

Piling on the pressure

The impacts of the
pulp and paper industry's
domination of the
biomass electricity market
in Portugal

GreenVolt's Figueira da Foz II dedicated biomass power station at the CELBI pulp mill.

Summary

*Portugal's pulp and paper sector is making record profits despite the current intersecting global crises. Its heavy investments in biomass electricity are a contributing factor, and it now produces **almost 80% of the electricity generated from burning biomass in Portugal** through its combined heat and power (CHP) and electricity-only power stations, and **operates over half of the dedicated biomass electricity capacity**.*

Underlying the sector's focus on biomass electricity are generous renewable energy subsidies. This incentive for burning woody biomass has encouraged the pulp and paper sector to **decouple biomass burning from relying on by-products** of the pulping process as a feedstock. **Less than half of the woody biomass burned by the sector comes from bark and other industrial by-products**, with the majority being sourced directly from forestry operations.

The two most significant recent developments are **Altri/GreenVolt's 34.5MW electricity-only biomass power station in Figueira da Foz**, and **The Navigator Company's neighbouring biomass boiler that replaced a fossil gas combined heat and power (CHP) plant**. Both are dependent on large volumes of woody biomass directly from forestry operations, and have been financed as "green" developments.

In total, six electricity-only biomass power stations and five CHP plants associated with the pulp and paper industry **burn around 2.9 million tonnes of woody biomass each year, more than any other sector**. Over half of this comes directly from forestry operations. Pulp and paper companies claim that only forestry residues and industrial by-products are burned in their power stations, but **far more woody biomass is burned by the biomass energy and wood pellet**

industries each year than could be available as genuine residues, as defined in Portuguese legislation.

The pulp sector claims that burning woody biomass helps it to meet its climate targets and reduce the risk of wildfires. However, biomass electricity often results in **greater emissions than fossil fuel equivalents**, and in recent years **the scale of wildfires has only increased, particularly in forestry areas, as biomass electricity capacity has grown**. On top of this, the over-extraction of woody biomass from forestry areas is harming soil health and adding to pressure for the expansion of harmful eucalyptus plantations.

Three key areas of action that must be taken are:

- The introduction of an immediate moratorium on new biomass electricity capacity, and ending its eligibility for renewable energy subsidies;
- A cap on woody biomass consumption at pulp mills so that only secondary biomass (i.e. pulp mill and other wood processing by-products) are used as feedstock for energy generation;
- For subsidies for biomass electricity generation to be redirected towards genuinely renewable energy generation, energy efficiency and fire risk reduction techniques that incentivise the conservation and regeneration of native forests.

Wood arriving at Altri's CELBI pulp mill, Figueira da Foz.



Introduction

*Pulp and paper is big business in Portugal and despite the ongoing economic, political and public health crises in recent years, the sector has seen unprecedented profits. Portugal's biggest pulp and paper producer, The Navigator Company, saw **profits of almost €400 million in 2022**, up almost 130% on the previous year. The second largest producer, Altri, saw **profits up almost 300% in 2021**, with this upward trend **continuing in 2022**.*

Biomass electricity is increasingly contributing to the profitability of these companies as they diversify into other areas of the bioeconomy and take advantage of strong policy support for burning biomass. Between them, Portugal's pulp and paper sector account for almost 80% of the biomass electricity generated in Portugal each year.¹ Dominating the sector is Altri, which operates three pulp mills and, together with its subsidiary GreenVolt, produces around 40% of the biomass electricity generated.² Sales of electricity from biomass burning **earned GreenVolt €130 million in 2021**, and it is estimated that Altri earned around

€100 million.³ The Navigator Company also operates three pulp mills and produces over a third of the electricity generated from biomass in Portugal, which **earned it €135 million in sales in 2021**. A seventh pulp mill is operated by DS Smith and produces an estimated 4% of the biomass electricity generated each year. Portugal's pulp and paper companies have benefited significantly from unprecedented increases in wholesale electricity prices, due primarily to Russia's invasion of Ukraine, to the extent that the value of The Navigator Company's electricity sales **doubled in 2022 compared to 2021**.

Glossary

Biomass electricity: Electricity generated through the combustion of biomass, including woody biomass and black liquor.

Dedicated/electricity-only biomass power station:

A power station that burns biomass and generates electricity, put where the heat produced is not utilised for another purpose.

Combined heat and power (CHP) power station:

A power station that produces electricity and utilises the heat generated for an industrial process, or for heating and cooling supplied to a district heat network or individual customers.

Woody biomass: Solid plant-based material with a high lignin content, such as woodchip, roundwood, bark or sawdust. Black liquor is not included in this definition.

Primary woody biomass: Any plant-based biomass that is sourced directly from forests and tree plantations. Also called "forest wood". Forestry or logging residues are included in this definition.

Secondary woody biomass: By-products and residues of wood processing industries such as pulp mills as sawmills.

Residual biomass: Plant-based material that is leftover from or a by-product of forestry or agricultural operations. This includes residual logging/ forestry residues, black liquor and bark.

Residual woody/forest biomass: Under Portuguese legislation this is defined as *"the biodegradable fraction of products and waste resulting from the installation, management and harvesting of forestry operations (stumps, roots, leaves, branches and tops), woody material resulting from phytosanitary operations and measures to defend the forest against fires, and control areas with invasive species..."*

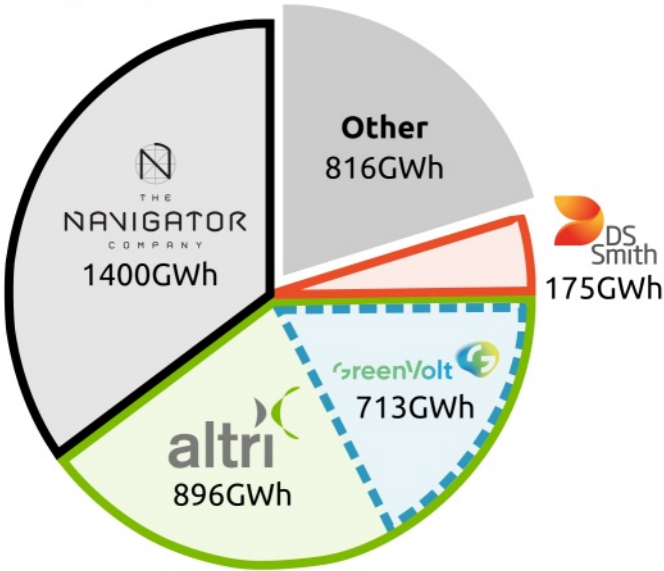
Industrial by-products: Processing residues that result from industrial processes. In pulp mills these are predominantly black liquor and tree bark.

Black liquor: An aqueous solution of lignin residues and other material that is extracted during the pulping process, when pulpwood is converted to paper pulp. It is usually burned in a recovery boiler to produce steam and electricity for pulp mill operations.

Pulp mills have traditionally generated heat and electricity for their own needs by burning black liquor and bark in combined heat and power (CHP) plants, two of the main by-products of the pulping process.

