University of Camerino - UNICAM (Italy)

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CASE STUDY 1

Wind farm planning in central Apennines

- **Type of case study:** pilot project within the Energetic-Environmental Plan of Marche Region (wind farm sustainable planning)
- **Promoter:** Marche Region, Union of Municipalities of Camerino district.
- **Target groups:** municipalities, economic operators of the energy sectors, students.
- **Funding:** public funding.
- **Location:** Monte Tolagna, central Apennines (Marche Region, Italy); about 1,000 hectares.
- **Timeframe:** 2009-2013.

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Wind farm planning in central Apennines

Main aim

✓ Developing an integrated and collaborative approach to plan a sustainable renewable energy plant (selecting the most suitable location to set the wind farm).

• **Environmental sustainability** of wind farm (reducing the environmental impact, especially on plant and bird diversity, by the participation of biologists and ecologists in the phases of the project building).

• **Economic sustainability**
Wind farm planning in central Apennines

- Guidelines for the executive project planning (building phase, adaptation of access roads).

- Biodiversity monitoring plan before, during and after the wind farm construction.

- Assessment of the citizens' perception of the planned wind farm and the level of acceptance by the local community.

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• Technical requirements (Energy-Environmental Plan of Marche region), engineering aspects, analysis of wind intensity and direction, and the economic plan

• Constraints linked to the presence of protected areas, elevation and slope angle ranges, existence of access roads (Regional Energy-Environmental Plan)

• Environmental value of the territory (landscape, plant communities and species of conservation interest)

• The study addressed the potential environmental impacts of the wind farm on plant biodiversity and bird community (especially migrating species, birds of prey, protected species)
Pastoral systems of Marche Region

- **Surface area**: ca. 50,000 ha
- **Plant species richness**: 800 species (20-25% of Marche’s flora)
- **Habitat 6210** (EU «Habitats» Directive)

**Habitat** of at least **20 bird species** included in the EU «Birds» Directive

**Habitat** of **numerous insect species** deemed conservation priorities by the EU «Habitats» Directive

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Analysis of geobotanic resources

Plant species inventory

Vegetation survey

Vegetation mapping
Assessment of geobotanic value

• Establishment of evaluation criteria (e.g. rarity, biogeographic interest; danger of extinction; habitat quality/rarity; protection laws)

• Evaluation of species’ and plant communities’ conservation value
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Floristic value

Habitats of community importance

Plant community value

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Geobotanic value

- High
- Low

Scale 1: 10 000

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Grasslands vulnerability

Scale 1: 10 000

Very high

Very low

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Detecting potential and real impacts for all elements which may cause impact (*also in the construction phase of the wind farm)

- alteration or destruction of habitats/plant communities / ecosystems;
- loss of plant species of high conservation interest;
- biodiversity loss; soil erosion;
- habitat fragmentation;
- cumulative impacts

(*) access roads; roads of internal service to the central area of excavation for the plinth supporting the turbine; pitch for the cranes that will lift the wind turbine; power lines, etc.
Mean impacts of wind farm building on the geobotanic system

Scale 1: 10 000
Geobotanic compatibility with wind farm building

Very low

High
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Geobotanic analysis

- Habitats map + Floristic value + Plant community value

Detection of impacts

- Geobotanic value

Resistance Resilience

Mean impacts + Vulnerability

Geobotanic compatibility of the wind farm

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Map of animal species habitats

Distance of 6 km from Gold Eagle’s nest

Map of bird corridors

Main corridor

Important bird area

Crossing place

Site of Community Importance

Secondary corridor

Special protection area

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Why the project is relevant for the purpose of ENEPLAN?

- Integrated method of planning a sustainable use of RES reducing the environmental impacts
- Collaboration among experts (biologists, ecologists, engineers, landscape architects and local public bodies) and set up of common procedures from the earliest stages of project design to achieve environmental and economic sustainability
- Involvement of local stakeholders

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CASE STUDY 2

Suitability study aimed at planning a wood-energy chain

- **Type of case study:** developing strategies of energy production through a sustainable use of forest resources.
- **Promoters:** Marche Region, Union of Municipalities of Camerino district, University of Camerino
- **Target groups:** local bodies of Macerata district (Marche, Italy), economic operators of the wood-energy sectors, students.
- **Funding:** EU, Leader Plus program related to regional agricultural development plans (PSL Sibilla-Intervento 1.2.H. “Renewable Energy Sources”).
- **Location:** Marche Region, Italy.
- **Timeframe:** 2005-2007.

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Italy

Marche

Camerino district
• **Resource assessment**: environmental analysis, description of forest types and biomass characterisation.

• **Suitability analysis** of the study area for a wood-energy chain and for agro-energy crops (SRF).

• Planning the most suitable type of *wood-energy chain* taking into account environmental sustainability and socio-economic aspects.

• **Dissemination** of the economic opportunity to realize a wood-energy chain in mountain territory of central Italy (local public bodies and companies).

• **Case studies**: forest management along river beds; economic and ecologic benefits of the replacement of non-renewable energy sources with renewable ones in public buildings.

