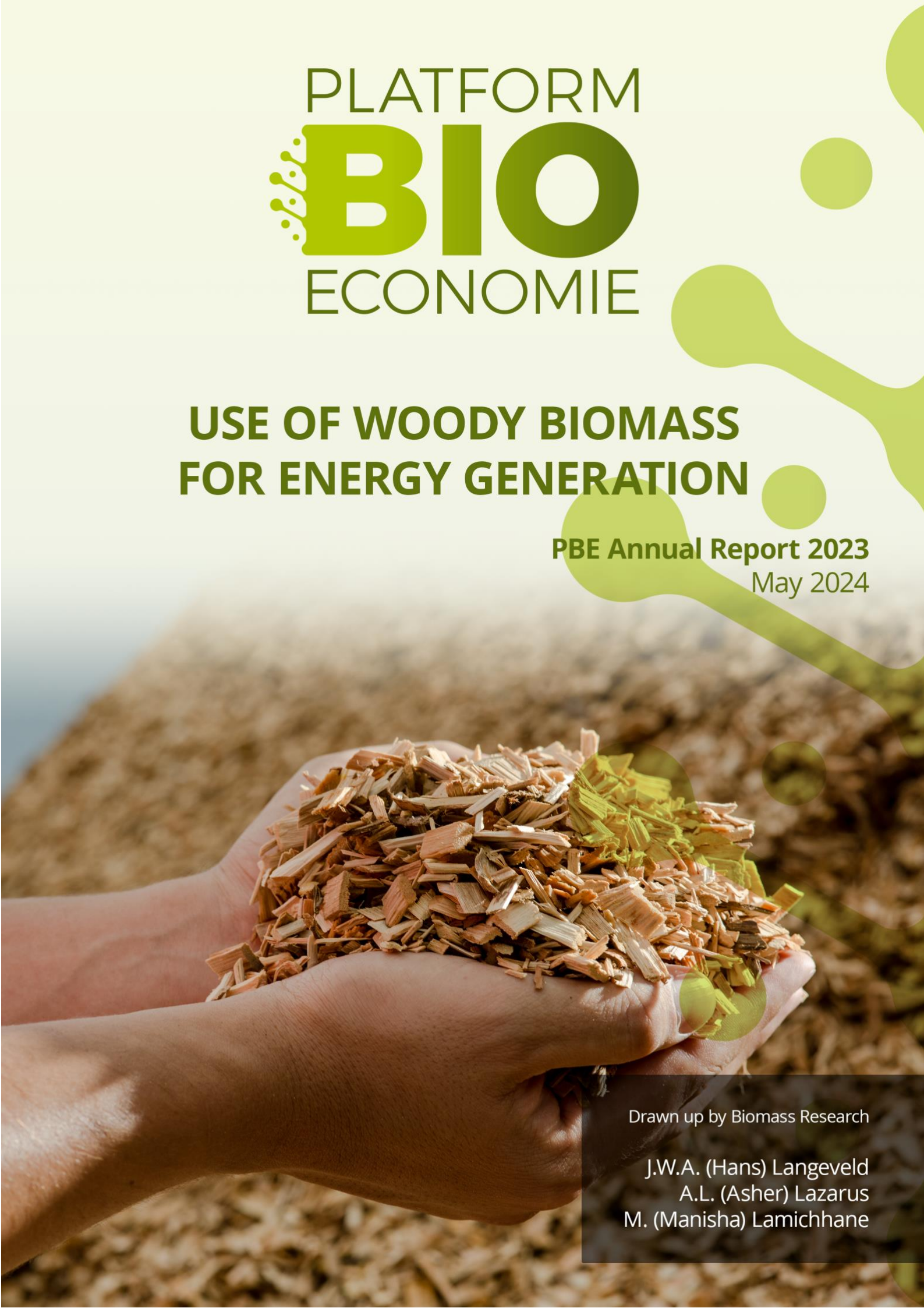
PLATFORM BIO ECONOMIE

USE OF WOODY BIOMASS FOR ENERGY GENERATION

PBE Annual Report 2023
May 2024



Drawn up by Biomass Research

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PLATFORM BIOECONOMIE

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Foreword

Here is the 12th edition of the annual report on woody biomass deployment in the Netherlands. It is of great importance that we are able to make transparent and substantiated figures available to government, industry and, ultimately, also Dutch citizens so that they can monitor developments in this field. Cooperation between government and industry is very important for this, as underlined by the close participation in this report.

Like last year, this report also shows that woody biomass is still mainly used for energy production. However in the process, biomass plants are increasingly combined with other energy systems such as batteries and e-boilers and advanced ICT systems in order to be able to optimally meet the increasing demand for flexible supply of electricity and heat in addition to an increasing share of variable electricity from solar and wind among other things.

In the coming years, biomass deployment will need to broaden significantly towards biofuels, green gas and chemicals and related sectors. With Platform Bio-Economy (PBE), we will respond to this broadening in the market and actively seek cooperation with these sectors. In order to provide a complete picture of the development of biomass deployment in the Netherlands in the coming years too, it is desirable to broaden the scope of this report as well. We will explore how to put this into practice in the future through consultation with the Ministry of Economic Affairs and Climate Policy (EZK), the Ministry of Infrastructure and Water Management (I&W) and market players.

Finally, I would like to thank EZK, I&W, RVO, Biomass Research and all participating companies for their contribution to the production of this report. Its power and relevance lie in its collectivity and transparency!

On behalf of the Board of Platform Bio-Economy,

Jos Keurentjes

Chairman

Summary

The amount of woody biomass used for energy purposes in 2023 (reported by participants in the annual survey) was 3.1 million tonnes. This means a reduction in consumption of about 1.0 million tonnes (24%) compared to 2022. The main reason for this decrease is lower use in co-firing.

Most woody biomass is used to produce electricity and heat in plants larger than 10 MW. That includes co-firing, where most woody biomass goes. Almost all woody biomass used consists of residual and waste flows which have no other useful applications. These mainly include residual flows from the agro, food and wood industries, residual flows from forest management, nature conservation and landscape management and waste wood (Grade A and Grade B wood).

There are significant differences in the origin and form of woody biomass between smaller and larger plants.

- Smaller plants (<10 MW) mainly use residual flows from landscape management, nature conservation and forest management and Grade B wood.
- Larger plants (>10 MW) including co-firing use a wider variety of sources with residual flows from the agro, food and wood industries being the most important.

A substantial share of bioenergy production is based on Dutch biomass: 1.3 million tonnes of all woody biomass comes from the Netherlands which is 0.2 million tonnes (18%) more than in 2022. North America is another major source of biomass (1.3 million tonnes; a decrease of 10% compared with 2022).

- Smaller plants (< 10 MW) use Dutch biomass almost exclusively.
- Importedwoody biomass comes mainly from North America and is mainly used as co-firing in coal-fired power plants.

In smaller plants, woody biomass is mainly used for the (small-scale) production of heat, including in heat networks. Private deployment, due to rising (gas) costs, is also expected to rise in the coming year. Woody biomass thus makes a crucial contribution to an integrated energy system which adapts to new and uncertain market conditions out of necessity.

In recent years, the use of sustainable woody biomass and thus sustainability reporting and verification has increased significantly. In 2023, 2.2 million tonnes had a sustainability certificate. The most commonly used certificates are SBP, GGL and Better Biomass. Waste wood and (in certain cases) residual flows from the agro, food and wood industries do not have to be certified.

Recent innovations and adaptations focus on the deployment of BECCS for CO_2-negative biomass chains, plans for improved sludge combustion and increasing the incineration temperature to prevent corrosion. Several companies are working on using waste heat for off-

site applications. Other options that are being looked at include using catalysts to reduce NOx emissions.

The main difficulty is the financial situation of companies that use biomass. This is related to the continuing high price of biomass combined with the withdrawal of the SDE subsidy. There are also problems with the use of Ad-blue and there is a feeling that there is a limited supply of Dutch biomass. In addition, social perception plays a role, especially around licensing.

Looking ahead, it is unclear what the introduction of the new RED III and EUDR will mean for the sector. The price of woody biomass is expected to remain relatively high which may have implications for use. The increasing availability of wind and solar energy has further increased the need for flexibilisation and stabilisation. Multiple flexibilisation options are being implemented, not only through technical adaptations but also through advanced ICT in order to be able to adequately respond to price fluctuations.

