EUSALP EU STRATEGY FOR THE ALPINE REGION

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EUSALP Performance Indicators for buildings

Report

80 million people, 7 countries, 48 regions, mountains and plains addressing together common challenges and opportunities

Interreg Alpine Space AlpGov

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Premise

This report is based on the discussion document "EUSALP KPIs for buildings" that was prepared by CESBA for an experts' workshop concerning "Key Performance Indicators for greening the Alpine infrastructure", held on 23 October 2017 in Garmisch-Partenkirchen to which external experts and EUSALP Action Group 9 members were invited. The report draws from the discussions and recommendations elaborated by the experts that participated in the workshop. The goal of this report is to show how a common set of KPIs in the Alpine area could be adopted and what the bottlenecks and challenges for the promotion of common KPIs are.

This report gives practical inputs and intends to advance the thinking of how harmonised, affordable and operational assessment tools for public authorities could be developed to promote and boost sustainable and low-carbon buildings in the Alpine Space as proposed of the EUSALP in the Action Plan concerning the European Union Strategy for the Alpine Region SWD(2015)147 final, as a possible activity.

This report does not necessarily reflect the opinions of the EUSALP Action Group 9 members.

Introduction

Harmonization strategy for building assessment systems in the Alpine space

Assessment systems are recognized to be a powerful tool to promote a more sustainable built environment. Only in Europe, more than 60 building rating systems are in use at local, regional and national level. This fact should be considered positive, but there is a critical issue: ratings (scores) and labels are not comparable. The assessment systems are different in methods, physical and time boundaries, issues taken into consideration, number of criteria, scoring systems, etc. This lack of conformity created confusion among the building sector stakeholders. A harmonization process is clearly needed at transnational level in the way to create a common approach to building assessment that would enforce the effectiveness of certification schemes.
The solution for the harmonization of building assessment systems cannot be their convergence in a unique common system. For two reasons.

The first is to respect the "contextualization" principle. Building practices, environmental, social and economic priorities are different in each region and the assessment systems must reflect them. The scoring scales of assessment systems must be based on targets that have been set with regard to the local practice. It is not meaningful to fix reference targets at transnational level because the minimum acceptable performance in each region is different. Assessment systems shall provide evaluations and scores indicating how a building is performing over the regional building standard practice. Contextualization means the use of local standards, regulations and units of measure. A contextualized assessment system is simpler to use, operational and affordable. It is suitable for a mass certification approach.

The second reason for the impracticability of a unique transnational assessment system is not technical. As already pointed out, dozens of assessment systems are already operative. All these systems are owned and managed by different public or private organizations. It would be impossible to have all of them converging in a unique common system.

To achieve the harmonization objective, the CESBA (Common European Sustainable Built Environment Assessment) process was launched in 2011 by initiative of a group of Interreg projects supported by public and private European organizations from 15 countries. The harmonization principle proposed by CESBA is to establish a transnational core set of KPIs (Key Performance Indicators) based on common metrics. A common denominator that any existing and future assessment system has to adopt to guarantee the comparability of key results related to the most important transnational sustainability goals. The document to compare transnationally the key results will be the building Passport. In future, it will be issued by the scheme operators besides the usual label/certificate. The Passport is not a new assessment system producing a rating for a building. The rating will be always assigned trough the local systems. The scope of the Passport is only to allow the transnational comparison in absolute terms (i.e. Global Warming Potential - Kg Co2eq/m2) of results achieved by buildings in different regions; in the way to measure the progress and contribution to the common transnational sustainability goals.

A similar harmonization approach has been proposed by the European Commission in the Communication 445 of 2014. In October 2017 the Beta version of the Level(s) system, proposing a common set of KPIs for the European Union, has been published by the European Commission.

In the context of EUSALP, the AG9 intends to develop a set of common KPIs (Key Performance Indicators) to harmonize the built environment assessment systems in use in the Alpine regions and to define an Alpine space Passport. The main objective is to establish a common language of sustainability for the built environment. This common language should enable actions to be taken that can make a clear contribution to EUSALP sustainability policy objectives.

The EUSALP "KPIs for Greening the Alpine Infrastructure" (EUSALP KPIs) is a framework of indicators and common metrics for measuring the sustainability of the built environment at building, urban and territorial scale. The EUSALP KPIs at building scale are based on the EU Level(s) systems and the CESBA KPIs.

Scope of the EUSALP KPIs for buildings

On the base of Level(s) and CESBA KPIs, a common set of indicators that reflect EUSALP and EU policy objectives for the environment, health and the built environment has been presented by CESBA and discussed by the experts. The intention has not been to create a new standalone building certification scheme, or to establish performance benchmarks, but rather to provide a set of common indicators to harmonize the building assessment systems in the alpine space. If building assessment schemes are aligned with or incorporate the set of indicators, then they can be used as a means of ensuring that building designs contribute to the same common policy objectives.

All dimensions of sustainability are addressed: environmental, social and economic.
The reference issues for EUSALP KPIs are:

- Energy and emissions
- Materials
- Water
- Indoor environmental quality
- Life cycle cos

The scope of the EUSALP KPIs framework encompasses both new and existing buildings at the point of major renovation. A major renovation is where:

- the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated

OR

- more than 25 % of the surface of the building envelope will undergo renovation.

The EUSALP KPIs are performance based and not prescriptive. They are intended to measure the performance of buildings and not to indicate design strategies or solutions.
An LCA approach to building sustainability is promoted. The reference standard for the LCA phases is the EN 15978 "Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method"

EUSALP KPIs for buildings

During the workshop "Key Performance Indicators for greening the Alpine infrastructure" held in Garmisch-Partenkirchen on October 23th 2017, AG9 experts selected 18 Key Performance Indicators for the Alpine regions;

- Mandatory KPIs:
  - Primary energy demand
  - Delivered energy demand
  - Renewable energy in primary energy consumptions
  - Renewable energy in final thermal energy consumptions
  - Renewable energy in final electric energy consumptions
  - Global Warming Potential
  - Quality of air - Ventilation
  - Quality of air – CO_2 concentration
  - TVOC from construction materials
  - Formaldehyde from construction materials

- Recommended KPIs:
  - Embodied non-renewable primary energy (product stage)
  - Materials from renewable sources
  - Recycled materials
  - Construction and demolition waste
  - Water consumption
  - Net potable water consumption
  - Thermal Comfort
  - Life cycle cost in the operational stage

The mandatory KPIs are the ones that all assessment schemes at building scale should include to be harmonized. The mandatory KPIs will compose the Passport for buildings that allows to compare in absolute terms the performances of buildings assessed in different alpine regions and with different schemes. The mandatory criteria are focused on energy, emissions and quality of air issues. They address the operational phase of buildings.

The recommended KPIs are proposed to EUSALP Action Group 9 to be included in the existing and future building certification systems. They are not mandatory. The recommended criteria deal with materials, water, thermal comfort and life cycle cost issues.

The 18 KPIs have been selected by the experts on the base of a Discussion Document presented during the workshop "Key Performance Indicators for greening the Alpine infrastructure". The main outcomes of the discussion are illustrated in the following table. Due to lack of time, calculation methods, reference standards and other details of each KPI were not discussed during the workshop.

Criterion	**Input**
Primary energy demand	Criterion approved as mandatory. It is necessary to clarify and set the primary energy factors for EUSALP regions. A common method to calculate the internal useful area has also to be established.
Delivered energy demand	Criterion approved as mandatory
Renewable energy in primary energy consumptions	Criterion approved as mandatory.
Renewable energy in final energy consumptions	Criterion approved as mandatory.
Life cycle Global Warming Potential	The experts decided that only the GHG emissions in the use stage shall be taken in account. The calculation of GHG emissions in the "Product Stage", "End of Life Stage" and "Benefits and loads beyond the system boundary" is not actually affordable for a scarce availability of data. The criterion is renamed "CO_{2eq} emissions (use stage)" The experts decided to include a new KPIs:" Embodied non-renewable primary energy (product stage"). This KPIs will allow to take into consideration the performance of materials in the Product Stage. The information for the calculation of the indicator is easily available with respects to the GHG embodied emissions.
Materials from renewable sources	Criterion approved as recommended.
Recycled materials	Criterion approved as recommended.
Regional materials	The experts decided to delete this criterion because the information necessary to calculate it is often not available. It is too difficult to know the distance at which the materials are extracted and manufactured.

Construction and demolition waste	Criterion approved as recommended.
Water consumption	Criterion approved as recommended.
Net potable water consumption	Criterion approved as recommended.
Ventilation (use stage)	Criterion approved as mandatory.
Quality of air – CO_2 concentration (use stage)	Criterion approved as mandatory.
Emissions from construction materials	Experts decided to maintain only two pollutants from the whole list: Formaldehyde and TVOC generated by construction materials. The EU LCI ratio has been not affordable. The external pollutants and radon have been considered out of scope. Two new criteria are set as mandatory: ○ TVOC from construction materials ○ Formaldehyde from construction materials
Thermal Comfort	Criterion approved as recommended.
Thermal Comfort 2030	Experts decided to delete this criterion because the information about the expected climatic profile in 2030 are not easily available for all regions.
Thermal Comfort 2050	Experts decided to delete this criterion because the information about the expected climatic profile in 2050 are not easily available for all regions.
Life cycle cost	Criterion approved as recommended.

In the following, the KPI´s chosen during the workshop are presented in detail, as formulated in the Discussion Document elaborated by CESBA.

ISSUE: Energy and emissions

Intent: minimise the total greenhouse gas emissions and energy consumptions along a building's life cycle, with a focus on consumptions and emissions related to energy in the use phase of a building and energy embodied in building materials.

Criteria:

1 – Primary energy demand
2 – Delivered energy demand
3 – Renewable energy in primary energy consumptions
4 – Renewable energy in total thermal energy consumptions
5 – Renewable energy in total final electric energy consumptions
6 – Embodied non-renewable primary energy
7 – Global warming potential

Criteria: 1. Primary energy demand, 2. Delivered energy demand

The indicators provide users with an understanding of a building's energy demand in the use stage. Use stage energy demand is in general responsible for the majority of life cycle energy use in the case of buildings constructed before the turn of the millennium.

Criterion	Primary Energy Demand	Delivered Energy Demand
Indicator	Annual primary energy demand per useful internal floor area.	Annual delivered energy demand per useful internal floor area.
Unit of measure	kWh/m2/yr	kWh/m2/yr
LCA Stage	Operation	Operation
Assessment	Estimation	Estimation, Metering

Definitions:

- Primary energy is defined by Article 2(5) of the Energy Performance of Buildings Directive 6 as 'the energy that has not undergone any conversion in the transformation process, calculated by energy carrier using a primary energy factor'. It is the energy that is required to generate the electricity, heating and cooling used by a building.
- Delivered energy measures is the energy delivered to the building in the form of electricity, heat and fuel. It is the energy per 'carrier' supplied to the building, to satisfy uses within the building (heating, cooling, ventilation, domestic hot water, lighting, appliances, etc.). The 'delivered energy' is generally the one metered by the utilities.

