Training Package Content

Module 4, Business opportunity recognition: energy, materials and industry

By Erasmus+ Knowledge Alliance for Business Opportunity Recognition in SDGs – SDG4BIZ (2021-2023)

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Module 4, Business opportunity recognition: energy, materials and industry

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Table of Contents

Introduction

You are holding in your hands the fourth part of the SDG4BIZ course material description which hopes to contribute to a more effective involvement of the private sector in the achievement of the UN's Sustainable Development Goals. The material is intended to be used by higher education institutions in entrepreneurship education. In addition to the academics, this material can also be used by the companies of the various kinds to train their own employees and executives and secondary education. The training material was created by the Erasmus+ Knowledge Alliance for Business Opportunity Recognition In SDGs - SDG4BIZ project team during autumn 2021 and spring 2022. The material was tested and piloted before the final version of this document was completed and published in the autumn of 2023. Although this package is mainly the result of the work of entrepreneurship education experts and researchers from two higher education institutions in Finland, it has been directly and indirectly influenced by the views and expertise of all SDG4BIZ project partnership.

The starting point for the development of this material has been that the Sustainable Development Goals (SDGs) set by the United Nations 2015 are likely not met by the target year 2030, if companies do not recognize and utilize the business opportunities inherent in them. It has been estimated that up to 80 million jobs would be created and €10 trillion in business opportunities would be unlocked, if SDGs were realized by 2030. However, the companies have not been able to utilize this growth potential so far. In addition, higher educational institutions (HEIs) focusing on business studies have not offered adequate training and support the competence building of future managers for solving the world's most urgent problems. The mainstream of the training efforts of SDGs, still focus on the awareness building only, not business opportunity recognition related to SDGs. We hope that the effort in SDG4BIZ project and the quality of this material will also motivate other educational institutions and organizations to adopt the training content.

The complete material of SDG4BIZ training consists of five parts, modules. This document, Training Package Content of Module 4 is the fourth part. It is titled: Business opportunity recognition: energy, materials and industry The other four modules, address specific opportunities in:

- Sustainable development goals in business opportunity recognition (Module 1)
- Food and agriculture (Module 2)
- Cities (Module 3)
- Health and wellbeing (Module 5)

Each module is equivalent to five credits (ECTS). Please note, that there is a description in a separate document for each module. The set of these descriptions of the five modules is supported by the curriculum (SDG4BIZ curriculum and training package description) and a learning platform (sdg4biz.itslearning.com). This material is available in several languages: in English, Finnish, Spanish, Slovak, German and Turkish. These language versions are more modest workflow-related text files, the function of which was to support the export of translated versions to the learning platform.

In the case that the pedagogical flow, a study path, is matter of interests as it is mounted on a learning platform, please, go to the project page at https://www.sdg4biz.eu/en/. On this page the final policy on how this pedagogical pathway, as implemented in the learning platform, will be accessible after the project.

This module 4 was developed by a large team of five project partners. The main responsibility was shared between two organizations: STU and Fenice. In addition, significant contributions were made by Metropolia UAS and TKNIKA. Haaga-Helia played a minor role as a content producer.

Learning goals

This module, Business opportunity recognition: energy, materials and industry, is divided into an orientation (0) and five sections (1-5) containing actual learning support materials. The orientation, the actual learning section and the expected learning outcomes are as follows.

Sections of module 2	ECTS	At the completion of the section…
	0	**Orientation** 0. the learner knows the overall structure of module 4 and how to utilize the learning diary.
	1	**Sustainable growth (SDGs)** 1. the learner is able to recognize the correct SDG's with respect to the field of operation (energy, industry and materials); the learner is able to categorize and specify the suitable development goals for the company activity for future development.
	1	**Context** 2. the learner understands how different social, economic and national contexts have a relevant influence in creating business opportunities related to SDGs in the field of energy, industry and materials.
	1,5	**Motivation** 3. the learner is able to reflect and evaluate motivational drivers to recognize sustainable business opportunities with respect to SDGs in energy, industry and materials sectors.
	0,5	**Resources and networks** 4. the learner is able to understand the importance of managing resources in energy, industrial and material sector supporting sustainable value creation; the learner is able to recognize/build networks for business opportunities enhancement in energy, industrial and material sector.
	1	**Business modelling** 5. The learner is able to recognize specific SDGs for green and sustainable energy; the learner understands how these SDGs are relevant for business opportunities recognition in green energy; the learner identifies and understands which are todays solutions and resources for Green Energy in Europe; the learner recognizes and understands differences and similarities in Green energy business models in different EU countries.

How to use this material

The structure of the document has been chosen specifically to help you build an online course using this material. The package can also be used in the classroom although in that case, the pedagogical material, such as workshop manuals or lecture notes, must be further developed. In other words, this material provides rich content and tips for the classroom yet requiring some adaptation.

In addition to the orientation and final parts of the Module, the course is divided into five different sections. In this document, these sections are numbered. The structure of the sections is displayed in a table with two columns. The left column of the table points out a number and a title as well as the order in which the items are designed to be presented. Regarding the content itself is in the right column. Not all the components carry a title nor a number. These elements fall under the headings above them. The intention is to emphasise the specificity of the content block in relation to the preceding ones, and to suggest certain order for the presentation of the items. The structure is demonstrated in the picture below: 3.4. indicates the place of the item in the study path, “Materials and sustainability...” is a sub-title and the content itself, in this case preceded by a suitable video, is in the right column.

3.4 Materials and sustainablity: key drivers of Innovation	Innovative materials and sustainability: key drivers for Innovation https://youtu.be/9glOwT20zJ4 In this video presentation, you will be introduced to the knowledge and importance of innovative materials as key driver of innovation in companies and societies. Also, the video will give you a specific definition of sustainable innovation and some significant examples of companies that are investing in sustainabilty as key growth and innovation driver Innovative materials and sustainability Materials and Sustainability_KeyDrivers_for_Innovation.pdf

As SDG4BIZ course is designed to be a self-study course, the learning diary and multiple-choice questions play an important role in verifying learning. Occasionally, the same questions are repeated in the immediate quizzes (Self-tests) and in the final examination (Actions to finalize the course, test). Poll questions (VOTE), in turn, have an orienting function. Poll questions, discussion questions and reflection exercises can also be used in the classroom.

The bibliography and references for each section can be found at the end of the section. Third-party material, books, videos and images form an important part of the study path. However, these have been removed from this material e.g. for copyright reasons. On the other hand, simple search functions, either on the international information network (known as Internet) or in library databases, enables one to replace the indication text (video, picture, article etc.) with updated resources available. In some cases, the material also includes a suggestion on the length of a video or a podcast. The selection of the original links (2021-2022) is added on annexes.

In the annexes you will find the lectures and the transcript frameworks.

0. What's in it for me?

Item: Welcome to the course

Page	**content**
Description	[image 1] Welcome to study business opportunities recognition considering sustainable development goals in materials, energy and industry. This module is structured in 5 sections and 4 sub-sections, each of which provides state of art, different points of view, new trends and best practices as inspiration. LEARNING OBJECTIVES This module has the following learning objectives: The learner recognizes the SDGs in the context of business in energy, material and industry sector. The learner learns how to apply SDGs to recognize business opportunities in energy, material and industry sector.

	The learner gets inspired from successful business cases related with sustainibility, in the field of circular industrial process, innovative building material and renewable energy.
0.1. Welcome to Module 4	Welcome! Welcome to the Module 4 of the SDG4BIZ training course: "Energy and material" Our group of co-designers warmly welcomes you to explore business opportunities brought up by the SDGs in the energy and material sector: Helena Fidlerová, Augustín Stareček, Natália Vraňáková, Henrieta Hrablik Chovanová, Helena Makyšová and Miriam Šefčíková from Slovak University of Technology in Bratislava, Slovakia Francesco Pulejo and Marco Scandaletti from Fenice Foundation, Italy Kaj Lindedahl from Metropolia University of Applied Sciences, Finland, Sami Nykter from Haaga-Helia University of Applied Sciences, Finland Miren Canellada from Tknika, Spain
0.2. About Learning Diary	**What is a learning diary?** About Learning diary What is a learning diary? Throughout this module, we will strongly encourage you to reflect on your own learning. Your needs and wishes to apply the course contents to your everyday work environments may vary heavily due to the various backgrounds you come from. If you reflect upon your learning on a regular basis and document your insights carefully, at the end of the course you have something tangible to start making the change happen! The learning diary is the concrete tool and we have designed the following path for you to follow. Please document your insights using the file format that suits you best and do save the documentation in your own files. The reflections may vary from text to mind maps and other visualizations. [image 2]

During the module you will be reminded on the course platorm when it is time to reflect. Then you see this icon [image 3]

You are not expected to submit the learning diary to us. However, you might want to share insights, for example, with your colleagues or business partners with whom you are developing your sustainable business opportunities or your everyday work practices. Enjoy the journey!
NOTE: The Learning Diary will be here (this link won't work if you have not done previously described activation). When you click the link the learning diary blog will be opened into a new browser tab. When you make a new post click "Add blog entry". In some cases you will be recommnded to give the blog post a specific title.

Activation of a personal Learning Diary

1. Sustainable Development Goals (SDGs)

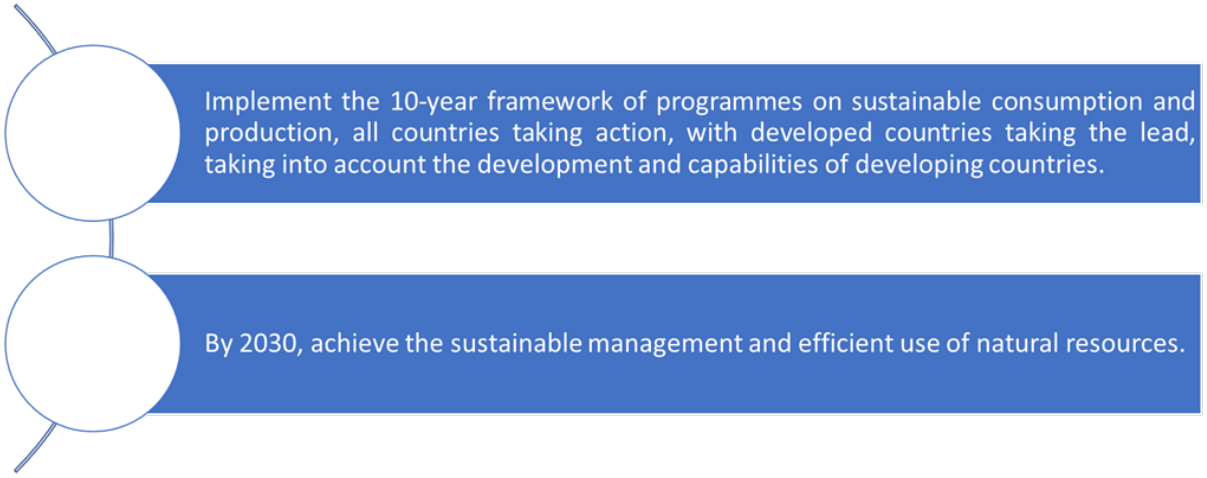
Page	Content
DESCRIPTION	DESCRIPTION In this section Sustainable Development Goals (SDGs) specific for energy, industry and material are introduced. You will get familiar with indicators, targets and state of art of specific SDGs. The knowledge of specific SDGs are essential to understand the following sections and to recognize business opportunities in this area. From this section you can start reflecting and documenting your learning process in to a Learning Diary. Open a Blog where the Learning Diary will be created from here. It will be opened into a new browser tab so you can keep it open as you go further. LEARNING OBJECTIVES The learner is able to recognize the correct SDG's with respect to the field of operation (energy, industry and materials)

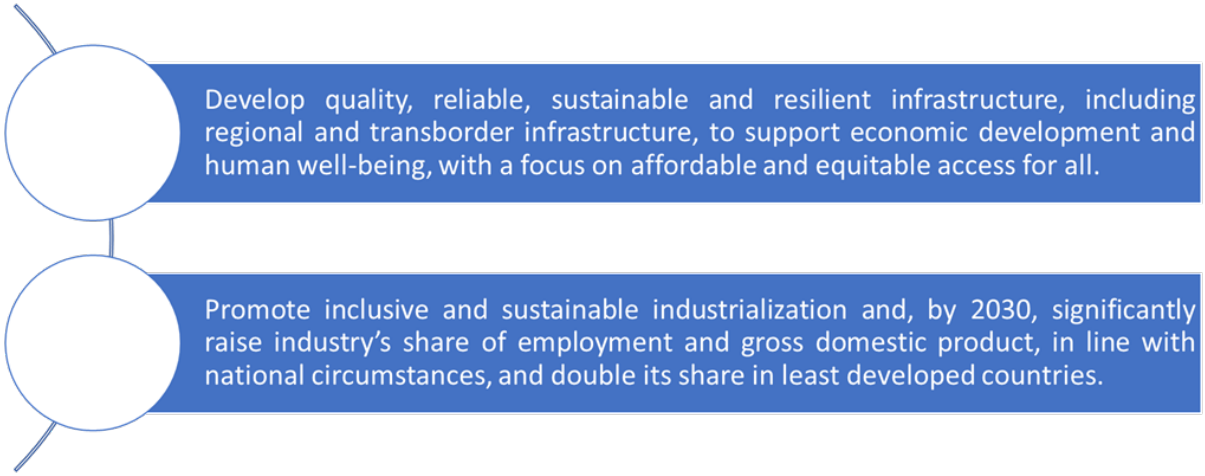
	The learner is able to categorize and specify the suitable development goals for the company activity for future development. RESOURCES AND ACTIVITIES 1.1 Relevant SDG's for the Energy and Material sector 1.2 Relevant SDGs for Industry 1.3 Targets of SDG relevant for Industry 1.4 VOTE - Your opinion about SDGs for industry 1.5 Additional reading SDGs relevant for energy, industry and materials 1.6 Selection of SDG's which has direct impact on the company and it's business 1.7 Literature references Learning Diary – SDGs 
1.1 Relevant SDG's for the Energy and Material sector	Which SDG's are relevant for the Industrial, Energy and Material sectors The relevant field of operation and implementation is important to recognize for the companies. In many cases the direct impact on the SDG's on the company decisions as well as daily activities might be difficult to realize. Hence in the later materials there will be examples from various field of operation and implementation , which makes it easier for companies to find their connections to SDG's. In case of different segments of SDG's these are implemented and there is direct impacts from and on energy and material sectors and companies, which are active within these sectors. There are several different institutes and research done with respect to different levels of SDG impacts on different sectors. Here is one possible approach:

	THE SDG WEDDING CAKE  Credit: Azote for Stockholm Resilience Centre, Stockholm University CC BY-ND 3.0 https://youtu.be/e-dwko8L1E8
1.2 Relevant SDGs for Industry	Connection of SDGs with industry A sustainable, just and peaceful world is aim that the sustainable development goals precede. More and more states, people and communities are realizing the importance of sustainability and the associated procedures and principles. The issue of sustainability regarding industry is important and highly topical. Which of the SGDs are interconnected with the industrial sector? Various publications have addressed this issue and four SDGs, which have the largest links to industry, have been identified.

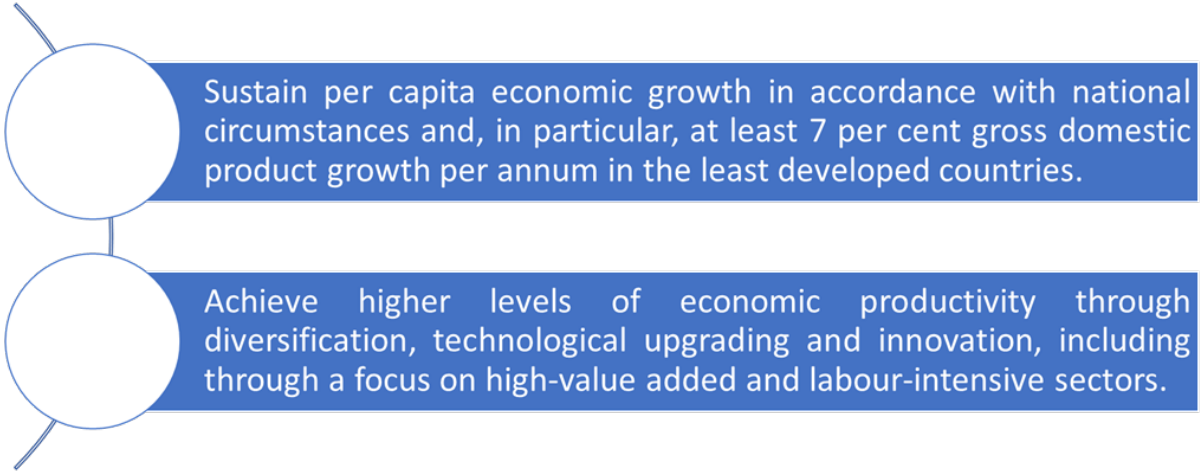
	[image 10] One of the important SDGs in the industrial sector is SDG4 - Quality education, while links to other SDGs have also been demonstrated (Hatayama, 2022). SDG4 is explained by the shortage of adequately trained teachers, poor school conditions, and equality issues related to the opportunities provided to rural children (Seehawer and Breidlid, 2022). However, the mentioned factors also affect significantly employees in the industrial sector. Employees are perceived as assets of the company, i.e. as a resource capable of generating economic benefits. The importance of human capital is particularly emphasized. Its level can be increased, whether through formal education or various forms of education and training in the workplace. From the point of view of companies and organizations, education and training are among the most important investments in human capital (Ali Taha and Sirková, 2011). [image 11] Decent work and economic growth (SDG8) are directly linked to business activities, so it should be easy to combine a company's activities with SDG8 (Hatayama, 2022). SDG8 is one of the most important goals in industries that are associated with the environmental side of production, which includes industrial production. In research from different countries, SDG8 has become the most reported target among companies (Gunawan, et al., 2020; Izzo, el al., 2020). Decent Work and Economic Growth (SDG8) requires sustainable and inclusive economic growth as well as full and productive employment, emphasising decent work for all. While emphasising the importance of universal labour rights, there is also significant tension. Despite many criticisms of the shortcomings of growth indicators, GDP per capita is still at the forefront (Rai, et al., 2019). [image 12] Industry, innovation and infrastructure (SDG9) and its indicators examine the level and patterns of growth of production activities and their impact on production, employment as well as the environment. Due to the small number of individual indicators, the index is easy to interpret for each user and thus caters to the general public (Kynčlová, et al., 2020). Industry, Innovation, and Infrastructure (SDG9) uses the field of industry to focus mainly on resource efficiency (Franklin-Johnson, et al., 2016; Low, et al., 2016), modernisation to more environmentally friendly and clean technologies (Favot, et. al., 2016), and the development of intelligent, energy- and cost-saving technologies (Chia, et al., 2021; Fassio and Tecco, 2019; Ahmad and Wong, 2019; Issa, et al., 2019). [image 13]

	Responsible consumption and production (SDG12) Its main contribution is to reduce primary resource consumption and waste generation by improving material efficiency in production processes and recycling. In addition, companies believe that SDG 12 can be achieved by building good relationships with suppliers and encouraging them to meet their sustainability goals (Hatayama, 2022). Responsible Consumption and Production (SDG12) looks at food as the most important area of consumption that impacts the environment (Sala and Castellani, 2019). This goal represents a consensus on the desired goals of sustainable consumption to do more and better for less and to improve the quality of life, ensuring that no one is left behind (Fischer, et al., 2021). [image 14] For more detailed information please follow references belllow: References: 1.The 17 goals, Available at: https://sdgs.un.org/ 2.Hatayama, H., 2022. The metals industry and the Sustainable Development Goals: The relationship explored based on SDG reporting. Resources, Conservation and Recycling 178, 106081. https://doi.org/10.1016/j.resconrec.2021.106081 3.Seehawer, M.; Breidlid, A. Dialogue between Epistemologies as Quality Education. Integrating Knowledges in Sub-Saharan African Classrooms to Foster Sustainability Learning and Contextually Relevant Education. Soc. Sci. Hum. Open 2021, 4, 100200. https://doi.org/10.1016/j.ssaho.2021.100200. 4.Ali Taha, V.; Sirková, M. Vzdelávanie a rozvoj zamestnancov In: Zborník vedeckých prác katedry ekonómie a ekonomiky ANNO 2011. Prešov : Prešovská univerzita v Prešove, 2011. - p. 15-27, ISBN 978-80-555-0415-5. 5.Izzo, M.F., Ciaburri, M., Tiscini, R., 2020. The challenge of sustainable development goal reporting: The first evidence from italian listed companies. Sustainability (Switzerland) 12. https://doi.org/10.3390/SU12083494 6.Hatayama, H., 2022. The metals industry and the Sustainable Development Goals: The relationship explored based on SDG reporting. Resources, Conservation and Recycling 178, 106081. https://doi.org/10.1016/j.resconrec.2021.106081 7.Rai, S.M.; Brown, B.D.; Ruwanpura, K.N. SDG 8: Decent Work and Economic Growth–A Gendered Analysis. World Dev. 2019, 113, 368–380. https://doi.org/10.1016/j.worlddev.2018.09.006. 8.Kynčlová, P., Upadhyaya, S., Nice, T., 2020. Composite index as a measure on achieving Sustainable Development Goal 9 (SDG-9) industry-related targets: The SDG-9 index. Applied Energy 265, 114755. https://doi.org/10.1016/j.apenergy.2020.114755 9.Franklin-Johnson, E.; Figge, F.; Canning, L. Resource Duration as a Managerial Indicator for Circular Economy Performance. J. Clean. Prod. 2016, 133, 589–598. https://doi.org/10.1016/j.jclepro.2016.05.023.

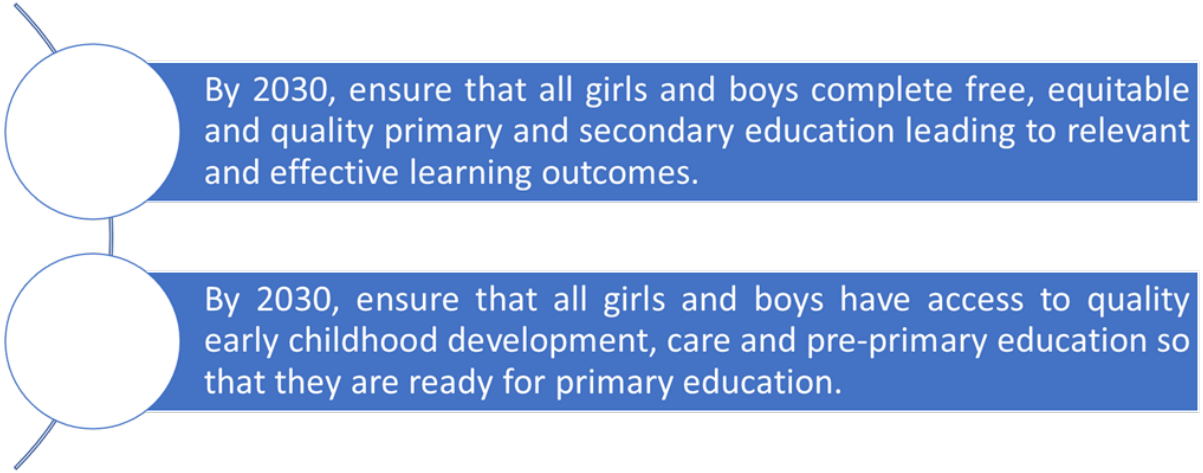
	10.Low, J.S.C.; Tjandra, T.B.; Lu, W.F.; Lee, H.M. Adaptation of the Product Structure-Based Integrated Life Cycle Analysis (PSILA) Technique for Carbon Footprint Modelling and Analysis of Closed-Loop Production Systems. J. Clean. Prod. 2016, 120, 105–123. https://doi.org/10.1016/j.jclepro.2015.09.095
1.3 Targets of SDG relevant for Industry	Introducing the targets relevant for industry In this part you will get familair with main targets for SDGs most relevant for industry. The SDG are in order of relevance. The first is SDG12 (Responsible consumption and production), the second SDG9 (Industry, innovation and infrastructure), the third SDG8 (Decent work and economic growth) and the fourth SDG4 (Quality education). To get the change which is needed to take the planetary boundaries into account, industry has to change their way to make business (look at the wedding cake and its message). Economic growth cannot anymore be the only target. Starting from responsible consumption and production, looking for innovations also with new companies and stakeholders (SDG17), it's for sure that there open new markets to make business and to get economic growth. For that quality education is needed to get changemakers to work in industry. Targets of SDG12 (Responsible consumption and production) [image 15]  Done by project team MTF STU Source: Targets and indicators SDG12, Available at: https://sdgs.un.org/goals/goal12 Targets of SDG 9 (Industry, innovation and infrastructure) [image 16]



Done by project team MTF STU
Source: Targets and indicators SDG9, Available at: https://sdgs.un.org/goals/goal9
Targets of SDG 8 (Decent work and economic growth)
[image 17]



Done by project team MTF STU
Source: Targets and indicators SDG8, Available at: https://sdgs.un.org/goals/goal8

	Targets of SDG 4 (Quality education) [image 18]  Done by project team MTF STU Source: Targets and indicators SDG4, Available at: https://sdgs.un.org/goals/goal
1.4 VOTE - Your opinion about SDGs for industry	Vote! To be completed Which of SDG is, in your opinion, the most essential with respect to sustainability in the industry? SDG4 Quality education SDG8 Decent work and economic growth SDG9 Industry, innovation and infrastructure SDG12 Responsible consumption and production Vote!
1.5 Additional reading SDGs relevant for energy, industry and materials	Additional reading SDGs relevant for Industry Systematic prioritisation of SDGs: Machine learning approach.pdf Corporate adoption of SDG reporting in a non-enabling institutional environment: Insights from Libyan oil industries.pdf Composite index as a measure on achieving Sustainable Development Goal 9 (SDG-9) industry-related targets: The SDG-9 index.pdf Tracking progress in meeting sustainable development goal 9 industry-related targets: An index for policy prioritization .pdf The metals industry and the Sustainable Development Goals: The relationship explored based on SDG reporting.pdf

1.6 Selection of SDG's which has direct impact on the company and it's business	From the four levels in SDG's there are specific SDG's for your company The company shall pay attention to especially following SDG's when they are operating with the Industry, Energy and Material sectors, because their activity and actions are having direct impact on these following highlighted in yellow SDG's. For better understanding of these divisions please refer to 1.1 section and image – "The SDGs weeding cake" -Biosphere [13] Climate Action, [14] Life Below Water, [15] Life on Land, [6] Clean water and Sanitation -Society [1] No Poverty, [2] Zero Hunger, [5] Gender Equality, [4] Quality Education, [3]Good Health and Well-Being, [7] Affordable and Clean Energy, [16] Peace, Justice and Strong Institutions, [11] Sustainable Cities and Communites -Economy [8] Decent Work and Economic Growth, [9] Industry Innovation and Infrastructure, [12] Responsible consumption and production, [10]Reduced Inequalities And finally and naturally also the no. [17] Partnership for the goals are having a direct impact on the companies business
1.7 Literature references	The 17 goals, Available at: https://sdgs.un.org/ Harmaala M., Harilainen H. Blueprint for a training program on business opportunity recognition in SDGs.2020. Available online at: https://uasjournal.fi/1-2020/businessopportunity-recognition-in-sdgs/ Fidlerová, H.; Stareček, A.; Vraňaková, N.; Bulut, C.; Keaney, M. Sustainable Entrepreneurship for Business Opportunity Recognition: Analysis of an Awareness Questionnaire among Organisations. Energies 2022, 15, 849. https://doi.org/10.3390/en15030849 https://www.mdpi.com/1996-1073/15/3/849 Targets and indicators SDG4, Available at: https://sdgs.un.org/goals/goal4 Targets and indicators SDG8, Availble at: https://sdgs.un.org/goals/goal8 Targets and indicators SDG9, Available at: https://sdgs.un.org/goals/goal9 Targets and indicators SDG12, Available at: https://sdgs.un.org/goals/goal12

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2. Context

Page	Content
DESCRIPTION	The "Context" section give learners an overview on how specific European, national and regional contexts influence the development of business opportunities related to sustainability and SDGs, specifically in the sector of energy, industry and material. The context analysis will include the analysis of economic, social and regulations contraints that can favorably or unfavorably shape the business opportunities and the way how to reach them. LEARNING OBJECTIVES The learner understands how different social, economic and national contexts have a relevant influence in creating business opportunities related to SDGs in the field of energy, industry and materials. RESOURCES AND ACTIVITIES 2.1 European Long Term renovation strategies 2.2 Energy efficiency for building strategy in the European Union 2.3 The road to nZEB (near zero emission building) in EU 2.4 Financial solutions in building renovation Learning Diary – Context
2.1 European Long Term	European long-term renovation strategies (LTRS) The construction has a critical role in achieving the Sustainable Development Goals (SDGs), not only in new constructions but also in the renovation of old constructions and buildings that are not energy sustainable.

renovation strategies	Building renovations are crucial for climate mitigation, the objective is the " transformation of existing buildings into nearly zero-energy buildings". European long-term renovation strategies (LTRS) are an an essential planning tool. They offer opportunities to decarbonise the building sector, improve living and working conditions of EU citizens and support economic recovery through new local jobs. For more information about European and Regional strategies read the next article: [image 19: https://www.bpie.eu/publication/a-review-of-eu-member-states-2020-long-term-renovation-strategies/] These strategies influence the way buildings are renovated. Let's look at what a green building is and its advantages! Green Buildings and Passive House Standard A 'green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. There are a number of features which can make a building 'green'. These include: Efficient use of energy, water and other resources Use of renewable energy, such as solar energy Pollution and waste reduction measures, and the enabling of re-use and recycling Good indoor environmental air quality Use of materials that are non-toxic, ethical and sustainable Consideration of the environment in design, construction and operation Consideration of the quality of life of occupants in design, construction and operation A design that enables adaptation to a changing environment Passive House is a building standard for designing and certifying energy efficient buildings (homes, schools, hospitals, offices, etc.). Using the 5 green building techniques explained in next video, Passive Houses need only 10% of the energy that a conventional home uses (that's a 90% energy saving!). https://youtu.be/Hz6qomFM_dw This standard can be applied to new buildings as well as to renovations of old constructions and buildings. In the next sections you will find information about what the motivations for using such standards may be and show several practical applications.

