



to our roots & **BEYOND**

REDUCING EMISSIONS FOR THE 2050 SOCIETY

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CEPI would like to thank all companies,
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Executive summary

Towards a low-carbon society

In a Swedish paper mill, heat from steam is recovered and delivered to the district heating network. In Poland, advanced technologies allow a paper mill to improve the energy conversion process hence dramatically reduce its use of coal. In Belgium, biomass from a paper mill supplies heat to a neighbouring car plant. In Portugal, solar panels make one of the country's most efficient paper mills even greener.

These are just a few of the stories from across the continent that show how our industry is leading the way toward the European Union's goal of developing a low-carbon economy by 2050. The shift will require an unprecedented transformation of our society, as citizens, companies and regulators rethink the way we make things, focusing on sustainable production and consumption. The challenges will be immense for all manufacturers. For the paper industry, a return to our foundational ideals of resource efficiency and renewability will help us take the lead, developing partnerships with other sectors to shape the low-carbon future.

The European forest fibre and paper industry outlined how transformation could happen by 2050 in our landmark Roadmap, which assessed the pathways to cut our carbon emissions by 80% while creating 50% more added value. It also estimated the capital spending required

to make this transformation happen in Europe. An extra €44 billion of investments, or a 40% increase on current levels, will be required.

This is not just a vision. The low-carbon, high-value transformation of our industry is already happening. Since 2010, the decoupling of our production from our energy intensity and carbon "footprint" has indeed seen a step change, as the chart below demonstrates. About 60% of our energy already comes from renewable sources, and we're not stopping there: We continue to invest in increasing the use of renewable energy, while reducing energy intensity.

New products and innovative solutions make low-carbon, renewable and recyclable alternatives a reality as we shift away from a fossil-based economy. With the right business and policy conditions in place, the pace of transformation can accelerate over the next decade.

To our Roots and Beyond

This report aims to show how our industry is taking practical steps today to advance the mission of decarbonisation and value creation. What does it take to reduce carbon emissions in our mills? To change energy platforms in complex production processes? To reduce our collective footprint?



Trends of production (t), energy consumption (TJ) and CO₂ emissions (per TJ) of the European paper Industry (2005-2015)

A successful transition towards a low-carbon economy requires a combination of approaches. The first one naturally focuses on improving production processes inside our mills, doing more with less energy and lower emissions; but it is the second approach that truly takes us back to the roots of our industry. Fully leveraging the renewable nature of our raw materials makes a real difference to the carbon intensity of both our processes and our products. These approaches are complementary, and often combined. Moving beyond our roots, we also see the potential to serve society as a whole by offering zero-carbon alternatives to virtually all fossil products.

Project Overview

This report is the first in a series that the forest fibre and paper industry will publish periodically to showcase our achievements as we work towards the 2050 vision.

The projects we describe have been designed and implemented in the past two years. In total, this report gathers 14 projects from 10 EU countries, involving 12 companies – representatives of the European industry, from large integrated production sites to SMEs.

The projects have been grouped into two categories:

🔥 **Inside the Mill projects –**
From boosting energy efficiency

through innovative technologies, to increasing the use of renewable energy, the projects shown give a clear picture of how the future will look.

🔥 **Beyond the Fence projects –**
Advancing progress to shift away from carbon-intensive fossil-based products, these projects show the added value of decarbonisation beyond the factory gate and for society at large.

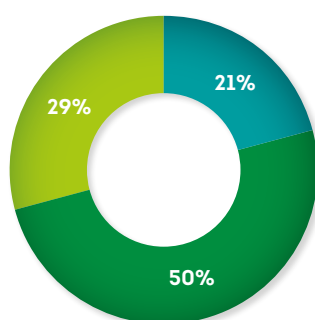
In addition to reporting on our industry's sustainability indicators, our commitment is to periodically report on the concrete steps made by our industry every two years.

Realising our sector's potential in Europe

These projects are part of a larger picture. Our industry has been investing an average of €3.5 billion each year in Europe over the past 10 years. The transformative investment agenda of our 2050 Roadmap goes 40% beyond this level.

