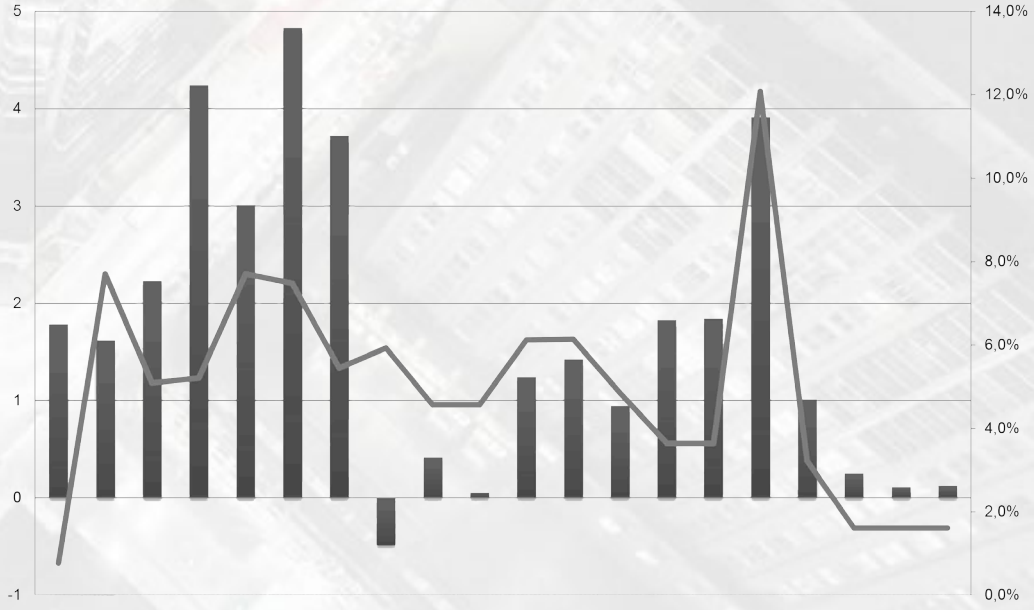
Standards, ratings and sustainability design for retrofit projects

Booklet 4



NewTREND

NewTREND, Booklet 4:

Standards, ratings and sustainability design for retrofit projects.

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Executive Summary

The European Union supports energy efficiency investments to help take maximum advantage of available and emergent financial and business instruments whilst also ensuring compliance with local legislation. The NewTREND project aims to align its IDM with this goal, as defined in the European Union 2012/27 Energy Efficiency Directive.

Such compliance can be proven by connecting NewTREND Key Performance Indicators (KPIs) and the performance measures in the examined instruments. The instruments consist of the energy efficiency legislation that define the legal structure for the energy efficiency goals of the EU, the financial and business instruments that incentivize the achievement of the above mentioned goals and the regional rating schemes that use standardised methods to evaluate and communicate building performance. The study thus focuses on an in-depth analysis of the energy efficiency legislation of the European Union, the supporting financial incentives and rating schemes and the main objective is to compare NewTREND KPIs with the way energy performance is measured by current and emerging practices of legislation, financial incentivisation and rating in the EU and provide recommendations to improving them.

The research methodology consisted of identifying and collecting the relevant EU level and national energy efficiency legislation, financial incentives both from EU countries and from round the world and regional sustainability rating schemes. The legislation data collection consisted of a general description and the main sustainability performance measures included in the legislation. The supporting financial instruments were grouped by their type and the following information was listed for each of them: instrument name, classification (tax incentive, non-refund financial support, loan, financial security, energy performance contracting), in force / not available, country, short description, incentive and performance standard. The collected data for the rating schemes were: general description, related incentive programs, in use / not available, related grants, related national or regional law, applicable buildings and the difficulty of assessment. After the data collection, the analysis focused on the relation between incentives, performances and scores, and the connections between the instruments and the NewTREND project and its KPIs.

The analysis of the legislation showed that the NewTREND KPIs included in the Environment category are overlapping the EU and national level performance measures described in the energy efficiency legislation (primary energy demand occurs in 57 % of analysed legislative instruments, on-site renewable energy in 17 %, impact on climate change in 4 %, comfort related KPIs in 12 % and operational costs in 4 %). This makes the results of the NewTREND methodology relevant to current policy trends. The national, regional and local level energetic action plans and strategies connect cost effectiveness to the topic of energy efficiency so a number of Economic indicators reflect this. Thermal, air quality and acoustic comfort are usually included in energy legislation as minimum thresholds (e.g. minimum ventilation level necessary for a space function). The ideal levels are defined in separate legislation or standards. However, NewTREND attempts to integrate these viewpoints into one system as most of the energy used in buildings aims at guaranteeing conditions of well-being, comfort and health for the buildings' occupants.

For the analysis of the financial and business incentives, the 50 financial instruments from T5.1 were incorporated and another 82 instruments were collected. Incentives provide a financial benefit package awarded for achieving sustainability performance, either measured through rating schemes, percentage based compliance with legislative thresholds, custom indicators, or a list of approved interventions.

The analysis showed that most incentives are still backed by public institutions, simply to fast-forward the sustainable transition of the built environment. Trickling down from the EU level to national, regional and local policy, a diverse array of instruments emerged in the past decade not only to directly incentivise end-users to sustainability interventions, but also to incentivise the market of bankable entities to sponsor them. In the scope of retrofitting, incentives either provide the liquidity to break down the entry barriers, or support competitive entities to make their own liquidity services more accessible. While improving the energy performance of the built environment yields realistic return on investment, many incentives – especially those aimed at residential buildings and public institutions – do not expect a payback. This is due to the fact that sustainability projects that are still on the way to becoming widely appreciated and deeply embedded in society. Governments fast-forward the transition with attractive, non-refund incentives. The share of refundable financial supports can be expected to grow as the solutions adopted in the projects mature. Moreover, market-based solutions, such as energy performance contracting, are expected to succeed public sector sponsored incentives.

For this study 6 rating schemes from 3 European countries were collected (Protocollo ITACA and Biover2 from Italy, KGA and Housing Subsidy from Austria, BDM and Social Housing Eco Compliance from France). These schemes all based on similar incentive policies and similarly structured environmental performance assessment systems. All chosen rating schemes address the challenge to evaluate buildings through the application of an assessment tool concerning environmental, economic and social aspects, but they are very different in composition, choice of criteria and calculation methods, because they come from different contexts. Applying a rating scheme could generate a reduction of costs consequently to an efficient use of environmental resources. The use of an assessment system could

also improve the sustainability performance of the buildings over their lifecycle, encouraging performance monitoring during the in-use phase. Out of the three main instrument categories (legislations, financial incentives, rating schemes), the NewTREND indicator framework is the closest to rating schemes as it has multiple objectives related to the different dimensions of sustainability.

The research question – Are NewTREND KPIs compatible with the way energy performance is measured by current and emerging practices of legislation, financial incentivisation and rating in the EU? – has been answered by dissecting 105 financial initiatives, the legislative background of the EU and the three demo sites, and 6 rating schemes tied to financial incentive programs. Only 7 of the examined instruments did not refer to NewTREND KPIs or similar. Especially the energy related indicators, and in particular primary energy demand, appeared to be the most common metrics. Comfort is the least covered theme among financial incentives and comfort indicators are more prevalent among rating schemes that aim for wholeness and among legislation, due to the comfort-related criteria present in all EU country building codes. On the other hand, cost reductions are more prevalent among incentives, especially in the case of market-based ESCOs, where the revenue stream is directly derived from reduced utility costs. Public financial incentives focus directly on energy demand and renewable energy.

This study tries to bridge the gap between the current market of financial incentives, rating schemes, the legislative background of the energetic sector of the building industry and NewTREND. It has the most relevance to the KPI list developed in T2.2, the methodology from T2.6 and the other financial tasks (T5.1, T5.2, T5.3).

Connecting KPIs to financial instruments can help to consider the financial and business instruments and the legislative environment of the particular project. Therefore, based on the findings of this study it is worth to consider the inclusion of the following updates to the KPI list, either in the near future or on a longer term:

- Harmonizing the energy efficiency requirements specified in EU member state legislation with KPI benchmarks would be beneficial for designers and decision makers as the legislative viability of a selected scenario can be determined quickly in each member state. As most states define energy efficiency requirements for major renovations this comparison would be later a necessity.
- Alternatively, users could customize their energy indicator benchmarks to a preferred legislation or performance measure of a financial incentive or rating scheme
- Going further with connecting NewTREND to the current field of financial instruments would be the development of an energy efficiency calculation methodology that can substitute performance calculations when applying for financial aid and compatible with EU/specific national calculation methodologies. One of the main constraint here is that the current energy consumption methodologies in most EU member states do not use dynamic energy simulations.

1. Introduction

This report addresses Task 5.4 of the NewTREND project, which comprises an in-depth analysis of the energy efficiency legislation of the European Union, the supporting financial incentives and rating schemes. This task has been carried out between December 2016 and August 2017.

Energy efficiency is one of the main objectives of the European Union [1]. Energy efficiency policies are developed to reduce greenhouse gas emissions, increase security of supply, competitiveness, sustainability of the European economy and job creation. The main target is a 20% energy use reduction by 2020 and 27% reduction by 2030 [2]. In order to reach the aforementioned goals, the European Union also supports energy efficiency investments with performance based financial instruments. According to 2012/27 Energy Efficiency Directive, energy efficiency investments should be supported by specific financial instruments with criteria ensuring the achievement of environmental and social objectives [3].

The NewTREND project aims to align its IDM with the current European legislation. Therefore the methodology aims to help take maximum advantage of available and emergent financial and business instruments whilst also ensuring compliance with local legislation. Such compliance can only be proven by connecting transferable information sets embedded in NewTREND with the examined instruments. In all cases, the transferable information set will be the indicators of energy performance.

NewTREND uses Key Performance Indicators (KPIs) for determining the energy and cost efficiency of retrofitting projects. They set benchmarks for minimum and best performances. The KPIs need to be put in context of the current industrial goals and averages. Decision-makers involved in retrofitting projects however, will primarily comply with the standards set out in the applied incentive. When describing the project in terms of NewTREND KPI targets, decision-makers must be able to tell whether they can consider a specific incentive or not. This is possible only if there is a clear transferability between the indicators of NewTREND, and the indicators commonly used in the EU. At a bare minimum, KPIs must be able to describe energy performance criteria of legislative instruments. Desirably, financial incentives that are on their way in, the typical funding schemes of a maturing energy retrofitting market focus on aspects of energy performance covered by NewTREND. And finally, NewTREND KPIs should be able to position itself among the leading rating schemes – not as a disruptive innovation, but as a natural improvement. This triad objective is verified via the analysis of the connection between the performance requirements of legislation, financial instruments, rating schemes and NewTREND through the KPIs; in other words, by answering:

Are NewTREND KPIs compatible with the way energy performance is measured by current and emerging practices of legislation, financial incentivisation and rating in the EU? (Figure 1)

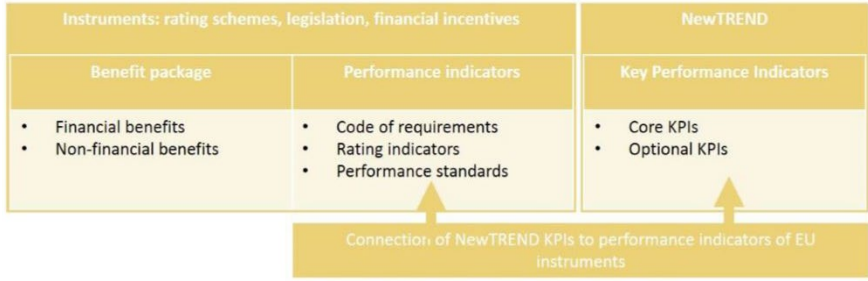


Figure 1: task 5.4 approach to analyse incentives, legislation and rating schemes

The study uses materials from previously reported NewTREND tasks and other tasks in progress as well. The main tasks on which this particular deliverable has built on further, are T2.2 and T5.1. Task 2.2 Definition of Sustainable Key Performance Indicators defines the core KPI set used for the performance analysis of the current state and the design scenarios of retrofitting projects. Task 5.4 Financing and Business models aims to further analyse the core KPI set from this study. Task 5.1 provides a review of the scope, applicability and constraints of the various financing and business models available for district-scale, energy efficient renovations. Our study further analyses the collected financial instruments and their performance requirements and incentive structure.

Energy legislation standards in European context

2. Energy legislation, standards

To reach its goals for energy efficiency in the building sector the EU has developed a number of energy efficiency legislation. The directives provide general rules for implementation in all member states. Each EU country develops its specific energetics policy individually meanwhile relying on the pooled knowledge of all member states. The country specific strategies are turned into national legislation, which gets further detailed in regional and local level.

The following chapters detail the current EU level energy efficiency legislation. Afterwards, the country specific policies are described for the 3 demo locations (Hungary, Finland, Spain) on national, regional and local level as well.

Then the described legislation it put into context with the NewTREND methodology to show their complementing features and mayor differences.

2.1 European Context

The building sector is responsible for about 40% of energy consumption and 36% of CO2 emissions in the EU [4] . Thus, improving the energy efficiency in the building sector is one of the key instruments to achieve EU 2020 targets which aim at increasing the energy efficiency by 20% and a 20% reducing the greenhouse gas emissions in comparison to values of 1990s and to have 20% of the energy generated from renewable energy sources. For 2030 the EU have set new, more ambitious targets, hence by 2030 the EU aim to achieve a 40% reducing the greenhouse gas emissions in comparison to values of 1990s, to have 27% increase in the energy efficiency and that 27% of the energy that is consumes in EU originate from renewable energy sources [5].

To reach these goals the EU has issued a number of specific energy efficiency directives aimed at reducing the energy consumption and CO2 emissions of buildings and promote the use of renewable energy sources and the development of the necessary policies and measures to comply with other international agreements such as the Kyoto protocol from 1997 and the Paris agreement of 2015. The first of these directives is the Energy Performance of Buildings Directive (Directive 2002/91/EC, EPBD), that dates back to 2002 in which all the EU countries were required to improve their energy regulations and to introduce energy certification schemes for buildings as well as to introduce minimum energy performance requirements for new as well as renovated buildings in their territory.

In 2010 the EPBD of 2002 was subsequently updated to become Directive 2010/31/EU. The recast dealt with some of the implementation challenges

of the 2002 Directive. Under the EPBD directive from 2010 the energy performance certificates are to be included in all advertisements for the sale or rental of buildings and displayed in all buildings occupied by a public authority and frequently visited by the public, where a total useful is over to 250 m² as of July 2015. According to the EPBD directive, the energy performance of a building can be determined on the basis of the calculated or actual annual energy consumption.

Furthermore, the Directive instructs all EU Member States to establish inspection schemes for heating and air conditioning systems or put in place measures with equivalent effect. In addition, all new buildings must be nearly zero energy buildings by 31 December 2020 (public buildings by 31 December 2018) and to set minimum energy performance requirements for new buildings, for the major renovation of buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls and so on) as well as to set lists of national financial measures to improve the energy efficiency of buildings.

Given that about 60% of the EU's buildings were built when energy efficiency requirements were limited or non-existent [6], renovating the building stock can be seen as the one of key aspects in reaching the EU 2020 and 2030 goals, this is clearly reflected in a number of provisions of European Directives related to energy such as article 7,8 and 10 of Energy Performance of Buildings Directive (EPBD, 2010/31/EC), article 4,5 of the Energy Efficiency Directive (EED 2012/27/EU) and the Renewable Energy Directive (2009/28/EC. A summary of these provisions is provided in Table 1. below:

Table 1: Examples of renovation related provisions of European Directives

Directive	Explanation
Energy Performance of Buildings Directive (2010/31/EU)	Article 7: When buildings undergo major renovation [7], the energy performance of the building or the renovated part thereof needs to meet the minimum energy performance requirements as far as this is technically, functionally and economically feasible.
	Article 8: Member States shall set system requirements for new, replacement and upgrading of technical building systems (HVAC and hot water systems) and shall be applied as far as they are technically, economically and functionally feasible.
	Article 10: The Commission shall, where appropriate, assist upon request Member States in setting up national or regional financial support programmes with the aim of increasing energy efficiency in buildings, especially of existing buildings
Renewable Energy Directive (2009/28/EC)	Member States should introduce measures to increase the share of energy from renewable sources in new and renovated buildings
Energy Efficiency Directive (EED 2012/27/EU)	Article 4: Member States shall establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private.
	Article 5: A renovation quota of 3% of all public buildings owned and occupied by central government shall be achieved.

Thus and in accordance with the EBPD of 2010, all EU Member States have introduced a set of minimum energy requirements for buildings that undergo major renovations, below (Table 2) is a summary of the main aspects of minimum energy requirements and the expected or targeted energy saving for most EU Member States:

Table 2: Summary of building requirements in case of major RENOVATIONS and EXPECTED RESULTING energy saving ([8] & [9])

State	Energy requirements for renovated buildings	Expected or targeted energy saving	Note
AT	Specific maximum heating energy demand targets for major renovation of residential and non-residential buildings. Values for renovated buildings are around 25-38% higher than new build requirements. Heat recovery must be added to ventilation systems when renewed. Maximum permitted U values for different elements in case of single measure or major renovations. Prescriptive requirements to limit summer over-heating.	3% building sector energy use reduction in the in 2020, compared to 2013.	Estimated
BE	There are specific component requirements (i.e. maximum U-values) as well as additional prescriptive requirements such as for ventilation, summer comfort etc. is the renovated volume > 800 m^3: same requirements as for new buildings (U/R-value, ventilation and summer overheating). For renovation project with a volume ≤ 800 m^3: only U/R-values for new and renovated parts of the building as well as ventilation	4288 GWh of final energy and 4581 GWh for primary energy saved by 2020.	Estimated for Belgium (Flanders)
BG	Regulations requiring performance-based standards of existing housing and other buildings after renovation. Requirements for new and renovated buildings are the same	n/a	
CH	Renovated buildings are required to use no more than 125% of the space heating demand of an equivalent new building. A single element approach may also be applicable for renovations.	n/a	

CY	Minimum energy performance requirements (class A or B) for buildings over 1 000 m2 undergoing major renovation	n/a	
CZ	Performance-based requirements when a building over 1 000 m2 is renovated. Requirements for new and renovated buildings are the same. Individual parts of the building envelope and systems in the buildings have to fulfil minimum requirements. If it is not possible to achieve the minimum performance criteria, this has to be proven by means of an energy audit. There are also minimum requirements in case of major renovation of individual building elements such as for U-values, thermal bridging, thermal stability of the room in summer and in winter, minimum efficiency of boilers	77 PJ saving of energy (45% reduction compared to current consumption) for heating in residential buildings.	Estimated
DE	Both energy performance and specific component-based requirements. For renovations of single components or systems, there are specific requirements for these components/systems. Alternatively, the building owner can choose to prove that the primary energy demand requirements for retrofitted buildings are met (140 % of the demand for a comparable new building). Building surface components and building system components must not be changed in a way that decreases the energy performance of the building. There are additional cost effective obligations that need to be fulfilled by the building owners within a specific time-frame for: insulation of hot water pipes and top floor ceilings, retrofit of HVAC systems and replacement of electrical heat storage systems.	337 PJ/year energy savings for period 2008-2020	Estimated
DK	Component level requirements when existing buildings are refurbished for change of use of the building and for complete or partial renovation of building elements or technical systems, regardless of the building size. Individual parts of the building envelope and systems in the buildings have to fulfil certain minimum requirements in the renovated building. Thus, there is no overall performance requirement for the renovated building, but only for the individual components and systems. Minimum U-values and linear losses requirements. The partial renovation measures must be cost-effective (i.e. payback time shorter than 75% of the measure's lifetime). If the implementation of the full requirement is not profitable to the owner, a lower level of renovation or indeed none at all, has to be implemented. In case of replacement of floors, external walls, doors, windows or roof structure, requirements apply regardless of cost-effectiveness. Thermal bridging should be avoided in external construction elements.	35% reduction in net energy consumption for heating and hot water in the building stock by 2050, compared to 2011.	Estimated
EE	Performance-based requirements for all building types when buildings undergo major renovations. Values for renovated buildings are around 25-38% higher than new build requirements.	3.5 PJ/y energy savings the building sector to be achieved by 2016.	Targeted

ES	Existing buildings over 1000 m2 must comply with the same minimum performance requirements as new buildings if more than 25% of the envelope is renovated. There are additional energy efficiency requirements for building elements, heating and lighting systems, minimum solar-thermal contribution and in certain cases also for minimum solar photovoltaic contribution.	n/a	
FI	There are three ways to achieve minimum energy requirements: a) by improving the heat retaining capacity of building parts that need reparation or renewal, b) improving the energy efficiency of the building by examining the whole building's energy consumption in relation to its surface area, c) reducing the building's E-number (the total calculated energy use of the building), by reducing the total energy consumption of the buildings. Technical systems (like heating and ventilation) have their own requirements and should be checked when insulation is added to the building, when air-tightness is improved, or when systems are renewed.	Saving of 8115 GWh by 2020, and 36889 GWh by 2050	Estimated
FR	Performance-based requirements for buildings undergoing renovation apply for residential buildings and values depend on the climate and type of heating (fossil fuel/ electricity). Requirements for components also apply during building renovation. For large renovations, a minimum summer comfort level is required in order to avoid the use of cooling systems. Smart systems should be installed every time there is major renovation work on a building	38% reduction of energy consumption of buildings by 2020 AND 400.000 dwellings per year should be energy renovated starting from 2013.	Targeted
GR	Individual parts of the building envelope and systems in the buildings have to fulfil certain minimum requirements in the renovated building. Minimum thermal resistances defined for different types of building components and also different efficiency of systems. Thermal bridges are also considered	At least 80% of the existing building stock renovated by 2050	Targeted
HU	Performance-based requirements (in terms of primary energy) apply for residential buildings, offices and educational buildings. Requirements for new and renovated buildings are the same. The specific primary energy consumption in kWh/m² must comply with the requirement, either for the renovated zone or for the whole building - option that can be selected by the designer. The requirement cannot be met if the components are of low quality	49PJ/y primary energy saving for the building sector at 2020	Targeted
IT	Energy performance requirements are based on single components, with the same requirements as new buildings. There are also minimum energy efficiency requirements for boilers	4.9 Mtoe/y final energy savings of the building sector by 2020 (3.67 Mtoe/y in the residential sector, 1.23 Mtoe/y in service sector) have been targeted; it is estimated that this could lead to a 24% reduction of primary energy consumption in comparison with the business as usual scenario	Targeted/ Estimated

