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# IO 1 A Report
# Part 1– Desk Research
# REPORT/ Comparative Analysis

| Erasmus+ UP4GREEN CONCRETE - UPskill Professionals FOR sustainable renovation plans of CONCRETE buildings<br><br>Ref.: 2020-1FR01-KA202-079810 | |
|---|---|
| **Deliverable description** | IO1 REPORT – Part 1<br>Desk Research/ Comparative Analysis |
| **Document coordinating partner** | 36,6 Competence Centre, POLAND |
| **Partners involved** | All |
| **Document status** | Final |
| **Date last update** | 19.03.2021 |



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# Introduction & Identification of the buildings

## ESTONIA

The aim of this document is to give an overview of strategies and tools that promote energy-efficient reconstruction of concrete apartment buildings in Estonia focusing in particular on the period 1950-1990. The bases of the document are several researches done either by Technical Universities or local governments with the purpose of discovering the sustainability of concrete buildings and the environment which most of these buildings are located.

The main purpose of reconstructing concrete apartment buildings in Estonia is energy saving and reduction of the heating cost. Second reason why the concrete apartment buildings are reconstructed is to ensure the regional sustainability in the context of declining population. That's why over the last decade several municipalities together with government have looked for strategies to ensure the sustainability of concrete buildings, especially apartment buildings. The focus has been both in major cities as well as in smaller towns and rural areas to renovate the concrete building and make them sustainable by approving the living conditions and lowering the heating cost.

## FRANCE

For this desk research, trainers, lecturers and experts in the field of construction have been involved (from CAPEB and National Education). Some other entities have been contacted in order to provide support: ADEME, Normandy Region Council ... the subject is of interest for them considering the state of the reconstruction real estate.

Indeed, Normandy has been the place of fierce battles during the Second World War and more specifically during D-Day and the following weeks; one of the main consequence has been the destruction of large part of towns and cities (for instance, in Saint-Lô, 90 % of the houses were completely destroyed between June 5$^{th}$ and 7$^{th}$ 1944) in all the region which has led to reconstruction programmes in the late 40s and 50s as well as during the following decades.

About technical specifications, Concrete is obtained by mixing cement and aggregates. Traditional formulations are close to 1/2/4: an apparent volume of cement for two of sand and four of gravel. To this mixture, water should be added to allow the cement to perform its role as a hydraulic binder. Reinforced concrete was born from the observation that concrete, which withstands compressions well, has poor resistance to traction. From there came the idea of reinforcing it with steel frames. On the technical level, we have been able to develop more and more efficient cements by associating them with new constituents of mineral origin, fines, or of organic origin, admixtures.



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Several architectural types are identified; Some follow the regional architectural rules with the use of granite (a local resources in some parts of the region) on the front façade on the street side and Grey cinder blocks walls on the yard side. For some others, reinforce concrete is used with prefabricated facing panels; some other buildings and houses mix both styles by associating materials and templates. For some other buildings/houses, reinforced concrete is associated with bricks providing the building with good thermal insulation.

About the key problems to be tackled, thermal bridges, thermal insulation, soundproofing, air quality.

## GREECE

The purpose of this report is to identify the current situation concerning renovation needs and requirements and provide a clear picture on Greek housing stock characteristics. Construction practices vary among countries, it is difficult to create guidelines that are applicable in all regions. Nevertheless, many problems have the same origin and their solutions are thus similar in principle. The results of desk research are expected to reveal the situation of the existing house stock of concrete buildings in Greece, allowing to identify renovation needs and respond to new energy and health standards. Data gathering from different climate zones and building techniques throughout partnership countries will be a valuable knowledge to create a state of the art report.

More than 55% of Greek houses were build until 1980 with very low energy efficiency, are responsible for approximately 15% of energy consumption while 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient, while only 0.4-1.2% (depending on the country) of the building stock is renovated each year. Therefore, more renovation of existing buildings has the potential to lead to significant energy savings – potentially reducing the EU's total energy consumption by 5-6% and lowering CO2 emissions by about 5%.

**RESEARCH FOCUS: PROFILE OF BUILDINGS**

**Building construction type:** Concrete structures. In Greece, concrete buildings constitute the vast majority of housing stock. A large percentage of them are outdated, with low energy efficient construction.

**Reference construction year**: After 1981.

In 1981, the building regulation changed radically following a severe earthquake that damaged a great portion of concrete buildings in the country. Since then, a new anti-seismic regulation is in place, setting new construction and building materials criteria. The national regulatory frame from energy efficiency (KENAK) was introduced officially on 2010 and reformed on 2017 and describes the minimum energy performance requirements for new and existing constructions and complies with the Energy performance of buildings Directive(EPBD) 2010/31/EU and the Energy efficiency Directive 2012/27/EU.



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**Climate zones**: Based on location, Greece can be divided into 4 climate zones

Zone A: South Greece/islands (wet climate, rainy with mild winter and medium summer)
Zone B: Athens and mainland (medium rain, soft winter, dry summer)
Zone C&D: North Greece (cold winter, dry summer and rainy all seasons in mountain areas)

**Size of building**: Two categories of concrete buildings can be identified based on the state of ownership that largely determine their size.

Family house with maximum 2 floors and roof
Condominium: Building or complex of buildings containing a number of individually owned apartments or houses

## ITALY

This research was developed by Formedil Emilia-Romagna and Associazione NET through the consultation of materials disseminated on the internet. The material was used to produce a summary of the Italian situation from different points of view: the concrete industry perspectives, innovation and research on materials, data on real estate and redevelopment, and incentives.

Of the Italian building stock, about 70% of the buildings are older than 60 years, and on average they are of a lower quality level than those in other European countries at the same time. The risks of low technical quality and poor design of buildings are due to the rapid construction process. A significant percentage of risk can be attributed to the construction boom of the late seventies and in general to the rapid and sudden urbanization of that period. Initially, and for many years after, it was thought that reinforced concrete could have an eternal life. This initial belief, combined with its ease of production, has generated a rapid development in the use of reinforced concrete, produced following sometimes imprecise compositional, production and design rules, which have caused an overall quality of the conglomerates that is often poor and not very durable. This approach combined with a lack of knowledge of highly degenerative forms of degradation, in most cases of natural origin, attacked and deteriorated, day-by-day, the reinforced concrete, preventing the durability of many works over time.
The cement conglomerate, like all stone materials, has a good compressive strength, while its behaviour to direct traction or bending traction is remarkably poor. For these types of stress, the combination with steel is exploited, used in the form of rods, which are responsible for absorbing the traction stress, thus giving rise to the composite material known as reinforced concrete.



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## POLAND

The 'Up4Green' Project team (from 36,6 Competence Centre based in Łódź supported by experts from the Faculty of Construction, Architecture and Environmental Engineering at Technical University of Lodz) carried out desk-research within the period December 2020 – January 2021 so to identify current state of the art concerning the renovation of concrete buildings in Poland.

Due to Covid-19 pandemic and restrictions imposed by regional sanitary authorities, the survey methodology was mainly limited to collection of data available from Internet resources.

Currently, there are 60,000 concrete blocks of flats in Poland, which makes a total of around 4 million apartments, in which 12 million Poles live, including one million just in Warsaw. According to the Central Statistical Office, flats built between 1945 and 1988 account for 57% of the total housing stock in Poland today. And they are everywhere – from metropolises to the smallest towns. So numerous that it is hard to ignore them, and at the same time so well blended into the landscape of contemporary cities that they are almost invisible on a daily basis. Common, yet provocative, often hated, covered with myths.

In Poland, unlike in Western Europe, living in a block is not a mark of social degradation but still an appreciated housing standard. It has been known for a long time that blocks of flats built in the 60s, 70s and 80s are experiencing a renaissance of status and apartments in great slabs are increasingly popular with buyers and tenants. Housing estates built in communist times have many advantages. First of all, they are much better designed than apartments built by modern developers. The space and the relatively loose arrangement of the large-panel housing estates are the merit of the urban planners, who had a real influence on the plans of the estates built until the end of the 70s. They incorporated kindergartens, schools, walking paths for children to safely return home after school, as well as commercial pavilions.

