Discovering the high potential of
Pulp and Paper Production Residues
Pulp and paper production residues...

Fewer production residues mean higher efficiency. This creates a natural incentive for the pulp and paper industry to minimise the amount of residues it generates. Pulp and paper manufacturing is characterised by different cycles, both internal and external, and respects the hierarchy of reusing (e.g. chemicals used in pulping), recycling (57% of paper consumed in Europe in 2003 was collected for recycling and many residues are used as raw materials in other industries or in landspreading) and what cannot be recycled any longer is sent to energy recovery (wood and bark residues, recycling residues, etc.).

Completely eliminating the generation of residues, however, will never be possible. Nevertheless, as pulp and paper production residues can be managed in a sustainable manner they can become a valuable raw material for other industries. Unfortunately, current Community legislation and the way it has been implemented in EU Member States makes it impossible to take full advantage of this potential to use pulp and paper production residues and some of them go to final disposal.

The purpose of this brochure is to provide a clear indication of how a well thought out policy on pulp and paper production residues can help the European Union to meet its sustainable development goals.

The pulp and paper industry has substantially decreased the residues it generates, but complete elimination is not feasible.

Different phases in the pulp and paper production process generate different residue flows

WOOD PROCUREMENT
The wood raw material consumed by the European pulp and paper industry comes from sustainably managed forests or are by-products from the sawmill industry. More than 90% of the wood comes from the EU-25. Logging residues are mainly left in forests but are increasingly being collected and used as biofuels.

VIRGIN PULP MANUFACTURING
Wood used for pulping is first debarked. Bark is mainly used as a biofuel and some small fractions are used for gardening and composting. In kraft pulping, the dominant chemical pulping method, wood chips are cooked with chemicals. Cooking removes lignin breaking up the wood into fibres. Black liquor, consisting of both lignin (organic) and spent cooking liquor (inorganic), is then washed out of the pulp. Chemicals from the inorganic part are regenerated and reused and energy is extracted from the biomass. The residues from chemical pulping are green liquor dregs, lime mud, and lime sludge.

In mechanical pulping fibres are separated from each other either by grinding logs against a rotating stone or by refining woodchips between a rotating disc and a fixed plate. The residues from mechanical pulping are mainly a mixture of fibres and bigger wood components.

RECOVERED PAPER PROCESSING
In Europe, recovered paper used for recycling is classified in accordance with the European Standard EN643, European List of Standard Grades of Recovered Paper and Board. The sourcing losses from this process mainly contain non-paper materials of which the amount and composition can differ greatly between the recovered paper grades. Process losses from paper recycling vary a great deal depending on the quality of the raw material and the type of new paper being made. For example, all inks, coating materials and fillers must be removed if it is to be processed into soft, absorbent tissue paper. This also results in higher residue levels.

PAPER PRODUCTION
Paper and paperboard production requires virgin and/or recycled pulp and minerals as well as other additives used as fillers, coaters and binders. Residues from paper production contain wood fibres and minerals.

EFFLUENT TREATMENT
Used process water from each stage in the pulp and paper production processes is treated in waste water treatment plants (a combination of mechanical, biological and/or chemical treatment), which results in effluent treatment sludge.

ENERGY PRODUCTION
Many pulp and paper residues from different production stages are used as biofuels inside mills to satisfy the electricity and heat needs of the processes. Sometimes mills produce more energy than they use and the excess is sold for external use, and sometimes pulp and paper residues are combusted by external users. Combustion of these biofuels results in ash.
The majority of the production residues in the pulp and paper industry originate from wood, a natural resource. Their composition is well known and constant as a result of controlled production processes, and they are not hazardous. This means that residues can be managed or disposed of in a safe and environmentally friendly way. The share of residues disposed of in landfills has constantly decreased in recent years. A shift to the most resource-efficient and environmentally friendly management options has been observed in all CEPI countries (see chart).

**Pulp & Paper Residues**

These are estimated figures and cover 56% of production in CEPI countries.

**USE AS SECONDARY RAW MATERIAL IN OTHER INDUSTRIES IS RISING**

Thanks to their homogeneity and well known composition, pulp and paper production residues are increasingly being used as a secondary raw material in various industries. Deinking sludge, for instance, is used as a combined fuel and raw material in cement kilns and as a raw material in cement, brick and tile manufacturing. Also ash is used as a raw material to produce construction materials.

