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GRINSCO
GREEN INSULATION SKILLS FOR CONSTRUCTION WORKERS

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# LEARNING UNIT 4: SUSTAINABILITY GOALS AND CONSIDERATIONS, TRANSVERSAL SKILLS, COMMUNICATION, EMPLOYMENT OPPORTUNITIES, PROFESSIONAL

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# LU4 Texts Lecture notes

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# 1 Know the concept of circular economy

The circular economy is about producing goods and services in a sustainable way by limiting the consumption and waste of resources and the production of waste. It is about moving from a disposable society to a more circular economic model. *(Excerpt from the website of the Ministry of Energy Transition, fr)*

## 1.1 The circular economy: fundamental principles

Preserving resources, our environment, our health, allowing the economic and industrial development of territories, reducing waste and waste are the fundamental principles of the circular economy. The circular economy is an economic model that aims to meet these challenges. It aims to move from a disposable society, based on a linear economy (extract, manufacture, consume, throw away) to a more circular economic model.

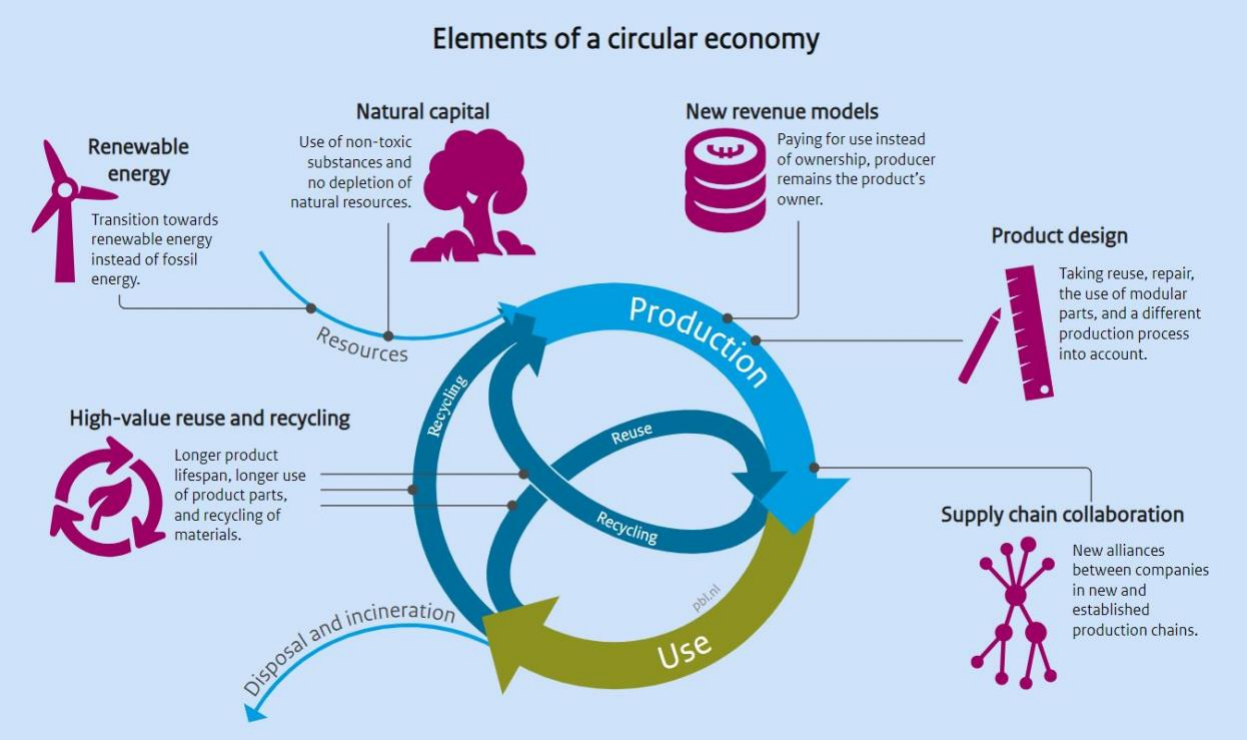
New production and consumption models linked to the circular economy can generate sustainable and non-relocatable activities and job creation.

The circular economy is part of the field of the green economy. The challenges of the circular economy are environmental, economic and social.

The transition to a circular economy is officially recognized as one of the objectives of the energy and ecological transition and as one of the commitments of sustainable development.

It requires progress in several areas.

- **Sustainable sourcing**: take into account the environmental and social impacts of the resources used, especially those associated with their extraction and exploitation.
- **Ecodesign**: taking into account environmental impacts over the entire life cycle of a product and integrating them from its design.
- **Industrial and territorial ecology**: synergizing and pooling, between several economic actors, the flows of materials, energy, water, infrastructure, goods or services in order to optimize the use of resources in a territory.
- **The functional economy**: favoring use over possession, selling a service rather than a good.
- **Responsible consumption** : taking into account environmental and social impacts at all stages of the product's life cycle in purchasing choices, whether the buyer is public or private.
- **Extending the useful life of products:** use of repair, sale or purchase of second-hand, by donation, as part of reuse and reuse.
- **Improving waste prevention, management** and **recycling**: reinjecting and reusing waste materials in the economic cycle.




## 1.1 The circular economy in the history of the Building industry

**Ancient periods**

Even if the expression "circular economy" dates from the seventies, the concept has existed for a long time in construction as in all human activities.
Archaeological research shows us that the first constructions are made of local materials (wood, earth, stone) except for exceptional constructions where Man has sometimes traveled a few hundred kilometers to have building materials of very good technical, aesthetic or symbolic qualities.

**The Middle Ages**

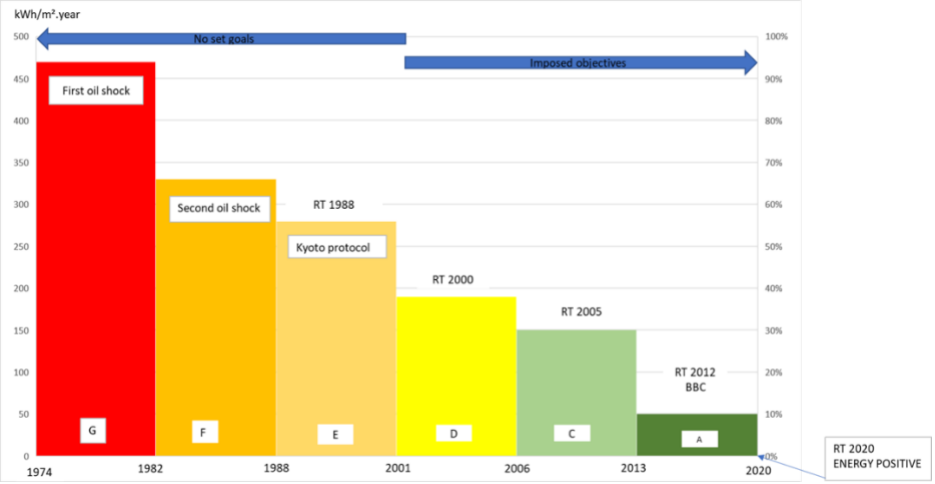
But the raw material is not infinite, and certain periods have forced society to adapt.
The example of the passage from Romanesque art to Gothic art (XII, XIIIth century) described by Roland Bechman in his book "The roots of cathedrals" where we can find similarities with the current period. Increase in population, explosion of construction, lack of mineral and vegetable materials forced the builders of the time to move towards new construction systems such as the pointed arch to save the quantities of stone, or the light frame (ancestor of the current farmhouse) to compensate for the lack of wood of large section. This period was also very rich in inventions and technological designs.
This period of transition lasted (certainly several generations) the time to accept to build

differently, to organize differently economically and socially.

**The industrial period**

Before the mid-nineteenth century, consumption was local, minimalist in vernacular construction and everything was a pretext for recycling. Industrialization and the development of means of transport have made it possible to produce more, and therefore to consume more. This runaway exchange and consumption of environmental wealth around the world has crowded out the circular economy over time, until we realized that our environment was not inexhaustible.

In 1974 a first world energy crisis warned of waste, excessive and unequal consumption in the world.




*Evolution of thermal regulations*

The reaction will be to force energy saving, one of the most polluting sectors, through thermal regulations to reduce primary energy consumption and, little by little, depollute buildings.
In 2022, energy regulations are put in place strengthening the requirements for insulation while considering the life cycle of materials and thus moving towards a more advanced circular economy for the building.
See the link: https://www.ecologie.gouv.fr/reglementation-environnementale-re2020.

## 1.2 The current context

These various energy crises, the shortage of raw materials, international conflicts, the disappearance of our biodiversity, the growing imbalance of our environment are pushing us towards a radical change in our society.

It was not until 2012 that the need and necessity of the circular economy was officially formalized. Today we no longer count the number of projects emerging around this economy such as "Third Places", cooperative workshops, coffee clubs, the multiplication of second-hand sales, repairs etc.,

so many initiatives that were difficult to emerge at the end of the seventies and that are multiplying today.

We are also seeing the development of the revalorization of local materials such as linen and hemp, whose insulating qualities are being rediscovered for use in the building industry in addition to textiles and car bodies or boat hulls or other such as the integration of old tires into road surfaces or phonic concrete walls, the use of fishery waste, scallops or oyster shells used for the manufacture of composite materials.
For the building trades in France, the revolution is in the fact of building more in plant (wood, hemp, straw) than mineral (sand, gravel, cement and stone which become materials in danger of disappearing or extraction more and more difficult)
For example, the Normandy Region in France is rich in its geographical and geological location and allows to produce in biodiversity from a mineral, plant and animal resources point of view. Let us know how to use the resources of our regions but also preserve them.
More and more participatory projects are carried out locally and often have the interest of empowering buyers or owners, working as much as possible with local materials, thus changing the behavior of craftsmen and consumers.

## Activity - Exercise to integrate the concept of circular economy.

Make the comparison between two insulators of a house by searching known databases for circular development criteria (For example, INIES for materials or the referencing of bio-based materials in Normandy, accessible on the "ARPE" website):

- Sustainable procurement.
- Ecodesign.
- Industrial and territorial ecology.
- The economy of functionality.
- Responsible consumption.
- Extending the service life.
- Improving waste prevention, management and recycling.

**Perhaps we need to create an easy-to-use comparison grid for the exercise?**

The comparison could be made between the choice of wood wool insulation, compared to hemp earth insulation for example.

**The same exercise can be done with any consumer product: clothes, food etc ...**

# 2 Highlight the benefits of ecological products, communicate effectively with the owner, the master builder and other professionals involved in the implementation of green insulation

## 2.1 Definition of an environmentally friendly product

We could summarize the definition of an ecological product by the fact that it comes from an operating chain, as respectful as possible for humans and their environment, knowing that the two are of course inseparable.

