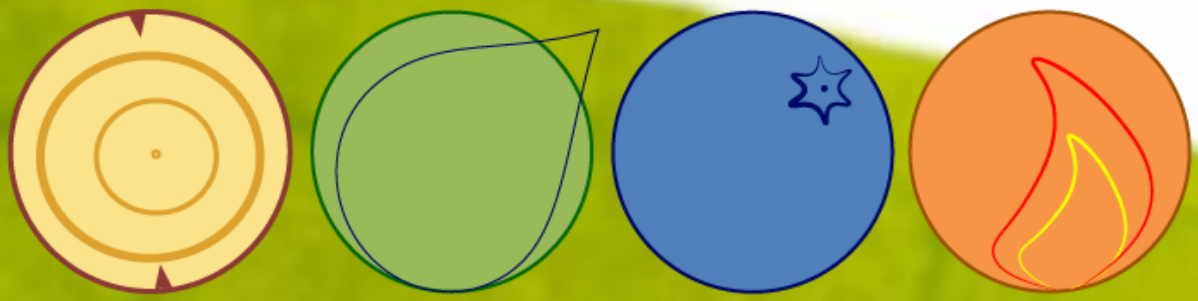

Vet4BioEconomy

CONTENT OF E-LEARNING IN MOODLE

August 2020

AGENCY FOR MOBILITY AND EU PROGRAMMES

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This E-course is a result of a strategic partnership supporting innovation within the project '**Innovative VET for key competences in the emerging field of forest bioeconomy (VET4BioECONOMY)**'. The project is co-funded by the Erasmus+ Programme of the European Union. The E-course was developed by following project partners: Croatian Forest Research Institute, Institute for Development and International Relations (IRMO), Slovenian Forestry Institute, Slovenia Forest Service, University of Natural Resources and Life Sciences (BOKU) and Austrian Research Centre for Forests (BFW).

CONTENT

SECTION 1: INTRODUCTION TO FOREST BASED BIOECONOMY (SFS)

AUTHORS: **Kristina Sever**, Marta Curman, Zoran Jančić (Video)

In this section, we aim to provide the basic knowledge about the bioeconomy, forest based bioeconomy, and other related economies and terms. Enjoy our introductory video about forest based bioeconomy.

VIDEO 1: INTRODUCTION TO FOREST BASED BIOECONOMY (ALGEBRA, SFS)

Screenplay: Kristina Sever, Video editing: Zoran Jančić

1.1. BIOECONOMY, CIRCULAR ECONOMY AND GREEN ECONOMY (SFS)

AUTHORS: Kristina Sever, Marta Curman

H5P PRESENTATION: WHAT ARE BIOECONOMY, CIRCULAR ECONOMY AND GREEN ECONOMY?

A short interactive presentation to learn more about bioeconomy, circular economy and green economy. Don't forget to click on to get some more information.

1. WHAT ARE BIOECONOMY, CIRCULAR ECONOMY AND GREEN ECONOMY?
2. Learning outcomes.

Participants will be able to:

- recognise the bio-resources and products of bioeconomy
- define what bioeconomy means
- explain main characteristic of a bioeconomy
- define what circular economy means
- define what green economy means
- distinguish between bioeconomy, circular and green economy

3. Take a moment and think what bioeconomy means to you.

Products made from bamboo are a part of bioeconomy? True/False

True. Fast-growing plants such as bamboo are easily cultivated and are therefore increasingly used by manufacturers as a renewable resource. Some companies, for example, produce bamboo tableware, consisting of up to 60% shredded bamboo fibres. The plants come from plantations which are regularly cut and replanted. So that colourful cups, plates and bowls can be made from renewable raw materials, the bamboo fibres are first ground and mixed with dyes and other raw materials, such as corn. For durability, a synthetic resin is often added to the bamboo, which makes the products food safe, odour and taste neutral, durable and dishwasher safe. Some companies use natural resin as a binding agent.

4. Take a moment and think what bioeconomy means to you.

What about the paper made from elephant dung, is it also bioeconomy? True/False

Yes. Elephant dung can be used for paper manufacture. Since an elephant's diet is completely vegetarian, the waste produced is basically raw cellulose. After cleaning and processing, it can be converted into paper and then into notebooks, cards and other. Unfortunately, the number of elephants is decreasing rapidly. Most of them are killed because they increasingly interfere with agriculture, due to habitat loss and human expansion. Although it shouldn't be like this, much may depend on how humans perceive the economic value of an elephant.

5. Take a moment and think what bioeconomy means to you.

Energy from plant biomass. Do you consider it as bioeconomy? Yes/no

Yes, energy for heat, fuels or electricity is considered as a part of bioeconomy. Biofuels such as bioethanol are derived from renewable raw materials. Until now, sugars from arable crops have been used, such as corn, soy, canola. To avoid competition with food production, residual materials such as straw have come to the attention of several biofuel manufacturers. This is because straw or wood is largely composed of lignocellulose fibres, which have a high potential for energy conversion. A Swiss chemical company has established a biorefinery demonstration plant, in which wheat straw bioethanol is produced. With the help of enzymes, the lignocellulose is decomposed and recovered from the plant fibre into its individual components. The resulting sugar molecules serve as food for yeast and are fermented by fungi into alcohol. This can then be added to premium petrol for petrol engines.

6. WHAT IS BIOECONOMY?

BIOECONOMY = BIO-BASED ECONOMY

VIDEO 2: EU SCIENCE & INNOVATION. 2014. THE BIOECONOMY STARTS HERE.

 https://audiovisual.ec.europa.eu/en/video/I-088655

According to the EU; the bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and microorganisms – to produce food, materials and energy. With other words, bioeconomy sustainably uses biological natural resources to produce goods that people use. Bioeconomy sectors and industries have strong innovation potential due to their use of a wide range of sciences, industrial technologies and local knowledge.

Bioeconomy implies a shift from fossil resources (oil, coal and gas) to renewable resources (biomass). This means that development and production of new products from biomass must take place in a sustainable manner. In theory, biomass can replace all oil-based products. It can be used for many products such as food, medicines, cosmetics, chemicals, plastic, lubricants and fuel. Earlier use of biological resources was limited to the main usage of the resource, such as for trees where for instance only the stem was

the resource and the rest of it was considered waste. This has changed, and with today's knowledge we are able to utilize the entire tree. Although, enough tree remains must be left in the forest for the nutrient cycle to function normally, and forests should not be overexploited.

All of today's bio-resources from farming, forestry and fishery are used in technologically advanced productions of new resources in addition to the primary product.

7. Main characteristics of bioeconomy:
    - Decrease dependency on fossil raw materials
    - Prevent deprivation of ecosystems
    - Promote economic development and create new jobs
    - Fostering innovation and inter-sectoral collaboration

Info: BIOECONOMY = biobased energy and material through knowledge and innovation

Info: 1.000.000 new jobs could be created by 2030 in the bio-based industries, according to industry estimates.

8. WHAT IS CIRCULAR ECONOMY?

It is important to ensure that the product stays in the cycle to transform into a new product rather than waste after its initial use. This is how a CIRCULAR ECONOMY works, as opposed to our current economy, which is linear. With today's linear economy many products are made from non-renewable resources and end up as a waste.

Drag and drop task: Drag and drop the text in squares to the right picture

CIRCULAR ECONOMY = efficiency and recycling in production systems

9. WHAT IS GREEN ECONOMY?

On the other side, GREEN ECONOMY is defined as an economy that aims at reducing environmental risks and ecological scarcities and aims for sustainable development without degrading the environment. These principles also correspond to principles of bioeconomy, so all three groups are well connected (circular economy, green economy and bioeconomy).

Green economy = nature-based solutions, conservation

Youtube video: OECD. 2012. Growing Green Economies.

https://www.youtube.com/watch?v=m9AS6KT7a5Y

10. THERE ARE DIFFERENCES AND OVERLAPS BETWEEN TERMS BIOECONOMY, GREEN ECONOMY AND CIRCULAR ECONOMY

The circular economy includes all kinds of material streams with different utilization routes. All kinds of raw materials are entering the cycle and being reused: fossil resources (crude oil, natural gas, coal), minerals, glass, plastic, metals, biomass from agriculture, forest and marine environments and potentially CO2.

The concept of bioeconomy is much more than the biomass flow itself. Important aspects of the bioeconomy, as well as important aspects of the other material sectors, are structurally outside the circular economy, which focuses on "maintaining the value of products, materials and resources in the economy for as long as possible and increasing the eco-efficiency of processes. The concept of bioeconomy goes far beyond the circular economy, including a lot more aspects such as new chemical building blocks, new processing routes, new functionalities and properties of products.

The definition of green economy is more general. Its main goal is to reduce environmental risks while focusing on sustainable development without degrading the environment. It is focused on preservation of natural resources and complementing technical fix with nature-based solutions.

Comments: It is clear that all terms have a common target which is a more sustainable and resource efficient world with a low carbon footprint. Also, all avoid using additional fossil carbon to contribute to climate targets.

11. SIMILARITY AND DIFFERENCES BETWEEN BIOECONOMY, GREEN ECONOMY AND CIRCULAR ECONOMY

Type of economy	Bioeconomy	Circular economy	Green economy
Similarities	Aim at more sustainable and resource efficient world with a low carbon footprint		
Differences	Economy based only on renewable biological resources	Economy based on reusing/recycling of different products (not only bio- based products)	Enhancing the functionality and resilience of socio-ecological systems by cherishing natural capital

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1.2. FOREST BASED BIOECONOMY (FBB) (SFS)

AUTHORS: Kristina Sever, Marta Curman

H5P PRESENTATION: FOREST BASED BIOECONOMY – INTRODUCTION

A short interactive presentation to learn more about forest based bioeconomy. Don't forget to click on to get some more information.

1. FOREST BASED BIOECONOMY – INTRODUCTION
2. Learning outcomes. Participants will be able to:
   - define what forest based bioeconomy (FBB) means
   - list FBB products and services examples
   - distinguish between bioeconomy and FBB
   - list main characteristics of FBB
3. Now that you know what bioeconomy is, take a moment and think what forest - based bioeconomy means to you.

Are forest based bioeconomy products made from wood? True/False

Wooden products and products made from lignin and cellulose, that can be extracted from wood. For example: vanillin, plastic, oil, wax, cellophane, sponges, food thickener, cosmetics, crayons, paper and so on.

4. Take a moment and think about what forest - based bioeconomy means to you.

What about forest services, is it also a part of forest - based bioeconomy? True/False

Yes, also forest services, like hunting, providing drinking water, tourism, collecting forest fruits, can be part of forest - based bioeconomy. Although it is difficult to measure the market of forest services, they still represent a non-negligible income for forest owners.

5. WHAT IS FOREST BASED BIOECONOMY?

The forest based bioeconomy comprises those parts of the economy that sustainably produce renewable biological resources from forests and convert them (and their waste streams) into **added value products and services**.

Forest based bioeconomy is focused on the use of wood and non-wood forest products as well as forest services, such as recreation, tourism, health and clean environment.

6. Characteristics of forest based bioeconomy:
    1. **Sustainable forest management:** To ensure sustainability of wood production from forests it is important that annual wood increment in a forest is higher than what is logged. With certification of timber (e.g. PEFC, FSC) we guarantee that the logging process has taken environmental considerations. Find more about sustainable forestry in Section 2.
    2. **Based on the renewable resources**: All organic resources are renewable (e.g. plants, wood, animal manure). Forest is a good example of a renewable resource.
    3. **Reducing dependence on fossil fuels**: It implies a shift from fossil resources (oil, coal and gas) to renewable resources (biomass). It means that wood biomass can replace some oil-based products.
    4. **Resource-efficiency:** FBB is characterized by cascading of resource use and energy and material efficiency.
    5. **Mitigation and adapting to climate change**: When using wood as a material, the carbon is still stored in the wood and it will not emit CO2 before it is burned or decomposed. For each ton of wood used instead of non-wood products, there is an average emissions reduction of approximately 2 tons of carbon.
    6. **Creating new jobs:** FBB could lead to the creation of jobs, particularly in rural areas through the growing participation of primary producers in their local bioeconomies. The fast-growing startup ecosystem in the biotechnology sector will play a leading role in realizing this potential.

7. **Fostering innovation and inter-sectoral collaboration:** Bioeconomy sectors and industries, including FBB, have strong innovation potential due to their use of a wide range of sciences, industrial technologies and local knowledge.

8. EXAMPLE OF FBB ON A CHAIR

Lack of resources is a reason why we encourage a shift towards bioeconomy. Today we extract resources, create a product which we use and later throw it away - we create waste.

Let's take a chair for example. When it is broken, we can repair it, but at one point, we will throw it away. Usually chairs and other wooden products can't be used as firewood, because they are often treated with chemicals (e.g. glue, varnish).

Today it is possible to produce wood based chemical products out of lignin and cellulose. If we plan ahead and make the whole chair out of renewable and degradable sources or we plan to reuse the product after its initial use, the resource will stay within the economy for a longer time. This will also reduce the quantity of waste we produce today.

9. Forest based bioeconomy in Finland

Watch an example of forest based bioeconomy in Finland and notice all the products that can be produced from wood.

Forest based bioeconomy in Finland. 2014. BiotalousFi.

https://www.youtube.com/watch?v=w8JaCLECuM4

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SECTION 2: FOREST-BASED VALUE CHAIN

AUTHORS: Darja Stare, Kristina Sever, Andrej Breznikar, Marta Curman, Anton Brenko, Andreja Gregorič, Boštjan Hren, Zoran Jančić

This section provides an understanding of the forest-based value chain concept, processes, and links. Presenting the forest based bioeconomy in forestry as an integrated strategy (for wood production, energy, non-wood products and services, and as a use of biomass), and its connection with other sectors (such as food, rural development, tourism and health). Also, it provides an understanding of the concepts of sustainable forest management and climate change, as well as cradle to cradle philosophy of design and production of products.

2.1. FOREST-BASED VALUE CHAIN

AUTHORS: Darja Stare, Marta Curman, Nike Krajnc

BOOK: FOREST-BASED VALUE CHAIN

Learning outcomes

After this book participants will be able to:

- Define value chain
- List the main processes of the forest-based value chain
- Explain forestry part in the forest-based value chain
- List and explain wood products and wood production types in the forest-based value chain
- Understand and plan a forest-based value chain in the local environment

1. FOREST-BASED VALUE CHAIN - DEFINITION AND MAIN PROCESSES

A value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumer, and final disposal after use (Kaplinsky & Morris, 2002).

The forest-based value chain connects different processes: (I) sustainable, multifunctional and close-to-nature forest management, (II) wood processing, (III) design, (IV) production and (V) sale of wood products and wood components. The forest-based value chain also connects processes of wood residues utilization and wood waste for energy production.

1.1 FORESTRY IN A FOREST-BASED VALUE CHAIN

What is the forestry part of the forest-based value chain?

Forestry represents several parts of the complex forest-based value chain. Technologically speaking, the forestry part in the forest-based value chain forms a series of production processes that transform natural resources from forests into products and services. Forest biomass is an important source of raw materials for many sectors, such as the wood processing industry, pulp, and paper production, crafts, construction, for home use by forest owners, energy, non-timber products, and services. From an economic point of view, biomass production provides jobs, helps to maintain rural settlement, represents additional income for forest owners, while maintaining jobs and adding value to wood throughout the forest-based value chain from forest to finished product.

What wood products and by-products derive from forestry?

The biggest amount of wood in a forest-based value chain derives from forests and plantations (wood from forests (regular or sanitary logging), parks, plantations of fast-growing trees and shrub species, and other plantations). Sustainable forest management ensures the continuous production of **roundwood** (high and low quality), which can be turned into high value-added products. High-quality roundwood is turned into high-value products in wood processing chains, while the low-quality roundwood is used for the production of bio-based products or energy. Important by-products of the primary production are **wood residues**. They can be used in the production of bio-based products with high added value or to produce wood fuels. The wood processing chain provides many jobs and raises awareness of the importance of wood as a material or energy source.

Other sources of wood for forest-based value chains are:

· *By-products and residues from the wood-processing industry*: chemically untreated wood residues (e.g. residues from barking, sawing, shaping, or pressing) or residues of chemically treated wood, if they do not contain heavy metals or halogenated organic constituents derived from the use of wood preservatives or coatings.

· *Waste Wood*: Wood that has already served its primary purpose and is being treated as waste by the user. For use, the same criteria apply as for the group "by-products and residues from the wood-processing industry". This means that waste wood that will be used as a source for further use/processing should not contain heavy metals or halogenated organic ingredients resulting from the use of wood preservatives or coatings.

2. TYPES OF WOOD PRODUCTION IN FOREST-BASED VALUE CHAIN

The production process of timber extraction takes place through the production stages. Production processes vary in different environments and have evolved in different directions over time. When performing technological procedures, different equipment and machines are required to enable a certain process to be performed. Production processes also vary by raw material (may also be a product or semi-finished product) in which they take place.

Environmental policies affect the entire forest-based bioeconomy value chain. Established standards constrain, on the one hand, opportunities for some bioeconomy-related activities. On the other hand, they may secure the provision of multiple forest ecosystem services and set conditions that positively affect the development of “green” industries.

Transport policies affect the logistically intense stages (e.g. limiting transport volumes and haulage) of the forest-based bioeconomy value chain. They might, on the one hand, hamper global competitiveness of the bioeconomy through higher logistic costs but, on the other hand, they facilitate the development of circular economy thinking based on domestic supply of bio-based resources.

Traditional production of roundwood

The most common system of wood production is a technology implemented in a combination of traditional felling with a chainsaw and skidding with an adapted forest tractor, followed by transport of roundwood with forest transport composition (truck). Technological scheme shows the production chain of timber felling, skidding and transport. The process begins in a forest stand with felling, trimming, and cross-cutting with a chainsaw with 4kW engine power. After that collecting and hauling timber to the forest road follows with an adapted forestry tractor which has a complete forestry upgrade (safety frame), forestry chains for wheels, double drum built-in winch (5t) and a radio controller unit. Transport of round wood to the end user is done by a semi-truck equipped with a crane for transporting roundwood.

Fully mechanized cutting

The example represents the nowadays well-established forms of fully mechanized cutting. Example represents fully mechanized cutting with the class of middle size harvesters, whose rated engine power is greater than 140 kW. Their weight is more than 21 tons but does not exceed 25 tons. Fully mechanized cutting requires skid trails with 20-25 metre spacing. In the event of thick trees in the intermediate zone, which is inaccessible by the machine's cranes (between skid trails), a combination with a wood cutter is necessary, which felling trees towards skid trails. Cutting and assortment production (4m length) take place along skid trails and are carried out by a harvester. Cutting is followed by haulage to the forest road with a forwarder. The greatest problem in this technological system is the machine's weight and with it associated possibility of damages being caused to the soil. This technology is limited mainly to soils with good ground bearing capacity and not too wet grounds. Biggest advantage of this production chain is high productivity rates in case of boreal stands. Transport of assortments to the end user is done by a truck.

Production of green wood chips

The example represents cutting according to the whole-tree method (forest worker fells a tree but does not finish it in full). Cutting is followed by haulage with a larger forest skidder, which is equipped with a (double drum) winch and permanent four-wheel drive. Haulage of whole trees (including crowns) from the stand takes place along the forest skid-road to the forest road, where trees are further processed into assortments and logging residues. In this case, the logging residues are gathered, without any further special procedures, along the forest road and are thus suitable for further processing into wood chips. In special cases, economy allowing, whole trees are recommended to be utilized into wood chips (e.g. coppice stands, pest infested trees, early 1st thinning…).

Graph-will be added to google drive

Non-professional production of wood chips for own use

The example represents production of wood chips for own use in households. Production starts in the forest stand with cutting, limbing, and crosscutting with a chainsaw. Collection and skidding of timber to skid road is done with an adapted agricultural tractor (e.g. light forestry safety frame, forest chains on tires) and electro-hydraulic single drum winch with radio control unit. From the forest road to the end-user transport of roundwood (i.e. pulpwood and fuelwood) is carried out with a forestry transport composition (three-axle truck for round wood with a crane and trailer). At the end user wood chips are produced using a chipper that is powered by a tractor and equipped with a loading device.

3. PLANNING OF FOREST-BASED VALUE CHAIN IN THE LOCAL ENVIRONMENT

Words are words only, but they can be turned into action to change our lives. Local forestry-wood chains and nature conservation are our keywords that we want to convey to the local environment.

https://www.youtube.com/watch?v=1_hbzEpOL3E&t=25s

As part of the ForBioEnergy project (Interreg MED), a plan has been drawn up to create a local forestry-wood value chain in the pilot area of the seasonal lakes of Pivka nature park. Municipality-owned forests and other forests in the surrounding area have great potential for extracting wood biomass mainly from overgrown areas. By clearing the overgrown surfaces, we would obtain wood biomass that could be used for heating in the district heating system at Krpan's home. This would preserve overgrown meadows and pastures protected by Natura 2000 and at the same time establish a local forest-based value chain in the municipality of Pivka.

Screenplay by: Nike Krajnc, Kristina Sever, Matevž Triplat

Production: http://Squareme.si

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H5P IMAGE HOTSPOT: FOREST-BASED VALUE CHAIN - ILLUSTRATIVE OVERVIEW

This interactive image will help you in a better understanding of the complex forest-based value chain.

Carbon storage

The value chain starts with carbon storage. This is the **vital ecosystem service** and is defined as the capture of atmospheric carbon in other carbon 'pools', such as forest vegetation or soil. Trees absorb carbon dioxide (CO2) during photosynthesis and emitting oxygen while using carbon to build woody stems, branches, roots, and leaves. On the other hand, trees release CO2 during respiration and after they die through decomposition or when they burn. Young forests sequester carbon faster than old forests because CO2 uptake greatly exceeds respiration, but old forests store more total carbon than young ones.

Find more information about the soil sequestration here and about positive impacts of forest sector carbon storage here.

Sustainable forest management

Sustainable forest management is a government commitment which ensures forest management according to the principles of sustainable development. It has to keep the balance between three main pillars: ecological, economical and socio-cultural.

Learn more about sustainable forest management and close to nature forest management in lesson 'Sustainable and close to nature forest management', Section 2.

Non-wood goods

Non-wood goods, or non-wood forest products (NWFPs) are all those goods that we can find and use from forests that derive from non-wood parts of forest trees, shrubs and other components of the forest ecosystem

Find out more in the lesson 'What are non-wood forest goods?', Section 2.

Services

Beside tangible forest products (wood and non-wood), forests provide us with various other services such as socio-cultural forest services and ecological forest functions.

Find out more in the lesson 'Benefits and services from the forest', Section 2.

Timber

Timber is nowadays economically the most valuable forest product derived as a result of sustainable forest management. By adding a value to the timber in the wood processing industry we can get primary and secondary wood products.

It can be used as a building material, or for production of furniture, toys, instruments, paper and bioenergy resources or even as wood-based chemicals. Wood quality characteristics have a profound impact on wood processing and utilization. Each final product has a unique set of requirements.

More information can be found in the lessons: 'Products from forest', 'Wood for energy' and 'Biomass', Section 2 and here.

Primary products

In the wood processing industry primary wood products are those produced directly from raw timber input. Those are low added value products such as chips, lumber, veneer, plywood and their by-products.

Secondary products

On the other hand, secondary products use primary products as input for remanufacturing, such as panels, engineered composites or dimension stock and final consumer products such as furniture, toys or instruments. Secondary wood products have higher added value compared to primary.

Recycling and Reusing

Recycling waste wood into usable products is highly beneficial and can reduce felling of more trees. Bedding for domestic animals, play areas surfacing, mulch and pathway coverings and fuel for bioenergy are just some of the several examples.

By reusing wood we reduce pressure on forests, waste less energy and reduce landfill emissions (wood which rots in landfill produces methane which is harmful for the environment). Also, reusing can be a trigger for social innovation and establishment of communities for furniture makeover (redesigning, restoration).

Reusing, together with repairing and recycling are at heart of the circular economy.

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- Community Wood Recycling: https://www.communitywoodrecycling.org.uk/learn-more/recycling-vs-reuse/

2.2. PRODUCTS AND RESOURCES IN FOREST BASED VALUE CHAIN

AUTHORS: Kristina Sever

BOOK: PRODUCTS FROM FOREST

This book will give you an insight on diverse use of wood and other forest products, such as wood as a product, wood-based chemicals, wood for food and medicine, paper and energy.