Use of the indicators at the different project stages

Project stage	Activities
1. Design stage (based on calculations)	Calculated Energy Performance of Buildings (EPB) assessment sub types: design or tailored
2. Completion stage (based on as-built drawings)	Calculated EPB assessment sub types: as built Quality testing: air tightness and building fabric integrity
3. Post-completion (based on commissioning and testing)	Commissioning: functional performance testing and seasonal testing.
4. Occupation (based on measured performance)	Measured EPB assessment sub types: climate corrected, use corrected or standard

Unit of measurement

The common unit of measurement for both use stage primary energy demand and use stage delivered energy is kilowatt hours per square metre of useful internal floor area per year (kWh/ m2 / yr).

Reference standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings) and prEN ISO 52000-1

The reference area (useful internal floor area) is defined in EN 15603 and prEN ISO 52000-1. It is a measurement of the net internal area inclusive of shared circulation areas that are within the thermal envelope.

Boundary and scope

The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water, (built-in) lighting, auxiliaries. For office buildings the electric consumption of appliances must be taken in account. In a life cycle approach, these uses are referred to as operational energy consumption.

The assessment boundary is the building. Energy can be imported or exported through the assessment boundary (the building) from/to on-site, nearby and distant locations – as illustrated by Figure 1. Inside the assessment boundary, the system losses are taken into account explicitly in the conversion factor applied to the energy carrier, also referred to as a primary energy factor.

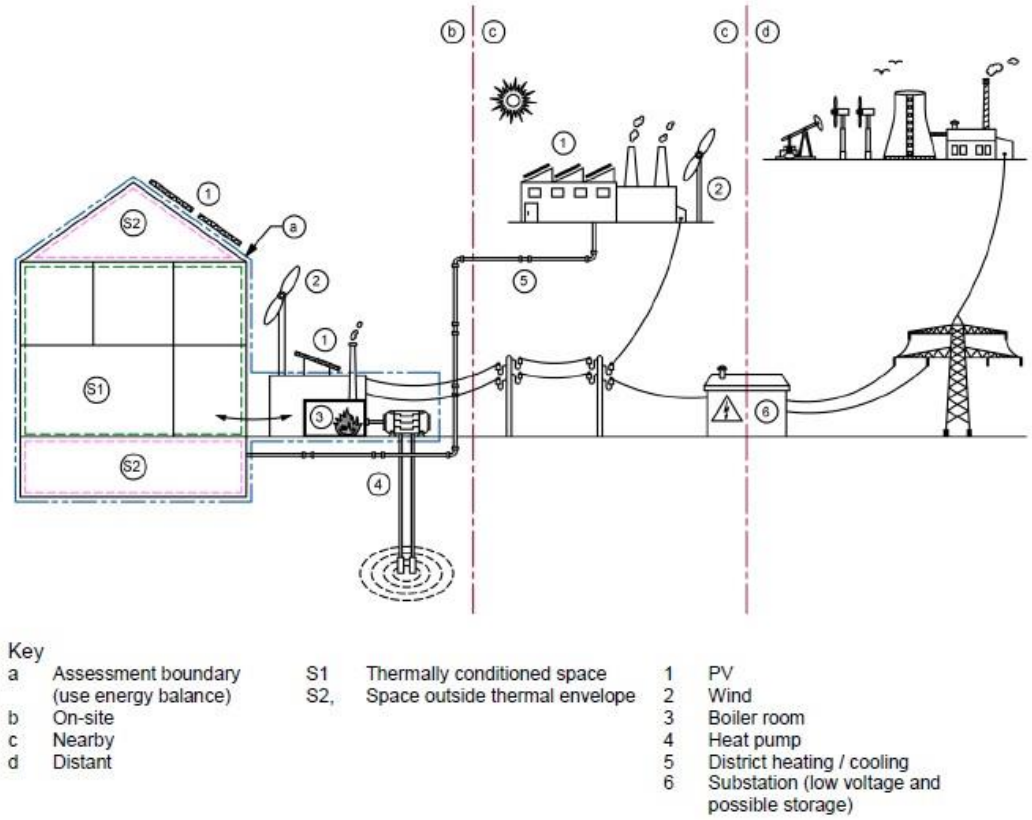

Figure 1.1.1

Fig.1:Building assessment boundary and energy balance locations Source: CEN (2017)

Calculation method and reference standards

The underlying calculation method for each sub-indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU.

The CEN standards series that currently forms the basis for most of national calculation methods includes EN 15603 (Energy performance of buildings. Overall energy use and definition of energy ratings) and EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling). As of 2017, this standards series will progressively be replaced by the new EN ISO 52000 series, but it is anticipated to take some time before national calculation methods are updated accordingly. This means that most national calculation methods that are required to be used to meet performance requirements or to complete Energy Performance Certificates (EPCs), and which are aligned with the EN standards series, can be used.

In case of existing buildings, the delivered thermal energy should be evaluated using data from metering. The metered delivered thermal energy demand (i.e. fuel consumption data) has to be calculated taking the average value over 3 years period.

The potential data sources to use are summarized in the following table:

Data item	**Potential source**	
	Default EU values	**National, regional or locally specific values**
Conditions of use and occupancy	EN ISO 13790 (Annex G8) ISO/TR 52000-1/2 EN ISO 52016-1	National or regional calculation method
Thermal envelope description	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method: certified products and details
Building services description	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method: certified products
Reference year climate file	Three climate zones (EN 15265 test cases)	National or regional calculation method Member State Meteorological Offices
Primary energy factors	EN 15603 (Annex E) EN 52000-1 (Annex B.10)	National or regional calculation method
Internal temperature set points	EN ISO 13790 (Annex G) EN ISO 52016-1	National or regional calculation method
Ventilation and infiltration rates	EN 15241 EN 15242	National or regional calculation method
Internal gains as heat flows	EN ISO 13790 (Annex J) EN ISO 52016-1	National or regional calculation method
Heating/cooling system characteristics and capacity	-	National or regional calculation method: certified products

Criterion: 3 Renewable energy in primary energy consumptions

The indicator assesses the share of primary energy demand that is met by renewable sources, without accounting for any export of renewable energy generated on site (such as from solar PV). This is because the EUSALP framework takes a life cycle approach and, according to reference standard EN 15978, exported energy is reported as a benefit beyond the building's system boundary, under Module D.

Criterion	**Renewable energy in primary energy consumptions**
Indicator	Primary energy demand of the building that is met by renewable sources on total primary energy demand
Unit of measure	%
LCA Stage	Operation
Assessment	Estimation

Unit of measurement

The common unit of measurement is the percentage representing the share of primary energy demand of the building that is met by renewable sources on the total primary energy demand (%).
Reference standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings) and prEN ISO 52000-1.

Boundary and scope

The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water and (built-in) lighting, auxiliaries. For office buildings the electric appliances must be taken in account. In a life cycle approach, these uses are referred to as operational energy consumption.
The assessment boundary is the building. Energy can be imported or exported through the assessment boundary (the building) from/to on-site, nearby and distant locations. Inside the assessment boundary, the system losses are considered explicitly in the conversion factor applied to the energy carrier, also referred to as a primary energy factor.

Calculation method

The calculation method is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU. The CEN standards series that currently forms the basis for most of national calculation methods includes EN 15603 (Energy performance of buildings. Overall energy use and definition of energy ratings) and EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling).

Criteria: 4 Renewable energy in total thermal energy consumptions, 5 Renewable energy in total electric energy consumptions

This indicator assesses the share of renewable energy in final thermal energy consumptions and, by implication, the degree to which renewable fuels have substituted fossil and/or nuclear fuels and therefore contributed to the decarbonisation of the Alpine space economy. It also shows what is the progress towards Europe 2020 target for renewable energies.

Criterion	**Renewable energy in total thermal energy consumptions**	**Renewable energy in total electric energy consumptions**
Indicator	Share of renewable energy in final thermal energy consumptions	Share of renewable energy in final electric energy consumptions
Unit of measure	%	%
LCA Stage	Operation	Operation
Assessment	Estimation, Metering	Estimation, Metering

Unit of measurement

The unit of measurement is a percentage that represents the share of renewable energy in final thermal or electric energy consumptions.
Reference standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings) and prEN ISO 52000-1.

Boundary and scope

The scope of the indicator includes the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water and (built-in) lighting, auxiliaries. For office buildings the electric appliances must be taken in account. In a life cycle approach, these uses are referred to as operational energy consumption.

Calculation method

The underlying calculation method for the indicator is provided by the CEN standards series that support implementation of the Energy Performance of Buildings Directive (EPBD) across the EU. The CEN standards series that currently forms the basis for most of national calculation methods.

In case of existing buildings, the share of renewable energy in total final thermal energy consumptions should be evaluated by energy metering.

Criterion 6: Embodied non-renewable primary energy

This indicator measures the embodied non-renewable primary energy of materials used for the building construction. The embodied energy is the energy consumed by all the processes associated with the production of construction materials, from the raw materials supply to manufacturing (cradle-to-gate) energy used for the acquisition of raw materials, processing, manufacturing and assembling building construction materials at the factory gate.
Cradle to Gate: energy used for the acquisition of raw materials, processing, manufacturing and assembling building construction materials at the factory gate.

Criterion	**Embodied primary non-renewable energy**
Indicator	MJ of embodied primary non-renewable energy per area
Unit of measure	MJ/m2
LCA Stage	Product
Assessment	Estimation

Unit of measurement

The unit of measurement to be used for reporting on this indicator is MJ /m2 (MJ = mega joules). The area for the calculation of the indicator is the gross area of the building. This unit of measurement is a commonly specified environmental impact category indicator used in Life Cycle Assessment

Boundary and scope

The scope comprises the product stage of the building (Module A1-3) i.e. from raw material supply to manufacturing. The scope encompasses the building materials excluding the technical installations. All the elements of the construction are taken in account: foundations, bearing structure, envelope, slabs. The minimum scope of the indicator shall include the following building parts and elements:

Building parts	**Related building elements**
Shell (substructure and superstructure)	
Foundations (substructure)	Piles Basements Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs) Upper floors External walls Balconies
Non-load bearing elements	Ground floor slab Internal walls, partitions and doors Stairs and ramps
Facades	External wall systems, cladding and shading devices Façade openings (including windows and external doors) External paints, coatings and renders
Roof	Structure Weatherproofing
Parking facilities	Underground

Calculation method and reference standards

The main reference standards for the indicator are ISO 14040/44, EN 15804 (Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products) and EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method).