1. Introduction

Platform Bio-Economy (PBE), in collaboration with the Netherlands Enterprise Agency (RVO), has produced an annual report on the use of woody biomass for energy generation since 2013. In 2023, as in previous years, woody biomass made a significant contribution to renewable energy.

This report provides an overview of the amount, origin, nature and use of woody biomass in 2023. In addition, the report highlights sustainability, emissions, innovations and possible strategies for increasing public support.

For this report, 81 companies which have plants with a minimum capacity of 1 MW were approached. Private individuals and companies with smaller plants, as well as plants producing biogas (digesters), were not included in this study. Of the companies approached, 44 participated in the survey. The response rate is therefore lower than in previous years (last year, 74 companies were approached and 48 participated).

Respondents provided data on 46 plants that collectively used 3.1 million tonnes of woody biomass to produce electricity, steam and/or heat. About 90% of the total woody biomass consumption for the plants described here (>1 MW) is expected to be included in this overview.

The structure of this report is as follows: Section 2 provides an overview of the amount of woody biomass used in 2023. The source and form are discussed in Sections 3 and 4 respectively. Section 5 presents information on origin. Sustainability and emissions are covered in Sections 6 and 7. Section 8 describes the innovations the companies involved are working on; difficulties are discussed in Section 9. Finally, Section 10 presents a number of conclusions and an outlook.

2. Amount of woody biomass used, type of plants and deployment

This section explains how much woody biomass was used, the type of plants used for this purpose and where they are located. These are plants with a total installed capacity of 1 MW-thermal or more, producing heat and/or electricity. Data from a number of smaller modular plants has also been included if several plants together have a combined capacity of more than 1 MW. Co-firing plants have been merged with combined heat and power plants.

The number of plants producing electricity, or electricity combined with heat and/or steam, is almost equal to the number producing heat only. Most plants (11) are large plants for electricity with heat/steam (>10 MW) or small plants (<10 MW) producing heat only (Figure 1). The category of other plants includes a gasification plant among others. Co-firing plants are included in the category EW>10 MW.

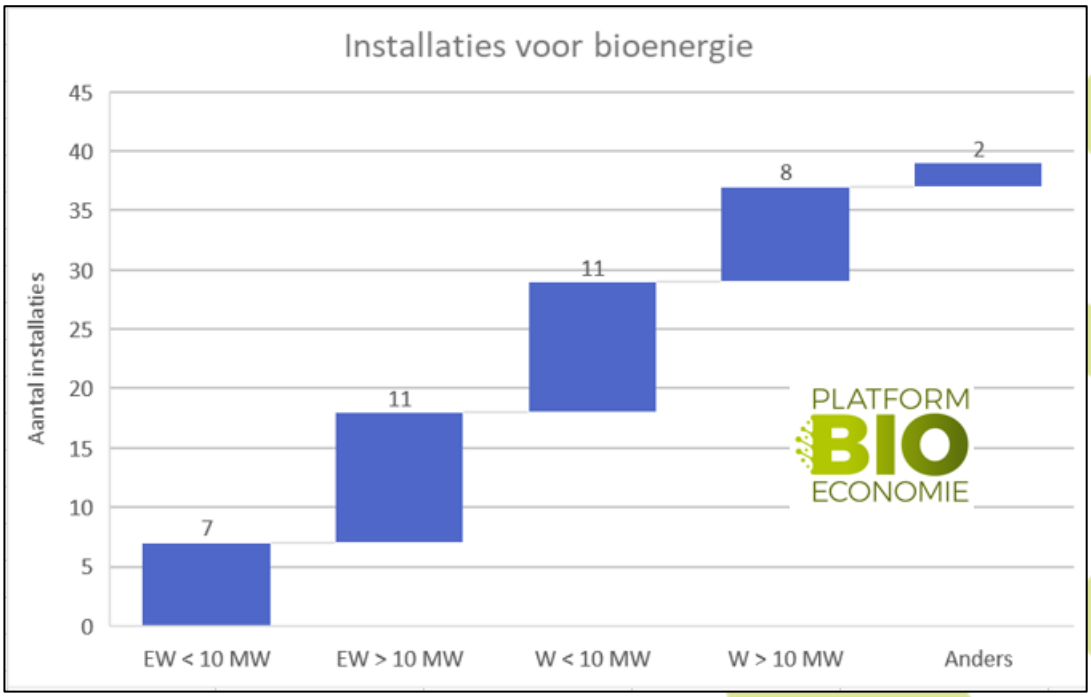

Figure 1: Plants reported in this overview for use of woody biomass for energy application (plants >1MW).

EW = simultaneous production of electricity or electricity and heat; W = heat only

Use of woody biomass

In 2023, 3.1 million tonnes of woody biomass was used for energy purposes at the reported plants. This represents a decrease of 0.9 million tonnes compared to reported use in 2022. This puts usage below pre-2020 levels (Figure 2).

The average dry matter content of the reported woody biomass is 77%, slightly lower than last year. In 2023, 2.4 million tonnes of dry woody biomass were used.

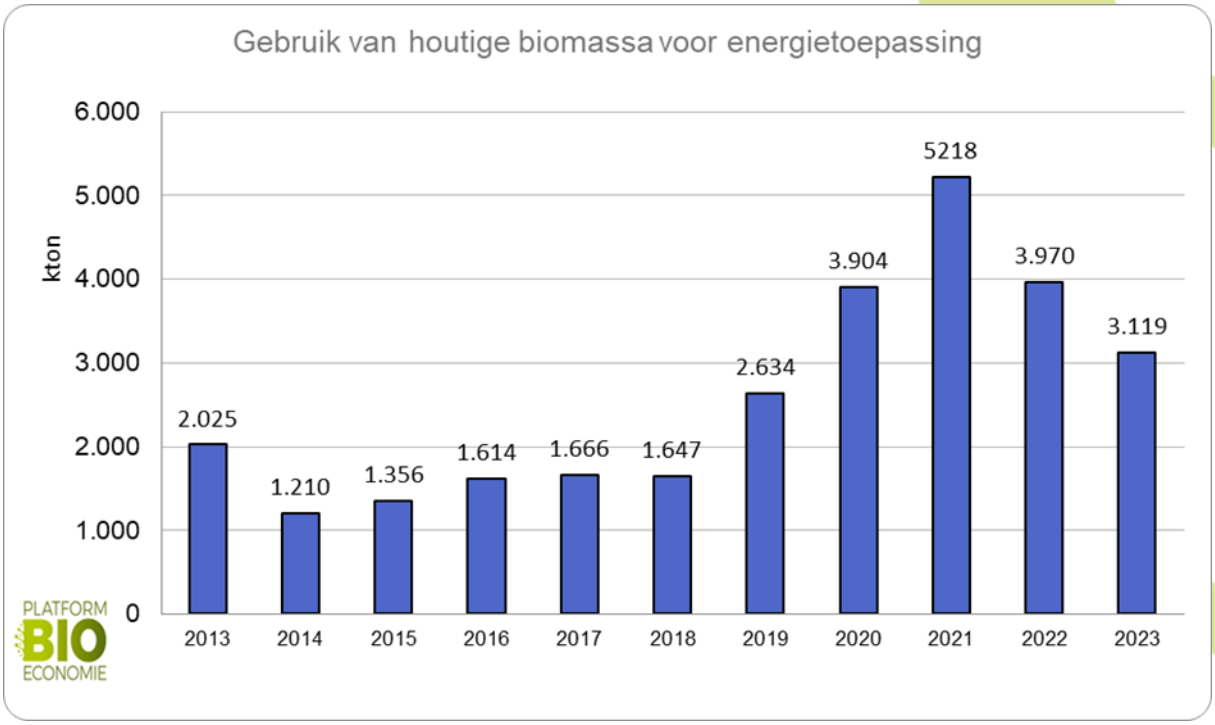

Figure 2: Use of woody biomass for energy application (plants >1MW). Source: PBE 2021 and this study.

Given the fact that a number of companies did not complete a questionnaire, it is possible that some of these companies did use biomass. Based on the number of companies that did not participate, it is possible to estimate the amount of woody biomass not included. It is assumed that the actual use of woody biomass is about 270 ktonnes higher than indicated in the report.

The calculated energy value of the woody biomass used in 2023 is 46 PJ, a reduction of 24% compared with 2022. It is only partly possible to compare historical data from CBS (Figure 3) because CBS figures for 2023 are not yet available.