1. Learning outcomes

After the lesson participants will be able to:

-be aware of diversity of products derived from forests

-recognize types of forest products

-list products from each type of products derived from forests

-recognize products that are based on lignin and cellulose derived from wood

2. Introduction

VIDEO: EUROPEAN FORESTS. 2016. FOREST EUROPE.

https://www.youtube.com/watch?v=9UXrdWVQSL0&feature=youtu.be

Forests provide a range of resources we depend on. It would be difficult to get through a day without using something that derives from forest. It could be firewood, newspaper, furniture, medicines or food. These are all products we can directly relate to forests, and there are many more. Learn all about products and resources from the forest in this book.

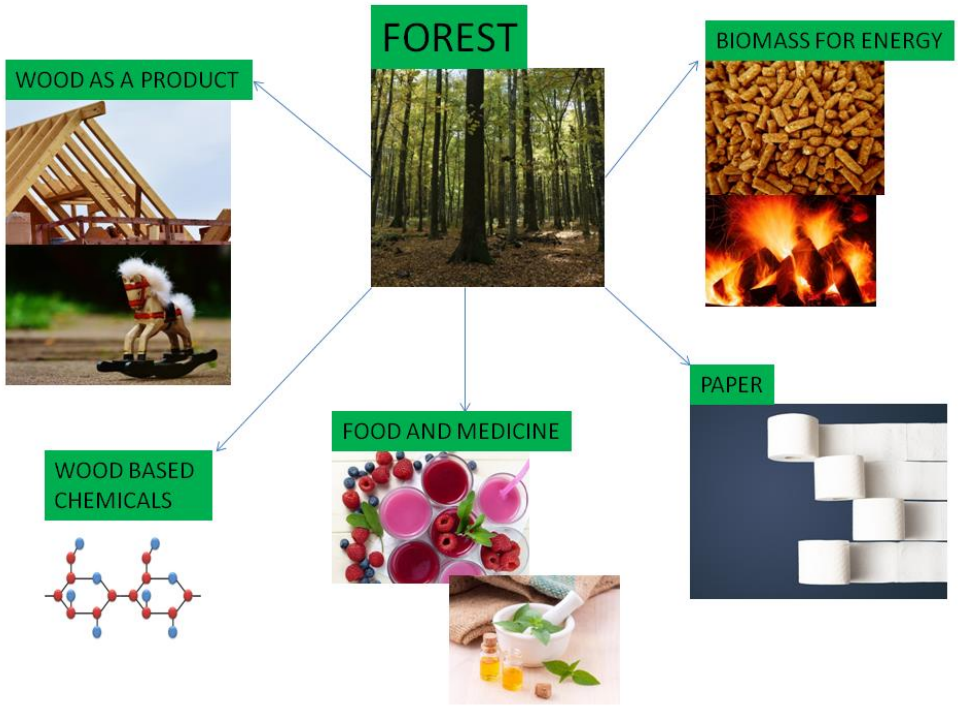
Primary production in forestry begins with the production and processing of **roundwood.** High quality roundwood is turned into high value-added products in wood processing chains, while low quality roundwood is used to produce bio-based products or energy. Important by-products of the primary production are **wood residues**. They can be used in the production of bio-based products with high added value or to produce wood fuels. The wood processing chain provides many jobs and raises awareness of the importance of wood as a material or energy source.

Forest products include materials derived from a forest for commercial and personal use. Forest products can be made from wood or other forest resources called non-wood forest products. By adding value to the raw forest products (eg. logs, logging residues, berries) their market value is growing.

However, bioeconomy is not just wooden products or fuel wood. Technology has taken wood to a greater level. Today, wood is a component in anything from toothpaste to asphalt, and now we can create plastic from it too. Anything made from hydrocarbons can also be made from wood. Scientists have already managed to make a car entirely from wood based plastic. Technology has demonstrated the possibility. And the research goes on.

Forests are an important source of income; forestry activities, wood processing and the pulp and paper industries contribute 0,8 % (103 billion €) to the Gross Domestic Product (GDP) of Europe as a whole. And this amount does not include the forest sector's additional contribution through other economic activities, such as forest based tourism, wood energy, manufacturing of furniture, manufacturing of wood processing equipment and trade in forest products.

Europe is a net exporter of wood products and remains one of the main round wood producers in the world. Concern about deforestation of tropical forests has reduced demand for tropical timber products and their imported volumes into Europe have dropped since 2000; they have been partly replaced by wood from Europe's well-managed forests.



Types of products from forests

3. Wood as a product

We can use wood for building houses, making furniture, boats, and bridges. The list is almost endless as there are very few things you can't make from wood. The great thing about using wood as building material is that it is very environmentally friendly. Compared to other materials like steel or concrete, production of wood requires less energy and produces less waste. It is estimated that for each ton of wood used instead of non-wood products, there is an average emissions reduction of approximately 2 tons of carbon. Moreover, wood products store the carbon over their entire lifetime, so the longer products are used, the higher environmental benefits. At the end of lifetime wood products could be recycled and used for new products or energy.

BUILDING MATERIAL

Wood is historically one of the greatest resources for constructions. It has excellent qualities like durability, usability and strength. Even today, wood is a number one choice in many countries for construction purposes. It is a multi-purpose material and has usages ranging from construction, planking, paneling, roofs and floors, window frames and doors, and a wide range of decorative purposes. One can use it for anything from a small house or 100 meters long glulam bridges. Compared to its own weight, it is extremely strong. This applies to everything from big logs to the smallest particles of fibers. The technique of glulam makes it possible to build huge buildings like airports or sports stadiums. Glulam (glue laminated timber) is a type of structural timber product com-posed of several layers of dimensioned timber bonded together with durable, moisture-resistant adhesives.

OTHER WOODEN PRODUCTS

Inside a house, you will always find products made from wood. Wooden furniture is one of the earliest, and most important, inventions intended strictly for human comfort and pleasure. The making of the very first musical instruments used wood. It is still an important material for many instruments. Tables, chairs, kitchen benches and cabinets are just some of the products made from wood often found in homes. Outside the house, you can see fences made from wood, or a child on a skateboard. Perhaps you take a trip in a wooden boat, departing from a jetty made from wood. Wood is surrounding us in our daily life in one way or another.

4. Wood – based chemicals

Trees do not only provide us with wood. Many chemicals are extracted for different uses ranging from medicine to industrial purposes. The great benefit is that "green chemistry" can replace or reduce chemical products that have a negative environmental impact. The two major sources for green chemistry are lignin and cellulose.

LIGNIN

A tree is made of wood fibres. A substance called lignin keeps the fibres together. The lignin can be extracted and used as either a binding or a dispersing agent in products like paint and concrete. From lignin, it is possible to extract the delicious vanillin. It tastes almost exactly as vanilla but is much cheaper. Most food with vanilla flavours is made from vanillin – consequently trees!

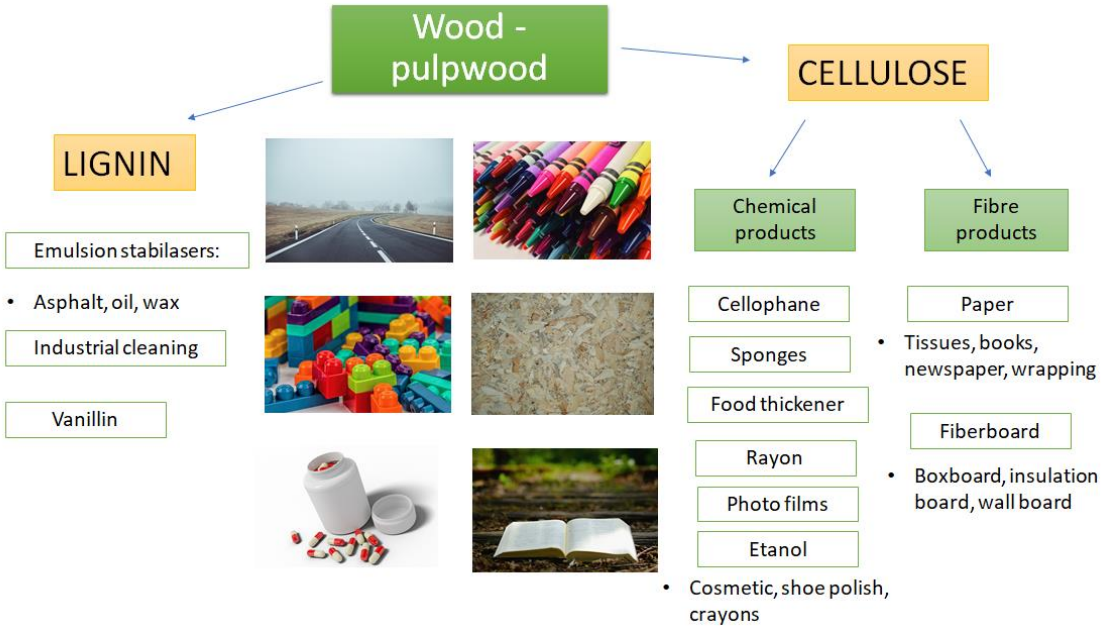
CELLULOSE

Cellulose is perhaps best known as the raw material for paper. However, it has many other purposes as well. Recent technology has made it possible to make plastic from cellulose. That is far more environmentally friendly than the plastic we are familiar with, made from oil.

You can also use cellulose for food. Cellulose powder serves as an excellent thickener that makes water and other liquids viscous/thick and sticky. Therefore, you can find it in, for instance, toothpaste. Pills consist mostly of cellulose, as the actual amount of medicine is so tiny it would be impossible to eat without some sort of filling that increases the size to something we can pick up and eat. Viscose (rayon) is a fabric for clothing also made from cellulose.

SUGAR

Wood contains sugars. By adding yeast, one can produce alcohol, which further usage can be methylated spirits and window washer fluid. The fermentation process produces carbon dioxide (CO_2), which is captured and used in carbonated soft drinks.



5. Food and medicine

Food and medicine mostly derive from non-wood forest products.

FOOD

The forest is a great provider of food. Many animals live in the forests and most cultures have a long history of hunting game for food, not only mammals but also, birds, fish, reptiles, and insects. Hunting, besides providing a very healthy and ethical source of meat, is a very important measure for managing wildlife populations and thus ensuring stability of (forest) habitats.

However, the forest can provide more than meat. You can find fruits, berries, mushrooms, nuts, herbs and edible plants in all forests to some extent. In some countries, gathering food is part of daily life, - whereas in other countries it is part of recreational habits. Their nutritional values actually exceeded the cash values for most of the NWFP produced by households in some countries, especially in least developed countries.

MEDICINE:

A great amount of the products in grocery stores is from the tropical forests: coffee, cocoa, coconut, vanilla, bananas, brazil nuts, pineapples and pepper, just to mention a few.

A drug store has an equally impressive number of products that originate from the forest. That is not surprising knowing that more than half of the world's plant species are native to the tropical forest.

In an environment with great competition from other species and the threat from myriads of insects, bacteria and fungi, tropical plants have developed a wide range of chemical compounds to protect themselves. These chemicals have given us drugs to treat cancer, malaria, heart disease, bronchitis, dysentery and tuberculosis to mention a few. In

addition, there are common drugstore products like headache pills and cortisone ointment. In fact, over 120 pharmaceutical products are plant derived, with a large portion originating from tropical species.

Recent research has shown that the Nordic spruce contains large amounts of compounds that may have preventive effects on common and widespread diseases like diabetes, cancer and cardiovascular disease.

Figures:

Blackberry and Porcino mushrooms

Different herbs and collection maple sap for maple syrup production

6. Paper

Paper is a product from nature, and the raw material comes from trees and other plants. Today it is hard to imagine a world without paper. We have books, money, packaging and even filters in cars to mention a few. It comes in different shapes and qualities depending on what we use it for. Paper can be recycled and used over and over again, which is good for the environment. There are three major categories for the different uses of paper: for print, packaging and hygienic use.

7. Wood biomass - Renewable energy source

Wood biomass is a renewable energy source from nature – trees. Bioenergy is an environmentally friendly alternative to fossil fuel. In modern forestry, every part of the tree can be used. The bottom part of the tree trunk is used for building material, the upper part for paper, and what is left over can be used for energy. Sometimes, if a tree has bad quality timber, all trees can be used as heating materials.

WOOD FOR ENERGY

Wood for bioenergy comes in many shapes. Residues from timber logging can be chopped into chips, sawdust can be compressed into pellets and briquettes and there is also regular firewood. These types of fuelwood are usually used in households, but it can also be used in bigger heating systems. In order to contribute to a clean and healthy environment, it is important to use good quality wood fuels with appropriate water content, to reduce air pollution.

Find more about the biomass here.

BIOFUEL FROM FOREST

The forest is also about to become a competitor to fossil fuel. Ethanol and biodiesel have been criticized as a source for fuel as they are made from food plants such as corn, sugar canes and rapeseeds. Research on second-generation biofuel suggests that forests can be a contributor, and they are currently studying how to make fuel from harvesting residues.

Wood as a source of energy has a lot of advantages but we should remember it is an intermediary source to combat climate change. Also, any misuse, e.g. pellets from tropical forests, should be strongly discouraged.

8. Innovation in the forest-based sector

Innovation is an important part of bioeconomy. Bioeconomy sectors and industries, including FBB, have strong innovation potential due to their use of a wide range of sciences, industrial technologies and local knowledge. Find more about innovation here (link to Innovation section).

Paper: Researchers in Sweden created the world strongest paper with Nanotechnology. It is water resistant and seven times stronger than normal paper. As it is solid as iron it is impossible to hit a nail through it.

Intelligent medicine wrapping can help a patient know when to take a pill, and it can communicate directly to the doctor and pharmacy when they need more pills. Intelligent wrapping can also prevent piracy of products.

Drink cartons for milk and juice that don't need refrigerated trucks for transportation and it keeps the products fresh until it reaches its consumers.

"Plastic" made from cellulose. Usually plastic is made from oil or natural gas, which causes emissions of CO2. However, it can also be made from cellulose. Toothbrushes, toys and instrument panels in cars are already products from trees, and we can assume the usage will increase in the future.

Food - Food additives are often synthetic; however, natural ingredients can replace many. One can make sausage skin from cellulose, and cellulose acts as an excellent binder in frozen food and milk based drinks, to mention a few. Recent research is considering possibilities to make animal food from trees to replace other biological sources like beans and rapeseeds.

Technology: Research and development in wood-based technology makes it possible to build even taller, stronger and more durable buildings from wood. They are also fire resistant, and since the building material is wood, it is far more environmentally friendly than other building materials.

Coloring: Color concentrates – using almond shells, which is a natural material, for coloring e.g. toys.

Dining utility: Companies in India have been using nut palm leaves to produce plates that are compostable and contain no additives, coatings or chemicals. After the leaves have naturally fallen from the tree, they are collected, soaked in water, heat pressed and dried. These plates will naturally decompose within 20 – 40 days. They can also pose an alternative to paper or disposables.

Dishes can be also made from fast-growing plants, such as bamboo. There are already companies that produce dishes and coffee cups from bamboo.

Sports: A bicycle made of real wood veneer as the basis for lightweight tubes.

Learn more about bioeconomy products here (link to Biostep booklet).

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H5P PRESENTATION: BIOMASS FOR BIOENERGY (DARJA)

The term biomass defines all organic matter. Energy sector treats biomass as an organic substance that can be used as an energy source. This group includes wood and wood residues (wood biomass), agricultural residues, non-woody plants useful for energy production, industrial plant residues, sorted household waste, sludge or sediment and the organic fraction of urban municipal waste and food industry wastewater. In this sense, biomass is a renewable energy source.

Wood biomass

Wood biomass is important **secondary raw material sources** (waste biomass, wood, lignocellulosic fibres) for further use arising from the production and processing of biomass in the forest-wood-paper chain:

- Wood residues from the production of forest wood assortments (bark, logging residues),
- wood processing residues (wood chips, sawdust, knots, ...),
- waste in the paper industry (paper dust, sludges),
- used wood.

Wood residues from the production of forest wood assortments

- Logging residues

When harvesting forest wood assortments, logging residues are formed. These are the result of regular harvesting, young forest tending and salvage logging. Branches should be especially emphasized among the wood residues.

It is important to note, however: Not everywhere it is ecologically justifiable to remove whole trees from the stand. The small twigs, branches and green parts of the trees contain a lot of nutrients, which are thus removed from the natural cycle and leading to degradation of the soil.

- Bark

In primary wood processing, large quantities of bark are generated, which represents waste. The bark represents 10-20% of the trunk and 20-35% of the tree and is an important raw material for bio-based products. Although important in terms of quantity, it usually represents a less economically significant part and is used as a waste product for energy use. However, since it contains up to 10 times more minerals than wood, a large amount of ash, which is approximately 10%, remains after burning.

Traditionally, the bark mulch is used in ornamental gardens, where it prevents the growth of weeds and retains moisture. Today, tannin production is one of the major industrial uses of the bark.

Wood processing residues

The efficiency of primary wood processing into sawn wood is about 50%. When manufacturing solid wood furniture, the material efficiency ranges from 5 to 20%. When processing wood, enough wood residues are produced that are suitable for other uses.

In the production of particle boards and fibre boards of coniferous wood, we have knots as a residue. Knots are an extremely interesting source of polyphenols. As the collection of knots is punctual, it is economically viable to collect and convert them into higher value-added products.

Waste in the paper industry

The production and processing of paper and paperboard generates various wastes that represent a secondary source of biomass or cellulose fibres. The main source of biomass waste is sludge from the wastewater treatment process and the removal of printing ink from recycled fibres.

Part of the accumulated biomass is used by paper mills as an energy source in their own production, with significant amounts of ash remaining. When cutting paper, paper dust is produced as waste, which is usually mixed with other types of biomass waste.

Used wood

There is a lot of reuse and recycling in the used wood. Much old furniture is converted into furniture, shelves, garden furniture or used for energy purposes. In addition, a market for used wood suitable for further processing has emerged in Europe. Prices of beautifully

aged used wood are often higher than the price of freshly cut wood. Used wood includes packaging waste, old furniture, used construction wood…

Quality wood fuels

Many enjoy wood-fired heating. But what and how we burn has a strong effect on the development of smoke and thus on our and our family, neighbours and friends' health. Wood is a renewable energy source that is available to us in large quantities. However, heating with wood in a house fire is also one of the main sources of particulate matter pollution. The answer to the question of what we can do for better air here and now is shown in the short video that was created as part of the ForBioEnergy project (Interreg MED) https://www.youtube.com/watch?v=TJjIqFLTd0A.

Screenplay by Nike Krajnc, Kristina Sever, Matevž Triplat; Production: http://Squareme.si

H5P DIALOG CARDS: WOOD FOR ENERGY (KRISTINA)

1. Learning outcomes

After the lesson participants will be able to:

- recognize different types of wood for energy use
- differentiate between different types of wood fuels
- list factors that have influence on wood fuels quality

2. Wood for heating:

Firewood

Residues from logging timber or low-quality logs can be chopped into firewood. Cut and split oven-ready fuelwood is used mostly in household wood burning appliances like stoves, fireplaces and central heating systems.

Firewood represents the traditional form of wood fuels, which are obtained directly from low quality round wood. As a rule, firewood has a length of 15 to 100 cm. They are available in various forms:

- Chunk wood: with cutting and splitting devices, cut and chopped wood is 15 to 50 cm long.
- Logs: split and cut wood of 50 cm or more length.
- Round firewood: unbranched, generally cut wood 50 cm or more in length.

3. It is usually produced by the heating of wood in the absence of oxygen:

Charcoal - Charcoal is usually produced by slow pyrolysis—the heating of wood or other organic materials in the absence of oxygen. This process is called charcoal burning. It can be used as industrial fuel, cooking fuel, art, medicine, cosmetic, filtration, etc.

4. Fuel from harvesting residues:

Biofuel from forests - The forest is also about to become a competitor to fossil fuel. Ethanol and biodiesel have been criticized as a source for fuel as they are made from food plants such as corn, sugar canes and rapeseeds. Research on second-generation biofuel suggests that forests can be a contributor, and they are currently studying how to make fuel from harvesting residues.

5. Chipped woody biomass, usually made from tree residuals:

Wood chips are chipped wood biomass. They are irregular rectangular shapes, typically 3 to 45 mm in length and of small thickness compared to other dimensions. They are usually made of fine wood, that is small diameter wood (e.g. wood from thinning, branches, canopy), low quality wood, residues of primary wood processing and green cut and waste/used wood. The quality of the chips depends on the quality of the feedstock,the chipping technology and the moisture content. The size of the chips is adjusted to the combustion plant.

6. Densified biofuel made from sawdust or other components:

Wood pellets are standardized biofuels made from woody biomass (most commonly sawdust and dry wood dust), cylindrical (usually 6 or 8 mm in diameter) and up to 50 mm in length. In the manufacturing process, using only high-pressure steam, the feedstock is pushed through the cylindrical holes of the matrix. Friction results in an increase in pressure and temperature, resulting in compression of the raw material particles and the formation of pellets. This reduces the water content and volume and increases the density. Due to their higher density, they have a higher heating value. The pellets should be free of chemical additives.

7. Densified biofuel made from sawdust of bigger dimensions:

Briquettes are larger presses made by compressing bark, dry wood dust, sawdust, and other unpolluted wood residues. They are of different shapes. Only high-pressure steam is used in the manufacturing process. Wood briquettes are especially suitable for small or rarely burned hearths such as fireplaces, saunas and stoves. Bigger dimensions as wood pellets.

8. Wood residues or waste

Wood residues are suitable for the production of energy when it comes to residues without additives of primary and secondary wood processing industry (sawdust, shavings, bark, knots, ...)

9. **Quality of wood fuels** is important for a healthy environment, efficient burning, better furnace operation and consequently lower costs.

MOISTURE CONTENT: is the most important factor for all wood fuels (firewood, wood chips, pellets, briquettes). By increasing the water content, the energy value of the wood decreases as some of the energy released during the combustion process is used to evaporate the water.

TREE SPECIES: wood of different wood species have different calorific values

SIZE, IMPURITY CONTENT and WOOD QUALITY: all these factors affect the heating value, the bulk density and the ash content of wood chips.

STABILITY and RAW MATERIAL influence the wood pellets quality. The color of the pellets does not say much about the quality of the pellets themselves. The only feature we can evaluate for ourselves is the mechanical stability - the proportion of fine dust and broken pellets at the bottom of the bag indicates a lower mechanical stability of the pellets.

References:

- Bioeconomy and European forest week 2017. 2017. Forestry Extension Institute Norway. https://foresteurope.org/wp-content/uploads/2016/08/Activity_booklet.pdf (11.11.2019)
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H5P DRAG AND DROP: WHAT CAN WE GET FROM A TREE (KRISTINA SEVER)

We can use trees and wood from the forest in many different fields of operation. Drag and drop the text to the right image that shows the different fields of wood use.

Wood residuals – energy

Logs – building material and products

Live trees – ecosystem and social services

ASSIGNMENT: WHAT WOOD I SEE (KRISTINA)

Wood is surrounding us in our daily life. But, do we actually notice it? Have you ever considered how much wood we actually use and where it is contained? Let's find out.

Purpose: This exercise lets students investigate what is made of wood, what derives from wood, and where it is used. They can do it at home, in a classroom or anywhere else.

Preparation: Wherever you are right now, take a look around:

1. **Examine what is made of wood in your surroundings. Go around, investigate and make notes in the inventory list.**

Examples of possible findings: walls, furniture, window frames,…

2. **Examine what products you use in one day that are made from wood and products that derive from wood.**

Examples of possible findings: toothpaste, clothes made from viscose, paper products, …

Afterward work: Think about your findings. Were there any surprises? What are the pros and cons of using wood as a material? Why is choosing products made of wood an environmentally friendly alternative?

INVENTORY LIST – WOOD PRODUCTS AND ITS DERIVATES

Name: _____

Date: _____

Area of investigation: _____

Note what wood products you have found, where (in which area or room) and for what they are used for.

WOOD PRODUCT	AREA, ROOM	USE

References:

- Bioeconomy Teaching material. 2016. 11th European Forest Pedagogics Congress 2016. Bioeconomy and Forest Pedagogics – a great chance for education for sustainable development.

