

Access to affordable low carbon energy: keeping the pulp and paper industry competitive in the energy transition

Policy briefing

The 2020 European Commission report on energy prices and cost in Europe shows that energy costs shares in production costs are important for the energy-intensive manufacturing sectors (ranging from 3% to 20%). Carbon-neutral energy today is often 2 or 3 times more expensive than conventional energy¹. Innovation may bring down these costs. But for our industry to remain internationally competitive in the transition to climate neutrality, we must have access to affordable clean energy.

The pulp and paper sector is in a key position to support the EU in becoming fit for 2050. Our sector has the potential to drive down greenhouse gas emissions with sustainable energy sources. From 2005, our industry has already cut carbon emissions by 29%, reduced energy consumption by 12% and increased the share of renewable energy to 60%.

Our sector has been an early-mover in low-carbon investments, focusing on energy efficiency and renewable energy solutions. We plan to grow our business in Europe, which is a significant part of the circular economy and the bio-economy. Our products contribute to lowering carbon emissions in other sectors.

Energy consumption in the pulp and paper sector

The paper industry is the fourth largest industrial energy consumer in Europe. Carbon emissions in the paper industry come almost entirely from the combustion of energy sources. Our sector is currently a net buyer of about 45 TWh of electricity.

There are mills integrated into a local forest economy. They have access to energy-rich by-products or low-grade forest residues. Such mills have heavily invested in green energy. They are largely self-supplying and often provide energy to users outside the mill. When only a part of the needed electricity is produced from biomass, the rest is purchased from the grid. For mills using recycled fibres, natural gas tends to be the most competitive energy source.

Larger mills often use high-efficiency Combined Heat and Power (CHP) plants. On average in Europe, electricity from CHP accounts for about half of the electricity needed by the industry. Smaller mills often use gas in heat boilers with electricity drawn from the grid.

Therefore, carbon saving solutions will inevitably be site-specific to 895 mills across Europe. The company decisions will depend on local, regional and national circumstances. Gaseous fuels use can be reduced with appropriate support but cannot be reduced to zero without breakthrough technologies.

Policy recommendations for decarbonising the industry's energy consumption

The policy framework can support our sector in implementing the technology options for further reducing our carbon emissions by:

¹ Energy-intensive industries. Challenges and opportunities in energy transition (2020) European Parliament

1. Supporting research, development and deployment of cost-competitive new solutions
 - De-risking financing programmes to mitigate the first-mover disadvantage in solutions integrated in paper mills such as collection and use of biogas and renewable heat solutions
 - Mobilising EU funding programmes, such as the Innovation Fund
 - Making the identified areas eligible for sustainable financing programmes
2. Promoting on-site renewable energy generation
 - Encouraging dialogue between renewable heat producers, industry and public authorities, to address existing barriers (such as knowledge gap, financing, or public acceptance)
 - Promoting energy recovery technologies, in compliance with the Waste Framework Directive
3. Ensuring timely availability of affordable clean energy supply and related infrastructure
 - Developing local and regional plans and partnerships to develop biogas production
 - Allowing industry to compete in the electricity market, on equal footing, in providing flexibility solutions
 - Excluding from the scope of the Energy Taxation Directive energy-intensive industries exposed to the risk of carbon leakage, such as the pulp and paper industry

Options for carbon savings in the pulp and paper industry

This paper explores the 5 most relevant carbon saving options. Combining different carbon saving options can potentially lead to progressively reducing carbon emission in our sector. Some technologies will be deployed by the paper sector, but we will also rely on the decarbonisation of the energy system. To date, none of the options on its own seems to be technologically and financially viable to meet the 2050 challenges.

Option 1: Innovative solutions for energy efficiency

Energy efficiency gains in our sector can deliver substantial societal benefits. Without innovative solutions for energy efficiency, it will be extremely difficult and cost-prohibitive to decarbonise our energy use.

Energy efficiency can be improved through higher on-site waste heat recovery and co-generation. The pulp and paper industry can benefit from information and communications technology (ICT) and digitalisation. Increased levels of automation and optimisation of production can significantly increase efficiencies in energy consumption.