Biomass electricity generation by company in 2021 in Portugal

Including black liquor

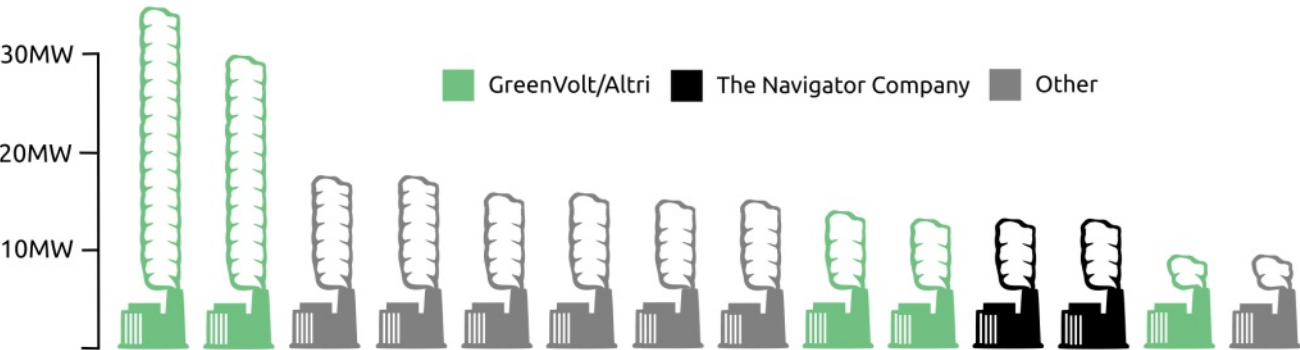


However, in order to take advantage of policy support and public subsidies for biomass electricity, highly inefficient electricity-only biomass boilers have been constructed inside pulp mill complexes. They require additional woody biomass to be brought in directly from forestry operations, and only export electricity to the public grid. The pulp and paper sector now controls over half of the installed capacity of electricity-only biomass power stations in Portugal.

Two new CHP plants that are fuelled exclusively with woody biomass have also been built recently (by The Navigator Company at its Figueira da Foz mill and Altri at its CAIMA mill) to replace fossil gas capacity. They also require significantly more biomass than the by-products produced by their respective pulp mills. The new plants allow the sector to claim significant emissions reductions, and in one case also sell electricity to the public grid at subsidised rates.

The [justification for burning biomass](#) at pulp mills centres around reducing emissions to meet climate targets and reducing the risk of wildfires.

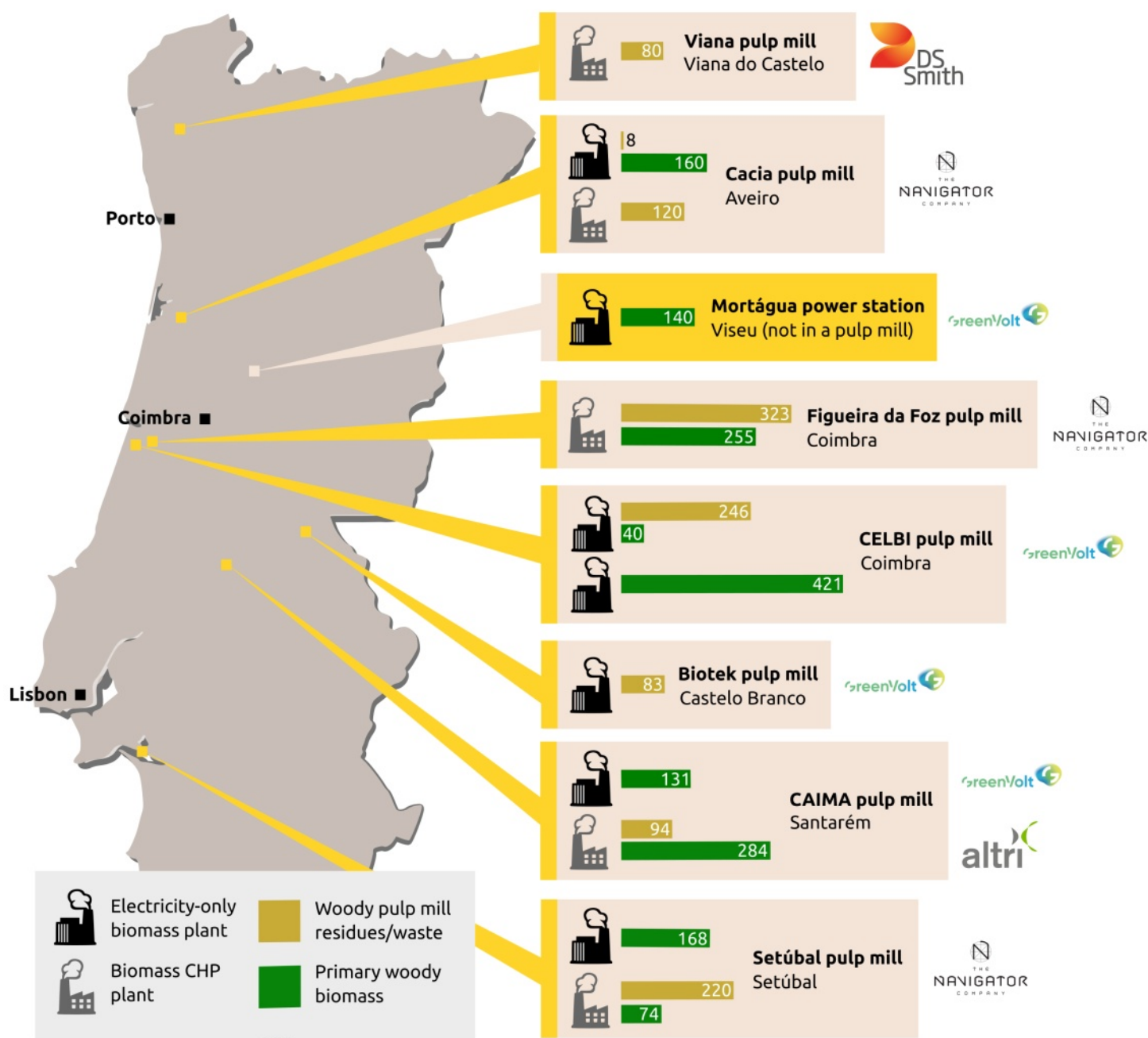
Electricity-only biomass power stations 10MW_e or larger in Portugal



Wood arriving at The Navigator Company's Figueira da Foz mill.



Biomass power plants associated with the pulp and paper industry and their estimated annual woody biomass consumption (thousands of tonnes)



The Navigator Company is by far Portugal's biggest corporate emitter of carbon from fossil fuels, with its three pulp mills falling within the top 11 biggest point sources of carbon emissions in the country.⁴ The Navigator Company has committed to [reaching "carbon neutrality" by 2035](#), which includes reducing direct CO₂ emissions in its industrial facilities by 86% by 2035 (relative to 2018) and achieving [80% renewable energy consumption by 2030](#). The remaining emissions are due to be [offset through plantation forestry projects](#). Biomass is a central pillar of its decarbonisation strategy because it is treated as

"carbon neutral". Its new biomass plant at the Figueira da Foz pulp mill is a flagship project that it claims has [reduced the company's overall emissions by 30%](#).

