INNOVAForONE

Innovations and networking in European Forestry

ONEforest Final Conference

18·19 April 2024
VALLADOLID

ONEforest Final Conference

First Day – 18 April 2024

INNOVAForONE

Project Overview

- 18 April 24 // Rosenheim Technical University

INNOVAForONE

ONEforest

Starting point

At the beginning, there is an idea…

Europe's forests are facing major challenges:
Climatic changes and increased vulnerability to storms, droughts, insects and forest fires.

Beetle infections

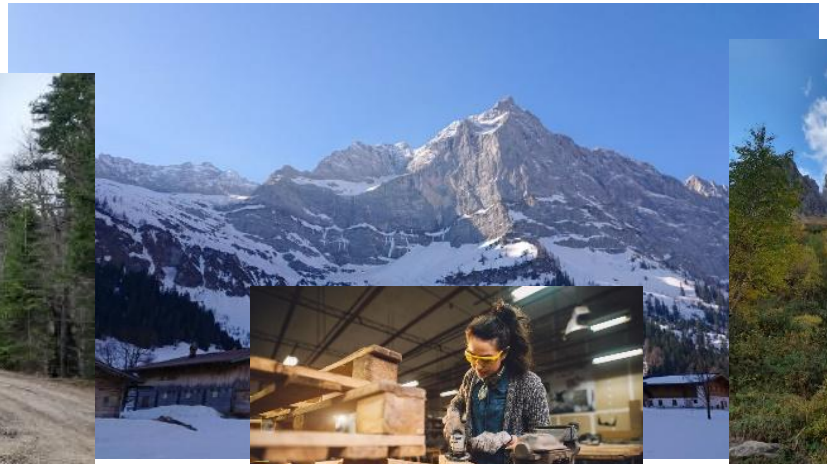
Forest after storm

Forest fire

Demand on European forests to contribute to climate protection.

Demand on forests to fulfill a variety of functions, e.g.

- to provide a steady supply of wood for the wood-processing industry,
- protection against avalanches and erosion,
- retention of rainwater,
- place for recreation for tourists.

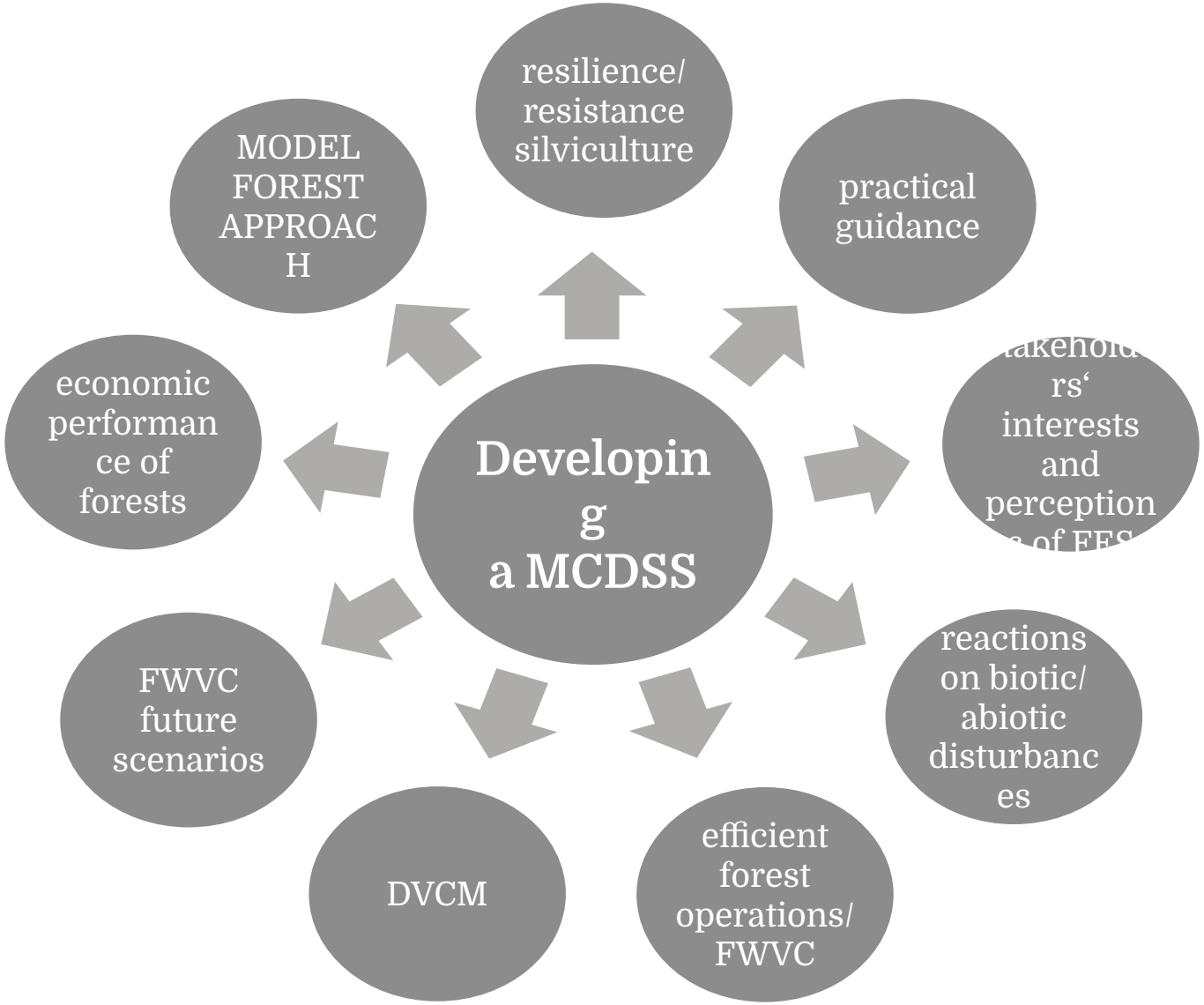


Decision-making in forest management and in the forest-wood value chain becomes more and more difficult and **complex**!

Objectives

Development of a multi-criteria decision support system

- to promote sustainable forest management,
- to illustrate synergies and trade-offs between forest ecosystem services,
- for a reliable wood supply,
- to integrate the interests of stakeholders by means of indicators for the forest-wood value chain, taking into account social, economic and environmental dimensions, and
- to ease decision-making.



INNOVAForONE

ONEforest

A Multi-Criteria Decision Support System for a common Forest Management to strengthen Forest Resilience, harmonise Stakeholder Interests and ensure Sustainable Wood Flows

Project duration: June 2021 - May 2024

Project consortium: 19 partners in 8 countries

Funding volume: 5.2 Mio. Euros

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement N° 101000406.

Partners

Rosenheim Technical University of Applied Sciences

ANW

Bavarian Research Alliance

ceseforo

CLIMATE ENDOWMENT

CTFC

www.emu.ee
Eesti Maaülikool
Estonian University of Life Sciences
Metsandus- ja maaehitusinstituut
Institute of Forestry and Rural Engineering

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Institute of SOIL MECHANICS, FOUNDATION ENGINEERING and COMPUTATIONAL GEOTECHNICS

