International biomass trade
Blas Mola-Yudego

Bioenergy markets and policies
*Lignoselluloosabiomassat ja niiden energiakäyttö*
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International trade

An illustration of biomass streams within a country and between countries. Products presented in brackets represent examples of products.

Finnish case

Wood streams in the Finnish forest industry in 2004 compiled by using the stream model described in the text, million m³, round wood includes bark.

Particle- and fibreboard mills were included in other wood products industry.

Finnish case

Consumption of biofuels in Finland (2004)

<table>
<thead>
<tr>
<th>Biofuel/consumption</th>
<th>(PJ)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black liquor</td>
<td>157.1</td>
<td>39.2</td>
</tr>
<tr>
<td>Industrial wood residues$^a$</td>
<td>77.6</td>
<td>19.3</td>
</tr>
<tr>
<td>Other wood industry byproducts and waste products$^b$</td>
<td>4.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Firewood</td>
<td>45.3</td>
<td>11.3</td>
</tr>
<tr>
<td>Forest chips</td>
<td>18.9</td>
<td>4.7</td>
</tr>
<tr>
<td>Recovered wood</td>
<td>2.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Wood pellets and briquettes$^c$</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Recovered fuels$^d$</td>
<td>3.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Biogas</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Bioliquid fuel in traffic, ethanol</td>
<td>0.2</td>
<td>0.0</td>
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<tr>
<td>Fuel peat</td>
<td>88.8</td>
<td>22.2</td>
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<tr>
<td>Other bioenergy$^e$</td>
<td>0.8</td>
<td>0.2</td>
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<tr>
<td>In total</td>
<td>401</td>
<td>100</td>
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</table>

Wood chip markets

Wood chips, derived mostly from recovered/waste wood or virgin wood (harvesting residues)

Baltic node: Sweden, Denmark and Germany main importers
Russia and Baltic countries as exporters

Other players: China (exp>imp), Japan (imp)

Waste wood markets

Dimensions of typical waste wood trade (> 50 ktonnes) across Europe

Pellets

Use of woody raw material

Other wood processing industry; e.g. plywood, particle board, planing, furniture industry

Round wood

Sawmillling

Sawdust

Pulp wood

Pulp chips

Pellet or briquette production

Cutter chips

Bark, residues

Heat and power (utilities and industry)

Heat in residential sector

Logging residues

Stem wood

Pulp and paper

Waste paper, sludges Black liquor

Recycled paper
Pellets

3:1 (pellet:oil)
Heating plants

Large scale
50 - 500 MW

Medium scale
1 - 50 MW

Domestic
5 - 20 kW

Small scale
5 - 20 kW

Finland & Sweden
Heating plants

- **Large scale**
  - 50 - 500 MW

- **Medium scale**
  - 1 - 50 MW

- **Domestic scale**
  - 5 - 20 kW

- **Small scale**
  - 20 - 1000 kW
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
Pellets
**Pellet trade flows**

*Global wood pellet trade streams in (a) 2010, (b) 2011, (c) 2012 [≥10 ktonnes] (Data: Cocchi et al. 2011; Lamers et al. 2012a; EUROSTAT 2013)*

## Pellet trade flows

15 largest operating pellet plants (2012)