Altri has similar emissions reductions targets, aiming for 60% reductions in process emissions by 2030, and 30% in fossil fuel emissions relating to its supply chain by 2030. It also aims to [increase the amount of renewable electricity](#) it injects into the public grid by 60% by 2030, as well as for 100% of the primary energy it consumes in its industrial units to be renewable in origin by 2030.

How much biomass is burned, and where does it come from?

Pulp and paper companies use on-site CHP boilers to produce heat and electricity for their own industrial processes in the pulp mills, and the excess electricity generated is sold to the public grid at subsidised rates. They also often have dedicated biomass power stations that only produce electricity, which is also injected into the public grid, usually at a higher subsidy level. As well as burning pulp mill by-products (mainly bark and black liquor) and primary woody biomass, some pulp mills in Portugal also still have fossil gas CHP plants that are operational or used as backup.

Within Portugal's pulp mill complexes there are currently six electricity-only biomass power stations and five CHP plants that burn woody biomass, plus one other electricity-only power station (highlighted in yellow in the diagram on page 5) that isn't associated with a pulp mill but is owned and operated by the sector. Although energy generated by burning black liquor is considered to be energy from biomass in Portugal and across the EU, for the purposes of this report only the impacts of woody biomass will be considered.

In total, around 2.9 million tonnes of woody biomass were burned in power plants associated with Portugal's pulp industry in 2021, of which around 57% was sourced directly from forestry operations (see table on page 17). The smaller share was made up of pulp mill by-products such as bark. Over one million tonnes of primary woody biomass (i.e. wood taken directly from forests or tree plantations) were burned by Altri and GreenVolt and the remaining 660,000 tonnes were burned by The Navigator Company.⁶

Of the 12 power stations described above that burn woody biomass, it is likely that only three exclusively burn by-products of the pulping process. On top of this, only two of Portugal's seven pulp mills (DS Smith's Viana mill and Altri's Biotek mill) are not thought to currently burn primary woody biomass for energy generation.

None of the companies mentioned in this report make biomass sourcing information publicly available, and all refused to supply information such as the quantity and type of biomass they burn. In addition, neither Portugal's Directorate General for Energy and Geology (DGEG) or Institute for Nature Conservation and Forests (ICNF) agreed to provide power station-specific sourcing

information, although DGEG did provide total biomass consumption figures for electricity generation.

The industry states repeatedly that only residual biomass⁷ is used in their power plants. [GreenVolt claims](#) to have "an absolutely unshakable principle: we only use residual biomass to produce electricity... This waste is given value, at the same time as encouraging forest clearing, thus contributing to mitigating the risk of fires." In theory, only electricity produced through burning forestry residues (as defined in Portuguese legislation) and industrial by-products is eligible for Portugal's subsidy scheme. However, sourcing claims are impossible to verify given that monitoring and reporting requirements are minimal, self-assessed and not independently verified, and have also not been made publicly available (this is discussed in more detail on page 10). In addition, the primary woody biomass that is burned enters through the same access as wood used for pulp production in all except one of the power stations discussed. Wood often arrives already chipped, making it impossible to ascertain what is being used.

Portugal's pulp and paper sector primarily uses eucalyptus to produce pulp and manages around a quarter of the extensive eucalyptus plantations that are concentrated in central and northern regions of the country. In addition, over 70% of all biomass burned for electricity generation in Portugal in 2021 was classed as eucalyptus residues,⁸ it can be assumed that the vast majority of the primary woody biomass sourced by the pulp industry comes directly from eucalyptus plantations.

The fire risk reduction myth

Wildfires are one of Portugal's biggest environmental, social and political problems, particularly in northern and central regions where they are most frequent. The biggest fires on record occurred in 2017 when over half a million hectares burned and more than 100 people lost their lives.

Fire risk reduction is one of two main justifications put forward both for burning woody biomass and for producing wood pellets (large amounts of which go to power stations in other European countries). The argument used by industry is that reducing fuel load through removing forestry residues in high-risk areas will help to reduce the spread and intensity of fires. If this were true, then fire severity should decrease as more woody biomass is burned in power stations or turned into wood pellets.

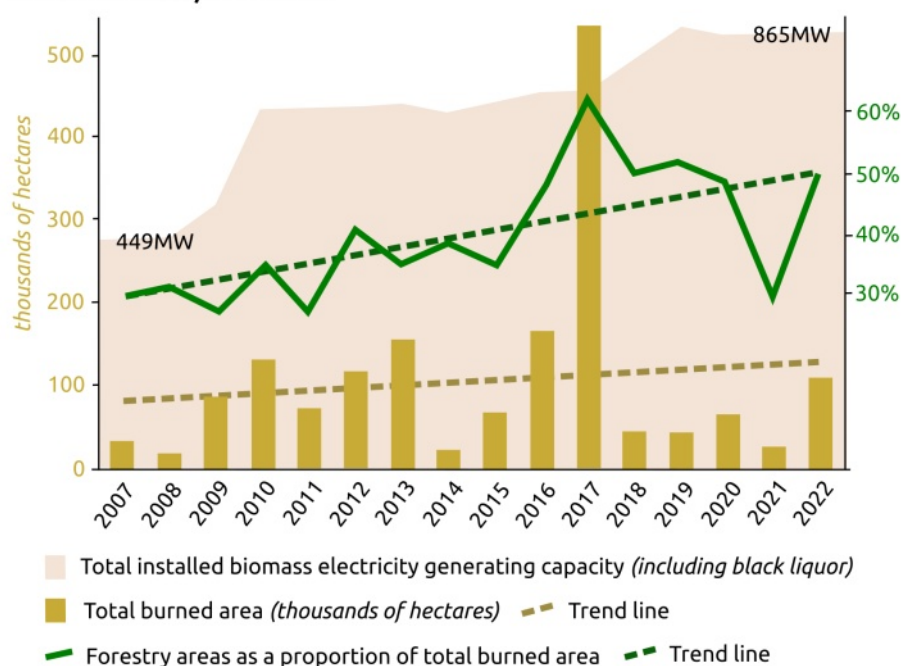
However, there is very little evidence that this strategy is working and, in fact, a [report prepared for the Portuguese parliament in 2013](#) found that “the idea that the construction of biomass plants throughout the country would decisively reduce the risk of fire...does not fully correspond to reality.” The total installed biomass electricity capacity has almost doubled in Portugal since 2007. This is partly the result of a [public tender for a series of new electricity-only biomass power stations](#) (see graph), which came in response to large-scale fires in previous years. Wood pellet production also increased significantly during this time. However, in the same time period, forestry areas (which include plantations) have overtaken other land uses (such as unmanaged forests and scrubland) as having the [highest amount of burned area](#), and in general the amount of land burned each year is still increasing.