SLU

TECHNISCHE UNIVERSITÄT DRESDEN

TECHNISCHE UNIVERSITÄT MÜNCHEN

unibz

UNI FREIBURG

UNIVERSITY OF TARTU

Univerza v Ljubljani

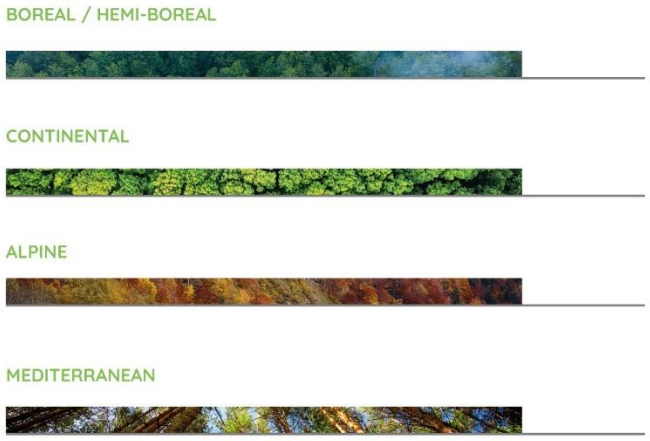
UNIVERSITY OF TRENTO

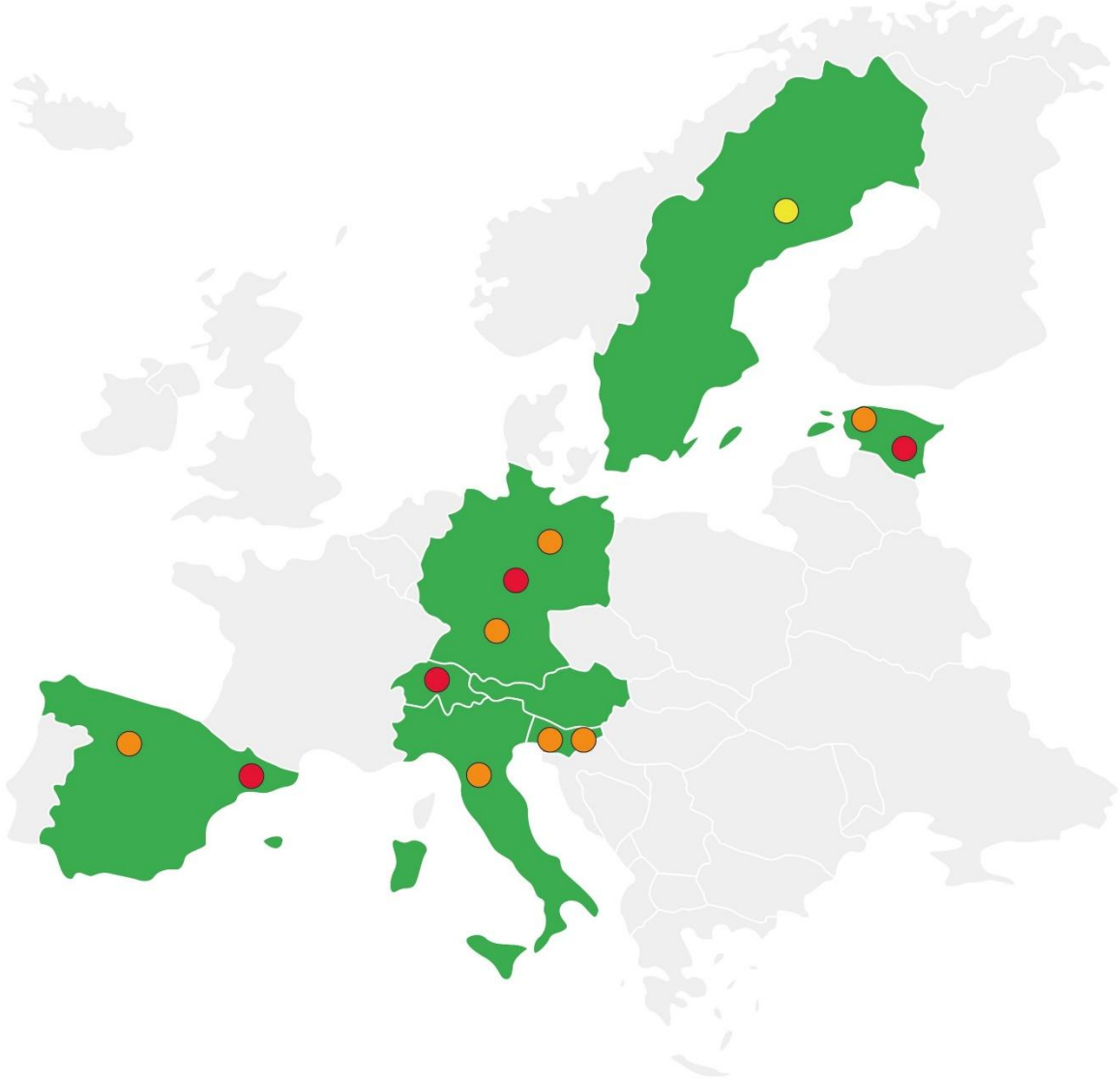
REGIONE TOSCANA

Mediterranean Model Forest Network

WSL

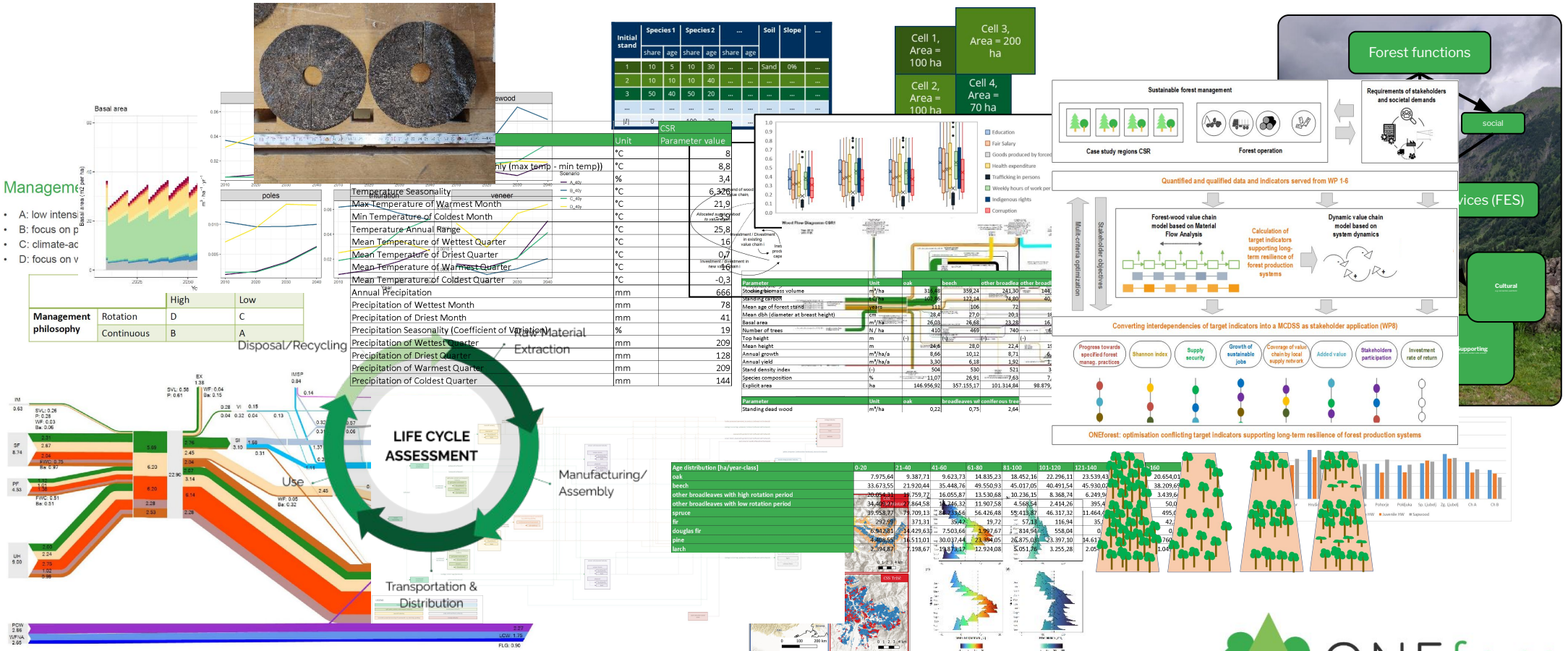
Case Study Regions





Work in the consortium

Project’s main final results



ONEforest

INNOVAForONE

Status and possible futures for Catalonia

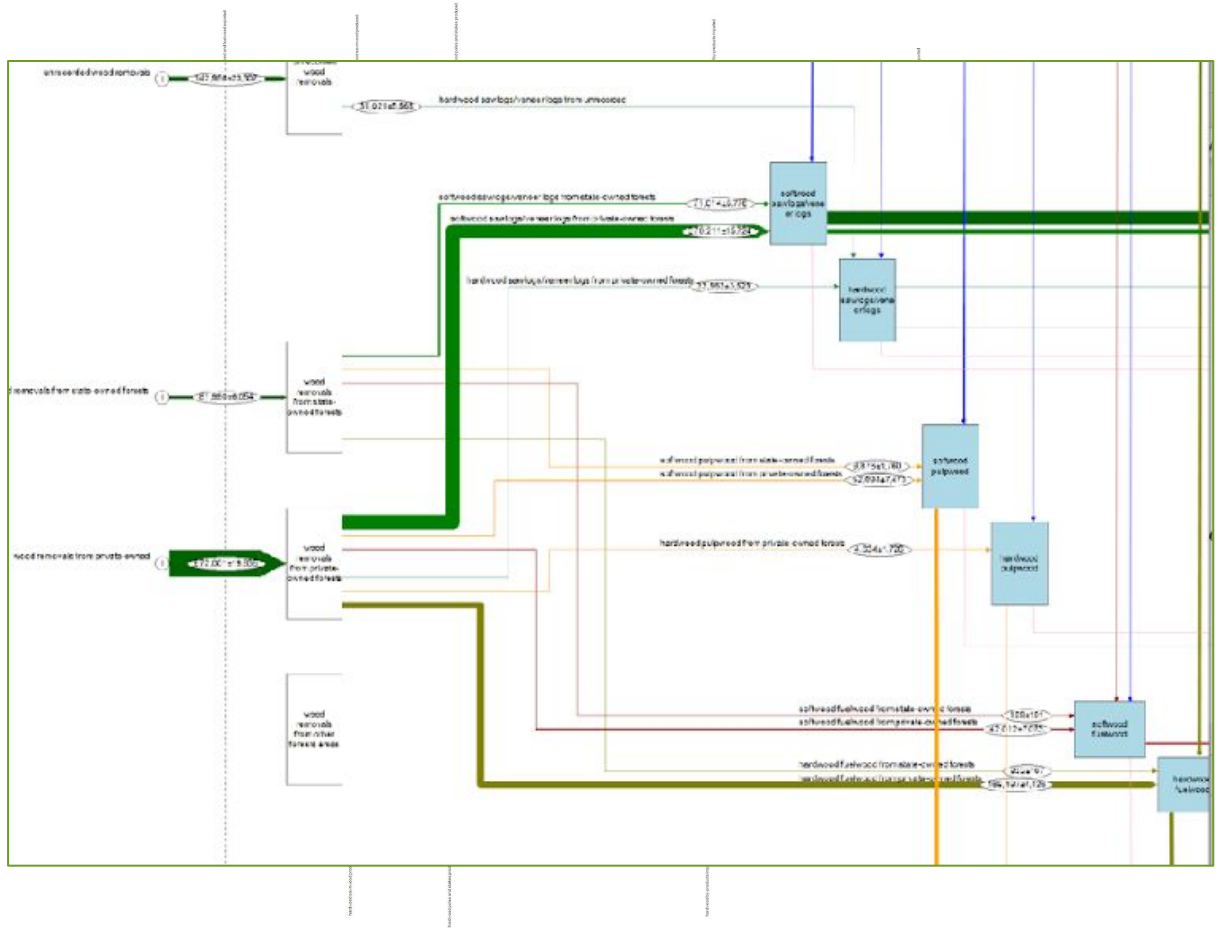
– forest, forest wood value chain and societal development

Overview about CSRs

	Estonia	Grisons (CH)	Catalonia (ES)	Hesse/Thuringia (DE)
Geography, forest type	Northern Europe, Boreal/Hemi-boreal forests	Central Europe Alpine forests	Southern Europe Mediterranean forests	Central Europe Continental forests
Total land CSR	4,533,900 ha	710,500 ha	281,000 ha	3,728,600 ha
Forest land	2,332,600 ha	201,240 ha	281,000 ha	1,443,300 ha
Managed forest land	2,003,800 ha	184,240 ha	187,000 ha*	1,356,700 ha*
Main species	Scots pine, Norway spruce, silver birch, alder and aspen	Spruce, larch and Scots pine	Scots pine and black pine	European beech, spruce and Scots pine
Forest ownership	Private and state	Private and state	Private and state	Private and state
Wood-based industries	From sawmill to pulp and biorefinery	Only sawmill and energy production	Sawmill, poles and stake, wood energy products, and energy production	From sawmill to pulp and biorefinery

