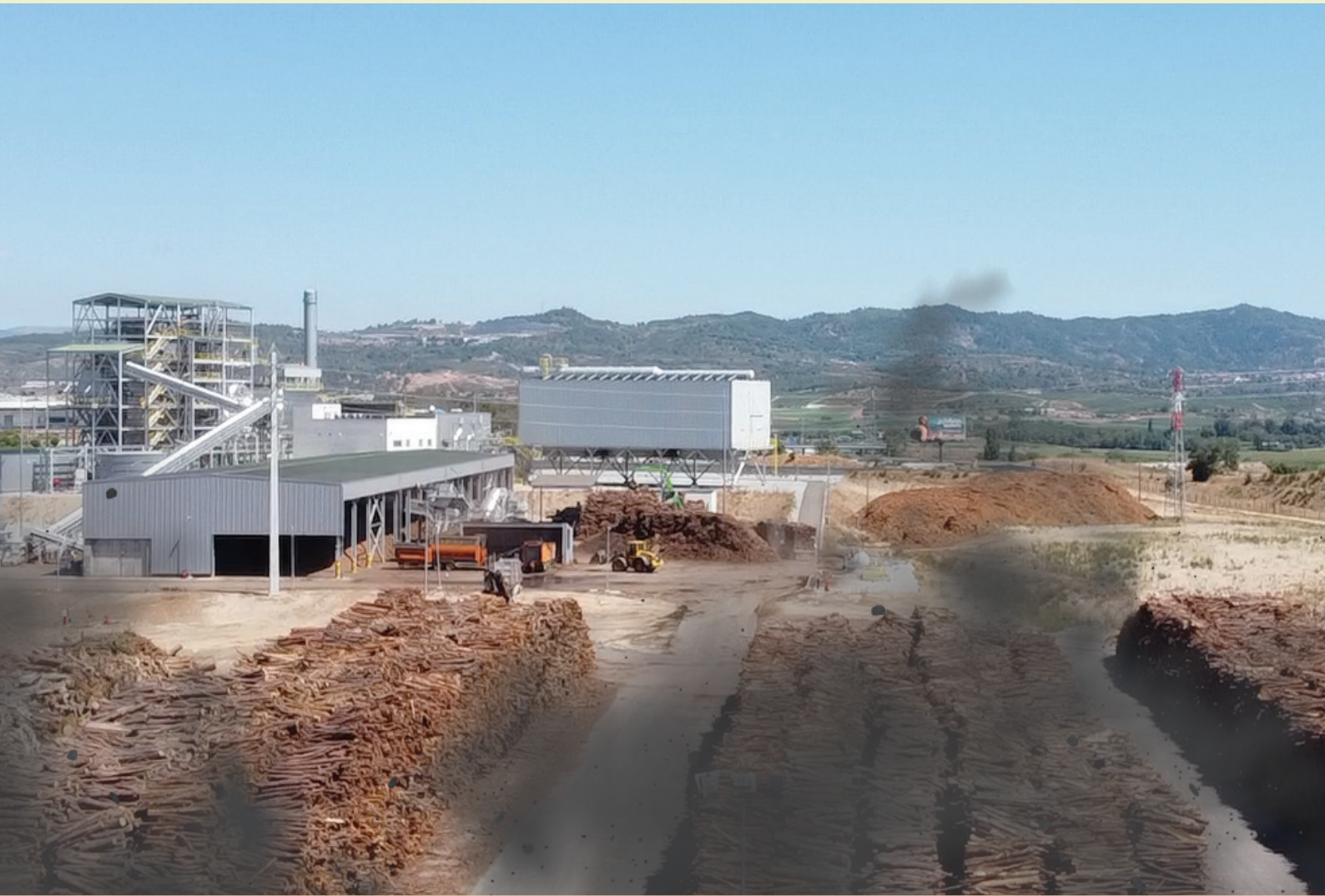
BIG BIOMASS IN PORTUGAL

OCTOBER 2021



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Pine trees (OM)

1. INTRODUCTION

"Large-scale energy generation and wood pellet production are an increasingly significant use of Portugal's forest resources"

Driven by a supportive policy framework and generous subsidies, large-scale energy generation and wood pellet production are an increasingly significant use of Portugal's forest resources. Legislation stipulates that only "residues" can be used, but under current EU rules this term can include any type of wood[1]. Given that Portugal has experienced an abrupt rise in harvested forest areas[2] alongside a rapid increase in biomass power generation and wood pellet production capacity, a close examination of the industry and its impacts is badly needed. After forest fires badly affected large areas of the country in 2003, the use of so-called residual forest biomass to reduce fuel load in forest areas was encouraged as a way to reduce fire risk. The success of this strategy is debatable, especially given the fact that less than 15 years later even more devastating fires tore through central and northern regions in 2017. However, the policy did result in the construction of a large number of electricity-only biomass power plants, as well as encouraging industrial forestry sectors such as pulp and paper and cork to cogenerate heat and electricity through burning biomass.