Rather than reducing the environmental damage caused by fires, the demand for woody biomass for energy generation in Portugal is putting more pressure on and over-exploiting forest resources. A significant part of Portugal's land mass is characterised by poor quality soils that have low organic content, and the over-extraction of logging residues only exacerbates this and increases the risks of soil degradation and desertification.⁹

There are many alternatives to managing fuel load in rural and forestry areas that can contribute to reducing fire risk, such as: using logging residues as fertiliser by chipping them and spreading the woodchip over soils; the appropriate use of controlled fire; and silvo-pastoralism, which can also bring economic benefits to rural populations. Any subsidy support redirected from biomass electricity generation towards these alternatives would support the livelihoods of small-scale farmers and rural landowners, whereas subsidies given to biomass power station operators end up in the hands of large companies and urban elites.¹⁰

It is also worth noting that the biomass electricity and wood pellet industries are likely to be the principal beneficiaries of wildfires, as the tree trunks that are left behind are a large source of relatively cheap and dry feedstock. Further still, the biomass that is suddenly made available following large fires [gives the false impression](#) that there is an abundance of woody biomass, when in fact it is becoming increasingly scarce, especially in the case of native pine forests.

Changes in Portugal in total installed biomass electricity capacity, total area burned in forest fires and forestry areas as a proportion of burned areas, 2007-2022



Source: ICNF 2022 and DGEG 2022

How much residual woody biomass is there in Portugal?

The availability of residual woody biomass as defined in Portuguese legislation (referred to as “residual forest biomass” in Portugal) is a controversial topic due to the scale of industry demand and competition for raw materials between the bioenergy and wood pellet industries in particular.

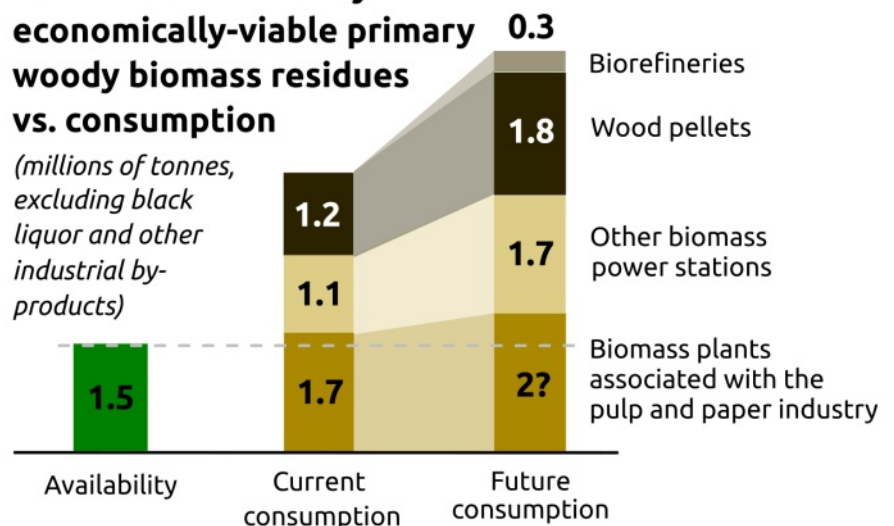
Also, definitions of what constitutes residual biomass are often so vague and monitoring systems so ineffective that in practice any type of wood can be classed as a residue. Throughout EU member states, terms like “forestry residues” and “low-value wood” [are being widely used](#) to include roundwood, i.e. wood from whole trees. Furthermore, regardless of definitions, burning any kind of wood has climate and ecosystem impacts.

In the absence of accurate reporting and verification, the claim that only residues are used to produce biomass electricity in Portugal can be assessed by comparing estimates of availability and demand. According to a [report submitted to Portugal’s parliament](#) by a group of parliamentarians convened by the Agriculture and Sea Commission in 2013, the annual availability of residual biomass was around two million tonnes, of which half was in the form of branches and tops from forestry operations. The report also stated that demand for residual biomass for energy generation and pellet production was already thought to exceed three million tonnes.

In 2017, as part of the National Plan for the Promotion of Biorefineries prepared by the National Laboratory of Energy and Geology (LNEG), the total availability of residual woody biomass for energy was determined as 2.8 million tonnes per year, of which about half corresponded to forestry operations¹¹ and would therefore be an economically viable feedstock. Another [study on using forest bioenergy to reduce fire risk](#) prepared for the Portuguese Parliament in 2021 indicates that there are potentially 2 million tonnes of residual woody biomass per year. The most recent available figures are from the [Bioeconomia 2030](#) report, prepared by the Office of Planning, Policies and General Administration (*Gabinete de Planeamento, Políticas e Administração Geral*) of the Portuguese

Estimated availability of economically-viable primary woody biomass residues vs. consumption

(millions of tonnes, excluding black liquor and other industrial by-products)



government. It quotes an annual residual woody biomass availability of three million tonnes, of which a third is from unmanaged forest and scrub areas, which are unlikely to be economically-viable, and only 440,000 tonnes are available from eucalyptus plantations nation-wide.

There is also a large discrepancy between the potential and the effective availability of residues from forestry operations. Given the steep terrain and poor road networks typical of much of Portugal’s tree-covered areas, the costs of extraction and transport of forest residues are high. In many cases it is [only economically viable to harvest a small fraction of residues for energy production](#). According to research by The University of Trás-os-Montes and Alto Douro (UTAD), the effective availability of biomass is 43-65% of the total potential.

Given the above, it is reasonable to assume that the annual availability of economically-viable residual woody biomass from forestry operations in Portugal is around 1.5 million tonnes in total, and residues from eucalyptus plantations less than half a million tonnes, which is considerably less than what is being burned by the pulp and paper sector each year. In addition, the



A eucalyptus plantation near Figueira da Foz.



Eucalyptus plantation logging residues at a biomass power station in Central Portugal.



Eucalyptus and pine roundwood at a biomass power station in Central Portugal.

pulp and paper sector isn't the only consumer of primary woody biomass for energy generation. Other biomass power stations consume around 1.1 million tonnes per year at full capacity, which is expected to rise given current policy support for new power stations¹² and wood pellet production is estimated to have consumed around 1.2 million tonnes in 2021, which is also expected to rise considerably.¹³ Further still, Portugal's National Plan for the Promotion of Biorefineries (*Plano Nacional de Promoção das Biorrefinarias*) calls for the [creation of three new biorefineries](#) with a total woody biomass demand of over 300,000 tonnes.

Government statistics provided by the Directorate-General for Energy and Geology (DGE) back these figures up, with the total consumption of residual woody biomass for electricity production (not including wood pellets) reported to be over 2.14 million tonnes in 2021. Further still, 1.35 million tonnes of this was eucalyptus, which is more than three times the estimated availability of eucalyptus residues published in the government's [Bioeconomia 2030](#) report in 2021. There must therefore be large amounts of roundwood from whole trees being burned in power stations each year, which wouldn't be classed as residual biomass under current legislation in Portugal.