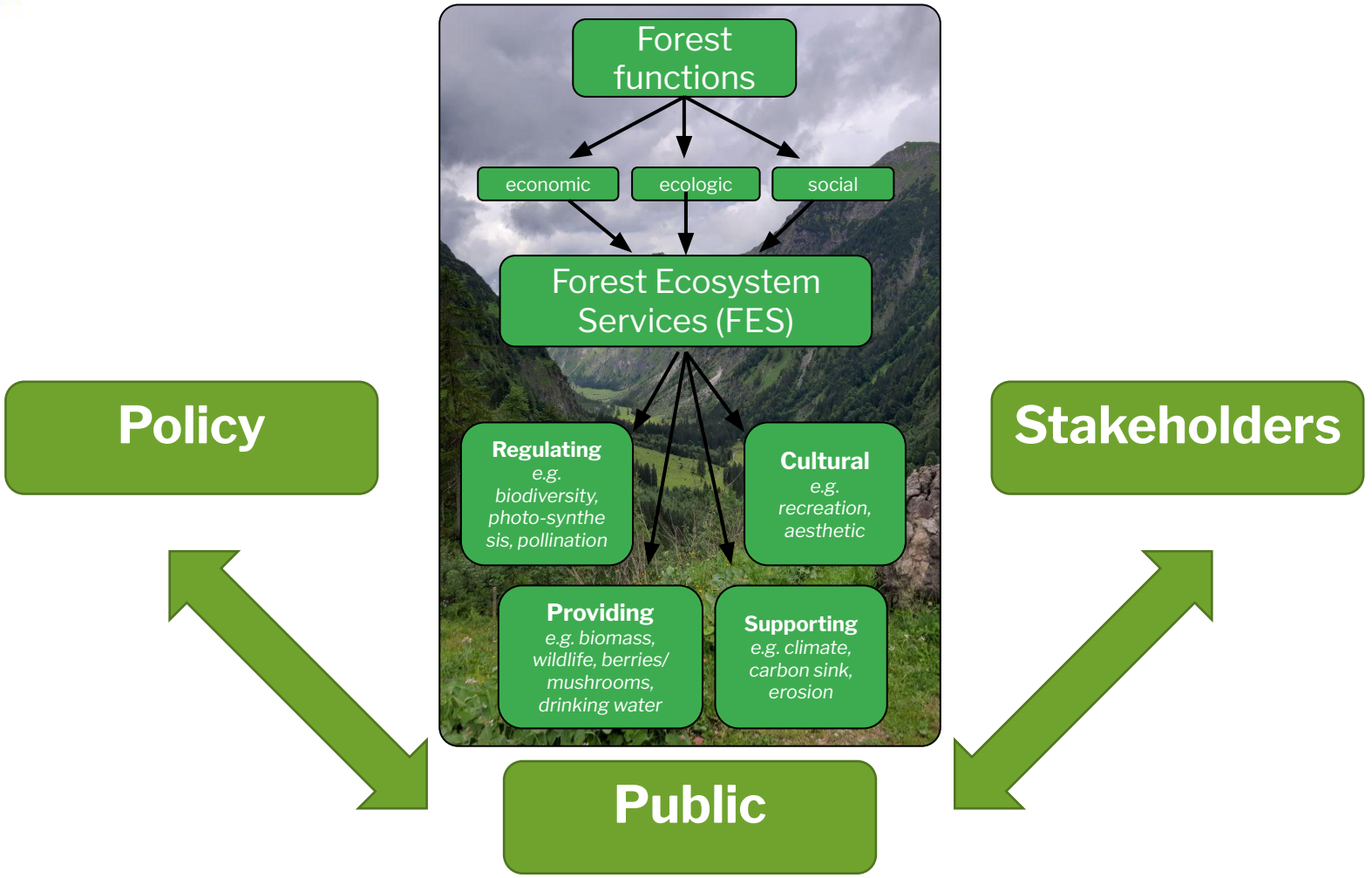
* partially protected

MFA of forest wood value chain in Catalonia (CSR3) based on data from 2018



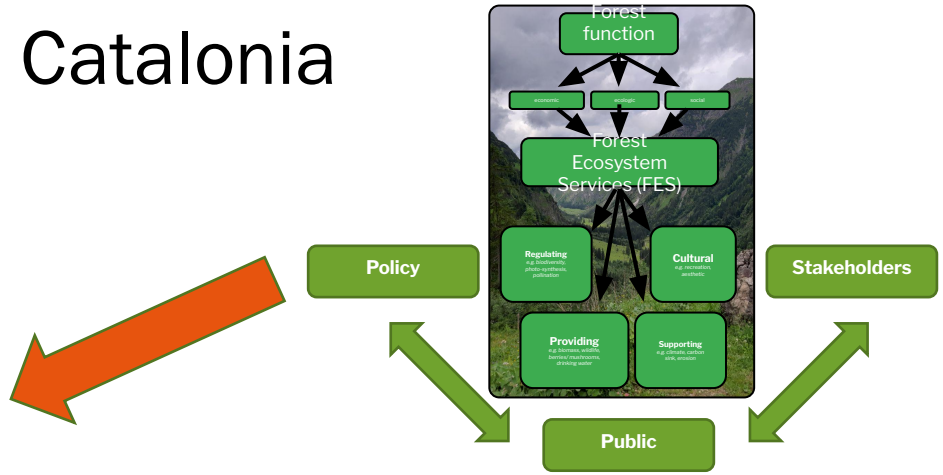
- **Wood removal and fellings**
  - high share of harvested timber from private-owned forests, in particular softwood
  - more fuel wood leaves Catalonia than it is “imported”
  - MFA confirms that a large share of wood removals are not recorded in the statistics
- **Wood processing**
  - a small proportion of the softwood is used to produce sawnwood products and poles and stakes
  - pulpwood all leaves Catalonia
  - by-products of the sawmills and poles and stakes productions are processed to energy products
  - hardwood from private forests is almost used as energy

How do we view forest ecosystem services in Catalonia?



Forest ecosystem services in Catalonia

Main goals/region	Catalonia (ES)
Biodiversity	Regulate forest management to be more sustainable
Bioeconomy	Connect growth with preserving environment
Climate change	Decrease greenhouse gas emissions
Energy	Promote use of bio-energy
Forest	Regulate forest management balancing economic values and preservation



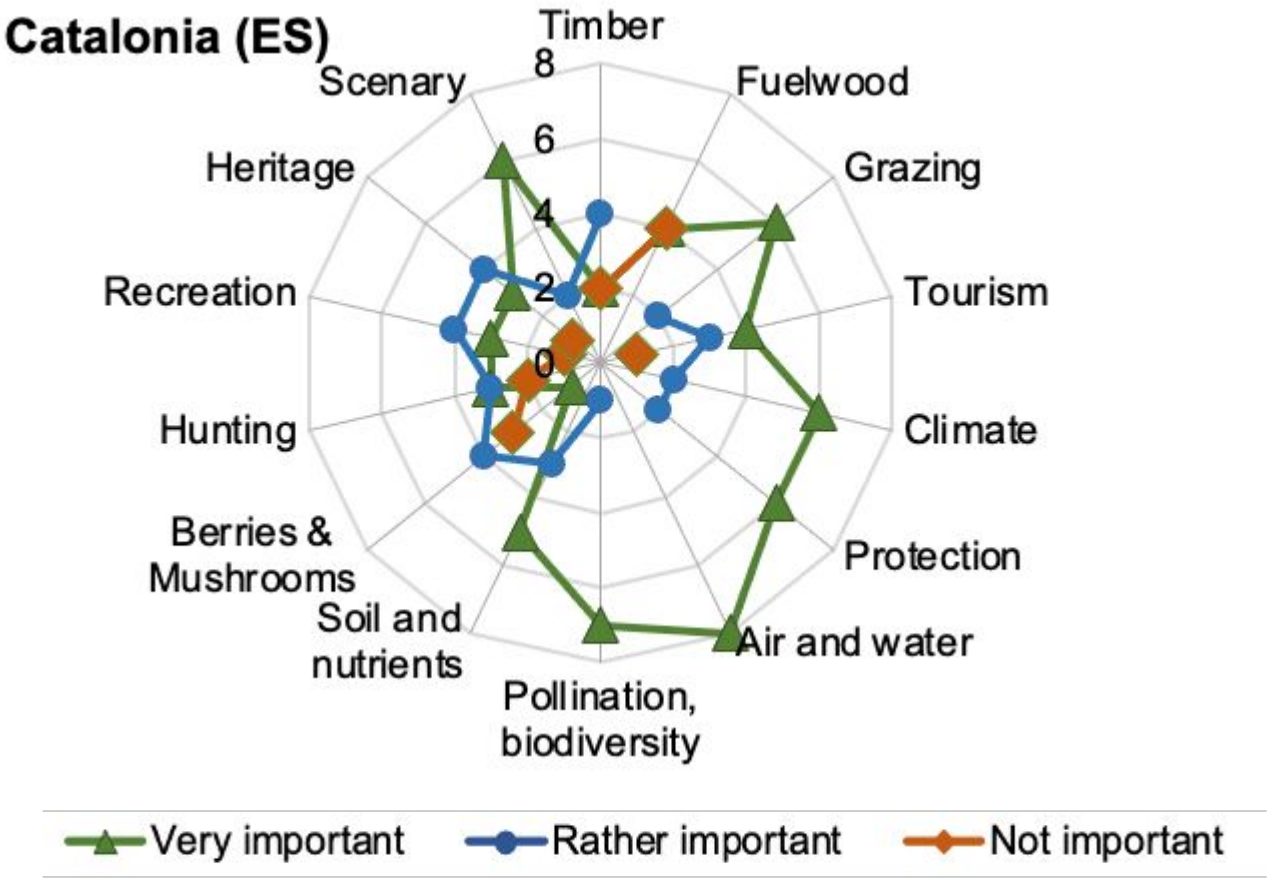
Conflicts

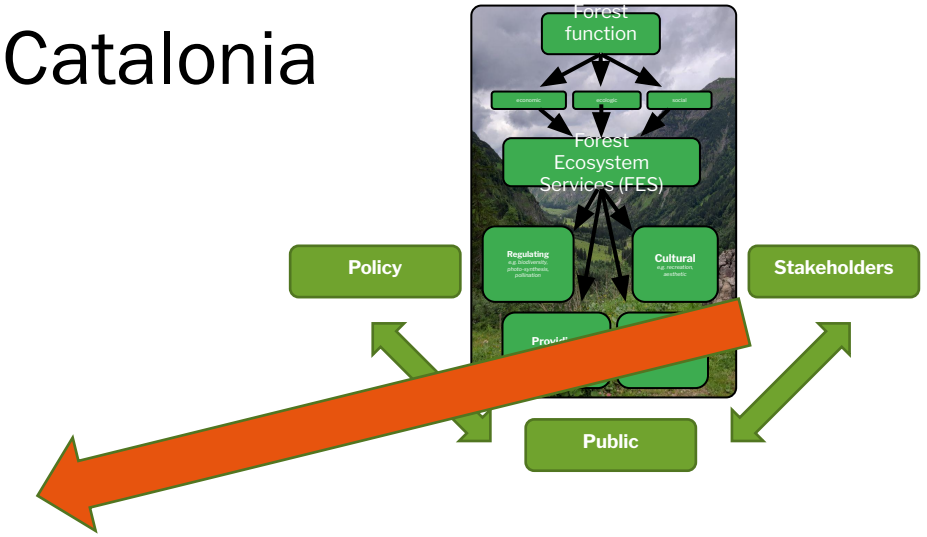
Forest protection ⟷ Economic values

Biodiversity ⟷ Biomass production

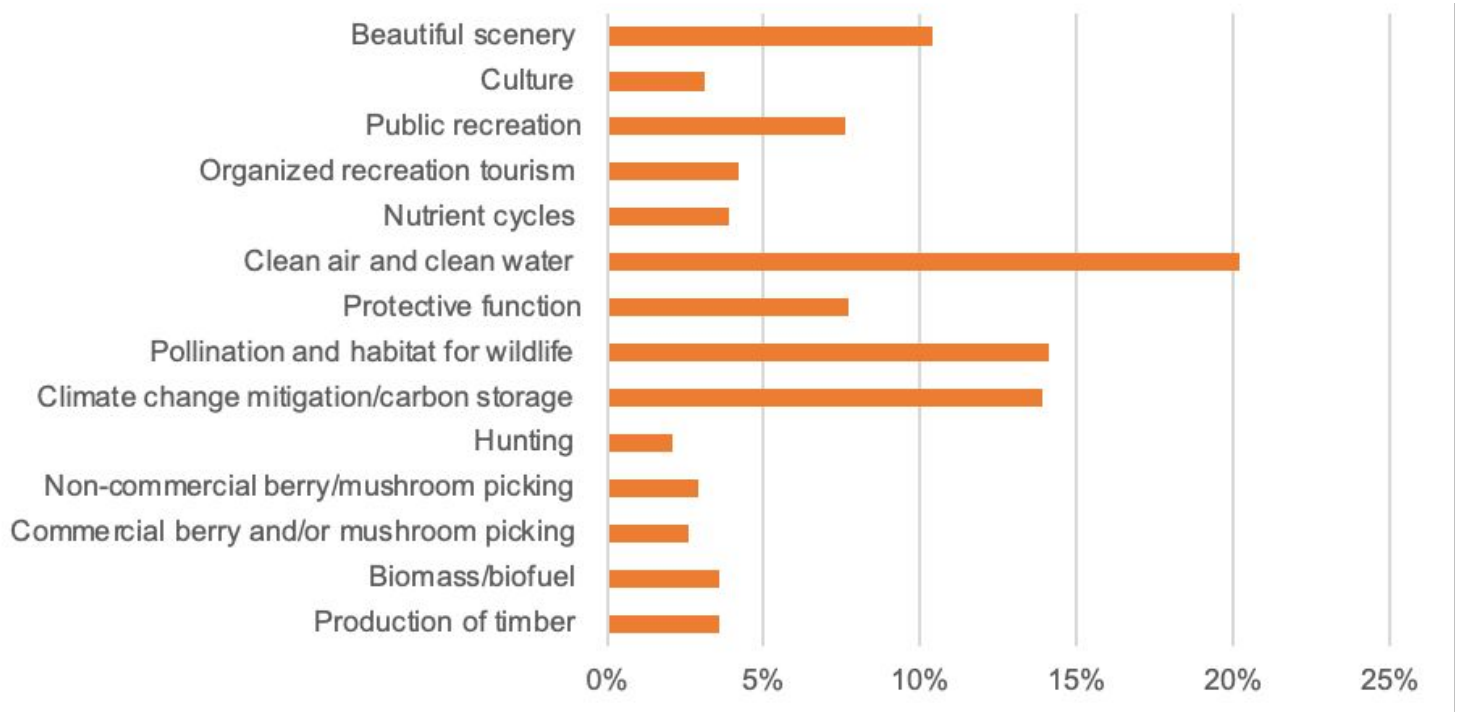
Forest preservation ⟷ Socioeconomic values