According to a recent study conducted by the Polish Institute of Construction Technology, large-panel buildings have a great future and are extremely durable. Blocks of flats from communist Poland may even survive another 100 years, provided that they are modernized. Unquestionably, in many Polish cities such actions are undertaken, but they usually end with insulating buildings and painting them in uninteresting colours.



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# 1.Identification of the points of vigilance of a building before renovation

## ESTONIA

**Condition of the facade concrete**. As the Estonian climate often alternates between cold and warm temperatures during the winter, numerous freeze-thaw cycles must be performed on the external walls during the service life of the building. Therefore, the **cold resistance of concrete** is very important to ensure the preservation of the external façade of large panel houses. Due to low frost tolerance, the facades of older buildings have begun to decay.

As concrete is primarily used to adoption compressive forces, **compressive strength** is one of the most important properties for concrete. It also is one of the main factors that determines the sustainability of the concrete building. **Corrosion of the metal** parts is another factor that determines the sustainability of the concrete buildings. Reinforced concrete is a material that is constantly undergoing chemical change and is often exposed to severe weather and load conditions.

**Condition of the exterior wall panels.** The external wall of large panel houses consists of internal and external concrete shell slabs and insulation between them. Insulation is usually made of TEP board, glass wool, polyurethane foam, reinforcement frame, cement mortar moulded individual reinforcement bars or heat-permeable steel ties. One of the causes of damage to external walls is water (either in the form of steam, water or ice). The external wall panels are made without ventilation, but the joints have openings for water drainage.

**Condition of the thermal bridges.** Thermal bridges are places where the thermal conductivity is higher locally. Thermal bridges can be geometric (corner of the external wall, connection of the floor and the external wall, connection of the roof ceiling and the external wall, etc.) or constructional (insulations or external wall connections, etc.). Lowering of the internal temperature can also be caused by faults in the installation of insulation, lack of insulation, wet insulation, leaks in the air barrier and the performance of heating and ventilation systems. In cold climates, it is important to consider cold bridges.

**Airtightness**. Insufficient airtightness of building walls is manifested in unplanned and uncontrolled airflow through cracks and leaks in the building walls. The airtightness of building is affected by the following factors:

- Energy efficiency of buildings
- Moisture technical problems, mould formation, water vapour condensation
- Spread of mould, air pollution and radon from the underground room to the interior, movement of unpleasant odours between apartments
- Excessive cooling of the walls
- Indoor climate quality and draft
- Ventilation system performance
- Noise problems
- Fire safety



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**Soundproof.** According to the Building Act, excessive propagation of noise in a building must be avoided. Approved noise level can be at a level that does not endanger human life or health and allows people to live and work in satisfactory conditions. Noise enters the apartment from the outside environment, other apartments and the stairwell. In addition, noise spreads between rooms within the apartment. Large panel houses were built between 1961 and 1990. Since then, the requirements for soundproofing have changed significantly.

**Ventilation.** Ventilation is a set of equipment and measures to ensure the prescribed indoor climate parameters by means of air exchange. The purpose of ventilation is to ensure clean air. In old large-panel houses, the indoor climate of apartments often does not meet the requirements. The main reason for this can be considered the fact that the provision of air exchange in these buildings is provided by natural ventilation, which, however, does not always ensure an adequate amount of airflow.

## FRANCE

In order to make a diagnosis about the nature of a building, an evaluation is required. Criteria are classified according to topics:

- Classification according to the historical period of construction and of the evolutions of the building. It's important to pay attention to the different periods, the moment when the building has been modified, building methods as well as mechanical and physic-chemical interactions of the different parts of the building.
- Classification according to significant architectural characteristics (Cornice, moulding, decoration, vaulting, cut stone, brickwork, stylistic elements, etc.).
- Classification according to structural criteria (Foundation, wall, floor, frame, stairs, beams, non-load-bearing elements, base)
- Classification according to comfort criteria (Insulation, natural ventilation, mechanical ventilation, direct solar gain, the building orientation, the prevailing wind, the climate of the place, building protected (or not) by its environment (another building, tree, peripheral walls).
- Classification according to building methods (masonry of small elements, natural stone, industrialized materials, concrete, wood, steel, associations of various materials).

In order to organize the criteria that will guide our work, we can propose the following classification grid to analyse the building.

**General architectural classification** (single or semi-detached house, dwelling building (less than 5 floors (no elevator)), dwelling building (more than 5 floors), cellar, common living space, common circulation space.

**Historical positioning of the building** (Period of construction, building classified as heritage or not, general building method (All wood, masonry of natural element, masonry of industrialized element, reinforced concrete, pressurised concrete, mixed structure wood-concrete, steel-concrete)

Classification by sub-element of the building (original historical construction, addition of construction adjoining the original construction, addition with no structural connection to the original building).

**Load-bearing structure**

Infrastructure: foundations (accessible or non-accessible)



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Superstructure:

- Peripheral walls and any supporting elements (including sheds, lintels, beams, columns)
- Floors
- Framework (including rafters)
- Stairs
- Railings and handrails (common areas)

**Notion of living comfort**: Waterproofing, insulation, finishes (for each element, target the initial solutions and modifications made over the life of the building, analyse and pay attention to the physic-chemical interactions between the different materials used (dew point, rotting of materials left in place, etc.).

- Roof waterproofing, under-roof insulation, ventilation and air renewal in converted attic space or unfinished roofs.
- Wall waterproofing (air tightness/ for each wall component from outside to inside)
- Wall waterproofing (watertight) (for each wall component from outside to inside)
- Thermal insulation of walls and joinery (thermal bridges, air leaks, dew point). Separate vertical walls, joineries, partitions and floor coverings
- Common area finishes: Condition of paints and wall coverings (mould, saltpetre, discoloration, flaking, peeling, odour, contact humidity).

**Equipment:** Heating, ventilation, temperature control system (air conditioning), supply of fluids through the walls (water, gas, electricity), tightness of supply networks, evacuation networks (waste water and black water), tightness of evacuation networks.

## GREECE

Concrete buildings constructed until 1980 don't have **thermal wall insulation**. They were built mainly with single bricks walls with no insulation layer material. Roof insulation was mainly performed by putting additional cement tiles or pumice stone on top of the roof floor. Tiled roof is not a common practice in city buildings due to mild weather conditions so the main purpose of roof insulation was to protect from excess heating from sunlight exposure.

Another notable point to mention is that Greek architecture is taking advantage of the sunny weather and thus balconies are of major importance. For that reason, buildings have more thermal losses due to doors and windows surfaces, the majority of which are still single glass layer.

**Air and noise pollution** is a major issue in urban environments. In Greece, residential buildings still use central diesel/petrol heating systems (even though lately there is a tendency of changing to individual ones with natural gas) and the use of fireplaces is still allowed, thus being responsible for a heavy concentration of air pollutants. The last 5 years there has been a national effort to expand the natural gas grid infrastructure in big cities, to make the transition to a more environmentally friendlier fuel (compared to diesel oil) in order to control air pollution and comply with emission standards.



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**Humidity** problems in residential buildings are an ongoing issue that is treated with short-term solutions of low budget such as use of dehumidifiers and insulation materials. Because of the good weather conditions in the country, there is no imperative need to provide holistic solutions neither are specialized and experienced technicians. To this end, humidity problems are largely underestimated in construction or/and renovation practices.

**Heating systems** in Greece is the last major point of vigilance to take under consideration. Although lately there is an effort to improve environmental performance and increase energy efficiency, still diesel and wood are in extensive use, burnt in outdated infrastructures resulting to an average consumption of 10,2 MWh of thermal energy on average per household.

## ITALY

Factors that can cause the deterioration of concrete are of different nature but can still be connected to three categories:

Physical causes;
Chemical causes;
Mechanical causes.

