

Pulp and Paper Industry in Brazil and in the World

an overview



Objective

Objective

This is a joint publication of EPE (Energy Research Office) and IEA (International Energy Agency), with contribution from IBÁ (Brazilian Tree Industry), and presents a brief overview of the Pulp and Paper industry in Brazil and in the world. It is the starting point of a broad cooperation between these institutions to understand and track the progress of energy efficiency in this very important sector for Brazilian and global economy.

This document aims to introduce the subject to the audience. A deeper dive into this sector will be done throughout 2022, with its results to be published in future versions of the Atlas of Energy Efficiency – Indicators Report.



Minister

Bento Albuquerque

Executive Secretary

Marisete Fátima Dadald Pereira

Secretary of Energy Planning and

Development

Paulo Cesar Magalhães Domingues



Team

Technical Coordination

Felipe Klein Soares

Rogério Antônio da Silva Matos

Technical Team

Felipe Klein Soares

Fernanda Marques Pereira Andreza

Patrícia Messer Rosenblum

Rogério Antônio da Silva Matos

Head of Department

Carla da Costa Lopes Achão

Deputy Head of Department

Gustavo Naciff de Andrade

Technical Advisors

Arnaldo dos Santos Junior

Glauco Vinícius Ramalho Faria

President

Thiago Vansconcellos Barral Ferreira

Director for Energy Economics and Environmental Studies

Giovani Vitória Machado

Director for Power System Studies

Erik Eduardo Rego

Director for Oil, Gas and Biofuels Studies

Heloisa Borges Bastos Esteves

Director for Corporate Management

Angela Regina Livino de Carvalho



Executive Director

Dr Fatih Birol

Director of Energy Markets and Security

Keisuke Sadamori

Head of Energy Efficiency

Dr Brian Motherway

Technical Coordination

Edith Bayer, Jack Miller

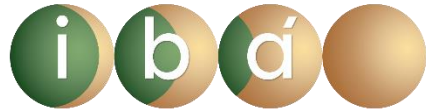
Main Authors

Hugo Salamanca

Assistance

Alexandre Gouy

Hana Mandova



indústria brasileira de árvores

The IBÁ team that contributed to the execution of this report was:

Manager of Sustainability and Forest Affairs

Nathalia Granato Loures

Especialista Sustainability and Forest Affairs

Camilla Bragotto Marangon de Campos

Executive Manager of Energy of Suzano S.A. and Coordinator of IBÁ's Energy Working Group

Paulo Henrique Squariz

Introduction

Introduction

The pulp and paper industry has been increasing its relevance in Brazil, and its energy consumption has increased from 5% of final industrial consumption in 1970 to 16% in 2020, with an average consumption growth of 5.4% p.a. (1970 a 2020). The sector can be segmented into pulp plants, paper plants and integrated plants, which produce pulp and paper - avoiding the energy demand for drying the pulp. Pulp production is characterized by large, technology-intensive plants, with production capacity of about 1 to 2 million tons per year.

The production process includes cooking the wood to extract the pulp, generating a liquid rich in sodium compounds and organic matter, the lye or black liquor. The lye is burned in boilers for the recovery of chemical reagents, steam and electricity production. Some plants already perform biorefining, producing green hydrogen and methanol consumed in the plants themselves, and other products such as lignin. The units also perform cogeneration from biomass boilers, making this industry with renewability rates above 85% and high self-production.

The paper production process is different, with lower specific consumption and no co-products for cogeneration. There is electricity consumption in basically all stages, such as pressing and refining, and steam demand for drying.

In the 2000s, pulp production started to expand more than paper production, increasing the ratio between pulp and paper production (Figure 1). The country is highly competitive in pulp production, especially in the forestry stage, due to the climate, soil and R&D, and with this today Brazil exports about 70% of its production. In the European Union, for example, the ratio of pulp production to paper was about 40% in 2019 (IEA, 2020), indicating that the bloc is an importer of pulp, and limiting comparisons of specific consumption.

Figure 1 – Pulp/paper production ratio in Brazil

Source: EPE (2020).

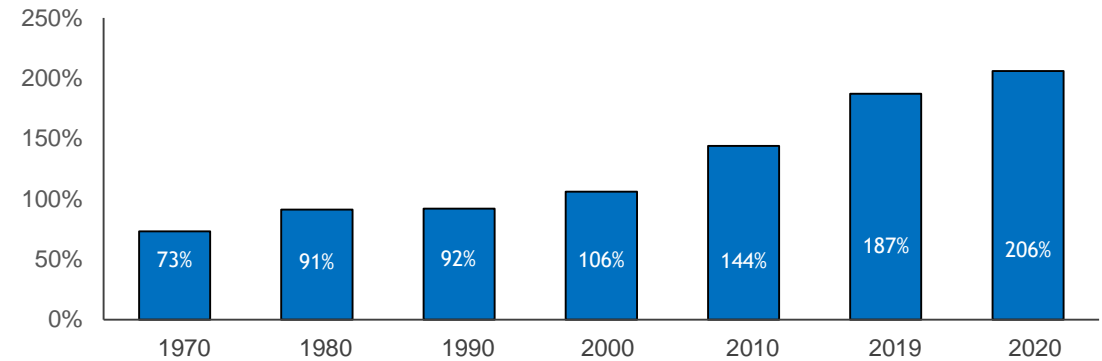
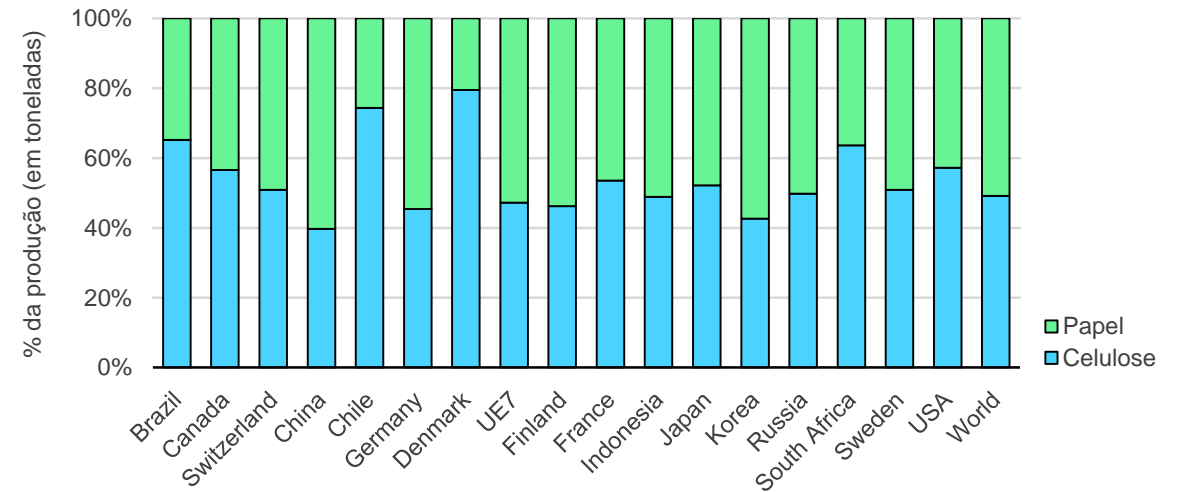


Figure 2 – Share of pulp and paper production in selected countries - 2019

Source: IEA (2021) and EPE (2021) for Brazil..