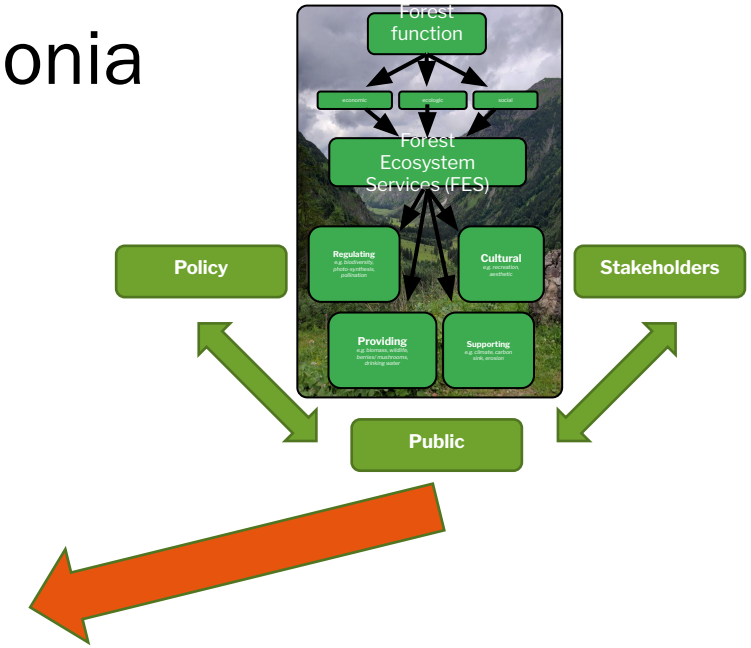
Forest ecosystem services in Catalonia





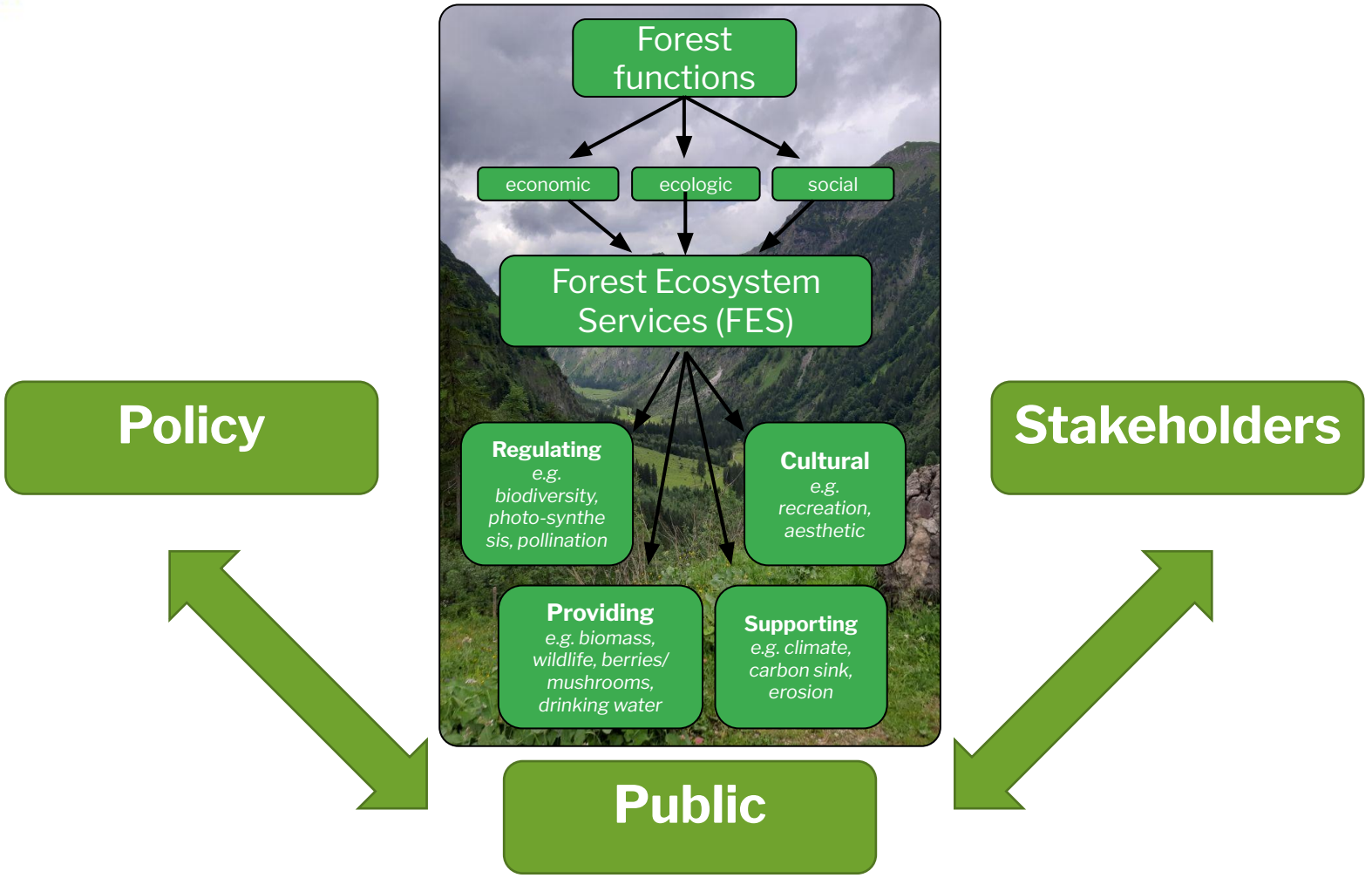
Forest ecosystem services in Catalonia



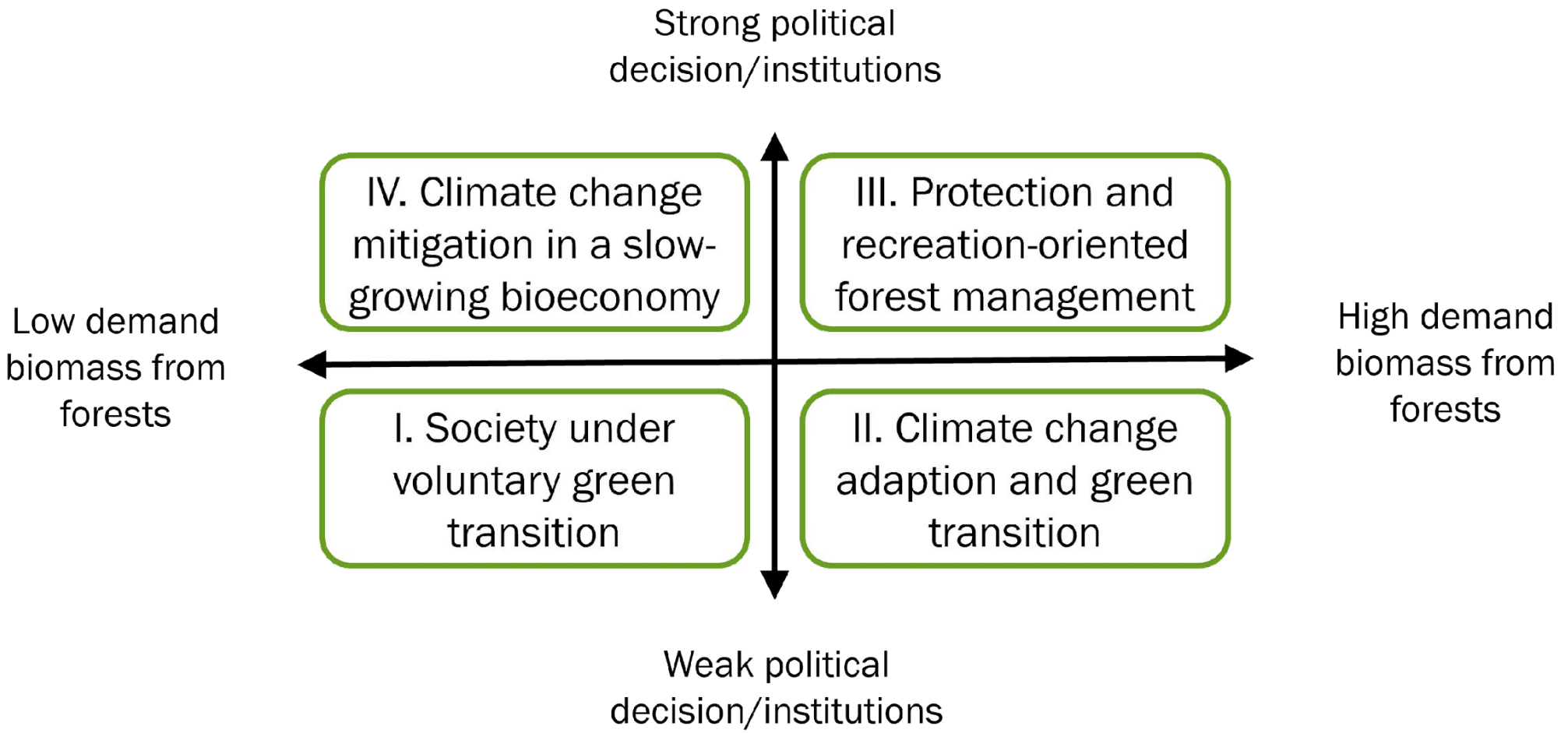


Most important forest ecosystem services

How do we view forest ecosystem services in Catalonia?



Pathways forward – scenarios in Catalonia



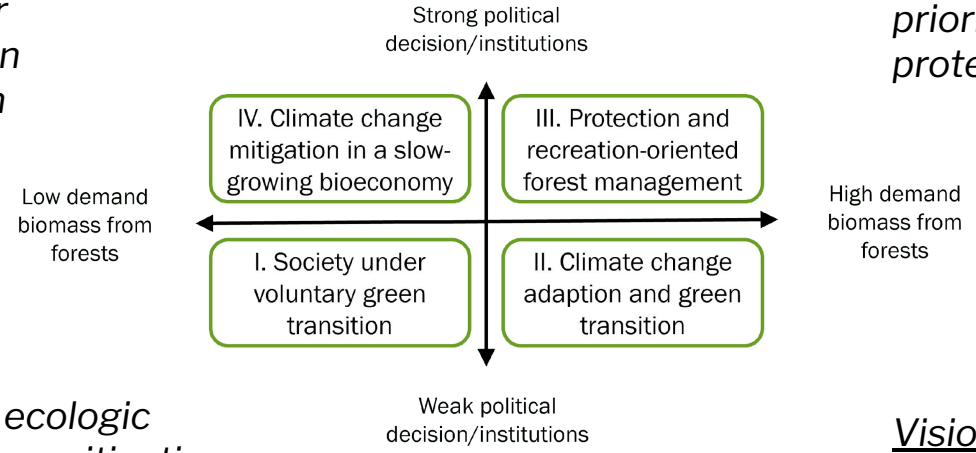
Vision and attitude in scenarios / Catalonia

Vision: Strong regulation to promote protection of forests for carbon storage.

Attitudes: supporting ecosystem services (carbon capture, water provision) and biodiversity are in focus, integrating preference in forest management decisions

Vision: protection of forests to promote ecosystem services like recreation and clean air and water

Attitudes: recreation and biodiversity are prioritized and conflicts between forestry or protection are more common.



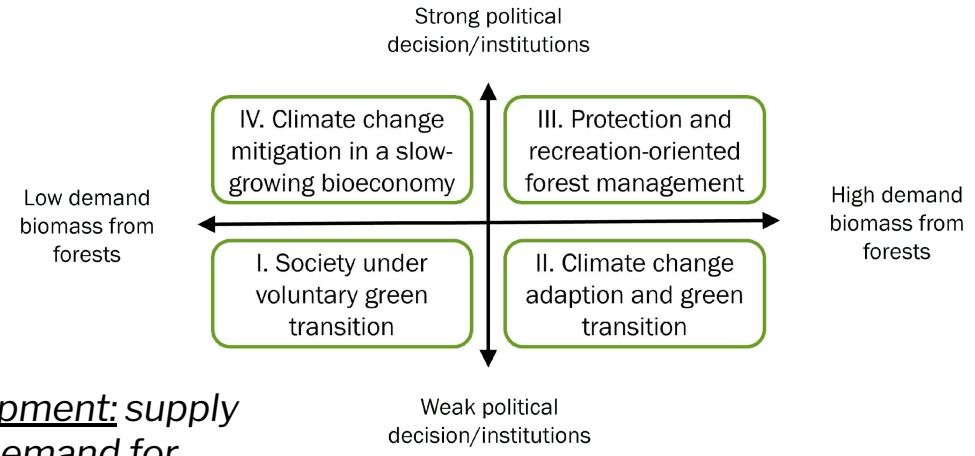
Vision: balancing economic and ecologic values, supporting climate change mitigation and adaptation.