LESSON: BENEFITS AND SERVICES FROM THE FOREST (KRISTINA)

1. Learning outcomes

After this lesson participants will be able to:

- be aware of the diversity of different forest roles and benefits

- differentiate between forest functions and forest ecosystem services

-list main groups of forest benefits

-list and describe ecological role of forest

-list and describe sociocultural role of forests

-list and describe production role of forests

2. Introduction

Bioeconomy covers much more than products made of wood. We mustn't forget the benefits and services from the forest. Forests are called 'lungs of the earth', although most of the oxygen we breath produces phytoplankton in oceans. However, young and tended trees absorb CO_2 faster and use it for growth, while the old trees grow slower and thus attract less CO_2. Nevertheless, we depend on numerous other benefits that forests provide – from drinking water and biodiversity to recreation and tourism. These benefits are of great importance for our well-being as well as for the economy, but some of them cannot be easily evaluated (e.g. hydrological function, scenic and landscape services…).

Not only wood and wood-based products, but also non-wood goods and services are marketed from forests. Total value of marketed non-wood goods reached 2,3 billion € in Europe in 2010, of which 73 % came from marketed plant products and 27 % from marketed animal products.

In forest management it is important to consider diversity of forest functions and adjust the management to them. For example; management in forest where ecosystem role is emphasized is different as in highly production forest. Some forest functions (e.g. timber production, hunting, non-wood forest products) are more easily evaluated in the terms of economics than others. Ecological forest functions are especially difficult to evaluate, since we don't know how much money, for example, biodiversity is actually worth. But these roles are especially important; because they provide us with a healthy environment, clean water and help us fight global warming.

In this lesson we will learn about different aspects and benefits of forests. We will focus on ecology, sociocultural services and forest production.

3. Ecosystem services

To understand the benefits of forests, let's first see what ecosystem services are.

There are three interlinked concepts related to the provision of ecosystem services, i.e. **ecosystem process, ecosystem function, and ecosystem service**.

Ecosystem process is any change or reaction which occurs within ecosystems, physical, chemical or biological. Ecosystem processes include decomposition, production, nutrient cycling, and fluxes of nutrients and energy.

Ecosystem function is a subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services.

Ecosystem services (ES) are the benefits that people obtain from ecosystems. They are direct and indirect contributions of ecosystems to human wellbeing. The scope of this lesson is specifically on **forest ecosystem services (FES)** that are provided by forest ecosystems.

People benefit from ecosystem (goods and) services. These benefits are, among others, nutrition, access to clean air and water, health, safety, and enjoyment and they affect (increase) human wellbeing, which is the key target of managing the socio-economic systems. The focus on benefits implies that ecosystem services are open to economic valuation. However, not all benefits to people from ecosystems can be measured in monetary terms. Therefore, it is important to include other values as well, such as health value, social value or conservation value.

4. Classification of ecosystem services

Several classification approaches of ecosystem services had been developed.

For example; MAES (2013), according to Common International Classification of Ecosystem Services (CICES), classifies ES into three groups:

- Provisioning,
- Regulating/Maintenance and
- Cultural services.

In this lesson the focus is not on classification, but rather on presentation of different aspects and benefits of forests.

ECOLOGY

- **WATER**: The forest interacts closely with the water cycle - it acts as the storehouse of water. Like a giant sponge, it soaks up rainfall during wet seasons and helps water percolate into the soil. During dry seasons, it pumps the water back into the atmosphere through evaporation and plant transpiration. In this way, the forest regulates the groundwater level, which is the biggest water resource for people on earth. Forests also contribute to the maintenance of good water quality. They significantly reduce soil erosion, which in turn reduces the level of sediments in rivers and lakes. Forests also filter and trap some pollutants. Without forests, rainfall would cause floods and soil erosion, which would wash away most of the nutrients and the elements needed to maintain life.

- **BIODIVERSITY**: Only about 1.2 million species on earth are identified. Yet scientists estimate the planet could be home to as many as 8.7 million different species of animals, plants, fungi and microorganisms. All these species and their habitats represent the world's biological diversity – biodiversity. Daily humans use more than 40.000 species for food, shelter, medicines and clothes. Forests are the most diverse ecosystem on land, and provide perfect habitat for life. We have tropical, temperate and boreal forests, each offer

unique and diverse habitats for plants, animals, fungi and microorganisms. In fact, forests contain more than 80 % of the world's terrestrial species.

- **FIGHTING GLOBAL WARMING**: Climate change and global warming are some of our biggest challenges today (besides loss of biodiversity). One of the main reasons for global warming is too much CO2 in the atmosphere – caused by human activities. CO2 is naturally present in the atmosphere, which is good because it is warming air and provides a temperature on earth, which makes it possible to live here. However, when there is too much, the temperature will increase and the impact on earth can have devastating effects.

Through the photosynthesis, trees capture CO2 from the air. The trees store the carbon, and release the oxygen back to the air. So not only do the trees clean the air and provide us with oxygen. They also store the carbon throughout its life cycle. Hence, the forests act as a carbon sink. If the tree dies and decomposes naturally, it is releasing its carbon back into the air. This is a carbon neutral cycle. However, when the wood is used for building a house, the house will continue to store the carbon. If the source for wood-based products is from sustainably managed forests, the products are environmentally friendly.

Check the environmental functions of forests (link).

https://foresteurope.org/wp-content/uploads/2016/10/INFOGRAFIA2.pdf

Description: The environmental functions of forests are crucial for our wellbeing:

- Forests help to reduce the effects of climate change with carbon absorption.
- Forests prevent soil erosion, which is especially important in mountainous areas and areas with extreme climates.
- Forests regulate the hydrological cycle – regulating surface and groundwater flows and helping to preserve water resources.
- Forests provide unique habitats – they are home to thousands of animals and plant species.

SOCIOCULTURAL BENEFITS

First check what social benefits of forests are (link).

https://foresteurope.org/wp-content/uploads/2016/10/INFOGRAFIA4.pdf

Description: Forests are a major source of benefits for the society. It provides employment for men and women, social welfare and cultural and spiritual benefits.

- **RECREATION**: Some people enjoy a quiet peaceful walk in the forest. Recent studies show that visiting a forest has real, quantifiable health benefits, both mentally and physically. Japanese technique named Shinrin – Yoku or forest bathing is a process of relaxation in forest and it is getting more and more attention worldwide. A walk in the forest can trigger all your senses. Sight, hearing, smell, touch and taste. Touching various species can be thrilling, and there is a lot to taste. Listening carefully, one can hear sounds

different from any other place. It may even let you see some of the animals in their natural habitat. Many cultures have long traditions for hunting, and harvesting berries, mushrooms and other species for food and medicine.

- **TOURISM**: Tourism can be closely related to recreation. Forests have a direct or indirect impact on tourism activities. They give the landscape a distinctive look that many tourists like. They are important for health tourism. Forests are strongly attracted to the segment of tourists who are attracted by nature and natural sights and movement in nature. As part of this, various activities can be developed, such as trekking, cycling on forest roads, photo hunting, wildlife watching, etc. Hunting tourism also plays an important role. Local communities can make very good use of forests for tourism purposes, and their revenue can be much higher than for timber sales.

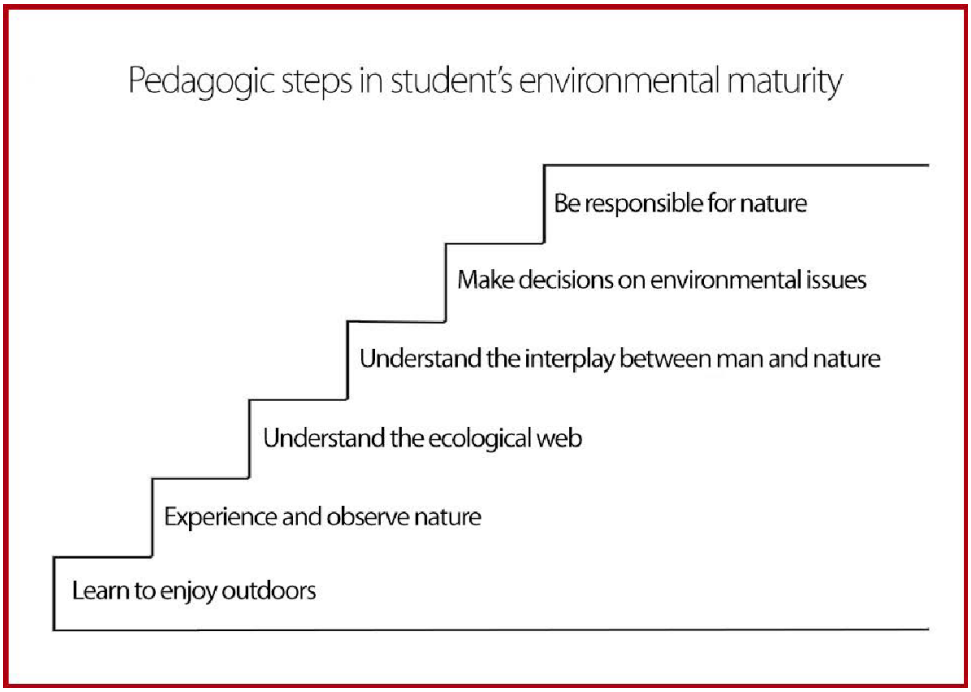
- **SCENIC AND LANDSCAPE SERVICES AND VALUES**: Imagine living on a planet without trees. Think of how a property can increase in value if there are old beautiful trees on the land. Many people value beautiful scenery, particularly when on holiday. Many hotels and resorts are built in or near a forest to provide pleasant surroundings.

- **HERITAGE ROLE OF FOREST**: Some forests can be part of natural or cultural monuments and we must protect and preserve these forests. Often these forests are part of nature parks, landscape parks or nature reserves. They are subject to specific restricted management conditions and all interventions must be carried out in accordance with the instructions of the institutions responsible for the conservation of the natural and cultural heritage.

- **EDUCATION**: Forests that have an educational role are intended to inform the public about nature, forests and forestry activities. In these forests there can be educational trails, open forest museums and stands where old forms of management are preserved. These forests are of great importance for the education of people with only little ties to the woods as well as for new generations of foresters. Nowadays, the impact of forest on health and education is getting more and more attention. In Europe there are already some forest schools and kindergartens that use forest as a classroom.

Forest pedagogy is a form of environmental education in the context of Education for Sustainable Development. It combines different learning approaches, from environmental education, movement education to social learning and general education. One of the main tasks is to familiarize the public (children and adults) with knowledge on the processes in forest and to increase their interests and values regarding nature protection and sustainable forest management.

Six steps of pedagogical approaches are described below. They describe the requirements to deliver education for sustainable development. Its goal is to make real changes in behaviour and attitudes amongst the participants. These six steps need repetition at different ages of the participants and the activities for each step must be harmonized with the age of participants, local forest conditions and relevant issues.



The educational role is often closely linked to the tourist - recreational role.

FOREST PRODUCTION

- **TIMBER PRODUCTION**: Currently, this function is the most important for forest owners, since wood from forest currently presents a main source of income. Bigger forest owners (100 or more hectares) can only make a living by selling wood from the forest and harvesting and selling forest fruits. The owner increases the value of the wood in the forest by investing in the care of the forest. Through the income from the wood, he receives funds he can partly invest back into the forest in the form of forest tending, and with that ensures a healthy and quality forest for the future. The timber production role, however, not only has a direct impact on the owner, but its economic impact is even greater. Forest management enables jobs for forest workers in forestry companies. In the next step, the wood is processed into goods or semi-finished products.Sawmills and timber industry also provide many jobs in rural areas. The areas where forest-wood supply chains from forest to finished product are established are most beneficial for the timber production role.

- **NON-WOOD FOREST PRODUCTS**: In our environment, gathering used to be of great importance for the survival of people, but today its importance has diminished. Nevertheless, gathering still plays a rather important role, especially from a recreational point of view and as a complementary source of income. Gathering meets the needs of people for forest fruits (blueberries, chestnuts, raspberries, mushrooms, cranberries) medicinal herbs, honey, ornamental greenery, tree cones, branches, resins etc.

- **HUNTING**: Wildlife is an integral part of the forest. It can be a source of income for hunters and landowners and indirectly for the state through the sale of hunting licences (depending on state regulations). Hunting is an economic activity that is usually of a sporting and prestigious character. But it is also a part of the cultural heritage.

The tourist role of the forest is also associated with this service, as watching wild animals in their natural habitats and photo hunting is getting more popular nowadays (wildlife photography in the natural environment).

Here you can see what the economic value of forests (link) is.

https://foresteurope.org/wp-content/uploads/2016/10/INFOGRAFIA3.pdf

Description: Forests are an important source of income. Wood, non-wood goods and forest services markets contribute billions to the Gross Domestic Product (GDP). Almost 3 million people in Europe earn their living from working in forestry and forest-based industries.

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2.3. CLIMATE CHANGE AND SUSTAINABLE FOREST MANAGEMENT IN THE FOREST BASED BIOECONOMY

AUTHORS: Andrej Breznikar, Kristina Sever

Sustainable and close to nature forest management is the core of forest based bioeconomy, the best way to mitigate negative consequences of climate change is to adapt.

VIDEO FROM ALGEBRA: CLIMATE CHANGE AND SUSTAINABLE FOREST MANAGEMENT IN THE FOREST BASED BIOECONOMY. (DETERMINE THE LOCATION OF THE VIDEO).

BOOK: CLIMATE CHANGE AND ITS CHALLENGES FOR FOREST BASED BIOECONOMY

Description: Sustainable and close to nature forest management is the core of forest based bioeconomy, the best way to mitigate negative consequences of climate change is to adapt to future uncertain climatic conditions. This book will show you what are the challenges related to climate change and forestry and how we can ensure climate change mitigation and adaptation with forest based bioeconomy.

1. Learning outcomes

After this lesson participants will be able to:

- understand what are causes and consequences of climate change
- understand what the role of forests in climate change mitigation is
- list and understand the ways to ensure climate change mitigation with forest based bioeconomy
- calculate CO2 stored in wood and trees
- understand adaptive forest management

2. Consequences of unsustainable use of natural resources

Non-sustainable use of natural resources (e.g. **deforestation**) is a major driver of climate change and other troubling consequences

- the emission of greenhouse gases (as CO_2)
- reduction of biodiversity in natural ecosystems
- increased concentration of aerosols in the atmosphere
- increased acidity of the oceans due to the increased presence of CO_2
- increasing the amount of nitrogen in the soil

https://www.youtube.com/watch?v=Ic-J6hcSKa8

Climate 101: Deforestation. 2017. National Geographic.

Climate change, including extreme events and associated increasing natural disturbances, is already affecting the whole society and also growth and stability of forests in Europe and worldwide. It is a major challenge for future forest management. Even if global warming can be limited to below two degrees by implementing the Paris agreement of December 2015 through ambitious international policy and drastic technological and

behavioural changes, it is unavoidable that changes in climate features, such as higher average temperature, more frequent and intensified droughts, changes in precipitation regime, more heat waves, changed frequency of natural disturbances, increases in insect, storm and fire damage, will affect the whole forestry sector and economy.

Rapid environmental change and increased climate variability imply that traditional forest management experience is no longer sufficient to guide future management practices.

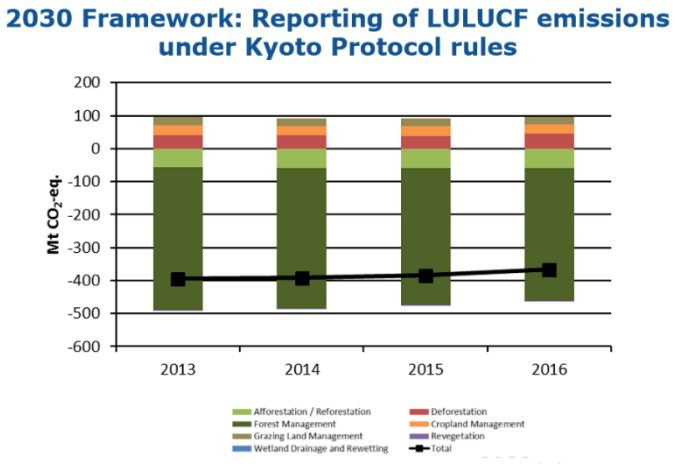
Role of forests in climate change mitigation

Forests have multiple roles, but the role of forests in climate change mitigation has become increasingly important due to the urgent need to reduce climate change impacts. Forests remove carbon dioxide from the atmosphere via photosynthesis, and store carbon in biomass and soil. A change from fossil to biological resources reduces the amount of fossil resources used and thus reduces the emission of CO2 into the atmosphere. When forests are harvested, part of the carbon is released and part is stored in all kinds of wood-based products. In addition to carbon storage in forest ecosystems and harvested wood products, using wood to substitute greenhouse gas intensive-materials and fossil fuels, has climate benefits.

Land use, land-use change and forestry (LULUCF)

LULUCF is defined by the United Nations Climate Change Secretariat as a "greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities." LULUCF has impacts on the global carbon cycle and as such, these activities can add or remove carbon dioxide from the atmosphere, influencing climate

EU forests, for example, absorb the equivalent of nearly 10% of total EU greenhouse gas emissions each year. Land use and forestry – which include our use of soils, trees, plants, biomass and timber – can thus contribute to a robust climate policy.



3. Di h forest based bioeconomy

Different ways to ensure climate change mitigation with forest based bioeconomy are:

a. Conservation of forests

Internationally, the most important forest-related climate change mitigation strategy is conservation management. Deforestation is a major contributor to global greenhouse gas emissions and significant efforts, particularly in tropical countries, are directed to reducing emissions from deforestation and forest degradation. Efforts directed at forest conservation in tropical countries have rarely been successful, because of the economic interests and the overall shortage of natural resources to supply an increasing world population. Land conversion to industrial cash crops (e.g. palm oil) or mining are incompatible with sustainable forest management and a forest-based bioeconomy.

Plant trees to create carbon sink.

b. Rising the amount of carbon in forests

Some mitigation strategies consist of sequestration management with the focus on sequestering carbon in forests. For example, secondary forests, as well as intensively managed forests, have low average growing stocks. When such forests are transformed into high growing stock stands, they remove more carbon dioxide from the atmosphere. In other words, the sequestration of carbon in forests can be increased through a reduction of harvesting, with the maturing of forest stands and their return to a more natural state (large carbon stocks in the ecosystem).

On the other hand, when management is over-reduced, it results in prolonged rotation length and higher average age of the managed forest. Disturbance risks increase with age, height and volume of forest stands. Carbon sinks resulting from decreased utilization are not permanent and can, for example in the case of large-scale storm damage or forest fires, relatively quickly turn into carbon sources. Another problem of forest protection and reduced harvest intensity is the locally reduced biomass supply to society, which also means less feedstock for the bioeconomy.

It is important to find the balance and implement close to nature forest management.

Carbon pool is a reservoir of carbon. A system which has the capacity to accumulate or release carbon. Earth carbon pools are:

- oceans,
- sedimentary rocks,
- the atmosphere and
- terrestrial ecosystem.

Forest is a terrestrial ecosystem which stores around 3,000 gigatonnes of carbon (GtC). How much is a gigatone you may wonder? A gigatonne is 1,000,000,000 tonnes, which is also roughly 200 million elephants; enough elephants to stretch from the Earth to the moon.

A gigatonne is also equivalent to:

- 5.5 million blue whales
- 3 million Boeing 747 jets and
- 2 million International Space Stations.

The participation of forests in climate change mitigation is thus three-fold:

• They are carbon pools,

• They become sources of CO2 when they burn, or, in general, when they are disturbed by natural or human action,

• They are CO2 sinks when they grow biomass or extend their area.

We divided carbon pools in forest to primary and secondary.

Primary carbon pools

Aboveground dendromas

Underground dendromas

Organic carbon bound in soils

Decomposing dendromas

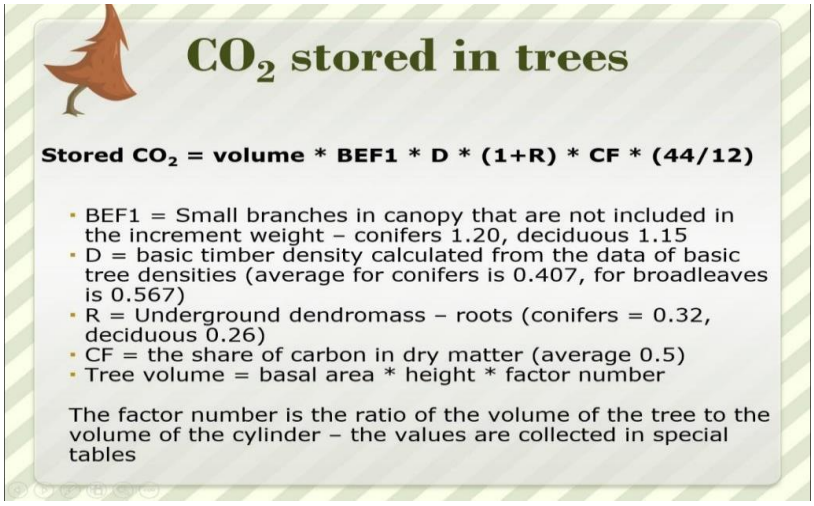
Plant litter

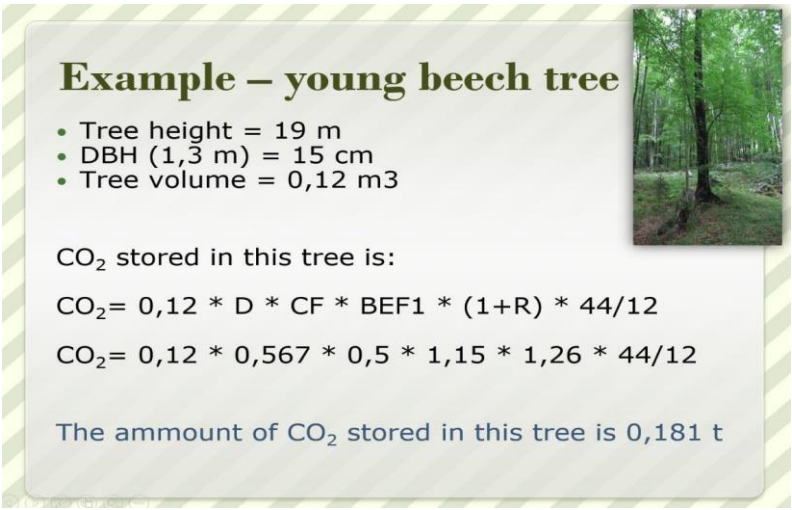
Secondary carbon pools

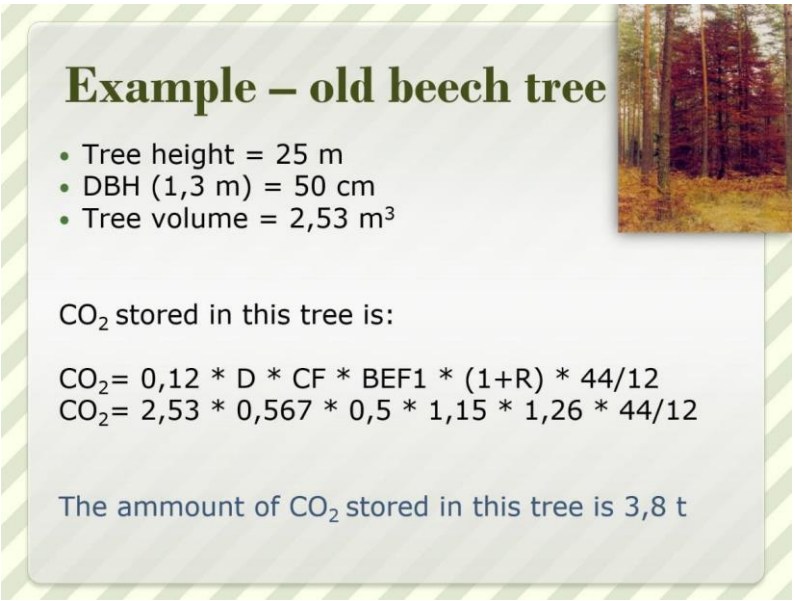
Logging residues

Round wood, this goes into further processing and is built into wooden products or used as energy.

