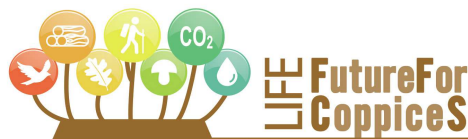


Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Shaping future forestry for sustainable coppices in southern Europe:
the legacy of past management trials

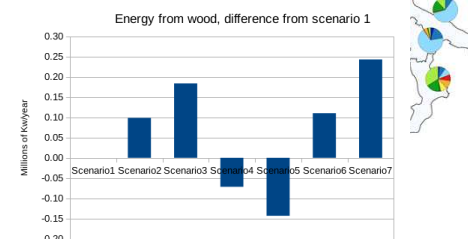
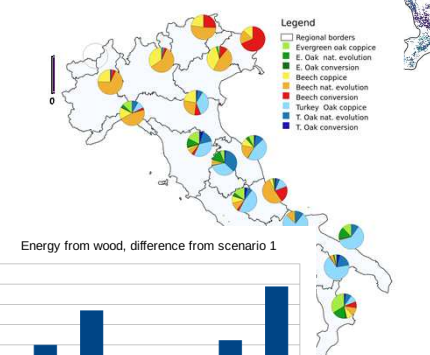
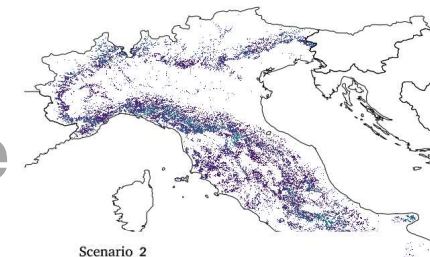
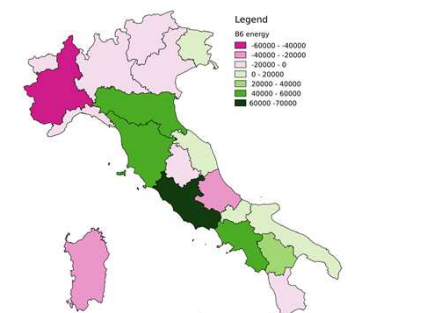


Coppice forest management options: sustainability and possible scenarios

Opzioni di gestione dei boschi di origine cedua: sostenibilità e possibili scenari

Pier Paolo Roggero – Università di Sassari

Duccio Rocchini – Università di Trento - Fondazione Edmund Mach



Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Project objectives

Obj 2) Evaluating the **sustainability** of the main coppice management options from **long term field experiments**

Obj 3) Summarizing and extending the project's results to broader geographical scales: **scenario analyses**



Evaluating sustainability

- **Multivariate approach (PCA) by EFT:**
 - mountainous beech forest *Fagus sylvatica* (7.3)
 - thermophilous deciduous forest *Quercus cerris* (8.2)
 - broadleaved evergreen forest *Quercus ilex* (9.1)
- Multivariate matrix for each EFT
 - **site x management x indicator**

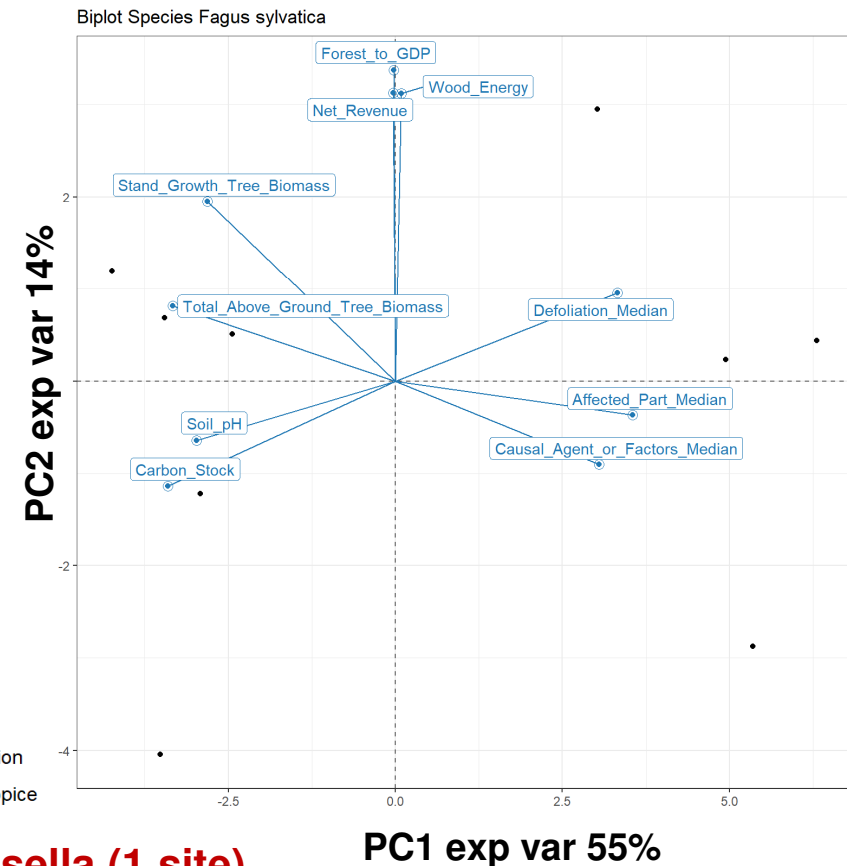
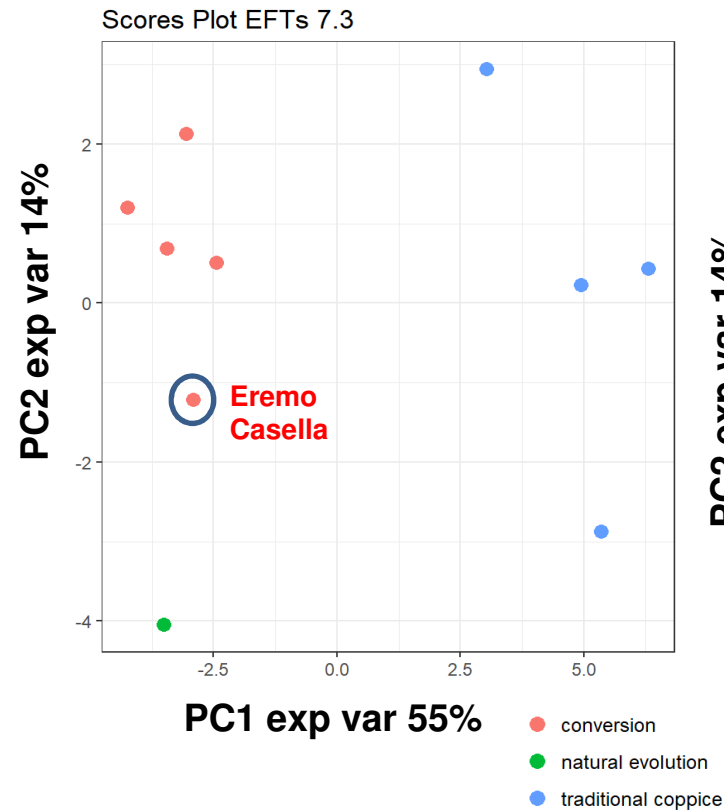
Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Sustainability