Attitudes: forest management to handle increasing forest damages (e.g., fire) is recognized as important.

Vision: Sustainable society, bioeconomy development with diversified forest use emphasizing climate change adaptation

Attitudes: forest management important to prevent effects of climate change (e.g., fire)

Wood value chain and industry development in Catalonia



<u>Wood-value chain market development:</u> supply for timber stays constant, while demand for timber for building sector increase as well as wood fuel.

<u>Industrial development:</u> traditional industry continues develop while new industry is not developing.

Scenarios, MCDSS and DVCM

How can decision-making be supported by a comprehensive tool for the forest wood value chain?

Time horizon 2020-2060

4 overriding scenarios for the forest wood value chain

MCDSS
Interest of stakeholders

Controller
Stakeholder

Indicators

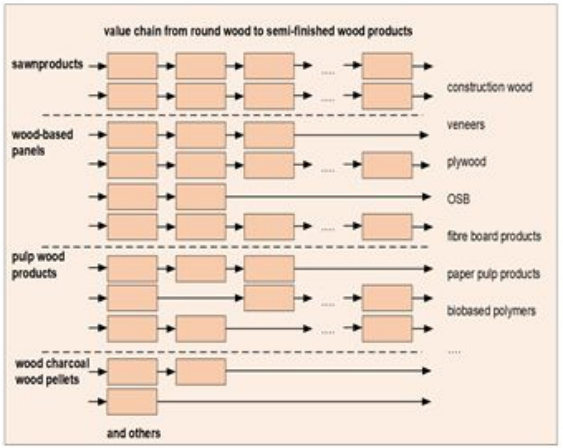
- **Standing timber volume**
- **Harvvested timber volume**
- **Wood revenues**
- **Number of large trees**
- **Visual attractiveness**
- **Volume of deadwood**
- ….

Forest Growth Models of 4 CSRs

Forest management options
Forest operations methods

wood assortments

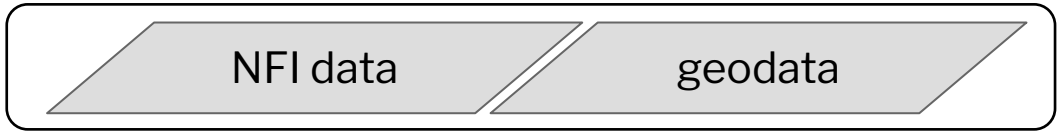
Dynamic Model of Wood Value Chain



Output: forest management options

Impact on wood value chain

Data generation process



CS R

Calc. indicators directly

Manage ment options

Climate assumpti ons

Scenario s

Landsca pe

Growth and yield software

RCP 2.6, 4.5, 8.5

Growth and yield simulations

Indicator calculations

Optimization **MCDSS**

Wood volumes

Indicator developments

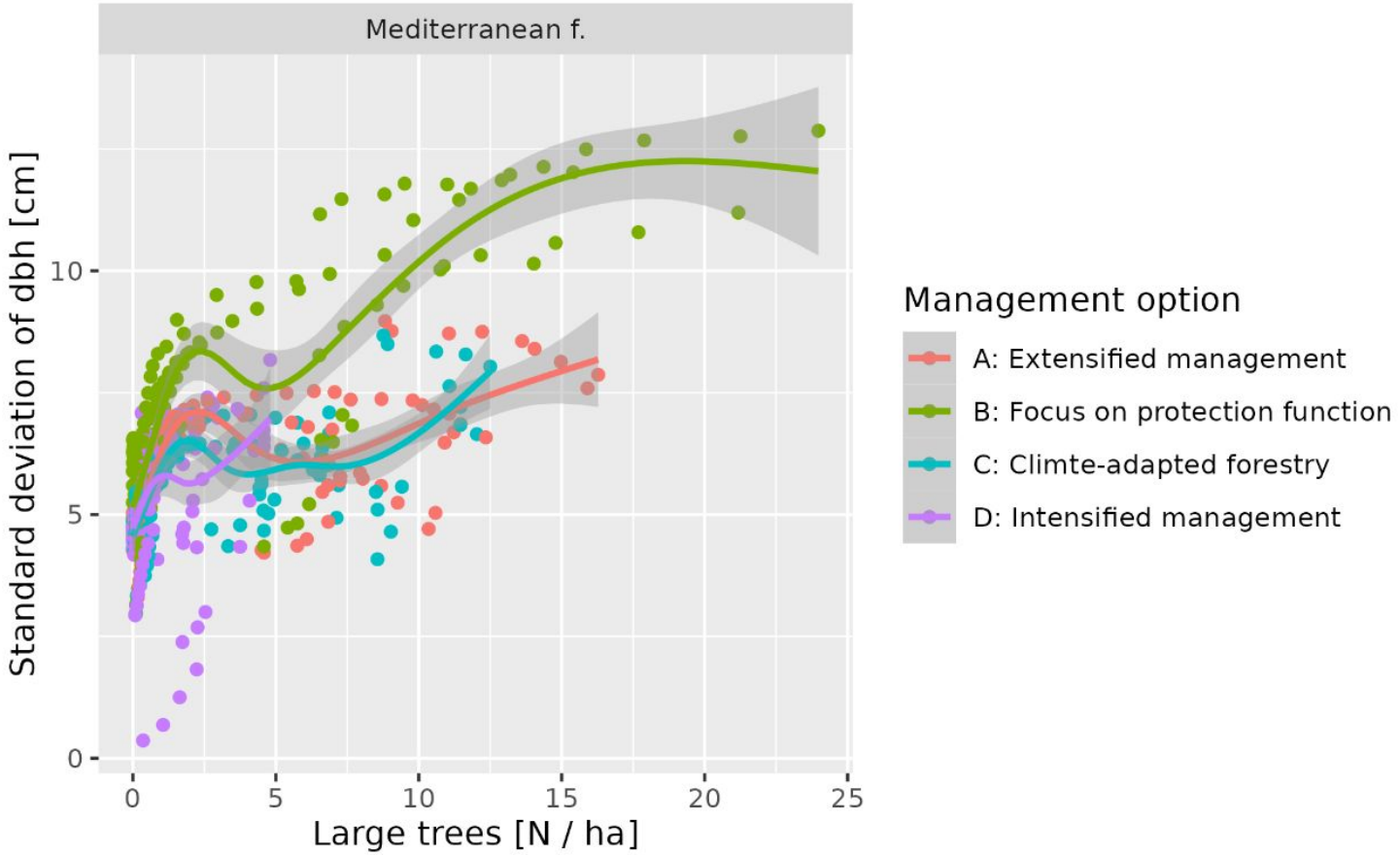
The Indicators

- Standing timber volume
- Harvested timber volume
- Wood revenues
- Number of large trees
- Visual attractiveness
- Volume of deadwood
- Carbon sequestration
- Shannon Index
- Diameter variability
- Risk of total loss
- Mean tree diameter
- ...

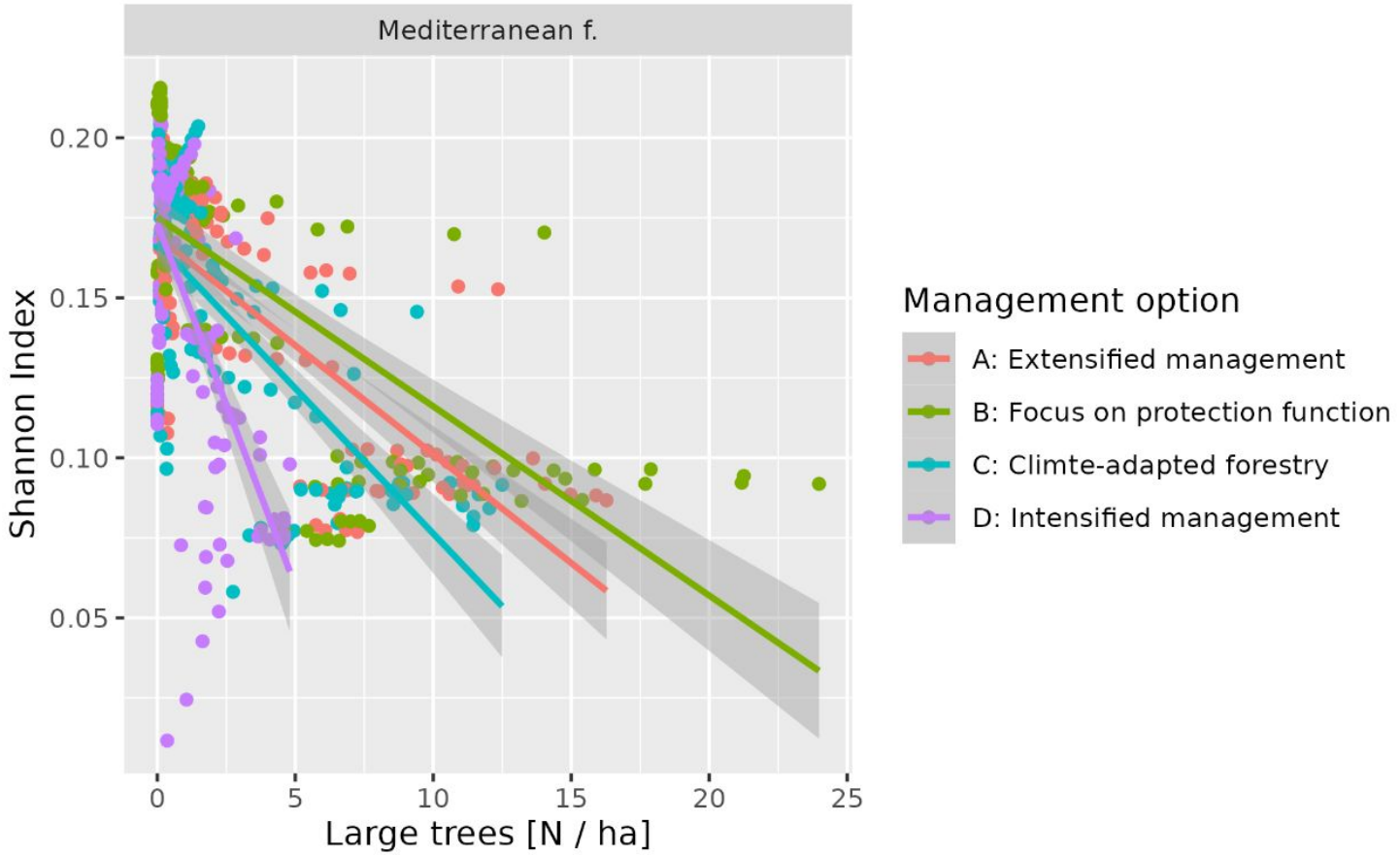
Examplary simulated development of one representative forest stand

Pure beech stand of medium age (CSR continental forests)

Shannon index vs. number of large trees



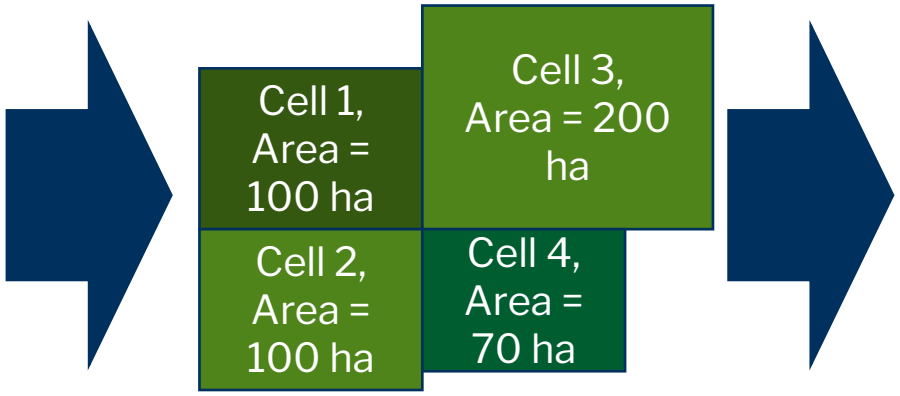
Diameter variability vs. number of large trees



MCDSS - Concept

Initial stand	Species 1	Species 2	...	...
	share	share	share	
1	10	10	...	...
2	10	10	...	...
3	50	50	...	...
...	...	...	...	...
	0	100	...	...

