

2050 DECARBONISATION OUTLOOK:

15 YEARS OF PROGRESS AND FUTURE PATHWAYS FOR THE EUROPEAN PULP AND PAPER INDUSTRY



The European pulp and paper industry has exceeded the decarbonisation ambition set out in Cepi's 2011 roadmap, demonstrating that industrial competitiveness and climate ambition can go hand in hand, as highlighted in a study by Vision Hunters for Cepi.

Since Cepi launched its first decarbonisation roadmap in 2011, Europe's pulp and paper industry has exceeded its original climate ambition, achieving an approximately 30% reduction in direct CO₂ emissions by 2025. This progress has been driven by investment in fossil-free energy, energy efficiency and modernising its production assets.

Today, the industry is entering a new phase, as carbon and energy costs continue to rise across Europe. While credible decarbonisation pathways exist, the remaining emissions will be harder and more expensive to eliminate. Delivering the transition will not only depend on mill investments but predominantly on enabling policy framework that secures access to infrastructure and competitively priced, fossil-free energy.

01 What has driven the progress? Structural industry changes have supported emission reductions

The pulp and paper emission reductions have been achieved through three main drivers:

- **Cleaner energy:** The largest contribution has come from replacing fossil fuels with biomass and other renewable fuels, alongside improvements in energy efficiency.
- **Modernisation:** Older, less efficient production assets have been replaced by modern facilities, while investment in process optimisation has reduced energy demand.
- **Structural change:** European paper and board production capacity has declined by approximately 9 million tonnes

since 2011, while demand and production have decreased by 13 million tonnes and 14 million tonnes, respectively. This structural change has been partly driven by improved resource efficiency and the development of innovative functionalities. In practice, the closure of older graphic paper mills has also contributed to lower emissions today.

European industry is facing growing global overcapacity and intensifying international competition, which are increasing the risk of carbon leakage and threatening its long-term competitiveness.

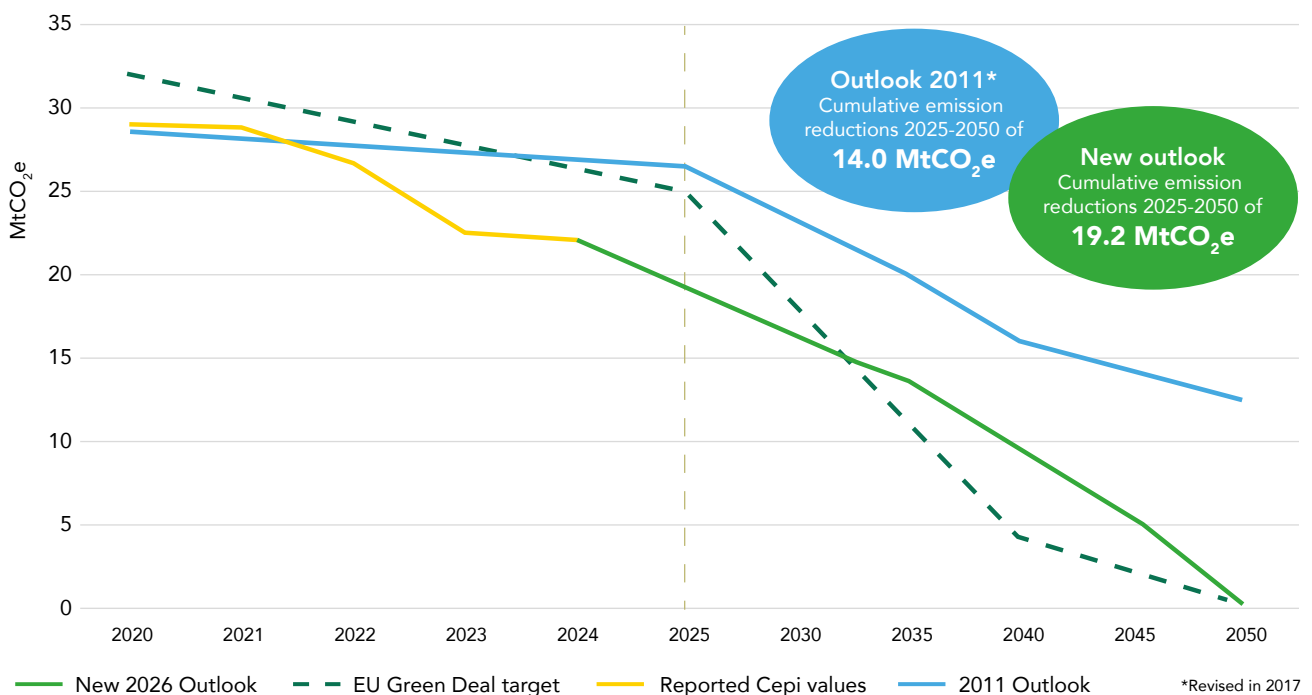
02 Future decarbonisation pathways: a credible route to net zero exists