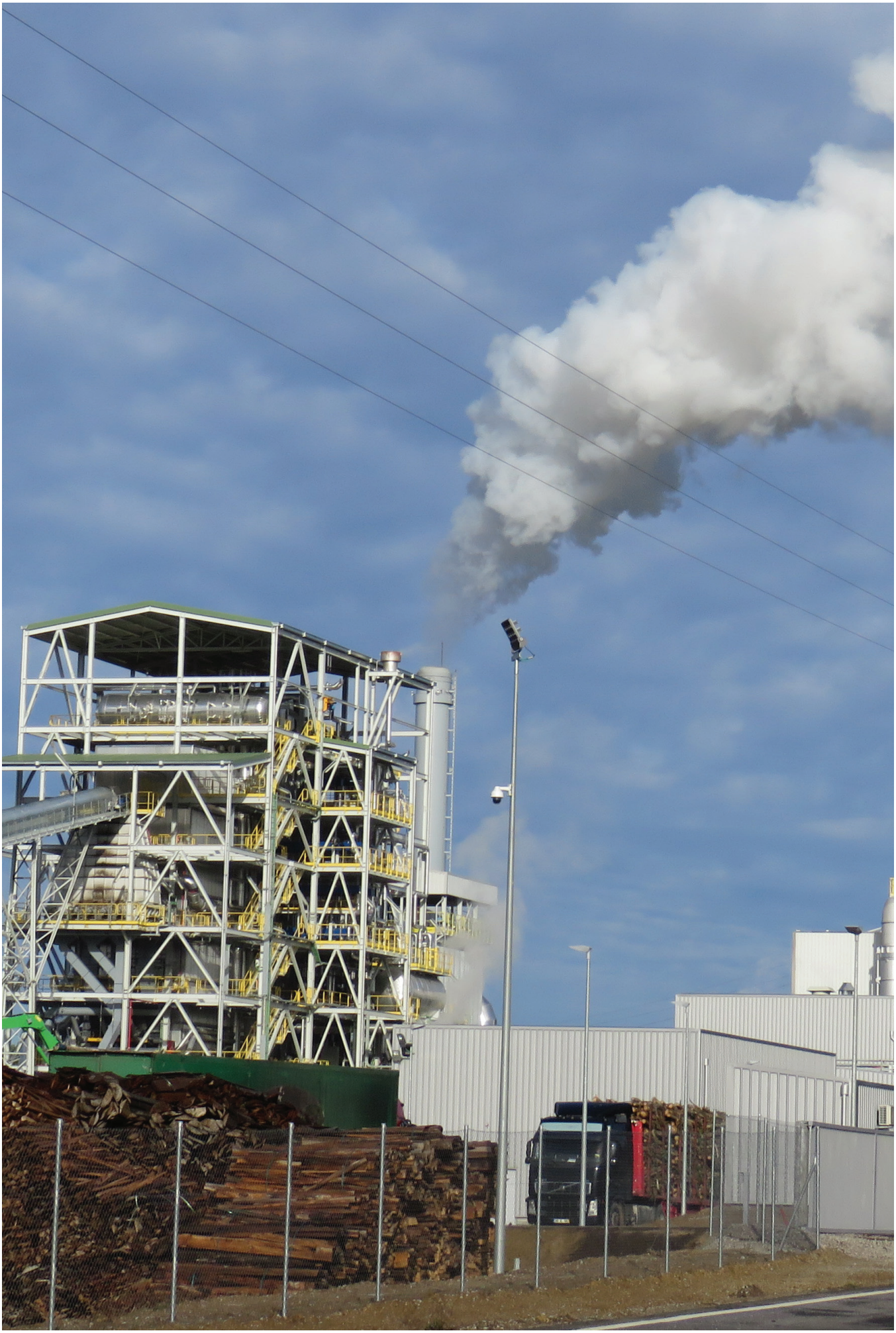
Alongside this, in recent years the development of biomass-based domestic heating systems and the conversion of coal-fired power stations to burning biomass in Europe have led to the exponential growth of the wood pellet market. In Portugal as in other European countries, the strength of the pellet market has led to the construction of numerous pellet mills across the country which has had a direct impact on the demand for biomass.

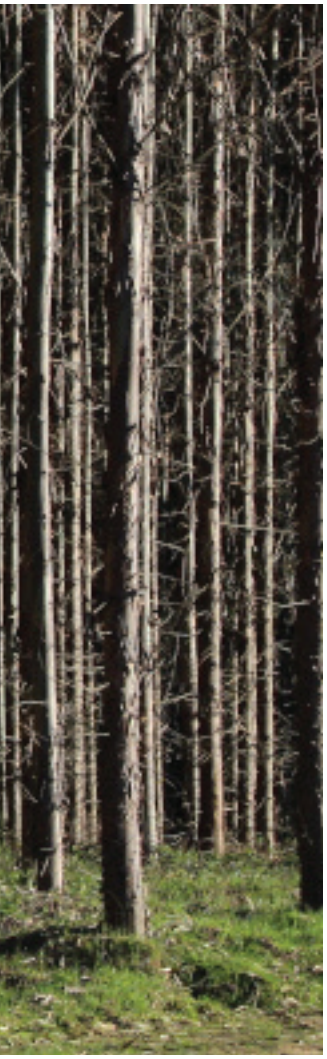
Another significant recent development is the planned conversion of Portugal's remaining coal-fired power station to burning biomass. At 628MW, Pego power station has the potential to dwarf all other requirements for forest biomass, and would undoubtedly also lead to significant imports of wood and/or pellets.

Put together, these projects based around direct or indirect energy generation require a considerable amount of biomass. This document seeks to analyze the current national context of the use of forest biomass for bioenergy generation, particularly in the production of pellets and for burning in dedicated biomass power plants.

The big question is: is the use of biomass sustainable?

Right: Biomass Power Plant in Viseu (NF)





2. PORTUGAL´S FOREST COVER

According to 2010 data, forests are the dominant land use in continental Portugal, occupying 35,4% of the country and covering over 3 million ha. This is close to the average for EU27 countries (37.6%, SOEF, 2011), and the figure includes forest stands and temporarily deforested areas (areas burned, cut and regenerating), where tree cover recovery is expected in the short term[3] . However, less than 0.5% of Portugal's tree cover is native forest, a value four times lower than the EU average[4], with the vast majority of it consisting of monocultures of a handful of species. Scrubland and pastures constitute the next largest land use accounting for 32%, and with bushes corresponding to 52% of this, or 1,500,157 ha. Agricultural areas correspond to 24% of the continental land area.

Portugal's forest structure has changed significantly in recent years, with just three species, those with the greatest economic value, occupying almost 75% of the forest area. Eucalyptus (Eucalyptus spp.) is the most common species (812,000 ha, 26%), followed by cork oak (Quercus suber, 737,000 ha, 23%) and maritime pine (Pinus pinaster, 714,000 ha, 23%). Both maritime pine and cork oak are native to Portugal, whereas eucalyptus is an exotic species. The most significant recent change to Portugal's forest structure is the replacement of pine with eucalyptus, driven by the demand created by the pulp and paper industry. Areas occupied by pine also saw a dramatic decline following the 2017 fires.

"Since 2006 successive governments have defended the importance of energy generation from forest biomass as a way of reducing fire risk."

3. BIOENERGY POLICY

Since 2006 and following the implementation of the National Plan for the Defence of Forests against Fires (PNDFCI), successive governments have defended the importance of energy generation from forest biomass as a way of reducing fire risk. They have stimulated the market for forestry waste supposedly in the name of good management practices and sustainable resource use, with alleged benefits to the local economy and rural communities.

More recently, Portugal's Strategic Vision for Economic Recovery 2020-2030 has once again put residual forest biomass at the heart of land-use policy. It includes the creation of a chain of biomass plants and integrated multi-product biorefineries, and the promotion of small decentralised plants for local energy generation (both for heat and combined heat and power). Once again, these plans lack a serious assessment and analysis of the impacts of bioenergy generation to date, or an inventory of the competing demands for forest biomass resources from different sectors, and whether these demands are compatible.