Initial Stand	Management option	Indicators ≈ 20				
		0	1	2	...	8
1	*A*	0	1	1	...	5
1	*B*	1	0	1	...	0
1	*C*	1	1	1	...	1
1	*D*	1	2	0	...	0
2	*A*	...	...	...	...	...
2	*B*	...	...	...	...	...
2	*C*	...	...	...	...	...
2	*D*	...	...	...	...	...
...		...	...	...	...	...
	A	...	...	...	...	...

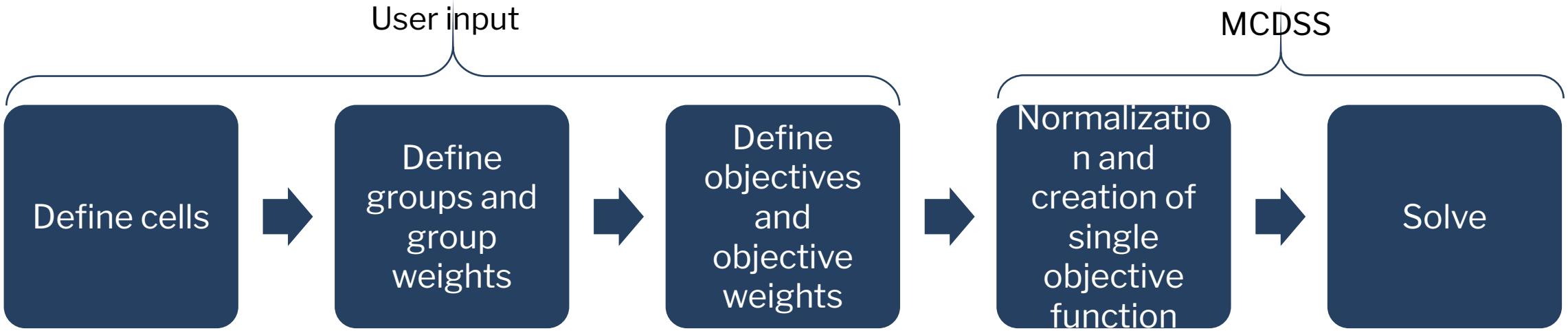


Cell	Management option
1	A
2	B
3	A
4	D

Management options (example):

A: Low intensity
B: Business as usual (BAU)
C: Climate adapted forestry
D: Intensified management

MCDSS - Solution steps



- Size
- Assign a stand to each cell

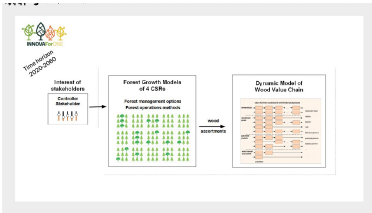
- Assign the cells to groups, if desired

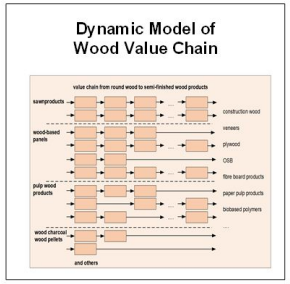
- For each group, select objectives and their corresponding weight

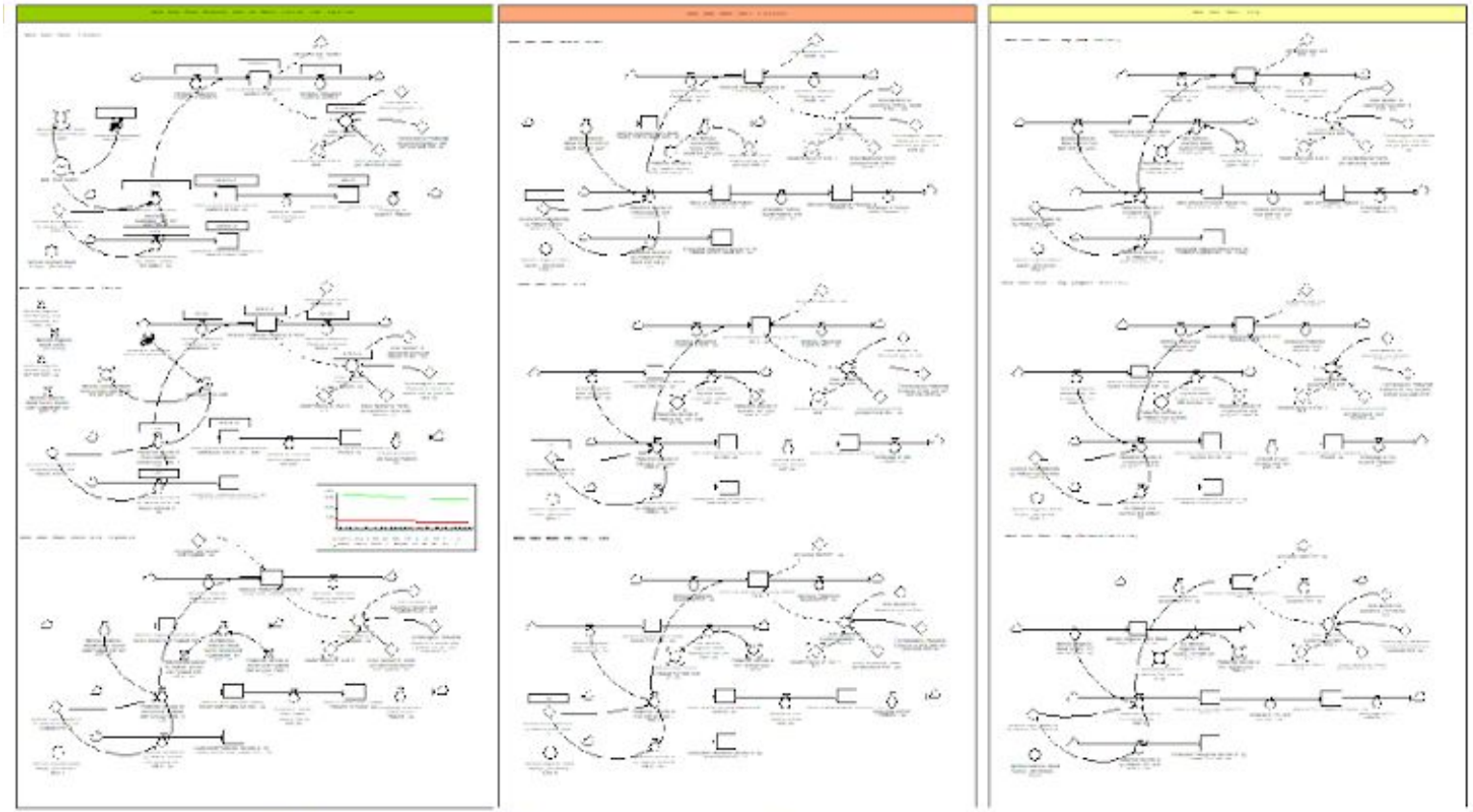
- Calculate upper and lower bounds of the objectives

- Merge the selected and weighted objectives into a single objective function

DVCM – What is the Dynamic Value Chain Model?







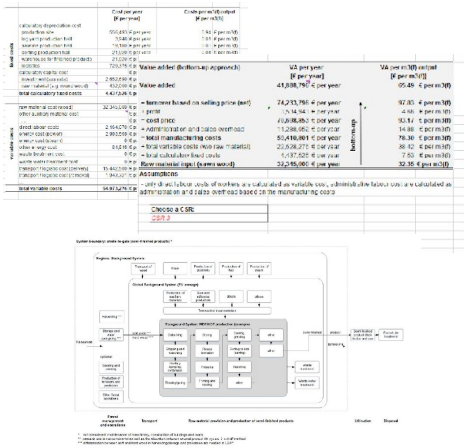
CSR-specific modeling of

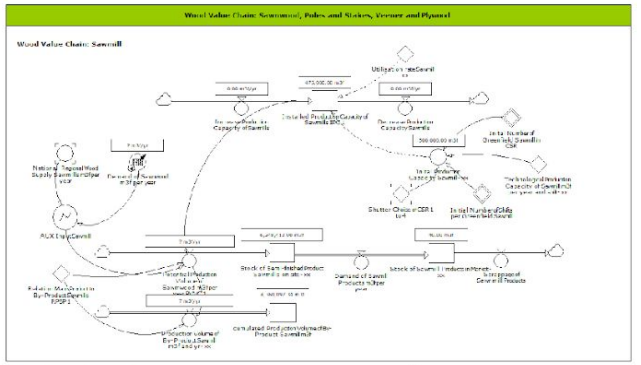
- different wood-based industries and their capacities
- the socio-economic impact
- the environment impact

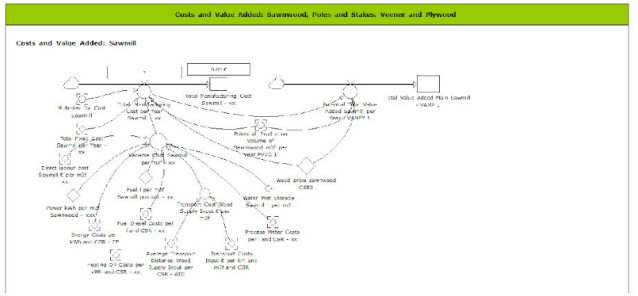
Methodology of the DVCM

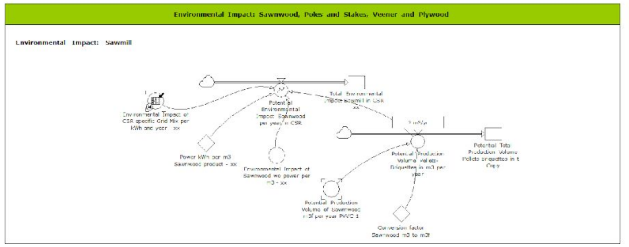
- DVCM uses the System Dynamics Approach (Club of Rome | World Model) to simulate the donwstream value chain by taking into account constraints or system behaviour over the time horizon from 2020 to 2060
  - 12 different wood value chains from sawnwood, different panel board and pulp to energy products

- To quantify the wood flow, socio-economic and environmental impact other methodologies are combined with System Dynamics
  - Value Added Calculation based on a greenfield approach
  - Life Cycle Assessment (cradle-to-gate) streamlined and prospective approach
  - Social Life Cycle Assessment









INNOVAForONE

Results

How can decision-making be supported by a comprehensive tool for the forest wood value chain?

4 overriding scenarios for the forest wood value chain

Interest of stakeholders

Controller Stakeholder

Indicators

- **Standing timber volume**
- **Harvvested timber volume**
- **Wood revenues**
- **Number of large trees**
- **Visual attractiveness**
- **Volume of deadwood**
- ….