Mountainous beech forest (7.3) *Fagus sylvatica*



Buca Zamponi and Eremo Casella (1 site)

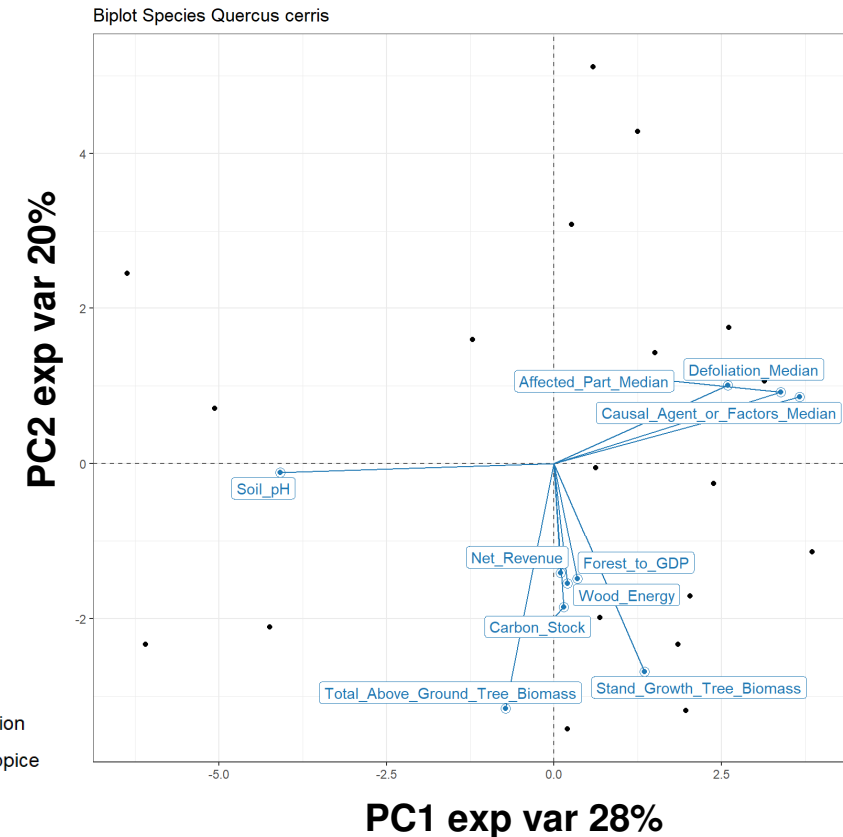
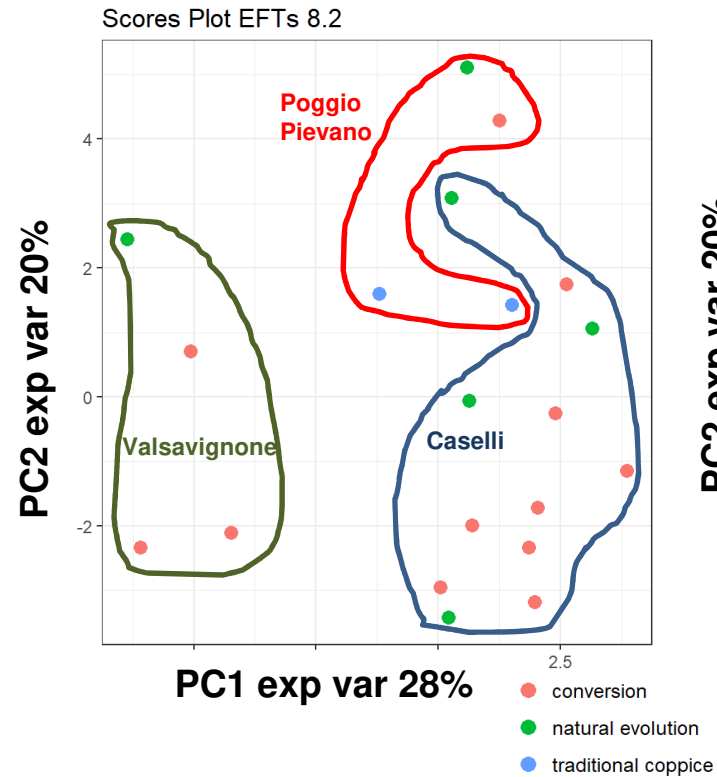
TC: damages and defoliation