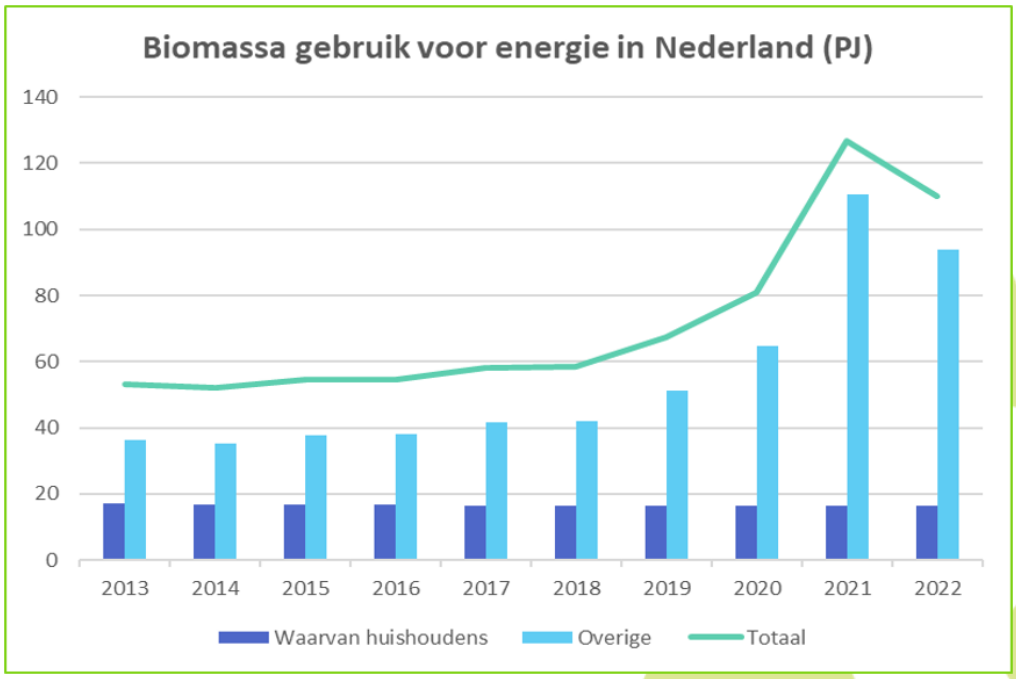

Figure 3: Biomass use for energy in the Netherlands (PJ).
Other: Waste incineration plants, co-firing, biomass boiler companies.
Source: calculated from CBS[1].

Types of plants

This report distinguishes between plants that generate both electricity and (steam or) heat – known as combined heat and power (CHP) plants – and plants that generate only steam, heat or electricity. A distinction is also made between large and smaller installations and respondents indicate the sector in which the plant is used.

Box 1 provides an overview of the categories of plants used in the analysis.

[1] CBS, Renewable energy in the Netherlands 2022.
https://www.cbs.nl/nl-nl/longread/rapportages/2023/hernieuwbare-energie-in-nederland-2022/8-biomassa
visited 30 May 2024

Box 1: Overview of plant categories used

This report shows use of plants with at least 1 MW capacity that use solid – woody – biomass. The plants are used to generate electricity, steam and/or heat.

The analysis distinguishes between different types of plants:

- Plants producing both electricity and (steam or) heat (so-called CHPs: combined heat and power plants)
- Plants producing only electricity, steam or heat

For both categories, a distinction is made between large and small plants, using 10 MW thermal capacity as the limit.

The term co-firing plants refers to power plants where biomass is used alongside other (fossil) fuel. These include plants that produce both electricity and heat and plants that produce only electricity. In this report, these plants are included in the CHP category>10 MW. [2]

Box 2 and Box 3 present practical examples of bio-heat companies that are working towards broad deployment of bioenergy and, hence, greater flexibility of the energy grid.

Box 2: Attero

Attero processes 1.8 million tonnes of residual waste a year from which plastic, metal and drinks cartons are separated. From the remaining residual waste, waste-to-energy plants (AEC) produce green gas, renewable electricity and sustainable heat. This energy and the raw materials recovered replace fossil fuels and primary raw materials which is a win for the environment. After wind energy, waste-to-energy plants in the Netherlands make the largest contribution to the amount of renewable energy produced.

The Moerdijk plant switches between producing renewable electricity and sustainable heat for industry and for future heat networks. At the Wijster site, Attero produces raw materials and energy from residual waste. Post-separation and digestion provide green gas, plastic, metal and packaging. In Wijster, Attero also produces renewable electricity and heat which is supplied to companies at the Energy Transition Park among others.

The biomass power plant in Odiliapeel produces renewable energy from the wood fraction derived from the green waste of several municipalities. Prunings are reduced. The resulting woody biomass arrives at the biomass power plant in the form of chips. From this, the plant produces sustainable steam which is transported to the Peka Kroef plant by pipeline. This potato processor uses steam in its production process to steam peel potatoes.

Sources:

[2] Two plants convert biomass into electricity only. In order to prevent data from being traceable to individual plants, their data have been included in the group that produces heat and electricity.

https://www.attero.nl/nl/nieuws/peka-kroef-en-attero-verlengen-overeenkomst-voor-duurzame-warmtelevering/
https://www.attero.nl/nl/locaties/odiliapeel/
https://www.attero.nl/nl/over-afvalverwerking/van-restafval-naar-energie-en-grondstof/

Large to very large biomass plants (>10 MW) that produce electricity or a combination of electricity with steam or heat use the most (81%) woody biomass (Figure 4). The proportion of woody biomass from smaller plants is proportionally limited. Biomass boilers of smaller size that generate both electricity and heat account for only 2% of the total use of woody biomass.

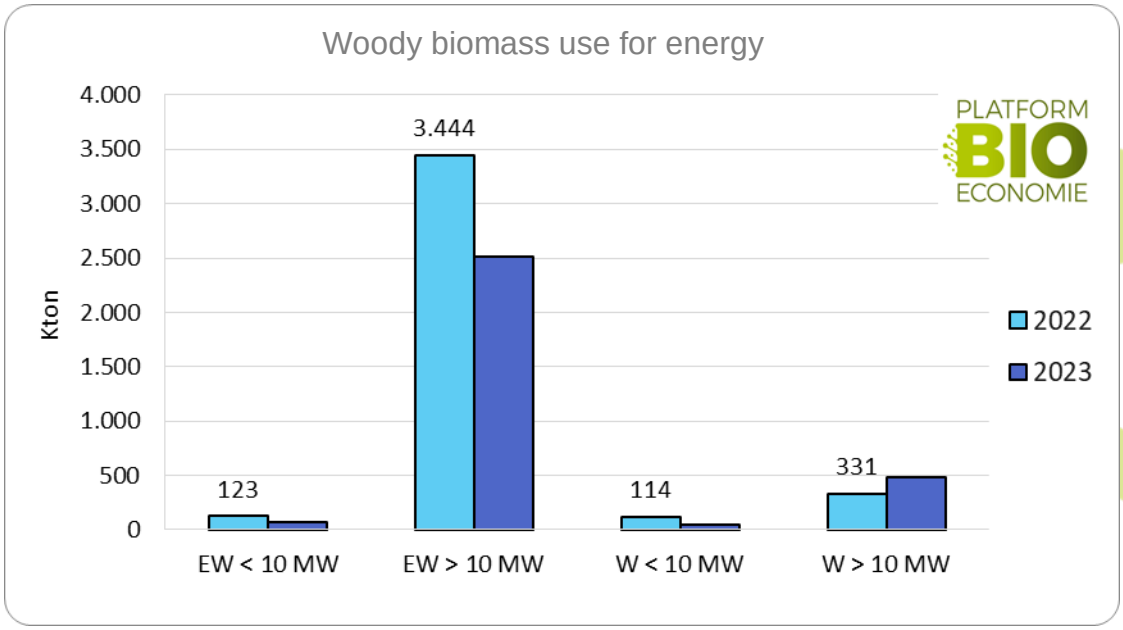

Figure 4: Use of woody biomass for energy application by type of plant (plants >1MW) in 2022 and 2023, total 4.0 and 3.1 million tonnes of woody biomass respectively.