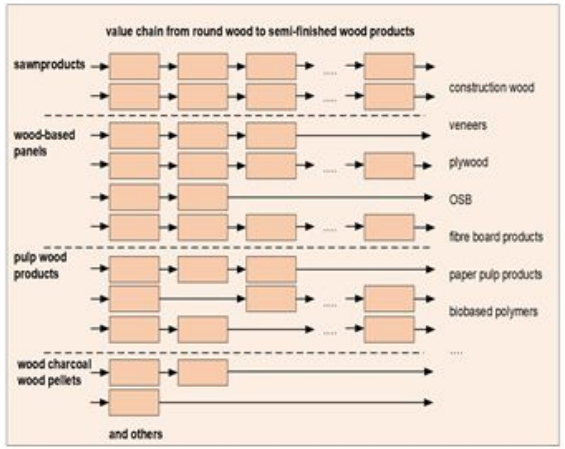
Forest Growth Models of 4 CSRs

Forest management options

Forest operations methods

wood assortments

Dynamic Model of Wood Value Chain



Output: forest management options

Impact on wood value chain

MCDSS - Indicator weights in scenarios

	Scenario I Society under voluntary green transition	Scenario II Climate change adaption and green transition	Scenario III Protection and recreation-oriented forest management	Scenario IV Climate change mitigation in a slow-growing bioeconomy
Standing timber		5	10	10
Harvested timber total	50	30	10	20
Periodic annual increment	5	5	5	5
QMD (harvested species)	5	3		
QMD (harvested stand)	10	3		
QMD (standing species)		2	5	
QMD (standing stand)		2	5	
Height variablity (SD)				5
Diamater variability (mean)				5
Deadwood with decomposition			10	10
Carbon in stock aboveground		5		5
Carbon sequestration	5	15		10
Number of large trees		5	20	10
Visual attractiveness		5	20	10
Risk of economic loss		5		
Shannon index	5	5	15	10
Wood revenues	20	10		

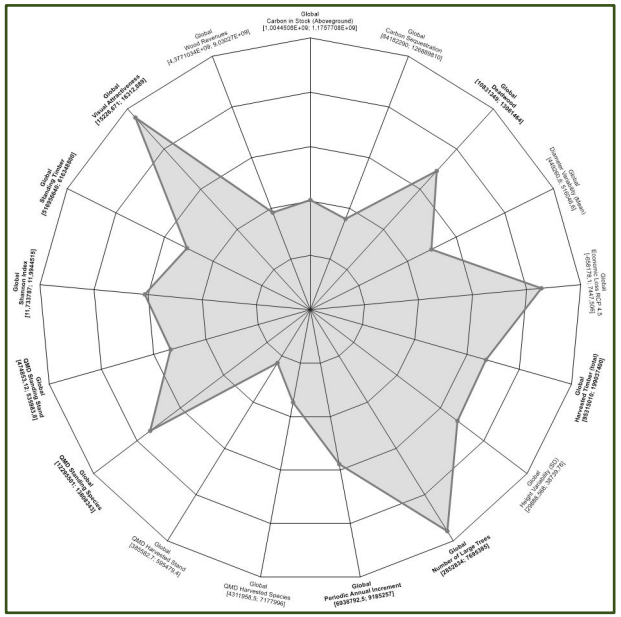
- 17 relevant indicators identified for CSR Catalonia
- Weights assigned to each indicator and for each scenario individually (THRO / SLU)

MCDSS - Results for Scenario III

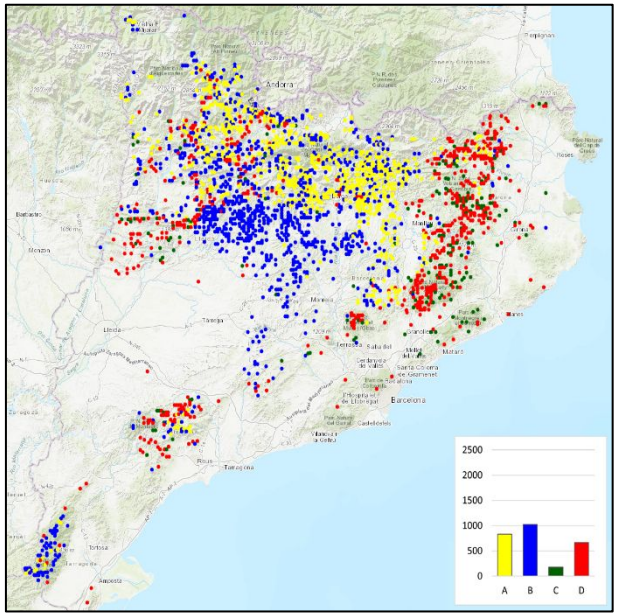
	A	B	C	D	E	F	G	H	I
1	Objective	0,7553							
2	Computation Time	68,3525016							
3	MIP Gap	NaN							
4									
5	group	obj	lb	ub	objValue				
6	Global	Shannon Index	11,73378668	11,9944512	11,89346649				
7	Global	Visual Attractiveness	15226,6713	16312,8882	16265,97758				
8	Global	Number of Large Trees	2852834,009	7695385,115	7491898,613				
9	Global	Deadwood	10831349,04	13061463,88	12371772,98				
10	Global	QMD Standing Stand	474853,1271	535983,8234	507564,084				
11	Global	QMD Standing Species	12295500,71	13808342,74	13413874,71				
12	Global	Standing Timber	516956634,7	616348773,8	567409297,4				
13	Global	Harvested Timber (total)	95315007,3	199037400,1	165055326,1				
14	Global	Periodic Annual Increment	6938792,489	9185256,945	8236465,088				
15	Global	QMD Harvested Species	4311958,507	7177996,161	5306642,03				
16	Global	QMD Harvested Stand	385582,6796	595479,4034	433882,1608				
17	Global	Height Variability (SD)	29888,5675	38739,7614	35898,11194				
18	Global	Diameter Variability (Mean)	449260,8015	516046,6055	482516,6468				
19	Global	Carbon in Stock (Aboveground)	1004450633	1175770764	1073615319				
20	Global	Carbon Sequestration	84182291,67	126889810	99477369,96				
21	Global	Economic Loss RCP 4.5	-658178,1021	7447,5058	-89413,9097				
22	Global	Wood Revenues	4377103291	9030269783	6161616134				
23									
24	stand	cell	mgmt opt	plot id					
25	21_LOW_YOUNG	1	B	80004					
26	21_LOW_MATURE	2	B	80006					
27	21_HIGH_MEDIUM	3	A	80012					
28	21_HIGH_YOUNG	4	B	80014					
29	21_HIGH_MEDIUM	5	A	80015					
30	21_LOW_MEDIUM	6	A	80019					
31	21_HIGH_MEDIUM	7	A	80020					
32	21_HIGH_MEDIUM	8	A	80021					
33	21_LOW_MEDIUM	9	A	80022					
34	21_LOW_MEDIUM	10	A	80024					
35	21_LOW_MEDIUM	11	A	80025					
36	21_LOW_MEDIUM	12	A	80027					
37	21_LOW_MEDIUM	13	A	80028					
38	21_LOW_MEDIUM	14	A	80029					
39	21_LOW_MEDIUM	15	A	80030					

Summary | Visual Attractiveness | Number of Large Trees | Deadwood | QMD Standing Stand | QMD Standing Specie

Numerical output with objective values and assignment of management options to cells

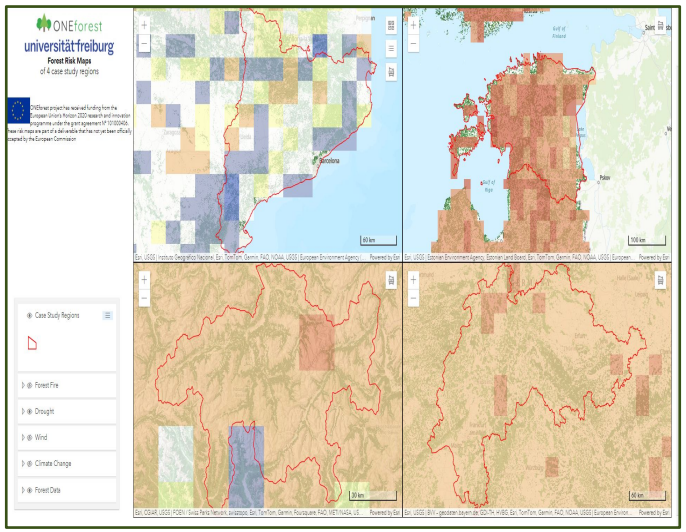


Radar chart with range of indicator values and optimization result



Distribution of management options in the CSR

Perspectives of Forest Operations

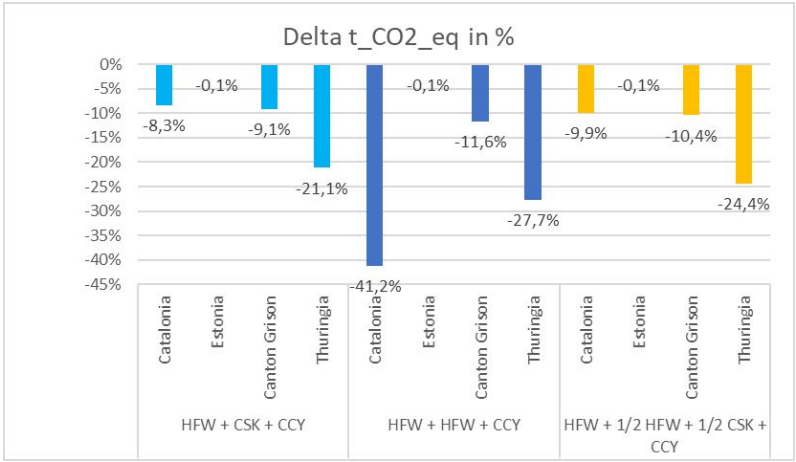


Risk maps and practical guidelines for preperation against disturbances for all CSR

regarding:Drougth, Fire and Wind

Planting with fully biodegradable Hydrogel based on wood fibers

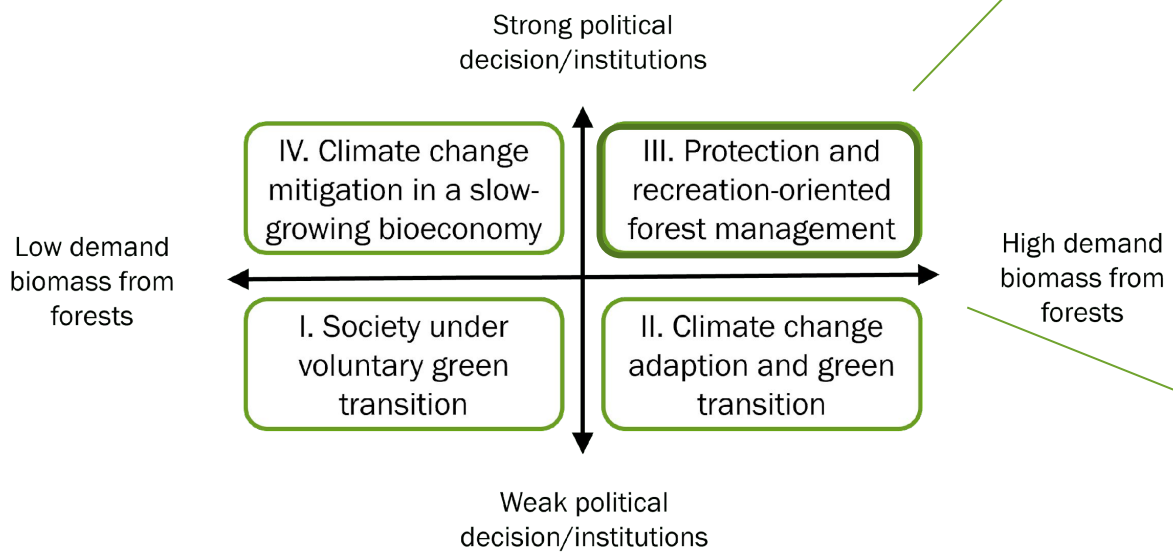
Studies on: Biomas analysis
Vegetative status
Degradability
Water storing capacity
Application



