Czech University of Life Sciences Prague
Faculty of Forestry and Wood Sciences

THIRD BIOECONOMY COURSE
University of South Bohemia
May 21st – May 25th 2018

FORESTRY BIOECONOMY

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Lecture structure

1. Introduction
2. Potential of forestry bioeconomy
3. Sustainable development
4. Strategy, expected directions of development
5. Conclusions

1. Forestry bioeconomy - definition

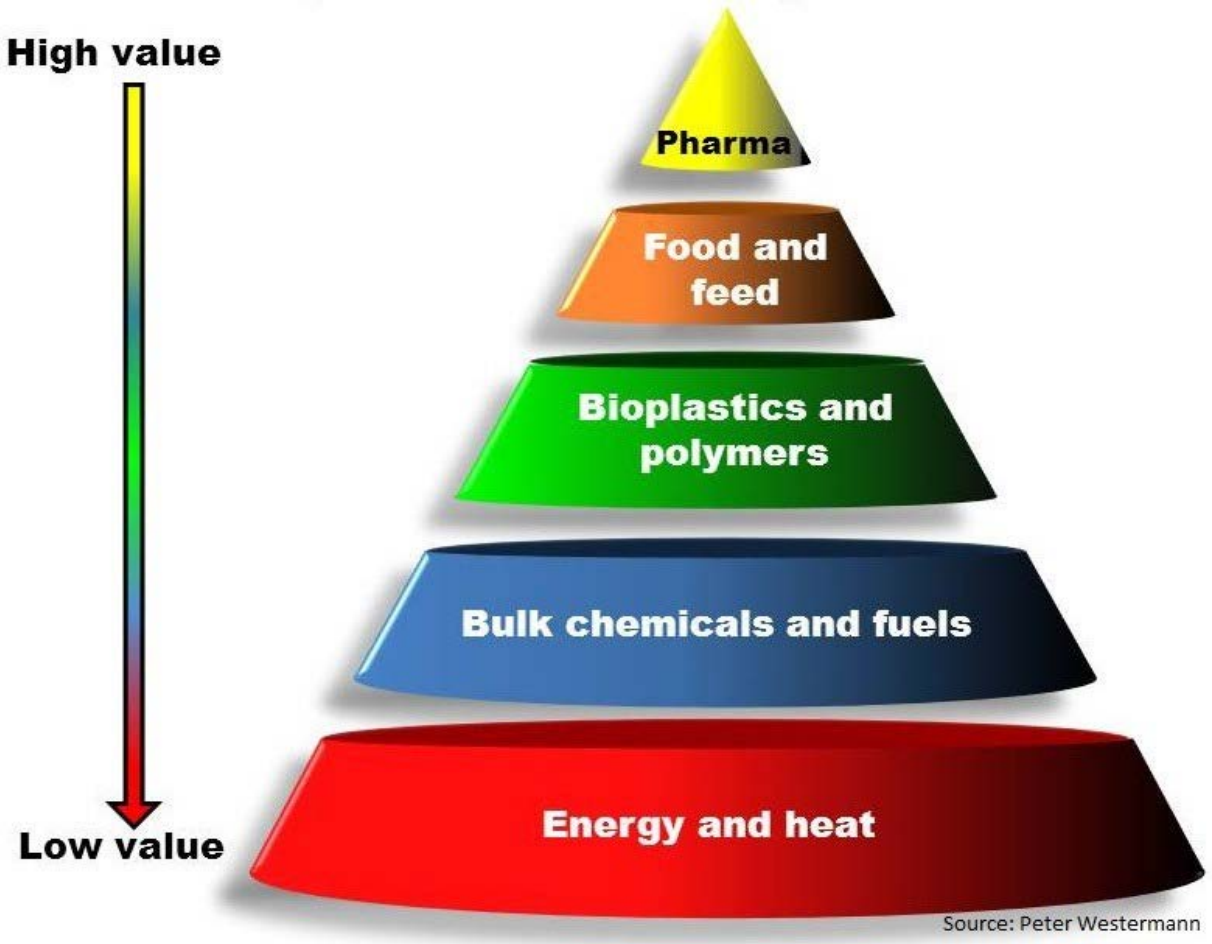
- Includes all economic activities related to forestry and forest ecosystem services
- an economy based on the innovative use of renewable natural resources
- a concept focused on current and expected future changes in the forestry sector
- synonym for the forestry sector

2. Potential of forestry bioeconomy

- All manufacturing industries using biomass, the traditional forestry sector, energy industry, the chemical industry, and the pharmaceutical industry
- Current efforts to expand the product matrix of the traditional forest industry and new ways of using wood biomass as industrial raw material.

