Parallel Session 2

Forests, agroforestry and bioenergy.

Multidimensional sustainability assessment of forest resource supply chain

Authors

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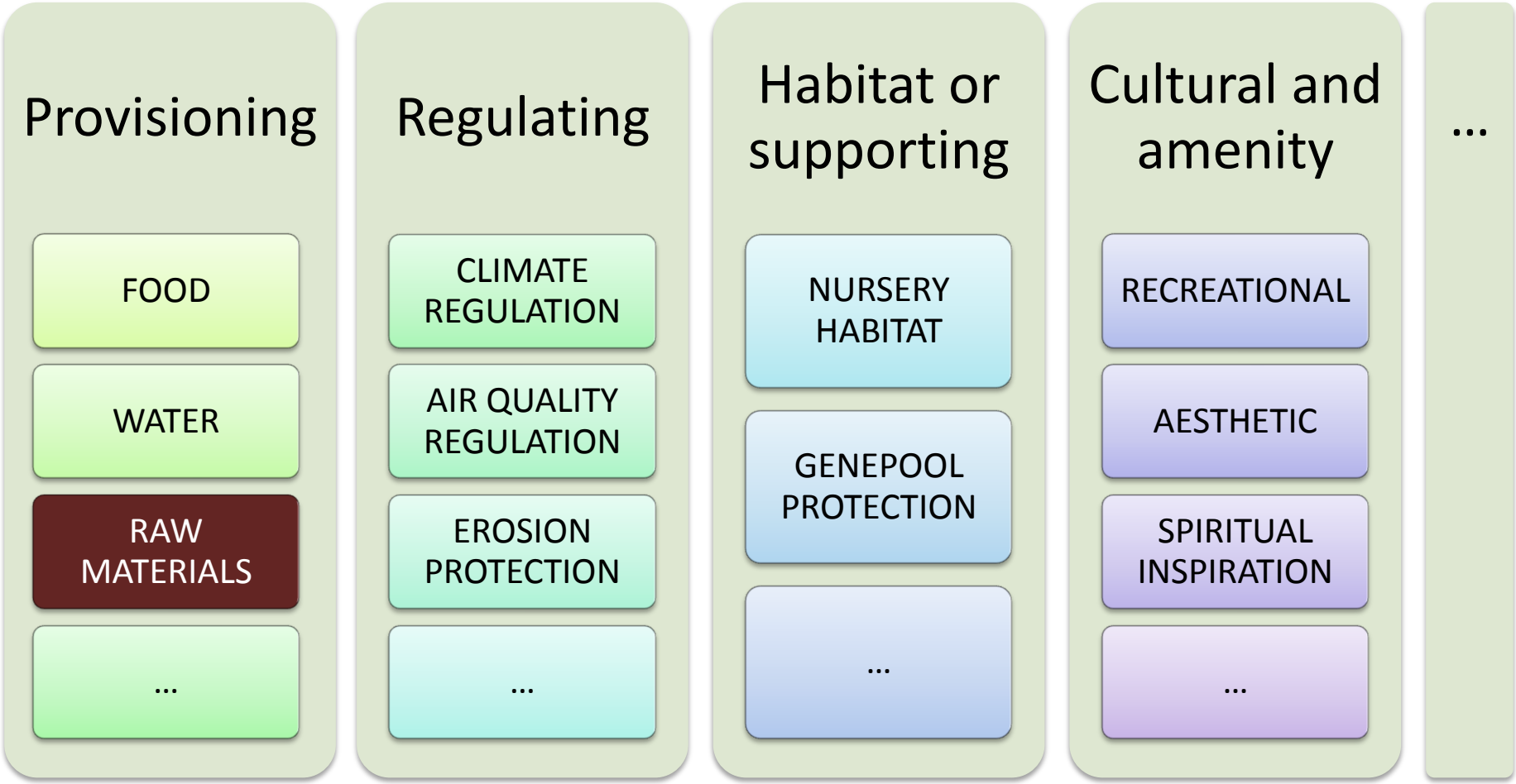
ECOSYSTEM SERVICES FROM FORESTS



Nasi R., Wunder S. and Campos J.. 2002. Forest Ecosystem Services: can they pay our way out of deforestation?. CIFOR for the Global Environmental Facility (GEF), Bogor, Indonesia.

De Grot R.S., Alkemade R., Braat L., Hein L. And Willemen L.. 2009. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making.

FOREST RESOURCES IN THE EU

Forest and other wooded land

178 million ha (42%)