Several areas for innovation are explored. Their potential to deliver promising carbon saving effects is assessed. The Cepi Energy Solutions Forum aims to accelerate the development and implementation of such technologies and concepts.

Option 2: On-site renewable energy sources

The use of on-site renewable energy can reduce the consumption of conventional fuels. Several solutions could be envisaged in the pulp and paper industry:

1. *Bioenergy from solid by-streams*

Energy recovery from solid by-streams (sludge and rejects) accounts for about 1% of energy fuels used in the paper industry. It can take the form of conversion to energy carriers (such as gasification, pyrolysis, anaerobic digestion and secondary fuels production) or direct conversion to energy (incineration). However, energy recovery often faces strong local opposition.

In most cases, technology is mature and could be more widespread across the sector. More than 50% of solid by-streams are composed of organic matter and, when used for energy purposes, count

towards meeting the European renewable energy target. In some cases, this has contributed to reducing carbon emissions in paper mills by a 30%.

Several paper mills are already producing biogas from anaerobic wastewater treatments. In some paper mills, biogas accounts for 5% of energy consumption, but it has the potential to go up to 10%.

2. *Heat pumps*

Heat pumps can be potentially deployed in paper mills. They are an interesting technology to reduce external energy input. However, the running costs stemming from the increased use of electricity, also fast-growing renewable electricity, remain a huge challenge.

Innovative heat recovery processes may significantly reduce energy demand in paper mills. But developments are still needed. The current papermaking processes are not designed to result in vapour of which heat can efficiently be recovered. But some preliminary studies suggest that heat pump could supply steam up to 160°C (with an efficiency of around 2.4), starting from groundwater of 10°C or higher temperature waters where the heat is currently economically unrecoverable.

Pilot projects already proved successful and demo plans in paper mills are ongoing. Research and development efforts are still needed to reduce capital expenses and increase the output temperatures.

3. *Geothermal*

Ultra-deep geothermal energy could potentially deliver the necessary heat for papermaking in individual cases. Drilling underground for several kilometres would require quite specific geological conditions and societal acceptance.

Projects could be developed in partnership with local municipalities or industries. The technology is currently being tested in other sectors, although it currently looks very expensive.

4. *Solar and wind*

Deploying photovoltaic panels, solar thermal or small wind turbines can be possible, depending on the size and the geographic conditions of the paper mill. Examples of roof-top photovoltaic are already present in some paper mills, while large scale solar heating is currently being installed in a first-of-a-kind project.

Considering the high volumes of energy currently needed for papermaking, the renewable energy produced on-site is unlikely to supply more than 5% of the energy demand in a given paper mill.

Option 3: Renewable and low carbon gases

The paper industry's natural gas demand could be replaced by renewable and low carbon gases. They could be delivered using the existing infrastructures or directly off the grid preserving current high energy efficiency use. The gas industry has identified the following options for decarbonisation:

1. *Hydrogen*: obtained from natural gas reforming with the carbon capture storage or electrolysis of water using clean electricity

A progressive blending of hydrogen in natural gas could be rather attractive. Blends of hydrogen can be used in existing boilers, resulting in carbon emission reductions by 2030.

The transition to pure hydrogen requires careful infrastructure planning and new combustion equipment in end-users. This option is not particularly attractive. Our sector would use hydrogen to generate steam up to 200°C, ranking quite low in the "hydrogen added value scale".

2. *Biogas*: produced from the decomposition of organic materials, including waste and residues
For the pulp and paper industry, it is ultimately efficient to directly use biogas locally, potentially representing the entire local demand. Treating biogas for direct use is less expensive than upgrading it to biomethane. Biogas strengthens the business case for high-efficient CHP, thus delivering energy savings for the total energy system.
3. *Biomethane*: methane produced from biomass through the upgrade of biogas
The paper industry could potentially be a good enabler of these solutions. Biomethane would allow paper mills to reduce carbon emissions “overnight” without changes in the paper machinery when the right volumes are available.