2.2 Energy efficiency for building strategy in the European Union	Energy efficiency for building strategy in the EU Reducing energy consumption and energy losses are becoming increasingly important for the EU. In 2007, EU leaders set the target to cut the Union's annual energy consumption by 20% by 2020. In 2018 it was set a new target to reduce energy consumption by at least 32.5% by 2030. This presentation presents you the European Strategy for energy efficiency in the building sector. It helps understanding the strategic and legal framework where companies need to operate, with its opportunities and contraints. Energy efficiency for building strategy in the EU EU energy efficiency in buildings strategy for EU.pdf
2.3 The road to nZEB (near zero emission building) in EU	The road to nZEB in EU According to European Commission data, buildings are responsible for 40% of energy consumption and 36% of CO2 emissions in the EU. By improving the energy efficiency of buildings, total EU energy consumption could be reduced by 5-6%, whilst CO2 emissions could decrease by about 5%. This presentation will provide you with key provisions for Member States regarding energy efficiency, and nZEB definition and application in EU member countries. Road to nZEB in the European Union Road to nZEB IN EU.pdf
2.4 Financial solutions in building renovation	Financial solutions in building renovation Building renovation is turning into a sector of great economic and business opportunities, thanks to a series of legislative instruments and financial incentives that, at EU level, are making it increasingly convenient. This presentation will help orient you in the context of this renewed framework, which offers new opportunities while respecting the environment and contributing to the achievement of sustainability goals. The presentation focuses on the financial instruments that support the building renovation sector. Financial solutions in building renovation Financial solutions in building renovation.pdf Learning Diary – Context

	Have you completed this task? Description From the definitions presented in this section write a short description on which are the goals and activities where SDG's are directly impacting on your business in your operational field and your own company. The writting can be in a form of an essay for your advertisement or for your internal communication. Now it's time to go to your Learning Diary  Open a Blog where the Learning Diary will be created from here. It will be opened into a new browser tab so you can keep it open as you go further.

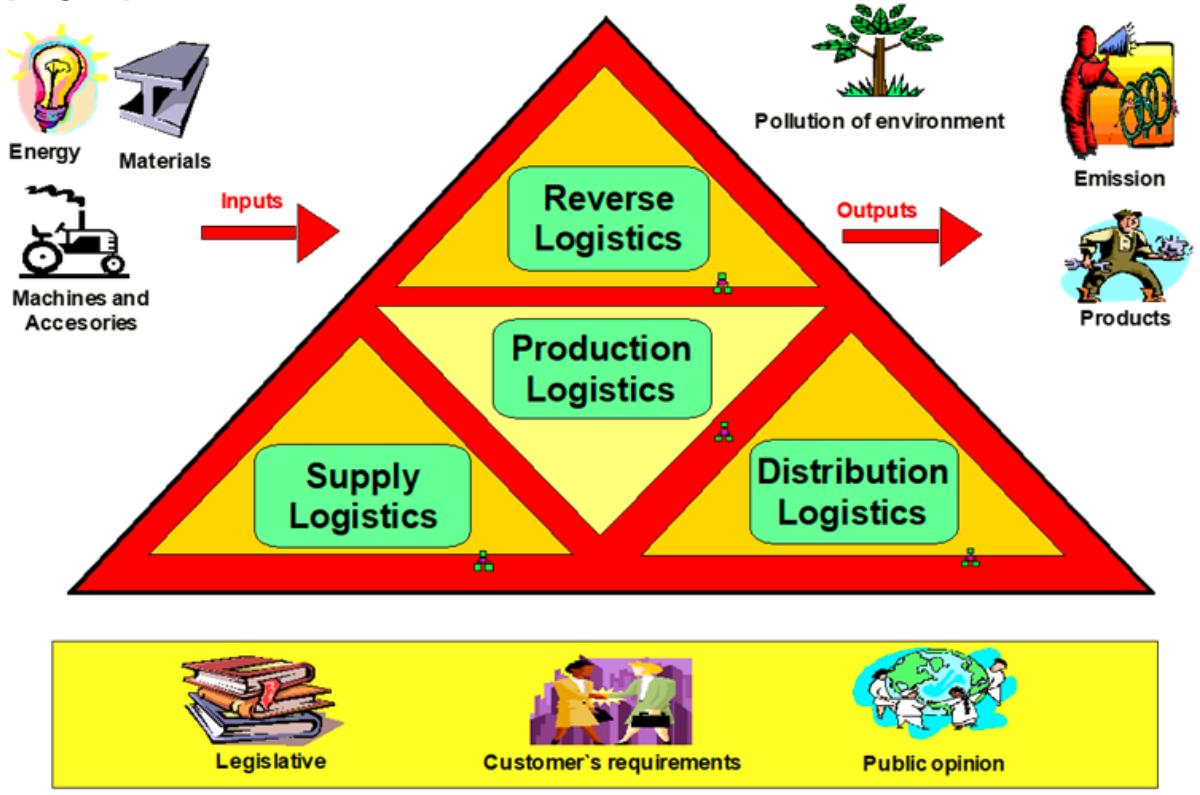
3. Motivation

Page	Content
DESCRIPTION	[image 20] In this section we explore the various motivational drivers of entrepreneurs, companies and individuals when identifying sustainable business opportunities in innovations of material and information flow and processes, considering new trends in industry. You will get familiar with new challenges in human – robot interaction and digitalization towards Industry 5.0, waste management, reverse logistics, agile project management regarding sustainable business solutions. LEARNING OBJECTIVES The learner is able to reflect and evaluate motivational drivers to recognize sustainable business opportunities with respect to SDGs in energy, industry and materials sectors. RESOURCES AND ACTIVITIES Introduction to motivation 3.1 Forwards or backwards? Both is essential for industry and environment 3.2 On way towards to the Industry 5.0 3.3 Agile project management 3.4 Materials and sustainablity: key drivers of Innovation

	3.5 CASE! Incorporating the SDGs as part of strategy in industrial enterprise 3.6 CASE! GREEN BUILDINGS 3.7 VOTE! Best motivation for sustainability challenge 3.8 Typical measures for buildings renovation and use of Renewable Energy systems 3.9 Sustainable competitiveness of the company 3.10 Financial solutions in building renovation 3.11 Literature Learning Diary – Motivation Introduction to motivation in industrial field In this part, you will learn about the main motivators in the industry in recent times that are stimulating the growth and influencing the sustainability of the enterprise and its stakeholders. First, the concept of Industry 4.0 followed by Industry 5.0 in the context of sustainability issues is presented. Second, reverse logistics in the context of sustainability and circualr economy is introduced. Third, agile project management is mentioned as an important source of innovation in the industry. Fourth, the important role that could be played by materials as key driver of innovation. All, this is interconnected with the sustainable competitiveness of the company. “We are made wise not by the recollection of our past, but by the responsibility for our future.” George Bernard Shaw.
3.1 Forwards or backwards? Both is essential for industry and environment	Sustainable reverse logistics Sustainable logistics as part of logistics is the process of planning and executing the efficient transportation and storage of goods from the point of origin to the point of consumption and backwards with understanding and to recognition of environmental, social and culture aspects of all logistics processes of industrial enterprise following the three-pillar principle of sustainability. You can see in the model of sustainable logistics (Fidlerova, 2013), that material and information flow in enterprise includes activities for supply of input (materials, energy, accesories), production process, distribution process (product and services) and reverse flow (waste). Reverse logistics involves disposition and disposal of waste materials caused by production, packaging and distribution processes of enterprise. Council of Logistics Management formulated definition of reverse logistics (1993) as a broad term referring to the logistics and operation management skills involved in recycling, waste management and disposal of products and packaging (both hazardous and safe). This includes reverse

distribution, which causes the flow of goods and information in a direction opposite to that of normal logistics.
Sustainable reverse logistics is most closely connected with the waste management in company and helps to meet objectives of sustainable development and the requirements of law at the same time. Sustainable reverse logistics represents an important part of logistics processes in industrial enterprise (Fidlerová, 2013).

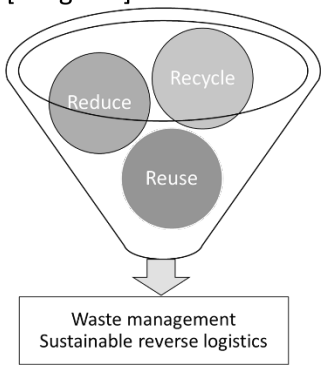
The model of sustainable logistics
[image 21]



Sustainable logistics of industrial enterprise
Source: Fidlerova, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava

	The circular economy taxatomy The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities. The EU taxonomy would provide companies, investors and policymakers with appropriate definitions for which economic activities can be considered environmentally sustainable. The Taxonomy Regulation establishes six environmental objectives • Climate change mitigation • Climate change adaptation • The sustainable use and protection of water and marine resources • The transition to a circular economy • Pollution prevention and control • The protection and restoration of biodiversity and ecosystems It is important for companies to realize that meeting sustainable standards will be directly or indirectly mandatory for more and more entities in the near future, and taxonomy may affect their access to finance, as many investors and banks will only increase their pressure on sustainability and related activities. Reporting sustainability standards will also affect small and medium-sized companies, as large companies will be forced to choose suppliers who meet as much as possible the defined sustainability standards defined by the EU in its new taxonomy. We agree that companies in industrial field that adapt to the transition to sustainability as soon as possible will have a competitive advantage not only in terms of financing, but also their contracts in supplier-customer relationships. Source: Urbinati A., Chiaroni D., Chiesa V.: Towards a new taxonomy of circular economy business models, Journal of Cleaner Production, Vol.168, 1 December 2017, pp. 487-498. Concept of 3R applied in waste management to achieve sustainable reverse logistics The reverse logistics in the context of sustainable development respects the hierarchy of the waste management and the 3R concept: prevention, preparing for reuse, recycling, and other recovery. The concept behind the first R, reduce, means that the number of purchases should be limited. The concept behind the second R, reuse, means that you should reuse items as much as possible before replacing them. The concept behind the third R, recycle means that items or their components are put to some new purpose as much as possible. On top of the waste hierarchy is prevention, which can ensure the protection of the environment and also reduce cost in the company. The second level of waste hierarchy is the reuse of waste and our improvement covers this area.

Concept of 3R applied in waste management to achieve sustainable reverse logistics
[image 22]



https://www.mtf.stuba.sk/buxus/docs/doc/casopis_Vedecke_prace/37/3_Fidlerova_Mlkva_PR.pdf

Circular economy concept in industry
"Circular business models represent fundamentally different ways of producing and consuming goods and services. They have the potential to drive the transition towards a more resource efficient and circular economy and, in doing so, significantly reduce the environmental pressure resulting from economic activity."
published in April 2019 by OECD, https://www.oecd.org/environment/business-models-for-the-circular-economy-g2g9dd62-en.htm
Switching from the current linear model of economy to a circular one would not only bring savings, but also significantly reduce the negative impact on the natural environment.
This is why the circular economy has attracted increased attention as one of the most powerful and most recent moves towards sustainability. The core component of the circular business model is the customer value proposition. Business Models combine three main aspects - environment, resources and economic benefits.
Each country has to find its own way of promoting green investment, and European policy should be built up together.

- Governments can create tax regimes that stimulate good behavioral patterns and punish the bad polluter pays.
- Governments can create the right regulations.
- Tightening environmental regulations is beneficial for greener businesses.
- Public investments in research and development, innovation, are needed to help implement research results in practice

More information at
https://www.oecd.org/environment/business-models-for-the-circular-economy-g2g9dd62-en.htm

Circular economy as motivation

	The circular economy is a way of rethinking our approach to waste. Circular Economy as the union between the environment and the economy, a union which can benefit industry as well as mitigate climate change. [image 23] [image 24] https://the-ficus.org/categorywise.php?cat=Circular%20Economy Today's manufacturing models primarily involve taking raw material from the environment, creating new products, and disposing them after use. This is not a sustainable model. The circular economy is a way of rethinking our approach to every single stage of a product's life cycle. By designing products for long life as well as for reuse and recycling, by shifting towards sharing models, rather than ownership, and by managing waste responsibly, we make our worlds more circular, more sustainable. The task ahead of us is a complicated one, and it involves everyone: industry, governments, international organizations, financial institutions, academia, start-ups, NGOs, and the public at large. We need to change our thinking.
3.2. On way towards to the Industry 5.0	Industry 5.0 - motivation for future sustainable development in industry Sustainability and Industry 5.0 can help all people in the future, but also the planet Earth. The combination of these concepts brings many benefits that motivate people to learn more about the issue. Key motivating factors include environmental protection, human, sustainable development goal, planning, and artificial intelligence. The term Industry 5.0 refers to people who work alongside robots and smart machines. It's about robots helping humans work better and faster by leveraging advanced technologies such as the Internet of Things (IoT) and big data. The vision for the fifth industrial revolution is mass personalisation and customization made possible by cooperation between man and machine, as human and artificial intelligence work together in harmony. In manufacturing environments, robots have historically performed dangerous, monotonous, or physically demanding work, such as welding and painting in car factories and loading and unloading heavy materials in warehouses. As machines in the workplace become smarter and more connected, Industry 5.0 aims to merge those cognitive computing capabilities with human intelligence and resourcefulness in collaborative operations. (Source: https://www.mastercontrol.com/gxp-lifeline/3-things-you-need-to-know-about-industry-5.0/) Development of Industry 5.0 [image 25] https://nickelinstitute.org/en/blog/2020/november/customising-the-future-the-next-industrial-revolution/

	The development of Industry 5.0 has been influenced by technical and technological progress. Despite the fact that Industry 4.0 is not fully implemented in business practice, it was necessary to address the coexistence of man and robot. Based on the available literature, we can place the beginnings of the development of the Industry 5.0 concept in 2020. Industry 4.0 -the rule of robots Allegedly coined by Klaus Schwab, a German engineer, economist and founder of the World Economic Forum (WEF), the concept of Industry 4.0 describes rapid changes in industries, technologies and processes, fueled by the integration of latest tech innovations. Considered by Schwab to be a substantive shift in industrial capitalism, transition to Industry 4.0 is primarily characterized by wide adoption of multiple automation technologies. Such as artificial intelligence (AI), robotics, large-scale machine-to-machine communication (M2M), Internet of Things (IoT), smart automation and interconnection techniques, etc.(Source: https://www.clarify.io/learn/industry-5-0) [image 26] The concept of Industry 4.0 was generated and developed by German Industrial and Academic communities with the support of the German Government with the intention of framing and developing the country's industrial competencies that have been powered by digitization of the production processes in several industrial sectors. (Source: H. Kagerman, W. Wahlster, J. Helbig Securing the Future of German Manufacturing Industry Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0 Final Report of the Industrie 4.0 Working Group (2013), 10.13140/RG.2.1.1205.8966) Industry 4.0 is a concept that emerged for the first time in 2011 with the objective of characterizing highly digitized manufacturing processes where information flows among machines in a controlled environment so that human intervention is reduced to a minimum (Source: J. Qin, Y. Liu, R. Grosvenor: A categorical framework of manufacturing for Industry 4.0 and beyond Procedia CIRP (2016), 10.1016/j.procir.2016.08.005 Sanders et al., 2016 (p. 816), introduce the theme of Industry 4.0 on production dynamics and state that "Industry 4.0 significantly influences the production environment with radical changes in the execution of operations. In contrast to conventional forecast based production planning, Industry 4.0 enables real-time planning of production plans, along with dynamic self-optimization". (Source: Sanders, A.; Elangeswaran, C.; Wulfsberg, J. Industry 4.0 implies lean manufacturing: Research activities in industry 4.0 function as enablers for lean manufacturing. J. Ind. Eng. Manag. 2016, 9, 811–833.) "Industrie 4.0 is a collective term for technologies and concepts of value chain organization. Within the modular structured Smart Factories of Industrie 4.0, Cyber-Physical Systems (CPS) monitor physical processes, create a virtual copy of the physical world and make decentralized decisions. Over the IoT (Internet of Things), CPS communicate and cooperate with each other and humans in real time. Via

	the IoS (Internet of Services), both internal and cross-organizational services are offered and utilized by participants of the value chain". (Source: M. Hermann, T. Pentek, and B. Otto, "Design Principles for Industrie 4.0 Scenarios: A Literature Review," 2015.) [image 27] Source: https://aie-internship.com/where-is-the-industry-4-0-in-our-life-by-busra-guler/ Elements (pillars) of the Industry 4.0 are Source: (https://circuitdigest.com/article/what-is-industry-4-and-its-nine-technology-pillars): 1) Big Data and Data analytics Data analytics, once an IT application is now penetrating into manufacturing and supply chain industry. Power of data analytics and pattern recognition can be harnessed in the manufacturing industry to reduce downtime and wastages. 2) Simulation A simulation, in present day is used to design components that are manufactured. In Industry 4.0, it can be used to simulate a virtual environment of the factory itself with the real time data and analyze the productivity before a change in the factory can be made. This helps engineers to visualize the design in a much better manner consequently helping them identify problems and obstacles in the early stage. 3) Horizontal and Vertical Integration Horizontal integration takes networking among the cyber-physical systems and enterprise systems to an unprecedented level. Every device and system at the same level of manufacturing in the same facility or the other is connected with each other. As this enables communication between systems in different facilities, jobs can be planned and adjusted by the machines themselves. Downtime at a facility can be compensated by overtime at another facility with no human intervention whatsoever Vertical integration makes it even better. Every system and humans at all hierarchy has all the data with required abstraction. Notable challenge faced in vertical integration is the communication protocol. It is insane to expect all the systems to talk the same language which they obviously don't. This can be overcome by using interfaces; Quite a painful job but worth the work. 4) Industrial Internet of Things - IOT IOT is an ecosystem in which all the sensors and actuators with the ability to function separately and communicate with every other element is called IOT. Industrial IOT is the same but with increased ruggedness to survive the harsh environments of the industry.

	5) Autonomous Robots Autonomous robots transfer raw materials, half-finished and completed goods in an easier, faster and smarter way. They operate based on a complex logic algorithm, meaning they don't require any preset path to carry out their duties. These robots catalyze the manufacturing process. The amount of time that can be gained and latency that can be cut down is equal to the amount of time taken to program controlled robots. Unlike the conveyor belt, it is portable and its duty can be varied. 6) The Cloud The cloud is a remote system that can be accessed from anywhere via the Internet. There are many cloud services available today, notable for IaaS, PaaS, SaaS. Communication between machines themselves and between machines and people is largely supported by cloud services. 7) Cyber Security in Industry 4.0 Cyber security becomes the talk of the town since the dawn of Information technology. The greatest nightmare of any information technology firm is having their server and data hacked. Preventing such a catastrophe and safeguarding the data and performance of the server is the sole purpose of cybersecurity. Cyber physical systems means that computers and networks are able to monitor the physical process of manufacturing at a certain process. Internet of Things (IoT) is what enables objects and machines such as mobile phones and sensors to "communicate" with each other as well as human beings to work out solutions. The Internet of Services (IoS) aims at creating a wrapper that simplifies all connected devices to make the most out of them by simplifying the process. Smart Factory can be defined as a factory where CPS communicate over the IoT and assist people and machines in the execution of their tasks. Source: (https://aie-internship.com/where-is-the-industry-4-0-in-our-life-by-busra-guler/) Whats is Industry 5.0 The term Industry 5.0 refers to people working alongside robots and smart machines. It's about robots helping humans work better and faster by leveraging advanced technologies like the Internet of Things (IoT) and big data. The vision for the fifth industrial revolution is mass personalisation and customization made possible by cooperation between man and machine, as human and artificial intelligence work together, in harmony. (Source: https://www.mastercontrol.com/gxp-lifeline/3-things-you-need-to-know-about-industry-5.0/)

	[image 28] In manufacturing environments, robots have historically performed dangerous, monotonous or physically demanding work, such as welding and painting in car factories and loading and unloading heavy materials in warehouses. As machines in the workplace get smarter and more connected, Industry 5.0 is aimed at merging those cognitive computing capabilities with human intelligence and resourcefulness in collaborative operations. (Source: https://www.mastercontrol.com/gxp-lifeline/3-things-you-need-to-know-about-industry-5.0/) Industry 5.0 does not replace Industry 4.0 [image 29] (Source: https://www.sigga.com/blog/industry-4.0-to-industry-5.0) The main idea of Industry 5.0 is to use the technology developed in Industry 4.0 and bring its benefits to human beings. Some places, implementing Industry 4.0 is still a challenge and that it may seem that getting to Industry 5.0 can take years or mixed in with intense cultural transformation. When thinking about the path to Industry 5.0, it may seem that we first have to go through Industry 2.0, 3.0 and, 4.0, but this is not the case. This process is not a ladder. Although not all stages of production can join Industry 5.0 right away, this should not stop you from implementing what is possible with your existing processes. Remember, no matter where you are in your technological journey, Industry 5.0 does not replace what you already have. (Source: https://www.sigga.com/blog/industry-4.0-to-industry-5.0) Industry 5.0 – Definition [image 30] We can find several definitionof Industry 5.0,you can find three of them bellow: (1) Industry 5.0 is a first industrial evolution led by the human based on the 6R (Recognize, Reconsider, Realize, Reduce, Reuse and Recycle) principles of industrial upcycling, a systematic waste prevention technique and logistics efficiency design to valuate life standard, innovative creations and produce high-quality custom products (Source: M. Rada, Industry 5.0 definition, 2020, URL https://michael-rada.medium.com/industry-5-0-definition-6a2f9922dc48.) (2) Industry 5.0, a symmetrical innovation and the next generation global governance, is an incremental advancement of Industry 4.0 (asymmetrical innovation). It aims to design orthogonal safe exits by segregating the hyperconnected automation systems for

	manufacturing and production. (Source: Y.K. Leong, J.H. Tan, K.W. Chew, P.L. Show, Significance of industry 5.0, in: P.L. Show, K.W. Chew, T.C. Ling (Eds.), The Prospect of Industry 5.0 in Biomanufacturing, CRC Press, 2020, pp. 1–20.) (3) Unlike the concept of Industry 4.0, Society 5.0 is not restricted only to a manufacturing sector, but it solves social problems with the help of integration of physical and virtual spaces. In fact, Society 5.0 is the society where the advanced IT technologies, IoT, robots, an artificial intelligence, augmented reality (AR) are actively used in people common life, in the industry, health care and other spheres of activity not for the progress, but for the benefit and convenience of each person.(Source: Society 5.0: Japan's digitization http://www.cebit.de/en/news-trends/news/society-5-0-japans-digitization-779) Industry 5.0 versus Industry 4.0 In short, the main difference of Industry 5.0 concept in comparison to Industry 4.0 is focus on adding the “human touch” to the machines and utilizing new technologies for better empowerment of human workers. And even though Industry 5.0 is a new step in the development of industrial automation (or at least it is expected to be that new step), you could also say that this concept is in many ways anti-industrial. (Source: https://www.clarify.io/learn/industry-5-0) [image 31] (Source: https://www.frost.com/frost-perspectives/industry-5-0-bringing-empowered-humans-back-to-the-shop-floor/) Industry 5.0 promotes Quality of Life, Inclusion and Sustainability As much as Industry 4.0 has brought us great technological advances, Industry 5.0 shows us that technology, by itself, is not the answer to everything. With people at the center of processes, Industry 5.0 focuses on three increasingly important aspects: quality of life, inclusion, and sustainability. Industry 5.0 aims to make workers’ lives safer and more comfortable, while ensuring access to technologies that enable automation and increase productivity. Industry 5.0’s human approach to technology emphasizes the contributions of the individual while creating a more inclusive space in the labor market, as well as in the access o products and services. [image 32] Industry 5.0 helps people understand that technology is an essential tool for developing and engaging in sustainable practices by caring for the environment, protecting the world’s ecosystems, and making the best use of available resources for current and future generations. Take a moment to look around and notice how these aspects have become everyday topics and have promoted a profound change in our approach to business, production, and our way of living. (Source: https://www.sigga.com/blog/industry-4.0-to-industry-5.0) The core of an Industry 5.0 approach and brings together three key systems principles, that can be summarised as: ● Design out waste and pollution.

	● Keep products and materials in productive use and circulation. ● Regenerate natural systems and enhance carbon sinks. European Commission, Directorate-General for Research and Innovation, Renda, A., Schwaag Serger, S., Tataj, D., et al. (2022) Industry 5.0, a transformative vision for Europe : governing systemic transformations towards a sustainable industry. https://data.europa.eu/doi/10.2777/17322 Interconnection for industry, sustainability and sustainable development Key drivers for interconnection of industry and and sustainability based on our Vosviewer analysis of the previous research are sustainable development, Industry 4.0, innovation, planning, economic and social effects (see figure below). If you are more intersted in Industry 5.0 concept you can find more by reading recommended literature. [image 33]
3.3 Agile project management	Agile methodologies „An agile methodology is a project management practice that promotes a collaborative, iterative and incremental approach to project management“. (Singh, 2020) The first signs of agile methodologies appeared in the late of 80’s, when it was observed by certain researchers that projects when using small and multidisciplinary teams, combining with Toyota’s production, by others called Lean, allowed to reduce the number of developed systems that were ultimately not used and also increased the perception of the quality of customers. But it was in 2001 that Agile Methodologies officially emerged. (Gouveia, 2015) The Agile methodology is a way to manage a project by breaking it up into several phases. It involves constant collaboration with stakeholders and continuous improvement at every stage. Once the work begins, teams cycle through a process of planning, executing, and evaluating. Continuous collaboration is vital, both with team members and project stakeholders. [image 34] Agile's four main values are: •Individuals and interactions over processes and tools; •Working software over comprehensive documentation; •Customer collaboration over contract negotiation; •Responding to change over following a plan. There are various Agile methods present in agile testing (Krishna, s.d.).

Agile Manifesto

In February 2001, in the U.S. state of Utah, seventeen personalities met to improve the performance of their projects in the software industry, thus arising the Agile Manifesto (Fernandes, 2016).

The document briefly lists the characteristics of agile methods compared to traditional ones. Thus, in this document it was defined the 12 agile principles to follow in the development of agile management, these being (Ribeiro, 2018):

1. The highest priority is to satisfy the customer and maintain a continuous and anticipated delivery of value-added software;
2. Accept changes to requirements even if they appear late in the development phase. Agile processes promote changes and competitive advantages for the client;
3. Deliver the working software frequently, from a few weeks to a few months, giving preference to the shorter calendar;
4. Executives and employees must work together daily throughout the project;
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done;
6. The most efficient method to deliver information, whether to the team or between the team, is through face-to-face;
7. The primary measure of project progress is the operation;
8. Agile processes promote sustainable development. Sponsors, developers and users should be able to maintain a steady pace indefinitely;
9. Continuous attention to technical excellence and good design increase agility of the project;
10. Simplicity, such as the art of maximizing the amount of work to do, is essential;
11. The best architecture, requirements and design arise from teams that have the autonomy to organize themselves;
12. At a regular interval, the team reflects on how to become more effective, adjusting and improving processes accordingly.

[image 35]

https://www.scrumalliance.org/_scrum/downloads/L_how_businesses_thrive_digital.pdf?fbclid=IwAR13eV3VXHzH3N0aZCLjk6d2r2nu2eHPynioT8Brpd0vkqCRRIzrm7vx7cw

5 advantages of using an agile methodology

1. Improved quality (Singh, 2020)

- When using an agile methodology, teams can breakdown projects into sprints and collaborate with one another to provide high-quality results.
- This method allows teams to deal with common project pitfalls such as managing costs, scope creep, and not respecting deadlines.
- Moreover, there is a testing phase for every task which allows teams to identify and solve issues quickly to avoid any long-term negative consequences.

	2. Speed and flexibility (Singh, 2020) : • The second benefit of using agile is its speed and flexibility thanks to a Scrum framework. • This practice places change at the heart of its development. If there is a deviation from the initial objectives, the approach and processes are immediately adapted to meet the new needs. • The Scrum method was originally designed for software development teams and their technical projects. However, today, it can be used for a wide range of projects, especially in marketing. • Scrum is one of the most used agile methods because it can be set up very quickly. Furthermore, it is based on an empirical approach, allowing self organizations to make room for changes as your project grows. 3. Complete visibility of the progress of each project in real-time (Singh, 2020) : • Another advantage of using an agile approach is the transparency of each project thanks to frequent exchanges with clients. This allows them to feel more involved and ask for changes throughout the project. • Moreover, the teams that are involved can show their progress to the client along with the obstacles that they have encountered. • This establishes a relationship of trust and collaboration between the team and the client and can lead to improved customer satisfaction and higher business value. 4. Stakeholders engagement (Singh, 2020): • A key part of using an agile method is the involvement of stakeholders when completing projects. • By collaborating with different stakeholders during each phase of the project, you will build a dynamic system based on the trust and confidence of each team member and forge stronger relationships within your teams. • To use this method effectively, it is recommended to have stakeholders participate actively as the project progresses. This will allow them to make make sure that tasks are being completed according to the plan and make changes if necessary. 5. Cost control (Singh, 2020): • An agile method can also be used to improve cost control. After each stage, the team reviews the budget when making future decisions. Then, they decide if they will continue, suspend or cancel tasks or even the project itself. • This is an essential part of project management as it allows teams to understand the costs of each feature with simplicity, which will then be taken into account when making strategic decisions. Agile Project Management There are a lot of advantages of implementing an agile methodology. According to (Universia Portugal, 2018), the top 3 advantages are: 1.Flexible Management Philosophy: Agile provides a broad spectrum of techniques applicable during the management of a project, providing a flexible philosophy that adapts to the constant changes undergone by projects of any type. Flexibility allows the companies to improve available resources and maximize results. 2.Fully Adaptable Planning: Under an agile approach, a project is executed based on interactions and planning is fully adaptable to new requirements that arise as it progresses.