CO and NE: C stock, soil pH, aboveground biomass



Sustainability

Thermophilous deciduous forest (8.2) *Quercus cerris*



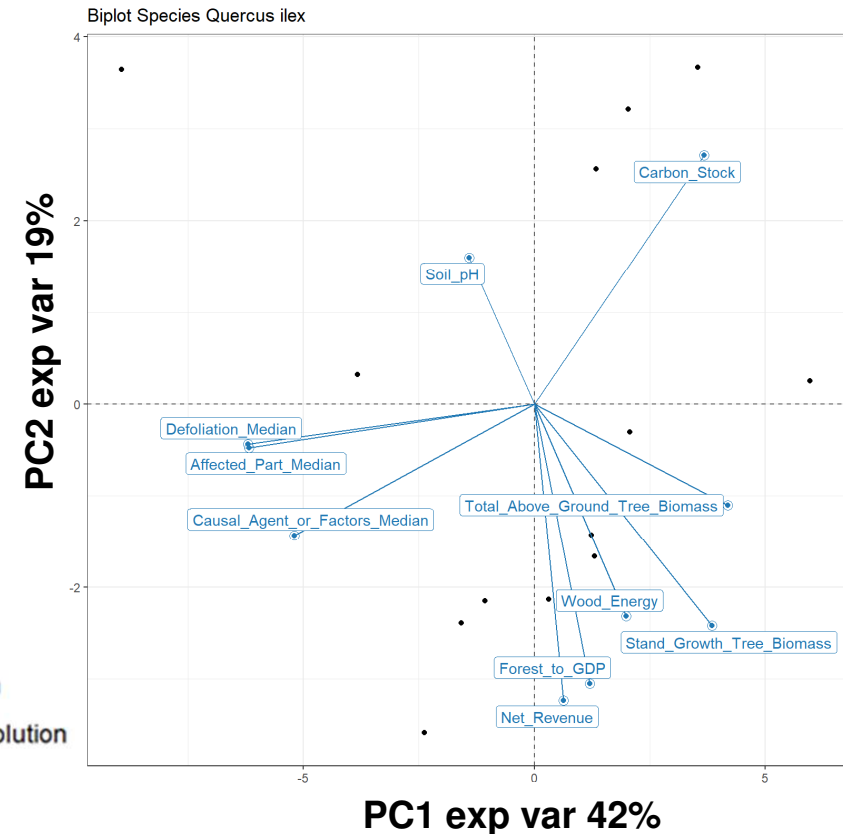
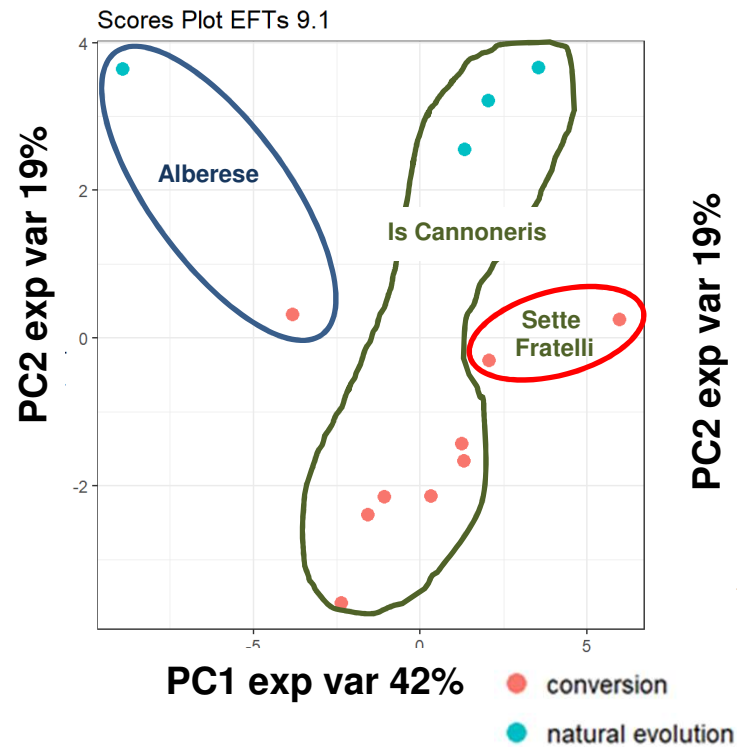
Low soil pH discriminates stands in Valsavignone

CO and NE: aboveground biomass, stand growth, C stock, GDP, Energy



Sustainability

Broadleaved evergreen forest (9.1) *Quercus ilex*



Tree damages and defoliation on Tuscan vs Sardinian sites both under CO or NE

NE: C stock, CO: net revenue or GDP, Energy, Strnd growth

Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Conversion

- Higher C and biom
- Better health
- <C on Q.ilex
- >growth Q. ilex

Sustainability



Beech forest (7.3)



Thermophilous deciduous forest (8.2)



Broadleaved evergreen forest (9.1)

Significantly Higher

Significantly Lower

C	Indicator	CO			NE			TC		
		7.3	8.2	9.1	7.3	8.2	9.1	7.3	8.2	9.1
	Carbon Stock	●	■	▲			▲	●	■	
C1	Growing Stock	●	■	▲			▲	●	■	
	<u>Total Above Ground Tree Biomass</u>	●	■					●	■	
	Soil pH	●						●		
	Defoliation	●						●		
C2	Forest damage	●						●		
	<u>Stand Growth Tree Biomass</u>			▲			▲			