Subsidy support for burning biomass

Portugal's recent legislation governing subsidies for new biomass power stations¹⁴ mandates that they must be located near to critical fire risk areas and/or areas with a high concentration of forestry land, and that specific types of biomass must be used in order for the electricity generated to be eligible for support. These are agricultural residues, residual woody biomass or fast-growing tree plantations planted specifically for energy generation.¹⁵

Agricultural residues are generally not an economically-viable option for energy generation except for industries that create the residues themselves, and tree plantations specifically for energy generation are not yet thought to have been planted on a large scale. The focus of biomass sourcing for energy generation is therefore on primary forestry residues,¹⁶ defined in Portugal (see glossary) as leftovers and waste from forestry operations, such as stumps, roots, leaves, branches and tree tops. In theory, roundwood or sections of tree trunk are excluded (except in the case of phytosanitary operations).

Monitoring of biomass feedstocks is carried out by the Institute for Nature Conservation and Forests (ICNF) and in order for electricity from biomass plants to be subsidised, operators must meet three main requirements:

- A 10-year action plan detailing the long-term sustainability of biomass supply must be approved and written into the contract signed between power station operators and public utilities;
- Operators must submit an annual report to ICNF describing and identifying the quantity, type and origin of the biomass consumed at the plant in the previous year; and,
- Operators must allow inspections of the plant, as well as undefined auditing and monitoring of biomass consumption by the ICNF, the Directorate-General for Energy and Geology (DGEG), or by an accredited entity hired by the producer, at their request.

Portuguese NGO ZERO recently revealed that of the 13 biomass power stations that were receiving subsidies for electricity generation¹⁷ at the time that their request for information was made, ICNF had only evaluated the 10-year plans of six plants. Just four had been approved, while one was approved conditionally

and another was rejected. Whether or not all of the plants continue to receive subsidies was not confirmed and, according to ICNF, any legal non-compliance with legislation is the responsibility of the DGEG. The content of the plans was also not made publicly available. This has led ZERO to fear that there is “a complete lack of control over the operation of biomass plants” and that “access to subsidies for biomass energy production does not comply with the legal framework”.

In addition, annual reporting requirements are fulfilled through self-assessment, and it is unclear if any level of independent verification or inspection is carried out by ICNF. ZERO states “that there is no monitoring system in place that allows for the accurate and credible identification of the type of biomass being used for energy nationwide. Theoretically this is done through harvesting reports that are filled in and accompany the transport of forest biomass that arrives at a given industrial site... However, ICNF refers to this as a guideline and does not enforce it as a requirement, meaning that it is of little value. On top of this, the fact that significant amounts of biomass used in power stations and pellet mills arrives as woodchip makes it practically impossible to trace its origin.”

The problems surrounding biomass electricity generation in Portugal are increasingly being recognised, even by industry. For example, the 2020 Portuguese Renewable Energy Forum concluded that “it does not make sense to promote dedicated biomass electricity, because these power stations will never reach the minimum greenhouse reduction values required in a sector that urgently needs to decarbonise... power plants dedicated to burning forest biomass should consequently be disincentivised.” Although new legislation has recently been introduced to oblige new biomass power stations to utilise the heat generated as well as generating electricity, the overall impacts of biomass sourcing will remain the same.

Case studies

GreenVolt and the Figueira da Foz II electricity-only power station

GreenVolt, which is 59% owned by Altri, operates and wholly-owns all four of the dedicated biomass electricity power stations at Altri's pulp mills, plus a dedicated biomass power station that isn't attached to a pulp mill. Its [total biomass electricity generating capacity in Portugal is 100MW](#), which it plans to expand by constructing at least one new power station. Greenvolt also owns a 51% stake in Tilbury Green Power, a 41MW biomass power station that burns waste wood in the UK. GreenVolt's power stations in Portugal [burned around 1.1 million tonnes of woody biomass in 2021](#), 65% of which came directly from forestry operations and the remaining 35% from pulp mill by-products, predominantly bark.

Through their wholly-owned subsidiary *Sociedade Bioelétrica do Mondego, S.A.*, GreenVolt operates Portugal's newest and largest dedicated biomass electricity power station, within Altri's CELBI pulp mill complex in Figueira da Foz. Figueira da Foz II has a 34.5MW_e capacity and operates at an alarmingly low efficiency of just 22%.¹⁸ This means that only around a fifth of the energy contained in the biomass is converted into electricity, with the other four fifths being lost to the atmosphere as heat. This is in part due to the fact that although GreenVolt claim that the power station is new, the biomass boiler was actually built decades ago. Altri decommissioned an old 310MW_e¹⁹ recovery boiler that previously burned black liquor, and it was then [retrofitted to burn solid biomass](#).

At full capacity the power station is designed to burn 460,000 tonnes of biomass per year, which is sourced entirely from outside of the pulp mill, meaning that no pulp mill residues such as bark or sawdust are burned in the power station. In 2021 the power station burned over 420,000 tonnes of biomass, requiring 1.44 tonnes of biomass per MWh of electricity generated. GreenVolt earned around €34 million in electricity sales through the operation of the plant and received an average tariff of €116/MWh through Portugal's renewable energy subsidy scheme.

GreenVolt operates another electricity-only biomass power station at CELBI, Figueira da Foz I, which has the capacity to inject 30MW of electricity into the public grid. In 2021 it burned over 350,000 tonnes of biomass and earned the company another €27 million in electricity sales. Figueira da Foz I mainly burns pulp mill wastes such as bark, although it also requires significant amounts of primary woody biomass sourced directly from forestry operations.

Figueira da Foz II was financed through the [issue of a Green Bond](#), whereby GreenVolt were able to raise [€50 million of the €83 million total cost](#) through almost [5,000 separate lenders](#). The success of the bond issue led the company to issue a second, eventually rising to €150 million, to [refinance the acquisition of Tillbury Green Energy](#) in the UK and expand its solar and wind portfolio.

Altri's CELBI pulp mill complex, Figueira da Foz.



Altri's new biomass boiler at the CAIMA pulp mill

A new CHP biomass boiler at Altri's CAIMA pulp mill was [approved by the Portuguese Environment Agency](#) in January 2022 and is currently under construction. The 76MW_t boiler will produce heat and electricity for the pulp mill and inject 5.3MW of electricity to the public grid. It replaces the existing but much smaller (24MW_t) biomass boiler, as well as an existing gas boiler, which will be used as a back-up. The biomass boiler will require [378,000 tonnes of woody biomass each year](#), three quarters of which will be brought in directly from forestry operations.