	3.Use of the Most Modern Technological Tools: The present advance of the technological tools used in the development and management of projects is an added value. In working groups, it is usual to use project management platforms, where, for example, prototypes are shared, opinions are exchanged, tasks are prioritized and meeting are scheduled, such as Trello, Asana, Icescrum, and others. In a quantitative aspect, some studies suggest that agile methodologies reduce 77% of costs, 62% of effort and also 80% of critical failures. In addition, it improves 91% of the meeting schedule, 97% of productivity and increases 400% the satisfaction (Viana, 2017). According to Project Management (PMI), companies that apply agile approaches in the management of their projects increase total benefits by up to 30% and increase profit by 37% faster than those who don't (Universia Portugal, 2018). Agile works best when •You can't estimate the time you'll need and don't know the full scope of requirements. •You don't know whether there's a need on the market for your software. •You can't map out the business needs, so the design needs to emerge through trial and error. •You have unlimited access to your customer who's ready for extensive involvement. •You can afford to iterate and don't need to deliver fully functional software at once. •Neither you nor your client has a complex bureaucracy that delays decision-making. •Clients don't have a fixed budget/schedule. •You need to capture the market before there's any competition. •Your customers don't have trouble updating their software (or don't even notice it, e.g., they use a web app). Agile Method Disadvantages Although there are many advantages to using an agile methodology, there are also a few disadvantages that you should consider before using one: • it can be difficult to predict efforts such as cost, time, and resources at the beginning of the project • it can be difficult to measure progress since agile methods deliver in increments • it can be difficult to implement since people naturally resist changes • teams can get sidetracked if they don't see any progress Disadvantages of Agile Project Management One disadvantage pointed to Agile Project Management is that they are not scalable. In fact, these were not designed for very long projects. "Agile development is more difficult with larger teams. The average project has only nine people, well within the reach of the most basic agile processes. Nevertheless, it is interesting to occasionally find successful agile projects with 120 or even 250 people" (Tomás, 2009).

	AGILE METHODOLOGY VS WATERFALL: WHICH IS RIGHT DEVELOPMENT METHODOLOGY FOR YOUR PROJECT? [image 36] Literature Boggs, M. (n. d.) SUSTAINABLE AGILITY: How businesses thrive in an era of change and disruption. https://www.scrumalliance.org/_scrum/downloads/L_how_businesses_thrive_digital.pdf?fbclid=IwAR13eV3VXHzH3N0aZCLjk6d2r2nu2eHPynioT8Brpd0vkqCRRIzrm7vx7cw Fernandes, D. L. (2016). Implementação de uma Ferramenta de Gestão de Projetos numa Consultora. Universidade do Porto, Faculdade de Engenharia. Gouveia, D. R. (2015). An Essay on Agile Project Management Practices. Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia. Hazevytch, L. (2020) WHAT IS AGILE? https://devcom.com/tech-blog/agile-advantages-for-business/ Hristovski, T. (2017) Agile methodologies: Kanban Vs Scrum – Advantages and Disadvantages. https://iwconnect.com/agile-methodologies-scrum-vs-kanban-advantages-disadvantages/ Krishna. (n.d.). Agile Methodology: What is Agile Software Development Model? Retrieved from Guru 99: https://www.guru99.com/agile-scrum-extreme-testing.html Olic, A. (2020) Advantages and Disadvantages of Agile Project Management [Checklist]. https://activecollab.com/blog/project-management/agile-project-management-advantages-disadvantages Ribeiro, A. F. (2018). Aplicação de uma metodologia ágil de desenvolvimento de software numa organização do sector público. Instituto Universitário de Lisboa, Departamento de Ciências e Tecnologias da Informação. Singh, R. (2020) 5 Advantages & Disadvantages of using an Agile Methodology, https://www.appvizer.co.uk/magazine/operations/project-management/advantages-of-agile-methodology Universia Portugal. (2018, October 10). 3 vantagens das metodologias ágeis na gestão de projetos. Retrieved from Universia Portugal: https://noticias.universia.pt/emprego/noticia/2018/10/10/1160968/3-vantagens-metodologiasageis-gestao-projetos.html

3.4 Materials and sustainablity : key drivers of Innovation	Innovative materials and sustainability: key drivers for Innovation https://youtu.be/9glOwT20zJ4 In this video presentation, you will be introduced to the knowledge and importance of innovative materials as key driver of innovation in companies and societies. Also, the video will give you a specific definition of sustainable innovation and some significant examples of companies that are investing in sustainabilty as key growth and innovation driver Innovative materials and sustainability Materials and Sustainability_KeyDrivers_for_Innovation.pdf
3.5 CASE! Incorporating the SDGs as part of strategy in industrial enterprise	Lyreco CE, SE Company Lyreco was founded in 1926 in France. Lyreco CE, SE has been operating in Slovakia since 2006. Lyreco CE, SE is an industrial company located in in Pezinok, Slovakia and belongs to Lyreco group which is European leader and third largest distributor of workplace products and services in the world. Lyreco has branch stores in 25 countries in Europe and Asia and can be seen as an innovating company as Lyreco constantly adapting to the evolution of workplace by focusing on excellence in customer experience and strong partnership and collaboration with renowned suppliers and efficient logistics (https://lyreco.com/group/ce/sk) This company aims at the sustainbility in its visio and mision. MISSION: “To simplify life at work.” VISION: “All you need at work: think Lyreco” [image 37] Fig. 2 Global player, local market expert (https://lyreco.com/group/about/lyreco-international-footprint) Informal association of companies Business Leaders Forum (BLF) brings together companies that are committed to being leaders in promoting the principles of corporate responsibility (CR, resp. CSR) in Slovakia. Lyreco is one of the member and supporter of BLF. Company officially made CSR a pillar of its business in 2012. The company's corporate social responsibility strategy covers 6 main pillars: the environment, the economy, people, ethics and sustainability in the supply chain, risk management and support, and community support (https://www.blf.sk/clenske-firmy-blf/, https://lyreco.com/group/lyreco-corporate-social-responsibility/csr-strategy). In the area of SUSTAINABLE DEVELOPMENT GOALS defined by United Nations in 2015, Lyreco CE, SE focuses on supporting 4 Sustainable Development Goals (Fig. 3 – https://lyreco.com/group/about/lyreco-international-footprint): [image 38] Fig. 3 Sustainable Development Goals supported by Lyreco

	Lyreco declares the fulfilment of the individual sustainable development goals as follows (https://lyreco.com/group/lyreco-corporate-social-responsibility/sustainable-development-goals): Decent work and economic growth: „Lyreco offers an extensive range of workplace products under its own private label. Ensuring that its manufacturers and importers respect human rights and the environment throughout the supply chain is of utmost priority. These requirements are applied in all our subsidiaries. Suppliers that would not comply with Lyreco policy in this field are black-listed“. Responsible consumption and production: „From paper to plastic items such as pens and office stationery, most workplace supply have a short lifespan, are disposable and natural resource consuming. Promoting to all our customers worldwide always more sustainable products and solutions is one of Lyreco major commitments for many years “. Climate action: “Reducing CO2 emission across the entire value chain, from our suppliers to our customers, is a priority goal in our efforts to mitigate Lyreco environmental impact and contribute to our customers' own objectives in this area“. Quality education: „Education is a long term commitment and a cause supported across all Lyreco subsidiaries“.
3.6 CASE! GREEN BUILDINGS	Critical Role of the Construction Industry in Achieving the Sustainable Development Goals As mentioned before, whether in new construction or in the field of renovation, the use of sustainable materials and construction techniques that enable energy sustainable building is very important. As a main motivation we can give a number of facts about EU context buildings: • Today, roughly 75% of the EU building stock is energy inefficient. • Collectively, buildings in the EU are responsible for 40% of our energy consumption and 36% of greenhouse gas emissions, which mainly stem from construction, usage, renovation and demolition. Source: https://ec.europa.eu/info/news/focus-energy-efficiency-buildings-2020-lut-17_en So we can say that the construction industry has a critical role in achieving the SDGs. You can learn more about that in next article: https://mdpi-res.com/d_attachment/sustainability/sustainability-13-09112/article_deploy/sustainability-13-09112-v2.pdf?version=1629109118 [image 39] The contribution of green buildings to the SDGs is extensive. You are invited to read the following articles and write down the conclusions in your learning diary (The Learning Diary will be here). 1. Green building and the UN Sustainable Development Goals: https://elemental.green/what-are-the-17-un-sdgs/ [image 40]

	1. Contribution of Passive House to SDGs: https://passipedia.org/basics/passive_house_and_the_sustainable_development_goals [image 41]
3.7 VOTE! Best motivation for sustainability challenge	VOTE! Motivation for change towards sustainability and SDGs Which of following trends has most important influence on sustainability and SDGs implementation in industry, material and energy sector from following? ○ Industry 4.0 /Industry 5.0 ○ Reverse flow / Waste management ○ Circular econonomy ○ Renewable energy ○ Other
3.8 Typical measures for buildings renovation and use of Renewable Energy systems	Typical measures for building renovation and use of Renewable Energy Systems (RES) The building sector is crucial for achieving the EU's energy and environmental goals. Renovation of existing buildings can lead to significant energy savings, up to real 70% of existing consumption. This presentation aims to motivate you to consider the environmental and economic impact of taking the path of energy saving and efficiency, giving straight reccomendations on how to implement renewable energy systems in buildings. Typical measures for building renovation and use of RES https://page.itslearning.com/Files/19015918/Typical+measures+for+buildings+renovation+and+use+of+RES.pdf
3.9 Sustainable competitiveness of the company	https://www.temjournal.com/content/52/TemJournalMay2016_241_247.html DESCRIPTION Sustainable competitiveness and sustainable competitive advantage Collapse sidebar
3.10 Financial solutions in building renovation	Financial solutions in building renovation Building renovation is turning into a sector of great economic and business opportunities, thanks to a series of legislative instruments and financial incentives that, at EU level, are making it increasingly convenient. This presentation will help orient you in the context of this renewed framework, which offers new opportunities while respecting the environment and contributing to the achievement of sustainability goals. The presentation focuses on the financial instruments that support the building renovation sector. Financial solutions in building renovation

	https://page.itslearning.com/Files/19015919/Financial+solutions+in+building+renovation.pdf
3.11 Literature	European Commission, Directorate-General for Research and Innovation, Renda, A., Schwaag Serger, S., Tataj, D., et al., Industry 5.0, a transformative vision for Europe : governing systemic transformations towards a sustainable industry, 2022, https://data.europa.eu/doi/10.2777/17322 Boggs, M. (n. d.) SUSTAINABLE AGILITY: How businesses thrive in an era of change and disruption. https://www.scrumalliance.org/_scrum/downloads/L_how_businesses_thrive_digital.pdf?fbclid=IwAR13eV3VXHzH3N0aZCLjk6d2r2nu2eHPynioT8Brpd0vkqCRRIzrm7vx7cw Richnák, P.; Fidlerová, H. Impact and Potential of Sustainable Development Goals in Dimension of the Technological Revolution Industry 4.0 within the Analysis of Industrial Enterprises. Energies 2022, 15, 3697. https://doi.org/10.3390/en15103697 Šnircová, J., Fidlerova, H., Božíková, L. (2016) Sustainable Global Competitiveness Model as a New Strategic Opportunity for the Companies in Slovakia' TEM Journal; Vol 5, No 2, 2016. ISSN 2217-8309. doi: 10.18421/tem52-19 , https://www.temjournal.com/content/52/TemJournalMay2016_241_247.html Fernandes, D. L. (2016). Implementação de uma Ferramenta de Gestão de Projetos numa Consultora. Universidade do Porto, Faculdade de Engenharia. Gouveia, D. R. (2015). An Essay on Agile Project Management Practices. Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia. Hazevytch, L. (2020) WHAT IS AGILE? https://devcom.com/tech-blog/agile-advantages-for-business/ Hrsitovski, T. (2017) Agile methodologies: Kanban Vs Scrum – Advantages and Disadvantages. https://iwconnect.com/agile-methodologies-scrum-vs-kanban-advantages-disadvantages/ Krishna. (n.d.). Agile Methodology: What is Agile Software Development Testing? Retrieved from Guru 99: https://www.guru99.com/agile-scrum-extreme-testing.html Olic, A. (2020) Advantages and Disadvantages of Agile Project Management [Checklist]. https://activecollab.com/blog/project-management/agile-project-management-advantages-disadvantages Ribeiro, A. F. (2018). Aplicação de uma metodologia ágil de desenvolvimento de software numa organização do sector público. Instituto Universitário de Lisboa, Departamento de Ciências e Tecnologias da Informação.

	Singh, R. (2020) 5 Advantages & Disadvantages of using an Agile Methodology, https://www.appvizer.co.uk/magazine/operations/project-management/advantages-of-agile-methodology https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/industry-50_en https://michael-rada.medium.com/industry-5-0-definition-6a2f9922dc48 https://www.sigga.com/blog/industry-4.0-to-industry-5.0
Learning Diary – Motivation	Have you completed this task? YesNo Description From the definitions presented in this section write a short description on which are the goals and activities where SDG's are directly impacting on your business in your operational field and your own company. The writing can be in a form of an essay for your advertisement or for your internal communication. Now it's time to go to your Learning Diary  Open a Blog where the Learning Diary will be created from here. It will be opened into a new browser tab so you can keep it open as you go further.

4. Resources and networks

Page	Content
DESCRIPTION	[image 42] In this section are introduced resources in energy, industrial and material sector supporting sustainable value creation. Important part are networks for business opportunities related to SDGs in energy, industrial and material sector. LEARNING OBJECTIVES Learner is able to understand the importance of managing resources in energy, industrial and material sector supporting sustainable value creation. Learner is able to recognize/build networks for business opportunities enhancement in energy, industrial and material sector. Introduction to the Networks and Resources section Welcome to the Networks and Resources section The main objectives of this section are as follows: Firstly, you will recognize different networks involved in material flows. Secondly, you will understand different roles of network entities and how to build co-operation between them.

	In order to meet the first objective, it is important to recognize the circular economy flows fall in two categories and the differences between them. Understanding the role of relevant network partners, actively searching for network partners and collaboration with them is essential. In this section we will encourage you to map your own material networks to create sustainable value. We encourage to use the collaboration too introduced in the module 1 to facilitate collaboration between different types of organizations. Enabling circular economy requires collaboration on many levels between various organizations! Enjoy this section!
4.1 Resources and network in Circular Economy.pdf	https://sdg4biz.itslearning.com/plans/courses/53/plan/385/resource/2266?BackDestination=5&planner2-sb-collapsed=false **Learning Diary: Reflections on material resources and networks** Have you completed this task? YesNo Description Now it's time to go to your Learning Diary  Open a Blog where the Learning Diary will be created from here. It will be opened into a new browser tab so you can keep it open as you go further.

5. Business modelling

Page	Content
5.1 Business Models in Green Energy	[image 43]

DESCRIPTION
This section reports succesful case studies for business opportunities in SD and SDGS in the Green Energy Sector (Energy green and renewable energies: biogas, wave energy, solar energy, geothermal, etc.).

LEARNING OBJECTIVES
The learner is able to recognize specific SDGs for green and sustainable energy.

The learner understands how these SDGs are relevant for business opportunities recognition in green energy.

The learner identifies and understands which are todays solutions and resources for Green Energy in Europe.

The learner recognizes and understands differences and similarities in Green energy business models in different EU countries.

RESOURCES AND ACTIVITIES
5.1.1 Ground source heat pump systems

	5.1.2 Examples of Green Energy solutions
5.1.1 Ground source heat pump systems	Ground source heat pump systems The presentation will introduce a high efficient system that allows to produce heat, cold and domestic hot water by exploiting the heat exchange with the ground. Geothermical energy is classified as a renewable source and offers great opportunities of cheap energy production and consumption. Ground source heat pumps https://page.itslearning.com/Files/19015921/Ground+Source+Heat+Pumps.pdf
5.1.2 Examples of Green Energy solutions	Interview with Gasmet Technologies Ltd SDG4BIZ project's interview (ID 24332) _gasmet_Tecnology_Ltd.pdf Interview with Gasmet Technologies Ltd- Podcast - Finnish language https://page.itslearning.com/Files/19015922/Gasmet+podcast_introlla.mp3
5.2 Business Models in Circular industry	[image 44]  DESCRIPTION

	This section reports succesful case studies for business opportunities in SD and SDGS in the Circular Economy Sector specifically related with industry LEARNING OBJECTIVES The learner is able to recognize SDGs specific for the Circular Economy sector The learner understands how these SDGs are relevant for business opportunities recognition in the Circular Economy sector. The learner is able to identify, understand and recognize business models (case studies) in the Circular economy sector (Automotive, manufacturing, design of products, waste management, reuse, recycle) RESOURCES AND ACTIVITIES 5.2.1 CASE STUDY! Circular economy in the company AfB Slovakia s.r.o 5.2.2 CASE STUDY! Innovative solution Ecocapsule
5.2.1 CASE STUDY! Circular economy in the company AfB Slovakia s.r.o	CASE STUDY ! Circular economy in the company AfB Slovakia s.r.o AfB Slovakia s.r.o Trnava, Slovakia https://www.afb-group.sk/en/ https://www.youtube.com/watch?v=QDfFZBBRHEY
5.2.2 CASE STUDY! Innovative solution Ecocapsule	Ecocapsule® ORIGINAL, Slovakia Beautiful, fully off-grid, smart, self-sustainable micro-unit, powered only by solar and wind energy. It allows you to stay in remote places out of reach of urban networks. Ecocapsule® offers a design way to fully equipped independent mid-term accomodation for one or two people usable as a cottage, pop-up hotel, mobile office, research station or anything you want it to be. More information can be find online https://www.ecocapsule.sk/ Watch videos to learn more about this successfull innovative concept. The Story of Ecocapsule https://www.youtube.com/watch?v=_uvl_qX5u78 Ecocapsule Innovation in Technology

	https://www.youtube.com/watch?v=lTrLB6MvRxU Live and work off-grid, with Ecocapsule https://www.youtube.com/watch?v=H12A6fVhB48
5.3 Business Models in innovative materials	[image 45]  DESCRIPTION This section reports successful case studies and potential for business opportunities in SD and SDGS in the Innovative and sustainable materials sector. LEARNING OBJECTIVES The learner is able to recognize sustainability area and SDGs specific for the sustainable and innovative materials sector. The learner understands how these SDGs are relevant for business opportunities recognition in the sustainable and innovative material sector. The learner is able to identify, understand and recognize business models and business potentiality in the sustainable and innovative material sector through successful case studies and through business trends analysis in different countries in the field of smart and green materials.

	RESOURCES AND ACTIVITIES 5.3.1 Innovative materials and industrial applications 5.3.2 Contemporary architecture: new challenging opportunities for smart materials 5.3.3 Smart Materials in green buildings: opportunities and potential 5.3.4 Ecomaterials and sound proofing solutions in green building
5.3.1 Innovative materials and industrial applications	Innovative materials and industrial applications https://youtu.be/EzFMSK6eCtg In this video you will see different examples of innovative materials and you will learn their potential industrial application. Innovative materials are constantly evolving with scientific and industrial researches. The video will tell you about new trends and uses and you will understand potential business applications and opportunities. Innovative materials and industrial applications https://page.itslearning.com/Files/19015924/Innovative+Materials+and+Industrial+applications.pdf
5.3.2 Contemporary architecture: new challenging opportunities for smart materials	Contemporary architecture: new challenging opportunities for smart materials https://youtu.be/76SJSTK3Rcw Through this video you will learn about new trends in contemporary architecture. You will see examples where innovative materials, new construction tecniques and sustainable approaches combine to create stunning buildings, as front-runners of new concepts for the whole building sector, based on energy efficiency and disrupting materials. The video will give you inspiration to approach the challenging sector of the smart materials, considering it as an open field of potential business opportunities. Contemporary architecture: dynamism of shapes https://page.itslearning.com/Files/19015925/Contemporary+architecture_new+challenging+opportunities.pdf
5.3.3 Smart Materials in green buildings: opportunities and potential	Smart materials in green buildings https://youtu.be/0oclItItQpV8 https://youtu.be/z-g4IinRI2o In these 2 video you will learn how smart and innovative materials are a great opportunities for the green building sector to increase the sustainability of new constructions and to achieve better solutions and results in terms of energy efficiency, reduction of emission and pollutants. The video will explain you the characterics of new materials, specifically polymers and thermocromic – related materials, and how they can help fostering the green building sector. Smart materials in green building: Polymers

	https://page.itslearning.com/Files/19015926/Smart+Materials+in+green+buildings_Polymers.pdf Smart materials in green building: thermochromic effect and solutions https://page.itslearning.com/Files/19015927/Smart+Materials+in+green+buildings-+Thermochromic+effect+and+solutions.pdf
5.3.4 Ecomaterials and sound proofing solutions in green building	Ecomaterials and sound proofing solutions in green building https://youtu.be/3IU8kiZkvxA https://youtu.be/D-lhT2lBW9Q https://youtu.be/02ZTuSeE4UE These 3 videos will teach you about the Sound management in green building. Acoustic well – being is one of the key concepts of green building and it has a great importance in terms of innovative and eco materials development. The videos first introduce general concepts about acoustic and sound management. They will then provide specific indication about eco materials, their caracteristics and they functionalities. The 3 presentations are related to new business opportunities specifically adressing the development of the green building sector. Sound management in green building https://page.itslearning.com/Files/19015929/Sound+management+in+green+building.pdf
5.4 Business Models in sustainable building	[image 46]

DESCRIPTION
This section reports succesful case studies for business opportunities in SD and SDGS in the sustainable building sector

LEARNING OBJECTIVES
The learner is able to recognize SDGs specific for the sustainable building sector
The learner understands how these SDGs are relevant for business opportunities recognition in the sustainable building sector.

The learner is able to identify, understand and recognize business models (case studies) in the sustainable building sector through successful case studies in different EU countries.

RESOURCES AND ACTIVITIES
5.4.1 CASE STUDY! TKNIKA - Spain
5.4.2 CASE STUDY! NeoClass + Project
5.4.3 CASE STUDY! The Fenice Foundation Green Energy Park - Padova - Italy
5.4.4 CASE STUDY! The Crowfunding Arena in the Fenice Green Energy Park
5.4.5 CASE STUDY! The A+ House

	5.4.6 Bibliography and Resources Learning diary - Business Models
5.4.1 CASE STUDY! **TKNIKA – Spain**	CASE STUDY: TKNIKA TINY HOUSE "A collaborative space for research-innovation and training in Sustainable and Intelligent Construction" The TKNIKA TINY HOUSE project proposes to analyze the necessary skills and form the relevant training according to the "Standar Passivhaus", which conforms to the European directive of almost zero buildings (directive 2012/27 / EU of the European Parliament and the council, of 25 October 2012 on energy efficiency (DEE)) and therefore, considered the future standard of European construction. Likewise, the best validation of a training in the Passivhaus method is to test with the practical execution of a singular prototype, with specific conditions. All this knowledge would open the way to expand the options of the Passive, Intelligent and Efficient construction, towards Self-Sufficient Energy Construction, known as "POSITIVE HOUSE". On the other hand, Intelligent Construction is the immediate future and this project is intended to be approached from an integral and multidisciplinary point of view to accelerate and increase the inclusion of the best possible solutions and technological systems in the building, with the aim of achieving more buildings efficient, safe, functional and accessible, as well as integrating buildings in the city. Therefore, it is proposed to make a mobile Tiny house: • what is a niche market in our country • that it is a real model of informative action to launch and obtain maximum social diffusion and work projection around the key to energy saving, which is the low energy demand • which is the base samples exportable to other building typology https://youtu.be/9RVFQcmmzkk?list=PLOYSs5_FlYNvlG6IpYStNpj-jVITPmJQR CASE STUDY: ENEGUR GREEN BUILDING PROJECT In USURBILGO LANBIDE ESKOLA, we have developed the GREEN BUILDING PROJECT called ENEGUR (From basque, where ENERGIA means energy and EGURRA means wood). [image 47]

	The combination of wood with reactive materials, such as zeolite and cavasite, and reactive hemp-clay plaster, allow the structure to absorb pollutants in the air, thus performing a purifying function. Moreover, the building uses the most advanced technologies in terms of termo – acoustic insolation. The Crowdfunding Arena A case study - Crowdfunding Arena in Fenice Green Energy Park.pdf https://page.itslearning.com/Files/19015937/A+case+study+-+Crowdfunding+Arena+in+Fenice+Green+Energy+Park.pdf
5.4.5 CASE STUDY! The A+ House	The A+ House project This presentation will show you the case of the A+ House project, developed by Fenice Foundation within its Green Energy Park in Padova, Italy. The A+ House project is a good example in the field of energy-efficient construction in sustainable building. It aimed to identify an "Integrated Construction Process Model" to optimize the outcome by containing production costs of a construction system (the “green building system”) still limited by costs that reduce its competitiveness in the market. The A+ House project Biobuilding and the A+ House project.pdf https://page.itslearning.com/Files/19015938/Biobuilding+and+the+A%2b+House+project.pdf
5.4.6 Bibliography and Resources	**Bibliography and Resources** Fei, W., Opoku, A., Agyekum, K., Oppon, J.A., Ahmed, V., Chen, C. and Lok, K.L., 2021. The Critical Role of the Construction Industry in Achieving the Sustainable Development Goals (SDGs): Delivering Projects for the Common Good. Sustainability, 13(16), p.9112. Staniaszek, D., Kockat, J. and Vitali Roscini, A., 2020. A Review of EU Member States 2020 Long-Therm Renovation Strategies. BPIE: Brussels, Belgium. Guidelines EN: https://passivehouse-international.org/index.php?page_id=80 Requierements EN: https://passivehouse.com/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm Concept passivhaus, guide (ES): https://passivehouse-international.org/upload/Guia-del-Estandar-Passivhaus-fenercom-2011.pdf Green building materials: https://buildingmaterials.com.my/ideas/15-green-building-materials-in-sustainable-construction Constructive elements catalogue (ES): https://www.passivehouse-international.org/index.php?page_id=569 https://issuu.com/kadk/docs/aechitecture_guide_un17_vol.2_web_single_pages

	Enegur: http://www.lhusurbil.eus/web/Ficheros/ENEGUR%20project%20-%20USURBILGO%20LANBIDE%20ESKOLA%20(2).pdf
Learning diary - Business Models	 Have you completed this task? YesNo Description From the case studies presented in this section write about what business opportunities you detect in your environment related to green or passive houses. The writting can be in a form of an essay for your advertisment or for your internal communication. NOTE: The Learning Diary will be here (this link won't work if you have not done previously described activation). When you click the link the learning diary blog will be opened into a new browser tab. When you make a new post click "Add blog entry". In some cases you will be recommnded to give the blog post a specific title.

6. Next steps

You have completed the module	**Congratulations, you completed Module 4 of the SDG4BIZ training course!**

Annexes

The annexes contain additional, links, slides and lecture slides, which can be used either as part of classroom teaching or to build a recorded lecture for online teaching. The links have been compiled in 2021 - 2022 and have not been updated since then.