Option 4: Fuel switch to electricity or biomass

1. Switch to electricity

An increased role of electricity in paper mills can be expected, but full electrification does not seem to be economically viable in the foreseeable future. Full electrification is particularly CAPEX intensive as it requires replacing current assets. In addition, the cost of grid-supplied electricity is 2 to 7 times higher than natural gas, making it prohibitively expensive.

Electrification is an option to decarbonise several other sectors. Such an increase in baseload demand would have to be matched by an increase in decarbonised electricity generation and by a programme to reinforce high voltage transmission lines. This would make the cost of using electricity even higher.

An option for decreasing the costs of renewable electricity would be removing obstacles to corporate renewable energy sourcing. Power purchase agreements (PPAs) have the potential for minimising risks of buying renewable electricity.

It can be estimated that replacing natural gas with electricity in our industry would increase our electricity baseload demand by a factor of almost 2.5. Delivering additional 153 TWh of final electricity demand would require an increase in electricity generation in the range of 330-375 TWh, due to energy conversion and network losses².

It is worth noting that a growing number of paper mills with electric boilers are engaged in demand-side flexibility programmes, driven by price signals. Our sector can provide flexibility to the network by ensuring grid stability and reducing network stress from peaks in electricity demand and supply. This creates added value as paper mills provide a service to the grid, without jeopardising paper production in Europe.

2. Switch to biomass

The paper industry has a long tradition of sustainable sourcing and using forest biomass. The industry optimises value creation by using the material for fibre-based products first and finally for energy.

The biomass potential is already mainly in use. This has required the industry to make sizeable investments in biomass boilers, handling, logistics and collection. Where possible, economically and socially justified, the development of sustainable biomass projects should be supported. Technologies for optimising efficient biomass use, such as low-temperature drying using waste heat or integrated dryers, can be further improved.

There is no technical reason impeding further biomass use. However, increasing the use of biomass seems can be limited due to a combination of factors, such as limited to no access to biomass

² Assuming a primary energy factor of 2.0 to 2.3 and a 7% average transmission losses.

feedstock, increased competition for biomass, lack of public acceptance by local communities, lack of storage facilities or logistics constraints.

Option 5: Carbon Capture Use and Storage (CCUS)

Carbon emissions from combustion can be captured, used or stored. But CCUS does not seem to be at the moment a primary solution for the paper industry to reduce carbon emissions. Negative emissions can be achieved thanks to bioenergy with carbon capture and storage (BECCS). Pulp and paper mills are seen as potential application sites for BECCS. But incentives are needed to drive the deployment of this technology.

Some major issues need to be resolved for the CCS technology to become cost-effective. Nowadays CCS is particularly expensive. In the case of the pulp and paper industry, the ratio of volumes over costs of CO₂ captured would be very low as emissions from gas-fired paper mills are quite low – no more than 400 ktCO₂/year.

CCUS could be more profitable if developed in other industrial facilities close to paper mills. One could ultimately imagine the possibility to cluster with those sites to join existing infrastructures to transport the captured CO₂.

CCUS deployment has also to be assessed from an overall energy balance perspective, as carbon-capturing generates efficiency penalties that might offset efficiency gains from co-generation.

For more information about the briefing, please contact Małgosia Rybak, Cepi's Climate Change & Energy Director at m.rybak@cepi.org or (+32) 471 21 07 61.

Cepi is the European association representing the paper industry. We offer a wide range of renewable and recyclable wood-based fibre solutions to EU citizens: from packaging to textile, hygiene and tissue products, printing and graphic papers as well as speciality papers, but also bio-chemicals for food and pharmaceuticals, bio-composites and bioenergy. We are a responsible industry: 92% of our raw materials are sourced in Europe and certified as sustainable, 91% of the water we use is returned in good condition to the environment. We are the world champion in recycling at the rate of 72%. At the forefront of the decarbonisation and industrial transformation of our economy, we embrace digitalisation and bring 20 billion value addition to the European economy and €5.5 billion investments annually. Through its 18 national associations, Cepi gathers 500 companies operating 895 mills across Europe and directly employing more than 180,000 people.