Overview of the Pulp and Paper Sector in Brazil

Qualitative profile of the industry in Brazil

The pulp and paper industry plays an important role in the national economy and also for the world scenario. This is due to the revenue generated, the high investments and due, also, to the impact that this sector has on the other various economic sectors, both for those before and after its production chain, as well as the energy production and consumption, environmental and social impact.

Pulp Segment

The pulp industry has different characteristics from other markets, due to the fact that it has a high level of technological development that uses industrial facilities with large production capacity, a broad base of planted forest resources, and intense capital applied in technology. An analysis of Table 1 shows that ten countries in this segment are considered to be the world's leading pulp producers, and together accounted for about 83% of world production in 2020 (IBÁ, 2021).

Even with the outbreak of the Covid-19 pandemic, pulp production in Brazil showed growth in 2020 of 6.6% compared to 2019, configuring the sector as one that quickly organized itself to meet the demands of the new consumption format of the various economic sectors, including households. The country remained as the world's second largest producer, reaching 21.0 million tons manufactured, second only to the United States. Brazil is recognized for the quality, as well as for the sustainable and certified origin of its pulp, and this fact has contributed to maintaining the national industry as a major reference in the world.

World's largest pulp producers

Figure 3 – Ranking of the world's largest pulp producers in 2020

Source: IBÁ (2021) and FAO (2021)

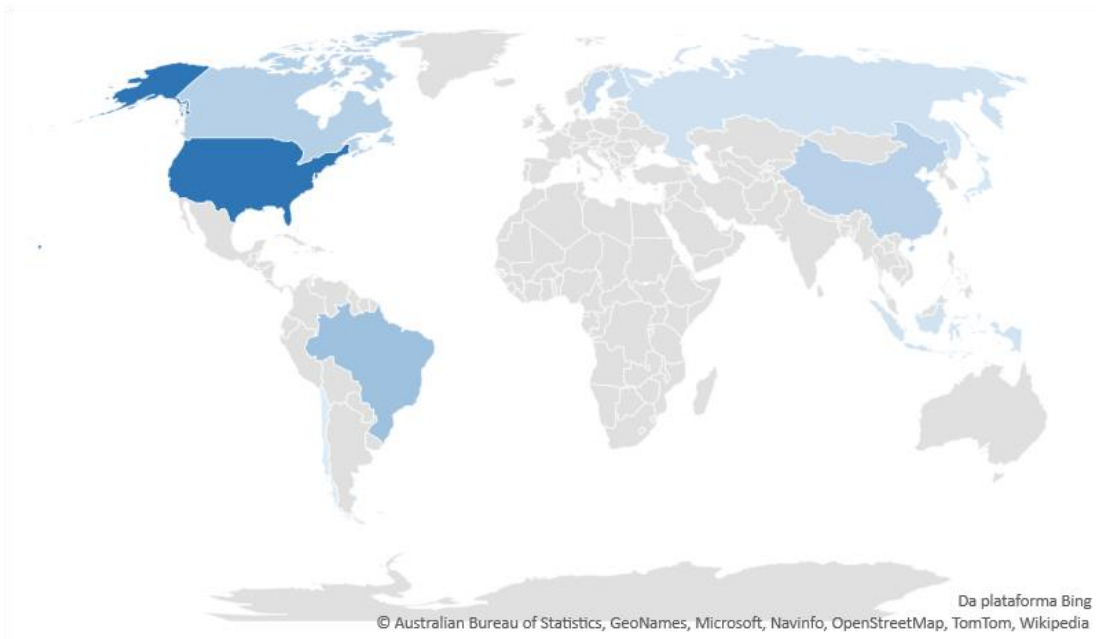


Tabela 1 – Ranking of the world's largest pulp producers in 2020

Source: IBÁ (2021) and FAO (2021)

Country	Production (10 ⁶ t)	% of production
USA	50.9	27.4%
Brazil	21.0	11.3%
Canada	15.4	8.3%
China	14.9	8.0%
Sweden	12.0	6.5%
Finland	10.5	5.7%
Russia	8.8	4.7%
Indonesia	8.4	4.5%
Japan	7.2	3.9%
Chile	5.2	2.8%

Highlight: Brazil is a world reference in forest plantation productivity. This is due to the climate and soil conditions, in addition to decades of investments in research, development, and innovation; forest management techniques; genetic improvement, and sustainable practices. The eucalyptus and pine planted today have evolved in productivity 40% more than the species/varieties brought to Brazil at their origin. (Embrapa, 2021). The average productivity of eucalyptus in Brazil is 36.8m³/ha and of pine is 30.4m³/ha (Ibá, 2021). The specific consumption of wood can vary greatly depending on several factors, the main one being the efficiency of the mill and its technological level.

Brazil is a large producer and exporter of pulp...

Each type of wood fiber results in distinct characteristics. Softwood pulp is more resistant, whereas hardwood pulp has a higher absorptive capacity, and high yield pulp can be obtained from both types of wood. The rotation time in Brazil is shorter, due to the fact that eucalyptus (short fiber), which is the main fiber of Brazilian pulp, reaches the ideal age for cutting faster, on average 7 years, than pine (long fiber), which takes on average 15 to 20 years (DEPEC/BRADESCO, 2016). These factors contribute to Brazil's higher productivity, which favors its lower production cost. In 2020, Brazil leads the world ranking for exporting more than 15 million tons of pulp, making it a major global supplier of this input. In 2020, more than 70% of the Brazilian production was destined for the foreign market. Canada ranks second, exporting 9 million tons. The United States ranks third with 7.8 million tons of exported pulp (FAO, 2021).