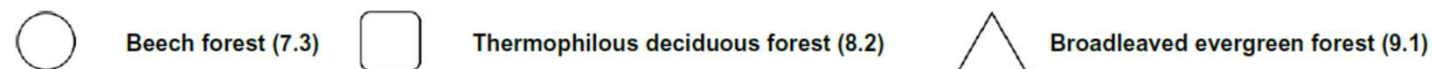
Conversion

- More roundwood
- More biodiversity

Coppice

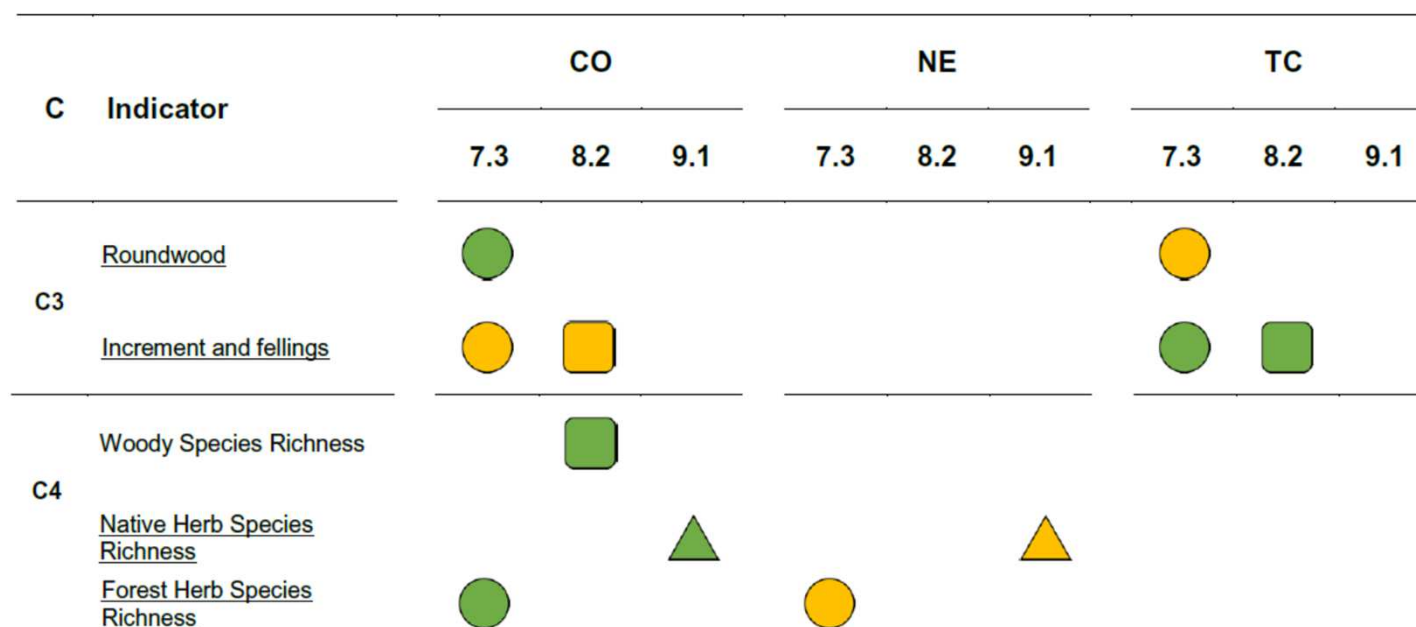
- More firewood

Sustainability



Significantly Higher

Significantly Lower



Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Conversion or TC
More net revenue
- More GDP
- More recreation

Conversion
- More energy
- Less cover /flood
retention

Coppice
- More net rev + recreation **Q. cerris**

Sustainability

○ Beech forest (7.3) □ Thermophilous deciduous forest (8.2) △ Broadleaved evergreen forest (9.1)

Significantly Higher

Significantly Lower

C	Indicator	CO			NE			TC		
		7.3	8.2	9.1	7.3	8.2	9.1	7.3	8.2	9.1
	<u>Flood retention</u>	●						●		
C5	<u>Overstorey cover</u>	●						●		
	<u>Understorey cover</u>	●		△			△	●		
	Forest to GDP		■	△		■	△			
	Net Revenue	●	■	△		■	△	●	■	
C6	<u>Energy</u>	●	■	△		■	△	●	■	
	<u>Recreation</u>	●	■	△		■	△	●	■	



Scenario analysis

- We modelled the changes in the proportion of the three management systems vs. the *status quo* (Scenario 1)
- Criteria for scenario building:
 - All management options maintained (different proportions)
 - Changes in management intensities applied to less than 10% of the area of each forest category (overall 8.5%)
 - the ecological characteristics of the different forest types and species

Data source

- F4C databases
- National Carbon Forestry Inventory (INFC)
- Tuscany and Sardinia Forestry Inventories

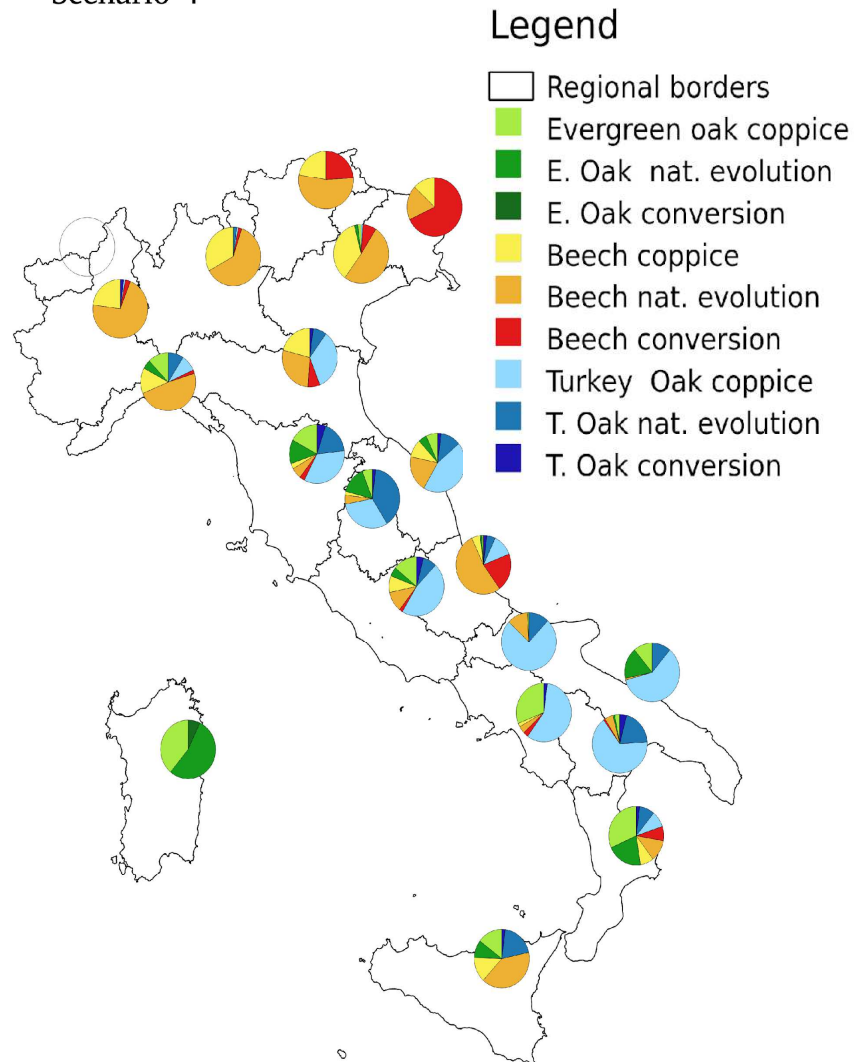


Scenario analysis

The modelled scenarios

- **Scenario1:** *status quo*, same proportions of NE, TC & CO as is now in each region
- **Modelled scenarios 2 to 7:**
 - replace from 5% to 30% of the area of one management type with another with higher or lower management intensity