This means that the product is as sober as possible from the beginning to the end of its life: use of basic natural products, a minimum processed, a minimum transported, a maximum used, which can be repaired at most and ending up in compostable, biodegradable in the short term or recyclable.

Examples of ecological products for the insulation of a building: hemp wool, wood wool which are basic natural products, but also recycled textiles or cellulose wadding for recycled paper.

## 2.2 Know the resources of ecological products

To communicate about green products, it is important to know the resources available, accessible to entrepreneurs and usable in accordance with local customs and laws, but it is also important to know the history.

For history, accessibility to raw materials is always linked to construction.

The first constructions (except (rock shelters) were made of plant and animal matter. The shelters of Neanderthals and the first Cro-Magnon are made with wood (tree branches) and animal skins from hunting. This habitat design lasted a very long time and still exists.
From the Neolithic to the Gallic period, in northern Europe, the constructions were largely made of wood and earth (cob, cob), with the exception of some common monuments made of stone (covered alleys, paving etc.).
Southern Europe and the countries of the Middle East already mastered stone construction quarried and worked (pyramids, Greek temples, Roman construction etc.)

The Roman conquest spread, in a part of Europe, the techniques of construction in stone, brick, concrete and some techniques still considered current as underfloor heating (hypocaust) or wall heating.

The collapse of this empire will make our regions return to construction based on wood and earth, easier to extract and transform. Stone constructions will often be carried out with the recovery of ancient Roman buildings.

The Middle Ages, especially after the year one thousand, will see the birth of a great impetus of construction in stone, for the walls, in wood for the frames, is in earth for the vernacular.
For several centuries Europe will extract gigantic quantities of stone, but also cut quantities of wood such that there will be shortages of materials and that it will be necessary to invent new techniques to save the raw material (invention of the pointed arch and the farmhouse for the frame for example).

In the nineteenth century, industrialization and technical discoveries will contribute to the extraction of natural resources and their large-scale transformation. It's time for steel, then concrete for construction.
The generalization of transport will disrupt our lifestyles and construction will also accelerate the extraction of raw materials, the processing of products and with pollution.

Slowed down by wars, this race for extraction, processing and excessive consumption will start again after the Second World War. Processed products will virtually wipe raw products out of our consumption until our environment reminds us that we live in a limited world.

It was first an energy crisis in 1974 that alerted us to our limits and then the raw materials crisis from 1974 to today.
Construction which, for decades, has mainly used minerals (sand, rock, iron ore, copper, aluminum, coal, oil etc.) must make a reason and begins to turn to plants, more interesting for its renewal, carbon storage and end of life less destructive for humans.

Since 1974, the building has adopted laws such as the Thermal Regulations for France, which are increasingly reasonable from an energy point of view but also from an ecological point of view.

## 2.3 Know the qualities of these resources

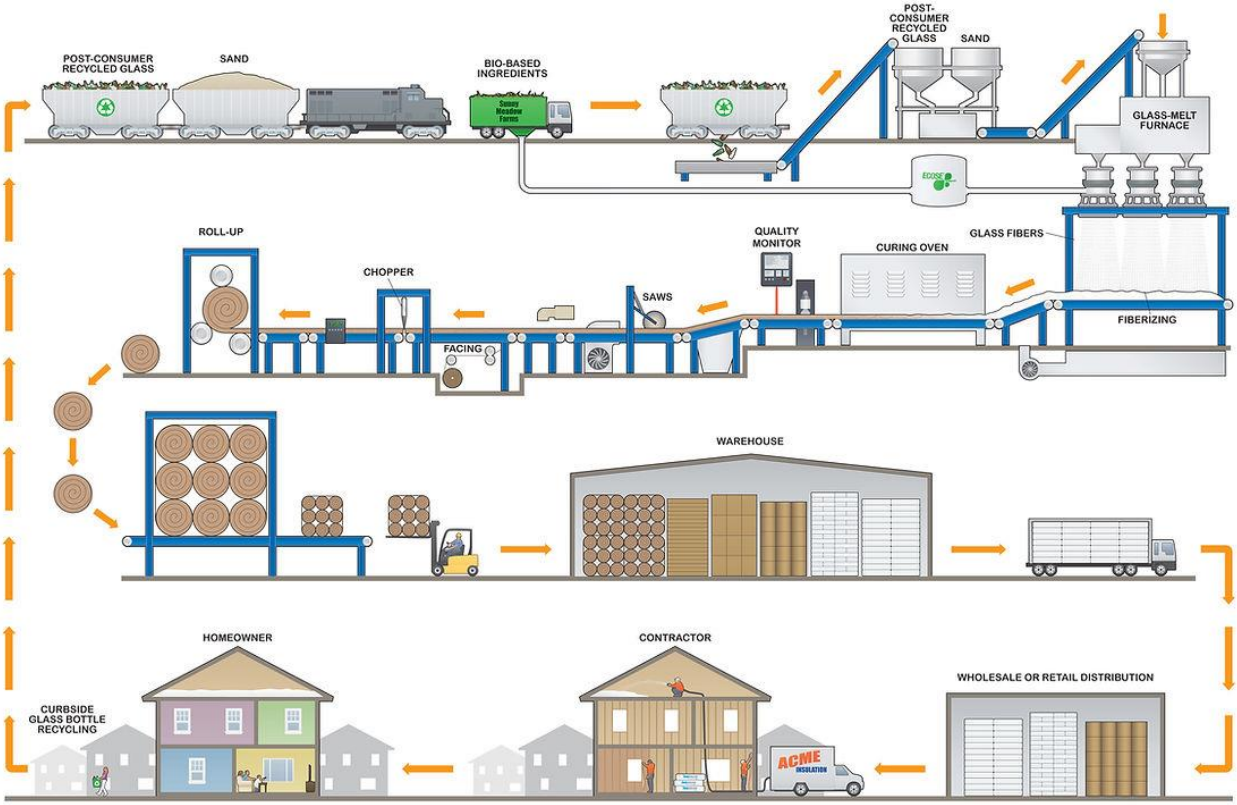
### 2.3.1 Available resources

History shows us that we can use several types of resources for insulation:

- **Mineral resources:** from the (underground) extraction of non-renewable products such as sand, rocks (limestone, volcanic and others), oil.

They are used to manufacture insulation such as glass wool, rock wool, cement, lime, plaster, clay as a binder.

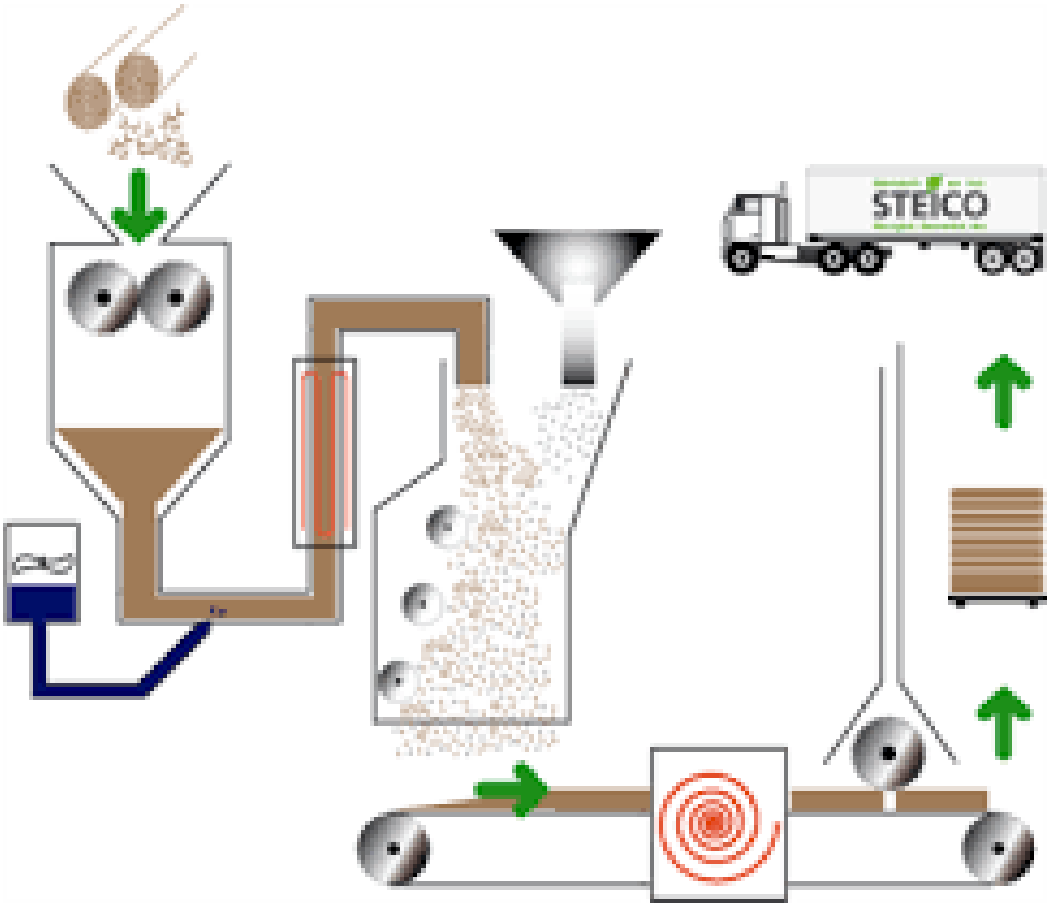
*Example of a glass wool production operating line*
*This diagram shows that the transformation of this type of insulation is energy-intensive. On these products, it is also necessary to take into account the energy required for the extraction, processing and transport of basic products such as sand, borax, dolomite, soda ash and glass.*



- **Petrochemical resources**: from the processing of petroleum products such as expanded or extruded polystyrene, or polyurethane foam.

- **Plant resources**: from aerial extraction of renewable products such as wood, flax, hemp, straw, reed etc ... They are used to make insulation such as wood wool, hemp wool, straw, flax/hemp felt.

*Example of the operating chain for the manufacture of wood fibre insulation*



- **Animal resources** : from renewable livestock products such as sheep's wool, duck feather and hair.

*Example sheep's wool insulation*

- **Recycling resources** : from various recoveries of our waste such as glass bottles, paper, old fabrics, corks.