• Experimentation of **sustainable forest cutting techniques**.

*(UNICAM - University of Camerino, Federico Maria Tardella)*
<table>
<thead>
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<th>Municipality</th>
<th>Surface (ha)</th>
<th>Woods extension (ha)</th>
<th>Woods extension (%)</th>
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<tr>
<td>Acquacanina</td>
<td>2,671</td>
<td>1,033</td>
<td>38.67</td>
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<tr>
<td>Bolognola</td>
<td>2,586</td>
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<td>36.20</td>
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<td>Camerino</td>
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<td>Castelsantangelo sul Nera</td>
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<td>Total</td>
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<td>30,153</td>
<td>40.15</td>
</tr>
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Data: RSA 2003

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Geology

Bioclimatic

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Landscape systems and subsystems

Temperate macroclimatic region

- **System of calcareous substrata**
  - Subsystem of lower mesotemperate bioclimatic belt
  - Subsystem of upper mesotemperate bioclimatic belt
  - Subsystem of lower supratemperate bioclimatic belt
  - Subsystem of upper supratemperate bioclimatic belt
  - Subsystem of orotemperate bioclimatic belt

- **System of marly-calcareous substrata**
  - Subsystem of upper supratemperate bioclimatic belt
  - Subsystem of lower mesotemperate bioclimatic belt

- **System of arenaceous substrata**
  - Subsystem of upper mesotemperate bioclimatic belt

- **System of pelitic-arenaceous substrata**
  - Subsystems of upper mesotemperate bioclimatic belts

- **System of alluvial deposits**
  - Subsystems of fluvial beds and actual and recent alluvial terraces

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Vegetation series = Land unit
Same potential vegetation
Same dynamic stages
(same potential for woody crops)

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Forest landscape

Legenda

- Bosco di leccio
  - Cyclaminio hederifolii-Quercetum ilicis cyclaminetosum hederifolii
- Bosco di leccio
  - Cephalanthro longifolae-Quercetum ilicis lathyretosum veneti
- Bosco di roverella con cistis a foglie sessili
  - Cyttis sessilifolii-Quercetum pubescentis
- Bosco di roverella con cistis a foglie sessili e cerro
  - Cyttis sessilifolii-Quercetum pubescentis quercetosum cerridis
- Bosco di roverella con erica arborea
  - Erico arboresum-Quercetum pubescentis ericetosum arboreae
- Bosco di roverella
  - Peucedano cervariae-Quercetum pubescentis peucedanetosum cervariae
- Bosco di carpino nero
  - Scutellario columnae-Ostryetum carpinifoliae violeotosum reichenbachianae
- Bosco di carpino nero e acero
  - Scutellario columnae-Ostryetum carpinifoliae prunetosum avii
- Bosco di carpino nero o di cerro e carpino nero
  - Hieracio murioli-Ostryetum carpinifoliae hizuletosum forsteri, Aceri obtusati-Quercetum cerridis
- Bosco di cerro
  - Carici sylvaticae-Quercetum cerridis
- Bosco di cerro con faggio
  - Aceri obtusati-Quercetum cerridis fagetosum sylvaticae
- Bosco di castagno
  - Cyclaminio hederifolii-Castaneetum satvae
- Bosco di faggio
  - Lathyro veneti-Fagetum sylvaticae lathyretosum veneti
- Bosco di faggio
  - Cardaminio kitaibeli-Fagetum sylvaticae
- Bosco ripariale a salice bianco
  - Salicetum albae, Salicetum albae alnetosum glutinosae

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Holm oak (*Quercus ilex* L.) woods

**Phytosociology** - *Cyclamino hederifolii-Quercetum ilicis; Cephalanthero longifoliae-Quercetum ilicis.*

**Ecology** - Lower and upper Mesotemperate belts; South-facing slopes (30-70°); limestones.

**Management** - Coppice with standards.

**Mean forest stand** - 120 m³/hectares.

White oak (*Quercus pubescens* L.) woods

**Phytosociology** - *Cytiso sessilifolii-Quercetum pubescentis; Peucedano cervariae-Quercetum pubescentis; Roso sempervirentis-Quercetum pubescentis*

**Ecology** - Upper Mesomediterranean, lower and upper Mesotemperate belt; South-facing slopes (10-40°); calcareous debris, limestones, marly-limestones, sandstones.

**Management** - Coppice with standards

**Mean forest stand** - 70 m³/hectares.

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Hop-hornbeam (*Ostrya carpinifolia* Scop.) woods

**Phytosociology** - *Scutellario columnae-Ostryetum carpinifoliae*; *Asparago acutifolii-Ostryetum carpinifoliae*; *Hieracio murori-Ostryetum carpinifoliae*.

**Ecology** - Lower and upper Mesotemperate belts; North-facing slopes (20-70°); limestones, marly-limestones; sandstones.