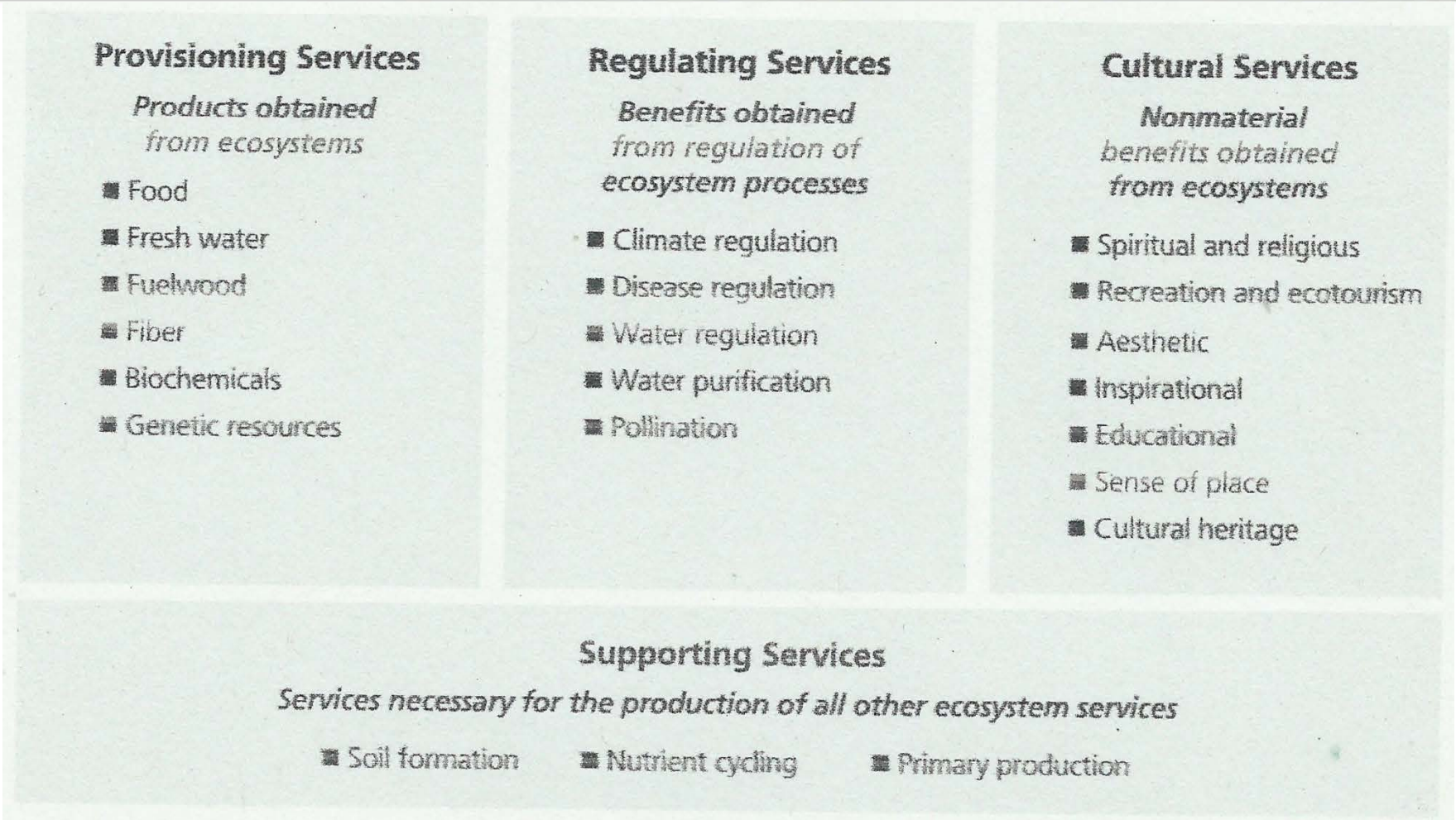




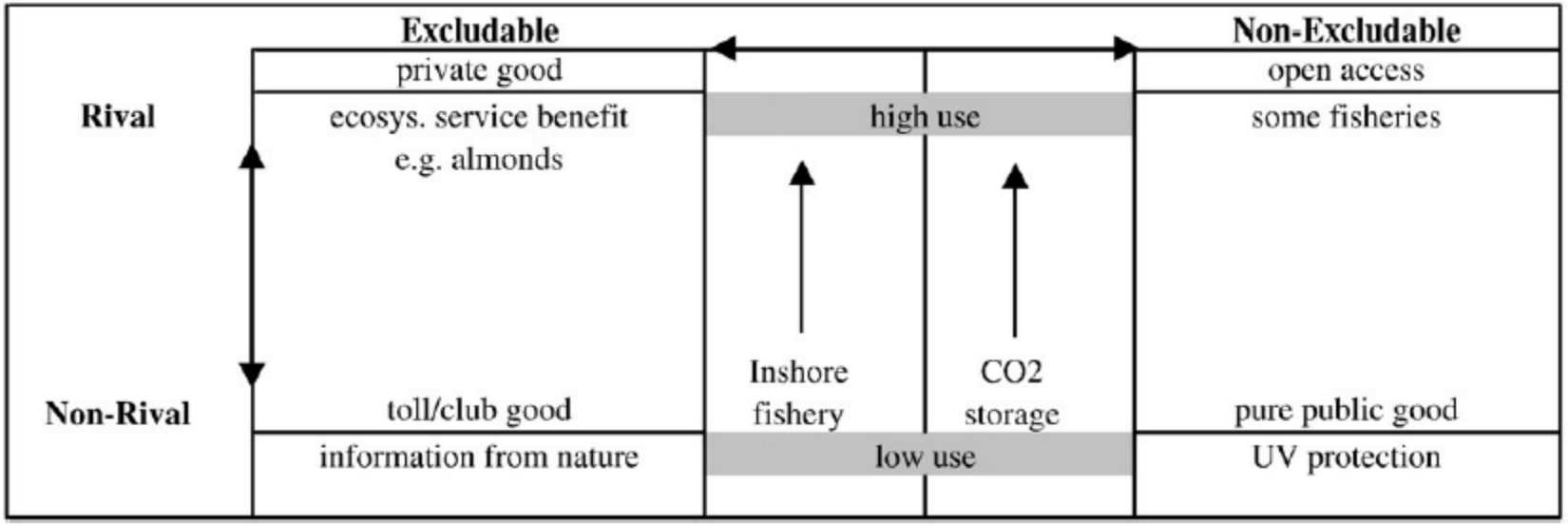


High value
Low value
Pharma
Food and feed
Bioplastics and polymers
Bulk chemicals and fuels
Energy and heat
Source: Peter Westermann

Forestry bioeconomy is not only wood – ecosystem services (World Resources Institute 2003)

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services that directly affect people and supporting services needed to maintain the other services.



Millennium Ecosystem Assessment 2005



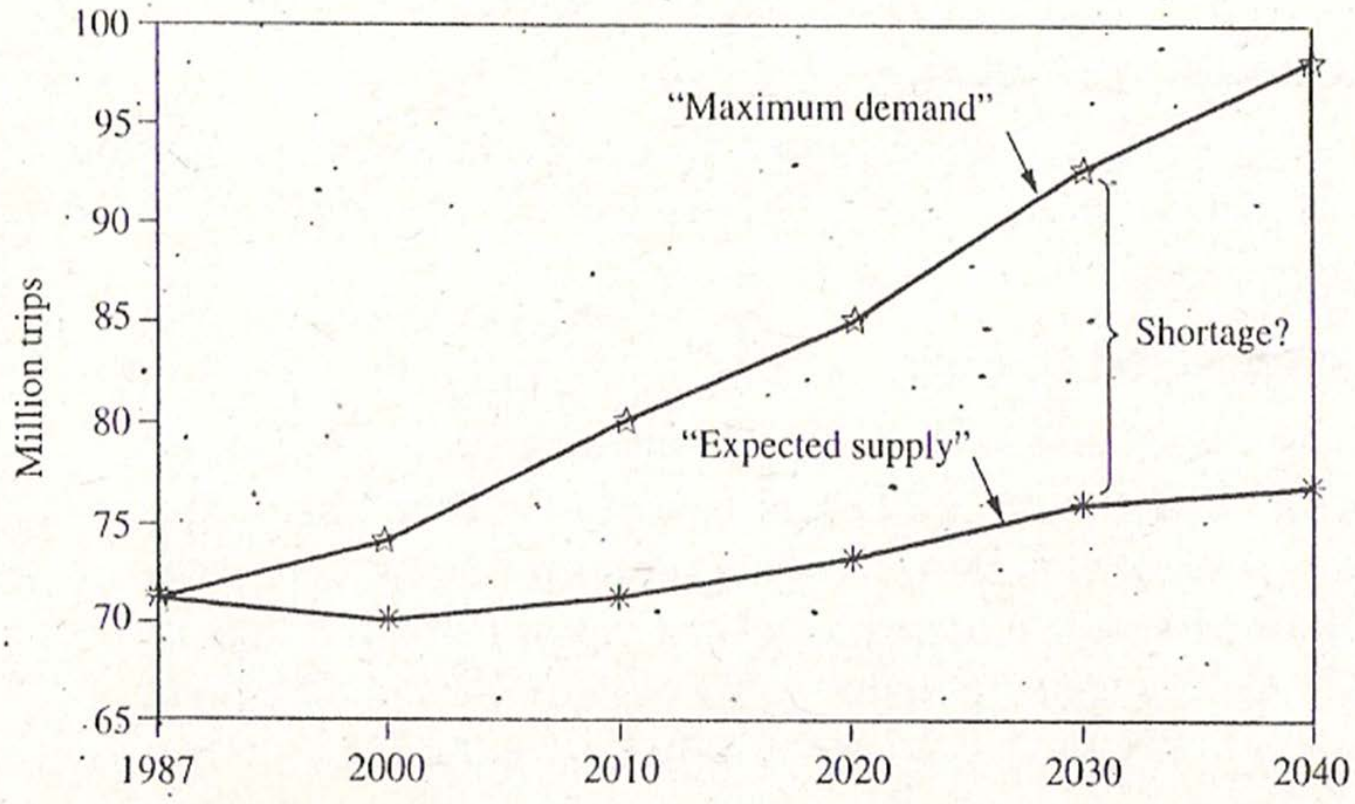
Fisher, B., Turner, R. K., Morling, P. 2009. Defining and classifying ecosystem services for decision making. Ecological Economics 68/3: 643-653.

