descri	ption - actual building	1	Recommendations for improvements	ent
System description	FCI units for 2 z	+ 2 circuits with 2-pipe system for ones (N/S)	3-рір	be VRF system + SPLIT cooling units (a	11- 
			cool	ed chiller for AHU), Heat / cold transfer:	VRF
Measurement,	Individually contro	olled FCU units	inaiv	vidually controlled cassette units	
automation, control					
	1				
VENTILATION,		Description - actual building		Recommendations	600
AIR-CONDITIONING					
Type of system:		Natural ventilation	DOA	IS, DCV	
Energy carrier:			elec	tricity	_
Measurement, automa	tion, control	Thermostats for FCU units	Indiv	vidually controlled cassette units	
System	Descri	ption - actual building	F	Recommendations for improvement	ent
System description	Low pressure me	chanical ventilation system with	Low	pressure mechanical ventilation system	n with
	AHUs, with air-co	ooled chiller + FCU units + natural	AHU	ls, with air-cooled chiller + VRF ceiling ι	ınits,
Measurement,	ventilation		natu	ral ventilation, heat recovery, DOAS, he	at
automation, control	Thermostats for F	-CLL units in individual rooms	Cen	tral control	
(Link to SRI)			Cen		
HOT WATER PREP	ARATION	Description - actual building		Recommendations	
Type of system:		Centralised with heating	Loca	al electric	T
Generation:		Low-temperature gas boilers	Insta	antaneous water heaters	
Energy carrier:		gas	elec	tricity	
Measurement and cont	trol	On-off, electric circulator	On-o	off on user demand	_
System	Dosorir	ation - actual building		acommondations for improvement	nt
Heating system	L ow-temperature	gas boilers. Centralized DHW		ntralized DHW preparation in local elect	
riealing system	preparation in ver	rtical storage heater in a boiler	instar	ntaneous water heaters, without storage	and
Measurement	room, vertical DH	W distribution system with	circul	ation	
automation, control	circulation			<i>.</i>	
(Link to SRI)	On-off, electric cil	rculator	On-oi	ff, on user demand	
LIGHTING		Description - actual build	ing	Recommendations	
Type of system:		Fluorescent lamps	<u> </u>	LED	
Type of lamps 1		Fluorescent lamps		LED light sources	
Type of lamps 2		·			
Measurement and cont	trol ( <i>Link to SRI</i> )	DALI- currently not fully exploited	ł	DALI - full use	
System	Descrir	ation - actual building	D	acommendations for improvement	nt
System description	Fluorescent lamp	s, some replaced by LED retrofits.	Instal	I highly effective solutions, new geometry	Υ.
system accomption	Different luminan	ce curve of the luminaire and a	contro	ol, and luminaires with LED light sources	sable
Measurement,	different distributi	ion of light in space.	to dim	nming.	
automation, control	DALI interface (D	igital Addressable Lighting	DALI	interface (Digital Addressable Lighting	
(Link to SRI)	intenace) – not w		merta		
	· · · · ·				
RENEWABLE ENER	RGY [	Description - actual building		Recommendations	
Production	n	0	PV pro	oduction (mono-crystalin)	
Export	n	0	PV pro	oduction (mono-crystalin)	
System	Descrip	otion - actual building	F	Recommendations for improveme	ent
System description	No	~	PV pa	anels: 53+2, Total PV area: 116,8 m2, m	nono-
·			crysta	alin, 6.7 Wh/(m2.a)	
OTHER INFORMAT					
Building name: Address:		Building Parcel No	catego	ory: Office building Cadaster:	
	No of or	ormy cortificato: 00001/5K	0001		
	NO. OF P		_0001/		