Left:
1) Eucalyptus (OM)
2) Oak acorns
3) Agroforestry
4) Roundwood (OM)

4. BIOMASS POWER PLANTS

Biomass power plant operations (NF)

In 2005 there were only two biomass power plants in Portugal that used biomass as a fuel: EDP in Mortágua and Centroliva in Vila Velha de Ródão. A number of dedicated biomass power plants were built across Portugal (and some are still under construction) following public tenders in 2006 promoted by the Directorate-General of Energy and Geology (DGEG), and which were licenced to burn forest biomass residues[5]. The main objective of the public tenders was to achieve 250 MW of electricity generation from forest biomass from 22 new power plants. However, the project encountered a high failure rate to various factors such as poor location, high raw material costs, problems with the availability of the raw material, the bureaucracy of the tendering processes and, more recently, a lack of financing from banks. Between 2007 and 2009, five new power stations were built with a combined power of 78 MW, increasing Portugal's total biomass generation capacity to over 100 MW but still far from the 250 MW goal[6]. In 2016 and 2017 new licences were granted to 8 biomass power plants with a combined capacity of more than 150 megawatts. According to data from the Directorate-General for Energy and Geology[7], by the end of 2020 there were 21 licensed dedicated biomass and cogeneration plants, requiring around 4 million tons of biomass each year[8] and corresponding to a total of 283 MW, of which 49 MW is attributable to four projects which are expected to be in operation by mid-2022.In addition, Decree-Law n.º120/2019 regulates a regime for the installation and operation of new biomass combined heat and power plants at the municipal level of up to 60 MW in total, and a maximum of 10 MW for each plant.

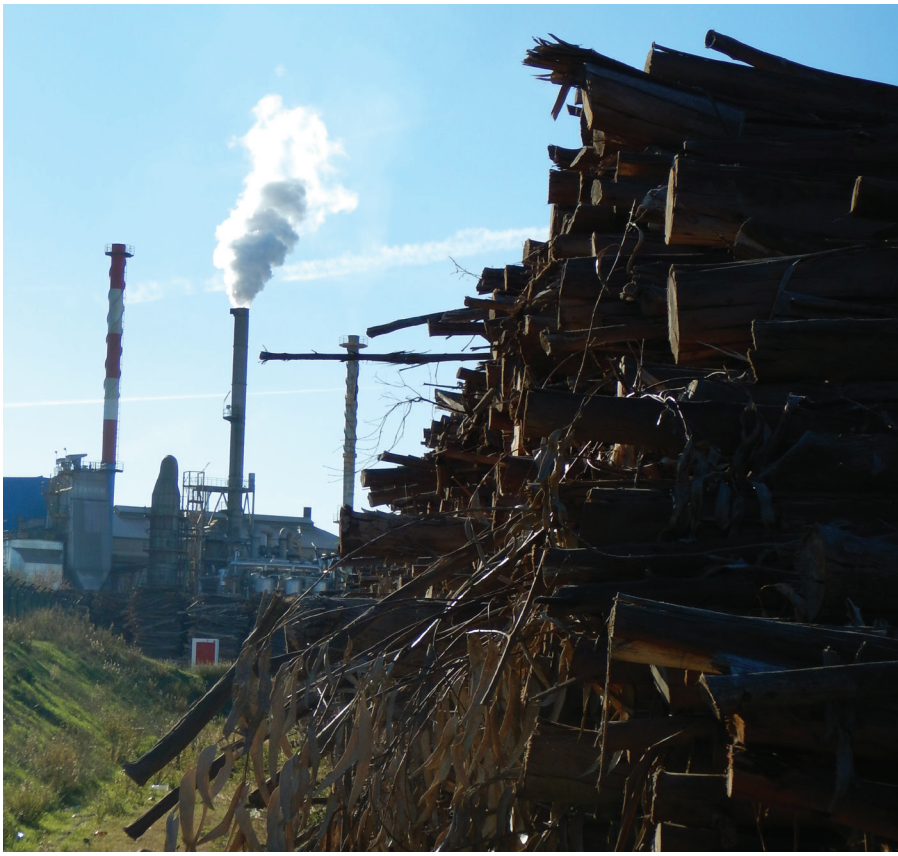
There are also serious doubts that many of the biomass plants in operation are complying with Decree-Law No. 5/2011, which states that they must present, in conjunction with local forestry producer organisations and local authorities, an action

plan aimed at ensuring the sustainability of raw materials sourced. To date, the numerous entities responsible have not made these plans public, even when requested under the European Directive on Access to Administrative Documents.

Biomass power generation and the pulp and paper industry

Biomass power generation is also closely linked to Portugal's large pulp and paper sector, which burns black liquor, eucalyptus residues and forest biomass in eight power stations. In 2019, the biggest pulp and paper company in Portugal, The Navigator Company, was also Portugal's largest producer of electricity from biomass, and currently has two electricity-only and four cogeneration plants buring biomass[9]. In December 2020, Navigator inaugurated a new and over-sized electricity-only biomass power station adjacent to its Figueira da Foz pulp mill with finance from the EIB. It is anticipated that a half of the plant's feedstock will come from primary forestry operations, in addition to eucalyptus residues from paper production[10]. This is a common trend amongst pulp producers who are taking advantage of lucrative subsidies and a supportive policy framework to construct electricity-only biomass plants that require far more wood than the pulp mills are able to supply in residues. This means that additional biomass must be brought in, increasing overall wood demand significantly.

Perhaps the most significant recent development is the growth of Greenvolt, a wholly-owned subsidiary of Altri, Portugal's second largest pulp and paper company. Greenvolt operates five biomass power stations in Portugal at a combined 98MW, giving it an almost 50% market share in terms of energy injected into the grid and quickly making it Portugal's largest biomass energy producer, overtaking The Navigator Company[11]. Greenvolt is also expanding it's operations abroad, and recently acquired the 42MW Tilbury Green Enerrgy biomass power station in the UK[12].



Caima pulp mill (PL)

"Biomass power generation is also closely linked to Portugal's large pulp and paper sector."

Left: Fundão biomass power plant (NF)
Top: Roundwood being delivered to a biomass power plant. (NF)

CONFLICTS WITH LOCAL RESIDENTS: FUNDÃO BIOMASS POWER STATION

The 18 MW Fundão biomass power station is less than 500 m away from a number of homes and has led to complaints by residents[13], who experience excessive noise and poor air quality. These impacts should have been assessed through an Environmental Impact Assessment, but carrying one out is only compulsory for plants larger than 50 MW.In terms of air quality, solid biomass power plants must comply with Decree-Law nº. 39/2018, which stipulates that particulate emissions for power plants above 15 MW must be limited to 50 mg/Nm3, as opposed to 30 mg/Nm3, which applies to larger plants. However, no monitoring of particulate emissions is carried out, so it is impossible to know if this requirement is being met. The Fundão power station is also located in a valley ("Cova da Beira") which could cause dangerous concentrations of particulate matter with significant impacts on public health, especially in combination with emissions from fireplaces in the winter. The absence of an Environmental Impact Assessment means that these impacts have not been properly assessed, which is of great concern.