Figure 4 – Ranking of the world's largest pulp exporters in 2020

Source: IBÁ (2021) and FAO (2021)



Table 2 – Ranking of the world's largest pulp exporters in 2020

Source: IBÁ (2021) and FAO (2021)

País	Production (10 ⁶ t)	% of production
Brazil	15.5	22.8%
Canada	9.0	13.2%
USA	7.8	11.5%
Indonesia	5.4	7.9%
Chile	4.7	6.9%
Finland	4.3	6.4%
Sweden	4.3	6.4%
Uruguay	2.6	3.8%
Russia	2.4	3.6%
Portugal	1.3	2.0%

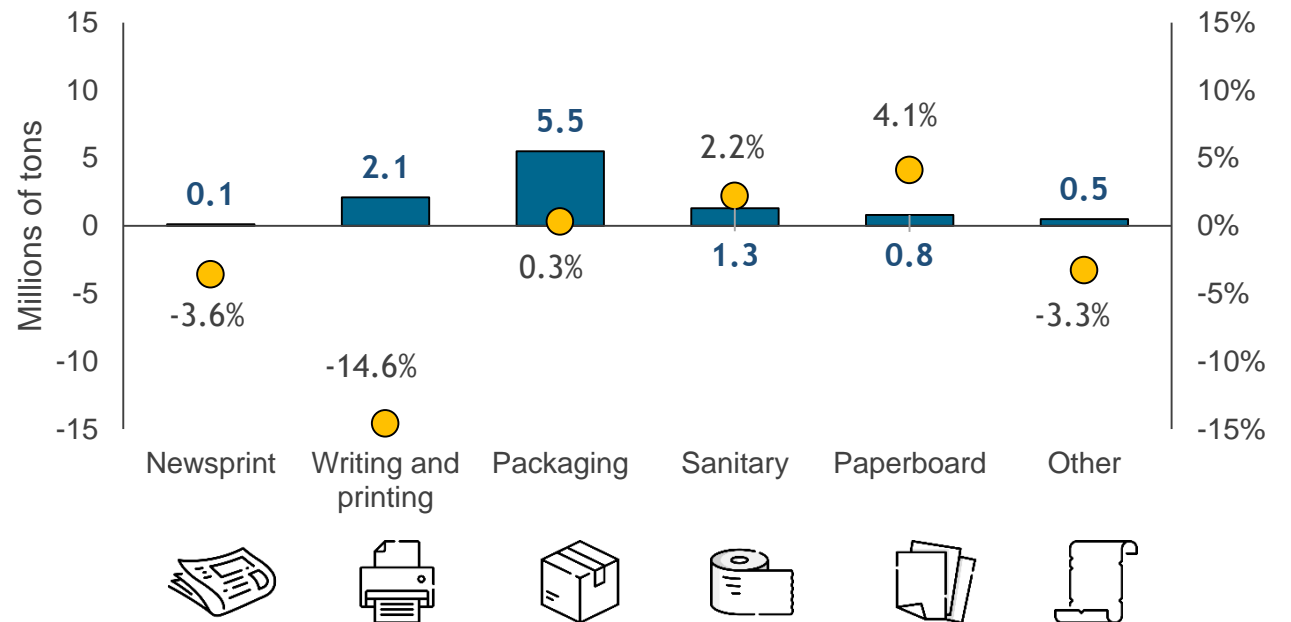
Paper production: an overview

The paper industry has important characteristics that differ from the pulp industry, because it has a less concentrated regional demand, a large number of consumers and producers, and a greater product differentiation compared to the pulp market. Medium-sized companies are active, prices are cyclical and tend to follow pulp prices (FIEPR, 2016). According to FAO data, in 2020 the world paper production was 518.4 million tons (FAO, 2021).

Paper production in Brazil fell by 2.8% in 2020, to 10.2 million tons. However, this drop was not homogeneous for all types of paper produced in the country. In 2020, with the outbreak of the Covid-19 pandemic, many basic and higher education institutions forcibly migrated to remote learning mode. Many companies were also forced to adopt telecommuting. With this, there was a significant drop in the production of printing and writing paper, with a decline of more than 14%. On the other hand, the adaptation of millions of Brazilians to the new routine has provoked an increase in the consumption of essential goods, such as food and personal hygiene items. The advance of home delivery orders and the rapid development of e-commerce provided a 4.1% increase in paperboard and the maintenance of the production of packaging paper, with an increase of 0.3%. In relation to personal hygiene items, paper for sanitary purposes registered an increase of 2.2% in 2020 (IBÁ, 2021)

Figure 5 – Production by type of paper in Brazil in 2020 and variation from 2019

Source: IBÁ (2021)



Paper production: an overview

Brazil remains among the 10 largest paper producers in the world in 2020, with paper exports totaling 2.1 million tons. Unlike the pulp segment, about 80% of national paper production is destined for the domestic market (IBÁ, 2021).

Figure 6 – Ranking of the world's largest paper producers in 2020

Source: IBÁ (2021) and FAO (2021)

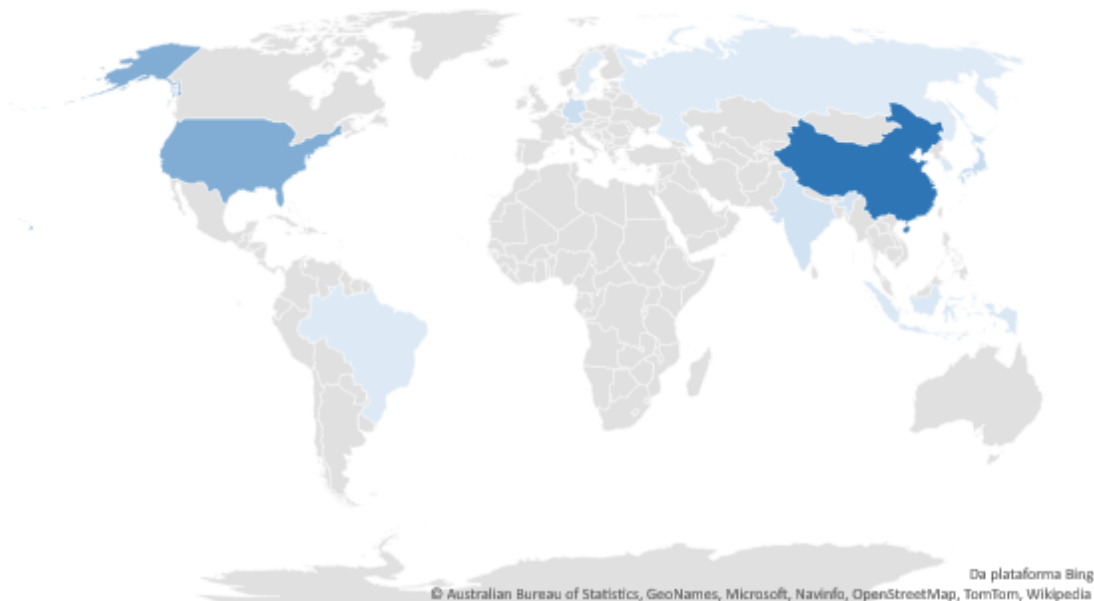


Table 3 – Ranking of the world's largest paper producers in 2020

Source: IBÁ (2021) and FAO (2021)

