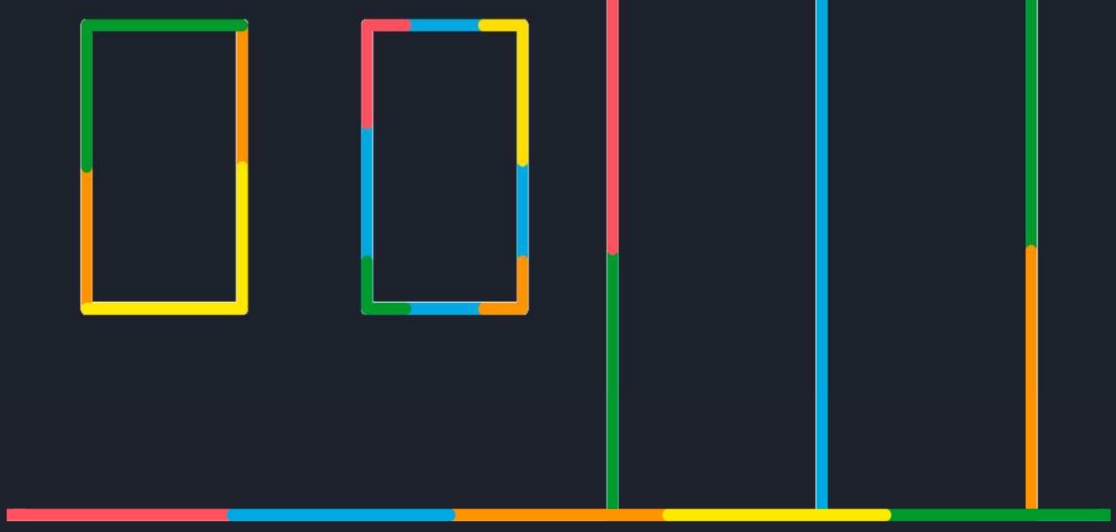
D2.2 - ALDREN Methodology note on energy rating procedure

ANNEX C
EUROPEAN VOLUNTARY CERTIFICATE



Project resume:

Start: 1 November 2017
End: 30 September 2020

Coordinator:

- **CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT** **France**

Participants:

- ENBEE Slovakia
- INSTITUTO VALENCIANO DE LA EDIFICACION Spain
- CERTIVEA France
- REHVA EU
- VERCO ADVISORY SERVICES LIMITED United Kingdom
- DANMARKS TEKNISKE UNIVERSITET Denmark
- POLITECNICO DI MILANO Italy

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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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Content

Abbreviations

CEN	the European Committee for Standardization
CO	Cost optimal level of energy performance of buildings
EPB standards	EN and ISO standards for the energy performance of building calculation developed under the European Commission's Mandate M/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

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

Hotels

Climate zone	ALDREN REF	ALDREN NZEB
Warm	**200**	70
Moderate	**270**	95
Cold	**310**	109

Table 1 Reference values (REF) for ALDREN scale expressed in kWh/(m^2.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.

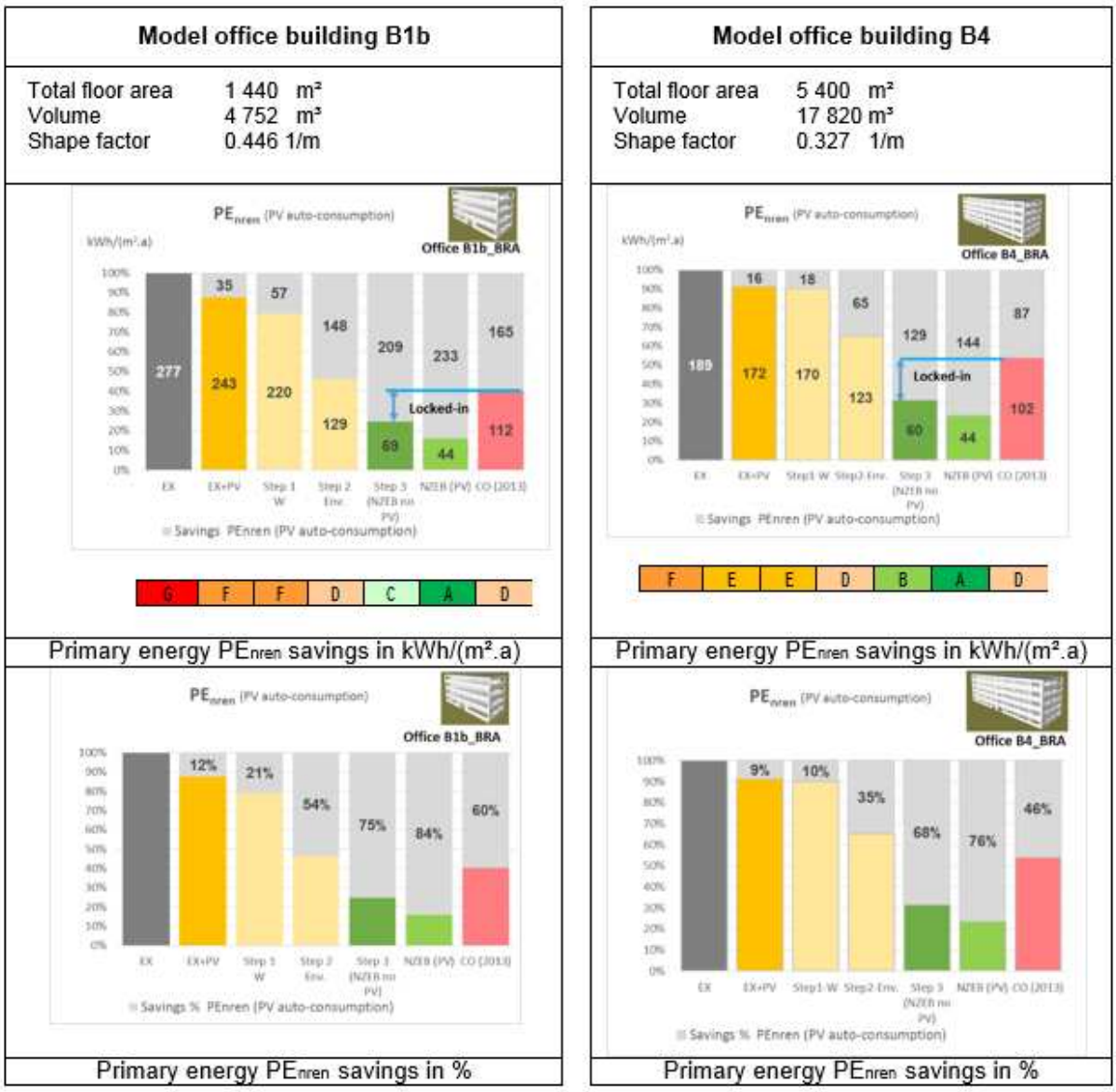


Figure 1 Example of ALDREN energy classes transition and energy savings by step-by step renovation from existing building (EX) to NZEB or to the CO level (2013) for two model office buildings in Bratislava