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of. The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics. BoM differs from a BoQ in that it describes the different materials (e.g. concrete, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator.

The following steps should be followed in order to compile the BoM:

- Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.
- Identify the basic composition of each building element. A breakdown of its constituent materials has to be carried out. The mass of each constituent material has to be estimated;
- Aggregation by material: The mass for each **constituent material** should thereafter be aggregated to obtain the total mass for each type of material.

Once the BoM has been compiled, it is possible to calculate the indicator associating to each constituent material the relative embodied primary non-renewable energy by multiplying the specific mass (i.e. kg) with its corresponding embodied energy coefficient (i.e. MJ/kg). The total value of embodied primary non-renewable energy is finally normalized by the gross area of the building.

Criterion 7: Global Warming Potential

This indicator measures the contribution of the greenhouse gas (GHG) emissions associated with the building's operational phase on the earth's global warming or climate change. The Global Warming Potential (GWP) was developed to allow for the comparison of the impact on global warming caused by different gases. Specifically, it is a relative measure of how much energy can be trapped in the atmosphere over a set time horizon by a mass of gas in comparison with the same mass of carbon dioxide (CO_2). A higher GWP means a larger warming effect in that period of time.

Criterion	**GWP**
Indicator	CO_2 equivalent emissions per useful internal floor area per year
Unit of measure	kg CO_2 equivalents/m2/yr
LCA Stage	Operation
Assessment	Calculation

Unit of measurement

The unit of measurement to be used for reporting on this indicator is kg CO_2 equivalents/m2/yr for the operational stage.

The reference area (useful internal floor area) is defined in EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings and prEN ISO 52000-1. It is a measurement of the net internal area inclusive of shared circulation areas that are within the thermal envelope.

Boundary and scope

The scope of the indicator comprises the use stage of the building (B2-4,B6)and includes the emissions correlated to the following energy uses, which are also referred to as technical building services – heating, cooling, ventilation, domestic hot water,(built-in) lighting, auxiliaries. For office buildings the emission correlated to the electric consumption of appliances has to be taken in account.

Calculation method and reference standards

Reference standard: EN 15603 (Energy performance of buildings - Overall energy use and definition of energy ratings) and prEN ISO 52000-1.

ISSUE: Materials

Intent: reduce the environmental impact of construction materials.

Indicators:

8 - Materials from renewable sources
9 - Recycled materials
10 - Construction and demolition waste

Criterion 8: Materials from renewable sources

This indicator assesses the amount of materials from renewable sources (i.e. wood) used in the building with regards to the total amount of building materials. The use of materials from renewable sources allows reducing the use and depletion of finite raw materials.

Criterion	**Materials from renewable sources**
Indicator	Weight of materials from renewable sources on total weight of materials
Unit of measure	%
Assessment	Estimation

Use of the indicators at the different project stages

Project stage	**Activities**
1. Design stage (based on calculations)	Calculated amount (mass) of materials from renewable sources on total amount of materials. Elaboration of the Bill of Materials.
2. Completion stage (based on as-built drawings)	Record of the quantities of materials used for the construction of the building. Coherence check with the Bill of Materials.
3. Post-completion (based on commissioning and testing)	n/a
4. Occupation (based on measured performance)	n/a

Unit of measurement

The unit of measurement to be used for reporting on this indicator is a percentage that represents the share of materials and products from renewable sources used in the building (kg) on the total amount of building materials. A renewable source of materials is regenerating over time. Examples are wood or the sheep wool.

Boundary and scope

The scope encompasses the building materials excluding the technical installations. All the elements of the construction are taken in account: foundations, bearing structure, envelope, and slabs.

The minimum scope of the indicator shall include the following building parts and elements:

Building parts	Related building elements
Shell (substructure and superstructure)	
Foundations (substructure)	Piles Basements Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs) Upper floors External walls Balconies
Non-load bearing elements	Ground floor slab Internal walls, partitions and doors Stairs and ramps
Facades	External wall systems, cladding and shading devices Façade openings (including windows and external doors) External paints, coatings and renders
Roof	Structure Weatherproofing
Parking facilities	Underground

Calculation method and reference standards

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of.

The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional performance characteristics. A BoM differs from a BoQ in that it describes the different materials (e.g. wood, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator.

The following steps should be followed in order to characterize the indicator:

- Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.
- Identify the basic composition of each building element. A breakdown of its constituent materials has to elaborated. The mass of each constituent material has to be estimated;
- Aggregation by material: the mass of all constituent material should thereafter be aggregated to obtain the **total mass of materials used in the building (A)**;
- Identify the renewable content of each constituent material (in mass);
- Aggregation by material: the renewable mass of all constituent materials should thereafter be aggregated to obtain the **total renewable mass of materials (B) used in the building**;
- The indicator's value is calculated as B/A (total mass of renewable materials on the total mass of materials).

Criterion 9: Recycled materials

This indicator assesses the amount of recycled materials used in the building with regards to the total amount of building materials.
The use of recycled materials allows to reduce the use and depletion of new materials.

Criterion	**Recycled materials**
Indicator	Weight of recycled materials on total weight of materials
Unit of measure	%
Assessment	Calculation

Use of the indicators at the different project stages

Project stage	**Activities**
1. Design stage (based on calculations)	Calculated amount (mass) of recycled materials on total amount of materials. Elaboration of the Bill of Materials.
2. Completion stage (based on as-built drawings)	Record of the quantities of materials used for the construction of the building. Coherence check with the Bill of Materials.
3. Post-completion (based on commissioning and testing)	n/a
4. Occupation (based on measured performance)	n/a

Unit of measurement

The unit of measurement to be used for reporting on this indicator is a percentage that represents the share of recycled materials used in the building (kg) on the total amount of building materials.

Boundary and scope

The scope encompasses the building materials excluding the technical installations. All the elements of the construction are taken in account: foundations, bearing structure, envelope, slabs.

It is possible to take in account both the postconsumer and preconsumer recycled content of a material. It is possible to include the preconsumer content in the calculation only if it isn't reused in the same industrial process.

The reference standard for the definition of preconsumer and postconsumer content is the EN ISO 14021 (Environmental labels and declarations - Self-declared environmental claims - Type II environmental labelling).

The minimum scope of the indicator shall include the following building parts and elements:

Building parts	**Related building elements**
Shell (substructure and superstructure)	
Foundations (substructure)	Piles Basements Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs) Upper floors External walls Balconies
Non-load bearing elements	Ground floor slab Internal walls, partitions and doors Stairs and ramps
Facades	External wall systems, cladding and shading devices Façade openings (including windows and external doors) External paints, coatings and renders
Roof	Structure weatherproofing
Parking facilities	Underground

Calculation method and reference standards

To calculate the value of the indicator it is necessary to compile a Bill of Materials (BoM) that is a mass-based inventory of the different materials (kg) that compose a building. The BoM is organised according to main elements that a building is composed of.

The starting point is the Bill of Quantities (BoQ) that specifies the elements of a building (e.g. foundations, columns). The BoQ comprises different categories of elements, which can have different functional

performance characteristics. A BoM differs from a BoQ in that it describes the different materials (e.g. wood, steel, aluminium) that are contained in the various building elements. Once the BoM has been compiled, it is possible to calculate the value of the indicator.

The following steps should be followed in order to characterize the indicator:

- Compile the Bill of Quantities: A BoQ is compiled which comprises the building elements accounting for at least 99% of the mass of the building.
- Identify the basic composition of each building element. A breakdown of its constituent materials has to elaborated. The mass of each constituent material has to be estimated;
- Aggregation by material: the mass of all constituent material should thereafter be aggregated to obtain the **total mass of materials used in the building (A)**;
- Identify the recycled content of each constituent material (in mass);
- Aggregation by material: the recycled mass of all constituent materials should thereafter be aggregated to obtain the **total recycled mass of materials (B) used in the building**;
- The indicator's value is calculated as B/A (total mass of recycled materials on the total mass of materials).

Criterion 10: Construction and demolition waste

The focus of the criterion is on waste that may arise in the life cycle of a building. The demolition of buildings can typically generate between 664 and 1637 kg/m2 of waste. Major renovations can generate between 20 and 326 kg/m2 of waste and construction sites can generate a further 48 – 135 kg/m2 of waste.
Consequently, there are significant opportunities to reduce waste by moving to a more circular economy-based approach that focuses on deconstruction instead of demolition, and on reuse and recycling instead of disposal.

Life cycle stage(s)	**Building-related activities**
Part of the previous building's life cycle	Deconstruction and demolition of a building(s) in order to clear a site for a new building construction
	Part deconstruction of a building(s) in order to prepare useful parts for in-situ reuse
	Preparation of a building in order to facilitate a major renovation
Life cycle stages A3/5 – Manufacturing, Transport, Construction	Construction on site of a new building and/or the prefabrication/construction of parts and elements off site
Life cycle stages C1/3, D – De-construction, Transport, Waste processing,	Deconstruction and demolition of the building at a future point in time beyond the end of its service life

Overview of the indicator

The common performance assessment focuses on gathering data to report on the total waste disposed of and waste diverted. This requires confirmation of the waste types and whether the data is estimated or from a site. The reporting is at a basic level, making a distinction between waste disposed of and waste diverted.

For each of the defined stages in the life cycle of a building, and as relevant to the nature of the building project being reported on, the following categories of output flows shall be reported on, with the option to disaggregate each flow by material stream:

- Waste disposed of: hazardous and non-hazardous waste streams. This shall include waste disposed of to landfill and by incineration.
- Components for re-use: This shall include all materials recovered for re- use either on or off site, with a focus on encouraging the reuse of structural elements.
- Materials for recycling: This shall include all materials recovered for recycling either on or off site. Waste materials used in backfilling operations on or off site are excluded.
- Materials for other material recovery operations: This shall include backfilling and processes that meet the EU definition of energy recovery.
- Waste generated during the prefabrication or assembly of parts or elements off site that would otherwise take place on site shall be included within reporting on waste disposed of. This is to ensure that any burden shifting in order to reduce on-site waste is accounted for.

The flows reported on under the scope of this indicator reflect those defined 'indicators describing additional environmental information' in the reference standards EN 15978 (Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method).