Country	Production (10 ⁶ t)	% of production
China	117.2	29.2%
USA	66.2	16.5%
Japan	22.7	5.7%
Germany	21.3	5.3%
India	17.3	4.3%
Korea	12.0	3.0%
Indonesia	12.0	3.0%
Brazil	10.2	2.5%
Russia	9.5	2.4%
Sweden	9.3	2.3%

Paper Recycling

Paper recycling is very important in the quest for sustainability, since there is no longer room for the linear economy, based on exploration, production, consumption, and disposal. Recycling promotes the intelligent use of resources, minimizing pressure on natural capital, which is the foundation of the circular economy.

The industry has a very positive track record in reverse logistics, having reached the 70.3% recycling rate milestone in 2020, an evolution compared to the previous year (IBÁ, 2021), while the global average for the sector is 59.1% (ICFPA, 2021).

Table 4 – Consumption of chips¹, apparent consumption of recyclable papers and recovery rate of the Pulp and Paper sector in Brazil

Source: IBÁ (2021)

	2019	2020
Consumption of chips (thousand t)	4,884	4,936
Apparent consumption of recyclable paper (thousand t)	7,384	7,018
Recovery rate	66.1%	70.3%

Highlight: the pulp and paper segment is a large user of water resources, but it returns on average 82% of the water it takes in to the body of water, after a rigorous process within the Effluent Treatment Stations (ETS). Most of the water volume that does not go directly back into the body of water returns to the environment in the form of steam, as in the chimneys of the factories, drying of the products, and evaporation from the effluent treatment tanks. Another part of the water used in the process remains in the product.

¹ Chipping: In this stage, large wood pieces are cut into small chips with the help of large machines. The chips are then used to produce chemical pulp..

Energy Sources in Brazil

The energy matrix of the Pulp and Paper sector has undergone significant transformations over the past 50 years (Figure 7). The lye increased its participation from 15% to 52%, due to better energy use and higher pulp production, becoming the most relevant source in the sector, used for cogeneration. Natural gas started to be used in the 1980's, gradually, and since the 2000's its participation has remained relatively stable at 7%, mainly in boilers.

Fuel oil, which was the main source at the beginning of the period analyzed (38%), had its use reduced rapidly in the first half of the 1980s, being replaced by firewood, lye and other renewables. It continues to lose share until it reaches only 2% of final consumption in 2020. Currently it is used in boiler startup, in lime kilns and also in fuel oil boilers in a few plants.

Figure 7 – Evolution of energy consumption¹ in the Pulp and Paper sector in Brazil

Source: EPE (2021)

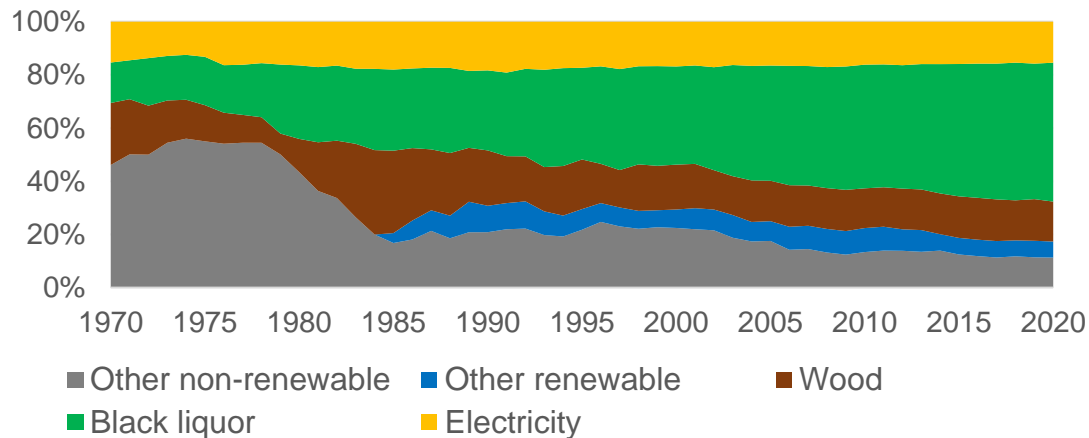
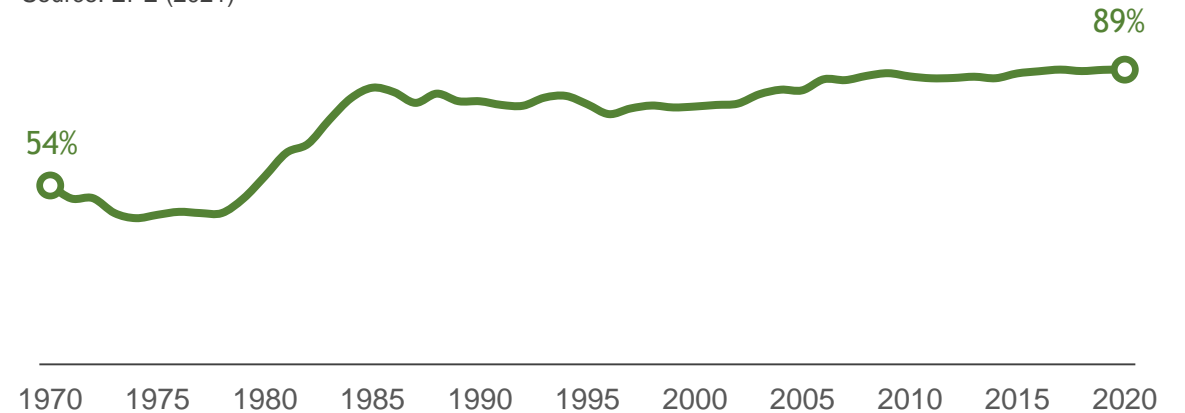


Figure 8 – Evolution of the percentage of renewable sources² in the energy consumption of the Pulp and Paper sector in Brazil

Source: EPE (2021)



As a consequence, the sector's energy matrix presents a high level of renewability, reaching about 89% in 2020, higher than the global average.