Among the **physical causes** we can identify the effects of atmospheric pollution, acid rain and water freezing and thawing cycles within the pores of the cement matrix. Water into the concrete, in particular for areas frequently saturated with moisture (horizontal parts such as cornices, front panels, etc.) causes, in the event of thawing, an internal swelling of the concrete.

As for the **chemical causes** of degradation, two very frequent factors are carbonation and attacks by chlorides. The first phenomenon is caused by the dissolution of carbon dioxide in water; the second from dissolution of salts. The carbon dioxide in the air reacts with the lime in the cement, generating the so-called **carbonation process**. This reaction begins on the surface to slowly progress towards the interior of the concrete, causing corrosion of the reinforcements, initially protected by the high alkalinity of the new cement.

Among **mechanical causes**, in case of infrastructures, we can also mention the loads and stress caused by traffic and the continuous transit of vehicles to which bridges, viaducts, stations, tunnels and metropolitan tunnels are constantly subjected.

Other factors that modify the durability of reinforced concrete structures are:

- The composition of the materials that constitute the concrete (cement, sand, aggregates, etc.);
- The installation techniques. The most common cause of buildings deterioration in Italy is poor quality in execution: untreated castings, excess water in the mixes, absent or insufficient vibration, poorly maintained castings, insufficient concrete cover, too dense reinforcement, forms that facilitate the stagnation of aggressive elements such as the absence of drips, etc.

The deterioration of concrete is hardly attributable to a single cause as often several processes can occur simultaneously, interacting with each other.



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# POLAND

Inspection of large-panel buildings in Poland (2019-2020)

The Ministry of Investment and Development has commissioned an examination of the technical condition and broadly understood safety, relating to the blocks of flats from the so-called great slabs. The inspection of the large-panel buildings turned out well, and certainly reassuring. Such structures, according to the study, do not threaten the safety.

As the ministry informs on its website, in Poland there are as many as 60 thousand buildings made of big plates. 80% of them were made in three-layer plate technology. The Building Research Institute has checked 300 buildings in the voivodships where there are most of them, which is in Mazowieckie, Łódzkie, Śląskie and Dolnośląskie voivodships.

Points of vigilance

Thanks to the study, the Building Research Institute (ITB) has also created criteria that will enable efficient periodic inspections of large-panel buildings in the future prior to revitalisation. The Deputy Minister also announced changes in the act on thermo modernization and renovations. They are to make it possible to finance the reinforcement of three-layer plates during thermal upgrading works.

*Assessment of the technical condition of the building should include: (recommended by ITB):*

- Installations/ heating systems,
- Thermal wall insulation,
- Ventilation/ air circulation
- Thermal bridges,
- Surfaces - uneven walls, floors,
- Condition of window woodwork
- Soundproof
- Humidity
- Airtightness
- Air pollution
- Condition of the building and elevators,



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## 2.The risks generated by these points of vigilance

### ESTONIA

The insufficient condition of the **façade panels** of the concrete can cause the increase of the corrosion of the metal details of the concrete panels and lower the life circle of the building. It will keep the concrete panel wet which causes increase the humidity of the building.

The insufficient condition of the **external walls** will cause a water vapour condensation and mould formation. Favourable conditions for mould growth are when the relative humidity is over 75 ... 80%

The lower internal surface temperature and the consequent higher relative humidity caused by the higher thermal conductivity through the **thermal bridge** can cause the growth of microorganisms, dirt on the wall or lead to condensation of water vapour. Water vapour condenses when the temperature drops below the saturation temperature when the relative humidity is 100%. Low surface temperatures in large areas reduce thermal comfort, mainly due to increased air movement and asymmetric radiation. Thermal bridges increase the energy consumption of building.

The energy consumption of a conventional building can be significantly higher than that of a building with very low **airtightness**. Poor airtightness also is a cause of cold floors. Residents of the buildings with poor airtightness complained about the increase of generation of mould and radon, which are both high risks for the respiratory diseases and allergies. Correct airtightness is also very important from the fire safety perspective. In the event of a possible fire, the spread of fire and smoke in buildings must be prevented. The airtightness of building envelopes affects fire safety, in particular through the spread of smoke from the initial stage of a fire through the partitions.

The main risk with insufficient **soundproof** of the building is the general inconvenient living conditions. It also means the building is losing its market value and prize. The building (apartment) is losing its sustainability, as it does not meet the current construction requirements.

Non-compliance with the indoor climate can cause problems in the building, which affect the construction and finishing materials of the building, but can also affect human health. Mechanical **ventilation** equipment is sometimes improperly built. For example, if air enters the ventilation equipment close to the ground, if there is a lot of mould, or if a noise-insulating material or filter is placed in the ventilation equipment, which promotes the condensation of moisture and thus the growth of mould. The presumed fresh air therefore contains a lot of fungal mixtures from the beginning. Ventilation equipment often has a thick layer of dust and a characteristic mouldy smell spreads. Ventilation systems have often not been cleaned since they were installed.



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## FRANCE

As for the diagnosis, it's necessary to establish a diagram of diseases induced by an unhealthy building. This diagram should include risks as different as:

**Structural Risks**: Immediate and/or delayed risks to the physical integrity of people.

- Probable and global damage (define the risk of imminent damage on a probable time scale)
- Isolated damage: Targeting Structural Elements
- Partial damage that may impact some other structural elements: identify the mechanical connections between the elements and the probability of chain reaction.
- Damage by immediate or delayed evolutionary pathology (carbonation of concrete, corrosion of steel, breakage of wooden elements by parasites, rotting of wooden structure by excessive wall humidification, etc.).

**Risks to the quality of life and comfort**: Delayed risks related to personal health

- Old materials declared harmful (lead paint, asbestos, varnish/paint with VOCs, etc.)
- Failure to ventilate heating equipment (carbon monoxide, moisture content by external combustion (supplementary heating system, oil, gas, wood).
- Failure to ventilate the home (mould, saltpetre, accumulation of volatile elements (allergies).
- Lack of overall insulation of the habitat (thermal bridge, dew point, wall humidification (mould, saltpetre, accumulation of volatile elements (allergy).

**Risks due to the equipment**:

Delayed and/or immediate risks for the health of people:

- Failure to earth the electrical network, drinking water network, gas network.
- Defective electrical tightness of equipment and connections (plugs, exposed wires, faulty equipment, etc.).

## GREECE

Indoor humidity and condensation affects the performance of buildings, causing problems such as mould growth, which can be a cause of respiratory allergies and bacteria growth on surfaces. If persistent, condensation on the surface of walls or roofs can spoil visual appearance through the damage it can cause to furnishings and fittings mould growth. The effects of interstitial condensation are more long term but potentially more damaging as it can cause the deterioration of the fabric of the building itself. Walls and roofs become mouldy and the smell of decay and deterioration of air quality may cause health problems.



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Overall, condensation in buildings may cause problems in two main ways:

**Surface condensation** is where water vapour condenses on a cold building element such as a window or wall that has a surface temperature below the dew point. The cold surface temperature of a building element locally depresses the air temperature to below the dew point and any excess moisture that the colder air can no longer hold condenses onto the cold surface. Alternatively, a brief hot shower for example can cause condensation in a cool bath-room by increasing the moisture content beyond the saturation point or dew point for that temperature. Note that the room may feel warm but still be subject to a condensation risk. In buildings of high-thermal-capacity construction such as cavity brick masonry and concrete panel, heated periodically, the depression of temperature at the internal surface will often be greater, as the element does not have sufficient time to warm up and remains cooler relative to the indoor temperature. Also, with single-brick walls, depending on the temperature difference, it may be difficult to heat the wall. In these situations the design of the element with respect to insulation, air gaps and vapour barriers needs to be considered more carefully.