2. The overview of the content of EVC

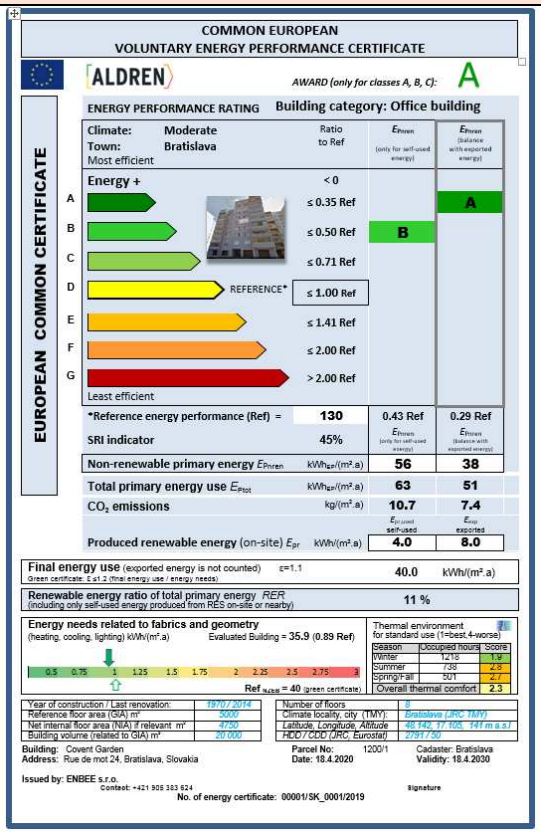
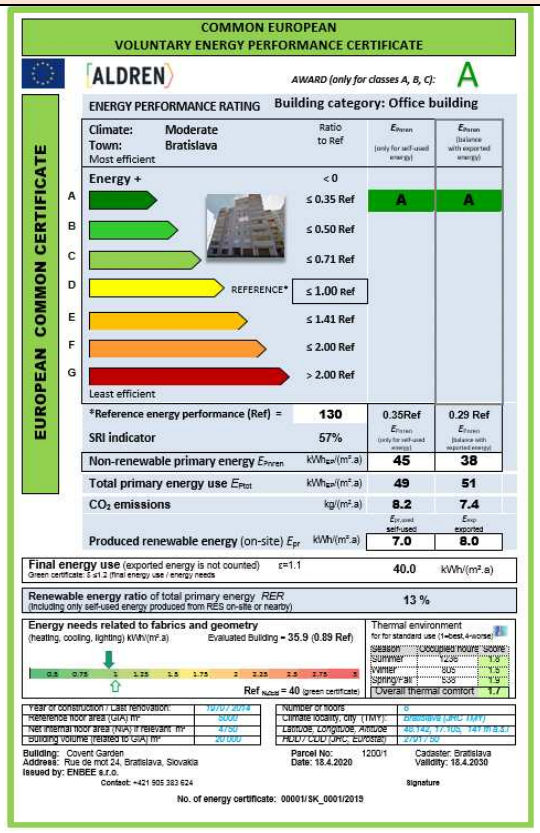
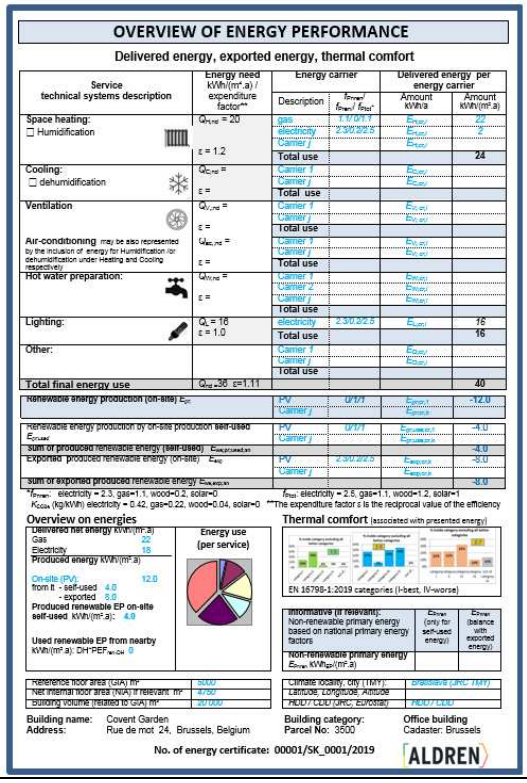
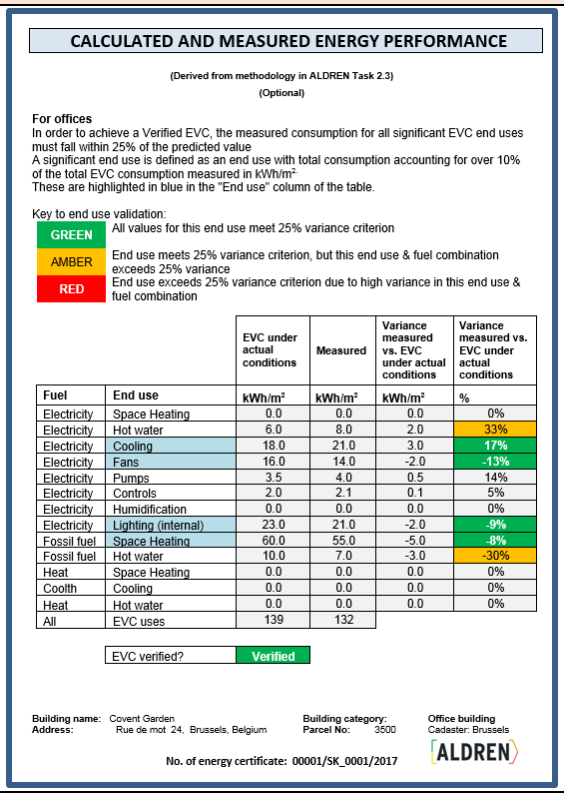
THE MAIN RESULTS, ENERGY PERFORMANCE AND RATINGS	
	
Page 1 – Energy performance certificate and Energy label	Page 1 (optional) – Energy performance certificate – **only for ALDREN NZEB** - h**ighlighting the high performing (green) building**
	
	Page 2 – Overview of energy performance

Figure 2 The main pages of the EVC template

ADDITIONAL ALDREN INDICATORS



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/m²
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	End use meets 25% variance criterion, but this end use & fuel combination exceeds 25% variance
RED	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/m²	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: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2017

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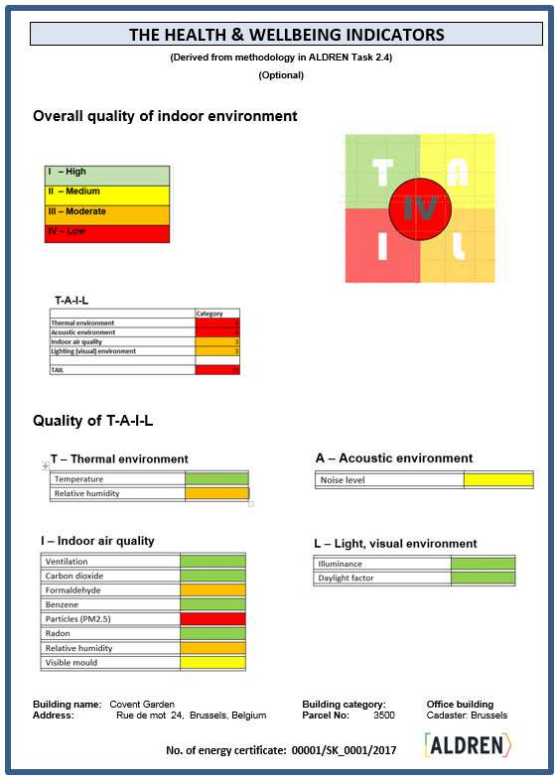
Page 3 – Gap between Calculated and measured energy performance



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

Thermal environment
Acoustic environment
Indoor air quality
Lighting (visual) environment
TAIL

Quality of T-A-I-L

T – Thermal environment
Temperature
Relative humidity

A – Acoustic environment
Noise level

I – Indoor air quality
Ventilation
Carbon dioxide
Formaldehyde
Benzene
Particles (PM2.5)
Radon
Relative humidity
Visible mould

L – Light, visual environment
Illuminance
Daylight factor

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2017

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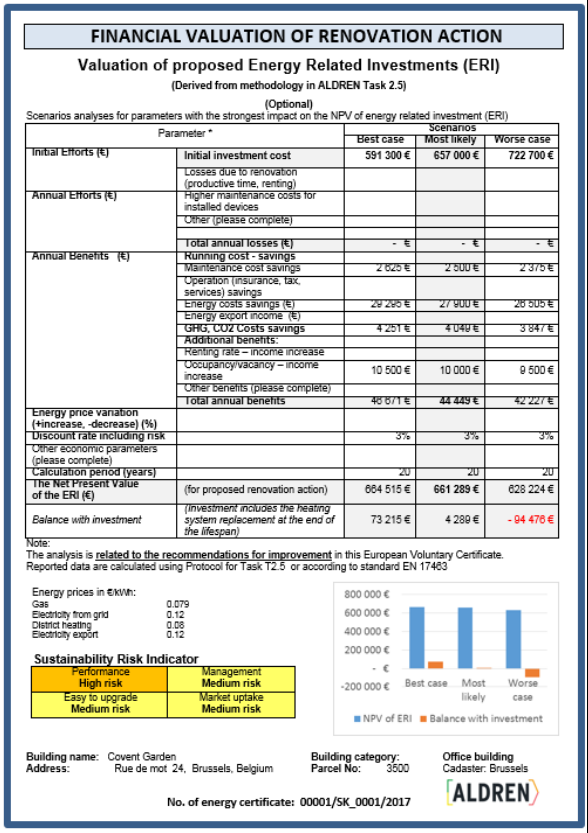
Page 4 - The health & wellbeing indicators



FINANCIAL VALUATION OF RENOVATION ACTION

Valuation of proposed Energy Related Investments (ERI)

(Derived from methodology in ALDREN Task 2.5)

(Optional)

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

Parameter *		Scenarios 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 (€)	- €	- €	- €
Annual Benefits (€)	Running cost - savings			
	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:

Gas	0.079
Electricity from grid	0.12
District heating	0.08
Electricity export	0.12

Sustainability Risk Indicator

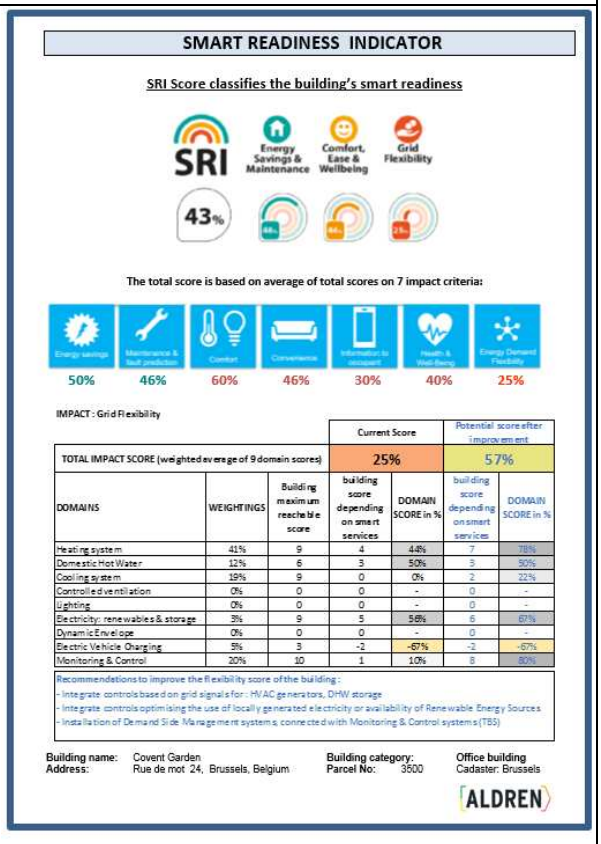
Performance High risk	Management Medium risk
Easy to upgrade Medium risk	Market uptake Medium risk