**USE ON LAND IS STABLE**

Residues are used as soil improvers in road construction and on land reconstruction applications. For example, a large fraction of deinking sludge consists of carbonates and clay and can act as liming agents, acidity controllers, and structure improvers in agricultural land. Ash can be used in land construction and also as a fertiliser.

**INCINERATION WITH ENERGY RECOVERY IS STABLE**

Since these residues are, to a large extent, based on wood they are ideal for co-combustion in heat or power generating plants. Since wood is a renewable resource, combustion of pulp and paper production residues with energy recovery contributes to the battle against global warming.

**DISPOSAL IN LANDFILLS IS DECREASING**

The fraction of residues going to landfills is continuously decreasing. Ash originating from the combustion of residues, deinking sludge and effluent treatment sludge that is not used as fuel, nor on land directly or after composting, may still end up in landfills.
... for a more sustainable European pulp and paper industry

Unfortunately the current legislation affecting pulp and paper production residues does not allow the full exploitation of the high potential of these resources.

COMPLICATED LEGAL REQUIREMENTS
EU legislation considers pulp and paper production residues as waste. Managing them needs specific permits, making it sometimes easier and cheaper just to send residues to landfill rather than comply with very complicated requirements.

INCOHERENT LANDFILL DIVERSION TARGETS
Recycling diverts biodegradable paper and board from landfills and, hence, contributes directly to the target set in the Landfill Directive. However, the more paper is recycled, the higher the share of already recycled fibres in a paper product and the higher the proportion of fibres that are lost in the production process. Also, greater collection of paper as such, and especially the increasing share of recovered paper from households, tends to imply a higher level of impurities and consequently greater losses from the recycling process.

Expensive and restricted possibilities to manage recycling residues increase the costs of recycling and reduce incentives to recycle paper.

VERY LIMITED POSSIBILITIES FOR THE USE OF PULP AND PAPER PRODUCTION RESIDUES ON LAND
Some Member States encourage pulp and paper production residues and deinking sludge in particular to be spread on agricultural land for their excellent soil improvement characteristics. In many Member States however, applying deinking sludge to agricultural land is forbidden or made so difficult and expensive that, in practice, it is not an option.

NOT ALL MEMBER STATES RECOGNISE PULP AND PAPER PRODUCTION RESIDUES AS A SOURCE OF RENEWABLE ENERGY
A "biodegradable fraction of products, waste and residues from forestry and related industries" are renewable energy sources according to European legislation. However, several Member States are not promoting all pulp and paper production residues as renewable energy sources.

NOT ALL PULP AND PAPER PRODUCTION RESIDUES ARE RECOGNISED AS GOOD AND CLEAN FUELS
While pulp and paper production residues should be supported as renewable energy sources, their use is also restricted by including some of them in the Waste Incineration Directive 2000/76/EC. As a result of the unnecessary stringent requirements, many residues, which might otherwise be valuable for energy recovery, are put into landfills.

CALORIFIC LIMIT VALUE IS NOT AN APPROPRIATE PARAMETER TO DISTINGUISH BETWEEN RECOVERY AND DISPOSAL
In spite of the ruling of the European Court of Justice concluding that calorific limit value is not an appropriate criterion for distinguishing between energy recovery and disposal, some Member States keep on using it. This being the case, combustion of pulp and paper residues does not qualify as energy recovery due to the high moisture content (wood itself is about 50% moisture). This results in a less efficient recovery of pulp and paper production residues as the Member States can and do object to cross-border shipments of waste for disposal.
Pulp and paper production residues in the future

The pulp and paper industry in Europe is a growing industry and with a growing production rate it is likely to generate a higher amount of residues in the future in spite of all the actions the industry is taking to increase its process efficiency.

Community policies support high levels of recycling and the paper industry is equally committed to this, which means that the amount of residues from paper recycling will increase for the reasons mentioned earlier.

The industry is actively searching for new ways to manage residues. There are some promising openings to use deinking sludges, for example, as a raw material for cement more efficiently than at present and to recover minerals and pigments for use in the manufacture of new paper.

In spite of new methods for managing pulp and paper production residues, there will always be a remaining fraction that is sent to landfills if legislation is not adapted to better account for the potential of pulp and paper production residues.

Pulp & Paper Industry Material and Residues Flows: Million tonnes - All volumes bone dry (100%) equivalent
CEPI Countries 2001

Source: Jaakko Pöyry Consulting
Recommendations

It is obvious that the management of residues from pulp and paper production will progress in the future. The industrial interest in pulp and paper production residues as a secondary raw material is also increasing. Legislation should therefore be designed in such a way that it supports this development. Current complex legislation restricts the use of many residues in a way that would best serve the environment and, hence, efficient and sustainable use of natural resources.