Use of the indicators at the different project stages

Project stage	Activities
1. Design stage (based on estimations)	Estimations of waste based on surveys of existing buildings that will undergo major renovation or where the structure will be reused (life cycle stage B5). Estimations based on scenarios for deconstruction and demolition of the building at a future point in time beyond the end of its service life (life cycle stages C1/3, D).
2. Construction stage (based on data recorded from the site)	Data from deconstruction and demolition of (a) building(s) in order to clear a site for a new building construction (as part of a previous life cycle). Data from the part deconstruction of (a) building(s) in order to prepare useful parts for in-situ reuse.Data from construction on site of a new building and/or the prefabrication/construction of parts and elements off site (life cycle stages A3/5). Data from preparation of a building in order to facilitate a major renovation.
3. Completion stage (based on estimations supported by as-built drawings)	Estimations based on scenarios for deconstruction and demolition of the building at a future point in time beyond the end of its service life (life cycle stages C1/3, D).
4. Post-completion (based on commissioning and testing)	n/a
5. Occupation (based on measured performance)	n/a
6. End of life (based on planned performance)	Details of measures that were taken at design stage to facilitate deconstruction, reuse and recycling at a future date (life cycle stages C1/3, D).

Unit of measurement

The common unit of measurement for output flows associated with construction and demolition processes is kg of waste and materials generated per 1 m2 of useful floor area demolished or constructed (kg/m2/life cycle stage reported on).

Boundary and scope

The scope shall encompass waste (output flows) arising from the end-of-life buildings and their parts, as well as all materials that are ready for construction that are brought onto a building site (input flows) and are intended to form part of a building and external works within the site boundary, as well as from associated application and assembly processes.

The boundary of the indicator will depend on the point in the project and its life cycle at which the waste being reported on arises.
Burden shifting of waste from construction sites shall be accounted for by extending the boundary of the reporting. In practice, this means that for any task that could have taken place on-site but has been shifted off-site to a factory (e.g. prefabricated wall panels or brick facings) the waste arisings associated with that activity in the factory shall be accounted for.

ISSUE: Water

Intent: Make efficient use of water resources

Criteria:

11: Water consumption
12: Net potable water consumption

Criteria: 10. Water consumption, 11. Net potable water consumption

The "Water consumption" criterion estimates or measures the water consumption of sanitary fittings/devices and water consuming appliances that are relevant to the building design, based on which consumption rates are used (i.e. specific data from suppliers or default data provided) and what usage factors are assumed. This indicator can be applied to new or existing buildings in order to understand, and ultimately decrease, the water demand.
The "Net potable water consumption" criterion estimate the net consumptions of potable water, subtracting from the total water consumption the non-potable water, for instance when rainwater or greywater collection systems are installed.

Criterion	**Water consumption**	**Net potable water consumption**
Indicator	Water consumption per occupant per year	Potable water consumption per occupant per year
Unit of measure	m^3 of water per occupant per year	m^3 of water per occupant per year
Assessment	Calculation, measurement	Calculation, measurement

Use of the indicators at the different project stages

Project stage	Activities
1. Design stage (based on calculations)	Calculated water consumptions and non potable water use.
2. Completion stage (based on as-built drawings)	Verification installed sanitary devices/fittings and water using appliances.
3. Post-completion (based on commissioning and testing)	Verification that as-built and installed sanitary devices/fittings and water using appliances reflect those as designed.
4. Occupation (based on measured performance)	Measurement of consumptions and non-potable water use.

Unit of measurement

Water consumption during the use phase of the building life cycle in m^3 per occupant per year is calculated based on the estimated use of water consuming appliances and sanitary fittings in the building.

Boundary and scope

The water use measured by the indicator relates to life cycle module B7 'operational water use' in the reference standard EN 15978. The scope of the term "operational water use" includes the use of both potable water and non-potable water and applies to processes for:

- drinking water,
- water for sanitation,
- domestic hot water,

The boundary covers the time period from the handover of the construction works to the point in time when the building is deconstructed/demolished.

Calculation method and reference standards

The user must include in the calculation the sanitary devices/fittings (i.e. toilets, taps and showers) and water using appliances (i.e dishwashers ans washing machines). Consumption rates for different sanitary devices and fittings are determined through specific data from suppliers. The specific usage factors have to be established. The number of days that the building is expected to be occupied per year has to be defined by the user. The principle of the per occupant water consumption calculation for taps and showers is as follows:

$$Total\ consumption\ \left(\frac{L}{occupant.\,d}\right) = Consumption\ rate\ \left(\frac{L}{min}\right) x\ Usage\ factor\ \left(\frac{min}{occupant.\,d}\right)$$

$$Total\ consumption\ \left(\frac{m^3}{ocucpant.\,year}\right) = Total\ consumption\ \left(\frac{L}{occupant.\,d}\right) x\ 0.001\left(\frac{m^3}{L}\right) x\ occupancy\ rate\ \left(\frac{d}{year}\right)$$

The exact same principle applies for calculations for toilets (except that flushes are used instead of minutes).

For cleaning, the basis of the calculation is as follows:

$$Total\ consumption\ \left(\frac{L}{year}\right) = Consumption\ rate\ \left(\frac{L}{m^2}\right) x\ area\ (m^2)\ x\ no.cleans\ per\ year\ (year^{-1})$$

$$Total\ consumption\ \left(\frac{m3}{occupant.year}\right) = Total\ consumption\ \left(\frac{L}{year}\right) x\ 0.001\left(\frac{m^3}{L}\right) \div\ full\ time\ eqivt.ocucpancy\ (occupant)$$

The consumption of water from not potable sources has to be specified (i.e. toilet flush from grey water).

ISSUE: Indoor environmental quality

Intent: design of buildings that are comfortable, attractive and productive to live and work in and which protect human health.

Criteria:

13 Quality of air - Ventilation (use stage)
14 Quality of air – CO_2 (use stage)
15 TVOC from construction materials
16 Formaldehyde from construction materials
17 Thermal Comfort

Criteria: 13 Quality of air - Ventilation, 14 Quality of air - CO_2 concentration, 15 TVOC from construction materials, 16 Formaldehyde from construction materials

The indicators for good quality indoor air conditions measure the two main parameters identified in EN 15251 (Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics) as being important to the provision of a healthy and comfortable indoor air supply to occupants – ventilation (rate of air change) and CO_2 levels.

The indicators for source control of target air pollutants measure the most significant potential hazards to human health that can enter indoor air. Building occupiers can be exposed to a range of potential emissions of volatile and carcinogenic organic compounds. In an air tight, modern home or office, the most significant direct emissions sources related to construction products and fit out materials are understood to be:

- paints and varnishes,
- textile furnishings,
- floor coverings,
- associated adhesives and sealants, and
- fit-out materials that incorporate particle board.

The indicators make it possible for users to evaluate indoor air conditions and the control of target air pollutants at three main points in time along the building project stages – design, post-completion (prior to occupation) and post- occupancy.

Criterion	**Quality of air - Ventilation**	**Quality of air – CO2**	**TVOC from building products**	**Formaldehyde from building products**
Indicator	Ventilation rate (air flow)	CO_2 concentration	TVOC concentration	Formaldehyde concentration
Unit of measure	Litres per second per square metre	Parts per million	µg per cube meter	µg per cube meter
Assessment	Calculation, measurement	Measurement	Measurement	Measurement

Use of the indicators at the different project stages

Project stage	**Activities**
1. Design stage (based on calculations)	Design of the building fabric and ventilation systems to meet target ventilation rates Source control of target pollutants by selection of building products according to their tested emissions.
2. Completion stage (based on as-built drawings)	Verification that as-built and installed building fabric and services reflect those as designed.
3. Post-completion (based on commissioning and testing)	In-situ measurement of the indoor concentration of target pollutants prior to occupation. Functional performance testing of ventilation filters and their suitability for the building location.
4. Occupation (based on measured performance)	In-situ measurement of the indoor concentration of target pollutants during occupation with furniture, fixtures and fittings in place. In-situ measurement of the CO2 and relative humidity levels.

Units of measurement

The indicators require the measurement of a number of parameters.

Criterion	Indicator	Units of measurement
Ventilation	Ventilation rate (air flow)	l/s per m2
Quality of air - CO_2	CO_2 concentration	ppm
TVOC from building products	TVOC concentration	µg/m³
Formaldehyde from building products	Formaldehyde concentration	µg/m³

The performance is assessed for the indoor air quality as experienced by occupiers of the useful (conditioned) space within a building. Within the EPB standards EN 15603 and prEN 52000-1, the good quality indoor air condition parameters form part of the building occupancy and operating conditions module.

The ventilation rate shall be normalised to the useful floor area of the building. This shall allow for the design ventilation rate to be related to the potential for dilution of indoor emissions as specified in EN 15251 and the superseding standard EN 16978.

CO_2, TVOC and Formaldehyde concentrations shall to be characterized trough in situ measurements prior to occupation (post-completion phase). Testing shall be carried out for a minimum of 10% of the apartments or units and be representative of any significant variations in apartment or unit typologies, configurations and materials. Sampling devices shall be placed in the centre of a room so as not to be influenced by doors, windows or heating/cooling inputs.

Formaldehyde concentration: sampling and detection method - 30 minutes average in accordance with ISO 16000-3 (Indoor air -- Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air -- Active sampling method)

TVOC concentration: sampling and detection method shall to be in accordance with ISO 16000-6 or equivalent.

CO^2 concentration: the direct sampling of the air in rooms shall to be carried out over 1 week or 7 working days.

In the design stage product testing shall to be used as a mean of source control. Test results showing the emissions after 28 days shall be reported for each material or finish to be installed that falls within the identified scope. The determination of emissions shall be in conformance with CEN/TS 16516 (Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air). Test data is therefore required from manufacturers/suppliers of the selected building products, as defined in the scope. All testing shall be on the as-finished product.

Boundary and scope

The boundary for the criteria is the useful conditioned floor area and the related indoor air conditions as experienced by occupants of a building within those zones of the building. The scope is at design stage, by the choice of any of the following building materials and products:

- Ceiling tiles
- Paints and varnishes, including those applied to stairs, doors and windows
- Textile floor and wall coverings
- Laminate and flexible floor coverings
- Wooden floor coverings
- Associated adhesives and sealants

In addition, internal insulation products, as well as special interior surface treatments (e.g. to resist damp), shall be included within the scope.

Criterion: 17. Thermal comfort

The focus of this indicator is on the ability of the building to maintain pre-defined thermal comfort conditions during the heating and cooling seasons

The indicator measures, by proxy, the proportion of the year when building occupiers may feel thermal discomfort.

Criterion	**Thermal comfort**
Indicator	Time outside the thermal comfort range
Unit of measure	Percentage of the time out of range of defined maximum and minimum temperatures during the heating and cooling seasons (%)
Assessment	Calculation, measurement

Use of the indicators at the different project stages

Project stage	Activities
1. Design stage (based on calculations)	As a component of calculated EPB assessment sub types: design or tailored Consideration of different aspects of thermal comfort, including localised discomfort effects
2. Completion stage (based on as-built drawings)	As a component of calculated EPB assessment sub types: as built
3. Post-completion (based on commissioning and testing)	Commissioning: functional performance testing
4. Occupation (based on measured performance)	As a component of measured EPB assessment sub types: climate corrected, use corrected or standard Comparison of estimated satisfaction levels with those obtained from occupier surveys.