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Predominant feedstock</th>
<th>Capacity [tonnes/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vyborgskaya Cellose</td>
<td>Russia</td>
<td>Unmerchantable timber</td>
<td>900,000</td>
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<tr>
<td>Georgia Biomass</td>
<td>GA, USA</td>
<td>Plantation roundwood</td>
<td>750,000</td>
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<tr>
<td>Green Circle (JCE Group)</td>
<td>FL, USA</td>
<td>Plantation roundwood</td>
<td>500,000</td>
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<td>Biowood</td>
<td>Averøy, Norway</td>
<td>Wood chips (imported)</td>
<td>450,000</td>
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<tr>
<td>Pinnacle Pellet Inc</td>
<td>BC, Canada</td>
<td>Sawdust, pine-beetle wood</td>
<td>400,000</td>
</tr>
<tr>
<td>Enviva, Hertford</td>
<td>NC, USA</td>
<td>Unknown</td>
<td>350,000</td>
</tr>
<tr>
<td>Pacific BioEnergy</td>
<td>BC, Canada</td>
<td>Sawdust, pine-beetle wood</td>
<td>350,000</td>
</tr>
<tr>
<td>German Pellets</td>
<td>Wismar, Germany</td>
<td>Sawdust</td>
<td>256,000</td>
</tr>
<tr>
<td>German Pellets</td>
<td>Herbrechtingen, Germany</td>
<td>Sawdust</td>
<td>256,000</td>
</tr>
<tr>
<td>Arkaim</td>
<td>Khabarovsk, Russia</td>
<td>Processing residues</td>
<td>250,000</td>
</tr>
<tr>
<td>Plantation Energy</td>
<td>Albany, Australia</td>
<td>Eucalyptus residues</td>
<td>250,000</td>
</tr>
<tr>
<td>Pinnacle Pellet Meadowbank</td>
<td>BC, Canada</td>
<td>Sawdust, pine-beetle wood</td>
<td>220,000</td>
</tr>
<tr>
<td>Ankit Pellets &amp; Briquettes</td>
<td>Bengaluru, India</td>
<td>Unknown</td>
<td>200,000</td>
</tr>
<tr>
<td>Houston Pellet Inc</td>
<td>BC, Canada</td>
<td>Sawdust, pine-beetle wood</td>
<td>180,000</td>
</tr>
<tr>
<td>Graanul Invest Incubals</td>
<td>Incukalns, Latvia</td>
<td>Sawdust</td>
<td>180,000</td>
</tr>
</tbody>
</table>

The consumption and production patterns have however been changing along the last 5 years. Lack of comprehensive statistics and accounts.
Production

- Germany: 20%
- Sweden: 19%
- Italy: 9%
- Austria: 8%
- Finland: 5%
- Poland: 5%
- France: 3%
- Denmark: 2%
- Netherlands: 2%
- Belgium: 4%
Per capita consumption (kilogram)

- Sweden
- Denmark
- Belgium
- Austria
- Netherlands
- Slovenia
- Finland
- Latvia
- Italy
- Switzerland
- Germany
- Luxembourg
- Norway
- Ireland
- Lithuania
- Romania
- Slovakia
- Poland
- France
- United Kingdom
- Greece
- Portugal
- Bulgaria
- Czech Republic
- Spain
- Hungary
- Estonia
Pellet trade flows

[Map showing trade flows between countries in Europe, with bars and charts indicating export and import volumes in thousand tonnes for various countries such as Germany, Estonia, Latvia, Austria, Finland, Sweden, Belgium, Portugal, Czech Republic, Lithuania, Netherlands, Romania, Spain, Poland, France, Hungary, Bulgaria, Denmark, UK, Italy, Ireland, and Iceland.]
Pellet trade flows

2011 Trade flows over 100k (left) and 500k (right)
Pellet trade flows

- Blas Mola
  - Yudego (blas.mola@uef.fi)
Pellet production in Northern Europe
Pellet production in Northern Europe

- Sweden
- Finland

Percentage of producers

Capacity (1000 t / yr)