This plant started its testing phase in 2019 and is subsequently in full operation, but after more than a year of complaints to the authorities, a solution has still not been found for local residents.

A COAL-TO-BIOMASS CONVERSION AT PEGO

Pego´s coal-fired power station (OM)

A significant potential future development is the conversion of Pego's coal unit to burning biomass, which Trustenergy, the power station's main shareholder, is pushing for. At 628MW, the demand for wood that this could create has the potential to dwarf all other biomass plants put together. Although publicly-available information on the conversion is still extremely limited, Trustenergy have indicated that it would operate during peak demand, using only forest small logging residues. Estimates for the wood requirement of a conversion vary significantly depending on the power station's hours of operation and the type of pellets that will be used, with a recent study estimating a wood requirement of 1.1 million tonnes a year at 10% capacity[14]. In the worst case scenario, at full capacity the power station could require up to 5 million tonnes a year[15]. In either case, as described in more detail below, the increased demand for raw material would far exceed the availability of forestry residues. A biomass conversion would therefore rely on large amounts of roundwood as its main feedstock. Trustenergy have also indicated that Pego will burn torrefied (black) pellets produced on-site. However, there are no examples of this working successfully in a coal-to-biomass conversion anywhere in the world to date. In fact, the only significant attempt which took place in Ontario, Canada, resulted in so much corrosion to the plant's boiler that the operators decided to close the power station down rather than repair it[16]. There have also been numerous failed attempts to produce torrefied pellets at scale. For example, CEG[17] in Derby, UK, claimed that they would become the world's largest producer of torrefied pellets, but have so far failed to scale-up production. There have also been a number of failed attempts in Portugal, including AFS[18] and YGE[19] who, after receiving millions in funding have since ceased to operate. Futerra Fuels in the North of Portugal also claim to be constructing one of the largest torrefied pellet facilities in the world with a production capacity of 120,000 tonnes of black pellets and 85,000 tonnes of white pellets. So far though the company is struggling to scale up black pellet production[20], and focusing on white instead, which can be produced interchangeably at its mill. All of this points to the fact that black pellet technologies are extremely difficult to scale up, and that it is much more likely that white pellets would be burned at Pego.Given all of the above, the most likely scenario for the origin of Pego's feedstock would therefore be imported white pellets, using the existing rail infrastructure that supplies coal to the plant. Pellet imports would likely come from the southeastern USA and Canada where there are already established industries that supply other power stations in Europe, and which are having significant impacts on highly biodiverse forests.

Also of note is that Trustenergy is seeking public finance for the conversion from the EU's 7.5 billion Euro Just Transition Fund (JTF) and Portugal's Recovery and Resilience Plan. The district that Pego is in is already highlighted in the JTF's eligibility map[21] as a priority investment area, making it likely that this could be a test case for using the fund to finance conversions rather than a transition to truly sustainable energy generation. Portugal's Recovery and Resilience Plan[22] also earmarks 715 million Euros for the decarbonisation of industry, included in which is "fuels derived from biomass residues". Of course, any subsidy the power station would receive on top of this for producing electricity would also ultimately be paid for by consumers, whose bills would increase further. Table I shows the current status of biomass power plants in Portugal.

Table I: Current status of biomass power plants in Portugal

License number	Municipality	Name	Installed capacity (kW)	Production License (Date)	Remuneratory Regime	Operation License	Estimated Date to Begin Operation
1123	PORTO DE MÓS	Central de Biomassa Florestal de Guimil	6 500	30/6/2016	Subsidized	8/10/2019	
1293	FUNDÃO	Fundão	17 700	5/8/2016	Subsidized	27/11/2018	
1354	VISEU	Central de Biomassa Florestal Residual de Viseu	17 700	30/6/2016	Subsidized	27/11/2018	
1361	VILA NOVA DE FAMALICÃO	Central Termoelétrica a Biomassa Florestal	15 830	30/6/2016	Subsidized	8/11/2017	
1421	VILA NOVA DE FAMALICAO	Central termoelétrica Florestal de Dorga de Fradelos	12 495	30/6/2017	Subsidized		31/12/2020
1440	CHAMUSCA	Central de Biomassa Termogreen	4 625	17/1/2017	Not subsidized	14/1/2020	
1443	SEIXAL	Central de Biomassa do Seixal	3 375	8/2/2017	Not subsidized		8/2/2022
1444	ARRUDA DOS VINHOS	Central de Biomassa de Arruda dos Vinhos	3 375	17/1/2017	Not subsidized		17/1/2022
1465	FIGUEIRA DA FOZ	Central de Biomassa da Figueira da Foz 2 *	34 500	30/6/2017	Subsidized	7/6/2019	
1466	VILA VELHA DE RÓDÃO	Central Biomassa de Vila Velha de Ródão *	30 000	30/6/2017	Subsidized		31/12/2020
1468	MANGUALDE	Central a Biomassa Florestal nas instalações da SIAF	12 600	30/6/2017	Subsidized	17/12/2011	
232	VILA VELHA DE RÓDÃO	Central termoelétrica da Centroliva	5 550	13/12/2007	DL 33-A/2005	17/12/2011	
259	Mortágua	Central termoelétrica de Mortágua	10 000	22/4/1999	DL 33-A/2005	26/7/1999	
993	Constância	Central Termoelétrica do Caima *	13 670	29/11/2007	Subsidized	14/8/2009	
997	FIGUEIRA DA FOZ	Central Termoelétrica de biomassa da Figueira da Foz *	34 317	28/8/2008	Subsidized	03/082009	
751	Olivera de Azemeis	Central de Biomassa Terras de Santa Maria	10 044	10/7/2006	Subsidized	24/1/2011	
1031	Aveiro	Central termoelétrica a biomassa florestal *	12 500	4/3/2008	Subsidized	25/11/2009	
1030	Setúbal	Central termoelétrica a biomassa florestal*	12 500	19/2/2008	Subsidized	6/9/2010	
1034	Sertã	Central termoelétrica a biomassa florestal	3 300	19/8/2009	Subsidized	4/2/2010	
934	VILA VELHA DE RÓDÃO	Rodão Power *	13 232	14/12/2006	Subsidized	28/8/2009	
344	Constância	Central termoelétrica a biomassa florestal *	8 800	31/1/2011	Subsidized	19/3/2012	

* associated with the pulp industry

5. WOOD PELLETS

"In 2020 Portugal produced around 860,000 tonnes of wood pellets"

