FOREST BIOMASS FOR BIOENERGY: OPPORTUNITIES AND CONSTRAINTS FOR A GOOD GOVERNANCE

Prof. Marco Marchetti

Department of Biosciences and Territory
UNIVERSITY OF MOLISE
OUTLINE

• Where the bioenergy boom comes from:
  carbon and global change
• EU 2020 Energy Strategy
• Renewable Energy Source (RES)
  • general issue
  • opportunities and constraints
• EU Governance context: the Forest Strategy
• Conclusions
which of these two extremes is the most likely?

< 420 ppm (2100)

July 2013: 394.28 ppm
July 2012: 390.93 ppm

Where humanity’s CO₂ comes from

- **Fossil Fuels & Cement**: 91% 33.4 billion metric tonnes
- **Land Use Change**: 9% 3.3 billion metric tonnes

**INCREASE**

- 89% 2013
- 11%

Investments in sustainable renewable energy

- **WIND**
- **HYDROPOWER**
- **SOLAR POWER**
- **BIOMASS**

References:
The annual average climate change for the Mediterranean region for the period 2040–2070 in comparison to 1960–1990

LULC change has been a common characteristic of the Mediterranean landscape over the past 10,000 yr.

Carbon sequestration and forestry

### Table: Forest Area and Carbon Stocks

<table>
<thead>
<tr>
<th>Region</th>
<th>Forest area, (mill. ha)</th>
<th>Annual change (mill. ha/yr)</th>
<th>Carbon stock in living biomass (MtCO₂)</th>
<th>Growing stock in 2005 (million m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>63,5412</td>
<td>-4.4</td>
<td>241,267</td>
<td>64,957</td>
</tr>
<tr>
<td>Asia</td>
<td>571,577</td>
<td>-0.8</td>
<td>150,700</td>
<td>47,111</td>
</tr>
<tr>
<td>Europea</td>
<td>1001,394</td>
<td>0.9</td>
<td>154,000</td>
<td>107,264</td>
</tr>
<tr>
<td>North and Central America</td>
<td>705,849</td>
<td>-0.3</td>
<td>150,333</td>
<td>78,582</td>
</tr>
<tr>
<td>Oceania</td>
<td>206,254</td>
<td>-0.4</td>
<td>42,533</td>
<td>7,361</td>
</tr>
<tr>
<td>South America</td>
<td>831,540</td>
<td>-3.8</td>
<td>356,233</td>
<td>128,944</td>
</tr>
<tr>
<td>World</td>
<td>3,952,026</td>
<td>-8.9</td>
<td>1,097,067</td>
<td>434,219</td>
</tr>
</tbody>
</table>

a) Including Russian Federation


Most of the current European forest sink originates from relatively recent (this century) land use change and changes in forest management practices.


Valentini et al. (2000)- Accounting for Carbon Sinks in the Biosphere, European perspective. CarboEurope European Office, Jena, Germany.
MASIFF - JRC (2011). Development of a Methodology for the Analysis of Socio-economic Impact of Forest Fires and economic efficiency of fire management.
Carbon sink saturation in Europe

Nabuurs et al. (2013). First signs of carbon sink saturation in European forest biomass. *Nature Climate Change*

**First signs**

1. Slow down in stem volume increment
2. Increased Deforestation
3. Increased Disturbances (biotic and abiotic)

**Spatially-diversified policies**

- High Carbon Stock densities in all forests
- High Carbon Stock forests on sensitive sites
- Protection of fire-prone forests
- Continuous Cover Forestry
- Silvicultural techniques optimization
EU 2020 Energy Strategy

Europe 2020 is the EU's growth strategy for the coming decade.

Climate change and energy target:
- To reduce greenhouse gas emissions by **20%** compared with **1990**
- To increase the share of **renewable energy** sources in final energy consumption to **20%**;
- To improve energy efficiency by **20%**