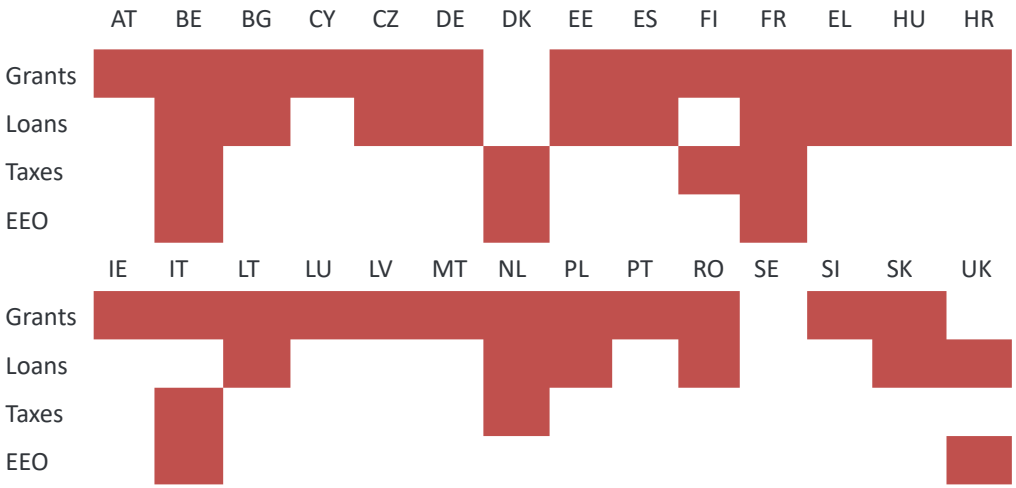
LT	Buildings over 1 000 m2 undergoing major renovation must achieve the energy performance standard of a Class D building where D corresponds to 110 kWh/m2 yr for buildings > 3 000 m2; 130 kWh/m2 yr for buildings from 501 to 3 000 m2; 145 kWh/m2a for buildings up to 500 m2. Not less than efficiency class D. Individual parts of the building envelope and systems in the buildings have to fulfil certain minimum requirements depending on renovation	At least 500 GWh of thermal energy to be saved (i.e. for space heating) by 2020.	Targeted
LV	Requirements on different elements are applicable	50% reduction of consumption of thermal energy for heating against the current indicator is the target to be achieved by 2030. It is estimated that by renovating 3% of State owned and used building areas each year, 186 GWh energy savings could be achieved over the period 2014–2020.	Targeted/ Estimated
MT	U-value requirements for building renovation	n/a	
NL	For renovations, the same EPN (energy performance coefficient) requirements as for new buildings apply. Stricter efficiency requirements for heating, hot water, cooling and ventilation systems in existing homes and large buildings	300,000 existing buildings per year to improve by at least two energy label steps; Average social rental property to achieve label B; 80% of private rental to achieve minimum label C by 2020; At least an average energy label A for buildings by 2030.	Targeted
NO	Building regulation requirements as for new buildings only apply when the purpose or use of the building is changed at renovation or in case of major renovations. The requirements are either for the renovated zone or for the whole building (an option of the designer)	n/a	
PL	For major renovations or system component replacement there are the same requirements as for new buildings.	n/a	
PT	Special requirements for buildings over 1000 m2 and over a specified energy cost threshold. A mandatory energy efficiency plan must be prepared and all energy efficiency improvement measures with a payback of less than 8 years must be implemented (compulsory by law). The threshold is based upon 40% of the worst performing buildings by typology. Minimum requirements for thermal resistances defined for different types of building components and for energy efficiency of buildings systems. There are minimum energy requirements for the building as a whole as well as minimum insulation levels for the building envelope and minimum requirements for shading of windows.	n/a	

RO	The renovated building has to fulfil certain minimum requirements for the individual components and systems as well as an overall performance requirement	n/a	
SI	Minimum requirements apply to major renovations (i.e. if at least 25 % of the envelope is renovated). There are also minimum requirements for heating systems	At least 16% final energy consumption in building decreased by 2020; 30% by 2030 (compared to 2005); almost carbon-free energy use in the building sector by 2050	Targeted
SE	The renovated zone has to fulfil the energy requirements for new buildings. In case of heritage buildings or when renovation may negatively influence other features of the building, then the energy requirements may be lowered. In case of major renovation, the minimum energy efficiency requirements may be extended also to other parts of the building.	12-25% reduction of final energy consumption for heating and domestic hot water (DHW) in buildings.	Estimated
SK	For major renovations, the requirements set limits to improve the thermal performance by at least 20%. There are minimum requirements in terms of energy use and energy performance (delivered energy), U-value for building structures as well as, walls, roofs, windows, insulation of heat and hot water systems, thermal comfort and indoor air quality	6928.6 GWh energy savings up to 2030	Estimated

However, in practice, a study by ICF International “Energy Performance of Buildings Directive (EPBD) Compliance Study” revealed that in most of EU Member States only 55 to 70% of the buildings comply with the energy performance requirement for renovated building [10] . This moderate level of compliance can be increased by providing appropriate financial and / or technical support [11].

Therefore, it can be said that all the EU Member States is using one or a combination of financial support schemes that target the improvement energy performance of existing buildings. The way Member States apply these instruments varies from country to the other as seen in Table 3 regarding the main in use financial by each EU Member State in 2013 [12]. The following table (Table 3) shows the financial instruments used by EU member states in 2013 targeting energy renovations.

Table 3: Financial instruments used by EU MS in 2013 targeting energy renovations11 (shaded areas indicate the applied financial instrument)



2.2 National legislation via the demo site context

The three demo site countries legislative background is described as a brief discourse analysis. The goal of this section is to highlight the occurrence and relevance of New TREND concepts, goals, components, Key Performance Indicators in the legislative and public strategic discourse. After a concise introduction to the system of energetic legislation and execution in each country, the individual legislative instruments and strategies are analysed following a logic of scale, going from the national, via the regional, to the local level.

HUNGARY

Hungarian energetics policy heavily relies on the pooled policymaking of member states in the European Union. Directives coming from the Commission and the Council are implemented via national strategies, which the turn into legislation supporting the implementation. Most importantly in the context of energetics, this includes the provision of budget and writing in energy related criteria and responsibilities into law on the national level.

NATIONAL POLICY

Legislative grounding of national energy policy

The Parliamentary decree 40/2008. (IV.17.) defines priority axes of the national energy policy in the 2008-2020 period. The wording of the document includes phrases referring to indicators building energy, representing the direction of the Hungarian legislative environment. The same document authorises government to devise and implement national energy strategies. The incumbent is the National Energy Strategy 2030, a document outlining the approach, goals and conditions to reach these goals for the state.

National Energy Strategy 2030

Along the overall national and interregional energy grid, compatibility to other relevant strategies and higher-level legislation, buildings are also considered a focus area, mostly from demand mitigation perspective. The strategy acknowledges that 40 % of energy consumption occurs in buildings and that two-thirds of this is spent on heating and cooling. Around 70 % of residential and public buildings do not meet contemporary thermo-engineering standards. The two key metrics referred to are „energy consumption by source", and „refurbishment depth" – mean savings of intervention regarding thermal energy demand. Among the perspectives, thermal energy efficiency, a share of renewables, modernising HVAC and lighting systems, and supporting ICT services are mentioned on the building level. On the district level, a case is made in support of decentralised energy systems, with goals of simplifying integrations with the larger grid, and supporting mixing technologies.

Regarding building and district level energetics, the National Energy Efficiency Action Plan and Building Energetics Strategy are the most relevant subsidiaries of the overall strategy. While the building Energetics Strategy is a specification of the National Energy Strategy on the focus point of building energetics, the National Energy Efficiency Action Plan contains the specific "to-do-list" and assigns resources to accomplish the above policies.

National Energy Efficiency Action Plan

The action plan identifies the lack of financial instruments as a major obstacle, also mentioning the complicated preparation of refurbishment projects. Knowledge-sharing is an important focus point, promoting the demonstration and dissemination of best practises, recent technologies, implementation lessons, practical knowledge among site managers, building owners, consultancies and the public sector. Interventions should provide means of monitoring on the project level in a transferable way to support upcoming energy performance statistics plans.

The action plan includes financial instruments to accomplish energy performance goals. The metrics used for their evaluation scheme follows the 7/2006. (V.24.) classification and the 176/2008. (VI.30.) certification schemes.

Building Energetics Strategy

The Building Energetics Strategy contains the energetic evaluation of the national building stock, and based on refurbishment scenarios, proposes a system of goals and tools.

Refurbishment scenarios are constructed to estimate larger scale funding demand. The input parameters for classification in the case of residential buildings are floor area, construction year, and building type (detached house, row house, condominium). The output parameters are primary energy consumption prior refurbishment and after "cost-optimised level" refurbishment (see National rating schemes), primary energy savings and estimated refurbishment costs.

The key indicator for the goal structure is the primary energy savings, aimed to be reduced by 49 PJ/a until 2020 and 111 PJ/a until 2030. Of the 49, 40 PJ/a savings are expected to come from residential and public building refurbishment, 4 from commercial building refurbishment, and 5 from energy savings by conscious use.

NATIONAL BUILDING CODES

National energy performance criteria

In accordance to the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010, the requirements for the energetic performance of buildings is defined by the Ministerial Decree 7/2006. (V.24.). The criteria presented there are to be fulfilled to obtain a building permit. The decree also imposes methodology for technical-environmental and economic validation of the following alternative energy systems: district heating and cooling, CHP, distributed systems utilising renewable energy, heat pumps. According to the legislation, the demo site refurbishment must comply with cost-optimised levels, meaning more disciplined thresholds for energy performance, but without the necessity of phasing in renewables. Additionally, the building must comply with criteria for the structure, HVAC, and indoor conditions.

National energy certification

The 176/2008. (VI.30.) Government Decree regulates certifications regarding energy performance. Energy performance certification is mandatory for all new constructions, transaction or lease of existing buildings and building units, and buildings public authorities larger than 250 m2. The 7/2006. (V.24.) decree contains the necessary calculations that partly also define energy performance categories within the certificate. In general, the classes are determined by their integrated energetic indicator in relation to the benchmark value derived from 7/2006. (V.24.).

REGIONAL POLICY

Budapest 2030

The examined region for legislative background is city of Budapest. The concept of urban development defines the long-term development goals and direction of changes on the city-scale, based on its environmental, economic, and social attributes. The concept for the capital, called Budapest 2030 was approved with Budapest General Assembly Resolution 1988/2011 (VI.22.). One of the priority axes of Budapest 2030 is "Climate protection and efficient use of energy". In accordance to 2010/31/EU, the priority axis focuses on the building stock, defining goals of: high energy performance, near-zero energy demand, high ratio of renewable sources for buildings. It proposes the definition of sustainable building in local plans and the application of sustainability criteria for the whole lifecycle in local building regulations. However, these concepts have yet to surface in city-scale regulations.

SEAP Budapest

The energy related goals of the SEAP Budapest – as all goals – are devised from the core objective of GHG emission. Because the initiative itself heavily relies on consistent monitoring, it operates with clear, measurable indicators related to emission. For instance, 1 MWh of electricity consumption is translated to 0,575 tons of CO2 emission, since roughly 60 % of the national electricity is produced in coal, or hydrocarbon plants. The document estimates 40 % energy savings via refurbishment projects of prefabricated residential housing estates, 25 % in detached houses, and further 30 % in inner city buildings. This results in an overall 35 % energy savings prediction for the entire residential building stock. The specific actions needed to reach these goals are generally insulation installations on the envelope structure, changing doors and windows, modernising HVAC systems, and deploying differentiated monitoring and controlling options.

LOCAL POLICY

The local (Budapest District XVIII.) policies of the demo site are derived from the national and regional strategies and detailed in the following documents:

- Development strategy of Pestszentlőrinc-Pestszentimre
- SEAP Pestszentlőrinc-Pestszentszentimre
- Local plan of Pestszentlőrinc-Pestszentszentimre

FINLAND

NATIONAL POLICY

National Energy and Climate Strategy [13]

The National Energy and Climate Strategy singled out the built environment for being responsible for 38 % of GHG emissions in Finland. To mitigate climate change, the strategy identifies policies promoting energy-efficient land use planning, improving energy performance of building stock, reducing carbon footprint of building materials and the promotion of the wider use of renewable sources. Approximately 0,9 Mt annual emissions cut by 2030 is expected from measures related to building-specific heating, waste management and cuts in industrial gas emissions, most notably by increasing renewable share in heating, improving combustion technology for burning wood and blending light fuel oils for heating with biofuels.

National Energy Efficiency Action Plan [14]

All EU countries present an Energy Efficiency Action plan every three years for the Commission, presenting progress and planning for meeting national energy efficiency goals, listing policies to implement the Energy Efficiency Directive 2012/27/EU. The action plan for Finland identifies buildings as the target area contributing the bulk of the energy savings (11 % of the consumption by 2016 and 15 % by 2020 respectively) through a variety of national government measures. Measures for the public building stock are also reported in the action plan.

National Strategy on the Energy Renovation of Buildings [15]

The National Strategy on the Energy Renovation of Buildings is the transposition of 2012/27/EU Article 4 into national law. The strategy is less focused on imposing criteria of performance and more on instruments to trigger investment in energy efficiency measures during scheduled and reactionary maintenance in both residential and commercial sectors. These instruments include financial incentives, decision-making support, consulting services, communication measures and various training programs for professionals. In the public sector, instead of compliance with the 3 % renovation target for central authorities in force by 2012/27/EU, Finland implements alternative, voluntary goals, calculated to achieve similar results as an annual 3 % renovation action. These alternative means include demand-side management measures, such as smart metering, tenant behaviour management, a bonus-malus contracting scheme, energy-efficiency improvements during maintenance, user-related services, streamlining space-use, an adding energy-efficiency measures to standard renovation projects. As for other public authorities, the strategy cites voluntary energy efficiency agreements (EEA) for municipalities.

National Energy Performance Requirements (from national building code)

Decree No 4/13 transposes the Energy Performance of Buildings Directive by introducing energy performance criteria to be met by building renovations, functional changes of buildings, and refurbishment of the technical installations. The criteria are added to the national building code, thus are requirements for obtaining building permits.

The calculation methodology is a national method appropriated with CEN principles – both standards can be used. The regulation is prescriptive, with fixed value thresholds for key energy performance metrics, but also for thermal comfort, indoor air quality, infiltration, thermal bridges and shading. Infiltration may be assessed via audit, on-site testing or other accepted quality management method in the building industry. The cornerstone indicator for overall energy consumption – as in other countries, is the primary energy factor, the amount of primary energy required to generate a unit of final energy: electricity or useable thermal energy. The threshold values depend on type and area of the building. While the code includes all heating sources it promotes the use of renewable energy sources.

Energy Performance Certification [16]

National energy performance certificates must be supplemented to building permit applications for new and renovated buildings or when a unit of the building is sold or rented. The ruling was introduced progressively from 2013 to July 2017.

The energy efficiency rating is expressed as an energy label that classifies buildings according their percentage based compliance with the primary energy factor criterion of the national building. For new buildings, this is a calculated value, for existing buildings, actual energy consumption must be reported when available. For renovated buildings, an on-site assessment if required for technical thermal components: the building envelope, heating and sanitary hot water installations, ventilation, lighting and other electrical installations. The certificate must also include recommendations for cost-effective energy efficiency improvement, albeit the exact suggestions are up to the experiences and qualifications of the assessor. The certificate is valid for 10 years.

Energy Efficiency Act [17]

The Energy Efficiency Act 1429/2014, with the purpose of promoting the energy efficiency transformation of the built environment, outlines regulations for energy auditing, for cost-benefit analyses of combined heat and power systems, and obliges energy suppliers to promote cost and energy efficient use in their customers operations. Obligatory investigation and documentation of the progress and potential benefits of energy efficient transformation helps anchor the need to invest in such transformation in corporate strategy. The law applies to energy providers, corporate energy audits and auditors, and owners and managers of district heating/cooling networks, including power plants.

LOCAL POLICY

The local policies for Seinajöki are defined in the following documents:

- Energy efficiency agreements [18]
- Builders Guide Seinajöki [19]
- Municipal environmental regulations and building codes [20], [21]

SPAIN

NATIONAL POLICY

NEEAP - National Action Plan on Energy Efficiency

As a general compliance with 2012/27/EU, the action plan is a broad assessment of energy consumption and production in the country, an overview of national energy efficiency targets, and the executive measures to reach these targets [22]. Alongside transportation, public organisations, agriculture, and efficiency of the grid, NEEAP identifies the building sector, and urban heating systems as the main target areas of energy efficiency policies. As a review document, it is concerned with reporting on the state of previously established indicators and introducing the policies and actions currently in force. The key mentioned indicators are: primary energy demand in toe; energy consumption by source; energy intensity indicator (=energy consumption/gross domestic product) [23]; annual change in energy prices; energy consumption by use. The document reports a solid decrease in total final energy demand in the building sector, reaching a total consumption of 29,7 % compared to the EU total of 38,5 %. The largest contributor to this output is the residential sector, with a predominant reliance on combustible sources. It is therefore acknowledged that countries in the European South, such as Spain, will likely always deliver better results on energy indicators. This also means that while heating will still take the largest share in the mix of household energy demands, the relative importance of hot season cooling, electronic appliances, and warm water production increases. The electricity use is even more prevalent in buildings of the services sector.

Long-term Strategy for the Energy Rehabilitation of the Building Sector

According to NEEAP 2017-2020, the most important action regarding building energy efficiency is the Energy rehabilitation strategy is the transcription of 2012/27/EU Article 4 to Spanish governance. It outlines a situation review, strategic goals, scenarios of implementations and necessary actions to deliver investment in the energetic refurbishment of the Spanish building stock, and is reviewed triennially [24]. The scenarios represent the costs and benefits of delivering refurbishment ambitions to various extents. They are used as arguments for a public-lead, public-private partnership based approach by quantifying investments and exploitable direct impacts as well as externalities related to building energy efficiency in a business-as-usual, a public subsidization, and subsidies progressively replaced by adequate loans scenario. Each scenario is evaluated by the number jobs generated (socio-economic impact), number of houses rehabilitated (complex impact), Kteps of energy saved, and million tons of CO2 emissions reduced (both environmental impact) – all metrics favouring public subsidies, progressively replaced by adequate loans [25].

CTE - Technical Building Code (RD 314/2006; last amendment as of writing this document: FOM 588/2017) [26]

The Technical Building Code is the basic normative framework defining criteria for construction. It consists of basic documents holding prescriptive standards regarding: structure, fire safety, safe use, sanitation, noise protection, and most notably, energy saving. The introduction of the energy performance thresholds is progressively registered in the basic document – energy saving, last raised by amendment FOM/1635/2013. The document is structured into six parts, with the first four referring to energy efficiency and the rest to the use of renewable energy. The standards are prescriptive, for each criterion, there is a quantification, a process of verification, justification rules for compliance and calculation methodology.

RITE – Regulation on Building Heating Installations (RD 238/2013) [27]

Regulation on Building Heat Installation is the law specifically regulating DB HE2 – Performance of Thermal Installations – section of the Technical Building Code. The law sets standards for designing, dimensioning, assembling, maintenance, and inspection on technical grounds, and more generally for administrative conditions, execution of installations, commissioning, inspection, manufacturers.

Alongside energy efficiency and security, the legislation recognizes so-called

welfare & hygiene requirements, including thermal comfort, air quality, hygiene and acoustic comfort. In the context of the legislation, indoor air quality refers to adequate ventilation, and thresholds for pollutant levels, hygiene refers to the biochemical quality of sanitary hot water, and acoustic comfort thresholds regulate vibration and noise levels of thermal installations. Thermal comfort and air quality include a set of quantified indicators, hygiene requirements are fulfilled by following specific instructions depending on the installation, while acoustic criteria are listed in a separate basic document.

Energy Efficiency Certification (RD 235/2013) [28]

The Royal Decree defining the national scheme of energy efficiency certification is a transposition of 2010/31/EU into Spanish law. It establishes the basic methodology for calculating a single energy efficiency rating, as well as the technical and administrative conditions for certification. As per RD 56/2016, it also enforces an obligation that all buildings constructed after 2020 to be near-zero energy consumption buildings.

The cornerstone of the certificate is the label, which is to be exhibited in the buildings themselves, and to be presented during promotion, bids, sale or lease contracts. The rating is defined as a percentage of the energy consumption benchmark set by the national energy performance criteria.

REGIONAL POLICY

As an autonomous region with its own government, considerable executive and legislative responsibilities are devolved to the regional level. Catalonia has its own Energy and Climate Change Plan, specific strategy for the energy refurbishment of buildings, even more specifically, strategy for the assets owned by the Catalan Generalitat, the devolved government. The region may also develop different thresholds for the national energy performance standards, but since the criteria themselves are similar to the national level, they are not discussed here [29].

The Energy and Climate Change Plan of Catalonia 2012-2020 [30]

The Energy and Climate Change Plan of Catalonia is the general framework of the devolved government for horizontal policies based on the inherent relationship between energetics and climate change. Its primary objectives are to ensure decision making is headed for a greater safety and quality in energy supply, economically sound regional energy model with less dependence on external sources, increase the proportion of renewables, reduce fossil fuel consumption, and improve efficiency of use. It consists of a regional energy modelling methodology as a foundation for strategic priority axes, among which it identifies the barriers of sustainable energy transition. The regional plan analyses a base and a high-commitment scenario with a hybrid energy modelling methodology including a bottom-up approach based on consumption patterns per sector and top-down econometric models to forecast the impact of policy on regional energetics. Among the quantified 2020 EU targets transposed to Catalonia (regarding primary energy consumption per sector, transportation losses, renewable mix, and emissions), the key regional energetics indicators focus on the consumption and grid losses of electric energy and natural gas. Other transferable insights are the main entry barriers in the way of sustainable energy transition. Barriers to the regional energy goals are identified as lack of technology and knowledge, the low returns on investments and high unaccounted externalities, low priority of efficiency actions, and the fragmentation of policy across sectors.33

The Building Energetic Refurbishment Strategy of Catalonia (ECREE) [31]

The Building Energetic Refurbishment Strategy of Catalonia is one of the nine unique strategies within the regional energy and climate change plan. It is a long term strategy defining goals and specific actions for the Catalan building stock, both residential and tertiary, both public and private.

To achieve the goals of the strategy, five actions are defined in the face of the five main barriers of energy transition specifically in the built environment. First, an information and planning system with tools and platforms supporting the execution energy refurbishment projects is promoted to overcome networking barriers. Second, training programs are to be initiated to stimulate demand and prepare personnel on the supply side of building energy refurbishment, eventually to artificially kick-start the energy renewal market of buildings. Action three is the identification, selection and facilitation of innovation among building energy efficiency products and services. It intends to afford a collection of, and a competition to produce best practices to disseminate. Next, an organisational model of management and coordination is to be established for the rest of the actions and to carry on facilitating and simplifying the public administrative end of energy renewal. Finally, an investment program is proposed to overcome financial barriers with the task of defining specific investments, plans to mobilise funding and to identify relevant financial instruments.