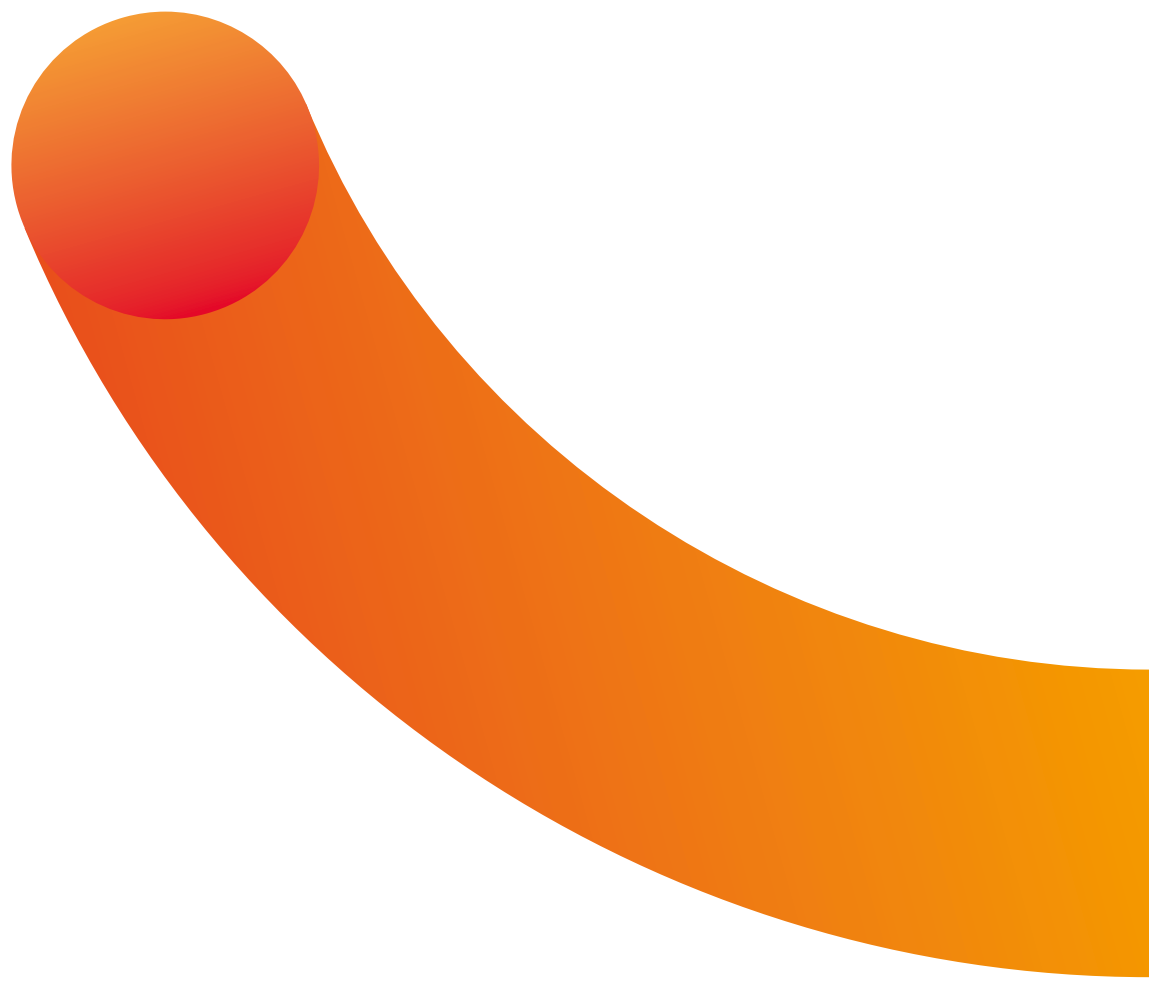
Finally, we must remember that this is taking place in the context of the global competition for leadership in technology and investment – a competition that our industry intends to win. With the right conditions in place to align the R&D agenda, policy frameworks and industry investment capacities over the next decade, we can make it happen in, from and for Europe.

Project Type



- Beyond the Fence
- Inside the Mill - Energy Efficiency
- Inside the Mill - Renewable Energy

INNOVATIVE PROJECTS





to our roots
& **BEYOND**



Karl Rittmannsberger
Energy Manager,
Mondi Neusiedler

Utilising biomass in electricity production

Project Description

Increases in renewable energy production have caused a major change in the electricity market, resulting in frequent imbalances in the electrical grid. The project contributes to carbon reduction through its use of biomass as a source of electricity production, increasing the share of green energy in the network while helping to address the imbalances caused by the rise of solar- and wind-generated power. The stakeholders included central procurement and energy managers in the mills; pool service providers; communication providers; and programming service providers. Challenges at the start of the project can be attributed to being early movers in the market. The registration procedures were unclear, and changed several times during the process. We also faced resistance from current market participants. Additional hurdles included ensuring production schedules were not affected, and technical difficulties programming the control panels in the energy department.

Project Purpose

The intended result of the project was to develop a service with the pool service provider that utilised flexibility in electricity production to earn income through participation in the balancing

market. Moreover, participating in the balancing market helps enable smoother integration of renewables into the market, improves security of supply and increases the capacity of the power system. There is the added benefit of using biomass-produced electricity in the mills, which increases the use of renewables for power generation and contributes further to carbon reduction. Two Mondi mills have been successfully registered and are now fully eligible to participate: Mondi Frantschach (since 2015) and Mondi Neusiedler (since 2016).

Project Evaluation

The project's success is measured by the income produced through activation from the grid operator. The project is successful in producing non-core income with a short ROI period of one to two months. Mondi is currently analysing the possibility of expanding this project into other countries where we have mill operations, including Poland, Czech Republic and Slovakia.

"With the experience of an energy manager, excellent staff at Mondi and a great project team, it was possible to successfully implement this project in only five months.

Mondi was already active on the balancing energy market.

As a consumer and producer of electricity, we can offer this flexibility by managing our own internal electricity production on-site. The steam produced by the production process is fed to a turbine generating electricity.

When grid demand is high, the excess electricity is sold to the market; if demand is low, we bypass the turbine and feed the steam via pressure reduction to the process, which stops or reduces electricity supply to the grid."

Main Features:

Investment
€84,000

Partnerships
Gen-I Vienna GmbH



Ismo Nousiainen
Senior Vice President,
Production, Metsä Fibre
(CEO of Metsä Fibre
as of 1 January 2018)

The first next-generation bioproduct mill – towards a carbon neutral society

Project Description

Metsä Group built the first next-generation bioproduct mill in Äänekoski, Finland – the largest investment of the European forest industry with a value of €1.2 billion. The new mill, starting in the third quarter of 2017, leads the industry to a new era of resource efficiency through operating with no fossil fuels and fossil CO₂ emissions, being the most energy-efficient pulp mill in the world and utilising 100% of the production side streams in an industrial ecosystem built with partners.

The new mill generates 2.4 times the amount of renewable electricity it consumes. It increases the renewable energy production in Finland by 2 percentage points. The mill also produces a large variety of biomaterials and biochemicals.

The mill is a flagship project of a resource-wise bioeconomy and circular economy, using both the raw material and the production side streams efficiently. For example, the sludge from the process is used for biogas production by our partner EcoEnergy SF to replace fossil fuels in traffic and industry. Another circular economy solution implemented at the mill is capturing sulphur emissions and converting them back to sulphuric acid for the process of the mill.