Scenario 1





Scenarios

Species	Management	Scenario1	Scenario2	Scenario3	Scenario4	Scenario5	Scenario6	Scenario7
Natural evolution	Ev. oak		-10	-15	+5	+10		-15
	Beech		-10	-15	+5	+10		-15
	Turkey oak		-10	-20	+5	+10	-30	-30
Coppice	Ev. oak		+5	+5	-5	-10		+5
	Beech		+5	+5	-5	-10		+5
	Turkey oak		+10	+15	-5	-10	+30	+30
Conversion	Ev. oak		+5	+10				+10
	Beech		+5	+10				+10
	Turkey oak			+5				

Species	Management	Scenario1	Scenario2	Scenario3	Scenario4	Scenario5	Scenario6	Scenario7
Natural evolution	Ev. oak	142 219	124 938	116 298	150 859	159 499	142 219	124 938
	Beech	303 993	290 369	283 557	310 805	317 617	303 993	290 369
	Turkey oak	177 229	159 506	141 783	199 221	221 213	124 061	124 061
Coppice	Ev. oak	172 806	181 447	181 447	164 166	155 526	172 806	181 447
	Beech	136 241	143 053	143 053	129 429	122 617	136 241	143 053
	Turkey oak	439 834	457 557	448 695	417 842	395 850	493 002	493 002
Conversion	Ev. oak	7 789	16 429	25 069	7 789	7 789	7 789	16 429
	Beech	78 279	85 091	91 903	78 279	78 279	78 279	85 091
	Turkey oak	35 173	35 173	61 758	35 173	35 173	35 173	35 173
Total		1 493 562	1 493 562	1 493 562	1 493 562	1 493 562	1 493 562	1 493 562

Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali

Scenario analysis

Scenario1

Scenario2

Scenario3

Scenario4

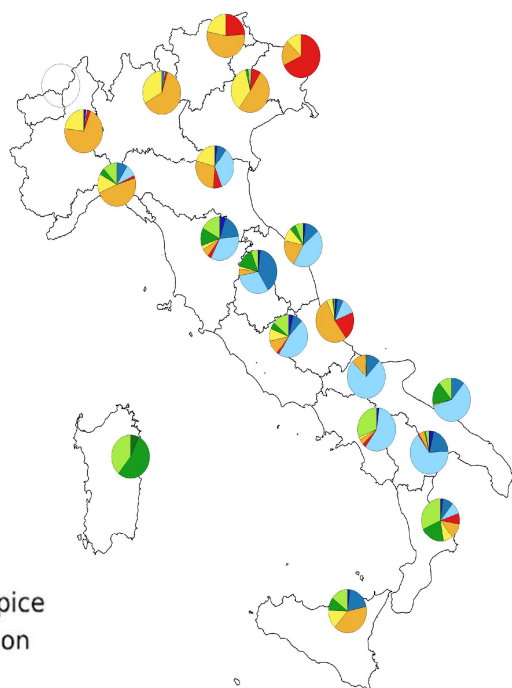
Scenario5

Scenario6

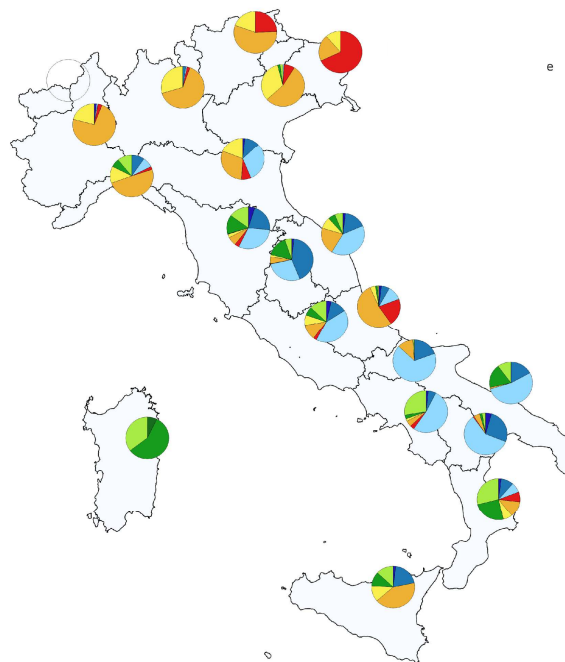
Scenario7



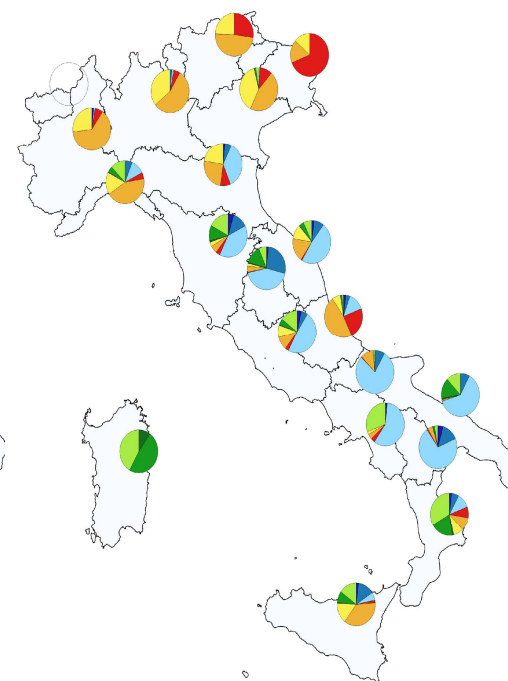
Scenario1



Scenario5



Scenario7



Legend

- Regional borders
- Evergreen oak coppice
- E. Oak nat. evolution
- E. Oak conversion
- Beech coppice
- Beech nat. evolution
- Beech conversion
- Turkey Oak coppice
- T. Oak nat. evolution
- T. Oak conversion

Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Scenario outcomes

The following criteria were effective in discriminating the scenarios



1. Contribute to global C cycle



3. Production functions (wood and non-wood)



6. Maintaining other functions and socio-economic conditions



Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Scenario outcomes

Other criteria showed negligible effects
or contrasting results



2. Maintaining health and vitality of forest ecosystems



4. Biodiversity of forest ecosystems



5. Maintaining and improving protection functions in the forest management

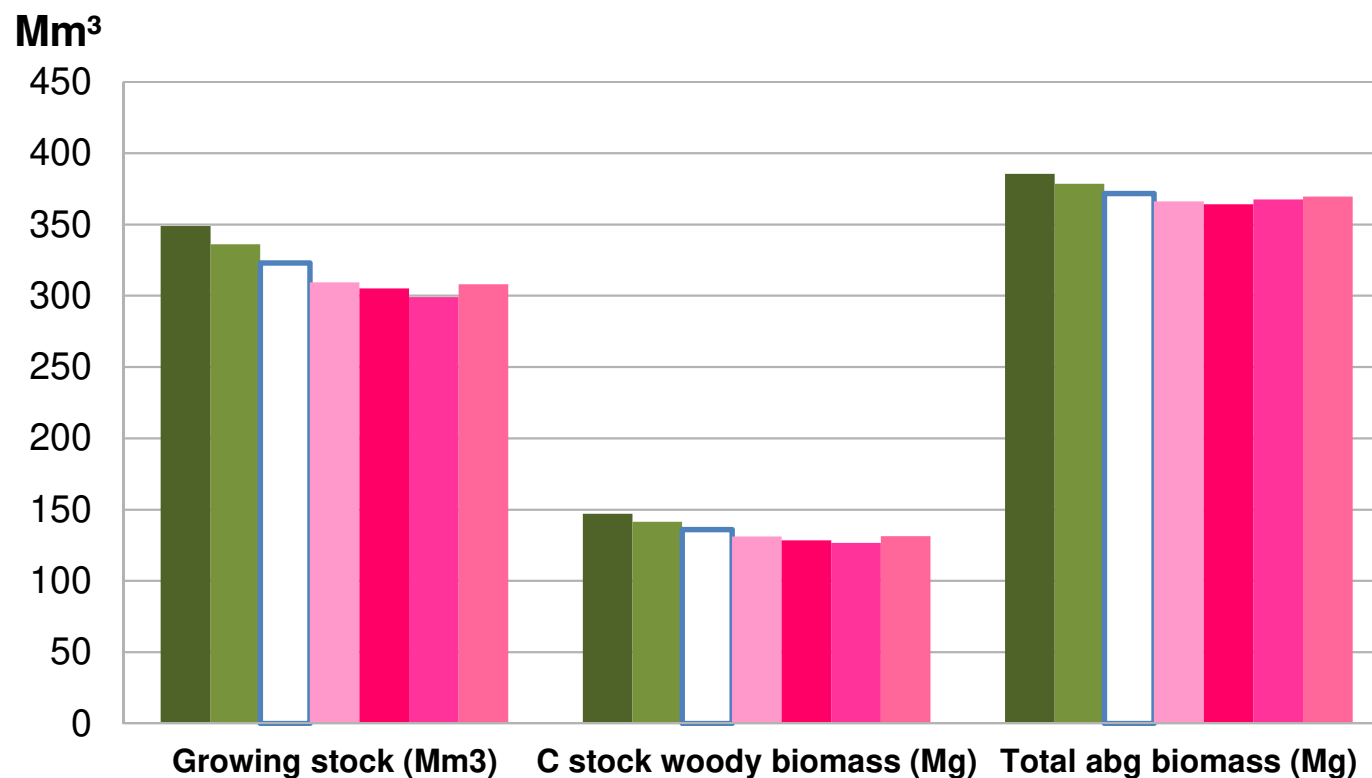




+ NE
+8% C stock

+ TC or CO
-4 to -8% C stock

Scenario outcomes – Criterion 1



	Scenario 5			Scenario 4			Scenario 1			Scenario 2			Scenario 6			Scenario 7			Scenario 3		
	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC
Beech	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. ilex	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. cerris	+10		-10	+5		-5	0	0	0	-10		+10	-30		+30	-30		+30	-20	+5	+15
	+Nat Evol			-Trad Coppice			Benchmark			-NE+CO+TC			-NE +TC			-NE +TC +CO			-NE +TC+CO		