The Plan on Savings and Energy Efficiency in the State Assets of the Generalitat of Catalonia [32]

The Plan on Savings and Energy Efficiency in the State Assets of the Generalitat of Catalonia (cat.: Plan de Ahorro y Eficiencia Energética en los edificios y equipamientos de la Generalitat de Cataluña) is an investment framework for the energy transition of state owned buildings and facilities within the region. It intends to serve an example to follow, highlighting

the environmental and economic benefits of energy services contracting. For the 2015-2017 period, the plan aims to reduce energy (operational) expenditures by 16 % compared to 2014 levels in each department. 5,9 % reduction is expected from demand response – optimising the contract of electricity utilities – while 10,1 % will be achieved from energy efficiency investments to reduce overall consumption. The execution of the measures is to be left to ESCOs, while the devolved government promotes investment platforms for their own and other energy efficiency projects, providing a more streamlined access to financing.

LOCAL POLICY

The municipality of Sant Cugat shares local plans, strategies, targets and monitoring via their e-governance and open data platform PACTE – Strategic Competetiveness and Alignment Plan [33]. Energetics is represented within the Municipal Action Plan as part of the higher level priority area: sustainability and urban quality [34].

2.3 Connections with NewTREND project KPIs

On the EU level the Energy Performance of Buildings Directive (2010/31/EU) and the related other European level policies aim at improving energy efficiency of buildings, reduce their CO2 emissions and increase the use of renewable energy sources. The indicators defined for the Environment category of the NewTREND KPI list covers the same topics (Table 4).

Table 4: Analysed EU policy performance measures and the corresponding NeWTREND KPIS

Policy	Relevant theme	Corresponding NewTREND KPI
Energy Performance of Buildings Directive	Energy efficiency	B1.1 B1.2
Renewable Energy Directive	Share of energy from renewable sources	B1.3
Energy Efficiency Directive	Energy efficiency	B1.1 B1.2

On national level a significant overlap among demo site legislative context and NewTREND are evident in the prevalence of NewTREND KPIs among legal energy efficiency criteria: primary energy demand occurs in 57 % of analysed legislative instruments, on-site renewable energy in 17 %, impact on climate change in 4 %, comfort related KPIs in 12 % and operational costs in 4 %. This makes the results of the NewTREND methodology relevant to current policy trends. The national, regional and local level energetic action plans and strategies connect cost effectiveness to the topic of energy efficiency so a number Economic indicators reflect this. Thermal, air quality and acoustic comfort in usually included in energy legislation as minimum thresholds (e.g.: minimum ventilation level necessary for a space function). The ideal levels are defined in separate legislation or standards. However, NewTREND attempts to integrate these viewpoints into one system as most of the energy used in buildings aims at guaranteeing conditions of well-being, comfort and health for the buildings' occupants. This creates the need to attempt the highest possible energy savings without compromising the comfort, health and productivity of the building users.

Finacial and business instruments

3. Financial and business instruments

In general, financial incentives are specific economic benefits tied to a specific range of actions. Schemes of incentivisation are usually deployed to overcome the economic barriers of socially valuable endeavours. In the context of NewTREND, building and district sustainability, particularly energy performance and its impact on comfort, emissions, and costs, are in focus.

Both the public sector and the private sector have deployed instruments with sustainability incentives. The economic barrier to overcome is the exceptionally high CAPEX of sustainability retrofitting projects. This entry barrier already locks out many privately owned residential units from sustainable transition. Thus, an overwhelming majority of incentives involve a bankable entity.

In the scope of retrofitting, incentives either provide the liquidity to break down the entry barriers, or support competitive entities to make their own liquidity services more accessible. The creditor can either be a public, or a private institution. The former is achieved through direct (such as grants and loans) and indirect financial support (such as tax credits and loan subsidies), the latter through security (such as loan guarantees). Some financial supports are not expected to be paid back based on the fast-forwarding principle of EU strategy. The diverse pool of incentives can be classified in the following categories:

- Tax incentives generate benefits by easing or tightening public obligations;
- Non-refund financial supports offer liquid cash to fund the project partially or fully;
- This liquid cash is expected to be paid back in a set period in the case of loans;
- Risk of lending is alleviated by loan guarantees, indirectly incentivising sustainability;
- Energy performance contracting is a business model binding revenue to energy performance, eliminating both risk, and CAPEX for the end-user.

The structure of incentives varies, but at their core, they all consist of a certain benefit package targeted at a barrier to the desired behaviour and a set of performance standards describing the desired behaviour itself. Performance standards are clearly defined, quantifiable, and in most cases, explicitly quantified indicators of improved sustainability. They are the basis of feedback towards legislation, as policies triggering the incentives also define a causal chain of activity, output, outcome, impact, all feeding into

the sustainability goals of said policy, and all measured by a set of causally connected indicators. Performance standards are often bound to a comprehensive system of indicators within a rating scheme. Ratings are tried and tested methods to evaluate and communicate building performance, with standardised, repeatable and transferable procedures of evaluation. Official rating schemes may appear in legislations, especially in continental EU, but are also produced independently for various certificates.

In this task, the 50 financial instruments from T5.1 were analysed and another 108 instruments, legislation and rating schemes were collected in T5.4. From the 107 collected items 82 were categorized as financial instruments. This chapter analyses the 82+50=132 collected instruments.

The data collection has been conducted in different phases of the project (before 2016 October for T5.1 and between 2017 January and June) Therefore some of the instruments could be out of use since its collection. In July 2017 107 of the 132 instruments were in use, the status of the other programs was not in use anymore, planned or just theoretical.

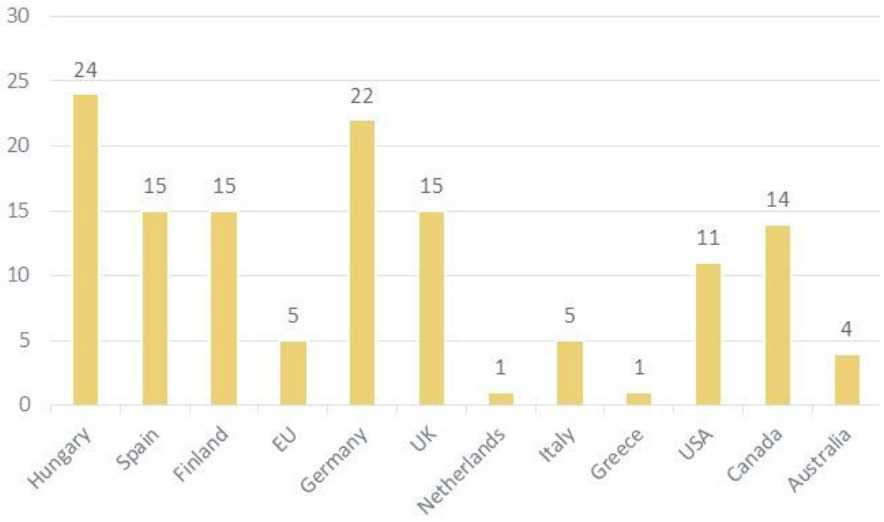


Figure 2: Number of collected instruments by countries

The instruments from T5.1 were mainly collected from European Union countries, especially from two of the countries with NewTREND demo sites (Finland and Spain). During T5.4 additional instruments were collected from the third country with demo site (Hungary) and also non-EU mechanisms from the US, Canada and Australia were included to provide a more complete perspective of current practice and potential initiatives.

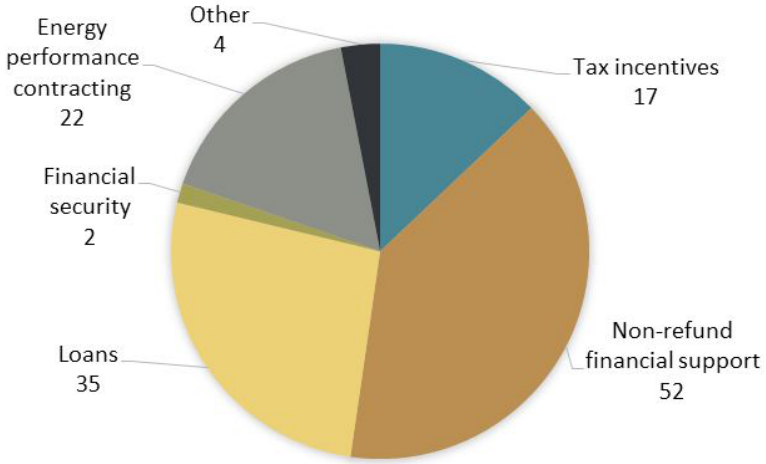


Figure 3: Types of financial instruments analysed

In the following chapters, the collected instruments are analysed. The mechanisms were first grouped into the five above mentioned categories and then their incentivization methods and related benchmarks were compared with the required performance from the buildings or building systems. The goal of the comparison is to determine the most common performance requirements of these mechanisms and the financial benefits of their use. The second part of the analysis focuses on the connection to the NewTREND Key Performance Indicators. The KPIs were evaluated based on their usefulness for financial planning. Their calculation methods were compared in detail to the generally used methods in the collected mechanisms.

3.1 Analysis of the indicators/benchmarks used in the financial incentives

3.1.1 Tax incentives

Tax incentives are part of instruments established by public institutions, exploiting their power over defining public obligations to ramp up their benefit package. These instruments come in the form of tax exemptions, deductions, rebates, depreciation ease, and levies. The exact benefit package tied to specific performance standards, as well as their associated NewTREND key performance indicators are analysed in Table 5. The following paragraphs describe the key implications of this analysis through the introduction to specific financial incentives.

Among the targeted performance standards energy efficiency is highly represented. In relation to NewTREND indicators, 10 out of 14 incentives refer to efficiency, with standards for energy savings, thermal/electrical energy demand, efficiency of building envelope, energy factor for electric appliances and efficiency of equipment within energy system. 6 out of 14 incentivise renewable energy production, including solar, biomass, and heat pump energy sources among eligible measures. Only the two levies include environmental impact indicators.

Benefit packages vary by target group and country substantially, and are in most analysed cases (79 %) defined progressively via a formula. 36 % of the incentives are based on investments, the cost of the interventions, while 45 % use achieved performance. Only 3 out of the 14 offer a flat tax credit. This means a substantial amount of tax incentives does not bind the size of the benefit to performance. In such cases, the sustainability goals are ensured by a list of supported interventions, manufacturers or technologies.

Tax related mechanisms also include negative incentives. For example, the Climate Change Levy (CCL) was instated in 2001 to encourage energy efficiency and reduce GHG emissions in the United Kingdom [35]. The levy applies to energy carriers, such as gas, electricity, liquefied petroleum gas (LPG) and coal. The rates of the levy are based on the potential energy exploitable from the different carriers. Also, in Australia, as a part of the carbon pricing mechanism, liable entities had to pay a price for every tonne of carbon or carbon equivalent of other greenhouse gases emitted [36]. Liable entities were to be required to report on their emissions, and can meet their obligations by either surrendering the appropriate number of allocated units, or paying a unit shortfall charge.

Table 5: Examples of tax incentives

Instrument name	Incentive	Performance standards	KPI ref
White Certificates	Contribution (tax) of EUR 68/MWh	Energy savings	B.1.1; D.1.1
Household allowance - State of Finland	The amount of deduction can be 45 % of the cost of work charge (including value added tax) when using a company, or when hiring a person, 15 % of the salary costs and employers' contributions. The household deduction can be at most 2400 € per person. The deduction is personal, so a couple can get at most 4800 € deduction per year. An excess of 100 € per person needs to be paid first.	List of accepted technologies	B.1.3
Legge	Tax rebate covering 55-65% of energy related cost	Cost saved per kWh; heating energy demand; cooling energy demand; sanitary hot water production energy demand; renewable energy generated on-site;	B.1.1; B.1.2; B.1.3
Enhanced Capital Allowances (ECA) - Energy Technology List	Full rebate as tax allowance	List of approved technologies for: energy efficiency; on-site renewable generation; demand management; Safety of supply; warm season thermal comfort; cold season thermal comfort	B.1.1; B.1.2; B.1.3; B.5.1; B.6.2; B.6.3
Climate Change Agreements	65 % tax allowance off Climate Change Levy	Energy use; carbon emission	B.1.1; B.1.2; B.2.1
Exemption from Climate Change Levy for Good Quality CHP	Full tax exemption from Climate change levy	Renewable energy generated on-site; Energy efficiency of equipment	B.1.1; B.1.2; B.1.3
Reduced VAT for energy-saving materials	Flat 12,5% decrease on VAT rate	List of accepted interventions	B.1.1; B.1.2; B.1.3
Special purpose entity model	Various tax credits	Varies	D.1.3

3.1.2 Non-refund financial supports

Non-refund financial supports are offered mostly by public institutions – in some cases, by utility providers as per their legal obligations. Non-refund financial supports are grants, co-financing schemes, uncharged consulting services and project cost rebates. The exact benefit package tied to specific performance standards, as well as their associated NewTREND key performance indicators are analysed in Table 6.

In the European context, grants ensure the sustainability performance of their supported actions through a rigorous project management framework conditionally imposed on grant recipients. EU grant calls are extensive documents, defining conditions for application, attachments, list of fully or partially supported actions, technical criteria for the intervention, criteria for project duration, milestones, realization, and perhaps most importantly, indicators. The KEHOP 5.1.1-17 EU funded operative program in Hungary supports installation of renewable electricity generation and CHP generation - linked to grid, not building-based – for corporations, excluding SMEs. To be considered for the grant, applicants must deliver a feasibility study, a licence for legal status of the company, annual report for the last two years, official decree of ownership for the concerned property, verification of deductibles, notification letter towards electricity suppliers about the project claim and a positive response not older than 30 days, all necessary approvals from various authorities, environmental impact assessment, declaration to avoid double financing, declaration concerning the source of the biomass (when applicable), certification for satisfactory procurements (when applicable), and finally a declaration about transparency [37]. It is questionable how many prospective projects fall out of grace simply because of the rigidity of grant procedures. When designing projects for non-refund subsidies in the EU, the project managers and owners should be prepared for strict compliance rules and laborious reporting commitments.

EU funds apply indicators to comply with sustainability goals. Indicators are clear, measurable, comparable, quantifications of performance standards. EU environmental strategy defines a log-frame for indicators: input, output, outcome, goal. The framework defines the translation of overall goals to specific project performance.

The benefit package for grants are defined by intensity and total maximum amount. Intensity refers to the percentage of project costs subjected to co-financing, as in most analysed grants, there are deductibles involved. Deductibles are leverages from the side of the grant recipient, to ensure both parties have a stake, and take at least some risk by investing in energy efficiency. From 45 analysed grant schemes, 7 do not mention intensity of support. 12 schemes offer full coverage – these are mostly targeted at bottom-of-the-pyramid earners, pensioners or other socially

Table 6: Examples for non-refund financial supports

Instrument name	Incentive	Performance standards	KPI ref
The European Investment Bank (EIB) "ELENA – European Local Energy Assistance "	Non-refund financial support; min EUR 30M; duration 2-4 years; max 90% intensity	CO2 reduced; Renewable energy generated; Energy consumption reduced; Energy source transition	B.1.1; B.1.2; B.1.3; D.1.1; D.1.2; D.1.3
PAREER	Non-refund financial support, 20-30% intensity, max EUR 3.000; zero-interest loan, 60-70% intensity 12 years duration, max EUR 6.000	kg CO2/(sqm*a)	B.2.1
Energy efficient renovation (430) - investment subsidy	Non-refund financial support; max 30.000 EUR per living unit	KfW Effizienzhaus: Primary energy demand; Heat transfer coefficient; Equipment efficiency	B.1.1; B.1.2
Energy efficiency building and renovation (431) - Subsidy building supervision	Subsidy up to 4.000 EUR; 50% intensity	KfW Effizienzhaus: Primary energy demand; Heat transfer coefficient; Equipment efficiency	B.1.1; B.1.2
Affordable Warmth Scheme	Grant up to GBP 10.000	List of accepted interventions	B.1.1; B.1.2; B.5.1
Otthon Melege Program ZFR-KAZ/2017	Non-refund financial support, max 40 % intensity, max 700 kHUF	CO2 emission reduction per annum; energy savings per annum	B.2.1; D.2.1; B.1.1; D.1.1
KEHOP - Environment and Energy Efficiency Operative Programme 5.1.1-17	Non-refund financial support; 10-45 % intensity; 2000-4300 mHUF	GHG emission reduction; Renewable energy capacity; Energy generated from renewable sources	B.1.3; D.1.3
KEHOP - Environment and Energy Efficiency Operative Programme 5.2.8	Non-refund financial support, max 80 % intensity; 50-250 mHUF	Renewable energy capacity; Primary energy consumption reduction; GHG emission reduction; Energy generated from renewable sources	B.2.1; D.2.1; B.1.1; D.1.1; B.1.3; D 1.3
TOP - Territorial and settlement operative program 2.1.2-16	Non-refund financial support, 100 % intensity, amount defined individually for counties	Area of rehabilitated or new open space; Population involved in redevelopment; Length of stormwater mitigation infrastructure; Number of rehabilitated public or commercial buildings; Area of rehabilitated or new green space	B.2.1; D.2.1
TOP - Territorial and settlement operative program 6.5.1-16	Non-refund financial support, 100 % intensity, amount defined individually for cities	GHG emission reduction; Primary energy consumption reduction; Renewable energy capacity; Energy generated from renewable sources	B.2.1; D.2.1; B.1.1; D.1.1; B.1.3; D.1.3

3.1.3 Refund financial supports

Financial support may also be subject to refund. The traditional tool to overcome high investment costs has always been borrowing, but in the context of sustainability, a long return period with a modest slope in cash flow is common – raising further barriers before investment. Refund financial supports are often subsidized to offer more attractive terms – interest rates, payback periods – than conventional loans. Various entities can be issuers of loans. Subsidized loans are traced back to public entities, government agencies, Municipalities, or the EU (e. g. GINOP, Operative Program for Economic Development and Innovation). There can be financial intermediaries involved, either publicly (e.g. KfW in Germany) or privately managed (e.g. Raiffeisen Bank retrofit loans for public institutions in Hungary).

Compared to non-refund financial support, the benefit packages of loans are usually larger, both in terms of support intensity and maximum absolute amount. Out of the 12 analysed loan schemes, 8 does not mention an intensity ceiling, 3 sets intensity to at least 60 %, and only 1 below. The differences are directly comparable within combined instruments, such as the Spanish PAREER: Aid Programme for Energy Rehabilitation in Buildings in the Household and Hotel Sectors. PAREER offers financial aid to improve energy efficiency, GHG emissions reduction, and renewable energy generation in buildings built before 2014. The benefit package is adjusted to four intervention types: thermal envelope energy efficiency, energy efficiency of appliances, biomass thermal energy generation, geothermal energy generation. The IDEA subsidy component of the scheme may cover 30, 20, 25, and 30 % of the intervention costs respectively, while the loan component goes up to 60, 70, 65, and 60 %. The cap imposed on the amount is EUR 3.000 for the grant and EUR 6.000 for the loan [38]. The trend carries over to loans in general: while grants are usually applied to co-financing type schemes, also relying on deductibles, loans can often be used to finance entire projects – precisely because a refund with interest is expected anyway.

The primary metrics of loans are not the amount and intensity, but the interest rate and the term of repayment. Interest rates and terms define the cost of borrowing adjusted to a timescale, which in turn defines the cash-flow, thus the viability of obtaining the loan in the first place. The diversity of loan types connected to improving energy performance of buildings is rooted in fiddling with interest rates and terms to lower the threshold of viability, thus to include more, otherwise left-behind borrowers to fast-forward national sustainability goals. The differences are clear when comparing commercial loans with subsidized loans in the same country.

Loan amounts are usually calculated from investment costs and performance standards, and subsidies may or may not be fine-tuned based on social vulnerability, while performance is also used as threshold for eligibility.

Table 7: Examples for refund financial supports

Instrument name	Incentive	Performance standards	KPI ref
PAREER	Non-refund financial support, 20-30% intensity, max EUR 3.000; zero-interest loan, 60-70% intensity 12 years duration, max EUR 6.000	kg CO2/sqm*a	B.2.1
JESSICA-FIDAE funds	- Amount: up to 70 % of eligible expenditure, with the limit of the budget available in each region. - Amortization depending on project need. Up to 15 years, with 3 years of grace period. - Interest rate: Euribor plus spread based on credit rating and guarantees provided. Rates of interest ranging from Euribor to Euribor + 0.75 % + 4 %. Projects in which the recipient of the funding is a public service and have no economic activity: - Amount: up to 100 % of eligible expenditure, with the limit of the budget available in each region. - Interest rate: 0%.	Energy savings per annum; energy cost savings per annum	B . 1 . 1 ; B . 1 . 2 ; B.10.1; D . 1 . 1 ; D . 1 . 2 ; D.10.1
Housing Fund of Finland - Loans for renovations	Loan guarantee covering max 70%, guarantee fee 2% of loan capital; subsidized loan, 3,4-3,5% interest rate	None	NULL
Energy efficient renovation (151, 152)	27.5% of the loan sum, max EUR 27.500 per residential unit	KfW Effizienzhaus 55 standard: primary energy demand; Thermal transmittance; list of accepted interventions	B . 1 . 1 ; B.1.2
Energy efficient renovation (167)	Credit loan up to 50.000 EUR for replacing existing heating system with renewable energy based heating system with a max period of 10 years with effective rate of 1,26 % per living unit.	Renewable energy generation (nominal heat output for heat pumps and biomass; panel area for solar)	B.1.3
Energy efficient building and renovation (217/218)	Credit loan with no maximum amount	KfW Effizienzhaus standard: Primary energy demand; Heat transfer coefficients; list of accepted interventions	B . 1 . 1 ; B.1.2
Renewable Energies - Standard (270)	Credit loan up to 50 Mil EUR with a rate of 1.05% for period of 20 years	Renewable energy generation (Act for the Expansion of Renewable Energies of 21 July 201); Energy stored	B . 1 . 1 ; B . 1 . 2 ; B.1.3
Renewable Energies - storage (275)	Credit loan with a rate of 1.00% for period of 20 years	The power of the installed photovoltaic system connected to the battery storage system shall not exceed 30 kWp.	B.1.3

3.1.4 Financial security

The public sector can also encourage sustainability investments indirectly. The buildings in the worst conditions, where a sustainability retrofit is most relevant and desirable are the ones who are more likely to fail securing funds. Given the associated financial risks, the users of these buildings deliver, it is no surprise that financial institutions – who are more inclined to give money to those who do not need it – are not eager to lend. To alleviate risks, public institutions, exploiting the fact that they shepherd over a steady, secure income, act as collaterals to incentivise lending.

The indirect incentives to invest in energy efficiency come in the form of loan guarantees and collateral funds. Take for example, the Energy Efficient Mortgages in the US. Homeowners can leverage EEMs for energy efficiency and renewable energy generation investments either for retrofit or new construction. In order to avert revenue losses from default and expanding the target group, the Federal House Authority or Veteran Affairs programs provide insurance, covering up to the total costs of the investment for 15 or 30-year terms [39].