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2017

ALDREN

Page 5 - Financial valuation of renovation action



SMART READINESS INDICATOR

SRI Score classifies the building's smart readiness

SRI
Energy Savings & Maintenance
Comfort, Ease & Wellbeing
Grid Flexibility
43%

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

50% 46% 60% 46% 30% 40% 25%

IMPACT : Grid Flexibility

			Current Score		Potential score after improvement	
TOTAL IMPACT SCORE (weighted average of 9 domain 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: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
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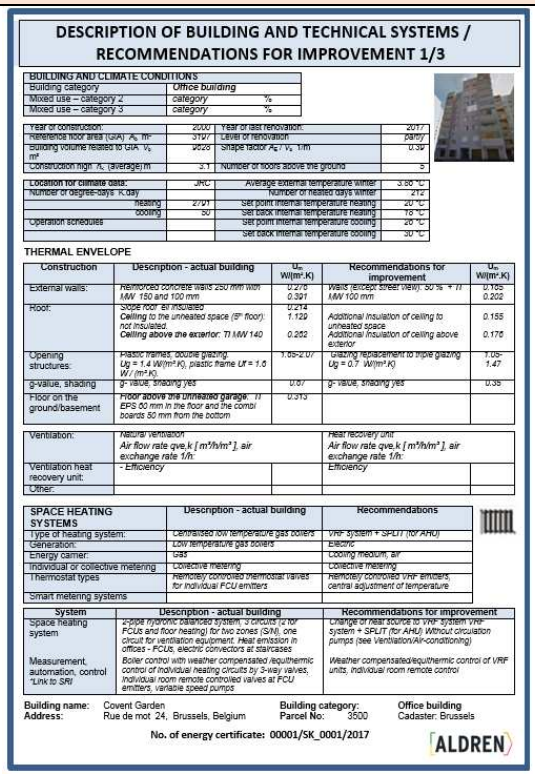
Page 6 - Smart readiness indicator– page can be repeated for next aspects

Figure 3 The additional indicators

DESCRIPTION / RECOMMENDATIONS FOR IMPROVEMENT OF BUILDING AND TECHNICAL SYSTEMS



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

BUILDING AND CLIMATE CONDITIONS

Building category	Office building		
Mixed use – category 2	category	%	
Mixed use – category 3	category	%	
Year of construction	2000	Year of last renovation:	2017
Reference floor area (SRA) A_f m²	3707	Level of renovation	partial
Building volume related to GFA V_e m³	9628	Shape factor A_E / V_e 1/m	0.39
Construction high h_s (average)m	2.1	Number of floors above the ground	5
Location for climate data:	JRC	Average external temperature winter	3.80 °C
Number of degree-days °K.day		Number of heated days winter	212
heating	2701	Set point internal temperature heating	20 °C
cooling	50	Set back internal temperature heating	16 °C
Operation schedules		Set point internal temperature cooling	26 °C
		Set back internal temperature cooling	30 °C

THERMAL ENVELOPE

Construction	Description - actual building	U_w W/(m².K)	Recommendations for improvement	U_w W/(m².K)
External walls:	Reinforced concrete walls 250 mm with MW 150 and 100 mm	0.276 0.391	Walls (except street view): 50 % + 11 MW 100 mm	0.155 0.202
Roof:	Slope roof: as insulated Ceiling to the unheated space (5th floor): not insulated Ceiling above the exterior: 11 MW 140	0.214 1.129 0.252	Additional insulation of ceiling to unheated space Additional insulation of ceiling above exterior	0.155 0.176
Opening structures:	Plastic frames, double glazing: Ug = 1.4 W/(m².K), plastic frame Uf = 1.6 W / (m².K)	1.65-2.07	Glazing replacement to triple glazing Ug = 0.7 W/(m².K)	1.05-1.47
g-value, shading	g- value, shading yes	0.67	g- value, shading yes	0.35
Floor on the ground/basement	Floor above the unheated garage: 11 EPS 50 mm in the floor and the combi boards 50 mm from the bottom	0.313		

Ventilation:	Natural ventilation Air flow rate $q_{v,e,k}$ [m³/h/m²], air exchange rate 1/h:		Heat recovery unit Air flow rate $q_{v,e,k}$ [m³/h/m²], air exchange rate 1/h:
Ventilation heat recovery unit:	- Efficiency		Efficiency
Other:			

SPACE HEATING SYSTEMS	Description - actual building	Recommendations
Type of heating system:	Centralized low temperature gas boilers	VRF System + SPLIT (for AHU)
Generation:	Low temperature gas boilers	Electric
Energy carrier:	Gas	Cooling medium, air
Individual or collective metering	Collective metering	Collective metering
Thermostat types	Remotely controlled thermostat valves for individual FCU emitters	Remotely controlled VRF emitters, central adjustment of temperature
Smart metering systems		

System	Description - actual building	Recommendations for improvement
Space heating system	2-pipe hydronic balanced system, 3 circuits (2 for FCUs and floor heating) for two zones (SW), one circuit for ventilation equipment. Heat emission in offices - FCUs, electric convectors at staircases	Change of heat source to VRF system VRF System + SPLIT (for AHU) Without circulation pumps (see Ventilation/Air-conditioning)
Measurement, automation, control "Link to SRI"	Boiler control with weather compensated /equithermic control of individual heating circuits by 3-way valves, individual room remote controlled valves at FCU emitters, variable speed pumps	Weather compensated/equithermic control of VRF units, individual room remote control

Building name: Covent Garden **Building category:** Office building
Address: Rue de mot 24, Brussels, Belgium **Parcel No:** 3500 **Cadaster:** Brussels

No. of energy certificate: 00001/SK_0001/2017

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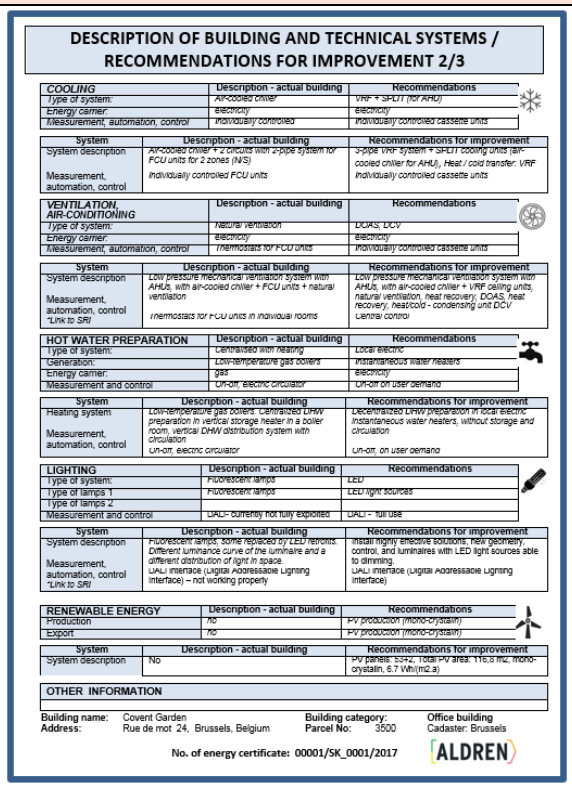
Page 7 – Recommendations for improvement 1/3



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

COOLING	Description - actual building	Recommendations
Type of system:	Air-cooled chiller	VRF + SPLIT (for AHU)
Energy carrier:	electricity	electricity
Measurement, automation, control	individually controlled	individually controlled cassette units

System	Description - actual building	Recommendations for improvement
System description	Air-cooled chiller + 2 circuits with 2-pipe system for FCU units for 2 zones (N/S)	3-pipe VRF System + SPLIT cooling units (air-cooled chiller for AHU), Heat / cold transfer: VRF
Measurement, automation, control	Individually controlled FCU units	Individually controlled cassette units

VENTILATION, AIR-CONDITIONING	Description - actual building	Recommendations
Type of system:	Natural ventilation	DCAS, DCV
Energy carrier:	electricity	electricity
Measurement, automation, control	Thermostats for FCU units	Individually controlled cassette units

System	Description - actual building	Recommendations for improvement
System description	Low pressure mechanical ventilation system with AHUs, with air-cooled chiller + FCU units + natural ventilation	Low pressure mechanical ventilation system with AHUs, with air-cooled chiller + VRF ceiling units, natural ventilation, heat recovery, DCAS, heat recovery, heat/cold - condensing unit DCV
Measurement, automation, control "Link to SRI"	Thermostats for FCU units in individual rooms	Central control

HOT WATER PREPARATION	Description - actual building	Recommendations
Type of system:	Centralized with heating	Local electric
Generation:	Low-temperature gas boilers	Instantaneous water heaters
Energy carrier:	gas	electricity
Measurement and control	On-off, electric circulator	On-off on user demand

System	Description - actual building	Recommendations for improvement
Heating system	Low-temperature gas boilers. Centralized DHW preparation in vertical storage heater in a boiler room, vertical DHW distribution system with circulation	Decentralized DHW preparation in local electric instantaneous water heaters, without storage and circulation
Measurement, automation, control	On-off, electric circulator	On-off, on user demand

LIGHTING	Description - actual building	Recommendations
Type of system:	Fluorescent lamps	LED
Type of lamps 1	Fluorescent lamps	LED light sources
Type of lamps 2		
Measurement and control	DALI - currently not fully exploited	DALI - full use

System	Description - actual building	Recommendations for improvement
System description	Fluorescent lamps, some replaced by LED retrofits. Different luminance curve of the luminaire and a different distribution of light in space.	Install highly effective solutions, new geometry, control, and luminaires with LED light sources able to dimming.
Measurement, automation, control "Link to SRI"	DALI interface (Digital Addressable Lighting Interface) – not working properly	DALI interface (Digital Addressable Lighting Interface)

RENEWABLE ENERGY	Description - actual building	Recommendations
Production	no	PV production (mono-crystalin)
Export	no	PV production (mono-crystalin)

System	Description - actual building	Recommendations for improvement
System description	No	PV panels: 3.042, Total PV area: 116,6 m2, mono-crystalin, 6.7 Wh/m2.a)

OTHER INFORMATION

Building name: Covent Garden **Building category:** Office building
Address: Rue de mot 24, Brussels, Belgium **Parcel No:** 3500 **Cadaster:** Brussels