¹ It does not include the inputs used to generate electricity.

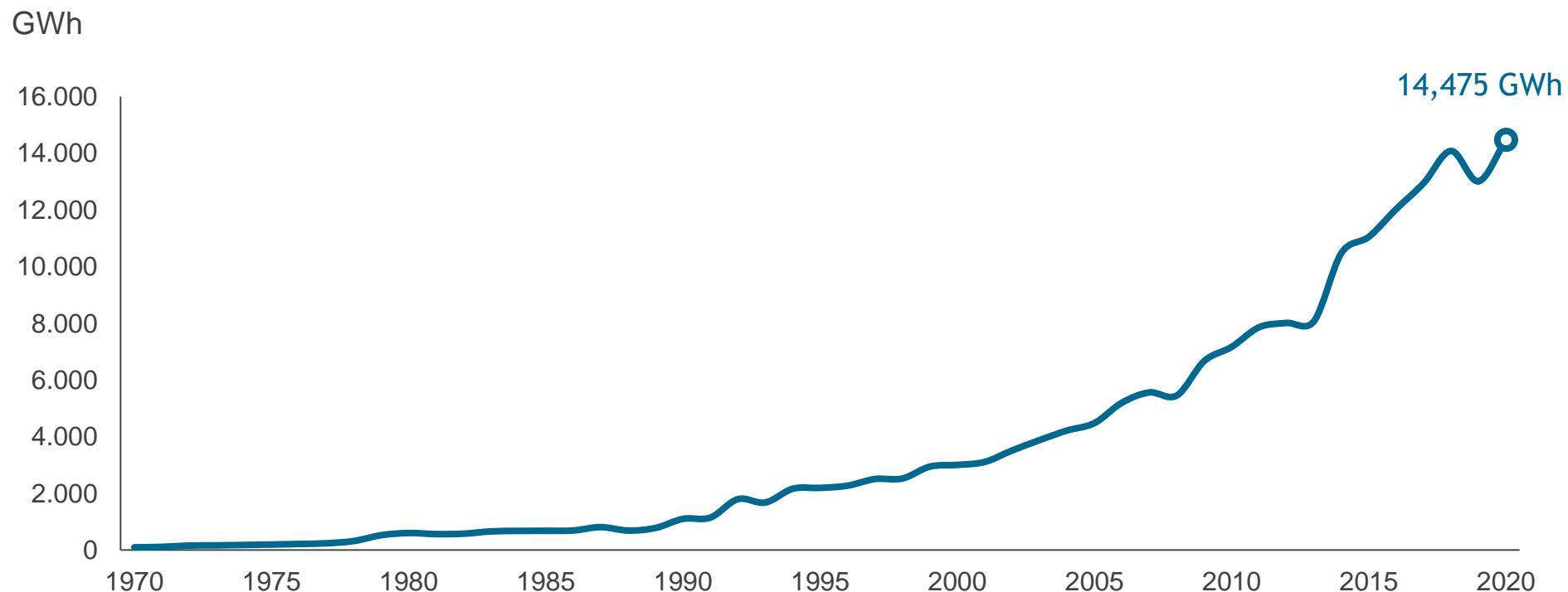
² All the electricity consumed by the sector is of renewable origin.

Electricity

Electricity consumption is configured as one of the most significant for various sectors of the economy, and it is no different for the Pulp and Paper industry, especially for paper production. This sector has an advantage that is the use of bleach, or black liquor (liquid waste from the digester after the wood cooking process), for the self-production of electricity. The sector is already an important exporter of renewable electricity. In the long term, the supply of renewable energy and the sector's contribution to national energy security should grow, as new pulp mills are under construction in Brazil.

Figure 9 – Generation of electricity through bleach source in the Paper and Pulp industry in Brazil

Source: EPE (2021)

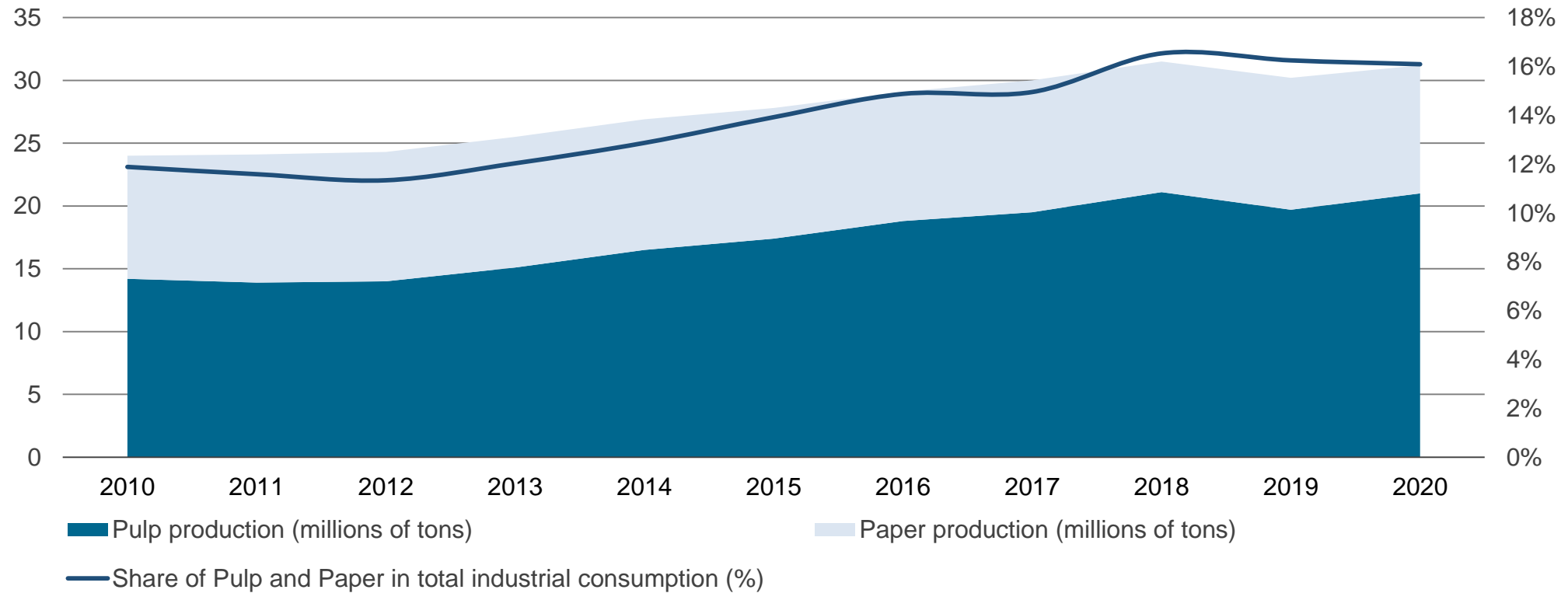


Pulp and Paper in the national context

The Pulp and Paper industry is quite significant, representing just over 16% of Brazil's industrial energy consumption. Thus, it becomes very important to adopt energy efficiency measures.