Forest ecosystem services (1)

The subject of bioeconomy is the first group of ecosystem services
Specific ecosystem services are different in location, time, etc.
Swedish example

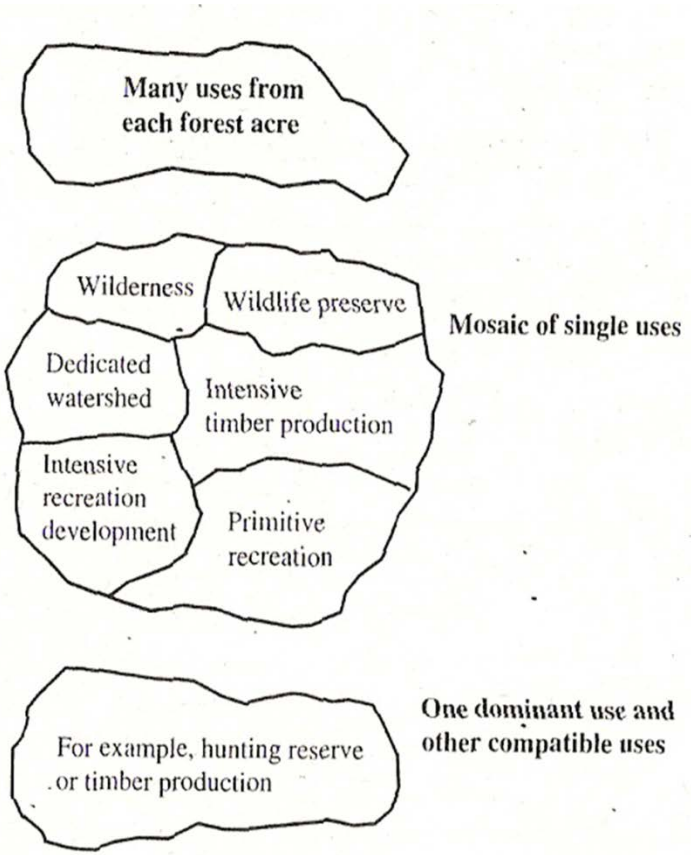
Class	Division	Ecosystem service
Provisioning services	Nutrition	Berries
		Mushrooms
		Game
		Reindeer and fodder
		Drinking water
	Materials	Timber and pulpwood
		Decorative materials
		Genetic resources
	Energy	Bioenergy

Projected "gap" between maximum demand and expected supply for nature study trips. (USFS [1990a], p. 69.)



Forest ecosystem services (2)

- Many outputs from each forestry area (to produce all outputs on each acre is impossible)
- a mosaic of single uses on separat areas
- various forms of multiple use
- management for a „dominant use and all other compatible uses
- many uses over time (clear-cut ca provide deer hunting)



The Forests of the City of Prague

The aim of the study was:

1. Information on the provision of ecosystem services in suburban forests
2. Valuation of the most important ecosystem services

The Forests of the City of Prague - **main departments**:

1. Department of forests
2. Department of watercourses
3. Department of city parks
4. Department of ecology education

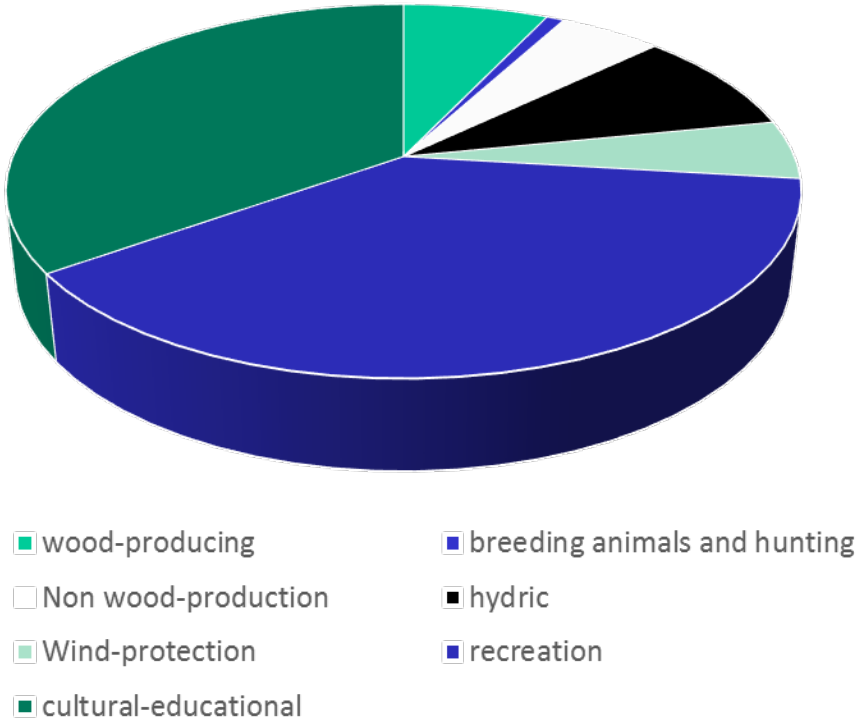
+ administrative, control and logistics departments

- The extent of Prague forests is 2900 ha
- We maintain watercourses (210 km) and dams (130 pcs)
- We have two forest nursery with ornamental flowers and trees
- Caring for injured wild animals in the rescue center
- We provide educational activities about nature for schools and the general public

- New activites:
  - Coordination of Environmental Education in Prague in schools and boroughs

- New activities:
  - Maintenance of important parks in Prague, such as Petrin, Vitkov

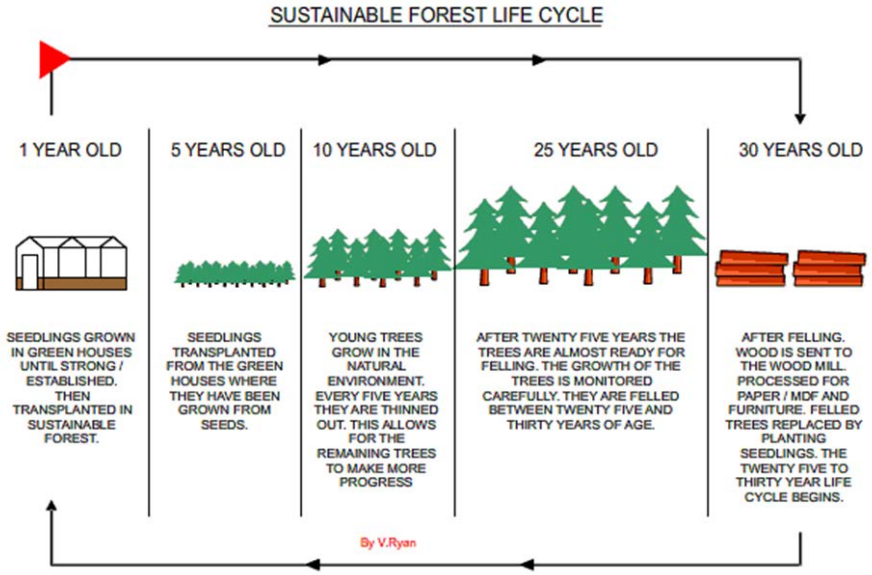
recreation	741 000 EUR
cultural-educational	675 000 EUR
hydric	173 220 EUR
wood-production	136 364 EUR
wind-protection	98 036 EUR
non wood-production	96 762 EUR
breeding animals and hunting	16 666 EUR