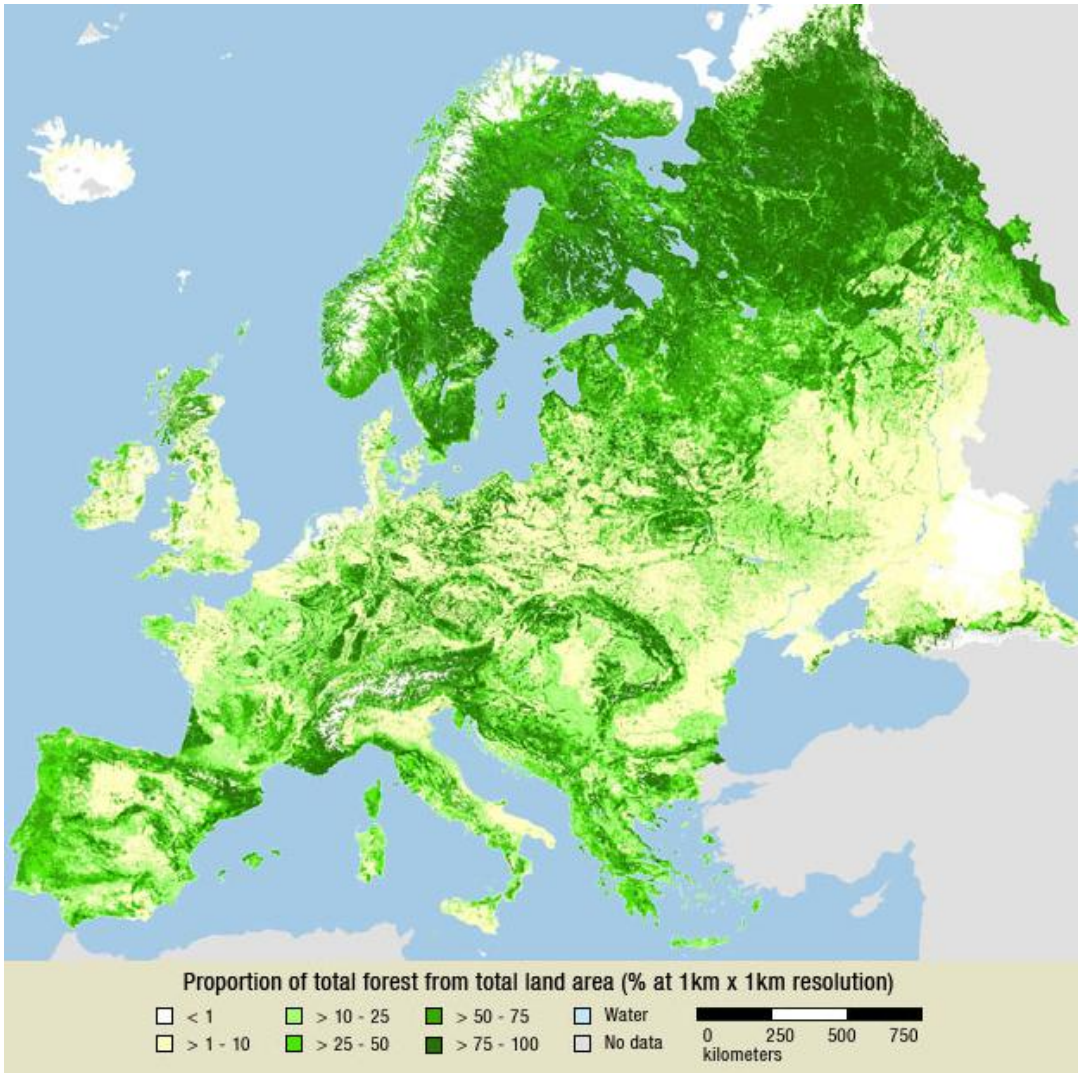
Growing stock (FOWL)

23 million m^3 (2005)

Felling

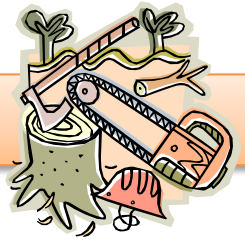
60% of the net annual increment in forest available for wood supply

FRA 2010 (http://www.fao.org/forestry/fra/62219/)

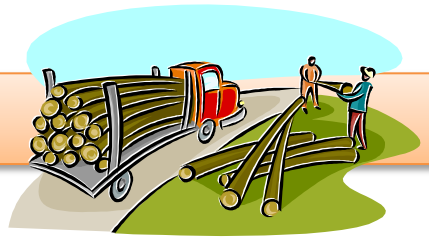


FOPER 2007 (http://foper.unu.edu)

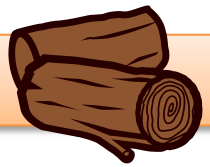
IS FOREST-WOOD SUPPLY CHAIN SUSTAINABLE?



harvesting and forest activities



Transportation



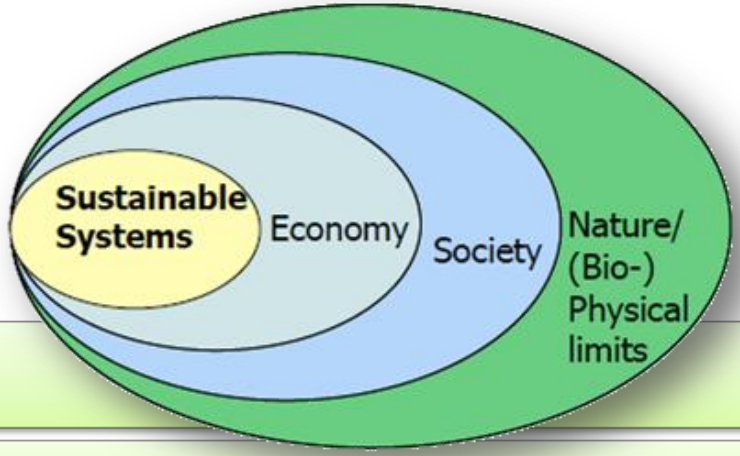
Use

Wood for bio-based products

Wood for energy production

Wood waste

IS FOREST-WOOD SUPPLY CHAIN SUSTAINABLE?



BIO-BASED

LIMITS OF RESOURCE

EMISSION AND IMPACTS (SUPPLY CHAIN)

- Forestry site (preparation and filling)
- Transportation
- Storage/warehousing
- Waste management

SOCIAL AND ECONOMICS ASPECTS

Forestry enterprise network

Employment

BACKGROUND STUDY

AREA OF STUDY : Rural Areas of Como Province

- Abandonment of rural areas
- Underutilized forests
- Few and small forestry enterprises