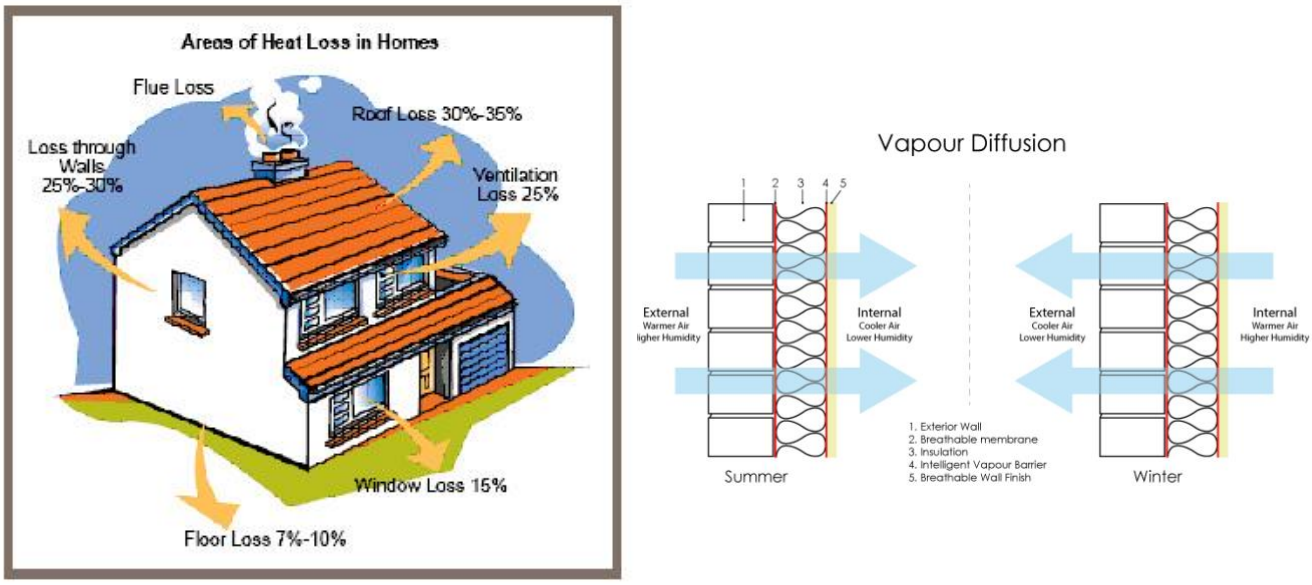
They are used to make glass wool (only partially), cellulose wadding, mestizo etc ...

*Example of the operating chain of the manufacture of mestizo*
https://www.youtube.com/watch?v=JNuAo4gNolg

### 2.3.2 The qualities for the walls of tomorrow

A few years ago (1980, 1990), in a classical apprenticeship it was explained to the future builder that a house was above all a story of structural solidity and that eventually it could be interesting to think about making insulation, but the crisis has worsened and supports less and less the expectation of change, which means that today the builder is asked to structure an insulation, This completely changes the profession and the organization of it, as well as all its sectors.

Insulation is becoming a priority today in construction to save energy and lower the costs of a home. And to properly insulate, it is already necessary to know which parts of a construction are the most vulnerable for heat loss.




*Heat loss on a conventional building.*

These losses can obviously vary according to the type of building, materials, quantity of bays, orientation and other parameters but the proportions of losses remain realistic.
What this diagram says is that roof insulation is a priority if you want to save money, as well as walls and good management of air renewal whether mechanical or not.
Then you have to take care of the bays (doors and windows) then the low floor and thermal bridges.

### 2.3.3 Isolate how?

There are several insulation techniques that can be classified into four categories:

- **Exterior insulation**: an effective technique that eliminates many thermal bridges*, eliminates dew point problems* inside the house and takes advantage of the inertia* capacity of building materials.

  *Thermal bridges: break in insulation due to a floor, balcony, duct passages or others.
  *Dew point : meeting point between hot air and cold air that will cause moisture in the form of water, for example between the insulation and the wall in the case of interior insulation at certain times of the year.
  *Inertia : property of a material to be stored and restored heat over time. Soil or concrete have good inertia for example.

This technique has the following disadvantages:

- to be often more expensive because the company will need scaffolding, in most cases, for the installation of insulation,
- to change the aesthetics of the buildings and therefore difficult to achieve for the built

heritage whose external appearance is to be preserved,

- to be outdoors and therefore subject to bad weather and the risk of more frequent accidents (shocks due to vehicles, children's games etc ...), which can lead to pollution if the materials are petrochemical-based such as polystyrene or materials that are difficult to recycle such as glass wool.

Despite these drawbacks, it remains a very effective and ecological technique if green materials such as wood particleboard or hemp lime blocks are used.

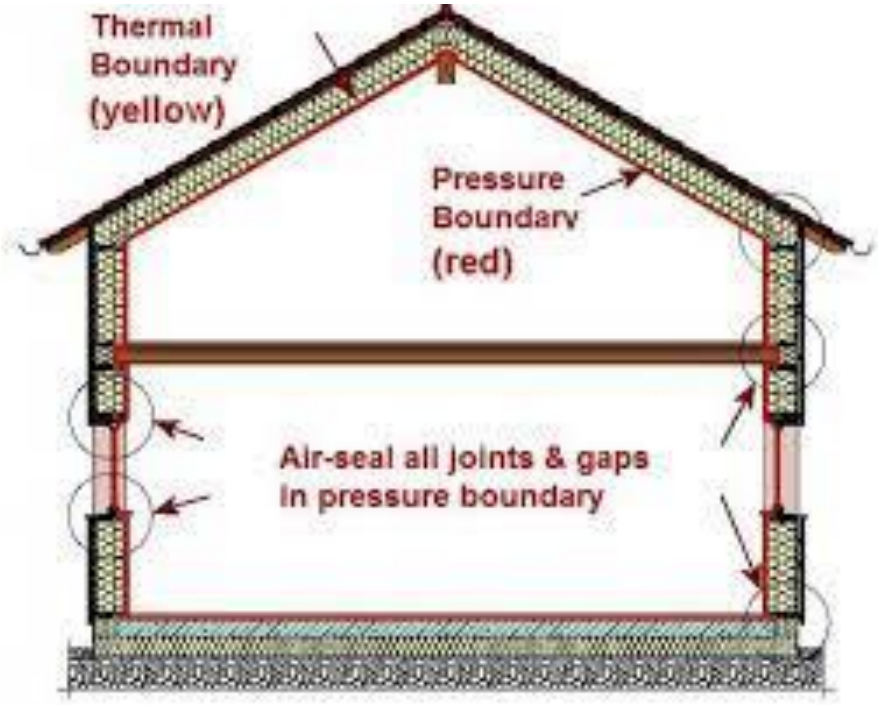



*Diagram explaining insulation from the inside in comparison with insulation from the outside.*

- **Interior insulation:** the most common in much of Europe, perhaps because for several centuries we had become accustomed to insulating our homes with interior comfort coatings with dyes, paints (some colors heat or cool) or by incorporating plant fibers (linen, straw, reeds).

This insulation technique has the advantage,

- to be easy to implement (no need for scaffolding to insulate all floors),
- to be protected from bad weather and occasional accidents,
- to be easy to maintain if there are repairs to be made.

But it also has major disadvantages such as:

- to be a source for dew points that requires great professionalism to remedy them correctly and find a suitable and sustainable solution by slowing down or blocking water vapour with membranes,

- to take up space inside the house,
- having to leave the premises during the work,
- to have a good management of the passage of fluids (water, electricity etc ...) and the facilities on the walls of the inhabitants.

- **Distributed insulation:** this is insulation that is distributed over the width of the load-bearing wall. It is an integral part of the wall.

This is a very good solution for new homes. This solution avoids additional insulation work, thus saving time in construction.
This solution allows a good airtightness and causes very few thermal bridges.
The best known are the houses made of aerated concrete, hollow bricks "monomur", pumice stone.

*Insulating brick*

*Aerated concrete*

- **Sandwich insulation:** the principle is to have insulation caught between two sidings. This insulation is now commonly used for roofs, sometimes for floors.

*OSB-rock wool panel*

*This type of panels has existed for several decades, some of which were made with straw in the 70s.*

### 2.3.4 So what is a good wall today?

- **It is a wall that prevents heat from coming out to the outside in winter and limits indoor heat in summer.**

To help differentiate between insulators, it is necessary to look at its thermal coefficient (thermal conductivity) lambda **λ** which is expressed in Watt/Meter.degrees Kelvin. The weaker it is, the more insulating the material will be.
For a wall, we look at its thermal resistance **R** = thickness of the material divided by lambda which must be as high as possible.
Or we look at its heat transfer coefficient which is 1divided by **R.** The smaller it is, the more effective the insulation.

- **It is a wall that prevents air from leaving or entering to be better controlled.**

Today any new house must be checked on its airtightness which is measured in cubic meters of air escaping from the building per hour and per square meter. The standard is 0.6 for RT 2012 and 0.16 for passive house.

- **It is a wall that lets water vapor pass if you do not want it to mold**

The measurement is the coefficient of resistance to water vapour diffusion: the μ factor
The reference is the μ factor of the air which is 1.
There is no ideal coefficient, it is to be seen according to the wall.
On the other hand, for a good migration in a wall, the μ factor must be smaller and smaller from the inside to the outside of the wall, 5 times smaller.

- **It is a non-toxic wall for the health of the inhabitants but also of craftsmen and manufacturers**

It is important to look at the product sheet when it exists. In principle, unprocessed or minimally processed natural products are not dangerous but precautions must still be taken for implementation.

- **It is a wall that does not endanger the inhabitants in case of fire**

In France, there is a classification, consisting of 6 categories, that defines the reaction to fire of materials.
This classification is recognizable by the letter M, followed by a number indicating the performance of the product:
• M0, "non-combustible";
• M1, "non-flammable";
• M2, "hardly flammable";
• M3, "moderately flammable";
• M4, "highly flammable";
• M5, "very readily flammable".

For CE marked products that must meet European harmonized standards, the Euroclass classification replaces the previous one.