<table>
<thead>
<tr>
<th>EU/Member States targets</th>
<th>Employment rate (in %)</th>
<th>R&amp;D in % of GDP</th>
<th>CO₂ emission reduction targets</th>
<th>Renewable energy</th>
<th>Energy efficiency – reduction of energy consumption in Mtoe</th>
<th>Early school leaving in %</th>
<th>Tertiary education in %</th>
<th>Reduction of population at risk of poverty or social exclusion in number of persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU headline target</td>
<td>75%</td>
<td>3%</td>
<td>-20% (compared to 1990 levels)</td>
<td>20%</td>
<td>20% increase in energy efficiency equalling 368 Mtoe</td>
<td>10%</td>
<td>40%</td>
<td>20,000,000</td>
</tr>
<tr>
<td>Estimated EU²</td>
<td>73.70-74%</td>
<td>2.65-2.72%</td>
<td>-20% (compared to 1990 levels)</td>
<td>20%</td>
<td>206.9 Mtoe</td>
<td>10.30-10.50%</td>
<td>37.50-38.0%</td>
<td>Result cannot be calculated because of differences in national methodologies</td>
</tr>
</tbody>
</table>

Using resources more efficiently will help us achieve many of the EU's objectives.
EU 2020 Energy Strategy

We need 5% more to reduce greenhouse gas emissions by 20% compared with 1990.
To **increase** the share of **renewable energy** sources in final energy consumption to **20%**

Eurostat (online data code, september 2013)
EU 2020 Energy Strategy

**Investment in renewable energy at global level**

To **improve** energy efficiency by **20%**
The EU produces 48% of its energy needs...

The EU depends on a few suppliers for its oil and gas supplies. Diversification of routes and sources is a strategic priority for the EU.
More than one third of Europe’s binding RES target of 20% by 2020

Can EU forests supply the woody biomass needed to meet the NREAPs? 

Developed sophisticated yield regulation and monitoring tools

Forest Management Plan

Certification Schemes

National Inventories

Differences among Countries

How to mobilize this forest biomass?

Prices

Market

Biomasfor: GIS GRASS extension to assess the exploitability of forest biomass

open-source spatial analysis model

calculates ecological availability depending on yield, forest management and forest treatment.

The scenario assessment framework defines not only the amount of biomass but also the supply/demand ratio and the economic added value for the entire forest chain according to the modeling of the input variables.

Calculates the supply of forest energy-biomass for a defined territory

conducts a multi-step analysis that can yield estimates of ecological, technical, economic and sustainable bioenergy.

Each of the categorised bioenergy typologies (ecological, technical, economic and sustainable) represents a Biomasfor sub-model,

http://sourceforge.net/p/biomasfor/code/ci/415ab11cda6fae799d77423a8cb400af780f9f09/tree/

University of Firenze
University of Trento
Assessment of potential bioenergy from coppice forests through the integration of remote sensing and field surveys

**European Forest Types** | **Coppice (ha)**
---|---
Italian downy oak | 604
Mesic Turkey oak forest | 6308
Meso-xeric Turkey oak forest | 1080
Other mixed broadleaved | 130
Appenine-Corsican montane beech | 1159

Landsat 7 image 30 m resolution + 99 Inventory plots

Non-parametric multivariate k-NN

RMSE = 25.6%

Woodfuel Integrated Supply/Demand Overview Mapping (FAO)

Potential supply of Firewood biomass (20 years rotation cycle)

49500 t.y⁻¹

= 3.5 x demand
Think Forest Event (April 2013)

What are the long-term effects of intensive biomass extraction on forest productivity?

Lead to nutrient depletion


Site Specific Consideration

Is there a need for legally binding sustainability criteria and thresholds for forest biomass for energy?

Biodiversity Conservation

High diversity forests

Carbon Neutrality

Deadwood threshold

Is really biomass Carbon Neutral?

European forests can suffer biodiversity loss due to a lack of harvesting

Verstraeten et al. (2013). Temporal changes in forest plant communities at different site types. Applied Vegetation Science.

European biodiversity under pressure

Nabuurs (2012). Think Forest
Which source of renewable energy is most important to the European Union?

**SOLAR POWER**
Europe has 3/4 of the world’s total installed capacity

**WIND**
Germany trebled its wind-power capacity

**WOOD**

**BIOMASS**
more than 50% of renewable-energy demand (80% somewhere).

**Carbon Neutral?**

**SFM**
Short Chain
Integration of harvesting operations

**STORED**

**The fuel of the future**
The fuel of the future

**ADVANTAGES**

- burn a mixture of 90% coal and 10% wood (called co-firing) with little new investment.
- wood energy is not intermittent
- not require backup power at night, or on calm days

**MONEY GROWS ON TREES**

The EU wants to get 20% of its energy from renewable sources by 2020.
European firms are scouring the Earth for wood.