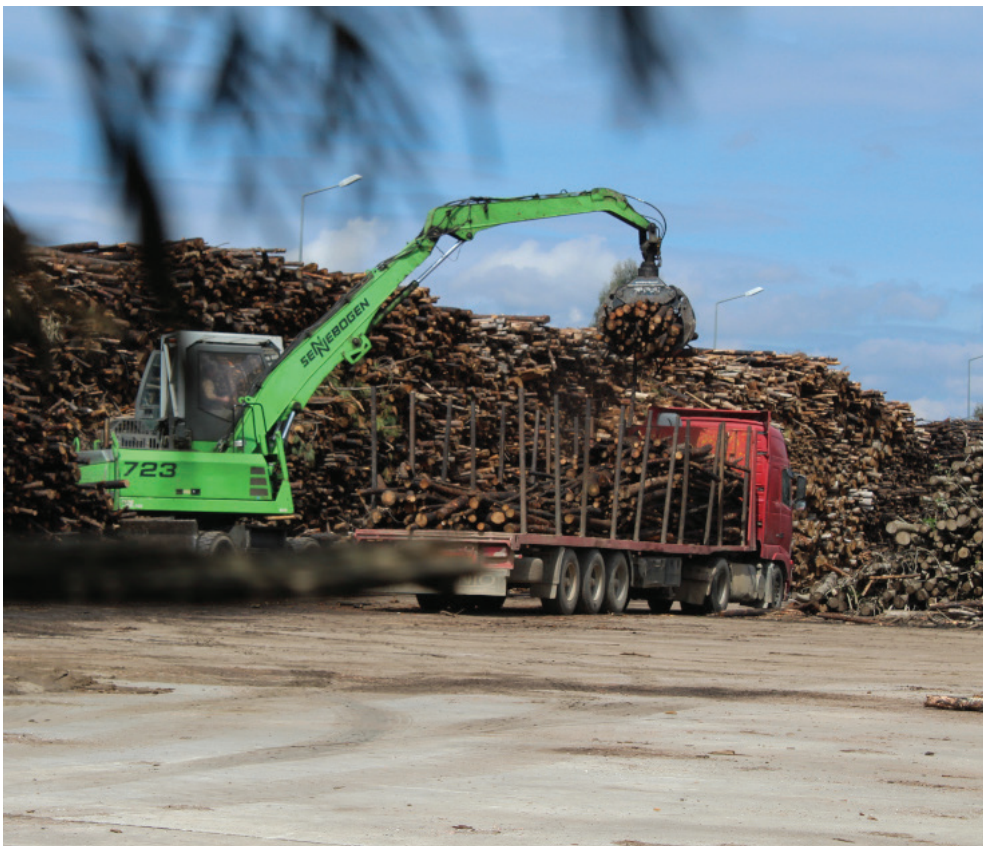
In 2020 Portugal produced around 860,000 tonnes of wood pellets (see table II), requiring around 1.8 million tonnes of biomass. Some 545,000 tonnes of pellets were exported, equivalent to 64% of the total production[23]. The three largest export markets were Denmark (184,000 tonnes), the UK (172,000 tonnes), Spain (131,000 tonnes) and the Netherlands (35,000 tonnes). Whilst exports to Spain are used for heating by residential and industrial users, buyers of Portuguese pellets in Denmark, the UK and the Netherlands burn them in converted coal-fired power stations or other biomass plants to produce electricity. In Denmark, the main buyer is Orsted[24], and Drax, the world's largest biomass power station, is the main buyer in the UK[25]. A lack of transparency in sourcing for Dutch utilities make it impossible to identify buyers there. Pellet production in Portugal has increased rapidly over the past two and a half decades, from just a few very small mills in 2005[26] to 26 today. These include 12 large-scale mills (>80,000 tonnes per year), of which three are under construction or only started producing this year, and another 14 smaller-scale producers (<80,000 tonnes per year). The total installed capacity is now over 1.6 million tonnes a year, almost double the production in 2020. Pine is the main species used by pellet producers due to the fact that eucalyptus causes boiler corrosion, and the vast majority of the feedstock is from primary sources, i.e. directly from forestry operations, with secondary sources such as industrial waste representing a much smaller share. The wood pellet market in Portugal is still considered to be at an early stage of development as it lacks significant domestic consumption[27], although the share of domestic consumption is growing each year. The domestic market consists of small direct consumers with peak demand over the winter period[28]. The main consumers of pellets domestically are public services, including elderly care homes, schools and sports facilities. Using pellets for electricity generation isn't currently economically attractive in Portugal due to the relatively low subsidy in place. The average rate of 119 Euros/MWhe is much lower than the 148 Euros/MWhe paid in the UK for example, meaning that it makes more economic sense for the bulk of pellet production to be exported to Northern European countries.

Table 2: List of wood pellet factories in Portugal

Name	Installed capacity (kT/yr)	Total production in 2020 (kT/yr)	Total biomass use in 2020 (kT/yr)	SBP?	Enplus?
Futerra Fuels*	205	0	0	YES	
AT Green*	180	0	0	YES	
Enerpellets/Pelletsfirst	140	100	197	YES	YES
Pinewells	140	120	243	YES	YES
Delitimbers Lda.*	120	0	0	YES	
Enerpellets/New Pellets	100	50	102	YES	YES
Pellets Power	100	75	171	YES	YES
Pellets Power 2	100	50	109	YES	YES
Tecpellets	100	100	217	YES	YES
Nova Lenha -JAF	90	75	146	YES	YES
Biohot	80	40	80		YES
Enermontijo	80	60	103	YES	
Palser	50	50	100	YES	YES
Raro	50	30	60		
ReginaCork	30	20	40	YES	YES
Omnipellets, Martos	25	22.5	45		YES
Biodensa	20	20	40		YES
CMC Biomassa	20	15	30		
Eurosov, Lda.	10	5	10		YES
Nutriaguiar	10	7	14		YES
Vimasol Pellets	10	10	20		YES
Green Edge	7	0,6	0,85		YES
Melpellets	5	5	10		YES
Transnil	5	5	10		YES
Soltotal	0,6	0,6	1,4		
Fenesteves	0,5	0,5	1		
Total:	**1678,1**	**861,2**	**1750,25**	**13**	**18**

* Under construction/hadn't started producing in 2020

Sources: Various, including certification reports, information directly from producers and extrapolation.



Roundwood being used to produce pellets (OM)

Although a number of pellet mills have closed down in recent years, the overall production capacity is still increasing, and this year will see a significant increase in production as three new large-scale pellet mills come online. With a combined capacity of over 400,000 tonnes a year, Futerra Fuels, AT Green and Delitimbers, all in the North of Portugal, represent a 30% increase in total pellet production capacity.