For construction products, the classifications are:
• A1, A2, B, C, D, E, F;
• S1, S2, S3 (for fumes);
• D0, D1, D2 (flaming droplets and debris).

| FIRE CLASSIFICATION STANDARDS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Classification French Standard NF | | Classification European Standard Euroclasses: NF EN 13501-1 | | | | | |
| | | | | s = smoke : Smoke production | | d = drop : Chute de gouttes et de débris | |
| - | - | A1 | Incombustible | - | - | - | - |
| M0 | Non-combustible materials | A2 | Virtually Incombustible | S1 | Low smoke production | D0 | No flaming droplets or particles |
| M1 | Non-flammable combustible materials | A2 | Virtually Incombustible | S1 | Low smoke production | D1 | Droplets or flaming particles persisting for less than 10 seconds |
| | | A2 | | S2 | Average production of smoke | D0 | No flaming droplets or particles |
| | | A2 | | S3 | Significant smoke production | D1 | Droplets or flaming particles persisting for less than 10 seconds |
| | | B | Resists prolonged attack by flames or an isolated object while limiting the spread of the flame | S1 | Low smoke production | D0 | No flaming droplets or particles |
| | | | | S2 | Average production of smoke | D1 | Droplets or flaming particles persisting for less than 10 seconds |
| | | | | S3 | Significant smoke production | | |
| M2 | Flammable materials with low flammability | C | Withstands a brief attack of flames or a single fiery object while limiting the spread of the flame | S1 | Low smoke production | D0 | No flaming droplets or particles |
| | | | | S2 | Average production of smoke | D1 | Droplets or flaming particles persisting for less than 10 seconds |
| | | | | S3 | Significant smoke production | | |
| M3 | Medium flammable combustible materials | D | Withstands a brief attack of small flames while limiting the spread of flame and an isolated arden object | S1 | Low smoke production | D0 | No flaming droplets or particles |
| M4 (not dripping) | Combustible materials Highly flammable | D | Resists a brief attack of small flames while limiting the spread of the flame and a fiery isolated object | S2 | Average production of smoke | D1 | Droplets or flaming particles persisting for less than 10 seconds |
| | | D | | S3 | Significant smoke production | | |
| M4 | Combustible materials Highly flammable | E | Resists a small flaming attack by limiting the spread of the flame | | | D2 | Droplets or flaming particles persisting for more than 10 seconds |
| | | F | No performance determined | | | | |

*Fire classification standards*

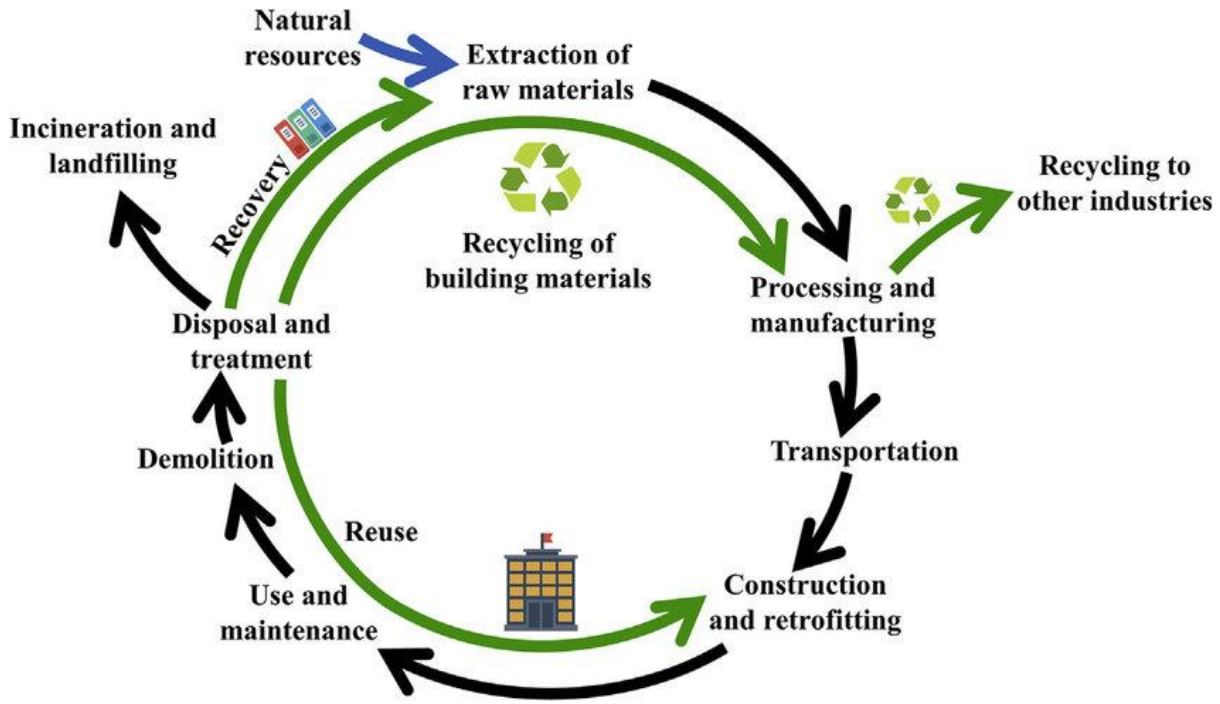
- **It is a wall that will end its life to compost, which will degrade easily without harming humans and therefore the environment, it is a wall that in the worst case can be recycled**

Natural products with little or no processing are very easy to recycle, while processed products containing a multitude of other products are often recyclable at the cost of a lot of effort and therefore little recycled for the moment.

- **It is a wall that will be built requiring a minimum of energy**

As a general rule, raw and local plant or animal insulation is the best on this ground.
We must look at the life cycle of materials when possible.

Example of a material life cycle (LCA)




**Activity - Instruction for a group exercise of two or 3 people.**

With equal constructive qualities, offer 3 insulation solutions (one per group), one of plant origin, one of animal origin, one of origin of recovery, in a specific context: region, type of building, possible participation or not of the customer, existence of local resources etc ...
Argue your choice to the other groups by taking into account the life cycle of the material, theconstructive qualities and their virtuous implementation for humans.
Use simple and effective diagrams to explain to the owner.

Then all groups will choose only one solution out of the three and give the reasons for their choice.

**Activity - Being able to assess their interests in a context.**

Realization of an exercise: a limestone wall and several materials available with data and software.

**Activity - To be able to communicate and exchange on the interests of an ecological product.**
Scenario

# 3 Understand the ethics of a construction professional and act accordingly on a daily basis in the workplace

## 3.1 What is ethics?

In the dictionary, ethics is what concerns morality.
The Building does not derogate from a professional ethic, on the contrary there is a long tradition of ethics in the construction trades.

For the proper functioning of the construction, we need rules,

- to be able to work together with coordination and trust,
- to respect customers and their environment,
- to respect the health and safety of workers,
- to avoid or resolve conflicts.

## 3.2 Is ethics in construction recent?

This ethic in construction is not recent, even if we do not have much writing on this subject. Ancient architectural treatises prove to us that there are rules on construction, **material, social and aesthetic.**
These three points of view have regularly been questioned, reorganized and consolidated.
There is a rulebook known as the "régius" dating back to 1390, in English, which may be a transcription of older texts that served as a framework for European builders.

*Excerpt from Regis, 1390:*
"*Point eleven, in great wisdom,*
*said to the mason, when he appears*
*than to the companion, of little address,*
*lacks the advice of a master expert,*
*to guide him in his work.*
*To better cut your tool*
*teach it to perfect use,*
*making better use of the bloc,*
*"Show him how to go about it, be charitable in your advice,*
*By God, if He knows how to understand You,*
*Deliver your art to its awakening.*

Other points explain how to settle conflicts on a construction site or what are the mandatory subjects for the apprenticeship of a good mason.
We can only advise the reading of ancient works advocating the "Rules of Art*" such as the books of Vitruvius, Palladio, Delormes, or Blondel. There are also Greek and Polish works to enrich and*

*master the basics of today's construction. The "Rules of the Art" have served as an ethic in building for centuries through treaties and apprenticeship.*
*In 1958, a DTU (document of unified techniques) was set up in France in order to better guarantee the work of construction companies. This DTU will become in 1993 a reference for French standards.*
*But the "Rules of the Art" remains a reference for old buildings before 1958.*

## 3.3 And today?

Ethics is still there, constant, with tools evolving to assert it, adapt it to our current needs and the constraints of our society.
Professional ethics is oriented in three directions,

- **material** (technical) ethics,
- **social** ethics,
- **aesthetic ethics.**

The building trades have created and are producing tools (rules) to communicate and respect this ethic.

### 3.3.1 Material ethics

For several decades, material ethics has focused on quality, quality of techniques governed by the DTU and the "Rules of the art", quality of tradesmen by titles such as best "worker of France" or part of an association recognized as "the companions of duty" but also the quality of materials by their provenance and reputation.
Since the 1990s, the energy crisis, the evolution of society, the multiplication of trades involved in construction require a significant evolution of the tools for verifying and controlling the proper functioning of the profession.

#### *3.3.1.1 For materials*

There is certification "under state control" such as the **ACERMI** marking (for insulators) which is the **association**for the **certification**of insulating materials. Since 1984 it has been supporting insulation innovation in a neutral and independent way. It validates the characteristics of thermal insulation in the factory and laboratory.
There is also NF or cstBat for certifications.

**The "CE" marking** which makes it possible to say that the product complies with European obligations and can circulate freely in Europe.


At European level, there is the **ETE** (European Technical Assessment) to validate the performance of construction products.

**Label Nature Plus** is an internationally recognised German label that guarantees the sustainable and ecological aspect of building materials.

The **FSC Label (f**orest **s**tewardship **c**ouncil) allows builders to use wood from responsibly managed forests.

**PEFC label** for products from certified forests.

#### *3.3.1.2 For implementation*

For implementation in a professional ethic, there are,

- **Training:**

Diploma courses, certified by the state such as CAP or BP or bac pro.

Qualifying training that does not give the right to a state diploma but to professional recognition as "pro-straw".

Training with certification that proves that you have been trained in a particular technique.

T he training labeled as RGE (recognized guarantor of the environment), qualibat, FEEBAT renovate, or Praxibat, for specialists in the implementation of insulators.

European ECVET training courses such as "Earth Building" or several EU countries decide to build a common training path with a common professional ethic.

- **Standards:**

The rules set out in the DTU for all Buildings built before 1958

The Eurocodes are being set up for the Union only for the implementation of the structure of the built environment for the moment.

- **The rules of the art:**

Old uses and techniques that will still be applied for old buildings

#### *3.3.1.3 For the frame*

As for materials or implementation, the building will benefit from a guarantee of quality construction on the one hand by the **RE 2020** law (environmental regulations, *https://www.ecologie.gouv.fr/reglementation-environnementale-re2020*) which follows the RT (thermal regulations) of 1974 for the first to the RT2012 for the one before the RE, obliging a minimum result for all constructions, with results in terms of economy, primary energy and respect for the environment.

Thus will be born voluntary labels such as **BBC** (low energy building)

The **HQE** label (high environmental quality)

The **BBCA** label (low-carbon building) or the Bio-based Building label created by the public authorities and set up by the decree of 19 December 2012 to develop the use of bio-based materials in construction.

### 3.3.2 Social ethics

- To solve the problems of social conflicts, between craftsmen and customers, between craftsmen and the State, between craftsmen and journeymen (in the sense of the building worker),
- To ensure the safety and hygiene of people,
- To respect individual rights, equity and parity,
- To combat illegal work,
- To respect the environment.

Professional society has long since reflected and found codes for a social ethic adapted to its time and its legitimate demands.