- As residues from the pulp and paper industry are not hazardous and their composition is well known and constant, permitting their usage could be substantially simplified without causing any detrimental effects on the environment.

- Pulp and paper production residues are quite different from sewage sludges. This must be clearly recognised in existing and emerging legislation, which should also promote the use of pulp and paper production residues as soil improvers.

- Pulp and paper production residues need to be recognised as renewable energy sources.

- It would be well justified to exclude pulp and paper production residues from the scope of the Waste Incineration Directive.

- Cross-border shipments of pulp and paper production residues should not be unnecessarily limited using unrealistic criteria, for example, calorific limit values or arbitrary limits for the minimum recycling percentage. Combustion of selected waste that generates a calorific gain should always be considered as energy recovery, in particular if the waste has been identified as a renewable energy source.

- For the time being, a special status for paper recycling residues should be considered in order to make access to landfills for some residues less costly.

- The impact future EU chemicals legislation (REACH) will have on managing pulp and paper production residues, in particular when they are used as raw materials for producing new products will have to be carefully assessed.

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Wood net imports 12 Mt (sob)
Wood residues 14 Mt (sub)
(By-products from mechanical wood industry)

Chemicals 2.0 Mt (BD)
By-products
Non-wood fibre 0.4 Mt
Dissolving pulp 0.5 Mt

Chemicals 0.2 Mt
Pulp (net) imports 5 Mt
Minerals & additives 14.6 Mt
Paper (net) exports 7 Mt

Paper converting losses 12% 9.2 Mt

Recovered paper utilisation 37.8 Mt

A = exports of converted products and packaging together with goods
B = imports of packaging materials and packaging together with goods
sob = solid over bark (wood)
sub = solid under bark (wood)
RP = recovered paper
AD = air dry volumes
BD = bone dry volumes

Air dry vs. bone dry multipliers

1 pulp (AD) tonne = 0.90 (BD) tonne
1 paper (AD) tonne = 0.95 (BD) tonne
1 wood m$^2$ = 0.42 (BD) tonne

Recovered paper net export 2.4 Mt

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**Glossary**

**Additives** – Coaters, fillers and binders like clay, dyes, pigments, sizing and other chemicals added to give paper greater smoothness, colour, opacity, or other desirable attributes.

**Air Dry (AD)** – Refers to the weight of a material in equilibrium with the atmosphere.

**Ash** – Inorganic residue resulting from the combustion/incineration process.

**Black Liquor** - Spent cooking liquor from kraft pulping consisting mainly of lignin dissolved from wood.

**Bone Dry (BD)** – Material with 0% moisture content.

**Calorific gain** – Positive difference between the energy released on combustion of a material and the energy needed to induce combustion.

**Calorific limit value** – Energy that can be produced from the combustion of a specific amount of fuel.

**Chemical pulping** – In kraft pulping – the dominant chemical pulping method – the woodchips are cooked with chemicals (caustic soda and sodium sulphate). Cooking removes lignin breaking up the wood into fibres. The yield in chemical pulping is about 45%, but as the rest of the wood is used to generate energy, chemical pulping generates more energy than it needs.

**Deinking** – Removal of printing ink and impurities from recovered paper to produce recycled pulp with specific whiteness and purity.

**Green liquor dregs, lime mud and lime sludge** – Residues from the recovery processes of the cooking chemicals used in chemical pulping (non-soluble components of metal hydroxides and carbonates, mainly from wood).

**Lignin** – Natural ‘adhesive’, which binds wood fibres together in the tree and provides rigidity. Pulp brightness depends on the amount of lignin remaining in the pulp.

**In mechanical pulping** – Logs are ground against a rotating stone. The heat generated by grinding softens the lignin and the mechanised forces separate the fibres from wood. An alternative way of producing mechanical pulp is using refiners, where woodchips are subjected to intensive shearing forces between a rotating disc and a fixed plate. In mechanical pulping almost all the wood is used (up to 95%), but it needs a lot of energy.

**Process losses from paper recycling** – Non-paper components (e.g. metal, plastic, glass, textiles, wood, sand) separated from the material flow during pulping, cleaning, screening, fine screening and deinking.

**Recovered paper sourcing losses** – Unusable materials in recovered paper including non-paper components (e.g. metal, plastic, glass, textiles, wood) separated from the material flow by sorting.