Europe consumed 13M tonnes of wood pellets in 2012. The International Wood Markets Group predicts that this could rise five or six fold from 10M-12M tons a year to 60M tons by 2020.

Europe does not produce enough timber to meet that extra demand.
Biomass sustainability

The United States are the largest wood pellet exporter in the world.

1.5 million tons in 2012 and are expected to jump to 5.7 million tons in 2015.


Conversions of large coal-burning power plants to wood (co-)firing in Europe have resulted in the explosive growth of wood pellet exports from North America.


bioenergy is very resource intensive. This contradicts the EU Resource Efficiency Initiative, which emphasises using resources where most efficient.

biomass criteria do not take into account negative effects from indirect land-use change (ILUC), like greenhouse gas emissions and biodiversity losses.

the proposal fails to protect high biodiversity value forests and fails to ensure a strong definition of sustainable forest management.

NGOs in the US have complained that EU bioenergy policy is destroying US forests.

burning trees to generate electricity releases more carbon than burning coal.

Biomass sustainability

Europe's Green-Fuel Search Turns to America's Forests

EU must focus on reducing energy consumption and becoming more energy efficient so that demand does not go beyond what can be sustainably supplied from well managed European forests.
The total growing stock of forests in the European regions is estimated at 24 134 million m³, of which 90% is available for wood supply.

Forests cover about 157.2 million ha in Europe, EU-27 (Forest Europe, 2011)


Lindner et al. (2010). Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. *Forest Ecology and Management*
Forest resources in the EU
A new EU Forest Strategy, 20/09/2013

42% of EU land area is covered with forest

Area covered by forests in Europe has increased

0.4% per year since 1990

60-70% of the annual increment is being cut

Afforestation programmes

Natural Succession of Vegetation

Abandonment of Farming

Forest Ecosystem Services (FES)

BIOMASS

Vital for the rural population
Forest resources in the EU
A new EU Forest Strategy, 20/09/2013

60% are in private hands → average size of 13 ha

40% are in public hands → average size more than 1000 ha

Increased competition for forest products and ecosystems services → Renewable energy

Maintaining forest ecosystems → Increasing the potential

Sustainable Forest Management

Principle & Criteria
Implementing Criteria and Indicators for Sustainable Forest Management in Europe

1990
• 1st MCPFE Strasbourg
• United Nations Conference on Environment and Development (UNCED)
• Agenda 21

1992

1993
• 2nd MCPFE Helsinki (SFM)

1994
• MCPFE Expert Level Meeting in Geneva (1st draft of C&I set)

1998
• 3rd MCPFE Lisbon (1st set of C&I)

2002
• MCPFE Expert Level Meeting in Geneva (improved Pan-European set)

2003
• 4th MCPFE Vienna (adoption of C&I set)
• SoEF 2003

2007
• 5th MCPFE Warsaw
• SoEF 2007

2011
• FOREST EUROPE Oslo
• SoEF 2011

http://www.ci-sfm.org/
Implementing Criteria and Indicators for Sustainable Forest Management in Europe

The marketed total roundwood shifted from 320M m³ in 1990 to 397M m³ in 2010 in Europe (without Russian Federation) incremented the value of 5000M €.

Wood fibres from forest, OWL & TOF are the most important source for wood energy providing 50% of wood biomass for energy generation in Europe.

<table>
<thead>
<tr>
<th>Region</th>
<th>Volume (1,000 m³)</th>
<th>Volume (m³/ha FAWS)</th>
<th>Value (million EUR)</th>
<th>Value (EUR/ha FAWS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian Federation</td>
<td>110,000</td>
<td>0.2</td>
<td>3,408</td>
<td>5.0</td>
</tr>
<tr>
<td>North Europe</td>
<td>143,813</td>
<td>3.0</td>
<td>4,979</td>
<td>110.9</td>
</tr>
<tr>
<td>Central-West Europe</td>
<td>150,473</td>
<td>4.4</td>
<td>7,941</td>
<td>240.9</td>
</tr>
<tr>
<td>Central-East Europe</td>
<td>103,500</td>
<td>3.3</td>
<td>2,596</td>
<td>180.7</td>
</tr>
<tr>
<td>South-West Europe</td>
<td>24,846</td>
<td>1.5</td>
<td>703</td>
<td>47.1</td>
</tr>
<tr>
<td>South-East Europe</td>
<td>45,048</td>
<td>2.2</td>
<td>1,524</td>
<td>109.7</td>
</tr>
<tr>
<td>Europe</td>
<td>577,680</td>
<td>0.7</td>
<td>21,152</td>
<td>26.6</td>
</tr>
<tr>
<td>Europe without the Russian Federation</td>
<td>467,680</td>
<td>3.1</td>
<td>17,743</td>
<td>145.2</td>
</tr>
<tr>
<td>EU-27</td>
<td>404,938</td>
<td>3.3</td>
<td>16,077</td>
<td>145.7</td>
</tr>
</tbody>
</table>

Volume and value of marketable and non-marketable roundwood, 2010.