In the Middle Ages, candle work (in the dark... under the table) was not recommended except for apprenticeship. Conflicts on construction sites were managed by a third party (neutral). Instructions warned against an unhealthy lifestyle, respect for others and hierarchy were not an option and the trades were very organized in corporations to defend the right of each person and the profession.

Women were more likely to work on construction sites than today if we explore the books of site accounts (example: "the construction sites in Normandy in the 16th century") or if we observe the iconography of the Middle Ages.

The industrial era of the nineteenth century changed social codes, often to the detriment of man and his environment. The current context of environmental crisis forces us to reorganize our social codes in the professions, with existing tools such as,

- Professional organizations such as the CAPEB (Chamber of Small Building Enterprises) or the FFB (French Building Federation) make it possible to represent the professions at national level and to help companies in certain conflicts,
- associations, groups or cooperatives, make it possible to support and accompany companies in the management and organization of the company,
- schools and learning centers to learn hygiene, safety and waste sorting in addition to the technical part.

States put in place laws to respect the right of the individual (collective agreement), equality, parity and safety and health obligations (labour inspection), the right to lifelong learning.

### 3.3.3 Aesthetic ethics

The aesthetic value may seem interesting in view of current environmental issues, however it must be taken into account that we have an important heritage to preserve and transmit whose aesthetics of construction and architectural thought must be preserved.

The Venice Charter allows to be guided in this ethic, but also the fact of teaching future builders the history of construction and developing their sense of observation will facilitate a constructive transition in respect of the environment and heritage.

# 4 Highlight the benefits of green materials

## 4.1 Definition of a green material

It is not easy to give a common and fixed definition of a green material,

- Are we talking about bio-based materials? These materials are made from renewable plant and animal organic materials, such as straw, hemp, flax, sheep's wool. etc.... https://www.ecologie.gouv.fr/materiaux-construction-biosources-et-geosources

- Are we talking about natural materials such as geo-based materials such as earth, stone which are minimally processed and reusable materials?

- Are we talking about highly processed materials but recycled to become a resource material, to save energy such as recycled fabrics by insulation, reusable woodworking scraps for wood fiber insulation?

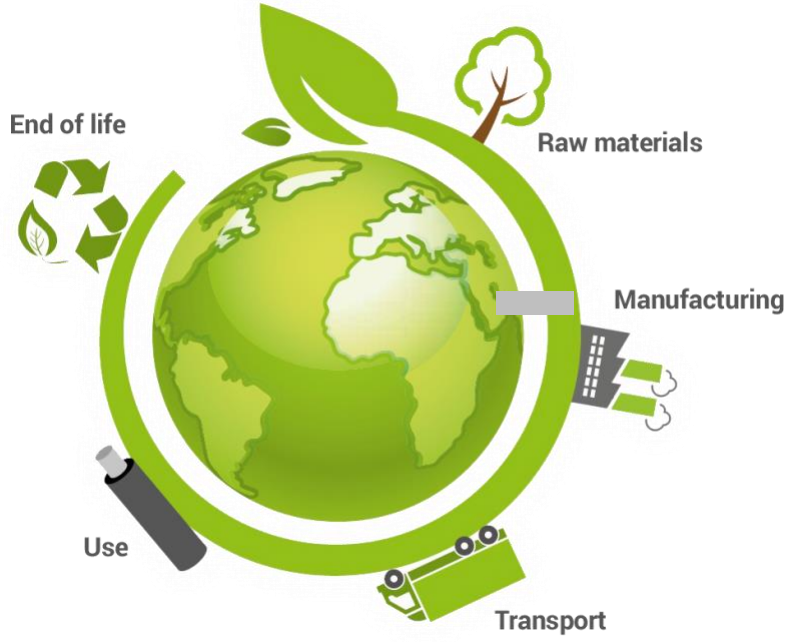
- Are we talking about materials with very high insulation performance but having a disastrous energy balance and although said "removable", are very little so in reality, because of their complexity of manufacture and transformation at the end of life such as polyurethanes, and polystyrene?

What we can propose is to **focus on several criteria** to make the greenest possible choice for the insulation to be put in place in a given context.

## 4.2 The 2 essential criteria for choosing green insulation

### 4.2.1 The embodied energy of the material

The embodied energy of the material is the amount of energy consumed during the life cycle of the material from extraction to recycling.




The unit of this embodied energy is the joule (unit of energy) per quantity of matter (square meter or cubic meter).

**Example: Grey energy for hemp wool** infused by the company "écopertica" according to a study made by Arpe and the Normandy Regional Council in 2020: 15 MJ/m3 so 15 megajoules for 1 cubic meter of hemp wool.

*Comparative table of different materials in embodied energy consumption*

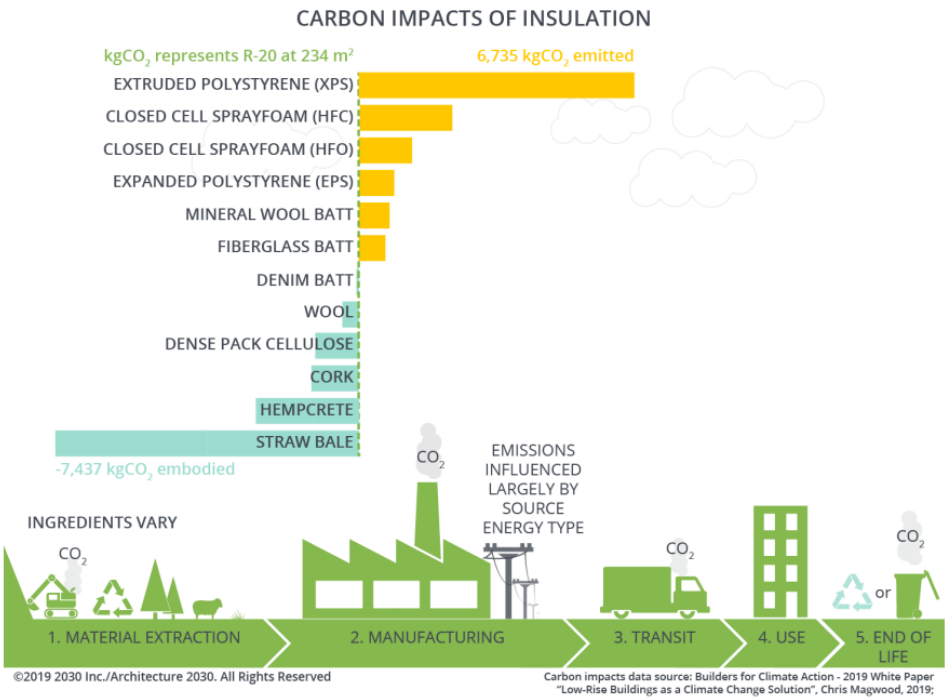



Figure 2. Carbon impact of insulation

Source: Architecture 2030. https://materialspalette.org/insulation

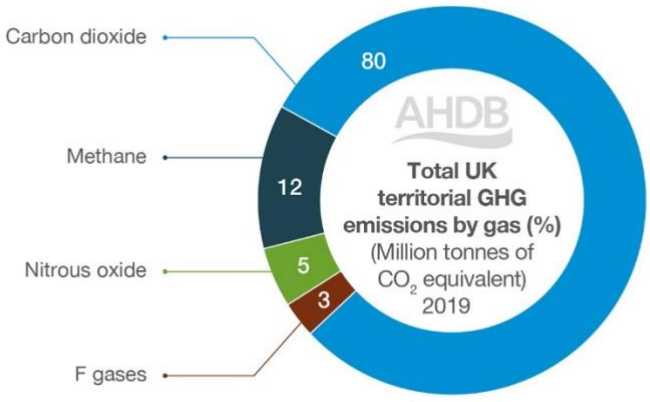
### 4.2.2 Greenhouse gas (GHG) emissions

The unit is CO2eq/kg: carbon equivalent of CO2 (carbon dioxide) per kilogram.

The greenhouse gases that contribute to global warming are numerous, there are carbon dioxide, methane, chlorofluorocarbons (CFCs), hydrochlorofluocarbons, ozone, nitrous oxide, hexafluoride, from human consumption.

For more understanding, carbon dioxide is used as a standard for comparing materials.
***Example***: 1 kilogram of CO2 contains 273 grams of carbon while 1 kg of methane contains the equivalent of 6.82 kg of carbon.

To use the same **example** as for embodied energy,
The GHG emission for hemp wool instilled by the company "écopertica" according to a study made by Arpe and the Normandy Regional Council in 2020: GHG emissions: -7 kg CO2eq/kg
The – is due to the fact that hemp retains carbon, which has a positive effect on the greenhouse effect.




*Comparative of different greenhouse gases*

Link to know the environmental balance of bio-based materials in Normandy:
https://drive.google.com/file/d/1cxIwEDwpWhoW9Ypw7EzAHgVL7iWRAFEi/view

## 4.3 Should we look at other criteria?

The two criteria detailed above for **an environmental assessment** are essential to the understanding and choice of insulation but often poorly informed by manufacturers, especially for processed materials because they are difficult to inform and difficult to sell. Knowing the environmental balance of polystyrene insulation is a difficult task for both the customer and the manufacturer.

## Activity - Find the environmental balance of a minimally processed insulation such as wood wool and a highly processed insulation such as "extruded polystyrene"

**Other criteria are also essential,**

- **The cost**

Many customer choices are made on the least cost, which facilitates the use of industrial products already on the market, less demanding of labor and know-how and more easily accessible today. These standard products are uniform on a European or even global scale and have the unfortunate ability to deplete our resources or the resources of countries that sometimes do not have access to finished materials.
Insulation products with high environmental values often have a higher cost because they require more work for implementation and the sectors are less organized.
In recent years, the plant sectors have developed strongly (hemp, flax, straw, etc.) and have obtained their labels and qualifications, making them materials of the future.
In addition, the use of these materials contributes to the diversity of materials that can be used on the insulation market and empowers populations when they are extracted and processed locally.
To offset costs, participatory craftsmanship is developing and allows customers and/or a community to participate in the construction site. These new markets make it possible to empower populations and reduce costs, to compete with industrial products and to develop new processes.

- **Technical efficiency: thermal, phonic, water**...

The choice of insulation must be made according to the result that is technically desired and insulators whether green or not all have their effectiveness.
It must still be taken into account that natural insulation is more suitable for building restoration and certain renovations.
For example, insulating an earthen wall with a material such as rock wool or polystyrene is recognized as an aberration by building professionals today.