Project Purpose

This major investment brings more than 2,500 jobs throughout the value chain in Finland, including 1,500 new jobs. It increases the value of exports by around €500 million per year. The new mill will also diversify the structure of the Finnish forest economy and bioeconomy by introducing new bioproducts with high value added.

Project Evaluation

The bioproduct mill uses no fossil fuels and causes no fossil CO₂ emissions. It only uses wood-based biofuels, generated mainly from its production side streams. The mill is a significant producer of renewable energy.

The production side streams will be utilised for higher added value products within the globally unique industrial ecosystem.

The new technologies of the bioproduct mill can be implemented at other mills. Taking into account growing global consumption, it is obvious that more resource-efficient solutions are needed, paving the way to a circular economy.

All the wood arriving at the mill comes from sustainably-managed forests, mainly in Finland.

"We have created the first next-generation bioproduct mill concept that takes resource efficiency to a totally new level. Our environmental performance has clearly improved: pulp production is 2.5 times higher than before, but the environmental impact remains at the former level.

The new recovery boiler is the most energy-efficient in the world: we produce 2.4 times the amount of electricity that the mill consumes.

We deliver significant amounts of energy to the grid, representing 2.5% of Finnish electricity production. The mill is completely fossil free as we use only biofuels. We utilise 100% of the side streams to produce a wide range of bioproducts within the industrial ecosystem by the site."

Main Features:

Fossil CO₂ emissions saved (tCO₂)

Direct fossil CO₂ reduction
65,000 tonnes/year

Investment

€1.2 billion

Partnerships

Aqvacom, Äänekosken Energia, Äänevoima, CP Kelco, EcoEnergy SF, Metsä Board, Specialty Minerals Nordic, Valio



Optimising energy balance and operational flexibility

Sami Lundgren
VP, UPM Environment
and Responsibility

Project Description

The Kymi-700 investment project at UPM Kymi pulp mill in Finland began in 2014, and was finalised by the end of 2015. It comprised a new pulp drying machine, modernisation of the softwood fibre line, a new debarking plant and improvements in the energy balance, resource efficiency and operational flexibility of the Kymi complex of pulp and paper mills.

Project Purpose

The purpose of the investment was to increase Kymi pulp mill's annual production capacity and debottle-neck the process to ensure better efficiency and capacity utilisation. The investment also improved the integrated mill site's energy efficiency. Despite the major increase in production capacity, total emissions into the air and water will remain at the same level as before, thus reducing emissions per tonne.

The improvements in energy balance, resource efficiency and operational flexibility meant that CO₂ emissions per tonne were decreased remarkably through the project. With increased pulp production, the amount of biomass-based surplus heat and electricity increased, partially replacing fossil fuels in the integrated mill.

Project Evaluation

The investments at the UPM Kymi pulp mill improved the efficiency of the entire integrated mill: the pulp and paper businesses can independently optimise their production and simultaneously benefit from synergies related to energy, logistics and environmental management.

"UPM's Biofore strategy is based on versatile use of renewable wood biomass, combined with innovation, resource efficiency and responsibility. This enables us to respond to some of the biggest global challenges, which are driving demand for sustainable solutions and responsible business practices. In 2015 we revised our focus areas, and established new targets and performance indicators through to 2030 to guide our responsibility activities.

UPM's expertise in renewable and recyclable materials, low-emission energy and resource efficiency is the key to developing sustainable businesses with high added value and competitive advantage. What could be a better example of providing solutions for the community than offering sustainable wood-based pulp products or turning residues from pulp production into advanced biofuel?"

Main Features:

CO₂ Emissions saved (tCO₂)
UPM Kymi mill's fossil CO₂ emissions/tonne of pulp produced decreased by 40%



Blue Circle: a model of decarbonisation

François Bru

Blue Paper Mill Manager

Project Description

Blue Paper is a joint venture owned by VPK Packaging Group and Klingele Papierwerke Group with an annual production of 400,000 tonnes of recycled corrugated paper. Through the recycling process, reusable paper fibres are cleaned and segregated from residual materials. The annual residue amounts to 25,000 tonnes, mainly wood fibres, textile and plastics extracted from raw material bales. In the near future, Blue Paper will use these process residues in a new heat plant that will convert their potential energy into steam, to be used on-site in the paper machine drying section. This ambitious project, called Blue Circle, will contribute to the circular economy and the use of green energy. With this project, Blue Paper aims to innovate for a sustainable future. The project has received significant support from local authorities, political leaders and the French energy agency.

Project Purpose

Blue Circle aims to reduce greenhouse gas emissions (minus 80% natural gas consumption, minus 500 trucks/year and minus 30% CO₂ emissions). The project will also reduce fossil energy consumption by replacing gas with process residues. It will increase the share of renewable

energy: the process residues contain partly worn-out fibres, wood, cardboard and textiles that constitute biomass. Another big contribution to the environment will be reducing landfill waste by reusing process residues, eliminating 12,000 tonnes of landfill waste per year. The Blue Circle project will thus contribute to developing the circular economy with local treatment of process residues and on-site consumption of the steam produced by the new heat plant.

Project Evaluation

Blue Paper currently uses external service providers to eliminate process residues (landfill in France and incineration in Germany). After the new heat plant comes online, Blue Paper will close the loop and use these residues onsite to produce steam, replacing two gas boilers.

"Since Blue Paper started, we have had to use external service providers to eliminate the impurities found in recycled paper bales, such as plastic, wood and textiles. As these process residues can be incinerated to generate green electricity, steam and heat, there was a clear opportunity to improve our environmental processes.

This project started in April 2017 and is currently proceeding as planned; we expect it to be operational in May 2018.

We have also enjoyed a very good working relationship with the local authorities and obtained the necessary permits and support from ADEME, the French Energy Agency. After implementation of the new heat plant, Blue Paper will close the loop and use these residues on-site to produce steam, replacing two gas boilers."