3. Sustainable development

One of the most important principles of bioeconomy is sustainability

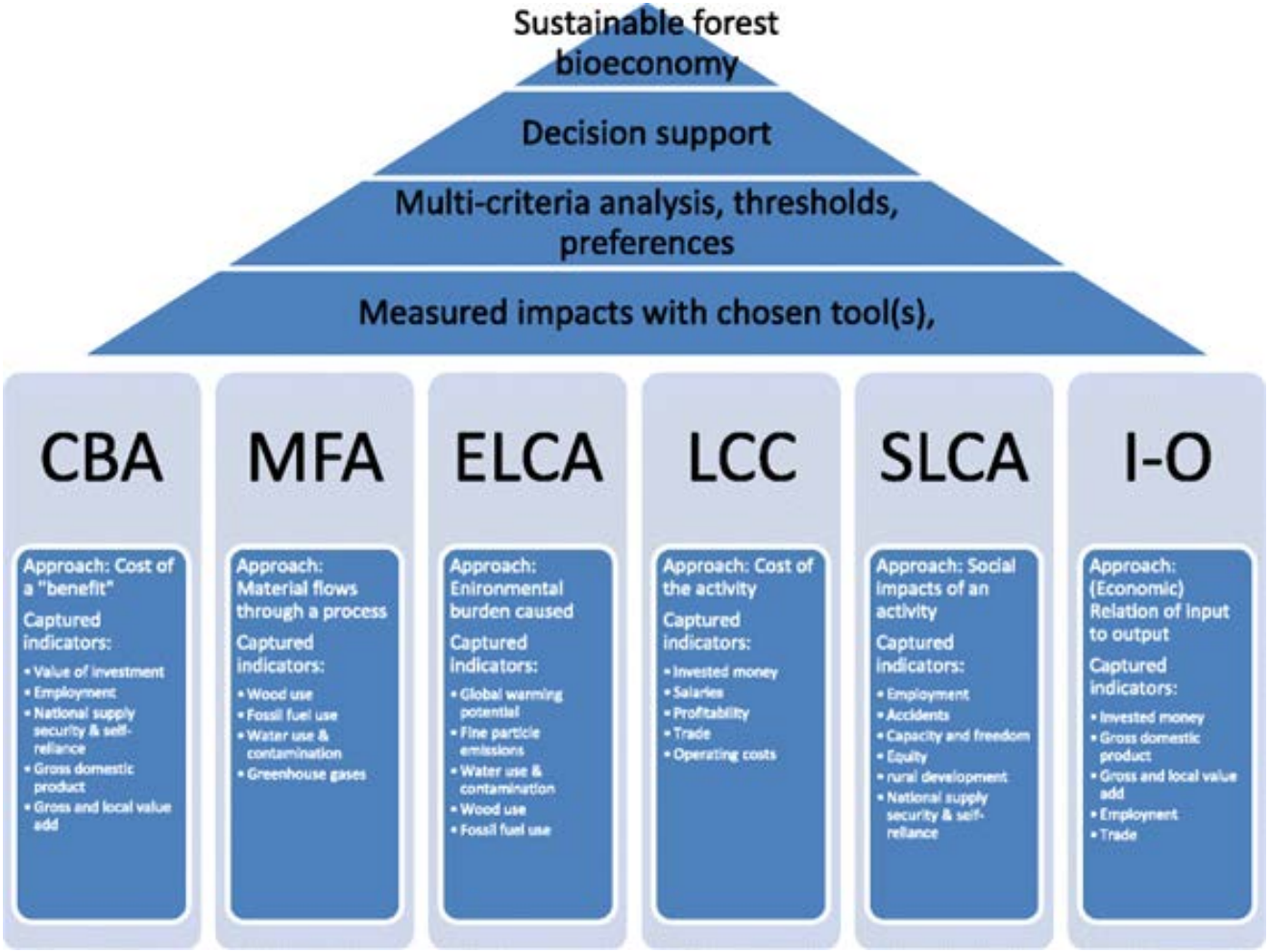
It is not just about the sustainability of the production process



General definition of sustainability

Sustainable forest management is a dynamic and evolving concept that aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations (UN 2008).

One of the deterrent examples of unsustainability is palm plantations

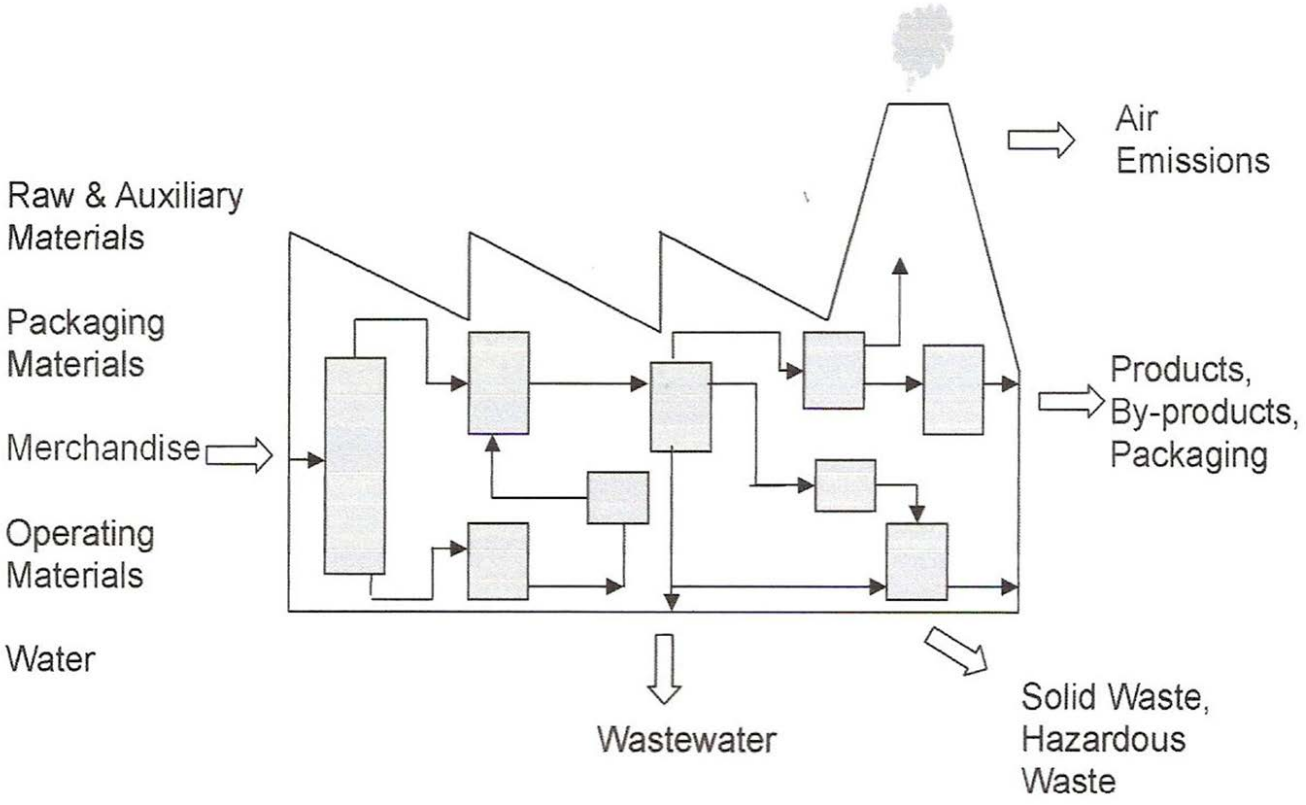

Sustainable forest bioeconomy
Decision support
Multi-criteria analysis, thresholds, preferences
Measured impacts with chosen tool(s),
CBA
Approach: Cost of a "benefit"
Captured indicators:
• Value of investment
• Employment
• National supply security & self-reliance
• Gross domestic product
• Gross and local value add
MFA
Approach: Material flows through a process
Captured indicators:
• Wood use
• Fossil fuel use
• Water use & contamination
• Greenhouse gases
ELCA
Approach: Enironmental burden caused
Captured indicators:
• Global warming potential
• Fine particle emissions
• Water use & contamination
• Wood use
• Fossil fuel use
LCC
Approach: Cost of the activity
Captured indicators:
• Invested money
• Salaries
• Profitability
• Trade
• Operating costs
SLCA
Approach: Social impacts of an activity
Captured indicators:
• Employment
• Accidents
• Capacity and freedom
• Equity
• rural development
• National supply security & self-reliance
I-O
Approach: (Economic) Relation of input to output
Captured indicators:
• Invested money
• Gross domestic product
• Gross and local value add
• Employment
• Trade