- **Maintenance**

Whether green or not, all buildings need regular maintenance because all buildings are subject to wear and tear related to weather and use.
For local natural insulation that is not very processed, it will always be easier to make repairs with little means and without impact on the environment.
**For example,** repairing a plaster with earth-sand or lime-sand mortar on an exterior façade, replacing a little hemp wool that has taken moisture in an attic, are within everyone's reach. The

waste will not have a significant impact on the environment, unlike repair with plaster on polystyrene insulation or replacement of glass wool damaged by moisture.
It must also be remembered that there is no more damage to natural insulation than to insulation such as polystyrene due to rodents.

- **Impact on health**

The balance sheet is unequivocal for natural materials that do not present a danger to the inhabitant, few dangers for implementation, and no danger when they are reprocessed.

The balance is more delicate for insulators such as glass wool, polystyrene or polyurethane foam, especially in case of fire, or during implementation, and reprocessing.

- **Sustainability**

Natural materials die hard contrary to popular belief, an earthen house if it is well maintained and properly realized can last several generations and its materials can be reused from one generation to the next.
Straw houses can also age with their inhabitants without problems.

**Reflection for a debate - Should we build for future generations knowing that they will deconstruct to rebuild in their own image and according to their own needs?**
**An essential question that builders have been asking themselves for several centuries.**

- **Social impact**

The current interest of natural, biosourced and recycled materials is to create jobs locally but also to recreate social ties through participatory worksites as we discussed in "the cost".
It is also what drives a renewal in the building trades, a breath of fresh air for the new generation of builders, giving meaning to trades that were emptying themselves of their essence.

**Activity - make a table on the advantages and disadvantages of green insulation (plant-based insulation such as flax, hemp, straw, sheep's wool, wood particles, recycled textile, etc.) and mineral-based insulation (glass wool, rock wool, polystyrene, polyurethane foam)**

# 5 Recognizing the benefits of personal development

## 5.1 Definition

Personal development is a set of practices aimed at self-knowledge, self-confidence, knowledge of others and one's environment, the development and broadening of one's perception, reflection and practices through one's profession.

## 5.2 Personal development in stages

The "personal" development of a building professional is often linked to several major steps that can follow each other or be set up simultaneously.
Learning and personal development times are very relative and specific to each individual.
Here are 7 steps that can of course get entangled because "*we can quite transmit by being in the practice of the profession and even in the apprenticeship"*

### 5.2.1 The discovery of a profession for oneself

A crucial and often difficult step is the question of how to choose a profession that interests me, that will help me to live properly financially and safely, that will allow me to flourish as a being and that will have meaning for the community?

### 5.2.2 Learning the trade

A stage focused on learning and discovering the profession through practical and theoretical exercises and by imitating the oldest, which allows to shape the body and mind to the requirements of the profession and society while respecting the requirements and needs of the learner. A stage where I discover belonging to a social group, where we discover our talents and abilities.

### 5.2.3 The practice of the profession

A stage or practice on site is often the essence of the activities. This is the moment when we discover the diversity of tasks, techniques, materials, work companions and places.
This step that forges the practitioner, provides assurance on his abilities learned during the apprenticeship and develops many skills related to the profession: physical endurance, work independently and work together. Constantly adapt to different situations. Use many tools, communicate with all corporations and stakeholders on construction sites, learn how to secure yourself and others.
And if the job is passionate, it is also a stage where you can discover other sciences such as geography, geology, history, where you can develop your sense of observation, listening and understanding. It is a stage where you develop your talents and skills.

### 5.2.4 Practical and theoretical mastery of the profession

It is often the culmination of a more or less long period of practice depending on the individual

where we take stock of our practical and theoretical learning on the construction sites and where we are led to manage our own company or a team and / or a site.
It is a stage where one develops one's manual and intellectual skills as well as self-esteem.

### 5.2.5 Mastery of the practical, theoretical and ethical profession

It is a stage where we ask ourselves questions about how to improve everything we have learned, how to be an actor of our present, of the future of the profession and the corporation. How to be a good professional while remaining fully in your personal life.
Looking for the links between one's profession and the demands of society to apprehend inevitable changes is the development of self-esteem and self-esteem.

### 5.2.6 Transmission

It is a stage where you master your job enough, and yourself to share it with others, with the youngest for the continuity of the job, with all audiences to make you want to do your job, to make you want to respect what you do and to remain visible and readable within a society constantly in motion.
Observation and listening are essential at this stage, as well as the esteem of others.

### 5.2.7 Give meaning to the profession or realize oneself

This stage is the one where we know how to transmit our know-how, our know-how, where we imagine the job of tomorrow, where we give meaning to today's job in society while anticipating the meaning it will have tomorrow. For oneself and for others, it is a step that leads to the development of the professional and the being.

It is during these 7 stages, discovery, learning, practice, mastery of one's practice, mastery of the profession, transmission and realization that one is led to discover one's capacity for creation, its usefulness and its place in society, one's own harmony and that of others. Living together.

## 5.3 Development tools

- Discovery on construction sites, in training centers, on various information networks, meetings with professions, associations,
- Training centers, companies, virtual tools, experimentation,
- The personal training account, online training, training within the corporation itself and between corporations, informal training, reading, participation in participatory and collective worksites
- training with a broader or different objective of his profession, conferences and debates, places of inter-professional exchange, inter-generational, debates and political and

philosophical information.

## 5.4 Development positioning tools

The portfolio, the portfolio of skills, the book, the CV, the national diplomas or European equivalences, from level 1-Basic general knowledge to level 8-Knowledge at the most advanced frontier of a field of work or study and at the interface of several fields, competitions (type Wordskills, best worker of France) and companionship.

**Activity - Build a table with sliders so that the person positions himself and recognizes himself in a development journey.**

| | I'm starting | It's ongoing | Confirmed | I master |
|---|---|---|---|---|
| Discovery. | | | | |
| Learning. | | | | |
| Practice. | | | | |
| Mastery of practice. | | | | |
| Mastery of the trade. | | | | |
| Transmission | | | | |
| Self-realization. | | | | |

# 6 Frequently Asked Questions

**1- What is the difference between the circular economy and the linear economy?**

Unlike the linear economy where a little more value is lost during each of the stages, values are added in the circular economy which takes the form of several series of loops whose main purpose is to combat the waste or loss of resources and energy. In the circular economy, it is about creating products using secondary raw materials. Products that will be used, reused and recycled. In a linear economy, it will be a question of extracting raw materials, using them and then throwing them away.

**2- What is the European Green Deal?**

Mobilising industry for a clean and circular economy is one of the 12 pillars of the European Green Deal presented in December 2019. The main objective is to make Europe the first climate-neutral continent, in particular by achieving carbon neutrality by 2050, i.e. the balance between carbon emissions and the absorption of carbon from the atmosphere by carbon sinks. European industry now accounts for 20% of EU emissions and 12% of the materials it uses come from recycling.

**3- What is RT 2012?**

Applied since the end of 2011, the RT2012 thermal regulation is mainly based on three expectations:

- minimum energy efficiency of buildings, Bbiomax (bioclimatic need of buildings);
- a maximum conventional consumption of primary energy, Cepmax, covering the consumption of heating, cooling, lighting, domestic hot water production and auxiliaries (pumps and fans);
- summer comfort in non-air-conditioned buildings, Ticref, limiting the maximum indoor temperature the building can reach during a sequence of 5 very hot summer days.

*Source France: https://www.ecologie.gouv.fr/reglementation-thermique-rt2012*

**4- What is the 2020 ER?**

Its objective is to continue to improve the energy performance and comfort of buildings, while reducing their carbon impact. It is structured around three main axes:

- Continue to improve the energy performance and reduce consumption of new buildings. The RE2020 goes beyond the requirement of the RT2012, with particular emphasis on the performance of insulation regardless of the heating mode installed, thanks to the strengthening of the requirements on the bioclimatic need indicator, Bbio.
- Reduce the climate impact of new buildings by taking into account all building emissions over its life cycle, from the construction phase to the end of life (construction materials, equipment), including the operation phase (heating, domestic hot water, air conditioning, lighting, etc.), via a life cycle analysis.
- Allow occupants to live in a living and working space adapted to future climatic conditions by pursuing the objective of comfort in summer. Buildings will have to be more resilient to heat waves, which will be more frequent and intense due to climate change.

The RE2020 is based on a gradual transformation of construction techniques, industrial sectors and energy solutions, in order to control construction costs and ensure the upskilling of professionals.
*Source France: https://www.ecologie.gouv.fr/reglementation-thermique-rt2012*

**5- What are the obligations related to listed buildings?**

Carrying out work in the vicinity of historical monuments requires the filing of prior authorization. Works likely to modify the external appearance of a building, built or not built (courtyard or garden for example), protected under the surroundings are subject to prior authorization requiring the agreement of the architect of the buildings of France.
If the architect of the buildings of France participates in the examination of applications for authorization of works, he also plays a preponderant role upstream of the realization of the projects. As such, it can be consulted on a preliminary draft and make observations that will allow applicants to adapt their project according to heritage issues.

*Source France: https://www.culture.gouv.fr/Thematiques/Monuments-Sites/Interventions-demarches/Travaux-sur-un-objet-un-immeuble-un-espace/Realiser-des-travaux-en-abords-d-un-monument-historique*

**6- What is a bio-based product?**

Bio-based building products are made from renewable plant or animal raw materials. They must meet the requirements of technical performance (mechanical, thermal, acoustic, fire behavior, etc.) and durability corresponding to the applications and uses claimed. These products are subject to a technical opinion (issued by the CSTB), an Acermi certification, a European technical approval or rules for their implementation (DTU or professional rules). These documents are essential to obtain insurability of the constructions in which they are used.
Apart from wood, the main bio-based products are cellulose wadding, hemp, flax, straw (wheat), sheep's wool, duck feathers, recycled textiles (cotton). Their use is still underdeveloped in the construction sector. They find their application mainly in the field of thermal and acoustic insulation and, for hemp, in the formulation of (light) concretes. Bio-based insulation represents about 5% of the insulation market (wood fibre insulation accounting for half of this share).
Source France: https://expertises.ademe.fr/batiment/passer-a-laction/elements-construction/dossier/parois-opaques/produits-construction-biosources-batiment

**7- What are the advantages and disadvantages of insulation from the inside?**

The insulation of the walls from the outside makes it possible to remedy heat losses by thermal bridge and therefore a better overall thermal performance than the internal insulation. It does not reduce the living space. It is this fact that often makes it preferred to interior insulation.
The downsides lie in the obligation to review the roof and the various installations such as swing shutters. The brightness of the building is reduced because of the insulation of the paintings and window sills. Insulation from the outside is also more expensive because it requires the installation of scaffolding.