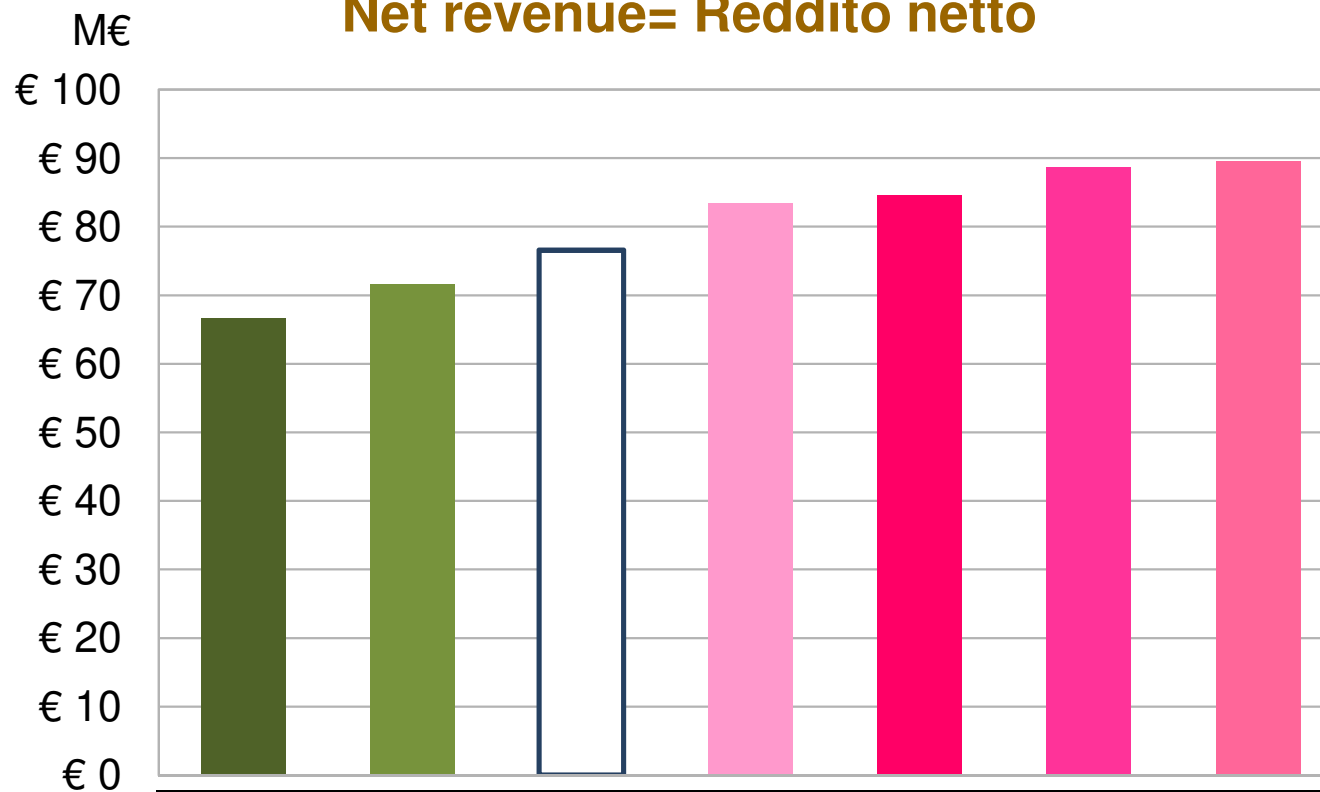
+ NE
- 13% net rev

+ CO or TC
+15-17% net rev

**2-3% of regional
agric GDP**

Scenario outcomes – Criterion 6

Net revenue= Reddito netto



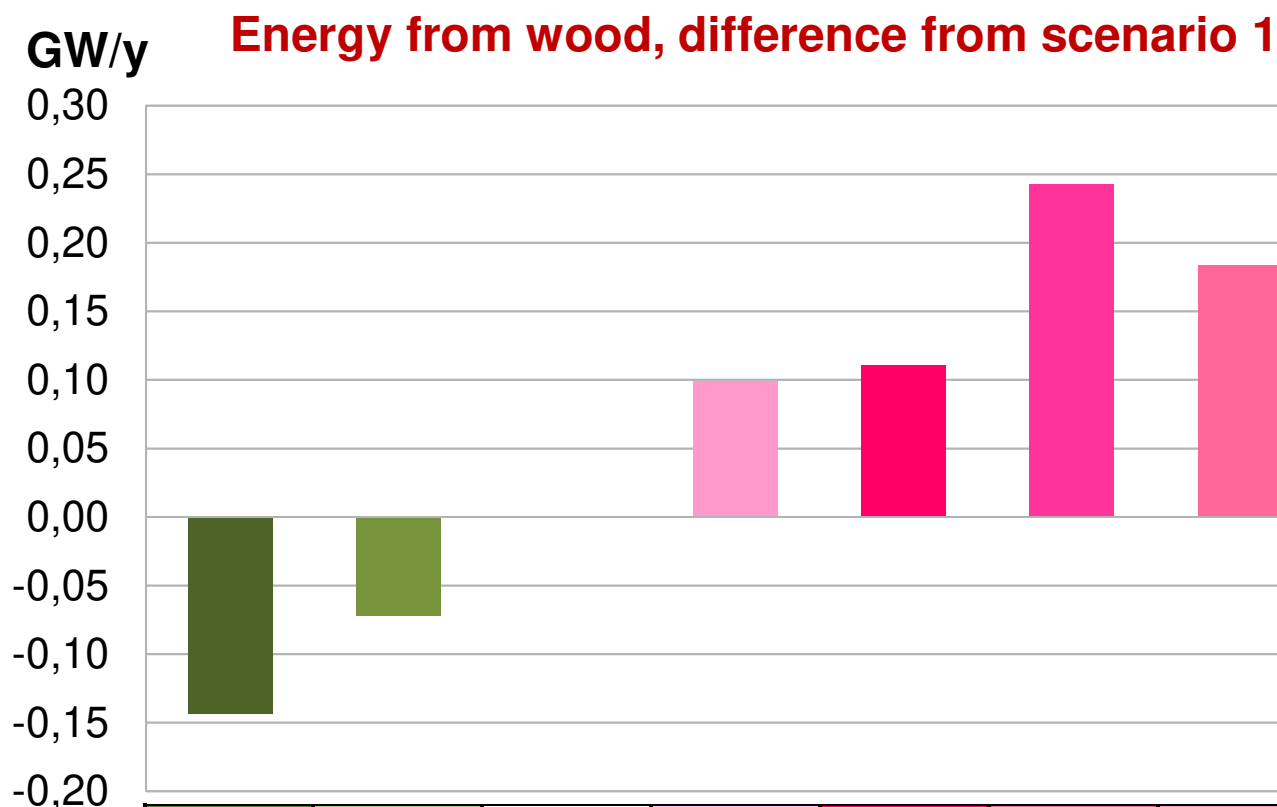
	Scenario 5			Scenario 4			Scenario 1			Scenario 2			Scenario 6			Scenario 7			Scenario 3		
	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC
Beech	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. ilex	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. cerris	+10		-10	+5		-5	0	0	0	-10		+10	-30		+30	-30		+30	-20	+5	+15
	+Nat Evol -Trad Coppice						Benchmark			-NE+CO+TC			-NE +TC			-NE +TC +CO			-NE +TC+CO		