Proportionally, smaller plants are relatively strongly represented in the survey in terms of numbers; 35 of the 46 reported plants used less than 25,000 tonnes of biomass in 2023. A total of 21 plants used less than 5000 tonnes. The consumption at fourteen plants was between 55,000000 and 25,000 tonnes each. Eight plants reported annual consumption of more than 100,000 tonnes.

The plants from the survey operate in different sectors (Figure 5). More than half of the biomass is used in power plants; companies in the agro and wood-processing industries are small users. Together, waste-processing companies, district heating and other industries used more than a third of the biomass. Differences compared with 2022 can be seen in power plants (where the amount of biomass used was halved), the wood-processing industry and greenhouse horticulture. The waste-processing industry shows a marked increase.

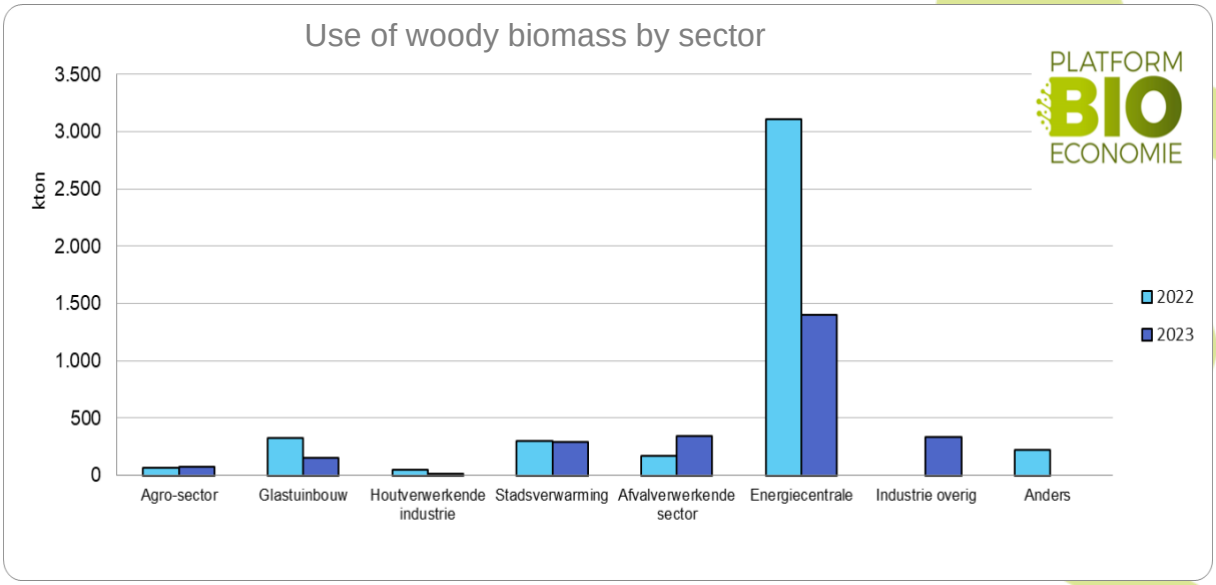

Figure 5: Use of woody biomass for energy application by sector. Total consumption of 4.0 and 3.1 million tonnes of woody biomass reported in 2022 and 2023 respectively.

Energy generated

The inventory presented here includes plants that convert woody biomass into heat (or steam), electricity or both (combined heat and power or CHP). There are only two plants that exclusively produce electricity. To prevent data from being traceable to individual plants, the figures for these plants have been included in the category of plants producing both heat (steam) and electricity. At 17%, the total share of woody biomass used exclusively for heat production is much higher than in 2022 (Figure 6). This percentage increase is explained by the sharp decline in biomass use in power plants.

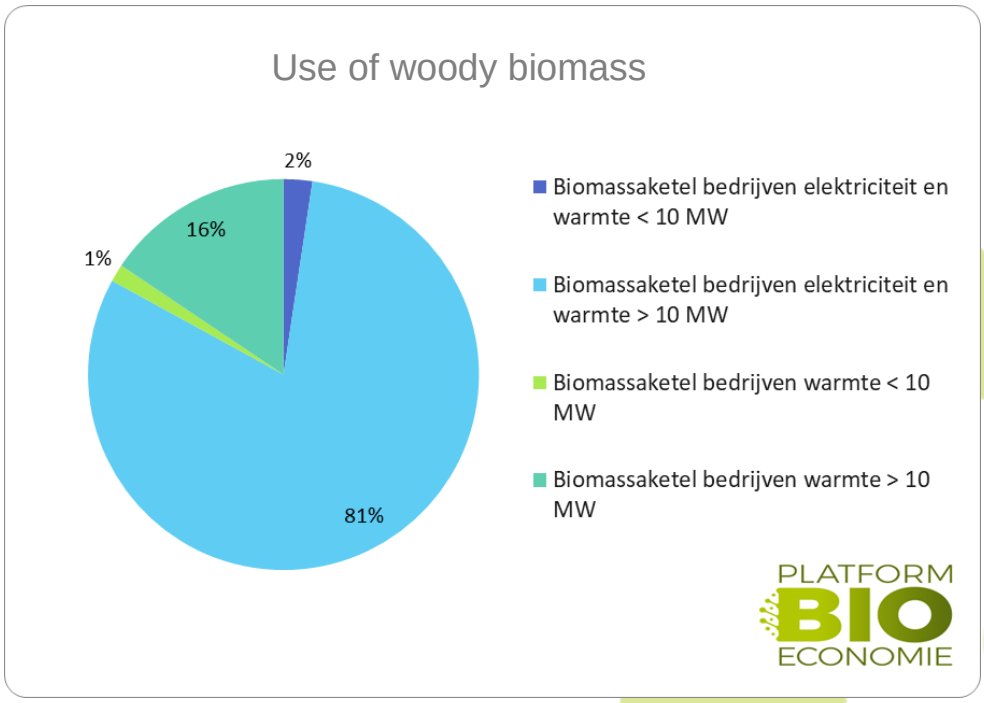

Figure 6: Conversion of biomass into various forms of energy by size of plant. Total 3.1 million tonnes of woody biomass.

Box 3: Bio Energie Centrale Cuijk

Bio Energie Centrale Cuijk (BECC) produces green power and steam from solid biomass, mainly regional biomass (prunings), collected within a 100-kilometre circle around the plant. About a quarter consists of waste timber that previously served a useful purpose. In addition, paper sludge from Essity paper mill is processed.

Because electricity production from solar and wind is weather-dependent, there is a need for power producers who can switch quickly in order to better match supply and demand. With the commissioning of a 10 MW (20 MWh) flexible battery, Bio Energie Centrale Cuijk can quickly switch from supplying power to storing power. The battery makes it possible for electricity produced to be stored until more electricity is needed which could be in a matter of minutes.

BECC also has a large industrial electric boiler, sourced from PARAT Halvorsen in Norway, which enables the BECC Energy Hub to operate more sustainably and cost-effectively. By converting cheap electricity from solar or wind into steam, BECC is able to smooth out fluctuations from the energy market in no time. The boiler is always on standby and can get up to a temperature of 239 to 270 degrees C within 30 seconds.

This type of boiler is normally used when converting electricity from hydropower to heat (steam). It supplies drilling rigs with heat and can also be found in the paper industry, breweries and in steel and aluminium production. The boiler, with a capacity of 10 MWe, is custom-built and virtually maintenance-free. Furthermore, BECC uses a sophisticated ICT system in order to be able to

adequately respond to price fluctuations in different electricity markets and thus make optimum use of flexibility. In doing so, BECC contributes to the future-proofing of the Dutch electricity grid.

Sources:
https://beccuijk.nl/
https://nl.linkedin.com/pulse/e-boiler-maakt-becc-energy-hub-compleet-beccbv?trk=article-ssr-frontend-pulse_more-articles_related-content-card

3. Source of woody biomass

The woody biomass used comes from various sources. Most biomass consists of residual and waste flows from the agro, food and wood-processing industries, or landscape management, nature conservation and forest management (Figure 7). Residual flows from the agro, food and wood-processing industries account for more than half of the biomass (1.8 million tonnes). No alternative application is available for this biomass; it is mainly supplied in the form of pellets.

In 2023, more than half a million tonnes of residual and waste flows from landscape management, nature conservation and forest management were used to generate energy. In addition, a significant amount (0.7 million tonnes) of Grade B wood (waste timber) and a small amount of Grade A wood were used. Other flows include sewage sludge and digestate. An overview of the main categories of wood flows, including definitions and background information, can be found in Box 4.