The updated 2026 outlook indicates that the industry can achieve net-zero emissions by 2050 through a combination of:

- Capacity modernisation,
- Process optimisation and energy efficiency improvements,
- Fuel switching to biomass and fossil-free fuels and heat,

- Increased electrification of industrial processes,
- Deployment of breakthrough technologies such as CCUS and bio-CCUS, advanced drying systems, hydrogen applications, and other emerging solutions.

CO₂ emission pathways



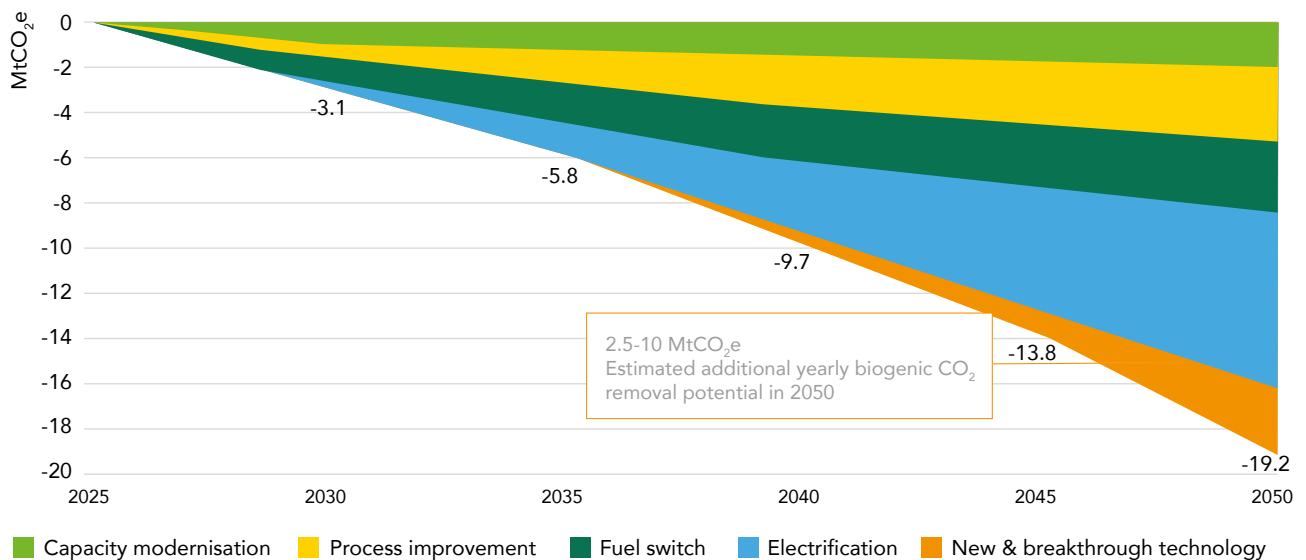
The revised outlook forecasts cumulative emission reductions of 19.2 MtCO₂e between 2025 and 2050, exceeding the 14.0 MtCO₂e reduction anticipated in the original roadmap.

03 Tomorrow's decarbonisation will look different than that of the last 15 years

Unlike the last decade, where fuel switching delivered most reductions, electrification will become the dominant

decarbonisation lever after 2030 as fossil-free electricity availability increases and new technologies mature, supported by breakthrough technologies reaching commercial scale.