- <5
- 5-10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-100
- 100-200

Pellet production in Northern Europe
Pellet consumption in Northern Europe

Finland

Sweden

Pellet consumption in Northern Europe
# Pellet Markets in Northern Europe

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Finland</strong></td>
<td><strong>Sweden</strong></td>
</tr>
<tr>
<td>- Enough domestic production to increase the number of pellet users</td>
<td>- Lack of good quality raw materials</td>
</tr>
<tr>
<td>- Domestic raw materials</td>
<td>- No pellet standard</td>
</tr>
<tr>
<td>- Many small scale producers</td>
<td>- Amount of fines formed in bulk deliveries</td>
</tr>
<tr>
<td>- Well develop delivery network</td>
<td>- Taxation</td>
</tr>
<tr>
<td>- Most of the pellets produced according to pellet standard</td>
<td></td>
</tr>
<tr>
<td>- Favourable taxation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Finland</strong></td>
<td><strong>Sweden</strong></td>
</tr>
<tr>
<td>- Development of pellet handling and transportation</td>
<td>- Competition for raw materials with other industries</td>
</tr>
<tr>
<td>- Make pellet market local instead of global</td>
<td>- Rise in the raw material price</td>
</tr>
<tr>
<td>- Increase the domestic pellet consumption</td>
<td>- Reduction in pellet importation</td>
</tr>
<tr>
<td>- New raw materials</td>
<td></td>
</tr>
<tr>
<td>- Improving the harbour facilities for handling imported pellets</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Lack of raw materials
- Many small producers do not follow any standards
- Quality of imported pellets (amount of fines)
By-product

Legend
- Pellet Plants
  - SawMills

- Austin
- Belgium
- Czechia
- Germany
- Estonia
- Spain
- Finland
- France
- Hungary
- Italy
- Latvia
- Norway
- Poland
- Sweden
- Slovakia
- United Kingdom

\[ R^2 = 0.51 \]

\[ R^2 = 0.79 \]

Aggregated pellet plants capacity (x 1000 t)

Aggregated sawmill capacity (x 1000 t)

Saw log production m³

Pellet capacity t (x 1000)
By-product

Demand Bioenergy

Demand Forest Products

Forest Biomass

Forest Wood
By-product

- Demand Pellets
- Demand Forest Products
- Sawdust
- Timber
Regionalised production
By-product

Case example: pellets

Pellet Market Areas

PVCs

- 10 %
- 30 %
- 60 %
- 90 %

Source: own elaboration
Production cores

The areas concentrate 30% of the total pellet capacity estimated for Europe
The areas with stripes, 50%
The whole light areas entail 90%

Main cores
A: Central Europe
B: Scandinavia
C: Finland
D: Baltic
Production cores

Characterization of the four main areas defined, according to their shares of the pellet capacity, their population and forest land covered.

<table>
<thead>
<tr>
<th></th>
<th>Central</th>
<th>Baltic</th>
<th>Scandinavia</th>
<th>Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N plants</strong></td>
<td>69</td>
<td>18</td>
<td>72</td>
<td>18</td>
</tr>
<tr>
<td><strong>% European plants</strong></td>
<td>18 %</td>
<td>5 %</td>
<td>19 %</td>
<td>5 %</td>
</tr>
<tr>
<td><strong>Pellet capacity</strong></td>
<td>2924</td>
<td>993</td>
<td>1975</td>
<td>834</td>
</tr>
<tr>
<td><strong>% European capacity</strong></td>
<td>25 %</td>
<td>8 %</td>
<td>17 %</td>
<td>7 %</td>
</tr>
<tr>
<td><strong>Population (hab. x10^6)</strong></td>
<td>58.5</td>
<td>2.9</td>
<td>7.2</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Population density (hab. km^-2)</strong></td>
<td>157.5</td>
<td>31.9</td>
<td>35.5</td>
<td>27.6</td>
</tr>
<tr>
<td><strong>% Forest land</strong></td>
<td>48 %</td>
<td>52 %</td>
<td>68 %</td>
<td>68 %</td>
</tr>
<tr>
<td><strong>% Agriculture land</strong></td>
<td>45 %</td>
<td>41 %</td>
<td>17 %</td>
<td>15 %</td>
</tr>
<tr>
<td><strong>Total Area (x 10^3 km^-2)</strong></td>
<td>371.1</td>
<td>90.5</td>
<td>204.0</td>
<td>105.1</td>
</tr>
</tbody>
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# Production cores