Table 8: Financial securities

Instrument name	Incentive	Performance standards	KPI ref
EUROPEAN COMMISSION - LIFE PROGRAMME Private Finance for Energy Efficiency instruments (PF4EE)	Up to 80 % collateral funding; loan EUR 40k-5M; 75 % intensity; duration max 20 years; technical consultancy	Heat supply cost; renewable energy generation; cost-optimum energy efficiency; primary energy savings	B.1.1; B.1.2; B.1.3; B.10.1; D.1.1; D.1.2; D.1.3; D.10.1
Housing Fund of Finland - Loans for renovations	Loan guarantee covering max 70%, guarantee fee 2% of loan capital; subsidized loan, 3,4-3,5% interest rate	None	NULL
Finnvera - Environmental loan guarantee	Loan guarantee covering max 80 %; 10-year term	Environmental impact; energy efficiency; Renewable energy generated	B.1.1; B.1.3; D.1.1, D.1.3
Energy Efficient Mortgages	Loan guarantee covering max 100 %; 15/30-year term	Energy efficiency (Energy Star)	B.1.1; B.1.2

3.1.5 Energy performance contracting

Energy performance contracting is an umbrella term for innovative, for-profit business models that seek revenue from energy performance. There is a wide variety of possible models, all harnessing reduced costs of more efficient/productive energy balance of buildings. The three most common types of business models based on energy performance are: demand response mechanisms, ESCOs, and prosumption.

Demand response mechanisms involves streamlining energy consumption to reduce costs for the consumer. This means the exploitation of loopholes in the energy provision, such as the uneven daily distribution of demand (peak hours versus off hours), pricing accuracy (lump sums versus smart metering), or interruptible energy.

Prosumption models build on the massive distribution of power generation, incentivising on-site, small-scale renewable energy generating projects. The term prosumption means production by consumers, and is gaining traction with the advent of technologies with a small footprint such as photovoltaic panels, small-scale combined heat-power generators, heat pumps or household wind power rotors. Apart from high investment cost, another key entry barrier for these technologies come from the uneven and in some cases difficult-to-predict production curve. A lot of excess power is generated, with limited storage options, creating an opening on the market for smart grids. To incentivise prosumption, the infrastructure to absorb excess, a clear framework for feed-in conditions, and attractive pricing schemes are required.

Energy services companies, or ESCOs are bankable entities whose business model is to invest in energy performance improving interventions to gain revenue from a percentage of the reduced utility costs of the customer. The contracts tie revenue to performance standards – the reduction in operational expenditures – incentivising the ESCO to a) investigate which projects yield higher energy savings potential, b) rigorously assess the most cost-efficient intervention applicable. There are multiple variations of the ESCO model.

When planning to seek financial incentives to increase energy performance, it is worthwhile to note that as technology matures, market options such as energy performance contracting become more viable against public financing products. The ESCO industry revenue in the US in 2011 was reportedly around USD 5,3 billion [40], compared to the USD 4,9 billion in 2009 [41], meaning a 9 % annual growth rate, drastically exceeding the US GDP growth of average 1,9 % [42]. In Europe, between 2010-2013 most of the EU countries also experienced market growth for energy performance contracting, albeit in some countries the market stagnated or declined (Hungary, Austria, the Netherlands) [43].

Table 9: Examples for energy performance contracting incentives

Instrument name	Incentive	Performance standards	KPI ref
BOOT	Capital investment coverage, share in savings	Energy cost savings	B.10.1; D.10.1
Guaranteed savings EPC contract	Capital investment coverage, share in savings	Energy cost savings	B.10.1; D.10.1
Interruptible service	Less utility expenditures	Energy consumption	B.1.1; D.1.1
ESCO / leasing - solar power financing	Capital investment coverage, share in savings; Non-refund financial support, 25% intensity	Energy cost savings	B.10.1; D.10.2; B.1.3; D.1.3
Fortum Fikso	max 15% savings on energy bill	Energy cost savings; energy efficiency	B.1.1; B.1.2; B.10.1
ENEL info/info+	Savings from streamlined invoicing	Primary energy consumption	B.1.1; B.1.2
Green Deal	Capital investment coverage, share in savings	Energy cost savings	B.1.1; B.1.2; B.1.3; B.10.1
Savesco EPA	Purchase guarantee	Locally generated energy	B.1.3; D.1.3
Savesco PBI	Emergency investment coverage, share in savings	Primary energy consumption reduction	B.2.1; D.2.1; B.1.1; D.1.1

3.2 Connections with NewTREND KPIs

In this subchapter, we analysed the indicators of the collected financial instruments in relation to the NewTREND KPIs. As Errore: sorgente del riferimento non trovata shows the NewTrend core KPIs set of 10 indicators and that only 6 of them are considered in financial instruments. The improvement of indoor air quality, summer comfort, and acoustics comfort are not deemed worthy for incentivisation.

In some instances, the financial instruments use similar indicators for measuring performance as NewTREND. In other cases, the purpose of the NewTREND indicators are in line with the goals of the financial instruments. Table 10: shows that most of the collected instruments consider energy use reduction as their targets, similarly to B1.1 Operation Primary Energy Demand and B1.3 renewable Energy on Site indicators. Also, global warming is also frequently considered by the instruments similarly to operational energy costs. Thermal comfort improvement is only considered for tax incentives and non-refundable instruments. The reason could be that energy efficiency improvements are more quantifiable, therefore it's easier to tie performance requirements to them. Also, efficiency is straightforward to monetize, thus provide a return to pay back external funding, while comfort is considered an externality. The comfort related instruments mainly target low income housing where the target is reaching the minimal levels of human comfort.

Table 10: Incentives in relation to NEWTREND KPIS

	KPI	Tax incentives	Non-refund	Refund	Security	EPC
B.1 Energy	B.1.1 Operational Primary Energy Demand	10	29	12	3	9
	B.1.3 Renewable Energy On Site	6	13	11	2	4
B.2 Impacts	B.2.1 Global Warming Potential	2	24	7	0	5
B.6 Thermal comfort	B.6 Thermal Comfort indicators	2	3	0	0	0
B.10 Operational costs	B.10.1 Operational Energy Costs	1	5	4	2	10
D.1-10	District scale indicators	5	28	11	2	12

Instruments relevant to the district scale are few in our collection. However, mostly the same instrument can be used for individual or groups of buildings as well. These district scale indicators mainly consider energy use reduction and operational cost of the district, but not thermal comfort.

COMPARISON OF NEWTREND AND INCENTIVES CALCULATION METHODOLOGIES

NewTREND calculation method is based on the method of PREN 15603 Energy performance of buildings – from the overarching standard: EPBD. The method is focused on the operational primary energy demand only the life cycle stage "B6" is considered in the calculations according to the EN 15978 standard.

The PREN 15603 standard provides a systematic, comprehensive and modular overall structure on the integrated energy performance of buildings, in order to ensure consistency among all CEN standards required to calculate the energy performance of buildings according to the EPBD (2010/31/EU).

The NewTREND energy use KPIs are calculated with the use of IES VE software. The NewTREND cost KPIs and the Global Warming Potential KPI use the output of the energy calculations as an input for their calculation formula. Therefore, these methods are analysed together in the following.

Comparison of energy and cost KPI calculations

The analysis of the financial instruments shows that they use different type of energy use calculation methods.

EPBD BASED CALCULATION

The main legislative instrument to calculate energy savings in the building sector of the European Union is the Energy Performance of Buildings Directive (EPBD - Directive 2010/31/EU) and its supplements. This directive is closely supported and complemented by other Directives: Energy Efficiency Directive, Renewables Directives and Ecodesign and Labelling Directive.

According to the EPBD the energy performance of design variants needs to be calculated following CEN standards or national standards. CEN technical report TR 15615 (Umbrella Document) gives the general relationship between the EPBD Directive and the European energy standards. Standard EN 15603:2008 provides the overall scheme for energy calculation.

The collected financial instruments use the national variants of the general energy efficiency framework. The current minimum performance calculations for new buildings are based on a national calculation method that follows the main principles of CEN standards.

The EPBD based calculation method has the same legislative basis as the NewTREND calculation methodology. The calculation processes of the member states do not require dynamic energy simulation based calculations, they can use simplified methods.

ASHRAE 90.2

The ASHRAE 90.1 standard is developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers. The standard provides Standard Energy Procedures for Rating Efficiency of an entire building. It states minimum requirements for the energy efficient design of buildings as well as Performance Rating Method (PRM), G, which is used in rating the building designs that exceed the minimum requirements of the standard. The general principle of the PRM rating is to compare cost or energy consumption of the proposed design to the baseline that satisfies the minimum standard requirement. The Performance Rating Method includes the total energy consumption of all end uses. The standard allows for variations in Climate, Building Sizes, Building Types, HVAC systems.

The performance is calculated by using detailed dynamic simulation programs. The baseline design is used to determine the specific proposed building's energy performance rating, typically expressed as the percentage of improvement in total energy cost in comparison to the design base benchmark value.

The ASHRAE 90.1 based calculation is similar to the NewTREND method in the use of dynamic energy simulation software. However, while the ASHRAE method defines energy use reduction compared to a reference building with predefined materials and systems, the NewTREND method defines the baseline as the actual existing building.

ENERGY STAR

The Energy Star rating is mainly used in the US and Canada. The performance standard has different paths to rate buildings for the different building types:

- Residential buildings
- Non-residential existing buildings
- Non-residential new buildings

For residential buildings, the ENERGY STAR certification can be obtained through a prescriptive or a performance path. The Prescriptive Path provides a single set of measures that can be used to construct an ENERGY STAR certified home. Energy simulation is not required. The Performance Path provides flexibility to select a custom combination of measures for each home. Equivalent performance is assessed through energy modelling. Energy modelling should be conducted using a RESNET-accredited Home Energy Rating software.

Existing non-residential (commercial and industrial) buildings can use the ENERGY STAR Portfolio Manager to upload the measured (monthly) energy / water consumption data. If the building performs among the top 25 percent of similar buildings nationwide the building earns the ENERGY STAR certification.

New non-residential building should use the third-party modelling path. The expected building performance can be compared to the existing building performance database and earn ENEGY STAR rating [44].

The ENERGY STAR performance path uses measured data or simulated data similarly to NewTREND advanced or premium modes. The benchmarking of the measure is different, as it compares a building to a sector-wide average performance.

MONITORING DATA

Actual building energy use data and actual cost data is also used by several financial instruments. These instruments are mainly taxes or demand response programs where the already operating building receives funs or pay taxes based on their previous performance.

The data requirements of these mechanisms are similar to those of NewTREND premium mode energy and cost KPIs. The difference is that NewTREND converts the data to primary energy use, but the taxes and demand response programs use energy end use data.

ENERGY AUDITS

Incentive programs from the US and Canada also determine building performance through energy audits. These performance measurements are used only for existing buildings for several building types. The use of an established energy use calculation method is the responsibility of the energy auditor who collect all necessary data and determines the building performance and later suggests refurbishment options. By contrast, the NewTREND calculation method provides an automated calculation process.

CUSTOM GUIDELINES

Several incentive programs differ from the international standards when determining building performance. These instruments developed custom procedures to assess the current the energy use or energy costs of the buildings and predict the effects of the retrofitting measures. Two main type of custom procedures can be discovered among the collected instruments:

- Custom guideline, spreadsheets: these instruments provide a guideline about how to assess the performance of the building or a spreadsheet to fill with the required data.
- Recommendation by accredited expert: these instruments require an assessor, often with a third-party accreditation to perform the necessary measurements, calculations to determine the building performance

These custom procedures largely differ from the NewTREND methodology as they either require expert assessment or filling an often simplified custom guide or spreadsheet.

Comparison of comfort KPI calculation

The comfort KPIs calculations inputs are based on custom modules integrated into IES software, specifically developed for NewTREND. Their formula and benchmarks are specified according to EN 15251:2007 Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.

The analysed financial instruments rarely incentivize interventions targeting comfort improvements. One of the 5 instruments that do cover comfort, uses Protocollo ITACA for performance standard. This rating scheme includes comfort related KPIs, which are further detailed in Chapter 74Errore: sorgente del riferimento non trovata. Other instruments defined a list of accepted interventions to improve comfort that can be incentivized. For example, the Affordable Warmth Scheme from the UK defined a list of interventions for low income housing to improve energy efficiency and to reach minimum comfort levels in residential buildings.

Rating schemes

4. Rating Schemes

Certification systems are quantitative standards to measure the concept of sustainable development in any region. By defining a set of criteria and a rating system to score them, these systems assess projects during a specific process, but every of these systems has a specific tool for assessing and measuring sustainability.

In the international scene, there are several types of rating schemes and many of these are based on the evaluation of sustainability across design, construction and operation of infrastructure. Sustainability evaluation includes environmental, social, economic and governance aspects of projects and assets. Rating schemes usually aims to support decisions to deliver enhanced environmental and social benefits for civil engineering works and better economic outcomes that benefit society. In general, rating schemes can be used as part of the initiation and development phase of project planning to incorporate sustainability considerations and outcomes into the overall project phases. Rating schemes may be associated with an Economic Incentive, and these incentives could be different in the amount of financial contribution, in the method of the delivery, in the accessing conditions, etc. and for this reason there are in fact, many typologies of incentives. Beneficiaries are those receiving the grants and also responsible for the application of the rating scheme. Usually the support is granted on the basis of the type of project and the achieved score. Economic incentives are grants disbursed by one party (often a government/public institution, corporation or foundation), to a recipient (a non-profit entity, public institution, business or an individual/consortium). Incentives can be arranged to serve a very specific purpose through a one-off targeted project and provided by municipalities, regions and by government agency level for smaller projects.

In order to receive a grant related to a rating scheme, a specific tool application process is usually required, for example the application of an assessment sustainable tool. It is also important to underline that not all project types are eligible for receiving the incentives. A large number of high performance buildings can act as a driver to push also the market toward a better sustainability. But to reach effective and real results, an incentive based program requesting high environmental and energy performances needs to be supported by adequate tools and training. For this reason the implementation of an integrated process to support the design and construction of high performance buildings is fundamental. This process should include assessment tools/criteria catalogues, hotline, website, training, observatories. The benefits of applying a rating scheme with a sustainable assessment tool, which allows to obtain economic incentives as part of project evaluation could be:

- An efficient use of environmental resources and consequently a reduction of costs;
- An improvement of the sustainability performance of the buildings over their lifecycle;
- A broader engagement across project's team to get better performance and so more financial support;
- To improve the capacity to make better decision and so to deliver more sustainable outcomes;
- To enhance the understanding of the importance of sustainability.

In urban planning, the interest in the criteria of sustainability of energy and environment is relatively recent, since recent are scientific approaches to coding procedures and parameters. In the building sector instead, coexist different protocols (BREEAM, LEED, CASBEE, GBC, HEQ, ITACA, CASACLIMA) well-established, based on a series of indicators that allow to control the entire building process, from the supply of building construction materials, to their disposal and/or reuse at the end of the life cycle assessment (LCA), including maintenance and in use phase, with relative energy consumption and consequent pollutant emissions. It is quite obvious how essential and indispensable is the alignment between architectural design and sustainable urban planning. It is important to be aware of the importance of developing it as an assessment tool for the environmental performance of groups of buildings, not just for individual buildings.

A comparative approach between different rating systems and sustainable building certification systems is not simple because Each of these systems has its own core set of indicators, a different weighing method, and a final score expressed differently for each. In this extensive scenery, the analysis of rating schemes has focused on the Italian, French and Austrian cases as all based on similar incentive policies and similarly structured environmental performance assessment systems. All chosen rating schemes address the challenge to evaluate buildings through the application of an assessment tool concerning environmental, economic and social aspects.

4.1 Rating schemes in the Italian context

Concerning Italian rating schemes, "Protocollo ITACA" and "Biover2" have been analysed according to their basic principles and in their own origin Region. The first was developed in Piedmont Region but rapidly expanded its interests also in many other regions, while the second one has spread in Veneto Region and it is consistent with the Protocollo ITACA. In the Italian territory there are many other rating systems but they are not connected with an economic incentive, as the official system of the Italian Regions, Protocollo ITACA is strongly focused on a broad assessment base, aiming at the widest application possible of the performance assessment approach in the everyday practice of designers and developers. It's based on the mass orientation principles.

4.1.1 Protocollo ITACA – Piedmont Region

Table 11: Synthetic scheme with key information about Protocollo Itaca

NAME OF THE RATING SCHEME	Protocollo ITACA
REGIONAL APPLICATION	Piedmont Region (Italy)
RELATED INCENTIVES PROGRAMS	"Programma Casa", "Contratti di Quartiere" and "PRUACS" Incentives Programs
IN USE AT THIS MOMENT	In use
RELATED GRANTS AT THIS MOMENT	Already finished: "Programma Casa", "Contratti di Quartiere" and "PRUACS" Incentives Programs Active: "POR- F.E.S.R. 2014-2020" the Regional operational programme about competitiveness and employment objective
RELATED NATIONAL/REGIONAL LAW	Based on National and Regional Law
TYPE OF BUILDINGS TO BE APPLIED ON	Residential buildings, non-residential buildings (schools, offices, commercial and industrial buildings).)
DIFFICULTY OF THE ASSESSMENT	Medium difficulty for the calculation of energetic criteria.

In 2001, ITACA, the "Institute for Innovation and Transparency in Procurement and Environmental Compatibility", launched an interregional working group on green building to develop the tools needed to make regional policies more sustainable in sustainable construction. The main goal was to develop a scoring system to allow to set purposes and measurable objectives in public policies and programs, to encourage sustainability of buildings.

The international tool called SBTool, promoted by the non-profit organization iiSBE (International Initiatives for a Sustainable Built Environment) and developed under the Green Building Challenge, has been adopted as a scientific reference for the development of the ITACA Protocol Assessment System. The basic principle of SBTool is to share a common methodology and indicators safeguarding, at the same time, the possibility of contextualizing the assessment tools to reflect their priorities and characteristics.

The first version of the ITACA Protocol was produced by the Piedmont Region and published in 2003 in response to the previous call for applications for urban redevelopment programs called "Contratti di Quartiere".

The official version of the ITACA Protocol for Residential Buildings was then approved on 15 January 2004 by the Conference of Regions and Autonomous Provinces. Subsequently, the Protocol was adopted by numerous Regions and other public administrations and used in policies, building codes, procurement, urban planning, etc.. In 2009 the Piedmont Region published an updated version of the ITACA Regional Protocol, composed of criteria aligned with the national version of the ITACA protocol and published, first, the version of ITACA Protocol for School Buildings (2007), Commercial Buildings (2010), High Buildings (2011) and Service Stations (2015). The Piedmont Region Protocols have subsequently become ITACA's assets which adopted and published them as National Protocol. Through the CABEE project, Piedmont Region has developed the first pilot version of the ITACA Protocol for Buildings in use and for urban areas (clusters). The latter was awarded to ITACA for the adoption at national level and in 2016 ITACA Protocol at Urban Scale was published.

ITACA protocol is an assessment tool, based on the methodology SBTool of iiSBE, whose purpose is the classification of the performance of a building. The end result is a score, a kind of "scoreboard", which indicates the level of sustainability of construction as an increase compared to current practice. The latter is defined by assigning weights to criteria and benchmarks for the regulations and technical standards in force. The ITACA Piedmont Region Protocol is in fact contextualized with respect to the Piedmont context and aligned with the regulations and standards of the region. The weighing system is nothing more than the aggregation through criteria, categories that arise following normalization of the scores. in particular, after the normalization step, a new set of data is available, composed of the normalized scores associated with each criterion.

In order to carry out the assessment of the final score of a building, the SBMethod should take shape in a tool that is its operative realization and it is called SBTool. Each criterion receives a score from -1 to 5, where zero is the standard performance and the best practice is 3. Scores obtained for each aspect evaluated are then aggregated through a weighed sum to define a single final total score, also expressed on the scale from -1 to +5. So, a building that gets a zero rating on all criteria is conceptually a standard building (benchmark) where the current regulatory limits have been respected. If design is advanced in terms of sustainability, the level gained will increase positively towards a practice of excellence (5 points).

The protocol is organized into five areas of assessment: Site Quality, Resource Consumption, Environmental Load, Indoor Environmental Quality and Quality of Service. A specific rating also allows to evaluate the quality of the localization. Protocollo ITACA is strongly focused on a broad assessment base, aiming at the widest application possible of the performance assessment approach in the everyday practice of designers and developers. The ITACA workgroup gives high relevance to the applicability of criteria and ease of use for technical experts, including the seamless introduction of the assessment in existing project development workflows. To achieve mass adoption of the system, Protocollo ITACA tends towards simplicity of use. The indicators are already part of the skillset of architects and building engineers, with a short course recommended to achieve full confidence in the assessment methodology.

Protocollo ITACA it's an open source protocol and all versions of the assessment system are freely available online for download.

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

Protocollo ITACA was born in Piedmont Region but it's today present and developed for their s regional versions in Marche, Puglia, Umbria, Piemonte, Valle d'Aosta, Friuli Venezia Giulia, Lazio, Basilicata and Calabria as well [45]. Protocollo ITACA is fully contextualized to the standards and laws in force in Italy, and is updated according to policy evolutions. Furthermore, in its capacity as a framework for assessment in different areas, it has been modified and adapted according to the context of various Italian regions, while maintaining the recognizable structure and key performance indicators.

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

In 2006, Piedmont Region launched a six-year social housing funding programme, called “Programma Casa 10.000 alloggi per il 2012” (Housing programme: 10.000 apartments for 2012), to support a wider access to housing for the population. Participants were required to evaluate their project using the sustainability assessment system Protocollo ITACA.

On the scale from -1 to 5, new constructions were required a mandatory score of 2, while retrofitting projects were required a minimum score of 1.

The programme further included an extensive and rigorous process of external technical review carried out by iiSBE Italia, tasked as validators of the assessment developed by the experts and designers working with the developers requesting the funding. The validation process included a review of the assessment in the design phase and of any necessary revisions during the construction phase, and a construction monitoring activity, to verify the adherence of the construction works to those elements which had been declared in the sustainability assessment. A large number of buildings were assessed through Protocollo ITACA because this programme had a high participation [46]. The innovative measures of the “Programma Casa”, generate projects and actions to respond to the needs of the weakest bands of society, such as young people, elderly and economically vulnerable people. The number of interventions concluded and validated with the ITACA Protocol was 132. Thirty were concerned with the renovation, while the remaining 102 were new construction works and actuators are private and public.

Another important funding programme for the environmental and social restoration of large parts of the urban territory, especially with regards to affordable and social housing. was called “Contratti di Quartiere” [47], born after the Law 8 February 2001, n°21. Call for tenders for urban regeneration projects, was co-financed by the Italian Department of Infrastructures and Transport and co-financed and managed by each regional government.