Cost benefit analysis

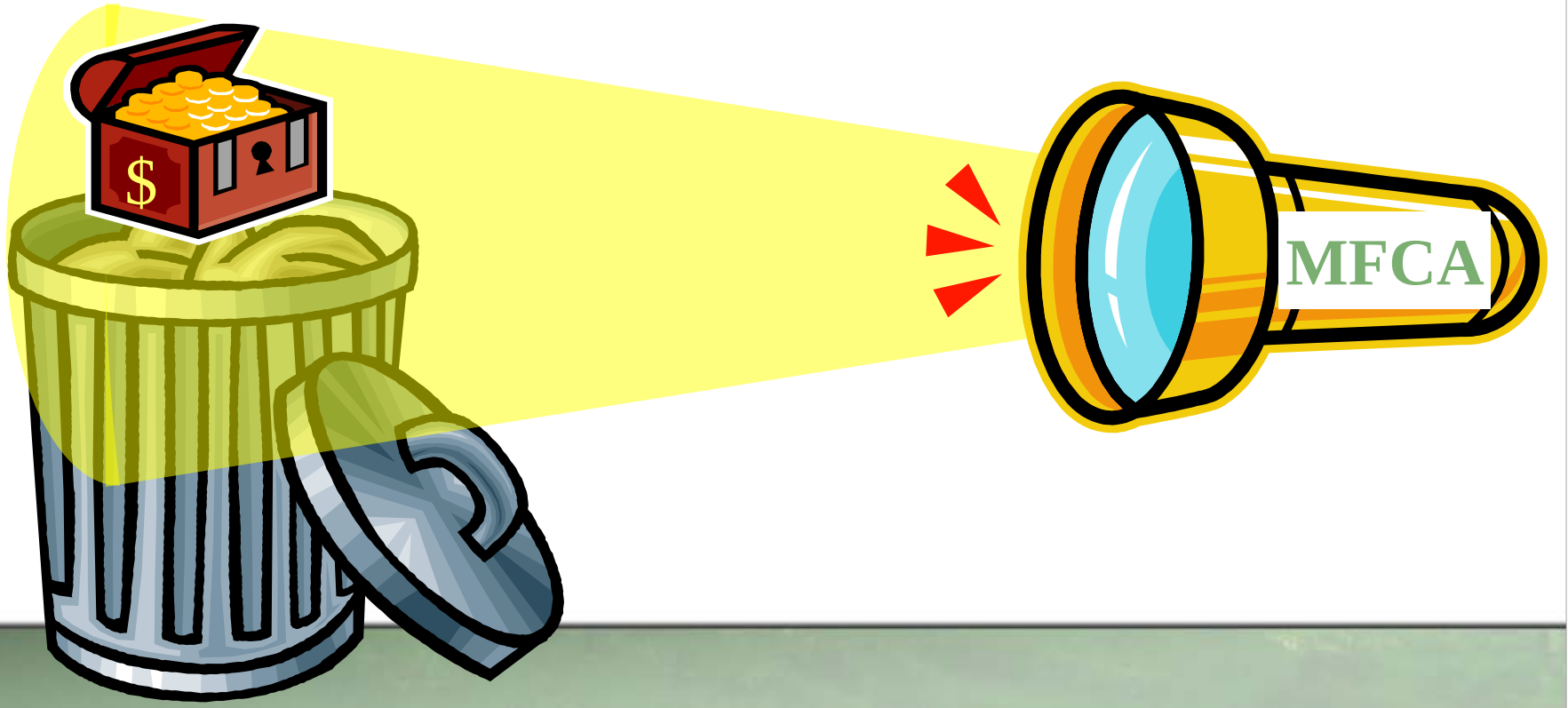
$$CBA = \sum_{n=1}^{N} B_n \frac{1}{(1+r)^n} - \sum_{n=1}^{N} C_n \frac{1}{(1+r)^n}$$

- CBA defines an investor´s willigness to pay for an asset based on estimated benefits, costs, and the desired rate of return
- CBA is powerful tool in valuing forest properties

Material flow accounting



- MFCA focuses on emission (waste)
- Profit is hidden in emission (waste)
- MFCA finds out the hidden profit