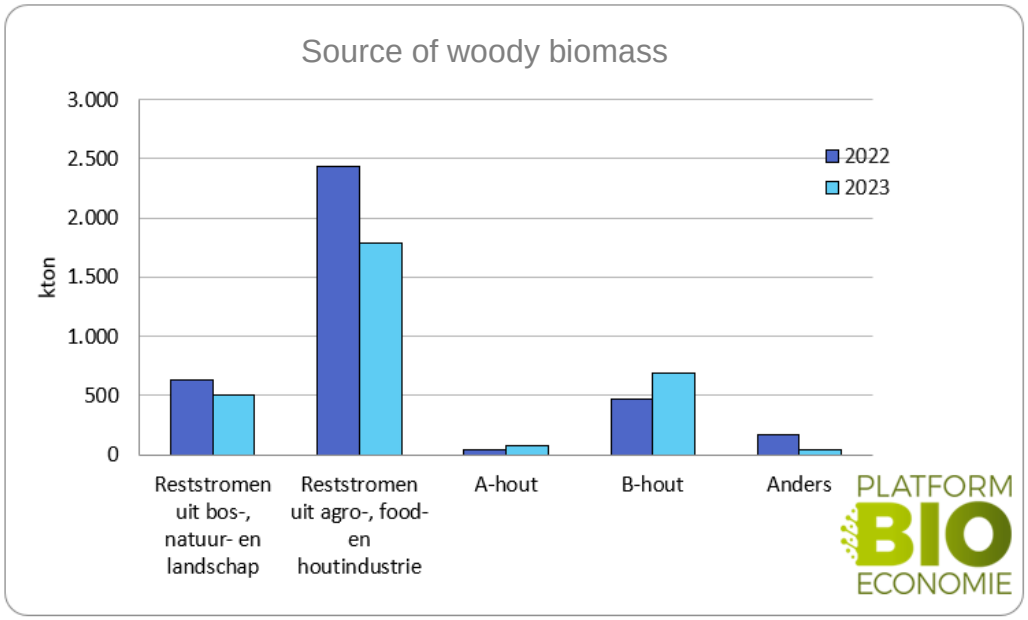

Figure 7: Source of woody biomass.
A total consumption of 3.1 million tonnes of woody biomass was reported in 2023.

Box 4: Overview of definitions and background of wood flows used

Woody biomass

When biomass is burnt in combustion plants, woody biomass is defined as follows (Environmental Law Decree, Annex 1 (Activities Decree):

- Agricultural or forestry plant material. Fresh wood is wood that is released from thinning, felling and grubbing-up operations in forests, landscaping, green spaces and nurseries, for example. Fresh wood can include whole trees, logging waste, branch and top wood, stumps or roundwood. Wood grown mainly for biomass and other uses also falls into this category which is the case on willow plantations, for example.
- Waste from agriculture and forestry, the paper industry, cork and wood industry.[3]

Respondents reported the total number of tonnes of woody biomass as received at the gate (i.e. not corrected for moisture content).

For Figures 8, 9a and 9b, the following categorisation was adopted for the source of woody biomass:

- **Residual flows from forest management, nature conservation and landscape management, and from management and implementation of (infra)structural projects and urban green spaces.** These are primary fresh wood residues from nature conservation and green management. Primary residues are created during harvesting, e.g. like branch and top wood when collecting wood for processing into wood products such as planks. They can also be trees from thinning or unwanted species harvested as part of nature conservation and landscape management activities.
- **Residual flows from the agro, food and wood industries.** These are secondary products from e.g. the wood-processing industry such as sawdust, trimmings, bark, chips and also residual flows from carpentry companies, kitchen manufacturers, doors, etc. They can also be caps from the food industry or residual and waste flows from the paper industry.
- **Grade A wood.** This refers to A-quality waste wood consisting of untreated, used wood such as wooden beams from residential construction, for example.
- **Grade B wood.** This refers to B-quality waste wood consisting of painted, varnished or glued used wood.
- **Other wood fibre residual flows (such as paper and WWTP sludge).**
- **Agricultural residual flows (e.g. maize stalks).**
- **Other.**

For Figure 10, a distinction is made in the category "Residual flows from landscape management, nature conservation and forest management and from management and implementation of (infra)structural projects and urban green spaces":

- Residual flows from regular forest management
- Regular landscape management
- Regular management of built environment and along infrastructure
- Residual flows from VFG (vegetable, fruit and garden waste)
- Timber released during construction of infrastructure/residential buildings
- Origin unknown

[3] RVO, Types of biomass for combustion, https://www.rvo.nl/onderwerpen/bio-energie/ketels-en-kachels/soorten-biomassa#definities-van-biomassa, visited 22 June 2022

Two thirds of the biomass used by smaller plants (<10 MW) consists of residual flows arising from the management of forest, nature and landscape elements. The rest comes from the agro, food and wood-processing industries and Grade A waste wood (Figure 8a). Large plants mainly use residual flows from the agro, food and wood-processing industries (Figure 8b), mainly expected to be residues from the wood industry. Additional sources here are residual flows from landscape management, nature conservation and forest management and Grade B wood (Figure 8b). This makes both plant types almost complementary.

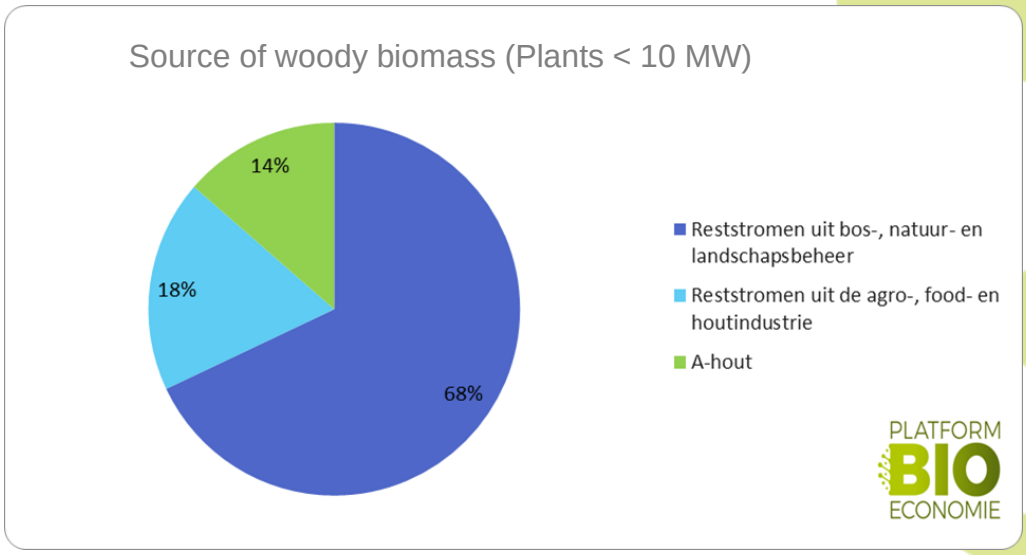

Figure 8a: Source of woody biomass by plant type: smaller plants (< 10 MW).

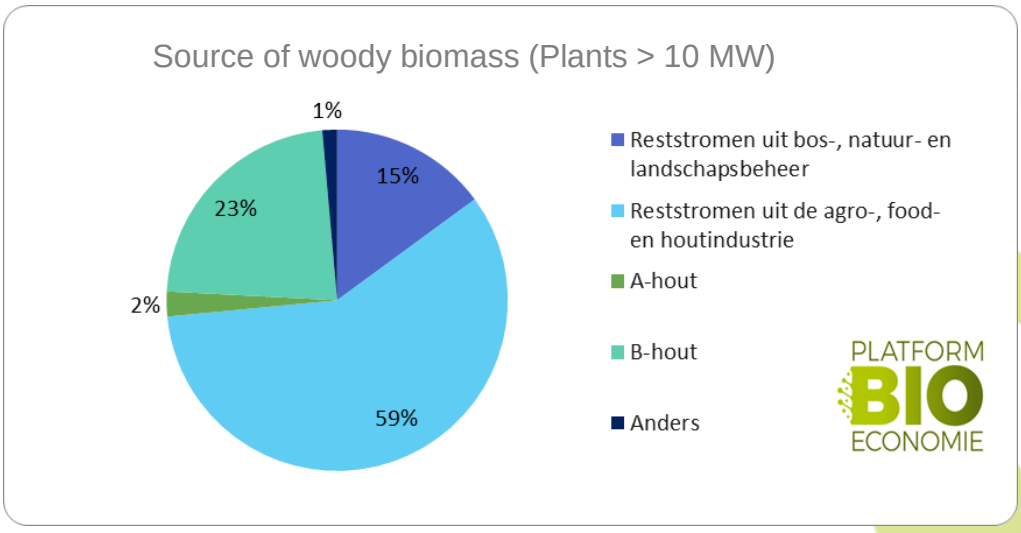

Figure 8b: Source of woody biomass by type of plant: larger plants (> 10 MW).