No. of energy certificate: 00001/SK_0001/2017

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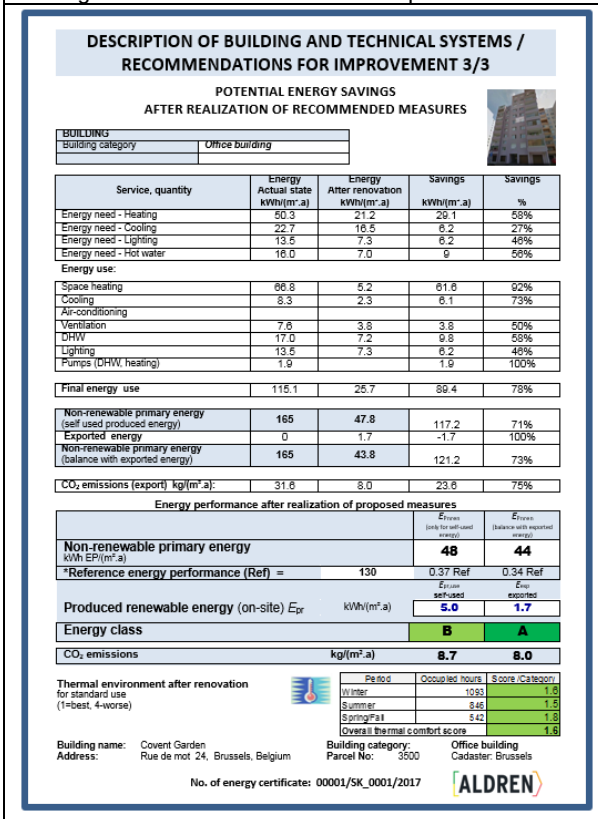
Page 8 – Recommendations for improvement 2/3



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

POTENTIAL ENERGY SAVINGS AFTER REALIZATION OF RECOMMENDED MEASURES

BUILDING	
Building category	Office building

Service, quantity	Energy Actual state kWh/(m².a)	Energy After renovation kWh/(m².a)	Savings kWh/(m².a)	Savings %
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_2 emissions (export) kg/(m².a):	31.6	8.0	23.6	75%

Energy performance after realization of proposed measures

		E_{Pnren} (only for self-used energy)	E_{Pnren} (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
		$E_{Pl,use}$ self-used	E_{Pexp} exported
Produced renewable energy (on-site) E_{Pr}	kWh/(m².a)	**5.0**	**1.7**
Energy class		**B**	**A**
CO_2 emissions	**kg/(m².a)**	**8.7**	**8.0**

Thermal environment after renovation for standard use (1=best, 4-worse)

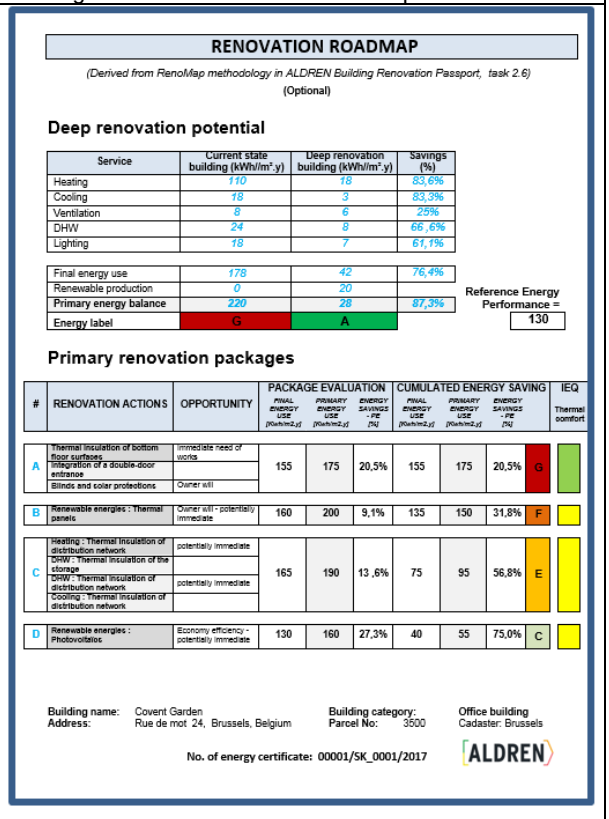
Period	Occupied hours	Score /Category
Winter	1093	1.6
Summer	846	1.5
Spring/Fall	542	1.8
Overall thermal comfort score		1.6

Building name: Covent Garden **Building category:** Office building
Address: Rue de mot 24, Brussels, Belgium **Parcel No:** 3500 **Cadaster:** Brussels

No. of energy certificate: 00001/SK_0001/2017

ALDREN

Page 9 – Recommendations for improvement 3/3
Calculation of potential energy savings



RENOVATION ROADMAP

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

(Optional)

Deep renovation potential

Service	Current state building (kWh/m².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	
Primary energy balance	220	28	87,3%
Energy label	G	A	

Reference Energy Performance = 130

Primary renovation packages

#	RENOVATION ACTIONS	OPPORTUNITY	PACKAGE EVALUATION: FINAL ENERGY USE [Kwh/m2.y]	PACKAGE EVALUATION: PRIMARY ENERGY USE [Kwh/m2.y]	PACKAGE EVALUATION: ENERGY SAVINGS - PE [%]	CUMULATED ENERGY SAVING: FINAL ENERGY USE [Kwh/m2.y]	CUMULATED ENERGY SAVING: PRIMARY ENERGY USE [Kwh/m2.y]	CUMULATED ENERGY SAVING: ENERGY SAVINGS - PE [%]	IEQ	Thermal comfort
A	Thermal insulation of bottom floor surfaces Integration of a double-door entrance Blinds and solar protections	immediate need of works Owner will	155	175	20,5%	155	175	20,5%	G	
B	Renewable energies : Thermal panels	Owner will - potentially immediate	160	200	9,1%	135	150	31,8%	F	
C	Heating : Thermal insulation of distribution network DHW : Thermal insulation of the storage DHW : Thermal insulation of distribution network Cooling : Thermal insulation of distribution network	potentially immediate potentially immediate	165	190	13 ,6%	75	95	56,8%	E	
D	Renewable energies : Photovoltaïc	Economy efficiency - potentially immediate	130	160	27,3%	40	55	75,0%	C	

Building name: Covent Garden **Building category:** Office building
Address: Rue de mot 24, Brussels, Belgium **Parcel No:** 3500 **Cadaster:** Brussels

No. of energy certificate: 00001/SK_0001/2017

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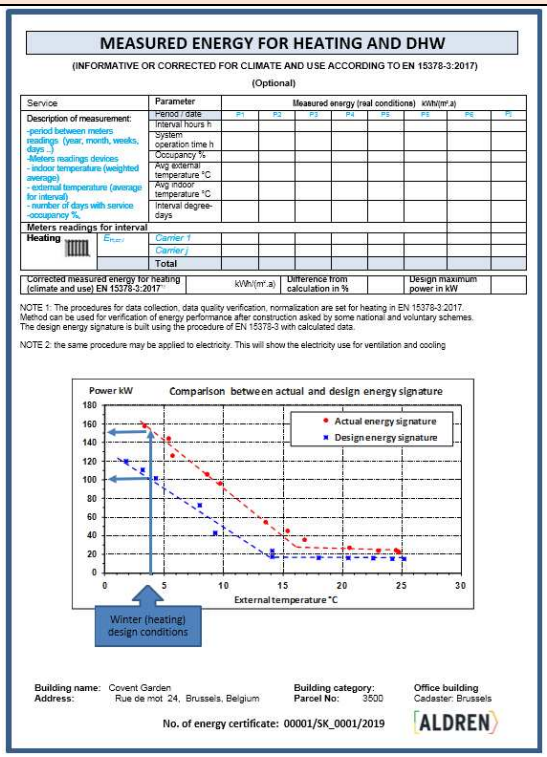
Page 10 - Detailed renovation roadmap RenoMap
towards NZEB to avoid lock-in effect

Figure 4 Recommendations for improvement of EP (link to RenoMap)

MEASURED ENERGY – BUILDING IN-USE - OPTIONAL



MEASURED ENERGY FOR HEATING AND DHW

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

(Optional)

Service	Parameter	Measured energy (real conditions) kWh/(m².a)							
Description of measurement: -period between meters readings (year, month, weeks, days ..) -Meters readings devices - indoor temperature (weighted average) - external temperature (average for interval) - number of days with service -occupancy %	Period / date	P1	P2	P3	P4	P5	P6	P7	P8
	Interval hours h								
	System operation time h								
	Occupancy %								
	Avg external temperature °C								
	Avg indoor temperature °C								
	Interval degree-days								
Meters readings for interval									
Heating $E_{H,del,i}$	Carrier 1								
	Carrier j								
	Total								

Corrected measured energy for heating (climate and use) EN 15378-3:2017	kWh/(m².a)	Difference from calculation 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.