<table>
<thead>
<tr>
<th>Area</th>
<th>Countries</th>
<th>Capacity (x10³ t y⁻¹)</th>
<th>% (Country Total Capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Central Europe”</td>
<td>Austria</td>
<td>957</td>
<td>95 %</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>1 388</td>
<td>74 %</td>
</tr>
<tr>
<td></td>
<td>Belgium</td>
<td>235</td>
<td>87 %</td>
</tr>
<tr>
<td></td>
<td>Switzerland</td>
<td>19</td>
<td>25 %</td>
</tr>
<tr>
<td></td>
<td>France</td>
<td>170</td>
<td>15 %</td>
</tr>
<tr>
<td></td>
<td>Italy</td>
<td>145</td>
<td>31 %</td>
</tr>
<tr>
<td></td>
<td>Slovenia</td>
<td>10</td>
<td>18 %</td>
</tr>
<tr>
<td>“Baltic”</td>
<td>Estonia</td>
<td>385</td>
<td>100 %</td>
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<tr>
<td></td>
<td>Latvia</td>
<td>14</td>
<td>9 %</td>
</tr>
<tr>
<td></td>
<td>Lithuania</td>
<td>514</td>
<td>88 %</td>
</tr>
<tr>
<td>“Scandinavia”</td>
<td>Denmark</td>
<td>180</td>
<td>44 %</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td>1 785</td>
<td>72 %</td>
</tr>
<tr>
<td>“Finland”</td>
<td>Finland</td>
<td>834</td>
<td>72 %</td>
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## Production cores

<table>
<thead>
<tr>
<th>Zone</th>
<th>Country</th>
<th>To / From</th>
<th>Export to</th>
<th>Import from</th>
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<tbody>
<tr>
<td><strong>Central Europe</strong></td>
<td>Germany</td>
<td>Austria</td>
<td>90.9</td>
<td>49.1</td>
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<td></td>
<td>France</td>
<td>20.8</td>
<td>60.3</td>
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<td></td>
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<td>204.8</td>
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<td>Austria</td>
<td>Czech Republic</td>
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<td>66.0</td>
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<tr>
<td></td>
<td>Italy</td>
<td>124.4</td>
<td>0</td>
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<td></td>
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<td>136.1</td>
<td>174.6</td>
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<td>Switzerland</td>
<td>Germany</td>
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<td>22.6</td>
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<td></td>
<td>Italy</td>
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<td></td>
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<td>5.6</td>
<td>43.6</td>
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<tr>
<td>Italy</td>
<td>Austria</td>
<td>0.1</td>
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<td></td>
<td>Slovenia</td>
<td>1.5</td>
<td>57.2</td>
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<td></td>
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<td>2.9</td>
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<td></td>
<td>Sweden</td>
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<td>0</td>
<td></td>
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<td>72.6</td>
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<td></td>
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<td>Sweden</td>
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<td><strong>“Finland”</strong></td>
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<td>EU27</td>
<td>125.2</td>
<td>6.6</td>
<td>Exporter</td>
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## Policy incentives

<table>
<thead>
<tr>
<th>Countries</th>
<th>Production growth (average)</th>
<th>Consumption growth (average)</th>
<th>Policy Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount (thousand tonnes)</td>
<td>%</td>
<td>Amount (thousand tonnes)</td>
</tr>
<tr>
<td>Austria</td>
<td>89</td>
<td>32</td>
<td>75</td>
</tr>
<tr>
<td>Belgium</td>
<td></td>
<td>190</td>
<td>26</td>
</tr>
<tr>
<td>Denmark</td>
<td>9</td>
<td>- 4</td>
<td>90</td>
</tr>
<tr>
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<td>42</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>France</td>
<td>54</td>
<td>91</td>
<td>50</td>
</tr>
<tr>
<td>Germany</td>
<td>2770</td>
<td>85</td>
<td>172</td>
</tr>
<tr>
<td>Netherland</td>
<td>3</td>
<td>3</td>
<td>103</td>
</tr>
<tr>
<td>Italy</td>
<td>98</td>
<td>33</td>
<td>128</td>
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<tr>
<td>Sweden</td>
<td>107</td>
<td>11</td>
<td>144</td>
</tr>
<tr>
<td>Poland</td>
<td>66</td>
<td>126</td>
<td>29</td>
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### Sweden