The pellet industry in Portugal is built around the premise that only forestry residues and industrial wastes are used as feedstock. Producers claim that wood is never harvested for the sole purpose of producing pellets, and that the more valuable trees are used by other industries such as sawmills. However, as is shown in the three case studies below, the larger pellet mills (i.e. those reliant on primary feedstock directly from forestry operations, and not scaled such that their feedstock is mainly secondary biomass from sawmills) are clearly using roundwood or sections of tree trunk as their main feedstock, which they are classifying as residues, "low-grade roundwood" or even secondary materials. Regardless of the quality of the wood being used, any primary feedstock (directly from forestry operations) has negative climate impacts[29], and the larger the diameter of the wood, the greater the impacts. A recent study in the US[30] shows that even when wood pellets are made primarily from pine plantation thinnings there's a negative impact on the climate for more than 40 years.

Despite this, Portugal's pellet producers claim that burning pellets is low carbon and sustainable. For example, one of the largest pellet producers in Portugal, Pinewells, claims that its pellets have no environmental impact and promote carbon emissions reductions[31]. The emissions from combustion are being ignored completely, whereby flawed accounting methodologies assume that new tree growth instantly reabsorbs carbon released when the pellets are burned. For this to be true, the amount of carbon in Portugal's pine forests would need to remain consistent each year—but it isn't.

According to Centro PINUS[32], in 2020 pellet production consumed almost a quarter of pine roundwood in Portugal and, by their own estimates, 56.6% more pine was harvested in Portugal than replaced by new growth. This represents a dramatic annual decline in pine forest carbon stocks, and underlines a study that found a "striking rise in harvested forest area" in Portugal in recent years[33]. Centro PINUS also reports that its members (predominantly in the sawmill and panel-board industry and representing almost half of pine consumption) imported 28.1% of the pine they consumed in 2020, pointing to pellet production and biomass energy generation in general being a key reason behind this.

Left: Pine roundwood arriving at a pellet mill (OM)
Top: Pine logs (Om)

> “Burning the wood instead of allowing it to decompose only adds to the climate impact that the fires had in the first place”

Pellet production in Portugal, as is the case in other producing countries, is providing a financial incentive to harvest wood sooner, whereby pine trees aren’t left to grow for long enough such that they could have value to other industries like sawmills. The pellet industry is therefore incentivising burning over uses that keep the carbon in the wood, such as construction or furniture-making. This in turn is leading to a shortage of pine in Portugal, forcing other industries to import large quantities each year.

It is also worth noting that there are currently large volumes of trees killed during the 2017 fires being turned into pellets by the large-scale producers. Pine forests were particularly badly affected, and have provided the pellet industry with an enormous supply of cheap wood.

The industry claims that burning it for energy generation is the best use for this wood in order to reduce future fire risk, and because the wood will decompose anyway. However, burning the wood instead of allowing it to decompose only adds to the climate impact that the fires had in the first place, as the carbon still in the trees is emitted to the atmosphere straight away. Whereas, decomposition would release it much more slowly and allow carbon to accumulate in the soil, which is badly needed after such widespread damage was caused[34].

PINEWELLS, ARGANIL

Pinewells viewed from above (NF)

Last year Drax power station in the UK burned almost 150,000 tonnes of pellets produced in Portugal, making Portugal it's fourth largest supplier. According to its annual report[35], 88% of the wood used consisted of "low-grade roundwood" and "thinnings". Owned by the Grupo Visibeira, the Pinewells pellet mill in Central Portugal[36] is Drax's main supplier there.

In 2020 Pinewells produced around 120,000 tonnes of pellets, most of which were exported. This required 243,000 tonnes of wood, of which over 80% of its feedstock was from primary forestry operations, predominantly from monoculture pine forests, and to a more limited extent eucalyptus plantations (pellet producers tend to use eucalyptus in the pellet mill dryers, and not to produce actual pellets). Pinewells claims that its primary feedstock is in the form of "residues, low-grade tree stems, sawdust and thinnings", and that harvesting operations do not take place solely for the production of wood pellets, as the more valuable trees are used by other industries.

On the Grupo Visabeira website, a photo captioned "Raw material used in Pinewells for pellet production" shows tree branches and tops being unloaded from a truck. However, visits to the Pinewells mill and a near-by chipping facility that supplies it found very little evidence that genuine residues are being used. The primary feedstock is clearly roundwood of varying sizes, including larger diameter trunks.

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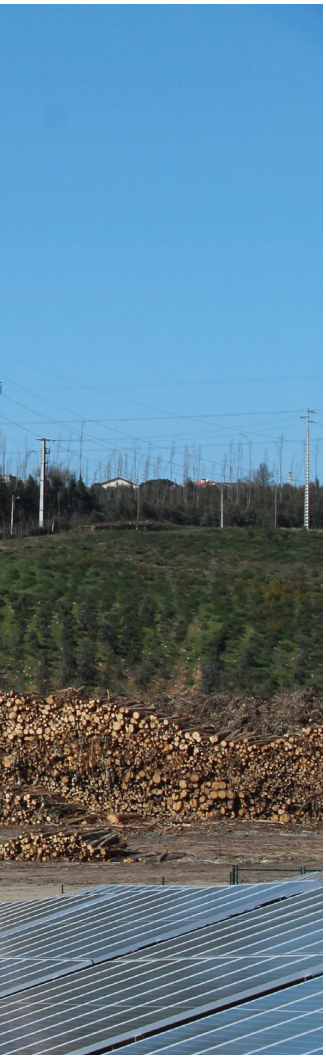


Left:
5) Pellets Power, Mortágua (OM)
6) Unloading pine trees at Pellets Power (OM)
7) JAF, Oleiros (OM)

Jose Afonso & Filhos S.A (JAF), Oleiros:

The JAF pellet mill in Oleiros, Castelo Branco, produces around 90,000 tonnes of pellets per year from 146,000 tonnes of wood. According to its SBP report for 2019[37] 100% of this wood was from secondary sources. However, the report also states that "only leftovers from forestry operations (branches, tops, etc) and secondary material is used to produce pellets", indicating that no primary raw materials are being used, but photographs taken of the wood piles next to the pellet mill clearly show a large amount of roundwood, whereas there were no visible piles of branches or tree tops. This is another example of the flaws of SBP voluntary certification (discussed in more detail below), where pellet manufacturers are classifying the same raw material differently, and claims made by the manufacturers bear little resemblance to reality. According to the company's website[38], "95% of its production is exported to a range of Western European and Scandinavian countries, with shipments of pellets leaving every 20 days", making it highly likely that these pellets are being burned in converted coal-fired power stations to produce electricity.