# **DESCRIPTION OF BUILDING AND TECHNICAL SYSTEMS / RECOMMENDATIONS FOR IMPROVEMENT 3/3**

### **POTENTIAL ENERGY SAVINGS** AFTER REALIZATION OF RECOMMENDED MEASURES



BUILDING Office building Building category

Service, quantity	Energy Actual state	Energy After renovation	Savings	Savings
	<b>KVVN/(m².a)</b>	KVVN/(m².a)	<b>KWN/(m².a)</b>	<b>%</b>
Energy need - Heating	50.3	21.2	29.1	58%
Energy need - Cooling	22.7	16.5	6.2	27%
Energy need - Lighting	13.5	7.3	6.2	46%
Energy need - Hot water	16.0	7.0	9	56%
Energy use:				
Space heating	66.8	5.2	61.6	92%
Cooling	8.3	2.3	6.1	73%
Air-conditioning				
Ventilation	7.6	3.8	3.8	50%
DHW	17.0	7.2	9.8	58%
Lighting	13.5	7.3	6.2	46%
Pumps (DHW, heating)	1.9		1.9	100%
Final energy use	115.1	25.7	89.4	78%
Non-renewable primary energy (self used produced energy)	165	47.8	117.2	71%
Exported energy	0	1.7	-1.7	100%
Non-renewable primary energy (balance with exported energy)	165	43.8	121.2	73%
CO <sub>2</sub> emissions (export) kg/(m <sup>2</sup> .a):	31.6	8.0	23.6	75%

Energy performance after realization of proposed measures

		EPnren (only for self-used energy)	EPnren (balance with exported energy)	
Non-renewable primary energy kWh EP/(m².a)		48	44	
*Reference energy performance (Ref) =	130	0.37 Ref	0.34 Ref	
		E <sub>pr,use</sub> self-used	E <sub>exp</sub> exported	
Produced renewable energy (on-site) E <sub>pr</sub>	kWh/(m².a)	5.0	1.7	
Energy class		В	Α	
CO <sub>2</sub> emissions	kg/(m².a)	8.7	8.0	
Thermal environment after renovation	Period	Occupied hours	Score /Category	
for standard use	Winter	1093	1.6	
(1=best, 4-worse)	Summer	846	1.5	
	Spring/Fall	542	1.8	
	Overall thermal c	omfort score	1.6	
Building name: Address:	Building category: Parcel No:	y: Office building Cadaster:		
No. of energy certificate: 0	0001/SK_0001/201		DREN	

# **RENOVATION ROADMAP**

## **RENOVATION ROADMAP**

(Derived from RenoMap methodology in ALDREN Building Renovation Passport, task 2.6)

(Optional)

# **Deep renovation potential**

Service	Current state building (kWh//m <sup>2</sup> .y)	Deep renovation building (kWh//m².y)	Savings (%)	
Heating	110	18	83,6%	
Cooling	18	3	83,3%	
Ventilation	8	6	25%	
DHW	24	8	66 ,6%	]
Lighting	18	7	61,1%	
Final energy use	178	42	76,4%	
Renewable production	0	20		Reference Ene
Primary energy balance	220	28	<b>87,3%</b>	Performan
Energy label	G	А		13

# **Primary renovation packages**

			PACKAG	GE EVALU	ATION	CUMULA	TED ENER	RGY SAV	<b>ING</b>	IEQ
#	RENOVATION ACTIONS	OPPORTUNITY	FINAL ENERGY USE [Kwh/m2.y]	PRIMARY ENERGY USE [Kwh/m2.y]	ENERGY SAVINGS - PE [%]	FINAL ENERGY USE [Kwh/m2.y]	PRIMARY ENERGY USE [Kwh/m2.y]	ENERGY SAVINGS - PE [%]		Thermal comfort
	Thermal insulation of bottom floor surfaces	Immediate need of works				155				
Α	Integration of a double-door entrance		155	175	20,5%		175	20,5%	G	
	Blinds and solar protections	Owner will								
В	Renewable energies : Thermal panels	Owner will - potentially immediate	160	200	9,1%	135	150	31,8%	F	
	·									
	Heating : Thermal insulation of distribution network	potentially immediate								
C	DHW : Thermal insulation of the storage		165	190	13 6%	75	95	56.8%	F	
Č	DHW : Thermal insulation of distribution network	potentially immediate	105	150	15,070	15	33	50,0 %	•	
	Cooling : Thermal insulation of distribution network									
D	Renewable energies : Photovoltaïcs	Economy efficiency - potentially immediate	130	160	27,3%	40	55	75,0%	С	