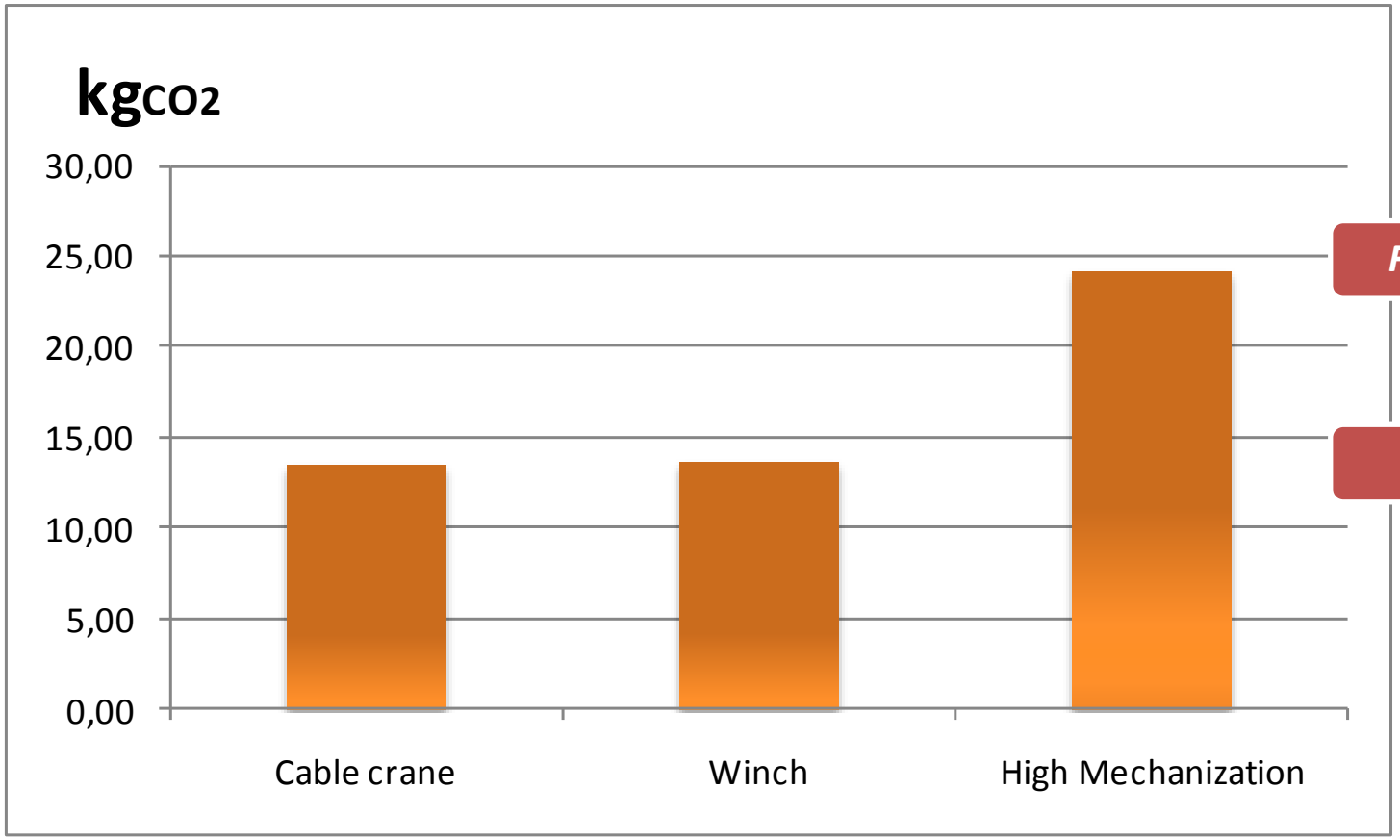
Life Cycle Assessment (1 ton of log wood)

Low mechanization

High mechanization

Como Lake

BACKGROUND STUDY - RESULTS

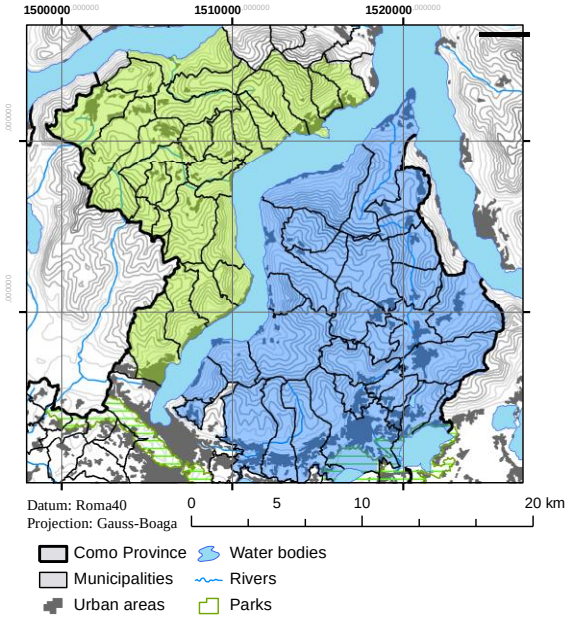


The accessibility of the area hampers the mobility of the heavy equipment and reduce their efficiency from 30-40m³/h to 15m³/h.

Life Cycle Assessment and Local Scale

EMISSION AND IMPACTS (SUPPLY CHAIN)

- Forestry site (preparation and filling)
- Transportation
- Storage/warehousing
- Waste management



LCIA do not consider

- ***soil compaction;***
- ***damage to roots and plants not involved in cutting;***
- ***removal of undergrowth;***
- ***local ecosystems and biodiversity;***
- ***carrying capacity of the system.***

DECISION SUPPORT SYSTEM

It explores all the steps of the supply chain and it is composed by indicators about:

1	***Feasibility***	Availability of biomass from local forests; local constraints (e.g. accessibility)
2	***Technology assessment***	Technology assessment of the machinery used in all stages of the supply chain ***LCA***
3	***Environmental impacts***	Environmental impact assessment for each stage of the supply chain (LCA and Biodiversity) ***LCA***
4	***Economics***	Sustainability evaluation of the economics of the system
5	***Social dimension***	Evaluation of the social dimension (leverage for local development) (e.g.: Employment)

DECISION SUPPORT SYSTEM
Methodological approach

SUSTAINABILITY CRITERIA

Site-specific | Carrying Capacity

↓

SYSTEM BOUNDARIES

↓

SUSTAINABILITY INDICATORS

resource availability | environmental impact | economic efficiency | social impacts

↓

"OPTIMUM OF APPLICATION"

Constraints | stakeholders

↓

SCORING

↓

COMPARISON OF OPTIONS

"A given indicator does not say anything about sustainability, unless a reference value such as thresholds is given to it" (Lancker & Nijkamp, 2000)

DECISION SUPPORT SYSTEM

It explores all the steps of the supply chain and it is composed by indicators about:

EVALUATION OF THE SYSTEM'S CARRYING CAPACITY

2	***Technology assessment***	Technology assessment of the machinery used in all stages of the supply chain
3	***Environmental impacts***	Environmental impact assessment for each stage of the supply chain (LCA and Biodiversity)
4	***Economics***	Sustainability evaluation of the economics of the system
5	***Social dimension***	Evaluation of the social dimension (leverage for local development) (e.g.: Employment)

AREAS OF STUDY

The areas of two local authorities: CMLI and CMTL in the Como Province (ITALY)

Energy Action Plan of Como Province

- Saving energy and energy efficiency
- Renewable sources
- Energy market and energy efficiency certificates
- Administrative and regulatory measures, voluntary agreements, R & D

Local Forest-Energy Supply Chain

Rural Areas of Como Province

- Abandonment of rural areas
- Underutilized forests
- Few and small forestry enterprises

Como Lake

HOW TO EVALUATE THE CARRYING CAPACITY?