**8- What are the advantages and disadvantages of insulation from the inside?**

The insulation of the walls from the inside makes it possible to remove the feeling of "cold wall". During a heavy renovation with redistribution of parts, it allows to pass all the ducts and make them invisible. The cost of work for interior insulation is less substantial than exterior cladding.
Still, this interior insulation solution requires, at the same time, the displacement of all the elements to the wall. Thus, switches, sockets and radiators must be moved.
The constraint becomes all the more heavy in the presence of central heating with exposed piping. Unless you include it in the dubbing, this work also involves exposing the pieces.

**9- What are the advantages and disadvantages of distributed insulation?**

The insulation is integrated into the building material. Very simple to implement during a construction, this process is efficient and quite inexpensive. Distributed thermal insulation or ITR is based on the use of building materials with high thermal performance. No additional insulation is required. This is called "monomurs". It is the air trapped inside the building material that provides an insulating function. There are 3 main types: honeycomb terracotta brick, lightweight concrete blocks and aerated concrete. These materials are extremely resistant to pressure and can be used for the construction of buildings. For timber frame houses, several materials of natural origin can be proposed: molded block of hemp and lime, hemp concrete or straw bale. The thermal performance of monowalls complies with the requirements of RT 2012 (R between 3 and 9 $m^2$. K/W). Distributed insulation is reserved for construction work since it concerns load-bearing walls.

**10- What is the cost of using bio-based materials?**

Bio-based insulation is on average 10 to 15% more expensive than traditional insulation. This is because they have other qualities: better acoustic comfort, better lifespan, and very little risk of toxic effects. This set of factors means that the market for bio-based insulation is now growing: currently it represents between 8 and 10% of the insulation market (for walls and roofs).

**11- How to talk about embodied energy with owners or project manager?**

Embodied energy represents all the primary energy consumed to make a good, recycle it or throw it away. It involves:

- extraction of raw materials;
- the production and/or processing of its constituent elements;
- the various packaging;
- transportation;
- maintenance;
- the end of life of the product (recycling or destruction).

Embodied energy corresponds to the "hidden energy" by the product. It thus measures the $_{CO2}$ emissions of a given element throughout its life cycle, "outside working life". It does not take into account energy consumption when using the product in question.

**12- How to reduce embodied energy?**

Everyone understands the importance of not wasting electricity, fuel or heating energy. It is just as important to save this embodied energy, which is less easy to foresee. We can certainly compare the grams of $CO_2$ on labels, but the easiest way is to apply a few simple principles on a daily basis:

- Choose local products, made of natural materials and good quality.
- Take care of devices so they last longer, and repair them in case of failure.
- Share the use of objects, borrowing and lending them.
- Give to others, or to a self-help association, what is no longer needed.
- Produce less waste, by recycling of course, but also by avoiding products with unnecessary packaging.

**13- Depending on the thermal insulation used, what are the health risks?**

The table below summarizes the health benefits and disadvantages of the most common thermal insulation materials:

| | Benefits | Disadvantages |
|---|---|---|
| **Expanded clay** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | Significant dust release during implementation |
| **Chenevotte** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | / |
| **Wood fibre** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Wood wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | / |
| **Wood-hemp wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Hemp wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Coconut wool** | No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | Polluting flame retardants |
| **Cotton-hemp wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Linen wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Sheep's wool** | No flame retardants<br>No formaldehyde emissions | Presence of biocides<br>Possible presence of synthetic binders |

| | | |
|---|---|---|
| | No VOC emissions | |
| **Duck or goose feather wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | Possible presence of synthetic binders |
| **Rock wool** | No flame retardants<br>No biocides<br>No formaldehyde emissions<br>Less than 5% binders<br>No VOC emissions | Breathable fibres during demolition and disposal |
| **Recycled textile wool** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | / |
| **Glass wool** | No flame retardants<br>No biocides<br>No formaldehyde emissions<br>No VOC emissions | Breathable fibres during demolition and disposal<br>Irritating in contact with skin |
| **Cork** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders (for bulk cork) | Possible presence of glues (only cork panels) emitting VOCs |
| **Cellular glass** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | Some implementations require the use of hot bitumens |
| **Straw** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | / |
| **Expanded perlite** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions<br>Absence of binders | In the case of rigid panels, products containing bitumen can release toxic substances |
| **Polyisocyanurate (PIR)** | No biocides | Polluting flame retardants<br>Toxic emissions during combustion<br>Emission of hydrocarbons at manufacturing |
| **Expanded polystyrene (EPS)** | No biocides | Polluting flame retardants<br>Toxic emissions during combustion<br>Emission of hydrocarbons at manufacturing |

| | | |
|---|---|---|
| **Extruded polystyrene (XPS)** | No biocides | Polluting flame retardants<br>Toxic emissions during combustion<br>Emission of hydrocarbons at manufacturing |
| **Polyurethane (PUR)** | No biocides | Polluting flame retardants<br>Toxic emissions during combustion |
| **Expanded vermiculite** | No flame retardants<br>No biocides<br>No VOC emissions<br>No formaldehyde emissions | / |
| **Cellulose flakes** | No biocides<br>Absence of binders | Polluting flame retardants<br>Large amount of breathable fibers during implementation, demolition and disposal |

**14- What is the CE marking?**

The CE marking appears on the majority of non-food products. It embodies the commitment of the manufacturer of the product on its conformity with the requirements laid down by Community rules. It must be affixed before a product is placed on the European market. The CE marking gives these products the right of free movement throughout the territory of the European Union.

In order to affix the CE marking to his product, the manufacturer must carry out, or have carried out, examinations and tests to ensure conformity of the product with the essential requirements defined in the relevant European texts.

The CE marking is not a certification mark.

Regulation (EC) No 765-2008 of 9 July 2008 lays down the general principles of the CE marking (see in particular Article 30 and Annex II).

**15- What is FSC certification?**

The FSC label is a certification system for forest management, but it also labels wood that is extracted from forests. When you see the FSC label on an object with wood, it guarantees that this wood comes from a legal forest harvest, with sustainable management.

- Compliance with the laws of the land
- Workers' rights and working conditions
- Rights of indigenous peoples
- Relations with local communities
- Profits generated by the forest
- Environmental values and impacts of forest management
- Management Planning
- Monitoring and evaluation of management practices
- High conservation values
- Practical implementation of management activities

**16- What are the requirements for PEFSC certification?**

The PEFC certification system is a safe and transparent system for tracking the flow of timber from the forest to the consumer. Independent certification bodies take care of the controls, both in the forest (forest management) and in companies that process wood like us (stock, treatment, transport, sale). Wood processing companies are increasingly ensuring that the origin of these materials is environmentally friendly and controlled. In the wood treatment process, each company must have a certificate, called a Chain of Custody certificate, in order for the wood to be marketed under the PEFC label.

**17- What types of PEFSC certification?**

All companies with a PEFC chain of custody certificate and a right to use the PEFC mark can affix the PEFC label to their PEFC-certified products. For this, 4 different labels exist depending on the composition of the product.

- The "PEFC Certified" label without recycled materials
  This label guarantees that the product contains at least 70% of materials from sustainably managed and PEFC-certified forests, the rest being composed of materials from controlled sources according to the PEFC due diligence system.
- The "PEFC Certified" label with recycled materials
  This label guarantees that the product contains at least 70% of materials from sustainably managed forests and PEFC certified or from recycled sources, the rest being composed of materials from controlled sources according to the PEFC due diligence system.
- The "PEFC Recycled
  " labelThis label guarantees that the product is exclusively composed of materials from recycled sources.
- The label "PEFC 100% Origin
  "This label guarantees that the product is exclusively composed of materials from sustainably managed forests and PEFC certified.

**18- What obligations with the BBC label?**

Since 2009, the BBC label (low energy building) certifies not only new buildings but also housing under renovation. In 2019, the project also extends to historic buildings with the Heritage label. The label sets energy consumption thresholds per square metre that manufacturers must respect:

- 50 kWhep/m2.year for new buildings
- 80 kWhep/m2.year after thermal renovation.

The proposed ceiling for renovations is more flexible because it takes into account the difficulty of modifying a construction as a whole (in terms of price in particular). At the time of design, it is easier for a construction craftsman:

- order suitable materials for insulation
- provide complete insulation;
- or to provide heating equipment adapted to the needs of the inhabitants.

In addition to the growing sensitivity of institutions and tenants to climate issues, the BBC Label is gaining momentum because the 2012 Thermal Regulation (RT 2012) made it mandatory for new housing. However, today, it isRE2020 that applies in new constructions. It is more demanding than the BBC label.

**19- What are the commitments of the HQE approach?**

A building certified HQE (high environmental quality) integrates environmental requirements criteria from the construction or rehabilitation project. HQE is not strictly speaking a label that meets a regulation, but a quality approach based on a reference framework.

The HQE™ approach was the subject in 2015 of a new optimized "reference framework", better readability, which is articulated in 4 transversal commitments, valid at all stages, from design to end of life through construction / rehabilitation and management / use,

- Quality of life : safety; health; facilities and services promoting practicality, comfort, pleasure and living together.
- Economic performance : optimized costs and charges; increased value (financial, patrimonial and use); involvement in the dynamics and development of the territory.
- Respect for the environment : rational use of resources and energies; limitation of polluting discharges; fight against global warming; natural context and biodiversity.
- Responsible management : adaptation of the organization to quality and performance objectives; consultation; control of the project, its implementation and its operation; evaluation procedures for continuous improvement.

**20- What obligations with the BBCA label?**

The BBCA label attests to the exemplary nature of a building in terms of carbon footprint. It concerns the new building or the renovated building. It is granted to buildings with limited greenhouse gas emissions over their entire life cycle. To obtain the BBCA label, a building must guarantee a significant reduction in its carbon footprint during its construction and operation over 50 years. It can be attributed to different types of projects: collective housing, office buildings or complete neighborhoods, new or from renovation.

The Low Carbon Building (BBCA) label is supported by the Association of the same name, created in 2015.

The BBCA label promotes all the low-carbon approaches of a building according to 4 pillars:

- CONSTRUCTION (intelligent mix of materials, sobriety of design...)
- EXPLOITATION (low-carbon energy, renewable energy...)
- CARBON STORAGE (presence of bio-based materials)
- CIRCULAR ECONOMY (selective deconstruction, reuse of products, pooling of spaces, potential for change of use, potential for extension)

**21- How is the recycling chain organised?**

Recycling is both a way of treating waste and producing resources. All stages of the material and product cycle must be taken into account to fully understand the challenges of **recycling**.

From waste collection to the production of goods:

- the eco-design of products, which may or may not provide for the incorporation of Recycling Raw Materials (MPR) and/or the "recyclability" of the product once used;
- collection, which determines the level of mobilization of waste deposits and used products intended for recycling;
- dismantling (dismantling and depollution), sorting (identification, extraction, and/or separation of materials) and preparation (shredding, shredding, etc.) of waste and materials derived from it, which makes it possible to increase and regularize flows. At this stage, the challenge is to optimize the quality of MPR while reducing the quantity of non-recovered ultimate residues;
- the transformation and implementation of materials from waste, which allows the increase of the integration of MPR in existing or new fields of application.