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D7 Module 4: Business opportunity recognition Energy, mat links

section-block index	Block title	content	link	Own production
1.1.	Relevant SDG's for the Energy and Material sector	Video: A New Take on the Sustainable Development Goals - Johan Rockström	https://youtu.be/e-dwko8L1E8	
1.2.	Relevant SDGs for Industry	Website: The 17 Goals	https://sdgs.un.org/	
1.2.	Relevant SDGs for Industry	PDF: The metals industry and the Sustainable Development Goals: The relationship explored based on SDG reporting	https://www.sciencedirect.com/science/article/pii/S0921344921006893?via%3Dihub	
1.2.	Relevant SDGs for Industry	PDF: Dialogue between epistemologies as quality aducation. Integrating knowledges in Sub-Saharan African classrooms to foster sustainability learning and contextually relevant education	https://www.sciencedirect.com/science/article/pii/S2590291121000966?via%3Dihub	
1.2.	Relevant SDGs for Industry	Article: The Challenge of Sustainable Development Goal Reporting: The First Evidence from Italian Listed Companies	https://www.mdpi.com/2071-1050/12/8/3494	
1.2.	Relevant SDGs for Industry	PDF: SDG 8: Decent work and economic growth - A gendered analysis	https://www.sciencedirect.com/science/article/pii/S0305750X18303309?via%3Dihub	
1.2.	Relevant SDGs for Industry	PDF: Adaptation of the Product Structure-based Integrated Life cycle Analysis (PSILA) technique for carbon footprint modelling and analysis of closed-loop production systems	https://www.sciencedirect.com/science/article/abs/pii/S0959652615013232?via%3Dihub	

1.3.	Targets of SDG relevant for Industry	Website: SDG 12 Ensure sustainable consumption and production patterns	https://sdgs.un.org/goals/goal12	
1.3.	Targets of SDG relevant for Industry	Website: SDG 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	https://sdgs.un.org/goals/goal9	
1.3.	Targets of SDG relevant for Industry	Website: SDG 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	https://sdgs.un.org/goals/goal8	
1.3.	Targets of SDG relevant for Industry	Website: SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	https://sdgs.un.org/goals/goal4	
1.5.	Additional reading SDGs relevant for energy, industry and materials	PDF: Systematic prioritisation of SDGs: Machine learning approach	https://filecache.itslearning.com/prod.eu-central-1.filerepo/f784/75ec-ba38-4f34-b285-22eed34a9623?response-cache-control=max-age%3D900&response-content-type=application%2Fpdf&response-content-disposition=inline%3B%20filename%3D%221-s2.0-S0305750X2030396X-main.pdf%22%3B&version=1&isDownloadRequest=0&expires=2023-03-28T13%3A05%3A17Z&sign=tEP2J8WRfhaeKlNjjAORgvoBvm8OY2mKtx8yGmuy97o%3D	

1.5.	Additional reading SDGs relevant for energy, industry and materials	PDF: Corporate adoption of SDG reporting in a non-enabling institutional environment: Insights from Libyan oil industries	https://filecache.itslearning.com/prod.eu-central-1.filerepo/efaf/81ea-992d-4eef-a5bc-07d7a80cab4c?response-cache-control=max-age%3D899&response-content-type=application%2Fpdf&response-content-disposition=inline%3B%20filename%3D%221-s2.0-S0301420721002518-main.pdf%22%3B&version=1&isDownloadRequest=0&expires=2023-03-28T13%3A09%3A59Z&sign=1k21MXr36fUIP80w5Y6IiG%2Fa2iAV%2FrqebX7oMv%2FLnLc%3D	
1.5.	Additional reading SDGs relevant for energy, industry and materials	PDF: Composite index as a measure on achieving Sustainable Development Goal 9 (SDG-9) industry-related targets: The SDG-9 index	https://filecache.itslearning.com/prod.eu-central-1.filerepo/39df/9887-f2cb-4b14-82d5-2dab8e4c7ab9?response-cache-control=max-age%3D900&response-content-type=application%2Fpdf&response-content-disposition=inline%3B%20filename%3D%221-s2.0-S0306261920302671-main.pdf%22%3B&version=1&isDownloadRequest=0&expires=2023-03-28T13%3A10%3A58Z&sign=FRAn05zTHFH8GCPjRgYLEf%2BDu7Ausy9t3kKDBEob5zg%3D	

1.5.	Additional reading SDGs relevant for energy, industry and materials	PDF: Tracking progress in meeting sustainable development goal 9 industry-related targets: An index for policy priorization	https://filecache.itslearning.com/prod.eu-central-1.filerepo/4ad9/f689-c4d7-44e6-8217-a2bec511c076?response-cache-control=max-age%3D899&response-content-type=application%2Fpdf&response-content-disposition=inline%3B%20filename%3D%221-s2.0-S0306261921000520-main.pdf%22%3B&version=1&isDownloadRequest=0&expires=2023-03-29T11%3A48%3A34Z&sign=7htAPaNs21m0eTIJ5EkwXYOMG79NUKZph5z4UkYTJOU%3D	
1.7.	Literature references	Article: Blueprint for a training program on business opportunity recognition in SDGs	https://uasjournal.fi/1-2020/business-opportunity-recognition-in-sdgs/	
1.7.	Literature references	Article: Sustainable Entrepreneurship for Business Opportunity Recognition: Analysis of an Awareness Questionnaire among Organisations	https://doi.org/10.3390/en15030849	
1.7.	Literature references	PDF: Resourse duration as a managerial indicator for Circular Economy performance	https://www.sciencedirect.com/science/article/pii/S0959652616304784?via%3Dihub	
1.7.	Literature references	PDF: The evolution of the Italian ERP system for the management of household Waste Electrical and Electronic Equipment (WEEE). Technical and economic performance in the spotlight	https://www.sciencedirect.com/science/article/pii/S0956053X16303105?via%3Dihub	
1.7.	Literature references	Article: The Development of an Automated Multi-Spit Lamb Rotisserie Machine for Improved Productivity	https://doi.org/10.3390/machines9080165	

1.7.	Literature references	PDF: Development of weighted triple-bottom line sustainability indicators for the Malaysian food maufacturing industry using the Delphi method	https://www.sciencedirect.com/science/article/pii/S0959652619315008?via%3Dihub	
1.7.	Literature references	Article: Circular Economy for Food: A Systemic Interpretation of 40 Case Histories in the Food System in Their Relationships with SDGs	https://doi.org/10.3390/systems7030043	
1.7.	Literature references	Article: Bioeconomy from experts' perspectives - Results of a global expert survey	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0215917	
1.7.	Literature references	Article: The consumer footprint: Monitoring sustainable development goal 12 with process-based life cycle assessment	https://doi.org/10.1016/j.jclepro.2019.118050	
1.7.	Literature references	Article: Sustainable consumption communication: A review of an emerging field of research	https://doi.org/10.1016/j.jclepro.2021.126880	
1.7.	Literature references	Website: source of pictures	https://pixabay.com/	
2.1.	European Long Term renovation strategies	PDF: A review of EU member states' 2020 long-term renovation strategies	https://cdn.mitma.gob.es/portal-web-drupal/planes_estartegicos/bpie_evaluacion.pdf	
2.1.	European Long Term renovation strategies	Video: Passive House = 90% Home Energy Reduction!	https://youtu.be/Hz6qomFM_dw	
3.1.	Forwards or backwards? Both is essential for industry and environment	PDF: Improving the reverse logistics respecting principles of sustainable development in an industrial company	https://www.mtf.stuba.sk/buxus/docs/doc/casopis_Vedecke_prace/37/3_Fidlerova_Mlkva_PR.pdf	
3.1.	Forwards or backwards? Both is essential for industry and environment	Website: Business Models for the Circular Economy	https://www.oecd.org/environment/business-models-for-the-circular-economy-g2g9dd62-en.htm	
3.2.	On my way towards to the Industry 5.0	Website: Industry 5.0: Top 3 Things You Need to Know	https://www.mastercontrol.com/gxp-lifeline/3-things-you-need-to-know-about-industry-5.0/	
3.2.	On my way towards to the Industry 5.0	Website: Customising the future - The next industrial revolution	https://nickelinstitute.org/en/blog/2020/november/customising-the-future-the-next-industrial-revolution/	

3.2.	On my way towards to the Industry 5.0	Website: Industry 5.0: Industrial Revolution With a Soul	https://www.clarify.io/learn/industry-5-0	
3.2.	On my way towards to the Industry 5.0	Website: "Where is the Industry 4.0 in our life" by Busra Guler	https://aie-internship.com/where-is-the-industry-4-0-in-our-life-by-busra-guler/	
3.2.	On my way towards to the Industry 5.0	Website: The leap from Industry 4.0 to Industry 5.0	https://www.sigga.com/blog/industry-4.0-to-industry-5.0	
3.2.	On my way towards to the Industry 5.0	Website: INDUSTRY 5.0 definition	https://michael-rada.medium.com/industry-5-0-definition-6a2f9922dc48	
3.2.	On my way towards to the Industry 5.0	Website: Japan's digitalization	http://www.cebit.de/en/news-trends/news/society-5-0-japans-digitization-779	
3.2.	On my way towards to the Industry 5.0	Website: Industry 5.0 - Bringing Empowered Humans Back to the Shop Floor	https://www.frost.com/frost-perspectives/industry-5-0-bringing-empowered-humans-back-to-the-shop-floor/	
3.2.	On my way towards to the Industry 5.0	Publication: Industry 5.0: A Transformative Vision for Europe	https://op.europa.eu/s/ypwq	
3.3.	Agile project management	PDF: How businesses thrive in an era of change and disruption	https://www.scrumalliance.org/_scrum/downloads/L_how_businesses_thrive_digital.pdf?fbclid=IwAR13eV3VXHzH3N0aZCLjk6d2r2nu2eHPynioT8Brpd0vkqCRRIzrm7vx7cw	
3.3.	Agile project management	Website: What is agile?	https://devcom.com/tech-blog/agile-advantages-for-business/	
3.3.	Agile project management	Website: Agile methodologies: Kanban Vs Scrum - Advantages and Disadvantages	https://iwconnect.com/agile-methodologies-scrum-vs-kanban-advantages-disadvantages/	
3.3.	Agile project management	Website: Agile Methodology: What is Agile Model in Software Testing?	https://www.guru99.com/agile-scrum-extreme-testing.html	
3.3.	Agile project management	Website: Advantages and Disadvantages of Agile Project Management (Checklist)	https://activecollab.com/blog/project-management/agile-project-management-advantages-disadvantages	

3.3.	Agile project management	Website: 5 Advantages & Disadvantages of using an Agile Methodology	https://www.appvizer.co.uk/magazine/operations/project-management/advantages-of-agile-methodology	
3.3.	Agile project management	Website: 3 vantagens das metodologias ágeis na gestão de projetos	https://noticias.universia.pt/emprego/noticia/2018/10/10/1160968/3-vantagens-metodologiasageis-gestao-projetos.html	
3.4.	Materials and sustainability: key drivers of Innovation	Video: Innovative materials and sustainability: key drivers for innovation	https://youtu.be/9glOwT20zJ4	
3.5.	CASE! Incorporating the SDGs as part of strategy in industrial enterprise	Website: Lyreco	https://lyreco.com/group/ce/sk	
3.5.	CASE! Incorporating the SDGs as part of strategy in industrial enterprise	Website: Lyreco International Footprint	https://lyreco.com/group/about/lyreco-international-footprint	
3.5.	CASE! Incorporating the SDGs as part of strategy in industrial enterprise	Website: Lyreco's sustainability strategy	https://lyreco.com/group/lyreco-corporate-social-responsibility/csr-strategy	
3.5.	CASE! Incorporating the SDGs as part of strategy in industrial enterprise	Website: Sustainable development goals	https://lyreco.com/group/lyreco-corporate-social-responsibility/sustainable-development-goals	
3.6.	CASE! GREEN BUILDINGS	Website: Energy efficiency in buildings	https://commission.europa.eu/news/focus-energy-efficiency-buildings-2020-02-17_en	
3.6.	CASE! GREEN BUILDINGS	PDF: The Critical Role of the Construction Industry in Achieving the Sustainable Development Goals (SDGs): Delivering Projects for the Common Good	https://mdpi-res.com/d_attachment/sustainability/sustainability-13-09112/article_deploy/sustainability-13-09112-v2.pdf?version=1629109118	
3.6.	CASE! GREEN BUILDINGS	Website: Green building and the UN sustainable development goals	https://elemental.green/what-are-the-17-un-sdgs/	
3.6.	CASE! GREEN BUILDINGS	Article: Passive House and the Sustainable Development Goals (SDGs): Connecting an international building standard with global aims	https://passipedia.org/basics/passive_house_and_the_sustainable_development_goals	

3.9.	Sustainable competitiveness of the company	PDF: Sustainable Global Competitiveness Model as a New Strategy Opportunity for the Companies in Slovakia	https://www.temjournal.com/content/52/TemJournalMay2016_241_247.html	
3.11.	Literature	Article: Impact and Potential of Sustainable Development Goals in Dimension of the Technological Revolution Industry 4.0 within the	https://doi.org/10.3390/en15103697	
3.11.	Literature	Website: Industry 5.0	https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/industry-50_en	
5.1.2.	Examples of Green Energy solutions	PDF: Interview with Gasmet Technology Ltd, Autumn 2022	https://filecache.itslearning.com/prod.eu-central-1.filerepo/d80b/ac94-9602-4b1c-981f-4b4bebc43d19?response-cache-control=max-age%3D899&response-content-type=application%2Fpdf&response-content-disposition=inline%3B%20filename%3D%22SDG4BIZ%2520project%2527s%2520interview%2520%2528ID%252024332%2529%2520_gasmet_Tecnology_Ltd.pdf%22%3Bfilename%2A%3Dutf-8%27%27SDG4BIZ%2520project%2527s%2520interview%2520%2528ID%2520243332%2529%2520_gasmet_Tecnology_Ltd.pdf%3B&version=1&isDownloadRequest=0&expires=2023-03-30T10%3A30%3A24Z&sign=uECB33aAYqufoyuqVgNW8ageIMEqTzrMec%2BsCM7Ytb8%3D	

5.1.2.	Examples of Green Energy solutions	Podcast: Interview with Gasmet Technology Ltd	https://filecache.itslearning.com/prod.eu-central-1.filerepo/d1d0/2a1c-6a57-43ee-8327-05bbe36cd637?response-cache-control=max-age%3D899&response-content-type=audio%2Fmpeg&response-content-disposition=inline%3B%20filename%3D%22Gasmet%2520podcast_introlla.mp3%22%3Bfilename%2A%3Dutf-8%27%27Gasmet%2520podcast_introlla.mp3%3B&version=1&isDownloadRequest=0&expires=2023-03-30T10%3A31%3A18Z&sign=qVbX83Bi%2F3zUc5gg%2FxgEXCjOuYlwsFklMXcjpY1DLfc%3D	
5.2.1.	CASE STUDY! Circular economy in the company AfB Slovakia s.r.o	Website: AfB	https://www.afb-group.sk/en/home/	
5.2.1.	CASE STUDY! Circular economy in the company AfB Slovakia s.r.o	Video: Benefits of cooperation with AfB	https://www.youtube.com/watch?v=QDfFZBBRHEY	
5.2.1.	CASE STUDY! Circular economy in the company AfB Slovakia s.r.o	Website: Communication on Progress (COP) 2019	https://www.unglobalcompact.org/participation/report/cop/create-and-submit/active/445502	
5.2.1.	CASE STUDY! Circular economy in the company AfB Slovakia s.r.o	Website: Good reason to become a partner	https://www.afb-group.sk/en/partners/becoming-a-partner/	
5.2.2.	CASE STUDY! Innovative solution Ecocapsule	Website: Ecocapsule	https://www.ecocapsule.sk/	
5.2.2.	CASE STUDY! Innovative solution Ecocapsule	Video: The Story of Ecocapsule	https://youtu.be/_uvl_qX5u78	
5.2.2.	CASE STUDY! Innovative solution Ecocapsule	Video: Energy & Technology	https://youtu.be/lTrLB6MvRxU	
5.2.2.	CASE STUDY! Innovative solution Ecocapsule	Video: Live and work off-grid, with Ecocapsule	https://youtu.be/H12A6fVhB48	
5.3.1.	Innovative materials and industrial applications	Video: Innovative materials and sustainability: key drivers for innovation	https://youtu.be/EzFMSK6eCtg	

5.3.2.	Contemporary architecture: new challenging opportunities for smart materials	Video: Contemporary architecture: new challenging opportunities for smart materials	https://youtu.be/76SJSTK3Rcw	
5.3.3.	Smart Materials in green buildings: opportunities and potential	Video: Smart materials in green building: the polymers	https://youtu.be/0ocItItQpV8	
5.3.3.	Smart Materials in green buildings: opportunities and potential	Video: Smart materials in green building: thermocromic effect and solutions	https://youtu.be/z-g4IinRI2o	
5.3.4.	Ecomaterials and sound proofing solutions in green building	Video: Sound management in green building - part 3	https://youtu.be/3IU8kiZkvxA	
5.3.4.	Ecomaterials and sound proofing solutions in green building	Video: Sound management in green building - part 2	https://youtu.be/D-lhT2lBW9Q	
5.3.4.	Ecomaterials and sound proofing solutions in green building	Video: Sound management in green building - part 1	https://youtu.be/02ZTuSeE4UE	
5.4.1.	CASE STUDY! TKNIKA - Spain	Video: TINNY EN	https://youtu.be/9RVFQcmmzkk	
5.4.1.	CASE STUDY! TKNIKA - Spain	Website: Usubilgo Lanbide Eskola	http://www.lhusurbil.eus/web/	
5.4.1.	CASE STUDY! TKNIKA - Spain	Video: ENEGUR - Timelapse de la construcción del edificio ecoeficiente	https://youtu.be/U8Q0w88gb8Q	
5.4.1.	CASE STUDY! TKNIKA - Spain	Website: Ennera Energy windera s	https://en.wind-turbine-models.com/turbines/1432-ennera-energy-windera-s	
5.4.1.	CASE STUDY! TKNIKA - Spain	Website: Monitoring tool	http://scada.lhusurbil.eus:1025/html5/index.html	
5.4.2.	CASE STUDY! NeoClass + Project	Video: Neo Class + Project	https://youtu.be/2Ws_uDtiR4o	
5.4.3.	CASE STUDY! The Fenice Foundation Green Energy Park - Padova - Italy	Video: Case study: Fenice Green Energy Park	https://youtu.be/cHUsUb7OTs0	
5.4.6.	Bibliography and Resources	Website: Passive House Guidelines	https://passivehouse-international.org/index.php?page_id=80	
5.4.6.	Bibliography and Resources	Website: Passive House requirements	https://passivehouse.com/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm	

5.4.6.	Bibliography and Resources	PDF: Guía del estándar Passivhaus	https://passivehouse-international.org/upload/Guia-del-Estandar-Passivhaus-fenercom-2011.pdf	
5.4.6.	Bibliography and Resources	Website: 15 Green Building Materials in Sustainable Construction	https://buildingmaterials.com.my/ideas/15-green-building-materials-in-sustainable-construction	
5.4.6.	Bibliography and Resources	Website: Efficiency: The First Renewable Energy #EfficiencyFirst	https://www.passivehouse-international.org/index.php?page_id=569	
5.4.6.	Bibliography and Resources	Website: An Architecture Guide to the UN 17 Sustainable Development Goals Volume 2	https://issuu.com/kadk/docs/aechitecture_guide_un17_vol.2_web_single_pages	
5.4.6	Bibliography and Resources	PDF: Enegur Project	http://www.lhusurbil.eus/web/Ficheros/	

SDG4BIZ M4 Section 2: Context

EU energy efficiency in buildings strategy for EU

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EUROPEAN STRATEGY ABOUT ENERGY EFFICIENCY

Reducing energy consumption and energy losses are becoming increasingly important for the EU. In 2007, EU leaders set the target to cut the union's annual energy consumption by 20% by 2020. In 2018 it was set a new target to reduce energy consumption by at least 32.5% by 2030.

(image)

Energy efficiency measures are increasingly recognized as a means not only to achieve sustainable energy supply, reduce greenhouse gas emissions, improve security of supply and reduce import costs, but also to promote the Union's competitiveness. **Energy efficiency is therefore a strategic priority** of the Energy Union, and the EU promotes the principle of ***energy efficiency first***. The future policy framework for the post-2030 period is under discussion and foresees new long-term limits (up to 2050)

Source: https://www.buildup.eu/

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EU CURRENT FRAMEWORK FOR ENERGY EFFICIENCY

The current framework for energy efficiency consists of a series of Directives, which are expected or ongoing to be revised.

The **Energy Efficiency Directive** (2012/27/EU - EED), which entered into force in December 2012, requires Member States to define **indicative national energy efficiency targets** to ensure that the EU achieves its main goal of reducing 20% energy consumption by 2020. Member States are free to adopt stricter minimum requirements to promote energy savings.

The 27 Directive also introduces a number of binding **measures to help Member States achieving the goals** and establishes legally binding rules for end users and energy suppliers.

Additional energy efficiency standards for products and buildings are set by the **Ecodesign Directive** (2009/125/EC), the **Energy Labeling Directive** (2010/30/EU), which was updated in 2017 (2017/1369/EU), and the **Energy Performance of Buildings Directive** (2010/31/EU - EPBD) updated in 2018 (2018/844/EU).

(image)

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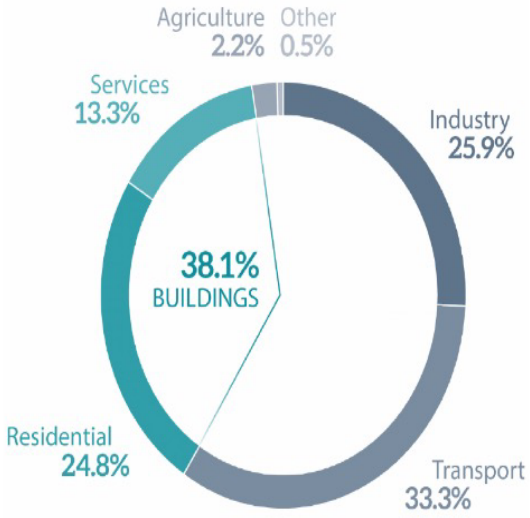
EU POLICY FRAMEWORK FOR ENERGY EFFICIENCY OF BUILDINGS

Buildings are the single largest energy consumer in Europe, they are responsible for approximately 40% of EU energy consumption and 36% of CO_2 emissions.

At present, about 35% of the EU's buildings are over 50 years old and almost **75% of the building stock is energy inefficient**. At the same time, only about 1% of the building stock is renovated each year.

Renovation of existing buildings can lead to significant energy savings as it could reduce the EU's total energy consumption by 5-6% and lower CO_2 emissions by about 5%. Investments in energy efficiency stimulates the economy, especially the construction industry, which generates about 9% of Europe's GDP and directly accounts for 18 million direct jobs. SMEs in particular benefit from a boosted renovation market, as they contribute more than 70% of the value-added in EU's building sector.



Energy consumption by sector in EU-28
Source: Eurostat

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SDG4BIZ

LONG-TERM RENOVATIONS STRATEGIES AND NEARLY ZERO-ENERGY BUILDINGS STRATEGY

All EU Countries must establish a long-term renovation strategy to support the **renovation of their national building stock** into a highly energy efficient and decarbonised building stock by 2050.

The requirement for EU countries to adopt a long-term renovation strategy is set out in EPBD.

These strategies will form part of EU Countries' integrated **National Energy and Climate Plans** (NECPs).

(image)

One EU requirement → 28 national implementation rules

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SDG4BIZ

LONG-TERM RENOVATIONS STRATEGIES AND NEARLY ZERO-ENERGY BUILDINGS STRATEGY

The EU has set **a target for all new buildings** to be nearly zero-energy (nZEB) by 2020.

nZEB have very high energy performance (in accordance with Annex I of the EPBD). The low amount of energy that these buildings require comes mostly from **renewable sources**. The EPBD requires all new buildings to be nearly zero-energy by the end of 2020. All new public buildings must be nearly zero-energy by 2018.

EU countries had to draw up and submit **nZEB national plans**, describing how they intended to increase the number of nZEBs in their respective Country to comply with the EPBD. The Commission closely monitors the **progress towards nZEB uptake** made by Member States to increase the number of nZEB, including through progress reports and studies.

In 2016, the Commission developed **guidelines for the promotion of nZEBs** in order to ensure that by 2020, all new buildings are nZEBs.

(image)

Timeline for nZEBs implementation according to the EPBD recast

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SDG4BIZ

CLEAN ENERGY FOR ALL EUROPEANS 22 PACKAGE

In 2019 the new energy legislative framework with new obligations as a significant step **towards the implementation of the energy union strategy** published in 2015.

The main goal is **to facilitate the transition away from fossil fuels towards cleaner energy** and to deliver on the EU's **Paris Agreement** commitments for reducing greenhouse gas emissions.

It will help to **decarbonize EU's energy system** in line with the **European Green Deal objectives.**

(image)

ENERGY EFFICIENCY FIRST!

- **Energy efficiency first**
  Specific measures for the building sector
- **More renewables**
- **A better governance of the Energy Union**
  NECPs through a new governance system
- **More rights for consumers**
- **A smarter and more efficient electricity market**

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SIX PILLARS FOR THE UE FUTURE

The EPBD covers a broad range of policies and support measures that help national EU government boost energy performance of buildings and improve the existing building stock. The **2018/844/EU update** provides 6 central pillars on which to base the process of making buildings more efficient.

These 6 pillars **will guide the EU in the coming years** with the aim of a greater energy efficiency in buildings both for new buildings and for refurbishment.

(image)

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CONCLUSION

- The new energy policy framework that has been created with the “Clean Energy for all Europeans” package provides several **opportunities to properly address the issues**. Building refurbishment has the biggest available energy saving potential in Europe.
- Increasing the energy performance of buildings can have a positive impact, not only in economic terms, but also as **regards public health and safety by improving indoor climate**.
- Addressing energy efficiency in buildings can help to trigger many co-benefits such as **tackling fuel poverty**.
- To achieve enhanced energy performance of buildings, there is a need for **much improved technical skills**. Training and qualification schemes should ensure that worker qualifications keep pace with the technical complexity of buildings and building components.
- Several projects with well-designed nZEB have demonstrated that ambition levels like **the benchmarks set out in the Commission’s recommendation are achievable at reasonable cost**, typically being only slightly above the cost-optimal point if well-designed.

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Thank you for your time!

Metropolia

Haaga-Helia

STU
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

YAŞAR ÜNİVERSİTESİ

FENICE
GREEN ENERGY PARK

brain Ideen

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its learning

Tknika

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Road to nZEB in EU

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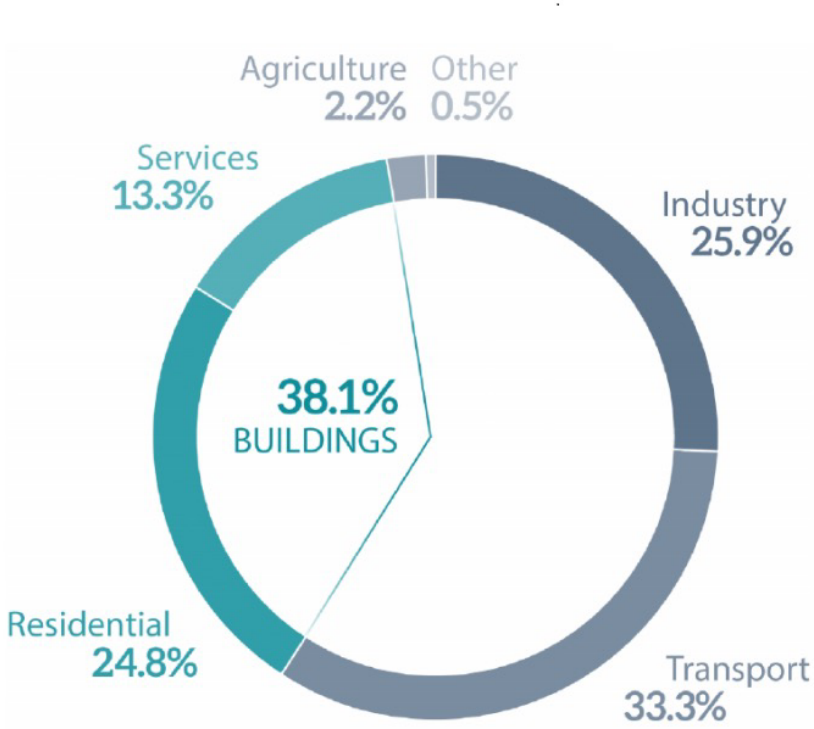
Energy consumption in buildings in the EU

- According to European Commission data, buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU.
- Currently, about 35% of EU buildings are over 50 years old.
- 75% of the existing European building stock is energy inefficient, and estimates show that 90% of these buildings will still be in use by 2050.
- By improving the energy efficiency of buildings, total EU energy consumption could be reduced by 5-6%, whilst CO_2 emissions could decrease by about 5%.



Data source: Eurostat

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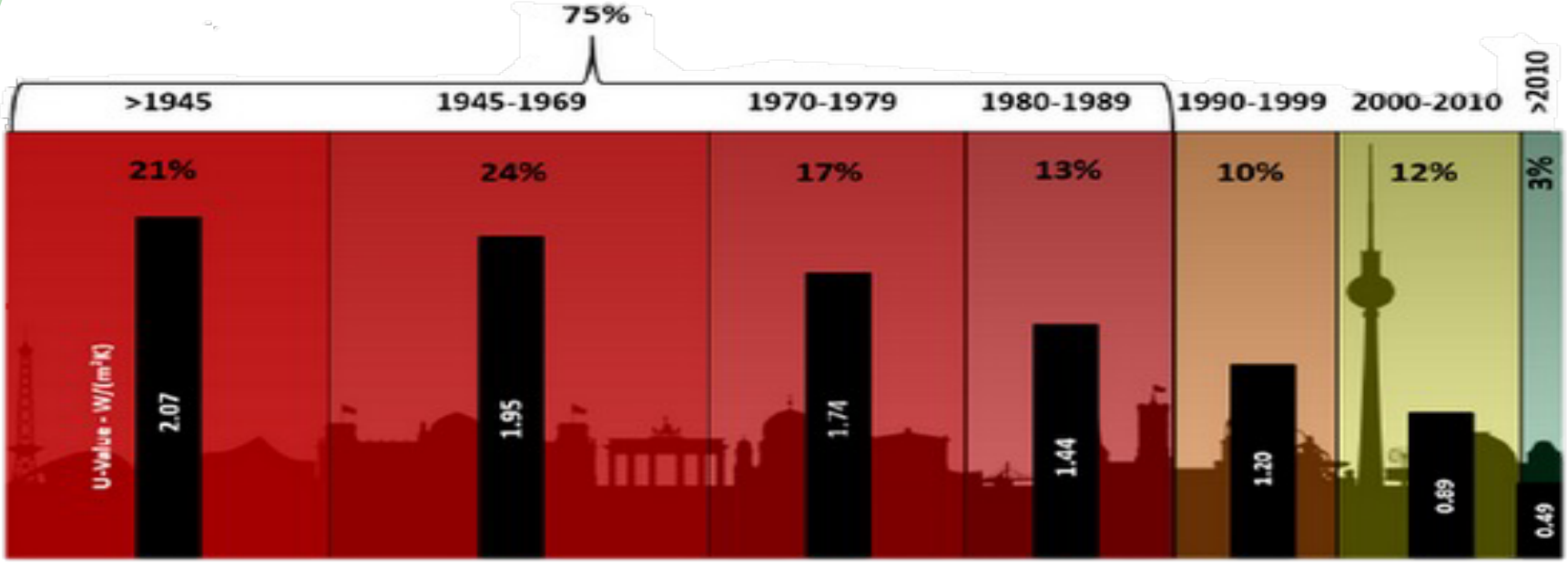
Energy consumption in buildings in the EU

To date:

- 35% of buildings in the EU are more than 50 years old
- About 75% of the building stock is energy inefficient
- Only 1% of the building stock is renovated every year



Age of the EU building stock and corresponding average U-value for building envelopes

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Energy consumption in buildings in the EU

Renovation of existing buildings can lead to:

- 5-6% reduction in European energy consumption
- Lower CO2 emissions by about 5%
- Economic benefits, particularly in the construction sector

Generates 9% of European GDP

Provides 18 million employment opportunities

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EU targets for reducing energy consumption

UE wants to promote the principle

Energy efficiency first!

