Outline

- ACEA
  - Our origins and activities

- Why choosing anaerobic-aerobic integrated system?
  - Drivers
  - Trends

- The waste treatment district: organic fraction for energy and soil conditioner
  - Managing a complex system
  - Energy production through cogeneration
  - Energy data and efficiency
  - Highlighting the need to match community expectation

- Conclusions
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• Conclusions
<table>
<thead>
<tr>
<th>Organization</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Officina del Gas</td>
<td>1856</td>
<td>Italian-French society for gas production from distilled coal</td>
</tr>
<tr>
<td>Acquedotto Municipale di Pinerolo</td>
<td>1914</td>
<td>Municipal Service for drinking water distribution in Pinerolo</td>
</tr>
<tr>
<td>A.M.G.A. (Azienda Municipalizzata Gas Acqua)</td>
<td>1964</td>
<td>Municipal Service for drinking water and natural gas distribution in Pinerolo</td>
</tr>
<tr>
<td>A.M.G.A.S. (Azienda Municipalizzata Gas Acqua Servizi)</td>
<td>1976</td>
<td>A.M.G.A. gains the management of Municipal Solid Waste</td>
</tr>
<tr>
<td>Consorzio Pinerolese Energia Ambiente</td>
<td>1986</td>
<td>Creation of the Consortium</td>
</tr>
<tr>
<td>ACEA</td>
<td>1993</td>
<td>Creation of ACEA</td>
</tr>
<tr>
<td>Azienda Consorziale Energia Ambiente</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRUPPO ACEA</td>
<td>1st January 2003</td>
<td>Creation of multiservice Group (Joint-stock Company)</td>
</tr>
</tbody>
</table>
ACEA is a modern Italian multi-utility company, which currently provides services for Municipalities, private companies and citizens. In more than 150 years the company has continued its territorial growth and the current Group operates in 47 Municipalities situated in the North West of Italy and serves a user base of over 150,000 inhabitants.

ACEA Pinerolese Industriale SpA is the joint stock company that control the Group. The special nature of the corporation is that the shareholders are the 47 Municipalities of the served area.
ACEA Operation figures (consolidated)

**n° of employees**

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
<tr>
<td>Value</td>
<td>289</td>
<td>293</td>
<td>295</td>
<td>298</td>
<td>311</td>
<td>322</td>
</tr>
</tbody>
</table>

**Revenues [M€]**

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
<tr>
<td>Value</td>
<td>33.3</td>
<td>37.3</td>
<td>43.9</td>
<td>44.1</td>
<td>45.2</td>
<td>48.8</td>
</tr>
</tbody>
</table>
The Activities Of The Group

**Business Units**

**WATER**
- Water Distribution and waste water treatment

**ENERGY**
- Natural Gas distribution and Heat Management

**ENVIRONMENT**
- Waste collection and treatment
The ENVIRONMENT department operates in the south west area of Turin province for 47 communities and 150,000 inhabitants with:

- MSW collection
- Separate waste collection
- Street sweeping and cleaning
- Waste treatment (including an ISO 14001 certified landfill and an ISO 14001 and 9001 Composting plant)

Now the Anaerobic-Aerobic Integrated System works for a third of the entire Turin province (800,000 inh. circa)
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• Conclusions
Drivers…

“The Council of the European Union […] IS AWARE that the issue of biodegradable waste is partially addressed, among others, by Directive 1999/31/EC on the landfill of waste, which sets the reduction targets for landfilling of biodegradable municipal waste, and by Directive 2008/98/EC on waste, which invites the Member States, among others, to introduce measures supporting separate collection and appropriate treatment of bio-waste […] ENCOURAGES the Commission to continue the impact assessment with a view to preparing, if appropriate, a EU legislative proposal on biodegradable waste by 2010[…]” from Council Conclusions Green Paper on the management of bio-waste in the European Union 2953rd ENVIRONMENT Council meeting Luxembourg, 25 June 2009

The Soil Framework Directive…

In Europe the so called landfill directive has created the fundamental push to ban organic fraction from landfill (answers comes different from different countries).

In Italy:
the delay and lack of technological solutions at the beginning of the 90’s for treating waste and, paradoxically, an already existing “end of waste” directive (748/84 law now 75/2010 law) has helped to developed the answers for collecting and treating the Organic Fraction of Municipal Solid Waste.