Methodology

TREE SPECIES

- Renewal rate
- Ecosystem Services

SPATIAL FEATURES

- Spatial distribution
- Accessibility

POTENTIAL AVAILABLE BIOMASS

CURRENT UTILIZATION OF WOOD

TECHNICAL LOSSES

POTENTIAL AVAILABLE BIOMASS FOR ENERGY USE

ENERGY VALORISATION

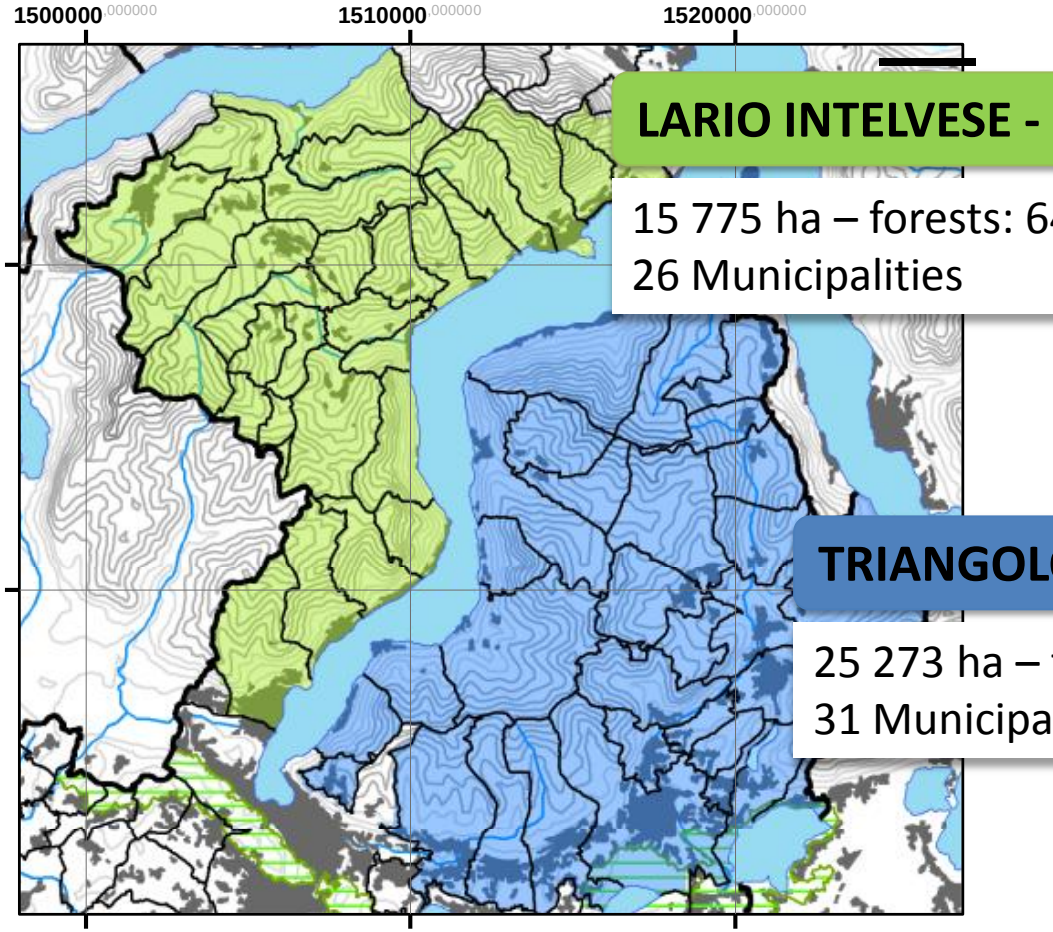
WOOD FEATURES

- Lower calorific value
- Water content

ENERGY POTENTIAL (kWh)

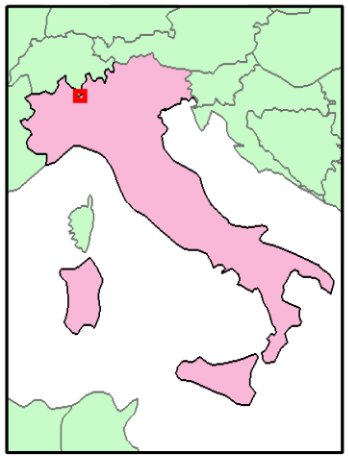
REPLACEMENT OF FOSSIL FUEL (toe)