Building name: Address: Building category: Parcel No: Office building Cadaster:

No. of energy certificate: 00001/SK\_0001/2017

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# **MEASURED ENERGY PERFORMANCE**

FOR HEATING AND DHW

### **MEASURED ENERGY FOR HEATING AND DHW**

(INFORMATIVE OR CORRECTED FOR CLIMATE AND USE ACCORDING TO EN 15378-3:2017)

### (Optional)

Heat	ting														
	Parameter		Measured energy (real conditions) kWh/(m <sup>2</sup> .a)												
	Period / date	Jan1 8	Feb 18	Mar 18	Apr1 8	Oct1 8	Nov 18	Dec 18	Jan1 9	Feb 19	Mar 19	Apr1 9	Oct1 9	Nov 19	Dec 19
1000000	Interval hours h	744	672	744	720	744	720	744	744	672	744	720	744	720	744
11111	System operation time h	744	672	744	720	744	720	744	744	672	744	720	744	720	744
	Occupancy %	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Avg external temperature ℃	3.11	-0.79	3.24	15.31	13.87	6.80	2.11	-0.23	4.20	8.15	11.84	12.61	8.23	3.20
	Avg indoor temperature ℃	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	Interval degree- days K.days	462	526	458	81	128	336	492	565	386	305	185	167	293	459
	Meters readin	gs for	interva	I - heat	ting										
	Gas kWh/m²	14.1	14.5	15.2	1.4	6.1	9.6	10.1	16.8	12.4	9.2	5.7	4.7	7.8	10.9
Eн															
	Total kWh/m <sup>2</sup>	14.1	14.5	15.2	1.4	6.1	9.6	10.1	16.8	12.4	9.2	5.7	4.7	7.8	10.9

#### Example from pilot building

Description of measurement:

-period between meters readings - months

-Meters readings devices - invoice

- indoor temperature (weighted average)

- external temperature (Eurostat)

Calculated energy for heating (gas) (standard climate and use)	62.1	kWh/(m².a)			Design power kW	
Corrected measured energy for heating (climate and use) EN 15378-3:2017 <sup>1)</sup>	73.3	kWh/(m².a)	Difference from calculation in %	18%	Power kW	

NOTE 1: The procedures for data collection, data quality verification, normalization are set for heating in EN 15378-3:2017. Method can be used for verification of energy performance after construction asked by some national and voluntary schemes. The design energy signature is built using the procedure of EN 15378-3 with calculated data.

NOTE 2: the same procedure may be applied to electricity. This will show the electricity use for ventilation and cooling



500

600

# **MEASURED ENERGY FOR HEATING AND DHW**

### (INFORMATIVE OR CORRECTED FOR CLIMATE AND USE ACCORDING TO EN 15378-3:2017)

(Optional)

Service		Parameter			Measured	energy (re	al conditio	ons) kWh/(m <sup>4</sup>	².a)	
Description of meas	surement.	Period / date	P1	P2	P3	P4	P5	P5	P6	Pj
Description of meas	,	Interval hours h								
-period between meters		System								
readings (year, mo	days)									
-Motors readings de	wices	Occupancy %								
<ul> <li>- indoor temperature (weighted average)</li> <li>- external temperature (average</li> </ul>		Avg external								
		temperature ℃								
		Avg indoor								
for interval)	<b>. . .</b>	temperature °C								
- number of days wi	ith service	Interval degree-								
-occupancy %,		days								
Meters readings	for interval									
Heating	E <sub>H;cr,i</sub>	Carrier 1								
		Carrier j								
		Total								
Corrected measur (climate and use)	ed energy for EN 15378-3:20	kWh/(m	kWh/(m <sup>2</sup> .a) Difference from calculation in %		from in %	Design maximum power in kW				

NOTE 1: The procedures for data collection, data quality verification, normalization are set for heating in EN 15378-3:2017. Method can be used for verification of energy performance after construction asked by some national and voluntary schemes. The design energy signature is built using the procedure of EN 15378-3 with calculated data.