Best-Harvesting Method calculated for all CSR with three combinations

regarding: CO_2-Emissions, Productivity, Jobs, Costs, Fuel Consumption

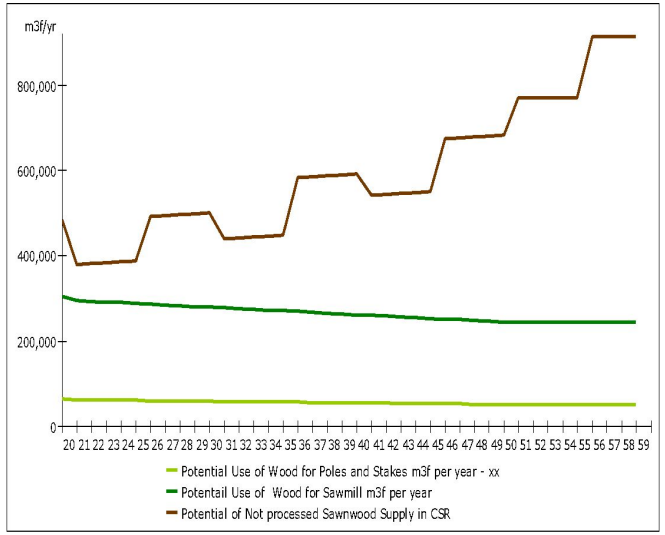
DVCM – Scenarios



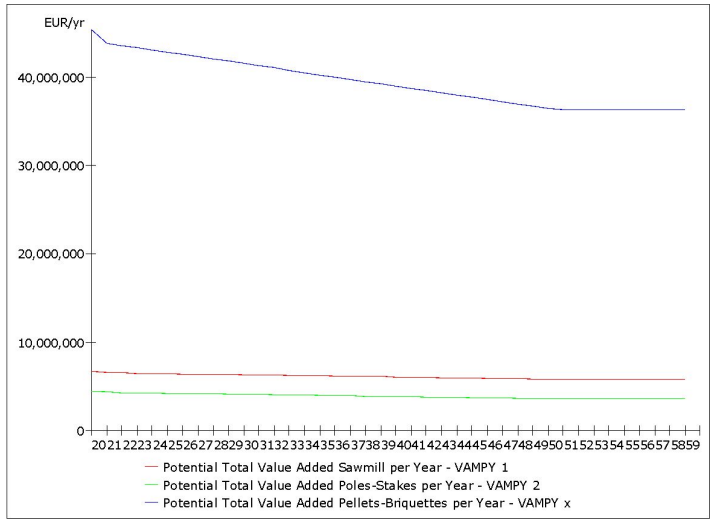
<u>Vision</u>: protection of forests to promote ecosystem services like recreation and clean air and water

<u>Attitudes</u>: recreation and biodiversity are prioritized and conflicts between forestry or protection are more common.

DVCM provides projections about … Scenario III



… potential wood supply vs. potential use of wood assortments in the specific value chains of the regions related to the forest management options



… potential socio-economic impacts of the specific and total wood value chains of the regions related to the forest management options

Value Added per kg CO2eq.

Time	Potential Value Added Sawmill	Potential Value Added Poles-Stakes	Potential Value Added Pellets-Briquettes	per kg C(
1 Jan 2020	€0.85	€0.04	€0.09	
1 Jan 2021	€0.87	€0.04	€0.09	
1 Jan 2022	€0.88	€0.04	€0.09	
1 Jan 2023	€0.90	€0.04	€0.09	
1 Jan 2024	€0.91	€0.04	€0.09	
1 Jan 2025	€0.92	€0.04	€0.09	
1 Jan 2026	€0.93	€0.04	€0.09	
1 Jan 2027	€0.95	€0.04	€0.09	
1 Jan 2028	€0.96	€0.04	€0.09	
1 Jan 2029	€0.97	€0.04	€0.09	
1 Jan 2030	€0.99	€0.04	€0.09	
1 Jan 2031	€0.99	€0.04	€0.09	
1 Jan 2032	€0.99	€0.04	€0.09	
1 Jan 2033	€0.98	€0.04	€0.09	
1 Jan 2034	€0.98	€0.04	€0.09	
1 Jan 2035	€0.98	€0.04	€0.09	
1 Jan 2036	€0.99	€0.04	€0.09	
1 Jan 2037	€1.00	€0.04	€0.09	

… potential environmental impacts of the specific and total wood value chains of the regions related to the forest management options

INNOVAForONE

Conclusion

ONEforest

- Multi-Criteria Decision Support System
- Dynamic Value Chain Model
- Data pool
- Policy Recommendations
- Top Soil Cover

Follow us

@ONEforest_H2020

/ONEforest project

oneforest.eu

INNOVAForONE

ONEforest

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement N° 101000406.

Thank you for your attention!

INNOVAForONE

Organized by

cesefor
FORESTRY HEART, research spirit

Co-organized by

ONEforest

FOREST4EU

Mediterranean Model Forest Network

Partnership

Funded by the European Union

NOS IMPULSA

competitividad empresarial ice

Junta de Castilla y León

Centr@Tec
Servicios Avanzados de Innovación para Pymes

Natural Resources Canada | Ressources naturelles Canada
Canada

Collaborate

RESONATE
Resilient Forests for Society

EUFORE

SMURF

EFI

BIOREGIONS
Forest bioeconomy in action

INNOVAWOOD

FAO

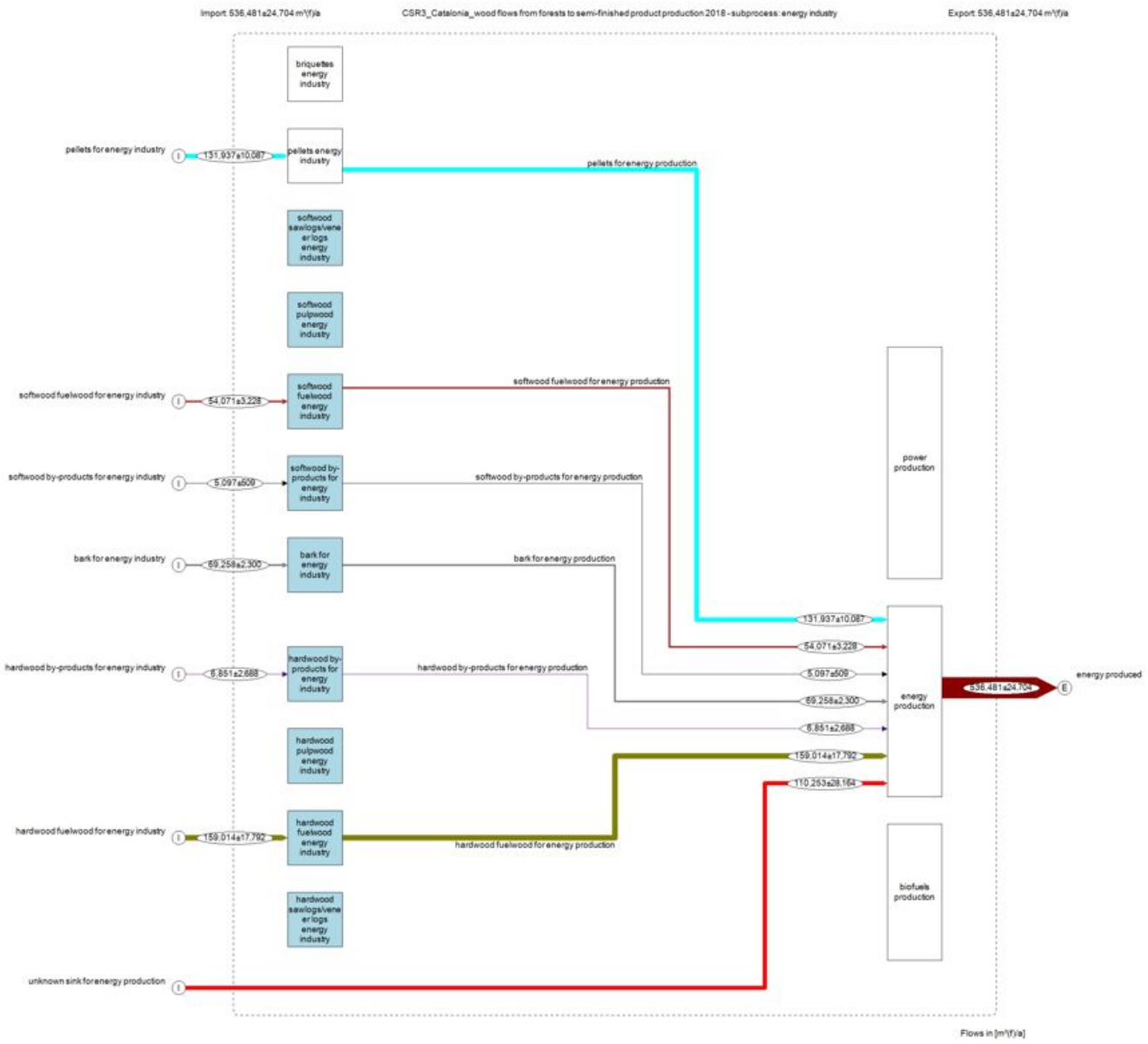
Silva Mediterranea

Sources

Picture Erntemaßnahme nach Kalamität:
https://www.sauerlandkurier.de/hochsauerlandkreis/wiederaufforstung-im-hochsauerland-stellt-regionalforstamt-vor-mammutaufgabe-90473084.html

Picture: Waldbrand
https://s.france24.com/media/display/d644d4fc-0529-11ed-9406-005056bfa79e/w:1280/p:16x9/AP22197421956257.jpg

All other pictures: Dr. Martin Brunsmeier


Import: 536,481±24,704 m³(f)/a
CSR3_Catalonia_wood flows from forests to semi-finished product production 2018 - subprocess: energy industry
Export: 536,481±24,704 m³(f)/a
briquettes energy industry
pellets for energy industry
131,937±10,087
pellets energy industry
pellets for energy production
softwood sawlogs/veneer logs energy industry
softwood pulpwood energy industry
softwood fuelwood for energy industry
54,071±3,228
softwood fuelwood energy industry
softwood fuelwood for energy production
softwood by-products for energy industry
5,097±509
softwood by-products for energy industry
softwood by-products for energy production
bark for energy industry
69,258±2,300
bark for energy industry
bark for energy production
hardwood by-products for energy industry
6,851±2,688
hardwood by-products for energy industry
hardwood by-products for energy production
hardwood pulpwood energy industry
hardwood fuelwood for energy industry
159,014±17,792
hardwood fuelwood energy industry
hardwood fuelwood for energy production
hardwood sawlogs/veneer logs energy industry
unknown sink for energy production
power production
131,937±10,087
54,071±3,228
5,097±509
69,258±2,300
6,851±2,688
159,014±17,792
110,253±28,164
energy production
536,481±24,704
E
energy produced
biofuels production
Flows in [m³(f)/a]

DVCM – Scenarios

	I Society under voluntary green transition	II Climate change adaption and green transition	III Protection and recreation-oriented forest management	IV Climate change mitigation in a slow-growing bioeconomy
supply of wood and semi-finished goods	transport radius for wood supply (pellets 200 km, sawnwood/panel production 200-300 km) --> increase of transport costs	transport radius for wood supply (pellets 200 km, sawnwood/panel production 200-300 km) --> increase of transport costs	regional/national wood supply is declining and wood is imported from European level --i> increase of transport radius and other transport means (trains)	transport radius for wood supply (pellets 200 km, sawnwood/panel production 200-300 km) --> increase of transport costs
demand of wood (and non-wood) products	demand of wood products is related to projected GDP (increase 2050)	demand of wood products increase by 30 % till 2050; favourisation of products that store carbon long time, fuel/energy wood will only be important till 2035, afterwards it decreases	demand of wood products decrease by 20 % till 2050 because wood-based products are becoming less attrative	demand of wood products is related to projected GDP (increase 2050)
development of industry (focus on capacity)	wood processing industry remains structurally unchanged, no increase/decrease of additional capacities (investments)	industry slowly dissolves, but is gradually replaced by large industry with a broader product portfolio	wood processing industry remains structurally unchanged, no increase/decrease of additional capacities (investments)	Wood processing industry increase their capacities and broaden their product portfolios including biomass products (energy) till 2050
development of industrial technologies and new industries	only rationalisation investments, no new industry from other sectors	new industry (biorefinery) enters the market from 2035 onwards	wood processing industry partly disappears and is replaced by other industries from other sectors (e.g. biorefinery)	only rationalisation investments, no new industry from other sectors
future work skills and work force	shortage of skilled labour in forestry and wood processing	due to increased wages and improved working conditions more skilled workers are attracted	increase of skilled workers, but they leave to work abroad due to low salary, poor working conditions and social recognition	by increasing wages and improving working conditions more skilled workers are attracted