You can calculate how much CO_2 is stored in trees:



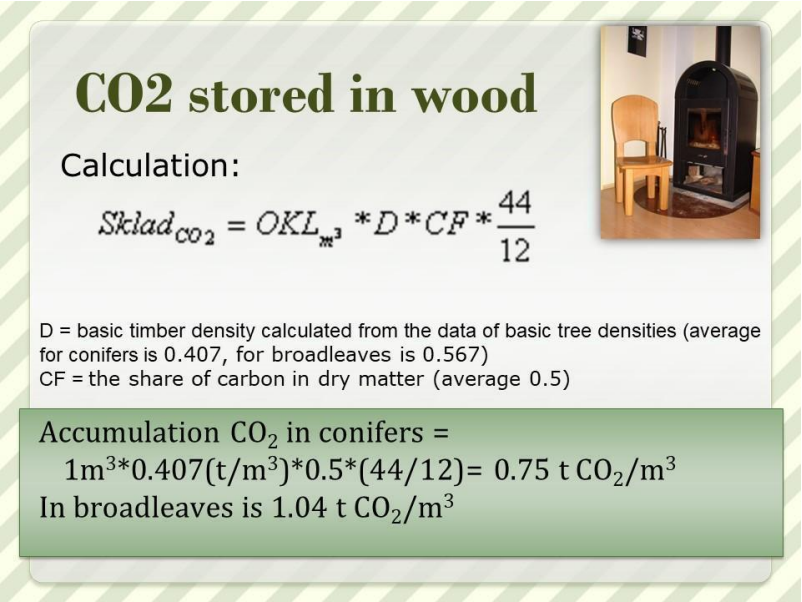




c. Increase of carbon storage in products from wood

Increasing carbon storage in products from wood is another mitigation strategy that can support bioeconomy development. Life spans of wood products can vary from zero to one year in the case of direct energy conversion, one to four years for paper products, a few decades for wood-based panels, and more than 100 years in durable wood construction. Promising opportunities to expand wood product carbon sequestration include the development of innovative wood products with long lifespan such as cross-laminated timber products that are increasingly used in the construction sector and bio-textiles produced from dissolved pulp. The cascading use of biomass, where discarded wood products are recycled and converted into another product, is another option to extend the lifespan of wood fibres, delaying the point in time when the carbon contained in these products is released back into the atmosphere, either through decomposition or, better, through its use for energy generation.

You can calculate how much CO_2 is stored in wood:



d. Substitution of materials, made from fossil fuels

Another climate change mitigation lever which is based on forests and their use is substitution management: when wood products or forest bioenergy substitute for fossil fuels and fossil fuel-intensive materials, such as concrete, steel or plastics, greenhouse gas emissions can be reduced in other sectors.

e. Mitigation strategies are not always complementary

The most critical conflict between bioeconomy development and climate change mitigation is a narrow mitigation strategy focusing on maximizing forest carbon pools through reduced management interventions, which cuts off the resource supply for the bioeconomy. If management intensity is reduced with larger areas of protected forests or increased tree retention, this may cause reduced biomass availability for the production of wood products, generation of bioenergy and consequently reduction of substitution potentials of wood. Maximization of carbon pools in the forest can be short-lived (two to three decades possibly), as forest carbon pools saturate and mature stands become more vulnerable to natural disturbances. When comparing alternative resource use strategies, it is essential to apply a wide system boundary that includes not only the forests, but entire economic sectors.

4. Adaptive management of forests is the key response to climate change

https://www.youtube.com/watch?v=FTPBxOkNNmw

FOREST AND CLIMATE CHANGES - VIDEOSPOT. 2020. ZAVOD ZA GOZDOVE SLOVENIJE TV.

https://www.youtube.com/watch?v=FTPBxOkNNmw

Video: FOREST AND CLIMATE CHANGE

https://www.youtube.com/watch?v=DeHqbYkcggc&list=UUpwuwPimigVFxKm244Z1cTA&index=1

Adaptation measures to reduce the negative effects of climate change on forests have become an integral part of nowadays forest management. A wide variety of adaptation strategies exist, including selection of suitable species or provenances that are well adapted to the changing climatic conditions (for example more drought tolerant), enhancement of ecological stability of forest stands, changes in forest regeneration techniques and management practices, disturbance risk mitigation and many more.

Main elements of adaptive forest management

One way of managing the uncertainty is to diversify adaptive management strategies at the district/landscape level. An important element in adaptive forest management strategies are measures aimed at improving the resistance of forest ecosystems to extreme weather events such as droughts, forest fires, storms and heavy snows. Generally, fostering genetic diversity is crucial to enhance the intrinsic adaptive capacity of forest ecosystems. Active management generally facilitates adaptation to climate change. The willingness to carry out this costly work is much more limited if legal regulations severely restrict the amount of logging and thus there is no economic incentive to manage the forests. In managed forests there are opportunities to influence species composition through silviculture and subsequent regeneration measures. Increased mortality in unmanaged forests leads to an accumulation of dead wood, which is positive for forest biodiversity but also represents a substantial fire risk, especially in Mediterranean and Continental climates.

Importance of knowledge transfer and local stakeholder involvement

Adaptive forest management decisions strongly depend on the awareness of forest owners and forest managers of the impact of expected climate change and available response strategies, which have to be adapted to local conditions. Therefore, it is critically important to communicate state-of-the-art scientific understanding on climate change to practice and to expand the capacity for mitigating climate related risks and decision-making under uncertainty in the local environment.

Forest based bioeconomy combines climate change mitigation and adaptation measures within sustainable forest management

Climate change adaptation and mitigation and bioeconomy developments can best be aligned through measures that support active, sustainable and close to nature forest management. Many successful approaches are already known such as enhanced biomass removals in fire-prone regions, diversification of stand structures and management regimes and planned species and genotype selection to ensure future vitality of forests. Several tree species with major economic importance are projected to be negatively affected by climate change. Norway spruce is particularly sensitive to climate change and is expected to decline in several regions. Bioeconomy developments need to recognize this threat to the most common European tree species and aim to also identify innovative uses for other species, which might expand their distribution in a changing climate. Particularly important would be a wider use of broadleaved species, which constitute the majority of underutilized biomass resources at present and might get even more abundant in the future.

https://www.youtube.com/watch?v=l2c4ouVAJcg

Forests and Climate Changes. 2020. Zavod za gozdove Slovenije TV.

Documentary Forest and Climate change

LIFEGENMON Documentary Forest and Climate change will be soon available with English subtitles.

The Documentary presents the LIFEGENMON project and its role in times of climate change. Among others, it features forestry experts, monitoring the genetic diversity of fir and beech trees, discussing conservation and use of diversity for the benefit of forests.

Forest based bioeconomy has to be sustainable in all dimensions

A forest bioeconomy based on biomass production can be one major strategy to mitigate climate change in the long term, through the sustainable use of renewable forest biomass. However, this does not mean per se that a forest-based bioeconomy is sustainable. In many cases there are conflicts between biomass production and social and environmental sustainability, which should be better taken into account in policies. For example: There is no bioeconomy without biodiversity, because biodiversity is a key feature of our natural capital and a basic condition for any biobased product or service.

Sustainability indicators

Sustainable and close to nature forest management is a necessary precondition for a successful forest-based bioeconomy. Sustainable forest management is defined as “management of forests that maintains and enhances the long-term health of forest ecosystems for the benefits of all living things while providing environmental, economic, social and cultural opportunities for present and future generations. Accepting sustainability as a lead concept underlying a forest-based bioeconomy requires instruments for measuring and assessing developments of the sector: indicators are proven tools to do so, but need further development for safeguarding sustainable

development and highlighting synergies and conflicts within natural resource use. The forest-based sector has rich experience in indicator work as primary tools for providing metrics and communication tools to address forestry issues.

Have a look at the set of pan-European indicators for sustainable forest management (SFM).

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BOOK: SUSTAINABLE AND CLOSE TO NATURE FOREST MANAGEMENT (KRISTINA SEVER AND ANDREJ BREZNIKAR)

1. Learning outcomes:

After this lesson participants will be able to:

- understand what close to nature forest management is
- list characteristics of close to nature forest management
- understand what main challenges in forest management are
-understand the main measures to adapt forest management to climate change

2. What is close to nature forest management?

The issue of ensuring sustainable development remains unsolved in many ways. It is therefore important to present the existing best practices of long-term forest management. Forestry faces increased demands on the resources of forests, such as the exploitation of renewable natural resources to the most possible extent and consequently increased felling in Europe, adaptation to climate change, growth on demand for ecological and social functions of forests and preservation of biological diversity.

Use of close-to-nature forest management to balance all needs shows that this is not an obsolete forest management practice but a flexible, continually developing approach. Due to its positive effects on the environment and long-term economic sustainability, close-to-nature forest management is also the basis for the development of a forest-based bioeconomy and can serve as a model for a sustainable global society.

Close to nature forestry uses forest management methods that promote conservation of nature and forests, as its most complex creation, while deriving tangible and intangible benefits from a forest in a way to preserve it as a natural ecosystem of all its diverse life forms and relations formed therein. It is based on forest management plans adapted to individual site and stand conditions as well as forest functions, and considering natural processes and structures specific to natural forest ecosystems. Natural processes are altered as little as possible, while still maintaining the financial profitability and social sustainability of forest management. Similarly, to natural processes, close to nature forestry also contains inbuilt mechanisms for continual internal checks (controls) providing timely response to modify measures, adapted in accordance with developmental characteristics of single forest stands and a forest as a whole.

3. Main characteristics of close-to-nature forest management

- **Preservation of the natural environment and ecological balance of the forest and the landscape** is characterized by management in a way to maintain its naturalness and beneficial effects on the broader environment. Forests and remains of forests are the last pieces of natural environment and essential component of the landscape used for the preservation of ecological balance in a country.
- **Sustainability of all forest functions** means preservation of the forest and its all functions - ecological, productive and social. This can be achieved only through maintenance of healthy forests and their biodiversity, protection of its natural fertility and water sources as well as other beneficial functions of forests in the

water and carbon cycle, sustainable supply of wood and other products from forest, profit and employment as well as means of recreation and other social benefits related to forests. Forests should be managed in a way to preserve their multifunctional role.

- **Integrated approach to a forest ecosystem** management represents enhancement of species-rich and structurally diverse forest ecosystems distinguished by complex relationships between animate and inanimate worlds, as well as by relationships occurring within each of these worlds. Forest ecosystems should be managed in a way to respect and preserve all their components as well as disturb their relationships in the least possible way to maintain dynamic balance of forest ecosystems. The forest ecosystem exists and develops as a unit. Functions of single elements and their complex relationships are not completely explained; they also constantly change in time and space. Limited approach to a forest (such as from the aspect of wood production) or introduction of new elements into the forest ecosystem can have unforeseen, even negative consequences for the forest ecosystem.
- **Close to nature forestry mimics natural processes and structures** as far as possible. Forest stands should be renewed naturally and should imitate a mixture of tree species and forest stands of natural forests. During thousands of years, forests have developed typical relations, processes and structures which enable their (relatively dynamic) stability and further development. Forest management can directly influence the tree stands in a forest ecosystem. Only with natural regeneration of forest stands, trees' adaptability to conditions of specific growing sites, evolved in thousand years, is preserved. Silvicultural systems should be carefully selected in an order to promote close-to-nature approaches and mimic natural processes in forest stands. In some places, however, it will be necessary to adopt completely new approaches to management. There, well-considered, completely new silvicultural concepts will have to be applied.
- **Adaptation to growing site individual characteristics** is the main direction of forest development. Site characteristics can change in short distances. If we want to preserve these characteristics and benefit from their specifics to the maximum extent, suitable mixed tree and forest stands structures should be used. Directed development of forest stands adapted to individual site and stand conditions, and forest functions, demands great flexibility in selection of a proper system (method) of forest management and careful planning of measures.
- **Cognitive approach, based on constant monitoring and learning** is essential since forest is a complex natural system, with characteristics not completely known in all aspects, and can therefore often react unusually to our measures. Because of that forestry has to establish a framework for long-term forest development and to provide close monitoring of its development and reactions to forest management measures. The lessons learned should be considered and included in further management activities in a forest.
- **Long-term economic efficiency** is one of the main commitments of close to nature forestry. It takes into consideration the economic benefits of a preserved environment. Close-to-nature management measures are reasonable since they

are based on the nature of a forest ecosystem to produce wood, regenerate itself and to provide all other processes necessary for its existence and development. Therefore, all advantages of a forest ecosystem should be considered in the light of economy, and only a minimal amount of energy required should be invested in directing production and other processes towards goals that are expected from a forest.

- The energy that green plants derive from sunlight is used in a forest ecosystem for growth and maintenance of matter and energy cycles. The goal of the forest ecosystem vaguely reflects our production goals in forest management when considering production of organic matter and its accumulation in wood and other materials. Specific requests in relation to a forest ecosystem, such as production of quality wood or slightly changed composition of tree species, can be achieved with minimal investments of energy precious even to us, with which we merely direct development of a forest stand towards our goals.

- Maintenance of forest stands is a basic tool in directed forest management. In the regeneration phase, maintenance means creating beneficial site conditions for a target forest stand. Later, when trees in our forest stand are thinned and their individual features are clearly seen, the trees for cut should be selected individually on the basis of their characteristics and specific goals we would like to achieve.

- **Close-to nature forestry needs to plan measures at a broader and more detailed level**. Adaptive forest management based on site and stand conditions as well as forest functions, with a flexible selection of a silvicultural system and measures optimal for specific conditions, requires careful and at the same time flexible (adaptive) forest planning based on careful and detailed enough study of growing sites, stands and forest functions as well as on cognitively established decision-making regarding the most suitable silvicultural system.

4. Main challenges in forest management

Main challenges in forest management today are:

1. Increasing demand for timber and non-productive functions of forests
2. Forest resources are not equally managed and used - small forest properties, lack of knowledge and motivation
3. Climate change and their pressure on forests, the need to adapt management

On one hand there is increasing demand for timber and non-timber forest products and non-production services like recreation and nature conservation on the other hand. Additionally we are facing rising numbers of non-active forest owners, who don’t manage

their forests due to the lack of knowledge, low profit, too small forest properties or other factors. It is important to identify and activate forest owners so they can contribute to the economy as well as to nature conservation.

Climate change is a fact. It is known that the annual temperature is rising and extreme natural events are more frequent. Some of them are causing severe damage to our forests (e.g. wind and snow breaks, diseases and pathogens). How can we adapt to these changes?

The main measures to adapt forest management to climate change are:

- Adaptation of tree composition in forest stands – where necessary:

  Conversion of non-native tree species stands (e.g. spruce in lowlands is not adapted to lowland conditions) towards more native species, use of minority tree species (e.g. cherry)

  se of tree species and provenances with wide ecological amplitude.
- Increasing forest resilience by diverse structures of forest stands and increasing their stability by early enough tending measures (e.g. thinning).
- Formation of multilayered and selective forest structures in suitable stands.
- Monitoring and conservation of forest biodiversity and genetic diversity.
- Construction of infrastructure (e.g. roads) in areas of increased risk of extreme natural events.
- Preparation of protocols measures for pest and disease emergence

5. Further reading

Forest management in many European countries (e.g. Slovenia, Croatia and Austria) is based on the principles of sustainability, naturalness and multifunctionality of forests.

Here you can learn more about Close to nature forest management in Slovenia.

http://www.zgs.si/fileadmin/zgs/English/Publications/ZGS-SonarG-ANG_small.pdf

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H5P INTERACTIVE VIDEO: CLOSE TO NATURE FOREST MANAGEMENT

1. **CLOSE TO NATURE FOREST MANAGEMENT**
2. Let's see what we have learned so far.
3. Choose the correct statement.

   Close to nature forestry uses forest management methods that promote conservation of nature and at the same time provide other benefits from forests.

   The most important for close to nature forestry is to gain profit from the forest, other forest functions are less important.
4. Sustainable and close to nature forest management represent the basis for forest based bioeconomy.
5. Why is close to nature forest management a basis for forest based bioeconomy?
   a. Choose correct answers.

   Close to nature forest management balances all needs and forest functions.

   Close to nature forest management is a flexible, continually developing approach.

   Close to nature forest management is focused mainly on providing income from the forest.

   Close to nature forest management mimics processes in nature and therefore has a beneficial environmental impact and long-term economic sustainability.

   Close to nature forest management focuses only on nature and wildlife preservation.
6. What about forest functions and benefits from forests?
7. Close to nature forest management takes all forest functions and services into account.
   a. True.
8. Fill in the missing words

   Benefits from forests can be divided into three main sections:

   1. *ecology/socio-cultural/sociocultural/social/production/forest production*
   2. *ecology/socio-cultural/sociocultural/social/production/forest production*
   3. *ecology/socio-cultural/sociocultural/social/production/forest production*

9. Drag and drop a square with a forest benefit that represents the photo.

   Socio-cultural

   Forest production

   Ecology

10. Close to nature forestry uses forest management methods that promote conservation of nature and forests, while deriving tangible and intangible benefits from a forest in a way to preserve it as a natural ecosystem of all its diverse life forms and relations formed therein.

2.4. CRADLE TO CRADLE (From less bad to doing it right)

AUTHORS: Andreja Gregorič, Boštjan Hren

H5P PRESENTATION:

1. Learning outcomes:

   • Participants will be able to define main characteristics of bioeconomy as a guiding future paradigm for sustainable use of natural resources

   • Participants will be able to identify different approaches for sustainable use of forest resources within forest-based bioeconomy

   • Participants will be able to formulate an example of idea/innovation for possible business opportunity in forest-based bioeconomy including relative context of climate change

Despite the fact that wood is a renewable resource, we must also lead development activities in the direction of reducing the impact of products on the environment. One of the key steps could be to develop products in the concept of **"Cradle to Cradle"** (C2C).

Michael Braungart, German chemist, and the American architect William McDonough are fathers of the "Cradle to Cradle" concept.

C2C paradigm differs from other approaches to sustainable design in:
• materials
• business models
• sustainable development

The Cradle to Cradle paradigm teaches us to think throughout the life cycle and expand our horizons to new business models, new opportunities, a new paradigm of designing and implementing in the principles of naturally efficient processes. The approach is based on patterns found in nature.

From “less bad” to “doing it right”

Moving from being “less bad” to becoming **“more good”**. Conventional eco-efficient demand side approaches often simply seek to reduce or minimize damage and shrink your “negative footprint”.

But instead, the goal should be to establish eco-effective supply side approaches and integrating positively defined goals. C2C could allow direct innovation and leadership towards a **"positive footprint"** instead of a "neutral footprint."

Three C2C principles derived from nature:

Everything is a resource for something else. Everything can be designed to be disassembled and safely returned to the soil as biological nutrients, or re-utilized as high-quality materials for new products as technical nutrients without contamination.

Use clean and renewable energy. Human constructs can utilize clean and renewable energy in many forms - such as solar, wind, geothermal, gravitational energy and other energy systems being developed today.

Celebrate diversity. Around the world, geology, hydrology, photosynthesis and nutrient cycling, adapted to locale, yield an astonishing diversity of natural and cultural life. Designs that respond to the challenges and opportunities offered by each place.

We should seek improvement in designs and share our discoveries with others.

Upcycling with biological and technical metabolisms

Materials are viewed as nutrients circulating in healthy, safe metabolisms. C2C model is sustainable and considerate of life and future generations. It **discourages downcycling** "cradle to grave", and rather encourages the manufacture of **products with the goal of upcycling** in mind.

Downcycling is the reuse of materials into lesser products. For example, a plastic computer case could be downcycled into a plastic bench; this eventually leads to plastic waste. In conventional understanding, this is no different from **recycling**. Upcycling, also known as creative reuse, is the process of transforming by-products, waste materials, useless, or unwanted products into new materials or products of better quality and environmental value.

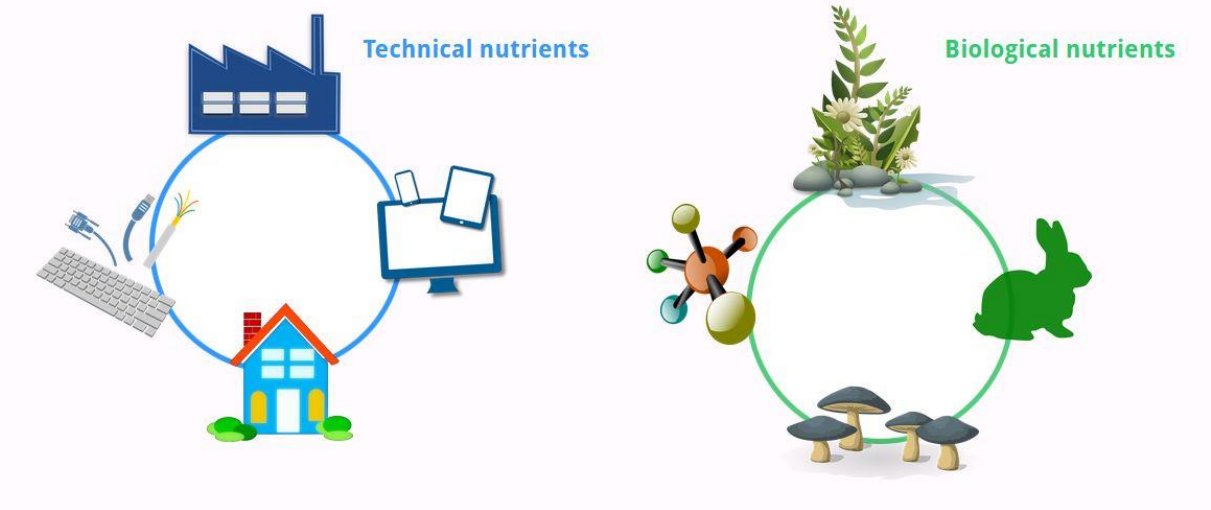
C2C

- systems that are waste-free
- high-quality use and circulation of organic and technical nutrients
- protect nature's biological metabolism while also maintaining a productive technical metabolism
- applied to industrial design and manufacturing, urban environments, buildings, economics and social systems

All materials fall into one of two categories: "technical" or "biological" nutrients.

1. **Technical nutrients**: non-toxic, non-harmful inorganic or synthetic materials; no negative effects on the natural environment; can be used in continuous cycles as the same product without losing their integrity or quality.

2. **Biological nutrients:** organic materials that; can be disposed of in any natural environment and decompose into the soil; food for small life forms without affecting the natural environment; dependent on the ecology of the region.



Author: Andreja Gregorič

Cradle to Cradle Certified™ Products

The term "Cradle to Cradle" is a registered trademark of McDonough Braungart Design Chemistry (MBDC) consultants. In 2005, MBDC created the Cradle to Cradle Certified Products Program to recognize high levels of sustainability achieved by its clients and to inspire others to optimize their products and “rethink the way they make things.” In 2012 MBDC turned the certification over to an independent non-profit called the Cradle to Cradle Products Innovation Institute. Independence, openness, and transparency are the Institute's first objectives for the certification protocols.

Products Innovation Institute's five certification criteria are:

1. **Material health:** Hazardous materials have to be reported. Other materials are reported where they exceed 100 ppm. For wood, the forest source is required. The risk for each material is assessed against criteria. The method uses the term 'risk' in the sense of hazard.
2. **Material reutilization**, which is about recovery and recycling at the end of product life.
3. **Assessment of energy required for production**, which for the highest level of certification needs to be based on at least 50% renewable energy for all parts and subassemblies.
4. **Water**, particularly usage and discharge quality.
5. **Social responsibility**, which assesses fair labor practices.

C2C dealing with “difficult” topics

Health: C2C seeks to remove dangerous technical nutrients from current life cycles. Eg., a fabric factory can eliminate all harmful technical nutrients by carefully reconsidering what chemicals they use in their dyes to achieve the colours they need.

Economics: The C2C model shows a high potential for reducing the financial cost of industrial systems. In the redesign of the Ford River Rouge Complex, the planting of Sedum vegetation on assembly plant roofs retains, cleanses rainwater and moderates the internal temperature. The roof saved Ford $30 million that would otherwise have been spent on mechanical treatment facilities.

Waste = Food is a basic concept of organic waste materials becoming food for bugs, insects and other small forms of life who can feed on it, decompose it and return it to the natural environment which we then indirectly use for food ourselves.

Existing synthetic materials: Materials that cannot be recycled or reintroduced to the natural environment is dealt with in C2C design. The materials that can be reused and retain their quality can be used within the technical nutrient cycles while other materials are far more difficult to deal with.

Finished C2C products

- Cradle-to-cradle shoe concepts had been made through the Nike Considered project

Rohner Textile AG Climatex-textile.

- Biofoam, a cradle-to-cradle alternative to expanded polystyrene.
- Sewage sludge treatment plants are facilities that may create fertiliser from sewage sludge. This approach is green retrofit for the current (inefficient) system of organic waste disposal.
- Aquion Energy large scale batteries.
- Ecovative Design packaging and insulation made from waste by binding it together with fungi-mycelium.

Implementation

The C2C model can be applied to almost any system in modern society: urban environments, buildings, manufacturing, social systems.