Main Features:

CO₂ Emissions saved (tCO₂)
This project will save 30% of CO₂ emissions.

Investment €25 million

Partnerships

The Blue Circle Project received a subsidy from ADEME, the French Energy Agency.



Kimberly-Clark



Revelation

Project Description

The objective of the Revelation project is to transform the energy efficiency and environmental impact of the site by pursuing three areas of improvement.

1 – Optimisation of natural gas combustion

The project will improve the current situation by installing a new generation of burners, fitted with in-line Carbon Monoxide (CO) monitoring and precise control of the air/gas ratio.

2 – Optimisation of the vacuum generation system

Currently the vacuum system is poorly adapted to variations in production demand. The installation of “blowers” (variable speed fans) to replace the vacuum pumps will enable the vacuum level to be adjusted to production demand.

3 – Recovery and re-use of waste heat

At this moment, warm air drawn from the production process is dumped into the atmosphere at 64° C. The air will be re-used by installing recovery equipment that will heat the production buildings and pre-heat the combustion air for the four production burners.

Project Purpose

The VSE factory emits 42,000 tonnes of CO₂ a year. The objective of the Revelation project is to reduce this by at least 10%, thanks to more than €2 million of investment in equipment. This is a dynamic and highly innovative project, piloted locally in France and with worldwide potential. In fact, the Kimberly-Clark group will rely on the experience of our French factory to replicate the improvements in some 15 similar production lines worldwide. The Revelation project was initiated by Kimberly Clark energy experts, who then joined forces with a design office to produce feasibility studies in 2013 and engineering studies in 2014. During the implementation phase (September 2015 to March 2016), 150 people from 25 sub-contractor companies (96% of them local, drawn from the Lorraine region) worked on the site.

Project Evaluation

Environmental benefits: reduction of 4,100 tonnes CO₂/year, equivalent to 10% of the site's emissions; reduction in the emission ratio (tonnes of CO₂ per tonne of paper produced) by 8%.

Energy benefits: reduction of 25 GWh, equivalent to 7% of the site's consumption.

Benefits in terms of atmospheric waste: reduction in CO content through combustion optimisation (controlling the air/gas ratio) and design of combustion equipment adapted to production demands.

Main Features:

CO₂ Emissions saved (tCO₂)

4,100 tonnes CO₂/year, equivalent to 10% of the site's emissions.

Investment

€2 million



Tom Berben
Environmental Compliance
Director, Essity

Transforming sludge into carbon neutral fuel

Project Description

Some of the biggest challenges when recycling paper are the outlets for deinking sludge and trash. Today, sludge is transported to cement and brick factories to serve as filler, or used in landspreading for soil improvement. The ultimate circular solution for such sludge is to have a small-footprint installation in the paper mill that transforms the sludge into carbon-neutral fuel and reusable high brightness fillers (CaCO_3). This would also avoid the emissions and traffic from transporting sludge. SCA, Alucha and the University of Twente have developed a pyrolysis installation for deinking sludge. The concept of the pyrolysis reactor was developed by Alucha. SCA supported the first test in a small pilot unit at the university, to confirm the unique design of the reactor. With successful results, it was decided to scale up to a medium-sized industrial installation with a capacity of 100kg/h. Ongoing tests confirm the process's reliability and mass and energy balances, allowing SCA to plan on scaling up to a large industrial installation.

Project Purpose

Develop a robust industrial-scale pyrolysis facility for deinking sludge, with a profitable energy balance and mass balance. Ensure the minerals

retain calcium carbonate at such purity that it can be reused in the paper industry. Key benefits: relatively low capital investment and small footprint; end sludge transport; reliable, cost-efficient and independent solution for deinking sludge; true circular economy solution.

Project Evaluation

Profitable energy balance: the process is auto thermal and has 50% excess energy, which can be used to generate carbon-neutral steam, replacing a mill's fossil fuel usage by up to 20%.

Value is generated in three areas in the project: avoiding sludge removal costs, selling the recovered minerals and avoiding the costs and CO_2 emissions of fossil fuels. Additional benefits are cleaner air and less traffic from sludge transport. Overall, the investment has achieved a calculated payback period of less than three years. The next step is to upscale to a large, industrial unit of 1.5 tonne/h and implement this technology in all our recycled fibre mills, around the world.

"Essity has set a clear strategy to support the concept of Circular Economy. This project brings all benefits together: it ensures a sustainable and cost efficient outlet for our deinking sludge with no impact to local communities. The sludge is recycled into two renewable materials: carbon-neutral fuels and reusable minerals for the paper industry. This project is so unique in circularity that it was easy to get full commitment from all management levels up to our CEO. The project will significantly contribute to achieving our challenging scientific-based carbon reduction targets."

Main Features:

CO_2 Emissions saved (tCO_2)
Full-size industrial installation will save up to 20,000 tonnes/year per mill.

Investment
(€3 million-€6 million depending on mill size)

Partnerships
The project is a partnership of Essity, Alucha and the University of Twente



Luca Loccia
Mill Manager

Reducing gas consumption through steam harmonization

Project Description

Ideal Cart S.p.A. designed and implemented a very efficient system to reduce emissions. Earlier, a gas turbine had provided electricity and steam to two machines. Changes to the production set-up eliminated one of the machines; which meant the turbine was only partially used, generating a thermic excess, and consequently hot fumes were leaking into the atmosphere.

In order to optimise that process, Ideal Cart decided to harness the excess fumes, significantly reducing gas consumption. A piping system now connects the turbine with the hood air system; the hot gases are also managed by a system of automatic closures, in order to harmonise steam production, hood activity and the constant pressure of the turbine. In addition, a further steam generator was installed on the hood drain to improve performance.

With this modification the two hood burners remain switched off for most of production, with huge economic benefits for the company.