NOTE 2: the same procedure may be applied to electricity. This will show the electricity use for ventilation and cooling



### **MEASURED ENERGY – BUILDINGS WITH SPECIFIC MEASUREMENT PROVISIONS**

### (INFORMATIVE OR CORRECTED FOR CLIMATE AND USE ACCORDING TO EN 15378-3:2017)

#### (Optional)

#### Alternative 1

#### Measured delivered energy energy per service – informative

	Symbol	Carrier	per e	Measure energy carri	ed delivered er and per conditions	d energy service – a	actual	Calculated (standard conditions)	Difference
Period / year			P1	P2	P3	Ave	rage		
Unit			kWh	kWh	kWh	kWh	kWh/m²a	kWh/(m².a)	%
Heating www	E <sub>H;cr,i</sub>	Carrier 1							
ЩЩ		Carrier 2							
Humidification		Total							
Cooling	Ec;cr,i	Carrier 1							
7.Fr		Carrier j							
Dehumidification		Total							
Ventilation	Ev;cr,i	Carrier j							
602		Total							
DHW 🔸	Ew;cr,i	Carrier j							
		Carrier j							
-		Total							
Lighting	E <sub>L;el</sub>	Electricity							
Other 💦	Eo;cr,i	Carrier 1							
(e.g. auxiliary) 🛛 🍟	E <sub>O;cr,i</sub>	Carrier j							
		Total							
Total									

### On site renewable energy production – informative

Electricity					
Produced energy	Eexp;cr,k				
Used energy					
Exported energy	Eexp;cr,k				

Thermal solar

Produced energy	Eexp;cr,k				
Used energy					
Exported energy	Eexp;cr,k				

Other:

Produced energy	Eexp;cr,k				
Used energy					
Exported energy	Eexp;cr,k				
					-

#### Notes

For the definition of Measured energy (corrected for climateand use) see Table B.9 Clauses 6 and 9 in EN ISO 52000-1:2017 This assessment is possible only in case the proper measurement and BACS are installed (e.g. Smart buildings) to allocate delivered energy carriers to each service. Use sheet "MEASURED ENERGY – BUILDINGS WITHOUT SPECIFIC MEASUREMENT PROVISIONS" if such provisions are not available

Air conditioning means the provision of internal humidity control. This is shown by inclusion of humidification and/or dehumidification under heating and cooling respectively.

The comparison of actual versus calculated measured energy can be used for comparison of actual energy performance versus designed energy performance after construction asked by some national and voluntary schemes.

Normalization methods for all influence factors are not available and consolidated for all services. Only average from minimal 3 years measurements is used to reduce the impact of influencing factors.

Building name: Address: Building category: Parcel No: Office building Cadaster:

No. of energy certificate: 00001/SK\_0001/2019

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### **MEASURED ENERGY – BUILDINGS WITHOUT SPECIFIC MEASUREMENT PROVISIONS**

### (INFORMATIVE OR CORRECTED FOR CLIMATE AND USE ACCORDING TO EN 15378-3:2017)

#### (Optional)

#### Alternative 2

### Measured delivered energy energy per service – informative <sup>1</sup>

		S	ervice	provide	ed								
Carrier	± □ ₫	₩	C □ Dhu ₩	V 🛞	L	0	per e	Measure energy ca	d delivere rrier – act	d energy ual cond	, itions	Calculated <sup>2</sup> (standard conditions)	Difference
Period / year							P1	P2	P3	Ave	erage		
Unit							kWh	kWh	kWh	kWh	kWh/m²a	kWh/(m².a)	%
<sup>3</sup> Electricity													
<sup>3</sup> Gas													
	1												
<sup>3</sup> Oil													
3-4													

### On site renewable energy production – informative

### Electricity

Produced energy	Eexp;cr,k				
Used energy					
Exported energy	E <sub>exp;cr,k</sub>				

