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The purpose of this study was to analyse direct and indirect value added and employment in the European pulp, paper and paperboard industry. Moreover, an alternative use of wood and recovered paper was studied, calculating the corresponding estimates for the bioenergy sector assuming that the same raw materials would be used to produce energy. Both these analyses were carried out on a sectoral level for the year 2008.

In addition, this report illustrates project based effects on value added and employment, using two greenfield projects – a pulp and paper mill and a CHP plant – as examples.
DEFINITIONS

• The definition of **value added** (VA) is the common National Accounts definition, which is used by the European countries. It is calculated from “the production value plus subsidies on products less the purchases of goods and services (other than those purchased for resale in the same condition) plus or minus the change in stocks of raw materials and consumables less other taxes on products which are linked to turnover but not deductible”. It represents the value added by the various factor inputs in the operating activities of the industries concerned.
  - Direct VA is defined to be the economic VA created in the focus industries, i.e. in (i) the pulp, paper and paperboard industry and in (ii) the bioenergy sector that utilises an equivalent amount of fibre to generate energy (heat and electricity).
  - In both alternatives, indirect VA is defined as the VA of first order inputs to the focus industry (upstream VA) and the VA of first order direct users of the outputs of the focus industry (downstream VA).

• **Employment** refers to the number of employees. It is defined as “persons who work for an employer and who have a contract of employment and receive compensation”. A worker from an employment agency is considered to be an employee of that temporary employment agency and not of the unit (customer) in which they work.
  - Direct employment refers to the number of employees in the focus industries.
  - Indirect employment refers to employment created by the focus industries at first order suppliers to the focus industry (upstream employment) and at first order direct users of the outputs of the focus industry (downstream employment).
SCOPE

- In the sectoral analysis, two options were studied
  - i. Industrial Alternative
    - Focus industry, i.e. pulp, paper and paperboard
    - Upstream, i.e. activities that supply first order inputs to pulp, paper and paperboard
    - Downstream, i.e. activities that are first order clients of pulp, paper and paperboard
  - ii. Fibre to Energy Alternative
    - Focus industry, i.e. wood based energy conversion
    - Upstream, which supplies first order inputs to wood based energy
    - Downstream, which are first order clients of wood based energy
- Identical concepts and calculation were used for the real (pulp, paper and paperboard) and for the hypothetical alternative (wood and recovered paper would be used to produce energy).
- The most recent comprehensive data was available for 2008.
- Geographically, the analysis covers EU27, Norway and Switzerland.
METHODOLOGY

Industrial alternative

- The basis of the methodology used in this study is in the macro economic theory and in the Standard National Accounts (SNA) and its principles of value added calculation.
  - The estimates for the focus industry are based on historical data on value added and employment.
  - Links both upstream and downstream from pulp, paper and paperboard industry are based on data on industrial linkages in Input-Output (I-O) tables and on value added and employment in these respective sectors.
  - The data sources include EUROSTAT, Statistics Norway and FAO.
- In order to ground the analysis on publicly available data and to guarantee a fair and equal treatment of the pulp, paper and paperboard and bioenergy sectors, there have been some methodological changes compared to the previous reports dating from 2005 and 2006.
  - Value added and employment in up/downstream sectors is included only to the extent they are related to pulp and paper (or to bioenergy in the fibre to energy alternative). Earlier, e.g. all paper-based publishing was included in the value added and employment estimates of the pulp, paper and paperboard industry, irrespective of numerous other inputs to the business sector (labour, machinery and equipment, etc.).
  - The analysis covers all inputs to the sectors (upstream) as well as all uses of the core industry products (downstream).
METHODOLOGY 2