5 steps are outlined in the book, *Cradle to Cradle: Remaking the Way We Make Things*:

1. Get "free of" known culprits
2. Follow informed personal preferences
3. Create "passive positive" lists—lists of materials used categorised according to their safety level
    1. The X list—substances that must be phased out.

2. The gray list—problematic substances that are not so urgently in need of phasing out
3. The P list—the "positive" list, substances actively defined as safe for use

4. Activate the positive list
5. Reinvent—the redesign of the former system

Products that adhere to all steps may be eligible to receive C2C certification.

Major implementations

- The Lyle Center for Regenerative Studies incorporates holistic & cyclic systems throughout the center.
- The Ford River Rouge Complex redevelopment, cleaning 20 billion US gallons (76,000,000 m^3) of rainwater annually.
- The Netherlands Institute of Ecology (NIOO-KNAW) planned to make its laboratory and office complex completely cradle-to-cradle compliant.
- Several private houses and communal buildings in the Netherlands
- Fashion Positive, an initiative to assist the fashion world in implementing the cradle-to-cradle model in five areas: material health, material reuse, renewable energy, water stewardship and social fairness.

Literature (useful and interesting):

- Video: Michael Braungart speech on "Cradle to Cradle" principles
- https://www.youtube.com/watch?v=SS8HirsRzsI
- The Cradle to Cradle Products Innovation Institute (certification body for the Cradle to Cradle Certified Product Standard)
- https://www.c2ccertified.org/
- C2C-Centre - The gateway for Cradle to Cradle knowledge, expertise and professionals
- http://www.c2c-centre.com (products, projects, literature)
- Company founded by architect William McDonough and chemist Dr. Michael Braungart
- https://mbdc.com/
- Examples of C2C products:
- https://inhabitat.com/13-cradle-to-cradle-products-for-a-safe-and-eco-conscious-home/sunpower-solar-panels/
- Book “Cradle to Cradle”
- https://www.scribd.com/book/212863884/Cradle-to-Cradle-Remaking-the-Way-We-Make-Things
- Book “Upcycle”

- https://www.scribd.com/book/182577280/The-Upcycle-Beyond-Sustainability-Designing-for-Abundance

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- https://wwd.com/business-news/human-resources/stella-mccartney-amber-valletta-and-alysia-reiner-on-fashion-positive-8034739/
- https://www.fashionpositive.org/
- https://en.wikipedia.org/wiki/Ford_River_Rouge_Complex

2.5. NON-WOOD FOREST PRODUCTS

AUTHORS: Marta Curman, Anton Brenko

H5P PRESENTATION: WHAT ARE NON-WOOD FOREST PRODUCTS?

1. Learning outcomes

After this lesson you will be able to:

- define non-wood forest products (NWFPs)
- list types of NWFPs
- distinguish NWFPs and non-timber forest products
- recognize the importance of NWFPs to humans

2. Take a moment and think! What is your favourite wild food?

Match the names of the yummy forest edibles to their image.

Boletus, wild garlic, chestnut

iNFO: Before foraging edible non-wood forest products, a collector should have certain knowledge in order to identify edible mushrooms or herbs from poisonous. Learn how to identify poisonous mushrooms or herbs effectively with a field guide by joining a local mycological group or foraging courses.

3. What are NWFPs?

There are different definitions of NWFPs. UNFAO defines them as goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests. We will define them as all those goods we can find and use from forests that derive from non-wood parts of forest trees, shrubs and other components of the forest ecosystem.

VIDEO WHAT ARE NWFPS?

1. Embedded - **What are non-wood forest products?**

What are non-wood forest products?

Forests are mainly managed to produce timber or firewood.

But, inside a forest we can find other goods, like…Mushrooms, Berries, Nuts,

Aromatic, medicinal and edible plants, Cork and resin, and even game…

These are all non-wood forest products. Some people include firewood into definition, in which case they are called non-timber forest products.

Non-wood forest products are all those goods we can find and use from the forest, other than timber.

Find our video on YouTube.

4. The importance of NWFPs in human development

-VIDEO PEOPLE AND NWFPS

2. embedded - **People and non-wood forest products**

Forests and their non-wood products play an important role in human societies.

Ten thousand years ago early humans were living in nomadic groups named hunter-gatherers.

Collecting wild plants, seeds and fruits, together with hunting activities, was their day-to-day preoccupation. Later on, the process of domestication took place.

Pear, apple and bilberry, are great examples of the successfully domesticated NWFPs.

Although the 'gathering' is quite simplified nowadays, in recent years the trend of collection of NWFPs is growing in popularity.

Find our video on YouTube.

5. Let's repeat!

Mushrooms, berries, seeds, leaves, flowers, cork, resin and game are some of the most common groups of NWFPs.

Task 1.

NWFPs are all those goods that we can find and use from forests that derive from non-wood parts of forest trees, shrubs and other components of the forest ecosystem.

True/False

Task 2.

If firewood is included into the NWFPs' definition, then we call them **non-timber forest products.**

True/False

Utilization of wild edible plants has played a very important role in human life since ancient times.

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- Non-wood forest products.UNFAO. Web page: http://www.fao.org/forestry/nwfp/en/
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H5P PRESENTATION: BIOECONOMY BASED ON NON-WOOD FOREST PRODUCTS

A presentation with short videos to learn more about the bioeconomy perspective of non-wood forest products. Don't forget to click on ?(iNFO) to get some more information.

1. Learning outcomes

After this lesson you will be able to:

- explain the opportunities of non-wood forest products (NWFPs) in bioeconomy
- list the possibilities of utilization of NWFPs in modern rural tourism
- explain the link between NWFPs and rural development
- explain economic, social and ecological benefits of NWFPs
- describe wide possibility of collecting NWFPs and producing of added value products
- recognize the self-employment possibilities related to NWFPs
- recognize the importance of sustainable management and usage of NWFPs

2. Take a moment and think! What is your favourite added value NWFPs?

Match the names of the products to their image. (Elderberry juice, wild garlic pesto, cork stopper)

INFO: The flowers, fruits and leaves of the elderberry plant are excellent sources of antioxidants.

Wild garlic pesto combining *wild garlic* leaves with parmesan, *garlic*, lemon and pine nuts.

Cork is an anti-microbial material, resistant to mold, mildew and insect infestations.

Introduction

NWFPs provide the basis for a wide range of enterprise activity or additional income. There is a possibility to collect raw NWFPs and sell it on the market as a final product. However, if improvement or addition of the raw product is involved, it will raise its value, and the product will be worth more on the market. NWFPs also provide income opportunities for modern rural tourism, such as truffle hunting.

Their importance is not only economical, but also sociological and ecological. Their nutritional and medicinal values are of great importance to people and they provide food and shelter for animals.

3. Here is a VIDEO ABOUT THE BIOECONOMY POSSIBILITIES OF NWFPS

Bioeconomy possibilities of non-wood forest products

Global urbanization and the separation of humans from nature led to a higher appreciation of natural, traditional and wild resources. Therefore, the popular culture around ‘wild foods’ and ‘foraging’ together with 'back to nature' lifestyle is increasingly gaining in importance. This provides an opportunity for the development of the **bioeconomy based on non-wood forest products** (NWFPs) and placing added value products on the market. This is particularly relevant for rural areas and **rural development**.

A broad range of possible wild species and products **provides income opportunities** for a wide range of people with different interests and skills. From collectors of edible mushrooms who sell their harvest on a local market to modern rural tourism which combines the collection of NWFPs with recreation or leisure.

Such modern rural tourism is divided into four rough groups of business opportunities:

1. Foraging courses about identification, picking and preparation of wild food
2. Bushcraft as survival training and experience
3. Gastronomy and regional tourism such as truffle hunting and fine dining as a holiday
4. Traditional skills and hobbies courses

The commercialization of NWFPs is particularly applicable when timber revenues fall, which is a trigger for innovation. With sufficient innovation and business planning, it is possible to develop income possibilities.

To conclude... Besides economic benefits, NWFPs have a positive impact on society’s

wellbeing, health and well-being. Also, they have an enormous ecological role by providing seeds for forest regeneration, food for animals, but also material for nesting or shelter and much more.That is why we have to manage NWFPs responsibly and use them in a sustainable manner.

Find our video on YouTube.

4. Here is a **VIDEO ABOUT ADDING VALUE TO NWFPS**

Added value of non-wood forest products

Until recently non-wood forest products were primarily considered as a source of food to the local population. Nowadays, with the development of the global health and food market, gathering NWFPs is gaining in popularity on account of their nutritional and medicinal values. Proteins, vitamins, minerals, antioxidants…this low-fat food can be used as a medicinal prevention and for treating the diseases from common flu to cancer. NWFPs can have an important role in developing the bioeconomy. Besides collecting wild products from forests, some of them can also be produced on agricultural lands or extensively managed on forest lands. Those techniques are often correlated with higher

market demand. And low natural production, depending on the product. In European Union, the average of 25% of households is picking non-wood forest products.

In Croatia 31%, Austria 36% and in Slovenia 53% of households are using NWFPs from nature. The production of NWFPs is rapidly increasing in demand and brings new opportunities. For gaining additional income to households or turning it into a family business. This especially applies to rural areas. There are many possibilities and self-employment opportunities such as collecting medicinal plants, berries and mushrooms, Cultivating abandoned agricultural lands, producing added value and final products from raw non-wood forest product. Organizing local food festivals and extended tourism offers like bushcraft and foraging.

These possibilities could have a positive impact on the development of the rural economy.

Find the video on YouTube.

5. Adding value - examples

Herbs collected from forests can be used for various purposes. We can use them as food, medicine, cosmetics or decoration. Here you can see examples of using herbs for preparing healthy shakes, macerates, pesto and juice.

Linden, acacia, chestnut and many other tree species that provide high levels of pollen and nectar, supply bees with their food and are known as honey plants.

6. **Let's repeat!**

Diversity of NWFPs provides various business opportunities for rural areas. Beside placing final products on the market there is a wide range of opportunities for modern rural tourism:

- **Foraging courses (**Identification and picking berries, Picking wild food – mushroom, Preparing wild food**)**
- **Bushcraft training (**Survival training and experience**)**
- **Gastro-/regional tourism (**Fine dining as a holiday, Photo-hunting, hunting, truffle hunting, etc.**)**
- **Traditional skills/hobbies (**Beekeeping, Mushroom festival, Preparing wild food**)**

7. Think about your own business idea based on non-wood forest products…

Would you rather supply local restaurants with wild food derived from forests or would you prefer to produce some high added-value product or service, and place it on market?

Here you can see food supplement (Silvasept) and chewing gum (Alpengummi), as examples of high added value products made from non-wood forest products.

Last, but not the least

In 2014, the European reported value of marketed NWFPs was 1.7 billion €. However, this value is considered as underestimated. Despite their real and potential value, most NWFPs are usually categorized as 'minor' products of forests and often associated with traditional uses, that are not widely known, or with poverty. However, research results point that NWFPs should be included in forest management, especially in Central Europe.

They play an important role for rural income, cultural heritage, recreation and ecology. They need to be used and managed in a sustainable manner. Local harvesting, trade and use of NWFPs are affected by many policy documents. Therefore, each country has its own rule for collecting NWFPs prescribed by national legislation. For example, by the Croatian Rulebook on collecting domestic wild species the harvesting is limited by the maximum daily weight of the harvested products. Commercial harvesting requires special permission issued by the competent Ministry.

References and other interesting sources:

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H5P image slider: Adding value: FROM CORK OAK TO CORK STOPPER (AND MUCH MORE)

<Names of the photos in image slider in order of preview>: 1. Cork oak tree, 2.Storage spot, 3.Industrial premises, 4.Processing,5. <no text>, 6. Cork stopper – final product, 7. Other final products made by cork

SECTION 3: CROSS-SECTORAL ASPECTS OF FOREST BASED BIOECONOMY

AUTHORS: Darja Stare

3.1. INTRODUCTION TO CROSS-SECTORAL ASPECTS OF FOREST BASED BIOECONOMY

AUTHOR: Darja Stare

H5P PRESENTATION: INTRODUCTION TO CROSS-SECTORAL FOREST BASED BIOECONOMY

The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services (EC, 2018).

The focus of the bioeconomy is on connecting the environment, society and the economy. To be successful, the European bioeconomy needs to have sustainability, circularity, the cascading use of resources and emphasizing the local at its heart. This will drive the renewal of our industries, the modernisation of our primary production systems, the protection of the environment and will enhance biodiversity.

The primary source of biomass is arable land, forests and seas. Biological residues in agriculture, forestry and fisheries, as well as residues from households, the food industry and other biomass processing, are becoming increasingly important. The objective of the bioeconomy is to use existing biomass sustainably and economically while keeping carbon emissions as low as possible. It also avoids the use of additional carbon of fossil origin and thus contributes to climate goals. The bioeconomy replaces fossil carbon with renewable ones and builds on improved use of resources with higher environmental performance and low carbon footprint.

The main objectives of the cross-sectoral bioeconomy are (EC, 2018):

1. Provision of food and food security
2. Sustainable management of natural resources
3. Reducing dependence on non-renewable, unsustainable resources, whether acquired at domestic or abroad
4. Climate change mitigation and adaptation
5. Strengthening competitiveness and job creation

Sectors in cross-sectoral bioeconomy:

- Agriculture
- Automotive sector
- Chemical industry (including bioplastic)
- Biofuels and energy
- Biorefineries
- Construction
- Consumer products (cleaners, cosmetics)
- Food and drink
- Fishing
- Forestry
- Health
- Knowledge and innovation
- Mining
- Pharmaceutical industry
- Pulp and paper
- Textile

The basic purpose of a cross-sectoral and social integration with a focus on local - new value chains:

- reduce dependence on foreign sources of raw materials,
- replace raw materials of fossil origin,
- create an effective system for closing material circles,
- seize opportunities in a growing market for green solutions,
- integrate local competences into innovative circular partnership structures,
- strengthen local socio-economic relations,
- encourage the action of the whole society towards green coexistence and
- make a significant contribution to reducing environmental burdens.

In forestry, we can talk about the strong multiplier effect of the industry. The ecological importance of the forest for the carbon cycle is also extremely important, providing habitats and regulating water regimes in addition to carbon sinks. In this context, it is worrying to note that the total forest area in the world has fallen by more than three percent between 1990 and 2015. Afforestation is slow. Forest resource industries play an important role in the EU.

H5P FLASHCARDS: SECTORS IN CROSS-SECTORAL BIOECONOMY

- Agriculture
- Automotive sector
- Chemical industry (including bioplastic)
- Biofuels and energy
- Biorefineries
- Construction
- Consumer products (cleaners, cosmetics)
- Food and drink
- Fishing
- Forestry
- Health
- Knowledge and innovation
- Mining
- Pharmaceutical industry
- Pulp and paper
- Textile

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3.2. FOREST-BASED BIOECONOMY IN DIFFERENT SECTORS IN AUSTRIA, SLOVENIA AND CROATIA

AUTHOR: Darja Stare

H5P PRESENTATION: BIOECONOMY IN SLOVENIA

At the Slovenian level, the bioeconomy is not uniquely defined and recognized as an independent field. Consequently, it is also scattered across industries in strategic and government documents. At the policy level in Slovenia, bioeconomy is defined by the " Roadmap towards the Circular Economy in Slovenia" of 2018, a strategic document highlighting the systemic transition from a linear to a circular economy model, within which industry (economy), policy makers and society (citizens) play an important role. Despite the heterogeneous strategy of introducing bioeconomy concepts in Slovenia, documents for the forestry and wood processing industries predict an increase in the sustainable use of wood biomass and an increase in the added value of the area covered.

In Slovenia, due to its natural characteristics, lignocellulosic biomass is mostly present, and its accessibility is a key factor in the transition to the bioeconomy. Despite its great raw material potential, it is more difficult to collect due to its local distribution. Of course, quality and price comparability are also important, which represent an additional barrier to sourcing resources and providing sustainable care.

Potential source for entry into biorefinery processing and production of new bio-based products is less quality wood, namely firewood and wood chips and wood residues. Production of these wood biomass categories in Slovenia amounted to 2,500,000 m3 in 2018.

Importance of wood use in the bioeconomy added value structure:

- Forestry, wood processing and furniture industry, as well as the paper industry in the field of wood and wood biomass use in the Slovenian bioeconomy represent 33% or 739.5 million EUR in annual gross value added.
- Over the last five years, the importance of wood use in the value-added structure of the bioeconomy has increased.
- Total wood use represents only 1.84% of total gross value added in Slovenia (SORS, 2019).

Wood use in the bioeconomy is influenced by:

- long-term and sustainable forest potential and wood availability (ownership),
- balances of wood use and market conditions of forest wood assortments and wood products,
- the social and legislative framework and
- economic importance.

Opportunities for further development of BioEconomy in Slovenia

Wood use within the bioeconomy has great development potential:

- Use of wood as a building material (carbon storage, avoiding the use of fossil fuel-related materials by industry)
- Replacing fossil fuels with bio-based products
- Production of bio-based products mainly through the development of chemical digestion of lignocellulosic biomass
- Production of textiles from cellulose fibers (modern processes to produce cellulose and nanocellulose)
- Generation of electricity in modern and efficient systems

Due to the modern chemical processing of wood, changes in the market are also expected - especially of lower quality wood and wood residues. A prerequisite, however, is investments in e.g. large wood processing plants and modern biorefinery systems.

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AUTHORS: Anton Brenko, Dijana Vuletić

H5P PRESENTATION: BIOECONOMY IN CROATIA

In spite that there is no Bioeconomy strategy in Croatia according to a long-term goals of three strategies (Croatian Government adopted the Development Strategy of Wood Processing and Furniture Manufacturing of the Republic of Croatia 2017–2020; Industrial strategy of Croatia (2014) and Croatian Smart Specialization Strategy 2016-2020) it is evident that Croatia has recognized the bioeconomy as a very important segment in the efforts to sustainable production and consumption, where renewable material, such as wood and wood based products have an excellent potential in the context of increasing ecological efficiency, boosting eco-certification and development of eco-innovations.

Total bioeconomy in Croatia is assessed on 204.000 employees which make 11.33 billion € turnover and 3.47 billion € added values in 2018. In 2015 Croatian bioeconomy has made 10 billion € turnover and 3 billion € of added values which was less than 1% or total turnover and cca 1% of added value of this sector on EU level. Production of wood, products from wood, without furniture employ 19% of all workers and production of furniture 3% and paper production addition 2%. The biggest turnover in bio economy

sectors is in food production (50.4%), followed by agriculture (21.2%) and wood industry and furniture production (11.1%).

Most of employees work in high intensity sectors and are characterised with low productivity which open the area for great potential in development of the bio economy sector in Croatia. Croatian forests are mainly (76%) owned by the state, while 581,770 hectares (24%) are owned by almost 500,000 private owners which indicates the size of private forestry properties. This resource is a very valuable source of biomass and can play an important role in the bio economy sector; still there is much to do to take this role.

Forestry sector produced in 2013 704,4 kToe (tonne of oil equivalent) of energy from renewable sources, while forestry and agricultural sectors combined during the same year spent 197,5 kToe.

The production of wood chips and wood residues (less quality wood) in 2018 in Croatia was 676 400 m^3. To that number we can add the production of 348 100 tonnes of wood pellets, which represents a close to average number of yearly production (for period 2012 – 2019).

Table 1. Industrial products of forestry in Croatia (source: Bureau of Statistics of Republic of Croatia, accessed on 03/09/2020)

	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
CHARCOAL (thousand t)	3,4	5,0	6,9	7,6	8,8	8,6	10,0	13,6
WOODCHIPS (thousand m3)	888,0	530,2	680,5	628,6	597,6	588,9	676,4	733,4
WOOD PELLETS (thousand t)	344,0	214,9	234,2	245,7	266,1	336,3	348,1	357,1
WOOD CELLULOSIS (thousand t)	73,0	40,4	32,7	32,0	33,6	38,9	38,8	46,9
PAPER AND CARDBOARD (thousand t)	499,7	299,3	264,1	288,8	337,7	349,0	341,0	342,2

The following forestry based strategic goals (needs) concerning bioeconomy are:

- Increasing the degree of professional competence, awareness and knowledge transfer,
- Development of quality system and greater involvement of manufacturers in quality schemes,
- Modernization of technologies, machines and equipment to perform forestry works and wood processing,
- Increasing level of production and usage of energy from renewable sources.

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AUTHORS: Christian Lackner, Wolfgang Engl

H5P PRESENTATION: BIOECONOMY IN AUSTRIA

Austria's Bio-economy Strategy 2019 aims to contribute to the efficient sustainable of wood as a raw material; material use options (such as timber construction) are to be expanded in order to achieve high CO2 storage. The value added in rural areas is to be increased.

Wood as a raw material plays a central role in the Austrian bioeconomy; the Bioeconomy Strategy 2019 makes strong reference to this. Around 48 % of Austria´s federal territory is covered by forest. This is high compared to other EU countries. Sustainable forest management has been the single most important contribution to the preservation of the forest over the centuries. For the last decades, both the areas covered by forest and the timber reserves per hectare have been continuously increasing.

The annual growth of wood in the commercial forest is 30.4 million solid cubic meters of timber and the annual utilization is about 26 million cubic meters. Thus, taking all sustainability aspects into account, 3-4 million cubic meters of timber could be harvested additionally every year.

About 80 % of the fresh wood from harvesting as well as importation passes through the wood processing industry as sawmill roundwood and industrial roundwood, about 20 % is used as firewood and wood chips for direct energy usage.

Importance of wood use in the bioeconomic value chain

Austria's particular strengths in key areas of the bioeconomy are the paper and pulp industry, the construction and timber sector and some sectors of the basic chemical

industry. In 2016, these sectors of the bioeconomy accounted for about 8% of Austria's gross domestic product.

Construction sector

A large proportion of the domestic wood is processed into buildings and construction-material. Indispensable for rural areas and first processing, the more than 1,000 companies in the wood-processing industry act as a link between the forestry and timber industry.

Here, too, it is planned to improve training opportunities and to standardize laws and standards, e.g. in the construction industry. An important innovation approach is the digitization of the entire value chain and the optimization of the logistics of preliminary, intermediate and finished products.

Paper

The pulp and paper industry is a traditionally strong sector in Austria. In order to cover the demand for raw materials (about 8.8 million solid cubic meters of wood), 29% was imported from the immediate neighbouring countries in 2016. In this context, Austria's policy aims to promote the development of new products from waste and by-products, to increase regional value added and to invest in training in areas relevant to the bioeconomy.

Fibers

In Austria, traditional plants such as hemp, linen or flax are hardly cultivated at all, so companies usually obtain their raw materials from abroad. However, fiber plants would be an interesting link in the crop rotation in Austria.

In Austria these fibers are primarily used for the production of building and insulation materials, for the production of molded parts or fiber composites. The development of reliable standards and suitable analytical methods for starting materials should be promoted in order to facilitate the conversion of fibers such as flax, hemp, reed, straw, linen, but also wood into chemical raw materials. In order to take the high importance of these substances into account, the expansion of the cultivation areas for fibre plants for the production of relevant quantities is to be promoted by means of cultivation advice and subsidies.

Insulation production

Of particular importance as insulating materials are cellulose insulation materials, lignin-based insulation materials, wood fiber and wood wool as well as insulation materials based on fiber plants. Due to prices, natural insulating materials currently still play a subordinate role in the economy. On the one hand, the planned increase in the renovation rate of buildings will expand the overall market, and on the other hand, the trend towards living with natural materials will greatly increase demand.

Bioenergy

Bioenergy is an important pillar of the domestic energy supply. The share of bioenergy in total energy consumption (including transport) was increased from 9 to 17% from 1990 to 2017. The share of biogenic fuels (solid, liquid, gaseous) in domestic electricity generation is about 7 %, and biogenic energy sources also account for about 45 % of local and district heating generation. By far the most important raw material for bioenergy is wood.

Austria's policy considers the ability to create regional added value and employment, especially in rural areas to be a major strength of bioenergy.

The conversion in the heating sector from fossil to renewable energy is one of the central challenges for the success of the energy turnaround. To this end, it is planned in Austria to prohibit the installation of heating systems based in fossil energy in new buildings. This would be a clear system change.

Conclusions

The bio-economy strategy strives to promote the mobilization of wood from domestic forests. On the one hand, the yields per hectare are to be increased by means of site-adapted tree species and, on the other hand, the vitality and resilience of the forest is to be improved by means of adequate forest management measures.

- Wood should be used more often as a building material.
- Fossil raw materials are to be replaced by bio-based raw materials and products.
- Textiles could be increasingly produced from cellulose fibers.
- Decentralized forestry structures allow processing and thermal use of by-products and residual materials in the region and thus reduce transport and environmental pollution.