Unit of measurement

The common unit of measurement is the percentage of the time out of range of defined maximum and minimum temperatures during the heating and cooling seasons. The performance is assessed for the useful floor area of the building and the projected pattern of use for the building. The performance of a building should always be assessed both with and without mechanical cooling. If energy modelling is carried out, an area weighted average shall be reported.

Boundary and scope

The scope of the indicator is the internal operating temperature and comfort condition of the occupiers within the building.

The assessment boundary is the building. Heat losses and gains that will affect the comfort conditions within the building, as well as the heating and cooling energy that may be required to maintain these conditions, are to be considered. The reported performance shall apply to 95% of the useful spaces assessed.

Calculation method and reference standards

Calculation of the reported performance shall be in accordance with the method described in Annex F of EN 15251 (Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics) and/or an overheating assessment that forms part of a National Calculation Method. Buildings with and without mechanical cooling shall be assessed. Those buildings which have full or mixed mode mechanical cooling shall additionally assess the performance of the building fabric without mechanical systems such as Heating, Ventilation and Air Conditioning (HVAC).

The quasi-steady state and simplified hourly methods described in EN ISO 13790 (Energy performance of buildings. Calculation of energy use for space heating and cooling) may be used. Alternatively, if a dynamic

method is used, the results shall be validated according to EN ISO 52016-1 or the criteria and test cases in EN 15265.

If there is the intention to carry out post-occupancy evaluation of satisfaction/dissatisfaction with the thermal environment, the Predicted Percentage Dissatisfied (PPD) shall be estimated based on EN ISO 7730 (for mechanically cooled buildings) or the acceptable summer indoor temperature range (for buildings without mechanical cooling). The estimate PPD can then be compared with the results from an occupier survey.

ISSUE: Life cycle cost

Intent: Optimisation of the life cycle cost and value of buildings to reflect the potential for long-term performance.

Criterion:
18. Life cycle cost in the operational stage

Criterion:18 Life cycle cost in the operational stage

Criterion	**Life cycle cost in the operational stage**
Indicator	Life cycle annual cost per usable floor area
Unit of measure	Euros per square metre of useable floor area per year (€/m2/yr)
Assessment	Calculation, measurement

The focus of the criteria is on the costs of operation and maintenance.
Reporting is required for the following stages:

- Use stage energy and water costs (life cycle stages B6 and B7). The utility costs associated with occupation of a building, inclusive of communal costs of operating a building and the costs associated with occupier energy and water use;

- Long-term maintenance, repair and replacement costs (life cycle stages A1-3/B2–4). The future cost assumptions relating to maintenance, repair and replacements shall be accounted for. This shall include reactive, cyclical and major planned activities.

Reporting can be based on estimated performance at the design stage and after monitoring of performance during occupation. This means they can be used by a range of project actors, including during the design stage, to estimate future performance and performance following occupation so as to check how the building is actually performing against projected short, medium and long-term cost schedules.

Use of the indicators at the different project stages

Project stage	Activities
1. Design stage (based on estimates and assumptions)	Cost estimates and modelling: Based on the client's requirements and detailed designs.
2. Completion stage (based on as-built drawings)	n/a
3. Post-completion (based on commissioning and testing)	n/a
4. Occupation (based on measured performance)	Metered utility costs: Real energy and water cost performance data. Monitoring of maintenance and replacement costs:.

Unit of measurement

The common unit of measurement for each life cycle stage is euros per square metre of useable floor area per year (€/m2/yr).

The common unit shall be based on the net present cost of each life cycle stage. This shall be calculated by applying a discount rate to the costs incurred for each year of the reference study period.

The net present costs should generally be calculated using real costs, i.e. excluding inflation. However, assumptions about inflation may also be included within the discount rate if nominal costs are required for the purpose of detailed financial planning.

Boundary and scope

The system boundary encompasses the product and operational life cycle stages.

The minimum scope of the indicator shall include the following building parts and elements:

Building parts	Related building elements
Shell (substructure and superstructure)	
Foundations (substructure)	Piles Basements Retaining walls
Load bearing structural frame	Frame (beams, columns and slabs) Upper floors External walls Balconies
Non-load bearing elements	Ground floor slab Internal walls, partitions and doors Stairs and ramps
Facades	External wall systems, cladding and shading devices Façade openings (including windows and external doors) External paints, coatings and renders
Roof	Structure Weatherproofing
Parking facilities	Underground

Core (fittings, furnishings and services)	
Fittings and furnishings	Sanitary fittings Cupboards, wardrobes and worktops (where provided in residential property) Ceilings Wall and ceiling finishes Floor coverings and finishes
In-built lighting system	Light fittings Control systems and sensors
Energy system	Heating plant and distribution Cooling plant and distribution Electricity generation and distribution
Ventilation system	Air handling units Ductwork and distribution
Sanitary systems	Cold water distribution Hot water distribution Water treatment systems Drainage system
Other systems	Lifts and escalators Firefighting installations Communication and security installations Telecoms and data installations
External works	
Utilities	Connections and diversions Substations and equipment
Landscaping	Paving and other hard surfacing Fencing, railings and walls Drainage systems

Calculation method and data requirements

The method for the common performance assessment requires reporting on the costs by life cycle stage. The reference standard for calculating the life cycle costs of each life cycle stage shall be ISO 15686-5 (Buildings and constructed assets. Service life planning. Life-cycle costing) and EN 16627 (Sustainability of construction works. Assessment of economic performance of buildings. Calculation methods). The reference standard ISO 15686-8 provides a methodology for calculating and estimating the design life of elements and components.

Implementation of Key Performance Indicators

In the workshop "Key Performance Indicators for greening the Alpine infrastructure" held in Garmisch-Partenkirchen on October 23th 2017, a second group of experts discussed the issue of the implementation of KPIs in the assessment tools and policies of the Alpine regions. In the following paragraphs, the main outcomes of the discussion are presented.

Introduction and challenges

Buildings play a central role in our societies, providing places to live, work and enjoy leisure time. They are the core of our urban environment, impacting the social, economic and ecological aspects of our lives such as our health, comfort and safety. On average, we spend over 80% of our lives within buildings and the construction sector is nowadays a key component of our economy.
Furthermore, the construction sector has a significant influence on environment, energy consumption and climate change. Alone, it represents around 42% of final energy consumption and 36% of CO_2 emissions throughout the EU and is a major consumer of intermediate products (raw materials, chemicals, electrical and electronic equipment, etc.).
Therefore, the building sector has become a cornerstone of the EU climate protection program and has a crucial role to play in the achievement of the long-term 80-95% greenhouse gas emission reduction objective. In this perspective, the EU released a series of political and legislative initiatives in order to reduce the environmental impact of buildings by improving their overall resource efficiency and, as a consequence, enhancing the competitiveness of construction businesses and the quality of life of citizen. Meaningful progress has already been made, but the gap with long-term European goals still remains substantial.
Buildings must be viewed holistically and examined in the context of their impact on the environment and across their life-cycle. Within this strategic context, building assessment systems are crucial tools in driving the built environment towards sustainability, but the plethora and mismatch of buildings regulations at regional and national level leads to considerable administrative burdens. They increase compliance costs for businesses, create confusion among the actors and lead to a very fragmented sustainable construction market. Every region / state in Alpine Space assess somehow the quality of buildings, mainly focusing on energy. Research has shown, the assessment differs in:

- different legal, cultural and environmental frameworks (mayor cities and small villages, local, regional and national building standards and construction codes, different level of integration in subsidy systems, different level of involvement of stakeholders);
- different assessment methods: coexistence of performance based and strategy-based tools;
- different assessment tools with different numbers and types of issues / indicators included in the tools and different distribution of criteria among the key issues: environmental, social and economic;
- different ways to score the performance;
- different actors, from national to regional institutions, most important are regional energy associations and assessment scheme operators.

Consequently, a comparison of building assessment results is nearly impossible, and the application of such tools is limited. As pointed out by the European Commission in its recent Communications "Resource efficiency opportunities in the building sector" (COM (2014) 445 final) and "Strategy for the sustainable

competitiveness of the construction sector and its enterprises" (COM/2012/0433 final) one of the main issues in the building sector remains the lack of comparable and accessible data and assessment methodologies. As the Alpine Space is fragile and affected by climate change, action is of highest importance. As the Alpine Space is fragmented in rather autonomous regions with independent building cultures the task is challenging.

Possible benefits and risks of an implementation of common key performance indicators for the building sector

The implantation of common key performance indicators for the building sector cannot be implemented in a top down approach. All stakeholders have to be convinced by the possible benefits of a common Alpine approach. CESBA - Common European Sustainable Built Environment Assessment suggests the harmonization of building assessment systems. Also, the European Commission in its "Action Plan concerning the European Union Strategy for the Alpine Region" suggested EUSALP Action Group 9 to support the development of harmonised, affordable and operational assessment tools to promote and boost sustainable and low-carbon buildings in the Alpine Region (COM/2015/147final). In the frame of its first triannual work plan 2017-2019, EUSALP Action Group 9 decided to investigate into the feasibility of developing and promoting a set of common key performance indicators for sustainable building assessment systems.

Main benefits of the harmonization of building assessment systems are:

- Comparability of the building stock performance and therefore enables policy makers to better steer the development of the sector. The competition between regions and policies will be enhanced and benefits of the different approaches will get visibility. A common communication on the building sector will emerge.
- Improvement of regional / national assessment systems by a guided harmonization process in line with latest European guidelines and regional / national success stories.
- Opportunity to change and improve the existing assessment systems by integrating the Alpine transnational approach. Minimum standards shall be defined, consequences of non-compliance shared. The modernization rate of buildings shall be increased. The quality of buildings will be improved as well as the quality of life of the building users.
- Enhancing knowledge diffusion among companies and thus improve the control of the quality of buildings and eliminate export burdens for SMEs. As underlined by the European Commission „Communication on Resource efficiency opportunities in the building sector" (COM (2014) 445 final): „There is a risk that the indicators they [Member States] eventually develop will differ, leading to an unnecessarily complex business environment." This may lead to lower costs for sustainability measures.

Nevertheless, any change of a running assessment system risks to increase complexity and the costs for measuring the performance of buildings. A top down process may lead to an unwanted damage of local building culture and communication flows, therefore a bottom up process is of outmost importance. Also, this may reduce the risk of introducing indicators without contextualization to regional needs.