Figure 10 – Breakdown of pulp and paper production and share of the sector's energy consumption in the national industry

Source: EPE (2021) and IBÁ (2021)



Global Overview of the Pulp and Paper Sector

Global context

The pulp, paper and printing sector accounted for 5.3% of industrial energy consumption in 2019, a share that has been declining over the last decades. Though its share of industrial energy use has been in decline since 2000, the sector continues to be among the top industrial energy consumers, and can play an important role in the transition to a low-carbon energy system.

Recent years have seen a positive evolution with fossil fuels accounting for a quarter of total energy consumption in 2019, a noticeable decline compared to last decade where they represented more than a third. This was done to the profit of a larger share for electricity and biofuels and waste. As fossil fuels are primarily used for onsite utilities, switching to lower-carbon fuels and electrification solutions (for drying in particular) could have an important impact in order to decarbonize the sector.

Figure 11 – Global production of pulp and paper and share of energy use in total energy use 2010 - 2019

Source: FAO (2021) and IEA (2021)

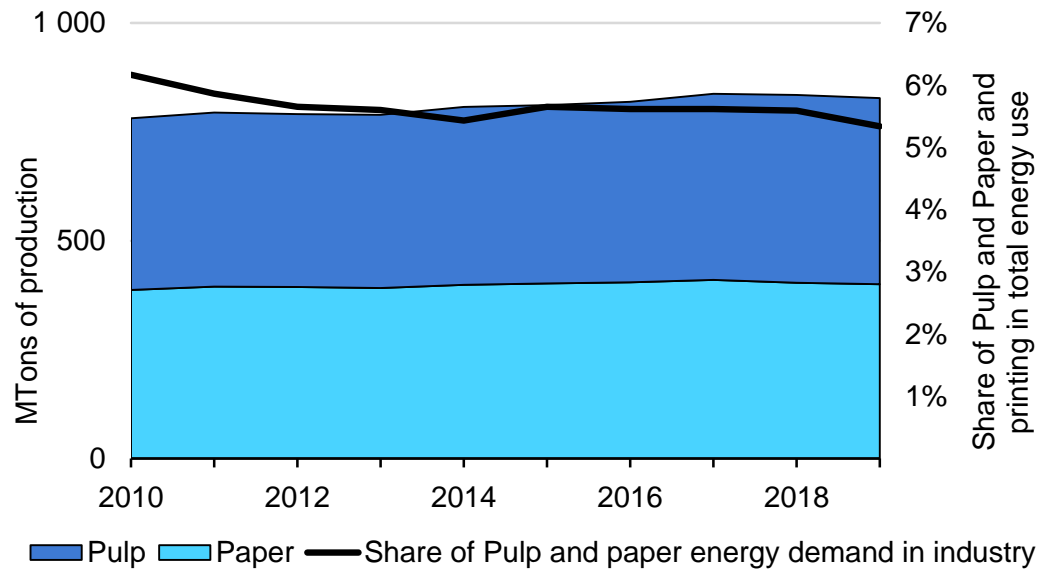
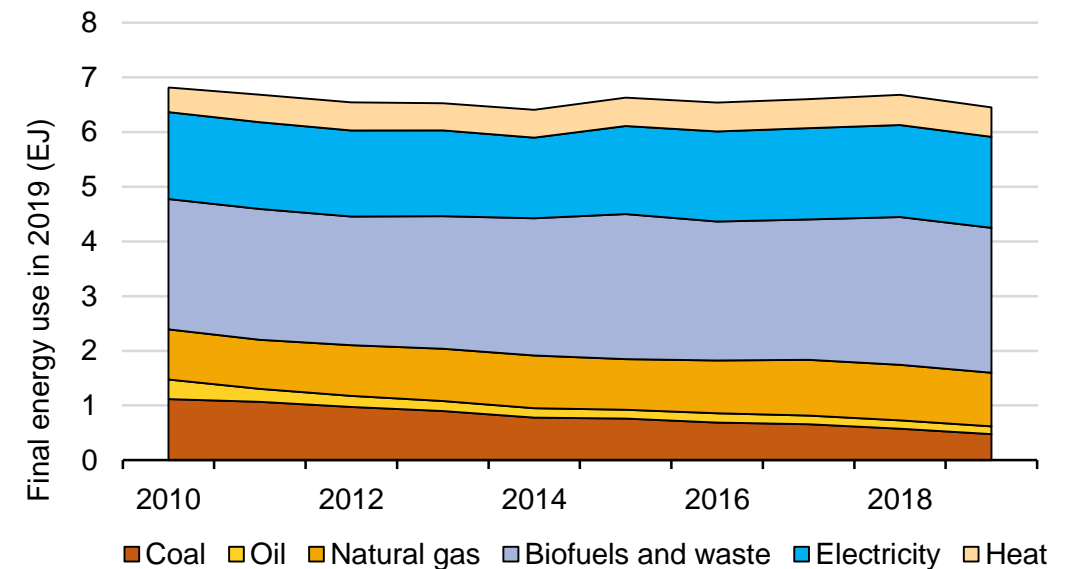


Figure 12 – Pulp and paper global final energy demand by fuel 2010 – 2019

Source: IEA (2021)



Trends in global production

Annual production of paper and paperboard has increased by 6% since 2010 (FAO, 2021). The trends noted in the work carried out by IEA (ETP 2017): rising population and living standards have increased demand for household and sanitary paper (27% increase since 2010), shipping of consumer's good has increased demand for packaging rising packaging material needs (23% increase). A trend that has been done while the digital era reduces demand for printing and writing papers decrease of 16%.

The share of wood pulp in paper production is seeing an increase in 2019, after having gone from 52% in 2000 to 43% in 2014. This has followed the rates of waste paper recovery and recycling. Recovered waste paper represents more than half of the fiber used for pulp manufacturing globally. This positive evolution (up from 44% in 2000) is to be pursued and encouraged.