Pellets Power, Mortágua:

Gesfinu operate two pellet mills of around 100,000 tonnes annual capacity each, most of which is exported to Northern and Central European countries through an export facility at the Port of Aveiro.[39] The latest SBP report for the mill in Mortágua does not provide information on feedstock use other than that between 0 and 200,000 tonnes of raw material are used each year due to reasons of commercial confidentiality[40]. However, the 2017[41] report states that the mill used 171,000 tonnes of feedstock, of which 91% was "low-grade roundwood", and the 2018 report[42] indicates that over 94% of the feedstock was also "low-grade roundwood". Whilst the "grade" of the roundwood is subjective, photos taken at the site clearly show large amounts of roundwood are used of varying diameters. The Mortágua mill is also adjacent to a biomass power station that was refitted to be able to receive branches and tree tops from forestry operations, and it is clearly the case that what could be described as "residues" are taken to the power station, whereas roundwood is taken to the pellet mill. Information is even more limited for the Pellet Power mill in Alcacer do Sal, the most specific data being that in 2016 109,000 tonnes of wood were used, 88% of which was low-grade roundwood[43].

"This is another example of the flaws of SBP voluntary certification, where pellet manufacturers are classifying the same raw material differently, and claims made by the manufacturers bear little resemblance to reality."

CAN CERTIFICATION ENSURE SUSTAINABILITY OF SUPPLY?

"The Sustainable Biomass Program (SBP) is an industry-created voluntary certification scheme"

The Sustainable Biomass Program (SBP) is an industry-created voluntary certification scheme that has been derided as a "smokescreen for forest destruction and corporate non-accountability" by NGOs[44]. Both Orsted[45] and Drax[46], the two largest buyers of Portuguese pellets, require SBP certification from their suppliers, and 13 pellet factories (and one woodchip producer) in Portugal currently have it[47] . In addition to indications on their respective websites, this is an accurate reflection of which pellet factories currently supply or are intending to supply to biomass electricity producers in Denmark, the UK and the Netherlands, which between them bought almost 400,000 tonnes of Portuguese pellets in 2020.

Although SBP claims to ensure the sustainability of pellet production, the scheme is clearly inadequate when it comes to pellet production in Portugal. First of all, it relies on self-reporting and self-auditing with no independent verification. Secondly, producers are often vague about the quantities of feedstock they use, with confidentiality clauses meaning that figures are only required to be presented as a range (eg 0-200,000 tonnes). Another issue is that classifications of raw material are extremely vague, with "low-grade roundwood" being the most common catch-all term, and some producers are classifying the same type of raw material differently, whereby in one report "low-grade roundwood" is considered to be a primary raw material, whereas in another it will be considered as secondary.

Another common form of certification is ENplus, which is geared towards ensuring pellet quality for domestic or residential use rather than for power generation, but has no bearing on the sustainability of the feedstock. Currently 18 operating pellet mills in Portugal have this certification. In a presentation[48] delivered at the International Domestic Wood Pellet Conference in 2019, João Ferreira, the Wood and Furniture Industry Association of Portugal's (AIMMP) energy division manager clearly states that there is a lack of raw material for the production of ENplus certified pellets in Portugal, owing to the fact that only a narrow range of feedstock is acceptable. Essentially, achieving ENplus certification requires that only roundwood is used as a feedstock (including sawdust from milling operations). It therefore rules out using what we would normally think of as residues (such as bark and branches), and what the large pellet producers claim that they are using.

6. SUSTAINABILITY OF BIOMASS FEEDSTOCKS

There are well-founded concerns about the type of feedstock that is being burned in biomass plants and turned into wood pellets, as already noted by ZERO[49], where operators claim to only use small logging residues or roundwood that is either from diseased or burned trees but are in fact using sections of tree trunk that should be left to grow, and used for higher value purposes that don't involve it being burned. It is also the case 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 manifests that are filled in, accompany the transport of forest biomass that arrives at a given industrial site, including biomass plants and pellet mills, and are delivered to the Institute for Nature Conservation and Forests (ICNF). 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 is practically impossible to trace its origin.

It is estimated that biomass consumption for electricity generation in 2020 could have reached 2.8 million tons if operating at full capacity. In addition, we estimate that around 1.8 million tons of biomass was used to produce pellets in 2020, the majority of which was classed as low-grade roundwood[50], but which is considered as a quality raw material in the panel board industry. This figure could rise considerably in 2021 as three new pellet mills begin production, potentially requiring an additional 0.8 million tonnes of biomass on top of existing demand. In future, the biomass demand from power stations and pellet mills could therefore reach as high as almost 6.5 million tonnes/year as a result of planned new biomass power stations and recently-built pellet mills. This figure excludes a potential conversion of Pego coal-fired power station, which would increase this figure far higher.

Woodchip (CC)

Table 3: Summary of biomass consumption for energy production

Category	Current consumption expected (ton / year)	Increased consumption in the future (ton / year)
Biomass use for pellet production in 2020(1)	1 755 250	
Additional pellet capacity from 2021		800 000
Biomass power plants/cogeneration (in operation)(2)	2 788 893	
Biomass power plants (to start operating until 2022)		535 000
Small municipal power plants (60MW)		600 000
Total	**4 544 143**	**1 935 000**

(1) This figure it the author's estimate based on certification reports, direct communications with producers and extrapolation. (2) this data is for the maximum potential installed

Drax power station (CC)