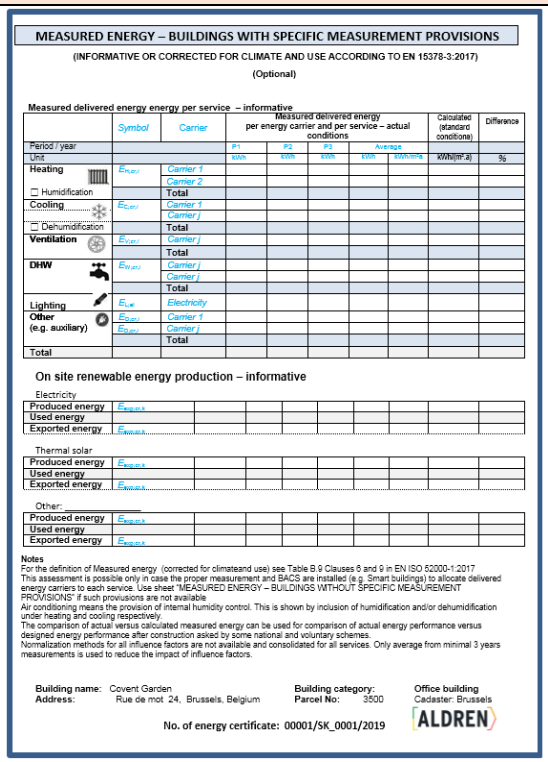
NOTE 2: the same procedure may be applied to electricity. This will show the electricity use for ventilation and cooling

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2019

ALDREN

Page 11 – Measured energy for heating and DHW (optional)



MEASURED ENERGY – BUILDINGS WITH SPECIFIC MEASUREMENT PROVISIONS

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

(Optional)

Measured delivered energy energy per service – informative

	Symbol	Carrier	Measured delivered energy per energy carrier and per service – actual conditions					Calculated (standard conditions)	Difference
Period / year			P1	P2	P3	Average			
Unit			kWh	kWh	kWh	kWh/m²	kWh/m³/a	kWh/(m².a)	%
Heating	$E_{H,del,i}$	Carrier 1							
		Carrier 2							
☐ Humidification		Total							
Cooling	$E_{C,del,i}$	Carrier 1							
		Carrier j							
☐ Dehumidification		Total							
Ventilation	$E_{V,del,i}$	Carrier j							
		Total							
DHW	$E_{W,del,i}$	Carrier j							
		Carrier j							
		Total							
Lighting	$E_{L,el}$	Electricity							
Other (e.g. auxiliary)	$E_{Aux,i}$	Carrier 1							
	$E_{Aux,i}$	Carrier j							
		Total							
Total									

On site renewable energy production – informative

Electricity										
Produced energy	$E_{exp,el,k}$									
Used energy										
Exported energy	$E_{exp,el,k}$									
Thermal solar										
Produced energy	$E_{exp,th,k}$									
Used energy										
Exported energy	$E_{exp,th,k}$									
Other: _____										
Produced energy	$E_{exp,x,k}$									
Used energy										
Exported energy	$E_{exp,x,k}$									

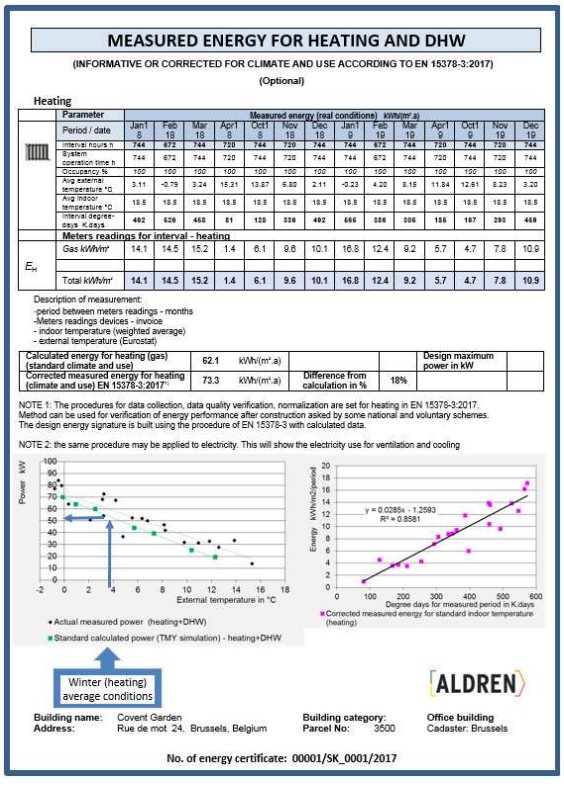
Notes
For the definition of Measured energy (corrected for climateand use) see Table B.9 Clauses 6 and 9 in EN ISO 52000-1:2017
This assessment is possible only in case the proper measurement and BACS are installed (e.g. Smart buildings) to allocate delivered energy carriers to each service. Use sheet "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 influence factors.

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2019

ALDREN

Page 12 (**alternative 1**) – Measured energy – buildings **with** specific measurements provisions (optional)



MEASURED ENERGY FOR HEATING AND DHW

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

(Optional)

Heating

	Parameter	Measured energy (real conditions) kWh/(m².a)												
	Period / date	Jan18	Feb 18	Mar 18	Apr18	Oct18	Nov 18	Dec 18	Jan19	Feb 19	Mar 19	Apr19	Oct19	Nov 19	Dec 19
	Interval hours h	744	672	744	720	744	720	744	744	672	744	720	744	720	744
	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 °C	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 °C	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	468	81	128	336	492	586	386	306	186	167	293	459
	Meters readings for interval - heating														
E_H	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
	Total 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

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 maximum power in kW	
Corrected measured energy for heating (climate and use) EN 15378-3:2017	73.3	kWh/(m².a)	Difference from calculation in %	18%		

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

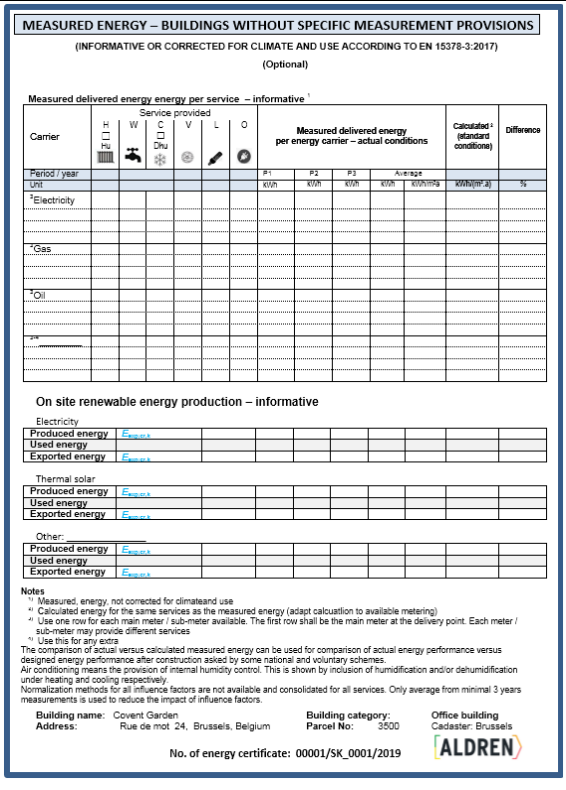
Winter (heating) average conditions

ALDREN

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2017

Page 8 – Measured energy – example of reporting (pilot building) (optional)



MEASURED ENERGY – BUILDINGS WITHOUT SPECIFIC MEASUREMENT PROVISIONS

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

(Optional)

Measured delivered energy energy per service – informative [1]

Carrier	Service provided: H ☐ Hu	W	C ☐ Dhu	V	L	O	Measured delivered energy per energy carrier – actual conditions					Calculated [2] (standard conditions)	Difference
Period / year							P1	P2	P3	Average			
Unit							kWh	kWh	kWh	kWh	kWh/m²a	kWh/(m².a)	%
[3]Electricity													
[3]Gas													
[3]Oil													
[3]_____													

On site renewable energy production – informative

Electricity										
Produced energy	$E_{exp,el,k}$									
Used energy										
Exported energy	$E_{exp,el,k}$									
Thermal solar										
Produced energy	$E_{exp,th,k}$									
Used energy										
Exported energy	$E_{exp,th,k}$									
Other: _____										
Produced energy	$E_{exp,x,k}$									
Used energy										
Exported energy	$E_{exp,x,k}$									

Notes
[1] Measured, energy, not corrected for climateand use
[2] Calculated energy for the same services as the measured energy (adapt calcuation to available metering)
[3] 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
[4] 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: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category:
Parcel No: 3500
Office building
Cadaster: Brussels

No. of energy certificate: 00001/SK_0001/2019

ALDREN

Page 12 (**alternative 2**) – Measured energy – buildings **without** specific measurements provisions (optional)

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

3 The template of EVC

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

COMMON EUROPEAN VOLUNTARY ENERGY PERFORMANCE CERTIFICATE

ALDREN

AWARD (only for classes A, B, C): **A**

EUROPEAN COMMON CERTIFICATE

ENERGY PERFORMANCE RATING — Building category: Office building

Climate: Moderate
Town: Bratislava

		Ratio to Ref	E_{Pnren} (only for self-used energy)	E_{Pnren} (balance with exported energy)
	Most efficient			
	Energy +	**< 0**		
A		**≤ 0.35 Ref**		**A**
B		**≤ 0.50 Ref**	**B**	
C		**≤ 0.71 Ref**		
D	REFERENCE*	**≤ 1.00 Ref**		
E		**≤ 1.41 Ref**		
F		**≤ 2.00 Ref**		
G		**> 2.00 Ref**		
	Least efficient			

***Reference energy performance (Ref) =**	**130**	**0.43 Ref**	**0.29 Ref**
SRI indicator	**45%**	E_{Pnren} (only for self-used energy)	E_{Pnren} (balance with exported energy)
Non-renewable primary energy E_{Pnren}	kWh$_{EP}$/(m².a)	**56**	**38**
Total primary energy use E_{Ptot}	kWh$_{EP}$/(m².a)	**63**	**51**
CO_2 emissions	kg/(m².a)	**10.7**	**7.4**
		$E_{pr,used}$ self-used	E_{exp} exported
Produced renewable energy (on-site) E_{pr}	kWh/(m².a)	**4.0**	**8.0**

Final energy use (exported energy is not counted) ε=1.1 — **40.0** kWh/(m².a)
Green certificate: ε ≤1.2 (final energy use / energy needs)

Renewable energy ratio of total primary energy *RER* — **11 %**
(including only self-used energy produced from RES on-site or nearby)

Energy needs related to fabrics and geometry
(heating, cooling, lighting) kWh/(m².a) — Evaluated Building = **35.9** (**0.89 Ref**)

0.5 | 0.75 | 1 | 1.25 | 1.5 | 1.75 | 2 | 2.25 | 2.5 | 2.75 | 3

Ref $_{NZEB}$ = 40 (green certificate)