Key issues for implementation

The implementation process needs preparation and agreement by the different regions / states in the Alpine Space. Furthermore, it needs a common agreement on basic principles. A political commitment for harmonizing the assessment of sustainability of buildings would be needed on the Alpine level to embed the process of developing and integrating EUSALP Key Performance Indicators for sustainable construction. The needs and benefits for such activities shall be officially formulated in a common policy paper, and could be developed by the EUSALP Action Group 9.

In general, the assessment scheme resulting from the bottom up harmonization process shall be easy to apply, simple to use, of low costs (only minimum additional costs to running systems), and based on a few indicators only. Key performance indicators shall cover building equipment and various aspects of building usage. Additionally, a common passport could help to contextualize regional results to the transnational approach.

The possible effects and access points for the implementation in the existing policy framework shall be addressed. The harmonization process could foster the integration of the assessment system to regional / national subsidy systems and green public procurement processes. Additionally, the distribution of European funds could relate to the assessment accordingly. Future regional activities shall contribute to the transnational activities.

A common database with product declarations or similar is needed but not defined yet. The existing databases Baubook (Austria) is a good starting point for elaboration. Further research on Alpine and European level is needed. The connectivity to running or upcoming European activities shall be approved. Furthermore, a common structure for collecting building results shall be established in correlation of running systems.

The harmonized building assessment system shall affect the wide building culture including trainings of workers, quality checks on the construction site, support of public administrations.

Partner to be involved

EUSALP Action Group 9 consists of various partners with various territorial expansions. The cooperation with the association CESBA offers further opportunities on assessment schemes. Nevertheless, the involvement of the ARGE Alp and Alpine Convention offer the strong linkage between the public and the intermediate sector on Alpine, national and regional level. The partnership shall be on mutual benefit to all. Further clarifications processing the partnership could be developed by EUSALP AG 9.

EUSALP KPIs and the EU initiative Level(s)

Level(s) is a voluntary reporting framework to improve the sustainability of buildings. Using existing standards, Level(s) provides a common EU approach to the assessment of environmental performance in the built environment. For each indicator, a 'graduated' approach is possible, enabling users to move from simple through to more complex and precise calculation methods and extended reporting. Each indicator within Level(s) can be used for different types of performance assessment, from a basic level to a full Life Cycle Assessment (LCA).

As stated before in this study, a common set of indicators that reflect EUSALP and EU policy objectives for the environment, health and the built environment has been defined by experts with the support of CESBA, on the base of Level(s) and CESBA KPIs. There is an important way of convergence between these two approaches:

Mandatory EUSALP KPIs:	**Source in LEVEL(s)**
Primary energy demand	Level(s) – indicator 1.1.1
Delivered energy demand	Level(s) - supporting indicator 1.1.2
Renewable energy in primary energy consumptions	Level(s) – indicator for reporting
Renewable energy in final thermal energy consumptions	Level(s) – indicator for reporting
Renewable energy in final electric energy consumptions	Level(s) – indicator for reporting
Global Warming Potential	Partial Level(s) indicator – Life cycle Global Warming Potential 1.2. Only the "use stage" life cycle stage is considered.
Quality of air - Ventilation	Level(s) – part of indicator 4.1.1
Quality of air – CO_2 concentration	Level(s) – part of indicator 4.1.1
TVOC from construction materials	Level(s) – part of indicator 4.1.2
Formaldehyde from construction materials	Level(s) – part of indicator 4.1.2

Recommended EUSALP KPIs:	Source in Level(s)
Embodied non-renewable primary energy	CESBA KPI but linked to Level(s) Life cycle tool 2.1
Materials from renewable sources	CESBA KPI but linked to Level(s) Life cycle tool 2.1
Recycled materials	CESBA KPI but linked to Level(s) Life cycle tool 2.1
Construction and demolition waste	Level(s) – indicator 2.3
Water consumption	Level(s) – indicator 3.1
Net potable water consumption	Level(s) – indicator for reporting
Thermal Comfort	Level(s) – indicator 4.2
Life cycle cost in the operational stage	Level(s) – indicator 6.1

Quantitative Level(s) Indicators not included (Garmisch-Partenkirchen workshop outcome) because not enough operational (complexity or lack of data) or considered out of scope:

- 1.2 Life Cycle Global Warming Potential, EUSALP KPI is not taking in account the life cycle stages product, end of life, benefits and loads beyond the system boundary
- 4.1.2 EU LCI ratio and Mould
- 4.1.2 Pollutants from outside air

Note: an indicator for reporting is intended to be an information complementary to the main indicator (i.e. Primary energy demand is the head indicator, Renewable energy in primary energy consumptions is an additional information to better understand the building's performance)

Appendix 1: Overview of main building assessment schemes in the EUSALP territory

This chapter lists the main building assessment schemes in the EUSALP territory. It is not exhaustive, as many assessment tools exist, at regional level, but also at local level, city level.

Every scheme has its own characteristics, perimeter, certification process, legal entity. Some schemes are only internal tool used by a public authority to subsidy sustainable buildings, other ones have their own legal entity, certification process.

But they all have in common the aim to encourage the construction/renovation on sustainable standards, and even if these standards are contextualized to the local/regional priorities, there is a potential for harmonization around few Key performance Indicators.

France: Region Provence Alpes Côte d'Azur

Who?

EnvirobatBDM is a non-profit organization that gathers stakeholders involved in sustainable urban planning, construction and renovating within Mediterranean climate: local authorities, private or public owners, project managers (engineers, architects…), companies, building industry trade associations. The goal is to promote the generalization of sustainable buildings in the Mediterranean area.

Functioning

EnvirobatBDM developed a support and assessment approach based on a Participatory Guarantee System (PGS), a master grid and an inter-professional validation. The protocol is dynamic, according to the context, the climate and the function (individual house, collective housing, tertiary building, school). All projects are managed by a EnvirobatBDM Assessor. This assessor is a member of the design team or assists the contractor or the future users. He coordinates the team to respond to the sustainable targets developed in our tools.
The assessment grid falls in 7 themes, with 4 levels of labelling (Cap, Bronze, Silver, Gold) with a 3 steps approach (conception, construction, in-use), in a participative management system (the commission is public and free). From 2017, EnvirobatBDM is also assessing neighborhoods. The approach of BDM is spreading in 3 other French regions.

Links with regional policies

EnvirobatBDM has many links with regional policies, and is partly funded by the regional council. As an example, secondary schools (regional competency) are built under the standards of EnvirobatBDM.

More info: www.envirobatbdm.eu

France: Region Auvergne Rhône-Alpes

Who?

In Auvergne Rhône-Alpes, there is no regional assessment scheme; local ones are in use in some cities. The one used for social housing is not anymore in use. Nevertheless, the regional council has chosen to finance energy efficient buildings through the use of ERDF funds (AXE2, OT4, OS12: thermal renovation or new construction, for tertiary sector).

Functioning

Department in charge of ERDF funds at region al council asked the regional energy agency (AURA-EE) and the professional organization of designers (VAD) to identify criteria for selecting the projects eligible to the ERDF fund. These criteria were selected in coordination with professional organizations, public authorities and regional/local energy agencies during a workshop in January 2017, and are now the one to be used.
There is a minimum energy consumption standard to respect as a criteria of eligibility (NZEB for new construction, BBC renovation Effinergie in renovation). Other 22 criteria, addressing issues of sustainability, allows to determine if the project can get the funding and applicants have to provide technical information to justify. These criteria are not quantitative for the moment.
The check is made by the regional council, with the support of VAD and AURA-EE.

Links with regional policies

The assessment was born because it was needed to justify the eligibility of subsidies (through ERDF operational funds). The system will be reinforced in the following years: evaluation in public project review, more quantitative criteria. It will be also put in line with the tool for Secondary school used by the regional council for new and renovation of secondary school.

More info: www.europe-en-auvergnerhonealpes.eu

Switzerland: SNBS

Standard Nachhaltiges Bauen Schweiz
Standard Construction durable Suisse

In Switzerland, there are no assessment schemes at canton level, but there is one public existing at national level: the national standard sustainable construction, SNBS 2.0.

Who?

The SNBS was developed at the initiative of the economy and public authorities. Its development was financed by the Swiss Federal Office of Energy via the SwissEnergy program. This broad support gives him credibility. The standard is supported and developed by the Swiss Sustainable Construction Network (NNBS). It aims to:

- develop a concept that covers sustainable construction as a whole, but also emphasizes the key points
- include the Swiss culture of planning and construction
- integrate proven Swiss instruments and labels
- optimize load for users during planning

Functioning

The SNBS proposes a general concept of sustainable construction in Switzerland. The SNBS Building includes the building itself and the site in the context of its environment. It allows the needs of society, the economy and the environment to be considered fairly and as fully as possible in planning, construction and operation. The condition is an overview of the life cycle of a property.
The objectives of the SNBS have been set according to the Federal Council's Sustainable Development Strategy and described using appropriate criteria and indicators. The first version was published in 2013 and tested on 28 buildings during a pilot phase. Since then, the standard has been revised several times because of the experiences. The goal has always been to develop a simple application instrument that adds value to the construction and planning sector.
Since the end of August 2016, the SNBS is available in its current version 2.0. Compared to previous versions, it has become even more flexible and consistent. A certification procedure has been added. It allows the building owner to have his services in terms of sustainable development confirmed by a neutral body. It is currently possible to have Office / Administration and Housing use types certified, whether they are new buildings or existing buildings. Mixed uses with shops on the ground floor are possible. If no certification is targeted, the standard can also be applied to other uses. In practice, schools or production buildings, for example, have already been evaluated with the standard.

More info on: www.nnbs.ch

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Austria: ÖGNI (Austrian Sustainable Building Council)

Who?

ÖGNI, Austrian Sustainable Building Council is an Austrian non-profit association which gathers stakeholders involved in sustainable buildings. ÖGNI is a member of the World Green Building Council

Functioning

ÖGNI certifies according to the German systems DGNB-Blue buildings and DGNB Stadtquartiere (DGNB neighborhood/quarter).

ÖGNI offers two instruments that focus on the entire life cycle of a building or quarter and are based on the idea of an integral planning. In this context, goals of sustainable construction are initially defined so that the future-oriented blue buildings can be realized in the state of the art.

The DGNB certification system is composed of six qualities: economic quality, ecological quality, socio cultural and functional quality, location quality, technical quality, process quality.
For each criterion of the certification system, unique values have been defined. Depending on the degree of fulfilment of a criterion, the auditor shall give his assessment. All criteria of a subject field are then combined into a partial fulfillment level. The partial fulfillment of the topics ecology, economy and socio-cultural and functional aspects as well as technology go into the overall assessment of a building or city quarter with 22.5% each, while processes are 10%. The location quality is shown separately in the buildings, but flows into the assessment via the criterion of marketability. In the certification of districts, the location quality is integrated into the individual criteria. The situation thus significantly influences the overall assessment of the city quarter.