Total financing were € 694.460.000 and the total financing is divided into different types of intervention:

- Housing 49%
- Secondary infrastructures (schools, public buildings, etc) 18%
- Primary infrastructures (streets, networks, etc) 13%
- Offices & Retail 11%
- Actions & Services 9%

The funding programme has envisaged the promotion of innovative urban programs aimed at increasing, with the participation of private investment, the infrastructure of municipalities with strong housing and employment disadvantages. Programs should also include measures and interventions to increase employment, to promote social integration and adaptation of housing supply.

Piedmont Region was the first in Italy to have included a score rating tool within a urban recovery plan. It was a very important step because it has gone from qualitative objectives, to the indication of quantitative and measurable objectives.

Another important incentive program related with the Protocollo ITACA in Piedmont Region is known as “PRUACS” which stands for Redevelopment Urban Programs for Sustainable fee Accommodations which started with Ministerial Decree 2295 (26 mar 2008). PRUACS are programs for the environmental and social restoration of large parts of urban territory, especially with regards to affordable and social housing. State and regional funding, overall intended for this purpose, was about 32 million euros. The proposals submitted by the Municipalities were eleven and the ones eligible for funding were seven. PRUACS referred to the ITACA Piedmont Region Protocol updated in 2009.

RELATED ECONOMIC INCENTIVES

In the funding programme called “Programma Casa 10.000 alloggi per il 2012”, the developers would receive 5.000 € in funding for each apartment, as recognition of extra costs required to implement sustainability principles and performances in the design. The achievement of a higher performance (2,5 for new buildings and 1,5 for retrofitting) was rewarded with an additional 5.000 € per apartment, bringing the funding to a total of 10.000 € per apartment .

In the funding programme called “Contratti di Quartiere”, projects were selected and financed based on a series of indicators: Environmental, Social and Economic sustainability. For the last one, the minimum criteria to participate to the call was: Housing covered at least 60% by central-regional government financing, Infrastructures covered at most 40% by central-regional government financing, Municipalities financing at least 10% of quota of central-regional government financing, Environmental sustainability testing for housing, no less than 20% and no more than 25% of the central-regional government financing, and maxed at 12.500 € per dwelling.

The notice for the funding programme Contratti di Quartiere contained the first version of the ITACA Piedmont Region Protocol for residential

buildings, according to the score obtained through the Protocol, social construction workers were able to receive a bonus of up to € 12,000 per accommodation.

RELATION INCENTIVES, PERFORMANCES AND SCORE

The analysis of the programme called "Programma Casa 10.000 alloggi per il 2012" (Housing programme: 10.000 apartments for 2012) has homogeneous data because concerns 100 projects that have been assessed in the 2010-2012 period by using the Protocollo ITACA 2009 Piedmont Region version.

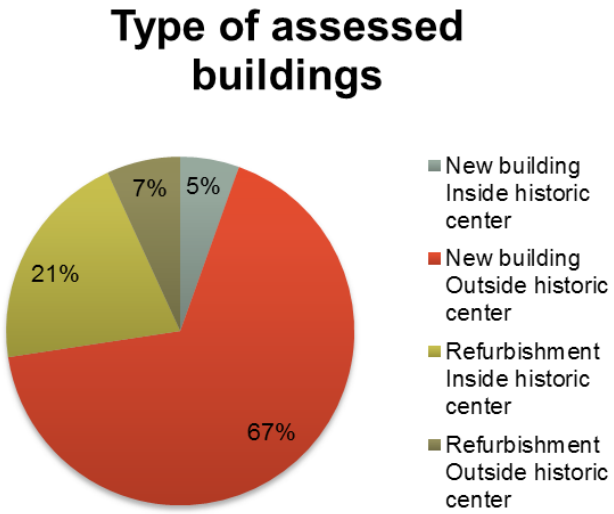


Figure 4: Types of buildings assessed with Protocollo ITACA

The territorial impact of the programme was high, with only 1/3 of the assessed buildings located in the Region capital (Torino) while the others were in the 7 major cities (Province capitals). It is interesting to highlight the fact that the application of the programme on new construction (or integral substitution of existing buildings) was prevalent, with almost 3/4th of the cases and most of these projects were carried out outside of historic city centers. The average scores for new buildings was 2,2. Regarding retrofitting projects, the majority were carried out in historic centers and the average score for them was 1,9.

Following the assessment criteria of the ITACA Protocol Piedmont Region 2009 tool.

Table 12: Protocollo Itaca assessment criteria for Piedmont Region in 2009

Protocollo ITACA Regione Piemonte 2009 – ASSESSMENT CRITERIA
1. Site quality
1.1 Site conditions
1.1.2 Level of site urbanization
2. Resource use
2.1 Non-renewable primary energy use during life cycle
2.1.2 Thermal transmittance of the building envelope
2.1.3 Net energy for heating
2.1.4 Primary energy for heating
2.1.5 Control of solar radiation
2.1.6 Thermal inertia of the building
2.1 Renewable energy
2.2.1 Thermal energy for Domestic Hot Water
2.2.2 Electric energy
2.3 Sustainable materials
2.3.1 Materials from renewable sources
2.3.2 Recycled/reused materials
2.4 Potable water
2.4.2 Potable water for indoor uses
3. Environmental loads
3.1 CO2 emissions
3.1.2 Emissions in operation phase
4. Indoor environmental quality
4.2 Thermal comfort
4.2.1 Air temperature
4.3 Visual comfort
4.3.1 Natural lighting
4.5 Electromagnetic pollution
4.5.1 ELF-EMF (50 Hertz)

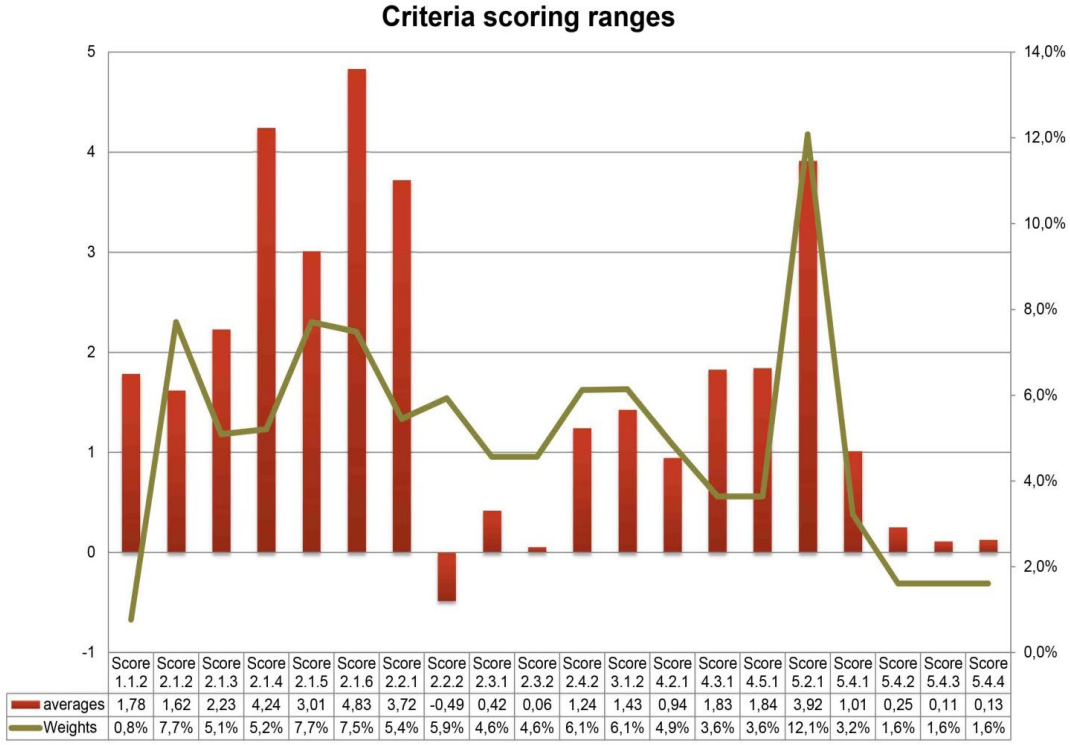
5. Service quality
5.2 Performance in operation phase
5.2.1 Availability of technical documents of buildings
5.4 Home automation
5.4.1 Quality of cabling
5.4.2 Video control
5.4.3 Access control and safety
5.4.4 Systems integration

The assessment areas analysis shows the most interesting results. In general, the main strategies for reducing energy consumption are due to the reduction of thermal transmittance of opaque and transparent structures and also the use of thick walls, characterized by high thermal inertia. In about 90% of the cases studied there was a widespread use of solar collectors for the production of hot water and PV for the production of electricity. The adopted mechanical systems solutions often involve the installation of centralized condensing boilers, combined with radiant floors, in other cases instead of connecting to district heating and in a few other interventions to the use of geothermal plants.

In terms of reducing drinking water consumption for indoor use, many of the analysed projects have included systems such as double-cot kettle taps, faucet aerators, which can save on drinking water. In order to reduce the consumption of outdoor drinking water, mainly used for irrigation, several projects have planned the installation of rainwater and wastewater recovery systems. Water, captured mainly by the roof surfaces, will be stored and purified by means of special filters that will allow it to be used both for irrigation and for filling the dual flush toilets.

Closely related to the theme of water is the topic of permeability of external areas. In the projects they have tried to use high permeability pavements that do not minimize the interruption of natural water flows. Analyzing the scores obtained, it is noted that the vertical bars show the individual scores (from -1 to 5) obtained by the Protocol criteria. These criteria are organized in five evaluation areas: Site Condition, Resource Consumption, Environmental Load, Indoor Environmental Quality and Quality of Service. The level of satisfaction of these criteria is verified through objective performance indicators.

The energy criteria showed very high average values in those indicators derived directly from the energy certification, specifically regarding the



	Score 1.1.2	Score 2.1.2	Score 2.1.3	Score 2.1.4	Score 2.1.5	Score 2.1.6	Score 2.2.1	Score 2.2.2	Score 2.3.1	Score 2.3.2	Score 2.4.2	Score 3.1.2	Score 4.2.1	Score 4.3.1	Score 4.5.1	Score 5.2.1	Score 5.4.1	Score 5.4.2	Score 5.4.3	Score 5.4.4
averages	1,78	1,62	2,23	4,24	3,01	4,83	3,72	-0,49	0,42	0,06	1,24	1,43	0,94	1,83	1,84	3,92	1,01	0,25	0,11	0,13
Weights	0,8%	7,7%	5,1%	5,2%	7,7%	7,5%	5,4%	5,9%	4,6%	4,6%	6,1%	6,1%	4,9%	3,6%	3,6%	12,1%	3,2%	1,6%	1,6%	1,6%

Figure 5: The average scores of criteria (red bars) and the relative importance of each criterion (brown polyline).

However, the average absolute values were not particularly high when compared to the certification standards, which led to a revision of the assessment scales towards a stricter adherence to the energy certification levels.

On the other hand, the materials criteria (2.3.1 – 2.3.2) showed very low values, which strongly correlated to the low weight of the criteria in the system. A closer study revealed that the indicators, assessing the percentage of renewable or recycled materials, considered the material weight, which proved unfavorable for materials more expensive than standard construction materials. The indicators were therefore revised to calculate the volume percentage, and the weight in the system was adjusted to increase the relevance of the subject in the overall assess

ment. What attracts the attention is the negative value of Criterion 2.2.2 - “Electricity”: the reason is the poor use of systems for the production of electricity from renewable sources. Among the evaluation areas there is also the one that evaluates the quality of the site, as the sustainability of a construction cannot depart from its location and, consequently, from the location choice, favoring settlement choices that minimize the impact of construction. The average score reached for criterion 1.1.2 - “ Level of site urbanization “ is 1.78, this means that the projects involved areas with low urbanization (peripheral areas). The assessment area represented by the “Environmental Loads”, whose purpose is to assess the impact of a building on the surrounding environment by addressing the issue of CO2 emissions, has as its only criterion the 3.1.2 - “Emissions in operation phase”, which gets 1.43 points; this is not a good result in absolute terms but, despite that, compared to the other criteria it is however an element not ignored by design.

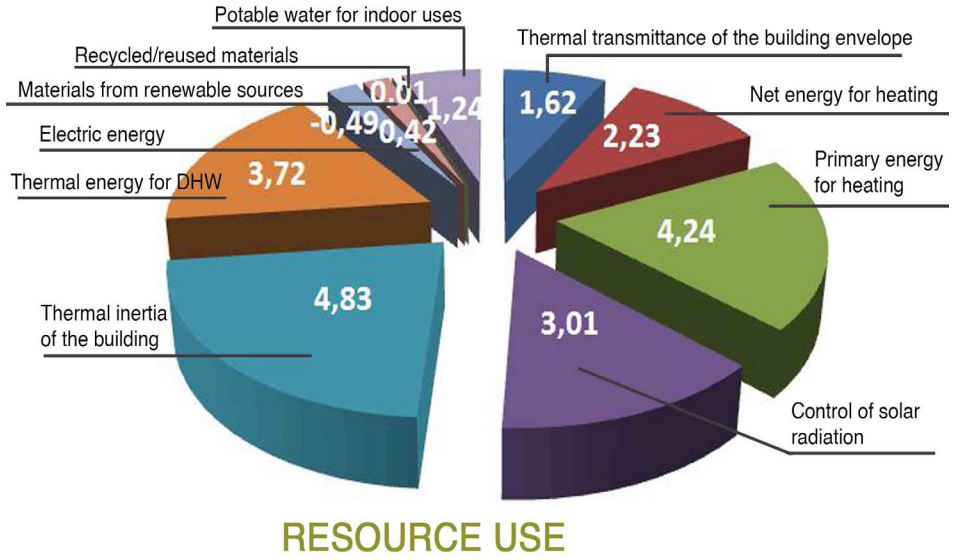


Figure 6: Pie chart showing the percentage distribution of resource use criteria scores, showing the relative effort of design spent on aspects within in resource use.

Great importance has been addressed to the problems associated with the production of hot water, Criterion 2.2.1 - "Thermal energy for Domestic Hot Water" reaches the average score of 3.72, which has grown considerably (Figure c). The installation of solar collectors promotes the reduction of energy consumption for the production of hot water through the use of solar energy. Minimizing the consumption of new raw materials is another of the indispensable elements of sustainability assessed by the ITACA Protocol. In fact, it is rewarded the reuse of existing structures, the use of reusable materials, recycled and/or recovered from renewable sources. The results have not been particularly positive; neither Criterion 2.3.1 - "Materials from renewable sources" nor Criterion 2.3.2 - "Recycled/reused materials" exceeded the threshold of 1 point as the average value among the cases analyzed, reaching values of the order of 0.4. Criterion 2.4.2 - "Potable water for indoor uses" keeps on discrete score values. The attention to the issue appears to be felt but the poor use of items, such as taps and low-water flushes, makes the performance decrease in terms of attention to the consumption of drinking water.

Surprising instead, the good average value achieved by Criterion 2.1.5 - "Control of solar radiation" equal to 3.01 points. In fact, the attention to solar radiation control has grown considerably. Its importance is not to be questioned as it allows to evaluate the efficiency of transparent building envelope elements and solar control systems to reduce solar inputs in the summer. The following pie chart (Figure d) shows the scores obtained in the "Indoor Environmental Quality" assessment area, which includes all measures to protect those who use buildings. The three criteria involved verify the level of comfort in indoor environments. The highest average score is obtained from Criterion 4.5.1 - "ELF-EMF (50 Hertz)” with 1.84 points. Through a performance scale, the presence of strategies in the electrical system for the reduction of exposure to electric and magnetic fields is evaluated. A high score is also achieved by Criterion 4.3.1 - "Natural lighting" that evaluates visual comfort in order to ensure adequate levels of natural illumination in all primary occupied spaces. The 1.83 value achieved shows that the average daylight factor has been taken into account by many of the projects analyzed, so the visual welfare of users will be ensured.

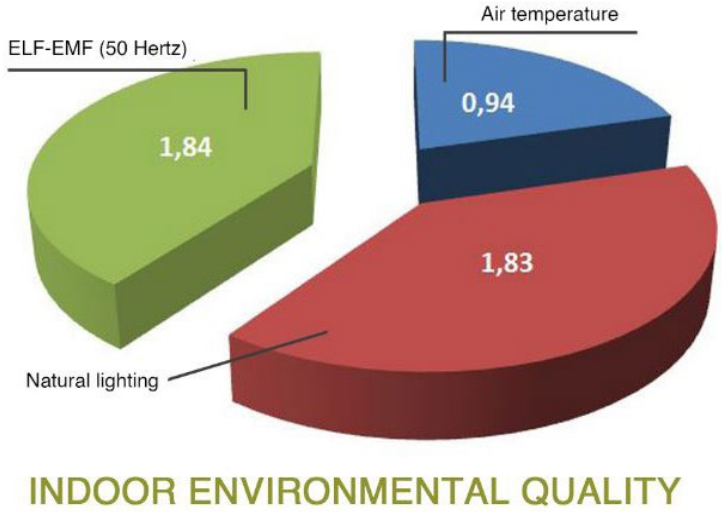


Figure 7: The percentage distribution of indoor environmental quality criteria scores, showing the relative effort of design spent on aspects within indoor environmental quality

Lastly, the score of Criterion 4.2.1 - "Air Temperature" has been taken into account, which got a score of 0.94. The indicator measures the heat exchange mode with the surfaces according to the type of distribution of the heating and cooling system, therefore if the score is not very high performing it may be due to the type of heating systems used.

At the conclusion of the analysis, some considerations on the evaluation area represented by the "Quality of Service". Home automation, maintaining performance during operation and efficient maintenance, are the issues addressed in this area. A peak was found in the quality of service assessment area, specifically regarding the availability of technical documentation (5.2.1). In this case, high scores were easy to achieve, and the weight of the criterion was very high, leading a lot of assessors to rely on this criterion to increase the overall score of the assessment. While the indicator itself was considered appropriate, the weight has been reduced to bring other criteria further to the attention of assessors [48].

Figure 8: Pie chart showing the percentage distribution of service quality criteria scores, showing the relative effort of design spent on aspects within service quality.

Less importance is given to the criteria for system integration, control and video control, probably because during the second biennia these instruments were not widely disseminated, as little known. While Criterion 5.4.1 - "Quality of cabling" occupies an important slice of the pie chart, reaching an average value of 1.01.

INTERCONNECTIONS WITH NEWTREND PROJECT

There is strong correspondence between many of the criteria of the ITACA Protocol and the key performance indicators of the NewTREND Project; the table below describes analogies and similitudes among criteria.

Tablle 13: Comparison of Protocollo Itaca criteria to NEWTREND key performance indicators

Protocollo ITACA Criteria	NewTREND Criteria	Comparison
2.1 Renewable energy 2.2.1 Thermal energy for DHW 2.2.2 Electric energy	B.1.3 Renewable Energy on Site	In both cases, it's calculated by the ratio of on-site yearly production of renewable energy and yearly average of operational energy demand [%].
4. Indoor environmental quality 4.2 Thermal comfort 4.2.1 Air temperature	B.5.1 Indoor Air Quality	The criteria are similar, in the case of ITACA Protocol the objective is to maintain a satisfactory level of thermal comfort, limiting energy consumption and emissions. While, for NewTREND criteria, it is established a quality category (I-IV) according to EN 15251 assigned on CO2 concentration above outdoor [ppm].
4. Indoor environmental quality 4.3 Visual comfort 4.3.1 Natural lighting	Availability of Daylight Solar Access	In both cases the daylight factor is calculated. The solar access of NewTREND is the amount of hours in which indoor environments receive natural light, is directly comparable with the Natural lighting of the ITACA Protocol.
2. Resource use 2.1.3 Net energy for heating	B.6.2 Thermal Comfort in Heating Season	NewTREND criterion is calculated according to ISO 7730, about thermal comfort standards while the criterion of ITACA Protocol is based on the verification compliance with the minimum thermal transmittance requirements of the existing legal framework at regional or national level (Legislative Decree 192/05 and Legislative Decree 311/06).

4.1.2 BIOVER2 – Veneto Region

Tablle 14: Synthetic scheme with key information about BIOVER2

NAME OF THE RATING SCHEME	BIOVER2
REGIONAL APPLICATION	Veneto Region (Italy)
RELATED INCENTIVES PROGRAMS	"Piano Casa" Incentive Program
IN USE AT THIS MOMENT	Yes
RELATED GRANTs AT THIS MOMENT	Yes, through the "Piano Casa" Incentive Program, until al 31st December 2018
RELATED NATIONAL/REGIONAL LAW	Based on the Regional Law 4/2007 "regional initiatives and measures for sustainable building"
TYPE OF BUILDINGS TO BE APPLIED ON	Residential buildings
DIFFICULTY OF THE ASSESSMENT	Medium difficulty for the calculation of some energetic criteria.

The building evaluation system called BIOVER2 was born in Veneto Region for the mass certification of buildings, with the aim to assess their performance and to allocate public incentives for sustainable building by local administrations. This rating scheme has been defined in collaboration with the Veneto's Metadistretto of Bioedilizia sector and is consistent with the Protocollo ITACA. The Regional Law 4/2007, known as the "regional initiatives and measures for sustainable building", is the main reference for sustainable building in Veneto. This Law was developed by the Public Work section of the Region in collaboration with the Consortium for the Green Building. Thanks to this Law, the framework requirements for sustainable building in Veneto was defined, its adoption was promoted by local administrations in their urban planning instruments and it was used for public aids, financial or volumetric incentives. After the approval of this Law, a regional certification system for buildings was defined; this rating scheme covers all the aspects of sustainability; Biover2 criteria evaluate just the design phase and do not include provision of user manuals or monitoring the in-use phase that would be important in a regional certification process of public buildings.

The application of the scheme is greatly simplified, it does not require special software/tools nor any special expense, training, specialized equipment, nor intensive special training. Biover2 has a calculation tool that greatly simplifies collecting and elaborating the data needed for the evaluation.

Regarding the implementation of low carbon materials a database of reference materials that allows the verification of this criterion is unfortunately too limited. Regarding the operability aspects, it's quick to assess effectively and it has a moderately time consuming for the evaluation.

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

The building evaluation system BIOVER2 is used by the Veneto Region and by local administrations to allocate public incentives for sustainable building. This protocol, defined in collaboration with the Veneto Metadistretto of Bioedilizia, is coherent with the Protocollo ITACA; it is currently widely disseminated throughout the region and has been adopted to provide incentives from numerous public administrations such as the City of Verona and the Province of Treviso. Residential buildings have been subject to public funding in the period 2007-2009 through the application of the Regional Law 4/2007; interventions are mostly for single-family homes and are distributed on the whole regional territory including both new construction and retrofitting. The protocol Biover2, the calculation tool and its user manuals are freely downloadable from the website of the Veneto Region to encourage a free open access to anyone [49] .