Incentives for renewable energy production were introduced in 1999, called Green Certificate (CV) on each 0,1 MWh produced for 8 years changes comes in 2004, 2007, …, L99/2009 where CV stand for 15 years and 1MWh (the incentives are a political decision - in times of austerity they changes rapidly)
Available technologies can be basically divided by total solid content into three categories:

- **Dry**: Over 20% TS
- **Semi-dry**: between 10 and 20% TS
- **Wet**: Under 10% TS

Temperature pays an important role (mesophillic or thermophillic) as well the pattern flow (mixed, plug flow) and number of steps (one or two).

Solutions are deeply influenced by the material available (MSW or OFMSW) especially pre-treatment complexity.
## Europe plant distributions

### European plant distribution based on different feeding typology

<table>
<thead>
<tr>
<th>Feeding typology</th>
<th>Numbers of operative plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFMSW</td>
<td>75</td>
</tr>
<tr>
<td>OFMSW + others biomasses*</td>
<td>81</td>
</tr>
<tr>
<td>MSW</td>
<td>31</td>
</tr>
<tr>
<td>MSW + OFMSW</td>
<td>8</td>
</tr>
<tr>
<td>MSW + others biomasses*</td>
<td>6</td>
</tr>
<tr>
<td>MSW + OFMSW + others biomasses*</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>202</td>
</tr>
</tbody>
</table>

* typically agricultural wastes, sewage sludge

## Thermal distributions vs typology

<table>
<thead>
<tr>
<th></th>
<th>Wet</th>
<th>Semi-Dry</th>
<th>Dry</th>
<th>n.d.</th>
<th>TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesofilo</td>
<td>39</td>
<td>14</td>
<td>15</td>
<td>3</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Mesofilo/Termofilo</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Termofilo</td>
<td>16</td>
<td>1</td>
<td>40</td>
<td>1</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Mesofilo+Termofilo</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>n.d.</td>
<td>26</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>TOT</td>
<td>88</td>
<td>23</td>
<td>61</td>
<td>4</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td></td>
<td>46</td>
</tr>
</tbody>
</table>

(1) = plants fed by OFMSW + other biomasses
(2) = plants fed by MSW + other biomasses (OFMSW included)

Why choosing anaerobic-aerobic integrated system?

The key factors that have led ACEA to the final choice are:

• complying with the legal framework
• easier control in odour emission of the integrated process compared to the simple composting process (decrease the odour impact)
• less surface needed per treated ton compared to the only compost solution
• high efficiency in recovering material (compost) and energy (biogas), in order to reduce the climate impact and to close the nutriment cycle using digestion residues as fertilizer
• Net energy producing process, open perspective on a long term for biogas as an energy vector
• available technical competence in ACEA

Drawing on its experience and technological know-how, ACEA has developed a Wet Thermophillic solutions fed with only OFMSW
Outline

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  ▪ Drivers
  ▪ Trends

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• Conclusions
The waste treatment district

- Composting plant: 20,000 ton/year
- Anaerobic digestion: 50,000 ton/year OFMSW
- Waste water treatment: 75,000 inh.
- Sludge/Digestate
- Biogas
- District heating
- Gas storage
- Landfill
- CHP
Incoming Material

**Organic fraction**
- SS-OFMSW
  - Households
- SC-OFMSW
  - Restaurants
  - Canteens
  - Markets

**Green waste**
- Green public area
- Domestic green waste

**AD-line**

**Composting line**
Anaerobic phase

The process consists of two digestion treatment lines based on:

- a mechanical pre-treatment (shredding and sieving)

- a mixing and particle reduction system in a continuous way to obtain a medium solid content (TS 10 %)

- a buffer tank (185 m$^3$) to reach the right digester feeding temperature (60 – 65°C)

- a bioreactor (2,500m$^3$) fed discontinuously (185 m$^3$ max)

Digestate is transferred to the aerobic treatment

Biogas is converted to energy thanks to three CHP for 3,3 MW$_{\text{electric}}$ installed, after a pretreatment and a gas storage
Flow chart anaerobic line