Figure 13 – Global production of pulp by product 2010 – 2019

Source: FAO (2021)

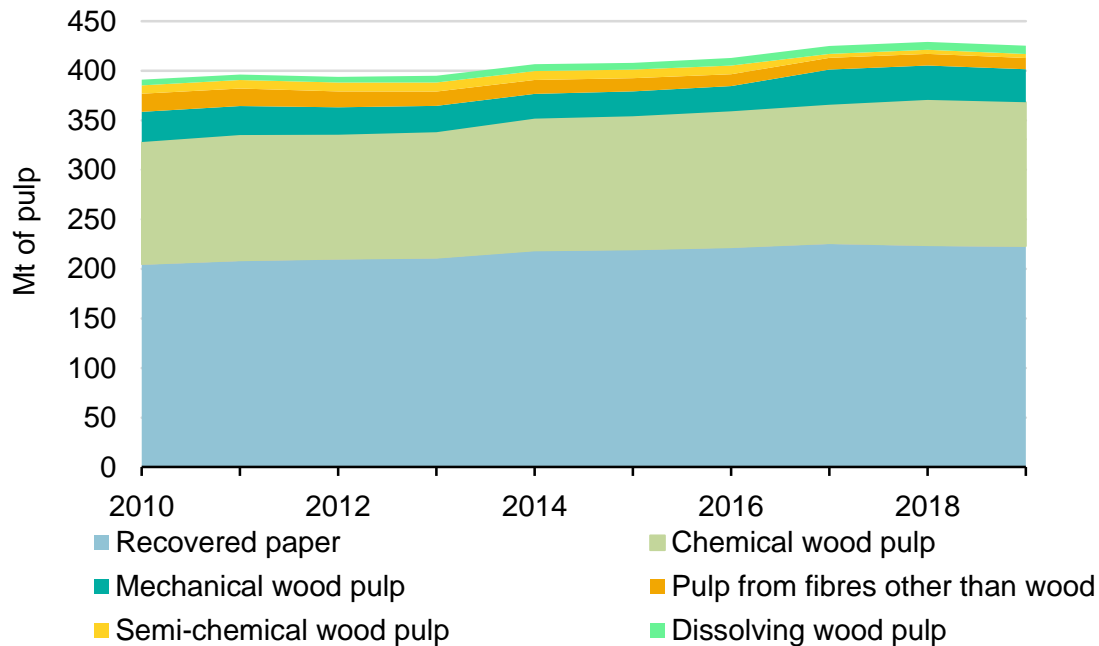
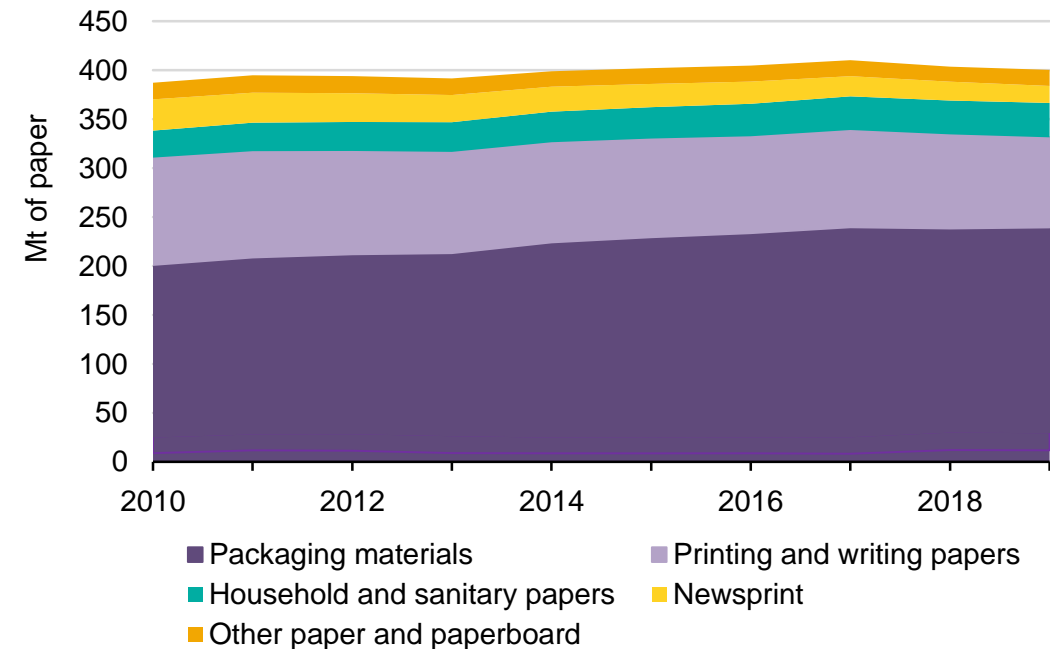


Figure 14 – Global production of paper by product 2010 – 2019

Source: FAO (2021)



Consumption perspectives

The year 2015 saw worldwide demand for paper decline for the first time ever, and the fall in demand for these products in North America and Europe over the past five years has been more pronounced than even the most pessimistic forecasts.