In addition to the official bioeconomy strategy of the Austrian government, there are large numbers of innovative projects and enterprises on many different levels. Some projects f.e. are currently running under the name of Green Care Forest, where especially the health aspects of a stay in the forest are to be investigated, published and thus made marketable.

In addition, there are also small and micro forest owners, who often manage to increase the added value of their forest through innovations or special cooperations and thus create local value chains.

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3.3. OPPORTUNITIES FOR FURTHER DEVELOPMENT OF BIOECONOMY IN SELECTED SECTORS

AUTHORS: Andreja Gregorič

H5P PRESENTATION: OPPORTUNITIES FOR FURTHER DEVELOPMENT

1. Learning outcomes:
   - Participants will be able to describe several different possibilities for further development of forest based bioeconomy in selected sectors
   - Participants will be able to express their views on the future of the bioeconomy

Bio-based industries aim to convert biological inputs, residue and wastes into greener everyday products.

The industry is small compared to more traditional ones and it is undergoing rapid developments. Developing bio-based products demand technological innovations and market development. Progress from the initial concept to a commercial product is often a long journey. Since countries are slowly shifting their policies toward sustainable development, they have opened the door to faster growth of bioeconomy. Now, bio-based products and services play an important role in “green” procurement, in “sustainable” procurement, and in “circular” procurement. The 2018 update of the EU Bioeconomy Strategy aims to accelerate the deployment of a sustainable European bioeconomy. The update proposes a three-tiered action plan to:

1. Strengthen and scale up the bio-based sectors, unlock investments and markets
2. Deploy local bioeconomies rapidly across the whole of Europe
3. Understand the ecological boundaries of the bioeconomy

References:

- A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment (October 2018): https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=strategy
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1. Strengthen and scale up the bio-based sectors, unlock investments and markets
2. Deploy local bioeconomies rapidly across the whole of Europe
3. Understand the ecological boundaries of the bioeconomy

Wood Products and The Future of the Forest-based Industries

Wood has always been integral to human society and visions of a sustainable future will continue to include wood since it has an important role in substituting non-renewable resources. However, there will be many exciting ways to use wood that we can currently just imagine.

Research and development of new uses for wood is more diverse than ever. Things such as tires, water and pop bottles, personal care products,high-rise buildings or even large capacity batteries are now not far away from our everyday life. In fact, wood has replaced steel for an increasing number of tall modern buildings, some as tall as nineteen stories.

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VIDEO: FOREST CAN BE CONVERTED INTO NEW ENVIRONMENTALLY FRIENDLY SUPER MATERIAL

https://www.youtube.com/watch?v=O8tz3KL76UY

Forest can be converted into new environmentally friendly **super material**. Nanocellulose, which is extracted from wood fiber, has several attractive properties. It is as strong as Kevlar, has a low weight and is entirely renewable.

Top emerging bio-based products

2018 study on bio-based products and services mapped the most relevant value chains currently under development that originate from different kinds of large-volume biomass components (natural rubber, vegetable fibres, lignin, renewable oils and fats) and low-volume high-value biomass components (eg. natural polyelectrolytes) as well as urban wastes.

Lignin was found to generate the highest number of innovative products: lignin-based carbon nanofibres, Bio-Btx aromatics, lignin high-purity bio-oil, lignin bio-based phenol and alkylphenols, lignin-based phenolic resins, lignin biocomposites reinforced with natural fibres.

Its natural abundance and global availability certainly represent the main reasons for the attempts at its exploitation. It has a relevant role as a bioenergy and it is an important source of aromatic building blocks. Aromatics, in general, are only available from fossil oil. They are essential in numerous industrial sectors (fuels, solvents, lubricants and plastic materials). Innovative products range from fundamental chemical building blocks (Btx aromatics), to materials for advanced applications in technical fields like construction engineering. Read more

Innovations for the future of forest based bioeconomy:

Computer Chips Made of Wood Could Help Curb Electronic Waste

Researchers at the University of Wisconsin have presented part of a solution for electronic waste. Derived from wood, their new computer chip is made mostly from nanocellulose. Conventional chips of today use large amounts of semiconductors such as silicon as a backbone to their electronic components. Their wood-based computer chips perform just as well as normal chips. The chips are also biodegradable, able to be broken down by a common fungus.

Paper That Can Store Energy

Scientists from Linköping University's Laboratory of Organic Electronics in Sweden have developed a new type of material that has the ability to store energy. A sheet of this material is only 15 centimeters in diameter and just a fraction of a millimeter thick, but despite its small size, can store up to 1 Farad. It can be recharged *hundreds* of times, and each charge only takes a few seconds. The material is built with cellulose fibres that are broken down into 20 mm-diameter fibers around which an electrically charged polymer forms a thin coating around. The cellulose-polymer material also set the world record for simultaneous conductivity for ions and electrons. That explains its remarkable capacity for energy storage.

Japanese Supercar NCV Made of Wood

The Nano Cellulose Vehicle isn't the first car made of wood, but today we most often find wood in the form of various interior trim pieces. The vehicle comes from a consortium of 22 Japanese universities, research institutes, and corporate suppliers launched in 2016 by Japan's Ministry of the Environment. Cellulose Nanofiber (CNF) is derived from plants and

recycled agricultural waste and has been used across the body, including the doors, roof, and hood. The use of these materials means the car's shell is up to 50 percent lighter than one made from more traditional ones. CNF has also been used extensively in the car's structural tub.

Wooden Bike for Sustainable Cycling

Unlike materials such as aluminium, iron or carbon, wood is a renewable resource. One company has designed LignoTUBEs, lightweight tubes made of real wood, which consist of multilayered veneer plies. The individual layers of veneer are glued crosswise. In combination with a specially developed technology it is possible to save more raw materials and weight compared to a solid wooden spar. Tubes are resilient and suitable for constructional tasks. Their first product is a designer bicycle built using a LignoTUBEs frame. Possible applications can vary from a chair leg in furniture construction, a lampshade in luminaire construction, a can in the packaging sector to a musical instrument.

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Chat / Forum: OPPORTUNITIES FOR BIOECONOMY

Leave a comment:

- How do you see the future of the bioeconomy?
- Do you believe current policies are going in the right direction?
- Recommend bio-based products to your fellow learners.

SECTION 4: POLITICAL FRAMEWORK FOR FOREST BASED BIOECONOMY (FBB)

AUTHORS: Ivana Živojinović, Bernhard Wolfslehner, Helga Pülzl, Stefanie Linser, Lukas Wagner, Gerhard Weiss

Overview of EU Bioeconomy policies and other related policies.

In this section, you will learn which EU sectoral strategies support forest based bioeconomy, which sectors are the most important and how they are involved in bioeconomy, how bioeconomy aspects are covered in forest based policies, as well to understand bioeconomy criteria and indicators and their relation to sustainable forest management criteria and indicator set. Also, different stakeholders' perceptions on forest based bioeconomy are presented.

4.1. EU BIOECONOMY STRATEGY AND FOREST SECTORAL STRATEGIES AND POLICIES SUPPORTING THE ACHIEVEMENT OF THE INDIVIDUAL OBJECTIVES OF BIOECONOMY

AUTHORS: Ivana Živojinović, Helga Pülzl, Lukas Wagner

1. Learning outcomes:

- identify and list EU sectoral strategies that support forest based bioeconomy
- point out the most important sectors and their involvement in bioeconomy in selected countries worldwide

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VIDEO 1: POLITICAL FRAMEWORK FOR FOREST BASED BIOECONOMY

Interviewee: Dr. Helga Pülzl

Video Editing: Zoran Jančić

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BOOK: OVERVIEW OF THE EU BIOECONOMY STRATEGY AND SECTORAL POLICIES OF RELEVANCE FOR FOREST BASED BIOECONOMY

AUTHORS: Lukas Wagner, Helga Pülzl, Ivana Živojinović

1. The EU bioeconomy strategy – An overview

The concept of bioeconomy (BE) was introduced on EU level in 2012 with a European bioeconomy strategy (European Commission, 2012). In 2018 an updated version followed: "A sustainable bioeconomy for Europe: strengthening the connection between economy,

society and the environment" is to date the newest European policy strategy, aiming to "maximise the contribution of the bioeconomy to major European policy priorities" (European Commission, 2018, p5).

The main objective of 2012, to pave the way to an innovative, resource efficient and competitive society, still holds in this updated version. The strategy also promotes three key points:

- Firstly, it aims to ensure food and nutrition security. To achieve this objective, the strategy emphasizes especially the transformation of organic wastes, residues and food discards into valuable and safe bio-based products, thus reducing overall raw material consumption.
- Secondly, the BE strategy promotes sustainable management of natural resources, to prevent and mitigate global threats such as climate change and ecosystem degradation.
- Thirdly, the BE strategy aims to reduce the dependence on non-renewable, unsustainable resources, whether sourced domestically or from abroad. This is necessary to meet the EU energy and climate targets and can be done by strengthening the bio-based sector.

2. Sectors encompassed by the EU Bioeconomy strategy

The EU Bioeconomy strategy encompasses all sectors and systems that rely on biological resources and includes all land and marine ecosystems that provide biological raw-material. Main sources for renewable raw-material are thus agriculture, forestry, fisheries and aquaculture. As already mentioned, the strategy also acknowledges waste and side streams of biological material, such as organic wastes or by-products, as important resources for the bio-based industry.

Three main action areas are proposed to achieve the policy objectives:

- Strengthen and scale-up the bio-based sectors, unlock investments and markets
- Deploy local bioeconomies rapidly across Europe
- Understand the ecological boundaries of the bioeconomy

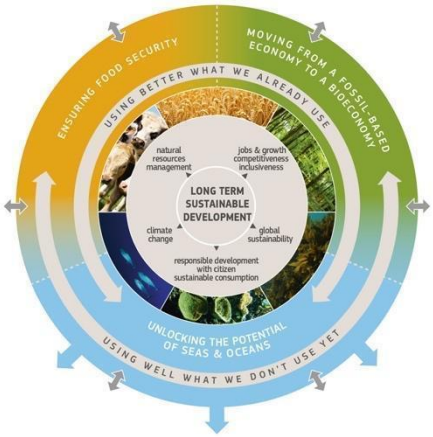


FIGURE: EU Bioeconomy strategy graph

3. Overall EU bioeconomy policy

To assess the state of the forest-based bioeconomy, in other words to analyze how the EU bioeconomy policy refers to and integrates forests in their efforts, it is important to clarify the overall EU bioeconomy policy situation.

On an EU level, there is no common policy regarding bioeconomy. That is to say, while there is an EU bioeconomy strategy (European Commission, 2018) it is not binding and applicable on national levels. Since the EU lacks a consistent competency with regards to bioeconomy Member States will come up with their own bioeconomy strategies and thus not necessarily coordinate it with an EU approach. The EU Bioeconomy strategy basically aims to coordinate different EU policies that affect the development of bioeconomy on different levels. It also tries to constitute a framework for a successful implementation of the concept of bioeconomy and to unite efforts regarding this implementation. Not part of the bioeconomy strategy but nevertheless a concrete example for this attempt to unite European efforts is the Joint Research Centre in Ispra. One of the six directorates, the Directorate for Sustainable Resources, is especially involved in supporting the development of a sustainable bioeconomy in Europe (PEER, 2017).

4. Bioeconomy strategies around the world

There are numerous bioeconomy strategies on different levels, ranging from the already mentioned EU bioeconomy to national and even regional and local bioeconomy strategies. The following figure gives an impression of the global situation regarding national bioeconomy policies.

Figure source: The German Bioeconomy Council, 2019

This phenomenon has also resulted in a great variety of bioeconomy strategies, because every region has a different starting situation, e.g. availability of natural resources, industries or infrastructure, and thus sets different priorities. On a national level, Germany (Federal Ministry of Food and Agriculture, 2014) and Finland (in 2014) were two of the first countries in Europe to develop their own strategies. To highlight the differences between national strategies these also represent good examples: while the Finnish strategy has a strong emphasis on forests, the German strategy is rather focused on research infrastructures and is more financially intensive. As can be also seen in Fig. 1, not every European country even has a strategy on bioeconomy.

5. Forests in the EU Bioeconomy strategy

The EU Bioeconomy strategy perceives forests as an important part of the strategy, and here especially since it presents a source of renewable raw-material, such as woody biomass, timber and side- and by-products of forest-based value chains. Forests are also perceived important as they provide forest ecosystem services, including carbon sinks that contribute to mitigate climate change. The deployment of locally available feedstocks from the forestry-based sector is promoted, as well as new recruitment of skilled wood-supply personal and new monitoring systems are addressed by the EU Bioeconomy strategy.

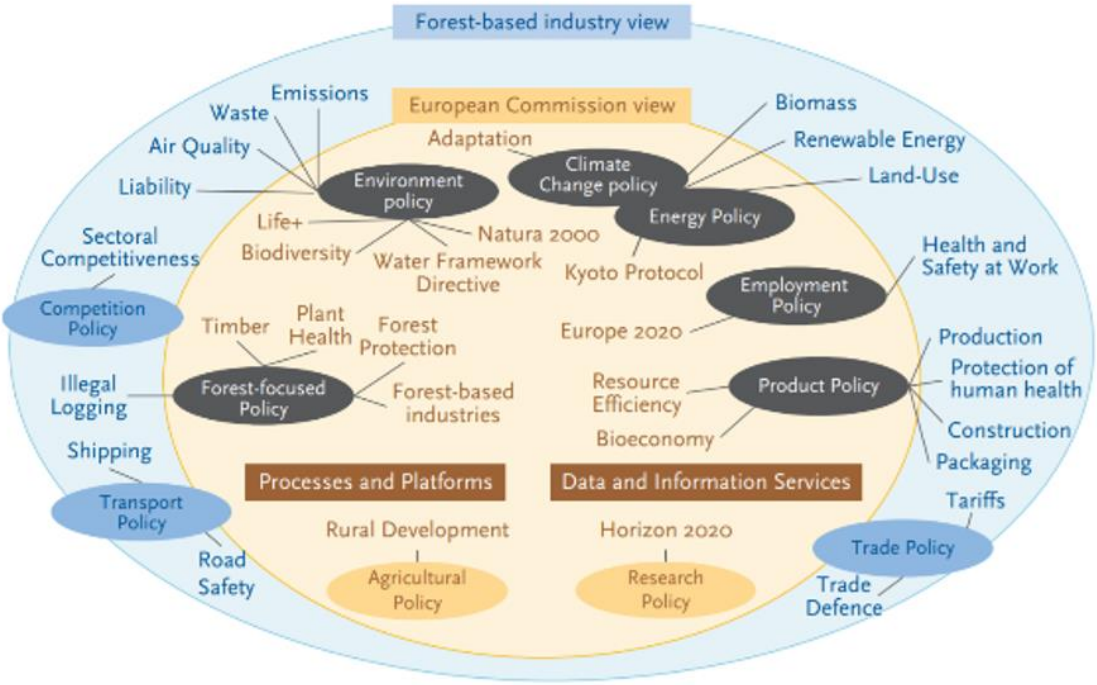
6. The forest-based bioeconomy on EU level

When it comes to a forest-based bioeconomy on EU level, several challenges should be mentioned: for one thing, the legal situation for forests at the EU level is complicated, since the EU does not hold the relevant competences, but nevertheless influences forest policy by referring to it in other policy areas (Aggestam et al., 2017). Forest policy presents again a policy area where exclusive competence lies within Member States. So for instance the protection of biodiversity, mitigation of climate change, and provision of clean air etc. to name just a few of the ecosystem services where the EU has developed legislation to be implemented throughout its territory is also taking place within forests. However, resulting targets are incoherently aligned and thus potentially arising conflicts arise (e.g. between renewable energies targets and biodiversity conservation goals (Aggestam et al., 2017)). The new green deal proposal constitutes an additional set of targets, which must

be brought in line with existing policies (Wolfslehner et al., 2020). But it also holds the potential for a more coherent approach regarding forest policy on EU level after 2020, because Member States have agreed on creating a new forest policy strategy. In regard, the Green Deal could contribute to it by strengthening the connection between forest policy and the existing EU bioeconomy strategy.

Apart from that, many policies on EU level have an impact on the development of the forest-based bioeconomy (FBB). In fact, there are as many as 570 policy documents that might affect the FBB in different ways (Rivera León, 2016). On the one hand, this is due to the comprehensiveness of the concept of bioeconomy: it promotes a vast variety of products and services, including many stakeholder and industrial sectors. On the other hand, the forestry sector itself is influenced by different areas of interest.

Because of this, policies along the whole forestry-wood value chain are relevant to the FBB. Because of this, policies along the whole forestry-wood value chain are relevant to the FBB. The Following figure gives a good overview of forest-related EU policy areas and policy instruments which are listed underneath.



EU forest-relevant policy areas and instruments (Source: Aggestam and Pülzl 2018)

7. Policy areas and policies concerning FBB on EU level

Concrete policy areas and policies concerning FBB on EU level (Aggestam, 2017):

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H5P: BIOECONOMY – WHAT DOES IT MEAN FOR FOREST POLICY?

AUTHORS: Helga Pülzl, Ivana Živojinović

A short interactive presentation to learn more about policy aspects related to forest based bioeconomy.

After this presentation you will be able to identify policy relevant aspects of forest based bioeconomy, to understand main conflict points between existing policies and actors, the main frames that exist in current forest based bioeconomy related policy making, and to identify main opportunities and risks in forest based bioeconomy

1. Bioeconomy – what does it mean for forest policy?
2. Learning outcomes
    - to identify policy relevant aspects of forest based bioeconomy

- to understand main conflict points between existing policies and actors
- to understand the main frames that exist in current forest based bioeconomy related policy making
- to identify main opportunities and risks in forest based bioeconomy

3. What does Bioeconomy mean?

Bioeconomy is increasingly popular in the last decade => Meaning differs

EU: based on the use of **biomass resources**

OECD/US: converting raw material into **value added products/ biotechnology**

4. Bioeconomy strategies exist, but do not prioritize same aspects

Within Europe: Development of bioeconomy since mid-2000

The New EU–bioeconomy strategy (2018) + national bioeconomy strategies (FI, SE, NO, DE, FR, IT, SP) including regional ones

- Spatial differences between different parts of Europe:

Northern: competitiveness; nature tourism; forest biodiversity

Mediterranean: forests for wood processing and paper industries; dependence on biomass imports

Western: increase/optimization of biomass production; protection of forest biodiversity and adaptation to climate change and recreation

5. & 6. Frontiers in the bioeconomy?

Take a look at the graphic and think about frontiers in bioeconomy:

Frontier here means: line of division between different or opposed things

Where do you think frontiers/potential conflicts in regard to bioeconomy policies could arise?

- related to institutions (rules frontier)
- related to interests (industrial research /civil society frontier)
- related to spatial importance (not correct!)
- related to ideas (economic/environmental frontier)

7. Frontiers in the bioeconomy

Frontiers arise between:

- Ideas: bioeconomy strategies differ a lot – but environmental dimension weak > **economic/environmental frontier**

- Interests: some actor groups are underrepresented in bioeconomy clusters > **industrial research /civil society frontier**
- Institutions: no vertical / weak (?) horizontal integration of bioeconomy policies with others > **rules frontier**

In the face of global/ societal challenges bioeconomy policies seem less novel from their governance perspective & less integrative

8. Ideas & bioeconomy: environmental - economic frontier (EU, FI, SE, DE, FR, NL)

Environmental concerns addressed

- mainly as a challenge rather than an independent goal or as part of a win-win solution.
- strategic pathways towards strengthening policy integration are lacking or remain superficial in most of the bioeconomy strategies
- less about balance between economic, social and ecological objectives but placed on a continuum between economic growth and ecological concerns

9. Interests & bioeconomy: industrial research – civil society frontier (DE)

Presence in 'strategic' bioeconomy networks

Central actors: political actors & industrial research =>No civil society/ classical forest stakeholders

Self-reflection:

-forest stakeholders "we are the bioeconomy", while not being part of the networks

-eNGOs: "we don't know, what it is" (WWF Germany)

10. Ideas & bioeconomy : Three major frames found (EU, FI, SE, DE, FR, NL)

- Environment challenged: environmental considerations viewed as major challenges for the bioeconomy
- Environment as a standard: strategies often respond to environmental challenges with environmental standards
- Environment as benefiting from economic growth: environmental considerations are framed as additional benefits resulting from the pursuit of other goals

11. Sustainable Development in the EU strategy

1. EU: weak sustainability approach
    - Natural resource can & should be substituted if needed (e.g. replace natural capital stock through for instance bio-engineered products)

2. EU: no holistic approach (3 pillars of SD)

- Weak emphasis on environmental dimensions (biodiversity, ecosystem services, amenities)
- Social dimensions diminished

12. Think about the information you have just read about the SD in the EU strategy

Where would you locate this SD as it is addressed in the EU strategy in the graphic on the right?

13. Bioeconomy strategies exist, but do not prioritize same aspects

- Baltic: focus on older notion of biotechnology, lacking a clear vision on bioeconomy => the role of forest in bioeconomy remains undecided.
- EU strategy 2012: Forests => biomass demand (e.g. forestry residues); use of forestry residues as alternative sources of carbon and energy + explicitly acknowledging carbon sequestration function of forests; bioeconomy to create new jobs in the forestry sector =>unaddressed by other national strategies

Economic goals are better integrated than environmental and social objectives

14. Unclear role of forest stakeholders /citizen in forest-based bioeconomy

- Bioeconomy as boundary concept for forest stakeholders: brings closer rather than divides them =>opportunity to “rebrand” themselves + re-legitimize their activities (“we are the bioeconomy”)
- Forest stakeholders consider themselves an important pillar of the bioeconomy => few national strategies actually consulted or involved forest actors in drafting process.
- Citizens’ values, interests, knowhow and environmental entitlements in bioeconomy setting still unclear

15. Opportunities of a bioeconomy

The implementation of bioeconomy will lead to the development and the production of new products. It promotes decentralized deployment of renewable resources and highlights the importance of sustainability.

How could these aspects of bioeconomy positively affect especially the economy and rural areas? (all correct)

- Potential for development of new bioeconomy value chains
- Social sustainability dimension in rural areas
- Jobs in rural areas

16. Risks of bioeconomy

Ecosystem products & services - bioeconomy risks

1. Trade-offs between products and services necessary (e.g. biomass for energy vs nature conservation)
2. Dislocation of resource use to other countries/continents might occur when resources are not available in a BE
3. Resource security poses a potential risk due to uncertainties related to natural resource production

17. Conclusions – European forest-based bioeconomy

- Frontiers
  - 1.Economic/environmental
  - 2.Industrial research/civil society
  - 3.Rules (different policies)
- Many bioeconomy strategies exist, but do not prioritize same aspects concerning a forest-based bioeconomy
  - Unclear role of forest stakeholders and citizens in forest based bioeconomy
  - Bioeconomy poses risks and opportunities for the economy, the environment and the society

References:

- Aggestam, F.; Winkel, G.; Pülzl, H.; Sotirov, M. 2017. The EU Policy Framework. in: Winkel, G. (Ed.), Towards a sustainable European forest-based bioeconomy – assessment and the way forward, 978-952-5980-42-4, European Forest Institute, Joensuu, pp. 19–35.
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- Wolfslehner, B., Linser, S., Pülzl, H., Bastrup-Birk, A., Camia, A. & Marchetti, M. 2016. Forest bioeconomy – a new role for sustainability indicators. From Science to Policy 4. European Forest Institute.

4.2. EXAMPLE OF FBB STRATEGIES

AUTHORS: Lukas Wagner, Helga Pülzl, Ivana Živojinović

This Book will provide an insight into the main aspects of the Austrian Bioeconomy strategy. From countries included in the VET4BioECONOMY4Bioeconomy project, Austria was the only country that has developed a strategy on bioeconomy so far. Even if it is not focused just on forestry, we will provide in this Book how this strategy refers to forestry in the context of bioeconomy.

The Learning outcome after reading this book is to get familiar with this specific bioeconomy strategy and be able to present forest-related aspects of it.

BOOK: BIOECONOMY – A STRATEGY FOR AUSTRIA

1. The concept of bioeconomy – the Austrian perspective

Bioeconomy (BE) is perceived as a solution to current problems, such as *environmental damage, climate change* and *scarcity of natural resources*. Because these problems are closely linked to the use of *fossil raw materials*, the aim of the Austrian bioeconomy strategy is to convert the current fossil based economy into a *sustainable economy* based on *renewable resources*.