AREAS OF STUDY



LARIO INTELVESE - CMLI

15 775 ha – forests: 64%
26 Municipalities



TRIANGOLO LARIANO - CMTL

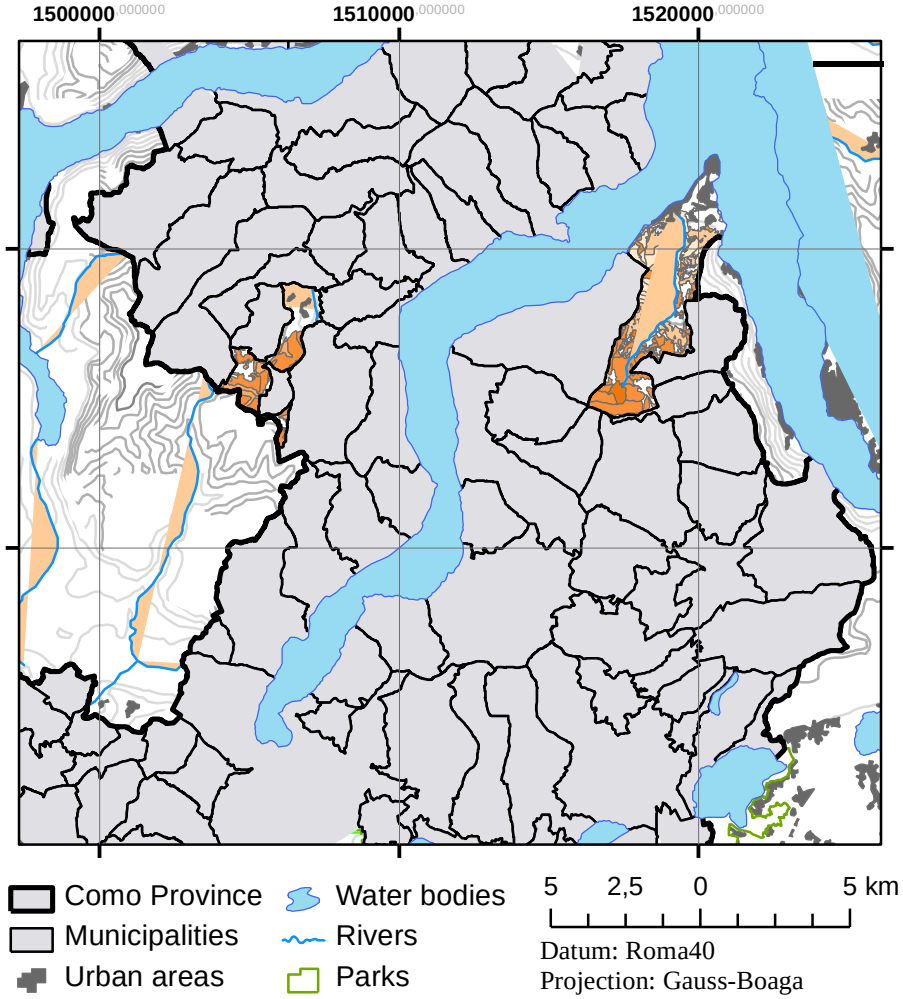
25 273 ha – forests: 62%
31 Municipalities

Local scale analysis

Similar datasets for the two areas (G.I.S.)

Authorities define criteria to evaluate forestry features

RESULTS



POTENTIAL AVAILABLE BIOMASS

TREE SPECIES FEATURES

- Renewal rate
- Functions (protective, productive, …)
- Humidity content: 20% - 40%

SPATIAL FEATURES

- Spatial distribution
- Accessibility Road network

RESULTS

CURRENT UTILIZATION OF WOOD

Forest Activity Statements of 2008 (municipal scale)

UNCERTAINITY

Local analysis (JRC – Lombardy Region)

62% for CMLI

66% for CMTL

TECHNICAL LOSSES

Statistics from
- Italian Biomass Association
- Italian National Institute of Statistics

(Provincial level - 2008)
80% for CMLI and CMTL

Local authority area	Current Utilization of wood* (t/y)	Potential available biomass for energy use* (t/y)
CMLI	15 672	7 684
CMTL	20 533	8 462

*medium values.

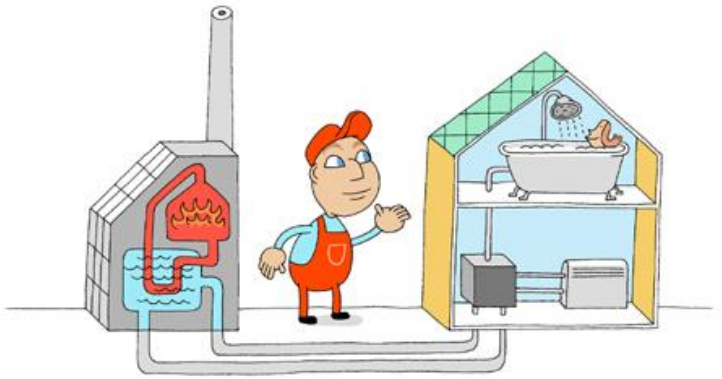
RESULTS

Local authority area	Energy potential* (GJ)	Replacement of fossil fuel* (toe)
CMLI	89 486	2 138
CMTL	98 395	2 351

Province of Como's Policies: small biomass plants (<1 MW) as optimal solution.