**Indoor condensation** is condensation occurring inside the building element. Depending on the water vapour pressures, water vapour can be moving inward or outward through any building element. If the temperature gradient through the element is such that at any point the temperature falls below the dew point then the excess moisture that can not be held as vapour will condense within the element. When conditions change, the water evaporates into vapour and continues to move through the element.

Examples of moisture-related problems in buildings

- Rainwater or groundwater leaking into the enclosure (roof, walls, windows or foundation), often resulting in mould growth, peeling paint, wood decay or corrosion;
- Plumbing leaks, perhaps resulting from improper design, installation, operation or maintenance (e.g. failure to inspect and repair plumbing leaks);
- Water wicking (capillary suction) through porous building materials (such as concrete or wood) from a moisture source (such as rainwater or plumbing water) to a material that does not tolerate wetting;
- Rainwater, condensation or plumbing water running along the top or bottom of a material (bridging), for example, along the top for some distance or clinging to the bottom of a truss, rafter, floor or suspended ceiling track before falling or being absorbed by a porous material;
- Infiltration/exfiltration of warm, moist outside air through cracks and holes in the enclosure during warm, humid weather – which can cause condensation on materials that are cooler,



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- Intentional or accidental vapour barriers in the wrong place, which can lead to condensation in the building enclosure;
- Insufficient dehumidification by heating, ventilating and air-conditioning systems, which may result in levels of interior humidity that are high enough to cause mould to grow on furniture, walls, ceilings or air-conditioning supply diffusers;
- Poor condensate drainage due to heating, ventilation and air-conditioning system deficiencies; condensation from cooling coils may overflow drain pans or leak from condensate drain lines; and
- Enclosure of wet materials in building assemblies during construction by materials that are prone to moisture problems and grow mould, delaminate or do not cure properly.

Exposure to air pollutants within the building, as generated by indoor activities and emitted from indoor materials or ventilation systems can have a variety of effects from the perception of unwanted odours to cancer. Increased risks of lung cancer, heart attack, heart disease and stroke have been linked to exposure to environmental tobacco smoke and to radon decay products. Ventilation rates usually reduce the indoor concentrations of these agents. The effects can be acute or longer-term. Ventilation dilutes the concentrations of (or disperses) airborne viruses or bacteria that can cause infectious diseases. Improved ventilation can improve task performance and productivity.

## ITALY

In recent years it has been found that the type of buildings dating back to the ‘60-‘70s can alter the psychophysical well being of the inhabitant.
Bio-architecture has identified that houses built with a massive presence of concrete have very significant **air quality problems**.
It is one thing to build foundations, beams, pillars, floors in concrete - which are a small part of the building in terms of "contact surface" with the inhabitant - one thing is to have all the walls and parts of the house made of concrete.
First of all, traditional cement does not allow the excess steam created by the inhabitant of the house to be drained out. In fact, it is a very common phenomenon that in winter condensation and mould can appear on the walls and corners of the wall that are in contact with the external environment. The reference is not only to very evident black moulds when there is the phenomenon of condensation, but also to smaller moulds not visible to us which are more pernicious for human health.
In addition, in the cement industry all around the world, it represents a solution to dispose of waste from other industries. This means that the industries that produce, for example, copper, vanadium, chromium, zinc, cadmium, arsenic, etc. ... can dispose these harmful compounds in the production of cement in doses regulated by law, instead of storing them in storage deposits for their conservation over time.
This aspect is true only in the production of the so-called “grey” cement, which is the one usually used in the structural parts. In the “white” cement, on the other hand, these compounds cannot be introduced, by law. And, in fact, bio-architecture tends to use only white concrete, in order to have a house with better biocompatibility and healthiness performance.


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Also, it should be borne in mind that the air change in homes is now increasingly reduced, due to the watertight fixtures necessary to avoid energy loss. The old wooden window frames used in the past guaranteed the natural indoor air exchange of the house and even the lime plasters also allowed a certain exchange with the outside.

## POLAND

Health-based risk

As far as the disadvantages of concrete slab apartments are concerned, first of all it should be pointed out that such apartments do not "breathe" as it is the case with apartments built in brick blocks. Thus, the risk of asthma or allergy attacks increases due to poor air circulation.

Comfort of living

The drawback of apartments in large slabs is also acoustics, or basically the lack of it. As a consequence you can know exactly the schedule of the neighbours from behind the wall. You can hear when someone moves in the apartment, when they turn on the water and talk.

It is similar with ventilation. All smells mix in the corridor or pass through ventilation ducts to other apartments.

Too few parking spaces are also an issue. In the days when housing estates were built, only a small number of residents could afford their own cars. Today, practically everyone has their own car, and often there are two cars per unit.

Too small balconies or their lack are often underlined as well. Nowadays people appreciate open space, and new apartments provide it - they have large balconies, terraces or small gardens.

# 3. Actions that limit these risks:

## ESTONIA

As the frost resistance of the **façade panels** of any building does not fully meet the requirements, measures should be taken for all houses to protect the concrete from the effects of the environment. Depending on the extent of the damage, there could in principle be two solutions:

In the case of buildings whose panels have not yet significantly crumbled, the façade should be covered with a waterproof façade covering which is ventilated from behind. It is also recommended to do additional insulation of the facade, as this prevents the concrete from freezing and increases the cost of facade repairs by only a few tens of percent, while significantly reducing the cost of heating energy.

In the case of buildings with severely crumbling panels, the crushed concrete should be removed and then treated as in the previous point.



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Additional insulation of external walls is more preferable solution, as it can also improve the energy efficiency of houses and reduce the impact of thermal bridges.

Additional insulation of the **external walls** is the most practical solution to reduce the risk of condensation inside the wall. As a result of the additional insulation, the temperature of the wall panel rises, which leads to a decrease in relative humidity. The inside of the wall and ceiling cannot be further insulated.
The higher thermal conductivity through **the thermal bridge** can be reduced by reducing the moisture load (better ventilation, proper heating, lower moisture production) and additional insulation of the external walls. This is indispensable to ensure a safe and healthy indoor climate. For the elimination of cold bridges, 50-70 mm thick external additional insulation is generally sufficient. However, such a small insulation thickness is not economically feasible. The share of insulation thickness in the total price of additional insulation (finishing, scaffolding work, etc.) is small compared to the energy savings from thicker insulation. Internal insulation of external boundaries should in any case be avoided, as this type of insulation does not eliminate cold bridges or reduce heat loss.
**An airtightness** of buildings plays an important role in the energy efficiency of buildings and has a direct impact on the heating costs of a building. However, it must be remembered that building envelopes, heating and ventilation form a single unit. If one of them does not work normally, then a building is not in a good condition. All ventilation of a building with airtight barriers must be ensured by effective ventilation. If there is no effective ventilation, the indoor climate will be contaminated. Also, a proper heating and ventilation system does not guarantee energy efficiency in a building whose railings are not air and heat resistant. So fixing the airtightness problem has to come hand in hand with building a good ventilation system and heating system.
If a building with airtight barriers does not have a functioning ventilation system, the indoor air will not be exchanged and the indoor climate will be damaged. The performance of the ventilation system must ensure:

- adequate ventilation and fresh air supply
- thermal comfort
- a balanced system that does not create an excessive difference in air pressures
- would not cause excessive noise
- airflow control
- energy efficiency of buildings

Energy savings must not come at the expense of a worse indoor climate! It is important to develop solutions to improve the **soundproofing** of apartments. This is made possible by a computational assessment of the soundproofing of the walls and the possibilities of improving them. Different standards are used to calculate where and how to improve soundproofing. The technical data of the walls and ceilings between the apartments are used for calculations.



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It is recommended that air enters into the **ventilation** unit from above and that the system can be thoroughly cleaned and disinfected. It is important to ensure that the system is regularly cleaned and the filters changed according to the manufacturer's instructions. If air is blown into the room through mechanical ventilation equipment, regular cleaning is important, as ventilation can disperse the dust in the room and thus cause additional problems.