The renewable raw material can be provided from different sources, namely *agriculture, forestry, water management and waste*. With the means of biotechnology, new and innovative materials and products can be produced and replace those based on fossil resources. The range of BE products is wide: it includes food and animal feed, materials (paper and pulp, fibers, chemicals, biopolymers, insulation and construction materials) and bioenergy.

The sustainable economy promoted by the BE strategy is based on the principles of *sufficiency, efficiency and consistency* (circular economy). It aims to reconcile technology and ecology and to enable a sustainable societal development. To reach these goals, incentive and regulatory instruments are proposed, as well as public relations and enhanced coordination between relevant stakeholders, including businesses and research institutions.

2. The objectives of the Austrian Bioeconomy strategy

The objective of the Bioeconomy Strategy is to identify concrete measures for the further establishment of the bioeconomy in Austria. These measures aim to:

Achieve climate goals: Bioeconomy has a double effect on the climate, CO_2 is sequestered in the renewable raw material and GHG emissions are reduced by saving fossil resources.

Reducing dependence on non-renewable resources: To reduce dependence on non-renewable resources, the share of renewable raw materials in total use of raw materials must be significantly increased by 2030.

Promoting innovation: The Austrian BE strategy aims to increase the number of scientific publications, transdisciplinary projects and patents in the field of BE.

Promoting economic development: To benefit from a transition to BE, Austria should become an exporter of highly developed, innovative bio-based products and services. Furthermore, the economy will be significantly supported by the material and energetic use of renewable local raw materials.

Securing and creating jobs: BE holds the potential for a substantial economic development for rural areas. It can also contribute to the further growth of green jobs.

Promoting sustainable societal transformation: Successful implementation of BE can only work with the support of the Austrian population. Therefore, the strategy aims to enhance knowledge and awareness regarding BE in the broader public.

3. The resources in the Austrian Bioeconomy strategy

As already mentioned, the key sectors providing the raw material for the BE in Austria are *agriculture, forestry, water management and waste*.

Agriculture

A variety of raw materials can be produced by agricultural businesses. These can be produced by well-known plants, which are already produced intensively, or crops with high fiber or protein content. To enhance this production, surface availability and a certain yield per hectare is necessary. On the other hand, the BE strategy recognizes natural limitations and overriding socially desirable goals.

Forestry

Forestry plays an important role in the BE strategy. The next section “The role of forestry in the Austrian bioeconomy strategy” will give you more profound information.

Water Management and its Special Types

This sector can provide a variety of algae products, which range from fat and oil-containing to starch and protein-containing biomasses. Algae biomass can also be utilized for energy recovery.

Residual, By-products and Wastes

The integration of biogenic wastes and agricultural and forestry residues can improve recycling rates and minimize the use of mineral fertilizers. An efficient collection and recycling system is therefore promoted.

4. The role of forestry in the Austrian bioeconomy strategy

As a resource:

- Wood *as a raw material* plays a central role in the Austrian BE
- From the annual 30.4 million cubic meters of wood growth, only 26 million are used. According to the BE strategy, this leaves 3-4 million solid cubic meters of harvested timber per year for an additional use
- In terms of *energetic utilization*, the BE strategy follows the principle of cascading use. In this case, this means that it promotes the *expansion of material utilization possibilities* (such as timber construction) to obtain the best possible CO_2-fixing effect. At the end of the useful life, these products can still be used for energy purposes and substitute fossil fuels

As ecosystems:

- Besides the focus on utility, the BE strategy appreciates forests also as ecosystems that fulfill *protective, welfare and recreational functions*
- In addition, sustainably managed forests act as *carbon sinks* and must be preserved accordingly

Objectives:

According to the perception of forests as resource, ecosystems and carbon sinks, the BE strategy aims to:

- *Accelerate timber mobilization* from local forests
    - Increase of yield per ha by site-adapted tree species or forest ecosystems
    - Improvement of vitality and resilience of forests through adequate forest management and thinning measures
- *Decentralize forestry structures* to allow the processing and thermal utilization of by-products and residues in the region, thus reducing transport and environmental impact
- *Sustain long-term competitiveness* of companies involved in the Austrian value chain "wood" by complying with internationally recognized sustainability standards and through future-oriented innovations

References:

Content is taken from:

- Federal Ministry for Sustainability and Tourism; Federal Ministry for Education, Science and Research; Federal Ministry for Transport, Innovation and Technology (2019) Bioeconomy – A Strategy for Austria (https://www.bmlrt.gv.at/english/environment/Climateprotect/Austria-s-Bioeconomy-Strategy.html)

FILES ATTACHED:

Austrian Bioeconomy strategy in English & German - in pdf

4.3. BIOECONOMY CRITERIA AND INDICATORS

AUTHORS: Stefanie Linser, Bernhard Wolfslehner, Ivana Živojinović

1. Learning outcome:

- understand a broader view of forest based bioeconomy with special emphasis on the bioeconomy criteria and SFM indicators

VIDEO 2: FOREST BASED BIOECONOMY CRITERIA AND INDICATORS

Interviewee: Dr. Stefanie Linser

Video editing: Zoran Jančić

H5P PRESENTATION: FOREST SUSTAINABILITY INDICATORS IN THE NEW LIGHT OF A BIOECONOMY

A short interactive presentation to learn more about forest sustainability indicators in the new light of a bioeconomy. This presentation will help you understand a broader view of forest based bioeconomy with special emphasis on the bioeconomy criteria and SFM indicators.

2. Forest sustainability indicators in the new light of a bioeconomy

The presentation is based on the EFI from Science to Policy 4 Publication from 2016 jointly elaborated by Bioeconomy and Indicator Experts from BOKU/EFI Vienna, EEA, EC JRC and Università degli Studi del Molise/Italy

3. Forest bioeconomy – a value chain approach

In this report, we follow the bioeconomy definition from EU Bioeconomy Strategy according to which bioeconomy is a more innovative and low-emissions economy, reconciling demands for sustainable agriculture and fisheries, food security, and the sustainable use of renewable biological resources for industrial purposes, while ensuring biodiversity and environmental protection. Although the concept has a technological origin, it strongly appeals to the forest-based sector, which consists of all the industrial activities that use forest biomass in general. Yet, it is important to also acknowledge the limitations of this definition. Especially, it does not include the *services* related to forests and forest sector, which are likely to be very important.

In a bioeconomy context, an important challenge for the forest-based sector is to overcome the narrow definition of forest resources and wood-based products, including

primary production. There is a need to move towards becoming a horizontally and vertically integrated sector **which covers the whole value chain** of forest products and services, taking *sustainable development* as its core principle.

FIG 1

4. Based on the content provided so far, and thinking of forest based bioeconomy, what is the limitation of current EU bioeconomy definition?

It does not include the services related to forests and forest sector

It does not include the products related to forests and forest sector

It does not include forest sector at all

5. … in a demanding policy environment

Monitoring forest bioeconomy development in the EU is complex due to fragmented policy framework. To understand the role of forest-related policies in a bioeconomy, it is important to understand the supranational EU forest policy framework, national policy objectives & their relation to bioeconomy, and the larger EU context.

By 2020, the EU identified five main policy targets for which seven flagship initiatives have been formulated. In 2014 a new EC defined 10 additional priorities. In the meantime, additional and more ambitious targets have been published reaching beyond 2020: e.g., climate & energy policies (2030), halting illegal logging (2030) and cohesion policy (2050).

FIG 2

6. Forest indicators – an advanced framework

Indicators are the tools of choice for measuring, monitoring, and assessing sustainability progress.

Sustainable forest management (SFM) indicators have so far been used for monitoring and reporting, for communicating information to a wider audience, for policy formulation in national forest programmes, and to a certain extent for performance assessment. The Pan-European Indicators for Sustainable Forest Management developed by FOREST EUROPE have been referred to in many political debates, and have been proven useful for forest monitoring and reporting both at national and European level.

These forest-related indicators have great potential to become functional instruments for a knowledge-based forest bioeconomy.

FIG 3

7. *Indicators* are the tools of choice for *measuring*, *monitoring*, and assessing sustainability progress.

Sustainable forest management indicators have great potential to become functional instruments for a knowledge-based *forest bioeconomy*.

8. What are possible developments of forest bioeconomy indicators?

A new approach also provides the opportunity to remove some frequently observed obstacles and difficulties, such as:

- too narrow focus on only the resource side, neglecting the market, technologies & whole forest-based value chain perspective;
- missing conceptual framework to explain the causal relationships of resource use & impacts;
- unclear references to political goals and objectives;
- limited operational design & data availability;
- lack of assessment features which provide diagnosis, warning signals & guidance;
- unbalanced indicator sets, that are often weak in terms of socio-economic aspects;
- weak harmonisation as regards forest information terms and definitions which hampers reliable indicator interpretation.

9. STUDY conducted by EFI

- Analysed 203 indicators from different sources
- Conceptualised connection of indicators to a bioeconomy
- Identified indicator and data availability gaps
- Explored 3 pathways for future bioeconomy indicator use
-

FIG 4

10. PATHWAY 1 - Complement existing SFM indicators towards forest bioeconomy

In black colour letters are the current FOREST EUROPE Indicators for SFM and in blue colour are complementing existing or proposed forest-related bioeconomy indicators from other sets.

FIG 5

11. PATHWAY 2 - Develop a new forest bioeconomy indicator set with thematic subsets of indicators

This option is conceptually more advanced.

It comprises some of the Pan-European indicators for SFM, but is intrinsically meant to be a process for developing new, additional indicators, following a new thinking. The central objective is no longer SFM, but is shifted towards the sustainability of the *whole* forest-based value chain, not just the forest management part.

The Bioeconomy Strategy is to provide the basis for the new indicator framework and relevant criteria for it. More specifically, in line with the five societal challenges of the EU Bioeconomy Strategy, five subsets of indicators should be developed.

This approach will require more time and resources to set up a related cross-sectoral indicator process, but will be more tightly linked to the EU Bioeconomy Strategy. It offers the opportunity for sectoral harmonisation and synchronised methods of data and information management. This approach requires a cross-sectoral dialogue on the sub-topics which are part of a forest bioeconomy. It will create a new picture of business services and ecosystem services, which relate to the sector and beyond

12. FIG 6

13. PATHWAY 3 - Bioeconomy key indicators

Pathway 3 is based on a new trend in indicator development and use, for example applied by Eurostat (Europe 2020 strategy headline indicators) and the European Environment Agency (Core set of indicators). It builds on a limited number of key, core or headline indicators which aim to deliver a short, understandable picture of sustainability aspects in a bioeconomy. This would allow communication to a broader audience, decrease data collection and reporting burdens, and support a concentrated discussion on what the key information needs for decision-making are.

This approach could run in parallel to, or be backed up by, larger sets which can be used to synthesise (sub)indicators or composite indicators (e.g., a footprint). Such key indicators are ideally designed in a way which supports cross-sectoral application.

Recent experiences show that selection processes and the simplification of information are very demanding, both in terms of rigidity and acceptance of stakeholders. On the other hand, selection could build on Options 1 and 2, and the outcomes of other processes that employ key indicators. It could be seen as an evolutionary step, following a consolidation of bioeconomy indicators.

A core set of key or headline indicators for forest bioeconomy is presented on the next slide.

14. FIG7

15. CONCLUSIONS

1) Bioeconomy indicators need to **capture synergies** and **trade-offs** among societal and cross-sectoral demands for forest resources
2) **A harmonized use of monitoring and statistics** helps reflect changes in increasingly diversified forest-based sector
3) Bioeconomy indicators should be **compliant with global initiatives** and **adaptive to national strategies**

4) Bioeconomy indicators have a huge potential to **communicate bioeconomy** at various levels and provide information to a broader public

The presentation is based on the EFI from Science to Policy 4 publication from 2016, which was jointly elaborated by Bioeconomy and Indicator Experts from BOKU/EFI Vienna, EEA, EC JRC and Università degli Studi del Molise/Italy.

References:

- Wolfslehner, B.; Linser, S.; Pülzl, H.; Bastrup-Birk, A.; Camia, A.;Marchetti,M. 2016. Forest Bioeconomy—A New Scope for Sustainability Indicators; From Science to Policy 4; European Forest Institute, EFI: Joensuu, Finland.

4.4. PERCEPTIONS OF DIFFERENT STAKEHOLDER GROUPS ABOUT POLITICAL FRAMEWORK

AUTHORS: PerForm project

<Videos taken from PerForm project. The titles will be in google drive folder>

VIDEO 4.4.1. ACTOR PERSPECTIVES IN INNOVATION MANAGEMENT

VIDEO 4.4.2. PUBLIC PERCEPTIONS OF THE FOREST-BASED BIOECONOMY

VIDEO 4.4.3. BIOECONOMY WORLDVIEWS- INSIGHTS FROM EIGHT EUROPEAN COUNTRIES (OPTIONAL)

SECTION 5. BOOSTING ENTREPRENEURSHIP AND INNOVATION

AUTHORS: Karolina Horvatinčić, Sanja Tišma, Ivana Živojinović, Gerhard Weiss, Lukas, Wolfgang Engl

5.1. THE IDEA AND BUSINESS OPPORTUNITY

AUTHORS: Karolina Horvatinčić, Sanja Tišma

VIDEO 5.1. HOW TO RECOGNIZE A BUSINESS OPPORTUNITY?

The potential of forest bioeconomy is huge. But only with an entrepreneurial venture or engaged entrepreneurial individuals, that potential can be transformed into new business models and change the way we produce and use the opportunities of the forest bioeconomy.

Every new job requires an idea and a business opportunity.

The idea is to think about something that can lead to a business solution. A business idea describes the possibility of realizing a new product or service, a new way of producing or working, and significantly influencing the way we live. A business idea is the beginning of any innovation.

But the idea itself is not enough. In order to be realized, there also must be a business opportunity. An opportunity is a favorable set of conditions that create a need for a new product, service, or business.

A business idea is not the same as a business opportunity.

A business idea is a tool in the hands of an entrepreneur with which he starts and develops his business. Unlike a business idea, a business opportunity has the following characteristics: First, it creates or adds value to the customer by satisfying the needs and desires of the customers. This solves a problem in the market that has so far not had a solution for customer needs. In the existing market, the needs were not met.

Second, the opportunity is sustainable, because there is a market, a product or a service that is something worth paying the customer for, and they make a profit. And it has growth potential.

Third and extremely important: the opportunity is timely. If we take the initiative at the right time, a window will open and a new job will be achieved, the idea will be realized.

How to check if there is a business opportunity for our idea? There are various models to check. One of them is the Timmons model, also known as the "four anchors" model.

A more detailed one is the model by Kathleen Allens This model offers questions to test the idea in four areas: product or service, industry, market and client, finance.

H5P PRESENTATION: BUSINESS OPPORTUNITY VALIDATION MODELS

1. Learning outcomes

- identify business opportunities and recognize if there is a basic need for their idea or product
- recognize the importance of having a clear idea of a potential business opportunity to work as a general guideline for future considerations

2. An idea may or may not meet the criteria of opportunity

Business opportunity checking is of utmost importance. Many entrepreneurial ventures fail despite the effort and good work of entrepreneurs. They fail because the business idea did not meet the criteria of a business opportunity. Therefore, before we are overwhelmed by the excitement of a business idea, it is necessary to check whether the idea meets a certain need and opportunity criteria.

3. How to evaluate business opportunities?

How to check if there is a business opportunity for our idea? There are various models to check. One of them is the Timmons model also known as the "four anchors" model.

A more detailed model is the model by author Kathleen Allens who devised the feasibility model.

4. Timmons model ‘four anchors’

Timmons has devised a simple and practical model for identifying business opportunities, which can be used by all entrepreneurs, even beginners, regardless of whether they have an economic education. It is known as the "four anchors" model for recognizing good opportunities.

5. 'The four anchors' model

"Extraordinary jobs have four anchors”:

First, create or add significant value to the customer or end final user.

Second, they do this because they solve an essential problem or satisfy an essential desire or a need for which someone wants to pay a certain fee.

Third That’s why they have a strong market, margin and money-making traits: large enough… have a high growth rate… high margins ... strong and achieved quickly free cash

inflow… high profit potential (at least 10-15% after taxes) and offer attractive rates of return to investors (at least 25-30% internal rates of return).

Fourth, the business is suitable for the founder and his team at that time and on that market, with a balance between risk and reward. ” (Timmons, 1999: 114).

6. Allens feasibility model

The Allens feasibility model consists of questions to test the idea in 4 areas:

1. Product / service
2. Industry
3. Market / client
4. Finances

7. Feasibility Analysis

Area of analysis	Question to be answered
Product / service	1. What are the features and benefits of the product / service? 2. What are the tasks related to product development and what is time frame for their execution? 3. Is there potential for intellectual property rights? 4. What makes this product / service different from others on the market?
Industry	5. What are the demographic characteristics, trends and stage of the industry? 6. Are there entry barriers? 7. What is the status of the technology and what are the costs for research and development? 8. What are the usual profit margins in the industry? 9. Have you talked to suppliers, competitors, people in retail, etc.?
	10. What are the demographic characteristics of the target market?

Market / client	11. Who is the customer / client and what is his profile? 12. Have you talked to clients? 13. Who are the competitors and how do you differ from them? 14. What alternative distribution channels are available and according to which clients will they be targeted at?
Finances	15. What are the financial requirements for starting a business? 16. How much working capital is needed? 17. What are the fixed costs? 18. How long does it take to achieve a positive financial result? 19. What is the coverage point?

8. Timmons and Allens model

Timmons four anchor model and Kathleen Allens feasibility model are simple and practical models for testing whether an idea is also a good opportunity. These are flash models for basic testing of an idea as an opportunity. After analysing these models, the idea can be dismissed as bad or accepted as a potentially good idea with areas that can be refined. The next step is to create a business plan that will fully test the feasibility and profitability.

References and other interesting sources:

- Timmons J.A., Spineli, S. (2003), New Venture Creation: Entrepreneurship For The 21st Century, McGraw Hill/Irwin
- Caner E. (2008) Pre-Business Feasibility Analysis and Opportunity Assessment. Innovation & Entrepreneurship Programs, Cleveland, USA

5.2. INNOVATIONS IN FOREST BASED BIOECONOMY

AUTHORS: Ivana Živojinović, Gerhard Weiss

1. Learning outcomes:
   - define innovations and understand how they can contribute to FBB
   - understand innovation processes, necessary skills and tools
   - gain insights to new research results from across Europe
   - recognize the importance of innovation in FBB

- becoming aware of raising opportunities lying within innovation:
    - getting a bigger picture
    - getting active
- list innovations in forestry that contribute bioeconomy, as well as variety of ecosystem products and services
- recognize the need for innovative approach in the forestry sector and how to achieve it

H5P PRESENTATION: INNOVATIONS IN FOREST BASED BIOECONOMY

A short interactive presentation to learn more about innovations in forest based bioeconomy. Don't forget to click on to get some more information.

WHAT INNOVATIONS ARE? ROLE OF INNOVATIONS IN FOREST BASED BIOECONOMY

1. Learning outcomes:

- define innovations and understand how they can contribute to FBB
- understand innovation processes
- recognize the importance of innovation in FBB
- becoming aware of raising opportunities lying within innovation

2. Take a moment and think what you understand under innovations?

- Creation of something that has not existed before
- An innovation can be a new, or improved, process or product

3. What is innovation?

- „Innovation is the doing of new things or the doing of things that are already being done in a new way… Innovation is a process by which new products and techniques are introduced into the economic system.“ (Schumpeter 1947)
- An innovation is the implementation of a new or significantly improved product, or process, a new marketing method, or a new organisational method in business practice, workplace organisation or external relations (OECD 2005)
- “the first commercialization of an idea” (Fagerberg 2001)

4. Why do we need innovations? What is their role?

- Innovation and entrepreneurship is the engine behind economic growth and job opportunities.

- Modern economic policy becomes more and more innovation policy („Lisbon Strategy“ of the EU, Green Deal)

- Societal changes mean new challenges for the forestry sector (global competition and growing demands on forests) but also new opportunities, such as: growing demand for timber, renewables (biomass), new products, new „services“ (recreation, biodiversity, spirituality, etc.), offering experiences etc.

5. Approaches to study innovations

- Linear model approach (e.g., New Product Development Process) – focus on firm only (Rogers 1995)

FIG (Linear model approach)

The Linear Model of Innovation was one of the first approaches designed to understand innovations as the relationship of science and technology that begins with basic research that flows into applied research, development and diffusion. This model prioritizes scientific research as the basis of innovation, and plays down the role of later players in the innovation process.

- Systems of innovation approach - systemic view on innovation process (Edquist 1997, Edquist and Hommen 1999)

-

6. FIG (Systems of innovation approach)

Systems of Innovation (SI) approach stresses that the flow of technology and information among people, enterprises, and institutions is key to an innovative process. It contains the interactions between the actors needed in order to turn an idea into a process, product, or service on the market. SI have been usually categorised into: national innovation system, regional innovation system and sectoral innovation system.

7. Central Elements of the Systemic Model

Knowledge and Learning (knowledge society) - learning is interactive between organisations in SI approach - firms do not generally innovate in isolation

Actors - “players of the game” - represented by a set of institutional actors that together play a major role in influencing innovative performance. Actors are usually considered organizations, which are seen as formal structures with explicit purposes that are consciously created (public and private/companies and stakeholders, universities, venture capital organisations, civil society, individuals, etc.)

Institutions - “rules of the game” - set of habits, routines, rules, laws or regulations (formal and informal) that regulate the relations and interactions among individuals, groups and organizations. They shape (and are shaped by) the actions of organisations and the relations between them

Interactions - complicated two-way relationship of mutual embeddedness between actors and institutions which influences innovation processes. Interaction of actors and

institutions, are open to and interact with the environment, which they depend on and contribute to.

Evolutionary characteristics - the innovation processes are often path dependent over time, they develop along certain trajectories - an innovation system never achieves equilibrium

8. Which of these are central elements in the systems of innovation approach?

a. Institutions

b. Aim at optimal allocation of resources

c. Knowledge and Learning

d. Actors

9. Innovations in traditional sectors such as forestry

- Knowledge base for innovation: relatively simple, generic, and embodied in equipment and materials, easy imitation

- Less engagement in research and development – more in pragmatic ways: learning by doing, learning by using

- Opportunities to innovate are mainly related to the search for lower production costs, e.g. through new capital, goods, inputs, and materials coming from suppliers

- The ability to innovate consists in the effective incorporation of new generic and codifiable knowledge into already existing products

- Focus on process rather than product innovation

- Appropriation of competitive advantages rests upon the use of less conventional means, like trademarks, aesthetic design…

- Competition on the basis of price as well as other non-price variables, like advertisement and post-sale assistance

- Hardly radical innovations, rigidity toward technological discontinuities and focus on incremental innovations

- High degrees of geographical dispersion of innovators – no sectoral concentration (Breschi and Malerba)

10. Actors and networks in forestry

• Little interaction with other sectors -> Strong **sectoral boundaries**, including to the wood industries and agriculture

• Forestry players prevail in process innovations, more players from other sectors are involved in product or service innovations (e.g. tourism, nature conservation or energy supply)

- No interactions between forest related institutions and actors of national innovation policy
- **Forestry innovation system is a rather closed system of specialised organisations with very few interdependencies with other sectors or other innovation systems**

11. What all of this means for innovations in forest based bioeconomy?

- Technology opportunities in the forest sector are limited, but growing with rise of **bio-economy**
- Low innovation activity in small, good in **large forest holdings -** high fragmentation of forestry impedes innovation
- Service and organisational innovations dominate
- Innovation relies on **endogenous** knowledge in combination with **interaction** with other actors
- Forestry IS has **strong sectoral boundaries** and provides relatively **little innovation support**
- Support for technological innovation and traditional products, and in **diffusion** phases

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VIDEO 3: INNOVATIONS IN FOREST BASED BIOECONOMY

Text and material: Ivana Živojinović

Video editing: Zoran Jančić

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H5P PRESENTATION: ALPENGUMMI THE FIRST NATURAL CHEWING GUM OF THE ALPS

Presentation provided by the company. – Thus content will not be changed (after revision of doc)

Explanation is also given in Section 6. Best practice examples

In power point – for translations

5.3. CREATIVE TECHNIQUES FOR SOLVING PROBLEMS

AUTHOR: Wolfgang Engl

H5P PRESENTATION: CREATIVE TECHNIQUES FOR NEW SOLUTIONS

Bioeconomy sometimes also means simply breaking new ground, trying something new or doing something different from what has been done before. After all, we often just move around in circles and are stuck with the same old ideas.
So if we want to create new opportunities for ourselves, we need a brilliant idea, a vision.