Figure 9 shows the origin of the "residual flows from forest management, nature conservation and landscape management" category. Over half come from the built environment (parks, avenues, etc.). In addition, part of the woody biomass comes from regular forest and landscape management.

Compared to 2022, there is a significant decrease in biomass from regular forest management and regular landscape management (- 124 ktonnes). Biomass from management of the built environment increased by 85 ktonnes (13%). That means that this source had a relatively higher share in the origin of biomass in 2023.

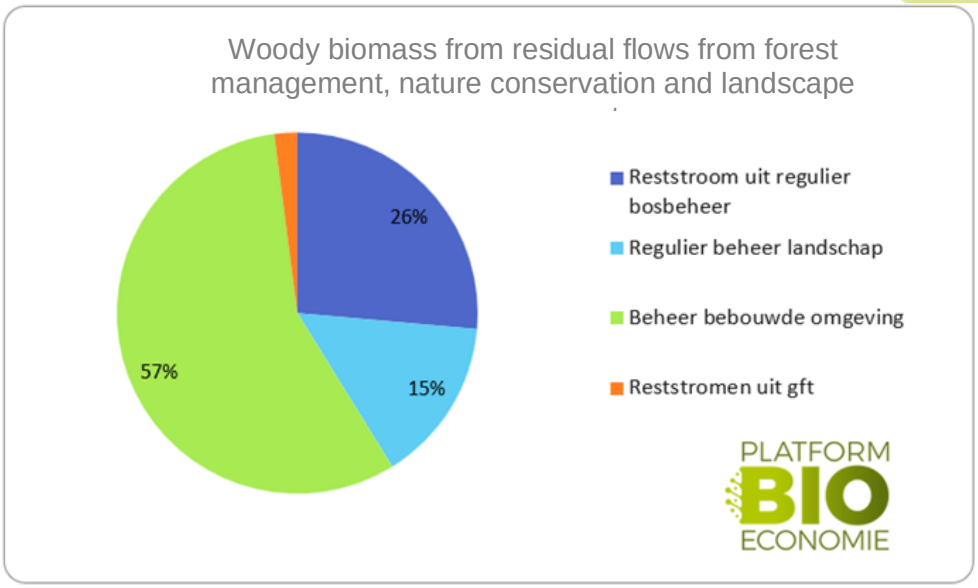

Figure 9: Woody biomass from forest management, nature conservation and landscape management.
Total includes 730 ktonnes of woody biomass

4. Form of woody biomass

Woody biomass is used at the various plants in different forms such as pellets, chips, shreds, sawdust or sludge (see Box 3). Woody residual flows are collected and pre-processed for this purpose. Figure 10 provides insight into the most common forms in which woody biomass is used in practice.

The predominant form of woody biomass is pellets (1.7 million tonnes) although the share of pellets was lower than in 2022. Because pellets have a low moisture content and high density, they are easier to transport and can be stored for longer. Besides pellets, wood chips (647 ktonnes) and wood shreds (594 ktonnes) are important categories. Other reported forms (in the "Other" category) include bleaching earth, sludge granules, coarse thinnings, sawdust and cocoa shells.

Compared to 2022, use of almost all forms of biomass has decreased. Only the share of shreds increased (0.6 million tonnes in 2023 so it has doubled).

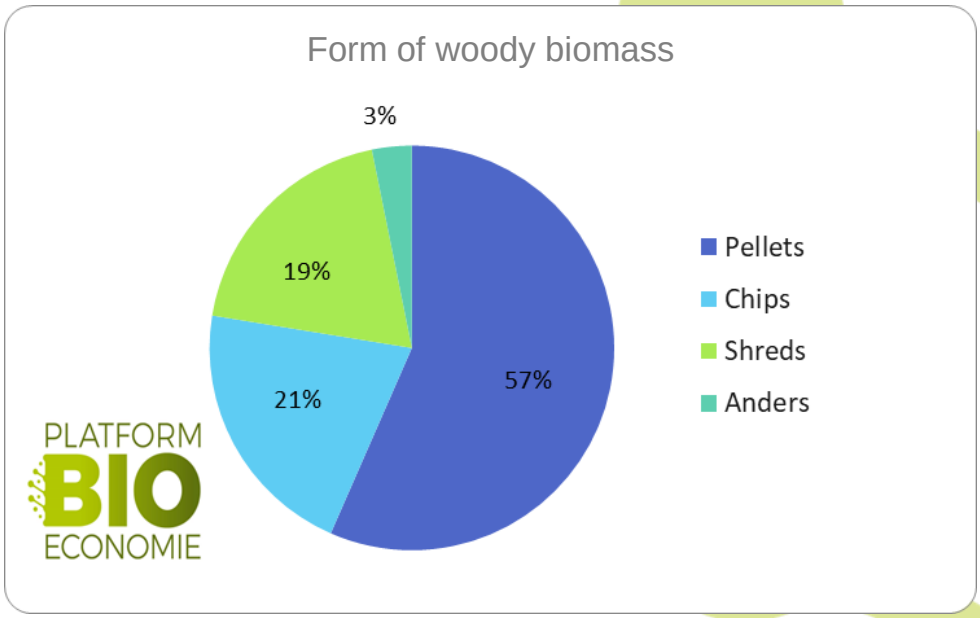

Figure 10: Final (traded/used) form of woody biomass used. In 2023, 3.1 million tonnes of woody biomass were used.

Small plants (<10 MW) mainly use chips and shreds while large plants mainly use pellets. Large plants (>10 MW) for producing both electricity (whether or not combined with steam or heat) mainly use pellets.

Box 5: Forms of woody biomass

Wood pellets

Wood pellets are compressed and dried wood pellets with a high energy density. They are compact and contain less moisture (<10%). Pellets are mainly made from sawdust from the wood-processing industry or from clean waste wood.
Because they are of consistent quality, pellets can easily be used in boilers that are cheaper and less prone to faults. In addition, less ash remains after combustion. Pellets are relatively expensive because of the processing steps required, namely, grinding, drying and pressing.

Wood chips

Wood chips or wood chippings consist of shredded wood. This can be fresh wood, untreated waste wood (Grade A wood) or Grade B wood. Most of the wood chips come from fresh branch and top wood from pruning waste. These contain 20-50% moisture on average.
Wood chips become economically interesting at capacities above 300 kW.

Shreds

Shreds or strips are fresh separated irregular pieces of wood whose individual wood fibres are still clearly visible. They are often made from roots and stumps released during the maintenance of green spaces. As a result, they contain more moisture and sand and have a lower energy density than wood chips or pellets. However, they are much cheaper. Shreds become economically interesting at capacities above 5 MW.

Source: Koppejan (2016)[4]

[4] Koppejan, J. (2016) Inventory of market applications of biomass boilers and bio-CHPs. Enschede: Procede Biomass B.V.

5. Origin

The origin of woody biomass refers to the country where the biomass was collected or processed. For collected wood, specific questions were asked about the country where the wood was given the status of Grade A or B wood.

In 2023, more than half (53%) of the biomass used came from the EU. The biomass used was mainly from the Netherlands and North America; the combined share for these amounted to 1.3 million tonnes (Figure 11). Use of Dutch biomass was almost the same as in 2022 but the amount of biomass from North America decreased by a quarter. Imports from the Baltic states and Russia also fell sharply. In 2023, more than half of the biomass came from the EU, approximately 80% of which came from the Netherlands.