**22- How and where to train throughout life?**

Lifelong learning is a continuum between initial, general or vocational training and all situations where skills are acquired: continuing training actions, professional activities, associative or voluntary involvement. It includes the steps of orientation, assessment, support towards employment, training and validation of acquired experience.

Continuing training is based on the obligation for employers to contribute to the financing of continuing training for employees, and on the right of employees to train during their working time**.** In each occupational branch, employers apply national interprofessional agreements negotiated by the social partners. Employees who have lost their jobs can also benefit from training programmes. Their financing is mainly based on unemployment insurance, the regions or the State.

Source FR: https://www.education.gouv.fr/la-formation-tout-au-long-de-la-vie-7508

**23- In short, what does the 6th IPCC report say in 2023?**

Consequences everywhere and in all sectors. All these disturbances in the climate system have led to observable adverse effects on ecosystems and human societies around the world:

- Extreme weather events (droughts, heat waves, floods, fires, tropical cyclones, etc.) occur more often and are more intense;
- Biodiversity is threatened, thousands of animal and plant species have already suffered local extinctions
- Health risks are increasing: there is an increase in mortality and morbidity related to heat, diseases, food shortages...
- Global agricultural production is also impacted, threatening food security in some countries
- About half of the world's population currently experiences severe water scarcity for at least part of the year.

Source: https://www.ecologie.gouv.fr/sites/default/files/20250_4pages-GIEC-2.pdf

**24- And for tomorrow, the expected impacts of global warming on the building?**

The 6th IPCC report once again warns of the context of climate emergency and the need to act. "Thetransition of the building sector, and in particular its decarbonization, is no longer an option!"

Cities and buildings will be directly impacted bythe effects of change and global warming. Some key points, highlighted in the report:

- Continued urbanization and increasingly severe heat waves linked to climate change will further amplify the effect of urban heat islands. By 2030, nearly 60% of the world's population is expected to live in urban areas;
- The choice of materials has a direct impact on urban warming: the modification of the albedo of their surface is a point proposed by the report (use of white paints on roofs for example) to increase the reflective effect and limit the heat effect;
- CO2 emissions from fossil fuels cover a large number of economic sectors, including buildings. An effort to reduce these emissions is therefore expected;
- More extreme cold waves will also have a direct impact on buildings (increased demand for heat and electricity, possible mechanical modification of buildings);
- Cities and buildings will be increasingly subject to heavy rainfall and flooding; just as repeated waves of drought can destabilize the structure of buildings.

**25- What impact does eco-construction have on sustainable development?**

The construction of a sustainable building requires a global consideration of the ecological, economic and social impact of the building.

| Approach | Actions |
|---|---|
| **Taking a more efficient approach to energy** | • **Minimize energy consumption** at all stages of a building's life cycle by making new and renovated buildings more comfortable and less costly to manage and by helping residents to adopt an energy-efficient approach as well;<br>• **Integrate renewable** and **low greenhouse gas emission** technologies to meet the energy needs of buildings. |
| **Conservation of water resources** | • **Minimize water consumption** in buildings by improving drinking water and wastewater management. |
| **Creating resilient structures** | • **Guarantee the resilience of buildings to climatic events** (fires, earthquakes, etc.);<br>• **Anticipate the evolution of the use of buildings** to avoid their demolition / reconstruction. |
| **Waste reduction and recycling** | • **Promote the use of sustainable and bio-sourced** materials that have a low impact on the environment and produce less waste;<br>• **Recycle waste** and **promote recycling practices** to residents. |
| **Promoting a sense** of **community** | • **Ensure the creation of an environment that brings added value to the community** in terms of economic and social impact. |

# 7 Multiple choice questions

## EVALUATION – MCQ MODALITE – DURATION 2 HOURS

1- In which year did the concept of sustainable development appear?
   a. **In 1987 at the United Nations World Commission on Environment and Development**
   b. In 1972 for the United Nations Conference on the Human Environment in Stockholm
   c. In 1992 at the Earth Summit in Rio de Janeiro
   d. In 2012 for the United Nations Conference in Rio de Janeiro

2- The challenges of the circular economy are:
   a. Environmental, energy, agricultural
   b. **Environmental, economic, social**
   c. Environmental, political, social

3- The disposable model is:
   a. **Extract, make, consume, throw away**
   b. Make, use, throw away
   c. Produce, sell, renew, throw away

4- The principle of circular economy appeared after the thermal regulation of:
   a. 2000
   b. 2005
   c. **2012**
   d. 2020

5- In the RT 2020 for the regulation of new building the heating consumption must be less than:
   a. 5 kwhep/m².
   b. **12 kwhep/m².**
   c. 15 kwhep/m².

6- In the RT 2020 for the regulation of new building the total energy consumption must be less than:
   a. 50 kWh/m²
   b. **100 kWh/m²**
   c. 100 kwhep/m².

7- In the RT 2020, the energy balance must be positive on the 5 utilities:
   a. Heating, appliances, hot water, air conditioning, auxiliaries
   **b. Heating, light fixtures, hot water, air conditioning, auxiliaries**
   c. Heating, light fixtures, appliances, air conditioning, auxiliaries

8- What are the 3 areas of action of the circular economy?
   **a. Production, consumption, waste management**
   b. Manufacturing, renovation, recycling
   c. Extraction, production, recycling

9- Which insulation material consumes the least energy in production?
   a. Glass wool
   b. Polyurethane foam
   c. Cellulose wadding
   **d. Hemp**

10- What is the most effective insulation technique?
   a. Interior insulation
   b. External insulation
   c. Distributed insulation
   d. Sandwich insulation
   **e. It depends on the building (place, new, renovation ...)**

11- Which insulation technique is the most expensive in terms of the overall amount of work?
   a. ITI
   **b. THE ITE**
   c. ITR

12- Thecalculation for the thermal resistance of a wall is:
   **a. R=e/ λ**
   b. U=1/R
   c. Sd = μ x thickness/m

13- What is the Sd coefficient:
   **a. Resistance to water vapour transmission**
   b. Lhas thermal resistance
   c. T a fire resistance

14- Why know the thermal resistance of a wall?

a. To promote the product to the customer
b. **To estimate the thickness of insulation to be put in place to achieve optimum** thermal performance
c. To choose the right insulation for the wall

15- What are the 3 types of ethics to take into account when insulating in new or renovated buildings?

| | | |
|---|---|---|
| **Materiality** | **Social** | **aesthetic** |

16- Aesthetic ethics responds to:

a. Artistic expression
b. **Heritage preservation**
c. The aesthetic coordination of the materials used

17- What is a bio-based material?

a. Recycled materials
b. **Materials made from renewable organic matter of plant or animal origin**
c. Materials from nature that can be transformed

18- What is the embodied energy of a material?

a. Its energy consumption to produce it
b. **Energy consumption for its entire lifetime, from extraction to recycling**
c. Waste and the costs it causes

19- Which insulation material consumes the most embodied energy in its production?

a. Sheep's wool
b. **Rock wool**
c. Glass wool
d. Cellulose wadding

20- Which sector produces the most greenhouse gases?

a. The building
b. Industry
c. **Energy production**
d. Agriculture

21- For an optimized environmental assessment, what priority criteria should be taken into account?

a. **The embodied energy of the material + GHG emissions + costs + thermal efficiency**
b. Thermal efficiency + GHGs + costs
c. GHGs + thermal efficiency + sustainability
d. Thermal efficiency + sustainability + social impact

22- In insulation, a green material must be made from:

a. Materials with very high thermal performance, sustainable materials
b. Recycled materials with a low carbon footprint
c. Recycled materials with no impact on health
d. **Bio-based materials, natural materials, recycled materials**

23- What are softskills?

a. The basic skills of any job
b. **The personal and relational qualities of an individual.**
c. Technical skills
d. Professional skills

24- How to define personal development (several possible answers)?

a. **Personal development is self-knowledge, self-confidence, knowledge of others and one's environment, a reflection on one's personal and professional action.**
b. **Personal development refers to all activities that propose to develop self-knowledge, to value one's talents and potential, to work towards a better quality of life, and to the realization of one's aspirations and dreams.**
c. **Personal development is a global process of reflection on oneself and valuing one's potential in order to improve the quality of one's life and achieve one's deepest aspirations.**

25- In advising a client or a professional, cite 6 main elements to value in your argument for the choice of bio-based insulation materials and techniques:

| | | |
|---|---|---|
| | | |
| | | |

# 8 ANNEXE

## FRAMEWORK OF EXPECTED LEARNING OUTCOMES – UNIT 4

| Objectives | Sub-objectives | Content | Teaching methods |
|---|---|---|---|
| **Know the concept of circular economy to transmit it** | Know the concept<br>Explain the concept<br>Share the concept through a scenario. | Definition of the circular economy.<br>History related to the circular economy.<br>The current context.<br>Example of circular economy application.<br>Theoretical and/or practical application exercises. | Visual support,<br><br>Games, questionnaires, analysis exercises. |
| **Know how to interact and communicate with the owner about eco-friendly products that can be installed and discuss the benefits.** | Know the language specific to the profession.<br>Know the generalities on the techniques and requirements of a building.<br>Know how to argue a choice of insulation. | Definition of environmentally friendly products.<br>Available resources.<br>The losses of a building.<br>Insulation techniques.<br>The qualities of an insulating wall | Visual support.<br>Group research work.<br>Scenario. |
| **Know how to interact and communicate with the owner about eco-friendly products that can be installed and discuss the benefits.** | Know the language specific to the profession.<br>Know the generalities on the techniques and requirements of a building.<br>Know how to argue a choice of insulation. | Definition of environmentally friendly products.<br>Available resources.<br>The losses of a building.<br>Insulation techniques.<br>The qualities of an insulating wall | Visual support.<br>Group research work.<br>Scenario. |
| **Understand the ethics of a construction professional and act accordingly on a daily basis in the workplace.** | Know laws, labels and obligations of a professional.<br>Know the rules of operation of the profession. | Definition of ethics.<br>Material ethics.<br>Social ethics.<br>Aesthetic ethics | Visual support.<br>Group and/or individual research work. |
| **Highlight the benefits of green materials.** | Know the criteria of the materials.<br>Know how to compare materials and argue a choice. | Definition of a green material.<br>The criteria defining a green insulation (ecological) | Visual support,<br><br>Games, questionnaires, analysis exercises. |
| **Recognize the benefits of personal development.** | Know the principles of personal development.<br>Know the tools for personal and professional development. | | Visual support.<br>Debate, questionnaire. |