+NE = -0.14 GW/y

+ CO TC = +0.24 GW/y

Scenario outcomes – Criterion 6



	Scenario 5			Scenario 4			Scenario 1			Scenario 2			Scenario 6			Scenario 7			Scenario 3		
	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC
Beech	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. ilex	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. cerris	+10		-10	+5		-5	0	0	0	-10		+10	-30		+30	-30		+30	-20	+5	+15
	+Nat Evol -Trad Coppice						Benchmark			-NE+CO+TC			-NE +TC			-NE +TC+CO			-NE +TC+CO		

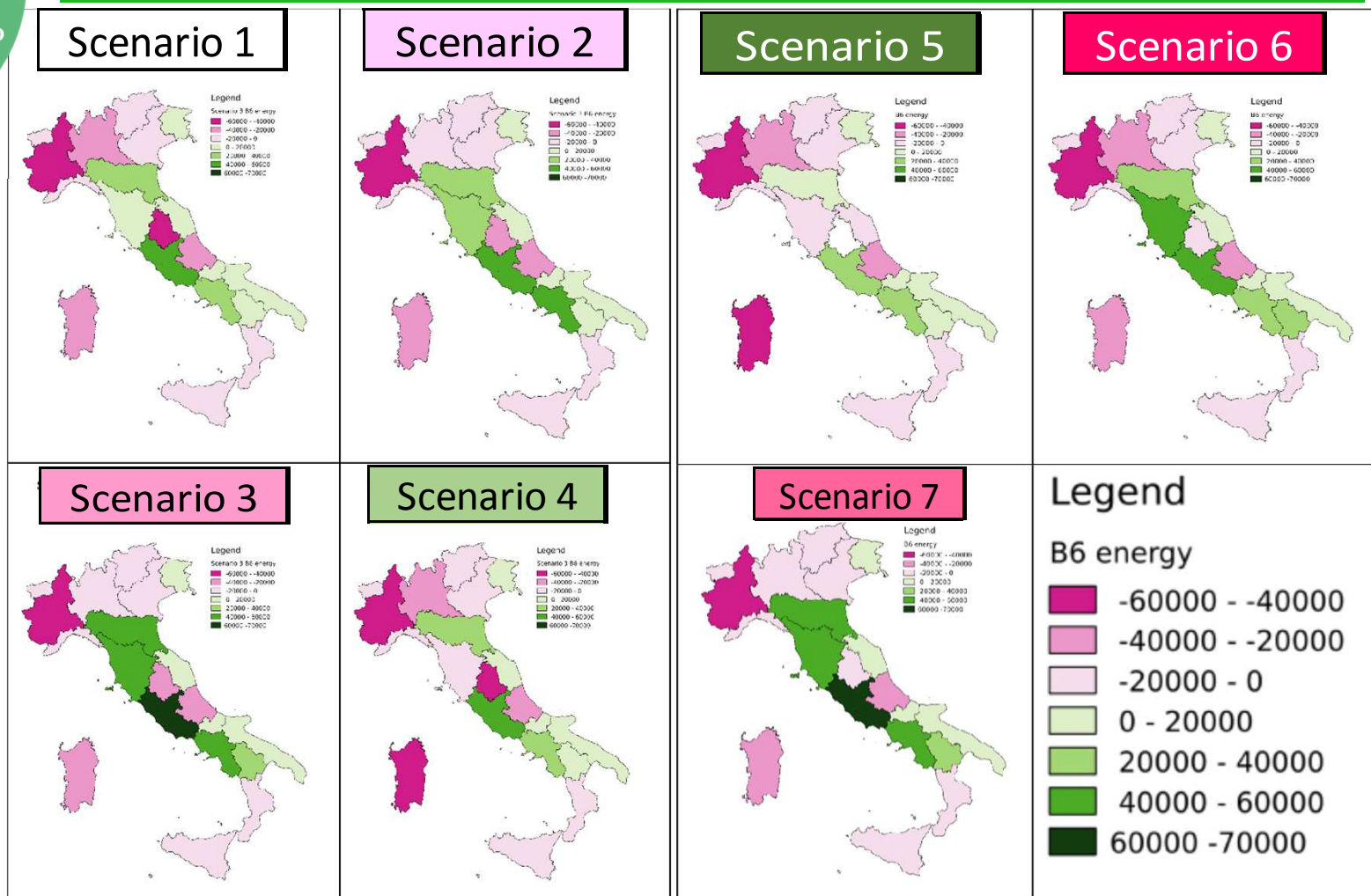
Workshop finale
del progetto LIFE
FutureForCoppiceS

Gestione sostenibile dei
boschi cedui:
indicazioni per il futuro
dall'eredità di prove
sperimentali



Energy from
wood

Scenario outcomes – Criterion 6



	Scenario 5			Scenario 4			Scenario 1			Scenario 2			Scenario 6			Scenario 7			Scenario 3		
	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC	NE	CO	TC
Beech	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. ilex	+10		-10	+5		-5	0	0	0	-10	+5	+5				-15	+10	+5	-15	+10	+5
Q. cerris	+10		-10	+5		-5	0	0	0	-10		+10	-30		+30	-30		+30	-20	+5	+15
	+Nat Evol -Trad Coppice						Benchmark			-NE+CO+TC			-NE+TC			-NE+TC+CO			-NE+TC+CO		



Conclusions

- The proposed scenarios do not substantially change the **landscape** at national scale, *but* their **economic impact** was substantial
- From a flexibility perspective, Scenario 6 which was designed for **-30% NE +30% TC** on just *Q. cerris*, *can* generate a considerable **net revenue increase**
- The spatial mapping of the different indicators was made relying on **free and open source software** and the code is freely available for further spatial analyses