Benefits of MFCA

Internal benefits

- Increasing profit
- Improving productivity

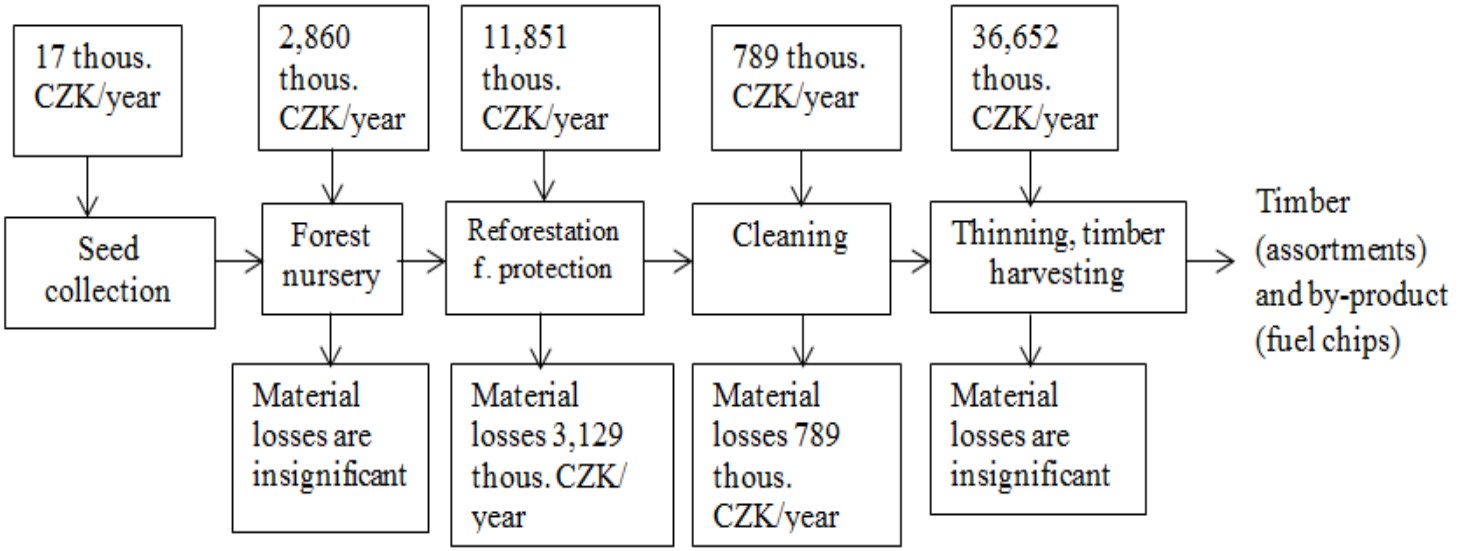
External benefits

- Reducing environmental impacts

Contributing to sustainable development

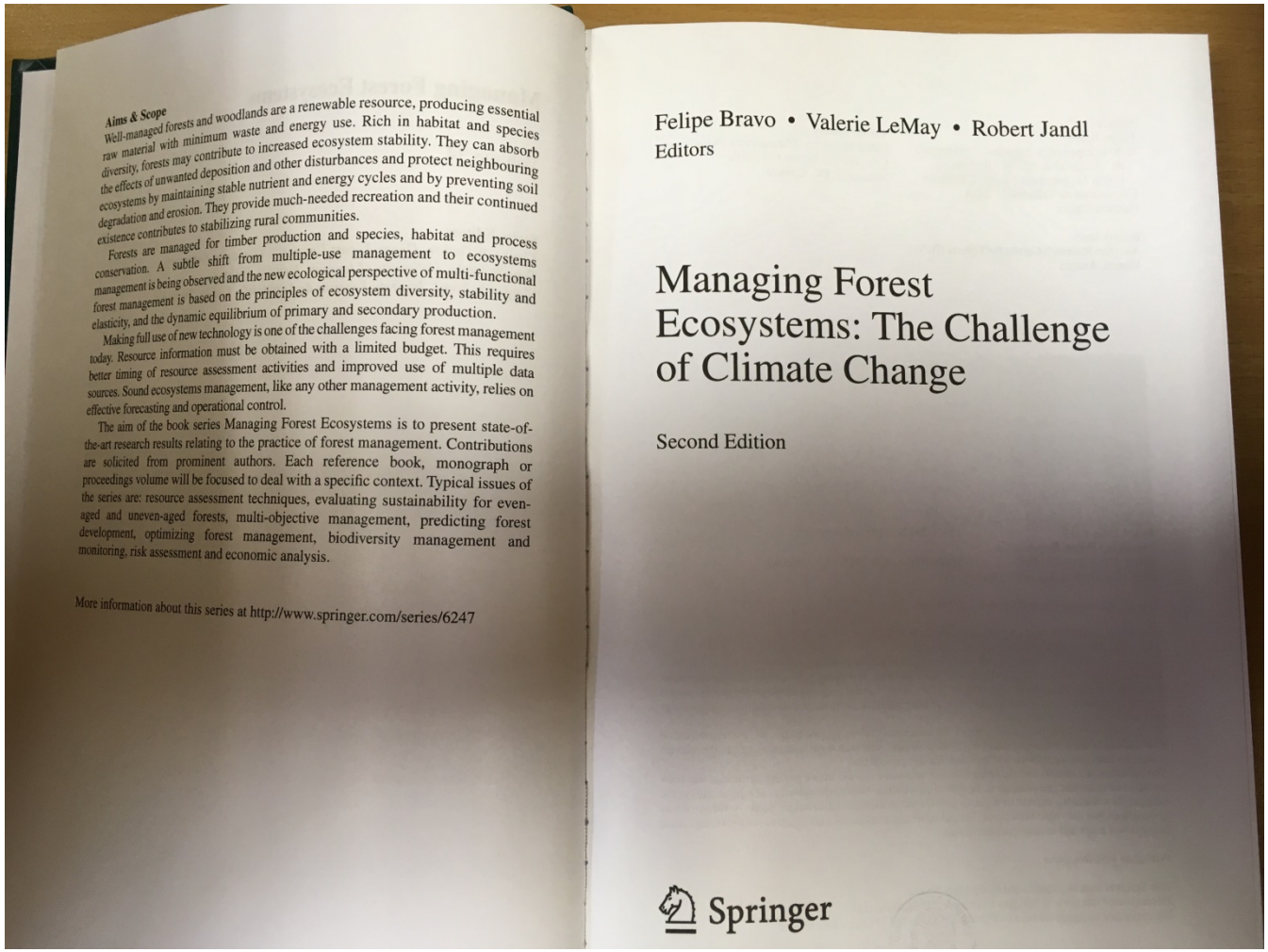
MFCA used in practice

- Training Forest Enterprise in Kostelec nad Černými lesy.
- Benefits in forest management can be seen not only in general areas of activities but also in the costs related to material losses and sales of logging residues.



Influence of forestry on climate change (mitigation)

- Increase stand-level carbon density
- Increase (or maintain) forest area
- Increase carbon stored in products
- Reduce or avoid fossil emissions through product substitution and through bioenergy use



Aims & Scope

Well-managed forests and woodlands are a renewable resource, producing essential raw material with minimum waste and energy use. Rich in habitat and species diversity, forests may contribute to increased ecosystem stability. They can absorb the effects of unwanted deposition and other disturbances and protect neighbouring ecosystems by maintaining stable nutrient and energy cycles and by preventing soil degradation and erosion. They provide much-needed recreation and their continued existence contributes to stabilizing rural communities.

Forests are managed for timber production and species, habitat and process conservation. A subtle shift from multiple-use management to ecosystems management is being observed and the new ecological perspective of multi-functional forest management is based on the principles of ecosystem diversity, stability and elasticity, and the dynamic equilibrium of primary and secondary production.

Making full use of new technology is one of the challenges facing forest management today. Resource information must be obtained with a limited budget. This requires better timing of resource assessment activities and improved use of multiple data sources. Sound ecosystems management, like any other management activity, relies on effective forecasting and operational control.

The aim of the book series Managing Forest Ecosystems is to present state-of-the-art research results relating to the practice of forest management. Contributions are solicited from prominent authors. Each reference book, monograph or proceedings volume will be focused to deal with a specific context. Typical issues of the series are: resource assessment techniques, evaluating sustainability for even-aged and uneven-aged forests, multi-objective management, predicting forest development, optimizing forest management, biodiversity management and monitoring, risk assessment and economic analysis.

More information about this series at http://www.springer.com/series/6247

Felipe Bravo • Valerie LeMay • Robert Jandl
Editors

Managing Forest Ecosystems: The Challenge of Climate Change

Second Edition

Springer

Characteristics of the two boreal case study areas located in eastern Finland (North Karelia).

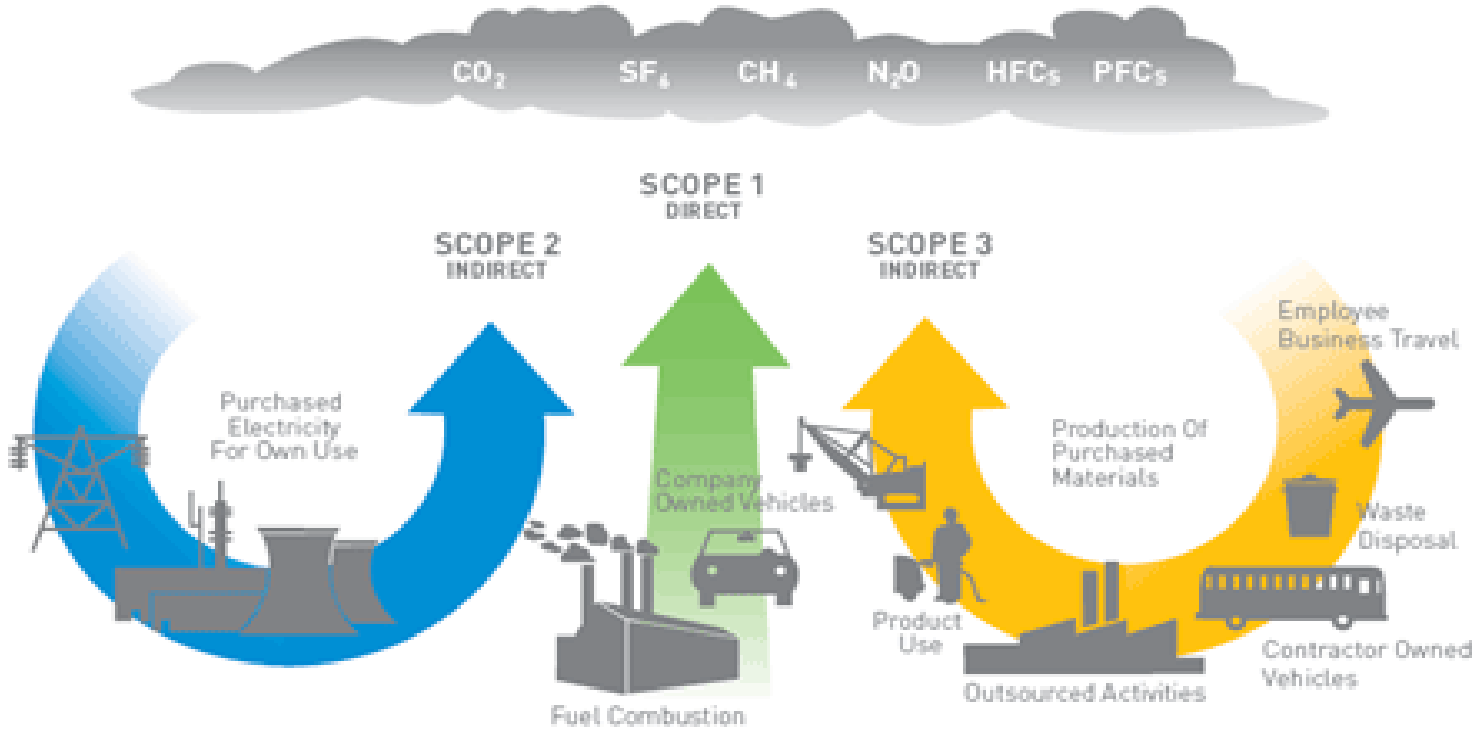
Case study areas	Pine-dominated forest (Vaivio)	Spruce-dominated forest (Koli)
Forest area, ha	950	1117
Forest biomass (above and below ground) stock, tonnes ha $^{-1}$	88	150
▪ Scots pine (%)	48	30
▪ Norway spruce (%)	9	47
▪ *Betula* sp. (%)	43	17
▪ Others broadleaves (%)	1	6
Total carbon stock, tonnes ha $^{-1}$	191	359
▪ Trees	41	65
▪ Mineral soils	150	294