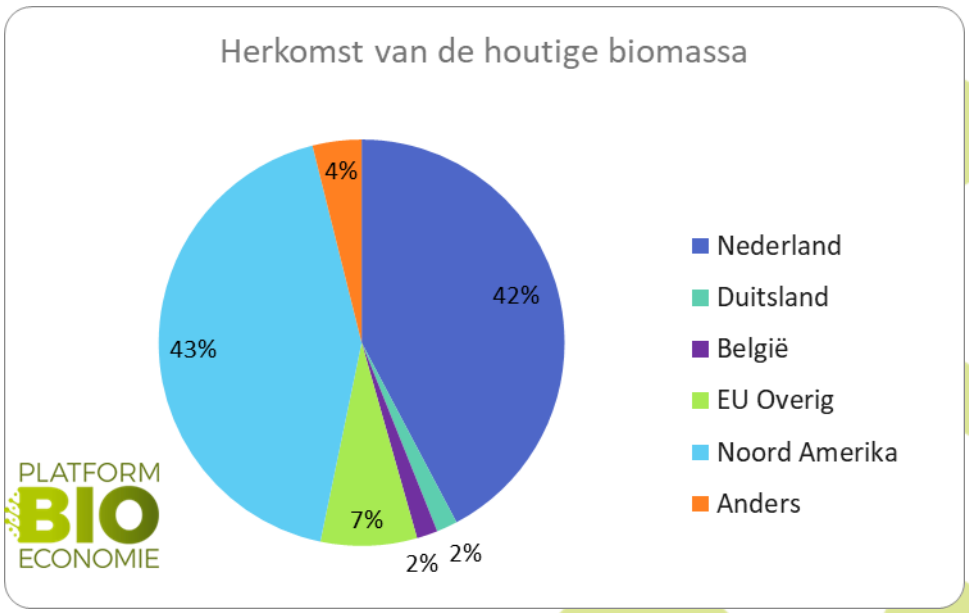

Figure 11: Origin of woody biomass.
Total 3.1 million tonnes of woody biomass.

Companies with small plants (<10 MW) mainly use Dutch biomass (Table 1). They are part of short chains where biomass sourced from the Netherlands is used locally. A small proportion of biomass comes from Germany and Belgium. This is different for large plants which only source a fraction (8%) of their biomass from domestic sources. These companies mainly use biomass from North America (62%). A small proportion comes from other EU countries.

Table 1: Origin of woody biomass by type of plant (in ktonnes) in 2023[1].

	All plants	Plants < 10 MW		Plants > 10 MW	
	ktonnes	ktonnes	%	ktonnes	%
Netherlands	1,257	117	93%	1,140	40%
Germany and Belgium	99	8	7%	91	3%
North-eastern Europe[2]	0	0	0%	0	0%
EU Other	228	0	0%	228	8%
North America	1,275	0	0%	1,275	45%
Other countries[3]	116	0	0%	116	4%

[1] Total is lower than all biomass used because some data on origin is missing
[2] Baltic States and Scandinavia
[3] Including: Malaysia, Thailand, Vietnam

Fresh woody biomass, such as wood shreds and wood chips, comes mainly from the Netherlands. Imported woody biomass consists mainly of pellets (see Table 2).

Table 2: Origin of woody biomass by form (in ktonnes) in 2023[1].

Category	Chips	Shreds	Pellets	Other	Total
Origin	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
Netherlands	596	570	0	89	1,255
Import	51	24	1,743	9	1,827
Total	647	594	1,743	98	3,082

[1] Total is lower than all biomass used because some data on origin is missing

6. Sustainability

The majority of the biomass used is certified. A total of 2.2 million tonnes of biomass is involved, including co-firing. Certification schemes for co-firing cannot be reported here because only two companies reported biomass consumption and that information may be sensitive. The other companies that participated in the survey are almost exclusively certified under the Better Biomass (NTA8080) certificate (Figure 12).

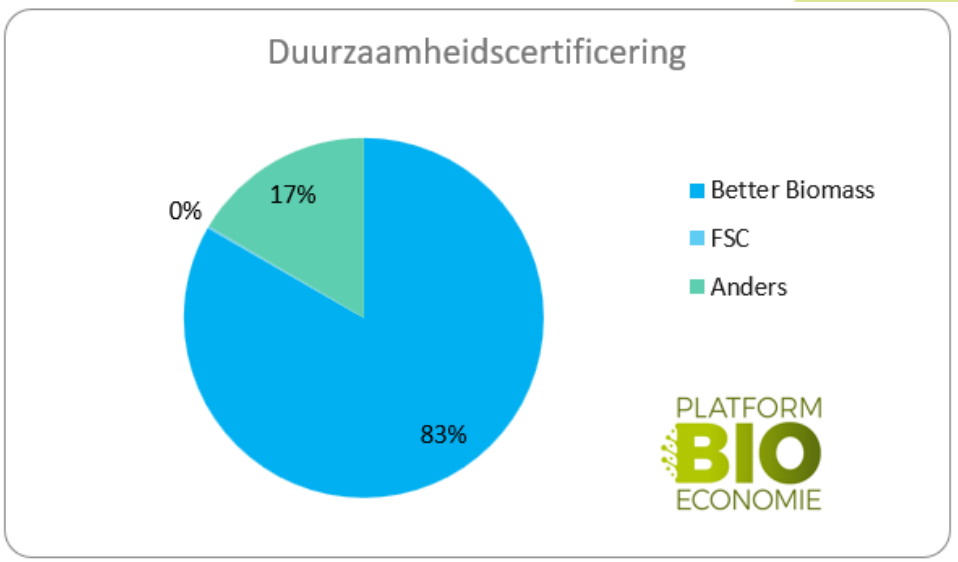

Figure 12: Sustainability certification by type of certificate.

More than half of the woody biomass used in small and medium-sized plants (other than co-firing) had a sustainability certificate. The remainder consists of residual flows from the agro, food and wood industries, residual flows from landscape management, nature conservation and forest management and waste wood.

In the Biomass Sustainability Covenant, power companies and environmental organisations established agreements on the sustainability of biomass to be used for co-firing in coal-fired power plants in the Netherlands. CE Delft (2024)[5] reports on efforts and results relating to sustainability of biomass used. According to this report, energy companies have demonstrated that the statutory requirements relating to sustainability have been met by providing verification statements.

Since early 2023, it has been mandatory for companies that fall under the EU ETS to demonstrate sustainability of biomass used. For pellets, there was already an obligation through the SDE, for other biomass this is a new development. In practice, what that means for wood from forest management is that the chain from source to end use must be certified

[5] R. van der Veen, E. van den Toorn, A. van Grinsven and C. Leguijt (2024). Biomass Sustainability Covenant 2023 Annual Report

for it to be counted as CO_2-free fuel. The introduction of this obligation resulted in a lot of extra effort for the parties concerned. Because the requirements were announced late and because they differ from other systems used (such as SDE), the implementation time was very short.

The new Renewable Energy Directive (RED III) takes effect from 1 January 2026. At present, it is not yet clear how the cascading clause that is part of this will be implemented in national regulations. In particular, it is unclear what monitoring requirements will be used.

The Ministry of Agriculture, Nature and Food Quality (LNV), the Dutch Food and Consumer Product Safety Authority and customs are currently working hard to implement the European Deforestation Regulation (EUDR). Under this regulation, every load of woody biomass imported, exported or placed on the market must be accompanied by a due diligence certificate to be issued by the EU. In particular, this requires information to be made available on the origin of the biomass which must demonstrate that no deforestation has taken place based on geographical data among other types.

Currently, there is still ambiguity about the data to be provided. Also, the IT environment developed for this purpose is not yet working satisfactorily. It is unclear whether the system will be ready on time. Because of that, there is pressure from various member states, sectors and interest groups on the EU to delay implementation.

7. Emissions

According to the "Solid biomass sustainability verification protocol for energy applications", use of woody biomass should contribute towards reducing greenhouse gas emissions compared to fossil fuels. The calculated CO_2 emissions must therefore be on average at least 70% lower than the EU reference value for fossil energy sources, or an average maximum emission of 56 g CO_2-eq/MJ for electricity and 24 g CO_2-eq/MJ for heat. The majority of the questionnaires, especially for plants smaller than 10 MW, did not provide specific values for CO_2 emissions.

8. System integration and optimisation

A lot of companies are busy working on system integration and optimisation. One of the questions in the survey was about recent developments in this area (Table 3). Eleven respondents reported new steps in the process. The main option is the supply of waste heat; 10% of the companies are engaged in this. Other things being worked on are aimed at reducing CO_2, nitrogen or particulate emissions, efficiency and flexibilisation.