(image: 2030 framework for energy and climate)

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Key provisions for Member States regarding energy efficiency

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Key provisions for Member States regarding energy efficiency

Directive 2010/31/EU on the energy performance of buildings (EPBD)

- Sets minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements
- Requires that all new buildings must be nearly zero-energy buildings ('nZEB') since 2021.
- Requires that buildings occupied and owned by public authorities must be nZEB since 2019.
- Member States are required to develop National Plans for increasing the number of NZEBs

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Key provisions for Member States regarding energy efficiency

Directive 2012/27/EU on energy efficiency (EED)

- Member States are required to make energy efficient renovations to at least 3% of buildings owned or leased by the central government every year,
- Member States are required to develop long-term building renovation strategies.

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Key provisions for Member States regarding energy efficiency

Directive (EU) 2018/844 amending 2010/31/EU and 2012/27/EU directives

- Each Member State shall establish a **long-term renovation strategy** (residential & non-residential buildings, public & private) facilitating the cost-effective transformation of existing buildings **into nearly zero-energy buildings by 2050.**
  - milestones for 2030, 2040 and 2050
  - the long-term 2050 goal of reducing greenhouse gas emissions in the EU by 80-95 % compared to 1990

- Member States shall not only to **set a national nZEB definition**, but also to actively promote higher market uptake of such buildings.

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nZEB definition and application in EU member countries

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Nzeb definition

General definition:

Nearly-zero-energy building means a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

EPBD Directive (2010/21/EU)

National definitions are required. Beside the general implications from the directive, they also need to:

- reflect national, regional or local conditions,
- include a numerical indicator of primary energy use expressed in kWh/m2 per year.

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Nzeb definition

- Each country develops its own definition
- Definitions should cover various building types, classes and categories

Type	Classification	Category	Subcategory
• New • Renovated	• Private • Public	• Residential • Non-residential	• apartment blocks • offices • educational buildings • hospitals • hotels • wholesale and retail buildings

Source: Synthesis Report on the National Plans for Nearly Zero Energy Buildings (NZEBs), JRC, 2016

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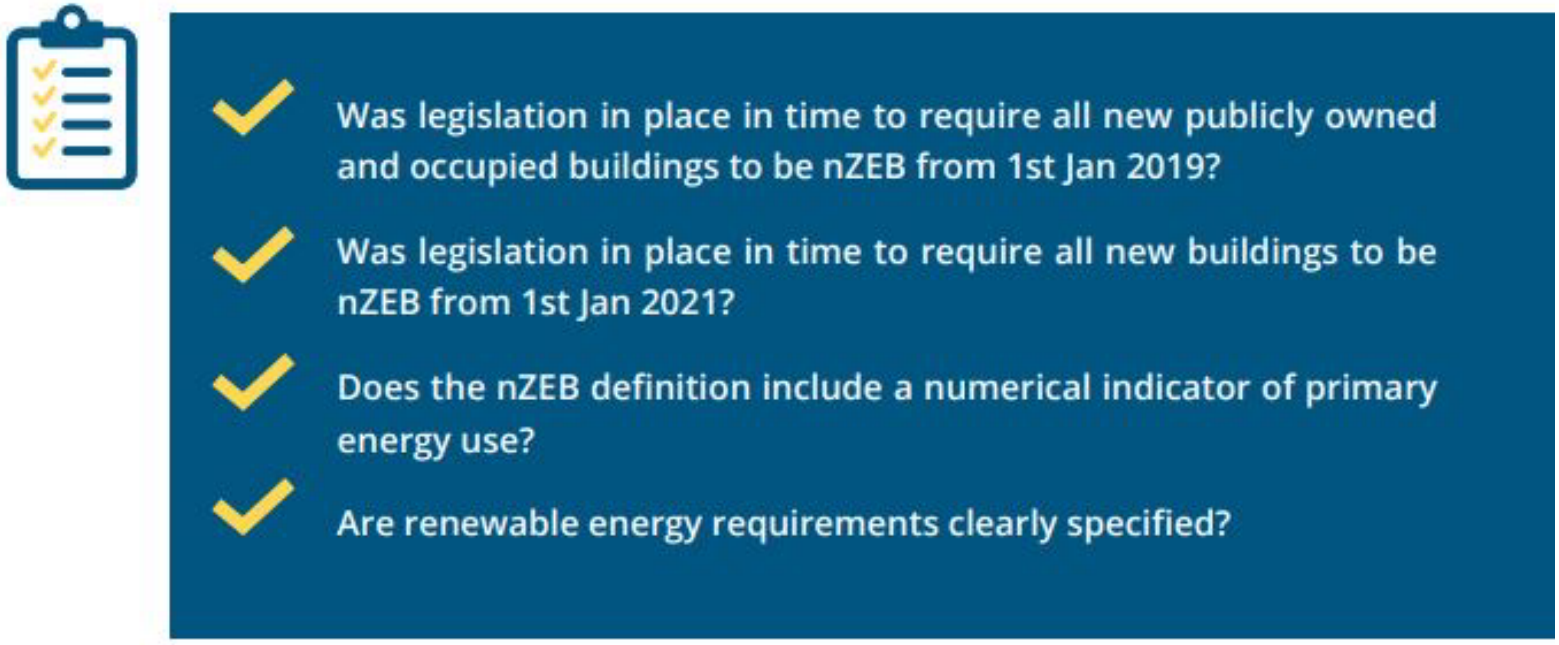
Nzeb in EU member countries

BPIE (Buildings Performance Institute Europe) has studied the evolution of nZEB in member countries in order to see whether the following basic provisions of the EPBD nZEB requirements were met:



BPIE (Buildings Performance Institute Europe) (2021). Nearly Zero: A review of EU Member State implementation of new build requirements. Available at: https://www.bpie.eu/publication/nearly-zero-a-review-of-eumember-state-implementation-of-new-build-requirements/

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Nzeb in EU member countries

Country/Region	Was nZEB legislation in place for public buildings by January 2019?	Was nZEB legislation in place for all buildings by January 2021?	Is there a numerical indicator of primary energy use expressed in kWh/m² per year?	Are renewable energy requirements clearly specified?
Austria	✓	✓	✗	✓
BE - Brussels	✓	✓	✓	✗
BE - Flanders	✓	✓	✗	✓
BE - Wallonia	✓	✓	✓	✗
Bulgaria	✗	✗	✓	✓
Croatia	✓	✓	✓	✓
Cyprus	✓	✓	✓	✗
Czechia	✓	✓	✓	✗
Denmark	✓	✓	✓	✓
Estonia	✓	✓	✓	✗
Finland	✓	✓	✓	✗
France	✓	✓	✓	✓
Germany	✗	✓	✗	✓
Greece	✗	✗	✓	✓
Hungary	✗	✗	✓	✓
Ireland	✓	✓	✓	✓
Italy	✓	✓	✗	✓

Source: NEARLY ZERO: A REVIEW OF EU MEMBER STATE IMPLEMENTATION OF NEW BUILD REQUIREMENTS by BPIE, June 2021

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Nzeb in EU member countries

Country/Region	Was nZEB legislation in place for public buildings by January 2019?	Was nZEB legislation in place for all buildings by January 2021?	Is there a numerical indicator of primary energy use expressed in kWh/m² per year?	Are renewable energy requirements clearly specified?
Latvia	✓	✓	✓	✗
Lithuania	✓	✓	✓	✓
Luxembourg	✓	✓	✗	✗
Malta	✓	✓	✓	✗
Netherlands	✓	✓	✓	✓
Poland	✓	✓	✓	✗
Portugal	✓	✓	✗	✓
Romania	✓	✓	✓	✓
Slovakia	✓	✓	✓	✗
Slovenia	✓	✓	✓	✓
Spain	✗	✓	✓	✓
Sweden	✓	✓	✓	✗

It can be seen that only 8 Member States complied with all four of these requirements: Croatia, Denmark, France, Ireland, Lithuania, Netherlands, Romania and Slovenia. The rest failed to adequately address at least one of the provisions

BPIE (Buildings Performance Institute Europe) (2021). Nearly Zero: A review of EU Member State implementation of new build requirements. Available at: https://www.bpie.eu/publication/nearly-zero-a-review-of-eumember-state-implementation-of-new-build-requirements/

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Nzeb in EU member countries

It is important to note that several Member States and one Belgian region do not specify kWh/m2/a values or ranges for energy performance for new buildings as part of their nZEB requirements.

Instead, they are based on minimum performance levels or achievable performance ranges calculated in comparison to reference buildings and considering building typology, U-values, geometry, climatic region, and a range of other factors.

This approach is used notably in: Austria, Flanders (Belgium), Germany, Italy, Luxembourg, and Portugal.

Table 2: European Commission building energy performance and renewables benchmarks.

A	B	C	D	E
	Net primary energy kWh/m²/a	Energy supplied from renewable energy sources kWh/m²/a	Primary energy threshold including that supplied from renewable sources kWh/m²/a	Renewables as % of total primary energy (based on mid-point)
SINGLE FAMILY HOUSE				
Mediterranean	0-15	50	50-65	87%
Oceanic	15-30	35	50-65	61%
Continental	20-40	30	50-70	50%
Nordic	40-65	25	65-90	32%
OFFICES				
Mediterranean	20-30	60	80-90	71%
Oceanic	40-55	45	85-100	49%
Continental	40-55	45	85-100	49%
Nordic	55-70	30	85-100	32%

Source: NEARLY ZERO: A REVIEW OF EU MEMBER STATE IMPLEMENTATION OF NEW BUILD REQUIREMENTS by BPIE, June 2021

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Nzeb in EU member countries

Based on the information presented, there is a wide degree of disparity across Member States in terms of the implementation of the Article 9 nZEB provisions of the EPBD.

Differences are present, notably with respect to:

- The availability and clarity of information regarding nZEB requirements on government websites
- Timeline of implementation of Article 9 requirements, with some Member States delayed while others introduced the requirements ahead of the deadlines
- Definitions and metrics used in determining national nZEBs
- Calculation methodologies and levels of energy performance that new buildings are required to achieve to attain nZEB status
- The extent to which residual energy requirements need to be covered by renewable energy

These differences are important considerations for EU policy makers as they look towards a revision of the EPBD and given the potential for nZEBs to contribute to the EU's wider objective of a highly energy efficient and decarbonised building stock by 2050

Thank you for your time!

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Financial solutions in building renovation and energy efficiency projects

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Overview of possible financial sources for EE projects

There are different possibility in order to find useful financial sources for energy efficiency projects, such as:

- Own (budget) financing
- Credit (loan) financing
- ESCO model
- PPP model
- Subsidies (grants)
- Combinations thereof

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Overview of possible financial sources for EE projects

OWN (BUDGET) FINANCING

Traditional financing of projects in cities and municipalities relies dominantly on the use of own budget

Challenges:

- insufficient revenue base with which to fund projects
- dependence on revenue transfers from regional or national governments (risk)

This introduces further uncertainties and makes commitment to multi-year programs of capital expenditures more difficult

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Overview of possible financial sources for EE projects

CREDIT (LOAN) FINANCING

National governments often impose limits on borrowing by municipalities to prevent them getting into financial difficulties and lead to uncontrolled increase of the public debt – > debt limitations

- EE projects are not typical capital expenditure projects that can be readily assessed and approved by higher authorities
- EE projects, with relatively low public profiles, are likely to have a lower priority than other pressing or mandated needs

Soft loans are dedicated credit lines for EE measures extended to end users at preferential terms in terms of maturity and/or interest rates - often provided by national or international development banks (e.g. EIB, EBRD) and further distributed to designated markets through regional partner retail banks

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Overview of possible financial sources for EE projects
ESCO MODEL

- ESCOs are companies that work on a basis of energy performance contracts (EPC)
- ESCO is responsible for **optimizing building services systems and system operations in existing buildings across all branches of construction and maintenance**
- ESCO is a guarantees level of savings over a defined period
- Before a tender is made, an energy cost baseline is determined for the building (or building pool) or facility
- Proceeding from the energy cost baseline, the ESCO guarantees an annual energy cost savings (in EUR, calculated on a fixed price basis with the energy prices of the reference year) to the customer over the entire contract period
- A fixed proportion of these guaranteed savings is set as the contracting fee, which the ESCO receives from the client to finance the investment, maintain the installations and attain a profit margin
- Usually, the fee is set lower that the guaranteed saving in order for client to immediately benefit from savings.

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Overview of possible financial sources for EE projects

ESCO MODEL

(image: energy performance contructing EnPC)

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Overview of possible financial sources for EE projects

PPP MODEL

A Public-Private Partnership (PPP) arrangement the public and private sectors collaborate to deliver public infrastructure projects (e.g. roads, railways, hospitals) which typically share the following features:

- a long-term contract between a public procuring authority (the “Authority”) and a private sector company (the “PPP Company”) based on the procurement of services, not assets;
- the transfer of certain project risks to the private sector, notably with regard to designing, building, operating and/or financing the project;
- a focus on the specification of project outputs rather than project inputs, taking account of the whole life cycle implications for the project;
- the application of private financing (often “project finance”) to underpin the risks transferred to the private sector; and
- payments to the private sector which reflect the services delivered. The PPP Company may be paid either by users through user charges (e.g. motorway tolls), by the Authority (e.g. availability payments, shadow tolls) or by a combination of both (e.g. low user charges together with public operating subsidies).

PPP arrangements are complex, require detailed project preparation and planning, proper management of the procurement phase, careful contract design, etc.

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Overview of possible financial sources for EE projects
SUBSIDIES (GRANTS)

- Most of available grant schemes are based on the use of European Unison structural and investment funds (ESI)
- EE projects in buildings belong to projects that generate net income after completion, i.e. the energy cost savings of the project are treated as net income
- Under the preamble (paragraph 13) of the Delegated Regulation 480/2014, as well as under recital (paragraph 58) of Regulation 1303/2013 of the EU, it is necessary to accurately calculate net income to ensure the efficient use of Union funds and to avoid over-financing of projects
- Co-financing is determined based on calculation of financing gap
- Financing gap is generated in energy efficiency projects when the investment in energy efficiency cannot be paid off from savings on energy costs

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Overview of possible financial sources for EE projects
COMBINATIONS THEREOF

Usually, EE projects in public buildings combine two financing models

Dominantly, grants (if available) are combined with own financing

Recently, with the availability of EU structural and investment funds for energy efficiency across the MS, the blending of such funds with other financing models becomes increasingly interesting

- the blending refers to combination of EU grants with other financing mechanism such as loans or ESCO/PPP model

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Comparative analysis of possible financial sources

Criteria/ Model	Own financing	Loan financing	Grants	ESCO model	PPP model
Neutral impact on government debt					
Administrative procedure complexity					
Guarantee of savings / service standard					
Capacities and capabilities of the public bodies to implement the model					
Estimated multiplier effect					
Projects for which the model is appropriate	Simple EE measures with short pay-back periods	Simpler EE measures with shorter pay-back periods	More complex projects, with longer pay-back periods	Highly complex projects, with moderate pay-back periods (up to 10 years)	Highly complex projects, usually with new buildings, long-term

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Thank you for your time!

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SDG4BIZ M4 Section 3: Motivation

Materials Innovation and Sustainability: Key Drivers of Innovation

Ing. Valeria Adriani
Galileo R&D MaTech

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THE ROLE OF MATERIALS - examples

(image)

Carbon Composite

(image)

F1 car racing

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THE ROLE OF MATERIALS - examples

(image)

(image)

Polymers (no glass)

Lenses for eyeglasses

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THE ROLE OF MATERIALS - examples

(image)

PP meltblown nonwoven for high performance filters

(image)

Surgical masks

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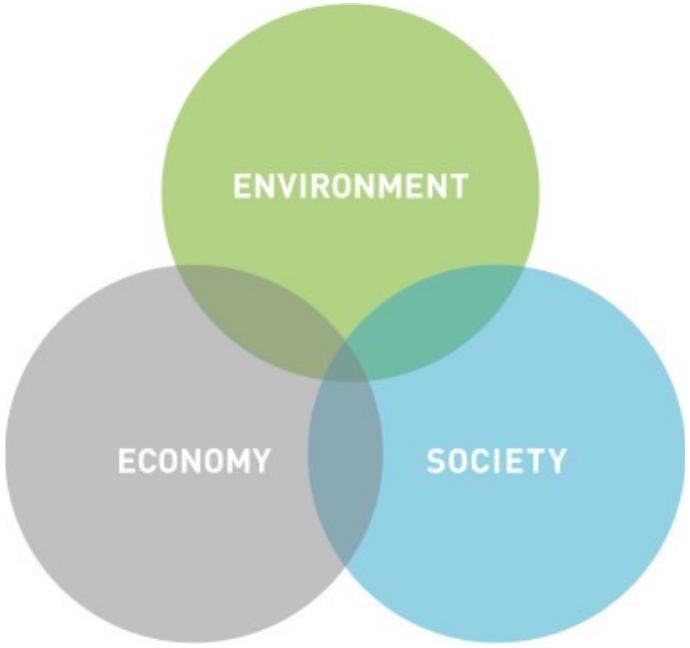
Sustainability

DEFINITION: Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs.

3 Pillars



«Sustainable innovation involves **making intentional changes to a company's products, services, or processes to generate long-term social and environmental benefits while creating economic profits for the firm**.»
(Richard Adams).

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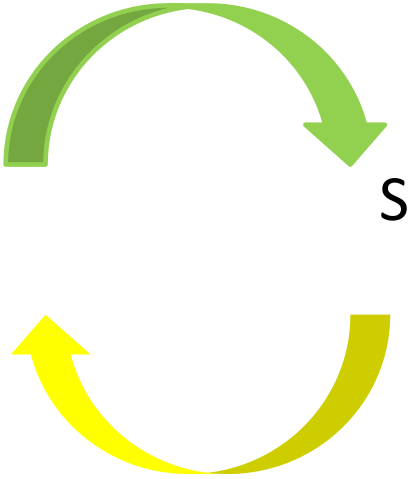
INNOVATION



SUSTAINABILITY

Sustainability - the Key Driver of Innovation

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"Sustainability"
strategic element in modern enterprises

1st type: it develops initiatives to ensure sustainable standards (respectful of the environment and working conditions) among its suppliers but also applies, through joint initiatives, the innovation of techniques, methods, materials, with a view, for example, to minimizing environmental impact.

A MORE SUSTAINABLE LIFE AT HOME:

(images)

- SAVE ENERGY
- SAVE WATER
- WASTE AND RECYCLING
- A HEALTHY LIFESTYLE

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"Sustainability"
strategic element in modern enterprises

2nd type: it is proposed on the market with products with clear sustainability aspects (eg products derived from recycled material, products made with alternative raw materials, more abundant in nature and less harmful to the environment)

(images)

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SDG4BIZ

"Sustainability"
strategic element in modern enterprises

FOAMS FROM ALGAE

(image)

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- HOW DO I REALIZE THE IDEA?
- HOW DO I INCREASE MY CREATIVITY?
- HOW DO I INNOVATE IN A SUISTAINABLE WAY?

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“The main fuel to speed the world's progress is our stock of knowledge, and the brake is our lack of imagination.”
JULIAN LINCOLN SIMON

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Explorers

(images)

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Thank you for your time!

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Typical measures for buildings renovation and use of RES

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Introduction

The building sector is crucial for achieving the EU's energy and environmental goals.

Buildings are responsible for approximately 40% of EU energy consumption and 36% of the CO_2 emissions. Buildings are therefore the single largest energy consumer in Europe.

At present, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. At the same time, only about 1% of the building stock is renovated each year – more or less efficient - with often lost opportunities for a long time.

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Introduction

For example, to compensate a gas consumption of 100.000 kWh per year, you need to plant 1760 trees

- comprehensive measures are necessary to protect climate, take advantage of your potentials!

Renovation of existing buildings can lead to significant energy savings, up to real 70% of existing consumption.

The goals are renovations towards nearly zero energy buildings.

(image: example of tree)

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Typical measures and potentials

To reach the CO2 reduction goals you have several typical measures in the building sector, especially in schools and public buildings:

- **insulation** of the exterior surface (walls, ceilings) and **new windows** (potential 20 – 80 %)
- **hydraulic optimization** of the heating distribution system and thermostatic valves (potential 10 – 20 %)
- **changing the heat and power source** towards CO2-friendly sources like biomass, solar energy and heat pumps
- new **LED lighting** (potential 50-80% of lighting consumption)
- ventilation with efficient **heat recovery**
- **efficient pumps**, insulation of pipes, effective and **optimized control** – potentials depending on existing conditions
- **energy management and control**, **behavioural change**

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SDG4BIZ

FIRST step - Know your weak points

The first step is to analyse your current situation as accurate as possible. The perfect instruments are:

- **Meter the consumptions** in detail – 15min intervals are recommended, smart meters help you!
- **Analyse** your energy performance certificate and existing consumption and equipment – make an entire **energy audit**
- **Compare** the proportion of real heat consumption and climatic conditions
- Use **thermographic analysis**
- Measure the buildings **air tightness**, make blower door tests (in combination with thermographic analysis)

it will show your potentials...

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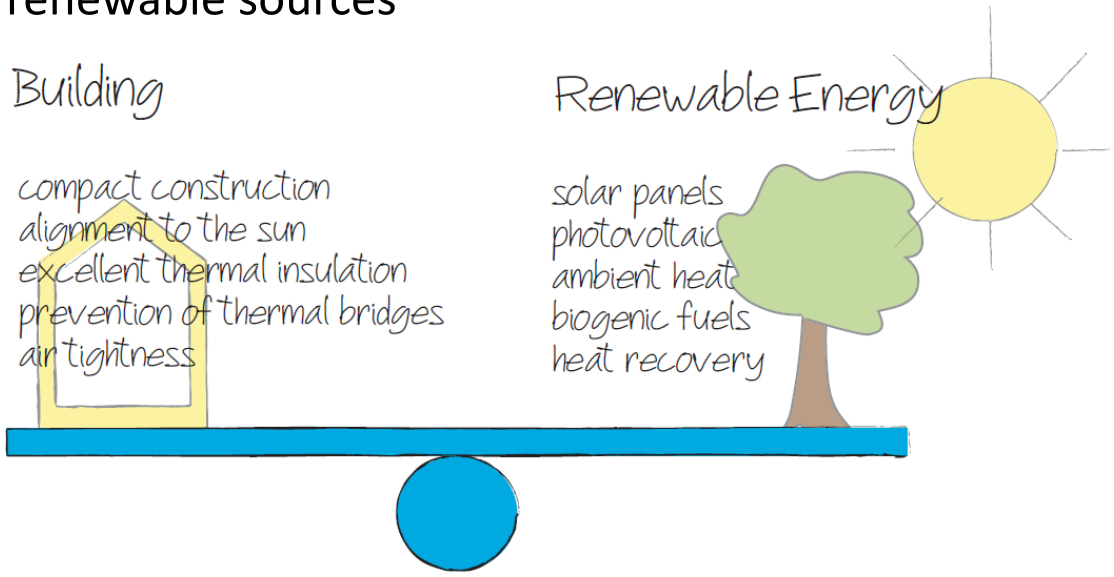
Recommendations insulation and planning

<u>Planning Phase – Integral planning:</u>

- Choose the right balance between building and energy source!
  A nearly zero-energy house combines very good insulation standards, a high-quality building envelope (no thermal bridges, airtightness) and active energy generation from renewable sources



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Recommendations insulation and planning

- Invest more in planning – especially in early planning phases!
- Define exact energetic and **environmental goals** (e.g. NZEB standard) and responsibilities
- **Integrate all specialists** as well as the users and operating personnel **from beginning on**, **focus on the operating phase**
- Define **quality control** standards and measures (e.g. thermographic analysis after renovation)
- All economic analyzes are based on **life cycle cost considerations**.

Integral planning combines economic, ecological and societal-social aspects in all phases of the life cycle from the first idea to planning, implementation, commissioning, operation until dismantling.

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Recommendations heating system and heat supply

The renewed heating system

- ✓ has energy efficient circulation pumps (efficiency class A)
- ✓ insulated pipes (at least the thickness of the pipe)
- ✓ needs hydraulic balancing
- ✓ has thermostatic valves
- ✓ has a modern control system (and at its high end predictive control)
- ✓ uses renewable resources
- ✓ takes care of not to high temperatures in the rooms each 1°C saves about 5% of heat consumption

(images)

Co-funded by the Erasmus+ Programme of the European Union

Recommendations lighting, Ventilation and electricity

The possibilities to optimize the electrical and lighting systems in schools and public buildings are numerous:

- ✓ LED lighting is state-of-the-art and cost optimal
- ✓ Switch off the lights if you leave the room or make automatic controls (daylight, presence)
- ✓ Reduce number of printers, copiers, fridges and vending machines
- ✓ Use timer for electric boilers (hot water)
- ✓ Use switchable power strips for your PCs and IT equipment
- ✓ Buy energy efficient equipment
- ✓ Reduce standby losses
- ✓ Change behaviour of peoople

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Recommendations lighting, Ventilation and electricity

LED lighting:

(image)

- ✓ Take care of the right illuminance (EN 12464-1)
  - if the existing illuminance is poor (very often with old lighting systems), savings are lower...
- ✓ Consumption with new lighting should be < 6 kWh/m² and year
- ✓ Use daylight and presence control in classrooms, most new lighting systems are prepared for it
- ✓ Sometimes retrofit solutions reduce costs – take care of technical limitations; very often the whole system should be changed

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Use of RES in buildings

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of the European Union

Introduction to RES

To implement renewables in buildings is state of the art and a very important factor for reducing CO2 emissions.

Renewables have grown rapidly in recent years, driven by cost reductions for solar photovoltaics and policy.

The use cases of renewables in buildings are very diverse:

Solar power for heat and electricity, geothermal power, biomass and biogas, maybe in future hydrogen...

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Thermal solar energy

Recommendations for the right dimensioning you can find on the following table:

only hot water usage		
recommended collector m² per liter hot water demand and day	storage volume [m³] per m² collector	typical specific solar gain [kWh] per year and m² collector
0,05 - 0,07	0,05 - 0,06	300 - 350
hot water and heating usage (50% solar share)		
recommended collector m² per 1 MWh heat consumption	storage volume [m³] per m² collector	typical specific solar gain [kWh] per year and m² collector
1,5 - 1,75	0,066 - 0,075	280 - 320

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Photovoltaics

- Typical gain per year ca. 1000 kWh per kWp (south oriented, 700 - 800 on south oriented facades
- don't forget lightning protection and other security equipment
- mind shading – make detailed simulation
- is a solar roof register or similar planning instruments available in your city?
- You need ≈ 6-8 m^2 panels per 1 kWp, the efficiency varies between 12 – 20%

images: examples of solar panels

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Environmental energy

Environmental energy can be used very well in combination with heat pumps (for heating and cooling).

You have several typical sources:

- ground heat (deep drill and flat collector)
- ground water (approval necessary!)
- air (often noise problems)
- solar heat (optimizes the solar gain of solar thermal collectors and PV-panels as electrica source – different types)

It is highly recommended to have a low temperature heat distribution system and a efficient storage system!

Environmental energy

ADVANTAGES – DISADVANTAGES of different heat pumps/situations:

Ground source (deep drill)	Ground water
+ works in a lot of areas + efficient heating and cooling + very efficient - permissions - higher investments	+ very efficient + heating & cooling + very reliabel + 5 - 500 kW possible - permissions - take care of the water content and
Air heat pump	**Solar heat pump**
+ almost everywhere possible + lower investments - high effort for defrosting - higher running costs - noise - very low efficiency for higher temperatures (hot water)	+ almost everywhere possible + very efficient + 100% renewable possible - higher investments (multiple systems) - control system cruzial point - not many manufacturers with proofed systems

Optimise the system for your location!

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SDG4BIZ

SELF ASSESSMENT TEST

How much solar gain do get out of 1 m^2 thermal collector and year?

- ☐ 30 kWh/year
- ☐ 280 – 350 kWh/year
- ☐ 1000 kWh/year

What are in general the problems with solar thermal energy in schools?

- ☐ The temperature is not sufficient for a hygienic hot water supply
- ☐ No or too less hot water and heat demand in summer
- ☐ It can not be integrated into the heating system

How much solar gain do you get out of 6-8 m^2 PV-panel on the roof (south oriented)?

- ☐ 300 kWh/year
- ☐ 500 kWh/year
- ☐ 1000 kWh/year

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SELF ASSESSMENT TEST

In which forms biomass is in general local accessible (multiple choices possible)?

- ☐ solid (like wood)
- ☐ liquid (like biofuel)
- ☐ gaseous (like biogas)
- ☐ radiation (like solar heat)

What are the advantages of solar heat pumps?

- ☐ A lot of proofed manufacturers are on the market
- ☐ Almost everywhere possible
- ☐ Easy to control

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Thank you for your time!

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SDG4BIZ M4 Section 4: Resources and network

Circular Economy Resources and Networks

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Why Circular Economy?