Fibre to energy alternative

- The starting point for the fibre to energy alternative is that the fibre input flow (i.e. roundwood, chips and RCP) of pulp, paper and paperboard industry would be redirected to energy production.
  - For the focus industry, Pöyry created a calculation model which estimates the creation of value added and employment due to the increased conversion of wood based energy. The model takes into account national fuel mixes and variations in existing energy generation capacity by applying three different technological categories for the national solid fuel based energy generation capacity (modern and older CHP plants and conventional condensing power plants). Additional wood based energy production was allocated to these categories according to their share in the national energy generation capacity.
  - It was assumed that all the produced heat could be sold at the national price of the industrial fuel mix. The industrial fuel mix was selected as a reference because it presents typical fuels in the country to produce heat both for communities and industries. The industrial fuel mix is based on Pöyry’s pulp and paper industry cost modelling tool.
  - Produced electricity was assumed to be sold to the national grid at current prices. No subsidies for green electricity have been used due to the extent of green electricity produced in the hypothetical situation.
  - Moreover, the plants were assumed to benefit from the selling of CO₂ allowances, the price of which was set at 20 €/tCO₂.
  - Based on Standard National Accounts (SNA) and their value added and employment data, transmission and distribution of electricity were included in the focus industry estimates, too.
METHODOLOGY 3

Fibre to energy alternative

- With regard to upstream activities, it was assumed that the wood raw material and RCP inputs were identical to the industrial alternative. Thus the same activities that supply first order wood and RCP inputs to pulp, paper and paperboard were analysed in the fibre to energy alternative as well.
- With regard to downstream activities, Input-Output (I-O) tables were used to trace the first order users of electricity and heat, completed with SNA data on value added and employment in these sectors.

- The data sources include EUROSTAT, Statistics Norway, IEA, CEPI, Pöyry and PPI.
- Basic assumptions
  - Calorific value of wood 2.2 MWh/m³ (8 GJ/m³)
  - Calorific value of RCP 3 MWh/t (11 GJ/t)
ENERGY PRICE, ESTIMATES BY COUNTRY

2008QIV

Source: Pöyry
METHODOLOGY 4

Project level effects

- On a project level, two alternative investments were compared
  - A greenfield pulp and paper mill
  - A greenfield CHP plant
- Pöyry reference cases were utilised as a data source, but the actual projects were scaled so that annual wood consumption was equal in both investments.
- Investment costs and direct employment were estimated based on actual investment calculations
  - Investment costs include machinery and equipment and civil works
  - Direct employment covers construction work, assembly and erection of equipment, engineering, and construction and project management
- Value added and indirect employment were estimated based on the data on industrial linkages in Input-Output (I-O) tables
  - Indirect employment refers to the manufacturing of machinery and materials
In 2008, the value added in the pulp, paper and paperboard industry was estimated at EUR 19.7 Billion. An additional EUR 20.6 Billion was created in upstream activities and EUR 56.8 Billion in downstream activities. The total value added of the industrial alternative amounted to EUR 97.1 Billion.

In the same year, the number of employees was estimated at 208,200 in pulp, paper and paperboard industry, at 337,300 in upstream and 1,051,700 in downstream activities. In total, there were 1,597,200 employees in the industrial alternative.
INDUSTRIAL ALTERNATIVE: UPSTREAM ACTIVITIES

Upstream activities include e.g. purchases of transport services, roundwood, chemicals, fuels and electricity.

Value added
- Trade and transport: 32%
- Business services: 17%
- Forestry: 10%
- Other industries: 41%

Employment
- Trade and transport: 36%
- Business services: 13%
- Forestry: 16%
- Other industries: 35%
INDUSTRIAL ALTERNATIVE: DOWNSTREAM ACTIVITIES

Other industries - converting, publishing and printing in particular - are the main clients of pulp, paper and paperboard. Value added and employment are also created in trade and transport and business services.
If all fibre would have been directed to energy conversion, a value added of EUR 9.3 Billion would have been created in the bioenergy sector. An additional EUR 7.3 Billion would have been created in upstream activities and EUR 3.5 Billion in downstream activities. The total value added of the fibre to energy alternative would have amounted to EUR 20.1 Billion.