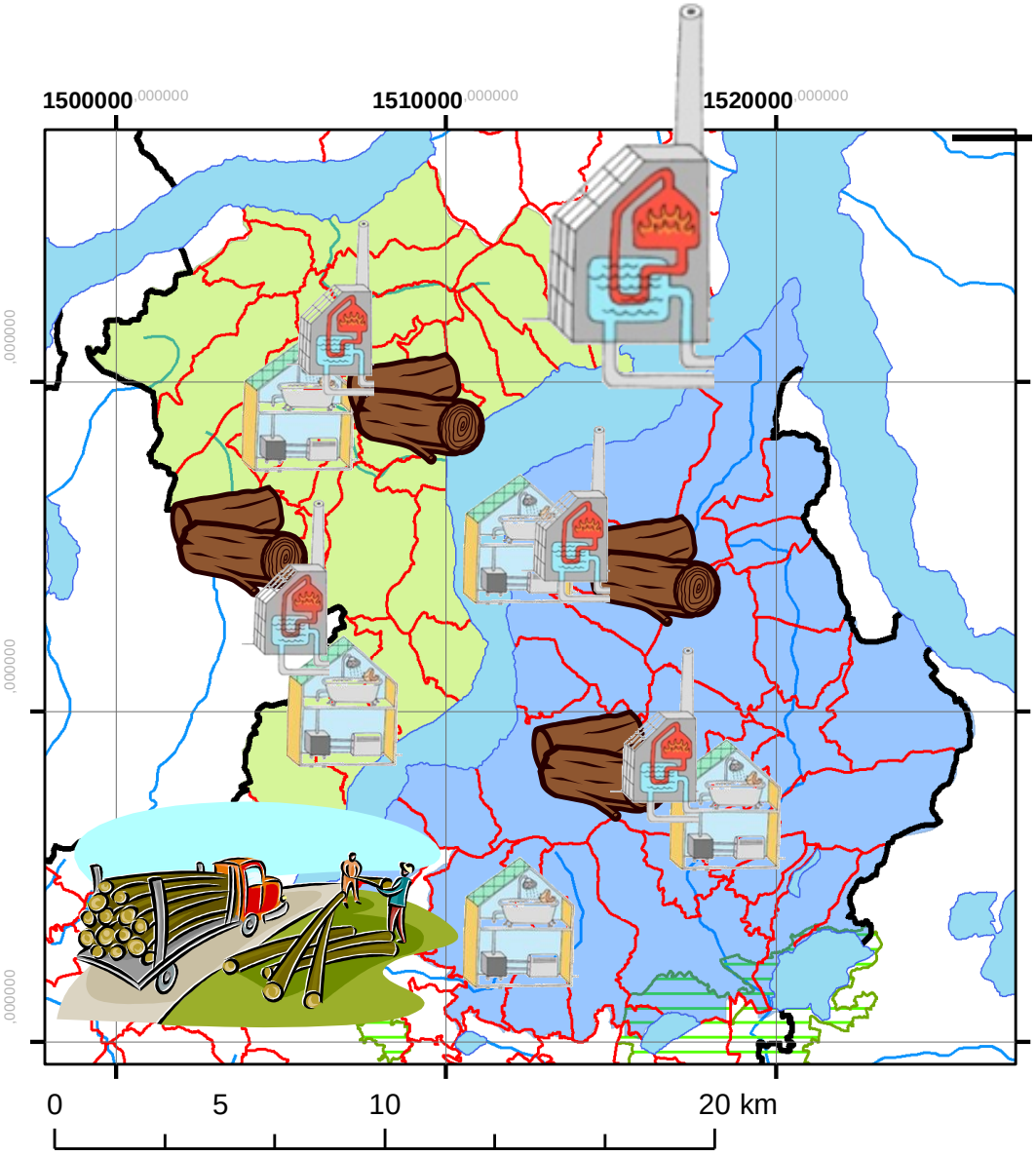
Thermal power plant of CMLI	
Power	240 kWt
Fuel	Forest chips
Utilities	Swimming pool

x40 (CMLI + CMTL)



*medium values.

CONCLUSIONS (1)



POWER PLANT LOCATION

Demand for energy

Distribution of biomass

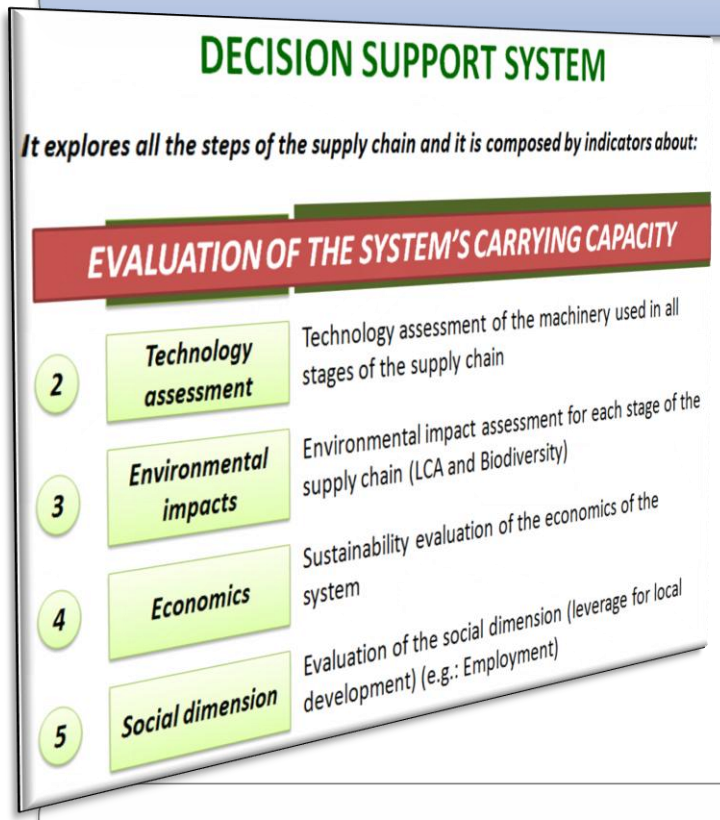
Transportation

Lario Intelvese
Triangolo Lariano
Como Province
Municipalities
Water bodies
Rivers
Parks

Datum: Roma40
Projection: Gauss-Boaga

CONCLUSIONS (2)

The proposed methodology evaluates the possibility for forests to provide the supply of raw material for energy production among ecosystem services.



POTENTIAL AVAILABLE BIOMASS

POTENTIAL AVAILABLE BIOMASS FOR ENERGY USE

ENERGY POTENTIAL

It is useful for the assessment of the possibility to consider forestry biomass in energy planning at local level.

FUTURE DEVELOPMENT

DSS for the case studies

Energy availability VS Energy demand

Replacement of fossil fuel*	Consumption of energy from Natural Gas, LPG and Diesel**
(toe)	(toe)
2 138	20 157

*medium values,
**2008, Database S.I.R.EN.A. - Lombardy Region

The potential can cover 10% of energy from fossil fuel consumption of the household sector of the CMLI.