- **BUNKER**
- **BAG OPENER**
- **DISC SCREEN**
- **LORAWIVA MORE**
- **BUFFER TANK**
- **ANAEROBIC DIGESTER**
- **DIGESTATE**
- **BIOGAS**

- Plastic scraps
- Light scraps
- Heavy scraps
- Not biodegradable scraps

Acea patent application (2009) n. n. TOA000736
The Composting plant is in operation since 2001 with sewage sludge.
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• Conclusions
Process control – anaerobic phase feeding

Over size material = K*light fraction (8-10%)
Where K depends on technology and state of the art

Waste quality control (18 samples 2008-2009)
Over size sieving material K factor

- Other inerts
- Others
- Paper
- Wood
- Metal scraps
- Residual organic
- Plastic
- Textile
- Glass

- Waste quality control (6 samples 2006)
### Table 1: Amounts of organic fraction of municipal solid waste (OFMSW) treated in Danish biogas plants 2001 and collection and pretreatment methods used (according to information from the biogas plants).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OFMSW (t/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>2000</td>
<td>6000</td>
<td>300</td>
<td>900</td>
<td>11000</td>
<td>2000</td>
</tr>
<tr>
<td>Expected</td>
<td>4000</td>
<td>12000</td>
<td>3000</td>
<td>1800</td>
<td>11000</td>
<td>17000</td>
</tr>
<tr>
<td>Other types of waste (t/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manure</td>
<td>-</td>
<td>175000</td>
<td>-</td>
<td>40000</td>
<td>113000</td>
<td>100000</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>28000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Industrial waste</td>
<td>4000</td>
<td>n. d.</td>
<td>-</td>
<td>8000</td>
<td>9000</td>
<td>-</td>
</tr>
</tbody>
</table>

| Collection system | Indoor | Plastic bags | Plastic bags | Plastic bags | Plastic bags | Plastic bags |
| Indoor Collection system | Paper bags |            |            |            |            |            |
| Outdoor Collection system | Paper bags or container | Paper bags or container | Paper bags or container | Paper bags or container | Paper bags or container | Plastic bags (green for OFMSW, black for grey waste) |

<table>
<thead>
<tr>
<th>Pretreatment Method</th>
<th>Crushing</th>
<th>Drum sieve + addition of straw</th>
<th>Dewaster</th>
<th>Dewaster</th>
<th>Roller sieve</th>
<th>Roller sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of reject</td>
<td>3%</td>
<td>25-30%</td>
<td>15-45%</td>
<td>20-40%</td>
<td>15-25%</td>
<td>15-45%</td>
</tr>
</tbody>
</table>

n.d., no data; FA, Fangel, HA, Hashøj, NY, Nysted.

Extracted from “Efficiency of the anaerobic treatment of the organic fraction of municipal solid waste: collection and pretreatment” su Waste management & Research 22/2004
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFMSW weekly medium fed</td>
<td>850 Mg</td>
</tr>
<tr>
<td>Waste produced from oversize sieve fraction</td>
<td>25 %</td>
</tr>
<tr>
<td>Total solid content in OFMSW</td>
<td>30 - 35%</td>
</tr>
<tr>
<td>Volatile solid content ratio to total solid content VS/TS</td>
<td>85% +/- 2%</td>
</tr>
<tr>
<td>pH value in feeding</td>
<td>4 - 5 +/- 10%</td>
</tr>
<tr>
<td>COD solubile</td>
<td>85,000 +/- 20%</td>
</tr>
<tr>
<td>Total solid content in the prepared digestor input</td>
<td>10 +/- 10%</td>
</tr>
</tbody>
</table>
Analytical control:
• Feeding to the digestor (TS, VS)

• Injection bacteria (Rα as AcOH/CaCO3)

Instrumental control:
• Biogas flow measure

• CH4/CO2

• Digestor temperature
Example of AcOH/CaCO3 ratio control 2009 data line A

- Process control – anaerobic phase - process
Process control – anaerobic phase – digestion T

Temperature in bioreactor A line
Process control – aerobic phase - process

Static respiration Index

Data
"Law" limit
Average value

(Oxygen demand for complete compost oxidation - 78 samples)
Process control – Biofilter Emissions

(Average on 80 samples on biofilter)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>average Input</td>
<td>16.478</td>
<td>332</td>
<td>6.086</td>
<td>531</td>
</tr>
<tr>
<td>Average Output</td>
<td>4.086</td>
<td>39</td>
<td>317</td>
<td>92</td>
</tr>
<tr>
<td>Removal efficiency</td>
<td>75%</td>
<td>88%</td>
<td>95%</td>
<td>83%</td>
</tr>
</tbody>
</table>
Through process control each lot is identified. This simple system allows us to define an ID card for each lot, giving back a complete traceability system from organic waste to the compost user.