This configuration reduces CO₂ emissions by more than 10%, so that the entire system contributes to the site's environmental sustainability in accordance with Ideal Cart's corporate philosophy. The overall cost of the project was approximately €1.7 million. The results were in line with expectations, and in addition to the CO₂ reduction, methane gas release was also reduced by more than 10%.

"The project was born from the company's strong commitment to reducing emissions. The global project envisaged a series of interventions in the production department, and, above all, the recovery of fumes from the gas turbine to feed the air system hoods.

The particular case of smoke recovery was exceptional, as we did a good job of transforming an unfavourable situation into a benefit for the environment and for the company. I think this intervention, under some special conditions, may be re-created in other situations as well. I would also add that the companies to which Ideal Cart supplies its finished product (CRC srl and Carind srl) have reduced emissions thanks to photovoltaic systems of about 460 kW cad."

Main Features:

CO₂ Emissions saved (tCO₂)
2016/2015 = - 1234 tCO₂

Investment
€1.7 million

Partnerships
Novimpianti



Martin Figacz
Energy Plant Manager

Waste heat recovery for heating demineralised water

Project Description

The project's goal was to reduce steam consumption in deaerators by using heat from the digesters (otherwise wasted) to heat demineralised water that was then used in the mill processes. The project was an internal cost reduction initiative achieved through the increased efficiency of steam and power generation, and significantly reduced fossil fuel consumption at the Kwidzyn mill.

The concept behind this innovative thinking was not to direct the dirt left after one technological process to the next process, but instead to use it for power generation at the mill's CHP unit. On top of the reduced cost from decreased coal consumption, the project achieved a remarkable environmental effect, notably reducing CO₂, dust, SOx and NOx.

The biggest conceptual challenge was how to separate and then utilise condensates with mixed temperatures (difference of up to 30-35 degrees Celsius) and pressure (pressurised and atmospheric vessels). One of the first operational challenges arose from the very short time for implementation: four days during the annual shutdown to connect new installations to the existing set-up. The second was the optimisation of the

new control system and the stabilisation of heat recovery.

Project Purpose

The main purpose of the project was to decrease coal consumption and subsequently CO₂ emissions at the mill. To achieve this goal two major changes to the previous process were introduced:

- New demineralised water heating installation (heat exchanger) fed by hot foul condensate from the digester plant (blowouts),
- Separating high-temperature condensates (from the existing condensed installation from the Cooking Plant, the Evaporator Plant and the District Heating Plant); collecting them in a pressurised system and then directing them to the non-deaerated feedwater collector directly before the deaerators.

Project Evaluation

Some of the achieved annual savings were: the additional thermal energy delivered to non-deaerated feed water (recovered waste heat) is 245,000 GJ/year; the average annual reduction of steam consumed in the degassing process is 4.2 t/h and the reduced coal purchases 12,000 tonnes (2016).

"In pulp and paper making processes, we need much more heat than electricity. In this context we eagerly welcome any heat recovery initiative, especially when we can increase the efficiency of power generation process at the same time. This is easier said than done; in most cases the heat waste sources identified have too low temperature potential, which makes it hard to recover heat. This project was truly exceptional because we were able to identify waste heat sources at high temperatures, which helped us improve the energy conversion process. I strongly recommend applying this approach in other integrated mills with fossil fuel power plants and process steam. The project was relatively quick to implement and brought both financial and environmental benefits."

Main Features:

CO₂ Emissions saved (tCO₂)
25-30,000t/year

Investment
€2.55 million



Frederico Pisco
Corporate Energy Manager

Reaping the benefits of solar: photovoltaic power plant

Project Description

The business model of the Navigator Company (NVG) is based on sustainable and certified management of forests, reconciling environmental, social and economic concerns.

Investment in low-carbon solutions allowed NVG to achieve an important milestone: In 2016, approximately 70% of NVG's total primary energy consumption was obtained from renewable sources. The measures we adopted have reduced the company's energy dependency.

In 2016 the company announced a medium-term Energy Efficiency Corporate Programme, based on seven strategic vectors: Energy Management System (ISO 50001), renewable energy, energy efficiency for lighting, behaviour changes, industrial processes, electric mobility and energy management information systems. NVG's long-term objective is to reduce dependence on fossil fuels and energy consumption in the production of pulp and paper.

Project Purpose

NVG's business model is by nature based on a low-carbon economy, in view of its consistent investment in technologies that use renewable energy sources and its commitment to sustainable forestry management. As part of its corporate energy pro-

gramme, NVG decided to invest in a solar photovoltaic power plant, further decarbonising the economy. This solar plant covers 13,000 square metres, on the roof of the paper plant in Setúbal, and supplies some of the electricity needed to power the 500,000 t/y mill. The facility began operations in June 2016.

Project Evaluation

The solar panels will generate approximately 3.1 GWh/year of electricity, or the average consumption of 850 Portuguese households. At the same time, the solar plant will avoid 1,140 tonnes of CO₂ emissions per year. Portugal is one of the European countries with the most hours of sunlight per day, making the investment even more attractive. Since the solar panels are on the roof, they reap the potential of an otherwise unused space. NVG is analysing opportunities to implement similar projects in other locations.

"It is essential for the company to look at every opportunity to produce renewable energy and promote energy efficiency. The technical and economic feasibility of the project, combined with the excellent solar conditions in the region where the paper mill is located, led Navigator to innovate how it generates its power, in another major step for its corporate strategy of promoting energy efficiency.

Solar energy is today a mature technology, and in recent years the investment costs have come down significantly, whilst efficiency has improved. This means that solar power is now able to address the company's technical and economic concerns and sustainability needs."