Thermal environment for standard use (1=best,4-worse)

Season	Occupied hours	Score
Winter	1218	1.9
Summer	738	2.8
Spring/Fall	501	2.7
Overall thermal comfort		2.3

Year of construction / Last renovation:	*1970 / 2014*
Reference floor area (GIA) m²	*5000*
Net internal floor area (NIA) if relevant m²	*4750*
Building volume (related to GIA) m³	*20 000*

Number of floors	*8*
Climate locality, city (TMY):	*Bratislava (JRC TMY)*
Latitude, Longitude, Altitude	*48.142, 17.105, 141 m a.s.l*
HDD / CDD (JRC, Eurostat)	*2791 / 50*

Building:
Address:

Parcel No:
Date: 18.4.2020

Cadaster:
Validity: 18.4.2030

Issued by:
Contact: +421

Signature

No. of energy certificate: 00001/SK_0001/2019

COMMON EUROPEAN VOLUNTARY ENERGY PERFORMANCE CERTIFICATE

ALDREN

AWARD (only for classes A, B, C): **A**

EUROPEAN COMMON CERTIFICATE

ENERGY PERFORMANCE RATING — Building category: Office building

Climate: Moderate
Town: Bratislava

		Ratio to Ref	E_{Pnren} (only for self-used energy)	E_{Pnren} (balance with exported energy)
	Most efficient			
	Energy +	**< 0**		
A		**≤ 0.35 Ref**	**A**	**A**
B		**≤ 0.50 Ref**		
C		**≤ 0.71 Ref**		
D	REFERENCE*	**≤ 1.00 Ref**		
E		**≤ 1.41 Ref**		
F		**≤ 2.00 Ref**		
G		**> 2.00 Ref**		
	Least efficient			

***Reference energy performance (Ref) =**	**130**	**0.35Ref**	**0.29 Ref**
SRI indicator	**57%**	E_{Pnren} (only for self-used energy)	E_{Pnren} (balance with exported energy)
Non-renewable primary energy E_{Pnren}	$kWh_{EP}/(m^2.a)$	**45**	**38**
Total primary energy use E_{Ptot}	$kWh_{EP}/(m^2.a)$	**49**	**51**
CO_2 emissions	$kg/(m^2.a)$	**8.2**	**7.4**
		$E_{pr,used}$ self-used	E_{exp} exported
Produced renewable energy (on-site) E_{pr}	kWh/(m².a)	**7.0**	**8.0**

Final energy use (exported energy is not counted) ε=1.1 — **40.0** kWh/(m².a)
Green certificate: ε ≤1.2 (final energy use / energy needs

Renewable energy ratio of total primary energy *RER* — **13 %**
(including only self-used energy produced from RES on-site or nearby)

Energy needs related to fabrics and geometry
(heating, cooling, lighting) kWh/(m².a) Evaluated Building = **35.9** (**0.89 Ref**)

0.5 | 0.75 | 1 | 1.25 | 1.5 | 1.75 | 2 | 2.25 | 2.5 | 2.75 | 3

Ref $_{NZEB}$ = 40 (green certificate)

Thermal environment
for for standard use (1=best,4-worse)

Season	Occupied hours	Score
Summer	1236	1.8
Winter	805	1.5
Spring/Fall	538	1.9
Overall thermal comfort		1.7

Year of construction / Last renovation:	*1970 / 2014*
Reference floor area (GIA) m^2	*5000*
Net internal floor area (NIA) if relevant m^2	*4750*
Building volume (related to GIA) m^3	*20 000*

Number of floors	*8*
Climate locality, city (TMY):	*Bratislava (JRC TMY)*
Latitude, Longitude, Altitude	*48.142, 17.105, 141 m a.s.l*
HDD / CDD (JRC, Eurostat)	*2791 / 50*

Building:
Address:
Issued by:
Contact: +421

Parcel No:
Date: 18.4.2020

Cadaster:
Validity: 18.4.2030

Signature

No. of energy certificate: 00001/SK_0001/2019

OVERVIEW OF ENERGY PERFORMANCE

Delivered energy, exported energy, thermal comfort

Service technical systems description	Energy need kWh/(m².a) / expenditure factor**	Energy carrier: Description	Energy carrier: f_{Pnren}/ f_{Pren}/ f_{Ptot}*	Delivered energy per energy carrier: Amount kWh/a	Delivered energy per energy carrier: Amount kWh/(m².a)
Space heating: ☐ Humidification	$Q_{H;nd}$ = 20 ε = 1.2	gas	1.1/ 0/1.1	$E_{H;cr,i}$	22
		electricity	2.3/0.2/2.5	$E_{H;cr,i}$	2
		Carrier *j*		$E_{H;cr,i}$	
		Total use			**24**
Cooling: ☐ dehumidification	$Q_{C;nd}$ = ε =	Carrier *1*		$E_{C;cr,i}$	
		Carrier *j*		$E_{C;cr,i}$	
		Total use			
Ventilation	$Q_{V,;nd}$ = ε =	Carrier *1*		$E_{V;\,cr,i}$	
		Carrier *j*		$E_{V;\,cr,i}$	
		Total use			
Air-conditioning may be also represented by the inclusion of energy for Humidification /or dehumidification under Heating and Cooling respectively	$Q_{ac,;nd}$ = ε =	Carrier *1*		$E_{V;\,cr,i}$	
		Carrier *j*		$E_{V;\,cr,i}$	
		Total use			
Hot water preparation:	$Q_{W;nd}$ = ε =	Carrier *1*		$E_{W;cr,i}$	
		Carrier 2		$E_{W;cr,i}$	
		Carrier *j*		$E_{W;cr,i}$	
		Total use			
Lighting:	Q_L = 16 ε = 1.0	electricity	2.3/0.2/2.5	$E_{L;cr,i}$	*16*
		Total use			**16**
Other:		Carrier *1*		$E_{O;cr,i}$	
		Carrier *j*		$E_{O;cr,i}$	
		Total use			
Total final energy use	Q_{nd} =36 ε=1.11				**40**

Renewable energy production (on-site) $E_{pr,}$	PV	0/1/1	$E_{pr;cr,1}$	**-12.0**
	Carrier *j*		$E_{pr;cr,k}$	
Renewable energy production by on-site production **self-used** $E_{pr;used}$	PV	0/1/1	$E_{pr;use;cr,1}$	-4.0
	Carrier *j*		$E_{pr;use;cr,k}$	
Sum of produced renewable energy **(self-used)** $E_{we;pr;used;an}$				**-4.0**
Exported produced renewable energy (on-site) E_{exp}	PV	2.3/0.2/2.5	$E_{exp;cr,k}$	-8.0
	Carrier *j*		$E_{exp;cr,k}$	
Sum of exported produced renewable energy $E_{we,exp;an}$				**-8.0**

*f_{Pnren}: electricity = 2.3, gas=1.1, wood=0.2, solar=0 f_{Ptot}: electricity = 2.5, gas=1.1, wood=1.2, solar=1

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

Overview on energies

Delivered net energy kWh/(m².a)
Gas 22
Electricity 18

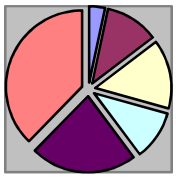
Produced energy kWh/(m².a)

On-site (PV): 12.0
from it - self-used 4.0
- exported 8.0

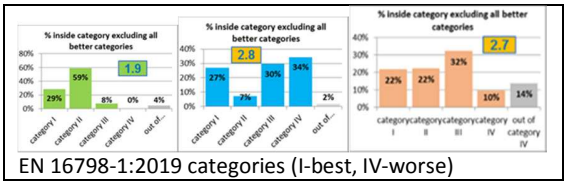
Produced renewable EP on-site self-used kWh/(m².a): **4.0**

Used renewable EP from nearby kWh/(m².a): DH*$PEF_{ren,DH}$ 0

Energy use (per service)



Thermal comfort (associated with presented energy)



EN 16798-1:2019 categories (I-best, IV-worse)

Informative (if relevant): Non-renewable primary energy based on national primary energy factors	E_{Pnren} (only for self-used energy)	E_{Pnren} (balance with exported energy)
Non-renewable primary energy E_{Pnren} kWh_{EP}/(m².a)		

Reference floor area (GIA) m²	*5000*
Net internal floor area (NIA) if relevant m²	*4750*
Building volume (related to GIA) m³	*20 000*

Climate locality, city (TMY):	*Bratislava (JRC TMY)*
Latitude, Longitude, Altitude	
HDD / CDD (JRC, Eurostat)	*HDD / CDD*

Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2019

ALDREN

THE HEALTH & WELLBEING INDICATORS

CALCULATED AND MEASURED ENERGY PERFORMANCE

FINANCIAL VALUATION OF RENOVATION ACTION

SMART READINESS INDICATOR

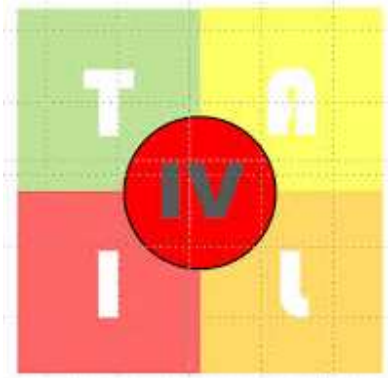
THE HEALTH & WELLBEING INDICATORS

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

Quality of T-A-I-L

T – Thermal environment

Temperature	
Relative humidity	

A – Acoustic environment

Noise level	

I – Indoor air quality

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

L – Light, visual environment

Illuminance	
Daylight factor	

Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

THE HEALTH & WELLBEING INDICATORS

(Derived from the methodology in ALDREN Task 2.4)

(Optional)

Example from pilot building

Overall quality of indoor environment

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

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			

A – Acoustic

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

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 name:
Address:

