DEVELOPMENT PERSPECTIVES FOR BIOGAS PRODUCTION FROM AGRICULTURAL WASTES IN FRIULI VENEZIA GIULIA (NORTH-EAST OF ITALY)

D. Dell’Antonia, S.R.S. Cividino, A. Carlino, R. Gubiani, G. Pergher
Introduction

Primary energy production of biogas in the EU

Source: EurObserv'ER
In 2012, some 994 plants in Italy were producing biogas with a total installed electric power of 750 MW(e).

Source: Piccinini 2013
Introduction

Biogas in Italy

- The Italian Energy Action Plan of 2010 set a target of at least 17% of total energy generated from renewable sources by 2020.
- The number of anaerobic digestion plants in Italy has increased, in recent years, thanks to the old Italian energy law from 244/2007, which provided an all-inclusive feed-in tariff (280 €/MWh) for electricity production from agricultural biomass, regardless of the feedstock type and the power of the plants.
- In July 2012, Italy adopted a new regulation for the production of electricity from biomass.
Materials and Methods

Law 6 July 2012:

- Feed-in tariffs range from:
  - a minimum of 91 €/MWh
  - to a max. of 236 depending on:
    - feedstock (higher for animal waste and agricultural by-products only)
    - power of the plants
    - additional reward
      - efficiency rate of energy conversion
      - use of waste heat
      - use of digestate as a fertilizer
Materials and Methods

Potential of agricultural wastes in FVG

- Animal waste from livestock (cattle, pigs and poultry)
- Agricultural by-products (straw and corn stalk)
Agricultural farms in Friuli Venezia Giulia

- In FVG there are 22,316 agricultural farms
- Only 3,343 farms are raising livestock
  - 61.7% cattle
  - 17.5% pigs
  - 11.7% poultry
  - 8% sheep and goats
  - 4.5% rabbits
Materials and Methods

Biogas production from animal waste

- Total number of animals with the relative categories for each municipality
- Statistical census of agriculture (ISTAT 2010)
Biogas production from animal waste

- Quantification of slurry and manure production
- According to the Law n.109 of 7 April 2006, were defined the wet waste for each type and age of animals

<table>
<thead>
<tr>
<th>Animal type</th>
<th>Categories</th>
<th>Life weight (kg)</th>
<th>Housing system</th>
<th>Waste yield (m$^3$ t.l.w.$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Slurry</td>
</tr>
<tr>
<td>Cattle</td>
<td>&lt;1 year</td>
<td>150</td>
<td>Free stall with litter</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Free stall without litter</td>
<td>22</td>
</tr>
<tr>
<td>Cattle</td>
<td>1-2 years</td>
<td>450</td>
<td>Free stall with litter</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Free stall without litter</td>
<td>26</td>
</tr>
<tr>
<td>Cattle</td>
<td>&gt;2 years</td>
<td>550</td>
<td>Free stall with litter</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Free stall without litter</td>
<td>26</td>
</tr>
</tbody>
</table>
Biogas production from animal waste

- Factors affecting the amount of waste produced by livestock
  - type and age of the animals
  - body weight
  - type of breeding (e.g. free stall and tie stall)
  - total solids ratio
  - volatile solids ratio
  - availability of waste
  - biogas yields
Biogas production from animal waste

- Biogas production of slurry and manure
  - Organic matter
  - Concentration of the methane in biogas