## FRANCE

The reduction in the energy consumption of buildings is done primarily by "confining" the buildings, to make them more airtight and more insulated.
In addition, the environmental health plan preserves the quality of indoor air for the protection of health, and air and ventilation are also very important for the preservation of the building (avoiding the creation of pathologies).
The renovation of old buildings therefore requires finding a balance between thermal measures allowing "better airtightness", while maintaining sufficient ventilation for comfort of use and preservation of the building.
In France, the implementing decree n ° 2016-711 dated May 30, 2016 relating to insulation works in the event of a façade refurbishing, roof repair or development of premises to make them habitable, defines the framework for 'intervention. Thus, when a building is the subject of renovation works (repair of the plaster, replacement or installation of a facing), of at least, 50% of a facade without openings, or repair of the roof with " at least 50% of the entire roof, the contracting authority is obliged to carry out thermal insulation works in accordance with the requirements defined in the RTE.
The Law on energy transition for green growth plans to reduce greenhouse gas emissions by 40%, final energy consumption by 20% and primary energy consumption of fossil fuels by 30% by 2030. But without taking into account the gray energy intrinsic to thermal renovation materials, the effectiveness of these thresholds remains marginal

## GREECE

The role of ventilation in controlling moisture and providing a healthy indoor environment is essential. The presence of house dampness or mould phenomena related to excess moisture are not only harmful to the health of a building's occupants, but also seriously affect the condition of the building structure, which may diminish the indoor air quality of the building.
Ventilation is intended to remove or dilute pollutants and to control the thermal environment and humidity in buildings. It must be sufficient either to remove pollutants and humidity generated indoors or to dilute their concentrations to acceptable levels for the health and comfort of the occupants and must be sufficient to maintain the building's integrity. A number of reviews have shown an association between ventilation and health. Ventilation can be provided by various natural and mechanical methods.



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Thermal insulation reduces unwanted heat loss or heat gain through a building envelope. This, in turn, reduces energy demand for cooling and heating of buildings, and thus is a mitigation measure to reduce emissions. Thermal insulation contributes to the preservation of resources and reduces environmental impacts. Providing additional layer to outside surface to allow evaporation of water, and prevent accumulation of water within wall. Thermal insulation assists in warming cold surfaces by controlling the loss of heat through the wall/floor.

## ITALY

The process of restoring deteriorated concrete follows a consolidated path: diagnosis, planning of the intervention, and execution of the restoration.
There are investigation systems, tools and methods, which allow to carry out a whole series of diagnostic activities, mainly non-invasive, rapid and generally inexpensive (pacometric, sclerometric test, ultrasound, measurement of corrosion potential, etc.), with which it is possible to characterize the structures and materials, recognize any deterioration pathologies, quantify the degree of evolution of the phenomenon and the level of involvement of the structure. These activities can provide interested parties (condominiums, administrator) with information on the state of health of the property, and are fundamental both in its management, and in case remediation interventions need to be planned, which can proportionate to the real situation, optimizing the effectiveness of the intervention and the cost / benefit ratio.

In the restoration of deteriorated works in reinforced cement, the following parameters must always be taken into account in order to achieve a successful intervention through the use of premixed cement mortars:

- Exposure class
- Application technology
- Adherence to the original concrete

**Exposure class:** in the design of reinforced concrete works, the environmental category to which the work is exposed, called exposure class, must be taken into account for the choice of durable concrete in this environment. Thus, also in the planning of restoration, on the basis of deterioration diagnosis, the exposure class must be taken into account so that, after the restoration, the work does not undergo the same deterioration again.

**Application technology**
The requirements according to which the restoration mortar must be applied are highly related to the thickness to be restored, to the density of the original reinforcement rods and of the supplementary ones.


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**Adherence to the original concrete**
Normally, cement-based mortars, regardless of the application technology, show the drawback of hygrometric shrinkage. A good restoration mortar must instead overcome this problem and guarantee perfect adhesion to the substrate.
The knowledge of the aggressions that act on the structure also allows to select the products for restoration, offering maximum durability towards the surrounding environment: sea water, freezing or thawing cycles, etc. Knowledge about the intervention location (e.g. urban area, aggressive environment ...) allows us to choose the most durable method of application.

The final **restoration** phase can be of two types, defined in the diagnostic phase:
**Cortical restoration**: refers to the restoration of non-load-bearing areas that do not compromise the stability of the structures and that concern only the superficial areas.

**Structural restoration:** refers to the restoration of deteriorated areas that directly contribute to the stability of the structure (degradation of structural elements with generalized degradation, even in depth).

## POLAND

The modernization of large-plate buildings due to modern requirements should include:

- Thermo-modernisation of high-altitude panel buildings, not yet insulated,
- Dismantling of asbestos-cement panel facades on existing buildings and products containing asbestos (balustrades, loggia walls, chimney flues) with development of rules for disposal of harmful substances, in accordance with the "Program for removal of asbestos and products containing asbestos used on the Polish territory until 2032" adopted by the Council of Ministers on 14 May 2002
- Replacement of window frames in apartments and staircases with energy-saving ones in buildings included in thermo-modernization after 2014, as well as corroded pipes of water, sewage, gas and heating systems with their adaptation to current technical and construction regulations,
- Adjustment of the heating system and hot water preparation through the rational use of renewable energy sources in the heat supply,
- Replacement of aluminium electrical installation in buildings (apartments and staircases)
- Giving up gas in high-rise and high rise buildings in use and switching to three-phase electric supply of kitchen appliances and electric hot water heaters,
- Modernization of natural gravitational and mechanical (supply and exhaust) ventilation after thermo-modernization of buildings in accordance with the requirements and technical conditions that should be met by buildings.


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Due to social expectations, but also functional-utility requirements, the directions of modernization activities in the area of large-panel buildings may also take into account the following aspects:

- Superstructures of additional storeys,
- Changes in the shape of roofs allowing for the creation of living space in the attics or creation of the second level of two-storey apartments,
- Reconstruction of entrances and staircases adjusting them to the needs of the disabled,
- Transformation of dwelling structure by combining too small apartments or improving their functionality,
- Reconstruction of transport systems in buildings, by eliminating corridor systems or increasing the number of staircases and elevators,
- Construction of additional elevators in five-story buildings,
- Reconstruction of buildings, by adjusting the size of buildings and/or adding new buildings or fragments of buildings, or partial demolition or transformation of façades
- Additional introduction of lower residential and commercial development.

## 4. Users' expectations:

### ESTONIA

According to the research made in 2009 most of the residence living in the big panel apartment buildings, are the owners of the apartments and have been living there since the building was first built. Over the years the residence has made financial investments to upgrade their living conditions, and performed minor renovations to keep the living conditions and comfort enjoyable. Most of them have changed the old wooden windows with PVC windows what has caused the apartments to be more air tight and warmer. But it also caused some health problems like no fresh air, dryness and dry cough.

The financial condition of the household is playing a big role how much they are willing to invest to upgrade their living conditions. It is expected to have comfortable living conditions and low cost which is not always achievable.

The biggest dissatisfaction the residence had was sounds and noise through the ceilings and floors. Thus, it means noise from the daily activities of upper and lower neighbours. The soundproof was mentioned as a major part of feeling the comfort and privacy.

Most of the residence of the big panel buildings expects their apartments to be full or light and warm. Generally, they are pleased with the condition of lighting as well no sounds from ventilations or other equipment. The residents of the apartments have been performing the minor renovation works that has been kept their living conditions satisfying for themselves.



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The external expectations for their building have been mostly to live in a modern looking buildings, and not a building that looks like a post-soviet building. There have been different solutions for the external looks: some have used an artwork on their buildings; some have used modern looking external construction materials and colours. A reduction in the carbon footprint in big panel apartment buildings depends on the willingness of the residents of the house to invest in technology that would reduce energy consumption. This depends also of the age of the residence. The younger generation is willing to invest because they see it as something that will raise the prize of their real estate. They see the benefit of the long run. The apartment buildings with older generations are slower to make investments into solar panels for example, because that would mean for them that they have to pay more for their living conditions, and less money is there for daily food and medicine.