The quality of an assessment is always dependent on how precisely your criteria are formulated. The basis of the DGNB certificate is the core system, which is divided into six thematic fields with some 40 criteria. These criteria can be weighted by usage-specific factors so that a customized assessment of different types of structures is possible. Each usage profile thus receives its own evaluation matrix, which is optimally adapted to the respective usage.

Links with regional policies

No special links to regional policies or public institutions. ÖGNI offers certification to all.

More info on: www.ogni.at/

Austria: ÖGNB

Who?

ÖGNB Österreichische Gesellschaft für Nachhaltiges Bauen or ASBC - Austrian Sustainable Building Council is a non-profit association which gathers stakeholders involved in sustainable buildings.
The ÖGNB was founded on the initiative of renowned independent institutions in the field of sustainable construction in Austria in January 2009. The five founding institutions are Austrian Institute of Ecology, Austrian Energy Agency, Austrian Society for Environment and Technology, Austrian Institute of Structural Biology and ecology and Energy Institute Vorarlberg.

Functioning

ÖGNB uses the total quality building (TQB) assessment system (founded by the Austrian Institute of Ecology and Austrian Institute of Structural Biology and ecology.
The main categories for assessment are:

- Location and Facilities
- Economy and Technical Quality
- Energy and Supply
- Health and Comfort
- Resource efficiency

The general procedure is carried out in five steps:

1. Building documentation using online declaration tools; carried out by ASBC consultants who are appointed by the Austrian Sustainable Building Council
2. Handover of submitted project to the Austrian Sustainable Building Council and application for building surveying (draft contract ASBC - proprietor - German language content)
3. Verification of proof by ASBC auditors, which are listed by the Austrian Sustainable Building Council (draft contract ASBC - third-party auditors - German language content), if necessary revision of proof by ASBC consultants
4. Approval of assessment results by ASBC after consulting with submitters
5. Publication of assessment results in ASBC press, above all on ASBC website

Links with regional policies

No special links to regional policies or public institutions. ÖGNB offers assessments to all.

More info on: www.oegnb.net

Austria: klimaaktiv

Who?

klimaaktiv - the Austrian climate protection initiative
klimaaktiv is the Austrian climate protection initiative launched by the Federal Ministry for Sustainability and Tourism, embedded in the Austrian federal climate strategy.

Functioning

Building declaration: The quality of the buildings is documented in the Online Declaration tool with the help of climate-active criteria. Even at this stage, planning offices or building owners must provide the necessary credentials. Residential buildings are declared in the Declaration tool for residential buildings on www.baubook.at. For service buildings, the online tool can be found on klimaaktiv.baudock.at.
Plausibility check: Through climate-active, a plausibility check of the building quality and the provided supporting notes is independent of the submissions. Only if this is positive, the building will be awarded the climate-active quality mark.
All buildings with the klimaaktiv quality mark are published in the building database www.klimaaktiv-gebaut.at. Particularly ambitious projects are actively supported by Austria-wide public relations activities of the program.

Klimaaktiv criteria
The main categories for assessment are:

- A – Location and quality assurance
- A 1 infrastructure in close proximity
- A 2 building envelope airtight
- A 3 Energy consumption monitoring
- B – Energy and supply
- B 1 Heating heat requirement
- B 2 externally induced cooling requirement
- B 3 Primary energy requirements
- B 4 CO2 emissions
- C construction materials and construction
- C 1 Exclusion of harmful substances
- C 2 avoidance of PVC and other halogen organic compounds
- C 3 Eco-index (OI3) of the whole building (Primary-Energy PEI, Greenhouse gas potential GWP, Acidification Potential AP)
- D – Comfort and indoor air quality
- D 1 Thermal comfort
- D 2 Indoor air quality measurement

Links with regional policies

Additional national support to existing certifications schemes and subsidies schemes of the provinces

More info on: www.klimaaktiv.at/bauen-sanieren

Austria: City of Vienna

Who?

Government of Vienna, Ökokauf Wien (Green Public Procurement in the City of Vienna)

Functioning

In 1998, the City of Vienna established the ÖkoKauf Wien programme to promote climate protection. The programme aims to follow ecological criteria when buying goods, products and services in all areas of the City Administration. In accordance with a decree issued by the Chief Executive Director, all results of the ÖkoKauf Wien project such as criteria catalogues, position papers, studies and sample folders are binding. Experts have drawn up criteria catalogues for procurement procedures in several working groups. An advisory committee for legal affairs evaluates the legal validity of the criteria catalogues. They are written in a way so that the wording can be directly used in the procurement documents.

Criteria

- Printing, Paper and Office Supplies
- Electrical Office Equipment and Household Appliances
- Vehicle Fleet
- Building Services and Lighting
- Construction
- Food
- Cleaning Agents
- Prevention
- Office Furniture
- Textiles
- Position Papers
- Guidelines
- Eco-friendly Building Interiors

Links with regional policies

Green Public Procurement in the City of Vienna

More info on:

https://www.wien.gv.at/english/environment/protection/oekokauf/index.html

Austria: Land Carinthia

Who?

Government of Carinthia, Wohnbauförderung Kärnten (public housing subsidies for Carinthia)

Functioning

The implementation of new environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Carinthia after according to following indicators:

- High density construction and densification
- Energy efficiency and Passive house
- Ecological Index (OI3) (primary-energy PEI, greenhouse gas potential GWP, Acidification potential AP)
- Solar energy
- Barrier-free construction
- Social qualities of users (young family)
- Disabled-accessible measures
- Location quality, structurally weak rural area

Links with regional policies

The regional assessment system was launched by the Government of Carinthia for steering housing standards in Carinthia.

More info on:

https://www.ktn.gv.at/Verwaltung/Amt%2dder%2dKaerntner%2dLandesregierung/Abteilung%2d2/Wohnbau/Wohnbauf%c3%b6rderung%202018

Austria: Land Lower Austria

Who?

Government of Lower Austria, Wohnbauförderung Niederösterreich (public housing subsidies for Lower Austria)

Functioning

The implementation of new environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Lower Austria after according to following indicators

- Heating system with renewable energy or biogenic district heating
- Alternatively, heat pump systems or connection to district heating from power heat coupling systems
- Photovoltaic system
- Controlled living room ventilation
- Ecological building materials
- Safety measures
- Green roof, ecological garden and open space design, rainwater use
- Accessibility

Links with regional policies

The regional assessment system was launched by the Government of Lower Austria for steering housing standards in Lower Austria.

More info on: www.noel.gv.at/noe/Wohnen-Leben

Austria: Land Salzburg

Who?

Government of Salzburg, Wohnbauförderung Salzburg (public housing subsidies for Salzburg)

Functioning

The implementation of new environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Salzburg after according to following indicators

- Ecological building materials (OI3-Index (Primary-Energy PEI, Greenhouse gas potential GWP, Acidification Potential AP)
- Thermal protection and energy efficiency
- Noise insulation
- Accessibility
- Equal opportunities for small enterprises

Links with regional policies

The regional assessment system was launched by the Government of Salzburg for steering housing standards in Salzburg.

More info on:

https://www.salzburg.gv.at/themen/bauen-wohnen/wohnen/wohnbaufoerderung

Austria: Land Styria

Who?

Ökologische Wohnbauförderung (für Sanierungen)
Government of Styria, Wohnbauförderung Steiermark (public housing subsidies for Styria)

Functioning

The renovation of environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Styria after according to following indicators:
Material flow

- Resource availability
- Ability to disconnect or dismantle of recycled materials
- Recyclability

OI3Index

- Primary-Energy PEI
- Greenhouse gas potential GWP
- Acidification Potential AP

Energy, innovation and social aspects

- Heating with 100% renewable raw materials
- Heat pump heating
- Decentralized heat transfer station
- Controlled living room ventilation
- Heat recovery and heat exchangers of technical equipment
- District heating Connection
- Solar thermal systems with or without heating (hot water)
- Level of technical innovation
- Ecological building materials, spatial planning aspects
- Minimum land sealing, rainwater use
- Passive House standard
- Material for windows, balconies and terraces doors (wood or wood-aluminum)
- Climate: Active – House certificate
- Special measures to increase soft, low-emission mobility (e-mobility, public transport, bicycle)
- Social aspects, such as voluntary lift installation, measures to increase safety

Links with regional policies

The regional assessment system was launched by the Gov. of Styria for steering housing standards in Styria.

More info on: http://www.wohnbau.steiermark.at

Austria: Land Tyrol

Who?

Government of Tyrol, Wohnbauförderung Tirol (public housing subsidies for Tyrol)

Functioning

The implementation of new and renovated environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Tyrol after according to following indicators:

- Improving energy efficiency
- Highly efficient alternative energy systems
- Solar energy use
- Sun protection device with time control
- Comfort Ventilation
- Ecological advantageous building materials
- Proof of quality for planning and execution (e.g. climate active)
- Air tightness

Links with regional policies

The regional assessment system was launched by the Government of Tyrol for steering housing standards in Tyrol.

More info on: www.tirol.gv.at/bauen-wohnen/wohnbaufoerderung/

Austria: Land Upper Austria

Who?

Government of Upper Austria, Wohnbauförderung Oberösterreich (public housing subsidies for Upper Austria)

Functioning

The implementation of new environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Upper Austria after according to following indicators:

- Ecological insulating materials (HFC-free and HCFCs-free thermal insulation and building materials)
- Minimum energy standards
- Technical equipment
- Furnishing of the apartments
- Total construction costs
- Underground garage

Links with regional policies

The regional assessment system was launched by the Government of Upper Austria for steering housing standards in Upper Austria.

More info on: www.land-oberoesterreich.gv.at/12819.htm

Austria: Land Vorarlberg

Umweltverband
Vorarlberger Gemeindehaus

Who?

Municipal building pass (Kommunalgebäudeausweis KGA)
Umweltverband – Vorarlberger Gemeindehaus (Environmental Association) supports municipalities by paying subsidies to municipalities who plan build or refurbish their municipal buildings optimised on energetic and ecological level.

Functionning

As a basis for the assessment, the Environmental Association has developed a municipal building pass with experts. This document evaluates the energetic and ecological performance of a general refurbishment or a new building in the following categories:

- Process and planning quality
- Energy and supply
- Health and Comfort
- Building materials and construction

The municipal building pass can be created by various offices-if they were not involved in the planning and/or execution process of the construction project.
The training of municipal building pass providers, an international exchange with experts and corresponding PR measures were developed within the framework of the transnational Alpinespace project ENERBUILD.