- ”Circular economy redefines how we produce, consume and manage materials and products”
- Circular economy offers new SDG compliant value creation oppurtunities
- Creating more value from what we have
- Keep the value within the economy for as long as possible by returning the used resources to the value creation cycle

Forslund et. al., 2022, Tackling Root Causes - Halting biodiversity loss through the circular economy, Sitra Studies 205, ISBN 978-952-347-259-4

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Circular economy resource cycles

Biological cycle

- Consists of anything biodegradeable
- Returning biomaterials back to soil
- Regenerative growth
- ”Returning resources to nature”

Technical Cycle

- Anything non-biodegradeable
  - Metals, plastics, composite materials etc.
- Recover assets that can be returned to the technical cycle after use
- ”Recover value from waste”

Ellen MacArthur Foundation, Basics of Circular Economy

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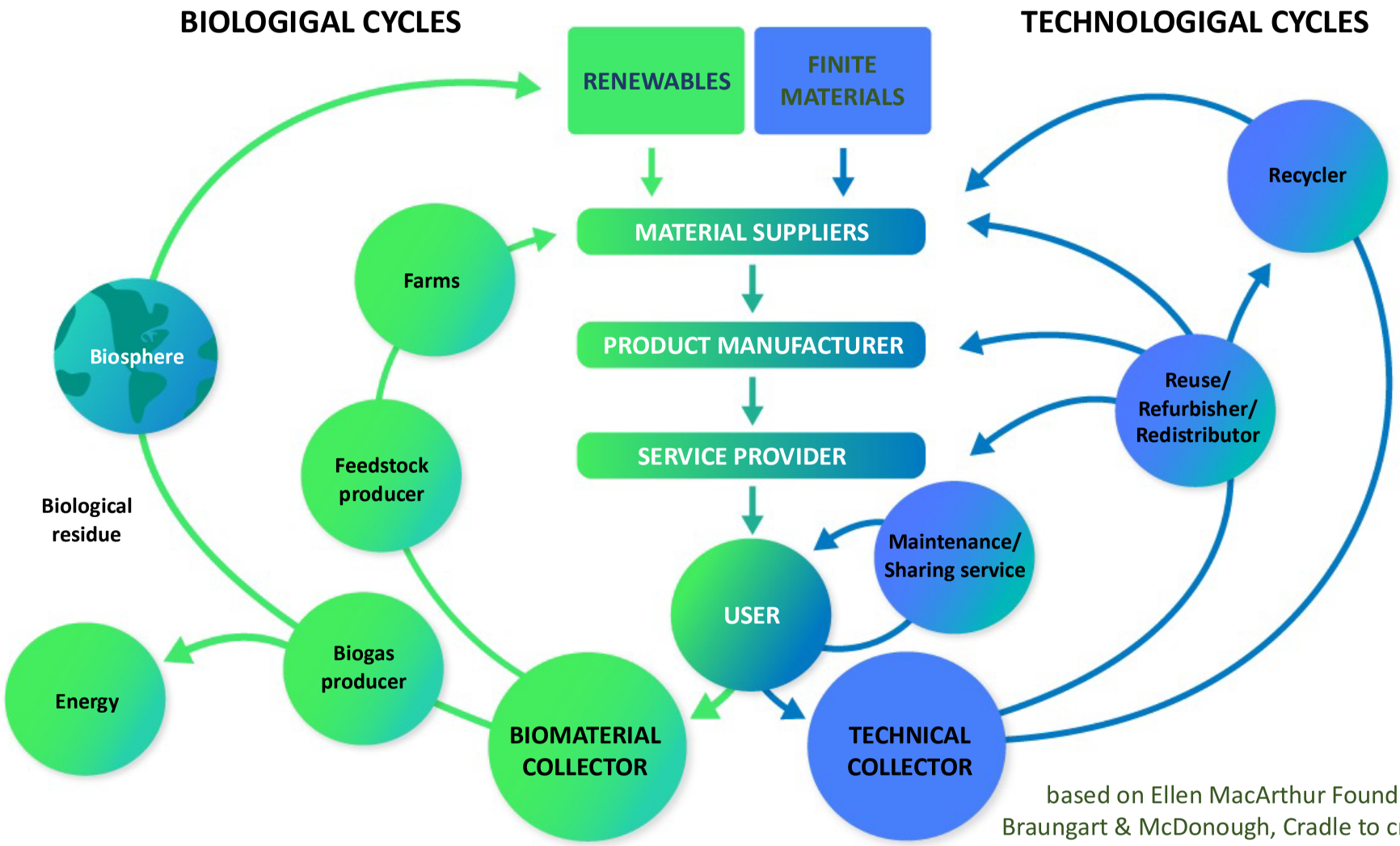

based on Ellen MacArthur Foundation, Braungart & McDonough, Cradle to cradle 2019

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SDG4BIZ

Circular Economy Supply Networks (CESN)

- Complex Adaptive System (CAS)
- Properties
  - Closed loop supply chain (CLSC), Open loop supply chain (OLSC) or a combination of both
  - Builds on Internal and External environments, and Emergent properties
    - Recovery of post-consumption products/byproducts
    - Reuse, repair, refurbish, remanufacture and recycling

Braz A.C. & Marotti de Mello A., 2022, Circular economy supply network management: A complex adaptive system, International Journal of Production Economics (243)

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Circular Economy Supply Chains

Closed loop supply chain

- Original manufacturer controls the network
  - OEM controls the solutions available, product development and lifecycle management

Open loop supply chain

- Network consists of independent actors
  - New solutions and products developed within the ecosystem by 3rd parties

Braz A.C. & Marotti de Mello A., 2022, Circular economy supply network management: A complex adaptive system, International Journal of Production Economics (243)

It’s all about design

1. Eliminate waste
    - Design using materials that can be used again and again
    - Design using biodegradable materials
2. Circulate products and materials
    - Design for extended product lifecycle
    - Desing for re-use in technical cycle
    - Design for biological cycle
3. Regenerate nature
    - Design to regenerate nature

Ellen MacArthur Foundation, Basics of Circulr Economy

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It’s also about data

- Integration of modern technologies (IT, IoT, robotics, automation)
  - Industry 4.0
  - Maintaining data in the EU circular economy information systems
  - Tracking the products throughout the lifecycle
- Share data with networks and partners
  - Material content to increase efficiency in recycling
  - Structural and functional data to enable repairs and upgrades (right to repair directive)
  - Ensuring the end-of-life products are recycled properly and resources are recovered for the next cycle

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SDG4BIZ M4 Section 5: Business modelling

GROUND SOURCE HEAT PUMP SYSTEMS

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SDG4BIZ

WHY GSHP SYSTEMS?

There are many reasons home and business owners choose geothermal systems for heating and cooling:

- Small cost to operate
- last many years
- they operate quietly.
- In addition to these benefits, environmentally conscious homeowners also choose geothermal systems because they are better for our planet.

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GSHP SYSTEMS: EFFICIENCY

Geothermal heating and cooling systems are the most environmentally friendly option for heating and cooling your home or business — here's why:

- Geothermal ground source heat pump systems are one of the most energy efficient, environmentally clean, and cost-effective space conditioning systems available.
- About 70 percent of the energy used by a geothermal heat pump system comes in the form of renewable energy from the ground.

High-efficiency geothermal systems are on average

- 48 percent more efficient than gas furnaces
- 75 percent more efficient than oil furnaces
- 43 percent more efficient when in the cooling mode.

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WHY GSHP SYSTEMS?

(images)

Although many parts of the country experience seasonal temperature extremes, from scorching heat in the summer to sub-zero cold in the winter, a few feet below the earth's surface the ground remains at a relatively constant temperature.

Depending on latitude, ground temperatures range from 7°C to 21°C. Like a cave, this ground temperature is warmer than the air above it during the winter and cooler than the air in the summer. The GHP takes advantage of this by exchanging heat with the earth through a ground heat exchanger.

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WHY GSHP SYSTEMS?

(image: how do air-source heat pumps work)

Relative to air-source heat pumps, they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air. Considerations including utility rates for electricity, natural gas, or other fuels can impact decisions to implement this technology.

Source: tssfacilities.co.uk/air-source-heat-pumps

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DISTRIBUTION SYSTEM

(images: radiant heat and convected heat)

- Because a geothermal heat pump is more efficient when producing a lot of warmth – as opposed to a small amount of heat – the distribution system in the building should match this:

a large area of underfloor heating distributing warmth is more efficient than a small area of radiators emitting high temperatures (and causing draughts).

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COEFFICIENT OF PERFORMANCE – PART 1

- The key to the efficiency of a heat pump is the Coefficient of Performance: the “CoP”. In spite of the first law of thermodynamics, which tells us that energy can neither be created nor destroyed, a heat pump in a good installation can yield up to four units of heat for each unit of electricity consumed. The geothermal heat pump is not creating this energy, but merely separating a medium temperature from the ground into warmth (which can be used for heating) and cold (which can be returned to the ground).

$$COP = \frac{useful\ heat}{electric\ power\ input}$$

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SDG4BIZ

COEFFICIENT OF PERFORMANCE – PART 2

- The CoP will vary with each installation, but the lower the output temperature to the heat distribution system the higher the CoP will be.
- The input temperature is also critical to the CoP of the heat pump.
- The higher the input temperature from the ground, the lower the amount of work needed from the heat pump, the higher the CoP will be. In fact, the critical factor is the “uplift” between the source temperature and the output temperature

COP variation with temperatures

Heat distribution system	supply/ return temp.	COP[1]
Conventional radiators	60/50°C	2.5
Floor or wall heating	35/30°C	4.0
Modern radiators	45/35°C	3.5
Hydronic convectors	48/38°C	3.5

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COEFFICIENT OF PERFORMANCE – PART 3

(image: heating supply temperature)

- Normally a geothermal heat pump starts with a ground temperature of about 10-14°C: this is the natural temperature of the ground at a depth of six metres.
- The CoP is critical because, although a pump can be efficient, electricity is more expensive than gas.
- If you do not get a high CoP from your heat pump it could be cheaper to use a gas boiler for heating.
- In terms of carbon saving a heat pump releases no CO_2 on site, but you should consider the CO_2 emitted at the power stations to create the electricity you use.

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SDG4BIZ

Heat pumps offer significant emission reductions potential, particularly where they are used for both heating and cooling and where the electricity is produced from renewable resources (i.e. PV panels).

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PROS OF GROUND SOURCE HEAT PUMPS

- high capital costs and low operational costs compared to other HVAC systems.

- Their overall economic benefit depends primarily on the relative costs of electricity and fuels, which are highly variable over time and across the world.

- lower operational costs than any other conventional heating source almost everywhere in the world.

(Natural gas is the only fuel with competitive operational costs, and only in a handful of countries where it is exceptionally cheap, or where electricity is exceptionally expensive)

- In general, a homeowner may save anywhere from 20% to 60% annually on utilities by switching from an ordinary system to a ground-source system.

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GSHP SYSTEMS: SERVICES PROVIDED

Geothermal Heating and Cooling Systems work by moving heat, rather than by converting chemical energy to heat like in a furnace.

Geothermal Heating and Cooling Systems provide:

- Heating
- Cooling
- Humidity control

They may also provide:

- Water heating, either to supplement or replace conventional water heaters.

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GSHP SYSTEMS: MAJOR SUBSYSTEMS

Every Geothermal Heating and Cooling Systems has three major subsystems or parts:

1. a geothermal heat pump to move heat between the building and the fluid in the earth connection
2. an earth connection for transferring heat between its fluid and the earth
3. a distribution subsystem for delivering heating or cooling to the building.

Each system may also have a desuperheater to supplement the building's water heater, or a full-demand water heater to meet all of the building's hot water needs.

(image: geothermal heat pump system's three basic components)

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GSHP: DISTRIBUTION SUBSYSTEM

Properly sized, constructed, and sealed ducts are essential to maintain system efficiency.

Ducts must be

- well insulated
- whenever possible, located inside of the building's thermal envelope (conditioned space).

(image: sources, type and output of GHP

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GSHP: DISTRIBUTION SUBSYSTEM FOR LARGE BUILDINGS

Geothermal heating and cooling systems for large commercial buildings, such as schools and offices, often use a different arrangement.

Multiple heat pumps (perhaps one for each classroom or office) are attached to the same earth connection by a loop inside the building. This way, each area of the building can be individually controlled.

The heat pumps on the sunny side of the building may provide cooling while those on the shady side are providing heat. This arrangement is very economical, as heat is merely being transferred from one area of the building to another, with the earth connection serving as the heat source or heat sink only for the difference between the building's heating and cooling needs.

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GSHP SYSTEMS: WATER HEATING

- Many *residential-sized* systems installed today are equipped with desuperheaters to provide domestic hot water when the system is providing heat or air conditioning.
- The desuperheater is a small auxiliary heat exchanger at the compressor outlet. It transfers excess heat from the compressed gas to a water line that circulates water to the house's hot water tank. In summer, when the air conditioning runs frequently, a desuperheater may provide all the hot water needed by a household. It can provide four to eight gallons of hot water per ton of cooling capacity each hour it operates. A desuperheater provides less hot water during the winter, and none during the spring and fall when the system is not operating.
- Because the heat pump is so much more efficient than other means of water heating, manufacturers are beginning to offer "triple function," "full condensing," or "full demand" systems that use a separate heat exchanger to meet all of a household hot water needs.
- A on demand system can also be installed as water heating system. This system provides hot water as soon as there is a demand for it. Using this type of system eliminates the need to heat stored water like a conventional hot water tank requires.

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GSHP SYSTEMS: CONFIGURATIONS

A ground source heat pump system can be used not only for heating, but also for cooling.

(image: basic schematic of water-to-water GSHP system)

The configurations manufactured are:

- water-to-air,
- water-to-water, and
- water to air split type

The water to water geothermal heat pumps are usually grouped together in a mechanical space, and can be treated as a conventional heater/ chiller plant. Basic schematic of water-to air GSHP system The unit sizes range from 3 tons to 30 tons. The most common type of heat pump used with GSHP systems is a “water-to-air” unit ranging in size from 3.5 kW to 35 kW of cooling capacity.

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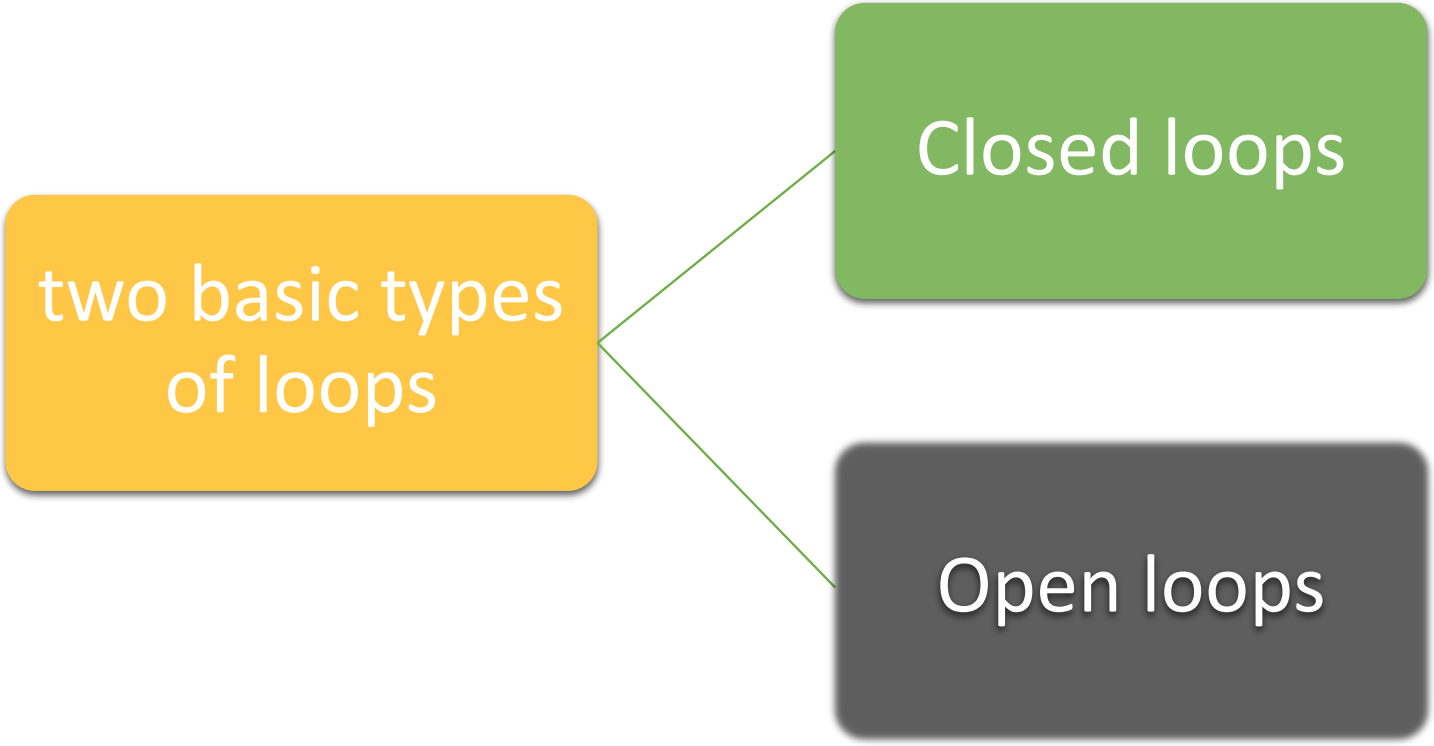
GSHP: TYPES OF SYSTEMS



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GSHP: OPEN LOOP SYSTEMS

Open loop systems are the simplest. Used successfully for decades, ground water is drawn from an aquifer through one well, passes through the heat pump's heat exchanger, and is discharged to the same aquifer through a second well at a distance from the first.

Generally, two to three gallons per minute per ton of capacity are necessary for effective heat exchange. Since the temperature of ground water is nearly constant throughout the year, open loops are a popular option in areas where they are permitted.

Open loop systems do have some associated challenges:

- Some local ground water chemical conditions can lead to fouling the heat pump's heat exchanger
- Such situations may require precautions to keep carbon dioxide and other gases in solution in the water.
- Other options include the use of cupronickel heat exchangers and heat exchangers that can be cleaned without introducing chemicals into the groundwater.

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GSHP: CLOSE LOOP SYSTEMS

Closed loop systems are becoming the most common. When properly installed, they are economical, efficient, and reliable. Water (or a water and antifreeze solution) is circulated through a continuous buried pipe keeping.

The closed loop system is environmentally friendly because water in the loop prevents contamination to the external environment.

The length of loop piping varies depending on

- ground temperature,
- thermal conductivity of the ground, soil moisture,
- system design. (Some heat pumps work well with larger inlet temperature variations, which allows marginally smaller loops).

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GSHP: HORIZONTAL LOOPS

(image: closed horizontal ground heat exchanger)

Horizontal closed loop installations are generally most cost-effective for small installations, particularly for new construction where sufficient land area is available.

(image: trench ground heat exchanger)

These installations involve burying pipe in trenches dug with back-hoes or chain trenchers. Up to six pipes, usually in parallel connections, are buried in each trench, with minimum separations of a foot between pipes and ten to fifteen feet between trenches.

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GSHP: VERTICAL LOOPS

Vertical closed loops are preferred in many situations. For example, most large commercial buildings and schools use vertical loops because the land area required for horizontal loops would be prohibitive.

Vertical loops are also used where the soil is too shallow for trenching. Vertical loops also minimize the disturbance to existing landscaping.

For vertical closed loop systems, a U-tube (more rarely, two U-tubes) is installed in a well drilled 100 to 400 feet deep. Because conditions in the ground may vary greatly, loop lengths can range from 130 to 300 feet per ton of heat exchange. Multiple drill holes are required for most installations, where the pipes are generally joined in parallel or series-parallel configurations.

(image: closed vertical loop system)

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GSHP: SLINKY LOOPS

(image: closed horizontal Slinky loop system)

"Slinky" coils, which can be overlapping coils of polyethylene pipe, are used to increase the heat exchange per foot of trench, but require more pipe per ton of capacity.

Two-pipe systems may require 200 to 300 feet of trench per ton of nominal heat exchange capacity.

The trench length decreases as the number of pipes in the trench increases or as Slinky coil overlap increases.

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GSHP: POND LOOP

(image: pond loop)

- Pond closed loops are a special kind of closed loop system. Where there is a pond or stream that is deep enough and with enough flow, closed loop coils can be placed on the pond bottom.
- Fluid is pumped just as for a conventional closed loop ground system where conditions are suitable, the economics are very attractive, and no aquatic system impacts have been show.

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GSHP: OPEN LOOP SYSTEMS (GROUNDWATER SYSTEMS)

Groundwater systems are more efficient than closed loop systems. The technology “normal” groundwater wells is used for energy extraction. The temperature of groundwater is practically constant all over the year and as such it is the best carrier of thermal energy.

(image: open groundwater loop system)

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GSHP: TECHNICAL LIMITATIONS

For systems using the underground for seasonal storage of heat and cold, the source of energy for storage may be different:

- waste heat from industrial process cooling
- waste cold from heat pump evaporators
- technical limitations such as load, duration, temperatures, availability.

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GSHP: GEOLOGICAL LIMITATIONS

The geological requirements differ according to what type of system is to be installed:

- Closed loop systems are in general applicable in all types of geology.
- Open systems require a geology containing one or several aquifers.

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GSHP: HYDRO GEOLOGICAL LIMITATIONS

The hydro geological conditions in practice govern the design of any open loop system.

For the design and realization of such systems essential are:

- type of aquifer,
- geometry,
- groundwater level and gradient,
- textural composition,
- hydraulic properties and boundaries.

For closed loop systems these parameters are of less importance, but can in some cases constitute limiting conditions.

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GSHP: CLIMATE CONDITIONS

Climate plays an important role in the application of GSHP systems.

One essential condition is that the ambient temperature of the ground is reflected by the average temperature in the air.

Another climate factor is the humidity. In hot climates with a high humidity, there will be temperature requirement for cooling that allows condensation.

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SDG4BIZ

CONCLUSION

- Geothermal energy is a largely CO2 free renewable energy source available at virtually every location.
- The technology is proven to reliably meet heating, cooling and electricity supply needs.
- Geothermal also promotes local economic development and job creation. It also is a significant contributor to energy security.
- Further deployment of this renewable resource requires a strong commitment by public authorities and the private sector. A major barrier to increased deployment of geothermal energy remains awareness of the technology.
- The support of public authorities plays a key role in promoting geothermal energy.

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SDG4BIZ

SELF ASSESSMENT TEST

1. Geothermal heat pumps are economically an advantage or a disvantage?

a) An advantage
b) A disvantage
c) A disvantage compared to traditionale gas boilers

1. Heat pumps offer significant emission reductions potential: it is true?

a) Yes
b) No
c) It depends on the climate

3. What does a heat pump do?

a) Heat pumps transfer heat stored in the Earth or ground water into a building.
b) Heat pumps run oil furnaces.
c) Heat pumps are part of a solar array.

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SELF ASSESSMENT TEST

4. Why is geothermal energy similar to solar energy?

a) Both are fossil fuels.

b) Both are sources of renewable energy.

c) Both are cheap to harness.

5. Can a heat pump also be used to cool a house?

a) Yes

b) No

c) Maybe

6. Which of the following terms best describes a type of geothermal system that pumps ground water directly from a well into a building, and then allows the water to leave the building?

a) closed-loop

b) open-loop system

c) horizontal

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SELF ASSESSMENT TEST

7. What type of geothermal system is a vertical loop?

a) closed-loop
b) circular-loop
c) open-loop

8. What percentage of a home's cooling and heating needs can a heat pump provide?

a) 100%
b) 50%
c) 75%

9. Which of the following statements is true?

a) Geothermal energy improves indoor air quality.
b) Geothermal energy cannot be used to heat office buildings.
c) Geothermal energy is cheap to install.

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Thank you for your time!

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Interview with Gasmet Technology Ltd, Autumn 2022.

1. Interviewer (Kaj Lindedahl): Can you introduce yourself, and your role in Gasmet?
   - Interviewed: (Ulla Kosonen) : QE Manager at Gasmet responsible for
   - ISO 9001, ISO 45001, ISO 14001 & sustainability and their continuous improvement

2. Kaj **Q** : Tell us a bit about Gasmet?
   - Ulla **A** : Founded in 1990, more than 130 employees.
   - Headquarter is located in Vantaa, Finland and regional offices in Canada, UK, Hong Kong, Germany and Austria.
   - Distributors in more than 80 countries.
   - Nederman acquired Gasmet in 2019.
     - Nederman's mission is to protect people, planet and production from the harmful effects of industrial processes to contribute to efficient production, environmental sustainability and a safer workplaces.
   - We design and manufacture world-class gas analysis system and emission monitoring solutions to measure gaseous emissions from industrial processes, gases related from natural sources into the atmosphere, and gases present at working environments.
   - We contribute to keeping people safe and the environment clean by providing reliable and accurate cutting-edge measurement technologies.

3. Kaj **Q** :What role do the SDGs play in Gasmet and its services?
   - Ulla **A**: At Gasmet we talk more about sustainability than SDGs, but our Sustainability strategy and SDGs below goes hand in hand.
   - Sustainability has a big role at Gasmet. We defined our Sustainability Strategy in 2017, it has seven areas with guiding principles, commitments, goals and actions Gasmet.com
   - In 2018, as a part of our Sustainability Strategy, we examined UN SDGs and recognized that our sustainability commitments met with a number of SDGs. We contribute to following UN's SDGs:
     - Climate Action, Life on Land, Sustainable cities and communities, Life below water, Responsible consumption and production, Good health and well-being, Decent work and economic growth
     - SDGs and Gasmet's Sustainability Strategy can be seen at our website Gasmet.com

(image: Gasmet's Sustainaility Areas and Impact Goals on SDG)

4. Kaj **Q** Which SDGs are most prominent in the daily activities of Gasmet? How are they seen in your daily activities?
    - Ulla **A** Actions related to SDGs/ our Sustainability Strategy (among others):
        - No. 13 Climate Action, No. 15 Life on Land, No. 11 Sustainable cities and communities, No. 14 Life below water, No. 12 Responsible consumption and production, No. 3 Good health and well-being, No. 8 Decent work and economic growth:
            - We provide accurate and reliable equipment for greenhouse gas measurements.
            - We provide portable and easy-to-use toxic gas analyzers to prevent accidents
            - We provide accurate emissions measurements, allowing regulators and operators control the emissions based on actual real emissions values
            - We have ISO 14001 and ISO 45001 certificates which means that we continuously improve our processes and activities related to these standards.
            - Gasmet is following our own sustainability strategy, which is controlled policy of sustainable development in its all operations including the waste management, choosing the suppliers, and setting the criteria for the manufacture and research and development.
            - In addition to our Sustainability Strategy, we have defined our own 1.5°C strategy. It is a strategy for limiting global warming to 1.5 °C and what Gasmet can do to contribute to that target. 1.5°C strategy has monthly themes that encourage us all to think sustainably and take environmentally friendly actions at work and during our free time
                - We have participated multiple events: Bike-To-Work, Zero Emissions Day, UN's International Day of clean Air, Earth Hour, Ham trick campaign by Neste.
                - We have raised awareness on sustainable consumption, recycling, our own carbon footprints and how to decrease it, energy consumption etc.
            - We organize environmental and sustainability training to our employees
            - We ship our products in wooden, recyclable boxes
            - One product one tree; we have planted a hundreds of trees together with One Tree Planted organization and Finnish Taimiteko project. We also plant a tree for each response to our quantitative customer satisfaction surveys
            - We reduce our energy consumption by replacing lighting with LED
            - Our analyzers are long-lasting and serviceable
            - Occupational health and safety in Gasmet and in our customers locations. For example container measurements help our customers to reduce their work-related injuries.
            - We follow our Code of Conduct and supplier Code of conduct

5. Kaj **Q** How has your work with SDGs benefited the business?
    - Ulla **A :**Sustainable business is good business. Environmental, social and economic sustainability is a must in today's business environment. A business strategy that is focusing on sustainability meets today's consumers and stakeholders demands, increases efficiency, attracts new valuable talents and keeps existing ones happy, creates new business opportunities and adds brand value.

6. Kaj **Q** Do you think green energy is worth investing in? Why/Why not?
    - Ulla **A** Yes it is. Green energy reduces pollution such as the emission of greenhouse gases. The benefits of green energy includes low emissions and cost, energy efficiency and reusability. More power generation based on renewables is therefore essential to achieving the targets of the Paris Agreement.

7. Kaj **Q** Is green energy being used or produced by your business?
    - Ulla **A:** Yes, we have used 100% certified wind energy since 01/2020.

8. Kaj **Q** How has using or producing green energy benefited the business?
    - Ulla **A:** We are going to update our Sustainability Strategy in near future. We will (most likely) add new target / targets based on our carbon footprint. The fact that we are already using green energy helps us to achieve these targets.

9. Kaj **Q** Is Public Relations (PR) a reason for the business encouraging and incorporating SDGs/green energy?
    - Ulla **A:** Of course it doesn't have a negative impact on our PR, but that is not the reason for it. Sustainable business is good business, which is why we have adopted our Sustainability Strategy. I also believe that sustainable business will play an even more important role in the future.
    - It is important to us that our Sustainability Strategy is up-to-date and that we reflect on our own operations on a regular basis so that we can meet the expectations and also reduce both our own emissions and help our customers reduce their own emissions and achieve their targets.
    - One important reason for incorporating sustainability strategy /(SDGs) is that we want to be part of solution to this global climate crisis.

Innovative materials and industrial applications

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SDG4BIZ

Steel fabrics

(image)

- Flexible and easily conformable
- Breathable and Transparent
- UV, heat, chemicals and corrosion resistant
- Mechanical, impact, scratch and abrasion resistant
- Fireproof, electrically and thermally conductive
- Antistatic
- EMI shielding
- 100% Recyclable

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Applications

(images)

Jewelry

Filtration

Luxury products

Motorcycle helmets

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SDG4BIZ

(images of constructions)

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Furnishings

(images)

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(images of cloth-type material)

Co-funded by the
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RIVA Lamp

(images)

Rod made of bricole from lagoon in Venice

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Phase change materials

(image)

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(images)

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Microcapsules

(images)

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FUNCTION: TEMPERATURE and HUMIDITY MANAGEMENT

Product Examples

(images)

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(images)

- Puma – TitanGolf Shoe Tours
- Ski boots
- Clothing
- Gloves
- Hoses
- ....

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BUILDING

(images)

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Comfort and storage

(images)

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NANOTECHNOLOGIES - COATINGS

(image)

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EASY-TO-CLEAN: lotus effect

(images)

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(images)

Co-funded by the
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Surfboards/water skis

(image)

(image)

⇨ Friction reduction!