Table 3: Recent innovations in chains of biomass use for energy

Innovation	Number of plants
Supply of waste heat to third parties	5
Reduction of emissions (e.g. CO_2 emissions, nitrogen (NO_x) and/or particulates)	4
Increasing process efficiency	3
Flexibilisation	1
No answer	39
	50

More details on innovations and adaptations can be found in Figure 13. Companies report plans to deploy BECCS in order to make the chain CO_2-negative. Other options mentioned include adding limestone for better combustion of sludge granules in the incinerator and increasing the incineration temperature to prevent corrosion. There are also plans for heating tap water and swimming pools in order to improve the efficiency and sustainability of the system. Selective catalytic reduction (SCR) instead of selective non-catalytic reduction (SNCR) is also being looked at in order to reduce NOx emissions.

Figure 13: Word cloud with answers to the question on system innovations.

Horticulture is known for its capacity for innovation. One of the themes for innovation in this sector is sustainability. As a major energy consumer, becoming more sustainable and striving to become CO_2-neutral is a key goal. With the deployment of geothermal energy and solar power, the demand for flexibility is becoming increasingly relevant. This is where biomass can offer a solution, in conjunction with battery storage and possibly supplemented by e-boilers, for example. Box 6 presents a brief description of an innovative example from practice.

Box 6: Hoogweg Paprika

One company that has gone a long way with implementing and optimising multiple energy solutions – read flexibilisation – is greenhouse horticulture company Hoogweg Paprika in Luttelgeest.

This company grows more than 50 million kilograms of peppers sustainably a year. Peppers are currently grown on a 153-hectare site (+ a planned extension of 54 hectares) using three geothermal energy sources with 50 MW of thermal capacity. In addition, the company installed 32,000 solar panels on the roof and water basin (18 MWpeak), an e-boiler (24.5 MW) for excess solar energy and two 14.9 MWth biomass boilers based on sustainably certified wood chips (Better Biomass/NTA 8080). The biomass boilers each have two flue gas condensers and a heat pump that is used in conjunction with low-, medium- and high-temperature heat grid and delivery systems. In addition, CO_2 fertilisation through dosing of captured, largely biogenic CO_2 from AVR, heat pumps in the greenhouses and at the geothermal heat source, and CHPs (combined heat and power).

The company has a unique and flexible system that not only uses renewable energy but also generates and feeds it back into the grid. Through the very varied combination of technologies, the greenhouse horticulture company is able to alleviate the grid and supplement its energy largely sustainably, while keeping it quite affordable.

9. Difficulties

A third of the questionnaires submitted contained comments on difficulties. Half of these relate to the financial situation of the companies concerned. This is related to the high price of biomass (which did not drop in 2023) combined with the withdrawal of the SDE subsidy. Other comments relate to issues such as the use of Ad-blue, limited supply and societal perceptions. A brief analysis of the responses can be found in Figure 14.

Figure 14: Word cloud with responses to the question on bottlenecks.

The figure shows that respondents identified two major problems: the loss of SDE income and the rising prices of renewable heat. Without subsidies, bioenergy projects are under financial pressure and the future is uncertain. Government policies that link the cost of renewable heat to gas prices and increase gas taxes every year make renewable energy sources such as wood chips expensive. This, combined with high production costs, makes many local bioenergy projects economically unfeasible.

10. Conclusion and outlook

The use of woody biomass for energy purposes further decreased to 3.1 million tonnes, or 2.4 million tonnes of dry wood, in 2023. The biomass used consists mainly of wood pellets. Because the importing of pellets decreased compared to previous years, the share of wood shreds and chips increased.

The majority of biomass was used in plants larger than 10 MW. As in previous years, they mainly use biomass from residual and waste flows from the agro, food and wood industries. Other important sources are landscape management, nature conservation and forest management and Grade B wood collected from businesses and consumers.

Small plants (<10 MW) use domestic biomass almost exclusively; the rest comes from Germany and Belgium. Imports from other countries play a role for the larger users in particular.

The Netherlands, along with North America, is now the main supplier of woody biomass used in the Netherlands. Both were responsible for 1.3 million tonnes in 2023. Use of Dutch biomass increased by 188 ktonnes; the amount of biomass from North America decreased by 10%. There were no imports from the Baltic states or Russia in 2023.

Recent innovations and adaptations focus on the deployment of BECCS for CO_2-negative biomass chains, plans for improved sludge combustion and increasing the incineration temperature to prevent corrosion. Several companies are working on using waste heat for off-site applications. Other options that are being looked at include using catalysts to reduce NOx emissions and in addition, several companies are working on optimising their energy production using ICT.

The main difficulty is the financial situation of companies that use biomass. This is related to the continuing high price of biomass combined with the withdrawal of the SDE subsidy. Furthermore, the feeling is that the supply of Dutch biomass is limited and societal perceptions play a role, especially with regard to licensing.

Looking ahead, it is unclear what the introduction of the new RED III and EUDR will mean for the sector. The price of biomass is expected to remain relatively high which may have implications for use. The increasing availability of wind and solar energy has further increased the need for flexibilisation and stabilisation.

Accountability

The survey presented here relating to the use of woody biomass in bioenergy plants with a capacity of more than 1 MW was carried out during the period from January to April 2024. Data collection on behalf of PBE was carried out by Biomass Research by means of an online questionnaire that was distributed to owners and operators of bioenergy plants in the Netherlands. Owners may have one or more plants in operation.

The questionnaire consisted of 23 questions, most of which contained multiple-choice options, including the "Other" option, and the opportunity to provide explanations. All questionnaires were completed online and processed centrally.

A total of 81 owners and/or operators were approached, 44 of whom completed one or more questionnaires. Owners and/or operators with bioenergy plants at multiple sites were able to complete a questionnaire for each site. Questionnaires were received for 46 plants. Below is a list of the participating companies that gave their consent with regard to being named.

A significant proportion of the companies indicated that they wished to be included in the report anonymously. They did not give their consent with regard to their company name being mentioned in this report. Reasons for not wanting to be mentioned may arise from a desire for privacy or due to commercial considerations. The names of those companies have therefore not been included on the list of names of participants.

The data provided by the participating companies is aggregated in this report so that individual company data is not identifiable or traceable. The privacy of the data has been ensured. No formal review or verification of these data took place, apart from a number of tests to check consistency of data provided. Participating companies are responsible for the content and quality of the data they provided.

Participating companies[6]

Attero BV
BES Exploitatie BV
Bio Energy Netherlands bv
Bio Forte BV
Brouwer Biocentrale BV
DES B.V.
Eneco Energy Trade B.V.
Energie voor Elkaar
Ennatuurlijk Aardwarmte
Evers vd Sandt
Foresco Dongen Biomassa B.V.
Grubbenvorst Biomass BV
Noordhoek broilers bv
Reinaerdt Deuren BV
RWE Eemshaven Holding II B.V.
RWE Generations NL B.V.
Snipperhout BV
Vattenfall
VP Energie
Wattplant bv
Wijnen Egchel Biomassa BV

[6] Some of the participating companies did not give their consent with regard to their name being mentioned in the report.

PLATFORM BIOECONOMIE

Appendix 1: Abbreviations

BECCS	Bioenergy combined with CO2 capture and storage
CCU	Capture & utilisation unit
ds	Dry substance
FSC	Forest Stewardship Council
Vfg	Vegetable, fruit and garden waste
GGL	Green Gold Label
HTS	High Temperature Storage
ISCC	International Sustainability and Carbon Certification
ktonne	Kilotonne is a unit of mass. 1 ktonne is 1000 tonnes or 1 million kilogrammes
ktonne CO_2-eq	The emitted or reduced amount of CO_2 or other greenhouse gases converted to the equivalent effect of CO_2 expressed in kilotonnes
MW	Megawatts
MWe	Megawatts electric
MWth	Megawatts thermal
PBE	Platform Bio-Economy
PEFC	Programme for Endorsement of Forest Certification Schemes
PJ	Petajoule: amount of energy produced; peta means 10^{15}
RVO	Netherlands Enterprise Agency
SBP	Sustainable Biomass Partnership
SDE	Stimulation of Sustainable Energy Production
CHP	A combined heat and power (CHP) plant produces both electricity and heat from a single fuel.