Main Features:

CO₂ Emissions saved (tCO₂)
1,140 t CO₂ / year

Investment
€2.1 million



Per Asplund
Manager of Projects
and Engineering at Ortvisken
and Östrand mills

Using recovered heat for the district heating network

Project Description

The city of Sundsvall has a well-established district heating network. Hot water is distributed by Sundsvall Energi AB to private and commercial consumers by a 300 km pipe network. In 2006, heat from flue gas originating from steam production was recovered and delivered to the district heating network. In 2013 SCA and Sundsvall Energi AB built on their relationship with an initiative aiming at increasing delivery of hot water from SCA based on renewable energy, thereby reducing consumption of heating oil and emissions of carbon dioxide.

Project Purpose

Prior to this investment, district heating was heavily dependent on fossil fuels. It had also become obvious that Sundsvall Energi AB needed to increase its capacity to ensure it met customer needs. The goal of the BioCoop project was thus to reduce consumption of heating oil and to offer district heating based on renewable sources, as well as avoiding a very costly investment to convert the Sundsvall Energi AB boiler from oil to biofuel. The capacity increase was achieved by:

- Installing two new condensers and redesigning two of the existing boilers at Ortvisken paper mill: Wood powder burners were installed,

improved flue gas cleaning was achieved by complementing and upgrading the electrostatic precipitators and a plant for processing wood pellets into wood powder was built. The design capacity was 60 MW.

- Utilising recovered secondary heat from SCA Östrand pulp mill with a new 10 km district heating pipe connected to Sundsvall Energi AB. The two projects provide a potential reduction of CO₂ emissions by 73,000 tonnes per year, of which 13,000 tonnes originate from replacing oil with wood pellets for internal steam production at the Ortvisken paper mill.

Project Evaluation

Since the launch in 2014, in addition to the 100 GWh of recovered heat based on flue gas, 120 GWh per year based on renewable energy has been delivered by SCA Ortvisken paper mill and SCA Östrand kraft pulp mill to the district heating network. Sundsvall Energi AB has reduced its emissions of fossil CO₂ by approximately 35,000 tonnes per year. CO₂ emissions by the Ortvisken paper mill have been reduced by 15,000 tonnes per year, or 65%, compared to the years 2004 to 2013.

"The capital cost for converting the municipal oil boiler far exceeded the cost of new equipment and conversion at the mills, so the project offered a much more attractive solution for all parties. We have biomass within our own business loop – giving us better control over supply, quality and costs. Most of the wood pellets fuelling the Ortvisken boilers are produced at SCA's pellet plant about 40 km away. To get a flying start on the project, we began the site preparation in advance of the decision.

We had the advantage of previous experience from 2011, when a new lime kiln fired by wood powder was installed at the Östrand paper mill. We basically copied the Östrand design so we could get started on pre-fabrication, meaning it took less than one year from the decision to the launch of operations."

Main Features:

CO₂ Emissions saved (tCO₂)
50,000 tonnes/year

Investment SEK
500 million (Sundsvall Energi AB, kr 100 million; SCA Östrand pulp mill, kr 60 million and SCA Ortvisken paper mill, kr 340 million)

Partnerships
Sundsvall Energi AB, SCA Östrand pulp mill and SCA Ortvisken paper mill



Henric Dernegård
Responsible for
strategic energy
issues at Södra

Bark: a mill by-product replacing fossil fuels

Project Description

Starting in the spring of 2015, substantial investments were made to replace fossil fuels with bark. This was achieved by installing a feeding system allowing tight control of the weight and the feed rate. Since 2012, the mill has been taking systematic steps to reduce the use of fossil fuels. In 2014, around 20% of the energy for the lime kiln came from fuel oil. Södra Cell Mönsterås has long used a unique process to fuel the kiln with bark, but this is problematic because the material is very abrasive, has a high risk of self-ignition and makes it difficult to maintain an even flow rate (like many other solid materials). Since the supply of good quality bark was a bottleneck in production, a new lifters section was installed in order to increase the heat transfer from the flue gas to the lime mud. The concept of using bark, a mill by-product, is very appealing. In this way, Södra is contributing to the circular economy and reducing the carbon footprint from production in several ways. Firstly through the substitution itself, and secondly by the savings on production and transport of the fuel.

Project Purpose

The project consisted of two parts: to enable a high amount of bark to

be fired in the lime kiln, and to lower the energy demand of the lime kiln by increasing heat transfer. The overall goal was to increase the use of internal fuels thereby eliminating fossil fuels.

Project Evaluation

The project has had several very positive effects. Bark usage increased from 50% in 2014 and early 2015 to more than 60% in 2015 and 2016 (Figure 1). Fuel oil consumption in the lime kiln was reduced from 6,000 cubic metres in 2014 to 2,800 cubic metres in 2015. Until the maintenance shutdown in September 2016, only 1,000 cubic metres of fuel oil were used (compared with 4,500 in the corresponding period of 2014). The project also utilised side streams from the pulp mill and turned a low-value by-product into a valuable substitution for costly fuel oil. This increased the use of internal fuels and produced an economic benefit of around €1 million per year.

"Before beginning this project, we had known for a long time that the lime kiln was the largest consumer of oil in the mill. We noticed that there were large variations in the bark feed rate and that those variations posed an obstacle to reducing the use of oil in the lime kiln. The project aimed at stabilising the process of supplying solid biofuel (bark) to the burner. This model shows that, as in many other cases, the key to continuous improvement is through stabilising a process.

Södra has made significant efforts towards decarbonising in the past and has set a very ambitious goal of using zero fossil fuels by 2020."

Main Features:

CO₂ reduction:

18,000 tonnes of CO₂ during 2015 and 2016 (9,000 tCO₂/year)

Investment

€2 million



Stora Enso and Volvo: Cooperation on reducing CO₂ emissions

Chris De Hollander
Managing Director
of Langerbrugge mill

Project Description

In November 2016, Stora Enso and Volvo Cars opened a 4 km pipeline between their manufacturing sites in Gent, Belgium. The pipeline takes hot water heated using renewable energy from Stora Enso's paper mill to the Volvo plant, where it is used to heat buildings and paint booths. While the mill is constantly seeking opportunities to improve its efficiency, this partnership is unique involving companies from different sectors and value chains. The project was supported with an ecology subsidy of €2 million by the Flemish Government.