Decarbonisation outlook to reach net zero by 2050 (cumulative)



Stand-alone mills, and recycled and virgin fibre mills relying on natural gas offer the greatest remaining opportunity for emission reduction (representing over 55% of the sector's capacity and almost 75% of GHG emissions today).

Meanwhile, integrated chemical and market pulp mills may unlock value from a new side stream, biogenic CO₂, potentially offering 2.5-10 MtCO₂e additional yearly carbon removal potential in 2050.

Emissions, MtCO ₂ e	Capacity Mt	Mill type
9.2	45	Stand-alone recycling: emission reduction through electrification. Growing adoption of MVR and heat pumps.
4.9	15	Stand-alone virgin fibre-based: natural gas reliance reduction. Replacement of aging fuel-fired assets, fuel switching, and increased electrification.
3.3	28	Integrated chemical: unlock value from biogenic carbon and CO ₂ streams.
1.3	10	Integrated mechanical: reduce energy intensity through capacity modernisation and electrification.
0.6	10	Market pulp: carbon negativity through capture and storage of biogenic CO ₂ .

04 What must Europe enable? Checklist of critical success factors

The industry's next phase of decarbonisation cannot be delivered by producers and mills acting alone. Achieving full decarbonisation will require transformation beyond the industry's direct control and depend on several external enablers:

- Availability of sustainable biomass and fossil-free energy (both heat and electricity),

- Expansion of electricity grids together with CO₂ transport and storage infrastructure,
- Supportive climate, energy, and carbon market policies,
- Commercialisation and scale-up of breakthrough technologies.

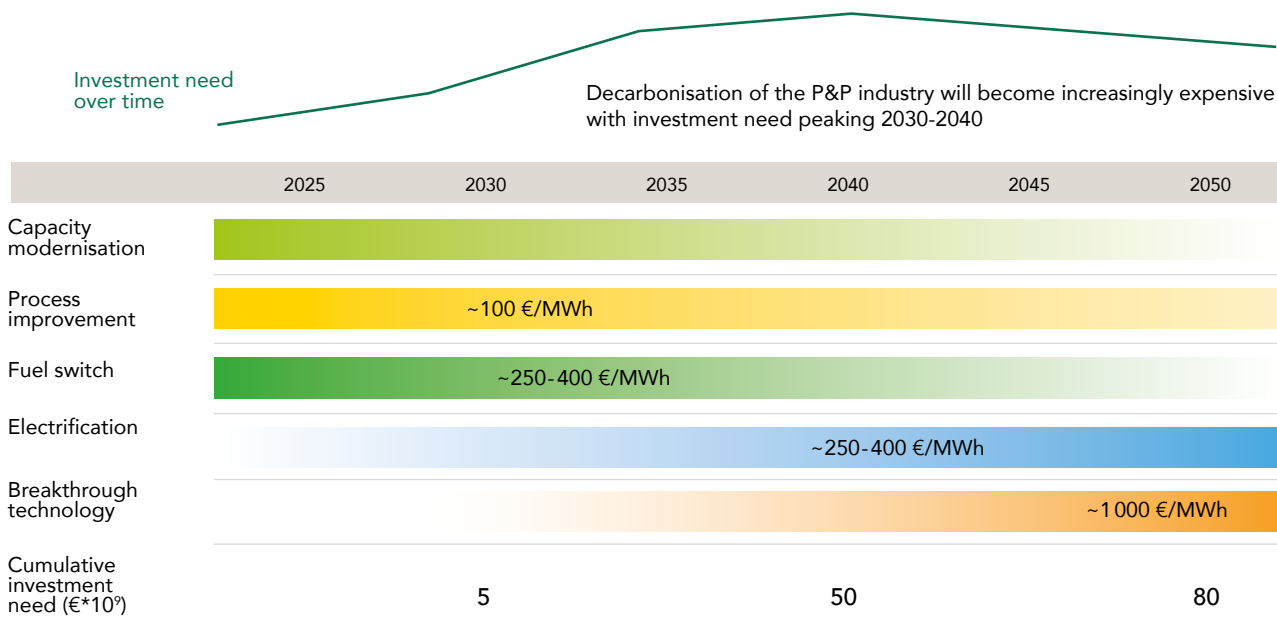
Many of the most significant breakthrough technologies are not expected to be deployed at scale until after 2030, making continued innovation and technology development essential.