The system is ISO 9000 and 14001 certified.
Compost application

Bob winter Olympic stadium San Sicario (TO)
Disposal 05/2007 Results 07/2007
Example of compost application in greenhouse (anemone and strawberry production)
Market distribution

Average value selling price early 2011: 14€/ton
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Energy production through cogeneration

The plant is based on three CATERPILLAR Combine Heat Power 1106 KWe and 1371 KWt each.
• Example of Electric Energy consumption, 11/2007
4 MW served grid end 2011
## District heating 2009/10

<table>
<thead>
<tr>
<th>Production</th>
<th>3 CHP biogas fed 3*1,3 MWt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 boiler fed on NG 2*1,75 MWt</td>
</tr>
<tr>
<td>Thermal energy recovered by CHP</td>
<td>4,3 GWh</td>
</tr>
<tr>
<td>Thermal energy from boilers</td>
<td>2 GWh</td>
</tr>
<tr>
<td>Heated volume</td>
<td>13.000 m³ (domestic)</td>
</tr>
<tr>
<td></td>
<td>145.000 m³ (shopping mall)</td>
</tr>
<tr>
<td>Distribution point</td>
<td>3</td>
</tr>
<tr>
<td>Heating district grid</td>
<td>1,8 km</td>
</tr>
<tr>
<td>Heating district temperature distribution</td>
<td>120°C</td>
</tr>
<tr>
<td>Heating district temperature return</td>
<td>70°C</td>
</tr>
</tbody>
</table>
First data on distribution heating
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## Electric and thermal energy

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas from AD OFMSW [ Mm³ ]</td>
<td>3,7</td>
<td>4</td>
</tr>
<tr>
<td>Biogas from landfill and waste water [ Mm³ ]</td>
<td>4</td>
<td>4,1</td>
</tr>
<tr>
<td>Potential Energy contained in biogas [GWh]</td>
<td>28,3</td>
<td>32,12</td>
</tr>
<tr>
<td>Electric energy (EE) produced [GWh]</td>
<td>10,1</td>
<td>12,3</td>
</tr>
<tr>
<td>EE consumed on the waste treatment district [GWh]</td>
<td>5,9</td>
<td>7,0</td>
</tr>
<tr>
<td>EE sold to the grid [GWh]</td>
<td>4,2</td>
<td>5,3</td>
</tr>
<tr>
<td>Thermal Energy (TE) produced [GWh]</td>
<td>11,1</td>
<td>13,5</td>
</tr>
<tr>
<td>TE recovered [GWh]</td>
<td>5,5</td>
<td>6,6</td>
</tr>
<tr>
<td>TE used on waste treatment district [GWh]</td>
<td>4,5</td>
<td>5</td>
</tr>
<tr>
<td>TE to the heating district [GWh]</td>
<td>1</td>
<td>1,6</td>
</tr>
</tbody>
</table>

Data are referred to the entire biogas production
### Efficiency control

#### Process efficiency (based on ANPA, ONR-2002)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic retention time HRT [days]</td>
<td>19</td>
</tr>
<tr>
<td>TS feded material [%]</td>
<td>10</td>
</tr>
<tr>
<td>Organic Load Rate OLR [Kg organic/m3bioreactor*day]</td>
<td>4-5</td>
</tr>
<tr>
<td>Specific biogas production in m3 biogas at 60%CH4/ton fed</td>
<td>140</td>
</tr>
<tr>
<td>Specific biogas production at 60% CH4 [m3/tonVs feded]</td>
<td>560</td>
</tr>
<tr>
<td>Substrate removal effectiveness Vs% [%]</td>
<td>70%</td>
</tr>
<tr>
<td>Biogas production rate [m3biogas/m3bioreactor *day]</td>
<td>4</td>
</tr>
<tr>
<td>Electric energy specific production [KWhe/ton feded]</td>
<td>310</td>
</tr>
</tbody>
</table>