Project Purpose

Long-term sustainable development and combatting global warming requires partnerships between governments, the private sector and civil society. Innovative business partnerships like this can be a powerful source of advocacy, setting the course for a carbon neutral economy and unlocking potential green growth. Stora Enso has committed to reducing the company's use of fossil fuels to as close to zero as is technically and commercially feasible over the next 10 years. The cooperation with Volvo Cars is a good example of the collaborative efforts Stora Enso is making to achieve its targets. The

Volvo Car Group has an ambition to be among the leaders in climate neutral operations and energy efficiency, and this project takes the company a significant step closer to its goal - reducing its European-wide CO₂ emissions by 24%.

Project Evaluation

Thanks to the pipeline, Volvo Cars uses substantially lower amounts of fossil fuels for heating. The project will lead to emission reductions estimated at 15,000 tonnes of CO₂ per year, cutting the Gent plant's total CO₂ emissions by more than 40%. For Stora Enso, the pipeline offers increased energy efficiency, which benefits the environment as well as increases the use of the mill's assets. There is great replication potential for similar partnerships. However, as was the case in this project, upfront capital investments can be high. Public sector subsidies and incentives that help reduce the initial financial burden are therefore key to replication. Replication may be enhanced by, for example, schedule incentives in the permitting process.

"The construction of a system of industrial district heating outside our premises and the delivery of external renewable energy to Volvo Car Gent leads to increased energy efficiency, which is beneficial to the environment and increases the use of our resources. Our power plants produce combined heat and power, currently providing all of the heat and more than 70% of the electricity to meet our mill's needs. With rising energy costs, this is a great asset for us. We can now deliver green heat to Volvo as well."

Main Features:

CO₂ Emissions saved (tCO₂)
15 000 tonnes of CO₂ per year, cutting the Gent plant's total CO₂ emissions by more than 40%

Partnerships

Volvo Car Gent, Stora Enso, Flemish Government



Jouni Laakso

Manager of Metsä Wood Lohja mill and the bioheating plant.

Producing Kerto LVL with bioenergy made of production side streams

Project Description

Metsä Wood, part of the Finnish Metsä Group, manufactures Kerto LVL® products for wood construction in Lohja, Finland. The wood always comes from 100% traceable sources. Over 90% of wood used at the mill is certified. Kerto LVL offers a wide range of solutions to global challenges in the entire value chain – locally in sourcing and production, and internationally in construction.

At Metsä Wood, the resource-wise use of wood drives operations and development. The yield of the mill has risen steadily due to careful planning and technological innovations. Part of the resource-wise operations, the side streams of Kerto LVL production are targeted to the highest value uses: sawdust and wood chips are used in pulp production and the rest, such as bark and other smaller fractions, to produce renewable energy at the local bioheating plant for running the mill and producing Kerto LVL with 100% bioenergy.

Project Purpose

The bioheating plant was built next to the Lohja mill to capture the full potential of the production side streams. The heat energy production exceeds the mill's needs. This means that Kerto LVL is made with

100% renewable energy and the energy provides district heat to the surrounding town of Lohja which supports the town's aim to become a low-carbon society. Building the bioheat plant was one of the main projects in the wider development programme for improving yield and energy efficiency.

Project Evaluation

Metsä Wood Kerto LVL production in Lohja is virtually run with wood-based bioenergy. Natural gas is used only to support the process in exceptional circumstances.

The bioheating plant was built in cooperation with Metsä Wood and the town of Lohja. "The local bioheat plant significantly supports our ambitious low-carbon energy goals," says Lohja Mayor, Mika Sivula. Lohja participates in Finland's national scheme to reduce greenhouse gas emissions by 80% by 2030. According to the Mayor, "the bioheat plant covers 80% of Lohja's heating needs. With this significant energy production, the town accomplished its first milestone: by 2016, we reduced our greenhouse gas emissions by 15%."

"As the sidestreams of Kerto LVL production are utilised either in Metsä Group's pulp production or at the mill for renewable energy production, resource efficiency is optimised and traffic emissions are minimised. This is really important as, on a global perspective, the production of construction materials is the most energy-intensive phase in the entire life cycle of a building. In buildings, Kerto LVL is an outstanding material, the structures are durable though light and wood as a carbon storage medium is a welcome solution for global challenges. Each cubic metre of wood in a building captures one tonne of carbon from the atmosphere - not contributing to the greenhouse effect."

Main Features:

Partnerships

Metsä Wood and the town of Lohja



BioVerno: a wood-based renewable diesel



Sari Mannonen
Vice President,
UPM Biofuels Business

Project Description

UPM Biofuels has innovated and developed a production process to transform a wood-based residue of its pulp production into a unique, high-quality renewable diesel that can be used in any of today's diesel engines – car, bus, truck or boat – without modification. UPM BioVerno reduces greenhouse gas emissions by up to 80% compared to fossil diesel, and does not compete with food production. There is no additional demand for biomass or extension of the area of forest harvesting, because to make BioVerno we take advantage of established production processes, using a residue as feedstock. Based on sustainable innovation and a five-year development phase at UPM's Lappeenranta R&D centre in Finland, the results from the pilot production and testing led UPM to build a commercial-scale biorefinery in February 2012. The final investment of €179 million was entirely financed by the company, without any public subsidies. Commercial production started in January 2015. The UPM Lappeenranta Biorefinery produces 100,000 tonnes of renewable diesel and renewable naphtha each year.

Project Purpose

The beneficiaries are:

- The global community, which can use a renewable fuel with minimal

impact on climate and air pollution, without competing with food and without affecting land use, directly or indirectly.