Shower cabin (Glass/Plexiglas)

⇨ Anti-limescale effect!

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SDG4BIZ

Display and electronics

(images)

Hydrophobic, oleophobic,
anti-fingerprint effect

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(images)

'Industrial' sector

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GRAFENE

(image)

- Monoatomic layer of carbon atoms

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CARBON NANOMATERIALS

(images)

Fullerenes – 0D
(discovered in 1985)
C60, C70, C84
Film, semi-conductor type n

Nanotubes – 1D
(discovered in 1991)
Single or multiple wall
Semi-conductors, conductors

Graphene – 2D
(discovered in 2004)
Nobel Prize (2010)
Conductor/transparent

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SDG4BIZ

What it looks like

Powder

(image)

Advantages:
Purity
Disadvantages:
Difficult to handle and mix

SOLUTION

(image)

Advantages:
Easy to handle
Disadvantages:
Low graphene concentration

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PROPERTIES

- Mechanical resistance > 200 times steel
- Electrical conductivity > copper
- Thermal conductivity ≈ Diamond
- Very high specific surface (2500 sqm/gr) - density
- High flexibility
- Transparency
- Antibacterial activity

(image: an elephant)

TECHNICAL DATA
Elastic modulus: about 1100 GPa
Breaking strength: ~130 GPa
Thermal conductivity: ~3000 W/m-K flat
Density: ~2 g/cm3.

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MAIN APPLICATION SECTORS

Batteries/
Super-capacitors

(images)

Conductive Inks and Sensors

Surface coatings

Composite

Membranes

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GRAPHENE + Rubber

(image)

Compound for increased speed, grip, durability and puncture resistance

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TENNIS RACKETS

(images)

2016

- Weight reduction
- Increased mechanical strength

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GRAPHENE + POLYMER

(image: eye glasses)

2017

- ADVANTAGES
- ultra lightness
- high mechanical strength (low thickness)

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SDG4BIZ

GRAPHENE + POLYMER

(images)

3D Printing - FDM

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Graphene and textiles

(image)

- **Thermoregulation:** able to keep the body temperature stable,

without thermal fluctuations.

- **Antistatic:** Being a natural conductor, the application of a continuous layer of graphene leads to the dispersion of electrical charges, preventing their accumulation on the surface.

- **Anti-bactericity:** Graphene nanoparticles are free of toxicity and offer high antibacterial properties.

Padding: 0.5% ~ 1.5% Graphene fiber - 99.5% ~ 98.5% recycled Polyester

Fabric: Cotton - 0.5% ~ 2% Graphene
Polyester - 0.5% ~ 2% Graphene
Nylon - 0.5% ~ 2% Graphene
Rayon - 0.5% ~ 2% Graphene

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Thank you for your time!

Metropolia

Haaga-Helia

STU
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

YAŞAR ÜNİVERSİTESİ

FENICE
GREEN ENERGY PARK

brain Ideen

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its learning

Tknika

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Contemporary architecture
Dynamism of shape

(images)

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Optimizing energy efficiency
in the new trends of sustainable architecture is

solar protection

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Ecomaterials and soundproofing solutions in green building

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(images)

What is a Green Building?

•"Green" buildings are buildings that are better for the environment (i.e more sustainable) than a conventional building in one or more ways. These ways include:

- Lower energy use in construction and operation
- Less water use in construction and/or operation
- Destroy less of the environment during construction and/or operation
- Provide a better indoor environmental quality (leading to better worker satisfaction and performance)

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The SOUND Management in building

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The SOUND – an introduction

Sound is characterised by:

1. ITS FREQUENCY
2. ITS SOUND LEVEL
3. ITS LENGTH

1. THE FREQUENCY of a sound is the number of air pressure fluctuations per second and is expressed in Hertz (Hz). This frequency determines the pitch of the sound: a low frequency produces a deep sound, whereas a high frequency will give a high-pitched sound.

(image)

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Sound is characterised by:

1. ITS FREQUENCY
2. ITS SOUND LEVEL
3. ITS LENGTH

2. THE SOUND LEVEL characterises a sound's amplitude. A low amplitude produces a quiet sound; a high amplitude produces a loud sound. As the human ear has a very wide perception scale, in practice we use a logarithmic scale to represent the sound amplitude. This smaller scale is expressed in decibels (dB).

(image)

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Sound is characterised by:

1. ITS FREQUENCY
2. ITS SOUND LEVEL
3. ITS LENGTH

3. LENGTH: the ability to perceive a given sound varies depending on how long the sound is heard.

Noise and the human ear

Physically, a noise is a set of sounds of differing frequencies and power levels.

(image)

The human ear can detect sounds of frequencies between 20 and 20,000 Hz with various degrees of sensitivity depending on the frequency.

As a result, in some cases we use the dB(A), a scale representing more accurately the sensitivity of the human ear. The dB(A) scale minimises the sounds less easily noticed by the ear (notably deep ones) and, to a lesser degree, high- pitched sounds.

In terms of the sound level, the smallest variation liable to be detected by the ear is around 2–3 dB (A).

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Decibel Chart

(image)

Frequency Chart

(image)

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Noise sources in building

(image)

There are 4 noise sources in the building acoustics domain:

1. Airborne noise from external sources: road, rail or aircraft noise, voices in the street, etc.
2. Airborne noise from internal sources: conversations, Hi-Fi, television, etc.
3. Impact noise: movements of people or furniture, falling objects, etc.
4. Equipment noise: elevators, valves, ventilation fans, etc.

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Sound Absoption and Insulation

Ability of a material to absorb sound energy : ACOUSTIC COMFORT

(image)

Sound absorption includes all those techniques designed to improve the internal acoustics of an environment, to guarantee **its acoustic comfort**. In other words, we need sound absorption in environments where reduced ambient noise is required and/or where sound clarity is required.

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The SOUND absorbtion

One of the fundamental principles of physics (on the conservation of energy), which also applies to acoustics, is that of the impossibility of destroying energy that can only be transformed.

(image: sound absorption and transmission)

Sound absorption is the ability of a material to dissipate sound energy by converting it into heat.

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Sound insulation and absorption

Insulating panels are not sound transparent; the sound wave is reflected in the place where it comes from.

(image)

Sound absorbing panels are porous and absorb the sound energy converting into heat.

Sound absorption and insulation Indicators

The **absorption coefficients** **'d'** of a material is

$$0 < \frac{\text{Energy absorbed}}{\text{Incident energy}} < 1$$

(image)

It depends on the angle of incidence of the sound (for convenience, a widespread incidence field is considered)
It also depends on the frequency of the sound.

D = 0 The sound is not absorbed but is completely reflected.

D = 1 The sound is completely absorbed and is not reflected

A material is sound absorbing (absorbs sound, d is ≤ 1)
or is sound insulating (reflects sound, d is ≥ 0)

Usually materials that are good sound absorbing are also good thermal insulators

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Some Absorption Coefficients

Material	Frequency (Hz)					
	125	250	500	1000	2000	4000
Concrete/brick	0.01	0.01	0.02	0.02	0.02	0.03
Glass	0.19	0.08	0.06	0.04	0.03	0.02
Plasterboard	0.20	0.15	0.10	0.08	0.04	0.02
Plywood	0.45	0.25	0.13	0.11	0.10	0.09
Carpet	0.10	0.20	0.30	0.35	0.50	0.60
Curtains	0.05	0.12	0.25	0.35	0.40	0.45
Acoustical board	0.25	0.45	0.80	0.90	0.90	0.90

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Sound absorption and insulation Indicators

The **transmission coefficient t** depends on the angle of incidence ϕ, on the frequency f, on the speed of sound c, on the density ρ of the materials the partition is made of:

$$t(\phi, f, c, \rho) = \frac{W_t(\phi, f, c, \rho)}{W_i(\phi, f, c, \rho)}$$

Following the typical non-linearity of sound phenomena, it is preferable to introduce the **Sound Reduction Index Rw**, a logarithmic quantity:

$$R(\phi, f, c, \rho) = 10 \log \frac{1}{t(\phi, f, c, \rho)}$$

The higher R_w is,
the better the wall's sound insulation.

In case of a plane sound wave, incident orthogonally on a flat wall of infinite size:

$$R_0(f) = 20 \cdot \log f \cdot M_s - 42.3$$

MASS LAW

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Solid wall behaviour: the Mass Law

Principle:
Solid walls are composed of a single material. Their acoustic performance varies depending on its nature and surface weight. In this particular case, the heavier and thicker the wall, the better the sound insulation.

The critical frequency is the frequency at which the sound insulation is the lowest.

(image: critical frequency)

Increasing the concrete thickness from 10 to 16 cm increases the sound inpedance at all frequencies by around 10 dB. Changing the material also affects the attenuation by switching from a gypsum board 10 cm thick (surface weight 100 kg/m²) to concrete of the same thickness (surface weight 220 kg/m²) reduces the critical frequency from 400 Hz to 100 Hz while increasing the wall sound insulation.

	10 cm gypsum board	10 cm concrete	16 cm concrete
R_w (C;C_{tr})	38(-1 ;-3)	49(-2 ;-7)	59(-2 ;-6)

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Different mechanism of Sound absorption

(image)

- Sound Absorption by POROSITY
- Sound Absorption by CAVITY RESONANCE
- Sound Absorption by MEMBRANE RESONANCE

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- Sound Absorption by POROSITY

We can say that the surface of an element is more absorbent greater is its ability to transform incident sound energy into heat by friction in the microcavities of the material

(image)

The best acoustic materials are, in fact, porous and fibrous ones: glass and rock wools, open-cell polyurethane foam foams, wood fibres, felts, etc.

The absorption coefficient of such materials depends on:
- porosity;
- thickness;
- density;
- frequency of incident sound;
- shape.

(image)

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Glass wool

(image)

Low density open cell polyurethane foam

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- Sound Absorption by CAVITY RESONANCE

Absorption occurs thanks to the damping of the oscillation of a small mass of air inside a cavity.
They are effective solutions for certain wave frequencies (limited range).

(image)

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- Sound Absorption by MEMBRANE RESONANCE

(image)

Sound absorbing systems for membrane resonance: simple system (fig. 1) and system with interposed porous material (fig. 2) to improve sound absorption over a wider frequency range

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Let’s START from MATERIALS

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(images)

Recycled polyester fiber panels

- Reverb control, remove background noise

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SDG4BIZ

Sound-proofing lamps – examples from the market

(images)

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High density Recycled polyester fiber panels

Product composed of a high-density polyester fiber panel (140 kg / m3), created for insulation from footsteps.

Material composed of 70% post-consumer recycled fiber, of unlimited duration, non-toxic, ecological.

It is completely insensitive to vapours.

It offers excellent sound absorption combined with sound insulation (given by the mass).

(images)

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Mineralized wood fiber panels

(image)

Mineralized wood wool bonded with cement

The cellular structure of the wood gives insulation, lightness and elasticity to the final panel; the interstices between the fibers, on the other hand, guarantee sound absorption

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Wood

Wood fibre offers excellent insulation, heat retention and sound absorption.

Cement

Cement, a proven and popular building material is the binder that provides strength, moisture resistance and fire protection.

Water

Finally water, the nontoxic liquid composed of hydrogen and oxygen, essential for life and wood wool, is added to the mix.

(images)

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Wood fiber panel

(image)

For the production of the panel, waste from the wood industry (packaging, firewood, etc.) is used as raw material; the material is reduced into pieces of equal size and subsequently processed with a process that uses only water vapor for the defibration and, as glue, the natural resin of the wood; finally, through a dehydration and drying process at 180 ° C, the soft insulating panel is obtained. In addition to thermal insulation characteristics, wood fibers also possess thermal accumulation properties (thermal capacity 2100 J / KgK). Thanks to the high density (from 160 to 250 kg / mc) of the material, the panel also has acoustic insulation properties. It is totally environmentally friendly as it uses only material of natural origin and therefore 100% recyclable.

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Mineralized wood fiber panels + Wood fiber layer

(image)

Composite thermal and acoustic insulation panel, consisting of a layer of mineralized spruce wood wool and bonded with grey Portland cement, 50 mm thick, coupled with a layer of wood fiber in compliance with the UNI EN 13171 standard.

Compliant with UNI EN 13168, it is available with FSC® certification.

Composite panel with a layer of wood wool and a layer of wood fiber of varying thickness. Specially designed for application on the roof, the panel combines good winter insulation, with a high degree of thermal inertia and attenuation in summer, thanks to the presence of mineralized wood wool peel which, thanks to its high density, creates conditions to face even the hottest summers.

Simple installation operations, drastically reducing the time.

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SDG4BIZ

Natural Sound absorbing panels

(image)

(images: hemp, kenaf, cotton and coconut fibre)

Nonwovens which are entirely made of natural fibres, like hemp, flax, jute or sisal (natural fibre from agave); for some applications, it is possible to mix them with synthetic fibres such as PP-polypropylene. During their production, first all fibres are pulped, carded, laid out and then processed on a needle machine to make the final nonwoven fabrics. These materials are natural, flexible, breathable and biodegradable; they also provide good thermal and sound insulation. They are available in rolls that are weighed and randomly tested for moisture content, longitudinal and lateral strength. Rolls can be cut into mats or into any shape required. These products find applications as padding in the furniture industry and as insulating material in the building field. They are used in the geo-textile industry and in agriculture; they can be impregnated with UF (Urea-Formaldehyde) or MDI (diphenyl methane diisocyanate) resins to make composite sandwiches; therefore, it is possible to obtain moulded parts that are used as reinforced structural materials in the automotive industry.

The high porosity structure allows a high degree of sound absorption

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PANELS from paper and bio-based resources

(image)

Cellulose

Cellulose from sustainably harvested Swedish and FSC controlled fir and pine trees.

Water

In production, the water is being recycled back into the factory's closed circular system to be reused again in the next batch.

Wheat

Non-GMO wheat bran. No paint that would compromised a vision of creating a 100%-bio-based product.
Instead, color is achieved using different percentages of wheat bran.

Potato Starch

For strength, a naturally catalytic combination of potato starch extracted from *potatoes* is used. The cells of the root tubers of the *potato* plant contain leucoplasts making it ideal for strength.

Wax

Plant-derived wax is used to further increase fire protection in the product.

Citrus fruits

For strength, a naturally catalytic combination of potato starch, plant-based wax and citrus fruit acids from lemons, limes, and oranges is used to provoke the cellulosic molecules into creating a powerful matrix of intermolecular fusions.

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(images)

100%
Bio-based

100%
Recyclable

100%
Biodegradable

0%
Pollution or waste

Biomimicry engineered

Lightweight

Durable

Fire retardant

Water repellent

Colors made from wheat

Laser enhanced sound absorption

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SDG4BIZ

Paper waste based absorbing solution

(image)

Natural thermal and acoustic insulation in medium and short cellulose fibers obtained from unsold newspaper paper. Additives with mineral components and powdered glue, they last over time and also offer good resistance to fire (Class 1 - Euroclass B-s2-d0). In the form of flakes, easily applicable by spray on different types of substrates (concrete, wood, plaster, iron, sheet metal, plasterboard, masonry, etc.). Thermal insulation is guaranteed by the high porosity that is formed between the cellulosic fibers and which blocks infiltrations and convective air currents; the acoustic insulation derives instead from the fibrous structure that disperses the sound waves. Finally, the cellulose fiber is breathable and hygroscopic.

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Sound absorbing solution from waste of textiles

The panel is made out of upcycled textile offcuts combined with a low melt polyester fibre.

(images)

Cork panels (for walls)

SOUND INSULATION – The cork panel is an excellent sound insulator, reducing airborne noise, trampling noises and intervening in the acoustic correction of indoor environments.

It's also THERMAL insulating. It allows to improve living comfort by insulating the building effectively, from heat, and cold.
Thermal conductivity at 10°C, λ = 0,036 W/mK

(image)

(image)

100% REUSABLE
AND RECYCLABLE

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Acoustic panel made of cork

(images)

- 100% natural recycled cork
- Natural dye infused pigmentation
- Can also be painted (acrylic paint)

- Made from 100% reclaimed, rapidly renewable cork
- Low-VOC, NAUF (No Added Urea Formaldehyde), PCP-free
- LEED and Portico Compliant
- Provides thermal and acoustic insulation
- Suitable for both residential and commercial applications

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Bio-based natural Sound absorbing solution

(images)

Cereal waste +

Mushroom mycelia +

Environmental conditions:

- Temperature
- Dark
- Humidity

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100% recyclable Polyolefin based solution

(images)

- High sound absorption power
- Low weight
- Self-supporting
- 100% Waterproof (made of PE)
- Flame retardant (Class of Fire reaction B_{s2D0})
- Easy to work
- 100% recyclable

(images)

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SDG4BIZ

Sound absorbing sandwich solution

(image)

Soundproofing, anti-vibration sandwich, composed of a cross-linked polyethylene layer shaped with spherical caps and a low modulus mass mechanical consisting of a polymer base with mineral additives.

- High sound insulating properties
- Anti-vibration properties
- Stain, humidity and oil vapours resistant
- Eco-sostainable (bitumen, halogen, phosphates, lead and PVC free)
- Flexible, easy to apply on rigid substrates and non regular surfaces

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Sound insulating flexible rubber solution

It is mostly mineral-filled EPDM rubber that reaches high densities in a small thickness (2-3 mm) and maintains good flexibility.
Density (standard) around 2 - 4 kg / dm3

It is commonly used instead of lead, coupled with a specific foam material, for the creation of soundproofing panels

(images)

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Transparent Sound absorbing solution

(image)

(image)

Transparency

Polymeric clear honeycomb with holes

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Textiles for Sound absorbing

(images)

Reverberation occurs when the incident wave is confused in the listener's ear with the reflected wave, while there is echo when the two waves are distinct.

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Galileo, as a Veneto Research Organization regularly registered with Innoveneto, has carried out activities in support of the "Neo-Class+" project, which foresees the development of a new simplified "Integrated Intervention System" for environmental regeneration, energy requalification and seismic adaptation of artisanal, industrial and commercial production buildings, through techniques of green building and sustainable architecture.

This project is part of the regional call for support for projects developed by business combinations – POR FESR 2014-2020 of Veneto approved by decision of the European Commission (EC) C(2015) 5903 amended by EC decision C(2018) 4873 final of 19/07/2018, referred to in the DGR Veneto n° 711 of 28/05/2019 -Action 1.1.4 "Support for collaborative R&D activities for the development of new sustainable technologies, of new products and services".

Galileo's support has been developed through a series of activities related to the research of bio-compatible and eco-sustainable Materials and Technologies aimed at the comfort and well-being of people within the environments. The aim of the activity is to deepen the possible choices and identify the most recent technological innovations suitable for intervening correctly and effectively.

GALILEO through its technical staff R&D has carried out technical support to the research of materials that, for each topic of interest, have taken into account what is articulated as follows.

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Brief definition

Activities of collection, among the members of the working group, of all the technical information related to the specific project, with definition of the objectives: research of materials and bio-compatible technologies aimed at the comfort and well-being of people within the environments. Specifically:

High level of insulation of the casing;
Energy efficiency of the systems and the building system;
Eco-sustainability of the proposed intervention (ITACA regional certification);
High level of indoor comfort;
Bio-compatibility of the materials used;
High Air Quality (IAQ);
Acoustic comfort of the rooms;
Lighting comfort with high quality of artificial lighting;
Healthiness of the environments;

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Feasibility study

Research activities that allowed us to identify, among the solutions available on the market, the most interesting design paths and in line with the requests of the working group. With this survey, the most interesting design paths were identified and the solutions were shared in a technical meeting both in presence at the Galileo headquarters (Mario Saggin 6 underpass – Padua) and on the zoom platform; the information was summarized in a short report delivered to all participants.
Further zoom meetings were held on September 2020 and the following solutions were developed and deepened:

Coat
False ceiling
Floors
Green facades

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Technical analysis, insights and supplier selection

Selection of suppliers of materials belonging to the technological strands identified in the previous phase; direct contact with them for the recovery of data (where available) useful for the project and relating to technical properties, application systems, indicative costs, availability and costs for a sampling.

Preparation of a summary table of the collected data

Collection of technical data sheets and costs

Organization of progress meetings with material suppliers
In particular, once the useful solutions and the relative level of innovation had been identified, the final choice of materials was also subordinated to the cost of the same.
All the values, including the eco-sustainability value, were put on the table and in-depth studies were carried out on the materials of which integration was requested (see geopolymers).

Meetings have been organized with the suppliers

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A) HIGH LEVEL OF QUALITY OF RESULTS BASED ON:
1) High level of insulation of the casing;
2) Energy efficiency of the systems and the building system;
3) Eco-sustainability of the proposed intervention (ITACA regional certification);
4) High level of indoor comfort;
5) Bio-compatibility of the materials used;
6) High Air Quality (IAQ);
7) Acoustic comfort of the rooms;
8) Maximum level of natural lighting;
9) High quality of artificial lighting;
10) Healthiness of the environments;

B) FINAL TARGETS OF THE WORK such as:
1) Energy requalification;
    a) Reduction of consumption and management costs;
    b) Increase in the value of the property;
2) Environmental quality and healthiness;
    a) Increase in the quality of life of employees with the consequential:
        - Increased productivity;
        - Consistent decrease in absenteeism
    b) Welfare aziendale;
    c) Decrease in "work-related stress";
3) Structural safety;
a) Increase in the value of the property;
4) Accessibility and inclusion.

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CNB – Canabium, the vegetable chipboard of hemp, performs the function of aggregate in place of gravel, crushed stone and sand.
Thanks to its characteristics, such as the high content of silica and the presence of millions of micropores with nanometric dimensions, hemp vegetable chipboard enjoys numerous properties among which the high thermal insulation and a perfect conveyance of water vapor stand out. There is no natural, mineral or synthetic material that can match these distinctive features.

LDN Natural® Dolomitic Binder, the binder based on dolomitic hydrated lime, stabilizes the vegetable component: it mineralizes it protecting it from the possibility of decomposing, burning or being attacked by insects or rodents. It also makes it able to sanitize environments through the sterilization of water vapor that escapes during the breathing process.

Applications:

roof and attic insulation
construction of insulating masonry
'coat' external insulation of existing buildings
internal insulation of existing buildings
underfloor insulation

Gamma Natural Concrete®:

Natural Beton® 200: mixed in a 1:1 ratio (binder and hemp) and available pre-mixed in a 2.00 mc Big Bag
Natural Beton® 300: mixed in a 2:1 ratio (binder and hemp)

Natural Beton® 500: mixed in a 4:1 ratio (binder and hemp)

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Hydrated mineral matrix calcium silicate-based plates has CE marking ETA-06/0219; Declaration of Performance (DoP) downloadable

slabs are obtained from a patented production system, with a density of about 875 Kg/m3 supplied in dimensions 1200 x 2500 mm.

Massa volumica	c.a. 875 kg/m3
Dimensioni	1200x2500 mm
Spessori	9, 10, 15, 18, 20, 25 mm
Tolleranza in larghezza	± 3 mm
Tolleranza in spessore delle lastre	± 0,5 mm
Resistenza al fuoco	Fino a R/REI 120 ed EI 180
Modulo di elasticità	Longitudinale 2500 N/mm2 Trasversale 2700 N/mm2
Resistenza alla flessione	Longitudinale 6.0 N/mm2 Trasversale 4.0 N/mm2
Resistenza alla trazione	Longitudinale 2.0 N/mm2 Trasversale 1.7 N/mm2
Resistenza alla compressione	9.0 N/mm2 (10%)
Conducibilità termica	Ca. 0,285 W/m°k
Grado d'acidità (pH)	Ca. 7.0

Horizontal compartments

With calcium silicate it is possible to carry out the fire-fighting redevelopment of the following floors: brick with traditional and prestressed joists, predalles, mixed concrete and steel.
In addition, it is possible to make continuous modular and membrane ceilings.

Vertical compartments

it is possible to carry out fire-fighting redevelopment of walls in: brick blocks and cinder blocks.
In addition, it is possible to realize: partitioning and self-supporting septa.

In many cases, even for aesthetic reasons, additional finishing of the surface or joints in constructions made of such plates is required. To simplify this operation and make it effective and economical, a number of procedures have been developed that allow to obtain a perfect result. The slabs can in fact be easily painted, painted or upholstered by means of a background pre-treatment with a drying time of about 24h.
Some of the ltipologies can also support a flooring in some specific applications.

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The cork panel is the result of a thermal process of expansion, improperly called "roasting" because of the brown color that the cork takes on at the end of production.

During the thermal process, the melting of the waxy substances naturally contained in the cork is achieved. With the fusion, the waxy substances act as a natural glue, allow the aggregation of the granules, making the panel compact and cover the individual granules with a protective layer that makes them waterproof.

The expansion process, completely natural, does not alter in any way the characteristics of the cork but amplifies them, determining the increase in the volume of the single granule and the improvement of the insulating power.

The expanded cork panel, in fact, isolates about 30% more than blond cork and compared to the latter does not contain adhesives for its production.

The cellular structure of the cork, after heat treatment, has a high breathability while being insensitive to moisture and water. The result is exceptional dimensional stability in all conditions.

ENERGY SAVING – allows a significant increase in the energy efficiency of the building, both in summer and in winter.

Density: 110/130 kg/mc

Specific heat: 1900 J/kgK

THERMAL INSULATION-allows to improve living comfort by insulating the building effectively, from heat, and cold.

Thermal conductivity at 10°C: Proven: λ = 0,036 W/mK; Declared: λD = 0.039 W/mK

SOUND INSULATION – The cork panel is also an excellent sound insulator, reducing airborne noise, trampling noises and intervening in the acoustic correction of indoor environments. Sound-insulating power – double wall (11+15cm) + cork4cm + tuned (external-internal): RW = 53 dB (ITECONS) Anti-trampling – Lightened concrete + cork 2cm + 14cm of concrete screed: ΔLw=19 dB (LNEC/LEAC)

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INSULATION AND FINISHING – Used as an exposed coat, it does not require further finishing work in addition to installation, with a considerable saving in terms of time and money.

100% REUSABLE AND RECYCLABLE – Any scraps of construction site processing can be ground and reused as granulate for other types of insulation or other uses (garden substrates, etc.). Even in case of demolition of the building, the cork can be recovered entirely, reused or ground to be used again, without any loss of performance.

FIRE AND HEAT RESISTANT – The panel is self-extinguishing, as it carbonizes but does not propagate the flame. Practical evidence shows that the reaction to fire is superior to other insulating materials. An unregulated test shows that it takes more than 90 minutes with a flame at 700 °C to pass a 4 cm thick panel. Reaction to fire: Euroclass E

NATUREPLUS AND ANAB | CERTIFICATE ICEA – The issuance of the Certificate of "product for bio-building" issued by ANAB | ICEA and the best known naureplus® certification attest that the cork panel is 100% natural, it is eco-sustainable, not harmful to humans and the environment.

NO RELEASE OF HARMFUL SUBSTANCES – The natureplus® certification has attested to the absence of substances harmful to health, both in the form of VOCs, and other carcinogenic and mutagenic substances. The tests show the total absence of substances such as benzopyrene (PAHs), despite the fact that the cork is subjected to a thermal combustion process.
the cork panel has been included in class A +, with regard to VOC emissions (Volatile Organic Compounds) and can be used, in complete safety, even indoors. As tested and certified by the Portuguese Laboratory LQAI, it is NON-TOXIC and does not release any harmful volatile substance (formaldehyde, acetaldehyde or other) neither in ordinary use nor in case of overheating or fire. (download the test certificate). The absence of harmful substances is also guaranteed by the naturelus and ANAB certificates | ICEA.

RESISTANT TO WATER AND HUMIDITY – With its closed cell structure, the panel is not afraid of moisture and even in the presence of water it does not deform avoiding damage to walls and coatin**gs.**

BREATHABLE AND ANTI-MOLD – Thanks to its low resistance to the passage of steam, the use of promotes ventilation, avoiding phenomena of "thermal bridge", reducing the problems of the presence of mold and condensation. Res. diff. water vapor: $\mu = 20$ (5-30)

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SIMPLE AND PRECISE INSTALLATION – Thanks to the perfect squaring and flatness of the panels, the installation is simple and fast, allowing precise combinations and maximum flatness of the surface

NO MAINTENANCE REQUIRED – , also applied as a visible coat, does not require any type of maintenance, resisting heat, cold and weather, without reporting any damage.

UNLIMITED DURATION – offers a practically unlimited duration over time, while maintaining the physical properties and insulating power. In the face of the countless cases of installations over 50 years of life, with cases even over 90 years, the manufacturing companies have prepared a Declaration of Durability at 50 years. This document declares that the characteristics of the panel and its insulating power remain unchanged even after more than 50 years. The panel, in practice, lasts longer and longer than the life of the building.
From a laboratory test, the thermal conductivity of the CORKPAN panel, after 45 years of use, has remained practically unchanged.
Tested life: 90 years.

DIMENSIONAL STABILITY – Thanks to the roasting process and the subsequent uniform cooling, the panel guarantees a high dimensional stability in all environmental conditions. Also for this reason, CORKPAN is normally used as a face-to-face coat system.

Operating temperature: -180°C+120°C
Compressive strength: 0.2 to 0.25 kg/cm2

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The products are CE marked according to the UNI EN 13168 standard, which specifies the requirements for wood wool products used for the thermal insulation of buildings and according to the UNI EN 13964 standard for false ceilings. The notified body Istituto Giordano carried out in accordance with system 1 the determination of the standard product on the basis of type tests, the initial inspection of the establishment and the production control system, as well as the continuous surveillance plan and issued the certificate of constancy of performance with regard to reaction to fire. According to system 3, the notified test laboratories determined the standard product on the basis of type tests for the other declared characteristics and issued the relevant test reports.