## FRANCE

Residents expect quality thermal comfort, acoustic comfort, sanitary comfort, good light for their housing. They also expect an accommodation, which is pleasant and customized.

**Life comfort:**

Thermal comfort:

The temperature depends on each room and its use. The felt comfort temperature depends on the ambient air temperature and that of the walls. Insulating the exterior walls is therefore essential for perceived comfort. In addition, an individual dwelling has heat losses: 7 to 10% through the floor, 13 to 15% through the joinery, 20 to 25% through the exterior walls and 30% through the ceiling (roof). Ceilings and roofs represent 1/3 of heat loss, hence the importance of insulating them. The ambient humidity level plays a very important role in the feeling of heat. High-performance ventilation helps reduce the humidity level. The speed of movement of the air present in the building, whether it is convection currents or ventilation, generates a sensation of cold.

Acoustic comfort is very important for well being, poor acoustic comfort generates negative effects on health (nervousness, stress, sleep deprivation, tiredness). The insulation of the exterior and interior walls will be privileged but also the joinery. The need for sound insulation will vary greatly depending on the environment.

Sanitary comfort came with the construction of post-war housing and the arrival of running water. Also compulsory are evacuation facilities for wastewaters with a system preventing the backflow of smells and effluents. The drinking water supply pipes must not cause diseases such as lead pipes, which caused lead poisoning for example. Waste treatment (wastewater in particular) is an integral part of the renovation of post-war housing, not connected to a collective water treatment system. Sanitary comfort also involves the ventilation of the rooms, in order to reduce the humidity level. It can generate a sensation of cold but also the development of mould fungi on the cold walls where the humidity condenses (can be the cause of respiratory diseases).



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Good light is essential.
The sun is a free source of light that will affect the well being of occupants.
Solar gain can be used as a direct or indirect heat source via interior walls with high inertia. They will restore the energy received by the sunshine throughout the day.

**Aesthetic aspect of buildings:**
Visually pleasant and customized accommodation is an element of rehabilitation to be taken into account, whether it is for the private or common parts of the building.
Reinforced concrete, which was the preferred material during post-war reconstruction, is a cold material. It is not completely smooth, therefore it easily and rapidly look dirty. In addition, it was rarely plastered or painted, hence the standardization of towns rebuilt after the war. Individualization of buildings would make it possible to personalize homes and allow populations to appropriate their homes and their cities.

**Materials with a low ecological footprint:**
The materials used for these renovations must have a low carbon footprint as much as possible). Many biomaterials and efficient materials allow this work to be carried out without polluting the atmosphere of the accommodation.
Among the best-known insulators, we could mention wood fibber, agglomerated cork, cellulose wadding, hemp fibber ... these are insulators produced in Europe with natural products or from recycling.
Motorized ventilation (single or double flow) is an essential element in improving the comfort of homes. This consumes electrical energy but this energy is offset by the energy savings generated by the insulation for the single flow, and by the low need for additional heating for a double flow.

## GREECE

Renovation is a common means of maintaining buildings in order to serve their users. In the building life cycle, renovation is a prevailing activity in order to maintain its performance. Better performing buildings provide higher levels of comfort and wellbeing for their occupants, and improve health by reducing illnesses caused by a poor indoor climate.

Due to changes in lifestyles, construction standards, and market trends, housing has changed significantly over time, especially in residential apartments. A renovation must be well planned and take under consideration users' expectations for the final outcome, such as:

**Insulation effectiveness** not only contributes in reducing the required heating/cooling system size but also in reducing the annual energy cost. Additionally, it helps in extending the periods of thermal comfort without reliance on mechanical support. Therefore, proper choice of thermal insulation in buildings enhances thermal comfort at less operating cost.



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**Comfort** is expected to improve after the completion of a successful renovation. The quality and the parameters of the building's internal environment, define the feeling of comfort for the users. The use of active materials, insulation and efficient airtightness combined with effective ventilation will guarantee healthy air. Additionally the internal and external design of the renovated building could be planned to meet the aesthetic needs of the user and add value to the final result.

**Environmental footprint** is a usual concern of inhabitants that are aware of the negative impact of CO2 emissions. Renovation offers the chance to minimize energy consumption and simultaneously protect the environment.

**Payback period** is crucial for the user and it refers to the amount of time it takes to recover the cost of an investment. Is period of time an investment reaches a break-even point. The desirability of an investment is directly related to its payback period. Select building specialists to plan and implement renovation. The application requirements of most building thermal insulation products include appropriate detailed design, good workmanship and appropriate product selection, handling and installation methods. Experienced and skilled building specialists will succeed in working together to design/renovate buildings in such a way that they allow their customers to enjoy comfortable, healthy living conditions. Correctly planned and implemented renovations lead to a considerable improvement in levels of home comfort, significantly reduced energy costs and ultimately an increase in the value of the respective property.

## ITALY

The construction market is becoming increasingly observant to sustainability issues and therefore asks cement and concrete for different performances other than strength alone. Not only that: using some products with particularly competitive performance can contribute to raising the scores in the sustainability protocols of the building.
When it comes to redevelopment, however, it is also essential to evaluate the economic and financial aspects present in the Italian real estate market.
In fact, the frame of this set-up is families' perception of the need for "maintenance" of their wealth which, almost always, coincides exclusively with their own accommodation (76 % owns the house they live in).
A research conducted by CRESME in 2011 reveals that building degradation is highest in cities where the oldest stock is concentrated. Nevertheless, in general, the redevelopment of the housing stock is less in cities than in municipalities with a smaller population size. There is probably another issue that crosses the different sensibilities of a city dweller with that of a small town: it is the different perception of the value of one's home.


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In cities, the price component (value) referred to the urban position is so high that it significantly compresses the other components (state of repair, aesthetics, etc.). In other words, the maintenance and modernization of a home brings a marginal share of the increase in real estate wealth that varies depending on the location. Despite the growing sensitivity from end users of the properties, despite the expansion of the range of "sustainable" products for construction, despite the incentive measures, satisfactory objectives have not been achieved to date in the energy efficiency of buildings.

## POLAND

Residents indicate specific aspects that affect their overall assessment of living conditions in a block of flats constituting their expectations:

- Noise level
- Air cleanliness
- Modern standards and design
- Parking places availability
- Additional storage space provided
- High standard of common areas such as corridors, staircases and elevators
- Safety (monitoring, guards, remote-control entry barriers)
- Close access to zone with commercial and service premises
- Indoor and outdoor recreation areas in housing estates
- Sport infrastructure
- Playgrounds for children
- Ecological solutions implemented e.g. photovoltaic panels to lower the operating costs of common parts of the estate, such as common area lighting or covering the energy consumed by the elevators

# ANNEX I: Incentives/ Programmes

## ESTONIA

State is working together with an Association KredEx to consult and support the apartment building associations about the renovations and energy performance. **Financial incentives/assistance**. KredEx is a foundation set up by the Ministry of Economic Affairs and Communications in 2001 with the aim of proving financial solutions based on the best practices of the world. They are constantly developing their services in cooperation with other financial market participants in order to offer financing options in a changing economic environment. Most of the housing in Estonia was built several decades ago and is in need of renovation. KredEx offers a financial services and direct support for renovation of private homes and apartment buildings. They offer various kinds of financial services to help increase energy performance and improve the indoor climate. Both non-returnable support and loan guarantees are available through KredEx.



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## FRANCE

The energy renovation of buildings is a priority for the French Government. Through financial incentives (zero-interest eco-loan, one-euro boiler, tax credit for energy transition, etc.), individuals, co-ownerships and communities can benefit from support in carrying out their works, which are often expensive and tedious.