SoEF (2011)
3.3.2 Fostering the competitiveness and sustainability of the EU’s Forest-based Industries, bio-energy and the wider green economy

- 58% of harvested EU wood biomass is processed by EU Forest-based Industries
- 7% of EU manufacturing GDP
- 3.5 million jobs
- 42% is used for energy
- 5% of total EU energy consumption
- Still the main Renewable source
Forest resources in the EU
A new EU Forest Strategy, 20/09/2013

Strategic orientations 3.3.2

- Promote the use of wood as a sustainable without damaging the forests and their ES
- Develop SFM criteria that can be applied in different policy contexts regardless of the end use of forest biomass
- Assess potential wood supply and facilitating increased sustainable wood mobilisation
- Stimulate market growth and internationalisation of EU Forest-based Industry products
- Facilitate access to third markets for EU Forest-based Industry products and raw materials via bilateral trade agreement
- Support the Forest-based Sector Technology Platform and encourage new initiatives, foster research and innovation
Italy consumed 2.2 M tonnes of wood pellets in 2012.

Italy consumed 2.5 M tonnes of wood pellets in 2013.

AIEL (2013. Italian Association of Energy Agroforestry)
Forest Biomass
The case of Italy

- Forest
- Waste wood processing
- Vine shoot

Electricity
910 km

Teleheating
4% of Italian Heat Market

750,000 tons forest chips to Short Chain

Source: Italian Producer of Renewable Energy Federation (FIPER) 2013
EU support for private forests: no tangible results from RDP, say EU Auditors

“The situation in the forestry sector in the EU was not specifically analysed so as to justify specific financial support aimed at improving the economic value of forests...”

“Member States used the measure to support operations which did not correspond to the programme’s goals”

Measure 122

“improvement of the economic value of forests”

2007-13

535 million

The ECA’s audit revealed deficiencies in the programme across the board - the design, implementation and monitoring of the measure

Member States did not manage the audited aspects of the support for the improvement of the economic value of forests efficiently and effectively.

period 2014-20

will be maintained
Woody biomass is the most important single source of renewable energy in Europe, accounting for almost as much as hydro, wind, solar, geothermal and other biomass put together.

Wood mobilization needs to be accompanied by strictly implemented biodiversity safeguards.

carbon neutrality depends on the type of forest used, how fast the trees grow, whether you use woodchips or whole trees and so on.

Carbon neutrality seems an absolute minimum requirement for a subsidized fossil fuel alternative, but a standardized science-based approach considering the complex time-and-space issues related to the greenhouse gas balance of the forest value chain is due.

However, according to Member States’ projections under Land Use, Land-Use Change and Forestry (LULUCF), harvest rates are expected to increase by around 30% by 2020 as compared to 2010.
A comprehensive approach is needed

**Supply**

- Mobilise more wood from existing forests
  - Raise harvest levels
  - Use more parts of the tree (above ground and below ground biomass)
- Increase supply of wood from outside the forest
  - Industry residues
  - Landscape care wood, trees outside the forest
  - Post consumer recovered wood
- Expand forest area (short rotation coppice)

**Demand**

- Promote energy efficiency
- Promote use of all renewables
- Use wood more efficiently, in industry and for energy
Challenges for Policymakers

✓ Sustainably mobilise enough wood to reach renewable energy targets, a more proactive forest sector

✓ Balance carbon sequestration with substitution of non-renewables with wood-based materials and energy

✓ Maintain wood supply for other forest sectors (pulp, paper, panels, furniture) and ES

✓ Respect biodiversity while increasing mobilisation

✓ Define sustainability criteria for local and imported wood energy
THANKS FOR YOUR ATTENTION

marchettimarco@unimol.it
Department of Biosciences and Territory, UNIMOL

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