Regulation (EU) No 305/2011 on the CE marking of construction products obliges the manufacturer to draw up the Declaration of Performance (DoP) for products falling within the scope of a harmonised standard or if they comply with a European Technical Assessment

Technical insights regarding the CAM Minimum Environmental Criteria required by GPP, the Green Procurement of the Public Administration, and recalled by the recent decree on tax incentives SUPERBONUS 110% and ECOBONUS.

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Cost analysis of the identified solutions

3. COUNTER WALL WITH PANEL IN ADHESION
-Natural fibrous solutions panel, 50x600x5mm, with bevelled edges on 4 sides (code S4): approx. 31.20 €/sqm (for more than 200 sqm)
- dowels for c.a.: 2,00 €/sqm
- installation: approx. 13,00 €/sqm
Total costs supply and installation: ca 46,20 €/sqm
Surcharge for any white painting (code S05/15): approx. 4.50 € / sqm (for quality over 200 square meters)
Surcharge for any mobile platform rental (in case of work at height): about 3-4 € / sqm
To add the business mark-up and general costs.

4. INSULATING PANELS FOR VENTILATED FAÇADE

- consider the diffrents Natural fibrous solutions, with a 35% discount for supply to the company

REMARKS
1.the above prices are exclusive of VAT and INDICATIVE: for a targeted estimate it is essential to consult an applicator specialized in dry systems who makes an inspection of the construction site
2. Material floor shooting costs are not included
3. any undertaking mark-ups in the case of subcontracted work shall not be considered
4. for different colors consult the table in the Celenit price list in force

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SOLUTIONS FOR THE BUILDING ENVELOPE WITH HIGH ENERGY EFFICIENCY AND HEALTHINESS HORIZONTAL EXTERIOR COATINGS FOR CASING AND INCLINED SURFACES

- **Insulation panels and waterproofing (flat and inclined roofs)**
- EPS insulation panels ready to receive the waterproof sheath layer and sheath protection systems;
- Same system with insulating panels with innovative eco-sustainable materials:
  - Wood Wool;
  - Wood fiber;
  - (c) Cooked or natural cork;
  - Hemp Fiber;
  - Calcium-silicate;
  - Lime and Hemp panels;
- Insulating panels for horizontal ventilated roof system, pre-coupled to a waterproof surface or ready to receive the last layer of sheath, with a base composed of the following materials:
  - EPS o XPS;
  - Wood Wool;
  - Fibreboard;
  - (d) Cooked or natural cork;
  - Hemp Fiber;
  - Calcium-silicate;
  - Lime and Hemp panels;
- Protection, reflection and/or shading systems for the reduction of albedo and the "heat island" effect;
- Insulation and protection system with "Green Roofs", consisting of main insulation, basic waterproofing sheaths, anti-root sheath, laying panel system and vegetable layer with extensive planting;
- Insulating and water-repellent spray coating system to be applied outside the appropriate thickness

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SDG4BIZ

INTERIOR CLADDING ON VERTICAL SURFACES

- **Insulating counterwalls**

•Counterwall composed of anchor structure, insulating panels and internal closing plate; insulating panels consisting of:

- EPS o XPS;
- Wood Wool;
- Fibreboard;
- (d) Cooked or natural cork;
- Hemp Fiber;
- Calcium-silicate;
- Lime and Hemp panels;

- internal closing/finishing plate consisting of:
- Drywall;
- Fibro-gypsum;
- (c) Stoneware or ceramics;
- Geopolymer plates;
- Wood wool;
- Sound-absorbing materials;
- Raw clay slabs;
- h) Lime and Hemp panels;
- Panels in "cannicciato" and natural lime;

- final paints suitable and compatible with the support and in particular:
- Bio-compatible paints in the absence of VOCs;
- Sanitizing paints;
- b) Pre-coupled panels with finished surface:

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SDG4BIZ

INTERIOR CLADDING ON VERTICAL SURFACES

- insulating layer consisting of:
- EPS o XPS;
- Wood Wool;
- Fibreboard;
- (d) Cooked or natural cork;
- Hemp Fiber;
- Calcium-silicate;
- Lime and Hemp panels;

- internal finishing surface consisting of:
- (a) Plasterboard;
- b) Fibro-gypsum;
- (c) Stoneware or ceramics;
- Geopolymer layer;
- Wood wool;
- (f) Sound-absorbing materials;
- Raw clay;
- Bio-compatible paints in the absence of VOCs;
- Sanitizing paints;

- **Insulating plasters**
- Traditional thick insulating plasters or with a dough base consisting of:
- (a) Mixed lime;
- Natural lime;
- Lime and cork dough
- Lime and hemp dough;
- Lime mixture and PCM materials (high heat capacity);
- Aerogel type doughs;

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SDG4BIZ

INTERIOR CLADDING ON VERTICAL SURFACES

- **Thin coatings (paints and/or varnishes)**

•Insulating plasters with added and added mixture of PCM or insulating spheres and/or enriched with nano-technologies;

- **Spray coatings**
- Insulating coating composed of a high adhesion layer laid by spraying with a mixing machine and a raw surface or
- pulled flat with a staggia;
- Example system with cellulose fibers;

- **Frames and load-bearing panels in steel or wood**
- Load-bearing support frames to be used also for structural consolidation
- anti-seismic, Insulating panels and finishing layer

with sheets of various materials (see point D.1.a)

- Fabrics
- Textile fabrics for wall coverings or visual partitions of interior spaces, to be used in
- simple suspension or with tensile structure systems, in order to improve:
- Thermal reflection;
- Light control;
- Shielding from Electro-Magnetic fields;
- Sound insulation;
- (e) Sound absorption;
- f) Air sanitization;

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SDG4BIZ

INTERIOR CLADDING ON HORIZONTAL SURFACES

- **Insulating ceilings**

•False ceiling composed of anchor structure, insulating panels and internal closing slab;

- insulating panels or layers consisting of:
- EPS o XPS;
- Wood Wool;
- Fibreboard;
- (d) Cooked or natural cork;
- Hemp Fiber;
- Calcium-silicate;
- Lime and Hemp panels;
- Foam to be laid by spraying;

- internal closing/finishing plate consisting of:
- Drywall;
- Fibro-gypsum;
- (c) Stoneware or ceramics;
- Geopolymer plates;
- Wood wool;
- Sound-absorbing materials;
- Raw clay slabs;
- h) Lime and Hemp panels;
- Panels in "cannicciato" and natural lime;

- final paints suitable and compatible with the support and in particular:
- Bio-compatible paints in the absence of VOCs;
- Sanitizing paints;

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SDG4BIZ

1) Thin coatings (paints and/or varnishes)

a)Insulating plasters with added and added mixture of PCM or insulating spheres and/or enriched with nano-technologies;

3) Spray coatings

a) Insulating coating composed of a high adhesion layer laid by spraying with mixing machine and raw surface or pulled flat with staggia;
Example system with cellulose fibers;

4) Frames and load-bearing panels in steel or wood

a) Load-bearing horizontal frames or panels to be used also for consolidation anti-seismic structural, Insulating panels and finishing layer with sheets of materials various (see point E.1.a)

5) F**abrics**

a)Fabrics for covering the ceilings of interior spaces, to be used in tension at the purpose to improve:
a) Thermal reflection;
b) Light control;
c) Shielding from Electro-Magnetic fields;
d) Sound insulation;
(e) Sound absorption;
f) Air sanitization;

6) Ground insulation system with raised floor

a)Insulation works, with moisture barrier, of the horizon on the ground (floor) with subsequent system of raised flooring to several load capacity (for office areas or warehouses with loads and handling lightweight);

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GLASS WALLS AND WINDOWS

- **Special glass**
- Insertion of special high-performance glass for:
- (a) Thermal insulation;
- Control of solar radiation;
- Control and management of natural light;

- **Shielding and reflective films**
- Application of high-performance external and/or internal films for:
- Thermal reflection;
- Control of solar radiation;
- Control and management of natural light;
- Shielding of Electro-Magnetic fields;

- **Fabrics for shielding curtains**
- Fabrics for interior curtains in order to improve:
- Control of natural light;
- Shielding from Electro-Magnetic fields;
- Sound absorption;
- Air sanitization;
- b) Fabrics for external curtains in order to improve:
- Solar shading;
- Control of natural light;
- Shielding from Electro-Magnetic fields;

- **Solar shading**
- **Fixed solar shading system;**
- **Mobile and/or motorized solar shading system;**

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SDG4BIZ

HIGH EFFICIENCY SYSTEMS

- **Winter and summer air conditioning**
- Traditional high-efficiency water systems;
- High efficiency air systems;
- Terminals composed of radiant wall and/or ceiling panels with
- surface prefinita;
- (d) High efficiency generator/heat exchanger system:
- Air – air
- Air - water;
- Earth – air (geothermal probes)
- Earth – water (geothermal probes)
- (e) Other;
- e) BACS control management system of the air conditioning system;

- **Artificial lighting**
- Energy-efficient lamps;
- Lamps with specific or adjustable temperature and light spectrum;
- Light intensity control and regulation systems;
- (d) System for the management and control of light intensity and
- quality;

- **Controlled Mechanical Ventilation**

•Centralized VMC plants with controlled management for the premises concerned;

- Point or mixed VMC plants dedicated to the premises concerned;

- **Structural systems for anti-seismic improvement**
- Supports for structural anchorages to nodes;
- Vertical anchoring and bracing frames;
- Horizontal anchoring and bracing frames;

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SDG4BIZ

•Geopolymers are chains or networks of mineral molecules bound with co-valent bonds: in practice they simulate the chemistry of natural rocks.

- Features

- **The nature of the material:**

•The geopolymeric material involves a chemical reaction at room temperature, between a reactive powder and a saline liquid.

- Reactive powders, at X diffractometry are amorphous.

•The mixing liquid is based on silicates with a precise molar ratio between Si and M+. In the hardened state, that is, condensed, they have a crystalline X diffractometry.

- **Route Summary:**

•The reacting liquid can have alkaline or acidic pH. Alkaline silicates (Na, K, etc.) are used with an "Environment friendly" molar ratio typical depending on the M+ metal used. As for the liquid with acid pH, phosphoric acid can be used at a precise concentration, but it is often not convenient for reasons related to the cost of the acid. The reactive powders are silico-aluminous, calcined at a precise temperature (about 750 ° C).

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SDG4BIZ

What are the differences with similar materials in construction?

Mainly they are not hydrated materials (they do not contain crystal clear or lattice water, therefore hydrated minerals). They are not subject to the problems deriving from these minerals (hydraulic shrinkage and resistance of thermal shocks). They are resistant to a large scale of PH, from 1 to 14 and for this reason they better withstand contact with sulfates and salt water. Since there are no organic substances, the VOC (Volatile Organic Compound) content is equal to 0, which means that the air quality for those who live inside a structure, made with such materials, is much healthier. In terms of performance, the main characteristics are as follows:

Mechanical resistance:

From comparable to superior to cementitious systems, as far as compression is concerned. The resistance to bending is much better than traditional systems, starting from the short seasoning (definitely necessary even in anti-seismic).

Chemical resistance:

Geopolymeric products well withstand acid attacks and contact with sulphate solutions, for these reasons they are excellent passivating agents for reinforcing irons and metals in general. They also have no difficulty in being used in environments in contact with salt water (coastal areas, platforms etc ...)

Resistance to temperature changes:

The freeze/thaw cycles do not cause damage to the structure because there is no water available that can expand both superficially and internally, plus they are mesoporous materials, so there is enough air to "absorb" the movements created by thermal shocks.

Fire resistance:

Being "totally" inorganic, they are completely fireproof.

Heat resistance:

Depending on the type of geopolymer binder used, there is excellent heat resistance up to temperatures of 1300 ° C - 1700 ° C. All this while maintaining mechanical resistance and with the only visible effect concerning the partial sintering of the surface (at these temperatures the silico-aluminous minerals of the matrix begin to melt).

Hygrometric shrinkage:

With these materials the shrinkage is very reduced or even zero already at room temperature, even more so if the maturation takes place at a temperature greater than 50 ° C - 70 ° C, because the percentage of water in the system is very small, considering that it is useful exclusively to obtain a certain workability.

Thermal inductance (λ):

By virtue of their " mesoporous " structure, geopolymeric materials have very low λ but variable depending on the geopolymer binder used and the density of the type of aggregates involved.

Waterproofing :

Another property linked to the mesoporous structure is the possibility of the passage within the geopolymer matrix, of the air molecules (vapor permeability), while the passage of water (macromolecule) is completely prevented, therefore there is no imbibition.

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How much do they cost?

They are produced at Km 0, that is, both the reactive powders, used for the binder, and the aggregates that give the mechanical characteristics to the finished product, are available anywhere in the world. Silico-aluminates are among the most widespread minerals on the planet.

What are the differences between geopolymeric materials and activated alkali materials?

Geopolimeri:

For example, they use flyash (flying ash) or a by-product of coal-fired power plants, calcined at a precise temperature. In geopolymers, the hardener or liquid reagent alkaline has a pH very similar to that detected in traditional systems (about 12-13), therefore "environment friendly" conditions (the product can travel through tanks on heavy vehicles). The flyash used in contact with the alkaline reagent liquid dissolve superficially by depolymerization, keeping intact their spheroidal nature. They will thus be easily condensed through the geopolymerization process.

Activated alkalis:

They use flyash without considering the calcination temperature, then injecting into the system bio-masses (coal and other organic substances), unburned and other mineral phases not suitable for a correct chemical dissolution. The liquid used has a lower molar ratio, so the pH can reach almost 14 with "environment hostile" conditions (corrosive, so the product needs transport in jerry cans, inside ADR regulated containers). The flyash are in contact with the activator alkaline liquid (the whole reaction is based on the effect of very high pH, therefore activating). They are dissolved by complete destruction of the starting spheroidal structure. This will result in a disordered condensation, implying elements not useful for the reaction and the presence of hydrated minerals, which will create weaknesses at the level of withdrawal, development of mechanical resistance, acid attacks and immersion in both water and sulphate substances.

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Next generation photocatalytic coatings

•1. INNOVATIVE ECOLOGICAL MICROMETRIC PHOTOCATALYTIC PRODUCT

- NO use of toxic and dangerous organic solvents, natural product
- based on MICROMETRIC particle size (does not present health risks related to inhalation
- and potential toxicity)
- high action on bacteria similar to the most powerful biocides with respect to which,
- however, it is not toxic
- product positively tested on a wide range of bacteria and is believed to have a valid effect on viruses as well
- spray use with normal devices (pumps, tankers etc ...) in environments to sanitize surfaces and make them self-sanitizing since its action lasts over time and it is not removed being designed to remain now to the surfaces especially porous ones such as asphalt or concrete.
- In the fight against COVID-19, it could be used to replace the products currently used to
- sanitize environments (roads, that, open places etc ...) such as sodium hypochlorite with a more effective, lasting, ecological and non-dangerous action.
- Another application that we are considering is to be able to use it in air purification devices.

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SDG4BIZ

•2. NATURAL ACTIVE INGREDIENTS FOR SANITIZING FORMULATIONS

•including and formulated for detergents, cleaning products, paints, coatings and fabrics, free of harmful solvents, toxic biocides and nanoparticles

- products have been positively tested against bacteria, but it is believed that they can also have a valid effect on viruses
- (under test)
- Post addiction in coating and/or paints

•In the fight against COVID-19, the products can be used as an active ingredient for detergents, or sanifying products, or for

•products to be sprayed on fabrics or on protective devices making them self-sanitizing.

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SDG4BIZ

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THE PROJECT

In particular, the combination of natural and/or controlled recycled materials have resulted in systems of walls, building roofs, and counter-ground parts, constituting the external envelope, capable of achieving:

(a) particularly high energy and less polluting performance,

(b) total eco-sustainable circularity,

(c) low thicknesses.

Such performance characteristics can greatly improve the energy standards required by current regulations, going so far as to achieve NZEB envelopes that can have a building classified as "active," drastically lowering energy consumption.

Finally, the production of these materials is carried out, by Italian industries that have perfected their plants and reduced the related environmental impact.

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The counterfloor

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COUNTERFLOOR

Perfecting the envelope by bringing it to "active" performance means also paying attention to the parts against the ground for which they were chosen:

- Thermal, acoustic, lightweight and durable eco-insulating subfloor composed of recycled and end-of-life recyclable material

- Certified screed

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COUNTERFLOOR - GMIX UNDERLAY 1

GMIX underlayment is made of cement and mixed polymer granulate from recycled nonhazardous post-consumer plastics that are used instead of traditional aggregates such as sand, expanded clay, etc.

This condition provides numerous advantages:

- Very low weight on site, about 600 kg/mc compared to the traditional 1800/2000 kg/mc
- Thermal insulation, given the inherent characteristics of plastic polymers (ƛ = 0.076 w/mK) that have performance comparable to that of a real insulation panel
- Acoustic insulation, being an elastic cementitious screed that cuts down noise and vibrations, reducing footfall noise from floors, both in the laboratory and in situ, reaching up to over 20 dB

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The envelope: walls and roof

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PERFORMANCE ENVELOPE WALLS

Structural walls designed with "Vaia" wood and high performance natural infill walls have been studied.

The characteristics of the whole structure guarantee energy efficiency well beyond the current standards of thermal and acoustic adjustment, so much so that the overall structure is considered an "active house" and not a passive one.

Among the objectives we can find:

- maximum reduction of consumption
- eco-sustainability of the production process and up to the end of the supply chain, reducing CO2 emissions and absorbing those emitted during the production of some raw materials; in addition, the materials provide for complete recycling at the end of the life of the construction

This frame solution, in the future, can be made with wood according to the most appropriate selection criteria; it provides, in any case, low consumption of biomass raw material from forests.

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PERFORMANCE ENVELOPE WALLS

Other aspect:

- Approximately 80% of the construction work will be done at the factory; the walls will be transported by truck and then assembled on site with significant savings in labor time on site.
- This makes it possible to consider short supply chain production; in whatever region one is located, it is possible to make the walls and assemble them on a wooden structure in such a way as to guarantee the exact energy performance required according to the relevant climatic zone and structural indications according to normative.

Finally:

- to complete the efficiency improving (also with cancellation of any thermal bridges), the structure is finished with natural lime-based mixtures and reactive pozzolanic aggregates, with reactive micronized natural volcanic zeolite, in order to obtain the maximum efficiency of the materials used to compose the walls and ensuring continuous well-being and comfort thanks to the properties of hygrometric regulation and natural stabilization of temperature.

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ROOF COMPOSITION

The wooden roof that embodies the well-known technical and performance characteristics of this project (natural, recyclable, ductile, elastic yet solid at the same time, increased safety in case of earthquakes, natural thermal insulation) was designed by reducing the thickness to a total of 31.40 cm.

In this way, all eave structures are undersized.

This is possible due to the use of materials already used in the counterfloor and walls.

The optimization of materials can be summarized in this way:

- Use of lightened GMIX subfloor, with thermal, acoustic, ecological, recyclable, eco-sustainable characteristics identifiable by prducts' data sheets relative to the parts against the ground
- Use of hemp fiber insulation SOF CANAPA with thermal efficiency, healthiness, hygrometric characteristics

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Heating and cooling system

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HEATING AND COOLING SYSTEM

The choice of heating and cooling systems was adopted from an already perfected performance envelope. This allowed a containment of the size of the systems. The objective was to reduce energy consumption and use eviromentally friendly systems.

The final choice was:

- Heating by means of a low-consumption electric radiant system
- Cooling by means of low-consumption heat pump. This heat pump also serves as a support for heating

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HEATING AND COOLING SYSTEM

Some considerations about Energy-efficient electric radiant heating system:

Electric radiant heating system for heating indoor rooms (wanting also outdoor areas) is more efficient and economical than traditional water heating systems.

RADIANT HEATING

Radiation is a heat exchange system that uses infrared waves as transfer vehicle. Two bodies or two objects having different temperatures radiate naturally one toward the other and the heat flow goes from the hotter element to the cooler one. The radiation emitted into the environment by this system is transformed into heat on contact with an object, wall or person. Infrared waves are therefore not absorbed by the air but by solid bodies, which transform them into heat energy. This energy is transmitted into the environment, thus creating the optimal conditions for occupants' comfort.

HEAT PUMP

The heat pump is in use for summer cooling and is supported for winter heating. Air-air or air-water has very low energy consumption, expected to be approx. 300-400 €/year (total consumption both summer and winter).

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HEATING AND COOLING SYSTEM

FEATURES AND PROS/1:

- Environmentally friendly, non-polluting, cost effective, quiet and safe. It does not require maintenance or fume control and ensures low energy consumption due to the shorter time to reach the target temperature with low thermal inertia

- It is designed for flexible and autonomous operation by zone or room with separately regulated thermostats in order to increase the possibility of energy saving

- It is practical, quick and non-invasive to install, does not require a boiler and is also suitable for large rooms where heating large volumes of air involves excessive energy consumption

- By not heating the air, it does not reduce the humidity level necessary for the environment and people's well-being

- Does not move the air consequently does not generate circulation of suspension and dust and mites. Therefore, it avoids the occurrence of allergies and respiratory system diseases.

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Innovative raw materials

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ABOUT RAW MATERIALS USED IN THE PROJECT

MATERIAPRIMA+'s FORNACE line of plasters and skim coats.

Plasters, skim coats and finishes of this line, chosen both for interior and exterior walls of the structure, are totally natural. They contain silt-free and mud-free river aggregates, formulated NHL lime binder, hydrated lime, and reactive pozzolanes for enhanced breathability and mechanical performance.

Above all, they contain micronized natural volcanic Zeolite, which is a real "natural dehumidifier." It transforms the mortars into a sort of "filter" capable of facilitating the hygrometric balance of rooms, naturally attracting and releasing water vapor according to the ambient humidity rate; this aspect makes these mortars particularly suitable not only for green building interventions, but also in new construction with hemp supports, a natural insulating material that bases its contribution to living wellbeing precisely on the particular natural hygrometric effect.

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ABOUT RAW MATERIALS USED IN THE PROJECT

DIFFERENCE FROM PLASTERS, SKIM COATS AND FINISHES NORMALLY FOUND ON THE MARKET

Materials in the Fornace line do not contain calcium carbonate aggregates and marble dust, which are normally used in traditional premixed plasters and come from crushing calcium carbonate rocks.

In fact, in order to obtain the classical calcium carbonate aggregates, a high environmental impact is required obtained by the use of drills, dynamites and mills that are highly polluting to the environment and landscape. Their inherent characteristic is: in contact with acidic substances (acid rain) they undergo decomposition releasing carbon dioxide CO2; moreover, in combination with humidity and heat they create the ideal environment to the proliferation of mold, fungi, algae, being their porous structure absorbent and therefore attackable by moisture and salts. Their negative characteristics cause mortars to lose thermal and mechanical performance, so much so that they agree with the term "plaster tumor."

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ABOUT RAW MATERIALS USED IN THE PROJECT

None of this happens in the plasters, skim coats and finishes of MateriaprimA+'s Furnace Line.

They are in fact:

- Highly resistant to degradation and salts
- Non-absorbent and non-gelling, not attackable by mold, fungi, algae
- Resistant to acid rain
- With high mechanical strength
- With natural raw materials whose extraction does not disfigure the landscape and does not require highly polluting machinery. Therefore, they are obtained with very low environmental impact (i.e. aggregates from river maintenance)
- Adequately processed to ensure, by their nature, quality mortars that are resistant to degradation over time and offer maximum environmental healthiness (basic ph both with fresh and hardened mortar) and therefore unassailable
- Also consisting of micronized natural volcanic Zeolite which can have benefits to humans and the environment as supported in many scientific studies
- Refractory to radioactivity and electromagnetism.

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ABOUT RAW MATERIALS USED IN THE PROJECT

Magnesite panels and hemp insulation panels.

By using Magnesite panels in wall systems can be achieved several structural and physical advantages. These include:

- Natural panel dens. 1000 fibered with reinforcing mesh on both sides
- fire resistant being in class A1
- with antibacterial characteristics
- resistant to humidity but permeable to vapor
- resistant to salt attack
- excellent nail and screw grip
- only material that immersed in water for the duration of 30 days does not lose the physical mechanical faculties but increases the performance

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ABOUT RAW MATERIALS USED IN THE PROJECT

Insulation with hemp panels

Coat insulation using hemp fiber insulation boards:

- density 40 or 110 kg/mc, thickness varying from 50 cm to 100 cm by specificity of position
- not attackable by insects, rodents and vermin
- with vapor resistance from 1 to 4
- with thermoregulator and humidity stabilizer function
- in the case of immersion in water does not rot and does not collapse
- has self-extinguishing characteristics
- has calorific value of remarkable performance equal to 1700

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Thank you for your time!

Metropolia

Haaga-Helia

STU
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

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Tknika

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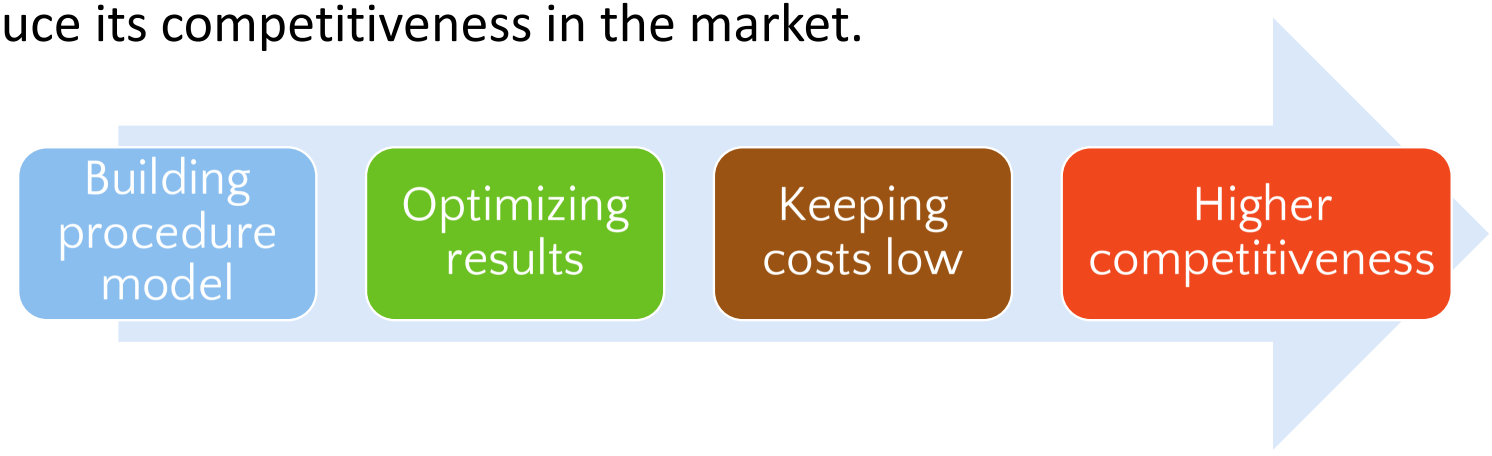
A+ HOUSE PROJECT

The project was of interest to the field of energy-efficient construction in sustainable building.

It aimed to identify an "Integrated Construction Process Model" to optimize the outcome by containing production costs to increase the productivity of a construction system still limited by costs that reduce its competitiveness in the market.



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A+ HOUSE PROJECT

The idea is to design a repetitive housing module in certified sustainable construction and high energy efficiency with minimal environmental impact and optimization of "living comfort."

1. The project will then provide a Simplified Procedure Model that will become a tool to be used for the construction, including mass production, of the tested module.

2. It will also serve to facilitate the process of transferring technology to practitioners properly and quickly through "on-site schooling."

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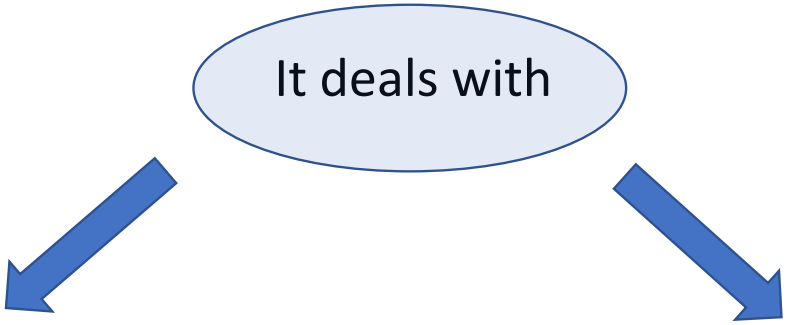
A+ HOUSE PROJECT

ENVIRONMENTALLY FRIENDLY ARCHITECTURE



"body" of the house:
in other words the research of healthier building materials which also prevent unpleasant effects on the body.

"soul" of the house:
On the effects of environment, shapes, colors and furnishings on the human psyche and suggests various practical solutions to increase the harmony experienced by those living in the confined space.

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Taking advantage of elements

Design and planning of a house: the aim is feeling well in my home

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TAKING ADVANTAGE OF ELEMENTS

THE IMPORTANCE OF SOLAR EXPOSURE

(images)

ORIENTATION

At **South** → Dining room, living room, study etc.

At **North** → Bathroom, kitchen, laundry room etc.

At **East** → Entrance, bedrooms

At **West** → Other day room and hallways

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TAKING ADVANTAGE OF ELEMENTS

THE IMPORTANCE OF NATURAL VENTILATION

It is important to know, monitor and consider the direction of local winds in order to take advantage of the natural ventilation

(images)

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TAKING ADVANTAGE OF ELEMENTS

THE IMPORTANCE OF NATURAL LIGHTING AND SHADING

NATURAL DAYLIGHTING SYSTEMS

(images)

(image)

In winter when the sunrays are at a slight angle to the horizon, we want to take advantage of the sun's free supply of energy and heat. In summer, for example, due to the shading of balconies and the fact that sunrays are more inclined we will try to take advantage of natural reflected and refracted light but not direct rays that increase the heat inside the house.

SUMMER **WINTER**

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Innovative materials in A+ House project

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