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Carbon tax and energy tax focus on heat</td>
</tr>
<tr>
<td>1997-2005</td>
<td>Investment subsidies</td>
</tr>
<tr>
<td>2001</td>
<td>Carbon tax increased</td>
</tr>
<tr>
<td>2003</td>
<td>Green electricity certificate system</td>
</tr>
<tr>
<td>2004</td>
<td>Tax on electricity for household and services</td>
</tr>
</tbody>
</table>

### Finland

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Carbon tax introduced</td>
</tr>
<tr>
<td>1990</td>
<td>Investment subsidies for CHP plants</td>
</tr>
<tr>
<td>1998</td>
<td>Energy tax increased</td>
</tr>
</tbody>
</table>
## Denmark

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Energy tax and carbon tax reformed</td>
</tr>
<tr>
<td>1993</td>
<td>Biomass agreement and compensation scheme for renewable electricity</td>
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<td>1994-1998</td>
<td>Energy tax increased on heating and power</td>
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<td>1995-2000</td>
<td>Subsidy scheme for small wood pellet boilers</td>
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<tr>
<td>1996</td>
<td>Feed in tariffs introduced</td>
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<tr>
<td>2008</td>
<td>Increasing the existing CO2 tax</td>
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<tr>
<td>2001</td>
<td>NOx tax introduced</td>
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## Austria

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>1990</td>
<td>Non refundable capital grants for biomass energy technology</td>
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<tr>
<td>1995</td>
<td>Emission regulation for small scale heating system</td>
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<td>1997</td>
<td>Emission regulation for industrial heating system</td>
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<td>1998-2007</td>
<td>Investment subsidies for biomass heating technology including pellet</td>
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<td>1998</td>
<td>Pellets and briquettes-Requirement and test specification introduced</td>
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<td>2004</td>
<td>Feed in tariff system in producing green electricity</td>
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<td>2008</td>
<td>New subsidy scheme for pellet heating installation</td>
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<td>Year</td>
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<tr>
<td>1991</td>
<td>Feed in tariffs for renewable energy</td>
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<tr>
<td>1999</td>
<td>Investment subsidies for automatic pellet heating system</td>
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<tr>
<td>1999</td>
<td>Taxes on fossil fuel increased and tax on non-renewable electricity introduced</td>
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<tr>
<td>2009</td>
<td>Renewable heat law introduced</td>
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## Belgium

<table>
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<tr>
<td>2002</td>
<td>Green Certificate system introduced in Flanders region</td>
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<tr>
<td>2003</td>
<td>Green Certificate system introduced in Wallonia region</td>
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<tr>
<td>2004</td>
<td>Green Certificate system introduced in Brussels capital region</td>
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<td>2004</td>
<td>Investment subsidies for pellet heating devices in Wallonia region</td>
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Local/Global role
Global position
Company competition index
Country averages for the pellet plants analysed, for global and local concentration indices (h20 and h80, respectively). The size of the circles represent the country’s total pellet capacity.
Main Barriers

Raw material supply: sawdust, localised production, new feedstocks, imports

Logistics: limitation (vs e.g. fossil fuels), location

Sustainability concerns: food vs wood, rising price, land

Fuel quality: lack certification, standards, quality control

Lacking financial policy support: subsidy, stability of policy framework

Unfair competition fossil fuels: VAT tariffs
## Main Barriers

<table>
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<tr>
<th>Country</th>
<th>Raw material supply</th>
<th>Logistics</th>
<th>Sustainability concerns</th>
<th>Fuel quality</th>
<th>Lacking financial policy support</th>
<th>Unfair competition with fossil fuels</th>
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