The new boiler will run alongside a recovery boiler that mostly burns black liquor, as well as GreenVolt's 12.8MW_e dedicated biomass power station, which operates at around 28% efficiency and requires 130,000 tonnes of woody biomass from forestry operations per year. In total, CAIMA's annual woody biomass requirement for energy generation will reach half a million tonnes, around 80% of which will be sourced from outside the pulp mill. Altri claims that the new boiler will mean that the CAIMA pulp mill runs entirely on "renewable energy".



The Navigator Company's Figueira da Foz mill.

The Navigator Company and its new biomass capacity

The Navigator Company's flagship decarbonisation project is a new biomass boiler at its Figueira da Foz pulp mill, which began operating at the end of 2020. It claims that it has [reduced the mill's emissions by 57%](#), and the company's overall emissions by 30% across its three pulp mills and other industrial sites. The 131MW_t boiler provides heat and electricity to the pulp mill and replaced a smaller biomass boiler and a 67MW_t fossil gas boiler. The European Investment Bank provided half of the total cost of the new boiler, with a €27,5 million loan, one of a number of loans that the bank has provided to the company in recent years.

Although the new boiler doesn't export electricity to the public grid, it is still reliant on primary woody biomass that is sourced directly from forestry operations, which accounts for [almost half of its annual biomass demand of around 580,000 tonnes](#).

The company notes in its 2021 annual report that the supply of biomass to the plant increased substantially during the first full year of the boilers operation.

The Navigator Company's original Environmental Impact Assessment quoted a residual woody biomass availability in the local area of 193,000 tonnes in a "maximum use scenario", which is considerably lower than the 255,000 tonnes required by the boiler each year. When questioned about this by the Portuguese Environment Agency, [the company claimed that biomass can be sourced from much further away](#), up to 120 km from the pulp mill by road, making available an additional 139,000 tonnes. It is generally accepted, however, that [residual biomass is only economically-viable as a feedstock up to 75 km away from where it is being burned](#) due to the cost of transportation. This either means that subsidy levels are so generous that

they allow sourcing from much further away, or that higher quality wood is being used (or both).

The Navigator Company is also in the process of converting its lime kilns to be fueled by biomass instead of fossil gas. Lime is used in the pulping process and most mills operate their own lime kilns. The first such conversion took place at its Setúbal mill in 2021, and was partly financed through a [€4.5 million grant from the EU's Innovation Fund](#). The company claims that this conversion is a first in Portugal, and will reduce the kiln's direct greenhouse gas emissions by 76%. The company plans to convert a second kiln in Setúbal and the kilns at its pulp mill in Cacia, Aveiro.

According to the company, the kiln will burn “100% *hardwood residues (eucalyptus sawdust and pellets)*”, which will be sourced from pulp mill by-products.

There is no publicly available information on the biomass consumption of the converted lime kiln, but it is estimated to be around 20,000 tonnes per year.²⁰ Converting all of the lime kilns at the Setúbal and Aveiro mills would require around 60,000 tonnes of additional biomass per year.²¹ It is likely that this would displace by-products currently being burned at the biomass CHP and electricity-only plants at the two pulp mills, meaning that they would need to source more woody biomass from forestry operations.

Industry plans for increased biomass burning and potential new developments

Portugal's pulp and paper sector is already heavily invested in and dependent on biomass heat and electricity, and it is unlikely that new electricity-only developments on the scale of Figueira da Foz II for example would be given consent in future, given the current legislative framework. In addition, all but two of the remaining fossil gas CHP plants have already been replaced with biomass. However, there are a number of planned expansions and possible new developments. These include:

A new biomass CHP plant at the Cacia mill in Aveiro:

The Navigator Company is planning to install [a new biomass CHP boiler at its Cacia mill](#), which will be slightly larger than and presumably replace the existing one (79MW_e). There is very little publicly available information about it and an application has not yet been made to the Portuguese Environment Agency.

Converting lime kilns at The Navigator Company's pulp mills:

As already discussed, further conversions of lime kilns to be fueled by biomass are planned at the Setúbal and Cacia pulp mills, requiring an estimated total of 60,000 tonnes of biomass per year.

Another biomass power station in Mortágua:

GreenVolt is currently waiting for a production licence to be granted by DGEG for a new 10MW_e biomass power station in Mortágua, after it entered into an agreement with the municipality. The new plant will be developed under the framework established by Decree-Law no. 64/2017,²² which legislates for an additional 60MW_e of biomass capacity in Portugal, with a maximum of 10MW_e per development. Whilst

originally planned as an electricity-only power station, changes to legislation now oblige operators to utilise the heat generated as well, although it is unclear who the power station's heat customer would be. The plant is likely to require around 140,000 tonnes of woody biomass per year, however, information about this development is extremely limited, given that Environmental Impact Assessments are only required for power stations above 50MW in Portugal.

Replacement of remaining fossil gas CHP plants:

There are two remaining fossil gas CHP plants at pulp mills in Portugal, one at The Navigator Company's Setúbal mill and the other at DS Smith's Viana mill. There are currently no publicly announced plans to replace either with biomass. However, in order for The Navigator Company to achieve its emissions reductions targets, it is likely that [within the next six to 12 years](#) it will need to replace fossil gas with biomass at the Setúbal mill. The new biomass CHP plant would need to be on a similar scale to the one recently constructed at its Figueira da Foz mill, and require similar quantities of woody biomass.

The impacts of eucalyptus plantations and the threat of their expansion

Given the pulp and paper sector's dependence on eucalyptus and the scarcity of forestry residues in general, their increased use of woody biomass for energy generation will lead to both increased imports of eucalyptus wood, and increased pressure for the expansion of plantations in Portugal, particularly plantations dedicated to energy generation.

In 2021 Portugal imported 1.6 million tonnes of eucalyptus woodchip and roundwood, mainly from Spain (950,000 tonnes), Brazil (650,000 tonnes), and most recently Mozambique (45,000 tonnes), altogether an increase of 23% on the year before. The impacts of eucalyptus plantations in Brazil are well documented, and include impacts on traditional and quilombola communities such as landgrabbing and loss of food sovereignty and water resources, as well as significant biodiversity impacts where eucalyptus monocultures are replacing diverse ecosystems such as the Cerrado. Imports from Mozambique come from highly-controversial plantations operated by Portucel Moçambique, a wholly-owned subsidiary of The Navigator Company. Numerous rights violations have been extensively documented in the provinces that the company operates in, including landgrabbing, and the harassment and intimidation of peasant farming communities.

While the social impacts of eucalyptus are less pronounced in Portugal and Spain than in Brazil and Mozambique, NGOs such as Quercus have been campaigning against the impacts of extensive plantations across the Iberian Peninsula for many years. Portugal already has proportionally more eucalyptus plantations than any country in the world, and their continued expansion would compound the many significant impacts that they are responsible for. Eucalyptus plantations are fire-prone and allow fires to spread quickly and with a high intensity across large areas, and, being an exotic and invasive species, they also reduce biodiversity considerably. They place significant strain on water resources, exacerbating the severe drought conditions that are being experienced more frequently due to climate change. Their planting

often involves using heavy machinery to plough on-contour, which removes existing vegetation and causes significant soil erosion and loss of soil fertility.