Building category: **Office building**
Parcel No: 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	End use meets 25% variance criterion, but this end use & fuel combination exceeds 25% variance
RED	End use exceeds 25% variance criterion due to high variance in this end use & fuel combination

Fuel	End use	EVC under actual conditions kWh/m^2	Measured kWh/m^2	Variance measured vs. EVC under actual conditions kWh/m^2	Variance measured vs. EVC under actual conditions %
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: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

FINANCIAL VALUATION OF RENOVATION ACTION

Valuation of proposed Energy Related Investments

(Derived from methodology in ALDREN Task 2.5)

(Optional)

Scenarios analyses for parameters with the strongest effect impact on the Net Present Value (NPV)

Parameter *		Scenarios		
		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

Demonstration graph for scenarios

Risk indicator (overall building)

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

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

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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)

Parameter *		Scenarios		
		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 (€)	- €	**- €**	- €
Annual Benefits (€)	**Running cost - savings**			
	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 €

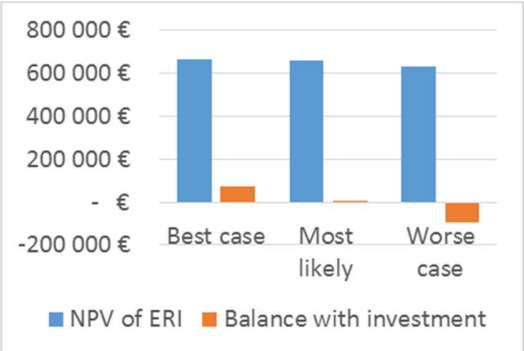
Note:
The analysis is **related to the recommendations for improvement** in this European Voluntary Certificate.
Reported data are calculated using Protocol for Task T2.5 or according to standard EN 17463

Energy prices in €/kWh:

Gas	0.079
Electricity from grid	0.12
District heating	0.08
Electricity export	0.12

Sustainability Risk Indicator

Performance **High risk**	Management **Medium risk**
Easy to upgrade **Medium risk**	Market uptake **Medium risk**



Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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:

50%	46%	60%	46%	30%	40%	25%

IMPACT : Grid Flexibility

			Current Score		Potential score after improvement	
TOTAL IMPACT SCORE (weighted average of 9 domain 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: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

DESCRIPTION / RECOMMENDATIONS FOR IMPROVEMENT OF BUILDING AND TECHNICAL SYSTEMS

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

BUILDING AND CLIMATE CONDITIONS	
Building category	***Office building***
Mixed use – category 2	*category* %
Mixed use – category 3	*category* %

Year of construction:	*2000*	Year of last renovation:	*2017*
Reference floor area (GIA) A_b m²	*3197*	Level of renovation	*partly*
Building volume related to GIA V_b m³	*9628*	Shape factor A_E / V_b 1/m	*0.39*
Construction high h_k (average) m	*3.1*	Number of floors above the ground	*5*

Location for climate data:	*JRC*	Average external temperature winter	*3.86 ℃*
Number of degree-days K.day		Number of heated days winter	*212*
heating	*2791*	Set point internal temperature heating	*20 ℃*
cooling	*50*	Set back internal temperature heating	*18 ℃*
Operation schedules		Set point internal temperature cooling	*26 ℃*
		Set back internal temperature cooling	*30 ℃*

THERMAL ENVELOPE

Construction	Description - actual building	U_m W/(m².K)	Recommendations for improvement	U_m W/(m².K)
External walls:	*Reinforced concrete walls 250 mm with MW 150 and 100 mm*	*0.276* *0.391*	*Walls (except street view): 50 % + TI MW 100 mm*	*0.165* *0.202*
Roof:	*Slope roof ell insulated* ***Ceiling*** *to the unheated space (5th floor): not insulated.* ***Ceiling above the exterior****: TI MW 140*	*0.214* *1.129* *0.262*	 *Additional insulation of ceiling to unheated space* *Additional insulation of ceiling above exterior*	 *0.155* *0.176*
Opening structures:	*Plastic frames, double glazing. Ug = 1.4 W/(m².K), plastic frame Uf = 1.6 W / (m².K).*	*1.65-2.07*	*Glazing replacement to triple glazing Ug = 0.7 W/(m².K)*	*1.05-1.47*
g-value, shading	*g- value, shading yes*	*0.67*	*g- value, shading yes*	*0.35*
Floor on the ground/basement	***Floor above the unheated garage****: TI EPS 60 mm in the floor and the combi boards 50 mm from the bottom*	*0.313*		

Ventilation:	*Natural ventilation* *Air flow rate qve,k [m³/h/m²], air exchange rate 1/h:*		*Heat recovery unit* *Air flow rate qve,k [m³/h/m²], air exchange rate 1/h:*	
Ventilation heat recovery unit:	*- Efficiency*		*Efficiency*	
Other:				

SPACE HEATING SYSTEMS	Description - actual building	Recommendations
Type of heating system:	*Centralised low temperature gas boilers*	*VRF system + SPLIT (for AHU)*
Generation:	*Low temperature gas boilers*	*Electric*
Energy carrier:	*Gas*	*Cooling medium, air*
Individual or collective metering	*Collective metering*	*Collective metering*
Thermostat types	*Remotely controlled thermostat valves for individual FCU emitters*	*Remotely controlled VRF emitters, central adjustment of temperature*
Smart metering systems		

System	Description - actual building	Recommendations for improvement
Space heating system	*2-pipe hydronic balanced system, 3 circuits (2 for FCUs and floor heating) for two zones (S/N), one circuit for ventilation equipment. Heat emission in offices - FCUs, electric convectors at staircases*	*Change of heat source to VRF system VRF system + SPLIT (for AHU) Without circulation pumps (see Ventilation/Air-conditioning)*
Measurement, automation, control ***(Link to SRI)***	*Boiler control with weather compensated /equithermic control of individual heating circuits by 3-way valves, individual room remote controlled valves at FCU emitters, variable speed pumps*	*Weather compensated/equithermic control of VRF units, individual room remote control*

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

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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

COOLING	**Description - actual building**	**Recommendations**
Type of system:	*Air-cooled chiller*	*VRF + SPLIT (for AHU)*
Energy carrier:	*electricity*	*electricity*
Measurement, automation, control	*Individually controlled*	*Individually controlled cassette units*

System	**Description - actual building**	**Recommendations for improvement**
System description Measurement, automation, control ***(Link to SRI)***	*Air-cooled chiller + 2 circuits with 2-pipe system for FCU units for 2 zones (N/S)* *Individually controlled FCU units*	*3-pipe VRF system + SPLIT cooling units (air-cooled chiller for AHU), Heat / cold transfer: VRF* *Individually controlled cassette units*

VENTILATION, AIR-CONDITIONING	**Description - actual building**	**Recommendations**
Type of system:	*Natural ventilation*	*DOAS, DCV*
Energy carrier:	*electricity*	*electricity*
Measurement, automation, control	*Thermostats for FCU units*	*Individually controlled cassette units*

System	**Description - actual building**	**Recommendations for improvement**
System description Measurement, automation, control ***(Link to SRI)***	*Low pressure mechanical ventilation system with AHUs, with air-cooled chiller + FCU units + natural ventilation* *Thermostats for FCU units in individual rooms*	*Low pressure mechanical ventilation system with AHUs, with air-cooled chiller + VRF ceiling units, natural ventilation, heat recovery, DOAS, heat recovery, heat/cold - condensing unit DCV* *Central control*

HOT WATER PREPARATION	**Description - actual building**	**Recommendations**
Type of system:	*Centralised with heating*	*Local electric*
Generation:	*Low-temperature gas boilers*	*Instantaneous water heaters*
Energy carrier:	*gas*	*electricity*
Measurement and control	*On-off, electric circulator*	*On-off on user demand*

System	**Description - actual building**	**Recommendations for improvement**
Heating system Measurement, automation, control ***(Link to SRI)***	*Low-temperature gas boilers. Centralized DHW preparation in vertical storage heater in a boiler room, vertical DHW distribution system with circulation* *On-off, electric circulator*	*Decentralized DHW preparation in local electric instantaneous water heaters, without storage and circulation* *On-off, on user demand*

LIGHTING	**Description - actual building**	**Recommendations**
Type of system:	*Fluorescent lamps*	*LED*
Type of lamps 1	*Fluorescent lamps*	*LED light sources*
Type of lamps 2		
Measurement and control (***Link to SRI)***	DALI- currently not fully exploited	DALI - full use

System	**Description - actual building**	**Recommendations for improvement**
System description Measurement, automation, control ***(Link to SRI)***	*Fluorescent lamps, some replaced by LED retrofits. Different luminance curve of the luminaire and a different distribution of light in space.* DALI interface (Digital Addressable Lighting Interface) – not working properly	Install highly effective solutions, new geometry, control, and luminaires with LED light sources able to dimming. DALI interface (Digital Addressable Lighting Interface)

RENEWABLE ENERGY	**Description - actual building**	**Recommendations**
Production	*no*	*PV production (mono-crystalin)*
Export	*no*	*PV production (mono-crystalin)*

System	**Description - actual building**	**Recommendations for improvement**
System description	No	PV panels: 53+2, Total PV area: 116,8 m2, mono-crystalin, 6.7 Wh/(m2.a)

OTHER INFORMATION

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

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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

POTENTIAL ENERGY SAVINGS AFTER REALIZATION OF RECOMMENDED MEASURES

BUILDING	
Building category	*Office building*

Service, quantity	Energy Actual state kWh/(m².a)	Energy After renovation kWh/(m².a)	Savings kWh/(m².a)	Savings %
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_2 emissions (export) kg/(m².a):	31.6	8.0	23.6	75%