Burning plants

Transport

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DECISION SUPPORT SYSTEM

Multidimensional DSS based on application of LCA in different contexts to optimise: Forest activities/Choice of technology/Location of plants

LCA of harvesting and forest activities

Operation related to biomass

LCA of bio-based products

Wood for bio-based products

Wood waste

LCA-based technology assessment

Wood for energy production

Local policy related to Land use and Spatial planning

Local policy related to enhancing local development in term of job/economic activities

Local policy related to energy planning

BIOMASS FOR ENERGY PRODUCTION

Europe. Objectives by 2020

- ***cutting energy consumption by 20% of projected 2020 levels by improving energy efficiency;***
- ***cutting greenhouse gases by at least 20% of 2005 levels;***
- ***increasing use of renewable (wind, solar, biomass, ..) to 20% of total energy production.***

An Energy Policy for Europe COM(2007)1

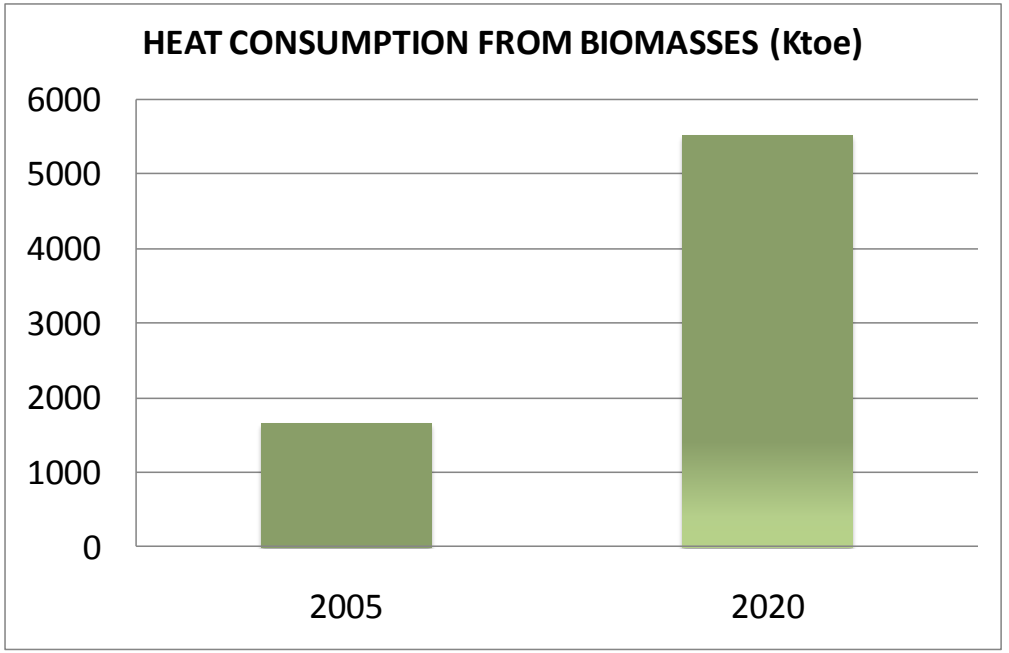
Biomass Action Plan COM(2005)628

Italy. National Action Plan

Consumptions by renewable resources: 22.3 Mtoe

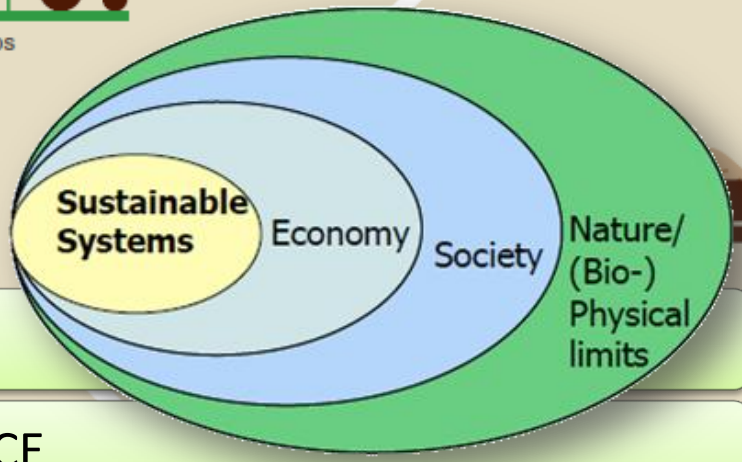
BIOMASSES (44%)

- 20% electric consumptions
- 58% heat consumptions
- 84% of transport



National Action Plan for Renewables of Italy (2010)

IS ENERGY PRODUCTION FROM WOODY BIOMASS SUSTAINABLE?



BIO-BASED

LIMITS OF RESOURCE

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SOCIAL AND ECONOMICS ASPECTS

CONCLUSIONS (1)