Thermal solar					
Produced energy	E <sub>exp;cr,k</sub>				
Used energy					
Exported energy	E <sub>exp;cr,k</sub>				

Other:

Produced energy <i>E</i> <sub>exp;cr,k</sub> Image: Comparison of the second se	ouldr					
Used energy Sector Sect	Produced energy	Eexp;cr,k				
Exported anoraly E	Used energy					
Exported energy Eexp;cr,k	Exported energy	Eexp;cr,k				

#### Notes

- <sup>1)</sup> Measured, energy, not corrected for climateand use
- <sup>2)</sup> Calculated energy for the same services as the measured energy (adapt calcuation to available metering)
- <sup>3)</sup> Use one row for each main meter / sub-meter available. The first row shall be the main meter at the delivery point. Each meter / sub-meter may provide different services
- <sup>4)</sup> Use this for any extra

The comparison of actual versus calculated measured energy can be used for comparison of actual energy performance versus designed energy performance after construction asked by some national and voluntary schemes.

Air conditioning means the provision of internal humidity control. This is shown by inclusion of humidification and/or dehumidification under heating and cooling respectively.

Normalization methods for all influence factors are not available and consolidated for all services. Only average from minimal 3 years measurements is used to reduce the impact of influence factors.

Building name: Address: Building category: Parcel No: Office building Cadaster:

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### 4 Description of calculation methodology based on Annex A to EN ISO 52000-1:2017

The EU voluntary energy performance certificate (EVC) developed under H2020 project ALDREN requires to use the European EPB standards developed under mandate M/480 given to the European Committee for Standardisation (CEN) for assessment of energy performance of non-residential buildings (offices, hotels)

Annex A "Input and method selection data sheet" to the EPB standards is an empty template that can be filled in with the national or regional data and choices or by choices for specific application. The template in Annex A to the standard shall be used to specify the choices between methods, the required input data and references to other standards.

Annex B to the standard "Input and method selection data sheet — Default choices" is informative and provides the recommended options for choices.

This section provides inputs for development of Annex A to EN ISO 52000-1:2017 [6] for description of the specific choices for calculation methodology for assessment of energy performance of non-residential buildings (offices, hotels) for EVC developed under H2020 project ALDREN.

Only choices for Annex A to EN ISO 52000-1:2017 [6], that are different for this specific application from the default informative choices in Annex B, are presented.

### Annex A - Input and method selection data sheet

### A.3 Overarching preparation steps

Table A.2 — Energy performance assess	nent types according to	building category and	application (5.3):
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Application:	Energy performance certificate a)
Building category:	office buildings, hotels
Assessment type:	As built type
Condition:	Existing building
Application:	Energy performance certificate a) - recommendations
Building category:	office buildings, hotels
Assessment type:	Design type
Conditions:	Prediction for stage after renovation reported in EVC

Note: a) European common voluntary certificate (EVC) developed under ALDREN H2020 project

#### Table A.3 — Object types (Clause 6 and 10.1):

Description	Subset <sup>b</sup>
Whole building	1
New building design	2
Existing building (all cases)	2
Non-residential building	3
Large public building	4
Other	4

Table A.4 — Building categories (Clauses 6 and 9)

Offices Hotels and restaurants

#### Table A.5 — Which building categories are included in EPB assessment (6.2.2)

Office buildings Hotels and restaurants – Comments: hosting functions All spaces inside the heat exchange envelope of building (see A.21)

### Table A.7 — Space categories (Clauses 6 and 9)

Different conditions of use may be set for the spaces for the day/night use in hotels as a group, or for individual hotel rooms, office spaces, lobbies, corridors, meeting rooms. Only hosting use is included for hotels.

#### Table A.8 — Application types (Clauses 6, 9 and 10.1)

Energy performance certification

#### Table A.9 — EPB assessment types (Clauses 6 and 9)

Calculated, design (prediction reported in certification of EP after application of recommended renovation measures) Calculated, as built

Measured, standard (corrected for climate and use)

#### Table A.10 — Combination services types (Clauses 6 and 9)

Services included for the EPB assessment of non-residential buildings

### A.4 Method

Table A.11 — Electricity use types (7.3.3.4.)