**The energy renovation plan for buildings** meets the objectives of the Climate Plan announced in July 2017 as it offers suitable tools to massif energy renovation, both of housing and professional buildings. The objective is to achieve carbon neutrality by 2050 while fighting fuel poverty. Indeed today, 7 million homes are poorly insulated and 14% of French people are cold in their homes

As part of the 2021-2022 Recovery Plan, the Ministry of Ecological Transition has opened a call for proposals intended to financially support social housing organizations engaging in the implementation of efficient and replicable industrial solutions for the energy renovation of housing of the social rental stock. A new financial incentive named MaPrimeRénov' has just been launched to support people so that they can improve the comfort of their housing and thus support the activity of the building sector.

In Normandy, the Regional Council wishes to encourage individuals, owners of individual houses, to carry out energy efficiency works to meet "Low Consumption Building" standards in one or more stages. For this, it proposes an eco-energy vouchers scheme, the implementation of a department to support energy renovation, the new national incentive maprimeRénov as well as the "LCB" experiment (financial incentives for diagnosis and works).

## GREECE

National program of building renovation, is the only source of financing and offers incentives for energy efficient upgrades through commercial banks. The program is linked with specific renovation features and the owner is responsible for the completion in order to receive the funding that ranges from 50-85% according to financial status and is implemented through commercial banks. The purpose of the program is to support the reduction of energy use and bridging the funding gap by the need to renovate the old building stock.

"Exoikonomo-Aftonomo" program was designed for the purpose of energy saving and autonomy through the introduction of new technologies in the residential building sector that characterize a "smart home". It is addressed to individuals whose main residence belongs to a low energy category. The beneficiary of the Program is Hellenic Development Bank.



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The eligible interventions are classified in 4 categories, depending on the purpose of implementation and they include the following subcategories of interventions.

1. Energy savings
   - Frame replacement
   - Thermal insulation installation/upgrade
   - Heating/ cooling system upgrade
   - Hot Water System using Renewable Energy Sources (RES)
2. Energy autonomy
   - Photovoltaic (PV) power plant, with energy offset
   - Electricity storage systems (electric accumulators) from PV
   - Electric vehicle recharging infrastructure
3. Smart home systems
   - Lighting / electrical charge handling
   - Heating / cooling
   - Remote control and monitoring
4. Other communal interventions (Apartment buildings)
   - Elevator upgrade and certification
   - Lighting upgrade of communal areas

The **total eligible budget** for the implementation of interventions is as follows:
**€ 50,000** for a detached house / individual apartment / apartment as part of an application for a type A apartment building
**€ 80,000**for a type B apartment building application. In case that a beneficiary has more than one application (owner-occupied and rented as main residence), the total funding cannot exceed € 100,000 in the sum of all applications.
In order to cover the cost of the required interventions, there is the option **to combine grant, borrowing and/ or own funds**. It is noted that the private participation, in the case of the applications of type B apartment building, will be covered exclusively with own funds.
The basic **criteria for a property** to be eligible for the Program are the following:

- It is used as a main residence
- It is legitimate (bears a building permit or other legitimate document*).
- It is classified according to the Energy Efficiency Certificate (EEP), issued after 26/11/2017, in a category less than or equal to C.
- It has not been characterized demolishable.

**Eligibility criteria** for the applicant:

- Retention of full, sparse or usufruct ownership of an eligible residence.
- Meeting the income criteria (for applications for individual apartments and houses) as defined by the program

The National program has eligible applicants only home owners and in case of condominium (block of apartments)-a vast majority of housing type in main cities-it is impossible for all owners to reach an agreement, thus energy upgrading through renovation could not be implemented in total. Although there are not yet implemented at National level, incentivising renovation and energy upgrading through income tax deduction could be efficient in case of high-income owners or companies in the future.



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## ITALY

The incentives financed by the Italian government are not expressly aimed at the requalification of concrete buildings but in general at the energy and/ or structural requalification of buildings.
The 2021 Budget Law has ordered the extension of some important incentives already in place in previous years which includes various devices:
**Bonus 110% -** tax deduction relating to expenses incurred from 1 July 2020 to 31 December 2021 for specific interventions on: residential properties - in the field of energy efficiency - anti-seismic interventions, installation of photovoltaic systems, infrastructures for charging electric vehicles and other expenses for technical activities such as sworn statements, compliance visas and project costs. The important news of the legislation is the possibility not only to use the bonus, in the form of a tax deduction in 5 years, but also to be able to transfer the tax credit to the Bank or obtain a discount from suppliers, thereby overcoming the economic-financial problem referred to in point 4.
**Bonus casa o bonus ristrutturazioni -** 50% of tax deduction of the costs incurred for building restoration interventions, for interventions that do not fall within the 110% bonus.

## POLAND

### Act on Thermo-modernization

Modernisation of communist blocks of flats is to be made possible by the recent amendment to the Act on Thermo-modernization. It provides for subsidies for renovation and insulation works for both communes and housing communities. According to the Ministry of Development, the amount of subsidy may reach even 50% of the investment value. It will also concern connection to the heat network and installation of renewable energy sources. Municipal buildings entered in the register of historic monuments or located in the area entered in this register will be covered by the subsidy of 60% of the project costs. The funds will be paid from the **Thermo-modernization and Renovation Fund**, managed by Bank Gospodarstwa Krajowego. In the years 2020-2029, the Fund will spend around 3.2 billion PLN for this purpose, of which around 2.2 billion PLN will relate to investments covered by the amended law. The costs of such renovations on a national scale (thermal modernisation and strengthening of slabs) are estimated at almost PLN 26 billion. The average cost of renovation of one building is about 500 thousand PLN. The subsidy programme is another step towards improving air quality in Poland, which is part of the government programme **"Clean Air".** Proper insulation of buildings allows for more efficient management of energy consumption, which leads to a reduction in emissions of harmful substances into the atmosphere.



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# ANNEX II: Quality requirements

## ESTONIA

Minimum requirements for energy performance

(1) Any new building that is being built or any existing building that is undergoing major renovation must conform to the minimum requirements for energy performance after the completion of the building or renovation work. If the building work was performed on the basis of a building permit, the construction work must conform to the minimum requirements for energy performance that were effective at the time the permit was issued.

(2) The building's outer envelope and technical systems that consume a significant amount of energy must be designed and built such that approaching them as an integral whole would allow for conformity to the minimum requirements for energy performance.

(3) The minister responsible for the area makes regulations to establish the minimum requirements for energy performance, including the requirements for technical systems that consume significant amounts of energy, and the conditions for introducing the use of renewable energy in buildings. The minimum requirements for energy performance are reviewed at least once every five years. When reviewing the minimum requirements for energy performance, technical progress is taken into account.

Following the Building Act and energy performance requirements will full fill the health related requirements.

## FRANCE

The so-called "global" renovation scheme defines an overall performance objective for the renovated building (RT Existent global). It only applies to certain projects which meet three criteria relating to the area, the date of completion and the cost of the works. It requires:

- An assessment of the initial condition of the building (initial energy performance, planned works and energy savings achieved)
- Energy savings (overall energy consumption lower than the reference consumption for the building for heating, hot water, sanitary, cooling, lighting). For housing, the regulations introduce a maximum consumption value. The energy consumption of the renovated building for heating, cooling and domestic hot water must indeed be less than a limit value which depends on the type of heating and the climate. This maximum consumption is between 80 and 165 kWh / m².year depending on the case, to be compared to the current average of the park which is of the order of 240 kWh / m².year. For non-residential buildings, the work should lead to a 30% gain in energy consumption compared to the previous state.
- Summer comfort (In order to limit the discomfort of the occupants and the use of air conditioning, the renovated building must provide acceptable summer comfort, as far as it is possible taking into account the existing building). The conventional indoor temperature reached in summer must therefore be lower than a reference temperature.



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"Guardrails" Minimum performance is required for a series of components (insulation, ventilation, heating system, etc.), when these are modified by renovation works. For all other renovation cases, the regulations define a minimum performance for the item replaced or installed. (RT Existent par element) (According to the law of May 3, 2007 (amended on January 1, 2018). The requirements target efficient techniques while taking into account the constraints of the occupant. The requirements concern: opaque walls (walls, roof, floors), glass walls, heating, domestic hot water, cooling systems, ventilation, and lighting.