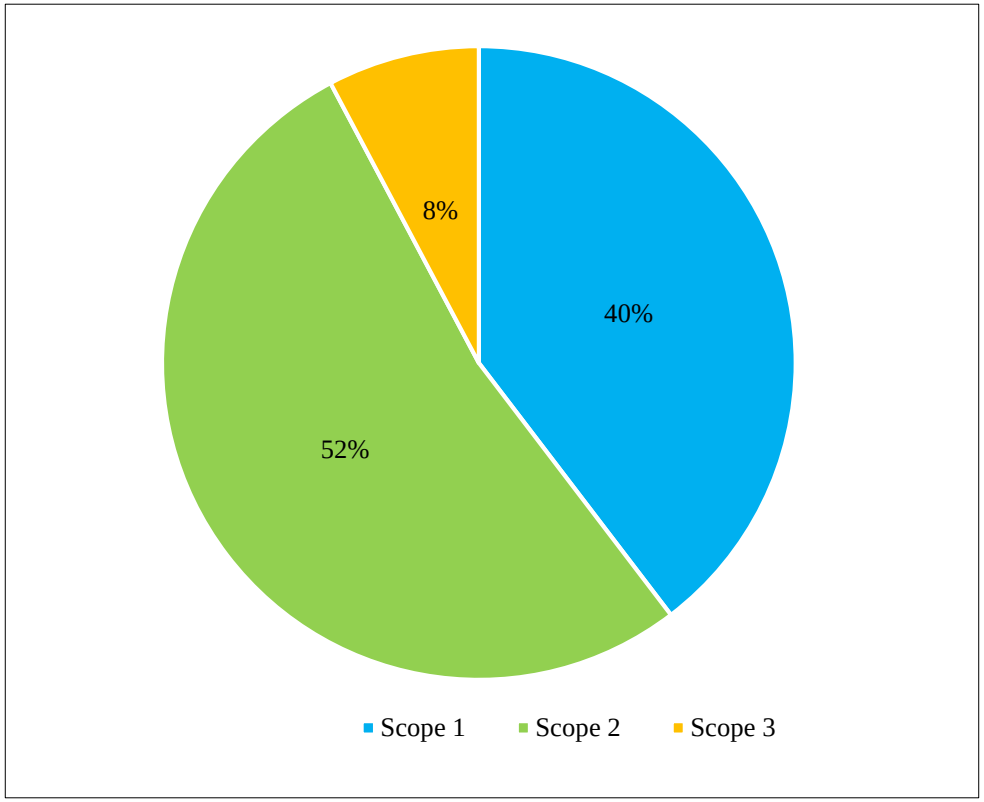
(Zubizarrea-Gerendiain et al. 2016)

Influence of forestry on climate change – carbon footprint

Carbon footprint –practical example - The School Forest Enterprise in Kostelec nad Černými lesy:

The carbon footprint is an increasingly used indicator of sustainable development. Its growing popularity both at the level of businesses and products or institutions of public administration is related to the fact that it has a clear link to one of the key challenges of today – global climate change. The indicator can also be relatively well communicated towards customers, suppliers and subscribers. On the example of the School Forest Enterprise in Kostelec nad Černými lesy survey, we show the possibilities of calculating this indicator at the level of the enterprise in forestry. Emissions are divided into three areas (Scopes).

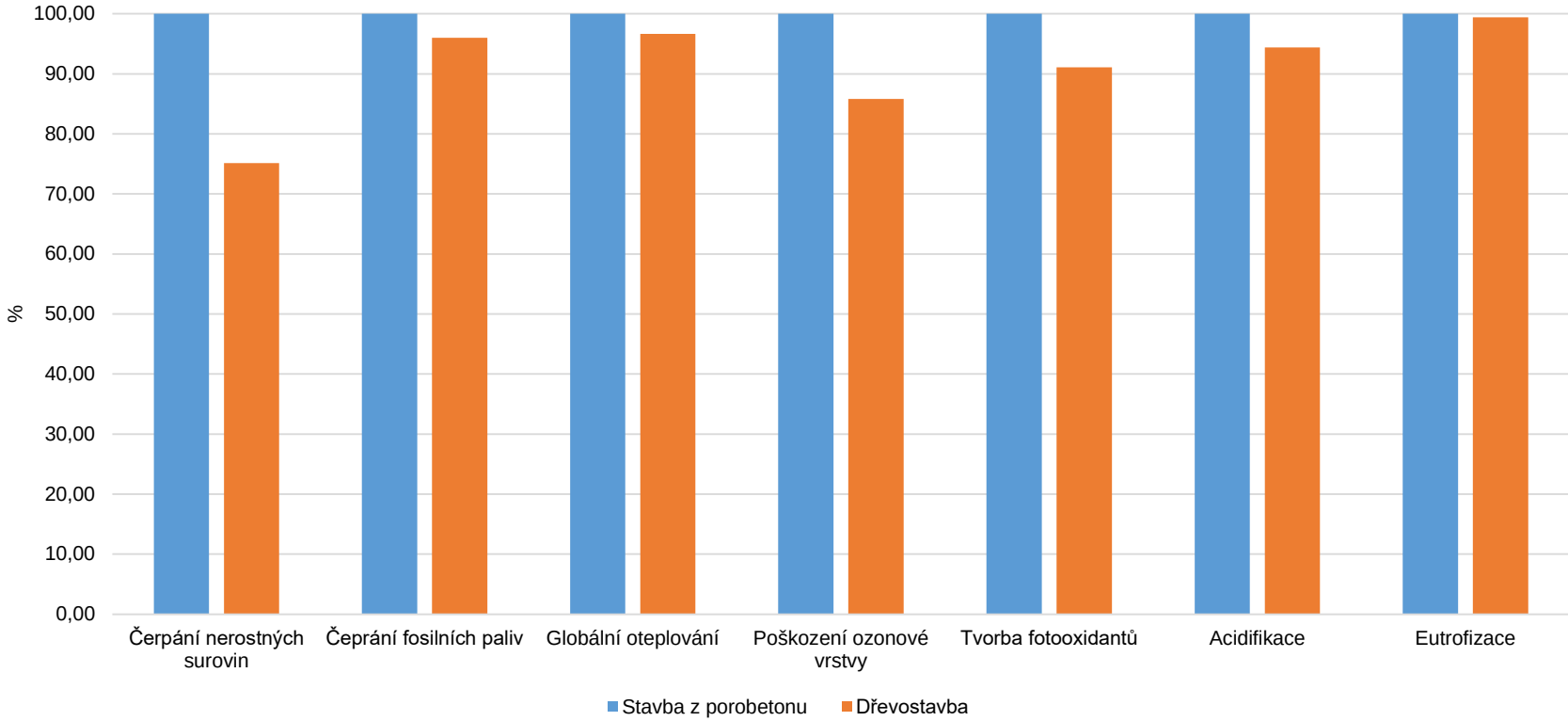

CO_2 SF_6 CH_4 N_2O HFCs PFCs
SCOPE 1
DIRECT
SCOPE 2
INDIRECT
SCOPE 3
INDIRECT
Purchased Electricity For Own Use
Company Owned Vehicles
Fuel Combustion
Production Of Purchased Materials
Employee Business Travel
Waste Disposal
Product Use
Outsourced Activities
Contractor Owned Vehicles


8%
40%
52%
Scope 1
Scope 2
Scope 3

No.	Item	Consumption	Unit	Emission factor	Unit	Emission (t CO_2e)
1.	Diesel	92,698	l	0.00266	t CO_2e / l	246.6
2.	Electricity	693	MWh	0.640	t CO_2e / MWh	327.3
3.	Chemicals	9,000	l/kg	0.0045	t CO_2e / l	41.0
4.	Fencing	8.4	tonne	0.87	t CO_2e / t	7.3
	Total					622.2