Despite the introduction of a law banning the establishment of new eucalyptus plantations in Portugal, the pulp and paper and forestry industries have continued to lobby strongly for an increase in plantation areas. The President of Portugal's National Association of Forestry, Agricultural and Environmental Companies (*Associação Nacional de Empresas Florestais, Agrícolas e do Ambiente/ANEFA*) called for new tree

plantations to be established in order to fulfil demand for biomass for energy generation, and in recognition of the fact that there is insufficient residual biomass to satisfy demand.

In January 2022 Quercus and other Portuguese NGOs criticised the Portuguese government for "giving in to pressure from the pulp and

paper industry" through its plans to increase the limits set for eucalyptus plantations across the country, effectively giving the green light to nearly 40,000 additional hectares. Then in August 2022 NGOs denounced calls by Portugal's pulp and paper industry association, CELPA, for the establishment of new eucalyptus plantations in unmanaged forest and scrub areas as a fire reduction strategy, and called for the overall area of plantations to be significantly reduced instead. The United Nations Special Rapporteur on human rights and the environment agrees with this position, having said in September 2022: "I saw extensive monocultures of Eucalyptus trees during my visit [to Portugal] and recommend taking steps to reduce the area of land covered by this species. Experts recommend substituting native species that are more fire resistant, such as oak, cork and chestnut trees, and creating more diverse landscape mosaics."

A eucalyptus plantation in Central Portugal.



The corporate capture of forestry policy-making in Portugal

The [extensive lobbying power of Portugal's pulp and paper industry](#) continues to exert a strong influence over forestry-related decision-making. Decades of privileged access to successive Portuguese governments has resulted in the dismantling of forestry regulation, the unimpeded spread of highly impactful eucalyptus plantations and vast public subsidies and support mechanisms directed towards the sector.

The authors of [Portugal em Chamas](#) (Portugal in Flames), published in 2018 describe how: *"In the last decades, the influence of the pulp and paper industry over political decisions relating to forestry has grown to the extent that it has become totally dominant, traversing the sphere of influence in the corridors of power, making public ultimatums to governments and arriving at direct governance... The revolving door between the public and private sectors in forestry is another dramatic example of these conflicts of interest, with high costs to the country and enormous benefits to the companies."*

The most recent example of this revolving door is the fact that Francisco Gomes da Silva, a former

Secretary of State for Forests and Rural Development, is now the director-general of the pulp and paper sector's industry association CELPA. He has [recently claimed](#) that eucalyptus trees sequester more than double the amount of carbon than any other species in Portugal, and that new plantations should be supported with climate finance as *"the fastest way to remove carbon from the atmosphere"*. However, [published scientific research](#) points to the fact that natural forests are 40 times better at sequestering carbon than plantations, and that *"plantations hold little more carbon, on average, than the land cleared to plant them."*

The climate impacts of burning wood for energy

The emissions associated with burning biomass for energy are usually ignored by industry, leading to claims that generating energy from biomass is carbon neutral and renewable. This is due to the fact that, under UNFCCC accounting rules, the CO₂ emitted through biomass combustion and the life-cycle greenhouse gas emissions associated with it do not have to be accounted for. In theory, these emissions are accounted for in the land use sector when carbon is lost from forests and other ecosystems, although this is often does not happen consistently and accurately.

However, [much scientific study](#) on the overall climate impacts of biomass burning suggests that rather than being carbon neutral, it is actually increasing levels of CO₂ in the atmosphere for substantial periods of time. The [immediate carbon emissions associated with burning woody biomass](#) are similar to and often even higher than burning coal (per unit of energy). This large initial increase in carbon emissions creates a "carbon debt" which increases over time as more and more biomass is burned. The carbon debt is highest when roundwood is burned. Regrowing trees and displacement of fossil fuels may eventually pay off this carbon debt, but [regrowth takes time that we do not have](#) when it comes to tackling climate change.

Even if the primary woody biomass burned by the pulp and paper sector were to be entirely logging residues and no roundwood whatsoever, this would still result in significant greenhouse gas emissions and cannot be considered carbon neutral. A [recent study](#) looking at biomass power stations that burn forestry residues in the US concluded that after 10 years the net emissions impact (NEI) ranges from 41%–95%. This means that if the wood had been allowed to decompose naturally rather than burned, after 10 years there would be up to 95% less carbon in the atmosphere, due to the fact that decomposition releases carbon much more slowly than combustion and leaves carbon behind in the soil as organic matter.

Another [recent study](#) in the US showed that burning wood pellets made primarily from pine plantation thinnings, considered a forestry residue, results in a negative impact on the climate for more than 40 years. Whilst the impact timescale might be less for plantation species with a shorter rotation such as eucalyptus, these timescales are still hugely significant given the urgency of the climate crisis and the need for emissions to be reduced immediately.

It is also important to note that, despite a shift towards digitalisation in recent decades, the [consumption of paper products has steadily increased](#). This is due to the growing production of single use products such as packaging, whereby paperboard and cardboard [now account for two thirds of global paper production](#). This has dramatically shortened the life of paper products, given that packaging is usually discarded on the same

day that it reaches its final consumer. The carbon contained in short-lived paper products is returned to the atmosphere almost immediately, meaning that paper products are storing less and less carbon over increasingly short timescales.



GreenVolt's dedicated biomass power station (right) and Altri's recovery boiler (left) at the Biotek pulp mill, Vila Velha de Ródão.

Conclusions and demands

The pulp and paper sector is now the largest consumer of woody biomass for energy generation in Portugal, and the biomass power stations associated with the industry burn some 1.7 million tonnes of primary woody biomass directly from forestry operations, in addition to 1.2 million tonnes of pulp mill waste each year. In order to profit from lucrative renewable energy subsidies for biomass electricity, and to meet climate targets, in recent years the sector has focused on building electricity-only power stations inside pulp mills and replacing fossil gas CHP boilers for woody biomass.

The sector's drive towards energy from woody biomass is decoupling power generation from pulp mill by-product streams, whereby more than two thirds of the woody biomass burned is now sourced directly from forestry operations. Operators are taking advantage of existing grid connection points and infrastructure, as well as established biomass supplies, to build highly inefficient and polluting power stations alongside already highly harmful pulp mills.

Rather than this being an example of a circular economy, or closed-loop system, it is resulting in more and more woody biomass being extracted and burned, which increases carbon emissions and impoverishes soils further. Such high demand for biomass in general is also driving increased imports of wood from places where community rights are being trampled on, and creating more political pressure for the expansion of eucalyptus plantations in Portugal.