The number of employees would have totalled 40,300 in the bioenergy sector, 151,900 in upstream and 46,700 in downstream activities. In total, there would have been 238,800 employees in the fibre to energy alternative.
COMPARISON OF INVESTMENT PROJECTS

Key economic figures per 1,000,000 m³ of wood consumption

- The investment cost for a greenfield pulp and paper mill scaled to an annual wood consumption of 1,000,000 m³ would total EUR 433 Million. When operational, the mill would create EUR 425 Million in annual value added in upstream, core and downstream activities.
- The investment cost for a greenfield CHP plant utilising the same amount of wood would total EUR 129 Million. When operational, the plant would create EUR 88 Million in annual value added in upstream, core and downstream activities.
COMPARISON OF INVESTMENT PROJECTS 2

Key employment figures per 1,000,000 m³ of wood consumption

- During the construction phase, a greenfield pulp and paper mill scaled to an annual wood consumption of 1,000,000 m³ would create direct employment for 3,000 persons. Additional 1,800 persons would be employed indirectly in the manufacturing of machinery and materials. When operational, the mill would create employment for 1,500, 900 and 4,600 persons in upstream, core and downstream activities, respectively.

- During the construction phase, a greenfield CHP plant utilising the same amount of wood would create direct employment for 800 persons. Additional 500 persons would be employed indirectly. When operational, the plant would create employment for 700, 200 and 200 persons in upstream, core and downstream activities, respectively.

### Key Employment Figures

<table>
<thead>
<tr>
<th></th>
<th>During Construction</th>
<th>During Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A pulp and paper mill</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>3,000</td>
<td>Pulp and paper mill 900</td>
</tr>
<tr>
<td>Indirect</td>
<td>1,800</td>
<td>Downstream 4,600</td>
</tr>
<tr>
<td>Total</td>
<td>4,700</td>
<td>Total 7,000</td>
</tr>
</tbody>
</table>

| **A CHP plant** |
| Direct         | 800                 | CHP plant 200     |
| Indirect       | 500                 | Downstream 200    |
| Total          | 1,400               | Total 1,000       |
CONCLUSIONS
CONCLUSIONS

The results support CEPI policy to promote the use of wood as a raw material, to encourage the recycling of used products, and to recover energy only when recycling is no longer feasible.

Value Added
- The value creation in the pulp, paper and paperboard industry totalled €19.7 Billion and in bioenergy €9.3 Billion (2-fold in pulp, paper and paperboard compared to the bioenergy alternative).
- When wider effects (upstream and downstream) were also included, the value added in pulp, paper and paperboard amounted to €97.1 Billion and that in bioenergy to €20.1 Billion (a 5 to 1 ratio).

Employment
- At the core level, pulp, paper and paperboard industry provided work for 208,200 employees while the same fibre raw material would create 40,300 jobs in the bioenergy sector (a 5 to 1 ratio).
- When taking into account upstream, core level and downstream employment, the comparable figures are 1,597,200 for the pulp, paper and paperboard industry and 238,800 for the bioenergy alternative (a nearly 7 to 1 ratio).
CONCLUSIONS 2

Comparison of investment projects

- A comparable investment (in terms of wood consumption) creates nearly 5 times more wealth (value added) in the pulp and paper industry than in bioenergy.
  - Per EUR invested, 1.4 times more wealth is created in the pulp and paper industry than in bioenergy.

- A comparable investment (in terms of wood consumption) creates nearly 7 times more employment in pulp and paper industry than in bioenergy.
  - Per EUR invested, 2 times more employment is created in the pulp and paper industry than in bioenergy.