Source: AEBIOM, Giraldi 2011
Materials and Methods

Biogas production from agricultural residues

- Quantification of total production of straw and corn stalks for the land area in Friuli Venezia Giulia
- Statistical census of agriculture (ISTAT 2010)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Corn</th>
<th>Soft wheat</th>
<th>Durum wheat</th>
<th>Rye</th>
<th>Barley</th>
<th>Oats</th>
<th>Rice</th>
<th>Sorghum</th>
<th>Other cereal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area (ha)</td>
<td>73 846</td>
<td>8 416</td>
<td>924</td>
<td>143</td>
<td>5 280</td>
<td>626</td>
<td>113</td>
<td>284</td>
<td>187</td>
<td>89 820</td>
</tr>
<tr>
<td>Agricultural farms</td>
<td>12 393</td>
<td>1 908</td>
<td>231</td>
<td>29</td>
<td>1 920</td>
<td>143</td>
<td>18</td>
<td>39</td>
<td>59</td>
<td>13 601</td>
</tr>
<tr>
<td>By-products yield (t/ha)</td>
<td>5,5</td>
<td>4,5</td>
<td>4,5</td>
<td>4,5</td>
<td>5</td>
<td>5</td>
<td>5,5</td>
<td>4,5</td>
<td>4,5</td>
<td>-</td>
</tr>
<tr>
<td>By-products (t/year)</td>
<td>406 154</td>
<td>37 871</td>
<td>4 158</td>
<td>644</td>
<td>26 399</td>
<td>3 134</td>
<td>621</td>
<td>1 279</td>
<td>843</td>
<td>481 102</td>
</tr>
</tbody>
</table>

Istituto Italiano per l’Alimentazione (AIIA) 2013
University of Tuscia, Viterbo – Italy, 8-12 September 2013
Biogas production from animal waste

- Biogas potential from animal waste only is about 38.5 Mio. of (N)m³

<table>
<thead>
<tr>
<th>Animal type</th>
<th>Biogas production (m³/year)</th>
<th>Energy potential (GJ/year)</th>
<th>Energy potential (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>19 425 929</td>
<td>380 748</td>
<td>49</td>
</tr>
<tr>
<td>Pig</td>
<td>12 455 854</td>
<td>255 345</td>
<td>33</td>
</tr>
<tr>
<td>Poultry</td>
<td>6 588 133</td>
<td>140 986</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>38 469 916</td>
<td>777 079</td>
<td>100</td>
</tr>
</tbody>
</table>
Map of biogas production from animal waste

Results
Map of biogas production

- The areas with high potential for biogas production are concentrated in Central-Eastern part of the Region
- High potential due to the presence of intensive farming
  - San Vito al Tagliamento for pigs and poultry
  - Spilimbergo for cattle and poultry
Results

Biogas production from agricultural residues

- Total biogas potential is about 187 Mio. of (N)m³
  - 21% from animal waste (38 Mio. of (N)m³)
  - 79% from agricultural residues (148 Mio. of (N)m³)

<table>
<thead>
<tr>
<th>Agricultural residues</th>
<th>Corn stalks</th>
<th>Straw</th>
<th>Animal waste</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha)</td>
<td>73 846</td>
<td>15 974</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>By-products (t/year)</td>
<td>406 153</td>
<td>74 949</td>
<td>2 416 102</td>
<td>2 897 204</td>
</tr>
<tr>
<td>Biogas (M(N)m³/year)</td>
<td>126</td>
<td>22</td>
<td>38</td>
<td>187</td>
</tr>
<tr>
<td>Energy potential (TJ/year)</td>
<td>2 430</td>
<td>429</td>
<td>777</td>
<td>3 636</td>
</tr>
<tr>
<td>Share of energy potential (%)</td>
<td>67</td>
<td>12</td>
<td>21</td>
<td>100</td>
</tr>
</tbody>
</table>
Energy potential

- The biogas produced from agricultural waste may be able to replace the 2.6% of final energy consumption in Friuli Venezia Giulia
- 3% of final electricity consumption
Conclusions

- This work has been a first step in a more complete evaluation of the biogas potential in Friuli Venezia Giulia.

- Important is to identify the technical and economic convenience of small biogas plants in the regional area (100-250 kWe) in relation to the different conditions in the area.

- In this view, public support for small farms producing biogas and electricity from wastes and by-products is still important.

- The contribution of biogas plants in the livestock sector can be a solution to support the agri-food sector.
Thanks