According to the decree dated September 29, 2009, **the "high energy performance renovation" label** applies only to buildings completed after January 1, 1948. It certifies that the building complies with a high energy performance level as well as a minimum level of comfort in summer. The label is issued as part of a certification also covering the overall quality of the building. Reading the DPE is facilitated by two labels with 7 levels from A to G (A corresponding to the best performance, G to the worst):one refers to energy consumption and the other one to the quantity of greenhouse gases emitted.

**The IAQ (Internal Air Quality) regulations** make the monitoring of Indoor Air Quality (IAQ) mandatory in certain organizations receiving youngsters under 18:

- Since January 1, 2018 for collective care establishments for children under six, nursery schools and elementary schools;
- Since January 1, 2020 for leisure centres and secondary education or vocational training establishments (middle schools, high schools, etc.);
- Before January 1, 2023 for the other establishments concerned.

The regulatory actions to be taken are:

- Self-assessment based on the grids from the Ministry of Ecological Transition,
- Evaluation of the means of ventilation,
- Assessment report,
- Implementation of the action plan to correct shortcomings.

## GREECE

To achieve the goal of reducing a building's carbon footprint and total energy costs while also increasing occupant comfort, renovation has to be in line with certain requirements. Insulation has the largest impact on energy efficiency in buildings, and it also has substantial impact on thermal comfort.

**The R-value** (thermal resistance) of insulation is a value that is used to measure how well a specific type of insulation can resist heat flow. The higher the R-value, the more effective the material is at preventing heat transfer. R-value is short for Resistance value. A building designed with high R-value insulation in the walls and roof, and with insulated glass units, will prevent heat from escaping the building during cold weather, and will prevent heat from entering the building during warm or hot weather.

**The U-value** (Thermal transmittance) is the rate of transfer of heat through a structure (which can be a single material or a composite), divided by the difference in temperature across that structure. The units of measurement are W/m²K. The better-insulated a structure is, the lower the U-value will be.



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**The lambda (λ) value**, or k **value** (thermal conductivity**)** is the number of Watts conducted per metre thickness of the material, per degree of temperature difference between one side and the other (W/mK).
The magnitude of energy savings as a result of using thermal insulation vary according to the building type, the climatic conditions at which the building is located as well as the type, thickness, and location of the insulating material used.
According to the updated Greek Regulatory agency for energy efficiency in buildings, its mandatory for new constructions to be in near zero energy building category after 2022. Although there are no renovation standards for old buildings, the National program that finances such actions, set as prerequisite the upgrade of at least 3 energy levels.
Ventilation when applied to deep renovation is still a major concern especially in terms of impact on comfort, costs and applicability. Further technological development is necessary on ventilation products tailored to the renovation market.

Air tightness also remains a major point of concern for deep renovation. Although technologies and procedures for delivering airtight buildings are by now well established, it is difficult to implement them in practice due to a shortage of appropriate skills.
Controls and control technologies are important in renovation, not only to improve the efficiency of building services but also to aid user control of energy performance, predictive maintenance and information on energy behaviour and behavioural change.

## ITALY

The main reasons for the success of concrete, as a building material, have always been its durability and versatility, but lately it has also been considered for its peculiar thermal characteristics. We must not forget that concrete is also a highly resistant, fireproof and acoustically insulating material.
It is the high thermal mass of the concrete that guarantees its ability to store heat, which is, then progressively released to heat the environment during winter days and to cool the environment during summer days, thus stabilizing both the climate and the temperature fluctuations inside the building, ensuring the occupants can live in a more comfortable environment. The high thermal mass can reduce the consumption of energy used for heating between 2 and 15%.
The concrete buildings are also able to provide excellent water tightness and this feature allows guaranteeing a further reduction of energy consumption for heating.
In addition, during the summer, the combination of the thermal mass with natural ventilation and shading of the sunrays can guarantee a reduction of up to 50% of the energy used for cooling a building. Furthermore, the use of alternative materials in the production of concrete or the partial replacement of some can avoid the harmfulness of some components used in the past: use of recycled concrete mixed with natural aggregates or use of alternative materials such as slag, fly ash together with cement.


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A further example of the latest generation of concrete, mainly used in the form of panels, is cellular concrete, also called calcium silicate.
Thanks to its porous structure that allows the masonry to transpire, it is able to determine a high permeability to water vapour, improving the quality of the air indoors.
Its porous surface absorbs moisture especially by capillarity from the masonry in contact and distributes it to the entire structure so as to cause evaporation towards the outside or inside of the premises.
The presence of di-calcium silicate gives excellent resistance to thermal changes.
**Thermal inertia** reduces heat loss in winter and keeps cool in summer.
**Uses and applications**
Calcium silicates are marketed in the format of panels, self-supporting blocks or granules to be applied in bulk. Considering the good insulating properties of the material, it is mainly used in **external insulation coats**. Cellular concrete **panels** can be used in the external insulation of ventilated facades and in the internal insulation of walls, ceilings, false ceilings in order to allow proper diffusion of water vapour.
It is a non-toxic product that does not contain volatile organic compounds, gases, fibbers or radioactive particles. Its high alkalinity and natural bactericidal action due to the presence of lime make it very resistant to mould with a reduction in the development of anaerobes in the internal environment. The absence of soluble salts prevents the formation of efflorescence and the development of pollutants of microbiological nature.
Finally, another example of the latest generation concrete is photo catalytic concrete, which uses a natural process (photo catalysis) to accelerate the oxidation processes and consequently the decomposition of volatile organic compounds. Used in large cities, it should help purify the air and keep the surfaces of buildings clean, preventing pollutants from accumulating and adhering to the walls.

## POLAND

**Construction Law** (Act of July 7, 1994./ recent amendments: February 2021) - the most important Polish act in the field of design, construction, supervision, maintenance and demolition of buildings and rules of operation of public administration bodies in this respect.

It's in accordance with the European Directives related to employee health and safety conditions; health and safety requirements at temporary or mobile construction sites; the energy performance of buildings; the promotion of the use of energy from renewable sources; the promotion of electricity produced from renewable energy sources in the internal electricity market; promoting the use of biofuels or other renewable fuels for transport.


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The Act also regulates matters related to:

- Environmental protection during activities related to demolition, erection of new facilities and their maintenance
- The place of execution of the investment and the manner of obtaining a building and demolition permit, as well as determination of the types of construction works and construction which do not require a building permit
- Commissioning of buildings for use
- Professional activity of persons involved in construction (qualifications to perform independent functions in construction, the so-called building permits) and their criminal and professional liability
- Rights and obligations of participants in the construction process
- Procedures in the event of a construction disaster.

The **new standards** became effective for the building industry on **January 1, 2021**. Old buildings to be expanded and modernized after December 31, 2020, will be brought into compliance with the new requirements.

The promotion of energy-efficient construction in European Union countries was initiated by a document from 2002, containing practical ways and principles of action in this direction. In 2010, the Directive of the European Parliament on the energy performance of buildings appeared. It standardized ways of calculating the energy performance of a building and introduced sanctions for violations.
Member states of the European Union have been obliged to amend their national regulations so that the constructed and modernized buildings meet minimum energy performance standards. The goal, however, is to achieve a state of zero energy consumption.
Stringent building regulations are a consequence of the pro-ecological policy of the European Union and the adoption of three standard postulates, known as the 3 x 20 climate law package:

1. Reduction of energy consumption by 20%
2. Reduction of carbon dioxide emissions by 20%
3. Increase in renewable energy production by 20%

**Changes to the building law in 2021**
The changes coming into effect as WT 2021 or Energy Standard 2021, address three areas:
1. Reduction of thermal conductivity of structural elements
2. Reducing energy demand in buildings
3. Modernisation of heating systems


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