- Employment during the construction phase is higher in pulp and paper than in bioenergy, too

The calculation methodology

- The calculation methodology has been revised in order to make it more transparent and in order to guarantee a fair and equal treatment of the pulp, paper and paperboard and bioenergy sectors
  - In order to further improve the analysis of the industrial alternative, there is a possibility to ask the statistical bureaus to produce custom-made input-output tables on a 3-digit level. This would provide an opportunity to better distinguish between manufacture of pulp, paper and paperboard and manufacture of articles of paper and paperboard.
### COMPARISON OF INITIAL DATA IN 2003 AND 2008

#### INDUSTRIAL ALTERNATIVE

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical area</td>
<td>EU25 + Nor + Che</td>
<td>EU27 + Nor + Che</td>
</tr>
<tr>
<td>Recovered paper consumption</td>
<td>44 Mt</td>
<td>50 Mt</td>
</tr>
<tr>
<td>Roundwood consumption</td>
<td>148 Mm$^3$</td>
<td>140 Mm$^3$</td>
</tr>
<tr>
<td>Imported pulp</td>
<td>14 Mt</td>
<td>19 Mt</td>
</tr>
<tr>
<td>Total paper &amp; paperboard production</td>
<td>96 Mt</td>
<td>101 Mt</td>
</tr>
</tbody>
</table>

#### FIBRE TO ENERGY ALTERNATIVE

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical area</td>
<td>EU25 + Nor + Che</td>
<td>EU27 + Nor + Che</td>
</tr>
<tr>
<td>Energy content of fibre</td>
<td>500 TWh</td>
<td>457 TWh</td>
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</table>
COMPARISON OF NUMERICAL VALUES IN 2003 AND 2008

INDUSTRIAL ALTERNATIVE

VALUE ADDED 2003
(EU25 + Norway + Switzerland)

Upstream
€ 19.4 Billion

Pulp, paper and paperboard industry
€ 27.5 Billion

Downstream
€ 106.8 Billion

Total
€ 153.7 Billion

VALUE ADDED 2008
(EU27 + Norway + Switzerland)

Upstream
€ 20.6 Billion

Pulp, paper and paperboard industry
€ 19.7 Billion

Downstream
€ 56.8 Billion

Total
€ 97.1 Billion

EMPLOYMENT 2005
(EU25 + Norway + Switzerland)

Upstream
129,800

Pulp, paper and paperboard industry
264,200

Downstream
1,682,400

Total
2,076,400

EMPLOYMENT 2008
(EU27 + Norway + Switzerland)

Upstream
337,300

Pulp, paper and paperboard industry
208,200

Downstream
1,051,700

Total
1,597,200
COMPARISON OF NUMERICAL VALUES IN 2003 AND 2008

FIBRE TO ENERGY ALTERNATIVE

VALUE ADDED 2003 (EU25 + Norway + Switzerland)
- Upstream: €6.7 Billion
- Bioenergy: €6.3 Billion
- Downstream: €13.1 Billion
- Total: €26.1 Billion

VALUE ADDED 2008 (EU27 + Norway + Switzerland)
- Upstream: €7.3 Billion
- Bioenergy: €9.3 Billion
- Downstream: €3.5 Billion
- Total: €20.1 Billion

EMPLOYMENT 2003 (EU25 + Norway + Switzerland)
- Upstream: NA *
- Bioenergy: 46,500
- Downstream: NA *
- Total: NA *

EMPLOYMENT 2008 (EU27 + Norway + Switzerland)
- Upstream: 151,900
- Bioenergy: 40,300
- Downstream: 46,700
- Total: 238,800

*Total upstream + bioenergy + downstream + multiplier effect = 229,000
## COMPARISON OF APPROACHES AND DATA SOURCES