In order to remedy the situation, the Portuguese government must urgently:

- Introduce a moratorium on new large-scale biomass energy generation capacity, and end its eligibility for renewable energy subsidies;
- Restrict biomass use at pulp mills such that only secondary and waste biomass can be used as feedstock for energy generation, not primary woody biomass;
- Overhaul monitoring, reporting and verification procedures so that accurate, independently verified and publicly available assessments of what feedstock is being used and its origin can be made at each power station or CHP plant;
- Ensure that no new eucalyptus plantations are licenced, and commit to an immediate and significant reduction in plantation areas;
- Redirect subsidies for biomass electricity towards genuinely low-carbon renewables, energy conservation and fire risk reduction techniques that incentivise the conservation and regeneration of native forests, and ensure that the benefits of financial support stay with small-scale land-owners in rural areas.

Biomass power stations associated with the pulp and paper sector in Portugal

Power station	Pulp mill and location	Operator	Type	Electrical grid injection capacity (MW)	Total thermal capacity (MW)	Estimated total woody biomass consumption in 2021 (thousand tonnes)	Estimated total primary woody biomass consumption (thousands of tonnes)
Termoelétrica de Constância		Greenvolt	Electricity only	12,8 MW	39MW	131	131
Central a biomassa CAIMA	CAIMA, Constância	Altri	CHP	5,3MW	76MW	378	284
Figueira da Foz I		Greenvolt	Electricity only	30 MW	95MW	353	40
Figueira da Foz II (SBM)	CELBI, Figueira da Foz	Greenvolt	Electricity only	34,5 MW	135 MW	421	421
Ródão Power	Biotek, Vila Velha de Ródão	Greenvolt	Electricity only	13 MW	40 MW**	83	0
Termoelétrica de Setúbal		Navigator	Electricity only	12,5 MW	40 MW**	168	168
Cogeração de Setúbal	Setúbal	Navigator	CHP	54MW*	150 MW**	294	74
Caldeira a Biomassa	Figueira da Foz	Navigator	CHP	-	131 MW	578	255
Termoelétrica de Cacia		Navigator	Electricity only	12,5 MW	49,75MW	168	160
Cogeração de Cacia	Cacia, Aveiro	Navigator	CHP	35,1 MW*	72 MW*	120	0
Caldeira de biomassa	Viana do Castelo	DS Smith (formerly Europac)	CHP	5 MW	35MW	80	0
Central Termoelétrica de Mortágua	N.A., Viseu	Greenvolt	Electricity only	10 MW		141	141
Total						2915	1674

* Total capacity for plant, which has a black liquor recovery boiler and woody biomass boiler
 ** Estimated

Notes

1. This includes dedicated biomass power stations and CHP plants that burn woody biomass and/or black liquor. The Navigator Company produced around 1400GWh of electric energy from biomass (black liquor and woody biomass) in 2021, Altri produced 896GWh (black liquor and woody biomass), Greenvolt produced 713GWh (woody biomass only), DS Smith produced an estimated 175GWh (black liquor and woody biomass), and the total biomass electricity generation in Portugal in 2021 was 4000GWh.
2. GreenVolt operates all of the electricity-only biomass power stations at Altri's pulp mills, whereas Altri operates the pulp mill CHP plants, which usually export excess electricity to the public grid.
3. This figure is an estimate as Altri has not published equivalent figures.
4. https://glasgowagreement.net/inventories/PT/Inventario_PT_Acordo_Glasgow_Relatorio.pdf. It should be noted however that this emissions inventory considers biomass as zero emissions, and therefore accepts bioenergy-related emissions reductions. Consequently, Portugal's largest pulp mill, CELBI operated by Altri, does not feature in the inventory.
5. Throughout the report the amounts of biomass referred to are green tonnes, or biomass with 50% humidity, rather than dry tonnes. These figures do not include black liquor as a feedstock.
6. See page 17 for a break-down of consumption at each pulp mill and power station.
7. In Portugal residual biomass is defined as the leftovers from agricultural and forestry operations, such as bark, branches and tree tops, and industrial waste and by-products, such as black liquor, bark and sawdust. See Text Box on "Subsidy support for burning biomass" for more information.
8. According to DGEG (2023), of the 2.14 million tonnes of biomass burned for electricity generation in Portugal in 2021, 1.53 million tonnes was eucalyptus residues. .
9. João Camargo and Paulo Pimenta de Castro, 2018. Portugal em Chamas - Como Resgatar as Florestas. <https://www.bertrandeditora.pt/produtos/ficha/portugal-em-chamas-como-resgatar-as-florestas/21475947>.
10. *Ibid.*
11. Gírio, F. Plano Nacional para a Promoção das Biorrefinarias – Horizonte 2030. LNEG. 2017.
12. This figure is an estimate based on 113MWe capacity operating 350 days per year and consuming 1.5 tonnes of biomass per MWh, and an estimated 20% of biomass from industrial by-product streams. Additional capacity of 60MW in the future is expected to require around 600,000 tonnes of biomass.
13. <https://zero.org/wp-content/uploads/2022/06/barometro-2022-pt.pdf>. Total consumption 1.5 million tonnes, minus an estimated 20% of biomass from industrial waste streams.
14. *Decreto-Lei n.º 64/2017, de 12 de junho*, amended by *Decreto-Lei n.º 120/2019, de 22 de agosto* and *Decreto-Lei n.º 73/2022, de 24 de outubro*.
15. Biomass from land clearance as part of fire protection measures and from operations to control invasive species and remove diseased trees are also included in this definition, although these tend not to be economically-viable due to transportation costs and the presence of contaminants such as soil.
16. According to DGEG (2023), 87% of the biomass burned to generate electricity in 2021 was eucalyptus and maritime pine, Portugal's two main forestry species.
17. Under *Decreto-Lei n.º 5/2011*, which is earlier legislation but still includes the obligation of a 10-year plan.
18. $34.5\text{MWe}/135\text{MWt}) \times 85\% \text{ boiler efficiency} = 22\%$
19. MWt = Total thermal capacity
20. Converting one kiln will avoid 185,000 tonnes of CO₂e over 10 years. The IPCC emissions factor for fossil gas is 56 tonnes of CO₂ per Tj, therefore 3,304 Tj of energy would have been produced by fossil gas. If eucalyptus wood produces around 19,000 Kj/kg (<https://cfnielsen.com/wp-content/uploads/2021/02/Calorific-value-biomass.pdf>), then 1.7 million tonnes are required over 10 years, or 17,000 tonnes per year. In addition, this study (<https://bioresources.cnr.ncsu.edu/resources/green-pulp-mill-renewable-alternatives-to-fossil-fuels-in-lime-kiln-operations/>) quotes a biomass demand of 382 tonnes of biomass per day for a 1,500,000 tonne pulp mill. Comparing this to Setúbal would equate to a biomass demand of 49,000 tonnes per year, or 24,500 tonnes per kiln.
21. If the Aveiro mill produces 320,000 tonnes of pulp per year compared to 550,000 at Setubal, the Aveiro mill will require around 58% as much biomass as Setubal in its lime kilns ($(20,000 \times 2) \times 1.58 = 63,000$).
22. Subsequently amended by *Decreto-Lei n.º 120/2019, de 22 de agosto* and *Decreto-Lei n.º 73/2022, de 24 de outubro*.



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