Main input to a generator Auxiliary energy Direct heating (Joule effect)

#### Table A.12 — Electricity generation types (7.3.3.6 and 9.6.6.2.4)

Photovoltaic Wind turbine Cogeneration

### Table B.16 — Weighting factors (based on gross or net calorific value)

Note (to District heating): The values reported by specific heat producer based on national reporting rules maybe used.

#### Table A.17 — kexp-factor (See 7.3.5 and 11.6.2.1)

 $k_{exp}$  factor that is used to control which part of the exported energy is included in the energy performance of the building

Main indicator (main energy class) $k_{exp} = 1$ Secondary indicator (energy class) $k_{exp} = 0$ 

#### Table A.18 — Building services considered in the energy performance calculation (8.2 and 8.5)

As in Table B.18 column for non-residential

#### Table A.19 — Principle assumed presence of systems (9.2)

Principle "Presence of system"

#### Table A.21 — Type or types of metric for the building size (9.3 and 9.4)

Reference floor area in m<sup>2</sup> specification:

**Gross internal area (GIA)**, that is the floor area contained within the building measured to the internal face of the external walls ignoring the internal partitions (using the "overall internal dimensions"). The external walls define the heat exchange envelope of building so that the reference floor area is coherent with the thermal losses calculation.

The rules and examples in the International Property Measurement Standards (IPMS) as developed by the International Property Measurement Standards Coalition (IPMSC) for Office buildings, IPMS 2 can be used for specific cases while the spaces outside the considered thermal envelope for losses calculation are excluded (e.g. **unheated basement with garage**) https://ipmsc.org/standards/office/

#### Table A.22 — Which space categories are contributing to the reference size (9.4)

As in table B.22 in case the space is located inside the heat exchange envelope (See A.21). Hospital rooms, theatre or cinema, sport facilities thermally unconditioned, adjacent spaces are excluded if can be extracted from heat exchange envelope. Heated or cooled storage space and engine rooms are included in case the space is located inside the heat exchange envelope. Individual garage or collective indoor car park is excluded.

### 5 References

- [1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast). Official Journal of the European Union, 18(06), 2010 and 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,
- [2] COMMISSION DELEGATED REGULATION (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements (Text with EEA relevance)
- [3] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements (2012/C 115/01)
- [4] COMMISSION RECOMMENDATION (EU) 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings
- [5] COMMISSION DELEGATED REGULATION (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements (Text with EEA relevance)
- [6] EN ISO 52000-1:2017 Energy performance of buildings Overarching EPB assessment Part 1: General framework and procedures,
- [7] EN ISO 52003-1:2017 Energy performance of buildings Indicators, requirements, ratings and certificates -Part 1: General aspects and application to the overall energy performance
- [8] ISO/TR 52003-2:2017 Energy performance of buildings Indicators, requirements and certification Part 2:Explanations and justifications for ISO 52003-1
- [9] EN 16798-1: 2018 Energy performance of buildings Ventilation of buildings Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.
- [10] EN 15378-3:2017 Energy performance of buildings Heating and DHW systems in buildings Part 3: Measured energy performance
- [11] neZEH reports, http://www.nezeh.eu/library/nezeh\_reports/index.html
- [12] Zirngibl J., Bendzalova J. Definition of an Energy Performance Scale for the "Voluntary EU certification for nonresidential buildings, Stakeholders consultation, Tender ENER/C3/2011/SI2.602654, January 2012 <u>http://www.buildup.eu/fr/node/43787</u>
- [13] Bendzalova J., "Specific criteria related to the label (display) and the content of energy performance certificate", presentation in Workshop public consultation, "Enabling the European Common Voluntary Certification Scheme for non-residential buildings" (Service contract no. ENER/C3/2015-545/SID.710527), Paris, April 2016