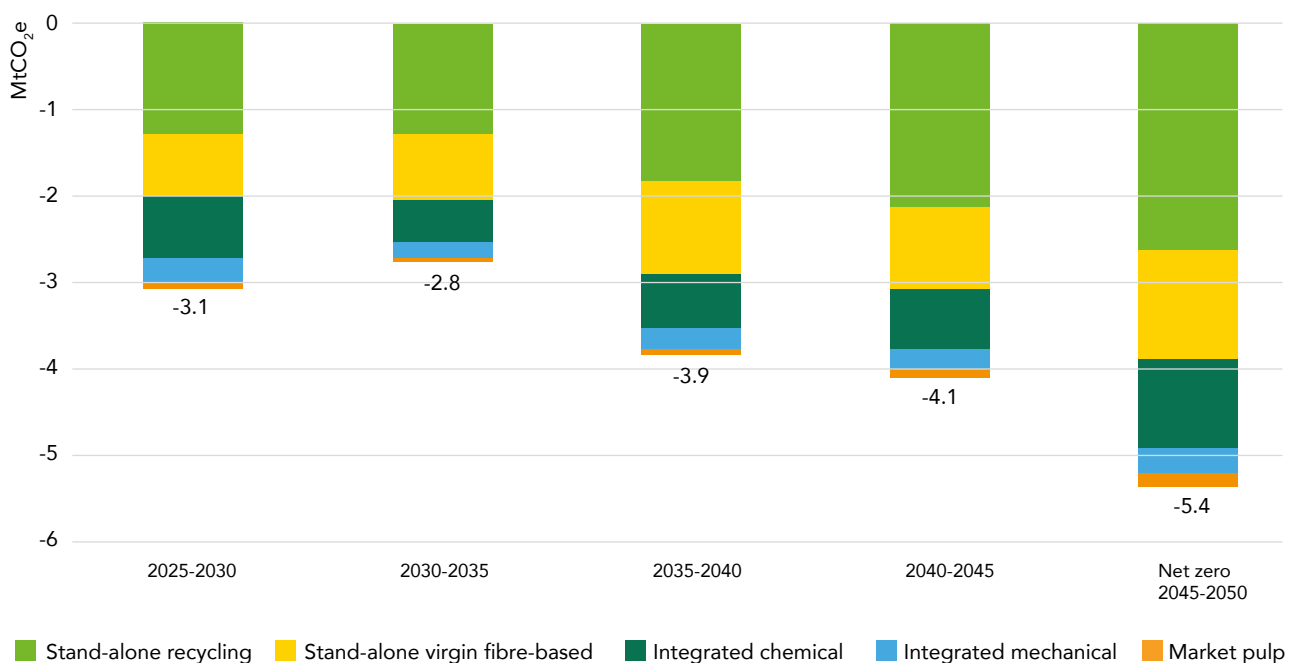
05 The investment challenge ahead: scale, speed and cost

The transition to a net-zero future requires significant and escalating financial commitment. It will require substantial and increasing investment over time. The cumulative investment need is estimated to rise by 2050, with investment peaking between 2030 and 2040.

The industry is expected to move from relatively mature and cost-effective solutions towards more capital-intensive technologies. Decarbonisation costs will rise significantly as the remaining emissions become harder to eliminate, thus increasing uncertainty around project economics and payback periods.



Decarbonisation outlook by mill type to reach net zero by 2050 (non-cumulative)



Conclusion

The European pulp and paper industry has demonstrated strong decarbonisation performance over the past 15 years, if not since 2005, largely meeting and exceeding the ambitions set out in the 2011 roadmap.

While credible decarbonisation pathways to 2050 exist, future progress will require accelerated technology deployment, substantial investment, supportive policy frameworks, and coordinated action across the broader energy and

industrial ecosystem. Success will not only depend on mill-level improvements, but predominantly on the availability of fossil-free energy, infrastructure development, and the commercialisation of next-generation low-carbon technologies needed to deliver carbon removals and further direct emissions reductions at mill sites.

The technologies exist. The ambition exists. Now, Europe must create the conditions to deliver them.