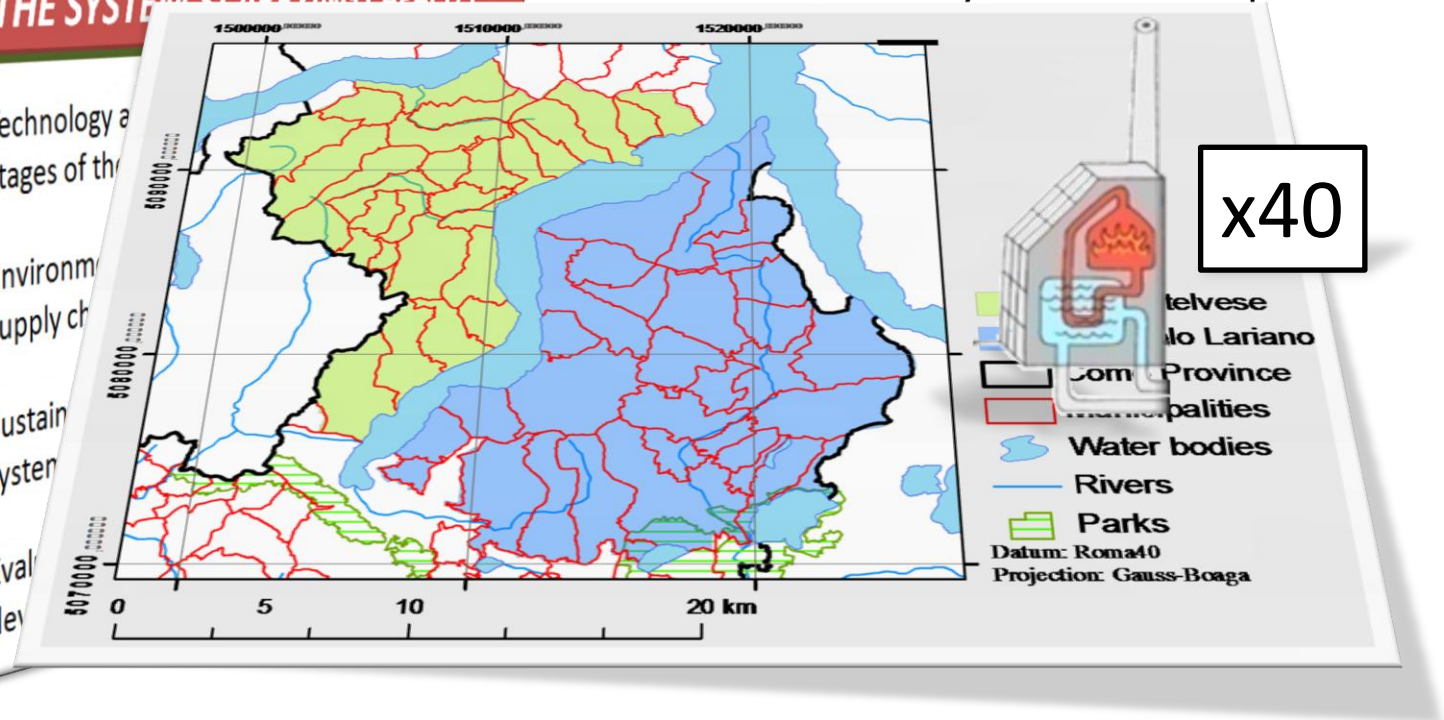
DECISION SUPPORT SYSTEM

It explores all the steps of the supply chain and it is composed by indicators about:

EVALUATION OF THE SYSTEM'S CARRYING CAPACITY

2. **Technology assessment** — Technology a… stages of th…
3. **Environmental impacts** — Environm… supply ch…
4. **Economics** — Sustain… systen…
5. **Social dimension** — Eval… dev…

Considering the **consumption** of such facilities and the **biomass availability**, calculated within the sustainability boundaries of the system, it is estimated that for the two study areas can be provided



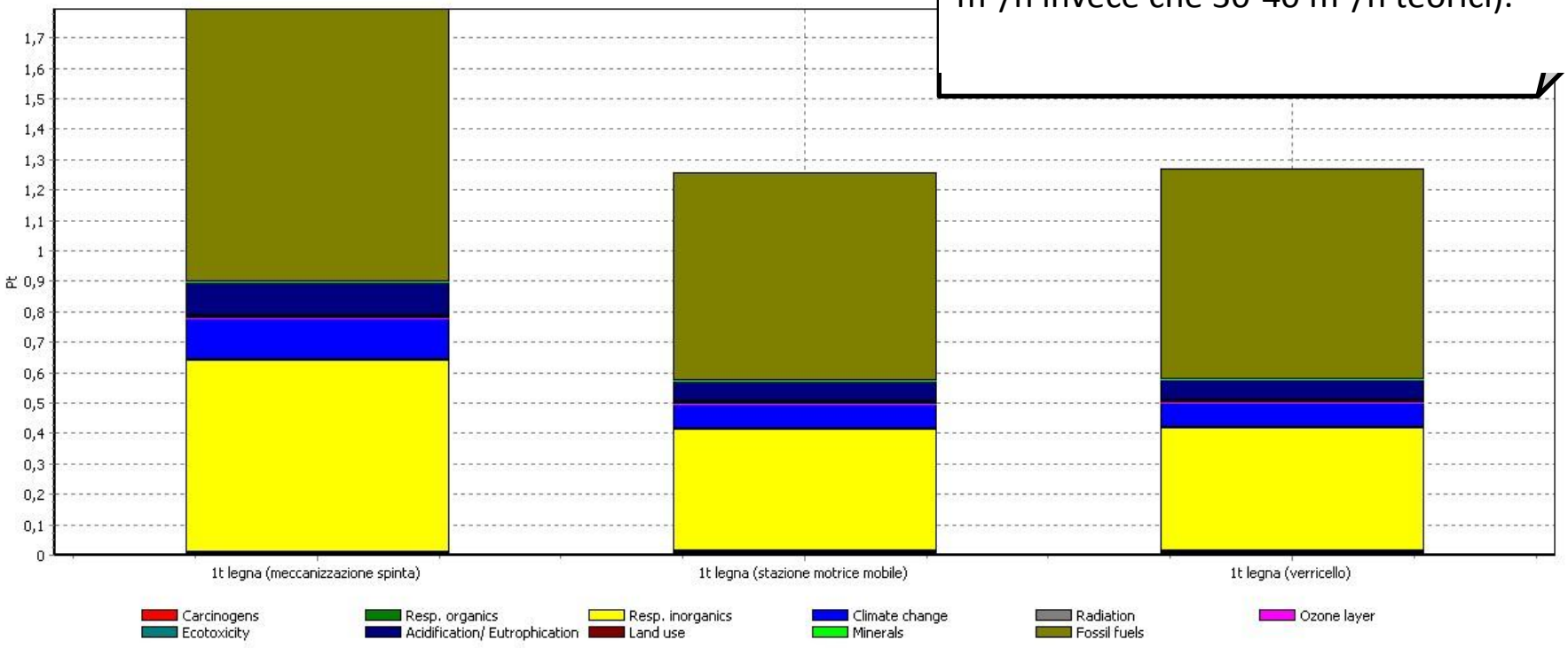
RISULTATI

3. Confronto tra livelli di meccanizzazione

MECCANIZZAZIONE SPINTA

+30-40%

Risultato influenzato dalla scarsa accessibilità dell'area che, durante le prove eseguite dal consorzio, non ha permesso di sfruttare appieno le potenzialità di questi macchinari (14 m^3/h invece che 30-40 m^3/h teorici).



Confronto di 1 ton '1t legna (meccanizzazione spinta)', 1 ton '1t legna (stazione motrice mobile)' e 1 ton '1t legna (verricello)'; Metodo: Eco-indicator 99 (H) V2.06 / Europe EI 99 H/A / punteggio singolo