### INDUSTRIAL ALTERNATIVE

<table>
<thead>
<tr>
<th>Year</th>
<th>Upstream</th>
<th>Core</th>
<th>Downstream</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>The analysis was based on a combination of National Accounts data and own modelling (e.g. Pöyry estimates on the cost structure of pulp and paper mills in defining upstream activities).</td>
<td>A combination of National Accounts data and own modelling.</td>
<td>The analysis included major paper / paperboard consuming activities (converting, printing and publishing) and counted in their value added &amp; employment.</td>
<td>Geographical scope EU25 + Norway + Switzerland</td>
</tr>
<tr>
<td>2008</td>
<td>The data source was changed to publicly available data included in the National Accounts. All relevant upstream sectors were included to the extent their value added / employment could be attributed to supplies to pulp and paper industry. Own modelling was only utilised in the separation of pulp, paper and paperboard inputs from inputs to a wider industrial sector (pulp, paper and paper products) for which statistical data is available.</td>
<td>The analysis was carried out based on publicly available data in the National Accounts.</td>
<td>The analysis included all paper / paperboard consuming sectors based on publicly available data in the National Accounts, to the extent that their value added / employment can be attributed to paper / paperboard inputs.</td>
<td>Geographical scope EU27 + Norway + Switzerland</td>
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# COMPARISON OF APPROACHES AND DATA SOURCES

## FIBRE TO ENERGY ALTERNATIVE

<table>
<thead>
<tr>
<th>Year</th>
<th>Upstream</th>
<th>Core</th>
<th>Downstream</th>
<th>Total</th>
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<tr>
<td>2003</td>
<td>The analysis covered the same fibre flows as in the industrial alternative.</td>
<td>The analysis was based on a Pöyry model for directing fibre into energy production, taking into account national fuel mixes and variations in existing energy generation capacity.</td>
<td>The analysis was based on a combination of National Accounts data, results of specific studies and own modelling.</td>
<td>Geographical scope EU25 + Norway + Switzerland</td>
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<tr>
<td>2008</td>
<td>No change in the approach, but the data source was changed to the publicly available data included in the National Accounts.</td>
<td>The same approach than for 2003, except for • transmission, distribution and trade of electricity were moved from downstream to core activities • imported pulp was excluded from the fibre to energy modelling.</td>
<td>The analysis included all energy consuming sectors based on publicly available data in the National Accounts, to the extent that their value added / employment can be attributed to energy inputs.</td>
<td>Geographical scope EU27 + Norway + Switzerland</td>
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## SUMMARY OF MAIN REASONS EXPLAINING THE DIFFERENCES

### INDUSTRIAL ALTERNATIVE

<table>
<thead>
<tr>
<th>Direction of Change</th>
<th>Upstream</th>
<th>Pulp, Paper &amp; Paperboard</th>
<th>Downstream</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Outsourcing in pulp and paper industry</td>
<td>• Slightly higher production volumes in 2008 than in 2003</td>
<td>• Improved methodology</td>
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<td></td>
<td>• Improved methodology</td>
<td></td>
<td>• Improved methodology</td>
</tr>
<tr>
<td></td>
<td>• Shut-downs of capacity</td>
<td>• Outsourcing</td>
<td>• Decline in the value added of paper based publishing</td>
</tr>
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<td></td>
<td>• Economic downturn</td>
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</table>

*Upstream Pulp, Paper & Paperboard*
SUMMARY OF MAIN REASONS EXPLAINING THE DIFFERENCES

FIBRE TO ENERGY ALTERNATIVE

<table>
<thead>
<tr>
<th>Direction of Change</th>
<th>Upstream</th>
<th>Bioenergy</th>
<th>Downstream</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>• Improved methodology</td>
<td>• Improved methodology</td>
</tr>
<tr>
<td></td>
<td>• Improved methodology</td>
<td>• Transmission, distribution and trade of electricity were moved from downstream to bioenergy activities</td>
<td>• Improved methodology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Considerably better profitability in 2008 than in 2003</td>
<td>• Lower production volume in 2008 than in 2003, because imported pulp was excluded from energy conversion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Transmission, distribution and trade of electricity were moved from downstream to core activities</td>
<td>• Transmission, distribution and trade of electricity were moved from downstream to bioenergy activities</td>
</tr>
</tbody>
</table>
EMPLOYMENT AND VALUE ADDED - A Comparison between the European Pulp and Paper Industry and the Bioenergy Sector

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