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

This rating scheme is the reference for some incentives of the Program "Piano Casa", because this rating scheme is sufficiently simple to use, affordable in terms of cost and time of compilation, contextualized locally and open source. The incentive program called "Piano Casa" was born to revitalize construction sector of the Italian economy. The government has launched a proposal for a plan that offers the possibility for individual citizens to carry out extensions and/or reconstruction of their home, taking advantage of incentives. "Piano Casa" had been introduced in 2008 with Legislative Decree n.112 of June 25 and it came into force at April 1st 2009, through an agreement between the State and the Regions. The agreement was that for an "exceptional" period, originally planned for a year and a half, the "Piano Casa" would allow, by way of derogation from the existing instruments, volumetric bonuses up to 20% for extensions and up to 35% for most radical replacements. Another element to be considered is its precise regional characterization: each region has its own "Piano Casa" to facilitate people that are really involved and are potentially interested in consistent construction work.

The incentives for building renovation, originated from the primary idea of the "Piano Casa", making them converging in parallel tax reliefs, with rules that govern them depending on energy efficiency, seismic consolidation, up to furnishing bonuses and incentives for young couples.

RELATED ECONOMIC INCENTIVES

As said before, after the approval of the 4/2007 Law Biover2, a regional certification system for buildings, was defined; in a similar way to what was described for the ITACA Protocol, also this rating scheme combines public aids to the achievement of a minimum score in the regional evaluation system.

RELATION AMONG INCENTIVES, PERFORMANCES AND SCORE

The BIOVER2 evaluation system is implemented though a software tool based on 34 criteria grouped into 17 categories belonging to 7 evaluation areas, it assigns to the analysed construction project a score from -1 (worse than the current practice) to 5 (high sustainability).

The evaluation areas of the Biover2 protocol include:

- external environmental quality (urbanization level, re-use existing structures, water pollution);
- resources consumption (renewable and not renewable energy, building and system energy performances, low carbon and eco-friendly materials, potable water);
- environmental loads (CO2 emissions, wastewater, heat island effects);
- indoor environmental quality (air pollutants, acoustic, light quality etc.);
- service quality (use of TSB and BACS);
- quality management (building documentation, maintenance and waste management system);
- transport (accessibility to public transport).

The following table shows the assessment criteria of the BIOVER2 tool.

Table 15: Assessment criteria for the BIOVER2 tool

BIOVER2 - ASSESSMENT CRITERIA
Urbanization level of the site
Existing structure reuse
Water pollution
Energy incorporated in constructing materials
Thermal transmittances in the building envelope
Primary energy for central heating
Solar radiation control
Thermal inertia of the building
Thermal energy for Domestic Hot Water
Electric energy
Materials from renewable sources
Recycled/Regenerated materials
Recyclable and detachable materials
Potable water for irrigation
Potable water for indoor uses
Ongoing expected emissions
Grey water sent to the sanitary sewer
Collected and stocked meteoric water
Soil permeability
Heat Island Effect with roofs
Heat Island Effect with paved external areas
Ventilation
Air pollutant control of Radon emissions
Air pollutant control of VOCs emissions
Air temperature
Natural day lighting
Acoustic insulation of the building envelope
Electromagnetic field of industry frequency (50Hz)
BACS (Building Automation and Control System) and TBM (Technical Building Management)
Available technical documentation of the building
Development and implementation of a maintenance plan
Maintenance of the performance factors of the building envelope
Waste management system
Accessibility to public transports

In the CABEE Project (http://www.cabee.eu/) different projects, that have applied Biover2 as rating scheme, were analysed and very interesting results have been produced. By looking at the average scores reached by the assessed projects per evaluation area, results shows that the evaluation areas that had a higher weight for the determination of the final score were those in which evaluated projects had the best performance. The assessment area that contributes the most to the achievement of the final score is resource consumption (45%) followed from the area related to the environmental loads with 25% and the quality of the indoor environment (17%).

About resource consumption, all the energy criteria get higher average scores thanks to the incentive policies for energy from renewable sources and to the existence of prescriptive rules for the energy performance of buildings, like for example the energy certification. The results achieved in this area are really important because represent the 45% of final score. Energy criteria considered are primary energy for heating, thermal inertia of the building and energy for DHW. Environmental criteria, for example the use of materials from renewable sources, recycled and recyclable materials, water treatment, are less performing. Another important sustainable aspect is directly connected with low carbon materials, the limitation of the database of reference materials makes the application in retrofitting project very difficult and the resulting score may not be reliable. Area 3 about environmental loads represent the 25% of final score and contains criteria strongly linked to CO2 emissions of building and high average scores were reached by analysed construction projects. Area 4 represents the comfort and the healthiness of the internal environments, it is related to the indoor environmental quality and represents the 17% of the final score. The scoring in this category suffers from the influence of the individual client that has strongly influenced the results, there are in fact a great disparity in scoring from the minimum to the maximum [50].

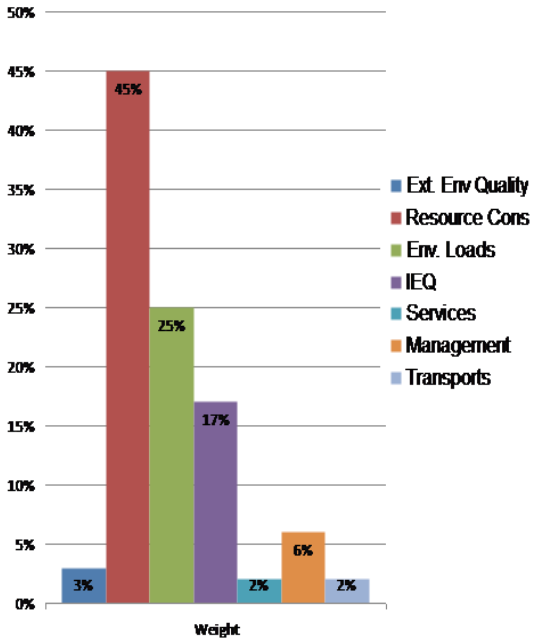


Figure 9: Weight of biover2 evaluation area

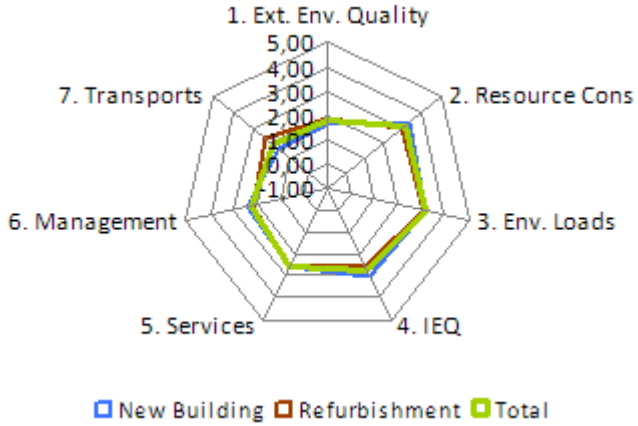


Figure 10: Average scores per evaluation area

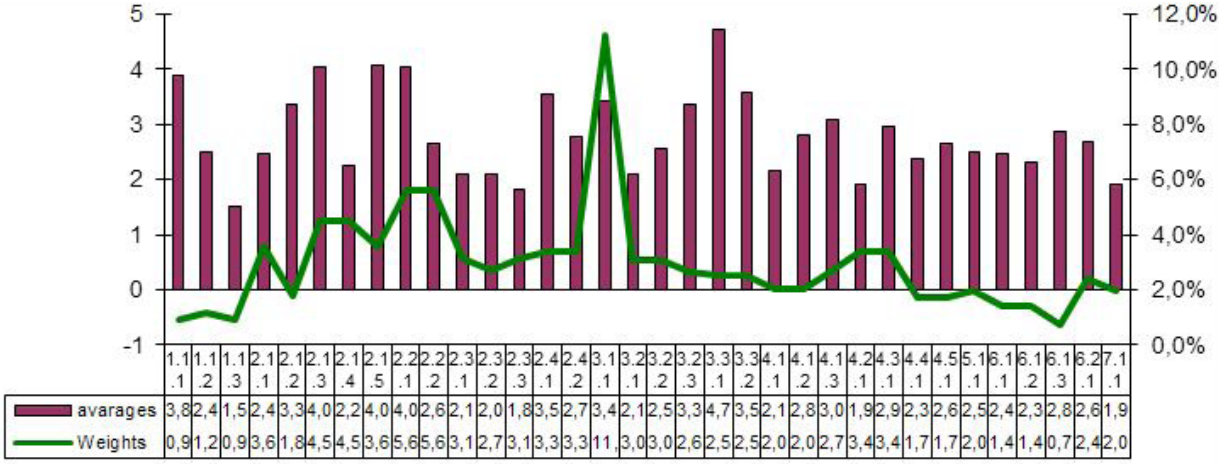


Figure 11: Weight and average scores of the criteria

INTERCONNECTIONS WITH NEWTREND PROJECT

The correspondence among many of the criteria contained in the Biover2 assessment tool and the key performance indicator of the NewTREND Project it is evident, actually some of them are exactly the same. In the chart below are described analogies and similitudes among criteria of this two assessment tools:

TABLE 16: Comparison of BIOVER2 criteria and NEWTREND key performance indicators

Biover2 Criteria	NewTREND Criteria	COMPARISON
Thermal energy for DHW Electric energy	B.1.3 Renewable Energy on Site	In both cases, it's calculated the ratio of on-site yearly production of renewable energy and yearly average of operational energy demand [%].
Air pollutant control of VOCs emissions Air pollutant control of Radon emissions Air temperature	B.5.1 Indoor Air Quality	The criteria are very similar, in the case Biover2 the objective is to ensure indoor air quality reducing the emissions. While, for NewTREND criteria, it is established a quality category (I-IV) according to EN 15251 assigned on CO2 concentration above outdoor [ppm].

Natural day lighting	Availability of Daylight Solar Access	In both cases is calculated the daylight factor while, the solar access of NewTREND, that is the amount of hours in which indoor environments receive natural light, is directly comparable with the Natural lighting of Biover2.
Primary energy for central heating	B.6.2 Thermal Comfort in Heating Season	NewTREND criterion is calculated according to ISO 7730, about thermal comfort standards while the criterion of Biover2 is based on the verification compliance with the minimum thermal transmittance requirements of the existing legal framework at regional or national level (Legislative Decree 192/05 and Legislative Decree 311/06).
Acoustic insulation of the building envelope	B.8.1 Acoustic Comfort	In NewTREND is verified the indoor sound pressure level (day and night) [dB] while the criterion of Biover2 is focused on the acoustic insulation but the aim is the same.

4.2 Rating schemes in the Austrian context

In the Austrian context, two types of rating schemes were analyzed, both widespread in the Vorarlberg Region, they are the "KGA" also known as the "Municipal Building Pass" and the "Housing Subsidy (wohnbauförderung)". The first one was developed in 2010 and used the first time in 2011. The KGA is only for public buildings and it could be applied to the new buildings as well as to refurbishments. KGA was connected with a funding system of the state of Vorarlberg, municipalities could gain up to 4% points of additional funding doing the KGA certification. The amount of additional certification was connected with the points they achieve in the KGA. The more points, the higher the funding. The assessment tool is a MS Excel™-Tool, it contains criteria about process and planning quality, energy and building system, health and comfort, building materials and construction and it is available for free and downloadable for everyone. Concerning the "Subsidisation of housing (wohnbauförderung)", also this rating scheme has an incentive mechanism based on the ability of increasing the points related to the environmental assessment tool.

4.2.1 KGA , the "Municipal Building Pass"

Table 17: Comparison of BIOVER2 criteria and NEWTREND key performance indicators

NAME OF THE RATING SCHEME	KGA (Kommunalgebäudeausweis) also known as "Municipal Building Pass"
REGIONAL APPLICATION	In Vorarlberg, Austria and suitable in whole central Europe
RELATED INCENTIVES PROGRAMS	Programs established with the Consulting team
IN USE AT THIS MOMENT	In use
RELATED GRANTS AT THIS MOMENT	Yes
RELATED NATIONAL/REGIONAL LAW	Based on Regional standard. Data input from PHPP (passive house projecting package)
TYPE OF BUILDINGS TO BE APPLIED ON	Only for public building, it is working for new buildings as well as for refurbishments
DIFFICULTY OF THE ASSESSMENT	Easy to assess

The KGA (in German: Kommunalgebäudeausweis, abbr. KGA) defines the standard for sustainable construction and refurbishment of public buildings in Vorarlberg, Austria since 2010. It is also known as the "Municipal Building Pass" [51].

The state of Vorarlberg has very different climate zones with its area of 2.601 km² and it is the most western of the nine federal states of Austria. KGA has been developed in that country in 2010, it is applicable only to public buildings as town halls, secondary and elementary schools, concert halls, residential care home for elderly, kindergartens, municipal offices, sport halls and music schools. The "Kommunalgebäudeausweis" (KGA – public building certificate) was used the first time in 2011 and now it is applicable to refurbishment and new buildings.

Before the KGA was developed, the buildings planned during that time being accompanied by the consulting team, that is formed by a group with members of different knowledge areas but with the same goal in focus without having unrealistic or too ideological thoughts, fulfil almost completely the same criteria as the newer ones having a KGA. Since the KGA was started most public buildings received a KGA.

It is not 100% possible to separate between the KGA and the consultancy because the development team of the KGA and the consulting team for almost all public buildings in Vorarlberg is the same [52] . The intent of KGA is to create benefit for users allowing himself working in the highly efficient and ecological buildings. The mass orientation of this system is clear also for the choice of the calculation system uses that is Microsoft Excel, a basic program widely spread; another possible data input comes from PHPP (passive house projecting package) that makes the KGA international, as the PHPP is one of the few tools in the world basing on building physics.

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

The referring regional contest is the state of Vorarlberg, but the system could be applied also in region having the same climate conditions. The KGA is a real 100% mass certification tool and the test of the mass certification approach has been implemented as part of the consulting process. It is an absolutely mass oriented system as it is freeware and all criteria are descripted in the public handbook, there are also no license fees and everybody is allowed to use it.

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

Since the beginning the KGA was connected with a funding system of the state of Vorarlberg. Incentives Programs are established with the Consulting team, the government and the administration see in this evaluation system an opportunity to increase the heritage of certified buildings.

RELATED ECONOMIC INCENTIVES

The connection with the funding system of the state of Vorarlberg has allowed the wider dissemination of this evaluation system, in fact, municipalities can gain additional funding when they are doing the KGA certification. This additional amount is directly connected with the achieved result in the KGA; the more points, the higher the funding. In general, thanks to the score obtained, all buildings doing the KGA received an additional funding.

RELATION BETWEEN INCENTIVES, PERFORMANCES AND SCORE

KGA assessment system is based on 14 criteria grouped into 4 evaluation Areas. Most points of the KGA focus on sustainable issues like energy efficiency, ecology, health and so on. In terms of economic sustainability the KGA is influencing the process due to extra points for life cycle assessment. The assessment criteria of the KGA tool is shown in the following table.

Table 18: Assessment criteria of KGA

KGA, the "Municipal Building Pass" ASSESSMENT CRITERIA
PROCESS AND PLANNING QUALITY
A.1.1 – Definition of checkable energetic and ecologic goals – program of sustainable building
A.1.2 – Simplified calculation of economic efficiency
A.1.3 – Product management – Use of regional, environmental friendly and low-polluting building products and constructions
A.1.4 – Detailed verification of the energy calculation according to PHPP
A.1.5 – Bicycle parking spaces
ENERGY AND SUPPLY
B.1.1 / B.1.1b – Space heat demand
B.1.2 / B.1.2b – Primary energy demand
B.1.3 / B.1.3b – CO2-emissions
B.1.4 / B.1.4b – PV systems
B.1.5 / B.1.5b – Differentiated collection of energy consumptions
HEALTH AND COMFORT
C.1.1 – Thermal comfort in summer
C.1.2 – Measuring indoor air quality
BUILDING MATERIALS AND CONSTRUCTION
D.1.1 – Avoidance of PVC
D.2.1 – OI3BG3,BZF ecological index of the total mass of the building

During the progress of the EU CABEE project (http://cabee.eu/), 27 public buildings were analyzed with the KGA assessment method to evaluate their performances. The analysis allows to compare the buildings by criteria groups, building type and also the minimum, maximum, average, median and the standard deviation was calculated for each criteria. The increase of subsidies was also calculated. The image below describes, the results obtained in the four main criteria groups (process and planning quality , energy and supply, health and comfort, building materials and construction) as well as the achieved points for every single sub-criterion.

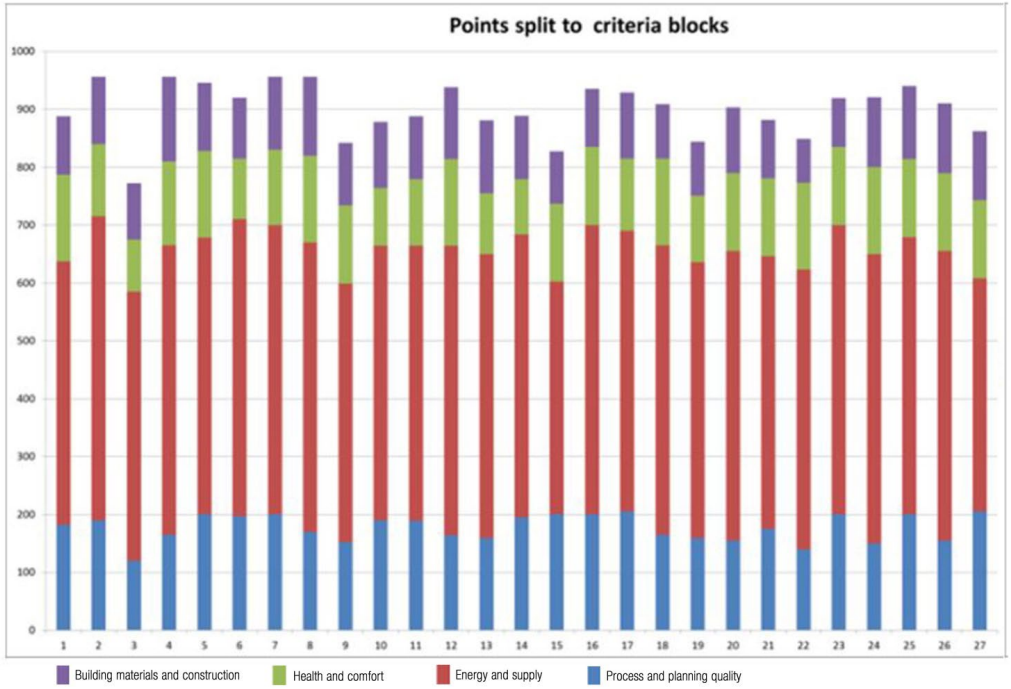


Figure 12: Results obtained in the four main criteria groups

INTERCONNECTIONS WITH NEWTREND PROJECT

The correspondence is high between the criteria of KGA assessment system and the key performance indicator of the NewTREND Project, many of them are exactly the same. In the chart below are described analogies and similitudes.

Table 19: Comparison of KGA assessment criteria to NEWTREND key performance indicators

KGA	NewTREND Criteria	Comparison
B.1.4 / B.1.4b – PV systems	B.1.3 Renewable Energy on Site	In both cases it's calculated by the ratio of on-site yearly production of renewable energy but for the KGA rating system the renewable energy considered is produced by PV systems.
C.1.2 – Measuring indoor air quality	B.5.1 Indoor Air Quality	The criteria are exactly the same, in both cases the objective is to maintain a satisfactory level of indoor air quality, limiting emissions. It is established a quality category (I-IV) according to EN 15251 assigned on CO2 concentration above outdoor [ppm].
B.1.2 / B.1.2b – Primary energy demand A.1.4 – Detailed verification of the energy calculation according to PHPP C.1.1 – Thermal comfort in summer	B.6.2 Thermal Comfort in Heating Season	NewTREND criterion is calculated according to ISO 7730 thermal comfort standard while the criterion of KGA is based on the verification compliance with the thermal transmittance requirements of the PHPP through UNI EN 832 (ISO 13 790) "Calculation of energy use for heating".
A.1.2 – Simplified calculation of economic efficiency	B.10 Operational Energy Costs	In NewTREND assessment tool the criterion is calculated by multiplying the energy demands and the energy price by fuel types then normalizing the operational energy costs for the buildings based on the reference floor area while KGA system is based on the optimal allocation of every resource.

4.2.2 Housing subsidy

Table 20: Synthetic scheme with key information about housing subsidy

NAME OF THE RATING SCHEME	Housing subsidy - Wohnbauförderung
REGIONAL CONTEXT	In Vorarlberg, Austria
RELATED INCENTIVES PROGRAMS	Related to the implementation of the Subsidisation of Housing's in Vorarlberg municipality
IN USE AT THIS MOMENT	In Use
RELATED GRANT AT THIS MOMENT	Yes
RELATED NATIONAL/REGIONAL LAW	Based on Regional standard
TYPE OF BUILDINGS TO BE APPLIED ON	Private buildings, new and refurbished buildings
DIFFICULTY OF THE ASSESSMENT	Easy to assess

The Housing Subsidy (in German: Wohnbauförderung) was developed and applied in Vorarlberg, Austria; it defines the standard for sustainable construction and refurbishment of private buildings contrary to the KGA, which was applied on public buildings. The Housing Subsidy allows to analyze the performances of private buildings within an area. It was developed in accordance with the Vorarlberg Regional Administration and the Department of Housing Promotion at the Office of the Provincial Government. Regarding the promotion of residential building, the regional government, in their work program 2014-2019, revised and simplified guidelines for the promotion of residential construction (for new construction and re-developments), and will continue to do so in the coming years in such a way that housing is made affordable for the population. This requires an even stronger consideration of the social conditions of the beneficiaries. Despite the focus on affordable housing, the promotion of residential housing will also create the prerequisites for resource-conserving and energy-efficient housing construction in the future [53].

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

As said before, this rating system was developed in accordance with the Vorarlberg Regional Administration and the Department of Housing Promotion at the Office of the Provincial Government. For that reason the assessment system is completely calibrated on the Vorarlberg Regional context and there applied.

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

The incentives programs by the Housing Subsidy are all related to the implementation of this rating scheme. Vorarlberg municipality has the power to grant incentives for private residential buildings in accordance with some specifications that will be described in the next paragraph.

RELATED ECONOMIC INCENTIVES

To incentivize performance described in rating scheme, the Department of Housing Promotion provides loans for [54]:

- Individuals for private homes, double and row houses, condominiums, service apartments, additions, conversions and extensions to homes.
- Legal persons and partnerships for employer accommodation.
- Non-profit building associations, corporations, institutions and foundations for rental and buying accommodation, dormitories, supervised apartments as well as emergency and start-up apartments.

Basic prerequisites for private individuals to receive housing promotion are: Austrian citizenship or under the EU law or contract, compliance with income limits and building codes, proven property and building rights, reasonable price for construction and land, commercial title of the developer according to Austrian law, etc.