Energy performance after realization of proposed measures

		E_{Pnren} (only for self-used energy)	E_{Pnren} (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
		$E_{pr,use}$ self-used	E_{exp} exported
Produced renewable energy (on-site) E_{pr}	kWh/(m².a)	**5.0**	**1.7**
Energy class		**B**	**A**
CO_2 emissions	**kg/(m².a)**	**8.7**	**8.0**

Thermal environment after renovation
for standard use
(1=best, 4-worse)

Period	Occupied hours	Score /Category
Winter	1093	1.6
Summer	846	1.5
Spring/Fall	542	1.8
Overall thermal comfort score		**1.6**

Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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//m².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*	
Primary energy balance	***220***	***28***	***87,3%***
Energy label	**G**	**A**	

Reference Energy Performance = **130**

Primary renovation packages

#	RENOVATION ACTIONS	OPPORTUNITY	PACKAGE EVALUATION			CUMULATED ENERGY SAVING				IEQ
			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
A	**Thermal insulation of bottom floor surfaces**	Immediate need of works	**155**	**175**	**20,5%**	**155**	**175**	**20,5%**	**G**	
	Integration of a double-door entrance									
	Blinds and solar protections	Owner will								
B	**Renewable energies : Thermal panels**	Owner will - potentially immediate	**160**	**200**	**9,1%**	**135**	**150**	**31,8%**	**F**	
C	**Heating : Thermal insulation of distribution network**	potentially immediate	**165**	**190**	**13 ,6%**	**75**	**95**	**56,8%**	**E**	
	DHW : Thermal insulation of the storage									
	DHW : Thermal insulation of distribution network	potentially immediate								
	Cooling : Thermal insulation of distribution network									
D	**Renewable energies : Photovoltaïcs**	Economy efficiency - potentially immediate	**130**	**160**	**27,3%**	**40**	**55**	**75,0%**	**C**	

Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

ALDREN

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)

Example from pilot building

Heating

	Parameter	Measured energy (real conditions) kWh/(m².a)													
	Period / date	Jan18	Feb 18	Mar 18	Apr18	Oct18	Nov 18	Dec 18	Jan19	Feb 19	Mar 19	Apr19	Oct19	Nov 19	Dec 19
	Interval hours h	**744**	**672**	**744**	**720**	**744**	**720**	**744**	**744**	**672**	**744**	**720**	**744**	**720**	**744**
	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 readings for interval - heating														
E_H	*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
	Total *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**

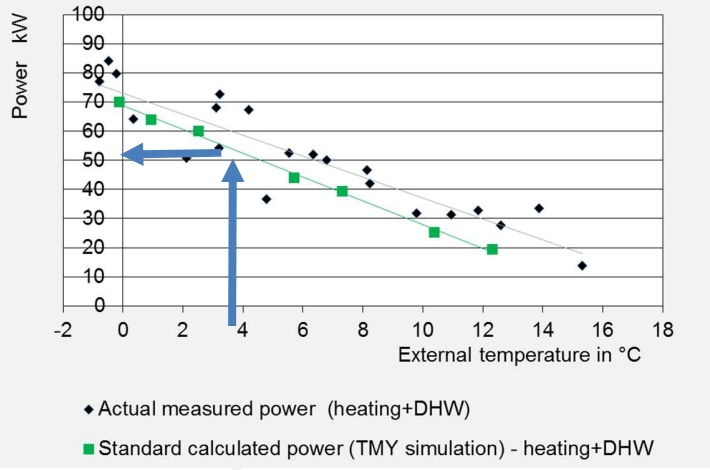
Description of measurement:

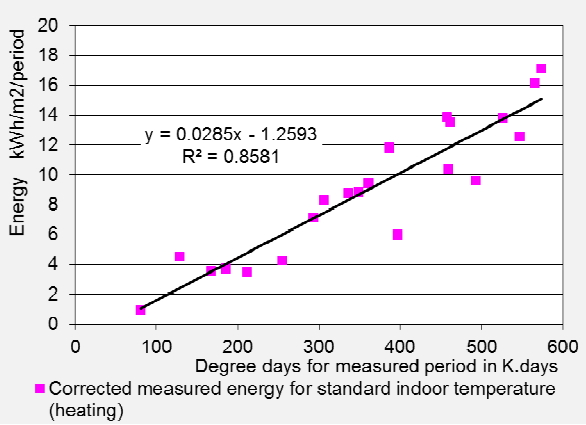
-period between meters readings - months
-Meters readings devices - invoice
- indoor temperature (weighted average)
- external temperature (Eurostat)

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[1)]	**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





Winter (heating) average conditions

Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2017

MEASURED ENERGY FOR HEATING AND DHW

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

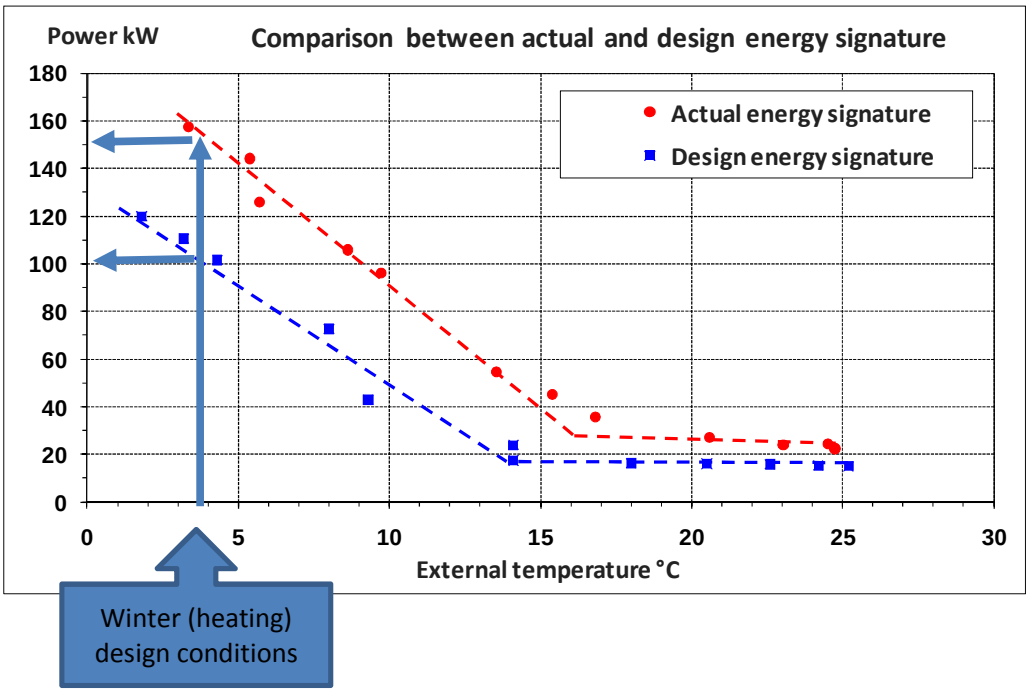
(Optional)

Service		**Parameter**	**Measured energy (real conditions) kWh/(m².a)**							
Description of measurement: -period between meters readings (year, month, weeks, days ..) -Meters readings devices - indoor temperature (weighted average) - external temperature (average for interval) - number of days with service -occupancy %,		Period / date	P1	P2	P3	P4	P5	P5	P6	Pj
		Interval hours h								
		System operation time h								
		Occupancy %								
		Avg external temperature ℃								
		Avg indoor temperature ℃								
		Interval degree-days								
Meters readings for interval										
Heating	$E_{H;cr,i}$	*Carrier 1*								
		Carrier j								
		Total								

Corrected measured energy for heating (climate and use) EN 15378-3:2017[1)]	kWh/(m².a)	**Difference from calculation 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



Building name:
Address:

Building category: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2019

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	Measured delivered energy per energy carrier and per service – actual conditions					Calculated (standard conditions)	Difference
Period / year			P1	P2	P3	Average			
Unit			kWh	kWh	kWh	kWh	kWh/m²a	kWh/(m².a)	%
Heating	$E_{H;cr,i}$	*Carrier 1*							
		Carrier 2							
☐ Humidification		**Total**							
Cooling	$E_{C;cr,i}$	*Carrier 1*							
		Carrier j							
☐ Dehumidification		**Total**							
Ventilation	$E_{V;cr,i}$	*Carrier j*							
		Total							
DHW	$E_{W;cr,i}$	*Carrier j*							
		Carrier j							
		Total							
Lighting	$E_{L;el}$	*Electricity*							
Other (e.g. auxiliary)	$E_{O;cr,i}$	*Carrier 1*							
	$E_{O;cr,i}$	*Carrier j*							
		Total							
Total									

On site renewable energy production – informative

Electricity

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

Thermal solar

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

Other: _____

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

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: **Office building**
Parcel No: Cadaster:

No. of energy certificate: 00001/SK_0001/2019

ALDREN

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 [1]

Carrier	Service provided						Measured delivered energy per energy carrier – actual conditions					Calculated [2] (standard conditions)	Difference
	H ☐ H_H	W	C ☐ Dhu	V	L	O							
Period / year							P1	P2	P3	Average			
Unit							kWh	kWh	kWh	kWh	kWh/m²a	**kWh/(m².a)**	%
[3]Electricity													
[3]Gas													
[3]Oil													
3-4 _____													

On site renewable energy production – informative

Electricity

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

Thermal solar

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

Other: _____

Produced energy	$E_{exp;cr,k}$								
Used energy									
Exported energy	$E_{exp;cr,k}$								

Notes

1) Measured, energy, not corrected for climateand use
2) **C**alculated energy for the same services as the measured energy (adapt calcuatlion to available metering)
3) 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
4) 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: **Building category:** **Office building**
Address: **Parcel No:** Cadaster:

No. of energy certificate: 00001/SK_0001/2019

ALDREN

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 assessment types according to building category and application (5.3):

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[b]
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 m² 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 non-residential buildings, Stakeholders consultation, Tender ENER/C3/2011/SI2.602654, January 2012 http://www.buildup.eu/fr/node/43787

[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