#### Energy used

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific electric energy (EE) consumed per tonne</td>
<td>75 KWhe/ton</td>
</tr>
<tr>
<td>Consumption of EE on the production</td>
<td>25 %</td>
</tr>
</tbody>
</table>

(2006 – 2010 data)
• ACEA
  ▪ Our origins and activities

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• Conclusions
Community involvement

All waste management processes require consensus and participation

Community consensus can only be achieved through an EFFECTIVE COMMUNICATION STRATEGY

- Waste treatment industry should be seen as a solution, not a problem
- Waste management and treatment facilities are necessary
- Waste recycling facilities can work only with a correct source selection of household waste
Communication strategy - Objectives

• Give “reasonable reasons” for convincing people to accept the plant:
  - Production of renewable energy and soil conditioner
  - Less waste going to landfill

• Highlight the benefits:
  - High efficiency compared to “classical” composting plant
  - Exportable technology
  - Provide work for local community

• Gain stakeholders/investors confidence

• Increase quality standard of source selected waste from household
UMIDO a regola d’arte

La qualità della raccolta differenziata dipende da te.

BROCHURE

POSTER and PRINT ADVERTISEMENT

UMIDO A REGOLA D’ARTE

Lo sapavi che...

Con il biogas prodotto da rifiuti organici, il Pôle Écologique ASEA si genera una quantità di energia termica ad alta pressione, utilizzabile per riscaldare circa 2.000 abitazioni o alimentare circa 4.000 appartamenti.

Con il rifiuto organico prodotto da una famiglia media in una settimana, si potrebbe alimentare un’auto per circa 3 km.

Nel rifiuto umido raccolto dai cassettini dorati sono presenti impurità, costituite prevalentemente da plastica, poliaccoppi (ad esempio la carta del formaggio), giornali e rifiuti tessili.

Nel territorio Pinerolese, diminuendo di un solo punto percentuale la impuntura della nostra raccolta differenziata dell’umido, potremmo evitare dal circuito circa 150 tonnellate di rifiuti in un anno: un impegno preciso che genera un grande risultato!

Consultata la indicazioni per la raccolta differenziata su:
www.amministrazione.comune.pinerolese.it
oppure richiedile al tuo Comune.

La qualità della raccolta differenziata dipende da te.
Communication strategy - Lines

MEETINGS

VISITS
Work in progress...first results

- More than 1,000 people involved in visits each year
- More than 20,000 students reached with yearly activities
- More than 500 participants to our composting courses each year
- More than 50,000 communications yearly sent to Citizens

- Citizens have accepted the plant
- Good reputation of the integrated system, now seen as a resource
- Increase of selected waste (from 30% in 2006 to 50% in 2009)
Outline

• ACEA
  ▪ Our origins and activities

• Why choosing anaerobic-aerobic integrated system?
  ▪ Drivers
  ▪ Trends

• The waste treatment district: organic fraction for energy and soil conditioner
  ▪ Managing a complex system
  ▪ Energy production through cogeneration
  ▪ Energy data and efficiency
  ▪ Highlighting the need to match community expectation

• Conclusions
Conclusions 1

Good results obtained by our integrated anaerobic/aerobic system and the know how acquired give us the opportunity to draw a brief set of considerations on our experience

• The processes supplement each others by degradation and transformation, good odour management and sanitation

• Quality and homogeneity of the digestate allow us a good compost production easily respecting the law limit for the final product (Italian law act 75/2010) and allow us to produce a compost well accepted and easily sold.

• Energy recovery of the organic waste through anaerobic digestion meet energy and environmental requirement.

• A communication strategy connected and effective with the system transferring to citizens, stake holders and investors the benefits obtained (environmental, social and economic aspects) plays a key role.

• Managing a complex system needs professional staff and only much more accurate control will allow a better management of the entire system, giving ability to improve efficiency and controlled results.
ACEA Waste treatment district has been awarded as best practice excellence example in using biotechnology, march 18th 2011 at Cremona fiere by a national committee (www.bioenergyitaly.com)
Thank you for your attention

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