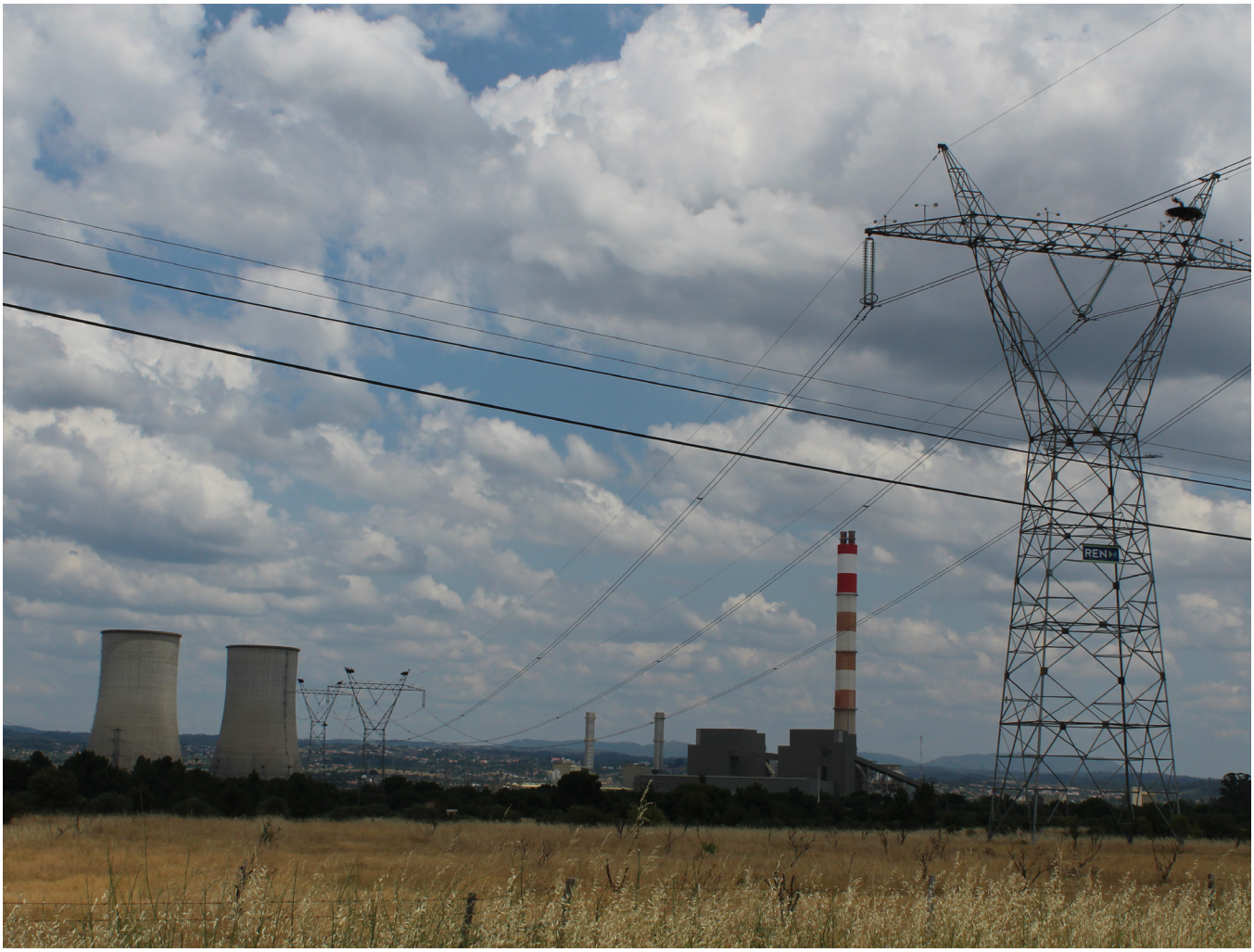
Bearing in mind the fact that much of the biomass being burned in Portugal or turned into pellets isn't genuine forestry residues despite what operators claim, and that under current EU rules the definition of residues is so wide that the term is essentially meaningless, comparing this overall demand for biomass from the power and pellet sectors to the estimated availability of forest biomass is still useful to gauge the extent to which forest resources are being over-exploited. However, figures quoted in the literature on Portugal's biomass availability vary widely, as described in a 2010 report [51]. For example, according to FAO data (Torres, 2006), there is a forest residues fuel potential availability in Portugal of approximately 3.6 million tonnes of dry matter per year. However, Campilho (2006) states that the annual availability of forest residues in Portugal amounts to more than 5 million tonnes of dry matter, of which 2.6 million tonnes is from shrubs that do not yet have economic value and 2.5 million tonnes is waste from industries using maritime pine (1.4 million tonnes) and eucalyptus (1.1 million tonnes).Campilho (2006) also states that there is a large discrepancy between the potential availability and the effective availability of residues in forests. Given the steep terrain and poor road networks common to much of Portugal's forest area, 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 varies from 43 to 65% of the total.

Another report, published in 2013 report[52] for the Portuguese Parliament, quotes the potential annual availability of residual forest biomass in Portugal as 2 million tonnes, plus an extra 0.2 million tonnes of waste produced by wood processing industries. The report also states that the consumption of residual forest biomass for producing energy and wood pellets in 2013 was already estimated to be over 3 million tonnes per year, and since its publication a further 150MW of biomass generation capacity has come online, requiring close to an additional 2 million tonnes per year.

In 2017, as part of the National Plan for the Promotion of Biorefineries prepared by LNEG, the total availability of residual forest biomass for energy was determined as 2.8 million tonnes/year, of which about half corresponded to shrubs, and which is stated to be a conservative estimate[53]. The same document points to the potential of 3 million tonnes/year from agricultural waste, including 1.6 million from pruning of fruit trees. But it also notes that only a fraction of the total available agricultural waste is suitable for removal and recovery.

A study on using forest bioenergy to reduce fire risk prepared for the Portuguese Parliament in 2020[54] states a potential of 2 million tons of residual forest biomass per year, and 5.3 million tonnes of waste from industry (primarily from pulp and saw mills), although it does not indicate what proportion of this is currently already being used by the various industrial sectors and what, if any, is currently still available. Despite the range of figures quoted it is still clear that demand for so-called "residual biomass" from the power and pellet sectors far outstrips any estimate of availability, and that's without factoring in other significant sources of demand, such as firewood for domestic heating.

Using forest biomass in dedicated biomass plants or to turn into pellets is also not a carbon neutral activity, no matter what type of feedstock is being used. Burning forest biomass emits large quantities of greenhouse gases into the atmosphere, especially where feedstock relies on whole trees. At the same time, it reduces the capacity of forests to sequester carbon, delaying the fight against climate change by decades. Even if the European Union treats biomass as "carbon neutral" at the point of combustion, burning trees is not a viable climate solution, especially when forests are being exploited faster than they can sequester carbon, as is clearly the case in Portugal. To make matters worse, biomass or wood pellets are usually burned at incredibly low efficiencies where heat is not recovered at the same time, wasting scarce forest resources further.



Pego power station (OM)

7. CONCLUSION

Although in theory Portugal's biomass power and pellet sectors only use residues and industrial waste, in reality what we are seeing is the unsustainable exploitation of forest resources where quality wood is being burned to produce electricity or turned into wood pellets. The impacts can be devastating in terms of the loss of soil quality, water storage capacity, biodiversity and tree cover, and in terms of greenhouse gas emissions, and these impacts will only worsen as new biomass power and pellet production capacity comes online. Driving these impacts are misguided policies at the EU and national level, and heavy subsidisation, that is ultimately paid for by consumers through higher energy bills.

There must be an immediate halt to new biomass generation and pellet production capacity, and a significant scaling back of both industries in Portugal. At the same time, forest resources must be used in the most efficient way possible, only burning them as a last resort and where no other options are available. Particularly where pine is concerned, policy should focus on proforestation, where trees are left in the forest as the most effective means of sequestering carbon. The most important first step in terms of policy change would be to end subsidies for biomass energy generation, both in Portugal and elsewhere in Europe, since these subsidies are also driving wood pellet production.

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