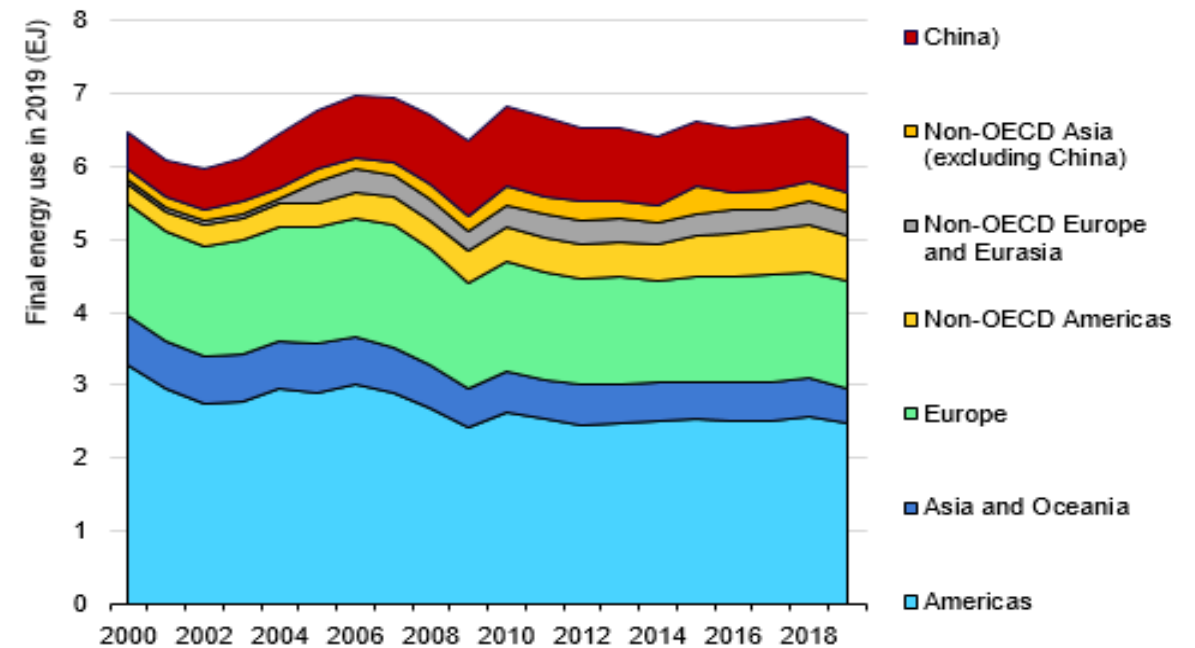
But the paper and forest-products industry as a whole is growing, albeit at a slower pace than before, as other products are filling the gap left by the shrinking graphic-paper. Packaging is growing all over the world, along with tissue papers, and pulp for hygiene products. (McKinsey 2020).

These last decade a increase in production of pulp and paper has been accompanied by a decrease in the sector's final energy use. This would indicate a decoupling between production and energy demand, however, structural effects, such as shifts in product mix or regions of production, can also influence energy use, and data quality issues make it difficult to draw concrete conclusions about the energy intensity trends.

Total paper and paperboard demand is expected to continue rising to 2030 in the IEA's Net Zero Emissions by 2050 Scenario, as lower printing-related paper requirements (due to digitalization) are outweighed by more need for packaging and sanitary paper as a result of population and economic growth. Efforts to curb demand and increase recycling can therefore help reduce growth in energy intensity and emissions.

Figure 15 – Final energy use of Pulp and Paper sector by region 2010 – 2019

Source: IEA (2017)



Recommendations

The sector should continue to focus on improving energy efficiency and use of renewable sources, moving towards BAT-level performance and increased recycling, while also supporting R&D&I efforts to develop future processes and technologies. Electrification of key processes (in particular heating and drying) offers major perspectives in CO₂ reduction and should be pursued.

In the longer term, the sector can further contribute to sustainable energy supply, for example, by feeding excess heat and electricity into the grid.

Energy efficiency can be improved through higher on-site waste heat recovery and cogeneration. Increasing the share of production from recovered fiber would also considerably reduce energy use. To this end, improving waste disposal channels can help increase collection of scrap paper products for recycling.

Pursuing the use of renewable energy sources is also important, particularly for recycled production. Other options include producing low-temperature heat from heat pumps, solar thermal energy or biogas.

Similarly, new applications for pulp and paper products may contribute to product life-cycle CO₂ emissions reductions, for example, through improved packaging or fiber-based textiles. Private- and public-sector stakeholders should collaborate to ensure the necessary framework of incentives is put in place to encourage such strategic and systemic thinking.

Tracking of energy efficiency improvements in pulp and paper manufacturing is difficult, because publicly available data on production, capacity and energy use are limited. Additionally, some countries do not report biomass use for the pulp and paper sector, which makes it difficult to get an accurate picture of the sector's energy needs. It is therefore important to improve data availability and make more granular data available.

To work towards such improvements in data availability, this initiative by EPE and IEA has led to trigger more discussions with industry associations, and in particular with IBÁ to create more synergies and improve partnerships towards more data sharing.

References

- DEPEC/BRADESCO. Departamento de Pesquisas e Estudos Econômicos do Bradesco: Divulga dados econômicos setoriais no contexto macroeconômico. . Accessed in October 2021. DEPEC/BRADESCO, 2016.
- EPE - Empresa de Pesquisa Energética.. BEN 50 anos. Disponível em: <https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/ben-50-anos>. Accessed in October 2021. EPE, 2020.
- _____. EPE - Empresa de Pesquisa Energética. Balanço Energético Nacional 2021, ano base 2020. Available at : <https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-ben>. Accessed in November 2021. EPE, 2021.
- Embrapa - Empresa Brasileira de Pesquisa Agropecuária. O eucalipto e a Embrapa: quatro décadas de pesquisa e desenvolvimento. Available at: <https://www.embrapa.br/florestas/busca-de-publicacoes/-/publicacao/1131510/o-eucalipto-e-a-embrapa-quatro-decadas-de-pesquisa-e-desenvolvimento>. Accessed in January 2022. Embrapa, 2021.
- FAO - Food and Agriculture Organization of the United Nations. Online data FAOSTAT. Available at: <https://www.fao.org/faostat/en/#data/FO> . Accessed December 2021. FAO, 2021.
- FIEPR - Federação das Indústrias do Estado do Paraná. Panorama Setorial; Indústria de celulose, papel, embalagens e artefatos de papel., Available at: [http://www.fiepr.org.br/parasindicatos/estudos-economicos/uploadAddress/papel_digital\[75083\].pdf](http://www.fiepr.org.br/parasindicatos/estudos-economicos/uploadAddress/papel_digital[75083].pdf). Accessed in October 2021. FIEPR, 2016.
- IBÁ – Indústria Brasileira de Árvores. Relatório Anual IBÁ 2021. Available at: <https://www.iba.org/publicacoes/relatorios>. Accessed in December 2021. IBÁ, 2021.
- ICFPA - International Council of Forest and Paper Associations. ICFPA Sustainability Progress Report, 2020-2021. Available at: https://icfpa.org/wp-content/uploads/2021/04/ICFPA-2021_Final-Draft_19-04-2021.pdf. Accessed in November 2021 . ICFPA, 2021.
- IEA - International Energy Agency. Energy Technology Perspectives 2017. Available at: <https://www.iea.org/reports/energy-technology-perspectives-2017>. Accessed in December 2021. IEA, 2017.
- _____. Energy balances (2021), IEA. Available at: <https://www.iea.org/reports/world-energy-balances-overview> . . Accessed in December 2021. IEA, 2021..
- McKinsey. Pulp, paper, and packaging in the next decade: Transformational change. Available at: <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/pulp-paper-and-packaging-in-the-next-decade-transformational-change>. Accessed in December 2021. McKinsey, 2020.