Housing subsidies are bound to income limits: for one person, EUR 3.000, for more, EUR 5.300 (the income calculation for workers are calculated by the statutory insurance contributions). The minimum size of a subsidized apartment is 25 m^2 of usable space (room, kitchen, wet cellar). The maximum housing size depends on the number of residents: up to a five-person household, the usable area can be 150 m^2. From a six-person household, the residential area is limited to 170 m^2. For private homes with two apartments, the total usable area is 200 m^2. In the case of residential buildings without a basement and attic, additional areas of up to 25 m^2 can be built for storage or technical use, without affecting the upper floor. Bonuses are linked to different aspects of the sustainability, following some examples on how to calculate rates for new construction and renovation loans:

- Energy-saving bonus :

- Improving the heating demand: up to € 120.
- Improvement of primary energy demand: up to € 120.
- Third improvement in CO2 emissions: up to € 120.

- Environmental Bonus:

- Improving the OI3 index: up to € 120. This surcharge is calculated from the improvement of the values for the ecological index.

- Windows, doors and shutters PVC free: € 50. This supplement is ensured for all the windows and doors (including interior doors) of the above-ground stores, together with the corresponding roller and folding shutters and slat blinds.

- Wooden facade:

- € 20, this surcharge is granted if the facade without windows, is covered by at least 60% of untreated wood. The ecological minimum requirements under section is that wood must come from sustainable production.

- Use of renewable insulating materials:

- € 30, this surcharge is granted if the insulation of the building façade without windows is based on land, at least 90% of renewable insulation materials.

- Bonus for barrier-free execution:

- for residential buildings with lift € 80.

- for residential buildings without elevator or at € 30.

RELATION BETWEEN INCENTIVES, PERFORMANCES AND SCORE

This Directive applies to applications for funding from 1 January 2017 to 31 December 2017.

Table 21: Housing subsidy assessment criteria from the action catalogue 2016

Housing Subsidy ASSESSMENT CRITERIA	
Action catalog 2016 - Residential House Refurbishment	
A - PLANNING - COMFORT AND FUNCTIONALITY	Points max 22
1.a Planning of the conversion / renovation by authorized building planners	4
1.b Carry out a planning competition	10
2.a Planning of the house technology by authorized building technicians	2
2.b Refurbishment consultants from the recommendation list	2
2.c Refurbishment consultants from the recommendation list to acceptance	4
3. Summer availability calculated according to ON B 8.110-3	2
4.a Building envelope, window connection heat bridges	2
4.b Building envelope heat bridges calculated	6
5.a Building envelope - air tightness standard	2
5.b Building envelope optimized for air tightness	6
A - LOCATION - SURFACE AND BASIC REQUIREMENTS	max 11
8.a Bicycle route Standard	3
8.b Bicycle parking space optimized	6
8.c Electric connection for electric bicycles at the bicycles	1
9. Provision of car-sharing parking spaces	4
B - ENERGY - HEATING DEMAND	max 100
1. Heating heat demand (HWB)	0-100
C - DOMESTIC APPLIANCES - POWER SUPPLY	max 32
1. Innovative climate-relevant heating system with additional options	7
2. Reduction of local air pollutants	3
3.a Heat pump as central heating	13
3.b Heat pump as central heating with green electricity	18
3.c Biomass heating or connection to biomass local heat or waste heat	25
C - DOMESTIC APPLIANCES, HEAT DISTRIBUTION, WATER HEATING	max 55
4. Warm water and buffer storage optimized insulated	5
5. Distribution system optimized insulated	6
6.a Solar water heating	22
6.b Solar water heating with heating	30
7.a Fresh air system	9
7.b Comfort ventilation with heat recovery	15
C - HOME APPLIANCES - WATER AND ELECTRIC POWER	max 23
8. Floor sealing a maximum of 5 m² per living unit	2
9. Near-natural drainage of rainwater	2
10. Rain water use or roof greening	4

11. Energy efficient household appliances	2
12. Energy-efficient lighting of general areas	2
13. Heating and circulation pumps of the energy class	4
14. Photovoltaic system	15
D - MATERIAL SELECTION - ECOLOGICAL ASSESSMENT	max 38
1. Building materials, insulation materials, construction elements	0
2. Correct disposal of insulation materials and material containing asbestos	6
3.a Windows, doors, roller shutters in the upper floors PVC free	6
3.b Windows, doors, roller shutters, light shafts in the basement , PVC free	3
4.a Electrical installation PVC, halogen-free - partial design	3
4.b Electrical installation PVC, halogen-free - optimized	6
5. Pipes in buildings, foils, waterproofing sheets, floor coverings, wallpaper PVC free	0
6. Sewage pipes and wall ducts in the ground PVC free	4
7. Polyurethane free thermal insulation	2
8. Thermal insulation of the connecting joints with filling materials, sealing tapes	3
10. Plaster with a maximum of 6% plastic content, glue cement-bonded	2
11. Facade coating solvent and biocide free	2
12. Bitumen pre-paints, paints and adhesives are solvent free	3
13. Wood from the region	5
14. Wood from primary forest not allowed (North and South America, Asia, Africa)	0
D - MATERIAL SELECTION - ECOINDEX 3	max 22
15. Ecological assessment of thermal sheath materials	0-22
D - MATERIAL SELECTION - SERVICE LIFE AND MAINTENANCE	max 19
16.a Barrier-free construction - partial extension	5
16.b Barrier-free construction - full configuration	15
18. Weather resistance of façade and windows	3
19. Domestic installations easy to access vertically	1
20. Improved intrusion protection	2

E - INTERIOR - LOW EMISSION	max 12
1. Laying materials low-emission	2
2. Floor coverings including surface treatment low-emission	2
3. Wall, ceiling paints, glue low-emission, softener-free	2
4. Metal and wood paints low-emission	2
5.a Fresh air system optimized	2
5.b Comfort ventilation optimized	4
6. Electrobiological home installation	2

INTERCONNECTIONS WITH NEWTREND PROJECT

Table 22: Comparison of housing subsidy assessment criteria and NEWTREND key performance indicators

Housing Subsidy	NewTREND Criteria	Comparison
13. Heating and circulation pumps of the energy class 14. Photovoltaic system 3.c Biomass heating or connection to biomass local heat or waste heat	B.1.3 Renewable Energy on Site	NewTREND's criterion calculates the ratio of on-site yearly production of renewable energy, into the Housing Subsidy system are taken into account many aspects and typologies of renewable energies, as for example the installation of biomass heating systems, the production of renewable energy by PV systems, etc.
1. Laying materials low-emission 2. Floor coverings including surface treatment low-emission 3. Wall, ceiling paints, glue low-emission, softener-free 4. Metal and wood paints low-emission 5.a Fresh air system optimized 5.b Comfort ventilation optimized 6. Electrobiological home installation	B.5.1 Indoor Air Quality	The criteria are exactly the same, in both cases the objective is to maintain a satisfactory level of indoor air quality, limiting emissions. In the Housing Subsidy system, big importance it's given to this aspect, in fact it's dedicated to the theme a whole area of the assessment system called E - INTERIOR - LOW EMISSION.
1. Heating heat demand (HWB)	B.6.2 Thermal Comfort in Heating Season	NewTREND criterion is calculated according to ISO 7730 thermal comfort standard while the criterion of Housing Subsidy is based on the calculation of the energy demand for heating.
7.a Fresh air system 7.b Comfort ventilation with heat recovery	B.6.3 Thermal Comfort in Cooling Season	Optimising the cooling systems is crucial to reduce the energy consumption, in both cases the purpose of this criterion is to assess and measure improvement in the cooling systems to guarantee the users' health and well-being.

4.3 Rating schemes in the French context

In France, the analysis has focused on two different rating scheme related to an economic incentive: the "Social Housing Eco Compliance" developed in Auvergne Rhone Alpes and the "BDM". About the first one, that was focused on social aspects, all the owner of social housing had to use it if they wanted financial assistance from the Region. But last year it was stopped by the regional authorities and so today in Auvergne-Rhône-Alpes there is no rating system at regional level. It is still important to demonstrate the operation of this assessment tool in relation also to the loans granted because, in the previous year, it was very well known in the territory. Instead, BDM it's a rating system very popular, spread across French territory with 378 projects certified. The BDM approach was born in PACA and it was supported by the Region Council of PACA by financial incentives. Today it is well known to the owners and many actors integrate it into their specifications. Economic incentives stopped last year, in 2016 so BDM it's now strongly recommended but no longer linked with incentives. Despite this, the analysis of this system is really significant because of its widespread on the territory and its numbers produced: 378 projects with 1.236 million m2 certified.

4.3.1 Social Housing Eco Compliance

Table 23: Synthetic scheme with key information about social housing eco compliance

NAME OF THE RATING SCHEME	Social Housing Eco Compliance subsidies
REGIONAL APPLICATION	Rhône-Alpes region, France
RELATED INCENTIVES PROGRAMS	Social Housing Program
IN USE AT THIS MOMENT	Not in use
RELATED GRANTS AT THIS MOMENT	No
RELATED NATIONAL/REGIONAL LAW	Relation with Regional measures and National law (under energetic aspects)
TYPE OF BUILDINGS TO BE APPLIED ON	New and retrofitted social housing
DIFFICULTY OF THE ASSESSMENT	The development of the know-how for environmental high quality building of the Staff of social housing and consultants

Faced with the challenges of energy renovation, many tools have been developed over the past few years and a network of players exists in the Rhône-Alpes region. Qualitative and quantitative progress are considerable and the aim is to achieve massification of sustainable buildings. The rating scheme analysed in this document is called "Social Housing Eco Compliance", it was born in 2007 and it's applied to new and retrofitted social housing. Several changes have been made over the years due to the updating regional laws, now it's no longer in use, but during the period it was in use, it has produced significant results in certification and more than 1000 new housing and more than a hundred retrofitted housing are concerned by these regional subsidies (about 2000 to 4000€ by housing) [55] .

The development of this rating system began after the increasing understanding of the vulnerability of people living in social housing. These social housings are old and their energy consumption very high, so the improvement of the energy efficiency of these buildings is the best answer to reduce rental charges. The regional action plan for environmental high quality buildings encourages to integrate more environmental quality and energy efficiency projects by conditioning aid to project performance and accompany them to change current practices. The responsible organization of the implementation are the regional Council of Rhône-Alpes, the ADEME-French Environment and Energy Management Agency and the ARRA HLM regional association for social housing. The Organisation for the delivering is RAEE, Rhônalpénergie Environnement.

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

Rhône-Alpes region estimates 6,021 millions of inhabitants on a surface of 43.698 km2. The region has 2,531,122 main homes, 81.8% of dwellings. The dwellings are divided between 46.2% of houses and 52.6% of apartments. 56.9% of households own their residence [56] .

Building is one of the main sources of energy consumption in France and the main challenge concerns existing buildings and the ability to renovate them in order to reduce their impact. Different rating schemes exist in the Rhône-Alpes region (high environmental quality private systems of reference, social housing systems of reference, secondary school systems of reference, Grand Lyon systems of reference, etc.), unfortunately, their varied nature and sometimes their complexity have an effect which is more restrictive than inclusive.

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

The main incentives programs related to the Social Housing Eco Compliance subsidies are the Social ones, directly connected with the regional association for social housing in Rhône-Alpes, ARRA HTL [57] . Founded in 1975, the Regional Association of the HLM Organisms of Rhône-Alpes, brings together 79 social housing organizations based in the Rhône-Alpes region: 24 Public Office for Housing, 24 social enterprises for the dwelling, 15 Cooperative Production Companies, 8 Societies Cooperatives of collective Interest into the access to the property and 8 Local Public Enterprises. Social incentive program includes:

- An assessment tool (criteria catalogue updated each year according to practices change and thermal regulation) with levels of energy efficiency, compulsory targets and soft targets for projects with local specificities,
- Training sessions for social housing staff and designers,
- Subsidies for study design and conception,
- Higher subsidies for efficient projects,
- A Website: http://www.logementsocialdurable.fr/ with all tools,
- A hotline for social housing staff and conceptors teams.

The main innovation of this rating scheme is the strong involvement of social housing staff and conceptors trough training sessions, web site and hotline.

RELATED ECONOMIC INCENTIVES

Since 2007 subsidies of the regional council of Rhône-Alpes for new and retrofitted social housing are conditioned to the environmental quality of projects, with a joint procedure between regional Council of Rhône-Alpes, ADEME-French Environment and Energy Management Agency and the ARRA HLM-regional association for social housing. Since 2007, more than 1000 new housing and more than a hundred retrofitted housing are concerned by these regional subsidies of about 2.000 to 4.000 € by housing. In 2011, 60% of new social housing was ahead of the regulation. The following financial aid can be obtained, depending on the level of performance achieved:

- A "baseline" level consisting of a simple commitment to apply the Social Housing Eco Compliance methodology that does not qualify for aid to the works.
- A "high-performance" level: implementation of the project management and building life requirements as well as the 5 themes of the technical reference, quantifying targets and receiving aids to support and work.
- A "low consumption" level: same level "very efficient" but with more ambitious objectives on energy and stronger demands on control of the comforts, giving right to assistance to accompany and work.

Key conditions for the success of this incentive program is due to a very efficient assistance, a strong involvement of the regional Council, ADEME and, above all, of social housing owners and contractors.

RELATION BETWEEN INCENTIVES, PERFORMANCES AND SCORE

The implementation of an integrated process to support the design and construction of high performance buildings is fundamental and this process should include assessment tools/criteria catalogues, hotline, website, training, observatories. The assessment criteria of the Social Housing Eco Compliance tool is subdivided into two macro areas:

- Management needs
- Technical requirements

The first one is divided into two categories of criteria:

- Project management
- Building's life cycle

This chapter includes the environmental management actions, load control-related studies and actions to the transition between the production and life cycle of the building.

Table 24: Social housing compliance assessment criteria. Type: (F) indispensible to obtain grant, (S) flexible requirement*

Social Housing Eco Compliance ASSESSMENT CRITERIA	
MANAGEMENT NEEDS PROJECT MANAGEMENT	
Requirement	Type*
A.1. References from one or more members of the Design Team The contracting authority will require and analyze the references and qualifications of the teams during the consultation	F
A.2. Existence of a project coordinator in the project management team The contracting authority will require the presentation of the qualifications of the coordinator, who will also be responsible for a project management assignment, as an architect	F

A.3. Performing an initial environmental analysis of the site The website analysis will be carried out upstream of the program and consultation of the project management. It will identify the characteristics of the site and present them in the form of assets and constraints, dealing at least with the following themes: Urban planning constraints Built environment and human / infrastructure nearby / transport Climate data Solar potential (solar passive and solar active) Local networks / resources (energy, water) Natural / technological risks Nuisances (acoustic, visual, olfactory, air quality) Pollution of the natural environment (pollution of air, soil, groundwater) A standard site analysis document is proposed as an annex to the repository. The Owner is free to use it or to propose another framework.	S
A.4. Implementation of an environmental program The environmental requirements of the client will be structured according to the themes proposed by the Region and integrated into the program of the operation. The environmental program will include, in particular, the target level of the reference system as well as the choice of requirements retained by the contracting authority.	F
A.5. Realization of an operational scoreboard and environmental validation The contracting authority will maintain an operational dashboard to trace the history of the environmental design phase by phase. This requirement will not be accepted if this document is not considered useful by the contracting authority. A standard dashboard document is proposed as an annex to the standard. The owner is free to use it or to propose another framework. The contracting authority will validate the elements submitted by the prime contractor through this dashboard.	S
A.6. Production of an environmental manual An environmental notice will be produced by the coordinator and will detail the answers given to the requirements of the program according to the 5 themes of the reference system.	S
A.7. Business skills Invitations to tender will incorporate a rating of the skills and experience in Social Housing Eco Compliance of companies, on the basis of a technical brief comprising at least: rating scheme references and method of management of the green building site	S
A.8. Training of companies (implementation of insulation, thermal bridges, air tightness, installations and adjustments of systems, etc.) Implementation of training courses for companies	S
BUILDING'S LIFE CYCLE	
Requirement	Type*
B.1. Estimated expenses Calculate the estimated costs by taking into account following items: - Heating - Common and individual electrical uses - Common and individual water consumption - Renewable electricity production	S
B.2. Comparative energy study Provide the energy comparative study of the 2 to 3 most relevant heating systems / DHW systems on the project, showing the investment cost and the environmental impact (CO2, SO2, NOx, nuclear waste). For buildings whose surface area is greater than 1000m², this study is imposed since 1 January 2008 and described in the decree of 18 December 2007. For buildings whose surface area is less than 1000m², the method of calculation is left free insofar as the elements mentioned above are present.	S s< 1000m² F s> 1000m²
B.3. Realization of a tenant's booklet At the delivery and at each change of tenants, a booklet "acts verts" will be given to the new occupants. As an illustrated document, it will include: - Information about the materials and equipment of the residence - Advice on the use and maintenance of these materials and systems - Green actions focusing on heating, electricity and water savings, waste management and the choice of furniture and maintenance products (impacts on air quality).	F
B.4. Creation of a management booklet At the delivery of the building, a maintenance booklet (10 to 20 pages) will be handed over to the manager. As an illustrated document, it will include: - Description of the materials and equipment of the residence (position, technical characteristics, photograph) - Maintenance actions to be provided on each of these equipment - Name of the maintenance company or the person in charge of these actions.	S
B.5. Consumption monitoring / Evaluation: simplified dashboard Set up a monitoring / evaluation system for the residence on the basis of the scoreboard provided in the appendix. It has been designed to allow internal monitoring / evaluation by the contracting authority.	F

The second area called "Technical requirements" encloses technical requirements and it is divided into 5 categories:

- 1. Building integration into the site: bioclimatic design, taking into account the quality of the layout of outdoor spaces and the management of rainwater.
- 2. Building materials and products: energy content and proximity of supply, wood, mineral fibers, prohibited materials, materials to avoid, glues, paints, varnishes and glazes.
- 3. Flow control: energy and water.
- 4. Control of the comforts: summer hygrothermal comfort, visual comfort.
- 5. Reduction of nuisances, pollution and risks: water quality, indoor air quality, household waste, clean building site.

Table 25: Social housing compliance technical requirements. Type: (F) indispensible to obtain grant, (S) flexible requiment*

TECHNICAL REQUIREMENTS	
1 - BUILDING INTEGRATION INTO THE SITE	
Requirement	Type*
1.1. Taking into account comfortable modes of travel - Presence of a sufficiently sized bicycle room. - Facilities facilitating pedestrian travel, bikes on the plot and access to public transport. - Reflection on the place of the car: reduction of the number of parking lots (provide the number of places / housing), collective parking away from housing	S
1.2. Passive approach and bioclimatic design The objective is to passively address the requirements of comfort and reduction of energy requirements. This will result in: - Optimized orientation of the building and dwellings. - The search for compactness of the building, while maintaining a balance with access to natural lighting. - A distribution of the perforations and a choice of solar protections favoring passive solar contributions in winter and limiting them in summer. - The use of vegetation in the treatment of summer comfort. These issues will be addressed based on local parameters arising from site analysis.	F
1.3. Quality of treatment of outdoor spaces - Create pleasant and comfortable outdoor spaces that take into account in their development the following elements: protection to prevailing winds, rain protection, noise protection, shaded areas. - When the operation allows, consider setting up and access for tenants to shared gardens.	S
1.4. Stormwater management Integrate an alternative management of rainwater on the plot: valleys, infiltration ponds, rainwater harvesting for watering and / or internal uses.	S

Table 26: Social housing compliance building materials and production criteria. Type: (F) indispensible to obtain grant, (S) flexible requiment*

2 - BUILDING MATERIALS AND PRODUCTS	
Requirement	Type*
2.1. Proximity of supply and materials with low gray energy Justify by a note the reflection that has been carried out in this direction and the choices of materials that have been made.	S
2.2. Calculation of the energy content (“gray energy”) of the building After having met the previous requirement, calculate the gray energy of the building (within the limits of the information available to date on the materials used). Indicate the consumption in total kWhEP and in kWhEP of renewable origin. The objective here is to identify the share of construction in the overall energy consumption of a building and to reduce it gradually.	S
2.3. Promote wood construction Promote the use of wood as a building material. Calculate the quantity of wood used according to the method of calculation provided in annex and justify the achievement of the following objective: 45 dm^3/m^2 Area.	S
2.4. Origin of woods Promote local species, implement FSC or PEFC certified wood and justify their origin.	F
2.5. Inland wood and treatment products: limiting their impact on health Prefer woods that do not require treatment (class adapted for use). If treatment is needed, focus on natural treatments. Require minimum CTB-P + certification of treatment products. It demonstrates the effectiveness of preservative products and their safety in terms of human health and environmental impacts. The list of certified products is available on the CTBA website. Agglomerated wood (kitchen furniture and bathrooms, cupboards, etc.): require E1 classification to guarantee a low formaldehyde content (according to EN13 986).	F
2.6. Glues, paints, varnishes and glazes: limit their impact on health and the environment Require waterborne paints for walls, ceilings, wood and VOC <1g / L for walls and ceilings. Prohibit the use of paints containing glycol ethers. Require adhesive flooring with the EMICODE EC1 label (low VOC emissions). Promote eco-labeled products.	F
2.7. Mineral wool: limiting their impact on health Limiting the use of mineral wool inside the building, exclude mineral wools blown and require carcinogenicity tests.	F
2.8. Prohibit products that are hazardous to the environment and health Require the safety data sheets of the following products: glues, mastics, paints, varnishes, glazes, wood treatment products, sealants, cleaning products. In design and on site, check the risk phrases of the products mentioned above. Prohibit, as far as possible, all products with a risk phrase. Where no alternative is available, allow only risk phrases: R10-R11-R22-R25-R36-R37-R38-R42-R43	S
2.9. Avoid materials that may contain endocrine disrupters and emit toxic gases in case of fire. No polyurethane insulation, PVC replaced by another material on the two following posts: exterior joinery, floor coverings.	S

Table 27: Social housing compliance flow control criteria. Type: (F) indispensible to obtain grant, (S) flexible requiment*