On the same area of the forest is carbon sequestration 1,897,500 tCO_2e. This means that **carbon sequestration is 3,050 times higher than annual carbon production.**

Life cycle asessment
classic – wooden building



Sustainability indicators

Independence of non-renewables
Carbon footprint
Resource productivity
Share of renewable energy in gross final energy consumption
Resource use of the bioeconomy
Indirect land use/ embodied land for agriculture and forestry products
Recycling rate for paper and wood products
Wood consumption
Raw material consumption
Production of goods and services in total FWC and by sub-sector
Use of wood in total FWC and by sub-sector
Cascading use of biomass
Use of permanent materials
Trade in wood
Cost-competitiveness of biofuels compared with non-renewable energy sources
Net energy balance
Wood energy

Sustainable resource management
Red List Index
Natural Resource Index
Forest area
Forests under management plan
Protected forests
Threatened forest species
Age structure and/or diameter distribution
Increment and fellings
Roundwood
Growing stock
Forest fragmentation
Tree species composition
Regeneration
Naturalness
Deadwood
Common forest bird species
Value of marketed services on forest and other wooded land
Recreation in forests
Impacts on human wellbeing
Urban forestry and human health
Trends in forest land degradation
Illegal logging and associated trade
Woody bioenergy feedstocks supplied in accordance with EUTR

Climate change adaptation & mitigation
GHG balance
Resource and materials efficiency
Forest-related carbon stocks
Forest damage
Deposition and concentration of air pollutants on forest and other wooded land
Defoliation
Soil condition
Introduced tree species
Economic impacts of invasive species
Genetic resources
Genetically modified trees
Protective forests

Food security
Blue water footprint of wood products
Water use in total FWC and by sub-sectors
Value and quantity of marketed non-wood goods from forest and other wooded land

Competitiveness & jobs
Employment in the total bioeconomy and its sectors, and the contribution of the bioeconomy to total regional employment
Eco-innovation index
Forest holdings
Contribution of forest sector to GDP
Forest sector workforce
Education time in total FWC & Training expenditure as % of turnover in total FWC
Quality of employment in total FWC
Occupational safety and health
Production & employment in wood-working, manufacture of pulp, paper & paper-board, converting, printing
Renewable energy jobs

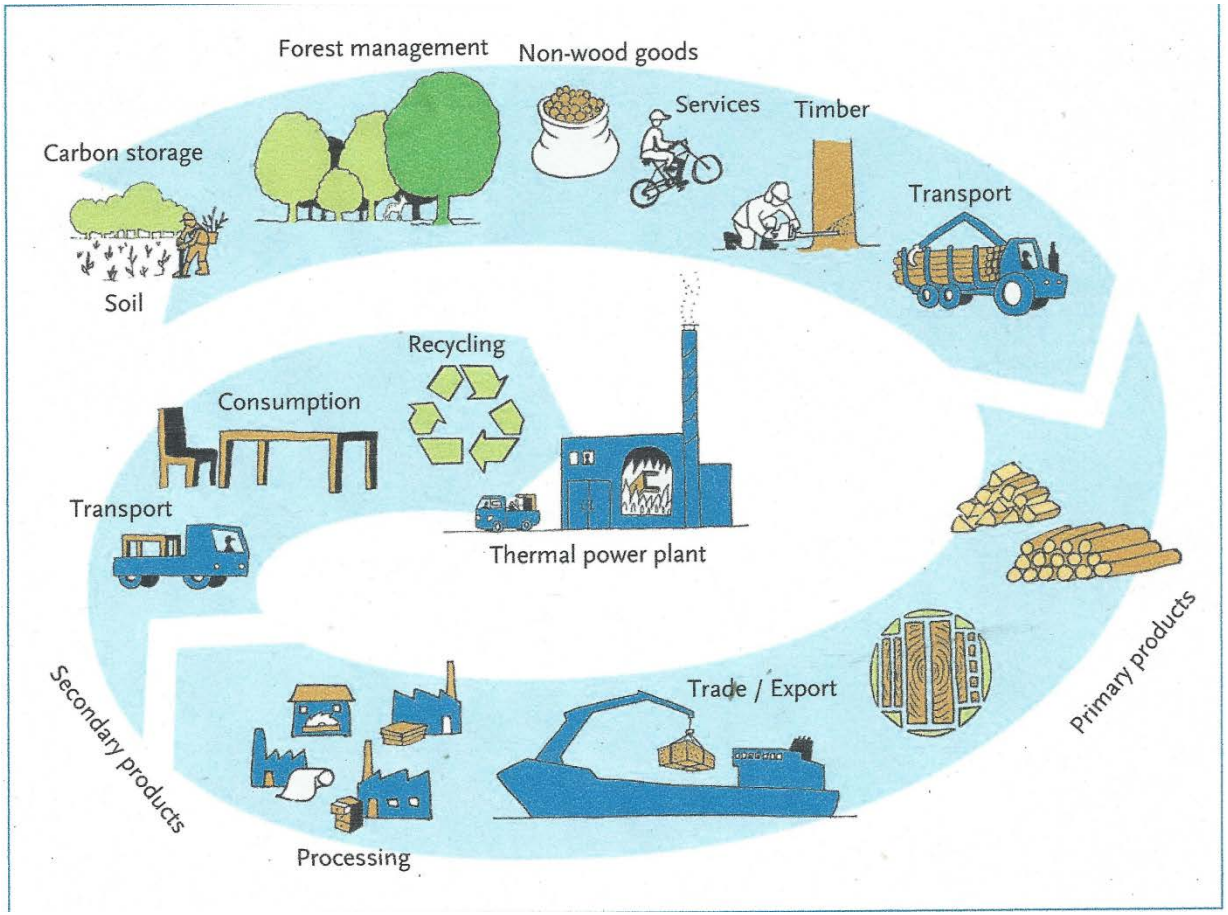
Innovation – new products in total FWC and by sub-sector
Growth of specific bio-based technologies, processes or products
Use and development of biotechnology in the bioeconomy
Development of advanced biorefinery technologies for the production of energy and materials
Research into technical and organisational aspects of new bioeconomy initiatives
Development of environment-related technologies, % all technologies
Patents on resource efficiency technologies
Share of biofuel industry that is part of the bioeconomy in terms of GDP, employment, turnover
Share of chemical industry that is part of the bioeconomy in terms of GDP, employment, turnover

4. Strategy, expected directions of development

EU dokument Innovating for Sustainable Growth: A Bioeconomy for Europe (2012):

The EU has a total forest area of approximately 177 million ha (around 40 % of the EU territory), of which 130 million ha are available for wood supply and the production of non-wood goods and services (cork, resins, berries, mushroom, hunting for example).

Forest based sector value chain



Priorities

- Supporting our rural and urban communities
- Fostering the competitiveness and sustainability of the EU's Forestbased Industries, bio-energy and the wider green economy
- Forests in a changing climate
- Protecting forests and enhancing ecosystem services
- What forests do we have and how are they changing?
- New and innovative forestry and added-value products
- Working together to coherently manage and better understand our forests
- Forests from a global perspective

Prioritise investments in

- modernising forestry technologies
- optimising the sector's contribution to the bio-economy
- improving the resilience, environmental value and mitigation potential of forest ecosystems archieving nature and biodiversity objectives
- adapting to climate change
- conserving genetic resources
- forest protection and information
- creating new wood and agro-forestry systems

Conclusion

- Forest Policy of the European Union points to the need for **greater recognition of the paradigm of sustainable development** in the functioning of the forestry and wood industry.
- Encouraged to work on a **comprehensive assessment of machinery and technologies used in forestry from the point of view of employment and the impact on the natural and social environment** at join - Foresty and Forest Based Industry

Thank you for your attention!

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