Here we introduce 4 different creative techniques to help to create something new. To create a path, off the beaten track.

All 4 techniques have one thing in common - they are designed to get creativity flowing. Or shed a new light onto an existing problem. These ideas do not have to be realistic and realizable at this stage. On the contrary, they can sound crazy, visionary and aloof. But maybe after the first "crazy" thoughts, there will be other ideas that are more realistic and feasible. Whether a vision then becomes a business idea and subsequently a business opportunity will be considered was presented in the Chapters 5.1 and 5.2. So it is not yet about producing "good" or "finished" ideas, but first only about producing as many or as "new" ideas as possible.

You have already tried one before but had no groundbreaking outcame? Don't worry, sometimes success will only come after multiple uses - so continuity and endurance are essential success factors. It is also advisable to think together with others. Even if the others have no expertise on the specific topic, certain ideas can still be valuable inputs for further thoughts. And because it is so important and sometimes so difficult, here is a

reminder: When thinking creatively, every idea can have its place. Even if it is completely unrealistic, it is simply noted down.

Brainstorming

THE classic among creativity techniques.

All you need is a pen and a paper.

Just write down the main question and then write down everything that comes to mind. This can also be objects, colors or completely different terms, which later nevertheless make sense.

In order to make the brainstorming as fruitful as possible, here are instructions on how to conduct it:

- Leader - if several people are brainstorming on a topic, then a leader is needed. This leader has the function to moderate and motivate the round.
- Number of participants - Brainstorming can also be done alone, but the best results are achieved with 5 to 10 people. This way you can stimulate each other and get a good flow of ideas going.
- Document ideas - One person is responsible for documenting ideas. Preferably in keywords, clearly visible to all.
- Define the goal - It must be clear to everyone what you want to achieve with the help of the brainstorming.
- Setting the time - A clear timeframe for the brainstorming process is set in advance. This time frame must be strictly adhered to. The more challenging the task is, the more time is needed.
- Calling out ideas - Each participant is actively involved and is also encouraged by the leader.
- Evaluation of ideas - No! No idea mentioned is evaluated or rated as bad, good, unrealistic etc. Now it is only time to collect!
- Promoting links - valuable solutions are often "born" through combinations. So everyone is allowed and encouraged to build on the ideas of others.
- Rephrasing - If after a short time no more ideas come up, a reformulation of the problem or question can be useful. By changing the perspective, the creativity process can be stimulated again.

Afterwards:

1. Collected ideas are evaluated: Which of them can be implemented, what do I need? (This evaluation can also be done alone)
2. Sort the ideas: Depending on the task, those ideas with the greatest potential and which can be implemented as quickly as possible are ranked at the beginning.
3. Action plan: In order to achieve my desired goals, I have to determine what exactly has to be done by whom and by when.

Mind mapping

Similar to brainstorming but then different. It facilitates the visualization of the creativity process. Because again, a term or a question is in the center.

First - take a large sheet of paper, ideally in landscape format.

Center the keyword in the middle of the sheet and circle it!

On another piece of paper we brainstorm and note down what comes to mind on the topic.

Next, the ideas of the brainstorming are sorted and linked and then supplemented and expanded

On the large sheet of paper we then hang so-called main branches on our central theme. These branches are our trains of thought, our ideas. With a glance back at our brainstorming-paper: Which generic term can be used for these main branches?

These headings are noted directly above the branches. From each main branch, further secondary branches with terms branch off. From there then again further ones. This way we can always plan in detail but might never lose the overview.

The advantages of mind mapping:

- It promotes creativity
- You get a good overview
- New information can be inserted quickly
- Connections become quickly visible
- Graphic representation helps to memorize information better

Invert Problem

The reversal of a problem or a question forces a change of perspective. This can help to find a solution that you might not have seen before.

For example, the question can be

"How can I increase the earnings of my forest property"

A reversal of the problem could be

"How can I reduce the added value to a minimum?"

The answers to this question often reveal particularly relevant points and can be used to generate ideas. This technique is particularly suitable in a groupwork to reduce the pressure of finding a solution.

Speculations - What if?

The famous question "What if ..." determines this creativity technique. Speculation allows a playful approach to a problem.

An example: *"What if there were no more forest?"*

The consequences that would result from this speculation can be spun very far and thus allow for a particularly profound creative activity.

There are a lot more other creative techniques available. They have advantages and disadvantages, but they are excellent for finding new solutions to existing problems. There is a suitable method for almost every situation. So you just have to dare to take new and perhaps unfamiliar paths.

The definition of madness is to do the same thing over and over again and expect different results.

Questions:

What does it take to be successful with creativity techniques?

- The right place
- Allow and note all ideas
- Exercise
- As much time as possible

When brainstorming with several participants, the leader should

- Also the superior being
- Know the best way to deal with the matter
- Encourage shy and reserved people
- Sort out "stupid" ideas.
- Giving new food for thought by reformulating the problem

5.4. PROFITABILITY ANALYSIS

AUTHORS: Sanja Tišma, Karolina Horvatinčić

VIDEO 5.4. DEVELOPING A BUSINESS PLAN

A business plan is a written document that answers the questions of what is being done, who is doing it and within what timeframe certain activities for the realization of an entrepreneurial venture have to be carried out. A business plan is a blueprint for the future business of the entrepreneur / craftsman, so he or she should be personally involved in its design and fully understand what the plan is about. Entrepreneur's responsibility is to collect as much quality information as possible on all aspects of the business on his own.

Before creating a business plan, the entrepreneur should assess the basic input elements of the business plan:

First, the price of your product or service. Second, the size of sales of products or services, or the number of pieces and the total realization. Third, the size of expenses, product

costs, salaries, taxes and other expenses. And fourth, possible additional sources of financing - loans, grants and similar.

When creating a business plan, it is useful to know a few things. First, a business plan requires time and money, which is returned multiple times later. In addition, the business plan helps to clearly see the business opportunity, easier to direct and lead business activities, attract potential partners, and find sources of funding.

With the business plan, the entrepreneur presents his business idea and answers the following questions: what product will you produce, who will be your customers, how will you sell, why will customers buy your product, what quantities do you plan to sell and at what price, how much will production, sales and marketing cost you, how much money you need for the project and how you will finance it, how much you will earn.

The better the business plan is developed and the more likely the business venture is to succeed.

H5P PRESENTATION: BUSINESS PLAN ELEMENTS

1. Learning outcomes

- develop business plan
- implement profitability analysis
- recognize the importance of profitability analysis

2. What is a business plan?

A business plan can have a different number of parts. It is important to know that there is no strict methodology for making a business plan. Different business ideas can be presented in different ways. However, every business plan must contain basic parts. In addition to these basic parts of the business plan, other units can be freely formed, depending on the style of writing, type of investment and so on. The following is a description of several basic parts of a business plan.

3. Description of the entrepreneur and his business strength

The first part of the business plan is a description of the entrepreneur and his business strength. This part of the business plan answers the question WHO? It is important to present yourself, your competencies and the experience that led to the entrepreneurial venture. It is crucial to explain what the entrepreneur is doing, how long he has been in business, what his experience is and who his main collaborators on the project are, if any. If the entrepreneur is a beginner, it is necessary to explain the previous experience of the founder on the basis of which the entrepreneur embarks on a business venture.

4. Description of the entrepreneurial idea

The second part of the business plan is a description of the entrepreneurial idea. A description of an entrepreneurial idea is a short description of the origin of the idea, the

product and the potential customers for whom the product is intended. A good business idea does not require a large initial investment or hiring more employees in the first year of operation. The idea is focused on a market where there is no unmet demand, has a defined competitive advantage and answers questions about what will be produced, how, for which target market and why.

5. Market analysis

The third part of the business plan is market analysis. Answers the questions WHAT? WHEN? HOW MUCH? This chapter explains the size of the market, the customer need that the product or service meets, the competitive advantage of the product or service, and other relevant information about the market in which it will operate. In accordance with the needs of the market, a projection of the amount of sales that can be realized, should be made.

6. Technical and technological description

The fourth part of the business plan is the technical and technological description of the project. The key question is HOW? This chapter describes the technical potentials and capabilities of entrepreneurs, meeting the prescribed standards, method of distribution, services and customer care.

7. Location analysis

The fifth part of the business plan is location analysis. The question WHERE? Is answered. In this chapter it is necessary to explain why the location where the activity will be performed is suitable for this type of product / service.

8. Profitability analysis

The sixth chapter of the business plan is the financial basis of the project. This chapter is actually a summary of the information obtained in the previous chapters and the importance of profitability analysis is visible. All available data is displayed numerically. It is necessary to make projections over the years with the total revenues and expenditures that will be generated. This provides information on the cost-effectiveness and liquidity of the project.

9. Evaluation of project effectiveness

Chapter seven is the evaluation of project effectiveness. This chapter contains the answer to the question of whether this project is profitable, or whether it can be expected to return the invested funds in a reasonable period. With the help of the projections made, the entrepreneur can decide whether it makes sense to enter into an entrepreneurial venture, regardless of the funds used.

10. Final evaluation of the project

The last chapter of the business plan is the final evaluation of the project. This chapter provides a summary of the key parameters that justify an investment. Based on the facts presented in the previous chapters and the conducted economic and financial analysis, a final decision is made on whether or not to accept the business plan. In this chapter, the results of the profitability analysis are crucial.

A business plan is an important document and the entrepreneur does it primarily for himself, and only then because of the demands of the environment.

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SECTION 6. BEST PRACTICE EXAMPLES

AUTHORS: Dijana Vuletić, Anton Brenko, Karolina Horvatinčić

6.1 WHAT BEST PRACTICE MEANS AND HOW DO WE USE IT

The term "Best Practice" has been used to describe "what works" in a particular situation or environment.

A best practice is a method or technique that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means, or because it has become a standard way of doing things, e.g., a standard way of complying with legal or ethical requirements.

There is a wide range of best practices. They can vary from something as simple as making several sets of plans for a construction project to a software project using an iterative development process, quality control, requirements management, and change control. Each of those items would also be broken down into a subset of processes on a large software project. Consequently, the complexity can range from simple to very complex.

The point is that research and knowledge are valuable tools in your arsenal for success. As good consumers of information, we must keep in mind that a particular practice that has worked for someone within a given set of variables may or may not yield the same results across educational environments.

Finding best practices is simply taking the time to research what you are planning to do and finding the best way to go about getting it done.

Finding the best practices for your field or project can save a lot of time, trouble, and improve your results. Good luck with your projects.

Source:

https://www.thatcompany.com/what-are-best-practices-and-why-are-they-important

6.2 BEST PRACTIC EXAMPLES FROM AUSTRIA, SLOVENIA AND CROATIA

In these sub-chapters we are bringing only some of chosen best practise in the area of Forest based Bioeconomy in the project countries. There is plenty more of them and some are also used in previous materials especially related to NWFPs.

Look for the VIDEOS on those examples on our YOUTUBE Channel

https://www.youtube.com/channel/UCdpEnT5EJiPl-SHvOUvi9Hw

It is our aim to raise some questions while you watch video's:

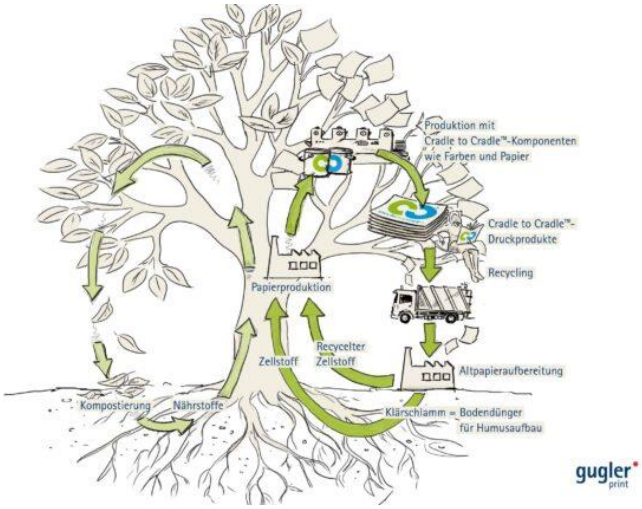
What are the challenges faced by different FSB entrepreneurs?

Are there some examples from your neighborhood? Are they boosting rural development and are they environmentally safe?

Do you have your own idea for business opportunity in forest based bioeconomy?

6.2.1 Best practice example from Austria: Cradle-to-Cradle printing, gugler* print

Since November 2011, gugler* print is one of the first print shops to produce cradle-to-cradle certified print products. What is Cradle to Cradle? One could say "from origin to origin": This means that one thinks in terms of complete product cycles from the very beginning. This saves resources and prevents waste. Even the sludge that forms during production can flow back into the biological cycle. And that's not all: all substances required for printing are retained in the cycles.



[1] In cradle-to-Cradle™ printing, gugler* only uses substances that can be returned to the biological cycle. © Photo: www.gugler.at

Cradle-to-Cradle: Three things make the difference.

Effectiveness instead of efficiency: Less bad is not good enough. Useful products are not created by reducing harmful substances. Eco-effectiveness is about doing the right thing. This means that harmful substances are not used in the first place.

Waste equals food: With the Cradle to Cradle concept there is no waste. Just like in nature, all substances remain in cycles. Cradle-to-Cradle certified print products are optimized for the recycling process. Any sludge produced in the process can be returned to the biological cycle.

Healthy all round: all ingredients of Cradle to Cradle certified print products are analyzed at gugler* in cooperation with the Environmental Research Institute EPEA. With regard to health compatibility such as allergy risks, etc., high requirements are met. Even the ashes of burnt print products can be scattered in the vegetable garden without hesitation.

VIDEO – Youtube.com (only in German available)

Cradle to Cradle - this is how nature would print

https://www.youtube.com/watch?v=6cCn4eV-yFQ

The inks used for letterpress printing, for example, are based on sustainability - regardless of whether the colors are bright or delicate: gugler* uses mineral oil-free printing inks based on vegetable oil. Although these inks are water-soluble, they are saponifiable and more easily biodegradable. They are easier to deink, which means that they can be removed more easily from the printed waste paper when recycling paper.

Cradle to Cradle vegetable oil paint ©Rita Newman

Green footprint

gugler* also focuses on climate protection measures: The amount of greenhouse gases is reduced, the remaining emissions are compensated with CO_2 certificates. In doing so, gugler* supports projects in which CO_2-binding measures are implemented, such as the Gold Standard project of VCS (Verified Carbon Standard) in a forest reserve in Zambia.

Measures to reduce CO_2 emissions

· The gugler* company has invested in a recyclable PlusEnergy building. For better insulation, walls were insulated with cellulose from cradle to cradle paper waste and windows with sheep wool, waste heat from machines and compressors is fed into the company's own heating system in an energy-saving manner, LED lighting and elaborate monitoring optimize power consumption during operation.

· Whenever possible, the field service uses Rail & Drive instead of diesel cars. Company cars have been and are constantly being replaced by e-cars.

· Seasonal vegetarian organic products from the region and from our own cultivation are used in the staff restaurant.

In cradle-to-cradle printing, only materials that are optimized for the biological cycle are used. They cause significantly less CO_2 during both production and disposal. The finished print products are theoretically compostable.

Comprehensive view

It is also important to the owner and managing director Ernst Gugler to live the philosophy comprehensively: "From a sustainable perspective, just as much attention should be paid to the side effects. A solution that wants to be future-proof must take into account aspects that go beyond the communicative performance - into economic, ecological and social aspects. This is why we are not only committed to the continuous improvement of environmental standards, but also support innovative economic approaches such as the common good economy".

6.2.2 Good practice example from Slovenia: BELINAL – White fir (Abies alba) extract

(H5P presentation)

VIDEOS – WAITING FOR THE PERMISSION

https://www.youtube.com/embed/g1lb2_jrH64?autoplay=1

https://www.facebook.com/Belinal.superior/videos/1842665775974654/

Description of the product:
Belinal is a dietary supplement that contains an extract from the branches and knots of the white fir (Abies alba Mill.). Researchers at the Institute of Chemistry, in collaboration with doctors and scientists, have proven that the extract from the branches of the white fir has various positive effects on human health. It helps lower the glycemic index of a carbohydrate meal, which has a positive effect on diabetics and those who want to control their weight. It also has a beneficial effect on the skin and skin diseases, the immune system, regeneration after sports activities, the heart and blood vessels, and plays an important role in the treatment and prevention of cerebrovascular diseases such as stroke and dementia.

Gathering and production:
White fir branches are obtained in Slovenian forests, especially in the Kočevje region, where the forests are well preserved and fir is naturally present. This ensures the highest quality ingredients and knowledge of the origin of the raw material. For the purpose extraction, only branches from regular felling are selected by hand, in this way the nature conservation and sustainable development is ensured. Further, the work is developed in a laboratory where the extraction from the wood takes place. With different laboratory methods the active substances are extracted and put into capsules.

Also, research and clinical studies are conducted, to be able to confirm the effectiveness and health benefits of Belinal and thus achieve optimal effects.

Contribution to the bioeconomy:
The product is made on the basis of an extract from the branches of the white fir, which is an autochthonous tree species in Slovenia and is naturally distributed throughout the country. For the purpose of extraction, they use branches that remain after felling and are a kind of a waste, as they would otherwise remain in the forest. They use natural material (wood), innovation techniques (extraction) and contribute to sustainable development and nature conservation which are all characteristics of forest based bioeconomy.

Interesting:
Belin was an ancient god of sun and light, worshiped by the Venetians and the Slovenes in several Roman provinces. It was also associated with water and healing, so people called it “holy” at the time, believing that it could be used to cure blindness.

References

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6.2.3 Good practice example from Slovenia: A wooden three house in urban forest of Celje

A wooden tree house in urban forest of Celje

A multi-purpose forest with an open air-classroom

Celje urban forest is a forest property on the edge of the city of Celje. It is a multi-purpose forest with many different roles; socio-cultural (e.g. recreation and education) is of greatest importance in this forest. This forest with its wooden tree house has become an open-air-classroom, which is an added value for children and youth learning about forests and forestry. It has elements of bioeconomy and is therefore presented as a good practice example. You will learn more about the tree house in the video.

VIDEO: WOODEN THREE HOUSE IN URBAN FORESTS OF CELJE

6.2.4 Good practice example from Croatia: Antela d.o.o. - Paper Straws

Antela d.o.o. started operating in Croatia in 2015 as an expansion of a Slovenian company that will cover the needs of the Croatian market for paper products. They have been producing paper straws since 2017, for which the idea arose as an adaptation to European Union standards - from 2021, the use of disposable plastic products will be banned in the EU.

Straws, along with cutlery, glasses and similar items, are on the 'black list' of plastic products that have been found to be among the biggest environmental nuisances, as they are mostly used once and then thrown away, creating waste that is difficult to, or it does not degrade in any way, so it becomes an increasing environmental problem. Economist Goran Mačinko is a partner and co-owner of Antela, registered in Bonaci near Baderna, Poreč, which he founded in 2015 with his Slovenian colleague Bostjan Zemljič, the founder of the company of the same name, which has been operating in Slovenia since 2007 as a paper stationery processor that processes about 400 tons per month and sells 1000 tons of paper products.

The capacity of the factory in Baderna is from one million and more of straws per month, which depends on the dimensions of individual straws and the frequency of format changes on the machines, as well as possible delays. Each paper straw is made of three layers of special cardboard / paper (paper straw cellulose) and these three layers are glued together in a spiral where they form a straw. They produce straws of different diameters and lengths, diameters are 6/7/8/10 mm and lengths depending on customer requirements from 12 to 55 cm. The packages are different depending on the needs of the customers, for hotel houses there are 1000 straws in a box, while for sale to end customers they are in smaller packages of 40 to 50 straws.

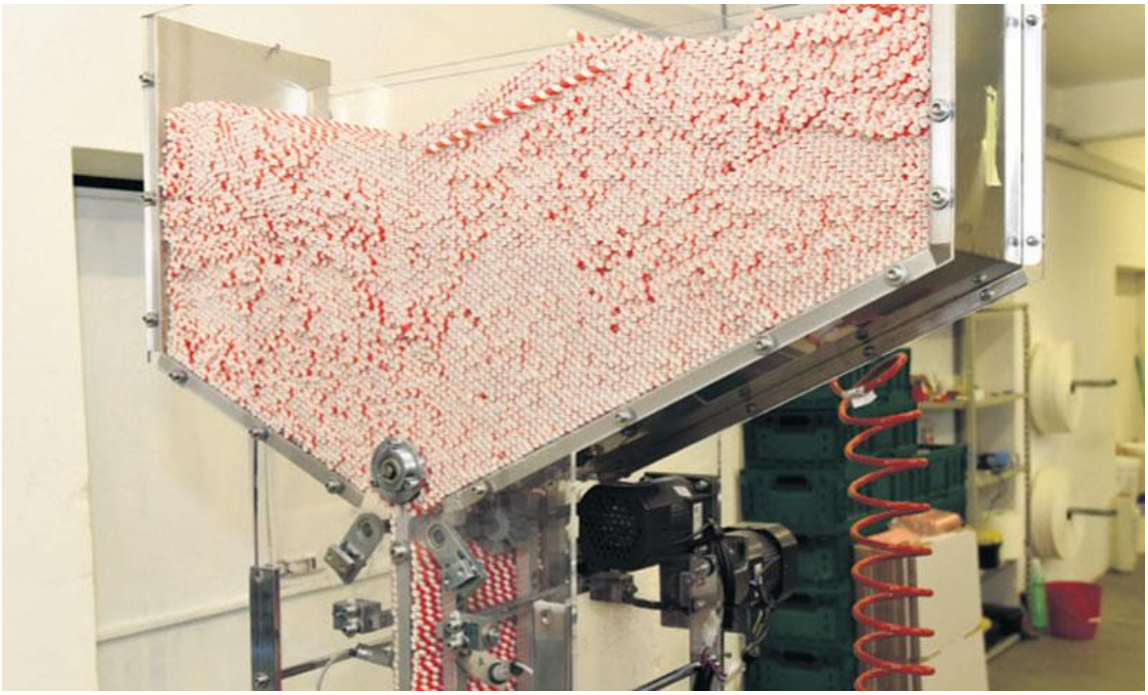
All machines of Chinese manufacturers are made of stainless steel to meet the technical requirements during production. If we take the negotiation period, the machines have been procured for more than a year and a half, and today they work closely with the manufacturer to eliminate errors. About 150,000 euros were invested in the plant, and the complete amount is from its own funds as a recapitalization of the company by Slovenian partners and company owners in Croatia. Additional investments required working capital and this was provided from Antela's regular operations.

Video: https://www.youtube.com/watch?v=o8oIif5dpaI

Photo: https://www.poslovni.hr/poduzetnik/milijuni-papirnatih-slamki-iz-istre-dobri-za-biznis-i-cuvaju-okolis-359857?multimedia=2

Picture 1. Goran Marčinko with a fan of paper straws

Picture 2. Part of a straw making machine



Picture 3. Part of a straw making machine

6.2.5 Good practice example from Croatia: Family-run farm ‘Jakopović’ – The House of the Magic Grass

The ‘House of the Magic Grass’ is a pioneer in the field of organic cosmetics in Croatia, developed from the original idea of growing the medicinal plant lemon balm.

Already with the first harvest, the need was created for the finalization of products from this and other medicinal plants, and for the expansion of activities to self-drying.

The first finished product was lemon balm tea (*Melissa officinalis*), whose properties have a spasmolytic effect, especially in various neuroses (gastrointestinal tract, heart neurosis, nervous disorders). It is also used in phytobalneology - lemon balm baths. Lemongrass is a plant that is used not only as a tea, but also largely in gastronomy, cosmetics and wellness.

Family-run farm Jakopović turned products from its own production that are 100% naturally grown and processed (ECO certificate) into a recognizable autochthonous souvenir, present in all stores of domestic Croatian products, souvenir shops, all major tourist destinations, spa hotels, wellness centers and the like.

"House of Magic Grass" is the first product range in Croatia to receive the labels 'ECO cosmetics', '100% natural cosmetics with ecological ingredients' and 'natural cosmetics with ecological ingredients'.

Video: https://www.youtube.com/watch?v=GmbapGgSVro

Photo: https://opg-jakopovic.hr/products/

Picture 4. 2in1 shampoo

Picture 5. After shave balsam

Picture 6. After sun body lotion

THE END