3 - FLOW CONTROL	
Requirement	Type*
3.1. Compact and efficient insulation - U ≤ 0.6 W / m²K and U ≤ 0.5 W / m²K - Insulation rating = Loss by walls (W / K) / Living area (m²) Insulation rating ≤ 0.8 W / m²K and ≤ 0.7 W / m²K	F
3.2. Area of bays Optimize bay surfaces in order to limit leakage while promoting winter solar contributions and natural lighting: 0.12 ≤ S bays / S inhab ≤ 0.20	F
3.3. Energy consumption in primary energy - Very High Level: Consumption ≤ 60 kWhep / m² Area x (a + b) - Low Consumption: Consumption ≤ 50 kWhep / m² Area x (a + b)	F
3.4. Building air-tightness control - High performance level: I4 ≤ 1.2 m3 / h.m² for collective dwellings I4 ≤ 0.8 m3 / h.m² for single-family houses - Low consumption level: I4 ≤ 1 m3 / h.m² for collective dwellings I4 ≤ 0.6 m3 / h.m² for single-family houses The achievement of this performance will be justified by a test at the end of the construction. It is also advisable to provide a leakage test during construction to allow identification of weak points.	F
3.5. Operation - 0 ≤ Consumption ≤ 40 kWh ep / m² area x (a + b) - Implementation of a leakage test justifying the achievement of the I4 value taken into account in the calculation and at a minimum the values below: I4 ≤ 0.6 m3 / h.m² for collective dwellings I4 ≤ 0.4 m3 / h.m² for single-family houses NB: the financing of the test and the follow-up of operation will be guaranteed by the ADEME for all the operations respecting this requirement.	S
3.6. Electricity of general services Implement the following technical solutions to reduce electricity consumption in general services: - Natural lighting of halls, circulations, level floors and stairwells (within the limits of technical and architectural constraints). - Detection of presence and brightness in halls, circulations and floor levels. - Timers or presence detection on stairwells. - Low consumption lamps or fluorescent tubes with electronic ballast in common areas (inside the building + car parks). - Lighting control of parking areas by presence detection. - External lighting control on clock and intercrepuscular - Low consumption fans. - Lifts with on-board machinery, without speed reducer, cabin lighting controlled by actual operation. This requirement will be fulfilled if at least 7 of the 8 points above have been met.	S
3.7. Electricity of the private areas - Impossibility of juxtaposing cold and cooking appliances. - Favor the drying of the laundry outside. - Individual boiler: control of the circulator to the room thermostat. - Natural lighting in bathrooms and toilets. - Low consumption lamps in the lodgings (stays and rooms). This requirement will be fulfilled if at least 4 of the 6 points above have been met	S
3.8. Water Consumption - Pressure limiting devices adapted not to exceed 3 bars at the origin of each housing. - Flow restriction devices on shower and kitchen mixers and bathroom - 3 / 6L double-flush flushers. - Absence of irrigation system outside the first 2 years of plant growth.	F
3.9. Domestic Hot Water networks: limitation of losses - The length of distribution between the hot water production point and each point of discharging will be limited to 10 meters. - Compliance with this requirement will be justified by a table specifying the lengths of distribution of each dwelling.	S
3.10. Share of renewable energies The share of renewable energies in the overall energy balance will be at least 20% in very efficient 40% in low consumption. The calculation note justifying these results will be provided with the grant application file. The method of calculation used may be either: - the toolbox proposed by the BET TRIBU - TH-CE calculation The renewable energies taken into account are: passive solar, solar thermal, solar photovoltaic, biomass, wind. Details of the two methods of calculation are given in the appendix.	F

Table 28: Social housing compliance criteria to control of comforts. Type: (F) indispensible to obtain grant, (S) flexible requiment*

4 - CONTROL OF THE COMFORTS	
Requirement	Type*
4.1. Summer thermal comfort: the principles Justify the devices put in place to ensure the summer comfort of the dwellings (orientations, through-holes, inertia, sun protection, night ventilation ...)	F
4.2. Summer thermal comfort: optimization for the buildings Justify 80% of houses crossing or bi-oriented on the building	S
4.3. Thermal summer comfort: optimization by dynamic thermal simulation Perform a dynamic thermal simulation on at least 20% of the dwellings (retaining the most exposed dwellings in summer) in order to optimize the comfort conditions.	S
4.4. Visual Comfort Specify the arrangements put in place to ensure the visual comfort of the dwellings. Optimize the natural illumination of the houses by simulating the daylight factor and justify by these simulations the respect of the objectives below (minimum 4 of the most disadvantaged premises): Light Average Day Factor (FLJ) for bedrooms 1.5%, for living rooms 2%.	S

Table 29: Social housing compliance criteria for reductions of nuisances, pollution and risks. Type: (F) indispensible to obtain grant, (S) flexible requiment*

5 - REDUCTION OF NUISANCES, POLLUTION AND RISKS	
Requirement	Type*
5.1. Water Quality Specify by a note the devices used to control the legionellosis risk (looping, limitation of dead arms, limiting the distances between production and consumption, etc.)	F
5.2. Indoor air quality Specify by a note the arrangements made to facilitate the maintenance of ventilation installations (ventilators, networks, outlets in dwellings). Observe the following conditions: - Windows in 50% of the minimum washrooms. - Outdoor space for laundry drying. - In the case of dual-flow ventilation, fresh air intakes shall be kept away from all sources of pollution and the installed filter shall be at least Class F5 and easily accessible for maintenance. Study the possibility of placing in the kitchen a high-capacity activated charcoal extractor hood which will operate in a closed circuit.	S
5.3. Household waste: collective rooms Allowing local sorting: - Sufficiently dimensioned: references of abacuses available in appendix. - Easy access: on the usual route of the tenants. If necessary, arrange several rooms to meet this requirement. - Easily cleanable (water point and evacuation).	F
5.4. Household waste: private rooms Provide a space for sorting waste in the dwellings (space under sink, cellar, etc.) equipped with minimum 3 bins. For dwellings benefiting from a private garden, plan a composter.	S
5.5. Low-noise site: management of the green building site Write a site charter with low nuisances. Ensure the sorting of construction waste, either by setting up sorting bins and a suitable management system, or by installing a common dumpster to a specialized sorting center.	F
5.6. Low-noise site: management of construction waste Separate the hazardous waste on site, store it in a leakproof and covered container and then evacuate it to a specialized treatment center. Justify the waste management by a balance at the end of the work (types and quantities of waste evacuated, difficulties encountered).	F

In general, after the evaluation of several projects, the main results achievable through the application of the Social Housing Eco Compliance assessment system and this kind of structured programs are:

- higher quality of buildings,
- reduction of consumption costs for tenants,
- better indoor environmental quality for tenants,
- reduction of fossil energy consumption and CO2 emissions,
- contribution to local employment,
- improvement of the knowledge of social housing staff,
- better understanding of the impact of policies.

INTERCONNECTIONS WITH NEWTREND PROJECT

In the chart below are described analogies and similitudes among criteria of this two assessment tools.

Table 30: Comparison of social housing eco compliance criteria and NEWTREND key performance indicators

Social Housing Eco Compliance Criteria	NewTREND Criteria	Comparison
3.10. Share of renewable energies	B.1.3 Renewable Energy on Site	In both cases renewable energies taken into account are: passive solar, solar thermal, solar photovoltaic, biomass, wind. In NewTREND it's calculated by the ratio of on-site yearly production of renewable energy and yearly average of operational energy demand [%], while the SHEC method evaluates the share of renewable energies in the overall energy balance.
5.2. Indoor air quality	B.5.1 Indoor Air Quality	The criteria are not so similar, in the case of SHEC the objective is to evaluate the arrangements made to facilitate the maintenance of ventilation installations (ventilators, networks, outlets in dwellings). While, for NewTREND criteria, it is established a quality category (I-IV) according to EN 15251 assigned on CO2 concentration above outdoor [ppm]. SHEC is a qualitative indicator not quantitative.
4.4. Visual Comfort	Availability of Daylight Solar Access	In both cases the daylight factor is calculated, The solar access of NewTREND, that is the amount of hours in which indoor environments receive natural light, is directly comparable with the Natural lighting of SHEC.
4.1. Summer thermal comfort: the principles 4.2. Summer thermal comfort: optimization for the buildings 4.3. Thermal summer comfort: optimization by dynamic thermal simulation	B.6.2 Thermal Comfort in Cooling Season	NewTREND criterion is calculated according to ISO 7730, about thermal comfort standards while the criteria of SHEC are based on the performing a dynamic thermal simulation on at least 20% of the dwellings (retaining the most exposed dwellings in summer) in order to optimize the comfort conditions. While in criteria 4.1 and 4.2 the request by the evaluation system is to justify the devices put in place to ensure the summer comfort of the dwellings (orientations, through-holes, inertia, sun protection, night ventilation ...).
5.5. Low-noise site: management of the green building site 5.6. Low-noise site: management of construction waste	B.8.1 Acoustic Comfort	In NewTREND the indoor sound pressure level (day and night) [dB] is verified while the criteria of SHEC are focused on the acoustic insulation in the site, related mainly to the management of construction waste.

4.3.2 BDM

Table 31: Synthetic scheme with key information about BDM

NAME OF THE RATING SCHEME	BDM
REGIONAL APPLICATION	PACA and mainly in French and Mediterranean territory
RELATED INCENTIVES PROGRAMS	Programs established by the Region Council of PACA
IN USE AT THIS MOMENT	Yes
RELATED GRANTS AT THIS MOMENT	No
RELATED NATIONAL/REGIONAL LAW	Based on Regional standard
TYPE OF BUILDINGS TO BE APPLIED ON	Individual privates houses, collective housing (university residences), schools, offices, public facilities and tertiary buildings.
DIFFICULTY OF THE ASSESSMENT	Easy to assess

BDM is a very popular rating system, spread across French territory with 378 projects certified. The BDM approach was born in PACA for the Mediterranean territory, only recently been taken up by other regions. When it was developed in 2008, it was supported by the Region Council of PACA by financial incentives, it contributed greatly to the launch of BDM, to its notoriety and therefore to its sustainability. Today it is no longer the case because it is now well known to the owners and many actors integrate it into their specifications. This is the case of the Regional Council for its high schools (the high schools are regional heritage). Any new high school or renovation, follows the BDM approach [58] . Despite of the stop of the economic incentives last year, in 2016, the analysis of this system is really significant because of its widespread on the territory and its large numbers produced: 378 projects with 1.236 million m2 certified. Projects are available on the map available at this link: http://polebdm.eu/projets.

Proposed by the professional association Envirobat-BDM, BDM is not a certification, it is an effective guide that allows constructions to move towards a more "sustainable approach" within available resources. The mission of that assessment system is, to circulate and become increasingly prevalent all over the French territory and out of the country, to evaluate lots of buildings through the transversality of the application and the systemic approach and to educate professionals, public contracting authorities, organizations, builders and craftsmen to the Bâtiment Durable Méditerranéen's practice.

BDM differs itself from other environmental certifications thanks to three particular aspects: it is local, participative and gives systematic feedback based on the experience. Indeed, obtaining a BDM recognition level is conditional on a validation that integrates the three main stages of the construction: design, implementation and operation. The BDM approach is adapted to all buildings built or refurbished in the Mediterranean or mountain environments [59] .

How does the Rating scheme works?

In most cases, it's the owner of the building who decide to assess with BDM rating scheme his building, he chooses the so-called "accompagnateur" who is the person that develops the evaluation of the project, according to the BDM's practice. Training of this professional is mandatory. Based on the final score you want to get (there are 4 levels: Base, Bronze, Silver and Gold), an access to a platform called "Beluga" is given to the accompagnateur which has to perform the evaluation of the building through the application of the criteria calibrated on the basis of the preset level. Each BDM project is assessed before an interprofessional commission starting from the designing of the project (in the case of new construction), going through the completion of the works and the operation with the users. BDM commissions are free and open to the public, it's composed by at least 6 people, usually one commission per month is established.

WHERE THE RATING SCHEME IS USED: REGIONAL CONTEXT

The approach BDM is particularly adapted to the context of all the Mediterranean arc but also alpine and pre-alpine because during 2011 was established a working group for "Sustainable Alpine Building" and the BDM rating scheme was enriched with criteria calibrated in this context.

INCENTIVES PROGRAMS RELATED TO THE RATING SCHEME

Economic incentives stopped last year, in 2016 so BDM it's now strongly recommended but no longer linked with economic incentives. There are two main reasons for the stop of the economic aid: the change of political majority in the Regional Council and the significant drop in community budgets. The combination of the two brought other priorities to the agenda.

RELATION BETWEEN INCENTIVES, PERFORMANCES AND SCORE

The structure of BDM rating scheme is organized around seven themes, as shown below.

Table 32: BDM assessment criteria

ASSESSMENT CRITERIA BDM
1 - TERRITORY AND SITE
1.1.1 Promoting urban density
1.1.2 Participate in urban renewal
1.1.3 Facilitate the access to local shops and services
1.1.4 Promote the use of alternative transport to the individual car
1.1.5 Optimize the benefits of the plot
1.1.6 Flow and parking management
1.2.1 Respect the rules of bioclimatic architecture
1.2.2 Provide spaces according to usage and needs
1.2.3 Do not create discomfort to the neighborhood and to the immediate environment
1.3.1 Managing soil
1.3.2 Creating transition spaces between inside and outside
1.3.3 Promote the maintenance and development of biodiversity
2 - MATERIALS
2.1.1 Use eco-materials in significant quantities
2.1.2 work and biosourced finishes
2.1.3 HHT and development
2.2.1 Encourage the development of local networks of eco-efficient materials
2.3.1 Minimize the use of new materials
3 - ENERGY
3.1.1 Search superior energy performance regulatory requirements
3.2.1 Reduce power consumption
3.2.2 Optimize energy efficiency of equipment
3.3.1 Production of renewable energies
4 - WATER
4.1.1 Reduce water consumption
4.2.1 Re-use rainwater and wastewater
4.3.1 Limiting soil waterproofing
4.3.2 Manage waste water
4.3.3 Preventing the pathologies of the building related to water and water vapor
5 - COMFORT AND HEALTH
5.1.1 Satisfying thermal comfort
5.1.2 Protect yourself from solar inputs in summer and use them in winter
5.2.1 Acoustic comfort consideration
5.2.2 Promote natural light and views
5.3.1 Limiting indoor pollution
5.4.1 Limit exposure to health risks
6 - SOCIAL AND ECONOMY
6.1.1 Using sustainable design tools
6.2.1 Generate participation
6.2.2 Promoting the social and solidarity economy
6.3.1 Promote social mix
6.3.2 Pooling equipment and services
6.4.1 Facilitate scalability and modularity
6.5.1 Improving the prevention of risks to the health and safety of workers
6.5.2 Preventing and compensating for prejudice
7 - PROJECT MANAGEMENT
7.1.1 Program and design your project in BDM approach
7.1.2 Finalize the BDM design phase
7.1.3 Monitor the progress of the BDM site and manage waste and nuisances
7.1.4 Monitor the energy and water consumption of the BDM building in operation
7.2.1 Promote competent professionals in Mediterranean Sustainable Buildings

INTERCONNECTIONS WITH NEWTREND PROJECT

Table 33: Comparison of BDM criteria and NEWTREND key performance indicators

BDM Criteria	NewTREND Criteria	Comparison
3.3.1 Production of renewable energies	B.1.3 Renewable Energy on Site	NewTREND's criterion calculates the ratio of on-site yearly production of renewable energy, into the BDM system are taken into account the production of renewable energy by PV systems, calling for 100% of electricity supply from renewable resources.
5.3.1 Limiting indoor pollution	B.5.1 Indoor Air Quality	The objective of this criteria is to maintain a satisfactory level of indoor air quality, limiting emissions. BDM system targets the objective by evaluating the mechanical ventilation system, as well as the type of materials used and their emissions. In addition, an air quality monitoring stage is also ensured during the in use phase of the building.
5.1.1 Satisfying thermal comfort	B.6.2 Thermal Comfort in Heating Season	NewTREND criterion is calculated according to ISO 7730 thermal comfort standard while in the BDM assessment system it's evaluated if the construction has a natural ventilation system at night in summer (warm period), if the heating control of the building is equipped with 2 climate sensors, if conditioned spaces will respect the Act of 1 July 2007 prohibiting air conditioning at less than 26 ° C
5.1.1 Satisfying thermal comfort	B.6.3 Thermal Comfort in Cooling Season	NewTREND's criterion has the purpose of optimising the cooling systems to reduce the energy consumption, while in BDM system it is taken into account more users' health and well-being through the evaluation of the heating temperature, that in winter has to be 19°C (and not air temperature) and if permanent use spaces have highly inertial.

4.4 Impact of using rating schemes

The use of rating scheme on retrofit projects is fundamental as it raises awareness to the sustainable refurbishment of buildings and enhance the understanding of the importance of sustainability. The application of the assessment system allows to measure the performance before and after the intervention to expose the improvement, or stagnation, of the performance. Rating schemes, as we have seen from previous analyses, are very different in composition, choice of criteria and calculation methods, because they come from different contexts. What unites them is the measurement of the environmental, social and economic sustainability of projects and assets, they could support professionals to deliver enhanced environmental benefits to obtain better social and economic outcomes.

They can be used also as part of the initiation and development phase of the retrofitting project planning, to incorporate sustainability considerations into the overall project. Another aspect important to underline is that a specific tool application process for retrofitting projects is usually required to receive a grant, for that reason rating schemes are really relevant also to get economic incentives through the application of an assessment sustainable tool. Applying a rating scheme could generate a reduction of costs consequently to an efficient use of environmental resources. The use of an assessment system could also improve the sustainability performance of the buildings over their lifecycle, encouraging performance monitoring during the in use phase.

5. Conclusions, recommendations

Legislations, incentives and rating schemes are the instruments to implement the sustainable transition of the built environment – they are the tools to turn ideas into reality. In the most concise way to put it, rating schemes allow us to organise sustainability goals, legislation is the formal agreement of society to (and how to) reach them, while incentives provide the muscle to push the process forward.

At the heart of each instrument are indicators: specific, quantified, measurable, clear information describing – more broadly – sustainability and – in NewTREND context – energy efficiency. Indicators are used to express a deficit in the first place, upon which legislation can register a social contract to overcome. National and supranational strategies set out targets for energy consumption, energy efficiency, renewable share for various sectors, including buildings, expressed through indicators and ask the legislative to transpose these targets into criteria embedded into technical codes of building.

Energy performance is generally economically advantageous, but significant investment costs and a long and risk-ridden return period with low returns discourage potential adopters and erect impassable entry barriers for others. Depending on the maturity of the technical solutions delivering them, implementing energy performance is a venture between financially not viable but socially valuable and financially and socially viable. Thus, public institutions agree to generate financial incentives to offset technical immaturity, bridge entry barriers, and eventually fast-forward sustainable transition. An incentive is a benefit package tied to energy performance standards, and the key difference between incentives and legislation is that the former makes energy performance more desirable, while the latter makes it obligatory.

No matter how we call them – targets, criteria or performance standards – performance indicators transmit the operation and impact of one instrument type to the other. To clarify and communicate complex energy and sustainability performance, indicators are organised into comprehensive frameworks: rating schemes. Rating schemes allow to easily compare projects, cities, regions, countries, and are often tied to financial incentives. There is a specific market for different rating schemes, but in the EU, national ratings are written into law for energy performance of buildings – derived from the calculations and thresholds from the energy performance criteria within building codes.

The research question – Are NewTREND KPIs compatible with the way energy performance is measured by current and emerging practices of legislation, financial incentivisation and rating in the EU – has been answered by dissecting 105 financial incentives, the legislative background of the EU and the three demo sites, and 6 rating schemes tied to financial incentive programs. Among the analysed instruments, the representation of indicators that are similar to NewTREND are very high (Table 58). Especially the energy related indicators, more specifically primary energy demand appeared to be the most common metrics. Comfort indicators are more prevalent among rating schemes that aim for wholeness and among legislation, due to the comfort-related criteria present in all EU country building codes. On the other hand, cost reductions are more prevalent among fincancial incentives, especially in the case of market-based ESCOs, where the revenue stream is directly derived from reduced utility costs. There were only seven incentives not mentioning related KPIs, these achieve sustainability goals solely via a list of approved interventions/manufacturers. The appearance of NewTREND KPIs are, on the one hand reassuring, as the professional and general discourse approaches energy performance similarly. On the other hand, effort must be directed to communicate how NewTREND KPIs provide additional value.

Table 34: Occurrence of NEWTREND KPIS among analysed instruments by instrument type

KPI	Legislation within demo site context	Incentives	Rating schemes
Primary energy demand	57 %	60 %	100 %
Renewable energy generated on-site	17 %	34 %	100 %
Impacts	4 %	36 %	No data
Comfort	12 %	5 %	100 %
Operational costs	4 %	21 %	17 %

Specific insights can be drawn by looking at the three instrument types separately. EU level legislation defines the market for the application of NewTREND, by stating that the building sector is responsible for about 40% of energy consumption and 36% of CO2 emissions in the EU and that in most of EU Member States only 55 to 70% of the buildings comply with the energy performance requirements for renovated buildings. National and regional strategies also identify the key barriers for sustainable transition, which are directly transferable challenges that NewTREND applications must also address. First, to kickstart the energy renewal market of buildings, both the demand side and the supply side needs to be far better equipped with knowledge, both general and technical. The former to shape attitude and create a culture for sustainability, and the latter to

share recent technologies, practical knowledge for site managers, building owners and best practices. Second, key stakeholders in often extensive networks temporarily coming together for a single project need to meet and share the necessary information to create an appetite for refurbishment. Finally, there are financial barriers explained before and addressed by incentives. In short, NewTREND must overcome barriers of information dissemination, barriers of collaboration, and barriers of funding.

Looking at incentives give insights on where the energy refurbishment market is headed. As technical solutions mature, they become cheaper and more accessible to segments of the society currently reached with incentives. The energy efficiency sector in the EU nowadays is pushed by an urgency to show leadership in the commitments of international treaties such as the Kyoto Protocol and the Paris Accords. Most intensive form of incentives are public and private (charitable) non-refund financial supports, followed by subsidized loans and tax incentives. At the end of the chain, energy performance contracting, unless subsidized, is a purely market based financing form. The EU is progressively shifting from grants to loan schemes, and in the meantime, the ESCO market is steadily growing – albeit it does so more consistently overseas.

Finally, the wide variety of rating schemes and their application to financial incentives raise a significant challenge to the NewTREND KPI system and methodology. Rating schemes, as seen from previous analyses, are very different in composition, choice of criteria and calculation methods, because they come from different contexts. This implies that there is no one-size-fits-all approach, and any new indicator system must be able to transform from application regime to application regime, which is one of the key values of the modular calculation methodology of NewTREND KPIs. This is extremely relevant given that many incentives require a specific or an equally qualified assessment methodology, and in these cases, the funding for a NewTREND supported project might depend on how easily this qualification can be proven. At the same time, NewTREND is in competition with other rating schemes, thus it must have a clear position that delivers added value compared to the rating schemes analysed here.

To summarize the results of this report, the key findings regarding the research question are:

1. Only 7 out of 141 units of analysis did not refer to NewTREND KPIs or similar.
2. The NewTREND indicator spectrum is wide enough to cover all common incentive type.
3. Out of the three main instrument categories (legislation, financial incentive, rating scheme), NewTREND indicator framework is the closest to rating schemes.
4. Comfort is the least covered theme among financial incentives.
5. Market-based financial incentives focus mainly on operational cost reduction.
6. Public financial incentives focus directly on energy demand and renewable energy.

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