**Management** - Coppice with standards.

**Mean forest stand** - 80 m³/hectares.

Turkey oak (*Quercus cerris* L.) woods

**Phytosociology** - *Carici sylvatica-Quercetum cerridis*; *Aceri obtusati-Quercetum cerridis*; *Daphno laureolae-Quercetum cerridis*.

**Ecology** - Lower and upper Mesotemperate belts; North-facing slopes (5-30°); calcareous-siliceous substratum, fersiallitic paleosols.

**Management** - Coppice with standards / high forest.

**Mean forest stand** - 120 m³/hectares.

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Chestnut (*Castanea sativa* Mill.) woods

**Phytosociology** - *Cyclamo no hederifolii-Castaneetum sativae*.

**Ecology** - Lower and Upper Mesotemperate belts; North-facing slopes (5-30°); sandstones, fersiallitic paleosols on limestones.

**Management** - Coppice with standards / high forest.

**Mean forest stand** - 200 m³/hectares.

Beech (*Fagus sylvatica* L.) woods

**Phytosociology** - *Lathyro veneti-Fagetum sylvaticae; Cardamino kitaibelii-Fagetum sylvaticae*.

**Ecology** - Lower and upper Supratemperate belts; North-facing slopes (20-50°); limestones.

**Management** - Coppice with standards / high forest.

**Mean forest stand** - 180 m³/hectares.

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Land suitability for woody biomass production of forest systems

Favourable factors

• High wood extension and high potential woody biomass availability

Unfavourable factors

• Most part of available biomasses used as firewood
• Difficult accessibility
• Low market value (6.5 Euro/quintal)
• Questionable use of wastes from forestry activities

Evaluation of the most suitable forest systems

• Presence of protected areas (National and Regional Parks, Natural Reserves, etc.)
• Type of management (high forest / coppice).
• Slope angle (slopes < 35°)
• Forest stand (< 100 m³/hectares; 100-150 m³/hectares; 150-200 m³/hectares)

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Land suitability for woody biomass production

FOR Forest STAND

- Forest stand between 150 and 200 m.s.l.
- Forest stand between 100 and 150 m.s.l.
- Forest stand <100 m.s.l.
- ZPS (State Directive 76/404/EEC)
- SCI ( Habitats Directive 92/43/EEC)
- Protected Area (L. 304/91)
- Floristic Area (L.R. 62/74)

SLOPE

- <25°
- >25°

High Forest

(UNICAM - University of Camerino, Federico Maria Tardella)
Land suitability for woody biomass production

(UNICAM - University of Camerino, Federico Maria Tardella)
Possible agro-energy production chains

In order to actuate development systems of the agro-energetic chain it is essential to perform a territorial analysis aimed to:

- evaluate local biomass availability (landuse, agronomic vocation, waste woody biomass availability, SRF etc.);
- quantify heat energy demand;
- locate suitable areas for installation of heat energy biomass powered plants.

**Productive chain at district scale**
- Complex planning
- Involvement of many stakeholders
- Getting at local scale balance between supply and demand

**Productive chain at local scale**
- Promoted by local public bodies (energy requirements of public buildings, schools, etc.)

**Productive chain at enterprise scale**
- Stronger control of land management
- Improvement of local resource use; economical aid for the enterprises; efficient employment of agricultural and industrial production wastes

*(UNICAM - University of Camerino, Federico Maria Tardella)*
Dissemination and communication activities

- Local stakeholders
- High Schools
- University Courses
- Publications

Andrea Catorci, Sabrina Cesaretti, Paolo Marchetti
(a cura di)

Vocazionalità del territorio della Comunità Montana di Camerino per la produzione di biomasse solide agro-forestali ad uso energetico

L’uomo e l’ambiente — 47

(UNICAM - University of Camerino, Federico Maria Tardella)
Research aimed at the sustainable use of renewable energy sources

Biomass recovery for energy production through interventions of maintenance of banks and river beds (in collaboration with National Research Council of Italy - Trees and Timber Institute “IVALSA”)

Tree cutting along the banks and river beds
4,000 quintals / km (river bed 20 m wide and selective cutting) – 13,300 Euros / km
(70% of material is unsuitable as firewood and round timber)
Costs (depending on transport costs and extension of the area) – 10,400 Euros / km

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Research aimed at the sustainable use of renewable energy sources

Feasibility study of agro-forestry and energy sector in high-hills and mountain territories, for the production of heat for the public and private service

Simulating the substitution of fossil fuel fired boiler with wood fired boiler in public buildings of three Municipalities (Camerino, Fiastra, Montecavallo)

- Energy saving (5-78 Toe/yr)
- Cost saving (5,000 - 70,000 Euro/yr)
- Reduction of CO₂ emissions (15-240 tonnes CO₂ eq/yr)

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Why the project is relevant for the purpose of ENEPLAN?

✓ This project is an example of planning sustainable use of biomass (forest and crop) energy sources.
✓ Use of a scientific approach to assess the suitability of a territory for biomass energy production.
✓ Planning taking into account environmental and socio-economic issues.
✓ Involvement of local stakeholders in planning process.

(UNICAM - University of Camerino, Federico Maria Tardella)
Thanks for your attention