- The local economy, which benefits from jobs, new technology, additional demand for equipment and labour as well as increasing domestic use of raw material.
- Local forest owners, who benefit from guaranteed purchases of wood locally for the biorefinery complex, using wood as raw material for various businesses, such as pulp, paper, sawn timber and biofuels.
- The automotive industry, which receives a high-quality fuel without the need to modify engines. The improved fuel characteristics result in improved engine performance and lower emissions (NOx, HC, particle emissions).

Project Evaluation

The project has been a success. The biorefinery has been running for two years, and has reached the technological and economic targets we set at the beginning. The world's first biorefinery for production of wood-based advanced biofuel has a capacity of 100,000 tonnes, which corresponds to approximately 250,000 tonnes of CO₂ emission reductions in the transport sector.

"Sustainable wood-based biofuels, such as UPM BioVerno, diversify the fuel supply base, help reach renewable energy targets and tackle oil dependence in the transport sector. UPM Lappeenranta Biorefinery is the biggest advanced biofuels plant in Europe. The unique process transforms crude tall oil, originating from wood resin into renewable diesel. The side streams – naphtha, turpentine, pitch and sodium bisulphite – are used to produce bioplastics, perfumes and bleaches. Based on the principles of the circular economy, each residue is utilised."

Main Features:

Reduces CO₂ emissions:
250,000 tonnes/year

Investment
€179 million, without public subsidies

Participating companies



Blue Paper

Blue Paper is a paper mill located in Strasbourg producing recycled corrugated paper for the packaging industry. This joint venture was created in 2013 by the Klingele Papierwerke (Germany) and VPK Packaging (Belgium) groups who decided to convert the virgin fibre paper machine for the production of fully recycled packaging paper. The site employs 150 People, operating 24/7 with a production output of 400,000 tonnes for a turnover of €135 M.

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Essity

Essity is a leading global hygiene and health company that develops, produces and sells Personal Care (Baby Care, Feminine Care, Incontinence Products and Medical Solutions), Consumer Tissue and Professional Hygiene Products and Solutions. Essity's vision is: Dedicated to improving well being through leading hygiene and health solutions.

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Ideal Cart

Ideal Cart S.p.A. produces paper mother reels destined to be transformed into tissue paper products, for hygienic or domestic use, in and away from home. It is considered as a semi-finished product, to be further converted into toilet paper, kitchen paper, paper napkins, paper handkerchiefs, and tissues, both for the consumers' market (B2C) and HO.RE.CA (B2B)

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Mondi Group

Mondi is an international packaging and paper group employing over 24,400 people with 102 operations across more than 30 countries, predominantly in central Europe, Russia and South Africa. We sustainably manage forests and purchase wood from responsible sources to produce pulp. Along with paper for recycling, we turn the pulp into containerboard, kraft paper and uncoated fine paper.

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The Navigator Company

The Navigator Company is Portugal's third largest exporter. NVG accounts for approximately 1% of Portugal's GDP and around 3% of total goods exports. Having consolidated its position as the leading European manufacturer of uncoated woodfree printing and writing paper, and the sixth largest in the world, NVG is also Europe's top producer of Bleached Eucalyptus Kraft Pulp and the world's fifth largest, and has entered the tissue market.

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SCA

The core of SCA's operations is its vast forest holdings in northern Sweden, 2.6 million hectares of forest land. Based on this unique resource, SCA has developed a well-invested and resource-efficient industry where the entire tree is used to create value. Our products include solid wood products, pulp, kraftliner, publication papers and renewable energy. Ortviken as well as Östrand mills use totally chlorine-free bleaching. The main markets for both mills are the Nordic countries and the rest of Europe.

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International Paper

International Paper (a global leader in packaging and paper) has been operational in Poland since 1992, where we have a portfolio of assets and investments employing in excess of 2,700 people across the country. Our largest facility is a paper mill situated in Kwidzyn (100 km south of Gdansk). Our contribution in Poland has been recognised through many varied awards over the years.

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Kimberly-Clark

Kimberly-Clark Corporation is an American company founded in 1872, specialising in the manufacture of cellulose pulp-based products, with 45,000 employees and 150 production units in 43 countries. In France we have two production sites, in Rouen (Seine Maritime) since 1976 and in Villey St Etienne - VSE - (Meurthe-et-Moselle) since 1990. For more than 20 years, these factories have been actively engaged in efforts to reduce the environmental impact of their activities.

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Metsä Group

Metsä Group is a leader in sustainable bioeconomy utilising renewable wood from sustainably-managed northern forests. Metsä Group focuses on wood supply and forest services, wood products, pulp, fresh fibre paperboard and tissue and cooking paper. Metsä Group's sales totalled €4.7 billion in 2016, and employs approximately 9,300 people. The Group operates in 30 countries.

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Södra

Södra is Sweden's largest forest-owner association, with more than 50,000 members owning more than 2 million acres. The overall assignment from its owners is to enable long-term profitability for their forest estates by utilising the forest and providing advice and support for responsible and sustainable forestry. The wood from the forest estates is processed in Södra's mills into sawn and planed timber, interior wood products, biofuel, and market and textile pulp.

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Stora Enso

Stora Enso is a leading provider of renewable solutions in packaging, biomaterials, wooden constructions and paper on global markets. Our aim is to replace fossil-based materials by innovating and developing new products and services based on wood and other renewable materials. We employ 25 000 people in more than 35 countries, and our sales in 2016 were EUR 9.8 billion.

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UPM

Through the renewal of bio and forest industries, UPM is building a sustainable future across six business areas: UPM Biorefining, UPM Energy, UPM Raflatac, UPM Specialty Papers, UPM Paper ENA and UPM Plywood. Our products are made of renewable raw materials and are recyclable. We serve customers worldwide. The group employs around 19,300 people and its annual sales are approximately €10 billion. UPM shares are listed on NASDAQ OMX Helsinki.

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