Links with regional policies

Energy autonomy Vorarlberg
The regional assessment system in Vorarlberg is used by the Government of Vorarlberg for its own public buildings.

More info on: www.umweltverband.at/bauen/kommunalgebaeudeausweis-kga

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Austria: Land Vorarlberg

Who?

Government of Vorarlberg, Wohnbauförderung Vorarlberg (public housing subsidies for Vorarlberg)

Functioning

The implementation of new and renovated environmentally-friendly and energy-saving buildings and dwellings will be financially supported by Government of Vorarlberg after according to following indicators:

- Sustainable Materials (PVC free and HFKW-free Materials, others)
- Sustainable value chain of materials used (wood)
- OI3-Index of materials (material index used in the building) Index (Primary-Energy PEI, Greenhouse gas potential GWP, Acidification Potential AP)
- Documentation of used materials
- Energy performance
- CO2-emissions
- Barrier-free construction
- Semi-public common grounds and infrastructure
- User participation
- Fuilding densification
- Financial- and social criteria

Links with regional policies

The regional assessment system in Vorarlberg was launched by the Government of Vorarlberg.
Energy autonomy Vorarlberg

More info:

www.vorarlberg.at/vorarlberg/bauen_wohnen/wohnen/wohnbaufoerderung/neuigkeiten_mitbild_/wohnbaufoerderungsrichtli.htm

Italy: PROTOCOLLO ITACA

Who?

Protocollo ITACA is a public building assessment system developed by ITACA (Federal Association of the Italian Regions) with the support of iiSBE Italia, national chapter of iiSBE (international initiative for a Sustainable Built Environment). Protocollo ITACA is based on the international assessment methodology SBTool and in 2015 it became an Italian national standard (UNI PdR 13:2015). The national version of Protocollo ITACA has been adapted to several regions in North Italy (Piemonte, Valle d'Aosta, Veneto, Friuli-Venezia Giulia) and integrated in many policies and programs.

Regione Piemonte

The first regional version of Protocollo ITACA (Protocollo ITACA Regione Piemonte) has been elaborated in 2003. Actually, the assessment systems is available for:

- Residential buildings
- Public buildings (offices, schools, libraries, etc.)
- Shopping centres

Functioning

The use of Protocollo ITACA in Piemonte is based on a framework agreement between Regione Piemonte and ITACA. In this agreement iiSBE Italia is identified as technical support acting as regional certification body.

The certification process is organised in 2 steps: Design and Construction,
In the Design stage, a professional (architect or engineer) produces a technical report illustrating the scores reached by the building on the base of Protocollo ITACA indicators. The technical report is validated by iiSBE Italia. In case of positive result, a provisional certificate is issued.
In the Construction stage, a second report is produced to demonstrate the conformity of the building to design specifications. iiSBE Italia carries out audits visiting the construction site. At the end of works, if the compliance is demonstrated, the final certificate is issued.

Links with regional policies

Protocollo ITACA is extensively applied by Regione Piemonte in several policies.
The first use of Protocollo ITACA has been done in 2003 for the urban renovations programs (Contratti di Quartiere). An extra financial contribution was given to high performance buildings.
Since 2007 Protocollo ITACA has been integrated in the funding programs for social houses. A mandatory minimum score is requested and a contribution up to 10.000 euro per apartment is given (Programma Casa 10.000 alloggi entro il 2012).
A very innovative regulation concerning shopping centres has been issued by Regione Piemonte in 2013, the Decree Law 44. For the first time, a minimum performance requirement, expressed in terms of Protocollo ITACA score, is fixed for all shopping centres with an area of more than 4.500 m2. The requirement is for new buildings, refurbishments, volume expansions, new commercial authorizations.
Another important incentive policy in Regione Piemonte, addressing private buildings, is the “Housing Plan” (Law 20). In case of demolition and reconstruction of a residential building, if the new building reaches the 2.5 score with regards to Protocollo ITACA, it is possible to increase the original volume of the building by 35%.
Incentives are included also in building codes to award the performances above the minimum acceptable performance. If the target score, evaluated with Protocollo ITACA, is reached a tax reduction is be obtained (i.e. urbanization costs).
The system is actually (2018) in use in funding programs for the renovation of public buildings in connection with the European Structural Funds. Buildings must reach a minimum performance. Higher it is, better will be the position in ranking.

More infos

www.regione.piemonte.it
www.iisbeitalia.org

Italy: Regione Valle d'Aosta

In the Regione Valle d'Aosta, Protocollo ITACA was connected with the Regional Law 24/2009 on housing. The use of the regional version of Protocollo ITACA was requested in case of:

- increase of volume up to 20% for existing buildings with a volume higher than 2000 m3
- demolition and reconstruction up to the 35% and 45%

The results of the assessment are introduced in a regional informatic system

More infos

http://www.regione.vda.it/territorio/territorio/pianificazione_territoriale/ple/edilizia/piano_casa/sost_ambientale_i/default_i.asp

Regione Friuli-Venezia Giulia

In Regione Friuli-Venezia Giulia, Protocollo ITACA has been renamed VEA (Valutazione Energetico Ambientale). A special version for single apartments has been elaborated beside the one for buildings. A registry of qualified assessors has been set up by the region. The VEA assessment has been requested in the context of some policies.

VEA was connected with the regional 18 august 2005 nr.23 on sustainable building. The assessment was requested for residential buildings (new constructions and refurbishments).

More infos

http://www.regione.fvg.it/rafvg/cms/RAFVG/famiglia-casa/casa/FOGLIA13/

Regione Veneto

The use of the regional version of Protocollo ITACA in Veneto has been foreseen in the housing plan of the region trought the law 8 July 2009 – nr. 14. The assessment was requested in the case of demolition and reconstruction to define the admissible volume extension.

More infos

http://www.regione.fvg.it/rafvg/cms/RAFVG/famiglia-casa/casa/FOGLIA13/

Italy: CASACLIMA NATURE

Who?

CasaClima Nature is the sustainability assessment systems managed by the Agentur für Energie Südtirol-KlimaHaus (Agenzia per l'Energia Alto Adige-CasaClima) of the Autonomous Province of Bolzano (South Tyrol). CasaClima Nature expands the CasaClima energy certification including issues concerning the environmental impact of materials, water consumptions, indoor air quality, radon, daylighting and the acoustic comfort.

Functioning

A technical directive describes the indicators and the calculation methods. Minimum energy efficiency requirements must be satisfied. The first step of the process is a certification request. The CasaClima Agency carries out an audit on the design documentation, evaluating the design strategies and the calculations. The design documentation has to be provided before the start of construction works. An auditor is named by the Agency. The audit follows during the construction phase to check the compliance of the building to the design. The quality of works is also evaluated. When the building is completed, tests (i.e. blower door test) are carried out for a final check.

In the Autonomous Province of South Tyrol, the certification CasaClima Nature is required according to the Decision of the Regional Council, as of 5August 2014, Nr. 964, in order to access the "Bonus Energia"/ "Energiebonus" up to 10% of additional built volume for new constructions.

More infos

http://www.agenziacasaclima.it/it/certificazionesostenibilita/casaclimanature-1387.html

Germany: BNK (Bewertungssystem Nachhaltiger Kleinwohnhausbau)

Who?

BNK has been developed by German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). The manager of the tool is BiRN – Bau-Institut für Ressourceneffizientes und Nachhaltiges Bauen GmbH.

Functioning

The certification is issued by the System Manger, BiRN.

A trained assessor is involved in the process. The assessor is hired by the owner/client and he acts as interface with the system manager.
The owners/clients provide the assessor with the necessary documentation that is then forwarded to the manager that will validate it.
The certification is issued by the System Manger, BiRN.

Links with regional policies

The tool is not used in laws and regulations by now. However, it is planned to be used in regulations within the next 5 years.
For the BNK-Certificate a subsidy from the German KfW-Bank (main grant supplier in Germany for buildings) is available. The subsidy grants 50% of all certification costs up to a max. of 8.000 € per residential building.

More infos

http://www.nachhaltigesbauen.de/nachhaltige-wohngebaeude.html
www.bau-irn.de

Germany: BNB (Bewertungssystem Nachhaltiges Bauen)

Who?

BNB has been developed by German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) in collaboration with the German Sustainable Building Council (DGNB). The manager of the tool is the Ministry itself.

Functioning

The assessment system considers the entire life cycle of buildings from design to use. Not only ecological, economic, social and cultural qualities are evaluated, but also technical and procedural aspects. The assessment of building qualities is accomplished in accordance with transparent rules and objective, essentially quantitative methods. The certification is issued by a certification body. A trained assessor is involved in the process.

Links with regional policies

Mandatory for governmental buildings.

More infos

http://www.nachhaltigesbauen.de/sustainable-building-english-speaking-information/sustainable-building.html

Slovenia

In Slovenia, energy audit is mandatory but there are no specific assessment schemes, neither at national or lower scale. Only international certification schemes are used.

Appendix 2: Workshop participants

Name	Institutional affiliation
BANCHER, Mariadonata	Technical Expert, Agency for Energy South Tyrol – CasaClima; Italy
BERCHTOLD-DOMIG, Markus	Project Manager, CESBA Network, Austria
EGGER, Philipp	Director, Energy Agency St. Gallen, Switzerland
ERBER, Sabine	Technical Expert, Energieinstitut Vorarlberg, Austria
FAURE, Daniel	Technical Expert, EnvirobatBDM, France
GORRINO, Alice	Technical Expert, Foundation for Environment
JAMER, Peter	Technical Expert, Dept. Economy, Land Vorarlberg, Austria
KRISTAN, Miro	Technical Expert, Soca Valley Development Centre, Slovenia
LUBITZ-PROHASKA, Beate	Technical Expert, Pulswerk, Austria
MAIR, Franz	Technical expert, Land Salzburg, Austria
MARENCO, Ludovica	Technical Expert, Infrastrutture Recupero Energia Agenzia Regionale Liguria, Italy
MEYER, Maren	Project Manager, Agency for Energy South Tyrol – CasaClima, Italy
MITTERMEIER, Paul	Technical Expert, Institute for Construction and Building Climatology, Munich University of Applied Sciences, Germany
MORO, Andrea	Technical Expert, iisbe Italia, Italy
SAGE, Angelique	Technical Manager, Collectif effinergie, France
SANTA, Ulrich	Director, Agency for Energy South Tyrol – CasaClima, Italy
SCHÖNY, Michael	Technical Expert, Forschung Burgenland, Austria
STEINHAUSER, Bernhard	Director Dept. Energy Saving and Energy Efficiency, Bavarian Ministry of Economy, Media, Energy and Technology, Germany
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